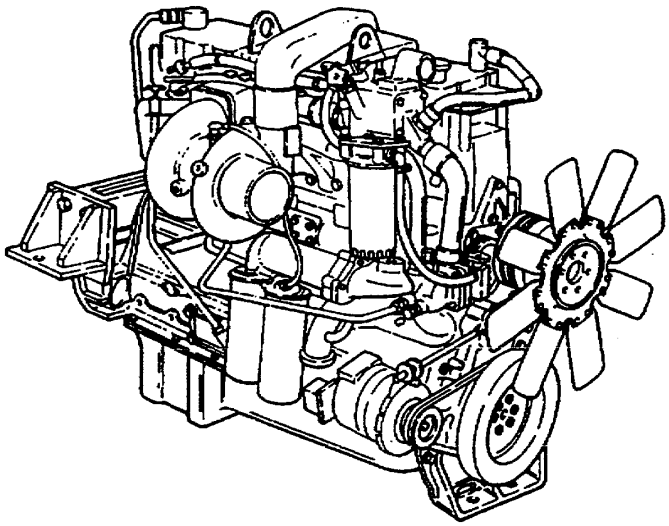
Supersedes TM 9-2815-225-34&P-1, TM 9-2815-225-34&P-2, TM 9-2815-222-34&P and all changes.

DIRECT SUPPORT AND GENERAL SUPPORT (DS/GS) MAINTENANCE MANUAL INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST (RPSTL) FOR

ENGINE, DIESEL: 6 CYLINDER IN-LINE, TURBOCHARGED, CUMMINS MODEL NTC-400 M915-M920 AND M915A4*/BIG CAM I (NSN 2815-01-082-8125) M915A1 AND M915A4*/BIG CAM III (NSN 2815-01-142-2745)



BIG CAM II SHOWN

*** M915A4 TRUCKS WILL BE EQUIPPED WITH EITHER BIG CAM I OR BIG CAM III ENGINES**

HEADQUARTERS, DEPARTMENT OF THE ARMY
AUGUST 2001

WARNING

CARBON MONOXIDE (EXHAUST GAS) CAN KILL YOU

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

1. **DO NOT operate personnel heater or engine of vehicle in a closed place unless the place has a lot of moving air.**
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. FOR ARTIFICIAL RESPIRATION, REFER TO FM 21-11.**
5. **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.

WARNING SUMMARY

- **Compressed air used for cleaning purposes will not exceed 30 psi. Use only with effective chip guarding and protective equipment such as goggles or shield, gloves, etc. Failure to comply may result in injury to personnel.**
- **Wear heat-resistant gloves when handling heated crankshaft gear. Failure to comply may result in injury to personnel.**
- **Perform operation out of doors or in a well-ventilated room. Failure to comply may result in injury to personnel.**
- **Remove pressure regulator assembly slowly to prevent spring tension from shooting assembly from oil pump body. Wear eye protection. Failure to comply may result in damage to equipment or injury to personnel.**
- **Eye protection must be worn when using wire brush for cleaning. Failure to comply may result in injury to personnel.**
- **The machined edges on turbine wheel are very sharp. Wear protective gloves. Failure to comply may result in injury to personnel.**
- **Wear rubber gloves when removing piston pin to prevent burns from boiling water or hot piston. Failure to comply may result in injury to personnel.**
- **Control valve cover is under pressure from control valve outer spring. Wear suitable eye protection and hold cover down when removing screw and cover. Failure to comply may result in injury to personnel.**

WARNING SUMMARY (Contd)

- **Improper cleaning methods and use of unauthorized cleaning solvents will not be used. Refer to TM 9-247 for proper cleaning methods and solvents. Failure to comply may result in damage to equipment or injury to personnel.**
- **The stamped steel oil pan on M915A1/Big Cam III or on M915/Big Cam I engines must not be used to support weight of engine; the pan will permanently deform and may collapse, allowing engine to fall over. Failure to comply may result in damage to equipment and injury to personnel.**
- **All personnel must stand clear during lifting operations. A snapped chain or swinging or shifting load may result in injury to personnel.**
- **Use extreme caution during disassembly or assembly; engine components are heavy. Failure to comply may result in damage to equipment or injury to personnel.**
- **Operation of a deadlined vehicle without preliminary inspection will cause further damage to a malfunctioning component and possible injury to personnel.**
- **Approved solvents may be flammable and will not be used near open flame. Use only in well-ventilated area. Failure to comply may result in injury to personnel.**
- **Do not perform fuel system procedures while smoking or within 50 ft (15.2 m) of sparks or open flame. Diesel fuel is flammable and may explode. Failure to comply may result in injury to personnel.**
- **Allow adequate ventilation for engine exhaust gases. Failure to comply may result in brain damage or death to personnel.**

LIST OF EFFECTIVE PAGES

REVISION SUPERSEDES COPIES DATED DECEMBER 1983, INCLUDING ALL CHANGES.

NOTE: The portion of the test affected by the revision is listed below.

Date of issue for original:
Original ..... 0..... 28 August 2001

TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 864, CONSISTING OF THE FOLLOWING:

Page No	*Change No.
Warning a - Warning b	0
A	0
B Blank	0
i - xi	0
xii Blank	0
1-1 - 1-6	0
2-1 - 2-10	0
3-1 - 3-537	0
3-538 Blank	0
3-539 - 3-706	0
A-1 - A-2	0
B-1 - B-5	0
Figure 1 - Page 52-1	0
52-2 Blank	0
I-1 - I-44	0
C-1 - C-4	0
D-1 - D-4	0
E-1 - E-4	0
F-1 - F-5	0
F-6 Blank	0
Glossary 1	0
Glossary 2 Blank	0
Index 1 - Index 6	0

*Zero in this column indicates original page.

TECHNICAL MANUAL

NO. 9-2815-225-34&P

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, D.C., *28 August 2001*

DIRECT SUPPORT AND GENERAL SUPPORT (DS/GS) MAINTENANCE MANUAL INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST (RPSTL) FOR ENGINE, DIESEL: 6 CYLINDER IN-LINE, TURBOCHARGED, CUMMINS MODEL NTC-400 M915-M920/BIG CAM I (NSN 2815-01-082-8125) M915A1/BIG CAM III (NSN 2815-01-142-2745)

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this publication. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Submit your DA Form 2028 (Recommended Changes to Publications and Blank Forms), through the Internet, on the Army Electronic Product Support (AEPS) website. The Internet address is http://aeps.ria.army.mil. If you need a password, scroll down and click on "ACCESS REQUEST FORM". The DA Form 2028 is located in the ONLINE FORMS PROCESSING section of the AEPS. Fill out the form and click on SUBMIT. Using this form on the AEPS will enable us to respond quicker to your comments and better manage the DA Form 2028 program. You may also mail, fax or E-mail your letter or DA Form 2028 direct to: AMSTA-LC-CI Tech Pubs, TACOM-RI, 1 Rock Island Arsenal, Rock Island, IL 61299-7630. The email address is TACOM-TECH-PUBS@ria.army.mil. The fax number is DSN 793-0726 or Commercial (309) 782-0726.

TABLE OF CONTENTS

* This manual supersedes TM 9-2815-225-34&P-1, TM 9-2815-225-34&P-2, dated Dec 1983 and TM 9-2815-222-34&P dated Dec 1980 and all changes.

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TABLE OF CONTENTS (Contd)

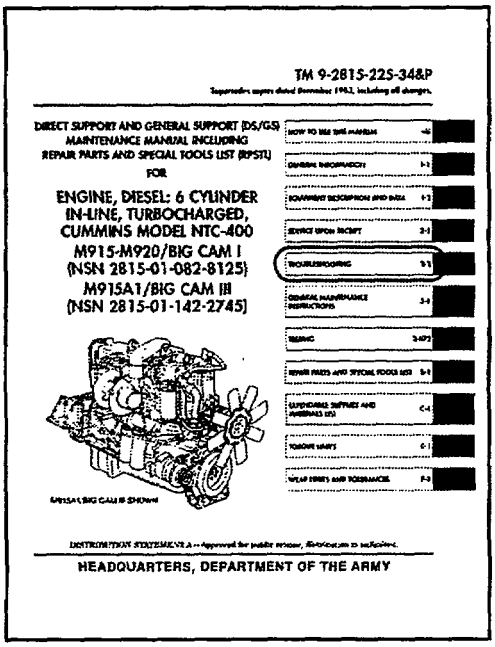
TABLE OF CONTENTS (Contd)

HOW TO USE THIS MANUAL

ABOUT YOUR MANUAL

Maintenance tasks in this manual are written in sequence for the complete disassembly of the engine. They can also be used in conjunction with troubleshooting to repair a specific engine component or part without performing a complete engine overhaul. In either event, always refer to the maintenance record (or attached instructions if the engine arrives for repair in a container). This will prevent any unnecessary work on your part. Follow the steps listed below under "Using Your Manual" to become familiar with how to use this book.

USING YOUR MANUAL

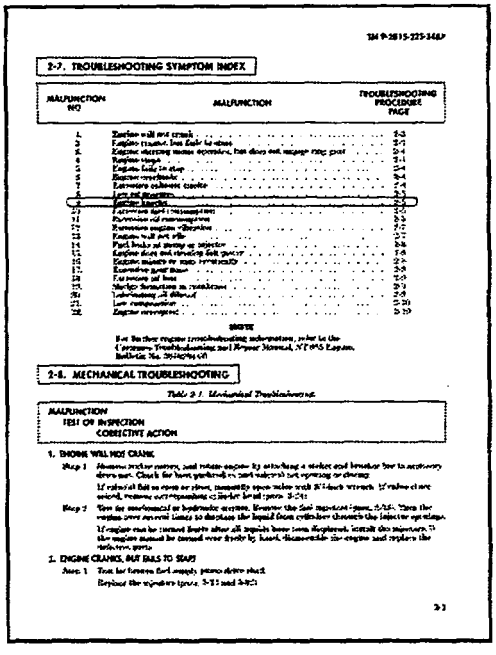


TM 9-2815-225-34&P

DIRECT SUPPORT AND GENERAL SUPPORT (DS/GS) MAINTENANCE MANUAL INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST (RPSTL) FOR

ENGINE, DIESEL: 6 CYLINDER IN-LINE, TURBOCHARGED, CUMMINS MODEL NTC-400 M915-M920/BIG CAM I (NSN 2815-01-082-8125) M915A1/BIG CAM III (NSN 2815-01-142-2745)

HEADQUARTERS, DEPARTMENT OF THE ARMY



2-7. TROUBLESHOOTING SYMPTOM INDEX

MALFUNCTION NO	MALFUNCTION	TROUBLESHOOTING PROCEDURE PAGE

2-8. MECHANICAL TROUBLESHOOTING

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

1. ENGINE WILL NOT CRANK

2. ENGINE CRANKS, BUT FAILS TO START

Task: The operator of an M915 series vehicle has complained the engine knocks under a load, and the vehicle has been assigned to you for repair.

TROUBLESHOOTING STEPS:

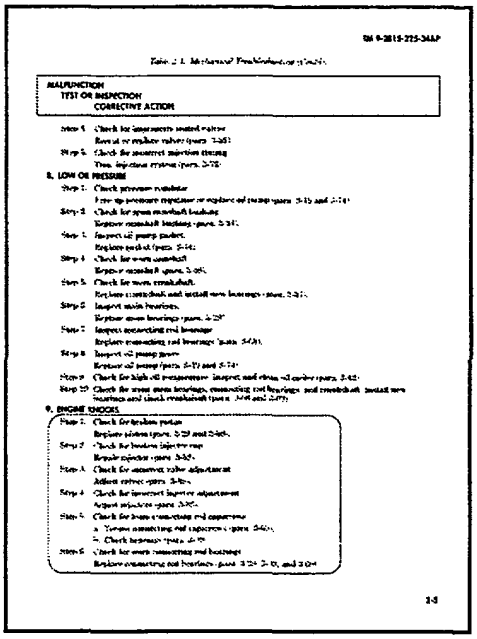
1. Look at the cover of this manual. You'll see chapter/section titles listed from top to bottom on the right-hand side.
2. Look at the right edge of the manual. On some of the pages you'll see black bars (edge indicators) that are aligned with the chapter/section bars on the cover. These are the locations of the chapters/section in the text.
3. Look for "TROUBLESHOOTING" in the chapter/section list on the cover.
4. Turn to those pages with the edge indicator matching the black bar for TROUBLESHOOTING. Page numbers are also listed next to chapter/section titles.
5. One of the first pages having the mechanical systems troubleshooting edge indicators is the "'TROUBLESHOOTING SYMPTOM INDEX."
6. Look down the list until you find "ENGINE KNOCKS."
7. Turn to the page indicated: 2-5.

8. On page 2-5, steps/tests relating to resolving the problem of "Engine Knocks" are listed:

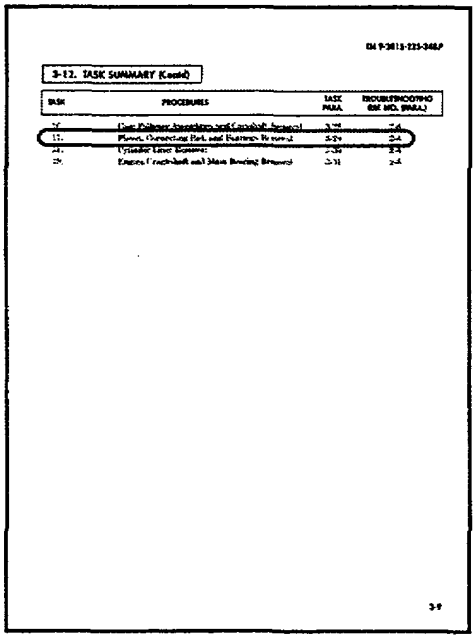
Step 1. You check for a possible damaged piston.

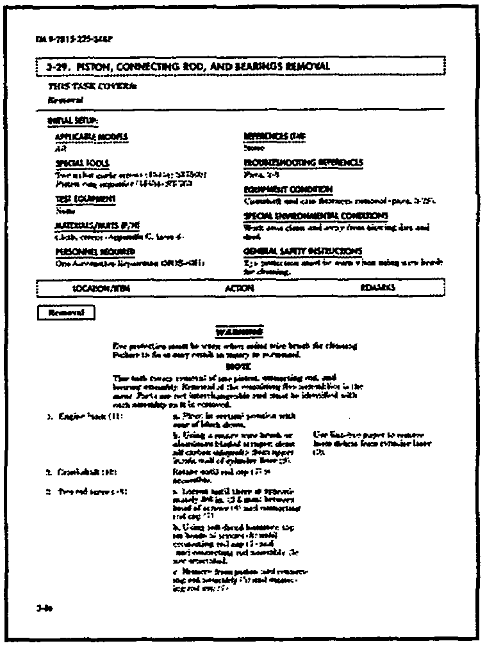
Step 2. During your inspection you discover that a piston is damaged. The part must be replaced. Chapter 3, paras. 29 and 69, are referenced.

9. Before turning to paras. 3-29 and 3-69, turn to chapter 3, section I, "GENERAL MAINTENANCE INSTRUCTIONS," and review the guidelines to be followed during maintenance of engine (paras. 3-2 through 3-10).



10. Because replacement of a piston is extensive, refer to chapter 3, section II, "DISASSEMBLY." Find "Piston, Connecting Rod, and Bearings Removal" in the task summary (para. 3-12.)




TM 9-2815-225-34&P

3-29. PISTON, CONNECTING ROD, AND BEARINGS REMOVAL

THIS TASK COVERS:
Removal

INITIAL SETUP:

APPLICABLE MODELS

REFERENCES (TM)

SPECIAL TOOLS

TROUBLESHOOTING REFERENCES

TEST EQUIPMENT

EQUIPMENT CONDITION

MATERIALS/PARTS (P/N)

SPECIAL ENVIRONMENTAL CONDITIONS

PERSONNEL REQUIRED

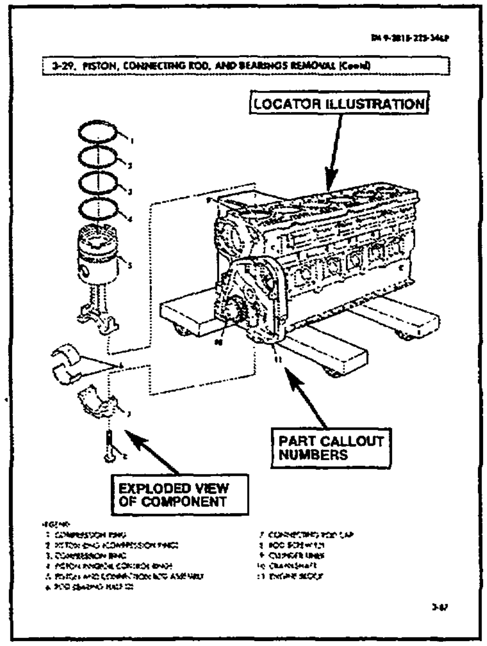
GENERAL SAFETY INSTRUCTIONS

LOCATION/ITEM	ACTION	REMARKS

Removal

WARNING

NOTE



11. Turn to para. 3-29 on page 3-89. Here you find the detailed procedure for removing the piston, connecting rod, and bearings.

DETAILED MAINTENANCE PROCEDURES:

12. Detailed procedures: Include everything you must do to accomplish a basic maintenance task.

a. Before beginning the maintenance task, look through the procedure. You must familiarize yourself with the entire maintenance procedure before beginning the maintenance task. The entire procedure of para. 3-29, "Piston, Connecting Rod, and Bearings Removal," include the task REMOVAL under the heading "THIS TASK COVERS."

b. The ten basic headings listed under "INITIAL SETUP" outline the task conditions, materials, manpower requirements, and special conditions or tools. They are:

- Applicable Models: Any models that require that particular maintenance task.
- Special Tools: Those special tools required to finish a maintenance task. The use of common tools is not explained.
- Test Equipment: Test equipment required to complete a task.
- Materials/Parts: All materials or parts required to complete a task.
- Personnel Required: The number and type of personnel needed to accomplish a task.
  NOTE: If you think an assistant will be necessary to correctly or safely complete a task (perhaps as the result of unusual conditions, etc.), alert your supervisor and ask for help.
- References (TM): Those manuals required to complete the task.
- Troubleshooting References: Specific troubleshooting symptom or those manuals required to complete the task.
- Equipment Condition: Notes the conditions that must exist prior to starting the task.
- Special Environmental Conditions: Outlines specific environmental conditions necessary to perform a task. For example: Work area clean and away from blowing dirt and dust.
- General Safety Instructions: Summarizes all safety warnings for the maintenance task.

c. A step-by-step maintenance procedure follows the INITIAL SETUP. Three columns "Location/Item," "Action," and "Remarks" give detailed instructions for the procedure. They are:

- Location/Item: Indicates the general location and specific part(s) you are working on in a step. For example, the location/item of step 2 is the "crankshaft (10)." The number(s) in parentheses correspond to that part(s) callout number(s) in the accompanying illustration.

- Action: Specifies the action to be taken with the part(s) listed in the Location/Item column. In our example, you are directed to "Rotate [the crankshaft (10)] until rod cap (7) is accessible."

- Remarks: Provide additional information. Our example notes: "Use lint-free paper to remove loose debris from cylinder liner (9)."

d. At the end of a procedure, "FOLLOW-ON TASK(S)" will list additional task(s) that must be performed to complete the procedure. The Follow-On Tasks for our example procedure is: "For repair or installation of piston, connecting rod, and bearings, refer to para. 3-69 or 3-39."

13. Refer to the example pages for para. 3-29, "Piston, Connecting Rod, and Bearings Removal," as we review the following points:

a. **Modular Text:** Both pages of text and illustrations are to be used together. This manual was designed so the two pages Would be visible at once, making part identification and procedure sequence easy to follow.

b. **Legend:** Use the legend found at bottom of each illustration page to find part name and callout number in relation to text and illustration.

c. **Illustrations:** A locator illustration of the cylinder block is provided. An exploded view of the component, removed from the cylinder block, shows specific part locations, attachments, and spatial relationships.

14. You can also use the Table of Contents (page ii) to find more information about the engine. For example: Appendix E, Torque Values.

15. Refer to Appendix B, Direct Support and General Support Maintenance Repair Parts and Special Tools List (RPSTL) when requisitioning parts, special tools, and equipment for organizational maintenance.

16. Your manual is easier to use once you understand its design and we hope this will encourage you to use it more often.

CHAPTER 1
INTRODUCTION

Section I. GENERAL INFORMATION

1-1. OVERVIEW

NOTE
All information contained in this manual applies to both M915 and M915A4/Big Cam I and M915A1 and M915A4/Big Cam III engines except where differences are specifically noted.

This chapter familiarizes the technician with standard forms, record data, and the equipment to be maintained at the direct support and general support maintenance levels. This information is covered in the following sections:

Section I. General Information
Section II. Equipment Description and Data

1-2. SCOPE

a. Type of Manual: Direct Support and General Support Army Maintenance.
b. Model Number and Name: NTC-400, Cummins, six-cylinder, in-line, turbocharged diesel engine.
c. Purpose of Equipment:
- Engine for M915 through M920 and M915A4 Truck, Big Cam I.
- Engine for M915A1 and M915A4 Truck, Big Cam III.

1-3. MAINTENANCE FORMS, RECORDS, AND REPORTS

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

1-4. DESTRUCTION OF ARMY MATERIEL TO PREVENT ENEMY USE

Procedures for destruction of Army equipment to prevent enemy use can be found in TM 750-244-6.

1-5. PREPARATION FOR STORAGE AND SHIPMENT

Information concerning storage or shipment of equipment can be found in TM 740-90-1. Additional information concerning storage of Cummins NTC-400 engine can be found in Chapter 3, Maintenance.

1-6. REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIRs)

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. You may mail, fax or email your letter, DA Form 2028, or DA Form 2028-2 direct to: Commander, U.S. Army Tank-automotive and Armaments Command, ATTN: AMSTA-LC-CIP-WT, Rock Island, IL 61299-7630. The email address is TACOM-TECH-PUBS@ria.armv.mil. The fax number is DSN 793-0726 or Commercial (309) 782-0726.

1-7. WARRANTY INFORMATION

The Cummins diesel engine (model NTC-400) is warranted in accordance with TB 9-2300-295-15/21. The warranty starts on the date found in block 23, DA Form 2408-9, in logbook. Report all defects in material or workmanship to your supervisor, who will take appropriate action.

Section II. EQUIPMENT DESCRIPTION AND DATA

1-8. EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES

NOTE
'"M9151Big Cam I" is intended and will be written hereafter to mean M915 through M920 series and M915A4 trucks with Big Cam I engines.

a. The Cummins NTC-400 diesel engine is used on all M915 through M920, M915A1, and M915A4 trucks. It is a turbocharged, liquid-cooled, overhead valve, four-cycle engine of in-line six-cylinder design. The NTC-400 engine has a compression ratio of 13.5: 1 (M915) and 14.0: 1 (M915A1), and develops 400 horsepower at 2100 rpm. Peak torque is 1150 lb-ft at 1500 rpm (M915) and 1300 lb-ft at 1300 rpm (M915A1).

b. The following engine characteristics and features apply to both M915/Big Cam I and M915A1/Big Cam III engines, except where differences are noted.

Camshaft: 2-1/2-inch diameter camshaft with gear drive controlling all valve and injector movement. Made of induction-hardened alloy steel. Camshaft followers are roller type.

Connecting Rods: Drop-forged, rifle-drilled for pressure lubrication.

Crankshaft: High-tensile steel forging. Bearing journals and fillets-induction hardened. Fully counterweighted.

Cylinder Block: Alloy cast iron with removable wet liners.

Cylinder Heads: Each head serves two cylinders. Drilled fuel supply and return lines. High temperature inserts on exhaust valve seats.

Turbocharger: Model T-50 (M915/Big Cam I); Model T-46-B, which has a redesigned compressor wheel, compressor housing, turbine wheel and shaft, bearing housing assembly, location of oil inlet line, and vee bands (M915A1/Big Cam III).

Exhaust Manifold: Conventional log-type (M915/Big Cam I). Pulse-type for less restriction (M915A1/Big Cam III).

Fuel System: Integral flywheel-type governor.

Injectors: Camshaft actuated top-stop type.

1-8. EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES (Contd)

Intake Manifold: Conventional aftercooler (M915/Big Cam I). Triple-pass water aftercooler (M915A1/Big Cam III).

Lubrication Oil Cooler: Conventional oil cooler and filter with separately mounted bypass oil filter on engine firewall (M915/Big Cam I). Demand flow automatically regulates oil pressure, routes engine coolant through engine oil cooler twice. Engine and cooler core are made of cast aluminum and incorporates mounting adapters for spin-on type full-flow and bypass oil filters, and incorporates a bypass valve and pressure sending unit (M915A1/Big Cam III).

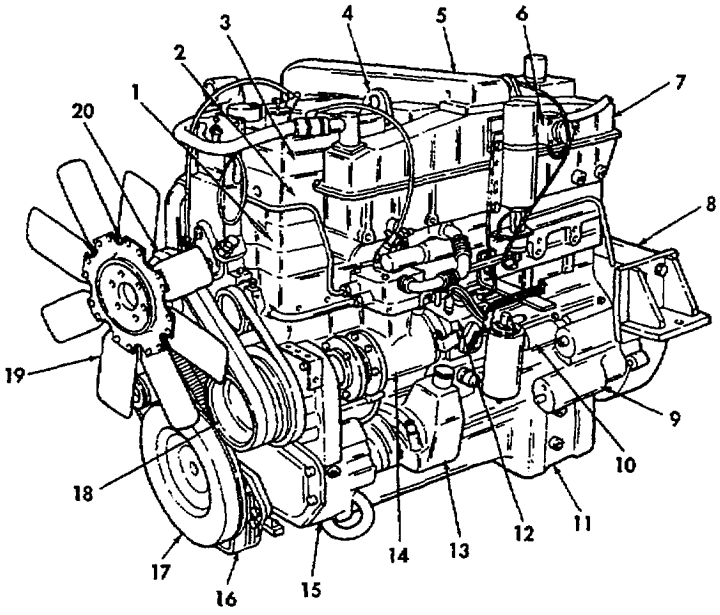
Oil Pan: Made of cast aluminum (M915(Big Cam I). Made of stamped steel (M915A1/Big Cam III).

Water Transfer Tube: Made of cast iron (M915/Big Cam I). Made of stamped, welded steel (M915A1/Big Cam III).

1-9. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS

Right and left views of the NTC-400 engine and its components are shown below and on the following page. Identification can be made from the engine identification plate located on the gear case mounting flange of the engine block. Because of changes made during production, some engines may have minor differences not shown in the following views.

NOTE
Below is a 3/4-view of right side of engine as viewed from front.

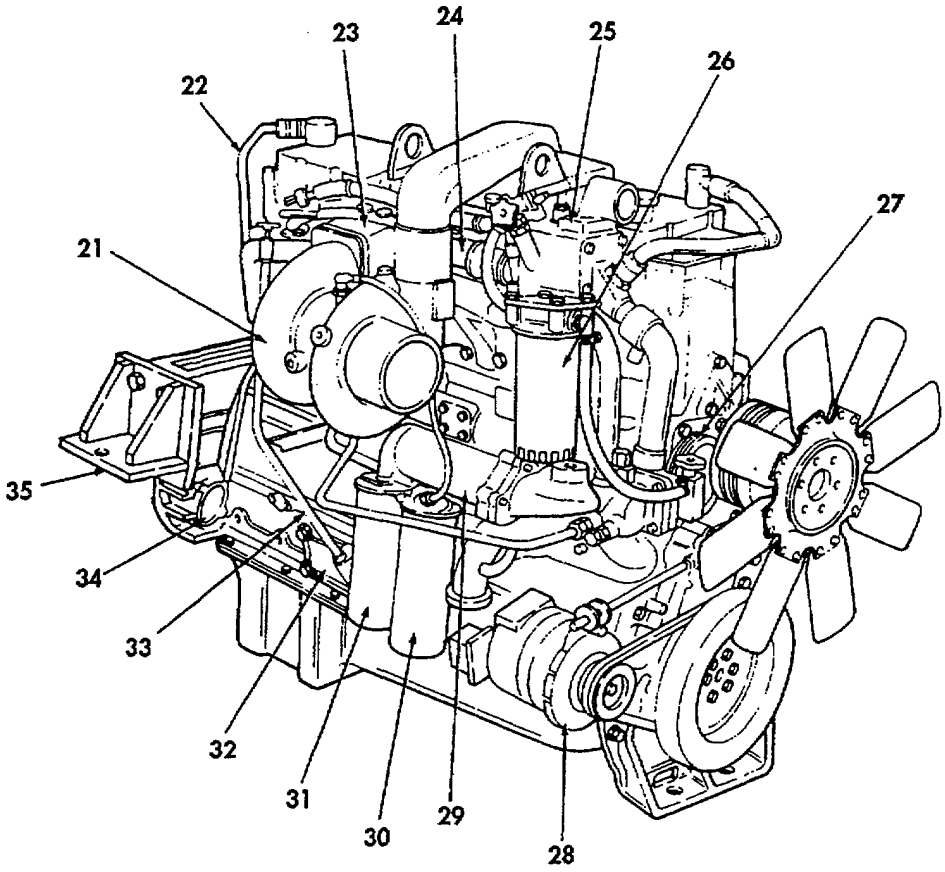


LEGEND:

1. CYLINDER HEAD ASSEMBLY (3)
2. ROCKER ARM ASSEMBLY (3)
3. ENGINE RETARDER (3)
4. ENGINE LIFTING BRACKET (2)
5. AIR CROSSOVER
6. DIAGNOSTIC CONNECTOR ASSEMBLY BRACKET
7. AIR AFTERCOOLER
8. FLYWHEEL HOUSING
9. STARTER
10. CAM FOLLOWER ASSEMBLY (3)
11. OIL PAN
12. FUEL PUMP
13. POWER STEERING PUMP AND RESERVOIR
14. AIR COMPRESSOR
15. LUBRICATION OIL PUMP
16. FRONT ENGINE MOUNT
17. VIBRATION DAMPER AND CRANKSHAFT PULLEY
18. ACCESSORY DRIVE PULLEY
19. FAN
20. FAN CLUTCH

1-9. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS (Contd)

NOTE
Below is a 3/4-view of left side of engine as viewed from front.



LEGEND:

21. TURBOCHARGER (AS SHOWN, MODEL T-50, M915/BIG CAM I); (MODEL T-46-B, M915A1/BIG CAM III)
22. CRANKCASE BREATHER TUBE
23. EXHAUST MANIFOLD
24. WATER MANIFOLD
25. THERMOSTAT HOUSING
26. WATER FILTER
27. WATER PUMP
28. ALTERNATOR
29. ENGINE OIL COOLER
30. FULL-FLOW OIL FILTER
31. BYPASS OIL FILTER (AS SHOWN, M915A1/BIG CAM III); (M915/BIG CAM I MAY BE MOUNTED ON FIREWALL)
32. HAND HOLE COVER
33. DIPSTICK AND TUBE
34. FLYWHEEL INDEX HOLE COVER
35. REAR ENGINE MOUNT

1-10. EQUIPMENT DATA

Manufacturer	Cummins Engine Company, Inc.
Model	NTC-400
Type	4-cycle, turbocharged diesel, compression ignition

DIMENSIONS

Length	58.88 in. (149.6 cm)
Width	33.63 in. (85.4 cm)
Height	50.91 in. (129.3 cm)
Net Weight, Dry	2,600 lbs (1,180.4 kg)

CYLINDERS

Number	6
Arrangement	In-line
Firing Order	1-5-3-6-2-4
Bore	5.5 in. (14 cm)
Stroke	6 in. (15.2 cm)
Displacement	855 cu-in. (14 L)
Compression Ratio	13.5:1 (M915/Big Cam I) 14.0:1 (M915A1/Big Cam III)

GOVERNED SPEED

Full Load	2100 rpm
No Load	2460 rpm
Idle Speed	600 rpm

LUBRICATION SYSTEM

Type	Force-fed
Operating Pressure (Normal)	35-45 psi (M915A1/Big Cam III) 50-70 psi (345-483 kPa) (M915/Big Cam I)
Operating Pressure (Minimum)	15 psi (100 kPa) @ idle
System Capacity Including Bypass Filter	44 qt (41.6 L) (M915A1) 46 qt (43.5 L) (M915)
Operating Temperature (Normal)	200-250°F (93-121°C)
Oil Pump	Gear-type

COOLING SYSTEM

Type	Liquid with fan and radiator
Operating Temperature (Normal)	175-195°F (79-91°C)
Thermostat	1

PERFORMANCE HEAD

Maximum Torque	1150 lb-ft @ 1500 rpm (M915/Big Cam I) 1300 lb-ft @ 1300 rpm (M915A1/Big Cam III)
Maximum Output	400 BHP
Piston Speed @ 2100 rpm	2100 ft/min

1-10. EQUIPMENT DATA (Contd)

Maximum No Load Governed Speed	2460 rpm
Maximum Approved Altitude, Transient Mode	12,000 ft (3658 m)
Maximum Approved Altitude, Continuous Operation	6000 ft (1829 m)
Ambient Air Temperature Above Which Output Should be Limited	100°F (37.8°C)
Air Flow @ 400 hp @ 2100 rpm	985 CFM
Exhaust Flow @ 400 hp @ 2100 rpm	2320 CFM
Nominal Fuel Consumption @ 2100 rpm	144 lb/hr
Nominal Fuel Consumption @ 500 rpm (Peak Torque)	116 lb/hr
Maximum Fuel Flow to Pump @ 2100 rpm	485 lb/hr
Maximum Allowable Restriction to Pump:	
Clean Filter	4.0 in. Hg
Dirty Filter	8.0 in. Hg
Maximum Allowable Return Line Restriction	2.5 in. Hg

CHAPTER 2
SERVICE AND TROUBLESHOOTING INSTRUCTIONS

Section I. REPAIR PARTS, SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT

NOTE
All information contained in this manual applies to both M915 and M915A4/Big Cam I and M915A1 and M915A4/Big Cam III engines except where differences are specifically noted.

2-1. OVERVIEW

a. This chapter provides information on common tools, special tools, service tools, service upon receipt, and troubleshooting.

b. The information is divided up into the following sections:

Section I. Repair Parts, Special Tools, Test Measurement and Diagnostic Equipment (TMDE), and Support Equipment
Section II. Service Upon Receipt
Section III. Troubleshooting

2-2. COMMON TOOLS AND EQUIPMENT

For authorized common tools and equipment, refer to the Modified Table of Organization and Equipment (MTOE) applicable to your unit.

2-3. SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT

Special tools and support equipment are listed in Appendix B of this manual.

2-4. REPAIR PARTS

Repair parts are listed and illustrated in Appendix B of this manual.

Section II. SERVICE UPON RECEIPT OF EQUIPMENT

2-5. ENGINE INSPECTION

a. Inspect for any damage done to engine during its removal from vehicle. Refer to engine removal procedures in TM 9-2320-273-20 and TM 9-2320-273-34 for M915/Big Cam I and TM 9-2320-283-20 and TM 9-2320-283-34 for M915A1/Big Cam III.

b. Inspect, upon receipt of engine, that all components are complete and that no engine subassemblies have been removed. Refer to information on engine dress upon removal in TM 9-2320-273-34 for M915/Big Cam I and TM 9-2320-283-34 for M915A1/Big Cam III.

c. If the engine has been transferred to you from another DS/GS maintenance facility, check the equipment against the packing slip to see if the shipment is complete. Report all discrepancies in accordance with instructions in TM 38-750.

Section III. TROUBLESHOOTING

2-6. GENERAL

a. This section provides troubleshooting information to diagnose and correct engine malfunctions in conjunction with troubleshooting procedures in TM 9-2320-273-20 and TM 9-2320-273-34 for M915/Big Cam I and TM 9-2320-283-20 and TM 9-2320-283-34 for M915A1/Big Cam III. For further engine troubleshooting information, refer to the Cummins troubleshooting and repair manual, NT 855 Engines, Bulletin No. 3810298-00.

b. The troubleshooting procedures are organized by malfunction, followed by steps instructing you to perform a test or inspection to determine the corrective action required. The corrective action is then provided and the appropriate procedure paragraph number(s) is given. The steps listed under each malfunction are in the order in which the causes are most likely to occur.

WARNING

Operation of a deadlined vehicle without preliminary inspection will cause further damage to a malfunctioning component and possible injury to personnel.

c. Check all tags, service request forms, and vehicle logbooks for repair history. This may lead to the source of the problems.

d. Debrief the operator (if possible) for a general description of the problem, then attempt to verify the fault. If the same fault is observed, refer to the troubleshooting symptom index for the precise troubleshooting malfunction and procedures.

e. Before correcting a problem, diagnose the cause of the problem. Do not allow the same failure to occur again. Engines very often are disassembled in search of the problem and the real evidence to its cause is destroyed. Check again to ensure an easier solution has not been overlooked.

f. When troubleshooting, always check the easiest and most obvious things first. This simple rule saves time and trouble. For example, low power complaints are often the result of loose throttle linkage, dirty fuel, or clogged air filters, and excessive oil consumption is often the result of leaky gaskets or loose line connections.

g. Doublecheck before disassembly. The source of many engine problems can be traced to more than one part in a system. For example, excessive fuel consumption may not be caused by the fuel pump alone. Instead, the trouble could be a clogged air cleaner or a restricted exhaust passage causing severe back pressure.

h. If a fault is not discovered until out-of-truck maintenance of the engine, refer to the troubleshooting procedures as necessary at a point where the fault is encountered for further diagnosis.

2-7. TROUBLESHOOTING SYMPTOM INDEX

NOTE

For further engine troubleshooting information, refer to the Cummins Troubleshooting and Repair Manual, NT 855 Engine, Bulletin No. 3810298-00.

2-8. MECHANICAL TROUBLESHOOTING

Table 2-1. Mechanical Troubleshooting.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

1. ENGINE WILL NOT CRANK

Step 1. Remove rocker covers, and rotate engine by attaching a socket and breaker bar to accessory drive nut. Check for bent pushrod(s), and valve(s) not opening or closing.

If valve(s) fail to open or close, manually open valve with 3/4-in. wrench. If valve(s) are seized, remove corresponding cylinder head (para. 3-24).

Step 2. Test for mechanical or hydraulic seizure. Remove the fuel injectors (para. 3-23). Turn the engine over several times to displace the liquid from cylinders through the injector openings.

If engine can be turned freely after all liquids have been displaced, install the injectors. If the engine cannot be turned over freely by hand, disassemble the engine and replace the defective parts.

2. ENGINE CRANKS BUT FAILS TO START

Step 1. Test for broken fuel supply pump driveshaft.

Replace the injectors (paras. 3-23 and 3-82).

Table 2-1. Mechanical Troubleshooting (Contd).

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

Step 2. Test for dirty or damaged injectors.
Replace injectors (paras. 3-23 and 3-82).
Step 3. Test for defective fuel solenoid valve.
Replace fuel solenoid valve (para. 3-57).
Step 4. Test for faulty fuel pump (disconnect fuel outlet hose; crank engine to see if fuel comes out).
Replace fuel pump (paras. 3-16 and 3-78).
Step 5 Test for incorrect adjustment.
Adjust injectors (para. 3-85).
Step 6. Test for incorrect valve clearance.
Adjust valve(s) (para. 3-85).
Step 7. Test for incorrect injector timing.
Adjust injector system timing (para. 3-72).

3. ENGINE STARTING MOTOR OPERATES BUT DOES NOT ENGAGE THE RING GEAR

Step 1. Inspect for defective starter pinion gear.
Replace starter pinion gear (TM 9-2320-283-34).
Step 2. Inspect for defective ring gear.
Replace ring gear (paras. 3-25 and 3-80).

4. ENGINE STOPS

Step 1. Check if engine is overheated.
See malfunction 6.
Step 2. Check for loose fuel solenoid wire and defective fuel solenoid valve.
Replace fuel solenoid valve (para. 3-57).
Step 3. Check for faulty fuel pump.
Replace fuel pump (paras. 3-16 and 3-78).

5. ENGINE FAILS TO STOP

Step 1. Check for stuck fuel solenoid valve.
Replace solenoid valve (para. 3-57).
Step 2. Check for turbocharger oil seal leak in compressor end.
Replace compressor oil seal (para. 3-47).

6. ENGINE OVERHEATS

Check for leaking or noisy water pump.
Repair water pump (para. 3-64).

7. EXCESSIVE EXHAUST SMOKE

Step 1. Check for incorrect injector adjustment.
Adjust injectors (para. 3-85).
Step 2. Check for defective fuel injector(s).
Replace defective fuel injector(s) (paras. 3-23 and 3-82).
Step 3. Check for blocked fuel return line in fuel system.
Repair fuel return line (TM 9-2320-283-20).

Table 2-1. Mechanical Troubleshooting (Contd).

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

Step 4. Check for improperly seated valves.

Reseat or replace valves (para. 3-35).

Step 5. Check for incorrect injection timing.

Adjust injection system timing (para. 3-72).

8. LOW OIL PRESSURE

Step 1. Check pressure regulator.

Free up pressure regulator or replace oil pump (paras. 3-19 and 3-74).

Step 2. Check for spun camshaft bushing.

Replace camshaft bushing (para. 3-34).

Step 3. Inspect oil pump gasket.

Replace gasket (para. 3-44).

Step 4. Check for worn camshaft.

Replace camshaft (para. 3-40).

Step 5. Check for worn crankshaft.

Replace crankshaft and install new bearings (para. 3-37).

Step 6. Inspect main bearings.

Replace main bearings (para. 3-29).

Step 7. Inspect connecting rod bearings.

Replace connecting rod bearings (para. 3-68).

Step 8. Inspect oil pump gears.

Replace oil pump (paras. 3-19 and 3-74).

Step 9. Check for high oil temperature. Inspect and clean oil cooler (para. 3-42).

Step 10. Check for worn main bearings, connecting rod bearings, and crankshaft. Install new bearings and check crankshaft (paras. 3-68 and 3-69).

9. ENGINE KNOCKS

Step 1. Check for broken piston.

Replace piston (paras. 3-29 and 3-69).

Step 2. Check for broken injector cup.

Repair injector (para. 3-52).

Step 3. Check for incorrect valve adjustment.

Adjust valves (para. 3-85).

Step 4. Check for incorrect injector adjustment.

Adjust injectors (para. 3-85).

Step 5. Check for loose connecting rod capscrews.

a. Tighten connecting rod capscrews to proper torque (para. 3-69).

b. Check bearings (para. 3-39).

Step 6. Check for worn connecting rod bearings.

Replace connecting rod bearings (paras. 3-29, 3-39, and 3-69).

Table 2-1. Mechanical Troubleshooting (Contd).

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

Step 7. Check for loose main bearing capscrews.

a. Torque main bearing capscrews (para. 3-68).

b. Check "e" bearings (para. 3-37).

Step 8. Check for worn main bearings.

Replace main bearings (paras. 3-31 and 3-68).

Step 9. Check for excessive crankshaft end clearance.

Check crankshaft end clearance (para. 3-68).

Step 10. Check for worn crankshaft.

Replace crankshaft and install new bearings (paras. 3-31 and 3-68).

Step 11. Check for worn piston pins.

Replace worn piston pins and bushings or replace rods (paras. 3-29, 3-39, and 3-69).

Step 12. Check for broken piston.

Replace piston (paras. 3-29 and 3-69).

Step 13. Check for incorrect injection timing.

Adjust injector system timing (para. 3-72).

10. EXCESSIVE FUEL CONSUMPTION

Step 1. Check for incorrect valve and injector adjustment.

Adjust valves and injectors (para. 3-85).

Step 2. Check for excessive fuel pressure.

Test and calibrate fuel pump (para. 3-63).

Step 3. Check for restricted fuel drain.

Repair fuel crossover tubes (para. 3-35).

Step 4. Check for defective injector(s).

Replace defective injector(s) (paras. 3-23 and 3-82).

Step 5. Check for leaking cylinder head gasket(s).

Replace cylinder head gasket(s) (paras. 3-24 and 3-71).

Step 6. Check for incorrect injection timing.

Adjust injector system timing (para. 3-72).

11. EXCESSIVE OIL CONSUMPTION

Step 1. Check for external leaks.

a. Tighten the external oil connections.

b. Replace damaged gasket(s).

Step 2. Check turbocharger oil seals.

Replace turbocharger oil seals (para. 3-47).

Step 3. Check for worn, stuck, or broken piston rings.

Replace piston rings (paras. 3-29 and 3-69).

Step 4. Check for worn piston(s) and cylinder liner(s).

Install new pistons and cylinder liners (paras. 3-67 and 3-69).

Step 5. Check for cracked piston.

Replace damaged piston (paras. 3-29, 3-39, and 3-69).

Table 2-1. Mechanical Troubleshooting (Contd).

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

12. EXCESSIVE ENGINE VIBRATION

Step 1. Check for loose or worn engine insulators.
Replace mounts (TM 9-2320-283-34).

Step 2. Check for loose or worn cab insulators.
Replace insulators (TM 9-2320-283-34).

Step 3. Check for burned valves.
Replace valves (para. 3-35).

Step 4. Check for excessive flexdisk and ring gear runout.
Correct flexdisk and ring gear runout (para. 3-80).

Step 5. Check for loose flexdisk and ring gear mounting screws.
Tighten flexdisk and ring gear mounting screws (para. 3-80).

Step 6. Check for loose flywheel housing screws.
Tighten flywheel housing screws (para. 3-80).

Step 7. Check for misalignment of flywheel housing.
Align flywheel housing (para. 3-80).

Step 8. Check for unbalanced flexdisk and ring gear.
Replace the flexdisk and ring gear (paras. 3-25 and 3-80).

Step 9. Check for loose vibration damper.
Tighten vibration damper screws (para. 3-79).

Step 10. Check for unbalanced vibration damper.
Install new vibration damper (para. 3-79).

Step 11. Check adjustment of valves and injectors.
Adjust valves and injectors (para. 3-85).

Step 12. Check timing for air compressor.
Adjust air compressor timing (para. 3-72).

Step 13. Check for incorrect injection timing.
Adjust injector system timing (para. 3-72).

Step 14. Check for excessive flywheel runout.
Correct flywheel runout (para. 3-38).

Step 15. Check for unbalanced flywheel or one or more injectors not performing properly.
a. Replace flywheel (para. 3-38, step 16).
b. Replace faulty injectors (para. 3-52).

13. ENGINE WILL NOT IDLE

Step 1. Check fuel pump idle setting.
Adjust idle setting (para. 3-93).

Step 2. Check for improperly assembled governor spring.
Assemble governor spring correctly (para. 3-60).

Table 2-1. Mechanical Troubleshooting (Contd).

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

Step 3. Check for stuck governor spring plunger.
Free governor spring plunger (para. 3-60).
Step 4. Check for plugged governor barrel.
Clean governor barrel (para. 3-61).

14. FUEL LEAKS AT FUEL PUMP OR INJECTOR

Step 1. Check for faulty seals and O-rings in fuel pump.
Install new seals and O-rings (para. 3-61).
Step 2. Check for mutilated injector O-rings.
Replace injector mounting O-rings (paras. 3-23 and 3-82).
Step 3. Check for faulty fuel filter gasket.
Replace gasket (paras. 3-58 and 3-62).

15. ENGINE DOES NOT DEVELOP FULL POWER

Step 1. Check for damaged turbocharger.
Repair turbocharger (para. 3-47).
Step 2. Check for improperly adjusted valves and injectors.
Adjust valves and injectors (para. 3-85).
Step 3. Check for worn or scored fuel pump components.
Repair or replace fuel pump (paras. 3-16, 3-56, and 3-78).
Step 4. Check for dirty fuel injector(s).
Clean fuel injector(s) (para. 3-52).
Step 5. Check for scuffed cylinder liners.
Replace cylinder liners (paras. 3-30 and 3-67).
Step 6. Check for incorrect injection timing.
Adjust injection system timing (para. 3-72).
Step 7. Check for plugged electric shutoff (solenoid) valve.
Clean electric shutoff valve (solenoid) (para. 3-57).
Step 8. Check for plugged fuel pump throttle control shaft.
Clean or replace the fuel pump throttle control shaft (para. 3-62).
Step 9. Check for burned valves.
Reface or replace valves and valve seats (para. 3-57).
Step 10. Check for plugged Air Fuel Control (AFC) breather (check valve).
Replace the AFC breather (para. 3-62).

16. ENGINE MISSES OR RUNS ERRATICALLY

Step 1. Check for improperly adjusted valves and injectors.
Adjust valves and injectors (para. 3-85).
Step 2. Check injector for leaking middle O-ring.
Replace injector middle O-ring (paras. 3-23 and 3-82).
Step 3. Check for damaged rocker arms.
Replace rocker arms (paras. 3-22 and 3-84).

Table 2-1. Mechanical Troubleshooting (Contd).

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

Step 4. Check for broken fuel injector plunger spring.
Replace fuel injector plunger spring (para. 3-52).
Step 5. Check for broken or deformed injector cup.
Replace injector cup (para. 3-52).
Step 6. Check for plugged injector cup spray holes.
Clean injector cups (para. 3-52).
Step 7. Check for plugged metering or drain orifice in fuel injectors.
Clean fuel injectors (para. 3-52).
Step 8. Check for burned or excessively pitted valves.
Reface or replace valves and valve seat inserts (para. 3-35).
Step 9. Check for cracked or broken valve seat inserts.
Replace damaged valve seat inserts (para. 3-35).
Step 10. Check for incorrect injection timing.
Adjust injection system timing (para. 3-72).
Step 11. Check for leaking injector sleeves.
Replace injector sleeves (para. 3-53).

17. EXCESSIVE GEAR NOISE

Step 1. Check for broken or worn gear teeth.
Replace gears or units having damaged teeth (refer to index for appropriate paragraphs).
Step 2. Check for excessive gear backlash.
Replace defective gears or shafts (refer to index for appropriate paragraphs).

18. EXCESSIVE OIL LOSS

Step 1. Check for cracked or broken front gearcase cover.
Replace front gearcase cover (paras. 3-27 and 3-75).
Step 2. Check for defective seals and gaskets.
Replace faulty seals and gaskets as required.
Step 3. Check for leaking rear cover oil seal or gaskets.
Replace rear cover oil seal or gaskets (paras. 3-25 and 3-80).

19. SLUDGE FORMATION IN CRANKCASE

Check for moisture in crankcase.
Isolate the source and repair as required.
Inspect for tears on head gaskets cylinder openings.

20. LUBRICATING OIL DILUTED

Step 1. Check for moisture in crankcase.
Isolate the source and repair as required.
Inspect for tears at head gaskets cylinder openings.
Step 2. Check injector for damaged O-ring.
Replace injector O-ring (para. 3-52).

Table 2-1. Mechanical Troubleshooting (Contd).

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

Step 3. Check for defective injector(s).

Repair or replace injectors (paras. 3-23, 3-52, and 3-82).

Step 4. Check for broken piston.

Replace piston (paras. 3-29 and 3-69).

Step 5. Check for cracked or broken piston rings.

Replace broken piston rings (para. 3-39).

21. LOW COMPRESSION

Step 1. Check adjustment of valve and injectors.

Adjust valves and injectors (para. 3-85).

Step 2. Check for worn cylinder liners.

Replace cylinder liners (paras. 3-30 and 3-67).

Step 3. Check for leaking cylinder head gasket.

Replace gasket (paras. 3-24 and 3-71).

Step 4. Check for worn piston rings.

Replace piston rings (paras. 3-29 and 3-69).

Step 5. Check for incorrect timing.

Adjust injection system timing (para. 3-72).

Step 6. Check for valves not seating.

Reface valves and seats (para. 3-35).

22. ENGINE OVERSPEED

Step 1. Check for improperly adjusted governor.

Adjust governor (para. 3-93).

Step 2. Check for defective governor or fuel pump.

Repair governor or fuel injection pump as necessary (paras. 3-61 and 3-56).

CHAPTER 3
MAINTENANCE

Section I. GENERAL MAINTENANCE INSTRUCTIONS

3-1. OVERVIEW

NOTE
All information contained in this manual applies to both M915 and M915A4/Big Cam I and M915A1 and M915A4/Big Cam III engines except where differences are specifically noted.

a. This chapter provides maintenance instructions for repair of the engine and components/parts authorized for direct support and general support levels.

b. Each section has a task summary listing procedures covered in that section.

3-2. GENERAL

a. This section provides general instructions for lifting, draining, cleaning, inspection, wear limits and tolerances, repair, and assembly of the engine and component parts.

b. Use the following guidelines during maintenance of the engine:

(1) Physically check all tags and forms attached to the equipment to determine the reason for its removal from service, and check that all equipment changes or modifications from Technical Bulletins (TB) and Modification Work Orders (MWO) have been accomplished.

(2) Following the procedures provided, disassemble the equipment, and inspect and evaluate each component to determine extent of repair required to bring the equipment to the standards specified in this manual.

(3) As components and accessories are removed, note clearances and any fit problems. Record these to serve as a guide during repair and assembly.

(4) Repair and replacement standards for engine components are in Appendix F.

(5) Engine valve and injector adjustments are in paragraph 3-85.

(6) Engine retarder adjustments are in paragraph 3-86.

(7) On-engine fuel pump adjustments are in paragraph 3-93.

c. Publications which provide additional information on general shop practice techniques, preservation, welding, sheet metal work, etc., are listed in Appendix A of this manual.

d. To find a particular general maintenance instruction, use the task summary (para. 3-3).

3-3. TASK SUMMARY

TASK PARA	PROCEDURES
3-4.	Lifting Engine
3-5.	Draining Engine
3-6.	Cleaning a. General Instructions b. Importance of Cleaning c. External Engine Cleaning d. Disassembled Parts Cleaning e. Castings f. Oil Passages g. Oil Seals, Electrical Cables, and Flexible Hoses h. Ball-Roller Bearings
3-7.	Inspection a. General Instructions b. Castings c. Bail-Roller Bearings d. Studs, Bolts, and Screws e. Gears f. Bearings, Bushings, and Bushing-Type Bearings g. Oil Seals h. Core Hole Expansion Plugs
3-8.	Wear Limits and Tolerances
3-9.	Repair a. General Instructions b. Castings c. Ball-Roller Bearings d. Studs e. Gears f. Bushings and Bushing-Type Bearings g. Oil Seals h. Cylinder Block and Cylinder Head
3-10.	Assembly a. General b. Precautionary Rules c. Pipe Plugs

3-4. LIFTING ENGINE

WARNING

The stamped, steel oil pan on M915A1/Big Cam III and M915/Big Cam I engines must not be used to support weight of engine; the pan will permanently deform and may collapse, allowing engine to fall over. Failure to comply may result in damage to equipment and injury to personnel.

Connect engine lifting fixture and a suitable sling to engine lifting brackets, and raise engine for draining, cleaning, and installation on maintenance stand. Refer to para. 3-13 and mount engine on maintenance stand.

3-5. DRAINING ENGINE

a. Remove oil drainplug from right rear side of oil pan. Drain engine oil completely, then replace drainplug. Tighten drainplug to 60-70 lb-ft (81-95 N•m). Remove oil filter (M915/Big Cam I) or bypass oil filter and full-flow oil filter (M915A1/Big Cam III) from oil cooler, and drain oil filter(s) and oil cooler housing.

b. Remove ether quick-start thermostat from right rear side of cylinder block. Open drainvalve on rear end of oil cooler. Open drainvalve on thermostat housing. Completely drain coolant from cylinder block and oil cooler, then close drainvalves and replace ether quick-start thermostat.

c. Open drainvalve on bottom of fuel/water separator. Completely drain fuel from separator, then close drainvalve.

3-6. CLEANING

a. General Instructions. Cleaning procedures will be the same for many of the parts and components that make up engine subassemblies. Follow general cleaning procedures detailed in steps b. through h.

b. Importance of Cleaning. Great care and effort are required in all cleaning operations. The presence of dirt and foreign material is a constant threat to satisfactory engine operation and maintenance. The following guidelines apply to all cleaning operations:

(1) All parts must be cleaned prior to inspection, after repair, and before assembly.

(2) Hands must be clean prior to handling cleaned parts.

(3) After cleaning, all parts must be covered or wrapped in plastic or paper to protect them from dust and debris.

WARNING

- **Approved solvents may be flammable and will not be used near open flame. Use only in well-ventilated area. Failure to comply may result in injury to personnel.**
- **Compressed air used for cleaning purposes will not exceed 30 psi. Use only with effective chip guarding and protective equipment such as goggles or shield, gloves, etc. Failure to comply may result in injury to personnel.**

c. External Engine Cleaning. All electrical components or other parts that could become damaged by cleaning or moisture must be removed. Close all openings on the engine with waterproof tape or suitable plugs. Thoroughly clean all external parts and outer surfaces. Ensure no foreign material enters working parts of the engine. Wash the engine using water under pressure to remove mud and dirt. Remove oil and grease using a stiff brush and approved solvent. Dry engine with compressed air.

3-6. CLEANING (Contd)

d. Disassembled Parts Cleaning. Place all disassembled parts in suitable wire baskets for cleaning.

(1) Dry and cover all cleaned parts.

(2) Place cleaned parts in containers or holding racks for inspection or repair.

(3) All parts subject to oxidation and rust must be lightly oiled and wrapped.

(4) Keep all related parts and components together. Do not mix parts.

WARNING

Improper cleaning methods and use of unauthorized cleaning solvents will not be used. Refer to TM 9-247 for proper cleaning methods and solvents. Failure to comply may result in damage to equipment or injury to personnel.

e. Castings.

(1) Clean inner and outer surfaces of castings (and all areas subject to grease and oil) with cleaning solvents. Refer to TM 9-247.

(2) Use a stiff brush to remove sludge and gum deposits.

WARNING

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

(3) Use compressed air to blow out all tapped screw holes and to dry castings after cleaning.

f. 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 any obstructions.

(1) Clean oil passages with wire brush probes to break up any sludge or gum deposits.

(2) Wash passages by flushing with solvent. See TM 9-247.

(3) Dry passages with compressed air.

CAUTION

Do not allow cleaning solvents to come in contact with seals, cables, or flexible hoses. Solvents can cause leather, rubber, and some synthetic materials to dry out, rot, and lose pliability, making them unserviceable.

g. Oil Seals, Electrical Cables, and Flexible Hoses. Clean with soap and water.

h. Ball-Roller Bearings.

(1) Bearings require special cleaning. After removing surface oil and gum deposits, place bearing in hot oil, 140°F (60°C), to loosen congealed oil and grease. Wipe bearings dry (do not use compressed air). After cleaning, coat bearings with oil, wrap in paper, and hold for inspection.

(2) See TM 9-214 for information about care of bearings.

3-7. INSPECTION

a. General Instructions. Inspection procedures will be the same for many of the engine parts and components that make up the engine subassemblies. Follow the general procedures for inspection detailed in steps b. through h. Dimensional standards for various parts have been fixed at extremely close tolerances: use the repair standards specification tables in Appendix F. Use specified inspection equipment for inspection where cracks or other damage cannot be otherwise found. Exercise extreme care in all phases of inspection.

3-7. INSPECTION (Contd)

b. Castings.

(1) Inspect castings for cracks using a magnifying glass and bright lighting.

(2) Refer to MIGI-68866 (Inspection Process, Penetrant Methods) and MIGG-6868 (Inspection Process, Magnetic Particles).

(3) Closely check area around studs, pipe plugs, threaded inserts, and sharp corners. Replace all cracked castings.

(4) Inspect machined surfaces for nicks, burrs, or raised metal. Mark damaged areas for repair or replacement.

(5) Inspect all pipe plugs, pipe plug openings, screws, and screw openings for damaged or stripped threads.

(6) Use a straightedge or surface plate and check all gasket mating surfaces, flanges on housings, and supports for warpage. Inspect mating flanges for discoloration, which may indicate persistent oil leakage.

(7) Check all castings for conformance to applicable repair standards.

c. Ball-Roller Bearings. See TM 9-214 for inspection of bearings. Check all bearings for conformance to applicable repair standards (Appendix F).

d. Studs, Bolts, and Screws. Replace studs, bolts, and screws if bent, loose, or threads are stretched or damaged.

e. Gears.

NOTE

There are no established gear teeth wear limits. Replace gears if any obvious physical damage to teeth or keyway slots is evident.

(1) Inspect all gears for cracks using a magnifying glass and bright lighting. No cracks are allowed.

(2) Inspect gear teeth for apparent excessive wear, sharp edges, chips, burrs, and galled or pitted surfaces.

(3) Check keyway slots for wear and/or damage.

CAUTION

Engine connecting rod bearings and main bearings are supplied in sets. Replacement of a single bearing is not permitted. If one bearing has failed, all bearings must be replaced.

f. Bearings, Bushings, and Bushing-Type Bearings.

(1) Check all bushings and bushing-type bearings for secure fit, evidence of heating, wear, burrs, nicks, and out-of-round condition.

(2) Check for dirt in lubrication holes or grooves. Holes and grooves must be clean and free from damage.

g. Oil Seals. Oil seals should always be replaced.

h. Core Hole Expansion Plugs. Inspect for leakage. Replace plug when leakage is present.

3-8. WEAR LIMITS AND TOLERANCES

Refer to Appendix F for engine wear limits and tolerances.

3-9. REPAIR

a. General Instructions. General procedures for repair of engine parts and components are detailed in steps b. through h.

3-9. REPAIR (Contd)

CAUTION

Repaired items must be thoroughly cleaned to remove metal chips and abrasives to prevent them from entering working parts of engine. Refer to Cleaning, para. 3-6.

b. Castings.

(1) All cracked castings will be replaced.

(2) Only minor repairs to machined surfaces, flanges, and gasket mating surfaces are permitted. Remove minor nicks, burrs, and/or scratches with:

(a) Fine mill file.

(b) Crocus cloth dipped in cleaning solvent.

(c) Lapping across a surface plate.

(3) Remachining of machined surfaces to repair damage, warpage, or uneven surfaces is not permitted. Replace casting.

(4) Repair damaged pipe threads and machine threads in castings with the proper thread tap. Repair oversize holes with threaded inserts.

c. Ball-Roller Bearings. See TM 9-214.

d. Studs. Replace all bent or stretched studs. Repair minor thread damage with a thread chaser. Replace studs having stripped or damaged threads as outlined below:

(1) Using a stud remover, remove stud. Back stud out slowly to avoid heat buildup and seizure, which can cause stud to break off.

CAUTION

See TM 9-237 (Welding Instructions) to avoid damage to castings if welding method is used.

(2) If studs break off too short to use a stud remover, use an extractor or the "welding method."

(3) Broken studs can be removed by welding bar stock or a nut to stud and removing with wrench.

NOTE

Standard studs may have a coarse thread on one end and a fine thread on the other end. The coarse threaded end is usually installed on the casting. Studs having coarse threads at both ends are used in some applications. The shorter threaded end is intended to be installed on the casting. See Appendix B for correct part number.

(4) All replacement studs have a special coating and must have a small amount of antiseize compound (MIL-A-13881) applied to their threads before installing. Install replacement stud slowly to prevent heat buildup and snapping off.

e. Gears.

(1) Remove gears using suitable pullers.

(2) Use the same methods described in para. 3-9.b., step 2, to remove minor nicks, burrs, or scratches from gear teeth.

(3) If keyways are worn or enlarged, replace gear.

f. Bushings and Bushing-Type Bearings. When bushings and bushing-type bearings become seized to a shaft or spin in a bore, they must be replaced along with their associated parts.

g. Oil Seals.

(1) Remove oil seals by pressing or prying out, being careful not to damage casting or adapter bore.

(2) Always install new oil seals using proper seal driver tool.

3-9. REPAIR (Contd)

h. Cylinder Block and Cylinder Head. Repair of cylinder block and cylinder head is limited to repair procedures outlined in paras. 3-34 and 3-35. Measurements found to be outside tolerance limits listed in Appendix F will require replacement of block or head.

3-10. ASSEMBLY

a. General. Extreme care must be exercised in all component assembly operations to ensure satisfactory engine performance. Precautionary rules for assembly are detailed in step b.

b. Precautionary Rules.

(1) Cleanliness is essential in all component assembly operations. Dirt and dust, even in very small quantities, are abrasive. Parts must be cleaned, as specified, and kept clean until assembly. Wrap or cover parts and components when assembly procedures are not immediately completed.

(2) Coat all bearings and contact surfaces with engine oil OE/HDO-10 (MIL-L2 104C) to ensure lubrication of parts during initial engine starting.

(3) Replace all gaskets and preformed packings during assembly.

c. Pipe Plugs. Certain pipe plugs require liquid thread sealant applied to pipe threads prior to installation of plug. This is done to provide a better seal, and will permit easier removal of pipe plug. Those pipe plugs requiring sealant will be identified in the task step prior to installation. The method of sealing these particular plugs is as follows:

(1) Ensure the pipe plug is thoroughly clean and dry prior to applying sealant. All dirt, grease, oil, and scale must be removed.

(2) Apply sealant one or two threads from the small or leading edge of plug.

(3) Apply sealant in the same direction as threads. Ensure sealant flows into inside diameter of threads.

(4) Tighten pipe plugs to their specified torque value. Do not use power tools. Torque limits for engine parts are provided in Appendix E.

Section II. DISASSEMBLY

3-11. GENERAL

a. This section provides maintenance procedures for preparation of engine for mounting on maintenance stand, removal of major components, and disassembly into subassemblies. The following procedures are for the engine removed from the vehicle.

b. In cases where it may only be necessary, or more time efficient, to partially disassemble the engine while installed in vehicle, follow the applicable portions of the tasks contained in this section to remove the part or component.

c. In the task summary listed below, a complete list of special tools, test equipment, materials, parts, and related information required to perform a complete engine disassembly is provided. To find a specific engine disassembly procedure contained in this section, see list of tasks below.

3-12. TASK SUMMARY

List of Tasks

TASK	PROCEDURES	TASK PARA.	TROUBLESHOOTING REF. NO. (PARA.)
1.	Mounting Engine on Maintenance Stand	3-13	2-8
	a. Lifting	3-13a	
	b. Draining	3-13b	
	c. Cleaning	3-13c	
	d. Inspection	3-13d	
	e. Component Removal	3-13e	
	f. Mounting to Maintenance Stand	3-13f	
2.	Vibration Damper and Crankshaft Pulley Removal	3-14	2-8
3.	Accessory Drive Pulley Removal	3-15	
4.	Fuel Pump Removal	3-16	2-8
5.	Air Compressor Removal	3-17	2-8
6.	Accessory Drive Housing Assembly Removal	3-18	2-8
7.	Oil Pump Removal	3-19	2-8
8.	Air Aftercooler Removal	3-20	2-8
9.	Engine Retarder Removal	3-21	2-8
10.	Rocker Arm Housing Assembly and Pushrods Removal	3-22	2-8
11.	Injector Assembly Removal	3-23	2-8
12.	Cylinder Head Assembly Removal	3-24	2-8
13.	Flexplate or Flywheel, Flywheel Housing, and Rear Cover Removal	3-25	2-8
14.	Oil Pan Removal	3-26	2-8
15.	Front Gear Cover Removal	3-27	2-8

3-12. TASK SUMMARY (Contd)

TASK	PROCEDURES	TASK PARA.	TROUBLESHOOTING REF. NO. (PARA.)
16.	Cam Follower Assemblies and Camshaft Removal	3-28	2-8
17.	Piston, Connecting Rod, and Bearings Removal	3-29	2-8
18.	Cylinder Liner Removal	3-30	2-8
19.	Engine Crankshaft and Main Bearing Removal	3-31	2-8

3-13. MOUNTING ENGINE ON MAINTENANCE STAND

THIS TASK COVERS:

a. Lifting
b. Draining
c. Cleaning
d. Inspection
e. Component Removal
f. Mounting to Maintenance Stand

INITIAL SETUP:

APPLICABLE CONFIGURATIONS
All

SPECIAL TOOLS
Engine lifting fixture (15434) ST-125
Engine stand (NSN 1740-00-338-6673) or suitable stand

TEST EQUIPMENT
None

MATERIALS/PARTS
Solvent, SD-3 (Appendix C, Item 30)
Cap and plug set (Appendix C, Item 31)
Six gaskets (15434) 3020943
Eight lockwashers (15434) 109594
Six lockwashers (96906) MS35338-48
Two lockwashers (96906) MS35338-46
Six lockwashers (15434) S-604
Gasket (15434) 3031858
Gasket (15434) 3008017
Gasket (15434) 70089-1
Six preformed packings (15434) 3007442

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES
LO 9-2320-273-12
TM 9-2320-273-20
TM 9-2320-273-34
LO 9-2320-283-12
TM 9-2320-283-20
TM 9-2320-283-34

TROUBLESHOOTING REFERENCES
para. 2-8

EQUIPMENT CONDITION
- Engine removed from vehicle (TM 9-2320-273-34 or TM 9-2320-283-34).
- Starter motor and solenoid removed (TM 9-2320-273-20 or TM 9-2320-283-20).
- Alternator, belts, and bracket removed (TM 9-2320-273-20 or TM 9-2320-283-20).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
- All personnel must stand clear during lifting operations.
- Use extreme caution during disassembly; engine components are heavy.
- Diesel fuel is flammable.
- Use approved solvents in well-ventilated area.

LOCATION/ITEM	ACTION	REMARKS

a. Lifting

WARNING

All personnel must stand clear during lifting operations. A snapped chain or swinging or shifting load may result in injury to personnel.

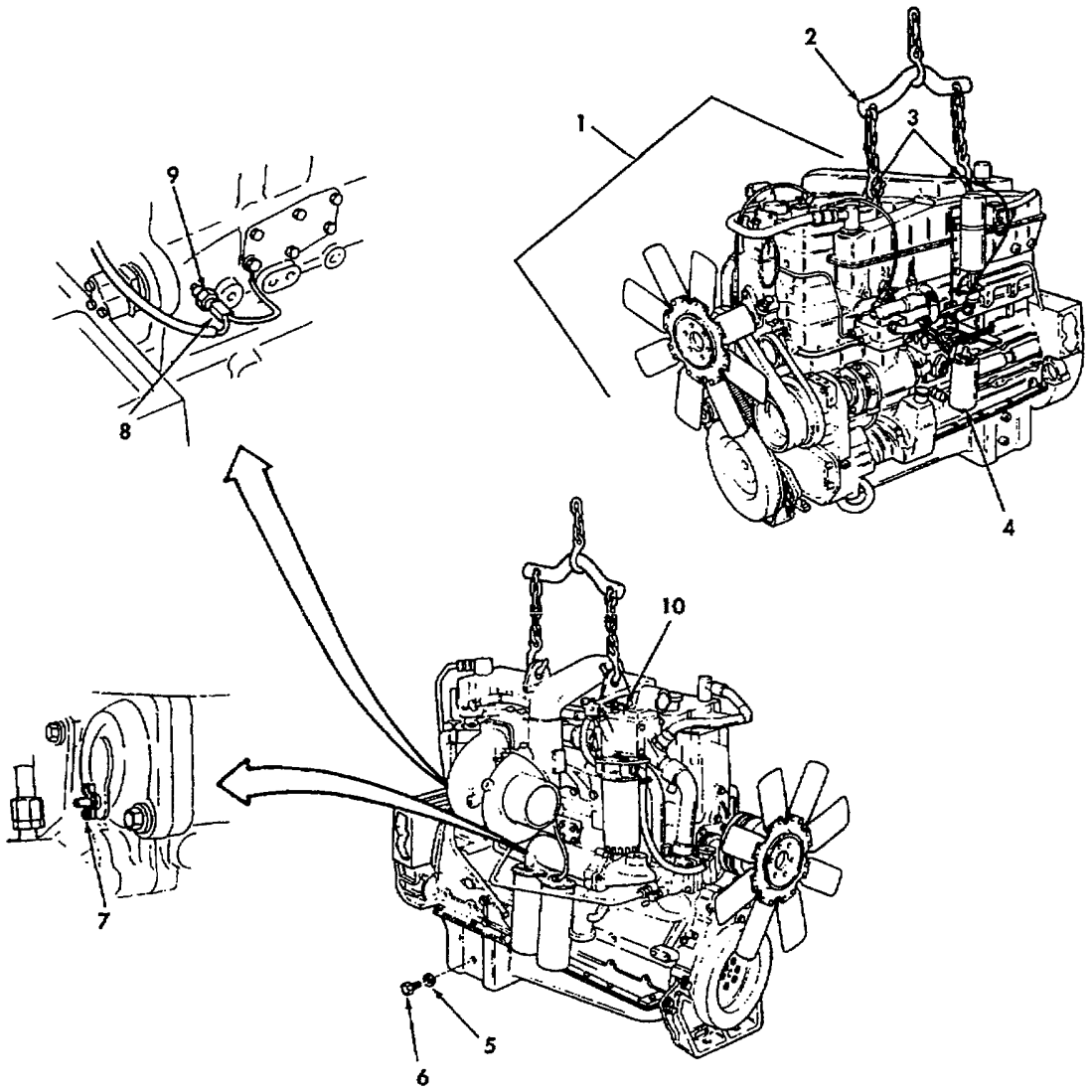
1.	Dressed engine assembly (1)	a. Connect engine lifting fixture (2) to two engine lifting brackets (3).

3-13. MOUNTING ENGINE ON MAINTENANCE STAND (Contd)		
LOCATION/ITEM	**ACTION**	**REMARKS**

NOTE
Assistant will help with step 1.

b. Using suitable sling and lifting device, lift engine for draining and cleaning,

Ensure lifting device and engine lifting fixture (2) distribute load equally on engine lifting brackets (3).



LEGEND:

1. DRESSED ENGINE ASSEMBLY
2. ENGINE LIFTING FIXTURE
3. ENGINE LIFTING BRACKET (2)
4. FUEL/WATER SEPARATOR DRAINVALVE
5. WASHER
6. OIL DRAINPLUG
7. OIL COOLER WATER DRAINVALVE
8. ETHER QUICK-START THERMOSTAT WIRE HARNESS CONNECTOR
9. ETHER QUICK-START THERMOSTAT
10. THERMOSTAT HOUSING DRAINVALVE

3-13. MOUNTING ENGINE ON MAINTENANCE STAND (Contd)

LOCATION/ITEM	ACTION	REMARKS
b. Draining		
	NOTE **Use separate containers for draining each system.**	
2. Oil drainplug (6)	a. Remove from oil pan (13). b. Install on oil pan (13) when oil stops draining.	Allow oil to drain out.
	WARNING **Do not perform fuel system procedures while smoking or within 50 ft (15.2 m) of sparks or open flame. Diesel fuel is flammable and may explode. Failure to comply may result in injury to personnel and/or damage to equipment.**	
3. Fuel/water separator drainvalve (4)	a. Open. b. Close when fuel stops draining.	Allow fuel to drain out.
4. Ether quick-start thermostat wire harness connector (8) and either quick-start thermostat (9)	a. Disconnect connector (8) from thermostat (9). b. Remove from cylinder block (12).	Drain coolant from cylinder block (12).
5. Oil cooler water drainvalve (7)	Open.	Drain coolant from oil cooler.
6. Thermostat housing drainvalve (10)	Open.	Provides air vent for draining thermostat housing.
7. Ether quick-start thermostat (9)	Install on cylinder block (12) when coolant stops draining.	Do not tighten.
8. Drainvalves (7) and (10)	Close when coolant stops draining.	
c. Cleaning		
9. Dressed engine assembly (1)	a. Cover all openings with water-proof tape or suitable caps or plugs. b. Clean all external parts and outer surfaces. c. Remove mud and dirt using water under pressure.	Ensure no foreign material enters the working parts of engine.
	WARNING **Approved solvents may be flammable and will not be used near open flame. Use only in well-ventilated area. Failure to comply may result in injury to personnel.**	
	d. Remove oil and grease using a stiff brush and approved solvent.	

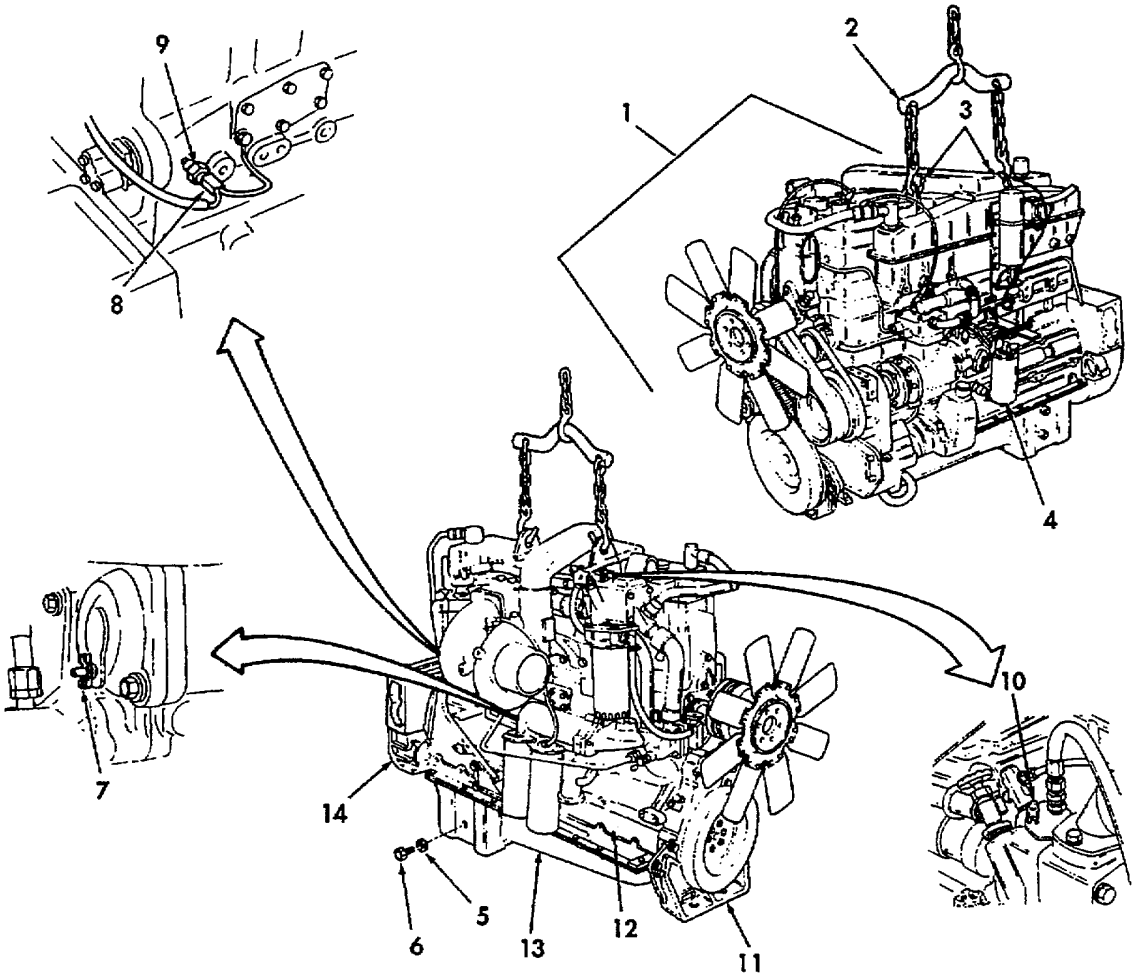
3-13. MOUNTING ENGINE ON MAINTENANCE STAND (Contd)		
LOCATION/ITEM	**ACTION**	**REMARKS**

WARNING

The stamped steel oil pan on M915A1/Big Cam III or M915/Big Cam I engines must not be used to support weight of engine; the pan will permanently deform and may collapse allowing engine to fall over. Failure to comply may result in damage to equipment and injury to personnel.

e. After cleaning, set on engine stand or suitable blocks, and remove lifting fixture (2) from two lifting brackets (3).

Ensure engine is supported by cylinder block (12), flywheel housing (14), or front support (11). Do not support engine on oil pan (13).



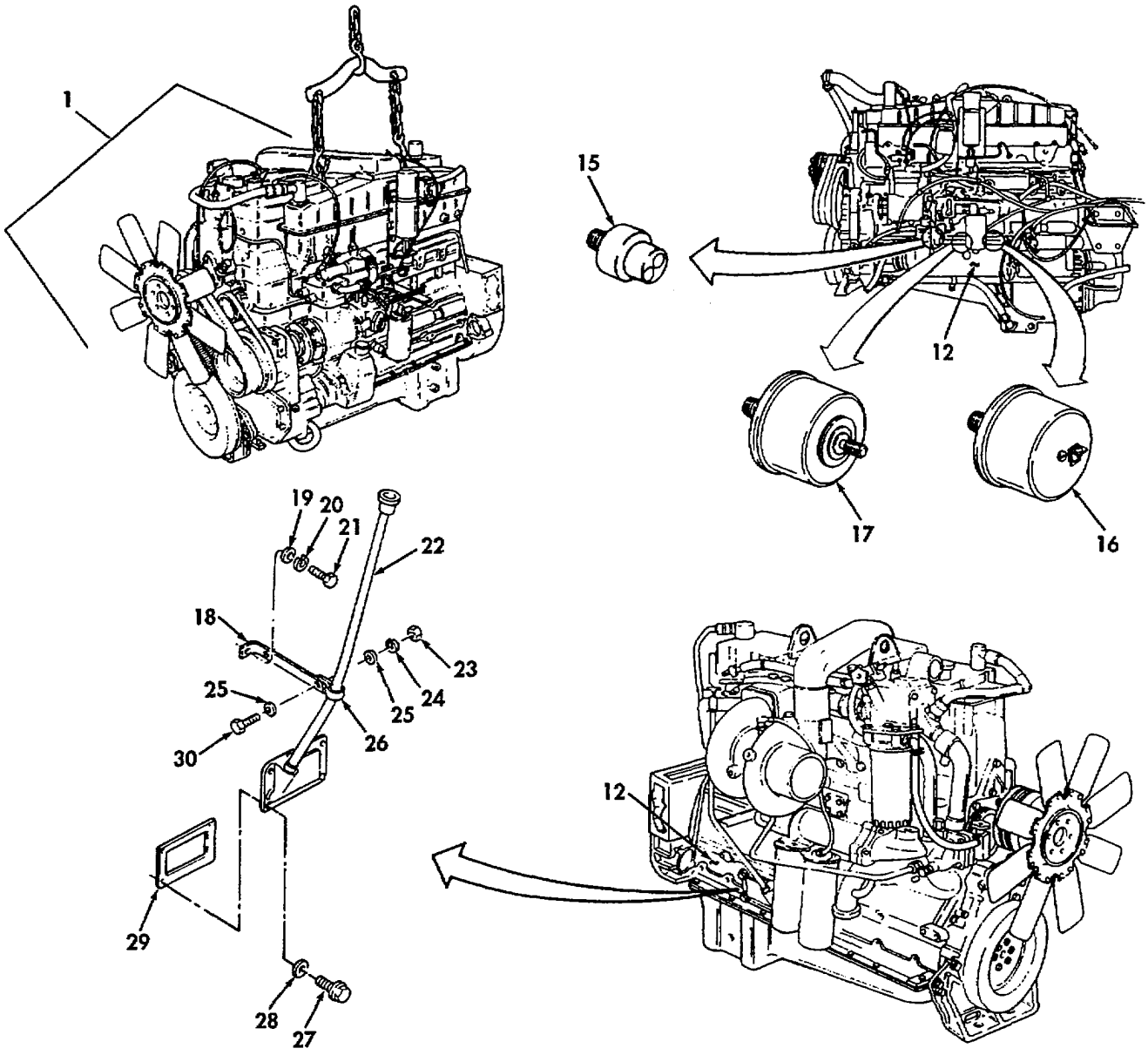
LEGEND:

1. DRESSED ENGINE ASSEMBLY
2. ENGINE LIFTING FIXTURE
3. ENGINE LIFTING BRACKET (2)
4. FUEL/WATER SEPARATOR DRAINVALVE
5. WASHER
6. OIL DRAINPLUG
7. OIL COOLER WATER DRAINVALVE
8. ETHER QUICK-START THERMOSTAT WIRE HARNESS CONNECTOR
9. ETHER QUICK-START THERMOSTAT
10. THERMOSTAT HOUSING DRAINVALVE
11. FRONT SUPPORT
12. CYLINDER BLOCK
13. OIL PAN
14. FLYWHEEL HOUSING

3-13. MOUNTING ENGINE ON MAINTENANCE STAND (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Inspection		
10. Dressed engine assembly (1)	Inspect external surfaces and components for bent, broken, or otherwise damaged condition of parts.	Mark damaged areas to serve as a guide for repair or replacement of defective/damaged parts.
e. Component Removal		
11. Oil pressure gauge sending unit (16) and low oil pressure warning light sending unit (17)	Remove from cylinder block (12).	
NOTE **Perform step 12 for M915/Big Cam I engines only.**		
12. Transmission control-body heating elements ON/OFF switch (15)	Remove from cylinder block (12).	
13. Heater return tube	Remove.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
14. Heater control valve, shutoff valve, and supply tube	Remove.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
15. Oil level dipstick	Remove.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
16. Screw (21), lockwasher (20), and washer (19)	Remove from cylinder block (12) and tube brace (18).	Discard lockwasher (20).
17. Remove nut (23), lockwasher (24), two washers (25), screw (30), clamp (26), and tube brace (18)	Remove from oil level dipstick tube and cover (22).	Discard lockwasher (24).
18. Four captive washer screws (27), washers (28), oil level dipstick tube and cover (22), and gasket (29)	Remove from cylinder block (12).	Discard gasket (29).
19. Oil breather tubes and hoses	Remove.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.

3-13. MOUNTING ENGINE ON MAINTENANCE STAND (Contd)



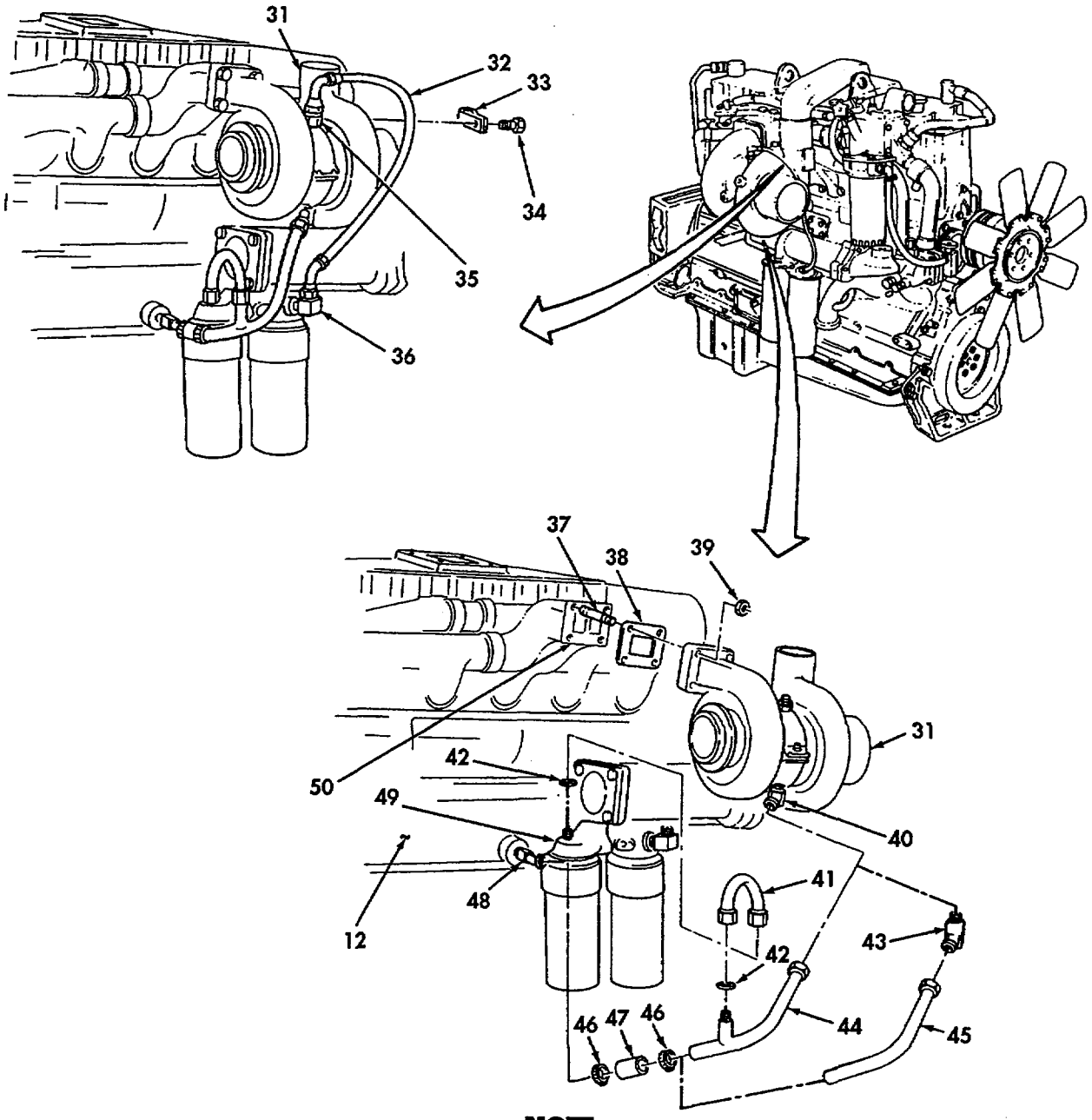
LEGEND:

1. DRESSED ENGINE ASSEMBLY
12. CYLINDER BLOCK
15. TRANSMISSION CONTROL-BODY HEATING ELEMENTS ON/OFF SWITCH (BIG CAM I ONLY)
16. OIL PRESSURE GAUGE SENDING UNIT
17. LOW OIL PRESSURE WARNING LIGHT SENDING UNIT
18. TUBE BRACE
19. WASHER
20. LOCKWASHER
21. SCREW
22. OIL LEVEL DIPSTICK TUBE AND COVER
23. NUT
24. LOCKWASHER
25. WASHER (2)
26. CLAMP
27. CAPTIVE WASHER SCREW (4)
28. WASHER (4)
29. GASKET
30. SCREW

3-13. MOUNTING ENGINE ON MAINTENANCE STAND (Contd)

LOCATION/ITEM	ACTION	REMARKS
e. Component Removal (Contd)		
	NOTE **Location of oil supply inlet port on turbochargers differs between models. M915A1/Big Cam III is shown.**	
20. Turbocharger air crossover connection	Remove.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
21. Screw (34), clamp (33), and turbocharger oil supply hose (32)	Remove from turbocharger (31), adapter (35), and elbow (36).	
	NOTE • **Perform step 22 for M915/Big Cam I only.** • **Perform steps 23 and 24 for M915A1/Big Cam III only.**	
22. Oil return tube (45), two clamps (46), and hose (47)	Remove from elbows (43) and (48).	
23. Oil return tube (41) and two bushings (42)	Remove from oil return tube (44) and filter head (49).	Retain bushings (42).
24. Oil return tube (44), two clamps (46), and hose (47)	Remove from elbows (40) and (48).	
25. Four nuts (39), turbocharger (31), and gasket (38)	Remove from studs (37) and exhaust manifold (50).	Discard gasket (38).

3-13. MOUNTING ENGINE ON MAINTENANCE STAND (Contd)



NOTE

M915/Big Cam I engines have a single oil filter on engine and a bypass filter on firewall. M915A1/Big Cam III engine is shown.

LEGEND:

12. CYLINDER BLOCK
31. TURBOCHARGER
32. OIL SUPPLY HOSE
33. CLAMP
34. SCREW
35. ADAPTER
36. ELBOW
37. STUD (4)
38. GASKET
39 NUT (4)
40. ELBOW (M915A1/BIG CAM III)
41. OIL RETURN TUBE
42. BUSHING (M915A1/BIG CAM III)(2)
43. ELBOW (M915/BIG CAM I)
44. OIL RETURN TUBE (M915A1/BIG CAM III)
45. OIL RETURN TUBE (M915/BIG CAM I)
46. CLAMP (2)
47. HOSE
48. ELBOW
49. FILTER HEAD
50. EXHAUST MANIFOLD

3-13. MOUNTING ENGINE ON MAINTENANCE STAND (Contd)

e. Component Removal (Contd)

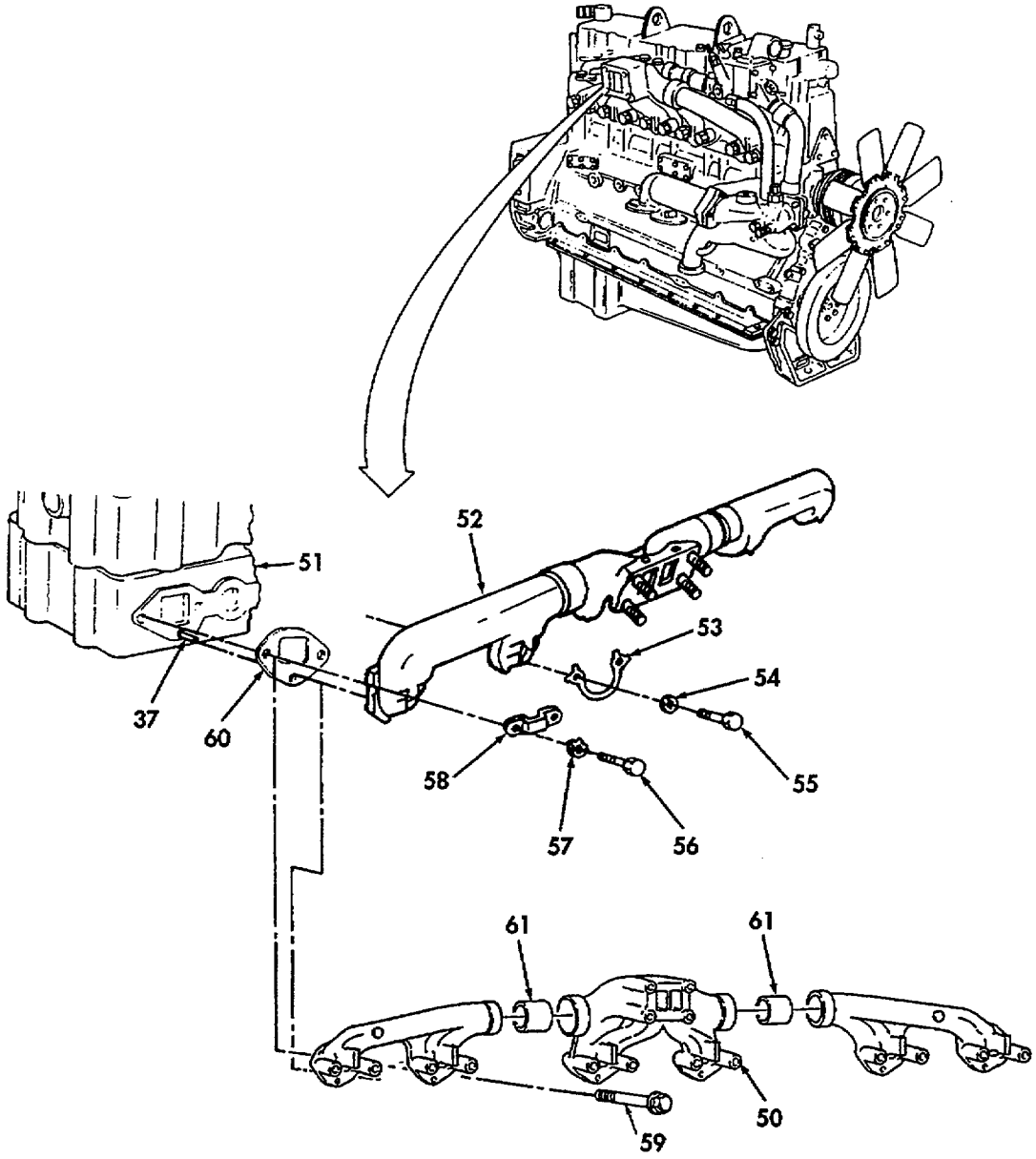
	LOCATION/ITEM	ACTION	REMARKS
26.	Water shutoff valves and hoses	Remove.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
27.	Water filter and bracket	Remove.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.

NOTE

- **Perform steps 28 and 29 for M915/Big Cam I only.**
- **Perform step 30 for M915A1/Big Cam III only.**

28.	Eight screws (55), lockwashers (54), and four lockplates (53)	Remove from cylinder heads (51) and exhaust manifold (52).	Discard lockwashers (54).
29.	Four screws (56), lockplates (57), two damps (58), and exhaust manifold (52)	Remove from cylinder heads (51) and six dowels (37).	Assistant will help hold exhaust manifold (52) during removal. Do not separate manifolds.
30.	Twelve captive washer screws (59) and exhaust manifold (50)	Remove from cylinder heads (51).	Assistant will help hold exhaust manifold (50) during removal. Do not separate manifolds and spacer inserts (61).
31.	Six gaskets (60)	Remove from cylinder heads (51) or exhaust manifold (52) or (50).	Discard gaskets (60).
32.	Air compressor cooling tube	Remove.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
33.	Water transfer tube and bracket	Remove.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
34.	Fan clutch air valve and air lines	Remove.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
35.	Thermostat and thermostat housing	Remove.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
36.	Water manifolds	Remove.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
37.	Lower water transfer tube	Remove.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
38.	Engine oil filter elements	Remove and discard.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.

3-13. MOUNTING ENGINE ON MAINTENANCE STAND (Contd)



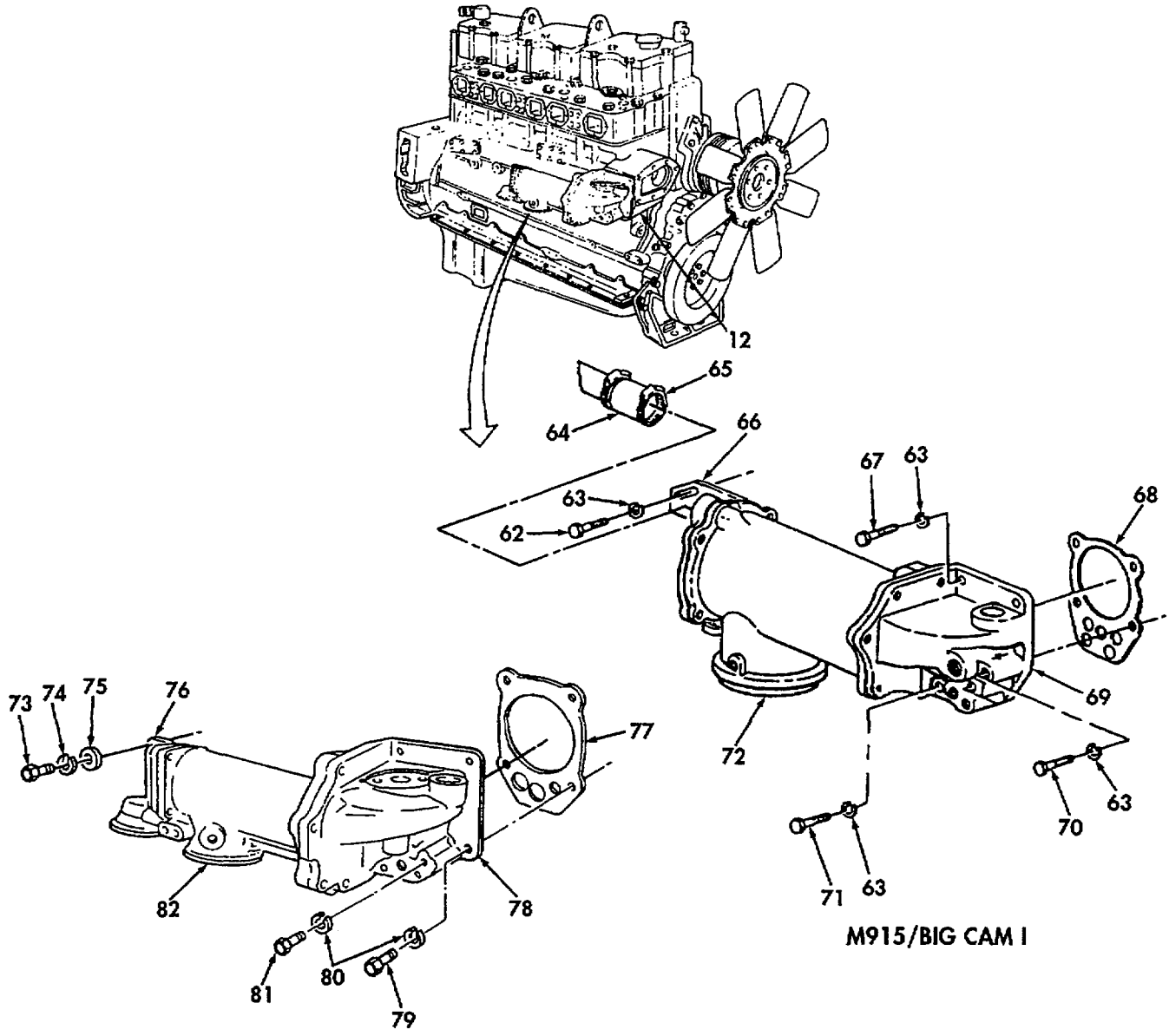
LEGEND:

37. DOWEL (4)
50. EXHAUST MANIFOLD (M915A1/BIG CAM III)
51. CYLINDER HEAD (3)
52. EXHAUST MANIFOLD (M915/BIG CAM I)
53. LOCKPLATE (4)
54. LOCKWASHER (8)
55. SCREW (8)
56. SCREW (4)
57. LOCKPLATE (4)
58. CLAMP (2)
59. CAPTIVE WASHER SCREW (12)
60. GASKET (6)
61. SPACER INSERTS (2) NEW DESIGN EXHAUST MANIFOLD (M915A1/BIG CAM III ONLY)

3-13. MOUNTING ENGINE ON MAINTENANCE STAND (Contd)

	LOCATION/ITEM	ACTION	REMARKS
e. Component Removal (Contd)			
39.	Hot engine temperature switch	Remove.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
40.	Water temperature sending unit	Remove.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
		NOTE • **Perform steps 41 through 43 for M915/Big Cam I only.** • **Perform steps 44 and 45 for M915A1/Big Cam III only.**	
41.	Screw (62) and lockwasher (63)	Remove from cylinder block (12) and support bracket (66).	Discard lockwasher (63).
42.	Clamp (65)	Loosen at water transfer hose (64).	
43.	Screw (71), two screws (67), screws (70), five lockwashers (63), oil cooler assembly (72), and gasket (68)	Remove from cylinder block (12), oil cooler support (69), and water transfer hose (64).	Free oil cooler assembly (72) by tapping with soft-nose hammer. Discard lockwashers (63) and gasket (68).
44.	Two screws (73), lock-washers (74), and washers (75)	Remove from cylinder block (12) and support bracket (76).	Discard lockwashers (74).
45.	Three screws (79), screws (81), six lockwashers (80), oil cooler assembly (82), and gasket (77)	Remove from cylinder block (12) and oil cooler support (78).	Free oil cooler support (78) by tapping with a soft-nose hammer.
46.	Water pump bypass hose	Remove.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
47.	Water pump to radiator connection	Remove.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
48.	Water bypass tube	Remove.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
49.	Air compressor discharge hose	Remove.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
50.	Air compressor intake tube	Remove.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
51.	Air compressor governor and air lines	Remove.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.

3-13. MOUNTING ENGINE ON MAINTENANCE STAND (Contd)



M915/BIG CAM I

M915A1/BIG CAM III

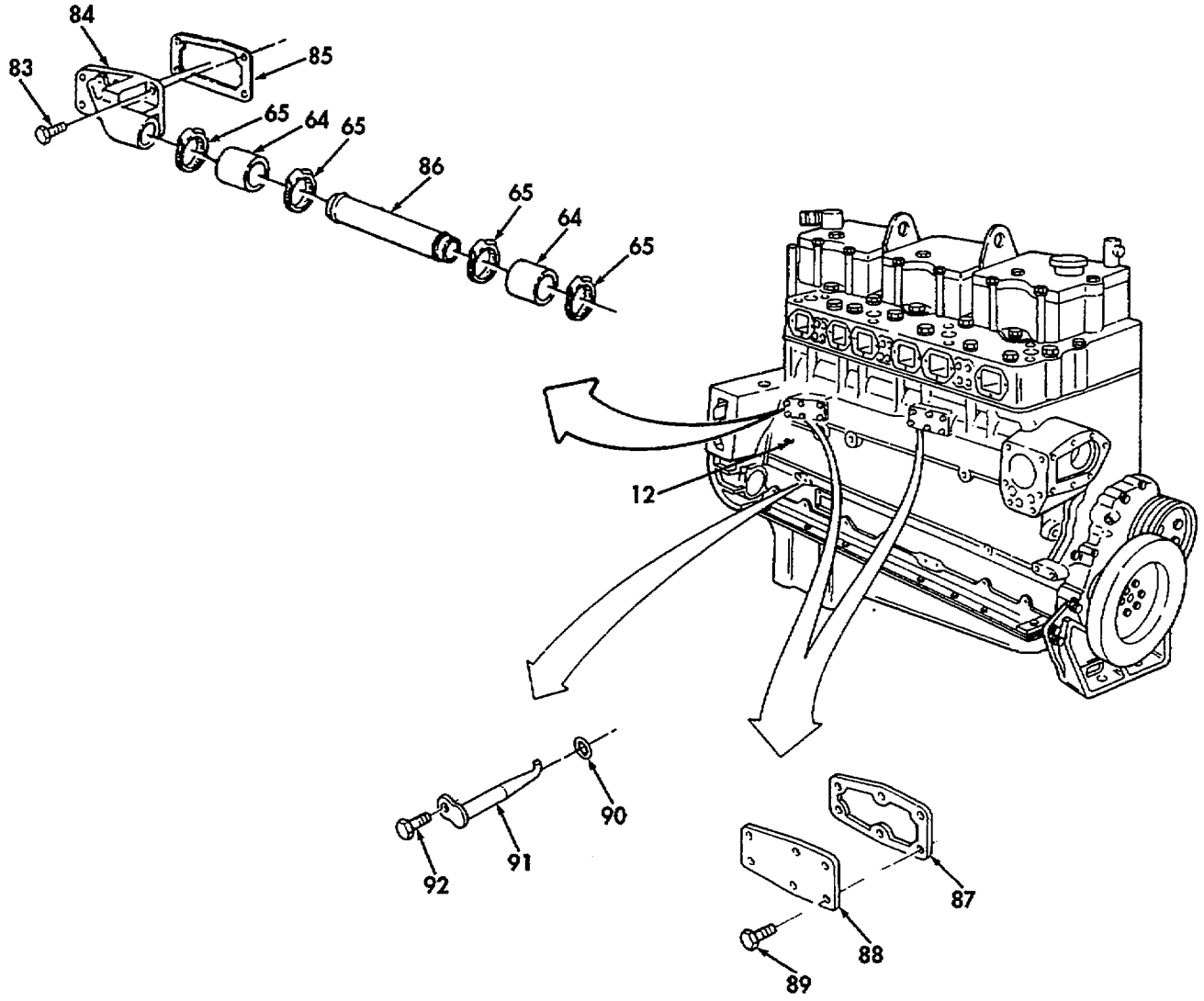
LEGEND:

12. CYLINDER BLOCK
62. SCREW
63. LOCKWASHER (6)
64. WATER TRANSFER HOSE
65. CLAMP
66. SUPPORT BRACKET
67. SCREW (2)
68. GASKET
69. OIL COOLER SUPPORT
70. SCREW (2)
71. SCREW
72. OIL COOLER ASSEMBLY
73. SCREW (2)
74. LOCKWASHER (2)
75. WASHER
76. SUPPORT BRACKET
77. GASKET
78. OIL COOLER SUPPORT
79. SCREW (3)
80. LOCKWASHER (6)
81. SCREW (3)
82. OIL COOLER ASSEMBLY

3-13. MOUNTING ENGINE ON MAINTENANCE STAND (Contd)

LOCATION/ITEM	ACTION	REMARKS
e. Component Removal (Contd)		
52. Modulator bracket and accelerator return spring	Remove.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
53. Ether quick-start cylinder, valve, and thermostat	Remove.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
54. Engine wiring harness connections	Tag for identification at reassembly, then disconnect.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
55. Engine wiring harness	Remove.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
56. Fan, fan clutch, and fan clutch drive belts	Remove.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
57. Fan brace, bracket, and spacers	Remove.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
58. Water pump and drive belts	Remove.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
59. Power steering pump and reservoir	Remove.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
	NOTE • **Perform steps 60 and 61 for M915/Big Cam I only.** • **Perform steps 62 and 63 for M915A1/Big Cam III only.**	
60. Four clamps (65), two water transfer hoses (64), and water transfer tube (86)	Remove from flange (84).	
61. Six screws (83), flange (84), and gasket (85)	Remove from cylinder block (12).	Discard gasket (85).
62. Twelve captive washer screws (89), two water header covers (88), and gaskets (87)	Remove from cylinder block (12).	Discard gaskets (87).
63. Six self-locking screws (92), nozzles (91), and preformed packings (90)	Remove from cylinder block (12).	Discard preformed packings (90).

3-13. MOUNTING ENGINE ON MAINTENANCE STAND (Contd)



LEGEND:

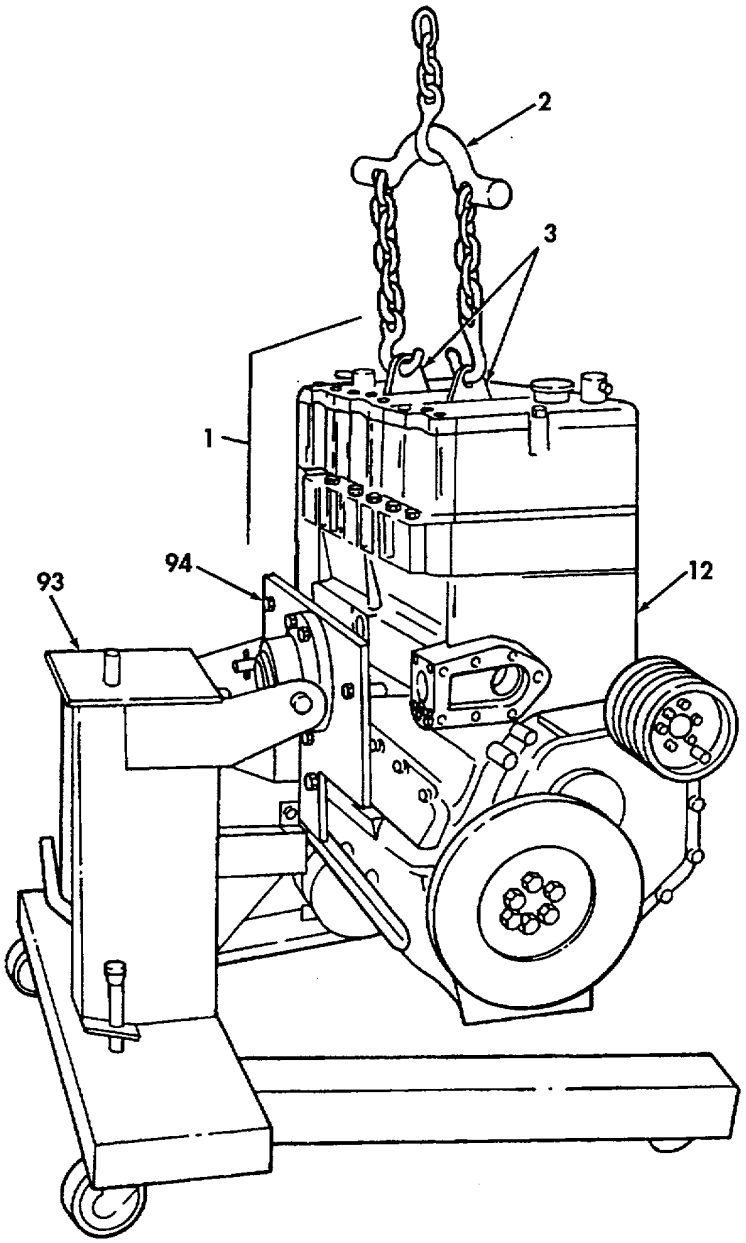
12. CYLINDER BLOCK
64. WATER TRANSFER HOSE (2)
65. CLAMPS (4)
83. SCREW (6)
84. FLANGE
85. GASKET
86. WATER TRANSFER TUBE
87. GASKET (2)
88. WATER HEADER COVER (2)
89. CAPTIVE WASHER SCREW (12)
90. PREFORMED PACKING (6)
91. PISTON COOLING NOZZLE (6)
92. SELF-LOCKING SCREW (6)

3-13. MOUNTING ENGINE ON MAINTENANCE STAND (Contd)

LOCATION/ITEM	ACTION	REMARKS
64. Dressed engine assembly (1)	a. Connect lifting fixture (2) to two engine lifting brackets (3). b. Using suitable sling and lifting device, lift and move engine to a suitable maintenance stand (93). c. Install right side of cylinder block (12) on maintenance stand (93) with four mounting screws (94).	Ensure lifting device and engine lifting fixture (2) distribute load equally on engine lifting brackets (3).
65. Engine lifting fixture (2)	Remove from two engine lifting brackets (3).	

FOLLOW-ON TASK: Proceed with engine maintenance.

3-13. MOUNTING ENGINE ON MAINTENANCE STAND (Contd)



LEGEND:

1. DRESSED ENGINE ASSEMBLY
2. ENGINE LIFTING FIXTURE
3. ENGINE LIFTING BRACKET (2)
12. CYLINDER BLOCK
93. MAINTENANCE STAND
94. MOUNTING SCREW (4)

3-14. VIBRATION DAMPER AND CRANKSHAFT PULLEY REMOVAL

THIS TASK COVERS:

Removal

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
None

TEST EQUIPMENT
None

MATERIALS/PARTS
None

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
Engine mounted on maintenance stand (para. 3-13).

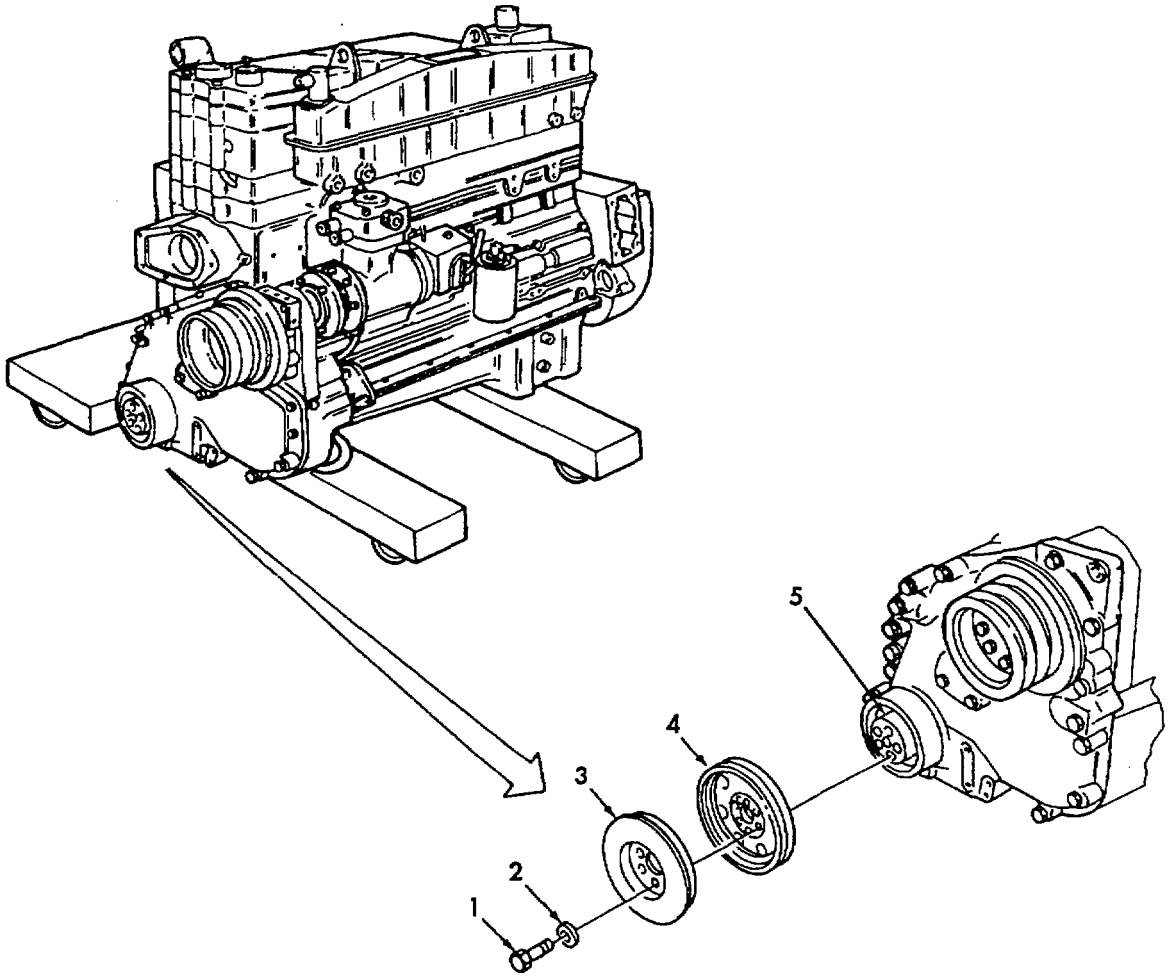
SPECIAL ENVIRONMENTAL CONDITION
Work area clean and away from blowing dust and dirt.

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS
Removal		
	CAUTION **Do not pound on vibration damper with hammer or pry with other tools during removal. These tools may damage vibration damper.**	
Six hexagon screws (1), washers (2), vibration damper (3), and crankshaft pulley (4)	Remove from crankshaft (5).	Do not let crankshaft (5) turn when removing screws (1). Lock crankshaft (5) at flywheel end to keep from turning. Hold vibration damper (3) and crankshaft pulley (4) when removing last screw (1) to avoid dropping vibration damper (3).

FOLLOW-ON TASKS:
- For repair of vibration damper and crankshaft pulley (para. 3-36).
- For installation of vibration damper and crankshaft pulley (para. 3-79).

3-14. VIBRATION DAMPER AND CRANKSHAFT PULLEY REMOVAL (Contd)



LEGEND:

1. SCREW (6)
2. WASHER (6)
3. VIBRATION DAMPER
4. CRANKSHAFT PULLEY
5. CRANKSHAFT

3-15. ACCESSORY DRIVE PULLEY REMOVAL

THIS TASK COVERS:

Removal

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
None

TEST EQUIPMENT
None

MATERIALS/PARTS
Locknut (15434) 3012526

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
Vibration damper and crankshaft pulley removed (para. 3-14).

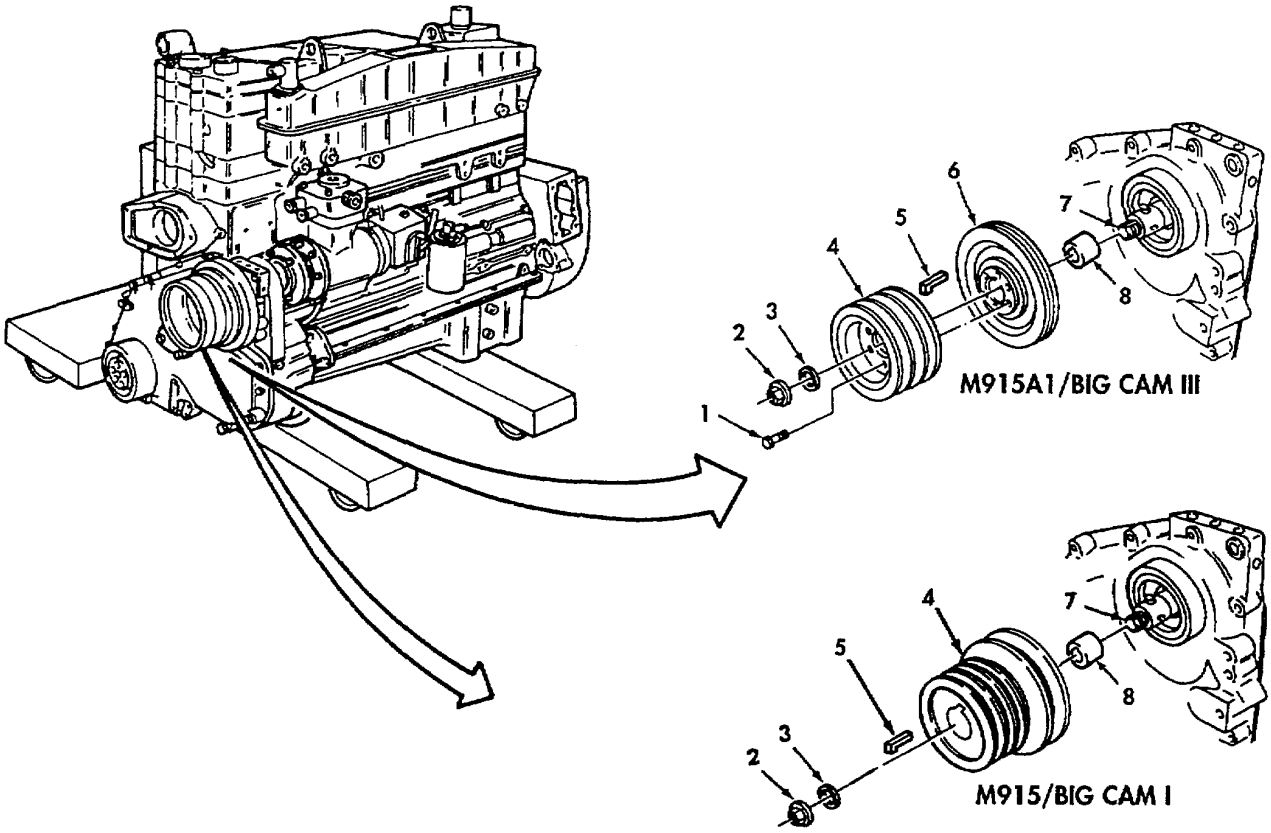
SPECIAL ENVIRONMENTAL CONDITION
Work area clean and away from blowing dust and dirt.

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS
Removal		
	NOTE **Perform step 1 for M915A1/Big Cam III engines only.**	
1. Six screws (1) and accessory drive pulley (4)	Remove from accessory drive pulley assembly (6).	Do not let accessory drive pulley (4) rotate when removing screws (1). Hold onto accessory drive pulley (4) when removing last screw (1).
	CAUTION • **Do not use jaw-type puller. Damage to pulley will result.** • **When installing puller, ensure screws do not bottom out on front gear cover. Damage to cover may result.**	
2. Locknut (2) and washer (3)	Remove from accessory driveshaft (7).	Discard locknut (2).
3. Accessory drive pulley assembly (6) (M915A1/ Big Cam III), accessory drive pulley (4) (M915/Big Cam I), keyway seal (5), and sleeve (8)	Using suitable puller, remove from accessory drive shaft (7).	Use caution not to damage accessory drive shaft (7). Do not use jaw-type puller; use puller as explained in above caution.

FOLLOW-ON TASKS:
- For repair of accessory drive pulley (para. 3-49).
- For installation of accessory drive pulley (para. 3-76).

3-15. ACCESSORY DRIVE PULLEY REMOVAL (Contd)



LEGEND:

1. SCREW (6) (M915A1/BIG CAM III ONLY)
2. LOCKNUT
3. WASHER
4. ACCESSORY DRIVE PULLEY
5. KEYWAY SEAL
6. ACCESSORY DRIVE PULLEY ASSEMBLY (M915A1/BIG CAM III ONLY)
7. ACCESSORY DRIVE SHAFT
8. SLEEVE

3-16. FUEL PUMP REMOVAL

THIS TASK COVERS:

Removal

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Air compressor wrench (15434) 3375159

TEST EQUIPMENT
None

MATERIALS/PARTS
Cap and plug set (Appendix C, Item 31)
Lockwasher (12204) 116122
Lockwasher (96906) MS35338-46
Two lockwashers (96906) MS122032
Three lockwashers (15434) S-604
Gasket (15434) 3035053

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
TM 9-2320-273-20
TM 9-2320-283-20

TROUBLESHOOTING REFERENCES
None

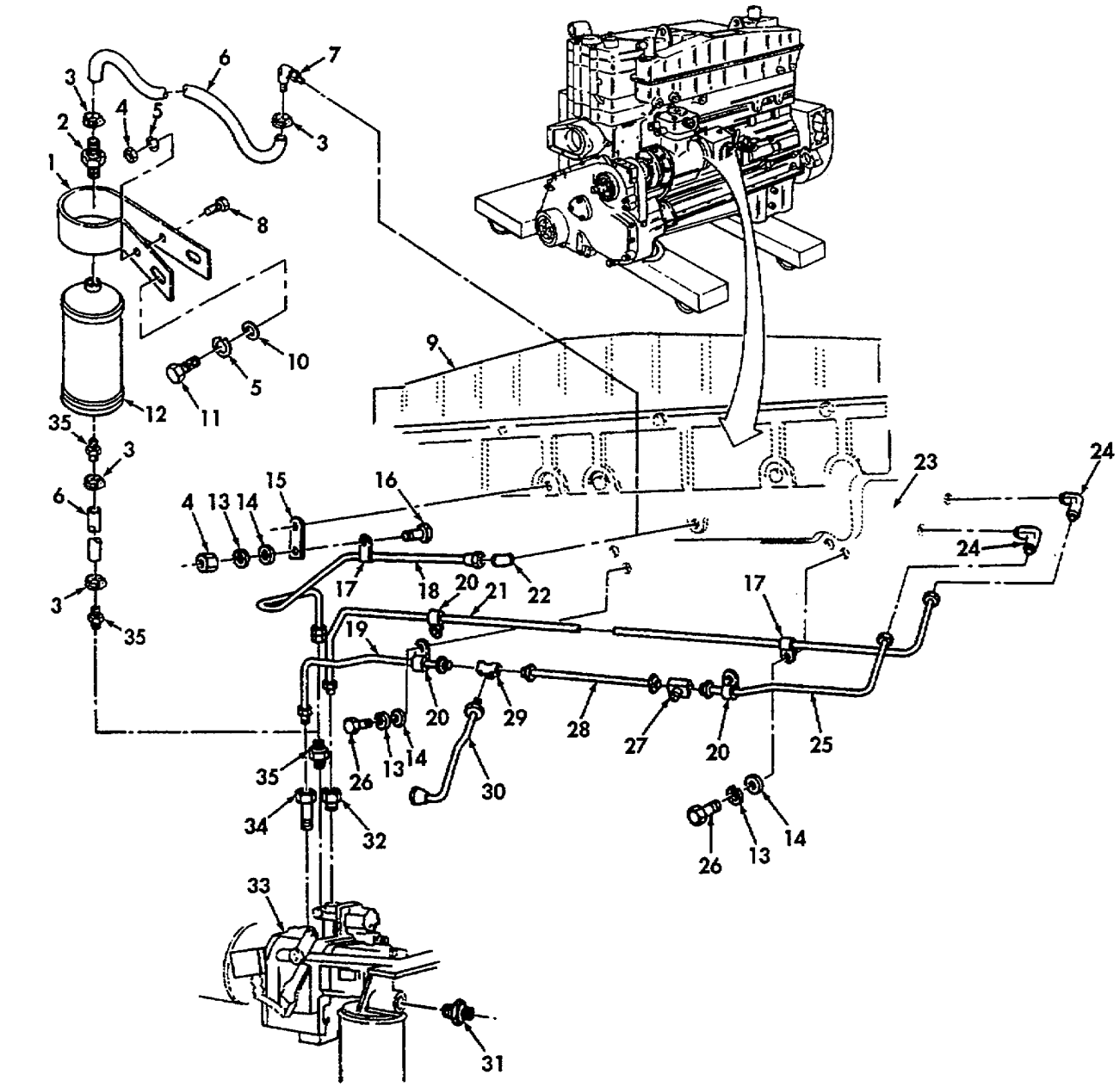
EQUIPMENT CONDITION
- Accessory drive pulley removed (para. 3-15).
- Fuel pump engine retarder switch removed (TM 9-2320-273-20 or TM 9-2320-283-20).
- Fuel filter and water separator removed (TM 9-2320-273-20 or TM 9-2320-283-20).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dust and dirt.

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS
Removal		
	NOTE • **Cap or plug all openings immediately after removal to prevent contamination.** • **Perform steps 1 through 4 for M915/Big Cam I equipped with Air Signal Attenuator (ASA) air tank. Some Big Cam I engines may or may not have an ASA air tank.**	
1. Four hose clamps (3) and two air supply hoses (6)	Remove from elbow (7), check valve (2), and two adapters (35).	
2. Two adapters (35), check valve (2), and elbow (7)	Remove from fuel pump (33), air tank (12), and aftercooler (9).	
3. Screw (11), lockwasher (5), washer (10), and air tank (12)	Remove from aftercooler (9) and clamp (1).	Discard lockwasher (5).
4. Nut (4), lockwasher (5), screw (8), and clamp (1)	Remove from air tank (12).	Discard lockwasher (5).
	NOTE **Perform step 5 for M915A1/Big Cam III only.**	
5. Nut (4), lockwasher (13), washer (14), and screw (16)	Remove from bracket (15) and clamp (17).	Discard lockwasher (13).
6. Air supply tube (18) and adapters (22) and (35)	Remove from fuel pump (33) and aftercooler (9).	

3-16. FUEL PUMP REMOVAL (Contd)



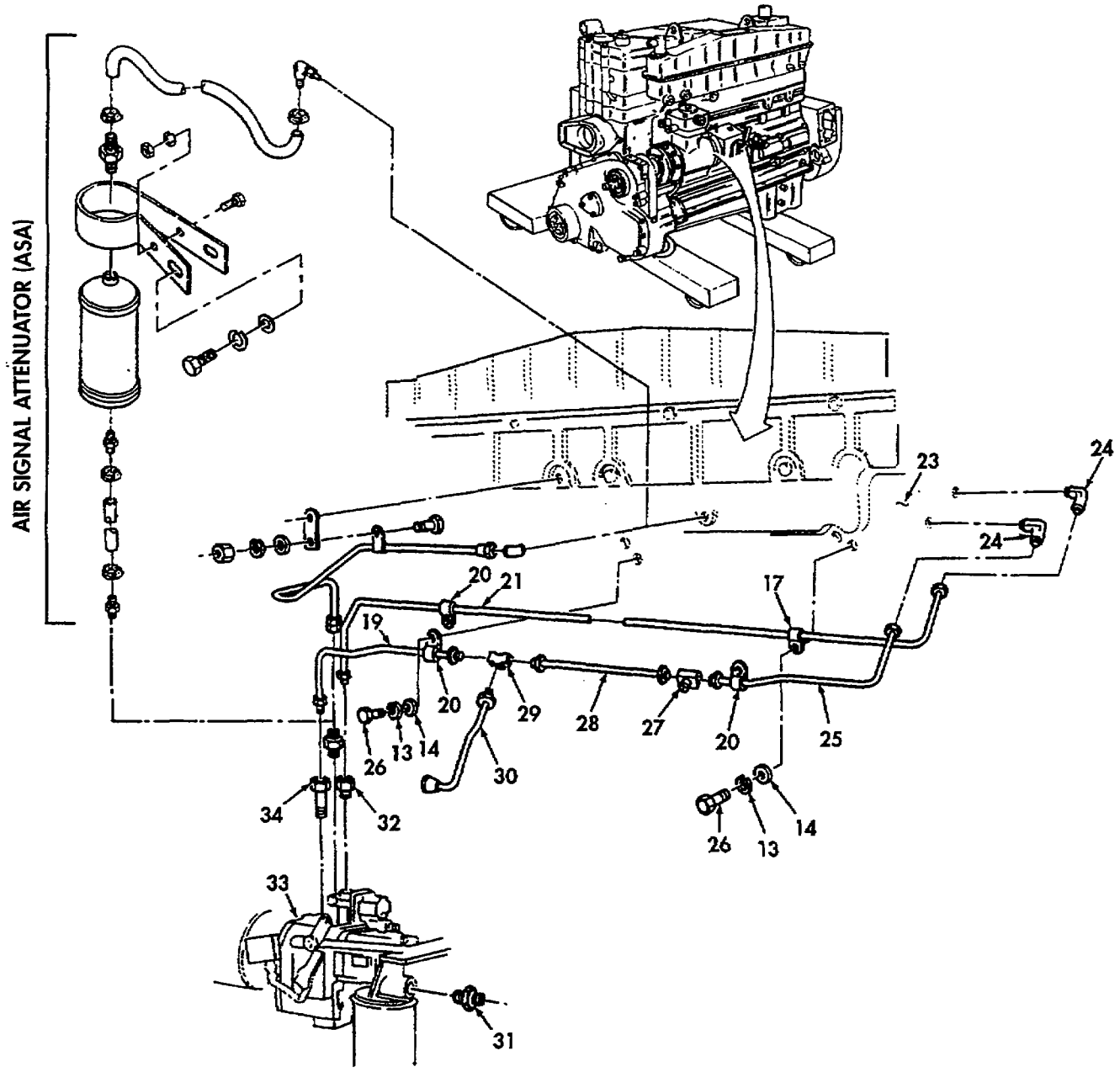
LEGEND:

1. CLAMP
2. CHECK VALVE
3. HOSE CLAMP (4)
4. NUT (2)
5. LOCKWASHER (2)
6. AIR SUPPLY HOSE (2) (M915/BIG CAM I ONLY)
7. ELBOW
8. SCREW
9. AFTERCOOLER
10. WASHER
11. SCREW
12. ASA AIR TANK (M915/BIG CAM I ONLY)
13. LOCKWASHER (2)
14. WASHER (2)
15. BRACKET
16. SCREW
17. CLAMP (2)
18. AIR SUPPLY TUBE (M915A1/BIG CAM III ONLY)
19. FUEL RETURN TUBE
20. CLAMP (3)
21. FUEL SUPPLY TUBE
22. ADAPTER
23. CYLINDER HEAD
24. ELBOW (2)
25. FUEL RETURN TUBE
26. SCREW (2)
27. TEE
28. FUEL RETURN TUBE
29. TEE
30. FUEL RETURN TUBE
31. ADAPTER
32. ADAPTER
33. FUEL PUMP
34. VALVE
35. ADAPTER (2)

3-16. FUEL PUMP REMOVAL (Contd)

LOCATION/ITEM	ACTION	REMARKS
Removal (Contd)		
7. Two screws (26), washers (14), and lockwashers (13)	Remove from cylinder head (23) and clamps (17) and (20).	Discard lockwashers (13).
8. Fuel return tube (30)	Remove from tee (29) and fuel pump (33).	
9. Fuel return tubes (19), (25), (28), and tees (27) and (29)	Remove from valve (34) and elbow (24).	
10. Fuel supply tube (21)	Remove from adapter (32) and elbow (24).	
11. Two elbows (24), valve (34), and adapters (32) and (31)	Remove from cylinder head (23) and fuel pump (33).	

3-16. FUEL PUMP REMOVAL (Contd)



LEGEND:

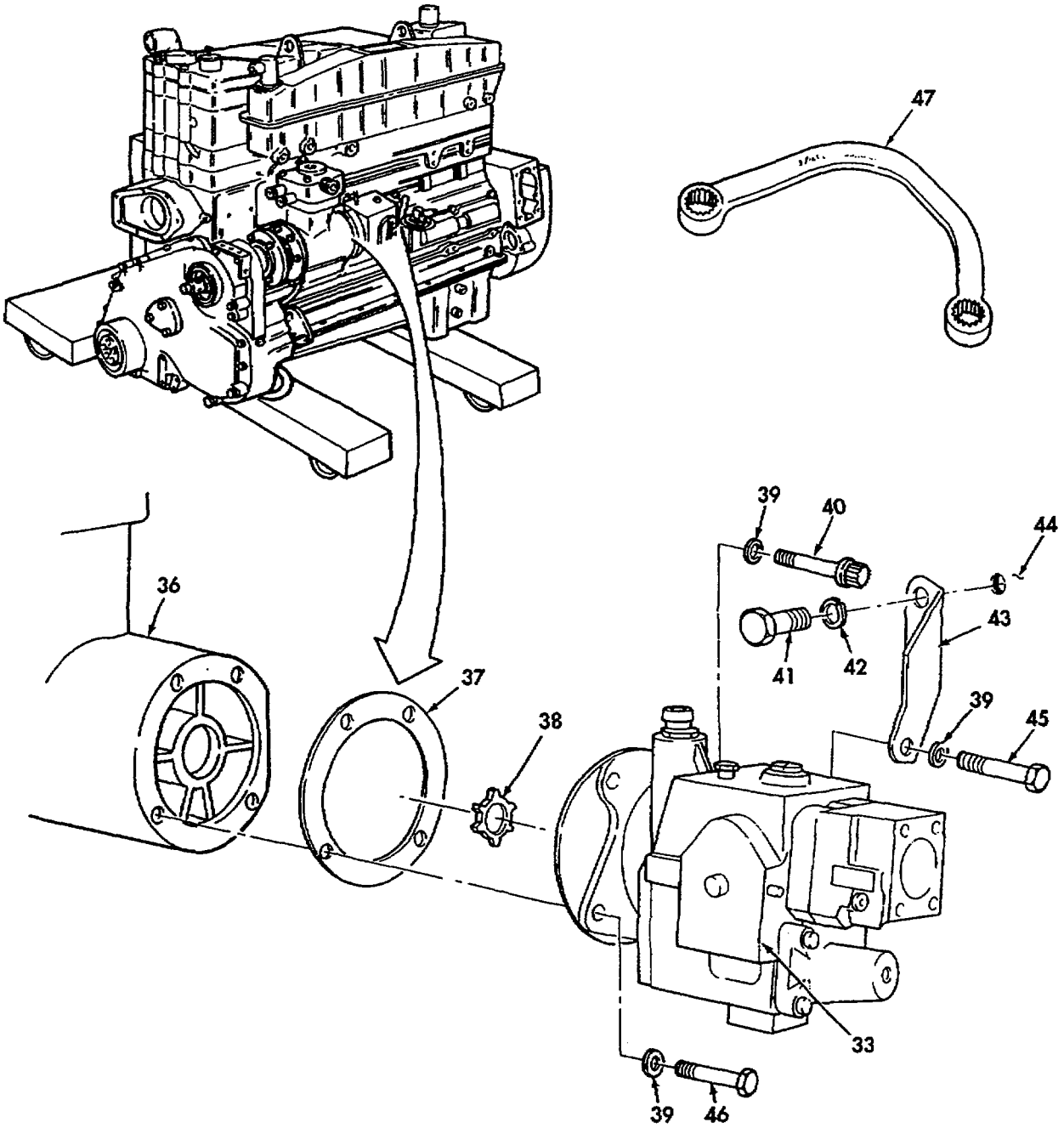
13. LOCKWASHER (2)
14. WASHER (2)
17. CLAMP (2)
19. FUEL RETURN TUBE
20. CLAMP (3)
21. FUEL SUPPLY TUBE
23. CYLINDER HEAD
24. ELBOW (2)
25. FUEL RETURN TUBE
26. SCREW (2)
27. TEE
28. FUEL RETURN TUBE
29. TEE
30. FUEL RETURN TUBE
31. ADAPTER
32. ADAPTER
33. FUEL PUMP
34. VALVE

3-16. FUEL PUMP REMOVAL (Contd)

LOCATION/ITEM	ACTION	REMARKS
Removal (Contd)		
	NOTE • **Perform step 12 for M915/Big Cam I only.** • **Perform steps 13 and 14 for M915A1/Big Cam III only.**	
12. Four screws (40) and washers (39)	Remove from air compressor (36), fuel pump (33), and support bracket (43).	Ensure all fuel pump (33) openings are covered to prevent dirt from entering the fuel system. Use air compressor wrench (47) (3375159).
13. Screws (40) and (45) and and two washers (39)	Remove from air compressor (36), fuel pump (33), and support bracket (43).	Use air compressor wrench (47) (3375159) to remove screw (40).
14. Two screws (46) and washers (39)	Remove from air compressor (36) and fuel pump (33).	
15. Screw (41), lockwasher (42), and support bracket (43)	Remove from cylinder block (44).	Discard lockwasher (42).
16. Fuel pump (33)	Remove from air compressor (36).	Free fuel pump (33) by tapping with soft-nose hammer.
17. Fuel pump-to-compressor spider coupling (38)	Remove from fuel pump (33) or air compressor (36).	Coupling (38) may remain on either fuel pump (33) or air compressor (36) when separated.
18. Gasket (37)	Remove from fuel pump (33) or air compressor (36).	Gasket (37) may remain on either surface. Inspect each surface and discard gasket (37).

FOLLOW-ON TASKS:
- For repair of fuel pump (para. 3-56).
- For installation of fuel pump (para. 3-78).

3-16. FUEL PUMP REMOVAL (Contd)



LEGEND:

33. FUEL PUMP
36. AIR COMPRESSOR
37. GASKET
38. FUEL PUMP-TO-COMPRESSOR SPIDER COUPLING
39. WASHER (4)
40. SCREW (4)
41. SCREW
42. LOCKWASHER
43. SUPPORT BRACKET
44. CYLINDER BLOCK
45. SCREW
46. SCREW (2)
47. AIR COMPRESSOR WRENCH

3-17. AIR COMPRESSOR REMOVAL

THIS TASK COVERS:

Removal

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Air compressor wrench (15434) 3375159

TEST EQUIPMENT
None

MATERIALS/PARTS
Four lockwashers (12204) 116122
Two lockwashers (96906) MS35338-45
Gasket (15434) 157911
Gasket (15434) 3005962

PERSONNEL REQUIRED
Automotive mechanic MOS 63H

REFERENCES (TM)
TM 9-2320-273-34
TM 9-2320-283-34

TROUBLESHOOTING REFERENCES
Para. 2-8

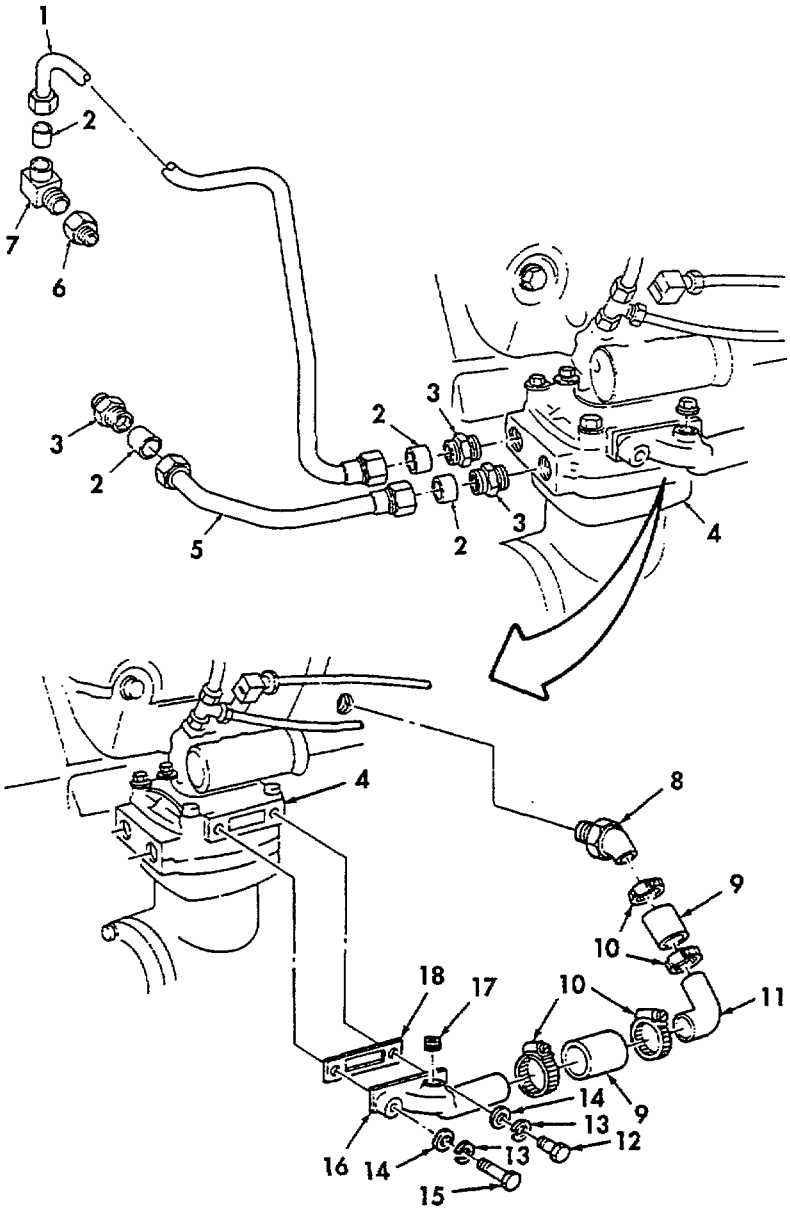
EQUIPMENT CONDITION
- Fuel pump removed (para. 3-16).
- Air compressor governor removed (TM 9-2320-273-34 or TM 9-2320-283-34).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS
Removal		
	NOTE **Removal of air compressor coolant lines, air lines, and fittings is basically the same for M915/Big Cam I and M915A1/Big Cam III engines. The M915A1/Big Cam III is shown.**	
1. Coolant inlet tube (5) and coolant outlet tube (1)	Disconnect and remove from three adapters (3) and elbow (7).	Remove and discard bushings (2) if damaged.
2. Three adapters (3), elbow (7), and coupling (6)	Remove from compressor (4) and aftercooler.	
3. Air inlet hoses (9) and tube (11)	Loosen four clamps (10), and remove from air inlet connector (16) and elbow (8).	
4. Screws (12) and (15), two lockwashers (13), washers (14), plug (17), air inlet connector (16), and gasket (18)	Remove from compressor (4).	Discard lockwashers (13) and gasket (18).

3-17. AIR COMPRESSOR REMOVAL (Contd)



LEGEND:

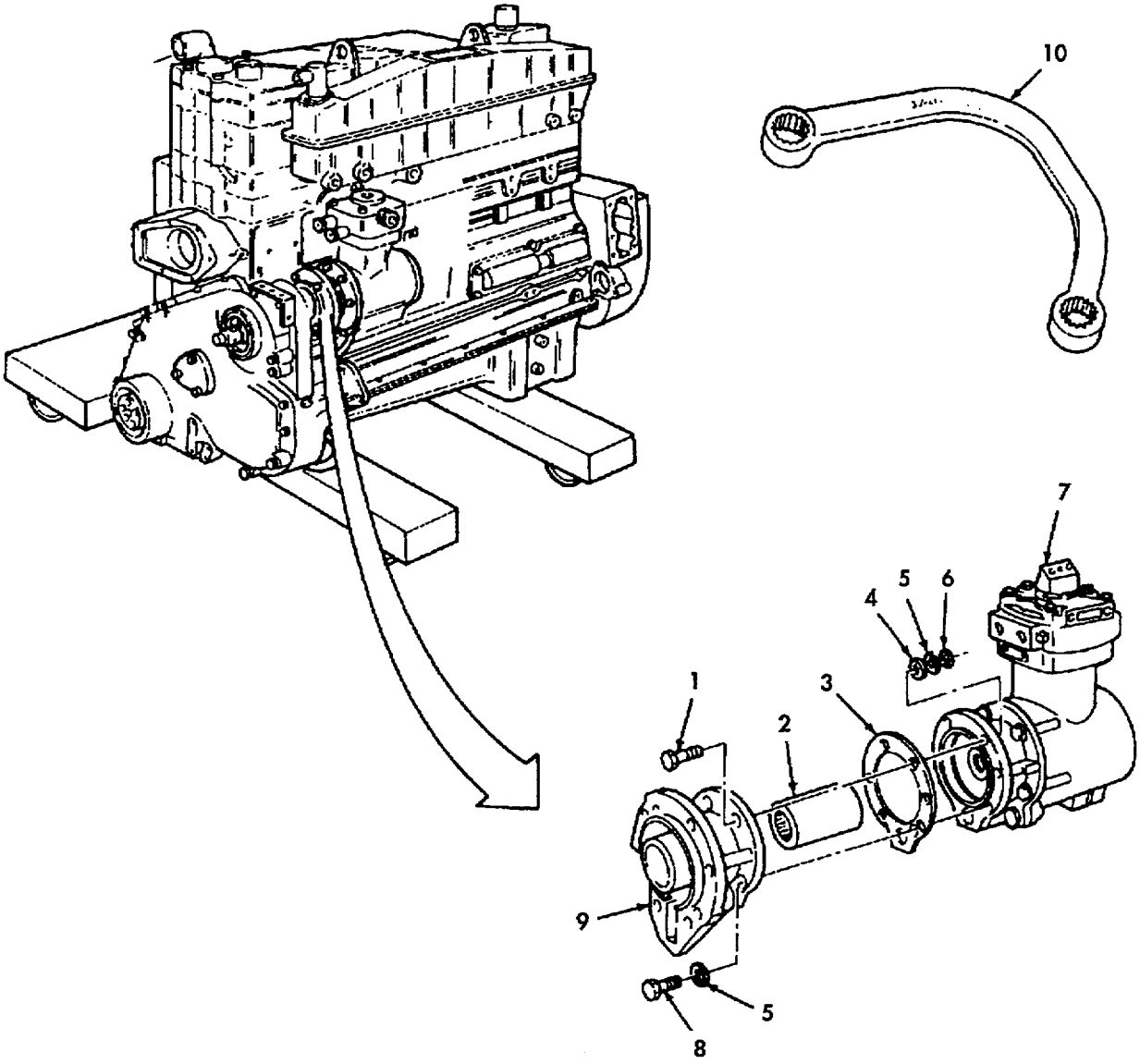
1. COOLANT OUTLET TUBE
2. BUSHING (4)
3. ADAPTER (3)
4. COMPRESSOR
5. COOLANT INLET TUBE
6. COUPLING
7. ELBOW
8. ELBOW
9. HOSE (2)
10. CLAMP (4)
11. TUBE
12. SCREW
13. LOCKWASHER (2)
14. WASHER (2)
15. SCREW
16. AIR INLET CONNECTOR
17. PLUG
18. GASKET

3-17. AIR COMPRESSOR REMOVAL (Contd)

LOCATION/ITEM	ACTION	REMARKS
Removal (Contd)		
5. Two screws (8) and lockwashers (5)	Remove from accessory drive housing (9) and air compressor (7).	Use air compressor wrench (10), (P/N 3375159). Discard lockwashers (5).
	NOTE **The M915/Big Cam I engines will not have washers as part of air compressor mounting hardware.**	
6. Two nuts (6) lockwashers (5), washers (4), gasket (3), and compressor (7)	Remove from accessory drive housing (9).	Hold air compressor (7) before removing last screw (1) and nut (6). Use air compressor wrench (10). Discard lockwashers (5) and gasket (3).
7. Drive coupling (2)	Remove from accessory drive housing (9) or compressor (7).	

FOLLOW-ON TASKS:
- For repair of air compressor (para. 3-51).
- For installation of air compressor (para. 3-77).

3-17. AIR COMPRESSOR REMOVAL (Contd)



LEGEND:

1. SCREW (2)
2. DRIVE COUPLING
3. COMPRESSOR GASKET
4. WASHER (2)
5. LOCKWASHER (4)
6. NUT (2)
7. AIR COMPRESSOR
8. SCREW (2)
9. ACCESSORY DRIVE HOUSING
10. AIR COMPRESSOR WRENCH

3-18. ACCESSORY DRIVE HOUSING ASSEMBLY REMOVAL

THIS TASK COVERS:

Removal

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
None

TEST EQUIPMENT
None

MATERIALS/PARTS
Gasket (15434) 200809

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCE (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
Air compressor removed (para. 3-17).

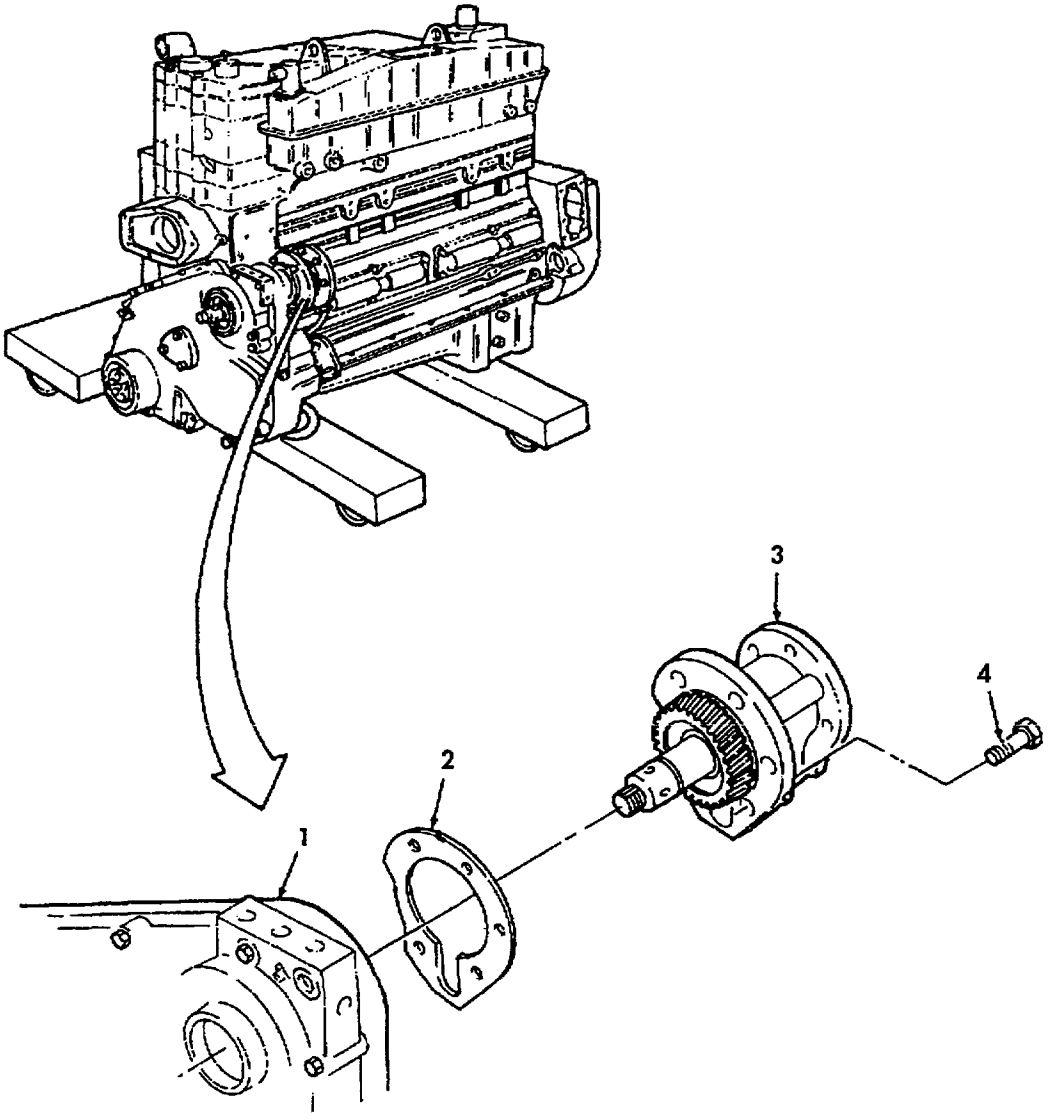
SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dust and dirt.

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS
Removal		
Five captive washer screws (4), accessory drive housing assembly (3), and gasket (2)	Remove from front gear cover (1).	If loose, hold accessory drive housing assembly (3) when removing last screw (4). Otherwise, free housing (3) by tapping with soft-nose hammer. Discard gasket (2).

FOLLOW-ON TASKS:
- For repair of accessory drive housing assembly (para. 3-49).
- For installation of accessory drive housing assembly (para. 3-73).

3-18. ACCESSORY DRIVE HOUSING ASSEMBLY REMOVAL (Contd)



LEGEND:

1. FRONT GEAR COVER
2. HOUSING GASKET
3. ACCESSORY DRIVE HOUSING ASSEMBLY
4. CAPTIVE WASHER SCREW (5)

3-19. OIL PUMP REMOVAL

THIS TASK COVERS:

Removal

INITIAL SETUP

APPLICABLE MODELS
All

SPECIAL TOOLS
None

TEST EQUIPMENT
None

MATERIALS/PARTS
Two lockwashers (96906) MS35338-46
Seven lockwashers (96906) MS35338-47 (M915/Big Cam I only)
Nine lockwashers (15434) S-604 (M915A1/Big Cam III only)
Gasket (15434) 121907 (M915/Big Cam I only)
Gasket (15434) 3031434 (M915A1/Big Cam III only)
Locknut (15434) S223
Two preformed packings (15434) 3029847
Gasket (15434) 3029846
Gasket (15434) 157551

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

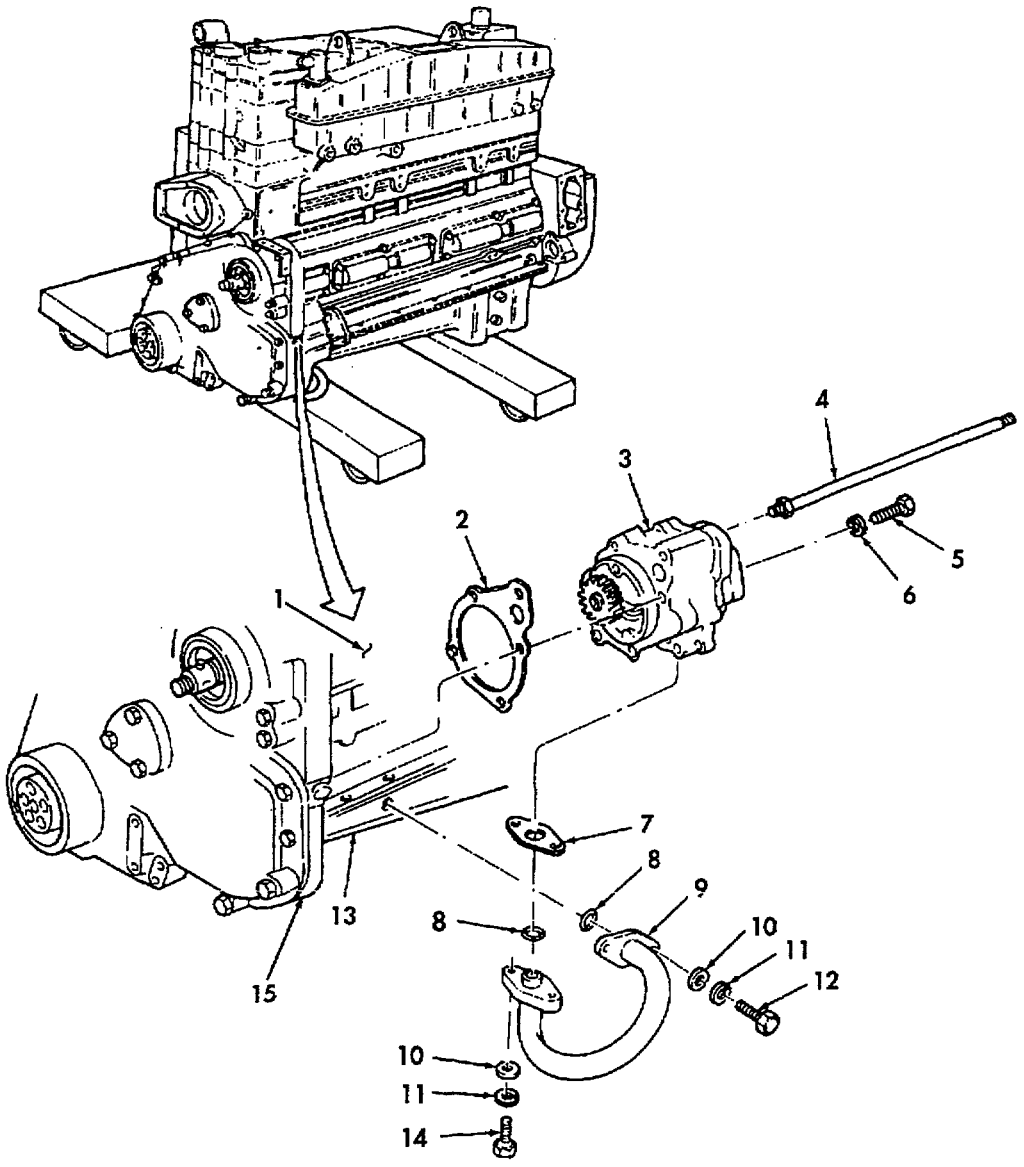
EQUIPMENT CONDITION
Accessory drive housing assembly removed (para. 3-18).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS
Removal		
	NOTE • **Perform steps 1 through 6 to remove oil pump from M915A1/Big Cam III.** • **Perform steps 7 through 12 to remove oil pump from M915/Big Cam I.**	
1. Two screws (12), lockwashers (11), and washers (10)	Remove from oil suction tube (9) and oil pan (13).	Discard lockwashers (11).
2. Two screws (14), lockwashers (11), and washers (10)	Remove from oil suction tube (9) and oil pump assembly (3).	Discard lockwashers (11).
3. Oil suction tube (9), two preformed packings (8), and gasket (7)	Remove from oil pan (13) and oil pump assembly (3).	Discard preformed packings (8) and gasket (7).
4. Oil transfer hose (4) (3) and cylinder block (1).	Remove from oil pump assembly	
5. Five screws (5) and lockwashers (6)	Remove from oil pump assembly (3).	Discard lockwashers (6).
6. Oil pump assembly (3) and gasket (2)	Remove from accessory drive housing (15).	Free oil pump assembly (3) by tapping with a soft-nose hammer. Discard gasket (2).

3-19. OIL PUMP REMOVAL (Contd)



M915A1/BIG CAM III ONLY

LEGEND:

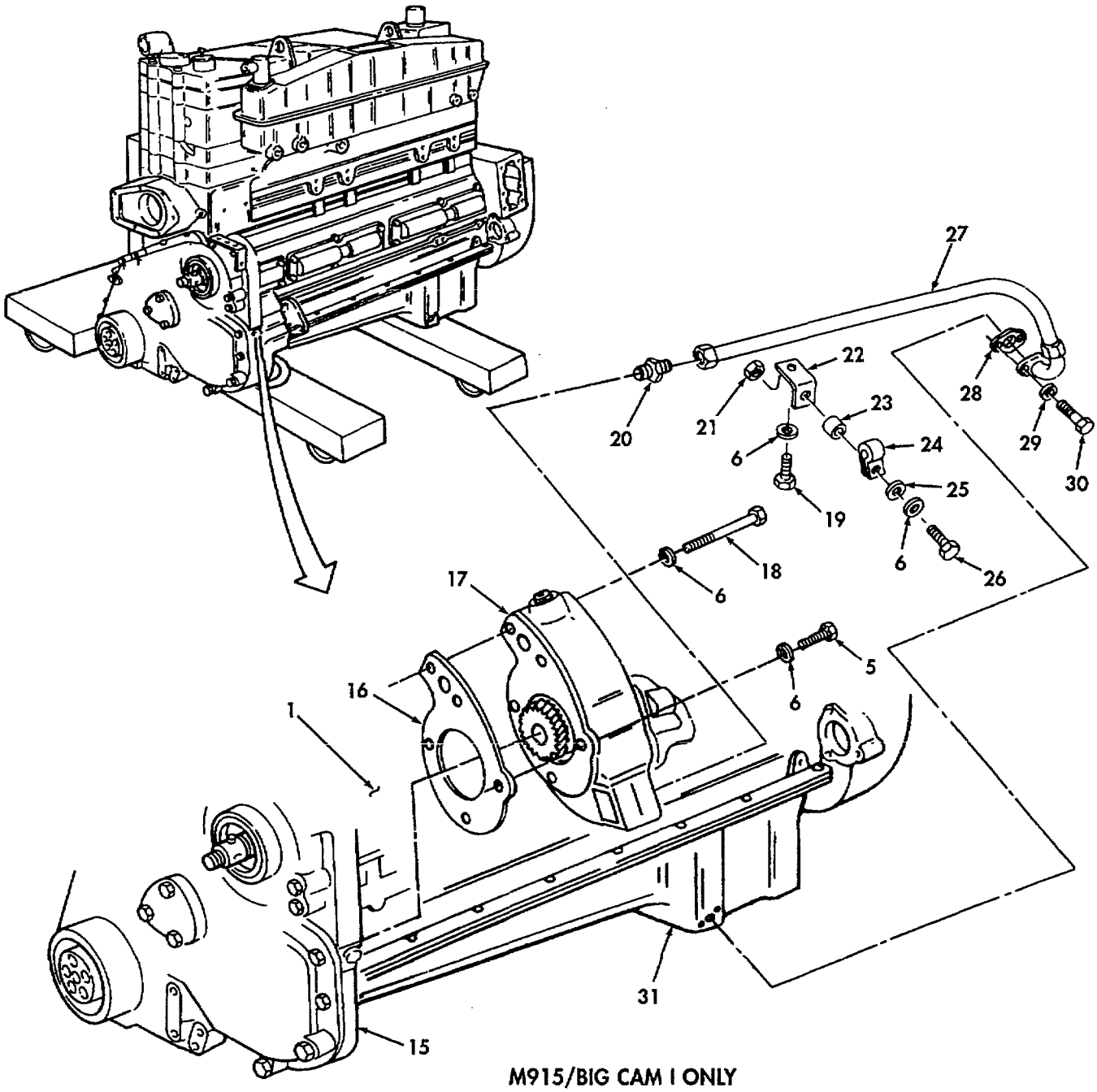
1. CYLINDER BLOCK
2. GASKET
3. OIL PUMP ASSEMBLY
4. OIL TRANSFER HOSE
5. SCREW (5)
6. LOCKWASHER (5)
7. GASKET
8. PREFORMED PACKING (2)
9. OIL SUCTION TUBE
10. WASHER (4)
11. LOCKWASHER (4)
12. SCREW (2)
13. ENGINE OIL PAN
14. SCREW (2)
15. ACCESSORY DRIVE HOUSING

3-19. OIL PUMP REMOVAL (Contd)

LOCATION/ITEM	ACTION	REMARKS
Removal (Contd)		
7. Locknut (21), spacer (23), clamp (24), washer (25), lockwasher (6), and screw (26)	Remove from bracket (22) and oil suction hose (27).	Discard locknut (21) and lockwasher (6).
8. Screw (19), lockwasher (6), and bracket (22)	Remove from oil pan (31) and cylinder block (1).	Discard lockwasher (6).
9. Two screws (30), lockwashers (29), and gasket (28)	Remove from oil suction hose (27) and oil pan (31).	Discard lockwashers (29) and gasket (28).
10. Oil suction hose (27) and adapter (20)	Remove from oil pan (31) and oil pump assembly (17).	
11. Three screws (18), two screws (5), and five lockwashers (6)	Remove from accessory drive housing (15) and oil pump assembly (17).	Discard lockwashers (6).
12. Oil pump assembly (17) and gasket (16)	Remove from accessory drive housing (15).	Free oil pump assembly (17) by tapping with a soft-nose hammer. Discard gasket (16).

FOLLOW-ON TASKS:
- For repair of oil pump (para. 3-44).
- For installation of oil pump (para. 3-74).

3-19. OIL PUMP REMOVAL (Contd)



M915/BIG CAM I ONLY

LEGEND:

1. CYLINDER BLOCK
5. SCREW (2)
6. LOCKWASHER (7)
15. ACCESSORY DRIVE HOUSING
16. GASKET
17. OIL PUMP ASSEMBLY
18. SCREW (3)
19. SCREW
20. ADAPTER
21. LOCKNUT
22. BRACKET
23. SPACER
24. CLAMP
25. WASHER
26. SCREW
27. OIL SUCTION HOSE
28. GASKET
29. LOCKWASHER (2)
30. SCREW (2)
31. OIL PAN

3-20. AIR AFTERCOOLER REMOVAL

THIS TASK COVERS:

Removal

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
None

TEST EQUIPMENT
None

MATERIALS/PARTS
Three gaskets (15434) 3008591
Three lockwashers (15434) S-604 (M915A1/Big Cam III only)
Three lockwashers (96906) MS122032 (M915/Big Cam I only)

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
TM 9-2320-273-20
TM 9-2320-283-20

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
- Oil pump removed (para. 3-19).
- Water crossover tube and connections removed (TM 9-2320-273-20 or TM 9-2320-283-20).

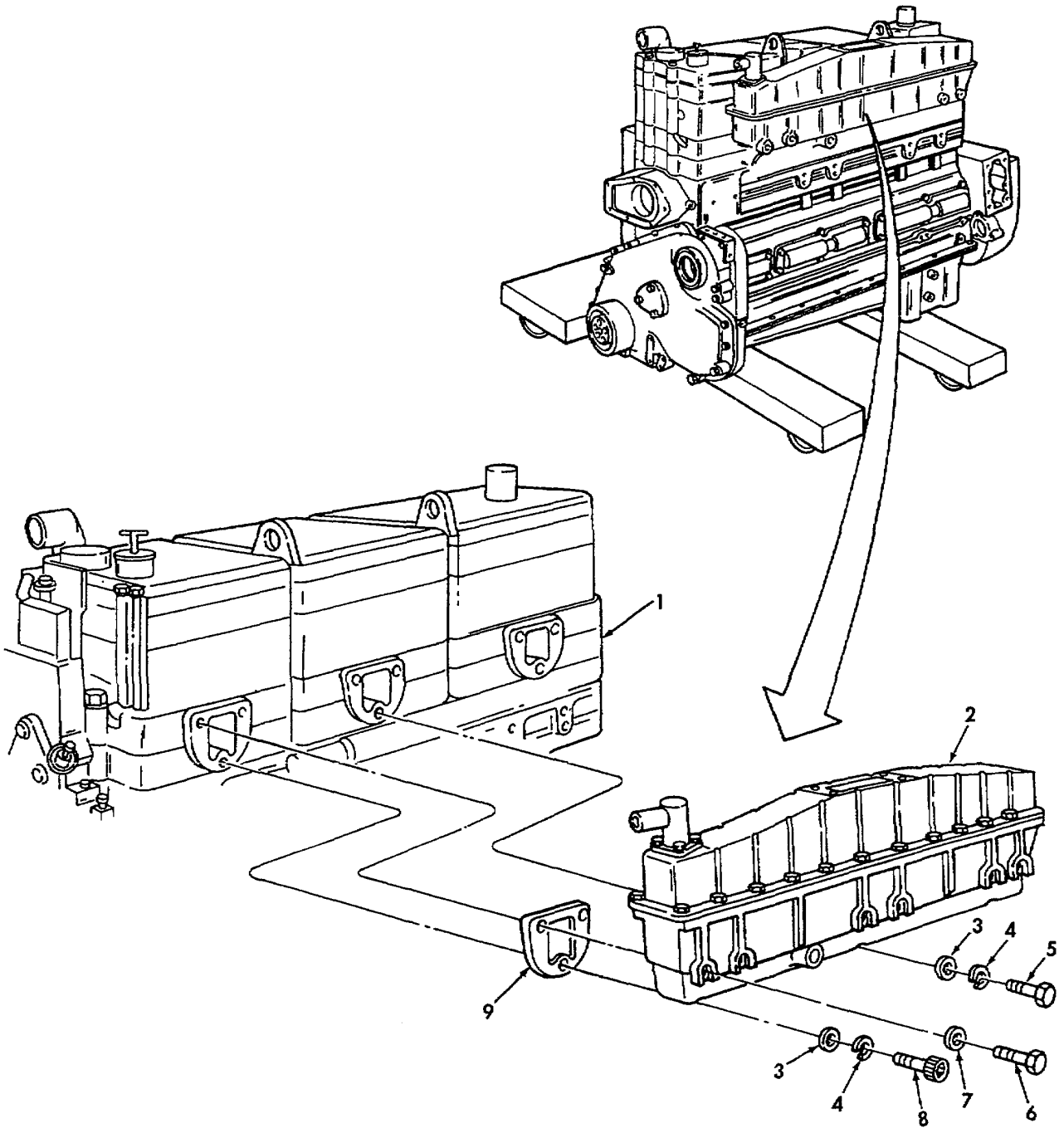
SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dust and dirt.

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS
Removal		
	NOTE • **Perform steps 1 and 2 for M915/Big Cam I only.** • **Perform steps 3 and 4 for M915A1/Big Cam III only.**	
1. Three screws (5), lockwashers (4), and washers (3)	Remove from cylinder heads (1) and air aftercooler (2).	Two screws (5) may have been previously removed. Discard lockwashers (4).
2. Six screws (6) and washers (7)	Remove from cylinder heads (1) and air aftercooler (2).	Install one suitable guide pin at each end of air aftercooler (2) before removing last two screws (6).
3. Screw (8), lockwasher (4), washer (3), two screws (5), lockwashers (4), and four washers (3)	Remove from cylinder heads (1) and air aftercooler (2).	Screws (5) may have been previously removed. Discard lockwashers (4).
4. Six captive washer screws (6)	Remove from cylinder heads (1) and air aftercooler (2).	Install one suitable guide pin at each end of air aftercooler before removing last two screws.
5. Air aftercooler (2)	Remove from cylinder heads (1) and lift off guide pins.	Remove guide pins from cylinder heads (1).
6. Three gaskets (9)	Remove from cylinder heads (1) or air aftercooler (2).	Discard gaskets (9).

FOLLOW-ON TASKS:
- For repair of air aftercooler (para. 3-45).
- For installation of air aftercooler (para. 3-87).

3-20. AIR AFTERCOOLER REMOVAL (Contd)



LEGEND:

1. CYLINDER HEAD (3)
2. AIR AFTERCOOLER
3. WASHER (3)
4. LOCKWASHER (3)
5. SCREW (3) (M915/BIG CAM I) OR (2) (M915A1/BIG CAM III)
6. SCREW (6) (M915/BIG CAM I ONLY), CAPTIVE WASHER SCREW (6) (M915A1/BIG CAM III ONLY)
7. WASHER (6) (M915/BIG CAM I ONLY)
8. SCREW (M915A1/BIG CAM III ONLY)
9. GASKET (3)

3-21. ENGINE RETARDER REMOVAL

THIS TASK COVERS:

Removal

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
None

TEST EQUIPMENT
None

MATERIALS/PARTS
Gasket (75078) 010279
Preformed packing (75078) 010180

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
TM 9-2320-273-20
TM 9-2320-283-20

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
- Air aftercooler removed (para. 3-20).
- Rocker cover and gasket removed (TM 9-2320-273-20 or TM 9-2320-283-20).
- Engine lifting brackets removed (TM 9-2320-273-20 or TM 9-2320-283-20).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dust and dirt.

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS

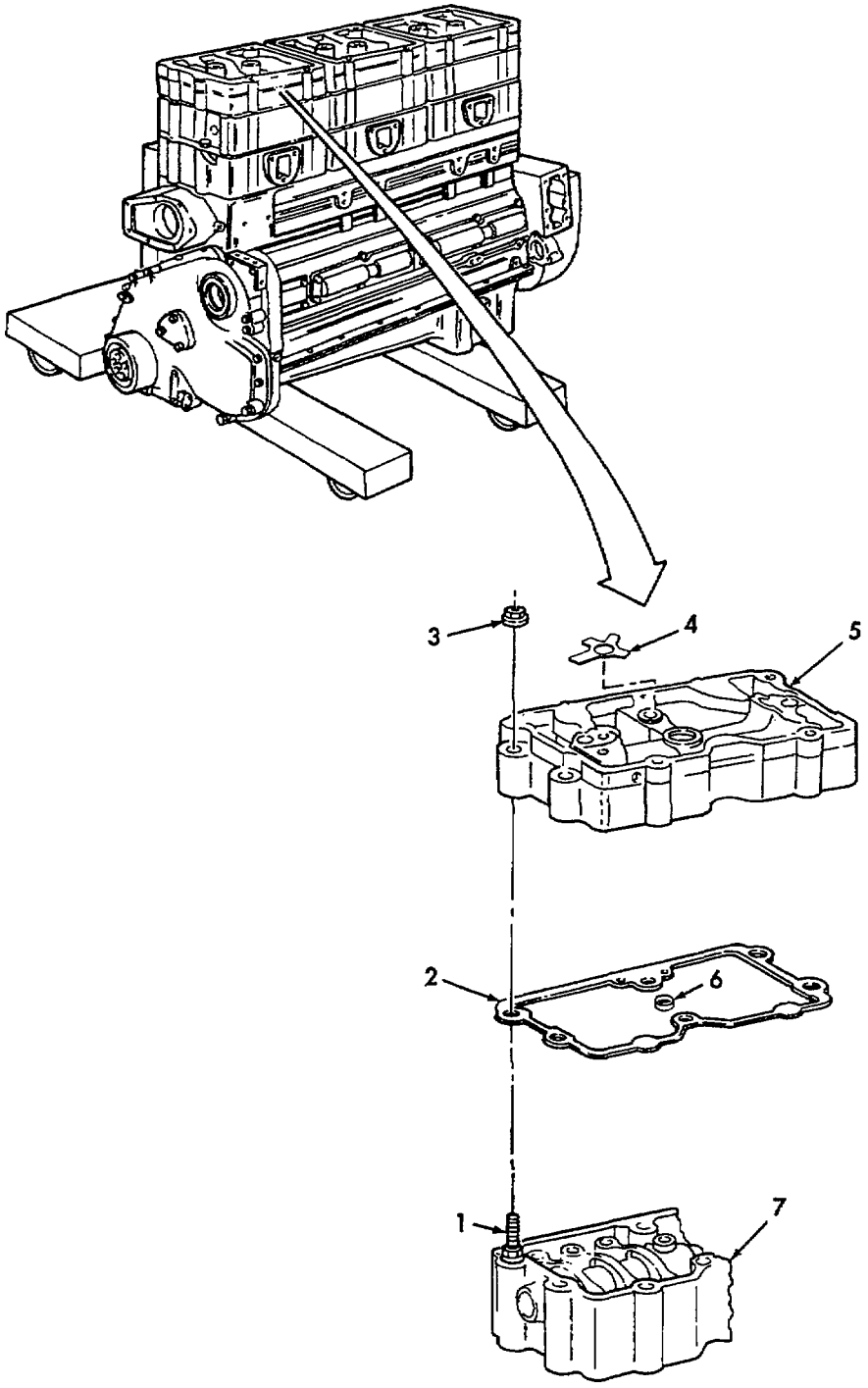
NOTE
- **The following procedure covers removal of one engine brake retarder.**
- **The removal of the remaining two engine brake retarders is similar.**

Removal

1.	Six nuts (3) and two locking plates (4)	Remove from six studs (1). Bend down tabs on locking plates (4) located on inside two studs (1) only.	If not removed, it will be necessary to remove fan support brace and spacers along with nuts (3).
2.	Engine brake retarder (5)	Remove from rocker arm housing (7) by pulling straight up.	Mark location of each engine brake retarder (5) if more than one will be removed.
3.	Gasket (2) and preformed packing (6)	Remove from rocker arm housing (7) or engine brake retarder (5).	Gasket (2) and preformed packing (6) may remain on engine brake retarder (5) or rocker arm housing (7). Discard gasket (2) and pre-formed packing (6).

FOLLOW-ON TASKS:
- For repair of engine retarder (para. 3-50).
- For installation of engine retarder (para. 3-86).

3-21. ENGINE RETARDER REMOVAL (Contd)



LEGEND:

1. ROCKER HOUSING STUD (6)
2. GASKET
3. NUT (6)
4. LOCKING PLATE (2)
5. ENGINE BRAKE RETARDER (HOUSING ONLY SHOWN)
6. PREFORMED PACKING
7. ROCKER ARM HOUSING

3-22. ROCKER ARM HOUSING ASSEMBLY AND PUSHRODS REMOVAL

THIS TASK COVERS:

Removal

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
None

TEST EQUIPMENT
None

MATERIALS/PARTS
Gasket (15434) 3017750

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
Engine retarder removed (para. 3-21).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dust and dirt.

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS

NOTE
The following procedure covers removal of one rocker arm housing assembly. Removal of remaining rocker arm housing assemblies is similar.

Removal

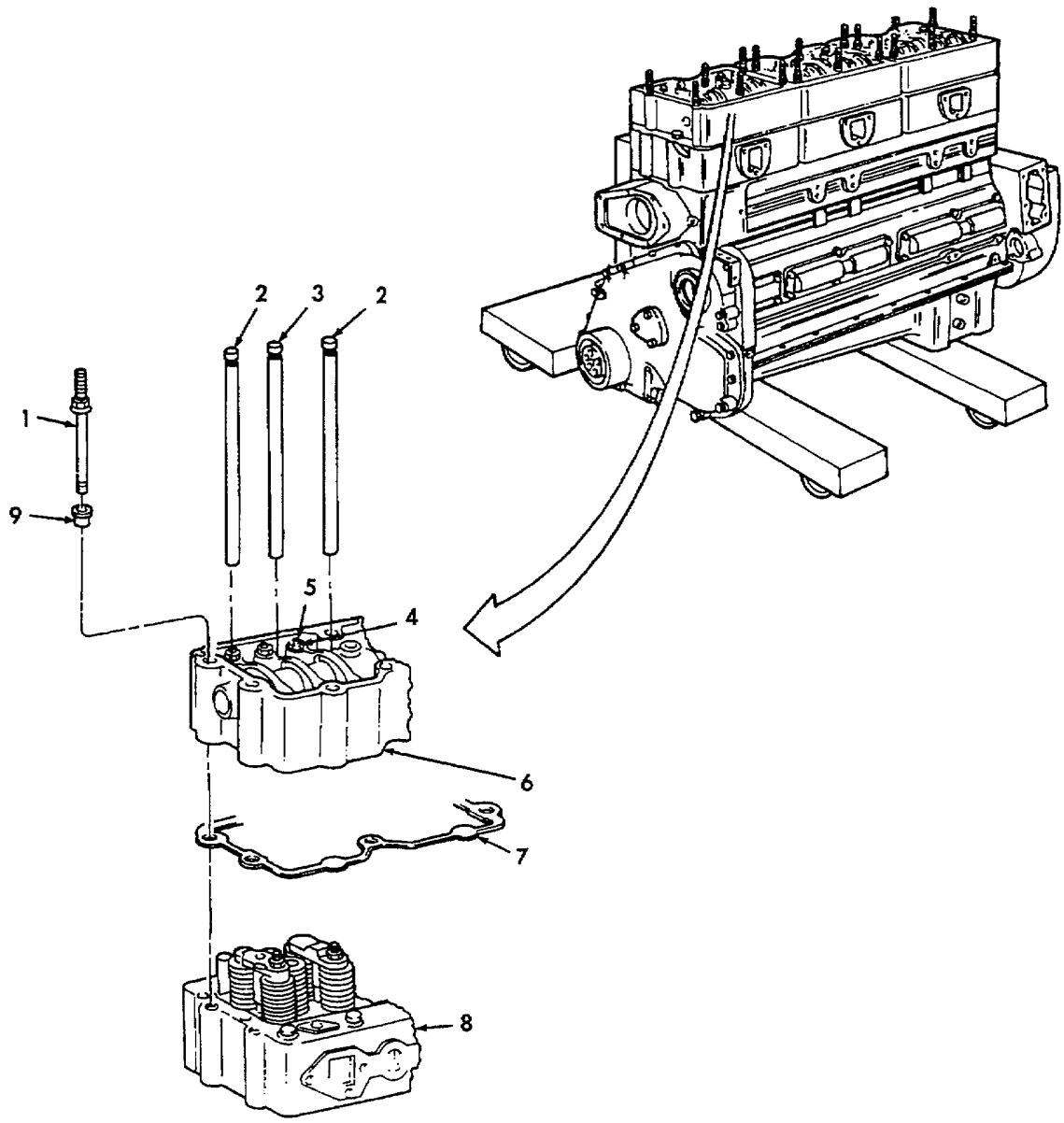
1.	Six adjusting screw nuts (4) and adjusting screws (5)	Loosen by turning counterclockwise until tension on pushrods (2) and (3) is released.	
2.	Six rocker arm housing studs (1) and washer bearings (9)	Remove from cylinder head (8) and and rocker arm housing assembly (6).	
3.	Rocker arm housing assembly (6)	Remove from cylinder head (8).	Mark each rocker arm housing assembly (6) to identify its location if more than one will be removed.
4.	Gasket (7)	Remove from cylinder head (8) or rocker arm housing assembly (6).	Gasket (7) may remain on rocker arm housing assembly (6) or cylinder head assembly (8). Discard gasket (7).

NOTE
Place pushrods in a suitable rack in the order they are removed to ensure proper order for installation and protect them from damage.

5.	Two intake pushrods (2), two exhaust pushrods (2), and two injector pushrods (3)	Remove from cylinder head (8).	

FOLLOW-ON TASKS:
- For repair of pushrods (para. 3-40).
- For repair of rocker levers and housing (para. 3-41).
- For installation of pushrods (para. 3-71).
- For installation of rocker levers and housing (para. 3-84).

3-22. ROCKER ARM HOUSING ASSEMBLY AND PUSHRODS REMOVAL (Contd)



LEGEND:

1. ROCKER ARM HOUSING STUD (6)
2. INTAKE AND EXHAUST PUSHROD (4)
3. INJECTOR PUSHROD (2)
4. ADJUSTING SCREW NUT (6)
5. ADJUSTING SCREW (6)
6. ROCKER ARM HOUSING ASSEMBLY (ONE CYL. SECTION ONLY SHOWN)
7. GASKET
8. CYLINDER HEAD
9. WASHER BEARING (6)

3-23. INJECTOR ASSEMBLY REMOVAL

THIS TASK COVERS:

Removal

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Injector puller (15434) 3376872

TEST EQUIPMENT
None

MATERIALS/PARTS
None

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
Rocker arm housing assembly and pushrods removed (para. 3-22).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dust and dirt.

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS
Removal		

CAUTION

Ensure injectors, injector links, and plungers are not intermixed. Keep all injector parts with individual injectors. After removal, put injectors in suitable rack to ensure proper order of installation and protect them from damage and dirt.

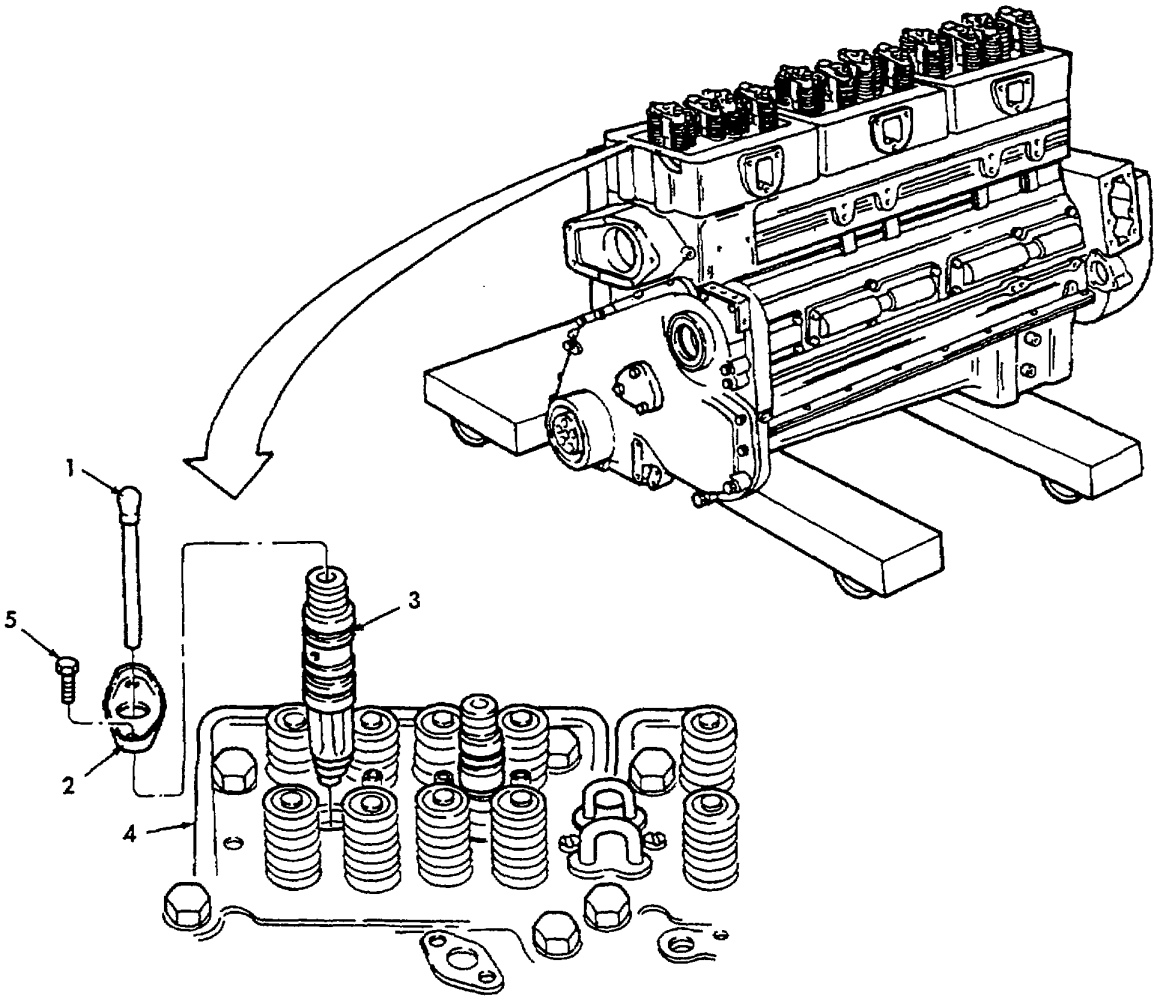
NOTE

The following procedure covers removal of one fuel injector. Removal of remaining fuel injectors is similar.

1.	Two screws (5) and retaining plate (2) (M915/Big Cam I) or clamp (2) (M915A1/Big Cam III)	Remove from cylinder head assembly (4) and injector assembly (3).	
2.	Detent plunger (1)	Remove from injector assembly (3).	
3.	Injector assembly (3)	Remove from cylinder head assembly (4).	Use injector puller (3376872) for removal. After removal, place detent plunger (1) in injector assembly (3) and wrap injector assembly (3) in clean cloth.

FOLLOW-ON TASKS:
- For repair of fuel injector (para. 3-52).
- For installation of injector assembly (para. 3-82).

3-23. INJECTOR ASSEMBLY REMOVAL (Contd)



LEGEND:

1. DETENT PLUNGER
2. RETAINING PLATE (M915/BIG CAM I) OR CLAMP (M915A1/BIG CAM III)
3. INJECTOR ASSEMBLY
4. CYLINDER HEAD ASSEMBLY
5. SELF-LOCKING SCREW (2) (M915/BIG CAM I) OR SCREW (2) (M915A1/BIG CAM III)

3-24. CYLINDER HEAD ASSEMBLY REMOVAL

THIS TASK COVERS:

Removal

INITIAL SETUP:

APPLICABLE MODELS
All

REFERENCES (TM)
None

SPECIAL TOOLS
None

TROUBLESHOOTING REFERENCES
Para. 2-9

TEST EQUIPMENT
None

EQUIPMENT CONDITION
Injector assemblies removed (para. 3-23).

MATERIALS/PARTS
Four preformed packings (15434) 131026
Gasket (15434) 3047402

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

PERSONNEL REQUIRED
Automotive repairman MOS 63H

GENERAL SAFETY INSTRUCTIONS

LOCATION/ITEM	ACTION	REMARKS

None

Removal

NOTE
The following procedure covers the removal of one cylinder head assembly. The removal of the remaining cylinder head assemblies is similar.

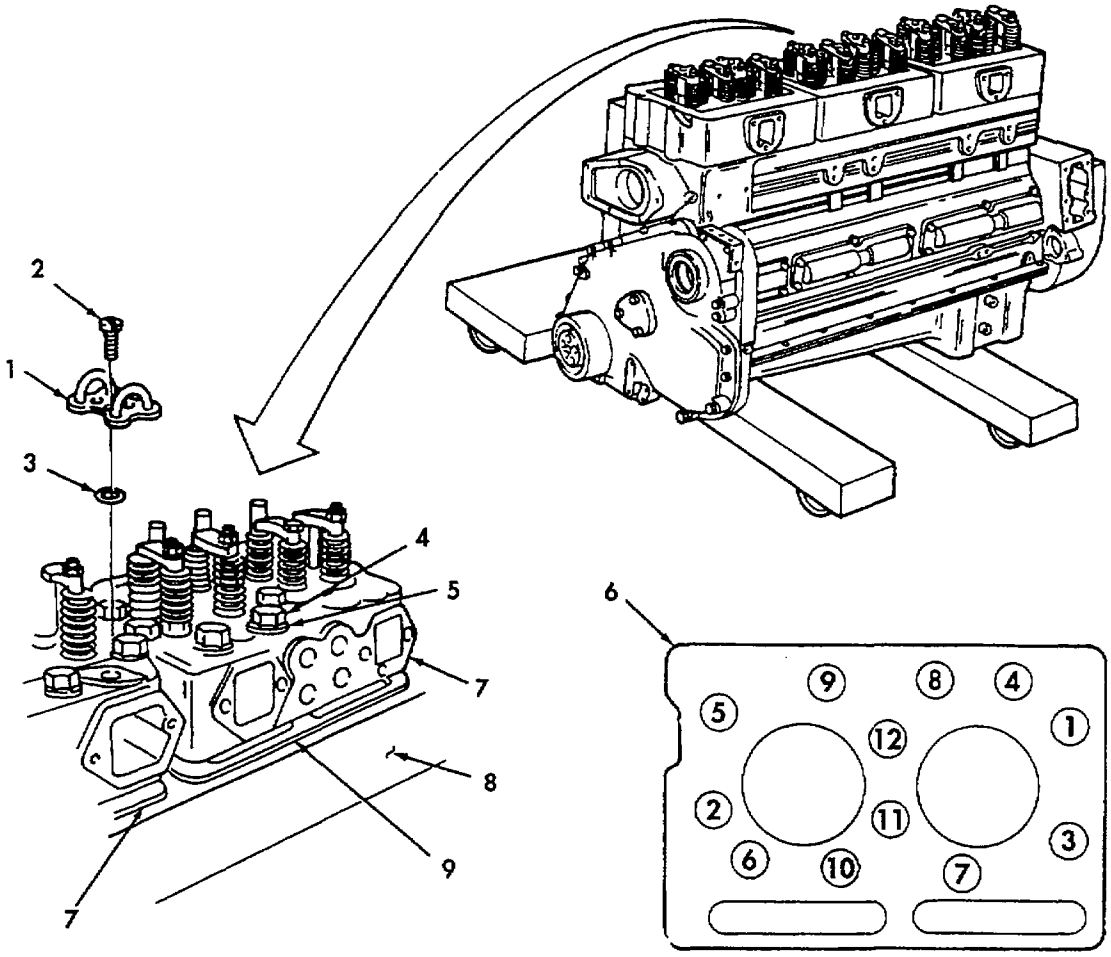
1.	Four screws (2), fuel crossover connection (1), and four preformed packings (3)	Remove from two cylinder head assemblies (7).	If you are removing the center cylinder head (7), it will be necessary to remove eight screws (2), two fuel crossover connections (1), and eight preformed packings (3). Discard preformed packings (3).
2.	Twelve screws (4) and washers (5)	Remove from cylinder block (8) and cylinder head assembly (7).	Use screw removal sequence (6) as shown in illustration.

NOTE
If more than one cylinder head assembly will be removed, mark location of each cylinder head assembly on the cylinder block for installation.

3.	Cylinder head assembly (7)	Lift from cylinder block (8).	Assistant will help lift cylinder head assembly (7).
4.	Cylinder head gasket (9)	Remove from cylinder block (8).	Discard gasket (9).

FOLLOW-ON TASKS:
- For repair of cylinder head and valves (para. 3-35).
- For installation of cylinder head assembly (para. 3-71).

3-24. CYLINDER HEAD ASSEMBLY REMOVAL (Contd)



LEGEND:

1. FUEL CROSSOVER CONNECTION
2. SCREW (4)
3. PREFORMED PACKING (4)
4. SCREW (12)
5. WASHER (12)
6. SCREW REMOVAL SEQUENCE
7. CYLINDER HEAD ASSEMBLY (2)
8. CYLINDER BLOCK
9. CYLINDER HEAD GASKET

3-25. FLEXPLATE OR FLYWHEEL, FLYWHEEL HOUSING, AND REAR COVER REMOVAL

THIS TASK COVERS:

Removal

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
None

TEST EQUIPMENT
None

MATERIALS/PARTS
Gasket (15434) 40662-A
Two lockwashers (96906) MS35338-46 (M915/Big Cam I)
Preformed packing (15434) 137075 (M915/Big Cam I)
Eleven preformed packings (15434) 172648 (M915/Big Cam I)
Seal (01212) M39807
Four lockwashers (96906) MS35338-45

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
Cylinder head assemblies removed (para. 3-24).

SPECIAL ENVIRONMENTAL CONDITION
Work area clean and away from blowing dirt and dust

GENERAL SAFETY INSTRUCTIONS
Use extreme caution during disassembly; engine components are heavy.

LOCATION/ITEM	ACTION	REMARKS

Removal

WARNING

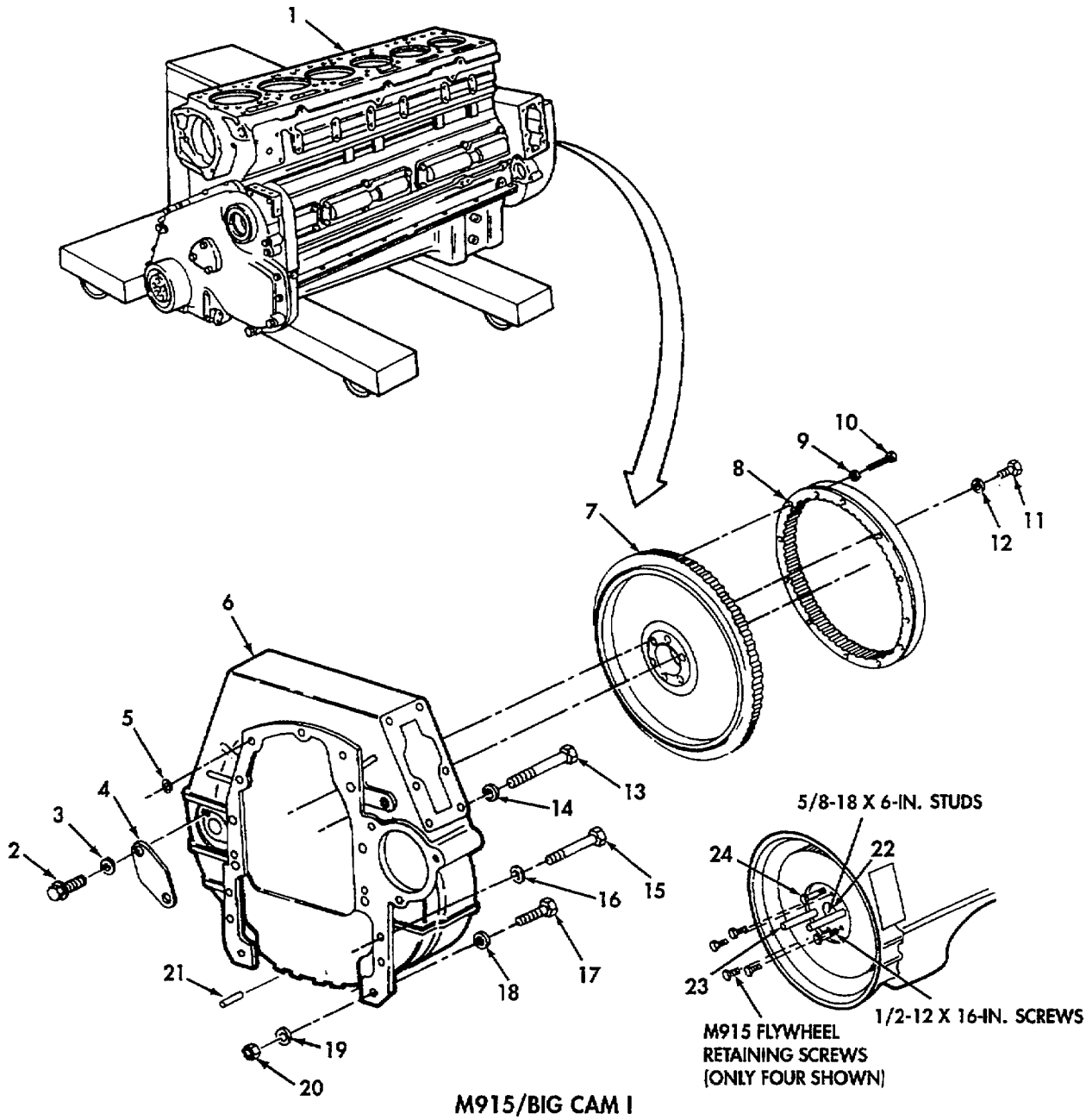
Use extreme caution during disassembly; engine components are heavy. Failure to comply may result in injury to personnel.

NOTE

- **M915/Big Cam I engines are equipped with a "wet" flywheel housing which is sealed with a preformed packing (O-ring seal) on crankshaft and eleven preformed packings between flywheel housing and cylinder block.**
- **Perform steps 1 through 4 for M915/Big Cam I only.**
- **Perform step 11 for M915A1/Big Cam III only.**

1.	Six screws (11) and washers (12)	Remove from crankshaft (22) and flywheel (7).	
2.	Two 5/8-18 x 6 in. studs (23)	Install on two opposite holes on crankshaft (22) until fully seated.	The studs will provide support for flywheel (7) during removal.
3.	Two 1/2-13 x 6 in. screws (24)	Install on flywheel (7) in opposite threaded holes provided until in contact with face of crankshaft (22).	Screws (24) are used as jacking screws.
4.	Flywheel (7)	Remove from crankshaft (22) by alternately turning two 1/2-13 x 6 in. screws (24.	Have assistant hold on to flywheel during removal. Remove 5/8-18 x 6 in. studs (23) from crankshaft (22), and remove 1/2-13 x 6 in. screws (24) from flywheel (7).

3-25. FLEXPLATE OR FLYWHEEL, FLYWHEEL HOUSING, AND REAR COVER REMOVAL (Contd)



M915/BIG CAM I

LEGEND:

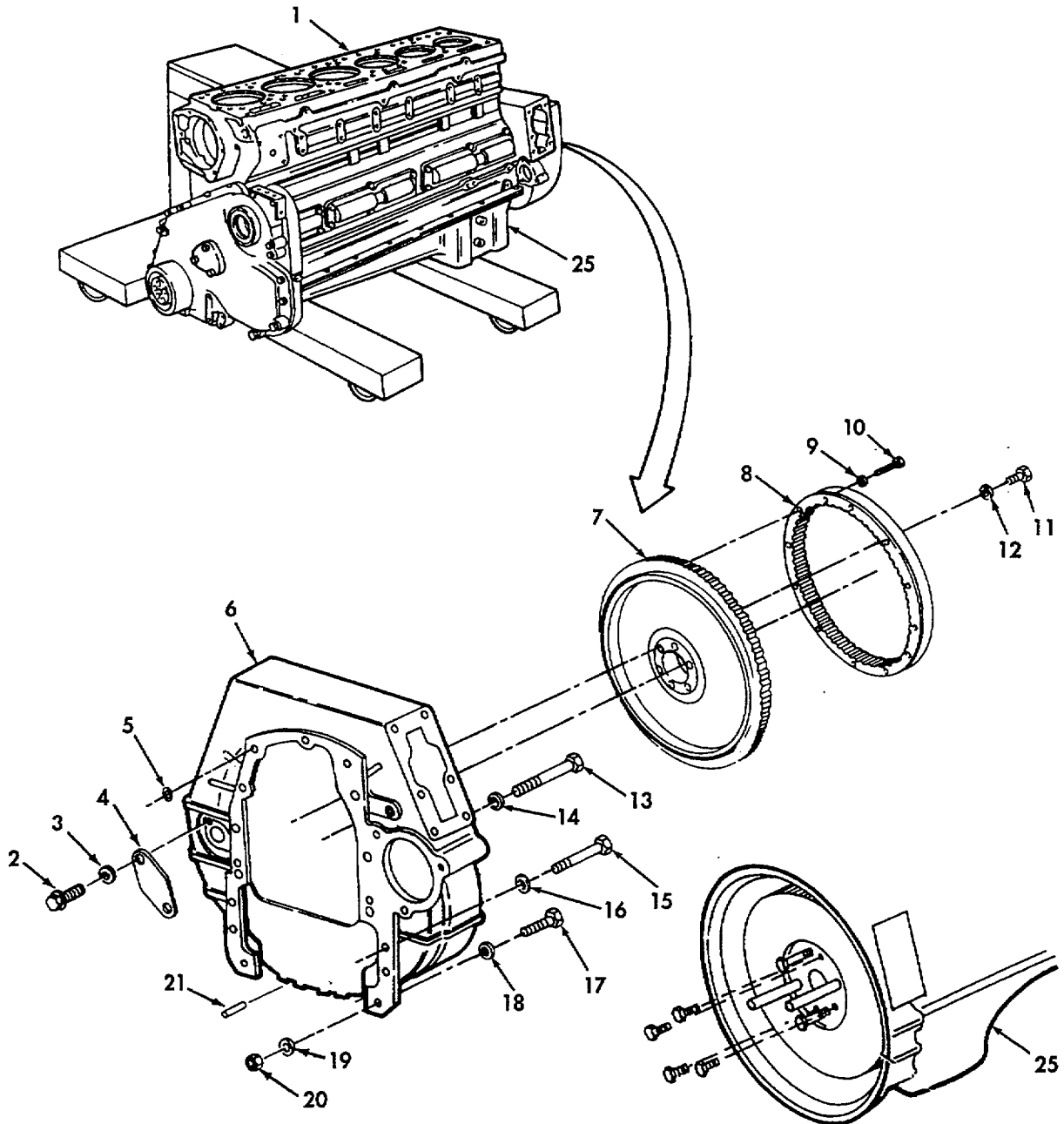
1. CYLINDER BLOCK
2. SCREW (2)
3. GASKET
4. ACCESS COVER
5. PREFORMED PACKING (11) (M915/BIG CAM I)
6. FLYWHEEL HOUSING
7. FLYWHEEL
8. SPACER GEAR
9. WASHER (12)
10. SCREW (12)
11. SCREW (6)
12. WASHER (6)
13. SCREW (9)
14. WASHER (9)
15. SCREW (4)
16. WASHER (4)
17. SCREW (2)
18. WASHER (4)
19. LOCKWASHER (2)
20. NUT (2)
21. DOWEL PIN (2)
22. CRANKSHAFT
23. STUD (2)
24. SCREW (2)

3-25. FLEXPLATE OR FLYWHEEL, FLYWHEEL HOUSING, AND REAR COVER REMOVAL (Contd)

LOCATION/ITEM	ACTION	REMARKS
Removal (Contd)		
5. Four screws (15), washers (16), two nuts (20), lockwashers (19), screws (17), and washers (18)	Remove from flywheel housing (6) and oil pan (25).	Discard lockwashers (19).
6. Nine screws (13) and washers (14)	Remove from cylinder block (1) and flywheel housing (6).	
7. Flywheel housing (6)	Remove from dowel pins (21) and cylinder block (1).	Support flywheel housing (6) during removal from dowel pins (21). Free flywheel housing (6) by driving off of dowel pins (21) with soft-nose hammer.
8. Two dowel pins (21) and eleven preformed packings (5)	Remove from flywheel housing (6).	Discard preformed packings (5).
NOTE **Perform step 9 if flywheel-to-clutch housing ring gear is to be removed for M915/Big Cam I only.**		
9. Twelve screws (10), washers (9), and spacer gear (8)	Remove from flywheel (7).	
10. Two screws (2), gasket (3), and access cover (4)	Remove from flywheel housing (6).	Access cover (4) may have been removed during engine removal. Discard gasket (3).

3-25. FLEXPLATE OR FLYWHEEL, FLYWHEEL HOUSING, AND REAR COVER REMOVAL (Contd)

LOCATION/ITEM	ACTION	REMARKS



M915/BIG CAM I

LEGEND:

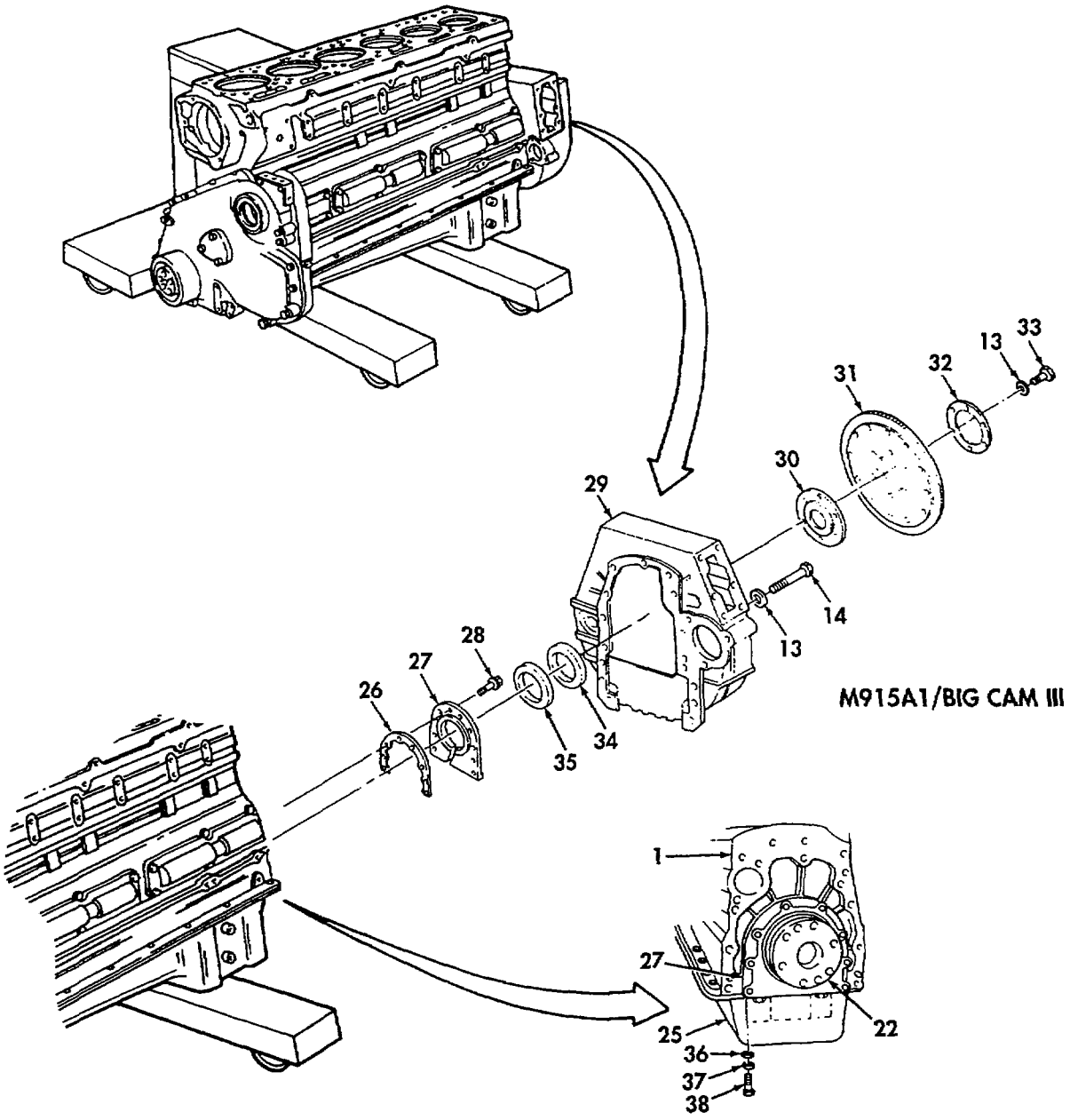
1. CYLINDER BLOCK
2. SCREW (2)
3. GASKET
4. ACCESS COVER
5. PREFORMED PACKING (11)
6. FLYWHEEL HOUSING
7. FLYWHEEL
8. SPACER GEAR
9. WASHER (12)
10. SCREW (12)
13. SCREW (9)
14. WASHER (9)
15. SCREW (4)
16. WASHER (4)
17. SCREW (2)
18. WASHER (4)
19. LOCKWASHER (2)
20. NUT (2)
21. DOWEL PIN (2)
25. OIL PAN

3-25. FLEXPLATE OR FLYWHEEL, FLYWHEEL HOUSING, AND REAR COVER REMOVAL (Contd)

LOCATION/ITEM	ACTION	REMARKS
Removal (Contd)		
	NOTE **Perform step 11 for M915A1/Big Cam III only.**	
11. Six screws (33), washers (13), washer bearing (32), flexplate (31), and retaining plate (30)	Remove from crankshaft (22).	Lock flexplate (31) to prevent crankshaft (22) from rotating when removing screws (33).
	NOTE **Perform step 12 for M915/Big Cam I only.**	
12. Preformed packing (34)	Remove from crankshaft (22).	Discard preformed packing (34).
13. Four screws (38), lock-washers (37), and washers (36)	Remove from oil pan (25) and rear cover (27).	On steel oil pans (M915A1/Big Cam III), two of the four screws (38) have been eliminated.
14. Eight screws (28), rear cover (27), and gasket (26)	Remove from cylinder block (1) and crankshaft (22).	Discard gasket (26).
15. Rear main seal (35)	Remove from rear cover (27).	Discard seal (35).

FOLLOW-ON TASKS:
- For repair of flexplate or flywheel, flywheel housing, and rear cover (para. 3-38).
- For installation of flexplate or flywheel, flywheel housing, and rear cover (para. 3-80).

3-25. FLEXPLATE OR FLYWHEEL, FLYWHEEL HOUSING, AND REAR COVER REMOVAL (Contd)



LEGEND:

1. CYLINDER BLOCK
13. WASHER (6)
14. SCREW (9)
22. CRANKSHAFT
25. OIL PAN
26. GASKET
27. REAR COVER (M915/BIG CAM I), COVER (M915A1/BIG CAM III)
28. SCREW (8)
29. FLYWHEEL HOUSING
30. RETAINING PLATE
31. FLEXPLATE
32. WASHER BEARING
33. SCREW (6)
34. PREFORMED PACKING (M915 ONLY)
35. REAR MAIN SEAL
36. WASHER (4)
37. LOCKWASHER (4)
38. SCREW (4)

3-26. OIL PAN REMOVAL

THIS TASK COVERS:

Removal

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
None

TEST EQUIPMENT
None

MATERIALS/PARTS
Gasket (15434) 3032861
Four lockwashers (96906) MS35338-45

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
LO 9-2320-273-12
LO 9-2320-283-12

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
Engine oil drained (LO 9-2320-273-12 or LO 9-2320-283-12).

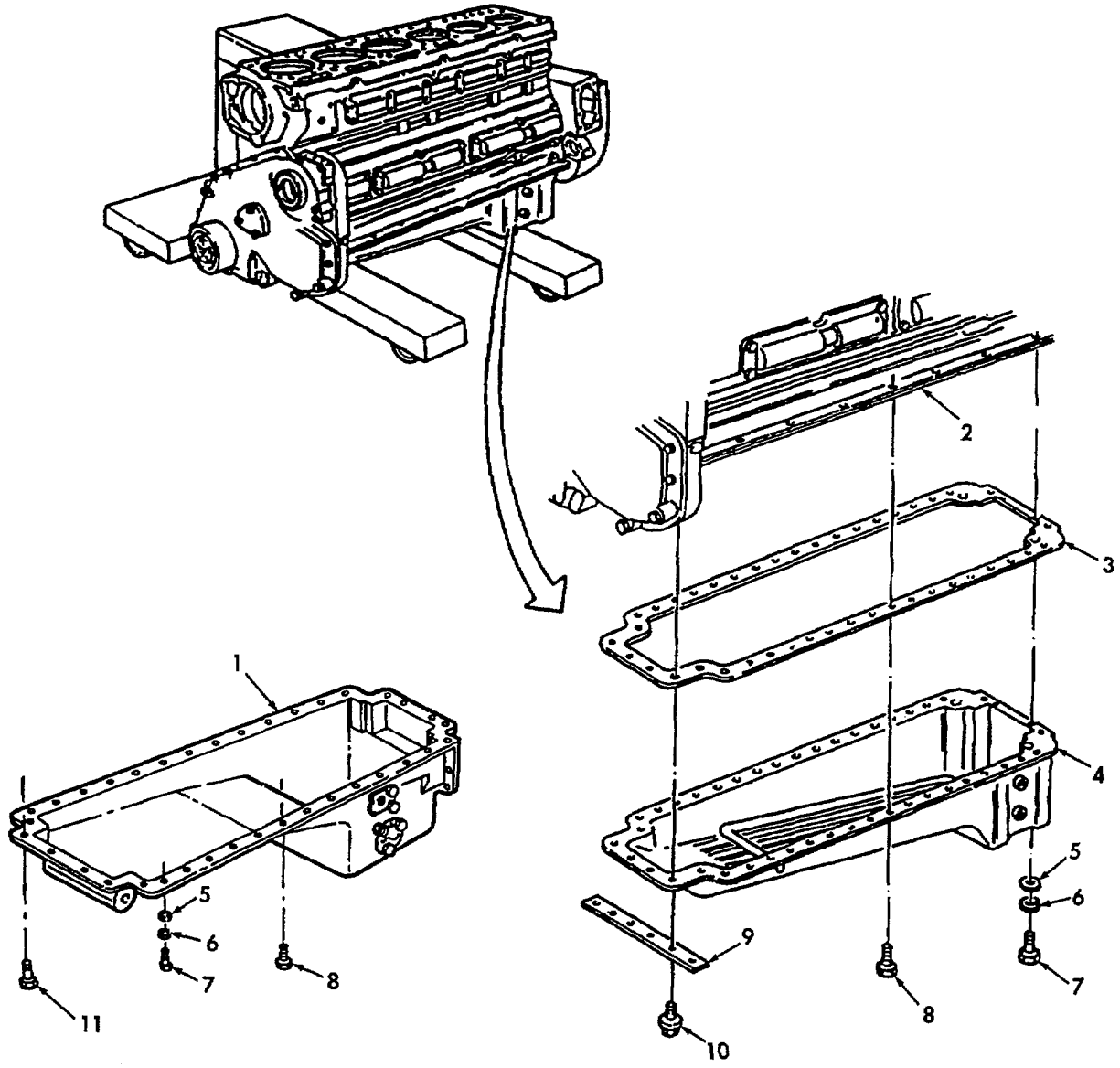
SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS
Removal		
	NOTE • **Removal of oil pan is basically the same for M915/Big Cam I and M915A1/Big Cam III. Big Cam I engines are equipped with a cast aluminum oil pan. Big Cam III engines are equipped with a stamped steel oil pan.** • **Perform step 1 for M915AlfBig Cam III only.** • **Perform step 2 for M915/Big Cam I only.**	
1. Four screw-assembled washers (10) and engine shipping support (9)	Remove from cylinder block (2) and oil pan (4).	
2. Four screws (11)	Remove from cylinder block (2) and oil pan (1).	
	NOTE **Two of the four screws may have been eliminated on newer M915A1/Big Cam III oil pans.**	
3. Four screws (7), lockwashers (6), and washers (5)	Remove from oil pan (4) (M915A1/Big Cam III) or oil pan (1) (M915/Big Cam I).	Screws (7) may have already been removed if rear cover was removed. Discard lockwashers (6).
4. Twenty-eight screws (8), oil pan (4) (M915A1/Big Cam III) or oil pan (1) (M915/Big Cam I), and gasket (3)	Remove from cylinder block (2).	Assistant will hold oil pan (4) or (1) during removal of last screw (8). Discard gasket (3).

FOLLOW-ON TASKS:
- For repair of oil pan (para. 3-43).
- For installation of oil pan (para. 3-81).

3-26. OIL PAN REMOVAL (Contd)



M915/BIG CAM I OIL PAN (CAST ALUMINUM)

M915A1/BIG CAM III OIL PAN (STAMPED STEEL)

LEGEND:

1. OIL PAN (M915/BIG CAM I)
2. CYLINDER BLOCK
3. GASKET
4. OIL PAN (M915A1/BIG CAM III)
5. WASHER (4)
6. LOCKWASHER (4)
7. SCREW (4)
8. SCREW (28)
9. ENGINE SHIPPING SUPPORT
10. SCREW-ASSEMBLED WASHER (4) (M915A1/BIG CAM III)
11. SCREW (4) (M915/BIG CAM I)

3-27. FRONT GEAR COVER REMOVAL

THIS TASK COVERS:

Removal

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
None

TEST EQUIPMENT
None

MATERIALS/PARTS
Gasket (15434) 3021704
Preformed packing (15434) 215705
Lockwasher (96906) MS35338-47 (M915/Big Cam I)
Three lockwashers (15434) S604 (M915/Big Cam I)

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
- Oil pan removed (para. 3-26).
- Vibration damper and crankshaft pulley removed (para. 3-14).
- Accessory drive pulley removed (para. 3-15).
- Accessory drive housing removed (para. 3-18).
- Oil pump removed (para. 3-19).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
None

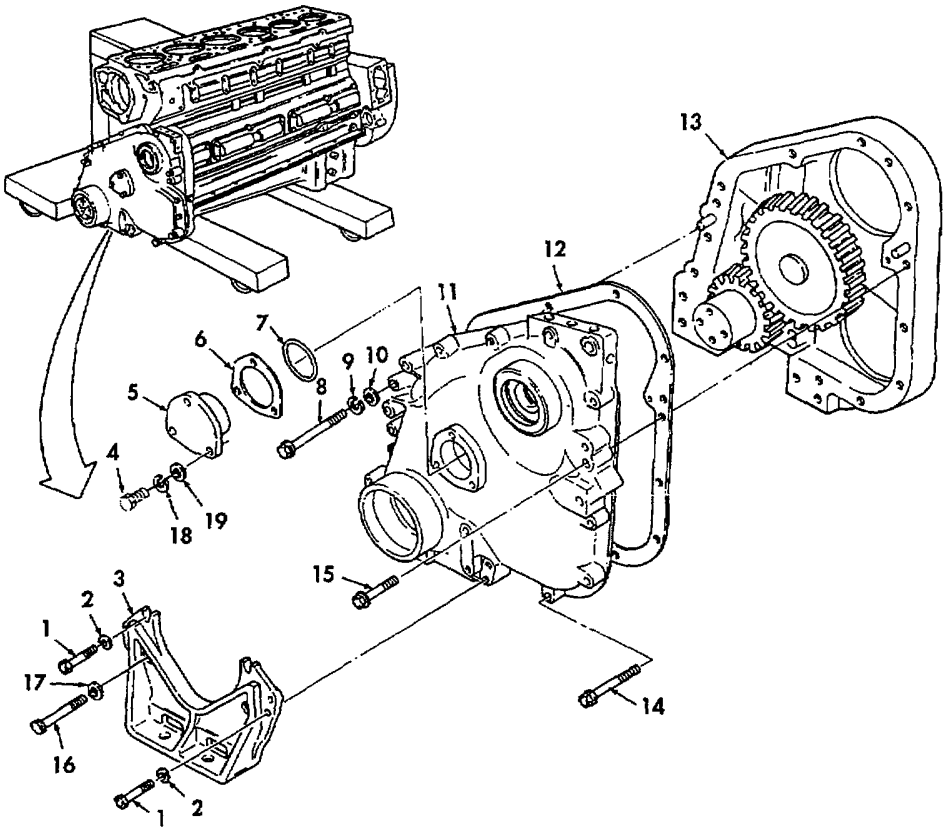
LOCATION/ITEM	ACTION	REMARKS
Removal		
1. Six screws (1), washers (2), two screws (16) (M915/Big Cam I) or two captive washer screws (16) (M915A1/Big Cam III only), two washers (17) (M915/Big Cam I only), and front engine support (3)	Remove from cylinder block (13) and gear cover (11).	Hold front engine support (3) during removal of last screw (16).
NOTE • **Perform step 2 for M915/Big Cam I only.** • **Perform step 3 for M915A1/Big Cam III only.**		
2. Three screws (4), lockwashers (18), washers (19), camshaft support (5), shim pack (6) and preformed packing (7)	Remove from gear cover (11).	Use a soft-nose hammer and gently tap camshaft support (5) loose, if necessary. Discard lockwashers (18) and packing (7).
3. Three captive washer screws (4), camshaft support (5), shim pack (6), and preformed packing (7)	Remove from gear cover (11).	Use a soft-nose hammer and gently tap camshaft support (5) to loosen, if necessary. Discard packing (7).
4. Two screws (8) (M915/Big Cam I only) or two captive washer screws (8) (M915A1/ Big Cam III only), lockwasher (9) and washer (10) (M915/ Big Cam I only), nine captive washer screws (15), and captive washer screw (14)	Remove from cylinder block (13) and gear cover (11).	Discard lockwasher (9).

3-27. FRONT GEAR COVER REMOVAL (Contd)

Removal (Contd)

5.	Front gear cover (11) and gasket (12)	Remove front cylinder block (13).	Install one 4-in. stud on each side of gear cover (11) for support during removal. Use a soft-nose hammer to loosen gear cover (11). Discard gasket (12).
6.	Camshaft support (5), shim pack (6), and three screws (4)	Install on front gear cover (11).	This step is recommended to prevent damage or loss of shim pack (6). Do not tighten screws (4).

FOLLOW-ON TASKS:
- For repair of front gear cover (para. 3-48).
- For installation of front gear cover (para. 3-75).



LEGEND:
1. SCREW (6)
2. WASHER (6)
3. FRONT ENGINE SUPPORT
4. SCREW (3) (M915/BIG CAM I), CAPTIVE WASHER SCREW (3) (M915A1/BIG CAM III)
5. CAMSHAFT SUPPORT
6. SHIM PACK
7. PREFORMED PACKING
8. SCREW (2) (M915/BIG CAM I) CAPTIVE WASHER SCREW (2) (M915A1/BIG CAM III)
9. LOCKWASHER (M915/BIG CAM I)
10. WASHER (M915/BIG CAM I)
11. GEAR COVER
12. GASKET
13. CYLINDER BLOCK
14. CAPTIVE WASHER SCREW
15. CAPTIVE WASHER SCREW (9)
16. SCREW (2) (M915/BIG CAM I) CAPTIVE WASHER SCREW (2) (M915A1/BIG CAM III)
17. WASHER (2) (M915/BIG CAM I)
18. LOCKWASHER (3) (M915/BIG CAM I)
19. WASHER (3) (M915/BIG CAM I)

3-28. CAM FOLLOWER ASSEMBLIES AND CAMSHAFT REMOVAL

THIS TASK COVERS:

Removal

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
None

TEST EQUIPMENT
None

MATERIALS/PARTS
Gasket (as required) (15434) 3011878 (M915/Big Cam I)
Six lockwashers (15434) S604 (M915/Big Cam I)
Gasket (15434) 3020000 (M915A1/Big Cam III)
Gasket (as required) (15434) 3020001, 3020002, 3020003, 3020004 (M915A1/Big Cam III)

REFERENCES (TM)
Automotive repairman MOS 63H

REFERENCE (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
Front gear cover removed (para. 3-27).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFE INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS
Removal		
	NOTE • **Perform steps 1 and 2 to remove any one of the three cam follower assemblies. Mark each cam follower assembly during removal so it can be installed in its original position on cylinder block.** • **All three cam follower assemblies must be removed from cylinder block before camshaft can be removed. Repeat steps 1 and 2 to remove each remaining cam follower assembly.**	
1. Six screws (5)	Remove from cam follower assembly (4) and cylinder block (2). Remove six lockwashers (6) (M915/Big Cam I).	Discard lockwashers (6) (M915/Big Cam I).
	NOTE **Measuring thickness of gasket or gaskets for each cam follower assembly is required for correct timing of injectors due to individual differences between castings.**	
2. Cam follower assembly (4) and gasket (3)	a. Carefully pry from dowels on cylinder block (2).	
	b. Measure gasket (3) at points A, B, and C as shown. Record the average thickness of gasket or gaskets for each cam follower assembly (4).	Use a suitable micrometer to measure gaskets (3). Discard gasket(s) (3) after taking measurement. Refer to Appendix B, Figure 7 for additional gasket sizes available.

3-28. CAM FOLLOWER ASSEMBLIES AND CAMSHAFT REMOVAL (Contd)

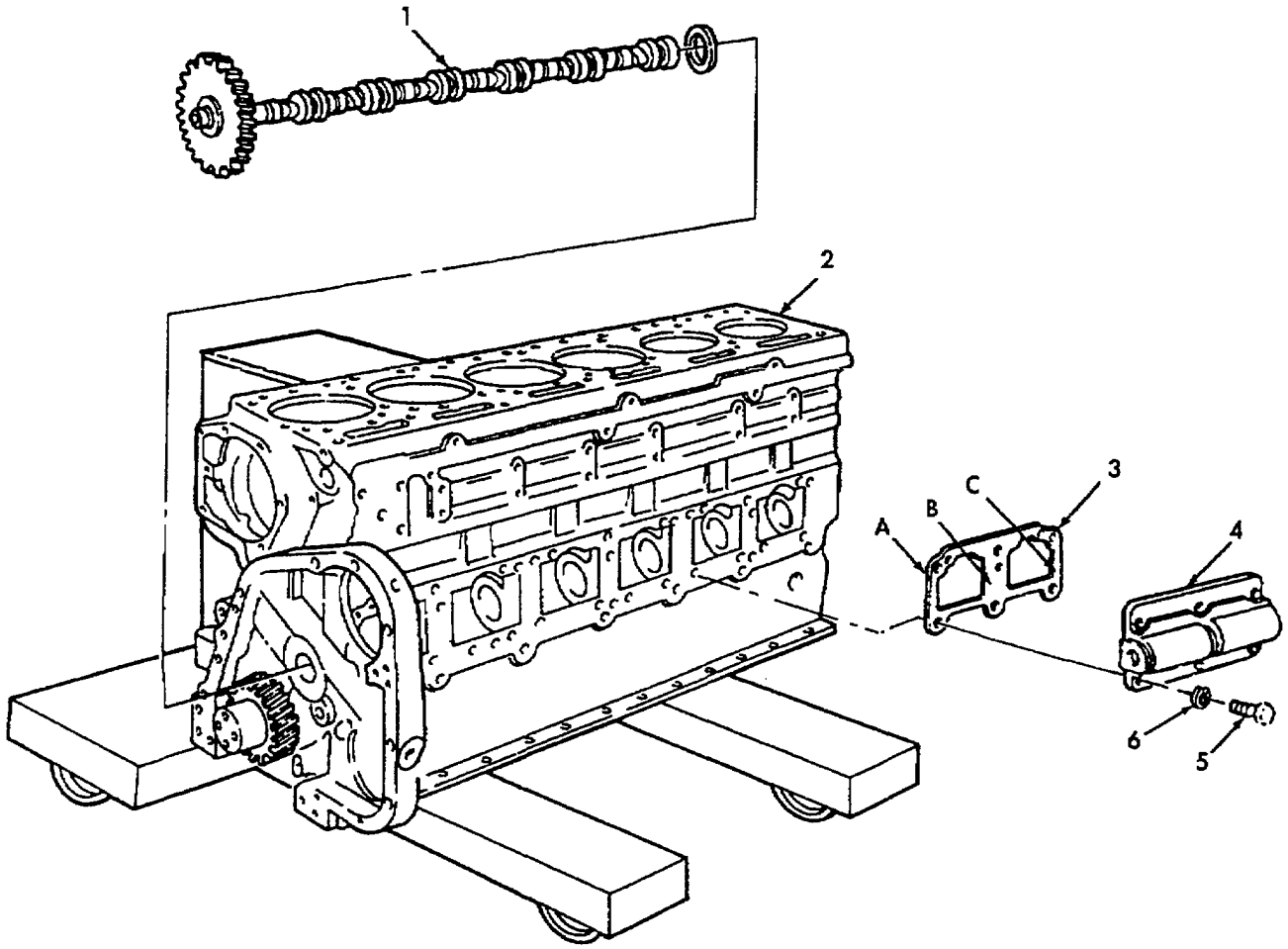
LOCATION/ITEM	ACTION	REMARKS

CAUTION
To avoid damaging camshaft bushings, use extreme caution when removing camshaft.

NOTE
Four camshaft pilot tools (3375268) may be used if available.

3.	Camshaft (1)	Remove from cylinder block (2) by slowly turning gear on camshaft (1) and lightly pulling at same time.	Have assistant help during removal. Remove camshaft pilot tools from camshaft (1) if utilized.

FOLLOW-ON TASKS:
- For repair of camshaft and cam follower assemblies (para. 3-40).
- For installation of camshaft and cam follower assemblies (para. 3-70).



LEGEND:
1. CAMSHAFT
2. CYLINDER BLOCK
3. GASKET
4. CAM FOLLOWER ASSEMBLY
5. SCREW (6)
6. LOCKWASHER (6) (M915/BIG CAM I)

3-29. PISTON, CONNECTING ROD, AND BEARINGS REMOVAL

THIS TASK COVERS:

Removal

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Two nylon guide screws (15434) 3375601
Piston ring expander (15434) ST-763

TEST EQUIPMENT
None

MATERIALS/PARTS
Cloth, crocus (Appendix C, Item 4)

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

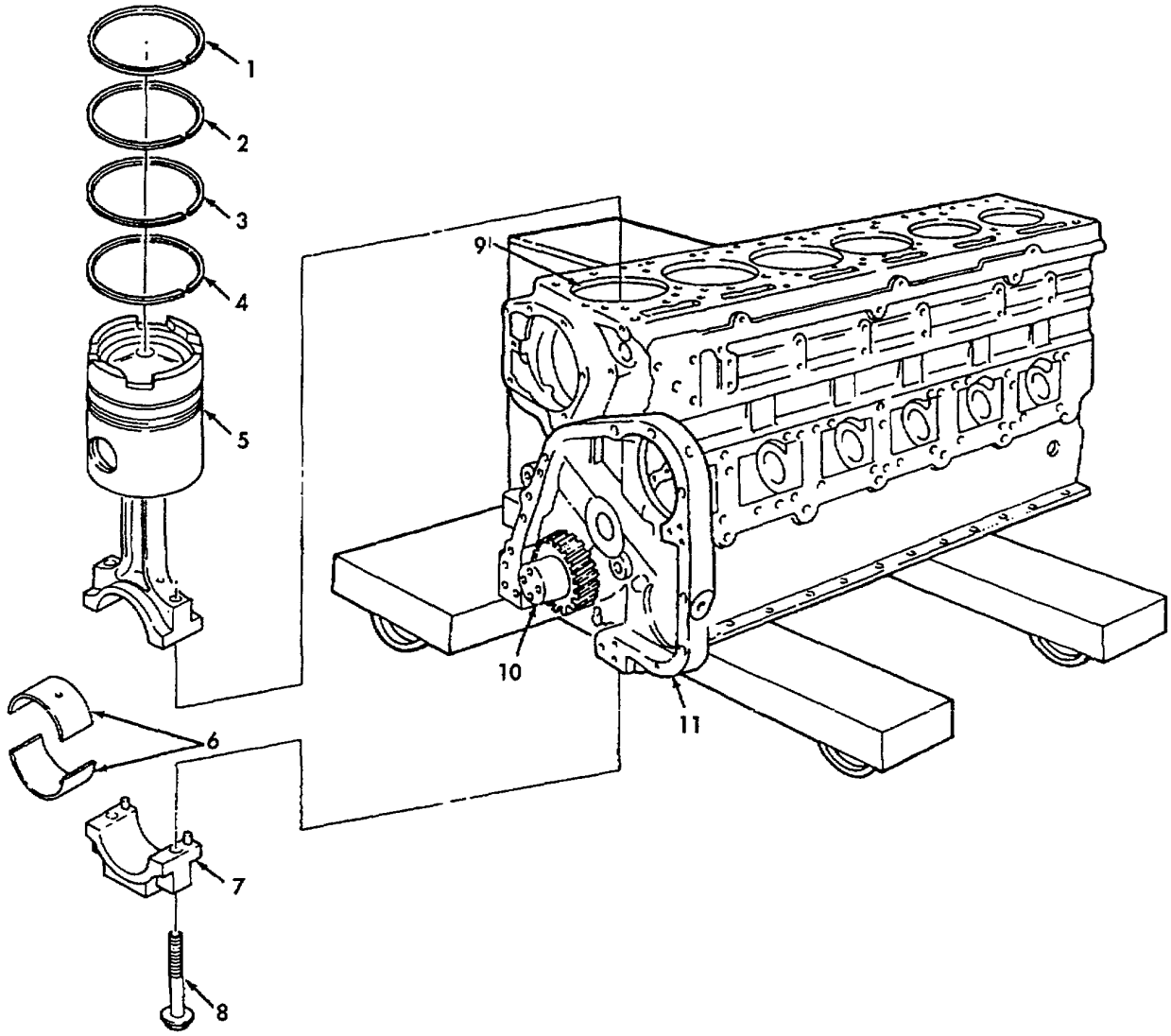
EQUIPMENT CONDITION
Camshaft and cam followers removed (para. 3-28).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
Eye protection must be worn when using wire brush for cleaning.

LOCATION/ITEM	ACTION	REMARKS
Removal		
	WARNING **Eye protection must be worn when using wire brush for cleaning. Failure to do so may result in injury to personnel.**	
	NOTE **This task covers removal of one piston, connecting rod, and bearing assembly. Removal of the remaining five assemblies is the same. Parts are not interchangeable and must be identified with each assembly as it is removed.**	
1. Cylinder block (11)	a. Place in vertical position with rear of block down. b. Using a rotary wire brush or aluminum bladed scraper, clean all carbon deposits from upper inside wall of cylinder liner (9).	This step is performed so rings will not snap or chip when piston and connecting rod assembly is removed. Use lint-free cloth to remove loose debris from cylinder liner (9).
2. Crankshaft (10)	Rotate until connecting rod cap (7) is accessible.	
3. Two rod screws (8)	a. Loosen until there is approximately 3/8 in. (9.5 mm) between head of screws (8) and connecting rod cap (7). b. Using soft-nose hammer, tap on heads of screws (8) until connecting rod cap (7) and piston and connecting rod assembly (5) are separated. c. Remove from piston and connecting rod assembly (5) and connecting rod cap (7).	

3-29. PISTON, CONNECTING ROD, AND BEARINGS REMOVAL (Contd)



LEGEND:

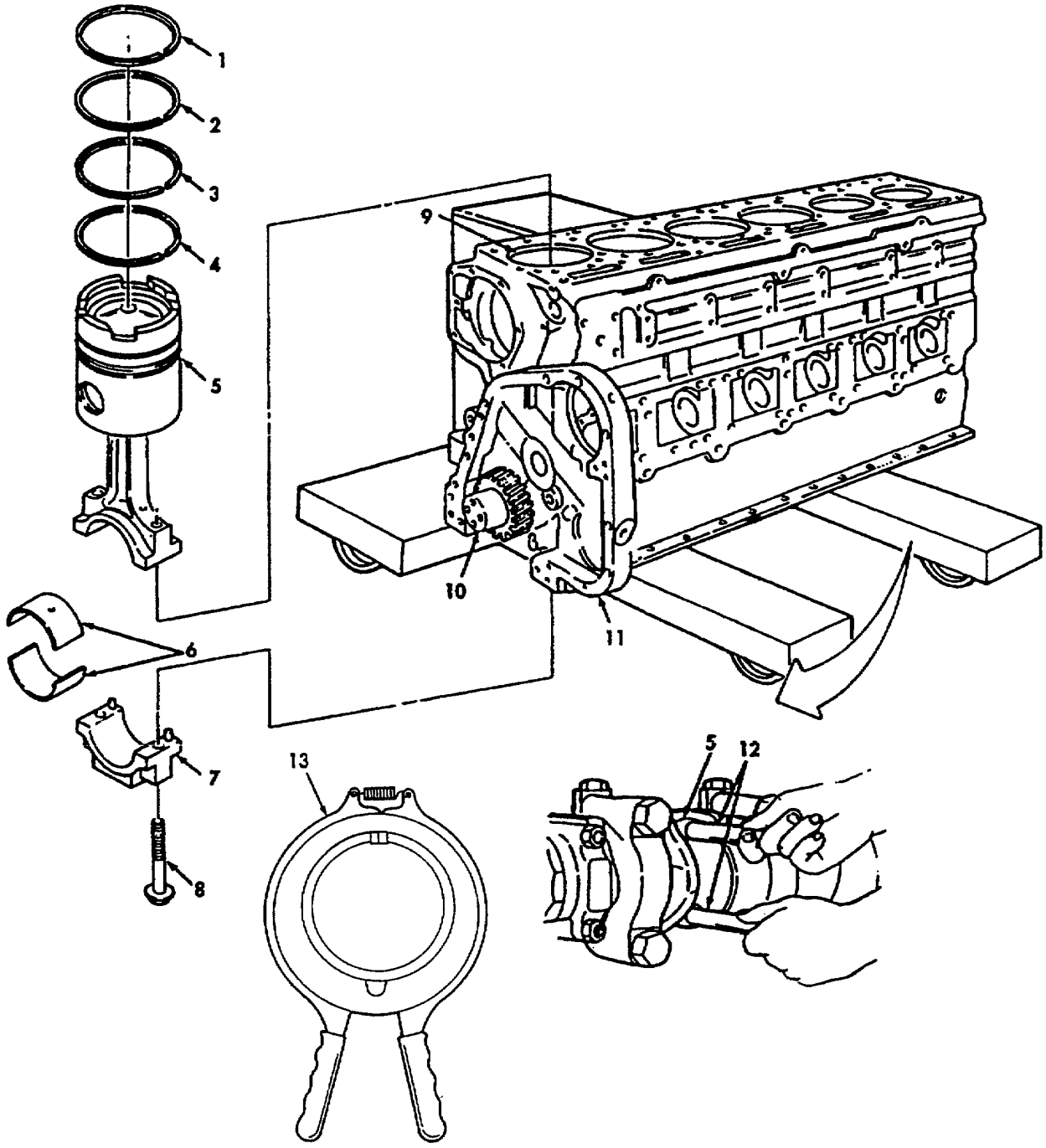
1. COMPRESSION RING
2. PISTON RING (COMPRESSION RING)
3. COMPRESSION RING
4. PISTON RING (OIL CONTROL RING)
5. PISTON AND CONNECTING ROD ASSEMBLY
6. ROD BEARING HALF (2)
7. CONNECTING ROD CAP
8. ROD SCREW (2)
9. CYLINDER LINER
10. CRANKSHAFT
11. CYLINDER BLOCK

3-29. PISTON, CONNECTING ROD, AND BEARINGS REMOVAL (Contd)

LOCATION/ITEM	ACTION	REMARKS
Removal (Contd)		
4. Connecting rod cap (7) and lower rod bearing half (6)	Remove from piston and connecting rod assembly (5) and crankshaft (10).	Ensure connecting rod and cap are identified together by cylinder number. Mark cylinder number and letter L on flat surface of bearing half (6).
5. Two nylon guide screws (12)	Install on piston and connecting rod assembly (5).	Use nylon guide screws (3375601) to prevent damage to cylinder liner (9).
6. Piston and connecting rod assembly (5)	Push out of cylinder liner (9) while holding assembly so it will not be dropped or damaged.	Mark cylinder number on top of piston at camshaft side of cylinder.
7. Two nylon guide screws (12)	Remove from piston and connecting rod assembly (5).	Mark cylinder number and letter U on flat surface of tang on rod bearing (6).
8. Upper rod bearing half (6)	Remove from piston and connecting rod assembly (5).	
9. Compression ring (1), piston ring (2), compression ring (3), and piston ring (4)	Remove from piston and connecting rod assembly (5).	Use piston ring expander (ST-763) (13). Discard rings (1), (2), (3), and (4).
10. Cylinder block (11)	Place in horizontal position.	

FOLLOW-ON TASKS:
- For repair of piston, connecting rod, and bearings (para. 3-69).
- For installation of piston, connecting rod, and bearings (para. 3-39).

3-29. PISTON, CONNECTING ROD, AND BEARINGS REMOVAL (Contd)



LEGEND:

1. COMPRESSION RING
2. PISTON RING (COMPRESSION RING)
3. COMPRESSION RING
4. PISTON RING (OIL CONTROL RING)
5. PISTON AND CONNECTING ROD ASSEMBLY
6. ROD BEARING HALF (2)
7. CONNECTING ROD CAP
8. ROD SCREW (2)
9. CYLINDER LINER
10. CRANKSHAFT
11. CYLINDER BLOCK
12. NYLON GUIDE SCREW (2)
13. PISTON RING EXPANDER

3-30. CYLINDER LINER REMOVAL

THIS TASK COVERS:

Removal

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Universal cylinder liner puller (15434) 3376015

TEST EQUIPMENT
None

MATERIALS/PARTS
Gasket (15434) 215090
Preformed packing (black) (15434) 3008998
Preformed packing (red) (15434) 183049

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8.

EQUIPMENT CONDITION
Piston, connecting rod, and bearings removed (para. 3-29).

SPECIAL ENVIRONMENTAL CONDITION
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS
Removal		

CAUTION

If shims are used under the cylinder liner, do not discard the shims. The shims will be reused during assembly. If more than one cylinder liner is to be removed, identify and tag the location of each cylinder liner and shim (if used).

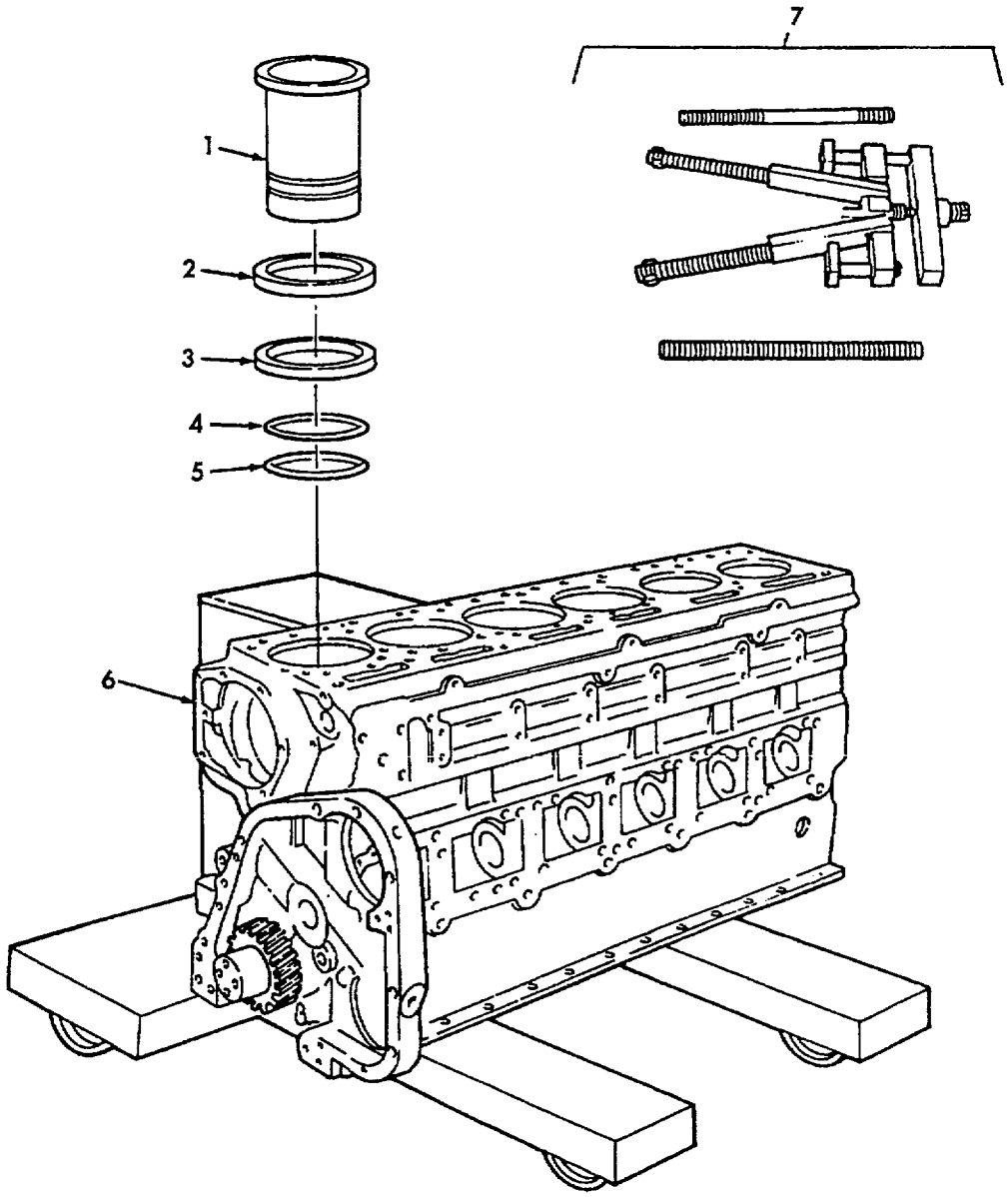
NOTE

The following procedure covers the removal of one cylinder liner. The removal of the remaining cylinder liners is the same.

1.	Cylinder liner (1)	Remove from cylinder block (6)	Use universal cylinder liner puller (7), and impact wrench. Cylinder liner shim (2), gasket (crevice seal) (3), black packing ring (4), and red packing ring (5) will remain on cylinder liner (1) during removal.
2.	Cylinder liner shim (2), gasket (crevice seal) (3), black packing ring (4), and red packing ring (5)	a. Remove from cylinder liner (1). b. Measure and record thickness of cylinder liner shim (2).	Discard gasket (crevice seal) (3), black packing ring (4), and red packing ring (5).

FOLLOW-ON TASKS:
- For repair of cylinder liner (para. 3-34).
- For installation of cylinder liner (para. 3-67).

3-30. CYLINDER LINER REMOVAL (Contd)



LEGEND:

1. CYLINDER LINER
2. CYLINDER LINER SHIM (IF REQUIRED)
3. GASKET (CREVICE SEAL)
4. BLACK PACKING RING
5. RED PACKING RING
6. CYLINDER BLOCK
7. UNIVERSAL CYLINDER LINER PULLER

3-31. ENGINE CRANKSHAFT AND MAIN BEARINGS REMOVAL

THIS TASK COVERS:

Removal

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Main bearing cap puller (15434) ST-1178

TEST EQUIPMENT
None

MATERIALS/PARTS
Fourteen lockplates (15434) 140218

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

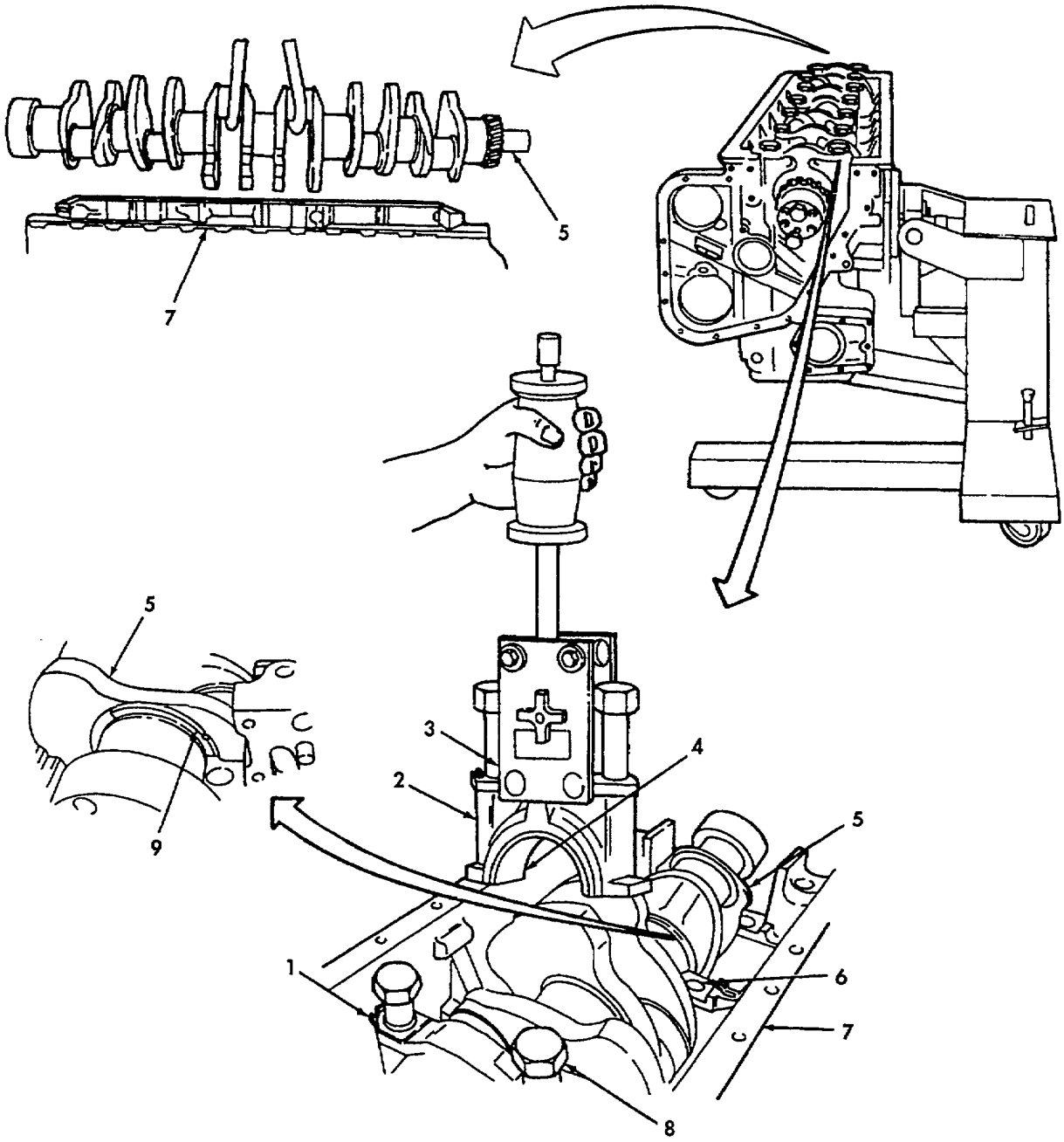
EQUIPMENT CONDITION
Piston connecting rods and connecting rod bearings removed (para. 3-29).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS
Removal		
	CAUTION **Cylinder block and main bearing caps are line bored. Before removing bearing caps, ensure all bearing caps are marked so they can be matched with their original position and location on cylinder block during installation. Installing the wrong cap in wrong position or location will damage engine.**	
1. Cylinder block (7)	Place in upside down position.	
2. Fourteen lockplates (1)	Bend edges down where necessary.	
3. Fourteen screws (8) and lockplates (1)	Remove from bearing caps (2) and cylinder block (7).	
	NOTE **When removing a bearing cap, hold onto the main bearing so it does not drop out of the bearing cap. Identify main bearing location with bearing cap.**	
4. Seven bearing caps (2)	Remove from cylinder block (7).	Use main bearing cap puller (3), (ST-1178).
5. Seven retaining rings (6)	Remove from cylinder block (7).	
6. Seven main bearing halves (4)	Remove from bearing caps (2).	Identify each for proper location.
7. Engine crankshaft (5)	Remove from cylinder block (7).	Use a hoist and hooks protected with a rubber hose or a lifting strap to remove engine crankshaft (5). Be careful not to damage surface of engine crankshaft (5).

3-31. ENGINE CRANKSHAFT AND MAIN BEARINGS REMOVAL (Contd)



LEGEND:

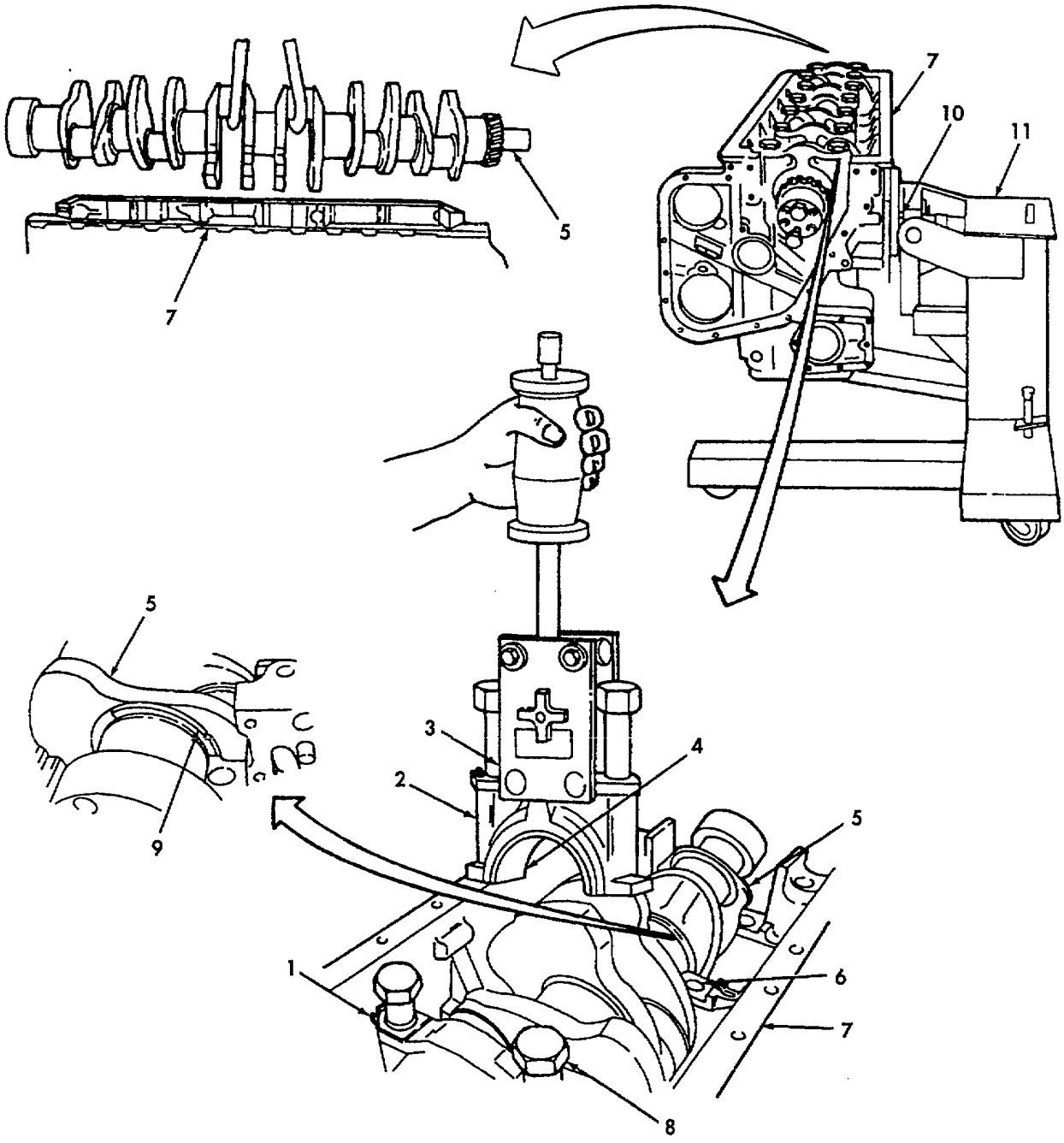
1. LOCKPLATE (14)
2. BEARING CAP (7)
3. MAIN BEARING CAP PULLER
4. MAIN BEARING HALF (4)
5. ENGINE CRANKSHAFT
6. RETAINING RING (7)
7. CYLINDER BLOCK
8. SCREW (14)
9. THRUST BEARING WASHER (4)

3-31. ENGINE CRANKSHAFT AND MAIN BEARINGS REMOVAL (Contd)

LOCATION/ITEM	ACTION	REMARKS
Removal (Contd)		
	NOTE **During thrust bearing washer removal, tag each thrust bearing washer to identify location.**	
8. Four thrust bearing washers (9)	Remove from engine crankshaft (5) and number seven main bearing cap (2).	
	NOTE **Tape the mating bearing halves together and label each pair and location for later reference.**	
9. Seven main bearing halves (4)	Remove from cylinder block (7).	Identify each with the previously removed bearing halves (4).
	NOTE **Prior to removing cylinder block from maintenance stand for cleaning, inspection, and repair, remove all cylinder block plugs and camshaft bushings.**	
10. Four mounting screws (10) and cylinder block (7)	Remove from maintenance stand (11).	Use a suitable chain and lifting device.

FOLLOW-ON TASKS:
- For repair of crankshaft (para. 3-37).
- For installation of engine crankshaft and main bearings (para. 3-68).

3-31. ENGINE CRANKSHAFT AND MAIN BEARINGS REMOVAL (Contd)



LEGEND:

1. LOCKPLATE (14)
2. BEARING CAP (7)
3. MAIN BEARING CAP PULLER
4. MAIN BEARING HALF (4)
5. ENGINE CRANKSHAFT
6. RETAINING RING (7)
7. CYLINDER BLOCK
8. SCREW (14)
9. THRUST BEARING WASHER (4)
10. MOUNTING SCREWS (4)
11. MAINTENANCE STAND

Section III. REPAIR

3-32. GENERAL

a. This section provides repair for the engine and all major components and subassemblies. The procedures are for the engine removed from the vehicle.

b. In cases where it may be necessary or more time-efficient to repair the engine while installed in vehicle, follow applicable portions of tasks contained in this section to remove part or component.

c. In task summary listed below, a complete list of special tools, test equipment, materials, parts, and related information required to perform engine repair is provided. To find a specific engine repair procedure contained in this section, see list of tasks below.

3-33. TASK SUMMARY

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Camshaft bushing driver kit (15434) 3376633
Liner driver (15434) ST-1229
Cylinder liner clamp (15434) ST-1184
Gauge block (15434) 3376220
Cylinder block
Counterbore tool (15434) 3375455
Camshaft bushing driver (15434) 3376637
Head holding fixture (15434) ST-583
Valve spring compressor (15434) ST-448
Fuel passage cleaning brush (15434) ST-876
Valve seat extractor (15434) S1-P27
Valve seat insert tool (15434) ST-257
Valve seat insert cutter (15434) ST-662
Valve guide arbor (15434) ST-663
Valve seat insert staking tool pilot (15434) ST-1124
Valve seat insert staking tool driver (15434) ST-1122
Dowel pin extractor (15434) ST-1134
Crosshead guide spacer (15343) ST-633
Valve guide driver (15434) 3375252
Injector sleeve puller (15434) ST-1244
Bead cutting tool (15434) ST-788
Injector seat cutting tool (15434) ST-824
Injector sleeve driver (15434) ST-1227
Injector sleeve holding tool (15434) ST-1179
Injector sleeve expander (15434) ST-880
Injector seat cutter (15434) ST-884
Valve spring tester (15434) 3375182
Expansion plug drivers (3/4-in.) (15434) 3375190
Expansion plug driver (1-in.) (15434) 3375191
Expansion plug driver (1-1/4 in.) (15434) 3375192
Valve vacuum tester (15434) ST-1257-A
Connecting rod bushing driver (15434) ST-1242
Connecting rod checking fixture (15434) ST-561
Connecting rod locating mandrel (15434) ST-563
Piston ring groove gauge (15434) ST-560
Rocker lever block and mandrel set (15434) ST-691
Spacer mandrel (15434) ST-1157
Air Fuel Control (AFC) pressure valve fixture (15434) 3376011
Puller (15434) 3376663
Solenoid valve wrench (75018) 011494
Air compressor mounting plate (15434) ST-749
Ball joint vise (15434) ST-302
Coupling half puller (15434) 337663
Air compressor bushing mandrel (15434) ST-1105
Injector stand (15434) ST-1298
Injector cup wrench (15434) ST-995
Crowfoot wrench (15434) ST-107
Injector adapter pot (15434) 3375086
Plug (15434) ST-669-14
Plunger extension (15434) ST-1089
Plunger bore plug assembly (15434) ST-668-5012
Test stand link (15434) ST-790-362
Master injector (15434) ST-1262
Conversion kit (15434) ST-1261
Top stop injector setting fixture (15434) 3375160
Fuel pump mounting plate (15434) 3375133
Pressurizing valve driver (15434) 3375959
Front cover and main shaft assembly tool kit (15434) 3375175
Oil seal assembly tool (15434) ST-419
Plunger protrusion checking tool (15434) ST-1241
AFC barrel puller (15434) 3375599
Ream fixture (15434) ST-490
Lock-cup driver (15434) 3376136
Fuel pump idle adjusting tool (15434) 3375981
AFC fuel pump adjusting tool kit (15434) 3375189
Throttle lever travel template (15434) 3375855
Bearing disassembly fixture (15434) ST-1114
Seal wear sleeve mandrel (15434) ST-1159
Water pump bearing mandrel (15434) ST-658
Oil seal driver(15434) ST-1191
Puller (15434) 3375257
Oil seal pilot(15434) 3375180
Water pump seal mandrel (15434) 3376091

3-33. TASK SUMMARY (Contd)

INITIAL SETUP (Cont):

TEST EQUIPMENT
Crack detection kit (15434) 3375432
Injector leakage tester (15434) ST-990
Injector test stand (15434) ST-790 or (05083) CD-3 (Refer to TM 9-4910-777-14&P)
Spray test fixture (15434) ST-668
Fuel injection tester 4910-00-817-7431

MATERIALS/PARTS
Solvent, SD-3 or suitable substitute (Appendix C, Item 30)
Oil, lubricating, OE/HDO 10 (Appendix C, Item 20)
Cloth, emery, 290-grit (Appendix C, Item 5)
Sealant, pipe (Appendix C, Item 26)
Sealant, cup plug (Appendix C, Item 25)
Oil, lubricating, OE/HDO 30 (Appendix C, Item 21)
Cloth, crocus (Appendix C, Item 4)
Oil, cutting (Appendix C, Item 18)
Compound, Prussian blue (Appendix C, Item 9)
Compound, Prussian blue (Appendix C, Item 2)
Sealant, thread (liquid) (Appendix C, Item 27)
Developer, spot-check, SKD-NF (Appendix C, Item 10)
Paper, aluminum oxide, 240-grit (Appendix C, Item 23)
Acid, muriatic (Appendix C, Item 1)
Acid, oxalic (Appendix C, Item 2)
Pyridene (Appendix C, Item 24)
Sodium carbonate (5 percent solution) (Appendix C, Item 28)
Compound, antiseize (Appendix C, Item 7)
Compound, lapping, 280-grit (Appendix C, Item 8)
Mineral spirits (Appendix C, Item 17)
Cloth, lint-free (Appendix C, Item 6)
Lubricant, high-pressure (Appendix C, Item 15)
Fluid, automatic transmission, type-A (Appendix C, Item 11)
Oil, fuel: diesel, regular (Appendix C, Item 19)
Fluid, calibration (Appendix C, Item 12)
Loctite (Appendix C, Item 14)
Six crevice seals (15434) 215090
Six black packing rings (15434) 3008998
Six red packing rings (15434) 183049
Six O-rings (15434) 3007442
Two water header cover gaskets (15434) D0089-1
Cup plug (15434) 3011952
Forty-eight valve collets (15434) 127554
Four O-ring seals (15434) 131026
3/4-in. expansion plug (15434) 213394
1-in. expansion plug (15434) 213395
Two 1-1/4 in. expansion plugs (15434) 216524
Injector assembly (15434) 3030445
Injector clamp (15434) 3028171
Two injector clamp screws (15434) 3028279
Injector O-ring seal (15434) 3007759
Rear main seal (15434) 211253
Rear cover gasket (15434) 40662-A
Six expansion plugs (15434) 213395
Two O-ring seals (15434) 3000521
Two expansion plugs (15434) 218736
Special expansion plug (15434) 61825
Gasket and seal kit (15434) 3801235
Oil pan gasket (15434) 3027983
O-ring seal (15434) 3029846
Cover gasket (15434) 3013778
Four O-rings (15434) 195952
Aftercooler cover gasket (15434) 216486 (M915A1/Big Cam III only)
Water outlet connection gasket (15434) 215044
Water inlet connection gasket (15434) 3032348
Bearing insert (15434) 170510
Two screws (15434) 194010
Four plain washers (15434) 5-631
Two clamp nuts (15434) 167299
Insulation packing (15434) 1672990277
Ring seal (15434) 154644
Two turbocharger seals (15434) 032836
O-ring (15434) 202456
Impeller nut (15434) 3-222A
Packing (15434) 215705
Accessory gear cover bushing (15434) 32770
Upper seal ring (15434) 001081
Center seal ring (15434) 001082
Lower seal ring (15434) 001083
Unloader valve O-ring (15434) 128086
Unloader cap seal (15434) 127936
Intake valve O-ring (15434) 211315
Exhaust valve O-ring (15434) 28085
Four lockwashers (15434) 5-605
Cover gasket (15434) 154996
Head gasket (15434) 54018
Piston ring kit (15434) AR-73350
Support gasket (15434) 76027
Four lockwashers (15434) 5-610
Rectangular ring seal (15434) 129888
Rectangular ring seal (15434) 154087
O-ring seal (15434) 90876
Four lockwashers (15434) 181466
Rectangular ring seal (15434) 139988
Rectangular ring seal (15434) 100099
Rectangular ring seal (15434) 151900
Rectangular ring seal (15434) 255622
Four lockwashers (15434) 181466
Gasket (15434) 110855
Gasket (15434) 3016683
Cover to fuel pump gasket (15434) 100764

3-33. TASK SUMMARY (Contd)

INITIAL SETUP (Contd):

MATERIALS/PARTS (Contd)
Tachometer drive seal (15434) 212603
Shaft seal (15434) 019962
Two O-rings (15434) 68061-A
O-ring (15434) 100478
Gasket washer (15434) 3023870
Bellows (15434) 3013811
O-ring (15434) 45505
O-ring (15434) 45504
O-ring (15434) 70775
O-ring (15434) 154088
O-ring (15434) 213768
Oil seal (15434) 203100
Seat and seal assembly (15434) 3028294
Oil seal (15434) 203101
O-ring (15434) 145506

PERSONNEL REQUIRED
Automotive repairman MOS 63H
Fuel and electrical system repairman MOS 63G

REFERENCES (TM)
TM 9-2320-283-20
TM 9-2320-273-20

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
- Refer to specific paragraph for this information.
- Refer to TM 9-4910-777-14&P.
- Refer to TM 9-4910-778-14&P.

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dust and dirt.

GENERAL SAFETY INSTRUCTIONS
- Always wear eye protection when using corn-pressed air.
- Eye protection required when removing control valve outer and inner springs. Eye protection required when removing slave piston retainer and spring.
- Diesel fuel is highly flammable. Do not perform fuel pump testing and calibration procedures near fire, flames, or sparks.
- Use toxic chemicals in well-ventilated area only. Always wear safety shield, gloves, etc.

List of Tasks

TASK PARA.	PROCEDURES	TASK REF.	TROUBLESHOOTING REF. NO. (PARA.)
1.	Engine Block Repair	3-34	2-8
	a. Disassembly	3-34a	
	b. Cleaning	3-34b	
	c. Inspection and Repair	3-34c	
	d. Assembly	3-34d	
2.	Cylinder Head and Valve Repair	3-35	2-8
	a. Disassembly	3-35a	
	b. Cleaning	3-35b	
	c. Inspection and Repair	3-35c	
	d. Assembly and Testing	3-35d	
3.	Vibration Damper and Crankshaft Pulley Repair	3-36	2-8
	a. Cleaning	3-36a	
	b. Inspection	3-36b	
4.	Crankshaft Repair	3-37	2-8
	a. Cleaning	3-37a	
	b. Inspection	3-37b	

3-33. TASK SUMMARY (Contd)

List of Tasks (Contd)

TASK PARA.	PROCEDURES	TASK REF.	TROUBLESHOOTING REF. NO. (PARA.)
5.	Flexplate or Flywheel, Flywheel Housing, and Rear Cover Repair	3-38	2-8
	a. Cleaning	3-38a	
	b. Inspection	3-38b	
6.	Piston, Connecting Rod, and Bearing Repair	3-39	2-8
	a. Disassembly	3-39a	
	b. Cleaning	3-39b	
	c. Inspection	3-39c	
	d. Assembly	3-39d	
7.	Camshaft, Cam Follower, and Pushrod Repair	3-40	2-8
	a. Disassembly	3-40a	
	b. Cleaning	3-40b	
	c. Inspection	3-40c	
	d. Assembly	3-40d	
8.	Rocker Levers and Housing Repair	3-41	2-8
	a. Disassembly	3-41a	
	b. Cleaning	3-41b	
	c. Inspection	3-41c	
	d. Assembly	3-41d	
9.	Oil Cooler Repair	3-42	2-8
	a. Disassembly	3-42a	
	b. Cleaning	3-42b	
	c. Inspection	3-42c	
	d. Assembly	3-42d	
10.	Oil Pan, Dipstick, Oil Suction Tubes, and Breather Tube Repair	3-43	2-8
	a. Disassembly	3-43a	
	b. Cleaning	3-43b	
	c. Inspection	3-43c	
	d. Assembly	3-43d	
11.	Oil Pump Repair	3-44	2-8
	a. Disassembly	3-44a	
	b. Cleaning	3-44b	
	c. Inspection	3-44c	
	d. Assembly	3-44d	

3-33. TASK SUMMARY (Contd)

List of Tasks (Contd)

TASK PARA.	PROCEDURES	TASK REF.	TROUBLESHOOTING REF. NO. (PARA.)
12.	Air Aftercooler Repair	3-45	2-8
	a. Disassembly	3-45a	
	b. Cleaning	3-45b	
	c. Inspection	3-45c	
	d. Assembly	3-45d	
13.	Exhaust Manifold Repair	3-46	2-8
	a. Disassembly	3-46a	
	b. Cleaning	3-46b	
	c. Inspection	3-46c	
	d. Assembly	3-46d	
14.	Turbocharger Repair	3-47	2-8
	a. Disassembly	3-47a	
	b. Cleaning and Inspection	3-47b	
	c. Assembly	3-47c	
15.	Front Gear Cover Repair	3-48	2-8
	a. Disassembly	3-48a	
	b. Cleaning	3-48b	
	c. Inspection	3-48c	
	d. Assembly	3-48d	
16.	Accessory Drive Repair	3-49	2-8
	a. Disassembly	3-49a	
	b. Cleaning	3-49b	
	c. Inspection	3-49c	
	d. Assembly	3-49d	
17.	Engine Retarder Repair	3-50	2-8
	a. Disassembly	3-50a	
	b. Testing	3-50b	
	c. Assembly	3-50c	
18.	Air Compressor Repair	3-51	2-8
	a. Disassembly	3-51a	
	b. Cleaning	3-51b	
	c. Inspection and Repair	3-51c	
	d. Assembly	3-51d	
19.	Fuel Injector Repair	3-52	2-8
	a. Disassembly	3-52a	
	b. Cleaning	3-52b	
	c. Inspection	3-52c	
	d. Assembly	3-52d	

3-33. TASK SUMMARY (Contd)

List of Tasks (Contd)

TASK PARA.	PROCEDURES	TASK REF.	TROUBLESHOOTING REF. NO. (PARA.)
20.	Fuel Injector Testing; Test No. 1	3-53	2-8
	a. Cup to Plunger Seal Test	3-53a	
	b. Check Ball Leakage Test	3-53b	
21.	Fuel Injector Testing; Test No. 2	3-54	2-8
	a. Setting Up Spray Pattern Tester	3-54a	
	b. Spray Pattern Test	3-54b	
22.	Fuel Injector Testing; Test No. 3	3-55	2-8
	a. Setting Up Test Stand	3-55a	
	b. Setting Up Injector on Test Stand	3-55b	
	c. Testing Check Ball Seating	3-55c	
	d. Adjusting and Measuring Fuel Delivery	3-55d	
	e. Top-stop Injector Adjustment	3-55e	
23.	Fuel Pump Repair	3-56	2-8
	a. Cleaning	3-56a	
	b. Inspection	3-56b	
24.	Solenoid Valve Repair	3-57	2-8
	a. Removal	3-57a	
	b. Disassembly	3-57b	
	c. Cleaning	3-57c	
	d. Inspection	3-57d	
	e. Assembly	3-57e	
	f. Installation	3-57f	
25.	Fuel Damper and Head Repair	3-58	2-8
	a. Removal	3-58a	
	b. Disassembly	3-58b	
	c. Cleaning	3-58c	
	d. Inspection	3-58d	
	e. Assembly	3-58e	
	f. Installation	3-58f	
26.	Fuel Gear Pump Repair	3-59	2-8
	a. Removal	3-59a	
	b. Disassembly	3-59b	
	c. Cleaning	3-59c	
	d. Inspection	3-59d	
	e. Assembly	3-59e	
	f. Installation	3-59f	

3-33. TASK SUMMARY (Contd)

List of Tasks (Contd)

TASK PARA.	PROCEDURES	TASK REF.	TROUBLESHOOTING REF. NO. (PARA.)
27.	Fuel Pump Governor Spring Repair	3-60	2-8
	a. Removal	3-60a	
	b. Cleaning	3-60b	
	c. Inspection	3-60c	
	d. Installation	3-60d	
28.	Fuel Pump Front Cover and Governor Repair	3-61	2-8
	a. Removal	3-61a	
	b. Disassembly	3-61b	
	c. Cleaning	3-61c	
	d. Inspection	3-61d	
	e. Assembly	3-61e	
	f. Installation	3-61f	
29.	Fuel Pump Main Housing Repair	3-62	2-8
	a. Disassembly	3-62a	
	b. Cleaning	3-62b	
	c. Inspection and Repair	3-62c	
	d. Assembly	3-62d	
30.	Fuel Pump Testing and Calibration	3-63	2-8
	a. Calibration Data	3-63a	
	b. Fuel Pump Nameplate Data	3-63b	
	c. Mounting Fuel Pump to Test Stand	3-63c	
	d. Fuel Pump Run-in	3-63d	
	e. Fuel Pump Vacuum and Seal Test	3-63e	
	f. Fuel Pump Vacuum Adjustment	3-63f	
	g. Governor Cut-off rpm Check	3-63g	
	h. Throttle Leakage Check	3-63h	
	i. Throttle Lever Travel Adjustment	3-63i	
	j. Fuel Pump Idle Speed Check	3-63j	
	k. Fuel Pump Main Pressure Adjustment	3-63k	
	l. Calibration Check Points	3-63l	
	m. AFC Plunger Setting Procedures	3-63m	
	n. No-Air Screw Adjustment	3-63n	
	o. Removing Fuel Pump from Test Stand	3-63o	
31.	Water Pump Repair	3-64	2-8
	a. Disassembly	3-64a	
	b. Cleaning	3-64b	
	c. Inspection	3-64c	
	d. Assembly	3-64d	

3-34. ENGINE BLOCK REPAIR

THIS TASK COVERS:

a. Disassembly
b. Cleaning
c. Inspection and Repair
d. Assembly

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Camshaft bushing driver kit (15434) 3376633
Cylinder sleeve driver (15434) ST-1229
Cylinder sleeve clamp (15434) ST-1154
Gauge block (15434) 3376220
Engine block counterbore tool (15434) 3375455
Bore alignment checking bar (15434) ST-1157

TEST EQUIPMENT
Crack detection kit (15434) 3375432

MATERIALS/PARTS
Solvent, SD-3 (Appendix C, Item 30)
Oil, lubricating, OE/HDO 10
(Appendix C, Item 20)
Cloth, emery, 290-grit (Appendix C, Item 5)
Sealant, pipe (Appendix C, Item 26)
Sealant, cup plug (Appendix C, Item 25)
Oil, lubricating, OE/HDO 30
(Appendix C, Item 21)
Silicone rubber (15434) MIL-A-46106
(NSN 8040-00-851-0211) or suitable substitute
Six gaskets (15434) 215090
Six black preformed packings (15434) 3008998
Six red preformed packings (15434) 183049
Six preformed packings (15434) 3007442
Two water header cover gaskets (15434) 70089-1

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
- Engine removed from vehicle (TM 9-2320-273-34 or TM 9-2320-283-34).
- Starter motor and solenoid removed (TM 9-2320-273-20 or TM 9-2320-283-20).
- Alternator, belts, and bracket removed (TM 9-2320-273-20 or TM 9-2320-283-20).
- Engine mounted on maintenance stand (para. 3-13).
- Vibration damper and crankshaft pulley removed (para. 3-14).
- Accessory drive pulley removed (para. 3-15).
- Fuel pump removed (para. 3-16).
- Air compressor removed (para. 3-17).
- Accessory drive housing assembly removed (para. 3-18).
- Oil pump removed (para. 3-19).
- Air aftercooler removed (para. 3-20).
- Engine retarders removed (para. 3-21).
- Rocker arm housing assemblies and pushrods removed (para. 3-22).
- Injector assemblies removed (para. 3-23).
- Cylinder head assemblies removed (para. 3-24).
- Flexplate or flywheel, flywheel housing, and rear cover removed (para. 3-25).
- Oil pan removed (para. 3-26).
- Front gear cover removed (para. 3-27).
- Camshaft and cam followers removed (para. 3-28).
- Pistons, connecting rods, and bearings removed (para. 3-29).
- Engine crankshaft and main bearings removed (para. 3-31).

SPECIAL ENVIRONMENTAL CONDITIONS
None

GENERAL SAFETY INSTRUCTIONS
- Improper cleaning methods and use of unauthorized cleaning solvents will not be used.
- Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa).

3-34. ENGINE BLOCK REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
a. Disassembly		
1. Six cylinder sleeves (2), cylinder sleeve shims (31 through 36), gasket (3), black preformed packing (4), and red preformed packing (5)	Remove from engine block (14) if not removed during engine disassembly.	Refer to para. 3-30.
2. Five plugs (7), four plugs (26), plug (27), washer (28), two plugs (29), and five plugs (30)	Remove from engine block (14) if not removed during engine disassembly.	
3. Fourteen screws (18), washers (17), and seven bearing caps (19), (20), and (21)	Remove from engine block (14) if installed after crankshaft removal.	Refer to para. 3-31.
4. Cap (25)	Remove from engine block (14).	Use a hammer and punch to remove. Discard cap (25).
b. Cleaning		

WARNING

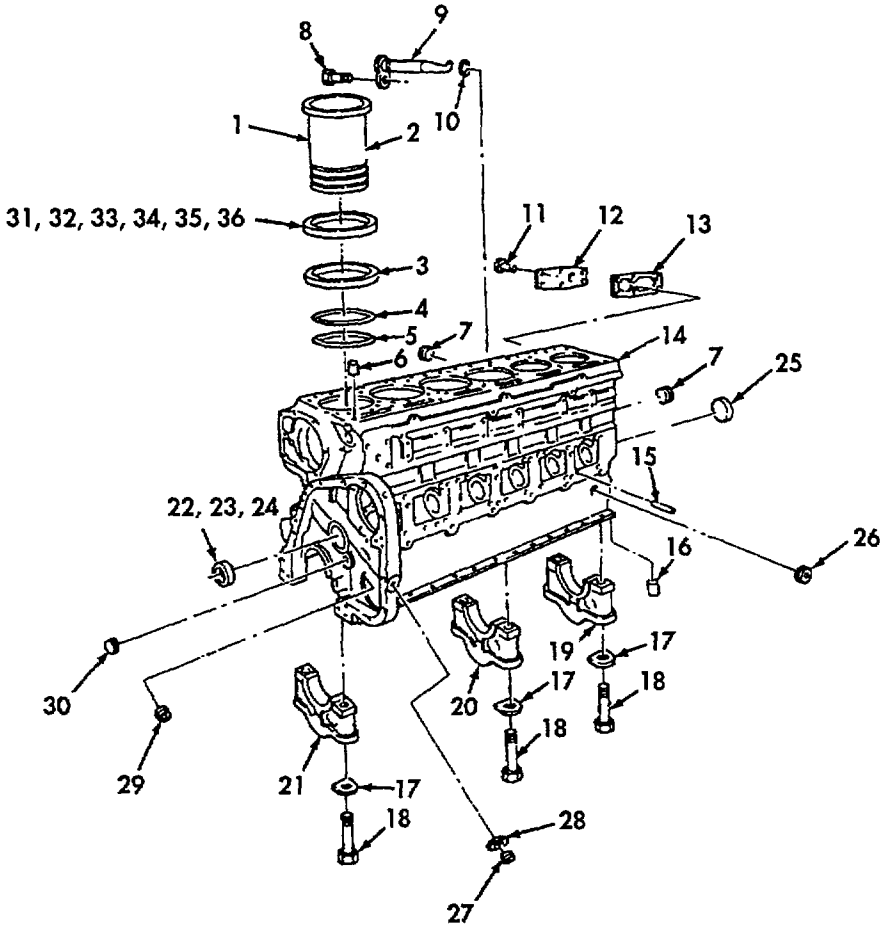
Approved solvents may be flammable and will not be used near open flame. Use only in well-ventilated area. Failure to comply may result in injury to personnel.

CAUTION

Do not immerse engine block in a hot cleaning solution without removing bearing sleeve and six camshaft bushings. Permanent damage to bearing sleeve and camshaft bearing surface will result.

5. Engine block (14)	Clean as follows:	
	a. Steam-clean exterior and interior surfaces. Clean area to be checked with SD-3 solvent.	Refer to para. 3-6. Scrape off any remaining gasket material from mating surfaces. Remove engine block (14) from maintenance stand if necessary (para. 3-13).
	b. Clean all oil and coolant passages.	Use suitable size brushes and extension rod to clear passages.
	c. Wire brush counterbore and lower bore.	Area where cylinder sleeves (2) are positioned.

3-34. ENGINE BLOCK REPAIR (Contd)



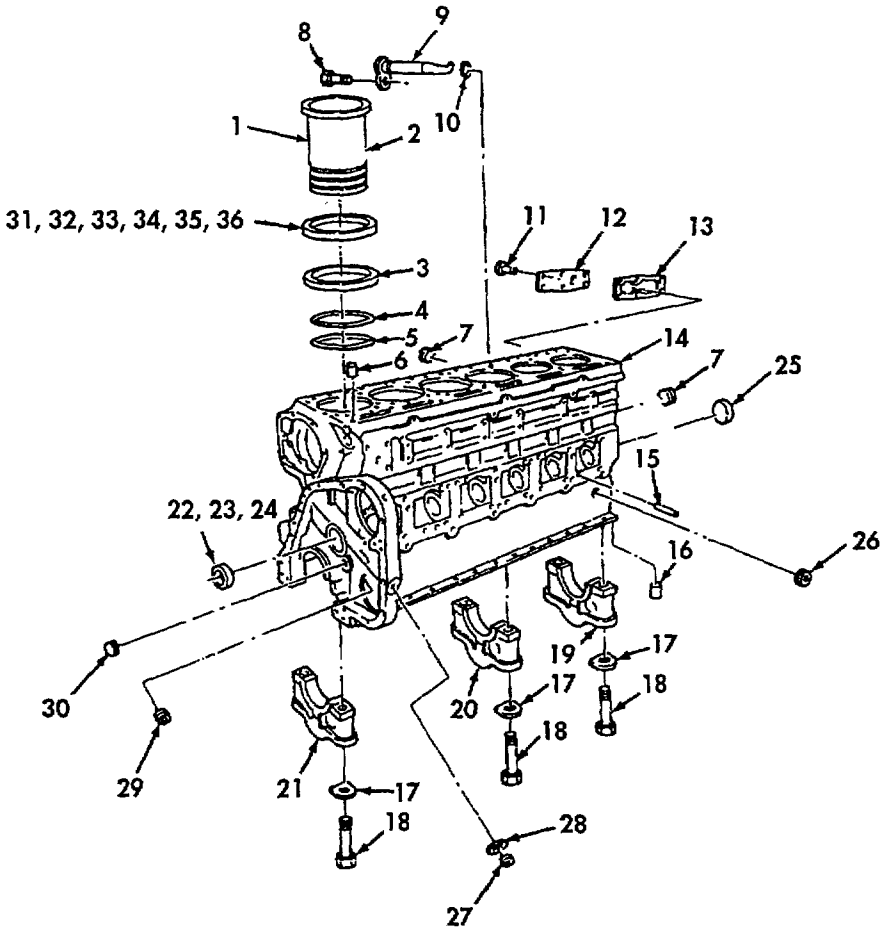
LEGEND:

1. CYLINDER SLEEVE ASSEMBLY (6)
2. CYLINDER SLEEVE (6)
3. GASKET (6)
4. BLACK PREFORMED PACKING (6)
5. RED PREFORMED PACKING (6)
6. HEAD-TO-BLOCK PIN (6)
7. PLUG (5)
8. SELF-LOCKING SCREW (6)
9. PISTON COOLING NOZZLE (6)
10. PREFORMED PACKING (6)
11. CAPTIVE WASHER SCREW (12)
12. WATER HEADER COVER (2)
13. GASKET (2)
14. ENGINE BLOCK
15. CAM FOLLOWER PIN (6)
16. REAR MAIN BEARING-TO-BLOCK PIN (2)
17. WASHER (14)
18. SCREW (14)
19. NO. 7 BEARING CAP
20. NO. 2, 4, AND 6 BEARING CAP (3)
21. NO. 1, 3, AND 5 BEARING CAP (3)
22. NO. 7 BEARING SLEEVE
23. NO. 1, 2, 4, AND 6 CAMSHAFT BUSHING (4)
24. NO. 3 AND 5 CAMSHAFT BUSHING (2)
25. CAP
26. PLUG (4)
27. PLUG
28. WASHER
29. PLUG (2)
30. PLUG (5)
31. CYLINDER SLEEVE SHIM 0.007
32. CYLINDER SLEEVE SHIM 0.008
33. CYLINDER SLEEVE SHIM 0.009
34. CYLINDER SLEEVE SHIM 0.020
35. CYLINDER SLEEVE SHIM 0.031
36. CYLINDER SLEEVE SHIM 0.062

3-34. ENGINE BLOCK REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
b. Cleaning (Contd)		
5. Engine block (14) (Contd)		
	WARNING **Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and protective equipment such as goggles or shield, gloves, etc. Failure to comply may result in injury to personnel.**	
	d. Clean water pump cavity vent hole in No. 1 cylinder.	Use compressed air.
	e. Clear all dirt and cleaning solvent from threaded screw holes and areas of bearing sleeve (22) and camshaft bushings (23) and (24).	Use compressed air.
	f. Remove all scale from cylinder sleeve (2) counterbore area.	
6. Six cylinder sleeves (2)	Clean as follows:	
	a. Clean with warm water and soap.	Use a bristle brush.
	b. Clean soap from cylinder sleeves (2) with steam.	Dry with compressed air.
	c. Apply a thick coat of OE/HDO 10 lubricating oil on inside bore of each and wait 10 minutes.	
	d. Remove oil with clean paper towels. Clean each bore until no black or gray marks are on paper towel.	
	e. Apply a light coat of OE/HDO 10 lubricating oil to each and set aside for inspection.	
7. All remaining parts	Clean with SD-3 solvent and dry.	Scrape off any remaining gasket material from mating surfaces. Dry with compressed air.

3-34. ENGINE BLOCK REPAIR (Contd)



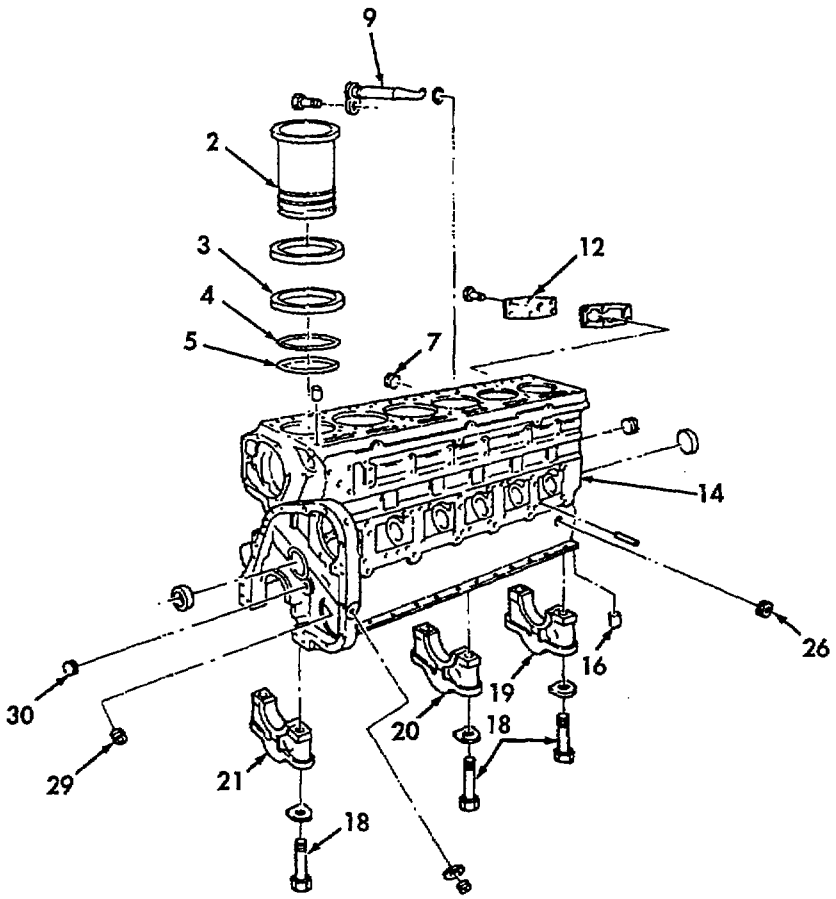
LEGEND:

1. CYLINDER SLEEVE ASSEMBLY (6)
2. CYLINDER SLEEVE (6)
3. GASKET (6)
4. BLACK PREFORMED PACKING (6)
5. RED PREFORMED PACKING (6)
6. HEAD-TO-BLOCK PIN (6)
7. PLUG (5)
8. SELF-LOCKING SCREW (6)
9. PISTON COOLING NOZZLE (6)
10. PREFORMED PACKING (6)
11. CAPTIVE WASHER SCREW (12)
12. WATER HEADER COVER (2)
13. GASKET (2)
14. ENGINE BLOCK
15. CAM FOLLOWER PIN (6)
16. REAR MAIN BEARING-TO-BLOCK PIN (2)
17. WASHER (14)
18. SCREW (14)
19. NO. 7 BEARING CAP
20. NO. 2, 4, AND 6 BEARING CAP (3)
21. NO. 1, 3, AND 5 BEARING CAP (3)
22. NO. 7 BEARING SLEEVE
23. NO. 1, 2, 4, AND 6 CAMSHAFT BUSHING (4)
24. NO. 3 AND 5 CAMSHAFT BUSHING (2)
25. CAP
26. PLUG (4)
27 PLUG
28. WASHER
29. PLUG (2)
30. PLUG (5)
31. CYLINDER SLEEVE SHIM 0.007
32. CYLINDER SLEEVE SHIM 0.008
33. CYLINDER SLEEVE SHIM 0.009
34. CYLINDER SLEEVE SHIM 0.020
35. CYLINDER SLEEVE SHIM 0.031
36. CYLINDER SLEEVE SHIM 0.062

3-34. ENGINE BLOCK REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection and Repair		
	CAUTION **Cylinder sleeves do not require honing or deglazing to provide proper ring seating. To minimize damage, liner deglazing and honing are not recommended.**	
8. Six cylinder sleeves (2)	Inspect for the following:	Refer to Appendix F for wear limits.
	a. Check for cracks under top flange, at bottom of liner, and above grooves of preformed packings (4) and (5), and gasket (3).	Cracks can be checked by using magnetic method or by using crack detector dye. Discard if cracked.
	b. Check for excessive corrosion or erosion and pits.	Discard if pits are deeper than 1/16 in. (1.6 mm).
	c. Check underside of top flange for dents, pitting, or worn surfaces.	Discard if surface cannot be made smooth by lapping with medium grit emery cloth.
	d. Check diameter of inside bore at several places.	Discard if inside diameter is greater than 5.505 in. (139.827 mm). Use a suitable dial bore gauge.
	NOTE **Piston cooling nozzles and water header covers were removed in para. 3-13.**	
9. Six piston cooling nozzles (9)	Inspect for cracks, chips, or distortion.	Discard if cracked, chipped, or distorted.
10. Two water header covers (12)	Inspect for cracks, excessive corrosion, or distortion.	Discard if cracked, corroded, or distorted.
11. Five plugs (7), four plugs (26), two plugs (29), and five plugs (30)	Inspect threads for damage.	Discard if damaged.
12. No. 7 bearing cap (19)	Inspect two rear main bearing-to-block pins (16) for damage.	Replace rear main bearing-to-block pins (16) if damaged. Remove by pulling out with gripping pliers. Install by tapping in.
13. Bearing cap (19), and three bearing caps (20) and (21)	Measure width of each and compare measurement with corresponding bearing support area of engine block (14).	Discard if width exceeds 0.004 in. (0.1016 mm).
14. Fourteen screws (18)	Inspect for stretched or damaged threads.	Discard if stretched or damaged.

3-34. ENGINE BLOCK REPAIR (Contd)



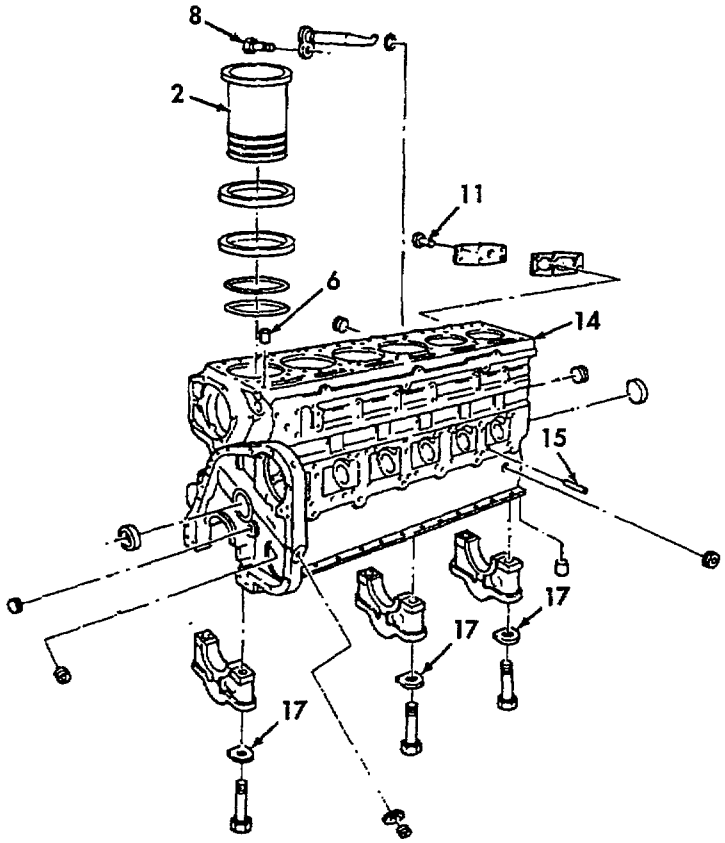
LEGEND:

2. CYLINDER SLEEVES (6)
3. GASKET (6)
4. BLACK PREFORMED PACKING (6)
5. RED PREFORMED PACKING (6)
7. PLUG (5)
9. PISTON COOLING NOZZLE (6)
12. WATER HEADER COVER (2)
14. ENGINE BLOCK
16. REAR MAIN BEARING-TO-BLOCK PIN (2)
18. SCREW (14)
19. NO. 7 BEARING CAP
20. NO. 2, 4, AND 6 BEARING CAP (3)
21. NO. 1, 3, AND 5 BEARING CAP (3)
26. PLUG (4)
29. PLUG (2)
30. PLUG (5)

3-34. ENGINE BLOCK REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection and Repair (Contd)		
15. Fourteen washers (17)	Inspect carefully for any cracks or indication of cracks.	Discard if any evidence or indication of cracks exist.
16. Six self-locking screws (8) and twelve captive washer screws (11)	Inspect threads for damage.	Discard if damaged.
	NOTE **Ensure engine block is checked on a flat surface to prevent distortion. Do not inspect engine block on maintenance stand.**	
17. Engine block (14)	Inspect for the following:	
	a. Check for wear or damage.	Discard if damage is beyond repair.
	b. Check for cracks.	Clean area to be checked with SD-3 solvent. Use crack detection kit (3375432) to find cracks.
	c. Check for corrosion.	Check for corrosion on engine block (14) near cylinder sleeves (2). Discard if counterbore area cannot be cleaned or repaired.
	d. Check for flatness.	Check with straightedge and feeler gauge. If milling is required and 0.01-0.02 in. (0.25-0.51 mm) of metal is removed from top of engine block (14), use oversize gasket (3036126) to maintain correct distance between cylinder head and engine block (14).
	e. Inspect all threads.	Repair with suitable thread chaser. Use solid bushing-type thread insert for damaged cylinder head screw threads, and Heli-Coil insert for damaged main bearing screw threads.
	f. Check for wear or damage in area of six head-to-block pins (6).	Replace if damaged or worn.
	g. Check for wear or damage in area of six cam follower pins (15).	Replace if damaged or worn.

3-34. ENGINE BLOCK REPAIR (Contd)



LEGEND:

2. CYLINDER SLEEVES (6)
6. HEAD-TO-BLOCK PIN (6)
8. SELF-LOCKING SCREW (6)
11. CAPTIVE WASHER SCREW (12)
14. ENGINE BLOCK
15. CAM FOLLOWER PIN (6)
17. WASHER (14)

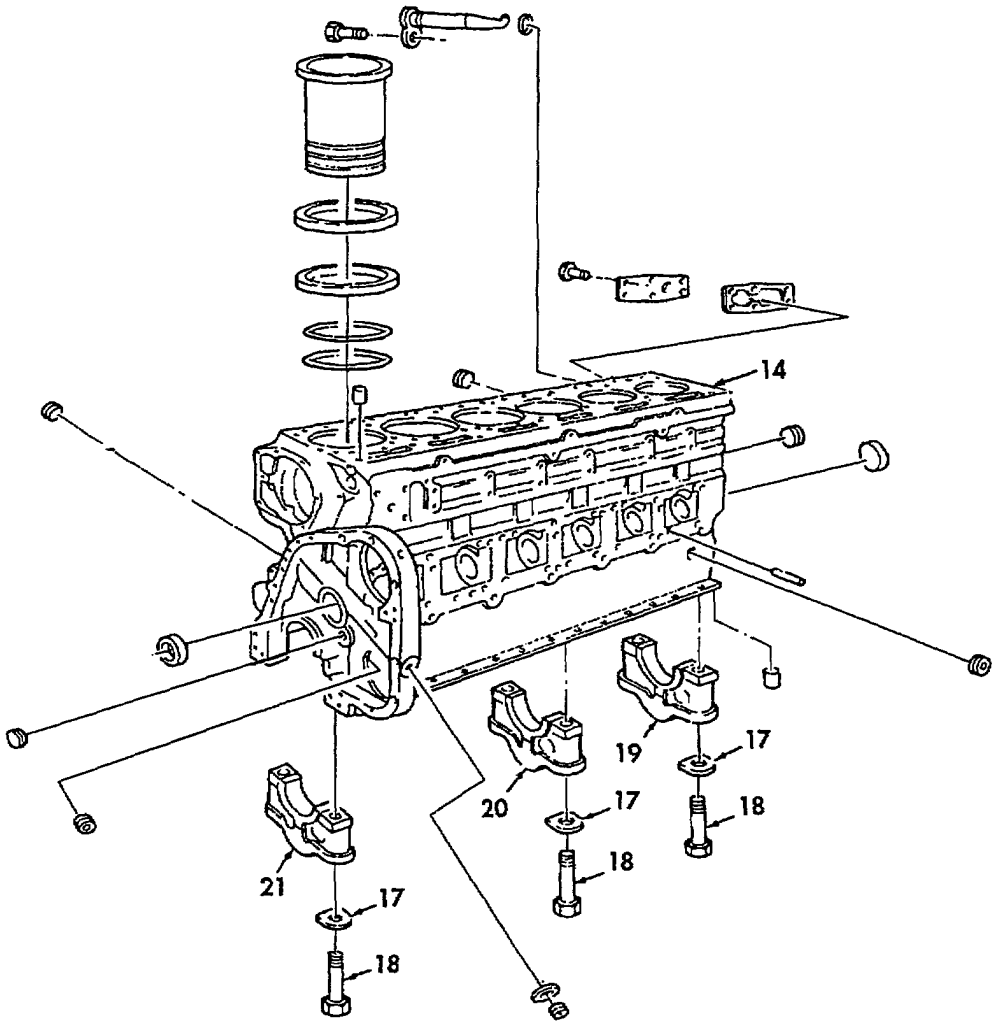
3-34. ENGINE BLOCK REPAIR (Contd)

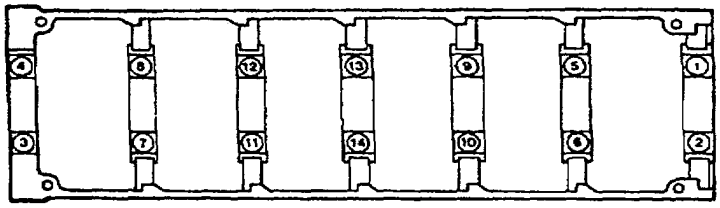
LOCATION/ITEM	ACTION	REMARKS
c. Inspection and Repair (Contd)		
18. Bearing cap (19), three bearing caps (20) and (21), fourteen washers (17), and screws (18)	Install on engine block (14) and tighten as follows: a. Tighten fourteen screws (18) to 85 lb-ft (115 N•m) in sequence shown. Then tighten each screw (18) to 250-260 lb-ft (339-353 N•rn). b. Loosen fourteen screws (18) three to five threads or a minimum of three complete turns. c. Repeat step 18a.	Ensure bearing caps (19), (20), and (21) are in their correct location and position.
19. Bores of installed bearing caps (19), (20), and (21) of engine block (14)	Install bore alignment checking bar. Measure bore diameter of each at three different locations.	Use bore alignment checking bar (ST-1157). For greater accuracy, place engine block (14) on end before measuring bore diameter. Minimum bore is 4.7485 in. (120.6119 mm); maximum is 4.7505 in. (120.6627 mm). Discard if maximum is exceeded.

CAUTION
Never use reamer in place of a check bar. Damage to cylinder block will result.

20. Bore alignment of installed bearing caps (19), (20), and (21) of engine block (14)	a. Install suitable bore alignment checking bar. Inspect for burrs or slight binding.	Bore alignment checking bar (ST-1157) should turn freely. Remove burrs with emery cloth. If a slight bind exists, perform step b.
	b. If necessary, remove 0.0002-0.003 in. (0.0051-0.076 mm) of stock from bottom milled surface of the main bearing caps which are out of alignment. Remove stock by lapping or surface grinding.	If alignment cannot be obtained, refer to step 21 and ream bore of installed bearing caps (19), (20), and (21).

3-34. ENGINE BLOCK REPAIR (Contd)





MAIN BEARING CAP TIGHTENING SEQUENCE

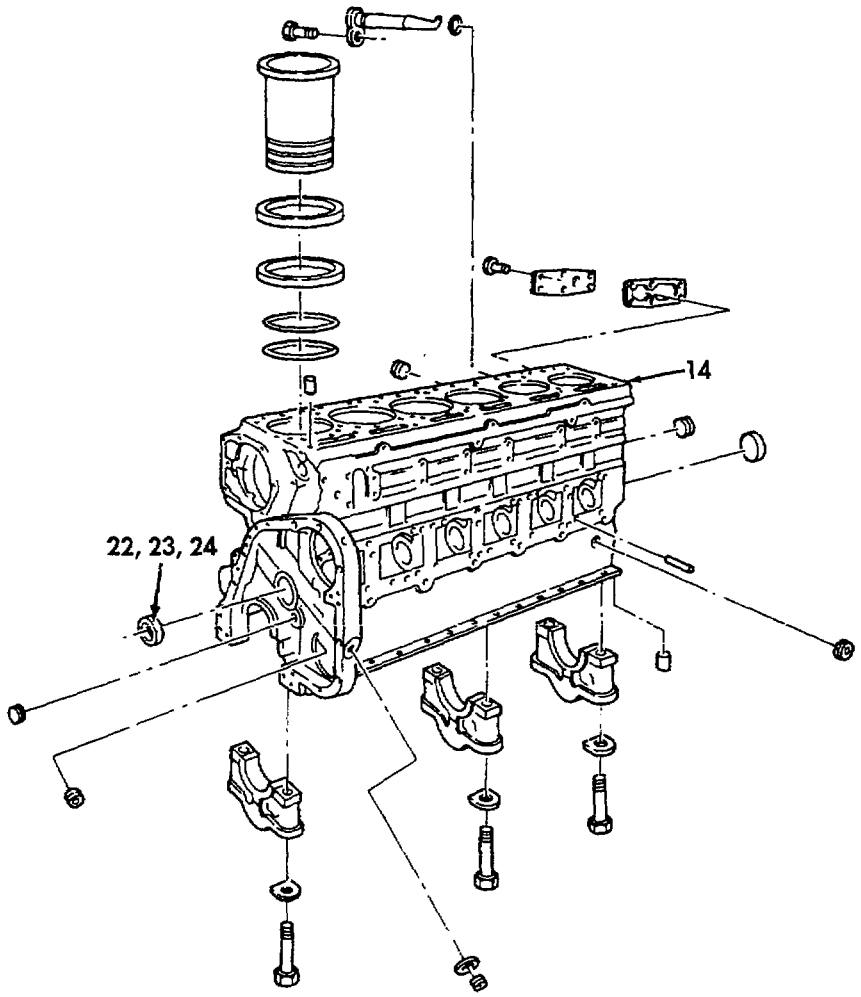
LEGEND:

14. ENGINE BLOCK
17. WASHER (14)
18. SCREW (14)
19. NO. 7 BEARING CAP
20. NO. 2, 4, AND 6 BEARING CAP (3)
21. NO. 1, 3, AND 5 BEARING CAP (3)

3-34. ENGINE BLOCK REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection and Repair (Contd)		
	NOTE • **Omit this step if replacement caps are being used.** • **Reaming of bearing cap bore requires bearing caps be installed and tightened to specifications.**	
21. Bearing cap bore of engine block (14)	Use suitable reamer; ream as follows:	
	a. Position reamer bar on engine block (14) so rear of bar is piloted in two good bearing cap bores.	
	b. Lubricate reamer with OE/HDO 10 lubricating oil.	
	c. Use hand driver to turn reamer.	
	d. Run reamer through all seven bearing cap bores without backing up or reversing.	
	e. Check bearing cap bore with checking bar and measure diameter with dial indicator.	Clean block thoroughly after reaming.
22. No. 7 bearing sleeve (22), four camshaft bushings (23), and two camshaft bushings (24)	Inspect for the following: a. Chips, scoring, or scratches.	Replace if scratched, scored, or chipped. Proceed to step 23 for removal.
	b. Spun or turned within bore of engine block (14).	If camshaft bushings have turned, oil passages will not be aligned. Remove and discard any camshaft bushing that has spun or turned. Proceed to step 23 for removal.
	c. Using inside micrometer or dial bore gauge, measure each inside diameter.	Refer to Appendix F for wear limits. Mark each camshaft bushing for replacement if not within wear limits. Proceed to step 23 for removal.

3-34. ENGINE BLOCK REPAIR (Contd)

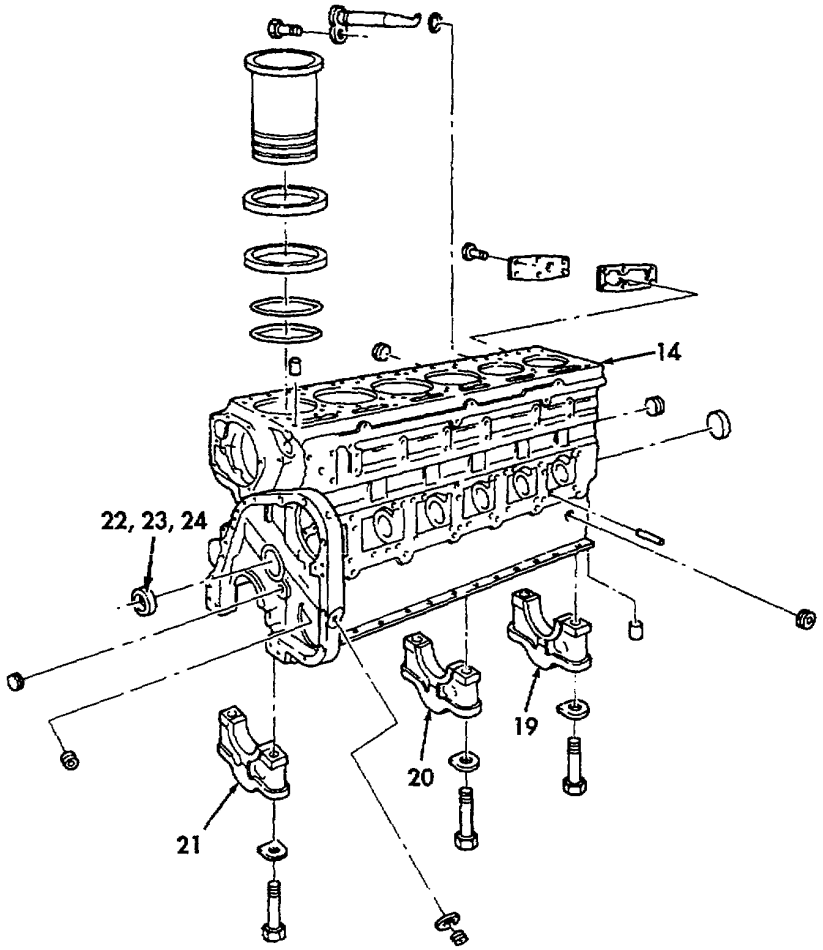


LEGEND:
14. ENGINE BLOCK
22. NO. 7 BEARING SLEEVE
23. NO. 1, 2, 4, AND 6 CAMSHAFT BUSHING (4)
24. NO. 3 AND 5 CAMSHAFT BUSHING (2)

3-34. ENGINE BLOCK REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection and Repair (Contd)		
23. No. 7 bearing sleeve (22), four camshaft bushings (23), or two camshaft bushings (24)	Remove from engine block (14).	Use camshaft bushing driver kit (3376633). Discard after removal.
	NOTE **Before installation of bearing sleeve and camshaft bushing(s), inspect camshaft bushing bore of cylinder block.**	
24. Camshaft bushing bore in engine block (14)	Inspect for the following:	Refer to Appendix F for wear limits.
	a. Check for burrs or nicks.	Remove with medium-grit emery cloth.
	b. Check for concentricity of camshaft bushing bore.	Use suitable measuring device.
	c. Open and clean oil passages.	Clean with suitable brush.
25. No. 7 bearing sleeve (22), four camshaft bushings (23), or two camshaft bushings (24)	Install on camshaft bushing bore of engine block (14) as follows:	
	a. Ensure oil passages are open in camshaft bushing bore.	
	b. Ensure there are no burrs in camshaft bushing bore of engine block (14).	
	c. Install with oil holes aligned to holes in camshaft bushing bores.	Use camshaft bushing driver kit (3376633). Apply a light coat of OE/HDO 10 lubricating oil to inside diameter of No. 7 bearing sleeve (22), camshaft bushing (23) or (24) after installation.
	d. The alignment notch on No. 7 bearing sleeve (22) must align with oil drain opening in No. 7 camshaft bushing bore.	

3-34. ENGINE BLOCK REPAIR (Contd)



LEGEND:
14. ENGINE BLOCK
22. NO. 7 BEARING SLEEVE
23. NO. 1, 2, 4, AND 6 CAMSHAFT BUSHING (4)
24. NO. 3 AND 5 CAMSHAFT BUSHING (2)

3-34. ENGINE BLOCK REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection and Repair (Contd)		
26. Cylinder liner counterbore of engine block (14)	Inspect for the following:	
	a. Check for dirty or rough edges.	Remove trapped dirt and clean rough edges.
	b. Check inside diameter and depth at four equally spaced positions. Refer to Appendix F for wear limits.	Counterbore diameter must be measured in liner press fit area 0.100 in. (2.54 mm) maximum below deck. Repair and shim cylinder liner counterbore if the following conditions are not met. Refer to step 27 for counterbore repair. a. Difference in measurement around circumference must not exceed 0.001 in. (0.0254 mm). b. Ledge must be parallel with top of engine block (14) to within 0.0014 in. (0.0356 mm).

NOTE

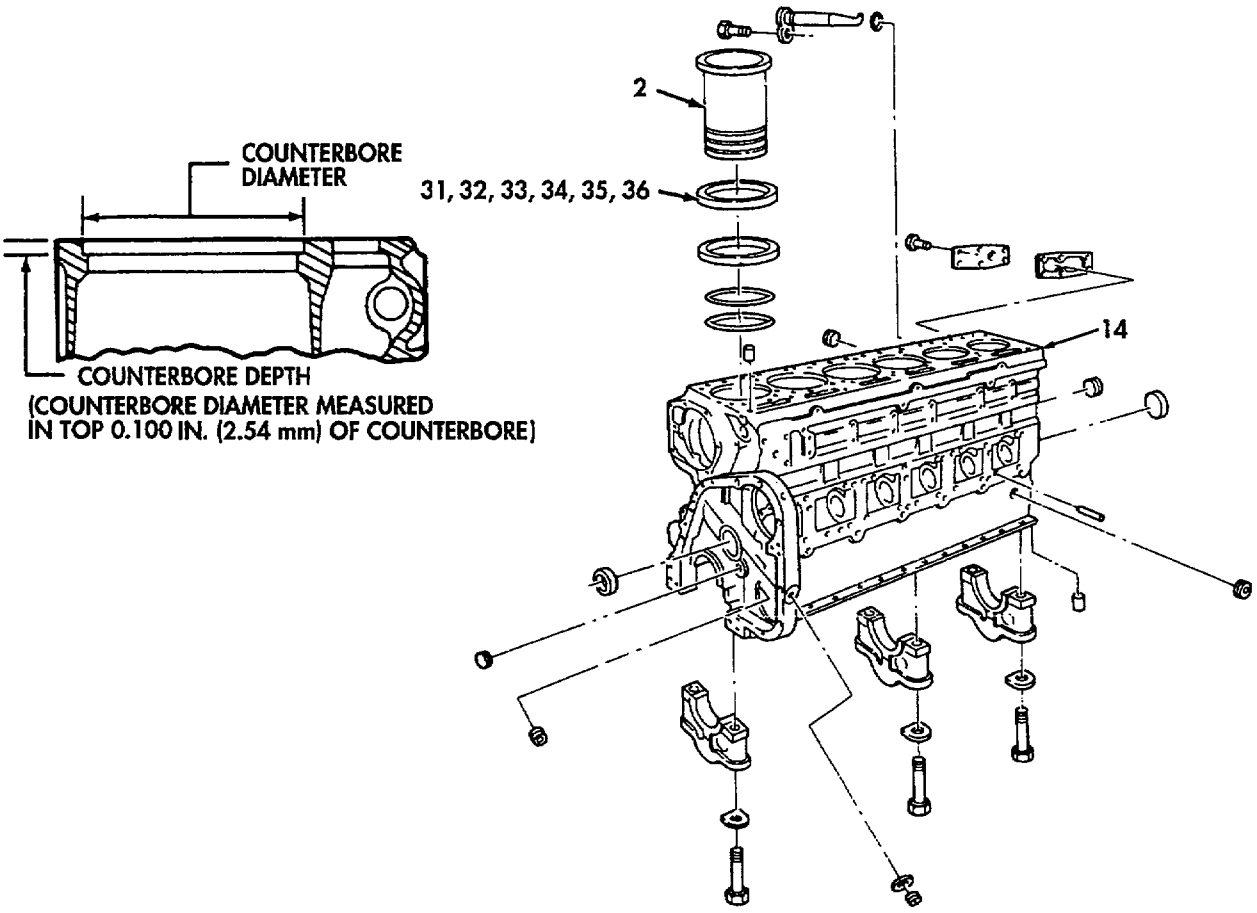
When checking cylinder liner protrusion, ensure shim(s) and cylinder sleeve correspond to cylinder being inspected as tagged during removal.

	c. Check cylinder sleeve (2) protrusion. Measure depth of cylinder sleeve counterbore of engine block (14) and outside flange of cylinder sleeve (2) for corresponding cylinder. Subtract difference to determine amount of shims and/or depth of counterbore cut.	Installing cylinder sleeve (2) is not necessary. Cylinder sleeve shims (31), (32), (33), (34), (35), and (36) are available in the following thicknesses: 0.007, 0.008, 0.009, 0.020, 0.031, and 0.062 in.

NOTE

Cylinder head surface of engine block must be flat and without damage or distortion. Use a straightedge and a 0.002-in. feeler gauge to check cylinder head surface.

3-34. ENGINE BLOCK REPAIR (Contd)

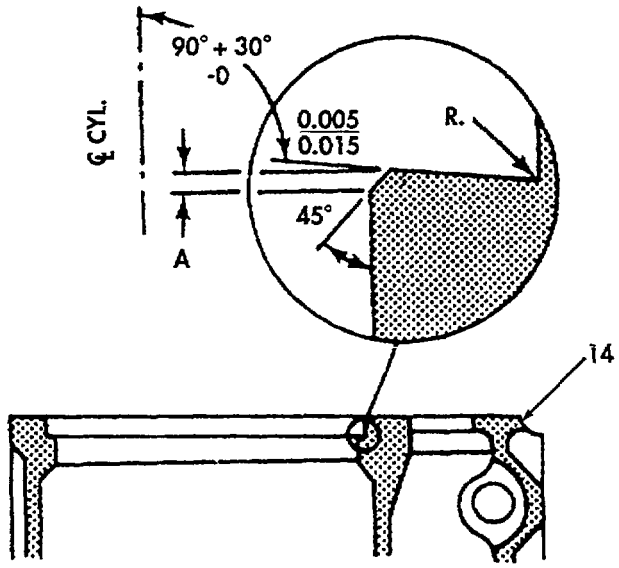


LEGEND:

2. CYLINDER SLEEVE (6)
14. ENGINE BLOCK
31. CYLINDER SLEEVE SHIM 0.007
32. CYLINDER SLEEVE SHIM 0.008
33. CYLINDER SLEEVE SHIM 0.009
34. CYLINDER SLEEVE SHIM 0.020
35. CYLINDER SLEEVE SHIM 0.031
36. CYLINDER SLEEVE SHIM 0.062

3-34. ENGINE BLOCK REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection and Repair (Contd)		
	NOTE **The cylinder sleeve counterbore must be altered or repaired if:** **a. Material has been milled from top surface of cylinder block.** **b. Ledge of counterbore is not flat or even.** **c. Protrusion of cylinder liner is not correct.** **d. Cracks extend more than halfway out from radius.**	
27. Cylinder sleeve counterbore of engine block (14)	Repair as follows:	
	a. Position adapter plate on cylinder sleeve counterbore.	Use engine block counterbore tool (3375455). Check counterbore tool bit before boring operation. A correctly ground tool bit will leave counterbore surface completely flat or cupped to a 30-degree angle. The cup is preferred with a 0.005-0.015-in. (0.127-0.381-mm) radius as shown in cylinder sleeve counterbore cross section.
	b. Tighten top and bottom locating pins by turning in screws.	
	c. Set tool adjustable sleeve so blade just contacts bottom of counterbore ledge.	



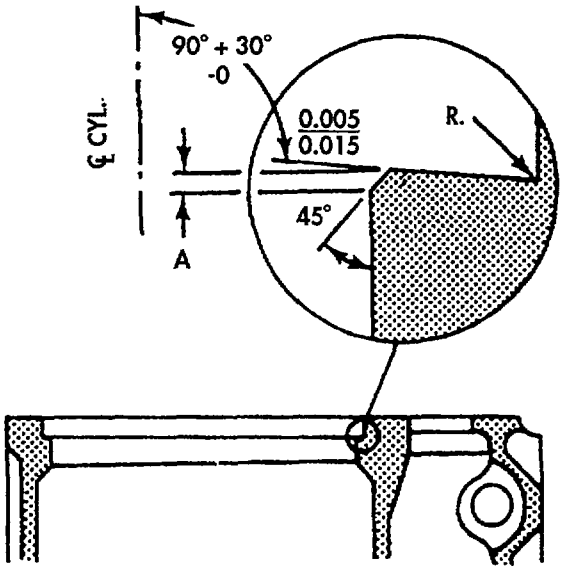
CYLINDER SLEEVE COUNTERBORE CROSS SECTION

LEGEND:
14. ENGINE BLOCK

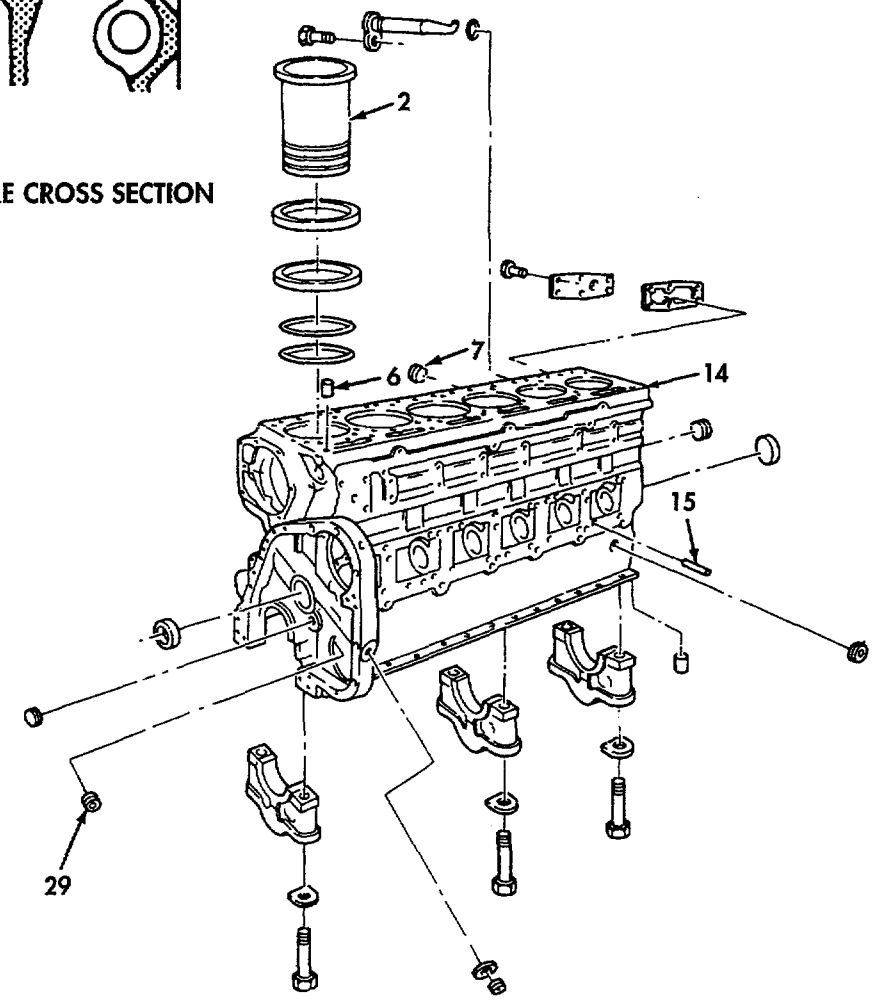
3-34. ENGINE BLOCK REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection and Repair (Contd)		
27. Cylinder sleeve counterbore of engine block (14) (Contd)		
	CAUTION • **Never turn counterbore tool counterclockwise. Doing so will damage cutter blade.** • **Do not remove more than a total of 0.062 in. (1.575 mm) of material when counterboring. Inside diameter of ledge should never be less than outside diameter of cylinder sleeve. A ledge that drops toward center of cylinder may cause cylinder sleeve to break during installation.**	
	d. Turn counterbore tool clockwise with even pressure.	
	e. Use a series of light cuts to clean up entire circumference of seat.	Do not remove more than 0.004 in. (0.102 mm) material per cut.
	f. Check seat to determine if additional cuts are required.	
	g. Chamfer edge of counterbore ledge 45° after counterboring. Do not chamfer deeper than 0.013-0.024 in. (0.330-0.610 mm).	Use shims to compensate for metal removed and to restore cylinder sleeve (2) protrusion to 0.003-0.006 in. (0.076-0.152 mm). Use as few shims as possible. Where possible, use one thick shim in place of two or more thinner shims.
	h. Remove counterboring tool.	
28. Six cam follower pins (15)	Inspect for wear or damage.	Replace if worn or damaged. Force may be required to remove cam follower pins (15). They are a press fit. Install using a brass hammer.
29. Six head-to-block pins (6)	Inspect for wear or damage.	Replace if worn or damaged. Force may be required to remove head-to-block pins (6). They are a press fit. Install using a brass hammer.
d. Assembly		
	NOTE • **Assembly steps 30 through 34 will to be completed prior to mounting engine block on maintenance stand.** • **Apply pipe sealant to threads of plugs installed for water passages, and apply lubricating oil to plugs installed for oil galleys.**	
30. Plug (7)	Install on engine block (14).	Tighten to 30 lb-ft (41 N•m).
31. Two plugs (29)	Install on engine block (14).	Balance of plugs are on opposite side of block. Tighten to 45 lb-ft (61 N•m).

3-34. ENGINE BLOCK REPAIR (Contd)



CYLINDER SLEEVE COUNTERBORE CROSS SECTION



LEGEND:

2. CYLINDER SLEEVE (6)
6. HEAD-TO-BLOCK PINS (6)
7. PLUG
14. ENGINE BLOCK
15. CAM FOLLOWER PINS (6)
29. PLUG (2)

3-34. ENGINE BLOCK REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Assembly (Contd)		
32. Four plugs (26)	Install on engine block (14).	Balance of plugs are on opposite side of block. Tighten to 15 lb-ft (20 N•m).
33. Five plugs (30)	Install on engine block (14).	Tighten plugs (30) to 35 lb-ft (48 N•m). One is shown; four are on opposite side of block.
34. Plug (27) and washer (28)	Install on engine block (14).	Tighten plug (27) to 70 lb-ft (95 N•m). When step 34 is completed, mount engine block (14) on suitable maintenance stand.

CAUTION

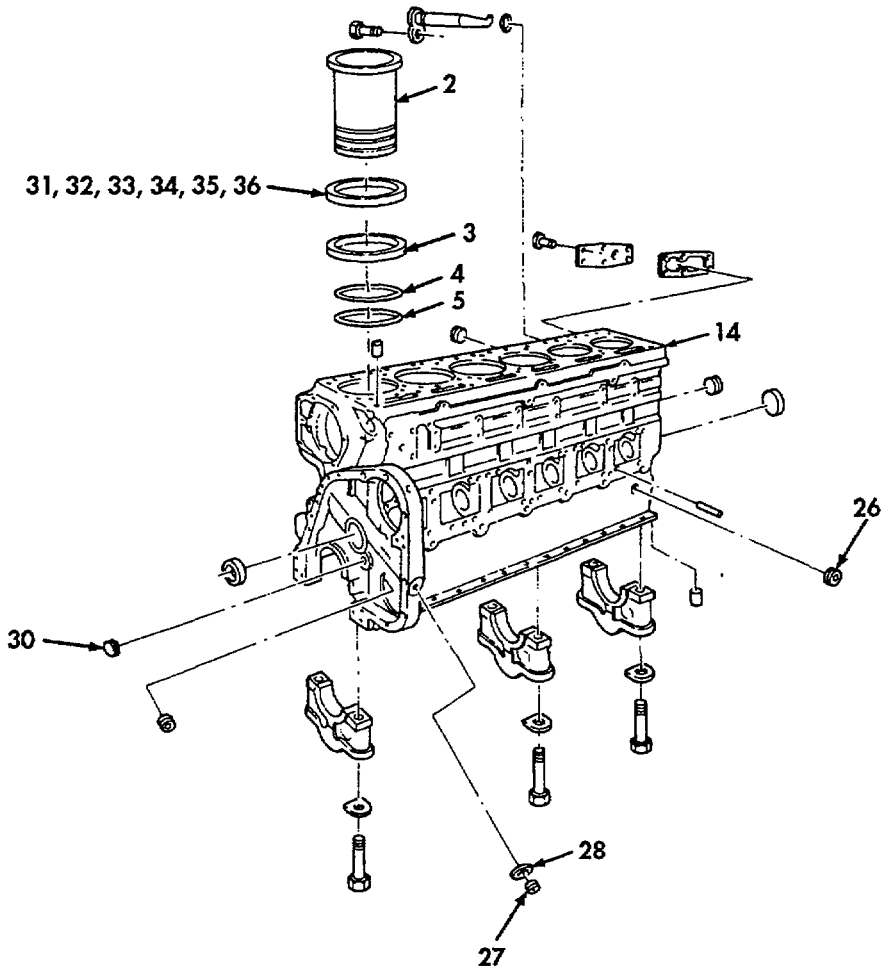
- **Prior to installation, engine block counterbore must be free of sharp edges that would cut or damage cylinder sleeve preformed packings.**
- **If engine block counterbore and cylinder sleeve flange are not clean and free from oil prior to installation, improper sealing or protrusion may result.**

NOTE

Before final installation of cylinder sleeves, ensure protrusion of each cylinder sleeve is correct. Refer to step 26 for checking protrusion.

35. Cylinder sleeve shims (31) through (36)	Install on cylinder sleeve (2) as required.	Amount of shims required was determined during inspection.
36. New gasket (3), new black preformed packing (4), and new red preformed packing (5)	Install on cylinder sleeve (2).	Install new gasket (3) with chamfer down in top groove, new black preformed packing (4) on center groove, and new red preformed packing (5) on bottom groove. Repeat this step for remaining cylinder sleeves (2).

3-34. ENGINE BLOCK REPAIR (Contd)



LEGEND:

2. CYLINDER SLEEVE (6)
3. GASKET (6)
4. BLACK PREFORMED PACKING (6)
5. RED PREFORMED PACKING (6)
14. ENGINE BLOCK
26. PLUG (4)
27. PLUG
28. WASHER
30. PLUG (5)
31. CYLINDER SLEEVE SHIM 0.007
32. CYLINDER SLEEVE SHIM 0.008
33. CYLINDER SLEEVE SHIM 0.009
34. CYLINDER SLEEVE SHIM 0.020
35. CYLINDER SLEEVE SHIM 0.031
36. CYLINDER SLEEVE SHIM 0.062

3-34. ENGINE BLOCK REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Assembly (Contd)		

CAUTION

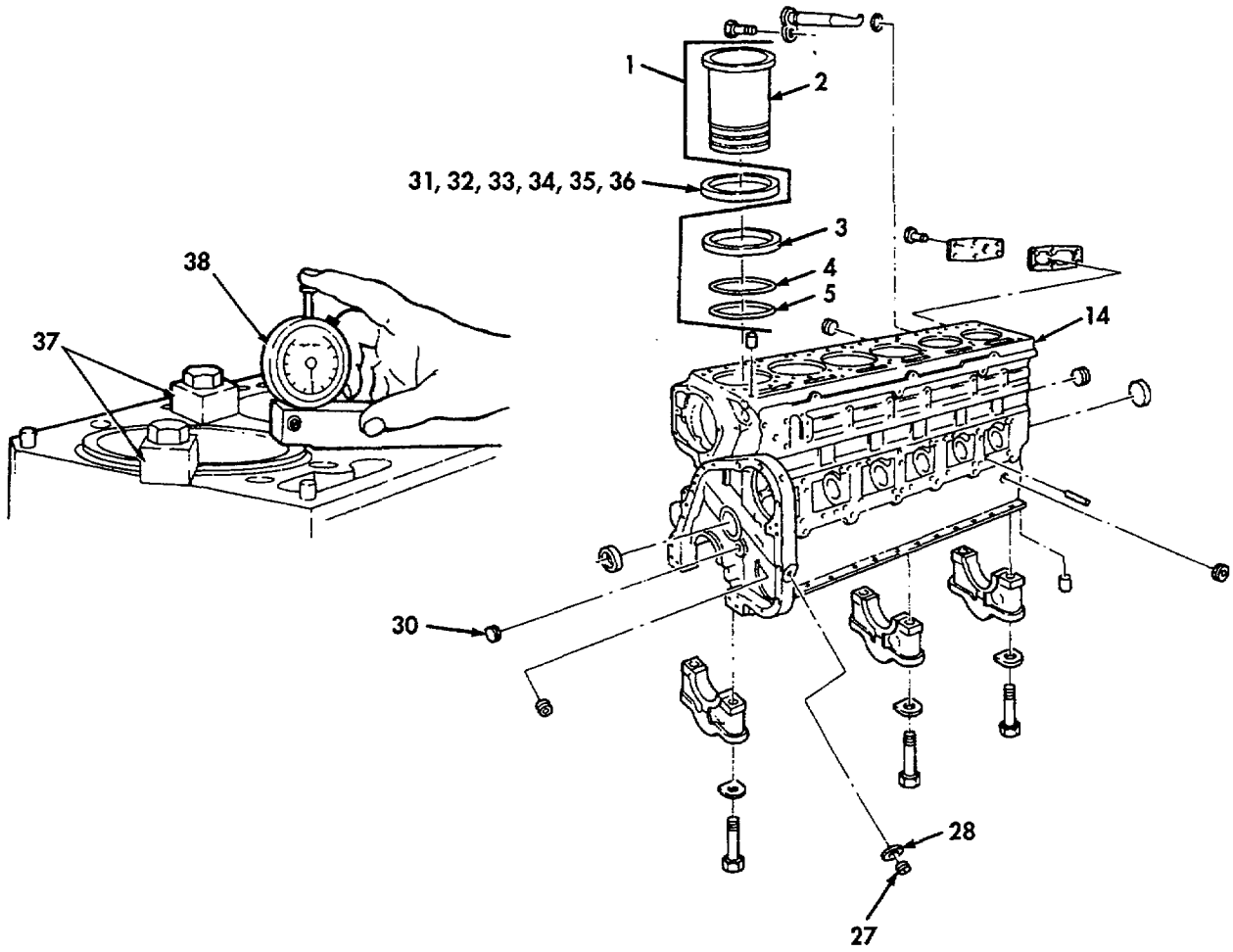
- **Do not lubricate preformed packing until ready to install assembled cylinder sleeve. Preformed packing will increase in size once in contact with OE/HDO 10 lubricating oil for more than 10 minutes.**
- **Prior to installing a cylinder sleeve, apply a bead of inner sealer on counterbore of cylinder sleeve flange. Do not use an excessive amount of sealer. Excessive amounts can cause problems in cooling system.**
- **Do not permit lubricating oil once applied to preformed packing to come in contact with liner sealant. Oil will prevent sealant from adhering to liner flange and counterbore contact surface.**

NOTE

Diameter of applied sealer bead must be at least 3/64 in. (1.2 mm) and not more than 1/16 in. (1.6 mm) wide. Cylinder sleeve must be installed within five minutes after sealer has been applied.

37.	Six cylinder sleeve assemblies (1)	Install on engine block (14) as follows:	Lubricate black preformed packing (4), red preformed packing (5), and gasket (3) with OE/HDO 10 lubricating oil. Install assembled cylinder sleeves (2) within 10 minutes.
		a. Place cylinder sleeve (2) on bore of engine block (14) by hand.	
		b. Push downward with one quick stroke.	Ensure preformed packings (4) and (5), and gasket (3) do not move from groove.
		c. Using cylinder sleeve driver and a mallet, drive flange against counterbore edge.	Use sleeve driver (ST-1229).
		d. Install two cylinder sleeve clamps (37) on engine block (14) and cylinder sleeve (2), and check sion after installation.	Tighten clamps to 50 lb-ft (68 N•m). Use cylinder sleeve clamps (ST-1154) (37) for securing protru- cylinder sleeve assembly (1) on cylinder sleeve bore. Use gauge block (3376220) (38) to check protrusion. The amount of protrusion must not exceed 0.003-0.006 in. (0.076-0.152 mm).
		e. Check inside diameter for out-of-round condition. Measure at several points within range of piston travel.	Bore must not be out-of-round more than 0.003 in. (0.076 mm) in top 1 in. (25.4 mm) area of piston travel and not more than 0.002 in. (0.051 mm) in area of gasket (3).

3-34. ENGINE BLOCK REPAIR (Contd)



LEGEND:

1. CYLINDER SLEEVE ASSEMBLY (6)
2. CYLINDER SLEEVE (6)
3. GASKET (6)
4. BLACK PREFORMED PACKING (6)
5. RED PREFORMED PACKING (6)
14. ENGINE BLOCK
37. CYLINDER SLEEVE CLAMP (2)
38. GAUGE BLOCK

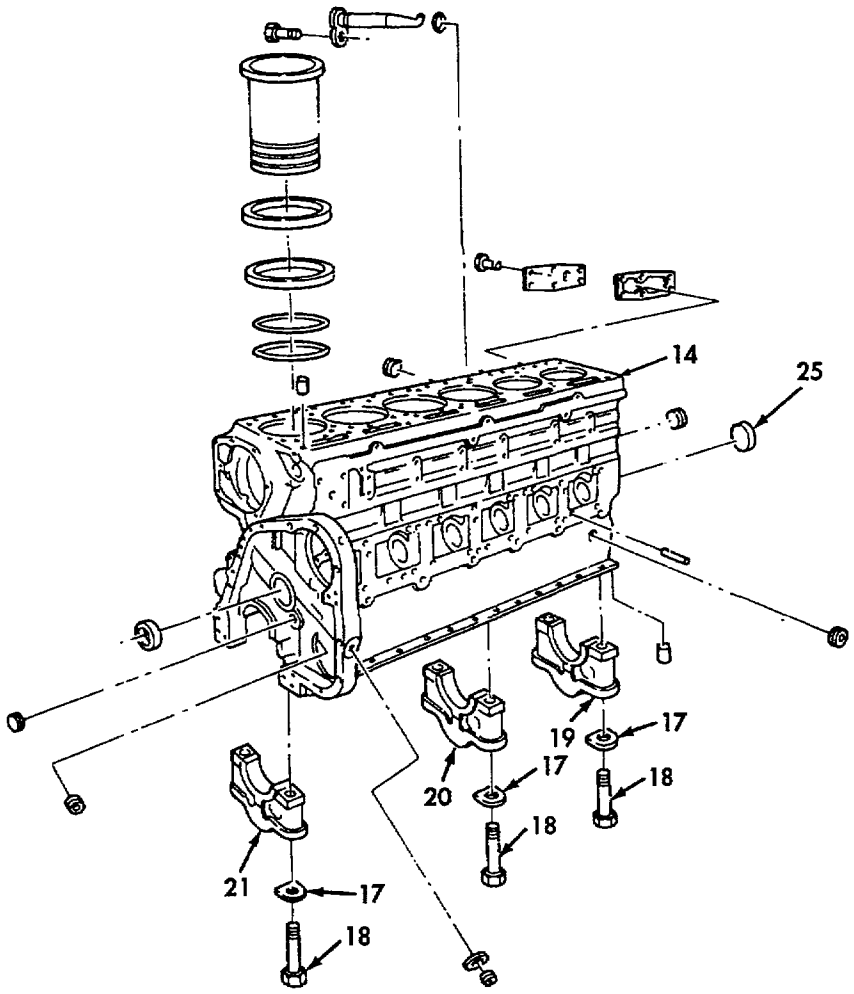
3-34. ENGINE BLOCK REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Assembly (Contd)		
38. Cap (25)	Install on rear of engine block (14).	Use suitable plug driver and pipe sealant around outside diameter of cap (25).
39. Fourteen screws (18), washers (17), No. 7 bearing cap (19), No. 2, 4, and 6 bearing caps (20), and No. 1, 3, and 5 bearing caps (21)	Install loosely on engine block (14).	Bearing caps will be removed at assembly during crankshaft installation.

FOLLOW-ON TASKS:

- Install engine crankshaft and main bearings (para. 3-68).
- Install pistons, connecting rods, and bearings (para. 3-69).
- Install camshaft and cam followers (para. 3-70).
- Install cylinder head assemblies and pushrods (para. 3-71).
- Install injector assemblies (para. 3-82).
- Perform injection timing (para. 3-72).
- Install accessory drive housing assembly (para. 3-73).
- Install oil pump (para. 3-74).
- Install front gear cover (para. 3-75).
- Install accessory drive pulley (para. 3-76).
- Install air compressor (para. 3-77).
- Install fuel pump (para. 3-78).
- Install vibration damper and crankshaft pulley (para. 3-79).
- Install flexplate or flywheel, flywheel housing, and rear cover (para. 3-80).
- Install oil pan (para. 3-81).
- Install and adjust valve crossheads (para. 3-83).
- Install rocker arm housing assemblies (para. 3-84).
- Adjust injectors and valves (para. 3-85).
- Install engine retarders (para. 3-86).
- Install air aftercooler (para. 3-87).
- Remove engine from maintenance stand (para. 3-88).
- Install starter motor and solenoid (TM 9-2320-273-20 or TM 9-2320-283-20).
- Install bracket, alternator, and belts (TM 9-2320-273-20 or TM 9-2320-283-20).
- Install engine on vehicle (TM 9-2320-273-34 or TM 9-2320-283-34).

3-34. ENGINE BLOCK REPAIR (Contd)



LEGEND:

14. ENGINE BLOCK
17. WASHER (14)
18. SCREW (14)
19. NO. 7 BEARING CAP
20. NO. 2, 4, AND 6 BEARING CAP (3)
21. NO. 1, 3, AND 5 BEARING CAP (3)
25. CAP

3-35. CYLINDER HEAD AND VALVE REPAIR

THIS TASK COVERS:

a. Disassembly
b. Cleaning
c. Inspection and Repair
d. Assembly and Testing

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Head holding fixture (15434) ST-583
Valve spring compressor (15434) ST-448
Fuel passage cleaning brush (15434) ST-876
Valve seat extractor (15434) ST-1279
Valve seat insert tool (15434) ST-257
Valve seat insert cutter (15434) ST-662
Valve guide arbor (15434) ST-663
Valve seat insert staking tool (15434) ST-1124
Valve seat insert staking tool driver (15434) ST-1122
Dowel pin extractor (15434) ST-1134
Crosshead guide spacer (15434) ST-633
Valve guide driver (15434) 3375282
Gauge block (15434) 3376220
Injector sleeve puller (15434) ST-1244
Bead cutting tool (15434) ST-788
Injector seat cutting tool (15434) ST-824
Injector sleeve driver (15434) ST-1227
Injector sleeve holding tool (15434) ST-1179
Injector sleeve expander (15434) ST-880
Injector seat cutter (15434) ST-884
Valve spring tester (15434) 3375182
Expansion plug driver (3/4-in.) (15434) 3375190
Expansion plug driver (1-in.) (15434) 3375191
Expansion plug driver (1-1/4 in.) (15434) 3375192
Valve vacuum tester (15434) ST-1257-A

TEST EQUIPMENT
None

MATERIALS/PARTS
Solvent, SD-3 (Appendix C, Item 30)
Cloth, crocus (Appendix C, Item 4)
Oil, cutting (Appendix C, Item 18)
Compound, Prussian blue (Appendix C, Item 9)
Oil, lubricating, OE/HDO 30 (Appendix C, Item 21)
Sealant, cup plug (Appendix C, Item 25)
Liquid thread sealant (Appendix C, Item 27)
Forty-eight valve collets (15434) 127554
Four O-ring seals (15434) 131026
Six 3/4-in. expansion plugs (15434) 213394
1-in. expansion plug (15434) 213395
Two 1-1/4 in. expansion plugs (15434) 216524
Injector assembly (15434) 3030445
Injector clamp (15434) 3028171
Two injector clamp screws (15434) 3028279
Six injector preformed packings (15434) 3007759

PERSONNEL REQUIRED
Automotive repairman MOS 63H

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
Cylinder head assembly removed (para. 3-24).

REFERENCES (TM)
None

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust

GENERAL SAFETY INSTRUCTIONS
- Always wear eye protection when using compressed air.
- Approved solvents may be flammable and will not be used near open flame.

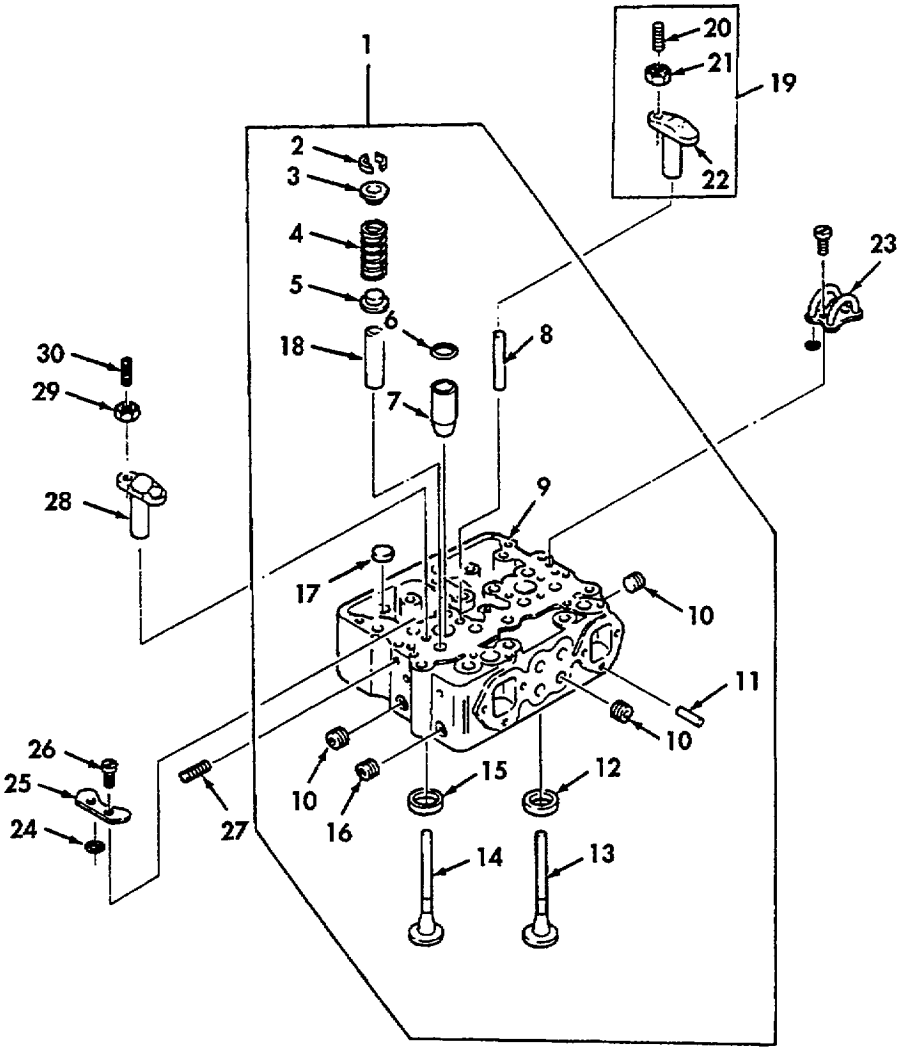
LOCATION/ITEM	ACTION	REMARKS

a. Disassembly

NOTE
This procedure covers repair of any one of three cylinder head assemblies. Quantities shown in legend are for one cylinder head assembly.

1.	Two locking nuts (21) and adjusting screws (20)	Remove from intake valve crossheads (22).	

3-35. CYLINDER HEAD AND VALVE REPAIR (Contd)



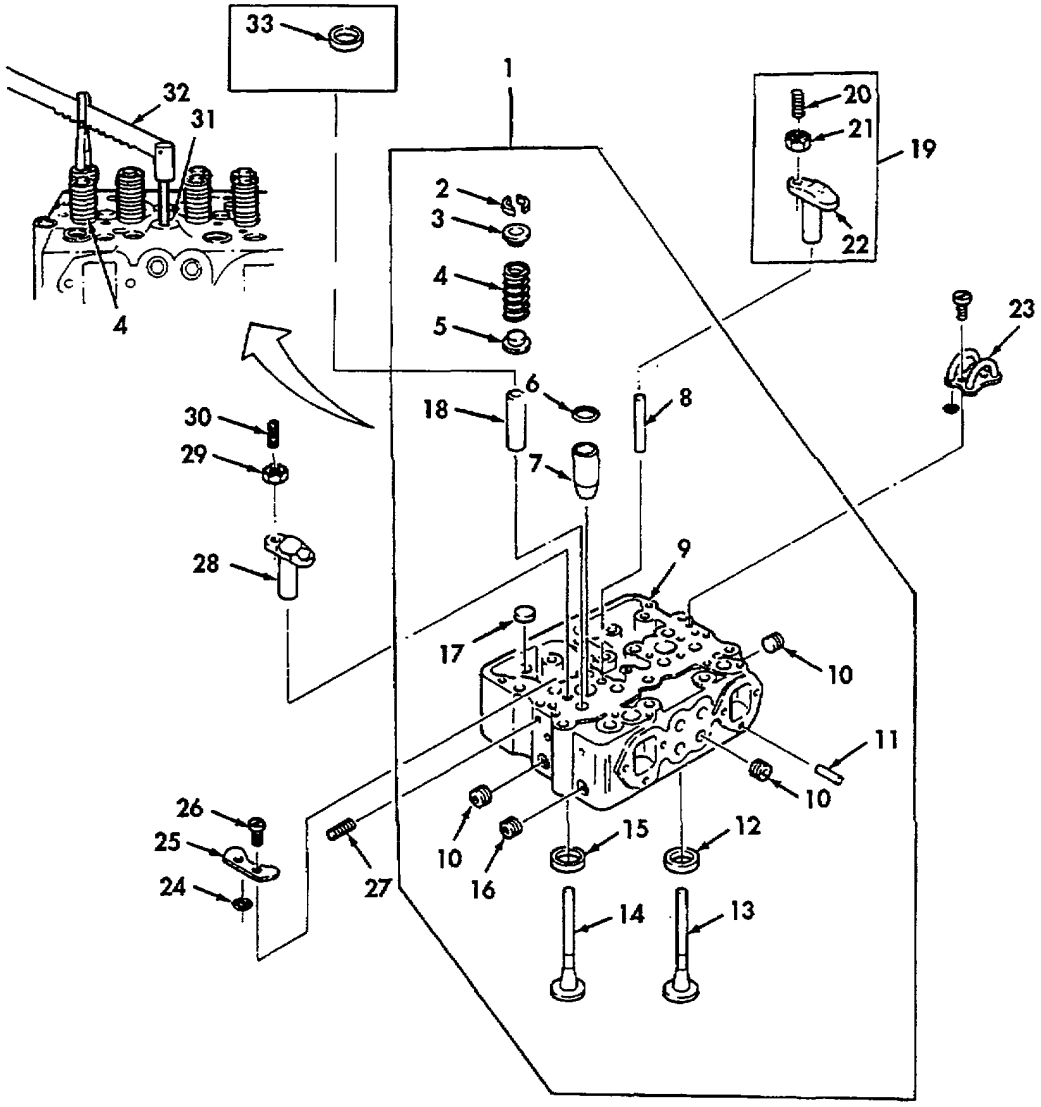
LEGEND:

1. CYLINDER HEAD ASSEMBLY
2. VALVE COLLET (16)
3. VALVE SPRING GUIDE (8)
4. VALVE SPRING (8)
5. VALVE SPRING GUIDE (8)
6. INJECTOR PREFORMED PACKING (2)
7. INJECTOR SLEEVE (2)
8. VALVE CROSSHEAD GUIDE (4)
9. CYLINDER HEAD
10. EXPANSION PLUG (6)
11. DOWEL (2)
12. INTAKE VALVE INSERT (4)
13. INTAKE VALVE (4)
14. EXHAUST VALVE (4)
15. EXHAUST VALVE INSERT (4)
16. EXPANSION PLUG
17. EXPANSION PLUG (2)
18. VALVE STEM GUIDE (8)
19. INTAKE VALVE CROSSHEAD ASSEMBLY
20. ADJUSTING SCREW (2)
21. LOCKING NUT (2)
22. INTAKE VALVE CROSSHEAD (2)
23. FUEL CONNECTION (2)
24. PREFORMED PACKING (2)
25. COVER PLATE
26. SCREW (2)
27. PIPE PLUG (4)
28. EXHAUST VALVE CROSSHEAD (2)
29. LOCKING NUT (2)
30. ADJUSTING SCREW (2)

3-35. CYLINDER HEAD AND VALVE REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
a. Disassembly (Contd)		
2. Two locking nuts (29) and adjusting screws (30)	Remove from exhaust valve crossheads (28).	
3. Two intake valve crossheads (22) and exhaust valve crossheads (28)	Remove from valve crosshead guides (8) on cylinder head (9).	
	WARNING **Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and protective equipment such as goggles or shield, gloves, etc. Failure to comply may result in injury to personnel.**	
4. Cylinder head assembly (1)	a. Steam clean and dry with compressed air. b. Put into head holding fixture.	Use head holding fixture (ST-583).
	NOTE **Repeat steps 5, 6, and 7 for each intake or exhaust valve.**	
5. Valve spring (4)	Compress.	Use valve spring compressor (ST-448) (32) and head holding fixture (ST-583). Stud of valve spring compressor (32) should be installed on screw hole (31). Keep a firm hold on valve spring compressor (32) until valve collets (2) are removed.
6. Two valve collets (2)	a. Tap head of valve (13) or (14) lightly to loosen.	
	b. Remove from valve and valve spring guide (3).	Use magnet if needed. Discard valve collets (2).
7. Intake valve (13), exhaust valve (14), valve spring (4), and valve spring guides (3) and (5), and spacers* (33), if used	Remove from cylinder head (9).	As each valve is removed, place on numbered board or stand. If spacers are used, cylinder head has been resurfaced at one time.
	NOTE **Step 8 does not apply to No. 2 cylinder head.**	
8. Two screws (26), cover plate (25), and two preformed packings (24)	Remove from cylinder head (9).	Discard preformed packings (24).
9. Four pipe plugs (27)	Remove two from each end of cylinder head (9).	No. 3 cylinder head has two pipe plugs in forward end only.
10. Six expansion plugs (10), expansion plug (16), and two expansion plugs (17)	Remove from cylinder head (9).	a. Using hammer and punch, hit outside diameter of expansion plugs to force one side out. b. Use screwdriver or pliers to remove expansion plug from hole. Discard expansion plugs (10), (16), and (17).

3-35. CYLINDER HEAD AND VALVE REPAIR (Contd)



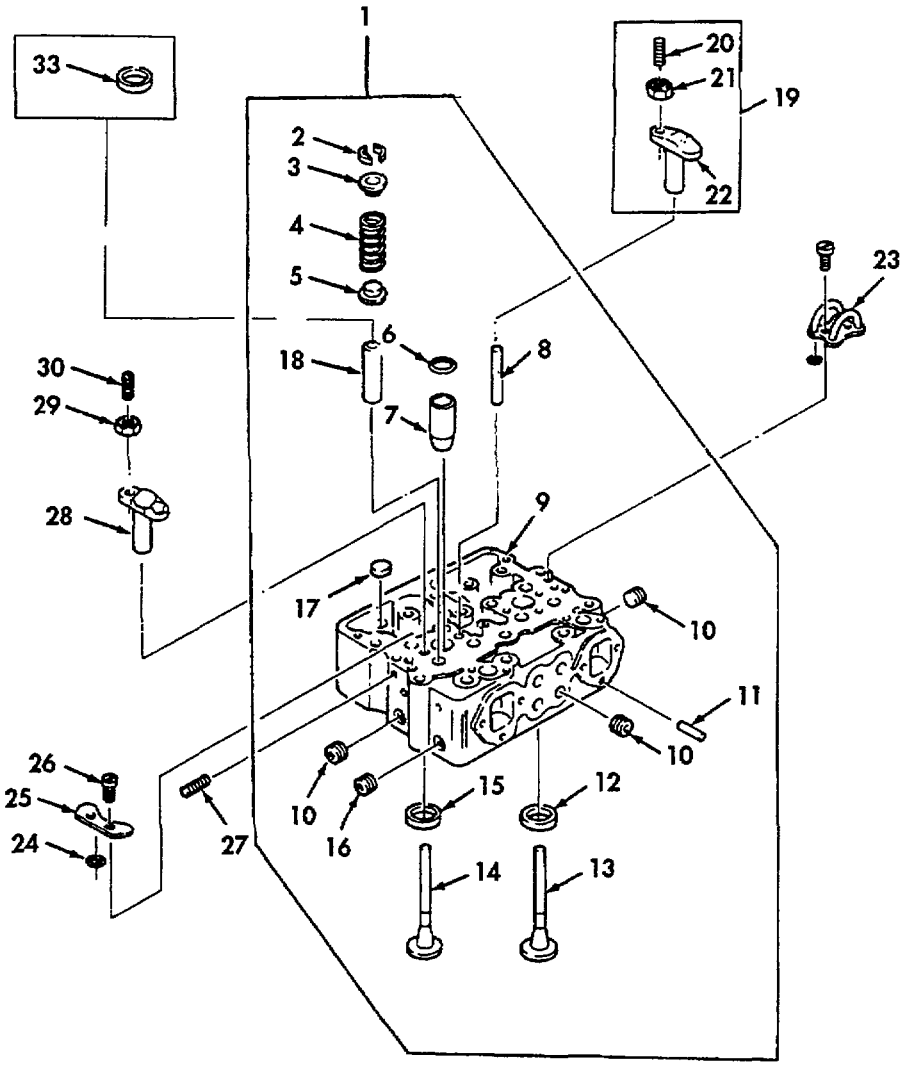
LEGEND:

1. CYLINDER HEAD ASSEMBLY
2. VALVE COLLET (16)
3. VALVE SPRING GUIDE (8)
4. VALVE SPRING (8)
5. VALVE SPRING GUIDE (8)
8. VALVE CROSSHEAD GUIDE (4)
9. CYLINDER HEAD
10. EXPANSION PLUG (6)
13. INTAKE VALVE (4)
14. EXHAUST VALVE (4)
16. EXPANSION PLUG
17. EXPANSION PLUG (2)
20. ADJUSTING SCREW (2)
21. LOCKING NUT (2)
22. INTAKE VALVE CROSSHEAD (2)
24. PREFORMED PACKING (2)
25. COVER PLATE
26. SCREW (2)
27. PIPE PLUG (4)
28. EXHAUST VALVE CROSSHEAD (2)
29. LOCKING NUT (2)
30. ADJUSTING SCREW (2)
31. ROCKER LEVER SCREW HOLE
32. VALVE SPRING COMPRESSOR
33. *SPACER (USED IF CYLINDER HEAD WAS RESURFACED)

3-35. CYLINDER HEAD AND VALVE REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
b. Cleaning		
	WARNING **Approved solvents may be flammable and will not be used near open flame. Use only in well-ventilated area. Failure to comply may result in injury to personnel.**	
11. Cylinder head assembly (1)	a. Clean by submerging in solvent SD-3.	Circulate solvent to increase effectiveness on salt, lime deposits, and grease, etc.
	b. Clean internal passages and flush passages with solvent SD-3 to remove deposits.	Use fuel passage cleaning brush (ST-876). Ensure lubricating oil passages are open and clean.
	WARNING **Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment goggles or shield, gloves, etc. Failure to comply may result in injury to personnel.**	
	c. Dry with compressed air.	
12. All other parts	Clean by submerging in solvent SD-3 and dry with compressed air.	Refer to para. 3-6 for additional cleaning instructions.

3-35. CYLINDER HEAD AND VALVE REPAIR (Contd)



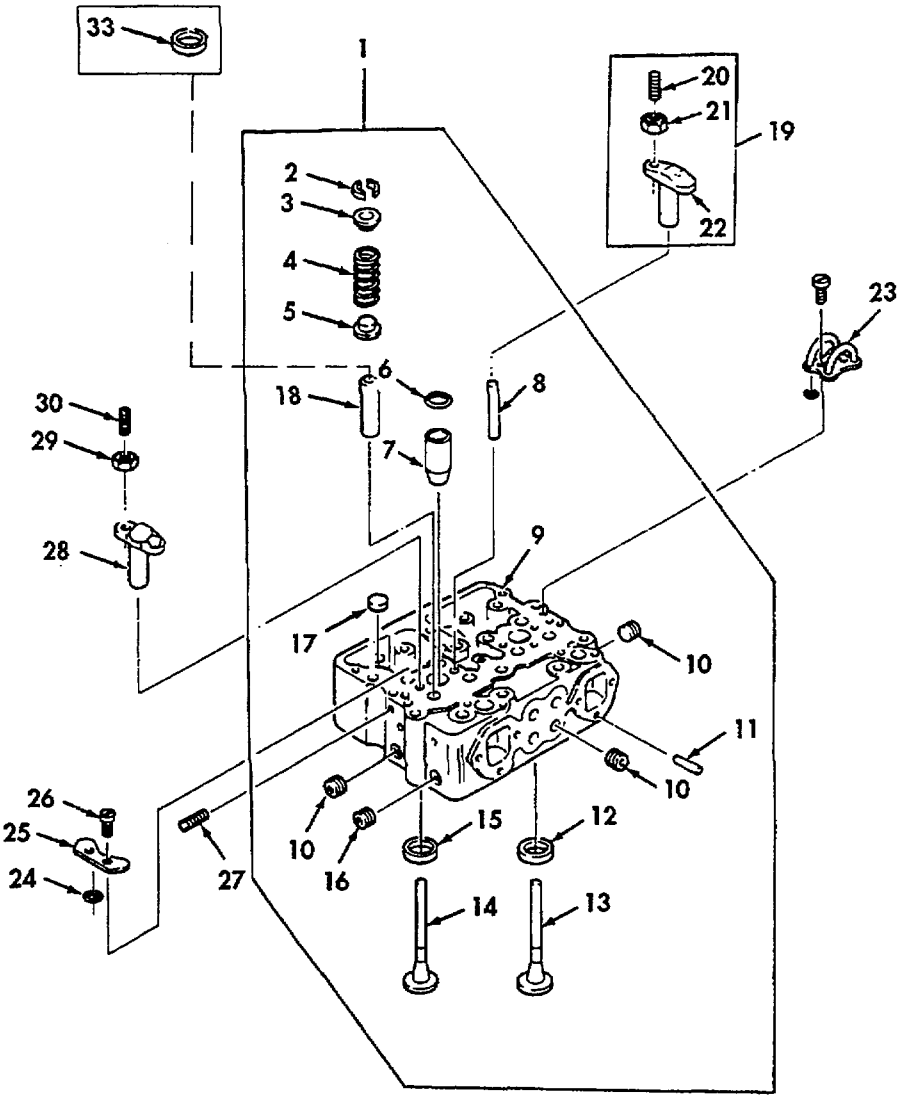
LEGEND:

1. CYLINDER HEAD ASSEMBLY
2. VALVE COLLET (16)
3. VALVE SPRING GUIDE (8)
4. VALVE SPRING (8)
5. VALVE SPRING GUIDE (8)
6. INJECTOR PREFORMED PACKING (2)
7. INJECTOR SLEEVE (2)
8. VALVE CROSSHEAD GUIDE (4)
9. CYLINDER HEAD
10. EXPANSION PLUG (6)
11. DOWEL (2)
12. INTAKE VALVE INSERT (4)
13. INTAKE VALVE (4)
14. EXHAUST VALVE
15. EXHAUST VALVE INSERT (4)
16. EXPANSION PLUG
17. EXPANSION PLUG (2)
18. VALVE STEM GUIDE (8)
19. INTAKE VALVE CROSSHEAD ASSEMBLY
20. ADJUSTING SCREW (2)
21. LOCKING NUT (2)
22. INTAKE VALVE CROSSHEAD (2)
23. FUEL CONNECTION (2)
24. PREFORMED PACKING (2)
25. COVER PLATE
26. SCREW (2)
27. PIPE PLUG (4)
28. EXHAUST VALVE CROSSHEAD (2)
29. LOCKING NUT (2)
30. ADJUSTING SCREW (2)

3-35. CYLINDER HEAD AND VALVE REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection and Repair		
	CAUTION **Do not use disk sander to polish cylinder head. Disk sander could cause serious damage to mating surface of head.**	
13. Cylinder head (9)	a. Polish mating surface.	Use crocus cloth or orbital sander. Polish just enough to shine finish. This allows for a more complete inspection of mating surface.
	b. Inspect for cracks, breaks, distortion, and broken-out areas.	Discard cylinder head assembly (1) if cylinder head (9) is damaged.
	c. Inspect for cracks using magnetic method.	Discard cylinder head assembly (1) if any cracks are found.
	d. Check for scratches or unevenness on mating surface.	Use straightedge and feeler gauge. Perform steps 13e through 13i if mating surface is scratched or uneven more than 0.002 in. (0.051 mm).
	e. Resurface mating surface.	Do not remove more than 0.005 in. (0.127 mm) of material at one time. Total amount of material removed must not exceed 0.040 in. (1.016 mm).
	f. Inspect four valve inserts (12) and (15) for cracks, broken, or chipped areas. Remove if damaged.	Refer to steps 15a through 15e for removal and installation. Discard damaged valve inserts (12) and (15).
	g. Polish mating surface.	Use crocus cloth or orbital sander.
	h. Measure cylinder head (9) height.	Use suitable vernier depth gauge. Discard cylinder head assembly (1) if cylinder head is less than wear limit shown below:
	Wear Limit ..... 4.340 in. (11.024 cm) New Minimum ..... 4.370 in. (11.100 cm) New Maximum ..... 4.380 in. (11.125 cm)	
	i. Remove two injector sleeves (7) from cylinder head (9).	Refer to steps 18d and 18e.

3-35. CYLINDER HEAD AND VALVE REPAIR (Contd)



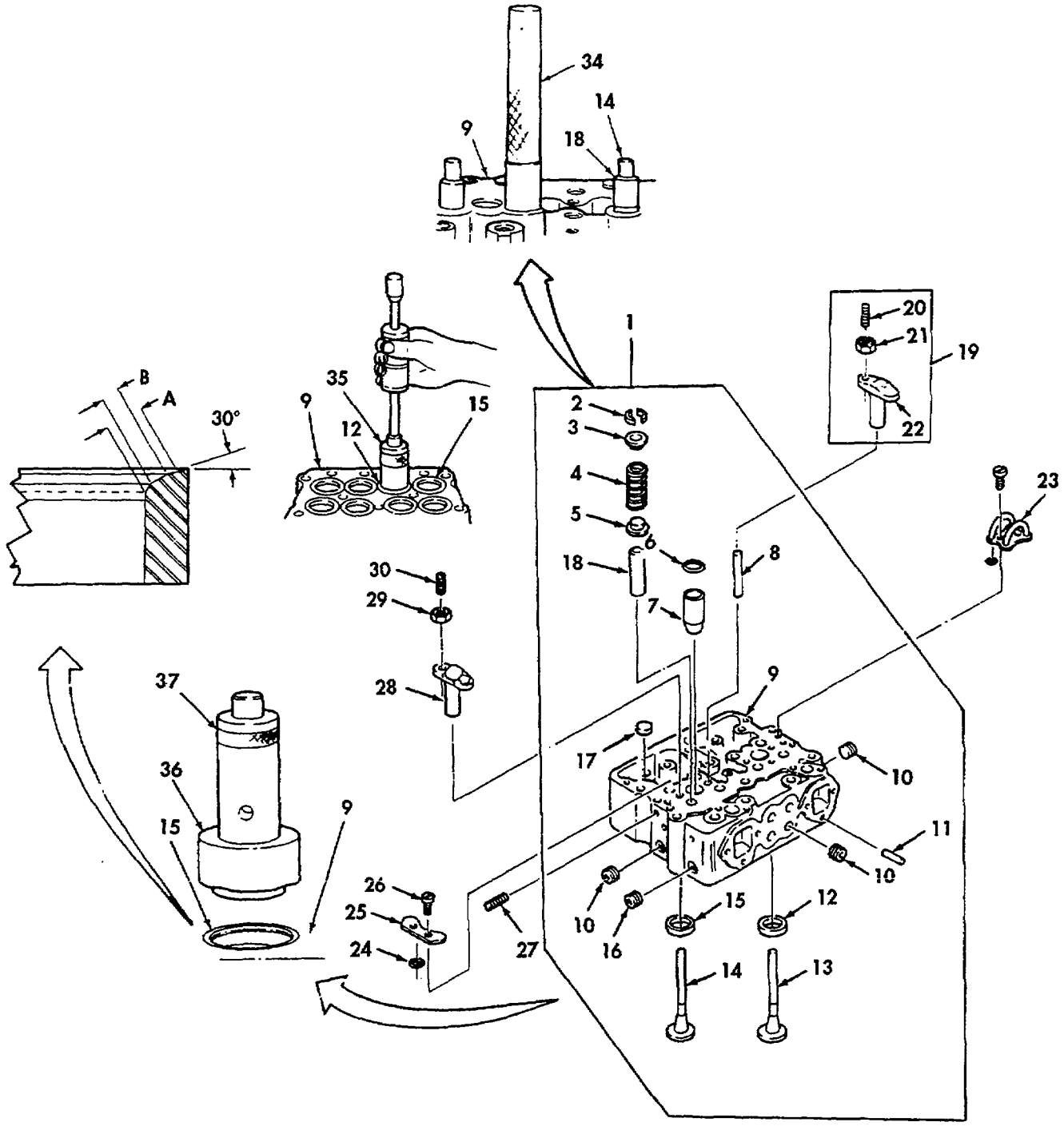
LEGEND:

1. CYLINDER HEAD ASSEMBLY
7. INJECTOR SLEEVE (2)
9. CYLINDER HEAD
12. INTAKE VALVE INSERT (4)
13. INTAKE VALVE (4)
14. EXHAUST VALVE (4)
15. EXHAUST VALVE INSERT (4)
18. VALVE STEM GUIDE (8)

3-35. CYLINDER HEAD AND VALVE REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection (Contd)		
14. Eight valve stem guides (18)	a. Inspect for chips, cracks, burrs, broken-out sections, and extensive wear.	Replace if damaged (refer to step 14d for replacement).
	b. Measure protrusion.	Use suitable micrometer. Replace if not within 1.270-1.280 in. (3.226-3.251 cm). (Refer to step 14d for replacement.)
	c. Set small bore gauge to 0.4552 in. (11.562 mm) and attempt to insert it in bore of valve stem guide.	Replace if gauge goes into bore or if bore is more than wear limit shown below. (Refer to step 14d for replacement.)
	Wear Limit ..... 0.4550 in. (11.557 mm) New Minimum ..... 0.4525 in. (11.494 mm) New Maximum ..... 0.4532 in. (11.511 mm)	
	d. Replace valve stem guide (18) as follows:	Do not replace unless damaged or not within wear limits.
	(1) Drive out valve stem guide (18) from underside of cylinder head (9).	Use suitable step punch. Discard valve stem guide.
	(2) Install new valve stem guide (18).	Use valve guide driver (3375282) (34). Ensure height of valve stem guide is between 1.270-1.280 in. (3.226-3.251 cm) after installation.
	(3) Using new valve (13) or (14), check bore of new valve stem guide.	If valve does not move freely in valve stem guide (18), ream valve stem guide (18) from bottom side of cylinder head (9) to specifications shown in step 14c.
15. Four intake valve inserts (12) and four exhaust valve inserts (15)	a. Check for looseness by carefully striking cylinder head (9) with wood block or rubber hammer.	
	b. Measure valve seat area width (A or B in illustration).	Perform step 15d only if width is less than 0.0625 in. (1.5875 mm) or more than 0.125 in. (3.175 mm) at any point.
	c. Check valve seat for concentricity with valve stem guide (18).	Total run out should not exceed 0.002 in. (0.051 mm).
	d. Replace valve insert (12) or (15) as follows:	
	(1) Clean area around valve seat.	
	(2) Place valve seat extractor (35) into valve seat and expand until jaws are under valve insert (12).	Use valve seat extractor (ST-1279) (35). Ensure extractor (35) is not canted.
	(3) Remove valve insert (12) or (15) from cylinder head (9).	Use suitable slide hammer. Discard valve insert (12) or (15).
	(4) Drive new valve insert (12) or (15) in valve seat insert counterbore of cylinder head (9) until fully seated.	Use valve seat insert staking tool (ST-1124) (36).

3-35. CYLINDER HEAD AND VALVE REPAIR (Contd)



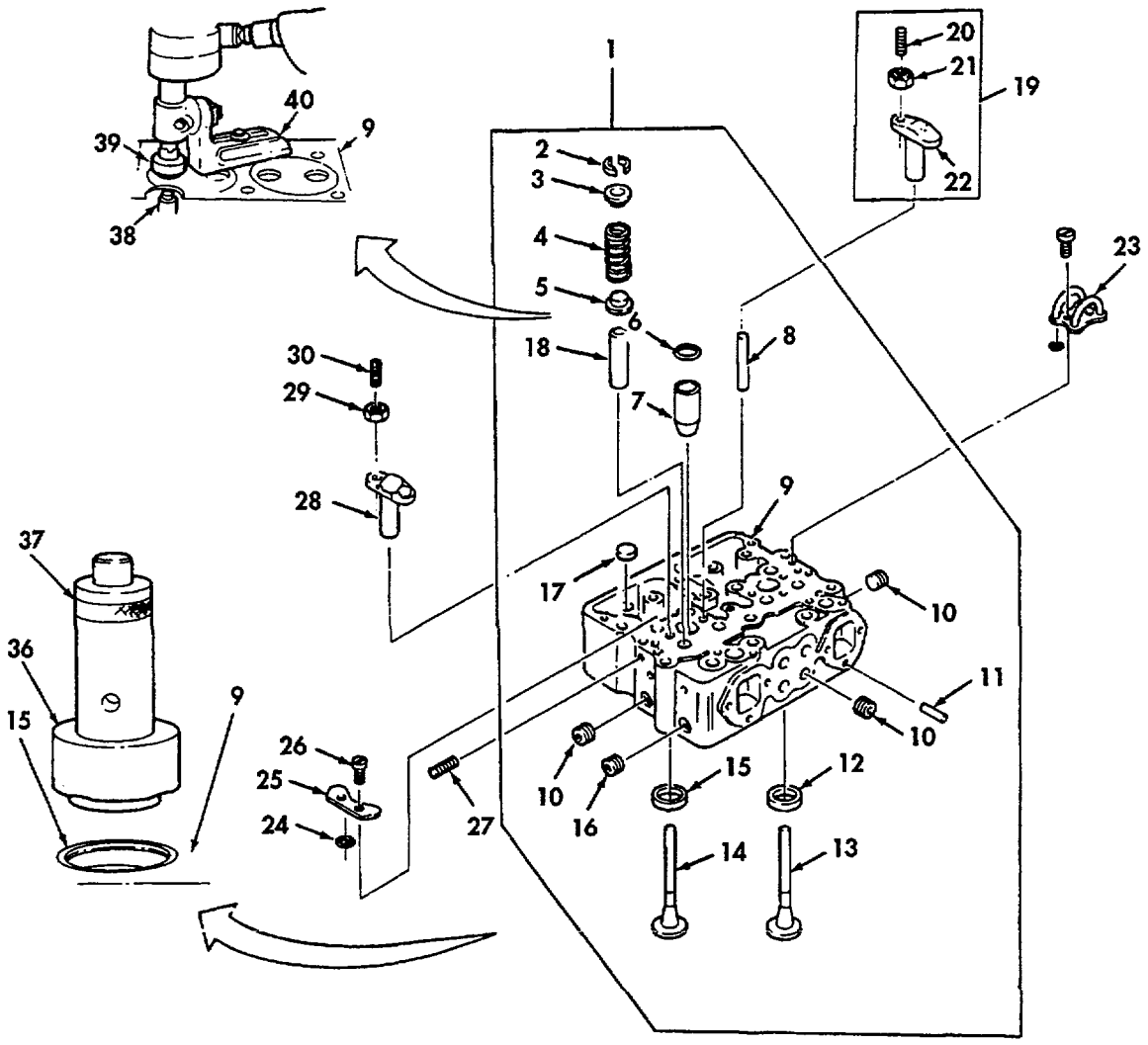
LEGEND:

9. CYLINDER HEAD
12. INTAKE VALVE INSERT (4)
13. INTAKE VALVE (4)
14. EXHAUST VALVE (4)
15. EXHAUST VALVE INSERT (4)
18. VALVE STEM GUIDE (8)
34. VALVE GUIDE DRIVER
35. VALVE SEAT EXTRACTOR
36. VALVE SEAT INSERT STAKING TOOL
37. VALVE SEAT INSERT STAKING TOOL DRIVER

3-35. CYLINDER HEAD AND VALVE REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection and Repair (Contd)		
15. Four intake valve inserts (12) and four exhaust valve inserts (15) (Contd)	(5) Stake (peen) cylinder head (9).	Use valve seat insert staking tool (ST-1124) (36) and driver (37) If valve seat insert staking tool (36) and driver (37) are not available, a punch with round end can be used to stake cylinder head (9).
	e. Machine valve insert counterbore for installing oversize inserts (12) or (15) as follows:	
	(1) Clamp base of insert tool (40) to cylinder head (9).	Use valve seat insert tool (ST-257) (40).
	(2) Install cutter (39).	Use valve seat insert cutter (ST-662) (39). Ensure valve seat insert tool (40) is securely clamped before starting electric drill.
	(3) Using arbor (38), center cutter (39) on valve seat insert (12) or (15).	Use valve guide arbor (ST-663) (38).
	(4) Cut counterbore 0.006-0.010 in. (0.152-0.254 mm) deeper than valve insert thickness.	This allows room for peening of cylinder head (9) to secure valve insert (12) or (15). Allow cutter to turn several revolutions to make sure counterbore surface is even. Remove valve seat insert tool (40), valve seat insert cutter (39), and valve guide arbor (38).
	(5) Clean out all chips and debris from valve insert counterbore.	

3-35. CYLINDER HEAD AND VALVE REPAIR (Contd)



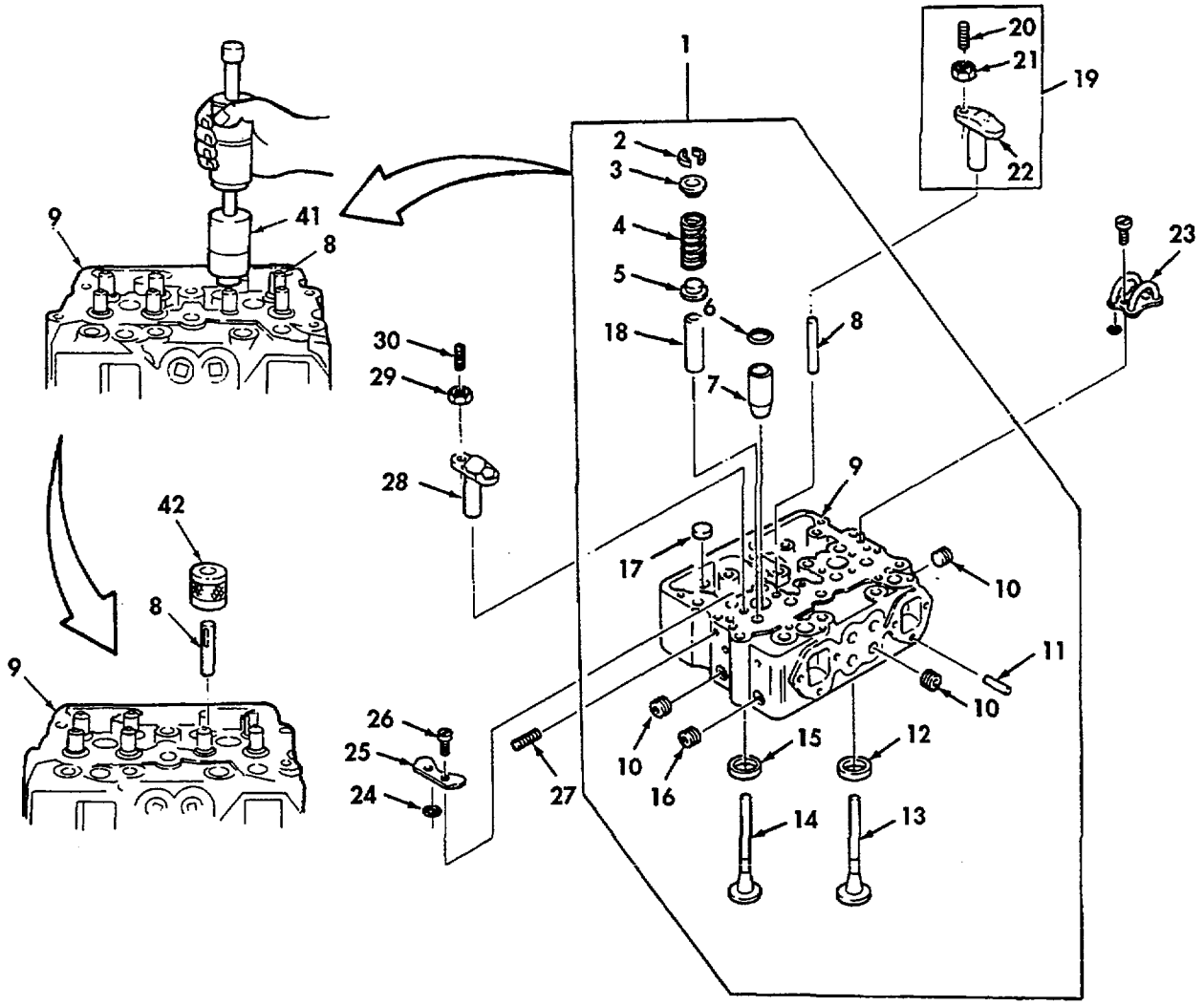
LEGEND:

9. CYLINDER HEAD
12. INTAKE VALVE INSERT (4)
15. EXHAUST VALVE INSERT (4)
36. VALVE SEAT INSERT STAKING TOOL
37. VALVE SEAT INSERT STAKING TOOL DRIVER
38. VALVE GUIDE ARBOR
39. VALVE SEAT INSERT CUTTER
40. VALVE SEAT INSERT TOOL

3-35. CYLINDER HEAD AND VALVE REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection and Repair (Contd)		
16. Four valve crosshead guides (8)	a. Inspect each for straightness and for being at a right angle to surface of cylinder head (9).	Replace valve crosshead guides (8) that are not straight or square to cylinder head (9). (Refer to step 16d for replacement.)
	b. Measure outside diameter.	Use suitable micrometer. Replace if less than wear limit shown below. (Refer to step 16d for replacement.)
	Wear Limit ..... .0.4320 in. (10.973 mm) New Minimum ..... 0.4330 in. (10.998 mm) New Maximum ..... 0.4335 in. (11.011 mm)	
	c. Using suitable micrometer, measure protrusion.	Replace if not within 1.860-1.880 in. (4.724-4.775 cm). (Refer to step 16d for replacement.)
	d. Replace valve crosshead guides (8) as follows:	Do not replace unless bent or not within wear limits.
	(1) Remove guide (8) from cylinder head (9).	Use dowel pin extractor (ST-1134) (41). Discard valve crosshead guide (8).
	(2) Clean crosshead guide (8) holes thoroughly.	
	(3) Install new valve crosshead guide (8) on cylinder head (9).	Use arbor press and crosshead guide spacer (ST-633) (42). Ensure height of valve crosshead guide (8) is between 1.860-1.880 in. (4.724-4.775 cm) after installation.
17. Two dowels (11)	Inspect for cracks, breaks, bending, or looseness.	Replace if damaged or loose.

3-35. CYLINDER HEAD AND VALVE REPAIR (Contd)



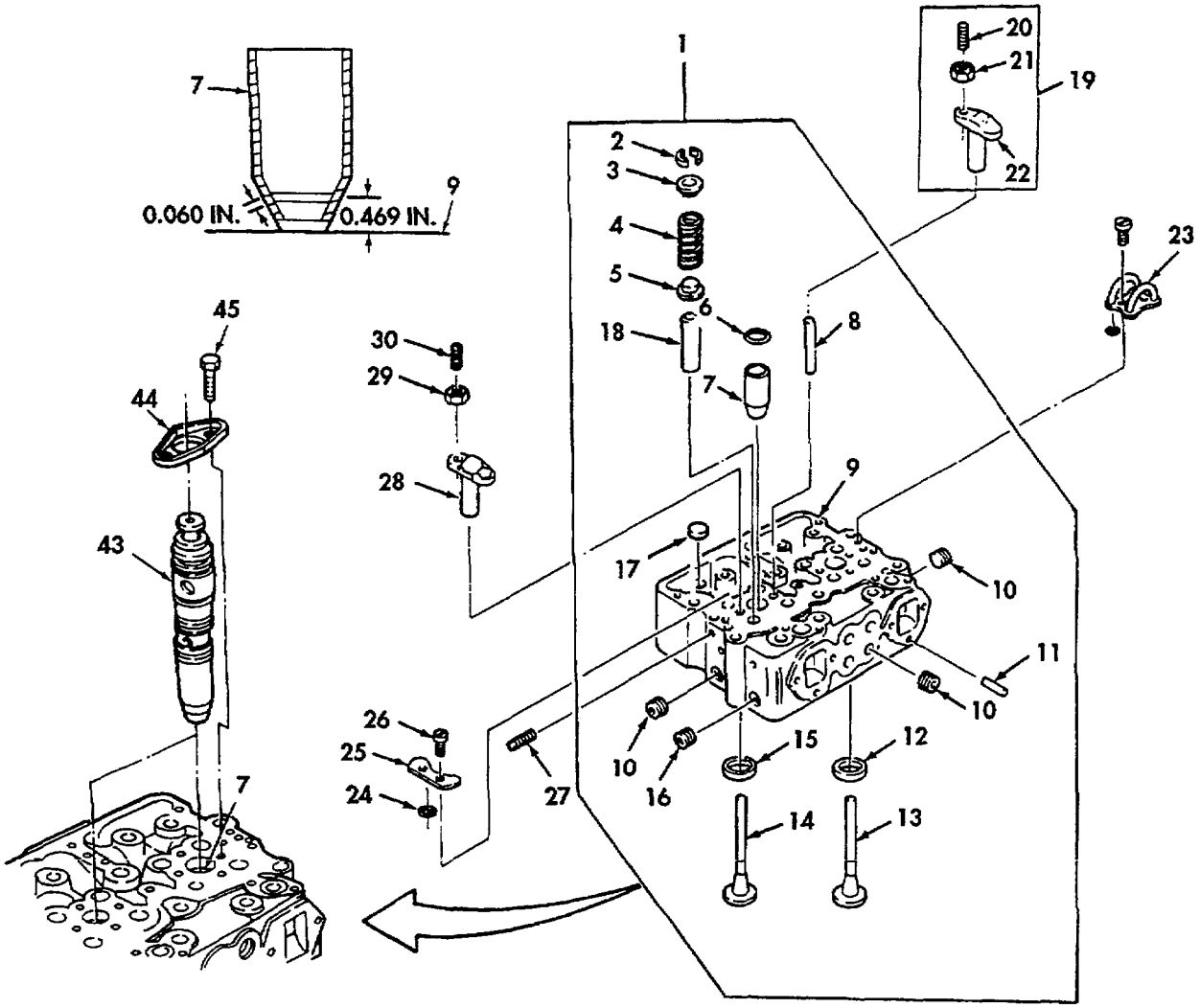
LEGEND:

8. VALVE CROSSHEAD GUIDE (4)
9. CYLINDER HEAD
11. DOWEL (2)
41. DOWEL PIN EXTRACTOR
42. CROSSHEAD GUIDE SPACER

3-35. CYLINDER HEAD AND VALVE REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection and Repair (Contd)		
18. Two injector sleeves (7)	a. Inspect for scratches on cup area and cracks at rolled seam.	Replace if any scratches are found. (Refer to step 18d for replacement.)
	b. Check seating pattern as follows:	
	NOTE **Ensure injector assembly is new or condition of injector assembly cup is satisfactory prior to checking seating pattern.**	
	(1) Lightly coat cup of injector assembly (43) with Prussian blue compound.	
	(2) Install injector assembly (43) on injector sleeve (7) and secure with injector damp (44) and two screws (45).	Tighten screws (45) alternately in 48 lb-in. (5 N•m) increments to 10-12 lb-ft (14-16 N•m).
	(3) Remove two screws (45), injector clamp (44), and injector assembly (43) from injector sleeve (7).	
	(4) Check seating pattern in cup seating area of injector sleeve (7).	Seating pattern must cover completely around injector seat and must be at least 0.060 in. (1.524 mm) wide and 0.469 in. (11.913 mm) from bottom surface of cylinder head (9) (refer to illustration). Replace old injector sleeve (7) if not within above specifications (refer to step 18d for replacement). Recut new injector sleeve (7) if not within above specifications (refer to step 18e for recutting).

3-35. CYLINDER HEAD AND VALVE REPAIR (Contd)



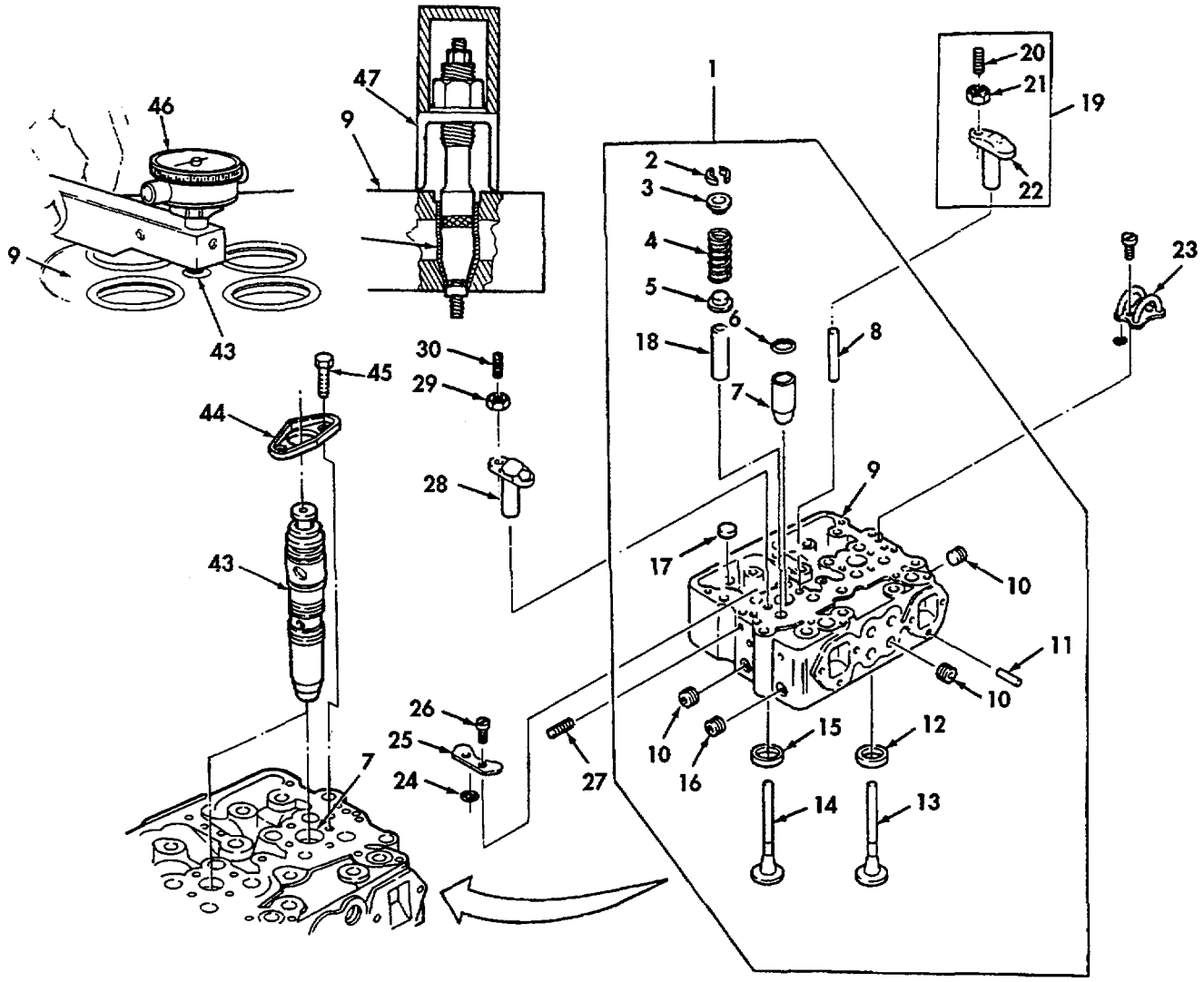
LEGEND:

7. INJECTOR SLEEVE (2)
9. CYLINDER HEAD
43. INJECTOR ASSEMBLY
44. INJECTOR CLAMP
45. INJECTOR CLAMP SCREW (2)

3-35. CYLINDER HEAD AND VALVE REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection and Repair (Contd)		
18. Two injector sleeves (7) (Contd)	c. Check protrusion of injector assembly (43) tip as follows:	
	NOTE **Ensure injector assembly is new or condition of injector assembly is known to be satisfactory prior to checking protrusion of tip.**	
	(1) Install injector assembly (43) on injector sleeve (7) with injector clamp (44) and two screws (45).	Tighten screws (45) alternately in 48 lb-in. (5 N•m) increments to 10-12 lb-ft (14-16 N•m).
	(2) Measure protrusion of tip.	Tip protrusion should be 0.060-0.070 in. (1.524-1.778 mm). Replace injector sleeve if protrusion is more than 0.070 in. (1.778 mm) (refer to step 18d for replacement). Recut injector sleeve (7) if protrusion is less than 0.060 in. (1.524 mm) (refer to step 18e for recutting).
	d. Replace injector sleeve (7) as follows:	Replace if damaged or not within wear limits.
	(1) Install puller (47) on injector sleeve (7) as shown in illustration.	Use injector sleeve puller (ST-1244) (47). Ensure puller (47) legs of support bridge are against surface of cylinder head (9) and both nuts are loose.
	(2) Strike puller (47) with hammer to push puller (47) into injector sleeve (7).	
	(3) Tighten small nut on puller (47) to 50 lb-ft (68 N•m).	Do not tighten small nut more than 60 lb-ft (81 N•m).

3-35. CYLINDER HEAD AND VALVE REPAIR (Contd)



LEGEND:

7. INJECTOR SLEEVE (2)
43. INJECTOR ASSEMBLY
44. INJECTOR CLAMP
45. INJECTOR CLAMP SCREW (2)
47. INJECTOR SLEEVE PULLER

3-35. CYLINDER HEAD AND VALVE REPAIR (Contd)

c. Inspection and Repair (Contd)

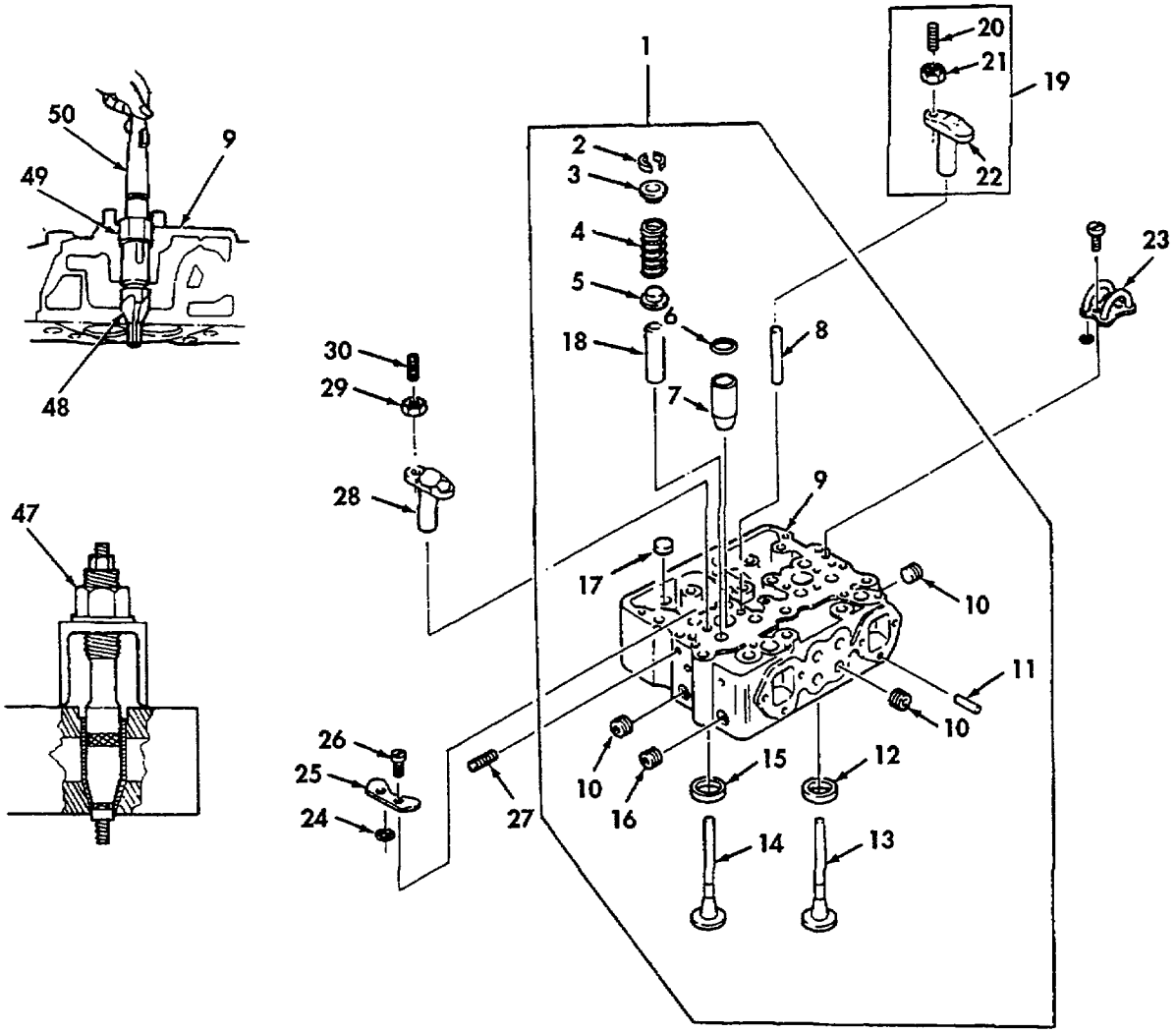
18. Two injector sleeves (7) (Contd)	(4) Turn large nut clockwise on puller (47) and remove injector sleeve (7) from cylinder head (9).	
	(5) Remove injector sleeve (7) from injector sleeve puller (47).	Loosen nuts. Tap small end of injector sleeve (7) to free from puller (47). Discard injector sleeve (7).
	(6) Remove injector preformed packing (6) from injector sleeve bore of cylinder head (9).	Discard preformed packing (6).
	(7) Remove all foreign material from injector sleeve sealing area with steel brush.	Use suitable steel brush. Refer to para. 3-6 for additional cleaning instructions.
	(8) Inspect injector sleeve seat area of cylinder head (9) for any possible damage incurred during removal.	

NOTE

Perform step 18d, tasks 9 through 18, only if injector sleeve seat area is damaged or bead is not smooth.

	(9) Install bead cutting tool (48), pilot (49), and holder (50) on drill press.	Use bead cutting tool (ST-788) (48). If drill press is not available, bead cutting tool (48) may also be turned by hand using tap wrench.
	(10) Place cylinder head (9) on drill press table.	Adjust table height to allow for proper clearance so that end of bead cutter (48) will protrude below cylinder head (9) surface into pilot hole of injector sleeve (7) seat area.

3-35. CYLINDER HEAD AND VALVE REPAIR (Contd)



LEGEND:

6. INJECTOR PREFORMED PACKING (2)
7. INJECTOR SLEEVE (2)
9. CYLINDER HEAD
47. INJECTOR SLEEVE PULLER
48. BEAD CUTTING TOOL
49. PILOT
50. HOLDER

3-35. CYLINDER HEAD AND VALVE REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection and Repair (Contd)		
18. Two injector sleeves (7) (Contd)	(11) Before starting drill press motor, insert bead cutting tool (48), pilot (49), and holder (50) in injector sleeve bore of cylinder head (9) to ensure proper alignment.	
	(12) Lubricate cutter (48) with cutting oil.	Raise cutter (48) high enough to lubricate.

CAUTION

- **Use extreme caution when cutting injector sleeve seat.**
- **Do not run drill press at speeds higher than 75 rpm. Tool chatter may occur at speeds higher than 75 rpm, damaging injector sleeve bore.**

NOTE
Do not cut more than 0.010 in. (0.254 mm) deep into cylinder head.

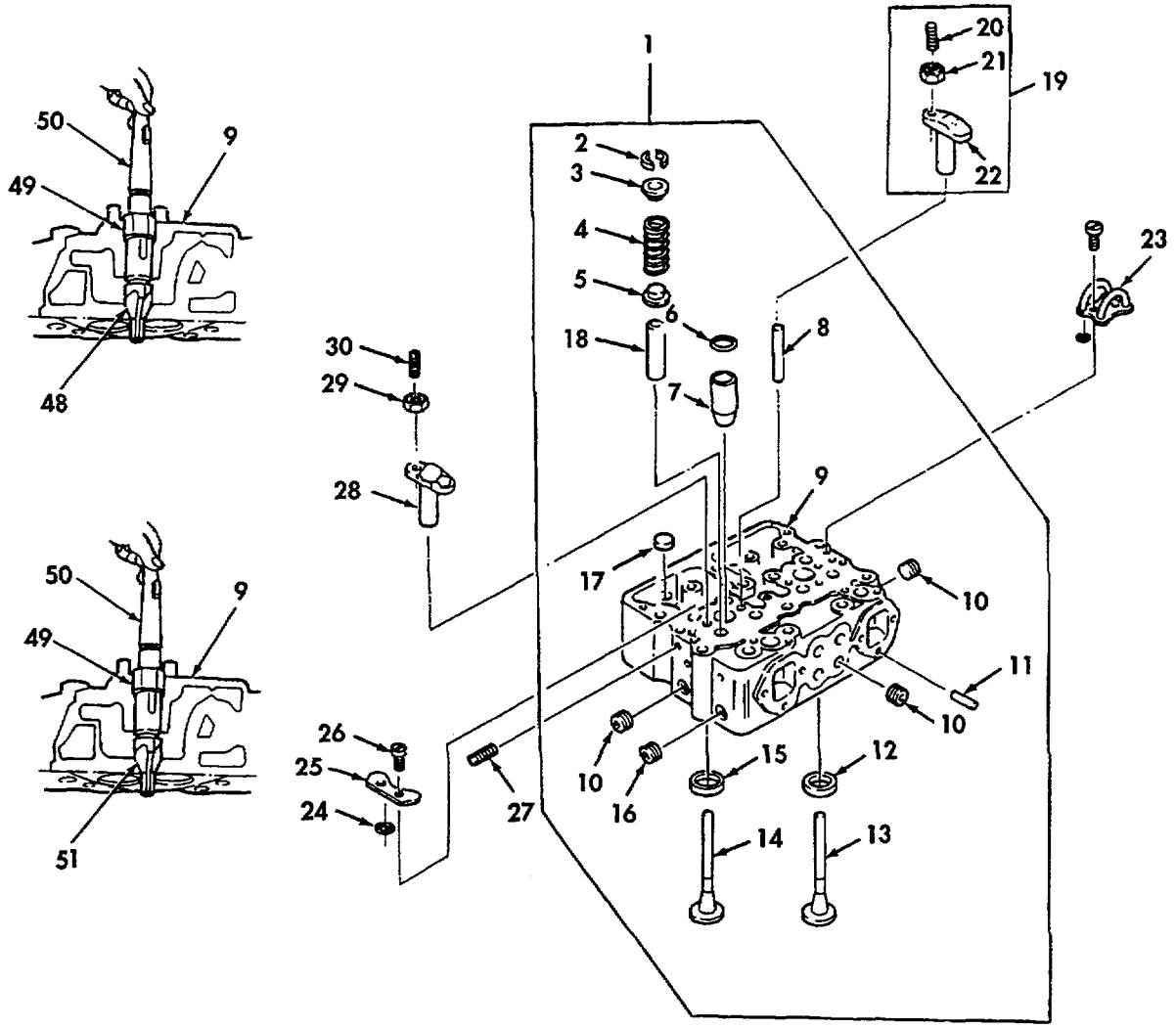
	(13) Turn on drill press motor and make a very light cut.	When proper cut depth has been reached, allow cutter (48) to turn in position for about 10 seconds to ensure a good seat and clean grooves.
	(14) Remove cutter (48), holder (50), and pilot (49) from drill press.	
	(15) Remove bead cutting tool (48) from holder (50) and pilot (49), and install injector seat cutting tool (51).	Use injector seat cutting tool (ST-824) (51) to cut a 70° chamfer at top edge of 60° seat. Apply Prussian blue compound to 60° seat to aid in determining amount of chamfer needed.
	(16) Lubricate and position cutter (51), holder (50), and pilot (49) on seat.	Lubricate cutter (51) with cutting oil.
	(17) Rotate cutter (51) while applying even pressure.	Use tap wrench. Remove cutter (51), holder (50), and pilot (49) when lower edge of 70° relief chamfer is about 0.125 in. (3.175 mm) from top of bead.

CAUTION

To prevent damage to injector sleeve during installation, ensure sleeve seat is free from oil, carbon, or any other foreign material.

	(18) Remove any bluing compound left on injector seat surface.	

3-35. CYLINDER HEAD AND VALVE REPAIR (Contd)



LEGEND:

7. INJECTOR SLEEVE
9. CYLINDER HEAD
48. BEAD CUTTING TOOL
49. PILOT
50. HOLDER
51. INJECTOR SEAT CUTTING TOOL

3-35. CYLINDER HEAD AND VALVE REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection and Repair (Contd)		
18. Two injector sleeves (7) (Contd)	(19) Apply a light coat of lubricating oil to new injector preformed packing (6).	Shake off excess oil.
	(20) Install injector preformed packing (6) on groove of injector sleeve bore of cylinder head (9).	
	(21) Using driver (52), push injector sleeve (7) into injector sleeve bore until firmly seated.	Use injector sleeve driver (ST-1227) (52). Install injector sleeve (7) by striking driver (52).
	(22) Remove driver (52).	
	(23) Install holding tool (53) on injector sleeve (7).	Use injector sleeve holding tool (ST-1179) (53). Tighten nut on holding tool (53) to 35-40 lb-ft (48-54 N•m).
	(24) Insert driver (52) in injector sleeve (7), and strike with soft-nose hammer until injector sleeve (7) is seated properly against bottom of injector sleeve bore.	Tighten nut on holding tool (53) again to 35-40 lb-ft (48-54 N•m).
	(25) Remove driver (52).	

CAUTION

- **To avoid distorting injector sleeve, do not roll lower area of sleeve.**
- **Over-rolling or peening injector sleeve will deform injector O-ring groove of sleeve.**

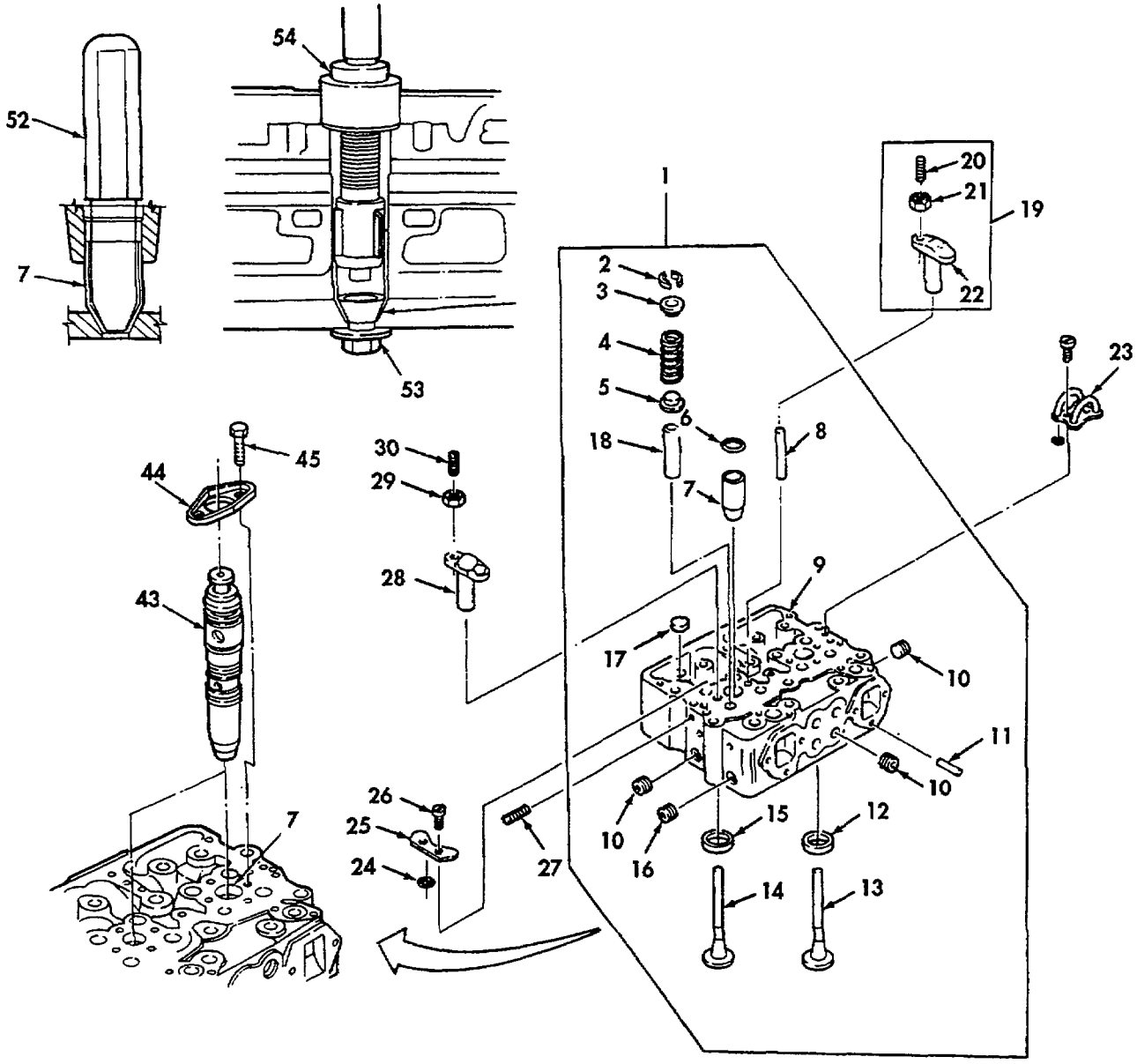
	(26) Install expander (54) on injector sleeve (7).	Use injector sleeve expander (ST-880) (54).
	(27) Tighten expander (54) to 75 lb-in. (102 N•m).	
	(28) Remove expander (54) and holding tool (53) from injector sleeve (7).	
	e. Cut injector seat as follows:	

NOTE

Ensure injector assembly is new or is known to be satisfactory prior to checking protrusion of tip.

	(1) Install injector assembly (43) on injector sleeve (7) with injector clamp (44) and two screws (45).	Tighten screws (45) alternately in 48 lb-in. (5 N•m) increments to 120-144 lb-in. (14-16 N•m).

3-35. CYLINDER HEAD AND VALVE REPAIR (Contd)



LEGEND:

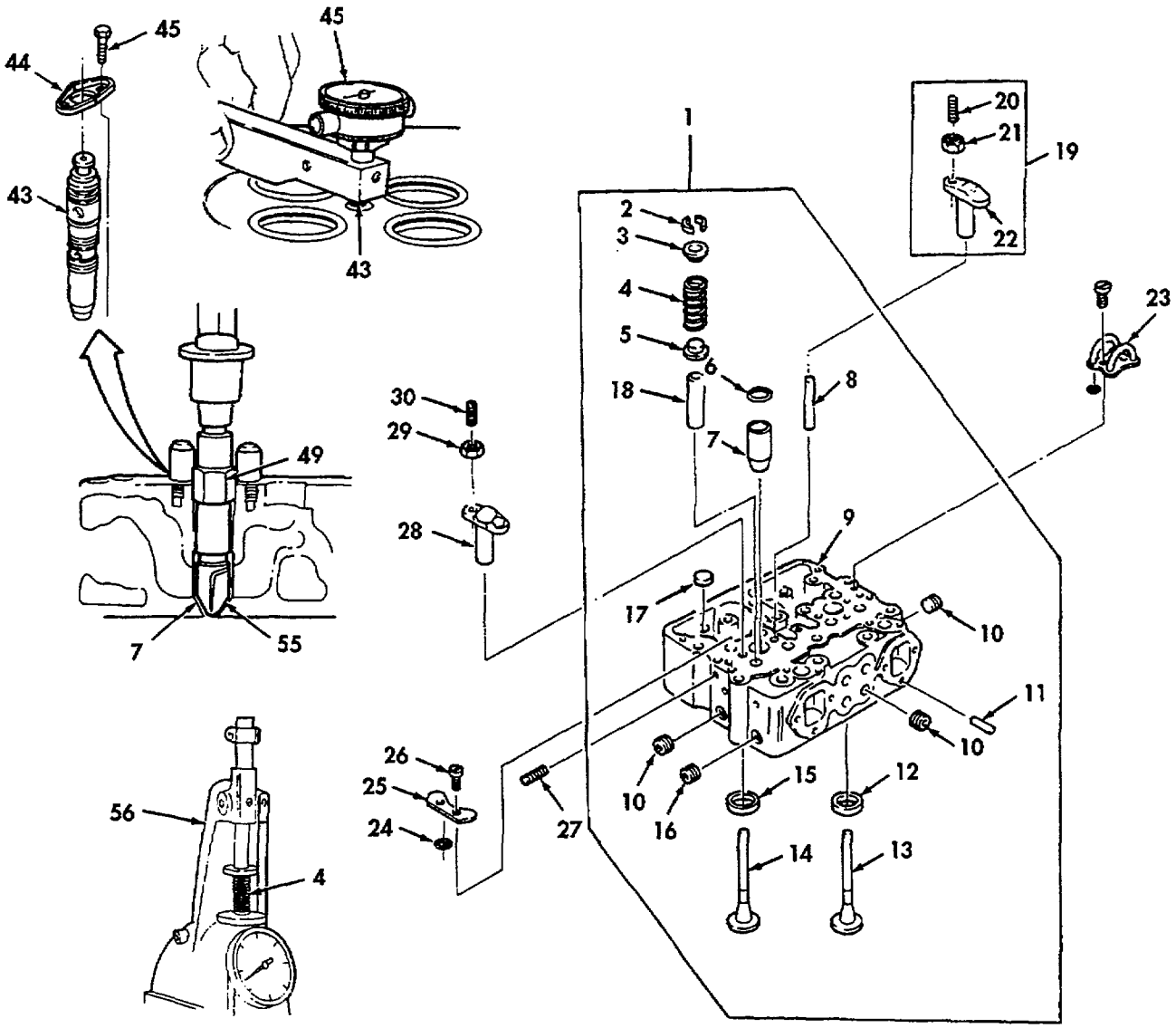
6. INJECTOR PREFORMED PACKING (2)
7. INJECTOR SLEEVE (2)
9. CYLINDER HEAD
43. INJECTOR ASSEMBLY
44. INJECTOR CLAMP
45. INJECTOR CLAMP SCREW (2)
52. INJECTOR SLEEVE DRIVER
53. INJECTOR HOLDING TOOL
54. INJECTOR SLEEVE EXPANDER

3-35. CYLINDER HEAD AND VALVE REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection and Repair (Contd)		
18. Two injector sleeves (7) (Contd)	(2) Using gauge block (46), measure protrusion of injector assembly (43) tip.	Use this measurement to determine amount that must be cut from sleeve. The protrusion of injector tip must be 0.060-0.070 in. (1.524-1.778 mm).
	(3) Remove two screws (45), injector clamp (44), and injector assembly (43) from injector sleeve (7).	
	(4) Install cutter (55) and pilot (49) on drill press and cut injector sleeve (7).	Use injector seat cutter (ST-884) (55). Ensure enough cutting oil is used to allow cutter (55) to cut freely without grabbing. When proper cut depth is reached, allow cutter (55) to turn in position for about 10 seconds to ensure a smooth seat.
	(5) Check injector (43) seating.	Refer to step 18b pattern.
	(6) Check protrusion of injector assembly (43) tip.	Refer to step 18c.
19. Eight valve springs (4)	a. Inspect for distortion, cracks, breaks, and collapsed coils.	Discard valve spring (4) if damaged.
	b. Using tester (56), compress to working length of 1.724 in. (4.379 cm).	Use valve spring tester (3375182) (56).
	c. Record amount of force required to compress valve spring (4).	Discard if less than wear limit shown below.

Wear Limit ..... 143.00 lb (64.92 kg)
New Minimum ..... 147.25 lb (66.85 kg)
New Maximum ..... 162.75 lb (73.89 kg)

3-35. CYLINDER HEAD AND VALVE REPAIR (Contd)



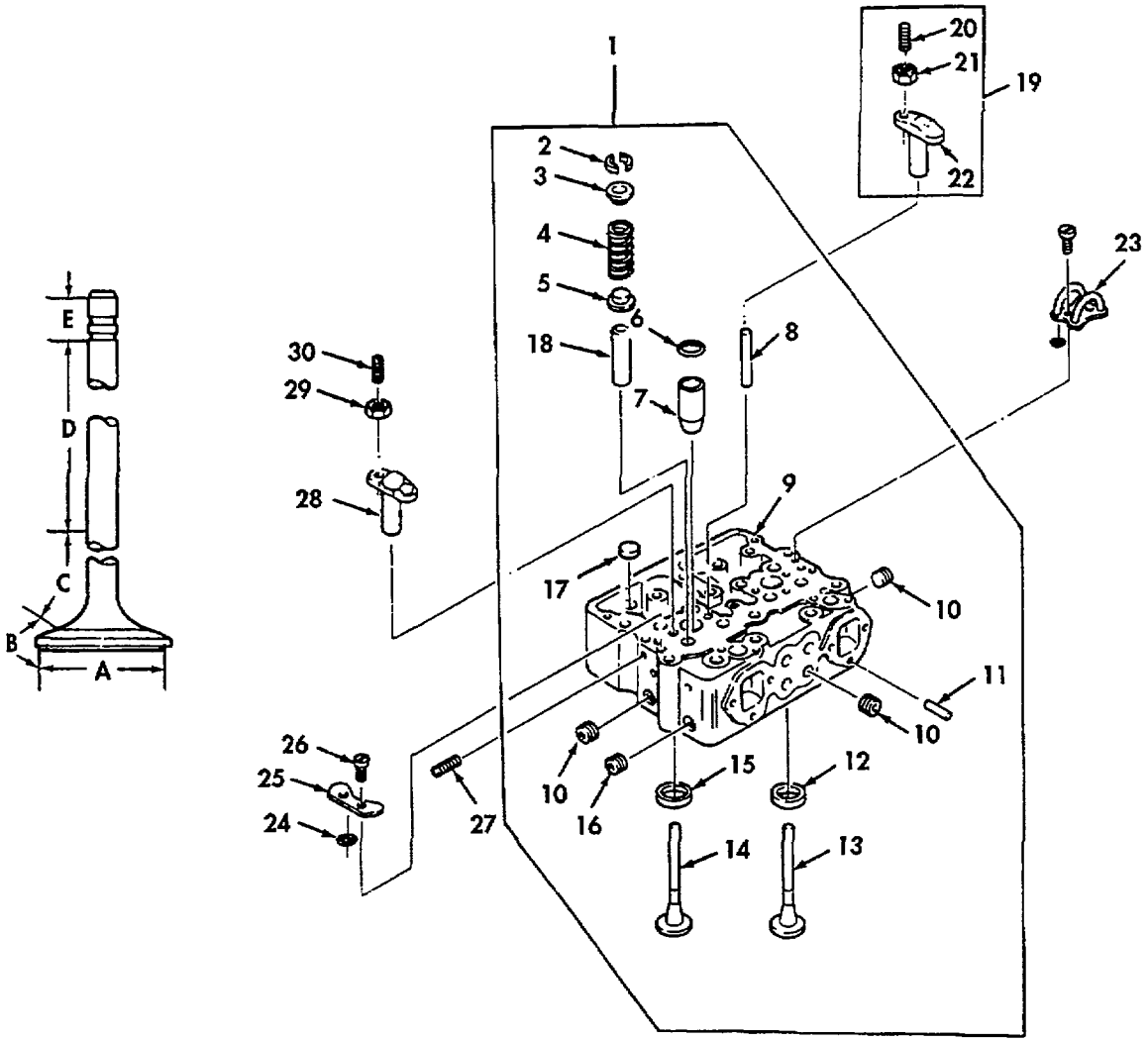
LEGEND:

4. VALVE SPRING (8)
7. INJECTOR SLEEVE (2)
43. NEW INJECTOR ASSEMBLY
44. INJECTOR CLAMP
45. INJECTOR CLAMP SCREW (2)
46. GAUGE BLOCK
49. PILOT
55. INJECTOR SEAT CUTTER
56. VALVE SPRING TESTER

3-35. CYLINDER HEAD AND VALVE REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection and Repair (Contd)		
	NOTE **Repeat step 20 for each intake and exhaust valve.**	
20. Valve (13) or (14)	a. Polish with crocus cloth.	
	b. Inspect head of valve (13) or (14) for cupping, cracking, pitting, and wear.	Discard if damaged or if valve head rim thickness is less than 0.105 in. (2.667 mm).
	c. Inspect stem of valve (13) or (14) for cracks, scoring, galling, wear or bends.	Discard if damaged or if stem diameter is less than wear limit shown below. Wear Limit ..... 0.449 in. (11.405 mm) New Minimum ..... 0.450 in. (11.430 mm) New Maximum ..... 0.451 in. (11.455 mm)
	d. Check collet grooves on valve (13) or (14) stem for wear.	Use new valve collets (2) to check grooves. Discard valve (13) or (14) if collets fit loosely in grooves.
	e. Inspect for cracks using magnetic method:	
	(1) Magnetize valve (13) or (14) in coil at 100 to 300 amperes, and inspect with residual Magnaglo. If damaged, defects will show around circumference of valve.	Inspect area A (refer to illustration) and discard valve (13) or (14) with more than five indications, longer than 0.500 in. (12.7 mm), or indications spaced closer than 0.125 in. (3.175 mm).
	(2) Magnetize valve (13) or (14) by headshot magnetization at 500 to 700 amperes, and inspect with residual Magnaglo.	Inspect areas B, C, D, and E (refer to illustration). No visible or magnetic indication is acceptable. Discard. Demagnetize acceptable valves (13) or (14).
	NOTE **Repeat step 21 for each intake and exhaust valve crosshead.**	
21. Valve crosshead (22) or (28)	a. Inspect for excessive wear, distortion, grooving, scoring, galling, stripped threads, broken areas, and out-of-round.	Discard if damaged.
	b. Inspect for cracks using magnetic method.	Discard if any cracks are found.

3-35. CYLINDER HEAD AND VALVE REPAIR (Contd)



LEGEND:

2. VALVE COLLET (16)
13. INTAKE VALVE (4)
14. EXHAUST VALVE (4)
22. INTAKE VALVE CROSSHEAD (2)
28. EXHAUST VALVE CROSSHEAD (2)

3-35. CYLINDER HEAD AND VALVE REPAIR (Contd)

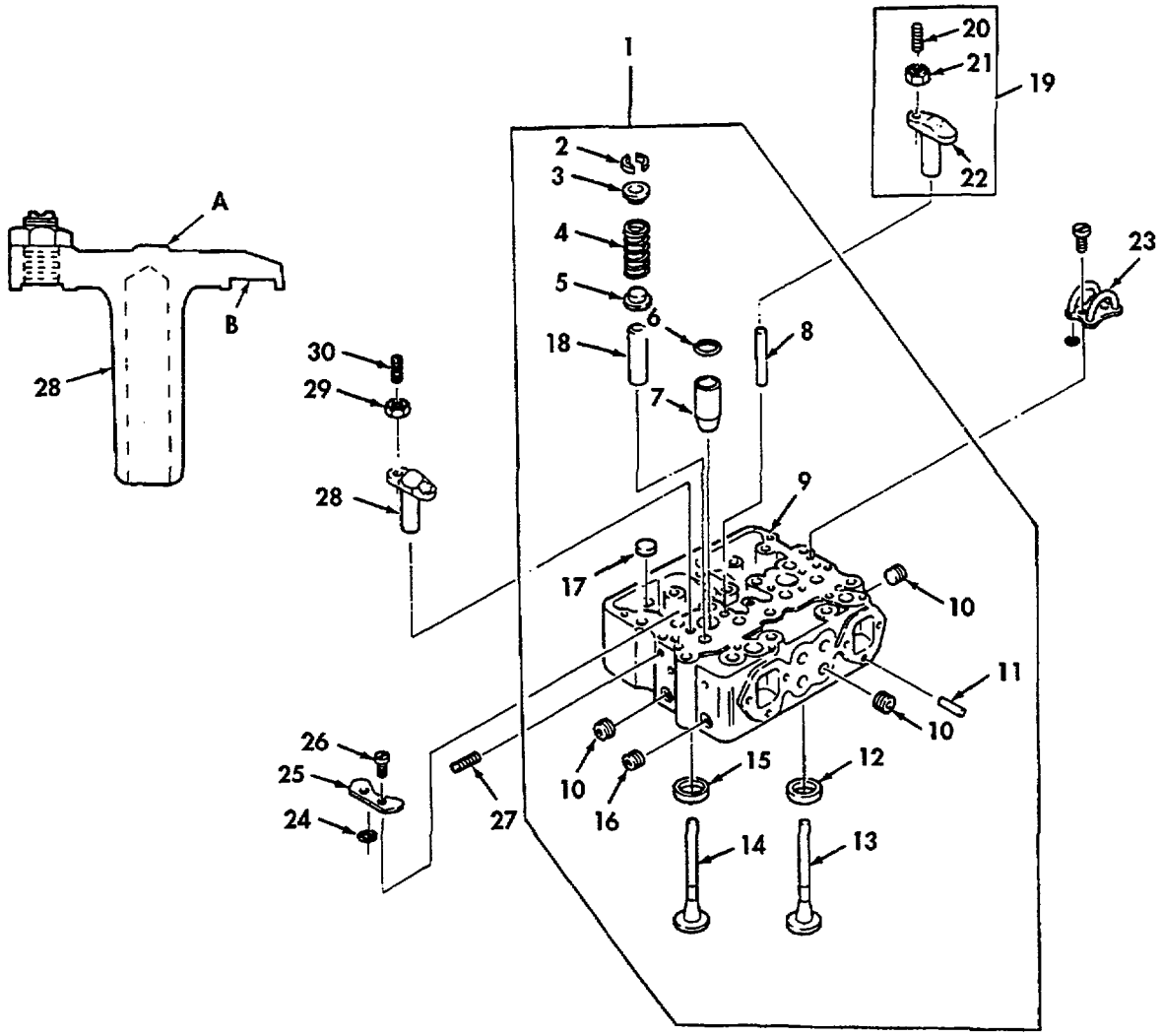
LOCATION/ITEM	ACTION	REMARKS
c. Inspection and Repair (Contd)		
21. Valve crosshead (22) or (28) (Contd)	c. Use suitable bore gauge. Measure crosshead bore diameter.	Discard if not within wear limit shown below.

Wear Limit ..... 0.440 in. (11.176 mm)
New Minimum ..... 0.434 in. (11.024 mm)
New Maximum ..... 0.436 in. (11.074 mm)

CAUTION
To prevent damage to valve crosshead, do not use plug gauge during next step.

	d. Check crosshead bore at four points, spaced 90° apart, for out-of-round.	Use suitable bore gauge. Discard if out-of-round.
	e. Inspect rocker lever contact surface (area A) and valve stem contact surface (area B) for wear (refer to illustration).	Discard if excessively worn or if surface is damaged.
22. Two fuel connections (23)	Inspect for cracks, breaks, and bends.	Discard if cracked, broken, or bent.
23. All other parts	a. Inspect for cracks, breaks, bends, excessive wear, and other damage.	Discard if damaged or worn.
	b. Inspect all threaded parts for stripped threads or cross-threading.	Discard any threaded parts that are stripped or cross-threaded.

3-35. CYLINDER HEAD AND VALVE REPAIR (Contd)



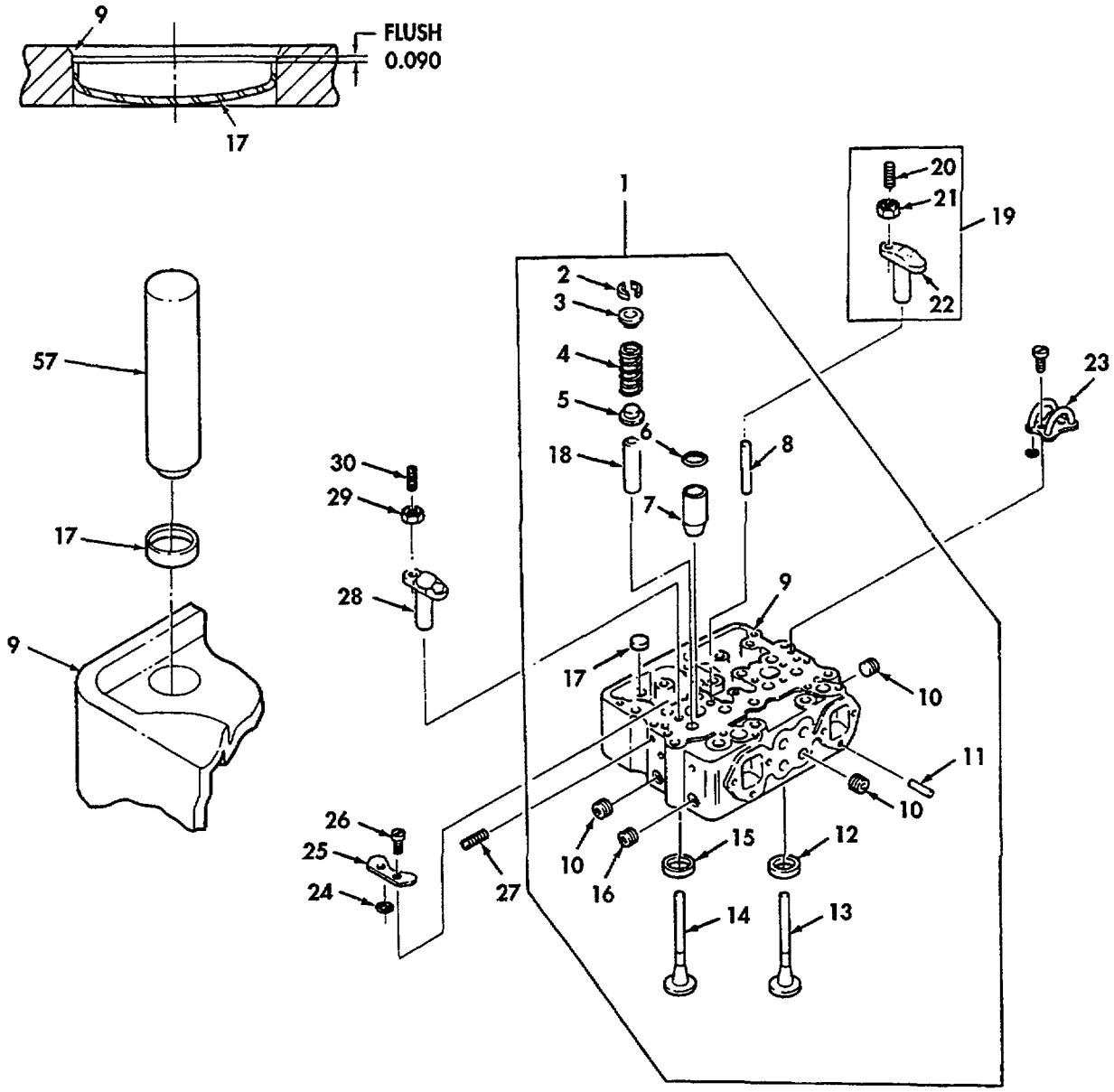
LEGEND:

22. INTAKE VALVE CROSSHEAD (2)
23. FUEL CONNECTION (2)
28. EXHAUST VALVE CROSSHEAD (2)

3-35. CYLINDER HEAD AND VALVE REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Assembly and Testing		
	NOTE **Ensure all parts are clean prior to assembling.**	
24. Six new expansion plugs (10), new expansion plug (16), and two new expansion plugs (17)	a. Apply a coat of cup plug sealant to expansion plugs and to inside diameter of water holes on cylinder head (9).	
	b. Using drivers (57), install expansion plugs (10), (16), and (17) on cylinder head (9).	Use expansion plug drivers (3375190, 3375191, and 3375192) (56). If expansion plug drivers (57) are not available, use mandrel of correct size and ensure expansion plugs (10), (16), and (17) are installed even (flush) with, or not more than, 0.090 in. (2.286 mm) below chamfer (see illustration). Do not push expansion plugs to bottom of counterbore.
25. Four pipe plugs (27)	a. Coat threads of each pipe plug (27) with liquid thread sealant.	
	b. Install two on each end of cylinder head (9).	No. 3 cylinder head has two pipe plugs (27) in forward end only. Tighten pipe plugs (27) to: **PLUG SIZE — TORQUE** 1/16 in. — 3-6 lb-ft (4-8 N•m) 1/8 in. — 5-10 lb-ft (7-14 N•m) 3/8 in. — 35-45 lb-ft (48-61 N•m) 1/2 in. — 60-70 lb-ft (81-95 N•m) 3/4 in. — 65-75 lb-ft (88-102 N•m) 1 in. — 135-145 lb-ft (183-197 N•m)

3-35. CYLINDER HEAD AND VALVE REPAIR (Contd)



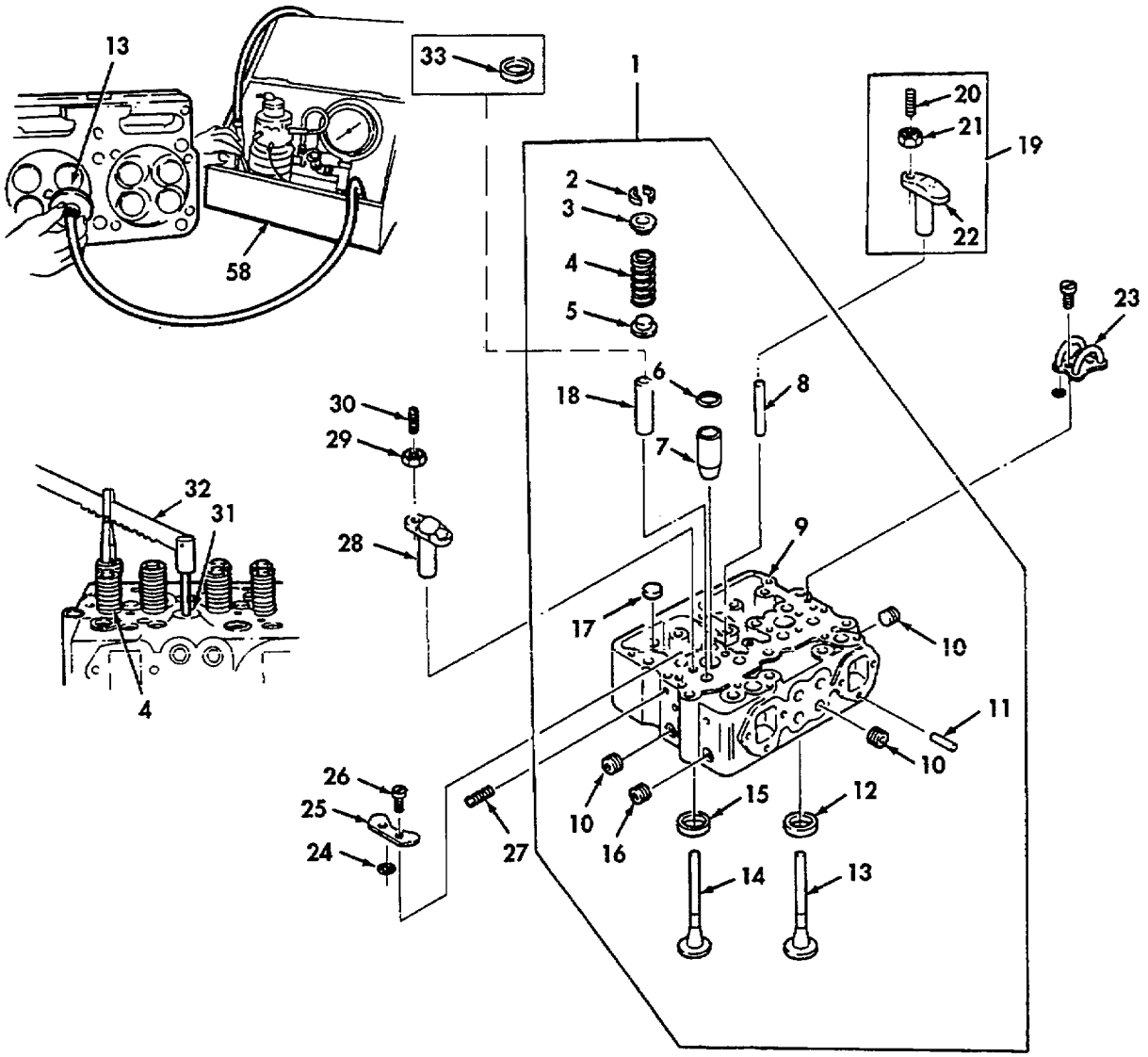
LEGEND:

9. CYLINDER HEAD
10. EXPANSION PLUG (6)
16. EXPANSION PLUG
17. EXPANSION PLUG (2)
27. PIPE PLUG (4)
57. EXPANSION PLUG DRIVER

3-35. CYLINDER HEAD AND VALVE REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Assembly and Testing (Contd)		
	NOTE **Step 26 does not apply to No. 2 cylinder head.**	
26. Cover plate (25) and two new preformed packings (24)	a. Install on cylinder head (9).	
	b. Secure with two screws (26).	
27. Four intake valves (13) and exhaust valves (14)	a. Dip valve stems into clean lubricating oil.	
	b. Install valves (13) or (14) on valve stem guides (18) from bottom side of cylinder head (9).	Ensure cylinder head is clean and valves are installed in their original locations as numbered in step 7. Ensure valve heads are fully seated on valve inserts (12) and (15).
28. Cylinder head (9)	Place on wooden bench or protective surface with machined surface down.	Wooden bench or protective surface will prevent damage to machined surface.
	NOTE **A maximum of two 0.031 in. (0.794 mm) spacers may be used under lower valve spring guide when cylinder head has been resurfaced and valve seat has been reground. Do not use spacers to compensate for weak springs.**	
29. Eight upper valve spring guides (3), valve springs springs (4), and lower valve spring guides (5) (spacers (33) if necessary)	a. Place over valve stem guides (18) on cylinder head (9).	
	b. Compress valve springs (4) and install sixteen new valve collets (2) on stems of valves (13) and (14).	Use valve spring compressor (ST-448) (32) and head holding fixture (ST-583). Stud of valve spring compressor (32) should be installed on rocker lever screw hole (31).
	NOTE **Ensure valves and valve seats are clean and dry.**	
30. Cylinder head assembly (1)	Check seal between valve (13) or (14) and valve seat as follows:	Use valve vacuum tester (ST-1257-A) (58).
	a. Select correct size vacuum cup for size of valve being tested.	
	b. Put vacuum cup over head of valve (13) or (14).	O-ring on vacuum cup must make seal on cylinder head (9) around valve (13) or (14). Grease can be applied to O-ring for a better seal.

3-35. CYLINDER HEAD AND VALVE REPAIR (Contd)



LEGEND:

1. CYLINDER HEAD ASSEMBLY
2. VALVE COLLET (16)
3. VALVE SPRING GUIDE (8)
4. VALVE SPRING (8)
5. VALVE SPRING GUIDE (8)
9. CYLINDER HEAD
12. INTAKE VALVE INSERT (4)
13. INTAKE VALVE (4)
14. EXHAUST VALVE (4)
15. EXHAUST VALVE INSERT (4)
18. VALVE STEM GUIDE (8)
24. PREFORMED PACKING (2)
25. COVER PLATE
26. SCREW (2)
31. ROCKER LEVER SCREW HOLE
32. VALVE SPRING COMPRESSOR
33. SPACER
58. VALVE VACUUM TESTER

3-35. CYLINDER HEAD AND VALVE REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Assembly and Testing (Contd)		
30. Cylinder head assembly (1) (Contd)	c. Turn hand shutoff valve to open position and hold down push button to operate valve vacuum tester (58).	
	d. Operate vacuum tester (58) until vacuum gauge indicates between 18 and 25 in. of vacuum.	Close hand shutoff valve and release push button to stop vacuum pump.
	e. Record vacuum drop to determine satisfactory valve sealing.	1. Start timing as soon as gauge hand reaches 18 in. of vacuum. 2. Stop timing when gauge hand reaches 8 in. of vacuum. 3. If time is less than 10 seconds, valve seating is unsatisfactory. Perform step 30f if valve seating is unsatisfactory.
	f. Tap stem end of valve (13) or (14) with soft-nose mallet and repeat vacuum test.	Lapping valves is permissible, if necessary, to create an air-tight seal.
	g. Check for leaking connections in valve vacuum tester (58).	Clean if necessary.
	h. Check for leaks between valve insert (12) or (15) and valve insert center bore in cylinder head (9).	1. Apply a coat of grease to outside diameter of insert to make a greade seal between insert and counterbore. 2. Vacuum test (refer to step 30d) and inspect grease seal. 3. If there is a break in grease seal, remove valve (13) or (14). Stake valve seat with valve seat insert staking tool (36) and driver (37).
31. Two adjusting screws (30) and nuts (29)	Install on exhaust valve crossheads (28).	
32. Two adjusting screws (20) and nuts (21)	Install on intake valve crossheads (22).	
33. Two exhaust valve crossheads (28) and intake valve crossheads (22)	Install on valve crosshead guides (8) on cylinder head (9).	

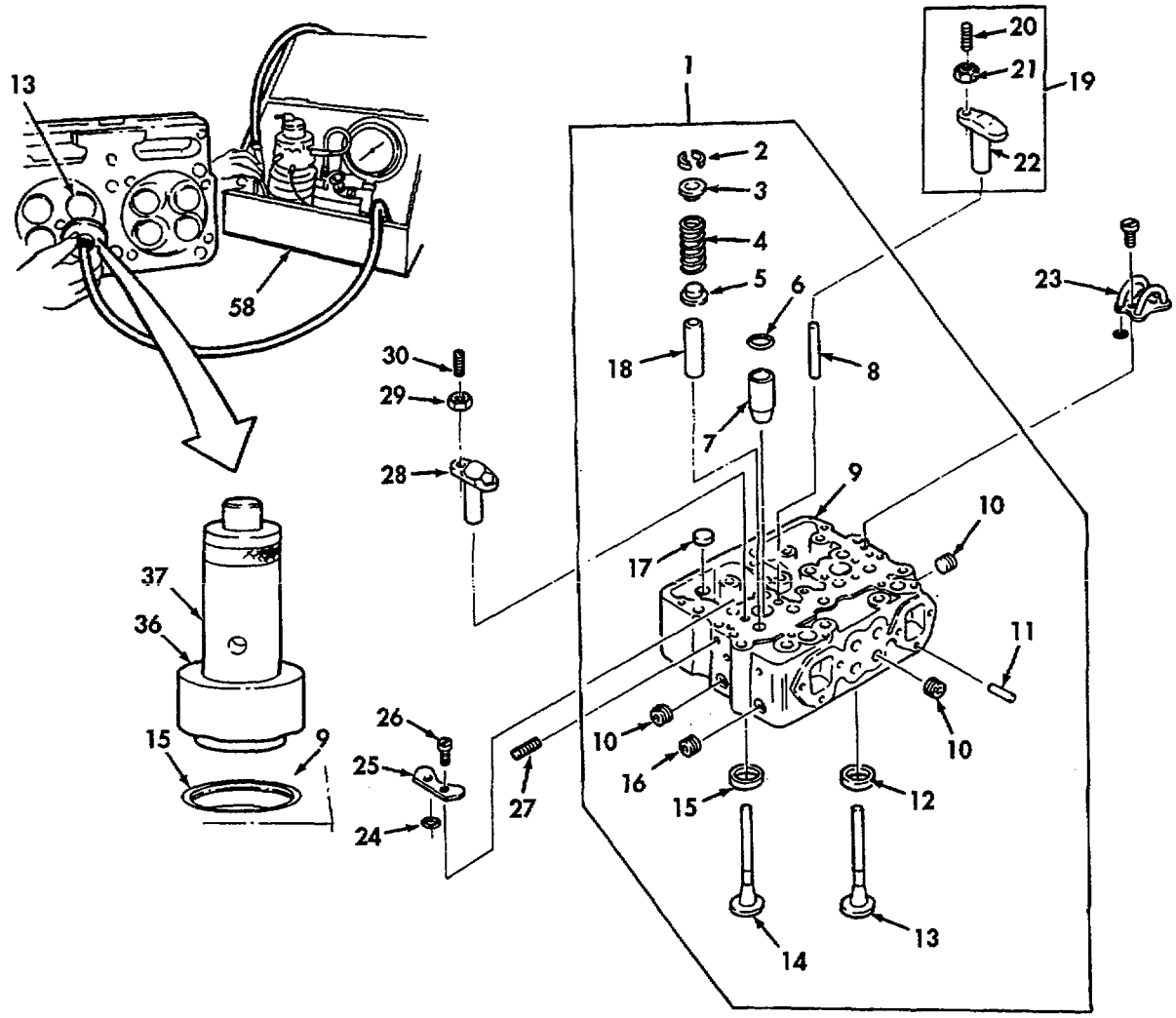
NOTE
Step 34 is for M915/Big Cam I vehicles only.

34. Plugpipes — Install all cylinder head pipe plugs and tighten to specifications shown below.

PIPE PLUG SIZE		MINIMUM		MAXIMUM	
INCH	(MM)	LB-FT	(N•m)	LB-FT	(N•m)
3/8	9.525	35	47	45	61
1/2	12.70	60	81	70	95
3/4	19	65	88	75	102
1	25	135	183	145	197

FOLLOW-ON TASK: Install cylinder head assembly (para. 3-71).

3-35. CYLINDER HEAD AND VALVE REPAIR (Contd)



LEGEND:

1. CYLINDER HEAD ASSEMBLY
8. VALVE CROSSHEAD GUIDE (4)
9. CYLINDER HEAD
12. INTAKE VALVE INSERT (4)
13. INTAKE VALVE (4)
14. EXHAUST VALVE (4)
15. EXHAUST VALVE INSERT (4)
20. ADJUSTING SCREW (2)
21. NUT (2)
22. INTAKE VALVE CROSSHEAD (2)
28. EXHAUST VALVE CROSSHEAD (2)
29. NUT (2)
30. ADJUSTING SCREW (2)
36. VALVE SEAT INSERT STAKING TOOL
37. VALVE SEAT INSERT STAKING TOOL DRIVER
58. VALVE VACUUM TESTER

3-36. VIBRATION DAMPER AND CRANKSHAFT PULLEY REPAIR

THIS TASK COVERS:

a. Cleaning **b. Inspection**

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
None

TEST EQUIPMENT
None

MATERIALS/PARTS
Solvent, SD-3 (Appendix C, Item 30)
Developer, spotcheck, SKD-NF (Appendix C, Item 10)
Cloth, emery, 290-grit (Appendix C, Item 5)

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
Vibration damper and crankshaft pulley removed (para. 3-14).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

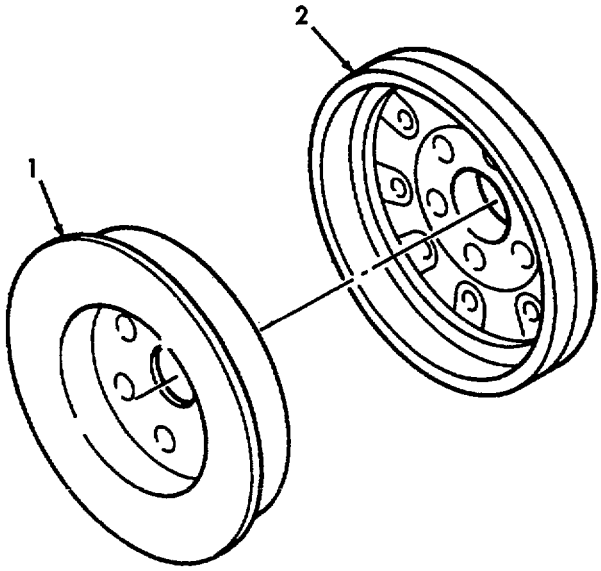
GENERAL SAFETY INSTRUCTIONS
- Always wear eye protection when working with compressed air.
- Use solvents away from flame and in well-ventilated area.

LOCATION/ITEM	ACTION	REMARKS
a. Cleaning		
	WARNING • **Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and protective equipment such as goggles or shield, gloves, etc. Failure to comply may result in injury to personnel.** • **Approved solvents may be flammable and will not be used near open flame. Use only in well-ventilated area. Failure to comply may result in injury to personnel.**	
1. Vibration damper (1) and crankshaft pulley (2)	Clean with solvent SD-3 and dry with compressed air.	Refer to para. 3-6 for additional cleaning instructions.
b. Inspection		
2. Crankshaft pulley (2)	Inspect for cracks, breaks, and other damage.	Discard if damaged.
3. Vibration damper (1)	a. Inspect for cracks, breaks, bends, and other damage.	Discard if damaged.

3-36. VIBRATION DAMPER AND CRANKSHAFT PULLEY REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
	b. Inspect for leaks as follows:	
	(1) Apply a spray of spotcheck developer.	
	(2) Put in oven heated to 200°F (93°C) for approximately 2 hours.	
	(3) Remove from oven when it reaches oven temperature.	Use protective gloves.
	(4) Inspect for oil leaks.	Discard if any leaks are found.
	c. Check thickness as follows:	
	(1) Using SD-3 solvent and 290-grit emery cloth, remove paint from four areas on each side.	Do not use coarse emery cloth or sharp tool to remove paint.
	(2) Measure thickness at four unpainted areas.	Use suitable micrometer. Measure approximately 0.125 in. (3.175 mm) from outside diameter of damper (1). Discard if difference between any two measurements is more than 0.010 in. (0.254 mm).

FOLLOW-ON TASK: Install vibration damper and crankshaft pulley (para. 3-79).



LEGEND:
1. VIBRATION DAMPER
2. CRANKSHAFT PULLEY

3-37. CRANKSHAFT REPAIR

THIS TASK COVERS:

a. Cleaning **b. Inspection**

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
None

TEST EQUIPMENT
None

MATERIALS/PARTS
Oil, lubricating, OE/HDO 30 (Appendix C, Item 21)
Solvent, SD-3 (Appendix C, Item 30)

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
Engine crankshaft and main bearings removed (para. 3-31).

SPECIAL ENVIRONMENTAL CONDITIONS
None

GENERAL SAFETY INSTRUCTIONS
- Compressed air used for cleaning purposes will not exceed 30 psi.
- Wear heat-resistant gloves when handling heated crankshaft gear.
- Use solvents away from flame and in well-ventilated area.

LOCATION/ITEM	ACTION	REMARKS

a. Cleaning

WARNING

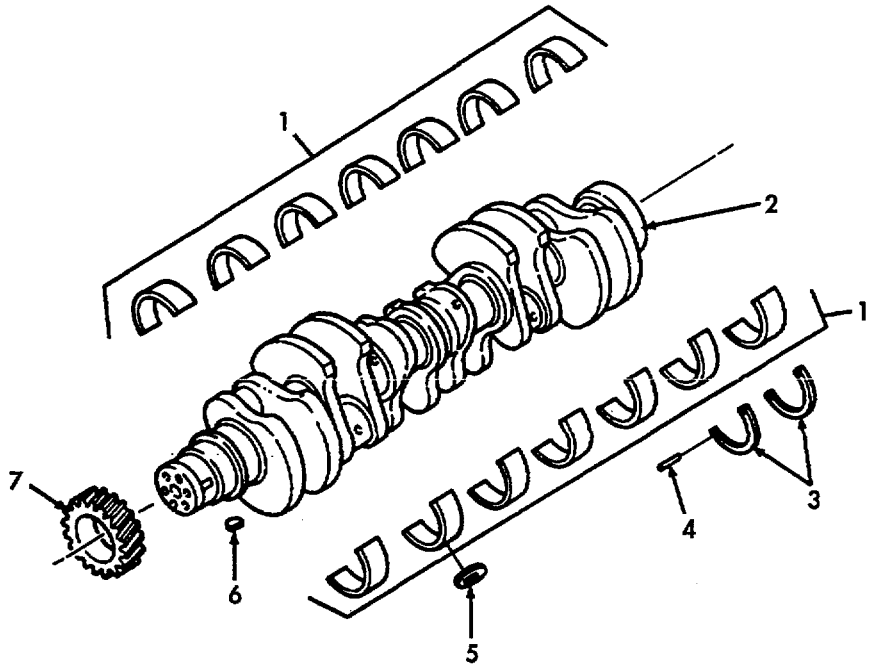
- **Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and protective equipment such as goggles or shield, gloves, etc. Failure to comply may result in injury to personnel.**
- **Approved solvents may be flammable and will not be used near open flame. Use only in well-ventilated area. Failure to comply may result in injury to personnel.**

CAUTION

Avoid heavy use of wire wheel or wire brush to clean rod bearing and main bearing journal surfaces. Failure to comply may result in an out-of-round condition to crankshaft journals.

1. Crankshaft (2)	Clean as follows:	
	a. Remove pipe plugs and clean all oil holes with nylon bristle brush soaked with SD-3 solvent.	Use SD-3 solvent to flush oil holes after cleaning.
	b. Clean remaining surfaces with SD-3 solvent.	
	c. Dry with compressed air.	
	d. Install and tighten pipe plugs to 5 lb-ft (7 N•m).	

3-37. CRANKSHAFT REPAIR (Contd)



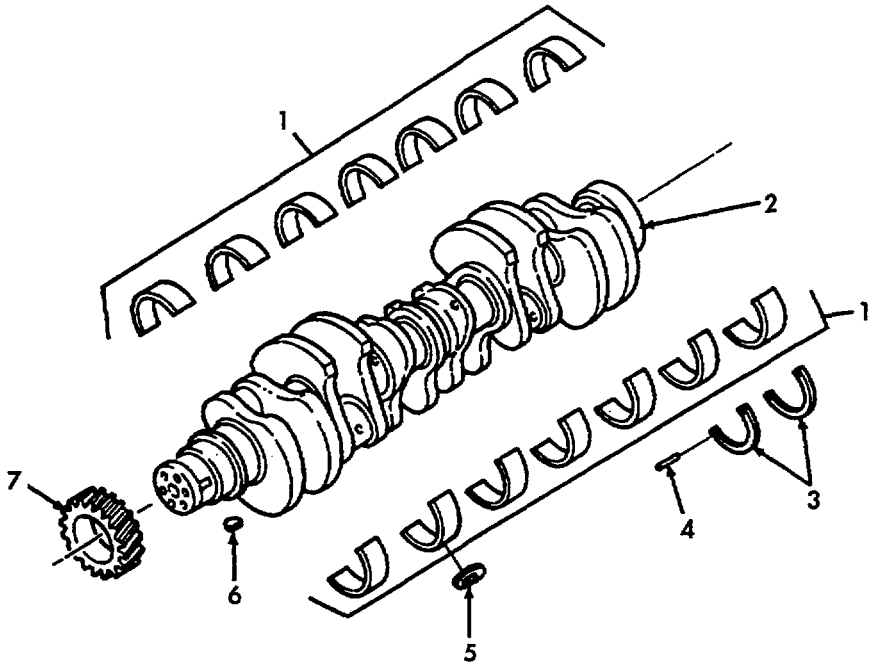
LEGEND:

1. STANDARD MAIN BEARING SET
2. CRANKSHAFT
3. THRUST RING (4)
4. THRUST RING PIN (2)
5. RETAINING RING (7)
6. GEAR-TO-CRANKSHAFT KEY
7. CRANKSHAFT GEAR

3-37. CRANKSHAFT REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
a. Cleaning (Contd)		
	NOTE **If inspection or installation of crankshaft will be performed later, coat all journal surfaces with a heavy film of OE/HDO 30 lubricating oil to prevent rust from forming.**	
2. Standard main bearing set (1), seven retaining rings (5), four thrust rings (3), and two thrust ring pins (4)	Clean with SD-3 solvent and blow dry.	
b. Inspection		
	NOTE **Main bearings are provisioned as a set. If one main bearing half is not within specifications or is found to be defective, discard entire main bearing set.**	
3. Standard main bearing set (1)	Inspect each main bearing half for the following: a. Pits, scratches, or grooves.	There are 14 main bearing halves to a standard main bearing set (1); inspect each half Discard if pitted, scratched, or grooved.
	CAUTION **Never remove any metal from bearing shells to change oil clearance. After operation, a bearing shell that is fitted correctly will be gray. Light areas on shell indicate that metal is touching metal without enough oil clearance. Dark areas on shell indicate that the clearance is too large.**	
	NOTE **Wear limits for undersized bearing halves may be determined by adding the correct amount (0.010 in. (0.254 mm), 0.020 in. (0.508 mm), and 0.030 in. (0.762 mm) to the minimum and maximum dimension of a standard bearing.**	
	b. Thickness of main bearing halves.	Use a micrometer that has a ball point. Minimum thickness is 0.123 in. (3.124 mm), maximum thickness is 0.1238 in. (3.144 mm), and wear limit is 0.1215 in. (3.0861 mm).
4. Four thrust rings (3)	Measure thickness of each thrust ring (3) at different locations.	Prior to taking measurements, place crankshaft (2) on cylinder block with corresponding bearing halves and caps installed. A new crankshaft (2) and new thrust ring (3) will have an end clearance of 0.007-0.017 in. (0.179-0.432 mm). If the clearance exceeds 0.022 in. (0.559 mm), install oversize thrust rings (3).
5. Two thrust ring pins (4)	Inspect for damage or wear.	Discard if damaged or worn.

3-37. CRANKSHAFT REPAIR (Contd)



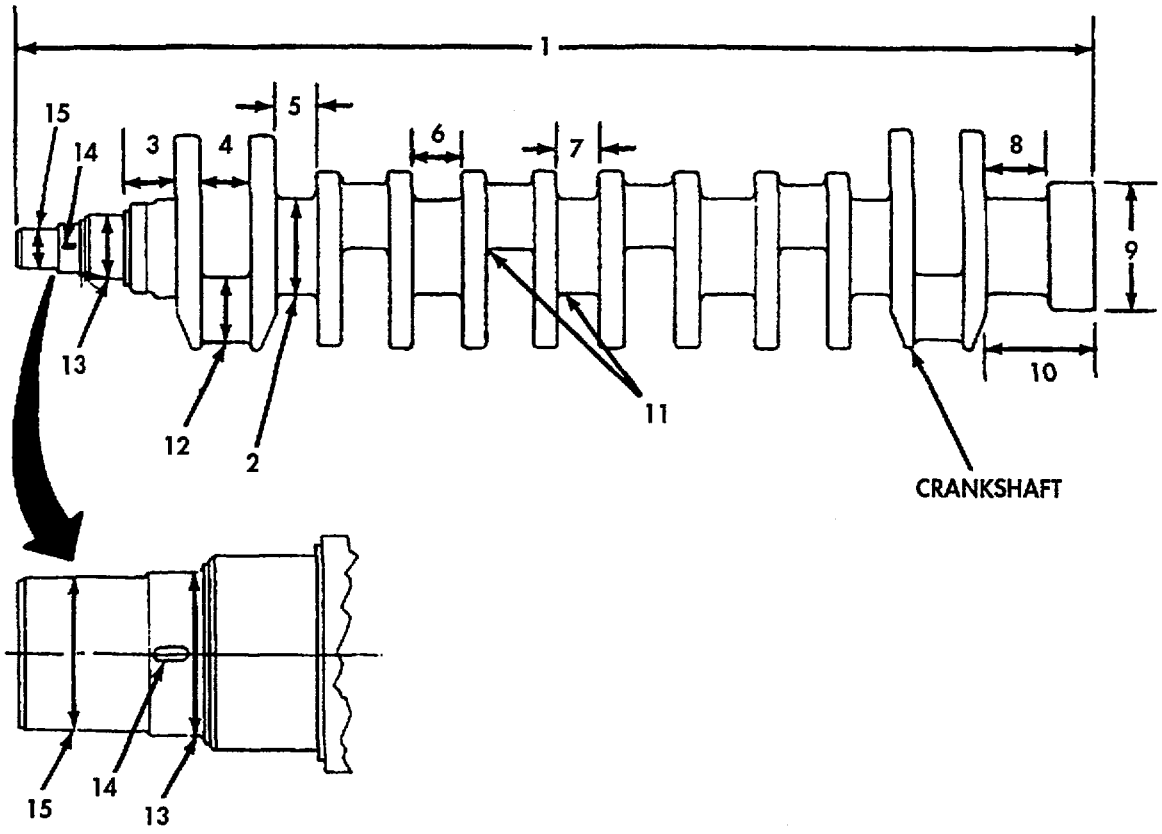
LEGEND:

1. STANDARD MAIN BEARING SET
2. CRANKSHAFT
3. THRUST RING (4)
4. THRUST RING PIN (2)
5. RETAINING RING (7)

3-37. CRANKSHAFT REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
b. Inspection (Contd)		
	NOTE **Perform step 6 for crankshaft dimensions and measurements for M915/Big Cam I only.**	
6. Crankshaft	a. Measure crankshaft journals for wear (refer to Table 1). Journals worn out-of-round more than 0.002 in. (0.051 mm) will make it necessary to regrind crankshaft. b. Measure crankshaft thrust flange by checking dimensions (Table 1, No. 8). If wear does not exceed 0.003 in. (0.0762 mm) at any one point, flange condition is acceptable. If wear is 0.003 in. (0.0762 mm) or more, regrind flange to restore flatness. c. If total wear and regrinding does not exceed 0.005 in. (0.127 mm), standard thrust rings may be used. d. If worn more than 0.007 in. (0.1778 mm), flange should be ground for 0.010 or 0.020 in. (0.254 or 0.508 mm) oversize thrust rings or built up by electric arc welding and reground to specifications (Table 1, No. 8). Regrinding must clean up a minimum of 90 percent of thrust surface and result in maintaining an installed crankshaft end clearance below 0.015 in. (0.381 mm). e. Crankshafts with oversize thrust rings should be stamped on rear crankshaft counterweight. Both thrust ring size and ring location should be included in stamping. For example: Front ..... 0.010 in. (0.254 mm) Rear ..... 0.020 in. (0.508 mm)	Check crankshaft thrust flange at No. 7 main bearing for scoring, scratches, nicks, and breaks. If surface is scored or scratched, flange should be reground.

3-37. CRANKSHAFT REPAIR (Contd)



1. 51.8125 IN. (1316.0375 MM)
2. 4.4965-4.500 IN. (114.262-114.3 MM)
3. 2.4375 IN. (61.9125 MM)
4. 2.126-2.128 IN. (54.0004-54.0512 MM)
5. 2.000 IN. (50.8 MM)
6. 2.500 IN. (63.5 MM)
7. 2.000 IN. (50.8 MM)
8. 3.001-3.003 IN. (76.2254-76.2762 MM)
9. 5.998-6.000 IN. (152.3492-152.4 MM)
10. 5.151-5.163 IN. (130.8354-131.1402 MM)
11. 0.1728-0.1958 IN. (79.3369-79.375 MM)
12. 3.1235-3.125 IN. (4.389-4.973 MM)
13. 3.7607 IN. (95.5218 MM)
14. 0.375 IN. (0.9525 MM)
15. 3.625-3.626 IN. (92.075-93.0 MM)

TABLE 1. CRANKSHAFT DIMENSIONS AND POINTS OF MEASUREMENT

3-37. CRANKSHAFT REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
b. Inspection (Contd)		
	f. Whenever structural damage to an engine has occurred, such as piston or valve breakage, a magnetic inspection should be performed on crankshaft as follows:	

NOTE

Ampere turns in amperage flowing through coil are multiplied by number of turns in coil; the currents listed below are for 4-turn coil.

	DIRECTION OF DEFECT LONGITUDINAL	DIRECTION OF DEFECT CIRCUMFERENTIAL
DC or Rectified	1200 Amp	3600-4000 amp turns
AC Equipment	1400 Amp	4200-4700 amp turns
Magnetizing Method	Head Shot	Coil Shot

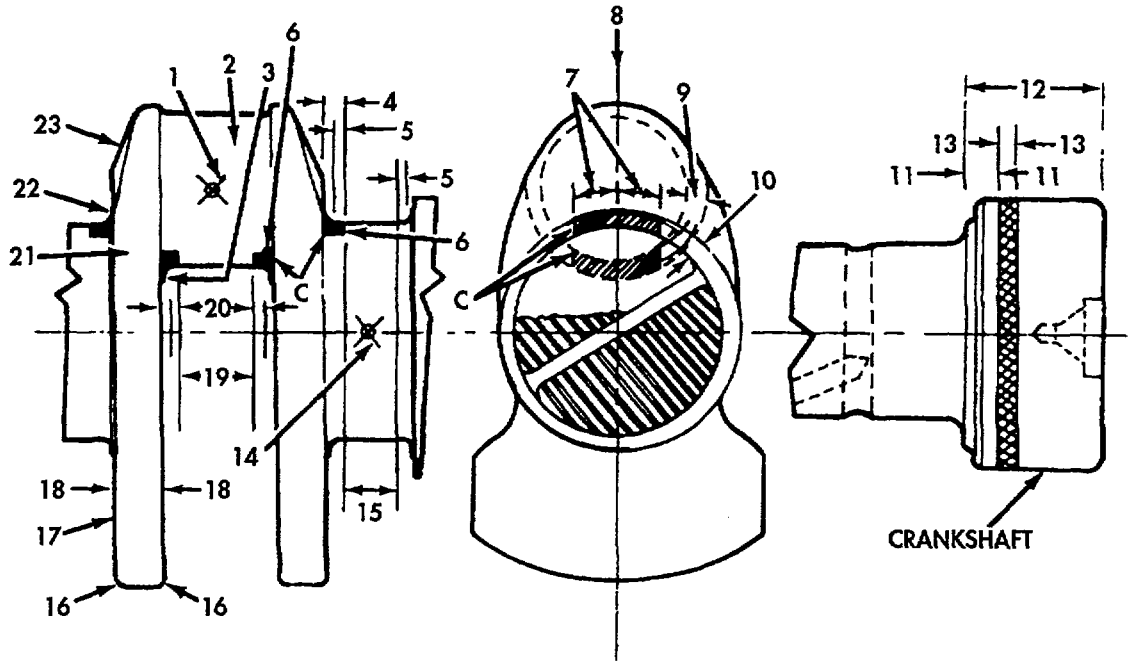
g. Wet complete surface with magnetic particle suspension before applying currents.

h. Use the following directional magnetizing currents for crankshaft magnetic inspection or Magnaflux inspection:

i. Flow magnetic particle suspension over part in advance of placing part through coil. — Turn current on coil and move coil full length of part.

(1) If shaft parts are within 2 in. (5.1 cm) or 3 in. (7.6 cm) of the coil inside diameter, ample magnetism will be obtained if 3 shots of current are passed through coil at each end and center of part length.

(2) The limits of acceptability, unless otherwise stated, apply only to light slag or oxide stringers usually defined as inherent inclusions. — Obvious cracks and circumferential or transverse defects are not acceptable.



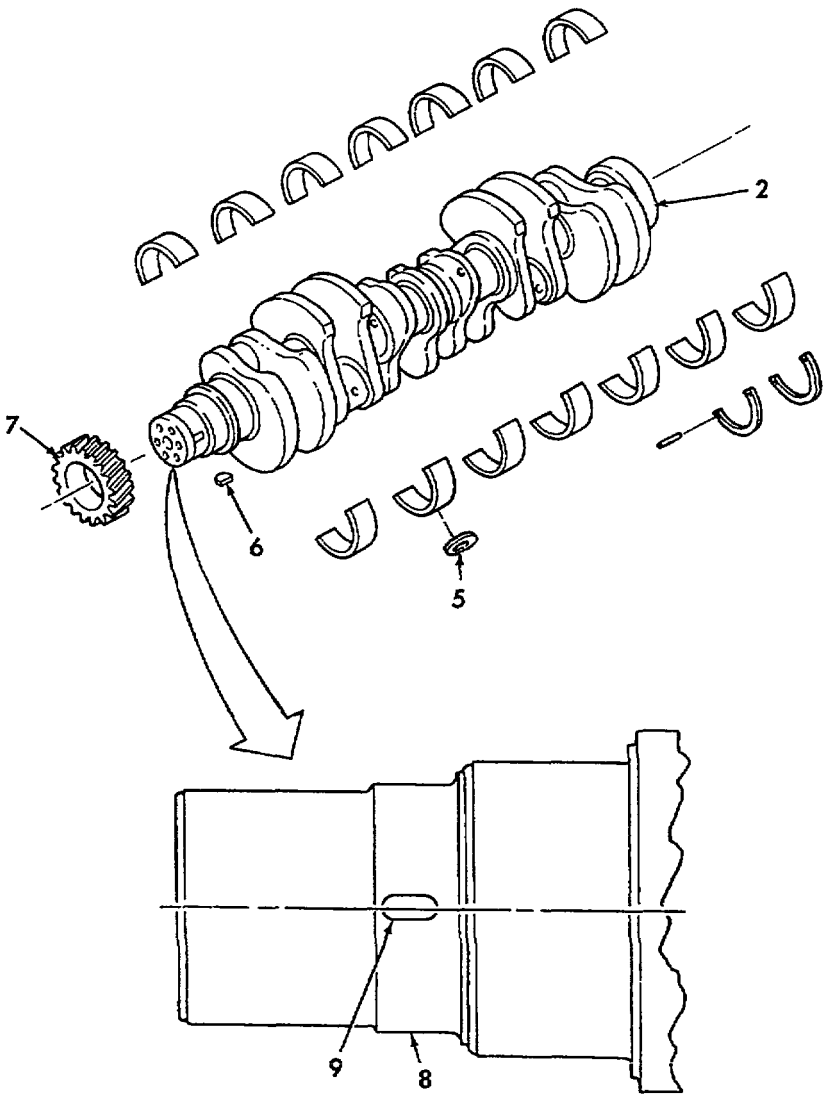
1. CRANKPIN WALL
2. CRANKPINS
3. CRANKPIN WALL
4. FILLETS-MAIN JOURNAL-DEEP
5. MAIN JOURNAL FILLETS
6. CRITICAL REGION
7. FILLET DEPTH
8. MAJOR AXIS OR CENTERLINE OF ADJACENT WEB
9. JOURNAL SURFACE DEPTH
10. JOURNAL SURFACE THICKNESS
11. REAR SEAL SURFACE FACES
12. SEAL AREA
13. KNURLING
14. CHAMBER OF MAIN BEARING OIL HOLE
15. MAIN BEARING JOURNAL SURFACES
16. COUNTERWEIGHT WELDS
17. WEBS
18. WEB SURFACES
19. CONNECTING ROD BEARING CRANKSHAFT JOURNAL SURFACES
20. CONNECTING ROD BEARING CRANKSHAFT JOURNAL SURFACE FILLETS
21. WEB PERIPHERY
22. MAIN JOURNAL WALLS
23. FLANK CHEEK

TABLE 2. CRANKSHAFT MAGNETIC INSPECTION

3-37. CRANKSHAFT REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
b. Inspection (Contd)		
7. Seven retaining rings (5)	Inspect for wear, out-of-round, or cracks.	Discard if worn, cracked, or out-of-round.
	NOTE **It is unnecessary to remove crankshaft gear for inspection; remove only if excessively worn or damaged.**	
8. Crankshaft gear (7)	Inspect for the following: a. Worn, cracked, or broken gear teeth.	Discard if cracked, worn, or broken. Refer to step 8c for removal.
	b. Loose or worn keyway (9) in area of gear-to-crankshaft key (6).	Remove. Refer to step 8c.
	c. Remove from crankshaft (2).	Use a suitable puller and wrench. Remove only if necessary due to damage. Discard crankshaft gear (7) and gear-to-crankshaft key (6) after removal.
	d. Buff all minor nicks and scratches using crocus cloth.	
	e. Repair threads in threaded holes as required.	
	f. If inspection shows crankshaft (2) is worn and must be reground and magnetic inspection reveals suitable for regrinding, grind crankshaft to next standard undersize.	
9. Crankshaft keyway (9)	Inspect only if gear (7) and key (6) are removed for the following:	
	a. Looseness, wear, or damage.	Discard crankshaft (2) or send to specialized repair station if worn, loose, or damaged in keyway (9) area.
	b. Width of keyway (9).	Discard crankshaft (2) or send to specialized repair station if width exceeds 0.375 in. (9.525 mm).
10. Crankshaft gear step (8)	Inspect for the following:	
	a. Wear, grooves, or damage.	Discard crankshaft (2), or send to specialized repair station, if worn, grooved, or damaged.
	b. Outside diameter should measure no less than 3.7607 in. (9.5522 cm).	Discard crankshaft (2), or send to specialized repair station, if outside diameter is less than 3.7607 in. (9.5522 cm).

3-37. CRANKSHAFT REPAIR (Contd)



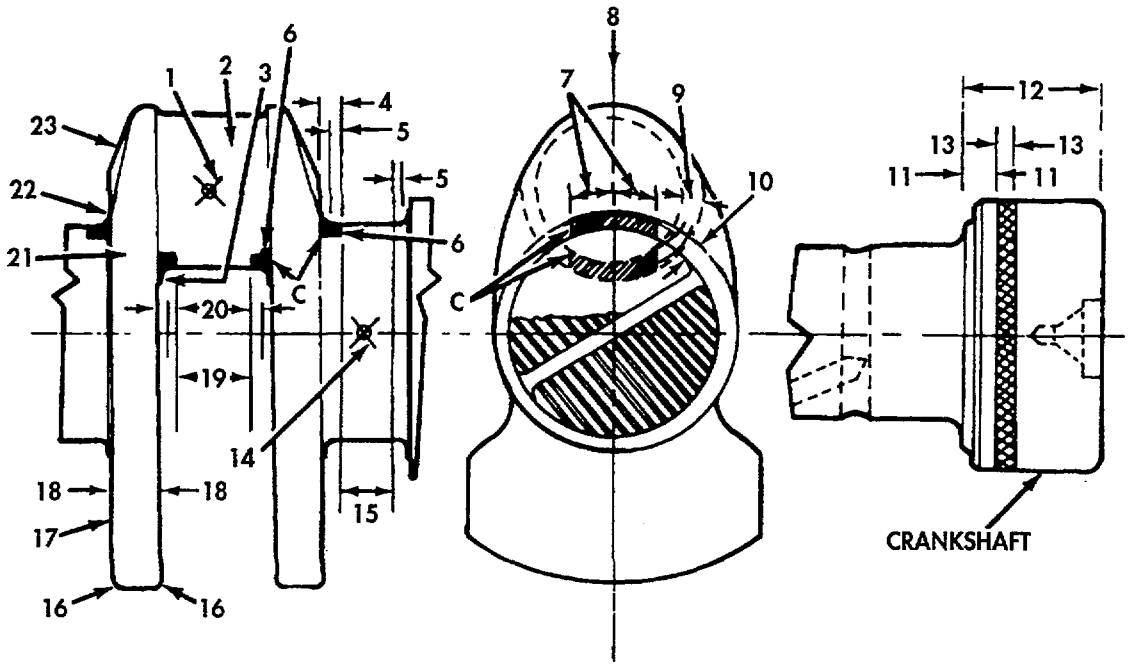
LEGEND:

2. CRANKSHAFT
5. RETAINING RING (7)
6. GEAR-TO-CRANKSHAFT KEY
7. CRANKSHAFT GEAR
8. CRANKSHAFT GEAR STEP
9. CRANKSHAFT KEYWAY

3-37. CRANKSHAFT REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
b. Inspection (Contd)		
11. Critical region (6), crankpin centerline (8), crankpin wall (1) and (3)	Limits listed in the following steps must be maintained within region C. Refer to Table 2.	Dimensional value of C is vertical distance measured downward from crankpin centerline (8) extending longitudinally for all webs (17) between crankpin walls (1) and (3).
12. Centerline (8), fillets (4), crankpin (2), main journal walls (22)	Indications located less than 1 in. (25 mm) from the major axis of centerline (8) of adjacent web (17) (measured circumferentially) must not exceed the following limits: a. Light indications in or entering fillets (4) are acceptable if not more than 0.125 in. (3.175 mm) long (open) or 0.250 in. (6.35 mm) long (subsurface). b. Light open indications on crankpin (2) and main journal walls (22) or bearing surface that extend closer than 0.125 in. (3.175 mm) to fillets (11), but do not enter fillets, are acceptable if 0.1875 in. (4.763 mm) long or less.	Light subsurface indications are acceptable.
13. Centerline (8), crankpin (2), main journal walls (22), fillets (4), corners of counterweight welds (16), webs (17), web periphery (21)	Indications located more than 1.00 in. (25.4 mm) from major axis or centerline (8) of adjacent web (17) (measure circumferentially) must not exceed following limits: a. Light open indication or entering fillets (4) are acceptable if 0.1875 in. (4.763 mm) long or less.	Light subsurface indications are acceptable.
	b. Light open indications on crankpin (2) and main journal walls (22) or bearing surfaces that extend closer than 0.125 in. (3.175 mm) to fillet (11), but do not enter fillet, are acceptable if 0.250 in. (6.35 mm) or less.	Light subsurface indications are acceptable.
	c. Nicks or sharp corners in counterweight welds (16) of webs (17) are not acceptable.	Crankshaft will be acceptable if nicks can be removed by grinding a 0.125 in. (3.175 mm) radius on corner.
	d. Imperfections on web periphery (21) may be ground out to a depth of 0.125 in. (3.175 mm) maximum using a 1.50 in. (38.1 mm) minimum radius grinding wheel, provided balance limits are maintained.	
	e. Light open indications that	All other subsurface

3-37. CRANKSHAFT REPAIR (Contd)



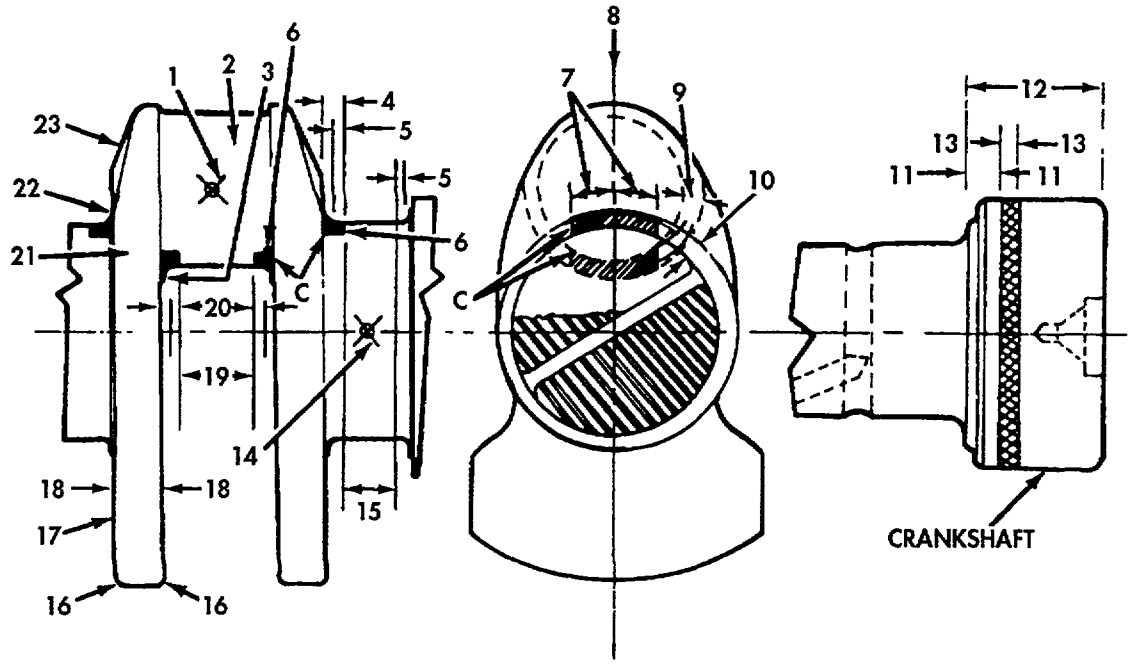
1. CRANKPIN WALL
2. CRANKPIN
3. CRANKPIN WALL
4. FILLETS-MAIN JOURNAL-DEEP
5. MAIN JOURNAL FILLETS
6. CRITICAL REGION
7. FILLET DEPTH
8. MAJOR AXIS OR CENTERLINE OF ADJACENT WEB
9. JOURNAL SURFACE DEPTH
10. JOURNAL SURFACE THICKNESS
11. REAR SEAL SURFACE FACES
12. SEAL AREA
13. KNURLING
14. CHAMBER OF MAIN BEARING OIL HOLE
15. MAIN BEARING JOURNAL SURFACES
16. COUNTERWEIGHT WELDS
17. WEBS
18. WEB SURFACES
19. CONNECTING ROD BEARING CRANKSHAFT JOURNAL SURFACES
20. CONNECTING ROD BEARING CRANKSHAFT JOURNAL SURFACE FILLETS
21. WEB PERIPHERY
22. MAIN JOURNAL WALLS
23. FLANK CHEEK

TABLE 2. CRANKSHAFT MAGNETIC INSPECTION

3-37. CRANKSHAFT REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
b. Inspection (Contd)		
	pass within 0.1875 in. (4.763 mm) of a crankpin wall (1) hole are acceptable if 0.50 in. (12.7 mm) long or less and does not enter oil hole chamfer or intersect 45° ± 10° diagonal. Only those subsurface indications that lay closer than 0.0625 in. (1.588 mm) to surface (measured at the chamfer at 45° + 10 diagonal) are not acceptable.	indications are acceptable.
14. Chamber of main bearing oil hole (14)	Light open indications that enter chamfer of any chamber of main bearing oil hole (14) are acceptable if they are 3.125 in. (79 mm) or less. Subsurface indications ending in a main bearing oil hole (14) are acceptable.	
15. Crankpin (2)	Fine subsurface salt and pepper-type indications are permitted on upper and lower sides of crankpins (2) on the trimming line.	
16. Main bearing journal surfaces (15) of crankpins (2)	Open longitudinal indications within main bearing journal surfaces (15) which are less than 1.125 in. (29 mm) on main journals and 0.875 in. (22.225 mm) long on crank-pins (2) are acceptable after sharp edges have been honed 0.002-0.004 in. (0.051-0.102 mm) below journal surface.	
17. Main bearing journal surfaces (15) and connecting rod bearing crankshaft journal surfaces (19)	Longitudinal surface indications within area (15) or (19) are acceptable.	
18. Fillet (4)	a. Parallel open indications that meet requirement of fillet (4) and other requirements on length and frequency are acceptable. b. Indications that contain loose or foreign particles or voids left by such particles are not acceptable.	
19. Main bearing journal surfaces (15), crankpin (2), and fillet (4)	a. Not more than three open indications are to appear on any one journal surfaces (15) or crank-pin (2). Scattered small, open, or subsurface indications, four per crankpin (2), and six per main bearing journal surface (15), 0.125 in. (3.175 mm) long or less, if not forming part of a long inter-mittent indicator or entering an oil hole (1) or (14) or fillet (4), will not be counted as indications in arriving at the total number permitted.	In addition to showing minimum number of acceptable indications for whole crankshaft, part also shows many widely scattered short indications, it must be rejected.
19. Main bearing journal	b. An inclusion which is	

3-37. CRANKSHAFT REPAIR (Contd)



1. CRANKPIN WALL
2. CRANKPIN
3. CRANKPIN WALL
4. FILLETS-MAIN JOURNAL-DEEP
5. MAIN JOURNAL FILLETS
6. CRITICAL REGION
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12. SEAL AREA
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14. CHAMBER OF MAIN BEARING OIL HOLE
15. MAIN BEARING JOURNAL SURFACES
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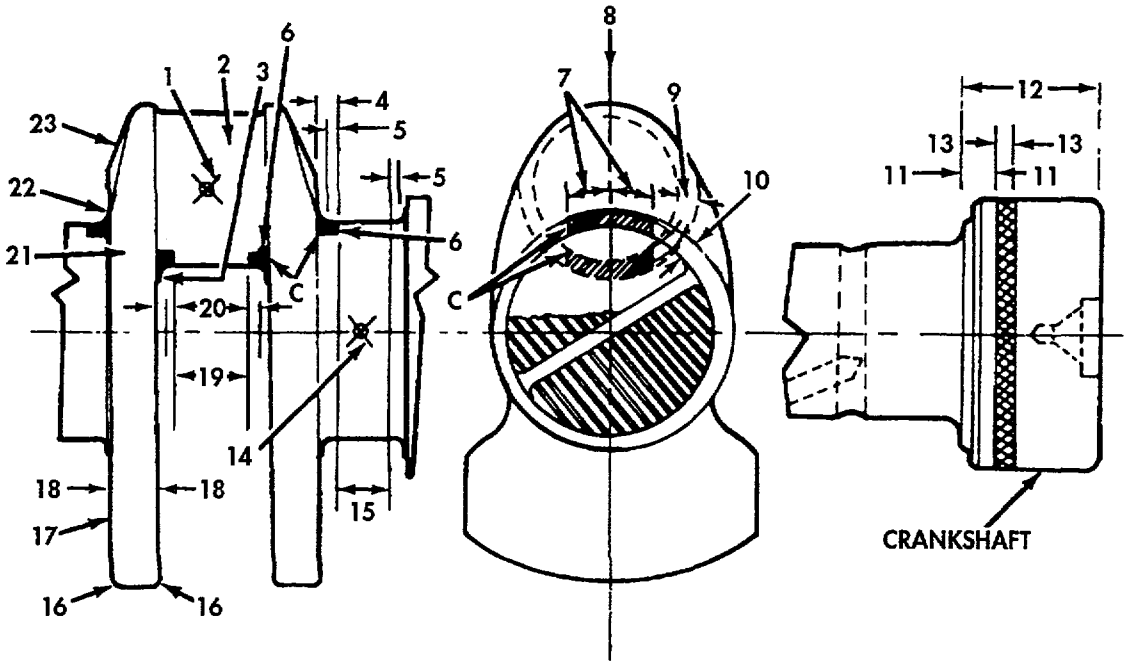
20. CONNECTING ROD BEARING CRANKSHAFT JOURNAL SURFACE FILLETS
21. WEB PERIPHERY
22. MAIN JOURNAL WALLS
23. FLANK CHEEK

TABLE 2. CRANKSHAFT MAGNETIC INSPECTION

3-37. CRANKSHAFT REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
b. Inspection (Contd)		
surfaces (15), crankpin (2), and fillet (4) (Contd)	intermittently open to a subsurface shall be considered and measured as an open indication after original indication has been wiped off. The entire modification must first meet requirements for subsurface limits. c. Open and subsurface indications on counterweights and crank throw bevel outside critical region are acceptable.	
20. Crankpin wall (1) and fillet (4)	Open seams on web periphery (21) that show visual depth on crankpin wall (1) may be removed from web periphery (21) with a 0.50 in. (12.7 mm) radius wheel, provided at least 0.0625 in. (1.588 mm) wall remains above crankpin fillet (4) after repair and balance limits are maintained.	
21. Crank web periphery (21)	Seams or indications outside the critical region (6) that extend over crank web periphery (21) but are not visible on crankpin wall are acceptable.	
22. Corner of flank cheek (23)	a. Indications due to weld defects are not acceptable in counterweight welds. Indications at corner of flank cheek (23) may be ground out and blended to a depth not exceeding 0.25 x 0.625 in. (0.635 x 1.588 cm) long. b. Open longitudinal indications in flywheel and thrust flange fillets longer than 0.375 in. (9.525 mm) are not acceptable. c. Limits of indications on the oil seal surface which, when wiped clean to not show sharp edges, are acceptable. d. After inspection where coil shot is used, give crankshaft head shot to put magnetic poles at ends of crank, not throws. The residual magnetic field should not exceed two units on magnaflux indication or equal.	

3-37. CRANKSHAFT REPAIR (Contd)



1. CRANKPIN WALL
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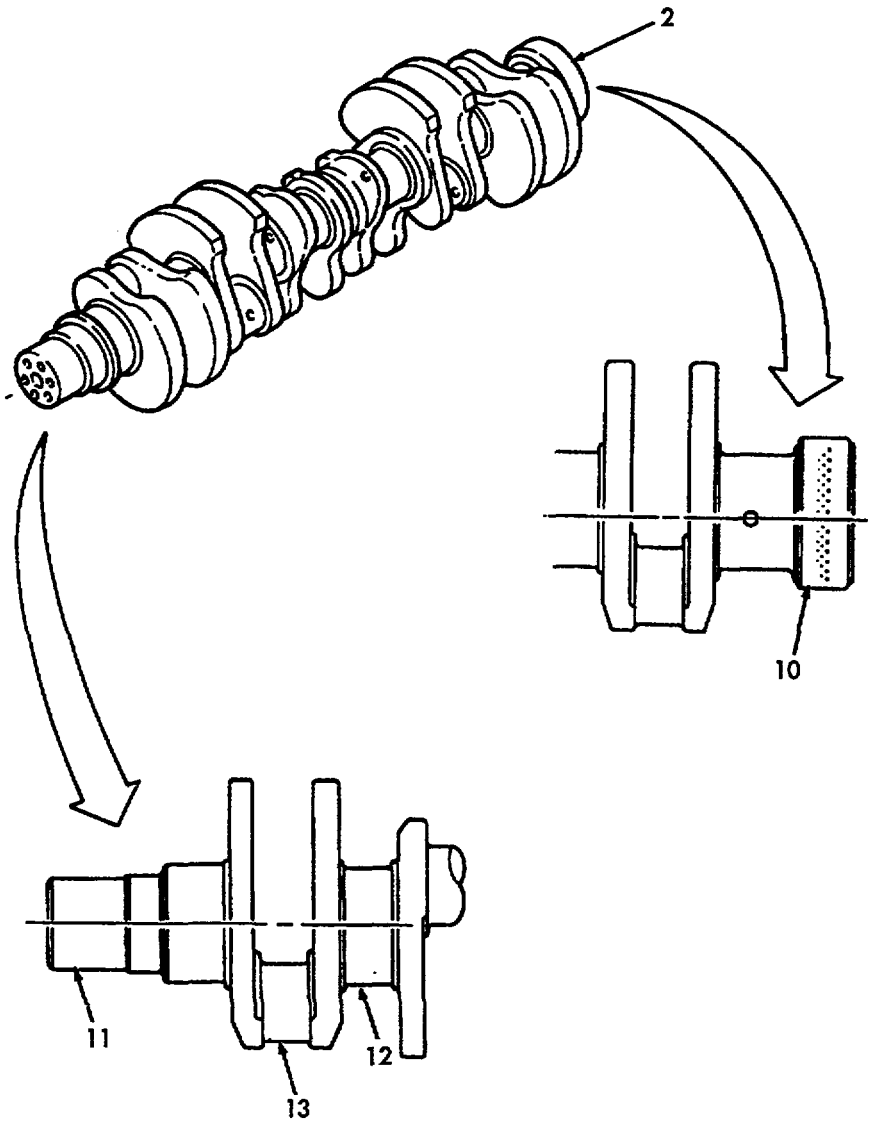
17. WEBS
18. WEB SURFACES
19. CONNECTING ROD BEARING CRANKSHAFT JOURNAL SURFACES
20. CONNECTING ROD BEARING CRANKSHAFT JOURNAL SURFACE FILLETS
21. WEB PERIPHERY
22. MAIN JOURNAL WALLS
23. FLANK CHEEK

TABLE 2. CRANKSHAFT MAGNETIC INSPECTION

3-37. CRANKSHAFT REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
b. Inspection (Contd)		
	CAUTION **When repairing threads, be careful not to cause damage to crankshaft oil seal area.**	
23. Crankshaft (2)	Inspect for the following:	
	a. Cracks, breaks, damage, or wear.	Discard if cracked, broken, damaged, or worn.
	b. Surface scratches or burrs.	Remove with fine-grit emery cloth.
	c. Damaged or distorted threads at front and/or rear.	Repair with suitable thread chaser.
	d. Grooved or worn rear oil seal contact area (10) or front oil seal contact area (11).	Clean with fine-grit emery cloth. If unable to remove groove, send crankshaft (2) to a specialized repair station.
	e. Outside diameter of rear oil seal contact area (10) is 5.998-6.000 in. (152.349-152.4 mm).	Discard crankshaft (2) or send to specialized repair station if rear oil seal contact area (10) is not within stated range.
	f. Outside diameter of front oil seal contact area (11) is 3.625-3.626 in. (92.075-92.100 mm).	Discard crankshaft (2) or send to specialized repair station if front oil seal contact area (11) is not within stated range.
	g. Rod bearing journal diameter (13) is a minimum diameter of 3.1235 in. (79.337 mm) up to a maximum diameter of 3.125 in. (79.375 mm). Measure at three and six o'clock position.	Measure six rod bearing journal diameters (13). Discard crankshaft (2) or send to a specialized repair station if any of six rod bearing journal diameters (13) are less than 3.122 in (79.299 mm).
	h. Main bearing journal diameter (12) is a minimum diameter of 4.4985 in. (114.262 mm) up to a maximum diameter of 4.500 in. (114.3 mm). Measure at three and six o'clock position. Wear limit is 4.4975 in. (114.237 mm).	Measure seven main bearing journal diameters (12). Discard crankshaft (2) or send to a specialized repair station if any of the seven main bearing journal diameters (12) are less than 4.4975 in. (114.237 mm).

3-37. CRANKSHAFT REPAIR (Contd)



LEGEND:

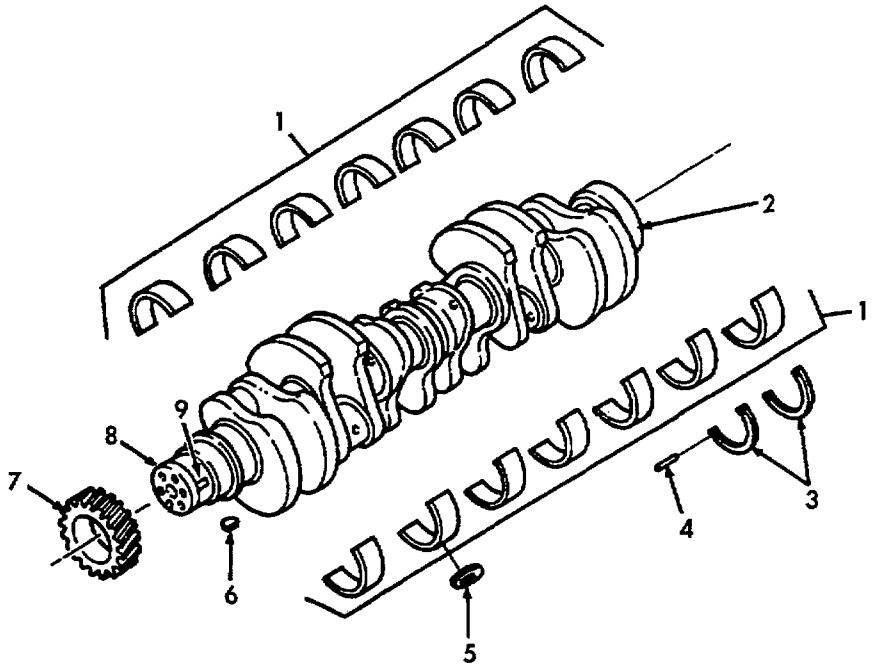
2. CRANKSHAFT
6. GEAR-TO-CRANKSHAFT KEY
7. CRANKSHAFT GEAR
8. CRANKSHAFT GEAR STEP
9. CRANKSHAFT KEYWAY
10. REAR OIL SEAL CONTACT AREA
11. FRONT OIL SEAL CONTACT AREA
12. MAIN BEARING JOURNAL DIAMETER
13. ROD BEARING JOURNAL DIAMETER

3-37. CRANKSHAFT REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
b. Inspection (Contd)		
24. New crankshaft gear (7) removed only if damaged	Install as follows:	
	a. Install new gear-to-crankshaft key (6) on crankshaft keyway (9).	
	WARNING **Wear heat-resistant gloves when handling heated crankshaft gear. Failure to comply may result in injury to personnel.**	
	CAUTION **Use caution when heating crankshaft gear. Make sure there is equal distribution of heat in oven. Do not let crankshaft gear become overheated. Overheating will change hardness of crankshaft.**	
	b. Heat new crankshaft gear (7) in oven at 400°F (204°C) for at least one hour. Then remove using heat-resistant gloves.	
	NOTE **The crankshaft gear must be installed with timing mark facing out.**	
	c. Liberally lubricate crankshaft gear step (8) of crankshaft (2) with OE/HDO 30 lubricating oil.	
	d. Align keyway on crankshaft gear (7) with new gear-to-crankshaft key (6) on crankshaft (2).	Wear heat-resistant gloves similar to welding gloves when handling hot crankshaft gear (7).
	e. Drive crankshaft gear (7) on crankshaft gear step (8) with a piece of tubing.	Tubing should have an inside diameter corresponding to outside diameter of crankshaft gear step (8).

FOLLOW-ON TASK: Install engine crankshaft and main bearings (para. 3-68).

3-37. CRANKSHAFT REPAIR (Contd)



LEGEND:

2. CRANKSHAFT
6. GEAR-TO-CRANKSHAFT KEY
7. CRANKSHAFT GEAR
8. CRANKSHAFT GEAR STEP
9. CRANKSHAFT KEYWAY

3-38. FLEXPLATE OR FLYWHEEL, FLYWHEEL HOUSING, AND REAR COVER REPAIR

THIS TASK COVERS

a. Cleaning **b. Inspection**

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
None

SPECIAL TOOLS
Magnetic crack detector, ST-1166

TEST EQUIPMENT
None

MATERIALS/PARTS
Solvent, SD-3 (Appendix C, Item 30)
Rear main seal (15434) 211253 (Big Cam III only)
Rear main seal (15434) 3006738 (Big Cam I only)
Rear cover gasket (15434) 40662-A

PERSONNEL REQUIRED
Automotive repairman MOS 63H

PREFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
Flexplate or flywheel, flywheel housing, and rear cover removed (para. 3-25).

SPECIAL ENVIRONMENTAL CONDITIONS
None

GENERAL SAFETY INSTRUCTIONS
- Wear protective equipment when cleaning with compressed air.

LOCATION/ITEM	ACTION	REMARKS

- Use approved solvent in well-ventilated area.

a. Cleaning

WARNING

- **Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and protective equipment such as goggles or shield, gloves, etc. Failure to comply may result in injury to personnel.**
- **Approved solvents may be flammable and will not be used near open flame. Use only in well-ventilated area. Failure to comply may result in injury to personnel.**

1.	All parts	Clean with SD-3 solvent and dry with compressed air.	Scrape off any remaining gasket material from mating surfaces.

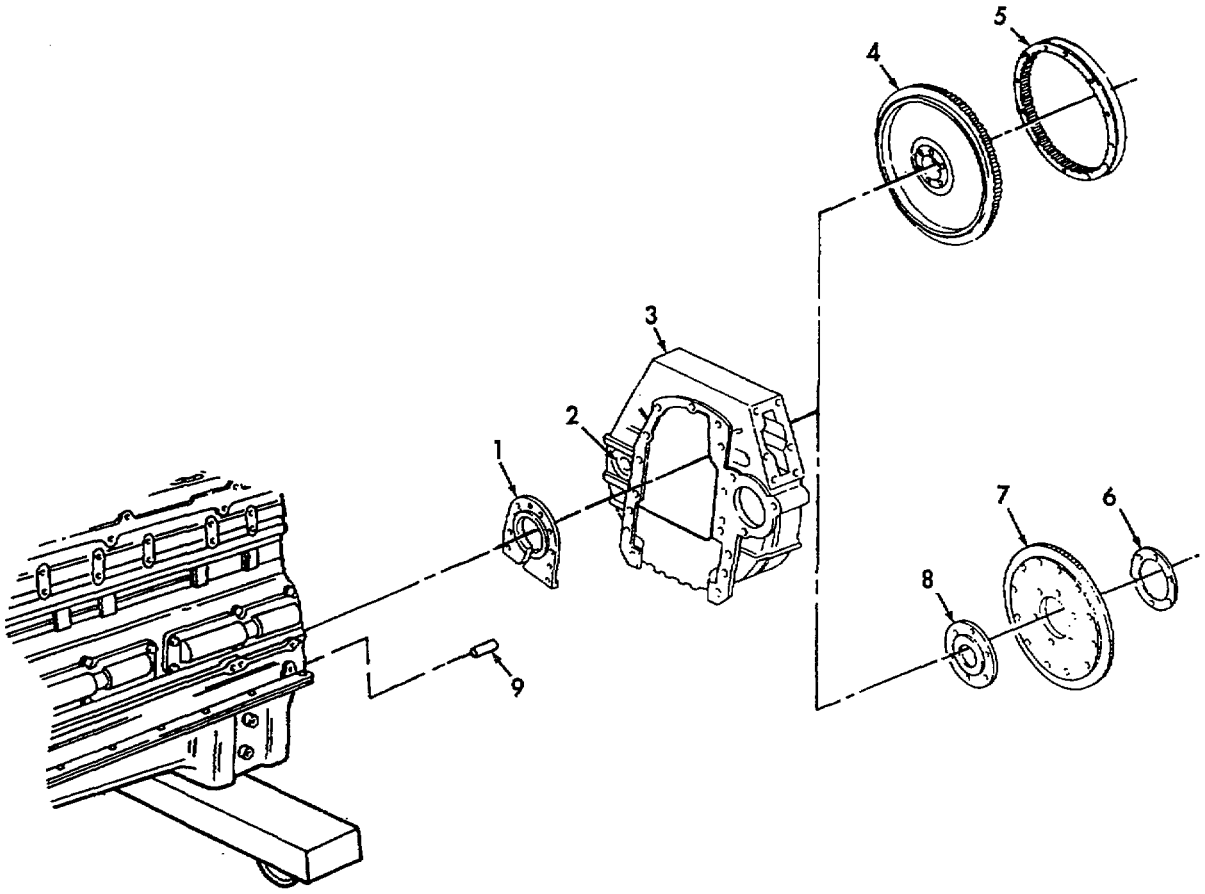
b. Inspection

NOTE

- **Perform step 2 for M915/Big Cam I only.**
- **Perform step 3 for M915A1/Big Cam III only.**

2.	Flywheel (4) and spacer gear (5)	Inspect for distortion, cracks, and damaged gear teeth.	Use magnetic crack detector (ST-1166). Discard if distorted, cracked, or gear teeth are damaged.
3.	Flexdisk and ring gear (7)	Inspect for the following:	

3-38. FLEXPLATE OR FLYWHEEL, FLYWHEEL HOUSING, AND REAR COVER REPAIR (Contd)



LEGEND:

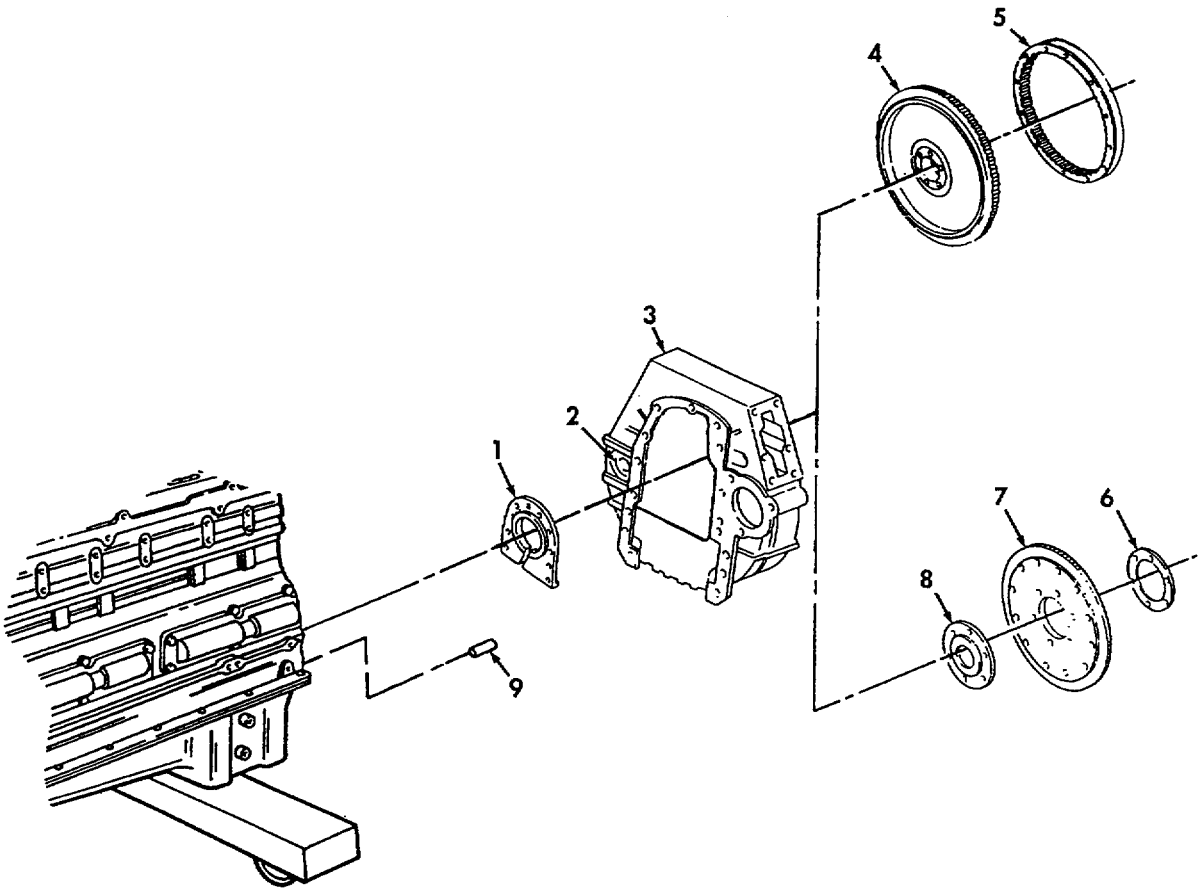
1. REAR COVER (M915/BIG CAM I), COVER (M915A1/BIG CAM III)
2. FLYWHEEL INDEX HOLE COVER
3. FLYWHEEL HOUSING
4. FLYWHEEL (M915/BIG CAM I)
5. SPACER GEAR (M915/BIG CAM I)
6. WASHER BEARING
7. FLEXPLATE AND RING GEAR (M915A1/BIG CAM III)
8. RETAINING PLATE
9. DOWEL (2)

3-38. FLEXPLATE OR FLYWHEEL, FLYWHEEL HOUSING, AND REAR COVER REPAIR (Contd)

LOCATION/ITEM		ACTION	REMARKS
b. Inspection (Contd)			
		a. Distortion.	Discard if distorted.
3.	Flexdisk and ring gear (7) (Contd)	b. Cracks in capscrew mounting area.	Use (ST-1166) magnetic crack detector. Discard if cracked.
		c. Inspect for distortion, cracks, and cracked or chipped gear teeth.	Use magnetic crack detector (ST-1166). Discard if distorted, cracked, or gear teeth are damaged.
4.	Flywheel housing (3)	Inspect for the following:	
		a. Cracks.	Discard if cracked.
		b. Mating surfaces are clean and free from damage.	
		c. Damaged or distorted threads.	Repair stripped threads with suitable thread chaser or thread inserts.
5.	Flywheel index hole cover (2)	Inspect for distortion or cracks.	Discard if cracked or distorted.
6.	Two dowels (9)	Inspect for damaged surface or damaged threads.	Discard if damaged or distorted.
7.	Rear cover (1) (M915/Big Cam I) or cover (1) (M915A1/Big Cam III)	Inspect for the following:	
		a. Cracks in mounting area.	Discard if cracked.
		b. Damage or cracks in surface area of rear cover gasket and area of rear main seal.	Discard if damaged or cracked.
		c. Worn holes in area of two dowels (9).	Discard if worn.
8.	All mounting hardware	Inspect for stretched or damaged threads.	Discard if damaged.

FOLLOW-ON TASK: Install flexplate or flywheel, flywheel housing, and rear cover (para. 3-80).

3-38. FLEXPLATE OR FLYWHEEL, FLYWHEEL HOUSING, AND REAR COVER REPAIR (Contd)



LEGEND:

1. REAR COVER (M915/BIG CAM I), COVER (M915A1/BIG CAM III)
2. FLYWHEEL INDEX HOLE COVER
3. FLYWHEEL HOUSING
4. FLYWHEEL (M915/BIG CAM I)
5. SPACER GEAR (M915/BIG CAM I)
6. WASHER BEARING
7. FLEXPLATE AND RING GEAR (M915A1/BIG CAM III)
8. RETAINING PLATE
9. DOWEL (2)

3-39. PISTON, CONNECTING ROD, AND BEARING REPAIR

THIS TASK COVERS:

a. Disassembly
b. Cleaning
c. Inspection
d. Assembly

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Connecting rod bushing driver (15434) ST-1242
Connecting rod checking fixture (15434) ST-561
Connecting rod locating mandrel (15434) ST-563
Piston ring groove gauge (15434) ST-560

TEST EQUIPMENT
None

MATERIALS/PARTS
Cloth, crocus (Appendix C, Item 4)

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
Piston, connecting rod, and bearings removed (para. 3-69).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS

LOCATION/ITEM	ACTION	REMARKS

Wear rubber gloves when removing piston pin to prevent burns from boiling water or hot piston.

NOTE
Use this procedure to repair any one of six piston, connecting rod, and bearing assemblies. Quantities shown in legend are for one piston, connecting rod, and bearing assembly.

a. Disassembly

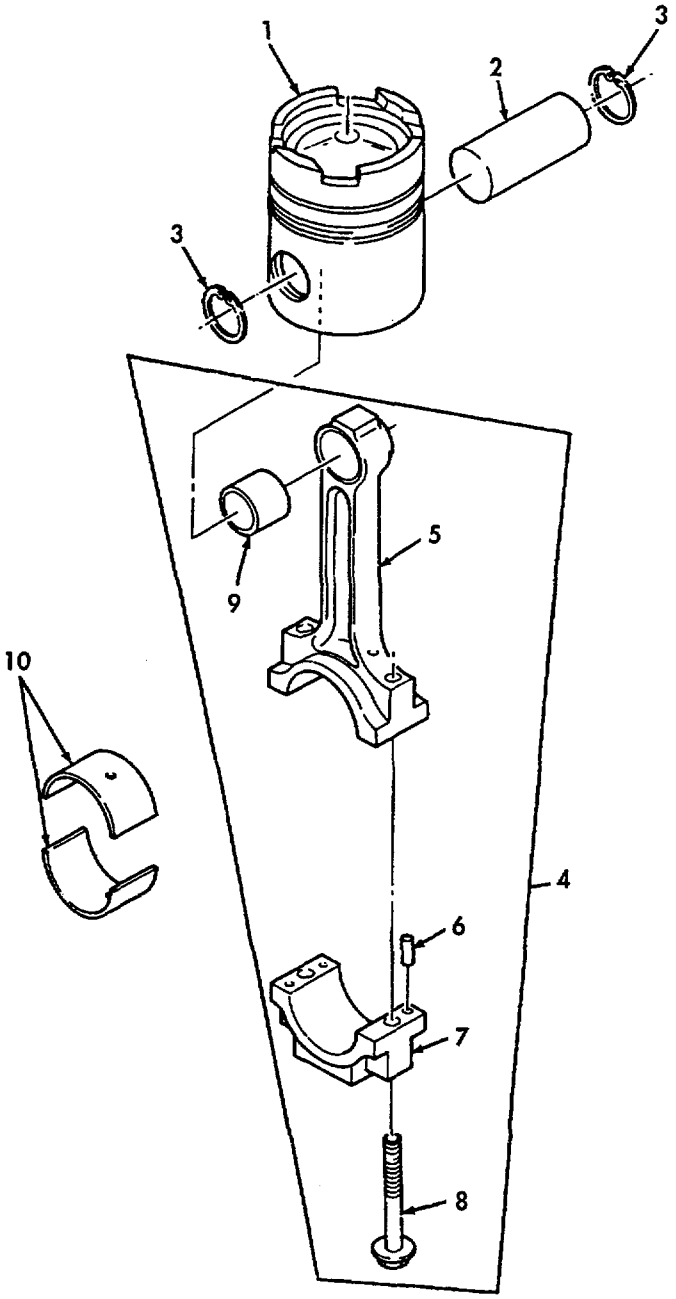
1.	Two piston pin retaining rings (3)	Remove from piston (1).	

WARNING
Wear rubber gloves when removing piston pin to prevent burns from boiling water or hot piston. Failure to comply may result in injury to personnel.

CAUTION
To avoid damage to piston, do not use hammer or any other tool to remove piston pin.

2.	Piston pin (2) and connecting rod (5)	a. Heat piston (1) 210°F (98.9°C) for 10 minutes in boiling water or oven. b. Push piston pin (2) from piston (1) and connecting rod (5) with	Use tongs or hook to remove piston from hot water.

3-39. PISTON, CONNECTING ROD, AND BEARING REPAIR (Contd)



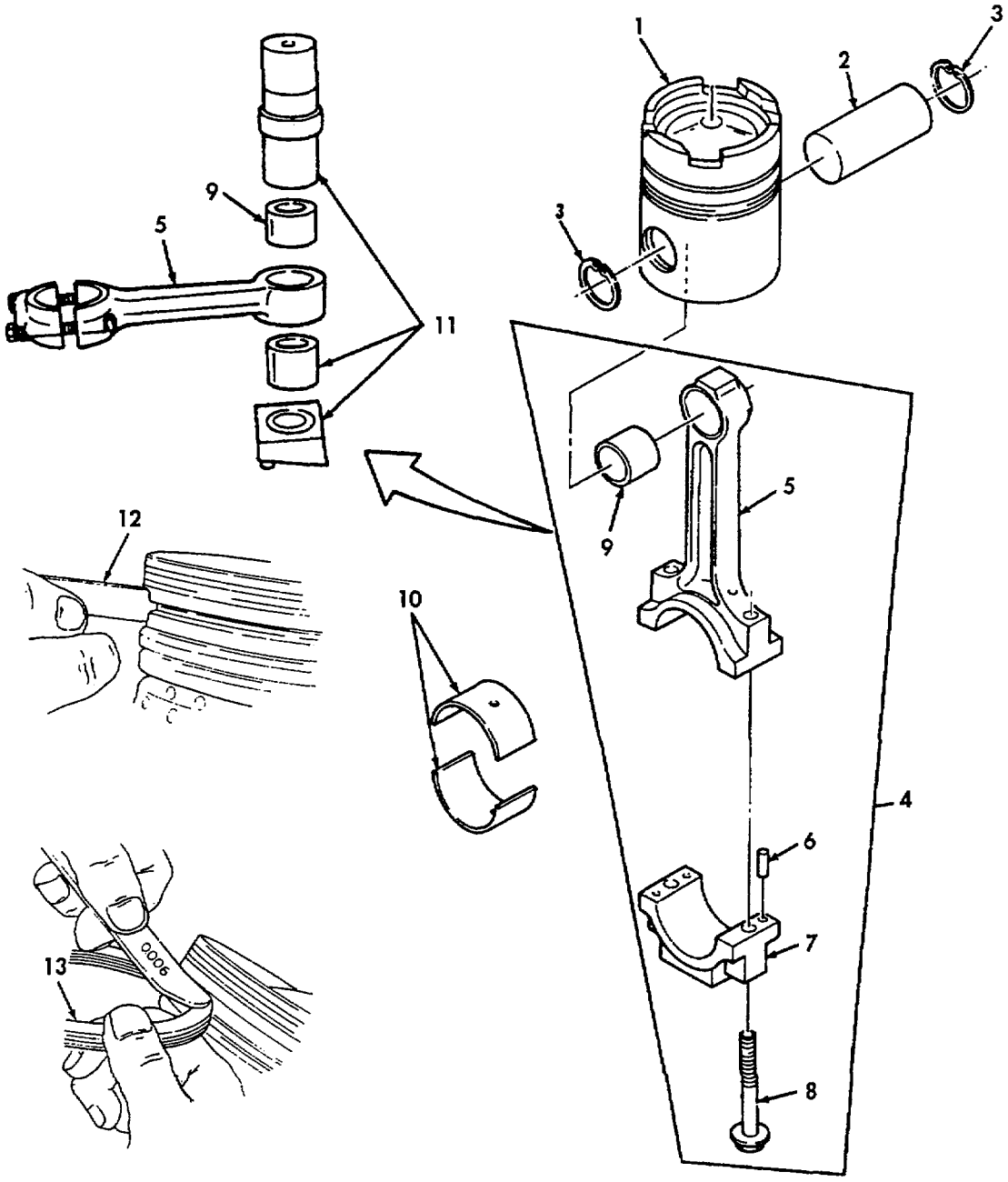
LEGEND:

1. PISTON
2. PISTON PIN
3. PISTON PIN RETAINING RING (2)
4. CONNECTING ROD ASSEMBLY
5. CONNECTING ROD
6. CONNECTING ROD DOWEL (2)
7. CONNECTING ROD CAP
8. ROD SCREW (2)
9. ROD BUSHING
10. ROD BEARING HALF (2)

3-39. PISTON, CONNECTING ROD, AND BEARING REPAIR (Contd)

LOCATION/ITEM		ACTION	REMARKS
a. Disassembly (Contd)			
		fingers.	
		NOTE **Prior to performing steps 3 and 4, clean and inspect rod bushing and connecting rod dowels (steps 6, 16, and 18). Do not remove rod bushing or connecting rod dowels unless they are damaged or not within wear limits.**	
3.	Rod bushing (9)	Using connecting rod bushing driver (ST-1242) (11), remove from connecting rod (5).	New bushing requires boring out of inside diameter.
4.	Two connecting rod dowels (6)	Pull out of connecting rod cap (7).	
b. Cleaning			
		CAUTION **Do not exceed water boiling point 212°F (100°C) when heating piston during cleaning. Piston skirt is coated with plating that may blister if overheated.**	
5.	Piston (1)	Clean.	Use solvent-cleaning bath that will not attack aluminum, or blast suitable material that will embed in or remove material from piston (1). Refer to para. 3-6 for additional cleaning instructions.
6.	Piston pin (2), two retaining rings (3), connecting rod assembly (4), and two rod bearing halves (10)	Clean.	Refer to para. 3-6 for cleaning information and instructions. Do not remove dowels from connecting rod cap or rod bushing from connecting rod during cleaning.
c. Inspection			
7.	Piston (1) and piston pin (2)	Check for cracks, breaks, scoring, galling, and scratches. Small scratches may be removed with crocus cloth.	Discard if damaged.
8.	Piston (1)	a. Inspect all ring grooves for missing sections, breaks, cracks, distortion, and galling.	Discard if damaged.
		NOTE **There are two ways to check piston ring grooves. If using piston ring groove gauge ST-560, perform step 8b. If piston ring groove gauge ST-560 is not available, perform step 8c.**	
		b. Using No. 2 piston ring groove gauge (12), check top and second ring grooves.	Ensure ring grooves are clean. Discard piston (1) if shoulder's widest part of guide touches it.
		c. Hold segment of new piston ring (13) in ring groove, and insert 0.006 in. (0.15 mm) feeler	Ensure ring grooves are clean. Discard piston (1) if gauge enters groove force or disengaging ring.

3-39. PISTON, CONNECTING ROD, AND BEARING REPAIR (Contd)



LEGEND:

1. PISTON
2. PISTON PIN
3. PISTON PIN RETAINING RING (2)
4. CONNECTING ROD ASSEMBLY
5. CONNECTING ROD
6. CONNECTING ROD DOWEL (2)
7. CONNECTING ROD CAP
8. ROD SCREW (2)
9. ROD BUSHING
10. ROD BEARING HALF (2)
11. CONNECTING ROD BUSHING DRIVER
12. PISTON RING GROOVE GAUGE
13. PISTON RING

3-39. PISTON, CONNECTING ROD, AND BEARING REPAIR (Contd)

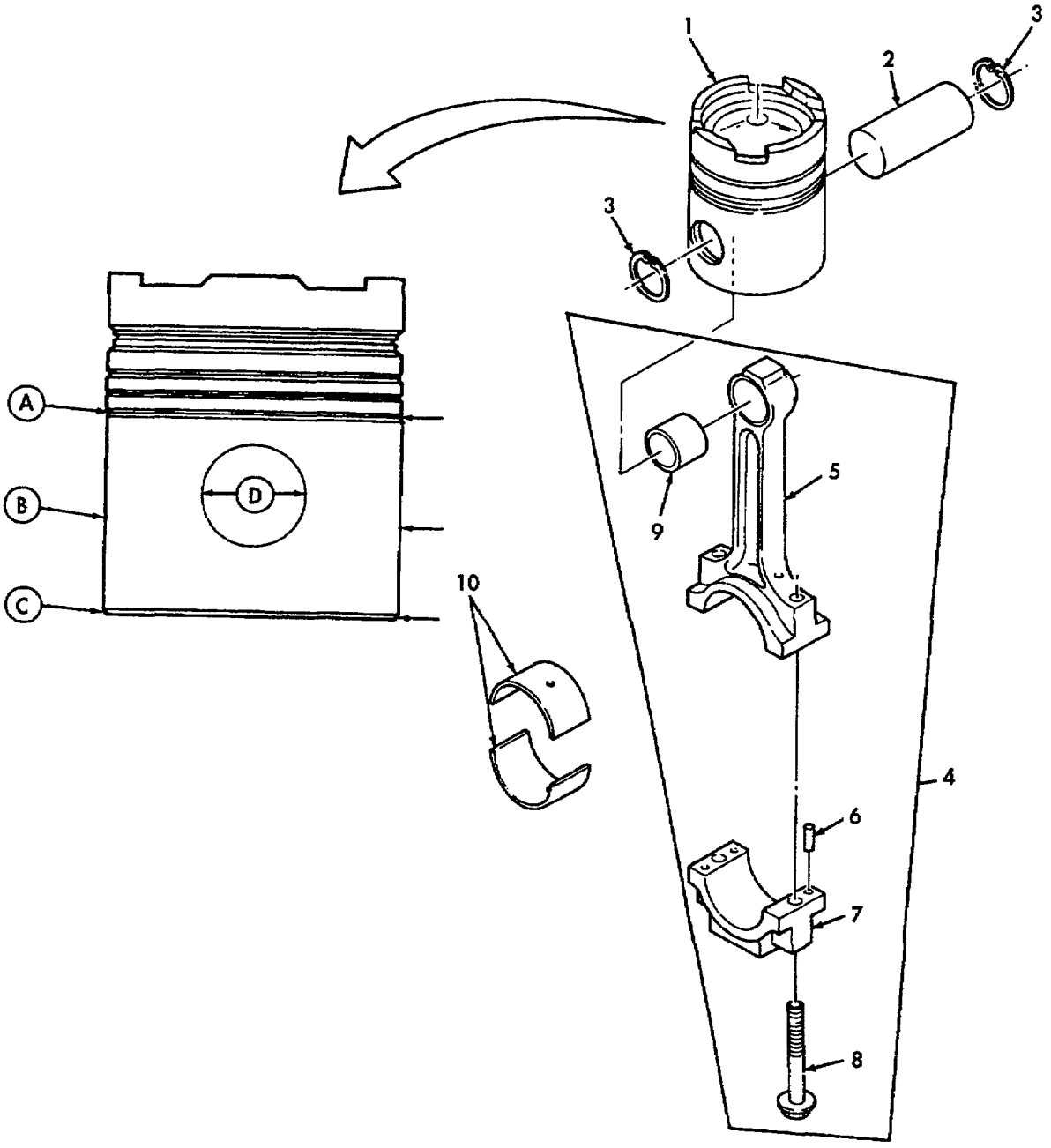
LOCATION/ITEM	ACTION	REMARKS
c. Inspection (Contd)		
	gauge.	
8. Piston (1) (Contd)	d. Using suitable micrometer, measure piston skirt diameter at angles to piston pin bore.	Ensure temperature is between 70-90°F (21-32°C). Take measurements at points A, B, and C. Discard if not within limits shown below:

	MINIMUM	MAXIMUM
Point A	5.477 in (139.116 mm)	5.480 in. (139.192 mm)
Point C	5.489 in. (139.421 mm)	5.493 in. (139.522 mm)

	e. Using suitable micrometer, measure piston pin bore.	Ensure temperature is between 70-90°F (21-32°C). Take measurement in area D. Discard if more than wear limit shown below at 70°F (21°C): Add 0.0005 in. (0.013 mm) per 10°F (-12°C) up to 90°F (32C).

Wear Limit	2.0000 in. (50.800 mm)
New Minimum	1.9985 in. (50.762 mm)
New Maximum	1.9990 in. (50.775 mm)

3-39. PISTON, CONNECTING ROD, AND BEARING REPAIR (Contd)

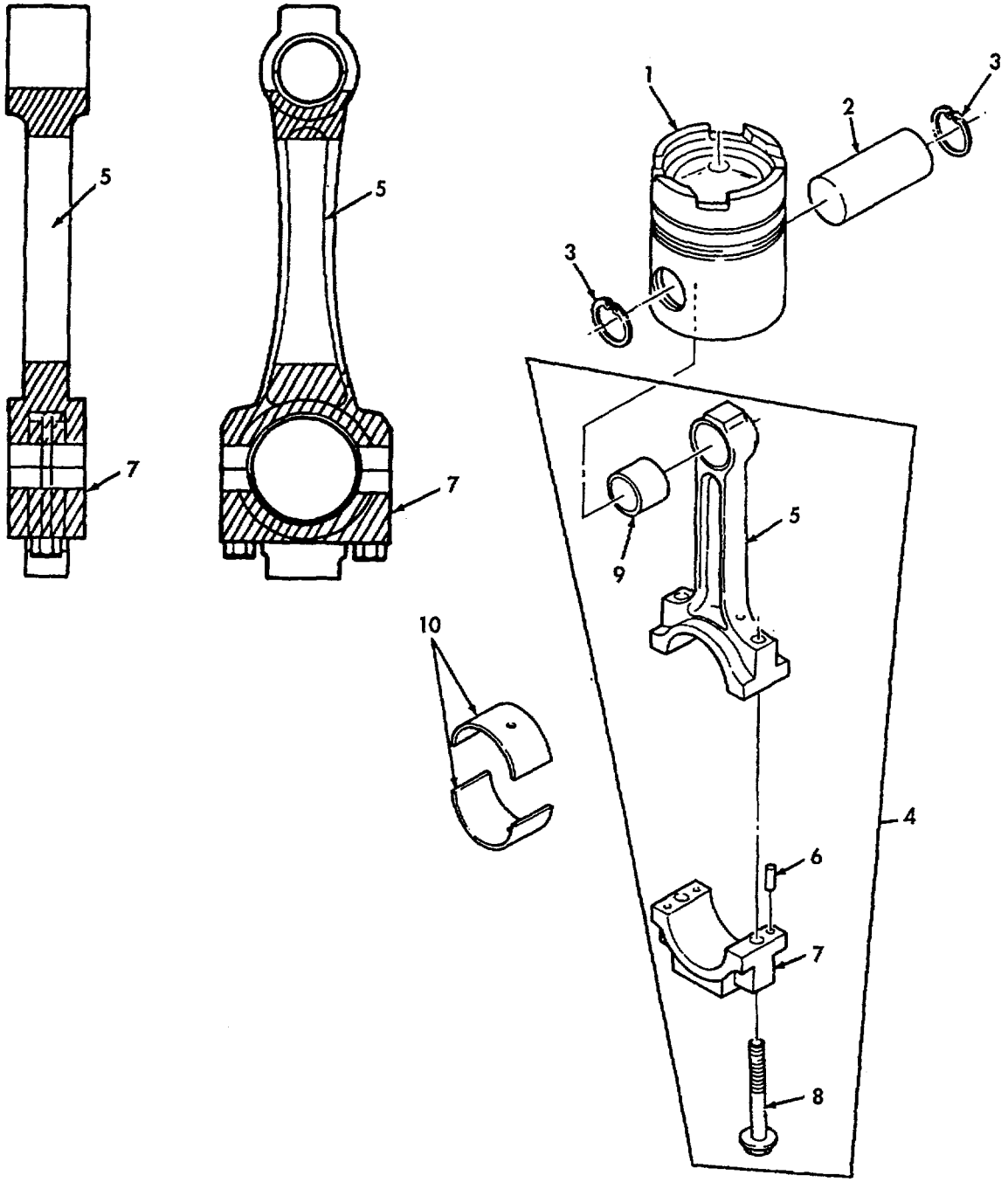


LEGEND:
1. PISTON

3-39. PISTON, CONNECTING ROD, AND BEARING REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection (Contd)		
9. Piston pin (2)	Using suitable micrometer, measure outside diameter.	Discard if out-of-round more than 0.001 in. (0.025 mm), or if less than wear shown below:
	Wear Limit ..... 1.9985 in. (50.762 mm) New Minimum ..... 1.9988 in. (50.769 mm) New Maximum ..... 1.9990 in. (50.775 mm)	
10. Connecting rod (5) and connecting rod cap (7)	Inspect surface area for nicks, dens, and gouges.	Discard all connecting rods (5) that have cuts, scratches, or other damage that is deeper than approximately 0.03125 in. (0.7938 mm) on I-beam.
11. Connecting rod (5), connecting rod cap (7), and two rod screws (8)	a. Assemble.	Refer to step 19 and accompanying Illustrations with torque values.
	b. Inspect for cracks using magnetic method:	
	(1) Check rods (5) for cracks using 1800 ampere AC current or 1500 ampere DC current applied longitudinally between plates.	Apply 1-1/2 percent wet solution while current is on. Make visual inspection after each application of current. Pay particular attention to shaded critical areas shown in illustration. Discard connecting rod assembly (4) if any cracks are detected.
	(2) Check rods (5) for cracks using 3000-3400 ampere AC or current 2600-2800 ampere turns DC.	

3-39. PISTON, CONNECTING ROD, AND BEARING REPAIR (Contd)

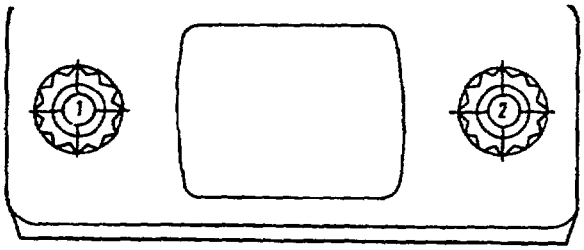


LEGEND:
2. PISTON PIN
4. CONNECTING ROD ASSEMBLY
5. CONNECTING ROD
7. CONNECTING ROD CAP
8. ROD SCREW (2)

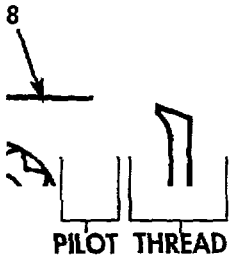
3-39. PISTON, CONNECTING ROD, AND BEARING REPAIR (Contd)

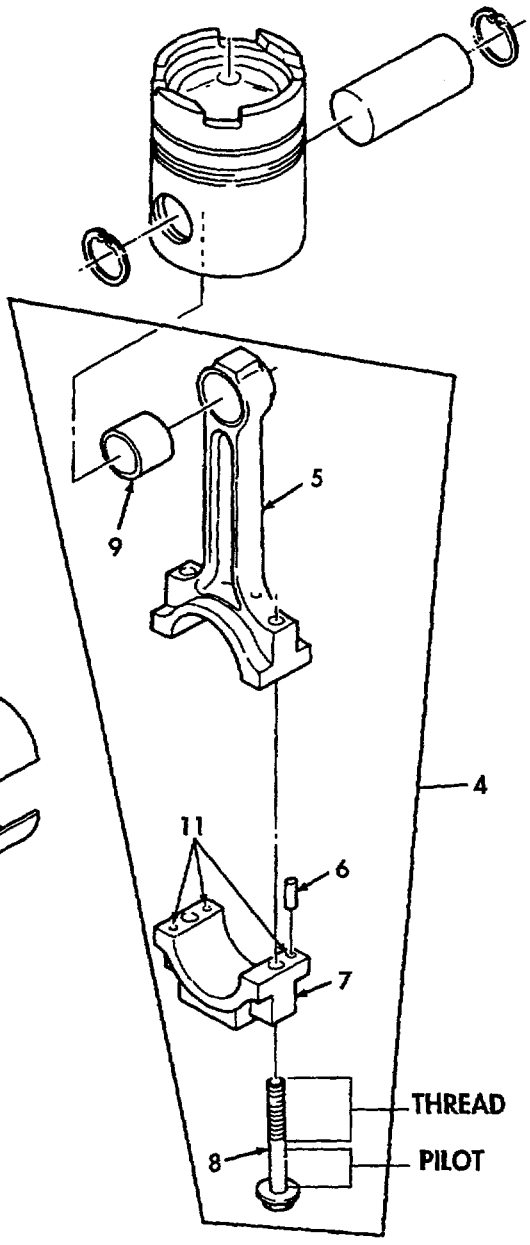
LOCATION/ITEM	ACTION	REMARKS
c. Inspection (Contd)		
12. Two rod screws (8)	a. Inspect for distorted threads.	Discard if threads are distorted.
	b. Using suitable micrometer, measure smallest diameter.	Discard if less than wear limit shown below:
Thread O.D. Wear Limit ..... 0.540 in. (13.72 mm)	Pilot O.D. Wear Limit .....0.6242 in. (15.855 mm)	
New Minimum ..... 0.541 in (13.74 mm)	.....0.6245 in. (15.862 mm)	(Refer to item 8 in figure.)
New Maximum ..... 0.545 in (13.84 mm)	.....0.6250 in. (15.875 mm)	
13. Connecting rod (5)	Using suitable micrometer, measure pilot bore of holes for rod screws (8).	Discard connecting rod assembly (4) if pilot bore is more than 0.6252 in. (15.880 mm).
	NOTE **See Appendix F for screw pilot outside diameter.**	
14. Connecting rod cap (7)	Using suitable micrometer, measure pilot bore of holes for rod screws (8).	Discard connecting rod assembly (4) if pilot bore is more than 0.6252 in. (15.880 mm).
15. Two connecting rod dowels (6)	a. Inspect for cracking and bending.	Remove and discard if cracked or bent. Install new connecting rod dowels (6) if needed.
	b. Using suitable micrometer, measure diameter.	Remove and discard if less than 0.3127 in. (7.943 mm). Install new connecting rod dowels (6) if needed.
	c. Using suitable micrometer, measure protrusion.	Remove and discard if not within limits shown below. Install new connecting rod dowels (6) if needed.
New Minimum ..... 0.220 in. (5.588 mm)		
New Maximum ..... 0.250 in. (6.35 mm)		
16. Connecting rod (5)	Using suitable micrometer, measure diameter of dowel holes (11).	Discard connecting rod assembly (4) if not within limits shown below:
New Minimum ..... 0.3128 in. (7.946 mm)		
New Maximum ..... 0.3133 in. (7.957 am)		
17. Rod bushing (9)	a. Inspect for nicks, gouges, and scoring.	Remove and discard if nicked, gouged or scored. Install new rod bushing (9) if needed.
	b. Using suitable micrometer, measure inside diameter.	Remove and discard if less than wear limit shown below. Install new rod bushing (9) if needed.
Wear Limit ..... 2.0022 in. (50.856 mm)		
New Minimum ..... 2.0010 in. (50.825 mm)		
New Maximum ..... 2.0015 in. (50.838 mm)		
18. Connecting rod (5) and connecting rod cap (7)	a. Assemble.	Ensure connecting rod dowels (6) fit into dowel holes (11) in connecting rod (5).
	b. Secure with two rod stews (8).	Alternately tighten screws (8) In order aid sequence shown in illustration.

3-39. PISTON, CONNECTING ROD, AND BEARING REPAIR (Contd)



(1) TIGHTEN (8) TO . . . . . 70-75 LB-FT (95-102 N•m)
(2) ADVANCE (8) TO . . . . . 140-150 LB-FT (190-203 N•m)
(3) LOOSEN ALL . . . . . COMPLETELY
(4) TIGHTEN (8) TO . . . . . 25-30 LB-FT (34-41 N•m)
(5) ADVANCE (8) TO . . . . . 70-75 LB-FT (95-102 N•m)
(6) ADVANCE (8) TO . . . . . 140-150 LB-FT (190-203 N•m)





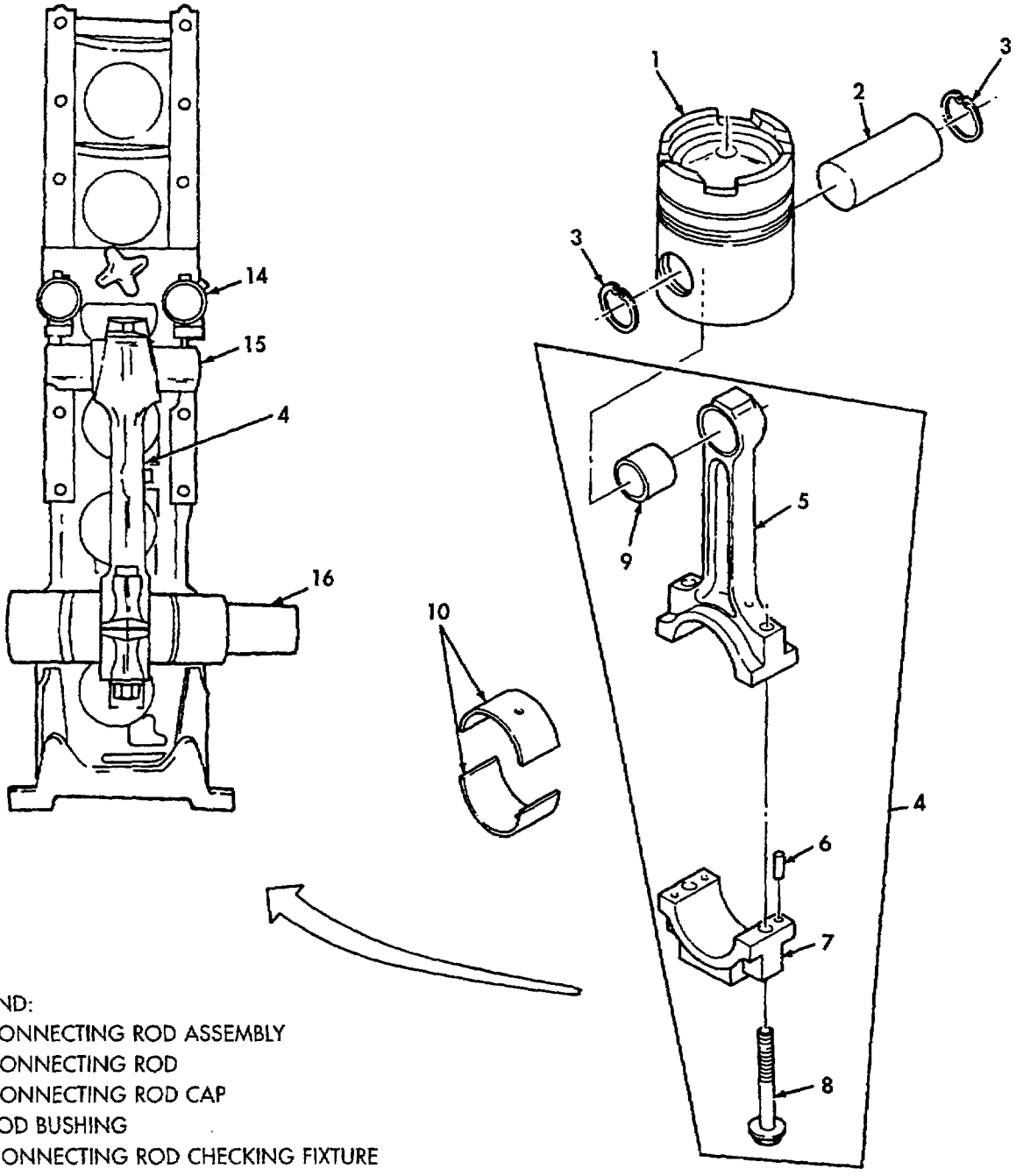
LEGEND:
4. CONNECTING ROD ASSEMBLY
5. CONNECTING ROD
6. CONNECTING ROD DOWEL (2)
7. CONNECTING ROD CAP
8. ROD SCREW (2)
9. ROD BUSHING
10. ROD BEARING HALF (2)
11. DOWEL HOLES

3-39. PISTON, CONNECTING ROD, AND BEARING REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection (Contd)		
19. Connecting rod assembly (4)	Using suitable micrometer, measure crankpin bore diameter.	Do not measure where connecting rod (5) and connecting rod cap (7) meet. Discard if diameter is not within 3.3157 in. (84.219 mm) and 3.3171 in. (84.254 mm) up to 30° on either side of parting line, 3.3157 in. (84.219 mm) and 3.3167 in. (84.244 mm) 30° on either side of parting line.
20. Connecting rod checking fixture (ST-561) (14)	Calibrate.	a. Use new connecting rod assembly (4) that has been checked for correct absolute center length of 12.00 in. (304.8 mm) between bore centers. b. Perform steps 18a and b. c. Place new connecting rod assembly (4) into fixture. d. Place correct piston pin mandrel (15) into piston pin bore. e. Install expanding arbor (16) into crankpin bore and tighten until snug. Ensure pin on expanding arbor (16) is down and locked in position in center of new connecting rod assembly (4). f. Move dial holder until contact points of indicators touch mandrel (15) in piston pin bore. g. Set indicator dials' checking fixture to zero. h. Remove new connecting rod assembly (4) from fixture. Turn rod assembly horizontally 180° and put back into fixture (14). i. If dial indicators show any change from first reading, adjust dials to divide difference. Fixture is now calibrated.
21. Connecting rod (5)	a. Assemble correct connecting rod assembly (4), pin mandrel (15), and expanding arbor (16). b. Put into calibrated connecting rod checking fixture (14). c. Take reading for length.	Discard if longer than rod used to calibrate fixture or more than 0.002 in. (0.050 mm) shorter.
	d. Take reading for alignment of of bores. Turn connecting rod assembly (4) 180° and take reading again.	Discard if difference in readings is more than 0.010 in. (0.254 mm) without bushing (9) installed, or 0.004 in. (0.101 mm) with rod bushing (9) installed.

3-39. PISTON, CONNECTING ROD, AND BEARING REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
21. Connecting rod (5) (Contd)	e. Using feeler gauge between piston pin mandrel (15) and dial indicator holding plate, measure twist.	Discard if twist is more than 0.020 in. (0.508 mm) without bushing (9) installed, or 0.010 in. (0.254 mm) bushing (9) installed and machined to correct size.



LEGEND:
4. CONNECTING ROD ASSEMBLY
5. CONNECTING ROD
7. CONNECTING ROD CAP
9. ROD BUSHING
14. CONNECTING ROD CHECKING FIXTURE
15. PISTON PIN MANDREL
16. EXPANDING ARBOR

3-39. PISTON, CONNECTING ROD, AND BEARING REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection (Contd)		

CAUTION

If one rod bearing half is damaged or worn, both rod bearing halves must be discarded. Failure to do so could cause damage to equipment.

NOTE

Undersize bearing shells can be determined by adding correct amount 0.010, 0.020, 0.030 in. (0.254, 0.508, 0.762 mm) to minimum and maximum dimension of a standard bearing.

22.	Rod bearing half (10)	a. Inspect for chipping, flaking, or scoring. b. Using suitable ballpoint micrometer, measure thickness.	Discard both if chipped, flaked, or scored. Discard both if less than wear limit of standard connecting rod bearing half (10) as shown below:

Wear Limit ..... 0.0930 in. (2.362 mm)
New Minimum ..... 0.0942 in. (2.392 mm)
New Maximum ..... 0.0947 in. (2.405 mm)

d. Assembly

23.	Rod bushing (9)	Using connecting rod bushing driver (ST-1242) (11), install into connecting rod (5).	Ensure oil holes are aligned and that a 0.125 in. (3.175 mm) diameter rod can move freely through connecting rod (5) and rod bushing (9).
24.	Two connecting rod dowels (6)	Install into connecting rod cap (7).	
25.	Piston pin retaining ring (3)	Install only one retaining ring (3) into groove of piston pin bore in piston (1).	

WARNING

Wear rubber gloves when installing piston pin to prevent burns from boiling water or hot piston. Failure to comply may result in injury to personnel.

26.	Piston (1) and piston pin (2)	a. Heat piston (1) for 15 minutes in boiling water or in oven set at 210°F (100°C).	

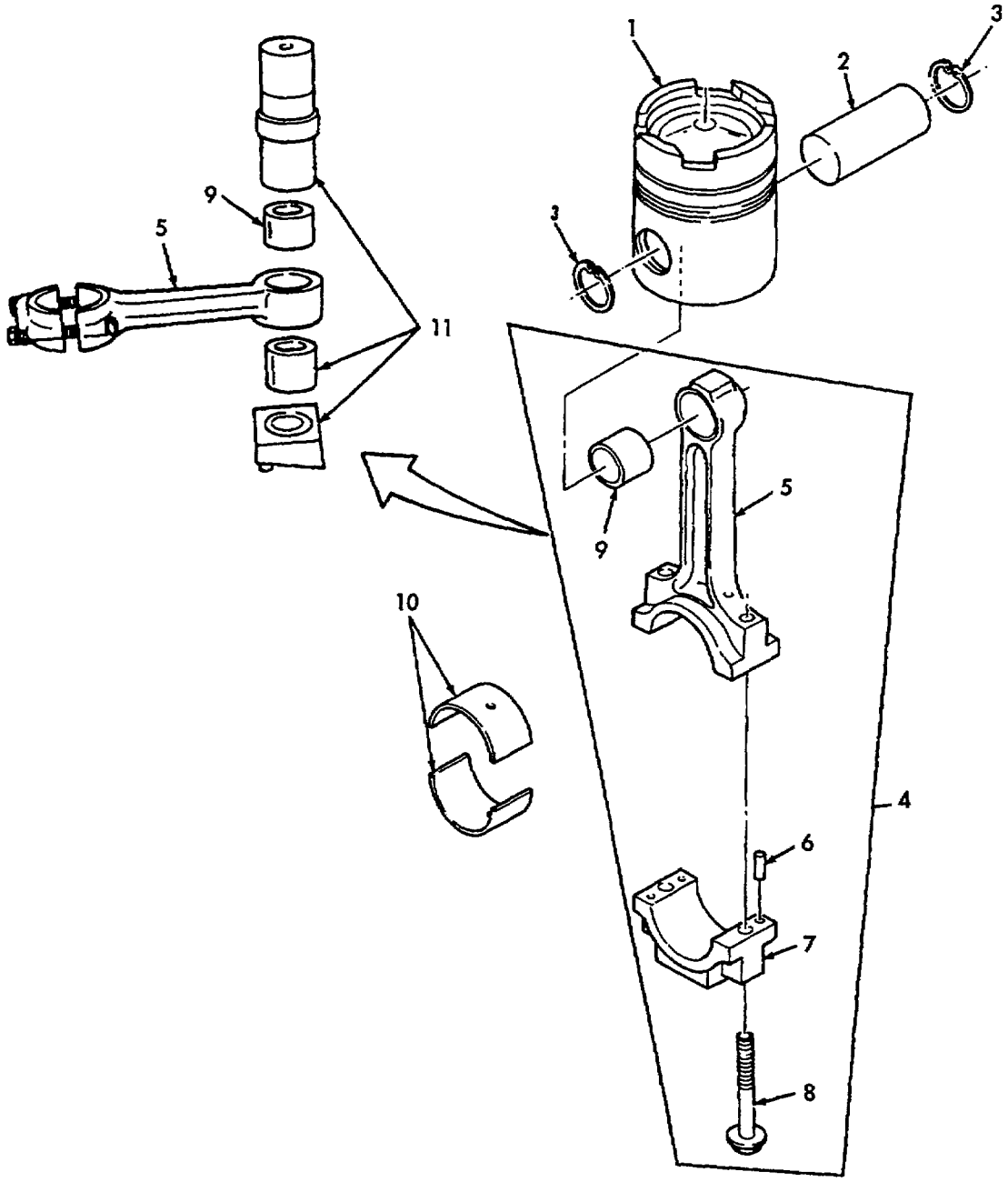
CAUTION

Never use a hammer to install piston pin. This can cause distortion in piston and piston seizure in cylinder liner. Ensure edges of piston pin retaining rings are in groove of piston pin bore.

		b. Install connecting rod (5) and piston pin (2) into piston (1) before it cools to 70°F (21°C). c. Install other piston pin retaining ring (3) in groove of piston pin bore in piston (1), opposite the one installed in step 25.	The piston pin (2) cannot be installed when temperature of piston (1) is below 70°F (21°C).

FOLLOW-ON TASK: Install piston, connecting rod, and bearings (para. 3-69).

3-39. PISTON, CONNECTING ROD, AND BEARING REPAIR (Contd)



LEGEND:

1. PISTON
2. PISTON PIN
3. PISTON PIN RETAINING RING (2)
5. CONNECTING ROD
6. CONNECTING ROD DOWEL (2)
7. CONNECTING ROD CAP
9. ROD BUSHING
10. ROD BEARING HALF
11. CONNECTING ROD BUSHING DRIVER

3-40. CAMSHAFT, CAM FOLLOWER, AND PUSHROD REPAIR

THIS TASK COVERS:

a. Disassembly
b. Cleaning
c. Inspection
d. Assembly

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
None

TEST EQUIPMENT
None

MATERIALS/PARTS
Compound, Prussian blue (Appendix C, Item 9)
Paper, aluminum oxide, 240-grit (Appendix C, Item 23)
Sealant, cup plug (Appendix C, Item 25)
Six expansion plugs (15434) 175831

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
- Pushrods removed (para. 3-22).
- Camshaft and cam follower housings removed (para. 3-28).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
Always wear eye protection when working with compressed air.

LOCATION/ITEM	ACTION	REMARKS

a. Disassembly

CAUTION
Do not use heating torch to remove camshaft gear from camshaft if camshaft gear is to be reused. Heating will damage camshaft gear.

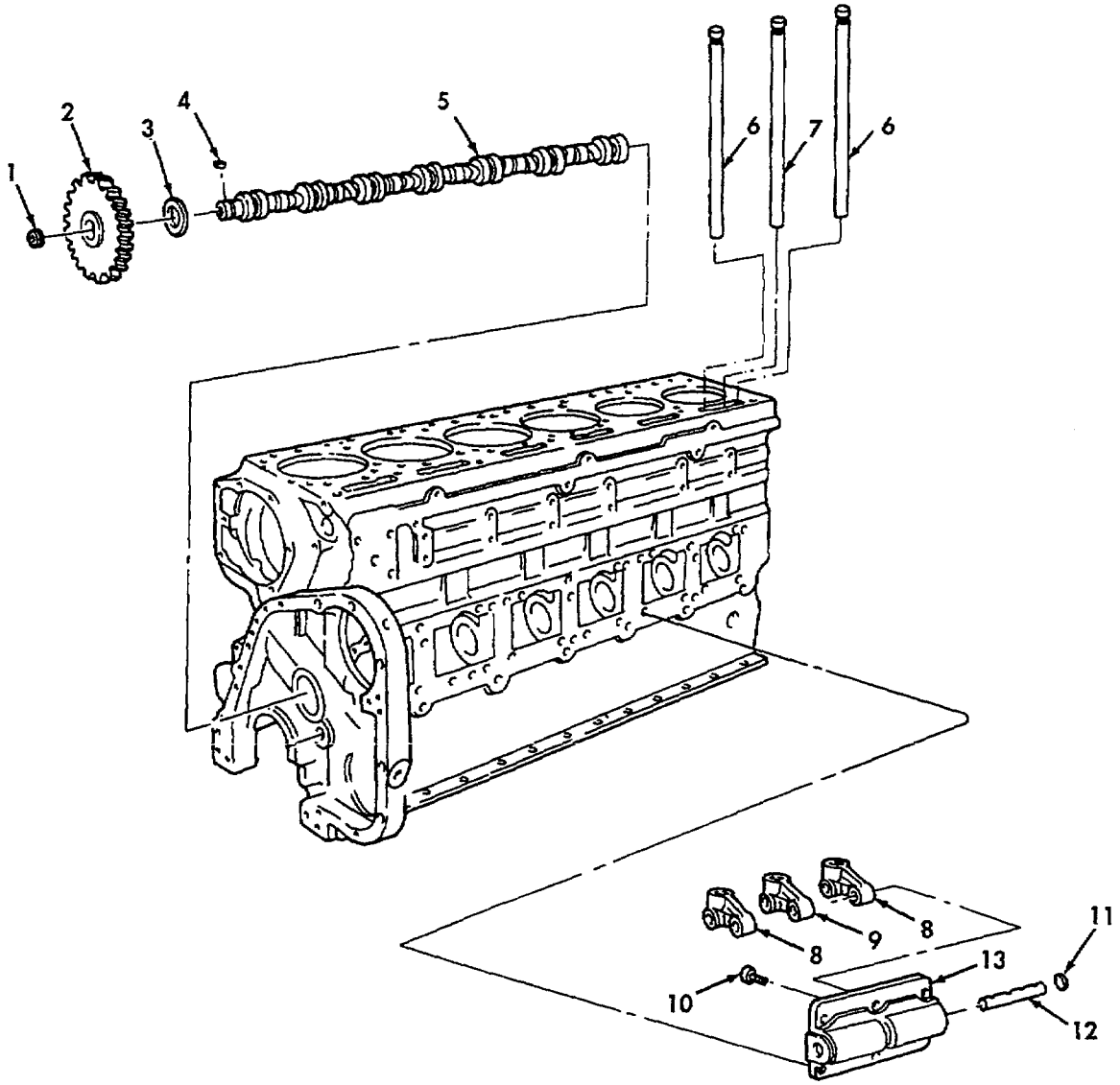
NOTE
Prior to step 1, clean and inspect camshaft and camshaft gear (steps 6, 8, and 9). Do not separate camshaft and camshaft gear unless damaged or not within wear limits.

1.	Camshaft(5)	a. Put in press. b. Put V-blocks under camshaft gear (2). c. Using press, remove camshaft gear (2). d. Remove gear-to-camshaft key (4).	Ensure V-blocks support hub area of camshaft gear (2).
2.	Camshaft orifice plug (1) and thrust washer (3)	Remove from camshaft (5).	

NOTE
Repeat steps 3, 4, and 5 for each cam follower assembly.

3.	Two shaft locking screws (10)	Remove from cam follower housing (13).	

3-40. CAMSHAFT CAM FOLLOWER, AND PUSHROD REPAIR (Contd)



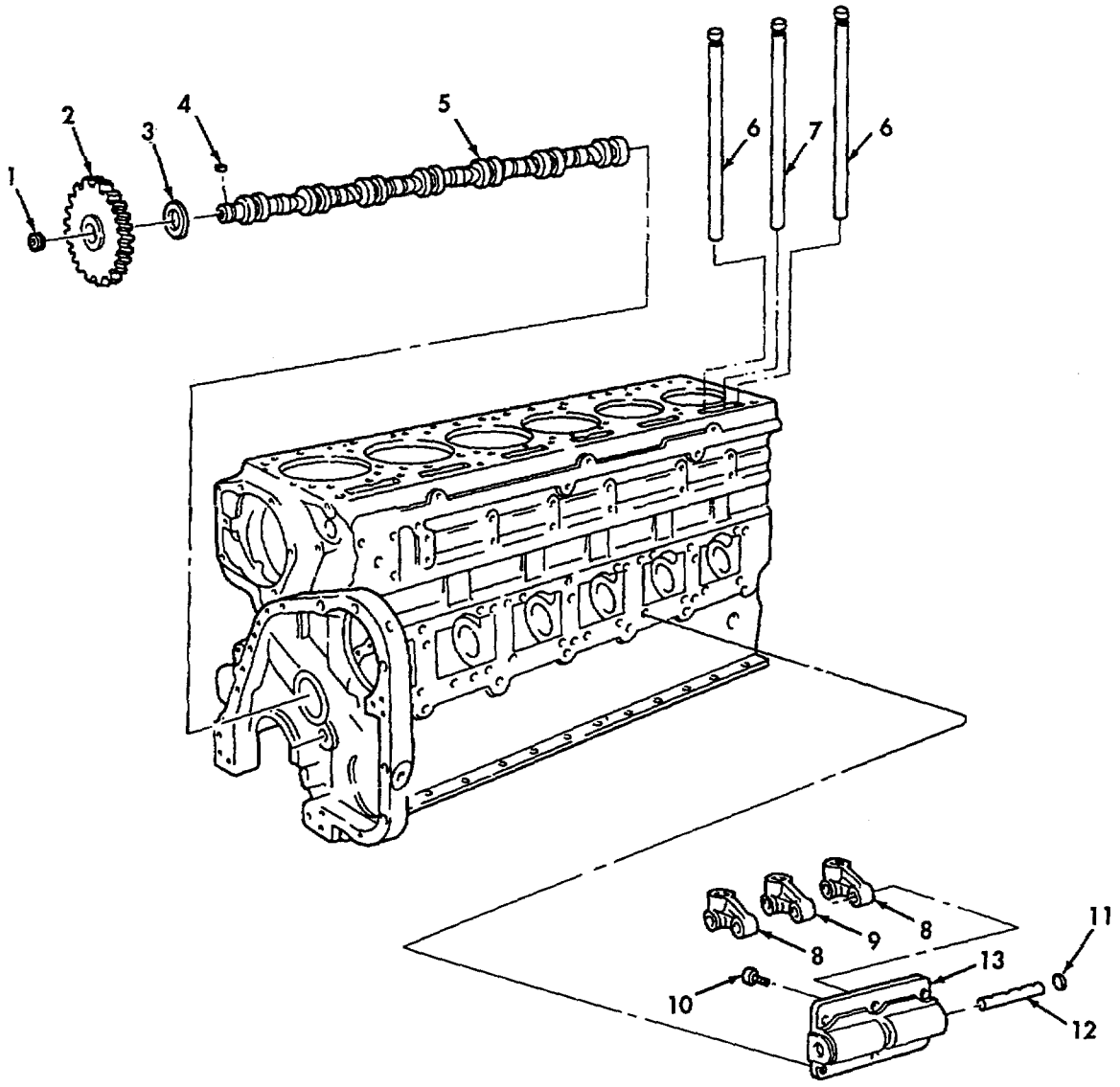
LEGEND:

1. CAMSHAFT ORIFICE PLUG
2. CAMSHAFT GEAR
3. THRUST WASHER
4. GEAR-TO-CAMSHAFT KEY
5. CAMSHAFT
6. INTAKE AND EXHAUST PUSHROD (12)
7. INJECTOR PUSHROD (6)
8. INTAKE AND EXHAUST CAM FOLLOWER (12)
9. INJECTOR CAM FOLLOWER (6)
10. SHAFT LOCKING SCREW (6)
11. EXPANSION PLUG (6)
12. CAM FOLLOWER SHAFT (6)
13. CAM FOLLOWER HOUSING (3)

3-40. CAMSHAFT CAM FOLLOWER, AND PUSHROD REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
a. Disassembly (Contd)		
4. Two expansion plugs (11)	Remove from ends of cam follower housing (13).	Use punch with sharp point to make hole in center of one expansion plug (11). Hit edge of same expansion plug to loosen it. Using pliers, remove expansion plug (11). Discard expansion plug (11).
5. Two cam follower shafts (12)	Push out of cam follower housing (13) and remove four intake and exhaust cam followers (8) and two injector cam followers (9).	Mark intake, exhaust, and injector cam followers (8) and (9) to identify their location in cam follower housing (13) as they are removed. Using mandrel and press, push both cam follower shafts (12) out opposite end of cam follower housing (13), forcing out other expansion plug (11). Discard expansion plug (11).
b. Cleaning		
	WARNING **Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and protective equipment such as goggles or shield, gloves, etc. Failure to comply may result in injury to personnel.**	
6. Camshaft orifice plug (1), camshaft gear (2), thrust washer (3), gear-to-camshaft key (4), and camshaft (5) (assembled)	Steam clean and dry with compressed air.	Refer to para. 3-6 for additional cleaning instructions.
	NOTE **Repeat step 7 for each cam follower and pushrod assembly.**	
7. Six intake, exhaust, and injector pushrods (6) and (7), intake exhaust and injector cam followers (8) and (9), shaft locking screws (10), cam follower shafts (12), and three cam follower housings (13)	Clean.	Refer to para. 3-6 for cleaning information and instructions. Be sure to clean out small oil passages in cam followers, and ensure all gasket material has been removed from cam follower housing (13).
c. Inspection		
8. Camshaft (5)	a. Using suitable micrometer, measure diameter of journals.	Disassemble and discard camshaft if less than wear limit shown below: Wear Limit ..... 2.495 in. (63.373 mm) New Minimum ..... 2.496 in. (63.398 mm) New Maximum ..... 2.497 in. (63.423 mm)
	b. inspect injector and valve lobes for scuffing, scoring, and cracks.	Disassemble and discard camshaft (5) if lobes are scuffed, scored, or cracked.

3-40. CAMSHAFT, CAM FOLLOWER, AND PUSHROD REPAIR (Contd)



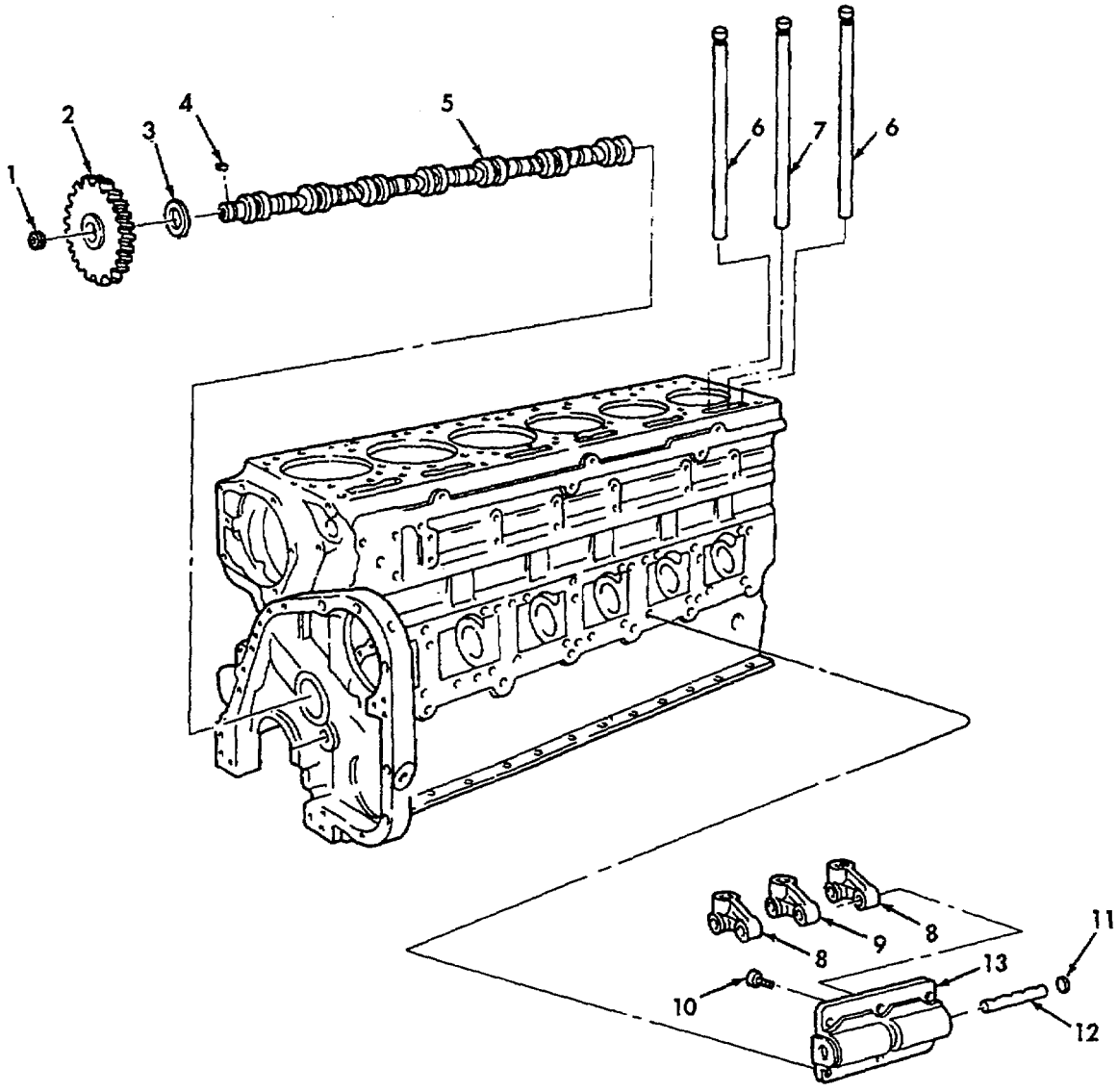
LEGEND:

1. CAMSHAFT ORIFICE PLUG
2. CAMSHAFT GEAR
3. THRUST WASHER
4. GEAR-TO-CAMSHAFT KEY
5. CAMSHAFT
6. INTAKE AND EXHAUST PUSHROD (12)
7. INJECTOR PUSHROD (6)
8. INTAKE AND EXHAUST CAM FOLLOWER (12)
9. INJECTOR CAM FOLLOWER (6)
10. SHAFT LOCKING SCREW (6)
11. EXPANSION PLUG (6)
12. CAM FOLLOWER SHAFT (6)
13. CAM FOLLOWER HOUSING (3)

3-40. CAMSHAFT CAM FOLLOWER, AND PUSHROD REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection (Contd)		
8. Camshaft (5) (Contd)	c. Inspect for cracks using magnetic method. Apply 1500 amperes DC longitudinal magnetic current for locating open seams and presence of non-metallic inclusions. Apply 2000 amperes DC circular magnetizing current for detecting grinding checks. (1) Subsurface longitudinal indications: • None accepted on nose. • Short longitudinal indications up to 0.625 in. (15.875 mm) long are acceptable in critical region on cam surface 0.500 in. (12.700 mm) before nose and 0.375 in. (9.525 mm) after nose. • Not more than two indications are allowable in critical region of any one cam. • Light longitudinal indications not exceeding two in number are allowable outside of critical region. • Parallel indications must be separated by at least 0.625 in. (15.875 mm) of metal. (2) Open longitudinal indications are not allowable except on base circle. A maximum of two longitudinal open indications 0.250 in. (6.350 mm) long or less will be allowed on base circle provided they are not closer than 0.250 in. (6.350 mm) and are visible only as tightly closed lines when surface is wiped clean. Open indications shall not be closer than 0.1875 in. (4.763 mm) to edge of cam (5). Circumferential indications, lying at an angle greater than 15° with longitudinal centerline, are not allowable. (3) Subsurface longitudinal indications: • 0.125 in. (3.715 mm) indications are allowable on nose. • Light longitudinal indications up to 0.500 in. (12.700 mm) are allowable on ramp. • Not more than two indications are allowable on ramp or nose of any one cam (5).	Whole surface of camshaft (5) must be wetted with magnetic particle suspension before magnetizing current is applied. Camshaft (5) must be magnetized by a single shot of current. Disassemble and discard camshaft if not within limits.

3-40. CAMSHAFT CAM FOLLOWER, AND PUSHROD REPAIR (Contd)

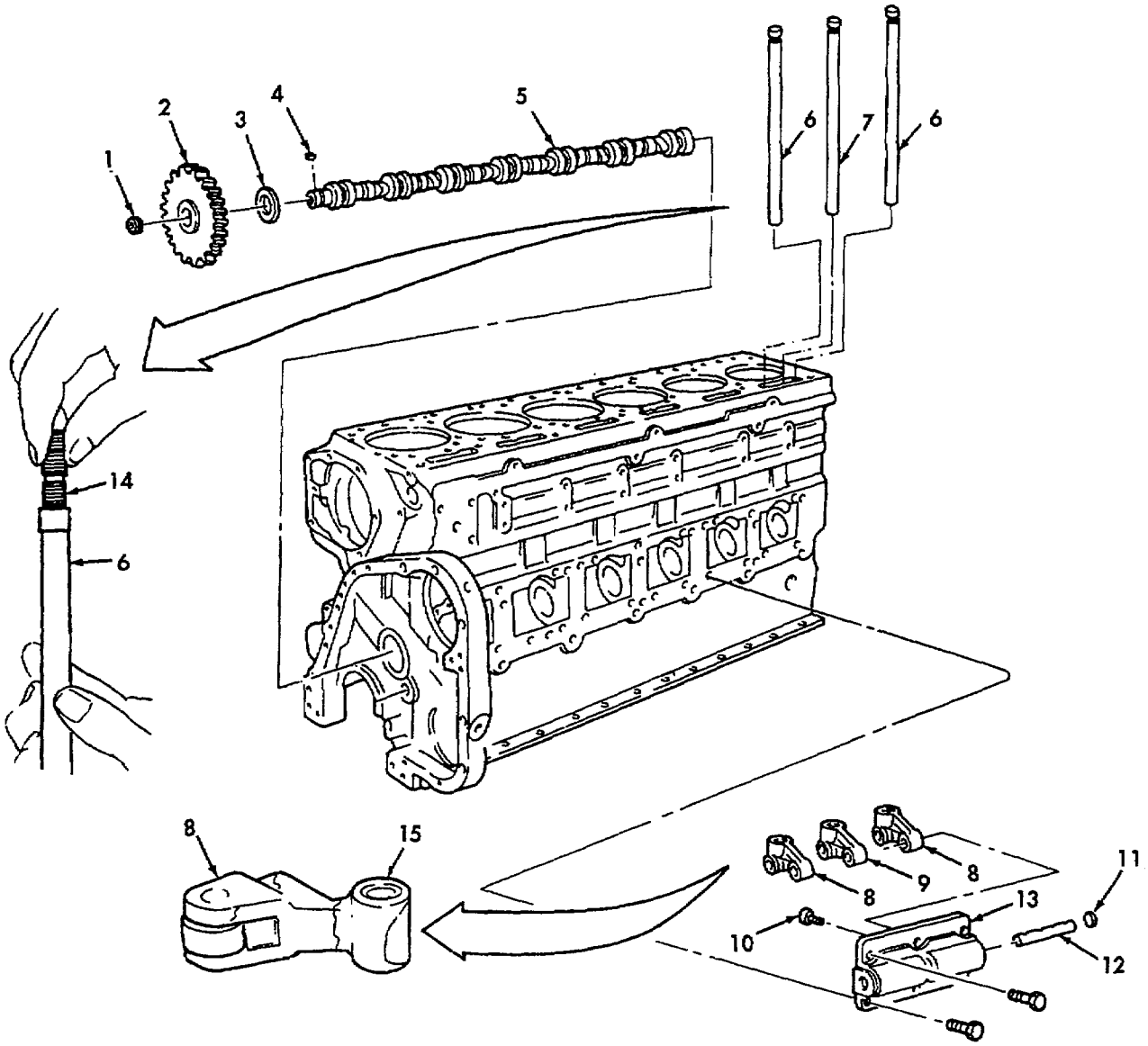


LEGEND:
5. CAMSHAFT

3-40. CAMSHAFT, CAM FOLLOWER, AND PUSHROD REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection (Contd)		
8. Camshaft (5) (Contd)	• Light longitudinal indications not exceeding two in number are allowed on base circle of any one cam. • Parallel indications must be separated by at least 0.250 in. (6.350 mm) on ramp and nose, and by 0.0625 in. (15.875 mm) on base circle. (4) Open longitudinal indications are not allowable except on base circle. A maximum of two longitudinal open indications 0.250 in. (6.350 mm) long or less will be allowed on base circle provided they are not closer together than 0.250 in. (6.350 mm) and are visible only as closed lines when surface is wiped clean. Open indications should not extend closer than 0.1875 in. (4.763 mm) to edge of cam. (5) Circumferential indications lying at an angle greater than 15P with longitudinal centerline are not allowable. (6) Subsurface indications are acceptable. Four open longitudinal indications are permitted in each section of bearing provided not more than half of them extend full width of bearing. Edges of such indications are to be stoned, not to exceed 0.005 in. (0.127 mm) deep.	
9. Camshaft gear (2)	Inspect for chipping, cracking, and visible wear.	Disassemble and discard camshaft gear if chipped, cracked, or visibly worn.
10. Thrust washer (3)	Inspect for flaking, burrs, distortion, and wear.	Discard if damaged or worn thinner than 0.083 in. (2.108 mm).

3-40. CAMSHAFT, CAM FOLLOWER, AND PUSHROD REPAIR (Contd)



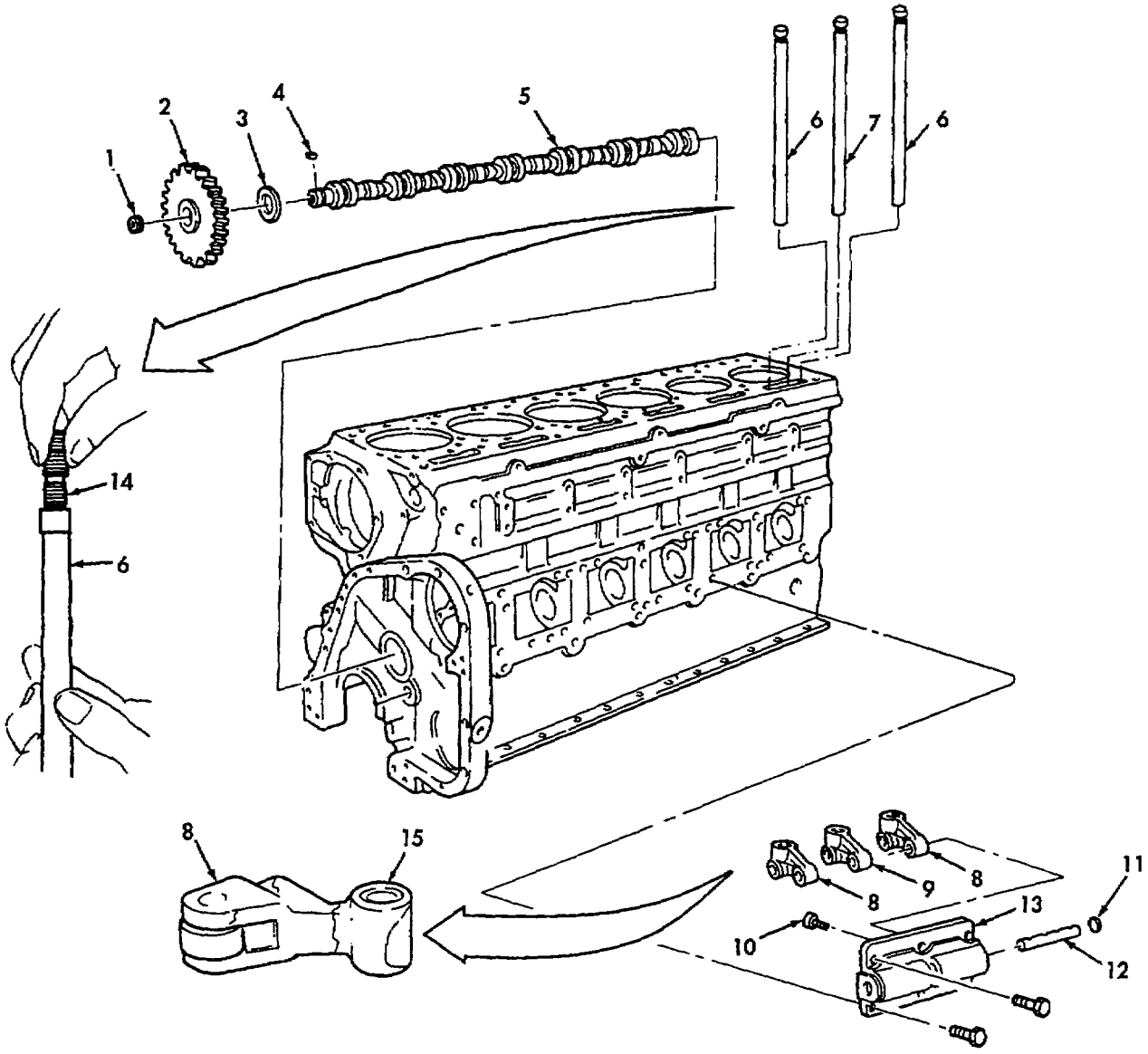
LEGEND:

2. CAMSHAFT GEAR
3. THRUST WASHER
5. CAMSHAFT
6. INTAKE AND EXHAUST PUSHROD (12)
7. INJECTOR PUSHROD (6)

3-40. CAMSHAFT CAM FOLLOWER, AND PUSHROD REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection (Contd)		
	NOTE **Intake, exhaust, and injector pushrods are inspected the same way. Perform step 11 for any intake, exhaust, or injector pushrod.**	
11. Pushrod (6) or (7)	a. Using radius gauge, check ball end.	Radius of ball end must be 0.619-0.625 in. (15.723-15.875 mm). Discard pushrod if ball end is damaged or measures less than 0.619 in. (15.723 mm).
	b. Using ball end of new rocker lever adjusting screw (14), check diameter of socket.	Apply a coat of Prussian blue compound to adjusting screw. Put adjusting screw (14) into socket and rotate 180°. Discard pushrod if socket is damaged or has less than 80 percent contact with adjusting screw.
	c. Inspect for bends or out-of-round.	Discard if bent or out-of-round more than 0.035 in. (0.889 mm).
	d. Check both ends for wear and looseness.	Discard if there is extreme wear on either end. Do not install pushrod with worn ball end into new cam follower socket.
	e. Check for lubricating oil inside.	Discard if pushrod (6) or (7) has begun to fill with oil.
	NOTE **Repeat step 12 for each cam follower shaft.**	
12. Cam follower shaft (12)	a. Using suitable micrometer, measure outside diameter.	Cam follower shaft (12) diameter must measure 0.7485-0.7490 in. (19.012-19.025 mm). Discard cam follower shaft if outside diameter measures less than 0.748 in. (18.999 mm).
	b. Inspect for cracks, breaks, galling, surface imperfections, and broken out areas.	Discard if damaged. Ensure grooves on shaft locking screw (10) are clean.

3-40. CAMSHAFT, CAM FOLLOWER, AND PUSHROD REPAIR (Contd)



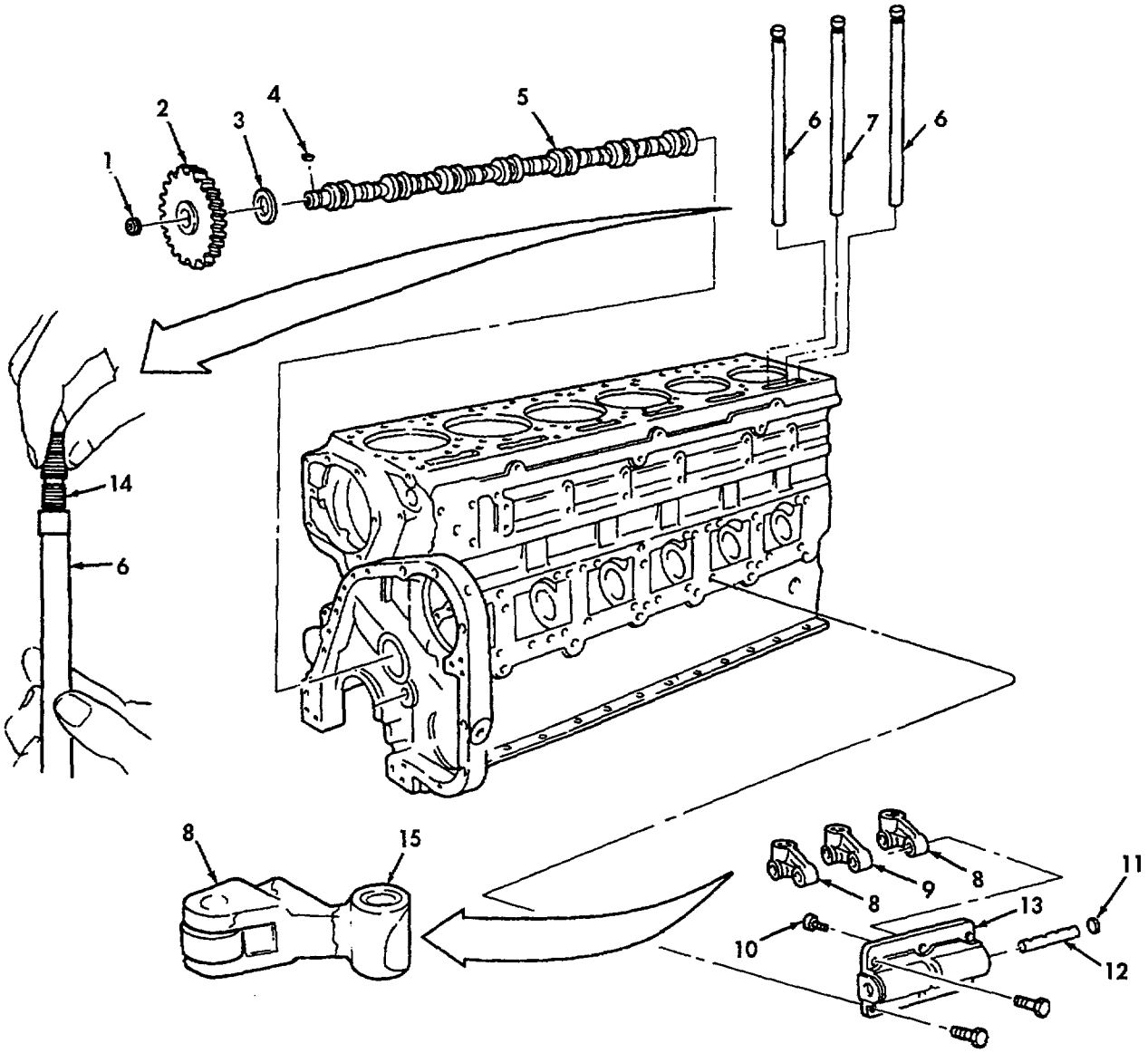
LEGEND:

6. INTAKE AND EXHAUST PUSHROD (12)
7. INJECTOR PUSHROD (6)
10. SHAFT LOCKING SCREW (6)
12. CAM FOLLOWER SHAFT (6)
14. NEW ROCKER LEVER ADJUSTING SCREW (18)

3-40. CAMSHAFT CAM FOLLOWER, AND PUSHROD REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection (Contd)		
	NOTE **Repeat step 13 for each cam follower housing.**	
13. Cam follower housing (13)	a. Inspect for cracks, breaks, gasket surface imperfections, broken-out sections, distortion, excessive wear, and other damage.	Discard if damaged or worn.
	b. Inspect edges of expansion plug holes for sharp edges, nick, and other damage.	If holes were damaged, use 240-grit aluminum paper to remove any sharp edges. Chamfer edge of holes to aid in installation of cam follower shaft (12).
	NOTE **Intake, exhaust, and injector cam followers are inspected the same way. Do steps 14 through 19 for any intake, exhaust, or injector cam followers.**	
14. Cam follower (8) or (9)	a. Inspect cam follower bushing (15) for scratches, pitting, scoring, and other damage.	Discard cam follower (8) or (9) if cam follower bushing (15) is damaged.
	b. Using suitable micrometer, measure inside diameter of cam follower bushing (15).	Cam follower bushing (15) diameter must measure 0.7501-0.7511 in. (19.053-19.078 mm). Discard cam follower if cam follower bushing (15) diameter measures more than 0.752 in. (19.101 mm).
	c. Inspect for cracks using magnetic method. Apply coil magnetization; amperage at 300-500 with residual Magnaglo.	Discard cam follower (8) or (9) if any cracks are found. Be sure to check carefully for cracks on areas of cam follower (8) or (9) shown in illustration.

3-40. CAMSHAFT, CAM FOLLOWER, AND PUSHROD REPAIR (Contd)



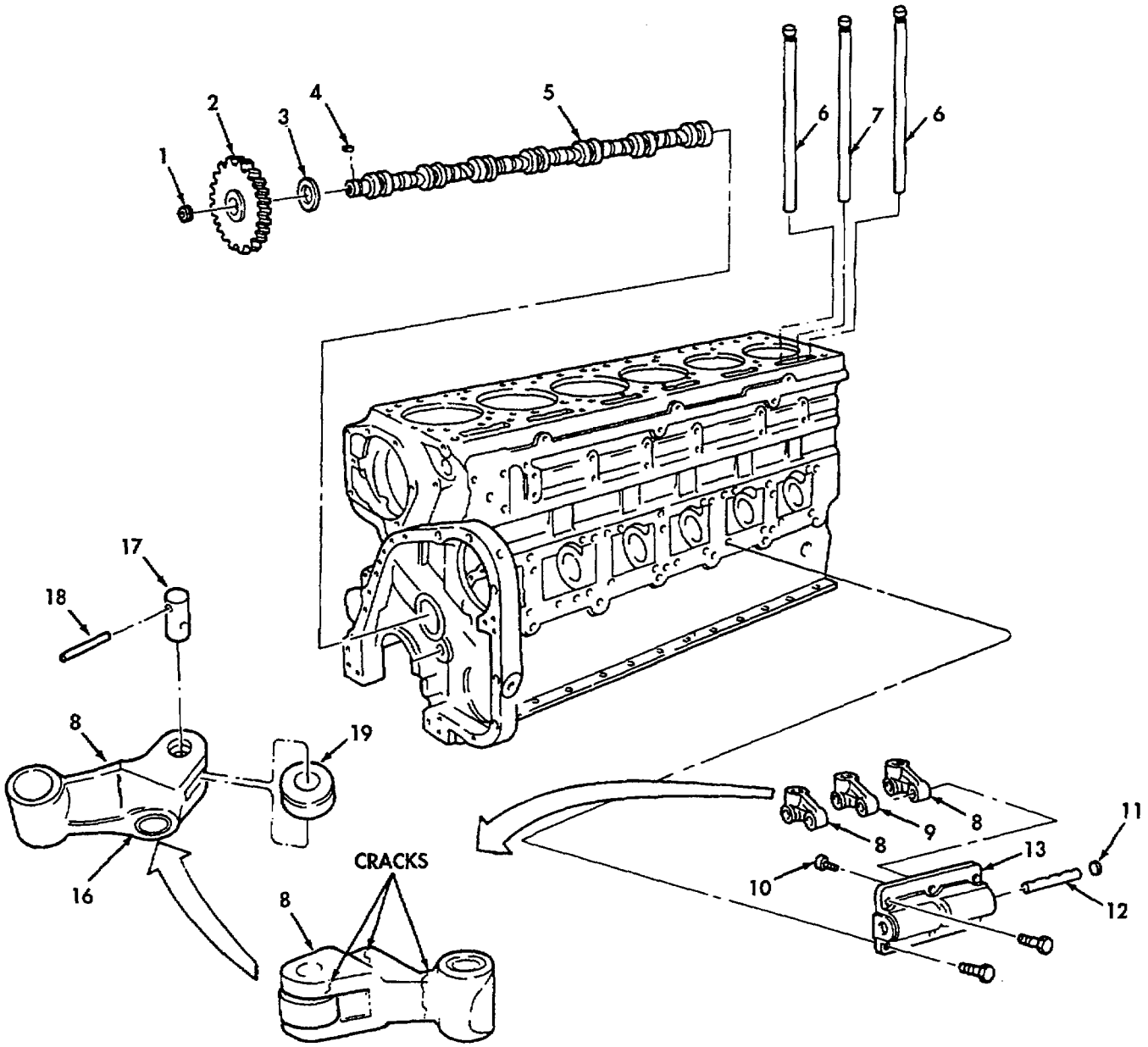
LEGEND:

8. INTAKE AND EXHAUST CAM FOLLOWER (12)
9. INJECTOR CAM FOLLOWER (6)
12. CAM FOLLOWER SHAFT (6)
13. CAM FOLLOWER HOUSING (3)
15. CAM FOLLOWER BUSHING (18)

3-40. CAMSHAFT, CAM FOLLOWER, AND PUSHROD REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection (Contd)		
14. Cam follower (8) or (9) (Contd)	d. Magnetization with Magnaglo is one of the best methods for this inspection. The part is magnetized and covered with a fine magnetic powder. In the vicinity of the crack, there is a disturbance of the Magnaglo which gathers in the crack and effectively marks it. e. Inspect pushrod insert (16) for scoring, galling, pitting, and excessive wear. f. Check pushrod insert (16) using ball end of new pushrod (6) or (7).	Apply a coat of Prussian blue compound to ball end of new pushrod (6) or (7). Put ball end of new pushrod (6) or (7) into pushrod insert (16) and rotate 80°. Replace cam follower (8) or (9) if pushrod insert (16) is damaged or has less than 80 percent contact with ball end of new pushrod (6) or (7).
15. Roll pin (18)	Using hammer and punch, drive out roll pin (18). Remove roller pin (17) and cam follower roller (19) from cam follower (8) or (9).	
16. Cam follower roller (19)	a. Inspect for cracks, breaks, and other damage.	Discard cam follower (8) or (9) if cam follower roller (19) is damaged.

3-40. CAMSHAFT, CAM FOLLOWER, AND PUSHROD REPAIR (Contd)



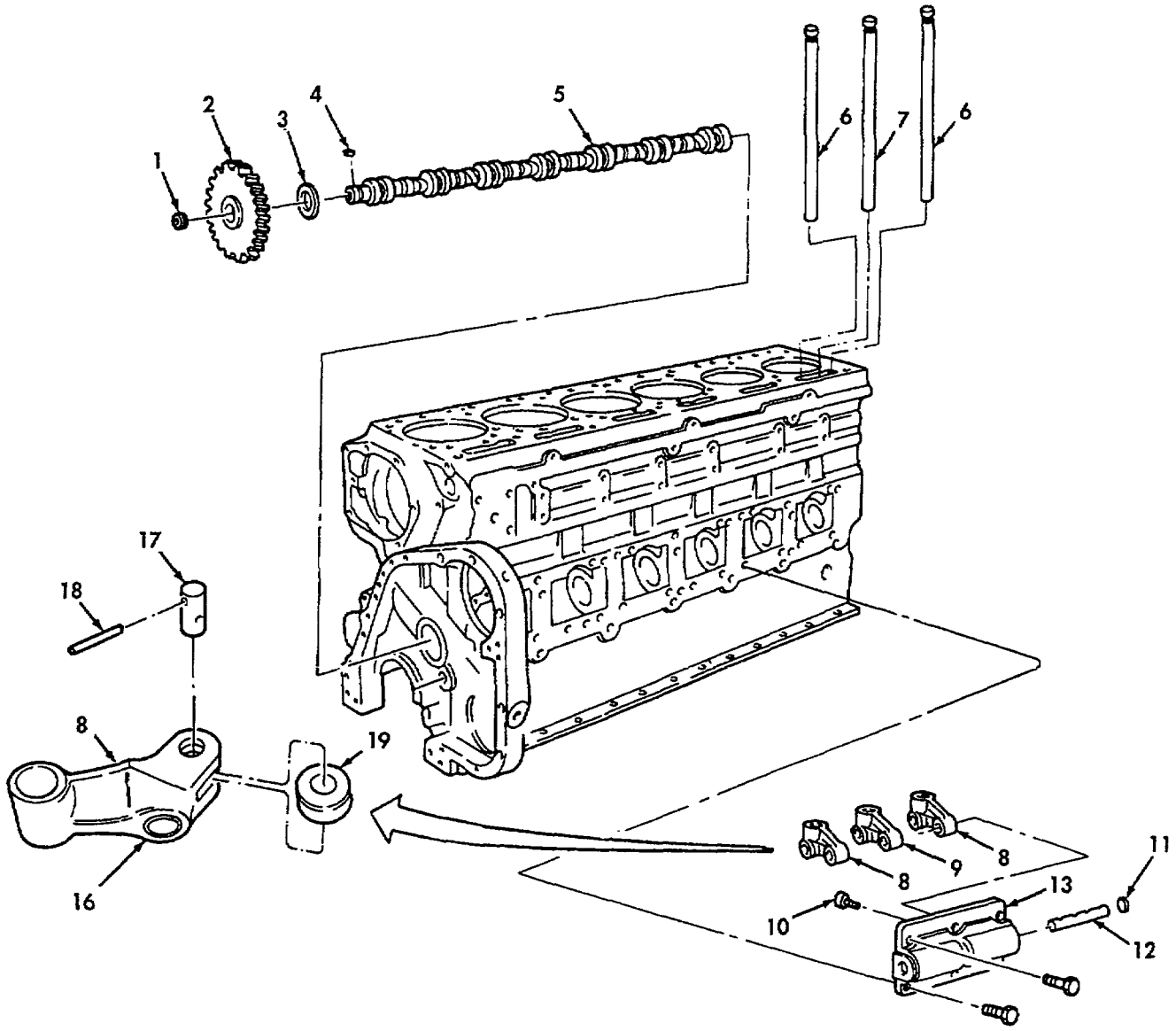
LEGEND:

6 INTAKE AND EXHAUST PUSHROD (12)
7. INJECTOR PUSHROD (6)
8 INTAKE AND EXHAUST CAM FOLLOWER (12)
9. INJECTOR CAM FOLLOWER (6)
16. PUSHROD INSERT (18)
17. ROLLER PIN (18)
18. ROLL PIN (18)
19. CAM FOLLOWER ROLLER (18)

3-40. CAMSHAFT CAM FOLLOWER, AND PUSHROD REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection (Contd)		
16. Cam follower roller (19) (Contd)	b. Using small bore gauge, measure inside diameter.	Intake or exhaust cam follower roller (19) inside diameter must measure 0.5005-0.5015 in. (12.713-12.738 mm). Discard cam follower (8) if inside diameter measures more than 0.503 in. (12.776 mm). Injector cam roller inside diameter must measure 0.703-0.704 in. (17.856-17.882 mm). Discard injector cam follower (9) if inside diameter measures more than 0.705 in. (17.907 mm).
	c. Inspect cam follower roller (19) to ensure it is not out-of-round.	Discard cam follower (8) or (9) if roller (19) is out-of-round.
	d. Using suitable micrometer, measure outside diameter.	Outside diameter of roller (19) must measure 1.2495-1.2505 in. (31.737-31.763 mm). Discard intake, exhaust, or injector cam follower (8) or (9) if outside diameter measures less than 1.2485 in. (31.712 ram).
	e. Check concentricity of inside diameter with outside diameter.	Discard cam follower (8) or (9) if not within 0.0020 in. (0.051 mm).
	f. Check squareness of sides with bore.	Discard cam followers (8) or (9) if sides are not parallel to each other or not square to bore within 0.0040 in. (0.102 mm).
17. Roller pin (17)	a. Inspect for cracks, breaks, and other damage.	Discard cam followers (8) or (9) if roller pin (17) is damaged.
	b. Using suitable micrometer, measure outside diameter.	Intake or exhaust roller pin (17) outside diameter must measure 0.4997-0.500 in. (12.692-12.700 mm). Discard intake or exhaust cam follower (8) if outside diameter measures less than 0.497 in. (12.624 mm). Injector roller pin (17) outside diameter must measure 0.6997-0.7000 in. (17.772-17.780 mm). Discard injector cam follower (9) if outside diameter measures less than 0.997 in. (17.704 mm).

3-40. CAMSHAFT, CAM FOLLOWER, AND PUSHROD REPAIR (Contd)



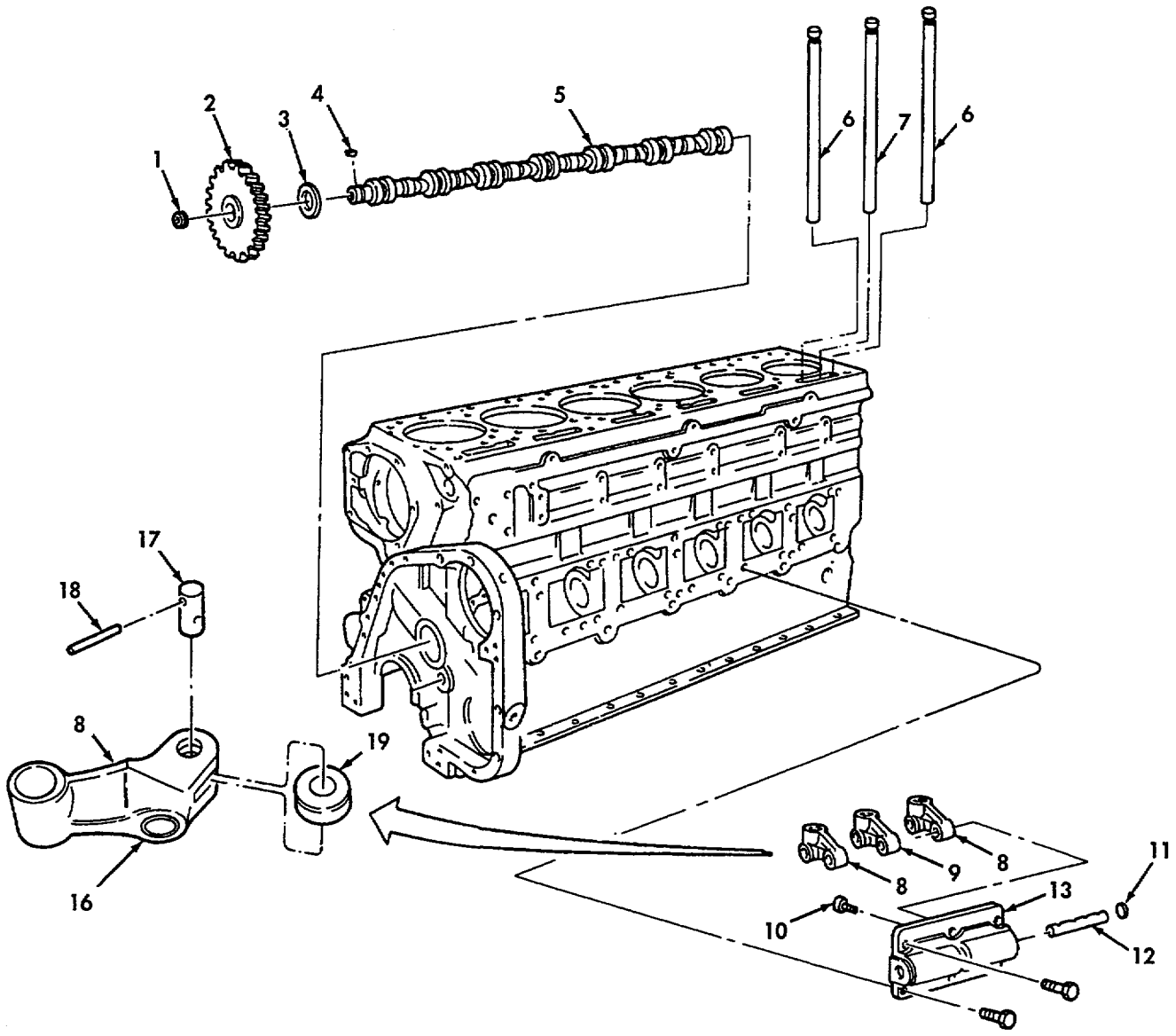
LEGEND:

8. INTAKE AND EXHAUST CAM FOLLOWER (12)
9. INJECTOR CAM FOLLOWER (6)
17. ROLLER PIN (18)
19. CAM FOLLOWER ROLLER (18)

3-40. CAMSHAFT CAM FOLLOWER, AND PUSHROD REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection (Contd)		
18. Cam follower (8) or (9)	Using suitable micrometer, measure roller pin bore.	Discard intake and exhaust cam follower (8) if roller pin bore is not within 0.4990 and 0.4995 in. (12.675 and 12.687 mm). Discard injector cam follower (9) if roller pin bore is not within 0.6992 and 0.6997 in. (17.760 and 17.772 mm).
d. Assembly		
19. Cam follower roller (19) and roller pin (17)	a. Install roller (19) on cam follower (8) or (9). b. Hold 0.006 in. (0.152 mm) feeler gauge between cam follower (8) or (9) and cam follower roller (19). c. Install roller pin (17) on cam follower (8) or (9) and cam follower roller (19). d. Secure roller pin (17) to cam follower (8) or (9) with roll pin (18).	
	NOTE **Repeat steps 20 through 22 for each cam follower assembly.**	
20. Four intake and exhaust cam followers (8), two injector cam followers (9), and two cam follower shafts (12)	Install on cam follower housing (13).	Ensure injector cam follower (9) is in center position, and that cam follower pushrod sockets are on same side as dowel holes in housing.
21. Cam follower shaft (12)	Install dummy screw.	Dummy screw is used to prevent breaking shaft locking screw (10) when expansion plugs (11) are installed on cam follower housing (13).

3-40. CAMSHAFT CAM FOLLOWER, AND PUSHROD REPAIR (Contd)



LEGEND:

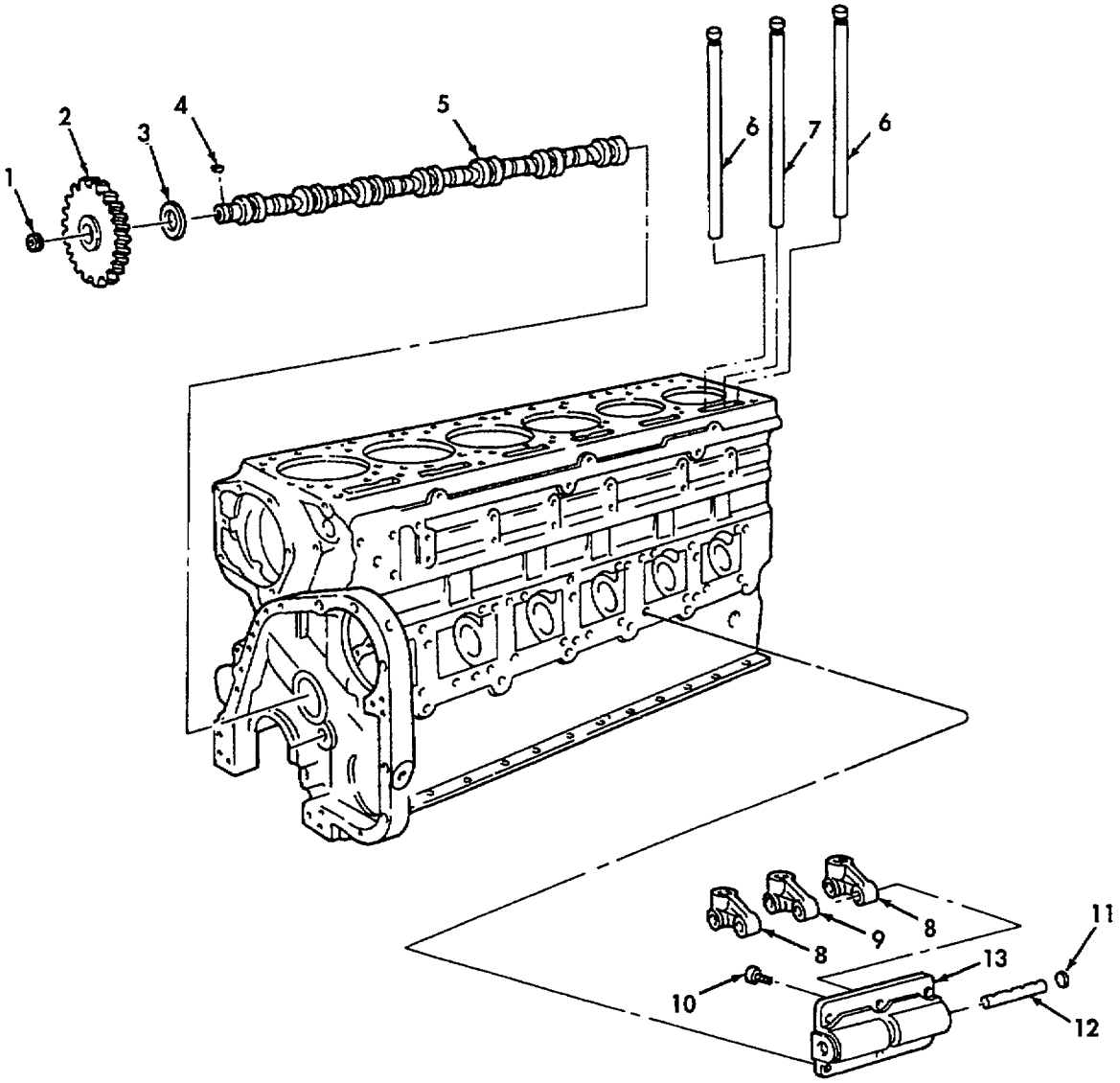
8. INTAKE AND EXHAUST CAM FOLLOWER (12)
9. INJECTOR CAM FOLLOWER (6)
10. SHAFT LOCKING SCREW (6)
11. EXPANSION PLUG (6)
12. CAM FOLLOWER SHAFT (6)
13. CAM FOLLOWER HOUSING (3)
17. ROLLER PIN (18)
18. ROLL PIN (18)
19. CAM FOLLOWER ROLLER (18)

3-40. CAMSHAFT CAM FOLLOWER, AND PUSHROD REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Assembly (Contd)		
22. Cam follower housing (13)	a. Apply light coat of cup plug sealant to expansion plug hole in each end. b. Using suitable mandrel, install two new expansion plugs (11). c. Remove dummy screw and install two shaft locking screws (10).	Expansion plugs (11) should be at least flush with edge of hole or not more than 0.010 in. (0.254 mm) below edge of hole.
23. Camshaft orifice plug (1)	Install on camshaft (5).	Torque 5-10 lb-f (7-13 N•m).
24. Thrust washer (3)	Install on camshaft (5).	
25. Camshaft gear (2)	If removed in step 1, heat gear (2) evenly in oven to 400° F.	Do not use cutting torch to heat camshaft gear (2); damage to gear (2) will result.
26. Camshaft(5)	a. Put in press. b. Install gear-to-camshaft key (4). c. Press camshaft gear (2) on camshaft (5) while still hot	

FOLLOW-ON TASK: Install camshaft and cam follower assemblies (para. 3-70).

3-40. CAMSHAFT, CAM FOLLOWER, AND PUSHROD REPAIR (Contd)



LEGEND:

1. CAMSHAFT ORIFICE PLUG
2. CAMSHAFT GEAR
3. THRUST WASHER
4. GEAR-TO-CAMSHAFT KEY
5. CAMSHAFT
10. SHAFT LOCKING SCREW (6)
11. EXPANSION PLUG (6)
13. CAM FOLLOWER HOUSING (3)

3-41. ROCKER LEVERS AND HOUSING REPAIR

THIS TASK COVERS:

a. Disassembly
b. Cleaning
c. Inspection
d. Assembly

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Rocker lever block and mandrel set
(15434) ST-691

TEST EQUIPMENT
None

MATERIALS/PARTS
Solvent, SD-3 (Appendix C, Item 30)
Paper, aluminum oxide, 240-grit
(Appendix C, Item 23)
Compound, Prussian blue (Appendix C, Item 9)
Oil, lubricating, OE/HDO 30
(Appendix C, Item 21)
Two O-ring seals (15434) 2000521
Two plugs (15434) 218736
Two special expansion plugs (15434) 161825

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
Rocker arm housing assembly removed (para. 3-22).

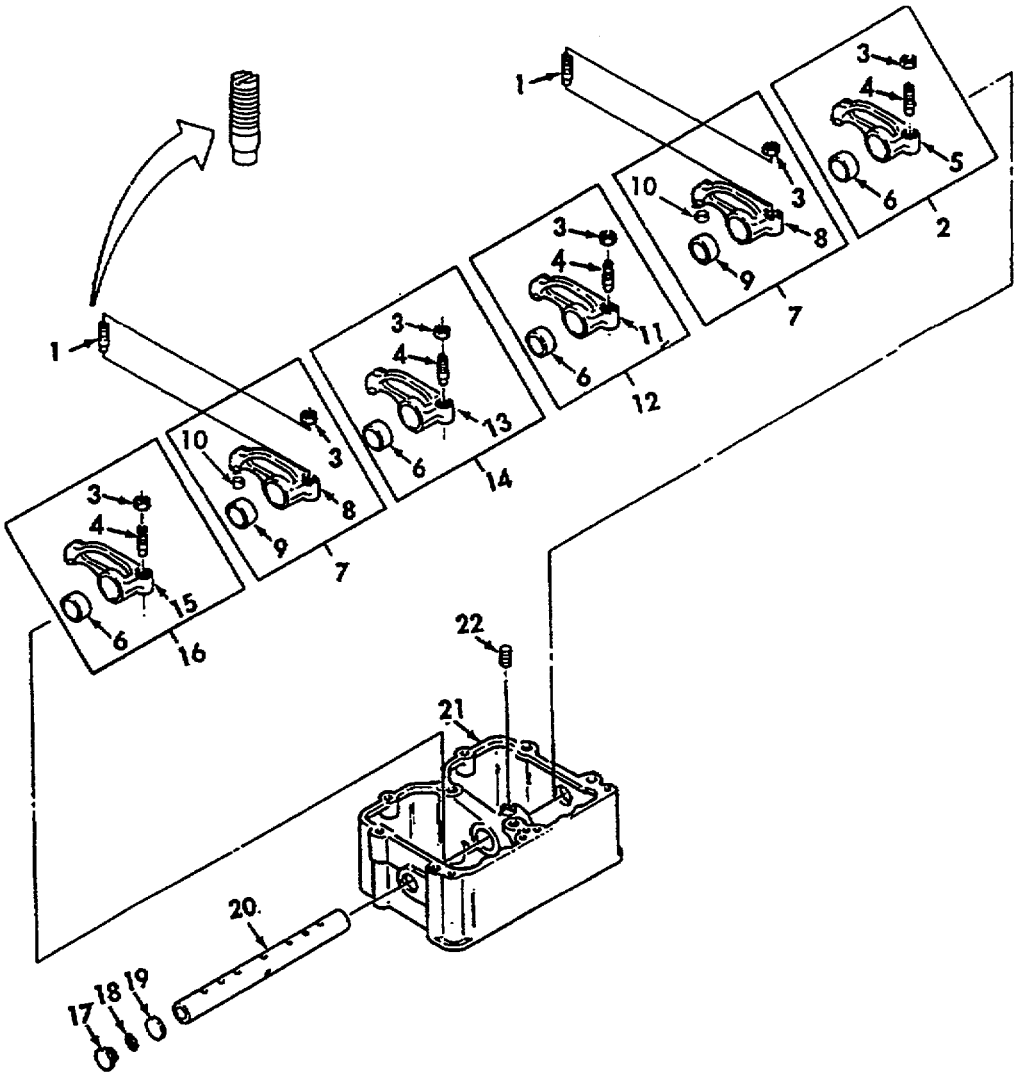
SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
Always wear eye protection when working with compressed air.

LOCATION/ITEM	ACTION	REMARKS
a. Disassembly		
	NOTE **Use this procedure to repair any one of the three rocker lever and housing assemblies. Quantities shown in legend are for one rocker lever and housing assembly.**	
1. Two adjusting screws (1), four adjusting screws (4), and six adjusting screw nuts (3)	Unscrew and remove from rocker levers (5), (8), (11), (13), and (15).	
2. Oil supply screw (22)	Unscrew and remove from rocker arm housing (21) and rocker lever shaft (20).	
3. Rocker lever shaft (20) and six rocker levers (5), (8), (11), (13), and (15)	Using suitable punch, press shaft (20) out of rocker arm housing (21) and remove rocker levers (5), (8), (11), (13), and (15).	Be careful not to damage bore in rocker arm housing (21). Tag each rocker lever as removed to ensure correct assembly.
4. Two O-ring seals (18)	Remove from plugs (17).	Discard O-ring seals (18).
5. Two plugs (17)	a. Put one plug (17) in vise.	Do not put rocker lever shaft (20) in vise.
	b. Rotate and pull off rocker lever shaft (20).	
	c. Repeat steps 5a and 5b for other plug (17).	Discard plugs (17).

3-41. ROCKER LEVERS AND HOUSING REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
6. Two special expansion plugs (19)	Punch out of rocker lever shaft (20).	Discard expansion plugs (19).



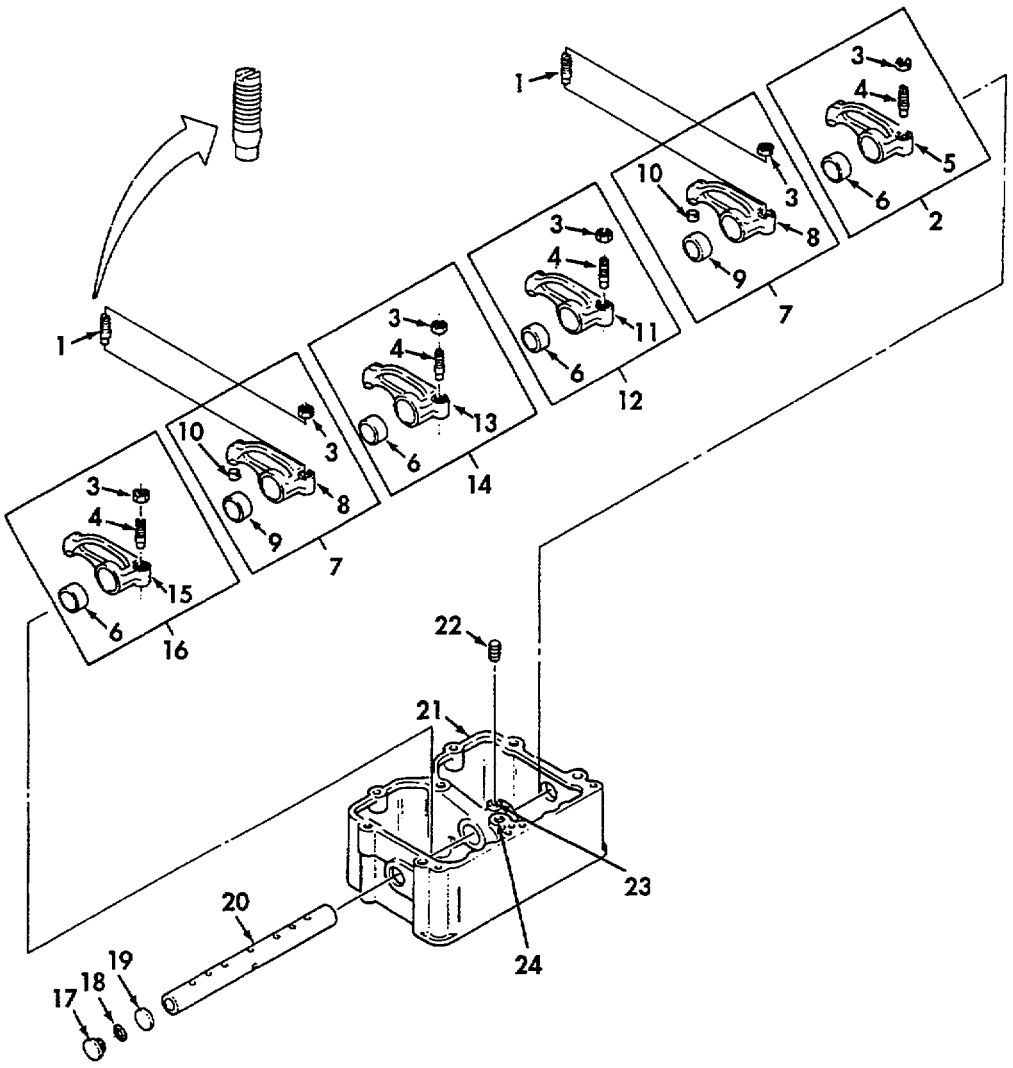
LEGEND:

1. ADJUSTING SCREW (2)
2. EXHAUST ROCKER LEVER ASSEMBLY
3. ADJUSTING SCREW NUT (6)
4. ADJUSTING SCREW (4)
5. EXHAUST ROCKER LEVER
6. BUSHING (4)
7. INJECTOR ROCKER LEVER ASSEMBLY (2)
8. INJECTOR ROCKER LEVER (2)
9. BUSHING (2)
10. BALL SOCKET SEAT (2)
11. INTAKE ROCKER LEVER
12. INTAKE ROCKER LEVER ASSEMBLY
13. INTAKE ROCKER LEVER
14. INTAKE ROCKER LEVER ASSEMBLY
15. EXHAUST ROCKER LEVER
16. EXHAUST ROCKER LEVER ASSEMBLY
17. PLUG (2)
18. O-RING SEAL (2)
19. SPECIAL EXPANSION PLUG (2)
20. ROCKER LEVER SHAFT
21. ROCKER ARM HOUSING
22. OIL SUPPLY SCREW

3-41. ROCKER LEVERS AND HOUSING REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
b. Cleaning		
7. Rocker lever shaft (20)	Using bottle brush, clean bore in shaft.	
	WARNING **Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and protective equipment such as goggles or shield, gloves, etc. Failure to comply may result in injury to personnel.**	
8. All parts	Clean in solvent SD-3 and blow dry with compressed air.	Make sure all gasket material has been removed from sealing surfaces of rocker arm housing (21). Refer to para. 3-6 for additional cleaning instructions.
c. Inspection		
9. All parts	Inspect for cracks, breaks, distortion, and other damage.	Discard damaged parts.
10. All threaded parts	Inspect for crossthreading, stripping, and other damage.	Discard damaged parts.
11. Rocker arm housing (21)	a. Inspect opening of shaft bore for sharp edges, nicks, or burrs.	Shaft bore opening should have slight radius. Sharp edges can be removed by using 240-grit aluminum oxide paper over a split rod, rotating in an electric drill.
	b. Check breather vent hole (24) and rocker lever oil passage (23) to make sure they are free of dirt and other foreign material.	
	c. Using suitable micrometer, measure rocker lever shaft bore inside diameter.	Discard rocker arm housing (21) if measurement is not between 1.1238 and 1.1246 in. (28.545 and 28.565 mm). (See Appendix F-2.)

3-41. ROCKER LEVERS AND HOUSING REPAIR (Contd)

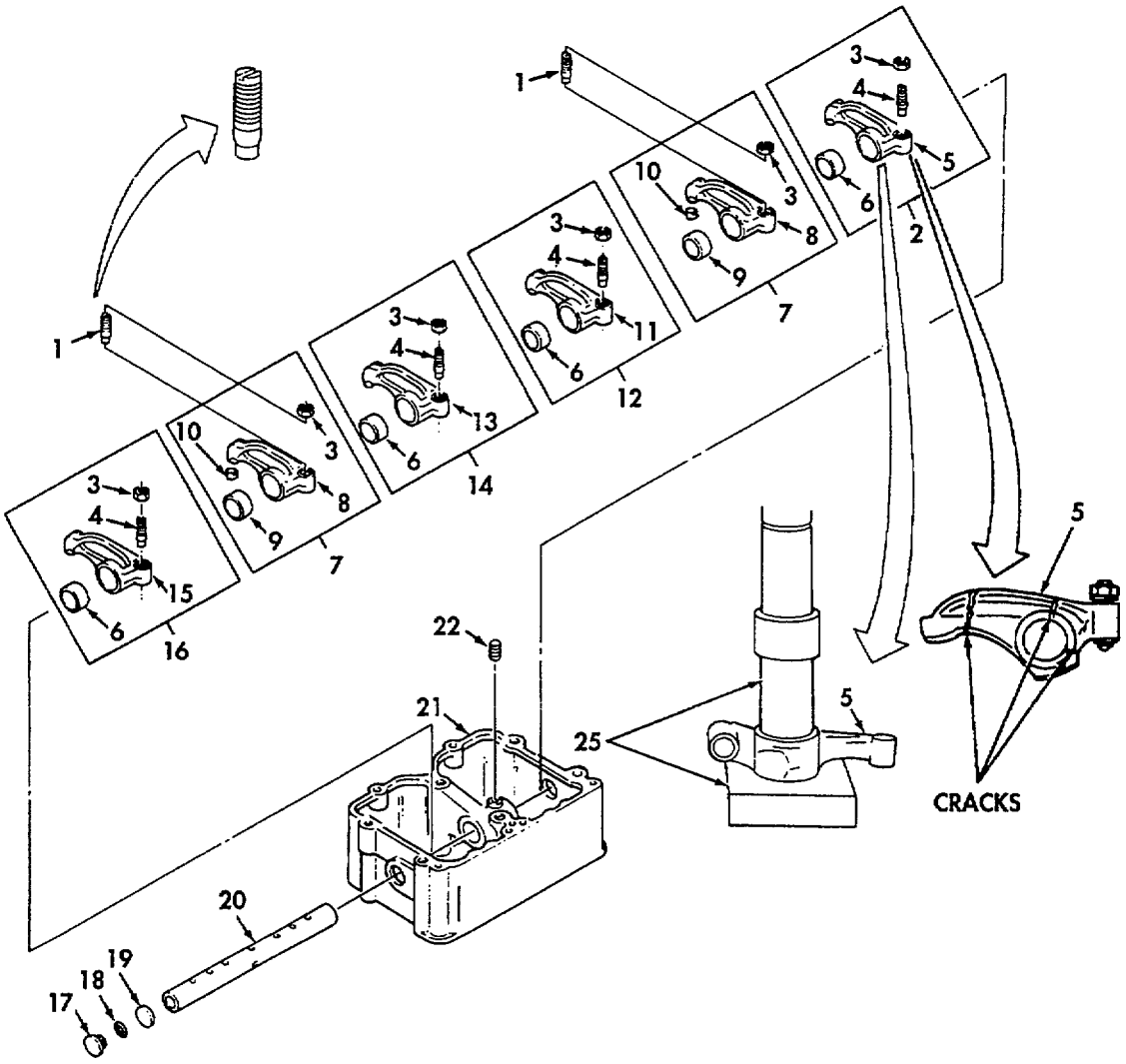


LEGEND:
20. ROCKER LEVER SHAFT
21. ROCKER ARM HOUSING
23. ROCKER LEVER OIL PASSAGE
24. BREATHER VENT HOLE

3-41. ROCKER LEVERS AND HOUSING REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection (Contd)		
	NOTE **Repeat step 12 for each exhaust, intake, or injector rocker lever.**	
12. Rocker levers (5), (8), (11), (13), or (15)	a. Check for cracks using magnetic inspection.	Use coil magnetization with amperage at 300 to 500 residual Magnaglo. Most areas of crack indication shown in illustration. Replace rocker lever assembly (2) (7), (12), (14), or (16) if rocker lever has cracks. Demagnetize levers that are to be reused.
	b. Using new adjusting screw (1) or (4), check condition of threads in rocker lever.	Discard rocker lever assembly if adjusting screw does not move freely in rocker lever.
	c. Inspect ball socket seat of injector rocker levers (8) for damage. Apply Prussian blue compound with 0.500 in. (12.70 mm) check ball.	If socket is damaged or if bluing pattern does not coat at least 80 percent of socket, drill small hole over ball socket seat and drive damaged ball socket seat (10) out of injector rocker lever (8). Stake hole and install a new ball socket seat (10) in injector rocker lever (8).
	d. Inspect bushings (6) or (9) for scratches, pitting, scoring, and excessive wear.	Replace bushings (6) or (9) if damaged or worn (refer to step 12f for replacement).
	e. Using suitable micrometer, measure bushing inside diameter.	Replace bushings (6) or (9) if not within limits shown below (refer to step 12f for replacement).
	New Minimum ..... 1.1245 in. (28.562 mm) New Maximum ..... 1.1275 in. (28.638 mm) Wear Limit ..... 1.1286 in. (28.666 mm)	
	f. Replace bushings (6) or (9) as follows:	Do this step only if bushings (6) or (9) are damaged or not within wear limits.
	(1) Using rocker lever block and mandrel set (25), press bushings (6) or (9) out.	Discard bushing(s).

3-41. ROCKER LEVERS AND HOUSING REPAIR (Contd)



LEGEND:

1. ADJUSTING SCREW (2)
2. EXHAUST ROCKER LEVER ASSEMBLY
3. ADJUSTING SCREW NUT (6)
4. ADJUSTING SCREW (4)
5. EXHAUST ROCKER LEVER
6. BUSHING (4)
7. INJECTOR ROCKER LEVER ASSEMBLY (2)
8. INJECTOR ROCKER LEVER (2)
9. BUSHING (2)
10. BALL SOCKET SEAT (2)
11. INTAKE ROCKER LEVER
12. INTAKE ROCKER LEVER ASSEMBLY
13. INTAKE ROCKER LEVER
14. INTAKE ROCKER LEVER ASSEMBLY
15. EXHAUST ROCKER LEVER
16. EXHAUST ROCKER LEVER ASSEMBLY
25. ROCKER LEVER BLOCK AND MANDREL SET

3-41. ROCKER LEVERS AND HOUSING REPAIR (Contd)

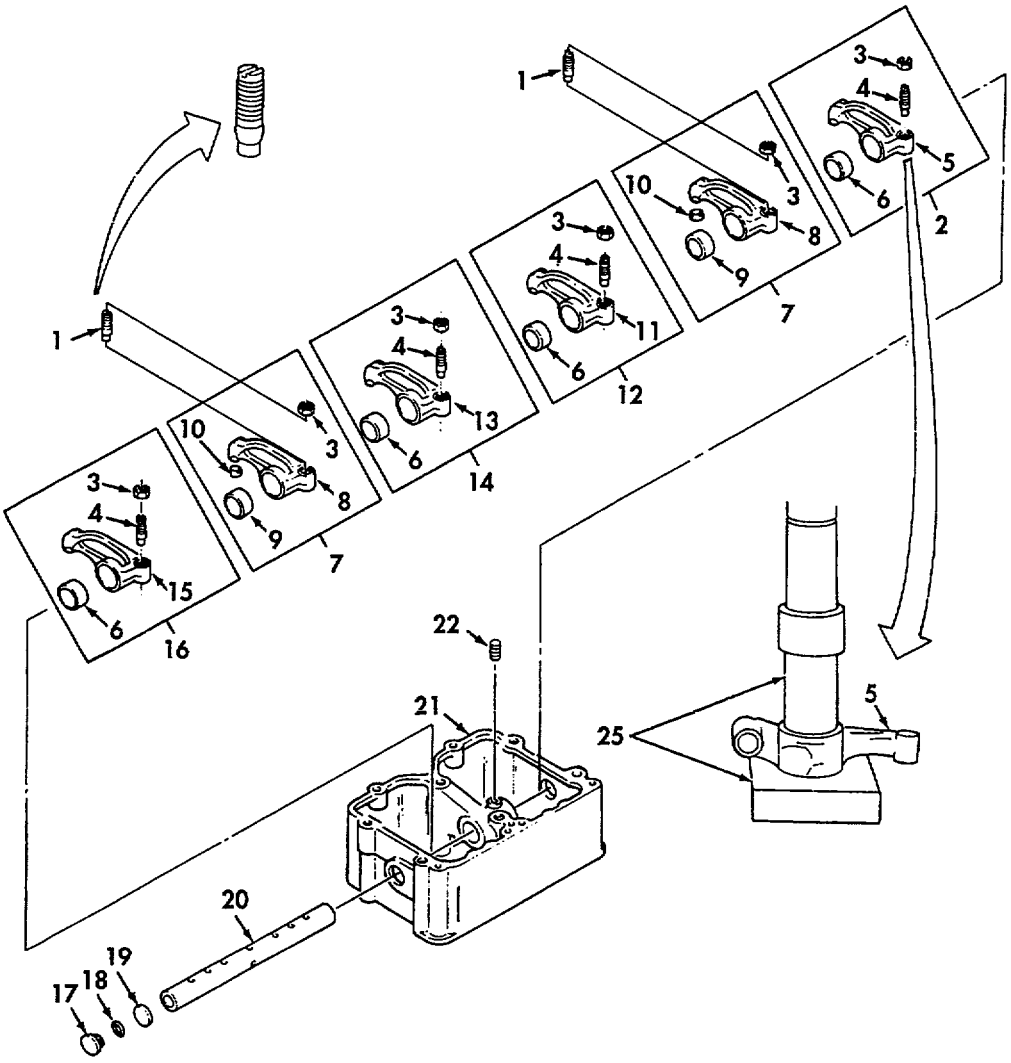
LOCATION/ITEM	ACTION	REMARKS
c. Inspection (Contd)		
	CAUTION • **To avoid damaging engine, do the following:** • **On injector and exhaust rocker levers, install bushing so oil holes to crosshead nose or injector link and adjusting screw are open for oil flow.** • **On intake valve rocker levers with oil drilling to crosshead nose end, install bushing so nose hole is closed and slot hole is in line with adjusting screw oil hole.** • **Do not cut a bore in steel bushings.**	
	(2) Using rocker lever block and mandrel set (25) and arbor press, press new bushings (6) or (9) into rocker levers (5), (8), (11), (13), or (15).	
	g. Check rocker lever-to-crosshead contact surface on intake or exhaust rocker levers (5), (11), (13), or (15).	Replace intake or exhaust rocker lever assembly (2), (12), (14), or (16) if damaged or worn.
	NOTE **Repeat step 13 for each adjusting screw.**	
13. Adjusting screws (1) or (4)	a. Using a 0.250 in. (6.350 mm) radius gauge, check ball end. b. Check thread condition.	Discard adjusting screw if ball end is out-of-round or flat at bottom. Check carefully for thread distortion at assembly position of adjusting screw nut (3). Discard adjusting screws (1) or (4) if threads are damaged, or if it does not move freely in rocker levers (5), (8), (11), (13), or (15).
14. Rocker lever shaft (20)	a. Inspect for scoring or excessive wear. b. Using suitable micrometer, measure outside diameter of shaft (20).	Discard if damaged, worn, or if it has ridges due to action of rocker levers (5), (8), (11), (13), or (15). Discard if outside diameter is not within limits shown below:

New Minimum ..... 1.1230 in. (28.524 mm)

New Maximum ..... 1.1240 in. (28.550 mm)

Wear Limit ..... 1.1220 in. (28.499 mm)

3-41. ROCKER LEVERS AND HOUSING REPAIR (Contd)



LEGEND:

1. ADJUSTING SCREW (2)
2. EXHAUST ROCKER LEVER ASSEMBLY
3. ADJUSTING SCREW NUT (6)
4. ADJUSTING SCREW (4)
5. EXHAUST ROCKER LEVER
6. BUSHING (4)
8. INJECTOR ROCKER LEVER (2)
9. BUSHING (2)
10. BALL SOCKET SEAT (2)
11. INTAKE ROCKER LEVER
12. INTAKE ROCKER LEVER ASSEMBLY
13. INTAKE ROCKER LEVER
14. INTAKE ROCKER LEVER ASSEMBLY
15. EXHAUST ROCKER LEVER
16. EXHAUST ROCKER LEVER ASSEMBLY
20. ROCKER LEVER SHAFT
25. ROCKER LEVER BLOCK AND MANDREL SET

3-41. ROCKER LEVERS AND HOUSING REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Assembly		
15. Two adjusting screws (1), four adjusting screws (4), and six adjusting screw nuts (3)	Screw into rocker levers (5), (8), (11), (13), and (15).	Be sure to install adjusting screws and nuts into correct rocker levers.
16. Two new special expansion plugs (19)	Press one into each end of rocker lever shaft (20).	
17. Two new plugs (17)	Using arbor press, install into rocker lever shaft (20).	Install both plugs (17) into shaft (20) at same time.
18. Rocker lever shaft (20)	a. Coat with clean lubricating oil.	
	b. Slide shaft (20) through rocker arm housing (21) and rocker lever assemblies (2), (7), (12), (14), and (16).	Let about 0.500 in. (12.70 mm) of shaft (20) extend out of housing (21).
	c. Install lightly oiled new O-ring seal (18) into groove of shaft (20).	
	d. Push shaft (20) into rocker arm housing (21) until other end extends about 0.500 in. (12.70 mm), and install other lightly oiled new O-ring seal (18) and push shaft (20) back into rocker arm housing (21).	

CAUTION

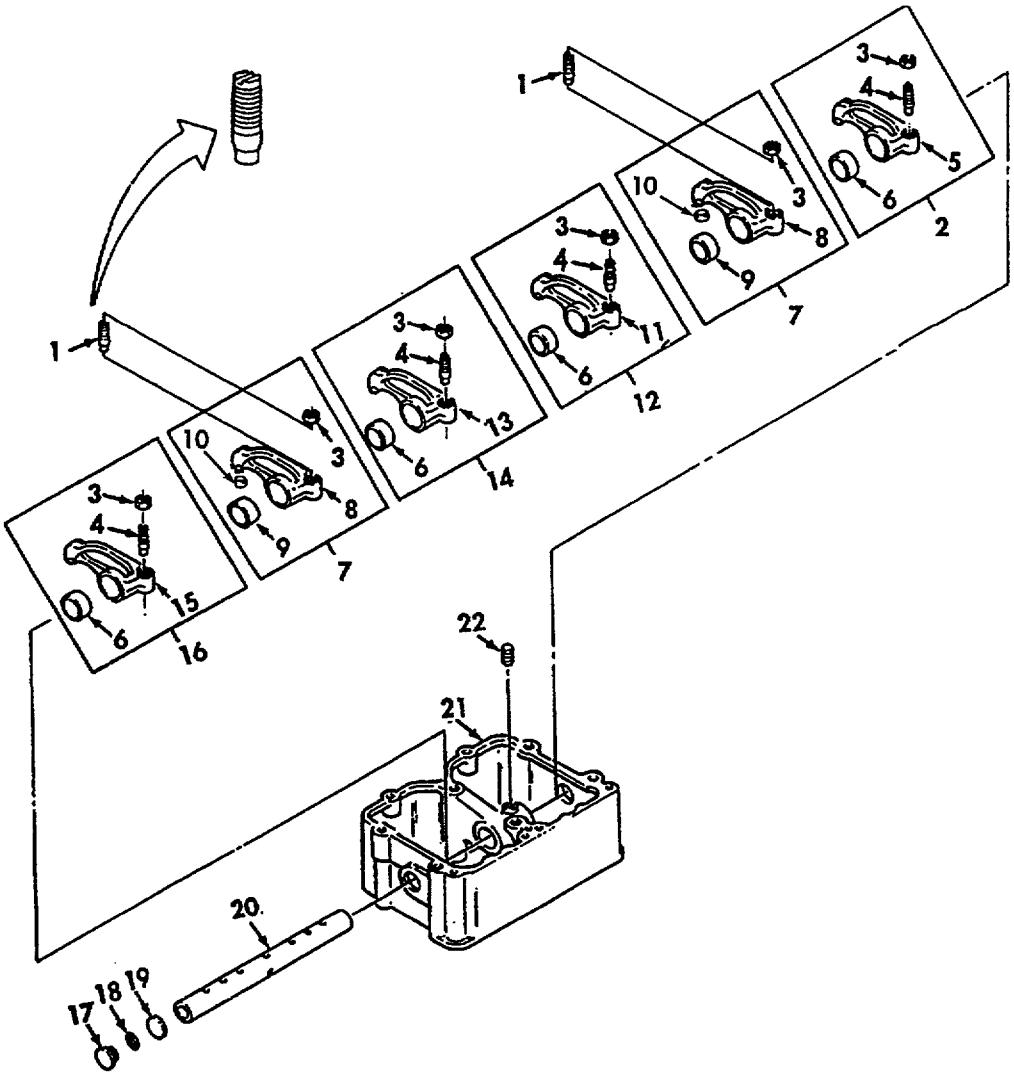
Ensure rocker lever shaft is installed correctly. Setscrew hole must be on top and seven oil holes must be toward flat side of rocker arm housing.

19. Rocker lever shaft (20)	e. Align shaft and housing locking holes and secure oil supply screw (22).	
	f. Check all rocker levers (5), (8), (11), (13), or (15) for freedom of movement on shaft (20).	This will prevent galling of shaft (20) and bushings (6) or (9).

NOTE

Install rocker arm housing assembly (para. 3-84).

3-41. ROCKER LEVERS AND HOUSING REPAIR (Contd)



LEGEND:

1. ADJUSTING SCREW (2)
2. EXHAUST ROCKER LEVER ASSEMBLY
3. ADJUSTING SCREW NUT (6)
4. ADJUSTING SCREW (4)
5. EXHAUST ROCKER LEVER
7. INJECTOR ROCKER LEVER ASSEMBLY (2)
8. INJECTOR ROCKER LEVER (2)
11. INTAKE ROCKER LEVER
12. INTAKE ROCKER LEVER ASSEMBLY
13. INTAKE ROCKER LEVER
14. INTAKE ROCKER LEVER ASSEMBLY
15. EXHAUST ROCKER LEVER
16. EXHAUST ROCKER LEVER ASSEMBLY
17. PLUG (2)
18. O-RING SEAL (2)
19. SPECIAL EXPANSION PLUG (2)
20. ROCKER LEVER SHAFT
21. ROCKER ARM HOUSING
22. OIL SUPPLY SCREW

3-42. OIL COOLER REPAIR

THIS TASK COVERS:

a. Disassembly
b. Cleaning
c. Inspection
d. Assembly

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
None

TEST EQUIPMENT
None

MATERIALS/PARTS
Solvent, SD-3 (Appendix C, Item 30)
Acid, muriatic (Appendix C, Item 1)
Acid, oxalic (Appendix C, Item 2)
Pyridene (Appendix C, Item 24)
Sodium, carbonate (5 percent solution) (Appendix C, Item 28)
Oil, lubricating, OE/HDO 30 (Appendix C, Item 21)
Expansion plug (15434) 142110
Gasket and seal kit (15434) 3018762 (M915/Big Cam I)
Ten lockwashers (96906) MS35338-48 (M915/Big Cam I)
Lockwasher (15434) 70216 (M915/Big Cam I)
Gasket and seal kit (15434) 3801235 (M915A1/Big Cam III)
Eleven lockwashers (15434) S-604 (M915A1/Big Cam III)
Three lockwashers (96906) MS122032 (M915A1/Big Cam III)

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
TM 9-2320-273-20
TM 9-2320-283-20

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
Oil cooler removed (para. 3-22).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
- Always wear eye protection when working with compressed air.
- Approved solvents may be flammable and will not be used near open flame. Use in well-ventilated area.

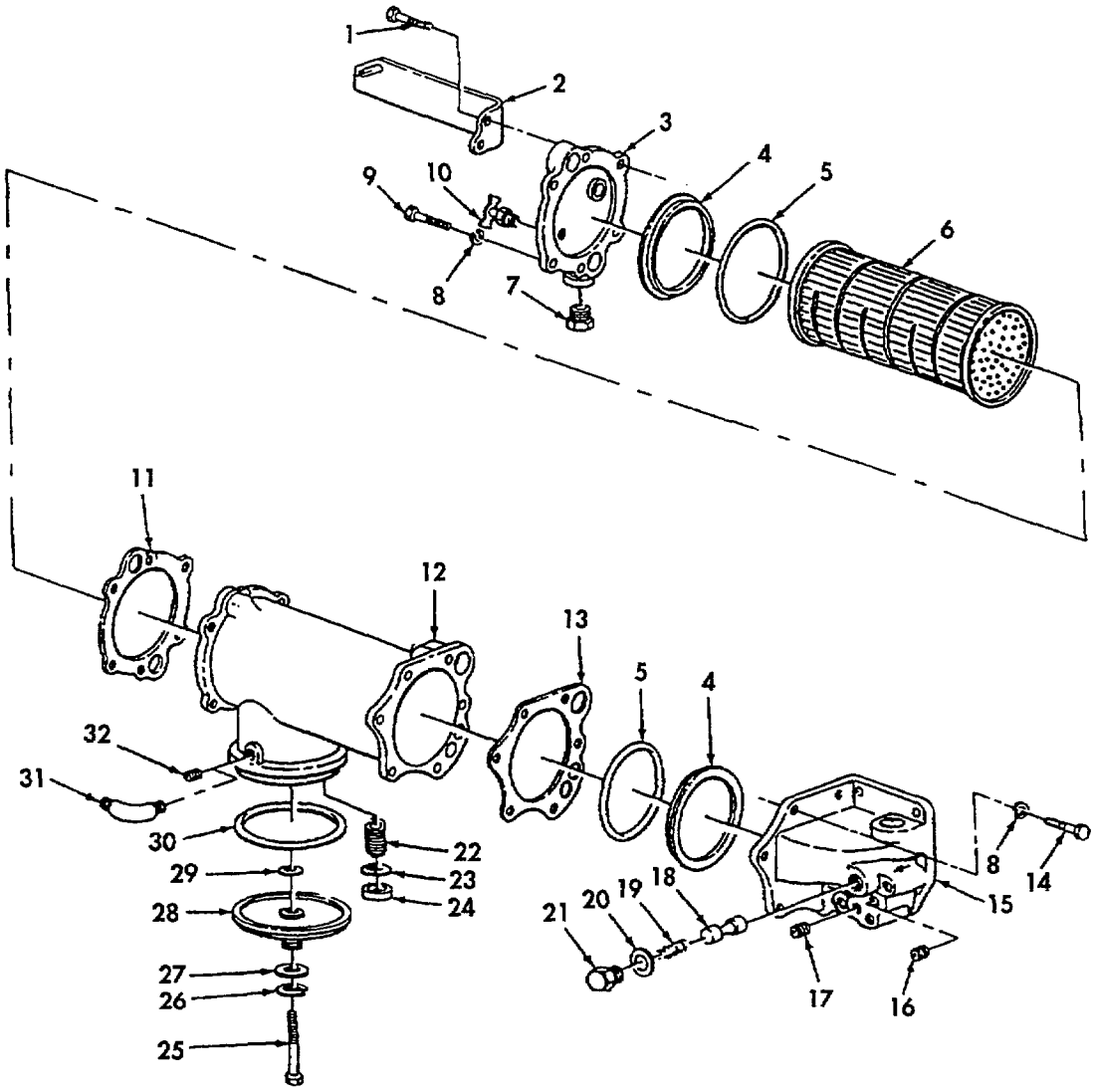
LOCATION/ITEM	ACTION	REMARKS

a. Disassembly

NOTE
- **Perform steps 1 through 7 for M915/Big Cam I only.**
- **Perform steps 8 through 16 for M915A1/Big Cam III only.**

1.	Pipe plugs (7), (17), and (32), expansion plug (16) or elbow (31), and drainvalve (10)	Remove from cover (15), housing (12), and cover (3).	

3-42. OIL COOLER REPAIR (Contd)



M915/BIG CAM I

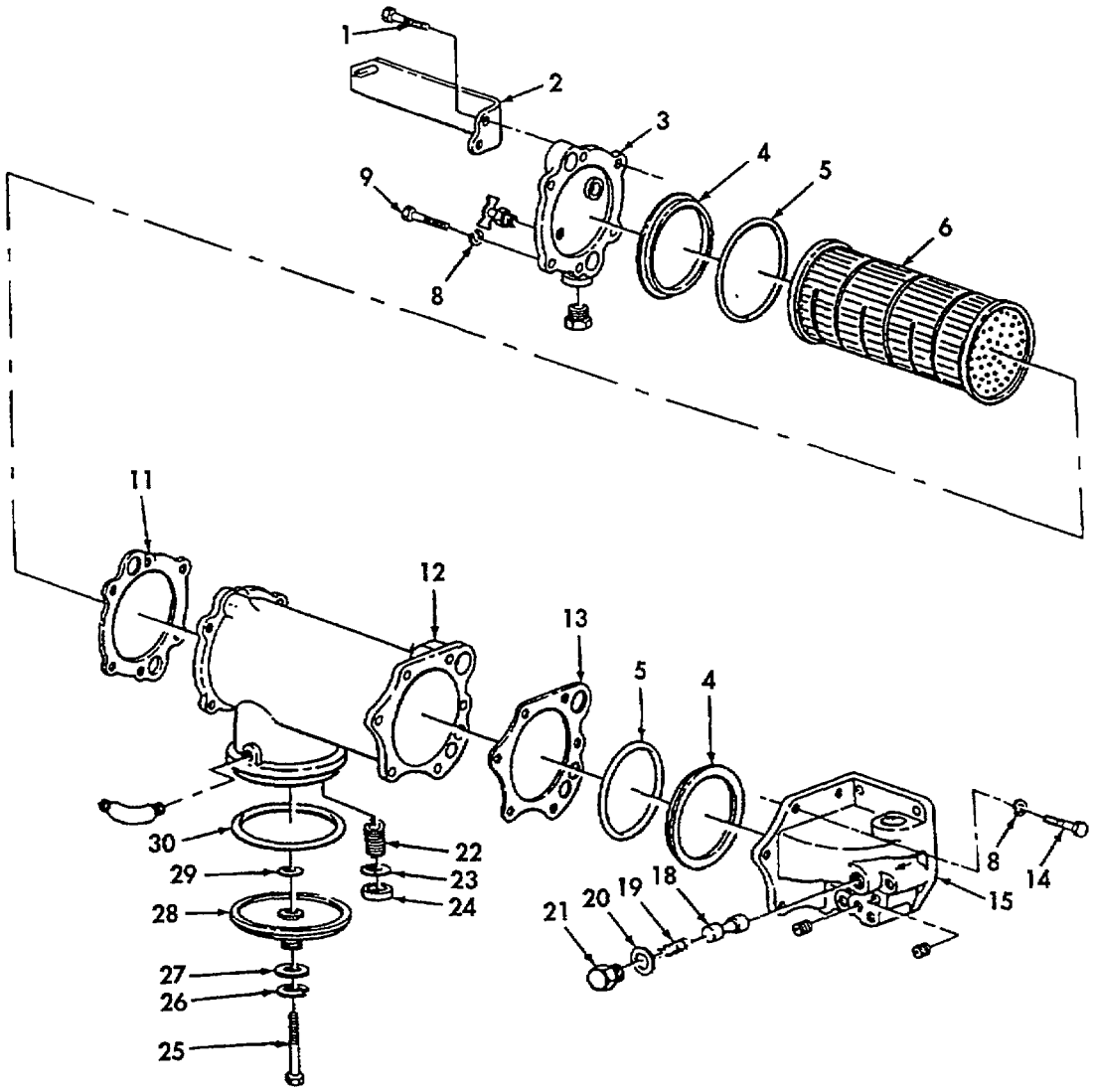
LEGEND:

1. SCREW (2)
2. BRACKET
3. COVER
4. RETAINING RING (2)
5. PREFORMED PACKING (2)
6. FILTER ELEMENT
7. PIPE PLUG
8. LOCKWASHER (10)
9. SCREW (4)
10. DRAINVALVE
11. GASKET
12. HOUSING
13. GASKET
14. SCREW (6)
15. COVER
16. EXPANSION PLUG
17. PIPE PLUG
18. PLUNGER
19. SPRING
20. SPACER
21. PLUG
22. SPRING
23. DISC
24. SEAT
25. SCREW
26. LOCKWASHER
27. WASHER
28. HEAD
29. GASKET
30. PREFORMED PACKING
31. ELBOW
32. PIPE PLUG

3-42. OIL COOLER REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
a. Disassembly (Contd)		
2. Screw (25), lockwasher (26), washer (27), head (28), gasket (29), and preformed packing (30)	Remove from housing (12).	Discard lockwasher (26), gasket (29), and preformed packing (30).
3. Seat (24), disc (23),. and spring (22)	Remove from housing (12).	
	NOTE **The pressure regulator valve is located on the oil cooler support. It controls oil pressure before oil passes through the filter element.**	
4. Plug (21), spacer (20), spring (19), and plunger (18)	Remove from cover (15).	
5. Six screws (14), lockwashers (8), cover (15), and gasket (13)	Remove from housing (12).	Discard lockwashers (8) and gasket (13).
6. Two screws (1), bracket (2), four screws (9), lockwashers (8), cover (3), and gasket (11)	Remove from housing (12).	Discard lockwashers (8) and gasket (11).
	NOTE **To prevent hardening and drying of foreign substances, clean element as soon as possible after removal.**	
7. Two retaining rings (4), preformed packings (5), and filter element (6)	To remove from housing (12): a. Insert two long rods in outside row of element tubes opposite each other. b. Place a flat bar on top of housing (12) and bundle face between rods, and rotate element in housing. c. Remove retaining rings (4) and preformed packings (5). d. Remove filter element (6) from housing (12).	Do not use a sharp object to remove preformed packings (5), or damage to housing (12) or retaining rings (4) may result. Discard preformed packings (5). Do not use a sharp object to remove. Filter element (6) may become damaged.

3-42. OIL COOLER REPAIR (Contd)



M915/BIG CAM I

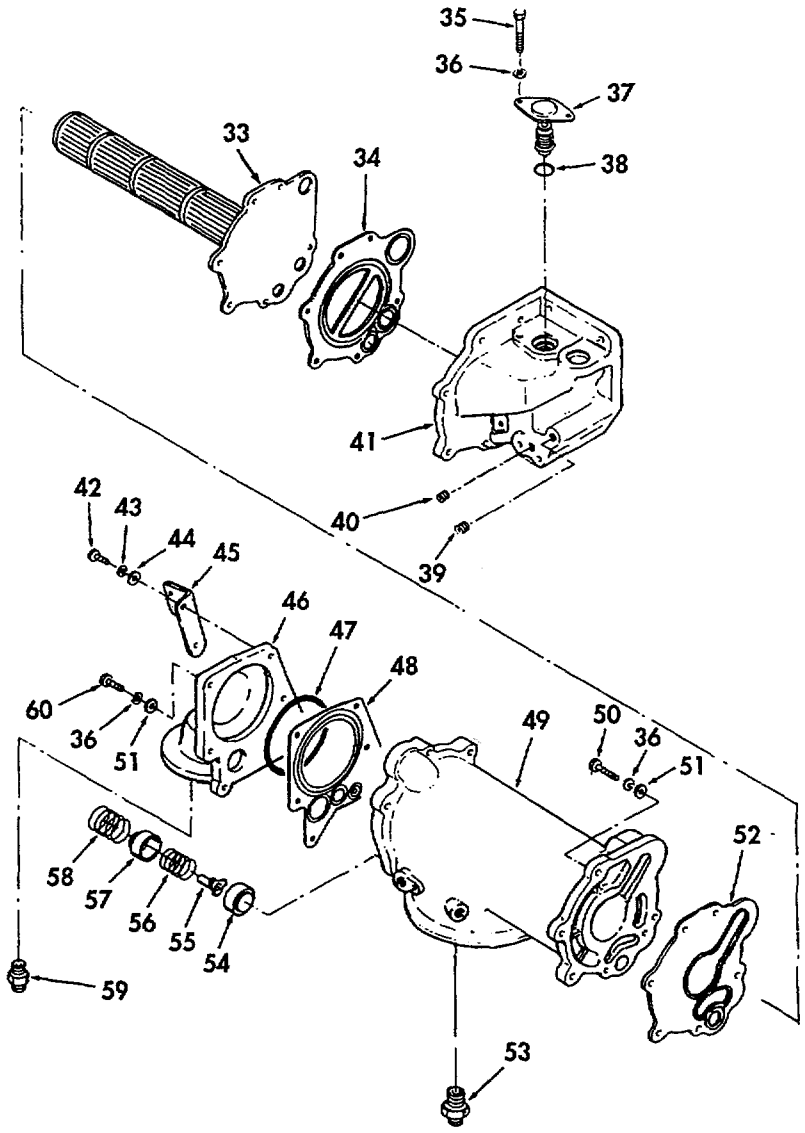
LEGEND:

1. SCREW (2)
2. BRACKET
3. COVER
4. RETAINING RING (2)
5. PREFORMED PACKING (2)
6. FILTER ELEMENT
8. LOCKWASHER (10)
9. SCREW (4)
11. GASKET
12. HOUSING
13. GASKET
14. SCREW (6)
15. COVER
18. PLUNGER
19. SPRING
20. SPACER
21. PLUG
22. SPRING
23. DISC
24. SEAT
25. SCREW
26. LOCKWASHER
27. WASHER
28. HEAD
29. GASKET
30. PREFORMED PACKING

3-42. OIL COOLER REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
a. Disassembly (Contd)		
8. Three screws (42), lockwashers (43), washers (44), and bracket (45)	Remove from head (46).	Screws (42), lockwashers (43), washers (44), and bracket (45) may have already been removed. Discard lockwashers (43).
9. Three screws (60), lockwashers (36), washers (51), head (46), preformed packing (47), and gasket (48)	Remove from housing (49).	Discard preformed packing (47) and gasket (48).
10. Low oil pressure switch	Remove.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
11. Spring (58), bypass valve piston (57), spring (56), bypass valve plunger (55), and pressure sensing piston (54)	Remove from housing (49) and separate.	
12. Six screws (50), lockwashers (36), washers (51), support (41), and gasket (34)	Remove from housing (49).	Discard lockwashers (36) and gasket (34).
	NOTE **To prevent hardening and drying of foreign substances, clean oil cooler core as soon as possible after removal.**	
13. Cooler core (33) and gasket (52)	Remove from housing (49).	Discard gasket (52).
14. Two screws (35), lockwashers (36), valve (37), and preformed packing (38)	Remove from support (41).	Discard preformed packing (38) and lockwasher (36).
15. Pipe plugs (40) and (39)	Remove from support (41).	
16. Adapters (53) and (59)	Remove from housing (49) and head (46).	

3-42. OIL COOLER REPAIR (Contd)



M915A1/BIG CAM III

LEGEND:

33. COOLER CORE
34. GASKET
35. SCREW (2)
36. LOCKWASHER (11)
37. VALVE
38. PREFORMED PACKING
39. PIPE PLUG
40. PIPE PLUG
41. SUPPORT
42. SCREW (3)
43. LOCKWASHER (3)
44. WASHER (3)
45. BRACKET
46. HEAD
47. PREFORMED PACKING
48. GASKET
49. HOUSING
50. SCREW (6)
51. WASHER (9)
52. GASKET
53. ADAPTER
54. PRESSURE SENSING PISTON
55. BYPASS VALVE PLUNGER
56. SPRING
57. BYPASS VALVE PISTON
58. SPRING
59. ADAPTER
60. SCREW (3)

3-42. OIL COOLER REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
b. Cleaning		

WARNING

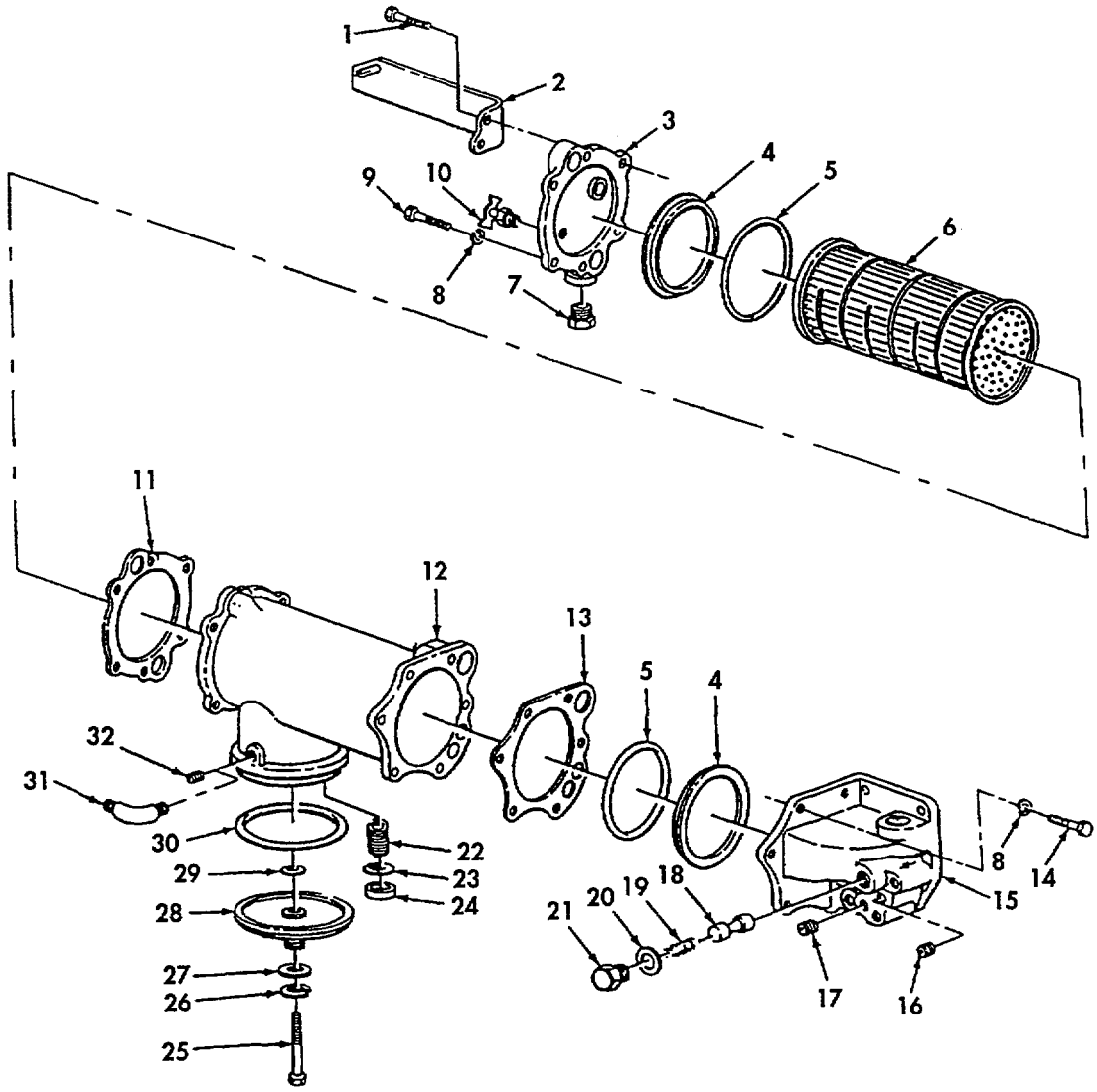
- **Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and protective equipment such as goggles or shield, gloves, etc. Failure to comply may result in injury to personnel.**
- **Approved solvents may be flammable and will not be used near open flame. Use only in well-ventilated area. Failure to comply may result in injury to personnel.**

NOTE

Cleaning procedures for the oil cooler assembly are the same for M915/Big Cam I and M915A1/Big Cam III. M915/Big Cam I is shown.

17.	Housing (12)	Clean lubricating oil and contaminants by forcing solvent SD-3 through oil ports in reverse direction of normal flow.	Use compressed air.
18.	Filter element (6)	a. Immerse in solvent SD-3 and let stand for several minutes.	Force solvent around tubes and clean using compressed air.
		b. After cleaning, flush thoroughly with hot water.	
		c. Prepare solution containing one part muriatic acid and nine parts water. Add 1 lb (0.454 Kg) oxalic acid and 1.28 fl. oz. (37.85 ml) pyridene to each 5 gal. (18.9 L) of muriatic acid.	
		d. Immerse in solution.	
		e. Remove when foaming and bubbling stops.	Reaction normally stops in 30 to 60 seconds.
		f. Immerse in 5 percent solution of sodium carbonate.	
		g. Remove when bubbling stops. Pressure-flush with clean, warm water.	Flush inside of tubes with light oil after both oil and water sides of cooler core are clean and dry.
19.	All other parts	Clean.	Refer to para. 3-6 for cleaning instructions.

3-42. OIL COOLER REPAIR (Contd)



M915/BIG CAM I

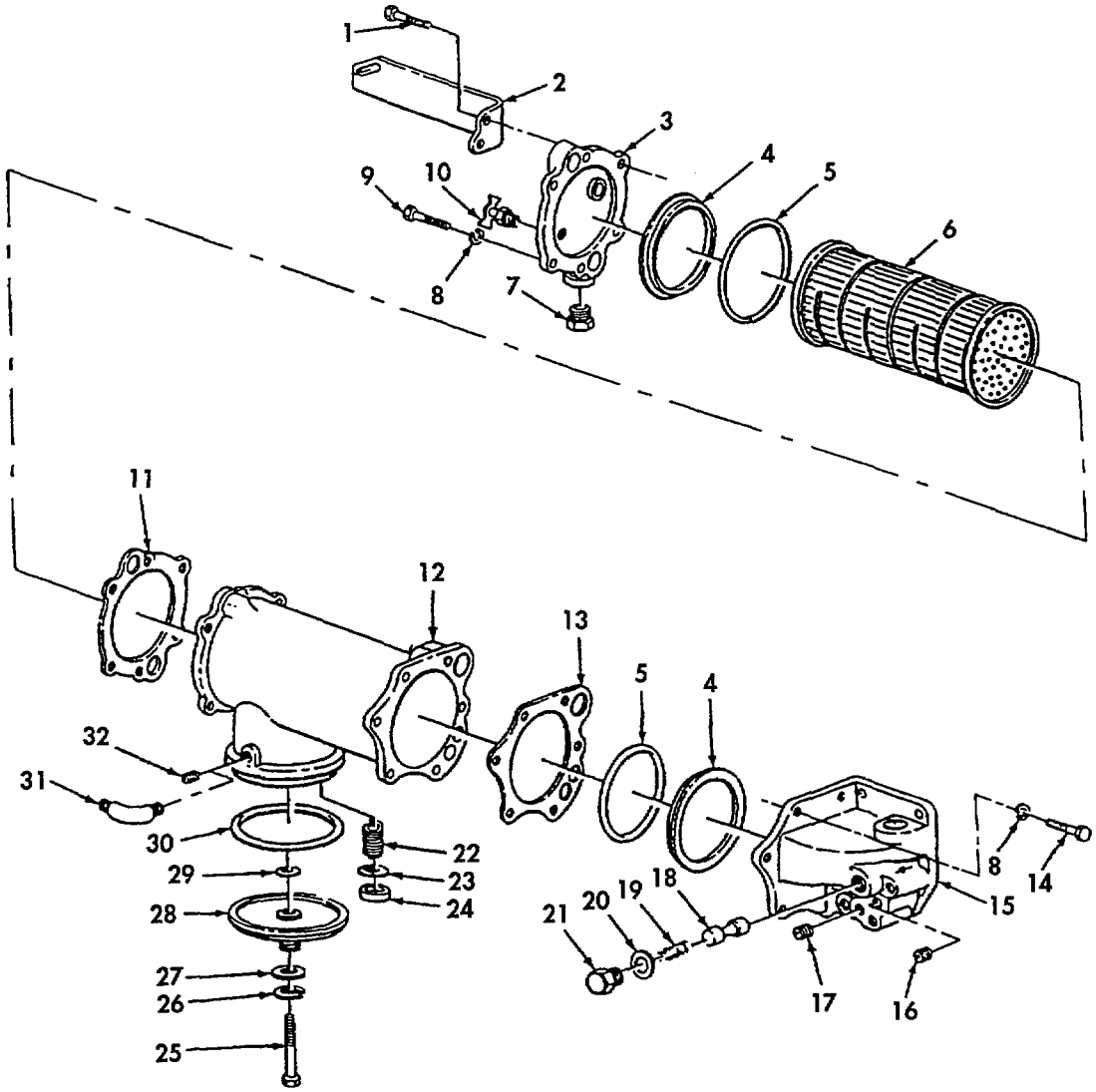
LEGEND:

1. SCREW (2)
2. BRACKET
3. COVER
4. RETAINING RING (2)
5. PREFORMED PACKING (2)
6. FILTER ELEMENT
7. PIPE PLUG
8. LOCKWASHER (10)
9. SCREW (4)
10. DRAINVALVE
11. GASKET
12. HOUSING
13. GASKET
14. SCREW (6)
15. COVER
16. EXPANSION PLUG
17. PIPE PLUG
18. PLUNGER
19. SPRING
20. SPACER
21. PLUG
22. SPRING
23. DISC
24. SEAT
25. SCREW
26. LOCKWASHER
27. WASHER
28. HEAD
29. GASKET
30. PREFORMED PACKING
31. ELBOW
32. PIPE PLUG

3-42. OIL COOLER REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection		
	NOTE • **Perform steps 20 and 21 for M915/Big Cam I only.** • **Perform steps 22 and 23 for M915A1/Big Cam III only.**	
20. All parts	Inspect for cracks, damaged threads, and excessive corrosion.	Discard any part where cracks, stripped threads, or excessive corrosion is found.
	WARNING **Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and protective equipment such as goggles or shield, gloves, etc. Failure to comply may result in injury to personnel.**	
21. Filter element (6)	Inspect and repair as follows:	
	a. Seal one end of tube bundle. Install suitable air fitting on opposite end and connect compressed air supply line. Immerse tube bundle in water and apply approximately 40 psi (276 kPa) air pressure. If air bubbles are observed, mark bundle for repair or replacement.	Refer to steps 21c and d for repair.
	b. Inspect cover (15) for broken or cracked welds. Repair or replace as necessary.	
	c. Header leaks may occur where tubes protrude through plate or where header is soldered in case.	
	d. Repair damaged tubes by inserting a smaller outside diameter tube inside damaged tube. Cut, flare, and solder both ends.	Use caution not to damage adjacent tubes or header material with heat while soldering. If more than 5 percent of the tubes are defective, discard filter element (6).

3-42. OIL COOLER REPAIR (Contd)



M915/BIG CAM I

LEGEND:

1. SCREW (2)
2. BRACKET
3. COVER
4. RETAINING RING (2)
5. PREFORMED PACKING (2)
6. FILTER ELEMENT
7. PIPE PLUG
8. LOCKWASHER (10)
9. SCREW (4)
10. DRAINVALVE
11. GASKET
12. HOUSING
13. GASKET
14. SCREW (6)
15. COVER
16. EXPANSION PLUG
17. PIPE PLUG
18. PLUNGER
19. SPRING
20. SPACER
21. PLUG
22. SPRING
23. DISC
24. SEAT
25. SCREW
26. LOCKWASHER
27. WASHER
28. HEAD
29. GASKET
30. PREFORMED PACKING
31. ELBOW
32. PIPE PLUG

3-42. OIL COOLER REPAIR (Contd)

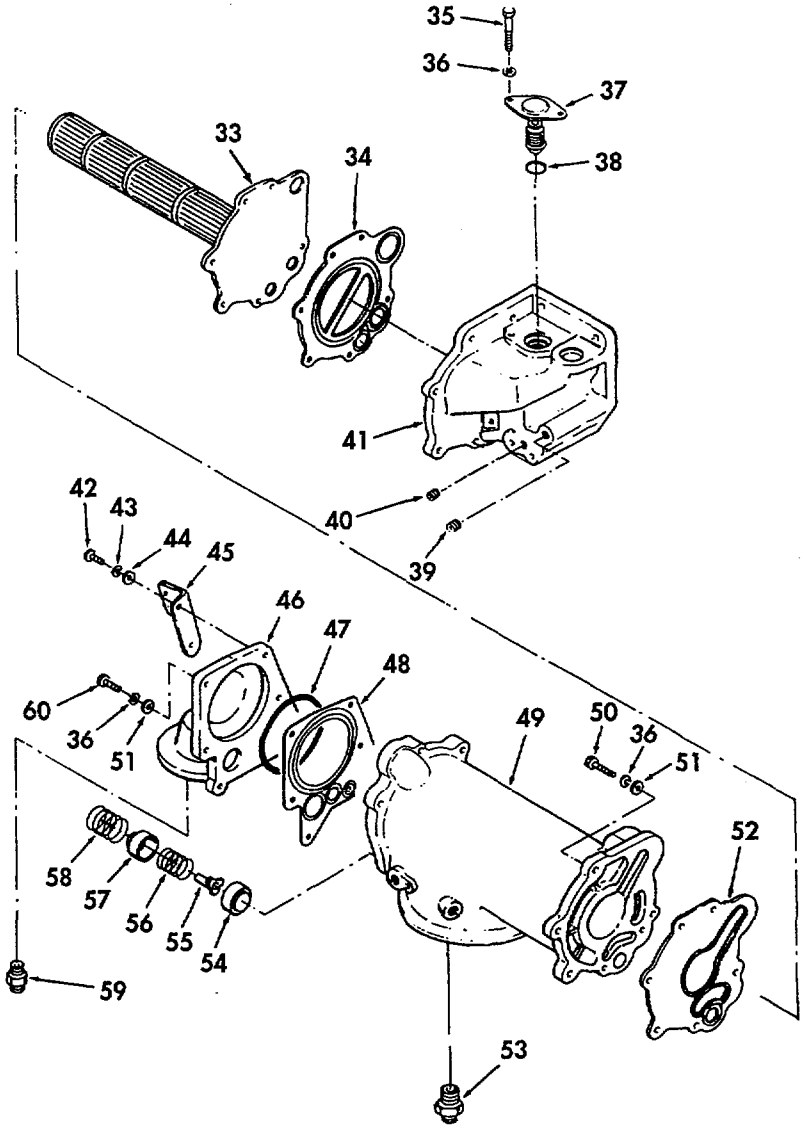
LOCATION/ITEM	ACTION	REMARKS
c. Inspection (Contd)		
22. All parts	Inspect for cracks, damaged threads, and excessive corrosion.	Discard any part where cracks, stripped threads, or excessive corrosion is found.

WARNING

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

23. Cooler core (33)	a. Seal one end and install suitable air fitting on opposite end. Connect compressed air supply line and apply air pressure.	Do not exceed 30 psi (207 kPa) for testing or cooler core (33) will rupture.
	b. Immerse in water and observe.	Discard cooler core (33) if air bubbles are present.
	c. Remove from water and disconnect air supply line and fitting.	

3-42. OIL COOLER REPAIR (Contd)



M915A1/BIG CAM III

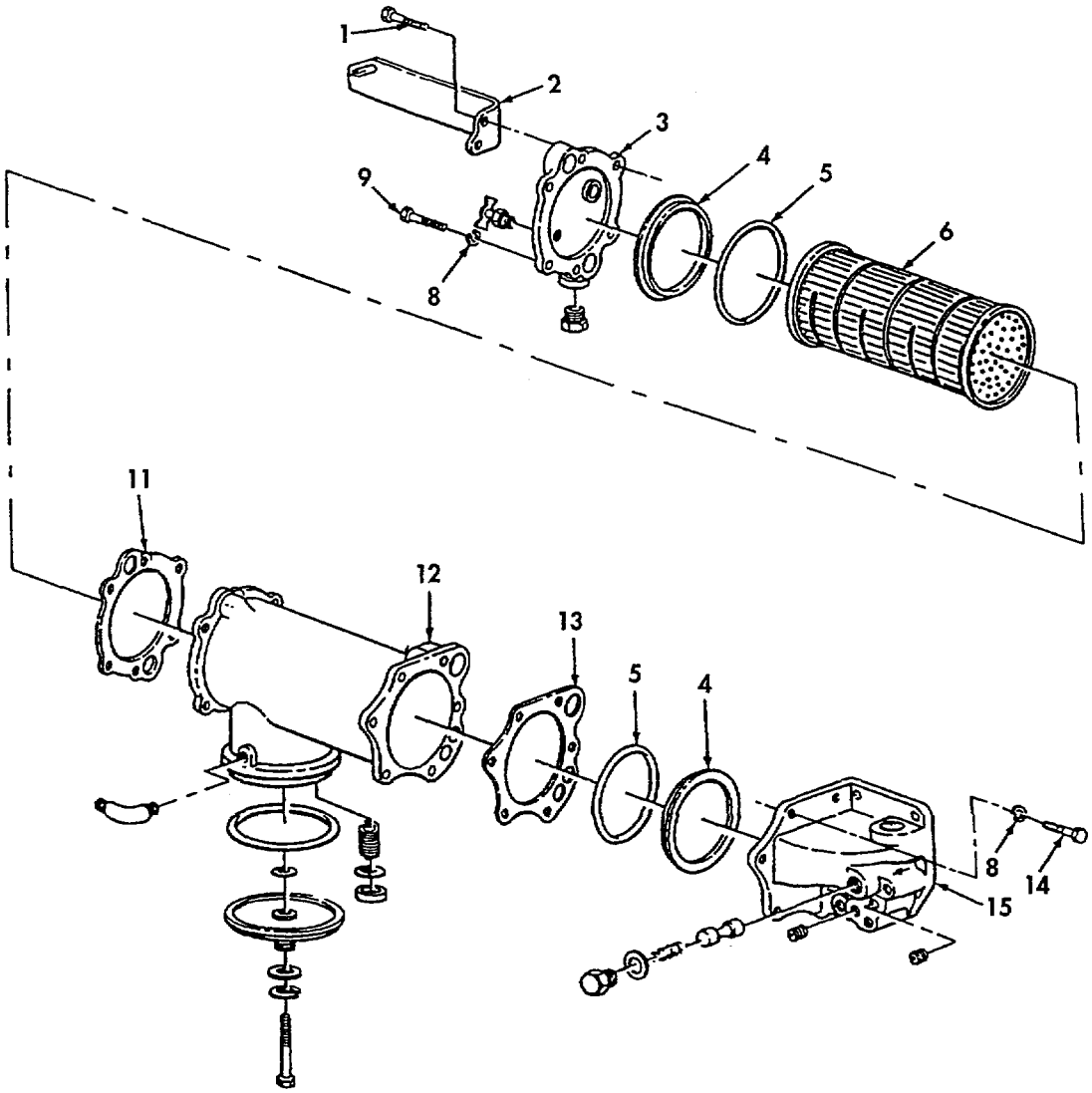
LEGEND:

33. COOLER CORE
34. GASKET
35. SCREW (2)
36. LOCKWASHER (11)
37. VALVE
38. PREFORMED PACKING
39. PIPE PLUG
40. PIPE PLUG
41. SUPPORT
42. SCREW (3)
43. LOCKWASHER (3)
44. WASHER (3)
45. BRACKET
46. HEAD
47. PREFORMED PACKING
48. GASKET
49. HOUSING
50. SCREW (6)
51. WASHER (9)
52. GASKET
53. ADAPTER
54. PRESSURE SENSING PISTON
55. BYPASS VALVE PLUNGER
56. SPRING
57. BYPASS VALVE PISTON
58. SPRING
59. ADAPTER
60. SCREW (3)

3-42. OIL COOLER REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Assembly		
	NOTE • **Perform steps 24 through 31 for M915/Big Cam I only.** • **Perform steps 32 through 39 for M915A1/Big Cam III only.**	
24. Filter element (6)	Install as follows:	Use OE/HDO 30 lubricating oil.
	a. Lubricate new preformed packing (5). Using an appropriate mandrel, place preformed packing (5) in groove at bottom of housing (12). Ensure preformed packing (5) is fully seated, not twisted, and is free of cuts and nicks.	
	b. Carefully push filter element (6) in housing (12), using aligning marks on housing (12) and filter element (6).	Do not fully seat filter element (6).
	c. Press second new preformed packing (5) around top of filter element (6) with equal pressure around preformed packing (5) circumference. Carefully seat filter element (6).	
	d. Install two retaining rings (4) on preformed packing (5) and housing (12).	
25. New gasket (11), cover (3), bracket (2), two screws (1), four lockwashers (8), and screws (9)	Install on housing (12).	Tighten screws (1) and (9) to 30-35 lb-ft (41-48 N•m).
26. New gasket (13), cover (15), six new lockwashers (8), and screws (14)	Install on housing (12).	Tighten screws (14) to 30-35 lb-ft (41-48 N•m).

3-42. OIL COOLER REPAIR (Contd)



M915/BIG CAM I

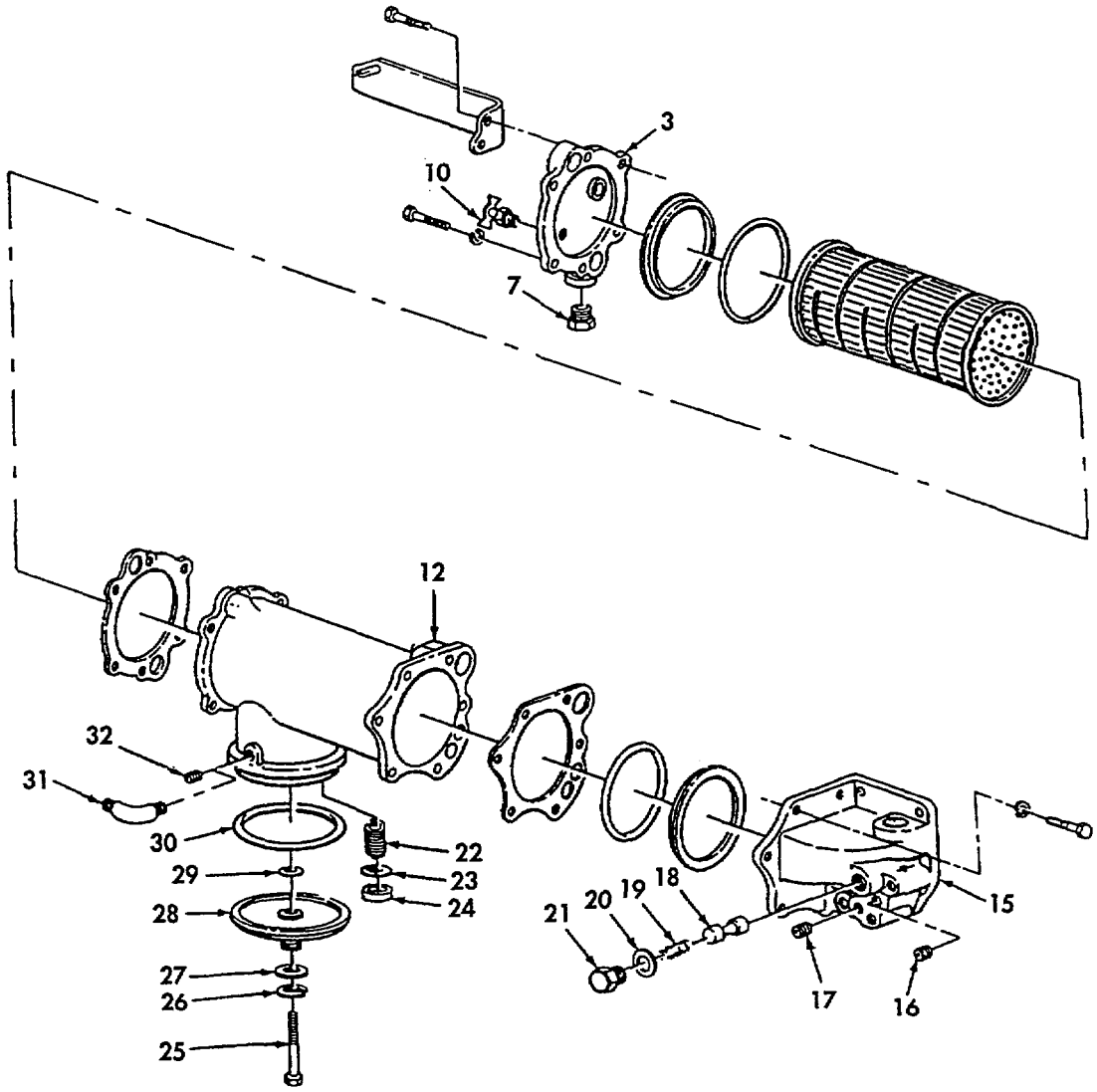
LEGEND:

1. SCREW (2)
2. BRACKET
3. COVER
4. RETAINING RING (2)
5. PREFORMED PACKING (2)
6. FILTER ELEMENT
8. LOCKWASHER (10)
9. SCREW (4)
11. GASKET
12. HOUSING
13. GASKET
14. SCREW (6)
15. COVER

3-42. OIL COOLER REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Assembly (Contd)		
27. Plunger (18), spring (19), spacer (20), and plug (21)	Install on cover (15).	
28. Spring (22), disc (23), and seat (24)	Install on housing (12).	
29. New preformed packing (30)	Lubricate and install on housing (12).	Use OE/HDO 30 lubricating oil.
30. New gasket (29), head (28), washer (27), new lockwasher (26), and screw (25)	Install on housing (12).	
31. Pipe plugs (7), (17), and (32), expansion plug (16) or pipe elbow (31), and drainvalve (10)	Install on cover (3), cover (15), and housing (12).	

3-42. OIL COOLER REPAIR (Contd)



M915/BIG CAM I

LEGEND:

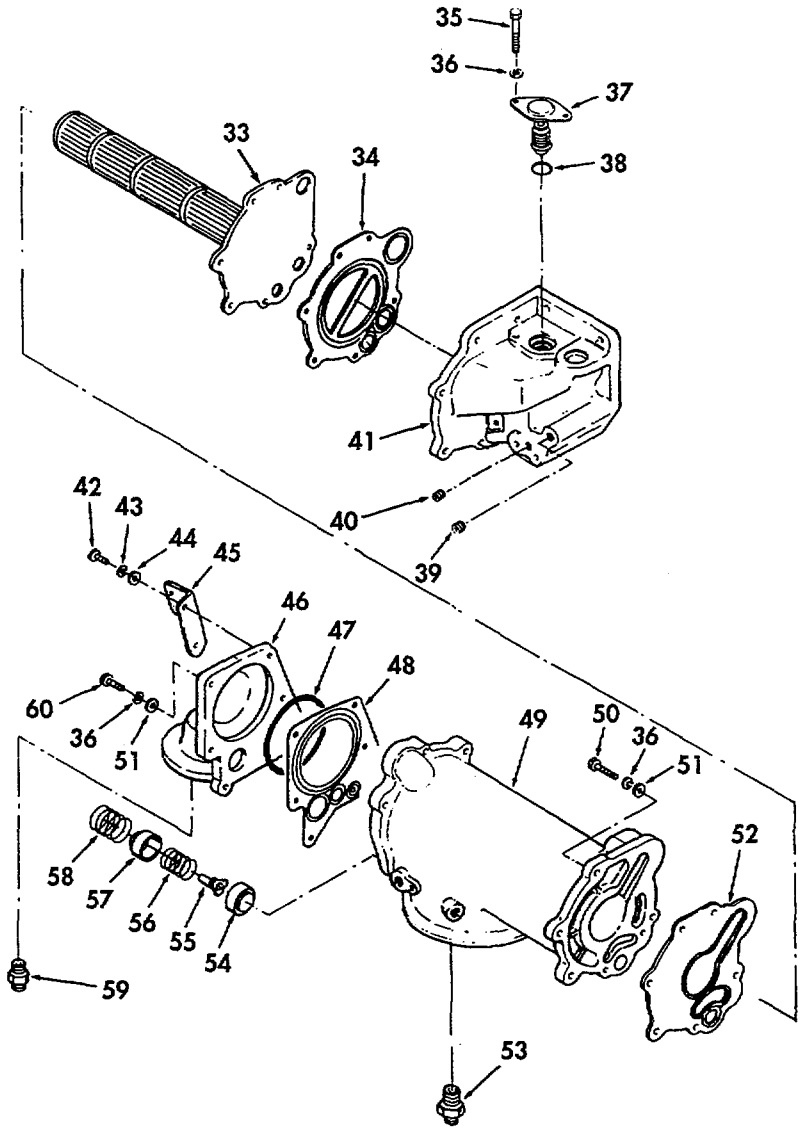
3. COVER
7. PIPE PLUG
10. DRAINVALVE
12. HOUSING
15. COVER
16. EXPANSION PLUG
17. PIPE PLUG
18. PLUNGER
19. SPRING
20. SPACER
21. PLUG
22. SPRING
23. DISC
24. SEAT
25. SCREW
26. LOCKWASHER
27. WASHER
28. HEAD
29. GASKET
30. PREFORMED PACKING
31. ELBOW
32. PIPE PLUG

3-42. OIL COOLER REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Assembly (Contd)		
32. Adapters (59) and (53)	Install on head (46) and housing (49).	
33. Pipe plugs (39) and (40)	Install on support (41).	Tighten pipe plug (39) to 60-84 lb-in. (7-10 N•m). Tighten pipe plug (40) to 15-25 lb-ft (20-34 N•m).
34. New preformed packing (38), valve (37), two new lockwashers (36), and screws (35)	Install on support (41).	Apply light coat of OE/HDO 30 lubricating oil to preformed packing (38). Tighten to 30-35 lb-ft (41-48 N•m).
35. New gasket (52), cooler core (33), gasket (34), support (41), six washers (51), new lockwashers (36), and screws (50)	Install on housing (49).	Tighten screws (50) to 30-35 lb-ft (41-48 N•m).
36. Pressure sensing piston (54), bypass valve plunger (55), spring (56), bypass valve piston (57), and spring (58)	Install on housing (49).	It will be necessary to hold in position at same time head (46) is installed.
37. New preformed packing (47), new gasket (48), head (46), three washers (51), new lockwashers (36), and screws (60)	Install on housing (49).	Apply light coat of OE/HDO 30 lubricating oil to preformed packing (47). Do not tighten screws (60).
38. Bracket (45), three washers (44), new lockwashers (43), and screws (42)	Install on head (46) and housing (49).	Tighten screws (42) and (60) to 30-35 lb-ft (41-48 N•m).
39. Low oil pressure switch	Install.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.

FOLLOW-ON TASK: Install oil cooler (para. 3-88).

3-42. OIL COOLER REPAIR (Contd)



M915A1/BIG CAM III

LEGEND:

33. COOLER CORE
34. GASKET
35. SCREW (2)
36. LOCKWASHER (11)
37. VALVE
38. PREFORMED PACKING
39. PIPE PLUG
40. PIPE PLUG
41. SUPPORT
42. SCREW (3)
43. LOCKWASHER (3)
44. WASHER (3)
45. BRACKET
46. HEAD
47. PREFORMED PACKING
48. GASKET
49. HOUSING
50. SCREW (6)
51. WASHER (9)
52. GASKET
53. ADAPTER
54. PRESSURE SENSING PISTON
55. BYPASS VALVE PLUNGER
56. SPRING
57. BYPASS VALVE PISTON
58. SPRING
59. ADAPTER
60. SCREW (3)

3-43. OIL PAN, DIPSTICK, OIL SUCTION TUBES, AND BREATHER TUBE REPAIR

THIS TASK COVERS:

a. Disassembly
b. Cleaning
c. Inspection
d. Assembly

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
None

TEST EQUIPMENT
None

MATERIALS/PARTS
Cloth, emery, 290-grit (Appendix C, Item 5)
Compound, Prussian blue (Appendix C, Item 9)
Solvent, SD-3 (Appendix C, Item 30)
Oil pan gasket (Big Cam III only) (15434) 3027983
O-ring seal (15434) 3029846
O-ring seal (15434) 30314699

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
TM 9-2320-273-20
TM 9-2320-273-34
TM 9-2320-283-20

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
- Oil suction tube removed (para. 3-19).
- Oil pan removed (para. 3-26).
- Oil breather tube removed (TM 9-2320-273-20 or TM 9-2320-283-20).
- Dipstick, dipstick tube, and cover removed (para. 3-13).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
- Always wear eye protection when using compressed air.
- Use approved solvents in well-ventilated area.

LOCATION/ITEM	ACTION	REMARKS

NOTE
- **Repair of oil pan is basically the same for M915/Big Cam I and M915A1/Big Cam III. Big Cam I engines are equipped with a cast aluminum oil pan. Big Cam III engines are equipped with a stamped steel oil pan.**
- **For M915/Big Cam I, it may be necessary to remove engine oil heater part of optional winterization kit. Refer to TM 9-2320-273-34. For engine oil heater thermostat removal, refer to TM 9-2320-273-20.**

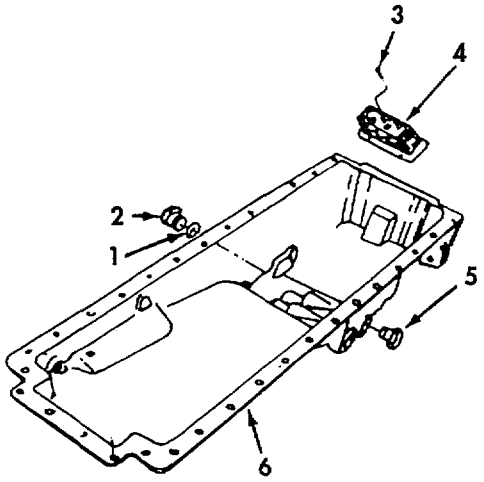
a. Disassembly

NOTE
- **Perform steps 1 and 2 for M915A1/Big Cam III only.**
- **Perform steps 3 and 4 for M915/Big Cam I only.**

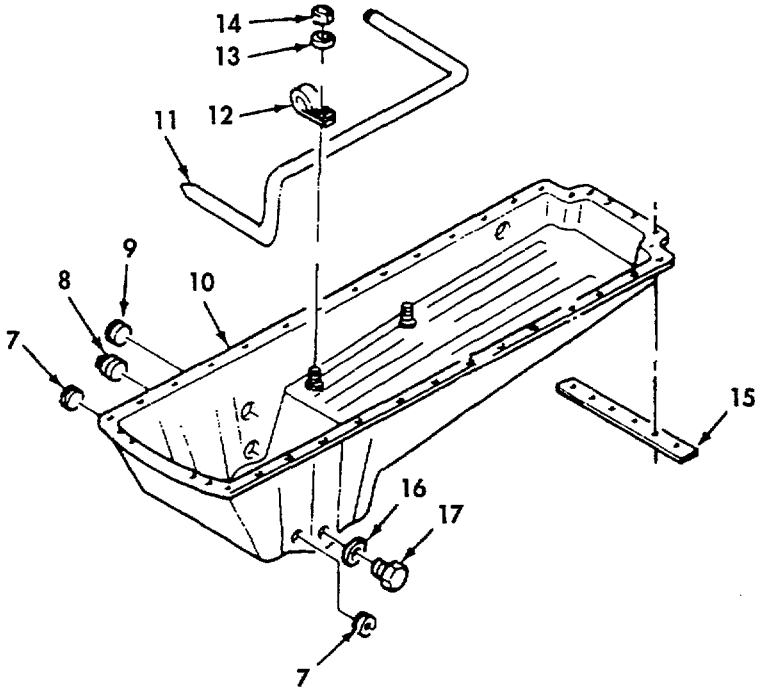
1.	Plug (2), spacer (1), and plug (5)	Remove from oil pan (6).
2.	Four screws (3) and strainer element (4)	Remove from oil pan (6).
3.	Three nuts (14), washers (13), clamps (12), and tube (11)	Remove from welded studs on oil pan (10).

3-43. OIL PAN, DIPSTICK, OIL SUCTION TUBES, AND BREATHER TUBE REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
4. Two pipe plugs (7), plugs (8) and (17), spacer (16), and pipe plug (9)	Remove from oil pan (10).	



M915/BIG CAM I OIL PAN
(CAST ALUMINUM)



M915A1/BIG CAM III OIL PAN
(STAMPED STEEL)

LEGEND:

1. SPACER
2. PLUG
3. SCREW (4)
4. STRAINER ELEMENT
5. PLUG
6. OIL PAN (M915/BIG CAM I)
7. PIPE PLUG (2)
8. PLUG
9. PIPE PLUG
10. OIL PAN (M915A1/BIG CAM III)
11. TUBE
12. CLAMP (3)
13. WASHER (3)
14. NUT (3)
15. ENGINE SHIPPING SUPPORT
16. SPACER
17. PLUG

3-43. OIL PAN, DIPSTICK, OIL SUCTION TUBES, AND BREATHER TUBE REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
b. Cleaning		

WARNING

- **Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and protective equipment such as goggles or shield, gloves, etc. Failure to comply may result in injury to personnel.**
- **Approved solvents may be flammable and will not be used near open flame. Use only in well-ventilated area. Failure to comply may result in injury to personnel.**

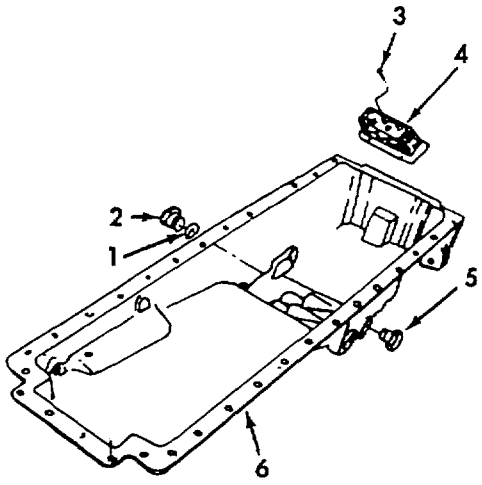
5.	All parts and mounting hardware	Clean with SD-3 solvent and dry with compressed air.	It may be necessary to scrape gasket material from mating surfaces.
c. Inspection			
6.	Engine oil pan (6) (M915/ Big Cam I) or oil pan (10) (M915A1/Big Cam III)	Inspect for the following:	
		a. Cracks.	Use detection dye. Discard if cracked.
		b. Damaged or distorted threads.	Repair with correct size die or thread chaser.
		c. Gasket surfaces smooth and free from burrs or distortion.	Remove burrs with emery cloth.

NOTE

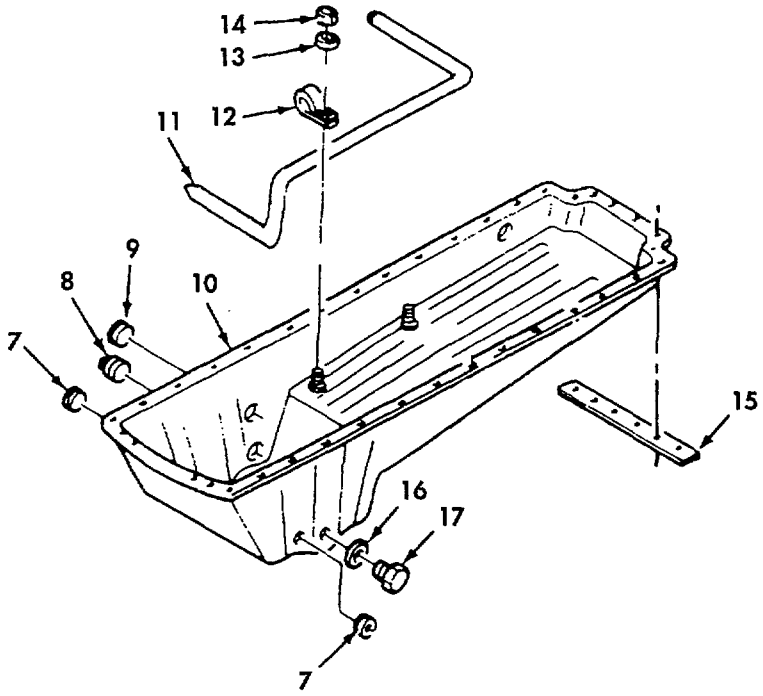
- **Perform steps 7 and 8 for M915/Big Cam I only.**
- **Perform steps 9 thru 11 for M915A1/Big Cam III only.**

7.	Plugs (2) and (5), spacer (1), and four screws (3)	Inspect for damaged or worn threads and surface condition of drainplug spacer (1).	Discard if threads are worn or damaged and if seating surface of spacer (1) is worn.
8.	Strainer element (4)	Inspect for damage.	Discard if damaged.
9.	Two pipe plugs (7), plug (8), pipe plug (9), plug (17), and spacer (16)	Inspect for damage or worn threads and surface condition of drainplug spacer (16).	Discard if threads are worn or damaged and if seating surface of drainplug spacer (16) is worn.
10.	Engine shipping support (15)	Inspect for cracks and distortion.	Discard if cracked.
11.	Oil suction tube (11), three clamps (12), washers (13), and nuts (14)	Inspect for the following:	
		a. Cracks.	Discard if cracked.
		b. Gasket and O-ring seal surfaces free from burrs or distortion.	Remove burrs with emery cloth.
		c. Inspect for damaged threads.	Discard if damaged.

3-43. OIL PAN, DIPSTICK, OIL SUCTION TUBES, AND BREATHER TUBE REPAIR (Contd)



M915/BIG CAM I OIL PAN (CAST ALUMINUM)



M915A1/BIG CAM III OIL PAN (STAMPED STEEL)

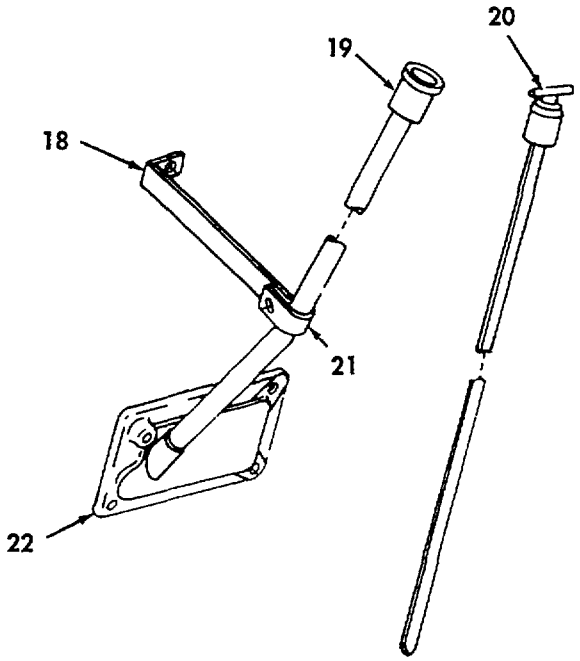
LEGEND:

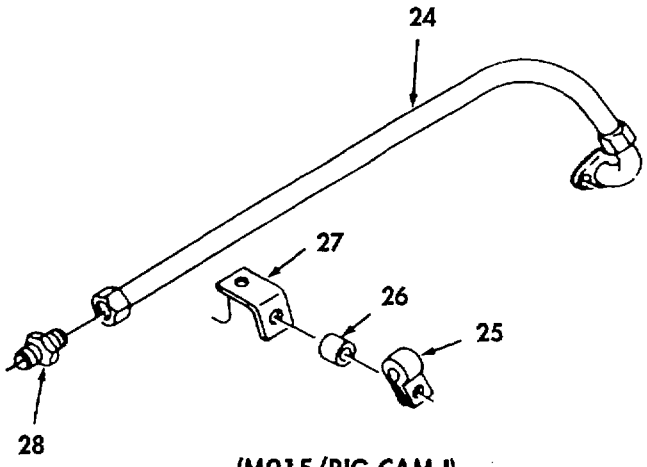
1. SPACER
2. PLUG
3. SCREW (4)
4. STRAINER ELEMENT
5. PLUG
6. OIL PAN (M915/BIG CAM I)
7. PIPE PLUG (2)
8. PLUG
9. PIPE PLUG
10. OIL PAN (M915A1/BIG CAM III)
11. TUBE
12. CLAMP (3)
13. WASHER (3)
14. NUT (3)
15. ENGINE SHIPPING SUPPORT
16. SPACER
17. PLUG

3-43. OIL PAN, DIPSTICK, OIL SUCTION TUBES, AND BREATHER TUBE REPAIR (Contd)

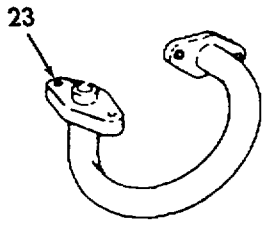
LOCATION/ITEM	ACTION	REMARKS
c. Inspection (Contd)		
12. Oil level dipstick (20), oil level dipstick tube (19), clamp (21), and cover (22)	Inspect for the following:	
	a. Cracks in area where clamp (21) is positioned around oil level dipstick tube (19).	Discard if cracked.
	b. Stress cracks in area where oil level dipstick tube (19) fits in cover (22).	This requires careful examination. Discard both if cracked. Do not separate oil level dipstick tube (19) from cover (22).
	c. Tightened seal where oil level dipstick (20) tightens against inside of oil level dipstick tube (19).	Discard oil level dipstick (20) if seal is worn.
	d. Cracks in oil level dipstick (20).	Discard if cracked.
13. Tube brace (18)	Inspect for cracks.	Discard if cracked.
	NOTE • **Perform step 14 for M915/Big Cam I only.** • **Perform step 15 for M915A1/Big Cam III only.**	
14. Oil suction hose (24) (M915/ Big Cam I), adapter (28), bracket (27), spacer (26), and clamp (25)	Inspect for cracks or damage caused by rubbing from vibration.	Discard if cracked, worn, or damaged.
15. Oil suction tube (23) (M915A1/Big Cam III)	Inspect for cracks or other damage.	Discard if cracked or damaged.

3-43. OIL PAN, DIPSTICK, OIL SUCTION TUBES, AND BREATHER TUBE REPAIR (Contd)





(M915/BIG CAM I)



(M915A1/BIG CAM III)

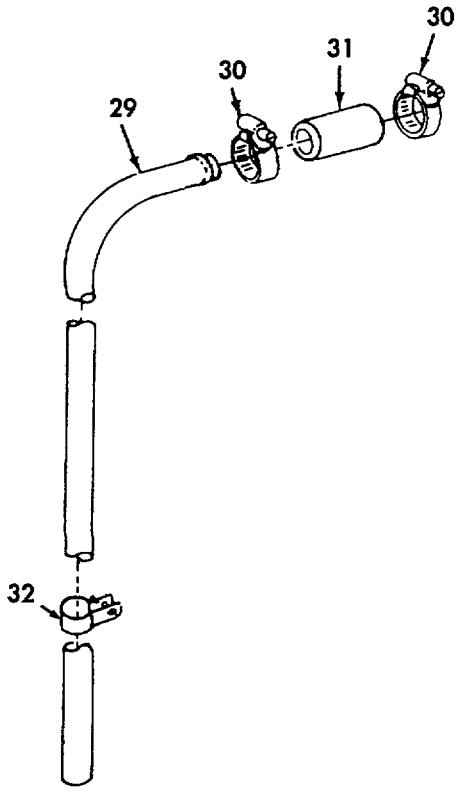
LEGEND:

18. TUBE BRACE
19. OIL LEVEL DIPSTICK TUBE
20. OIL LEVEL DIPSTICK
21. CLAMP
22. COVER
23. OIL SUCTION TUBE (M915A1/BIG CAM III)
24. OIL SUCTION HOSE (M915/BIG CAM I)
25. CLAMP
26. SPACER
27. BRACKET
28. ADAPTER

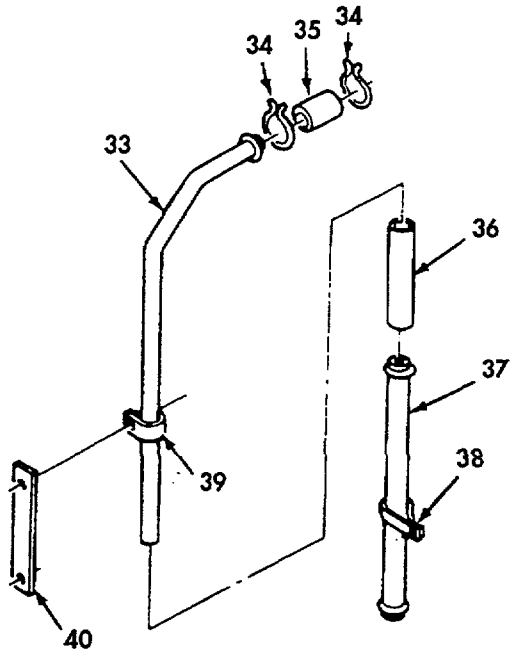
3-43. OIL PAN, DIPSTICK, OIL SUCTION TUBES, AND BREATHER TUBE REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection (Contd)		
	NOTE • **Perform steps 16 and 17 for M915/Big Cam I only.** • **Perform steps 18 and 19 for M915A1/Big Cam III only.**	
16. Breather tube (29), two clamps (30), and clamp (32)	Inspect for cracks and distortion.	Discard if cracked or distorted.
17. Hose (31)	Inspect for damage and deterioration caused by heat, oil, and rubbing from vibration.	Discard if worn or deteriorated.
18. Breather tube (33), two clamps (34), tube (37), clamps (38) and (39), and aftercooler bracket (40)	Inspect for cracks and distortion.	Discard if cracked or distorted.
19. Hoses (35) and (36)	Inspect for damage and deterioration caused by heat, oil, and rubbing from vibration.	Discard if worn or deteriorated.
20. All mounting hardware	Inspect for stripped threads, distortion, and extensive corrosion.	Discard if damaged.

3-43. OIL PAN, DIPSTICK, OIL SUCTION TUBES, AND BREATHER TUBE REPAIR (Contd)



M915/BIG CAM I



M915A1/BIG CAM III

LEGEND:

29. BREATHER TUBE (M915/BIG CAM I)
30. CLAMP (2)
31. HOSE
32. CLAMP
33. BREATHER TUBE (M915A1/BIG CAM III)
34. CLAMP (2)
35. HOSE
36. HOSE
37. TUBE
38. CLAMP
39. CLAMP
40. AFTERCOOLER BRACKET

3-43. OIL PAN, DIPSTICK, OIL SUCTION TUBES, AND BREATHER TUBE REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Assembly		

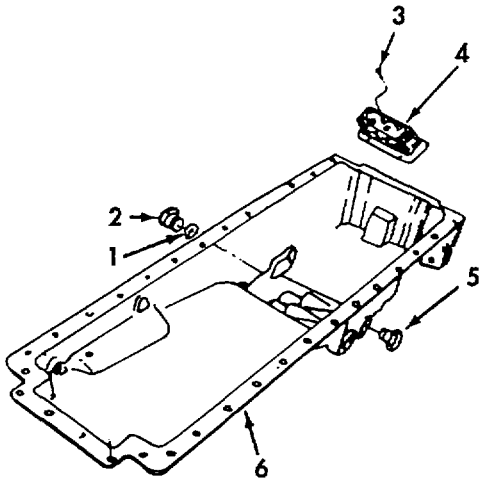
NOTE

- **Perform steps 21 and 22 for M915/Big Cam I only.**
- **Perform steps 23 and 24 for M915A1/Big Cam III only.**

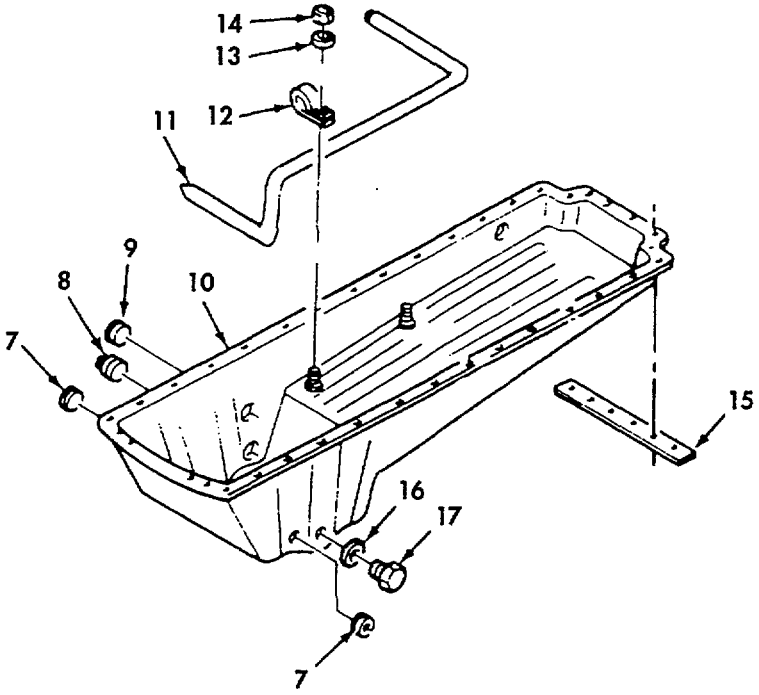
21.	Strainer element (4) and four screws (3)	Install on oil pan (6).
22.	Plug (5), spacer (1), and plug (2)	Install on oil pan (6).
23.	Pipe plug (9), spacer (16), plugs (17) and (8), and two pipe plugs (7)	Install on oil pan (10).
24.	Tube (11), three clamps (12), washers (13), and nuts (14)	Install on welded studs on oil pan (10).

FOLLOW-ON TASK: Install oil pan and oil suction tube (para. 3-81).

3-43. OIL PAN, DIPSTICK, OIL SUCTION TUBES, AND BREATHER TUBE REPAIR (Contd)



M915/BIG CAM I OIL PAN (CAST ALUMINUM)



M915A1/BIG CAM III OIL PAN (STAMPED STEEL)

LEGEND:

1. SPACER
2. PLUG
3. SCREW (4)
4. STRAINER ELEMENT
5. PLUG
6. OIL PAN (M915/BIG CAM I)
7. PIPE PLUG (2)
8. PLUG
9. PIPE PLUG
10. OIL PAN (M915A1/BIG CAM III)
11. TUBE
12. CLAMP (3)
13. WASHER (3)
14. NUT (3)
15. ENGINE SHIPPING SUPPORT
16. SPACER
17. PLUG

3-44. OIL PUMP REPAIR

THIS TASK COVERS:

a. Disassembly
b. Cleaning
c. Inspection
d. Assembly

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Spacer mandrel (15434) ST-1157
DFC pressure valve fixture (15434) 3376011

TEST EQUIPMENT
None

MATERIALS/PARTS
Solvent, SD-3 (Appendix C, Item 30)
Oil, lubricating, OE/HDO 10 (Appendix C, Item 20)
Sealant, thread (liquid) (Appendix C, Item 27)
Gasket (15434) 203145 (M915/Big Cam I)
Gasket (15434) 3014778 (M915Al/Big Cam III)
Three lockwashers (15434) S610 (M915/Big Cam I)
Two preformed packings (15434) 145504 (M915A1/Big Cam III)

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

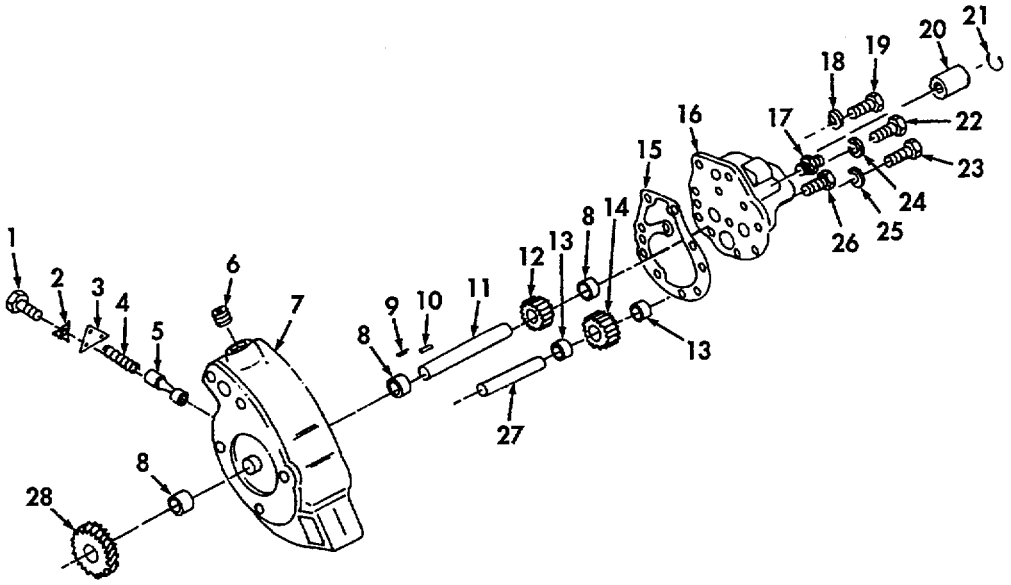
EQUIPMENT CONDITION
Oil pump removed (para. 3-19).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
- Wear eye protection when cleaning with compressed air and when removing pressure regulator assembly.
- Use solvents in well-ventilated area and away from open flame.

LOCATION/ITEM	ACTION	REMARKS
a. Disassembly		
	NOTE • **Perform steps 1 through 10 for M915/Big Cam I only.** • **Perform steps 11 through 18 for M915A1/Big Cam III only.**	
1. Gear (28) and woodruff key (9)	Remove from shaft (11).	Use a suitable gear puller.
2. Snapring (21) and coupling (20)	Remove from shaft (11).	
3. Screw (19), washer (18), screw (22), washer (24), screw (26), three screws (23), and lockwashers (25)	Remove from body (7) and housing (16).	Discard lockwashers (25).
4. Housing (16) and gasket (15)	Remove from pin (10) and body (7).	Use a soft-nose hammer to loosen housing (16).

3-44. OIL PUMP REPAIR (Contd)



M915/BIG CAM I

LEGEND:

1. SCREW
2. LOCKPLATE
3. RETAINING YOKE
4. SPRING
5. PLUNGER
6. PIPE PLUG
7. BODY
8. SLEEVE BEARING (3)
9. WOODRUFF KEY
10. PIN
11. SHAFT
12. OIL PUMPING GEAR
13. SPLIT BUSHING (2)
14. GEAR
15. GASKET
16. HOUSING
17. CONNECTOR
18. WASHER
19. SCREW
20. COUPLING
21. SNAPRING
22. SCREW
23. SCREW (3)
24. WASHER
25. LOCKWASHER (3)
26. SCREW
27. SHAFT
28. GEAR

3-44. OIL PUMP REPAIR (Contd)

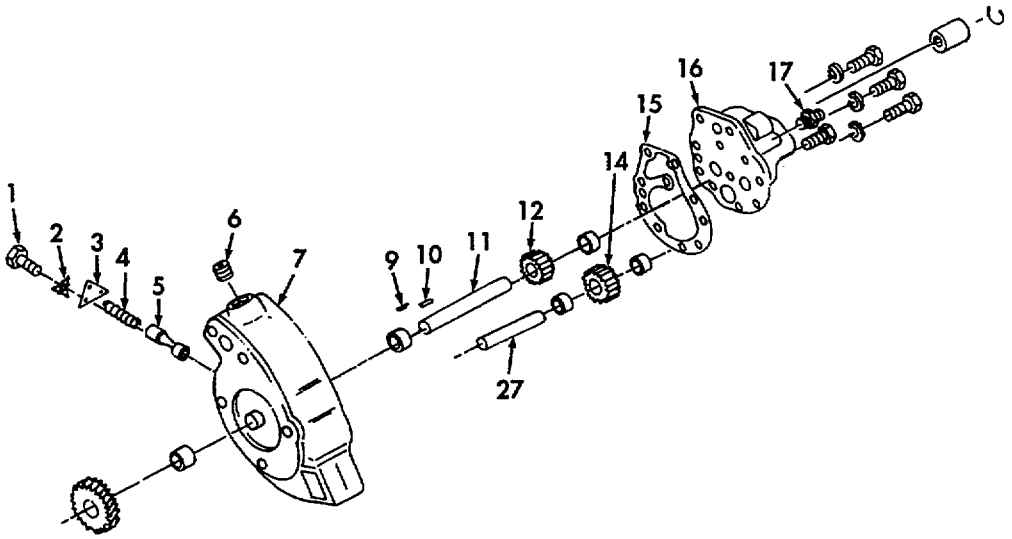
LOCATION/ITEM	ACTION	REMARKS
a. Disassembly (Contd)		
5. Gear (14)	Remove from shaft (27).	Lift gear off shaft (27).
6. Shaft (11) and oil pumping gear (12)	Remove from body (7).	Use suitable arbor press.
7. Shaft (11)	Remove from oil pumping gear (12).	Use suitable arbor press.
8. Shaft (27)	Remove from body (7).	Use suitable arbor press.
9. Connector (17) and pipe plug (6)	Remove from housing (16) and body (7).	

WARNING

Remove pressure regulator assembly slowly to prevent spring tension from shooting regulator assembly from oil pump body. Wear eye protection. Failure to comply may result in damage to equipment or injury to personnel.

10. Screw (1), lockplate (2), retaining yoke (3), spring (4), and plunger (5)	Remove from body (7).	

3-44. OIL PUMP REPAIR (Contd)



M915/BIG CAM I

LEGEND:

1. SCREW
2. LOCKPLATE
3. RETAINING YOKE
4. SPRING
5. PLUNGER
6. PIPE PLUG
7. BODY
9. WOODRUFF KEY
10. PIN
11. SHAFT
12. OIL PUMPING GEAR
14. GEAR
15. GASKET
16. HOUSING
17. CONNECTOR
27. SHAFT

3-44. OIL PUMP REPAIR (Contd)

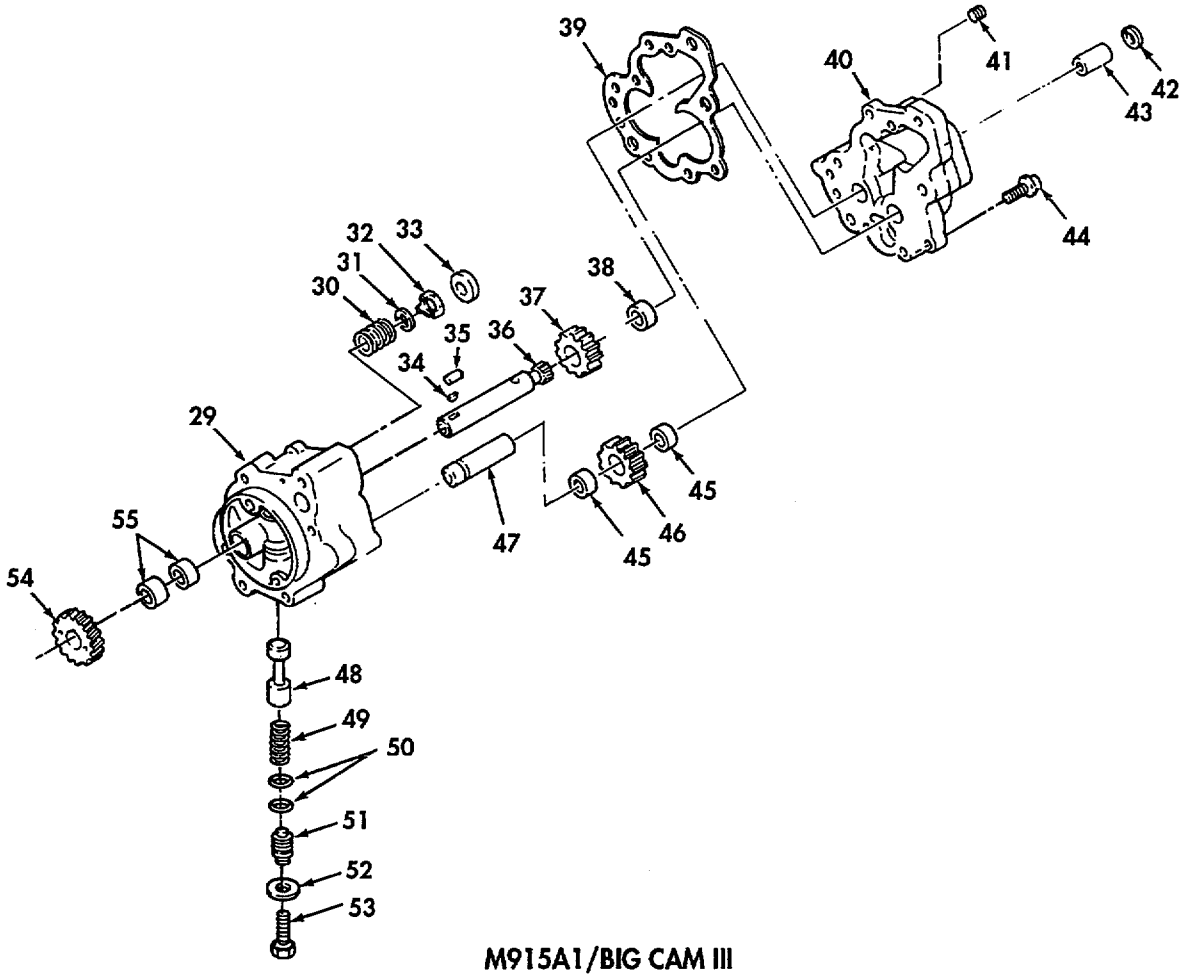
LOCATION/ITEM	ACTION	REMARKS
a. Disassembly (Contd)		
11. Retaining ring (42) and steering pump coupling (43)	Remove from shaft (36).	
12. Gear (54) and woodruff key (34)	Remove from shaft (36).	Use a suitable gear puller.
13. Seven captive washer screws (44), cover (40), and gasket (39)	Remove from pin (35) and body (29).	Use a soft-nose hammer to loosen cover (40). Discard gasket (39).
14. Gear (46)	Remove from shaft (47).	Lift gear (46) off shaft (47).
15. Shaft (36) and gear (37)	Remove from body (29).	Use suitable arbor press.
16. Shaft (36)	Remove from gear (37).	Use suitable arbor press.
17. Shaft (47)	Remove from body (29).	

WARNING

Remove pressure regulator assembly slowly to prevent spring tension from shooting assembly from oil pump body. Wear eye protection. Failure to comply may result in damage to equipment or injury to personnel.

18. Screw (53), washer (52), retainer (51), two preformed packings (50), spring (49), and plunger (48)	Remove from body (29).	Discard preformed packings (50).

3-44. OIL PUMP REPAIR (Contd)



M915A1/BIG CAM III

LEGEND:

29. BODY
30. BYPASS VALVE SPRING
31. WASHER
32. VALVE DISK
33. BYPASS VALVE SEAT
34. WOODRUFF KEY
35. PIN
36. SHAFT
37. OIL PUMPING GEAR
38. SLEEVE BEARING
39. GASKET
40. COVER
41. PIPE PLUG
42. RETAINING RING
43. STEERING PUMP COUPLING
44. CAPTIVE WASHER SCREW (7)
45. SLEEVE BEARING (2)
46. GEAR
47. SHAFT
48. PLUNGER
49. SPRING
50. PREFORMED PACKING (2)
51. RETAINER
52. WASHER
53. SCREW
54. GEAR
55. SLEEVE BEARING (2)

3-44. OIL PUMP REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
a. Disassembly (Contd)		
19. Pipe plug (41)	Remove from cover (40).	
20. Bypass valve seat (33), valve disc (32), washer (31), and bypass valve spring (30)	Remove from body (29).	Use caution not to damage bypass valve seat (33) during removal.
b. Cleaning		

WARNING

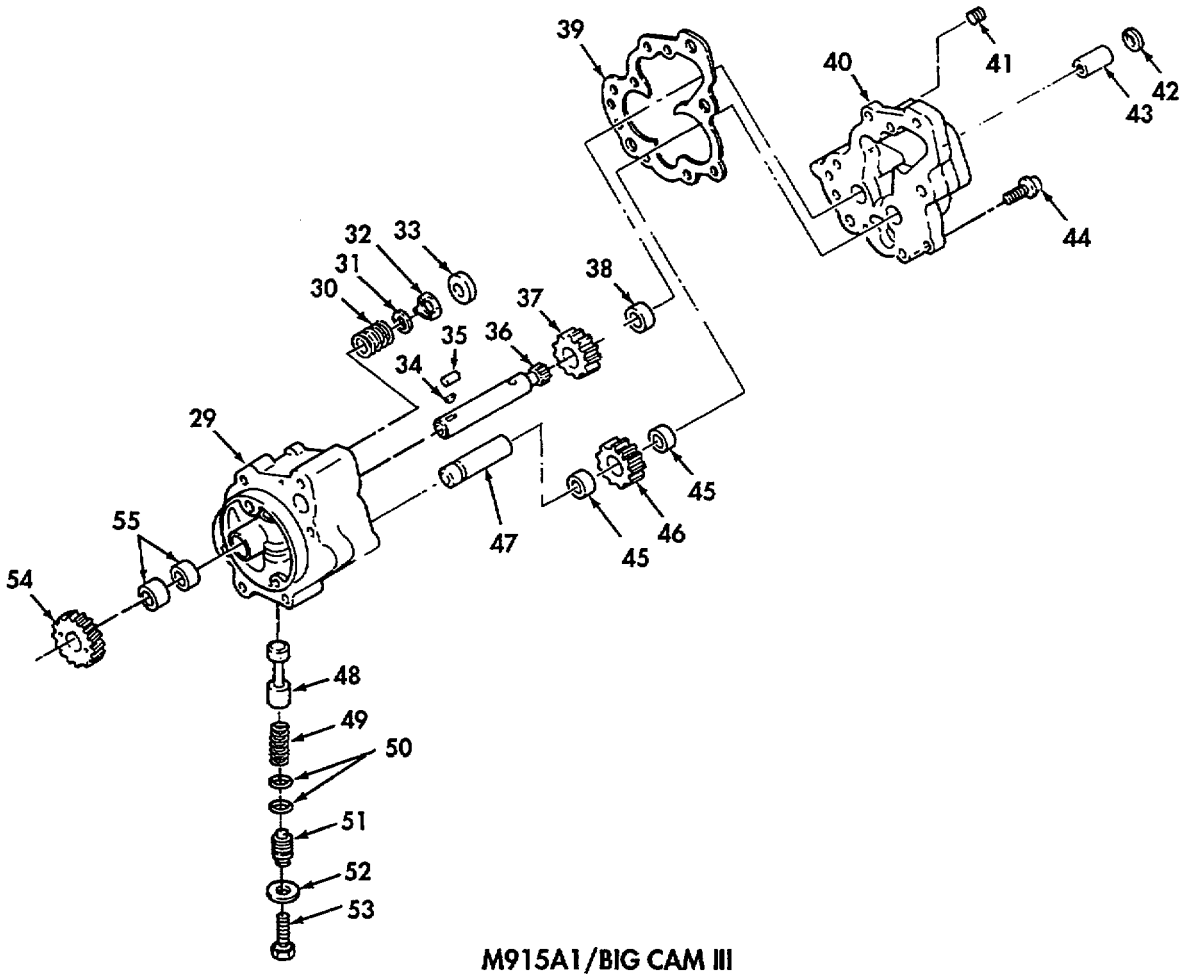
- **Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and protective equipment such as goggles or shield, gloves, etc. Failure to comply may result in injury to personnel.**
- **Approved solvents may be flammable and will not be used near open flame. Use only in well-ventilated area. Failure to comply may result in injury to personnel.**

NOTE

Cleaning procedures are the same for M915/Big Cam I and M915A1/Big Cam III oil pump assemblies. M915A1/Big Cam III is shown.

21. All parts	Clean with SD-3 solvent and dry with compressed air.	Refer to para. 3-6 for cleaning instructions. Ensure all drilled passages are opened and cleaned.

3-44. OIL PUMP REPAIR (Contd)



M915A1/BIG CAM III

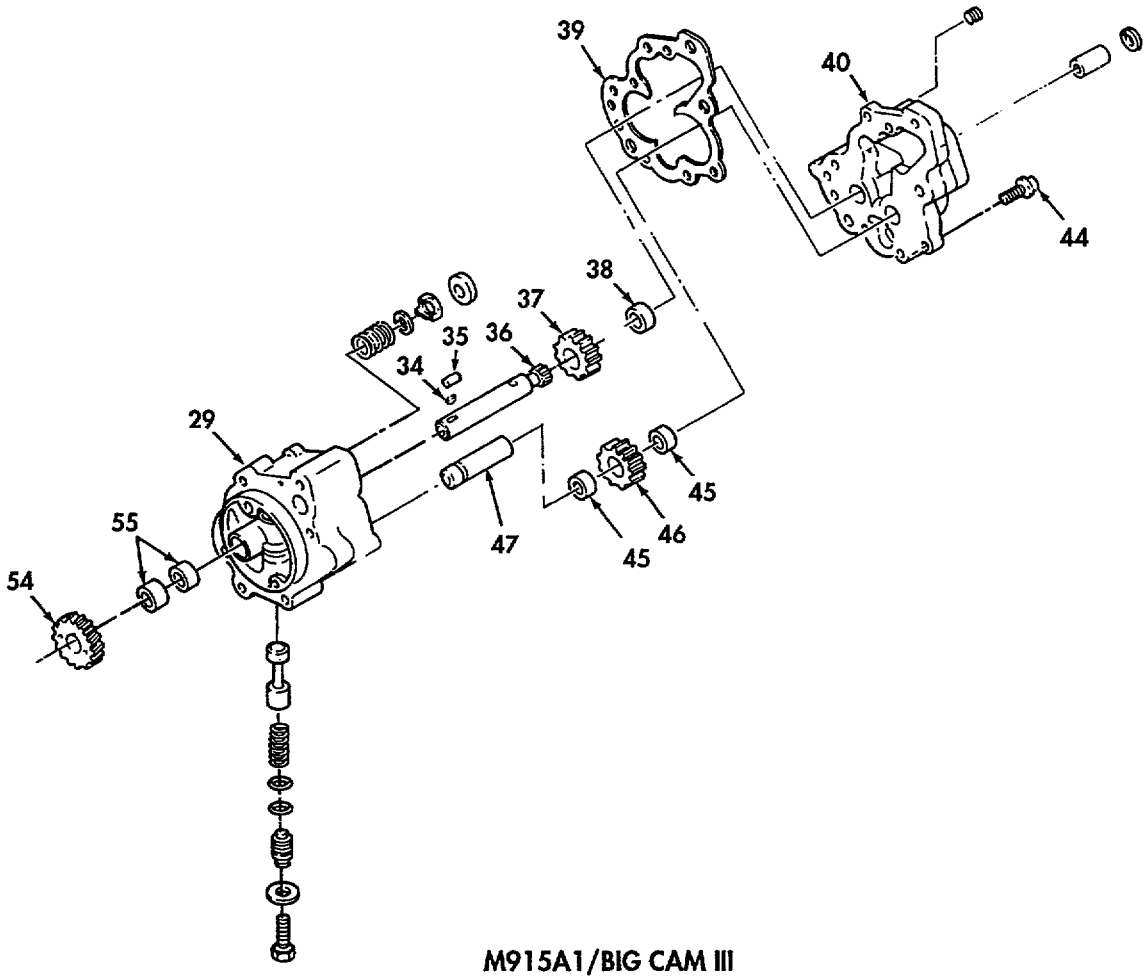
LEGEND:

29. BODY
30. BYPASS VALVE SPRING
31. WASHER
32. VALVE DISC
33. BYPASS VALVE SEAT
34. WOODRUFF KEY
35. PIN
36. SHAFT
37. GEAR
38. SLEEVE BEARING
39. GASKET
40. COVER
41. PIPE PLUG
42. RETAINING RING
43. STEERING PUMP COUPLING
44. CAPTIVE WASHER SCREW (7)
45. SLEEVE BEARING (2)
46. GEAR
47. SHAFT
48. PLUNGER
49. SPRING
50. PREFORMED PACKING (2)
51. RETAINER
52. WASHER
53. SCREW
54. GEAR
55. SLEEVE BEARING (2)

3-44. OIL PUMP REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection		
	NOTE **Inspection procedures are the same, including all corresponding measurements, for M915/Big Cam I and M915A1/Big Cam III oil pump assemblies. M915A1/Big Cam III is shown.**	
22. Gears (37) and (46) and pump drive gear (54)	Inspect for excessive wear, cracks, chips, or missing gear teeth.	Replace if worn, cracked, chipped, or broken.
23. Two sleeve bearings (55) and sleeve bearing (38)	a. Measure inside diameter.	If inside diameter exceeds 0.879 in. (22.327 mm), replace sleeve bearing.
	CAUTION **New sleeve bearings must be reamed to size after installation. Sleeve bearings in pump cover and body must be line-reamed with cover installed on body to ensure accuracy.**	
	NOTE **Perform steps 23b through 23d only if bushings will be replaced.**	
	b. Press out. c. Press in three new sleeve bearings (55) and (38) in body (29) and cover (40). d. Line-ream inside diameter of two new sleeve bearings (55) and and (38) to 0.8767-0.8777 in. (22.268-22.294 mm).	Use suitable mandrel. Do not press sleeve bearings (55) and (38) more than 0.020 in. (0.508 mm) below top surface of body (29). After reaming, thoroughly clean body (29), sleeve bearings (55), and sleeve bearing (38).
24. Dowel pin (35)	a. Inspect for damage.	
	NOTE **Perform steps 24b and 24c if dowel pin is damaged and will be replaced.**	
	b. Remove using suitable dowel pin extractor. c. Install using suitable arbor press.	
25. Body (29)	Inspect for the following: a. Cracks or damage. b. Damaged or distorted threads. c. Gasket surface for scratches, wear, or damage.	 Discard if cracked. Chase damaged or distorted threads with suitable tap. Replace if excessively worn or damaged.
26. Sleeve bearing (45) on gear (46)	a. Measure inside diameter.	One sleeve bearing (45) is located on gear (46). If inside diameter exceeds 0.879 in. (22.327 mm), replace sleeve bearing (45).

3-44. OIL PUMP REPAIR (Contd)



M915A1/BIG CAM III

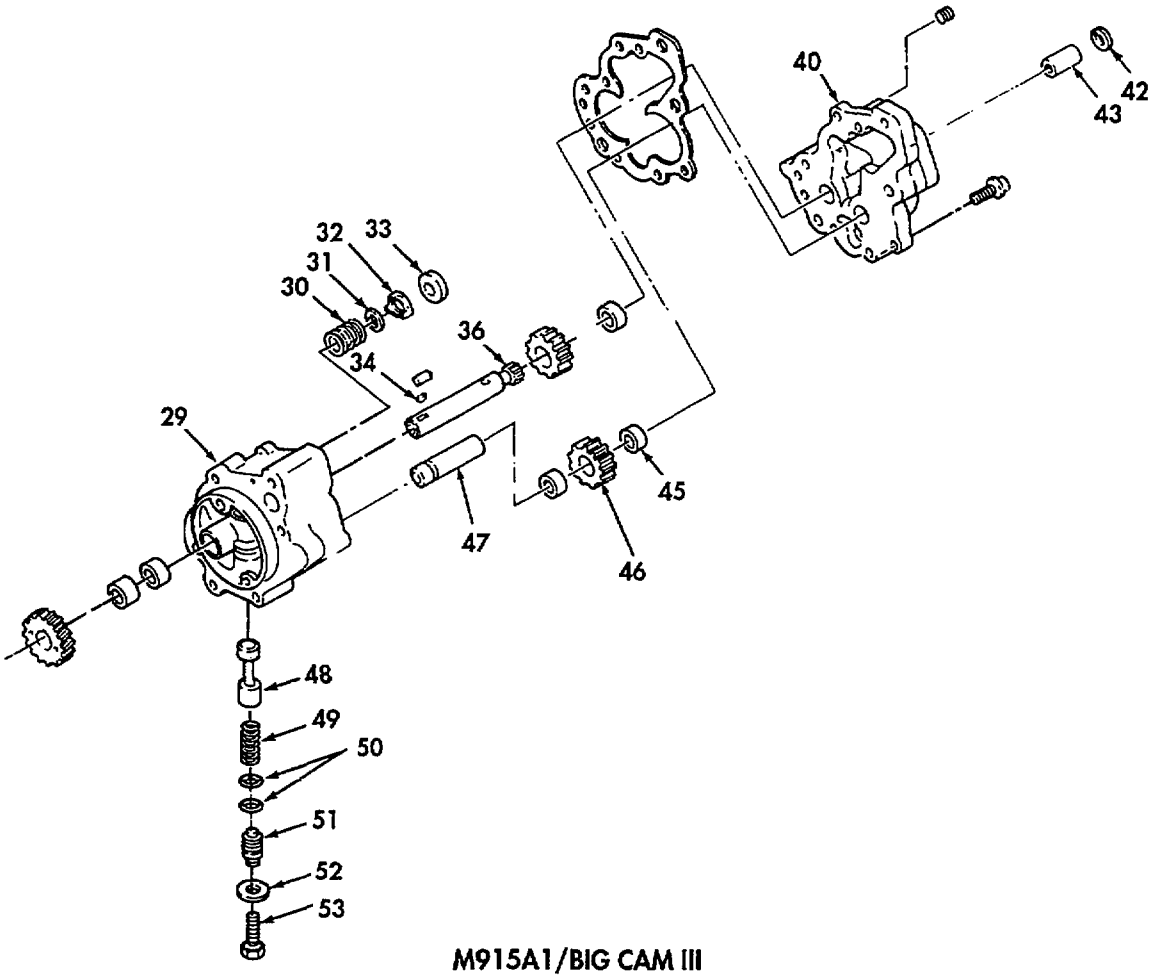
LEGEND:

29. BODY
34. WOODRUFF KEY
35. PIN
36. SHAFT
37. OIL PUMPING GEAR
38. SLEEVE BEARING
39. GASKET
40. COVER
44. CAPTIVE WASHER SCREW (7)
45. SLEEVE BEARING (2)
46. GEAR
47. SHAFT
54. PUMP DRIVE GEAR
55. SLEEVE BEARING (2)

3-44. OIL PUMP REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection (Contd)		
	NOTE **Perform steps 26b through 26d if gear sleeve bearing will be replaced.**	
	b. Press out.	Use suitable mandrel.
	c. Press in new sleeve bearing (45) more than 0.020 in. (0.508 mm).	Do not press bushing below top surface of gear (46).
	d. Line-ream new sleeve bearing (45) inner diameter to 0.8767-0.8777 in. (22.268-22.293 mm).	Thoroughly clean gear (46) and sleeve bearing (45) after reaming.
27. Pump cover (40)	Inspect for the following:	
	a. Cracks or damage.	Discard if cracked.
	b. Gasket surface for scratches or damage.	Discard if damaged.
28. Sleeve bearing (45) on cover (40)	a. Measure inside diameter.	If inside diameter of sleeve bearing (45) exceeds 0.879 in. (22.327 mm), replace sleeve bearing (45).
	NOTE **Perform steps 28b through 28d if pump cover assembly sleeve bearing will be replaced.**	
	b. Press out.	Use suitable mandrel.
	c. Press in new sleeve bearing (45).	
	d. Line-ream inner diameter of new sleeve bearing (45) to 0.8767-0.8777 in. (22.268-22-294 mm).	Thoroughly clean pump cover (40) and sleeve bearing (45) after reaming.
29. Drive shaft (36) and idler shaft (47)	Inspect for the following:	
	a. Galling, breaks, or cracks.	Replace, if galled, broken, or cracked.
	b. Check outside diameter using micrometer.	If outside diameter is less than 0.874 in. (22.20 mm), discard.
	c. Wear on woodruff key slot on shaft (36).	Discard if woodruff key (34) fits loosely.
30. Pressure regulator plunger (48)	Verify it moves freely in bore of body (29).	Discard if it sticks, binds, or is excessively loose.
31. Valve disc (32)	Inspect for damage.	Discard if damaged.
32. Bypass valve spring (30)	Inspect for damage, breaks, or weakness.	Discard if damaged, broken, or weak.
33. Power steering pump coupling (43)	Inspect for internal wear or cracks in spline area.	Discard if worn or cracked.
34. Woodruff key (34)	Inspect for wear or cracks.	Discard if any wear or cracks are noticeable.

3-44. OIL PUMP REPAIR (Contd)



M915A1/BIG CAM III

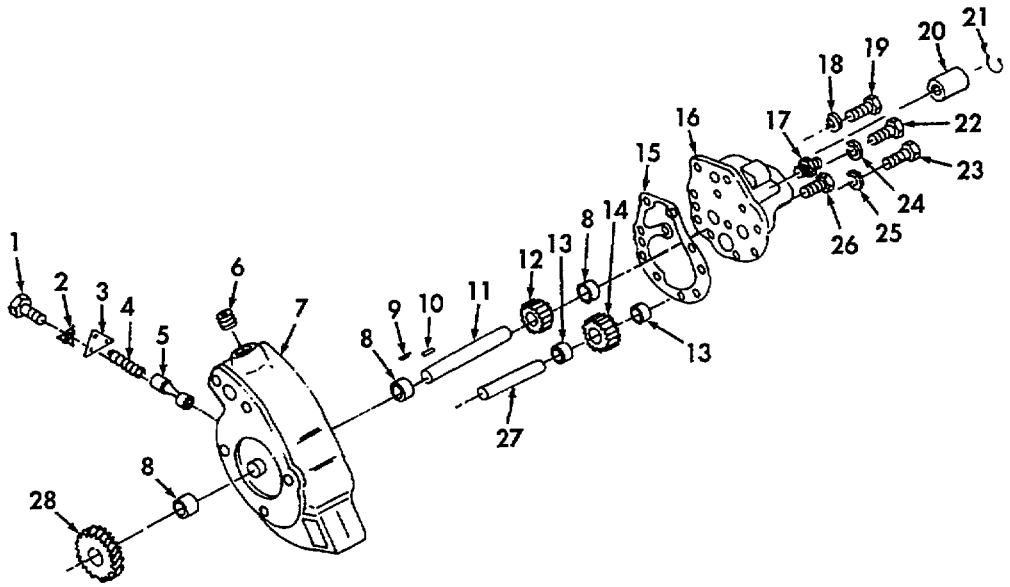
LEGEND:

29. BODY
30. BYPASS VALVE SPRING
31. WASHER
32. VALVE DISC
33. BYPASS VALVE SEAT
34. WOODRUFF KEY
36. DRIVE SHAFT
40. PUMP COVER
42. RETAINING RING
43. POWER STEERING PUMP COUPLING
45. SLEEVE BEARING (2)
46. GEAR
47. SHAFT
48. PLUNGER
49. SPRING
50. PREFORMED PACKING (2)
51. RETAINER
52. WASHER
53. SCREW

3-44. OIL PUMP REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Assembly		
	NOTE • **Perform steps 35 through 42 for M915/Big Cam I only.** • **Perform steps 43 through 52 for M915A1/Big Cam III only.**	
35. Gear (12)	Install on shaft (11) 2.125-2.250 in. (53.975-57.15 mm) from splined end of shaft (11).	Use suitable arbor press.
36. Shaft (11)	Install on body (7). Place 0.060-0.070 in. (1.52-1.78 mm) feeler gauge between gear (12) and body (7) and further press gear (12) on shaft (11).	Oil pumping gear-to-body clearance must be 0.060-0.070 in. (1.52-1.78 mm).
37. Shaft (27)	Install on body (7) so that large diameter end protrudes 0.9375-1.0 in. (23.81-25.40 mm) above body on face of housing (16).	Use suitable arbor press.
38. Gear(14)	Install on shaft (27).	Lubricate gears, shafts, bushings, and gear pockets with OE/HDO 10 lubricating oil.
39. Plunger (5), spring (4), retaining yoke (3), lockplate (2), and screw (1)	Install on body (7).	
40. New gasket (15), housing (16), three new lockwashers (25), screws (23), washer (18), screw (19), washer (24), and screw (22)	Install on body (7).	Tighten screws (23), (19), and (22) to 35 lb-ft (48 N•m). Rotate shaft (11) to ensure gears turn free.
41. Woodruff key (9), drive gear (28), coupling (20), and snapring (21)	Install on shaft (11) and check shaft (11) end play.	Use suitable arbor press. End play should be 0.002-0.008 in. (0.05-0.20 mm).
42. Pipe plug (6) and connector (17)	Install on body (7) and housing (16).	Coat threads with liquid thread sealant.

3-44. OIL PUMP REPAIR (Contd)



M915/BIG CAM I

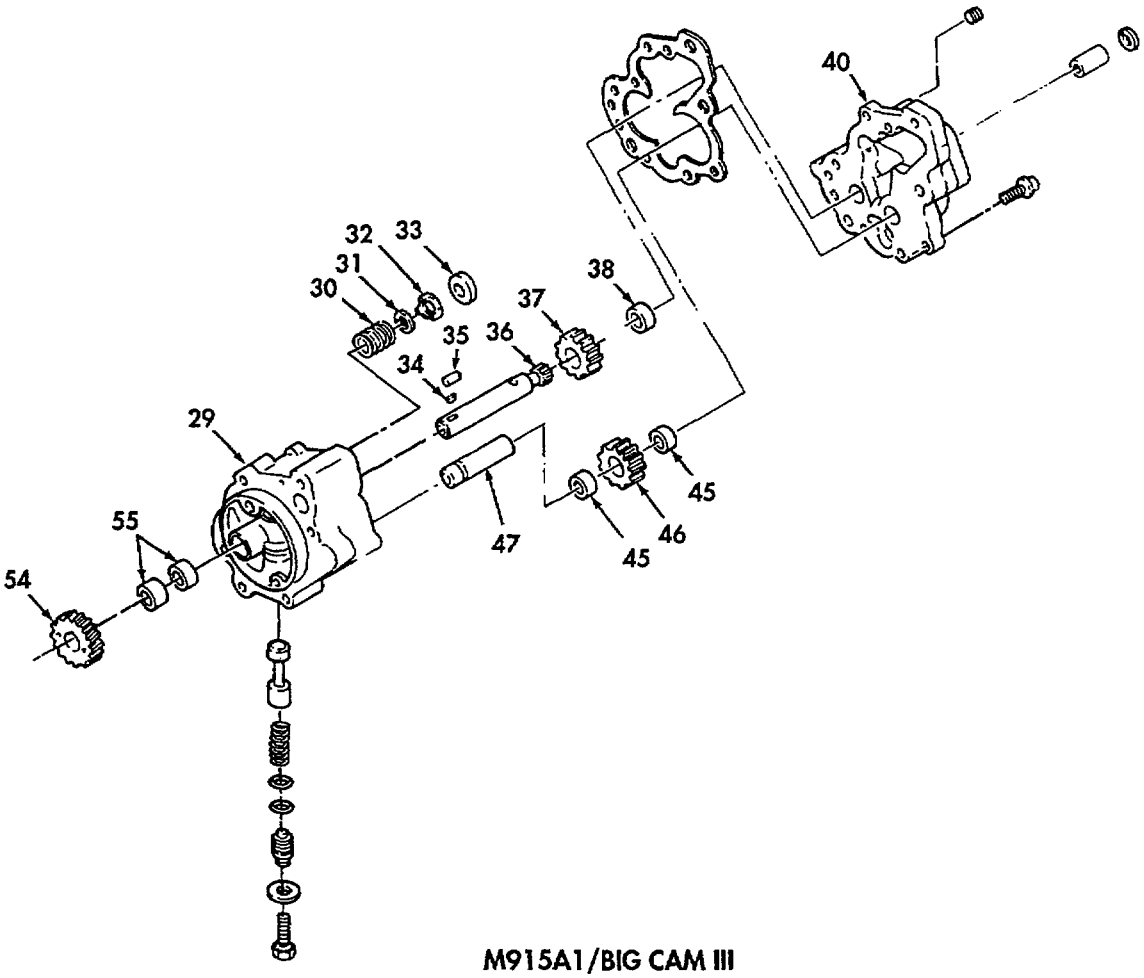
LEGEND:

1. SCREW
2. LOCKPLATE
3. RETAINING YOKE
4. SPRING
5. PLUNGER
6. PIPE PLUG
7. BODY
8. SLEEVE BEARING (3)
9. WOODRUFF KEY
10. PIN
11. SHAFT
12. OIL PUMPING GEAR
13. SPLIT BUSHING (2)
14. GEAR
15. GASKET
16. HOUSING
17. CONNECTOR
18. WASHER
19. SCREW
20. COUPLING
21. SNAPRING
22. SCREW
23. SCREW (3)
24. WASHER
25. LOCKWASHER (3)
26. SCREW
27. SHAFT
28. GEAR

3-44. OIL PUMP REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Assembly (Contd)		
	NOTE **Lubricate all moving parts prior to assembly with OE/HDO 10 lubricating oil.**	
43. Shaft (47)	Press large diameter end until it protrudes a minimum of 0.705 in. (17.907 mm) and a maximum of 0.735 in. (18.669 mm) from cover face of body (29).	Use suitable arbor press to install shaft (47). The cover face is at the opposite side of gasket surface.
44. Oil pumping gear (37)	Press on shaft (36) until it protrudes a minimum of 1.990 in. (50.546 mm) and a maximum of 2.010 in. (51.054 mm) from gasket surface of body (29).	Use suitable arbor press to install gear (37).
45. Shaft (36), gear (37), woodruff key (34), and gear (54)	Install as follows: a. Slide shaft (36) and gear (37) through sleeve bearings (55) on body (29). b. Insert woodruff key (34) in keyway of shaft (36). c. Press gear (54) until shaft (36) protrudes a minimum of 0.050 in. (1.270 mm) and has a maximum end play of 0.070 in. (1.778 mm) from gear (54).	Use shallow end of spacer mandrel (ST-1157).
46. Gear (46)	Install on shaft (47).	
47. Bypass valve spring (30), washer (31), valve disc (32), and bypass valve seat (33)	Install on body (29).	Use DFC pressure valve fixture (3376011) for installation. Ensure the prongs of valve disc (32) are pointing down during installation.

3-44. OIL PUMP REPAIR (Contd)



M915A1/BIG CAM III

LEGEND:

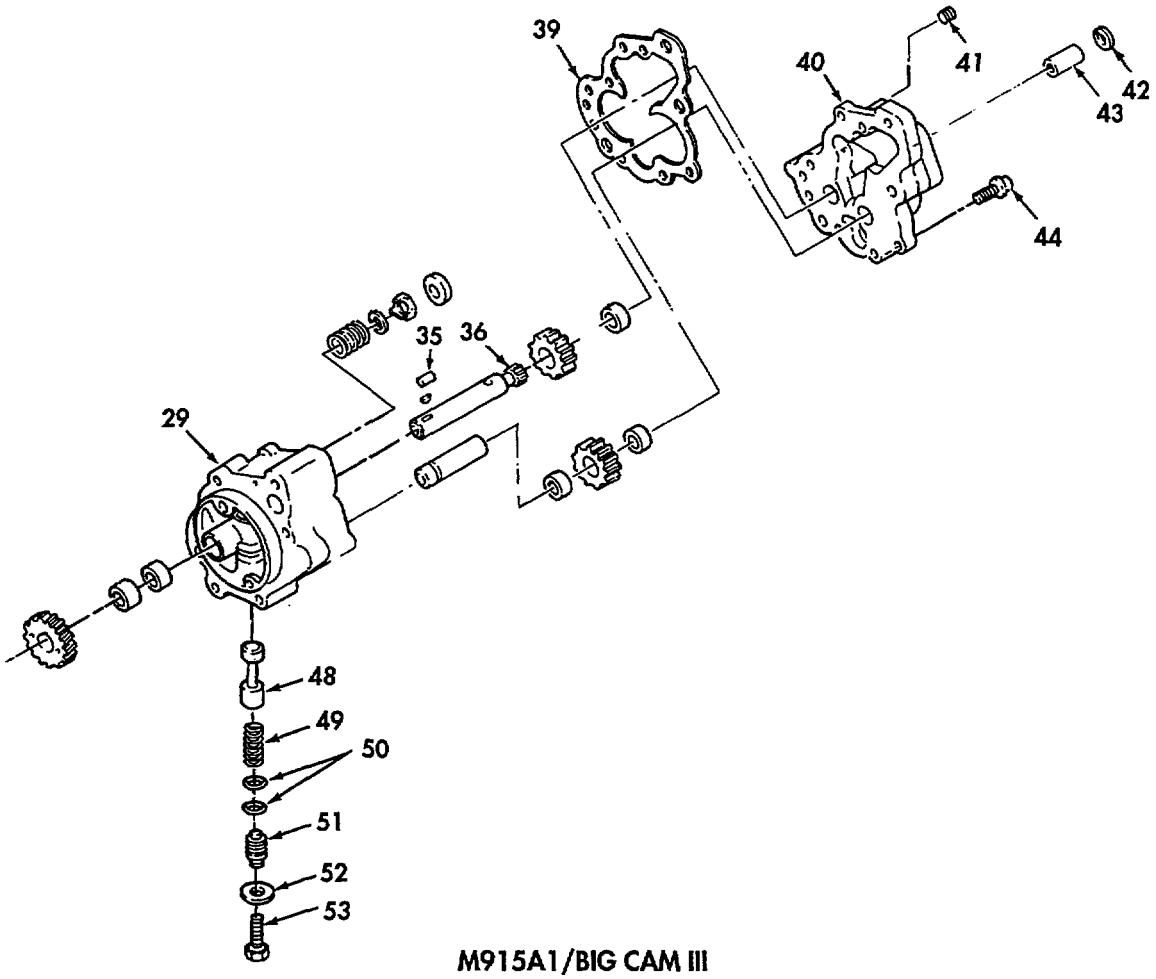
29. BODY
30. BYPASS VALVE SPRING
31. WASHER
32. VALVE DISC
33. BYPASS VALVE SEAT
34. WOODRUFF KEY
35. PIN
36. SHAFT
37. OIL PUMPING GEAR
38. SLEEVE BEARING
40. COVER
45. SLEEVE BEARING (2)
46. GEAR
47. SHAFT
54. GEAR
55. SLEEVE BEARING (2)

3-44. OIL PUMP REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Assembly (Contd)		
48. New gasket (39) and cover (40)	Install on dowel pin (35) and body (29).	It may be necessary to tap on the cover (40) lightly with a soft-nose hammer to seat cover on dowel pin (35).
49. Seven captive washer screws (44)	Install on cover (40) and body (29).	Tighten captive washer screws (44) to 35 lb-ft (48 N•m). Rotate shaft (36) to ensure gears turn free.
50. Plunger (48), spring (49), two new preformed packings (50), retainer (51), washer (52), and screw (53)	Install on body (29).	Tighten screw (53) to 35 lb-ft (48 N•m). Be certain pressure regulator plunger (48) slides freely within bore. Rotate shaft (36) and check end play to ensure it is within 0.002 in. (0.051 mm) minimum and 0.005 in. (0.127 mm) maximum range.
51. Pipe plug (41)	Install on cover (40).	Tighten pipe plug (41) to 30 lb-ft (41 N•m). Coat threads with liquid thread sealant.
52. Steering pump coupling (43) and retaining ring (42)	Install on shaft (36).	

FOLLOW-ON TASK: Install oil pump (para. 3-74).

3-44. OIL PUMP REPAIR (Contd)



M915A1/BIG CAM III

LEGEND:

29. BODY
35. DOWEL PIN
36. SHAFT
39. GASKET
40. COVER
41. PIPE PLUG
42. RETAINING RING
43. STEERING PUMP COUPLING
44. CAPTIVE WASHER SCREW (7)
48. PLUNGER
49. SPRING
50. PREFORMED PACKING (2)
51. RETAINER
52. WASHER
53. SCREW

3-45. AIR AFTERCOOLER REPAIR

THIS TASK COVERS:

a. Disassembly
b. Cleaning
c. Inspection
d. Assembly

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
None

TEST EQUIPMENT
None

MATERIALS/PARTS
Solvent, SD-3 (Appendix C, Item 30)
Oil, lubricating, OE/HDO 10 (Appendix C, Item 20)
Four preformed packings (15434) 195952
Aftercooler cover gasket (15434) 216486
Water outlet connection gasket (15434) 215044
Water inlet connection gasket (15434) 3032348
Three lockwashers (96906) MS35338-45 (M915A1/Big Cam III)

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
Air aftercooler removed (para. 3-20).

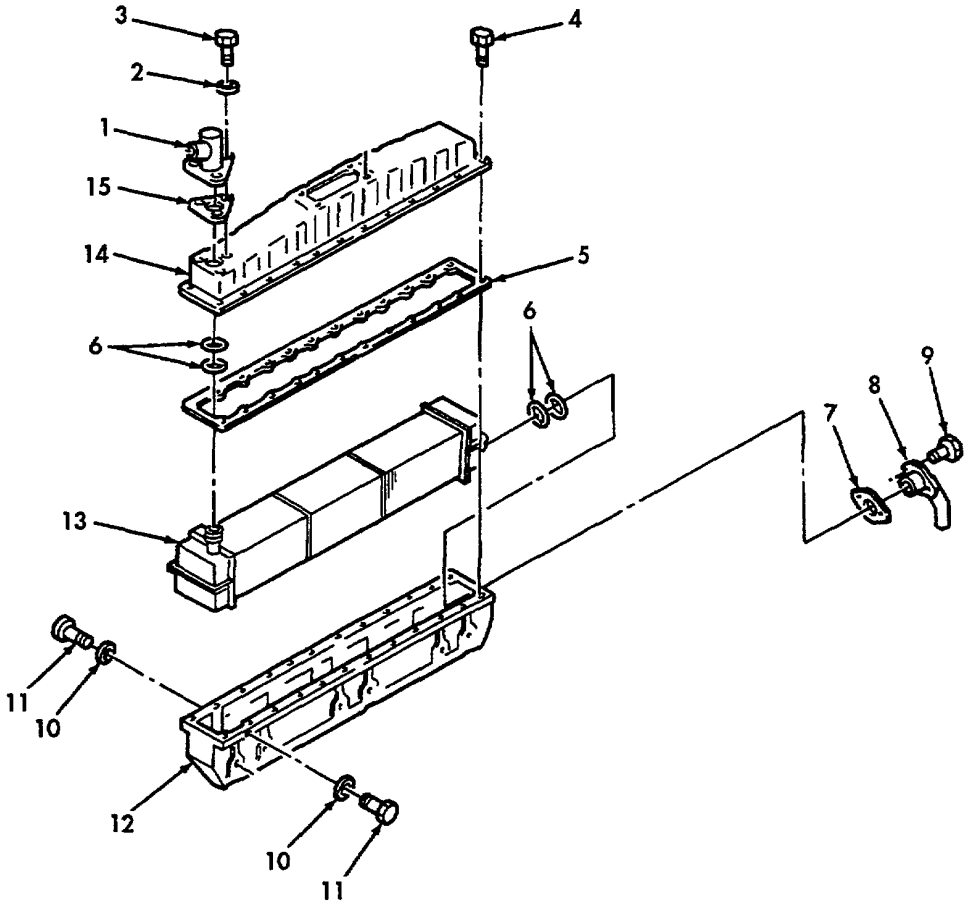
SPECIAL ENVIRONMENTAL CONDITIONS
None

GENERAL SAFETY INSTRUCTIONS
- Always wear eye protection when cleaning with compressed air.
- Use approved solvent in well-ventilated area.

LOCATION/ITEM	ACTION	REMARKS
a. Disassembly		
1. Three screws (3), washers (M915/Big Cam I), or lockwashers (M915A1/Big Cam III) (2)	Remove from aftercooler cover (14).	Discard lockwashers (2).
2. Water outlet connection (1) and gasket (15)	Remove from aftercooler cover (14).	Pry out if necessary. Discard gasket (15).
3. Twenty-four screws (M915/Big Cam I) or captive washer screws (M915A1/Big Cam III) (4)	Remove from aftercooler cover (14) and intake manifold (12).	
NOTE **It may require some force to separate aftercooler cover from intake manifold.**		
4. Aftercooler cover (14) and gasket (5) (M915A1/Big Cam III)	Remove from intake manifold (12) and aftercooler element (13).	Discard gasket (5).
NOTE **Perform step 5 for M915A1/Big Cam III only.**		
5. Eight screws (11) and washers (10)	Remove from aftercooler element (13) and intake manifold (12).	

3-45. AIR AFTERCOOLER REPAIR (Contd)

	LOCATION/ITEM	ACTION	REMARKS
6.	Two screws (M915/Big Cam I) or captive washer screws (M915A1/Big Cam III) (9)	Remove from intake manifold (12) and water inlet connection (8).	
7.	Water inlet connection (8) and gasket (7)	Remove from intake manifold (12).	Discard gasket (7).
8.	Aftercooler element (13) and gasket (5) (M915/Big Cam I)	Remove from intake manifold (12).	Discard gasket (5).
9.	Four preformed packings (6)	Remove from aftercooler element (13).	Discard preformed packings (6).



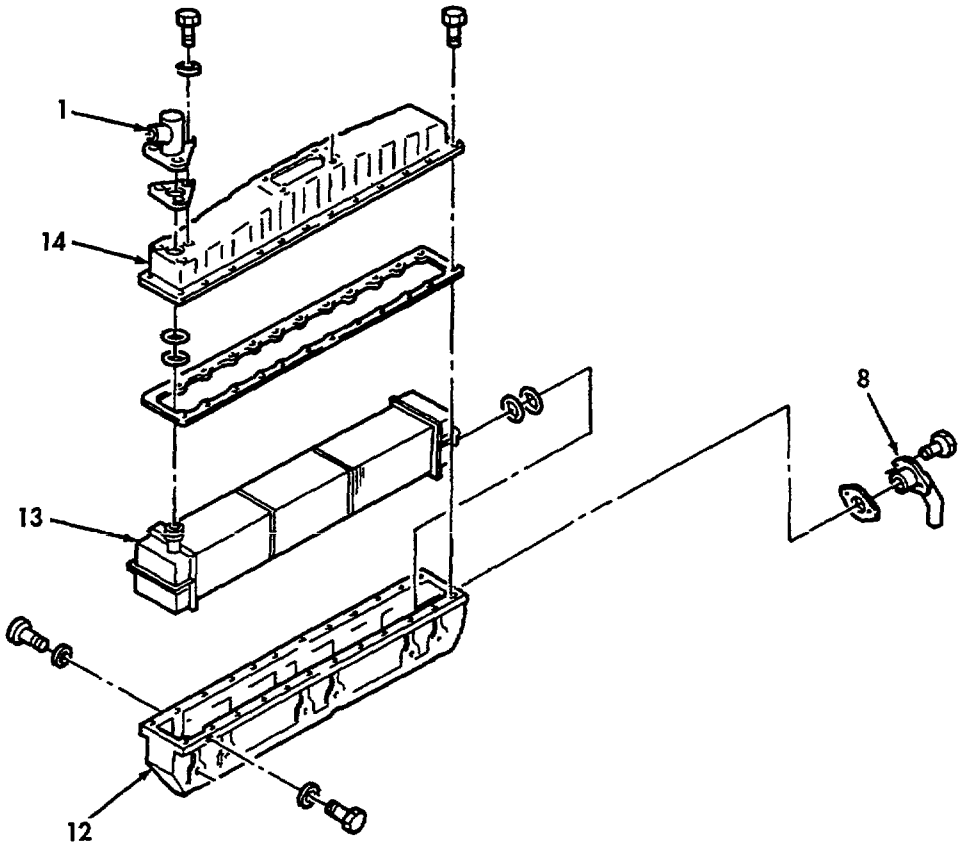
LEGEND:

1. WATER OUTLET CONNECTION
2. WASHER (3) (M915/BIG CAM I), LOCKWASHER (3) (M915A1/BIG CAM III)
3. SCREW (3)
4. SCREW (24) (M915/BIG CAM I), CAPTIVE WASHER SCREW (24) (M915A1/BIG CAM III)
5. GASKET
6. PREFORMED PACKING (4)
7. GASKET
8. WATER INLET CONNECTION
9. SCREW (2) (M915/BIG CAM I), CAPTIVE WASHER SCREW (2) (M915A1/BIG CAM III)
10. WASHER (8)
11. SCREW (8)
12. INTAKE MANIFOLD
13. AFTERCOOLER ELEMENT
14. AFTERCOOLER COVER
15. GASKET

3-45. AIR AFTERCOOLER REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
b. Cleaning		
	WARNING • **Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and protective equipment such as goggles or shield, gloves, etc. Failure to comply may result in injury to personnel.** • **Approved solvents may be flammable and will not be used near open flame. Use only in well-ventilated area. Failure to comply may result in injury to personnel.**	
10. Water outlet connection (1), aftercooler cover (14), intake manifold (12), water inlet connection (8), and all mounting hardware	Steam clean and dry with compressed air.	Use SD-3 solvent.
	CAUTION **The aftercooler element is made from a copper alloy. Using a cleaning solution not made for copper alloy may cause corrosion.**	
11. Aftercooler element (13)	Clean and dry with compressed air.	Use cleaning solution made especially for copper alloy.
c. Inspection		
12. Water outlet connection (1), aftercooler cover (14), water inlet connection (8), and intake manifold (12)	Inspect for cracks, distortion, or damaged threads.	Discard if cracked or distorted. Repair damaged threads with correct thread tap.
13. Aftercooler element (13)	Inspect and test for leaks as follows: a. Cap one end air-tight. b. Connect a suitable pressure tester to remaining open end of aftercooler element (13). c. Apply 20 psi (138 kPa) and maintain pressure for two minutes. d. Immerse in water while maintaining 20 psi (138 kPa) and look for air bubbles.	If a leak is detected, repairs should be made by an individual qualified in repairing radiator cores.

3-45. AIR AFTERCOOLER REPAIR (Contd)

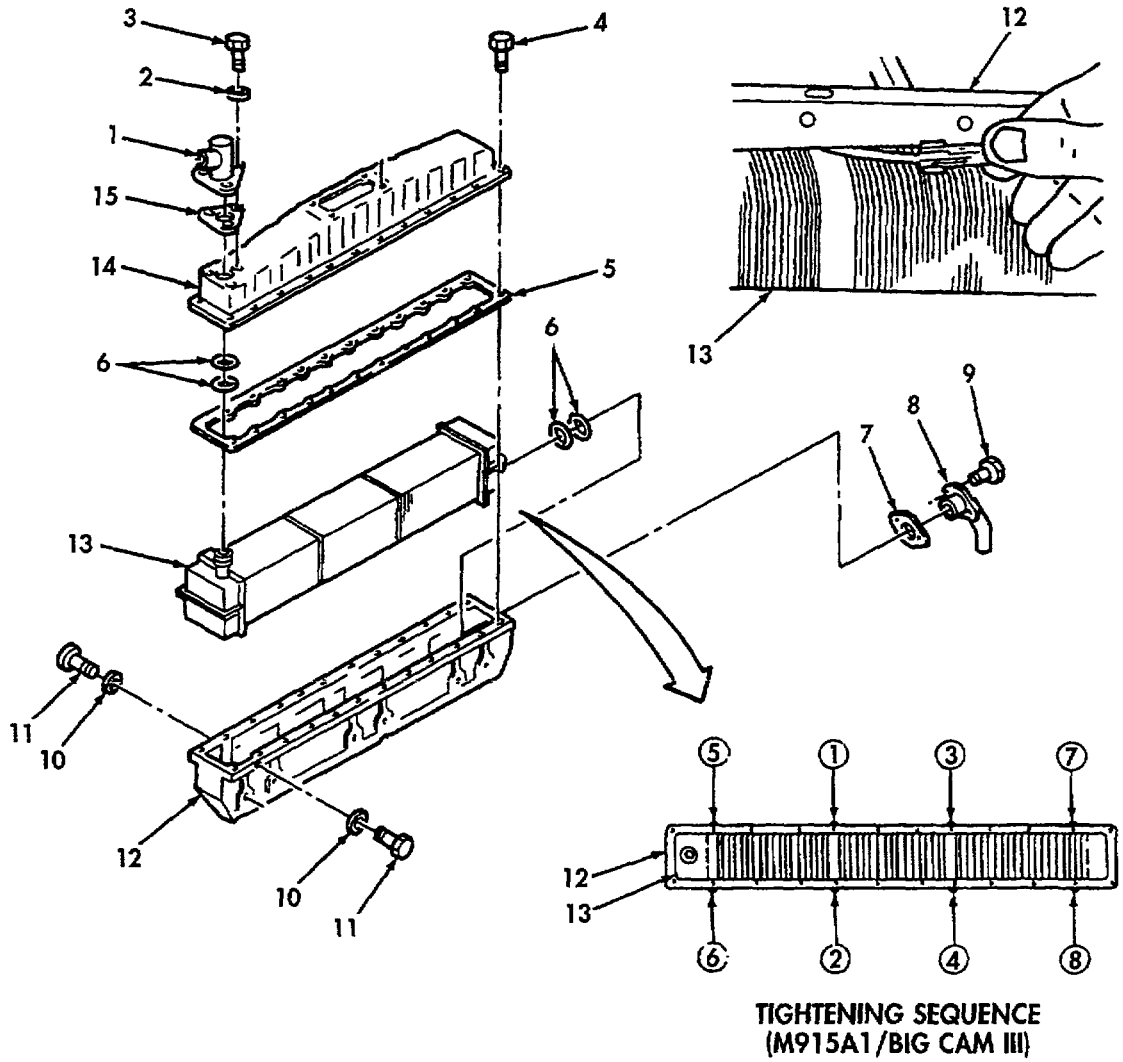


LEGEND:
1. WATER OUTLET CONNECTION
8. WATER INLET CONNECTION
12. INTAKE MANIFOLD
13. AFTERCOOLER ELEMENT
14. AFTERCOOLER COVER

3-45. AIR AFTERCOOLER REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Assembly		
14. Four new preformed packings (6)	Install on inlet and outlet fittings of aftercooler element (13).	Lubricate four new preformed packings (6) with OE/HDO 10 lubricating oil prior to installation.
	NOTE **Perform steps 15b and 16 for M915A1/Big Cam III only.**	
15. New gasket (5) (M915/Big Cam I) and aftercooler element (13)	Install on intake manifold (12) as follows:	Ensure holes in new gasket (5) are aligned.
	NOTE **The aftercooler element has a precision fit in intake manifold. Move element carefully during installation.**	
	a. Position on intake manifold (12) and gasket (5) (M915/Big Cam I). b. Check clearance at two locations between aftercooler element (13) and intake manifold (12) as shown.	When measuring clearance, hold aftercooler element (13) against side of intake manifold (12). Clearance must not be less than 0.003 in. (0.076 mm) or more than 0.013 in. (0.330 mm).
16. Eight washers (10) and screws (11)	Install on intake manifold (12) to secure aftercooler element (13) as follows: a. Carefully align holes. b. Tighten four center screws to 15 lb-ft (20 N•m). c. Tighten four end screws to 15 lb-ft (20 N•m). d. Tighten four center screws to 25 lb-ft (34 N•m). e. Tighten four end screws to 25 lb-ft (34 N•m).	Use tightening sequence shown.
	CAUTION **When installing water inlet connection and water outlet connection, be careful not to damage or distort new preformed packings.**	
17. New gasket (7), water inlet connection (8), and two screws (M915/Big Cam I) or captive washer screws (M915A1/Big Cam III) (9)	Install on intake manifold (12) finger-tight.	
18. New gasket (5) (M915A1/ Big Cam III) and aftercooler cover (14)	Install on aftercooler element (13).	Ensure holes in new gasket (5) are aligned.

3-45. AIR AFTERCOOLER REPAIR (Contd)



TIGHTENING SEQUENCE (M915A1/BIG CAM III)

LEGEND:

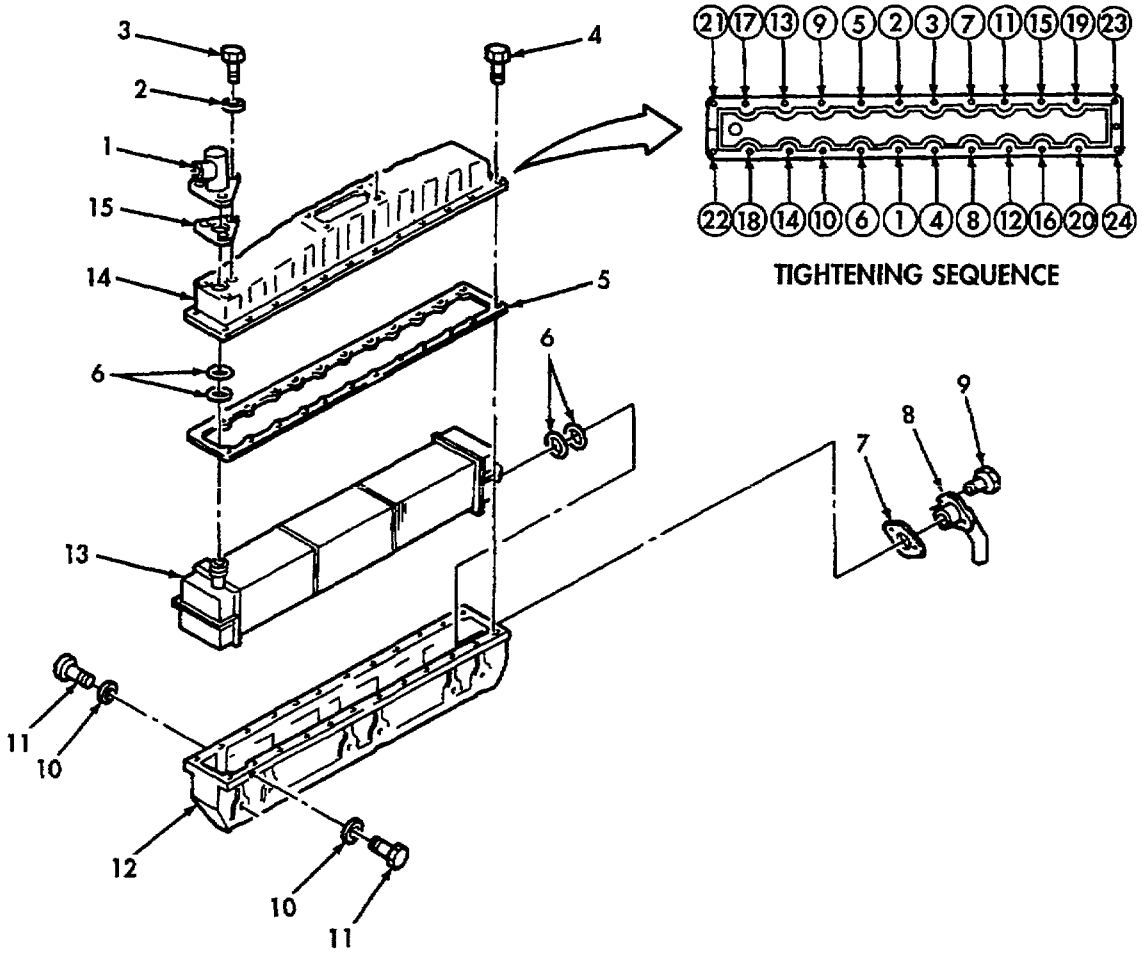
5. GASKET
6. PREFORMED PACKING (4)
7. GASKET
8. WATER INLET CONNECTION
9. SCREW (2) (M915/BIG CAM I), CAPTIVE WASHER SCREW (2) (M915A1/BIG CAM III)
10. WASHER (8)
11. SCREW (8)
12. INTAKE MANIFOLD
13. AFTERCOOLER ELEMENT
14. AFTERCOOLER COVER

3-45. AIR AFTERCOOLER REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Assembly (Contd)		
19. Twenty-four screws (M915/ Big Cam I) or captive washer screws (M915A1/ Big Cam III) (4)	Install on aftercooler cover (14) and intake manifold (12).	Do not tighten at this time.
20. New gasket (15), water outlet connection (1), three washers (M915/Big Cam I) or new lockwashers (M915A1/Big Cam III) (2), and screws (3)	Install on aftercooler cover (14).	Use caution not to damage new preformed packings (6). Do not tighten screws (3) at this time.
21. Two screws (M915/Big Cam I) or captive washer screws (M915A1/Big Cam III) (9)	Tighten to 32 lb-ft (43 N•m).	
22. Twenty-four screws (M915/ Big Cam I) or captive washer screws (M915A1/Big Cam III) (4)	Tighten to 25 lb-ft (34 N•m).	Use tightening sequence shown.
23. Three screws (3)	Tighten to 20 lb-ft (27 N•m).	

FOLLOW-ON TASK: Install air aftercooler on engine (para. 3-87).

3-45. AIR AFTERCOOLER REPAIR (Contd)



LEGEND:

1. WATER OUTLET CONNECTION
2. WASHER (3) (M915/BIG CAM I), LOCKWASHER (3) (M915A1/BIG CAM III)
3. SCREW (3)
4. SCREW (24) (M915/BIG CAM I), CAPTIVE WASHER SCREW (24) (M915A1/BIG CAM III)
9. SCREW (2) (M915/BIG CAM I), CAPTIVE WASHER SCREW (2) (M915A1/BIG CAM III)
12. INTAKE MANIFOLD
14. AFTERCOOLER COVER
15. GASKET

3-46. EXHAUST MANIFOLD REPAIR

THIS TASK COVERS:

a. Disassembly
b. Cleaning
c. Inspection
d. Assembly

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
None

TEST EQUIPMENT
None

MATERIALS/PARTS
Compound, antiseize (Appendix C, Item 7)
Sealant, pipe (Appendix C, Item 26)
Two spacer inserts (15434) 3020718

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
TM 9-2320-273-20
TM 9-2320-283-20

TROUBLESHOOTING REFERENCES
None

EQUIPMENT CONDITION
Exhaust manifold removed (para. 3-13).

SPECIAL ENVIRONMENTAL CONDITIONS
None

GENERAL SAFETY INSTRUCTIONS
Eye protection must be worn when using wire brush for cleaning.

LOCATION/ITEM	ACTION	REMARKS

NOTE
M915/Big Cam I engines utilize a conventional log-type exhaust manifold. M915A1/Big Cam III engines utilize a pulse-type exhaust manifold and a new design exhaust manifold with two spacer inserts. Disassembly and repair of manifolds is basically the same.

a. Disassembly

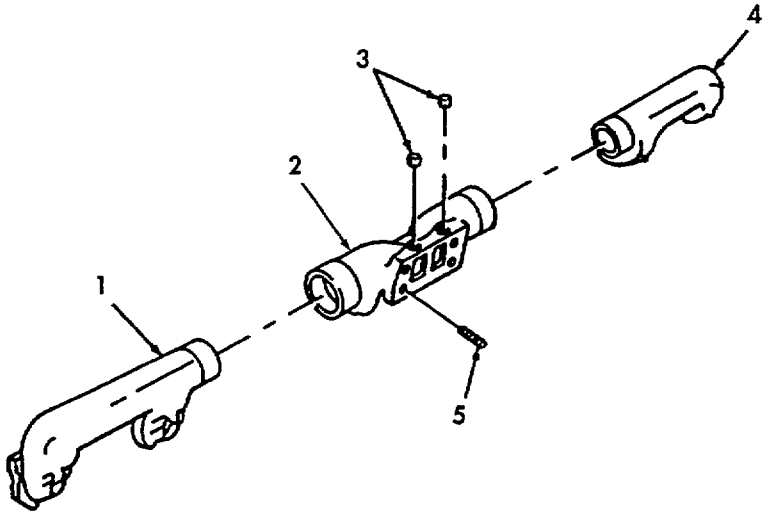
1.	Rear exhaust manifold (1), center exhaust manifold (2), and front exhaust manifold (4)	Separate (1), (2), and (4) on early design and two spacer inserts (6) on new design for M915A1/ Big Cam III only.	Exertion of force may be required to separate the three sections.
2.	Two pipe plugs (3) (M915/Big Cam I only)	Remove from center exhaust manifold (2).	

b. Cleaning

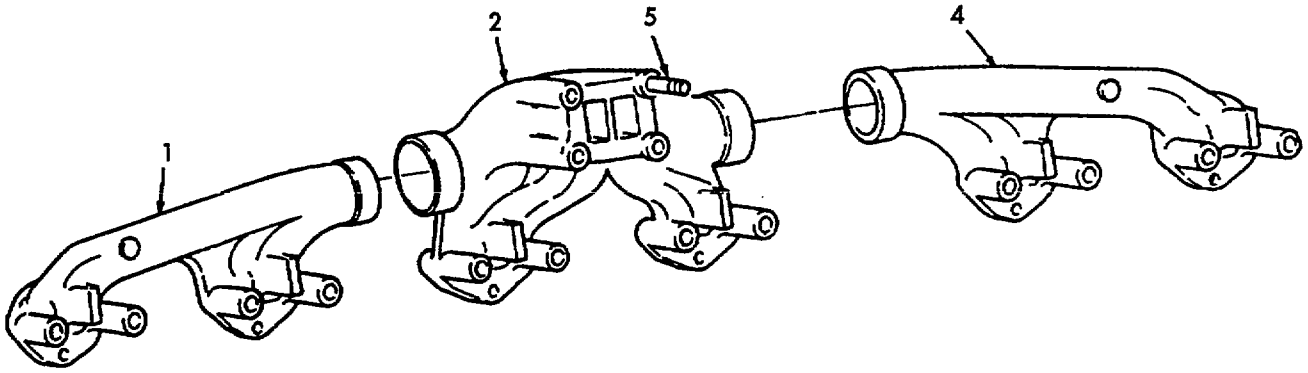
WARNING
Eye protection must be worn when using wire brush for cleaning. Failure to comply may result in injury to personnel.

3.	Rear exhaust manifold (1), center exhaust manifold (2), and front exhaust manifold (4)	Remove carbon and rust with steam cleaner.	Use a suitable wire wheel to clean mating surfaces.

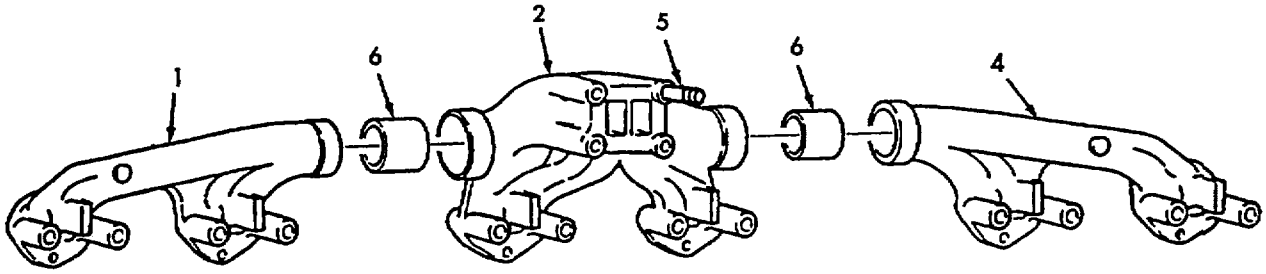
3-46. EXHAUST MANIFOLD REPAIR (Contd)



M915/BIG CAM I



M915A1/BIG CAM III



M915A1/BIG CAM III - NEW DESIGN

LEGEND:

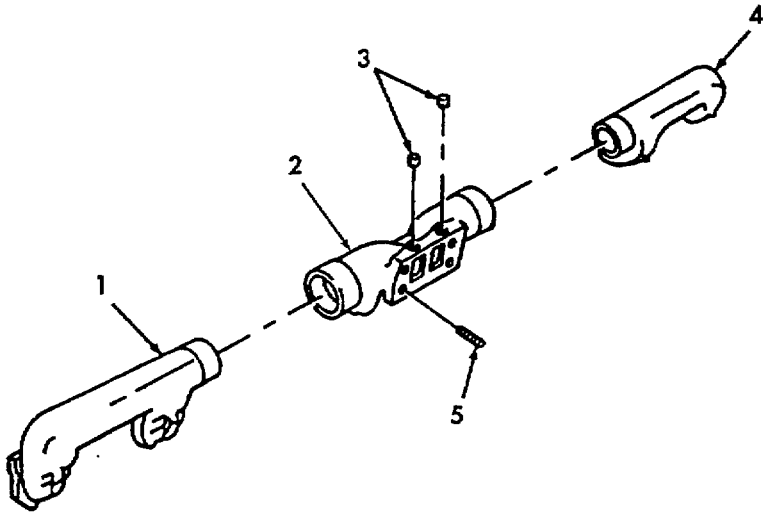
1. REAR EXHAUST MANIFOLD
2. CENTER EXHAUST MANIFOLD
3. PIPE PLUG (2) (M915/BIG CAM I ONLY)
4. FRONT EXHAUST MANIFOLD
5. STUD (4)
6. SPACER INSERTS (2) NEW DESIGN EXHAUST MANIFOLD (M915A1/BIG CAM III ONLY)

3-46. EXHAUST MANIFOLD REPAIR (Contd)

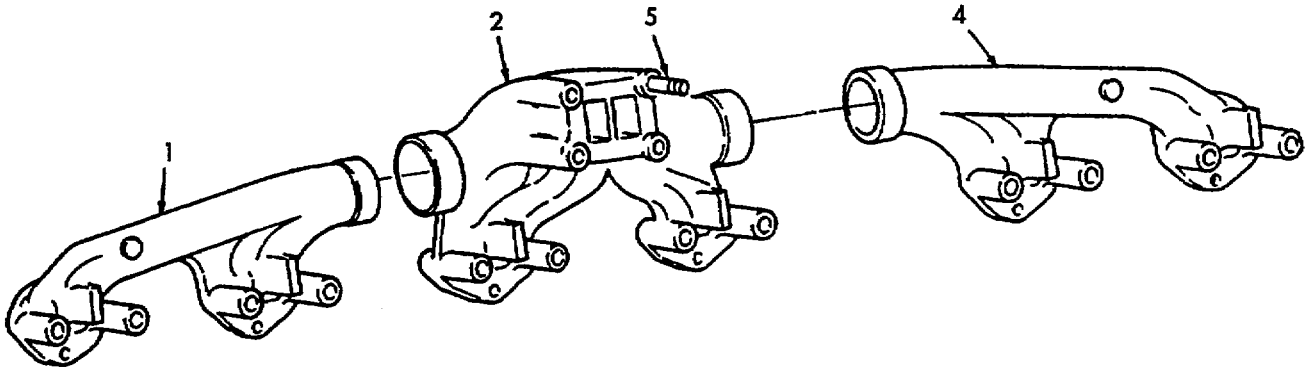
LOCATION/ITEM	ACTION	REMARKS
c. Inspection		
4. Rear exhaust manifold (1), center exhaust manifold (2), and front exhaust manifold (4)	Inspect for cracks or heat distortion at mating surfaces or flanges.	Discard if cracked or distorted.
5. Four turbocharger mounting studs (5)	Inspect for damaged threads or wear around unthreaded area.	Chase threads if damaged. Replace if worn or threads are stripped. Coat threads of new stud(s) (5) with antiseize compound.
d. Assembly		
6. Two pipe plugs (3) (M915/ Big Cam I only)	Install on center exhaust manifold (2).	Apply pipe sealant to threads of pipe plugs (3).
7. Rear exhaust manifold (1), center exhaust manifold (2), front exhaust manifold (4), and two spacer inserts (6) (on M915A1/ Big Cam III with new design manifold only)	Assemble.	Apply antiseize compound to mating surfaces to facilitate assembly.

FOLLOW-ON TASK: Install exhaust manifold (para. 3-88).

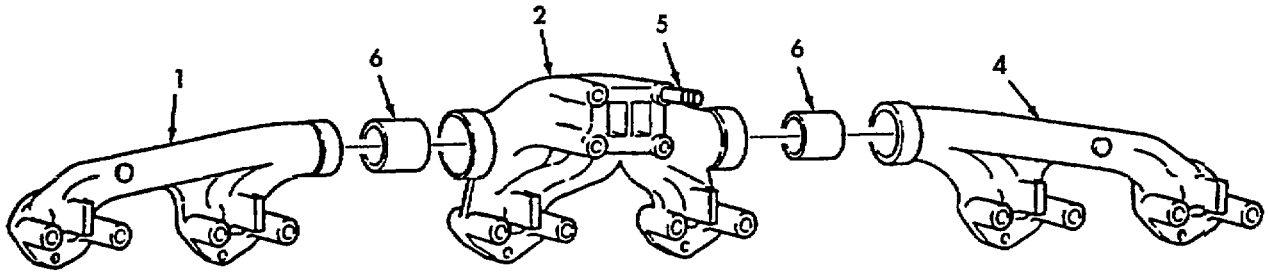
3-46. EXHAUST MANIFOLD REPAIR (Contd)



M915/BIG CAM I



M915A1/BIG CAM III



M915A1/BIG CAM III - NEW DESIGN

LEGEND:

1. REAR EXHAUST MANIFOLD
2. CENTER EXHAUST MANIFOLD
3. PIPE PLUG (2) (M915/BIG CAM I ONLY)
4. FRONT EXHAUST MANIFOLD
5. STUD (4)
6. SPACER INSERTS (2) NEW DESIGN EXHAUST MANIFOLD (M915A1/BIG CAM III ONLY)

3-47. TURBOCHARGER REPAIR

THIS TASK COVERS:

a. Disassembly
b. Cleaning and Inspection
c. Assembly

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
None

TEST EQUIPMENT
None

MATERIALS/PARTS
Oil, lubricating, OE/HDO 30 (Appendix C, Item 21)
Compound, antiseize (Appendix C, Item 7)
Bearing insert pad (15434) 170510
Two screws (15434) 194010
Four washers (15434) 5-631
Two locknuts (15434) 167299
Insulation packing (15434) 202377
Ring seal (15434) 154644
Two turbocharger seals (15434) 3032836
O-ring (15434) 202456
Impeller locknut (15434) 3-222A

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
MI-I-6866

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
Turbocharger removed (para. 3-13).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
- Machined edges on wheel and shaft and on turbocharger impeller are very sharp. Wear protective gloves.
- Always wear eye protection when using compressed air.

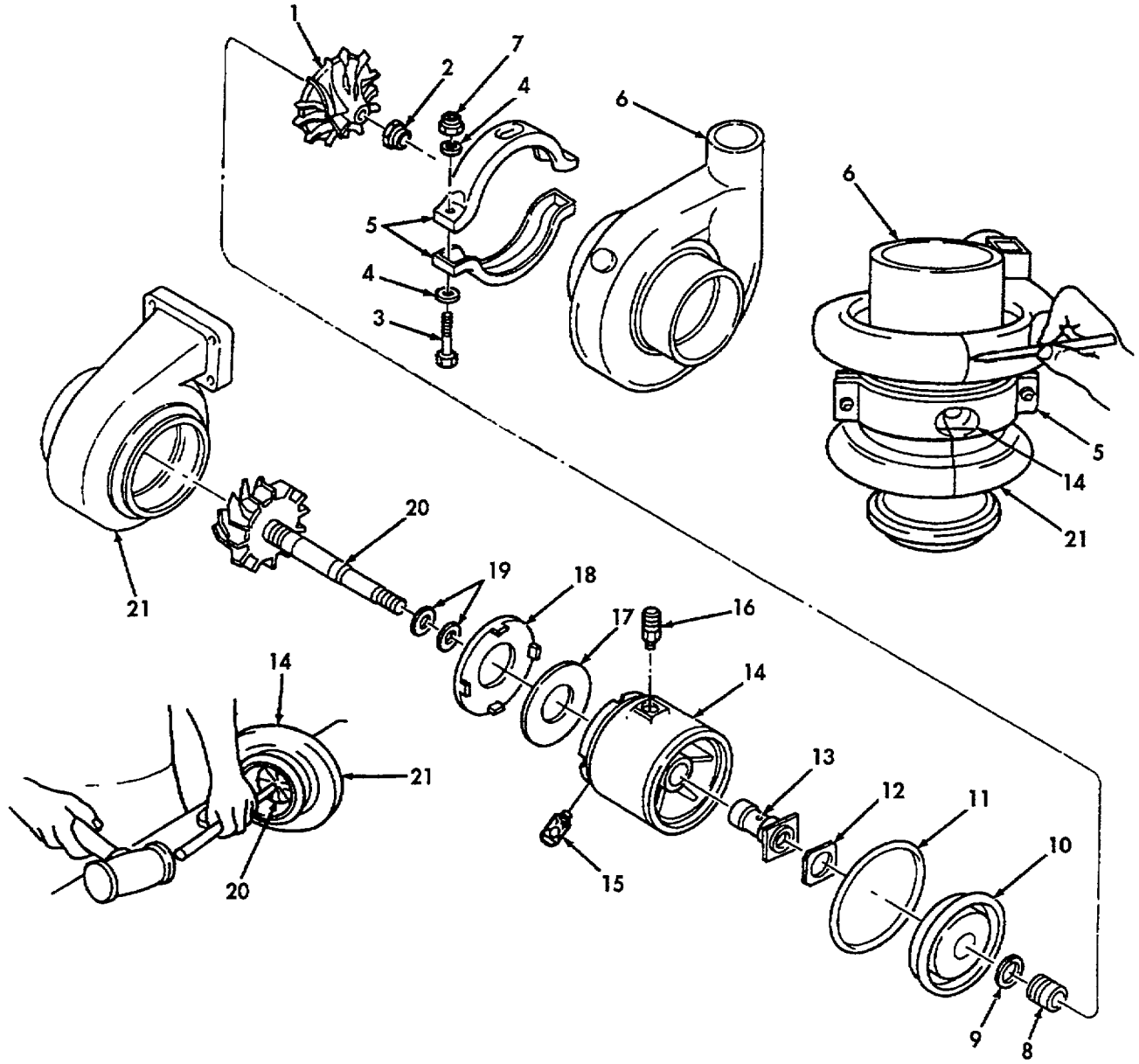
LOCATION/ITEM	ACTION	REMARKS

a. Disassembly

NOTE
The turbocharger used on the M915A1/Big Cam III has been changed for greater efficiency. The repair procedures for M915/Big Cam I and M915A1/Big Cam III turbocharger are the same. Only size and part numbers have changed.

1.	Adapters (15) and (16)	Remove from housing (14).	
2.	Housings (6), (14), and (21), and clamp (5)	Mark (5), (6), (14), and (21) to help in alignment during reassembly.	Make marks at convenient points with chalk or felt-tip marking pen (see illustration).
3.	Two locknuts (7), screws (3), and four washers (4)	Remove from V-band clamp (5).	Discard screws (3), washers (4), and locknuts (7).
4.	V-band clamp (5)	Remove from housing (14).	Retain damp (5) for reassembly.
5.	Impeller housing (6)	Lift off housing (14).	Use soft-nose hammer to loosen impeller housing (6) from bearing housing (14).
6.	Turbine housing (21) and bearing housing (14)	Position turbine housing (21) on workbench with mounting flange of exhaust manifold mating surface facing down.	Support bearing housing (14) with wood shim placed between workbench surface and bearing housing (14).

3-47. TURBOCHARGER REPAIR (Contd)



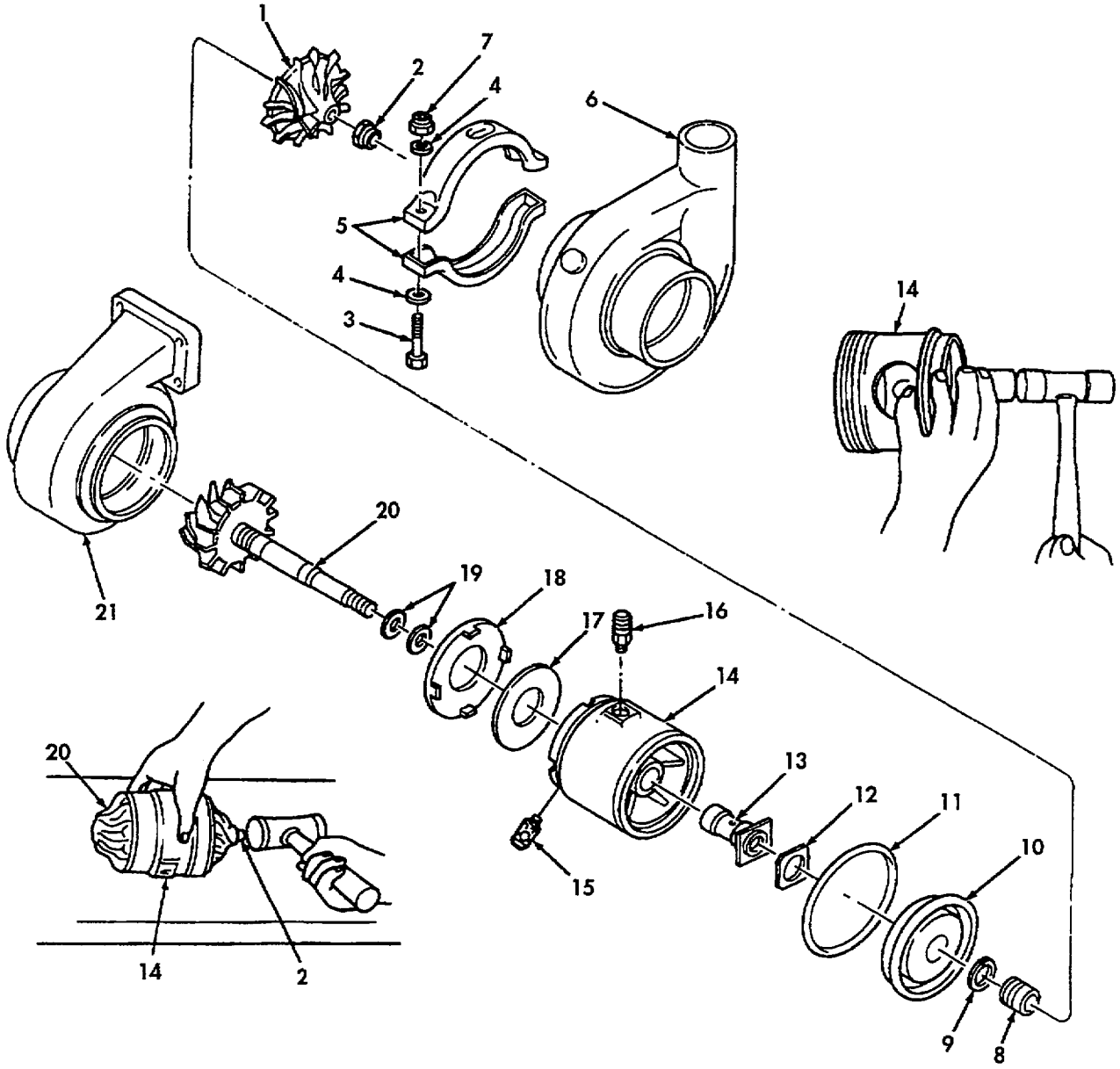
LEGEND:

1. TURBOCHARGER IMPELLER
2. IMPELLER LOCKNUT
3. SCREW (2)
4. WASHER (4)
5. V-BAND CLAMP
6. IMPELLER HOUSING
7. LOCKNUT (2)
8. SLEEVE
9. RING SEAL
10. DIFFUSER PLATE
11. O-RING
12. BEARING INSERT PAD
13. BEARING
14. BEARING HOUSING
15. ADAPTER
16. ADAPTER
17. INSULATED PACKING
18. HEAT SHIELD
19. SEAL (2)
20. WHEEL AND SHAFT
21. TURBINE HOUSING

3-47. TURBOCHARGER REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
a. Disassembly (Contd)		
7. Wheel and shaft (20)	Insert brass drift or wood block through exhaust outlet end of turbine housing (21) and hold against balance lug nut on wheel end of wheel and shaft (20). Tap on drift or wood block to separate bearing housing (14) from turbine housing (21). Hold turbine housing (21) to prevent it from moving when striking wheel and shaft (20). Wheel and shaft (20), bearing housing (14), and turbocharger impeller (1) will separate from turbine housing (21).	Heat may cause turbine housing (21) and bearing housing (14) to seize. If necessary, install in press. Use shop rags to cushion wheel and shaft (20), bearing housing (14), and turbocharger impeller (1) as they drop from turbine housing (21).
8. Turbocharger impeller (1) and impeller locknut (2)	Partially remove impeller locknut (2).	Hold balance lug nut at wheel and shaft (20) end to keep turbocharger impeller (1) from turning.
9. Wheel and shaft (20), bearing housing (14), and turbocharger impeller (1)	Hold bearing housing (14) and tap impeller locknut (2) with soft hammer or install in press.	This will separate wheel and shaft (20) from bearing housing (14). If necessary to use press, remove impeller locknut (2).
10. Turbocharger impeller (1) and impeller locknut (2)	Remove and slide wheel and shaft (20), insulated packing (17), and heat shield (18) from bearing housing (14).	Discard impeller locknut (2).
	CAUTION **Do not use sharp object to pry between diffuser plate and bearing housing. Failure to observe caution can result in damage to oil seal and turbocharger.**	
11. Bearing housing (14) and diffuser plate (10)	Remove diffuser plate (10) from bearing housing (14).	Use a 7/8-in. deepwell socket. Install at wheel and shaft (20) end and tap with soft hammer (see illustration).
12. Bearing housing (14), bearing (13), and bearing insert pad (12)	Remove bearing insert pad (12) and bearing (13).	Discard bearing insert pad (12).
13. Diffuser plate (10) and sleeve (8)	Remove sleeve (8).	Push out sleeve (8) with thumbs.
14. Diffuser plate (10) and O-ring (11)	Remove O-ring (11).	Discard O-ring (11).

3-47. TURBOCHARGER REPAIR (Contd)



LEGEND:

1. TURBOCHARGER IMPELLER
2. IMPELLER LOCKNUT
8. SLEEVE
10. DIFFUSER PLATE
11. O-RING
12. BEARING INSERT PAD
13. BEARING
14. BEARING HOUSING
17. INSULATED PACKING
18. HEAT SHIELD
20. WHEEL AND SHAFT
21. TURBINE HOUSING

3-47. TURBOCHARGER REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
a. Disassembly (Contd)		
15. Sleeve (8) and ring seal (9)	Remove ring seal (9) by spreading open with snapring pliers or small screwdriver.	Discard ring seal (9).
16. Wheel and shaft (20) and two turbocharger seals (19)	Remove two seals (19) with small screwdriver or snapring pliers.	Discard seals (19).
b. Cleaning and Inspection		
17. All parts	Place in a divided wire basket. Clean with hot water and soap, mineral spirits, or steam clean. Use soft brush to clean parts.	Carbon deposits will form on turbocharger parts. Divided wire basket will keep parts from being damaged during cleaning. Leave parts in mineral spirits cleaning solvent for 12 to 24 hours for maximum cleaning.

WARNING

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

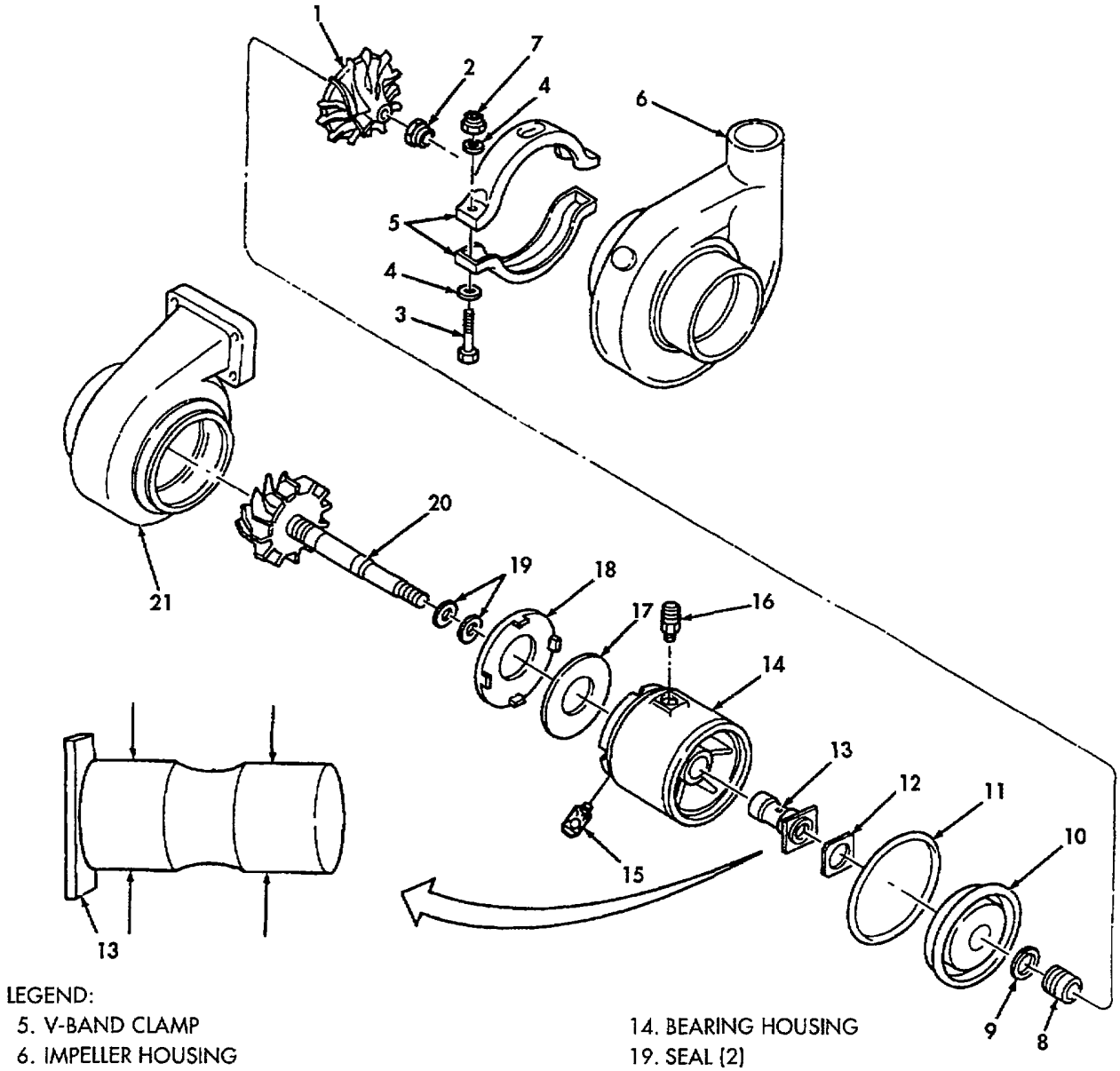
CAUTION

Never use a caustic solution solvent that may attack aluminum, Stellite, or nonresistant alloys.

18. Cleaned parts	Blow off excess water and dry with moisture-free compressed air.	Place parts in clean basket to avoid damage and dirt.
19. Bearing (13)	Inspect for: a. Minimum accepted length of 3.077 in. (78.156 mm). b. Outside diameter at two locations shown is a minimum of 1.272 in. (32.309 mm). c. Inside diameter of corresponding area is a maximum of 0.7525 in. (19.114 mm). d. Replace bearing if scratches, nicks, or dents are found in above areas.	Discard bearing (13) if specifications below are not met.
20. Impeller housing (6)	Inspect for chips and scratches.	Use crocus cloth to smooth out small chips and scratches on machined surfaces of impeller housing (6).
21. Turbine housing (21)	Inspect for: a. Wheel to housing contact.	Use crocus cloth to smooth out small chips and scratches on machined surfaces of turbine housing (21).

3-47. TURBOCHARGER REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
21. Turbine housing (21) (Contd)	b. Cracks in mounting flange and V-band clamp (5) contact area.	Discard if cracked. Use straight-edge to check flange for distortion.
22. Bearing housing (14)	Inspect for: a. Cracks.	Discard if cracked.
	b. Inside diameter of bore.	Discard if diameter is 1.276 in. (32.410 mm) or greater.
	c. Notches in dome area at wheel end of wheel and shaft (20).	Discard if notches are found.



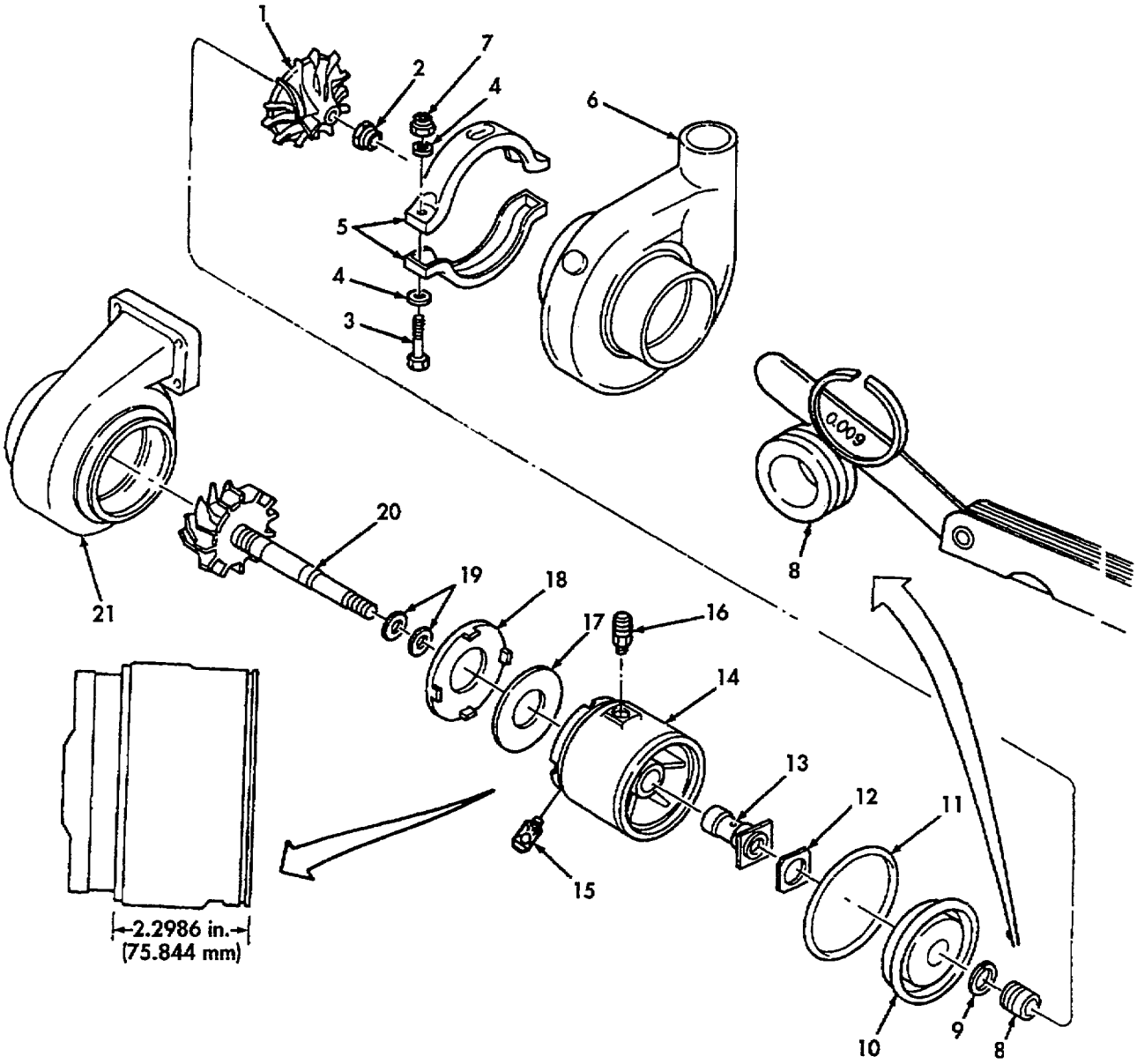
LEGEND:

5. V-BAND CLAMP
6. IMPELLER HOUSING
8. SLEEVE
9. RING SEAL
13. BEARING
14. BEARING HOUSING
19. SEAL (2)
20. WHEEL AND SHAFT
21. TURBINE HOUSING

3-47. TURBOCHARGER REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
b. Cleaning and Inspection (Contd)		
22. Bearing housing (21) (Contd)	d. Measure from compressor housing stop to turbine housing stop at four equal locations.	Minimum length is 2.986 in. (75.844 mm). Discard if distorted (see illustration).
23. Diffuser plate (10)	Inspect for: a. Damage at contact point of bearing insert pad (12).	
	b. Cracks, burrs, and distortion.	Discard if damaged or cracked.
24. Sleeve (8)	Inspect for: a. Uniform thickness of sleeve.	Measure for indication of wear.
	b. Maximum clearance between sleeve (8) groove and new ring seal (9) is 0.009 in. (0.229 mm).	Discard if maximum is exceeded (see illustration).
25. Heat shield (18)	Inspect for: a. Cracks.	
	b. Distortion.	Use a straightedge to check. Discard if cracked or distorted.
26. Turbocharger impeller (1)	Inspect for: a. Cracks.	Use a dye solution for crack detection. Refer to MI-I-6866 for inspection and penetrant methods. Discard if cracked or damaged.
	b. Damage to vane area.	Discard if damaged.
	c. Damage caused by housing contact.	Discard if damaged.

3-47. TURBOCHARGER REPAIR (Contd)



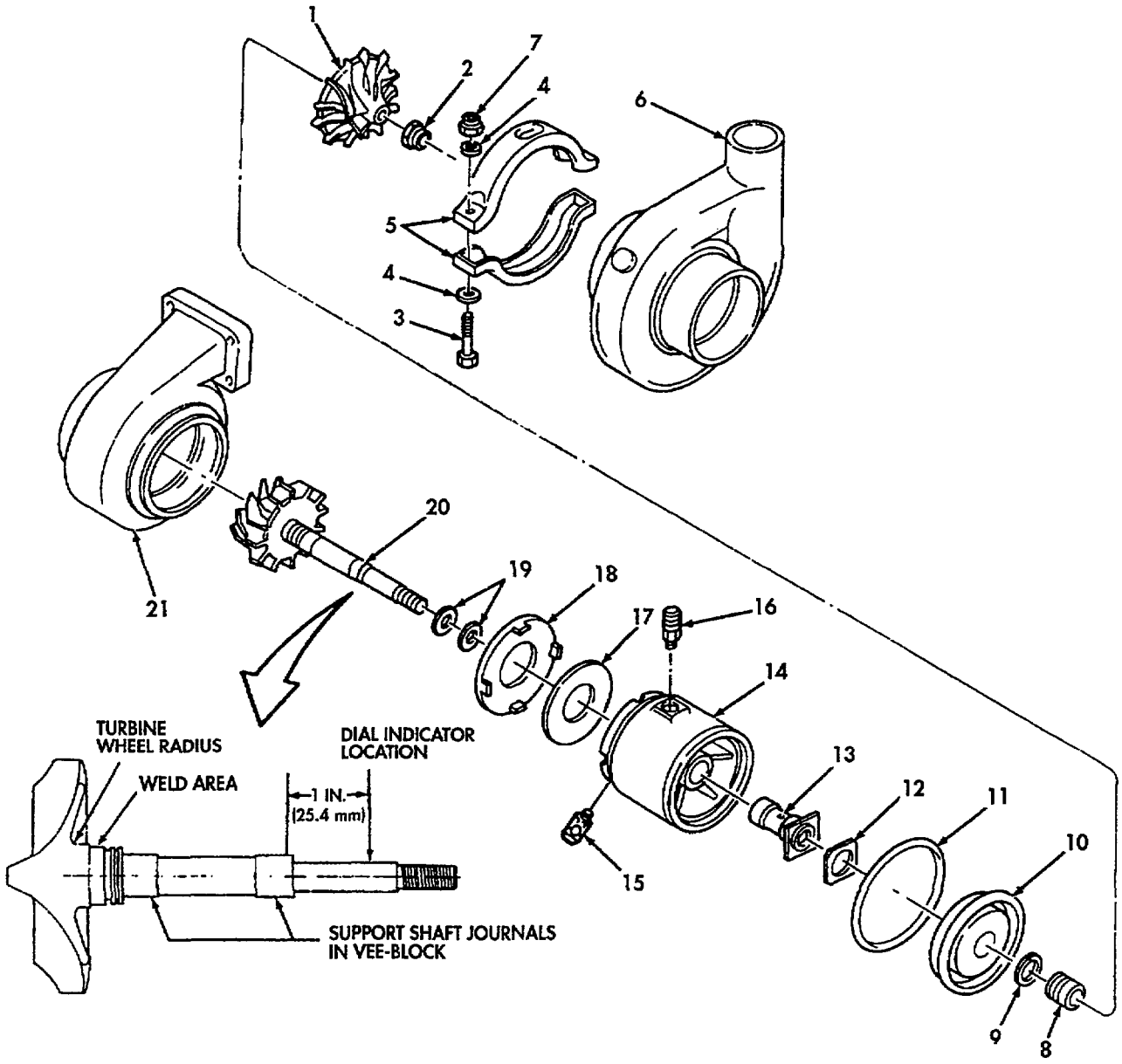
LEGEND:

1. TURBOCHARGER IMPELLER
8. SLEEVE
9. RING SEAL
10. DIFFUSER PLATE
12. BEARING INSERT PAD
14. BEARING HOUSING
18. HEAT SHIELD
20. WHEEL AND SHAFT
21. TURBINE HOUSING

3-47. TURBOCHARGER REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
b. Cleaning and Inspection (Contd)		
27. Wheel and shaft (20)	Inspect for:	
	a. Turbocharger seal groove damage.	Use crocus cloth to smooth out small grooves and marks.
	b. Thrust edge for scratches.	
	c. Cracks.	Use dye solution. Refer to MI-I-6866 for inspection and penetrant methods. Discard if cracked.
	d. Damaged threads.	Discard if damaged.
28. Wheel and shaft (20) weld area	Inspect for:	
	a. Chips or scratches near weld area.	Discard if chipped or scratched.
	b. One hole in welded area allowed. Maximum hole diameter of 0.080 in. (2.032 mm) is acceptable.	Visual inspection.
	c. Holes in weld area not to exceed 0.015 in. (0.381 mm).	Dye solution crack detection method. Very small holes that cannot be seen in visual inspection are allowed.
	d. Cracks in weld area not to exceed 0.3750 in. (9.525 mm) in length.	Use a suitable crack detector other than visual inspection.
	e. Not to exceed three cracks in weld area.	
	f. Minimum distance of 0.250 in. (6.35 mm) between cracks.	
	g. Cracks on circumference of welded area not to exceed 0.0625 in. (1.587 mm) in length.	
	h. Discard if fails to meet any of the above conditions.	
29. Wheel and shaft (20) circumference	Inspect for shaft runout. Not to exceed 0.0005 in. (0.0127 mm).	Remove aluminum deposit with crocus cloth before inspection. Rotate and support shaft in Vee-block and position dial indicator to determine runout. Discard if exceeded (see illustration).

3-47. TURBOCHARGER REPAIR (Contd)

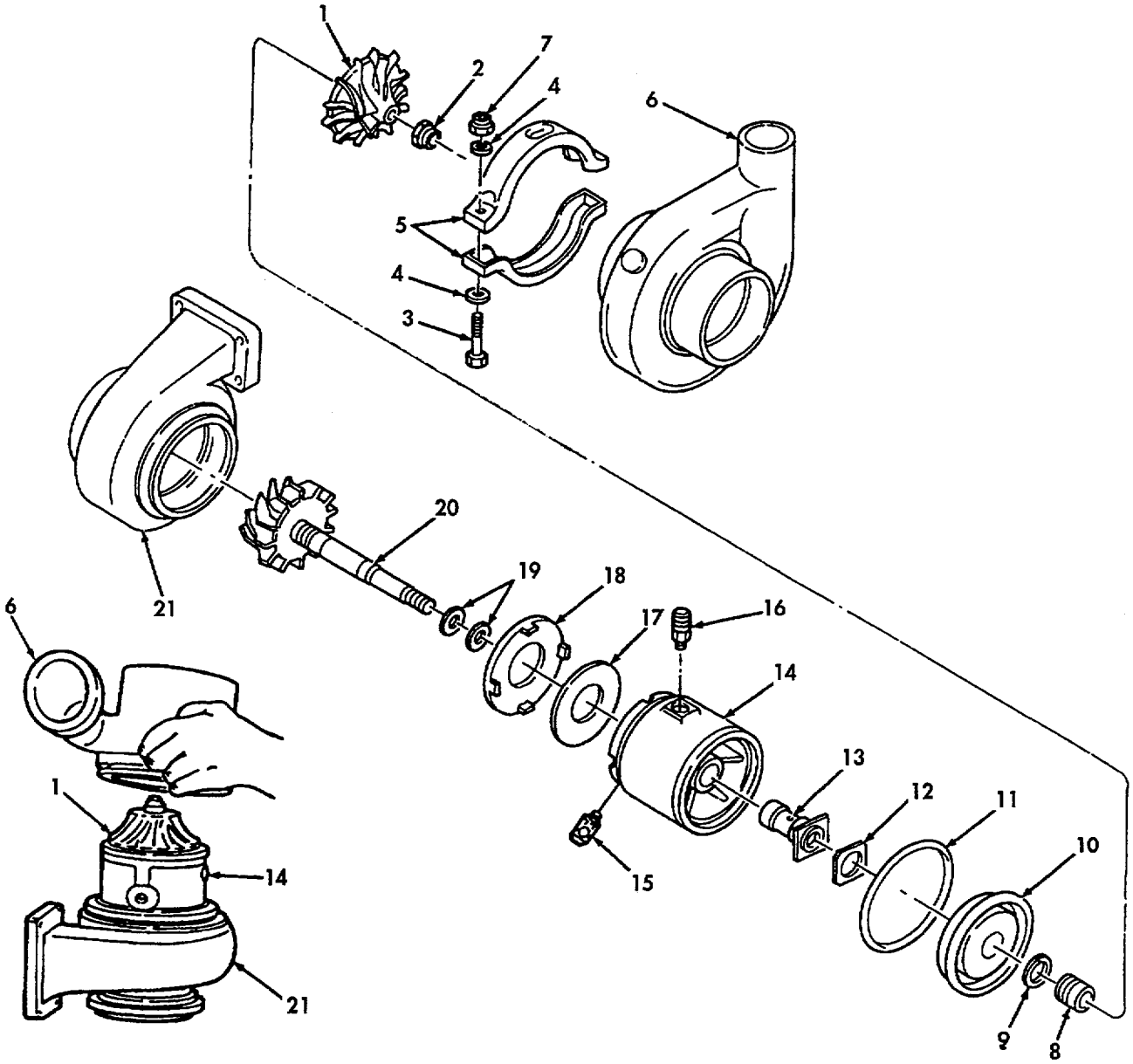


LEGEND:
20. WHEEL AND SHAFT

3-47. TURBOCHARGER REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Assembly		
	CAUTION **All parts and work area must be free of grease, oil, and dirt to keep abrasives out of turbocharger during assembly.**	
30. Bearing housing (14)	a. Install bearing (13).	Lightly coat bearing surface with OE/HDO 30 oil.
	b. Install new bearing insert pad (12) over bearing (13) from diffuser plate (10) end.	Fold down edges of bearing insert pad (12) and coat mating surfaces with OE/HDO 30 oil before installing.
31. Sleeve (8)	Install new ring seal (9).	Lightly coat ring seal (9) with OE/HDO 30 oil. Expand ring seal (9) to clear sleeve (8). Do not expand ring seal (9) more than necessary.
32. Diffuser plate (10)	Insert end of sleeve (8) with ring seal (9) installed into bore of diffuser plate (10). Spiral grooves must face toward bearing (13).	Lightly coat bore of diffuser plate (10) with OE/HDO 30 oil before insertion. Use finger pressure when compressing ring seal (9). Push sleeve (8) in bore until flush with turbocharger impeller (1) end.
33. New O-ring (11)	Install on diffuser plate (10).	Lightly coat O-ring (11) with OE/HDO 30 oil.
34. Diffuser plate (10)	Install on bearing housing (14). Press on diffuser plate (10) with palms of hands.	Align bearing (13) flange with diffuser plate (10). Make certain bearing insert pad (12) is centered on bearing (13).
	CAUTION **Do not rotate diffuser plate after assembly. Any rotation will displace and damage bearing insert pad.**	
	NOTE **New insulated packing must be compressed approximately 0.050 in. (1.27 mm). Lightly tap packing at four locations with soft-nose hammer but avoid insulation contact with bearing housing.**	
35. Bearing housing (14) at wheel and shaft (20) end	Install new insulation packing (17).	Be sure flat side of insulated packing (17) is up.
36. Heat shield (18)	Install on top of insulated packing (17).	Align locating lugs on heat shield (18) with depressions on bearing housing (14) at wheel and shaft (20) end.
37. Wheel and shaft (20)	Install two new turbocharger seals (19).	Expand seals (19) to install. Rotate ring gaps 180° apart. Do not expand turbocharger seals (19) more than necessary.

3-47. TURBOCHARGER REPAIR (Contd)



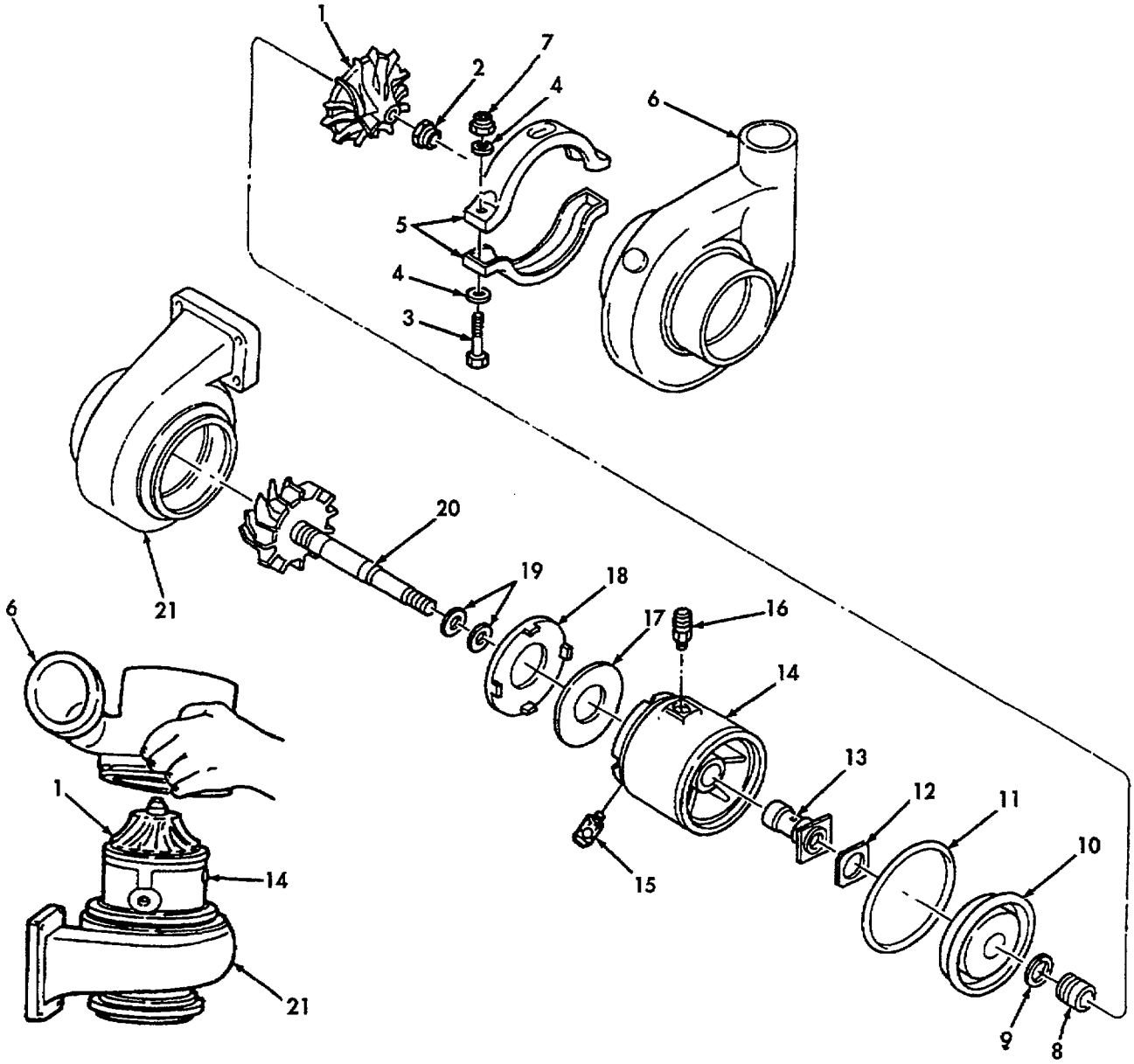
LEGEND:

1. TURBOCHARGER IMPELLER
8. SLEEVE
9. RING SEAL
10. DIFFUSER PLATE
11. O-RING
12. BEARING INSERT PAD
13. BEARING
14. BEARING HOUSING
17. INSULATED PACKING
18. HEAT SHIELD
19. SEAL (2)
20. WHEEL AND SHAFT
21. TURBINE HOUSING

3-47. TURBOCHARGER REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Assembly (Contd)		
	WARNING **The machined edges on the turbine wheel are very sharp. Wear protective gloves to avoid being cut.**	
38. Bearing housing (14)	a. Insert wheel and shaft (20) through bore in bearing (13). Hold sleeve (8) to keep it from slipping out.	Ensure sleeve (8) and heat shield (18) remain in position.
	b. Install turbocharger impeller (1) on wheel and shaft (20).	If necessary, mount bearing housing (14) in suitable press and press on center of turbocharger impeller (1).
39. Wheel and shaft (20) at turbocharger impeller (1) end	Install new impeller locknut (2) and tighten to 20-24 lb-ft (27-32 N•m).	Use a suitable socket and breaker bar at other end to prevent assembly from turning.
	NOTE **Place turbine housing assembly on exhaust outlet end to perform steps 40, 41, and 42.** **Before installing bearing housing, lubricate turbine housing bore with antiseize compound.**	
40. Turbine housing (21)	Insert bearing housing (14) assembly into turbine housing (21).	Align marks made before disassembly.
41. Turbine housing (21) and bearing housing (14)	Install impeller housing (6) on bearing housing (14).	Align marks made before disassembly.
	CAUTION **Do not exceed recommended torque. This causes V-band clamp distortion and loosening.** **Do not torque V-band clamp again during operation.**	
42. Turbocharger assembly	a. Install V-band clamp (5), two new screws (3), four new washers (4), and two new locknuts (7). Tighten to 58-68 lb-in. (6.6-7.7 N•m).	There must be a minimum of 0.035 in. (0.889 mm) clearance between turbine housing (21) and V-band clamp (5).
	b. Install and tighten adapter (16) to 20-25 lb-ft (27-34 N•m).	Coat with antiseize compound before installing.
	c. Install and tighten adapter (15) to 50 lb-ft (68 N•m).	Coat with antiseize compound before installing.
43. Turbocharger impeller (1)	Inspect for clearance between impeller (1) wheel vanes and side of impeller housing (6) bore. Minimum clearance is 0.006-0.025 in. (0.152-0.635 mm).	Push the shaft toward impeller housing (6) bore.

3-47. TURBOCHARGER REPAIR (Contd)



LEGEND:

1. TURBOCHARGER IMPELLER
2. IMPELLER LOCKNUT
3. SCREW (2)
4. WASHER (4)
5. V-BAND CLAMP
6. IMPELLER HOUSING
7. LOCKNUT (2)
8. SLEEVE
13. BEARING
14. BEARING HOUSING
15. ADAPTER
16. ADAPTER
18. HEAT SHIELD
20. WHEEL AND SHAFT
21. TURBINE HOUSING

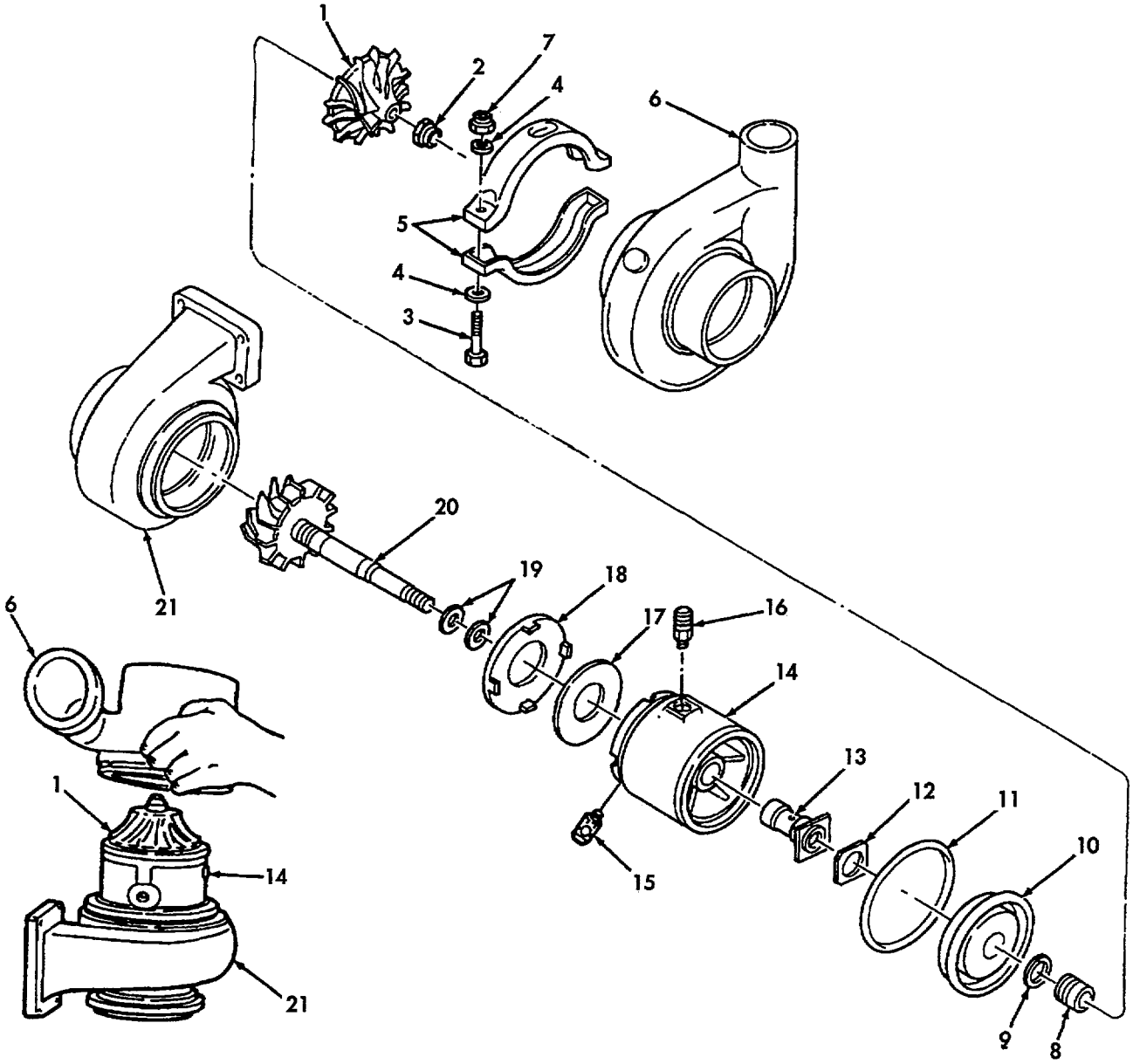
3-47. TURBOCHARGER REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Assembly (Contd)		
44. Turbine housing (21)	Turn assembly over, and inspect for clearance between wheel and shaft (20) and turbine housing (21) bore. Minimum clearance is 0.005-0.043 in. (0.127-1.092 mm).	Push wheel and shaft (20) toward side of turbine housing (21) bore.
45. Impeller housing (6)	Check rotor end clearance with dial indicator. Clearance must be within 0.006-0.018 in. (0.152-0.457 mm).	Position dial indicator across impeller housing (6) opening and wheel and shaft (20). Measure by moving wheel and shaft (20) in and out. Turn compressor to check for binding. Tape opening to prevent dirt and abrasives from entering turbocharger after repair.

CAUTION
Remove tape from openings before installing turbocharger on vehicle.

FOLLOW-ON TASK: Install turbocharger (para. 3-88).

3-47. TURBOCHARGER REPAIR (Contd)



LEGEND:
6. IMPELLER HOUSING
20. WHEEL AND SHAFT
21. TURBINE HOUSING

3-48. FRONT GEAR COVER REPAIR

THIS TASK COVERS:

a. Disassembly
b. Cleaning
c. Inspection
d. Assembly

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Puller/installer (15434) ST-1259
Oil seal expander (15434) 3375151
Seal mandrel (15434) ST-113

TEST EQUIPMENT
None

MATERIALS/PARTS
Sealant, thread (liquid) (Appendix C, Item 27)
Preformed packing (15434) 215705
Accessory gear cover bushing (15434) 132770
Oil seal (15434) 3004316
Crankshaft oil seal (15434) 3006736

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

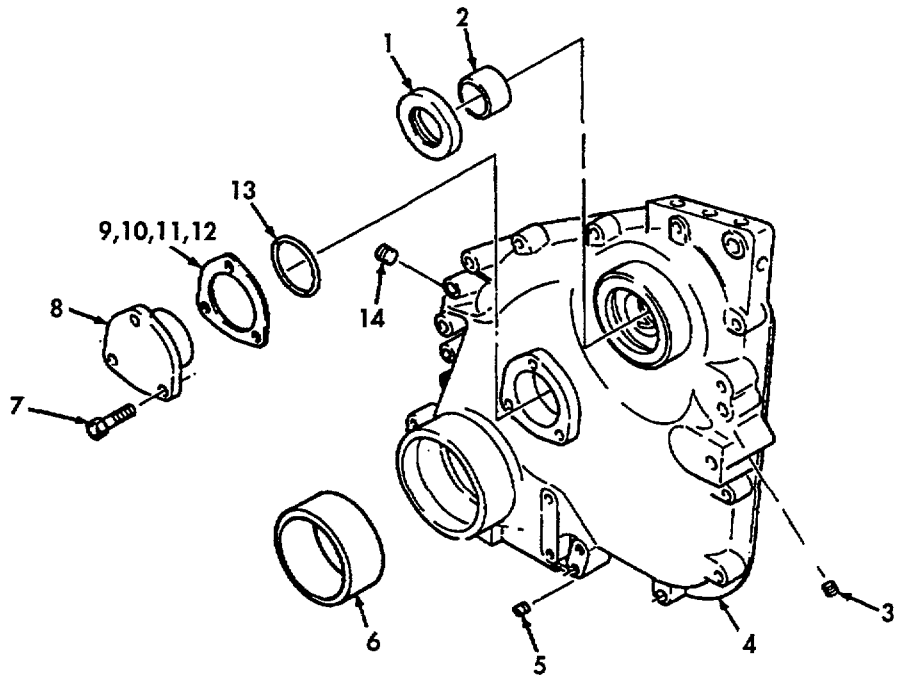
EQUIPMENT CONDITION
Front gear cover removed (para. 3-27).

SPECIAL ENVIRONMENTAL CONDITIONS
None

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS
a. Disassembly		
1. Oil seal (1)	Remove from gear cover (4).	Use puller/installer (ST-1259). Discard oil seal (1).
2. Crankshaft oil seal (6)	Remove from gear cover (4).	Use puller/installer (ST-1259). Discard crankshaft oil seal (6).
3. Three captive washer screws (7), camshaft support (8), shims (9), (10), (11), and (12), and preformed packing (13)	Remove from gear cover (4).	More than one shim may be used. Retain shims (9), (10), (11), and (12). Discard packing (13) if present.
4. Three pipe plugs (3), (5), and (14)	Remove from gear cover (4).	
b. Cleaning		
5. Gear cover (4) and camshaft support (8)	a. Clean in accordance with instructions in para. 3-6. b. Remove all gasket material.	
c. Inspection		
6. Gear cover (4)	Inspect for distortion and cracks. Remove imperfections on mating surface with crocus cloth.	Discard if cracked or distorted. Use surface plate to eliminate high and low areas on gear cover (4) mating surface.

3-48. FRONT GEAR COVER REPAIR (Contd)



LEGEND:

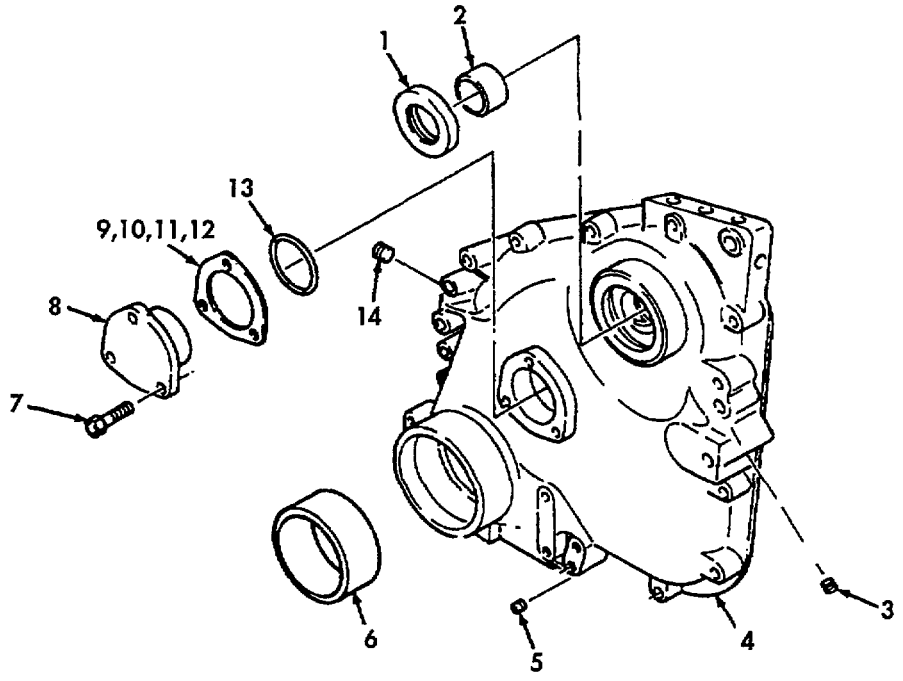
1. OIL SEAL
2. SLEEVE BEARING
3. PIPE PLUG
4. GEAR COVER
5. PIPE PLUG
6. CRANKSHAFT OIL SEAL
7. CAPTIVE WASHER SCREW (3)
8. CAMSHAFT SUPPORT
9. INSERT SHIM
10. SHIM 0.010
11. SHIM 0.050
12. SHIM 0.002
13. PREFORMED PACKING
14. PIPE PLUG

3-48. FRONT GEAR COVER REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection (Contd)		
7. Sleeve bearing (2)	a. Inspect for scoring and pitting. b. Using suitable micrometer, measure inside diameter.	Discard if scored or pitted. Remove and discard if inside diameter is not within limits shown below. Use suitable arbor press to remove sleeve. Minimum ..... 1.565 in. (39.751 mm) Maximum ..... 1.569 in. (39.853 mm) Limit ..... 1.571 in. (39.903 mm)
8. Bore for crankshaft oil seal (6)	Inspect for: a. Nicks, burrs, and gouges.	Small nicks, burrs, and gouges can be smoothed out with crocus cloth or fine-cut mill file.
	b. Cracks.	Discard if cracked.
	CAUTION **Discard camshaft support if removal of shims will not allow for correct camshaft end play.**	
9. Camshaft support (8)	Inspect for: a. Scoring, pitting, or cracks.	Discard if scored, pitted, or cracked.
	b. Using suitable micrometer, measure inside diameter.	Inside diameter is not to exceed 1.757 in. (44.628 mm). Discard if limits are exceeded.
10. Three pipe plugs (3), (5), and (14)	Inspect for damaged threads.	Discard if threads are damaged.
d. Assembly		
	CAUTION **All surfaces in contact with oil seals must be completely free of oil. Oil on a Teflon seal will destroy its sealing properties.**	
11. New sleeve bearing (2) and new oil seal (1)	Install on gear cover (4).	Use mandrel (ST-1173) for installation of sleeve bearing (2). Ensure oil holes are aligned. Oil seal must be flush with gear cover (4).
12. New crankshaft oil seal (6)	Install on gear cover (4).	Use puller/installer (ST-1259) and oil seal expander (3375151).
13. Three pipe plugs (3), (5), and (14)	Apply liquid thread sealant and install on gear cover (4).	
14. New preformed packing (13), shims (9), (10), (11), and (12), camshaft support (8), and three captive washer screws (7)	Install on gear cover (4).	The number of shims used will be determined by camshaft end play. Tighten captive washer screws (7) to 25 lb-ft (34 N•m).

FOLLOW-ON TASK: Install front gear cover (para. 3-75).

3-48. FRONT GEAR COVER REPAIR (Contd)



LEGEND:

1. OIL SEAL
2. SLEEVE BEARING
3. PIPE PLUG
4. GEAR COVER
5. PIPE PLUG
6. CRANKSHAFT OIL SEAL
7. CAPTIVE WASHER SCREW (3)
8. CAMSHAFT SUPPORT
9. INSERT SHIM
10. SHIM 0.010
11. SHIM 0.050
12. SHIM 0.002
13. PREFORMED PACKING
14. PIPE PLUG

3-49. ACCESSORY DRIVE REPAIR

THIS TASK COVERS:

a. Disassembly
b. Cleaning
c. Inspection
d. Assembly

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Puller (15434) 3376663

TEST EQUIPMENT
None

MATERIALS/PARTS
Solvent, SD-3 (Appendix C, Item 30)
Oil, lubricating, OE/HDO 10 (Appendix C, Item 20)
Self-locking screw (15434) 3000173

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
None

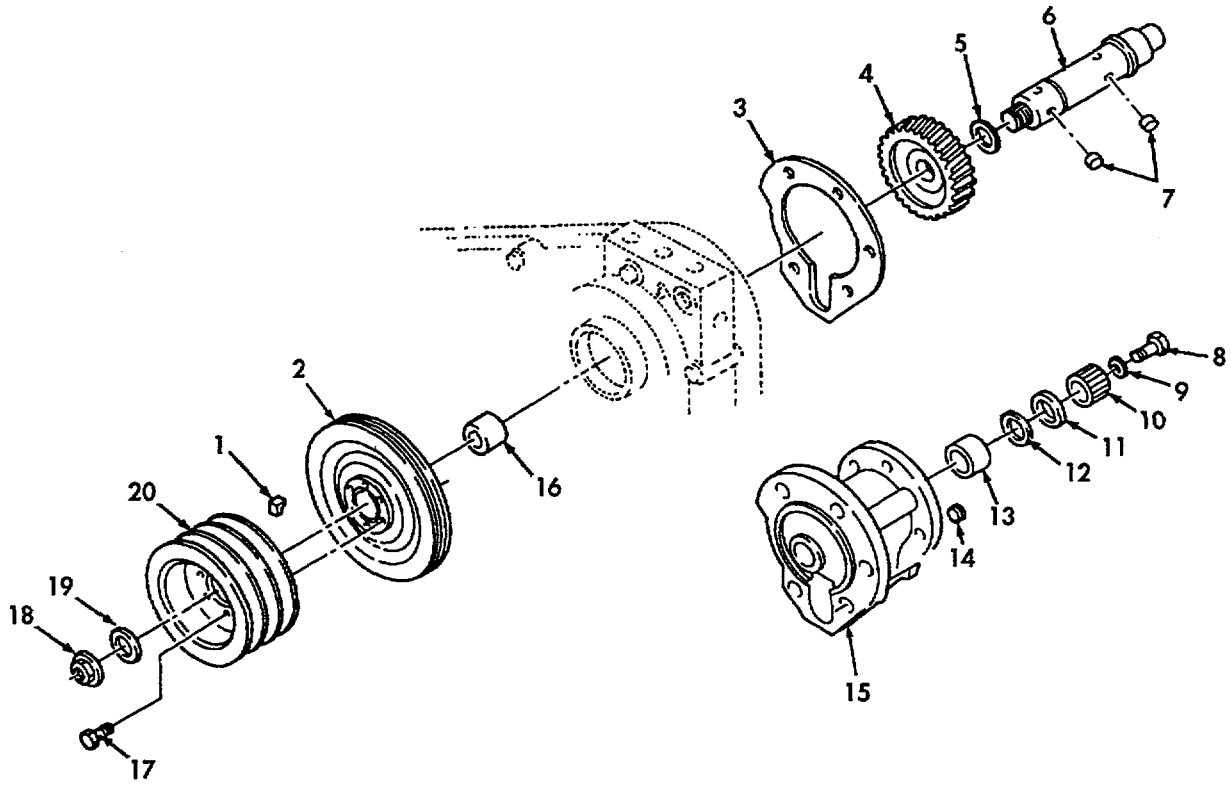
EQUIPMENT CONDITION
- Accessory drive pulley removed (para. 3-15).
- Accessory drive housing assembly removed (para. 3-18).

SPECIAL ENVIRONMENTAL CONDITIONS
None

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS
a. Disassembly		
1. Self-locking screw (8) and washer (9)	Remove from accessory drive shaft (6).	Install self-locking screw (8) to prevent damage to shaft (6) when using puller (3376663).
2. Spline coupling hub (10)	Remove from accessory drive shaft (6).	Use puller (3376663). Remove and discard self-locking screw (8) after removal of spline coupling hub (10).
3. Washer (11) and thrust bearing (12)	Remove from accessory drive shaft (6).	
4. Accessory drive shaft (6) and accessory drive gear (4)	Remove from accessory drive housing (15).	
5. Front dowel pin (7)	Remove from accessory drive shaft (6).	
6. Accessory drive gear (4) and thrust bearing (5)	Remove from accessory drive shaft (6).	Use suitable arbor press. Put housing side of gear (4) on a support.
7. Rear dowel pin (7)	Remove from accessory drive shaft (6).	
8. Plug (14)	Remove from accessory drive housing (15).	

3-49. ACCESSORY DRIVE REPAIR (Contd)



LEGEND:

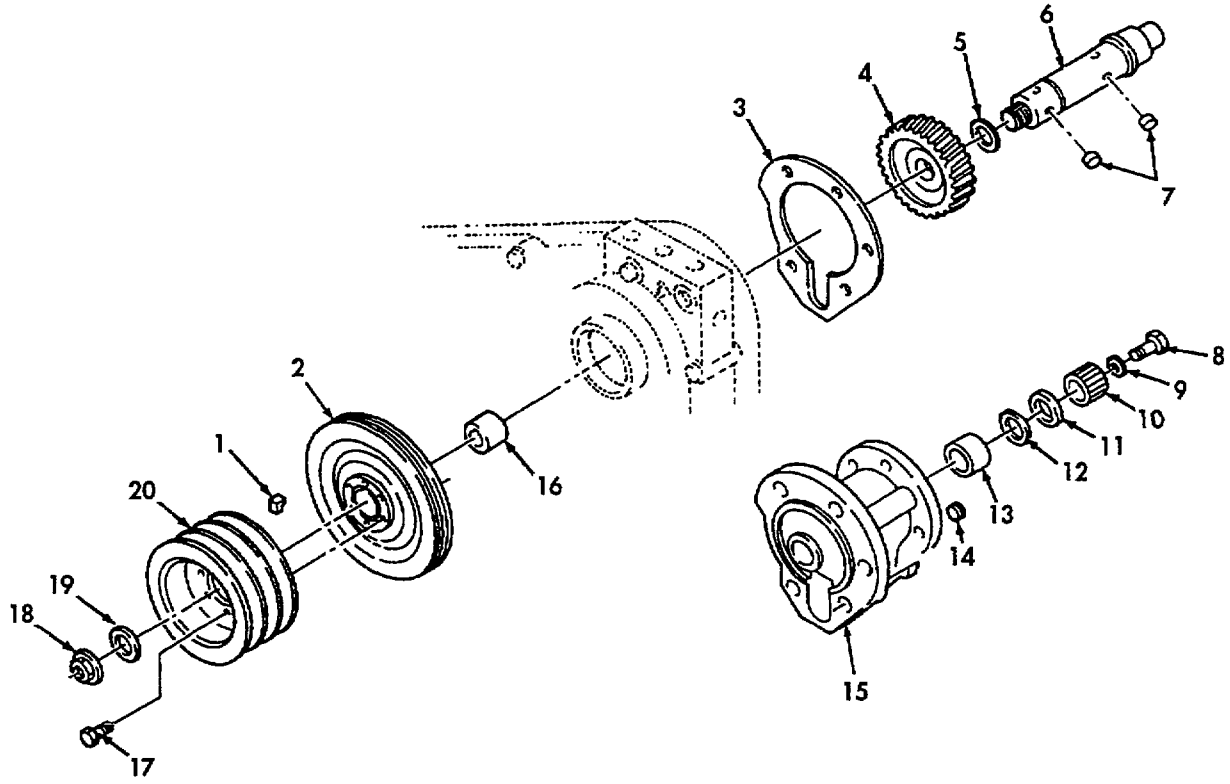
1. KEYWAY SEAL
2. ACCESSORY DRIVE PULLEY
3. HOUSING GASKET
4. ACCESSORY DRIVE GEAR
5. THRUST BEARING
6. ACCESSORY DRIVE SHAFT
7. DOWEL PIN (2)
8. SELF-LOCKING SCREW
9. WASHER
10. SPLINE COUPLING HUB
11. WASHER
12. THRUST BEARING
13. BUSHING
14. PLUG
15. ACCESSORY DRIVE HOUSING
16. WEAR SLEEVE
17. SCREW
18. FLANGE NUT
19. WASHER
20. ACCESSORY DRIVE PULLEY

3-49. ACCESSORY DRIVE REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
b. Cleaning		
	WARNING **Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and protective equipment such as goggles or shield, gloves, etc. Failure to comply may result in injury to personnel.**	
9. All parts	Clean in SD-3 cleaning solvent and dry with compressed air.	Remove housing gasket (3) material from accessory drive housing (15) assembly.
c. Inspection		
10. Accessory drive housing (15), bushing (13), and plug (14)	Inspect for the following:	Refer to Appendix F for wear limits and tolerances.
	a. Cracks around area of bushing (13).	Discard if cracked.
	b. Inside diameter of bushing (13).	Remove and discard if dimension exceeds 1.321 in. (33.553 mm). Use suitable arbor press.
	c. Out-of-round.	Remove and discard if out-of-round exceeds 0.002 in. (0.051 mm). Use suitable arbor press.
	d. Inspect mating threads on plug (14).	Chase threads or use thread insert.
11. Accessory drive shaft (6)	Inspect for the following:	
	a. Distortion or damage.	Discard if distorted or damaged.
	b. Outside diameter of bushing (13) location.	Discard if dimension is less than 1.310 in. (33.274 mm).
	c. Excessive wear at area of dowel pins (7).	Discard if excessive wear is detected.
12. Accessory drive gear (4) and spline coupling hub (10)	Inspect for cracked or chipped teeth and uneven wear.	Discard if cracked, chipped, or uneven wear is detected.
13. Thrust bearings (5) and (12) and washer (11)	Inspect for wear or galling.	Discard if worn or galled.
	NOTE **Accessory drive pulleys on M915/Big Cam I and M915A1/Big Cam III are similar. M915A1/Big Cam III configuration is shown.**	
14. Accessory drive pulleys (20) and (2)	Inspect for:	
	a. Cracks and chips in hub (10).	Discard if cracked or chipped.
	b. Wear in grooves.	Discard if excessively worn.
	c. Distorted thread holes.	Discard if excessively distorted.
	d. Excessive play or wobble in area of wear sleeve (16).	Discard if excessive play evident.

3-49. ACCESSORY DRIVE REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
15. Wear sleeve (16)	Inspect for wear in grooves.	Discard if worn. To remove wear sleeve (16), use a round-nose punch through one of the threaded puller holes and drive wear sleeve (16) off. Installation requires the use of a mandrel and arbor press. Press to 0.015 in. (0.381 mm) below face of accessory drive pulley (2) with chamfered end away from pulley (2).



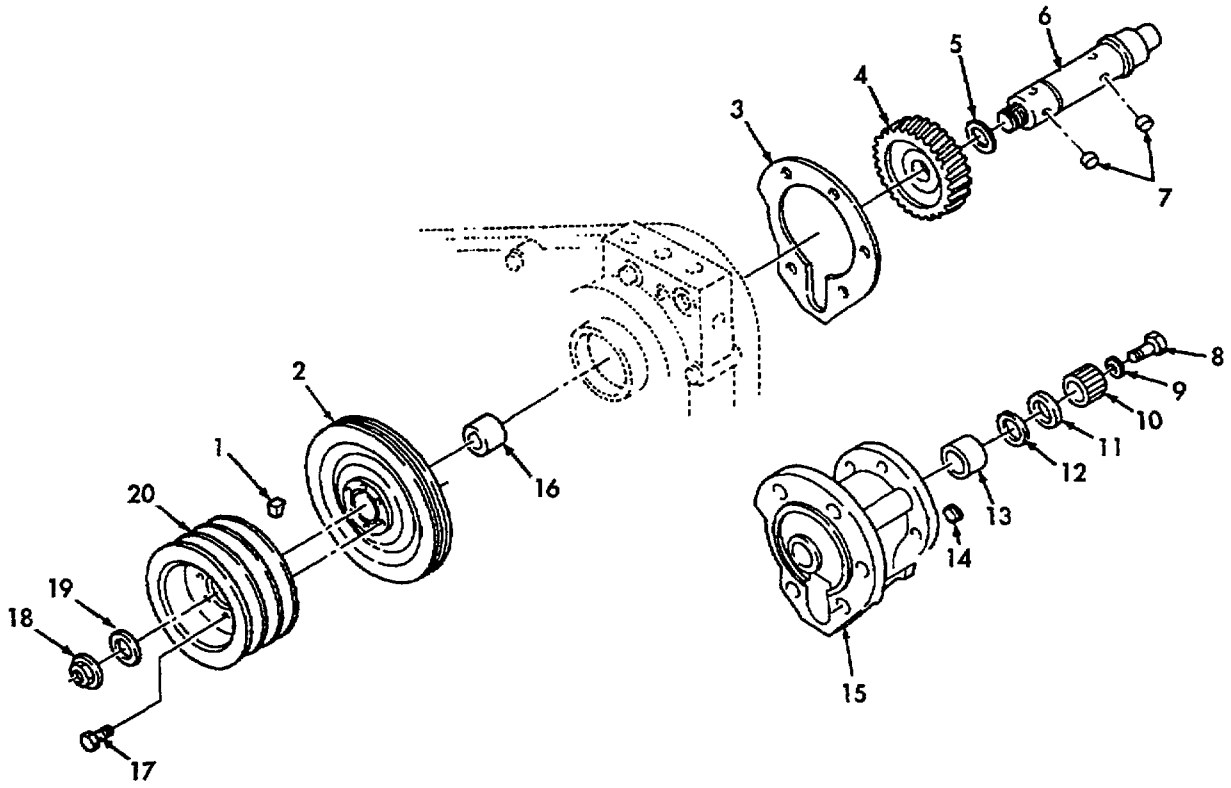
LEGEND:

1. KEYWAY SEAL
2. ACCESSORY DRIVE PULLEY
3. HOUSING GASKET
4. ACCESSORY DRIVE GEAR
5. THRUST BEARING
6. ACCESSORY DRIVE SHAFT
7. DOWEL PIN (2)
8. SELF-LOCKING SCREW
9. WASHER
10. SPLINE COUPLING HUB
11. WASHER
12. THRUST BEARING
13. BUSHING
14. PLUG
15. ACCESSORY DRIVE HOUSING
16. WEAR SLEEVE
17. SCREW (6)
18. FLANGE NUT
19. WASHER
20. ACCESSORY DRIVE PULLEY

3-49. ACCESSORY DRIVE REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection (Contd)		
16. Keyway seal (1), washer (19), flange nut (18), and six screws (17)	Inspect for distortion, burrs, or damaged threads.	Discard and replace if distorted, burred, or damaged.
d. Assembly		
17. Two dowel pins (7)	Install on accessory drive shaft (6).	
18. Accessory drive gear (4)	Install on accessory drive shaft (6).	Use suitable arbor press. Press until accessory drive gear (4) is against shoulder.
	NOTE **Perform step 19 if original bushing was removed.**	
19. New bushing (13)	a. Line up oil holes.	
	b. Install on bore of accessory drive housing (15).	Use suitable arbor press. Bore must be clean before bushing (13) is installed. Lubricate bore of bushing (13) after installation with OE/HDO 10 lubricating oil.
	CAUTION **Install grooved side of thrust bearings away from housing. The steel backing against cast iron housing will keep thrust bearings from turning. Incorrect installation will result in excessive wear and increased end play, which causes early failure of the accessory drive housing assembly.**	
	NOTE **Apply a thin coat of OE/HDO 10 lubricating oil to parts listed in steps 20 and 21 prior to installation on accessory drive housing.**	
20. Thrust bearing (5)	Install on accessory drive housing (15).	Ensure grooved side of thrust bearing (5) is away from housing (15).
21. Accessory drive gear (4) and accessory drive shaft (6)	Install on thrust bearing (5), bushing (13), and accessory drive housing (15) assembly.	

3-49. ACCESSORY DRIVE REPAIR (Contd)



LEGEND:

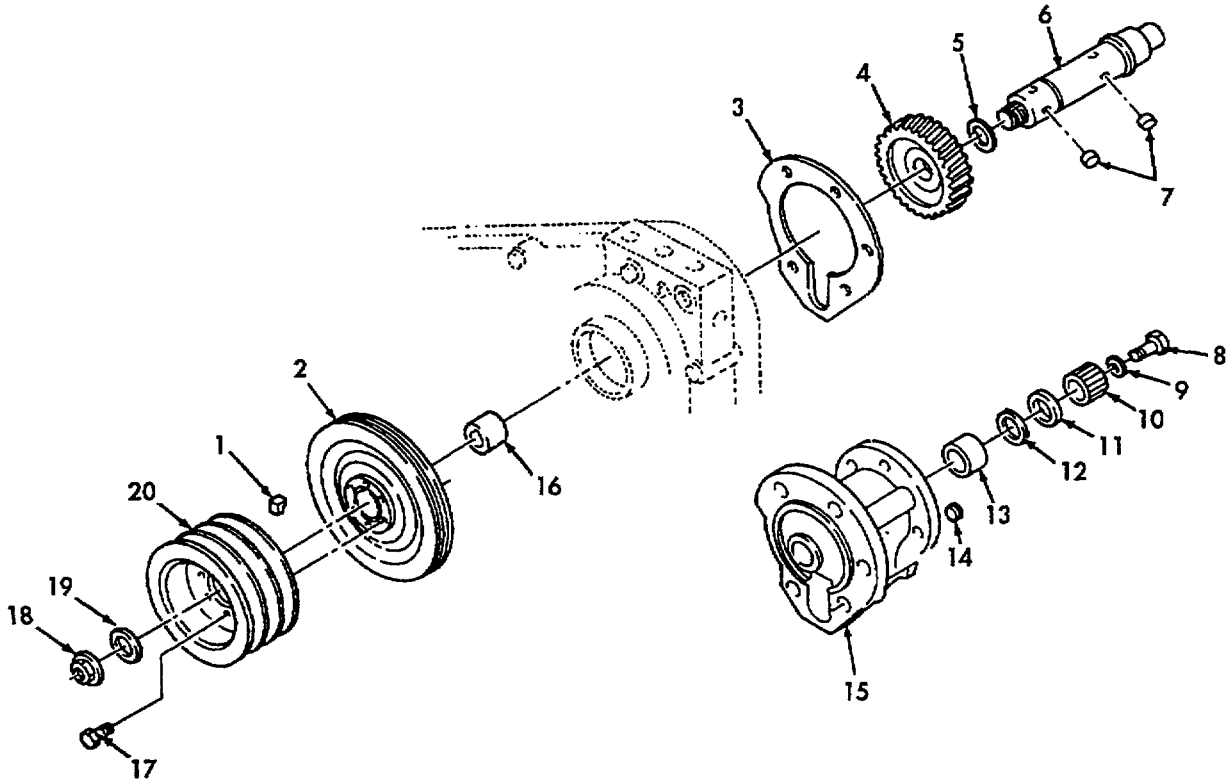
1. KEYWAY SEAL
2. ACCESSORY DRIVE PULLEY
3. HOUSING GASKET
4. ACCESSORY DRIVE GEAR
5. THRUST BEARING
6. ACCESSORY DRIVE SHAFT
7. DOWEL PIN (2)
8. SELF-LOCKING SCREW
9. WASHER
10. SPLINE COUPLING HUB
11. WASHER
12. THRUST BEARING
13. BUSHING
14. PLUG
15. ACCESSORY DRIVE HOUSING
16. WEAR SLEEVE
17. SCREW (6)
18. FLANGE NUT
19. WASHER
20. ACCESSORY DRIVE PULLEY

3-49. ACCESSORY DRIVE REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Assembly (Contd)		
22. Accessory drive housing (15)	Turn over so accessory drive gear (4) is face down.	Ensure thrust bearing (5) remains in position.
23. Thrust bearing (12)	Install on accessory drive shaft (6).	Grooved side of thrust bearing (5) is away from housing (15).
24. Washer (11)	Install onto accessory drive shaft (6).	
CAUTION **Exercise caution not to damage threads on accessory drive shaft when pressing on spine coupling hub.**		
25. Spline coupling hub (10)	Install on accessory drive shaft (6).	Use suitable arbor press.
26. Accessory drive gear (4) and accessory drive housing (15)	Using feeler gauge, check end clearance between gear (4) and housing (15).	Allowable end clearance is 0.002-0.012 in. (0.051-0.305 mm).
27. Washer (9) and new self-locking screw (8)	Install on accessory drive shaft (6).	Tighten to 30-35 lb-ft (41-48 N•m).
28. Plug (14)	Install on accessory drive housing (15).	

FOLLOW-ON TASKS:
- Install accessory drive housing assembly (para. 3-73).
- Install accessory drive pulley (para. 3-76).

3-49. ACCESSORY DRIVE REPAIR (Contd)



LEGEND:

1. KEYWAY SEAL
2. ACCESSORY DRIVE PULLEY
3. HOUSING GASKET
4. ACCESSORY DRIVE GEAR
5. THRUST BEARING
6. ACCESSORY DRIVE SHAFT
7. DOWEL PIN (2)
8. SELF-LOCKING SCREW
9. WASHER
10. SPLINE COUPLING HUB
11. WASHER
12. THRUST BEARING
13. BUSHING
14. PLUG
15. ACCESSORY DRIVE HOUSING
16. WEAR SLEEVE
17. SCREW (6)
18. FLANGE NUT
19. WASHER
20. ACCESSORY DRIVE PULLEY

3-50. ENGINE RETARDER REPAIR

THIS TASK COVERS:

a. Disassembly
b. Testing
c. Assembly

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Solenoid valve wrench (75078) 011494
Spring tester (15434) 3375182
Jake brake socket B1465A

TEST EQUIPMENT
None

MATERIALS/PARTS
Oil, lubricating, OE/HDO 30 (Appendix C, Item 21)
Upper seal ring (15434) 001081
Center seal ring (15434) 001082
Lower seal ring (15434) 001083

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
TM 9-2320-273-20
TM 9-2320-283-20

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
Engine retarder removed (para. 3-21).

SPECIAL ENVIRONMENTAL CONDITIONS
None

GENERAL SAFETY INSTRUCTIONS
Eye protection is required when removing control valve outer and inner springs, slave piston retainer, and spring.

LOCATION/ITEM	ACTION	REMARKS

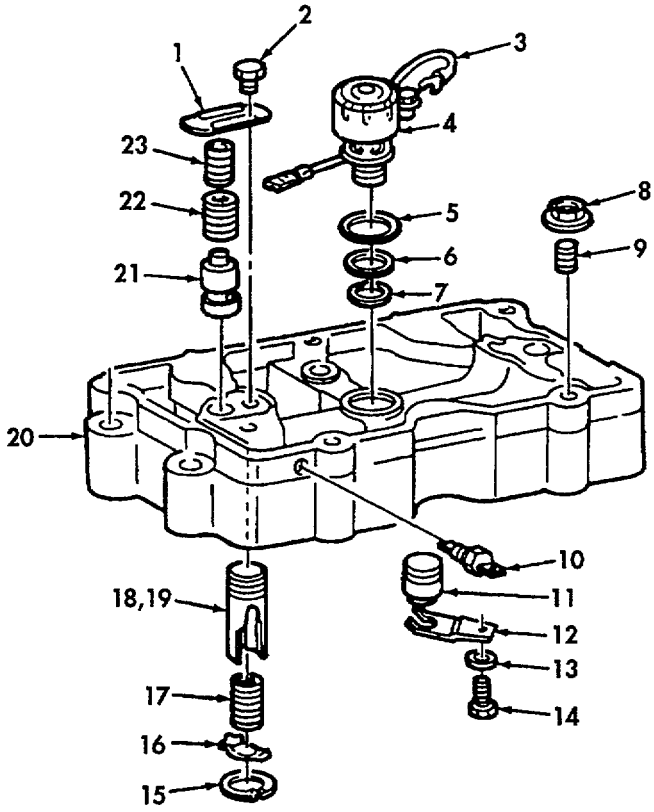
NOTE
All three engine retarders are disassembled and repaired the same way. This procedure covers repair of one engine retarder.

a. Disassembly

WARNING
Control valve cover is under pressure by control valve outer spring. Move cover down when removing screw. Wear suitable eye protection. Failure to comply may result in injury to personnel.

1.	Two screws (2) and control valve covers (1)	Remove from brake housing (20).	
2.	Two control valve outer springs (22)	Remove from control valve (21).	
3.	Two control valve inner springs (23)	Remove from control valve (21).	Retain control valve inner springs (23) for testing.
4.	Two control valves (21)	Remove from brake housing (20).	Use needle-nose pliers to remove. Pull control valves (21) straight up and out of their bores.
5.	Harness (3)	Remove from solenoid valve assembly (4).	
6.	Solenoid valve assembly (4)	Remove from brake housing (20).	Use solenoid valve wrench (011494).

3-50. ENGINE RETARDER REPAIR (Contd)



LEGEND:

1. CONTROL VALVE COVER (2)
2. SCREW (2)
3. HARNESS
4. SOLENOID VALVE ASSEMBLY
5 UPPER SEAL RING
6. CENTER SEAL RING
7. LOWER SEAL RING
8. LOCKNUT (2)
9. SETSCREW (2)
10. TERMINAL
11. MASTER PISTON (2)
12. MASTER PISTON SPRING (2)
13. WASHER (2)
14. SCREW (2)
15. RETAINING RING (2)
16. SLAVE PISTON RETAINER (2)
17. SLAVE PISTON SPRING (2)
18. SLAVE PISTON (2)
19. SLAVE PISTON (2) (FOR MILLED CYLINDER HEADS)
20. BRAKE HOUSING
21. CONTROL VALVE (2)
22. CONTROL VALVE OUTER SPRING (2)
23. CONTROL VALVE INNER SPRING (2)

3-50. ENGINE RETARDER REPAIR (Contd)

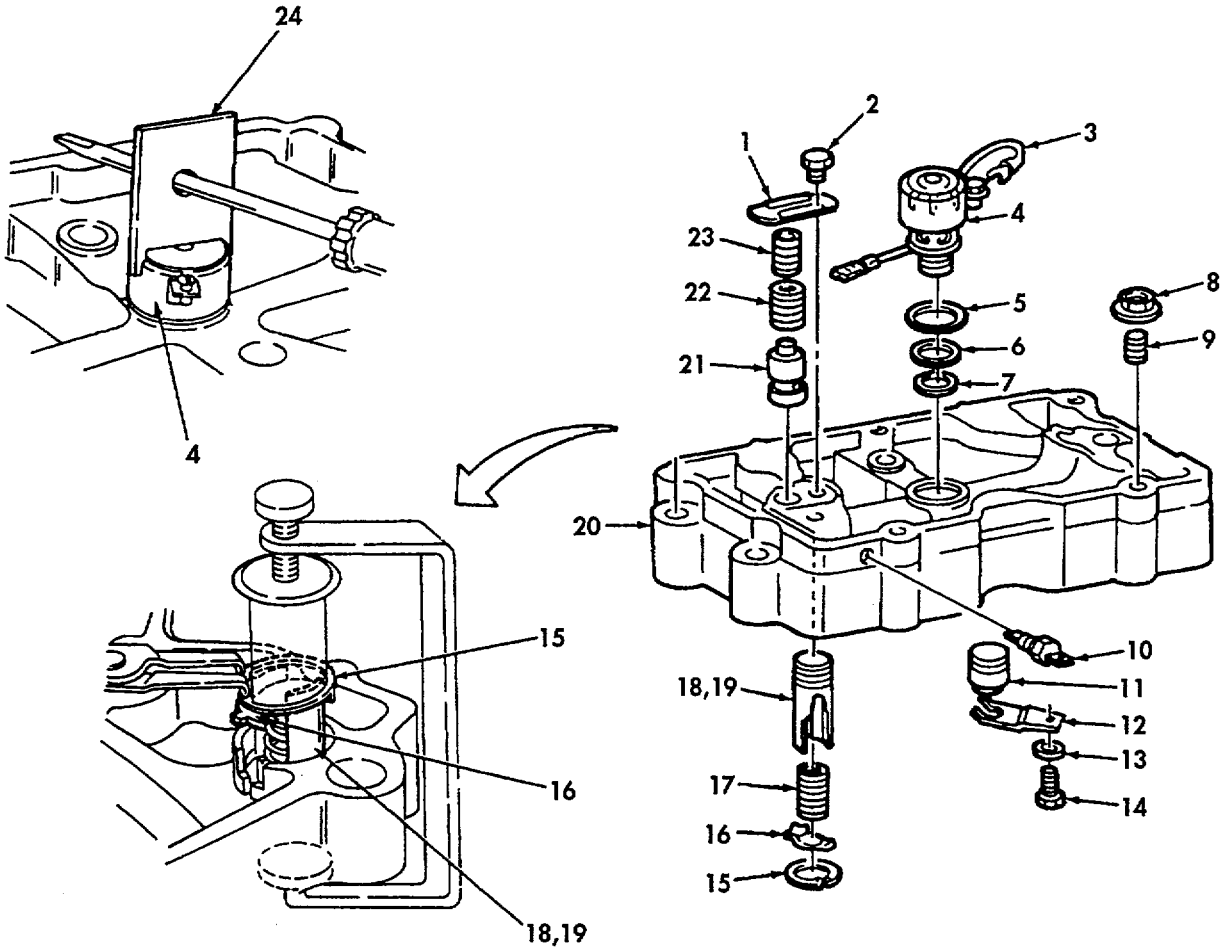
LOCATION/ITEM	ACTION	REMARKS
a. Disassembly (Contd)		
7. Center seal ring (6) and upper seal ring (5)	Remove from brake housing assembly (20).	Discard seal rings (5) and (6).
8. Lower seal ring (7)	Remove from solenoid valve assembly bore on brake housing assembly (20).	Discard lower seal ring (7).
9. Two screws (14), washers (13), and master piston springs (12)	Remove from bottom of brake housing assembly (20).	
10. Two master pistons (11)	Remove from brake housing assembly (20).	Slide out of bores.
11. Two locknuts (8)	Loosen.	Locknuts (8) must be loosened to remove setscrews (9).
12. Two setscrews (9)	Remove from brake housing assembly (20).	Keep locknuts (8) on setscrews (9).

WARNING

Retaining ring, spring, and slave piston retainer are under heavy compression. Wear eye protection. Use deepwell socket and C-clamp (or vise) to remove. Failure to comply may result in injury to personal.

13. Two retaining rings (15)	Remove from brake housing assembly (20).	Slowly remove tension on retaining rings (15) by using deep-well socket and C-clamp (or vise).

3-50. ENGINE RETARDER REPAIR (Contd)



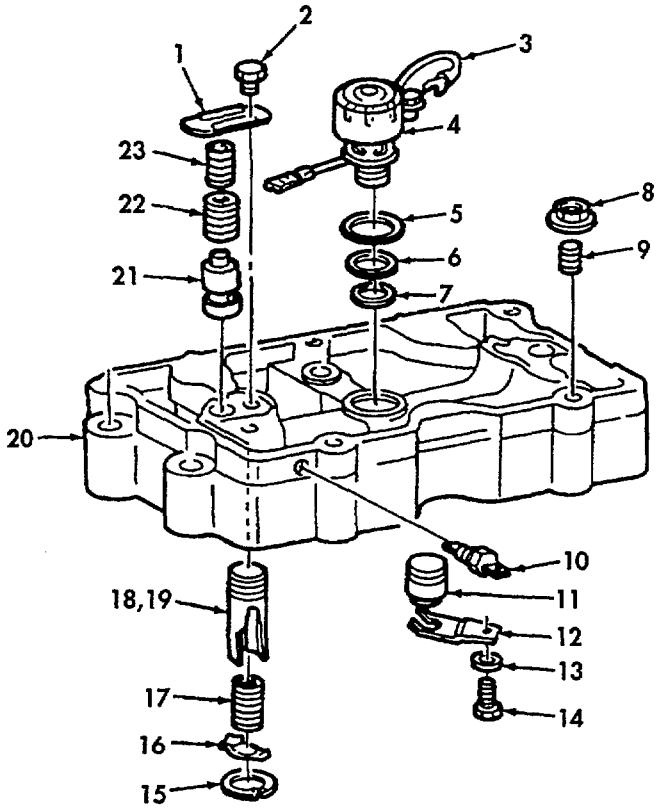
LEGEND:

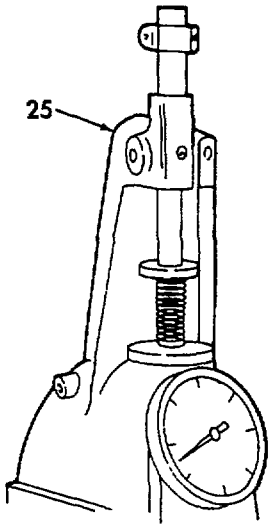
5. UPPER SEAL RING
6. CENTER SEAL RING
7. LOWER SEAL RING
8. LOCKNUT (2)
9. SETSCREW (2)
11. MASTER PISTON (2)
12. MASTER PISTON SPRING (2)
13. WASHER (2)
14. SCREW (2)
15. RETAINING RING (2)
16. SLAVE PISTON RETAINER (2)
17. SLAVE PISTON SPRING (2)
20. BRAKE HOUSING ASSEMBLY
21. CONTROL VALVE (2)
22. CONTROL VALVE OUTER SPRING (2)
23. CONTROL VALVE INNER SPRING (2)
24. SOLENOID VALVE WRENCH

3-50. ENGINE RETARDER REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
a. Disassembly (Contd)		
14. Two slave piston retainers (16)	Remove from brake housing (20).	
15. Two slave piston springs (17)	Remove from two pistons (18) or (19).	Retain slave piston springs (17) for testing.
16. Two slave pistons (18) or (19)	Remove from brake housing (20).	Piston (19) is for milled cylinder heads.
17. Harness (3)	Disconnect from terminal (10).	
18. Terminal (10)	Remove from brake housing (20).	Inspect. Discard if insulation is cracked.
b.		
19. Two control valve inner springs (23)	Mount in spring tester (3375182) (25) and check.	Load at 1.625 in. (4.128 cm) 62.5-69.5 lb (28.4-31.6 kg). Load at 1.478 in. 71.5-80.5 lb (32.5-36.6 kg). Free length 2.58 in. (6.553 cm). Number of coils is approximately 13. If operation does not meet specifications, replace control valve inner spring (23).
20. Two slave piston springs (17)	Mount in spring tester (3375782) (25) and check.	Load at 0.5 in. (12.7 mm): 4.7-5.3 lb (2.1-2.4 kg). Load at 0.812 in. (2.062 cm) 0.7-1.3 lb. Free length 0.9 in. (2.286 cm). Number of coils is approximately 15. If operation does not meet specifications, replace slave piston spring (17).
21. Two control valves (21)	Must move freely in their bores.	Replace if worn or damaged.
22. Two slave pistons (18) or (19)	Must move freely in their bores.	Replace if worn or damaged.
23. Two slave piston retainers (16)	Check for wear and damage.	Replace if worn or damaged.
24. Two control valve outer springs (22)	Check for wear and damage.	Replace if worn or damaged.

3-50. ENGINE RETARDER REPAIR (Contd)





LEGEND:

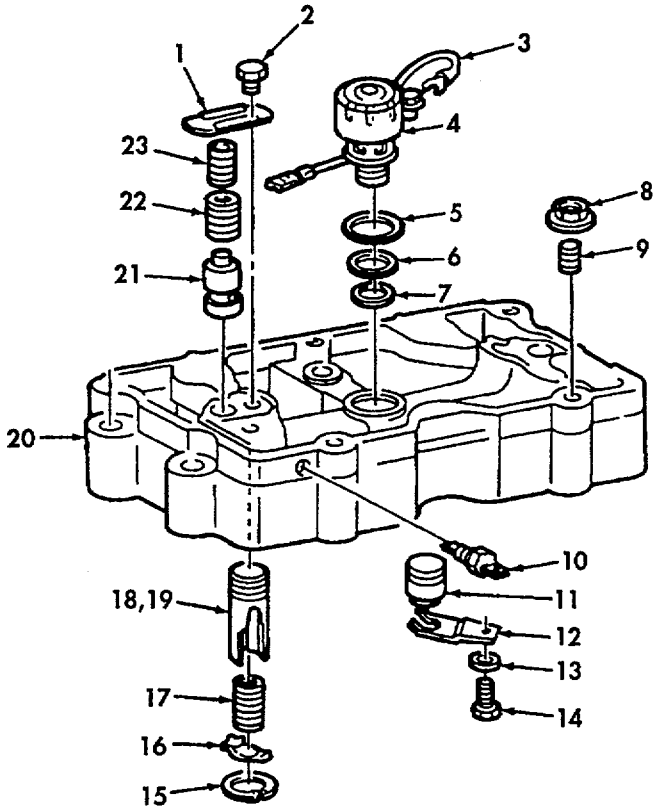
3. HARNESS
10. TERMINAL
16. SLAVE PISTON RETAINER (2)
17. SLAVE PISTON SPRING (2)
18. SLAVE PISTON (2)
19. SLAVE PISTON (2) (FOR MILLED CYLINDER HEADS)
20. BRAKE HOUSING
21. CONTROL VALVE (2)
22. CONTROL VALVE OUTER SPRING (2)
23. CONTROL VALVE INNER SPRING (2)
25. SPRING TESTER

3-50. ENGINE RETARDER REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Assembly		
25. Two slave pistons (18) or (19)	Install on brake housing (20).	Slave piston (19) is for milled cylinder heads.
26. Two springs (17), retainers (16), and retaining rings (15)	Depress slave piston springs (17) and slave piston retainers (16) with deepwell socket and C-clamp. Install retaining rings (15).	Make certain slave piston retainers (16) are positioned in grooves of slave pistons (18) or (19).
27. Two setscrews (9) and locknuts (8)	Install on brake housing (20).	Setscrews (9) and locknuts (8) are tightened during clearance adjustment during engine assembly.
28. Two master pistons (11)	Install on brake housing (20).	
29. Two master piston springs (12), washers (13), and screws (14)	Install on master pistons (11) and brake housing (20).	Assemble spring (12) to piston (11) with concave part of spring (12) toward piston (11) and centered on turned boss on piston (11) top.
30. Three new rings (5), (6), and (7)	Lubricate with OE/HDO 30 lubricating oil.	
31. New lower seal ring (7)	Install on bottom of bore on brake housing (20).	
32. New upper seal ring (5) and center seal ring (6)	Install on solenoid valve assembly (4).	
33. Solenoid valve assembly (4)	Install on brake housing (20) and tighten with solenoid valve wrench.	Use solenoid valve wrench (011494). Do not disturb position of upper seal ring (5) or center seal ring (6).
34. Harness (3)	Connect to solenoid valve assembly (4).	
35. Terminal (10)	Install on brake housing (20).	
36. Harness (3)	Connect to terminal (10).	
37. Two control valves (21)	Install on brake housing (20).	
38. Two control valve inner springs (23)	Install on control valves (21).	
39. Two control valve outer springs (22)	Install on control valves (21).	
40. Two control valve covers (1) and screws (2)	Position control valve covers (1) over valve bore and secure with screws (2).	

FOLLOW-ON TASK: Install engine retarder and adjust slave piston (para. 3-86).

3-50. ENGINE RETARDER REPAIR (Contd)



LEGEND:

1. CONTROL VALVE COVER (2)
2. SCREW (2)
3. HARNESS
4. SOLENOID VALVE ASSEMBLY
5. UPPER SEAL RING
6. CENTER SEAL RING
7. LOWER SEAL RING
8. LOCKNUT (2)
9. SETSCREW (2)
10. TERMINAL
11. MASTER PISTON (2)
12. MASTER PISTON SPRING (2)
13. WASHER (2)
14. SCREW (2)
15. RETAINING RING (2)
16. SLAVE PISTON RETAINER (2)
17. SLAVE PISTON SPRING (2)
18. SLAVE PISTON (2)
19. SLAVE PISTON (2) (FOR MILLED CYLINDER HEADS)
20. BRAKE HOUSING
21. CONTROL VALVE (2)
22. CONTROL VALVE OUTER SPRING (2)
23. CONTROL VALVE INNER SPRING (2)

3-51. AIR COMPRESSOR REPAIR

THIS TASK COVERS:

a. Disassembly
b. Cleaning
c. Inspection and Repair
d. Assembly

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Air compressor mounting plate (15434) ST-749
Ball joint vise (15434) ST-302
Coupling half puller (15434) ST-1249 or (15434) 3376663
Air compressor bushing mandrel (15434) ST-1105 or ST-1143

TEST EQUIPMENT
None

MATERIALS/PARTS (P/N)
Solvent, SD-3 (Appendix C, Item 30)
Cloth, crocus (Appendix C, Item 4)
Compound, Prussian blue (Appendix C, Item 9)
Oil, lubricating: OE/HDO 30 (Appendix C, Item 21)
Compound, antiseize (Appendix C, Item 7)
Compound, lapping, 280-grit (Appendix C, Item 8)
Preformed packing (15434) 128086
Preformed packing (15434) 127936
Preformed packing (15434) 128085
Preformed packing (15434) 3043995
Gasket (15434) 3047159
Gasket (15434) 154018
Gasket (15434) 176027
Piston ring kit (15434) AR-73350
Four lockwashers (96906) MS35338-47
Four lockwashers (96906) MS35338-45

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCE (TM)
TM 9-2320-273-20
TM 9-2320-283-20

TROUBLESHOOTING REFERENCES
None

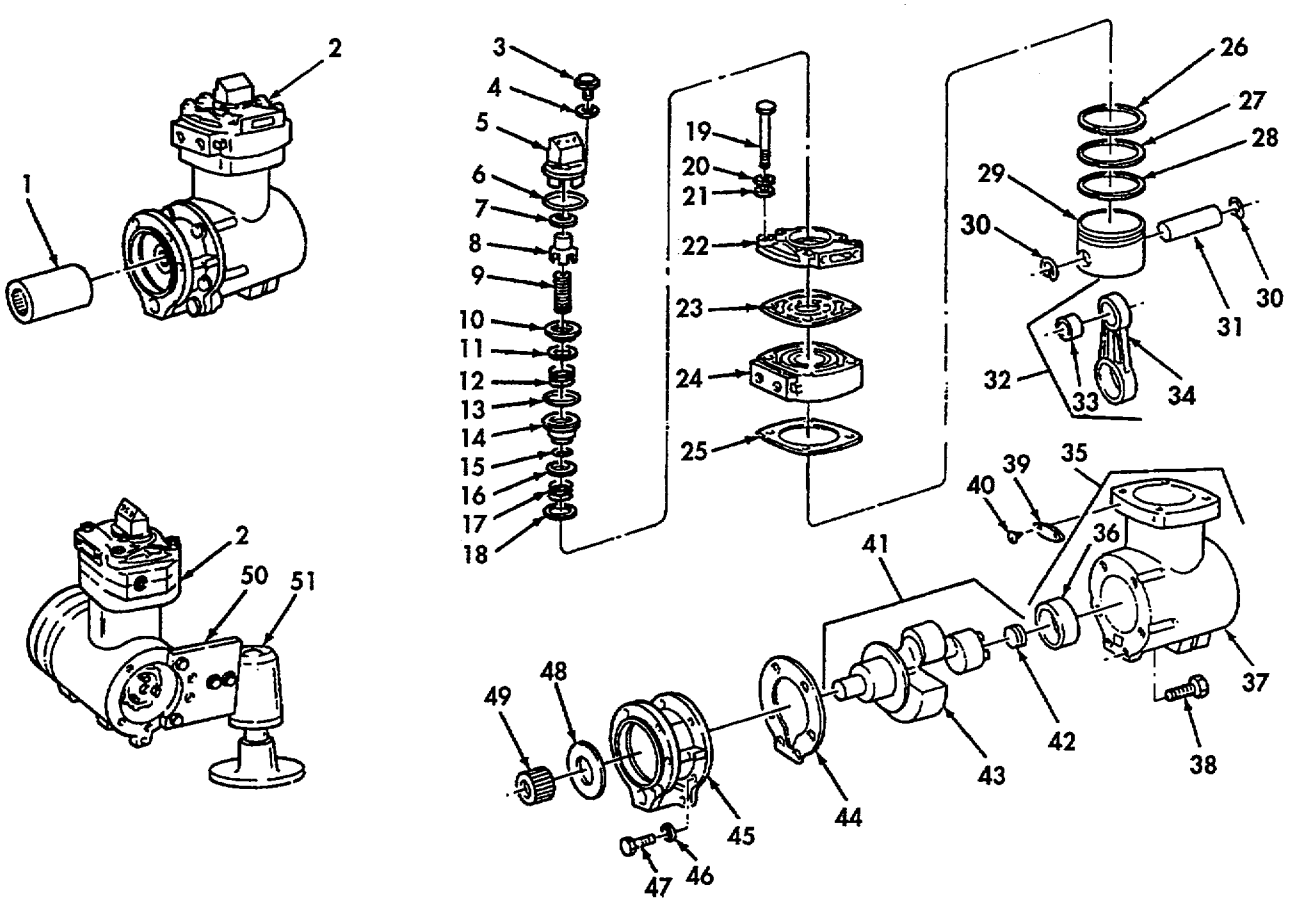
EQUIPMENT CONDITION
Air compressor removed (para. 3-17).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area dean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
- Always wear eye protection when using corn-pressed air.
- Approved solvents may be flammable and will not be used near open flame. Use in well-ventilated area.

LOCATION/ITEM	ACTION	REMARKS
a. Disassembly		
1. Air compressor (2)	Install on air compressor mounting plate (50) and ball joint vise (51).	Use air compressor mounting plate (ST-749) (50) and ball joint vise (ST-302) (51).
2. Two captive washer screws (3)	Unscrew and remove two washers (4) and valve body (5) from cover (22).	
3. Preformed packings (6) and (7) and cap (8)	Remove from valve body (5).	Discard preformed packings (6) and (7).
4. Spring (9)	Remove from cover (22).	Spring (9) may have come out with valve body (5).
5. Seat (10), valve (11), and spring (12)	Remove from inside of cylinder head (24).	

3-51. AIR COMPRESSOR REPAIR (Contd)



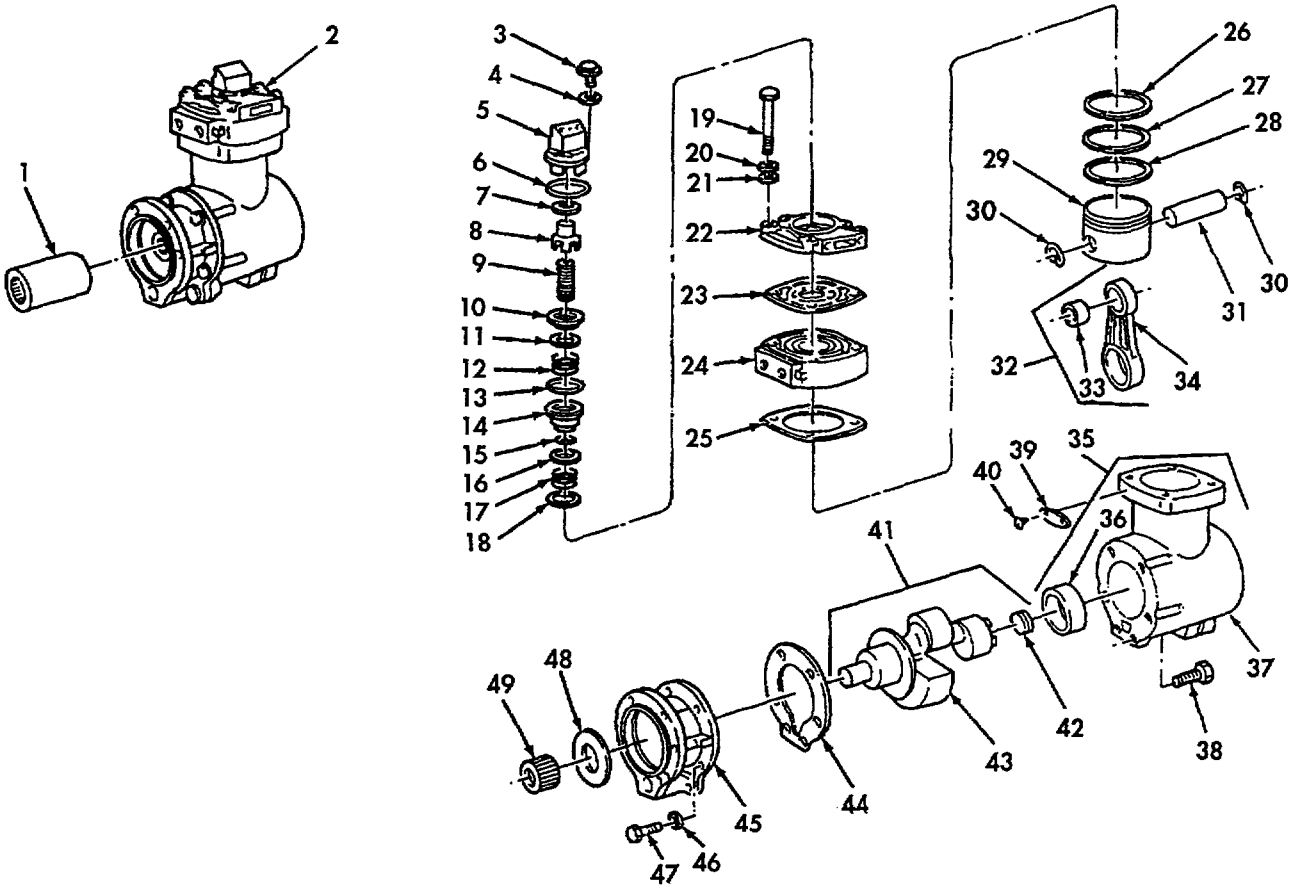
LEGEND:

1. DRIVE COUPLING
2. AIR COMPRESSOR
3. CAPTIVE WASHER SCREW (2)
4. WASHER (2)
5. VALVE BODY
6. PREFORMED PACKING
7. PREFORMED PACKING
8. CAP
9. SPRING
10. SEAT
11. VALVE
12. SPRING
13. PREFORMED PACKING
14. SEAT
15. PREFORMED PACKING
16. DISC
17. SPRING
18. SHIM
19. SCREW (4)
20. LOCKWASHER (4)
21. WASHER (4)
22. COVER
23. GASKET
24. CYLINDER HEAD
25. GASKET
26. RING
27. RING
28. RING
29. PISTON
30. RETAINING RING (2)
31. PIN
32. CONNECTING ROD ASSEMBLY
33. BUSHING
34. CONNECTING ROD
35. CRANKCASE ASSEMBLY
36. BEARING
37. HOUSING
38. CAPTIVE WASHER SCREW (2)
39. PLATE
40. SCREW (2)
41. CRANKSHAFT ASSEMBLY
42. PIPE PLUG
43. CRANKSHAFT
44. GASKET
45. SUPPORT
46. LOCKWASHER (4)
47. SCREW (4)
48. THRUST BEARING
49. HALF COUPLING
50. AIR COMPRESSOR MOUNTING PLATE
51. BALL JOINT VISE

3-51. AIR COMPRESSOR REPAIR (Contd)

LOCATION/ITEM		ACTION	REMARKS
a. Disassembly (Contd)			
6.	Cylinder head (24)	Unscrew and remove four screws (19), lockwashers (20), washers (21), cover (22), and gasket (23).	Discard gasket (23).
7.	Cylinder head (24) and gasket (25)	Remove from housing (37).	Discard gasket (25).
8.	Seat (14)	Press out from bottom side of cylinder head (24).	Preformed packings (13) and (15) are attached to seat (14) when removed.

3-51. AIR COMPRESSOR REPAIR (Contd)



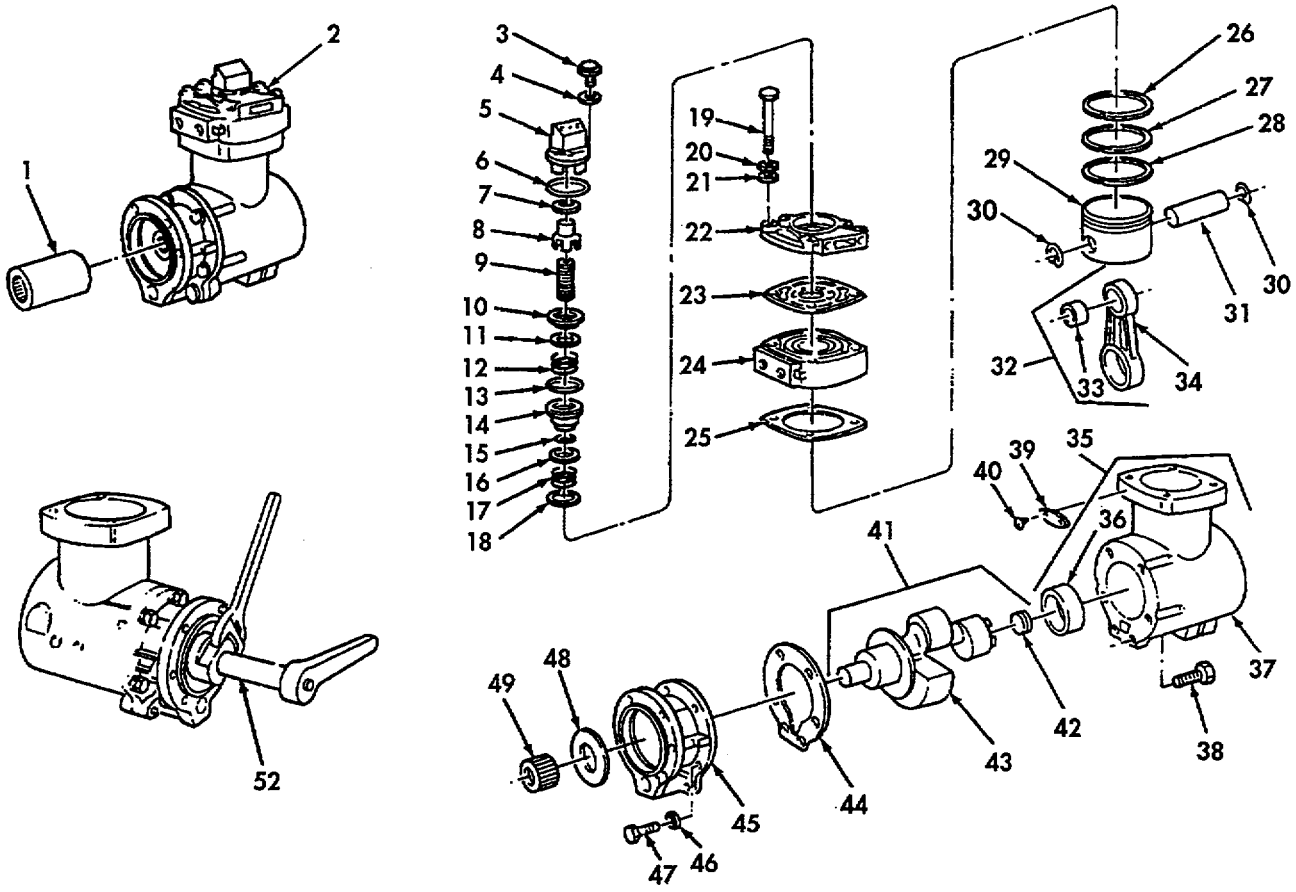
LEGEND:

2. AIR COMPRESSOR
10. SEAT
11. VALVE
12. SPRING
13. PREFORMED PACKING
14. SEAT
15. PREFORMED PACKING
19. SCREW (4)
20. LOCKWASHER (4)
21. WASHER (4)
22. COVER
23. GASKET
24. CYLINDER HEAD
25. GASKET
37. HOUSING

3-51. AIR COMPRESSOR REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
a. Disassembly (Contd)		
9. Preformed packings (13) and (15)	Remove from seat (14).	Discard preformed packings (13) and (15).
10. Disc (16), spring (17), and shim (18)	Remove from cylinder head (24).	Disc (16) might be attached to seat (14).
11. Drive coupling (1)	Remove from half coupling (49), if not already removed.	
	NOTE **Assistant may be required for the following step.**	
12. Half coupling (49)	Remove from crankshaft (43).	Use coupling half puller (ST-1249) or (3376663) (52). Use locating key in puller (52) to index puller teeth behind coupling (49) teeth.
13. Thrust bearing (48)	Remove from crankshaft (43).	
14. Two captive washer screws (38) and four screws (47)	Unscrew and remove four lockwashers (46), support (45), and gasket (44) from housing (37).	Discard lockwashers (46) and gasket (44).
15. Crankshaft (43)	a. Rotate until piston (29) is about 90° before or after top dead center. b. Move crankshaft (43) around while pulling it out of connecting rod (34).	Piston (29) and crankshaft (43) must be in this position before crankshaft (43) can be removed.

3-51. AIR COMPRESSOR REPAIR (Contd)



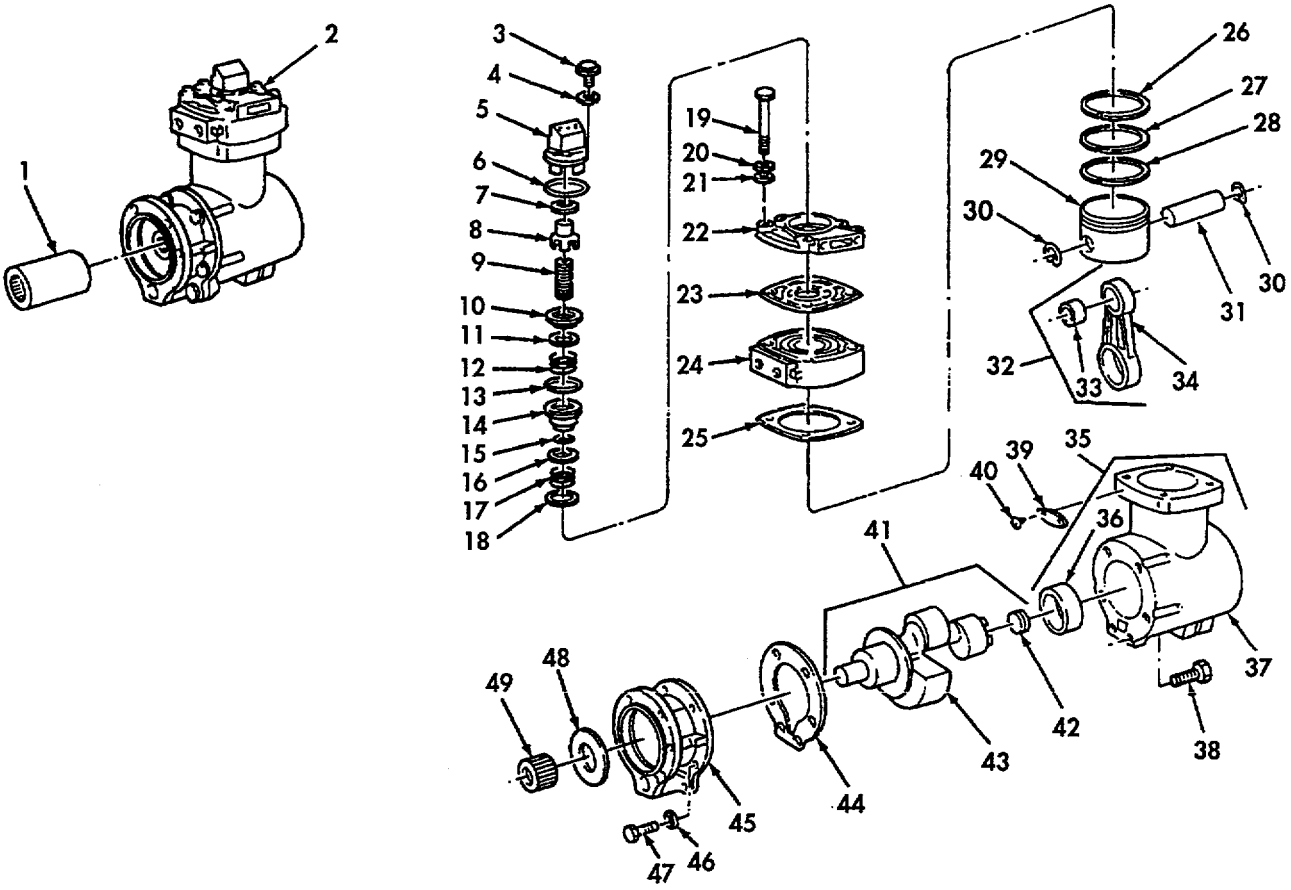
LEGEND:

1. DRIVE COUPLING
13. PREFORMED PACKING
14. SEAT
15. PREFORMED PACKING
16. DISC
17. SPRING
18. SHIM
24. CYLINDER HEAD
29. PISTON
34. CONNECTING ROD
37. HOUSING
38. CAPTIVE WASHER SCREW (2)
43. CRANKSHAFT
44. GASKET
45. SUPPORT
46. LOCKWASHER (4)
47. SCREW (4)
48. THRUST BEARING
49. HALF COUPLING
52. COUPLING HALF PULLER

3-51. AIR COMPRESSOR REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
a. Disassembly (Contd)		
16. Two screws (40)	Unscrew and remove plate (39) from housing (37).	
17. Housing (37)	Using a suitable ridge reamer, remove any carbon deposits or worn ridges from top of cylinder.	Make sure carbon deposits and ridges are removed before air compressor piston (29) is pushed through cylinder of housing (37).
18. Piston (29) and connecting rod (34) (assembled)	Push out through cylinder of housing (37).	
19. Two retaining rings (30)	Remove from piston (29).	Discard retaining rings (30) if damaged during removal.
	CAUTION **Driving piston pin from piston pin bore could damage piston. If piston pin cannot be removed by hand pressure, place piston in hot water to expand piston pin bore and allow piston pin to be removed.**	
20. Piston pin (31)	Remove by pushing through connecting rod (34) and piston (29) with hand pressure.	Use gloves if piston (29) has been in hot water.

3-51. AIR COMPRESSOR REPAIR (Contd)



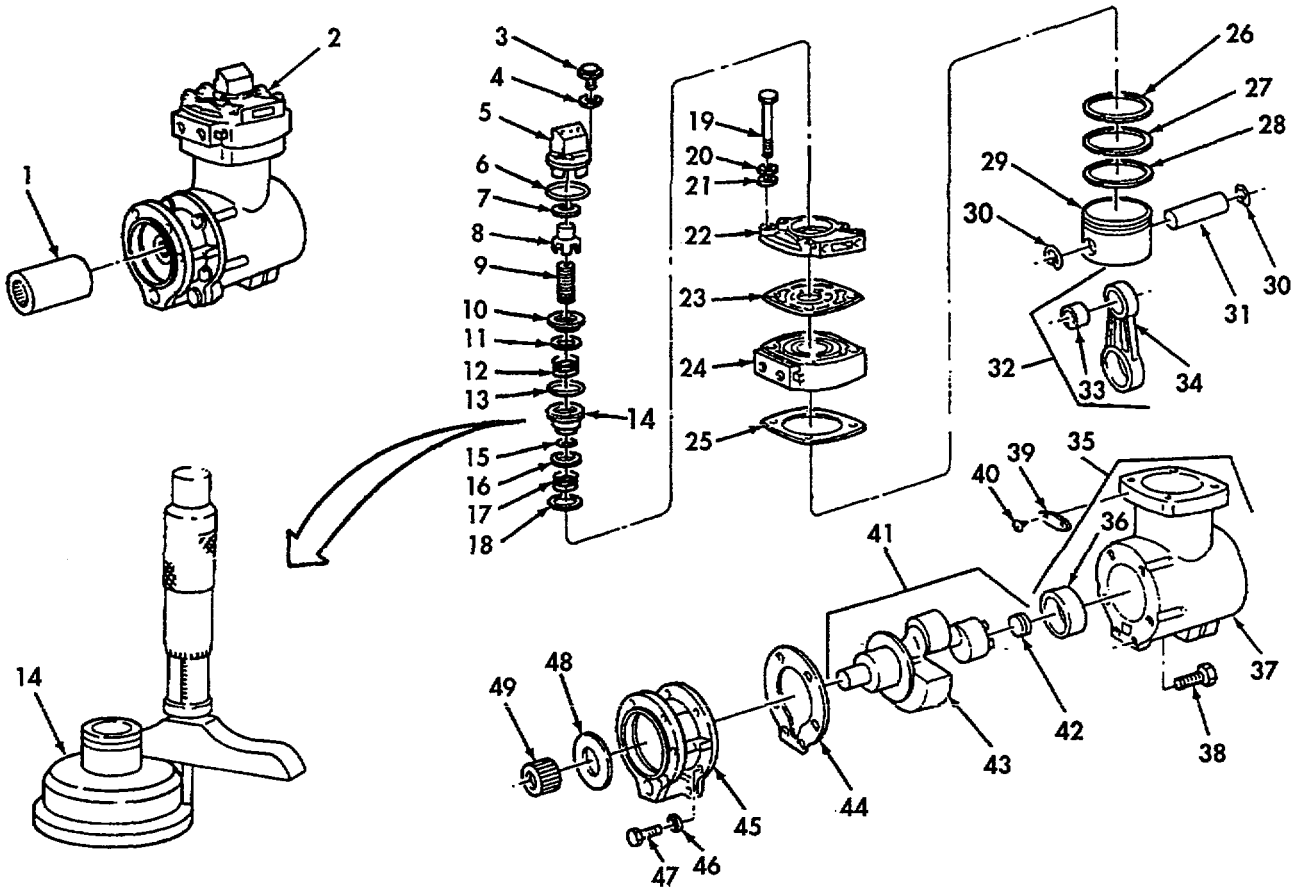
LEGEND:

29. AIR COMPRESSOR PISTON
30. RETAINING RING (2)
31. PISTON PIN
34. CONNECTING ROD
37. HOUSING
39. PLATE
40. SCREW (2)

3-51. AIR COMPRESSOR REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
a. Disassembly (Contd)		
21. Piston (29)	Remove from connecting rod (34).	
	CAUTION **Be very careful not to score or scratch piston when removing rings. Scoring and scratching can cause damage to piston.**	
22. Three rings (26), (27), and (28)	Remove from piston (29).	Discard rings (26), (27), and (28).
b. Cleaning		
	WARNING • **Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and protective equipment such as goggles or shield, gloves, etc. Failure to comply may result in injury to personnel.** • **Approved solvents may be flammable and will not be used near open flame. Use only in well-ventilated area. Failure to comply may result in injury to personnel.**	
23. Cover (22) and cylinder head (24)	a. Immerse in SD-3 solvent to remove carbon and scale. b. Remove carbon from valve cavities, and remove rust and scale from water cavities. c. Blow dry with compressed air.	
	WARNING **Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and protective equipment such as goggles or shield, gloves, etc. Failure to comply may result in injury to personnel.**	
24. Crankshaft (43)	a. Unscrew and take out pipe plug (42). b. Using SD-3 solvent, thoroughly clean oil drilling and blow dry with compressed air. c. Screw in pipe plug (42).	
25. All other parts	Clean in SD-3 solvent and blow dry with compressed air.	Ensure all gasket surfaces are clean and smooth.
c. Inspection and Repair		
26. All parts	Inspect for cracks, breaks, and other damage.	Discard any damaged parts.
27. Cylinder head (24) and cover (22)	Inspect mating surfaces for scratches, scoring, and other damage.	Discard if damaged. Do not grind top surface of cylinder head (24). Top surface is contoured and grinding will cause cylinder head (24) to leak.
28. Seat(14)	Using suitable micrometer, measure height of seating area.	Discard if height is less than 0.485 in. (12.319 mm).

3-51. AIR COMPRESSOR REPAIR (Contd)



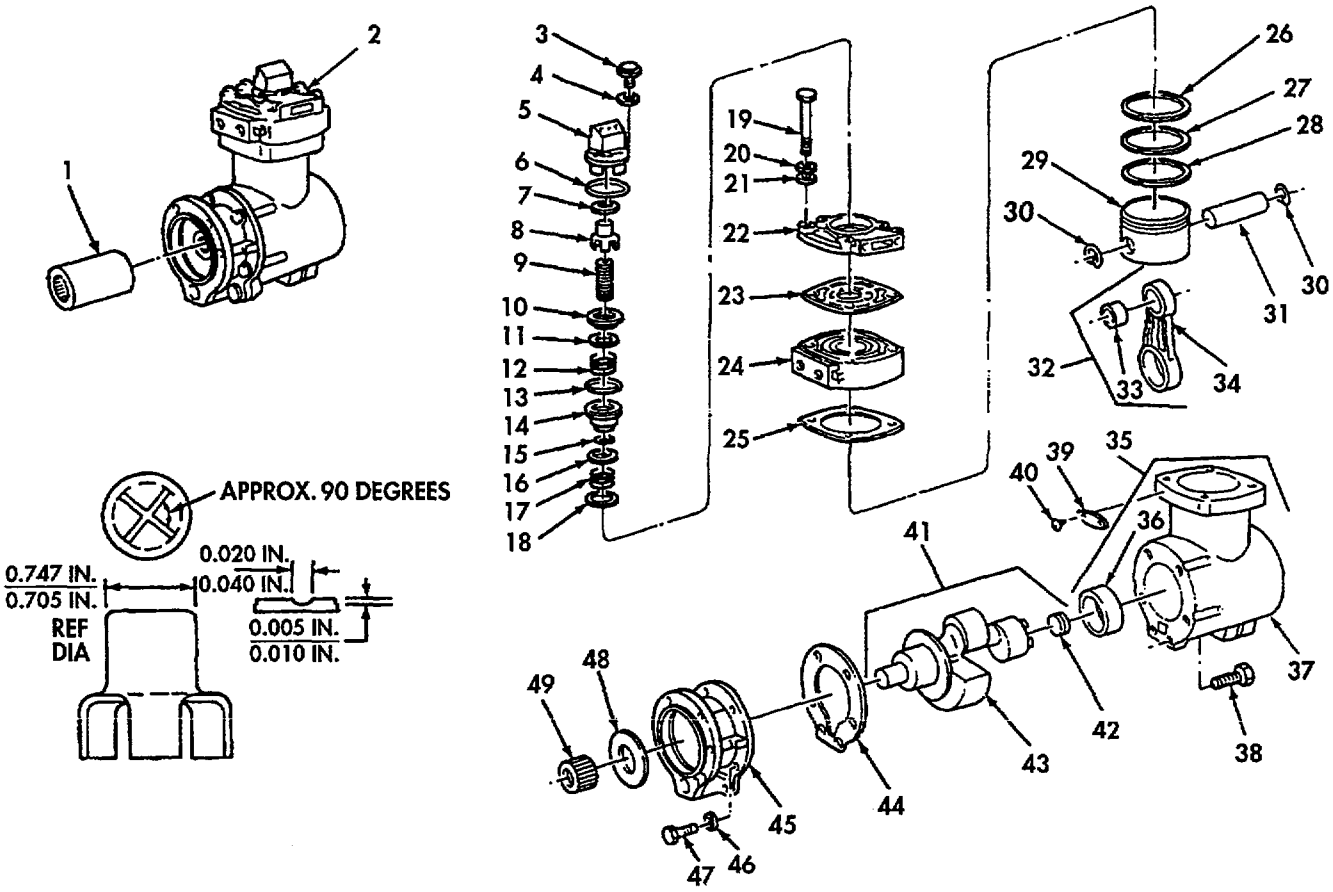
LEGEND:

14. SEAT
22. COVER
24. CYLINDER HEAD
26. RING
27. RING
28. RING
29. PISTON
34. CONNECTING ROD
42. PIPE PLUG
43. CRANKSHAFT

3-51. AIR COMPRESSOR REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection and Repair (Contd)		
29. Seat (10)	Using suitable micrometer, measure height of seating area.	Discard if height is less than 0.270 in. (6.858 mm).
30. Seat (14) and disc (16)	a. Using Prussian blue compound, check seating surfaces.	Do step 30b only if surfaces are not 100 percent true.
	b. Using lapping compound, lap seating surfaces.	If lapping will reduce valve seat height beyond wear limits, discard disc (16) and seat (14). Disc (16) must be flat within 0.001 in. (0.025 mm) of total indicator reading.
31. Seat (10) and valve (11)	Repeat steps 30a and 30b.	
32. Cap (8)	a. Inspect upper part where preformed packing (7) seats for scoring and excessive wear.	Discard if damaged or worn.
	b. Inspect lower seating area for distortion, pitting, and excessive wear.	Discard if damaged or worn.
33. Valve body (5) and cap (8)	a. Install new preformed packing (7) on valve body (5).	Position so the 'V' is at top of valve body (5).
	b. Move cap (8) in and out of valve body (5) to check for smooth operation.	If top of cap (8) sticks to bottom of valve body (5), file a cross on top of cap (8) (see illustration). Discard cap (8) if it has already been filed and still sticks.

3-51. AIR COMPRESSOR REPAIR (Contd)



LEGEND:

5. VALVE BODY
7. PREFORMED PACKING
8. CAP
10. SEAT
11. VALVE
14. SEAT
16. DISC

3-51. AIR COMPRESSOR REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection and Repair (Contd)		
34. Springs (9), (12), and (17)	Test each spring on a spring tester that is capable of very accurate measurements of spring length and load.	Discard any spring not within limits shown below.

Approximate Free Length:
- Unloader Valve Spring (9) ..... 1.65 in. (41.91 mm)
- Intake Valve Spring (12) ..... 0.5 in. (12.7 mm)
- Exhaust Valve Spring (17) ..... 0.67 in. (17.02 mm)

No. of Coils:
- Spring (9) 12.0
- Spring (12) 2.80
- Spring (17) 3.0

Wire Diameter:
- Spring (9) ..... 0.072 in. (1.83 mm)
- Spring (12) ..... 0.062 in. (1.58 mm)
- Spring (17) ..... 0.080 in. (2.03 mm)

Working Length:
- Spring (9) ..... 0.98 in. (24.89 mm)
- Spring (12) ..... 0.280 in. (7.11 mm)
- Spring (17) ..... 0.280 in. (7.11 mm)

New Minimum:
- Spring (9) ..... 18 lb (8.07 kg)
- Spring (12) ..... 0.65 lb (0.30 kg)
- Spring (17) ..... 8.50 lb (3.86 kg)

New Maximum:
- Spring (9) ..... 22 lb (9.98 kg)
- Spring (12) ..... 1.10 lb (0.50 kg)
- Spring (17) ..... 10.4 lb (4.72 kg)

Wear Limit:
- Spring (9) ..... 17.0 lb (7.72 kg)
- Spring (12) ..... 0.55 lb (0.25 kg)
- Spring (17) ..... 8.0 lb (3.63 kg)

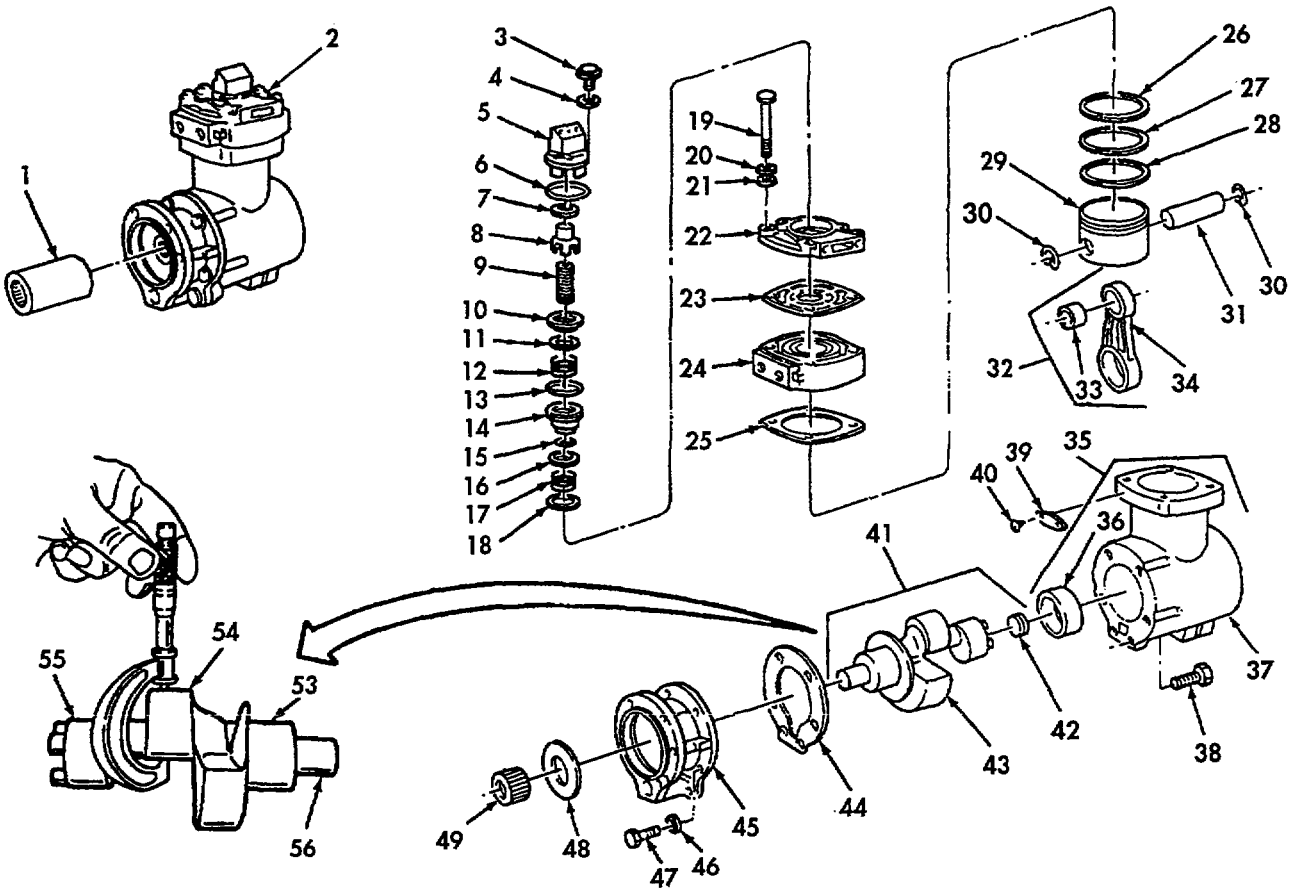
35. Crankshaft assembly (41)	a. Inspect for scratches and scoring.	Discard if damaged.
	b. Using suitable micrometer, measure diameter of the following items:	Discard if not within limits shown below.

New Minimum:
- Front Support Journal (53) ..... 1.872 in. (47.549 mm)
- Connecting Rod Journal (54) ..... 1.9345 in. (49.1363 mm)
- Rear Coupling Journal (55) ..... 1.872 in. (47.549 mm)
- Half Coupling Shaft (56) ..... 1.003 in. (25.476 mm)

New Maximum:
- Front Support Journal (53) ..... 1.873 in. (47.574 mm)
- Connecting Rod Journal (54) ..... 1.9355 in. (49.1617 mm)
- Rear Coupling Journal (55) ..... 1.873 in. (47.574 mm)
- Half Coupling Shaft (56) ..... 1.0035 in. (25.4889 mm)

Wear Limit:
- Front Support Journal (53) ..... 1.871 in. (47.523 mm)
- Connecting Rod Journal (54) ..... 1.9330 in. (49.0982 mm)
- Rear Coupling Journal (55) ..... 1.871 in. (47.523 mm)

3-51. AIR COMPRESSOR REPAIR (Contd)



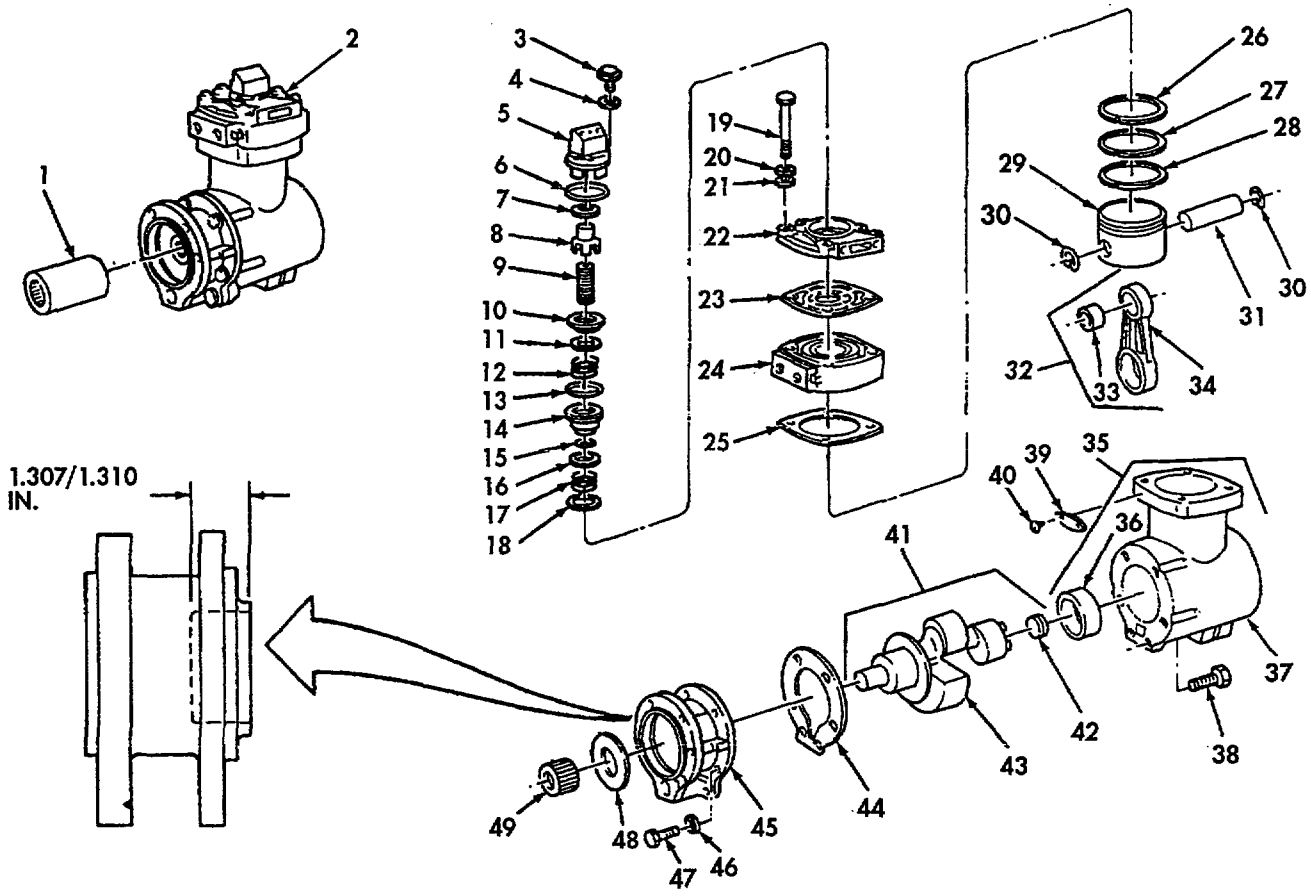
LEGEND:

9. SPRING
12. SPRING
17. SPRING
41. CRANKSHAFT ASSEMBLY
53. FRONT SUPPORT JOURNAL
54. CONNECTING ROD JOURNAL
55. REAR COUPLING JOURNAL
56. HALF COUPLING SHAFT

3-51. AIR COMPRESSOR REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection and Repair (Contd)		
36. Support (45)	a. Inspect for scratches and scoring.	Discard if damaged.
	b. Using suitable depth micrometer, measure support thrust flange (see illustration).	Discard if not within 1.307-1.310 in. (33.198-33.274 mm).
	c. Using suitable micrometer, measure inside diameter of support bearing.	Discard support (45) if inside diameter of bearing is not within limits shown below.
	New Minimum ..... 1.8740 in. (47.5996 mm) New Maximum ..... 1.8760 in. (47.6504 mm) Wear Limit ..... 1.8775 in. (47.6885 mm)	
37. Thrust bearing (48)	Using suitable micrometer, measure thickness.	Discard if not within 0.2400-0.2480 in. (6.096-6.2992 mm).
38. Drive coupling (1) and half coupling (49)	a. Inspect for excessive wear, scoring, and other damage.	Discard if worn or damaged.
	b. Using suitable micrometer, measure inside diameter of half coupling (49).	Discard if inside diameter is not within 1.000-1.001 in. (25.4-25.425 mm).
39. Connecting rod assembly (32)	a. Inspect inside diameter of both ends for scoring and other damage.	Discard if damaged.
	b. Using suitable micrometer, measure inside diameter of crankshaft end.	Discard if more than 1.935 in. (49.149 mm).
	c. Using suitable micrometer, measure inside diameter of bushing (33).	Remove and discard bushing (33) if more than 0.6895 in. (17.5133 mm).
	d. Check for bend and twist.	Discard if bend is more than 0.002 in. (0.508 mm) or twist is more than 0.004 in. (0.102 mm).

3-51. AIR COMPRESSOR REPAIR (Contd)



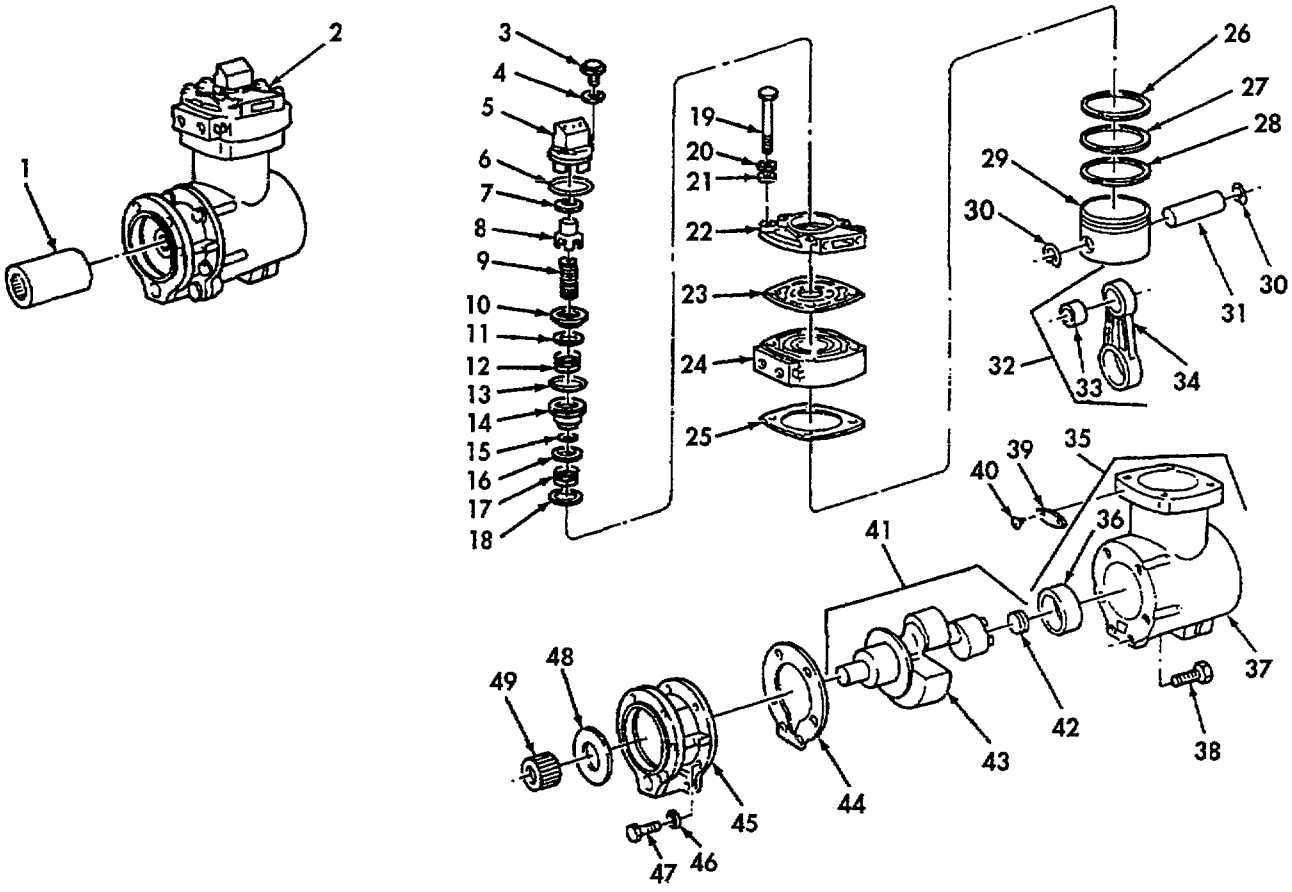
LEGEND:

1. DRIVE COUPLING
32. CONNECTING ROD ASSEMBLY
33. BUSHING
45. SUPPORT
48. THRUST BEARING
49. HALF COUPLING

3-51. AIR COMPRESSOR REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection and Repair (Contd)		
40. Piston pin (31)	Using suitable micrometer, outside diameter.	Discard if not within limits measure shown below.
	New Minimum ..... 0.6875 in. (17.4625 mm) New Maximum ..... 0.6876 in. (17.465 mm) Wear Limit ..... 0.6872 in. (17.4549 mm)	
41. Piston (29)	a. Inspect for scoring, cracks, wear, and other damage.	Discard if damaged or worn.
	b. Using suitable micrometer, measure outside diameter 1 in. (25.4 mm) below and at a right angle to pin bore.	Discard if not within limits shown below at 70°F (21°C).
	New Minimum ..... 3.619 in. (91.923 mm) New Maximum ..... 3.620 in. (91.948 mm) Wear Limit ..... 3.6165 in. (91.8591 mm)	
	c. Using suitable micrometer, measure pin bore.	Discard if not within limits shown below at 70°F (21°C).
	New Minimum ..... 0.6880 in. (17.4752 mm) New Maximum ..... 0.6885 in. (17.4879 mm) Wear Limit ..... 0.6890 in. (17.5006 mm)	
	d. Check ring grooves as follows:	
	(1) Install new rings (26), (27), and (28) on piston ring grooves.	
	(2) Insert a 0.004 in. (0.1016 mm) feeler gauge between ring and ring groove.	
	(3) Compress ring into ring groove.	Discard piston (29) if ring goes below piston land surface with feeler gauge in place.
	e. Check piston ring end gap as follows:	
	(1) Install new rings (26), (27), and (28) on cylinder bore of housing (37).	Use piston head to seat rings squarely on an unworn portion of cylinder bore. Repeat this step until all three rings have been installed.
	(2) Measure piston ring end gap with feeler gauge.	Discard any ring with gap not within 0.010-0.020 in. (0.254-0.508 mm).

3-51. AIR COMPRESSOR REPAIR (Contd)



LEGEND:

26. RING
27. RING
28. RING
29. PISTON
31. PISTON PIN
33. BUSHING
37. HOUSING

3-51. AIR COMPRESSOR REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection and Repair (Contd)		
42. Crankcase assembly (35)	a. Inspect for scoring and other damage.	Discard if damaged.
	b. Hone cylinder bore as required to remove glaze. Clean with SD-3 solvent.	
	c. Using suitable dial bore gauge, check cylinder bore for out-of-round and wear.	Discard if not within limits shown below.

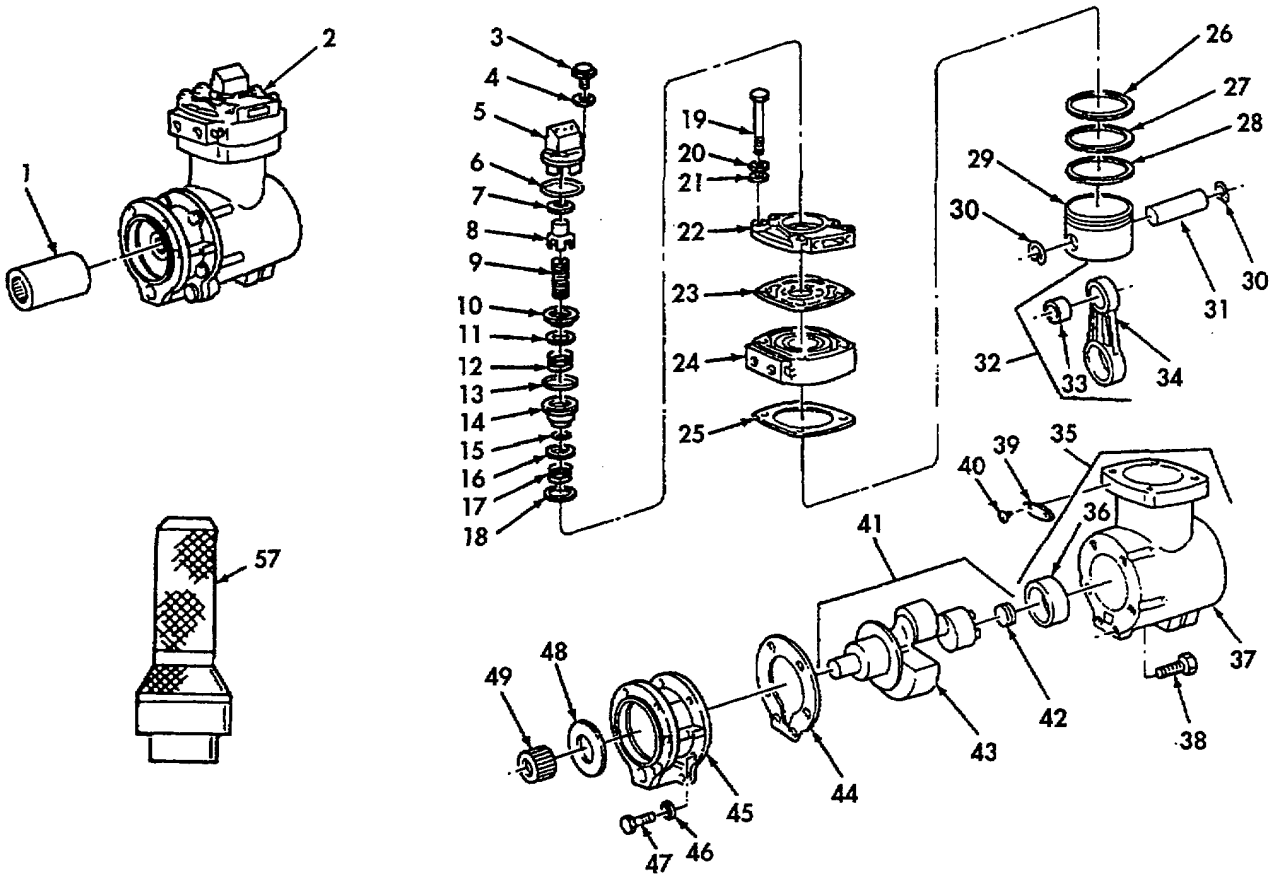
Out-of-Round (Maximum) ..... 0.0015 in. (0.0381 mm)
Bore Diameter (Maximum) ..... 3.6285 in. (92.1639 mm)

	d. Using suitable micrometer, measure inside diameter of bearing (36).	Do step 42e only if more than 1.8780 in. (47.7012 mm).

CAUTION
To avoid damage, always support housing when removing or installing bearing.

	e. Replace bearing (36) as follows:	Do this step only if bearing (36) is damaged or not within wear limits.
	(1) Press bearing (36) out of housing (37).	Use air compressor bushing mandrel (ST-1105 or ST-1143) (57).
	(2) Lubricate bushing bore in housing (37) and press in new bearing (36).	Bearing (36) should be flush with bore surface of housing (37).

3-51. AIR COMPRESSOR REPAIR (Contd)



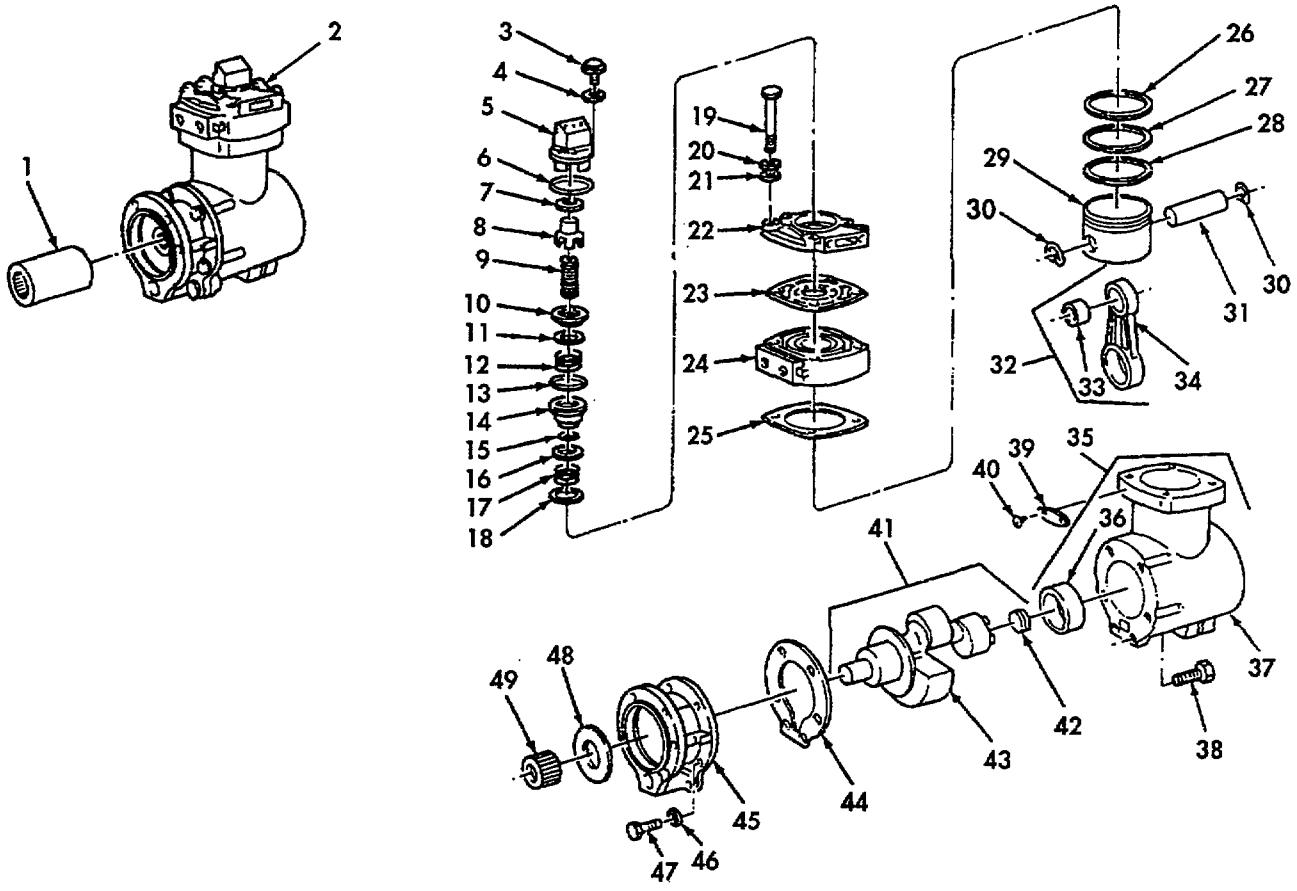
LEGEND:

35. CRANKCASE ASSEMBLY
36. BEARING
37. HOUSING
57. AIR COMPRESSOR BUSHING MANDREL

3-51. AIR COMPRESSOR REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Assembly		
43. Piston (29), two retaining rings (30), pin (31), and connecting rod assembly (32)	a. Install one retaining ring (30) on retaining ring groove on piston (29). b. Position and align connecting rod assembly (32) with piston (29).	
	CAUTION **Driving pin in pin bore could damage piston. If pin cannot be installed by hand pressure, pace piston in hot water to expand pin bore and allow pin to be installed.**	
	c. Install pin (31) through pin bore and connecting rod assembly (32) until it seats against installed retaining ring (30). d. Install other retaining ring (30) on retaining ring groove on piston (29).	Use gloves if piston (29) has been in hot water.
44. New ring (28)	Install on bottom piston ring groove.	Be careful not to scratch piston (29) as ring (28) is installed.
45. New rings (26) and (27)	Install in top and middle piston ring grooves.	Be careful not to scratch piston (29) as rings (26) and (27) are installed. Rings are installed with word "top" toward crown of piston (29). Top and middle rings are different and are not interchangeable.
46. New rings (26), (27), and (28)	Stagger ring gaps until they are about 180' apart and are not located over pin bore.	
47. Piston (29), connecting rod assembly (32), and crankcase assembly (35)	a. Lubricate rings (26), (27), and (28), and crankcase assembly (35) with lubricating oil. b. Install a standard ring compressor on piston (29) to compress rings.	Make sure rings are in grooves of piston (29) and are not in a bind.
	CAUTION **Any difficulty in installing piston and connecting rod assembly into cylinder bore of housing may indicate that a ring is in a bind. To avoid cracking a ring and damaging cylinder wall, do not force piston into cylinder bore.**	
	c. Install piston (29) and connecting rod assembly (32) into cylinder bore of housing (37).	Use a suitable tool with soft face to carefully push piston (29) from ring compressor into cylinder bore.
48. Plate (39)	a. Place on housing (37). b. Secure with two screws (40).	

3-51. AIR COMPRESSOR REPAIR (Contd)



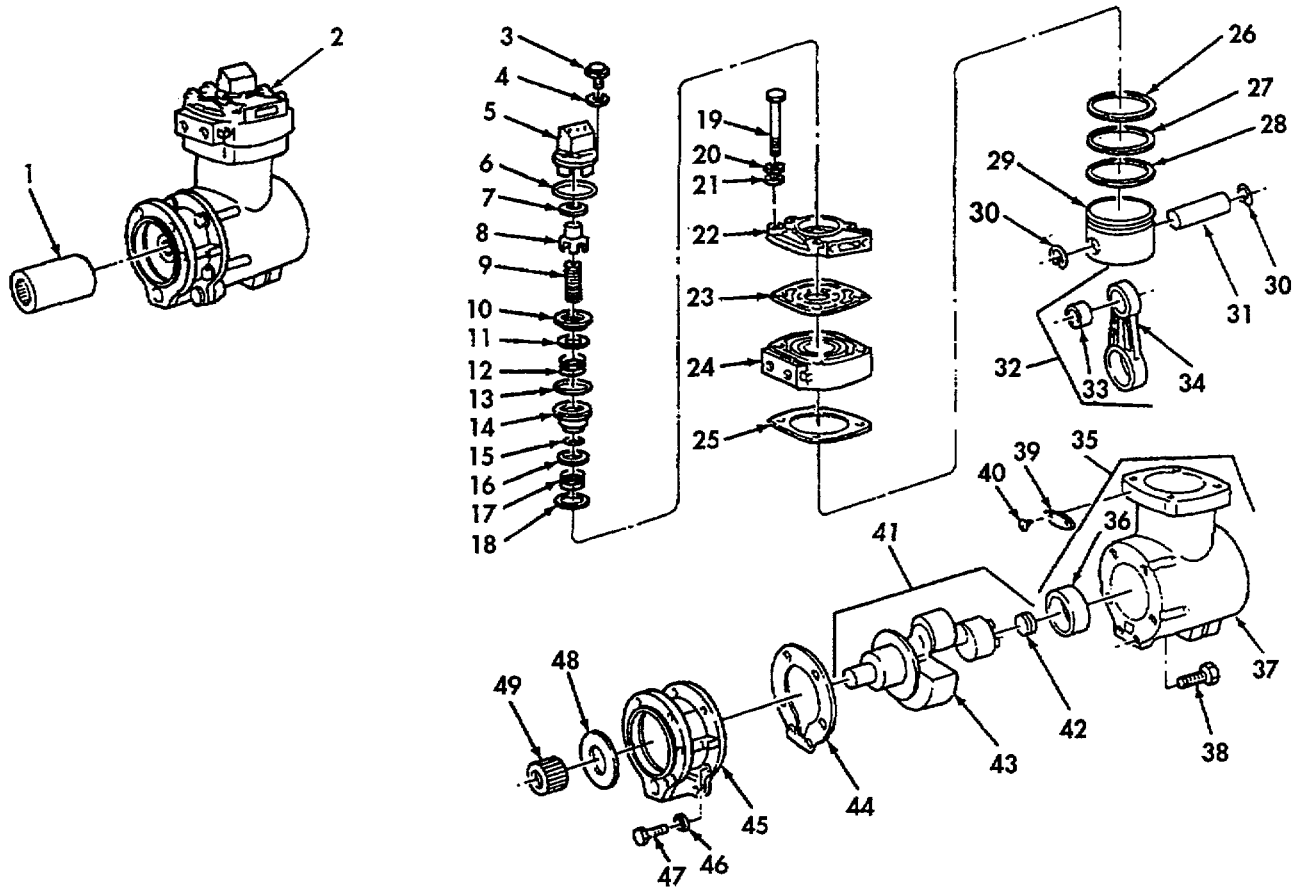
LEGEND:

26. RING
27. RING
28. RING
29. PISTON
30. RETAINING RING (2)
31. PIN
32. CONNECTING ROD ASSEMBLY
35. CRANKCASE ASSEMBLY
37. HOUSING
39. PLATE
40. SCREW (2)

3-51. AIR COMPRESSOR REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Assembly (Contd)		
49. Crankshaft assembly (35) and support (45)	a. Lubricate front support journal of crankshaft (43) and bearing (36) on support (45) with lubricating oil. b. Install crankshaft assembly (41) on support (45). c. Secure support (45) to crankcase assembly (35) with two captive washer screws (38), four screws (47), and four new lockwashers (46).	Tighten captive washer screws (88) and (47) to 30-35 lb-ft (41-47 N•m).
50. Thrust bearing (48)	a. Lubricate slotted end with lubricating oil. b. Install over end of crankshaft (43) and on support (45).	Slotted side of thrust bearing (48) is installed toward crankshaft (43) and support (45).
	CAUTION **To avoid damaging air compressor support, make sure crankshaft is properly secured before using press.**	
51. Half coupling (49)	Press on crankshaft (43) until it bottoms out.	

3-51. AIR COMPRESSOR REPAIR (Contd)



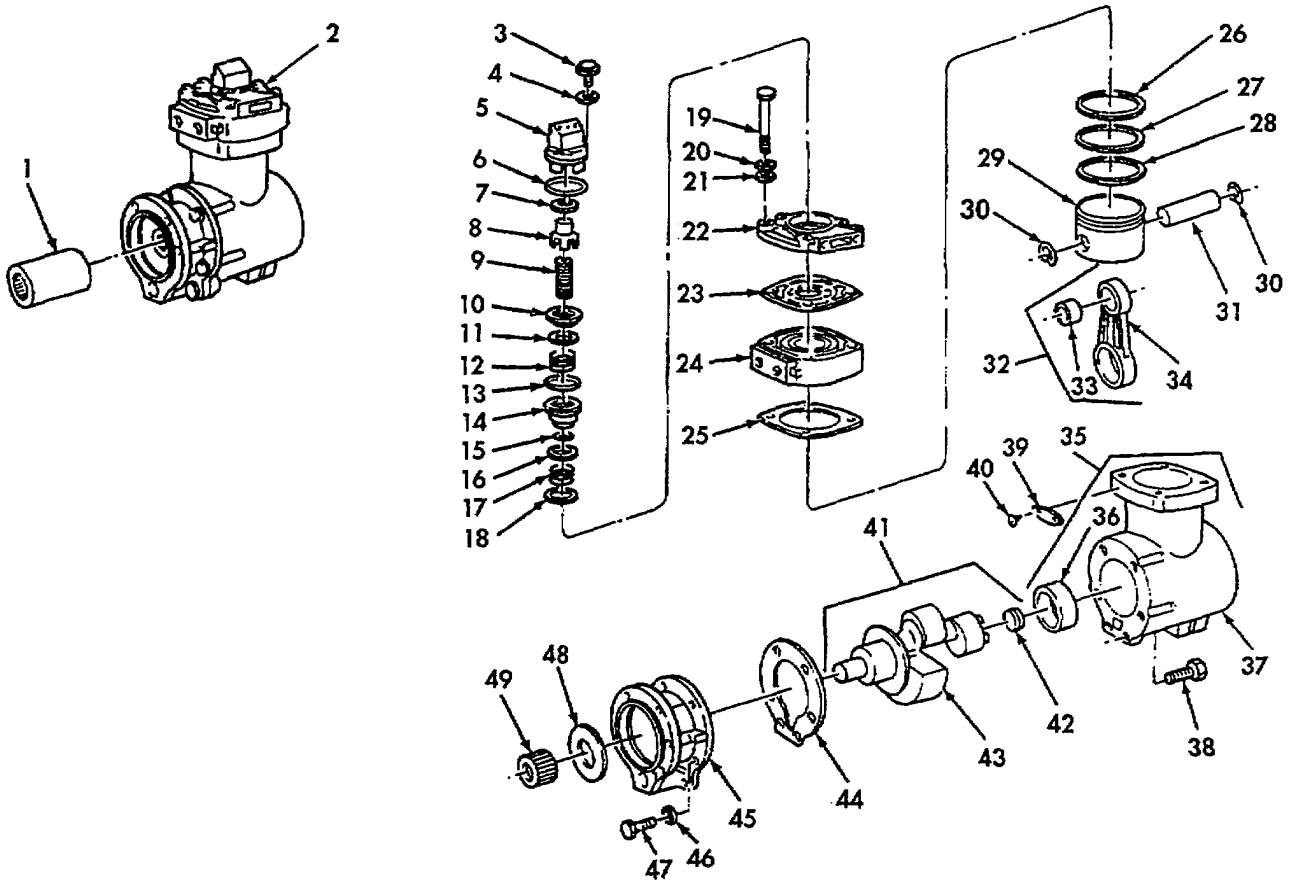
LEGEND:

35. CRANKCASE ASSEMBLY
36. BEARING
38. CAPTIVE WASHER SCREW (2)
41. CRANKSHAFT ASSEMBLY
43. CRANKSHAFT
45. SUPPORT
46. LOCKWASHER (4)
47. SCREW (4)
48. THRUST BEARING
49. HALF COUPLING

3-51. AIR COMPRESSOR REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Assembly (Contd)		
52. Crankshaft (43), support (45), new gasket (44), and crankcase assembly (35)	a. Position piston (29) at 90° after top dead center to allow crankshaft (43) to be installed through connecting rod (34). b. Install crankshaft (43) on crankcase assembly (35) and through crankshaft bore end of connecting rod (34).	
53. Disc (16)	Position on seat (14).	
54. New preformed packings (13) and (15)	Install seat (14).	Lubricate preformed packings (13) and (15) with clean lubricating oil.
55. Shim (18), spring (17), and seat (14)	Install on cylinder head (24).	Use thumb pressure to press seat (14) in position with cylinder head (24).
56. Spring (12), valve (11), and seat (10)	Install seat (14) on cylinder head(24).	
57. New gasket (25), cylinder head (24), new gasket (23), and cover (22)	a. Position on cylinder bore of crankcase assembly (35).	
	b. Secure with four screws (19), four new lockwashers (20), and four washers (21).	Tighten screws (19) to 15-19 lb-ft (20-26 N•m).

3-51. AIR COMPRESSOR REPAIR (Contd)



LEGEND:

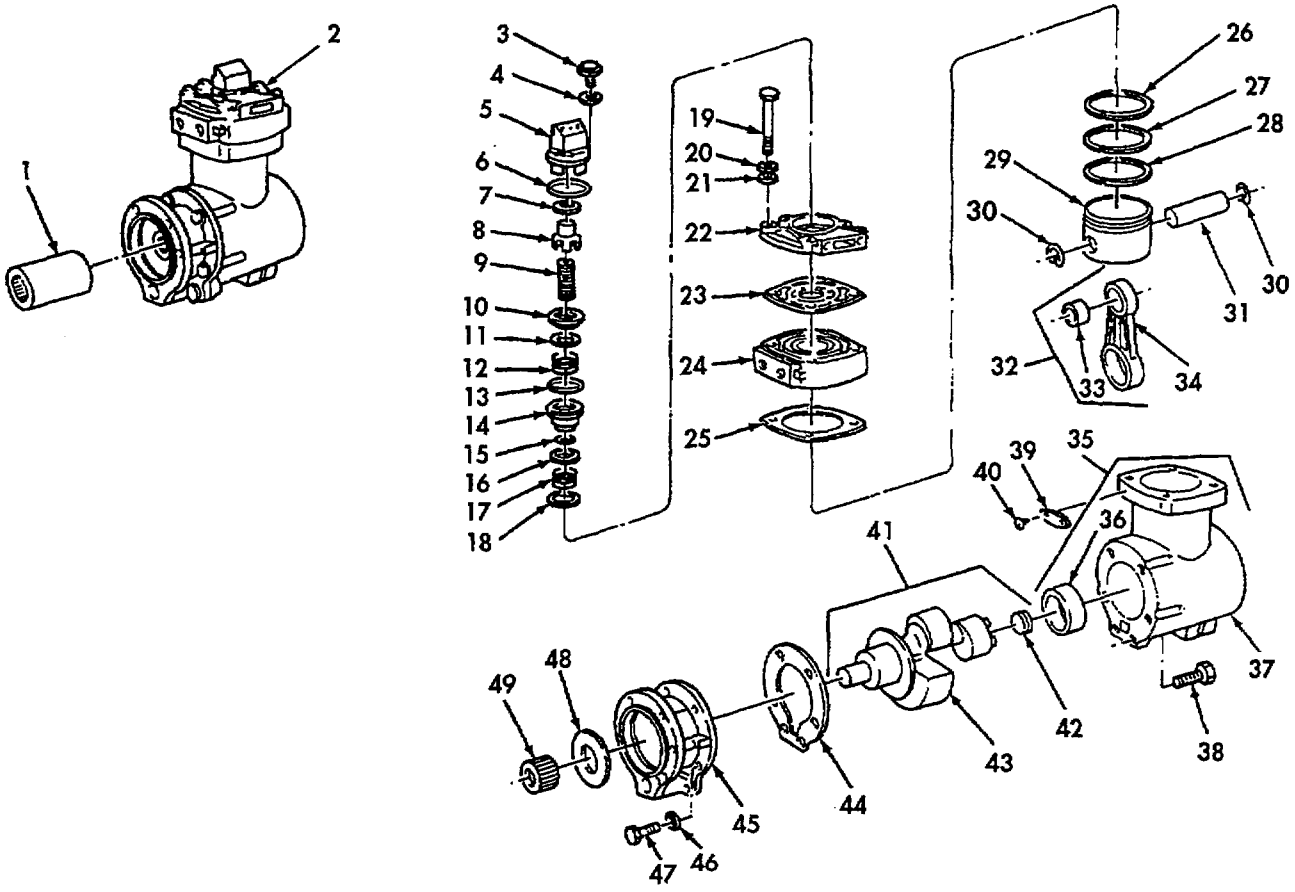
10. SEAT
11. VALVE
12. SPRING
13. PREFORMED PACKING
14. SEAT
15. PREFORMED PACKING
16. DISC
17. SPRING
18. SHIM
19. SCREW (4)
20. LOCKWASHER (4)
21. WASHER (4)
22. COVER
23. GASKET
24. CYLINDER HEAD
25. GASKET
29. PISTON
34. CONNECTING ROD
35. CRANKCASE ASSEMBLY
43. CRANKSHAFT
44. GASKET
45. SUPPORT

3-51. AIR COMPRESSOR REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Assembly (Contd)		
58. New preformed packings (6) and (7)	Install on cap (8).	Lubricate preformed packing (6) with clean lubricating oil, and use antiseize compound on preformed packing (7).
59. Valve body (5)	Install on cap (8).	
60. Spring (9)	Place on cylinder head (24).	
61. Valve body (5) and cap (8)	a. Install over spring (9) and on cover (22). b. Secure with two captive washer screws (3) and two washers (4).	Align three prongs on cap (8) with openings on seat (10). Tighten captive washer screws (3) to 96-132 lb-in. (11-15 N•m).

FOLLOW-ON TASK: Install air compressor (para. 3-77).

3-51. AIR COMPRESSOR REPAIR (Contd)



LEGEND:

3. CAPTIVE WASHER SCREW (2)
4. WASHER (2)
5. VALVE BODY
6. PREFORMED PACKING
7. PREFORMED PACKING
8. CAP
9. SPRING
10. SEAT
22. COVER
24. CYLINDER HEAD

3-52. FUEL INJECTOR REPAIR

THIS TASK COVERS:

a. Disassembly
b. Cleaning
c. Inspection
d. Assembly

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Injector stand (15434) ST-1298
Injector cup wrench (15434) ST-995
Crowfoot wrench (15434) ST-1072

TEST EQUIPMENT
None

MATERIALS/PARTS
Mineral spirits (Appendix C, Item 17)
Solvent, SD-3 (Appendix C, Item 4)
Diesel fuel, regular (Appendix C, Item 19)
Lapping compound, 280-grit (Appendix C, Item 8)
Compound, Prussian blue (Appendix C, Item 9)
Oil, lubricating, OE/HDO 10 (Appendix C, Item 20)
Gasket (15434) 173086
Three gaskets (15434) 193736

PERSONNEL REQUIRED
Fuel and electrical systems repairman MOS 63G

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
Injector assembly removed (para. 3-23).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
- Diesel fuel is flammable.
- Always wear eye protection when cleaning with compressed air.
- Use approved solvent in well-ventilated area.

LOCATION/ITEM	ACTION	REMARKS

a. Disassembly

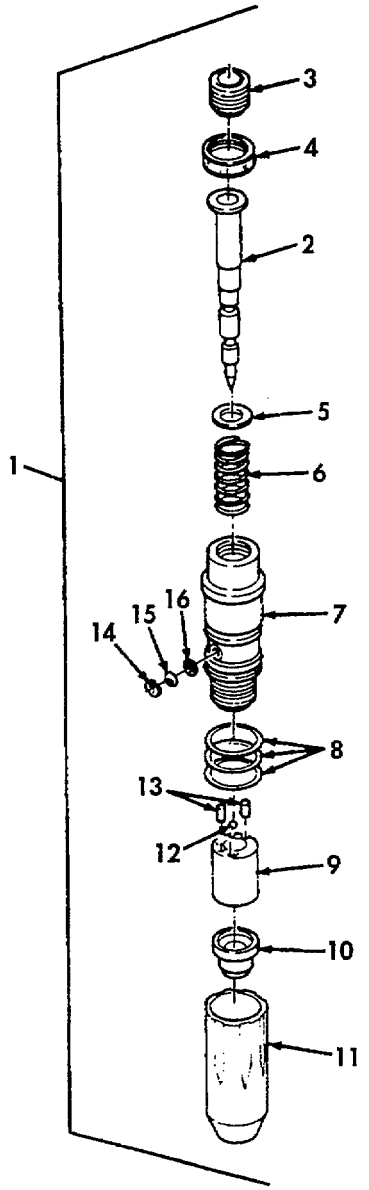
NOTE
- **Injector barrels and plungers are not interchangeable.**
- **Use this procedure to repair any of the six fuel injector assemblies.**

1.	Plunger (2)	Lift out.	Store plunger (2) by standing it on coupling end.
2.	Top-stop locknut (4) and top-stop screw (3)	Remove.	
3.	Washer(5) and injector spring (6)	Lift out.	
4.	Three gaskets (8)	Remove.	Discard gaskets (8).
5.	Filter screen clip (14), filter screen (15), and gasket (16)	Remove from top-stop adapter (7). screen (15) only if damaged.	Discard gasket (16). Discard filter

NOTE
Do not remove or turn adjustable orifice plug located behind filter screen. The orifice plug has been pre-set. Fuel delivery is adjusted by changing orifice plug or by burnishing plug in its operating position.

6.	Top-stop adapter (7) and cup retainer (11)	Loosen.	Secure injector assembly (1) into injector stand (ST-1298). Using body and injector cup wrench (ST-995), loosen retainer (11) but do not remove. When loose, remove injector from stand.

3-52. FUEL INJECTOR REPAIR (Contd)



LEGEND:

1. INJECTOR ASSEMBLY
2. PLUNGER
3. TOP-STOP SCREW
4. TOP-STOP LOCKNUT
5. WASHER
6. INJECTOR SPRING
7. TOP-STOP ADAPTER
8. GASKET (3)
9. BARREL
10. INJECTOR CUP
11. CUP RETAINER
12. CHECK BALL
13. ROLL PIN (2)
14. FILTER SCREEN CLIP
15. FILTER SCREEN
16. GASKET

3-52. FUEL INJECTOR REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
a. Disassembly (Contd)		
7. Top-stop adapter (7) and cup retainer (11)	Separate.	

CAUTION

- **Do not pry against machined surface when removing two roll pins. Damage to machine surface may result**
- **Do not lose check ball.**

8. Barrel (9), injector cup (10), check ball (12), and two roll pins (13)	Remove.	

CAUTION

Do not use drills or other instruments to clean cup holes that will alter size of holes. Wires may be used if a smaller size wire is used than spray hole. Do not use a wire brush or crocus cloth to clean cup tip area, or damage to cup tip may result.

NOTE

Most injector failures occur because of dirt. Clean parts thoroughly before assembly.

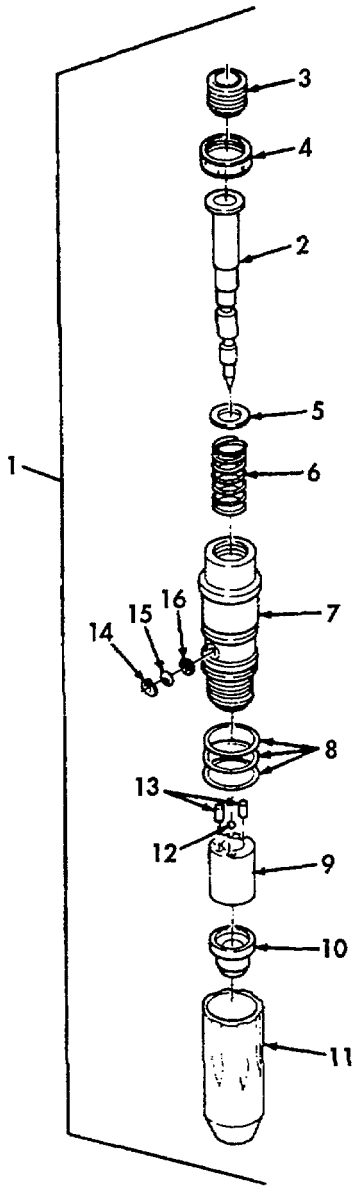
b. Cleaning

WARNING

Approved solvents may be flammable and will not be used near open flame. Use only in well-ventilated area. Failure to comply may result in injury to personnel.

9. Injector spring (6), top-stop locknut (4), top-stop adapter (7), and cup retainer (11)	Clean.	Soak parts in a suitable cleaning solvent, such as SD-3, to remove carbon varnish. This may require several hours of soaking. Neutralize solvent after cleaning by dipping parts in mineral spirits.

3-52. FUEL INJECTOR REPAIR (Contd)



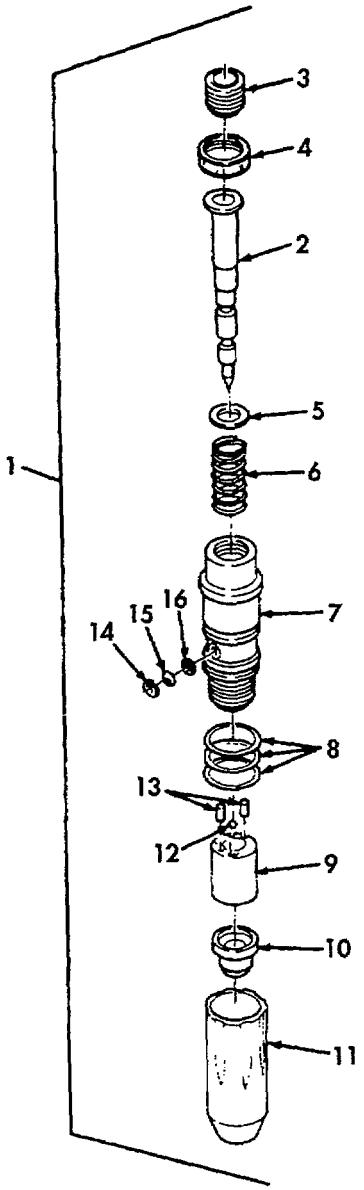
LEGEND:

4. TOP-STOP LOCKNUT
6. INJECTOR SPRING
7. TOP-STOP ADAPTER
9. BARREL
10. INJECTOR CUP
11. CUP RETAINER
12. CHECK BALL
13. ROLL PIN (2)

3-52. FUEL INJECTOR REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
b. Cleaning(Contd)		
	CAUTION **Injector barrels and plungers are not interchangeable. To avoid equipment damage, do not mix injector barrels and plungers.**	
10. Plunger (2), barrel (9), and injector cup (10)	Clean.	The use of an ultrasonic cleaner is recommended for plunger, barrel, and injector cup.
	WARNING **Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and protective equipment such as goggles or shield, gloves, etc. Failure to comply may result in injury to personnel.**	
11. All cleaned parts	Dry with compressed air.	Place all cleaned injector assembly (1) part under cover to prevent contamination.
c. Inspection		
	CAUTION **Handle injector plunger with care to prevent damage.**	
12. Plunger (2)	Inspect for:	
	a. Scuffing or scoring.	Replace plunger (2) and barrel (9) if scuffed or scored.
	b. Bright spots at machined area bottom and mid-point.	This is a normal condition.
	c. Surface defects.	Replace if evident.
	d. Cracks or looseness.	Replace if cracked or loose. Rotate by hand to determine looseness.
13. Injector spring (6)	Inspect for:	
	a. Excessive wear.	
	b. Spring compression.	Use suitable spring tester. Discard if 138 lb (62.65 kg) or less at 1.663 in. (42.240 mm) spring height.
	c. Spring squareness.	Use dial indicator. Rotate spring and measure at top and bottom of spring (6). Discard if 0.016 in. (0.406 mm) is exceeded.
14. Injector cup (10)	Inspect spray holes and tip for:	Use magnifying glass. Compare to new cup.
	a. Abrasive wear.	Internally and externally.
	b. Corrosion and erosion.	If hole size has not changed, reuse.
	c. Enlarged or distorted spray holes.	Discard if holes are enlarged.

3-52. FUEL INJECTOR REPAIR (Contd)



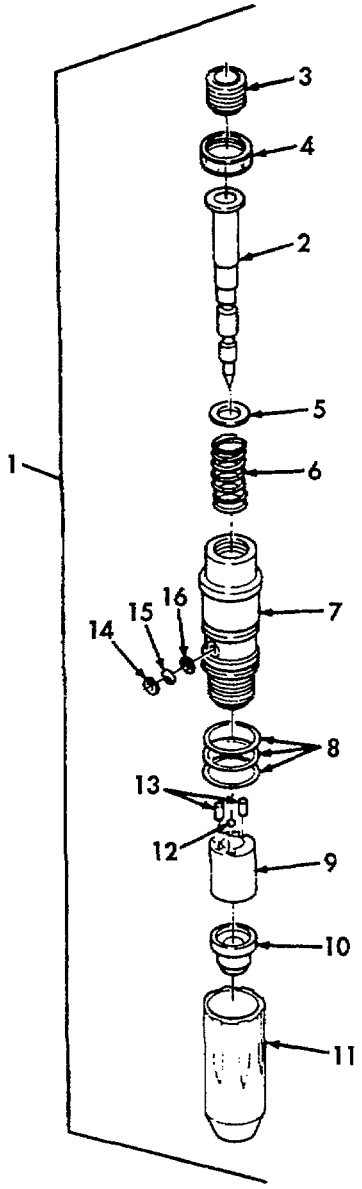
LEGEND:

1. INJECTOR ASSEMBLY
2. PLUNGER
6. INJECTOR SPRING
9. BARREL
10. INJECTOR CUP

3-52. FUEL INJECTOR REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection (Contd)		
	CAUTION **The injector plunger must seat in cup from 1/4 of upper cone area to full cone area. Reject a cup that seats in lower 14 cup tip area. If a cup seats in the tip area, it must seat more than 1/2 of cone area to be accepted.**	
	d. Plunger seat pattern.	Using new injector plunger (2), coat with Prussian blue and rotate 90°. If 40 percent continuous coverage is maintained, it may be reused but must pass the cup-to-plunger test.
15. Cup retainer (11)	Inspect for a. Damaged threads. b. Nicks and burrs on outside heat seating area and inside seating ledge.	 Nicks and burrs will prevent proper seating.
	NOTE **If injector passes leakage test, barrel is usable. If leakage is high, barrel and plunger must be replaced.**	
16. Barrel (9)	Inspect for: a. Scoring of bore area. b. Burrs, carbon, and distorted radius in the orifice. c. Loose or cracked fuel passage plugs. d. Damage and flatness at mating surfaces.	 Lap with a grade A 280-grit lapping compound to remove mutilation or unevenness. Use a surface plate to check surface flatness.
17. Check ball (12) and ball seat	Inspect for: a. Nicks and burrs on ball (12). b. Depth of ball seat.	 Discard if burred or nicked. Maximum is 0.050 in. (1.27 mm) below surface of barrel (9).
18. Top-stop adapter (7)	Inspect for: a. Burrs or obstructions around orifice. b. Obstructions in fuel passage openings. c. Damaged threads. d. Gasket area for nicks or burrs. e. Mating surface for nicks or burs. f. Damage and flatness at mating surfaces.	 Discard if unable to remove. Clean. Rethread. Remove nicks or burrs, or gaskets (8) will be damaged. Discard if unable to remove.

3-52. FUEL INJECTOR REPAIR (Contd)



LEGEND:

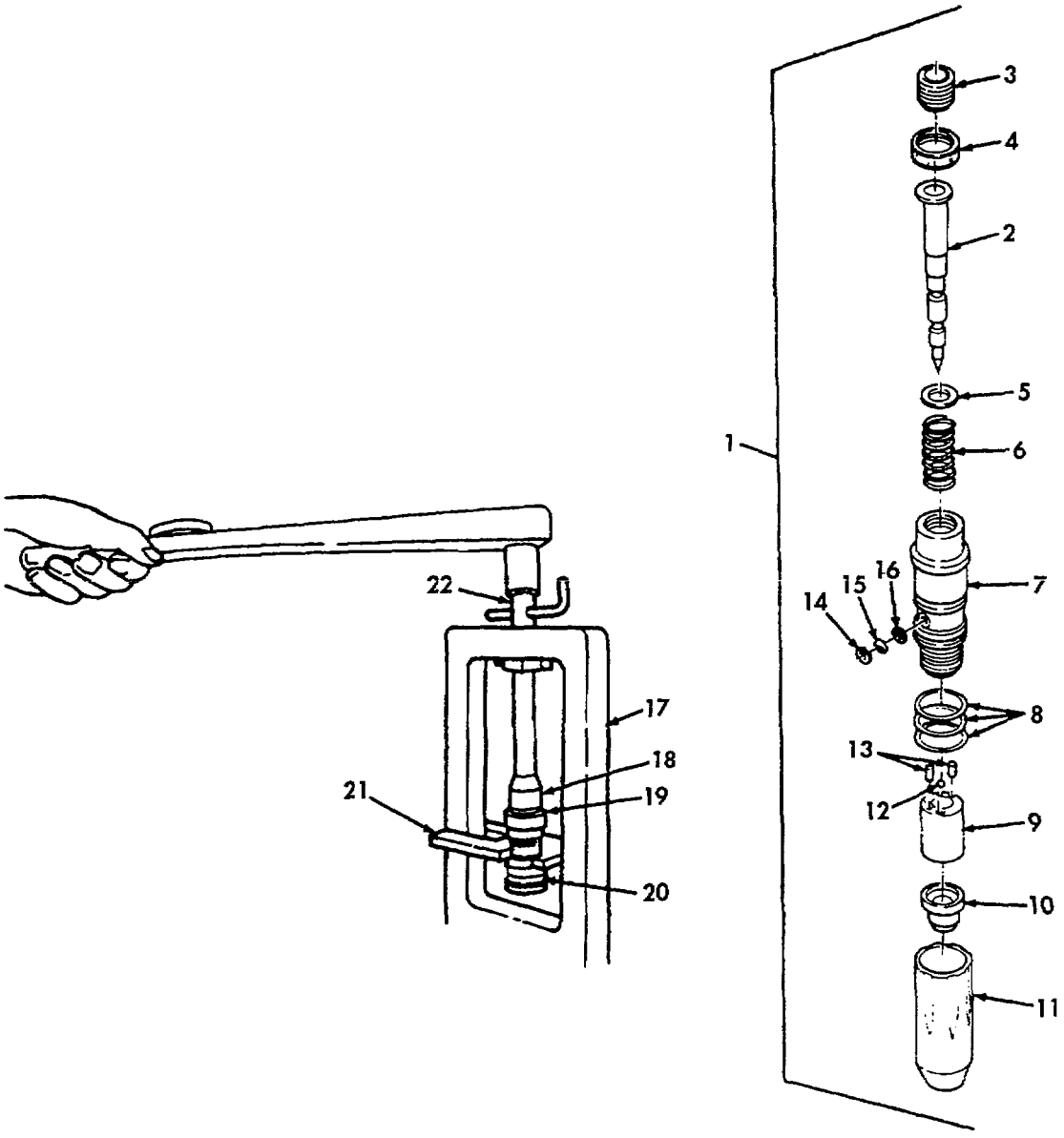
2. PLUNGER
7. TOP-STOP ADAPTER
8. GASKET (3)
9. BARREL
11. CUP RETAINER
12. CHECK BALL

3-52. FUEL INJECTOR REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Assembly		
	CAUTION **Be certain all mating surface parts are clean and free of burrs or defects which will result in incorrect flow or torque.**	
19. Check ball (12)	Insert in barrel (9).	
20. Two roll pins (13)	Install on top-stop adapter (7).	
	CAUTION **Be aware that check ball could fall out during assembly of barrel and injector cup which could render injector useless.**	
21. Barrel (9) and injector cup (10)	Insert in top-stop adapter (7).	Apply a light coat of OE/HDO 10 lubricating oil to barrel (9) and injector cup (10).
22. Cup retainer (11) and top-stop adapter (7)	Screw down finger-tight. Loosen 1/4 turn.	
	WARNING **Do not perform fuel system procedures while smoking or within 50 ft (15.2 m) of sparks or open flame. Diesel fuel is flammable and may explode. Failure to comply may result in injury to personnel.**	
23. Plunger(2)	Insert in injector assembly (1).	Immerse plunger (2) in clean diesel fuel.
24. Injector assembly (1)	Place in injector stand (17) as follows: a. Position base with single pin in center of injector stand (17). b. Back off stud (22) from injector stand (17) and slide clamp bar (21) over injector assembly flats (20). c. Place retainer cup wrench (19) on cup retainer (11). d. Tighten stud (22) in injector stand (17) to 75 lb-in. (8. N•m).	Lubricate threads on stud (22) and screw in injector stand (17) with OE/HDO 10 lubricating oil. This aligns cup and injector plunger.
	CAUTION **When removing injector from injector stand, do not hit cup retainer on stud.**	
	e. Tighten cup retainer (11) with crowfoot wrench to 53-57 lb-ft (72-77 N•m).	Use crowfoot wrench (ST-1072). Remove from injector stand (ST-1298) (17) when task is completed.
25. Plunger (2)	Check injector cup (10) to plunger (2) alignment as follows: a. Coat plunger (2) with clean diesel fuel.	Hold injector assembly (1) with injector cup (10) down and allow plunger (2) to drip a few drops of diesel fuel.

3-52. FUEL INJECTOR REPAIR (Contd)

b. Insert in barrel (9) so plunger (2) remains 0.50 in. (12.7 mm) from edge of top-stop adapter (7).
c. Jam plunger (2) with palm of hand to seat in injector cup (10). Hold plunger (2) firmly against seat and rotate 90°.



LEGEND:

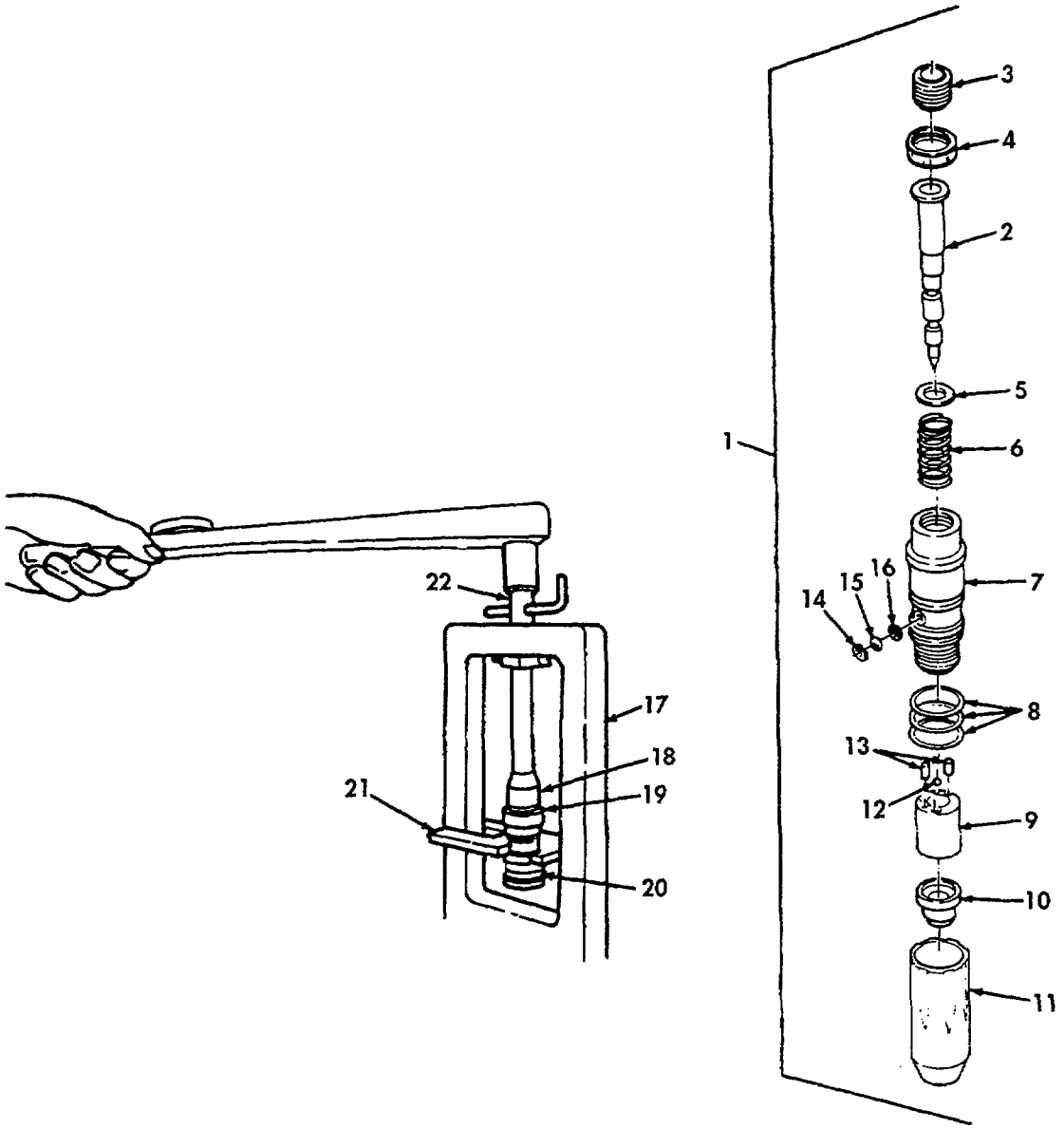
1. INJECTOR ASSEMBLY
2. PLUNGER
7. TOP-STOP ADAPTER
9. BARREL
10. INJECTOR CUP
11. CUP RETAINER
12. CHECK BALL
13. ROLL PIN (2)
17. INJECTOR STAND
19. RETAINER CUP WRENCH
20. INJECTOR ASSEMBLY FLATS
21. CLAMP BAR
22. STUD

3-52. FUEL INJECTOR REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Assembly (Contd)		
	CAUTION **Do not allow plunger to fall out when holding injector assembly with cup facing up.**	
	d. With one hand, turn injector assembly (1) so injector cup (10) faces upward. Plunger (2) should slide out immediately.	If plunger (2) does not slide out immediately, injector assembly (1) is not aligned and must be reassembled as outlined in steps 19 through 25.
26. Three new gaskets (8)	Install on grooves.	
27. New gasket (16), filter screen (15), and filter screen clip (14)	Install on top-stop adapter (7).	Replace gasket (16) if required.
	NOTE **After assembly, store injector in a clean place until ready for testing and calibration.**	
28. Injector spring (6) and washer (5)	Install on plunger (2) and insert in top-stop adapter (7) on injector assembly (1).	Do not install top-stop locknut (4) and top-stop screw (3) at this time. Store with injector assembly (1).

FOLLOW-ON TASK: Perform fuel injector testing; Test No. 1 (para. 3-53).

3-52. FUEL INJECTOR REPAIR (Contd)



LEGEND:

1. INJECTOR ASSEMBLY
2. PLUNGER
3. TOP-STOP SCREW
4. TOP-STOP LOCKNUT
5. WASHER
6. INJECTOR SPRING
7. TOP-STOP ADAPTER
8. GASKET (3)
10. INJECTOR CUP
14. FILTER SCREEN CLIP
15. FILTER SCREEN
16. GASKET

3-53. FUEL INJECTOR TESTING; TEST NO. 1

THIS TASK COVERS:

a. Cup to Plunger Seal Test

c. Check Ball Leakage Test

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Injector adapter pot (15434) 3375086
Plug (15434) ST-668-14
Plunger extension (15434) ST-1089

TEST EQUIPMENT
Injector leakage tester (15434) 3375375

MATERIALS/PARTS
Oil, lubricating, OE/HDO 10
(Appendix C, Item 20)

PERSONNEL REQUIRED
Fuel and electrical system repairman
MOS 63G

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

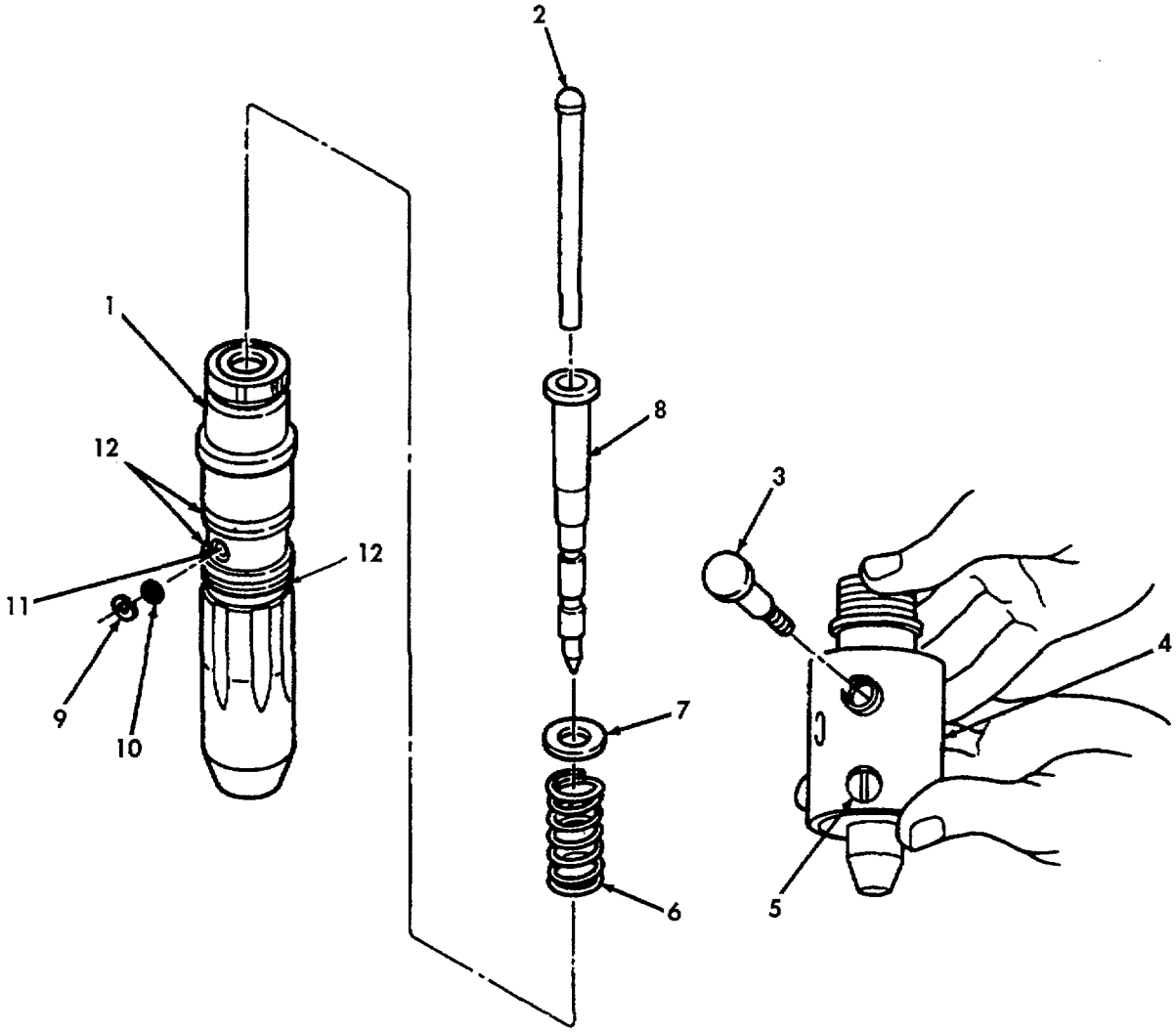
EQUIPMENT CONDITION
Injector assembly removed (para. 3-23).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS
a. Cup to Plunger Seal		
	NOTE **The assembled injector is tested and calibrated without the top-stop screw and top-stop locknut.**	
1. Plunger(8), retainer (7), injector spring (6), filter screen clip (9), and filter screen (10)	Remove.	
2. Plunger extension (2)	Install on plunger (8) and place in injector assembly (1).	
3. Injector assembly (1)	a. Align injector delivery orifice (11) with burnishing hole (5). b. Using hand pressure, press into adapter (4) until it bottoms. c. Insert and tighten locating screw (3) in adapter (4). d. Plug fuel inlet port.	Lubricate three gaskets (12) with OE/HDO 10 lubricating oil. Use plug (ST-668-14).

3-53. FUEL INJECTOR TESTING; TEST NO. 1 (Contd)



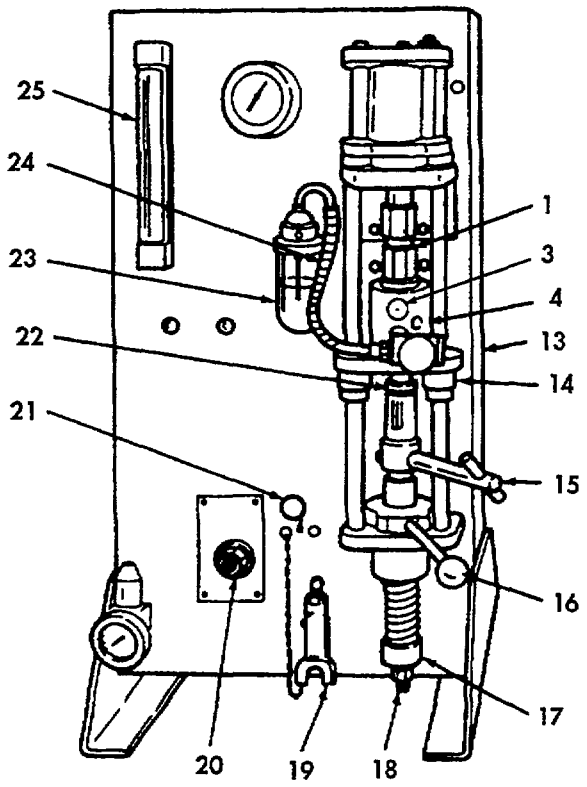
LEGEND:

1. INJECTOR ASSEMBLY
2. PLUNGER EXTENSION
3. LOCATING SCREW
4. ADAPTER
5. BURNISHING HOLE
6. INJECTOR SPRING
7. RETAINER
8. PLUNGER
9. FILTER SCREEN CLIP
10. FILTER SCREEN
11. INJECTOR DELIVERY ORIFICE
12. GASKET (3)

3-53. FUEL INJECTOR TESTING; TEST NO. 1 (Contd)

LOCATION/ITEM	ACTION	REMARKS
a. Cup to Plunger Seal Test (Contd)		
	e. Install on leakage tester (13) and clamp in position.	Support plate (14) may be tilted for easier installation. Use spacer (22).
4. Knurled knob (17)	Adjust to obtain proper clearance with feeler gauge (19).	Do not adjust locknut (18).
5. Transfer line (24)	Install and tighten on drain port of injector assembly (1).	This is port on right when facing front of leakage tester (13).
6. T-handle clamp (15)	Tighten.	
7. Retractor lever (16)	Shift from position A to position B.	Ensure plunger retracts. The plunger may stick in cup seat.
	NOTE **Disregard presence of bubbles in bubble checker. Read air flow meter at top of ball flat.**	
8. Spacer (22)	a. Rotate in clockwise direction in small increments while reading air flow meter (25). Stop rotating when highest reading is obtained.	Do not touch plunger top under spacer (22) or any part of the cleaning mechanism while taking reading. External forces will disturb plunger from its normal position and may affect barrel-to-plunger leakage in cup area.
	b. Air flow meter (25) should not indicate over 4.5.	If reading is over 4.5, replace plunger and barrel in injector assembly (1).
9. Retractor lever (16)	Shift from B to A.	
10. T-handle clamp (15)	a. Loosen.	This will apply 200 lbs (889 kg) load to spacer (22).
	b. Check for injector cup leakage as follows: (1) Observe bubble checker (23). Bubbles should not appear during first 10 seconds of testing. (2) Once a bubble does appear, observe time it takes for next one to appear. Not more than one bubble can appear every five seconds.	If bubbling is too high, replace cup in injector assembly (1).

3-53. FUEL INJECTOR TESTING; TEST NO. 1 (Contd)



LEGEND:

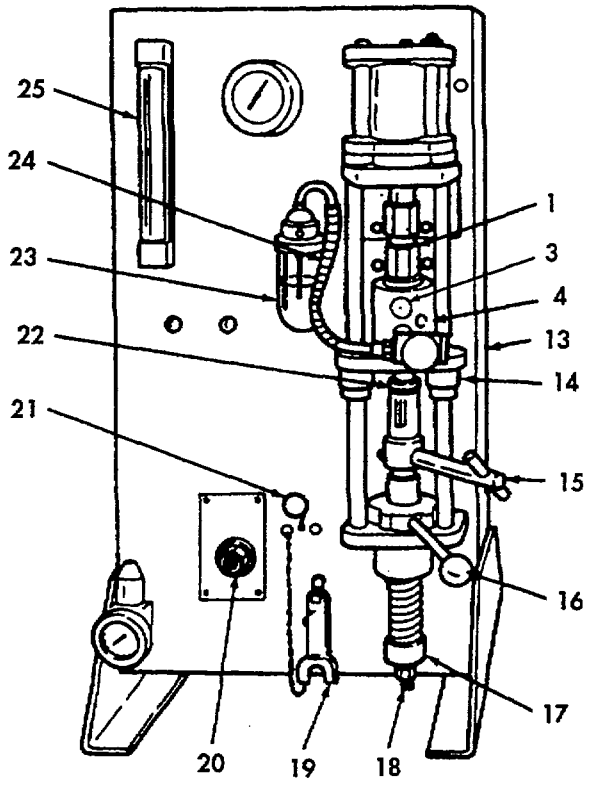
1. INJECTOR ASSEMBLY
13. LEAKAGE TESTER
14. SUPPORT PLATE
15. T-HANDLE CLAMP
16. RETRACTOR LEVER
17. KNURLED KNOB
18. LOCKNUT
19. FEELER GAUGE
22. SPACER
23. BUBBLE CHECKER
24. TRANSFER LINE
25. AIR FLOW METER

3-53. FUEL INJECTOR TESTING; TEST NO. 1 (Contd)

LOCATION/ITEM	ACTION	REMARKS
a. Cup to Plunger Seal Test (Contd)		
11. Transfer line (24)	Remove from adapter (4).	
12. Cylinder actuation valve (21)	Release air pressure.	
13. Injector assembly (1)	Remove from leakage tester (13) and adapter (4).	
14. Locating screw (3)	Remove from adapter (4).	
b. Check Ball Leakage		
15. Transfer line (24)	Install on inlet port of adapter (4).	
16. Adapter (4)	Install plug.	This is plug ST-668-14.
17. Pressure regulator (20)	Adjust to 80 psi (551 kPa).	
18. Cylinder actuation valve (21)	Direct air flow to plug.	
19. Air flow meter (25)	Observe reading.	Maximum reading of 12 units is acceptable. If reading exceeds 12, rework injector seat. In some cases, replacing check ball is all that is required.

FOLLOW-ON TASK: Perform fuel injector testing: Test No. 2 (para. 3-54).

3-53. FUEL INJECTOR TESTING; TEST NO. 1 (Contd)



LEGEND:

1. INJECTOR ASSEMBLY
3. LOCATION SCREW
4. ADAPTER
13. LEAKAGE TESTER
20. PRESSURE REGULATOR
21. CYLINDER ACTUATION VALVE
24. TRANSFER LINE
25. AIR FLOW METER

3-54. FUEL INJECTOR TESTING; TEST NO. 2

THIS TASK COVERS:

a. Setting Up Spray Pattern Tester

b. Spray Pattern Test

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Plunger bore plug assembly (15434) ST-668-5012

TEST EQUIPMENT
Injector test stand (15434) ST-790
Spray test fixture (15434) ST-668

MATERIALS/PARTS
None

PERSONNEL REQUIRED
Fuel and electrical systems repairman
MOS 63G

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Table 2-8

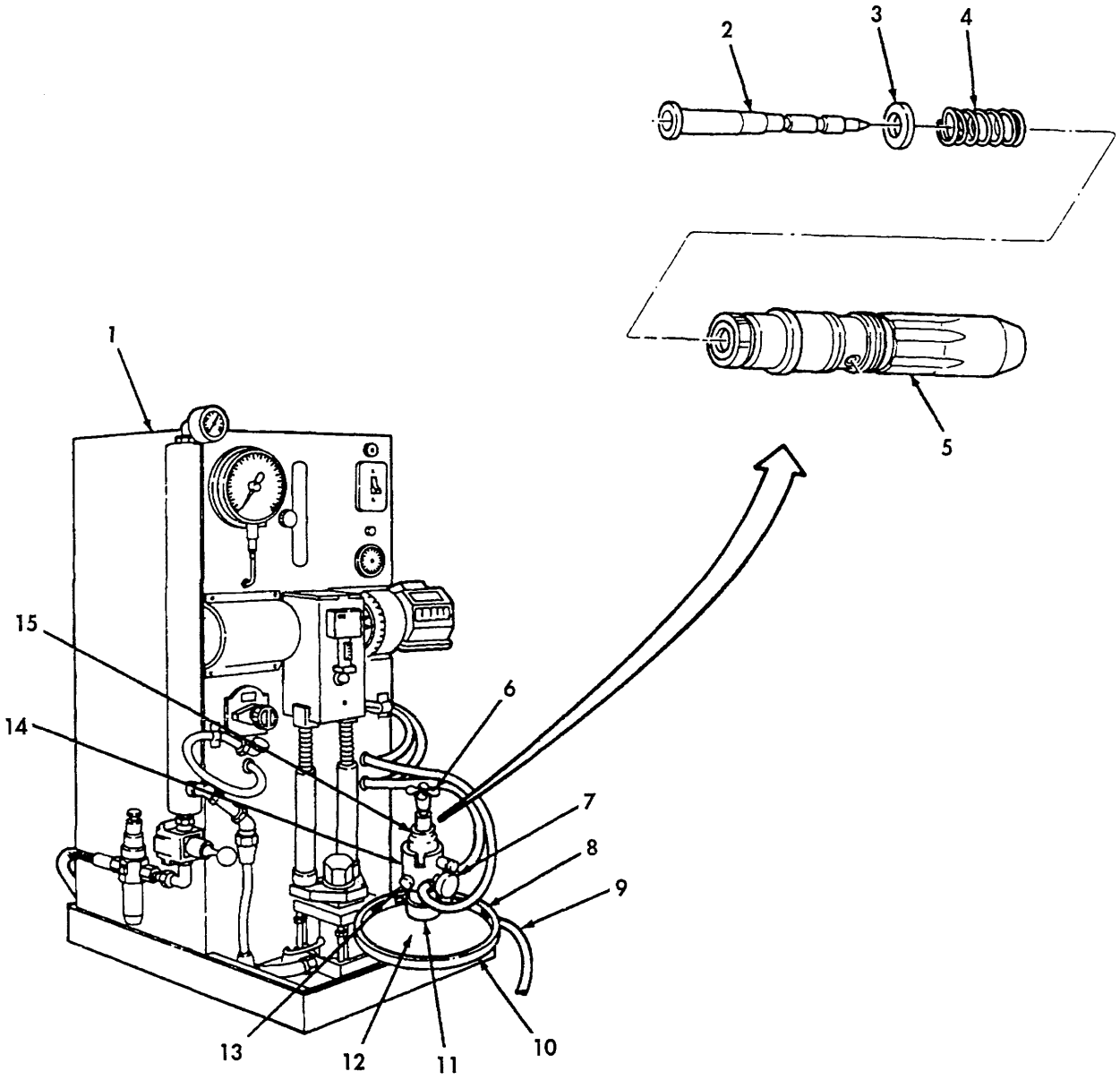
EQUIPMENT CONDITION
Fuel injector test No. 1 performed (para. 3-53).

SPECIAL ENVIRONMENTAL CONDITION
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS
a. Setting Up Spray Pattern Tester		
1. Injector assembly (5)	a. Remove plunger (2), injector spring (4), and spring retainer (3). b. Install on adapter (14).	Store plunger (2), spring retainer (3), and injector spring (4) in a safe place.
2. Injector plunger bore of injector assembly (5)	Install plunger bore plug with rubber seal.	The correct type of plunger bore plug and rubber seal is determined by the type of injector.
3. Knurled plug (13)	Install on adapter (14) drain opening.	
4. Seat bracket bore (11)	Install applicable seat spacer.	Use an 18° cup with spacer marking H-18. Seat spacer is part of spray test fixture.
5. Target ring (12)	Place in spray pattern adapter base (10).	Select correct target ring (12). Target rings (12) are marked on handle.
6. Injector assembly (5)	Place in spray pattern tester (8) and tighten inlet hose connector (7).	
7. Holddown bracket (15)	Position injector assembly (5) in holddown bracket (15) and secure with knurled plug (13).	
8. Spray pattern tester (8)	Locate near or on injector test stand (1).	Any source of 22 psi (152 kPa) constant fuel pressure will operate spray pattern tester.

3-54. FUEL INJECTOR TESTING; TEST NO. 2 (Contd)



LEGEND:

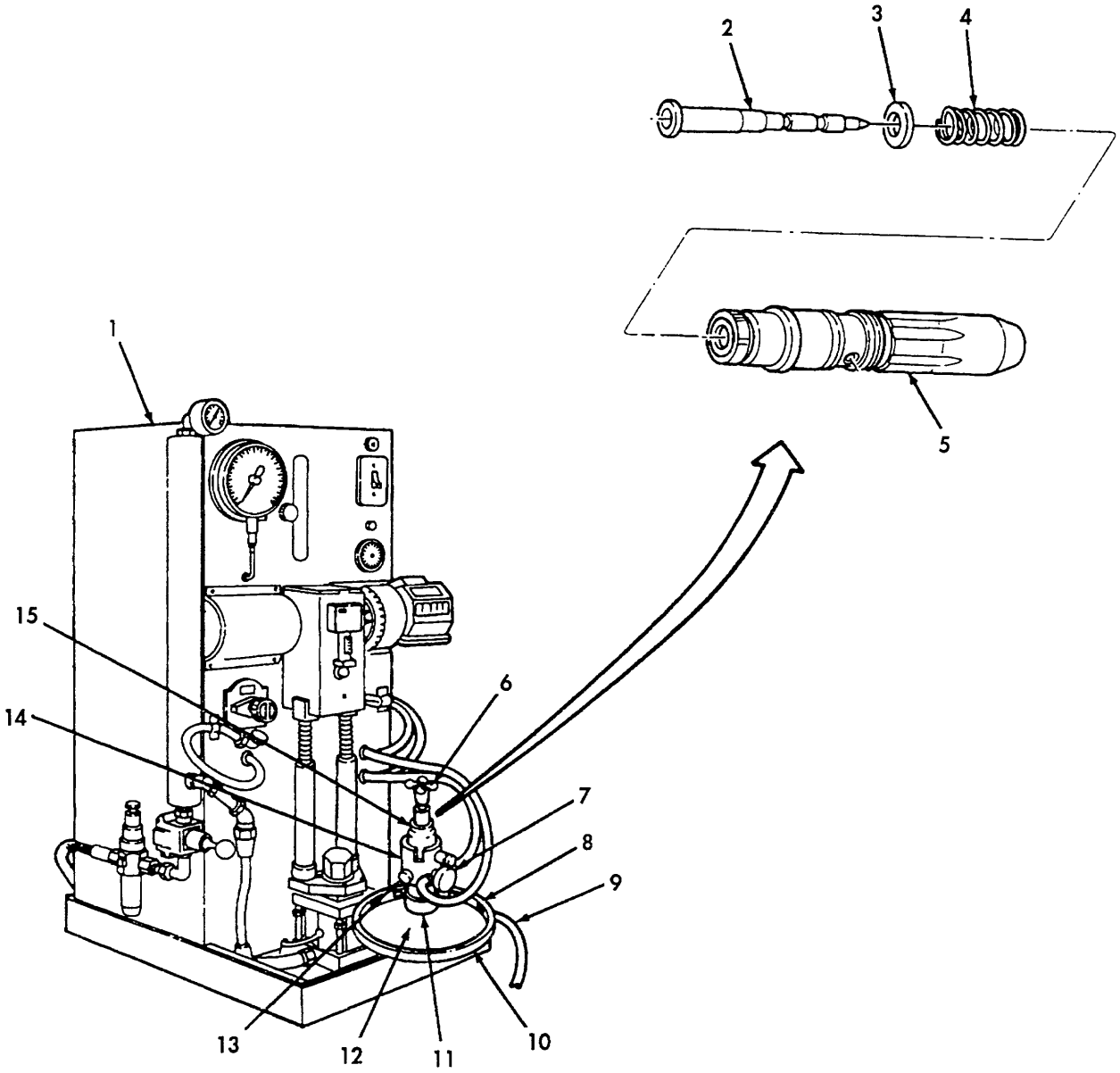
1. INJECTOR TEST STAND
2. PLUNGER
3. SPRING RETAINER
4. INJECTOR SPRING
5. INJECTOR ASSEMBLY
6. KNOB
7. INLET HOSE CONNECTOR
8. SPRAY PATTERN TESTER
9. DRAIN HOSE
10. ADAPTER BASE
11. SEAT BRACKET BORE
12. TARGET RING
13. KNURLED PLUG
14. ADAPTER
15. HOLDDOWN BRACKET

3-54. FUEL INJECTOR TESTING; TEST NO. 2 (Contd)

LOCATION/ITEM	ACTION	REMARKS
a. Setting Up Spray Pattern Tester (Contd)		
9. Inlet hose connector (7)	Connect to adapter (14) from injector test stand (1).	
10. Drain hose (9)	Connect to adapter base (10) and place loose end in test stand drain pan.	
b. Spray Pattern		
11. Injector test stand (1)	Apply 22 psi (152 kPa) fuel pressure.	
12. Target ring (12)	a. Shift so one spray stream hits center of No. 1 or index window.	This can be observed through window and is next to target slide handle.
	b. Each spray stream must hit a window in target ring (12).	
13. Holddown bracket (15)	Loosen knob (6).	
14. Injector assembly (5)	Remove from spray pattern tester (8).	
15. Knurled plug (13)	Remove from adapter (14).	
16. Injector assembly (5)	Remove from adapter (14).	
17. Injector spring (4), spring retainer (3), and plunger (2)	Install on injector assembly (5).	

FOLLOW-ON TASK: Perform fuel injector testing; Test No. 3 (para. 3-55).

3-54. FUEL INJECTOR TESTING; TEST NO. 2 (Contd)



LEGEND:

1. INJECTOR TEST STAND
2. PLUNGER
3. SPRING RETAINER
4. INJECTOR SPRING
5. INJECTOR ASSEMBLY
6. KNOB
7. INLET HOSE CONNECTOR
8. SPRAY PATTERN TESTER
9. DRAIN HOSE
10. ADAPTER BASE
12. TARGET RING
13. KNURLED PLUG
14. ADAPTER
15. HOLDDOWN BRACKET

3-55. FUEL INJECTOR TESTING; TEST NO. 3

THIS TASK COVERS:

a. Setting Up Test Stand
b. Setting Up Injector on Test Stand
c. Testing Check Ball Seating
d. Adjusting and Measuring Fuel Delivery
e. Top-stop Injector Adjustment

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Test stand link (15434) ST 790-331
Master injector (15434) ST-1262

TEST EQUIPMENT
Injector test stand (15434) ST-790

MATERIALS/PARTS
Fluid, automatic transmission, type A (Appendix C, Item 11)
Oil, lubricating, OE/HDO 30 (Appendix C, Item 21)

PERSONNEL REQUIRED
Fuel and electrical systems repairman
MOS 63G

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
Fuel injector test No. 2 performed (para. 3-54).

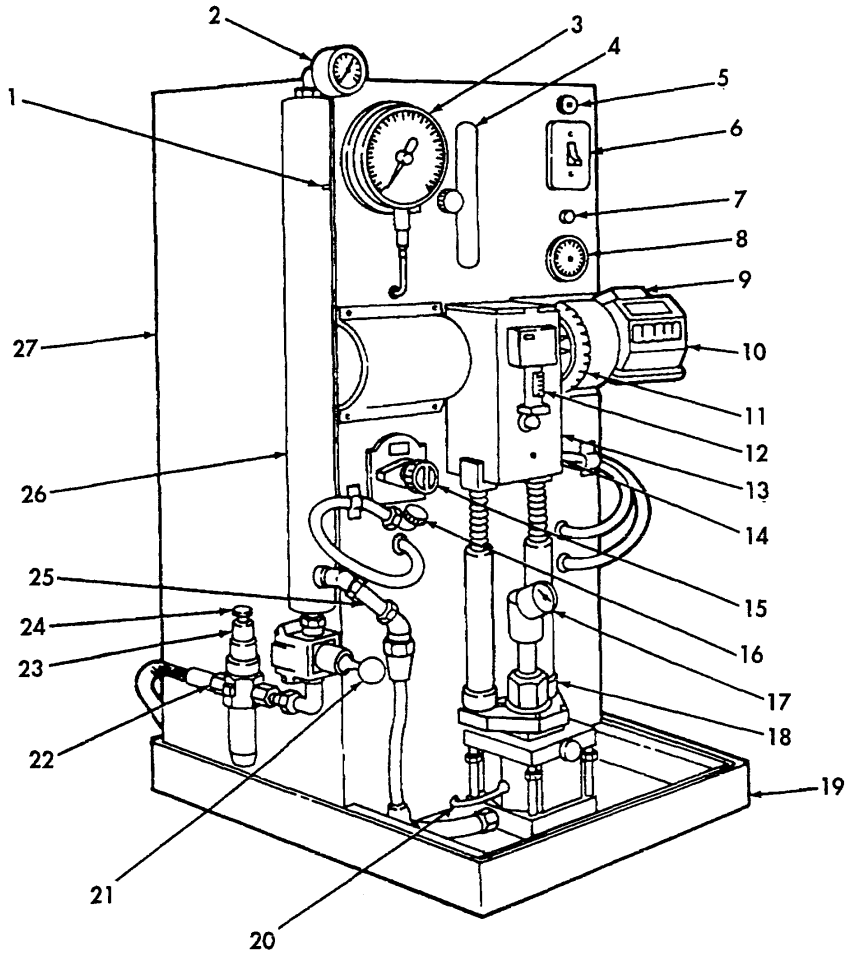
SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS
a. Setting Up Test		
	NOTE **Check fluid levels on injector test stand. The cam box is filled to the top level of sight glass with OE/HDO 30 lubricating oil. Refill when oil level drops to bottom level of sight glass. Fill hydraulic fluid reservoir to bulb level with type A automatic transmission fluid. Be careful not to allow oil to enter standpipe in center of reservoir. The test oil level in stand must be kept at least 3/4 full of test fuel.**	
1. Timing wheel (11)	Rotate so wheel mark and pointer are aligned.	
2. Hydraulic valve (20)	Open.	
	CAUTION **Do not operate test stand with load cell in position or damage may result.**	
3. Load cell tester (17)	Position on test stand (27) and secure by opening air valve (21).	
4. Air pressure regulator (22)	a. Adjust by turning knurled knob (24) until load cell tester (17) registers within coded range markings. b. Lock in place with locknut (23).	Load cell tester (17) must be between 370 and 390 when adjusted within marked band on dial.

3-55. FUEL INJECTOR TESTING; TEST NO. 3 (Contd)

LOCATION/ITEM	ACTION	REMARKS
5. Load cell tester (17)	Remove as follows:	
	a. Place air valve (21) to center position.	
	b. Remove load cell tester (17).	With cylinder down, hydraulic fluid level should show in hydraulic fluid level sight bulb (1). If fluid level is low, add type A Automatic transmission fluid.



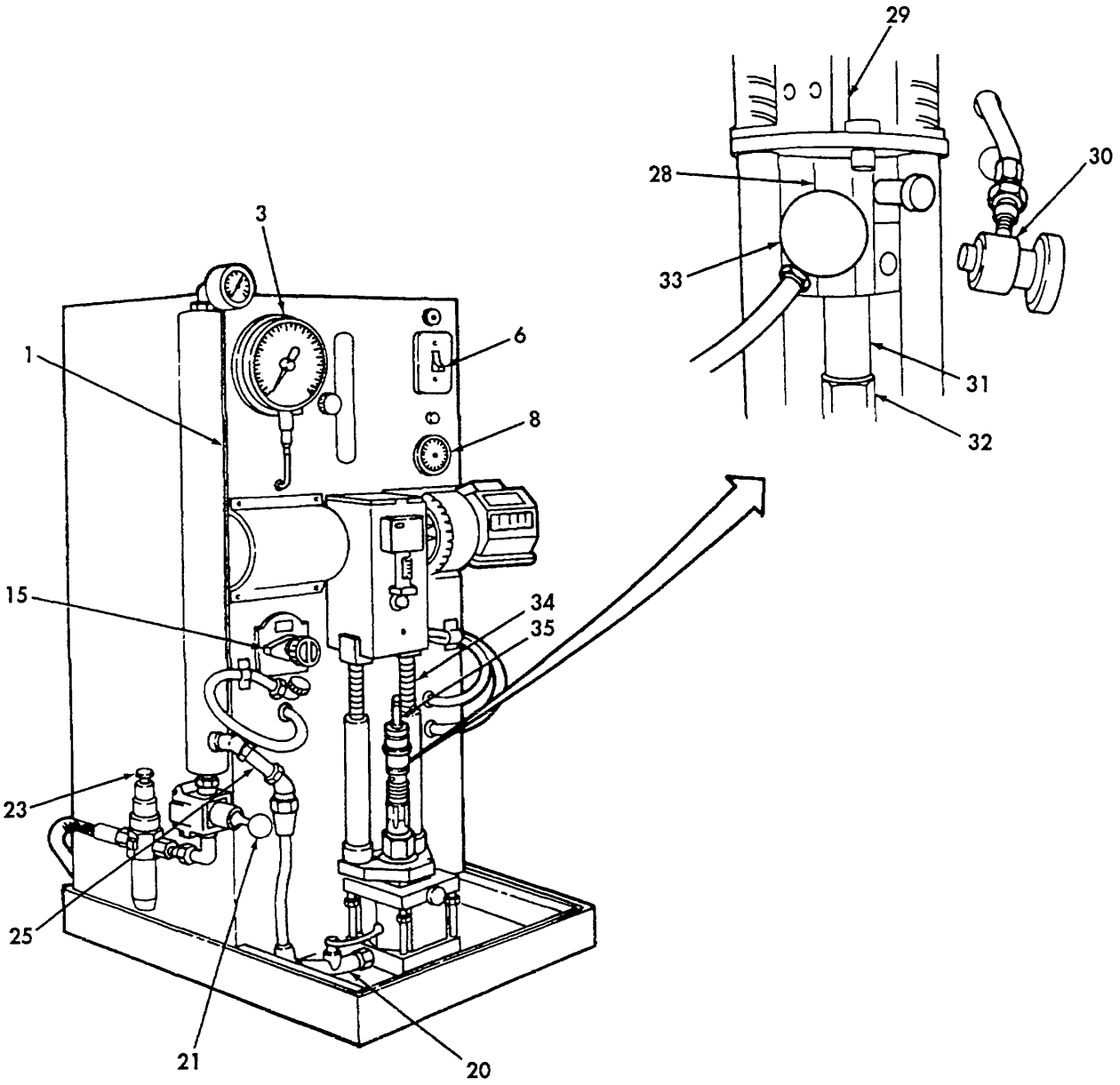
LEGEND:

1. HYDRAULIC FLUID LEVEL SIGHT BULB
2. AIR GAUGE
3. FUEL PRESSURE GAUGE
4. VIAL GRADUATE
5. VIAL LIGHT SWITCH
6. START-STOP SWITCH
7. FLOW START SWITCH
8. TEMPERATURE GAUGE
9. SOLENOID
10. COUNTER
11. TIMING WHEEL
12. SIGHT GLASS
13. CAM BOX
14. INLET
15. PRESSURE REGULATOR
16. OUTLET
17. LOAD CELL TESTER
18. ORIFICE HOLDER
19. DRAIN PAN
20. HYDRAULIC VALVE
21. AIR VALVE
22. AIR PRESSURE REGULATOR
23. LOCKNUT
24. KNURLED KNOB
25. HYDRAULIC FLUID SIGHT GLASS
26. HYDRAULIC FLUID RESERVOIR
27. INJECTOR TEST STAND

3-55. FUEL INJECTOR TESTING; TEST NO. 3 (Contd)

LOCATION/ITEM	ACTION	REMARKS
a. Setting Up Test Stand (Contd)		
6. Air valve (21)	Open with cylinder at top of its travel; no air should show in hydraulic fluid sight glass (25).	If air is indicated, tighten all line connections.
	CAUTION **The master injector is precalibrated and must never be reset or accuracy of test will be affected.**	
7. Adapter (28)	Place on master injector (31).	Ensure timing marks are aligned at timing wheel (step 1).
	CAUTION **Ensure injector seat contains 0.020 in. (0.508 mm) restrictor orifice or damage to injector seat may result.**	
8. Test stand link (29)	Position over plunger link (35). Place master injector (31) in injector seat (32).	Tip back until test stand link (29) is below test stand pushrod (34) and not rubbing.
9. Air valve (21)	Open to clamp master injector (31) in place.	Ensure test stand link (29) is aligned.
10. Hydraulic valve (20)	Close to lock master injector (31) in place.	
11. Fuel drain connector (33)	Connect to adapter (28).	
12. Fuel inlet connector (30)	Connect to adapter (28).	

3-55. FUEL INJECTOR TESTING; TEST NO. 3 (Contd)



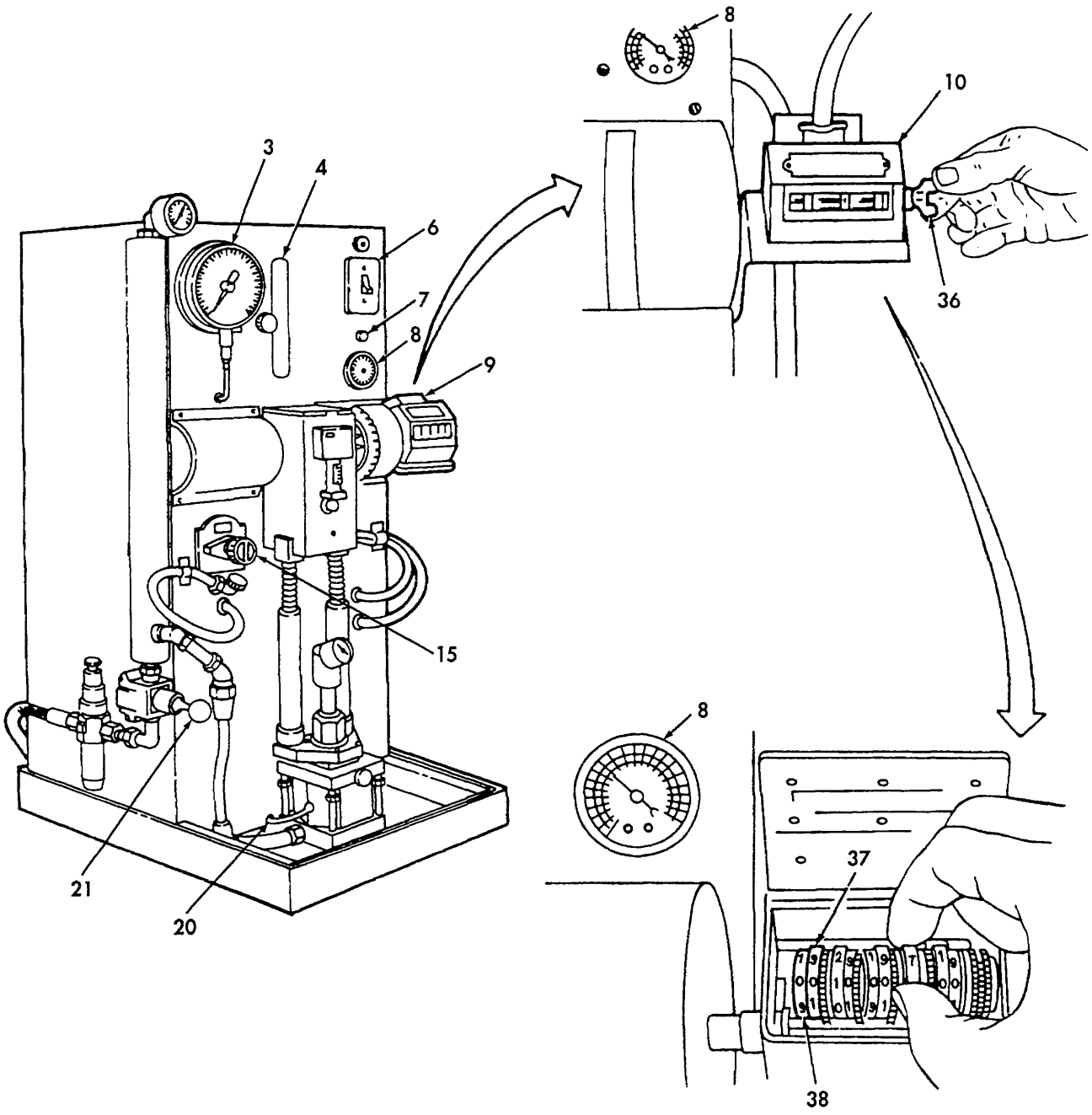
LEGEND:

1. HYDRAULIC FLUID LEVEL SIGHT BULB
17. LOAD CELL TESTER
20. HYDRAULIC VALVE
21. AIR VALVE
23. LOCKNUT
25. HYDRAULIC FLUID SIGHT GLASS
28. ADAPTER
29. TEST STAND LINK
30. FUEL INLET CONNECTOR
31. MASTER INJECTOR
32. INJECTOR SET
33. FUEL DRAIN CONNECTOR
34. PUSHROD
35. PLUNGER LINK

3-55. FUEL INJECTOR TESTING; TEST NO. 3 (Contd)

LOCATION/ITEM	ACTION	REMARKS
a. Setting Up Test Stand (Contd)		
	CAUTION **Test oil must be a minimum 90°F (32°C). If temperature is not up to 90°F (32°C), test stand must be warmed up on a standard injector, not a master injector. If temperature exceeds 95°F (35°C), increase cold water flow. If temperature exceeds 135°F (57°C), drain and replace with new test oil.**	
13. Start-stop switch (6)	Place in start position.	Temperature gauge (8) should read 90-95°F (32-35°C).
14. Pressure regulator (15)	Adjust by turning until fuel pressure gauge (3) reads 120 psi (827 kPa).	Pressure must be maintained at 120 psi (827 kPa) during injector calibration.
15. Counter (10)	Set as follows:	
	a. Shift silver counter wheels (38) to the right.	
	b. Rotate to indicate 1,020 strokes and release.	
	c. Clear counter (10) by rotating thumbscrew (36) one complete revolution.	All white counter wheels (37) must read zero.
16. Flow start switch (7)	Press in and out until counter (10) reads 1,020 strokes.	Stir fuel with a rod to settle out foam. Check amount of fuel collected in vial graduate (4) at end of 1,020 counter strokes.
17. Vial graduate (4)	Look directly into vial graduate (4) and observe reading.	Look directly into vial graduate (4) at fuel to avoid parallax. Correct reading is 178 cc at 80 percent of stroke travel.
	NOTE **Reading of 178 cc at 80 percent of stroke travel indicates test stand is in calibration. If reading is more than 178 cc, test stand is not set up properly. Repeat set-up steps if reading is below 178 cc.**	
18. Counter (10)	a. Roll counter (10) back.	Refer to step 15.
	b. Set counter (10) up seven strokes for each cc less than 178 cc.	
19. Vial graduate (4)	Dump fuel.	
20. Flow start switch (7)	Press in and out until counter (10) sets strokes to obtain 178 cc.	
	NOTE **If counter is set beyond 1,050 strokes to obtain 178 cc, test stand is not properly calibrated. Repeat set-up steps. If counter reads 1,050 or below, test stand is in calibration.**	
21. Start-stop switch (6)	Place in stop position.	

3-55. FUEL INJECTOR TESTING; TEST NO. 3 (Contd)



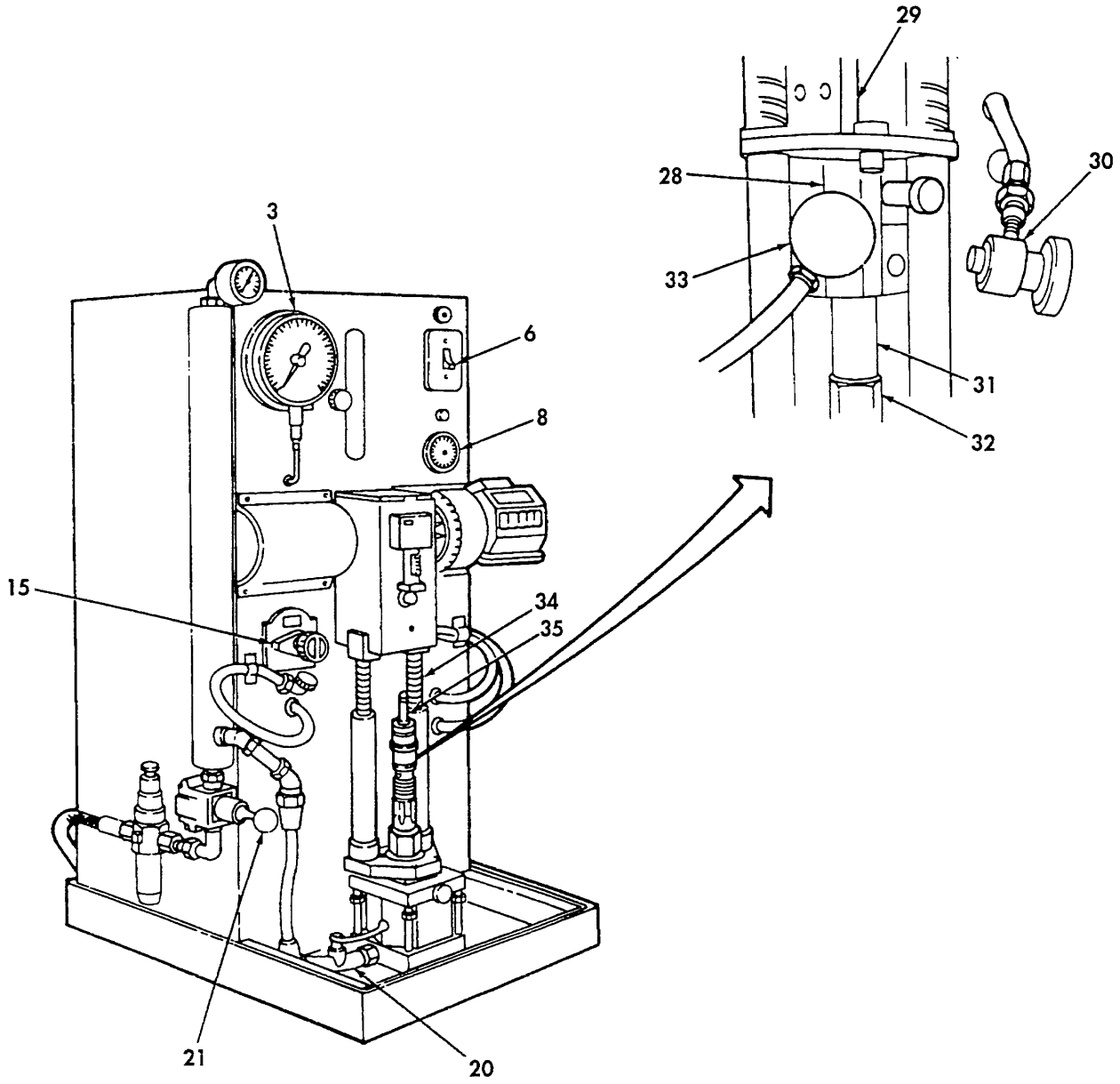
LEGEND:

3. FUEL PRESSURE GAUGE
4. VIAL GRADUATE
6. START-STOP SWITCH
7. FLOW START SWITCH
8. TEMPERATURE GAUGE
9. SOLENOID
10. COUNTER
15. PRESSURE REGULATOR
20. HYDRAULIC VALVE
21. AIR VALVE
36. THUMBSCREW
37. WHITE COUNTER WHEELS
38. SILVER COUNTER WHEELS

3-55. FUEL INJECTOR TESTING; TEST NO. 3 (Contd)

LOCATION/ITEM	ACTION	REMARKS
a. Setting Up Test Stand (Contd)		
22. Fuel inlet connector (30)	Remove from adapter (28).	
23. Hydraulic valve (20)	Open.	
24. Air valve (21)	Close.	
25. Master injector (31)	Remove.	
26. Test stand link (29)	Slide off plunger link (35).	
27. Adapter (28)	a. Remove test stand fuel inlet connector (30). b. Remove adapter (28) from master injector (31).	

3-55. FUEL INJECTOR TESTING; TEST NO. 3 (Contd)



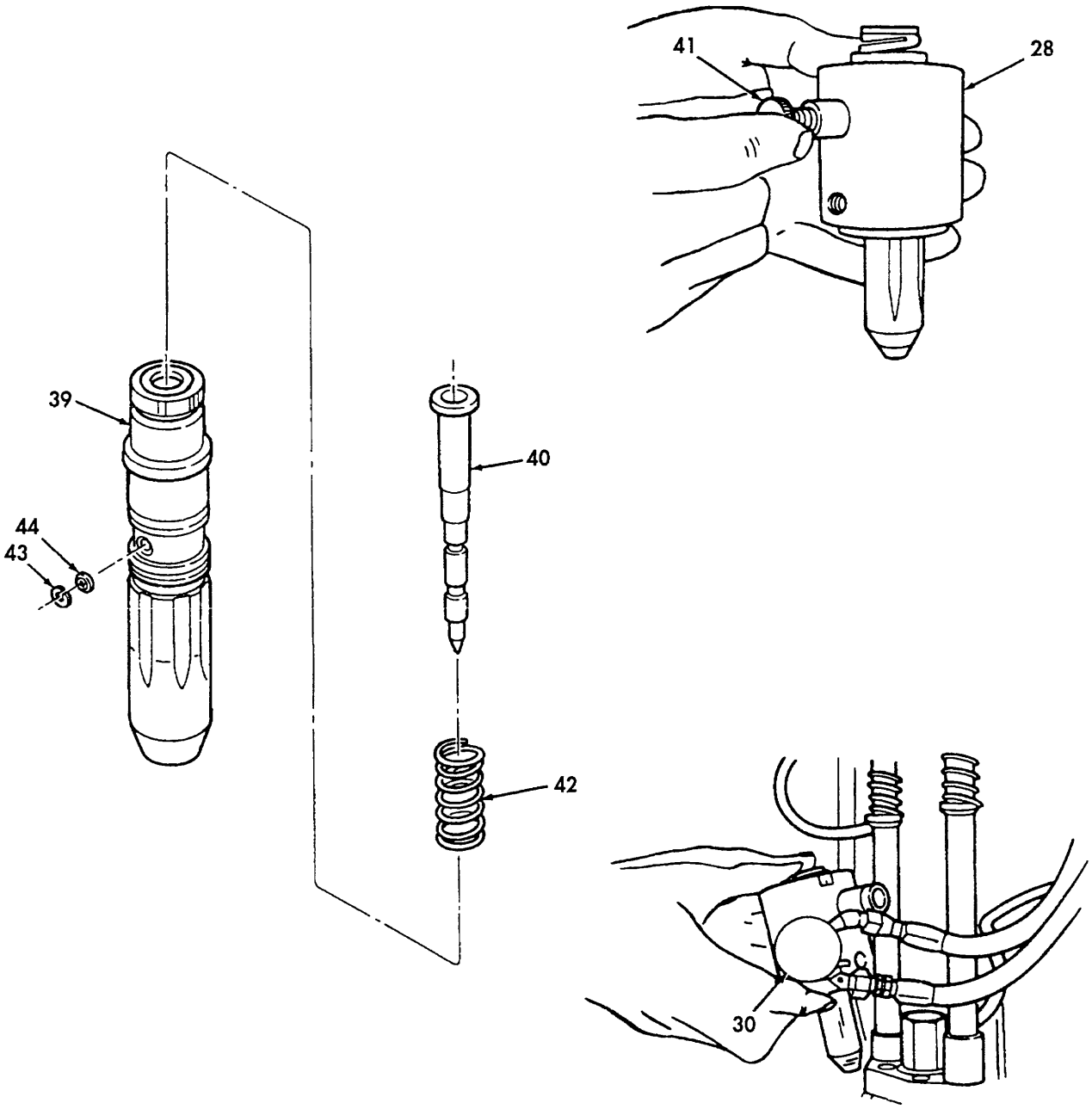
LEGEND:

6. START-STOP SWITCH
20. HYDRAULIC VALVE
21. AIR VALVE
28. ADAPTER
29. TEST STAND LINK
30. FUEL INLET CONNECTOR
31. MASTER INJECTOR
35. PLUNGER LINK

3-55. FUEL INJECTOR TESTING; TEST NO. 3 (Contd)

LOCATION/ITEM	ACTION	REMARKS
b. Setting Up Injector on Test		
	NOTE • **The top-stop adjustment is made after top-stop type injector is calibrated.** • **Install 0.020 in. (0.508 mm) restriction orifice in cup seat and tighten to 6 lb-in. (0.9 N•m).**	
28. Filter and screen clip (43) and filter screen (44)	Remove.	
29. Plunger (40) and injector spring (42)	Remove.	
30. Plunger (40)	Place in injector assembly (39) without injector spring (42).	
31. Adapter (28)	Lubricate inside with diesel fuel.	Lubrication permits O-rings to slide more easily in adapter (28).
32. Injector assembly (39)	a. Position in adapter (28) so injector assembly (39) inlet port and adapter (28) inlet holes are aligned. b. Secure by tightening locating screw (41) on adapter (28).	
33. Fuel inlet connector (30)	Connect to adapter (28).	

3-55. FUEL INJECTOR TESTING; TEST NO. 3 (Contd)



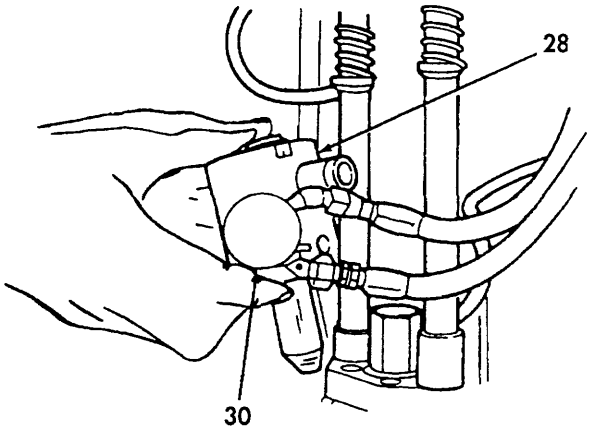
LEGEND:

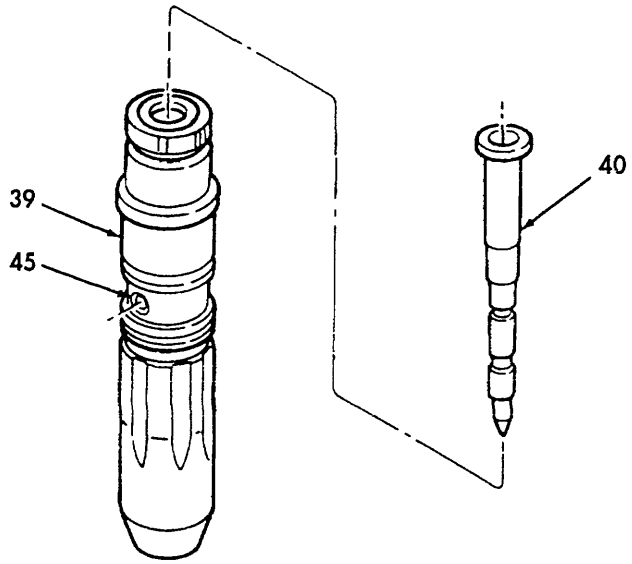
28. ADAPTER
30. FUEL INLET CONNECTOR
39. INJECTOR ASSEMBLY
40. PLUNGER
41. LOCATING SCREW
42. INJECTOR SPRING
43. FILTER AND SCREEN CLIP
44. FILTER SCREEN

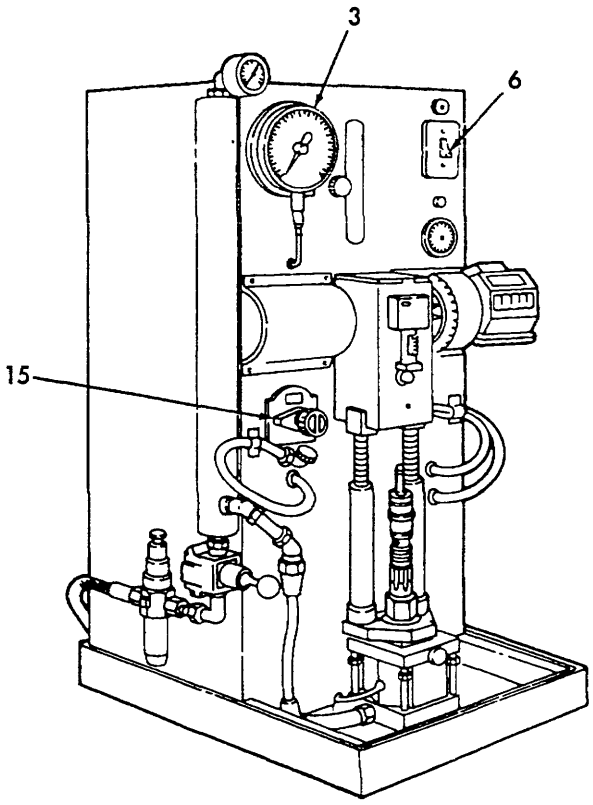
3-55. FUEL INJECTOR TESTING; TEST NO. 3 (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Testing Check Ball Seating		
	NOTE **Hold injector in hand; do not place in test stand holding device.**	
34. Plunger (40)	Hold plunger (40) down in injector assembly (39).	Injector assembly (39) must be in vertical position.
35. Start-stop switch (6)	Place in start position.	
36. Pressure regulator (15)	Adjust to 150 psi (1034 kPa) on fuel pressure gauge (3).	
37. Orifice plug inlet opening (45)	Check for leakage.	Plunger (40) must be seated in cup. If leakage is observed, check ball must be replaced. Slight seepage is acceptable.
38. Start-stop switch (6)	Place in stop position.	
39. Fuel inlet connector (30)	Disconnect from adapter (28).	

3-55. FUEL INJECTOR TESTING; TEST NO. 3 (Contd)







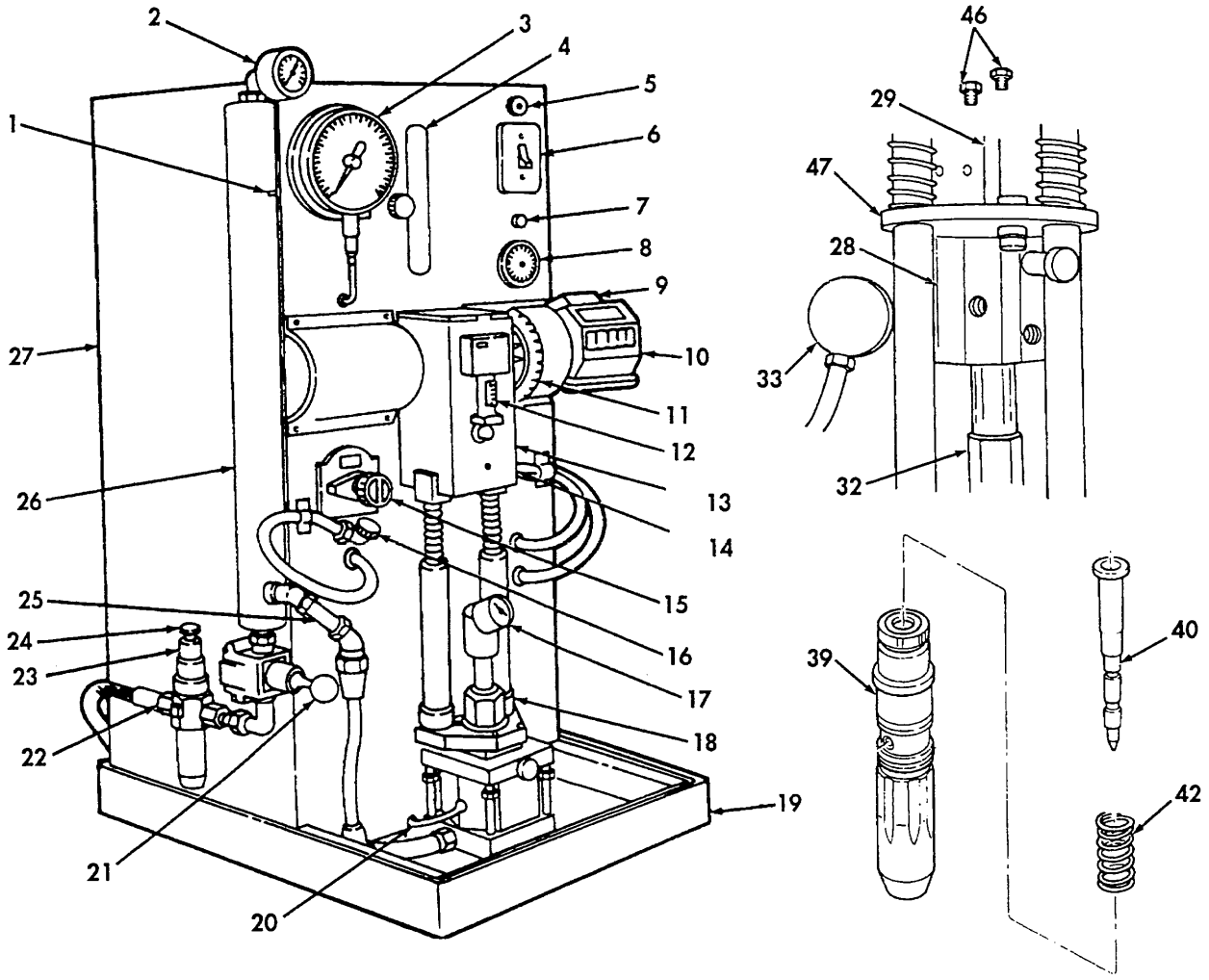
LEGEND:

3. FUEL PRESSURE GAUGE
6. START-STOP SWITCH
15. PRESSURE REGULATOR
28. ADAPTER
30. FUEL INLET CONNECTOR
39. INJECTOR ASSEMBLY
40. PLUNGER
45. ORIFICE PLUG INLET OPENING

3-55. FUEL INJECTOR TESTING; TEST NO. 3 (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Adjusting and Measuring Fuel Delivery		
40. Plunger (40)	Remove from injector assembly (39).	
41. Injector spring (42) and plunger (40)	Place in injector assembly (39).	
42. Retainer plate (47)	Place over injector assembly (39).	
43. Two pins (46)	Screw on adapter (28).	
44. Test stand link (29)	Place on adapter (28) so contact is made with top plunger (40).	Use test stand link (29) 6.50 in. (165 mm) long.
NOTE **All tests on test stand are performed without an inlet screen in injector.**		
45. Injector assembly (39)	Place on test stand so injector assembly is in injector seat (32).	

3-55. FUEL INJECTOR TESTING; TEST NO. 3 (Contd)



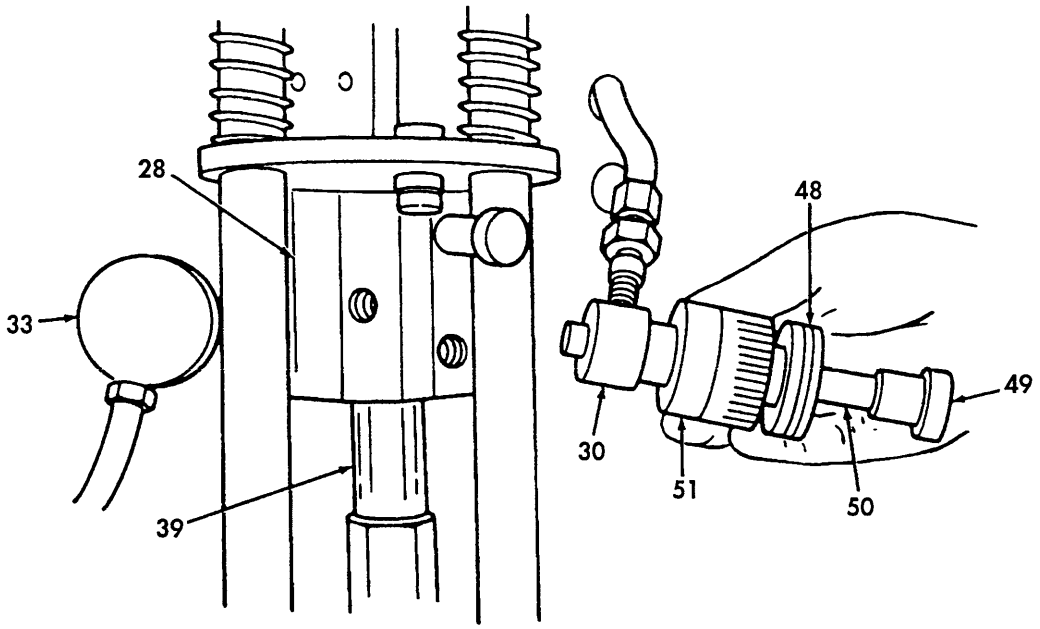
LEGEND:

28. ADAPTER
29. TEST STAND LINK
32. INJECTOR SEAT
39. INJECTOR ASSEMBLY
40. PLUNGER
42. INJECTOR SPRING
46. PIN (2)
47. RETAINER PLATE

3-55. FUEL INJECTOR TESTING; TEST NO. 3 (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Adjusting and Measuring Fuel Delivery (Contd)		
46. Burnishing tool (51)	Install on test stand fuel inlet connector (30).	
47. Burnishing tool needle (50)	Retract by pulling small knob (49) out.	With needle (50) retracted, burnishing tool (51) may be left in adapter during all test operations.
48. Fuel inlet connector (30)	Connect to adapter (28) inlet hole.	Connect by turning in large knob (48).
49. Fuel drain connector (33)	Turn screw on adapter (28).	
50. Injector assembly (39)	Run through test cycle.	Check cc delivery. If 600 stroke delivery is lower than 175-176 cc with top-stop set at 0.224 in. (5.670 mm), turn knob with indicator point until it is spaced 0.375 in. (9.525 mm) from large knob.

3-55. FUEL INJECTOR TESTING; TEST NO. 3 (Contd)



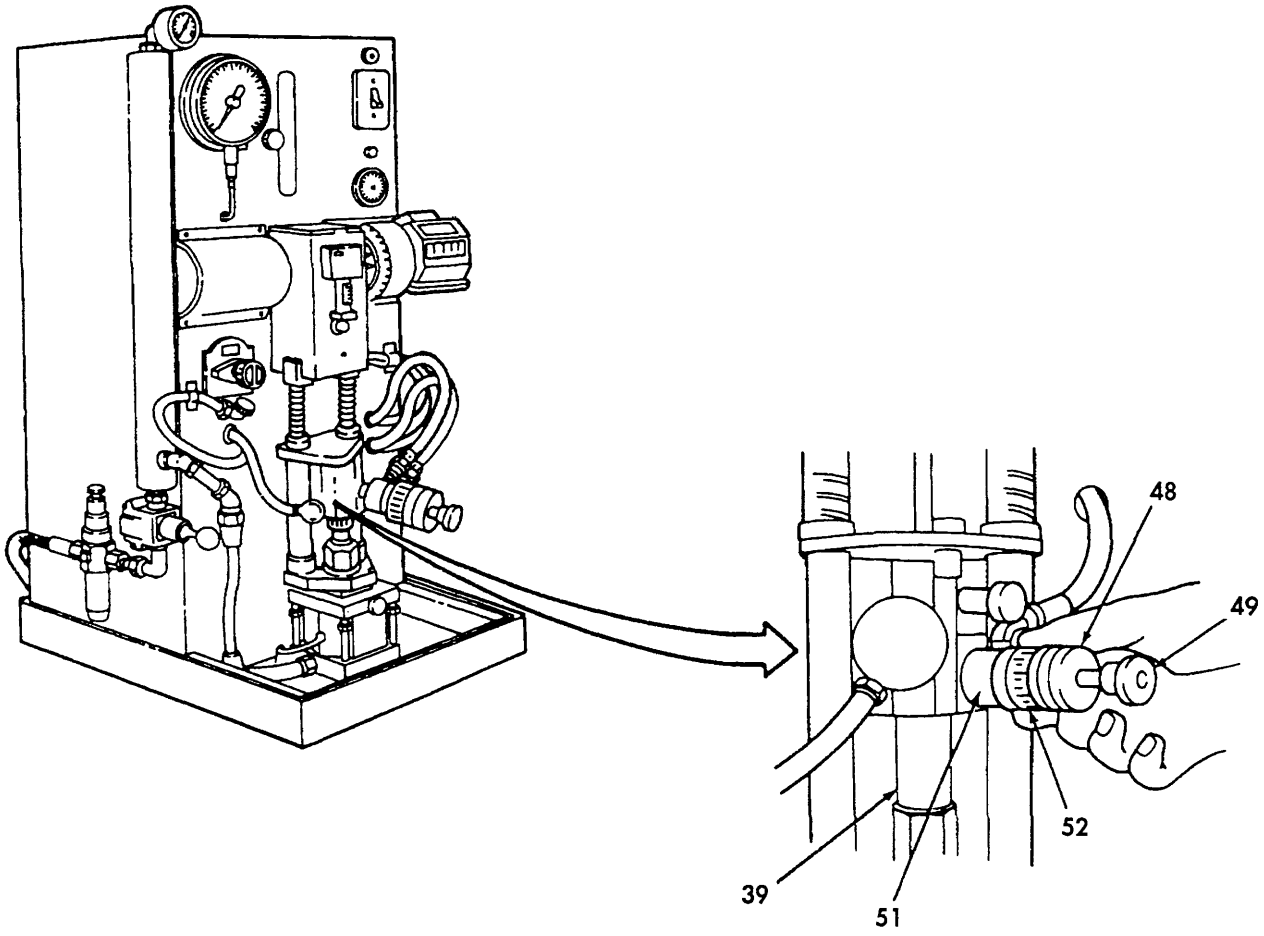
LEGEND:

28. ADAPTER
30. FUEL INLET CONNECTOR
33. FUEL DRAIN CONNECTOR
39. INJECTOR ASSEMBLY
48. LARGE KNOB
49. SMALL KNOB
50. BURNISHING TOOL NEEDLE
51. BURNISHING TOOL

3-55. FUEL INJECTOR TESTING; TEST NO. 3 (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Adjusting and Measuring Fuel Delivery (Contd)		
	NOTE **The following instructions are for ST-790 test stand only. Refer to operating instructions for any other test stand.**	
	CAUTION **When seating burnishing tool, use care not to push small knob in too hard or overtighten indicator knob. Stop when slight contact is made. Damage can be caused to injector assembly. Test stand must be running while burnishing.**	
51. Burnishing tool (51)	Burnish as follows:	
	a. Turn indicating knob (52) until there is a space 0.375 in. (9.525 mm) from large knob (48).	
	b. Slowly push small knob (49) in until slight contact is made on injector assembly (39).	
	c. Turn small knob (49) counterclockwise to lock with large knob (48) and indicating knob (52).	
	d. Slowly turn indicating knob (52) in until slightly seated in injector assembly (39).	Do not overtighten.
	e. Index indicator knob (52) with mark on large knob (48).	
	f. Advance indicator knob (52) one mark and back off until spaced 0.375 in. (9.525 mm).	Check fuel delivery. After each four cycles, reclamp injector assembly to ensure accuracy.

3-55. FUEL INJECTOR TESTING; TEST NO. 3 (Contd)



LEGEND:

39. INJECTOR ASSEMBLY
48. LARGE KNOB
49. SMALL KNOB
51. BURNISHING TOOL
52. INDICATING KNOB

3-55. FUEL INJECTOR TESTING; TEST NO. 3 (Contd)

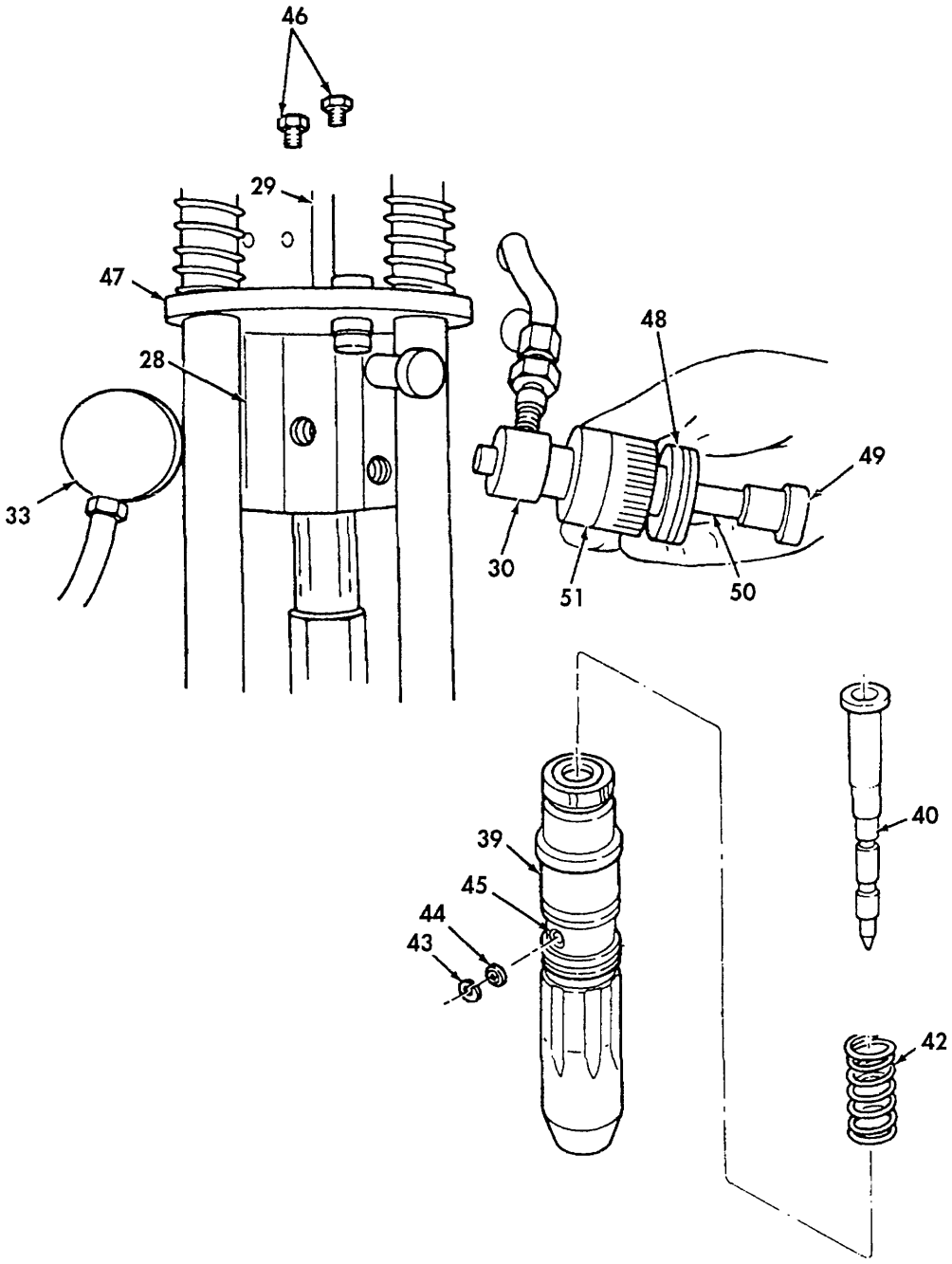
LOCATION/ITEM	ACTION	REMARKS
d. Adjusting and Measuring Fuel Delivery (Contd)		

NOTE

- **If fuel delivery is more than 176 cc, a new adjustable orifice must be installed in the injector. Tighten orifice plug to 8-10 lb-in. (11-14 N•m).**
- **Orifice plugs have flanges and require a gasket between flange and adapter.**

		g. Replacement inlet orifice plugs on burnishing tool (51) contain enough stock in inside diameter so a small displacement of metal by burnishing will increase fuel delivery.	
52.	Fuel inlet connector (30), fuel drain connector (33), and burnishing tool (51)	Disconnect from adapter (28).	Turn out large knob (48) on burnishing tool (51).
53.	Injector assembly (39)	Remove from test stand link (29).	
54.	Plunger (40) and injector spring (42)	Remove from injector assembly (39).	
55.	Adapter (28)	Remove from injector assembly (39).	
56.	Test stand link (29)	Slide out of adapter (28).	
57.	Two pins (46) and retainer plate (47)	Remove from adapter (28).	
58.	Filter and screen clip (43) and filter screen (44)	Install on orifice plug inlet opening (45) of injector assembly (39).	
59.	Plunger (40) and injector spring (42)	Install on injector assembly (39).	

3-55. FUEL INJECTOR TESTING; TEST NO. 3 (Contd)



LEGEND:

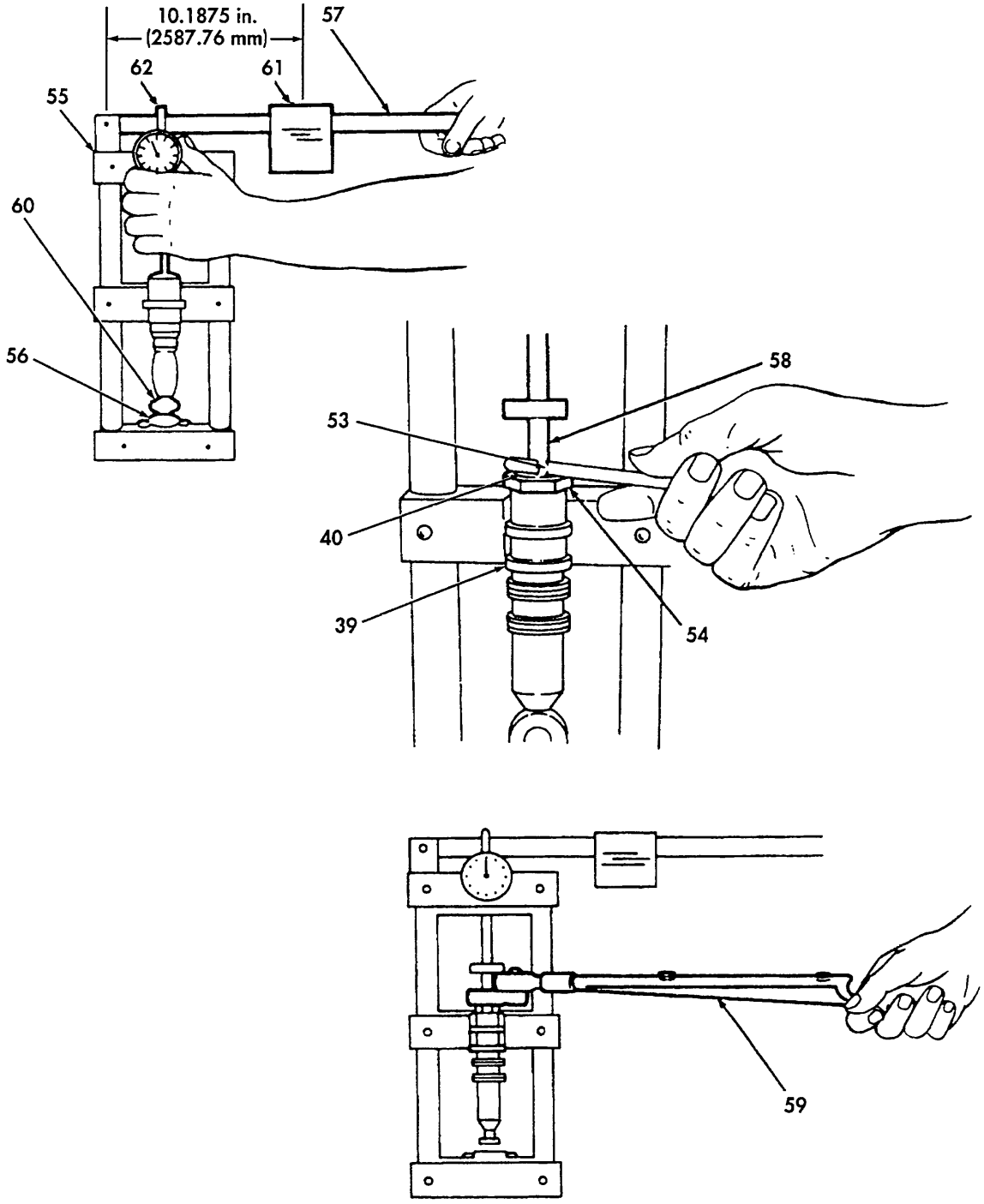
28. ADAPTER
29. TEST STAND LINK
30. FUEL INLET CONNECTOR
33. FUEL DRAIN CONNECTOR
39. INJECTOR ASSEMBLY
40. PLUNGER
42. INJECTOR SPRING
43. FILTER AND SCREEN CLIP
44. FILTER SCREEN
45. ORIFICE PLUG INLET OPENING
46. PIN (2)
47. RETAINER PLATE
48. LARGE KNOB
49. SMALL KNOB
50. BURNISHING TOOL NEEDLE
51. BURNISHING TOOL

3-55. FUEL INJECTOR TESTING; TEST NO. 3 (Contd)

LOCATION/ITEM	ACTION	REMARKS
e. Top-stop Injector		
60. Top-stop screw (53) and top-stop locknut (54)	Install on injector assembly (39).	Install with two threads of top-stop screw (53) protruding above top-stop locknut (54). This is a reference point only.
61. Injector assembly (39)	Install on setting fixture (55) and tighten.	Be certain that seat and cup of injector assembly (39) is centered over cup retainer (56).
62. Cup retainer (56)	Adjust and tighten upward to 100-115 lb-in. (11.3-12.5 N•m).	
63. Plunger (40)	a. Bottom in cup seat (60) with fixture handle (57).	Set dial indicator at zero. Weight (61) should be 10.1875 in. (258.76 mm) from centerline of dowel (62).
	b. Release slowly.	Observe travel required until plunger (40) spring washer contacts injector top-stop screw (53). Bottom plunger again and adjust stop (58) up or down as required until travel equals 0.224 in. (5.690 mm) ± 0.0005 in. ± (0.0127 mm).
64. Top-stop locknut (54)	Using torque wrench (59), tighten to 55 lb-ft (75 N•m).	Recheck travel after torquing.

FOLLOW-ON TASK: Install injector assembly (para. 3-82).

3-55. FUEL INJECTOR TESTING; TEST NO. 3 (Contd)



LEGEND:

39. INJECTOR ASSEMBLY
40. PLUNGER
53. TOP-STOP SCREW
54. TOP-STOP LOCKNUT
55. SETTING FIXTURE
56. CUP RETAINER
57. FIXTURE HANDLE
58. STOP
59. TORQUE WRENCH
60. CUP SEAT
61. WEIGHT
62. DOWEL

3-56. FUEL PUMP REPAIR

THIS TASK COVERS:

a. Installing Fuel Pump on Vise
b. Cleaning
c. Inspection
d. Removing Fuel Pump From Vise

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Fuel pump mounting plate (15434) 3375133
Ball joint vise (15434) ST-302

TEST EQUIPMENT
None

MATERIALS/PARTS
Solvent, SD-3 (Appendix C, Item 30)

PERSONNEL REQUIRED
Fuel and electrical systems repairman
MOS 63G

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
Fuel pump removed (para. 3-16).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
- Always wear eye protection when using compressed air.
- Use approved solvent in well-ventilated area and away from open flame.

LOCATION/ITEM	ACTION	REMARKS
a. Installing Fuel Pump on Vise		
1. Fuel pump (2)	Install fuel pump (2) on fuel pump mounting plate (3) with two screws and nuts.	
2. Ball joint vise (4)	Install fuel pump (2) and fuel pump mounting plate (3) on ball joint vise (4) with two screws.	Fuel pump mounting plate (3375133) (3) may be mounted on ball joint vise (ST-302) (4) before installing fuel pump (2).
b. Cleaning		

WARNING

- **Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and protective equipment such as goggles or shield, gloves, etc. Failure to comply may result in injury to personnel.**
- **Approved solvents may be flammable and will not be used near open flame. Use only in well-ventilated area. Failure to comply may result in injury to personnel.**

NOTE

Fuel pumps used on M915/Big Cam I and M915A1/Big Cam III diesel engines are very similar but not identical. Adjust for change accordingly.

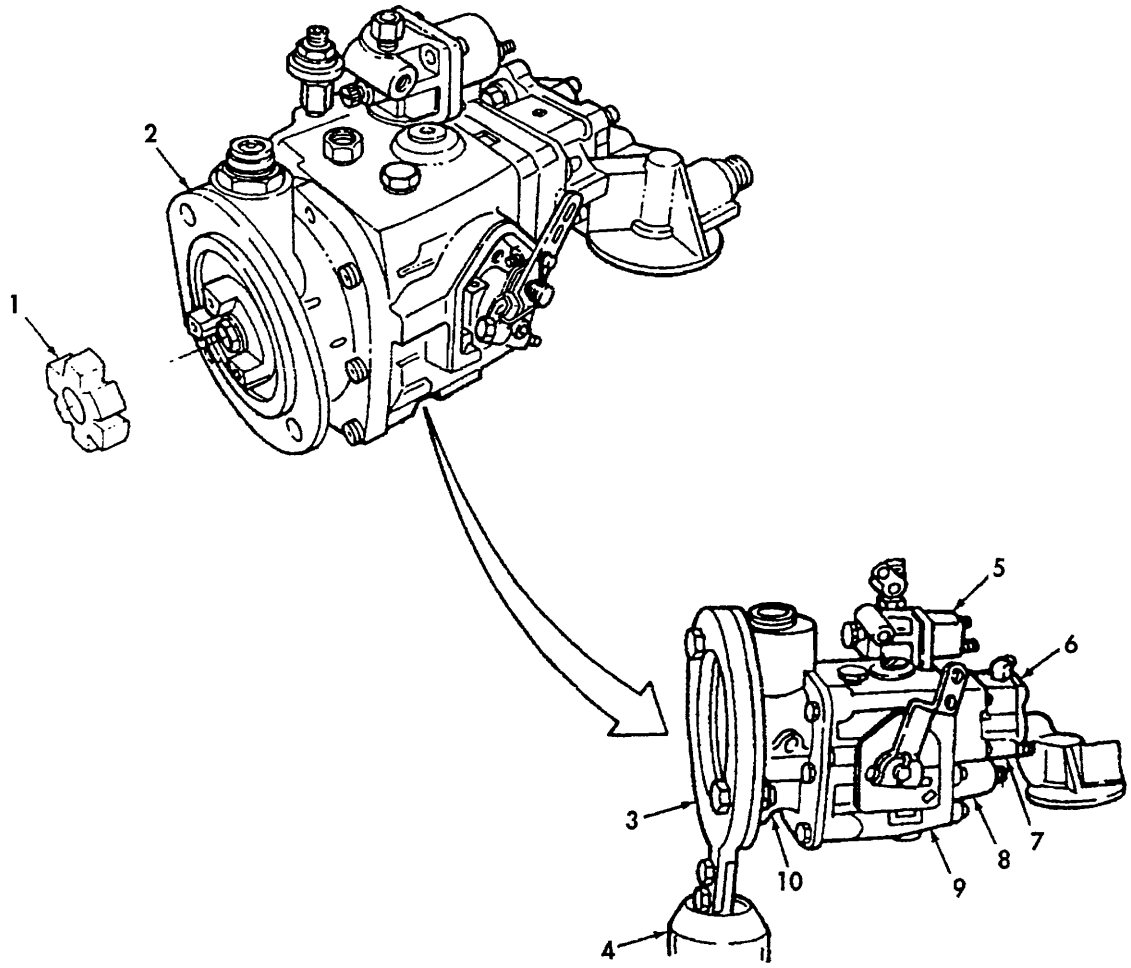
3-56. FUEL PUMP REPAIR (Contd)

1.	Fuel pump-to-compressor spider coupling (1)	Clean with solvent and dry with compressed air.	

CAUTION

Cleaning solvent can cause damage if it gets inside fuel pump. Ensure all fuel pump port plugs are secure so cleaning solvent does not get inside.

2.	Fuel pump (2)	Clean outside with SD-3 solvent and dry with compressed air.	Refer to para. 3-6 for additional cleaning instructions.



LEGEND:

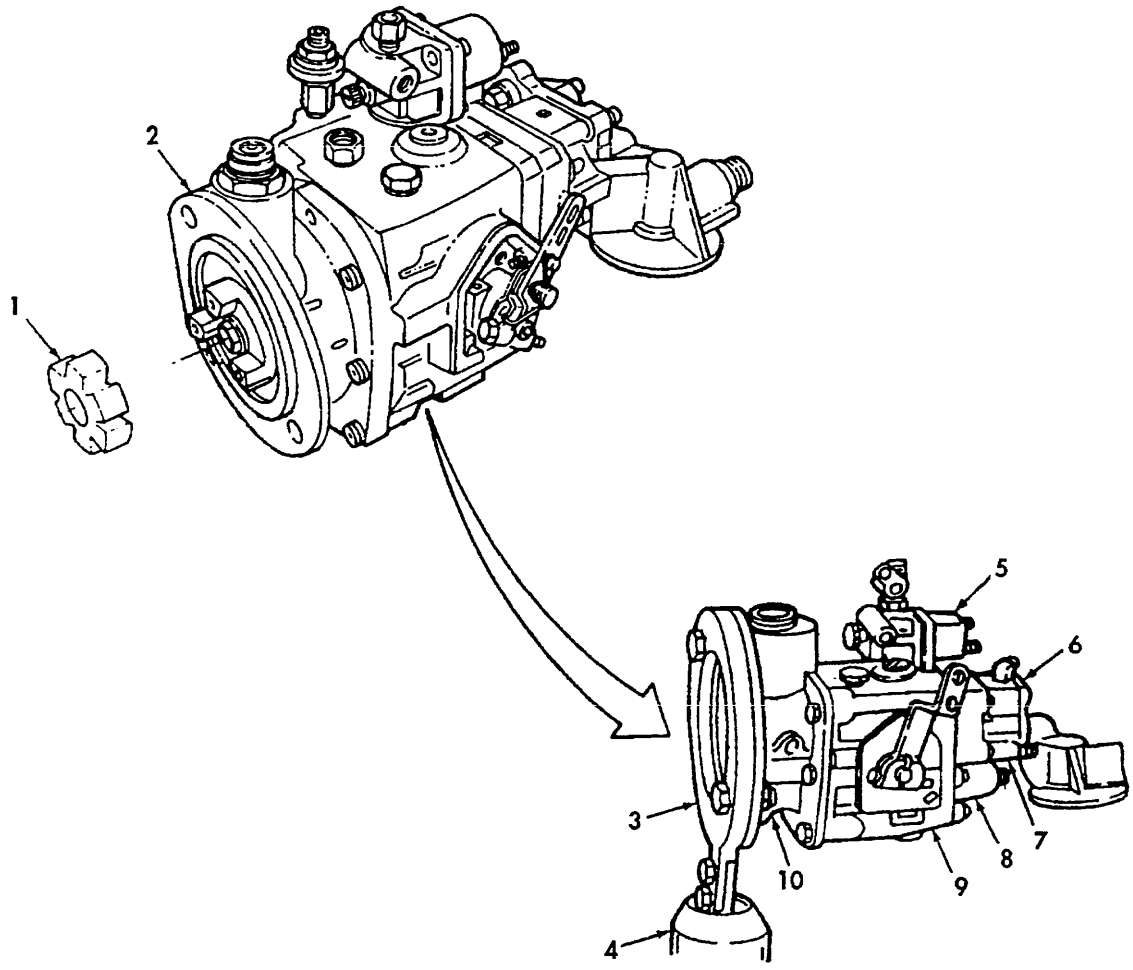
1. FUEL PUMP-TO-COMPRESSOR SPIDER COUPLING
2. FUEL PUMP
3. FUEL PUMP MOUNTING PLATE
4. BALL JOINT VISE
5. SOLENOID VALVE
6. FUEL PUMP DAMPER AND HEAD
7. FUEL GEAR PUMP
8. FUEL PUMP GOVERNOR SPRING PACK
9. FUEL PUMP MAIN HOUSING
10. FUEL PUMP FRONT COVER AND GOVERNOR

3-56. FUEL PUMP REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection		
3. Fuel pump-to-compressor spider coupling (1)	Inspect for cracks, breaks, bending, and other damage.	Discard if damaged.
4. Fuel pump (2)	Inspect for cracks, breaks, bending, corrosion, and other damage.	Repair component parts if necessary.
	Solenoid valve (5) repair	Para. 3-57
	Fuel pump damper and head (6) repair	Para. 3-58
	Fuel gear pump (7) repair	Para. 3-59
	Fuel pump governor spring pack (8) repair	Para. 3-60
	Fuel pump front cover and governor (10) repair	Para. 3-61
	Fuel pump main housing (9) repair	Para. 3-62
d. Removing Fuel Pump From Vise		
1. Fuel pump mounting plate (3)	Remove two screws and fuel pump (2) with fuel pump mounting plate (3) from ball joint vise (4).	Fuel pump (2) may be removed from mounting without removing plate (3) from ball joint vise (4).
2. Fuel pump (2)	Remove two screws, nuts, and fuel pump (2) from fuel pump mounting plate (3).	

FOLLOW-ON TASK: Install fuel pump (para. 3-78).

3-56. FUEL PUMP REPAIR (Contd)



LEGEND:

1. FUEL PUMP-TO-COMPRESSOR SPIDER COUPLING
2. FUEL PUMP
3. FUEL PUMP MOUNTING PLATE
4. BALL JOINT VISE
5. SOLENOID VALVE
6. FUEL PUMP DAMPER AND HEAD
7. FUEL GEAR PUMP
8. FUEL PUMP GOVERNOR SPRING PACK
9. FUEL PUMP MAIN HOUSING
10. FUEL PUMP FRONT COVER AND GOVERNOR

3-57. SOLENOID VALVE REPAIR

THIS TASK COVERS:

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

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
None

TEST EQUIPMENT
None

MATERIALS/PARTS
Cloth, lint-free (Appendix C, Item 6)
Solvent, SD-3 (Appendix C, Item 30)
Oil, lubricating, OE/HDO 30 (Appendix C, Item 21)
Rectangular ring seal (15434) 129888
Rectangular ring seal (15434) 154087
O-ring seal (15434) 190876
Two lockwashers (15434) 181466

PERSONNEL REQUIRED
Fuel and electrical systems repairman
MOS 63G

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

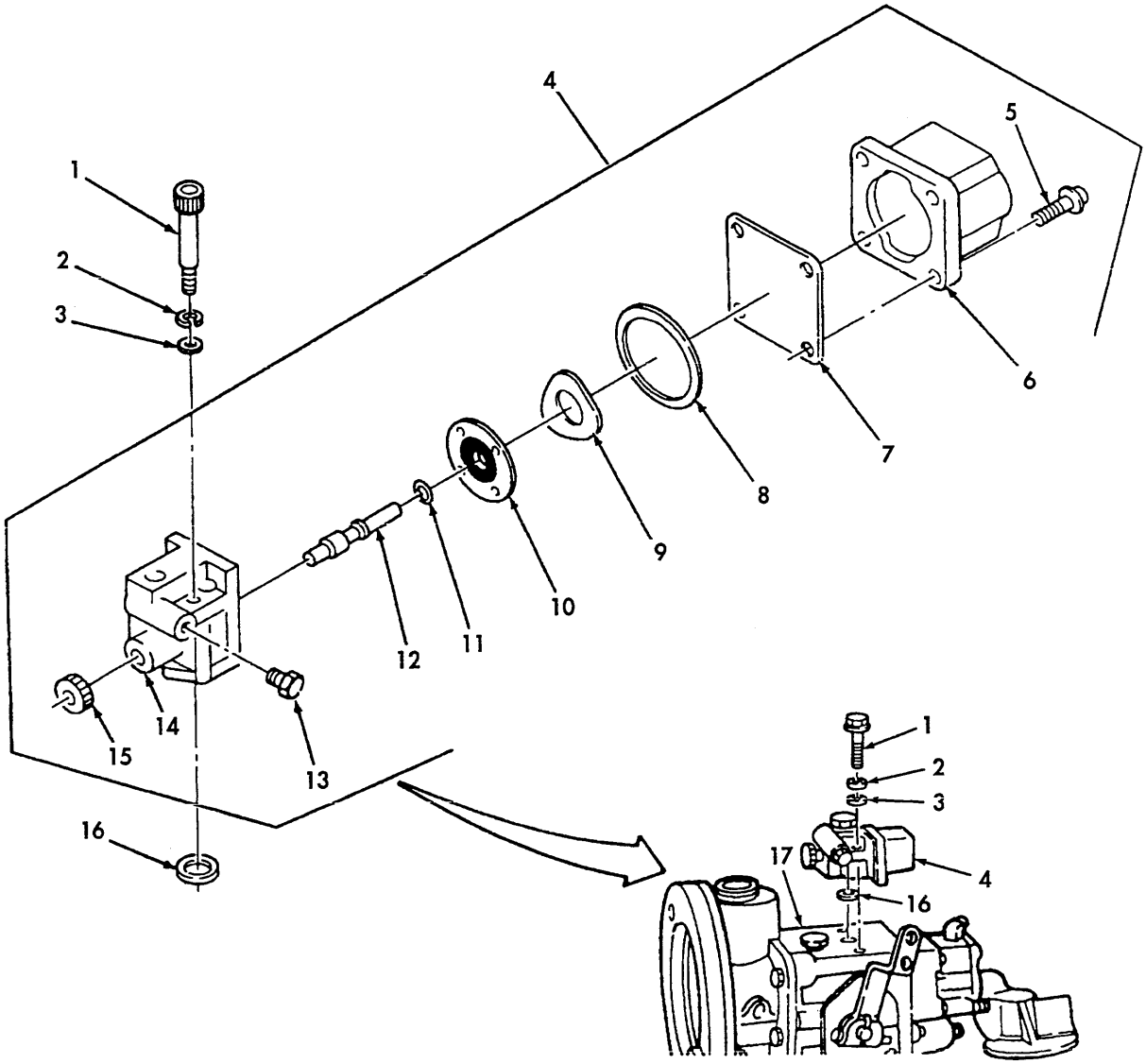
EQUIPMENT CONDITION
Fuel pump removed (para. 3-16).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
- Always wear eye protection when using compressed air.
- Use approved solvent in well-ventilated area and away from open flame.

LOCATION/ITEM	ACTION	REMARKS
a. Removal		
1. Two screws (1), lockwashers (2), washers (3), solenoid valve (4), and rectangular ring seal (16)	Remove from fuel pump (17).	Discard rectangular ring seal (16) and lockwashers (2).
b. Disassembly		
2. Four solenoid mounting screws (5)	Remove electrical solenoid (6) from valve body (14).	
3. Shutoff valve shield (7), rectangular ring seal (8), shutoff valve spring (9), and valve disk (10)	Remove from valve body (14).	Discard rectangular ring seal (8).
4. Shutoff valve knob (15)	Remove from shutoff valve shaft (12).	This is done by turning knob and shaft clockwise. Threads on shaft will act as a puller.
5. Shutoff valve shaft (12), plug (13), and O-ring seal (11)	Remove from valve body (14).	Discard O-ring seal (11).

3-57. SOLENOID VALVE REPAIR (Contd)



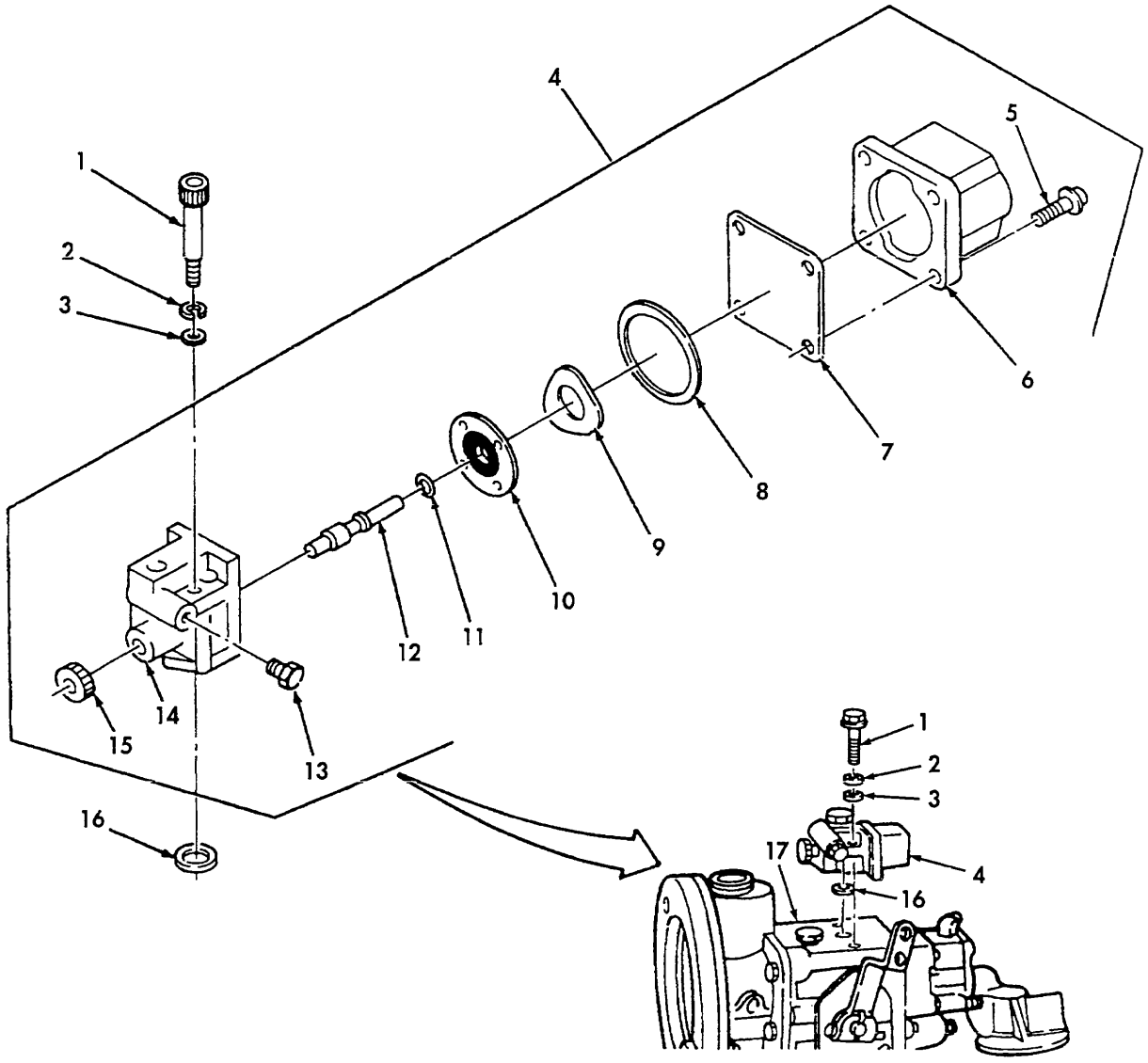
LEGEND:

1. SCREW (2)
2. LOCKWASHER (2)
3. WASHER (2)
4. SOLENOID VALVE
5. SOLENOID MOUNTING SCREW (4)
6. ELECTRICAL SOLENOID
7. SHUTOFF VALVE SHIELD
8. RECTANGULAR RING SEAL
9. SHUTOFF VALVE SPRING
10. VALVE DISK
11. O-RING SEAL
12. SHUTOFF VALVE SHAFT
13. PLUG
14. VALVE BODY
15. SHUTOFF VALVE KNOB
16. RECTANGULAR RING SEAL
17. FUEL PUMP

3-57. SOLENOID VALVE REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Cleaning		
6. Electrical solenoid (6)	Wipe clean with lint-free cloth.	Do not use solvent.
	WARNING • **Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and protective equipment such as goggles or shield, gloves, etc. Failure to comply may result in injury to personnel.** • **Approved solvents may be flammable and will not be used near open flame. Use only in well-ventilated area. Failure to comply may result in injury to personnel.**	
7. All parts except electrical solenoid (6)	Clean with SD-3 solvent and dry with compressed air.	Refer to para. 3-6 for additional cleaning instructions.
d. Inspection		
8. All parts	Inspect for cracks, breaks, excessive wear, and other damage.	Discard any parts that are damaged or worn.
9. Valve body (14)	a. Inspect valve seat for wear, bonding separation, failure, and corrosion.	Discard if damaged or worn.
	b. Using suitable micrometer, measure width of valve seat.	Discard valve body if width of valve seat is less than 0.015 in. (0.381 mm).
10. Electrical solenoid (6)	Using multimeter, check resistance between long terminal and base.	Discard electrical solenoid if resistance is not within 28-32 ohms.
e. Assembly		
11. New O-ring seal (11)	Install on shutoff valve shaft (12).	Apply a light coat of lubricating oil on O-ring seal (11) at installation.
12. Shutoff valve shaft (12)	a. Turn in valve body (14) until it reaches bottom of bore.	
	b. Using depth micrometer set at 0.118 in. (2.997 mm), check distance from face of valve body (14) to tip of shutoff valve shaft (12).	Distance should be 0.118 in. (2.997 mm). If necessary, back out shutoff valve shaft (12) until it is 0.118 in. (2.997 mm) below valve body (14) face.
	c. Without moving shutoff valve, press on shutoff valve knob (15).	Shutoff valve knob (15) acts as a stop.
13. Valve disk (10)	Place in valve body (14) with rubber side toward valve body (14).	
14. New rectangular ring seal (8)	Coat with lubricating oil and seat in groove on valve body (14).	

3-57. SOLENOID VALVE REPAIR (Contd)



LEGEND:

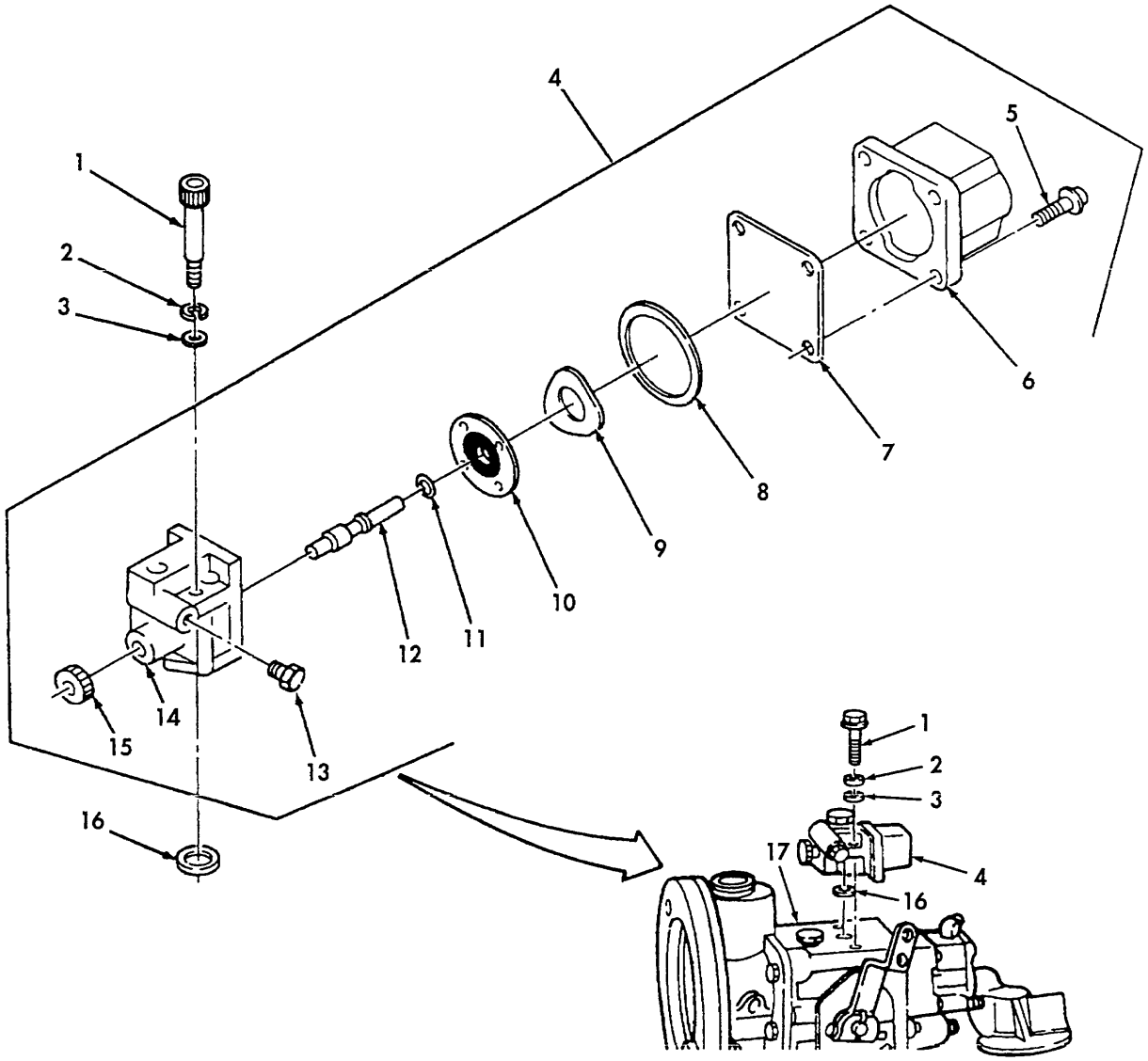
1. SCREW (2)
2. LOCKWASHER (2)
3. WASHER
4. SOLENOID VALVE
5. SOLENOID MOUNTING SCREW (4)
6. ELECTRICAL SOLENOID
7. SHUTOFF VALVE SHIELD
8. RECTANGULAR RING SEAL
9. SHUTOFF VALVE SPRING
10. VALVE DISK
11. O-RING SEAL
12. SHUTOFF VALVE SHAFT
13. PLUG
14. VALVE BODY
15. SHUTOFF VALVE KNOB
16. RECTANGULAR RING SEAL
17. FUEL PUMP

3-57. SOLENOID VALVE REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
e. Assembly (Contd)		
15. Shutoff valve spring (9)	Place in valve body (14) with concave side up.	
16. Electrical solenoid (6) and shutoff valve shield (7)	a. Place on valve body (14).	
	b. Secure with four solenoid mounting screws (5).	Tighten to 25-30 lb-ft (34-40 N•m).
f. Installation		
17. New rectangular ring seal (16)	Install on solenoid valve (4).	Apply a light coat of lubricating oil on rectangular ring seal (16) at installation.
18. Solenoid valve (4)	a. Install on fuel pump (17).	
	b. Secure with two screws (1), new lockwashers (2), and washers (3).	
19. Plug (13)	Install on valve body (14).	

FOLLOW-ON TASK: Install fuel pump (para. 3-78).

3-57. SOLENOID VALVE REPAIR (Contd)



LEGEND:

1. SCREW (2)
2. LOCKWASHER (2)
3. WASHER (2)
4. SOLENOID VALVE
5. SOLENOID MOUNTING SCREW (4)
6. ELECTRICAL SOLENOID
7. SHUTOFF VALVE SHIELD
8. RECTANGULAR RING SEAL
9. SHUTOFF VALVE SPRING
10. VALVE DISK
11. O-RING SEAL
12. SHUTOFF VALVE SHAFT
13. PLUG
14. VALVE BODY
15. SHUTOFF VALVE KNOB
16. RECTANGULAR RING SEAL
17. FUEL PUMP

3-58. FUEL DAMPER AND HEAD REPAIR

THIS TASK COVERS:

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

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
None

TEST EQUIPMENT
None

MATERIALS/PARTS
Solvent, SD-3 (Appendix C, Item 30)
Oil, lubricating, OE/HDO 30 (Appendix C, Item 21)
Four lockwashers (154340) 181466
Rectangular ring seal (15434) 139988
Rectangular ring seal (15434) 100099
Rectangular ring seal (15434) 151900
Rectangular ring seal (15434) 255622

PERSONNEL REQUIRED
Fuel and electrical systems repairman
MOS 63G

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

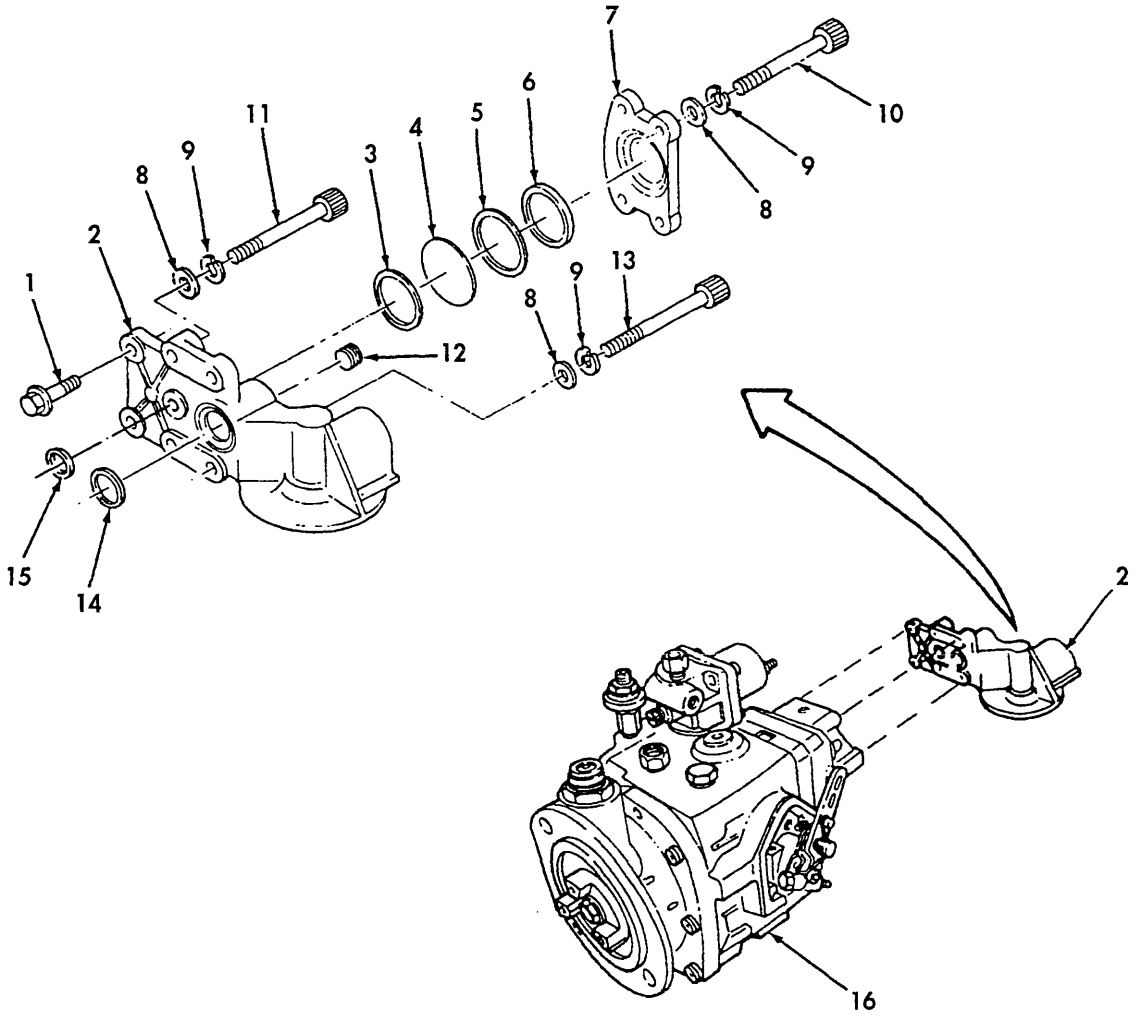
EQUIPMENT CONDITION
Fuel pump removed (para. 3-16).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust

GENERAL SAFETY INSTRUCTIONS
- Always wear eye protection when using compressed air.
- Use approved solvent in well-ventilated area and away from open flame.

LOCATION/ITEM	ACTION	REMARKS
a. Removal		
1. Two screws (10), screws (11) and (13), four lockwashers (9), and washers (8)	Remove filter head (2) and rectangular ring seals (14) and (15) from fuel pump (16).	Discard lockwashers (9) and rectangular ring seals (14) and (15).
b. Disassembly		
2. Two captive washer screws (1)	Remove plate (7), nylon washer (6), rectangular ring seal (5), fuel pump damper diaphragm (4), and rectangular ring seal (3) from filter head (2).	Discard rectangular ring seals (3) and (5).
3. Pipe plug (12)	Remove from filter head (2).	

3-58. FUEL DAMPER AND HEAD REPAIR (Contd)



LEGEND:

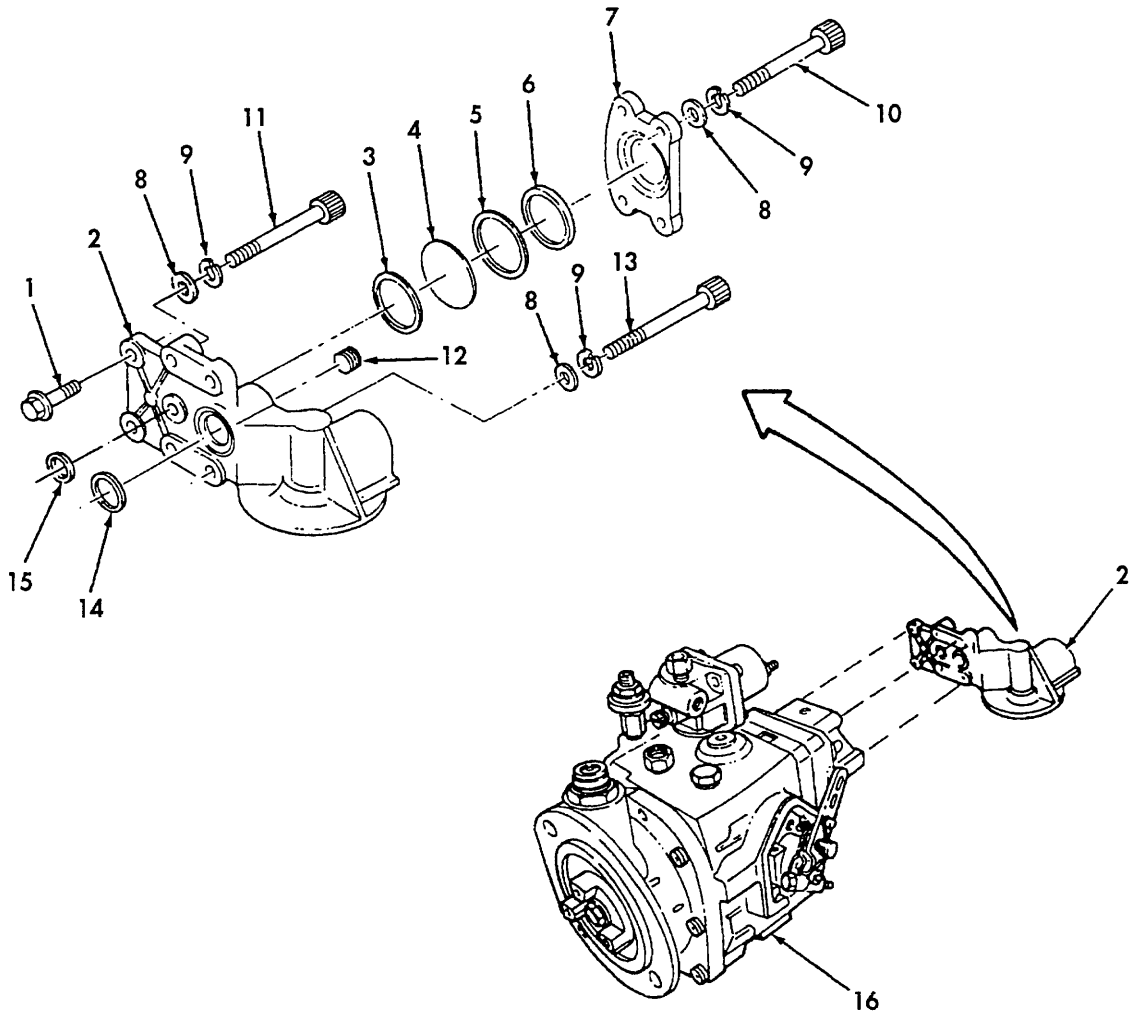
1. CAPTIVE WASHER SCREW (2)
2. FILTER HEAD
3. RECTANGULAR RING SEAL
4. FUEL PUMP DAMPER DIAPHRAGM
5. RECTANGULAR RING SEAL
6. NYLON WASHER
7. PLATE
8. WASHER (4)
9. LOCKWASHER (4)
10. SCREW (2)
11. SCREW
12. PIPE PLUG
13. SCREW
14. RECTANGULAR RING SEAL
15. RECTANGULAR RING SEAL
16. FUEL PUMP

3-58. FUEL DAMPER AND HEAD REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Cleaning		
	WARNING • **Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and protective equipment such as goggles or shield, gloves, etc. Failure to comply may result in injury to personnel.** • **Approved solvents may be flammable and will not be used near open flame. Use only in well-ventilated area. Failure to comply may result in injury to personnel.**	
4. All parts	Clean with SD-3 solvent and blow dry with compressed air.	Refer to para. 3-6 for additional cleaning instructions.
d. Inspection		
5. All parts	Inspect for corrosion, excessive wear, and cracks.	Discard damaged or worn parts.
6. Fuel pump damper diaphragm (4)	Check for hidden cracks by dropping on a hard, flat surface.	Diaphragm (4) should have a clear ring. Discard if it has a flat sound.
e. Assembly		
7. Pipe plug (12)	Install on filter head (2).	
8. New rectangular ring seal (5) and nylon washer (6)	Install in plate (7).	
9. New rectangular ring seal (3)	Install on filter head (2).	
10. Fuel pump damper diaphragm (4)	a. Coat with lubricating oil. b. Install in plate (7).	Ensure diaphragm (4) is clean.
11. Plate (7)	a. Install on filter head (2). b. Secure with two captive washer screws (1).	Tighten screws (1) to 11-13 lb-ft (15-18 N•m).
f. Installation		
12. New rectangular ring seals (14) and (15)	Install on filter head (2).	Apply a light coat of lubricating oil on rectangular ring seals (14) and (15) at installation.
13. Filter head (2)	a. Install on fuel pump (16). b. Secure with two screws (10), and screws (11) and (13), four new lockwashers (9), and washers (8).	Screw (13) is longest and screw (11) is shortest. Tighten all screws to 11-13 lb-ft (15-18 N•m).

FOLLOW-ON TASK: Install fuel pump (para. 3-78).

3-58. FUEL DAMPER AND HEAD REPAIR (Contd)



LEGEND:

1. CAPTIVE WASHER SCREW (2)
2. FILTER HEAD
3. RECTANGULAR RING SEAL
4. FUEL PUMP DAMPER DIAPHRAGM
5. RECTANGULAR RING SEAL
6. NYLON WASHER
7. PLATE
8. WASHER (4)
9. LOCKWASHER (4)
10. SCREW (2)
11. SCREW
12. PIPE PLUG
13. SCREW
14. RECTANGULAR RING SEAL
15. RECTANGULAR RING SEAL
16. FUEL PUMP

3-59. FUEL GEAR PUMP REPAIR

THIS TASK COVERS:

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

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Pressurizing valve driver (15434) 3375959

TEST EQUIPMENT
None

MATERIALS/PARTS
Solvent, SD-3 (Appendix C, Item 30)
Oil lubricating, OE/HDO 30 (Appendix C, Item 21)
Four lockwashers (15434) 181466
Gasket (15434) 110855
Gasket (15434) 3016683

PERSONNEL REQUIRED
Fuel and electrical systems repairman
MOS 63G

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
Fuel damper and head removed (para. 3-58).

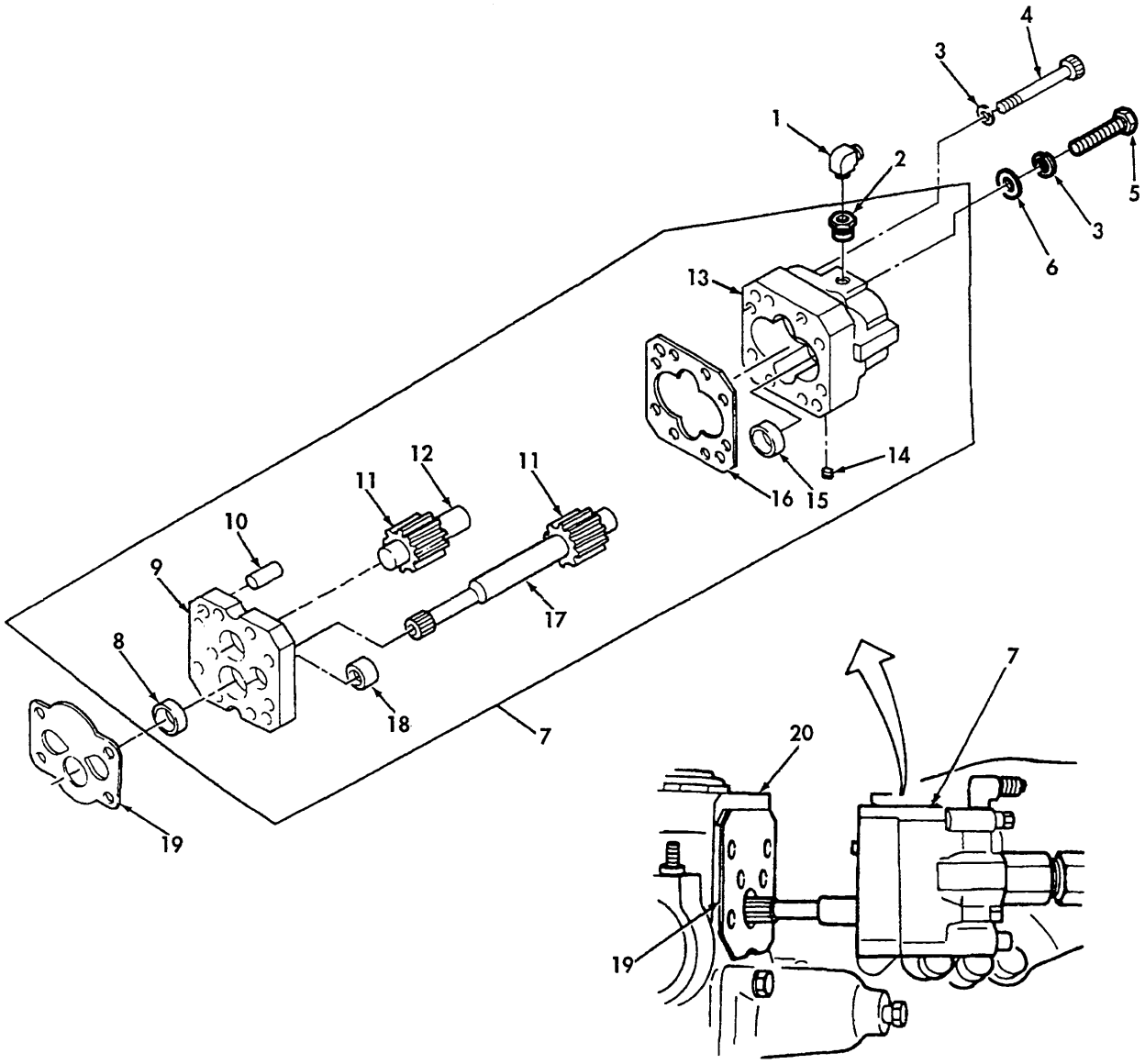
SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust

GENERAL SAFETY INSTRUCTIONS
- Always wear eye protection when using compressed air.
- Use approved solvent in well-ventilated area and away from open flame.

	LOCATION/ITEM	ACTION	REMARKS
	a. Removal		
1.	Four screws (4), lockwashers (3), fuel gear pump assembly (7), and gasket (19)	Remove from fuel pump (20).	Tap sides of fuel gear pump assembly (7) with plastic-faced hammer to help loosen. Discard lockwashers (3) and gasket (19).
	b. Disassembly		
		NOTE **The fuel supply elbow contains a check ball. Do not replace with a standard elbow.**	
2.	Fuel supply elbow (1) and adapter (2)	Remove from gear body (13).	
3.	Two screws (5), washers (6), and lockwashers (3)	Remove from gear body (13).	Discard lockwashers (3).
4.	Gear body (13)	a. Install two screws (4) on threaded holes of gear body (13).	
		b. Tap screws (4) with soft-nose hammer to separate gear body (13) from gear cover (9).	Discard gasket (16).
5.	Idler shaft (12), drive shaft (17), and two gears (11)	Remove from gear body (13).	Do not separate gears (11) from shafts (12) and (17) at this time.

3-59. FUEL GEAR PUMP REPAIR (Contd)

6.	Pressure valve (18), dowel ring (8), and four bearing sleeves (15)	Remove from gear cover (9) and gear body (13).	Only remove dowel ring (8) and bearing sleeves (15) if damaged or loose.
7.	Pipe plug (14)	Remove from gear body (13).	



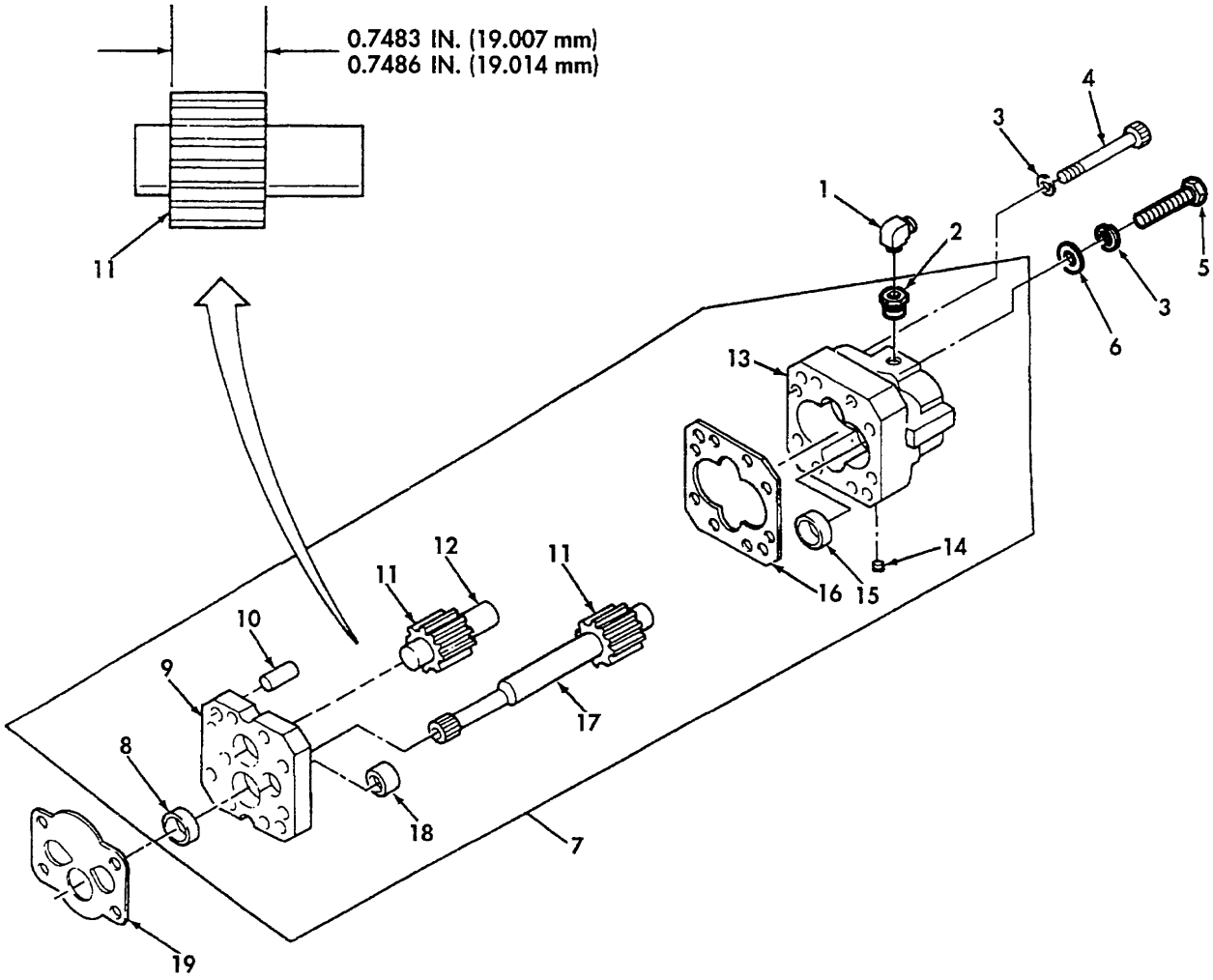
LEGEND:

1. FUEL SUPPLY ELBOW
2. ADAPTER
3. LOCKWASHER (6)
4. SCREW (4)
5. SCREW (2)
6. WASHER (2)
7. FUEL GEAR PUMP ASSEMBLY
8. DOWEL RING
9. GEAR COVER
10. COVER DOWEL (2)
11. GEAR (2)
12. IDLER SHAFT
13. GEAR BODY
14. PIPE PLUG
15. BEARING SLEEVE (4)
16. GASKET
17. DRIVE SHAFT
18. PRESSURE VALVE
19. GASKET
20. FUEL PUMP

3-59. FUEL GEAR PUMP REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Cleaning		
	WARNING • **Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and protective equipment such as goggles or shield, gloves, etc. Failure to comply may result in injury to personnel.** • **Approved solvents may be flammable and will not be used near open flame. Use only in well-ventilated area. Failure to comply may result in injury to personnel.**	
8. Fuel gear pump assembly (7) and all mounting hardware	Clean with SD-3 solvent and dry with compressed air.	Refer to para. 3-6 for additional cleaning instructions.
d. Inspection		
9. Idler shaft (12) and drive shaft (17)	a. Check for scoring, wear, and other damage.	If bearing sleeves (15) are worn or damaged, remove gears (11) and discard shaft (12) or (17) and bearing sleeves (15).
	b. Using suitable micrometer, measure outside diameter.	If bearing sleeves (15) are not within 0.4998-0.5001 in. (12.695-12.703 mm), discard shaft (12) or (17) and bearing sleeves (15).
10. Two gears (11)	a. Inspect for scoring, wear, and other damage.	Remove and discard if damaged or worn.
	b. Using suitable micrometer, measure width (see illustration).	Remove and discard if width is not within 0.7483 and 0.7486 in. (19.007 and 19.014 mm).
11. Gear cover (9) and gear body (13)	a. Inspect for scoring, wear, and other damage.	Discard fuel gear pump assembly (7) if scored, damaged, or worn.
	b. Using suitable micrometer, measure gear pocket depth in gear body (13).	Discard fuel gear pump assembly (7) if gear pocket depth is not within 0.7478 and 0.7481 in. (18.994 and 19.002 mm).
	c. Using suitable micrometer, measure shaft bores in gear cover (9) and gear body (13).	Discard fuel gear pump assembly (7) if any shaft bore measurements are not within 0.5011 and 0.5016 in. (12.728 and 12.741 mm).
	d. Check lubrication holes in gear cover (9) and gear body (13).	Lubrication holes must be clean.
12. All other parts	Inspect for cracks, breaks, and other damage.	Discard any damaged parts.

3-59. FUEL GEAR PUMP REPAIR (Contd)



LEGEND:

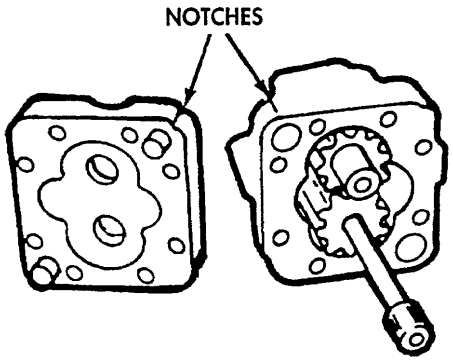
7. FUEL GEAR PUMP ASSEMBLY
9. GEAR COVER
11. GEAR (2)
12. IDLER SHAFT
13. GEAR BODY
14. PIPE PLUG
15. BEARING SLEEVE (4)
17. DRIVE SHAFT

3-59. FUEL GEAR PUMP REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
e. Assembly		

NOTE
Prior to assembly, place gear cover and gear body on bench.

13.	Four bearing sleeves (15) and dowel ring (8)	Install on gear cover (9) and gear body (13).	Perform this step only if bearing sleeves (15) and dowel ring (8) were removed from gear body (13) and gear cover (9).
14.	Pipe plug (14)	Install on gear body (13).	Tighten plug (14) to 10-13 lb-ft (14-18 N•m).
15.	Two gears (11)	Press on idler shaft (12) and drive shaft (17) 0.680-0.690 in. (17.272-17.526 mm) away from gear body end of shaft.	Perform this step only if gear was removed from shaft. Repeat this step for each gear.
16.	Pressure valve (18)	Using pressurizing valve driver, install on gear cover (9).	Use pressurizing valve driver (3375959). Pressure valve must be even to 0.015 in. (0.381 mm) below face of gear cover (9). If valve is damaged at all during installation, replace with new valve.



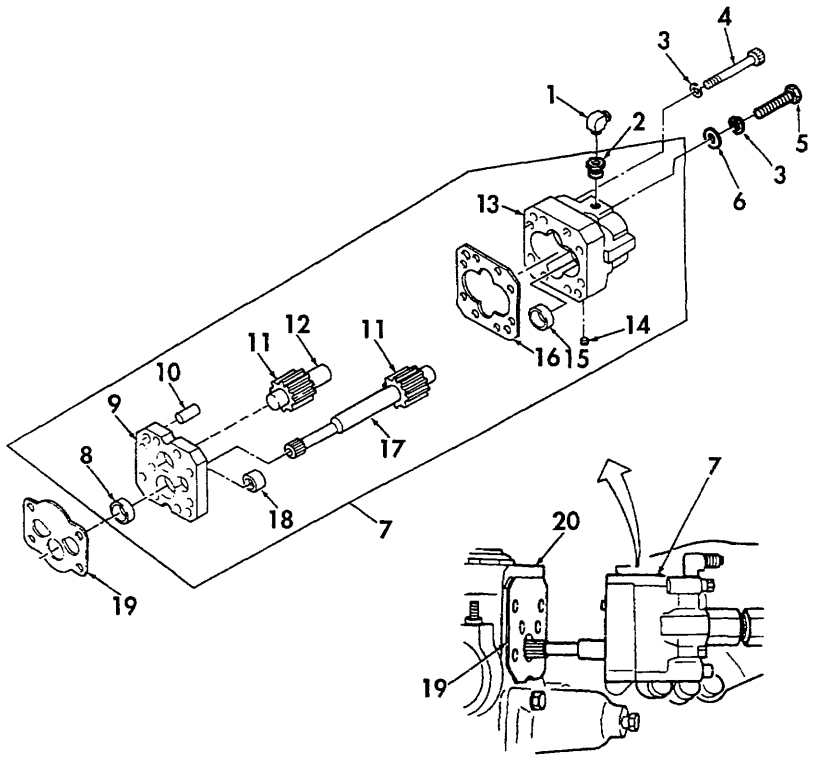
NOTE
- **Location of notches or ridges and drive shaft determine pump rotation.**
- **When a right-hand rotation pump is being assembled, place driven gear shaft of gear pump in pocket nearest locating notches or ridges. Place driving gear shaft in other pocket. The dowel ring is always located around drive shaft.**

17.	Idler shaft (12), drive shaft (17), and two gears (11)	Lubricate and install on gear body (13).	Ensure all parts are clean.
18.	Gear cover (9) and new gasket(16)	a. Install on gear body (13). b. Install two screws (5), washers (6), and new lockwashers (3).	Ensure location notches are aligned.

NOTE
Drive shaft must protrude 2.370-2A12 in. (60.198-61.265 mm) from gear body. End clearance should not exceed 0.0015 in. (0.0381 mm), nor be less than 0.0009 in. (0.0228 mm). Gaskets are available in 0.0020 and 0.0015 in. (0.0509 mm and 0.0381 mm). If pump binds, has excessive play or gear backlash, check for error in assembly which must be corrected to prevent early pump failure. Total gear backlash must be 0.001-0.004 in. (0.0254-0.1016 mm).

3-59. FUEL GEAR PUMP REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
f. Installation		
19. Fuel supply elbow (1) and adapter (2)	Install on gear body (13).	
	NOTE **Use correct gasket in step 20 and ensure that it is positioned correctly. Be certain main housing fuel holes match gear pump holes.**	
20. Fuel gear pump assembly (7) and new gasket (19)	a. Install on fuel pump (20).	Locate notch to upper right-hand corner (looking from behind fuel pump).
	b. Secure with four screws (4) and new lockwashers (3).	Tighten screws (4) and (5) to 11-13 lb-ft (15-18 N•m). Check that gear pump shaft rotates freely.



LEGEND:

1. FUEL SUPPLY ELBOW
2. ADAPTER
3. LOCKWASHER (6)
4. SCREW (4)
5. SCREW (2)
6. WASHER (2)
7. FUEL GEAR PUMP ASSEMBLY
8. DOWEL RING
9. GEAR COVER
11. GEAR (2)
12. IDLER SHAFT
13. GEAR BODY
14. PIPE PLUG
15. BEARING SLEEVES (4)
16. GASKET
17. DRIVE SHAFT
18. PRESSURE VALVE
19. GASKET
20. FUEL PUMP

3-60. FUEL PUMP GOVERNOR SPRING REPAIR

THIS TASK COVERS:

a. Removal
b. Cleaning
c. Inspection
d. Installation

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
None

TEST EQUIPMENT
None

MATERIALS/PARTS
Solvent, SD-3 (Appendix C, Item 30)
Seal and wire (15434) 3003156
Gasket (15434) 70705

PERSONNEL REQUIRED
Fuel and electrical systems repairman
MOS 63G

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

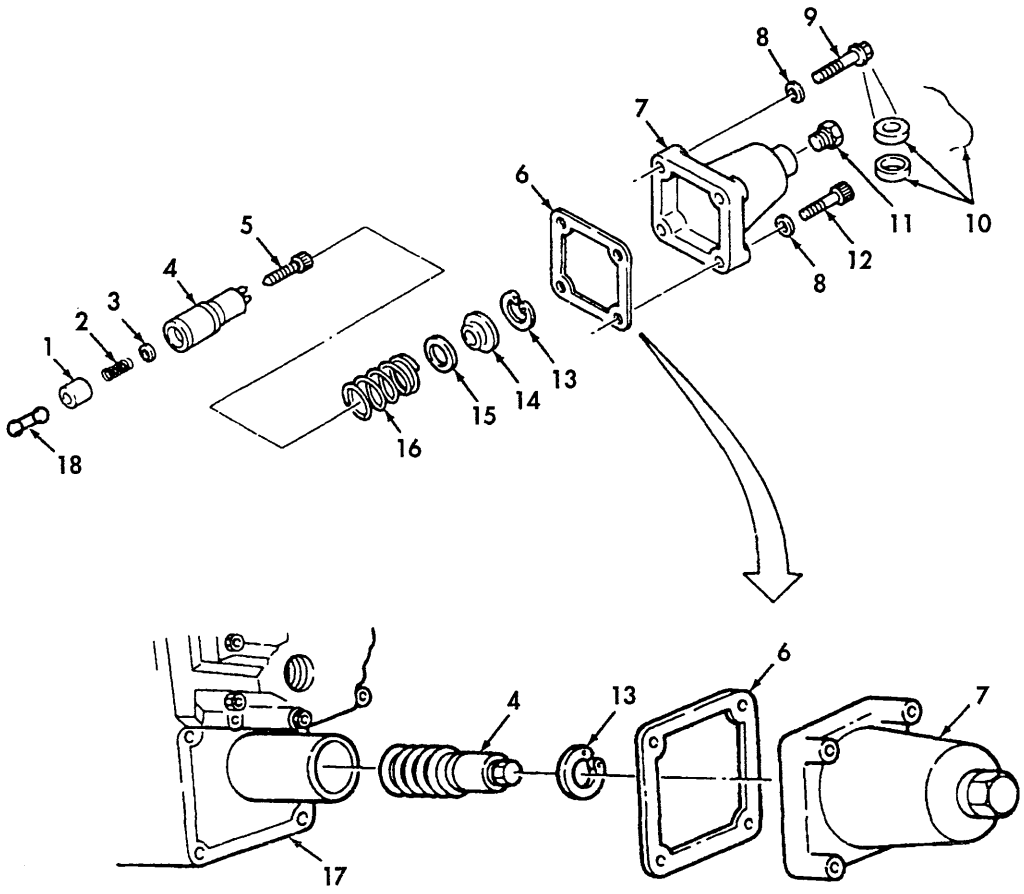
EQUIPMENT CONDITION
Fuel pump removed (para. 3-16).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
- Always wear eye protection when using compressed air.
- Use approved solvent in well-ventilated area and away from open flame.

LOCATION/ITEM		ACTION	REMARKS
a. Removal			
1.	Adjusting screw seal and wire (10)	Remove.	Discard adjusting screw seal and wire (10).
2.	Three captive washer screws (9), screw (12), four washers (8), spring pack cover (7), and spring pack cover-to-fuel pump gasket (6)	Remove from fuel pump (17).	Discard gasket (6).
3.	Cover plug (11)	Remove from spring pack cover (7).	
4.	Snapring (13)	Remove from fuel pump (17).	Discard snapring (13) if damaged during removal.
5.	High-speed spring retainer (14), shim (15), and compression spring (16)	Remove from guide (4).	
6.	Guide (4)	Remove from fuel pump (17).	
7.	Idle adjusting screw (5)	Remove from guide (4).	
8.	Idle spring plunger (1), idling spring (2), adjusting screw washer (3), and lead seal (18)	Remove from guide (4).	Lead seal (18) is used on M915/ Big Cam I only.

3-60. FUEL PUMP GOVERNOR SPRING REPAIR (Contd)



LEGEND:

1. IDLE SPRING PLUNGER
2. IDLING SPRING
3. ADJUSTING SCREW WASHER
4. GUIDE
5. IDLE ADJUSTING SCREW
6. SPRING PACK COVER-TO-FUEL PUMP GASKET
7. SPRING PACK COVER
8. WASHERS (4)
9. CAPTIVE WASHER SCREW (3)
10. ADJUSTING SCREW SEAL AND WIRE
11. COVER PLUG
12. SCREW
13. SNAPRING
14. HIGH-SPEED SPRING RETAINER
15. SHIM (AS REQUIRED)
16. COMPRESSION SPRING
17. FUEL PUMP
18. LEAD SEAL (M915/BIG CAM I ONLY)

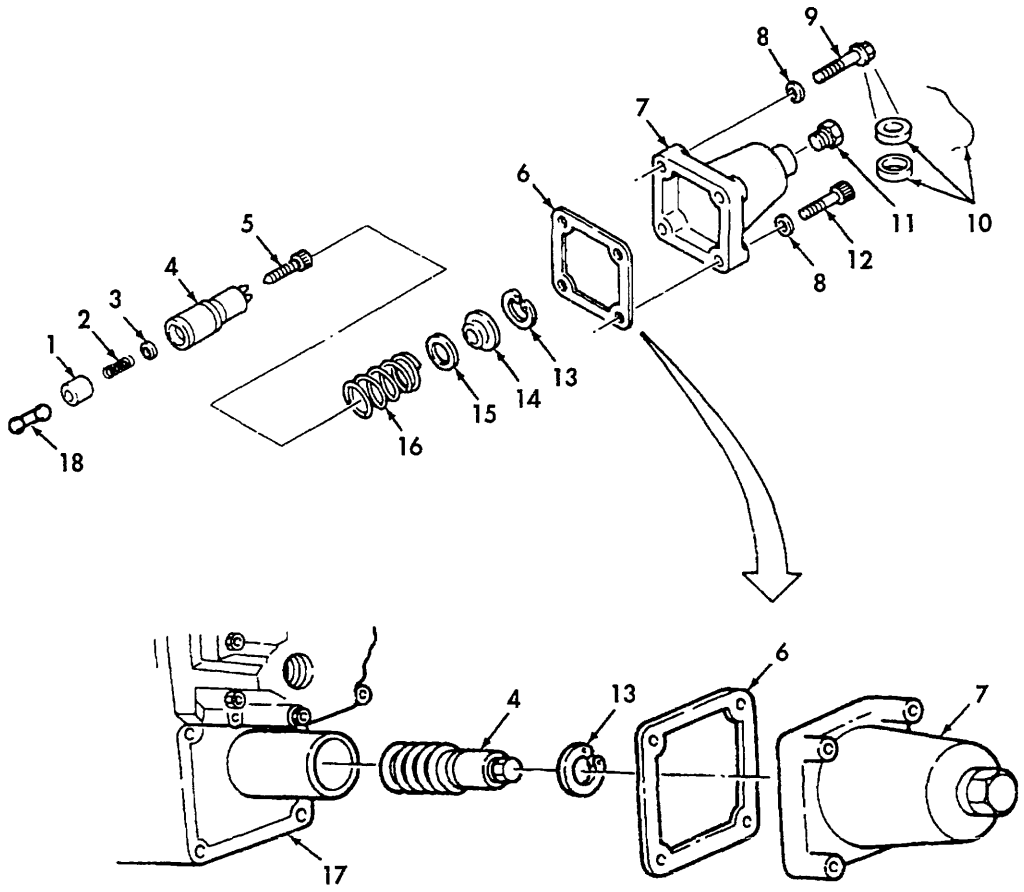
3-60. FUEL PUMP GOVERNOR SPRING REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
b. Cleaning		
	WARNING • **Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and protective equipment such as goggles or shield, gloves, etc. Failure to comply may result in injury to personnel.** • **Approved solvents may be flammable and will not be used near open flame. Use only in well-ventilated area. Failure to comply may result in injury to personnel.**	
9. All parts	Clean with SD-3 solvent and dry with compressed air.	Refer to para. 3-6 for additional cleaning instructions.
c. Inspection		
10. All parts	Inspect for cracks, breaks, and other damage.	Discard any damaged parts.
11. All threaded parts	Inspect for crossthreading, stripped threads, and other damage.	Discard any damaged parts.
d. Installation		
12. Idle adjusting screw (5)	Install on guide (4).	
13. Adjusting screw washer (3)	Place over idle adjusting screw (5) in guide (4).	
14. Idling spring (2)	Slide in guide (4) and over idle adjusting screw (5).	
15. Idle spring plunger (1)	Place in guide (4) against idling spring (2).	
16. Compression spring (16), shim (15), and high-speed spring retainer (14)	Slide on guide (4).	Final number of shims (15), is determined at calibration.
17. Guide (4) and attached parts	a. Place in fuel pump (17). b. Secure with snapring (13).	
18. Idle adjusting screw (5)	Turn clockwise by hand until contact is made with seat.	Final adjustment is made at calibration.
19. Cover plug (11)	Install on spring pack cover (7).	
20. Cover (7) and new spring pack cover-to-fuel pump gasket (6)	a. Install on fuel pump (17). b. Secure with three captive washer screws (9), screw (12), and four washers (8).	Put screw with lockwire hole in lower right corner. Torque all screws to 9-11 lb-ft (12-15 N•m).

3-60. FUEL PUMP GOVERNOR SPRING REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
21. New adjusting screw seal and wire (10)	Do not install at this time.	Final calibration and on-engine fuel pump adjustments must be made prior to installation of seal and wire (10).

FOLLOW-ON TASKS:
- Perform fuel pump testing and calibration (para. 3-63).
- Perform on-engine fuel pump adjustments (para. 3-93).



LEGEND:
1. IDLE SPRING PLUNGER
2. IDLING SPRING
3. ADJUSTING SCREW WASHER
4. GUIDE
5. IDLE ADJUSTING SCREW
6. SPRING PACK COVER-TO-FUEL PUMP GASKET
7. SPRING PACK COVER
8. WASHERS (4)
9. CAPTIVE WASHER SCREW (3)
10. ADJUSTING SCREW SEAL AND WIRE
11. COVER PLUG
12. SCREW
13. SNAPRING
14. HIGH-SPEED SPRING RETAINER
15. SHIM (AS REQUIRED)
16. COMPRESSION SPRING
17. FUEL PUMP

3-61. FUEL PUMP FRONT COVER AND GOVERNOR REPAIR

THIS TASK COVERS:

a. Removal
b. Disassembly (M915A1/Big Cam III)
c. Cleaning
d. Inspection (M915A1/Big Cam III)
e. Assembly (M915A1/Big Cam III)
f. Installation
g. Disassembly (M915/Big Cam I)
h. Inspection (M915/Big Cam I)
i. Assembly (M915/Big Cam I)

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Fuel pump mounting plate (15434) 3375133
Ball joint vise (15434) ST-302
Front cover and main shaft assembly tool kit (15434) 3375175
Oil seal assembly tool (15434) ST-419
Plunger protrusion checking tool (15434) ST-1241

TEST EQUIPMENT
None

MATERIALS/PARTS
Solvent, SD-3 (Appendix C, Item 30)
Diesel fuel, regular (Appendix C, Item 19)
Cover-to-fuel pump gasket (15434) 100754
Tachometer drive seal (15434) 212603
Two shaft seals (15434) 3019962

PERSONNEL REQUIRED
Fuel and electrical systems repairman MOS 63G

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

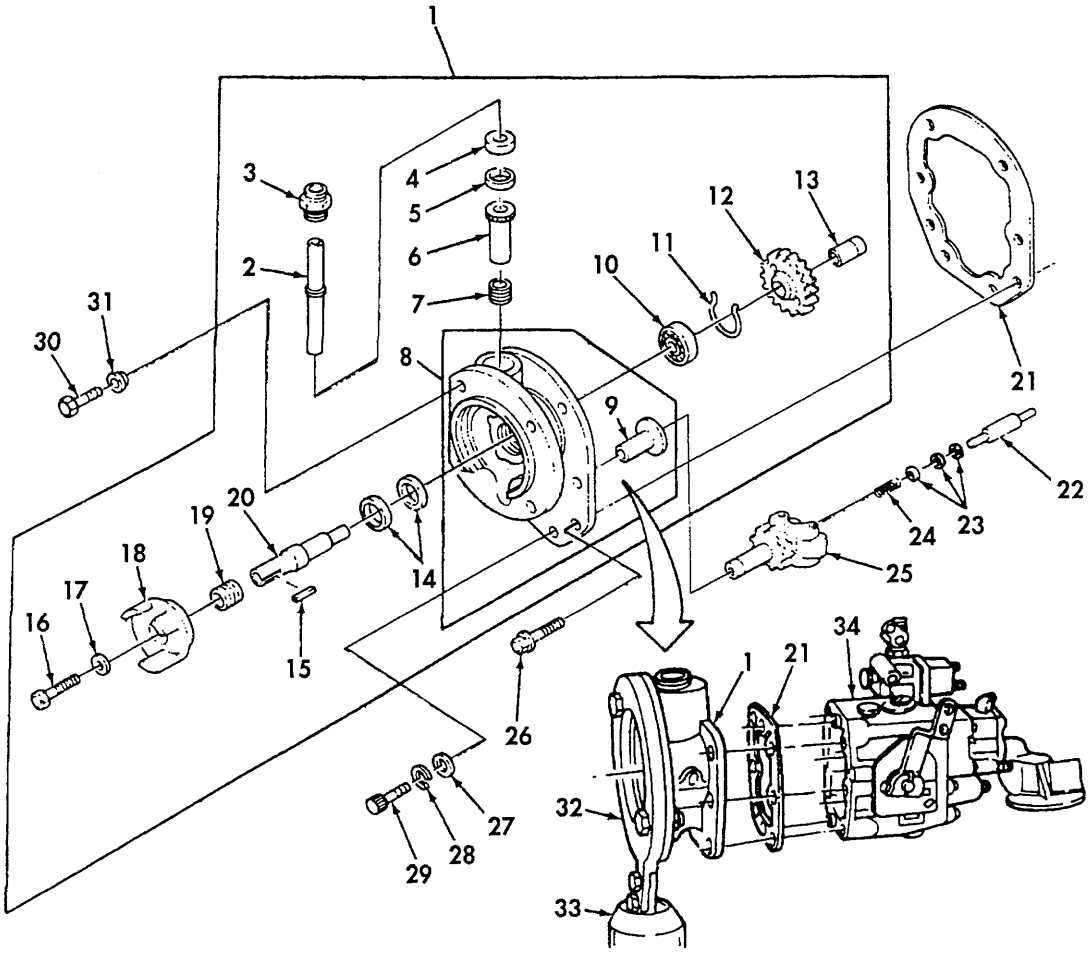
EQUIPMENT CONDITION
Fuel pump removed (para. 3-16).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
Always wear eye protection when using compressed air.

LOCATION/ITEM	ACTION	REMARKS
a. Removal		
	NOTE • **Steps 5 through 36 are performed in repairing fuel pump front cover and governor for fuel pumps used on the M915A1/Big Cam III engine.** • **Steps 37 through 58 are performed in repairing fuel pump front cover and governor for fuel pumps used on the M915/Big Cam I engine.**	
1. Fuel pump front cover assembly (1)	Install on fuel pump mounting plate (32) and ball joint vise (33).	Use fuel pump mounting plate (3375133) (32) and ball joint vise (ST-302) (33).
2. Screw (30) and plastic bushing seal (31)	Remove from fuel pump front cover assembly (1).	Discard plastic bushing seal (31).
3. Screw (29), washer (27), and lockwashers (28)	Remove from fuel pump front cover assembly (1).	
4. Five captive washer screws (26), fuel pump main housing (34), and cover-to-fuel pump gasket (21)	Remove from fuel pump front cover assembly (1).	Tap fuel pump main housing (34) with plastic-face hammer to loosen. Discard cover-to-fuel pump gasket (21).

3-61. FUEL PUMP FRONT COVER AND GOVERNOR REPAIR (Contd)



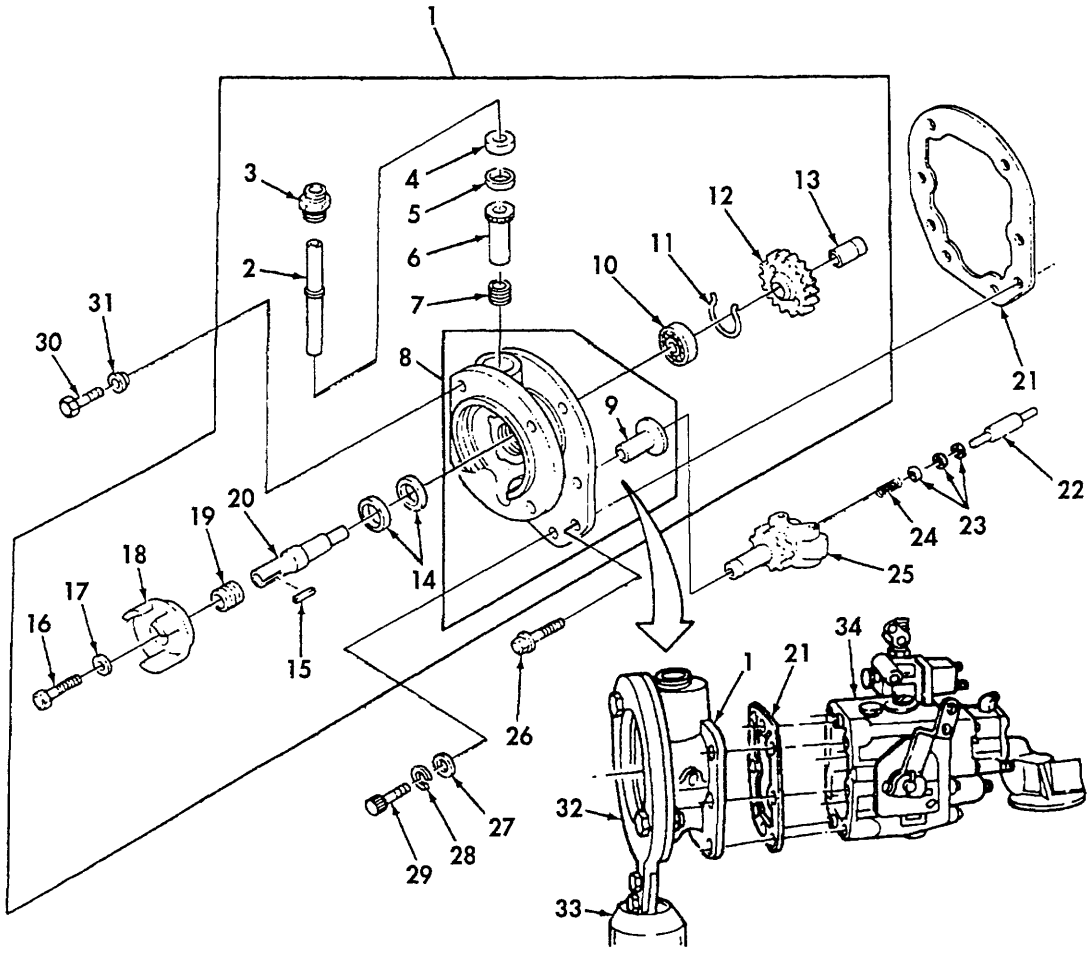
LEGEND:

1. FUEL PUMP FRONT COVER ASSEMBLY
2. TACHOMETER DRIVE SHAFT
3. TACHOMETER DRIVE HOUSING
4. TACHOMETER DRIVE SEAL
5. TACHOMETER DRIVE SPACER
6. TACHOMETER DRIVE BUSHING
7. TACHOMETER DRIVE GEAR
8. COVER ASSEMBLY
9. GOVERNOR BUSHING
10. BEARING
11. RETAINING RING
12. FUEL PUMP DRIVE GEAR
13. COUPLING
14. SHAFT SEAL (2)
15. COUPLING KEY
16. SCREW
17. WASHER
18. FUEL PUMP DRIVE COUPLING
19. TACHOMETER DRIVE GEAR
20. FUEL PUMP DRIVE SHAFT
21. COVER-TO-FUEL PUMP GASKET
22. WEIGHT ASSIST PLUNGER
23. SHIM (3)
24. SPRING
25. GOVERNOR ASSEMBLY
26. CAPTIVE WASHER SCREW (5)
27. WASHER
28. LOCKWASHER
29. SCREW
30. SCREW
31. PLASTIC BUSHING SEAL
32. FUEL PUMP MOUNTING PLATE
33. BALL JOINT VISE
34. FUEL PUMP MAIN HOUSING

3-61. FUEL PUMP FRONT COVER AND GOVERNOR REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
b. Disassembly (M915A1/Big Cam III)		
	CAUTION **Exercise caution when removing weight-assist plunger. A slight nick can cause extensive damage. After removal, place plunger where it will not be damaged.**	
5. Governor assembly (25)	a. Before removing, check shaft of governor assembly (25) for excessive wear.	Shaft has excessive wear if it can be moved from side to side in governor bushing (9). Discard governor assembly (25) and governor bushing (9) if there is excessive wear.
	b. Check gear backlash between gear of governor assembly (25) and fuel pump drive gear (12).	Normal backlash is 0.005-0.009 in. (0.127-0.228 mm). Discard governor assembly (25) and fuel pump drive gear (12) if backlash is more than 0.009 in. (0.228 mm).
	c. Remove governor bushing (9) from cover assembly (8).	Use internal engaging puller to remove bushing (9).
6. Weight-assist plunger (22), shims (23), and spring (24)	Remove from governor assembly (25).	Be careful not to lose spring (24) and shims (23) during removal of plunger (22). Keep plunger (22), shims (23), and spring (24) together.
7. Screw (16) and washer (17)	Remove from fuel pump drive coupling (18) and fuel pump drive shaft (20).	
8. Fuel pump drive coupling (18), tachometer drive gear (19), and coupling key (15)	Using suitable puller, remove from fuel pump drive shaft (20).	
9. Retaining ring (11)	Remove from fuel pump drive shaft (20).	Use hose clamp pliers.
10. Fuel pump drive shaft (20), bearing (10), fuel pump drive gear (12), and coupling (13) (assembled)	Press out of cover assembly (8).	
11. Two shaft seals (14)	Press out of cover assembly (8) or remove from fuel pump drive shaft (20).	Discard two shaft seals (14).
12. Coupling (13) and gear (12)	Press from fuel pump drive shaft (20).	Do not press bearing (10) from fuel pump drive shaft (20) at this time.
13. Tachometer drive housing (3)	Remove from cover assembly (8).	
14. Shaft (2), seal (4), spacer (5), bushing (6), and gear (7)	Using brass punch, remove from cover assembly (8).	Discard tachometer drive seal (4).
15. Gear (7) and bushing (6)	Remove from tachometer drive shaft (2).	

3-61. FUEL PUMP FRONT COVER AND GOVERNOR REPAIR (Contd)



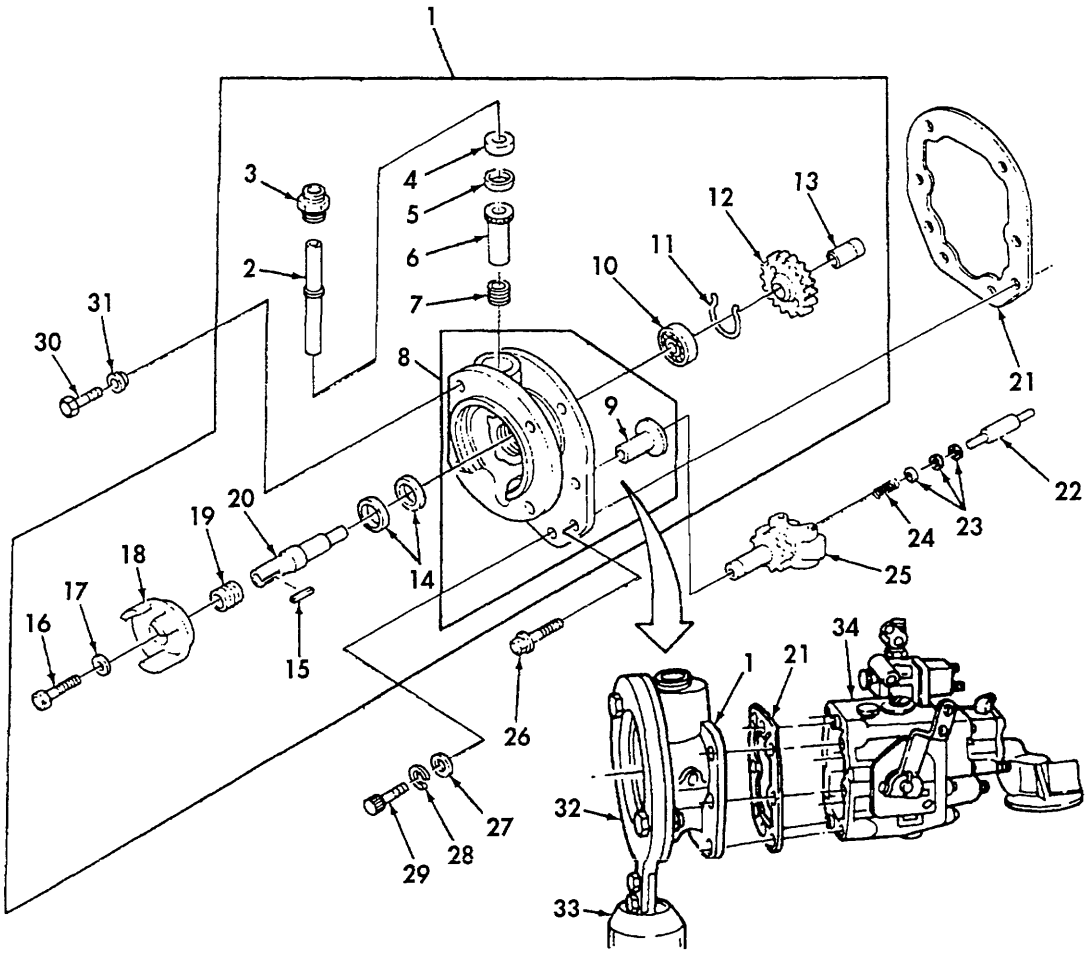
LEGEND:

2. TACHOMETER DRIVE SHAFT
3. TACHOMETER DRIVE HOUSING
4. TACHOMETER DRIVE SEAL
5. TACHOMETER DRIVE SPACER
6. TACHOMETER DRIVE BUSHING
7. TACHOMETER DRIVE GEAR
8. COVER ASSEMBLY
9. GOVERNOR BUSHING
10. BEARING
11. RETAINING RING
12. FUEL PUMP DRIVE GEAR
13. COUPLING
14. SHAFT SEAL (2)
15. COUPLING KEY
16. SCREW
17. WASHER
18. FUEL PUMP DRIVE COUPLING
19. TACHOMETER DRIVE GEAR
20. FUEL PUMP DRIVE SHAFT
22. WEIGHT-ASSIST PLUNGER
23. SHIM (3)
24. SPRING
25. GOVERNOR ASSEMBLY

3-61. FUEL PUMP FRONT COVER AND GOVERNOR REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Cleaning		
	WARNING **Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and protective equipment such as goggles or shield, gloves, etc. Failure to comply may result in injury to personnel.**	
16. All parts	Clean with solvent SD-3 and dry with compressed air.	Refer to para. 3-6 for additional cleaning instructions.
d. Inspection (M915A1/Big Cam)		
17. All parts	Inspect for cracks, breaks, excessive wear, and other damage.	Discard any damaged or worn parts.
18. Governor bushing (9)	Using suitable micrometer, measure inside diameter.	Remove from cover assembly (8) and discard if more than 0.504 in. (12.801 mm).
19. Fuel pump drive shaft (20) and bearing (10)	a. Inspect shaft (20) for scoring, wear grooves, and other damage.	Remove bearing (10) (step 20c.) and discard fuel pump drive shaft (20) if damaged. Install bearing (10) (step 20d.) on new shaft (20) as needed.
	b. Inspect bearing (10) for roughness and ease of operation.	Remove bearing (10) (step 20c.) and discard if rough or not easy to operate. Install new bearing (10) (step 20d.) as needed.
	c. Press bearing (10) from fuel pump drive shaft (20).	
	d. Lubricate shaft (20) with clean diesel fuel and, using main shaft gear and bearing installation tool, press bearing (10) onto fuel pump drive shaft (20).	Main shaft gear and bearing installation tool are part of front cover and main shaft assembly tool kit (3375175). Be sure to press against inner race of bearing.

3-61. FUEL PUMP FRONT COVER AND GOVERNOR REPAIR (Contd)

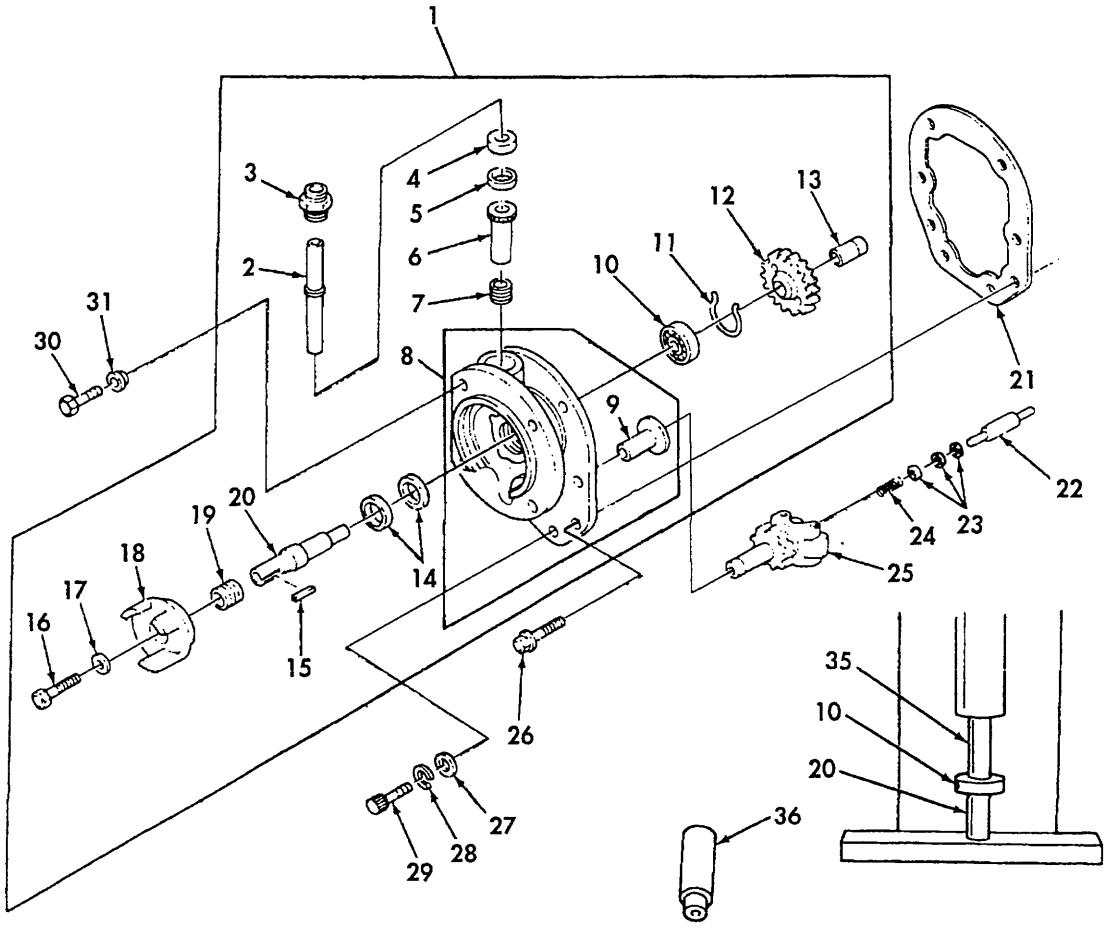


LEGEND:
8. COVER ASSEMBLY
9. GOVERNOR BUSHING
10. BEARING
20. FUEL PUMP DRIVE SHAFT

3-61. FUEL PUMP FRONT COVER AND GOVERNOR REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
e. Assembly (M915A1/Big Cam)		
20. Bushing (6) and gear (7)	a. Install bushing on tachometer drive shaft (2). b. Put a 0.004 in. (0.101 mm) feeler gauge on top of bushing (6). c. Press gear onto tachometer drive shaft (2).	There should be 0.002-0.005 in. (0.050-0.127 mm) clearance between bushing (6) and gear (7).
21. Shaft (2), bushing (6), and gear (7) (assembled)	a. Line up oil groove in top of bushing (6) with fuel pump drive shaft (20). b. Press into cover assembly (8) until bushing (6) bottoms.	
22. Tachometer drive spacer (5)	Install on top of tachometer drive bushing (6) with slotted edge down.	Spacer (5) must bottom on bushing (6).
23. Tachometer drive seal (4)	Using front cover tachometer seal driver (36), install with spring side down.	Front cover tachometer seal driver (36) is part of front cover and main shaft assembly tool kit (3375175).
24. Tachometer drive housing (3)	Screw into cover assembly (8).	Do not overtighten housing. This will compress tachometer drive spacer (5) too much and will reduce its effectiveness.
25. Fuel pump drive gear (12)	Using main shaft gear and bearing installation tool (35), press onto fuel pump drive shaft (20) until against bearing (10).	Use front cover and main shaft assembly tool kit (3375175). Flat side of gear should face away from bearing.
26. Fuel pump drive coupling (13)	a. Lubricate fuel pump drive shaft (20) and bore of coupling. b. Press onto fuel pump drive shaft (20) until against fuel pump drive gear (12).	

3-61. FUEL PUMP FRONT COVER AND GOVERNOR REPAIR (Contd)



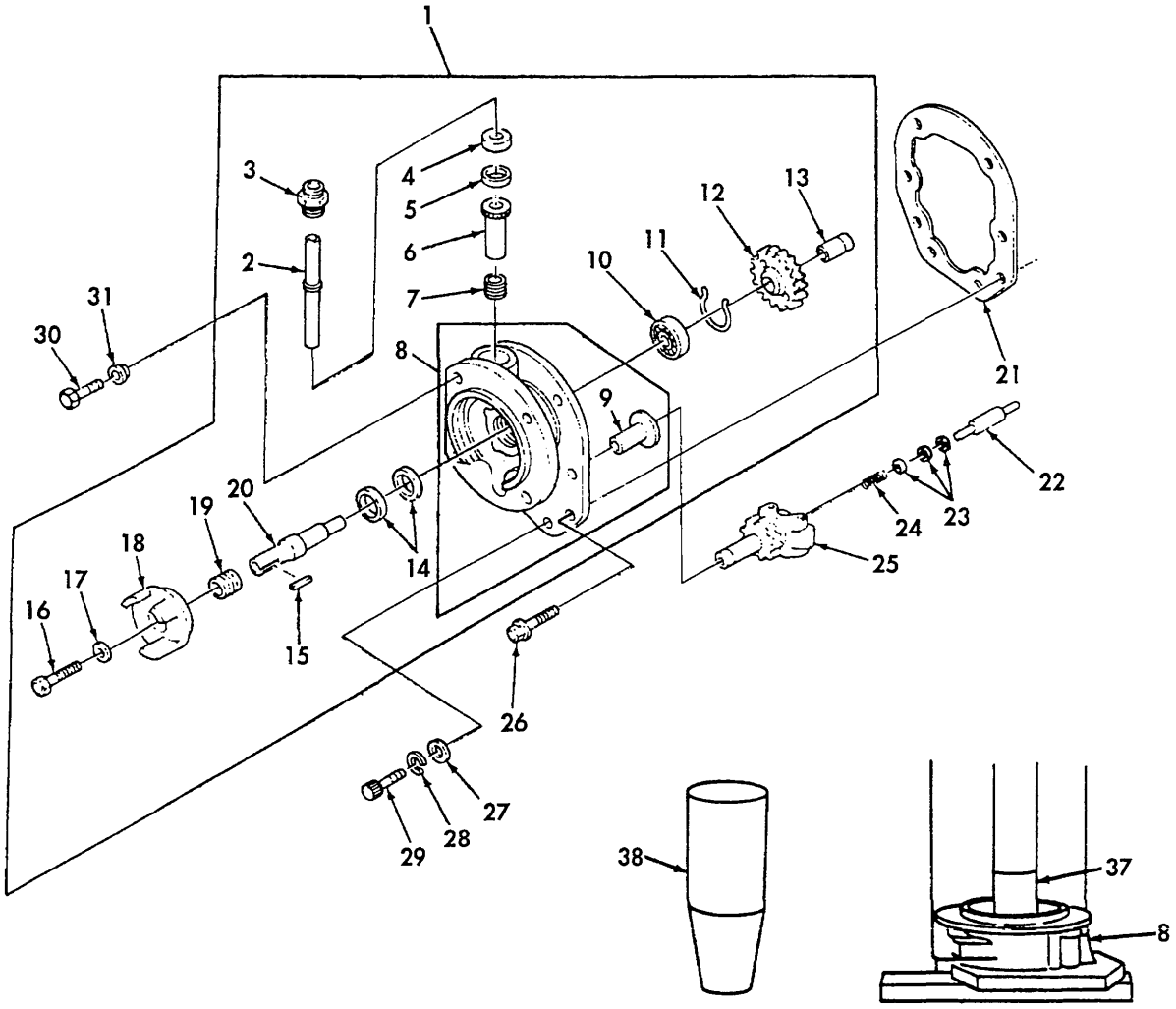
LEGEND:

2. TACHOMETER DRIVE SHAFT
3. TACHOMETER DRIVE HOUSING
4. TACHOMETER DRIVE SEAL
5. TACHOMETER DRIVE SPACER
6. TACHOMETER DRIVE BUSHING
7. TACHOMETER DRIVE GEAR
8. COVER ASSEMBLY
10. BEARING
12. FUEL PUMP DRIVE GEAR
13. FUEL PUMP DRIVE COUPLING
20. FUEL PUMP DRIVE SHAFT
35. MAIN SHAFT GEAR AND BEARING INSTALLATION TOOL
36. FRONT COVER TACHOMETER SEAL DRIVER

3-61. FUEL PUMP FRONT COVER AND GOVERNOR REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
e. Assembly (M915A1/Big Cam III) (Contd)		
27. Two new shaft seals (14)	a. Using main shaft seal driver (37), press first shaft seal on cover assembly (8) with lip toward back of cover assembly (8).	Main shaft seal driver (37) is part of front cover and main shaft assembly tool kit (3375175).
	b. Using main shaft seal driver (37), press second shaft seal on cover assembly (8) with lip toward front of cover assembly.	Use front cover and main shaft assembly tool kit (3375175). Shaft seals must be spaced so weep hole is not covered.
28. Fuel pump drive shaft (20) and attached parts	a. Install oil seal assembly tool (38) on shaft (20).	Use oil seal assembly tool (ST-419) (38).
	b. Carefully press shaft (20) on cover assembly (8) until bearing (10) is against bottom of cover assembly (8) hole.	Be careful not to move shaft seals (14).
29. Retaining ring (11)	Install on fuel pump drive shaft (20) between fuel pump drive gear (12) and bearing (10).	Look through holes in gear to ensure retaining ring (11) is in groove.
30. Coupling key (15)	Install on fuel pump drive shaft (20).	
31. Tachometer drive gear (19) and fuel pump drive coupling (18)	a. Position on fuel pump drive shaft (20).	Ensure tachometer gear teeth are aligned.
	b. Press slowly and straight onto shaft (20).	
	c. Secure with screw (16) and washer (17).	Hold fuel pump drive coupling (18) in copper-jawed vise. Tighten screw to 5 lb-ft (7 N•m).
32. Governor assembly (25)	a. Slide on governor bushing (9).	
	b. Rotate with weights opened out to ensure it will turn completely in housing.	
33. Weight-assist plunger (22), shims (23), and spring (24)	a. Install between governor weights in bore of governor assembly (25).	Always install weight-assist plunger (22) with smallest end toward governor weights.

3-61. FUEL PUMP FRONT COVER AND GOVERNOR REPAIR (Contd)



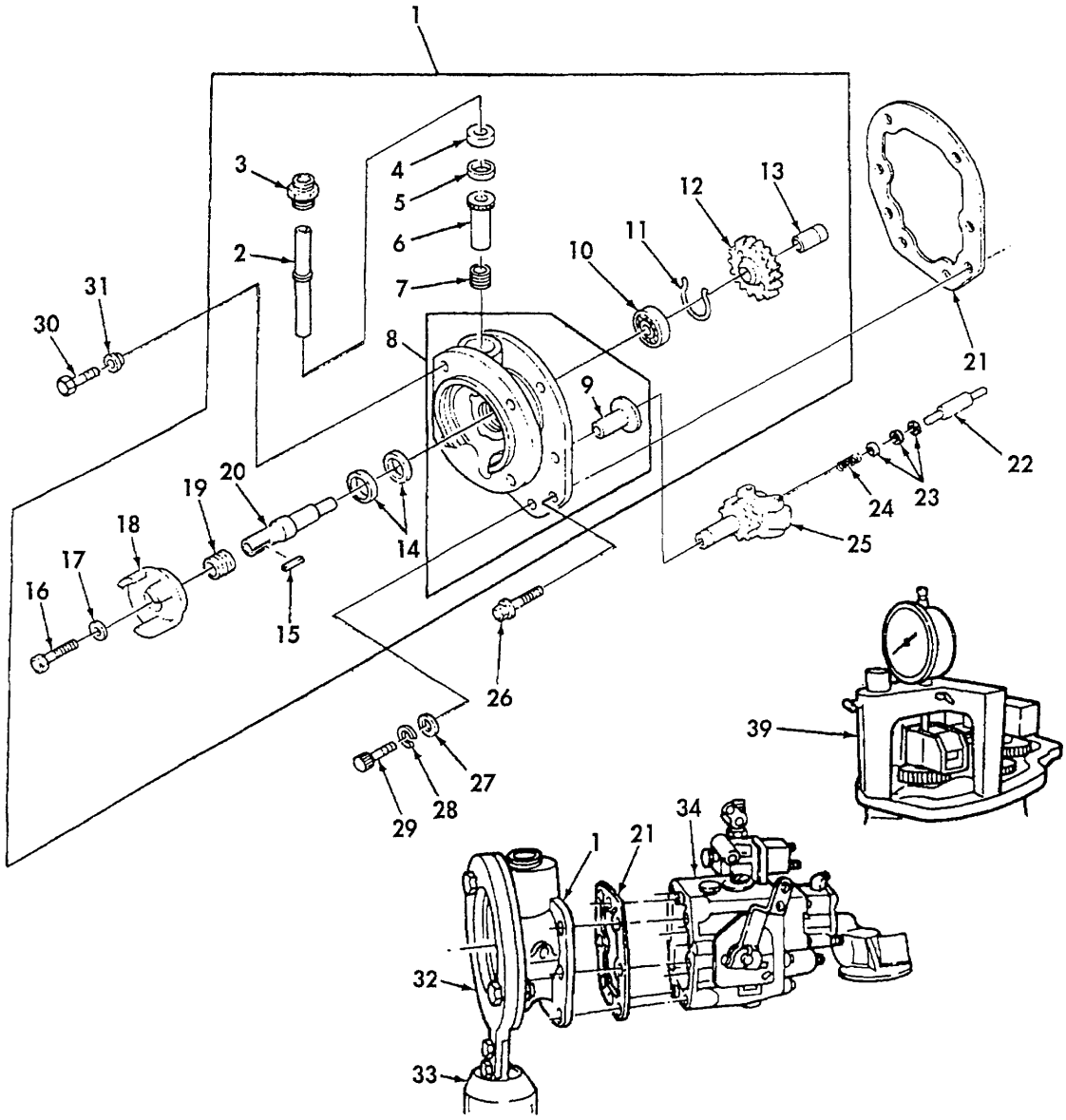
LEGEND:

8. COVER ASSEMBLY
9. GOVERNOR BUSHING
10. BEARING
11. RETAINING RING
12. FUEL PUMP DRIVE GEAR
14. SHAFT SEAL (2)
15. COUPLING KEY
16. SCREW
17. WASHER
18. FUEL PUMP DRIVE COUPLING
19. TACHOMETER DRIVE GEAR
20. FUEL PUMP DRIVE SHAFT
22. WEIGHT-ASSIST PLUNGER
23. SHIMS (3)
24. SPRING
25. GOVERNOR ASSEMBLY
37. MAIN SHAFT SEAL DRIVER
38. OIL SEAL ASSEMBLY TOOL

3-61. FUEL PUMP FRONT COVER AND GOVERNOR REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
e. Assembly (M915A1/Big Cam III) (Contd)		
33. Weight-assist plunger (22), shims (23), and spring (24) (Contd)	b. Add enough shims (23) to back of spring (24) to make weight-assist plunger (22) protrude above gasket face of cover assembly (8).	
	c. Check protrusion of weight-assist plunger (22) as follows:	
	(1) Put plunger protrusion checking tool (39) on surface of cover assembly (8).	Use plunger protrusion checking tool (ST-1241).
	(2) Put contact point of dial indicator on 12-in. diameter, 1-in. long gauge pin and zero dial indicator.	
	(3) Measure protrusion of weight-assist plunger (22).	Dial indicator will give weight direct reading of protrusion. If protrusion is below 0.800 in. (20.32 mm), add shims. If protrusion is above 0.800 in. (20.32 mm), remove shims or grind end of weight-assist plunger (22) if no shims (23) are in use.
f. Installation		
34. New cover-to-fuel pump gasket (21)	Place on dowel pins of fuel pump main housing (34).	See illustration.
35. Fuel pump main housing (34) with cover-to-fuel pump gasket (21)	a. Install on fuel pump front cover assembly (1).	Position governor weight housing carrier horizontally and hold governor weights while installing fuel pump main housing (34). Ensure governor weights are properly engaged with tang on governor plunger.
	b. Secure with screw (30), new plastic bushing seal (31), screw (29), lockwasher (28), washer (27), and five captive washer screws (26).	Tighten all screws to 9-11 lb-ft (12-15 N•m).
36. Fuel pump front cover assembly (1)	Remove from mounting plate (32) and ball joint vise (33).	

3-61. FUEL PUMP FRONT COVER AND GOVERNOR REPAIR (Contd)



LEGEND:

1. FUEL PUMP FRONT COVER ASSEMBLY
8. COVER ASSEMBLY
21. COVER-TO-FUEL PUMP GASKET
22. WEIGHT-ASSIST PLUNGER
23. SHIM (3)
24. SPRING
26. CAPTIVE WASHER SCREW (5)
27. WASHER
28. LOCKWASHER
29. SCREW
30. SCREW
31. PLASTIC BUSHING SEAL
32. MOUNTING PLATE
33. BALL JOINT VISE
34. FUEL PUMP MAIN HOUSING
39. PLUNGER PROTRUSION CHECKING TOOL

3-61. FUEL PUMP FRONT COVER AND GOVERNOR REPAIR (Contd)

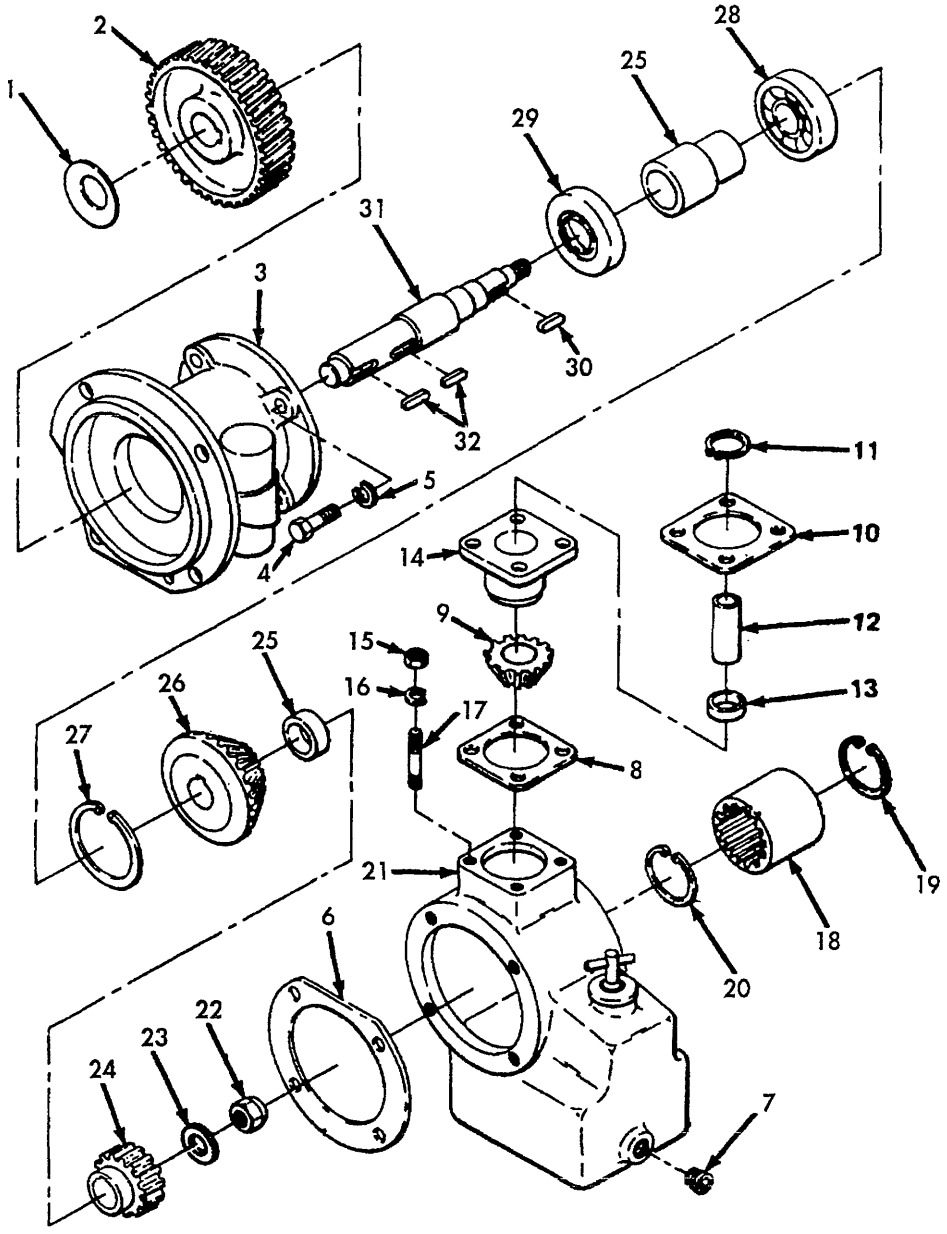
LOCATION/ITEM	ACTION	REMARKS
g. Disassembly (M915/Big Cam I)		
37. Governor drive shaft (12)	a. Before removing, check drive shaft (12) for excessive wear.	Drive shaft (12) has excessive wear if it can be moved from side to side in governor housing (14). Discard governor housing (14) if there is excessive wear.
	b. Check gear backlash between gear (9) and drive gear (26).	Normal backlash is 0.005-0.009 in. (0.127-0.228 mm). Discard collar (13), gear (9), and drive gear (26) if backlash is more than 0.009 in. (0.228 mm).
38. Governor drive assembly snapring (11), ball key (30), and collar (13)	Remove.	
39. Drive shaft (12)	Press on opposite gear end and remove all units from housing (14).	
40. Drive gear (2) and support (3)	Remove from reservoir (21). Remove drain plug, dipstick, vent plug, and elbow.	
41. Locknut (22) and washer (23)	Remove from shaft (31).	
42. Coupling gear (24)	Press on small end of sham (31) to remove shaft from support (3) and large end of shaft to remove drive gear (26).	Use coupling puller (ST-1249).
43. Spacers (25) and governor drive gear (26)	Remove.	
44. Two keys (32)	Remove from shaft (31) keyways.	
45. Snapring (27) and support (3)	Remove and invert support and press out rear bearing (28) and oil seal (29).	
h. Inspection (M915/Big Cam)		

NOTE

After disassembly, check bearing for worn race or rough action. Check gears for chipped, broken teeth, or uneven wear. Inspect governor shaft housing oil holes to make certain they are open and clear of foreign matter.

46. Support (3) and reservoir (21)	Inspect for cracks, breaks, or rough mating surfaces.	Replace all damaged, worn, or defective parts as necessary.

3-61. FUEL PUMP FRONT COVER AND GOVERNOR REPAIR (Contd)



BIG CAM I

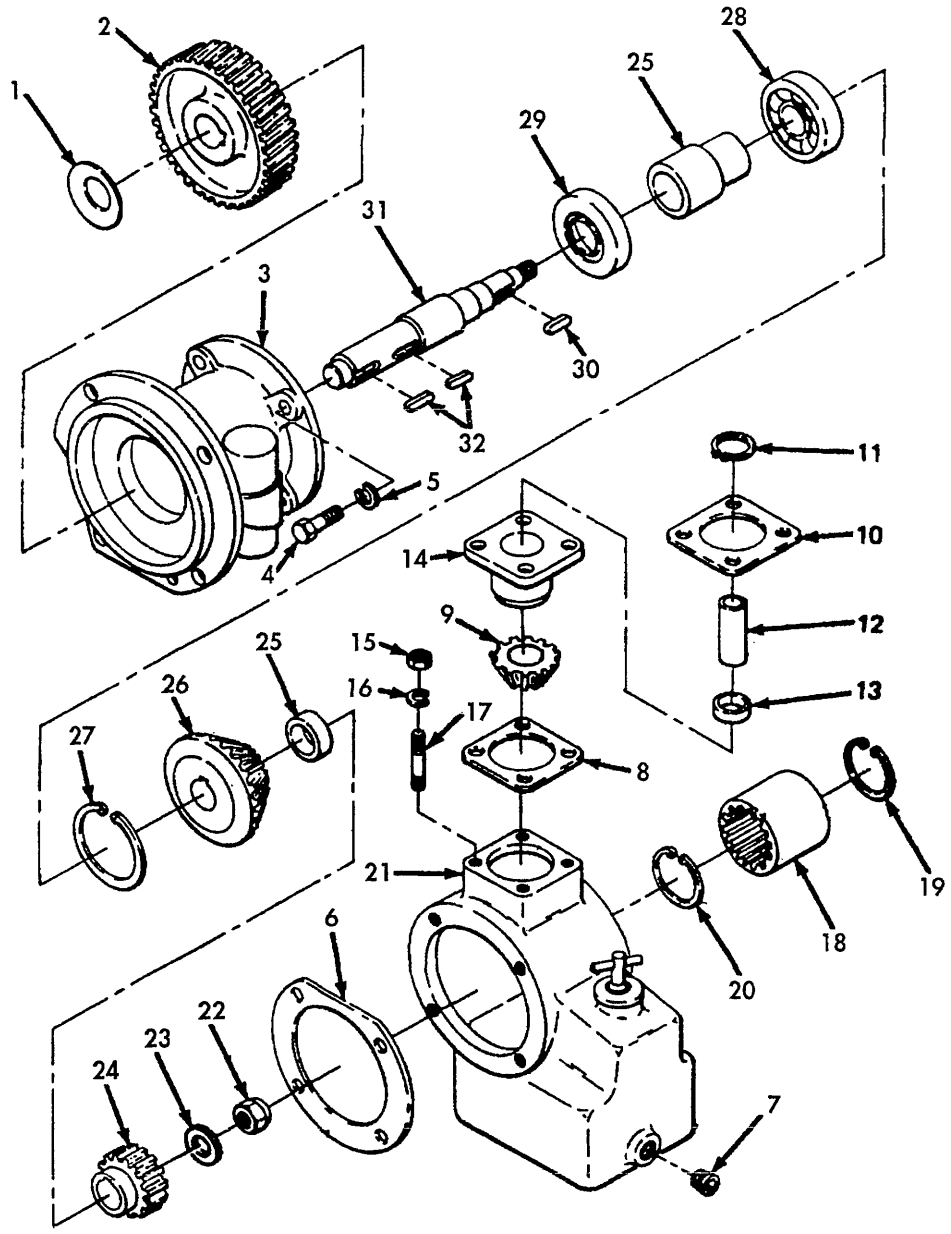
LEGEND:

1. SLINGER	9. GEAR	17. STUD (4)	25. SPACER (2)
2. DRIVE GEAR	10. GASKET	18. COUPLING	26. DRIVE GEAR
3. SUPPORT	11. SNAPRING	19. SNAPRING	27. SNAPRING
4. SCREW (4)	12. DRIVE SHAFT	20. SNAPRING	28. BEARING
5. LOCKWASHER (4)	13. COLLAR	21. RESERVOIR	29. OIL SEAL
6. GASKET	14. GOVERNOR HOUSING	22. LOCKNUT	30. BALL KEY
7. PIPE PLUG	15. NUT (4)	23. WASHER	31. SHAFT
8. GASKET	16. LOCKWASHER (4)	24. COUPLING GEAR	32. KEY (2)

3-61. FUEL PUMP FRONT COVER AND GOVERNOR REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
i. Assembly (M915/Big Cam I)		
47. Oil seal (29) and support (3)	Lubricate outside of seal (29) and press into support from large end.	Open end of seal must be facing down.
48. Bearing (28) and snapring (27)	Lubricate rear bearing (28) and press into support (3). Insert snapring (27) with flat side down.	
49. Drive shaft (31) and keys (32)	Lubricate drive shaft (31) and place key (32) in drive shaft (31) keyway. Press drive shaft (31) into flat side of drive gear (2) until shoulder seats on gear face.	
50. Support (3) and drive gear (26)	Press small end of shaft assembly into large end of support (3). Press governor drive gear (26) onto drive shaft (31) until it bottoms on bearing (28).	
51. Ball key (30) and coupling gear (24)	Insert key (30) and press on coupling gear (24). Shoulder of coupling goes against drive gear (26) unless a spacer (25) is used.	
52. Washer (23) and locknut (22)	Install.	Tighten locknut (22).
53. Reservoir (21) and studs (17)	Position reservoir (21) in vise and, with governor's drive studs (17) up, install dipstick, vent plug, drain plug, and elbow.	
	NOTE **Use the following assembly instructions for governors with 2:1 gear ratio.**	
54. Drive shaft (12) and snapring (11)	a. Install drive shaft (12), with splined end up, and collar (13) on housing (14).	
	b. Lubricate ball key (30) and insert in drive shaft (31) and install snapring (11).	Align ball key (30) with collar (13).
55. Gear (9)	Invert assembly and press on gear (9).	Allow clearance of 0.003-0.006 in. (0.08-0.15 mm).

3-61. FUEL PUMP FRONT COVER AND GOVERNOR REPAIR (Contd)



BIG CAM I

LEGEND:

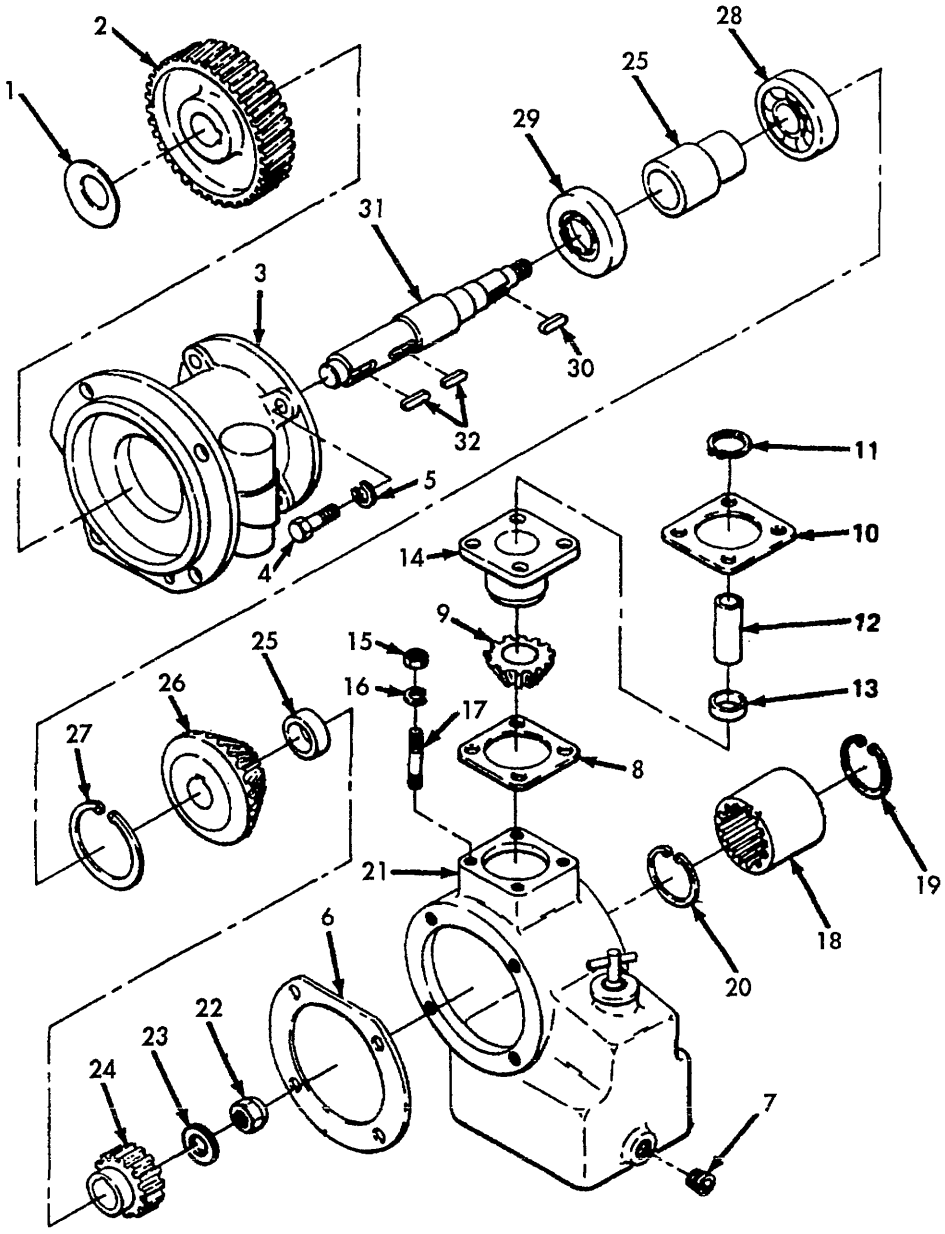
1. SLINGER
2. DRIVE GEAR
3. SUPPORT
4. SCREWS (4)
5. LOCKWASHERS (4)
6. GASKET
7. PIPE PLUG
8. GASKET
9. GEAR
10. GASKET
11. SNAPRING
12. DRIVE SHAFT
13. COLLAR
14. GOVERNOR HOUSING
15. NUTS (4)
16. LOCKWASHERS (4)
17. STUD (4)
18. COUPLING
19. SNAPRING
20. SNAPRING
21. RESERVOIR
22. LOCKNUT
23. WASHER
24. COUPLING GEAR
25. SPACER (2)
26. DRIVE GEAR
27. SNAPRING
28. BEARING
29. OIL SEAL
30. BALL KEY
31. DRIVE SHAFT
32. KEY (2)

3-61. FUEL PUMP FRONT COVER AND GOVERNOR REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
i. Assembly (M915/Big Cam I) (Contd)		
	NOTE **Use the following assembly instructions for governors with 3:1 gear ratio.**	
56. Drive shaft (12)	a. Press governor two-piece drive shaft (12) on washer flush with bottom side. b. Press shaft assembly on cylinder until shoulder on drive shaft (12) is flush with end of cylinder. Slide assembly into governor housing (14) so washer rests on bronze bushing. c. Invert assembly and install ball key (30), collar (13), and snapring (11). Press on end of cylinder until flat washer is against bronze bushing. Press gear into position allowing end clearance of 0.003 to 0.006 in. (0.08 to 0.15 mm).	Note relief in washer to start shaft.
57. Gasket (8)	Position and install drive gear and housing assembly on serial number side of reservoir (21).	Large oil hole in housing must be at top.
58. Slinger (1)	Install on gear end of drive shaft (12).	

FOLLOW-ON TASK: For M915/Big Cam I engines only, proceed to follow-on tasks listed at the end of para. 3-62.

3-61. FUEL PUMP FRONT COVER AND GOVERNOR REPAIR (Contd)



BIG CAM I

LEGEND:

1. SLINGER
8. GASKET
11. SNAPRING
12. DRIVE SHAFT
13. COLLAR
14. GOVERNOR HOUSING
21. RESERVOIR
30. BALL KEY

3-62. FUEL PUMP MAIN HOUSING REPAIR

THIS TASK COVERS:

a. Disassembly
b. Cleaning
c. Inspection and Repair
d. Assembly

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
AFC barrel puller (15434) 3375599
Installer tool (15434) 3375416
Ream fixture (15434) ST-490
Lock-clip driver (15434) 3376136

TEST EQUIPMENT
None

MATERIALS/PARTS
Solvent, SD-3 (Appendix C, Item 30)
Lubricant, high-pressure (Appendix C, Item 15)
Oil, cutting (Appendix C, Item 18)
Cloth, crocus (Appendix C, Item 4)
Oil, lubricating, OE/HDO 30 (Appendix C, Item 21)
O-ring (94135) 12Z9026-5
O-ring (15434) 145505
O-ring (15434) 145504
O-ring (15434) 70775
Cap seal ring (15434) 154088
O-ring (15434) 213768
O-ring (15434) 190876
Two O-rings (15434) 68061-A (M915/Big Cam I)
O-ring (15434) 100478
Gasket washer (15434) 3023870
Bellows (15434) 3013811
Throttle shaft ball (15434) 213796

PERSONNEL REQUIRED
Fuel and electrical systems repairman MOS 63G

REFERENCES (TM)
TM 9-2320-273-20
TM 9-2320-273-34
TM 9-2320-283-20
TM 9-2320-283-34

TROUBLESHOOTING REFERENCES
Para. 2-8

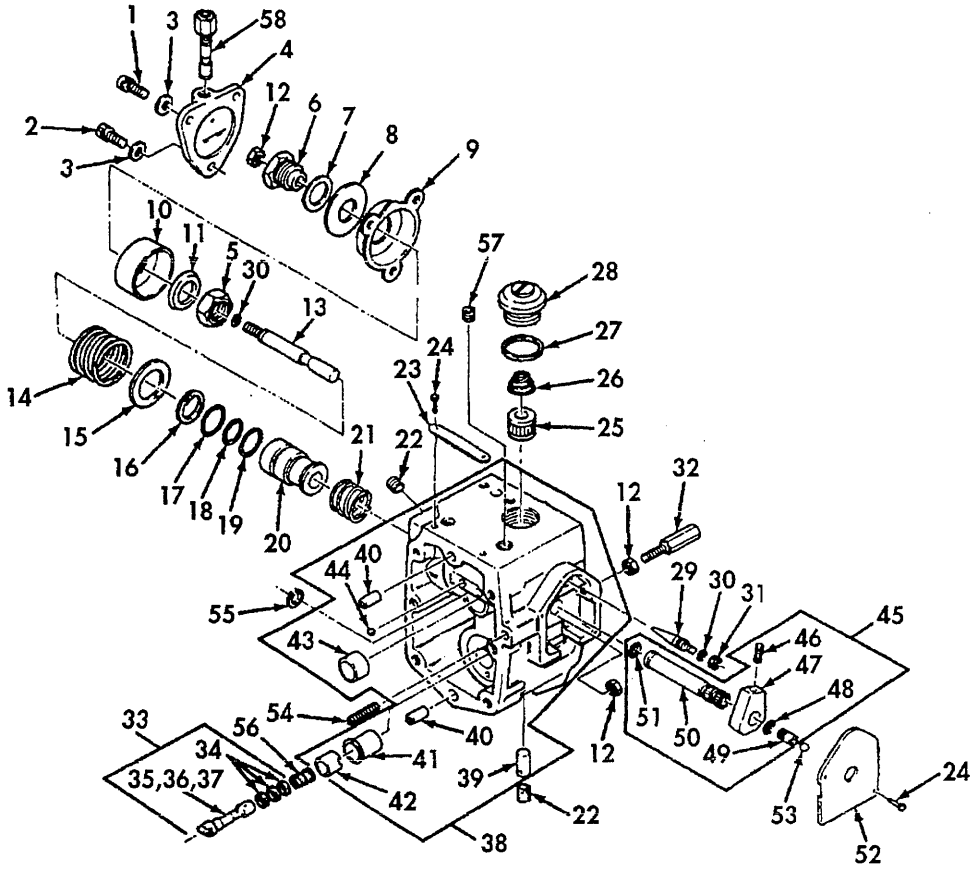
EQUIPMENT CONDITION
- Water pump removed (TM 9-2320-273-20, TM 9-2320-273-34 or TM 9-2320-283-20, TM 9-2320-283-34).
- Fuel pump mounted on ball joint vise (para. 3-56).
- Solenoid valve removed (para. 3-57).
- Fuel gear pump removed (para. 3-59).
- Fuel pump governor spring removed (para. 3-60).
- Fuel pump front cover and governor removed (para. 3-61).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
- Always wear eye protection when using compressed air.
- Use approved solvent in well-ventilated area and away from flame.

LOCATION/ITEM		ACTION	REMARKS
a. Disassembly			
1.	Two drive screws (24)	Remove from throttle shaft cover (52).	
2.	Throttle shaft cover (52)	Remove from housing (38).	
3.	Retaining ring (55)	Remove from throttle shaft (50).	Discard retaining ring (55) if damaged during removal.
4.	Throttle shaft (50) and and O-ring (51)	Remove from housing (38).	Discard O-ring (51).
5.	Throttle shaft ball (53)	Drill out of throttle shaft (50).	Be careful not to damage throttle shaft (50) when drilling. Discard ball (53).

3-62. FUEL PUMP MAIN HOUSING REPAIR (Contd)



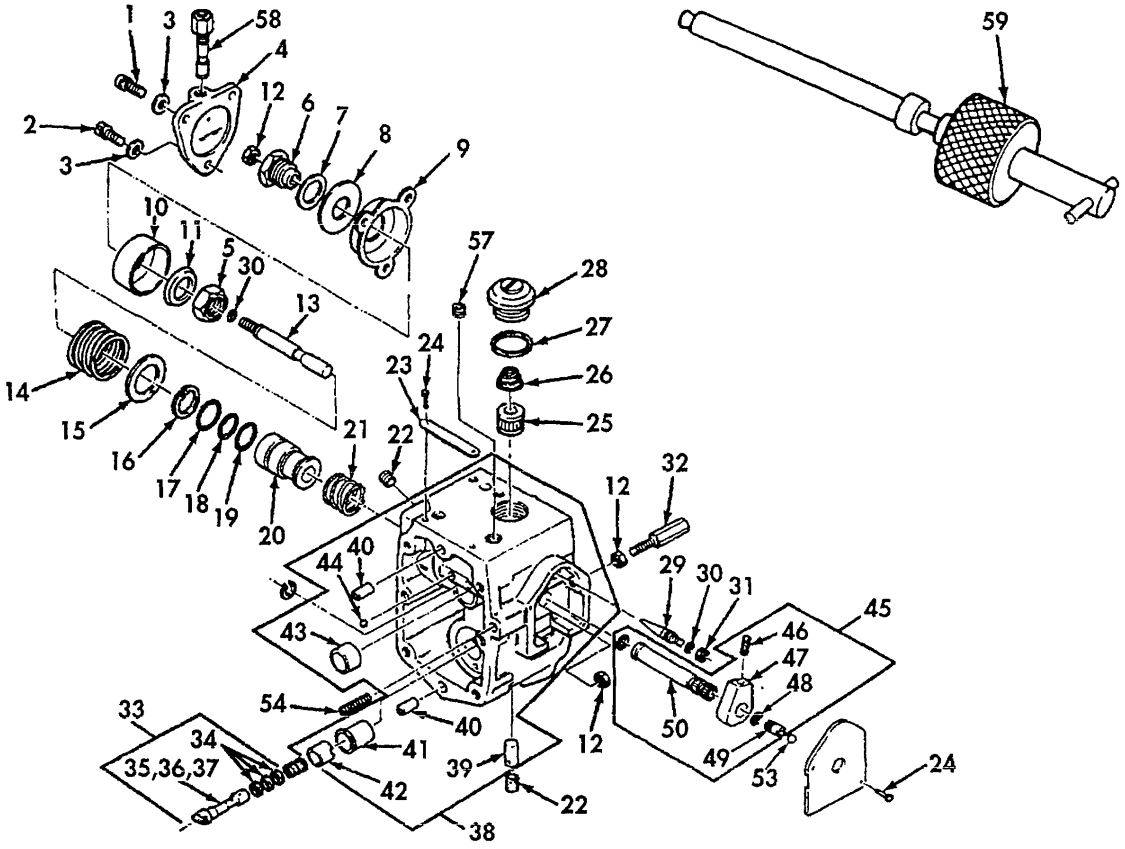
LEGEND:

1. SCREW (2)
2. DRILLED-HEAD SCREW
3. WASHER (3)
4. FUEL CONTROL COVER
5. NUT
6. AIR FUEL CONTROL PISTON INSERT
7. GASKET WASHER
8. RETAINER WASHER
9. BELLOWS
10. AFC PISTON
11. PISTON SPACER
12. JAMNUT (3)
13. THROTTLE PLUNGER
14. SPRING
15. AFC SHIM
16. RETAINING RING
17. O-RING
18. O-RING (2)
19. O-RING
20. BARREL
21. BARREL SPRING
22. PIPE PLUG (4)
23. NAMEPLATE
24. DRIVE SCREW (4)
25. FUEL FILTER SCREEN
26. FILTER SPRING
27. CAP SEAL RING
28. FILTER SCREEN CAP
29. AFC NEEDLE VALVE
30. O-RING (2)
31. NUT
32. THREADED STUD
33. GOVERNOR PLUNGER ASSEMBLY
34. SHIM (3)
35. GOVERNOR SPACER
36. GOVERNOR PLUNGER
37. GOVERNOR PLUNGER DRIVER
38. HOUSING
39. ROLL PIN
40. DOWEL (2)
41. SPRING PACK HOUSING
42. GOVERNOR BARREL
43. TACHOMETER DRIVE BUSHING
44. AFC PLUG BALL (2)
45. THROTTLE SHAFT ASSEMBLY
46. SETSCREW
47. STOP
48. O-RING
49. FUEL ADJUSTING SCREW
50. THROTTLE SHAFT
51. O-RING
52. THROTTLE SHAFT COVER
53. THROTTLE SHAFT BALL
54. TAPERED STUD
55. RETAINING RING
56. TORQUE SPRING
57. PIPE PLUG
58. CHECK VALVE

3-62. FUEL PUMP MAIN HOUSING REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
a. Disassembly (Contd)		
6. Fuel adjusting screw (49) and O-ring (48)	Remove from throttle shaft (50).	Discard O-ring (48).
7. Setscrew (46)	Remove from stop (47).	
8. Throttle shaft (50)	Remove from stop (47).	
9. AFC needle valve (29)	a. Loosen nut (31).	
	b. Remove valve (29) and O-ring (30).	Discard O-ring (30).
	c. Remove nut (31) from valve (29).	
10. Threaded stud (32)	a. Remove from housing (38).	
	b. Remove from jamnut (12).	
11. Jamnut (12)	Remove from tapered stud (54).	
12. Tapered stud (54)	Remove from housing (38).	
13. Filter screen cap (28), cap seal ring (27), filter spring (26), and fuel filter screen (25)	Remove from filter housing (38).	Discard cap seal ring (27).
14. Check valve (58)	Remove from fuel control cover (4).	
15. Two screws (1), drilled head screw (2), and three washers (3)	Remove fuel control cover (4) from housing (38).	
16. Bellows (9)	Carefully lift away from sealing surface of housing (38) and remove with attached parts.	
17. Spring (14) and AFC shim (15)	Remove from housing (38).	
18. Retaining ring (16)	Remove from housing (38).	Discard retaining ring (16) if damaged during removal.
19. Barrel (20) and four(59). O-rings (17), (18), and (19)	Remove from housing (38).	Use AFC barrel puller (3375599) Discard O-rings (17), (18), and (19).
20. Barrel spring (21)	Remove from housing (38).	Earlier pump models did not require a barrel spring (21).
21. Jamnut (12)	Remove from throttle plunger (13).	
22. Throttle plunger (13) and O-ring (30)	Remove from air fuel control piston insert (6).	Discard O-ring (30).
23. Nut (5), air fuel control piston insert (6), gasket washer (7), retainer washer (8), AFC piston (10), and piston spacer (11)	Remove nut (5) from air fuel control piston insert (6) and separate all parts.	Discard gasket washer (7) and bellows (9).

3-62. FUEL PUMP MAIN HOUSING REPAIR (Contd)



LEGEND:

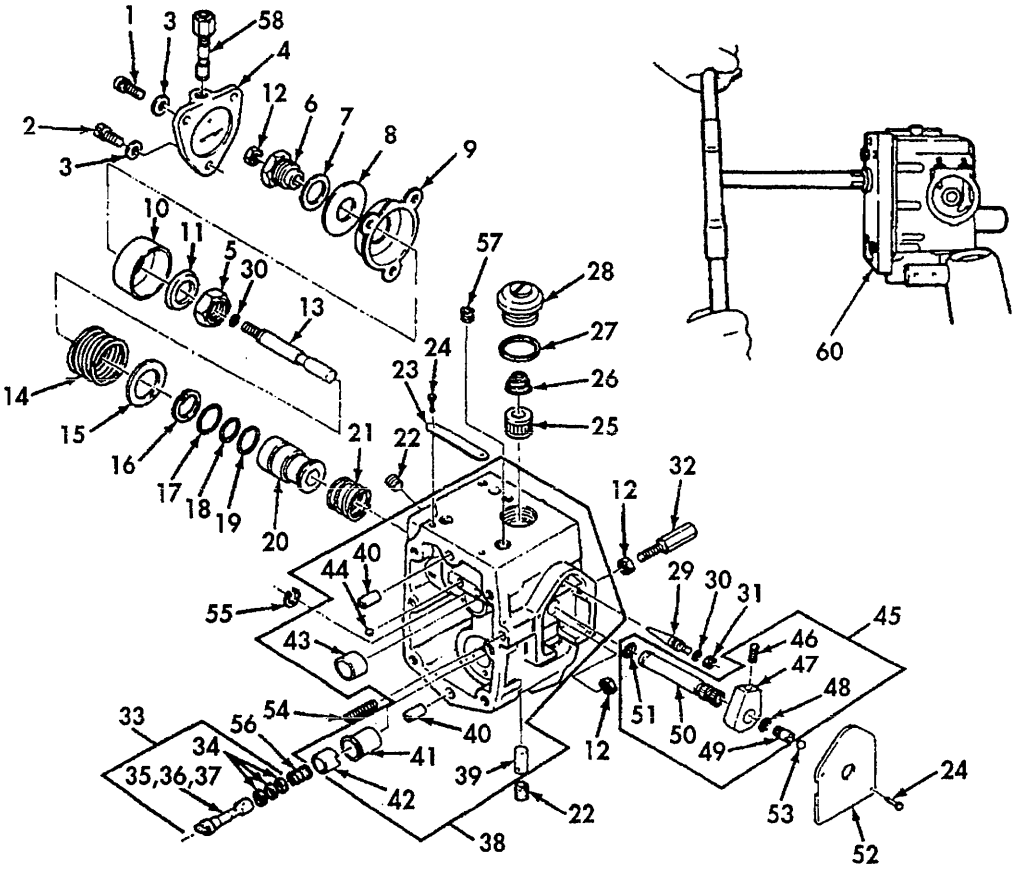
1. SCREW (2)
2. DRILLED-HEAD SCREW
3. WASHER (3)
4. FUEL CONTROL COVER
5. NUT
6. AIR FUEL CONTROL PISTON INSERT
7. GASKET WASHER
8. RETAINER WASHER
9. BELLOWS
10. AFC PISTON
11. PISTON SPACER
12. JAMNUT (3)
13. THROTTLE PLUNGER
14. SPRING
15. AFC SHIM
16. RETAINING RING
17. O-RING
18. O-RING (2)
19. O-RING
20. BARREL
21. BARREL SPRING
22. PIPE PLUG (4)
23. NAMEPLATE
24. DRIVE SCREW (4)
25. FUEL FILTER SCREEN
26. FILTER SPRING
27. CAP SEAL RING
28. FILTER SCREEN CAP
29. AFC NEEDLE VALVE
30. O-RING (2)
31. NUT
32. THREADED STUD
33. GOVERNOR PLUNGER ASSEMBLY
34. SHIMS
35. GOVERNOR SPACER
36. GOVERNOR PLUNGER
37. GOVERNOR PLUNGER DRIVER
38. HOUSING
39. ROLL PIN
40. DOWEL (2)
41. SPRING PACK HOUSING
42. GOVERNOR BARREL
43. TACHOMETER DRIVE BUSHING
44. AFC PLUG BALL (2)
45. THROTTLE SHAFT ASSEMBLY
46. SETSCREW
47. STOP
48. O-RING
49. FUEL ADJUSTING SCREW
50. THROTTLE SHAFT
53. THROTTLE SHAFT BALL
54. TAPERED STUD
58. CHECK VALVE
59. AFC BARREL PULLER

3-62. FUEL PUMP MAIN HOUSING REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
a. Disassembly (Contd)		
24. Governor plunger assembly (33), shims (34), and torque spring (56) (assembled)	Remove from housing (38).	
25. Torque spring (56) and shims (34)	Remove from governor plunger assembly (33), spacer (35), and driver (37).	It may be necessary to twist spring (56) off plunger (36) to remove it. Do not pull spring off. Pulling spring will expand it beyond its elastic limit, requiring its replacement.
26. Five pipe plugs (22) and (57)	Remove from housing (38).	
b. Cleaning		
	WARNING • **Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and protective equipment such as goggles or shield, gloves, etc. Failure to comply may result in injury to personnel.** • **Approved solvents may be flammable and will not be used near open flame. Use only in well-ventilated area. Failure to comply may result in injury to personnel.**	
27. All parts	Clean with SD-3 solvent and dry with compressed air.	Refer to para. 3-6 for additional cleaning instructions.
c. Inspection and Repair		
28. Tachometer drive bushing (43)	a. Inspect for scoring, burrs, and other damage.	Replace bushing (43) if damaged (refer to step 28b.1 for replacement).
	b. Using suitable micrometer, measure inside diameter.	Replace bushing (43) if inside diameter is more than 0.7525 in. (19.114 mm) (refer to step 28b.1 for replacement).
	Replace bushing (43) as follows:	Do this step only if bushing (43) is damaged or worn beyond limits.
	(1) Remove bushing (43).	Using 1/2 in. pipe tap, put a thread in bushing (43). Install punch through rear of housing (38) until it is against pipe tap. Hit punch and remove bushing (43).
	(2) Apply a thin coat of high-pressure lubricant to new bushing (43).	
	(3) Using arbor press, drive bushing (43) into housing (38).	Bushing (43) must be even with housing bore.

3-62. FUEL PUMP MAIN HOUSING REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
28. Tachometer drive bushing (43) (Contd)	(4) Using ream fixture (60) and well oiled 0.750-in. (19.05 mm) reamer line, ream bushing (43) to 0.7495-0.7505 in. (19.037-19.063 mm).	Use reamer fixture (ST-490). Check bushing inside diameter after reaming. Bushing must be less than 0.7525 in. (19.114 mm).



LEGEND:

22. PIPE PLUG (4)
33. GOVERNOR PLUNGER ASSEMBLY
34. SHIMS
35. GOVERNOR SPACER
36. GOVERNOR PLUNGER
37. GOVERNOR PLUNGER DRIVER
38. HOUSING
43. TACHOMETER DRIVE BUSHING
56. TORQUE SPRING
57. PIPE PLUG
60. REAM FIXTURE

3-62. FUEL PUMP MAIN HOUSING REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection and Repair (Contd)		
29. Governor barrel (42)	a. Inspect for wear.	Governor barrel (42) is hardened and wears very little. If barrel is worn or if governor plunger assembly (33) shows signs of damage, governor barrel (42) and spring pack housing (41) must be replaced (refer to step 29b. for replacement).
	b. Replace governor barrel (42) and spring pack housing (41) as follows:	Do this step only if governor and barrel (42) is worn or damaged.
	(1) Remove roll pin (39).	Using a wire hook, pull roll pin (39) out through plug hole in bottom of housing (38).
	(2) Heat housing (38) in oven to 300°F (149°C).	This will permit governor barrel (42) to be pressed out with less damage to housing bore.
	(3) Press out of housing (38).	Discard housing (38) if bore is not at least 0.002 in. (0.051 mm) smaller than governor barrel (42) outside diameter.
	(4) Using suitable governor barrel (42) outside micrometer, measure barrel diameter of bore in housing (38) and outside diameter of a new governor barrel (42).	
	(5) Check bore of housing (38) for score marks.	Remove slight score marks with crocus cloth. Discard housing (38) if deeply scored.

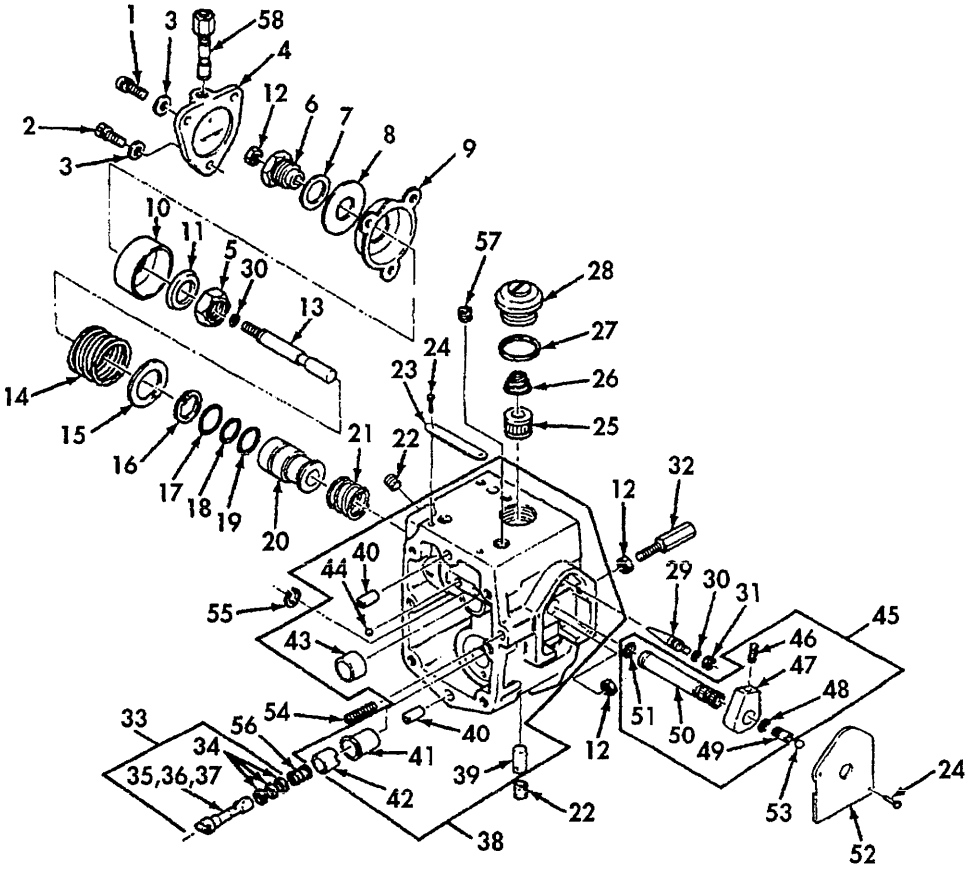
NOTE
Steps 29b.(6) and 29b.(7) refer to M915/Big Cam I older-style fuel pumps only.

	(6) If governor barrel (42) is worn or shows signs of scoring, heat the housing (38) in an oven to 300°F (149° C) and press out governor barrel (42).	Heat will expand aluminum housing and permit steel barrel to be pressed out with less chance of damaging housing bore.

NOTE
Check through-plug hole in bottom of pump for spring dowel which secures barrel in fuel pumps before attempting to remove governor barrel. Sometimes a wire hook, inserted into hole provided, will pull the spring dowel.

	(7) Check barrel bore in housing (38) to determine whether standard and 1.5020-1.5025 in. (38.15-38.16 mm) or 0.020 in. (0.51 mm) oversize must be used. Minimum 0.002 in. (0.05 mm) interference fit is required.	Check the bore for score marks; remove marks if found.

3-62. FUEL PUMP MAIN HOUSING REPAIR (Contd)



LEGEND:

33. GOVERNOR PLUNGER ASSEMBLY
38. HOUSING
39. ROLL PIN
41. SPRING PACK HOUSING
42. GOVERNOR BARREL

3-62. FUEL PUMP MAIN HOUSING REPAIR (Contd)

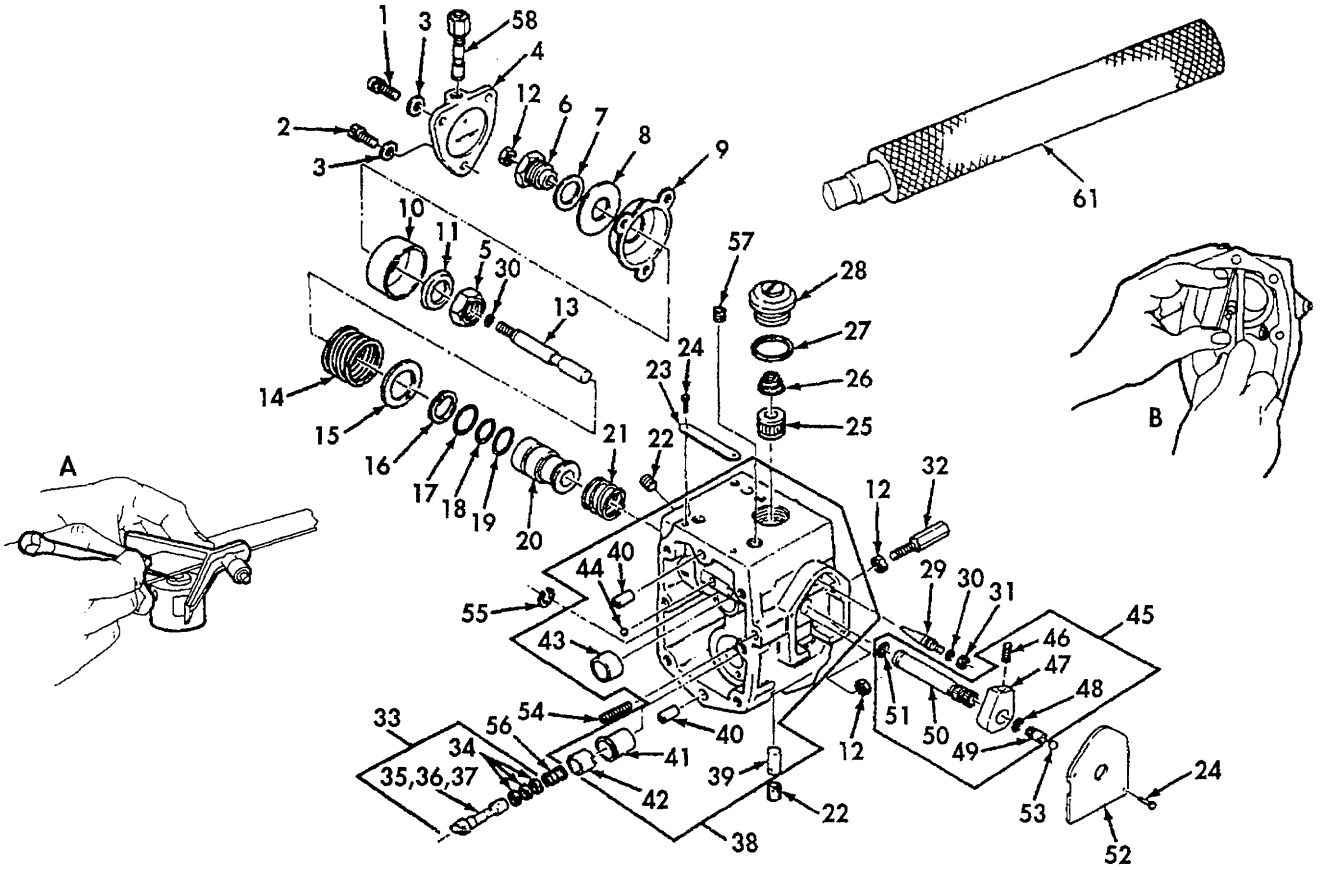
LOCATION/ITEM	ACTION	REMARKS
c. Inspection and Repair (Contd)		
29. Governor barrel (42) (Contd)	(8) Scribe a centerline on new governor barrel (42) and housing (38) as shown in figures A and B.	This mark is used to line up fuel passages so fuel flow will not have any restrictions.
	(9) Heat housing (38) in oven to 300°F (149°C).	
	(10) Apply a thin coat of high-pressure lubricant on new governor barrel (42).	
	(11) Place spring pack housing (41) into housing (38).	
	(12) Place governor barrel (42) in bore of housing (38) with chamfered end first and location pin on bottom side.	Line up location scribe marks on barrel (42) and governor housing (38).
	(13) Press into housing (38) using an arbor press if necessary, until it bottoms against spring pack housing (41).	Ensure retaining pin holes of barrel (42) and housing (38) are aligned.
	(14) Using governor barrel lock-clip driver (61), install roll pin (39) with ST-853 driver through plug hole in bottom of housing (38) with the slot of the pin to front of housing.	Use lock-clip driver (3376136). Slot of roll pin (39) must be toward front of housing (38).
30. Governor plunger assembly (33)	a. Inspect for damage or wear. If only the thrust washer is worn, drive retainer from end of plunger assembly (33) and pull the governor plunger drive from the plunger assembly (33). If it is necessary to remove the stop sleeve, press the stop sleeve off the shaft.	If governor plunger (36) outside diameter is worn, replace it with a new plunger of the same class size as etched on barrel face. Replace damaged or worn plunger assembly (33).
	b. Selecting a new class size plunger (36). See chart.	Select a new class 2 (green color code) plunger and attempt to fit it in the barrel; if plunger enters, try a class 3 (yellow). Keep trying larger sizes until one will not fit, then select a plunger two sizes smaller. The plunger must drop into the bore of its own weight. Remark governor barrel with the new class size of the plunger.
31. Housing (38)	Inspect throttle shaft sleeve in shaft housing (38) for damage.	Discard housing (38) if throttle sleeve is damaged.
32. Nameplate (23)	a. Inspect for damage.	If damaged, do step 32b.
	b. Remove two drive screws (24) and discard nameplate (23).	
	c. Install new nameplate (23) and drive screws (24).	Be sure to transfer information from damaged nameplate (23) to new nameplate.

3-62. FUEL PUMP MAIN HOUSING REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
33. Two dowels (40)	Inspect for damage.	Replace if damaged.
34. Fuel filter screen (25)	Inspect for holes or embedded metal particles in mesh.	Discard if damaged.
35. All parts	Inspect for cracks, breaks, and other damage.	Discard any damaged parts. Do not remove two AFC plug balls (44) from housing (38). Discard housing (38) if balls (44) are damaged.

Class and Size PTG-AFC Governor Plungers.

CODE	Red	Blue	Green	Yellow	Orange	Black	Gray	Purple
SIZE	0	1	2	3	4	5	6	7



LEGEND:

23. NAMEPLATE
24. DRIVE SCREW
25. FUEL FILTER SCREEN
33. GOVERNOR PLUNGER ASSEMBLY
36. GOVERNOR PLUNGER
38. HOUSING
39. ROLL PIN
40. DOWEL (2)
41. SPRING PACK HOUSING
42. GOVERNOR BARREL
44. AFC PLUG BALL (2)
61. GOVERNOR BARREL LOCK-CLIP DRIVER

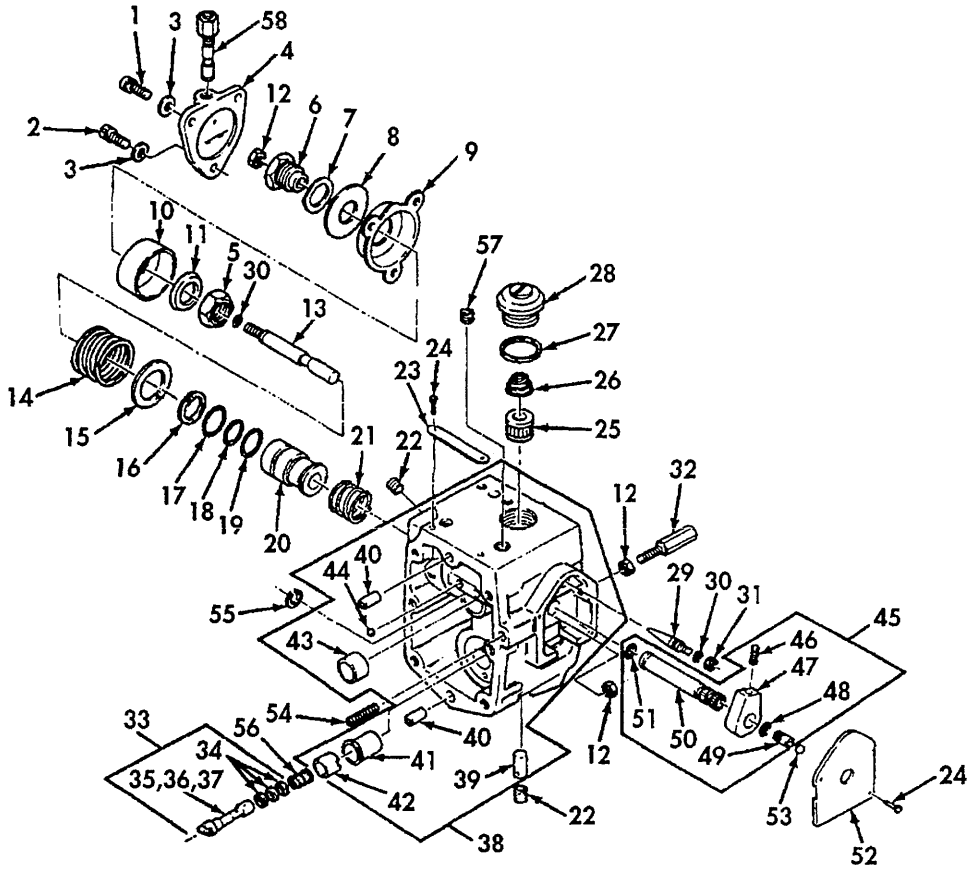
3-62. FUEL PUMP MAIN HOUSING REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Assembly		
36. Five pipe plugs (22) and (57)	Install on housing (38).	Tighten to 5-8 lb-ft (7-11 N•m).
37. Torque spring (56) and and shims (34)	Install on governor plunger assembly (36).	Put small diameter of spring (56) on shoulder end of plunger (33) with twisting motion to avoid damaging spring.
38. Governor plunger assembly (33), shims (34), and torque spring (56) (assembled)	Install on housing (38).	
	NOTE **For fuel pump used in M915/Big Cam I engine, perform step 38a.**	
	a. If governor spacer (35) was removed, press governor spacer (35) on plunger (36).	Ensure notched end goes on plunger (36) first with notches facing toward governor barrel (42).
	CAUTION **The governor plunger has a Lubrite finish. Protect it by laying governor plunger on a copper-jawed vise or V-block to prevent damage to finish when installing pin.**	
	b. Assemble governor plunger driver (37) through governor spacer (35) and drive into plunger (36). Driver (37) must have interference fit in plunger.	
	c. Drive retainer pin through plunger (36) and plunger driver (37).	
	NOTE **The chamfered side of governor spacer must be installed next to driver. There must be at least 0.002-0.005 in. (0.05-0.13 mm) clearance between spacer face and driver so spacer will "float."**	
	d. Install the torque spring (56) and shims (34) as required.	Put small end of spring (56) on shoulder end of plunger (36) with a twisting motion to avoid distorting spring (56).

Springs and Specifications Table

COLOR CODE	WIRE DIA. INCHES(MM)	NUMBER	POUNDS LOAD (KG)	LENGTH INCHES (MM)	FREE LENGTH INCHES (MM)
Red/Yellow	0.051 (1.30)	5.5	6.601-7.04 (3.0-3.2)	0.340 (8.64)	0.640-0.660 (16.26-16.76)
Red/Purple	0.148 (3.76)	3.7	47.0-51.0 (21.34-23.15)	0.850 (21.59)	1.200 (30.48)

3-62. FUEL PUMP MAIN HOUSING REPAIR (Contd)



LEGEND:

22. PIPE PLUG (4)
33. GOVERNOR PLUNGER ASSEMBLY
34. SHIMS
35. GOVERNOR SPACER
36. GOVERNOR PLUNGER
37. GOVERNOR PLUNGER DRIVER
38. HOUSING
42. GOVERNOR BARREL
44. AFC PLUG BALL (2)
45. THROTTLE SHAFT ASSEMBLY
56. TORQUE SPRING
57. PIPE PLUG

3-62. FUEL PUMP MAIN HOUSING REPAIR (Contd)

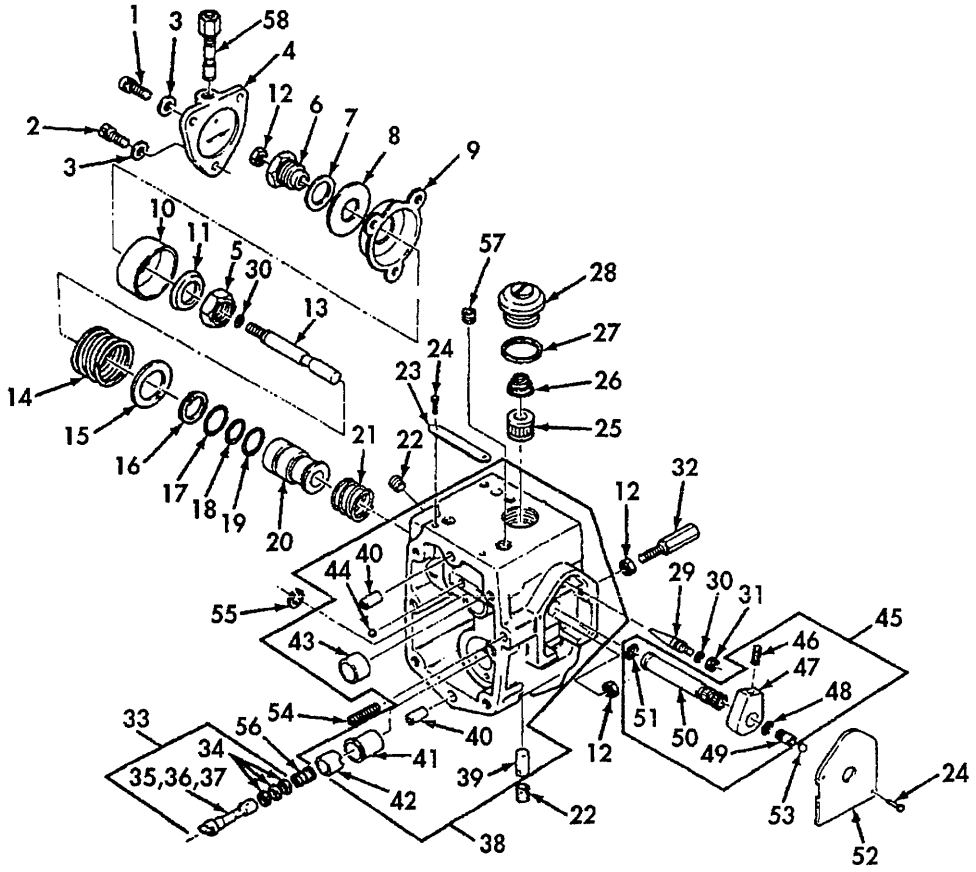
LOCATION/ITEM	ACTION	REMARKS
d. Assembly (Contd)		
39. New gasket washer (7), retainer washer (8), new bellows (9), AFC piston (10), and piston spacer (11)	a. Install on air fuel control piston insert (6).	Round end of retainer washer (8) must be against bellows (9) when assembled. If bellows has a part number, it must face toward piston (10).
	b. Secure with nut (5).	Ensure all parts are aligned. Do not twist bellows (9). Torque nut (5) to 30-40 lb-ft (41-54 N•m).
40. Throttle plunger (13) and new O-ring (30)	Install on air fuel control piston insert (6).	Lubricate O-ring (30). Threaded end of plunger (13) should be flush with outer edge of piston insert (6).
41. Jamnut (12)	Turn on throttle plunger (13) until finger-tight.	
42. Barrel spring (21), barrel (20), and new O-rings (17), (18), and (19)	a. Install barrel spring (21) on housing (38).	
	b. Apply a light coat of lubricating oil to O-rings (17), (18), and (19), and install on barrel (20).	
	c. Press barrel (20) into housing (38).	
	d. Secure with retaining ring (16).	

NOTE

- **For M915A1/Big Cam III engine fuel pumps, proceed to step 43 after completing step 42d.**
- **For M915/Big Cam I engine fuel pumps, perform steps 42e through 42o. Do not perform steps 43 or 44.**

	e. Lubricate barrel O-rings (17), (18), and (19), and install in grooves in barrel (20). Press barrel into housing (38) and secure with retaining ring (16).	

3-62. FUEL PUMP MAIN HOUSING REPAIR (Contd)



LEGEND:

5. NUT
6. AIR FUEL CONTROL PISTON INSERT
7. GASKET WASHER
8. RETAINER WASHER
9. BELLOWS
10. AFC PISTON
11. PISTON SPACER
12. JAMNUT (3)
13. THROTTLE PLUNGER
16. RETAINING RING
17. O-RING
18. O-RING
19. O-RING
20. BARREL
21. BARREL SPRING
30. O-RING (2)
38. HOUSING

3-62. FUEL PUMP MAIN HOUSING REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS

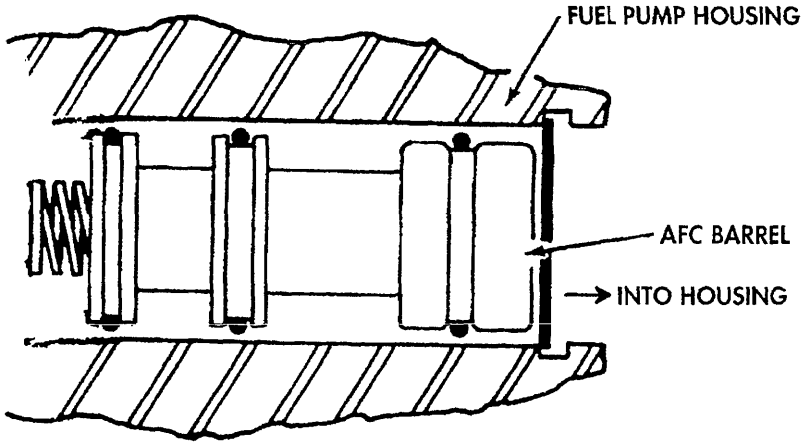
d. Assembly (Contd)

42. Barrel spring (21), barrel (20), and new O-rings (17), (18), and (19) (Contd)

(OLDER-STYLE PUMPS ONLY)

NOTE

If barrel is loose, remove barrel and place barrel spring behind barrel. Secure with flat retaining ring (see illustration below).



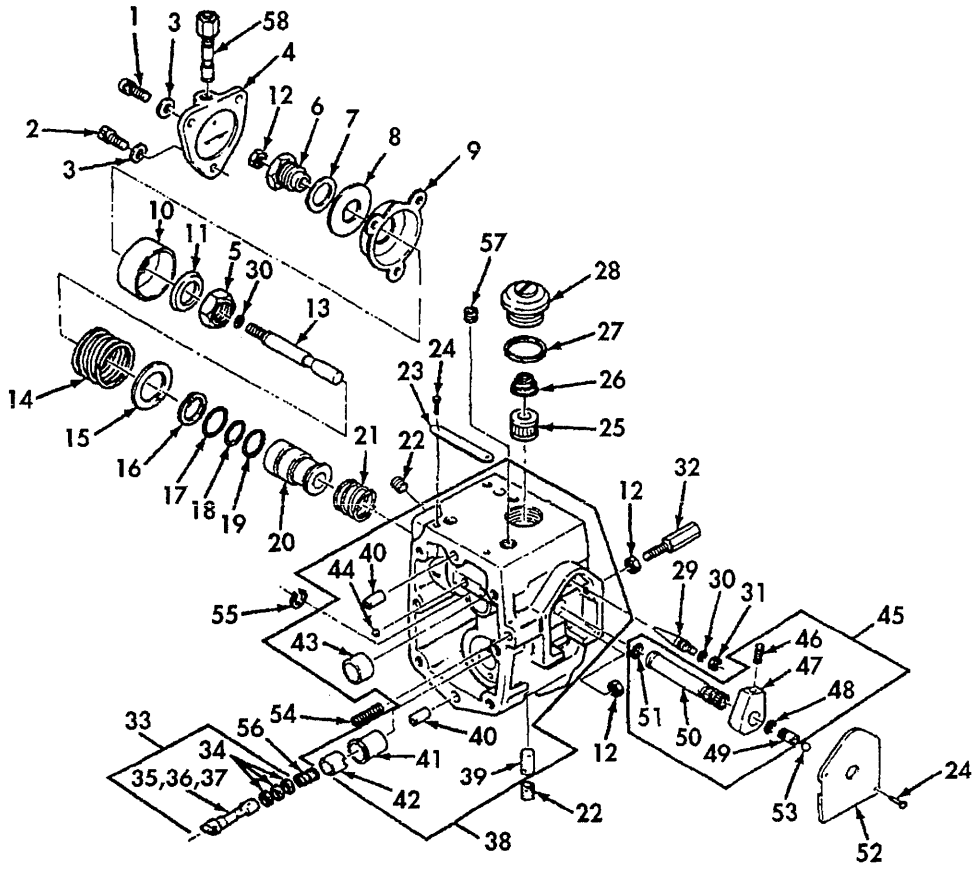
AFC BARREL, WITH SPRING, IN FUEL PUMP HOUSING

f. Place AFC shim (15) in diaphragm spring (14) set groove.

g. Install barrel spring (21) with small end in housing (38).

h. Lubricate O-ring and install over control plunger using installer tool (3375146), then install glide ring over tool and plunger on top of O-ring.

3-62. FUEL PUMP MAIN HOUSING REPAIR (Contd)



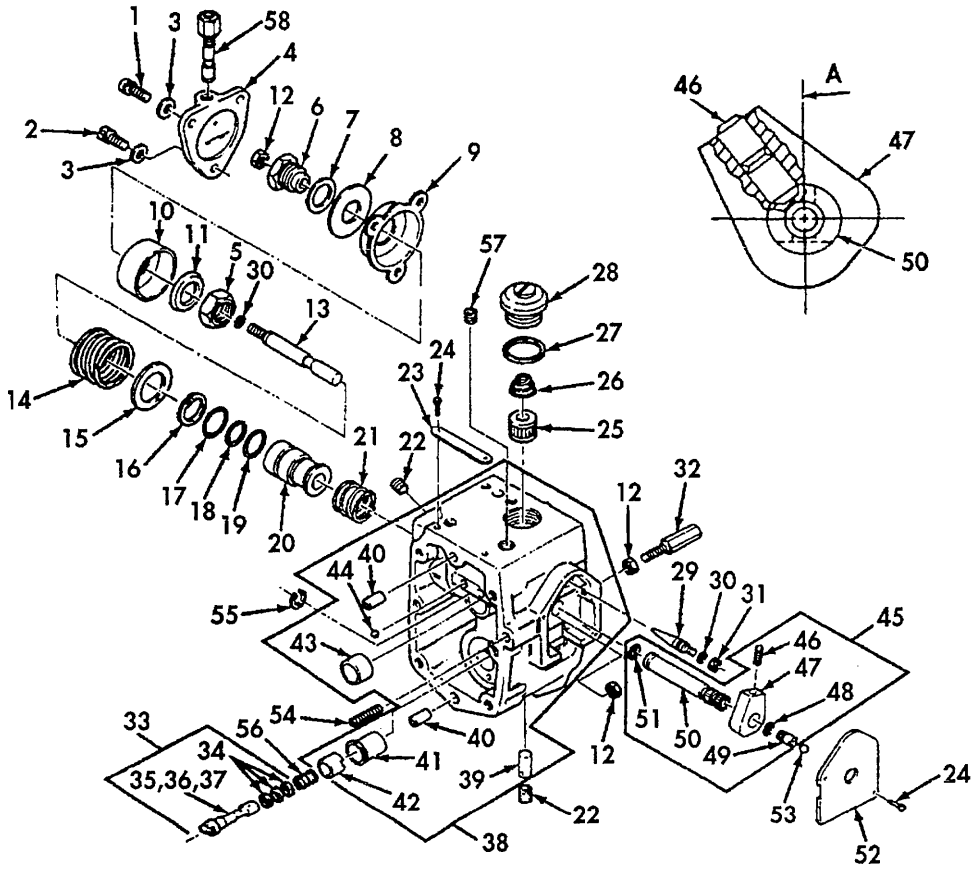
LEGEND:

14. SPRING
15. AFC SHIM
17. O-RING
18. O-RING
19. O-RING
20. BARREL
21. BARREL SPRING
38. HOUSING
55. RETAINING RING

3-62. FUEL PUMP MAIN HOUSING REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Assembly (Contd)		
42. Barrel spring (21), barrel (20), and new O-rings (17), (18), and (19) (Contd)		
	NOTE **If barrel contains a 15° plunger lead in chamfer, do not use glide ring forming tool.**	
	i. Assemble gasket washer (7), retainer washer (8) with rounded edge toward bellows (9) (bellows with part number toward piston), piston (10), retainer washer (8), and jamnut (12) on air fuel control piston insert (6).	
	j. Hold assembly by hex on air fuel control piston insert (5) and center bellows AFC piston (10) and retainer washer (8) without twisting bellows (9). Ensure parts are centered.	Tighten nut (5) to 30-40 lb-in. (3.4-4.5 N•m).
	k. Wrap throttle plunger (13) threads with Teflon tape and install throttle plunger (13) into center bolt until threaded end of throttle plunger (13) is flush with center bolt surface. Install jamnut (12), but leave loose.	
	l. Slide throttle plunger (13) and piston bellows assembly in barrel (20). Insert assembly very carefully to avoid damage to glide ring.	
	m. Cup bellows (9) between piston (10) and housing (38) to ensure bellows (9) do not wrinkle when cover is installed.	
	n. Line up bellows holes with housing and cover plate holes. Install screws and washers.	Screws are to be tightened to 30-33 lb-in. (3.4-3.7 N•m). Tighten after setting AFC on test stand.
	o. Install lubricated O-ring (30) on AFC needle valve (29) using assembly tool (3375148).	
	p. Install check valve (58) on cover plate.	
43. Spring (14) and AFC shim (15)	a. Check spring as follows:	
	(1) Put 10 lb (4.54 kg) of load on spring (14).	
	(2) Compress spring 0.300 in. (7.62 mm) more than dimension of step 1.	Discard spring (14) if not within 37.5-42.4 lb (17.0-19.2 kg) of step 1.
	b. Install AFC shim (15) and spring (14) on housing (38).	

3-62. FUEL PUMP MAIN HOUSING REPAIR (Contd)



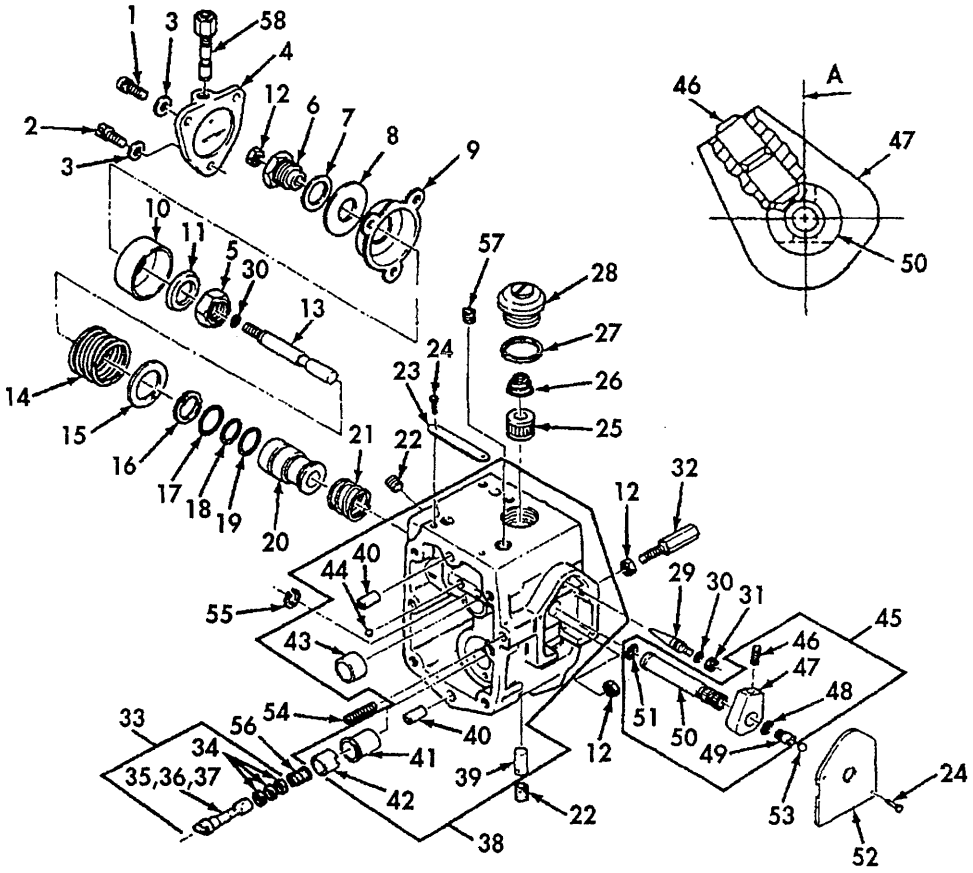
LEGEND:

5. NUT
6. AIR FUEL CONTROL PISTON INSERT
7. GASKET WASHER
8. RETAINER WASHER
9. BELLOWS
10. AFC PISTON
12. JAMNUT (3)
13. THROTTLE PLUNGER
14. SPRING
15. AFC SHIM
20. BARREL
29. AFC NEEDLE VALVE
30. O-RING (2)
38. HOUSING
45. THROTTLE SHAFT ASSEMBLY
58. CHECK VALVE

3-62. FUEL PUMP MAIN HOUSING REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Assembly (Contd)		
44. Throttle plunger (13) (with attached parts)	Install on barrel (20).	Insert very carefully to avoid damage to plunger (13).
45. Bellows (9)	a. Carefully push down between AFC piston (10) and housing (38).	Ensure bellows (9) is flat where it touches housing (38).
	b. Line up holes in bellows (9) with holes in housing (38).	Ensure bellows (9) is flat where it touches housing (38).
46. Fuel control cover (4)	a. Install on bellows (9) and housing (38).	
	b. Secure with two screws (1), drilled-head screw (2), and three washers (3).	Do not tighten screws (1). This will be done after AFC is set on test stand.
47. Check valve (58)	a. Ensure check ball is loose and hole near bottom of valve (58) is not plugged.	
	b. Turn on top of fuel control cover (4).	Tighten to 5 lb-ft (7 N•m).
48. Fuel filter screen (25), spring (26), new cap seal ring (27), and filter screen cap (28)	Install on housing (38).	Ensure hole in fuel filter screen (25) faces down. Tighten filter screen cap (28) to 8-12 lb-ft (11-16 N•m).
49. Tapered stud (54)	Install on housing (38).	
50. Jamnut (12)	Install on tapered stud (54).	
51. Threaded stud (32) and jamnut (12)	a. Assemble together.	
	b. Install on housing (38).	
52. AFC needle valve (29) and new O-ring (30)	a. Lubricate O-ring (30) and install on AFC needle valve (29).	
	b. Install on housing (38) until AFC needle valve (29) bottoms out.	
53. Throttle shaft (50)	a. Install on stop (47).	
	b. Secure with setscrew (46).	Do not tighten at this time.
54. Fuel adjusting screw (49) and new O-ring (48)	a. Lubricate O-ring (48) and install on fuel adjusting screw (49).	
	b. Insert fuel adjusting screw (49) in throttle shaft (50) about six rotations.	Ensure fuel hole in throttle shaft (50) is open.
55. Throttle shaft (50) and new O-ring (51)	a. Lubricate O-ring (51) and install on throttle shaft (50).	
	b. Insert throttle shaft (50) into housing (38) with counterbore of fuel port facing down.	Setscrew (46) in stop (47) faces upward.
	c. Tighten setscrew (46) to 7-9 lb-ft (9-12 N•m).	

3-62. FUEL PUMP MAIN HOUSING REPAIR (Contd)



LEGEND:

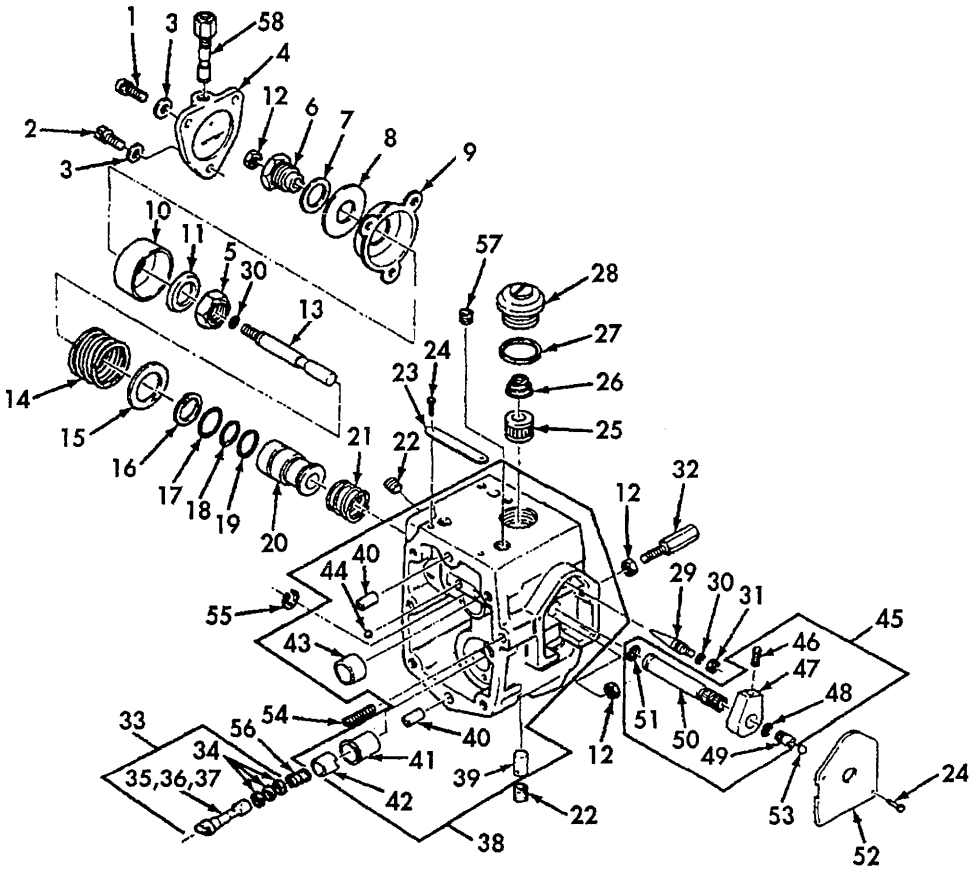
1. SCREW (2)
2. DRILLED-HEAD SCREW
3. WASHER (3)
4. FUEL CONTROL COVER
9. BELLOWS
10. AFC PISTON
12. JAMNUT (3)
13. THROTTLE PLUNGER
20. BARREL
25. FUEL FILTER SCREEN
26. FILTER SPRING
27. CAP SEAL RING
28. FILTER SCREEN CAP
29. AFC NEEDLE VALVE
30. O-RING (2)
32. THREADED STUD
38. HOUSING
46. SETSCREW
47. STOP
48. O-RING
49. FUEL ADJUSTING SCREW
50. THROTTLE SHAFT
51. O-RING
54. TAPERED STUD
58. CHECK VALVE

3-62. FUEL PUMP MAIN HOUSING REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Assembly (Contd)		
56. Retaining ring (55)	Install on end of throttle shaft (50).	
57. New throttle shaft ball (53), throttle shaft cover (52), and two drive screws (24)	Do not install at this time.	These parts will. be installed after fuel pump has been calibrated.

FOLLOW-ON TASKS:
- Install fuel pump front cover and governor (para. 3-61).
- Install fuel pump governor spring (para. 3-60).
- Install fuel gear pump (para. 3-59).
- Install solenoid valve (para. 3-57).
- Remove fuel pump from mounting plate and ball joint vise (para. 3-56).
- Perform fuel pump testing and calibration (para. 3-3).

3-62. FUEL PUMP MAIN HOUSING REPAIR (Contd)



LEGEND:
24. DRIVE SCREW (2)
50. THROTTLE SHAFT
52. THROTTLE SHAFT COVER
53. THROTTLE SHAFT BALL
55. RETAINING RING

3-63. FUEL PUMP TESTING AND CALIBRATION

THIS TASK COVERS:

a. Calibration Data
b. Fuel Pump Nameplate Data
c. Mounting Fuel Pump to Test Stand
d. Fuel Pump Run-in (Big Cam I and Big Cam III)
e. Fuel Pump Vacuum and Seal Test
f. Fuel Pump Vacuum Adjustment
g. Governor Cutoff RPM Check Stand
h. Throttle Leakage
i. Throttle Lever Travel Adjustment
j. Fuel Pump Idle Speed Check
k. Fuel Pump Main Pressure Adjustment
l. Calibration Check Points
m. AFC Plunger Setting Procedures
n. No-Air Screw Adjustment
o. Removing Fuel Pump From Test

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Fuel pump idle adjusting tool (15434) 3375981
AFC fuel pump adjusting tool kit (15434) 3375189
Level and angle indicator (15434) 3375855

TEST EQUIPMENT
Fuel injection pump test stand (19204) 11020200
Fuel injection pump test stand (use with Model A8020 FITS only) (59678) DFP-156

MATERIALS/PARTS
Fluid, calibration (Appendix C, Item 12)
Lubricant, high-pressure (Appendix C, Item 15)

PERSONNEL REQUIRED
Fuel and electrical systems repairman MOS 63G

REFERENCES (TM)
TM 9-4910-778-14&P

TROUBLESHOOTING REFERENCES
Para. 2-8

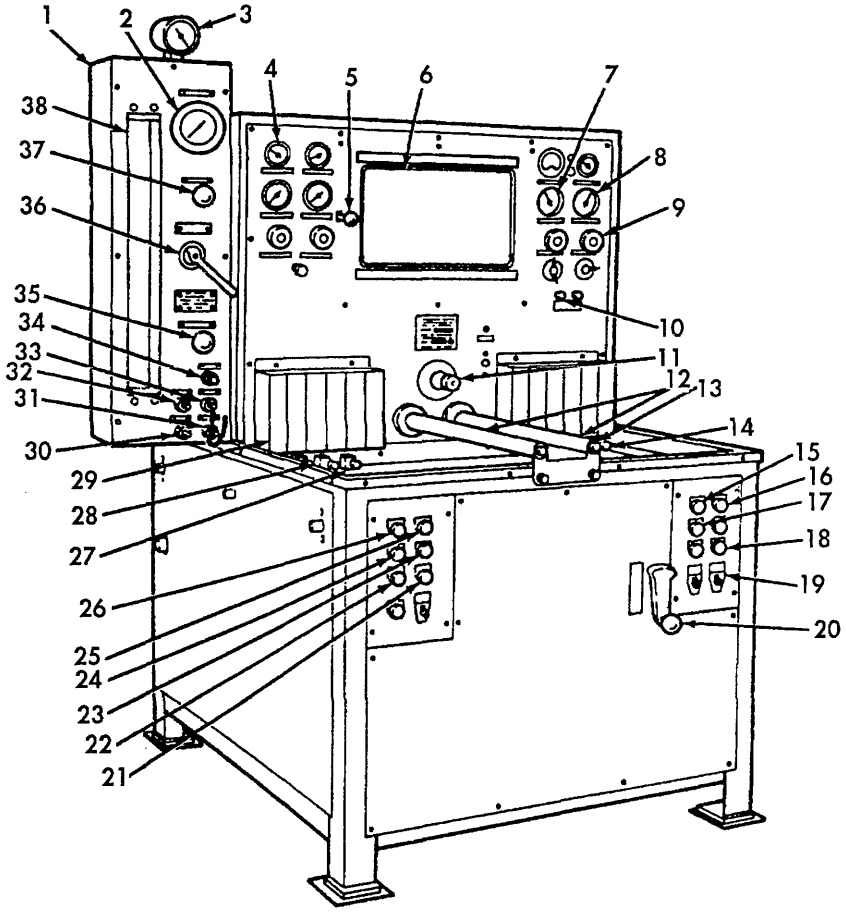
EQUIPMENT CONDITION
Fuel pump removed (para. 3-16).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust

GENERAL SAFETY INSTRUCTIONS
Diesel fuel is highly flammable. Do not perform fuel pump testing and calibration procedures near fire, flames, or sparks.

LOCATION/ITEM	ACTION	REMARKS
a. Calibration Data		
1. PT (type G) AFC fuel pump (see page 3-461 and 3-462 for identification of fuel pump major components)	Test and calibrate on fuel pump test stand (see pages 3-450 through 3-460) using the following calibration data:	Fill fuel pump test stand with calibration fluid (if calibration fluid is not available, use diesel fuel).

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)



LEGEND:

1. TEST STAND
2. FUEL PRESSURE GAUGE
3. NO. 2 VACUUM GAUGE
4. FUEL TEMPERATURE GAUGE
5. DUMPING LEVER
6. BURETTES
7. TACHOMETER
8. PRESSURE GAUGE
9. PRESSURE REGULATOR
10. MANIFOLD INLET
11. DRIVE SHAFT COUPLING
12. MOUNTING RAILS
13. LUBE OIL RETURN
14. FUEL RETURN
15. START COUNT BUTTON
16. COUNT "ON" LIGHT
17. COUNT SELECTOR SWITCH
18. FUEL HEAT "ON" LIGHT
19. FUEL HEAT SWITCH
20. SPEED SHIFTING CRANK
21. POWER "ON" LIGHT
22. MOTOR SWITCH
23. SLOW SWITCH
24. STOP BUTTON
25. FAST BUTTON
26. START BUTTON
27. LUBE OIL PRESSURE OUTLET
28. PRIMER PRESSURE OUTLET
29. NO. 1 ACCUMULATOR
30. FUEL INPUT CONNECTOR
31. FUEL OUTLET CONNECTOR
32. PRESSURE GAUGE OUTLET
33. AUXILIARY RETURN
34. LEAK TEST CONNECTOR
35. BYPASS VALVE
36. SELECTOR VALVE
37. FLOW CONTROL VALVE
38. FLOWMETER GLASS TUBE

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
Pump code; Date; CPL		3894-F; 6-82; 0531 (Big Cam III)
Test Hp Rated RPM		400 @ 2100
Engine Fuel		148-164 PSI(1020-1130 kPa)
Fuel Rate lb/hr		139-145
Auto Governor Cut Off RPM		2130-2150
Throttle Leakage cc/1000 RPM		45 to 69
Throttle Travel Degrees		27-29
Idle Speed @ RPM		32 PSI(220 kPa) @ 500
Intake Manifold		39-47
Calibration @ RPM (Flow)		157 PSI (1082 kPa) @ 2100 (470)
Check Point 1		
PSI @ RPM (Flow)		109-115 PSI(751-793 kPa) @ 1,000 1300 (380)
Check Point 2		
PSI @ RPM (Flow)		76-84 PSI(524-579 kPa) @ 1,000 (300)
AFC Setting		
In-Hg RPM		10 @ 1,600
Fuel (Flow)		85 PSI(586 kPa) (325)
No-Air Set RPM Flow		1600 39 PSI(269 kPa) (220)
Weight Assist Setting		0.800 in.
Weight Assist Spring		P/N 143854
Idle Plunger		Code 25 - P/N 141631
Idle Spring		P/N 3018767
Torque Spring		P/N 3002048
Torque Spring Shims (Thickness)		0.005 in. (0.127 mm) P/N 101841 0.010 in. (0.254 mm) P/N 101842 0.020 in. (0.508 mm) P/N 101843
Governor Might		P/N 146437
Governor Spring		P/N 143753
AFC Spring		P/N 179826

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS

Pump code; Date; CPL .....4333-B 89; 0891 (Big Cam III)
Test Hp Rated RPM .....400 @ 2100
Engine Fuel .....155-172 PSI(1068-1185 kPa)
Torque Rise % Curve 25%
Fuel Rate lb/hr 142-148
Auto Governor Cutoff RPM 2130-2150
Throttle Leakage cc/1000 RPM .....110 cc/mim
Throttle Travel Degrees 27-29
Idle Speed @ RPM.....37 PSI (255 kPa) @ 500
Idle Speed cc @ RPM .....210-215cc @ 630
Intake Mfd. Press .....42-50 In./Hg.
Calibration @ RPM (Flow) .....164 PSI(1130 kPa) @ 2100
Calibration Flow Lb./Hr 482
Check Point 1
PSI @ RPM .....108-116 (744-799 kPa) @ 1300
Calibration Flow Lb./Hr 390
AFC Setting
In-Hg PSI.....8
AFC or Aneroid RPM 1600
Fuel (Flow) .....59 PSI (406 kPa) (272)
Certified-Year-By 1989-EPA
Engine Model .....NTC-400 Big Cam III
No-Air Set RPM (Flow) .....1600 42 PSI(289 kPa) (224)
Weight-Assist Setting- Spring. .....0.800 in. (20.3 mm)
Weight-Assist Spring .....P/N 143854
Idle Plunger .....Code 27- P/N 141632
Auto. Idle Spring .....P/N 3018767
Torque Spring Shims (Thickness) .....0.020 in. (0.508 mm) P/N 139586
Auto Governor Spring .....P/N 153238
Gear Pump Size .....3/4 in.
Auto. Governor Weights .....P/N 146437
Auto. Governor Plunger .....P/N 3040750
AFC Spring .....P/N 179834

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
Pump code; Date; CPL		0324 9-77; 4-78; 3643 (Big Cam I)
Test Hp Rated RPM		400 @ 2100
Engine Fuel		149-155 PSI (1027-1068 kPa)
Fuel Rate lb/hr		144-150
Auto Governor Cutoff RPM		2130-2150
Throttle Leakage cc/1000 RPM		12 1/2 to 16 12 cc/mim
Throttle Travel Degrees		27-29
Idle Speed @ RPM		20 PSI (138 kPa) @ 500
Calibration @ RPM (Flow)		155 PSI (1068 kPa) @ 2100 (495)
Check Point 1		
PSI @ RPM (Flow)		115-121 PSI (793-834 kPa) @ 1500 (410)
Check Point 2		
PSI @ RPM (Flow)		51-63 PSI (351-434 kPa) @ 1000 (265)
AFC Setting		
In-Hg RPM		6 @ 1600
Fuel (Flow)		72 PSI (496 kPa) (335)
No-Air Set RPM (Flow)		1600 32 PSI (220 kPa) (200)
Weight-Assist Setting		0.870 in. (22.09 mm)
Weight-Assist Spring		P/N 143849
Idle Plunger		Code 37 - P/N 140418
Idle Spring		P/N 3018767
Torque Spring		P/N 138780
Torque Spring Shims (Thickness)		0.005 in. (0.127 mm) P/N 101841 0.010 in. (0.254 mm) P/N 101842 0.020 in. (0.508 mm) P/N 101843
Governor Might		P/N 143251
Governor Spring		P/N 143751
AFC Spring		P/N 179820

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
Pump code; Date; CPL		1 33859-77; 0324 4-78; 3619 (Big Cam I)
Test Hp Rated RPM		400 @ 2100
Engine Fuel		154-170 PSI (1061-1172 kPa)
Fuel Rate lb/hr		144-150
Auto Governor Cutoff RPM		2,130-2,150
Throttle Leakage cc/1000 RPM		12 1/2 to 16 1/2 cc/mim
Throttle Travel Degrees		27-29
Idle Speed @ RPM		20 PSI (138 kPa) @ 500
Calibration @ RPM (Flow)		164 PSI (1130 kPa) @ 2100 (505)
Check Point 1 PSI @ RPM (Flow)		118-124 PSI (813-855 kPa) @ 1500 (415)
AFC Setting In-Hg RPM Fuel (Flow)		6 @ 1600 62 PSI (427 kPa) (285)
No-Air Set RPM (Flow)		1600 33 PSI (227 kPa) (210)
Weight-Assist Setting		0.840 in. (21.33 mm)
Weight-Assist Spring		P/N 143848
Idle Plunger		Code 40 -P/N 137370
Idle Spring		P/N 3018767
Torque Spring		P/N 138781
Torque Spring Shims (Thickness)		0.005 in. (0.127 mm) P/N 101841 0.010 in. (0.254 mm) P/N 101842 0.020 in. (0.508 mm) P/N 101843
Governor Might		P/N 146437
Governor Spring		P/N 143252
AFC Spring		P/N 179822

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
Pump code; Date; CPL		0324 9-77; 4-78; 3894 (Big Cam I)
Test Hp Rated RPM		400 @ 2100
Engine Fuel		148-164 PSI(1020-1130 kPa)
Fuel Rate lb/hr		140-146
Auto Governor Cutoff RPM		2130-2150
Throttle Leakage cc/1000 RPM		12 1/2 to 16 1/2 cc/mim
Throttle Travel Degrees		27-29
Idle Speed @ RPM		32 PSI (220 kPa) @ 500
Calibration @ RPM (Flow)		162 PSI (1117 kPa) @ 2100 (473)
Check Point 1		
PSI @ RPM (Flow)		112-118 PS I(772-813 kPa) @ 1300 (389)
AFC Setting		
In-Hg RPM		10 @ 1600
Fuel (Flow)		85 PSI (586 kPa) (325)
No-Air Set RPM (Flow)		1600 39 PSI (269 kPa) (220)
Weight-Assist Setting		0.800 in. (20.3 mm)
Weight-Assist Spring		P/N 143854
Idle Plunger		Code 22- P/N 141630
Idle Spring		P/N 3018767
Torque Spring		P/N 3002048
Torque Spring Shims (Thickness)		0.005 in. (0.127 mm) P/N 101841 0.010 in. (0.254 mm) P/N 101842 0.020 in. (0.508 mm) P/N 101843
Governor Might		P/N 146437
Governor Spring		P/N 153235
AFC Spring		P/N 179826

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
Pump code; Date; CPL		0324 9-77; 4-78; 4128 (Big Cam I)
Test Hp Rated RPM		400 @ 2100
Engine Fuel		154-170 PSI (1061-1172 kPa)
Fuel Rate lb/hr		144-150
Auto Governor Cutoff RPM		2130-2150
Throttle Leakage cc/1000 RPM		12 1/2 to 16 1/2 cc/mim
Throttle Travel Degrees		27-29
Idle Speed @ RPM		38 PSI (262 kPa) @ 500
Calibration @ RPM (Flow)		165 PSI (1137 kPa) @ 2100 (490)
Check Point 1		
PSI @ RPM (Flow)		128-136 PSI (882-937 kPa) @ 1500 (430)
AFC Setting		
In-Hg RPM		12 @ 1600
Fuel (Flow)		65 PSI (448 kPa) (267)
No-Air Set RPM (Flow)		1600 45 PSI (310 kPa) (220)
Weight-Assist Setting		0.870 in. (22.09 mm)
Weight-Assist Spring		P/N 143847
Idle Plunger		Code 25- P/N 141631
Idle Spring 144195 Torque Spring		P/N 138783
Torque Spring Shims (Thickness)		0.005 in. (0.127 mm) P/N 101841 0.010 in. (0.254 mm) P/N 101842 0.020 in. (0.508 mm) P/N 101843
Governor Might		P/N 146437
Governor Spring		P/N 3001148
AFC Spring		P/N 179834

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
Pump code; Date; CPL		0324 9-77; 4-78; 3449 (Big Cam I)
Test Hp Rated RPM		400 @ 2100
Fuel Rate lb/hr		149-165
Auto Governor Cutoff RPM		2130-2150
Throttle Leakage cc/1000 RPM		12 1/2 to 16 1/2 cc/mim
Throttle Travel Degrees		27-29
Idle Speed @ RPM		32 PSI (220 kPa) @ 500
Calibration @ RPM (Flow)		155 PSI (1068 kPa) @ 2100 (500)
Check Point 1		
PSI @ RPM (Flow)		117-123 PSI (806-848 kPa) @ 1500 (425)
Check Point 2		
PSI @ RPM (Flow)		69-77 PSI (475-530 kPA) @ 1000 (315)
AFC Setting		
In-Hg RPM		12 @ 1600
Fuel (Flow)		65 PSI (448 kPa) (267)
No-Air Set RPM (Flow)		1600 45 PSI (310 kPa) (235)
Weight-Assist Setting		0.900 in. (22.8 mm)
Weight-Assist Spring		P/N 143848
Idle Plunger		Code 40 - P/N 137370
Idle Spring		P/N 144195
Torque Spring		P/N 138769
Torque Spring Shims (Thickness)		0.005 in. (0.127 mm) P/N 101841 0.010 in. (0.254 mm) P/N 101842 0.020 in. (0.508 mm) P/N 101843
Governor Might		P/N 146437
Governor Spring		P/N 143251

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS

Pump code; Date; CPL .....4567-A 87; 0531 (Big Cam III)
Engine Fuel .....148-164 PSI (1020-1130 kPa)
Torque Rise % Curve 25%
Fuel Rate lb/hr 140-146
Idle Speed @ RPM .....40 PSI (275 kPa) @ 500
Idle Speed cc @ RPM .....190-195cc @ 650
Intake Mfd. Press .....39-47 In./Hg.
Calibration @ RPM (Flow) .....162 PSI(1117 kPa) @ 2100
Calibration Flow Lb./Hr 473
Check Point 1
PSI @ RPM .....111-118 PSI (765-813 kPa) @ 1300
Calibration Flow Lb./Hr 389
AFC Setting
In-Hg PSL 10
Fuel (Flow) .....85 PSI (586 kPa) (325)
Certified-Year-By 1987-EPA
Engine Model .....NTC-400 Big Cam III
No-Air Set RPM (Flow) .....32 (220 kPa) (220)
Idle Plunger .....Code 22 - P/N 141630
Torque Spring Shims (Thickness) .....0.025 m (0.635 mm) P/N 3002058
Auto Governor Spring .....P/N 3000941
AFC Spring .....P/N 179826

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
Pump code; Date; CPL		3619-G 87; 0393 (Big Cam I)
Test Hp Rated RPM		400 @ 2100
Engine Fuel		154-170 PSI (1061-1172 kPa)
Torque Rise % Curve		15%
Fuel Rate lb/hr		144-150
Auto Governor Cutoff RPM		2130-2150
Throttle Leakage cc/1000 RPM		110 cc
Throttle Travel Degrees		27-29
Idle Speed @ RPM		20 PSI (138 kPa) @ 500
Idle Speed cc @ RPM		200-215 cc @ 600
Intake Mfd. Press		43-51 In./Hg.
Calibration @ RPM		164 PSI (1130 kPa) @ 2100
Calibration Flow Lb./Hr		505
Check Point 1 PSI @ RPM		118-124 PSI (813-855 kPA) @ 1500
Calibration Flow Lb./Hr		415
Weight-Assist Setting- Spring		0.800 in. (20.3 mm)
Weight-Assist Spring		P/N 143848
Calibration Flow Lb./Hr		389
AFC Setting In-Hg PSI		6
Fuel (Flow)		62 PSI (427 kPa) (285)
Certified-Year-By		1987-EPA
Engine Model		NTC-400 Big Cam I
No-Air Set RPM (Flow)		32 PSI (220 kPa) (220)
Idle Plunger		P/N 137370
Auto. Idle Spring		P/N 3018767
Torque Spring Shims (Thickness)		P/N 138781
Auto Governor Spring		P/N 143252
Gear Pump Size		3/4 in.
Auto. Governor Weights		P/N 146437
Auto. Governor Plunger		P/N 3009380
AFC Spring		P/N 179822
No-Air Set RPM (Flow)		1600 33 PSI (227 kPa) (210)

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS

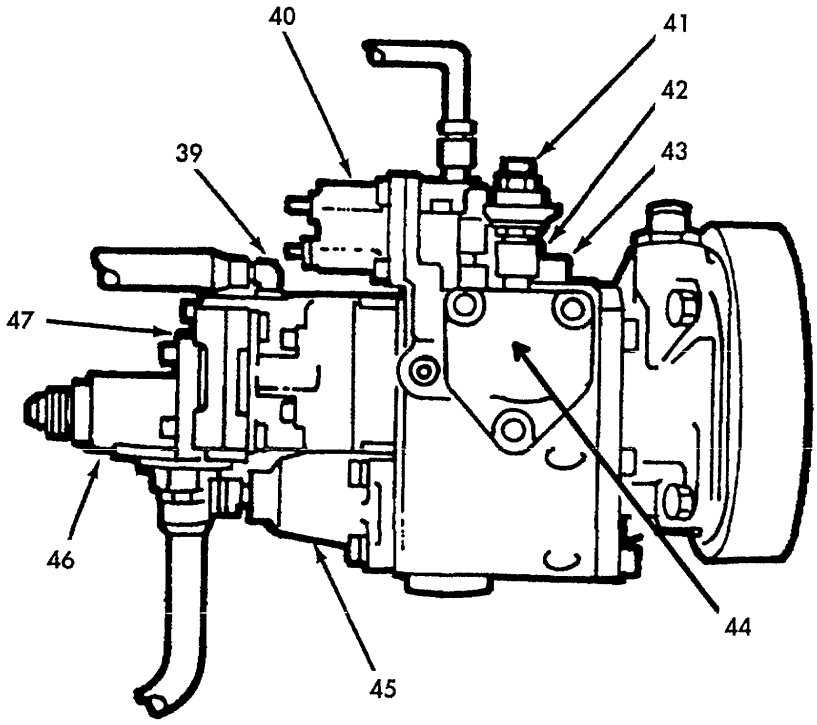
Pump code; Date; CPL .....4128-C 82; 0267 (Big Cam I)
Idle Speed @ RPM .....38 PSI (262 kPa) @ 500
Idle Speed cc @ RPM .....17015 cc @ 590
Intake Mfd. Press .....41-49 In./Hg.
Calibration @ RPM (Flow) .....165 (1137 kPa) @ 2100
Calibration Flow Lb./Hr 490
Check Point 1
PSI @ RPM .....128-136 PSI (882-937 kPa) @ 1300
Calibration Flow Lb./Hr 430
Weight-Assist Setting - Spring .....0.870 in. (22.09 mm)
Weight-Assist Spring .....P/N 143847
AFC Setting
In-Hg PSI 12
Fuel (Flow) .....65 PSI (1137 kPa) (267)
Certified-Year-By 1982-EPA
Engine Model .....NTC-400 Big Cam I
No-Air Set RPM (Flow) .....32 PSI (220 kPa) 220
Idle Plunger .....Code 25-P/N 141631
Auto. Idle Spring .....P/N 144195
Torque Spring Shims (Thickness) .....0.020 in. (0.508 mm) P/N 138783
Auto Governor Spring .....P/N 3001148
AFC Spring .....P/N 179834

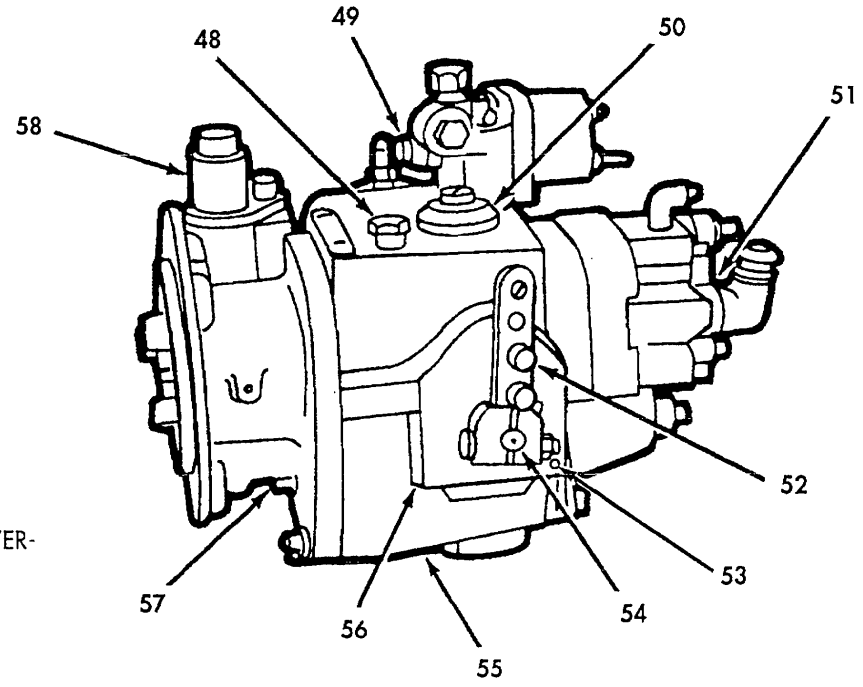
NOTE
For other pump codes not listed, use Cummins Fuel Pump PT (Type G) Calibration Values.

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
Pump code; Date; CPL		0324 9-77; 4-78; 3257 (Big Cam I)
Test Hp Rated RPM		400 @ 2100
Engine Fuel		154-170 PSI (1061-1172 kPa)
Fuel Rate lb/hr		144-150
Auto Governor Cutoff RPM		2130-2150
Throttle Leakage cc/1000 RPM		12 1/2 to 16 1/2 cc/mim
Throttle Travel Degrees		27-29
Idle Speed @ RPM		38 PSI (262 kPa) @ 500
Calibration @ RPM (Flow)		165 PSI (1137 kPa) @ 2100 (480)
Check Point 1		
PSI @ RPM (Flow)		130-136 PSI (896-937 kPa) @ 1500 (410)
Check Point 2		
PSI @ RPM (Flow)		71-77 PSI (489-531 kPa) @ 1000 (290)
AFC Setting		
In-Hg RPM		14 @ 1600
Fuel PSI (Flow)		65 PSI (448 kPa) (267)
No-Air Set RPM (Flow)		1600 PSI (310 kPa)
		45 PSI (310 kPa) (220)
Weight-Assist Setting		0.870 in. (22.09 mm)
Weight-Assist Spring		P/N 143847
Idle Plunger		Code 25 -P/N 141631
Idle Spring		P/N 144195
Torque Spring		P/N 138783
Torque Spring Shims (Thickness)		0.005 in. (0.127 mm) P/N 101841 0.010 in. (0.254 mm) P/N 101842 0.020 in. (0.508 mm) P/N 101843
Governor Might		P/N 146437
Governor Spring		P/N 143752
AFC Spring		P/N 179834

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

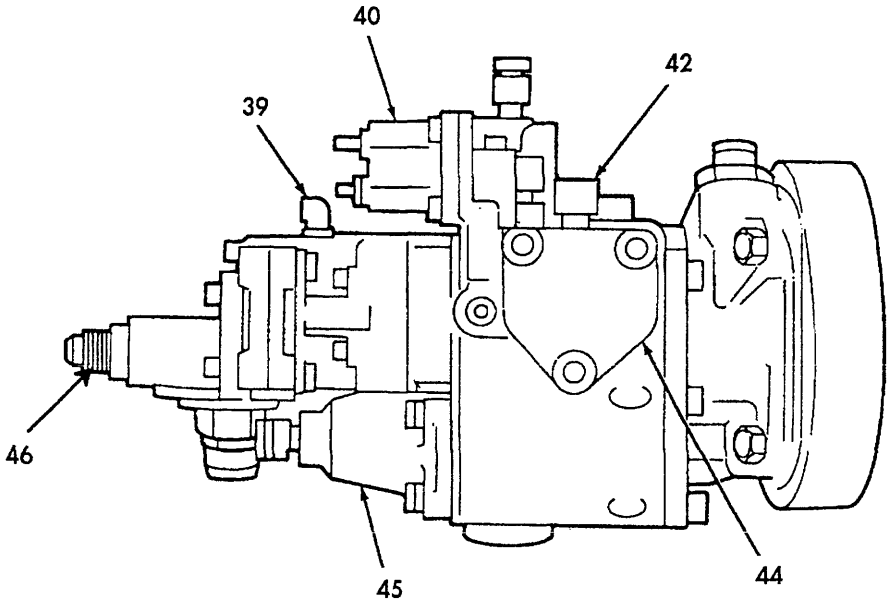


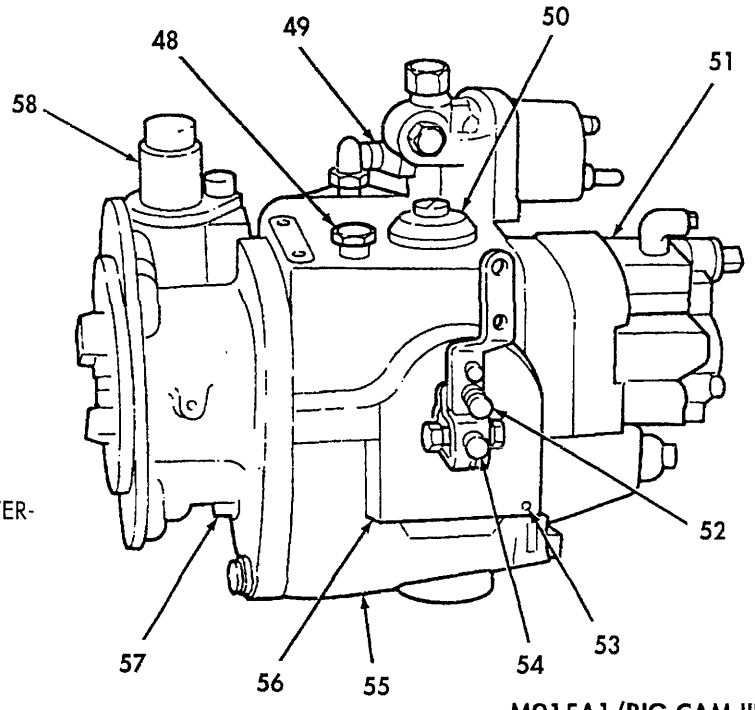


LEGEND:
39. CHECK VALVE
40. SHUTDOWN SOLENOID VALVE
41. AFC SIGNAL ATTENUATOR
42. RESTRICTOR
43. AFC CASE VENT
44. AFC COVER PLATE
45. GOVERNOR SPRING PACK HOUSING
46. EXTERNAL FUEL FILTER HOUSING
47. PULSATION DAMPER
48. CASE FILL PLUG
49. SHUTDOWN SOLENOID MANUAL OVER-RIDE KNOB
50. FUEL FILTER SCREEN
51. GEAR PUMP
52. THROTTLE LEVER
53. DRIVE PIN (2)
54. THROTTLE SHAFT
55. FUEL PUMP MAIN HOUSING
56. THROTTLE SHAFT COVER
57. FRONT COVER
58. TACHOMETER DRIVE

M915/BIG CAM I
FUEL PUMP COMPONENTS

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

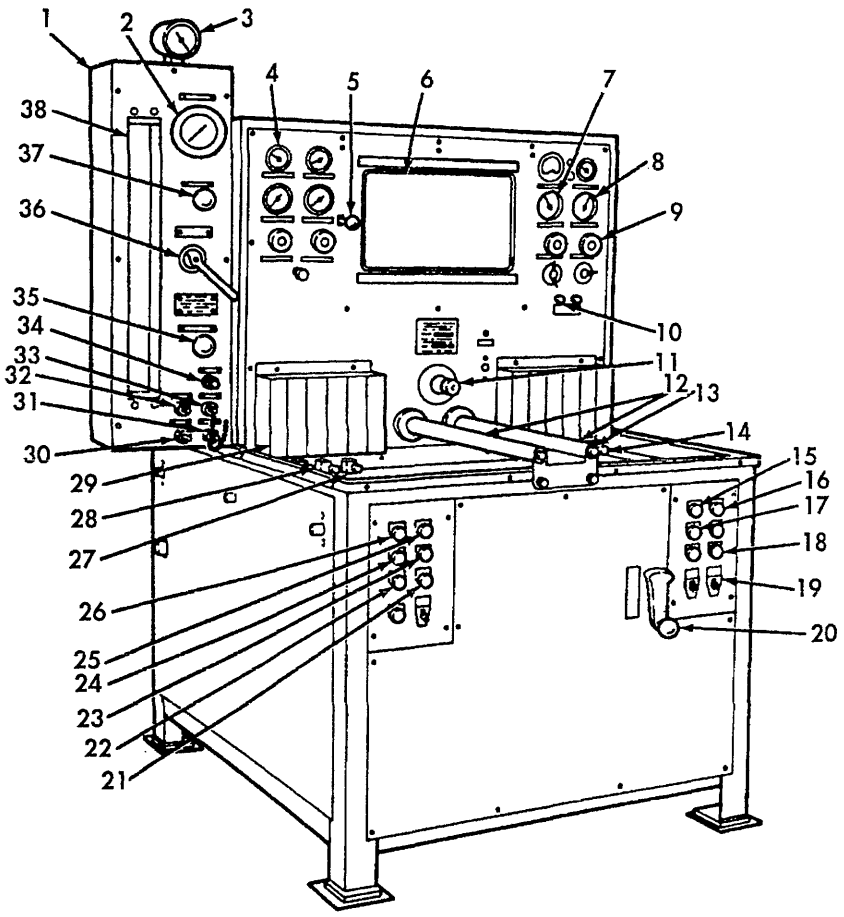




LEGEND:
39. CHECK VALVE
40. SHUTDOWN SOLENOID VALVE
42. RESTRICTOR
44. AFC COVER PLATE
45. GOVERNOR SPRING PACK HOUSING
46. EXTERNAL FUEL FILTER HOUSING
48. CASE FILL PLUG
49. SHUTDOWN SOLENOID MANUAL OVER-RIDE KNOB
50. FUEL FILTER SCREEN
51. GEAR PUMP
52. THROTTLE LEVER
53. DRIVE PIN (2)
54. THROTTLE SHAFT
55. FUEL PUMP MAIN HOUSING
56. THROTTLE SHAFT COVER
57. FRONT COVER
58. TACHOMETER DRIVE

M915A1/BIG CAM III FUEL PUMP COMPONENTS

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)



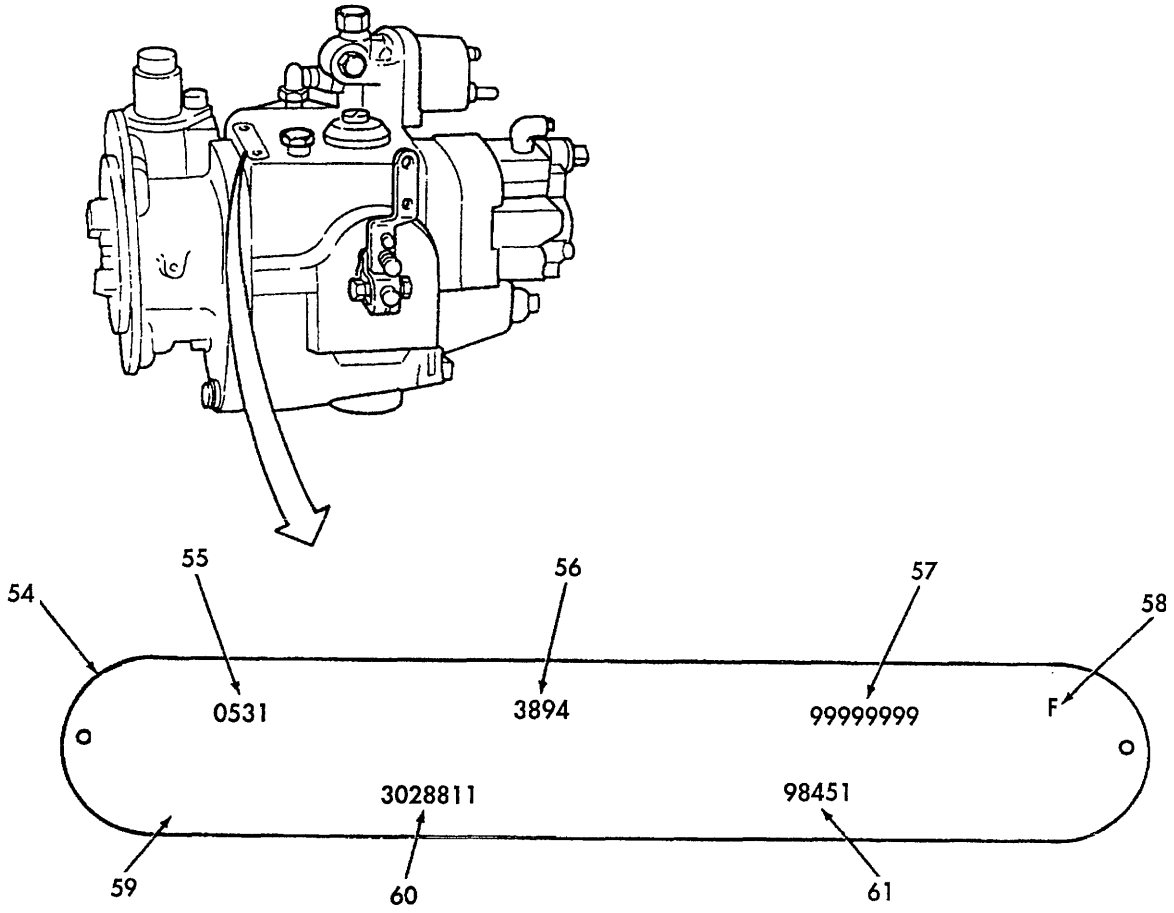
LEGEND:

1. TEST STAND
2. FUEL PRESSURE GAUGE
3. NO. 2 VACUUM GAUGE
4. FUEL TEMPERATURE GAUGE
5. DUMPING LEVER
6. BURETTES
7. TACHOMETER
8. PRESSURE GAUGE
9. PRESSURE REGULATOR
10. MANIFOLD INLET
11. DRIVE SHAFT COUPLING
12. MOUNTING RAILS
13. LUBE OIL RETURN
14. FUEL RETURN
15. START COUNT BUTTON
16. COUNT "ON" LIGHT
17. COUNT SELECTOR SWITCH
18. FUEL HEAT "ON" LIGHT
19. FUEL HEAT SWITCH
20. SPEED SHIFTING CRANK
21. POWER "ON" LIGHT
22. MOTOR SWITCH
23. SLOW SWITCH
24. STOP BUTTON
25. FAST BUTTON
26. START BUTTON
27. LUBE OIL PRESSURE OUTLET
28. PRIMER PRESSURE OUTLET
29. NO. 1 ACCUMULATOR
30. FUEL INPUT CONNECTOR
31. FUEL OUTLET CONNECTOR
32. PRESSURE GAUGE OUTLET
33. AUXILIARY RETURN
34. LEAK TEST CONNECTOR
35. BYPASS VALVE
36. SELECTOR VALVE
37. FLOW CONTROL VALVE
38. FLOWMETER GLASS TUBE

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
b. Fuel Pump Nameplate Data		
2. Fuel pump nameplate (54)	Make sure nameplate properly describes fuel pump to be calibrated.	a. First set of digits on top line provides pump control parts list (55). b. Next four spaces on top line provide base fuel pump code (56). c. Next eight spaces on top line provide fuel pump serial number (57). d. Last space on top line provides latest fuel pump revision code (58). e. First space on bottom line provides fuel pump direction of rotation (59) (right-hand rotation pump is not marked and this space will be blank if pump has right-band rotation). Use REVERSE position on fuel pump test stand to drive fuel pump clockwise for right rotation. f. Next seven spaces on bottom line provide fuel pump assembly number (60). g. Last five spaces on bottom line provide engine shop order number (61).

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)



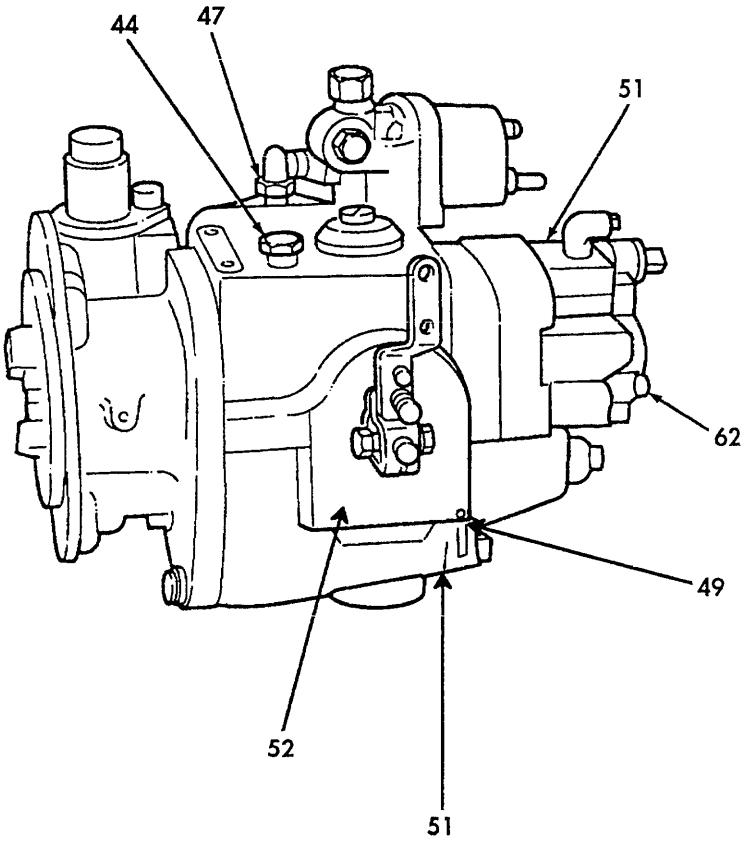
LEGEND:

54. FUEL PUMP NAMEPLATE
55. CONTROL PARTS LIST
56. FUEL PUMP CODE
57. FUEL PUMP SERIAL NUMBER
58. LATEST FUEL PUMP REVISION CODE
59. FUEL PUMP ROTATION
60. FUEL PUMP ASSEMBLY NUMBER
61. ENGINE SHOP ORDER NUMBER

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Mounting Fuel Pump to Test		
3. Fuel damper and head	Remove.	Refer to para. 3-58.
4. Fuel damper from 5-ton injection pump (62)	Install on gear pump (47).	Make sure to plug fuel damper outlet with suitable plug.
5. Case fill plug (44)	a. Remove from fuel pump main housing (51). b. Fill main housing (51) with clean calibration fluid. c. Install case fill plug (44) into main housing (51).	Tighten enough to make sure no leakage will occur during air test.
	NOTE **If the throttle shaft cover has not already been removed, remove to gain access to the no-air adjustment screw. Adjusting the screw is necessary to properly calibrate fuel pump. Complete steps 6 through 10 to remove the throttle shaft cover.**	
6. Two screws (49)	Carefully remove from throttle shaft cover (52).	Use channel-lock pliers or chisel to remove screws (49). Use care to prevent damage to fuel pump main housing (51).

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)



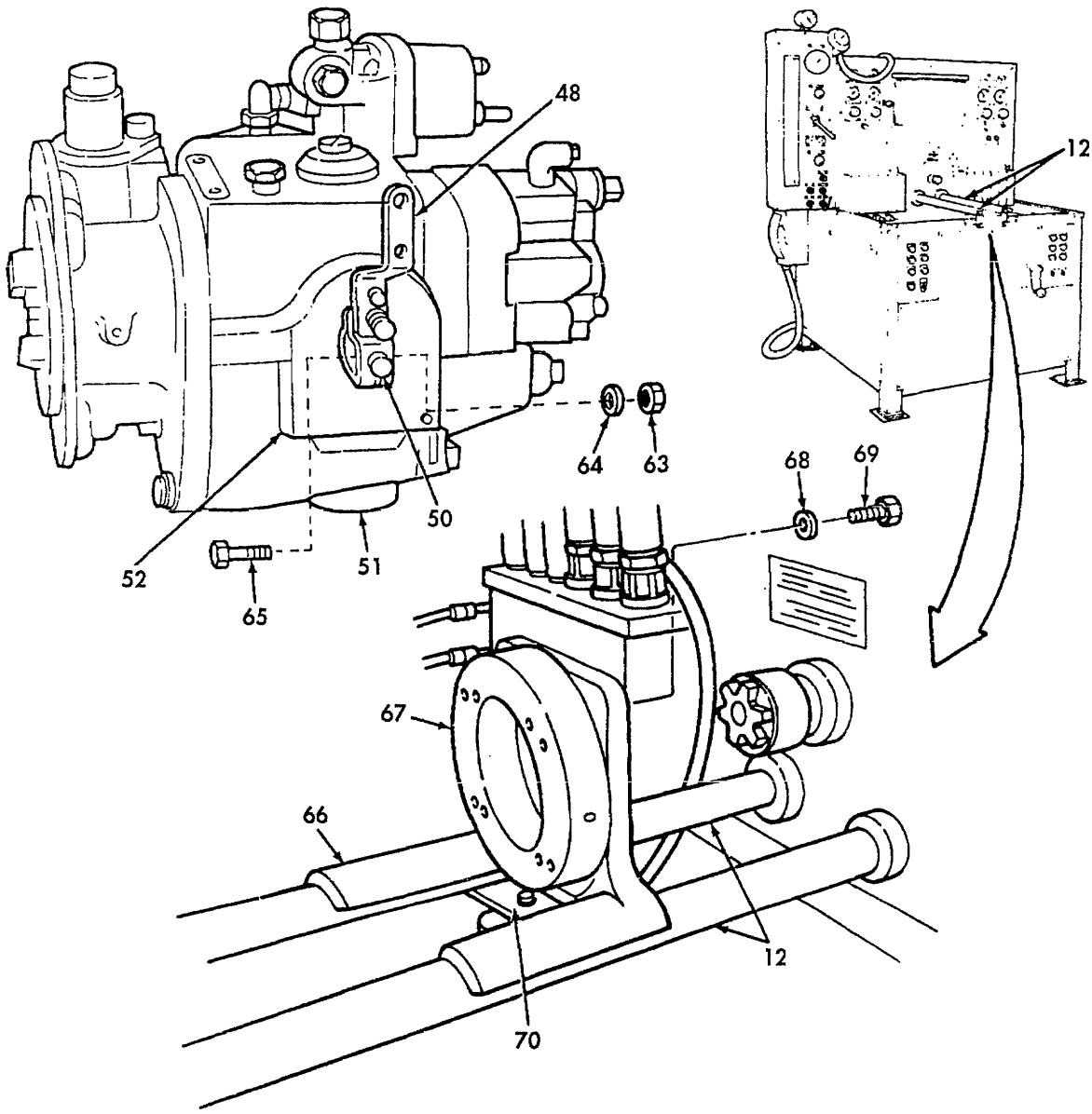
LEGEND:

44. CASE FILL PLUG
47. GEAR PUMP
49. SCREWS (2)
51. FUEL PUMP MAIN HOUSING
52. THROTTLE SHAFT COVER
62. FUEL DAMPER FROM 5-TON INJECTION PUMP

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Mounting Fuel Pump to Test Stand (Contd)		
	NOTE **Scribe position of throttle shaft and throttle lever before removing.**	
7. Jamnut (63), washer (64), and screw (65)	Remove from throttle lever (48).	
8. Throttle lever (48)	Remove from throttle shaft (50).	
9. Throttle shaft cover (52)	Remove from fuel pump main housing (51).	
10. Throttle shaft (50)	a. Install on throttle lever (48). b. Install and tighten screw (65), washer (64), and jamnut (63).	
11. Test stand adapter ring (67)	a. Install on test stand adapter bracket (66).	Word "TOP" (or adapter ring part number) must be visible on top side of ring (67) when assembled.
	b. Secure with four screws (69) and washers (68).	
12. Test stand adapter ring (67) and test stand adapter bracket (66) (assembled)	a. Install on test stand mounting rails (12).	
	b. Secure to rails (12) with clamp bar (70).	Tighten clamp bar (70) finger-tight only at this time.

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)



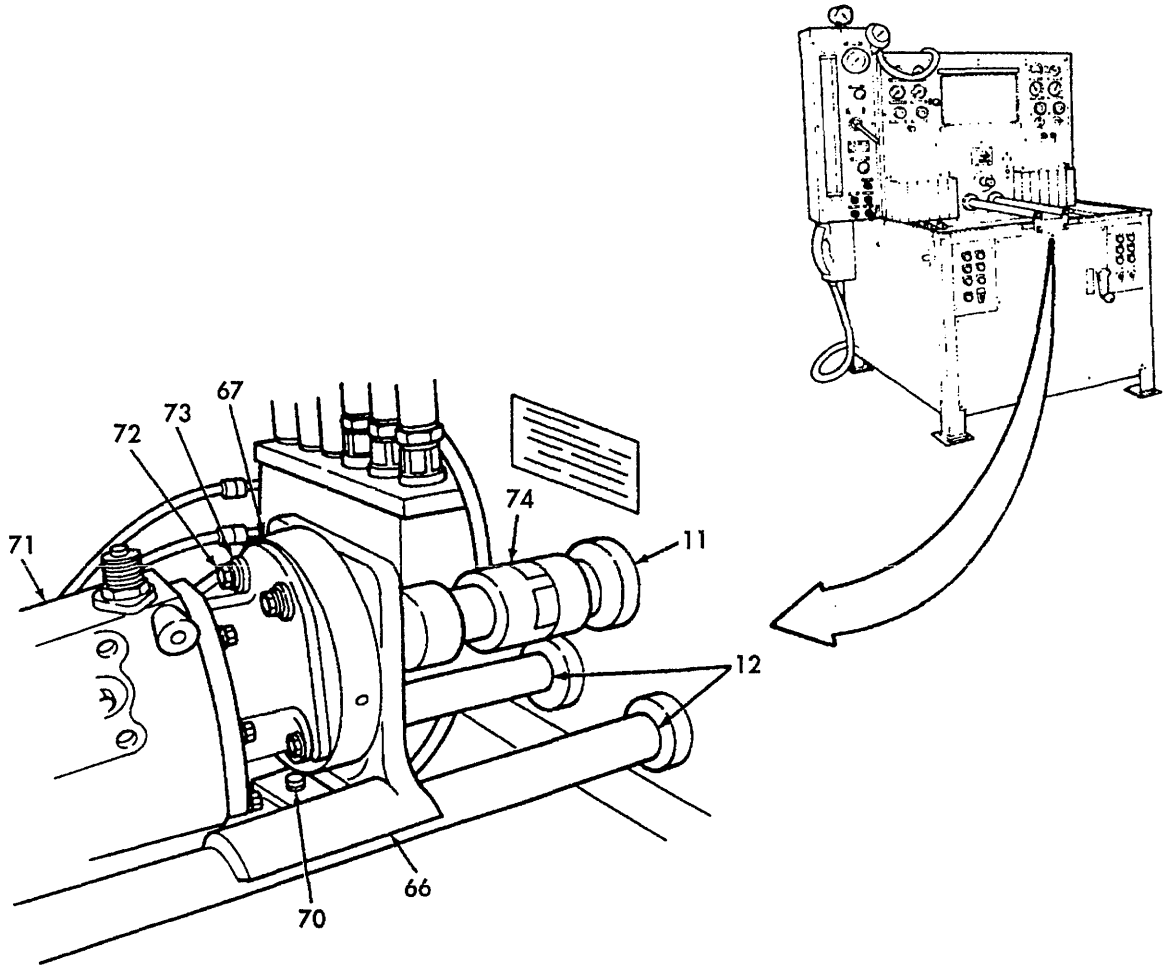
LEGEND:

12. TEST STAND MOUNTING RAIL (2)
48. THROTTLE LEVER
50. THROTTLE SHAFT
51. FUEL PUMP MAIN HOUSING
52. THROTTLE SHAFT COVER
63. JAMNUT
64. WASHER
65. SCREW
66. TEST STAND ADAPTER BRACKET
67. TEST STAND ADAPTER RING
68. WASHER (4)
69. SCREW (4)
70. CLAMP BAR

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Mounting Fuel Pump to Test Stand (Contd)		
	NOTE **Lubricate tachometer drive gears in front cover to protect them from excessive wear during calibration.**	
13. Fuel pump assembly (71)	a. Mount on test stand adapter ring (67). b. Secure with four screws (72) and washers (73). c. Rotate main shaft so that one lug on drive flange is located at 12 o'clock position.	
14. Test stand coupling insert (74)	Place into test stand drive shaft coupling (11) so that one lug of insert is at 11 o'clock position and another lug is at 1 o'clock position.	It may be necessary to hand rotate drive shaft coupling (11) to attain this positioning of insert lugs. This is to assure easy engagement of fuel pump drive flange lugs into test stand coupling insert (74).
15. Clamp bar (70)	Loosen and slide fuel pump assembly (71), test stand adapter ring (67), and test stand adapter bracket (66) on mounting rails (12) until they engage with test stand coupling insert (74).	Allow 0.0625 in. (1.5875 mm) end clearance between drive coupling on fuel pump assembly (71) and coupling insert (74) on test stand. Tighten clamp bar (70) when fuel pump assembly (71) is properly engaged.

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)



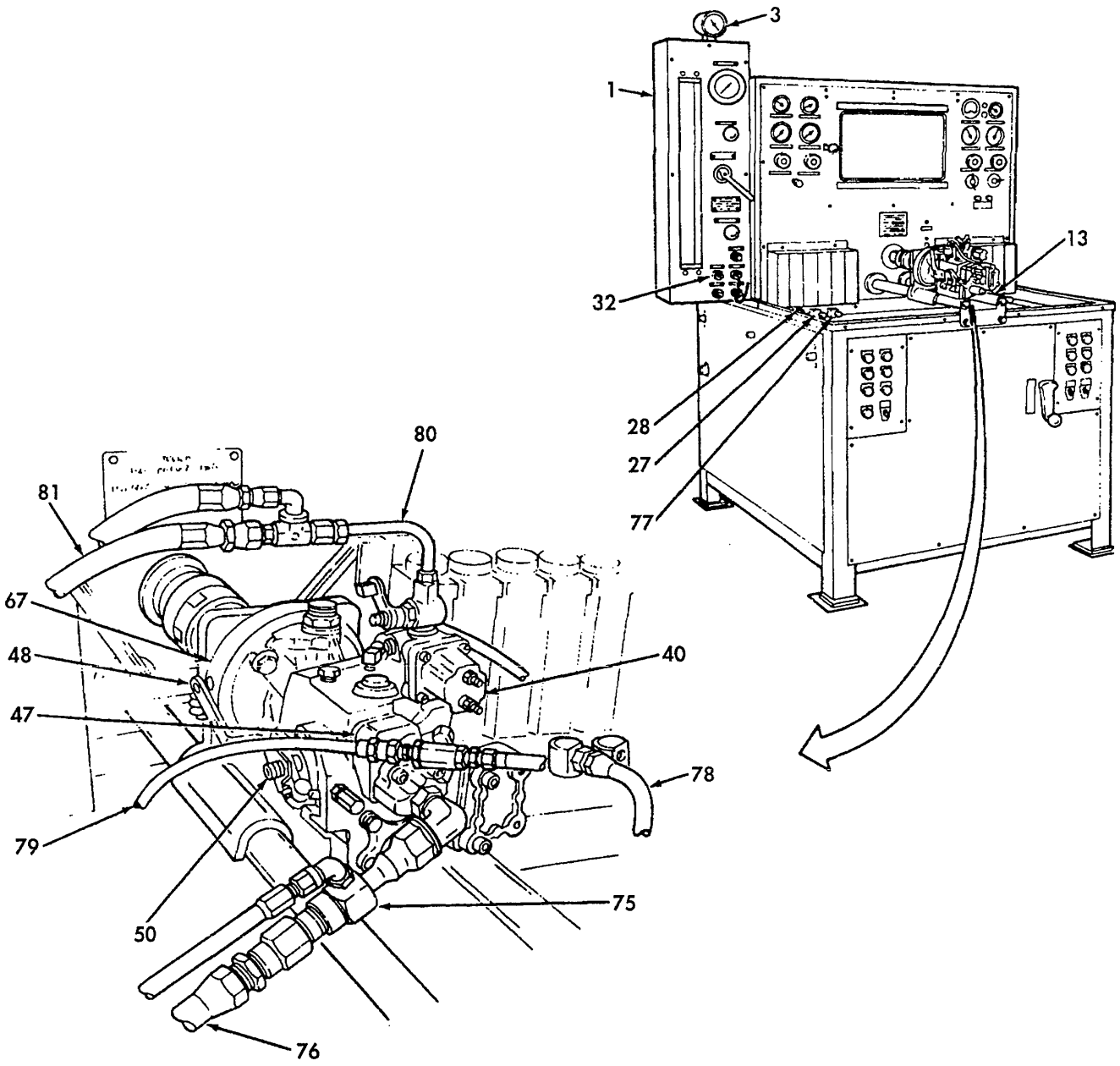
LEGEND:

11. TEST STAND DRIVE SHAFT COUPLING
12. MOUNTING RAIL (2)
66. TEST STAND ADAPTER BRACKET
67. TEST STAND ADAPTER RING
70. CLAMP BAR
71. FUEL PUMP ASSEMBLY
72. SCREW (4)
73. WASHER (4)
74. TEST STAND COUPLING INSERT

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Mounting Fuel Pump to Test Stand (Contd)		
16. Throttle shaft (50)	Rotate toward test stand (1) (to wide-open position) and retain with a spring between throttle lever (48) and adapter ring (67).	Use test stand (11020200) (1).
17. Inlet adapter assembly (75)	Install on gear pump (47).	
18. Fuel suction hose (76)	Connect from suction control valve (77) to inlet adapter assembly (75).	
19. Primer pressure outlet (28)	Plug with suitable pipe plug.	
20. Fuel return hose (78)	Connect from lube oil pressure outlet (27) to lube oil return (13).	
21. Fuel manifold hose (79)	Connect from No. 2 vacuum gauge (3) to side connection on inlet adapter assembly (75).	
22. Pump discharge fitting assembly (80)	Install on top of shutdown solenoid valve (40).	
23. Fuel pressure hose (81)	Connect from pressure gauge outlet (32) to pump discharge fitting assembly (80).	

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)



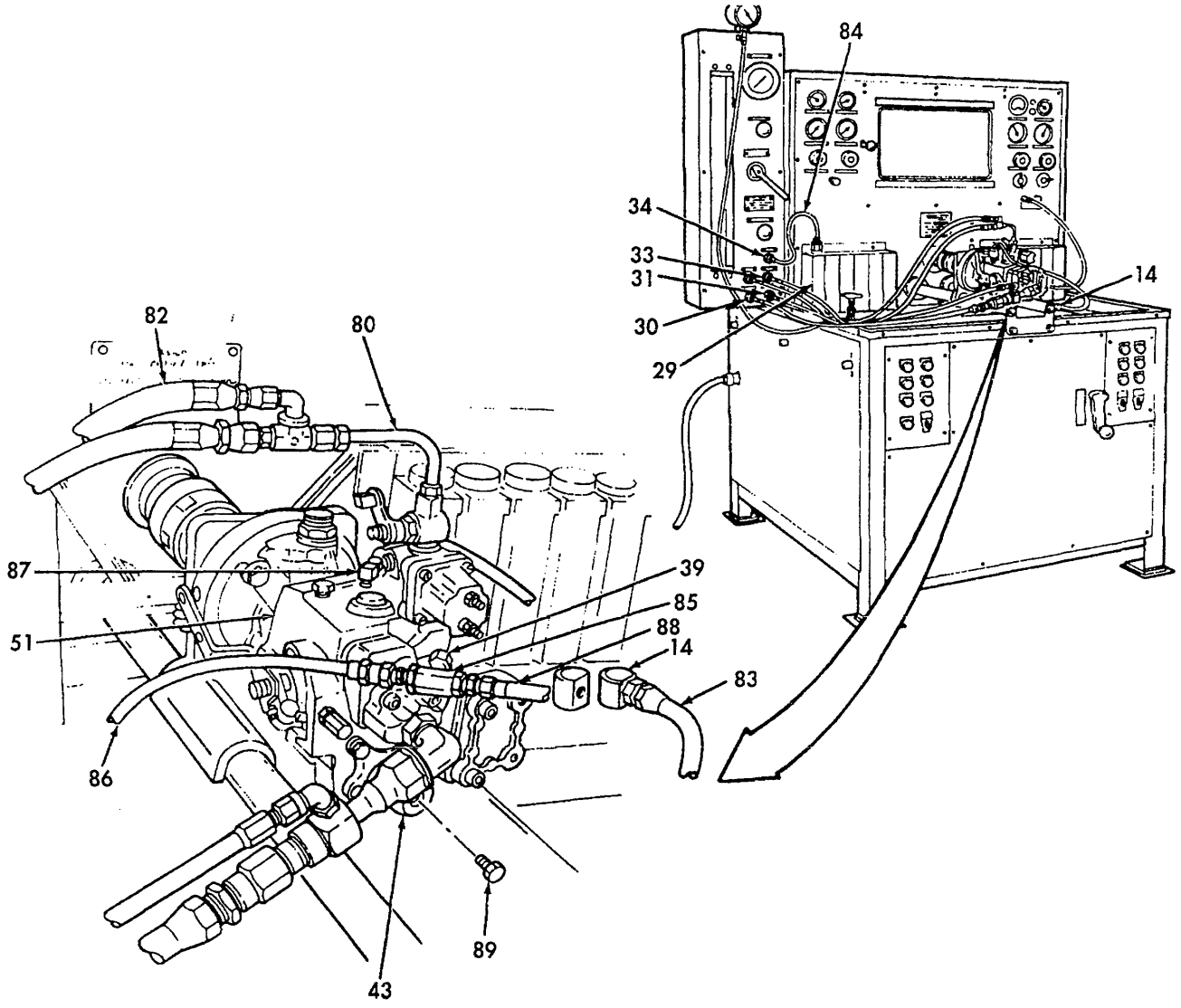
LEGEND:

1. TEST STAND
3. NO. 2 VACUUM GAUGE
13. LUBE OIL RETURN
27. LUBE OIL PRESSURE OUTLET
28. PRIMER PRESSURE OUTLET
32. PRESSURE GAUGE OUTLET
40. SHUTDOWN SOLENOID VALVE
47. GEAR PUMP
48. THROTTLE LEVER
50. THROTTLE SHAFT
67. ADAPTER RING
75. INLET ADAPTER ASSEMBLY
76. FUEL SUCTION HOSE
77. SUCTION CONTROL VALVE
78. FUEL RETURN HOSE
79. FUEL MANIFOLD HOSE
80. PUMP DISCHARGE FITTING ASSEMBLY
81. FUEL PRESSURE HOSE

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Mounting Fuel Pump to Test Stand (Contd)		
24. Fuel input hose (82)	Connect from fuel input connector (30) to pump discharge fitting assembly (80).	
25. Fuel hose (83)	Connect from fuel outlet connector (31) to fuel return (14).	
26. Flexible hose (84)	Connect from leak test connector (34) to No. 1 accumulator (29).	
27. Tee fitting (85)	Install on bleed drain fitting (87).	
28. Leakage accumulator hose (86)	Connect from auxiliary return (33) to tee fitting (85).	
29. Check valve (39)	Install into AFC vent cooling outlet on fuel pump main housing (51).	
30. Flexible hose (88)	Connect from bleed drain fitting (87) to tee fitting (85).	
31. Governor spring pack housing (43)	a. Remove plug (89).	

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)



LEGEND:

14. FUEL RETURN
29. NO. 1 ACCUMULATOR
30. FUEL INPUT CONNECTOR
31. FUEL OUTLET CONNECTOR
33. AUXILIARY RETURN
34. LEAK TEST CONNECTOR
39. CHECK VALVE
43. GOVERNOR SPRING PACK HOUSING
51. FUEL PUMP MAIN HOUSING
80. PUMP DISCHARGE FITTING ASSEMBLY
82. FUEL INPUT HOSE
83. FUEL HOSE
84. FLEXIBLE HOSE
85. TEE FITTING
86. LEAKAGE ACCUMULATOR HOSE
87. BLEED DRAIN FITTING
88. FLEXIBLE HOSE
89. PLUG

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Mounting Fuel Pump to Test Stand (Contd)		
31. Governor spring pack housing (43) (Contd)	b. Install fuel pump idle adjusting tool (90) on governor spring pack housing (43).	Use fuel pump idle adjusting tool (3375981). To assure that governor has enough clearance to cut off during calibration adjustments, carefully pull tool shaft out so that snapring is lightly resting against stop. If too much force is put on tool, snapring may be pushed off tool shaft and down into fuel pump main housing (51).
32. AFC cover plate (42) and restrictor (41)	Remove from fuel pump main housing (51) and replace with AFC adjusting tool (91).	AFC adjusting tool is part of AFC fuel pump adjusting tool kit (3375189). Pull out knobs on tool to disengage sockets. Relief cuts on tool must face toward rear of pump to allow clearance for AFC fuel passage pipe plug (92).
33. Regulated shop air source	Connect to test stand (1).	Maximum pressure should not exceed 40 psi (275 kPa).
34. Aneroid AFC adjusting line (93)	Connect to AFC adjusting tool (91).	

NOTE

Some Big Cam I engines may have fuel pumps having the Air Signal Attenuator (ASA). For those pumps, perform step 35. Big Cam III engine fuel pumps do not require step 35 to be performed.

35. Air Signal Attenuator (ASA) and restrictor. (The ASA and restrictor are collectively called the smoke control valve.)	a. Calibrate the fuel pump without the smoke control valve. Valve is threaded into AFC cover plate (42). See illustration on next page.	Smoke control valve produces a delay in intake manifold pressure signal to the AFC, resulting in a reduction of accelerated smoke.

CAUTION

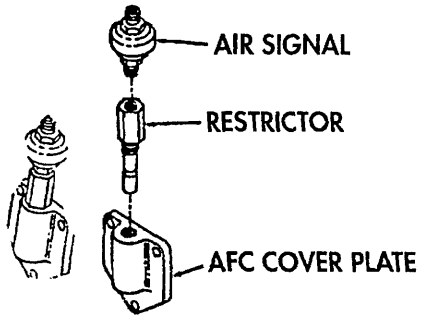
When removing the ASA from the AFC cover plate, do not disassemble by placing the wrench on top of the ASA. Place the wrench on the hex at the bottom of the ASA, just above the top of the restrictor for disassembly.

	b. Check valve by blowing through each side of valve.	There should be free air flow when blowing through the 1/8-NPT end of valve (AFC cover plate end) and restricted flow when blowing through intake manifold end (almost no air flow).
	c. Check restrictor check ball for sticking by shaking it and listening for check ball to rattle in restrictor (41). If check ball is stuck and not moving when restrictor is shaken, replace the unit.	Check ball is located in the restrictor (41) to prevent a reverse fuel flow to the intake manifold if AFC bellows ruptures.
	d. Check restrictor orifice by connecting it to an air line. Immerse restrictor (41) in clean test fluid and pressurize it with	If no air bubbles are coming out of orifice, restrictor (41) is plugged or contaminated and should be replaced.

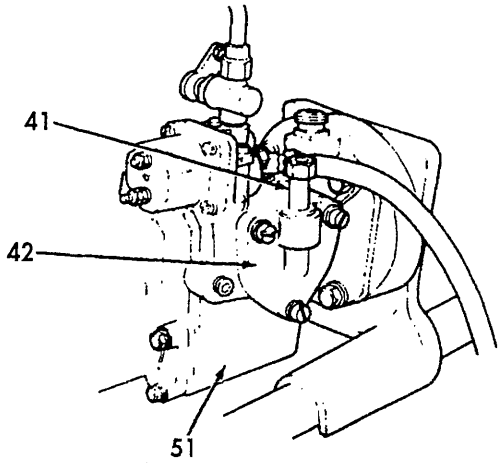
3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)		
LOCATION/ITEM	**ACTION**	**REMARKS**

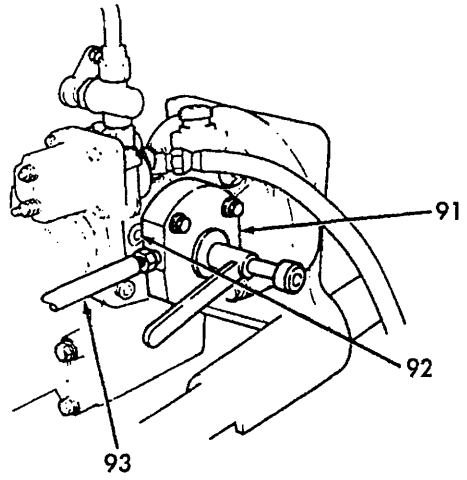
10 psi (69 kPa).

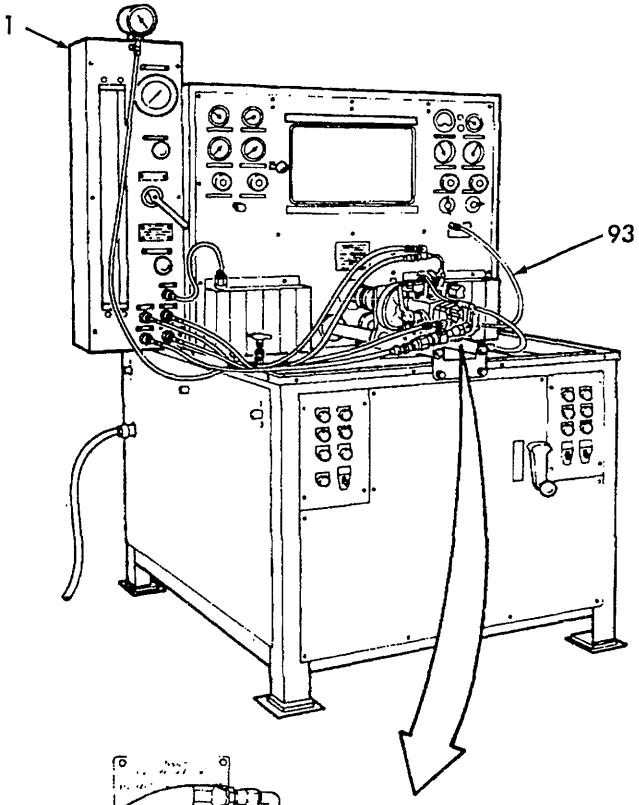
NOTE

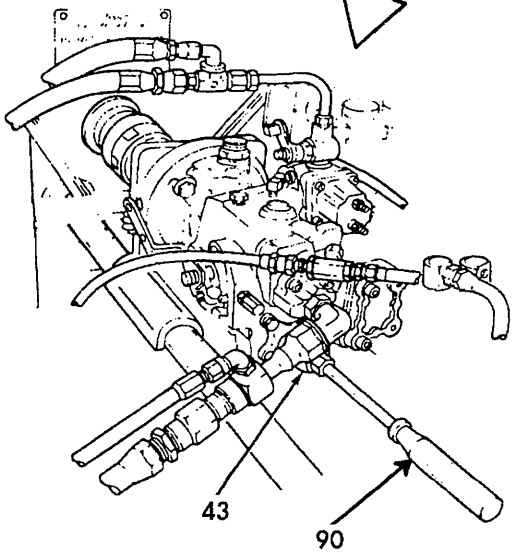


AIR SIGNAL ATTENUATOR AND RESTRICTOR









LEGEND:

1. TEST STAND
41. RESTRICTOR
42. AFC COVER PLATE
43. GOVERNOR SPRING PACK HOUSING
51. FUEL PUMP MAIN HOUSING
90. FUEL PUMP IDLE ADJUSTING TOOL
91. AFC ADJUSTING TOOL
92. AFC FUEL PASSAGE PIPE PLUG
93. ANEROID AFC ADJUSTING LINE

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS

d. Fuel Pump Run-in (Big Cam I and Big Cam III)

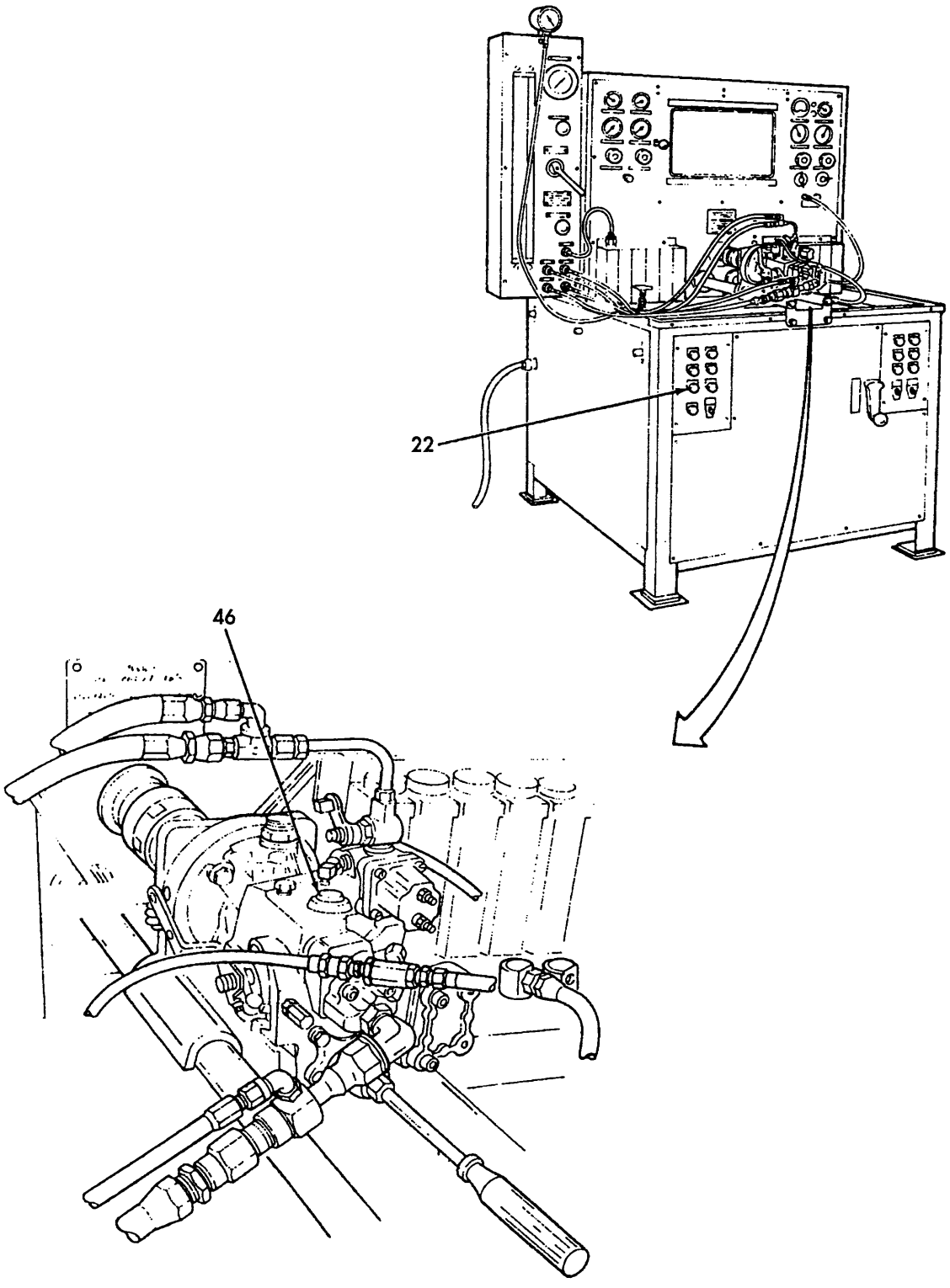
CAUTION

- **The test stand motor switch (22) is marked "REVERSE" and "FORWARD." For all testing of this pump, the test stand motor switch (22) must be set to the "REVERSE" position. This position corresponds to the right-hand drive rotation requirements for this fuel pump. If the motor switch (22) is in the incorrect position, the pump will run dry and could be damaged.**
- **Be certain the fuel filter screen (46) is clean and installed correctly. Foreign material in the pump could damage seals, gears, or shafts, and plug up the fuel passages. Check to see that the fuel filter screen (46) is installed with the hole in the screen at the bottom. If the fuel filter screen (46) is installed upside down, it will cut off all fuel flow to the pump. The pump will then run dry and could be damaged.**

NOTE

For a complete description and location of the test stand controls, refer to TM 9-4910-387-14&P, Tester, Fuel Injection, Single End Drive, 150 to 3000 RPM.

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

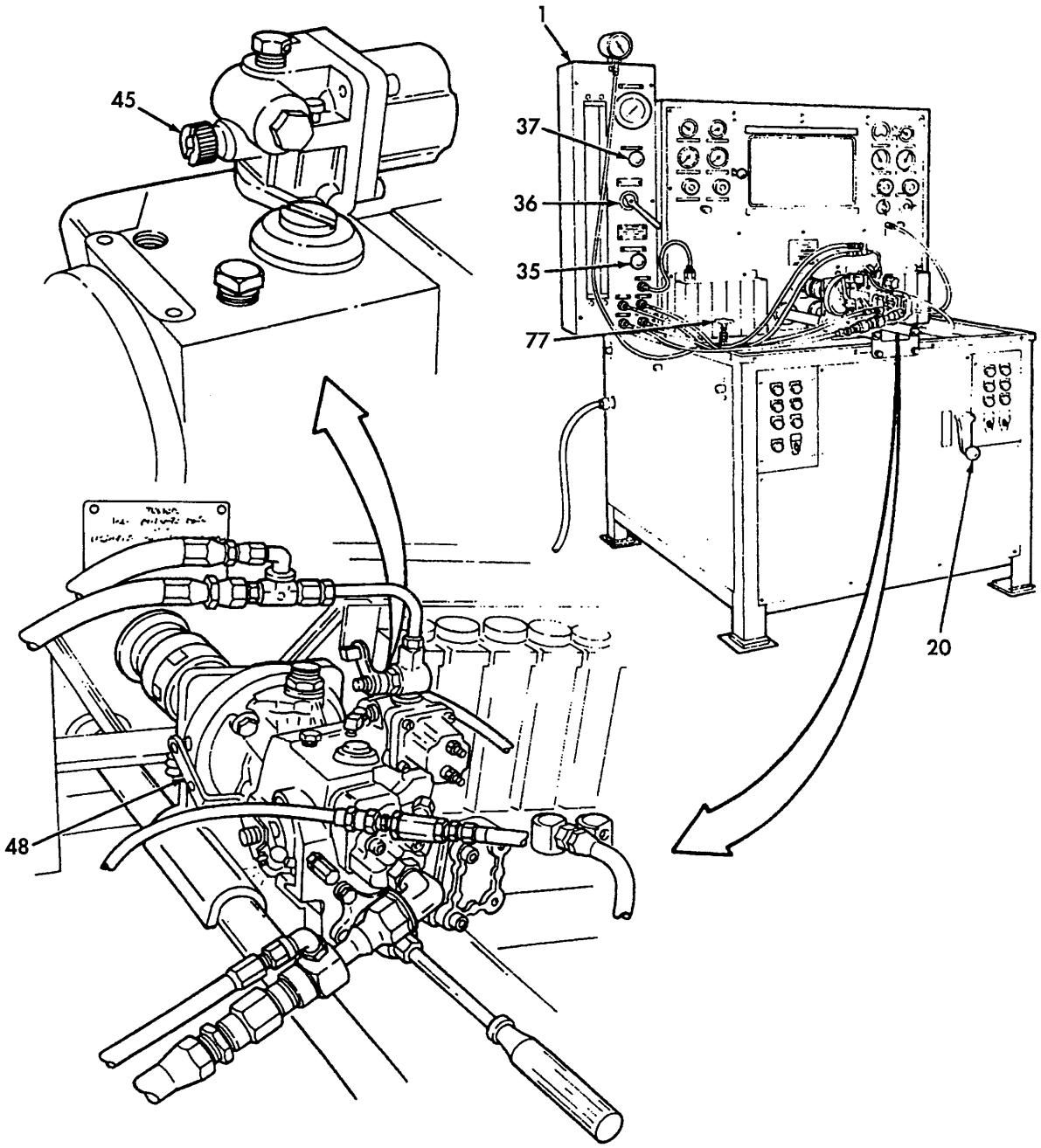


LEGEND:
22. MOTOR SWITCH
46. FUEL FILTER SCREEN

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Fuel Pump Run-in (Big Cam I and Big Cam III) (Contd)		
36. Shutdown solenoid manual override knob (45)	Open by turning clockwise.	This step is needed to cancel out the normal electrical shutdown through the solenoid and allow fuel flow for testing purposes.
37. Bypass valve (35), suction control valve (77), and flow control valve (37)	Open.	
38. All other valves on test stand (1)	Backseat to prevent leakage.	
39. Speed-shifting crank (20)	Set to HIGH range.	After crank has been set to HIGH range, turn it back (counterclockwise) about one turn so that the handle load is neutralized.
40. Throttle lever (48)	Make sure it is in the wide-open position and secured with a spring.	
41. Selector valve (36)	Turn to ROTAMETER position.	

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd])



LEGEND:

1. TEST STAND
20. SPEED-SHIFTING CRANK
35. BYPASS VALVE
36. SELECTOR VALVE
37. FLOW CONTROL VALVE
45. SHUTDOWN SOLENOID MANUAL OVERRIDE KNOB
48. THROTTLE LEVER
77. SUCTION CONTROL VALVE

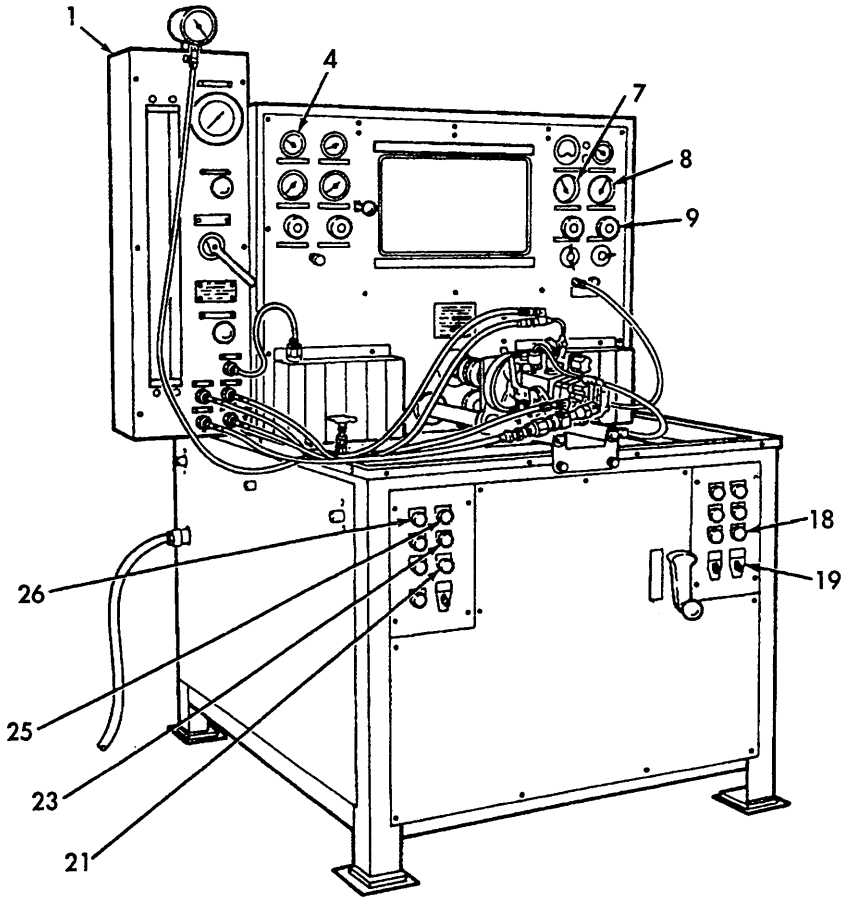
3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Fuel Pump Run-in (Big Cam I and Big Cam III) (Contd)		
42. Power switch on test stand (1)	Turn to ON position.	Power "ON" light (21) should light up.
43. Fuel heat switch (19)	Turn to ON position and observe fuel temperature on fuel temperature gauge (4).	Fuel heat "ON" light (18) should light up. Proper operating temperature for calibration fluid is 90-100°F (32.2-37.8°C). The test stand (1) built-in thermometer will automatically maintain this temperature once the fluid has been circulated.
44. Pressure regulator (9)	Adjust until a reading of 50.00 Hg (180,000 kPa) registers on pressure gauge (8).	
45. Start button (26)	Depress to start test stand (1).	
46. Fast switch (25) and slow switch (23)	Depress and release as necessary until exactly 500 rpm is indicated on tachometer (7).	

NOTE

Check the flowmeter glass tube for air in the fuel flow. If air bubbles are present, work the fuel pump throttle lever from full-open to idle several times to relieve any trapped air in the pump. If air bubbles persist, it is an indication of an air leak in the system. Turn the test stand off and check all line connections between the test stand and fuel pump for tightness. Check the rating of gear pump to main housing and check to see that test stand reservoir is full of fluid.

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)



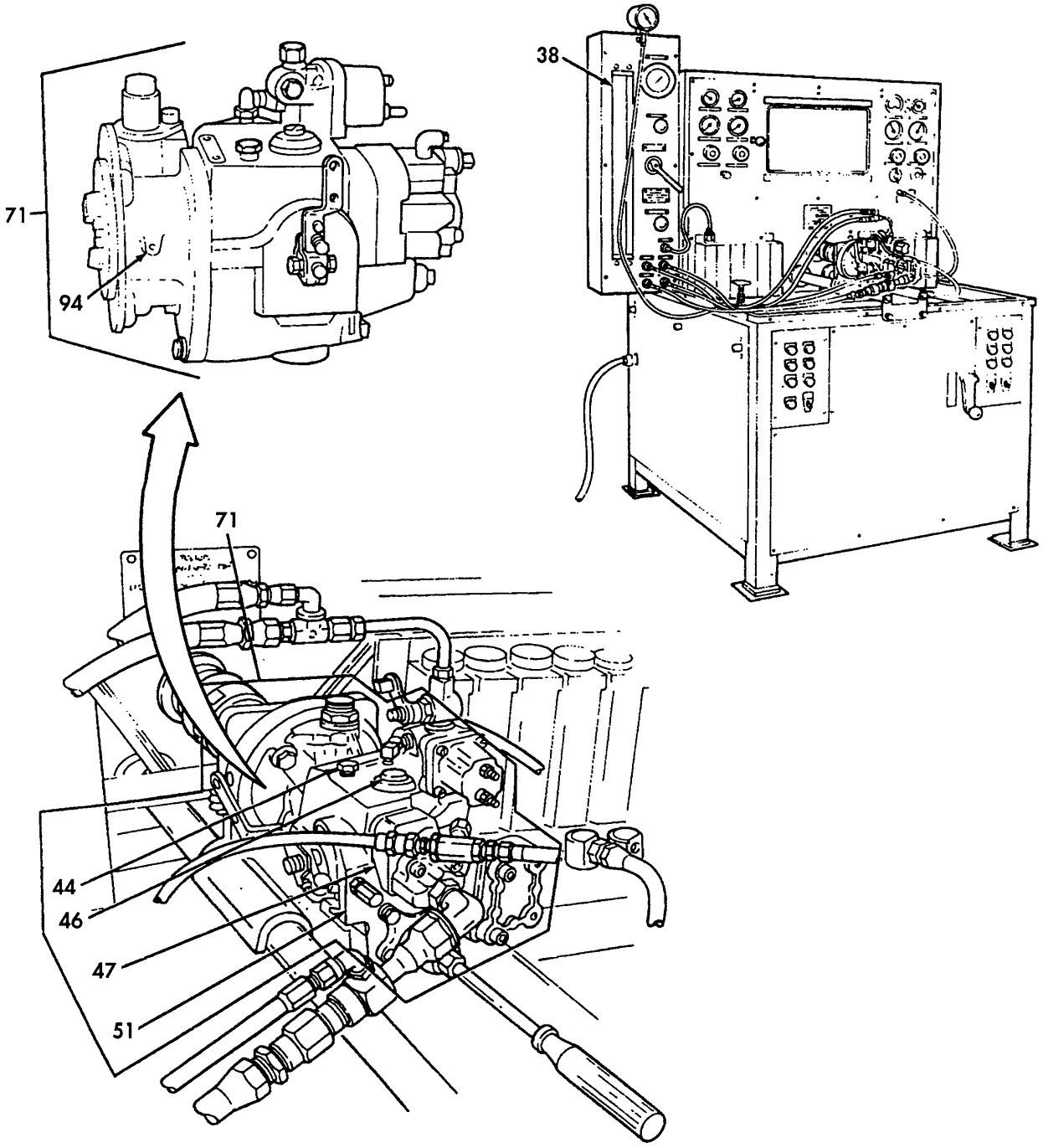
LEGEND:

1. TEST STAND
4. FUEL TEMPERATURE GAUGE
7. TACHOMETER
8. PRESSURE GAUGE
9. PRESSURE REGULATOR
18. FUEL HEAT "ON" LIGHT
19. FUEL HEAT SWITCH
21. POWER "ON" LIGHT
23. SLOW SWITCH
25. FAST SWITCH
26. START BUTTON

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Fuel Pump Run-in (Big Cam I and Big Cam III) Contd)		
47. Fuel pump assembly (71)	Run at 500 rpm for five minutes.	This step is done to purge all air from the system. The gear pump (47) must be able to pick up fluid at this speed without the aid of priming. If no fluid pickup is indicated in the flowmeter glass tube (38), check the fuel filter screen (46) for proper installation; check that the test stand motor switch is set to the correct position; check that the test stand suction control valve is open; and check all hose connections and gear pump (47) for condition.
e. Fuel Pump Vacuum and Seal		
48. Case fill plug (44)	a. Remove from fuel pump main housing (51). b. Look on fuel pump main housing (51) and make sure fuel is present. c. Install plug (44) on main housing (51).	
49. Fuel pump assembly (71)	Check mating surfaces and weep hole (94) for leaks.	Replace seals as required.

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)



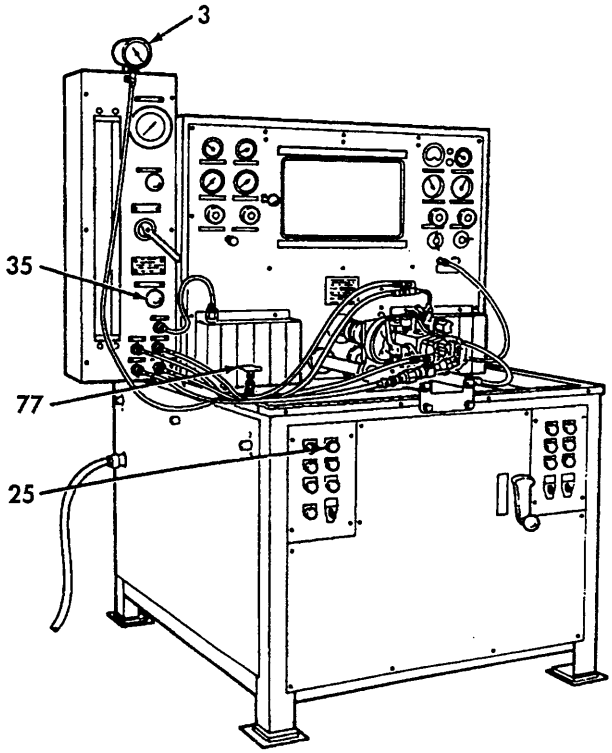
LEGEND:

38. FLOWMETER GLASS TUBE
44. CASE FILL PLUG
46. FUEL FILTER SCREEN
47. GEAR PUMP
51. FUEL PUMP MAIN HOUSING
71. FUEL PUMP ASSEMBLY
94. WEEP HOLE

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
f. Fuel Pump Vacuum		
50. Bypass valve (35)	Close.	
51. Suction control valve (77)	Open completely.	
52. Fast button (25)	Depress until fuel pump speed is 2000 rpm.	
53. Suction control valve (77)	Adjust to obtain exactly 8.00 in. Hg. (28,800 kPa) reading on No. 2 vacuum gauge (3) at 2000 rpm pump speed.	Once this suction control valve setting is attained, it must not be changed during later calibration procedures.

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

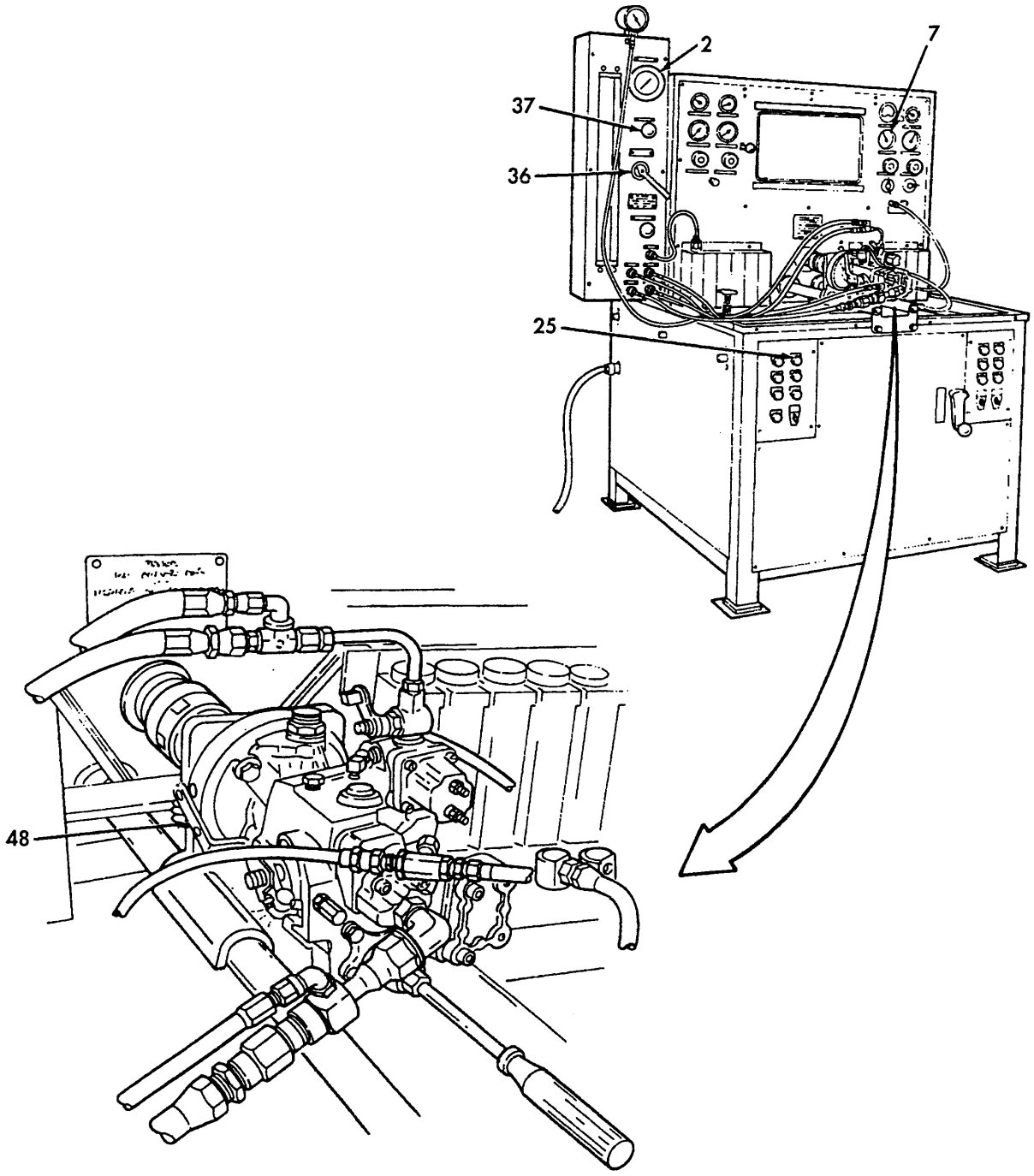


LEGEND:
3. NO. 2 VACUUM GAUGE
25. FAST BUTTON
35. BYPASS VALVE
77. SUCTION CONTROL VALVE

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
g. Governor Cutoff RPM Check		
54. Fast button (25)	Depress until pump speed is 2100 rpm as indicated on tachometer (7).	Make sure flow control valve (37) is open and selector valve (36) is set at the ROTAMETER position.
55. Flow control valve (37)	Adjust to 470 pph.	Fuel pump throttle lever (48) should remain in wide-open position and be secured by a spring.
56. Fast button (25)	While watching fuel pressure gauge (2), gradually increase pump speed until pressure drops slightly instead of rising.	Pressure should drop when reading on tachometer (7) is between 2130 and 2150 rpm. If governor cutoff point (as indicated by the tachometer) is not within above limits, do steps 57 through 60. If governor cutoff point is within limits, go to step 61.

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)



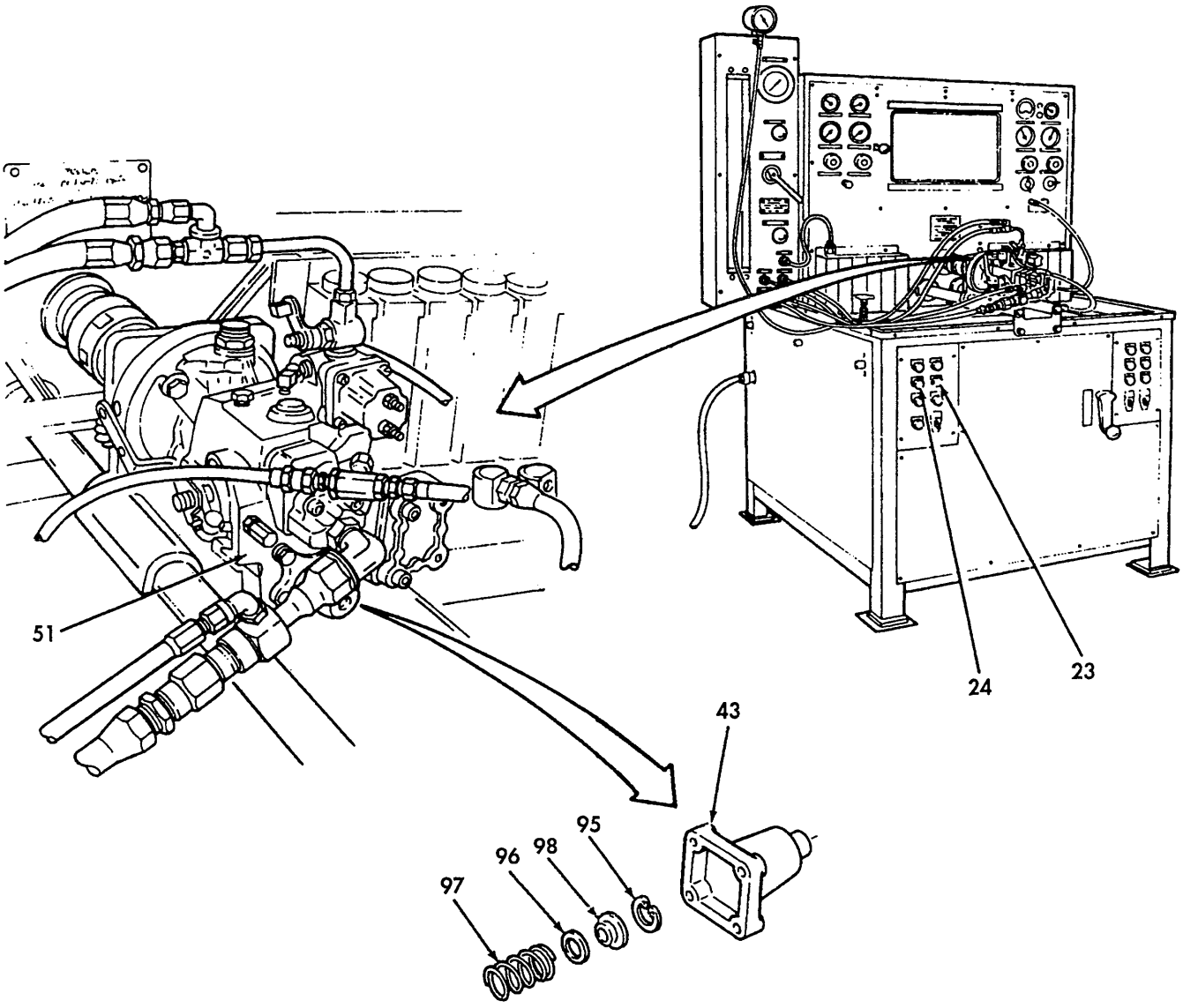
LEGEND:

2. FUEL PRESSURE GAUGE
7. TACHOMETER
25. FAST BUTTON
36. SELECTOR VALVE
37. FLOW CONTROL VALVE
48. THROTTLE LEVER

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
g. Governor Cutoff RPM Check (Contd)		
57. Slow button (23) and stop button (24)	a. Depress slow button (23) to slow test stand to minimum speed. b. Depress stop button (24) to stop test stand.	
58. Governor spring pack housing (43) and snapring (95)	Remove from fuel pump main housing (51).	
59. Shims (96)	Remove to decrease governor cutoff speed and add to increase governor cutoff speed.	Each 0.001 in. (0.025 am) thickness of shim will change the governor cutoff speed about 2 rpm. Shims are available in 0.005, 0.010, and 0.020 in. (0.127, 0.254, and 0.508 mm) thickness. They should be placed between governor spring (97) and retainer (98). If more than 0.150 in. (3.81 mm) total shim thickness is required, replace governor spring (97).
60. Snapring (95) and governor spring pack housing (43)	Install on fuel pump main housing (51).	After installing shims, snapring, and spring pack housing, purge the fuel pump of air as described in step 47. When fluid in flowmeter glass tube is clear again, recheck governor cutoff point as described in steps 54 through 56.

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)



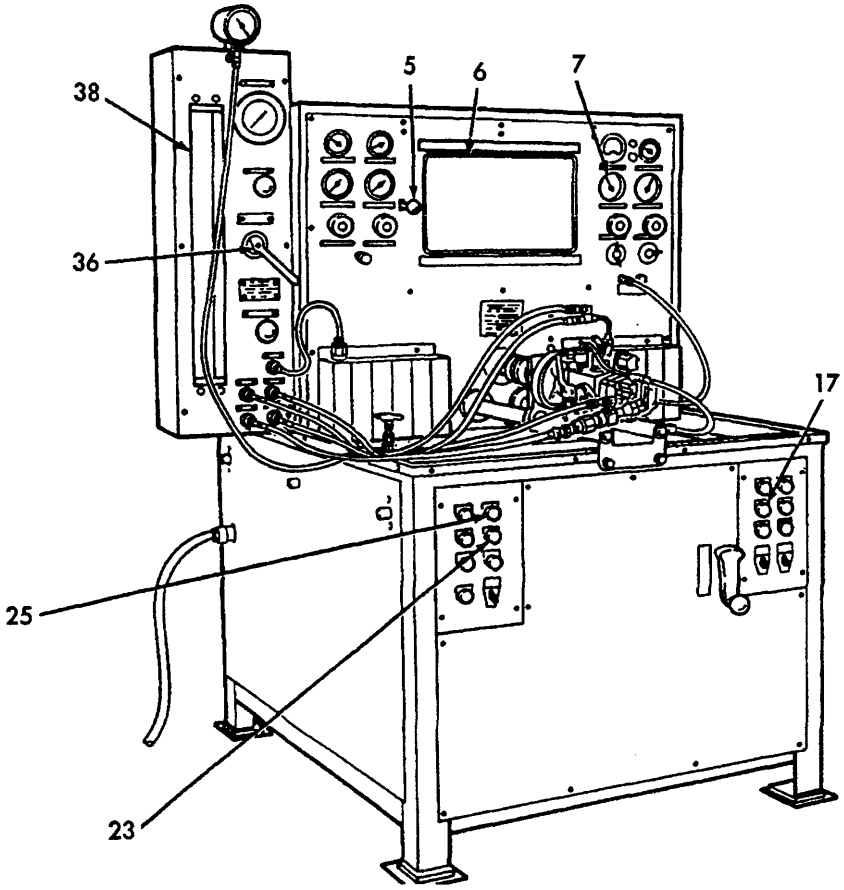
LEGEND:

23. SLOW BUTTON
24. STOP BUTTON
43. GOVERNOR SPRING PACK HOUSING
51. FUEL PUMP MAIN HOUSING
95. SNAPRING
96. SHIM (1 TO 3)
97. GOVERNOR SPRING
98. RETAINER

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
h. Throttle Leakage		
	NOTE **This setting is important because it controls the deceleration time of the engine.**	
61. Fast button (25) and slow button (23)	Depress and release until fuel pump speed is at 2100 rpm as indicated on the tachometer (7).	
62. Flowmeter glass tube (38)	Check fuel flow at exactly 470 pph.	If balance has changed between rpm speed and fuel flow, it must be reset. Also, selector valve (36) must be at ROTAMETER position.
63. Selector valve (36)	Turn to LEAKAGE TEST position.	
64. Count selector switch (17)	Turn to OFF position.	
65. Dumping lever (5)	Pull out so that fuel will be retained in the No. 1 burette (6).	

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)



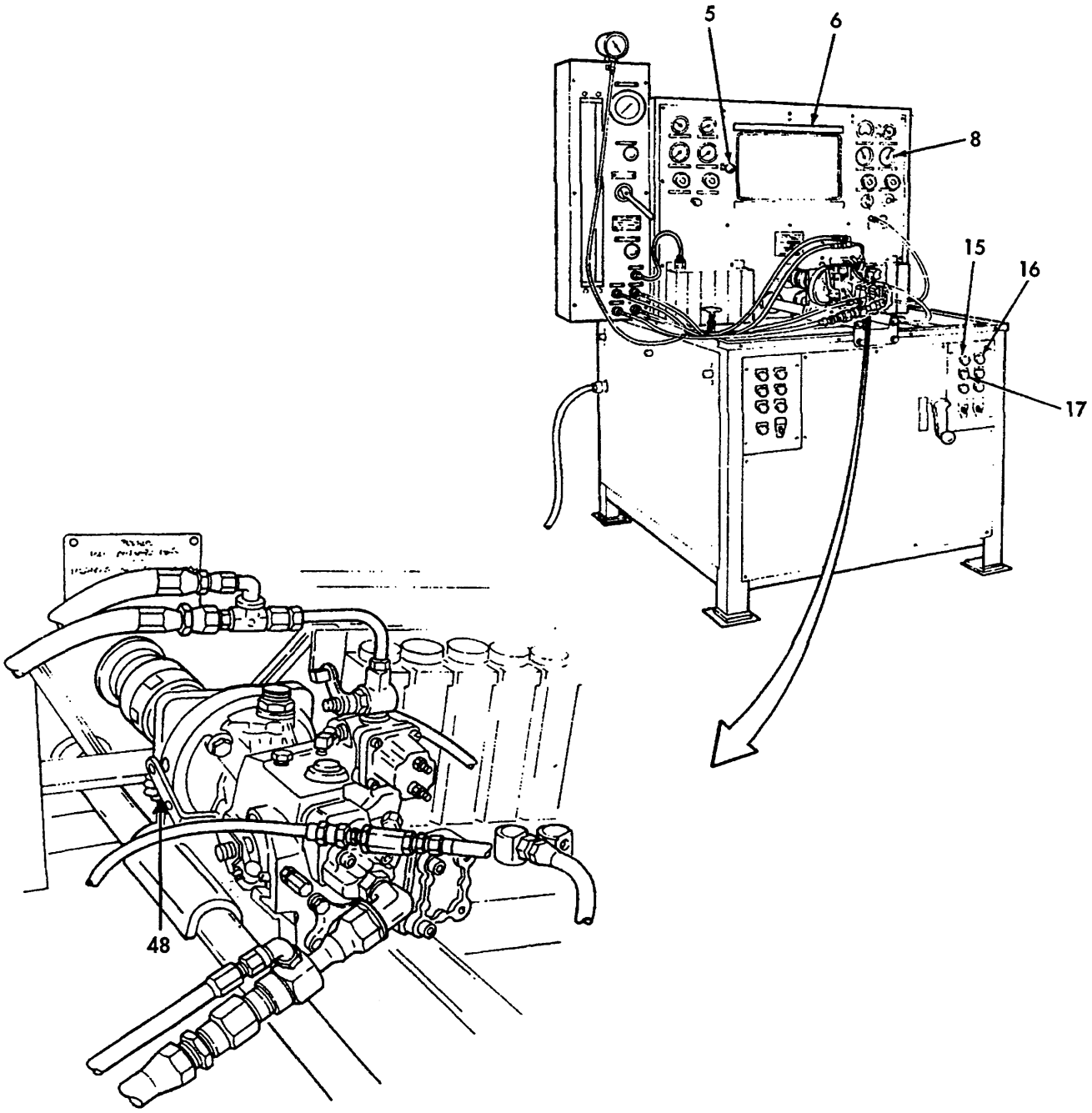
LEGEND:

5. DUMPING LEVER
6. NO. 1 BURETTE
7. TACHOMETER
17. COUNT SELECTOR SWITCH
23. SLOW BUTTON
25. FAST BUTTON
36. SELECTOR VALVE
38. FLOWMETER GLASS TUBE

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
h. Throttle Leakage (Contd)		
66. Throttle lever (48)	Move to full fuel position, and press start count button (15) to start the fuel count.	Count "ON" light (16) should light up.
67. Dumping lever (5)	Push in when No. 1 burette (6) is full to dump fuel collected.	By operating count selector for one cycle before measuring fuel flow, the inside of the burette will be wet. This makes a more accurate reading possible.
68. Count selector switch (17)	Turn to "1000" position.	
	CAUTION **Do not hold the fuel pump throttle lever in the idle position any longer than necessary to complete the tests. The pump may overheat since fuel flow is used to cool and lubricate the pump.**	
69. Throttle lever (48)	a. Move to idle position until pressure gauge (8) stabilizes at lowest reading. b. Press start count button (15).	Allow No. 1 burette (6) to fill.

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)



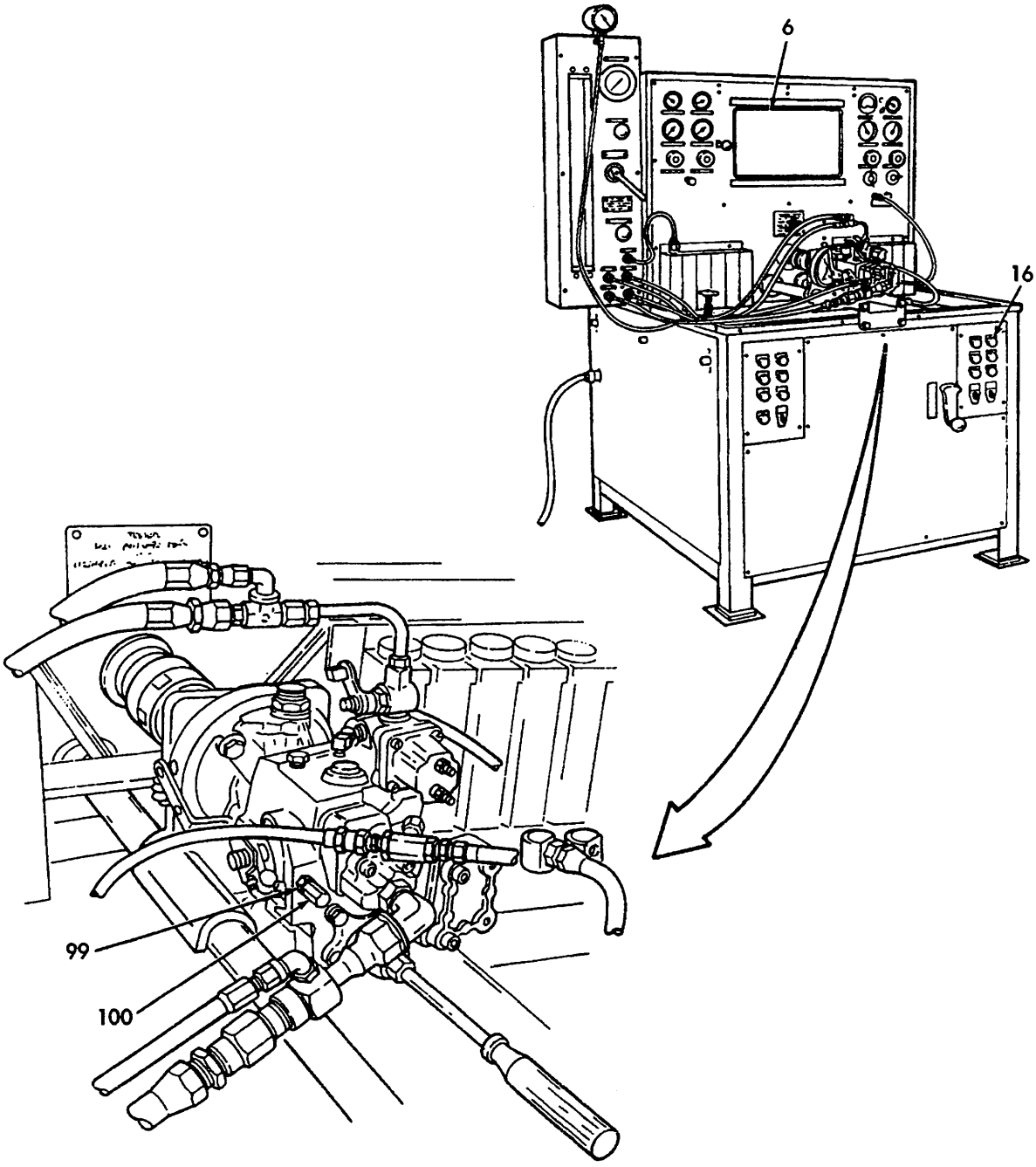
LEGEND:

5. DUMPING LEVER
6. NO. 1 BURETTE
8. PRESSURE GAUGE
15. START COUNT BUTTON
16. COUNT "ON" LIGHT
17. COUNT SELECTOR SWITCH
48. THROTTLE LEVER

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
h. Throttle Leakage (Contd)		
70. No. 1 burette (6)	When count cycle ends and count "ON" light (16) goes out, release lever. Read amount of fuel delivered.	The scale on the burette is measured in cubic centimeters (cc). Normal throttle leakage for this pump is 45 to 59 cc at 1000 rpm. Repeat steps 67 through 70 at least three times to ensure accuracy. (For Big Cam I engine fuel pumps, 12.5 to 16.5 cc throttle linkage is normal). If throttle leakage is not within limits shown above, do step 71. If throttle leakage is within limits shown above, go to step 72.
71. Rear throttle stopscrew (99) and locknut (100)	Loosen locknut (100) and adjust rear throttle stopscrew (99) to adjust fuel delivery.	Turning stopscrew (99) in will increase fuel flow, and turning stopscrew (99) out will decrease fuel flow. Even a slight movement of stopscrew (99) will make several cubic centimeters difference in fuel flow. Sometimes just loosening and retightening the locknut (100) will be enough.

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)



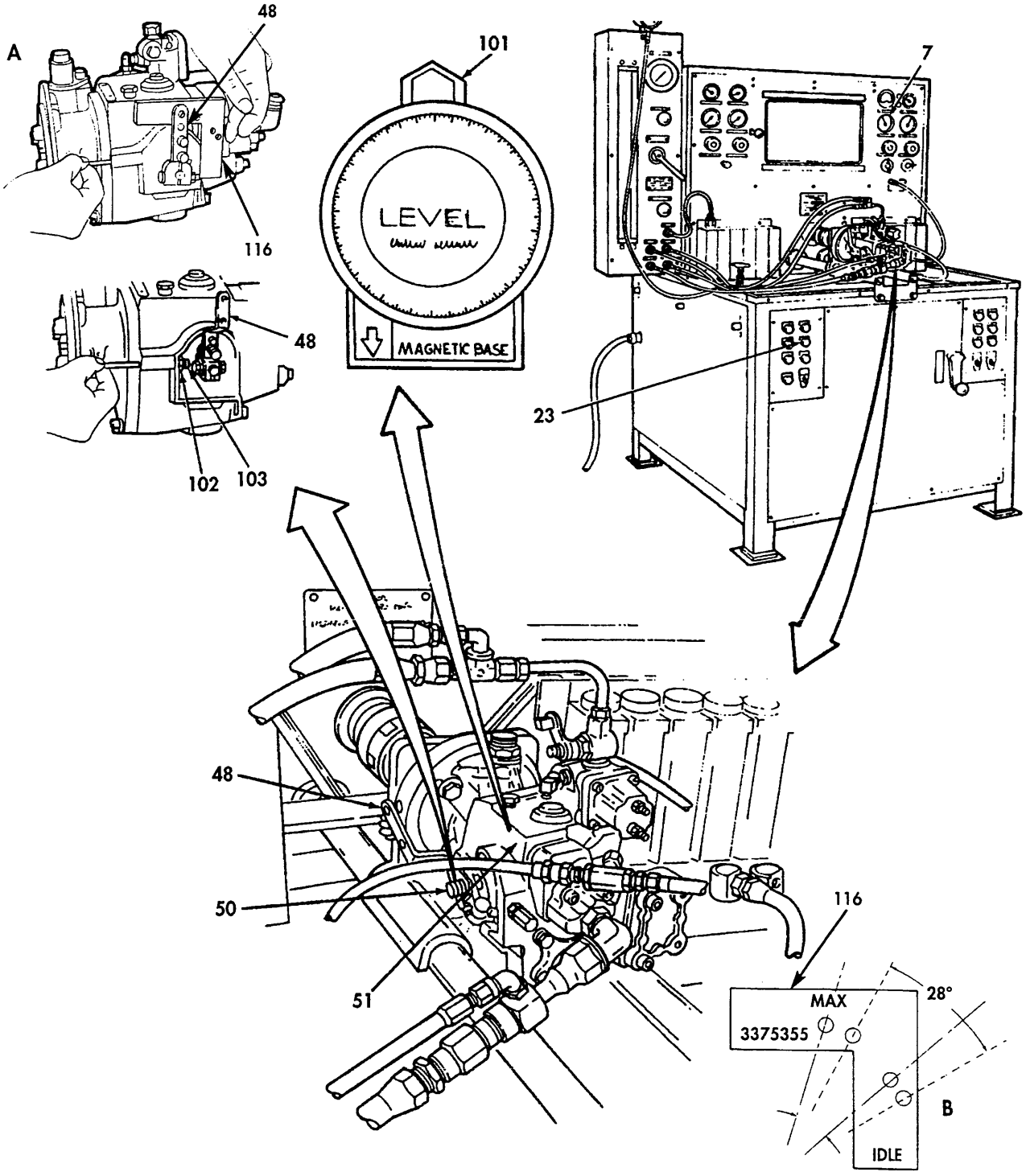
LEGEND:

6. NO. 1 BURETTE
16. COUNT "ON" LIGHT
99. REAR THROTTLE STOPSCREW
100. LOCKNUT

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
i. Throttle Lever Travel Adjustment		
72. Slow switch (23)	Depress until 500 rpm is indicated on tachometer (7).	
73. Level and angle indicator (101)	Position on fuel pump main housing (51).	Use level and angle indicator (3375855) (101).
	NOTE **Do not adjust rear throttle stop from the position it was adjusted to under THROTTLE LEAKAGE ADJUSTMENT. The rear throttle stopscrew has already been set to provide the proper deceleration time for the engine, and any change at this point will require recalibration of throttle leakage.**	
74. Throttle lever (48)	a. Using level and angle indicator (101), set the idle position centerline of throttle lever (48) at 55° from the vertical on the centerline of throttle shaft (50).	The throttle lever (48) may be repositioned on the throttle shaft (50) as required to attain 55°.
	b. Move to full-throttle position. At this position, the centerline of the throttle lever must be 27° as shown on level and angle indicator (101).	Check centerline travel of throttle lever (48). Centerline travel from idle position to full-throttle position must be 27°. If throttle lever (48) travel is not correct, loosen jamnut (102) and adjust front throttle stopscrew (103) to attain 27° travel, then lock setting with jamnut (102).
	c. Checking and adjusting throttle lever (48) travel using tool 3375355, throttle lever travel template (116).	The throttle lever travel template has two sets of matched holes for lever alinement that may be used. The first and third holes, moving clockwise from MAX to IDLE on the template, will set lever travel for 27°-29° movement. The second and fourth holes, moving clockwise from MAX to IDLE will also set lever travel for 27°-29° movement. Either set of holes may be used, but do not use the first and last hole in combination or the second and third holes; otherwise an erroneous reading will result. See figure B.
	d. Position template (116) on fuel pump housing as shown in figure A.	Move the throttle lever to idle position, and line up the hole on the throttle shaft lever with the idle hole on the template. The throttle shaft lever may be repositioned on the throttle shaft as required to line up the holes.
	e. Move throttle lever (48) to full throttle position.	Line up the hole on the throttle lever (48) with the appropriate MAX hole on the template. If throttle lever travel is not correct, loosen the jamnut (102) and adjust the front throttle stopscrew (103) to line up the holes.

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)



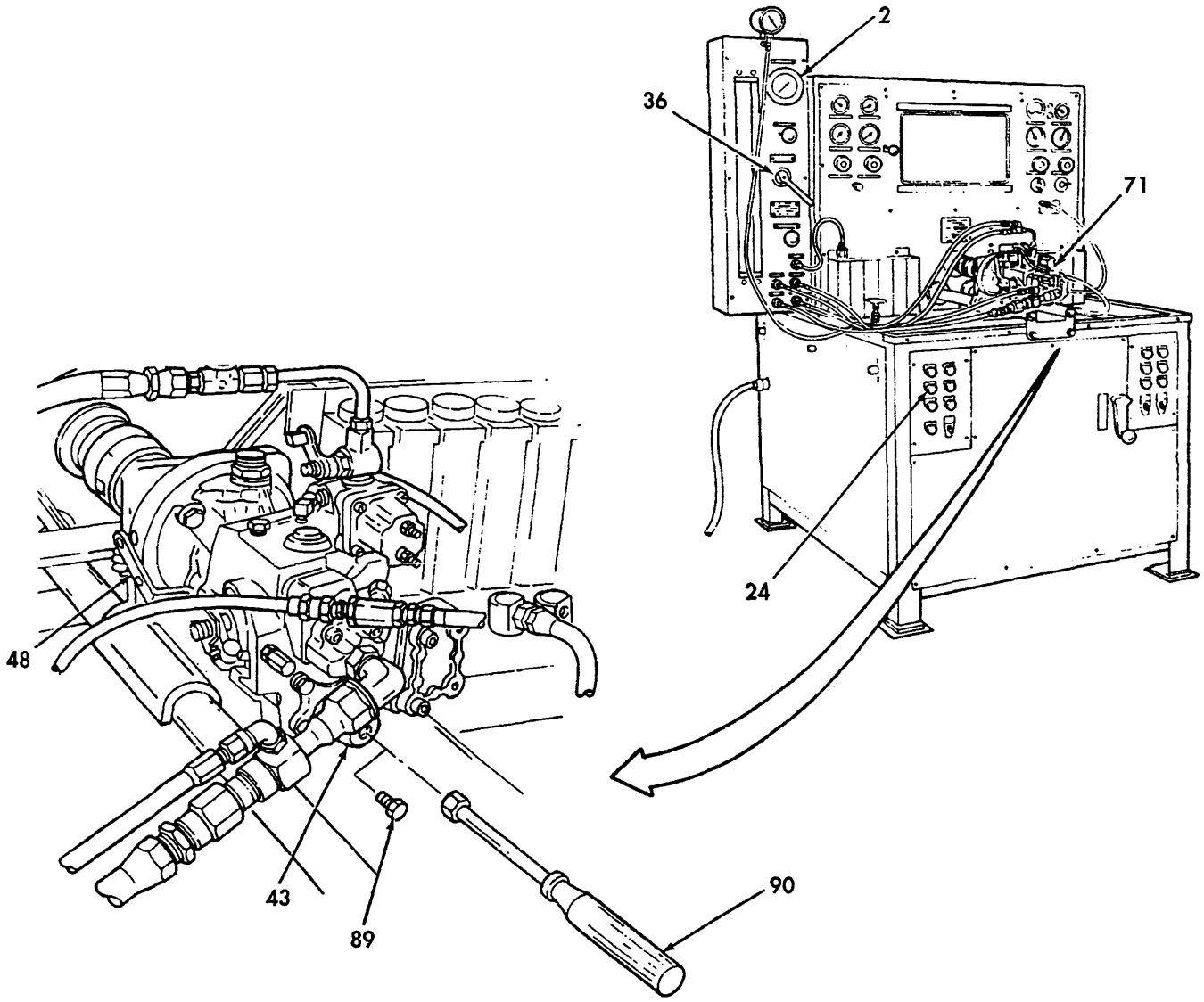
LEGEND:

7. TACHOMETER
23. SLOW SWITCH
48. THROTTLE LEVER
50. THROTTLE SHAFT
51. FUEL PUMP MAIN HOUSING
101. LEVEL AND ANGLE INDICATOR
102. JAMNUT
103. FRONT THROTTLE STOPSCREW
116. THROTTLE LEVER TRAVEL TEMPLATE 3375355

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
j. Fuel Pump Idle Speed Check		
75. Selector valve (36)	Turn to IDLE position.	
76. Fuel pump assembly (71)	Run at 500 rpm.	
77. Throttle lever (48)	Hold at idle position.	Pressure reading on fuel pressure gauge (2) should be 32 psi (220 kPa). If fuel pressure is incorrect, do step 78. If fuel pressure is correct, go to step 79.
78. Governor spring pack housing (43)	Using fuel pump idle adjusting tool (90), turn idle adjusting screw in housing (43) until proper fuel pressure is obtained.	Turn fuel pump idle adjusting tool (3375981) (90) clockwise to raise fuel pressure or counterclockwise to lower fuel pressure. If adjusting screw bottoms out, stop the test stand, remove the housing (43), and add washers to spring end of screw.
79. Fuel pump idle adjusting tool (90)	Depress stop button (24) and disengage from governor spring pack housing (43).	Reinstall plug (89) after adjusting tool (90) has been removed.

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)



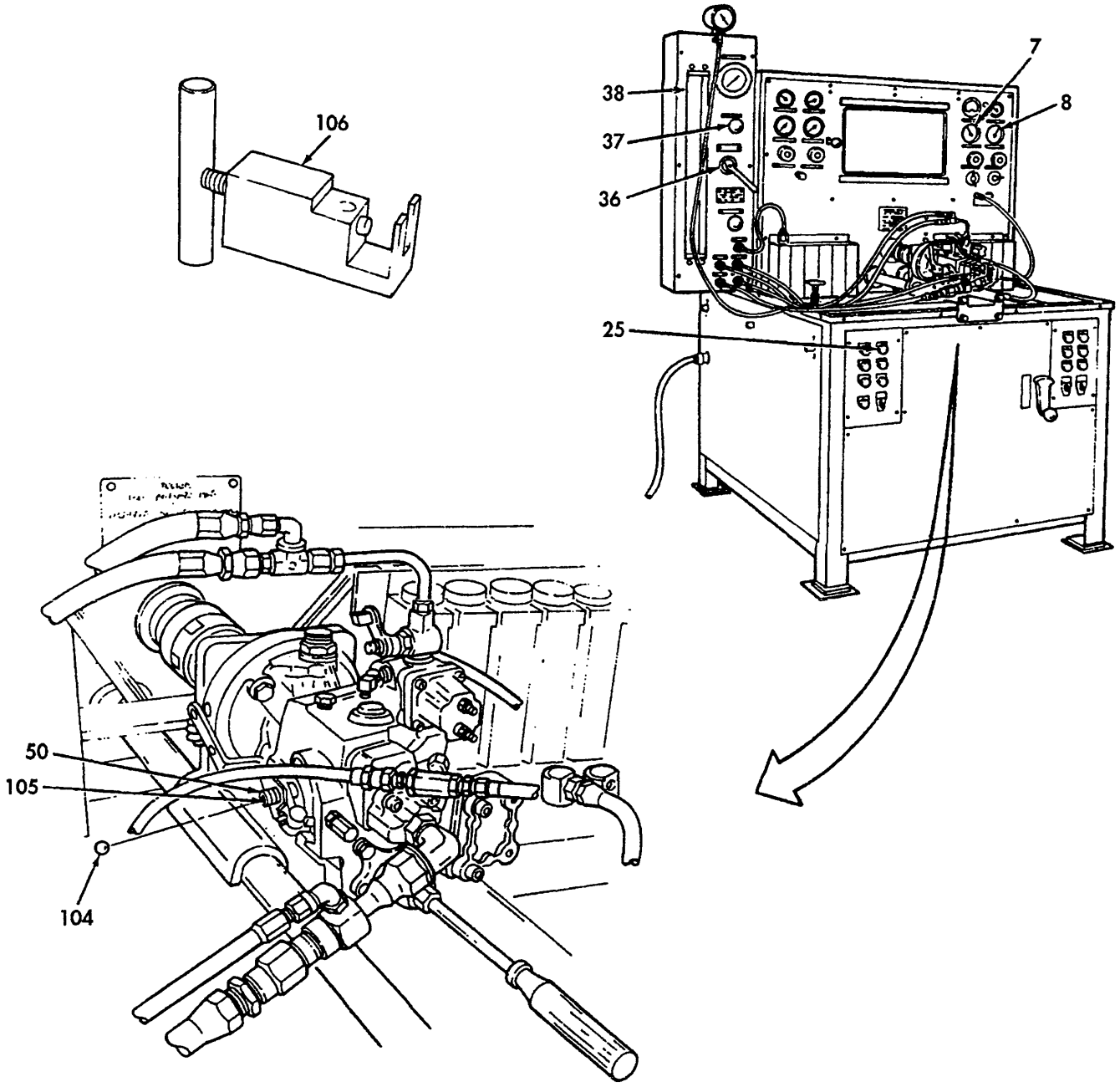
LEGEND:

2. FUEL PRESSURE GAUGE
24. STOP BUTTON
36. SELECTOR VALVE
43. GOVERNOR SPRING PACK HOUSING
48. THROTTLE LEVER
71. FUEL PUMP ASSEMBLY
89. PLUG
90. FUEL PUMP IDLE ADJUSTING TOOL

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
k. Fuel Pump Main Pressure Adjustment		
80. Selector valve (36)	Turn to ROTAMETER position.	
81. Fast button (25)	Depress until pump speed is at 2100 rpm as indicated on tachometer (7).	Pressure gauge (8) must be maintained at 50.00 in. Hg. (180,000 kPa).
82. Flow control valve (37)	Adjust until exactly 470 pph is indicated by the flowmeter glass tube (38).	Pressure indicated on the fuel pressure gauge (8) should be 157 psi (1082 kPa) at 470 pph. If pressure is not correct, perform steps 82 through 84. If pressure is correct, go to step 85.
83. Throttle shaft (50)	Remove throttle ball (104) if not already removed.	Center punch and drill out with 1/4-in. drill bit. Be careful when drilling so bore of throttle shaft (50) does not get damaged. Discard throttle ball (104).
84. Throttle shaft internal fuel adjusting screw (105)	Adjust until proper fuel pressure is obtained.	Turn adjusting screw (105) counterclockwise to increase pressure or clockwise to decrease pressure. If torque required to turn adjusting screw (105) is less than 100-112 lb-in. (11-12 N•m), a new screw should be installed.
85. Throttle shaft (50)	Install new throttle ball (104) with throttle ball installation tool (106).	Throttle ball installation tool (106) is part of AFC fuel pump adjusting tool kit (3375189). Recheck governor cutoff rpm, steps 50 through 56, after making main pressure adjustment.

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)



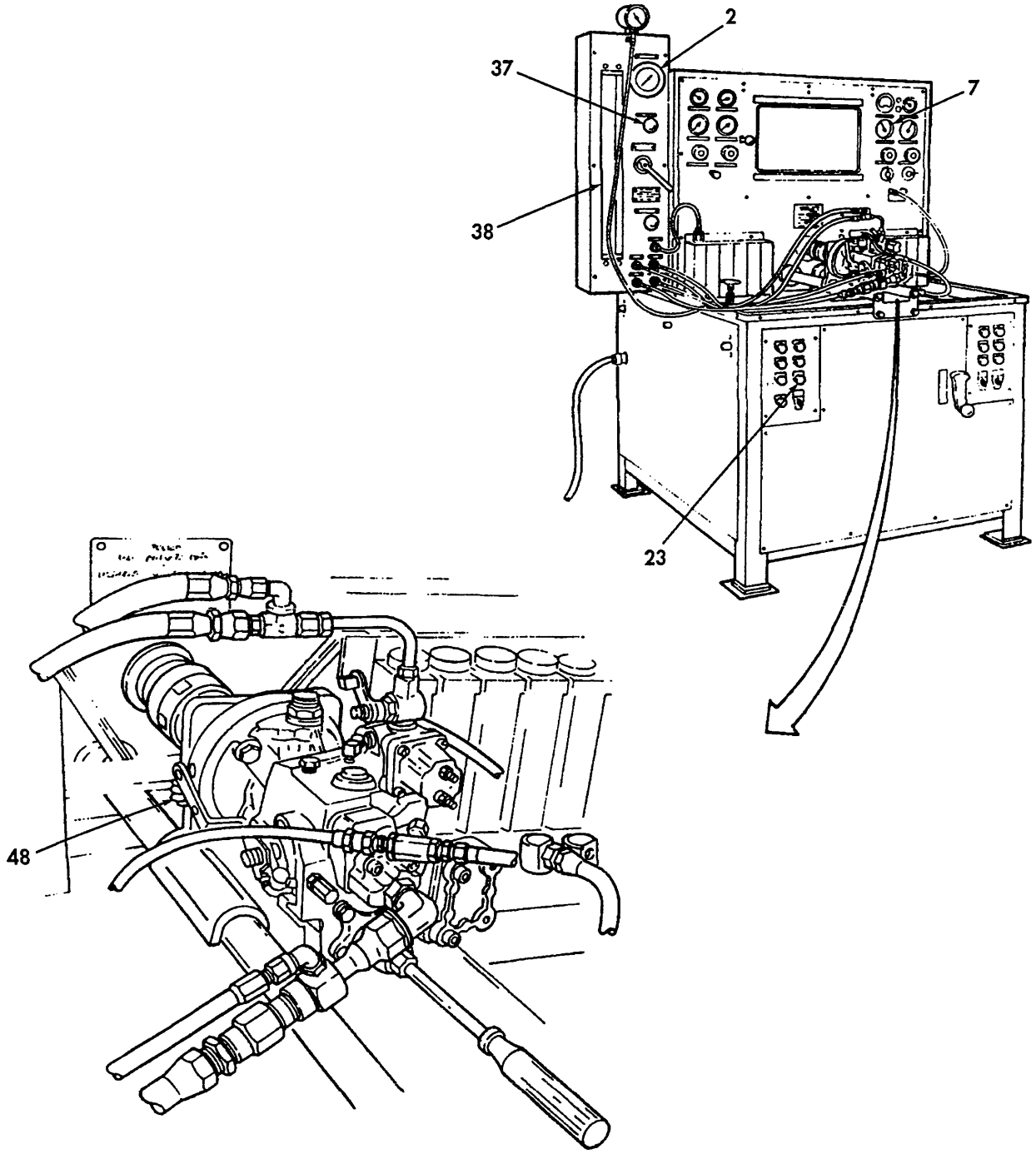
LEGEND:

7. TACHOMETER
8. PRESSURE GAUGE
25. FAST BUTTON
36. SELECTOR VALVE
37. FLOW CONTROL VALVE
38. FLOWMETER GLASS TUBE
50. THROTTLE SHAFT
104. THROTTLE BALL
105. THROTTLE SHAFT INTERNAL FUEL ADJUSTING SCREW
106. THROTTLE BALL INSTALLATION TOOL

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
l. Calibration Check Points		
	NOTE **There are two calibration check points. Steps 86 through 88 are for calibration check point No. 1 which checks torque spring accuracy. Steps 89 through 92 are for calibration check point No. 2 which checks weight-assist plunger.**	
86. Slow switch (23)	Depress until 1300 rpm is indicated on tachometer (7).	Throttle lever (48) should be held at full-throttle position.
87. Flow control valve (37)	Adjust until fuel flow through flowmeter glass tube (38) is exactly 380 pph as indicated by float in tube.	
88. Fuel pressure gauge (2)	Check fuel pressure reading. (See Table 3-8; check point 1 for both Big Cam I and Big Cam III fuel pumps, based on their CPLs.) Before performing steps 89 and 91, use values shown.	Proper reading should be between 109 and 115 psi (751 and 793 kPa) at 380 pph fuel flow. If reading is correct, go to step 91. If pressure reading is above or below desired range, do steps 91 through 94 and repeat steps 86 through 89. If pressure reading is still above or below desired range, do step 90.

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)



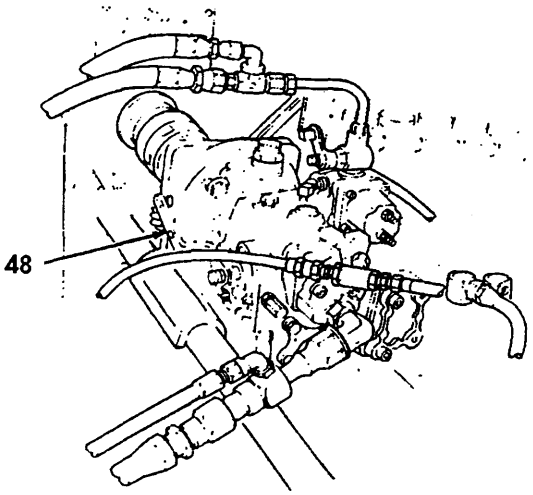
LEGEND:

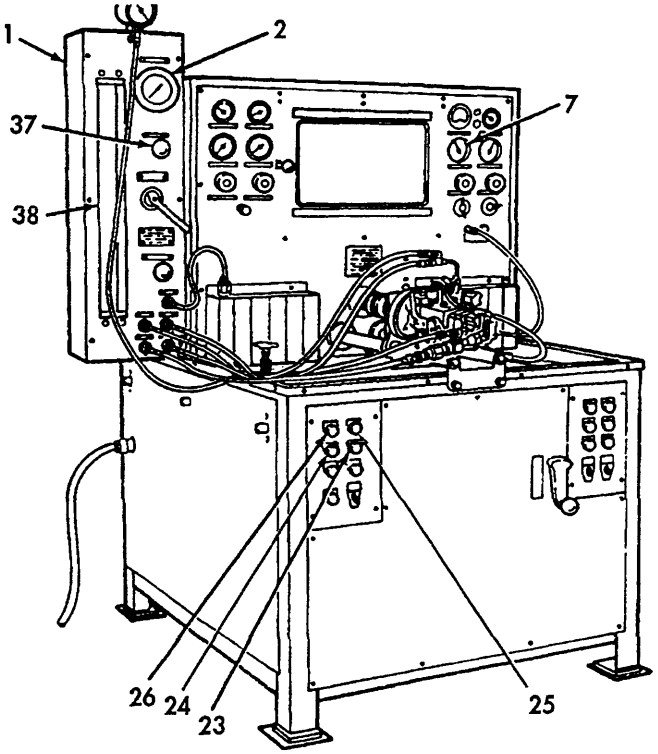
2. FUEL PRESSURE GAUGE
7. TACHOMETER
23. SLOW SWITCH
37. FLOW CONTROL VALVE
38. FLOWMETER GLASS TUBE
48. THROTTLE LEVER

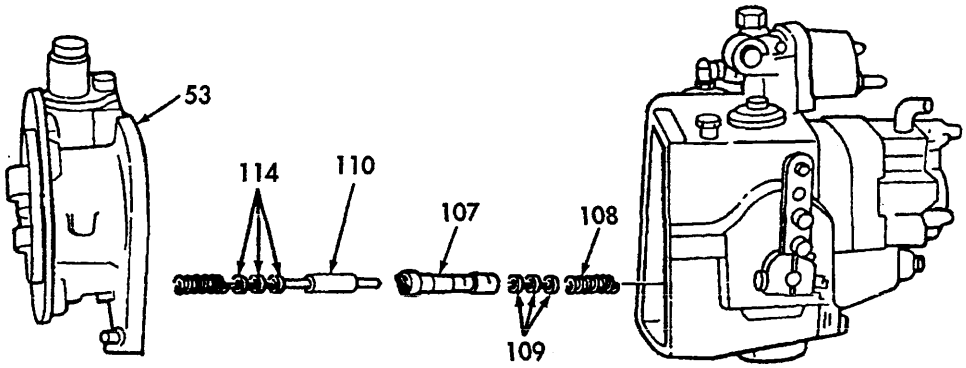
3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
I. Calibration Check Points (Contd)		
89. Front cover (53) and governor plunger (107)	a. Stop test stand (1) and remove cover (53) and plunger (107).	Refer to para. 3-61 for removal.
	b. Check torque spring (108) and shims (109).	Incorrect spring may have been used or spring may be improperly seated or shimmed. Install correct spring and shims as needed. Torque spring shims are available in 0.005, 0.010, and 0.020 in. (0.127, 0.254 and 0.508 mm) thickness. If new torque spring or shims are installed, recalibrate pump.
	c. Install cover (53) and plunger (107) and start test stand (1).	Refer to para. 3-61 for installation.
90. Slow switch (23) and fast button (25)	Depress and release until pump speed is at 1000 rpm as indicated on tachometer (7).	Throttle lever (48) should still be in full-throttle position.
91. Flow control valve (37)	Adjust until fuel flow through flowmeter glass tube (38) is exactly 300 pph as indicated by float in tube.	
92. Fuel pressure gauge (2)	Check fuel pressure reading. (See Table 3-8 for Big Cam I fuel pump values only).	Proper reading should be between 73 and 81 psi (503 and 558 kPa) at 300 pph fuel flow. If pressure reading is incorrect, do step 93. If pressure reading is correct, go to step 94.
93. Front cover (53) and weight-assist plunger (110)	a. Stop test stand (1) by depressing stop button (24) and remove front cover (53) and weight-assist plunger (110).	Refer to para. 3-61 for removal.
	b. Add or remove shim (114) until correct fuel pressure reading is obtained.	Add shims to increase pressure and remove shims to decrease pressure. Shims are available in 0.007 and 0.015 in. (0.177 and 0.381 mm) thickness.
	c. Install front cover (53) and weight-assist plunger (110). Start test stand (1) by depressing start button (26) and repeat calibration beginning with step 54.	Refer to para. 3-61 for installation.

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)







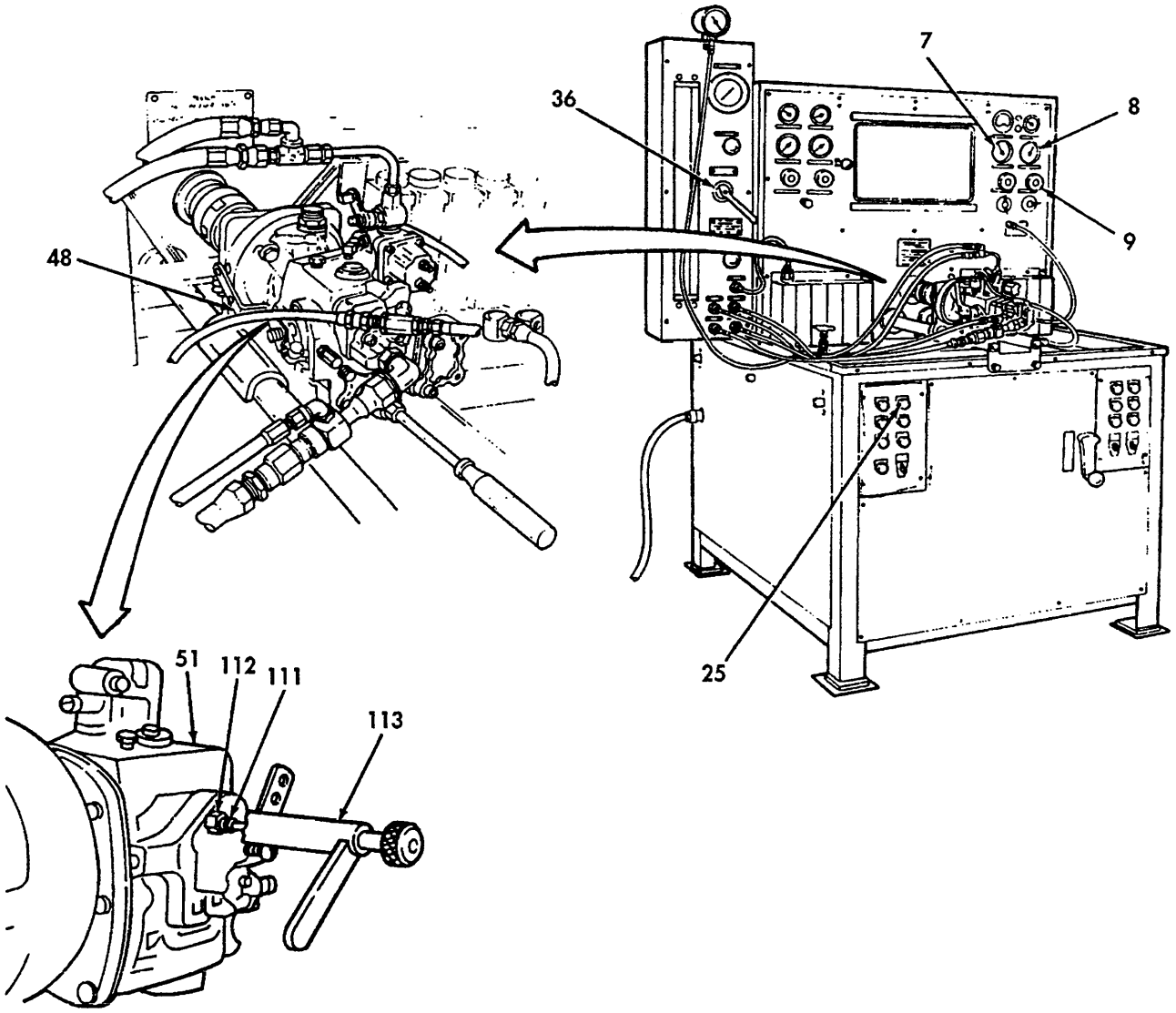
LEGEND:

1. TEST STAND
2. FUEL PRESSURE GAUGE
7. TACHOMETER
23. SLOW SWITCH
24. STOP BUTTON
25. FAST BUTTON
26. START BUTTON
37. FLOW CONTROL VALVE
38. FLOWMETER GLASS TUBE
48. THROTTLE LEVER
53. FRONT COVER
107. GOVERNOR PLUNGER
108. TORQUE SPRING
109. SHIM (3)
110. WEIGHT-ASSIST PLUNGER
114. SHIM (3)

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
m. AFC Plunger Setting Procedures		
94. Selector valve (36)	Ensure it is set at ROTAMETER position.	Throttle lever (48) should remain at full position.
95. No-air adjusting screw (111) and locknut (112)	Using no-air adjusting tool (113), loosen locknut (112) and turn no-air adjusting screw (111) until it bottoms on fuel pump main housing (51).	No-air adjusting tool (113) is part of AFC fuel pump adjusting tool kit (3375189). All adjustments to the AFC plunger setting must be made when the no-air adjusting screw (111) is bottomed on the main housing (51). Also ensure that the AFC plunger threads are sealed with liquid thread sealant.
96. Fast button (25)	Depress until pump speed is 1600 rpm as indicated on tachometer (7).	
97. Pressure regulator (9)	Adjust to reduce air pressure reading on pressure gauge (8) to 10.00 in. Hg. (36,000 kPa).	

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)



LEGEND:

7. TACHOMETER
8. PRESSURE GAUGE
9. PRESSURE REGULATOR
25. FAST BUTTON
36. SELECTOR VALVE
48. THROTTLE LEVER
51. FUEL PUMP MAIN HOUSING
111. NO-AIR ADJUSTING SCREW
112. LOCKNUT
113. NO-AIR ADJUSTING TOOL

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS

m. AFC Plunger Setting Procedures (Contd)

98. Flowmeter glass tube (38) — Allow fuel to escape until float in tube stabilizes at or near zero.

NOTE

Air pressure during AFC plunger setting procedures must always be reached while increasing air pressure on the AFC bellows. If specified pressure reading is overshot, reduce the pressure to 0 in. Hg. (0 kPa) on fuel pressure gauge (2), and wait until the fuel flow stabilizes at or near zero in flowmeter glass tube before increasing or decreasing the setting.

99. Pressure regulator (9) — Adjust to increase air pressure reading on pressure gauge (8) to exactly 10.00 in. Hg. (36,000 kPa).

100. Flow control valve (37) — Adjust until fuel flow through flowmeter glass tube (38) is exactly 385 pph as indicated by float in tube.

CAUTION

- **The AFC adjusting tool must be used with care. The large movable center hex socket engages the nut that retains the AFC bellows to the plunger. Use a hex-head socket wrench to move the plunger in and out to attain the proper adjustment.**
- **If large hex socket is not properly engaged, the AFC bellows can be torn or ripped. The proper sequence is to first engage the large hex socket, then the smaller hex socket, and finally the hex-head socket wrench.**

NOTE

If adjustment is required, reduce air pressure to 9 psi (62 kPa).

101. AFC adjusting tool (91)

a. Using adjusting tool, adjust fuel pressure reading on fuel pressure gauge (2) to a reading of 83-87 psi (572-599 kPa).

AFC adjusting tool (91) is part of AFC fuel pump adjusting tool kit (3375189). During this adjustment, it may be necessary to adjust the flow control valve (37) to maintain the fuel flow rate of 385 pph. Use extreme care; fuel flow rate must be maintained during tightening to an approximate value of 25-35 lb-in. (2.8-3.9 N•m).

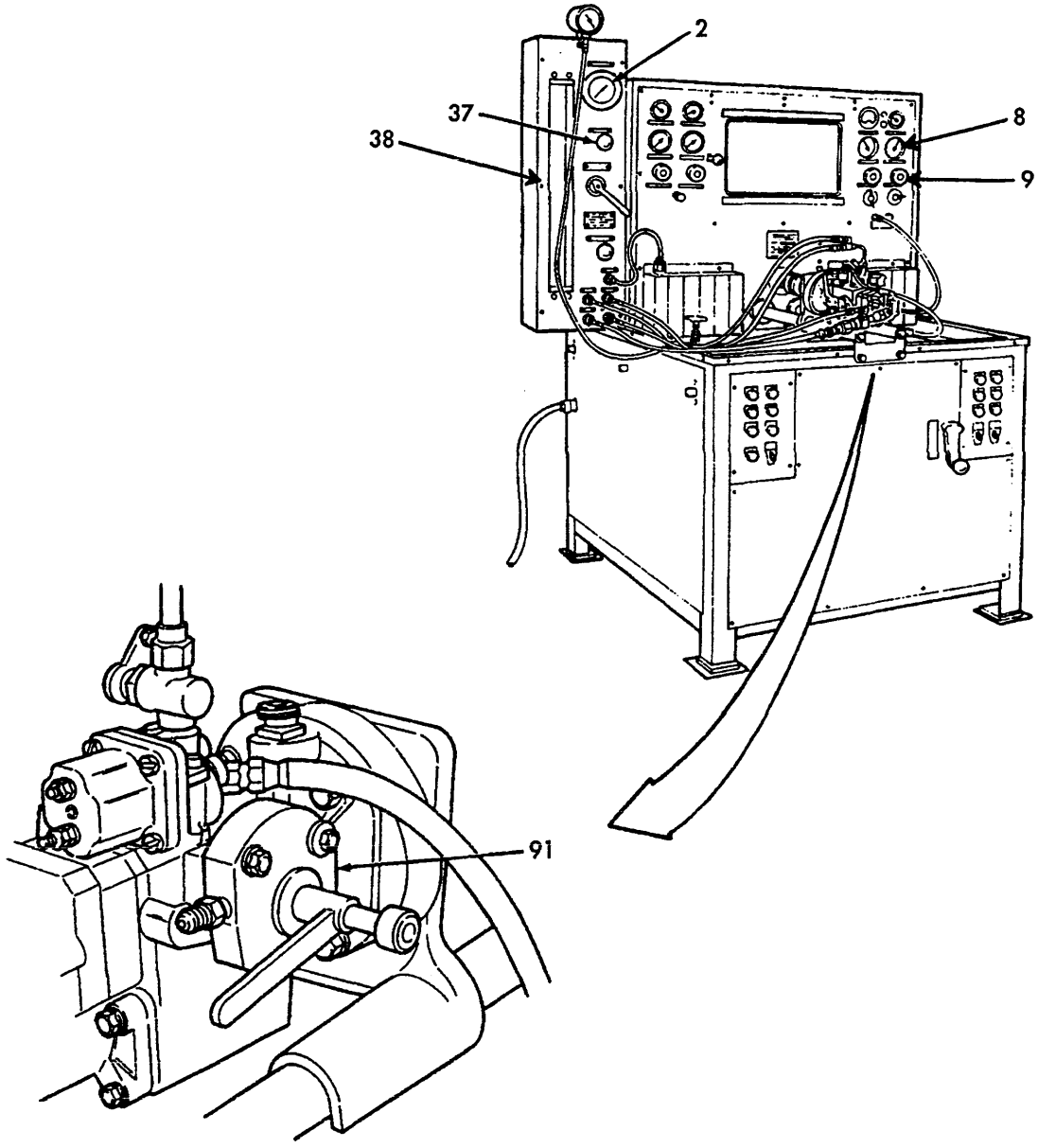
CAUTION

The AFC plunger can be very easily broken when tightening the jamnut. Use extreme care when tightening three jamnuts to the required 25-35 lb-in. (2.8-3.9 N•m) torque. The large and small hex sockets must be fully retracted after loosening the plunger jamnut to avoid interfering with the AFC piston travel. If the AFC piston position is disturbed while adjusting the plunger, repeat the entire adjustment sequence (steps 94 through 101).

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

m. AFC Plunger Setting Procedures (Contd)

101. AFC adjusting tool (91) (Contd)	b. When AFC control plunger adjustment is correct, use adjusting tool (91) to tighten jamnut to 25-35 lb-in. (2.8-3.9 N•m).	
	c. Carefully recheck fuel pressure on the fuel pressure gauge (2) and fuel flow on flowmeter glass tube (38) to ensure they have remained within specified limits.	Fuel pressure gauge (2) should read 83-87 psi (572-599 kPa) and flowmeter glass tube (38) should read 385 pph.



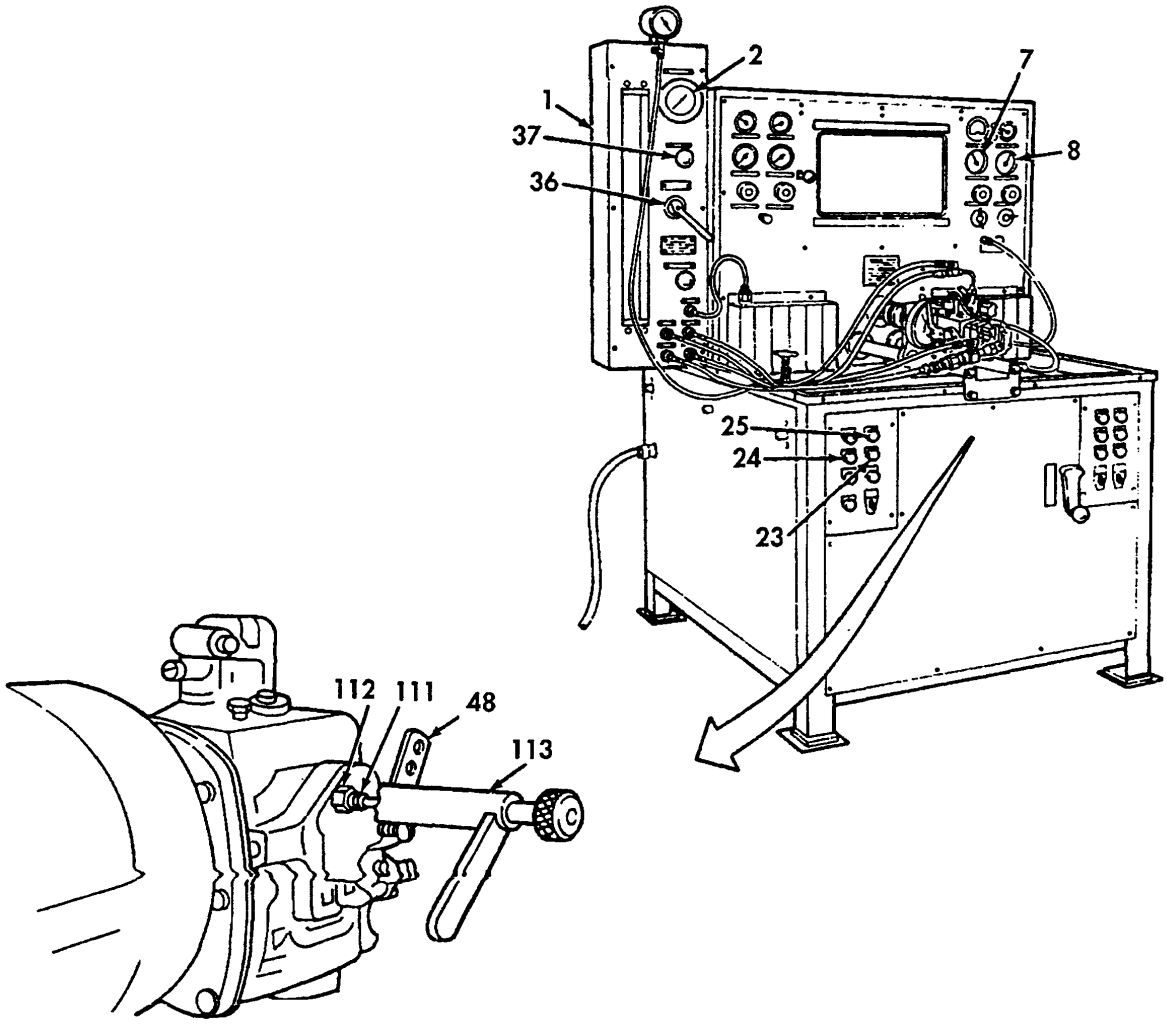
LEGEND:

2. FUEL PRESSURE GAUGE
8. PRESSURE GAUGE
9. PRESSURE REGULATOR
37. FLOW CONTROL VALVE
38. FLOWMETER GLASS TUBE
91. AFC ADJUSTING TOOL

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
n. No-Air Screw		
102. Slow switch (23) and fast button (25)	Depress and release until pump speed is 1600 rpm as indicated on tachometer (7).	Throttle lever (48) should be held at full-throttle position. Air pressure reading on pressure gauge (8) should be 0.00 in. Hg. (0 kPa).
103. Selector valve (36)	Ensure it is set to ROTAMETER position.	
104. No-air adjusting screw (111) and locknut (112)	a. Loosen locknut (112).	
	b. Using no-air adjustment tool (113), adjust no-air adjusting screw (111) until 39 psi (268 kPa) fuel pressure is indicated on fuel pressure gauge (2). c. When proper adjustment has been reached, tighten locknut (112).	Fuel flow of 220 pph must be maintained during this adjustment. Reset flow control valve (37) as necessary to maintain 220 pph.
105. Slow switch (23) and stop button (24)	When all calibration checks have been completed, slow down test stand (1) to minimum speed, then stop test stand.	

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)



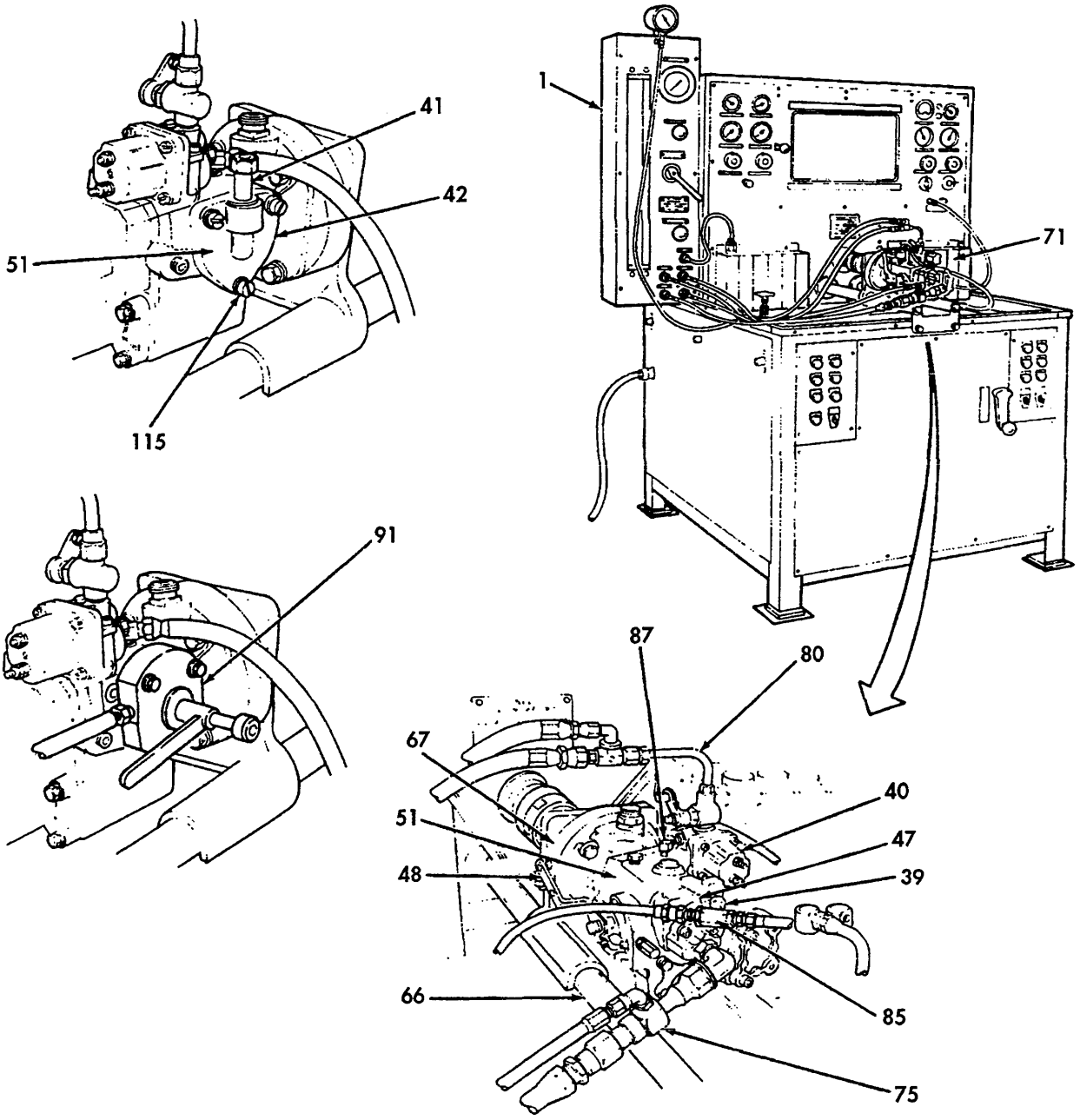
LEGEND:

1. TEST STAND
2. FUEL PRESSURE GAUGE
7. TACHOMETER
8. PRESSURE GAUGE
23. SLOW SWITCH
24. STOP BUTTON
25. FAST BUTTON
36. SELECTOR VALVE
37. FLOW CONTROL VALVE
48. THROTTLE LEVER
111. NO-AIR ADJUSTING SCREW
112. LOCKNUT
113. NO-AIR ADJUSTMENT TOOL

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
o. Removing Fuel Pump From Test Stand		
106. AFC adjusting tool (91)	Remove from fuel pump main housing (51).	
107. AFC cover plate (42) and restrictor (41)	a. Install on fuel pump main housing (51). b. Secure with three screws (115).	Bottom screw (115) should have a hole drilled in it. Tighten screws (115) to 30-45 lb-in. (3.3-5.0 N•m).
108. All hoses	Remove from fuel pump assembly (71) and test stand (1).	
109. Check valve (39)	Remove from fuel pump main housing (51).	
110. Tee fitting (85)	Remove from bleed drain fitting (87).	
111. Pump discharge fitting assembly (80)	Remove from shutdown solenoid valve (40).	
112. Inlet adapter assembly (75)	Remove from gear pump (47).	
113. Throttle lever (48) and adapter ring (67)	Remove spring.	
114. Fuel pump assembly (71), adapter ring (67), and adapter bracket (66)	a. Remove from test stand (1). b. Separate.	

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)



LEGEND:

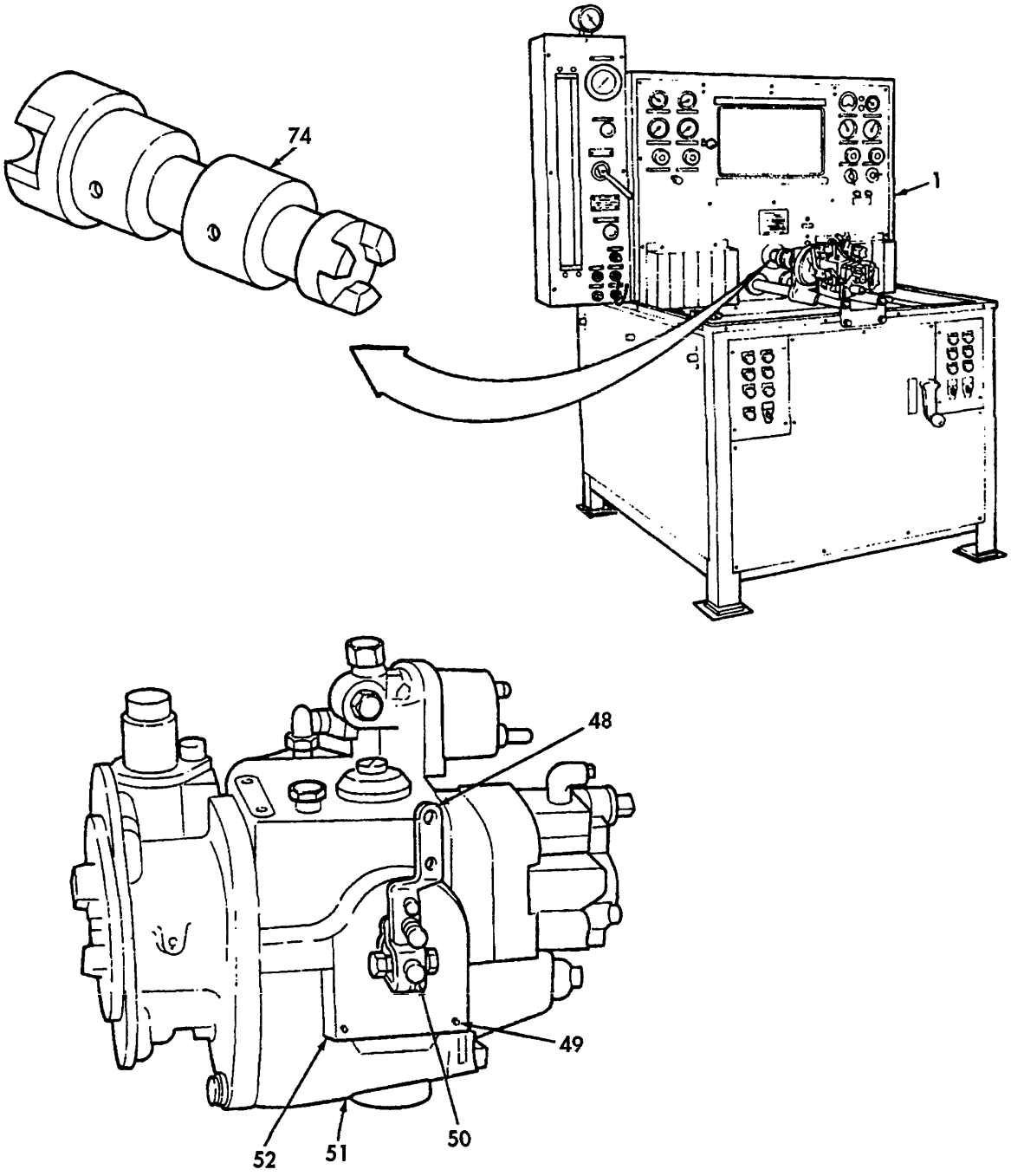
1. TEST STAND
39. CHECK VALVE
40. SHUTDOWN SOLENOID VALVE
41. RESTRICTOR
42. AFC COVER PLATE
47. GEAR PUMP
48. THROTTLE LEVER
51. FUEL PUMP MAIN HOUSING
66. ADAPTER BRACKET
67. ADAPTER RING
71. FUEL PUMP ASSEMBLY
75. INLET ADAPTER ASSEMBLY
80. PUMP DISCHARGE FITTING ASSEMBLY
85. TEE FITTING
87. BLEED DRAIN FITTING
91. AFC ADJUSTING TOOL
115. SCREW

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
o. Removing Fuel Pump from Test Stand (Contd)		
115. Test stand coupling insert (74)	Remove from test stand (1).	
116. Throttle shaft cover (52) and two screws (49)	Do not install on fuel pump main housing (51) at this time.	Throttle shaft cover (52) must be removed to perform on-engine fuel pump adjustment. A cover will be installed after on-engine fuel adjustment has been made.
117. Throttle lever (48)	a. Remove from throttle shaft (50). b. Installed on throttle shaft (50) in on-engine operating position.	

FOLLOW-ON TASKS:
- Install fuel pump (para. 3-78).
- Perform on-engine fuel pump adjustment (para. 3-93).

3-63. FUEL PUMP TESTING AND CALIBRATION (Contd)



LEGEND:

1. TEST STAND
48. THROTTLE LEVER
49. SCREW (2)
50. THROTTLE SHAFT
51. FUEL PUMP MAIN HOUSING
52. THROTTLE SHAFT COVER
74. TEST STAND COUPLING INSERT

3-64. WATER PUMP REPAIR

THIS TASK COVERS:

a. Disassembly
b. Cleaning
c. Inspection
d. Assembly

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Bearing disassembly fixture (15434) ST-1114
Seal wear sleeve mandrel (15434) ST-1159
Water pump bearing mandrel (15434) ST-658
Oil seal driver (15434) ST-1191
Puller (15434) 3375265
Oil seal pilot (15434) 3375180
Water pump seal mandrel (15434) 3375448

TEST EQUIPMENT
None

MATERIALS/PARTS
Loctite (Appendix C, Item 14)
Oil, lubricating, OE/HDO 10 (Appendix C, Item 20)
Solvent, SD-3 (Appendix C, Item 30)
Sealant, thread (liquid) (Appendix C, Item 27)
Gasket (15434) 3038997
Seat and seal assembly (15434) 3028294
Six lockwashers (15434) S604
Preformed packing (15434) 145506
Gasket and seal kit (15434) 3801350 (M915/Big Cam I)
Gasket and seal kit (15434) 3801235 (M915A1/Big Cam III)

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
TM 9-2320-273-20
TM 9-2320-283-20

TROUBLESHOOTING REFERENCES
Para. 2-8

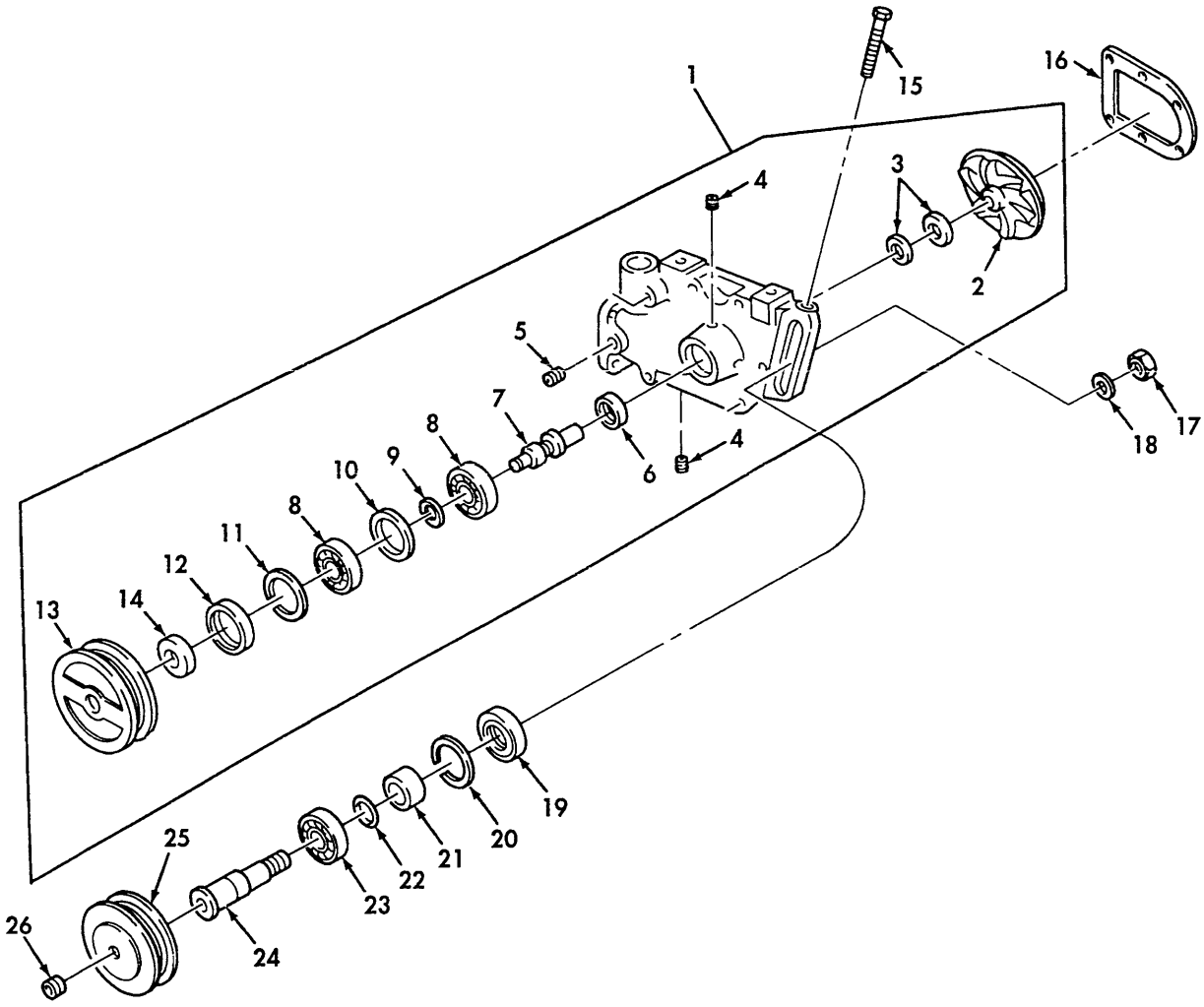
EQUIPMENT CONDITION
Water pump removed (TM 9-2320-273-20 or TM 9-2320-283-20).

SPECIAL ENVIRONMENTAL CONDITIONS
None

GENERAL SAFETY INSTRUCTIONS
- Always wear eye protection when using compressed air.
- Use approved solvent in well-ventilated area and away from open flame.

LOCATION/ITEM	ACTION	REMARKS
a. Disassembly		
1. Screw (15), shaft (24), nut (17), and washer (18)	Remove.	
2. Pulley (13) and impeller (2)	Remove from shaft (7).	Use puller (3375265).
3. Seal (12)	Remove from water pump assembly (1).	Discard seal (12). Use a prybar for easy removal.
4. Retaining ring (11)	Remove from water pump assembly (1).	
5. Shaft (7) and two bearings (8)	Remove from water pump assembly (1).	To remove, push on shaft (7) from impeller (2) side of pump assembly (1).
6. Seat and seal assembly (3) and gasket (6)	Remove.	Use a drift punch to push parts out. Discard seat and seal assembly (3) and gasket (6).

3-64. WATER PUMP REPAIR (Contd)



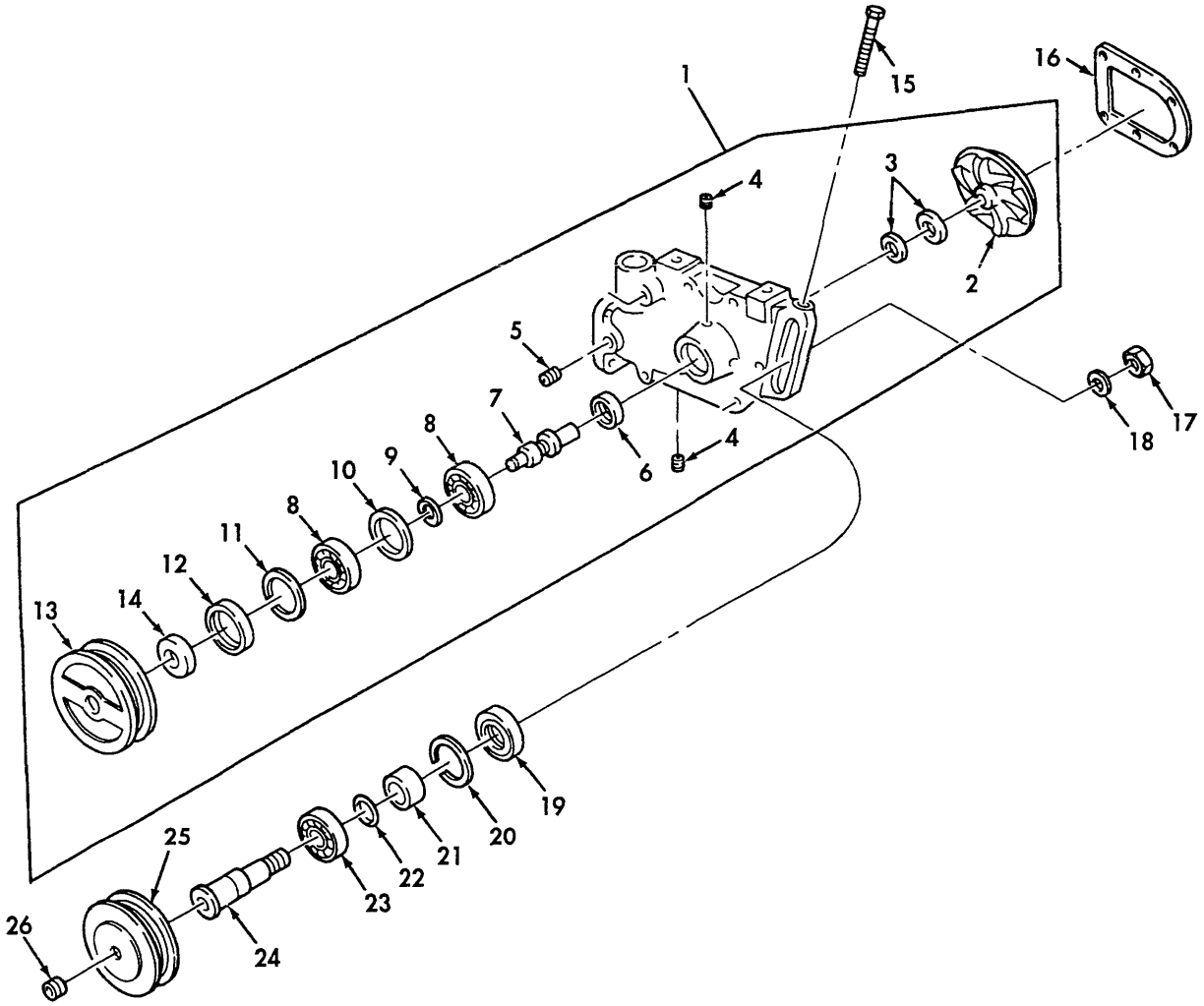
LEGEND:

1. WATER PUMP ASSEMBLY
2. IMPELLER
3. SEAT AND SEAL ASSEMBLY
4. PIPE PLUG (2)
5. PIPE PLUG
6. GASKET
7. SHAFT
8. BEARING (2)
9. RETAINING RING
10. SPACER
11. RETAINING RING
12. SEAL
13. PULLEY
14. BEARING
15. SCREW
16. GASKET
17. NUT
18. WASHER
19. SEAL
20. RETAINING RING
21. SPACER
22. PREFORMED PACKING
23. BEARING
24. SHAFT
25. PULLEY
26. PIPE PLUG

3-64. WATER PUMP REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
a. Disassembly (Contd)		
7. Bearing (8) and spacer (10)	Remove from shaft (7).	The outer bearing (8) is removed first. Use bearing disassembly fixture (ST-1114) for removal of bearing (8).
8. Retaining ring (9)	Remove from shaft (7).	
9. Bearing (8)	Remove from shaft (7).	The inner bearing (8) nearest the impeller (2) is removed next. Use bearing disassembly fixture (ST-1114) for removal of bearing (8).
10. Spacer (21)	Remove from shaft (24) by lightly tapping shaft (24) with plastic hammer.	Hold spacer (21) in the jaws of a vise with copper protector plates to prevent damage.
11. Seal (19)	Remove from pulley (25).	Use round end of prybar. Discard seal (19).

3-64. WATER PUMP REPAIR (Contd)



LEGEND:

1. WATER PUMP ASSEMBLY
2. IMPELLER
7. SHAFT
8. BEARING (2)
9. RETAINING RING
10. SPACER
19. SEAL
21. SPACER
24. SHAFT
25. PULLEY

3-64. WATER PUMP REPAIR (Contd)

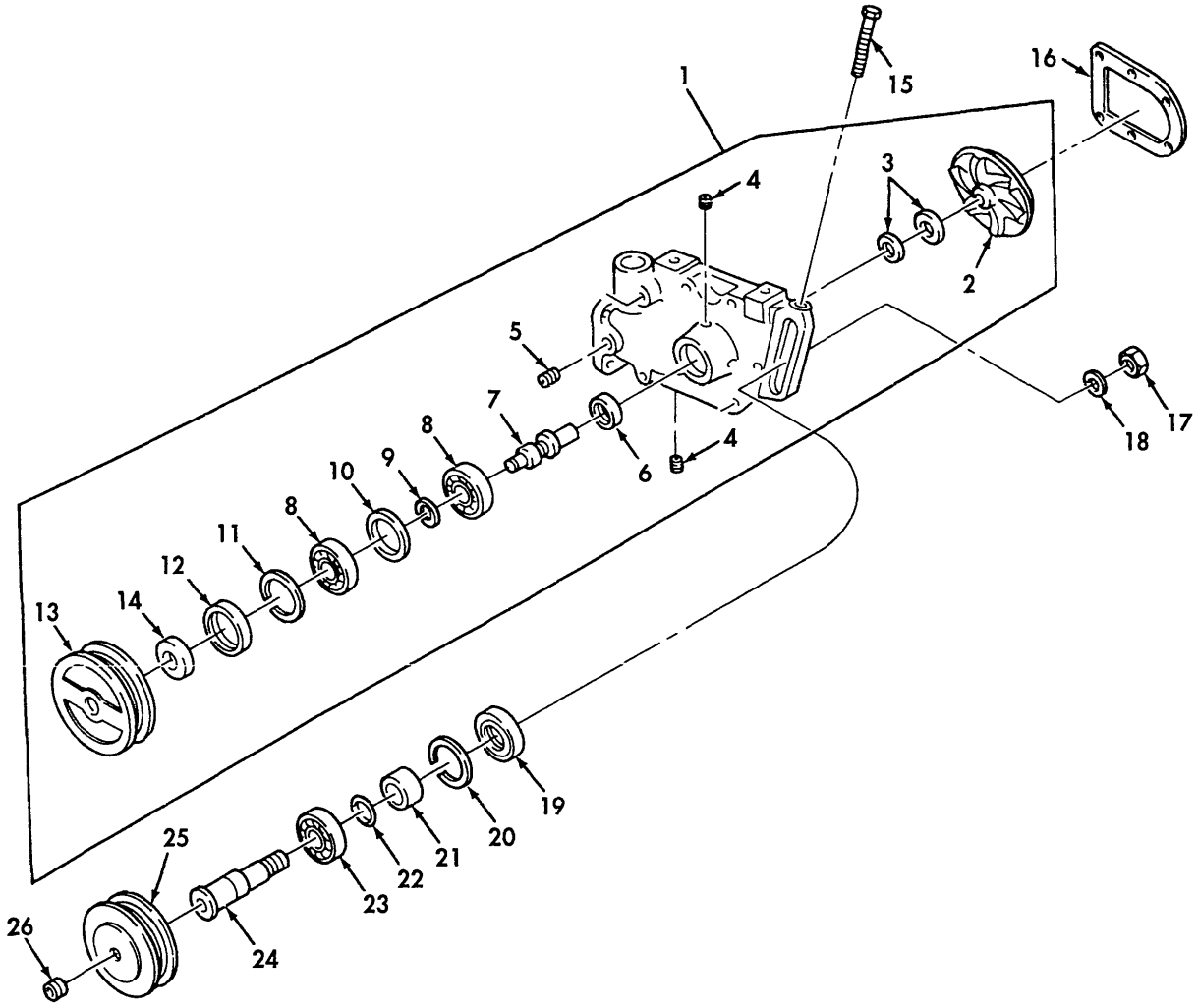
LOCATION/ITEM	ACTION	REMARKS
a. Disassembly (Contd)		
12. Retaining ring (20)	Remove from shaft (24).	
13. Preformed packing (22)	Remove and discard.	
14. Bearing (23) and pipe plug (26)	Remove from pulley (25).	Hold pulley (25) in vise and lightly hit bearing (23) with flat punch through hole for pipe plug (26).
15. Bearing (23) and shaft (24)	Separate.	Use a press and mandrel (ST-658).
16. Two pipe plugs (4) and pipe plug (5)	Remove.	
b. Cleaning		

WARNING

- **Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and protective equipment such as goggles or shield, gloves, etc. Failure to comply may result in injury to personnel.**
- **Approved solvents may be flammable and will not be used near open flame. Use only in well-ventilated area. Failure to comply may result in injury to personnel.**

17. Gasket (16)	Scrape from mounting surface of water pump housing.	
18. All other parts	Clean and dry with compressed air.	Use SD-3 solvent.

3-64. WATER PUMP REPAIR (Contd)



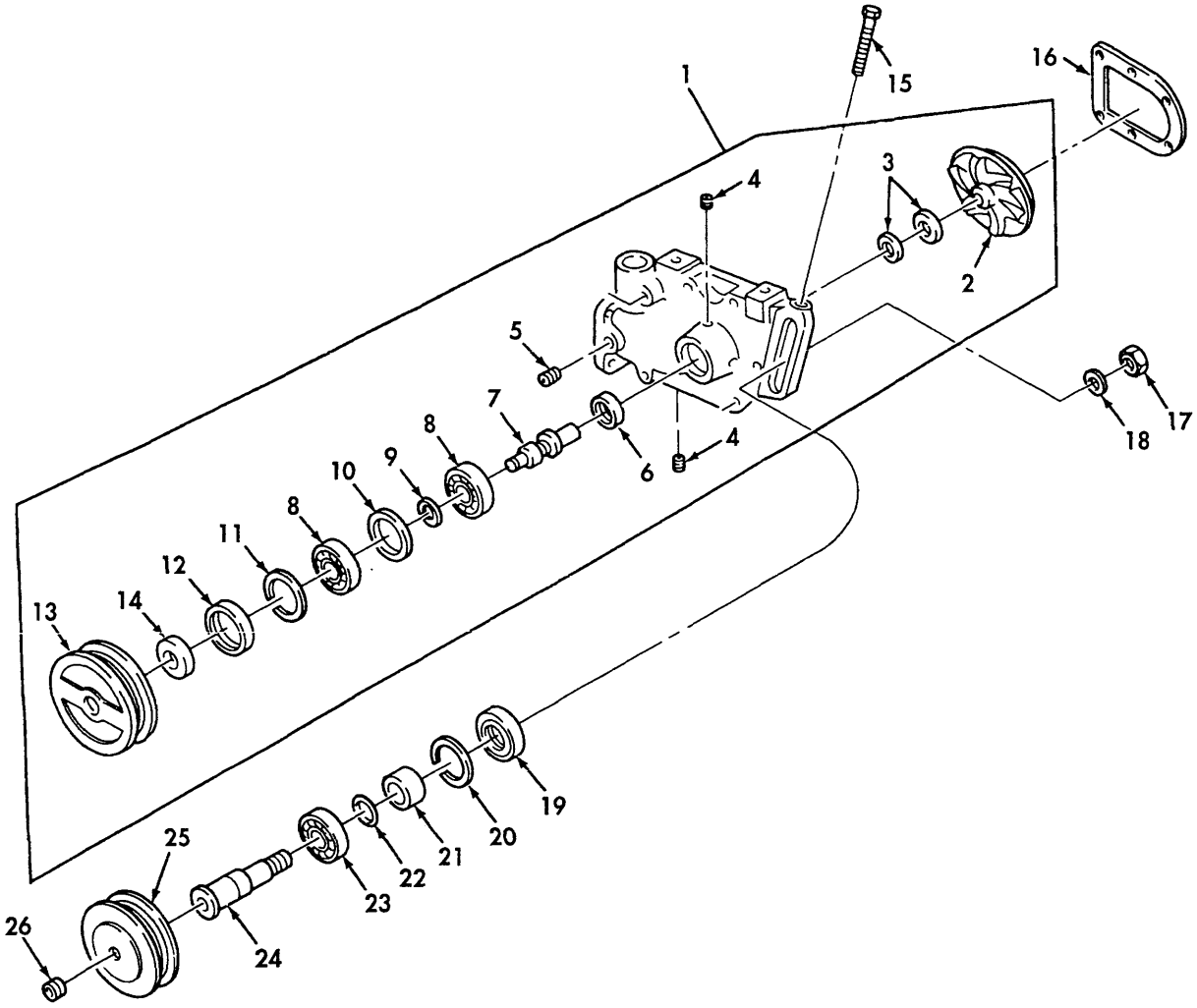
LEGEND:

4. PIPE PLUG (2)
5. PIPE PLUG
16. GASKET
20. RETAINING RING
22. PREFORMED PACKING
23. BEARING
24. SHAFT
25. PULLEY
26. PIPE PLUG

3-64. WATER PUMP REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection		
19. Two bearings (8) and bearing (23)	Inspect for wear and damage.	Replace if worn or damaged.
20. Shaft (7) and shaft (24)	Inspect for: a. Wear on outside diameter of bearing surfaces. b. Straightness and damage. c. Measure impeller (2) end of shaft (7).	 Replace if worn or damaged. Replace if bent or damaged. Outside diameter of impeller (2) end of shaft (7) should be 0.001 in. (0.025 mm) bigger than bore of impeller (2). Replace shaft (7) if less than 0.001 in. (0.025 mm).
21. Impeller (2)	a. Inspect for cracks, corrosion, or wear. b. Measure the bore.	Replace if cracked, corroded, or worn. Refer to step 20c.

3-64. WATER PUMP REPAIR (Contd)



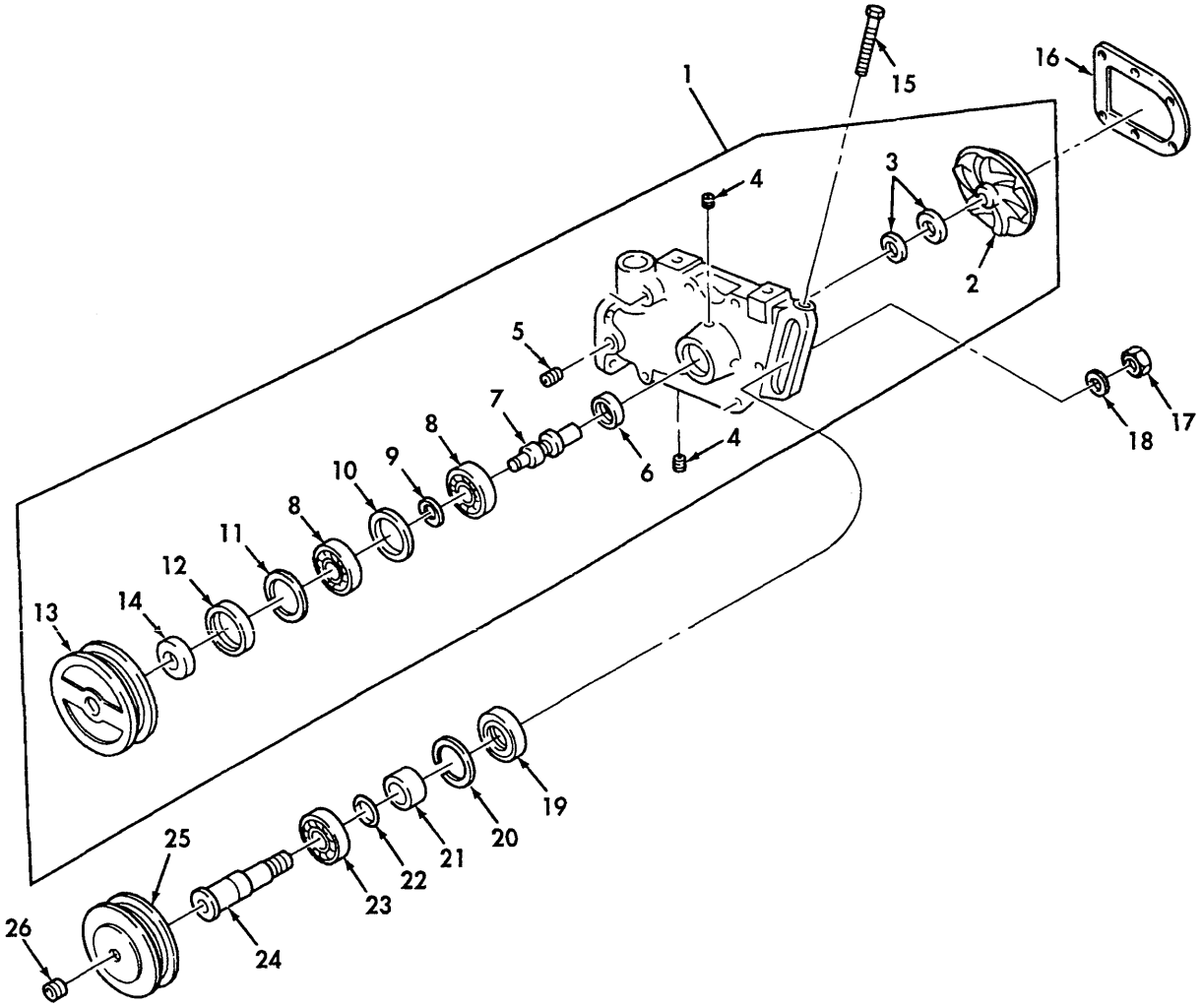
LEGEND:

2. IMPELLER
7. SHAFT
8. BEARING (2)
23. BEARING
24. SHAFT

3-64. WATER PUMP REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Inspection (Contd)		
22. Water pump assembly (1)	Inspect for the following:	
	a. Cracks in housing.	Replace if cracked.
	b. Bearing bore diameter.	Discard the housing if bearing bore is larger than 2.4494 in. (62.2148 mm).
	c. Weep hole is open.	Hole directly below bearing bore.
23. Bearing (14)	Inspect for wear or damage.	Replace if damaged or worn. Replacement is covered in step 41.
24. Pulley (13) and pulley (25)	Inspect the following:	
	a. Pulley grooves for wear or damage.	Replace if worn or damaged.
	b. Bore diameters.	There must be at least 0.001 in. (0.025 mm) press fit between pulley bores and outside diameter of shaft (7) and shaft (24).

3-64. WATER PUMP REPAIR (Contd)



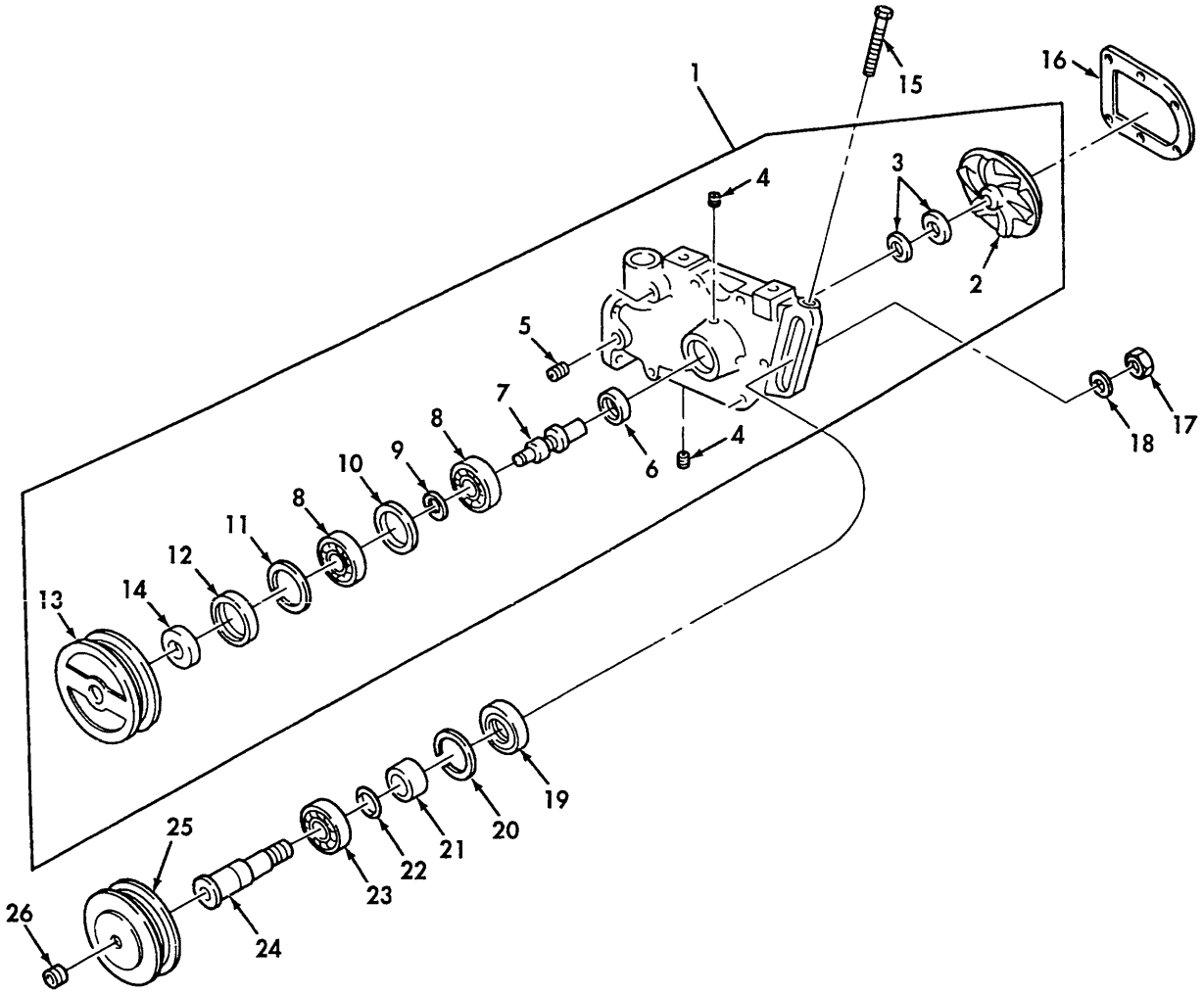
LEGEND:

1. WATER PUMP ASSEMBLY
7. SHAFT
13. PULLEY
14. BEARING
24. SHAFT
25. PULLEY

3-64. WATER PUMP REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Assembly		
25. Shaft (24)	a. Install bearing (23) on shaft (24).	Apply a thin coat of OE/HDO 10 lubricating oil to shaft (24) for easier installation. Use water pump bearing mandrel (ST-658).
	CAUTION **Ensure Loctite does not migrate to inside diameter of bearing. Bearing failure could result.**	
	b. Install on pulley (25).	Use suitable press and water pump bearing mandrel (ST-658). Apply a light coat of Loctite to outside diameter of bearing (23) before installation. Press until it bottoms.
26. Retaining ring (20)	Install on shaft (24).	Install flat side of retaining ring (20) toward bearing (23).
	CAUTION **Prior to installing the pipe plug, install a grease fitting and lubricate until you can see the grease through the bearing. Remove the grease fitting and install the pipe plug.**	

3-64. WATER PUMP REPAIR (Contd)



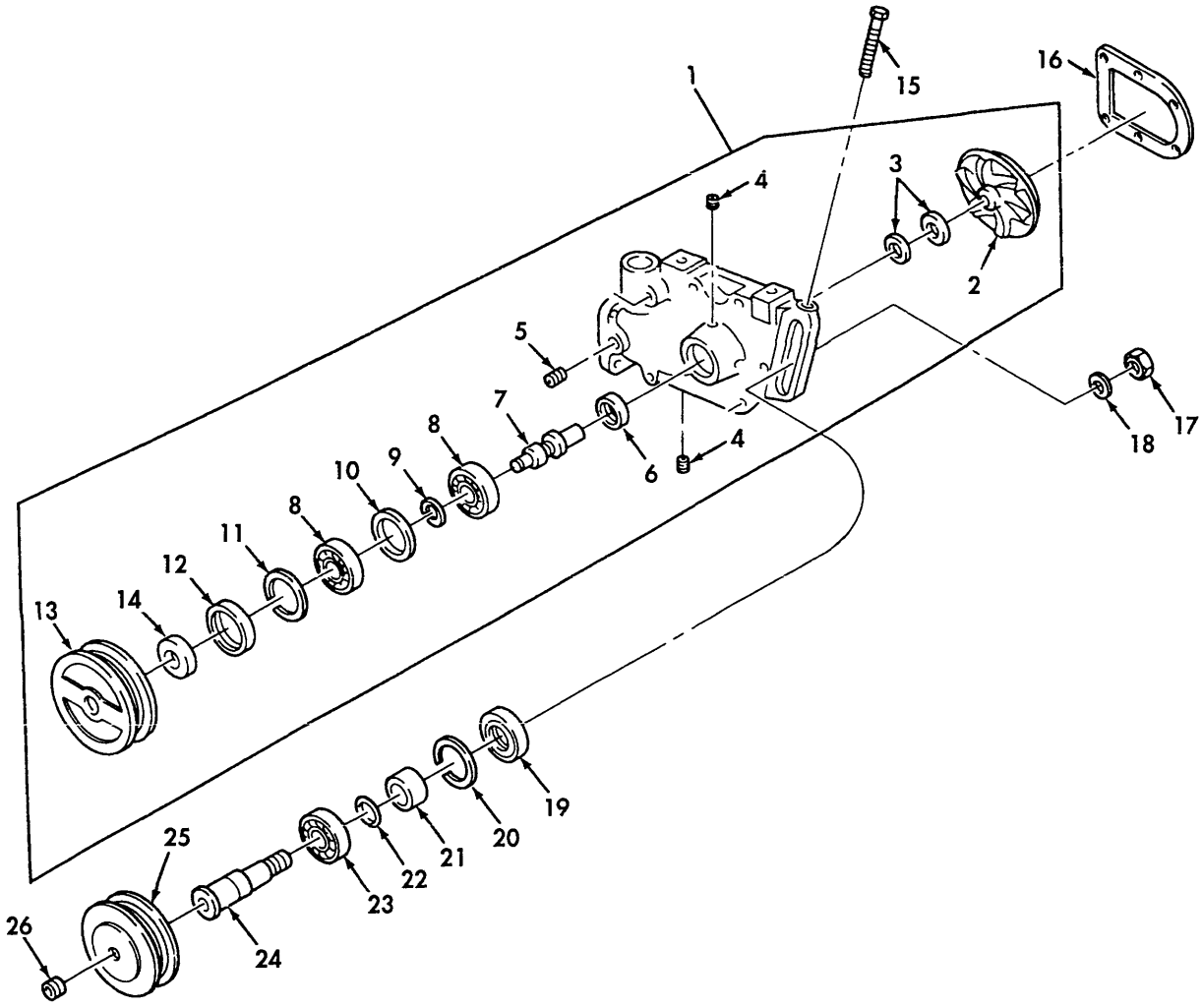
LEGEND:

20. RETAINING RING
23. BEARING
24. SHAFT
25. PULLEY

3-64. WATER PUMP REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Assembly (Contd)		
27. Pipe plug (26)	Install on pulley (25).	Coat pipe plug (26) with liquid thread sealant prior to installation.
28. New seal (19)	Install on pulley (25).	Install lip of new seal (19) toward pulley (25). Use oil seal driver (ST-1191) and oil seal pilot (3375180).
29. New preformed packing (22)	Install on shaft (24).	Lubricate new preformed packing (22) with OE/HDO 10 lubricating oil prior to installing.
30. Spacer (21)	Install on shaft (24).	Push until spacer (21) is against bearing (23). Pulley (25), with assembled parts, should be set aside for later use.
31. New gasket (6)	Install on water pump assembly (1).	Use oil seal driver (ST-1191) and oil seal pilot (3375180). Install lip of seal toward oil seal driver (ST-1191). Push new gasket (6) until at bottom of bore.
32. Bearing(8)	Install on shaft (7).	Apply a film of OE/HDO 10 lubricating oil to shaft (7) for easier installation. Use water pump bearing mandrel (ST-658) for installation.

3-64. WATER PUMP REPAIR (Contd)



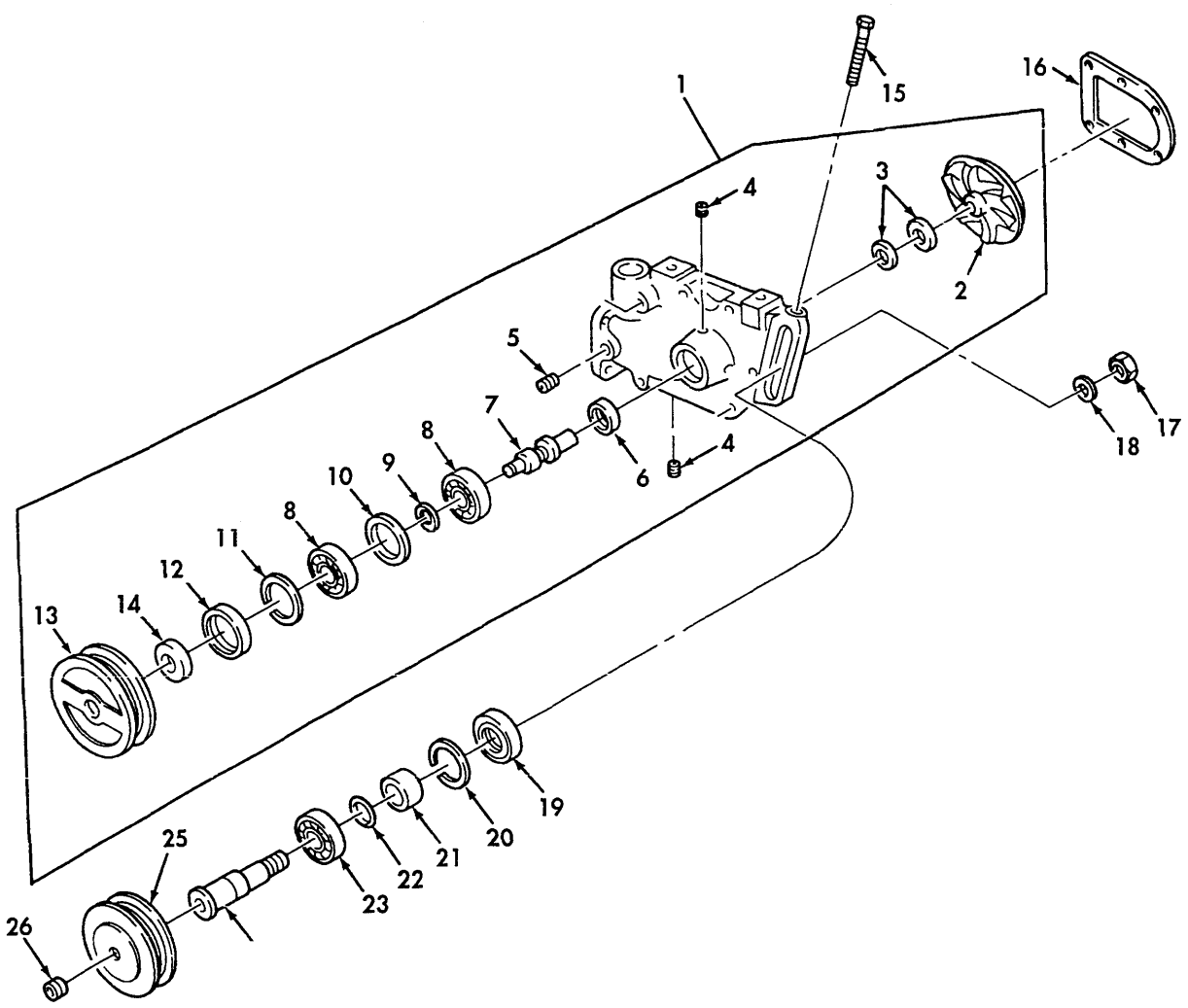
LEGEND:

1. WATER PUMP ASSEMBLY
6. GASKET
7. SHAFT
8. BEARING (2)
19. SEAL
21. SPACER
22. PREFORMED PACKING
23. BEARING
24. SHAFT
25. PULLEY
26. PIPE PLUG

3-64. WATER PUMP REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Assembly (Contd)		
33. Retaining ring (9)	Install on shaft (7).	
	CAUTION **To prevent damage to the ball bearing, make sure the inner face of the ball bearing is not pressed tight against the bearing spacer.**	
34. Spacer (10) and bearings (8)	Install on shaft (7).	Use water pump bearing mandrel (ST-658). Make sure bearings (8) turn freely after installation.
	CAUTION **Ensure Loctite does not migrate to inside diameter of bearing. Bearing failure could result.**	
35. Two bearings (8) and shaft (7)	Install in bore of water pump assembly (1).	Apply a thin coat of Loctite to outer surface of two bearings (8). Use water pump bearing mandrel (ST-658). Press on impeller end of shaft (7).
36. Retaining ring (11)	Install on shaft (7).	Install flat side of retaining ring (11) toward bearings (8).

3-64. WATER PUMP REPAIR (Contd)



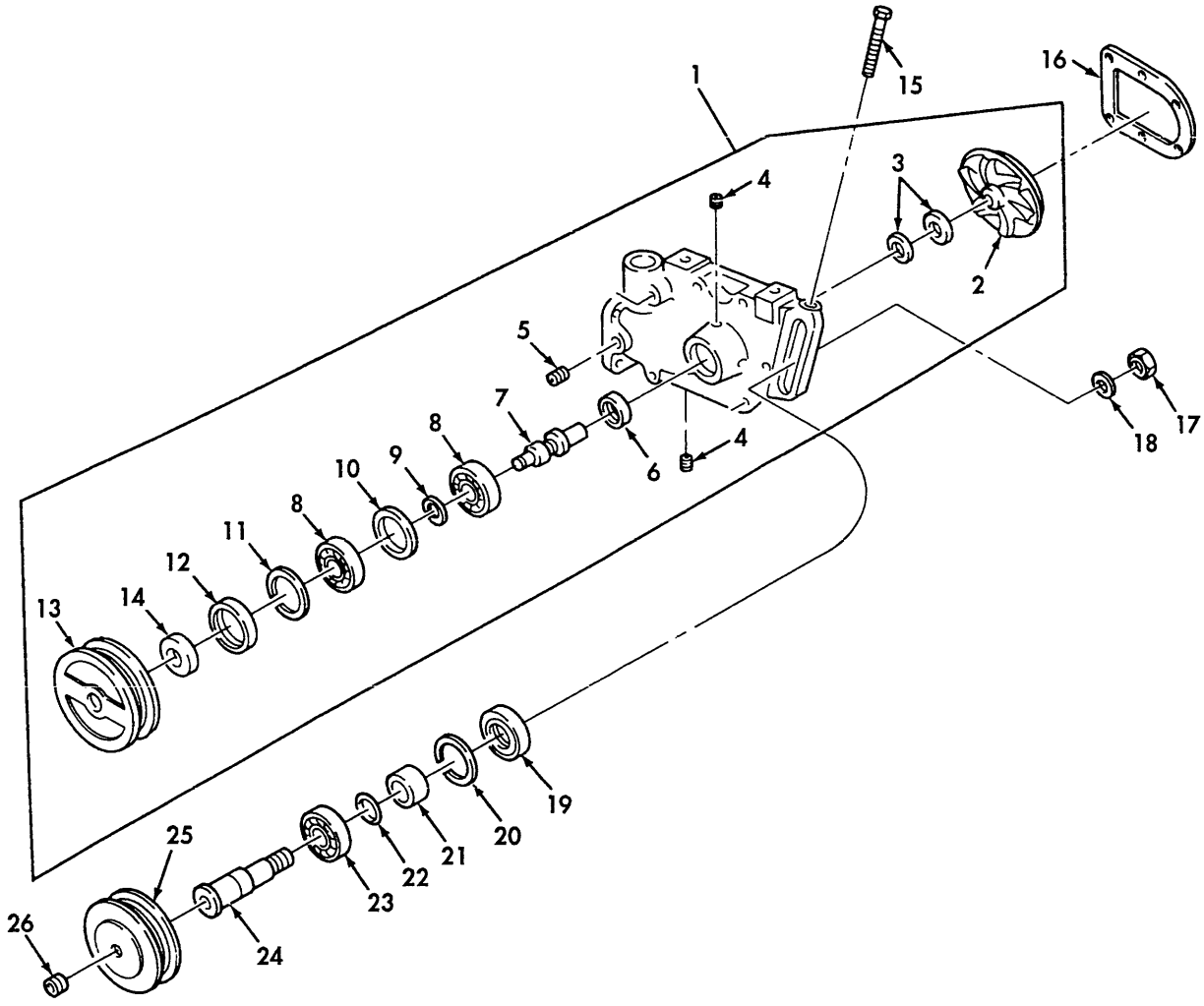
LEGEND:

1. WATER PUMP ASSEMBLY
7. SHAFT
8. BEARING (2)
9. RETAINING RING
10. SPACER
11. RETAINING RING

3-64. WATER PUMP REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Assembly (Contd)		
	CAUTION **Prior to installing the pipe plugs in the bearing bore of the water pump assembly, install a grease fitting and lubricate the ball bearings until you can see grease through the outer ball bearing.**	
37. Two pipe plugs (4)	Install on water pump assembly (1).	Coat with liquid thread sealant.
38. Pipe plug (5)	Install on water pump assembly (1).	Coat with liquid thread sealant.
39. New seal (12)	Install on water pump assembly (1).	Lip of new seal (12) must be toward bearings (8) and installed even with top edge of bore. Use oil seal driver (ST-1191) and oil seal pilot (3375180).
40. New seat and seal assembly (3)	Install on water pump assembly (1).	Coat brass part of outside diameter with Loctite. Apply one drop only of Loctite between new seat and seal assembly (3) and shaft (7). Use water pump seal mandrel (3375448).

3-64. WATER PUMP REPAIR (Contd)



LEGEND:

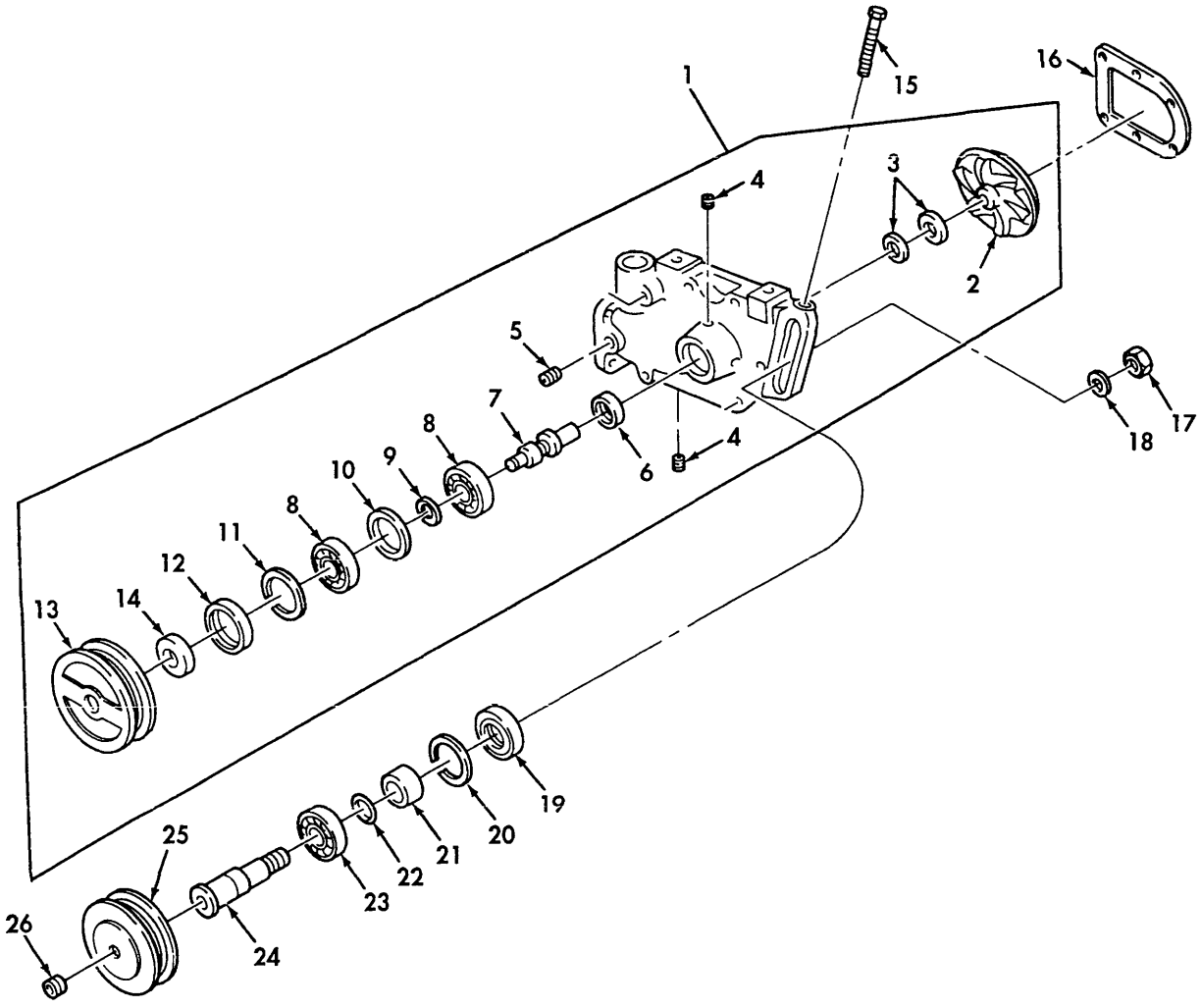
1. WATER PUMP ASSEMBLY
3. SEAT AND SEAL ASSEMBLY
4. PIPE PLUG (2)
5. PIPE PLUG
7. SHAFT
8. BEARING (2)
12. SEAL

3-64. WATER PUMP REPAIR (Contd)

LOCATION/ITEM	ACTION	REMARKS
d. Assembly (Contd)		
41. Bearing (14)	Install on pulley (13).	Use oil seal driver (ST-1191) for installation.
42. Pulley (13) and bearing (14)	Install on shaft (7).	Apply a light coat of Loctite to the bore of pulley (13). Use suitable press and install until pulley (13) is against large diameter of shaft (7).
43. Impeller (2)	Install on shaft (7).	Apply a light coat of Loctite to the bore of impeller (2). Check clearance after installation; should be 0.020-0.040 in. (0.508-1.016 mm).
44. Pulley (25) with assembled parts	a. Install on water pump assembly (1). b. Secure with screw (15), washer (18), and nut (17).	

FOLLOW-ON TASK: Install water pump (TM 9-2320-273-20 or TM 9-2320-283-20).

3-64. WATER PUMP REPAIR (Contd)



LEGEND:

1. WATER PUMP ASSEMBLY
2. IMPELLER
7. SHAFT
13. PULLEY
14. BEARING
15. SCREW
17. NUT
18. WASHER
25. PULLEY

Section IV. ASSEMBLY

3-65. GENERAL

a. This section provides maintenance procedures for assembly of subassemblies, installation of major components, and removal of engine from maintenance stand. These procedures are for the engine removed from the vehicle.

b. In cases where it may only be necessary, or more time efficient, to assemble the engine while installed in vehicle, follow the applicable portions of the tasks contained in this section to install the part or component.

c. In the task summary listed below, a complete list of special tools, test equipment, materials, parts, and related information required to perform a complete engine assembly is provided. To find a specific engine assembly procedure contained in this section, see list of tasks.

3-66. TASK SUMMARY

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Piston ring expander (15434) ST-763
Two connecting rod guide pins (15434) 3375601
Piston ring compressor (15434) 3375162
Oil seal installer (15434) ST-1259
Oil seal expander (15434) 3375151
Fuel pump drive oil seal mandrel (15434) ST-1173
Pulley installation assembly tool (15434) 3376326
Air compressor wrench (15434) 3375159
Crankshaft rear oil seal driver (15434) ST-997
Dial gauge attachment (15434) ST-1325
Dial indicator and sleeve assembly (15434) 3376050
Injector puller (15434) 3375161
Torque wrench adapter (15434) ST-669

TEST EQUIPMENT
Injection timing fixture (15434) 3375522

MATERIALS/PARTS
Oil, lubricating, OE/HDO 30 (Appendix C, Item 21)
Oil, lubricating gear, 60-80/140 (Appendix C, Item 22)
Lubricant, high-pressure (Appendix C, Item 15)
Lubricant, rust preventative (Appendix C, Item 16)
Sealant, pipe (Appendix C, Item 26)
Solvent, SD-3 (Appendix C, Item 30)
Grease, GAA (Appendix C, Item 13)
Oil, lubricating, OE/HDO 10 (Appendix C, Item 20)
Compound, antiseize (Appendix C, Item 7)

MATERIALS/PARTS (Contd)
Sealant, thread (liquid) (Appendix C, Item 27)
Main bearing set, standard: (15434) AR-7110
0.010 under: (15434) AR-711
0.020 under: (15434) 157282
Thrust ring, standard: (15434) 157280
0.010 under: (15434) 157281
0.020 under: (15434) 157282
Piston ring set (15434) 3014149
Cam follower housing gasket (15434) 3020000
Cam follower housing gasket (as required) (15434) 3020001,3020002, 3020003,3020004
Cylinder head gasket (15434) 3001667
Four O-ring seals (15434) 131026
Housing gasket (15434) 200809
Pump mounting gasket (15434) 3031434
Crankshaft oil seal (15434) 3006736
Accessory drive oil seal (15434) 3004316
Compressor gasket (15434) 3005962
Four lockwashers (15434) S-609
Fuel pump mounting gasket (15434) 200817
Rear cover gasket (15434) 40662-A
Rear main seal (15434) 211253
Suction tube gasket (15434) 157551
Oil pan gasket (15434) 3027983
O-ring seal (15434) 3029846
O-ring seal (15434) 3029847
Gasket, rocker housing (15434) 3017750
Gasket, brake housing (75078) 010279
Three intake manifold gaskets (15434) 3008591
Three lockwashers (15434) S-602
Two water header cover gaskets (15434) 70089-1
Six piston cooling nozzle O-rings (15434) 3007442
Support gasket (15434) 3031858
Two grommets (15434) S-1003-A
Six exhaust manifold gaskets (15434) 3020943
Turbocharger mounting gasket (15434) 190849

3-66. TASK SUMMARY (Contd)

INITIAL SETUP (Contd):

Cover gasket (15434) 65274

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
Refer to specific paragraph for this information.

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dust and dirt.

GENERAL SAFETY INSTRUCTIONS
Engine components are heavy. Use extreme caution during assembly to prevent injury to personnel and/or damage to equipment.

List of Tasks

TASK PARA.	PROCEDURES	TASK REF.	TROUBLESHOOTING REF. NO. (PARA.)
1.	Cylinder Liner Installation	3-67	2-8
2.	Engine Crankshaft and Main Bearings Installation	3-68	2-8
3.	Piston, Connecting Rod, and Bearing Installation	3-69	2-8
4.	Camshaft and Cam Followers Installation	3-70	2-8
5.	Cylinder Head Assembly and Pushrods Installation	3-71	2-8
6.	Injection Timing	3-72	2-8
	a. Setup	3-72a	
	b. Injection Timing Cylinder No. 1	3-72b	
	c. Changing Injection Timing	3-72c	
	d. Injection Timing Cylinder No. 3	3-72d	
	e. Injection Timing Cylinder No. 5	3-72e	
7.	Accessory Drive Housing Assembly Installation	3-73	2-8
8.	Oil Pump Installation	3-74	2-8
9.	Front Gear Cover Installation	3-75	2-8
10.	Accessory Drive Pulley Installation	3-76	2-8
11.	Air Compressor Installation	3-77	2-8
12.	Fuel Pump Installation	3-78	2-8
13.	Vibration Damper and Crankshaft Pulley Installation	3-79	2-8
14.	Flexplate or Flywheel, Flywheel Housing, and Rear Cover Installation	3-80	2-8
15.	Oil Pan Installation	3-81	2-8
16.	Injector Assembly Installation	3-82	2-8

3-66. TASK SUMMARY (Contd)

List of Tasks (Contd)

TASK PARA.	PROCEDURES	TASK REF.	TROUBLESHOOTING REF. NO. (PARA.)
17.	Valve Crossheads Installation and Adjustment	3-83	2-8
	a. Installation	3-83a	
	b. Adjustment	3-83b	
18.	Rocker Arm Housing Assembly Installation	3-84	2-8
19.	Injector and Valve Adjustment	3-85	2-8
20.	Engine Retarder Installation	3-86	2-8
	a. Installation	3-86a	
	b. Slave Piston Adjustment	3-86b	
21.	Air Aftercooler Installation	3-87	2-8
22.	Removing Engine from Maintenance Stand	3-88	2-8
	a. Removal from Maintenance Stand	3-88a	
	b. Component Installation	3-88b	

3-67. CYLINDER LINER INSTALLATION

THIS TASK COVERS:

Installation

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
None

TEST EQUIPMENT
None

MATERIALS/PARTS
Oil, lubricating, OE/HDO 30
(Appendix C, Item 21)
Oil, lubricating, gear 60-80/140
(Appendix C, Item 22)

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
Cylinder liners removed (para. 3-30).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
None

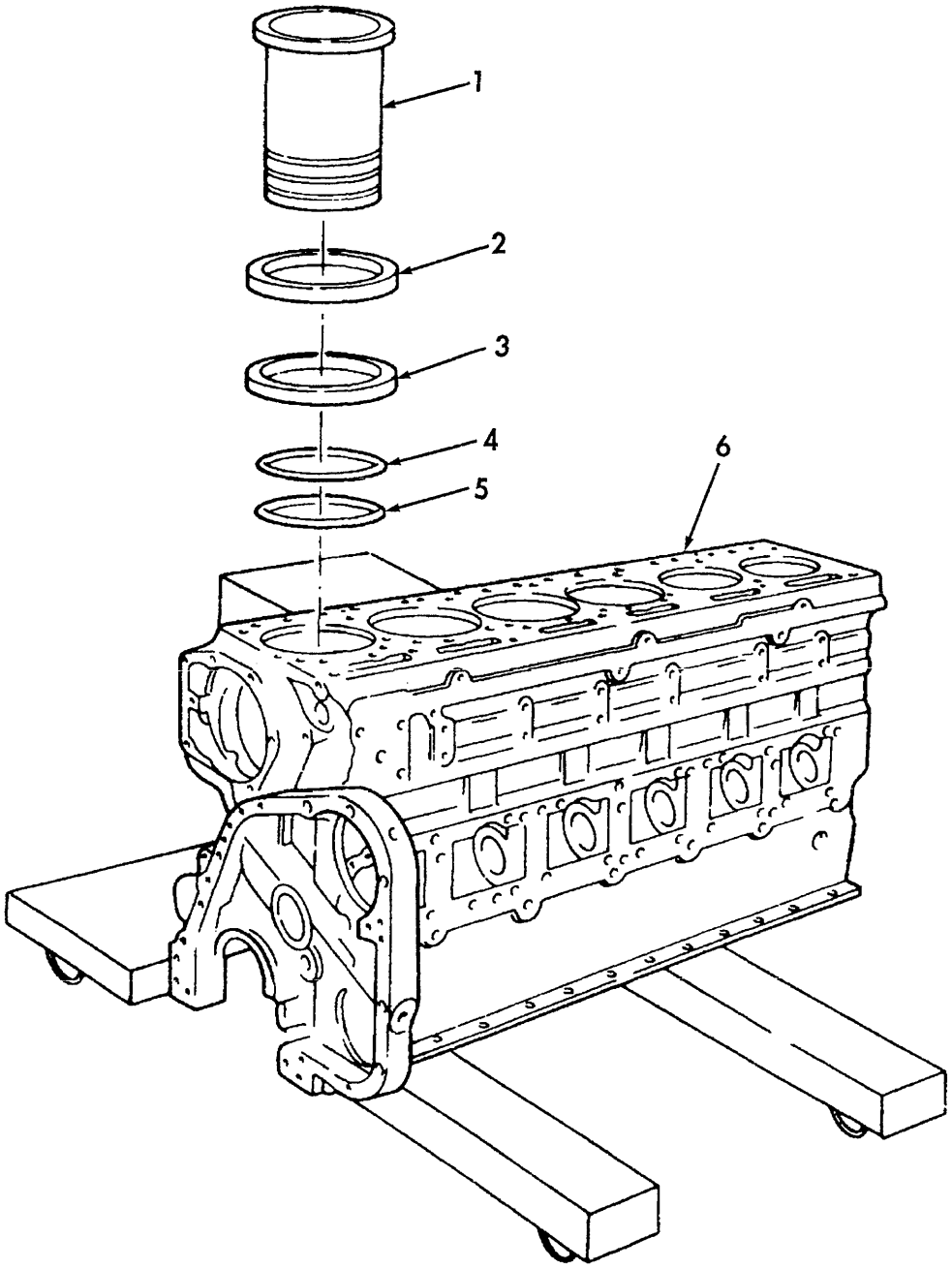
LOCATION/ITEM	ACTION	REMARKS
Installation		

NOTE

- **Installation of cylinder liners is carried out during cylinder block repair. This is necessary to check cylinder liner counterbore diameter, depth, protrusion, sealant application procedure, and type of packing ring lubricant used.**
- **Refer to para. 3-34, Cylinder Block Repair, for complete installation procedure of cylinder liners.**

FOLLOW-ON TASK: Install engine crankshaft and main bearings (para. 3-68).

3-67. CYLINDER LINER INSTALLATION (Contd)



LEGEND:

1. CYLINDER LINER
2. CYLINDER LINER SHIM (IF REQUIRED)
3. GASKET (CREVICE SEAL)
4. BLACK PACKING RING
5. RED PACKING RING
6. CYLINDER BLOCK

3-68. ENGINE CRANKSHAFT AND MAIN BEARINGS INSTALLATION

THIS TASK COVERS:

Installation

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
None

TEST EQUIPMENT
None

MATERIALS/PARTS
Oil, lubricating, OE/HDO 30
(Appendix C, Item 21)
Oil, lubricating, gear 60-80/140
(Appendix C, Item 22)
Fourteen lockplates (15434) 140218
Main bearing set
Standard: (15434) 3801260
0.010 Under: (15434) 3801261
0.020 Under: (15434) 3801262
Four thrust bearing washers
Standard: (15434)
0.010 Over: (15434)
0.020 Over: (15434)

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
Engine crankshaft and main bearings removed (para. 3-31).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
Use extreme caution during assembly; engine components are heavy.

LOCATION/ITEM	ACTION	REMARKS

Installation

CAUTION

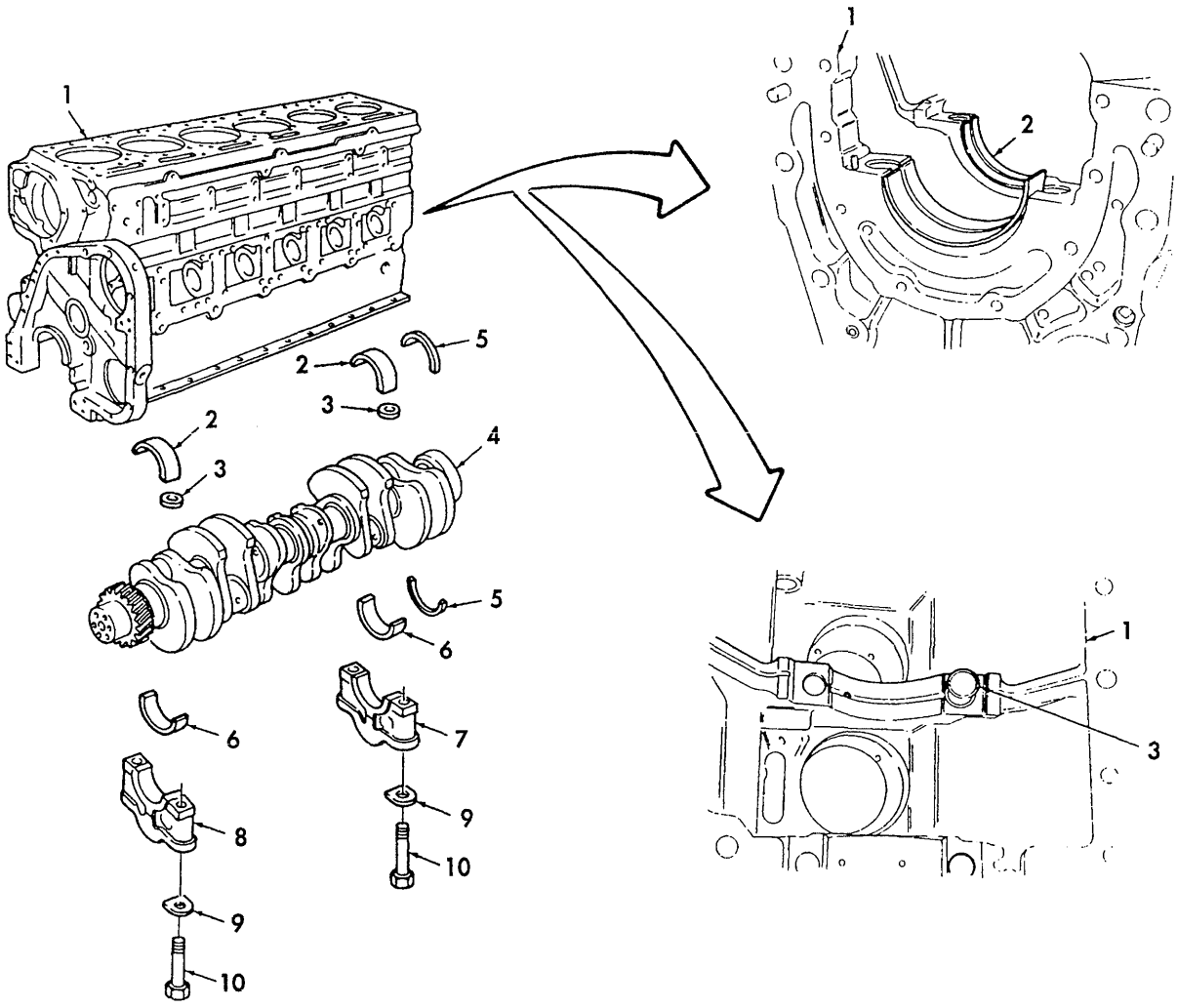
- **The cylinder block saddle and cap mating surfaces must be clean and dry when bearing halves are installed or engine damage may result.**
- **Wipe main bearing bores, main bearings, engine crankshaft, and related parts with a clean cloth. Ensure cloth does not leave any particles or lint in or on parts and bores or engine damage may result.**

NOTE

- **The upper main bearings have a groove and oil hole to permit lubrication of engine crankshaft; the lower main bearing halves do not. The upper main bearings for No. 2, 4, and 6 are the same. The groove in upper main bearing half for No. 7 is not in the center. Install the No. 7 main bearing so wider part of bearing (from groove) is toward flywheel end of the cylinder block. Each main bearing has a groove. Install main bearings so grooves will fit retaining rings.**
- **Check for marks on crankshaft to determine size of main bearings and thrust rings. If there are no marks, use standard-size parts.**

3-68. ENGINE CRANKSHAFT AND MAIN BEARINGS INSTALLATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
1. Seven new upper main bearing halves (2)	Install on cylinder block (1).	Lubricate main bearing contact surface with OE/HDO 30 lubricating oil.
2. Seven retaining rings (3)	Install on cylinder block (1).	



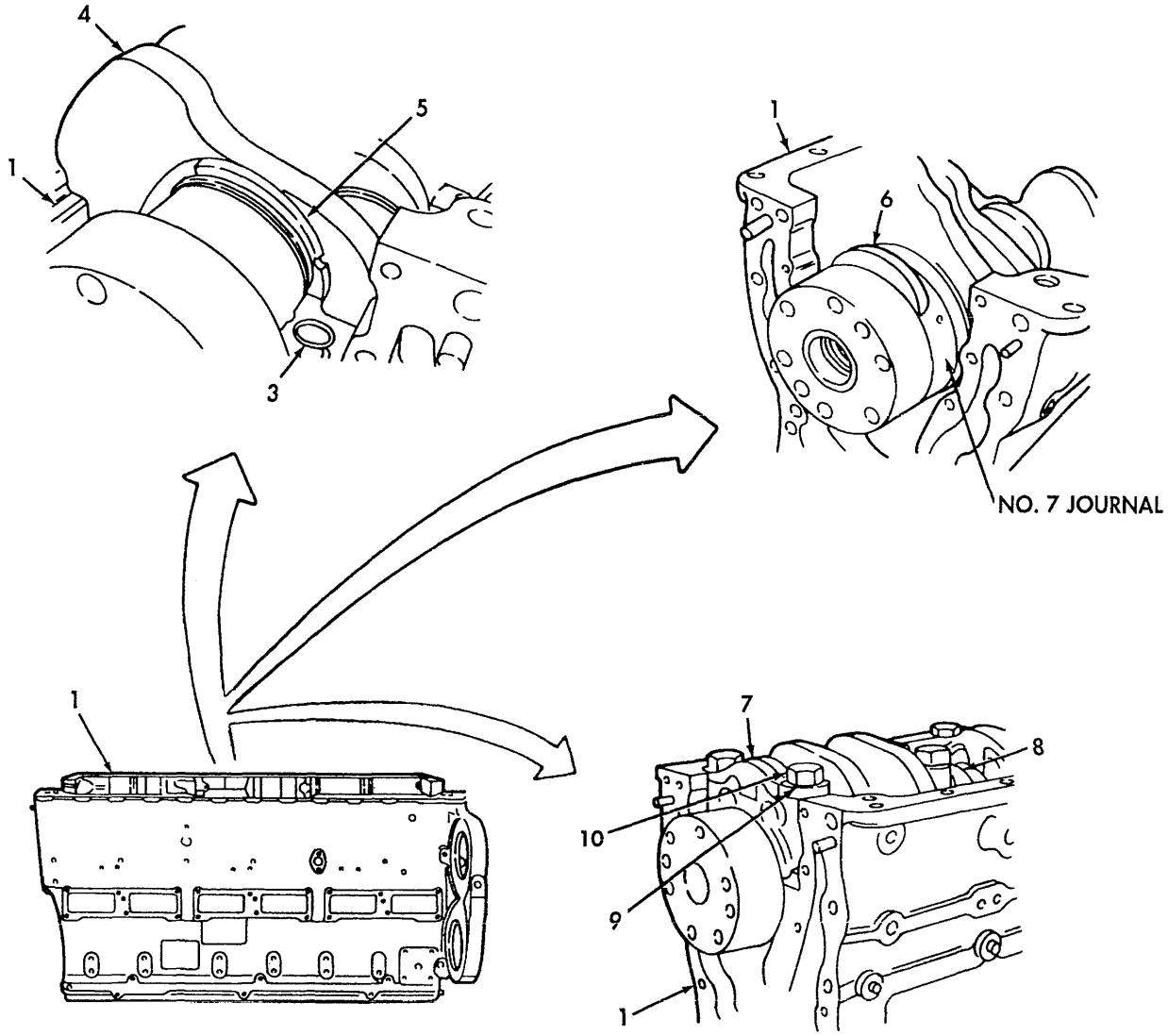
LEGEND:

1. CYLINDER BLOCK
2. UPPER MAIN BEARING HALF (7)
3. RETAINING RING (7)
4. CRANKSHAFT
5. THRUST BEARING WASHER (2)
6. LOWER MAIN BEARING HALF (7)
7. NO. 7 BEARING CAP
8. BEARING CAP (6)
9. LOCKPLATE (14)
10. SCREW (14)

3-68. ENGINE CRANKSHAFT AND MAIN BEARINGS INSTALLATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
Installation (Contd)		
	WARNING **Use extreme caution during assembly; engine components are heavy. Failure to comply may result in damage to equipment or injury to personnel.**	
3. Crankshaft (4)	Install on cylinder block (1).	Assistant will help lift crankshaft (4). Use a suitable lifting device and hooks protected with a rubber hose or a lifting strap to lower crankshaft (4) on cylinder block (1).
4. New upper thrust bearing washers (5)	Roll into position on the No. 7 journal of crankshaft (4).	Ensure grooved thrust side of thrust bearing washers (5) are against the flange of crankshaft (4). The upper thrust rings are not doweled to cylinder block (1). The lower thrust bearing washers (5) are doweled to No. 7 bearing cap.
5. Seven new lower main bearing halves (6)	Install on main bearing journals of crankshaft (4).	Lubricate contact surface of seven lower main bearing halves (6) and main bearing journal surface of crankshaft (4) with OE/HDO lubricating oil prior to installation. Make certain lower main bearing halves (6) are aligned with retaining rings (3).
6. No. 1 through No. 6 bearing caps (8)	Install on cylinder block (1) over crankshaft (4).	Ensure each bearing cap (8) is in its correct location and position.
7. Lower thrust bearing washers (5)	Install on No. 7 bearing cap (7).	The grooved side of two lower thrust bearing washers (5) must be toward flange of crankshaft (4).
8. No. 7 bearing cap (7) with thrust bearing washers (5)	Install on cylinder block (1) over No. 7 main bearing journal of crankshaft (4).	
9. Fourteen screws (10) and new lockplates (9)	Install on bearing caps (7) and (8) on cylinder block (1) finger-tight.	Coat threads with OE/HDO 30 lubricating oil and lockplates (9) with gear 60-80/140 lubricating oil. Allow excess oil to drain off prior to installing screws (10) on cylinder block (1).

3-68. ENGINE CRANKSHAFT AND MAIN BEARINGS INSTALLATION (Contd)



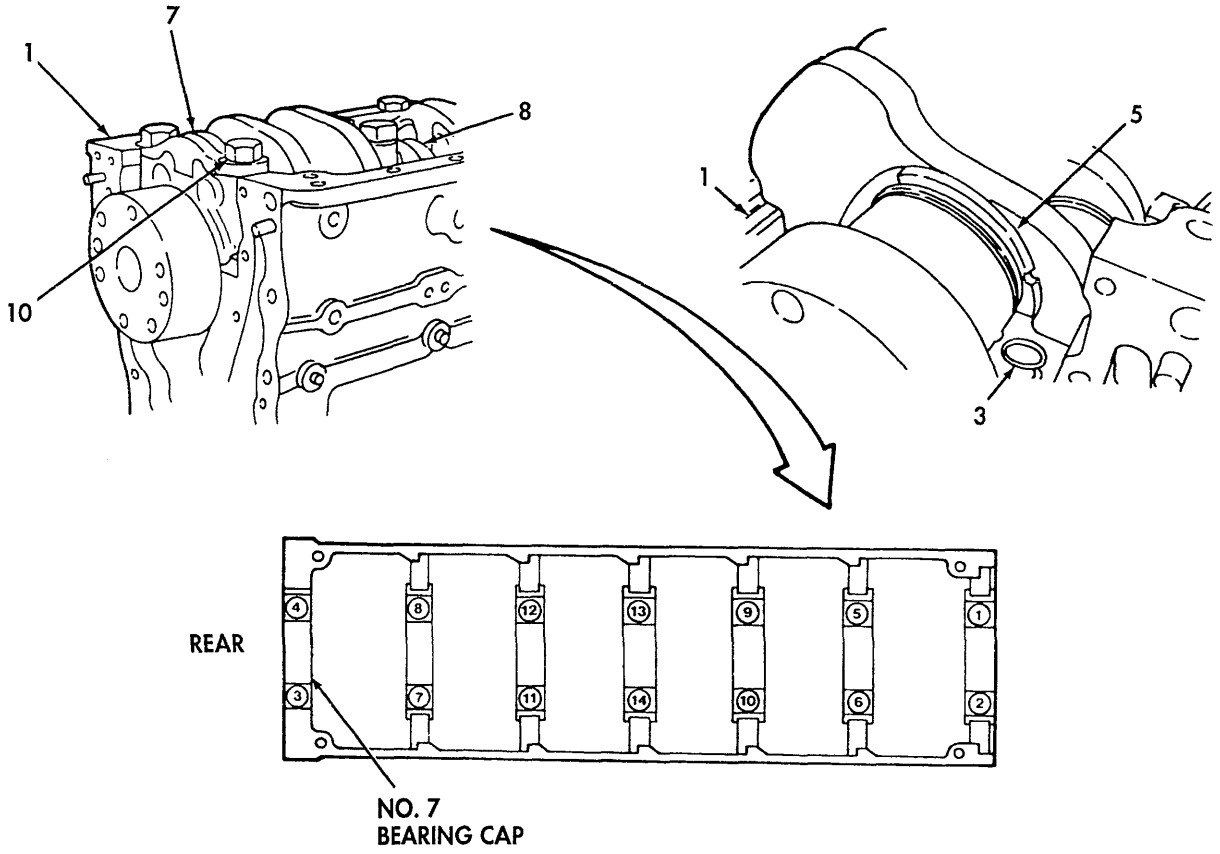
LEGEND:

1. CYLINDER BLOCK
3. RETAINING RING (7)
4. CRANKSHAFT
5. THRUST BEARING WASHER (4)
6. LOWER MAIN BEARING HALF (7)
7. NO. 7 BEARING CAP
8. BEARING CAP (6)
9. LOCKPLATE (14)
10. SCREW (14)

3-68. ENGINE CRANKSHAFT AND MAIN BEARINGS INSTALLATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
Installation (Contd)		
	CAUTION **When striking bearing caps, ensure bearing halves and retaining rings do not move or damage may result.**	
10. No. 7 bearing cap (7) and No. 1 through No. 6 bearing caps (8)	Strike with rubber mallet to push into position on cylinder block (1).	Ensure dowel pins and thrust bearing washers (5) for No. 7 bearing cap (7) are correctly aligned.
11. Fourteen screws (10)	a. Tighten each screw (10) to 85 lb-ft (115 N•m) at a time in sequence shown until each screw is tightened to 250-260 lb-ft (339-353 N•m). b. Loosen fourteen screws (10) three to five threads or a minimum of three complete turns. c. Repeat step 11a.	

3-68. ENGINE CRANKSHAFT AND MAIN BEARINGS INSTALLATION (Contd)



LEGEND:

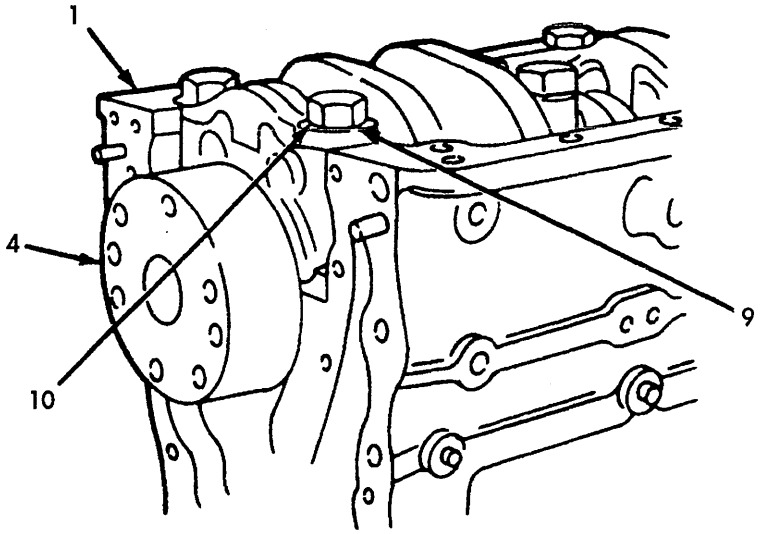
1. CYLINDER BLOCK
5. THRUST BEARING WASHER (4)
7. NO. 7 BEARING CAP
8. BEARING CAP (6)
10. SCREW (14)

3-68. ENGINE CRANKSHAFT AND MAIN BEARINGS INSTALLATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
Installation (Contd)		
12. Crankshaft (4)	a. Use hands to rotate. If crankshaft (4) does not rotate freely, refer to para. 3-37, Engine Crankshaft Repair.	
	b. Install a dial indicator on rear of cylinder block (1) with contact tip resting on crankshaft flange end face.	
	c. Pry crankshaft (4) toward front of cylinder block (1).	Use a suitable prybar.
	d. Remove prybar and set dial indicator to zero.	
	e. Pry crankshaft (4) toward rear of the cylinder block (1).	The total end clearance for a new crankshaft (4) and new thrust bearing washers should be 0.007-0.018 in. (0.178-0.457 mm). Maximum clearance for worn parts is 0.022 in. (0.559 mm).
	f. If clearance is less than 0.007 in., (0.178 mm) proceed as follows: (1) Loosen fourteen screws (10) one turn. (2) Pry crankshaft (4) toward front and rear of cylinder block (1). (3) Tighten fourteen screws (10) according to steps 11 a, b, and c. (4) Recheck end clearance.	
	g. If clearance is more than 0.022 in. (0.559 mm), use oversize thrust bearing washers.	
13. Fourteen lockplates (9)	Bend tangs against heads of fourteen screws (10).	

FOLLOW-ON TASK: Install piston, connecting rod, and bearings (para. 3-69).

3-68. ENGINE CRANKSHAFT AND MAIN BEARINGS INSTALLATION (Contd)



LEGEND:

1. CYLINDER BLOCK
4. CRANKSHAFT
9. LOCKPLATE (14)
10. SCREW (14)

3-69. PISTON, CONNECTING ROD, AND BEARINGS INSTALLATION

THIS TASK COVERS:

Installation

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Piston ring expander (15434) ST-763
Two connecting rod guide pins (15434) 3375601
Piston ring compressor (15434) 3375162

TEST EQUIPMENT
None

MATERIALS/PARTS
Oil, lubricating, OE/HDO 30 (Appendix C, Item 21)
Piston ring set (15434) 3801056

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

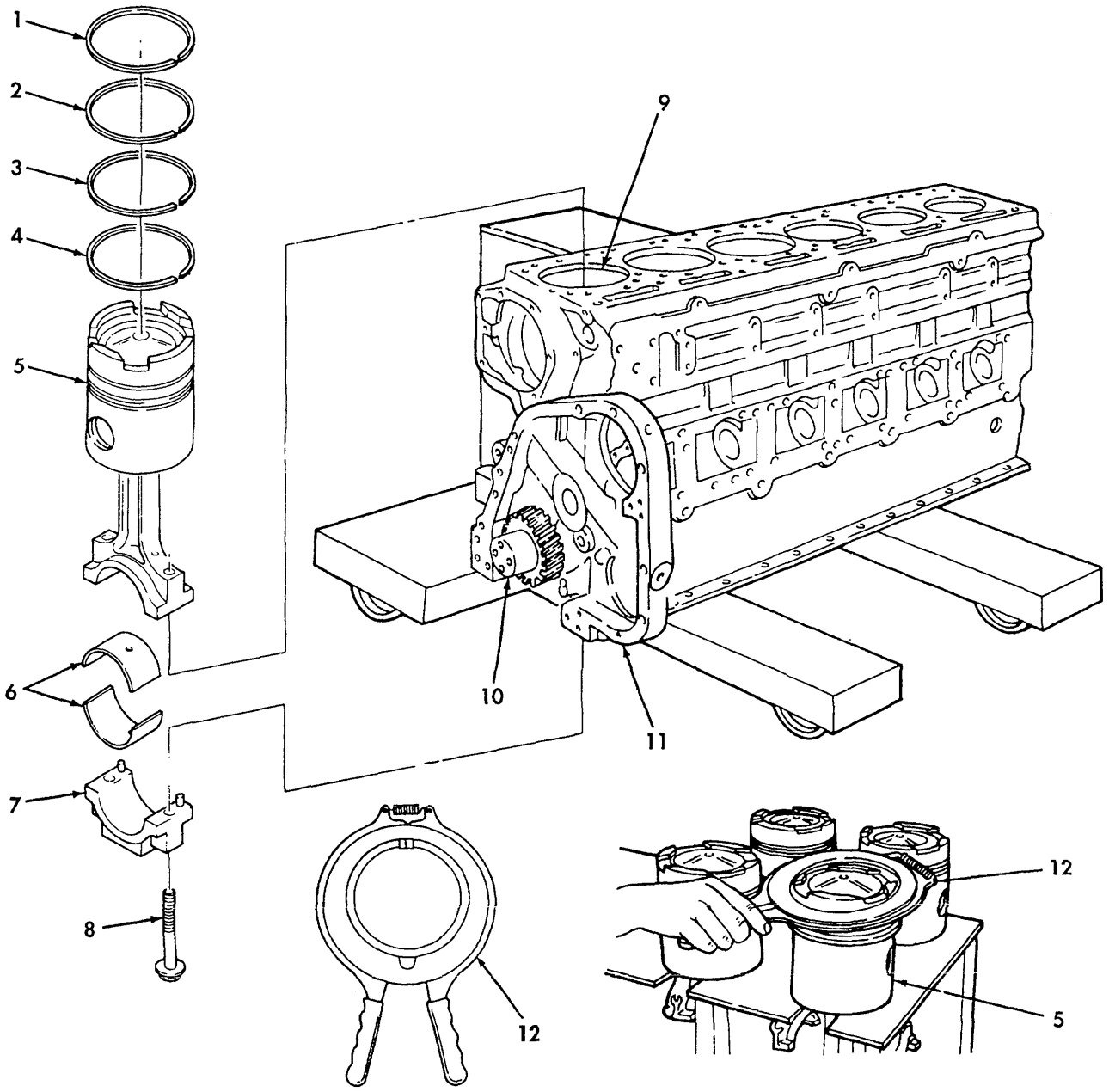
EQUIPMENT CONDITION
- Cylinder liners installed (para. 3-67).
- Crankshaft and main bearings installed (para. 3-68).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS
Installation		
	NOTE • **Use this procedure to install any one of the six piston, connecting rod, and bearings assemblies.** • **Parts are not interchangeable. Do not mix parts from one assembly with another.** • **Always replace bearing halves in pairs (upper and lower).** • **Check for marks on crankshaft to determine bearing size. If there are no marks, use standard-size parts.**	
1. Two new compression rings (1) and (3) and two new piston rings (2) and (4)	a. Using piston ring expander (12), install on piston and connecting rod assembly (5).	Use piston ring expander (ST-763). To avoid damaging rings, do not overexpand during installation. Rings should only be expanded enough to allow them to fit over piston. Install rings with word "top" toward top of piston.
	b. Stagger ring gaps so they are not in line with each other or with piston pin.	
2. Upper rod bearing half (6)	Install on piston and connecting rod assembly (5).	Tang of bearing half (6) must be into slot of connecting rod. Ensure oil hole in bearing half (6) lines up with oil hole in connecting rod.
3. Lower rod bearing half (6)	Install on connecting rod cap (7).	Tang of bearing half (6) must be into slot of connecting rod cap (7). Cap (7) does not have an oil hole.

3-69. PISTON, CONNECTING ROD, AND BEARINGS INSTALLATION (Contd)



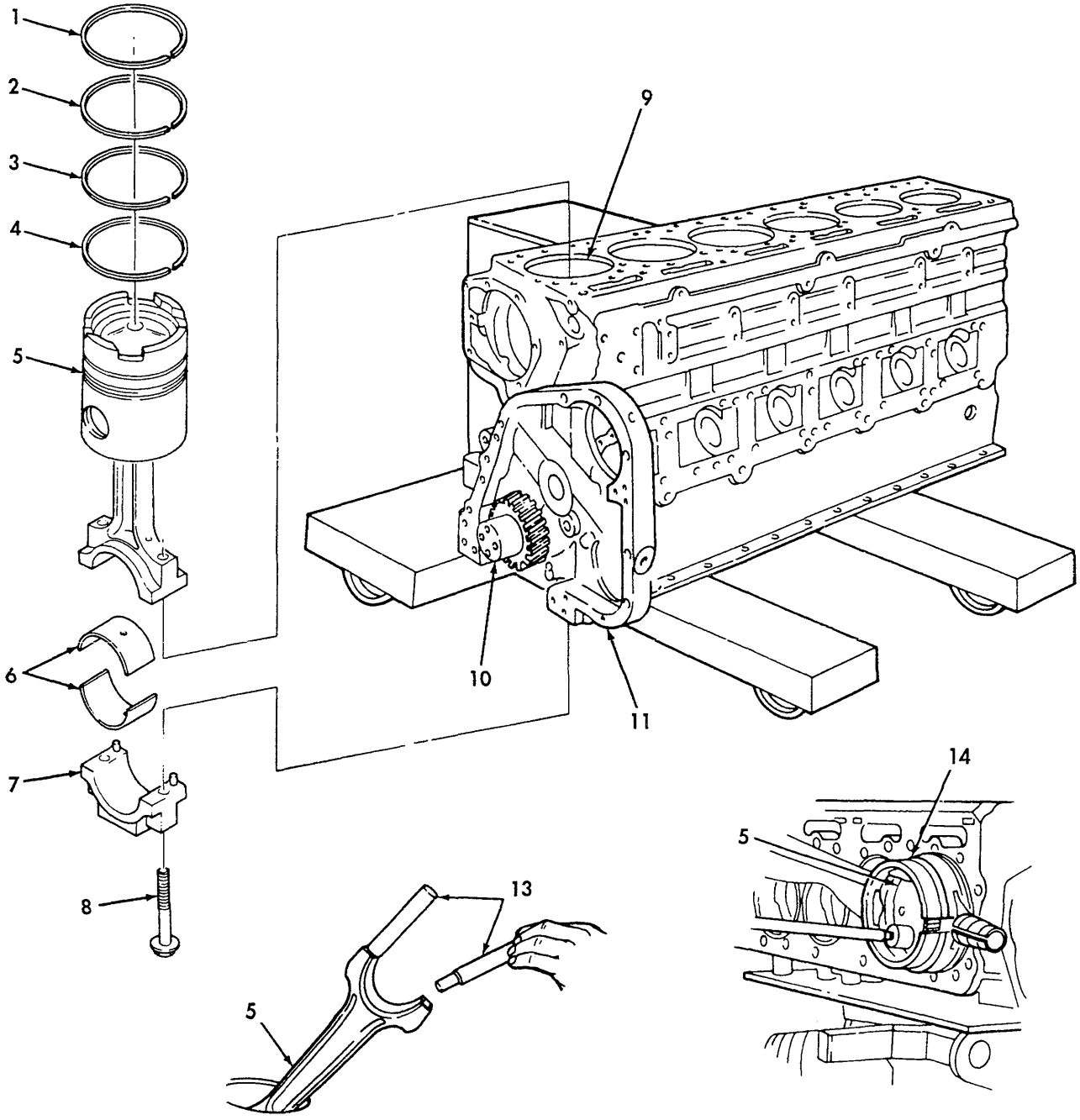
LEGEND:

1. COMPRESSION RING
2. PISTON RING (COMPRESSION RING)
3. COMPRESSION RING
4. PISTON RING (OIL CONTROL RING)
5. PISTON AND CONNECTING ROD ASSEMBLY
6. ROD BEARING HALF (2)
7. CONNECTING ROD CAP
8. ROD SCREW (2)
9. CYLINDER LINER
10. CRANKSHAFT
11. CYLINDER BLOCK
12. PISTON RING EXPANDER

3-69. PISTON, CONNECTING ROD, AND BEARINGS INSTALLATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
Installation (Contd)		
4. Two rod bearing halves (6)	Lubricate with clean lubricating oil.	Use OE/HDO 30 lubricating oil (Appendix C, Item 21).
5. Piston and connecting rod assembly (5)	a. Immerse piston and rings (1), (2), (3), (4), and (5), into container of clean lubricating oil.	
	b. Install two connecting rod guide pins (13).	Use connecting rod guide pin (3375601).
	c. Using piston ring compressor (14), compress rings.	Use piston ring compressor (3375162) (14). Ensure piston rings are correctly located in grooves of piston.
6 Cylinder block (11)	Place in vertical position with rear of block (11) down.	
7. Crankshaft (10)	Rotate until journal for piston and connecting rod assembly (5) being installed is at bottom dead center.	
8. Piston and connecting rod assembly (5)	a. Position numbered side of connecting rod assembly (5) toward camshaft side of cylinder block (11).	
	b. Push piston through piston ring compressor (14) and into cylinder liner (9).	Guide connecting rod on journal of crankshaft (10) as piston is installed on cylinder liner (9).
	c. Ensure piston moves freely in cylinder liner (9).	If not, remove and check for broken or damaged rings.

3-69. PISTON, CONNECTING ROD, AND BEARINGS INSTALLATION (Contd)



LEGEND:

1. COMPRESSION RING
2. PISTON RING (COMPRESSION RING)
3. COMPRESSION RING
4. PISTON RING (OIL CONTROL RING)
5. PISTON AND CONNECTING ROD ASSEMBLY
6. ROD BEARING HALF (2)
9. CYLINDER LINER
10. CRANKSHAFT
11. CYLINDER BLOCK
13. CONNECTING ROD GUIDE PIN (2)
14. PISTON RING COMPRESSOR

3-69. PISTON, CONNECTING ROD, AND BEARINGS INSTALLATION (Contd)

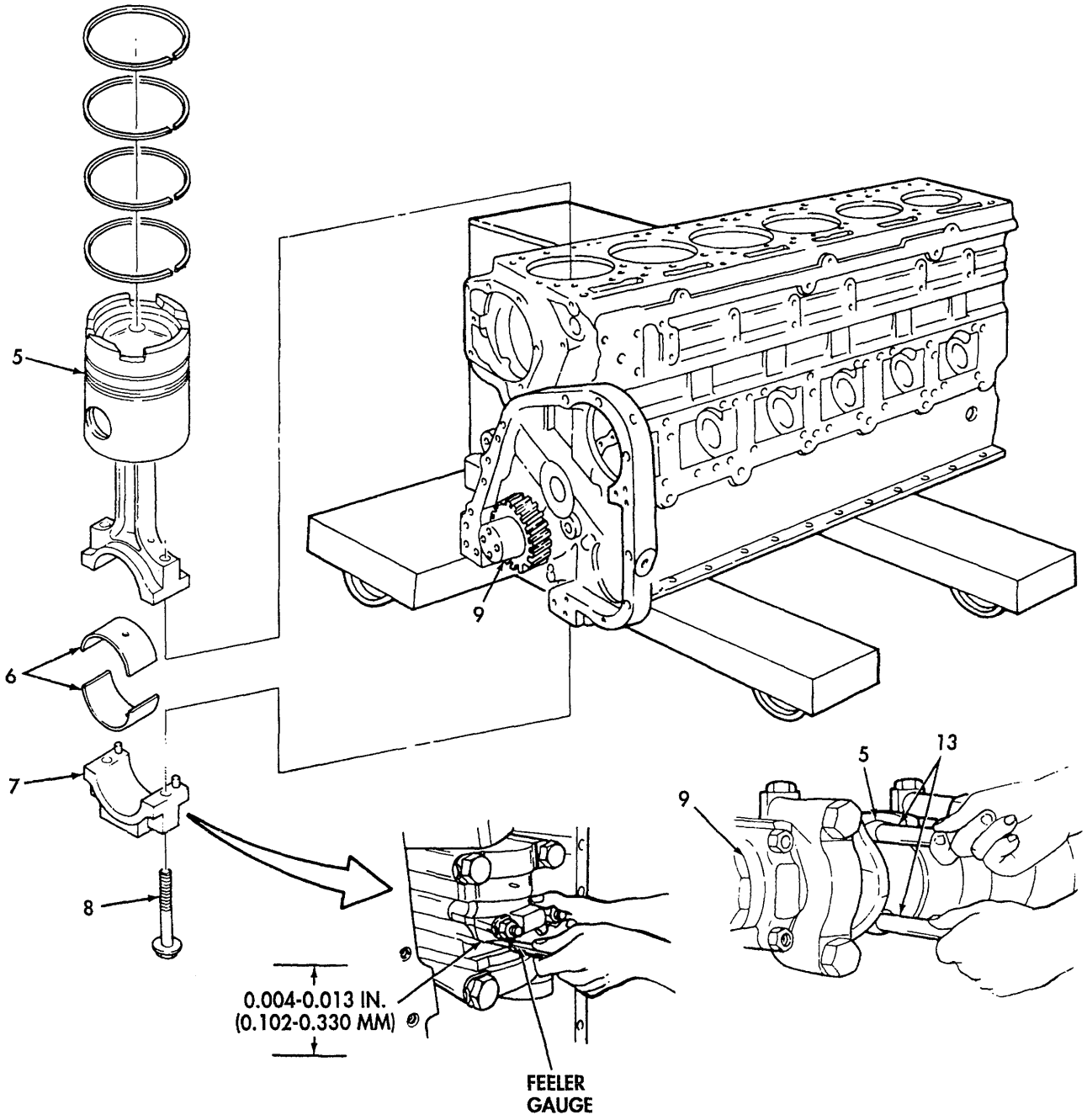
LOCATION/ITEM	ACTION	REMARKS
Installation (Contd)		
	d. Using connecting rod guide pins (13), pull connecting rod in position against crankshaft (9).	
	e. Remove two connecting rod guide pins (13).	
9. Connecting rod cap (7)	a. Install on crankshaft (9) and on piston and connecting rod assembly (5).	Ensure numbered side of connecting rod cap (7) is on same side as numbered side of connecting rod.
	b. Lubricate two screws (8) with clean lubricating oil.	Use OE/HDO 30 lubricating oil (Appendix C, Item 21).

STEP NO.	MINIMUM	MAXIMUM
1. Tighten to	70 lb-ft (95 N•m)	75 lb-ft (102 N•m)
2. Tighten to	140 lb-ft (190 N•m)	150 lb-ft (203 N•m)
3. Loosen completely	—	—
4. Tighten to	25 lb-ft (34 N•m)	30 lb-ft (41 N•m)
5. Tighten to	70 lb-ft (95 N•m)	75 lb-ft (102 N•m)
6. Tighten to	140 lb-ft (190 N•m)	150 lb-ft (203 N•m)

	c. Install screws (8) on connecting rod cap (7) and connecting rod.	Tighten in sequence listed below.
10. Piston and connecting rod assembly (5)	a. Check side-to-side movement.	Piston and connecting rod assembly (5) must move freely on crankshaft journal with hand pressure. If connecting rod does not move freely, remove connecting rod cap (7) and check for dirt, damage, or improper bearing half (6).
	b. Using feeler gauge, check side clearance as shown.	Side clearance must be between 0.004-0.013 in. (0.102-0.330 mm).

FOLLOW-ON TASK: Install camshaft and cam followers (para. 3-70).

3-69. PISTON, CONNECTING ROD, AND BEARINGS INSTALLATION (Contd)



LEGEND:

5. PISTON AND CONNECTING ROD ASSEMBLY
6. ROD BEARING HALF (2)
7. CONNECTING ROD CAP
8. SCREW (2)
9. CRANKSHAFT
13. CONNECTING ROD GUIDE PIN (2)

3-70. CAM FOLLOWER ASSEMBLIES AND CAMSHAFT INSTALLATION

THIS TASK COVERS:

Installation

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
None

TEST EQUIPMENT
None

MATERIALS/PARTS
Lubricant, high-pressure (Appendix C, Item 15)
Gasket (as required) (15434) 3011878
(M915/Big Cam I)
(M915/Big Cam I)
Six lockwashers (15434) S604
(M915/Big Cam I)
Gasket (15434) 3020000 (M915A1/Big Cam III)
Gasket (as required) (15434) 3020001, 3020002, 3020003, 3020004
(M915A1/Big Cam III)

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
Camshaft and main bearing installed (para. 3-68).

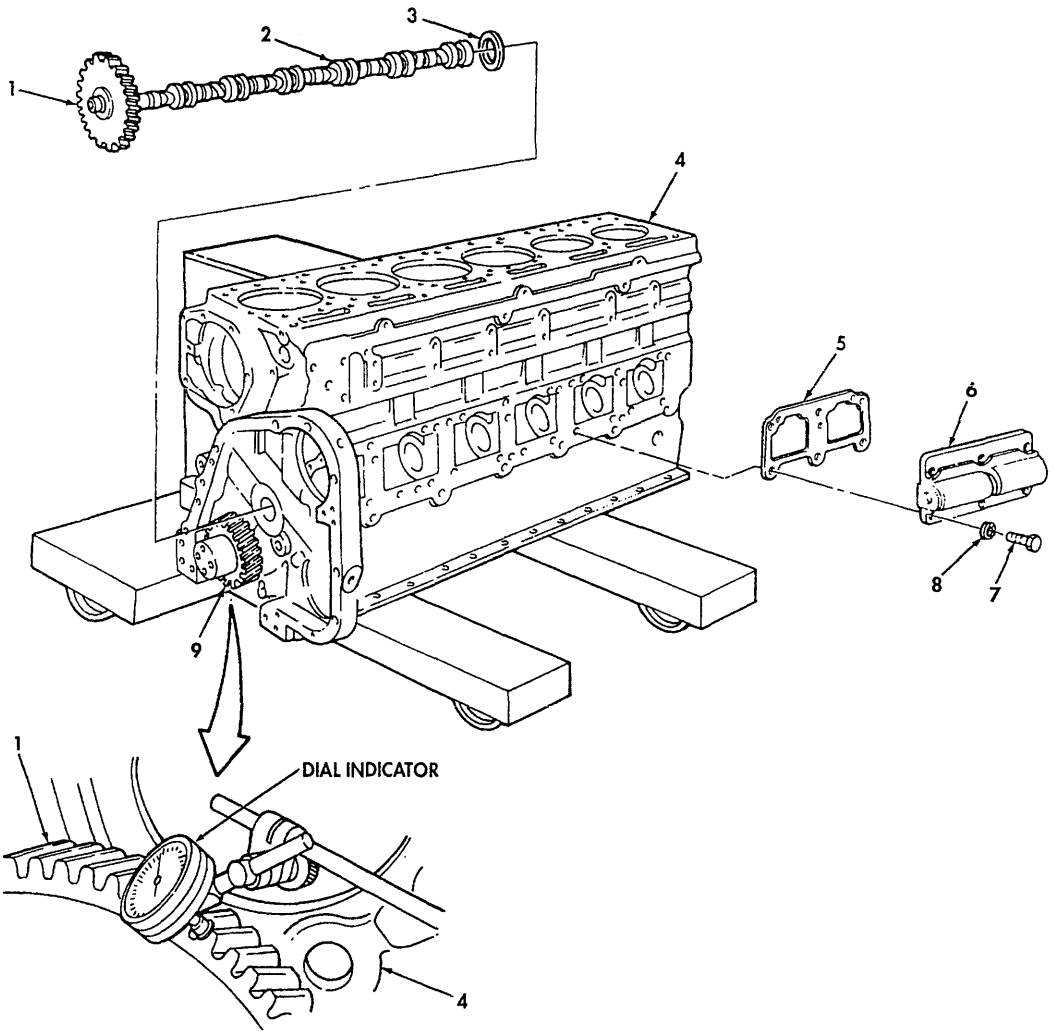
SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS
Installation		
	CAUTION **The oil grooves on thrust washer must be installed facing camshaft gear or thrust washer failure will result.**	
	NOTE **Four camshaft pilot tools, Part No. 3375268, may be used to assist with camshaft installation if available.**	
1. Thrust washer (3)	a. Coat both sides with high-pressure lubricant.	
	b. Slide over end of camshaft (2) until seated next to camshaft gear (1).	Ensure oil grooves in thrust washer (3) are toward camshaft gear (1).
2. Camshaft (2)	a. Lubricate cam lobes with high-pressure lubricant.	
	b. Install on cylinder block (4) while rotating slowly.	Be careful not to damage lobes on camshaft (2) or bushings on cylinder block (4) during installation.
	c. Line up timing mark "O" on camshaft gear (1) with timing mark "O" on crankshaft gear (9) and fully seat camshaft (2) and thrust washer (3) against cylinder block (4). Remove camshaft pilot tools from camshaft (2) if utilized.	
	d. Check camshaft-to-crankshaft	

3-70. CAM FOLLOWER ASSEMBLIES AND CAMSHAFT INSTALLATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
	backlash as follows:	
	(1) Install a dial indicator on font of cylinder block (4), and position tip of indicator against a tooth on camshaft gear (1).	See illustration.
	(2) Rotate camshaft gear (1) as far as it will freely move.	Ensure crankshaft gear (9) does not move.
	(3) Turn dial indicator to zero.	



LEGEND:

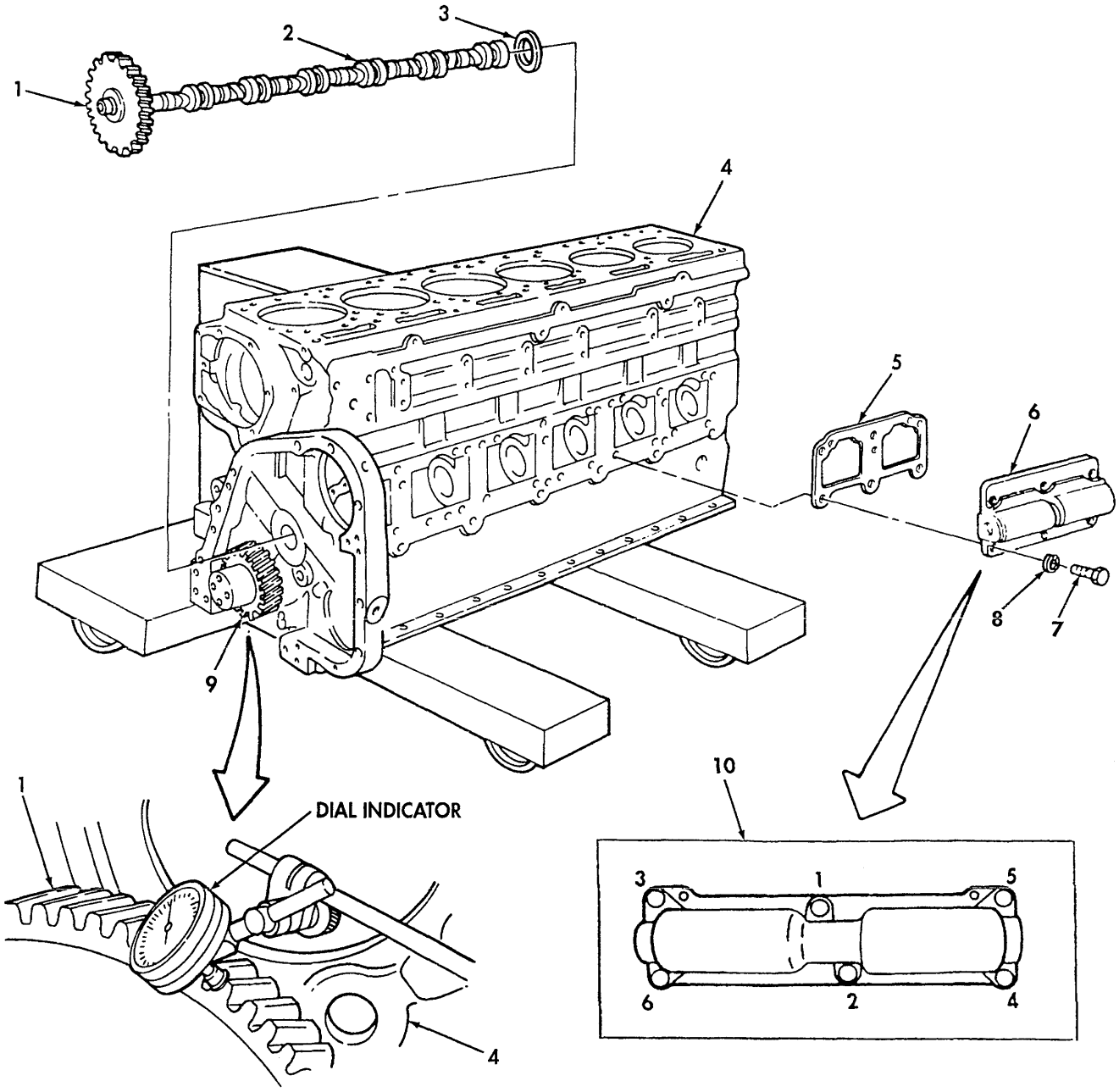
1. CAMSHAFT GEAR
2. CAMSHAFT
3. THRUST WASHER
4. CYLINDER BLOCK
5. CAM FOLLOWER ASSEMBLY GASKET
6. CAM FOLLOWER ASSEMBLY
7. SCREW (6)
8. LOCKWASHER (6) (M915/BIG CAM I)
9. CRANKSHAFT GEAR

3-70. CAM FOLLOWER ASSEMBLIES AND CAMSHAFT INSTALLATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
Installation (Contd)		
2. Camshaft (2) (Contd)	(4) Rotate camshaft gear (1) in opposite direction as far as it will freely move. The reading on indicator shows amount of backlash between gears.	Normal backlash is 0.004-0.016 in. (0.102-0.406 mm) between a new camshaft gear (1) and a new crankshaft gear (9). Minimum backlash for a new camshaft gear is 0.002 in. (0.051 mm). Gears will begin to make noise if backlash exceeds 0.010 in. (0.254 mm). If noise is acceptable, do not replace gears unless backlash exceeds 0.020 in. (0.508 mm).
	NOTE **Perform steps 3 and 4 to install any one of the three cam follower assemblies. Repeat steps 3 and 4 as required to install each additional cam follower assembly.**	
3. New cam follower assembly gasket (5)	Install on dowel pins and cylinder block (4).	Use gasket or gaskets with same thickness as those removed (refer to para. 3-28). Total gasket thickness must be between 0.014-0.080 in. (0.356-2.032 mm). Install gasket (P/N 3020000) (M915A1/ Big Cam III) so that it is against cylinder block (4) and sealing bead faces cam follower assembly (6).
4. Cam follower assembly (6)	a. Install on cylinder block (4).	Strike housing with soft-nose hammer to push it onto dowel pins on cylinder block (4).
	b. Secure with six screws (7). Six lockwashers (8) are also used on M915/Big Cam I engines.	Tighten to 15 lb-ft (20 N•m) in tightening sequence (10) shown in illustration, then tighten to 30-35 lb-ft (41-48 N•m).

FOLLOW-ON TASK: Install cylinder head assembly and pushrods (para. 3-71).

3-70. CAM FOLLOWER ASSEMBLIES AND CAMSHAFT INSTALLATION (Contd)



LEGEND:

1. CAMSHAFT GEAR
2. CAMSHAFT
3. THRUST WASHER
4. CYLINDER BLOCK
5. CAM FOLLOWER ASSEMBLY GASKET
6. CAM FOLLOWER ASSEMBLY
7. SCREW (6)
8. LOCKWASHER (6) (M915/BIG CAM I)
9. CRANKSHAFT GEAR
10. SCREW TORQUE SEQUENCE, CAM FOLLOWER ASSEMBLY

3-71. CYLINDER HEAD ASSEMBLY AND PUSHRODS INSTALLATION

THIS TASK COVERS:

Installation

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
None

TEST EQUIPMENT
None

MATERIALS/PARTS
Lubricant, rust preventative
(Appendix C, Item 16)
Oil, lubricating, gear GO-80/140
(Appendix C, Item 22)
Cylinder head gasket (15434) 3047402
Four preformed packings (15434) 131026

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
Pistons, connecting rods, and bearings installed (para. 3-69).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS
Installation		

NOTE

- **The following procedure involves installation of one cylinder head assembly. Installation of remaining cylinder heads is similar. Repeat steps 1 through 9 to install each additional cylinder head assembly as required.**
- **Ensure marks made on each cylinder head and cylinder block during removal are matched together during installation so that each cylinder head assembly is installed in its original position on cylinder block.**

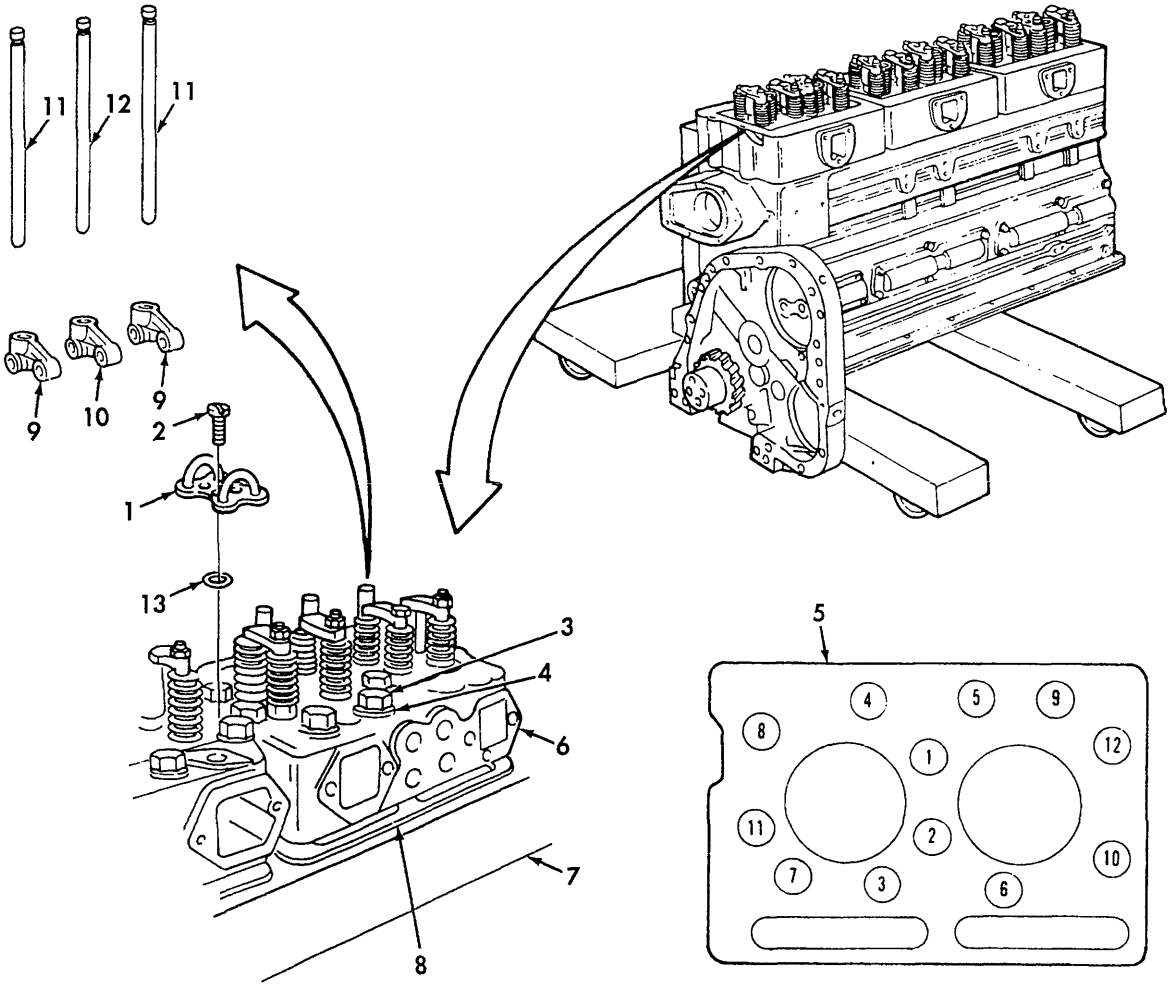
1.	New cylinder head gasket (8)	Install on dowel pins of cylinder block (7).	Ensure new cylinder head gasket (8) has the side with word TOP facing upwards.
2.	Cylinder head assembly (6)	Install on cylinder block (7).	Assistant will help lift cylinder head assembly (6). Use T-handles to assist in positioning cylinder head assembly (6).

CAUTION

Cylinder head screws on turbocharged engines are made of hardened material. The letters NT are stamped on the head of these screws. Do not use any other screws to secure cylinder heads. Engine damage may result.

3-71. CYLINDER HEAD ASSEMBLY AND PUSHRODS INSTALLATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
3. Twelve screws (3)	Lubricate with rust preventative lubricant. Allow excess lubricant to drip from screw threads before installation.	



LEGEND:

1. FUEL CROSSOVER CONNECTION (2)
2. SCREW (4)
3. SCREW (12)
4. WASHER (12)
5. TIGHTENING SEQUENCE
6. CYLINDER HEAD ASSEMBLY
7. CYLINDER BLOCK
8. CYLINDER HEAD GASKET
9. INTAKE AND EXHAUST CAM FOLLOWER (4)
10. INJECTOR CAM FOLLOWER (2)
11. INTAKE AND EXHAUST PUSHROD (4)
12. INJECTOR PUSHROD (2)
13. PREFORMED PACKING (4)

3-71. CYLINDER HEAD ASSEMBLY AND PUSHRODS INSTALLATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
Installation (Contd)		
4. Twelve screws (3) and washers (4)	Install on cylinder head assembly (6) and cylinder block (7) and tighten as follows: a. Tighten to 25 lb-ft (34 N•m) as shown in tightening sequence (5). b. Tighten to 100 lb-ft (136 N•m) as shown in tightening sequence (5). c. Tighten to 305 lb-ft (414 N•m) (M915/Big Cam I) or 285 lb-ft (387 N•m) (M915A1/Big Cam III) as shown in tightening sequence (5).	
5. Four new preformed packings (13)	Install on counterbores of cylinder head assembly (6).	
6. Two fuel crossover connections (1) head assembly (6).	Install on new preformed packings (13) and cylinder	
7. Four screws (2)	Install on fuel crossover connections (1) and tighten to 38 lb-in. (4.3 N•m).	
8. Four intake and exhaust pushrods (11) and two injector pushrods (12)	Lubricate ball ends with gear GO-80/140 lubricating oil.	

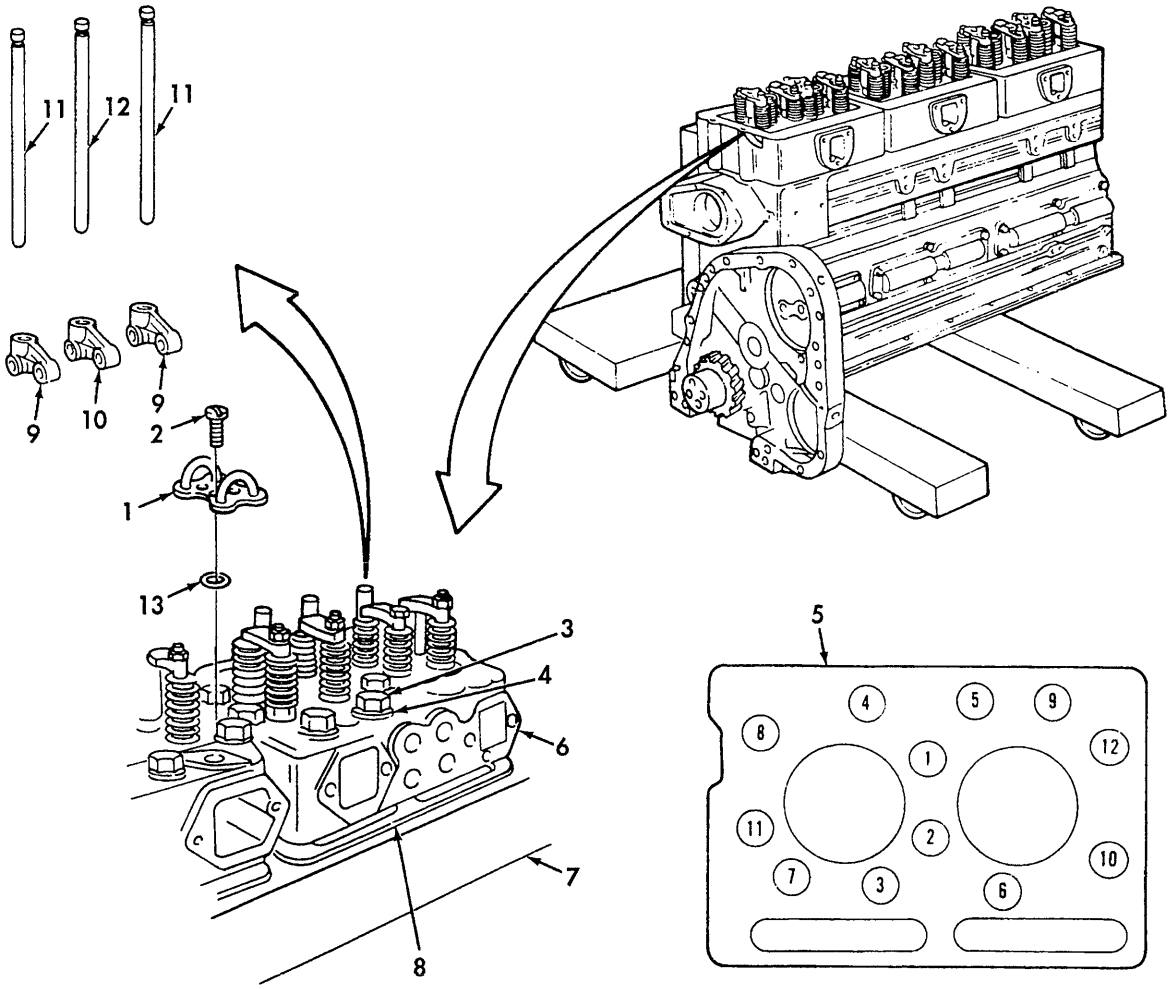
NOTE

- **The injector pushrods are larger in diameter than the valve pushrods. The valve pushrods are 0.007 in. (0.178 mm) longer than injector pushrods.**
- **Ensure each pushrod is installed in same position as noted during removal.**

9. Four intake and exhaust pushrods (11) and two injector pushrods (12)	Install on cam followers (9) and (10).	Ball end of pushrods (11) and (12) must fit into socket of cam followers (9) and (10). The injector pushrod (12) is installed on center injector cam follower (10).

FOLLOW-ON TASK: Perform injection timing (para. 3-72).

3-71. CYLINDER HEAD ASSEMBLY AND PUSHRODS INSTALLATION (Contd)



LEGEND:

1. FUEL CROSSOVER CONNECTION (2)
2. SCREW (4)
3. SCREW (12)
4. WASHER (12)
5. TIGHTENING SEQUENCE
6. CYLINDER HEAD ASSEMBLY
7. CYLINDER BLOCK
8. CYLINDER HEAD GASKET
9. INTAKE AND EXHAUST CAM FOLLOWER (4)
10. INJECTOR CAM FOLLOWER (2)
11. INTAKE AND EXHAUST PUSHROD (4)
12. INJECTOR PUSHROD (2)
13. PREFORMED PACKING (4)

3-72. INJECTION TIMING

THIS TASK COVERS:

a. Setup
b. Injection Timing Cylinder No. 1
c. Changing Injection Timing
d. Injection Timing Cylinder No. 3
e. Injection Timing Cylinder No. 5

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
None

TEST EQUIPMENT
Injection timing fixture (15434) 3375522

MATERIALS/PARTS
Gasket (as required) (15434) 3011878 (M915/Big Cam I)
Gasket (15434) 302000 (M915A1/Big Cam III)
Gasket (as required) (15434) 3020001, 3020002, 3020003, 3020004 (M915A1/Big Cam III)

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

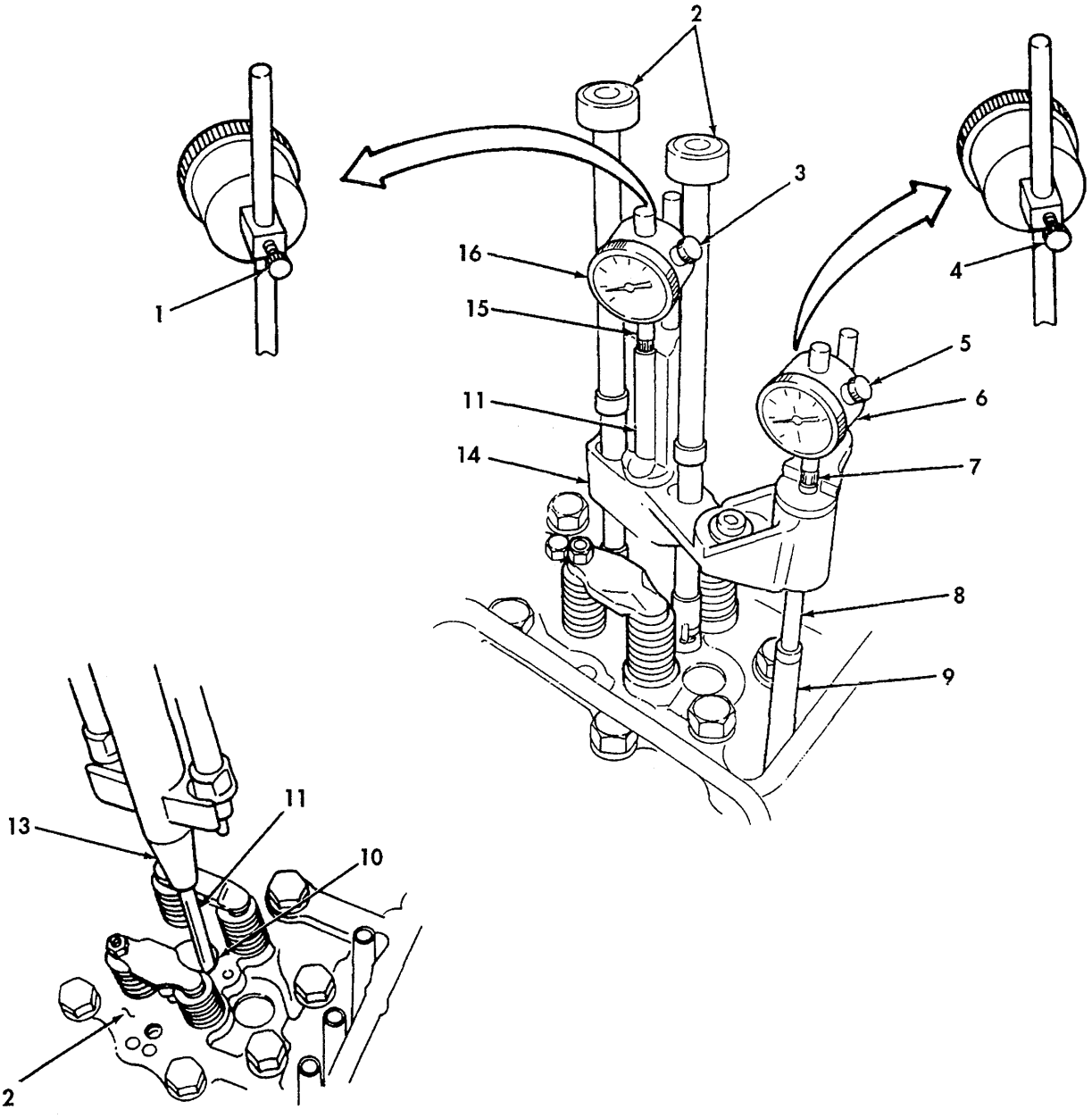
EQUIPMENT CONDITION
Cylinder head assemblies and pushrods installed (para. 3-71).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS
a. Setup		
1. Injection timing fixture (14)	Install as follows:	Use injection timing fixture (3375522).
	a. Loosen piston and pushrod dial indicator setscrews (1) and (4). Slide both dial indicators (6) and (16) to the uppermost position and tighten setscrews (1) and (4).	This is necessary to prevent damage to both dial indicators during tool installation, and when trying to locate Top Dead Center (TDC).
	b. Position timing fixture sleeve (13) with piston follower rod (11) into injector sleeve (10) of No. 1 cylinder.	
	c. Secure in two threaded holes with two knurled holddowns (2).	Ensure injection timing fixture (14) is mounted straight on cylinder head (12).
	d. Align pushrod follower rod (8) with injector pushrod (9).	

3-72. INJECTION TIMING (Contd)



LEGEND:

1. PISTON DIAL INDICATOR SETSCREW
2. KNURLED HOLDDOWN (2)
3. PISTON DIAL INDICATOR THUMBSCREW
4. PUSHROD DIAL INDICATOR SETSCREW
5. PUSHROD DIAL INDICATOR THUMBSCREW
6. PUSHROD DIAL INDICATOR
7. PUSHROD DIAL INDICATOR STEM
8. PUSHROD FOLLOWER ROD
9. INJECTOR PUSHROD
10. INJECTOR SLEEVE
11. PISTON FOLLOWER ROD
12. CYLINDER HEAD
13. TIMING FIXTURE SLEEVE
14. INJECTION TIMING FIXTURE
15. PISTON DIAL INDICATOR STEM
16. PISTON DIAL INDICATOR

3-72. INJECTION TIMING (Contd)

LOCATION/ITEM	ACTION	REMARKS

b. Injection Timing Cylinder No.

CAUTION

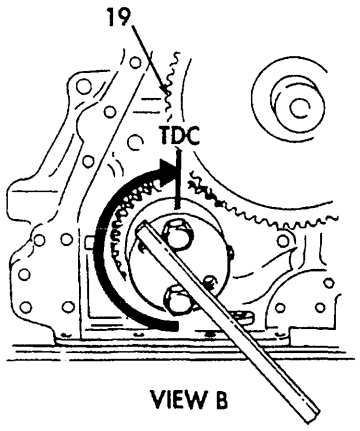
Injection timing for No. 1 cylinder requires that No. 1 piston be set at TDC. TDC will occur during both compression stroke and exhaust stroke. Injection timing is performed when piston is at TDC on compression stroke.

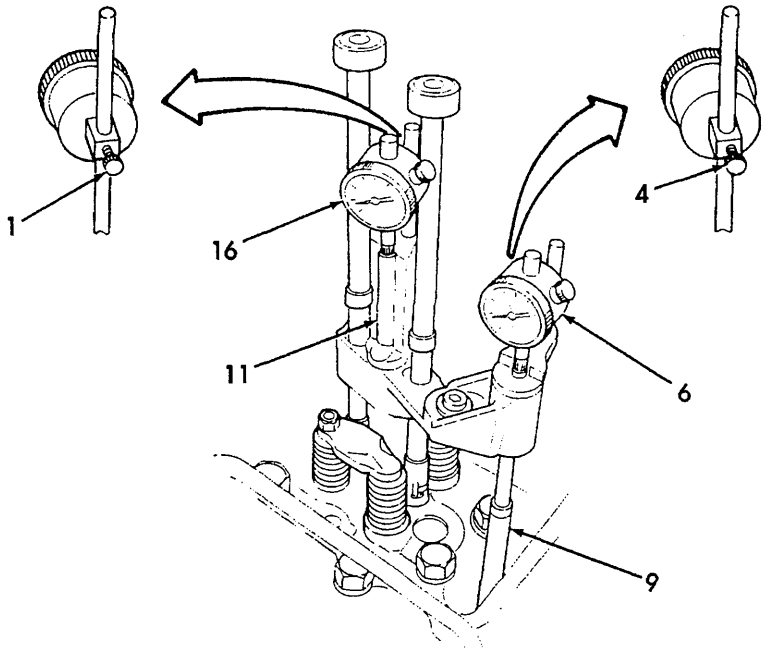
NOTE

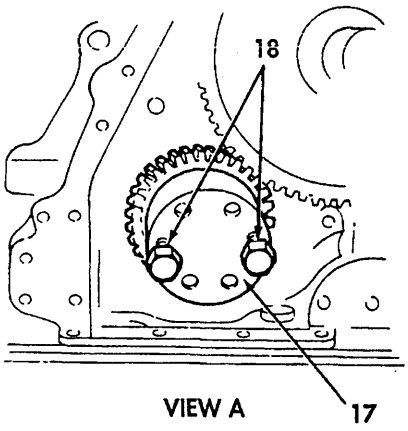
- **Adjustments to injection timing are made by altering thickness of cam follower assembly gaskets.**
- **Injection timing may be advanced or retarded by adding or removing cam follower assembly gaskets.**
- **Use cylinder Nos. 1, 3, and 5 to check injection timing.**
- **Dial indicators used in injection timing must have a total travel of at least 0.25 in. (6.350 mm).**
- **Ensure camshaft is pushed in every time crankshaft is rotated.**
- **Use only the crankshaft to rotate engine. The use of gears will result in false measurements. Gear lash must be closed up in the direction of normal rotation (crankshaft rotating clockwise when facing crankshaft front pulley).**

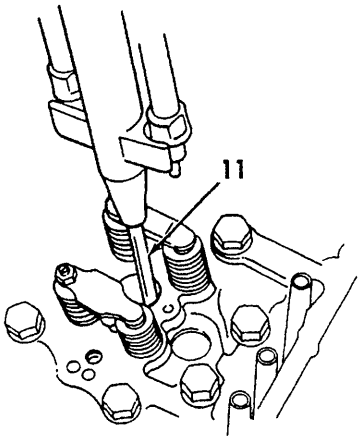
2.	Two screws (18)	Install on threaded holes on front of crankshaft (17). See view A.	The two screws (18) will be used for turning crankshaft (17) to locate TDC (19).
3.	Crankshaft (17)	Rotate clockwise to TDC (19) on compression stroke, using a suitable bar between two screws (18). Refer to view B.	TDC can be determined when both rods (9) and (11) start moving upward. Continue rotating until piston follower rod (11) reaches its uppermost travel position. When TDC (19) is determined, remove two screws (18) and install on locations shown in view A.
4.	Piston dial indicator (16) and pushrod dial indicator (6)	Adjust as follows: a. Move both downward until seated on piston follower rod (11) in their fully compressed position. b. Raise both approximately 0.02 in. (0.508 mm). c. Lock in place with piston dial indicator setscrew (1) and push-rod dial indicator setscrew (4).	

3-72. INJECTION TIMING (Contd)









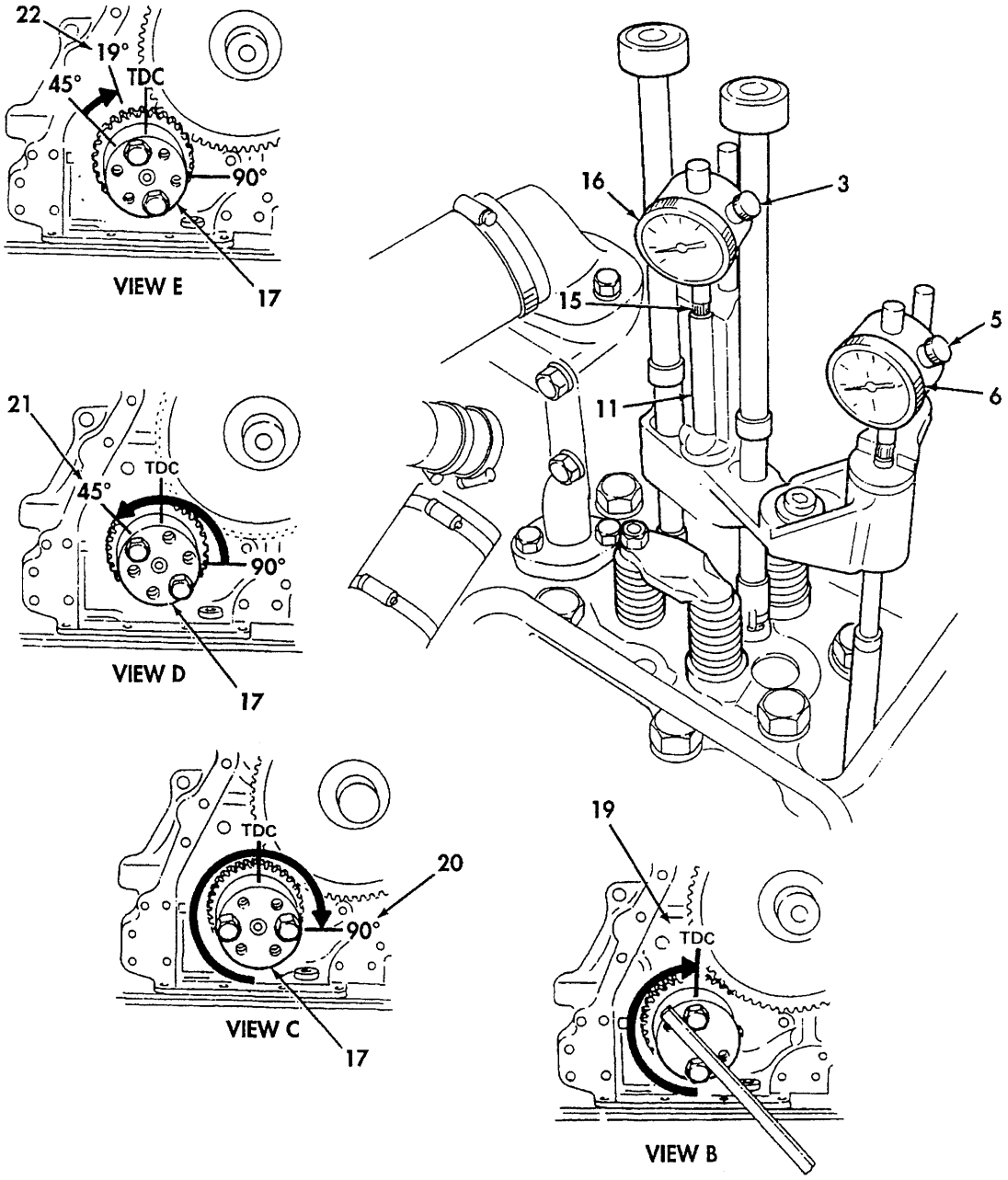
LEGEND:

1. PISTON DIAL INDICATOR SETSCREW
4. PUSHROD DIAL INDICATOR SETSCREW
6. PUSHROD DIAL INDICATOR
9. INJECTOR PUSHROD
11. PISTON FOLLOWER ROD
16. PISTON DIAL INDICATOR
17. CRANKSHAFT
18. SCREW (2)
19. TOP DEAD CENTER (TDC)

3-72. INJECTION TIMING (Contd)

LOCATION/ITEM	ACTION	REMARKS
b. Injection Timing Cylinder No. 1 (Contd)		
5. Crankshaft (17)	Slowly rotate several degrees clockwise and counterclockwise to ensure piston is at TDC (19) and pushrod dial indicator (6) is at TDC. Refer to view B.	The piston dial indicator (16) and pushrod dial indicator (6) will move in the same direction when piston is on compression stroke.
	NOTE **Always set dial indicator at zero at TDC with crankshaft having just been rotated in the direction of normal rotation (clockwise).**	
6. Piston dial indicator thumbscrew (3)	Loosen and adjust face of piston dial indicator (16) to align zero with pointer. Tighten piston dial indicator thumbscrew (3).	
7. Crankshaft (17)	Rotate clockwise 90° after TDC (20). Refer to view C.	Piston follower rod (11) will be near bottom of its travel.
8. Pushrod dial indicator thumbscrew (5)	Loosen and adjust face of push-rod dial indicator (6) to align zero with the pointer. Tighten piston rod dial indicator thumbscrew (5).	
9. Crankshaft (17)	a. Rotate counterclockwise past TDC to 45° before TDC (21). Refer to view D. b. Slowly rotate clockwise to 19° before TDC (22) until piston follower rod (11) is almost in contact with piston dial indicator stem (15). Refer to view E.	This step is necessary to remove gear backlash and provide more accurate dial indicator readings for the next step.

3-72. INJECTION TIMING (Contd)



LEGEND:

3. PISTON DIAL INDICATOR THUMBSCREW
5. PUSHROD DIAL INDICATOR THUMBSCREW
6. PUSHROD DIAL INDICATOR
11. PISTON FOLLOWER ROD
15. PISTON DIAL INDICATOR STEM
16. PISTON DIAL INDICATOR
17. CRANKSHAFT
19. TOP DEAD CENTER (TDC)
20. 90° AFTER TDC
21. 45° BEFORE TDC
22. 19° BEFORE TDC

3-72. INJECTION TIMING (Contd)

LOCATION/ITEM	ACTION	REMARKS
b. Injection Timing Cylinder No. 1 (Contd)		
9. Crankshaft (17) (Contd)	c. Slowly rotate crankshaft (17) clockwise until piston dial indicator (16) reads 0.0032 in. (0.0813 mm) before zero.	This reading of 0.0032 in. (0.0813 mm) is actually 0.2032 in. (5.1613 mm) before zero since piston dial indicator (16) will have reached over 0.200 in. (5.08 mm) as the crankshaft (17) was moved to 45 degrees before TDC (21). Refer to view E. Each revolution of the dial indicator hand represents 0.100 in. (2.54 mm).
	d. Read total travel of pointer on pushrod dial indicator (6).	Each mark on pushrod dial indicator (6) represents 0.001 in. (0.025 mm).

NOTE

- **Engine assembly, as described in this section, is with the assumption that all units have been repaired or are new and are ready to be assembled. During assembly operations, it is important to closely inspect each unit to make sure nothing has been overlooked during inspection and repair. Plugs should be checked for tightness, parts kept clean, openings covered, and machined surfaces protected. Application of any type lubricant should be performed from covered containers.**
- **The timing code for this engine is <u>BM</u> Big Cam I or <u>BY</u> Big Cam III, reference the engine data plate. Code <u>BM</u> is used for CPL 324 and 327. Code <u>BY</u> is used for CPL 393.**

	BM Big Cam I (CPL 324 and 327)	BY Big Cam III (CPL 393)
Nominal	0.053 in. (1.35 mm)	0.070 in. (1.78 mm)
Fast	.0.052 in. (1.32 mm)	.0.069 in. (1.75 mm)
Slow	0.054 in. (1.37 mm)	0.070 in. (1.78 mm)

	e. Reading on pushrod dial indicator (6) should be within 0.069-0.071 in. (1.752-1.803 mm) for Big Cam III or 0.053-0.054 in. (1.35-1.37 mm) for Big Cam I.	If reading is not within limits, follow the procedures in task c., Changing Injection Timing.
	f. If push rod travel is greater than limits indicated above, engine timing is slow. If the push rod travel is less, timing is fast.	

c. Changing Injection Timing

CAUTION

Never change cam follower assembly gaskets to correct injection timing until checking the following:

- **Timing tool is correctly installed.**
- **Dial indicators are correctly adjusted.**
- **Crankshaft has been rotated in the correct direction.**
- **Screws for cam follower assemblies have been tightened to 30-35 lb-ft (41-48 N•m).**

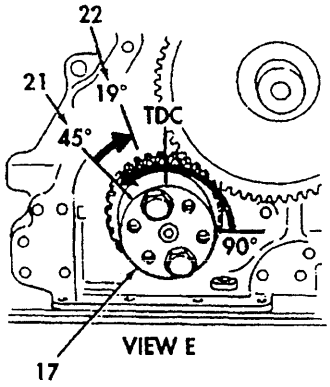
3-72. INJECTION TIMING (Contd)

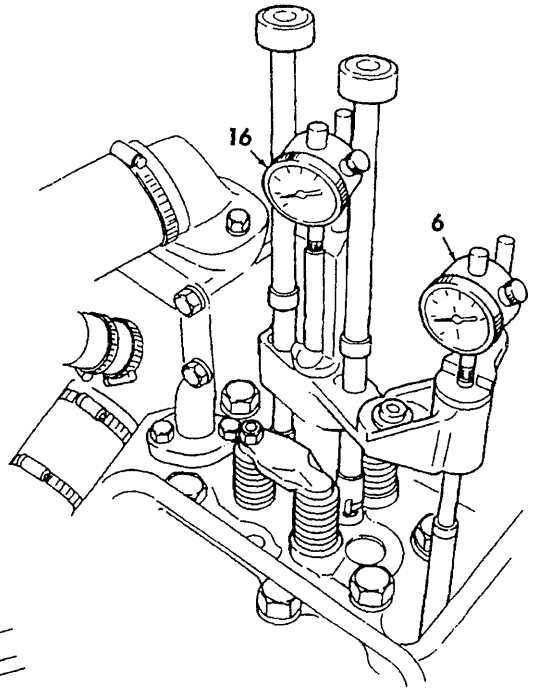
c. Changing Injection Timing

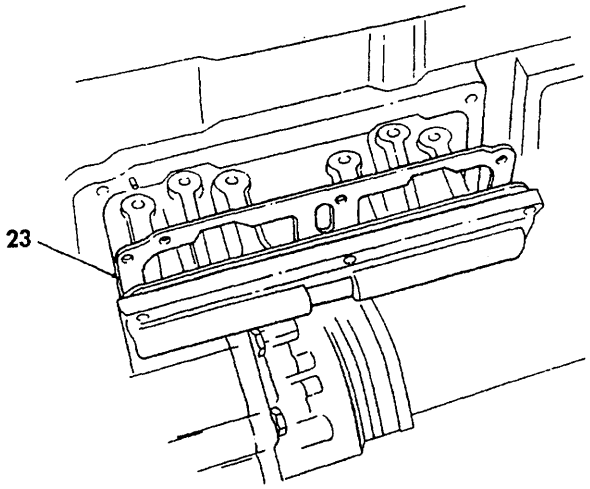
NOTE

Do not increase the total gasket thickness to more than 0.080 in. (2.032 mm). The minimum total thickness must be at least 0.014 in. (0.356 mm).

10.	Cam follower assembly gasket (23)	Advance or retard timing as follows:	
		a. Advance timing by increasing thickness of cam follower assembly gasket (23).	Cam follower assembly gaskets are available in three thicknesses. Thickness sizes vary between M915/Big Cam I and M915A1/Big Cam III engine series.







LEGEND:

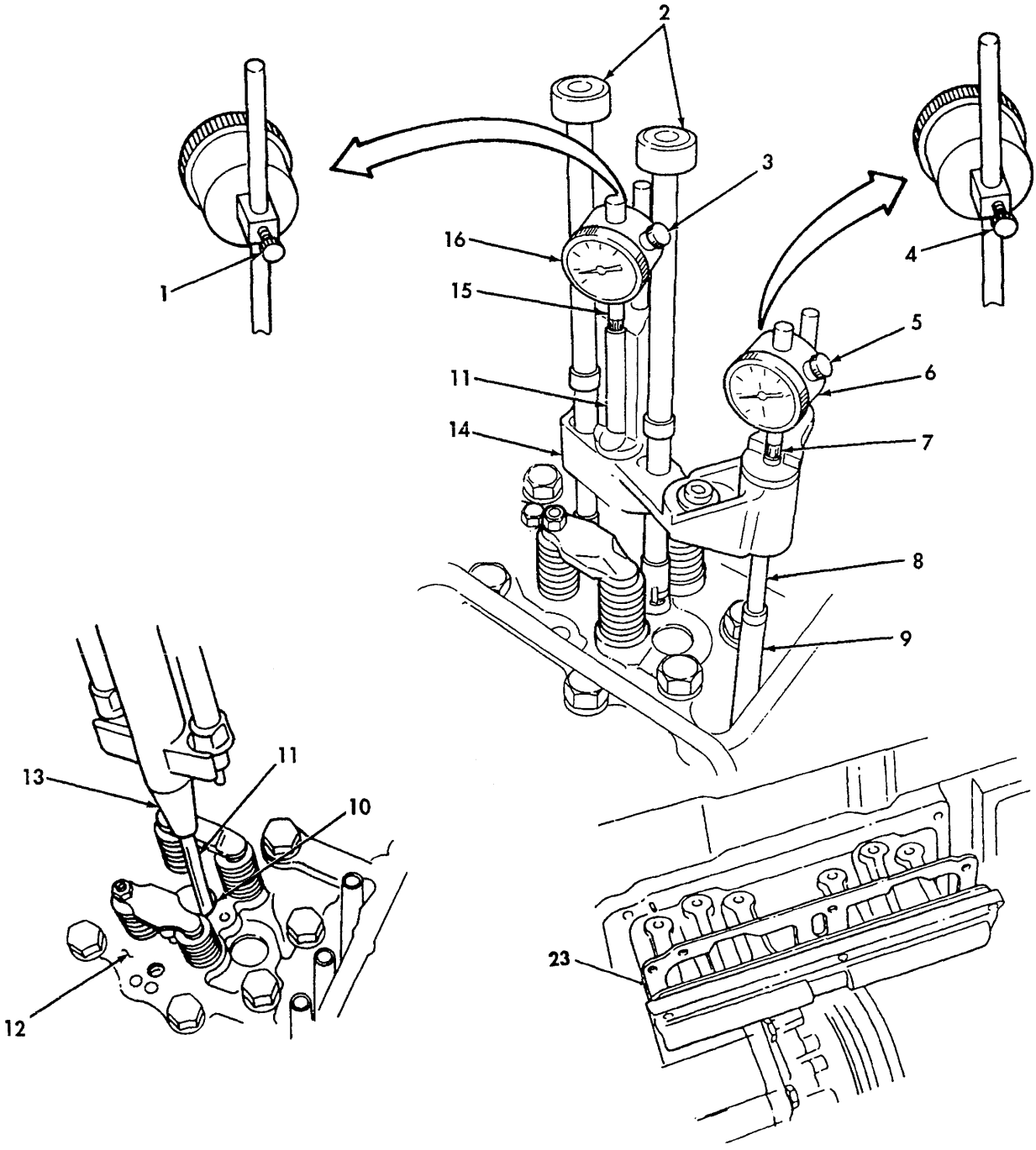
6. PUSHROD DIAL INDICATOR
16. PISTON DIAL INDICATOR
17. CRANKSHAFT
21. 45° BEFORE TDC
22. 19° BEFORE TDC
23. CAM FOLLOWER ASSEMBLY GASKET

3-72. INJECTION TIMING (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Changing Injection Timing (Contd)		
		Refer to para. 3-28 for cam follower assembly gasket removal, and para. 3-70 for cam follower assembly gasket installation.
	b. Retard timing by decreasing thickness of cam follower assembly gasket (23).	Refer to para. 3-28 for cam follower assembly gasket removal, and para. 3-70 for cam follower assembly gasket installation.
d. Injection Timing Cylinder No. 3		
	NOTE **The injection timing procedure for cylinder No. 3 is similar to timing No. 1 cylinder with one exception; the timing fixture must be moved to cylinder No. 3 and piston No. 3 must be used as the reference for determining Top Dead Center (TDC).**	
e. Injection Timing Cylinder No. 5		
	NOTE **The injection timing procedure for cylinder No. 5 is similar to timing No. 1 cylinder with one exception; the timing fixture must be moved to cylinder No. 5 and piston No. 5 must be used as reference for determining TDC.**	

FOLLOW-ON TASK: Install accessory drive housing assembly (para. 3-73).

3-72. INJECTION TIMING (Contd)



LEGEND:

1. PISTON DIAL INDICATOR SETSCREW
2. KNURLED HOLDDOWN (2)
3. PISTON DIAL INDICATOR THUMBSCREW
4. PUSHROD DIAL INDICATOR SETSCREW
5. PUSHROD DIAL INDICATOR THUMBSCREW
6. PUSHROD DIAL INDICATOR
7. PUSHROD DIAL INDICATOR STEM
8. PUSHROD FOLLOWER ROD
9. INJECTOR PUSHROD
10. INJECTOR SLEEVE
11. PISTON FOLLOWER ROD
12. CYLINDER HEAD
13. TIMING FIXTURE SLEEVE
14. INJECTION TIMING FIXTURE
15. PISTON DIAL INDICATOR STEM
16. PISTON DIAL INDICATOR
23. CAM FOLLOWER ASSEMBLY GASKET (3)

3-73. ACCESSORY DRIVE HOUSING ASSEMBLY INSTALLATION

THIS TASK COVERS:

Installation

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
None

TEST EQUIPMENT
Dial gauge attachment (15434) ST-1325
Dial indicator and sleeve assembly (15434) 3376050

MATERIALS/PARTS
Gasket (15434) 200809

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

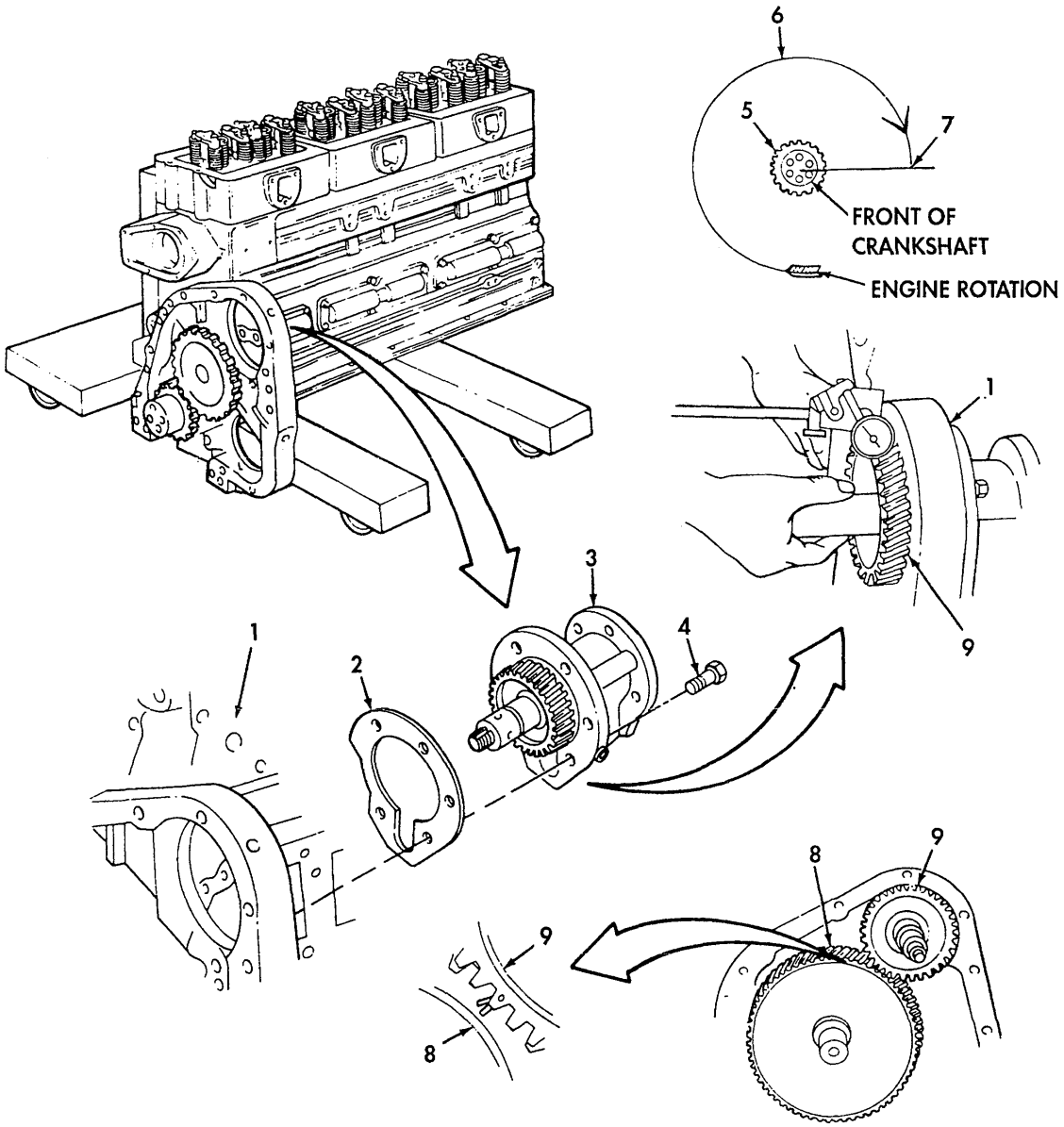
EQUIPMENT CONDITION
Camshaft and cam followers installed (para. 3-70).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS
Installation		
1. Crankshaft (5)	a. Turn in direction of engine rotation until No. 1 cylinder is at Top Dead Center (TDC) of compression stroke (6). b. Turn in direction of engine rotation to 90° after (TDC) (7).	Rotate crankshaft clockwise when facing front of crankshaft (5).
2. Accessory drive housing assembly (3) and new gasket (2)	Position on cylinder block (1).	Ensure timing mark on accessory drive gear (9) lines up with timing mark on camshaft gear (8). This alignment is necessary so that valve and injector adjustment marks on accessory drive pulley will be correctly aligned.
3. Five captive washer screws (4)	Install on accessory drive housing assembly (3), gasket (2), and cylinder block (1).	Tighten to 40-45 lb-ft (54-61 N•m).
4. Accessory drive gear (9) and camshaft gear (8)	Check accessory drive gear-to-camshaft gear backlash as follows: a. Install dial indicator on front of cylinder block (1), and position tip of indicator against a tooth of accessory drive gear (9).	Use dial gauge attachment (ST-1325) and dial indicator and sleeve assembly (3376050).

3-73. ACCESSORY DRIVE HOUSING ASSEMBLY INSTALLATION (Contd)



LEGEND:

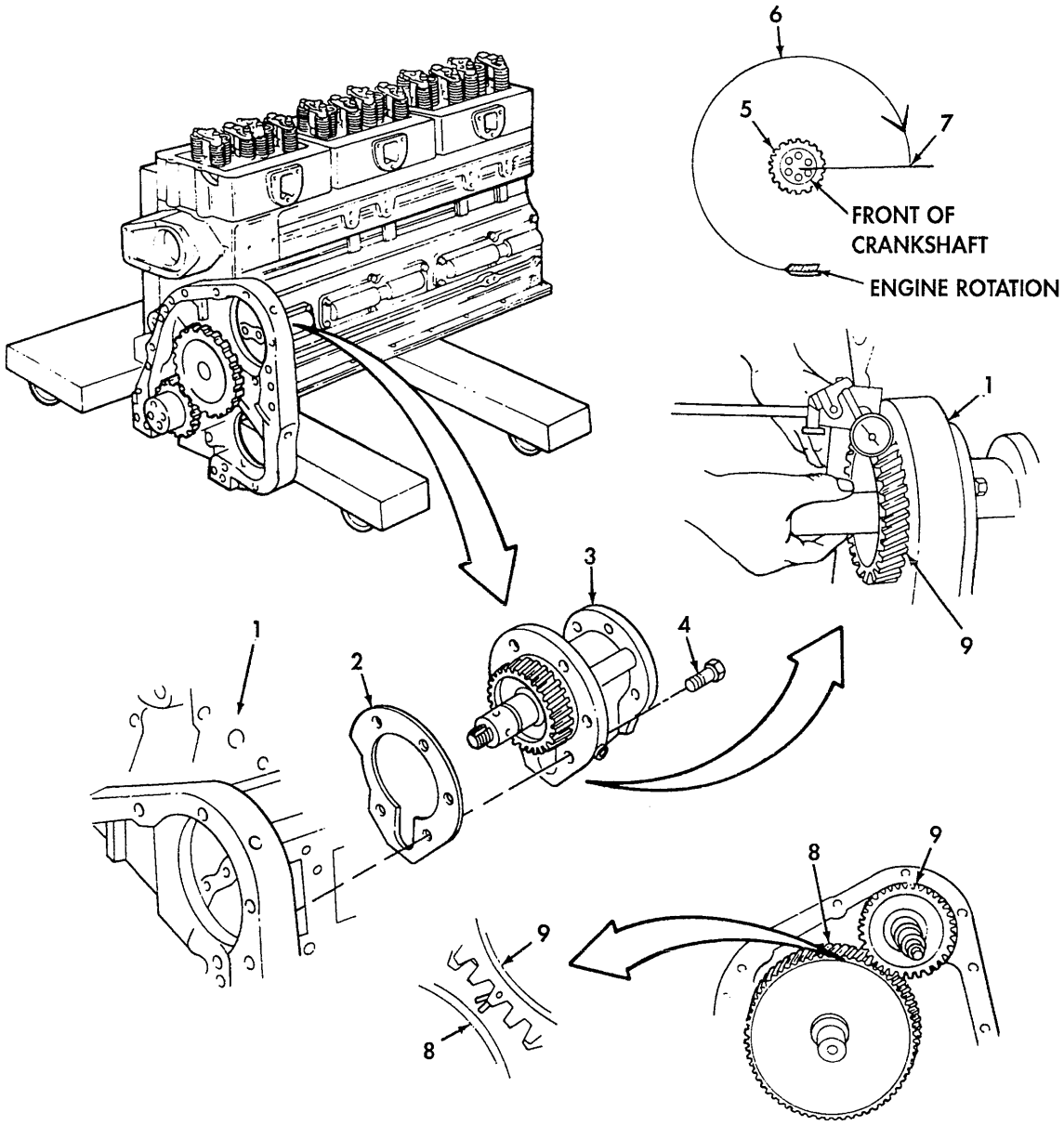
1. CYLINDER BLOCK
2. GASKET
3. ACCESSORY DRIVE HOUSING ASSEMBLY
4. CAPTIVE WASHER SCREW (5)
5. CRANKSHAFT
6. TOP DEAD CENTER (TDC) OF COMPRESSION STROKE
7. 90° AFTER TOP DEAD CENTER
8. CAMSHAFT GEAR
9. ACCESSORY DRIVE GEAR

3-73. ACCESSORY DRIVE HOUSING ASSEMBLY INSTALLATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
Installation (Contd)		
4. Accessory drive gear (9) and camshaft gear (8) (Contd)	b. Rotate accessory drive gear (9) as far as it will freely move.	Ensure camshaft gear (8) does not move.
	c. Turn dial on indicator to zero.	
	d. Rotate accessory drive gear (9) in opposite direction. Reading on indicator shows amount of backlash between gears.	Normal backlash between a new accessory drive gear (9) and a new camshaft gear (8) is 0.004-0.016 in. (0.102-0.406 mm). Backlash for new accessory drive gear (8) must be at least 0.002 in. (0.051 mm). If backlash is more than 0.016 in. (0.406 mm), remove accessory drive housing assembly (3) and replace accessory drive gear (9) (para. 3-49).

FOLLOW-ON TASK: Install oil pump (para. 3-74).

3-73. ACCESSORY DRIVE HOUSING ASSEMBLY INSTALLATION (Contd)



LEGEND:

3. ACCESSORY DRIVE HOUSING ASSEMBLY
8. CAMSHAFT GEAR
9. ACCESSORY DRIVE GEAR

3-74. OIL PUMP INSTALLATION

THIS TASK COVERS:

Installation

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
None

TEST EQUIPMENT
Dial gauge attachment (15434) ST-1325
Dial indicator and sleeve assembly (15434) 3376050

MATERIALS/PARTS
Sealant, pipe (Appendix C, Item 26)
Gasket (15434) 121907 (M915/Big Cam I)
Gasket (15434) 3031434 (M915A1/Big Cam III)
Five lockwashers (15434) S610
Five lockwashers (96906) MS35338-47

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

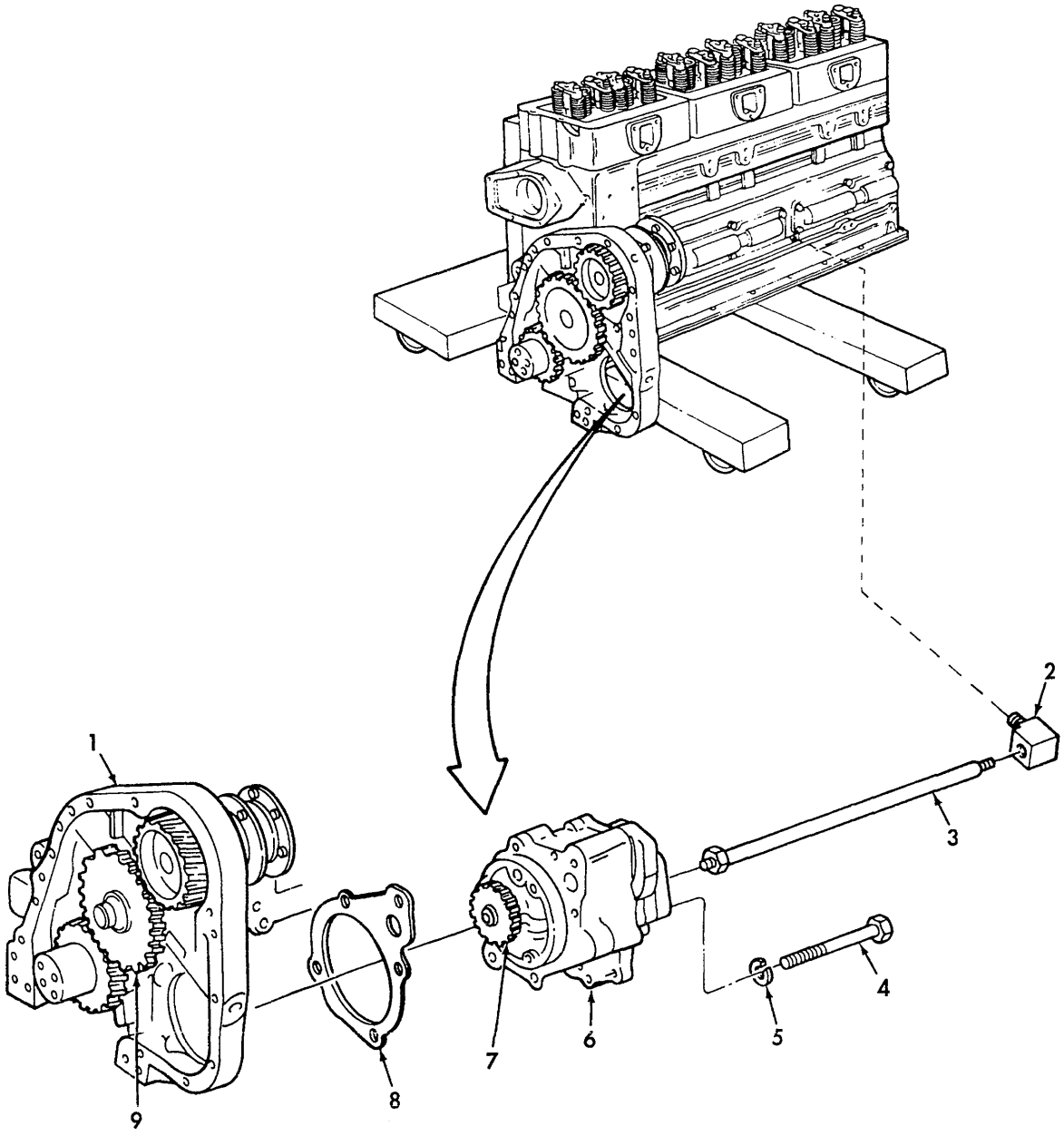
EQUIPMENT CONDITION
Accessory drive housing assembly installed (para. 3-73).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS
Installation		
	NOTE **Perform steps 1 through 6 for M915A1/Big Cam III only.**	
1. Elbow (2) (M915A1/Big Cam III)	Install on cylinder block (1).	Coat threads with pipe sealant.
2. Oil transfer hose (3) (M915A1/Big Cam III)	Install on elbow (2).	Coat threads with pipe sealant.
3. New gasket (8) (M915A1/Big Cam III)	Install on oil pump assembly (6).	
4. Oil pump assembly (6) (M915A1/Big Cam III)	Position in mounting hole of cylinder block (1).	Ensure that pump drive gear (7) of oil pump assembly (6) aligns with teeth of camshaft gear (9).
5. Five screws (4) and new lockwashers (5) (M915A1/Big Cam III)	Install on oil pump assembly (6) and cylinder block (1).	Tighten to 45 lb-ft (61 N•m).
6. Oil transfer hose (3) (M915A1/Big Cam III)	Install loose end of oil transfer hose (3) to oil pump assembly (6).	Coat threads with pipe sealant.

3-74. OIL PUMP INSTALLATION (Contd)



M915A1/BIG CAM III ONLY

LEGEND:

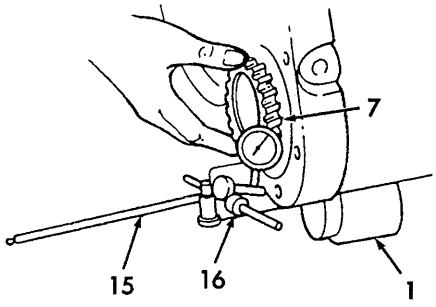
1. CYLINDER BLOCK
2. ELBOW (M915A1/BIG CAM III)
3. OIL TRANSFER HOSE (M915A1/BIG CAM III)
4. SCREW (5) (M915A1/BIG CAM III)
5. LOCKWASHER (5) (M915A1/BIG CAM III)
6. OIL PUMP ASSEMBLY (M915A1/BIG CAM III)
7. PUMP DRIVE GEAR
8. GASKET (M915A1/BIG CAM III)
9. CAMSHAFT GEAR

3-74. OIL PUMP INSTALLATION (Contd)

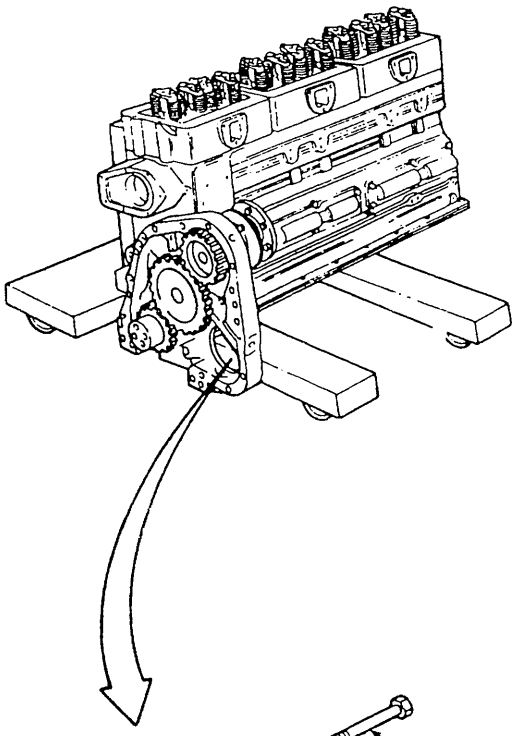
LOCATION/ITEM	ACTION	REMARKS
Installation (Contd)		
	NOTE **Perform steps 7 through 9 for M915/Big Cam I only.**	
7. New gasket (10) (M915/ Big Cam I)	Install on oil pump assembly (11).	
8. Oil pump assembly (11) (M915/Big Cam I)	Position in mounting hole of cylinder block (1).	Ensure pump drive gear (7) of oil pump assembly (11) aligns with teeth on camshaft gear (9).
9. Three screws (12), two screws (14), and five new lockwashers (13) (M915/ (Big Cam I)	Install on oil pump assembly (11) and cylinder block (1).	Tighten to 40 lb-ft (54 N•m).
	NOTE **The oil pump gear backlash check procedure is identical for both M915/Big Cam I and M915A1/Big Cam III engines.**	
10. Pump drive gear (7) (M915/ Big Cam I and M915A1/ Big Cam III)	Check for backlash against camshaft gear (9) as follows:	
	(1) Install dial indicator and sleeve assembly (16) and dial gauge attachment (15) on front of cylinder block (1), and position tip of indicator (16) against a tooth of pump drive gear (7).	Use dial gauge attachment (15) (ST-1325) and dial indicator and sleeve assembly (16) (3376050).
	(2) Rotate pump drive gear (7) as as far as it will freely move.	Ensure camshaft gear (9) does not move.
	(3) Turn dial of indicator to zero.	
	(4) Rotate pump drive gear (7) in opposite direction. The reading on indicator (16) shows amount of backlash between gears.	Minimum backlash is 0.002 in. (0.051 mm) and maximum backlash is 0.016 in. (0.406 mm). Replace pump drive gear (7) if not within specifications. Refer to para. 3-44 for pump drive gear (7) removal and installation.

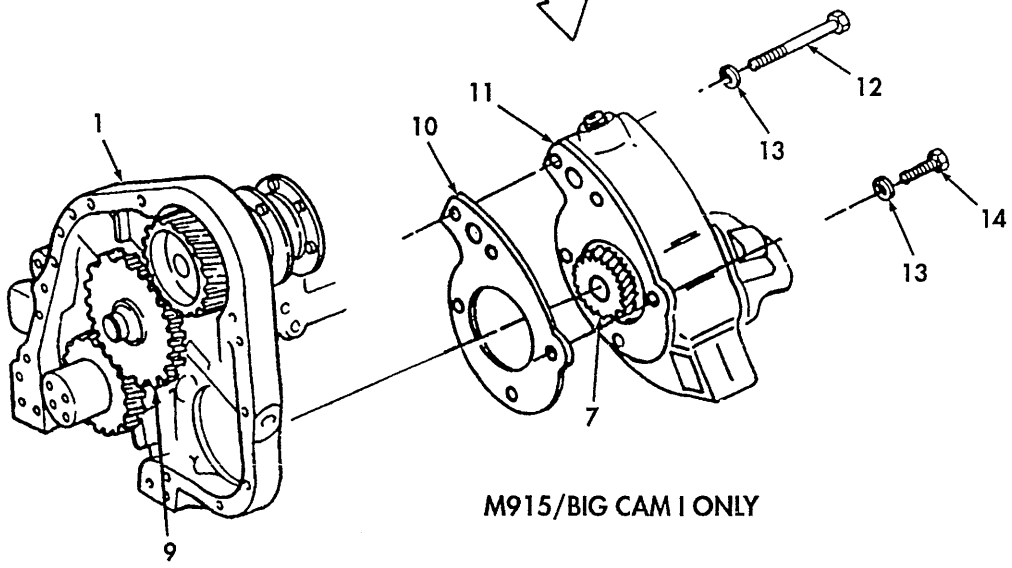
FOLLOW-ON TASK: Install front gear cover (para. 3-75).

3-74. OIL PUMP INSTALLATION (Contd)



OIL PUMP GEAR BACKLASH CHECK (BOTH M915/BIG CAM I AND M915A1/BIG CAM III ENGINE SERIES)





M915/BIG CAM I ONLY

LEGEND:

1. CYLINDER BLOCK
7. PUMP DRIVE GEAR
9. CAMSHAFT GEAR
10. GASKET (M915/BIG CAM I)
11. OIL PUMP ASSEMBLY (M915/BIG CAM I)
12. SCREW (3) (M915/BIG CAM I)
13. LOCKWASHER (5) (M915/BIG CAM I)
14. SCREW (2) (M915/BIG CAM I)
15. DIAL GAUGE ATTACHMENT
16. DIAL INDICATOR AND SLEEVE ASSEMBLY

3-75. FRONT GEAR COVER INSTALLATION

THIS TASK COVERS:

Installation

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Dial gauge attachment (15434) ST-1325
Dial indicator and sleeve assembly (15434) 3376050

TEST EQUIPMENT
None

MATERIALS/PARTS
Lubricant, high-pressure (Appendix C, Item 15)
Gasket (15434) 3021704
Lockwasher (96906) MS35338-47 (M915/Big Cam I)
Preformed packing (15434) 215705
Shim (as required) (15434) 185573, 65259-A, 65259-B, 65259-C
Three lockwashers (15434) S-604 (M915/Big Cam I)

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Table 2-1

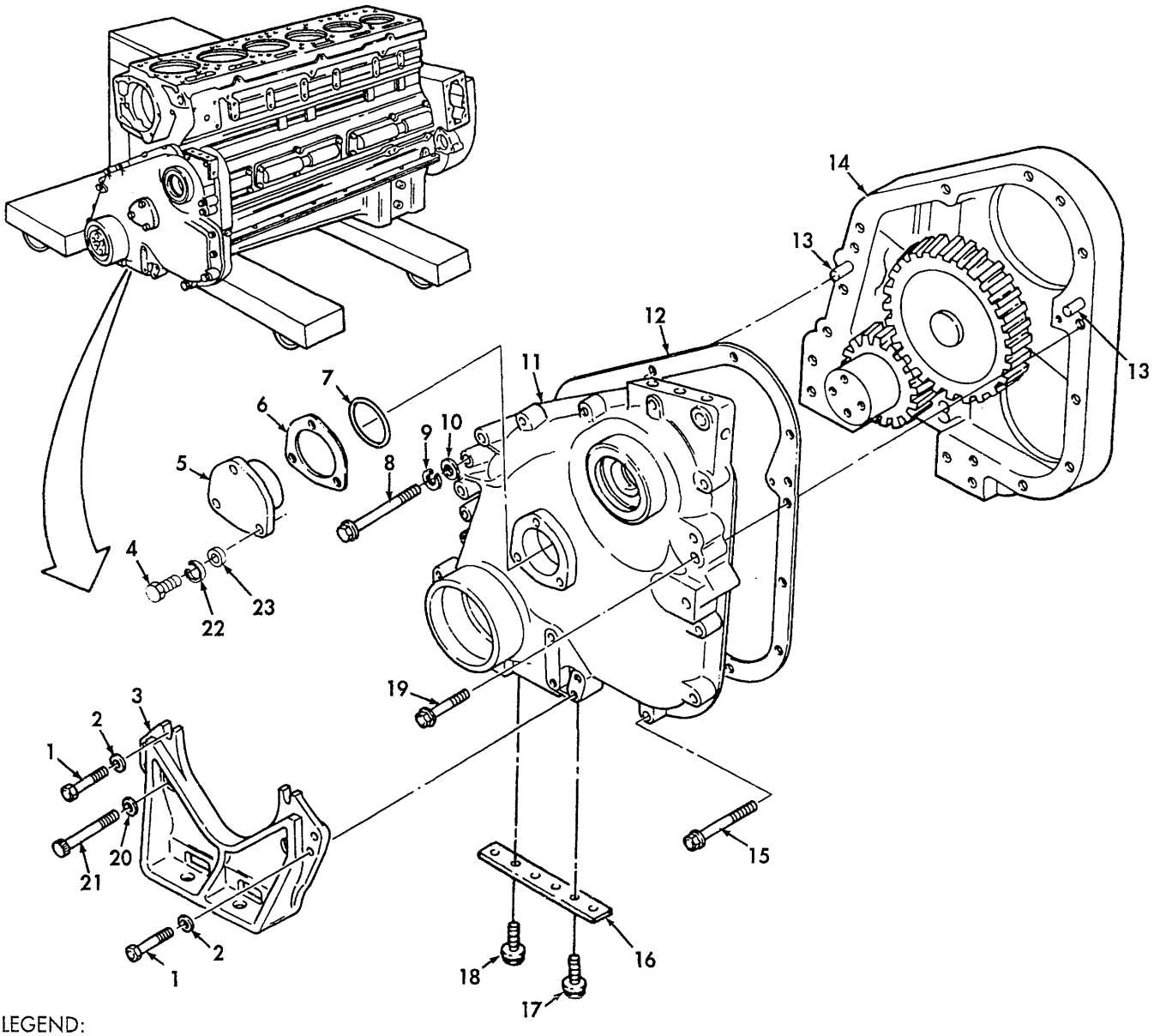
EQUIPMENT CONDITION
Oil pump installed (para. 3-74).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS
Installation		
	NOTE • **To replace crankshaft and accessory drive oil seals, refer to para. 3-48.** • **Perform step 1 for M915/Big Cam I only.** • **Perform step 2 for M915A1/Big Cam III only.**	
1. Three screws (4), lockwashers (22), and washers (23)	Remove from camshaft support (5). Remove camshaft support (5), shim pack (6), and preformed packing (7) from gear cover (11).	These parts must be removed before installing gear cover (11).
2. Three captive washer screws (4)	Remove from camshaft support (5). Remove camshaft support (5), shim pack (6), and preformed packing (7) from gear cover (11).	These parts must be removed before installing gear cover (11).
	CAUTION **All surfaces in contact with oil seals must be completely free of oil. Oil on a Teflon seal will destroy its sealing properties.**	
3. New gasket (12)	a. Coat with high-pressure lubricant. b. Install on gear cover (11).	
4. Gear cover (11) with gasket (12)	Install on two dowels (13) and cylinder block (14).	

3-75. FRONT GEAR COVER INSTALLATION (Contd)



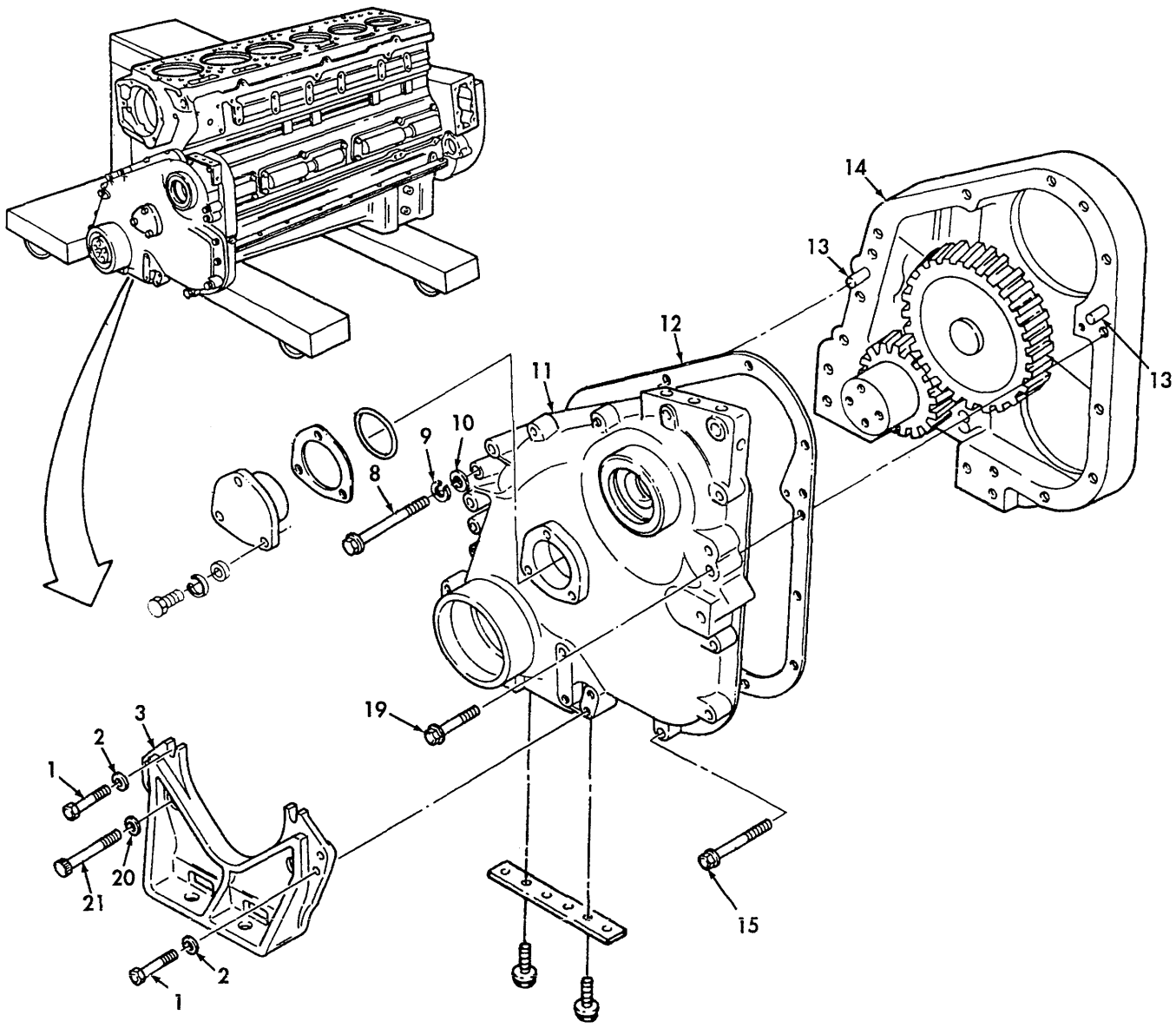
LEGEND:

1. SCREW (6)
2. WASHER (6)
3. FRONT ENGINE SUPPORT
4. SCREW (3) (M915/BIG CAM I)
   CAPTIVE WASHER SCREW (3) (M915A1/BIG CAM III)
5. CAMSHAFT SUPPORT
6. SHIM PACK
7. PREFORMED PACKING
8. SCREW (M915/BIG CAM I)
   CAPTIVE WASHER SCREW (2) (M915A1/BIG CAM III)
9. LOCKWASHER (M915/BIG CAM I)
10. WASHER (M915/BIG CAM I)
11. GEAR COVER
12. GASKET
13. DOWEL (2)
14. CYLINDER BLOCK
15. CAPTIVE WASHER SCREW
16. ENGINE SHIPPING SUPPORT
17. CAPTIVE WASHER SCREW (4) (M915A1/BIG CAM III)
18. SCREW (4) (M915/BIG CAM I)
19. CAPTIVE WASHER SCREW (9)
20. WASHER (2) (M915/BIG CAM I)
21. SCREW (2) (M915/BIG CAM I)
    CAPTIVE WASHER SCREW (2) (M915A1/BIG CAM III)
22. LOCKWASHER (3) (M915/BIG CAM I)
23. WASHER (3) (M915/BIG CAM I)

3-75. FRONT GEAR COVER INSTALLATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
Installation (Contd)		
	NOTE • **Perform step 5 for M915/Big Cam I only.** • **Perform step 6 for M915A1/Big Cam III only.**	
5. Screw (8), lockwasher (9), washer (10), captive washer screw (15), and nine captive washer screws (19)	Install on gear cover (11) and cylinder block (14).	Tighten screw (8), and captive washer screws (15) and (19) to 45-55 lb-ft (61-75 N•m).
6. Three captive washer screws (8), captive washer screw (15), and nine captive washer screws (19)	Install on gear cover (11) and cylinder block (14).	Tighten captive washer screws (8), (15), and (19) to 45-55 lb-ft (61-75 N•m).
7. Front engine support (3)	Position on gear cover (11).	
	NOTE • **Perform step 8 for 1M915/Big Cam I only.** • **Perform step 9 for M915A1/Big Cam III only.**	
8. Six screws (1), washers (2), two screws (21), and washers (20)	Install on front engine support (3) and gear cover (11).	Tighten screws (1) and (21) to 45-55 lb-ft (61-75 N•m).
9. Six screws (1), washers (2), two captive washer screws (21)	Install on front engine support (3) and gear cover (11).	Tighten screw (1) and captive washer screws (21) to 45-55 lb-ft (61-75 N•m).
10. New gasket (12)	Trim off excess gasket material so gasket (12) is even with oil pan mounting flange.	
11. Gear cover (11)	a. Using straightedge and feeler gauge, check alignment of oil pan mounting flange on gear cover (11) with oil pan mounting flange on cylinder block (14).	Gear cover flange must be even with front cylinder block flange within 0.004 in. (0.102 mm).
	b. Check for difference between centers of crankshaft and crankshaft seal bore in gear cover (11) as follows:	
	(1) Install a dial indicator on front of crankshaft, and position tip of indicator against inner surface of crankshaft seal bore.	Use dial gauge attachment (ST-1325) and dial indicator and sleeve assembly (3376050).
	(2) Turn dial of indicator to zero.	
	(3) Rotate crankshaft one complete revolution. Reading on indicator shows difference.	If total indicator reading exceeds 0.010 in. (0.254 mm), remove, clean, and relocate between common centers.

3-75. FRONT GEAR COVER INSTALLATION (Contd)



LEGEND:

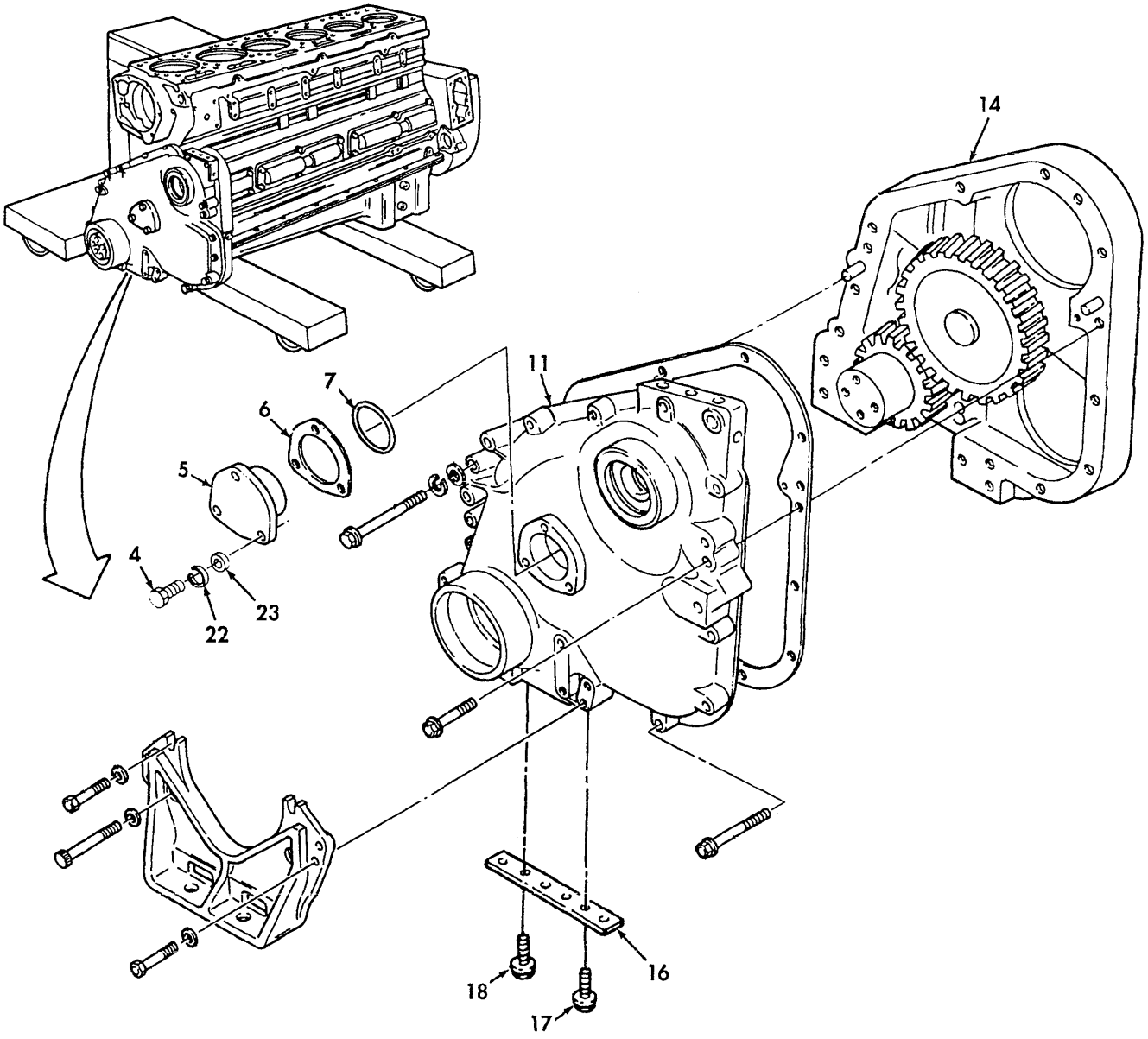
1. SCREW (6)
2. WASHER (6)
3. FRONT ENGINE SUPPORT
8. SCREW (M915/BIG CAM I)
   CAPTIVE WASHER SCREW (M915A1/BIG CAM III)
9. LOCKWASHER (M915/BIG CAM I)
10. WASHER (M915/BIG CAM I)
11. GEAR COVER
12. GASKET
13 DOWEL (2)
14. CYLINDER BLOCK
15. CAPTIVE WASHER SCREW
19. CAPTIVE WASHER SCREW (9)
20. WASHER (2) (M915/BIG CAM I)
21. SCREW (2) (M915/BIG CAM I)
    CAPTIVE WASHER SCREW (2) (M915A1/BIG CAM III)

3-75. FRONT GEAR COVER INSTALLATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
Installation (Contd)		
12. Camshaft support (5), shim pack (6), and preformed packing (7)	a. Remove shim pack (6) and preformed packing (7) from camshaft support (5).	
	b. Install camshaft support (5) on gear cover (11), and hold it against end of camshaft.	Ensure camshaft is pushed back against cylinder block (14).
	c. Using feeler gauge, measure space between mounting flange of camshaft support (5) and gear cover (11).	Use measurement to determine thickness of shim pack needed to provide 0.008-0.13 in. (0.203-3.302 mm) clearance. Shim packs are available in four different thicknesses.
	d. Remove camshaft support (5) from gear cover (11).	
	e. Install shim pack (6) and preformed packing (7) on camshaft support (5).	
	f. Install camshaft support (5), shim pack (6), and preformed packing (7) on gear cover (11).	
	NOTE • **Perform step 13 for M915/Big Cam I only.** • **Perform step 14 for M915A1/Big Cam III only.**	
13. Three screws (4), new lockwashers (22), and washers (23)	Install on camshaft support (5), shim pack (6), and gear cover (11).	Tighten screws (4) to 15-20 lb-ft (20-27 N•m).
14. Three captive washer screws (4)	Install on camshaft support (5), shim pack (6), and gear cover (11).	Tighten captive washer screws (4) to 15-20 lb-ft (20-27 N•m).
	NOTE **Perform steps 15 and 16 if oil pan is installed.**	
15. Engine shipping support (16)	Position on bottom front of engine oil pan.	
16. Four captive washer screws (17) (M915A1/Big Cam III) or four screws (18) (M915/Big Cam I)	Install on engine shipping support (16), engine oil pan, and gear cover (11).	Tighten captive washer screws or screws (18) to 35-40 lb-ft (48-54 N•m).

FOLLOW-ON TASK: Install accessory drive pulley (para. 3-76).

3-75. FRONT GEAR COVER INSTALLATION (Contd)



LEGEND:

4. SCREW (3) (M915/BIG CAM I)
   CAPTIVE WASHER SCREW (3) (M915/BIG CAM III)
5. CAMSHAFT SUPPORT
6. SHIM PACK
7. PREFORMED PACKING
11. GEAR COVER
14. CYLINDER BLOCK
16. ENGINE SHIPPING SUPPORT
17. CAPTIVE WASHER SCREW (4) (M915A1/BIG CAM III)
18. SCREW (4) (M915/BIG CAM I)
22. LOCKWASHER (3) (M915/BIG CAM I)
23. WASHER (3) (M915/BIG CAM I)

3-76. ACCESSORY DRIVE PULLEY INSTALLATION

THIS TASK COVERS:

Installation

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Pulley installation assembly tool
(15434) 3376326

TEST EQUIPMENT
None

MATERIALS/PARTS
Lubricant, high-pressure (Appendix C, Item 15)
Locknut (15434) 3012526

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
Front gear cover installed (para. 3-75).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area dean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM		ACTION	REMARKS
Installation			
		NOTE **Remove pipe plug from front gear cover and ensure timing marks on camshaft gear and accessory drive gear are aligned. Reinstall pipe plug in front gear cover and torque to 35-45 lb-ft (48-61 N•m).**	
1.	Accessory drive shaft (7)	Coat with high-pressure lubricant.	Refer to Appendix C, Item 15.
2.	Accessory drive pulley (4) (M915/Big Cam I) or accessory drive pulley assembly (6) (M915A1/Big Cam III)	a. Line up keyway with dowel pin (8) in accessory drive shaft (7).	
		b. Position on dowel pin (8) and drive shaft (7).	
		c. Install on accessory drive shaft (7) until seated.	Use pulley installation assembly tool (3376326).
		NOTE **Discard and replace keyway seal if it is deteriorated or damaged.**	
3.	Keyway seal (5)	Install on keyway of accessory drive pulley (4) (M915/Big Cam I) or accessory drive pulley assembly (6) (M915A1/Big Cam III).	Ensure short leg of keyway seal (5) faces toward inside of accessory drive shaft (7) and washer (3) will crush against "L" of seal (5).
4.	New locknut (2) and washer (3)	Install and tighten on accessory drive shaft (7).	Tighten locknut (2) to 300-310 lb-ft (407-420 N•m). Hold crankshaft at flywheel end when applying torque.

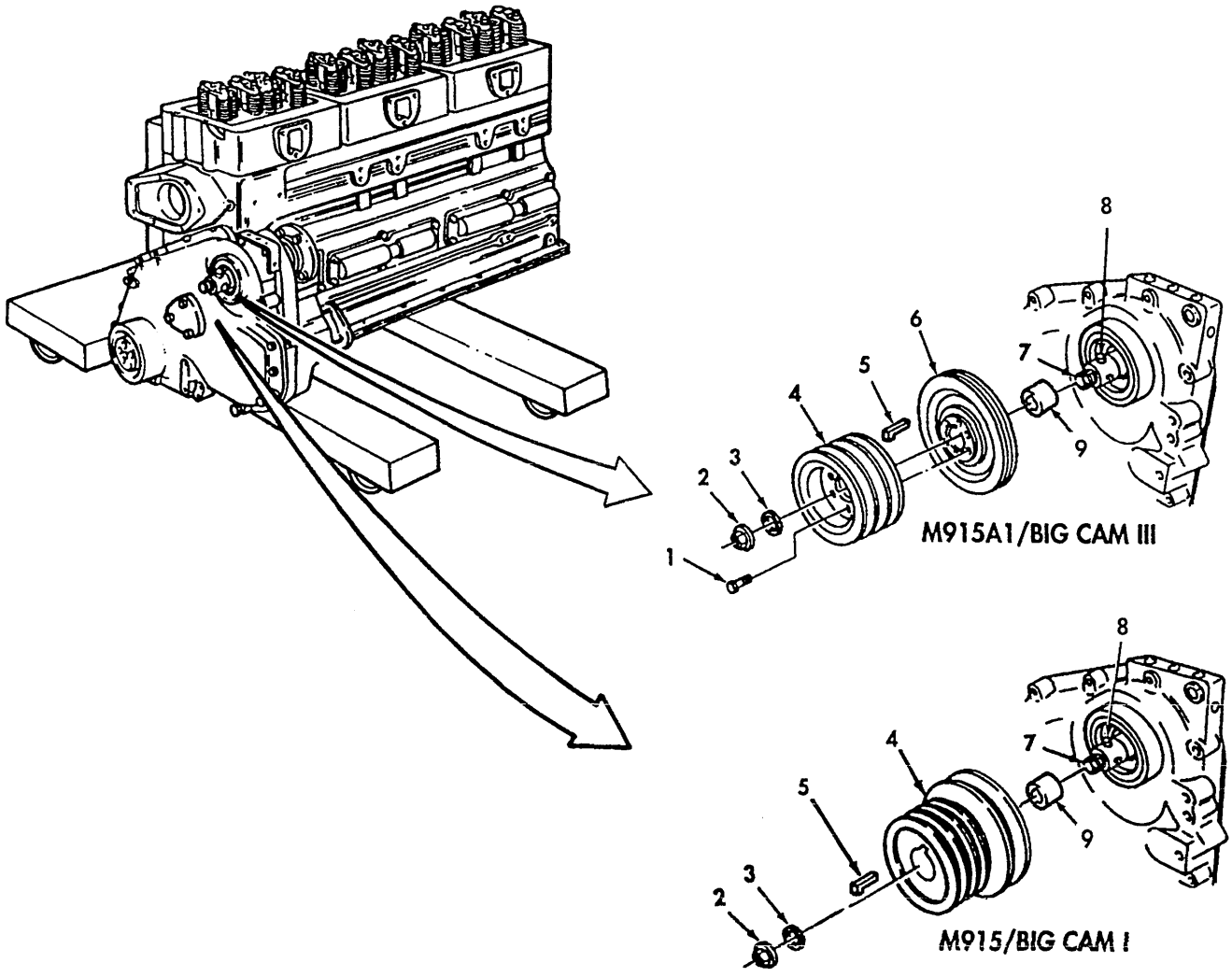
3-76. ACCESSORY DRIVE PULLEY INSTALLATION (Contd)

LOCATION/ITEM	ACTION	REMARKS

NOTE
Perform steps 5 and 6 for M915A1/Big Cam III only.

5.	Accessory drive pulley (4) (M915A1/Big Cam III)	Position on accessory drive pulley assembly (6).	
6.	Six screws (1) (M915A1/ Big Cam III)	Install on accessory drive pulley assembly (6).	Tighten screws (1) to 40-45 lb-ft (54-61 N•m).

FOLLOW-ON TASK: Install air compressor (para. 3-77).



LEGEND:

1. SCREW (6) (M915A1/BIG CAM III ONLY)
2. LOCKNUT
3. WASHER
4. ACCESSORY DRIVE PULLEY (M915/BIG CAM I ONLY)
5. KEYWAY SEAL
6. ACCESSORY DRIVE PULLEY ASSEMBLY (M915A1/BIG CAM III ONLY)
7. ACCESSORY DRIVE SHAFT
8. DOWEL PIN
9. SLEEVE

3-77. AIR COMPRESSOR INSTALLATION

THIS TASK COVERS:

Installation

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Air compressor wrench (15484) 3375159

TEST EQUIPMENT
None

MATERIALS/PARTS
Pipe sealant (Appendix C, Item 26)
Compressor gasket (15434) 3005962
Four lockwashers (15434) S-609

PERSONNEL REQUIRED
Automotive repairman MOS 63H

EQUIPMENT CONDITION
Oil pump installed (para. 3-74).

REFERENCES (TM)
None

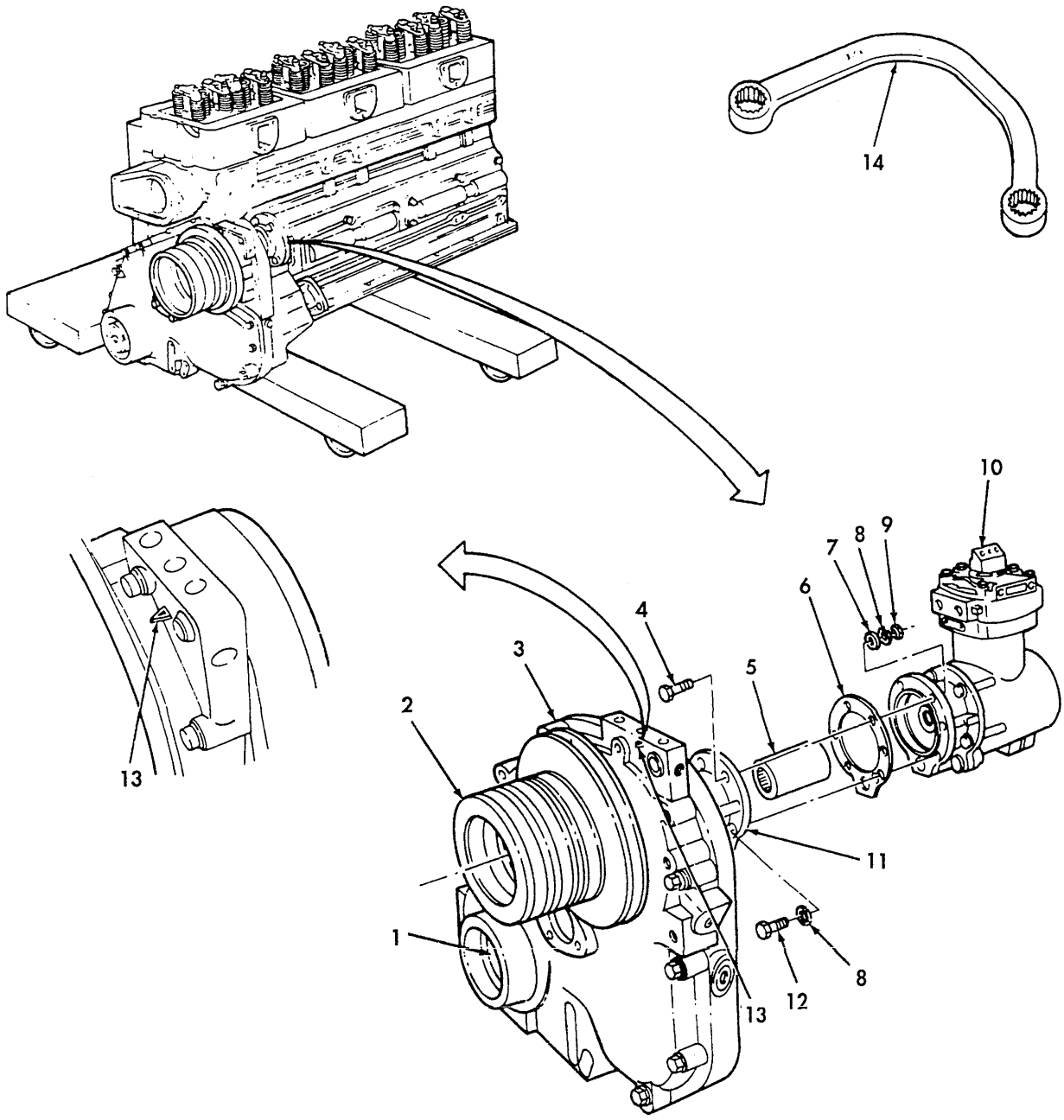
TROUBLESHOOTING REFERENCES
Para. 2-8

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dust and dirt.

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS
Installation		
	NOTE **Air compressor must be timed to engine firing order.**	
1. Crankshaft (1)	Rotate until valve set mark A on accessory drive pulley (2) is aligned with pointer (13) on front gear cover (3).	
2. Air compressor (10)	Look at hub end and rotate air compressor crankshaft until scribe mark on hub is positioned halfway between 9 and 10 o'clock.	
3. Drive coupling (5)	Install on air compressor (10).	
4. Air compressor (10) and new compressor gasket (6)	a. Install on accessory drive housing (11).	
	b. Secure with two screws (4) and (12), washers (7), four new lockwashers (8), and two nuts (9).	Tighten screws to 40-45 lb-ft (54-62 N•m). Use air compressor wrench (14).

3-77. AIR COMPRESSOR INSTALLATION (Contd)



LEGEND:

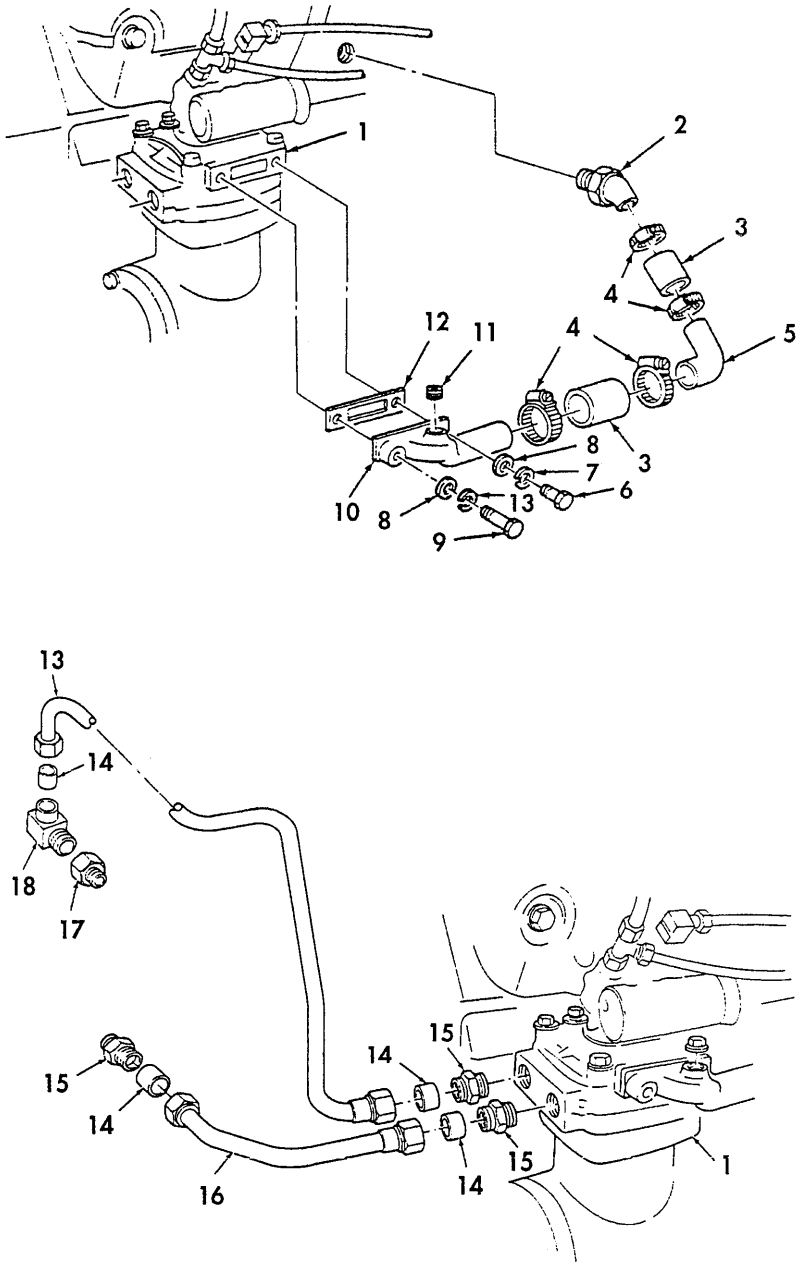
1. CRANKSHAFT
2. ACCESSORY DRIVE PULLEY
3. FRONT GEAR COVER
4. SCREW (2)
5. DRIVE COUPLING
6. COMPRESSOR GASKET
7. WASHER (2)
8. LOCKWASHER (4)
9. NUT (2)
10. AIR COMPRESSOR
11. ACCESSORY DRIVE HOUSING
12. SCREW (2)
13. POINTER
14. AIR COMPRESSOR WRENCH

3-77. AIR COMPRESSOR INSTALLATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
Installation (Contd)		
	NOTE • **Installation of air compressor coolant lines, air lines, and fittings is basically the same. The M915A1/Big Cam III is shown.** • **Not all engines are equipped with Air Supply Attenuators (ASAs).**	
5. Air inlet connector (10)	Install on compressor (1) with new gasket (12), two washers (8), new lockwashers (7), screws (9) and (6), and plug (11).	Apply pipe sealant to male pipe threads.
6. Two air inlet hoses (3) and tube (5)	Install on air inlet connector (10) and elbow (2) with four clamps (4).	
7. Three adapters (15), coupling (17), and elbow (18)	Install on compressor (1) and aftercooler.	Apply pipe sealant to male pipe threads.
8. Four bushings (14), coolant outlet tube (13), and coolant inlet tube (16)	Install on three adapters (15) and elbow (18).	

FOLLOW-ON TASKS:
- Install air compressor governor (TM 9-2320-273-34 or TM 9-2320-283-34).
- Install fuel pump (para. 3-78).

3-77. AIR COMPRESSOR INSTALLATION (Contd)



LEGEND:

1. COMPRESSOR
2. ELBOW
3. AIR INLET HOSE (2)
4. CLAMP (4)
5. TUBE
6. SCREW
7. LOCKWASHER (2)
8. WASHER (2)
9. SCREW
10. AIR INLET CONNECTOR
11. PLUG
12. GASKET
13. COOLANT OUTLET TUBE
14. BUSHING (4)
15. ADAPTER (3)
16. COOLANT INLET TUBE
17. COUPLING
18. ELBOW

3-78. FUEL PUMP INSTALLATION

THIS TASK COVERS:

a. Fuel Pump Installation
b. Fuel Supply Line Installation
c. Attenuator Air Tank Installation (M915/Big Cam I Only)

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Air compressor wrench (15434) 3375159

TEST EQUIPMENT
None

MATERIALS/PARTS
Gasket (15434) 3035053
Lockwasher (12204) 116122
Lockwasher (96906) MS353388-46
Two lockwashers (96906) MS122032 (M915/Big Cam I only)
Three lockwashers (15434) S604 (M915A1/Big Cam III only)

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

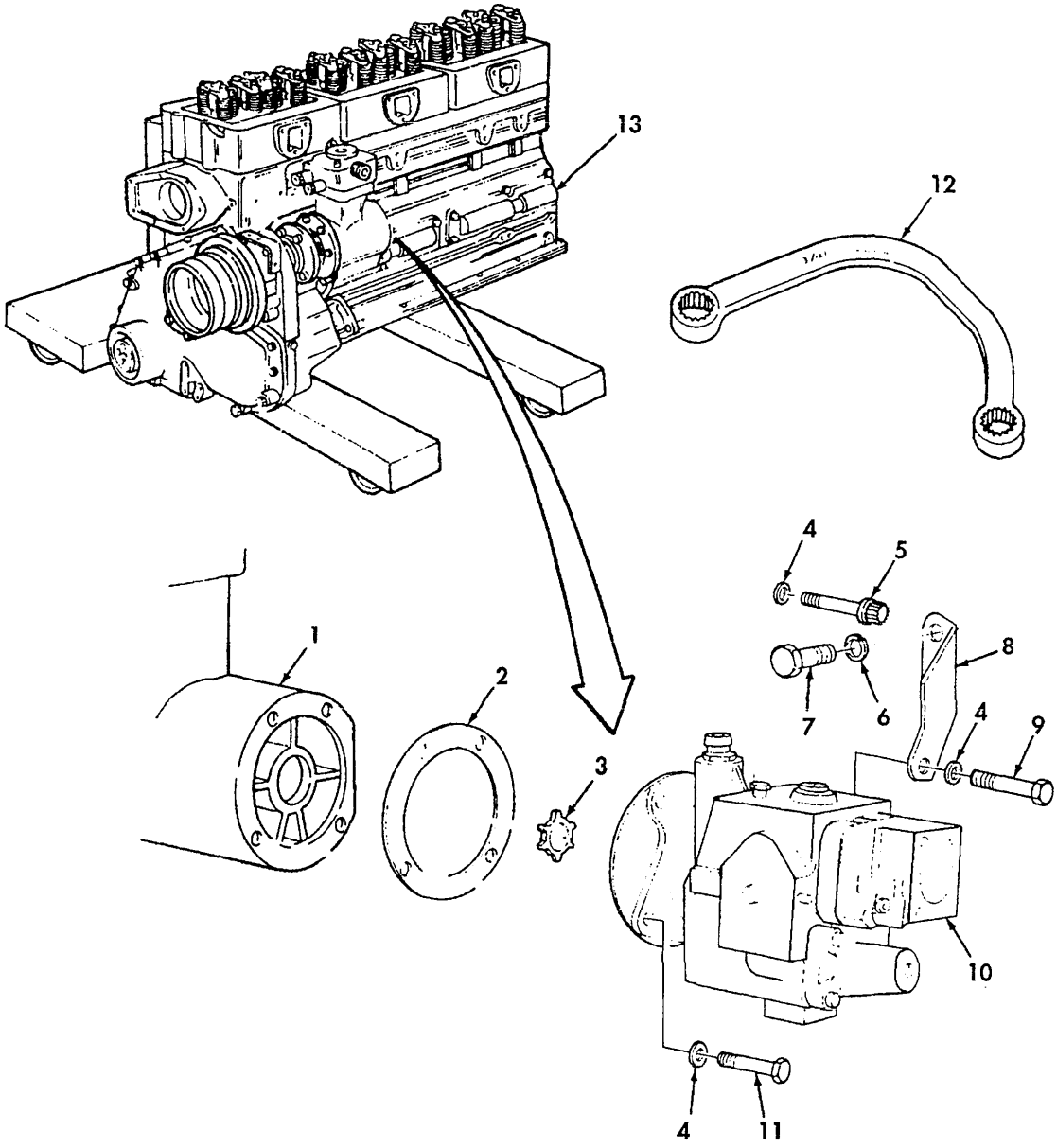
EQUIPMENT CONDITION
Air compressor installed (para. 3-77).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS
a. Fuel Pump Installation		
1. Fuel pump to compressor spider coupling (3)	Install on air compressor (1).	
2. Fuel pump (10) and new gasket (2)	Position on air compressor (1).	
3. Two screws (11) and washers (4)	Install on fuel pump (10), gasket (2), and into air compressor (1).	Tighten screws (11) finger-tight only.
4. Support bracket (8)	Position on fuel pump (10) and cylinder block (13).	
5. Screw (7) and new lockwasher (6)	Install on support bracket (8) and cylinder block (13).	Tighten screws (11) and (7).

3-78. FUEL PUMP INSTALLATION (Contd)



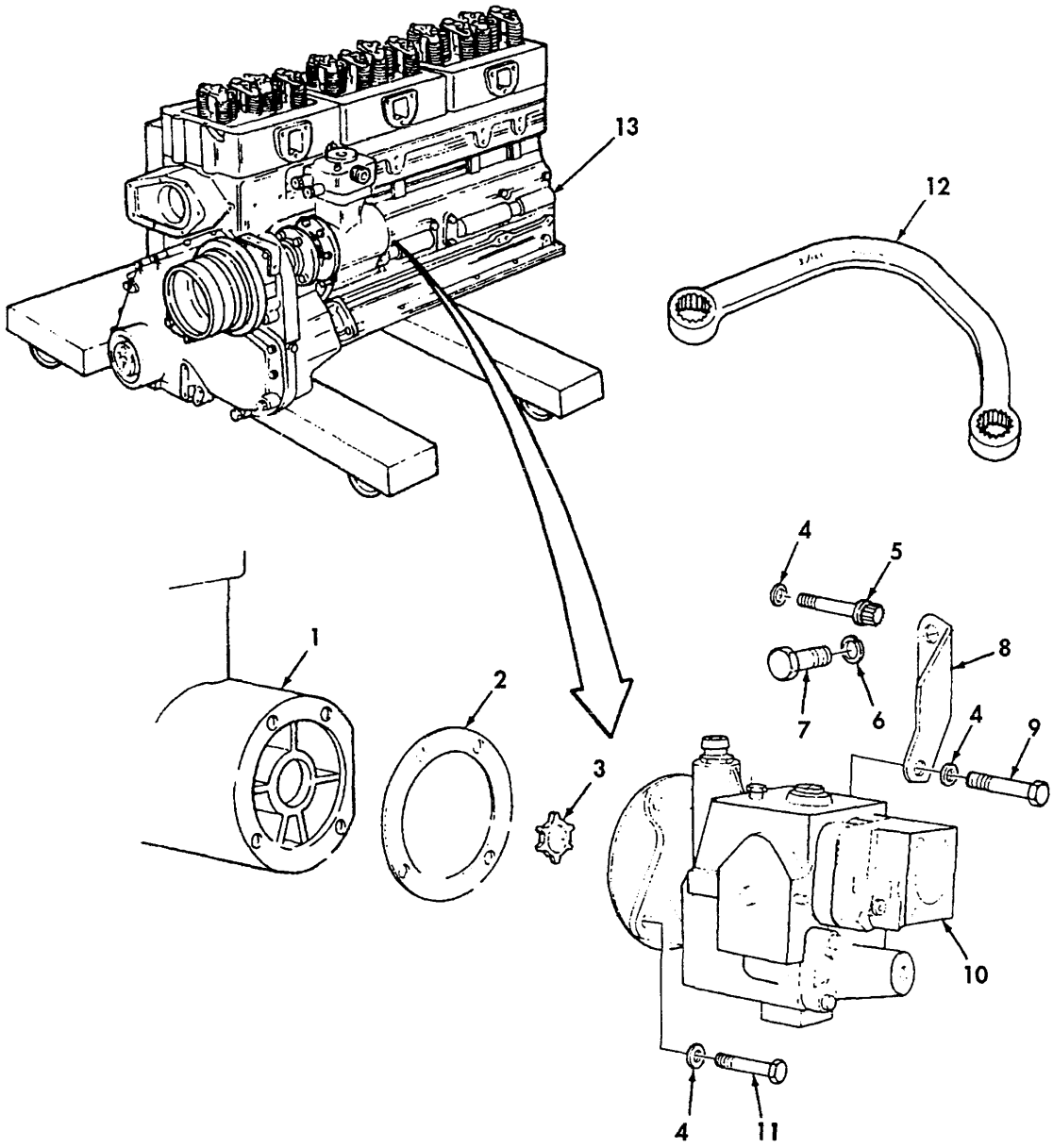
LEGEND:

1. AIR COMPRESSOR
2. GASKET
3. FUEL PUMP TO COMPRESSOR SPIDER COUPLING
4. WASHER (4)
5. SCREW (1) (M915A1/BIG CAM III), (2) (M915/BIG CAM I)
6. LOCKWASHER
7. SCREW
8. SUPPORT BRACKET
9. SCREW (M915A1/BIG CAM III ONLY)
10. FUEL PUMP
11. SCREW (2)
12. AIR COMPRESSOR WRENCH
13. CYLINDER BLOCK

3-78. FUEL PUMP INSTALLATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
a. Fuel Pump Installation (Contd)		
	NOTE • **Perform step 6 for M915/Big Cam I only.** • **Perform steps 7 and 8 for M915A1/Big Cam III only.**	
6. Two screws (5) and washers (4) (M915/Big Cam I)	Install on support bracket (8), fuel pump (10), gasket (2), and air compressor (1).	Use air compressor wrench (3375159) (12). Do not tighten screws (5) at this time.
7. Screw (9) and washer (4) (M915A1/Big Cam III)	Install on support bracket (8), fuel pump (10), gasket (2), and air compressor (1).	Use air compressor wrench (3375159) (12). Do not tighten screw (9) at this time.
8. One screw (5) and washer (4) (M915A1/Big Cam III)	Install on fuel pump (10), gasket (2), and air compressor (1).	Use air compressor wrench (3375159) (12).
9. Screws (5) and (9) (M915A1/Big Cam III)	Tighten to 30-35 lb-ft (41-48 N•m).	If air compressor wrench (12) is used, tighten screws until tight.
10. Tachometer drive	Connect to fuel pump (10).	Refer to TM 9-2320-283-20.

3-78. FUEL PUMP INSTALLATION (Contd)



LEGEND:

1. AIR COMPRESSOR
2. GASKET
4. WASHER (4)
5. SCREW (1) (M915A1/BIG CAM III), (2) (M915/BIG CAM I)
8. SUPPORT BRACKET
9. SCREW (M915A1/BIG CAM III ONLY)
10. FUEL PUMP
11. SCREW (2)
12. AIR COMPRESSOR WRENCH

3-78. FUEL PUMP INSTALLATION (Contd)

LOCATION/ITEM	ACTION	REMARKS

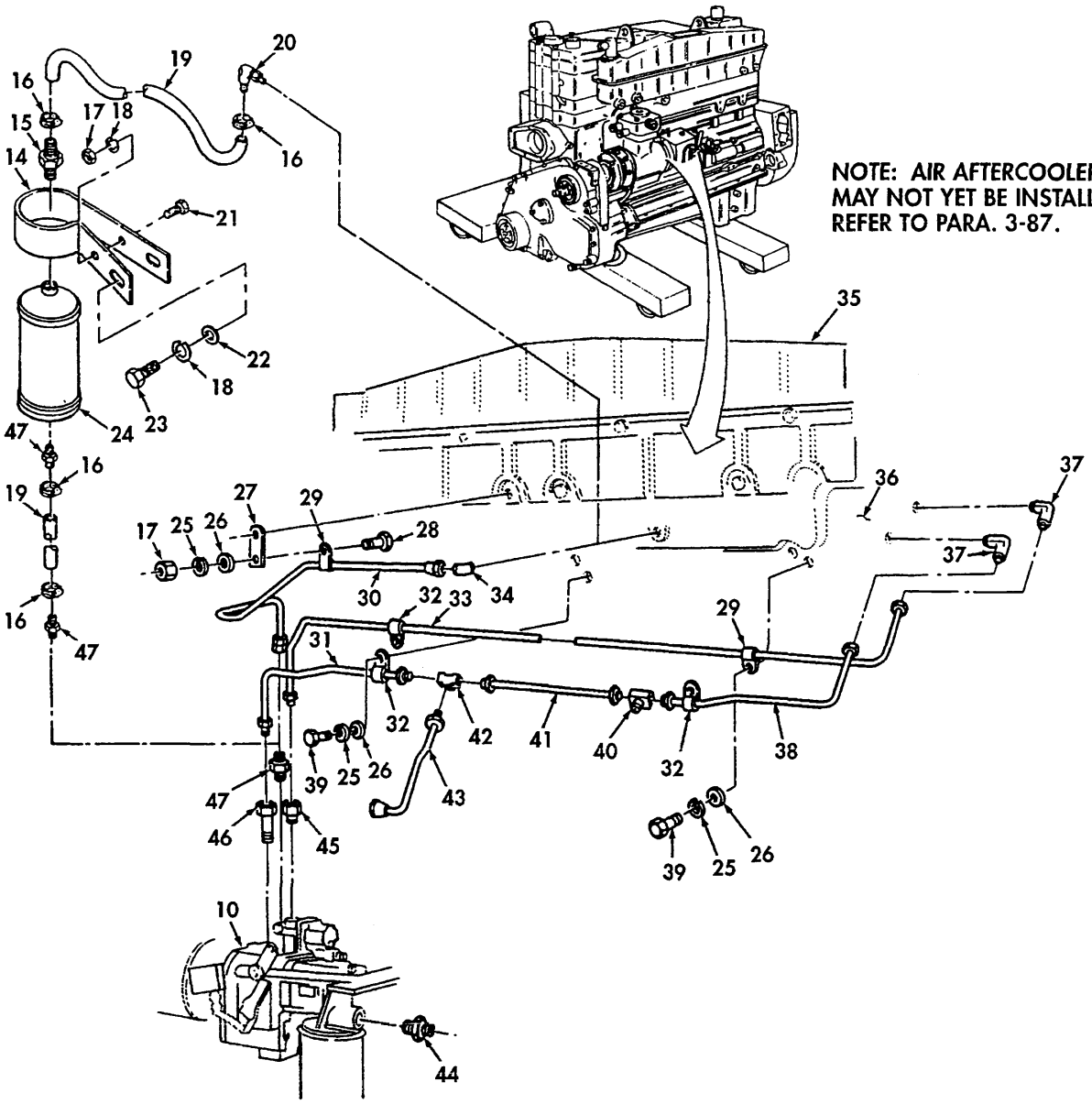
b. Fuel Supply Line Installation

NOTE

- **Apply Teflon tape or equivalent to fuel fittings. Use care not to contaminate or block fuel lines or fittings.**
- **If a fitting is not in alignment with the fuel tubing once torque has been performed, turn the fitting in the tightening direction until aligned. Do not loosen fitting to align.**
- **Tighten tubing nuts as follows: Tighten 5/16-in. tubing nuts to 17 lb-ft (23 N•m) and tighten 1/2-in. tubing nuts to 28 lb-ft (38 N•m).**

11.	Two elbows (37)	Install on cylinder head (36).
12.	Valve (46) and adapters (45) and (44)	Install on fuel pump (10).
13.	Fuel supply tube (33)	Install on adapter (45) and elbow (37).
14.	Fuel return tubes (31), (38), and (41), and tees (40) and (42)	Install on valve (46) and elbow (37).
15.	Fuel return tube (43)	Install on tee (42) and fuel pump (10).

3-78. FUEL PUMP INSTALLATION (Contd)



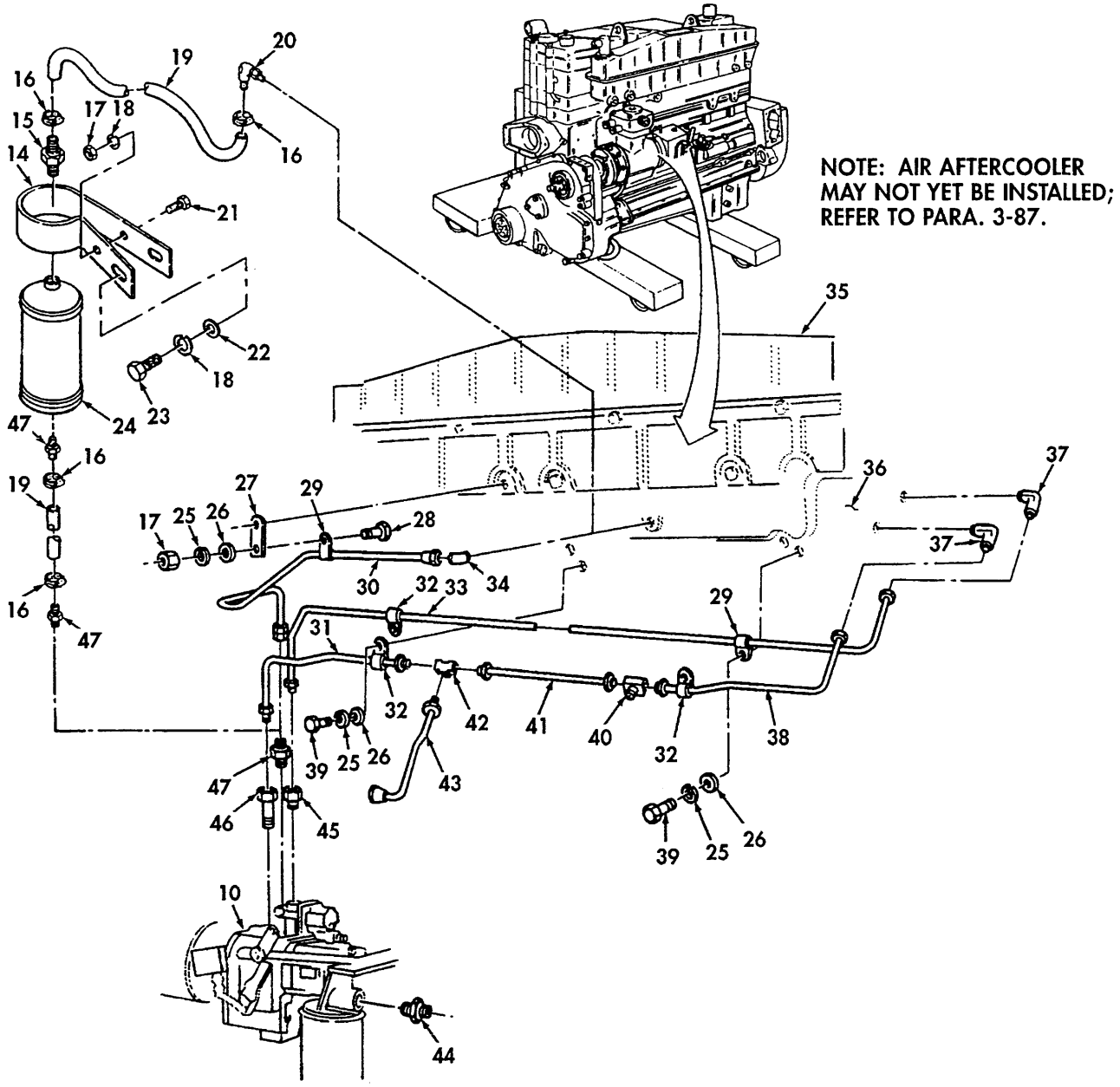
LEGEND:

10. FUEL PUMP
14. CLAMP
15. CHECK VALVE
16. HOSE CLAMP (4)
17. NUT (2)
18. LOCKWASHER (2)
19. AIR SUPPLY HOSE (M915/BIG CAM I ONLY)
20. ELBOW
21. SCREW
22. WASHER
23. SCREW
24. AIR TANK
25. LOCKWASHER (3)
26. WASHER (3)
27. BRACKET
28. SCREW
29. CLAMP (2)
30. AIR SUPPLY TUBE (M915A1/BIG CAM III ONLY)
31. FUEL RETURN TUBE
32. CLAMP (3)
33. FUEL SUPPLY TUBE
34. ADAPTER
35. AIR AFTERCOOLER
36. CYLINDER HEAD
37. ELBOW (2)
38. FUEL RETURN TUBE
39. SCREW (2)
40. TEE
41. FUEL RETURN TUBE
42. TEE
43. FUEL RETURN TUBE
44. ADAPTER
45. ADAPTER
46. VALVE
47 ADAPTER (3)

3-78. FUEL PUMP INSTALLATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
b. Fuel Supply Line Installation (Contd)		
16. Two screws (39), new lockwashers (25), and washers (26)	Install on three clamps (32), clamp (29), and cylinder head (36).	
17. Adapter (47)	Install on fuel pump (10).	
18. Adapter (34)	Install on air aftercooler (35).	Air aftercooler (35) may not yet be installed. Refer to para. 3-87.
19. Air supply tube (30)	Install on adapters (47) and (34).	Air aftercooler (35) may not yet be installed. Refer to para. 3-87.
	NOTE **Perform step 20 for M915A1/Big Cam III only.**	
20. Nut (17), new lockwasher (25), washer (26), and screw (28) (M915A1/Big Cam III)	Install on clamp (29) and bracket (27).	
21. Bracket (27)	Install on air aftercooler (35).	Air aftercooler (35) and ether starting kit must be installed prior to installation of bracket (27). Refer to para. 3-87 for air aftercooler (35) installation. Refer to TM 9-2320-283-20 for ether starting kit installation.

3-78. FUEL PUMP INSTALLATION (Contd)



LEGEND:

10. FUEL PUMP
17. NUT (2)
25. LOCKWASHER (3)
26. WASHER (3)
27. BRACKET
28. SCREW
29. CLAMP (2)
30. AIR SUPPLY TUBE (M915A1/BIG CAM III ONLY)
32. CLAMP (3)
34. ADAPTER
35. AIR AFTERCOOLER
36. CYLINDER HEAD
39. SCREW (2)
47. ADAPTER (3)

3-78. FUEL PUMP INSTALLATION (Contd)

LOCATION/ITEM	ACTION	REMARKS

c. Attenuator Air Tank Installation (M915/Big Cam I Only)

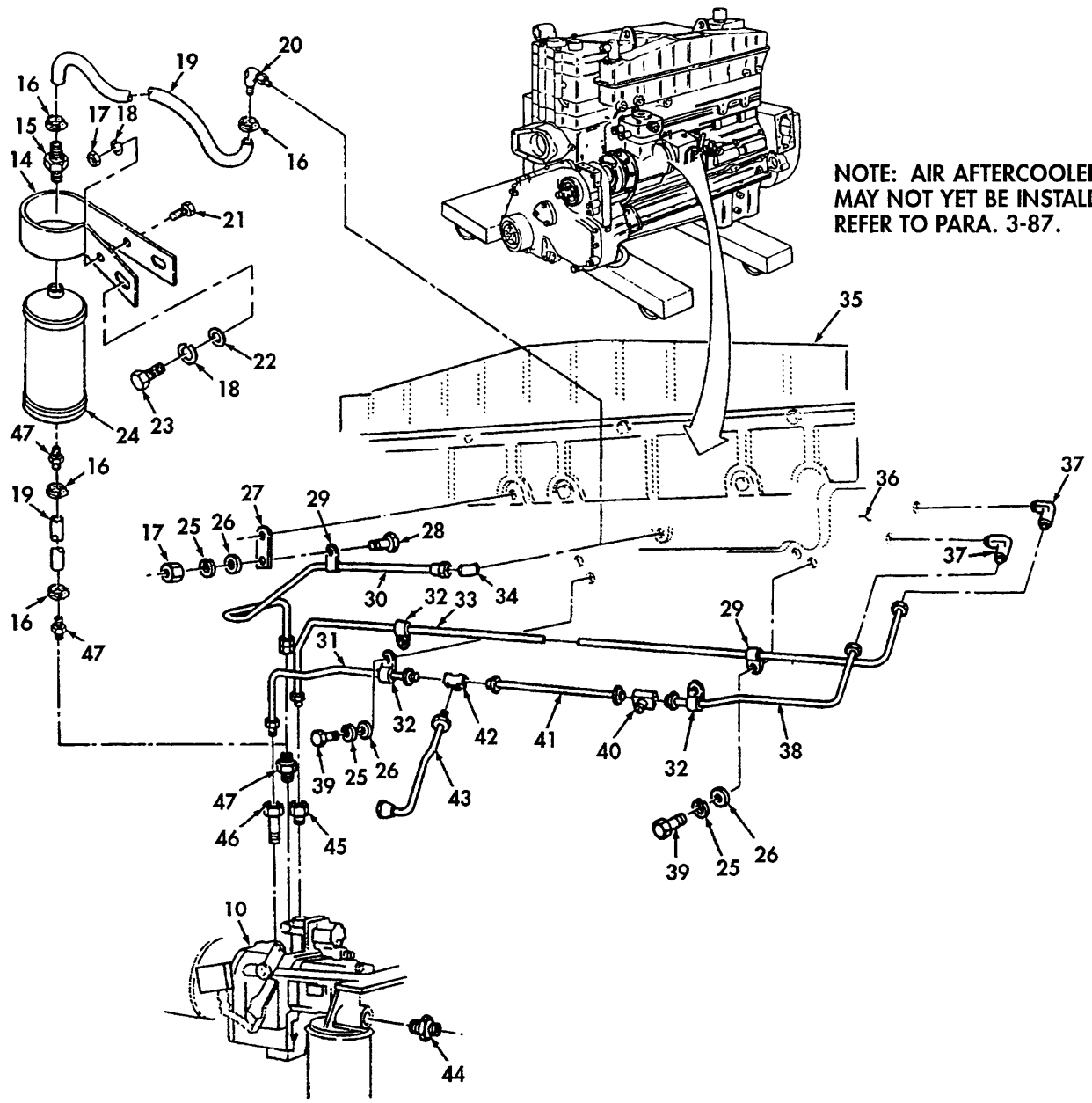
NOTE

- **Perform steps 22 through 28 for M915/Big Cam I equipped with air supply attenuator air tank. Some Big Cam I engines may or may not have an ASA air tank.**
- **Air aftercooler must be installed to install air supply attenuator air tank. Refer to para. 3-87.**

22.	Clamp (14), screw (21), new lockwasher (18), and nut (17) (M915/Big Cam I)	Install on air tank (24).
23.	Clamp (14) and air tank (24) (M915/Big Cam I)	Position on air aftercooler (35).
24.	Screw (23), new lockwasher (18), and washer (22) (M915/Big Cam I)	Install on clamp (14) and air aftercooler (35).
25.	Elbow (20) (M915/Big Cam I)	Install on air aftercooler (35).
26.	Adapter (47) and checkvalve (15) (M915/Big Cam I)	Install on air tank (24).
27.	Adapter (47) (M915/Big Cam I)	Install on fuel pump (10).
28.	Two air supply hoses (19) and four hose clamps (16) (M915/Big Cam I)	a. Install one air supply hose (19) with two hose clamps (16) between adapter (47) on air tank (24) and adapter (47) on fuel pump (10). b. Install one air supply hose (19) with two hose clamps (16) between checkvalve (15) on air tank (24) and elbow (20) on air aftercooler (35).

FOLLOW-ON TASKS:
- Install fuel filter and water separator (TM 9-2320-273-20 or TM 9-2320-283-20).
- Install fuel pump engine retarder switch (TM 9-2320-283-20).
- Install vibration damper and crankshaft pulley (para. 3-79).

3-78. FUEL PUMP INSTALLATION (Contd)



LEGEND:

10. FUEL PUMP
14. CLAMP
15. CHECKVALVE
16. HOSE CLAMP (4)
17. NUT (2)
18. LOCKWASHER (2)
19. AIR SUPPLY HOSE (2) (M915/BIG CAM I ONLY)
20. ELBOW
21. SCREW
22. WASHER
23. SCREW
24. AIR TANK
35. AIR AFTERCOOLER
47. ADAPTER (3)

3-79. VIBRATION DAMPER AND CRANKSHAFT PULLEY INSTALLATION

THIS TASK COVERS:

Installation

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Two vibration damper guide pins (Appendix D, Item 2)

TEST EQUIPMENT
None

MATERIALS/PARTS
Oil, lubricating, OE/HDO 30 (Appendix C, Item 21)

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
Front gear cover installed (para. 3-75).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

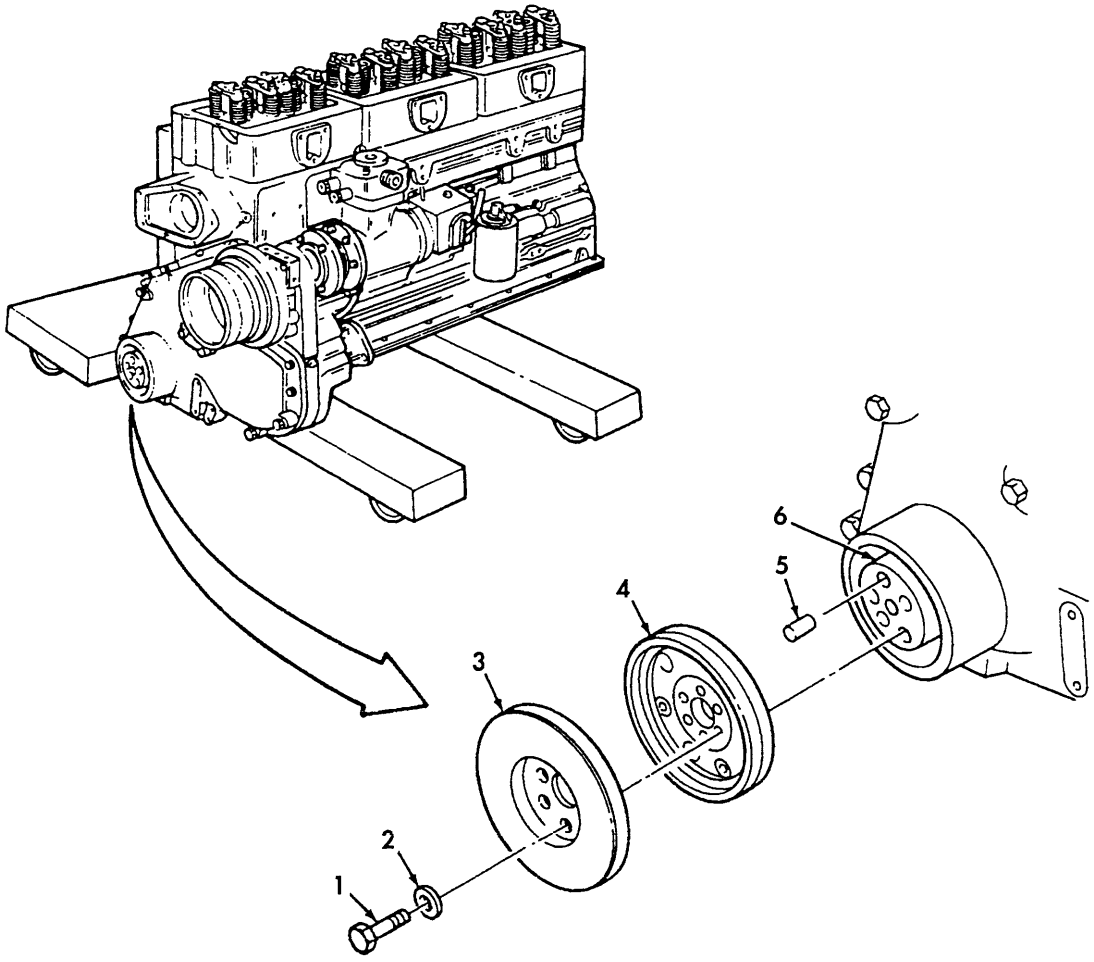
GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS
Installation		
	CAUTION **To avoid engine damage, ensure mounting surfaces of vibration damper and crankshaft are clean and dry. Do not get any lubricating oil on these surfaces.**	
1. Two vibration damper guide pins (5)	Install on two opposite holes in face of crankshaft (6).	See Item 2, Appendix D.
2. Crankshaft pulley (4) and vibration damper (3)	Install on two guide pins (5) and push onto crankshaft (6) until seated.	
3. Six screws (1) and washers (2)	a. Apply a coat of clean lubricating oil to threads of screws (1) and face of washers (2). b. Install on vibration damper (3), crankshaft pulley (4), and crankshaft (6).	Use OE/HDO 30 lubricating oil. Install four screws (1) and washers (2), then remove two guide pins (5) and install remaining two screws (1) and washers (2). Tighten screws (1) to 190 lb-ft (258 N•m).
4. Vibration damper (3)	a. Using dial indicator, measure movement on vibration damper (3) circumference by rotating crankshaft (6).	Total indicator reading must not exceed 0.004 in. (0.102 mm) per 1.0 in. (25.4 mm) of the damper diameter. Remove and discard vibration damper (3) if not within limits.

3-79. VIBRATION DAMPER AND CRANKSHAFT PULLEY INSTALLATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
	b. Using dial indicator gauge, measure movement of vibration damper (3) face by rotating crankshaft (6).	Crankshaft (6) must be kept at front or rear limit of thrust clearance while measuring movement of vibration damper (3) face. Total indicator reading must not exceed 0.007 in. (0.178 mm) per 1.0 in. (25.4 mm) of the damper radius. Remove and discard vibration damper (3) if not within limits.

FOLLOW-ON TASK: Install flexplate or flywheel, flywheel housing, and rear cover (para. 3-80).



LEGEND:

1. SCREW (6)
2. WASHER (6)
3. VIBRATION DAMPER
4. CRANKSHAFT PULLEY
5. VIBRATION DAMPER GUIDE PIN (2)
6. CRANKSHAFT

3-80. FLEXPLATE OR FLYWHEEL, FLYWHEEL HOUSING, AND REAR COVER INSTALLATION

THIS TASK COVERS:

Installation

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Crankshaft oil seal driver (15434) ST-997
Dial gauge attachment (15434) ST-1325
Dial indicator and sleeve assembly (15434) 3376050
Two flywheel housing guide pins (Appendix D, Item 3)

TEST EQUIPMENT
None

MATERIALS/PARTS
Solvent, cleaning,
Oil, lubricating, OE/DO 30 (Appendix C, Item 21)
Gasket (15434) 40662-A
Seal (15434) 211253
Preformed packing (15434) 137075 (M915/Big Cam I)
Eleven preformed packings (15434) 172648 (M915/Big Cam I)

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
Vibration damper and crankshaft pulley installed (para. 3-79).

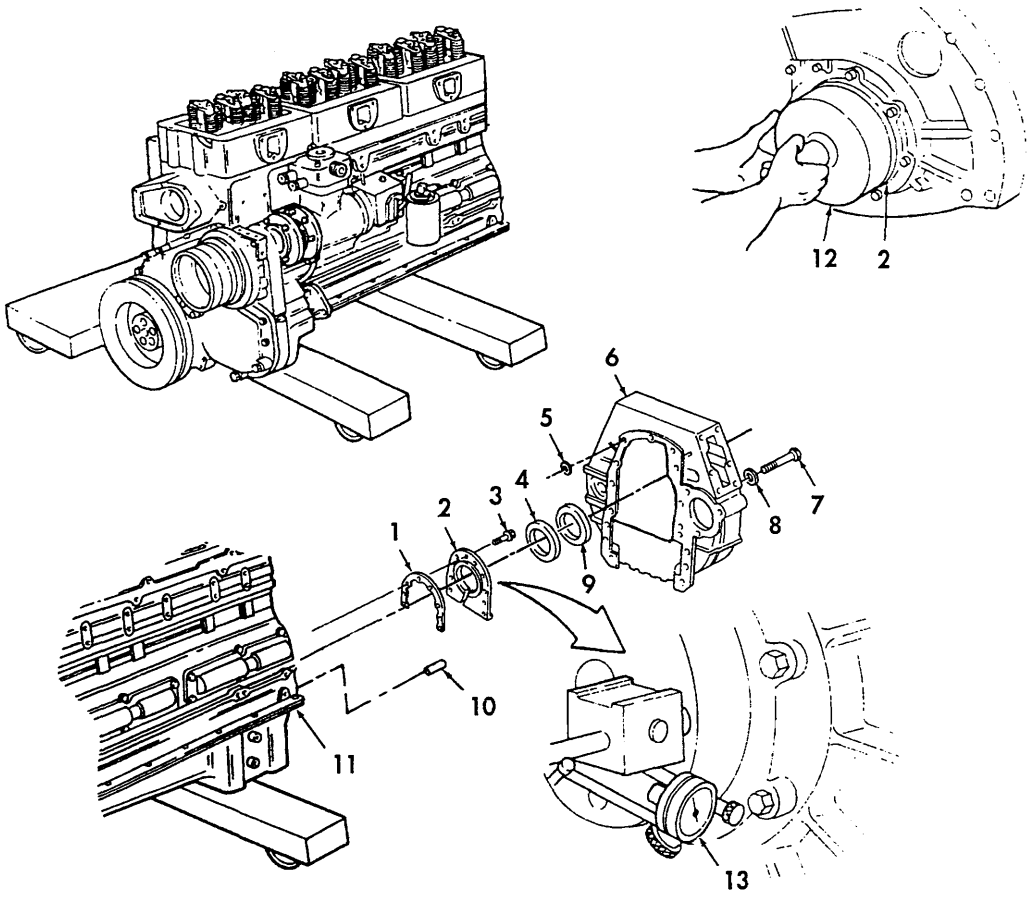
SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS
Installation		
	CAUTION **All surfaces in contact with rear main seal must be completely free of oil. Oil on rear main seal will destroy its sealing properties.**	
1. Rear cover (M915/Big Cam I) or cover (M915A1/Big Cam III) (2) and new gasket (1)	a. Clean oil seal area on crankshaft with an approved solvent. Refer to para. 3-6 for cleaning solvents.	
	b. Install rear cover (M915/Big Cam I) or cover (M915A/Big Cam III) (2) and gasket (1) on cylinder block (11).	
	c. Secure with eight screws (3).	Tighten screws (3) only enough to hold rear cover (M915/Big Cam I) or cover (M915A1/Big Cam III) (2) in position.
	d. Using crankshaft oil seal driver (12), align rear cover (M915/Big Cam I) or cover (M915A1/Big Cam III) (2) with crankshaft.	Use crankshaft oil seal driver (ST-997) (12). Remove pins (10) from driver before using.

3-80. FLEXPLATE OR FLYWHEEL, FLYWHEEL HOUSING, AND REAR COVER INSTALLATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
	e. Using dial indicator (13), check alignment of rear cover (M915/Big Cam I) or cover (M915A1/Big Cam III) (2).	Must be on a common center with crankshaft within 0.010 in. (0.254 mm). Must be square to centerline of crankshaft within 0.010 in. (0.254 mm). Must be within 0.004 in. (0.102 mm) of being flat with oil pan flange of cylinder block (11).
	f. Tighten eight screws (3) to 30-35 lb-ft (41-48 N•m).	
	g. Cut off excess gasket (1) material.	Gasket (1) must be even with or not more than 0.010 in. (0.254 mm) above oil pan flange.



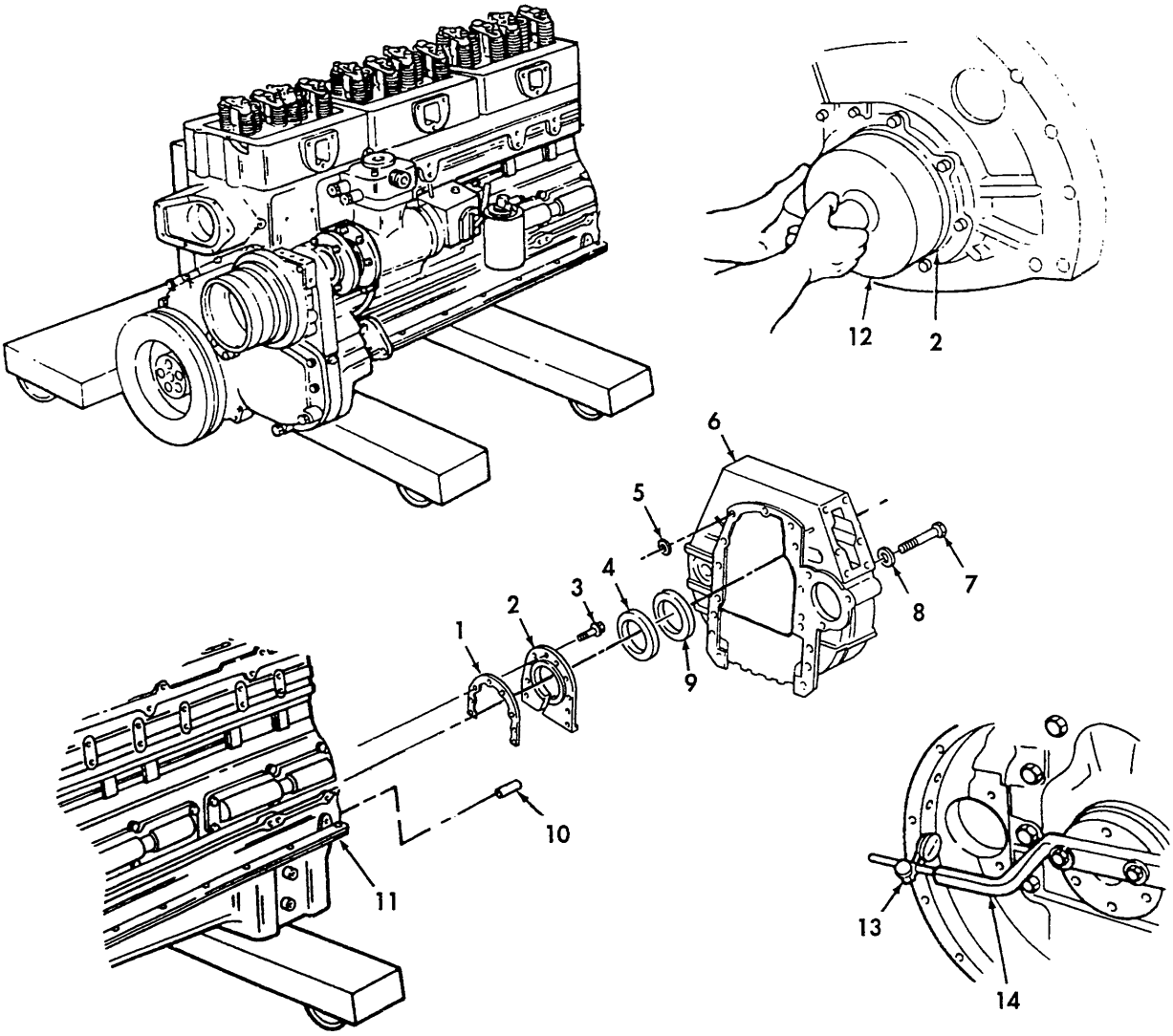
LEGEND:

1. GASKET
2. REAR COVER (M915/BIG CAM I), COVER (M915A1/BIG CAM III)
3. SCREW (8)
4. SEAL
5. PREFORMED PACKING (11) (M915/BIG CAM I)
6. FLYWHEEL HOUSING
7. SCREW (9)
8. WASHER (9)
9. PREFORMED PACKING (M915/BIG CAM I)
10. DOWEL PIN (2)
11. CYLINDER BLOCK
12. CRANKSHAFT OIL SEAL DRIVER
13. DIAL INDICATOR

3-80. FLEXPLATE OR FLYWHEEL, FLYWHEEL HOUSING, AND REAR COVER INSTALLATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
Installation (Contd)		
	NOTE • **New rear main seals have an assembly tool which protects seal lip during shipment and installation.** • **Do not use any lubricant to install seal. Oil seal must be installed with lip of seal and crankshaft clean and dry.**	
2. New seal (4) (with assembly tool)	a. Install on crankshaft.	Position largest diameter of assembly tool toward cylinder block (11).
	b. Push seal (4) from assembly tool onto crankshaft.	Remove and discard assembly tool.
	c. Using crankshaft rear oil seal driver (12), drive seal (4) on rear cover (M915/Big Cam I) or cover (M915A1/Big Cam III) (2).	Use crankshaft oil seal driver (ST-997) (12). Install pins on driver before using.
	CAUTION **If a new flywheel housing is being installed, dowel pins must be removed from cylinder block prior to installing housing to prevent damage to housing. The housing must be doweled with oversize dowel pins after alignment.**	
3. Two dowel pins (10)	Remove dowel pins (10) if installing new flywheel housing (6) and dowel is damaged or outside diameter is less than 0.5005 in. (12.713 mm).	
	NOTE • **M915/Big Cam I engines are equipped with a wet flywheel housing which utilizes preformed packings between flywheel housing and cylinder block.** • **Perform steps 4b and 4c for M915/Big Cam I only.**	
4. Flywheel housing (6)	a. Install two flywheel housing guide pins on cylinder block (11).	Guide pins are used to support flywheel housing (6) (see Appendix D, Item 3).
	b. For wet-type flywheel housings (M915/Big Cam I), install new preformed packing (9) on crankshaft flange.	Lubricate preformed packing (9) with OE/HDO 30 oil prior to installation.
	CAUTION **If engine is to be tested with dynamometer, preformed packing must not be installed on crankshaft until after test. Dry-running will destroy this seal.**	
	c. For wet-type flywheel housing (M915/Big Cam I), install eleven new preformed packings (5) on flywheel housing (6) (M915/Big Cam I).	Use an approved gasket adhesive to seal preformed packings (5) to flywheel housing (6) and cylinder block (11).
	d. Install flywheel housing (6) on cylinder block (11) with seven screws (7) and washers (8).	Tighten screws (7) to 10-20 lb-ft (14-27 N•m).

3-80. FLEXPLATE OR FLYWHEEL, FLYWHEEL HOUSING, AND REAR COVER INSTALLATION (Contd)



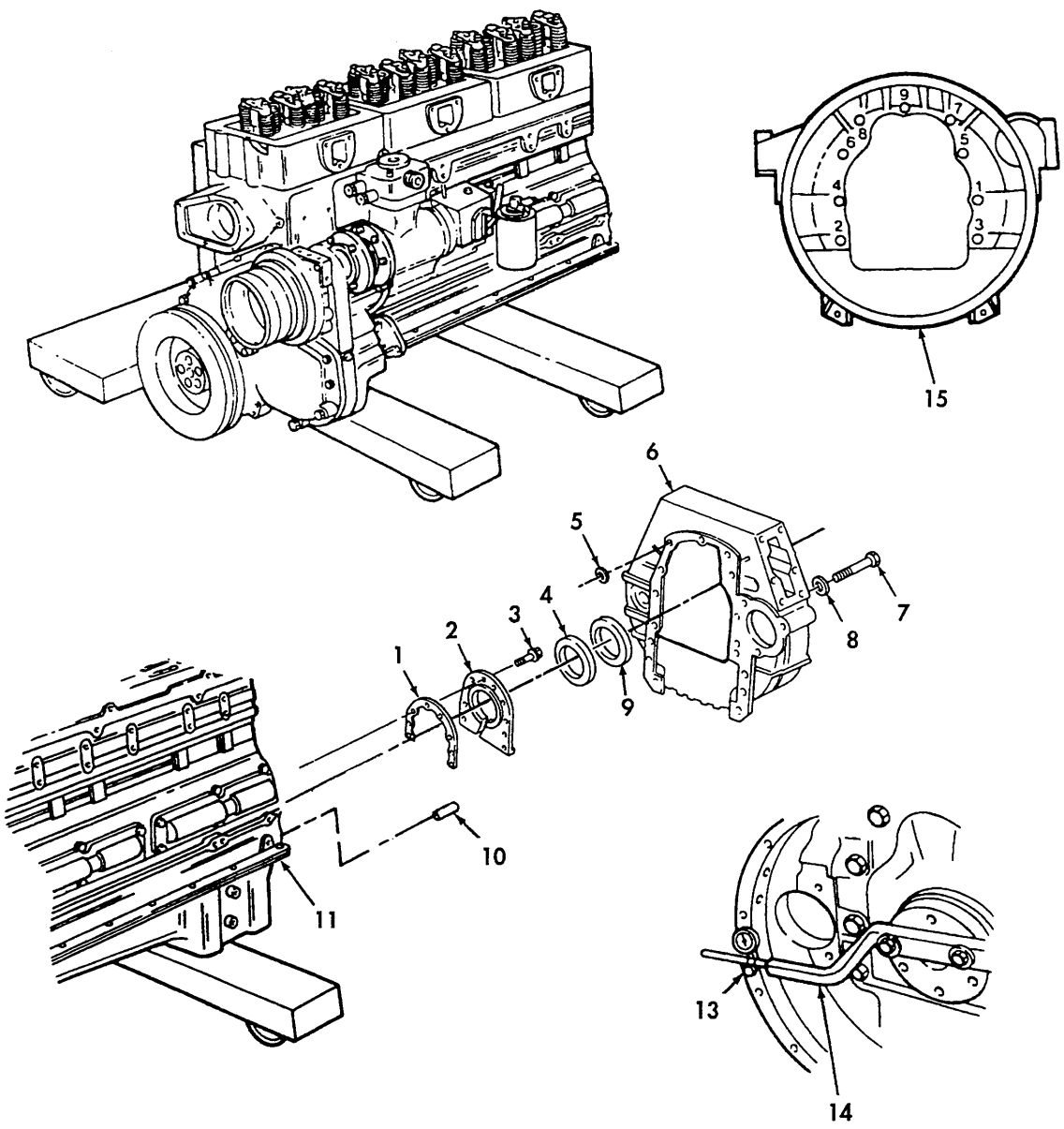
LEGEND:

2. REAR COVER (M915/BIG CAM I), COVER (M915A1/BIG CAM III)
4. SEAL
5. PREFORMED PACKING (11) (M915/BIG CAM I)
6. FLYWHEEL HOUSING
7. SCREW (9)
8. WASHER (9)
9. PREFORMED PACKING (M915/BIG CAM I)
10. DOWEL PIN (2)
11. CYLINDER BLOCK
12. CRANKSHAFT OIL SEAL DRIVER
13. DIAL INDICATOR AND SLEEVE ASSEMBLY
14. DIAL GAUGE ATTACHMENT

3-80. FLEXPLATE OR FLYWHEEL, FLYWHEEL HOUSING, AND REAR COVER INSTALLATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
Installation (Contd)		
4. Flywheel housing (6) (Contd)	e. Remove two flywheel housing guide pins and install two remaining screws (7) and washers (8).	Tighten screws (7) to 10-20 lb-ft (14-27 N•m).
	f. Check location of bore as follows:	
	(1) Install dial gauge attachment (14) and dial indicator and sleeve assembly (13).	Use dial gauge attachment (ST-1325) (14) and dial indicator and sleeve assembly (3376050) (13).
	(2) Using chalk, mark housing at 12, 3, 6, and 9 o'clock positions.	
	(3) Check readings at 3 o'clock and 9 o'clock positions.	If runout exceeds 0.008 in. (0.203 mm), move flywheel housing (6) horizontally one-half distance of total indicator reading. Use prybars to move housing.
	(4) Check readings at 12 o'clock and 6 o'clock positions.	If runout exceeds 0.008 in. (0.203 mm), move flywheel housing (6) vertically one-half distance of total indicator reading. Use prybars to move housing.
	(5) Check circumference of bore. Use a prybar to move the housing.	Total indicator reading must not exceed 0.008 in. (0.203 mm). Adjust flywheel housing (6) until within limit.
	(6) After readings are within limits, tighten screws (7) to 140-160 lb-ft (190-217 N•m) as shown in tightening sequence (15).	Use prybars to move flywheel housing (6).
	g. Check alignment of flywheel housing (6) as follows:	
	(1) Adjust dial indicator and sleeve assembly (13) to measure alignment of face on flywheel housing (6).	
	(2) Push crankshaft toward front of cylinder block (11) to remove crankshaft end clearance.	
	(3) Rotate crankshaft and check alignment of face on flywheel housing (6).	Ensure crankshaft is pushed toward front of cylinder block (11) when checking alignment. Total indicator reading must not exceed 0.008 in. (0.203 mm). If alignment is not within limits, remove flywheel housing (6) and check mating surfaces.
	h. If dowel pins (10) were removed from cylinder block (11), use a drill and fixture to ream dowel holes to next oversize and install two new dowel pins (10) if required.	

3-80. FLEXPLATE OR FLYWHEEL, FLYWHEEL HOUSING, AND REAR COVER INSTALLATION (Contd)



LEGEND:

6. FLYWHEEL HOUSING
7. SCREW (9)
8. WASHER (9)
10. DOWEL PIN (2)
11. CYLINDER BLOCK
13. DIAL INDICATOR AND SLEEVE ASSEMBLY
14. DIAL GAUGE ATTACHMENT
15. TIGHTENING SEQUENCE (FLYWHEEL HOUSING SCREWS)

3-80. FLEXPLATE OR FLYWHEEL, FLYWHEEL HOUSING, AND REAR COVER INSTALLATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
Installation (Contd)		

NOTE

- **M915A1/Big Cam III engines are equipped with a flexplate-type flywheel with retaining plate and washer bearing. Perform step 5 for M915A1/Big Cam III only.**
- **Perform steps 6, 7, 8, and 9 for M915/Big Cam I only.**

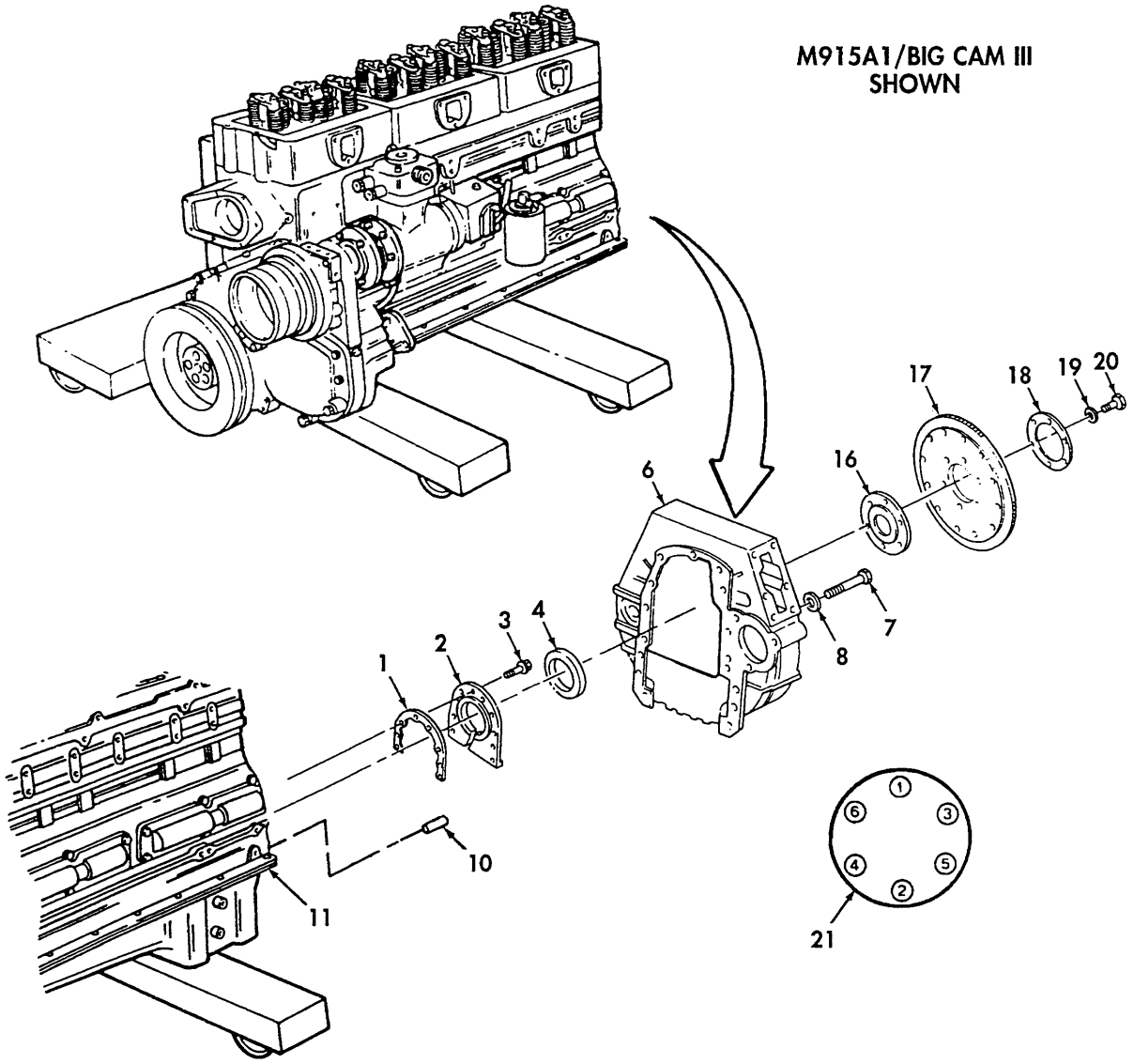
5.	Retaining plate (16), flexplate (17), and washer bearing (18)	a. Install on crankshaft.	
		b. Install six screws (20) and washers (19).	Apply thin coat of lubricating oil to threads of screws (20) and face of washers (19) prior to installing. Tighten screws to 200-220 lb-ft (271-298 N•m) as shown in tightening sequence (21).

CAUTION

If engine is to be tested with dynamometer, wet seal must not be installed until after test. Dry-running will destroy this seal.

6.	Wet clutch seal and seal carrier (M915/Big Cam I)	a. Press new seal on seal carrier with spring-loaded sealing lip facing flywheel until seated in carrier. b. Install seal carrier with new gasket on flywheel housing (6) with Nylok screws. Using indicator, center seal carrier to crankshaft. Carrier must be centered within 0.006 in. (0.152 mm) Total Indicator Reading (TIR). c. Tighten screws for seal carrier-to-flywheel housing to 97 lb-in. (11 N•m). If access cover plate was removed, install with copper washers and screws.	

3-80. FLEXPLATE OR FLYWHEEL, FLYWHEEL HOUSING, AND REAR COVER INSTALLATION (Contd)



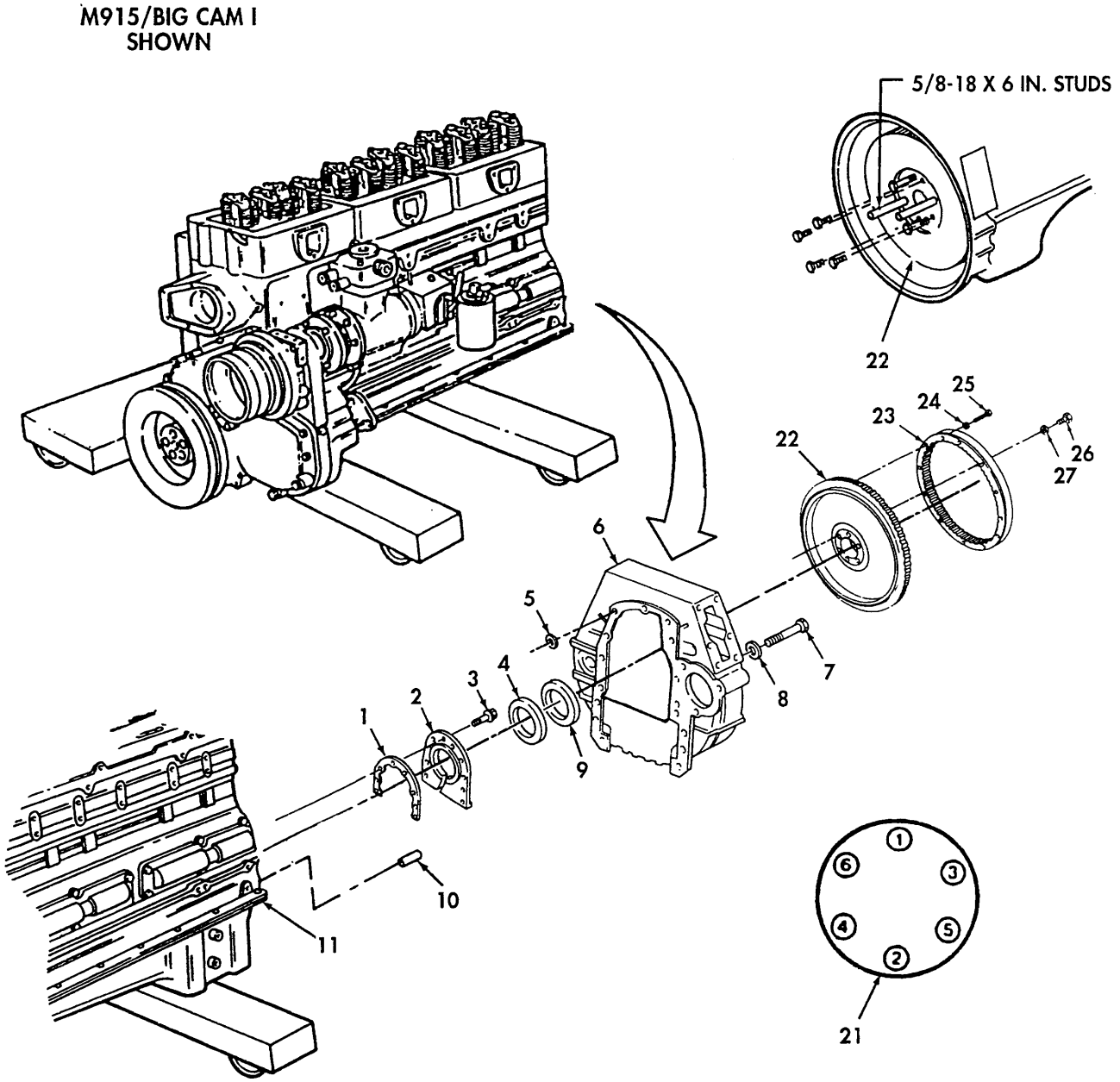
LEGEND:

6. FLYWHEEL HOUSING
16. RETAINING PLATE (M915/BIG CAM I)
17. FLEXPLATE (M915A1/BIG CAM III)
18. WASHER BEARING (M915A1/BIG CAM III)
19. WASHER (6)
20. SCREW (6) (M915/BIG CAM I)
21. TIGHTENING SEQUENCE (FLEXPLATE TO CRANKSHAFT SCREWS)

3-80. FLEXPLATE OR FLYWHEEL, FLYWHEEL HOUSING, AND REAR COVER INSTALLATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
Installation (Contd)		
7. Flywheel (22) and ring gear (23)	a. Install two 5/8-18 x 6 in. studs on opposite holes on crankshaft to function as guides. Install studs on crankshaft until fully seated. b. Lubricate threads of screws (26) and face of washers (27) with lubricating oil. Allow excess oil to drain from screw threads. c. Install four screws (26) and washers (27) on flywheel (22) and crankshaft flange. Tighten screws (26) as shown in tightening sequence (21) until flywheel (22) is seated against crankshaft flange. d. Remove two 5/8-18 x 6 in. studs from crankshaft flange and flywheel (22). Install two remaining screws (26) and washers (27) through flywheel (22) and into crankshaft flange until seated. e. Using tightening sequence (21), tighten all screws (26) to 70 lb-ft (95 N•m), then to 140 lb-ft (190 N•m), and finally to 200-220 lb-ft (271-298 N•m).	Use OE/HDO 30 lubricating oil.

3-80. FLEXPLATE OR FLYWHEEL, FLYWHEEL HOUSING, AND REAR COVER INSTALLATION (Contd)



LEGEND:

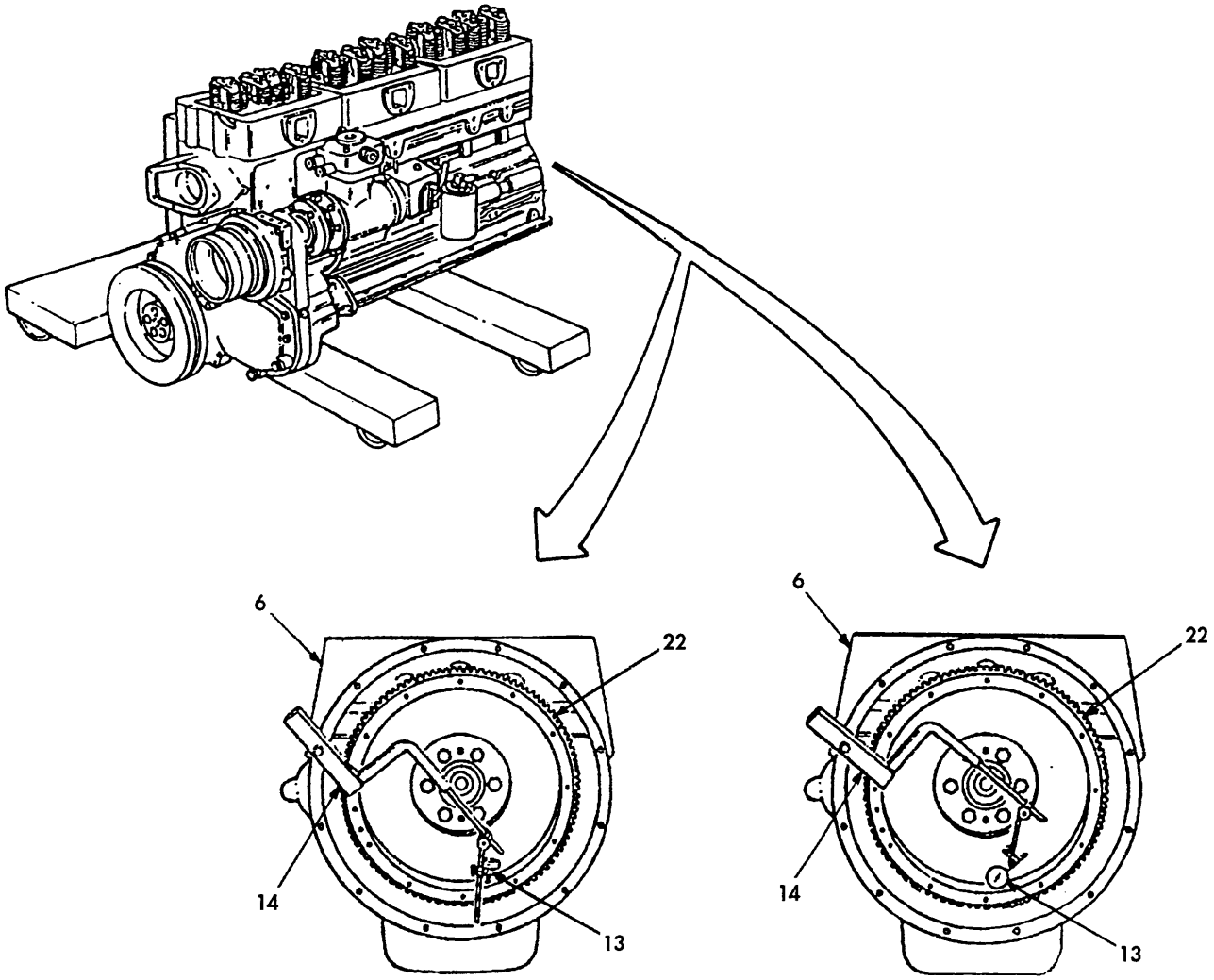
21. TIGHTENING SEQUENCE (FLYWHEEL TO CRANKSHAFT SCREWS)
22. FLYWHEEL (M915/BIG CAM I)
23. RING GEAR (M915/BIG CAM I)
26. SCREW (6) (M915/BIG CAM I)
27. WASHER (6)

3-80. FLEXPLATE OR FLYWHEEL, FLYWHEEL HOUSING, AND REAR COVER INSTALLATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
Installation (Contd)		
	NOTE • **The flywheel must be pushed toward front of engine to remove crankshaft end clearance when crankshaft is rotated and measurements are taken.** • **If total indicator readings exceed limits listed in steps 8 and 9, remove flywheel; clean flywheel and crankshaft flange faces, install, and repeat runout checks.**	
8. Inspect flywheel (22) bore runout (M915/Big Cam I)	a. Install dial gauge attachment (14) and dial indicator and sleeve assembly (13) on flywheel housing (6). Position contact tip of dial indicator against wide diameter of flywheel bore and set dial indicator to zero.	Use dial gauge attachment (ST-1325) and dial indicator and sleeve assembly (3376050).
	b. Use accessory drive shaft to rotate crankshaft one complete revolution.	Total indicator reading must not exceed 0.005 in. (0.127 mm).
9. Inspect flywheel (22) face runout (M915/Big Cam I)	a. Install or reposition dial indicator and sleeve assembly (13) on flywheel housing (6). Position contact tip of dial indicator against face of flywheel (22) as close to outside diameter as possible.	Use dial indicator and sleeve assembly (3376050).
	b. Use accessory drive shaft to rotate crankshaft one complete revolution.	Total indicator reading must not exceed 0.005 in. (0.127 mm).

FOLLOW-ON TASK: Install oil pan (para. 3-81).

3-80. FLEXPLATE OR FLYWHEEL, FLYWHEEL HOUSING, AND REAR COVER INSTALLATION (Contd)



M915/BIG CAM I FLYWHEEL BORE RUNOUT CHECK

M915/BIG CAM I FLYWHEEL FACE RUNOUT CHECK

LEGEND:

6. FLYWHEEL HOUSING
13. DIAL INDICATOR AND SLEEVE ASSEMBLY
14. DIAL GAUGE ATTACHMENT
22. FLYWHEEL (M915/BIG CAM I)

3-81. OIL PAN INSTALLATION

THIS TASK COVERS:

Installation

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
None

TEST EQUIPMENT
None

MATERIALS/PARTS
Grease, automotive and artillery, GAA (Appendix C, Item 13)
Gasket and seal kit (15434) 3801235
Four lockwashers (96906) MS35338-45
Four lockwashers (96906) MS35338-47 (M915A1/Big Cam III), (one M915/Big Cam I)
Two lockwashers (96906) MS35338-48
Two lockwashers (15434) S-608 (M915/Big Cam I)
Lockwasher (15434) S-610 (M915/Big Cam I)

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
TM 9-2320-273-20
TM 9-2320-273-34

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
- Front gear cover installed (para. 3-75).
- Flexdisk or flywheel, flywheel housing, and rear cover installed (para. 3-80).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS

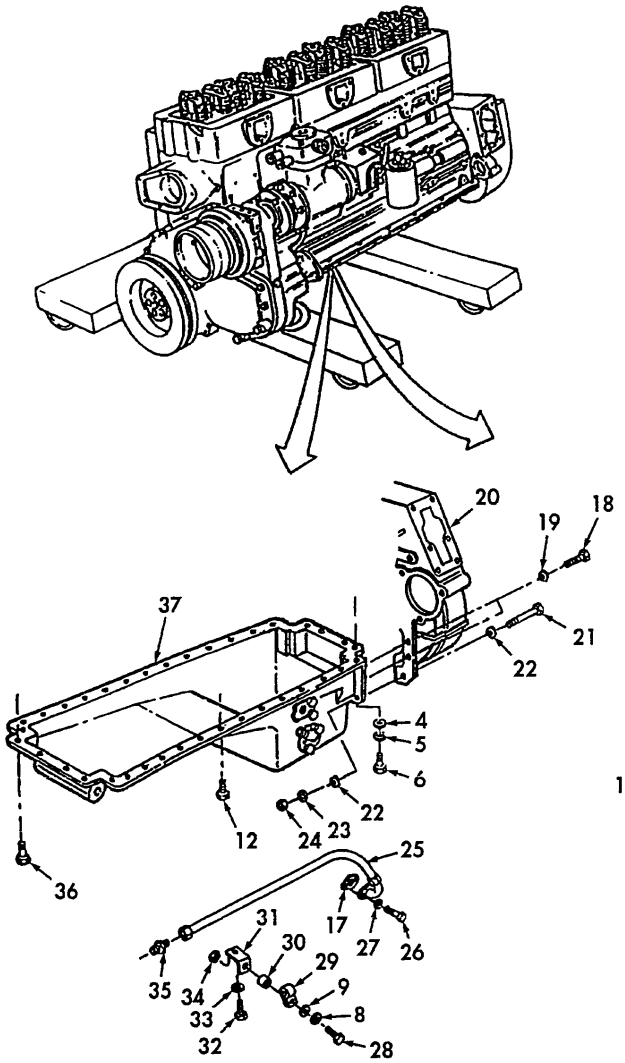
Installation

NOTE

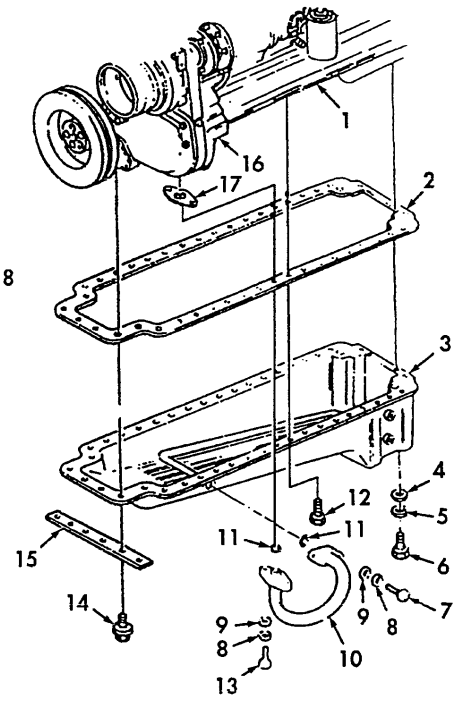
- **Do not rotate engine more than 90 from an upright position during oil pan installation. Otherwise, pushrods could fall out. If any pushrods fall out, refer to para. 3-71 to install.**
- **For M915/Big Cam I only, it may be necessary to refer to TM 9-2320-273-34, installation of engine oil heater. For engine oil heater thermostat installation, refer to TM 9-2320-273-20.**
- **Installation of oil pan is similar between M915/Big Cam I and M915A1/Big Cam III engines. M915/Big Cam I engines use a cast aluminum oil pan that is mounted to the flywheel housing with additional fasteners. M915A1/Big Cam III engines use a stamped steel oil pan that does not mount with flywheel housing.**
- **Perform steps 7, 9, 12, 13, and 14 for M915/Big Cam I only.**

1.	Cylinder block (1)	Apply a thin coat of GAA grease to oil pan mounting surface.	
2.	New oil pan gasket (2)	Line up holes with holes in cylinder block (1) and install on cylinder block (1).	

3-81. OIL PAN INSTALLATION (Contd)



M915/BIG CAM I OIL PAN (CAST ALUMINUM)



M915A1/BIG CAM III OIL PAN (STAMPED STEEL)

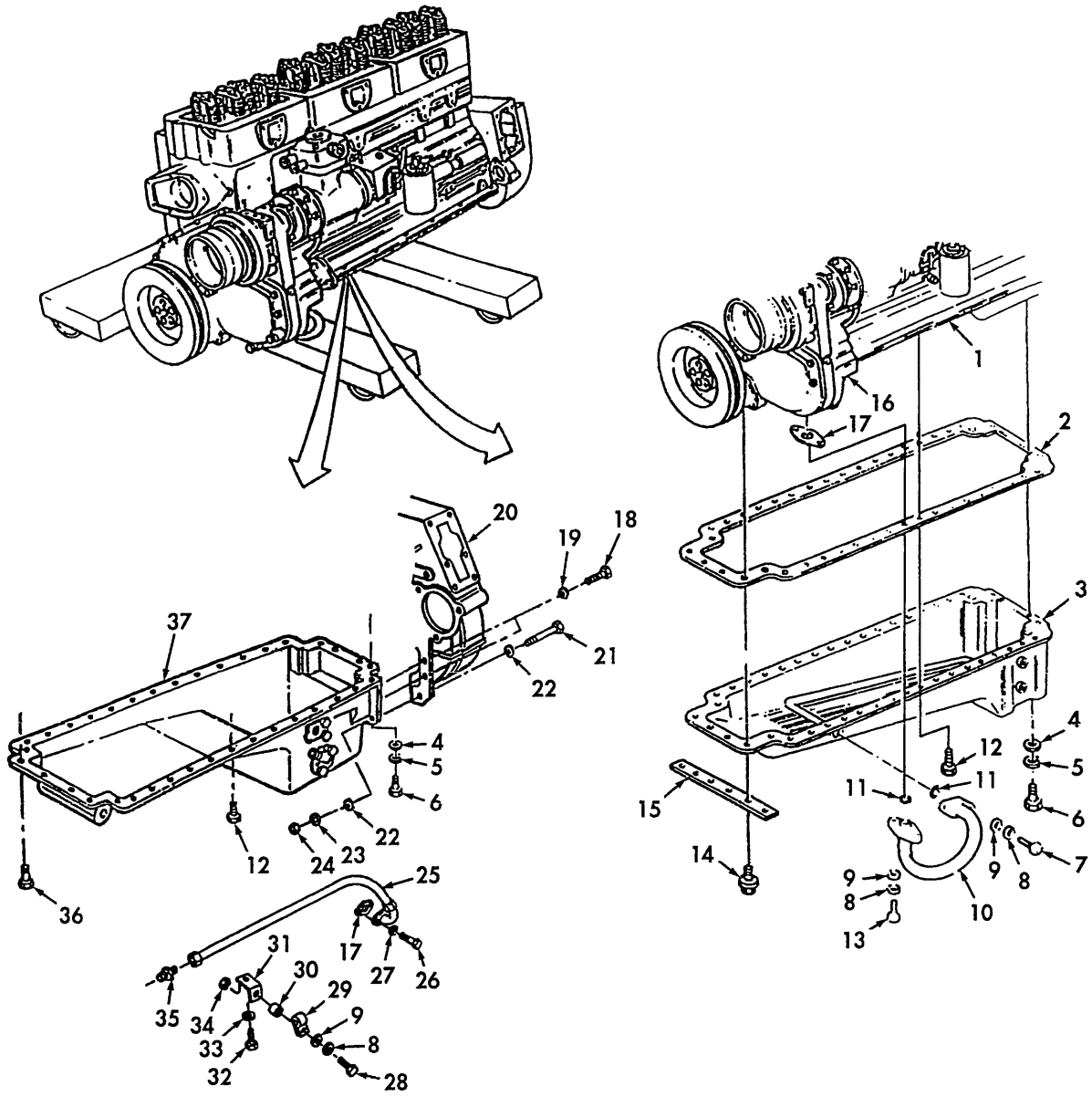
LEGEND:

1. CYLINDER BLOCK
2. OIL PAN GASKET
3. OIL PAN (M915A1/BIG CAM III)
4. WASHER (4)
5. LOCKWASHER (4)
6. SCREW (4)
7. SCREW (2) (M915A1/BIG CAM III)
8. LOCKWASHER (1) (M915/BIG CAM I), (4) (M915A1/BIG CAM III)
9. WASHER (1) (M915/BIG CAM I), (4) (M915A1/BIG CAM III)
10. OIL SUCTION TUBE (METALLIC) (M915A1/BIG CAM III)
11. PREFORMED PACKING (2) (M915A1/BIG CAM III)
12. SCREW (28)
13. SCREW (2) (M915A1/BIG CAM III)
14. SCREW (4) (M915A1/BIG CAM III)
15. ENGINE SHIPPING SUPPORT
16. OIL PUMP
17. GASKET
18. SCREW (4) (M915/BIG CAM I)
19. WASHER (4) (M915/BIG CAM I)
20. FLYWHEEL HOUSING
21. SCREW (2) (M915/BIG CAM I)
22. WASHER (4) (M915/BIG CAM I)
23. LOCKWASHER (2) (M915/BIG CAM I)
24. NUT (2) (M915/BIG CAM I)
25. OIL SUCTION HOSE (NONMETALLIC) (M915/BIG CAM I)
26. SCREW (2) (M915/BIG CAM I)
27. LOCKWASHER (2) (M915/BIG CAM I)
28. SCREW (M915/BIG CAM I)
29. CLAMP (M915/BIG CAM I)
30. SPACER (M915/BIG CAM I)
31. BRACKET (M915/BIG CAM I)
32. SCREW (M915/BIG CAM I)
33. LOCKWASHER (M915/BIG CAM I)
34. NUT (M915/BIG CAM I)
35. ADAPTER (M915/BIG CAM I)
36. SCREW (4) (M915/BIG CAM I)
37. OIL PAN (M915/BIG CAM I)

3-81. OIL PAN INSTALLATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
Installation (Contd)		
3. Oil pan (3) (M915A1/Big Cam III) or (37) (M915/Big Cam I)	Position on oil pan gasket (2) and cylinder block (1).	
4. Twenty-eight screws (12)	Install on oil pan (3) (M915A11 Big Cam III) or (37) (M915/ Big Cam I) and cylinder block (1).	Do not tighten screws at this time.
5. Four screws (6), new lock-washers (5), and washer (4)	Install on oil pan (3) (M915A1/Big Cam III) or (37) (M915/Big Cam I) and rear cover.	Do not tighten screws at this time.
	NOTE **Two of the four screws may have been eliminated on newer M915A1/Big Cam III oil pans.**	
6. Engine shipping support (15)	Install on front of oil pan (3) (M915A1/Big Cam III) or (37) (M915/Big Cam I) with four screws (14) (M915A1/Big Cam III) or four screws (36) (M915/Big Cam I).	Do not tighten screws at this time.
7. Two screws (18) and washers (19) (M915/Big Cam I)	Install on middle holes of flywheel housing (20) and oil pan (37).	Use middle three holes on each side of flywheel housing (20). This step ensures proper location of oil pan (37) during initial assembly. Do not tighten screws at this time.
8. Two screws (12)	Finger-tighten one screw (12) on each side of oil pan flange, in a position located halfway between front and rear of oil pan (3) (M915A1/Big Cam III) or (37) (M915/Big Cam I).	
9. Two screws (18) and washers (19) (M915/Big Cam I)	Remove from middle holes of flywheel housing (20) and oil pan (37).	This step is necessary to provide clearance to perform step 10.

3-81. OIL PAN INSTALLATION (Contd)



M915/BIG CAM I OIL PAN (CAST ALUMINUM)

LEGEND:

1. CYLINDER BLOCK
2. OIL PAN GASKET
3. OIL PAN (M915A1/BIG CAM III)
4. WASHER (4)
5. LOCKWASHER (4)
6. SCREW (4)
12. SCREW (28)

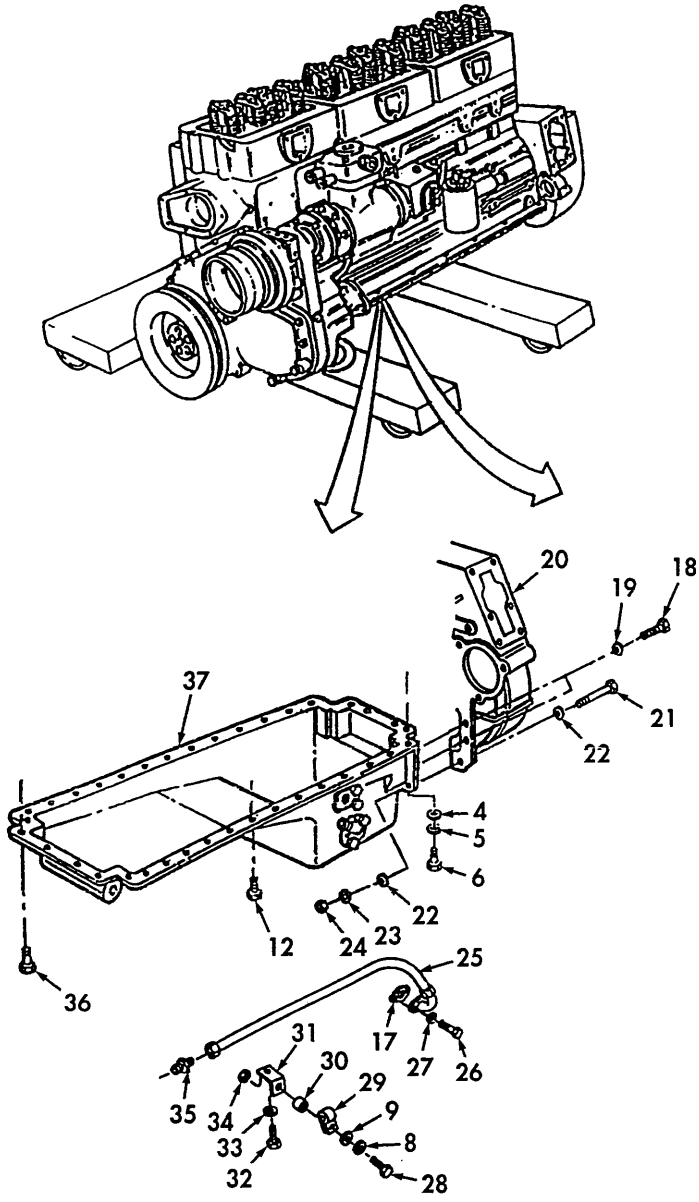
M915A1/BIG CAM III OIL PAN (STAMPED STEEL)

14. SCREW (4) (M915A1/BIG CAM III)
15. ENGINE SHIPPING SUPPORT
18. SCREW (4) (M915/BIG CAM I)
19. WASHER (4) (M915/BIG CAM I)
20. FLYWHEEL HOUSING
36. SCREW (4) (M915/BIG CAM I)
37. OIL PAN (M915/BIG CAM I)

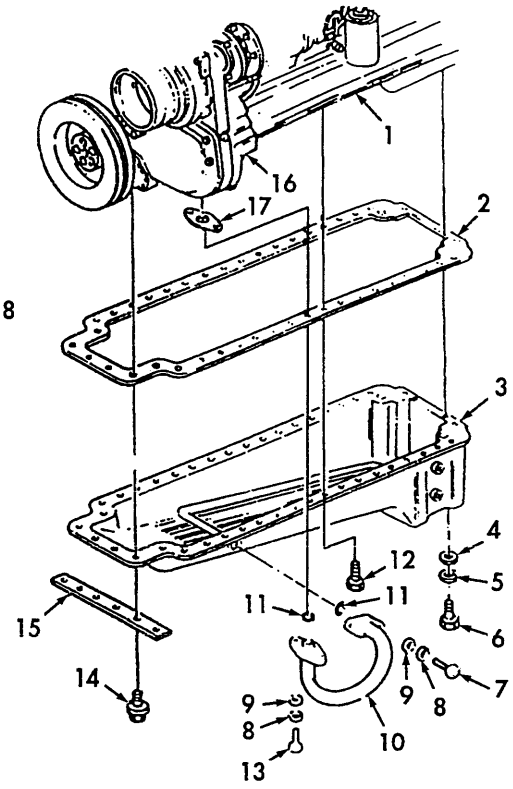
3-81. OIL PAN INSTALLATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
Installation (Contd)		
10. Four screws (12)	Finger-tighten two screws (12) on each side of oil pan rear corner.	
11. Twenty-eight screws (12) and four screws (14) (M915AllBig Cam III) or (36) (M915/Big Cam I)	Tighten on oil pan (3) (M915/Big Cam III) or (37) (M915/Big Cam I) to cylinder block (1) and front cover.	Tighten screws to 35-40 lb-ft (41-48 N•m).
12. Four screws (18) and washers (19)	Install on flywheel housing (20) (M915/Big Cam I) and oil pan (37).	Do not tighten screws at this time.
13. Two screws (21), four washers (22), new lock-washers (23), and nuts (24) (M915/Big Cam I)	Install on oil pan (37) and flywheel housing (20).	
14. Four screws (18) and two nuts (24) (M915/Big Cam I)	Install on flywheel housing (20) and oil pan (37).	Tighten screws to 70-80 lb-ft (95-109 N•m).
15. Four screws (6), new lockwashers (5), and washers (4)	Install on oil pan (37).	Tighten screws to 15-20 lb-ft (20-27 N•m).

3-81. OIL PAN INSTALLATION (Contd)



M915/BIG CAM I OIL PAN (CAST ALUMINUM)



M915A1/BIG CAM III OIL PAN (STAMPED STEEL)

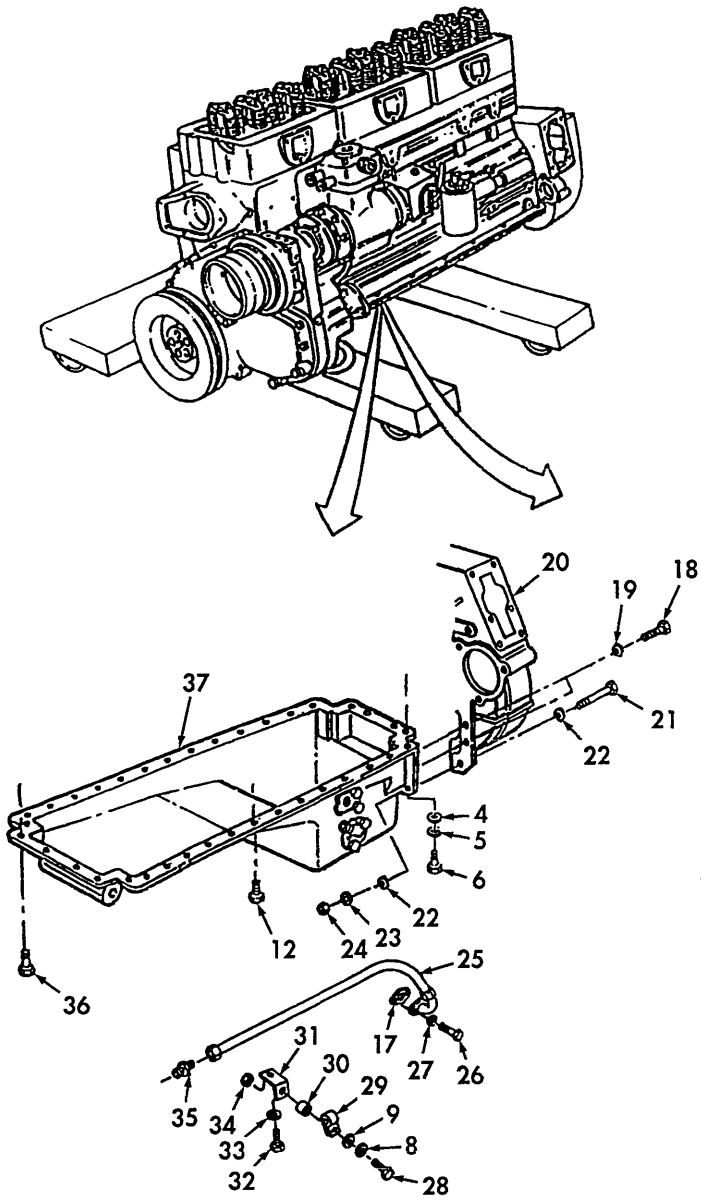
LEGEND:

1. CYLINDER BLOCK
3. OIL PAN (M915A1/BIG CAM III)
4. WASHER (4)
5. LOCKWASHER (4)
6. SCREW (4)
12. SCREW (28)
14. SCREW (4) (M915A1/BIG CAM III)
18. SCREW (4) (M915/BIG CAM I)
19. WASHER (4) (M915/BIG CAM I)
20. FLYWHEEL HOUSING
21. SCREW (2) (M915/BIG CAM I)
22. WASHER (4) (M915/BIG CAM I)
23. LOCKWASHER (2) (M915/BIG CAM I)
24. NUT (2) (M915/BIG CAM I)
36. SCREW (4) (M915/BIG CAM I)
37. OIL PAN (M915/BIG CAM I)

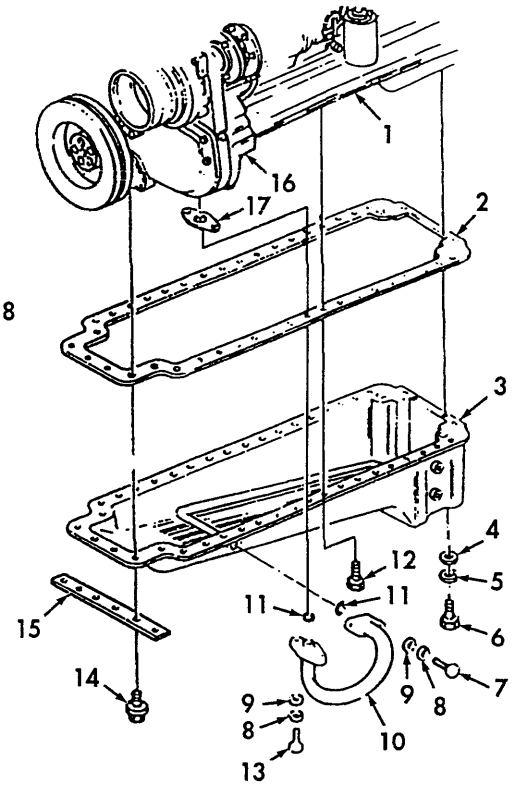
3-81. OIL PAN INSTALLATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
Installation (Contd)		
	NOTE • **M915/Big Cam I engines use a two-piece nonmetallic oil suction hose assembly consisting of an oil pan mounting flange and a flexible oil suction hose. M915A1/Big Cam III engines use a metallic oil suction tube.** • **Perform steps 16 and 17 for M915A1/Big Cam III only.** • **Perform steps 18 through 26 for M915/Big Cam I only.**	
16. New gasket (17) and two new preformed packings (11) (M915A1/Big Cam III)	Position on oil suction tube (10) and position assembly on oil pan (3) and oil pump (16).	
17. Oil suction tube (10), two screws (7), screws (13), four new lockwashers (8), and washers (9) (M915A1/Big Cam III)	a. Install on oil pan (3) and oil pump (16).	
	b. Tighten screws to 30-35 lb-ft (41-48 N•m).	Tighten screws (7) before screws (13).
18. Oil suction hose (25) and new gasket (17) (M915/Big Cam I)	Install on oil pan (37) with two new lockwashers (27) and screws (26).	Do not tighten screws (26) at this time.

3-81. OIL PAN INSTALLATION (Contd)



M915/BIG CAM I OIL PAN (CAST ALUMINUM)



M915A1/BIG CAM III OIL PAN (STAMPED STEEL)

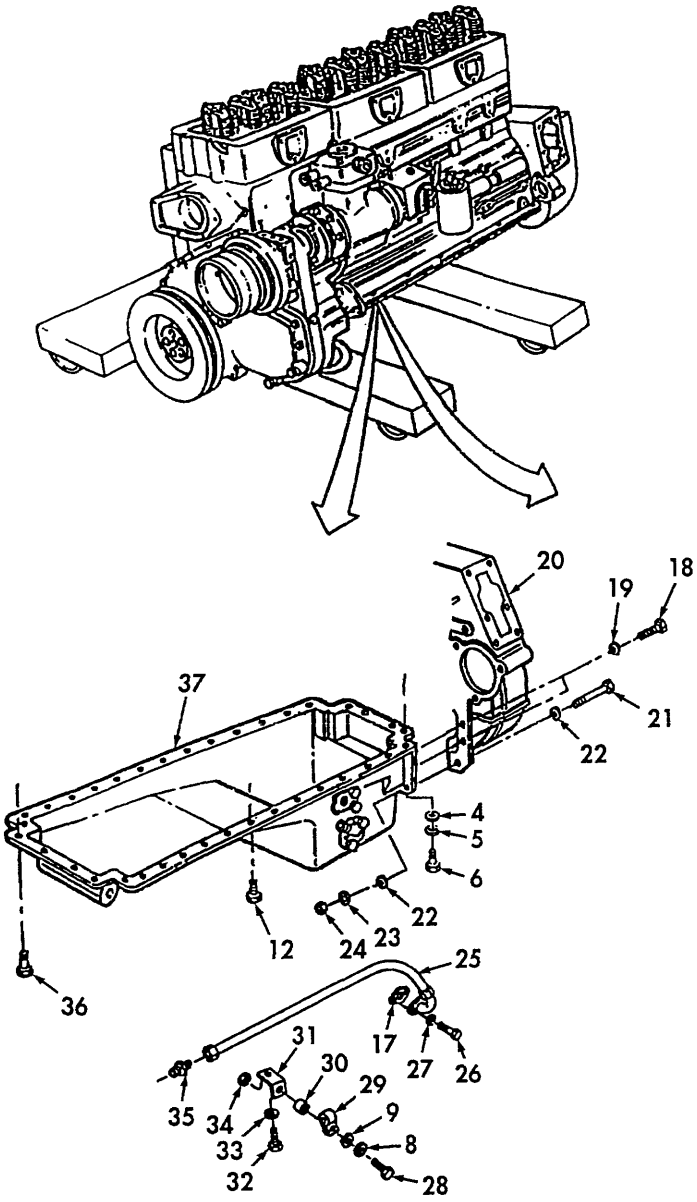
LEGEND:

3. OIL PAN (M915A1/BIG CAM III)
7. SCREW (2) (M915A1/BIG CAM III)
8. LOCKWASHER (1) (M915/BIG CAM I), (4) (M915A1/BIG CAM III)
9. WASHER (1) (M915/BIG CAM I), (4) (M915A1/BIG CAM III)
10. OIL SUCTION TUBE (METALLIC) (M915A1/BIG CAM III)
11. PREFORMED PACKING (2) (M915A1/BIG CAM III)
13. SCREW (2) (M915A1/BIG CAM III)
16. OIL PUMP
17. GASKET
25. OIL SUCTION HOSE (NONMETALLIC) (M915/BIG CAM I)
26. SCREW (2) (M915/BIG CAM I)
27. LOCKWASHER (2) (M915/BIG CAM I)
37. OIL PAN (M915/BIG CAM I)

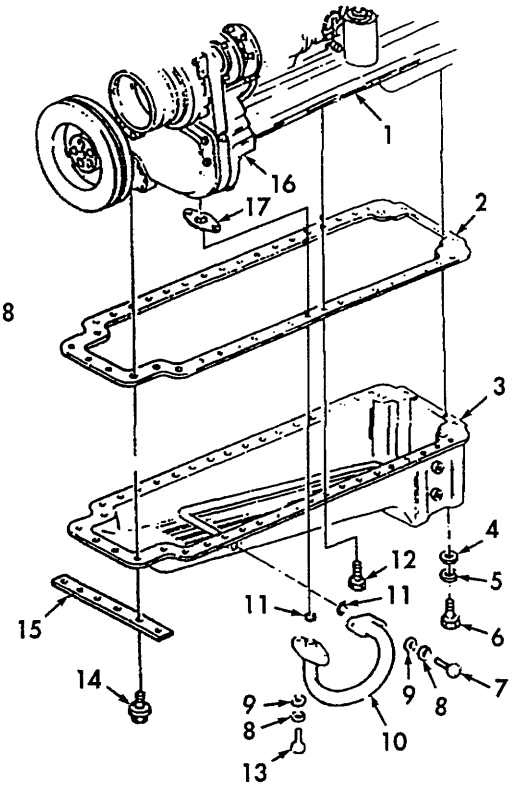
3-81. OIL PAN INSTALLATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
Installation (Contd)		
19. Adapter (35) and oil suction hose (25) (M915/Big Cam I)	Install on oil pump (16) and hand-tighten hose nut until snug, then tighten nut an additional 1 to 1-1/4 turn.	
20. Two screws (26) (M915/Big Cam I)	Tighten to 30-35 lb-ft (41-48 N•m).	
21. Oil suction hose (25) (M915/Big Cam I)	Tighten nut on oil suction hose (25) mounting flange until nut is against stop on mounting flange.	
22. Screw (12) (M915/Big Cam I)	Remove one screw (12) from left side flange of oil pan (37).	Remove sixth screw from front of flange on left side of oil pan (37).
23. Bracket (31), screw (32), and new lockwasher (33) (M915/Big Cam I)	a. Install on sixth hole from front on left side of oil pan (37). b. Tighten screw to 35-40 lb-ft (41-48 N•m).	

3-81. OIL PAN INSTALLATION (Contd)



M915/BIG CAM I OIL PAN (CAST ALUMINUM)



M915A1/BIG CAM III OIL PAN (STAMPED STEEL)

LEGEND:

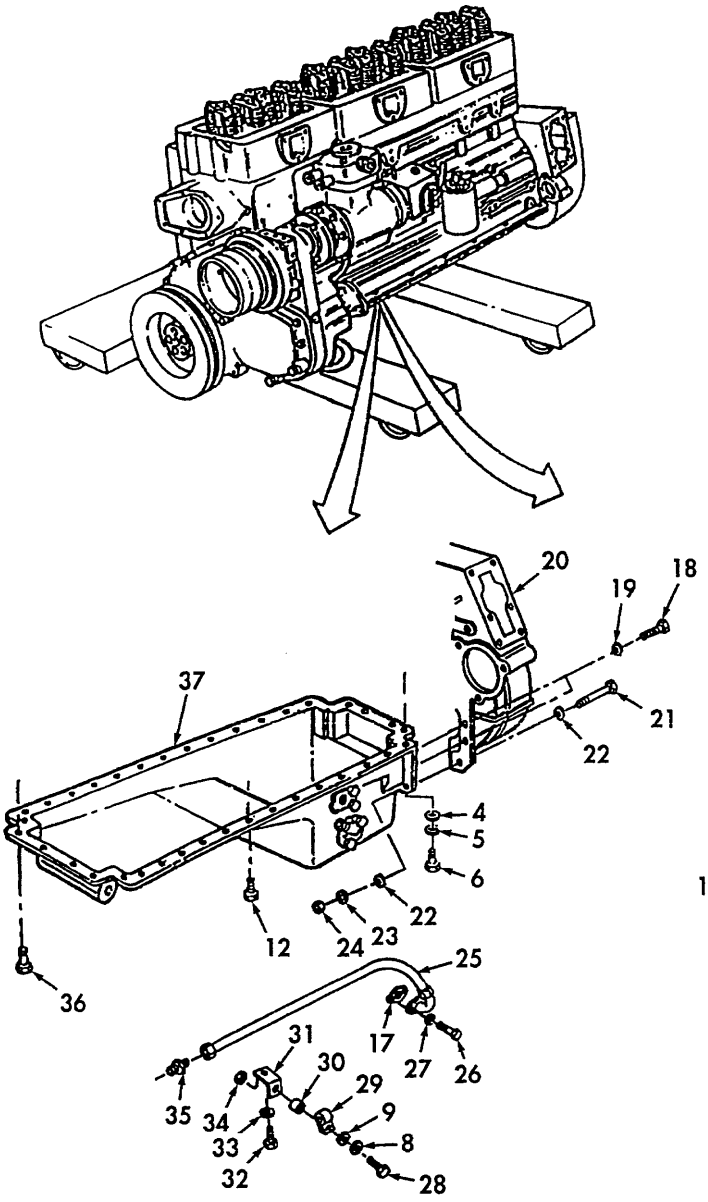
12. SCREW (28)
16. OIL PUMP
25. OIL SUCTION HOSE (NONMETALLIC) (M915/BIG CAM I)
26. SCREW (2) (M915/BIG CAM I)
31. BRACKET (M915/BIG CAM I)
32. SCREW (M915/BIG CAM I)
33. LOCKWASHER (M915/BIG CAM I)
35. ADAPTER (M915/BIG CAM I)
37. OIL PAN (M915/BIG CAM I)

3-81. OIL PAN INSTALLATION (Contd)

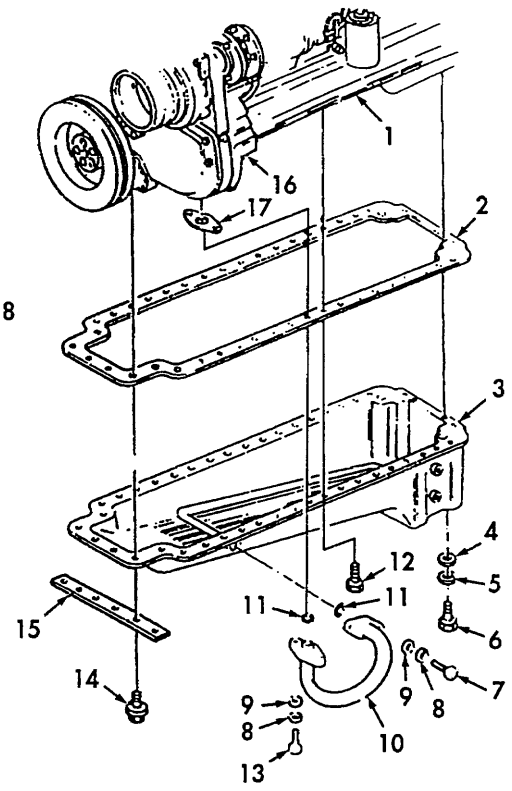
LOCATION/ITEM	ACTION	REMARKS
Installation (Contd)		
24. Clamp (29) (M915/Big Cam I)	Position on oil suction hose (25).	
25. Spacer (30) (M915/Big Cam I)	Position between bracket (31) and clamp (29).	
26. Screw (28), new lockwasher (8), washer (9), and nut (34) (M915/Big Cam I)	Install on bracket (31) and clamp (29).	Ensure oil suction hose (25) is supported properly and is not pinched or binding.

FOLLOW-ON TASK: Install injector assemblies (para. 3-82).

3-81. OIL PAN INSTALLATION (Contd)



M915/BIG CAM I OIL PAN (CAST ALUMINUM)



M915A1/BIG CAM III OIL PAN (STAMPED STEEL)

LEGEND:

8. LOCKWASHER (M915/BIG CAM I)
9. WASHER (M915/BIG CAM I)
25. OIL SUCTION HOSE (NONMETALLIC) (M915/BIG CAM I)
28. SCREW (M915/BIG CAM I)
29. CLAMP (M915/BIG CAM I)
30. SPACER (M915/BIG CAM I)
31. BRACKET (M915/BIG CAM I)
34. NUT (M915/BIG CAM I)

3-82. INJECTOR ASSEMBLY INSTALLATION

THIS TASK COVERS:

Installation

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Injector puller (15434) 3376872

TEST EQUIPMENT
None

MATERIALS/PARTS
Oil, lubricating OE/HDO 10
(Appendix C, Item 20)
Three preformed packings (15434) 193736

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
Injection timing completed (para. 3-72).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS

CAUTION

If injector assembly fails to seat completely, remove and check for a twisted or damaged preformed packing (O-ring).

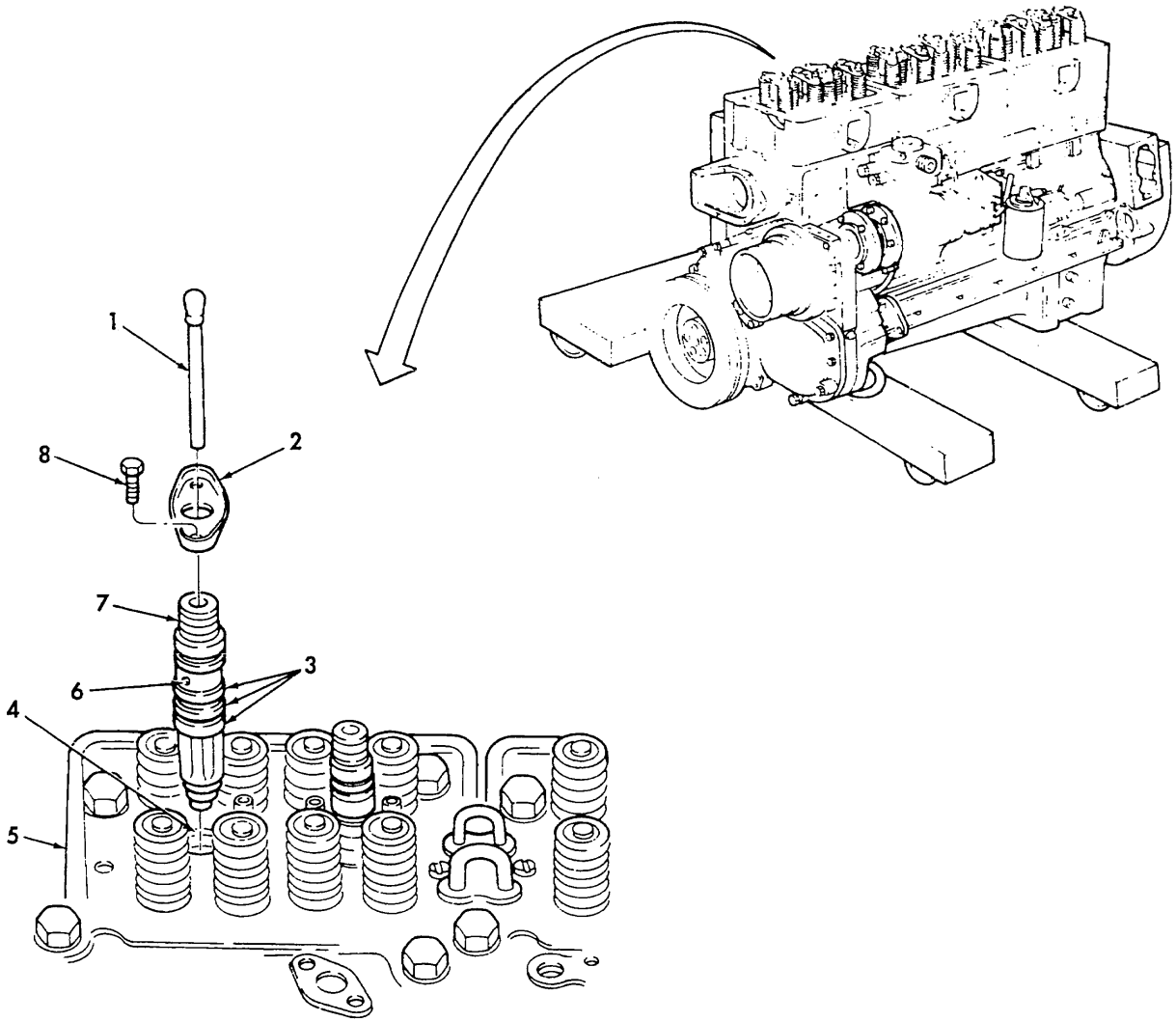
NOTE

- **Inspect fuel cooling sleeve in cylinder head prior to installing injector. Remove any dirt with a lint-free cloth.**
- **The following procedure involves installation of one injector assembly. Installation of remaining five is similar.**
- **Ensure injector assemblies are installed in same location as noted during removal.**

Installation

1.	Three new preformed packings (3) and injector assembly (M915/Big Cam I) or fuel injection nozzle assembly (M915A1/Big Cam III) (7)	Lubricate lightly with OE/HDO 10 lubricating oil.	
2.	Injector assembly (M915/ Big Cam I) or fuel injection nozzle assembly (M915/ Big Cam III) (7)	Install on fuel cooling sleeve (4) of cylinder head assembly (5).	Align filter screen of fuel inlet (6) hole so that it is toward exhaust side of the cylinder head assembly (5). Use injector puller (3376872) for installation. A snap should be heard and felt as injector assembly (M915/Big Cam I) or fuel injection nozzle assembly (M915A1/Big Cam III) (7) seats in fuel cooling sleeve (4) of cylinder head assembly (5).

3-82. INJECTOR ASSEMBLY INSTALLATION (Contd)



LEGEND:

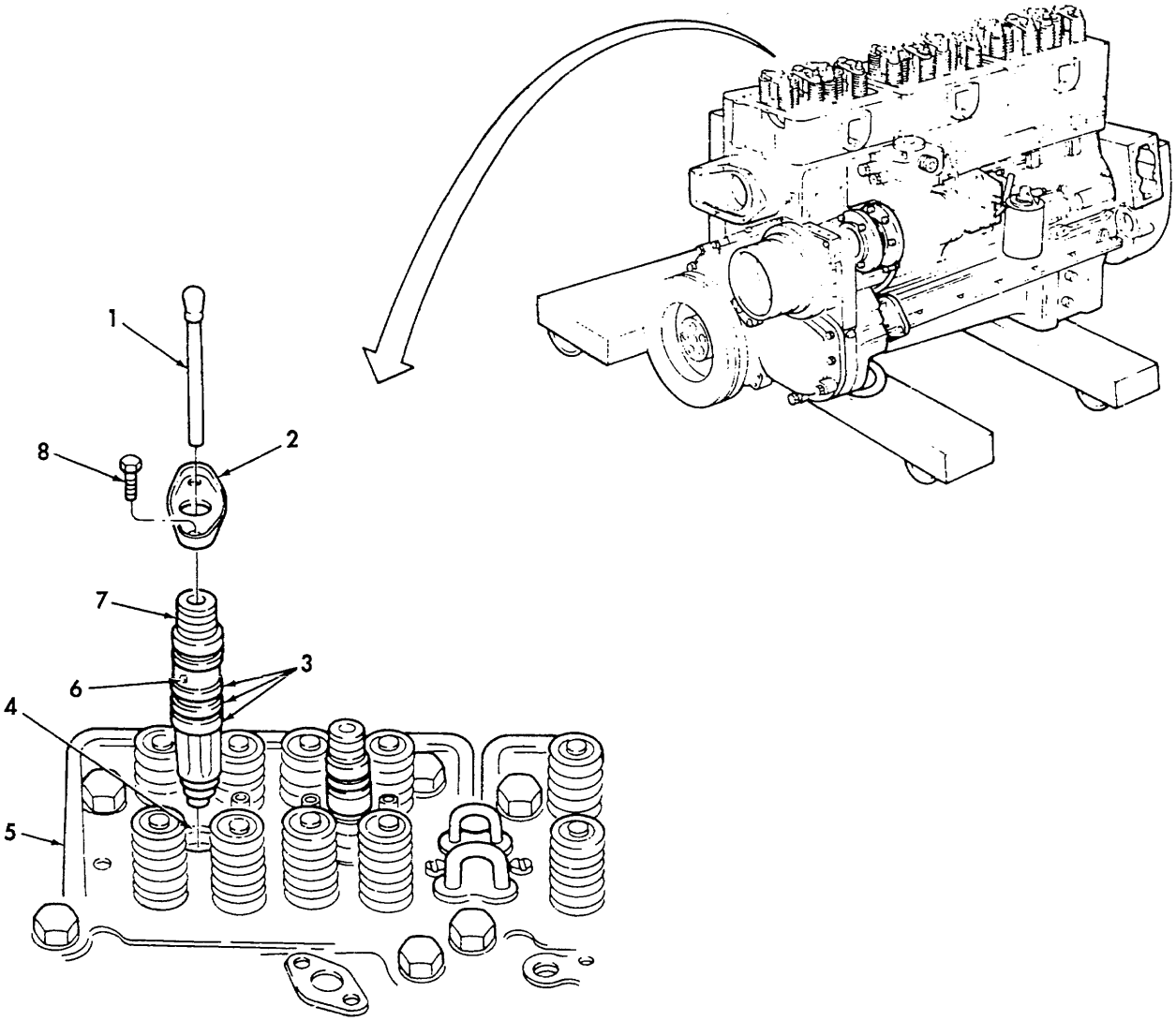
1. DETENT PLUNGER
2. RETAINING PLATE (M915/BIG CAM I) OR CLAMP (M915A1/BIG CAM III)
3. PREFORMED PACKING (3)
4. FUEL COOLING SLEEVE
5. CYLINDER HEAD ASSEMBLY
6. FUEL INLET
7. INJECTOR ASSEMBLY (M915/BIG CAM I) OR FUEL INJECTION NOZZLE ASSEMBLY (M915A1/BIG CAM III)
8. SCREW (2)

3-82. INJECTOR ASSEMBLY INSTALLATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
Installation (Contd)		
3. Retaining plate (M915/ Big Cam I) or clamp (M915A1/Big Cam III) (2)	Install on injector assembly (M915A1/Big Cam I) or fuel injection nozzle assembly (M915A1/ Big Cam III) (7).	
4. Detent plunger (1)	Install on top of injector assembly (M915/Big Cam I) or fuel injection nozzle assembly (M915A1/Big Cam III) (7).	
5. Two screws (8)	Install and tighten in steps of 5 lb-ft (7 N•m) until a final torque of 12 lb-ft (16 N•m) is obtained.	
6. Detent plunger (1)	Check for free movement after tightening. If detent plunger (1) does not move freely, loosen two screws (8) and retighten. Detent plunger (1) must move freely.	

FOLLOW-ON TASK: Install and adjust valve crossheads (para. 3-83).

3-82. INJECTOR ASSEMBLY INSTALLATION (Contd)



LEGEND:

1. DETENT PLUNGER
2. RETAINING PLATE (M915/BIG CAM I) OR CLAMP (M915A1/BIG CAM III)
7. INJECTOR ASSEMBLY (M915/BIG CAM I) OR FUEL INJECTION NOZZLE ASSEMBLY (M915A1/BIG CAM III)
8. SCREW (2)

3-83. VALVE CROSSHEADS INSTALLATION AND ADJUSTMENT

THIS TASK COVERS:

Installation

INITIAL SETUP:

APPLICABLE MODELS
All

REFERENCES (TM)
None

SPECIAL TOOLS
Torque driver (15434) ST-669

TROUBLESHOOTING REFERENCES
Para. 2-8

TEST EQUIPMENT
None

EQUIPMENT CONDITION
Injectors installed (para. 3-82).

MATERIALS/PARTS
Oil, lubricating, OE/HDO 10
(Appendix C, Item 20)

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

PERSONNEL REQUIRED
Automotive repairman MOS 63H

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS

Installation

NOTE

- **There is one intake valve crosshead and one exhaust valve crosshead per cylinder, or two each per cylinder head.**
- **The following procedure involves installation and adjustment of one exhaust and one intake valve crosshead. Installation and adjustment of remaining valve crossheads is similar.**

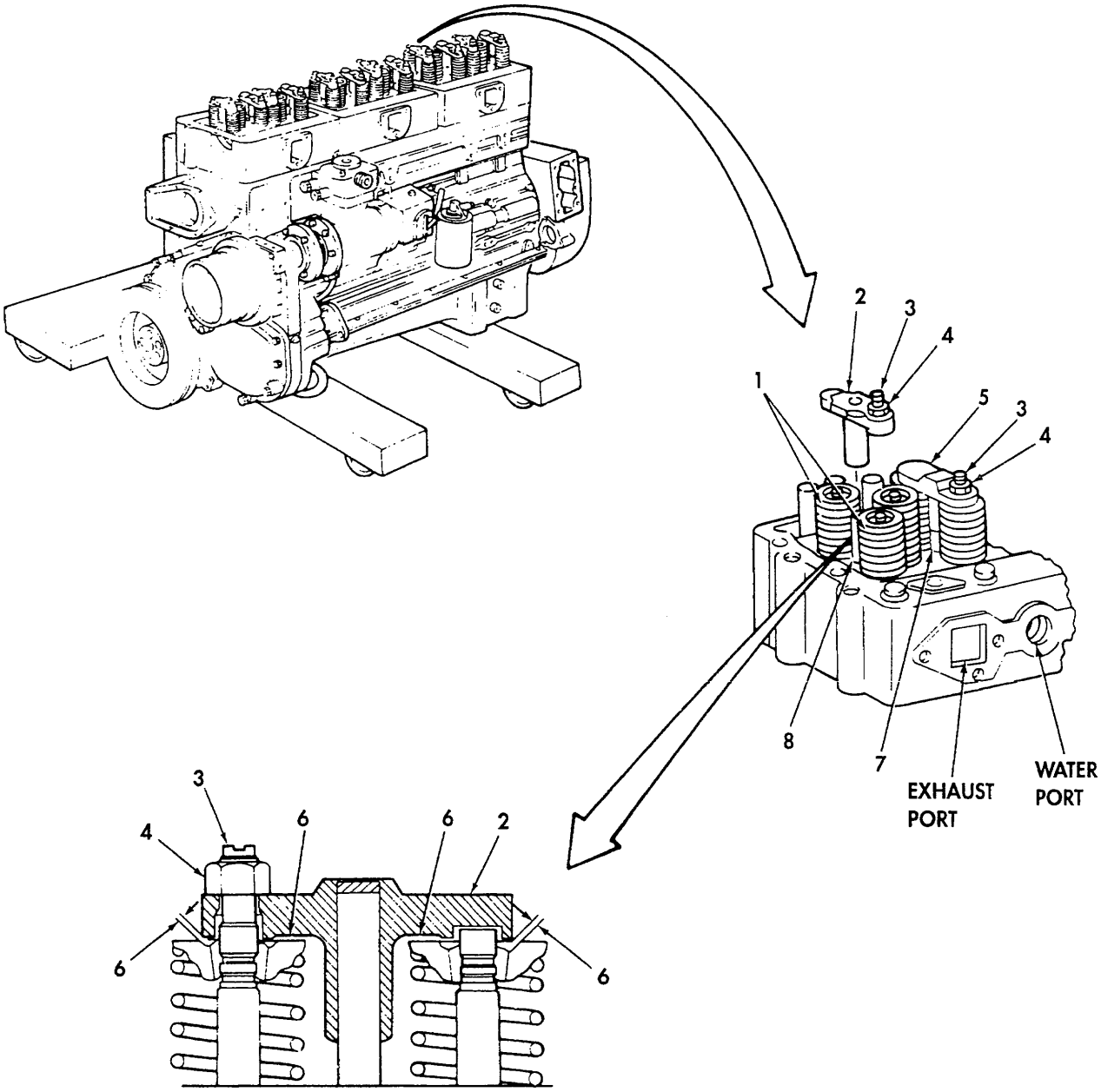
1.	Four valve stems (1), intake valve crosshead guide (7), and exhaust valve crosshead guide (8)	Lubricate valve stem ends and entire valve crosshead guides (7) and (8) with OE/HDO 10 lubricating oil.	

CAUTION

The exhaust valve crossheads and intake valve crossheads are different. The exhaust valve crosshead is wider and has a drilled oil passage hole through the top. Improper installation may result in engine damage.

2.	Exhaust valve crosshead (2)	Install on exhaust valve crosshead guide (8).	Adjusting screw (3) and locking nut (4) must be towards exhaust and water ports.
3.	Intake valve crosshead (5)	Install on intake valve crosshead guide (7).	Adjusting screw (3) and locking nut (4) must be towards exhaust and water ports.

3-83. VALVE CROSSHEADS INSTALLATION AND ADJUSTMENT (Contd)



LEGEND:

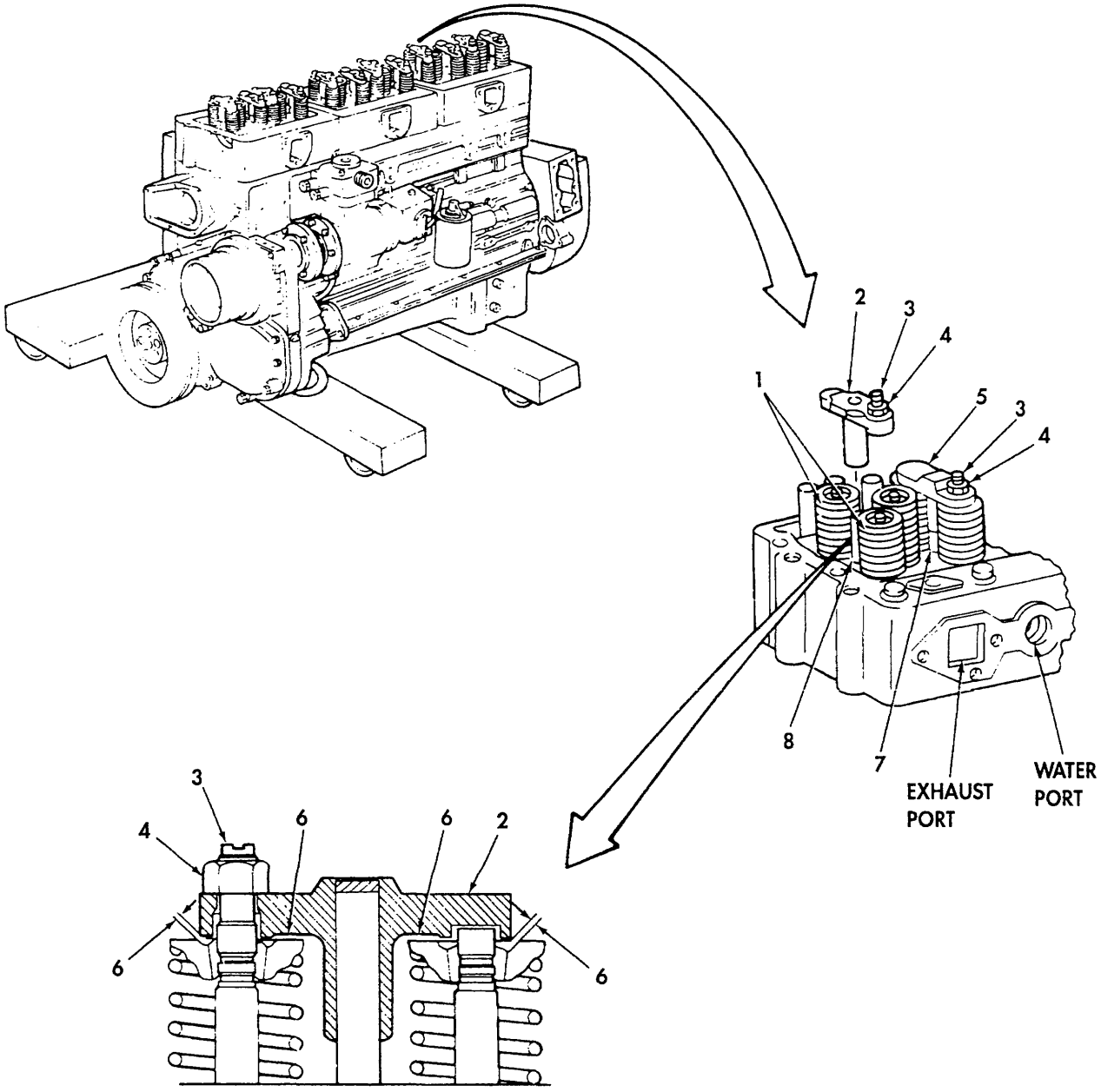
1. VALVE STEM (4)
2. EXHAUST VALVE CROSSHEAD
3. ADJUSTING SCREW
4. LOCKING NUT
5. INTAKE VALVE CROSSHEAD
6. CROSSHEAD CLEARANCE (4)
7. INTAKE VALVE CROSSHEAD GUIDE
8. EXHAUST VALVE CROSSHEAD GUIDE

3-83. VALVE CROSSHEADS INSTALLATION AND ADJUSTMENT (Contd)

LOCATION/ITEM	ACTION	REMARKS
Installation (Contd)		
4. Two locking nuts (4) and adjusting screws (3)	Loosen one full turn.	
5. Two exhaust valves and two intake valve adjusting screws (3)	Adjust as follows:	
	a. Using light pressure, hold exhaust valve crosshead (2) or intake valve crosshead (5) against valve stem (1). Turn exhaust or intake valve adjusting screw (3) until it touches valve stem (1), but does not raise exhaust valve crosshead (2) or intake valve crosshead (5).	The adjustment procedure for exhaust valve crosshead (2) is the same for intake valve crosshead (5).
	b. Hold adjusting screw (3) and tighten locking nut (4) to 25 lb-ft (34 N•m).	Use a round and a flat feeler gauge to check the crosshead clearances (6) at four locations. Refer to illustration. There must be a minimum of 0.025 in. (0.635 mm) clearance (6) between exhaust valve crosshead (2), intake valve crosshead (5), and valve spring retainers.
	c. Recheck clearance.	

FOLLOW-ON TASK: Install rocker arm housing assembly (para. 3-84).

3-83. VALVE CROSSHEADS INSTALLATION AND ADJUSTMENT (Contd)



LEGEND:

1. VALVE STEM (4)
2. EXHAUST VALVE CROSSHEAD
3. ADJUSTING SCREW (2)
4. LOCKING NUT (2)
5. INTAKE VALVE CROSSHEAD
6. CROSSHEAD CLEARANCE (4)

3-84. ROCKER ARM HOUSING ASSEMBLY INSTALLATION

THIS TASK COVERS:

Installation

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
None

TEST EQUIPMENT
None

MATERIALS/PARTS
Gasket (15434) 3017750

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

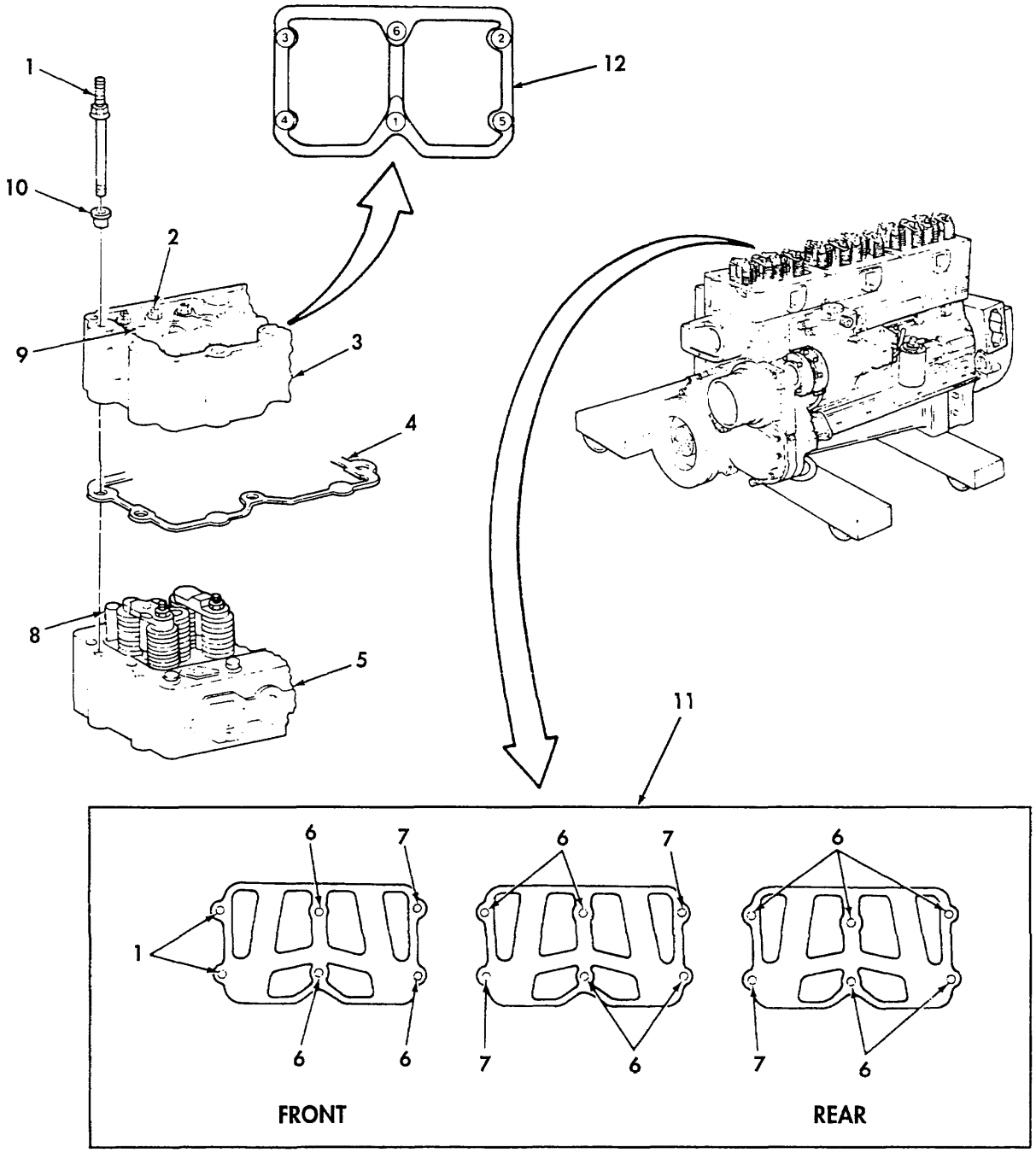
EQUIPMENT CONDITION
Valve crossheads installed and adjusted (para. 3-83)

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS
Installation		
	NOTE **The following procedure covers the installation of one rocker arm housing assembly. The installation of the remaining rocker arm housing assemblies is similar.**	
1. New gasket (4)	Install on cylinder head assembly (5).	
2. Six adjusting screws (2)	Loosen three complete turns.	The six adjusting screws (2) must be loose before installing rocker arm housing assembly (3).
3. Rocker arm housing assembly (3)	Install on new gasket (4) and cylinder head assembly (5). Position the six rocker assembly levers (9) so ball end of adjusting screw (2) drops into sockets of six pushrods (8).	

3-84. ROCKER ARM HOUSING ASSEMBLY INSTALLATION (Contd)



LEGEND:

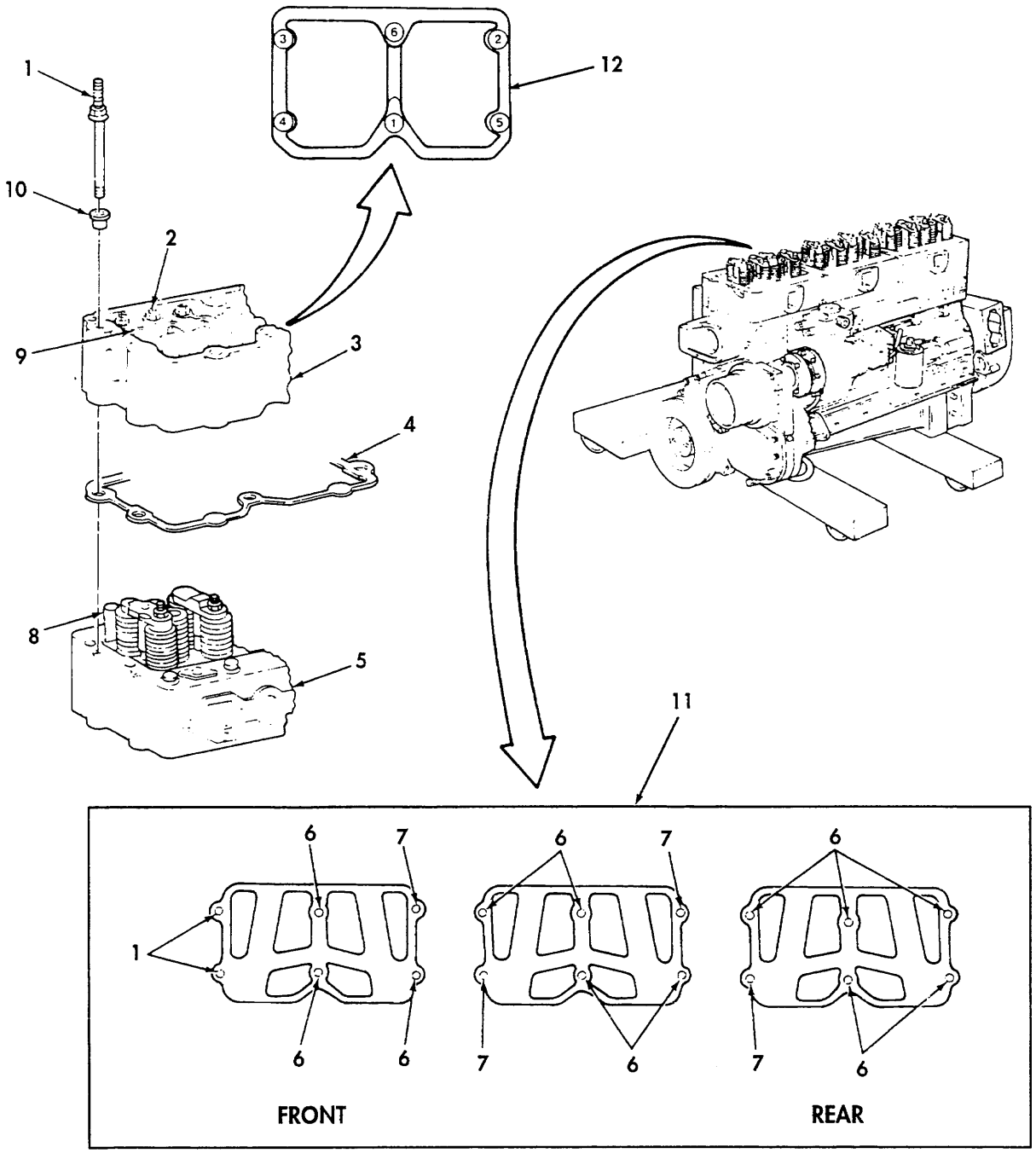
1. ROCKER HOUSING STUD 8-5/8 IN. (2 PER ENGINE)
2. ADJUSTING SCREW (6 PER ROCKER HOUSING ASSEMBLY)
3. ROCKER ARM HOUSING ASSEMBLY
4. GASKET
5. CYLINDER HEAD ASSEMBLY
6. ROCKER HOUSING STUD 7 IN. (12 PER ENGINE)
7. ROCKER HOUSING STUD 8-1/8 IN. (4 PER ENGINE)
8. PUSHROD (6 PER ROCKER HOUSING ASSEMBLY)
9. ROCKER ASSEMBLY LEVER (6 PER ROCKER HOUSING ASSEMBLY)
10. WASHER BEARING (6 PER ROCKER HOUSING ASSEMBLY)
11. INSTALLATION SEQUENCE
12. TIGHTENING SEQUENCE

3-84. ROCKER ARM HOUSING ASSEMBLY INSTALLATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
Installation (Contd)		
4. Six washer bearings (10)	Install on rocker arm housing assembly (3).	
	CAUTION **There are three different sizes of rocker housing studs. Install correct rocker housing stud in correct rocker arm housing assembly. Damage to rocker housing stud threads will result if substitution of length is made. See illustration for proper locations.**	
5. Six rocker housing studs (1), (6), and (7)	Install and tighten to 65 lb-ft (88 N•m) as shown in installation sequence (11) and tightening sequence (12).	The center and rear rocker arm housing assemblies do not use the 8-5/8 in. long rocker housing stud (1).

FOLLOW-ON TASK: Perform injector and valve adjustment (para. 3-85).

3-84. ROCKER ARM HOUSING ASSEMBLY INSTALLATION (Contd)



LEGEND:

1. ROCKER HOUSING STUD 8-5/8 IN. (2 PER ENGINE)
3. ROCKER ARM HOUSING ASSEMBLY
6. ROCKER HOUSING STUD 7 IN. (12 PER ENGINE)
7. ROCKER HOUSING STUD 8-1/8 IN. (4 PER ENGINE)
10. WASHER BEARING (6 PER ROCKER HOUSING ASSEMBLY)
11. INSTALLATION SEQUENCE
12. TIGHTENING SEQUENCE

3-85. INJECTOR AND VALVE ADJUSTMENT

THIS TASK COVERS:

Adjustment

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Torque driver (15434) ST-669

TEST EQUIPMENT
None

MATERIALS/PARTS
None

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
Rocker arm housing assembly installed (para. 3-84).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS
Adjustment		

CAUTION

Injector specifications and valve clearances given are for a cold engine only. Do not use these specifications or clearances for a warm or hot engine or damage will result to related parts.

NOTE

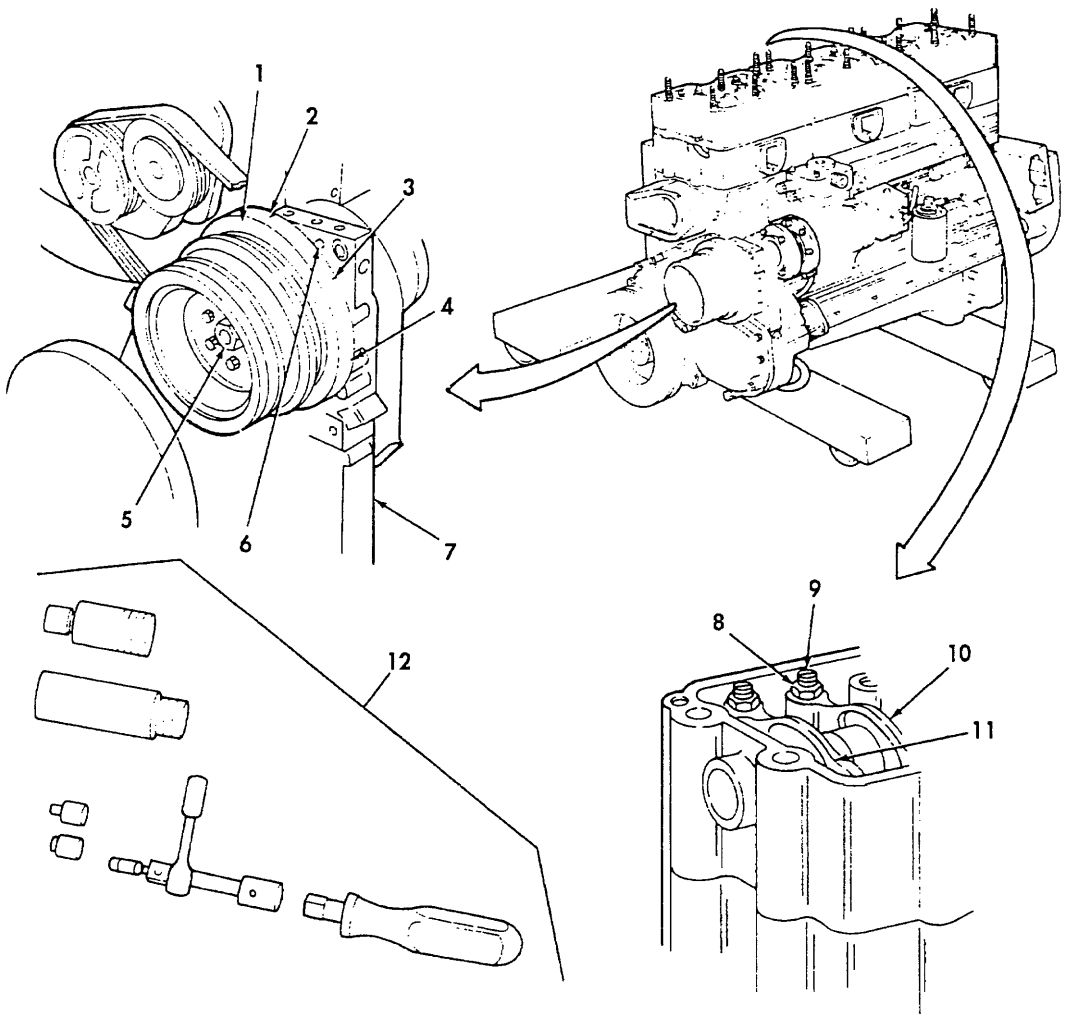
- **Engine cylinders are numbered in sequence, starting at front with No. 1 cylinder. The engine firing order is 1-5-3-6-2-4.**
- **The valves and injectors for the same cylinder are not adjusted at same index mark on accessory drive pulley. One pair of valves from one cylinder and one injector on a different cylinder are adjusted at each pulley index mark before rotating accessory drive to next index mark.**
- **Two crankshaft revolutions are required to adjust all valves and injectors.**

1.	Accessory drive pulley assembly (1)	a. Remove paint on timing marks A (2), B (3), and C (4).	Use a medium-grit emery cloth. Only the A (2), B (3), and C (4) timing marks will be used for injector and valve adjustment.
		b. Rotate engine crankshaft clockwise until line in front of timing mark A (2) aligns with pointer (6) on front gear cover (7).	Do not use nut (5) on the accessory drive pulley assembly (1) to rotate. The intake and exhaust rocker lever assemblies (10) for cylinder No. 5 will be loose. If they are not, rotate crankshaft another 360° and realign the A mark (2).

3-85. INJECTOR AND VALVE ADJUSTMENT (Contd)

Injector and Valve Set Position

Rotate in Clockwise Direction	Pulley Position		Cylinder Firing	Set Cylinder	
				Injector	Valve
Start	A	or	1	3	5
Advance to	B	or	5	6	3
Advance to	C	or	3	2	6
Advance to	A	or	6	4	2
Advance to	B	or	2	1	4
Advance to	C	or	4	5	1



LEGEND:

1. ACCESSORY DRIVE PULLEY ASSEMBLY
2. TIMING MARK A
3. TIMING MARK B
4. TIMING MARK C
5. NUT
6. POINTER
7. FRONT GEAR COVER
8. ADJUSTING SCREW NUT
9. ADJUSTING SCREW
10. ROCKER LEVER ASSEMBLY
11. CROSSHEAD
12. TORQUE DRIVER

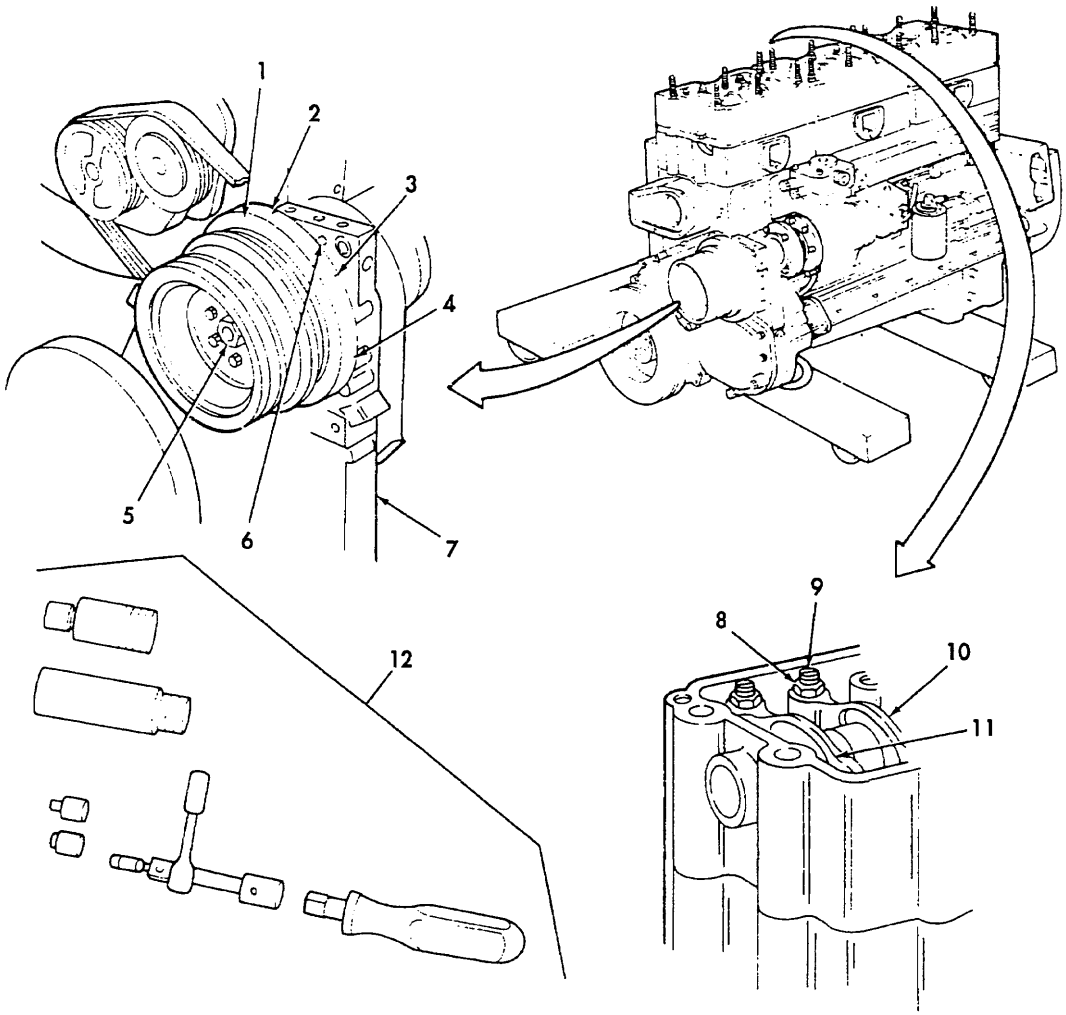
3-85. INJECTOR AND VALVE ADJUSTMENT (Contd)

LOCATION/ITEM	ACTION	REMARKS
Adjustment (Contd)		
2. Injector adjustment for cylinder No. 3	Adjust as follows:	
	a. Loosen the adjusting screw nut (8) several turns.	The rocker lever assembly (10) for the injector is between the intake and exhaust valves.
	b. Tighten adjusting screw (9) until all clearance is removed between rocker lever assembly (10) and injector detent plunger. Then tighten adjusting screw (9) one additional turn.	
	c. Loosen the adjusting screw (9) one complete turn until the spring washer inside the injector is against the stop of the injector.	Turn counterclockwise to loosen. The spring washer cannot be seen. When tension is removed from adjusting screw (9), this usually indicates that the spring washer is against the stop of the injector.
	d. Tighten the adjusting screw (9) to 5-6 lb-in. (0.6-0.7 N•m).	Repeat step 2d several times to make certain that it is correctly tightened.
	e. Keep adjusting screw (9) from turning and torque adjusting screw nut (8) to 45 lb-f (61 N•m).	If torque driver (ST-669) (12) is used, tighten adjusting screw nut (8) to 35 lb-ft (48 N•m).
	NOTE **The adjustment procedure for the intake valve is similar to the exhaust valve, except for valve clearance difference.**	
3. Intake and exhaust valve adjustment for cylinder No. 5	Adjust as follows:	
	a. Loosen adjusting screw nut (8).	Do not rotate engine crankshaft until completing all of step 3.
	b. Put a feeler gauge between the rocker lever assembly (10) and the crosshead (11).	Cold valve clearance for the exhaust valve is 0.023 in. (0.584 mm) and valve clearance for the intake valve is 0.011 in. (0.279 mm).
	c. Slowly tighten the adjusting screw (9) until the rocker lever assembly (10) touches the feeler gauge.	
	d. Hold the adjusting screw (9) in place and torque adjusting screw nut (8) to 45 lb-ft (61 N•m).	If torque driver (ST-669) (12) is used, tighten adjusting screw nut (8) to 40 lb-ft (54 N•m).

3-85. INJECTOR AND VALVE ADJUSTMENT (Contd)

Injector and Valve Set Position

Rotate in Clockwise Direction	Pulley Position		Cylinder Firing	Set Cylinder	
				Injector	Valve
Start	A	or	1	3	5
Advance to	B	or	5	6	3
Advance to	C	or	3	2	6
Advance to	A	or	6	4	2
Advance to	B	or	2	1	4
Advance to	C	or	4	5	1



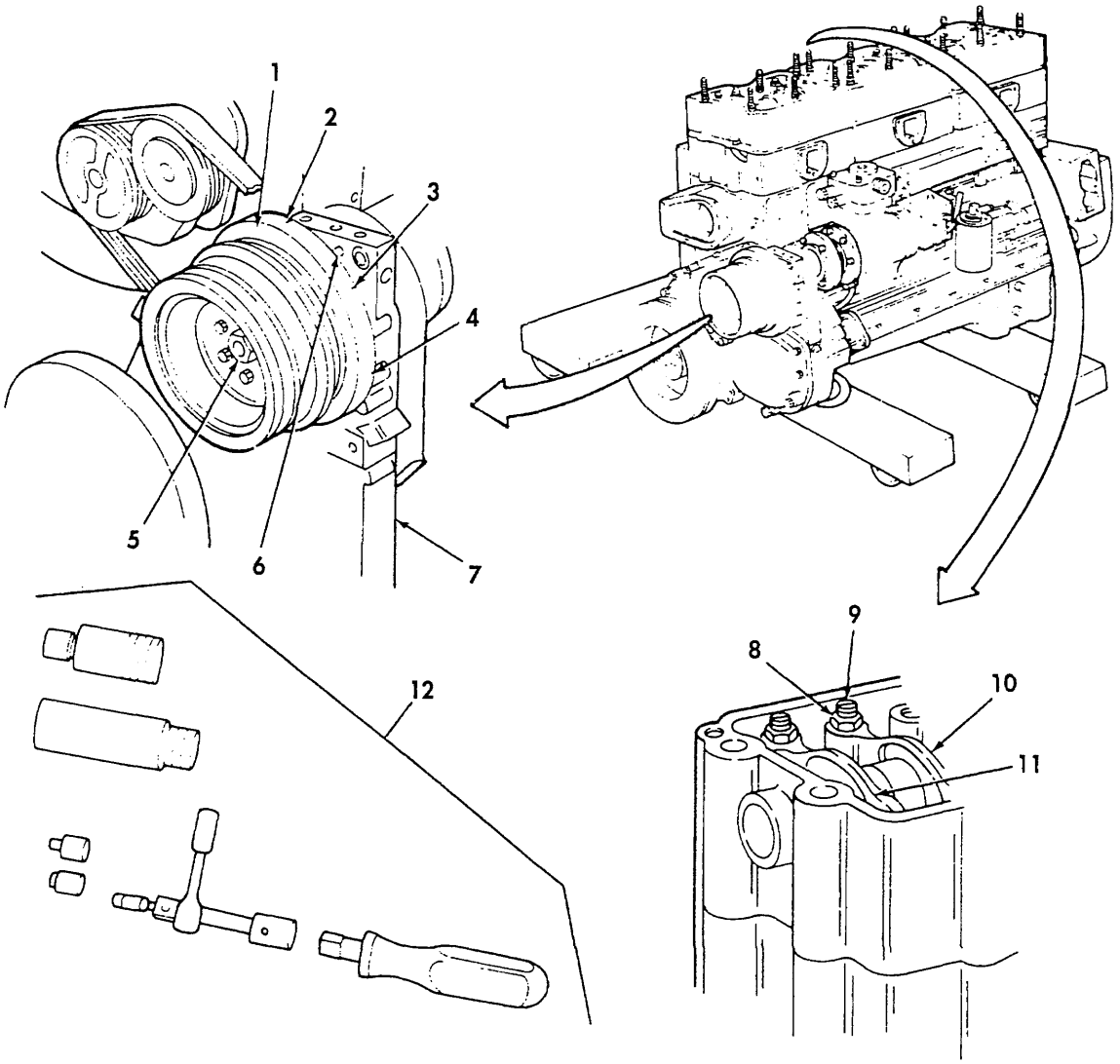
LEGEND:
1. DRIVE PULLEY
8. ADJUSTING SCREW NUT
9. ADJUSTING SCREW
10. ROCKER LEVER ASSEMBLY
11. CROSSHEAD
12. TORQUE DRIVER

3-85. INJECTOR AND VALVE ADJUSTMENT (Contd)

LOCATION/ITEM	ACTION	REMARKS
Adjustment (Contd)		
4. Accessory drive pulley assembly (1)	Slowly rotate clockwise until the line in front of timing mark B (3) aligns with the pointer (6) on the front gear cover (7).	Use engine crankshaft to rotate.
5. Injector adjustment for cylinder No. 6	Repeat step 2.	
6. Intake and exhaust valve adjustment for cylinder No. 3	Repeat step 3.	
7. Accessory drive pulley assembly (1)	Slowly rotate clockwise until the line in front of timing mark C (4) aligns with the pointer (6) on the front gear cover (7).	Use engine crankshaft to rotate.
8. Injector adjustment for cylinder No. 2	Repeat step 2.	
9. Intake and exhaust valve adjustment for cylinder No. 6	Repeat step 3.	
10. Accessory drive pulley assembly (1)	Slowly rotate clockwise until the line in front of timing mark A (2) aligns with pointer (6) on the front gear cover (7).	Use engine crankshaft to rotate.
11. Injector adjustment for cylinder No. 4	Repeat step 2.	
12. Intake and exhaust valve adjustment for cylinder No. 2	Repeat step 3.	
13. Accessory drive pulley assembly (1)	Slowly rotate clockwise until the line in front of timing mark B (3) aligns with pointer (6) on the front gear cover (7).	Use engine crankshaft to rotate.
14. Injector adjustment for cylinder No. 1	Repeat step 2.	
15. Intake and exhaust valve adjustment for cylinder No. 4	Repeat step 3.	
16. Accessory drive pulley assembly (1)	Slowly rotate clockwise until line in front of timing mark C (4) aligns with pointer (6) on the front gear cover (7).	Use engine crankshaft to rotate.
17. Injector adjustment for cylinder No. 5	Repeat step 2.	
18. Intake and exhaust valve adjustment for cylinder No. 1	Repeat step 3.	

FOLLOW-ON TASK: Install engine retarder (para. 3-86).

3-85. INJECTOR AND VALVE ADJUSTMENT (Contd)



LEGEND:

1. ACCESSORY DRIVE PULLEY ASSEMBLY
2. TIMING MARK A
3. TIMING MARK B
4. TIMING MARK C
5. NUT
6. POINTER
7. FRONT GEAR COVER

3-86. ENGINE RETARDER INSTALLATION

THIS TASK COVERS:

a. Installation **b. Slave Piston Adjustment**

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
None

TEST EQUIPMENT
None

MATERIALS/PARTS
Gasket (75078) 010279
Preformed packing (75078) 010180

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
TM 9-2320-273-20
TM 9-2320-283-20

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
- Rocker arm housing installed (para. 3-84).
- Injector and valve adjustment performed (para. 3-85).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS

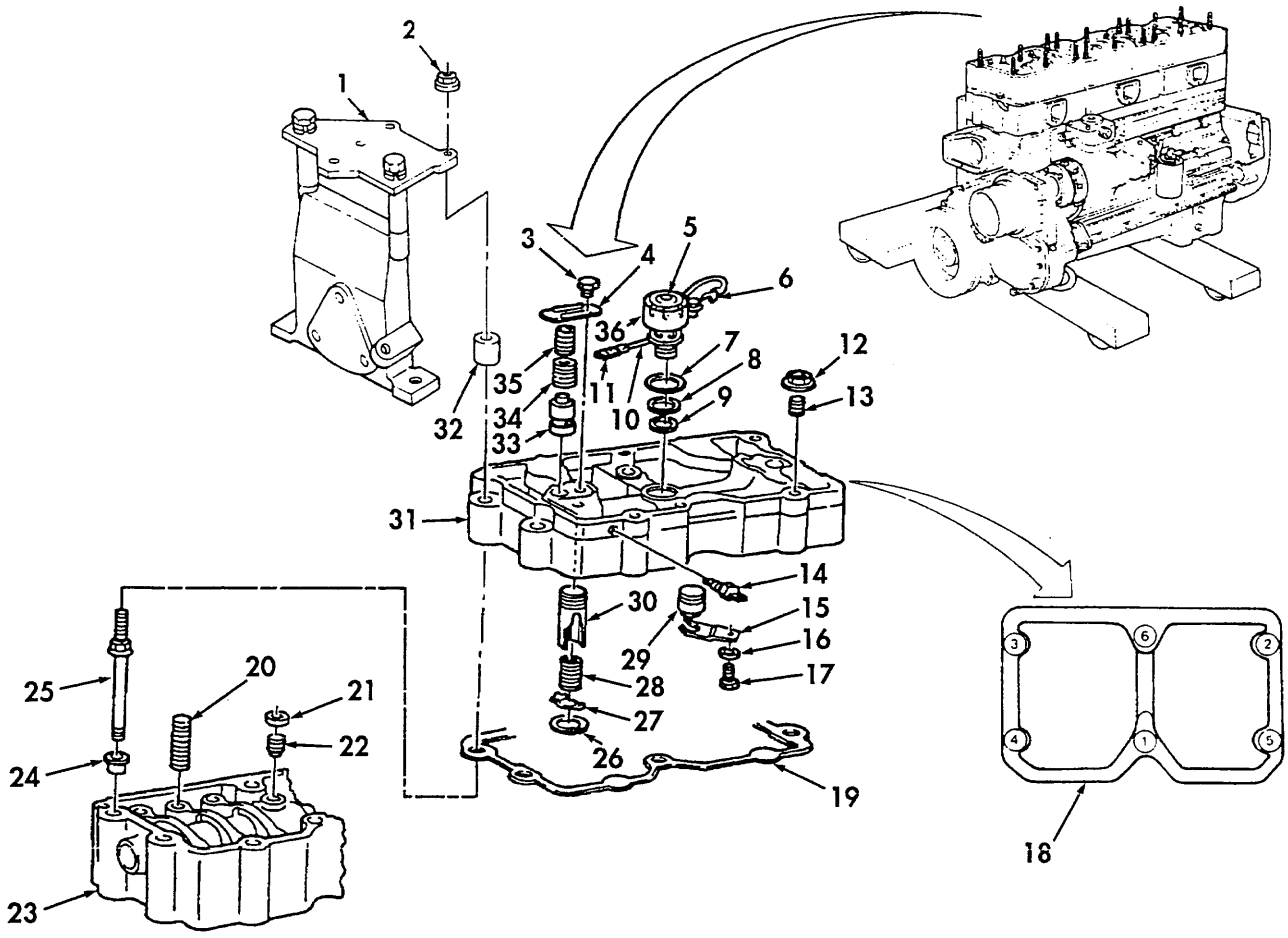
a. Installation

NOTE
- **The following procedure involves installation of one engine brake retarder. Installation of remaining engine brake retarders is similar.**
- **The engine retarder over cylinders No. 1 and 2 requires installation of a fan bracket assembly. The fan bracket assembly is installed in steps 9 and 10. Omit steps 3 and 4 if installing engine retarders over cylinders No. 3 and 4, or No. 5 and 6.**
- **If studs were removed from rocker housings, replace and tighten to 65-75 lb-ft (88-102 N•m); tighten in sequence as shown.**

1.	Slave piston (30), slave piston spring (28), helical retainer (27), and retaining ring (26)	Install on engine brake retarder assembly (31), if not installed.
2.	Master piston (29) and flat spring (15)	Install on engine brake retarder assembly (31) with washer (16) and screw (17), if not installed.
3.	Weighted valve (33), control valve outer spring (34), and control valve inner spring (35)	Install on engine brake retarder assembly (31) with control valve cover plate (4) and screw (3), if not installed.

CAUTION
Ensure preformed packing (rubber seal ring) in oil inlet supply bore on underside of engine brake retarder remains in place during installation or brake retarder will not operate properly.

3-86. ENGINE RETARDER INSTALLATION (Contd)



LEGEND:

1. FAN BRACKET ASSEMBLY
2. NUT (6)
3. SCREW (2)
4. CONTROL VALVE COVER PLATE (2)
5. SOLENOID ARMATURE
6. SPADE END (OF SOLENOID HARNESS)
7. PREFORMED PACKING
8. PREFORMED PACKING
9. PREFORMED PACKING
10. SOLENOID HARNESS
11. RECEIVER END (OF SOLENOID HARNESS)
12. LOCKNUT
13. SETSCREW
14. TERMINAL
15. FLAT SPRING (2)
16. WASHER (2)
17. SCREW (2)
18. TIGHTENING SEQUENCE
19. GASKET
20. EXTERNAL BOLT (2)
21. PREFORMED PACKING (3)
22. LOCKSHAFT SCREW (3)
23. ROCKER ARM HOUSING
24. BEARING WASHER (18)
25. ROCKER HOUSING STUD (6)
26. RETAINING RING (2)
27. HELICAL RETAINER (2)
28. SLAVE PISTON SPRING (2)
29. MASTER PISTON (2)
30. SLAVE PISTON (2)
31. ENGINE BRAKE RETARDER ASSEMBLY
32. SHORT SPACER (2)
33. WEIGHTED VALVE (2)
34. CONTROL VALVE OUTER SPRING (2)
35. CONTROL VALVE INNER SPRING (2)
36. SOLENOID VALVE ASSEMBLY

3-86. ENGINE RETARDER INSTALLATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
a. Installation (Contd)		
4. Solenoid valve assembly (36) and new preformed packing (7), (8), and (9)	Install on engine brake retarder (31), if not installed.	
5. Lockshaft screw (22), bolt (20), and preformed packing (21)	Install on rocker arm housing (23), if not installed.	
6. Terminal (14)	Install on engine brake retarder (31), if not installed.	
7. New gasket (19)	Position on rocker arm housing (23) and engine brake retarder (31).	
8. Engine brake retarder assembly (31)	Install on rocker arm housing (23).	
9. Two short spacers (32)	Install on two rocker housing studs (25).	Two short spacers (32) are needed for fan bracket assembly (1) which mounts on two front rocker housing studs (25) of engine brake retarder (31) for No. 1 and 2 cylinders.
10. Fan bracket assembly (1)	Install on two rocker housing studs (25) on top of two short spacers (32) on engine brake retarder (31).	The fan bracket assembly (1) fits on two front rocker housing studs (25) on top of two short spacers (32) on brake retarder (31) for cylinders No. 1 and 2.
11. Six nuts (2)	Install on rocker housing studs (25) and tighten to 60 lb-ft (81 N•m) as shown in tightening sequence (18).	

b. Slave Piston

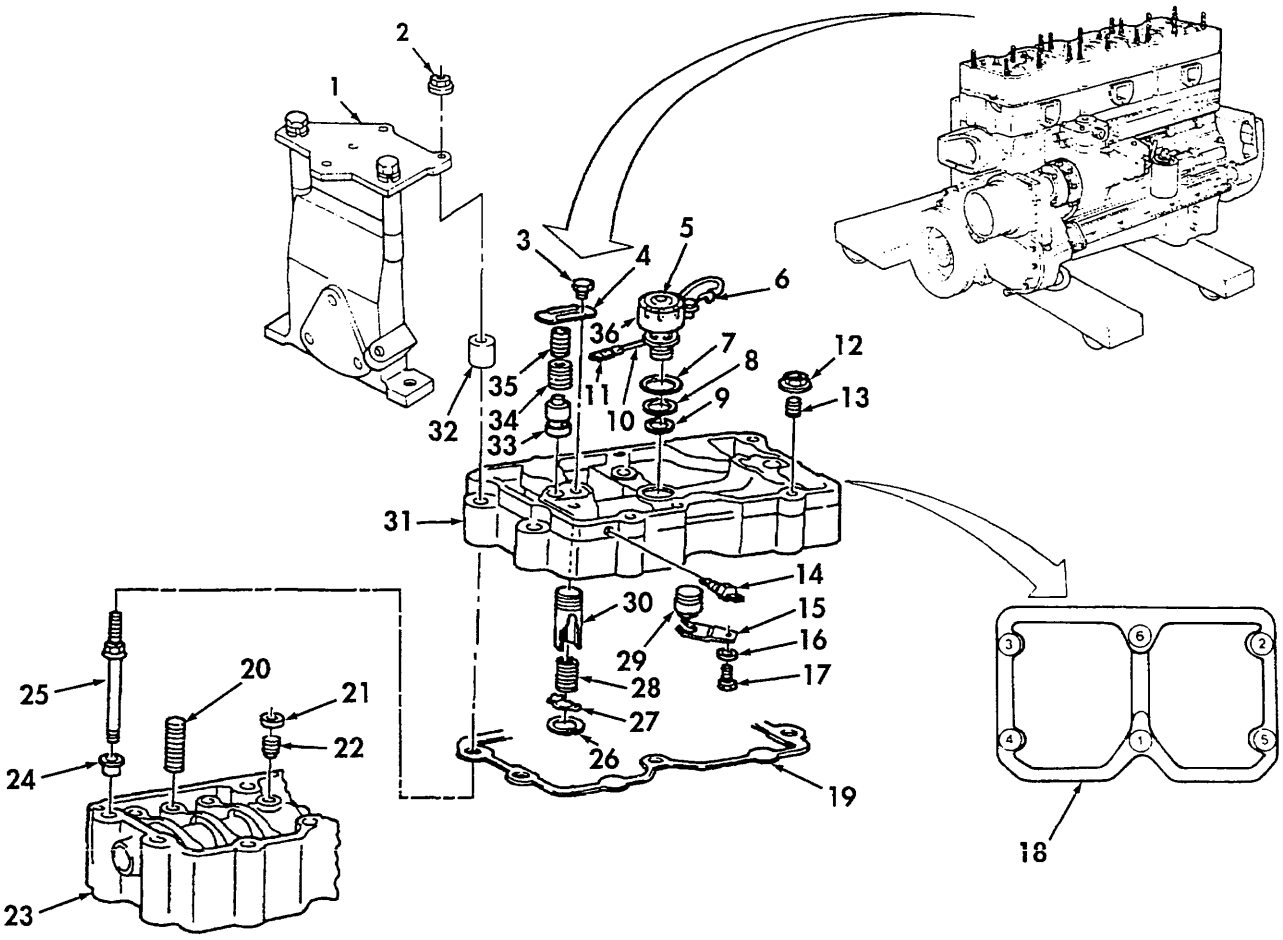
CAUTION

Adjusting slave piston by any other method than specified in this procedure will cause damage to related parts.

NOTE

- **The following procedure involves adjustment for one slave piston. There are two slave pistons per brake retarder, or one per cylinder. The adjustment for the remaining five slave pistons is similar. Ensure locknuts are loose before adjusting setscrew.**
- **Slave piston adjustment must be made with engine stopped and cold. Exhaust valve on cylinder to be adjusted must be fully closed.**
- **The adjustment procedure for slave piston requires engine crankshaft to be rotated and accessory drive pulley assembly positioned on timing mark A, B, or C. When positioned at timing mark A, cylinders No. 5 or 2 can be adjusted. When positioned at timing mark B, cylinders No. 3 or 4 can be adjusted. When positioned at timing mark C, cylinders No. 6 or 1 can be adjusted.**

3-86. ENGINE RETARDER INSTALLATION (Contd)



LEGEND:

1. FAN BRACKET ASSEMBLY
2. NUT (6)
3. SCREW (2)
4. CONTROL VALVE COVER PLATE (2)
5. SOLENOID ARMATURE
6. SPADE END (OF SOLENOID HARNESS)
7. PREFORMED PACKING
8. PREFORMED PACKING
9. PREFORMED PACKING
10. SOLENOID HARNESS
11. RECEIVER END (OF SOLENOID HARNESS)
12. LOCKNUT
13. SETSCREW
14. TERMINAL
15. FLAT SPRING (2)
16. WASHER (2)
17. SCREW (2)
18. TIGHTENING SEQUENCE
19. GASKET
20. EXTERNAL BOLT (2)
21. PREFORMED PACKING (3)
22. LOCKSHAFT SCREW (3)
23. ROCKER ARM HOUSING
24. BEARING WASHER (18)
25. ROCKER HOUSING STUD (6)
26. RETAINING RING (2)
27. HELICAL RETAINER (2)
28. SLAVE PISTON SPRING (2)
29. MASTER PISTON (2)
30. SLAVE PISTON (2)
31. ENGINE BRAKE RETARDER ASSEMBLY
32. SHORT SPACER (2)
33. WEIGHTED VALVE (2)
34. CONTROL VALVE OUTER SPRING (2)
35. CONTROL VALVE INNER SPRING (2)
36. SOLENOID VALVE ASSEMBLY

3-86. ENGINE RETARDER INSTALLATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
b. Slave Piston Adjustment (Contd)		
12. Slave piston (30)	Adjust clearance as follows:	
	a. Loosen locknut (6).	
	b. Loosen setscrew (7) several turns.	Turn counterclockwise to loosen until there is no pressure or tension.
	c. Insert feeler gauge between slave piston (30) and crosshead. Adjust clearance to 0.018 in. (0.457 mm).	A slight drag should be felt on the feeler gauge when setscrew (7) is properly adjusted.

CAUTION

After slave piston adjusting screw locknut has been tightened to specified value, check clearance with feeler gauge again. Do not overtighten adjusting screw locknut or clearance may change and result in damage to engine.

	d. Tighten locknut (6) to 40 lb-ft (54 N•m).	
	e. Recheck clearance between slave piston (30) and crosshead with feeler gauge.	Refer to CAUTION before step 6d. Repeat steps 6a through 6d if any change in clearance is found.
13. Solenoid harness (10)	Connect spade end (6) to solenoid valve assembly (36). Connect receiver end (11) to terminal (14) inside of engine brake retarder assembly (31).	

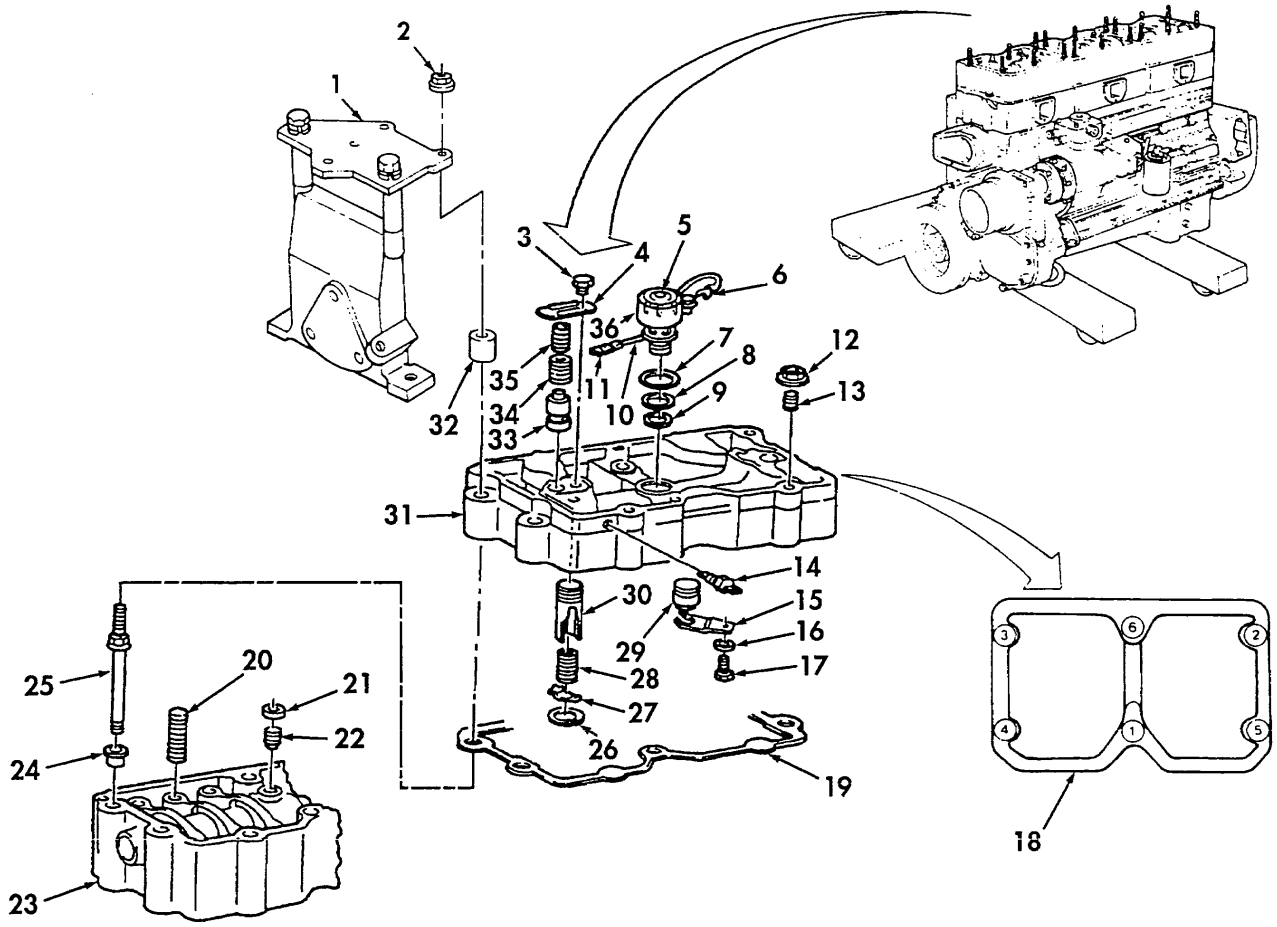
NOTE

If engine will be started after installation and adjustment of engine retarder, it will then be necessary to bleed air from engine retarder assembly and proceed with step 14. If it will not be started, proceed with follow-on tasks.

14. Engine brake retarder assembly (31)	When engine is installed on dynamometer test stand, bleed and purge air as follows:	
	a. Start engine and run for several minutes.	
	b. Rev engine to 1800 rpm and release throttle.	
	c. Push down on solenoid armature (5) five or six times to permit engine lubricating oil to fill engine brake retarder housing oil passages.	

FOLLOW-ON TASKS:
- Install engine lifting brackets (TM 9-2320-273-20 or TM 9-2320-283-20).
- Install rocker covers and gaskets (TM 9-2320-273-20 or TM 9-2320-283-20).
- Install air aftercooler (para. 3-87).

3-86. ENGINE RETARDER INSTALLATION (Contd)



LEGEND:

1. FAN BRACKET ASSEMBLY
2. NUT (6)
3. SCREW (2)
4. CONTROL VALVE COVER PLATE (2)
5. SOLENOID ARMATURE
6. SPADE END (OF SOLENOID HARNESS)
7. PREFORMED PACKING
8. PREFORMED PACKING
9. PREFORMED PACKING
10. SOLENOID HARNESS
11. RECEIVER END (OF SOLENOID HARNESS)
12. LOCKNUT
13. SETSCREW
14. TERMINAL
15. FLAT SPRING (2)
16. WASHER (2)
17. SCREW (2)
18. TIGHTENING SEQUENCE
19. GASKET
20. EXTERNAL BOLT (2)
21. PREFORMED PACKING (3)
22. LOCKSHAFT SCREW (3)
23. ROCKER ARM HOUSING
24. BEARING WASHER (18)
25. ROCKER HOUSING STUD (6)
26. RETAINING RING (2)
27. HELICAL RETAINER (2)
28. SLAVE PISTON SPRING (2)
29. MASTER PISTON (2)
30. SLAVE PISTON (2)
31. ENGINE BRAKE RETARDER ASSEMBLY
32. SHORT SPACER (2)
33. WEIGHTED VALVE (2)
34. CONTROL VALVE OUTER SPRING (2)
35. CONTROL VALVE INNER SPRING (2)
36. SOLENOID VALVE ASSEMBLY

3-87. AIR AFTERCOOLER INSTALLATION

THIS TASK COVERS:

Installation

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
None

TEST EQUIPMENT
None

MATERIALS/PARTS
Lubricant, high-pressure (Appendix C, Item 15)
Three gaskets (15434) 3008591
Two lockwashers (15434) S-604
(M915A1/Big Cam III only)
Three lockwashers (96906) MS122032
(M915/Big Cam I only)

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
TM 9-2320-273-20
TM 9-2320-283-20

TROUBLESHOOTING REFERENCES
Para. 2-8

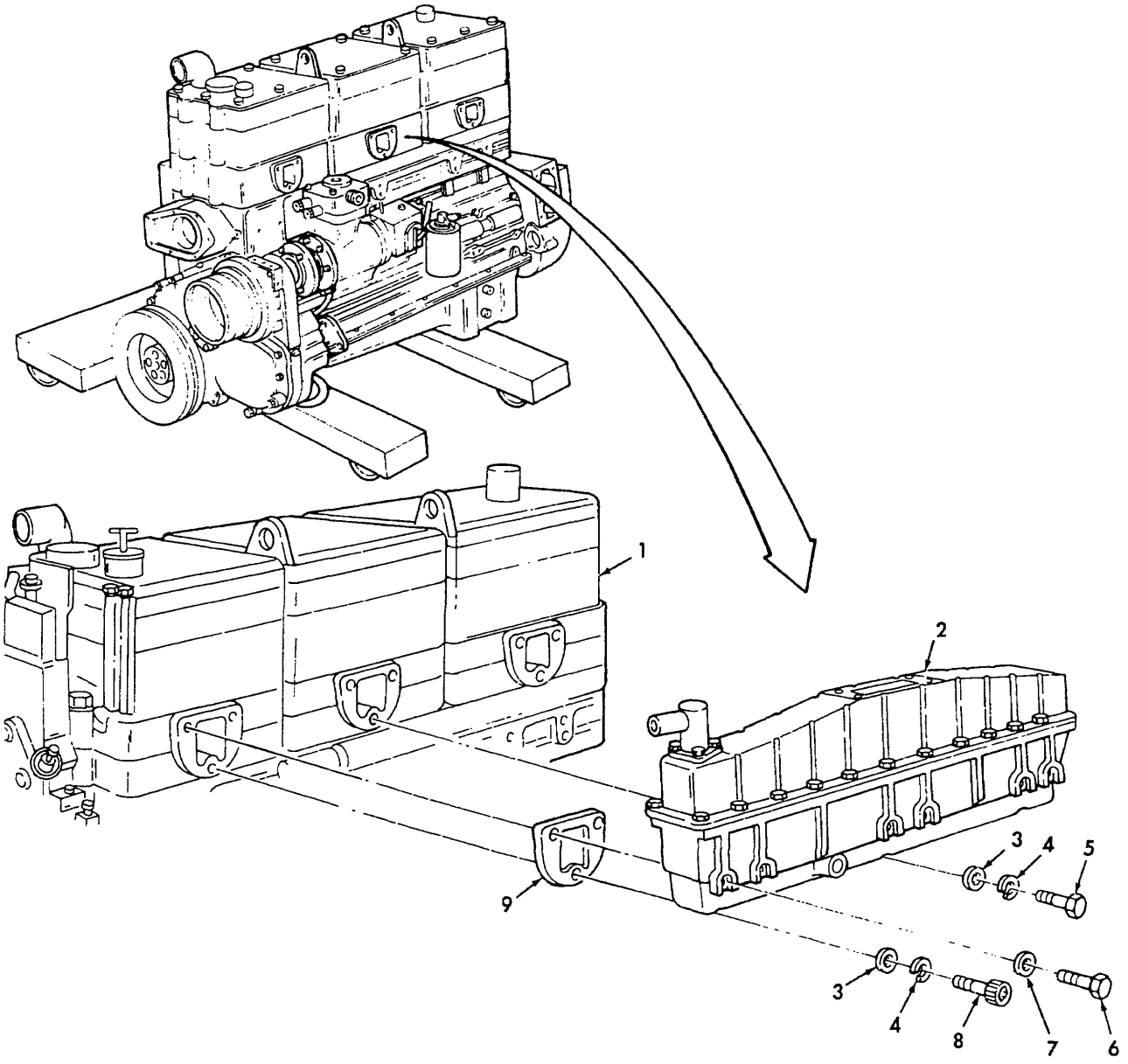
EQUIPMENT CONDITION
Engine retarders installed (para. 3-86).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
None

LOCATION/ITEM	ACTION	REMARKS
Installation		
	NOTE • **Perform steps 2 and 5 for M915/Big Cam I.** • **Perform steps 3 and 6 for M915A1/Big Cam III.**	
1. Three new gaskets (9)	Install on three cylinder heads (1).	Use a small amount of high-pressure lubricant to hold gaskets (9) in place.
2. Three screws (5), new lockwashers (4), and washers (3) (M915/Big Cam I)	Install on bottom hole of each cylinder head (1).	Thread in three to five turns.
3. Screw (8), two screws (5), three new lockwashers (4), and washers (3) (M915A1/ Big Cam III)	Install on bottom hole of each cylinder head (1).	Thread in three to five turns.

3-87. AIR AFTERCOOLER INSTALLATION (Contd)



LEGEND:

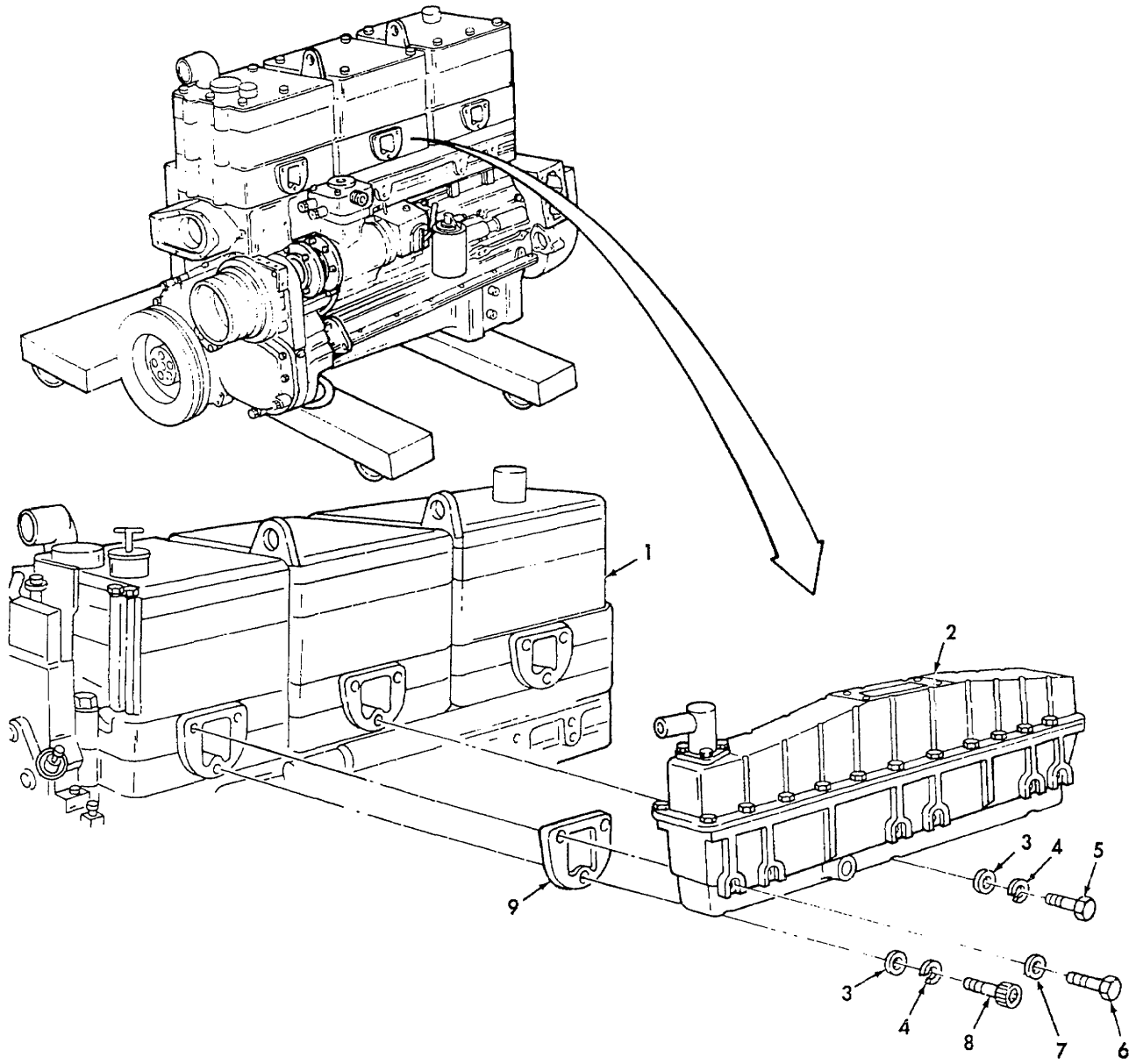
1. CYLINDER HEAD (3)
2. AIR AFTERCOOLER
3. WASHER (3)
4. LOCKWASHER (3)
5. SCREW (3) (M915/BIG CAM I) OR (2) (M915A1/BIG CAM III)
6. SCREW (6) (M915/BIG CAM I ONLY) OR CAPTIVE WASHER SCREW (6) (M915A1/BIG CAM III ONLY)
7. WASHER (6) (M915/BIG CAM I ONLY)
8. SCREW (M915A1/BIG CAM III ONLY)
9. GASKET (3)

3-87. AIR AFTERCOOLER INSTALLATION (Contd)

LOCATION/ITEM	ACTION	REMARKS
Installation (Contd)		
4. Air aftercooler (2) and three gaskets (9)	Install on three cylinder heads (1) with three screws (5) or screw (8) (M915A1/Big Cam III) and three washers (3) and new lockwashers (4).	
NOTE • **Two middle holes in air aftercooler are used for mounting ether starting kit.** • **Refer to TM 9-2320-273-20 or TM 9-2320-283-20 to install ether starting kit.** • **Tighten screws from the center outwards. Tighten all screws (M915A1/Big Cam III) to 20-25 lb-ft (27-34 N•m).**		
5. Three screws (5), new lockwashers (4), and washers (3) (M915/Big Cam I)	Install on three outside holes in air aftercooler (2), three gaskets (9), and three outer cylinder heads (1).	Tighten, but do not torque, screws (5). Install two remaining screws (5) once ether starting kit has been installed. Refer to TM 9-2320-283-20.
6. Screw (8), two screws (5), three new lockwashers (4), and washers (3) (M915A1/ Big Cam III)	Install on four outside holes in air aftercooler (2), three gaskets (9), and three cylinder heads (1).	Tighten, but do not torque, screws (5) and screw (8). Install two remaining screws (5) once ether starting kit has been installed. Refer to TM 9-2320-283-20.

FOLLOW-ON TASKS:
- Install water crossover tube and connection (TM 9-2320-273-20 or TM 9-2320-283-20).
- Remove engine from maintenance stand (para. 3-88).

3-87. AIR AFTERCOOLER INSTALLATION (Contd)



LEGEND:

1. CYLINDER HEAD (3)
2. AIR AFTERCOOLER
3. WASHER (3)
4. LOCKWASHER (3)
5. SCREW (3) (M915/BIG CAM I) OR (2) (M915A1/BIG CAM III)
6. SCREW (6) (M915/BIG CAM I ONLY) OR CAPTIVE WASHER SCREW (6) (M915A1/BIG CAM III ONLY)
8. SCREW (M915A1/BIG CAM III ONLY)
9. GASKET (3)

3-88. REMOVING ENGINE FROM MAINTENANCE STAND

THIS TASK COVERS:

a. Removal **b. Component Installation**

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Engine lifting fixture (15434) ST-125

TEST EQUIPMENT
None

MATERIALS/PARTS
Compound, antiseize (Appendix C, Item 7)
Sealant, thread (liquid) (Appendix C, Item 27)
Oil, lubricating, OE/HDO 10 (Appendix C, Item 20)
Two water header cover gaskets (15434) 70089-1
Six piston cooling nozzle O-rings (15434) 3007443
Gasket (15434) 3031858
Two grommets (15434) S-1003-A
Six exhaust manifold gaskets (15434) 3020943
Turbocharger mounting gasket (15434) 190849
Cover gasket (15434) 65274

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
LO 9-2320-273-12
TM 9-2320-273-20
TM 9-2320-273-34
LO 9-2320-283-12
TM 9-2320-283-20
TM 9-2320-283-34

TROUBLESHOOTING REFERENCES
None

EQUIPMENT CONDITION
None

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
- All personnel must stand clear during lifting operations.
- Use extreme caution during disassembly or assembly; engine components are heavy.

LOCATION/ITEM	ACTION	REMARKS

WARNING
Use extreme caution during disassembly or assembly; engine components are heavy. Failure to comply may result in damage to equipment or injury to personnel.

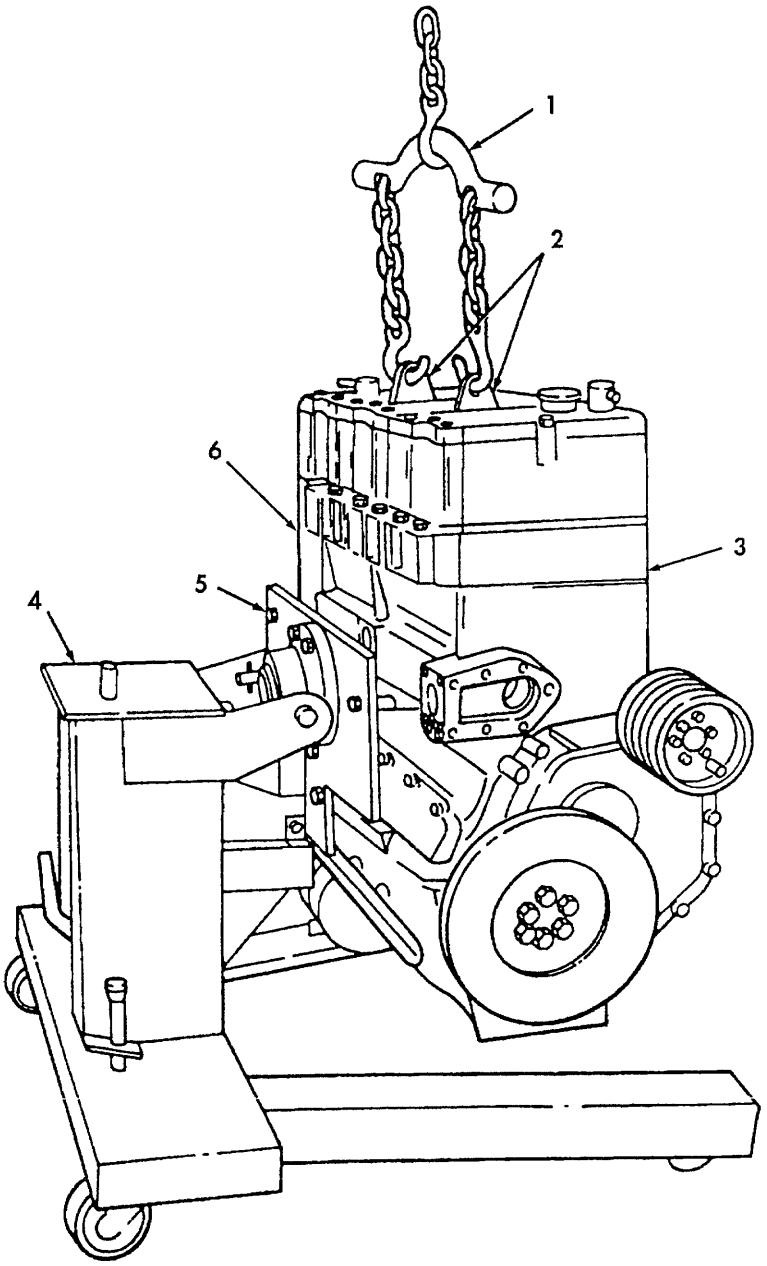
a. Removal

1.	Dressed engine assembly (3)	a. Connect engine lifting fixture (1) to two engine lifting brackets (2).	Use engine lifting fixture (ST-125) (1).
		b. Using suitable sling and lifting device, raise engine just enough to take weight off maintenance stand (4).	Ensure lifting device and engine lifting fixture (1) distribute load equally on engine lifting brackets (2).

WARNING
All personnel must stand clear during lifting operations. A snapped chain or swinging or shifting load may result in injury to personnel.

		c. Remove four mounting screws (5) and maintenance stand (4), and set on suitable blocks.	Ensure engine is supported by cylinder block (6), flywheel housing, or front support. Do not support engine on oil pan.
2.	Engine lifting fixture (1)	Remove from two engine lifting brackets (2).	

3-88. REMOVING ENGINE FROM MAINTENANCE STAND (Contd)



LEGEND:

1. ENGINE LIFTING FIXTURE
2. ENGINE LIFTING BRACKET (2)
3. DRESSED ENGINE ASSEMBLY
4. MAINTENANCE STAND
5. MOUNTING SCREW (4)
6. CYLINDER BLOCK

3-88. REMOVING ENGINE FROM MAINTENANCE STAND (Contd)

LOCATION/ITEM	ACTION	REMARKS
b. Component Installation		

NOTE

- **Perform steps 3 and 4 for M915/Big Cam I only.**
- **Perform steps 5 through 7 for M915A1/Big Cam III only.**

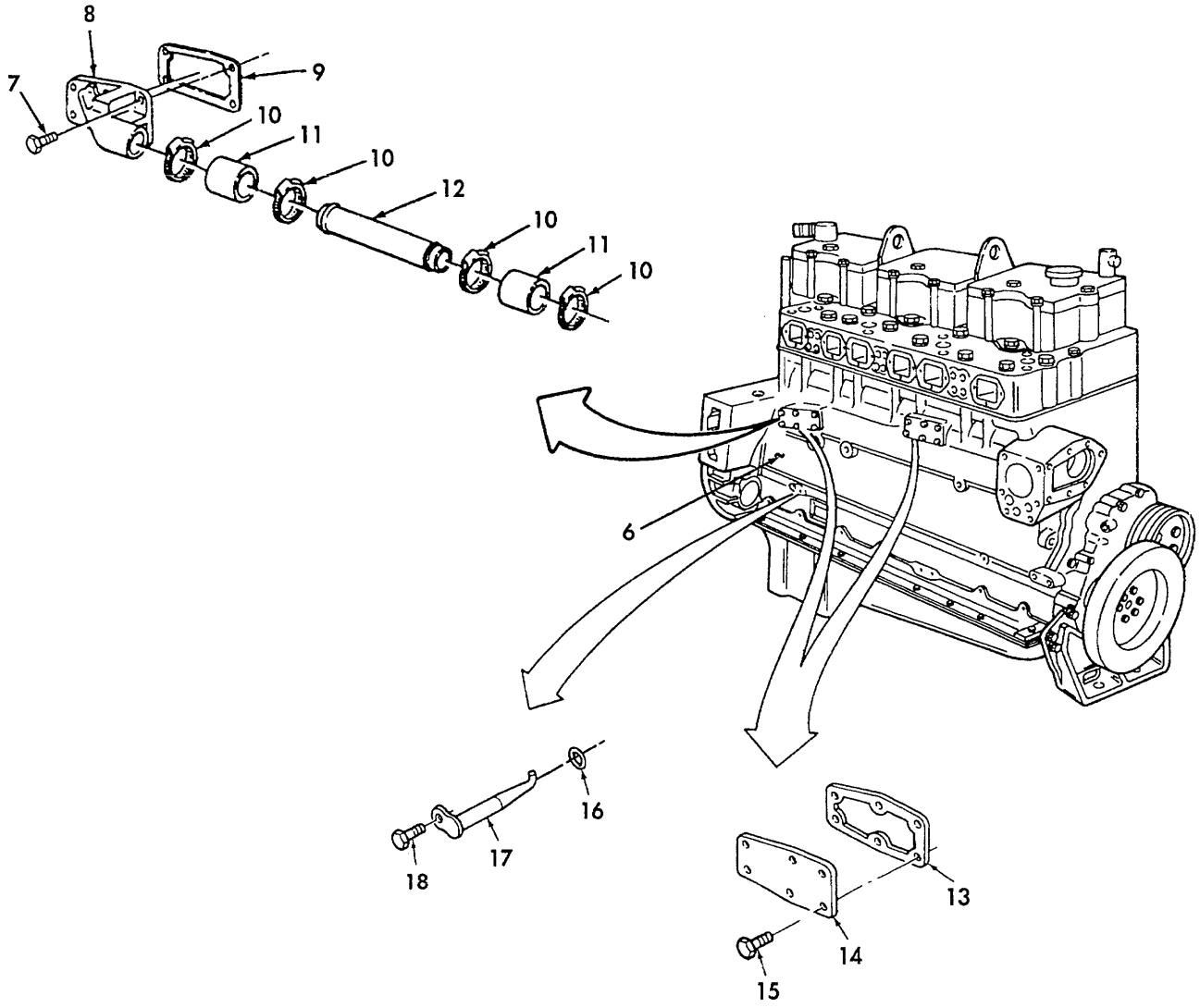
3.	New gasket (9), flange (8), and six screws (7)	Install on cylinder block (6).	
4.	Water transfer tube (12), two water transfer hoses (11), and four clamps (10)	Install on flange (8).	
5.	Two new gaskets (13), water header covers (14), and twelve captive washer screws (15)	Install on cylinder block (6).	

NOTE

Do not soak piston cooling nozzle O-rings in lubricating oil for any length of time or O-rings will swell.

6.	Six new preformed packings (16)	Lubricate with OE/HDO 10 lubricating oil and position on six piston cooling nozzles (17).	Ensure piston cooling nozzles (17) are not twisted in groove.
7.	Six piston cooling nozzles (17) and self-locking screws (18)	Install on cylinder block (6).	Tighten to 140 lb-in. (16 N•m).
8.	Power steering pump and reservoir	Install.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
9.	Water pump and drivebelts	Install.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
10.	Fan brace, bracket, and spacers	Install.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
11.	Fan, fan clutch, and fan clutch drivebelts	Install.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
12.	Engine wiring harness	Install.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
13.	Ether quick-start cylinder, valve, safety switch, and thermostat	Install.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.

3-88. REMOVING ENGINE FROM MAINTENANCE STAND (Contd)



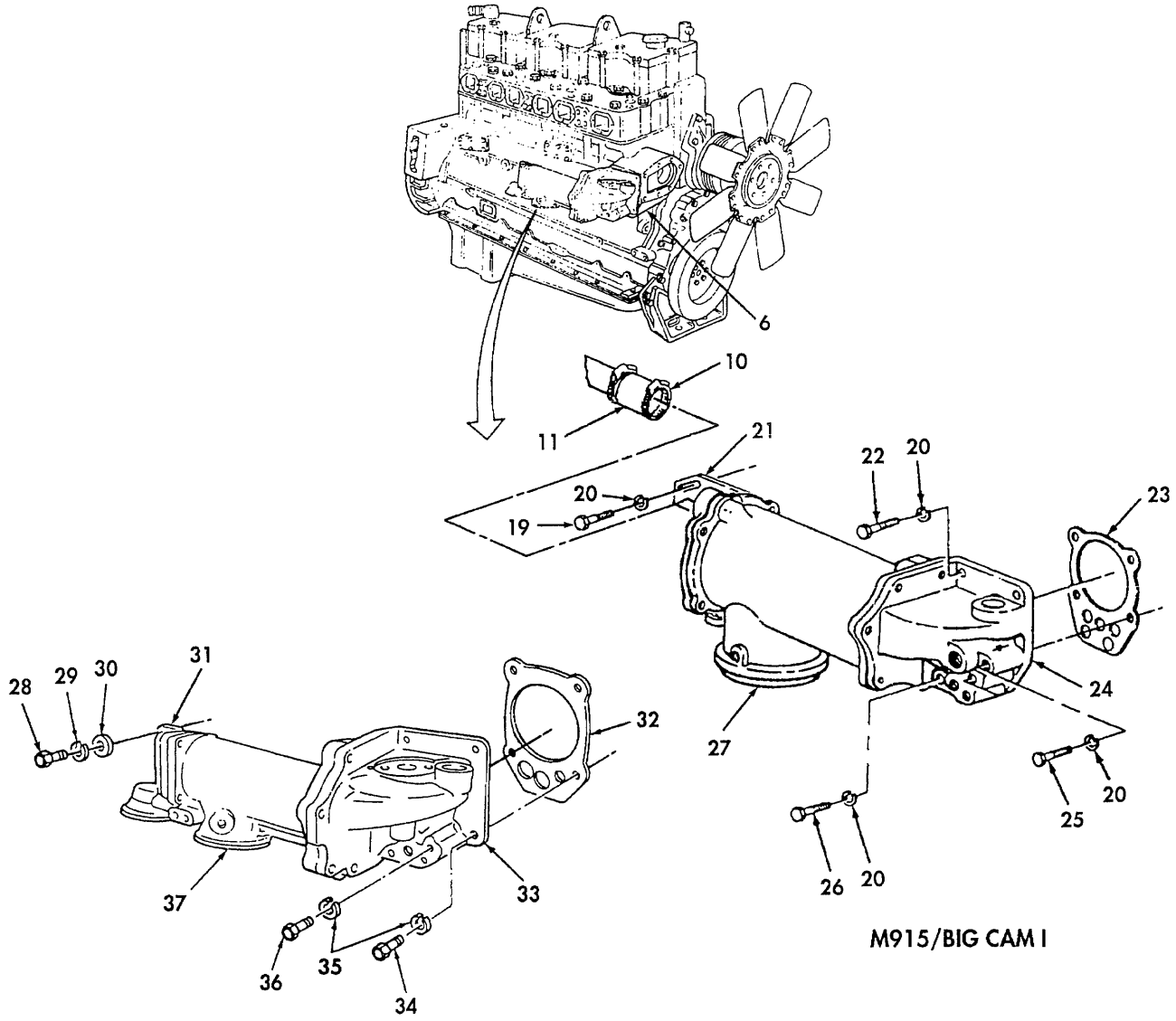
LEGEND:

6. CYLINDER BLOCK
7. SCREW (6)
8. FLANGE
9. GASKET
10. CLAMP (4)
11. WATER TRANSFER HOSE (2)
12. WATER TRANSFER TUBE
13. GASKET (2)
14. WATER HEADER COVER (2)
15. CAPTIVE WASHER SCREW (12)
16. PREFORMED PACKING (6)
17. PISTON COOLING NOZZLE (6)
18. SELF-LOCKING SCREW (6)

3-88. REMOVING ENGINE FROM MAINTENANCE STAND (Contd)

LOCATION/ITEM	ACTION	REMARKS
b. Component Installation (Contd)		
14. Modulator bracket and accelerator return spring	Install.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
15. Air compressor governor and air lines	Install.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
16. Air compressor intake tube	Install.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
17. Air compressor discharge hose	Install.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
18. Water bypass tube	Install.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
19. Water pump-to-radiator connection	Install.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
20. Water pump bypass hose	Install.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
	NOTE • **Perform steps 21 through 23 for M915/Big Cam I only.** • **Perform steps 24 and 25 for M915A1/Big Cam III only.**	
21. Gasket (23), oil cooler assembly (27), five new lockwashers (20), two screws (25), two screws (22), and screw (26)	Install on water transfer hose (11), cylinder block (6), and oil cooler support (24).	Tighten screws (25), (22), and (26) to 30-35 lb-ft (41-48 N•m).
22. Clamp (10)	Tighten at water transfer hose (11).	
23. New lockwasher (20) and screw (19)	Install on support bracket (21) and cylinder block (6).	Tighten screw (19) to 30-35 lb-ft (41-48 N•m).
24. Gasket (32), oil cooler assembly (37), six new lockwashers (35), three screws (36), and screws (34)	Install on oil cooler support (33) and cylinder block (6).	Tighten screws (36) and (34) to 30-35 lb-ft (41-48 N•m).
25. Two washers (30), new lockwashers (29), and screws (28)	Install on support bracket (31) and cylinder block (6).	Tighten screws (28) to 30-35 lb-ft (41-48 N•m).

3-88. REMOVING ENGINE FROM MAINTENANCE STAND (Contd)



LEGEND:

6. CYLINDER BLOCK
10. CLAMP
11. WATER TRANSFER HOSE
19. SCREW
20. LOCKWASHER (6)
21. SUPPORT BRACKET
22. SCREW (2)
23. GASKET
24. OIL COOLER SUPPORT
25. SCREW (2)
26. SCREW
27. OIL COOLER ASSEMBLY
28. SCREW (2)
29. LOCKWASHER (2)
30. WASHER (2)
31. SUPPORT BRACKET
32. GASKET
33. OIL COOLER SUPPORT
34. SCREW (3)
35. LOCKWASHER (6)
36. SCREW (3)
37. OIL COOLER ASSEMBLY

3-88. REMOVING ENGINE FROM MAINTENANCE STAND (Contd)

LOCATION/ITEM	ACTION	REMARKS
b. Component Installation (Contd)		
26. New engine oil filter elements	Fill and install.	Refer to TM 9-2320-273-20 and LO 9-2320-273-12 or TM 9-2320-283-20 or LO 9-2320-283-12.
27. Lower water transfer tube	Install.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
28. Alcohol evaporator	Install.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
29. Engine retarder microswitch	Install.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
30. Water manifolds	Install.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
31. Thermostat and thermostat housing	Install.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
32. Engine temperature sending units and fuel line fittings	Install.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
33. Fan clutch air valve and air lines	Connect.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
34. Water transfer tube and bracket	Install.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
35. Air compressor cooling tube	Install.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
36. Six new gaskets (48)	Install on cylinder heads (38).	Install gaskets (48) with the word OUT facing exhaust manifold.

NOTE

- **Perform steps 37 and 38 for M915/Big Cam I only.**
- **Perform step 39 for M915A1/Big Cam III only.**

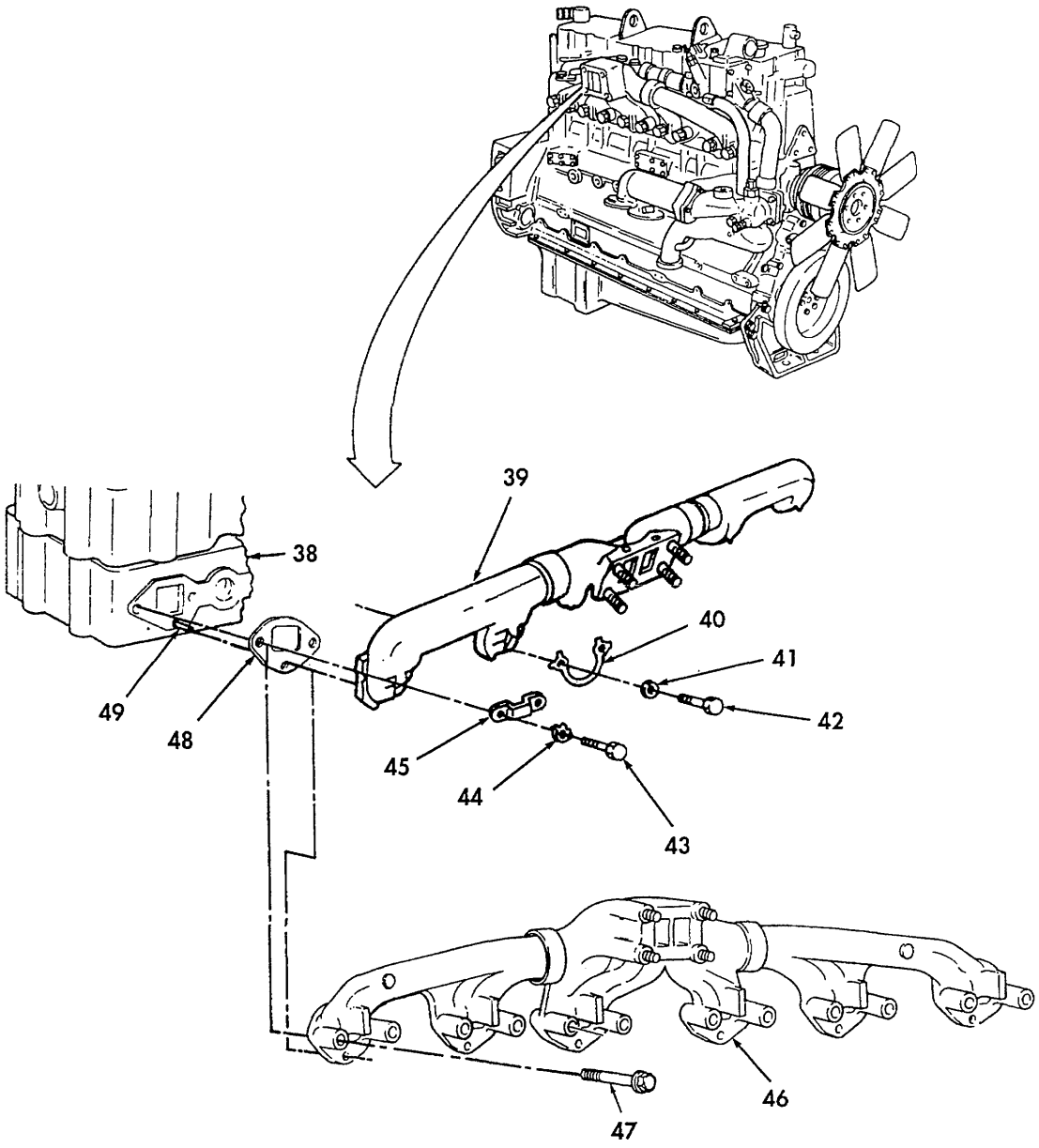
37. Exhaust manifold (39), two clamps (45), four lockplates (44), and screws (43)	Install on six dowels (49) and three cylinder heads (38).	Coat threads of screws (43) with antiseize compound. Assistant will help hold exhaust manifold (39) during installation. Do not tighten screws (43).

NOTE

M915A1/Big Cam III engines utilize two types of exhaust manifolds, an early pulse type and a new design with two spacer inserts placed between center exhaust manifold and two end exhaust manifolds. Installation of manifolds is basically the same.

38. Four lockplates (40), eight new lockwashers (41), and screws (42)	Install on exhaust manifold (39) and cylinder heads (38).	Tighten screws (42) and (43) alternately and evenly to 15-20 lb-ft (20-27 N•m) and then to 40-45 lb-ft (54-61 N•m).
39. Exhaust manifold (46) and twelve captive washer screws (47)	Install on cylinder heads (38).	Coat threads of captive washer screws (47) with antiseize compound. Tighten alternately and evenly to 15-20 lb-ft (20-27 N•m) and then to 40-45 lb-ft (54-61 N•m).

3-88. REMOVING ENGINE FROM MAINTENANCE STAND (Contd)



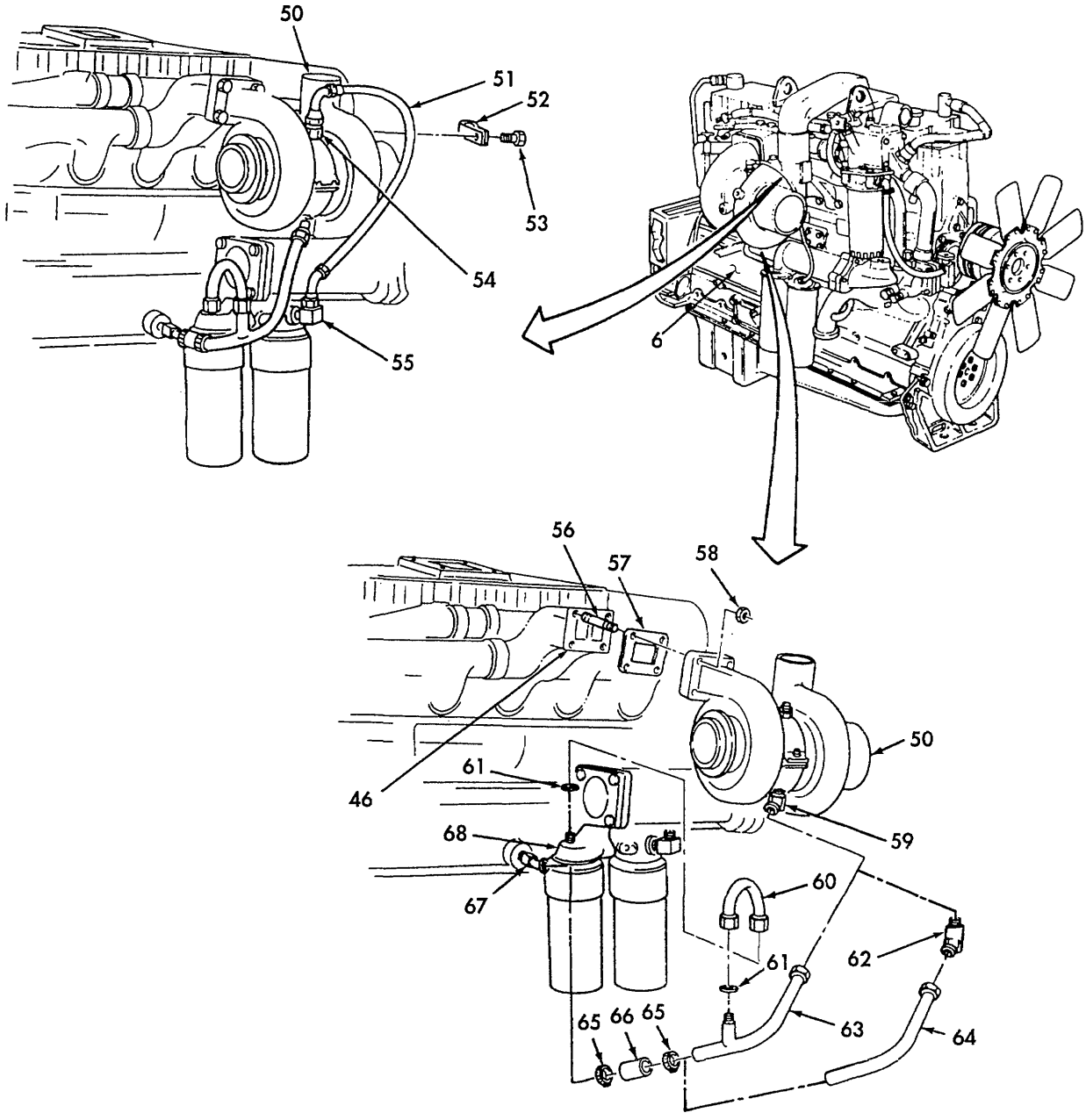
LEGEND:

38. CYLINDER HEAD (3)
39. EXHAUST MANIFOLD (M915/BIG CAM I)
40. LOCKPLATE (4)
41. LOCKWASHER (8)
42. SCREW (8)
43. SCREW (4)
44. LOCKPLATE (4)
45. CLAMP (2)
46. EXHAUST MANIFOLD (M915A1/BIG CAM III)
47. CAPTIVE WASHER SCREW (12)
48. GASKET (6)
49. DOWEL (6)

3-88. REMOVING ENGINE FROM MAINTENANCE STAND (Contd)

LOCATION/ITEM	ACTION	REMARKS
b. Component Installation (Contd)		
40. Water filter and bracket	Install.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
41. Water shutoff valves and hoses	Install.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
42. New gasket (57)	Install on studs (56).	Install gasket (57) with bead facing turbocharger (50). Coat threads of studs (56) with anti-seize compound.
43. Turbocharger (50) and four nuts (58)	Install on studs (56) and exhaust manifold (46).	Tighten nuts (58) to 20-25 lb-ft (27-34 N•m).
NOTE • **Perform step 44 for M915/Big Cam I only.** • **Perform steps 45 and 46 for M915A1/Big Cam III only.**		
44. Hose (66), two clamps (65), and oil return tube (64)	Install on elbows (67) and (62).	Tighten clamps (65) to 35-45 lb-ft (48-61 N•m).
45. Hose (66), two clamps (65), and oil return tube (63)	Install on elbows (67) and (59).	Tighten clamps (65) to 35-45 lb-ft (48-61 N•m).
46. Two bushings (61) and oil return tube (60)	Install on filter head (68) and oil return tube (63).	Tighten fittings on oil return tube (60) to 50-60 lb-ft (68-81 N•m).
47. Oil supply hose (51)	Install on adapter (54) and elbow (55).	Tighten fittings on oil supply hose (51) to 50-60 lb-ft (68-81 N•m).
48. Clamp (52) and screw (53)	Install on oil supply hose (51) and turbocharger (50).	Tighten screw (53) to 14 lb-ft (19 N•m).
49. Turbocharger air crossover connection	Install.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
50. Oil breather tubes and hoses	Install.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.

3-88. REMOVING ENGINE FROM MAINTENANCE STAND (Contd)



NOTE

M915/Big Cam I engines have a single oil filter. M915A1/Big Cam III engine is shown.

LEGEND:

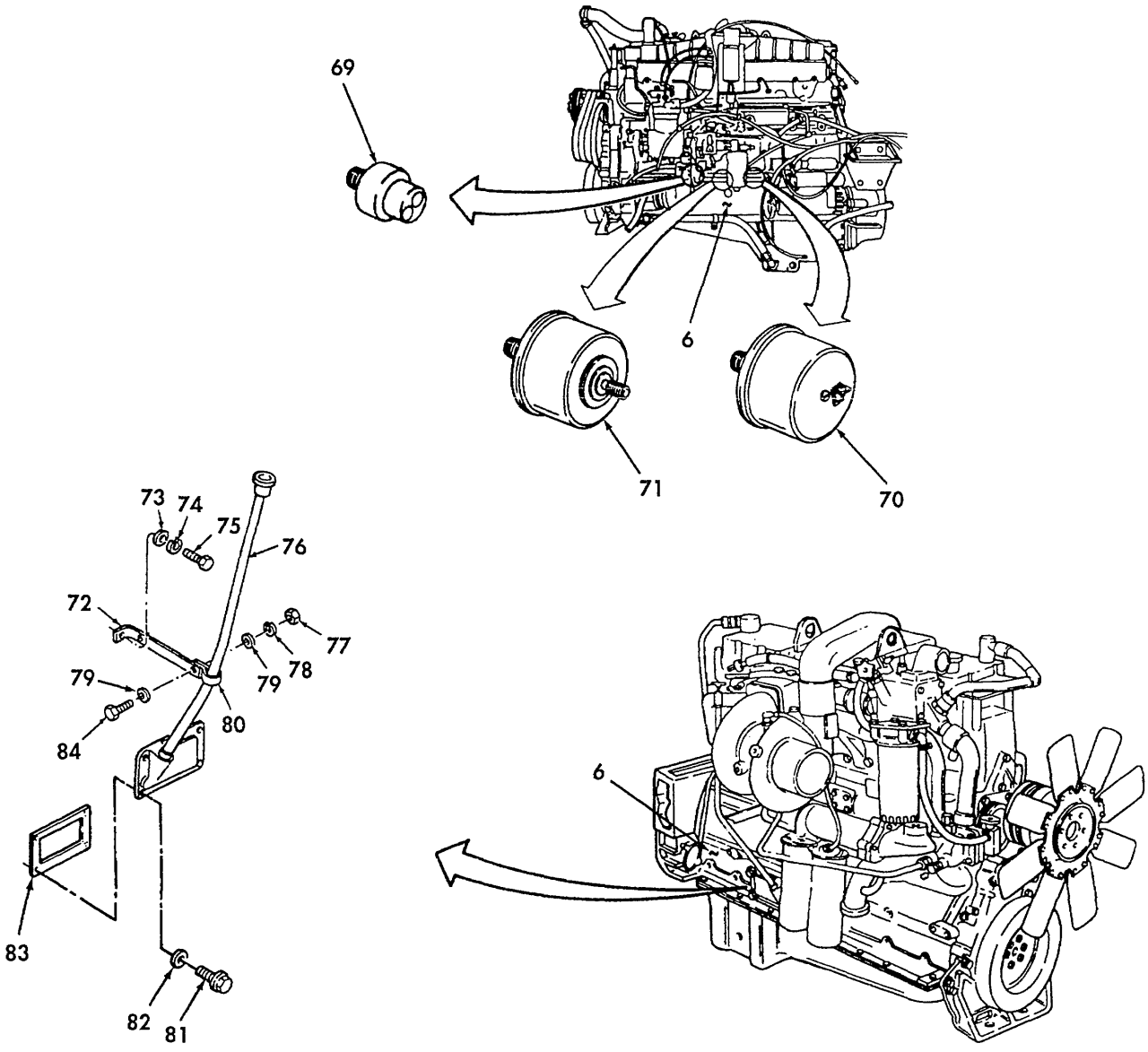
6. CYLINDER BLOCK
46. EXHAUST MANIFOLD (M915A1/BIG CAM III SHOWN)
50. TURBOCHARGER
51. OIL SUPPLY HOSE
52. CLAMP
53. SCREW
54. ADAPTER
55. ELBOW
56. STUD (4)
57. GASKET
58. NUT (4)
59. ELBOW (M915A1/BIG CAM III)
60. OIL RETURN TUBE
61. BUSHING (2)
62. ELBOW (M915/BIG CAM I)
63. OIL RETURN TUBE (M915A1/BIG CAM III)
64. OIL RETURN TUBE (M915/BIG CAM I)
65. CLAMP (2)
66. HOSE
67. ELBOW
68. FILTER HEAD

3-88. REMOVING ENGINE FROM MAINTENANCE STAND (Contd)

LOCATION/ITEM	ACTION	REMARKS
b. Component Installation (Contd)		
51. New gasket (83), oil level dipstick tube and cover (76), four washers (82), and captive washer screws (81)	Install on cylinder block (6).	Tighten captive washer screws (81) to 30-35 lb-ft (41-48 N•m).
52. Tube brace (72), clamp (80), two washers (79), screw (84), new lockwasher (78), and nut (77)	Install on oil level dipstick tube and cover (76).	
53. Washer (73), new lockwasher (74), and screw (75)	Install on tube brace (72) and cylinder block (6).	
54. Oil level dipstick	Install.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
55. Heater control valve, shutoff valve, and supply tube	Install.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
56. Heater return tube	Install.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.
	NOTE **Perform step 57 for M915/Big Cam I only.**	
57. Transmission control-body heating elements ON/OFF switch (69)	Install on cylinder block (6).	
58. Oil pressure gauge sending unit (70) and low oil pressure warning light sending unit (71)	Install on cylinder block (6).	
59. Engine wiring harness leads	Connect.	Refer to TM 9-2320-273-20 or TM 9-2320-283-20.

FOLLOW-ON TASKS:
- Install starter motor and solenoid (TM 9-2320-273-20 or TM 9-2320-283-20).
- Install alternator, belts, and bracket (TM 9-2320-273-20 or TM 9-2320-283-20).
- Start repaired engine (para. 3-91).
- Install STE/ICE harness, receptacle, and bracket (TM 9-2320-273-20 or TM 9-2320-283-20).

3-88. REMOVING ENGINE FROM MAINTENANCE STAND (Contd)



LEGEND:

6. CYLINDER BLOCK
69. TRANSMISSION CONTROL-BODY HEATING ELEMENTS ON/OFF SWITCH
70. OIL PRESSURE GAUGE SENDING UNIT
71. LOW OIL PRESSURE WARNING LIGHT SENDING UNIT
72. TUBE BRACE
73. WASHER
74. LOCKWASHER
75. SCREW
76. OIL LEVEL DIPSTICK TUBE AND COVER
77. NUT
78. LOCKWASHER
79. WASHER (2)
80. CLAMP
81. CAPTIVE WASHER SCREW (4)
82. WASHER (4)
83. GASKET
84. SCREW

Section V. TESTING

3-89. GENERAL

a. This section provides procedures for starting a new or rebuilt engine, engine break-in, dynamometer testing, and on-engine fuel pump adjustment. The testing procedures in this section are accomplished with the engine removed from the vehicle.

b. If repair operations are performed without removing engine from vehicle, follow the applicable portions of instructions and use a suitable chassis-type engine dynamometer.

3-90. TASK SUMMARY

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Blow-by measuring tool (15434) 3375150
Idle speed adjusting tool (15434) 3375981
Throttle shaft ball installing tool (15434) 3375204

TEST EQUIPMENT
Dynamometer (NSN 4910-01-180-6171) or suitable dynamometer
Opacity meter

MATERIALS/PARTS
Antifreeze, permanent ethylene gylcol –60°F (-51.1°C) inhibited (Appendix C, Item 3)
Oil, lubricating, OD/HDO 30 (Appendix C, Item 21)
Oil, fuel, diesel, regular (Appendix C, Item 19)
Gasket (15434) 70705
Throttle shaft ball (15434) 213769
Lockwire and seal (15434) 3003156
Throttle shaft cover (15434) 300466
Two drive screws (15434) S-2286

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
LO 9-2320-273-12
LO 9-2320-283-12

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
Refer to specific paragraph for this information.

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dust and dirt.

GENERAL SAFETY INSTRUCTIONS
- Allow adequate ventilation for engine exhaust gases.
- Diesel fuel is highly flammable. Do not perform fuel pump adjustments near fire, flames, or sparks.

List of Tasks

TASK PARA.	PROCEDURES	TASK REF.	TROUBLESHOOTING REF. NO. (PARA.)
1	Starting Repaired Engine	3-91	2-8
	a. Installation of Engine on Dynamometer	3-91a	
	b. Priming Cooling System	3-91b	
	c. Priming Fuel System	3-91c	
	d. Priming Lubricating System	3-91d	
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	b. Idle Speed Adjustment	3-93b	
	c. High Speed Adjustment	3-93c	
	d. High Idle Speed Adjustment	3-93e	
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	i. Checking Fuel Filter Restriction	3-93i	
	j. Fuel Pump Seal Installation	3-93j	
	k. Throttle Shaft Cover Plate Installation	3-93k	

3-91. STARTING REPAIRED ENGINE

THIS TASK COVERS:

a. Installation of Engine on Dynamometer
b. Priming Cooling System
c. Priming Fuel System
d. Priming Lubricating System
e. Prerun Startup

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
None

TEST EQUIPMENT
Dynamometer test stand (15434) 3375710

MATERIALS/PARTS
Antifreeze, permanent ethylene gylcol –60°F (-51.1°C) inhibited (Appendix C, Item 3)
Oil, lubricating, OE/HDO 30 (Appendix C, Item 21)
Oil, fuel, diesel, regular (Appendix C, Item 19)

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
LO 9-2320-273-12
TM 9-2320-273-20
LO 9-2320-283-12
TM 9-2320-283-20

TROUBLESHOOTING REFERENCES
Para. 2-8

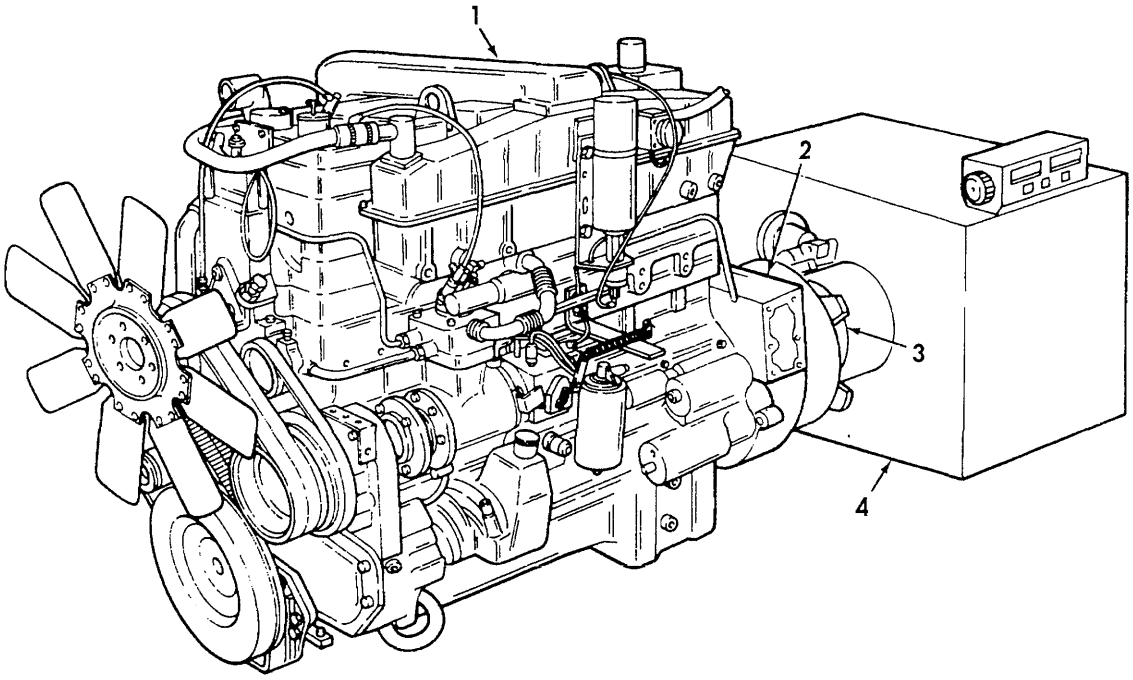
EQUIPMENT CONDITION
- Throttle linkage disconnected (TM 9-2320-273-20 or TM 9-2320-283-20).
- Cooling system drainplugs and drainvalves closed (TM 9-2320-273-20 or TM 9-2320-283-20).
- Starter electrical leads connected (TM 9-2320-273-20 or TM 9-2320-283-20).

SPECIAL ENVIRONMENTAL CONDITIONS
None

GENERAL SAFETY INSTRUCTIONS
- Allow adequate ventilation for engine exhaust gases.
- Diesel fuel is flammable.

LOCATION/ITEM	ACTION	REMARKS
a. Installation of Engine on Dynamometer		
	NOTE **Engine break-in will take place during dynamometer testing. Break-in on a new or rebuilt engine provides a short running period where moving parts acquire their final finish and mating surfaces reach a full seat. Engine dynamometer testing helps to find assembly errors, determine where adjustments are necessary after engine break-in, and test-runs engine long enough so final adjustments can be made.**	
1. Engine assembly (1)	a. Secure to suitable dynamometer test stand (4).	Check dynamometer capacity. Ensure capacity is enough to permit testing at 96 percent of maximum engine horsepower. Dynamometer must be accurately calibrated.
	b. Connect all instruments on control panel of dynamometer test stand.	
2. Engine flexplate or flywheel, ring gear assembly (2) and dynamometer drive shaft flange (3)	Connect.	Check for proper alignment per dynamometer manufacturer's instructions.

3-91. STARTING REPAIRED ENGINE (Contd)



LEGEND:
1. ENGINE ASSEMBLY
2. FLEXPLATE OR FLYWHEEL, RING GEAR ASSEMBLY
3. DYNAMOMETER DRIVE SHAFT FLANGE
4. DYNAMOMETER TEST STAND

3-91. STARTING REPAIRED ENGINE (Contd)

LOCATION/ITEM	ACTION	REMARKS
3. Water supply and return hose	Secure to engine cooling system inlet and outlet connections.	
4. Fuel consumption gauge	Connect to fuel pump.	Refer to manufacturer's instructions.
5. Throttle linkage instrument	Connect to lever control.	Refer to manufacturer's instructions.
6. Turbocharger assembly	a. Connect suitable exhaust piping to exhaust side. b. Connect suitable filtered air intake piping to intake side.	
b. Priming Cooling System		
7. Drainvalve (5)	Open.	Fill cooling system with a 50/50 mixture of permanent ethylene glycol antifreeze and water until it flows from drainvalve (5), then close and complete priming of cooling system.
c. Priming Fuel System		

WARNING

Do not perform fuel system procedures while smoking or within 50 ft (15.2 m) of sparks or open flame. Diesel fuel is flammable and may explode. Failure to comply may result in injury to personnel.

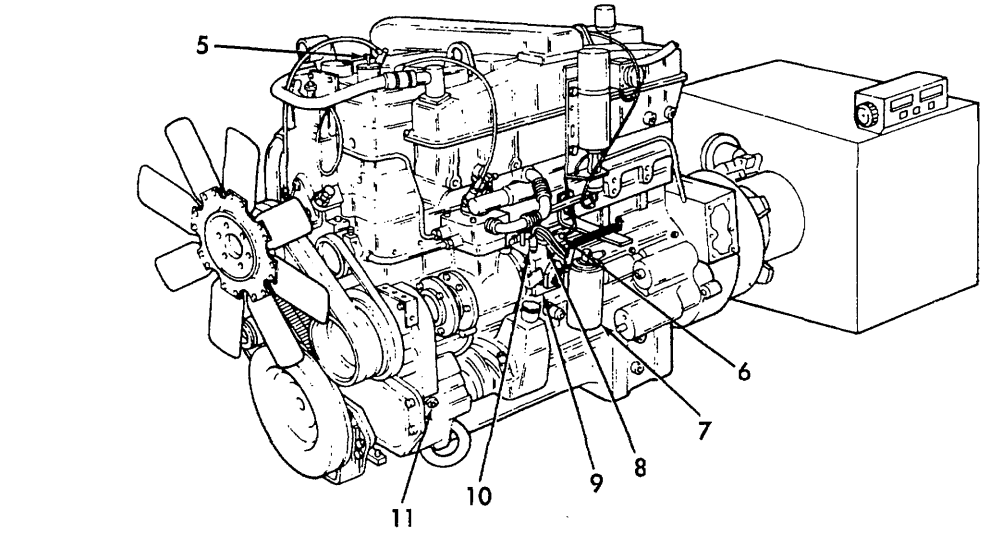
8. Spin-on fuel filter (7)	Fill with clean diesel fuel.	
9. Fuel pump (9)	a. Remove case fill plug (10). b. Fill fuel pump (9) with clean diesel fuel. c. Reinstall case fill plug (10).	
d. Priming Lubricating System		
10. Full-flow oil filter element (13) and bypass oil filter element (12)	Fill with clean OE/HDO 30 oil.	

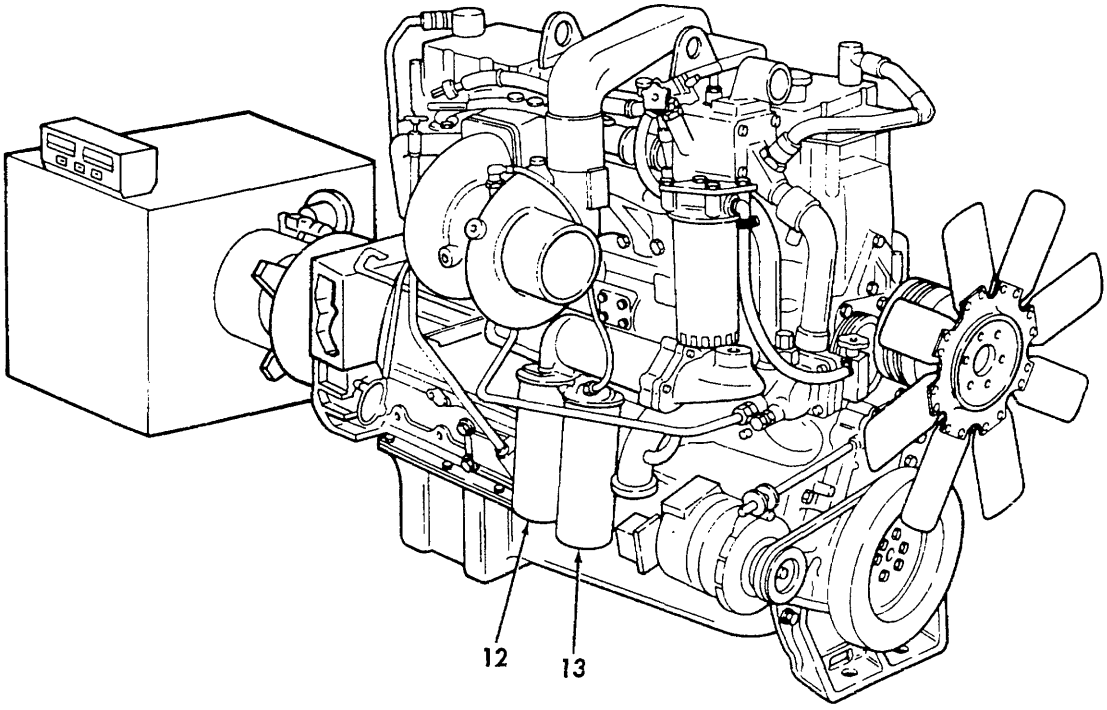
CAUTION

Remove turbocharger oil supply hose from turbocharger adapter, and lubricate bearing with approximately 2-3 oz (59-89 ml) of clean engine oil. Also, fill oil supply hose with engine lubricating oil. Connect oil supply hose. Failure to prelubricate turbocharger may result in bearing damage.

11. Crankcase	Fill to low mark (L) on dipstick.	Refer to LO 9-2320-273-12 or LO 9-2320-283-12.
12. Internal hexagon plug (11)	Remove.	Internal hexagon plug (11) is located on cylinder block flange at oil pump.

3-91. STARTING REPAIRED ENGINE (Contd)





LEGEND:

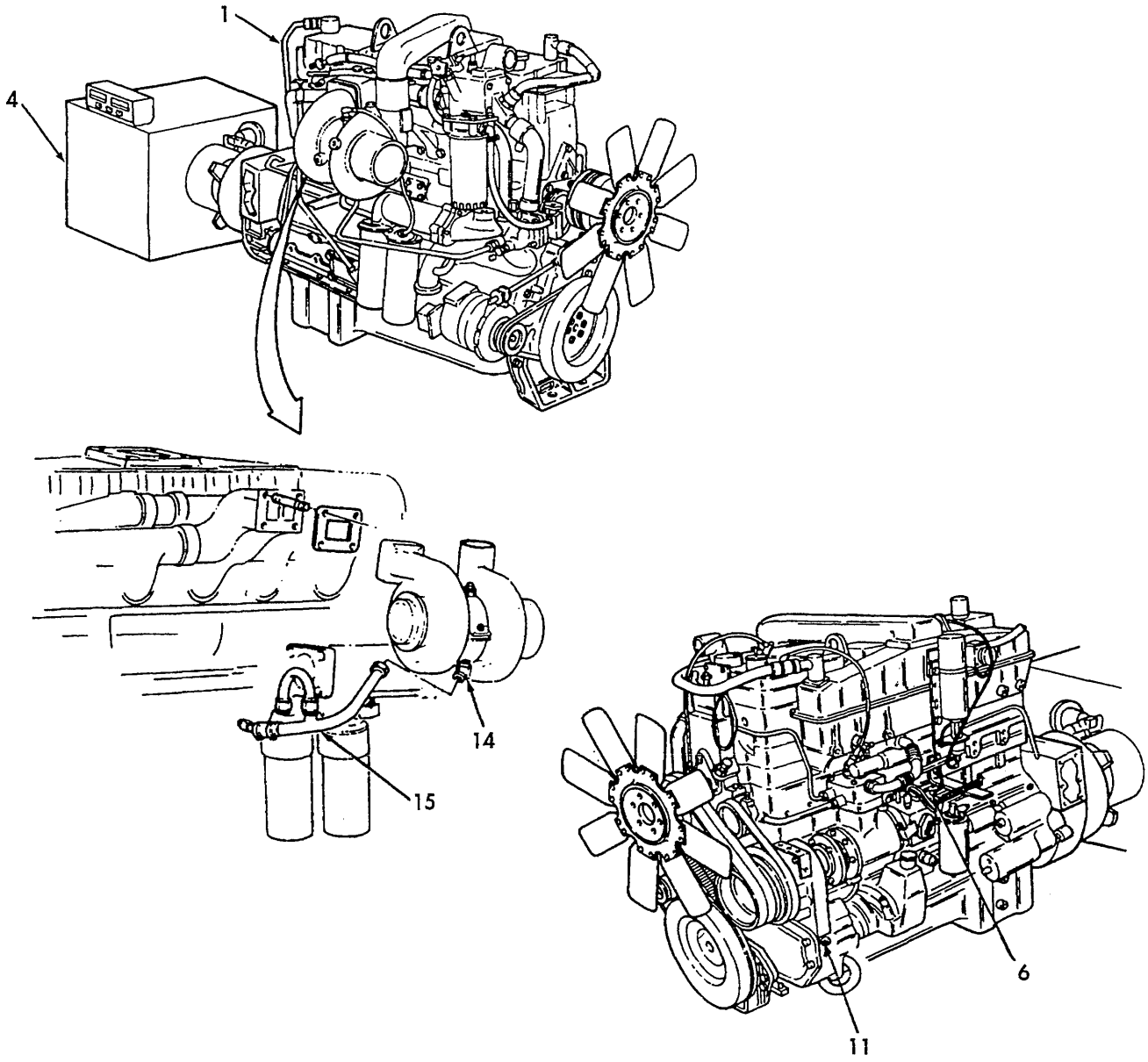
5. DRAINVALVE
7. SPIN-ON FUEL FILTER
8. FUEL PUMP PRESSURE SENDING UNIT
9. FUEL PUMP
10. CASE FILL PLUG
11. INTERNAL HEXAGON PLUG
12. BYPASS OIL FILTER ELEMENT
13. FULL-FLOW OIL FILTER ELEMENT

3-91. STARTING REPAIRED ENGINE (Contd)

LOCATION/ITEM	ACTION	REMARKS
13. Priming pump oil supply	Connect to internal hexagon plug hole.	Use a hand or motor line driven priming pump and a source of clean lubricating oil. Prime until a 30 psi (207 kPa) maximum pressure is reached.
14. Fuel shutoff solenoid wiring harness connector (6)	Disconnect.	Prevents engine from starting.
15. Crankshaft	Rotate with starter for 15 seconds.	Keep external oil pressure at a minimum of 15 psi (103 kPa).
16. Wiring harness connector (6)	Connect to fuel shutoff solenoid.	
17. Priming pump oil supply line	Remove.	
18. Internal hexagon plug (11)	Install.	Tighten plug (11) to 60-70 lb-ft (81-95 N•m).
19. Crankcase	Fill to high mark (H) on dipstick.	Refer to LO 9-2320-273-12 or LO 9-2320-283-12. Check for leaks.
20. Turbocharger drain tube (15)	Remove from 45° adapter (14).	
e. Prerun Startup		
21. Engine assembly (1)	Start.	Maintain low rpm.
22. 45° adapter (14)	Check for oil flow.	Oil must drain from turbocharger in 10-15 seconds. If no oil flows in 10-15 seconds, stop engine and troubleshoot problem. Refer to troubleshooting para. 2-8. Connect turbocharger drain tube (15) to 45° adapter (14) once oil flow is established. Tighten fitting to 50-60 lb-ft (68-81 N•m).
23. Dynamometer test stand (4)	Add water per manufacturer's instructions.	
24. Tubes, hoses, fittings, and plugs	Check for leaks.	Correct as necessary.
25. Engine assembly (1)	Stop.	

FOLLOW-ON TASK: Perform engine dynamometer testing (para. 3-92).

3-91. STARTING REPAIRED ENGINE (Contd)



LEGEND:

1. ENGINE ASSEMBLY
4. DYNAMOMETER TEST STAND
6. WIRING HARNESS CONNECTOR
11. INTERNAL HEXAGON PLUG
14. 45° ADAPTER
15. TURBOCHARGER DRAIN TUBE

3-92. ENGINE DYNAMOMETER TESTING

THIS TASK COVERS:

a. Setup
b. Break-in Running
c. Power Check
d. Smoke Level Check
e. Final Check

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Blow-by measuring tool (15434) 3375150

TEST EQUIPMENT
Opacity meter

MATERIALS/PARTS
None

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (TM)
None

TROUBLESHOOTING REFERENCES
None

EQUIPMENT CONDITION
Engine mounted to dynamometer test stand (para. 3-91).

SPECIAL ENVIRONMENTAL CONDITIONS
None

GENERAL SAFETY INSTRUCTIONS
Allow adequate ventilation for engine exhaust gases.

LOCATION/ITEM	ACTION	REMARKS

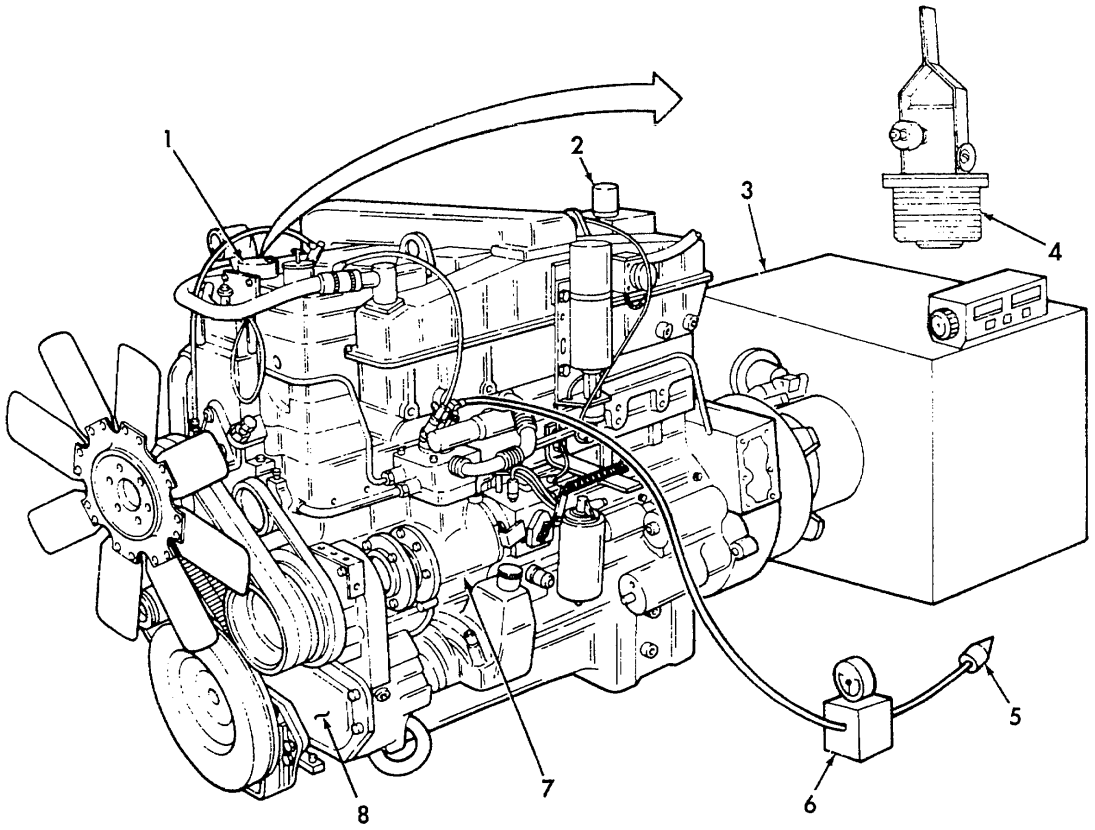
WARNING

Allow adequate ventilation for engine exhaust gases. Failure to comply may result in brain damage or death to personnel.

a. Setup

1. Breather tube (2)	Cover or plug.	
2. Blow-by measuring tool (4)	Install in place of oil filler cap (1).	Use blow-by measuring tool (3375150) (4) and water manometer. Fill to 0 mark at middle of scale. Close all other engine openings that would allow blow-by pressure to escape.
3. Air compressor (7)	Connect to a 0.125-0.130 in. (3.175-3.302 mm) diameter orifice adapter (5) located downstream from a 150 psi (1034 kPa) pressure relief valve (6).	Provides dynamic load for air compressor (7).

3-92. ENGINE DYNAMOMETER TESTING (Contd)



LEGEND:

1. FILLER CAP
2. BREATHER TUBE
3. DYNAMOMETER TEST STAND
4. BLOW-BY MEASURING TOOL
5. ORIFICE ADAPTER
6. PRESSURE RELIEF VALVE
7. AIR COMPRESSOR
8. ENGINE

3-92. ENGINE DYNAMOMETER TESTING (Contd)

LOCATION/ITEM	ACTION	REMARKS

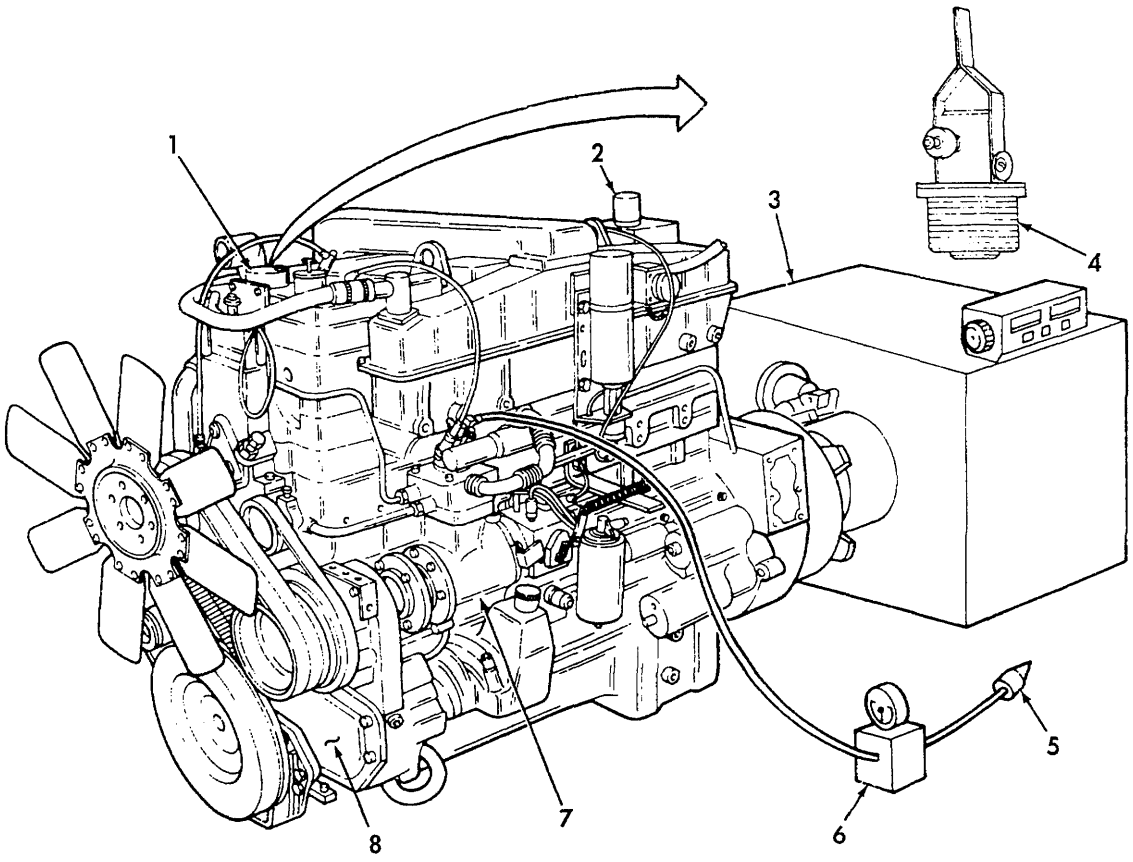
CAUTION

- **Lubricating oil pressure should remain at or near a constant figure at constant engine speed and load after normal operating temperature is reached. Acceptable lubricating oil pressures are 5-20 psi (34-138 kPa) at idle speed and 35-45 psi (241-310 kPa) for Big Cam III and 40-75 psi (276-517 kPa) for Big Cam I at rated speed. Abnormally high pressures may indicate blocked lubricating oil lines. Abnormally low pressures indicate an insufficient supply of lubricating oil from the pump or increased engine clearances which may be due to bearing failure. Damage to engine may occur if oil pressure falls outside of acceptable range at indicated speeds.**
- **Lubricating oil temperature must not rise sharply above 225°F (107°C). Shut down engine and correct as necessary. Damage to engine may occur if oil temperature rises above acceptable limit.**
- **Check temperature of coolant. Temperature should not exceed 200°F (93°C) or drop below 160°F (71°C) during engine tests. Do not turn engine off immediately after a load run. Heat stored in engine will boil coolant in the water jackets if air and coolant circulation are immediately stopped while engine is hot. Allow engine to idle a minimum of three minutes before shutting down.**
- **Do not idle engine for prolonged periods of time before completing break-in running.**

b. Break-in Running

4.	Engine (8)	Start engine (8) and check oil pressure, oil temperature, and water temperature. Check for leaks. Operate air compressor (7) in pumping mode.	Idle at approximately 1200 rpm no-load for 5 to 10 minutes.

3-92. ENGINE DYNAMOMETER TESTING (Contd)



LEGEND:
7. AIR COMPRESSOR
8. ENGINE

3-92. ENGINE DYNAMOMETER TESTING (Contd)

LOCATION/ITEM	ACTION	REMARKS

NOTE

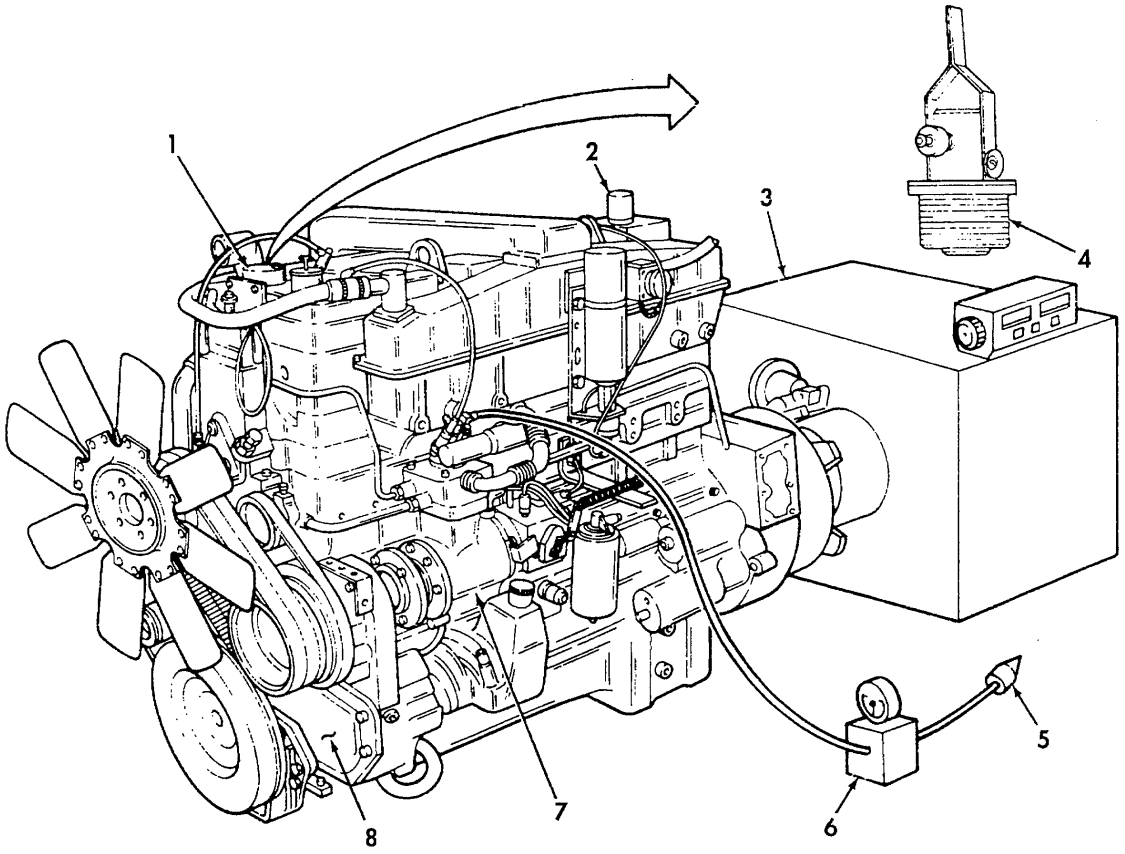
- **At each phase, record crankcase pressure blow-by, engine speed, and load at one minute intervals. Watch for increases or wide shifts in blow-by pressure. If a sudden increase in blow-by pressure occurs or if blow-by exceeds 12" H_2O, return to the previous phase test or repeat phase 1 test and operate engine an additional 15 minutes. If blow-by does not reach an acceptable level after repeating test for 15 minutes, discontinue test and determine cause. If blow-by is within an acceptable level, proceed to next phase test.**
- **After each test, check for fuel, air, water, oil, or exhaust leaks and correct as necessary.**
- **Lubricating oil level is checked only when engine is shut down or incorrect readings on dipstick will result.**

5.	Dynamometer test stand (3)	a. Perform phase 1 test. Apply load to engine (8) at ±10 percent horsepower, ±5 percent speed. Check crankcase pressure with blow-by measuring tool (4). Operate engine (8) until normal oil operating temperature is attained. Stop engine (8) and check lubricating oil level. Add lubricating oil to bring level up to H (high) on dipstick. Allow oil temperature to stabilize. Operate air compressor (7) in pumping mode.	Refer to phase 1 test in test chart.

Table 3-1. Dynamometer Test Chart

ENGINE	HP @ RPM	RATED HP @ RPM 500 FT-ALT	FUEL RATE LB/HR	AIR MANIFOLD PRESSURE IN/HG	ALTITUDE MAX. HP ALT.	CRANKCASE PRESSURE W/TURBO T46B	PHASE 1 TO 160°F HP @ RPM	PHASE 2 2 MIN. HP @ RPM	PHASE 3 5 MIN. HP @ RPM	PHASE 4 4 MIN. HP @ RPM	POWER CHECK 4 MIN. HP @ RPM
NTC 400	400 @ 2100	400 @ 2100	139-145	39/47	12,000	12"H_2O	100 @ 1200	160 @1200	260 @1600	Full Load @1200	384 @ 2100

3-92. ENGINE DYNAMOMETER TESTING (Contd)



LEGEND:

3. DYNAMOMETER TEST STAND
4. BLOW-BY MEASURING TOOL
7. AIR COMPRESSOR
8. ENGINE

3-92. ENGINE DYNAMOMETER TESTING (Contd)

LOCATION/ITEM	ACTION	REMARKS

NOTE

- **At each phase, record crankcase pressure blow-by, engine speed, and load at one-minute intervals. Watch for increases or wide shifts in blow-by pressure. If a sudden increase in blow-by pressure occurs or if blow-by exceeds 12" H_2O, return to the previous phase test or repeat phase 1 test and operate engine an additional 15 minutes. If blow-by does not reach an acceptable level after repeating test for 15 minutes, discontinue test and determine cause. If blow-by is within an acceptable level, proceed to next phase test.**
- **After each test, check for fuel, air, water, oil, or exhaust leaks and correct as necessary.**

	b. Perform phase 2 test. Apply load to engine (8) at ±10 percent horsepower, ±5 percent speed. Check pressure with blow-by measuring tool (4). Set idle speed to 600 rpm and set full load governed speed to 2100 rpm. Adjust load and rpm until specified readings are obtained. Set fuel rate. Operate air compressor (7) in pumping mode.	Refer to phase 2 test in test chart. Return fuel from injector drain is routed through float tank so when float tank is filled, float valve opens and allows return fuel flow to flowmeter. The amount of fuel being consumed by engine will flow through flowmeter and show rate of fuel consumption in pounds per hour. Turbocharger engines do not require fuel deaerating below maximum altitudes shown in table 3-1. Above maximum altitudes, deaerate at 4 percent for each 1000 ft (305 m) additional altitude and 1 percent for each 10°F (-12°C) air temperature rise above 12°F (-11°C).
	c. Perform phase 3 test. Apply load to engine (8) at ±10 percent horsepower, ±5 percent speed. Check crankcase pressure with blow-by measuring tool (4). Operate air compressor (7) in pumping mode.	Refer to phase 3 test on table 3-1.

CAUTION

After phase 4 test is completed, allow engine to run at low idle for a minimum of three minutes before shutting down.

	d. Perform phase 4 test. Apply load to engine at ±10 percent horsepower ±5 percent speed. Check crankcase pressure with blow-by measuring tool (4). Check for leaks and retighten all external screws to correct specifications. Operate air compressor (7) in non-pumping mode.	Refer to phase 4 test in test chart.

NOTE

Readjustment of valves and injectors after one hour of operation is necessary to assure lowest smoke potential and avoid excessive injector loads.

6.	Valves	Recheck valves.	Refer to para. 3-85.
7.	Injectors	Recheck injectors.	Refer to para. 3-85.

3-92. ENGINE DYNAMOMETER TESTING (Contd)

LOCATION/ITEM	ACTION	REMARKS

c. Power Check

CAUTION

Do not shut engine down immediately after power check is complete. Serious engine damage will result.

8.	Engine (8)	a. Run at 2100 rpm for 4 minutes. Check crankcase pressure with blow-by measuring tool (4). Repeat procedure until engine (8) develops 96-100% rated horsepower at standard fuel rate within permissible crankcase pressure limit. Operate air compressor (7) in non-pumping mode.	Refer to power check in test chart.

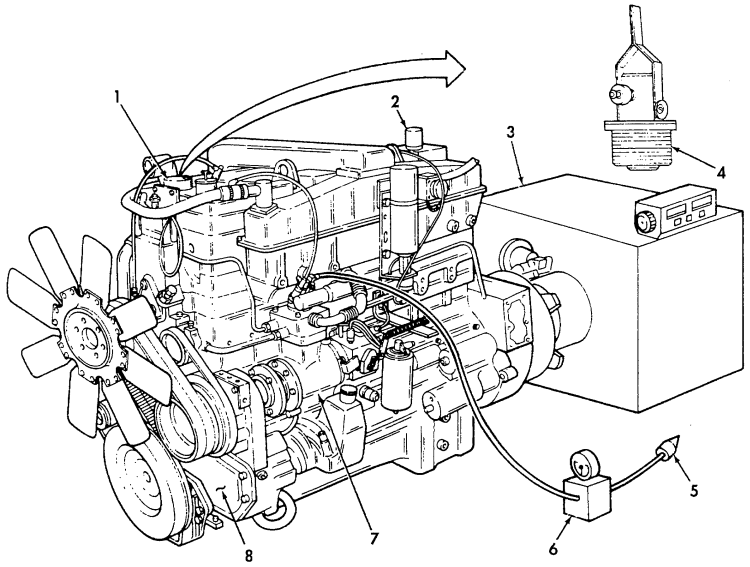
NOTE

At each phase, record crankcase pressure (blow-by), engine speed, and load at one-minute intervals. Watch for increases or wide shifts in blow-by pressure. If sudden increase happens, or if it is more than 12" H_2O, do the preceding test over again and run engine 15 more minutes. When blow-by is OK, do next test. If not OK, stop the test and find reason for too much blow-by. Check engine for fuel, oil, water, air, or exhaust leaks after each test and fix as needed.

Phase 1 - 25% HP @1200 RPM @160° water temperature.
Phase 2 - 40% HP @1200 RPM
Phase 3 - 65% HP @1600 RPM
Phase 4 - 100% HP @ Nominal torque peak RPM *(1200) RPM
Power Check - 96-100% HP @1600 RPM
*100 RPM below torque peak RPM

Table 3-1. Dynamometer Test Chart

ENGINE	HP @ RPM	RATED HP @ RPM 500 FT-ALT	FUEL RATE LB/HR	AIR MANIFOLD PRESSURE IN/HG	ALTITUDE MAX. HP ALT.	CRANKCASE PRESSURE W/TURBO T46B	PHASE 1 TO 160°F HP @ RPM	PHASE 2 2 MIN. HP @ RPM	PHASE 3 5 MIN. HP @ RPM	PHASE 4 4 MIN. HP @ RPM	POWER CHECK 4 MIN. HP @ RPM
NTC 400	400 @ 2100	400 @ 2100	139-145	39/47	12,000	12"H_2O	100 @ 1200	160 @1200	260 @1600	Full Load @1200	384 @ 2100



LEGEND:
3. DYNAMOMETER TEST STAND
4. BLOW-BY MEASURING TOOL
7. AIR COMPRESSOR
8. ENGINE

3-92. ENGINE DYNAMOMETER TESTING (Contd)

LOCATION/ITEM	ACTION	REMARKS
c. Power Check (Contd)		
	NOTE **After each test, check for fuel, air, water, oil, or exhaust leaks and correct as necessary.**	
	b. Apply dynamometer test stand (3) load as engine (8) rpm is increased until rated rpm and horsepower are reached and load is stabilized.	Engine (8) at normal oil operating temperature.
d. Smoke Level Check		
	NOTE **An accurate smoke reading can usually be obtained in 10 to 15 seconds.**	
9. Opacity meter	Zero and place at exhaust side of turbocharger. Record reading.	Use 0-20 scale on opacity meter. Remove opacity meter after reading is taken. (12.84 percent) (3.6 percent Bosch)
10. Engine (8)	Increase dynamometer test stand (3) load until rpm is reduced to 60 percent of rated rpm.	
11. Opacity meter	Zero and place at exhaust side of turbocharger. Record reading.	Use 0-20 scale on opacity meter. Remove meter after reading is taken. (3.87 percent) (1.0 percent Bosch)
12. Engine (8)	Reduce dynamometer test stand (3) load and engine (8) rpm. Accelerate engine (8) to rated rpm, no-load. Return to idle.	Full acceleration should occur in 3-5 seconds.
13. Opacity meter	Zero and place at exhaust side of turbocharger.	Use 0-100 scale.
14. Engine (8)	Accelerate engine (8) to rated rpm, no-load. Record highest reading. Return engine (8) to idle.	Remove opacity meter after reading is taken. (22 percent) (4.3 percent Bosch)
e. Final Check		
15. Crankcase pressure blow-by measuring tool (4)	Check pressure at end of testing procedure. If pressure is greater than specification listed in test chart, run engine (8) for additional 30 minutes at 96-100 percent rated load and rpm.	If there is no rapid change in excess of 2 in. of water and reading does not exceed 100 percent of representative pressure, blow-by is acceptable. Manometer readings not exceeding 0.3 in. (7.62 mm) surge are desirable.

3-92. ENGINE DYNAMOMETER TESTING (Contd)

LOCATION/ITEM	ACTION	REMARKS

e. Final Check (Contd)

16. Orifice adapter (5) and air compressor (7) — Remove from air compressor relief valve (6).

17. Blow-by measuring tool (4) and manometer — Remove from engine (8) and install filler cap 1).

18. Breather tube (2) — Unplug.

NOTE

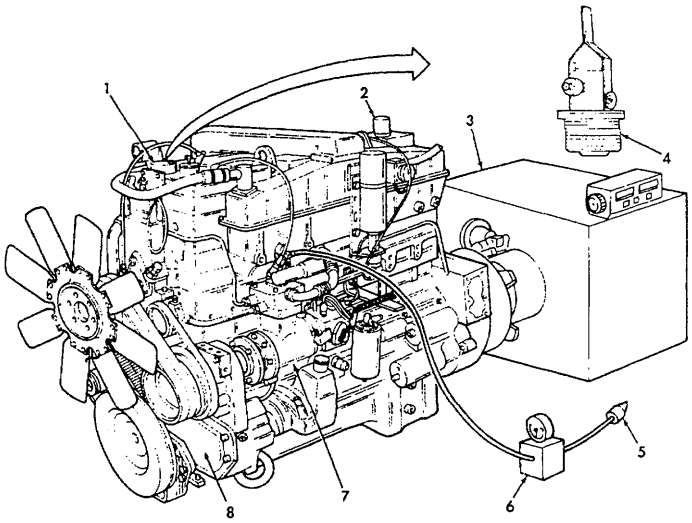
At each phase, record crankcase pressure (blow-by), engine speed, and load at one minute intervals. Watch for increases or wide shifts in blow-by pressure. If sudden increase happens, or if it is more than 12" H_2O, do the preceding test over again and run engine 15 more minutes. When blow-by is OK, do next test. If not OK, stop the test and find reason for too much blow-by. Check engine for fuel, oil, water, air, or exhaust leaks after each test and fix as needed.

Phase 1 - 25% HP @ 1200 RPM @ 160° water temperature.
Phase 2 - 40% HP @ 1200 RPM
Phase 3 - 65% HP @ 1600 RPM
Phase 4 - 100% HP @ Nominal torque peak RPM *(1200) RPM
Power Check - 96-100% HP @ 1600 RPM
***100 RPM below torque peak RPM**

FOLLOW-ON TASK: Perform on-engine fuel pump adjustment (para. 3-93).

Table 3-1. Dynamometer Test Chart

ENGINE	HP @ RPM	RATED HP @ RPM 500 FT-ALT	FUEL RATE LB/HR	AIR MANIFOLD PRESSURE IN/HG	ALTITUDE MAX. HP ALT.	CRANKCASE PRESSURE W/TURBO T46B	PHASE 1 TO 160°f HP @ RPM	PHASE 2 2 MIN. HP @ RPM	PHASE 3 5 MIN. HP @ RPM	PHASE 4 4 MIN. HP @ RPM	POWER CHECK 4 MIN. HP @ RPM
NTC 400	400 @ 2100	400 @ 2100	139-145	39/47	12,000	12" H_2O	100 @ 1200	160 @ 1200	260 @ 1600	Full Load @ 1200	384 @ 2100



LEGEND:

1. FILLER CAP
2. BREATHER TUBE
3. DYNAMOMETER TEST STAND
4. BLOW-BY MEASURING TOOL
5. ORIFICE ADAPTER
6. RELIEF VALVE
7. AIR COMPRESSOR
8. ENGINE

3-93. ON-ENGINE FUEL PUMP ADJUSTMENT

THIS TASK COVERS:

a. Preadjustment Checks
b. Idle Speed Adjustment
c. High Speed Adjustment
d. High Idle Speed Adjustment
e. Checking and Adjusting Fuel Rail Pressure
f. Checking and Adjusting Engine Fuel Rate
g. Checking and Adjusting Throttle Leakage
h. Checking Engine Power
i. Checking Fuel Filter Restriction
j. Fuel Pump Seal Installation
k. Throttle Shaft Cover Plate Installation

INITIAL SETUP:

APPLICABLE MODELS
All

SPECIAL TOOLS
Fuel pump idle adjusting tool (15434) 3315981
Throttle shaft ball installing tool (15434) 3315204

TEST EQUIPMENT
Dynamometer

MATERIALS/PARTS
Gasket (15434) 10105
Throttle shaft ball (15434) 213159
Lockwire and seal (15434) 3003156
Throttle shaft cover (15434) 3000466
Two drive screws (15434) 5-2286

PERSONNEL REQUIRED
Automotive repairman MOS 63H

REFERENCES (FM)
LO 9-2320-273-12
TM 9-2320-273-20
TM 9-2320-273-34
LO 9-2320-283-12
TM 9-2320-283-20
TM 9-2320-283-34

TROUBLESHOOTING REFERENCES
Para. 2-8

EQUIPMENT CONDITION
- Fuel control lever and throttle linkage adjusted (TM 9-2320-273-34 or TM 9-2320-283-34).
- Fuel lines connected (TM 9-2320-273-20 or TM 9-2320-283-20).
- Engine mounted to dynamometer (para. 3-91).
- Fuel pump primed (para. 3-91).
- Engine at operating temperature. Fuel temperature not above 110°F (43°C) (para. 3-91).
- Tachometer connected to tachometer drive shaft connection (para. 3-91).
- Shutoff valve electrical connection made. Manual control valve dosed (screwed out) (para. 3-88).
- Injection timing adjusted (para. 3-72).
- Valves and injectors adjusted. Fuel manifold pressure gauge connected (para. 3-85).
- Throttle shaft ball removed if fuel rail pressure adjustment is needed (para. 3-62).

SPECIAL ENVIRONMENTAL CONDITIONS
Work area clean and away from blowing dirt and dust.

GENERAL SAFETY INSTRUCTIONS
- Diesel fuel is highly flammable. Do not perform fuel pump adjustments near fire, flames, or sparks.
- Allow adequate ventilation for engine exhaust.

LOCATION/ITEM	ACTION	REMARKS

WARNING

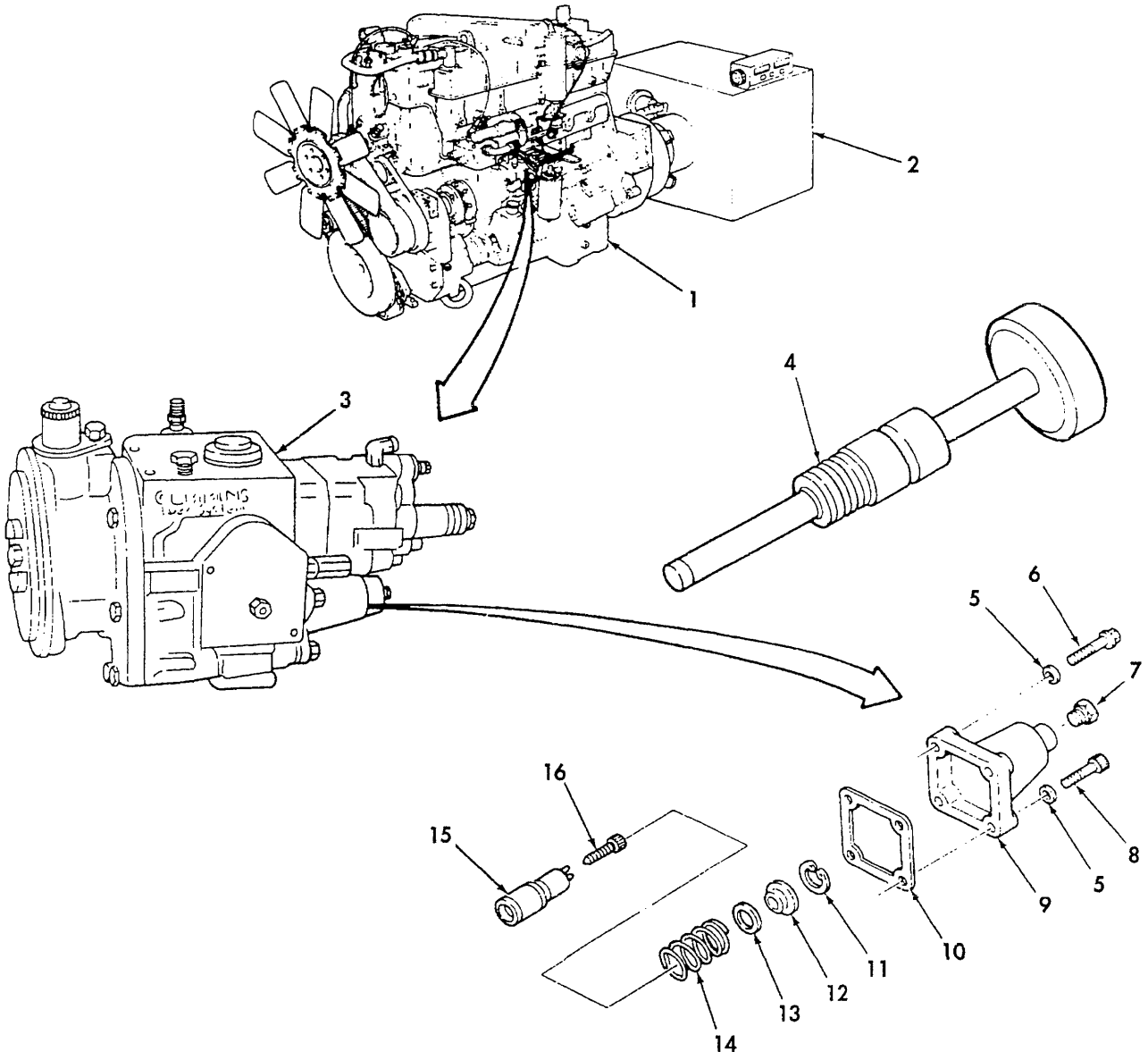
- **Allow adequate ventilation for engine exhaust gases. Failure to comply may result in brain damage or death to personnel.**
- **Do not perform fuel system procedures while smoking or within 50 ft (15.2 m) of sparks or open flame. Diesel fuel is flammable and may explode. Failure to comply may result in injury to personnel.**

a. Preadjustment Checks

CAUTION

Do not alter pump settings to match gauges and tachometers of unknown accuracy.

3-93. ON-ENGINE FUEL PUMP ADJUSTMENT (Contd)



LEGEND:

1. ENGINE
2. DYNAMOMETER
3. FUEL PUMP ASSEMBLY
4. IDLE ADJUSTING TOOL
5. WASHER (4)
6. CAPTIVE WASHER SCREW (3)
7. PLUG
8. SCREW
9. SPRING PACK COVER
10. GASKET
11. SNAPRING
12. SPRING RETAINER
13. SHIM(S)
14. SPRING
15. GUIDE
16. IDLE ADJUSTING SCREW

3-93. ON-ENGINE FUEL PUMP ADJUSTMENT (Contd)

LOCATION/ITEM	ACTION	REMARKS
a. Preadjustment Checks (Contd)		

NOTE

- **Vehicle fuel control lever and throttle stop linkage should have a maximum throttle stop, so when fuel pump full throttle is obtained, override pressure will not be on throttle shaft.**
- **When fuel pump has been properly calibrated, very little adjustment should be required after installation on engine except idle, since this setting is dependent on parasitic loads. Fine adjustment of governor settings and fuel manifold pressure is permissible within the limits specified if justified by engine performance tests.**

1.	Throttle control linkage	Check and adjust for: a. Full throttle operation. b. Throttle released operation with throttle stopped by throttle leakage adjusting screw.	Refer to TM 9-2320-283-34 or TM 9-2320-273-34.
	b. Idle Speed Adjustment		

NOTE

Idle speed adjustment should never be made on a cold engine. Engine must be operated a sufficient period of time to purge all air from the fuel system and to bring the engine up to operating temperature (at least 165°F (74°C) oil temperature).

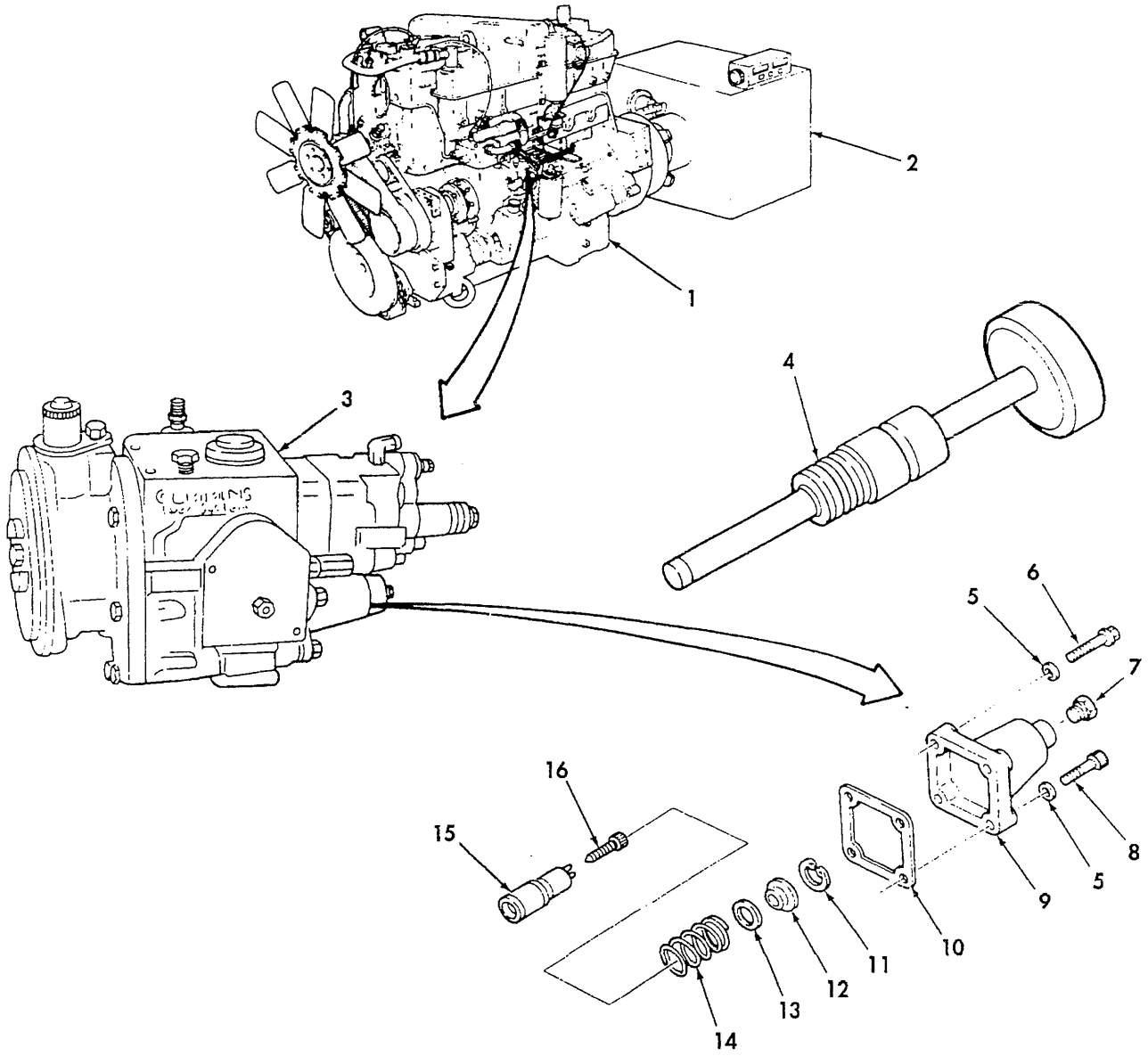
2.	Spring pack cover (9)	Remove plug (7).	
3.	Engine (1)	Start.	Engine (1) mounted to dynamometer (2).
4.	Idle adjusting screw (16)	Adjust while engine (1) is running. Use idle adjusting tool (4) to set idle to 600 ± 2 rpm.	Turn idle adjusting screw (16) in to increase engine (1) rpm; out to decrease rpm. Fuel pump idle adjusting tool (3375981) (4) will not let the spring pack cover (9) leak when the idle is adjusted.
5.	Spring pack cover (9)	Install plug (7).	
	c. High Speed Adjustment		

NOTE

A means of loading the engine must be used to perform this check. The tachometer and fuel manifold pressure gauge must be of high accuracy. The engine fuel system must be purged of all air and at operating temperature. If spring pack cover is opened to make adjustment, fuel pump must be purged of air before attempting cutoff setting adjustment. The preferred method of loading engine is on an engine or chassis dynamometer.

6.	Spring pack cover (9), three captive washer screws (6), screw (8), and four washers (5)	Remove from fuel pump assembly (3).	
7.	Fuel pump gasket (10)	Remove.	Discard gasket (10).
8.	Snapring (11)	Remove.	Use snapring pliers.

3-93. ON-ENGINE FUEL PUMP ADJUSTMENT (Contd)



LEGEND:

1. ENGINE
2. DYNAMOMETER
3. FUEL PUMP ASSEMBLY
4. IDLE ADJUSTING TOOL
5. WASHER (4)
6. CAPTIVE WASHER SCREW (3)
7. PLUG
8. SCREW
9. SPRING PACK COVER
10. FUEL PUMP GASKET
11. SNAPRING
16. IDLE ADJUSTING SCREW

3-93. ON-ENGINE FUEL PUMP ADJUSTMENT (Contd)

LOCATION/ITEM	ACTION	REMARKS
9. Spring retainer (12)	Remove.	
10. New shim(s) (13)	Add or remove from behind spring (14). High speed adjustment should be 2130 to 2150 rpm.	Each 0.001 in. (0.025 mm) shim thickness will change speed approximately two rpm.
11. Spring retainer (12) and snapring (11)	Install on guide (15).	Use snapring pliers. Make certain shim(s) (13) do not slip off of guide (15).
12. Spring pack cover (9)	Secure with three captive washer screws (6), screw (8), and four washers (5).	Tighten screws (6) and (8) to 9-11 lb-ft (12-15 N•m). Screw (8) has hole drilled through head for sealing wire insertion.

d. High Idle Speed Adjustment

NOTE

Do not use this check to make governor speed adjustments. If no-load speed is much greater than specifications, examine governor for malfunction or faulty parts.

13. Engine (1)	a. Operate to purge air from fuel system and bring up to operating temperature. b. Bring to full throttle and hold. Note maximum rpm.	Speed should be 10-12 percent greater than governor speed cutoff point. If on-engine fuel pump adjustments made with engine mounted in vehicle, rpm will depend on engine parasitic loads (fan, pumps, etc.).

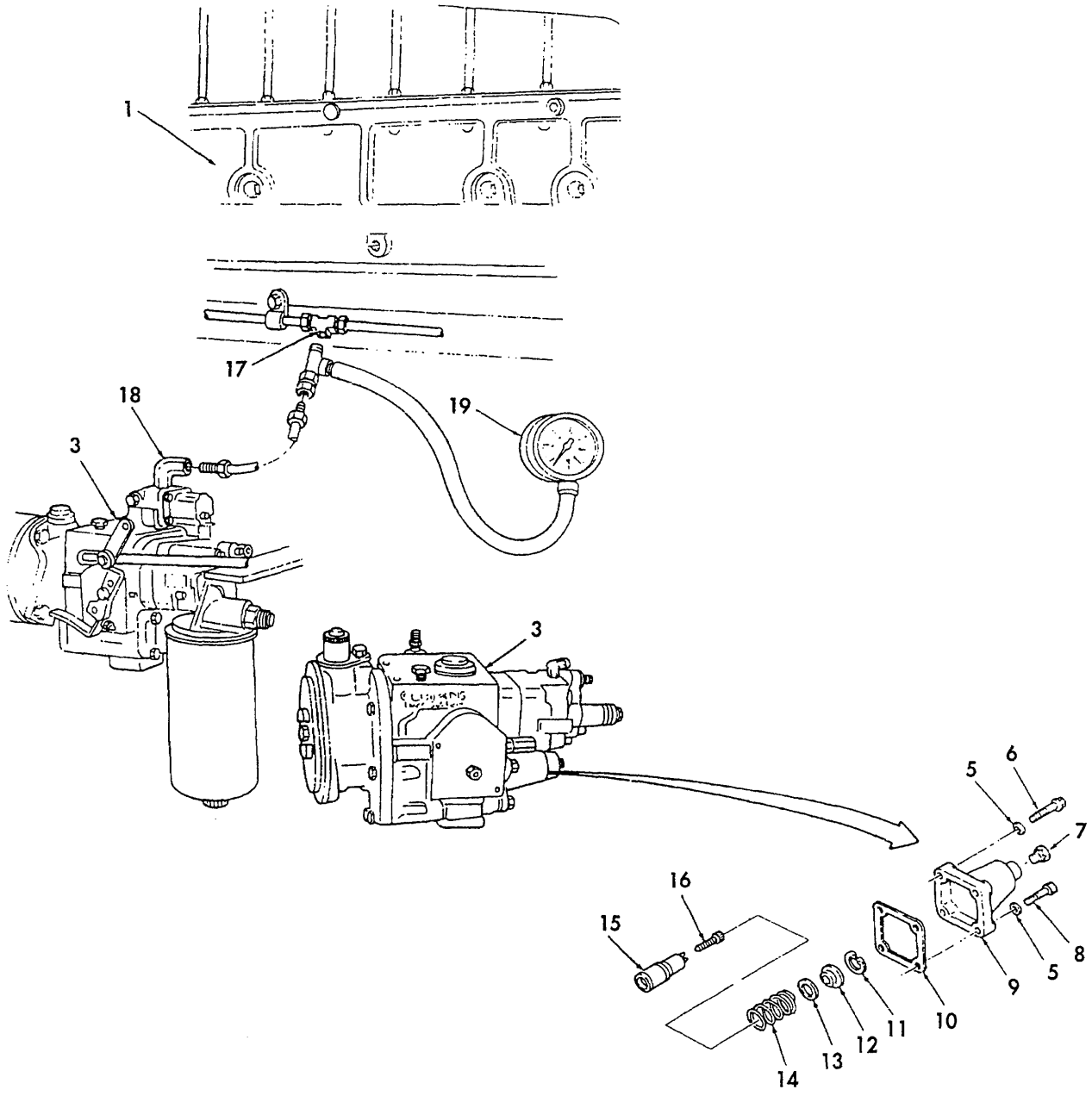
e. Checking and Adjusting Fuel Rail

NOTE

- **It should not be necessary to adjust fuel rail pressure on a newly calibrated fuel pump more than ± 2 psi (± 14 kPa). If adjustments greater than this are required, fuel pump test stand, injector test stand, or engine problems may exist. Do not remove throttle shaft ball unless fuel rail pressure adjustment needs to be performed.**
- **The correct method of checking engine fuel rail pressure is with engine installed on a chassis or engine dynamometer.**

14. Governor speed cutoff	Check setting point.	Adjust, if necessary.
15. Fuel rail pressure gauge (19)	Install between fuel supply elbow (18) on fuel pump assembly (3) and female union tee (17).	
16. Engine(1)	Bring to full throttle load until rpm falls to rated speed.	Accurate tachometer must be used to measure rpm.
17. Fuel rail pressure gauge (19) Note reading.		If pressure is above or below the minimum specification, do step 18. If OK, go to step 19.

3-93. ON-ENGINE FUEL PUMP ADJUSTMENT (Contd)



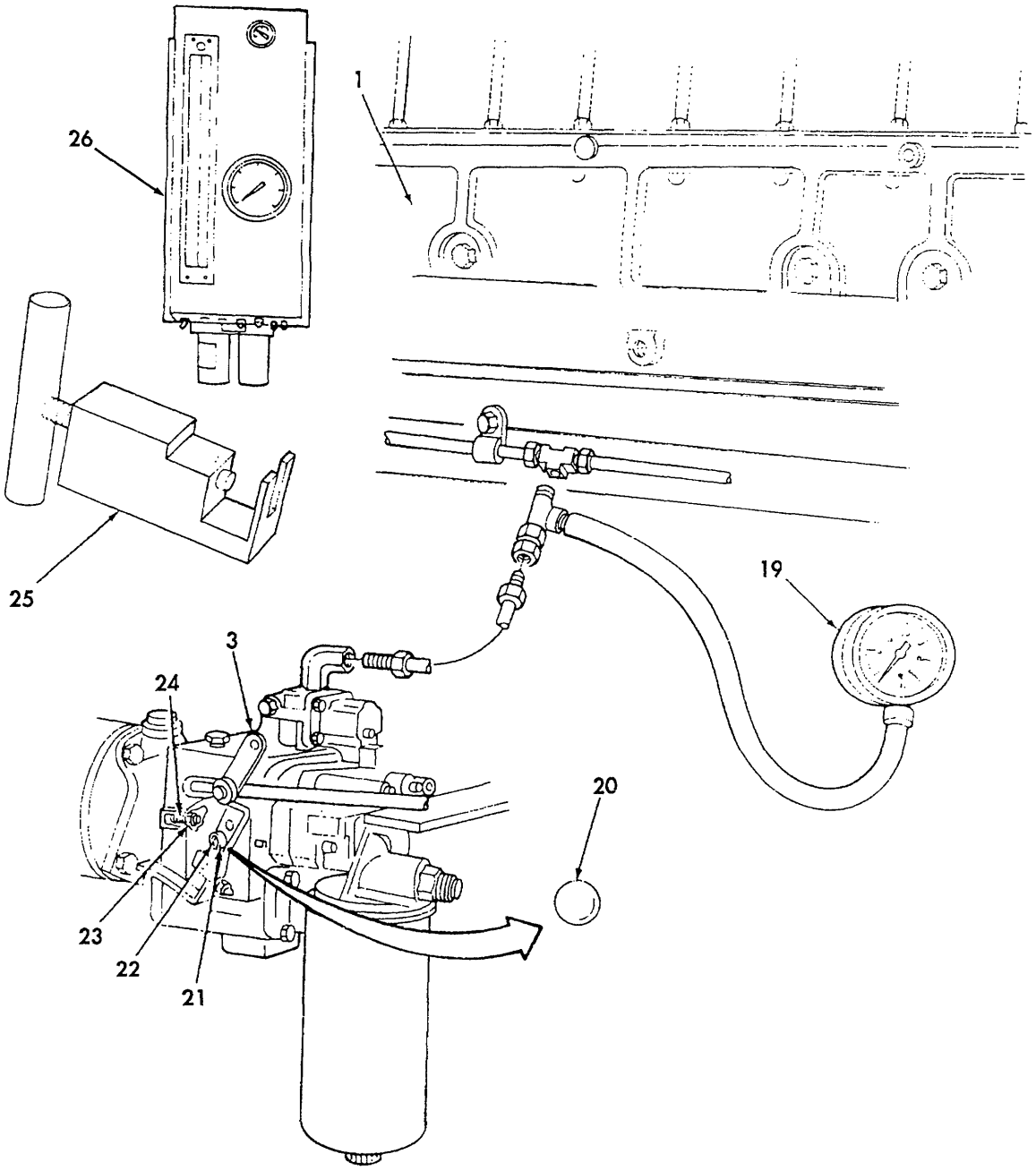
LEGEND:

1. ENGINE
3. FUEL PUMP ASSEMBLY
5. WASHER (4)
6. CAPTIVE WASHER SCREW (3)
8. SCREW
9. SPRING PACK COVER
11. SNAPRING
12. SPRING RETAINER
13. SHIM(S)
14. SPRING
15. GUIDE
17. FEMALE UNION TEE
18. FUEL SUPPLY ELBOW
19. FUEL RAIL PRESSURE GAUGE

3-93. ON-ENGINE FUEL PUMP ADJUSTMENT (Contd)

LOCATION/ITEM	ACTION	REMARKS
18. Threaded stud (24)	To adjust fuel rail pressure:	
	CAUTION **Do not turn threaded stud out beyond maximum throttle travel. The fuel hole in the throttle shaft will begin to close. Never adjust fuel rail pressure above maximum specifications. This will void engine warranty and violate EPA requirements.**	
	a. Turn out to get maximum throttle travel. Secure with jamnut (23).	This will reduce throttle restriction.
	b. Remove throttle shaft ball (20).	Refer to para. 3-62.
	c. Turn fuel adjusting screw (22) in throttle shaft (21) in to increase or out to decrease pressure while watching fuel rail pressure gauge (19).	
	d. It should not be necessary to adjust fuel manifold pressure on a newly calibrated pump more than ± 2 psi (± .14 kPa). If adjustments greater than these are required, fuel pump test, injector test stand, or engine problems may exist.	
	e. Install throttle shaft ball (20) into end of throttle shaft (21) with throttle shaft ball installing tool (3375204) (25) after adjustment.	
f. Checking and Adjusting Engine Fuel		
19. Fuel pump assembly (3)	Connect suitable fuel rate meter (26).	
	NOTE **The fuel rate specified on fuel pump calibration specifications is at full throttle and rated speed. An engine or chassis dynamometer must be used. Accurate fuel rail pressure and speed readings must also be taken.**	
20. Engine (1)	a. Bring engine (1) to full throttle and increase dynamometer load until engine rpm falls to rated speed.	
	b. Check governor speed cut-off while a load is on engine (1).	
	c. Check fuel rail pressure gauge (19) at maximum speed.	
	d. Hold engine speed and load at maximum speed long enough for fuel rate meter (26) to stabilize.	
	e. Verify correct fuel rate measurement with fuel rate meter (26).	

3-93. ON-ENGINE FUEL PUMP ADJUSTMENT (Contd)



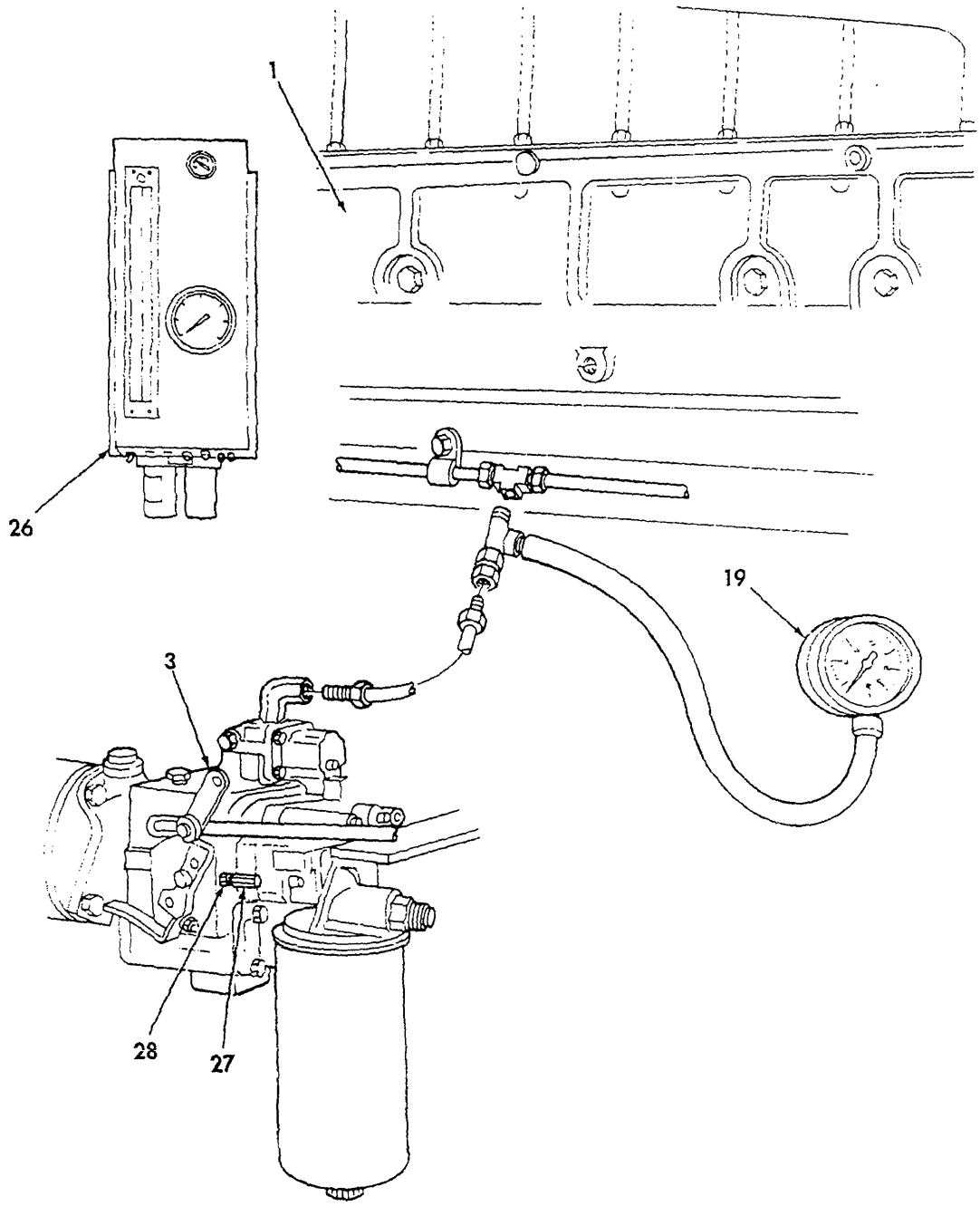
LEGEND:

1. ENGINE
3. FUEL PUMP ASSEMBLY
19. FUEL RAIL PRESSURE GAUGE
20. THROTTLE SHAFT BALL
21. THROTTLE SHAFT
22. FUEL ADJUSTING SCREW
23. JAMNUT
24. THREADED STUD
25. THROTTLE SHAFT BALL INSTALLING TOOL
26. FUEL RATE METER

3-93. ON-ENGINE FUEL PUMP ADJUSTMENT (Contd)

LOCATION/ITEM	ACTION	REMARKS
g. Checking and Adjusting Throttle		
	NOTE **If throttle leakage is adjusted correctly on fuel pump test stand, fuel pump will not need to be adjusted on engine. Vehicle throttle linkage must be adjusted so that threaded stud of throttle leakage adjusting screw (rear screw) just contacts stop on pump throttle.**	
21. Engine (1)	a. Bring engine to full throttle and allow engine to run at maximum no-load speed.	The purpose of the throttle leakage is to keep the fuel lines and injector drilling full of fuel during closed throttle operation. The correct throttle leakage will help acceleration when the throttle is opened after going down a grade. Throttle leakage will also prevent stalling when it slows down to the idle speed. (Too much leakage will cause slow deceleration.)
	b. Release or move throttle quickly and start a suitable timer or stopwatch at the same time. c. Stop timer when 1000 rpm is reached and check deceleration time. Repeat this check several times. d. Increase leakage if engine (1) begins to stall (idle governor does catch engine after deceleration from high idle).	
22. Threaded stud (27)	a. Increase leakage by turning in. b. Recheck engine (1) deceleration until time is increased 1-2 seconds. c. Lock threaded stud (27) with jamnut (28). d. Recheck idle speed and readjust as necessary. e. Set engine to high idle. f. Check deceleration time when shutoff valve is closed (engine (1) is shut down).	If deceleration time is not faster by this method, throttle leakage is not the problem. If the deceleration time is faster by this method, throttle leakage must be reduced.

3-93. ON-ENGINE FUEL PUMP ADJUSTMENT (Contd)

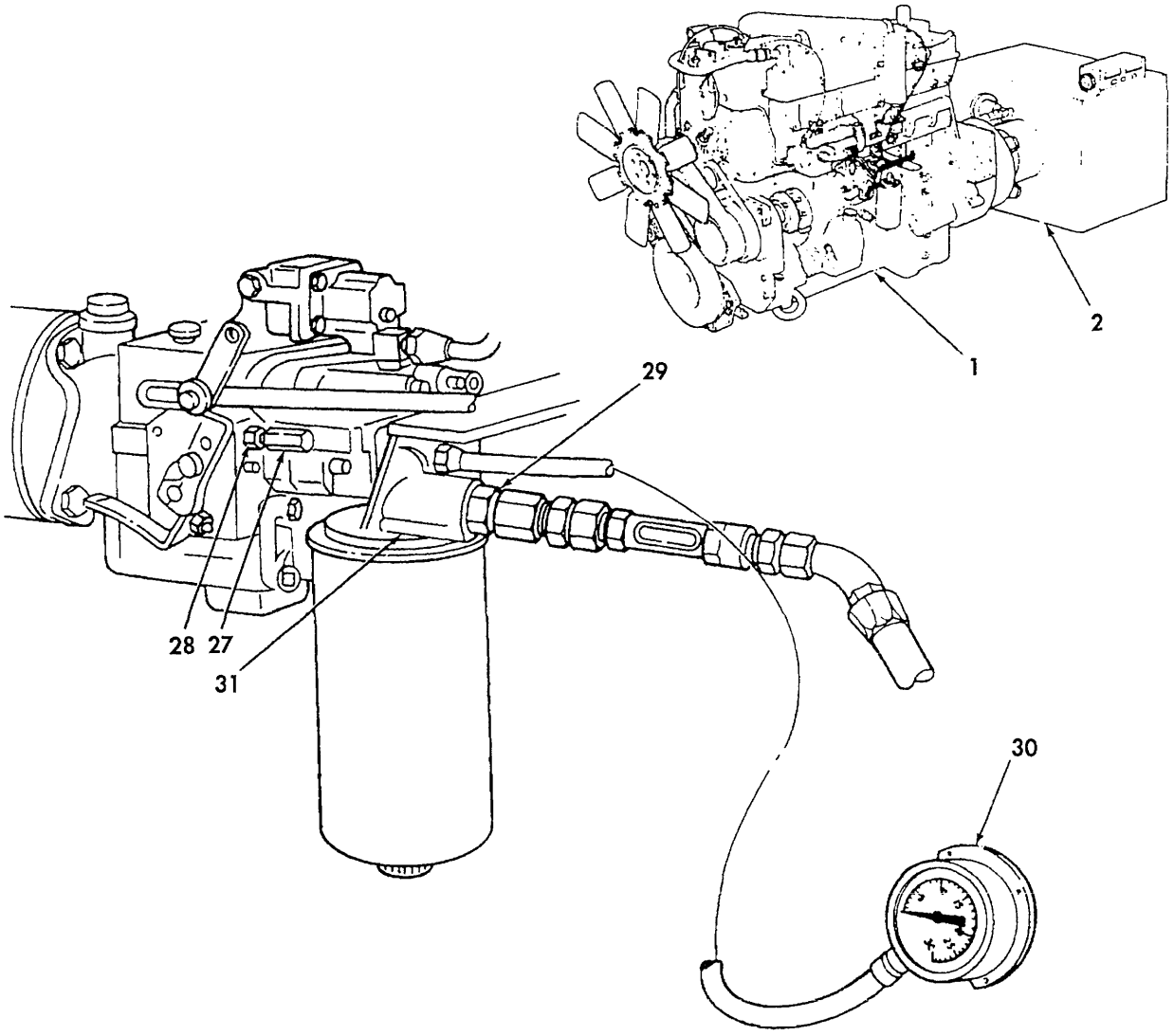


LEGEND:
1. ENGINE
27. THREADED STUD
28. JAMNUT

3-93. ON-ENGINE FUEL PUMP ADJUSTMENT (Contd)

LOCATION/ITEM	ACTION	REMARKS
23. Threaded stud (27)	a. Decrease leakage by turning out until engine (1) tends to stall after deceleration to high idle. b. Turn in until deceleration is increased 1-2 seconds. Lock threaded stud (27) with jamnut (28). c. Recheck idle speed and readjust as necessary.	
	NOTE **Engine power cannot be set accurately in any other way except on engine dynamometer. Fuel pump adjustments must not be made on an engine when the engine power comes from an estimate. Before any adjustments on the fuel pump are made, the following engine performance data must be checked so that adjustments are justified.**	
24. Fuel rail pressure, fuel rate, speed setting, smoke, coolant temperature, combustion smoothness, exhaust restriction, fuel quality, air intake restriction, engine oil level, engine power reducing factors	Check.	Under no circumstances should specifications be exceeded.
h. Checking Engine Power		
25. Governor speed cutoff	Recheck setting point.	Readjust if necessary.
i. Checking Fuel Filter Restriction		
26. Vacuum gauge (30)	Connect to fuel inlet (29) on damper (31).	Use suitable adapter.
27. Engine (1)	Bring engine (1) to full throttle and full load on dynamometer (2) and check vacuum gauge (30).	If restriction reads 8 in. (203 mm) of vacuum while engine (1) is running at full throttle and full load, change fuel filter. Refer to LO 9-2320-273-12 and LO 9-2320-283-12. Also check other sources of restriction. Use sight glass to check for moving bubbles and possible gasket or other leaks. If air bubbles are still seen after above checks, check float valve in float tank used for test. Fuel pump may be pumping more fuel than float valve will allow to pass into the float tank.

3-93. ON-ENGINE FUEL PUMP ADJUSTMENT (Contd)



LEGEND:

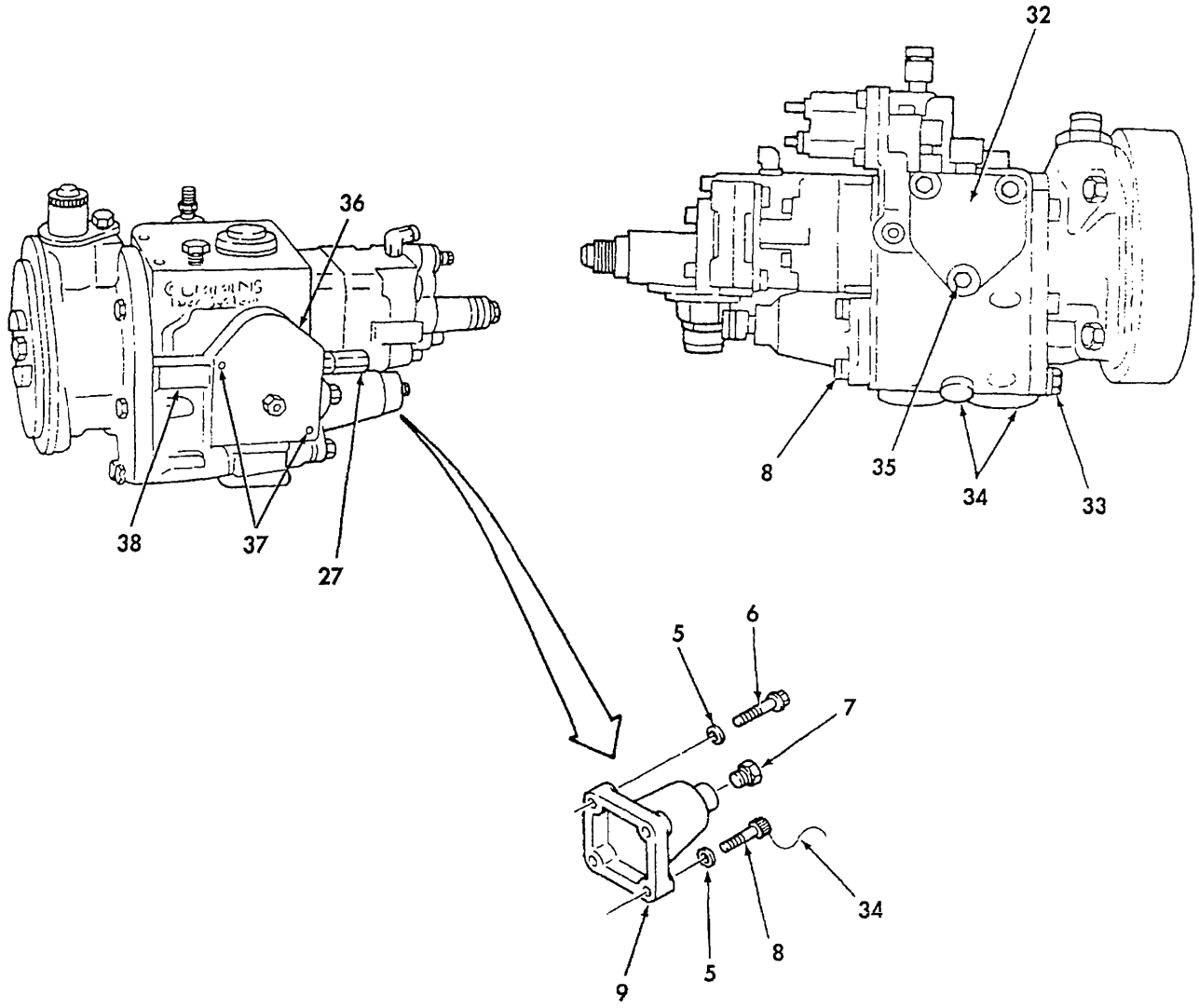
1. ENGINE
2. DYNAMOMETER
27. THREADED STUD
28. JAMNUT
29. FUEL INLET
30. VACUUM GAUGE
31. DAMPER

3-93. ON-ENGINE FUEL PUMP ADJUSTMENT (Contd)

LOCATION/ITEM	ACTION	REMARKS
j. Fuel Pump Seal Installation		
	NOTE **Fuel pump must be sealed after final adjustments are made to prevent tampering.**	
28. Spring pack cover (9), screw (8), threaded stud (27), and plug (7)	a. Using lockwire and seal (34), insert lockwire through screw (8), plug (7), and threaded stud (27). b. Twist lockwires together until connection is secure and lockwire is tight. c. Bend twisted lockwire into seal and press on top half of seal.	Seals spring pack cover (9) and threaded stud (27).
29. Spring pack cover (9), screw (8), cover assembly (32), captive washer screw (33), and drilled fllister head screw (35)	a. Using lockwire and seal (34), insert lockwire through screw (8), drilled fillister head screw (35), and captive washer screw (33). b. Twist lockwires together until connection is secure and lockwire is tight. c. Bend twisted lockwire into seal and press on top half of seal.	Seals cover assembly (32).
k. Throttle Shaft Cover Plate Installation		
30. Throttle shaft cover plate (36) and two drive screws (37)	a. Position new throttle shaft cover plate (36) on housing (38). b. Drill two new holes on opposite sides of throttle shaft cover plate (36) 0.235 in. (5.969 mm) into pump housing. Do not attempt to drill out and reuse old mounting holes. c. Secure new throttle shaft cover plate (36) with two drive screws (37).	Use No. 44 0.086 in. (2.184 mm) drill. Use etching tool or steel stamp and imprint date of repair on backside of throttle shaft cover plate (36) for future reference.

FOLLOW-ON TASK: Install engine in vehicle if tests done on engine dynamometer (TM 9-2320-273-34).

3-93. ON-ENGINE FUEL PUMP ADJUSTMENT (Contd)



LEGEND:

7. PLUG
8. SCREW
9. SPRING PACK COVER
27. THREADED STUD
32. COVER ASSEMBLY
33. CAPTIVE WASHER SCREW
34. LOCKWIRE AND SEAL
35. DRILLED FILLISTER HEAD SCREW
36. THROTTLE SHAFT COVER PLATE
37. DRIVE SCREWS (2)
38. HOUSING

Section VI. GENERAL MAINTENANCE INSTRUCTIONS

3-94. GENERAL

This section provides general instructions for temporary storage, long-term storage, and preparing an engine from storage to service. Additional information concerning storage of equipment can be found in TM 740-90-1.

3-95. TASK SUMMARY

TASK PARA	PROCEDURES
3-96.	Temporary Storage
	a. General Instructions
	b. Out-of-Service Engines
3-97.	Long-Term Storage
	a. General Instructions
	b. Out-of-Service Engines
3-98.	Preparing an Engine from Storage to Service
	a. General Instructions
	b. Cleaning the Engine
	c. Inspecting the Engine
	d. Additional Inspection

3-96. TEMPORARY STORAGE

a. General Instructions. All surfaces of an engine will rust or corrode if they are not protected. Ensure all outside surfaces of engine are painted before placing it in storage. Protect inside of engine during storage as described below.

b. Out-of-Service Engines. If an engine remains out of service from three or four weeks, to a maximum of six months, take steps to prevent rust. The operations listed below are required to prevent damage to engines in temporary storage.

(1) Start engine and gradually increase speed to 1200 rpm with no load. Operate engine until water temperature is at least 160°F (71°C).

(2) Stop engine and disconnect both fuel lines at fuel supply tank. Fill two portable containers, one with diesel fuel and a second with preservative oil, U.S. Military Specification VV-L-800, Type P-9.

(3) Start engine with fuel inlet line pulling fuel from can with diesel fuel. Let drain line flow into same container with inlet diesel fuel. After engine is started and is running at idle, move fuel line to container with preservative oil. Operate engine 5 to 10 minutes on preservative oil. Stop engine and reconnect fuel lines to supply tank.

(4) The oil sump (crankcase) fuel filter and fuel tank must be drained and drainplugs installed. New oil can be added to the sump.

(5) Rotate engine crankshaft while applying a spray of LOW oil into intake manifold and air compressor.

(6) Put tape over all intake manifold openings to keep out dirt and moisture.

(7) Put tape over all engine openings including coolant inlet, cylinder block, oil breather, and crankcase.

(8) Drain coolant from cooling system unless permanent antifreeze with rust inhibitor is present.

(9) Put engine in a place protected from the weather. Air should be dry and temperature even.

(10) Rotate engine crankshaft two or three revolutions every three or four weeks.

(11) Protect flexdisk with a rust preventative.

3-97. LONG-TERM STORAGE

NOTE

After engine has been in storage for 24 months, flush it with solvent and repeat preparation for storage.

a. General Instructions. When an engine is to be in storage for six months or more, it must be protected against rust and corrosion. Ensure all outside surfaces of engine are painted before placing it in storage.

b. Out-of-Service Engines. If an engine remains out of service for six months or more, take steps listed below to prevent damage:

(1) Start engine and gradually increase speed to 1200 rpm with no load. Operate engine until water temperature is at least 160°F (71°C). Stop engine and drain oil.

(2) Drain and fill crankcase to full mark on dipstick with preservative oil, U.S. Military Specification MIL-L-21260, Type P-10, type II, SAE 30.

(3) Disconnect both fuel lines at fuel supply tank. Fill two portable containers, one with diesel fuel and the second with preservative oil, U.S. Military Specifications VV-L-800, Type P-9.

(4) Start engine with fuel inlet and drain lines in can with diesel fuel. After engine is started and is running at idle, move fuel inlet line to container with preservative oil. Operate engine 5 to 10 minutes on preservative oil. Stop engine and reconnect fuel lines.

(5) Drain fuel and oil pumps, compressor, cooler, filters, and crankcase. Replace all plugs after draining.

(6) Remove intake and exhaust manifolds. Apply preservative oil in a spray into the intake and exhaust ports of the engine. Also apply it into intake port of the air compressor. Install intake and exhaust manifolds.

(7) Inspect coolant in cooling system. If coolant contains rust, drain and flush the system and fill it with a rust preventative. Use an oil which has rust inhibitors that will mix with water. Flush cooling system before returning it to service.

(8) Ensure all outside surfaces of engine are painted.

(9) Remove valve covers and apply preservative oil to rocker levers, valve stem, springs, guide, crossheads, and push tubes. Install valve covers.

(10) All engine openings must be covered with heavy paper and tape.

(11) Protect flexdisk with a rust preventative.

(12) Put a tag on engine to show the following:

(a) Engine has been prepared for storage.

(b) Coolant has been removed.

(c) Crankshaft must not be rotated.

(d) Date engine was prepared for storage.

(e) Compound used for storage must be removed before running engine.

(13) Put engine in a place protected from the weather and where the air is dry and temperature is even.

(14) Keep all rust-preventing compounds clean.

3-98. PREPARING AN ENGINE FROM STORAGE TO SERVICE

CAUTION

Excess preservative oil in the combustion chamber can cause a hydraulic lock. Engine damage will occur if started before oil is removed.

a. General Instructions. When an engine is removed from storage and put into service, operations listed below must be completed.

b. Cleaning the Engine. Do the following to prepare engine for service:

(1) Remove all dirt from the outside of engine.

(2) Remove all paper covers and tape.

(3) Use solvent to remove rust preventative from engine exterior.

(4) Fill crankcase with clean oil.

(5) Flush cooling system and refill with permanent-type antifreeze in a mixture suitable for appropriate temperature range.

c. Inspecting the Engine. Check for proper adjustment of injectors, valves, and belts if engine was held in storage for six months or less. Also check the oil filters, air filters, hose connections, and cylinder-head screws.

d. Additional Inspection. When engine has been in storage for six months or more, the following specific procedures must be followed:

(1) Flush fuel system with fuel oil until fuel system is clean.

(2) Remove plug from oil filter head and run hot, light, mineral oil through oil passages. Rotate engine by hand three or four times during the flushing operations.

(3) Remove all filter screens and make sure they are clean before starting the engine.

(4) Apply oil under pressure to lubricating system before starting engine.

(5) Ensure all preservative oil is flushed away.

FOLLOW-ON TASK: Perform procedures under Starting Repaired Engine (para. 3-91).

APPENDIX A
REFERENCES

A-1. PUBLICATIONS INDEXES

Indexes should be consulted frequently for latest changes or revisions of references given in this appendix and for new publications relating to material covered in this publication.

a. Military Publication Indexes.

Consolidated Index of Army Publications and Blank Forms ..... DA Pam 310-1
Index of Blank Forms ..... DA Pam 310-2
Index of Doctrinal, Training, and Organizational Publications ..... DA Pam 310-3
Index of Technical Manuals, Technical Bulletins, Supply Manuals
(Types 7, 8, and 9), Supply Bulletins, and Lubrication Orders ..... DA Pam 310-4
Index of Graphic Training Aids and Devices ..... DA Pam 310-5
Index of Army Motion Pictures and Related Audiovisual Aids ..... DA Pam 108-1
U.S. Army Equipment Index of Modification Work Orders .....DA Pam 750-10

b. General References.

Catalog of Abbreviations and Brevity Codes .....AR 310-50
How to Prepare and Conduct Military Training ..... FM 21-6
Military Symbols ..... FM 21-30

A-2. FORMS

Refer to DA Pam 738-750, The Army Maintenance Management System (TAMMS), for instructions on the use of maintenance forms pertaining to the materials.

A-3. OTHER PUBLICATIONS

The following publications contain information pertinent to the major item material and associated equipment:

a. Vehicle.

Lubrication Order, Truck Tractor, M915, M916, and M920 ..... LO 9-2320-273-12
Lubrication Order, Truck Tractor, M915A1 ..... LO 9-2320-283-12
Lubrication Order, Dump Truck, M917 ..... LO 5-3805-274-12
Lubrication Order, Bituminous Distributor, M918 ..... LO 5-3895-224-12
Lubrication Order, Concrete Mobile, M919 ..... LO 5-3895-372-12
Operators Manual, Truck Tractor, M915 .....TM 9-2320-273-10
Operator's Manual, Truck Tractor, M915A1 .....TM 9-2320-283-10
Organizational Maintenance, Truck Tractor, M915 .....TM 9-2320-273-20
Organizational Maintenance, Truck Tractor, M915A1 .....TM 9-2320-283-20
Organizational Maintenance Repair Parts and
Special Tools List, Truck Tractor, M915 ..... TM 9-2320-273-20P
Organizational Maintenance Repair Parts and
Special Tools List, Truck Tractor, M915A1 ..... TM 9-2320-283-20P
Direct and General Support Maintenance, Truck Tractor, M915 .....TM 9-2320-273-34
Direct and General Support Maintenance, Truck Tractor, M915A1 .....TM 9-2320-283-34

A-3. OTHER PUBLICATIONS (Contd)

Direct and General Support Repair Parts and
Special Tools List, Truck Tractor, M915 ..... TM 9-2320-273-34P
Direct and General Support Repair Parts and
Special Tools List, Truck Tractor, M915A1 ..... TM 9-2320-283-34P

b. Camouflage.
Camouflaged ..... FM 5-20

c. Decontamination.
Chemical, Biological, and Radiological (CBR) Decontamination ..... TM 3-220
NBC (Nuclear, Biological, and Chemical) Defense ..... FM 21-40

d. General.
Basic Cold Weather Manual ..... FM 31-70
Cooling System: Tactical Vehicles ..... TM 750-254
Manual for Wheeled Vehicles Driver ..... FM 21-305
Driver Selection and Training (Wheeled Vehicle) ..... FM 55-30
Northern Operations ..... FM 31-71
Operation and Maintenance of Ordnance Material
in Extreme Cold Weather (0° to -65°F) ..... TM 9-207
Principles of Automotive Vehicles ..... TM 9-8000
Prevention of Motor Vehicle Accidents ..... AR 385-55
Procedures for Destruction of Tank-Automotive Equipment
to Prevent Enemy Use ..... TM 750-244-6

e. Maintenance and Repair.
Description, Use, Bonding Techniques, and Properties of Adhesives ..... TB ORD 1032
Inspection, Care, and Maintenance of Antifriction Bearings ..... TM 9-214
Materials Used for Cleaning, Preserving, Abrading, and
Cementing Ordnance Materiel and
Related Materials including Chemicals .TM ..... TM 9-247
Metal Body Repair and Related Operations ..... FM 43-2
Operation and Organizational, Field and
Depot Maintenance: Storage Batteries, Lead-Acid Type ..... TM 9-6140-200-12
Painting Instructions for Field Use ..... TM 43-0139
Use of Antifreeze Solutions and Cleaning Compounds
in Engine Cooling System ..... TM 43-0139
Welding Theory and Application ..... TM 9-237

f. Administrative Storage.
General Packaging Instructions for Field Units ..... TM 746-10

APPENDIX B

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE REPAIR PARTS AND SPECIAL TOOLS LIST

Section I. INTRODUCTION

B-1. Scope.

This Repair Parts and Special Tools List (RPSTL) lists and authorizes spares and repair parts; special tools; Test, Measurement, and Diagnostic Equipment (TMDE); and other special support equipment required for performance of direct support, and general support maintenance of the NTC-400 Cummins Big Cam I and Big Cam III engines. It authorizes the requisitioning, issue, and disposition of spares, repair parts, and special tools as indicated by the Source, Maintenance, and Recoverability (SMR) codes.

B-2. General.

This RPSTL is divided into the following sections:

a. Section II. Repair Parts List. A list of spares and repair parts authorized 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 reparable special tools are also listed in this section. Items listed are shown on the associated illustration(s)/figure(s).

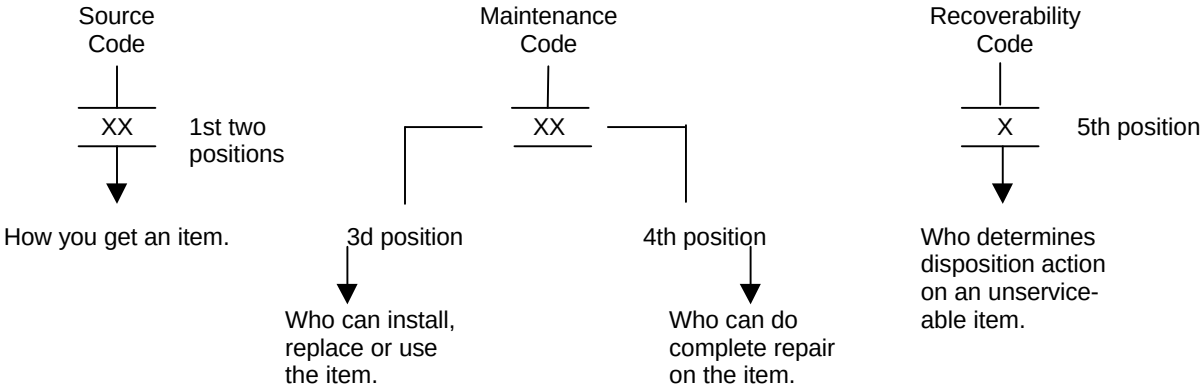
b. Section III. Special Tools List. A list of special tools, special TMDE, and other special support equipment authorized by this RPSTL (as indicated by Basis of Issue (BOI) information in DESCRIPTION AND USABLE ON CODE column) for the performance of maintenance.

c. Section IV. National Stock Number and Part Number Index. A list, in ascending National Item Identification Number (NIIN) (last nine numerals) 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.

B-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.

(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:

Code	Explanation
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. **** NOTE: Items coded PC are subject to deterioration.**
KD KF KB	Items with these codes are not to be requested/requisitioned individually. They are part 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 Unit Level) MF - (Made at DS Level) MH - (Made at GS Level) ML - (Made at Specialized Repair Activity (SPA)) MD - (Made at Depot)	Items with these codes are not to be requested/requisitioned individually. They must be made from bulk material which is identified by the part number in the DESCRIPTION AND USABLE ON CODE (UOC) column and listed in the bulk material group of the repair parts list in the 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 Unit Level) AF - (Assembled by DS Level) AH - (Assembled by GS Level) AL - (Assembled by SRA) AD - (Assembled by Depot)	Items with these codes are not to be requested/requisitioned individually. The parts that make up the assembled item must be requisitioned or fabricated and assembled at the level of maintenance indicated by the source code. If the 3d position code of the SMR code authorizes you to replace the item, but the source code indicates the item is assembled at a higher level, order the item from the higher level of maintenance.

XA - Do not requisition an XA-coded item. Order its next higher assembly. (Also refer to the note below.)
XB - If an XB-coded item is not available from salvage, order it using the CAGEC and part number given.
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 CAGEC and part number given if no NSN is available.

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.

(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 3d and 4th positions of the SMR code as follows:

(a) The maintenance code entered in the 3d position tells you the lowest maintenance level authorized to remove, replace, and use an item. The maintenance code entered in the 3d position will indicate authorization to one of the following levels of maintenance.

Code	Application/Explanation
C	- Crew or operator maintenance done within unit maintenance.
O	- Unit level can remove, replace, and use the item.
F	- Direct support 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.

(b) The maintenance code entered in the 4th position tells you 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**). (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.)** This position will contain one of the following maintenance codes:

Code	Application/Explanation
O	- Unit is the lowest level that can do complete repair of the item.
F	- Direct support is the lowest level that 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 (designate the 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.

(3) Recoverability Code. Recoverability codes are assigned to items to indicate the disposition action on unserviceable items. The recoverability code is entered in the 5th position of the SMR code as follows:

Recoverability Code	Application/Explanation
Z	- Nonreparable item. When unserviceable, condemn and dispose of the item at the level of maintenance shown in 3d position of SMR code.
O	- Reparable item. When uneconomically reparable, condemn and dispose of the item at unit level.
F	- Reparable item. When uneconomically reparable, condemn and dispose of the item at the direct support 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 not authorized below 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. National Stock Number (Column (3)). This column indicates the National Stock Number (NSN) assigned to the item. Use the NSN for requests/requisitions.

d. CAGE Code (Column (4)). The Commercial and Government Entity Code (CAGEC) is a 5-digit numeric code which is used to identify the manufacturer, distributor, or Government agency, etc., that supplies the item.

e. Part Number (Column (5)). 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.

NOTE

When you use a NSN to requisition an item, the item you receive may have a different part number from the part ordered.

f. Description and Usable on Codes (UOC) (Column (6)). This column includes the following information:

(1) The Federal item name and, when required, a minimum description to identify the item.

(2) Items that are included in kits and sets are listed below the name of the kit or set.

(3) Spare/repair parts that make up an assembled item are listed immediately following the assembled item line entry.

(4) Part numbers for bulk materials are referenced in this column in the line item entry for the item to be manufactured/ fabricated.

(5) 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).

(6) The usable on code, when applicable (refer to paragraph 5, Special Information).

(7) 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 equipment supported exceeds density spread indicated in the basis of issue, the total authorization is increased proportionately.

(8) The statement END OF FIGURE appears just below the last item description in column 6 for a given figure in both section II and section III.

g. QTY (Column (7)). The Quantity Incorporated in Unit (QTY INC IN UNIT) 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 place of a quantity indicates that no specific quantity is applicable (e.g., shims, spacers).

B-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., 5305-01-674-1467). 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.

NSN
NIIN

(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 Code (CAGEC) is a 5-digit numeric 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, 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.

(3) Stock Number Column. This column lists the NSN for the associated part number and manufacturer identified in the PART NUMBER and CAGEC 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.

B-5. Special Information.

Usable on Code. Not Applicable.

B-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.

b. When National Stock Number or Part Number is Known.

(1) First. Using the Index of National Stock Numbers and Part Numbers, find the pertinent National Stock Number or Part Number. The NSN index is in National Item Identification Number (NIIN) sequence (see 4.a.(1)). The part numbers in the Part Number index are listed in ascending alphanumeric sequence (see 4.b.). Both indexes cross-reference you to the illustration figure and item number of the item you are looking for.

(2) Second. After finding 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.

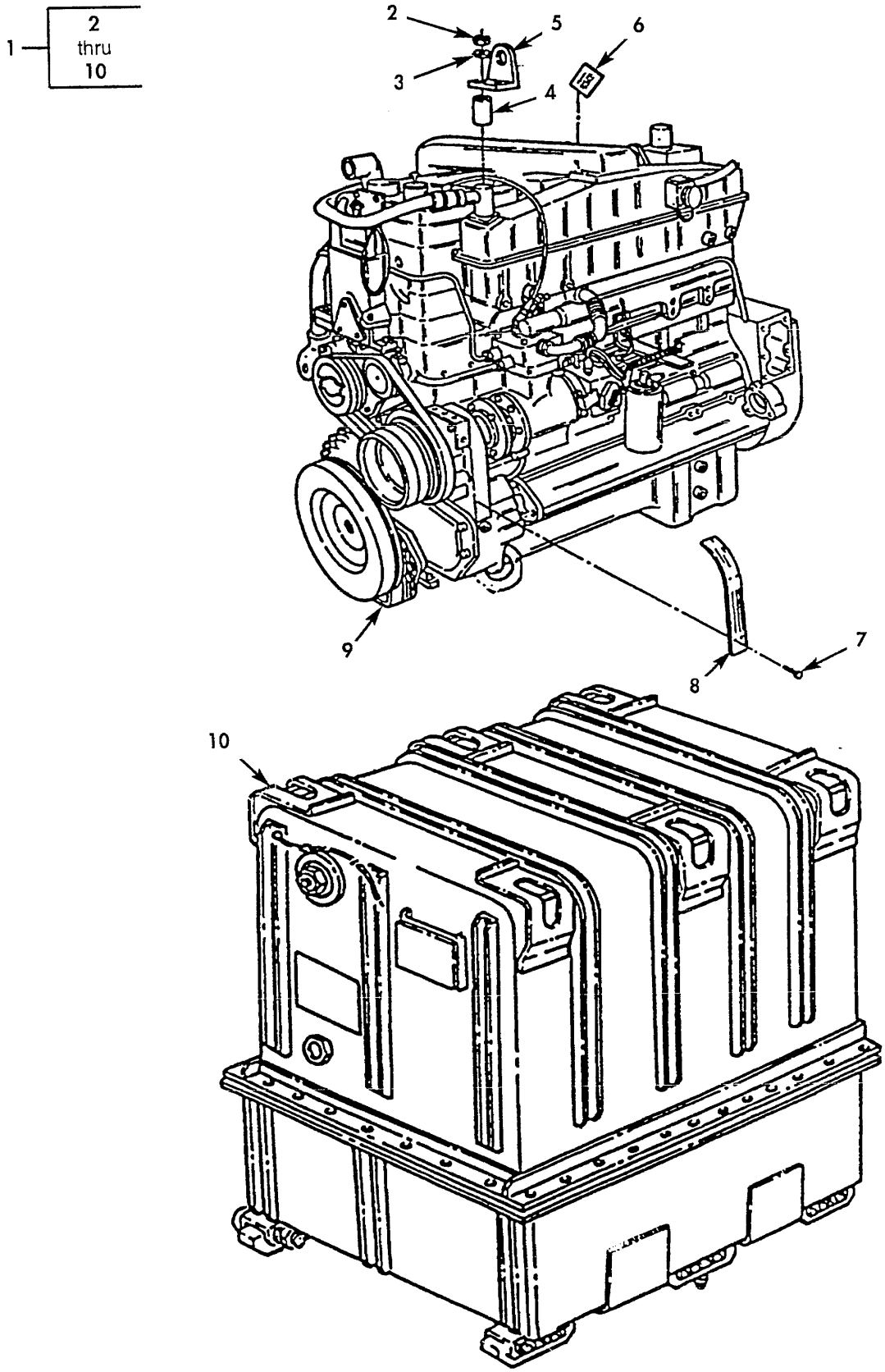


Figure 1. Dressed Engine and Container.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 01 ENGINE	
					GROUP 0100 ENGINE ASSEMBLY	
					FIG. 1 DRESSED ENGINE AND CONTAINER	
1	PAFHH	2815014381517	19207	57K3603	ENGINE, DIESEL DRESSED, W/CONTAINER, M915A1, BIG CAM III	1
1	PAFHH	2815014373901	19207	57K3602	ENGINE, DIESEL DRESSED, W/CONTAINER, M915, BIG CAM I	1
2	PAOZZ	5310011446115	75078	001094	.NUT, PLAIN, CONE SEAT	4
3	PAOZZ	5310005845272	96906	MS35338-48	.WASHER, LOCK	4
4	PAOZZ	5365011475030	75078	001234	.SPACER, SLEEVE	4
5	PAOZZ	5342004042946	15434	170226	.BRACKET, ENGINE LIFT	2
6	XBOZZ		15434	3003480	.LABEL M915	1
7	PAOZZ	5305008046318	15434	S-2286	.SCREW	5
8	PAOZZ	7690010946720	15434	3045551	.MARKER, IDENTIFICATI M915 BIG CAM I	1
8	PAOZZ	9905011470933	15434	3027282	.PLATE, IDENTIFICATIO M915A1 BIG CAM III	1
9	PAFHH	2815011422745	19207	11669835	.ENGINE, DIESEL DRESSED, W/O CONTAINER, M915A1	1
9	PAFHH	2815010843447	34623	MA87-21005	.ENGINE, DIESEL DRESSED, W/O CONTAINER, M915	1
10	PAFFF	8145014458271	19207	12389942-1	.SHIPPING AND STORAG WITHOUT ENGINE	1

END OF FIGURE

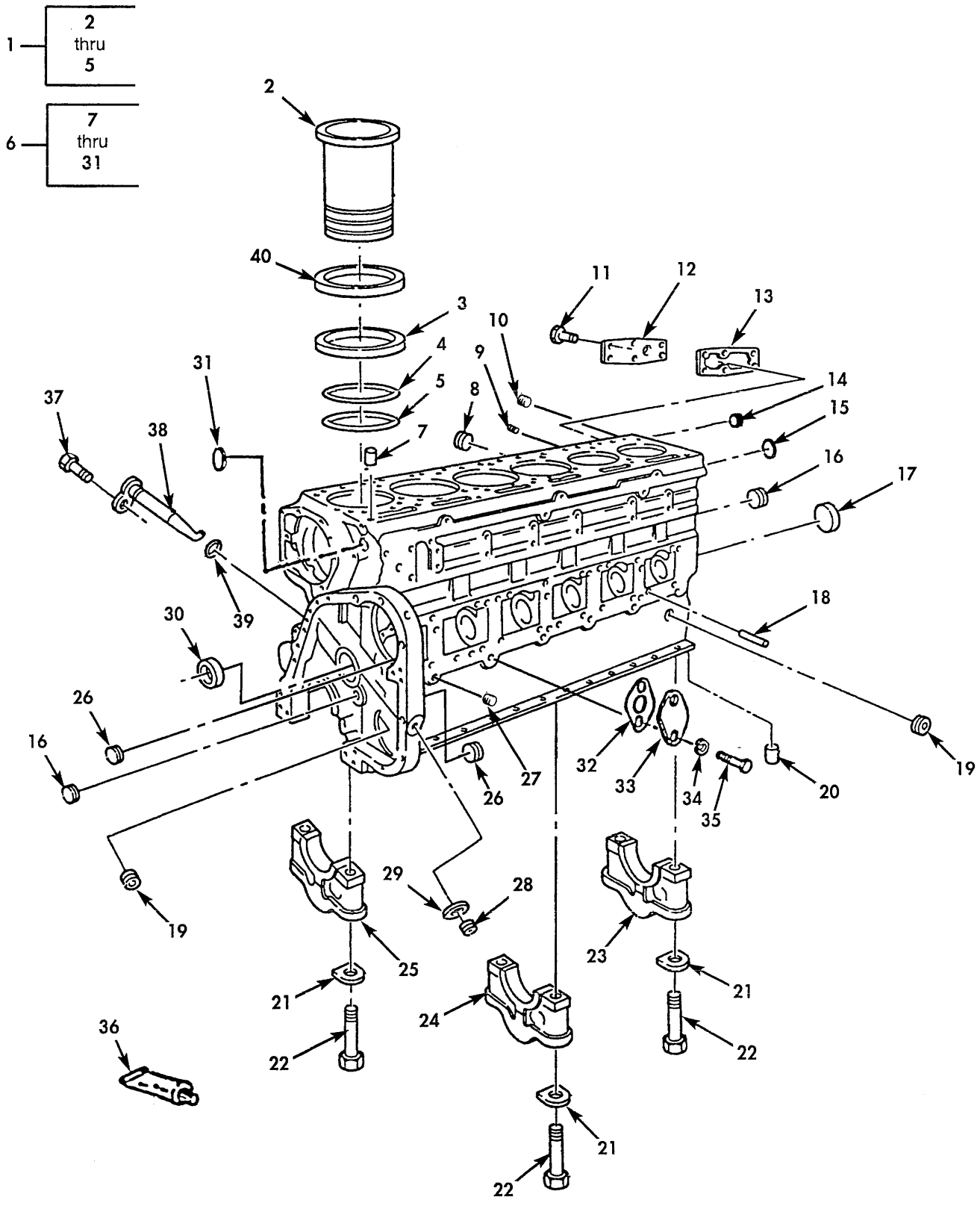
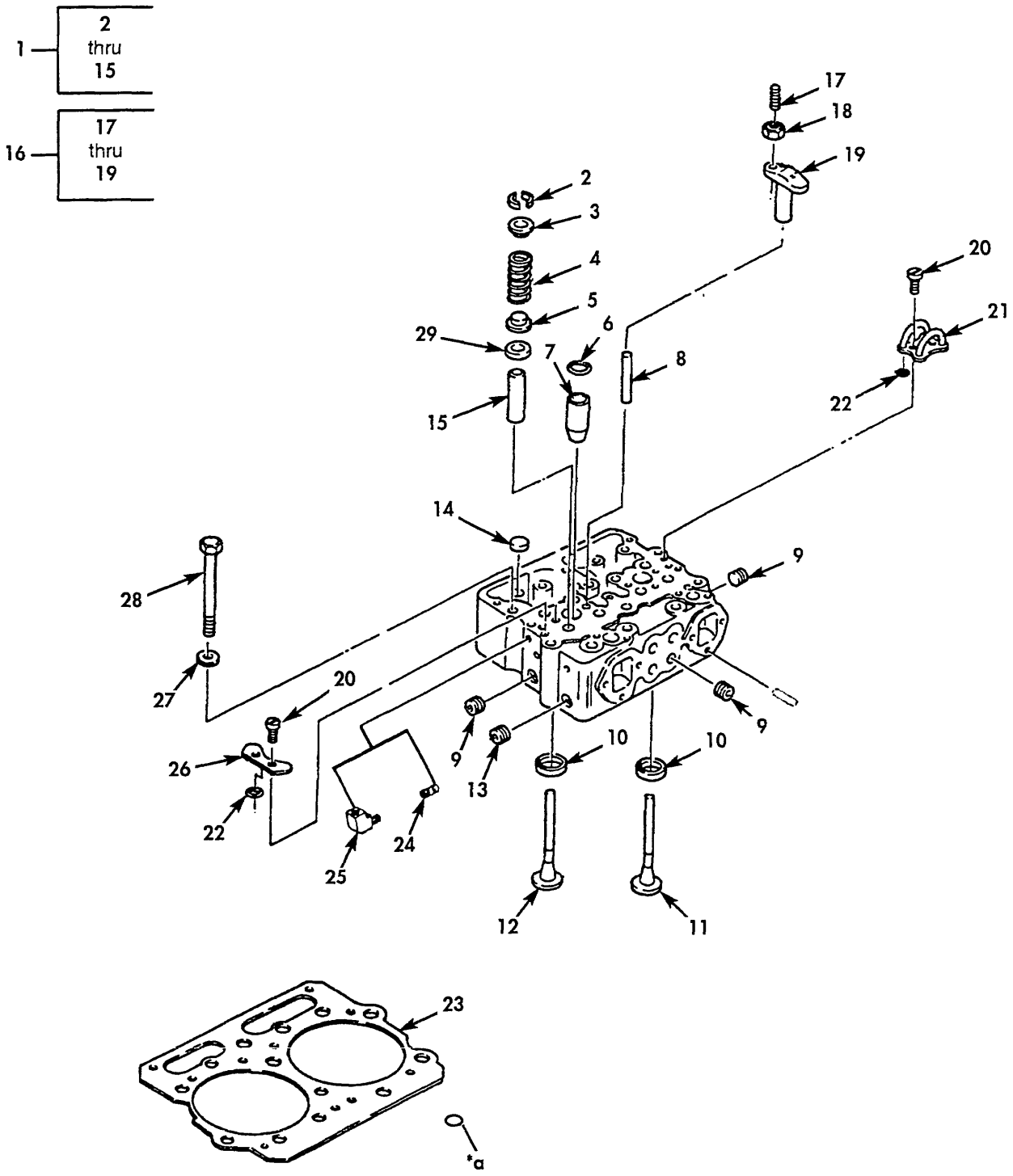


Figure 2. Engine Block.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 0101 CRANKCASE, BLOCK, CYLINDER HEAD	
					FIG. 2 ENGINE BLOCK	
1	PAHHH	2815000117786	15434	3801826	CYLINDER SLEEVE ASSEMBLY	6
2	XBHZZ		15434	213740	.CYLINDER SLEEVE	1
3	PCHZZ	5330000644399	15434	215090	.GASKET	1
4	PCHZZ	5330010490466	15434	3008998	.PACKING BLACK	1
5	PCHZZ	5331000581767	15434	149105PC183049	.O-RING RED	1
6	PAHHH	2815011058768	15434	3013909	ENGINE BLOCK, DIESEL M915	1
6	PAHHH	2815011419370	15434	3801310	ENGINE BLOCK, DIESEL M915A1	1
7	PAHZZ	5315002817610	15434	68445	.PIN, GROOVED, HEADLES HEAD TO BLOCK.	6
8	PAHZZ	4730012147081	15434	3008469	.PLUG, PIPE 3/4"	1
9	PAHZZ	4730000819618	79470	C3159X2	.PLUG, PIPE 1/8-27 NPTF	7
10	PAHZZ	4730009541281	02978	MS49005-4	.PLUG, PIPE 1/4-18 NPTF	3
11	PAHZZ	5305011129021	15434	3013904	.SCREW WITH CAPTIVE WASHER, 1/4-20 X 5/8	6
12	PAHZZ	5340007990843	15434	132019	.COVER, ACCESS WATER HEADER	1
13	PFHZZ	5330005372382	15434	70089-1	.GASKET WATER HEADER COVER PART OF KIT P/N 3801235	1
14	PAHZZ	4730002030549	15434	S-966E	.PLUG, PIPE 1-1/2 NPT	1
15	PAHZZ	5340000501600	96906	MS35648-8	.PLUG, EXPANSION 1-1/8"	1
16	PAHZZ	4730011615115	15434	3013786	.PLUG, PIPE 3/8 NPT	6
17	PAHZZ	5340011459362	15434	3011952	.CAP, PROTECTIVE, DUST CAM HOLE	1
18	PAHZZ	5315000141195	15434	68585	.PIN, STRAIGHT, HEADLE CAM FOLLOWER	6
19	PAHZZ	4730002212139	96906	MS20913-4S	.PLUG, PIPE 1/2-14 NPT	2
20	PAHZZ	5315005329388	64104	B2568	.PIN, STRAIGHT, HEADLE REAR MAIN BEARING CAP TO BLOCK	2
21	PAHZZ	5310003561447	15434	3009213	.WASHER, LOCK BLOCK, DIESEL ENGINE, M915 ONLY	14
21	PAHZZ	5310000821882	15434	140218	.WASHER, FLAT BLOCK, DIESEL ENGINE. M915A1 ONLY	14
22	PAHZZ	5306008042468	15434	105953	.BOLT, MACHINE M915 ONLY	14
22	PAHZZ	5305011792380	15434	208346	.SCREW, CAP, HEXAGON H M915A1 ONLY	14
23	PAHZZ	2815004848360	15434	42647	.CAP, MAIN BEARING NUMBER 7, BLOCK, DIESEL ENGINE. M915 ONLY	1
23	PAHZZ	3130011461228	15434	3008049	.CAP, PILLOW BLOCK NUMBER 7. M915A1 ONLY	1
24	PAHZZ	3130004089041	15434	42646	.CAP, PILLOW BLOCK MAIN 2, 4 AND 6, BLOCK, DIESEL ENGINE. M915 ONLY	3
24	PAHZZ	3130011464504	15434	3008048	.CAP, BEARING NUMBER 2, 4 AND 6. M915A1 ONLY	3
25	PAHZZ	2815004848359	15434	42645	.CAP, MAIN BEARING MAIN 1, 3 AND 5, BLOCK, DIESEL ENGINE. M915 ONLY	3
25	PAHZZ	3130011461150	15434	3008047	.CAP, PILLOW BLOCK NUMBER 1, 3 AND 5. M915A1 ONLY	3
26	PAHZZ	4730008018186	15434	S-915-A	.PLUG, PIPE	2
27	PAHZZ	4730000189566	15434	S911B	PLUG, PIPE 1/8-27 NPT	2
28	PAHZZ	5365011506257	15434	210884	.PLUG, MACHINE THREAD HEXAGON HEAD, 7/8-18 UNS-2A	1
29	PAHZZ	5310001975304	15434	66292	.WASHER, FLAT	1
30	PFHZZ	3120010796823	15434	3011951	.BEARING, SLEEVE CAMSHAFT, NUMBER 7.	1

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					M915A1 PART OF KIT P/N 3801106	
30	PFHZZ	3120012088102	15434	3028075	.BUSHING, CAMSHAFT, NUMBER 1, 2, 4 AND 6. M915A1 PART OF KIT P/N 3801106.	4
30	PFHZZ	3120022088103	15434	3028269	.BUSHING, CAMSHAFT, NUMBER 3 AND 5. M915A1 PART OF KIT P/N 3801106	2
30	PFHZZ	3120010796823	15434	3011951	.BEARING, SLEEVE CAMSHAFT M915	7
31	PAHZZ	5340002765847	15434	S719	.PLUG, EXPANSION	1
32	PAHZZ	5330001717267	15434	67963	GASKET	1
33	PFHZZ	4730004042909	15434	13264800	FLANGE, PIPE, BLIND	1
34	PAHZZ	5310002617340	15434	S604	WASHER, LOCK 3/8	2
35	PAHZZ	5305005466698	15434	S129	SCREW, CAP, HEXAGON H	2
36	PCHZZ	8030011478661	15434	3801048	SEALING COMPOUND (3 OZ TUBE)	1
37	PAHZZ	5305011446204	34623	5731317	SCREW , SELF-LOCKING	6
38	PAHZZ	2910011467955	15434	3013591	NOZZLE, PISTON COOLI	6
39	PCHZZ	5331011455377	15434	3007442	O-RING COOLING NOZZLE PART OF KIT P/N 3801235	6
40	PBHZZ	5365011479802	15434	3019955	GASKET CYLINDER LINER, 0.007	6
40	PBHZZ	5365004880799	15434	3019956	SPACER, RING CYLINDER LINER, 0.008	6
40	PBHZZ	5365011472495	15434	3019960	SHIM CYLINDER LINER, 0.062	6
40	PBHZZ	5365011472497	15434	3019958	SPACER, RING CYLINDER LINER, 0.020	6
40	PBHZZ	5365011472496	15434	3019957	SHIM CYLINDER LINER, 0.009	6
40	PBHZZ	5365011488353	15434	3019959	SHIM CYLINDER LINER, 0.031	6

END OF FIGURE



* **a** PART OF ITEM 23

Figure 3. Cylinder Head Assembly.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 0101 CRANKCASE, BLOCK, CYLINDER HEAD	
					FIG. 3 CYLINDER HEAD ASSEMBLY	
1	PAFFD	2815010858282	15434	3041993	CYLINDER HEAD, DIESE	3
2	PAFZZ	2805002939699	77220	H231	.LOCK, VALVE SPRING R	16
3	PAFZZ	5340009333009	15434	170296	.SEAT, HELICAL COMPRE	8
4	PAFZZ	5360000099270	15434	211999	.SPRING, HELICAL, COMP	8
5	PAFZZ	5340006326239	15434	172034	.SEAT, HELICAL COMPRE	8
6	PCFZZ	5331010724436	15434	3007759	.O-RING PART OF KIT P/N 3804280	2
7	PAFZZ	2910000857442	15434	147056	.SLEEVE, COOLING, FUEL HEAD M915 ONLY	2
7	PAFZZ	2910011460048	15434	3011934	.SLEEVE, COOLING, FUEL M915A1 ONLY	2
8	PAFZZ	5315008665015	15434	123558	.PIN, STRAIGHT, HEADLE VALVE CROSSHEAD	4
9	PAFZZ	5340010870681	15434	213395	.PLUG, EXPANSION 1.010-1.012	6
10	PAFZZ	2815000857434	15434	3017759	.INSERT, ENGINE VALVE INTAKE AND EXHAUST	8
10	PAFZZ	2815001320240	15434	3014622	.INSERT, ENGINE VALVE 0.010 OVERSIZE	V
10	PAFZZ	2815011271060	15434	3014623	.INSERT, VALVE SEAT 0.020 OVERSIZE	V
10	PAFZZ	2815011273597	15434	3014624	.INSERT, ENGINE VALVE 0.030 OVERSIZE	V
10	PAFZZ	2815011273598	15434	3014625	.INSERT, VALVE SEAT 0.040 OVERSIZE	V
11	XDFZZ		15434	3000926	.VALVE, POPPET, ENGINE INTAKE M915 ONLY	4
11	PAFZZ	2815013542702	15434	3803512	.VALVE, POPPET, ENGINE INTAKE M915A1 ONLY	4
12	PAFZZ	2815009625623	15434	3803524	.VALVE, POPPET, ENGINE EXHAUST	4
13	PAFZZ	5340010870682	15434	213394	.PLUG, EXPANSION 3/4	1
14	PAFZZ	5340010866193	15434	216524	.PLUG, EXPANSION 1-1/4	2
15	PAFZZ	2815010852618	15434	3006456	.GUIDE, VALVE STEM INTAKE AND EXHAUST STANDARD	8
15	XDFZZ		15434	3006457	.GUIDE, VALVE STEM 0.010 OVERSIZE	V
15	XDFZZ		15434	3006458	.GUIDE, VALVE STEM 0.020 OVERSIZE	V
16	PAFZZ	2815011591789	15434	3030038	VALVE, CROSSHEAD ASS INTAKE AND EXHAUST	12
17	PAFZZ	5305000624378	15434	147389	.SETSCREW 3/8-24 UNF-2A THREAD	1
18	PAFZZ	5310004263990	15434	203131	.NUT, CROSS HD	1
19	PAFZZ	2815010853733	75078	011573	.CROSSHEAD, VALVE	1
20	PAFZZ	5305004776769	15434	70772	SCREW, ASSEMBLED WAS 1/4-20 X 1/2	12
21	PAFZZ	2910009283505	15434	147100	CROSSOVER, FUEL	2
22	PCFZZ	5331001438485	15434	131026	O-RING PART OF KIT P/N 3804280 PART OF KIT P/N 3804275	12
23	PAFZZ	5330010805021	15434	3076189	GASKET CYLINDER HEAD STANDARD PART OF KIT P/N 3804280 PART OF KIT P/N 3804275	3
23	XDFZZ		15434	3040180	GASKET, CYLINDER HEA 0.010-0.020 OVERSIZE	3
24	PAFZZ	4730000189566	15434	S-911-B	PLUG, PIPE 1/8-27 NPT	10
25	PAFZZ	4730004441710	15434	181213	ELBOW, PIPE TO TUBE FUEL LINE TO HEAD	2
26	PAFZZ	2815011464164	15434	135308	PLATE, FUEL CROSSOVE	2
27	PAFZZ	5310002858833	15434	538174	WASHER, FLAT 0.708-0.710	36
28	PAFZZ	5305011458379	15434	3013623	SCREW, CAP, HEXAGON H	36

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
29	PAFZZ		15434	68803-A	VALVE SPRING SPACER V	

END OF FIGURE

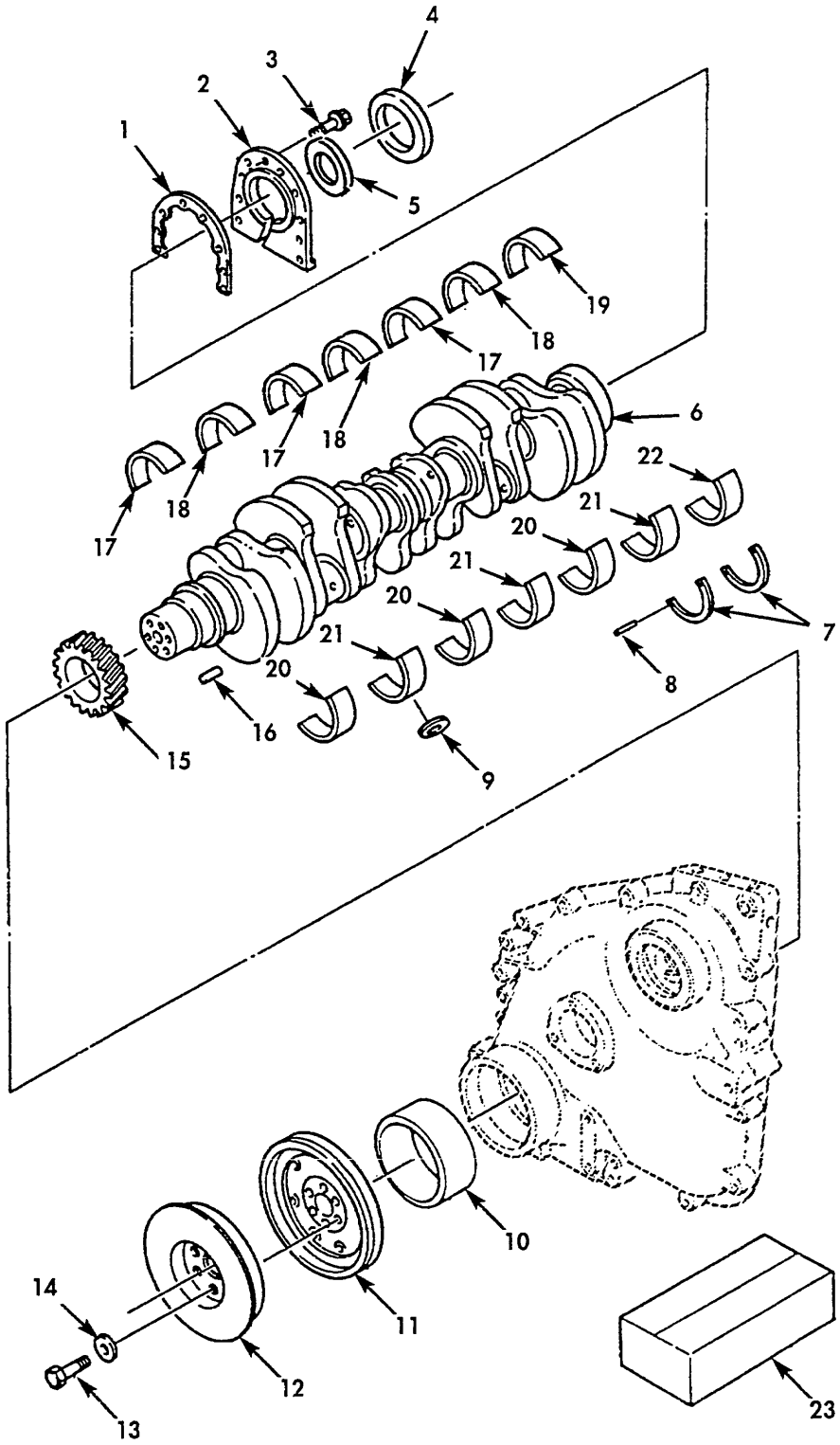


Figure 4. Crankshaft Assembly.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 0102 CRANKSHAFT	
					FIG. 4 CRANKSHAFT ASSEMBLY	
1	PCFZZ	5330003612955	15434	3067616	GASKET PART OF KIT P/N 3801235 V	
2	PAHZZ	2990011202883	15434	216165	COVER, REAR CAMSHAFT M915 ONLY.....	1
2	PAFZZ	2815011465925	15434	209919	COVER, TIMING GEAR, I CAMSHAFT ..... M915A1 ONLY	1
3	PAFZZ	5305011306100	15434	3010594	SCREW, CAP, HEXAGON H WITH CAPTIVE ..... WASHER, 3/8-24 X 1.500	8
4	PCHZZ	5330010866112	15434	3006738	GASKET M915 ONLY	1
4	PAFZZ	5330000050858	01212	M39807	SEAL REAR CAMSHAFT OIL M915A1 ONLY ..... PART OF KIT P/N 3801235	1
5	PCHZZ	5331004209624	15434	137075	O-RING REAR CAMSHAFT OIL SEAL.....	1
6	PAHZH	2815013034224	15434	3608833	CRANKSHAFT, ENGINE.....	1
7	PAHZZ	3120012147779	15434	3019218	BEARING, WASHER, THRU STANDARD	4
7	XDHZZ		15434	157281	BEARING, WASHER, THRU 0.010 OVERSIZE. V	
7	XDHZZ		15434	157282	BEARING, WASHER, THRU 0.020 OVERSIZE. V	
8	PAHZZ	5315010584551	15434	202903	PIN STRAIGHT HEXAGO 0.219 X 0.5475-..... 0.5775	2
9	PAHZZ	5365004286201	15434	60575	SPACER, RING.....	7
10	PAHZZ	5330000050856	15434	3006736	SEAL PART OF KIT P/N 3801235.....	1
11	PAFZZ	3020010774411	15434	211918	PULLEY, GROOVE.....	1
12	PAFZZ	2815010791632	15434	21732300	DAMPENER, VIBRATION	1
13	PAFZZ	5305007959336	15434	204165	SCREW, CAP 1-5/8 LONG	6
14	PAFZZ	5310000818500	15434	127316	WASHER, RECESSED.....	6
15	PAHZZ	3020010772229	15434	215965	GEAR, HELICAL M915 ONLY	1
15	PAFZZ	3020011460107	15434	3014614	GEAR, HELICAL M915A1 ONLY	1
16	PAFZZ	5315010796740	15434	210179	KEY, MACHINE GEAR TO CRANKSHAFT.....	1
17	PAHZZ	3120003496444	15434	44383	BEARING HALF, SLEEVE NUMBER 1, 3 AND..... 5 UPPER PART OF KIT P/N 3801260	3
18	XDHZZ		15434	195210	BEARING HALF, SLEEVE NUMBER 2, 4 AND..... 6 UPPER PART OF KIT P/N 3801260	3
19	PAHZZ	3120000905504	15434	44387	BEARING HALF, SLEEVE NUMBER 7 UPPER ..... PART OF KIT P/N 3801260	1
20	PAHZF	3120006951232	15434	3019180	BEARING HALF, SLEEVE NUMBER 1, 3 AND..... 5 LOWER PART OF KIT P/N 3801260	3
21	PAHZZ	3120000050602	01212	1962CPA	BEARING HALF, SLEEVE NUMBER 2, 4 AND..... 6 LOWER PART OF KIT P/N 3801260	3
22	PAHZZ	3120005931507	15434	3019204	BEARING HALF, SLEEVE NUMBER 7 LOWER ..... PART OF KIT P/N 3801260.....	1
23	PFHZZ	3120002195461	15434	AR07110	BEARING HALF SET, SL STANDARD	1
23	PFHZZ	3120011439547	15434	3801261	BEARING HALF SET, SL 0.010 UNDERSIZE.....	1
23	PBHZZ	3120011459132	15434	3801263	BEARING HALF SET, SL 0.030 UNDERSIZE.....	1
23	PFHZZ	3120011937083	01212	5116M40	BEARING SET, SLEEVE 0.040 UNDERSIZE.	1
23	PAHZZ	3120011448882	15434	3801262	BEARING HALF SET, SL 0.020 UNDERSIZE.....	1

END OF FIGURE

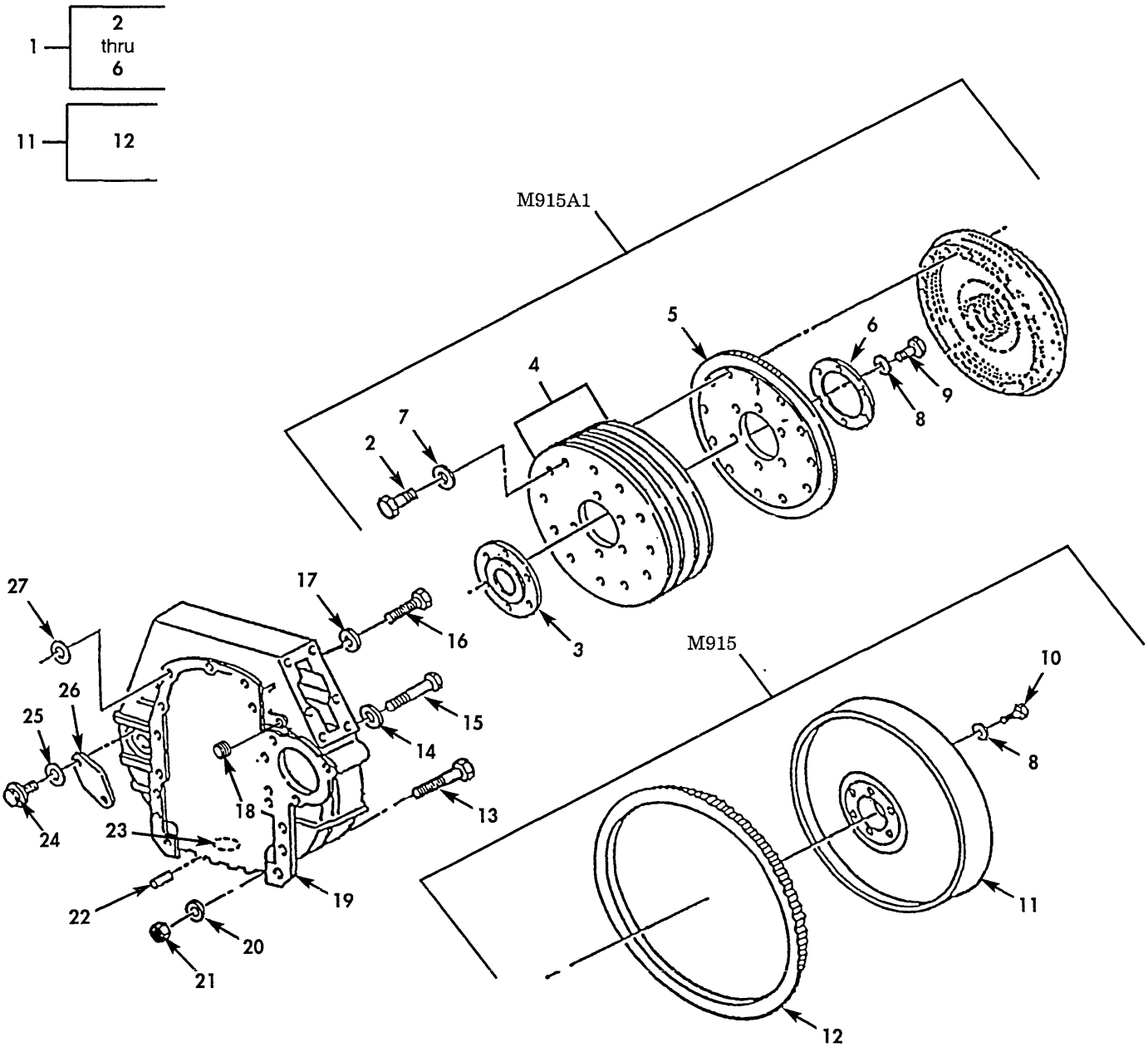


Figure 5. Flexdisk, Ring Gear, and Housing.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 0103 FLYWHEEL ASSEMBLY	
					FIG. 5 FLEXDISK, RING GEAR, AND HOUSING	
1	XDFZZ		15434	3031751	DISC, FLEX ASSEMBLY USE ONLY FOR INTERFACING BIG CAM III ENG W/ ALLISON HT-750 CRD TRANSMISSION	1
2	PAFZZ	5305002693240	80204	B1821BH038F150N	.SCREW, CAP, HEXAGON H 3/8-24 X 1.50 M915A1 ONLY	12
3	PBFZZ	3040011460028	15434	3031752	.PLATE, RETAINING, SHA M915A1 ONLY	1
4	XDFZZ		15434	3031750	.DISKS, FLEXPLATE USE ONLY FOR INTERFACING BIG CAM III ENG W/ ALLISON HT-750 CRD TRANSMISSION	1
5	PBFZZ	2815011460102	15434	3031749	.FLYWHEEL, ENGINE M915A1 ONLY	1
6	PBFZZ	3120011478118	15434	3031753	.BEARING, WASHER, THRU M915A1 ONLY	1
7	PAFZZ	5310000806004	96906	MS27183-14	WASHER, FLAT 3/8 M915A1 ONLY	12
8	PAFZZ	5310001344171	15434	200861	WASHER, FLAT	6
9	PAFZZ	5305011129698	15434	180175	SCREW, CAP, HEXAGON H 1.44 LONG M915A1 ONLY	6
10	PAFZZ	5305007959336	15434	204165	SCREW, CAP M915 ONLY	6
11	PAFFF	2815010851881	15434	3021660	FLYWHEEL, ENGINE M915 ONLY	1
12	PAFZZ	3020005285053	15434	4797	.GEAR, SPUR M915 ONLY	1
13	PAFZZ	5305000914009	15434	106289	SCREW, CAP, HEXAGON H FLYWHEEL HS'G TO CRANKCASE M915 ONLY	2
14	PAFZZ	5310000818500	15434	127316	WASHER, RECESSED 0.630-0.650 X 1.185-1.195	9
15	PAFZZ	5305011458380	15434	S-189-B	SCREW, CAP, HEXAGON H	9
16	PAFZZ	5305011146386	15434	3012483	SCREW, CAP, HEXAGON H 1/2-13 X 2.00 FLYWHEEL HS'G TO BLOCK M915 ONLY	4
17	PAFZZ	5310001344168	15434	S601	WASHER, FLAT FLYWHEEL HS'G TO BLOCK M915 ONLY	1
18	PBFZZ	4730011060202	15434	3008469	PLUG, PIPE 3/4 NPT FLYWHEEL HS'G MOUNTED M915 ONLY	1
19	PAFZZ	2815011605820	15434	3016637	HOUSING, FLYWHEEL M915 ONLY	1
19	PBFZZ	2815011410845	15434	3036005	HOUSING, FLYWHEEL M915A1 ONLY	1
20	PAFZZ	5310005845272	96906	MS35338-48	WASHER, LOCK 3/8 FLYWHEEL HS'G TO BLOCK M915 ONLY	2
21	PAFZZ	5310004693998	15434	S200	NUT, PLAIN, HEXAGON FLYWHEEL HS'G TO BLOCK M915 ONLY	2
22	PAFZZ	5315000141284	24617	141284	PIN, STRAIGHT, HEADLE FLYWHEEL HS'G MOUNTING	2
23	PAFZZ	4730000189566	15434	S911B	PLUG, PIPE FLYWHEEL HS'G MOUNTED, 1/ 4-NPT, M915 ONLY	1
24	PAFZZ	5305011474025	15434	3001646	SCREW, TAPPING FLYWHEEL INDEX HOLE COVER 1/4-20 X 5/8	2
25	PAFZZ	5330010826985	15434	3021735	GASKET FLYWHEEL INDEX HOLE COVER, M915 ONLY	2
26	PBFZZ	5340011228002	15434	70657	COVER, ACCESS FLYWHEEL INDEX HOLE	1
27	PCFZZ	5330004042920	15434	172648	PACKING, PREFORMED M915 ONLY	11

END OF FIGURE

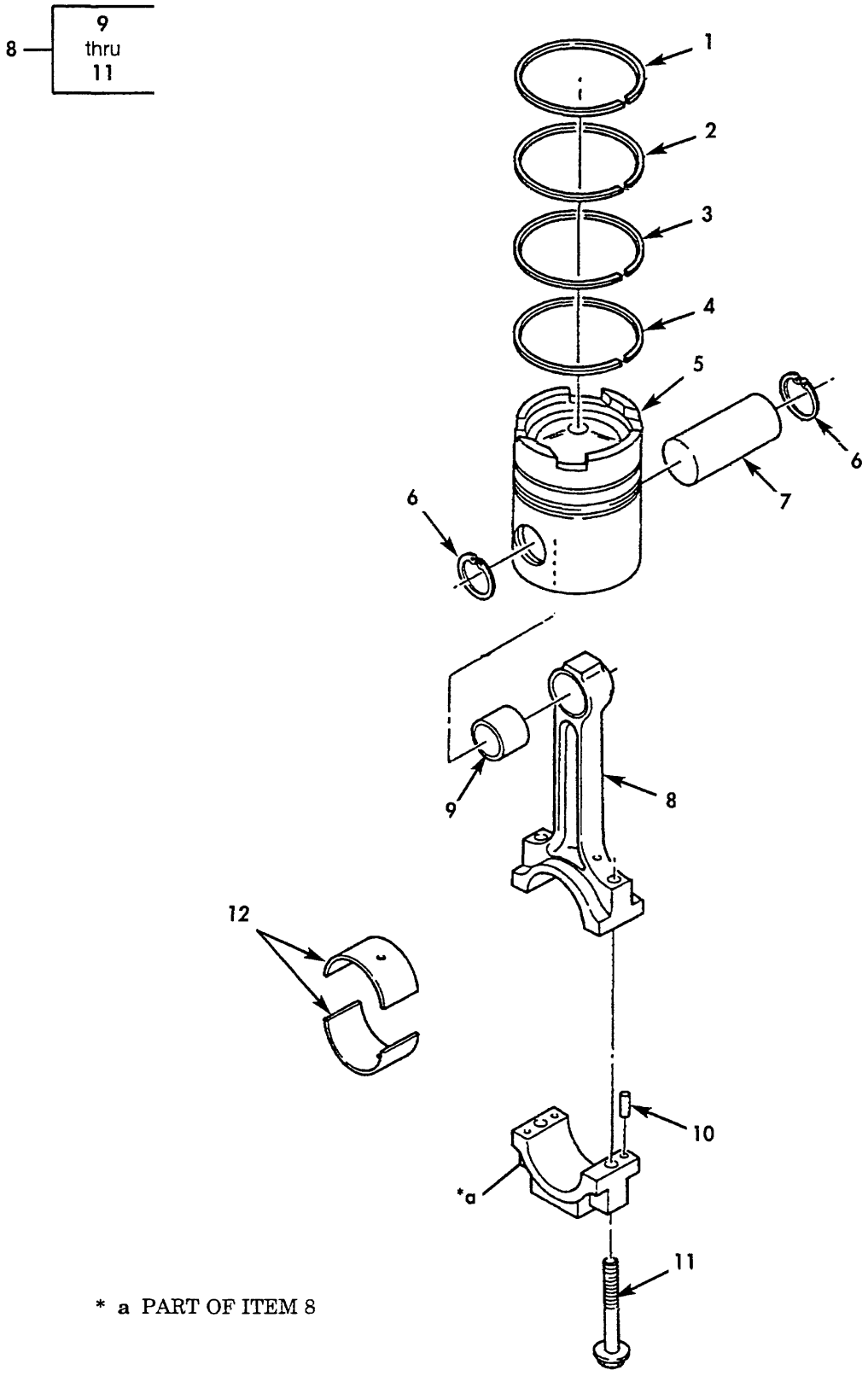
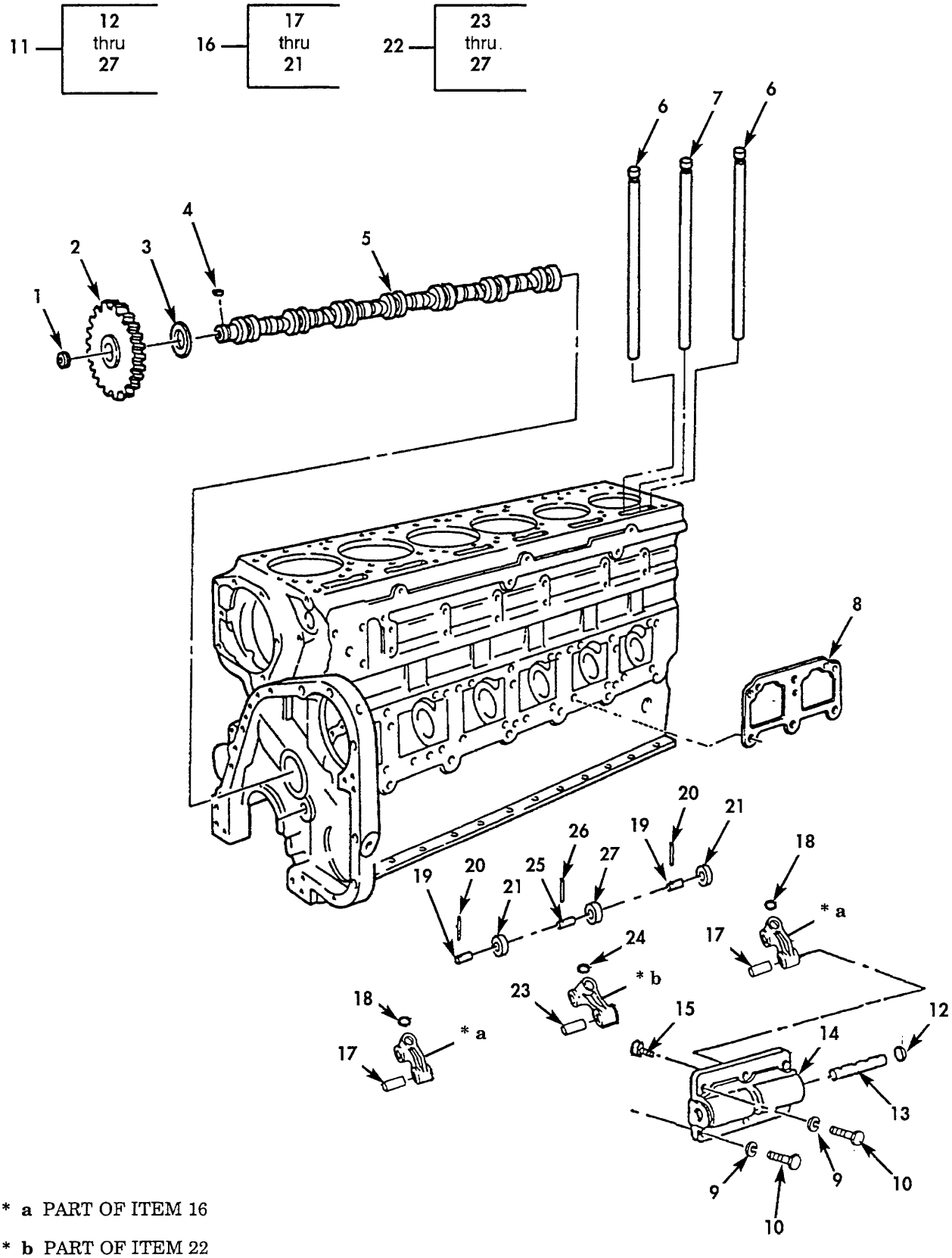


Figure 6. Piston and Connecting Rod Assembly.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 0104 PISTONS, CONNECTING RODS	
					FIG. 6 PISTON AND CONNECTING ROD ASSEMBLY	
1	PFHZZ	2815009944427	15434	3012331	RING, TOP PART OF KIT P/N 3801056	6
2	PFHZZ	2815012416580	15434	301233200	RING, PISTON PART OF KIT P/N 3801056	6
3	PFHZZ	2815012416581	15434	214730	RING, PISTON PART OF KIT P/N 3801056	6
4	PFHZZ	2815009944429	15434	218732	RING, PISTON, PART OF KIT P/N 3801056	6
5	PAHZZ	2815010771482	15434	3051555	PISTON, INTERNAL COM M915 ONLY	6
5	PAHZZ	2815012103426	15434	3028685	PISTON, INTERNAL COM M915A1 ONLY PART OF KIT P/N 3801058	6
6	PAHZZ	5325012414318	15434	175755	RING, RETAINING PISTON PIN (OLD) M915 ONLY	12
6	PBHZZ	5325008042784	96906	MS16625-1200	RING, RETAINING PISTON PIN PART OF KIT P/N 3801058	12
7	PFHZZ	2815004804347	15434	191970	PIN, PISTON PART OF KIT P/N 3801058	6
8	PAHHZ	2815010864508	15434	3013930	CONNECTING ROD, PIST ASSEMBLY	6
9	PAHZZ	5365001320273	15434	187420	.BUSHING, PISTON PIN	1
10	PBHZZ	2815011240232	15434	70550	.PIN, PISTON CONNECTING ROD 5/16 X 1/2	2
11	PAHZZ	5306010797027	15434	219153	.BOLT, MACHINE	2
12	PAHZZ	3120011554442	15434	214951	BEARING, SLEEVE 0.010 UNDERSIZE	12
12	PAHZZ	3120011573316	15434	214952	BEARING, SLEEVE 0.020 UNDERSIZE	12
12	PAHZZ	3120010873004	15434	214950	BEARING STANDARD	12
12	PAHZZ	3120011558707	01212	3725CP-30	BEARING, SLEEVE .030 UNDERSIZE	12

END OF FIGURE



* a PART OF ITEM 16

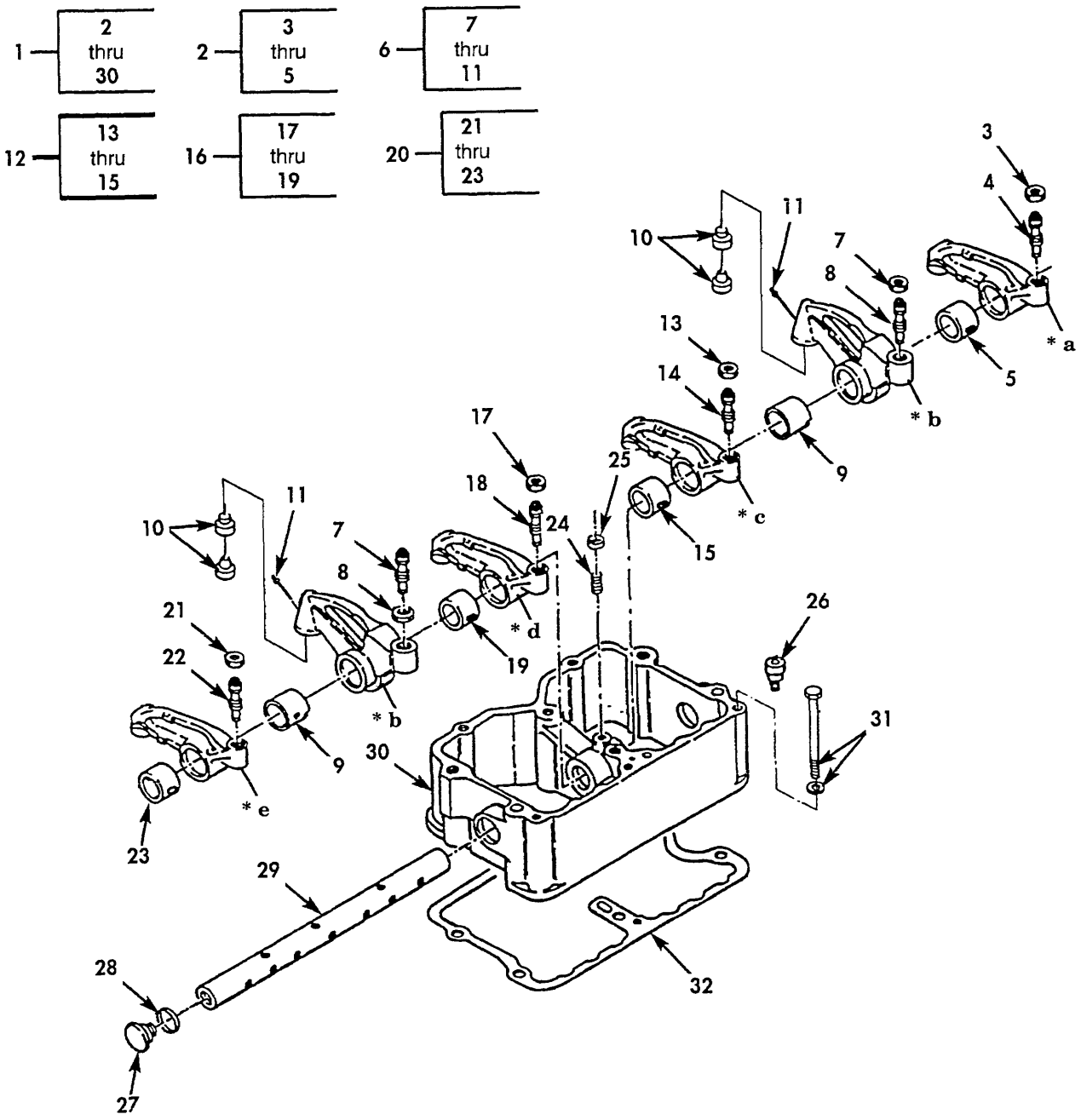
* b PART OF ITEM 22

Figure 7. Camshaft Assembly and Followers.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 0105 VALVES, CAMSHAFTS AND TIMING SYSTEM	
					FIG. 7 CAMSHAFT ASSEMBLY AND FOLLOWERS	
1	PAHZZ	5340004042944	15434	68193	PLUG, VENT CAMSHAFT ORIFICE, SPECIAL	1
2	PAHZZ	3020004249995	15434	215966	GEAR, CAMSHAFT M915 ONLY	1
2	PAHZZ	3020011458568	15434	3002901	GEAR, HELICAL M915A1 ONLY	1
3	PAHZZ	3120010798194	15434	215233	BEARING, WASHER, THRU M915 ONLY	1
3	XDHZZ		15434	3021602	BEARING, WASHER, THRU M915A1 ONLY	1
4	PAHZZ	5315010866187	15434	3012328	KEY, WOODRUFF GEAR TO CAMSHAFT, M915 ONLY	1
4	PAHZZ	5315011456080	15434	3021596	KEY, WOODRUFF GEAR TO CAMSHAFT, M915A1 ONLY	1
5	PAHZZ	2815010793380	15434	3801047	CAMSHAFT, ENGINE M915 ONLY	1
5	PAHZZ	2815011461049	15434	3049024	CAMSHAFT, ENGINE M915A1 ONLY	1
6	PAHZZ	2815010855190	15434	217929	PUSH ROD, ENGINE POP INTAKE AND EXHAUST, CAM FOLLOWER ASSY, M915 ONLY	12
6	PAFZZ	2815011461041	15434	3012462	PUSH ROD, ENGINE POP INTAKE AND EXHAUST, CAM FOLLOWER ASSY, M915A1 ONLY	12
7	PAFZZ	2815010852615	15434	3032681	PUSH ROD, ENGINE POP	6
8	PCHZZ	5330011453983	15434	3074401	GASKET CAM FOLLOWER HOUSING, STANDARD, M915A1 ONLY PART OF KIT P/N 3801235	3
8	PCHZZ	5330011453984	15434	3074404	GASKET CAM FOLLOWER HOUSING, 0.027-0.033, PART OF KIT P/N 3801235	V
8	PFHZZ	5330011469928	15434	3074403	GASKET CAM FOLLOWER HOUSING, 0.020-0.024 PART OF KIT P/N 3801235	V
8	PFHZZ	5330011467172	15434	3074400	GASKET CAM FOLLOWER HOUSING, PRINT-O-SEAL, 0.014-0.020, PART OF KIT P/N 3801235	V
8	PCHZZ	5330011469775	15434	3074402	GASKET CAM FOLLOWER HOUSING, 0.014-0.020 PART OF KIT P/N 3801235	V
8	PAHZZ	5330010665349	15434	3011878	GASKET CAM FOLLOWER HOUSING, STANDARD, M915 ONLY PART OF KIT P/N 3018762	3
9	PAHZZ	5310002617340	15434	S604	WASHER, LOCK 3/8	18
10	PAHZZ	5305005466698	15434	S-129	SCREW, CAP, HEXAGON H	18
11	PFHZZ	2815011663415	15434	3066796	HOUSING ASSEMBLY, CA	3
12	PAHZZ	5340004850945	15434	175831	.PLUG, EXPANSION 3/4 INCH	2
13	PAHZZ	3040011460075	15434	3017031	.SHAFT, SHOULDERED CAM FOLLOWER ASSEMBLY	2
14	PBHZZ	2815011467039	15434	3016887	.COVER, ENGINE POPPET CAM FOLLOWER	1
15	PAHZZ	5305003391415	15434	69736	.SCREW, MACHINE SHAFT LOCKING, 5/16-18 UNC-2A CAM FOLLOWER	2
16	PAHZZ	2815011467914	15434	3036935	.ROCKER ARM, ENGINE P CAM FOLLOWER ASSY, INTAKE & EXHAUST	4
17	PFHZZ	3120006597808	15434	118378	..BEARING, SLEEVE CAM FOLLOWER ASSY, INTAKE & EXHAUST	4
18	PAHZZ	2815010486702	15434	213559	..SOCKET, CAM FOLLOWER INTAKE &	4

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					EXHAUST	
19	XBHZZ		15434	3002069	..PIN, STRAIGHT, HEADED CAM FOLLOWER	4
					ASSY, INTAKE & EXHAUST, M915 ONLY	
19	PAHZZ	5315012100616	15434	3013331	..PIN, STRAIGHT, HEADED CAM FOLLOWER	4
					ASSY, INTAKE & EXHAUST, M915A1 ONLY	
20	PAHZZ	5315007773544	15434	118939	..PIN, STRAIGHT, HEADLE CAM FOLLOWER	4
					ASSY, INTAKE & EXHAUST	
21	PAHZZ	3120012124472	15434	3036933	..ROLLER, LINEAR-ROTAR CAM FOLLOWER	4
					ASSY, INTAKE & EXHAUST	
22	PAHZZ	2910010869757	15434	3056569	.ROCKER ARM, ENGINE P CAM FOLLOWER	2
					ASSY, INJECTOR	
23	PFHZZ	3120007911440	15434	118377	..BEARING, SLEEVE CAM FOLLOWER ASSY,	2
					INJECTOR	
24	PAHZZ	2815005055119	15434	107738	..SOCKET, CAM FOLLOWER INJECTOR	2
25	XBHZZ		15434	219107	..PIN, STRAIGHT, HEADED CAM FOLLOWER	2
					ASSY, INJECTOR	
26	PAHZZ	5315007773544	15434	118939	..PIN, STRAIGHT, HEADLE CAM FOLLOWER	2
					ASSY, INJECTOR	
27	PFHZZ	3120010795451	15434	3036934	..ROLLER, LINEAR-ROTAR CAM FOLLOWER	2
					ASSY, INJECTOR	

END OF FIGURE



* **a** PART OF ITEM 2

* **b** PART OF ITEM 6

* **c** PART OF ITEM 12

* **d** PART OF ITEM 16

* **e** PART OF ITEM 20

Figure 8. Rocker Arm Assembly.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 0105 VALVES, CAMSHAFTS AND TIMING SYSTEM	
					FIG. 8 ROCKER ARM ASSEMBLY	
1	PAFFF	2815010852569	15434	3035961	HOUSING AND ROCKER ROCKER ARM ASSEMBLY	3
2	PAFZZ	2815010969198	15434	BM95161	.ROCKER ARM, ENGINE P EXHAUST	1
3	PAFZZ	5310007320560	96906	MS51968-14	..NUT, PLAIN, HEXAGON ROCKER ARM ADJUSTING SCREW, EXHAUST 1/2-20 UNF-2B R/H	1
4	PAFZZ	5305009473437	15434	168306	..SETSCREW ROCKER ARM, EXH, HEADLESS W/SLOT 1/2-20X2.045 UNF-3A R/H	1
5	PAFZZ	3120005893537	15434	140330	..BUSHING, SLEEVE ROCKER ARM EXHAUST	1
6	PAFZZ	2815000057431	15434	AR-2308	.LEVER, INJECTOR, FUEL	2
7	PAFZZ	5310007320560	96906	MS51968-14	..NUT, PLAIN, HEXAGON ROCKER ARM ADJUSTING SCREW, INJECTOR 1/2-20 UNF-2B R/H	1
8	PAFZZ	5305009473437	15434	168306	..SETSCREW ROCKER ARM, INJ, HEADLESS W/SLOT 1/2-20X2.045 UNF-3A R/H	1
9	PAFZZ	3120010795208	15434	218153	..BUSHING, SLEEVE ROCKER ARM INJECTOR	1
10	PAFZZ	5340004042940	15434	194037	..SEAT, BALL SOCKET ROCKER ARM INJECTOR	1
11	PAFZZ	5340002082083	75272	PC0625	..PLUG, EXPANSION SPECIAL	
12	PAFZZ	2815001955894	15434	BM95159	.ROCKER ARM, ENGINE P INTAKE	1
13	PAFZZ	5310007320560	96906	MS51968-14	..NUT, PLAIN, HEXAGON ROCKER ARM ADJUSTING SCREW, INTAKE 1/2-20 UNF-2B R/H	1
14	PAFZZ	5305009473437	15434	168306	..SETSCREW ROCKER ARM, INT, HEADLESS W/SLOT 1/2-20X2.045 UNF-3A R/H	1
15	PAFZZ	3120005893537	15434	140330	..BUSHING, SLEEVE ROCKER ARM INTAKE	1
16	PAFZZ	2815001955897	15434	BM95160	.ROCKER ARM, ENGINE P INTAKE	1
17	PAFZZ	5310007320560	96906	MS51968-14	..NUT, PLAIN, HEXAGON ROCKER ARM ADJUSTING SCREW, INTAKE 1/2-20 UNF-2B R/H	1
18	PAFZZ	5305009473437	15434	168306	..SETSCREW ROCKER ARM, INT, HEADLESS W/SLOT 1/2-20X2.045 UNF-3A R/H	1
19	PAFZZ	3120005893537	15434	140330	..BUSHING, SLEEVE ROCKER ARM INTAKE	1
20	PAFZZ	2815008517637	15434	BM96162	.ROCKER ARM, ENGINE P EXHAUST	1
21	PAFZZ	5310007320560	96906	MS51968-14	..NUT, PLAIN, HEXAGON ROCKER ARM ADJUSTING SCREW, EXHAUST 1/2-20 UNF-2B R/H	1
22	PAFZZ	5305009473437	15434	168306	..SETSCREW ROCKER ARM, EXH, HEADLESS W/SLOT 1/2-20X2.045 UNF-3A R/H	1
23	PAFZZ	3120005893537	15434	140330	..BUSHING, SLEEVE ROCKER ARM EXHAUST	1
24	PAFZZ	5305002974022	15434	168319	.SETSCREW ROCKER ARM SHAFT	1
25	PAFZZ	5330011456083	75078	010180	.PACKING, PREFORMED	1
26	PAFZZ	5340011637118	15434	216296	.PLUG, VENT ROCKER ARM HOUSING	1
27	PAFZZ	4730011240293	15434	218736	.PLUG, QUICK DISCONNE ROCKER ARM SHAFT	2
28	PCFZZ	5331009843756	19207	7374401	.O-RING ROCKER ARM SHAFT	2
29	PAFZZ	3040010791799	15434	3801433	.SHAFT, STRAIGHT ROCKER ARM HOUSING.	1

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
30	PBFZZ	2815012106947	15434	3036285	.HOUSING, ROCKER ARM.....	1
31	PAFZZ	5305011296901	15434	3010589	SCREW, ASSEMBLED WAS ROCKER ARM ..... HOUSING ASSY 1/2-13 X 4.750 UNC-2A.....	18
32	PFFZZ	5330008618592	15434	3017750	GASKET ROCKER ARM HOUSING ASSEMBLY..... PART OF KIT P/N 3804280 PART OF KIT..... P/N 3804275.....	3

END OF FIGURE

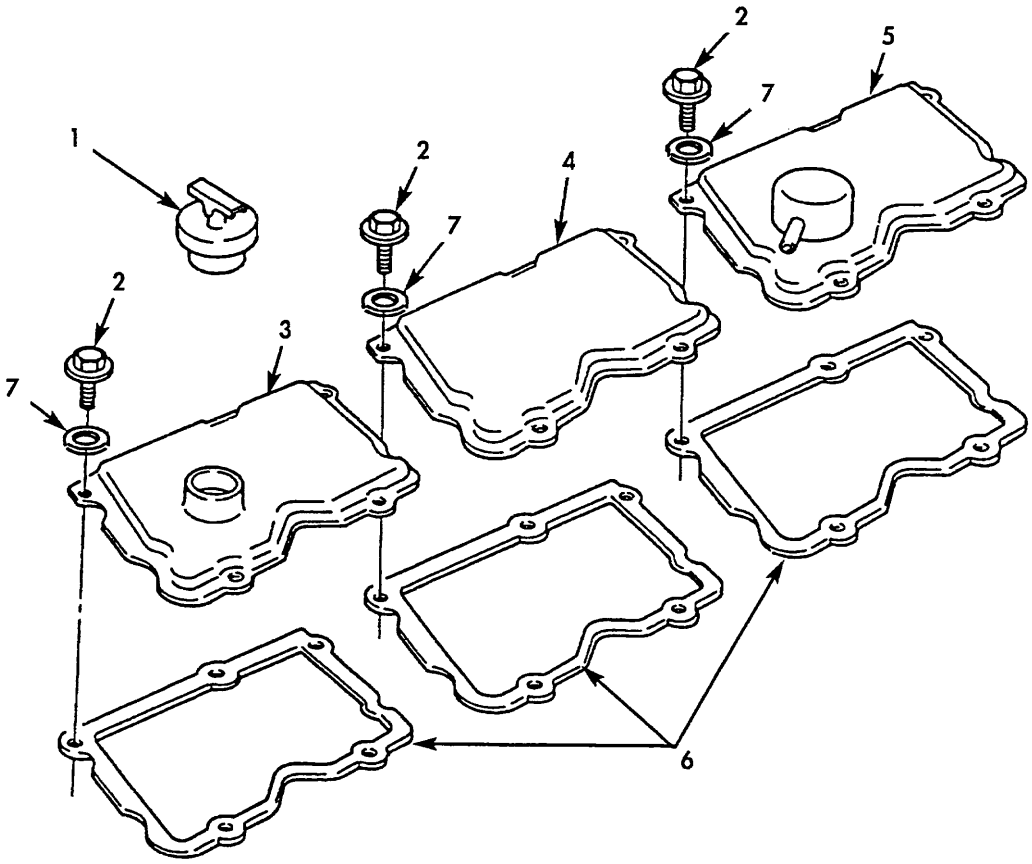


Figure 9. Rocker Cover.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 0105 VALVES, CAMSHAFTS AND TIMING SYSTEM	
					FIG. 9 ROCKER COVER	
1	PAOZZ	2590005907378	15434	101322	CAP, FILLER OPENING	1
2	PAOZZ	5305011188826	15434	3006182	SCREW, CAP, HEXAGON H CAPTIVE WASHER, 3/8-16UNC-2A X 0.845-0.875	15
3	PBOZZ	2815011646103	15434	3006349	COVER, ENGINE POPPET ROCKER AND RETARDER, M915 ONLY	1
3	PAOZZ	2815011591737	15434	3006187	COVER, ENGINE POPPET M915A1 ONLY	1
4	PAOZZ	2815011421732	15434	3006183	COVER, ENGINE POPPET	1
5	PAOZZ	2815011461024	15434	3006358	COVER, ENGINE POPPET	1
6	PCOZZ	5330011453985	15434	3044514	GASKET ROCKER COVER, M915A1 ONLY	3
7	PBOZZ	5365012413903	15434	64709	SPACER, SLEEVE	15

END OF FIGURE

1 — 2 thru 29

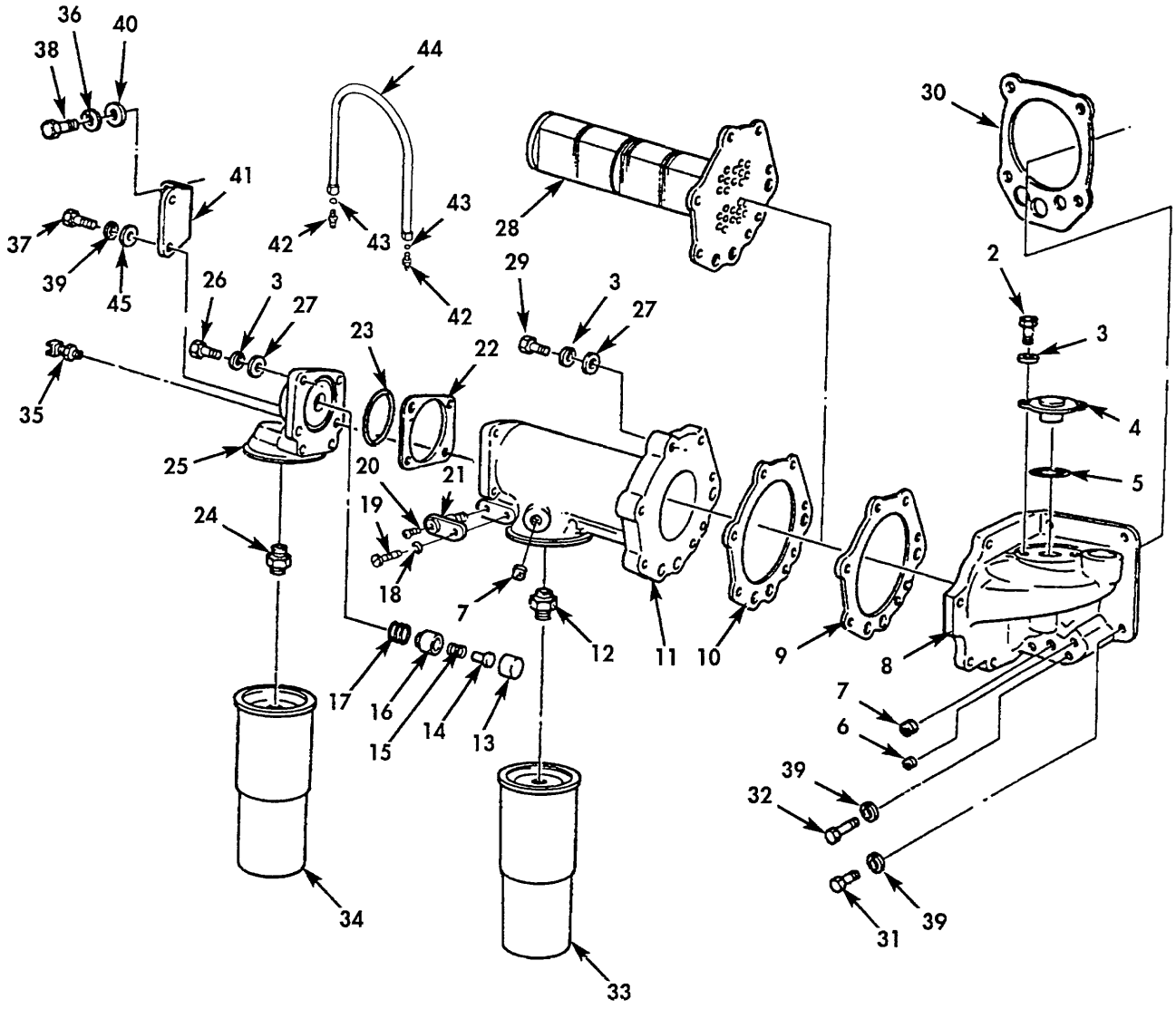


Figure 10. Oil Cooler and Filter, M915A1 Only.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 0106 ENGINE LUBRICATION SYSTEM	
					FIG. 10 OIL COOLER AND FILTER, M915A1 ONLY	
1	PAFHH	2930011410918	15434	3032307	COOLER, LUBRICATING OIL	1
2	PAHZZ	5305000914006	15434	137795	.SCREW, CAP, HEXAGON H 3/8-16 X 5/8	2
3	PAHZZ	5310006379541	96906	MS35338-46	.WASHER, LOCK 3/8	12
4	PAHZZ	2930011459537	15434	3023512	.VALVE, BYPASS	1
5	PCHZZ	5331011456085	15434	3045979	.O-RING PART OF KIT P/N 3801235	1
6	PFHZZ	4730000428988	6N299	0907859	.PLUG, PIPE 1/4	1
7	PAHZZ	4730000575555	15434	S-908	.PLUG, PIPE 3/8	2
8	PBHZZ	2930011459538	15434	3027460	.SUPPORT, OIL COOLER	1
9	PFHZZ	5330011456911	15434	3018696	.GASKET OIL COOLER CORE PART OF KIT P/N 3801235	1
10	PCHZZ	5330011456910	15434	3018693	.GASKET PART OF KIT P/N 3801235	1
11	XDHZZ		15434	3018690	.HOUSING, OIL COOLER	1
12	PAOZZ	2940011459398	15434	3034578	.ADAPTER, FILTER HEAD	1
13	PAHZZ	2940011459399	15434	3030804	.PISTON, BYPASS VALVE PRESSURE, SENSING	1
14	PAHZZ	2940011459400	15434	3030806	.PLUNGER, BYPASS VALV	1
15	PAHZZ	5360011453974	15434	3030803	.SPRING, HELICAL, COMP COMPRESSION	1
16	PAHZZ	4820012103573	15434	3030805	.PISTON, BYPASS VALVE	1
17	PAHZZ	5360011453975	15434	3039296	.SPRING, HELICAL, COMP	1
18	PAOZZ	5331011456086	15434	3030808	.O-RING PART OF KIT P/N 3801235	1
19	PAOZZ	5305011446232	15434	3031005	.SCREW, CAP, HEXAGON H	1
20	XDOZZ		15434	101996	.CAPSCREW 18-32 X 3/8	1
21	PAOZZ	5930011770346	15434	3035028	.SWITCH, PRESSURE	1
22	PCHZZ	5330011456909	15434	3027496	.GASKET PART OF KIT P/N 3801235	1
23	PFHZZ	5331011544316	15434	3018695	.O-RING PART OF KIT P/N 3801235	1
24	PAOZZ	4330011461082	15434	3021656	.ADAPTER, FILTER HEAD	1
25	PAHZZ	2940011465846	15434	3018700	.HEAD, FLUID FILTER	1
26	PAHZZ	5305007252317	80204	B1821BH038C150N	.SCREW, CAP, HEXAGON H 3/8-16 X 1.50.	4
27	PAHZZ	5310000806004	96906	MS27183-14	.WASHER, FLAT 13/32	12
28	PAHZZ	2930011461081	15434	3018692	.CORE, OIL COOLER	1
29	PAHZZ	5305007829489	80204	B1821BH038C200N	.SCREW, CAP, HEXAGON H 3/8-16 X 2.00.	6
30	PFFZZ	5330011456912	15434	3031858	GASKET PART OF KIT P/N 3801235	1
31	PAFZZ	5305000680511	80204	B1821BH038C125N	SCREW, CAP, HEXAGON H 3/8-16 X 1.25	3
32	PAFZZ	5305004041388	15434	S-199-B	SCREW, CAP, HEXAGON H 3/8-16 X 3.75	3
33	PAOZZ	2940010194513	15434	299670	FILTER ELEMENT, FLUI SPIN ON	1
34	PAOZZ	2940011459455	01637	FL797-A	FILTER ELEMENT, FLUI SPIN ON	1
35	PAOZZ	4820002769041	15434	107947	COCK, DRAIN	1
36	PAFZZ	5310001596209	96906	MS122032	WASHER, LOCK 1/4	2
37	PAFZZ	5305006388920	80204	B1821BH038C225N	SCREW, CAP, HEXAGON H 3/8-16 X 2.25	2
38	PAFZZ	5305000712517	80204	B1821BH025C350N	SCREW, CAP, HEXAGON H 1/4-20 X 1.00	2
39	PAFZZ	5310006379541	96906	MS35338-46	WASHER, LOCK 3/8	8
40	PAFZZ	5310005626560	15434	S-631	WASHER, FLAT 9/32	2
41	PBFZZ	5340011450772	15434	3018697	BRACKET, ANGLE	1
42	PFOZZ	4730003652690	15434	S-1002-A	ADAPTER, STRAIGHT, TU	2
43	PAOZZ	5330012222306	15434	3034579	SEAL	2
44	PAOZZ	4710011587507	15434	3035595	TUBE ASSEMBLY, METAL	1
45	PAOZZ	5310011036042	24617	120392	WASHER, FLAT 3/8	2

END OF FIGURE

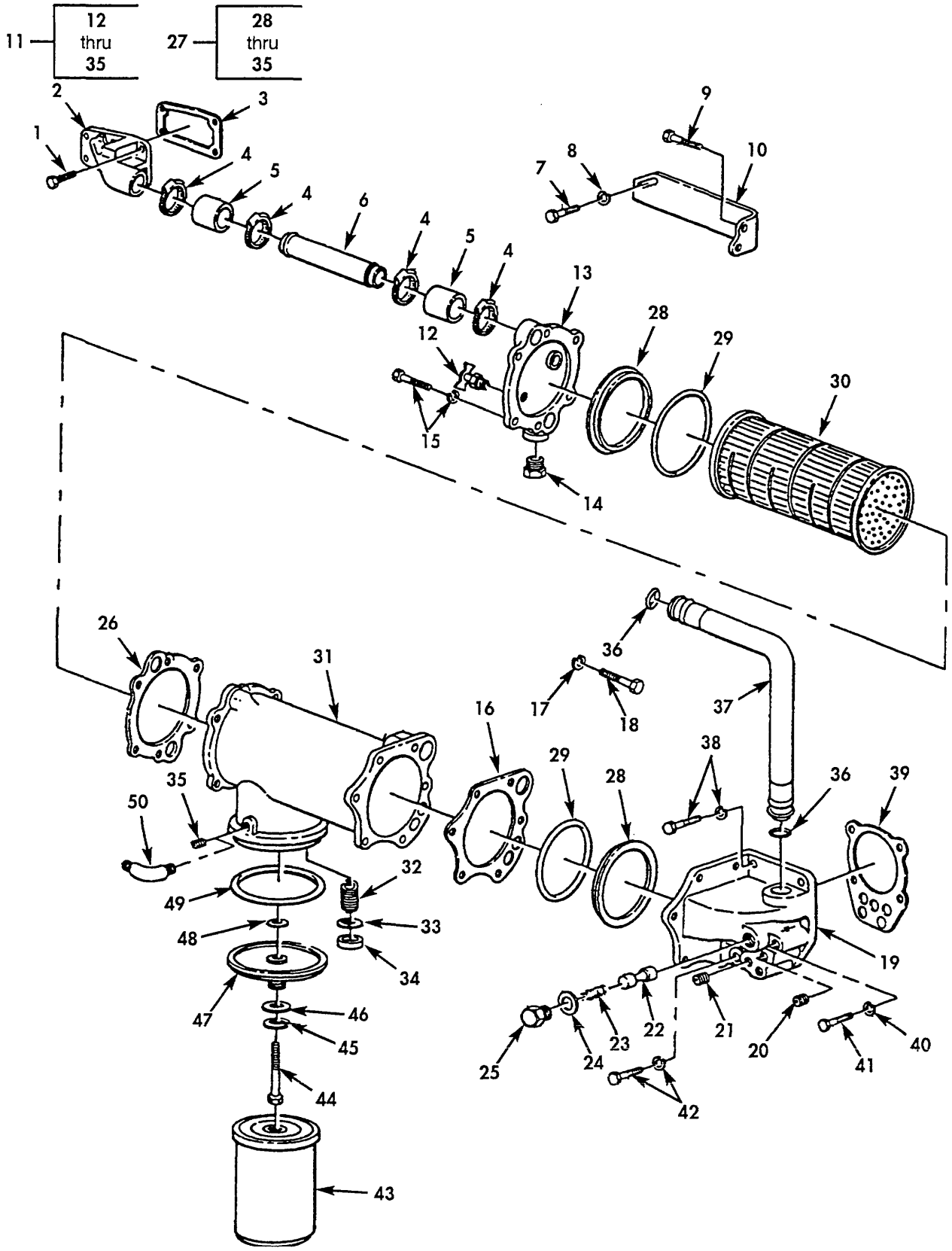


Figure 11. Oil Cooler and Filter, M915 Only.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 0106 ENGINE LUBRICATION SYSTEM	
					FIG. 11 OIL COOLER AND FILTER, M915 ONLY	
1	PAFZZ	5305011355344	15434	3011342	SCREW	6
2	PFFZZ	4730012417258	15434	3011233	ELBOW, FLANGE TO HOS	1
3	PAFZZ	5330005372382	15434	70089-1	GASKET PART OF KIT P/N 3018762	2
4	PAFZZ	4730011637192	15434	3008690	CLAMP, HOSE	4
5	PCFZZ	4720010852571	15434	3031560	HOSE, NONMETALLIC	2
6	PFFZZ	4710011811956	15434	3000907	TUBE, WATER TRANSFER	1
7	PBFZZ	5305012036444	15434	S145	SCREW, CAP, HEXAGON H 1/2-13 X 1.25	1
8	PAFZZ	5310005845272	96906	MS35338-48	WASHER, LOCK 1/2	1
9	PBFZZ	5305010858197	15434	3010595	SCREW, MACHINE W/LOCKWASHER 3/8-16 X 1.00	2
10	PAFZZ	5340012420805	15434	210966	BRACKET, ANGLE	1
11	PAFHH	2520010904473	15434	3003814	COOLER ASSEMBLY, OIL	1
12	PAFZZ	4820002769041	15434	107947	.COCK, DRAIN	1
13	PAHZZ	2930012311661	15434	217315	.COVER, COOLER	1
14	PFFZZ	5365007083434	15434	110907	.PLUG, MACHINE THREAD 1-18 X1-1/16 UNS R/H EXTERNAL	1
15	PAFZZ	5305010886019	15434	3010596	.SCREW, ASSEMBLED WAS 3/8-16 X 3.75.	10
16	PAFZZ	5330010463144	15434	3010030	.GASKET PART OF KIT P/N 3018762	1
17	PAFZZ	5310002617340	96906	MS35338-8	.WASHER, LOCK 3/8	1
18	PAFZZ	5305001775552	15434	S126	.SCREW, CAP, HEXAGON H	1
19	PFHZZ	5340013423610	15434	210967	.COVER, ACCESS	1
20	XBHZZ		15434	142110	.PLUG, EXPANSION	1
21	PBHZZ	4730011603579	15434	S-910-B	.PLUG, PIPE 1/4, EXTERNAL R/H NPT, RECESSED HEX HEAD	1
22	PAHZZ	2815007911453	15434	127558	.PLUNGER, OIL PUMP RE	1
23	PAHZZ	5360006645343	15434	68274	.SPRING, HELICAL, COMP	1
24	PCHZZ	5365001979327	15434	67946	.SPACER, RING PART OF KIT P/N 3018762	1
25	PBFZZ	4730013093321	15434	3060882	.PLUG, TUBE FITTING, T	1
26	PAFZZ	5330010461991	15434	218245	.GASKET PART OF KIT P/N 3018762	1
27	PBFHZ	2930011654581	15434	AR-09999	.COOLER, LUBRICATING	1
28	PAFZZ	5325011396738	15434	3006745	..RING, RETAINING.	2
29	PCHZZ	5330010866197	15434	3007713	..PACKING, PREFORMED PART OF KIT P/N 3018762	2
30	PAFZZ	2930010657113	15434	3021581	..FILTER ELEMENT, FLUI	1
31	PFHZZ	2815012414719	15434	210915	..HOUSING, OIL COOLER	1
32	PFHZZ	5360012000323	15434	202128	..SPRING, HELICAL, COMP	1
33	XAHZZ		15434	210707	..DISC, BY-PASS	1
34	PAHZZ	2940011461995	15434	179063	..SEAT, BYPASS FILTER	1
35	PAHZZ	4730000189566	15434	S911B	..PLUG, PIPE	1
36	PCFZZ	5331010775228	15434	212161	O-RING	2
37	PAFZZ	4710011463086	15434	3024666	TUBE, BENT, METALLIC	1
38	PAFZZ	5305010886019	15434	3010596	SCREW, ASSEMBLED WAS 3/8-16 X 1.25	2
39	PAFZZ	5330010796514	15434	3008017	GASKET PART OF KIT P/N 3018762	1
40	PFFZZ	5310002617340	96906	MS35338-8	WASHER, LOCK 3/8	2
41	PAFZZ	5305001658157	72582	450517	SCREW, CAP, HEXAGON H 3/8-16 X 4.75	2
42	PAFZZ	5305010867036	15434	3010597	SCREW WITH LOCKWASHER, 3/8-16 X 3.75	2
43	PAOZZ	2940010194513	15434	299670	FILTER ELEMENT, FLUI SPIN ON	1

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
44	XBHZZ		15434	S152B	SCREW, CAP, HEX HEAD	1
45	PFHZZ	5310008206653	96906	MS35338-50	WASHER, LOCK 5/8	1
46	PFHZZ	5310001344171	15434	200861	WASHER, FLAT 5/8	1
47	PAOZZ	2940010657076	33457	3300922S	HEAD, FLUID FILTER	1
48	PAOZZ	5330011640944	33457	3308958	GASKET PART OF KIT P/N 3018762	1
49	PAFZZ	5330001320248	15434	173368	PACKING, PREFORMED PART OF KIT P/N 3018762	1
50	XDFZZ		79470	49X6X2	ELBOW, PIPE TO TUBE	1

END OF FIGURE

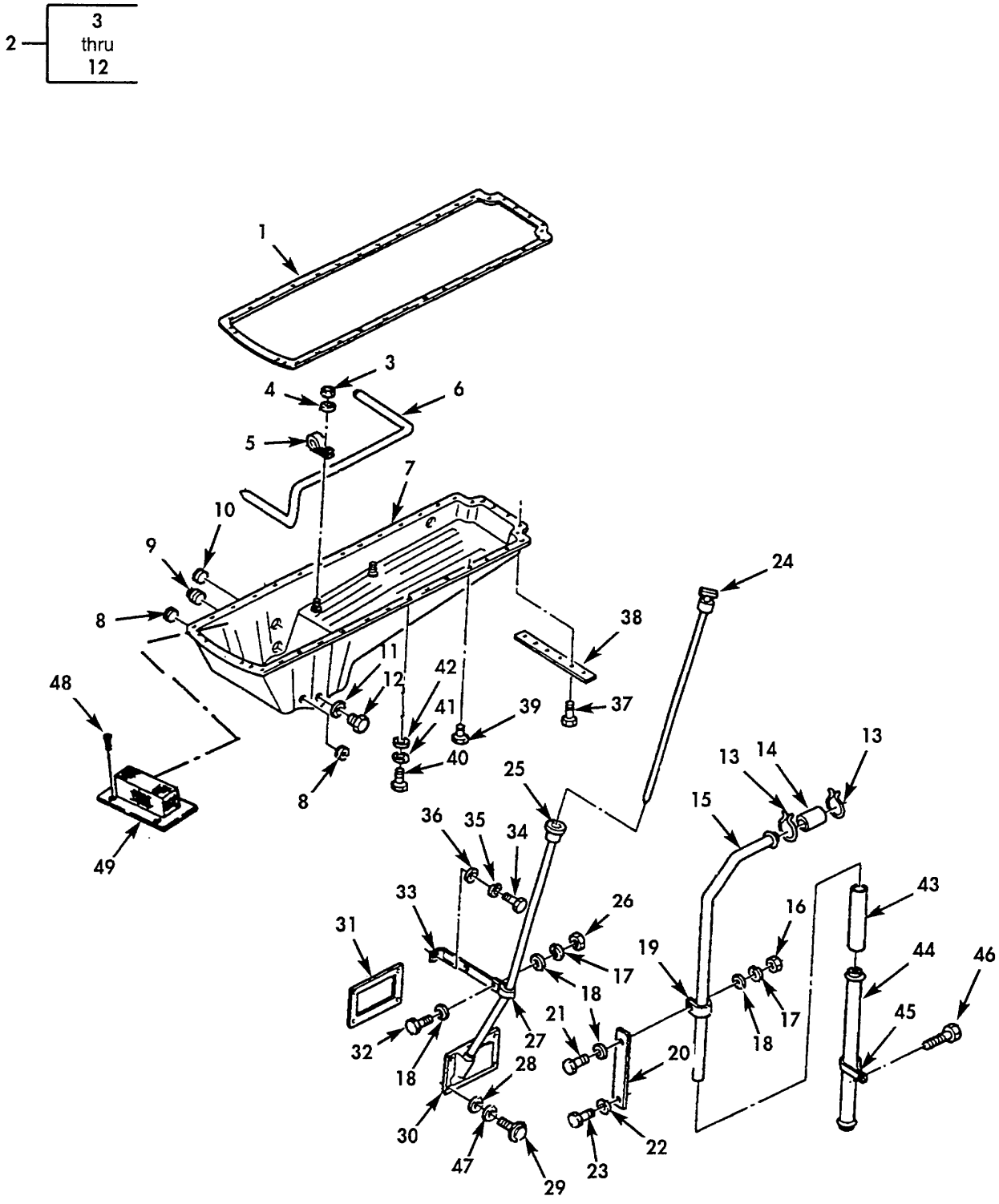


Figure 12. Oil Pan, Dipstick, and Breather Tube.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 0106 ENGINE LUBRICATION SYSTEM	
					FIG. 12 OIL PAN, DIPSTICK, AND BREATHER TUBE	
1	PFFZZ	5330011470748	15434	3032861	GASKET PART OF KIT P/N 3801235	1
2	PAFZZ	2815011332445	15434	193625	OIL PAN M915 ONLY	1
2	PBFFF	2815011410919	15434	3031959	OIL PAN M915A1 ONLY	1
3	PBFZZ	5310008284827	15434	69832	.NUT, GOVERNOR STUD 5/16-18	3
4	PAFZZ	5310005626558	15434	S-626	.WASHER, FLAT 0.344 X 0.688	3
5	PAFZZ	5340011469992	15434	3032708	.CLAMP, LOOP	3
6	PBFZZ	4710011461052	15434	3032707	.TUBE, BENT, METALLIC	1
7	XAFZZ		15434	3030257	.PAN, ENGINE OIL	1
8	PAOZZ	4730000103867	77640	103879	.PLUG, PIPE M915 ONLY	2
8	PAOZZ	4730011472223	15434	3008468	.PLUG, PIPE M915A1 ONLY	2
9	PAFZZ	5342011436045	15434	3008470	.PLUG 1-11 1/2	1
10	PAFZZ	4730000444715	15434	S962	.PLUG, PIPE 1 INCH NPTF	1
11	PAOZZ	5365001979327	15434	67946	.SPACER, RING	1
12	PAOZZ	5365006951247	15434	69962	.PLUG, MACHINE THREAD	1
13	PAOZZ	4730011463111	15434	3008596	CLAMP, HOSE	2
14	PCOZZ	4720002784890	28835	2CA647	HOSE, NONMETALLIC	1
15	PBOZZ	4710012158158	15434	3008599	TUBE ASSEMBLY, METAL M915 ONLY	1
15	PFOZZ	4710011460049	15434	3038035	TUBE, BENT, METALLIC M915A1 ONLY	1
16	PAOZZ	5310004516643	15434	S-213-A	NUT 5/8-18	1
17	PAFZZ	5310002617340	15434	S604	WASHER, LOCK M915 ONLY	4
17	PAOZZ	5310008206653	15434	S-603	WASHER, LOCK M915A1 ONLY	4
18	PAOZZ	5310008238803	96906	MS27183-21	WASHER, FLAT	4
19	PAOZZ	5340008390653	15434	68425	CLAMP, LOOP	1
20	PFOZZ	5342011459540	15434	217934	BRACKET, AFTERCOOLER	1
21	PAOZZ	5305009448292	96906	MS35308-458	SCREW, CAP, HEXAGON H	1
22	PAOZZ	5310002617340	15434	S-604	WASHER, LOCK	1
23	PAOZZ	5305005466698	15434	S-129	SCREW, CAP, HEXAGON H 3/8-24 X 1.00	1
24	PAOZZ	6680011087410	15434	3017292	GAGE ROD, LIQUID LEV	1
25	PAFZZ	4710011421667	15434	3022377	BREATHER TUBE, OIL	1
26	PAOZZ	5310011269404	24617	9422277	NUT, SELF-LOCKING, HE 3/8-16	1
27	PAOZZ	5340004175800	15434	200064	CLAMP, LOOP	1
28	PAFZZ	5310000806004	96906	MS27183-14	WASHER, FLAT	4
29	PAFZZ	5305005434372	80204	B1821BH038C075N	SCREW, CAP, HEXAGON H 3/8-16 X 3/4 M915 ONLY	4
29	PAFZZ	5305010858197	15434	3010595	SCREW, MACHINE WITH CAPTIVE WASHER, 3/8-16 X 1.00, M915A1 ONLY	4
30	PAFZZ	5342011407158	15434	178074	BRACKET M915 ONLY	1
30	PBFZZ	5342011459539	15434	41044	BRACKET, OIL GAGE M915A1 ONLY	1
31	PCFZZ	5330002460309	15434	65274	GASKET PART OF KIT P/N 3801235	1
32	PAHZZ	5305005434372	80204	B1821BH038C075N	SCREW, CAP, HEXAGON H M915 ONLY	5
33	PFOZZ	5340011475389	15434	134561	BRACKET, ANGLE	1
34	PAOZZ	5305010322311	80204	B1821BH044C425N	SCREW, CAP, HEXAGON H	1
35	PAOZZ	5310002090965	96906	MS35338-47	WASHER, LOCK	5
36	PAOZZ	5310008094085	96906	MS27183-16	WASHER, FLAT	1
37	PAHZZ	5305012125210	15434	3008069	SCREW, CAP, HEXAGON H M915 ONLY	4
37	PAFZZ	5305011458358	15434	3017049	SCREW, ASSEMBLED WAS M915A1 ONLY	4
38	PFFZZ	5340011506248	15434	218813	PLATE, MENDING ENGINE SHIPPING	1
39	PAFZZ	5305011451113	15434	3032674	SCREW HEXAGON	28

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
40	PAFZZ	5305000429478	96906	MS90725-90	SCREW, CAP, HEXAGON H 7/16-14 X 1 3/4	4
41	PAFZZ	5310004079566	96906	MS35338-45	WASHER, LOCK.	4
42	PAFZZ	5310000814219	96906	MS27183-12	WASHER, FLAT	4
43	MOOZZ		19207	8710557-10	HOSE, RUBBER, MAKE FROM HOSE, NONMETALLIC, 10 IN. MAKE FROM P/N 8710557	1
44	PAOZZ	4710010920109	34623	MB320-20011	TUBE, METALLIC BREATHER EXTENSION	1
45	PAOZZ	5340011539425	75272	COV-1109	CLAMP, LOOP	1
46	PAOZZ	5305011129021	15434	3013904	SCREW	1
47	PAOZZ	5310006379541	96906	MS35338-46	WASHER, LOCK 3/8	4
48	PAFZZ	5305008046454	15434	S1354	SCREW, TAPPING	2
49	PAFZZ	4730003386839	34623	MA207-21139	STRAINER ELEMENT, SE	1

END OF FIGURE

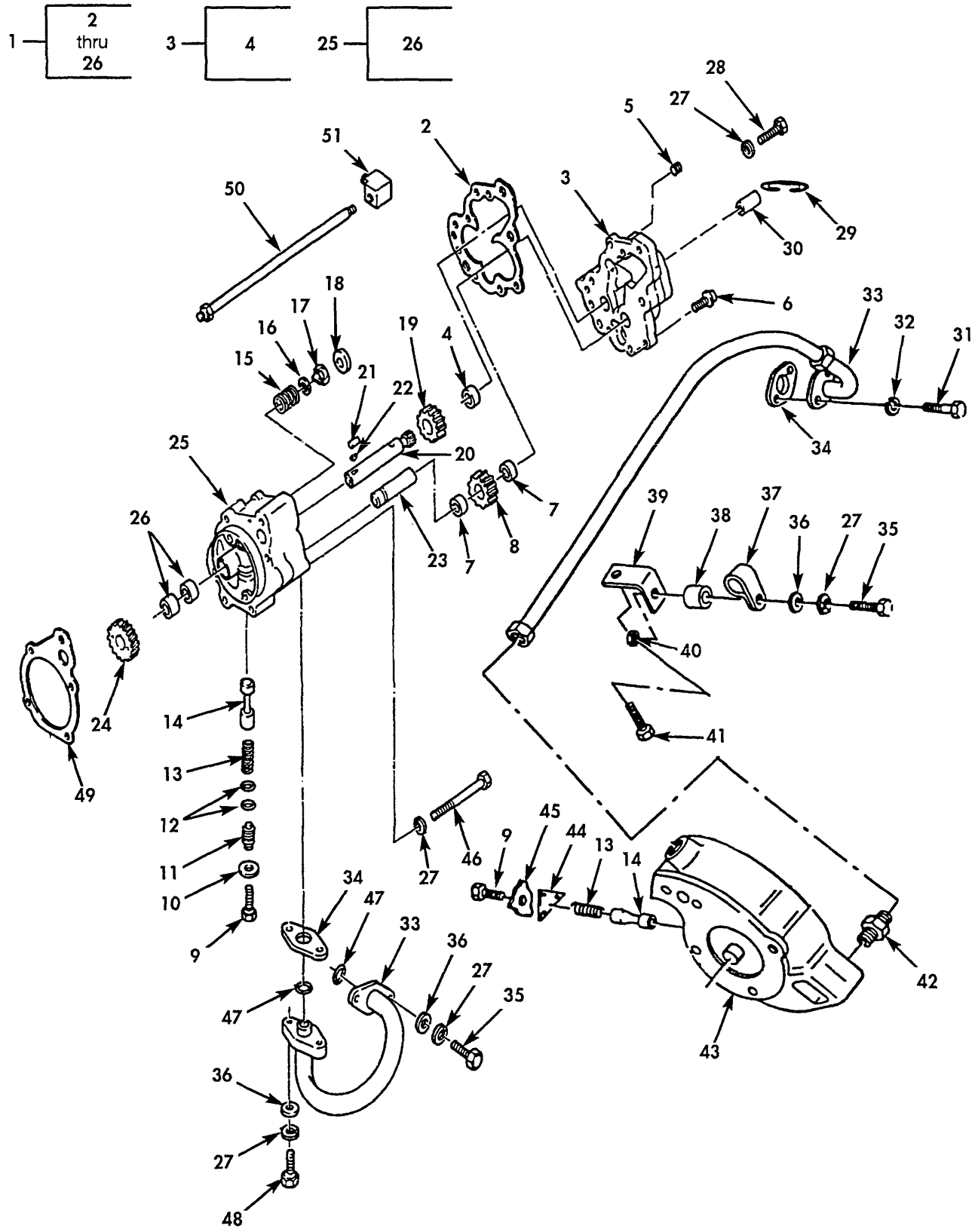


Figure 13. Oil Lubricating Pump.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 0106 ENGINE LUBRICATION SYSTEM	
					FIG. 13 OIL LUBRICATING PUMP	
1	PAFHH	2815010852573	15434	AR10172	OIL PUMP ASSEMBLY, E M9I5 ONLY	1
1	PAFHH	2815011415299	15434	3821572	PUMP ASSEMBLY, OIL M915A1 ONLY	1
2	PFHZZ	5330011471274	15434	3014778	.GASKET M915A1 ONLY PART OF KIT P/N 3801235	1
2	PAFZZ	5330010663910	15434	203145	.GASKET OIL COVER TO PUMP, M915 ONLY PART OF KIT P/N 3018762	1
3	XBHZZ		15434	AR8667	.HSG, HYDR ADAPTER M915 ONLY	1
3	PAHZZ	5340011459451	15434	3014964	.COVER, ACCESS M915A1 ONLY	1
4	PAHZZ	3120006276697	15434	69521	..BEARING, SLEEVE	1
5	PAHZZ	4730011060202	15434	3008469	.PLUG, PIPE M915 ONLY	1
5	PAHZZ	4730011615115	15434	3013786	.PLUG, PIPE M915A1 ONLY	1
6	PAHZZ	5305011294214	15434	3022590	.SCREW, CAPTIVE WITH CAPTIVE WASHER, 5/16 - 18 X 1.00	7
7	PAHZZ	3120005660480	15434	68365	.BUSHING, SLEEVE M915 ONLY	2
7	PAHZZ	3120011495414	15434	199586	.BUSHING, SLEEVE M915A1 ONLY	2
8	PAHZZ	3020011460108	15434	3014788	.GEAR, SPUR	1
9	PAHZZ	5305010102362	96906	MS18154-59	.SCREW, CAP, HEXAGON H M915 ONLY	1
9	PAHZZ	5305005434372	80204	B1821BH038C075N	.SCREW, CAP, HEXAGON H M915A1 ONLY	5
10	PAHZZ	5310010750991	15434	146161	.WASHER, FLAT	1
11	PAHZZ	5342011450645	15434	3012726	.RETAINER	1
12	PCHZZ	5330010514243	15434	145504	.PACKING, PREFORMED PART OF KIT P/N 3010242	2
13	PAHZZ	5360010384659	15434	211939	.SPRING, HELICAL, COMP M915 ONLY	1
13	PAHZZ	5360011457554	15434	3010146	.SPRING, HELICAL, COMP M915A1 ONLY	1
14	PAHZZ	2815007052856	15434	109333	.PLUNGER, PRESSURE RE M915 ONLY	1
14	PAHZZ	5340011450802	15434	3012529	.PLUNGER, DETENT M915A1 ONLY	1
15	PAHZZ	5360011480303	15434	3014756	.SPRING, HELICAL, COMP BYPASS VALVE	1
16	PAHZZ	5310011446224	15434	3014754	.WASHER, FLAT	1
17	PAHZZ	4820011459457	15434	3014755	.DISK, VALVE	1
18	PAHZZ	2940011461995	15434	179063	.SEAT, BYPASS FILTER	1
19	PAHZZ	3020010849640	15434	3014783	.GEAR, SPUR M915 ONLY	1
19	PAHZZ	3020011460109	15434	3014787	.GEAR, SPUR M915A1 ONLY	1
20	PAHZZ	3040010791748	15434	199587	.SHAFT, SHOULDERED M915 ONLY	1
20	PAHZZ	3040011459637	15434	3012532	.GEARSHAFT, SPUR M915A1 ONLY	1
21	PAHZZ	5315004752574	15434	69519	.PIN, STRAIGHT, HEADLE	1
22	PAHZZ	5315000431787	96906	MS35756-34	.KEY, WOODRUFF M915 ONLY	1
22	XBHZZ		15434	183695	.KEY, WOODRUFF M915A1 ONLY	1
23	PAHZZ	3040010793469	15434	177419	.SHAFT, SHOULDERED M915 ONLY	1
23	XDHZZ		15434	3012531	.SHAFT, STRAIGHT M915A1 ONLY	1
24	PAHZZ	3020010853779	15434	204832	.GEAR, HELICAL	1
25	XDHZZ		15434	AR09832	.BODY, OIL PUMP WITH M915 ONLY	1
25	PAHZZ	3040011465935	15434	3014798	.HOUSING, MECHANICAL M915A1 ONLY	1
26	PAHZZ	3120006276697	15434	69521	..BEARING, SLEEVE M915A1 ONLY	2
27	PAFZZ	5310002090965	96906	MS35338-47	WASHER, LOCK M915 ONLY	9
27	PAFZZ	5310002617340	15434	S-604	WASHER, LOCK M915A1 ONLY	13
28	PAHZZ	5305000680511	96906	MS90728-62	SCREW, CAP, HEXAGON H M915 ONLY	3
28	PAFZZ	5305001373269	15434	S-108-A	SCREW M915A1 ONLY	3
29	PAFZZ	5325010849033	15434	100475	RING, RETAINING	1
30	PAHZZ	3010010791788	15434	199589	COUPLING, SHAFT, RIGI PUMP ASSY, OIL	1

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					LUBRICATING, M915 ONLY	
30	PAFZZ	3010011460113	15434	3023506	COUPLING, SHAFT, RIGI POWER STEERING PUMP, M915A1 ONLY	1
31	PAHZZ	5305004264142	15434	S105	SCREW, CAP, HEXAGON H	2
32	PAHZZ	5310006379541	96906	MS35338-46	WASHER, LOCK	2
33	PAHZZ	4720010793285	34623	MA145B21000	HOSE ASSEMBLY, NONME M915 ONLY	1
33	PAFZZ	4710011460050	15434	3031962	TUBE, BENT, METALLIC M915A1 ONLY	1
34	PFFZZ	5330011456913	15434	3029846	GASKET PART OF KIT P/N 3801235 M915 ONLY	2
34	PCFZZ	5330001438376	15434	157551	GASKET PART OF KIT P/N 3801235 M915A1 ONLY	2
35	PAFZZ	5305000680511	80204	B1821BH038C125N	SCREW, CAP, HEXAGON H	2
36	PFHZZ	5310005626557	15434	S622	WASHER, FLAT M915 ONLY	4
36	PAFZZ	5310000806004	96906	MS27183 -14	WASHER, FLAT M915A1 ONLY	4
37	PAHZZ	5340010856269	15434	105182	CLAMP, LOOP PUMP ASSY, OIL LUBRICATING, M915 ONLY	1
38	XBHZZ		15434	9674F	SPACER CLAMP TO HOSE TO SUPPORT OIL PAN, PUMP ASSY, OIL LUBRICATING	1
39	PAHZZ	5340010662947	15434	68038	BRACKET, ANGLE PUMP ASSY, OIL LUBRICATING	1
40	PAFZZ	5310005218595	15434	S223	NUT HE,AGON OUTLET PIPE TO BRACE	1
41	XDHZZ		15434	300869	SCREW	1
42	PAHZZ	4730002028470	01276	2021-20-20S	ADAPTER, STRAIGHT, PI PUMP ASSY, OIL LUBRICATING, M915 ONLY	1
43	PAHZZ		15434	AR9832	BODY AND SPRING	1
44	PAHZZ	2815008287013	15434	126304	YOKE, CAP RETAINING PUMP ASSY, OIL LUBRICATING, M915 ONLY	1
45	PAHZZ	2815004068936	15434	109319	LOCK PLATE YOKE TO HOUSING, PUMP ASSY, OIL LUBRICATING	1
46	PAFZZ	5305007959352	15434	3012479	SCREW, CAP, HEXAGON H M915 ONLY	2
46	PAFZZ	5305011472443	15434	S-142-A	SCREW, CAP, HEXAGON H M915A1 ONLY	2
47	PCFZZ	5331011450715	15434	3029847	O-RING PART OF KIT P/N 3801235	2
48	PAFZZ	5305005434372	80204	B1821BH038C075N	SCREW, CAP, HEXAGON H M915A1 ONLY	2
48	PAFZZ	5305009422196	96906	MS18154-60	SCREW, CAP, HEXAGON H M915 ONLY	6
49	PFFZZ	5330011474071	15434	3031434	GASKET PUMP MOUNTING PART OF KIT P/N 3801235	1
50	PAFZZ	4720011520156	15434	AS0401100MS	HOSE ASSEMBLY, NONME	1
51	PAFZZ	4730011428524	15434	68139	ELBOW, PIPE TO TUBE	1

END OF FIGURE

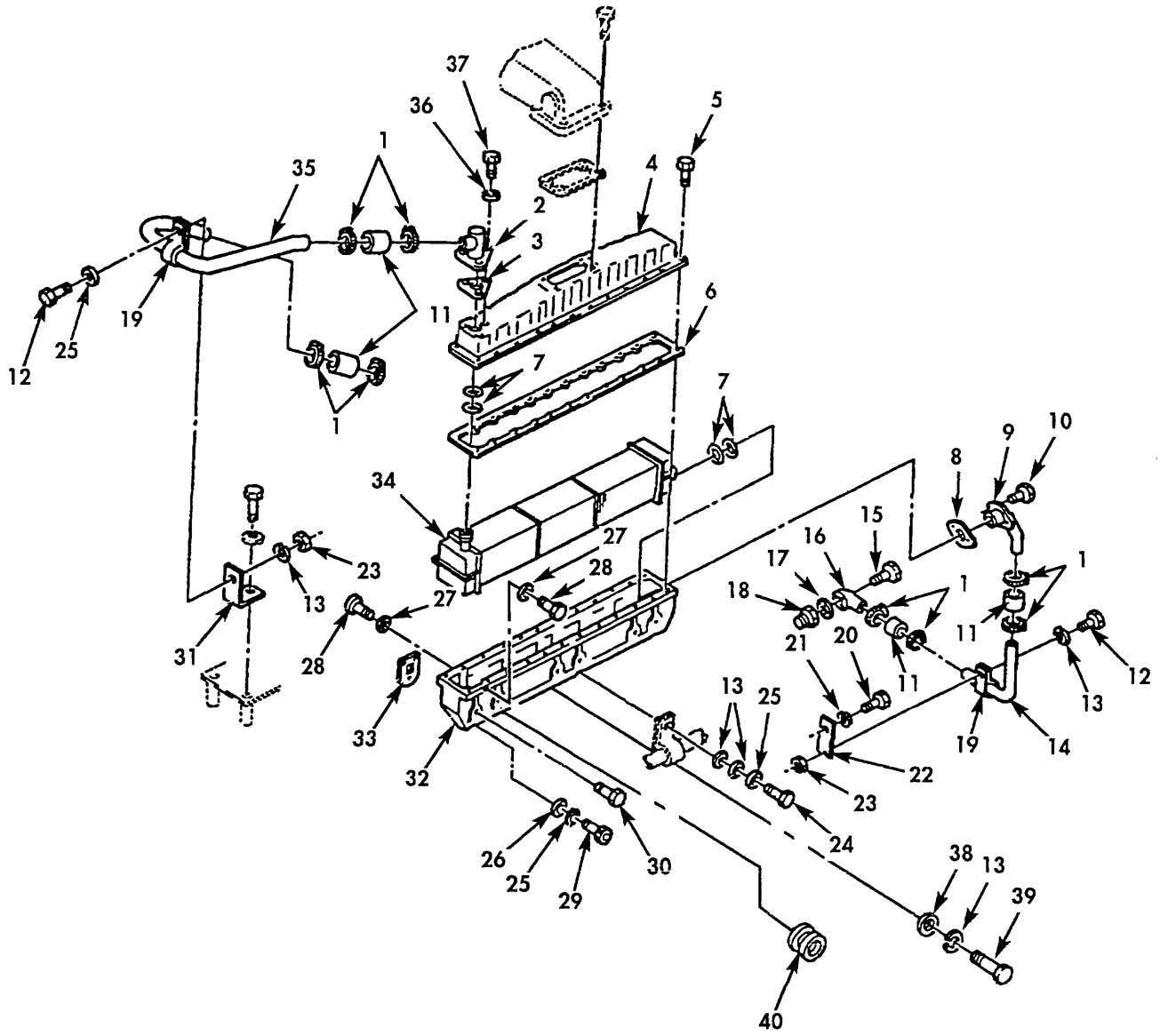


Figure 14. Air Aftercooler.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 0108 MANIFOLDS	
					FIG. 14 AIR AFTERCOOLER	
1	PAOZZ	4730005558263	53496	5561 1-2A	CLAMP, HOSE 13/16-1 1/2	8
2	PFFZZ	4730011461065	15434	3013295	ELBOW, FLANGE TO HOS WATER OUTLET, M915A1 ONLY	1
3	PCFZZ	5330010665351	15434	215044	GASKET WATER OUTLET CONNECTION PART OF KIT P/N 3804275	1
4	PBFZZ	2930011461083	15434	3046170	COVER, INTERCOOLER	1
5	PAFZZ	5305011472444	15434	3005508	SCREW, CAP, HEXAGON H WITH CAPTIVE WASHER	24
6	PAFZZ	5330010665352	15434	216486	GASKET AFTERCOOLER COVER	1
7	PFOZZ	5330010663904	15434	195952	PACKING, PREFORMED PART OF KIT P/N 3804275	4
8	PFOZZ	5330011474072	15434	3032348	GASKET WATER INLET CONNECTION PART OF KIT P/N 3804275	1
9	XBOZZ		15434	211222	CONNECTOR, WATER M915 ONLY	1
9	PAOZZ	2930011461996	15434	3028282	CONNECTOR, WATER INL WATER INLET, M915A1 ONLY	1
10	PAOZZ	5305000680511	96906	B1821BH038C125N	SCREW, CAP, HEXAGON H M915 ONLY	2
10	PAOZZ	5305010728818	15434	3012471	SCREW WITH CAPTIVE WASHER, 3/8-16 X 1 1/8, M915A1 ONLY	2
11	PCOZZ	4720010856131	15434	155789	HOSE, NONMETALLIC	4
12	PAOZZ	5305005434372	80204	B1821BH038C075N	SCREW, CAP, HEXAGON H HEXAGON CAP, 3/8 - 16 X 1.00, M915A1 ONLY	2
13	PAOZZ	5310001596209	96906	MS122032	WASHER, LOCK M915 ONLY	6
13	PAOZZ	5310002617340	15434	S-604	WASHER, LOCK M915A1 ONLY	6
14	PAOZZ	4710011464083	15434	217933	TUBE, BENT, METALLIC WATER CROSSOVER.	1
15	PAFZZ	5305011471215	15434	3019572	SCREW, CAP, HEXAGON H WITH CAPTIVE WASHER, M915A1 ONLY	3
16	PAOZZ	4730011463109	15434	217932	ELBOW, FLANGE TO TUB WATER OUTLET, M915A1 ONLY	1
17	PCOZZ	5330010826984	15434	215045	GASKET WATER OUTLET	1
18	PFOZZ	4730011461064	15434	215587	ADAPTER, STRAIGHT, FL WATER OUTLET	1
19	PAOZZ	5340000877486	15434	107460	CLAMP, LOOP	2
20	PAOZZ	5305009448292	15434	S-190	SCREW, CAP, HEXAGON H	1
21	PAOZZ	5310008206653	15434	S-603	WASHER, LOCK	1
22	PAOZZ	5342011459540	15434	217934	BRACKET, AFTERCOOLER	1
23	PAOZZ	5310005218595	15434	S-223	NUT HE, AGON 3/8 - 16	2
24	PAOZZ	5305005434372	80204	B1821BH038C075N	SCREW, CAP, HEXAGON H M915 ONLY	1
24	PAOZZ	5305011376706	15434	3012473	SCREW 3/8 - 16 X 1 3/4, M915A1 ONLY	2
25	PAOZZ	5310004862505	15434	108330	WASHER, FLAT M915A1 ONLY	1
25	PAOZZ	5310002617340	15434	S-604	WASHER, LOCK M915 ONLY	1
26	PAOZZ	5310000806004	96906	MS27183-14	WASHER, FLAT	1
27	PAFZZ	5310011458403	15434	3011610	WASHER, FLAT	8
28	PAFZZ	5305011472445	15434	3030286	SCREW, CAP, HEXAGON H 5/8-18 X 1.50	8
29	PAFZZ	5305011467285	15434	69047-A	SCREW, CAP, SOCKET HE SOCKET HEAD CAP, 3/8-16 X 1.50	1
30	PAFZZ	5305004041390	15434	S149A	SCREW, CAP, HEXAGON H M915 ONLY	6
30	PAFZZ	5305011478729	15434	3028967	SCREW, CAP, HEXAGON H WITH CAPTIVE WASHER, 3/8-16 X 1.125, M915A1 ONLY	6
31	PAOZZ	5340011450773	15434	3035607	BRACKET, ANGLE TUBE SUPPORT, M915A1	1

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					ONLY	
32	PBFZZ	2930011460111	15434	3008425	MANIFOLD, FLUID COOL M915A1 ONLY.....	1
33	PCFZZ	5330010863523	15434	3008591	GASKET INTAKE MANIFOLD PART OF KIT.....	3
					P/N 3804280 PART OF KIT P/N 3804275.....	
34	XBFZZ		15434	214836	CORE, AFTERCOOLER M915 ONLY.....	1
34	PAFZZ	2930011419277	15434	3028997	CORE, AFTERCOOLER AFTERCOOLER,.....	1
					M915A1 ONLY.....	
35	PAOZZ	4710010856132	15434	215041	TUBE, BENT, METALLIC M915 ONLY	1
35	PAOZZ	4710011461053	15434	3018099	TUBE, BENT, METALLIC WATER TRANSFER, ...	1
					M915A1 ONLY.....	
36	PAFZZ	5330000031771	15434	S684	GASKET M915 ONLY.....	3
36	PAFZZ	5310004079566	96906	MS35338-45	WASHER, LOCK	3
37	PAFZZ	5306002258499	96906	MS90725-34	BOLT, MACHINE 5/16 - 18 X 1.00.....	3
38	PAFZZ	5310001344169	15434	63842	WASHER, FLAT	3
39	PAHZZ	5305007252317	80204	B1821BH038C150N	SCREW, CAP, HEXAGON H.....	3
40	PAFZZ	4730000189566	15434	S911B	PLUG, PIPE.....	1

END OF FIGURE

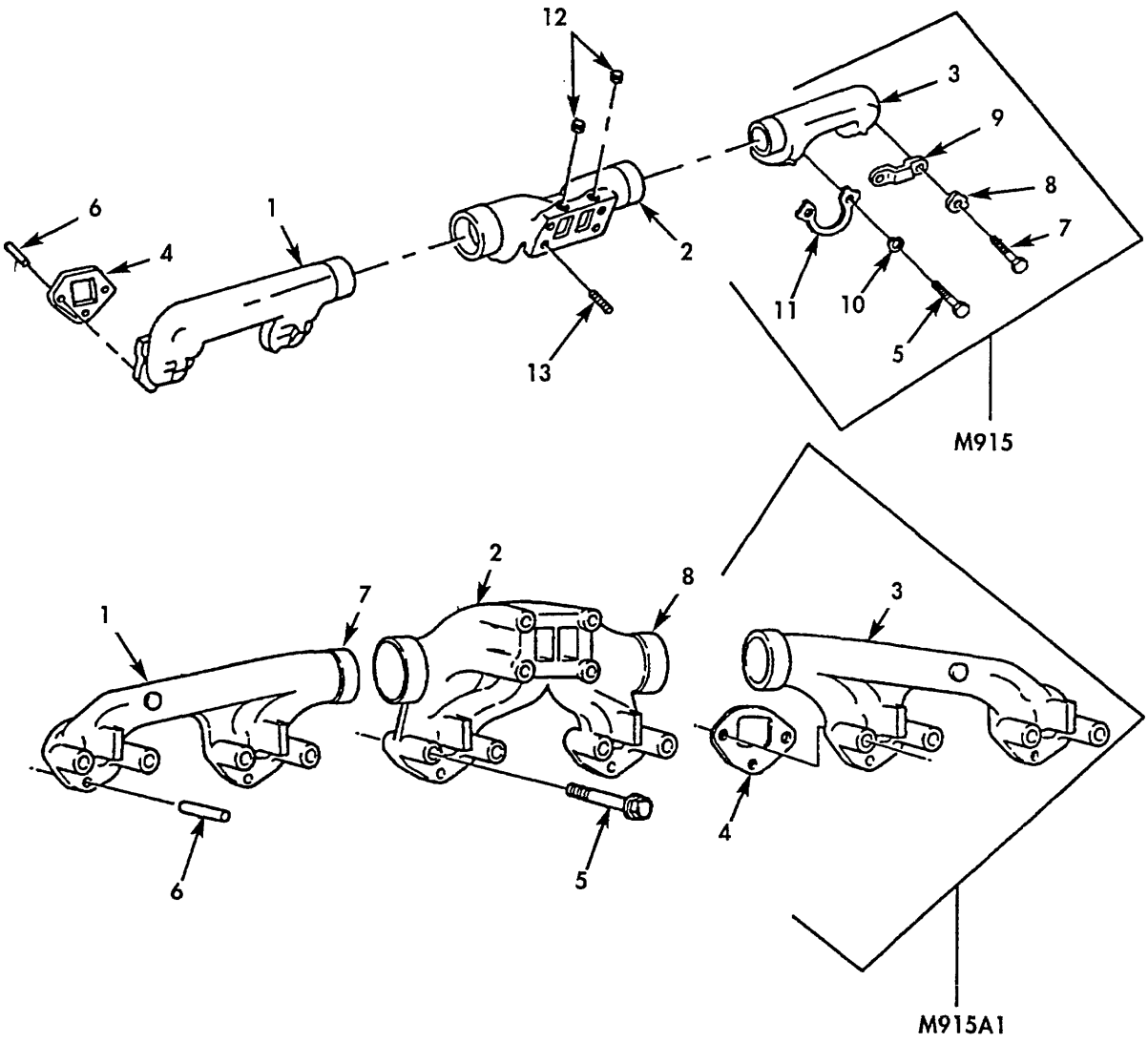
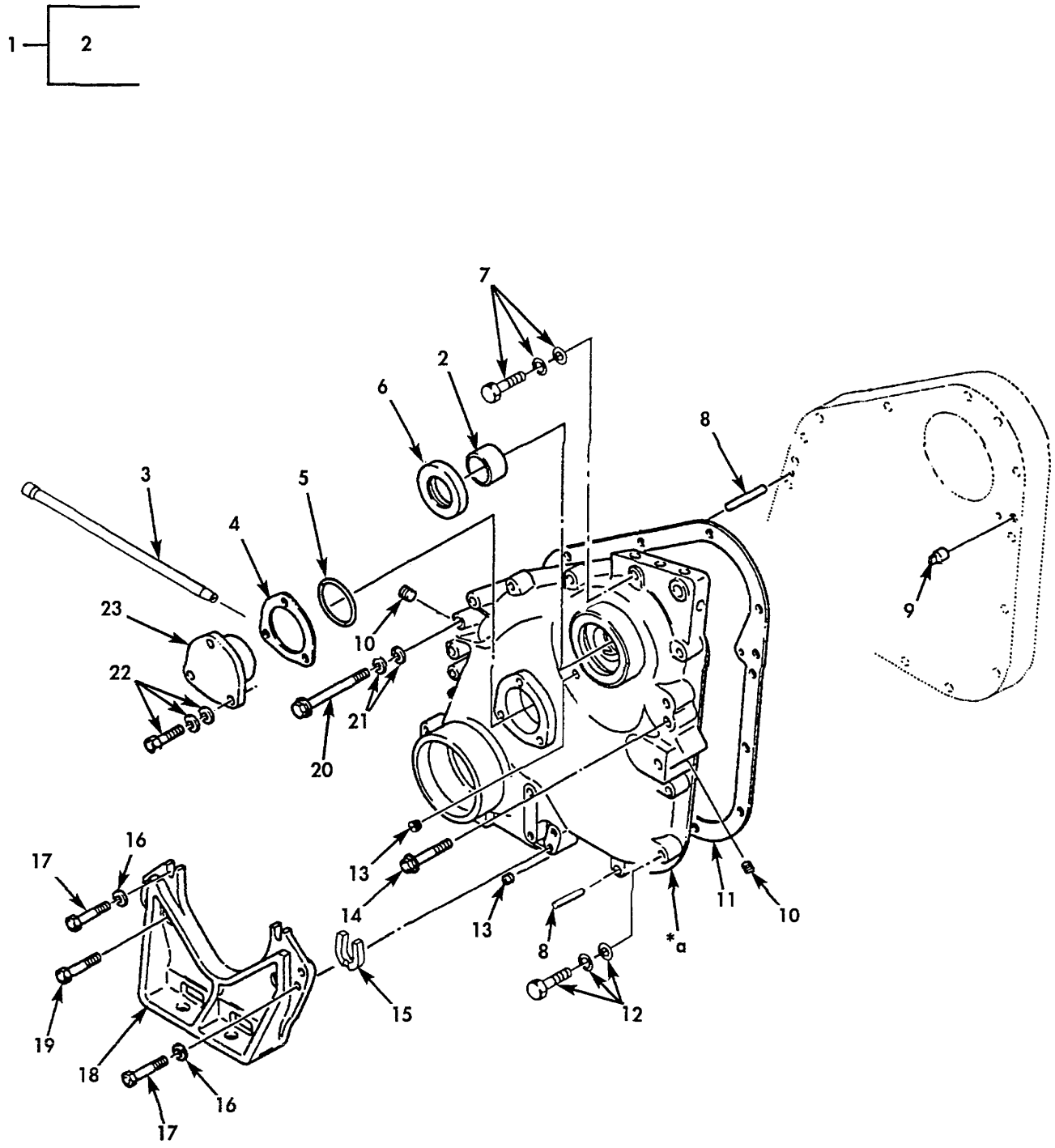


Figure 15. Exhaust Manifold.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 0108 MANIFOLDS	
					FIG. 15 EXHAUST MANIFOLD	
1	PAFZZ	2815011461103	15434	3031186	MANIFOLD, EXHAUST REAR, M915A1 ONLY	1
2	PAFZZ	2815010774463	15434	200566	MANIFOLD, CENTER SEC REAR, EXHAUST MANIFOLDS ASSEMBLY, M915 ONLY	1
2	PAFZZ	2815011463159	15434	3029614	MANIFOLD, EXHAUST CENTER, M915A1 ONLY	1
3	PAFZZ	2815009202073	15434	151478	MANIFOLD, EXHAUST EXHAUST MANIFOLDS, M915 ONLY	1
3	PAFZZ	2815011460112	15434	3031187	MANIFOLD, EXHAUST FRONT, M915A1 ONLY.	1
4	PAFZZ	5330006593178	15434	3020943	GASKET MANIFOLD PART OF KIT P/N 3804280 PART OF KIT P/N 3804275	6
5	PAFZZ	5305010288869	15434	S155	SCREW, CAP, HEXAGON H M915 ONLY	8
5	PAFZZ	5305011478730	15434	3043647	SCREW, CAP, HEXAGON H CAPTIVE WASHER, M915A1 ONLY	12
6	PAFZZ	2815008295227	15434	105199	DOWEL, MANIFOLD	6
7	PAFZZ	5305004770395	15434	110266	SCREW M915 ONLY	4
8	PAFZZ	5310008878325	15434	114638	WASHER, KEY M915 ONLY	4
8	PAFZZ		15434	3027653	RING, EXHAUST M915A1 ONLY	1
9	PAFZZ	5340001323203	15434	200919	STRAP, RETAINING M915 ONLY	2
10	PAFZZ	3120010796527	15434	109594	BEARING, SLEEVE M915 ONLY	8
11	PAFZZ	5340007674012	15434	116982	LOCKING PLATE, NUT A M915 ONLY	4
12	PAFZZ	4730010857328	15434	217632	PLUG, PIPE M915 ONLY	2
13	PAFZZ	5307009222626	15434	3006289	STUD, PLAIN M915 ONLY	4

END OF FIGURE



* a PART OF ITEM 1

Figure 16. Gear Cover

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 0109 ACCESSORY DRIVING MECHANISMS	
					FIG. 16 GEAR COVER	
1	PAFZZ	2815011590872	15434	3024442	GEAR COVER ASSEMBLY	1
2	PAFZZ	3120008772213	15434	3029852	.BEARING, SLEEVE	1
3	PFFZZ	4710012096742	15434	210416	TUBE, METALLIC	1
4	PAFZZ	5365005073254	15434	65259-C	SHIM 0.002 V	
4	PAFZZ	5365010867788	15434	185573	SHIM INSERT V	
4	PAFZZ	5365011470912	15434	65259-A	SHIM 0.010 V	
4	PAFZZ	5365011470913	15434	65259-B	SHIM 0.005 V	
5	PCFZZ	5331011450716	15434	215705	O-RING PART OF KIT P/N 3801235	1
6	PAFZZ		15434	211255	SEAL, PLAIN ENCASED PART OF KIT P/N 3801235	1
7	PAFZZ	5305011458381	15434	3011713	SCREW, CAP, HEXAGON H W/CAPTIVE WASHERS 7/16-20 X 2-5/8	1
8	PAFZZ	2815007729434	15434	70653	DOWEL, METALLIC	1
9	PAFZZ	5315002380882	15434	60408	PIN, STRAIGHT, HEADLE.	1
10	PFFZZ	4730000189566	15434	S911B	PLUG, PIPE 1/8 NPTF	2
11	PCFZZ	5330011456914	15434	3021704	GASKET FRONT ENGINE GEAR COVER PART OF KIT P/N 3801235	1
12	PFFZZ	5305011474033	15434	3011711	SCREW, CAP, HEXAGON H W/CAPTIVE WASHERS 7/16 - 20 X 1 -3 /8. M915	9
12	PFFZZ	5305012407155	15434	3011712	SCREW, ASSEMBLED WAS 7/16 - 20 X 2 - 3/ 16. M915A1	9
13	PAFZZ	4730000103867	24617	219191	PLUG, PIPE 3/8 NPT	1
13	PAFZZ	4730000428988	11862	117244	PLUG, PIPE 1/4 NPT. M915 ONLY	3
14	PFFZZ	5305011653300	15434	S-119-C	SCREW, CAP, HEXAGON H	1
15	XBFZZ		15434	218716	SPACER, PLATE	8
16	PFFZZ	5310011124306	15434	203760	WASHER, FLAT 15/32	2
16	PAFZZ	5310011458404	15434	3000082	WASHER, FLAT 15/32	6
17	PAFZZ	5305011478731	15434	213456	SCREW, CAP, HEXAGON H 7/16 - 20 X 2 - 3/4	6
18	PAFZZ	2815010799146	15434	214306	SUPPORT, FRONT, ENGIN	1
19	PAFZZ	5306011469866	15434	3058664	BOLT, MACHINE TWELVE POINT CAP, 7/ 16 - 20 X 2.500	2
20	PAFZZ	5305011653892	15434	3011714	SCREW HEXAGON HEAD, WITH CAPTIVE WASHERS, 7/16 - 20 X 3.00	3
21	PAFZZ	5310002090965	96906	MS35338-47	WASHER, LOCK 7/16 M915.	1
22	PAFZZ	5305010728816	15434	3011715	SCREW HEXAGON HEAD W/CAPTIVE WASHERS, 3/8-16 X 13/16	3
23	PAFZZ	2815011459401	15434	3008530	SUPPORT, CAMSHAFT	1

END OF FIGURE

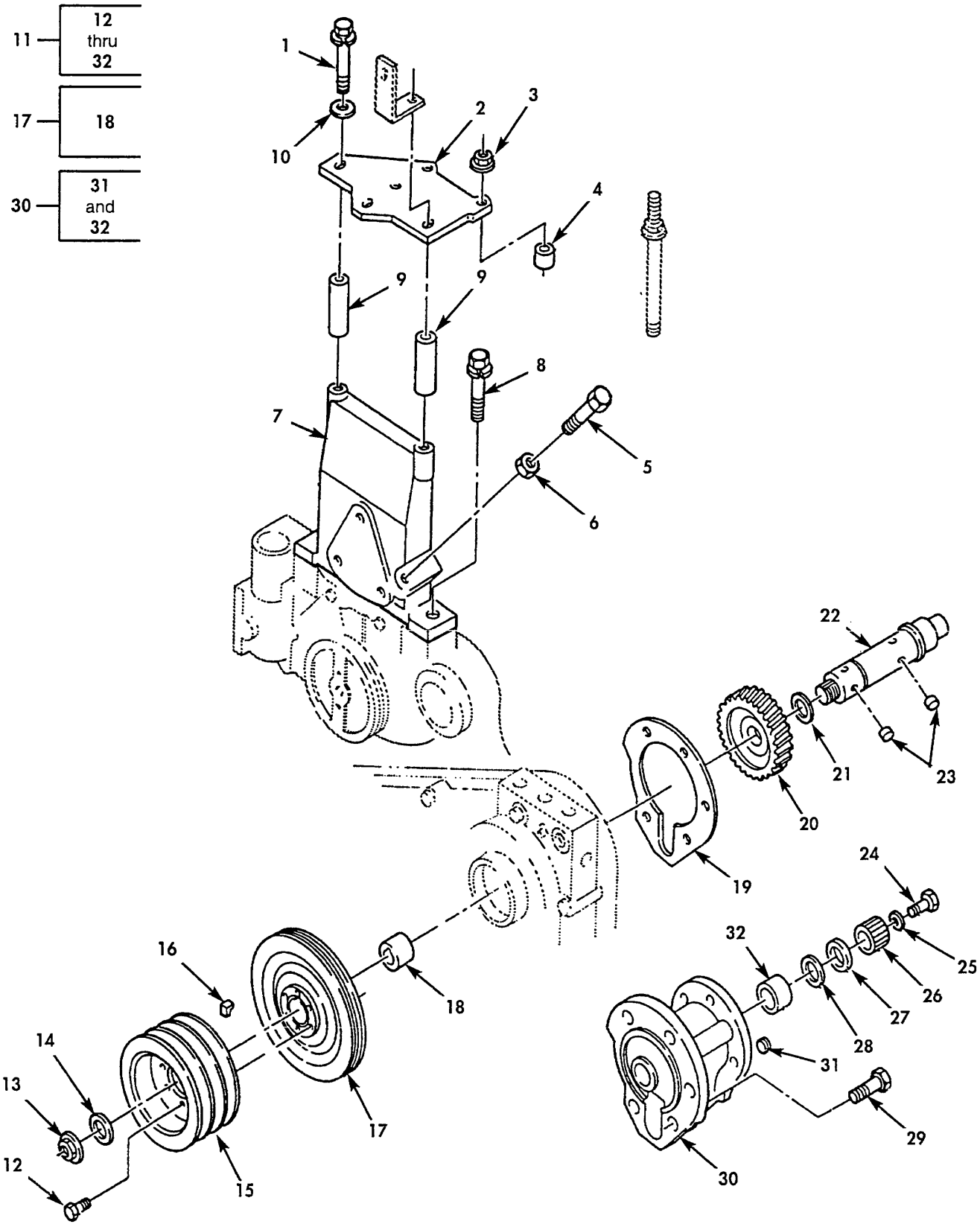


Figure 17. Accessory Drive Pulley and Fan Clutch.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 0109 ACCESSORY DRIVEING MECHANISMS	
					FIG. 17 ACCESSORY DRIVE PULLEY AND FAN CLUTCH	
1	PAOZZ	5305011458382	75078	012647	SCREW, CAP, HEXAGON H WITH CAPTIVE WASHER, SEE GROUP 0112	1
2	PAOZZ	2930010976755	15434	217034	BRACE, FAN BRACKET	1
3	PAOZZ	5310011446115	75078	001094	NUT, PLAIN, CONE SEAT	2
4	PAOZZ	5365011475030	75078	001234	SPACER, SLEEVE SEE GROUP 0112	1
5	PAOZZ	5305010912498	15434	166777	SCREW 1/2 - 13	1
6	PAOZZ	5310004706154	15434	S-285	NUT, PLAIN, HEXAGON 1/2 - 13	1
7	PBOZZ	5342010980175	15434	208829	BRACKET, FAN SUPPORT	1
8	PAOZZ	5305011450776	15434	3019574	SCREW, CAP, HEXAGON H WITH CAPTIVE WASHER	2
9	PAOZZ	5365010955666	75078	003251	SPACER, SLEEVE FAN BRACE, SEE GROUP 0112	2
10	PAOZZ	5310011458405	75078	001030	WASHER, FLAT	1
11	PAFFH	4310010929815	15434	3005133	DRIVE ACCESSORY, COM	1
12	PAFZZ	5305011458383	15434	175833	.SCREW, CAP, HEXAGON H 3/8-16 X 1 1/8	6
13	PAFZZ	5310011261045	15434	3012526	.NUT, SELF-LOCKING, HE	1
14	PAFZZ	5310011246463	15434	193136	.WASHER, FLAT	1
15	PAFZZ	3020011463773	15434	3013336	.PULLEY, CONE ACCESSORY DRIVE	1
16	PCFZZ	5330011296541	15434	3008947	.RUBBER STRIP	1
17	PAFZZ	3020011463163	15434	3023473	.PULLEY, FLAT ACCESSORY DRIVE	1
18	PAFZZ	2930004019531	15434	190397	.SLEEVE, PULLEY, PUMP	1
19	PCFZZ	5330000262931	15434	200809	.GASKET PART OF KIT P/N 3801235	1
20	PAFZZ	3020001609092	15434	142689	.GEAR, HELICAL ACCESSORY DRIVE	1
21	PAFZZ	3120011475275	15434	3026556	.BEARING, WASHER, THRU	1
22	PAFZZ	4310010929816	15434	3000171	.SHAFT, AIR COMPRESSO ACCESSORY DRIVE	1
23	PAFZZ	2815011240232	15434	70550	.PIN, PISTON	2
24	PAFZZ	5306011194271	15434	3000173	.BOLT, INTERNALLY REL SELF-LOCKING, 3/8-16 X 1.00	1
25	PAFZZ	5310004862507	15434	170664	.WASHER, FLAT	1
26	PAFZZ	3010010852732	15434	3000174	.COUPLING HALF, SHAFT SPLINE COUPLING	1
27	PAFZZ	5310000819292	15434	3014103	.WASHER, FLAT	1
28	PAFZZ	3120011447368	15434	3026557	.BEARING, WASHER, THRU	1
29	PAFZZ	5305011198621	15434	3010590	.SCREW WITH CAPTIVE WASHER, 7/16-20 X 1.125/1.063	5
30	PAFZZ	3040011294302	15434	AR-45724	.HOUSING, MECHANICAL ACCESSORY DRIVE	1
31	PAFZZ	4730000189566	15434	S-911-B	..PLUG, PIPE	2
32	PAFZZ	3120007929834	15434	116391	..BEARING, SLEEVE	1

END OF FIGURE

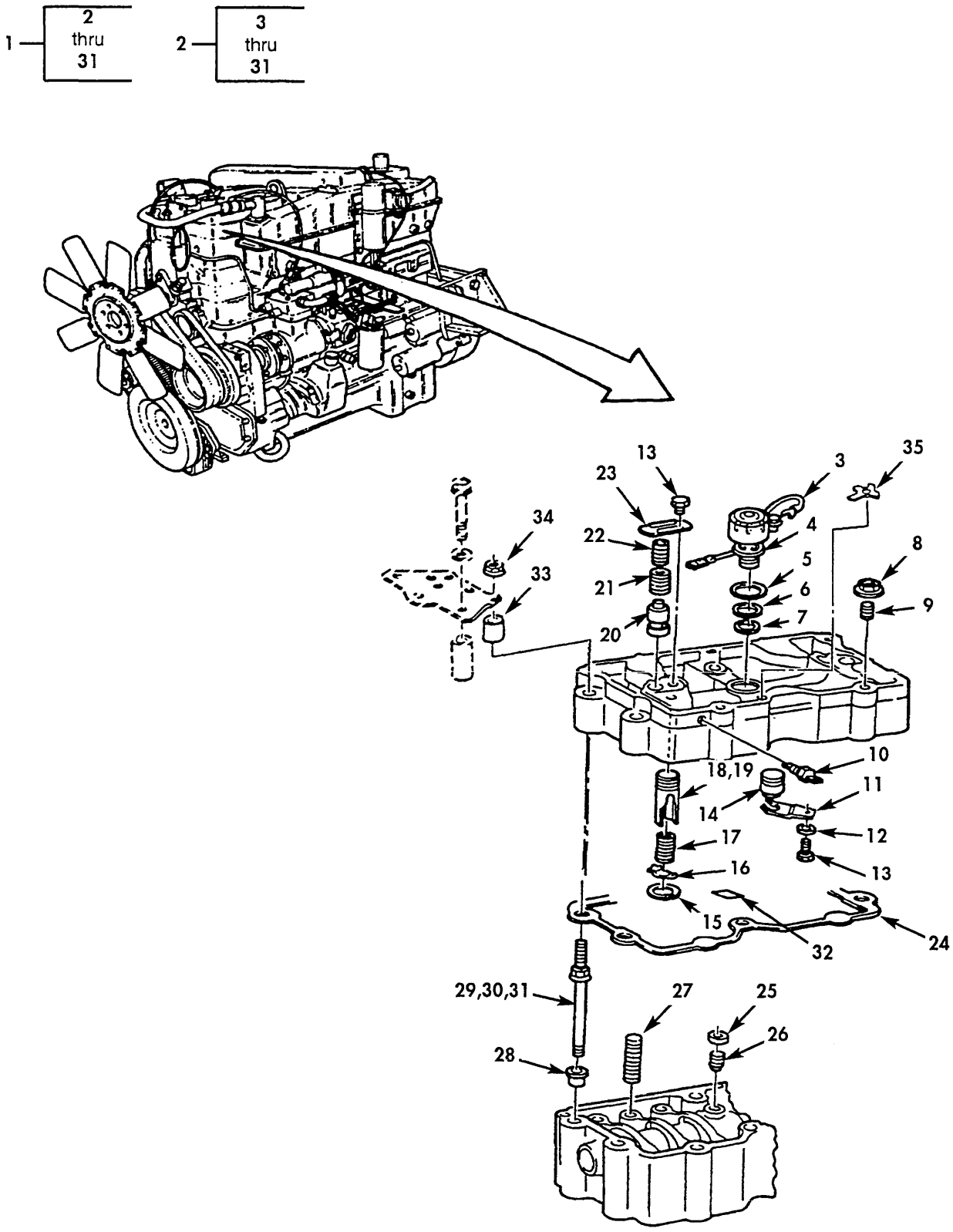
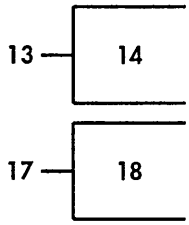


Figure 18. Engine Retarder.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 0112 ENGINE BRAKE	
					FIG. 18 ENGINE RETARDER	
1	PAFHH	2815010852574	75078	016053	BRAKE ASSEMBLY, ENGI ENGINE BRAKE	1
2	PAFHH	2815011413261	75078	009917	.HOUSING, ENGINE RETA BRAKE	3
3	PCHZZ	6150011147119	75078	002390	..LEAD, ELECTRICAL	1
4	PAHZZ	4810010890534	75078	004205	..CARTRIDGE, SOLENOID SOLENOID	1
5	PCHZZ	5331010861013	75078	001081	..O-RING	1
6	PCHZZ	5331010853105	75078	001082	..O-RING	1
7	PCHZZ	5330010866196	75078	001083	..PACKING, PREFORMED	1
8	PAHZZ	5310011573762	75078	001026	..NUT, PLAIN, HEXAGON M915 ONLY	2
8	PAHZZ	5310011467302	75078	009353	..NUT, SELF-LOCKING, EX M915A1 ONLY	2
9	PAHZZ	5305011867042	75078	001031	..SETSCREW 0.375-24X0.75IN.LG, RETARDER, ENGINE-JACOBS BR.M915 ONLY	2
9	PAHZZ	5305011446206	75078	009916	..SETSCREW M915A1 ONLY	2
10	PAHZZ	5940010854426	75078	002299	..TERMINAL, FEEDTHRU, I	1
11	PAHZZ	5360011457607	75078	007447	..SPRING, FLAT MASTER PISTON	2
12	PAHZZ	5310011458405	75078	001030	..WASHER, FLAT	1
13	PAHZZ	5305011458384	75078	001492	..SCREW, CAP, HEXAGON H	2
14	PAHZZ	2815010887328	75078	004089	..PISTON, MASTER.	2
15	PAHZZ	5325010878727	75078	001023	..RING, RETAINING	2
16	PAHZZ	5340010854439	75078	008895	..RETAINER, HELICAL CO SLAVE PISTON.	2
17	PAHZZ	5360010849066	75078	001022	..SPRING, HELICAL, COMP	2
18	PAHZZ	2815010986755	75078	001484	..PISTON, SLAVE M915 ONLY	2
18	PAHZZ	2815010986755	75078	007623	..PISTON, SLAVE M915A1 ONLY	2
19	PAHZZ	2815011461997	75078	007696	..PISTON, SLAVE SLAVE, FOR MILLED CYLINDER HEADS	2
20	PAHZZ	4820010893939	75078	001521	..CARTRIDGE, CHECK VAL M915 ONLY	2
20	PAHZZ	4820011464593	75078	007505	..VALVE, CHECK M915A1 ONLY	2
21	PAHZZ	5360010899103	75078	001519	..SPRING CONTROL VALVE, OUTER	2
22	PAHZZ	5360011457555	75078	007500	..SPRING, HELICAL, COMP CONTROL VALVE, INNER	2
23	PAHZZ	2815011459402	75078	004136	..PLATE, COVER, VALVE, D CONTROL VALVE	2
24	PCFZZ	5330010863996	75078	13294	..GASKET BRAKE HOUSING	3
25	PCFZZ	5330011456083	75078	010180	..PACKING, PREFORMED	3
26	PAFZZ	2520010856128	75078	002969	..SCREW SHAFT LOCK	2
27	PAFZZ	5307011095972	75078	1764	..STUD, SHOULDERED AND M915 ONLY	2
27	PAFZZ	5306011076371	75078	003678	..BOLT, EXTERNALLY REL M915A1 ONLY	1
28	PAFZZ	5310011475072	75078	002514	..WASHER, BEARING	1
29	PFFZZ	5307011471316	75078	2856	..STUD, SHOULDERED M915 ONLY	2
29	PAFZZ	5307011471316	75078	002856	..STUD, SHOULDERED M915A1 ONLY	1
30	PAFZZ	5307011472821	75078	001232	..STUD, SHOULDERED	4
31	PAFZZ	5307011458449	75078	001199	..STUD, SHOULDERED.	8
32	PAOZZ		15434	3045534	RECTANGULAR SEAL	1
33	PAOZZ	5365011475030	75078	001234	SPACER, SLEEVE	6
34	PAOZZ	5310011446115	75078	001094	NUT, PLAIN, CONE SEAT	6
35	PAOZZ		75078	002680	LOCK, PLATE	6

END OF FIGURE



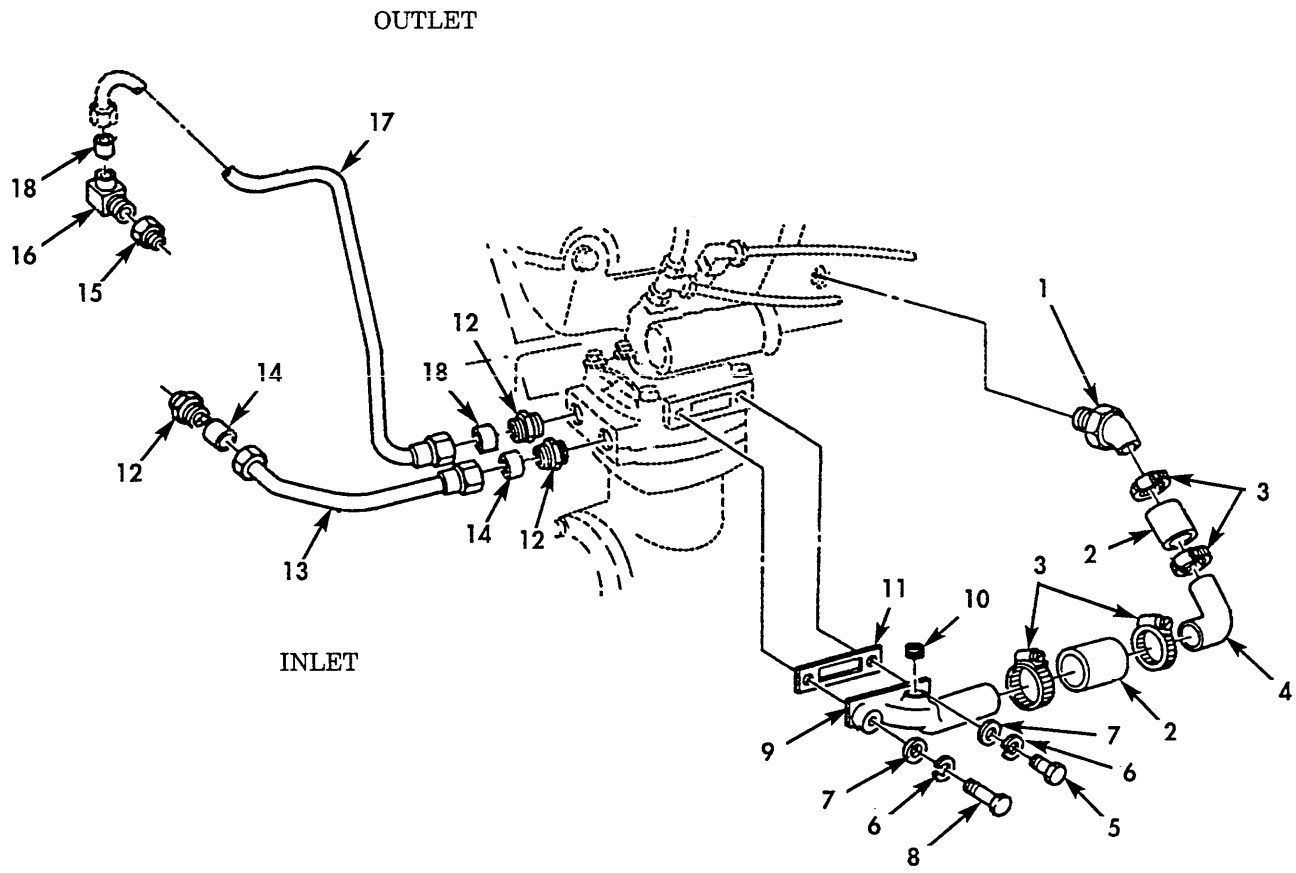


Figure 19. Air Compressor Lines and Fittings.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 0121 COMPRESSOR ASSEMBLY	
					FIG. 19 AIR COMPRESSOR LINES AND FITTINGS	
1	PAOZZ	4730010793273	15434	3002074	ELBOW, PIPE TO HOSE AIR INTAKE	1
2	PCOZZ	4720009189634	15434	61554	HOSE, PREFORMED	2
3	PAOZZ	4730005558263	70403	A11	CLAMP, HOSE M915 ONLY	8
3	PAOZZ	4730005558263	53496	5561 1-2A	CLAMP, HOSE M915A1 ONLY	4
4	PAOZZ	4710011463085	15434	217939	TUBE, BENT, METALLIC	1
5	PAOZZ	5305002264831	80204	B1821BH031C150N	SCREW, CAP, HEXAGON H 5/16 - 18 X 1.50	1
6	PAOZZ	5310004079566	96906	MS35338-45	WASHER, LOCK	2
7	PAOZZ	5310005626558	15434	S-626	WASHER, FLAT	2
8	PAOZZ	5305011294214	15434	3022590	SCREW, CAPTIVE	1
9	PAOZZ	4730010854156	15434	196282	ELBOW, FLANGE TO HOS AIR COMPRESSOR INTAKE	1
10	PAOZZ	4730000189566	15434	S-911-B	PLUG, PIPE	1
11	PAOZZ	5330011810630	15434	3201386	GASKET	1
12	PAOZZ	4730003652690	15434	S-1002-A	ADAPTER, STRAIGHT, TU	3
13	PAOZZ	4710010958683	15434	21609300	TUBE, BENT, METALLIC OUTLET M915A1	1
13	PAOZZ	4710010793492	15434	3038060	TUBE ASSEMBLY, METAL COMPRESSOR COOLING M915	1
14	PCOZZ	5365005985255	15434	S-1003-A	.BUSHING, NONMETALLIC	2
15	PAOZZ	4730001383906	15434	187317	COUPLING, PIPE PLAIN STRAIGHT, 3/8 NPT	1
16	PAOZZ	4730003744282	15434	S-1005-A	ELBOW, PIPE TO TUBE	1
17	PAOZZ	4710011461112	15434	3026999	TUBE, BENT, METALLIC OUTLET M915A1	1
17	PAOZZ	4710011463168	15434	3028642	TUBE ASSEMBLY, METAL COMPRESSOR COOLING M915	1
18	PCOZZ	5365005985255	15434	S-1003-A	.BUSHING, NONMETALLIC	2

END OF FIGURE

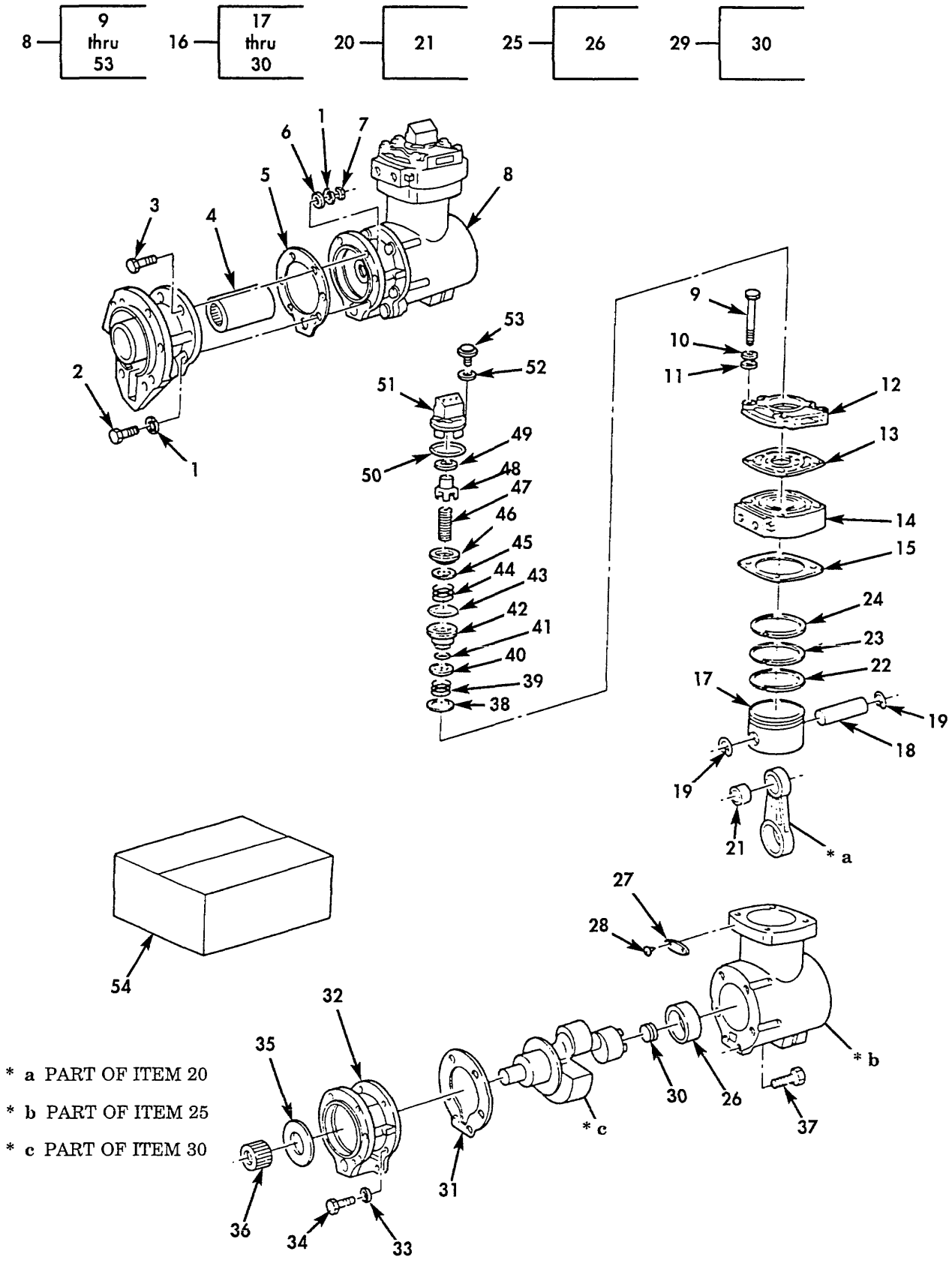


Figure 20. Air Compressor and Governor Assembly (Sheet 1 of 2).

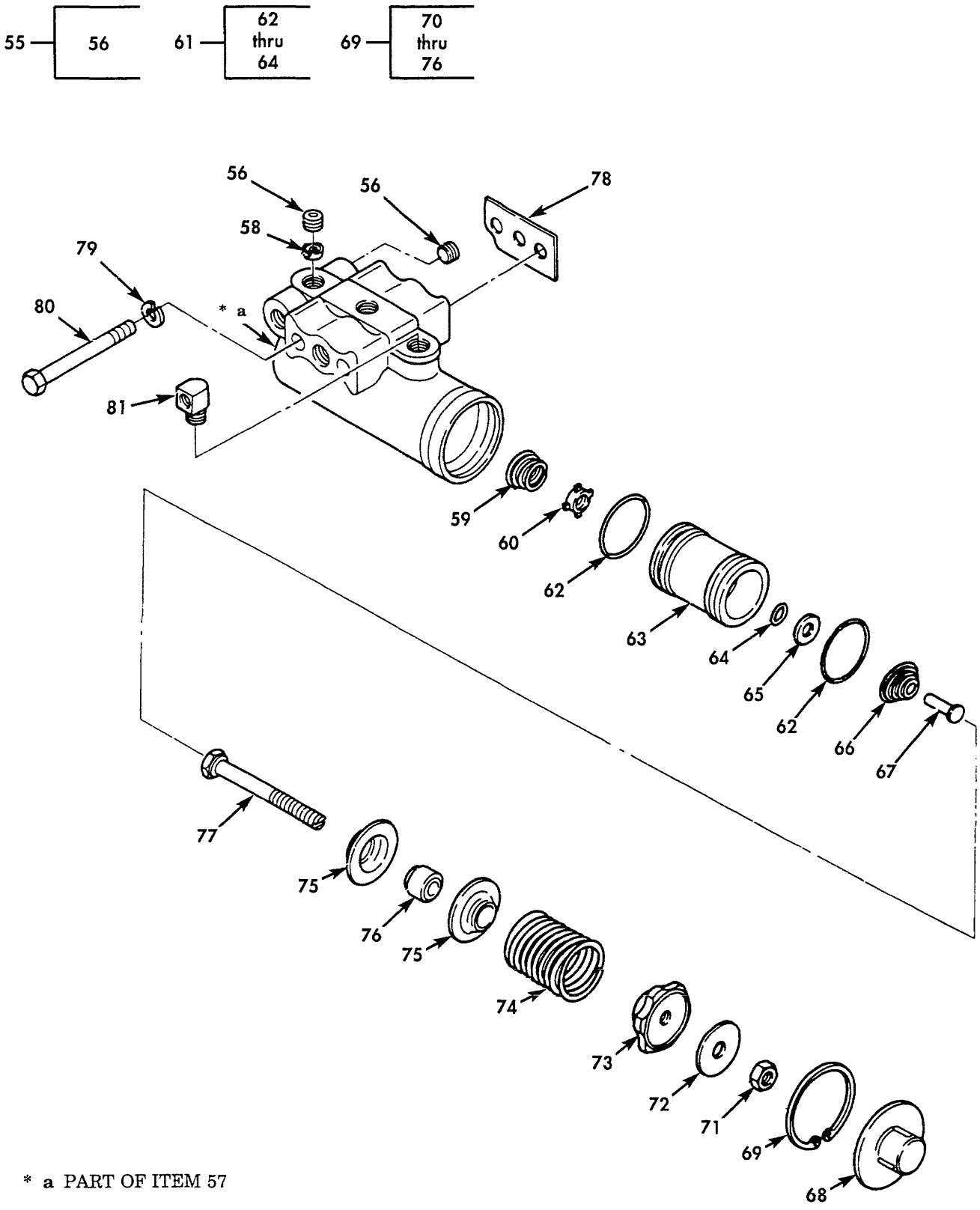


Figure 20. Air Compressor and Governor Assembly (Sheet 2 of 2).

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 0121 COMPRESSOR ASSEMBLY	
					FIG. 20 AIR COMPRESSOR AND GOVERNOR ASSEMBLY	
1	PAFZZ	5310000116122	12204	116122	WASHER, LOCK	4
2	PAFZZ	5305011474034	15434	S-122-C	SCREW, CAP, HEXAGON H	2
3	XBFZZ		96906	MS90725-90	SCREW, CAP, HEXAGON H	2
4	PAFZZ	3010010793461	15434	199349	COUPLING, SHAFT, RIGI	1
5	PAFZZ	5330011810631	15434	320-1850	GASKET	1
6	PAFZZ	5310011124307	15434	69324	WASHER, FLAT	2
7	PAFZZ	5310006500187	15434	S-217	NUT, PLAIN, HEXAGON	2
8	PAFFD	4310011410879	15434	3024365	COMPRESSOR, RECIPROC	1
9	PAFZZ	5305002258507	96906	MS90725-43	.SCREW, CAP, HEXAGON H	4
10	PAFZZ	5310004079566	96906	MS35338-45	.WASHER, LOCK	2
11	PAFZZ	5310005626558	15434	S-626	.WASHER, FLAT	2
12	PFFZZ	4310011465921	15434	153964	.COVER, AIR COMPRESSO	1
13	PCFZZ	5330001317072	15434	3047159	.GASKET	1
14	PFFZZ	4310011461097	15434	218793	.CYLINDER HEAD, COMPR	1
15	PCFZZ	5330008527347	15434	154018	.GASKET	1
16	XBFFZ		15434	3018488	.PISTON, COMPRESSOR	1
17	PAFZZ	4310010796938	15434	165430	..PISTON, COMPRESSOR	1
18	PAFZZ	4310009037174	15434	119810	..PIN, PISTON	1
19	PAFZZ	5325009229101	15434	119859	..RING, RETAINING	2
20	PAFZZ	2815003697846	15434	3558655	..CONNECTING ROD, PIST	1
21	PAFZZ	3120011467196	15434	3018153	..BUSHING, SLEEVE.	1
22	KFFZZ		15434	180810	..RING, PISTON PART OF KIT P/N AR-73350	1
23	KFFZZ		15434	1875350	RING, COMPRESSION, PART OF KIT P/N AR-73350	1
24	KFFZZ		15434	650330	..RING, PISTON PART OF KIT P/N AR-73350	1
25	PAFZZ	4310010793319	15434	3558653	..HOUSING, AIR COMPRES	1
26	PAFZZ	3120010164883	15434	147610	..BEARING, SLEEVE	1
27	PFFZZ	9905004737260	15434	136403	..PLATE, MARKING, BLANK	1
28	PFFZZ	5305008046318	15434	S-2286	..SCREW	2
29	PAFZZ	4310010793383	15435	AR-10922	..CRANKSHAFT, COMPRESS	1
30	PAFZZ	4730009647548	21450	444683	...PLUG, PIPE	1
31	PFFZZ	5330001299389	15434	176027	.GASKET	1
32	PAFZZ	2530011302339	15434	3005152	.SUPPORT, AIR COMPRES	1
33	PAFZZ	5310002090965	96906	MS35338-47	.WASHER, LOCK	4
34	PAFZZ	5305011294384	15434	3015282	.SCREW, CAP, HEXAGON H	4
35	PAFZZ	3120011297659	15434	211662	.BEARING, WASHER, THRU	1
36	PAFZZ	3010010852732	15434	3000174	.COUPLING HALF, SHAFT	1
37	PAFZZ	5305011458359	15434	3019573	.SCREW, ASSEMBLED WAS	2
38	PAFZZ	5365003694729	15434	183429	.SHIM	1
39	PAFZZ	5360008953216	15434	128080	.SPRING, HELICAL, COMP EXHAUST VALVE.	1
40	PAFZZ	4820004450610	15434	127940	.DISK, VALVE	1
41	PCFZZ	5331009052679	15434	128085	.O-RING EXHAUST VALVE	1
42	PAFZZ	4820009094174	15434	144714	.SEAT, VALVE	1
43	PCFZZ	5330010609061	15434	211315	.PACKING, PREFORMED	1
44	PAFZZ	5360001299415	15434	190334	.SPRING, HELICAL, COMP INTAKE VALVE	1
45	PAFZZ	3805009555320	15434	144948	.VALVE INTAKE COMPRE	1

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
46	PAFZZ	4820009094175	15434	145028	.SEAT, VALVE	1
47	PAFZZ	5360010863480	15434	3023101	.SPRING, HELICAL, COMP UNLOADER VALVE	1
48	PAFZZ	4310010847148	8X479	191037	.CAP, UNLOADER	1
49	PCFZZ	5331009413762	15434	127936	.O-RING	1
50	PCFZZ	5331004410145	15434	128086	.O-RING UNLOADER VALVE	1
51	PAFZZ	4310011464155	15434	185847	.BODY, UNLOADING VALV UNLOADER VALVE	1
52	PAFZZ	5310010561371	28265	14978	.WASHER, FLAT	2
53	PAFZZ	5305011446233	15434	3021470	.SCREW, CAP, HEXAGON H WITH CAPTIVE WASHER, 5/16	2
54	PAFFZ	2530008275934	06853	275707	GOVERNOR ASSEMBLY, A	1
55	PFFZZ	2530010930872	06853	275230	HOUSING, AIR BRAKE G	1
56	PAFZZ	4730006023707	25511	P49787	.PLUG, PIPE	3
57	PAFZZ	4730002250710	06853	240346	STRAINER ELEMENT, SE	2
58	PAFZZ	5360002250709	06853	240336	SPRING, HELICAL, COMP	1
59	PAFZZ	4820002250708	06853	240334	DISK, VALVE	1
60	PAFZZ	5331002250707	06853	239658	PACKING, PREFORMED	2
61	PFFZZ	2530006031532	06853	103840	PISTON, LINEAR ACTUA	1
62	XAFZZ		06853	240331	.PISTON, GOVERNOR, COM	1
63	PAFZZ	5331003119188	06853	230175	.PACKING, PREFORMED	1
64	PAFZZ	5310001435722	04998	WA1248	.WASHER, FLAT	1
65	PAFZZ	5360000791940	06853	240338	SPRING, HELICAL, COMP	1
66	PAFZZ	4820001179103	06853	240339	STEM, EXHAUST	1
67	PAFZZ	5340009223522	06853	240347	COVER, ACCESS	1
68	PAFZZ	5340007387552	06853	240345	CLIP, RETAINING	1
69	PFFZZ	4310002250706	06853	275202	PARTS KIT, GASOLINE	1
70	PAFZZ	5310004037731	06853	202961	.NUT, PLAIN, HEXAGON	1
71	PAFZZ	5310011577361	06853	246075	.WASHER, FLAT	1
72	PAFZZ	5340001179102	06853	240344	.SEAT, HELICAL COMPRE	1
73	PAFZZ	5360006031518	06853	240343	.SPRING, HELICAL, COMP	1
74	PAFZZ	5340001166767	06853	240341	.SEAT, HELICAL COMP RE	2
75	PAFZZ	2530001169953	06853	240342	.GUIDE, SPRING	1
76	PAFZZ	5305008396230	06853	240340	.SETSCREW	1
77	PCFZZ	5330010977791	06853	237303	GASKET	1
78	PAFZZ	5310010978039	24617	9417953	WASHER, LOCK	2
79	PAFZZ	5305011184285	24617	9418993	SCREW, CAP, HEXAGON H	2
80	PAFZZ	4730002778269	79470	400X3	ELBOW, PIPE TO TUBE	1

END OF FIGURE

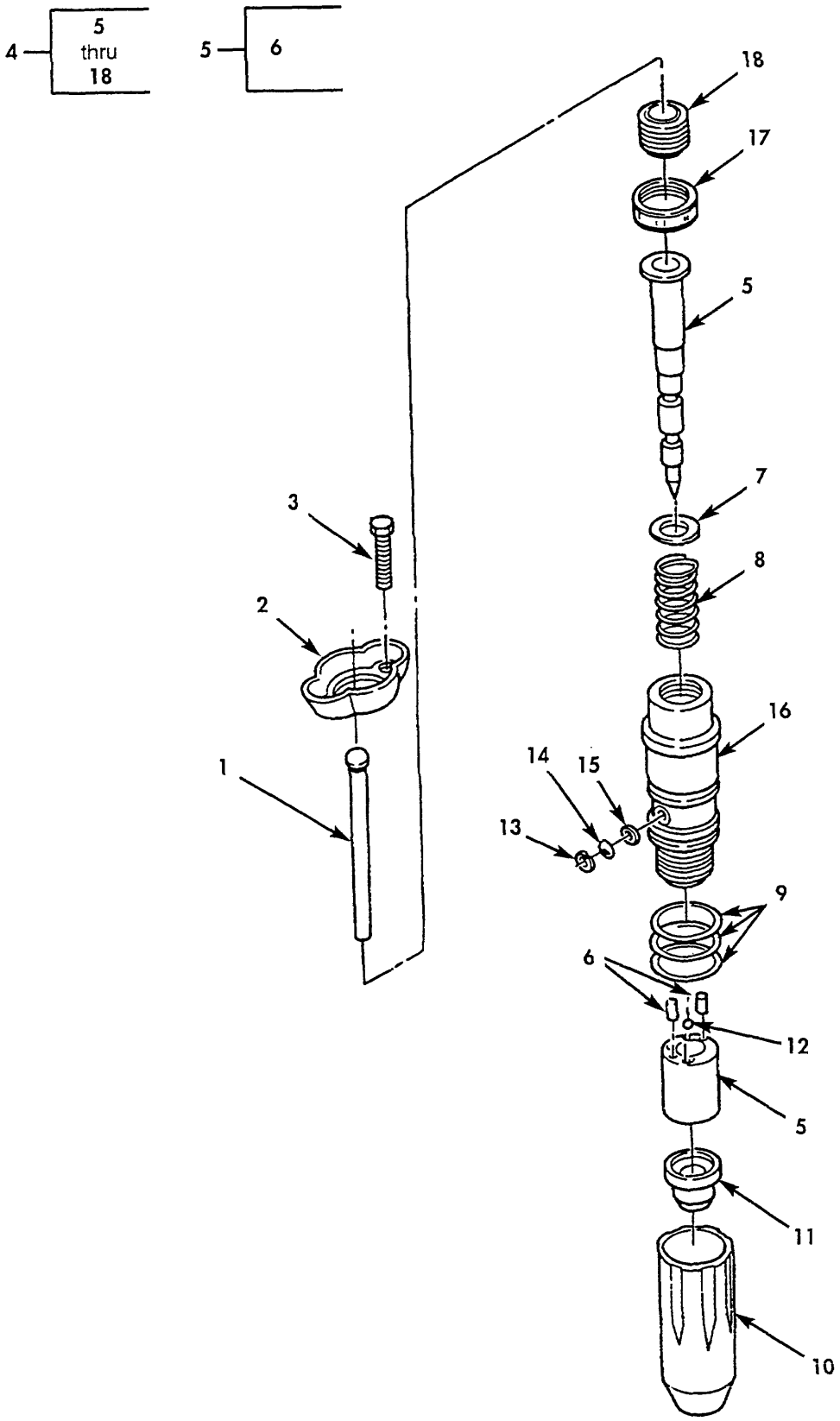


Figure 21. Fuel Injector.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 03 FUEL SYSTEM	
					GROUP 0301 CARBURETOR, FUEL INJECTOR	
					FIG. 21 FUEL INJECTOR	
1	PAFZZ	5340002385435	15434	191916	PLUNGER, DETENT	6
2	PAFZZ	3040010774976	15434	3003682	PLATE, RETAINING, SHA INJECTOR TO CYLINDER HEAD, INJECTOR, FUEL, M915 ONLY	6
2	PAFZZ	5342011450646	15434	3028171	CLAMP M915A1 ONLY	6
3	PAFZZ	5305010867285	15434	202069	SCREW, CAP, SOCKET HE INJECTOR TO CYLINDER HEAD, INJECTOR, FUEL, M915 ONLY	12
3	PAFZZ	5305011450777	15434	3028279	SCREW, CAP, HEXAGON H INJECTOR CLAMP, M915A1 ONLY	12
4	PAFHH	2910011127712	15434	3054071	INJECTOR ASSEMBLY, F M915 ONLY	6
4	PAFHH	2910011459403	15434	3030445	NOZZLE, FUEL INJECTI M915A1 ONLY	6
5	PAHZZ	5340011450647	15434	3047963	.PLUNGER, QUICK RELEA	1
6	PAHZZ	5315010796506	15434	203426	..PIN, SPRING	2
7	PAHZZ	5310010796529	15434	208525	.WASHER, SHOULDERED A M915 ONLY	1
7	PAHZZ	5310011451114	15434	3015469	.WASHER M915A1 ONLY	1
8	PAHZZ	5360001320245	15434	166009	.SPRING, HELICAL, COMP	1
9	PCHZZ	5330001320276	15434	193736	.GASKET PART OF KIT P/N 3804280 PART OF KIT P/N 3804275	3
10	PAHZZ	5342010794678	15434	185138	.RETAINER, CUP	1
11	PAHZZ	2910010863974	15434	3012538	.CUP, INJECTOR INJECTOR, FUEL, M915 ONLY	1
11	PAHZZ	2910011461998	15434	3023556	.CUP, INJECTOR, FUEL M915A1 ONLY	1
12	PAHZZ	4820010709710	15434	167157	.BALL CHECK, FUEL INJ	1
13	PAHZZ	5365008151137	15434	174299	.RING, RETAINING	1
14	PAHZZ	4730010772016	15434	3008706	.STRAINER ELEMENT, SE	1
15	PCHZZ	5330001320247	15434	173086	.GASKET	1
16	PAHZZ	2910010768632	15434	3000464	.ADAPTER, INJECTOR	1
17	PAHZZ	5310010796708	15434	3000465	.NUT, PLAIN, DODECAGON	1
18	PAHZZ	5305010797028	15434	212954	.SCREW	1

END OF FIGURE

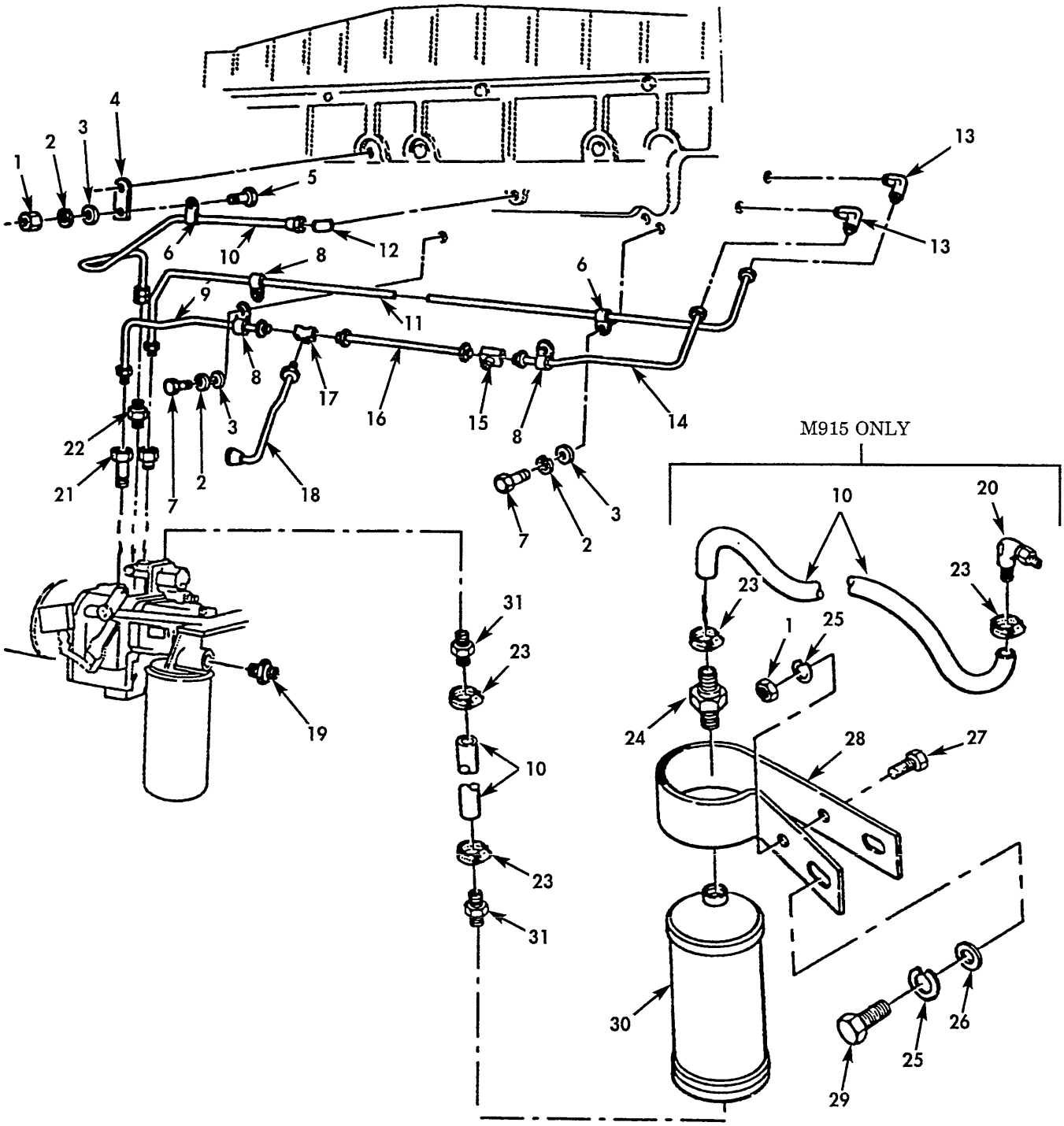


Figure 22. Fuel Lines and Fittings.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 0302 FUEL PUMP	
					FIG. 22 FUEL LINES AND FITTINGS	
1	PAOZZ	5310005218595	15434	S-223	NUT HE, AGON	2
2	PAOZZ	5310001596209	96906	MS122032	WASHER, LOCK M915 ONLY	2
2	PAOZZ	5310002617340	15434	S-604	WASHER, LOCK M915A1 ONLY	3
3	PAFZZ	5310005626560	15434	S631	WASHER, FLAT M915 ONLY	4
3	PAOZZ	5310004862505	15434	108330	WASHER, FLAT M915A1 ONLY	3
4	PFOZZ	5342008583507	15434	147135	BRACKET, TUBE SUPPOR	1
5	PAOZZ	5305010291193	15434	S-117	SCREW 3/8-16 X 3/4	1
6	PAOZZ	5340010798097	15434	180371	CLAMP, LOOP	2
7	PAOZZ	5306012043297	15434	137796	BOLT, MACHINE M915 ONLY	1
7	PAOZZ	5305007959345	15434	S190C	SCREW, CAP 3/8 - 24 X 5/8 M915 ONLY	2
8	PAOZZ	5340007194601	15434	180372	CLAMP, LOOP	3
9	PBOZZ	4710010859348	15434	3015373	TUBE ASSEMBLY, METAL M915 ONLY	1
9	PAOZZ	4710011463779	15434	3022821	TUBE ASSEMBLY, METAL M915A1 ONLY	1
10	PAOZZ	4710011461115	15434	3038037	TUBE ASSEMBLY, METAL M915A1 ONLY	1
10	MOOZZ	19207	5414243-20		HOSE, NONMETALLIC M915 ONLY, MAKE FROM P/N 28430 PART OF KIT P/N 302112400	2
11	PBOZZ	4710010793493	15434	216128	TUBE ASSEMBLY, METAL M915 ONLY	1
11	PAOZZ	4710011461114	15434	202185	TUBE ASSEMBLY, METAL M915A1 ONLY	1
12	PAOZZ	4730011314884	15434	S-1097	ADAPTER, STRAIGHT, PI WITH ADAPTER AND PLUG	1
13	PAOZZ	4730004441710	15434	181213	ELBOW, PIPE TO TUBE	2
14	PBOZZ	4710011068068	15434	3009848	TUBE ASSEMBLY, METAL M915 ONLY	1
14	PAOZZ	4710011461116	15434	3013161	TUBE ASSEMBLY, METAL M91A1 ONLY	1
15	PAOZZ	4730011463633	15434	3014398	TEE, TUBE	1
16	PBOZZ	4710010856134	15434	3015393	TUBE ASSEMBLY, METAL M915 ONLY	1
16	PAOZZ	4710011461113	15434	3015389	TUBE ASSEMBLY, METAL M915A1 ONLY	1
17	PAOZZ	4730011098501	15434	3014397	TEE, TUBE	1
18	PBOZZ	4710010859349	15434	3015375	TUBE ASSEMBLY, METAL M915 ONLY	1
18	PAOZZ	4710011463169	15434	3015387	TUBE ASSEMBLY, METAL M915A1 ONLY	1
19	PAOZZ	4730011064700	15434	129866	ADAPTER, STRAIGHT, TU	1
20	PAOZZ	4730011428524	15434	68139	ELBOW, PIPE TO TUBE	1
21	PAOZZ	2910011460093	15434	3020760	VALVE	1
22	PAOZZ	4730011463040	15434	3018889	ADAPTER, STRAIGHT, PI	1
23	PAOZZ	4730002789200	88044	AN737TW22	CLAMP, HOSE M915 ONLY PART OF KIT P/N 302112400	4
24	KFOZZ		15434	3020754	BODY, CHECK VALVE M915 ONLY PART OF KIT P/N 302112400	1
25	PAOZZ	5310006379541	96906	MS35338-46	WASHER, LOCK M915 ONLY PART OF KIT P/N 302112400	2
26	KFOZZ		15434	S689	WASHER, PLAIN M915 ONLY PART OF KIT P/N 302112400	1
27	KFOZZ		15434	S-109	SCREW, CAP, HEXAGON M915 ONLY PART OF KIT P/N 302112400	1
28	KFOZZ		15434	170970	CLAMP M915 ONLY PART KIT P/N 302112400	1
29	KFOZZ		15434	S-151C	SCREW, CAP, HEXAGON M915 ONLY PART OF KIT P/N 302112400	1
30	KFOZZ		15434	3020753	TANK, AIR PART OF KIT P/N 302112400.	1

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
31	PAOZZ	4730009003296	72983	248X4	ADAPTER, STRAIGHT, PI PART OF KIT P/N 302112400	2

END OF FIGURE

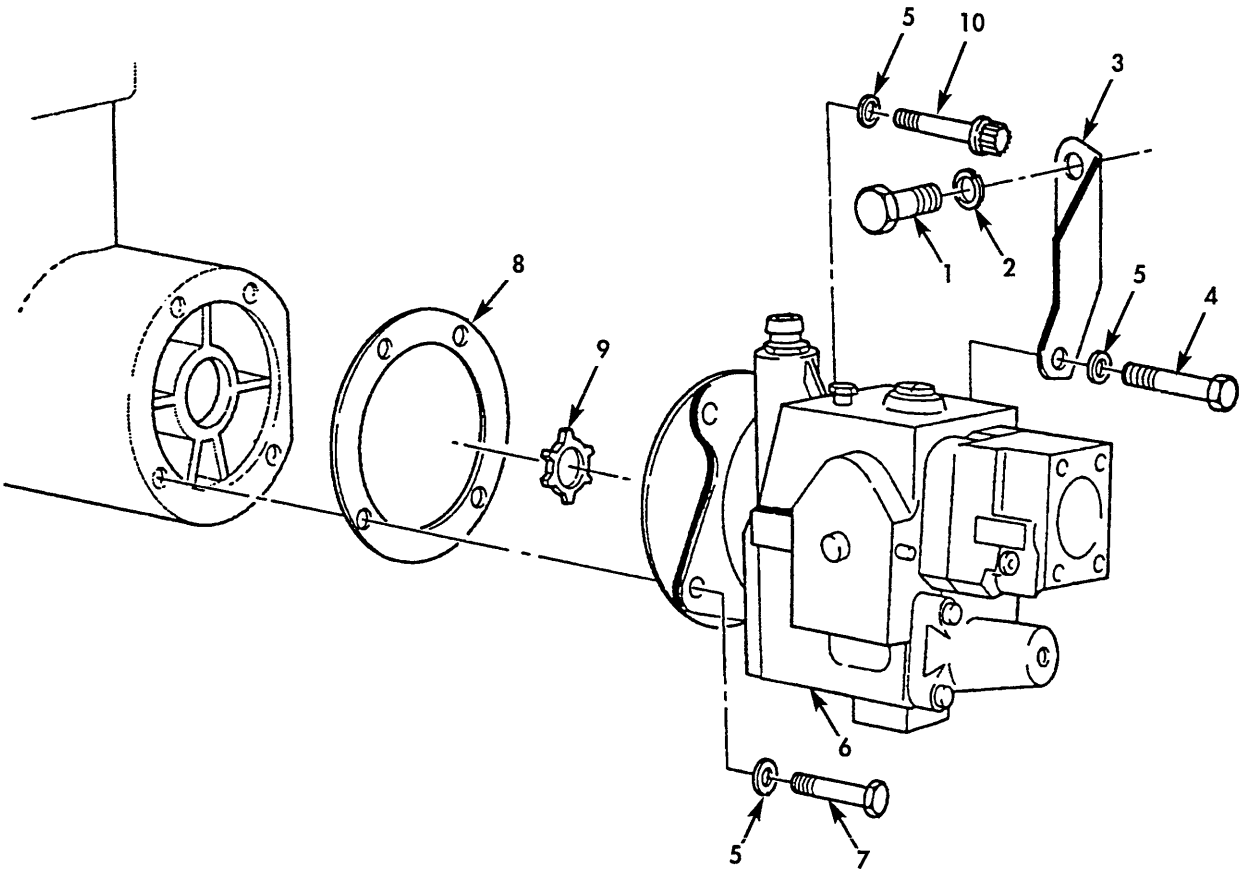


Figure 23. Fuel Pump.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 0302 FUEL PUMP	
					FIG. 23 FUEL PUMP	
1	PAFZZ	5305011474034	15434	S-122-C	SCREW, CAP, HEXAGON H 9/16-18 X 7/8	1
2	PAFZZ	5310000116122	12204	116122	WASHER, LOCK	1
3	PFFZZ	5342010854153	15434	3001296	BRACKET, AIR COMPRES	1
4	PAFZZ	5305011478732	15434	3012481	SCREW, CAP, HEXAGON H 7/16-14 X 1 1/2, M915A1 ONLY	1
5	PAFZZ	5310011124307	15434	69324	WASHER, FLAT	4
6	PAFHH	2910011419372	15434	3060202-3894	PUMP, FUEL, METERING "BUSHED GEAR." CAN BE USED W/ALL DIESEL FUELS. M915A1	1
6	PAFHH	2910010653979	15434	3060199-4128	PUMP, FUEL, ENGINE "NON-BUSHED GEAR" M915 ONLY	1
7	PAFZZ	5305011294384	15434	3015282	SCREW, CAP, HEXAGON H M915 ONLY	2
7	PAFZZ	5305011450777	15434	3028279	SCREW, CAP, HEXAGON H M915A1 ONLY	1
8	PAHZZ	5330011607460	15434	3035053	GASKET	1
9	PAFZZ	3010004479799	15434	162426	INSERT, FLEXIBLE COU FUEL PUMP TO AIR COMPRESSOR	1
10	PAFZZ	5305011131179	15434	206326	SCREW, CAP, HEXAGON H 7/16-14 X 1 1/4	1

END OF FIGURE

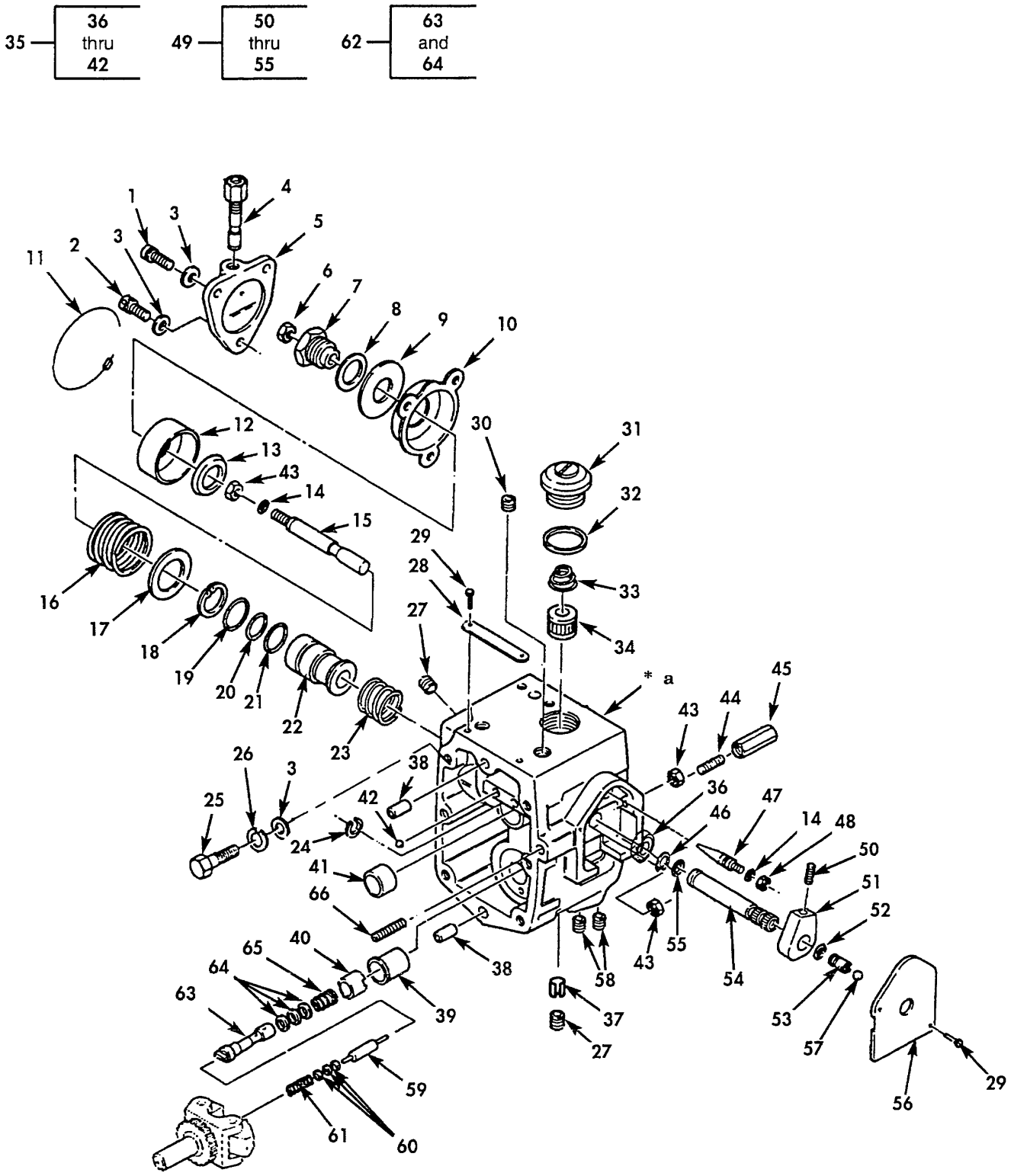


Figure 24. Fuel Pump Main Housing.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 0302 FUEL PUMP	
					FIG. 24 FUEL PUMP MAIN HOUSING	
1	PAHZZ	5305011294385	15434	70772-B	SCREW, CAP, HEXAGON H FILSTER HEAD, 1/4-20 X 1.00	2
2	PAHZZ	5305011294218	15434	3012558	SCREW DRILLED FILSTER HEAD, 1/4-20 X 1.00	1
3	PAHZZ	5310005626560	15434	S-631	WASHER, FLAT	3
4	PAHZZ	4820010793241	15434	3015522	CARTRIDGE, VALVE, CHE	1
5	PAHZZ	2910011414967	15434	3015520	COVER, FUEL CONTROL	1
6	PAHZZ	5310004516643	15434	S-213-A	NUT, FLYWHEEL	1
7	PAHZZ	2910011414029	15434	3023171	HOUSING, SPRING PUMP	1
8	PAHZZ	5330011422784	15434	3023870	GASKET PART OF KIT P/N 3010242	1
9	PAHZZ	5310011450761	15434	214150	WASHER, FLAT	1
10	PAHZZ	4820010793320	15434	3013811	DIAPHRAGM, VALVE	1
11	PAHZZ	5330010728830	15434	3003156	SEAL, SPECIAL PART OF KIT P/N 3010242	1
12	PAHZZ	2910011427455	15434	3013810	PISTON, AIR FLOW	1
13	PAHZZ	5310011422812	15434	3023088	WASHER, FLAT	1
14	PCHZZ	5331009703461	15434	68061-A	O-RING PART OF KIT P/N 3010242	2
15	PAHZZ	2910011269053	15434	3021676	PLUNGER, AIR FLOW	1
16	PAHZZ	5360010866113	15434	179834	SPRING, HELICAL, COMP M915 ONLY	1
16	PAHZZ	5360011470054	15434	179822	SPRING, HELICAL, COMP M915A1 ONLY	1
17	PAHZZ	5365010798373	15434	3001707	SHIM	1
18	PAHZZ	5325005589412	96906	MS16629-1100	RING, RETAINING	1
19	PAHZZ	5330010728982	15434	145505	PACKING, PREFORMED PART OF KIT P/N 3010242	1
20	PAHZZ	5330010514243	15434	145504	PACKING, PREFORMED PART OF KIT P/N 3010242	1
21	PCHZZ	5330004039896	15434	193734	PACKING, PREFORMED M915 ONLY	1
21	PAHZZ	5330005992962	94135	12Z9026-5	PACKING, PREFORMED M915A1 ONLY	1
22	PAHZZ	3040010861651	15434	214146	CYLINDER, ACTUATING M915 ONLY	1
22	PAHZZ	2910011424953	15434	3021068	BARREL, AIR FLOW M915A1 ONLY	1
23	PAHZZ	5360011345602	15434	3018655	SPRING, HELICAL, COMP	1
24	PAHZZ	5325002562846	96906	MS16632-1050	RING, RETAINING	1
25	PAFZZ	5305004264146	15434	S105X	SCREW, CAP	6
26	PAFZZ	5310004841718	15434	181466	WASHER, LOCK	6
27	PAFZZ	4730011243762	15434	3025460	PLUG, PIPE	4
28	PFHZZ	9905007337622	15434	105375	PLATE, IDENTIFICATIO	1
29	PFHZZ	5305008046318	15434	S-2286	SCREW	4
30	PAHZZ	4730005558292	24617	444704	PLUG, PIPE M915A1 ONLY	1
30	PAFZZ	4730000428988	11862	117244	PLUG, PIPE M915 ONLY	1
31	PAOZZ	5365005073271	15434	157088	PLUG, MACHINE THREAD	1
32	PCOZZ	5330009619470	15434	154088	SEAL CAP PART OF KIT P/N 3010242	1
33	PAOZZ	5360005974570	15434	70700	SPRING, HELICAL, COMP	1
34	PAOZZ	2910007908736	15434	146483	FILTER ELEMENT, FLUI	1
35	XDHZZ		15434	AR41022	HOSING, FUEL PUMP M915 ONLY	1
35	PAHZZ	2910011461084	15434	3010042	BARREL, GOVERNOR M915A1 ONLY	1
36	PAHZZ	3120010803275	15434	209760	.BUSHING, SLEEVE.	1
37	PAHZZ	5342004005178	15434	163733	.CLIP, GOVERNOR BARRE	1
38	PAHZZ	5315008440140	15434	118227	.PIN, HOLLOW	4
39	PAHZZ	2910010985118	15434	217798	.HOUSING, SPRING PACK	1
40	PAHZZ	2910011479913	15434	3001847	.BARREL ASSEMBLY, GOV	1

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
41	PAHZZ	3120008106032	15434	100193	.BEARING, SLEEVE TACHOMETER DRIVE	1
42	PAHZZ	2910011414028	15434	214139	.BALL, PLUG BRASS	2
43	PAHZZ	5310009717989	96906	MS35691-5	NUT, PLAIN, HEXAGON	3
44	PAHZZ	5340007164975	15434	110058	POST, ELECTRICAL-MEC	1
45	PAHZZ	5305011099307	15434	195755	SCREW	1
46	PAHZZ	5325002562846	96906	MS16632-1050	RING, RETAINING	1
47	PAHZZ	2910010917507	15434	214144	VALVE, NEEDLE CARBUR	1
48	PFHZZ	5310000056052	15434	S248	NUT, PLAIN, HEXAGON	1
49	PAHHZ	2910010803149	15434	AR-41010	SHAFT ASSEMBLY, THRO	1
50	PFHZZ	5305011355446	15434	3006344	.SETSCREW 1/4-28UNF-3A	1
51	PFHZZ	3040010861449	15434	3006343	.END, CONTROL R	1
52	PCHZZ	5331010728983	15434	213768	.O-RING PART OF KIT P/N 3010242	1
53	PAHZZ	5305010728826	15434	3006175	.SCREW FUEL ADJUSTING	1
54	PAHZZ	3040011504926	15434	3006350	.SHAFT, THROTTLE	1
55	PAHZZ	5331000819289	15434	100478	.O-RING	1
56	PAHZZ	4320010985115	15434	3000446	COVER THROTTLE SHAFT	1
57	PAHZZ	3110010798190	15434	213769	BALL, BEARING	1
58	PAHZZ	4730010786364	15434	20063500	PLUG, PIPE M915 ONLY	2
59	PAHZZ	5315000820448	15434	144178	PIN, SHOULDER, HEADLE M915A1 ONLY	1
60	PAHZZ	5310007278353	15434	144179	WASHER, FLAT M915A1 ONLY	3
61	PAHZZ	5360010953661	15434	143848	SPRING, HELICAL, COMP M915A1 ONLY	1
62	PFHZZ	2910010709712	15434	3039070	PLUNGER ASSEMBLY, GO M915 ONLY	1
62	PAHZZ	5342011451549	15434	3010810	PLUNGER M915A1 ONLY	1
63	PAHZZ	2910010805570	15434	203350	.PLUNGER, GOVERNOR M915 ONLY	1
63	PAHZZ	5365008295604	15434	144302	.SPACER, FUEL PUMP M915A1 ONLY	1
63	PAHZZ	2910011363331	15434	3009380	.PLUNGER, GOVERNOR M915A1 ONLY	1
63	PAHZZ	2990007721778	15434	70690	.DRIVER, PLUNGER, GOVE GOVERNOR PLUNGER	1
64	PAHZZ	5365005073224	15434	101841	.SHIM	V
64	PAHZZ	5365005073225	15434	101842	.SHIM	V
64	PAHZZ	5365005433744	15434	101843	.SPACER, RING	V
64	XDHZZ		15434	3026733	.SHIM M915A1 ONLY	V
65	PAHZZ	5360010866114	15434	138769	SPRING, HELICAL, COMP M915 ONLY	1
65	PAHZZ	5360011386638	15434	138781	SPRING, HELICAL, COMP M915A1 ONLY	1
66	PAHZZ	5305000635043	88044	AN565F428H24	SETSCREW	1

END OF FIGURE

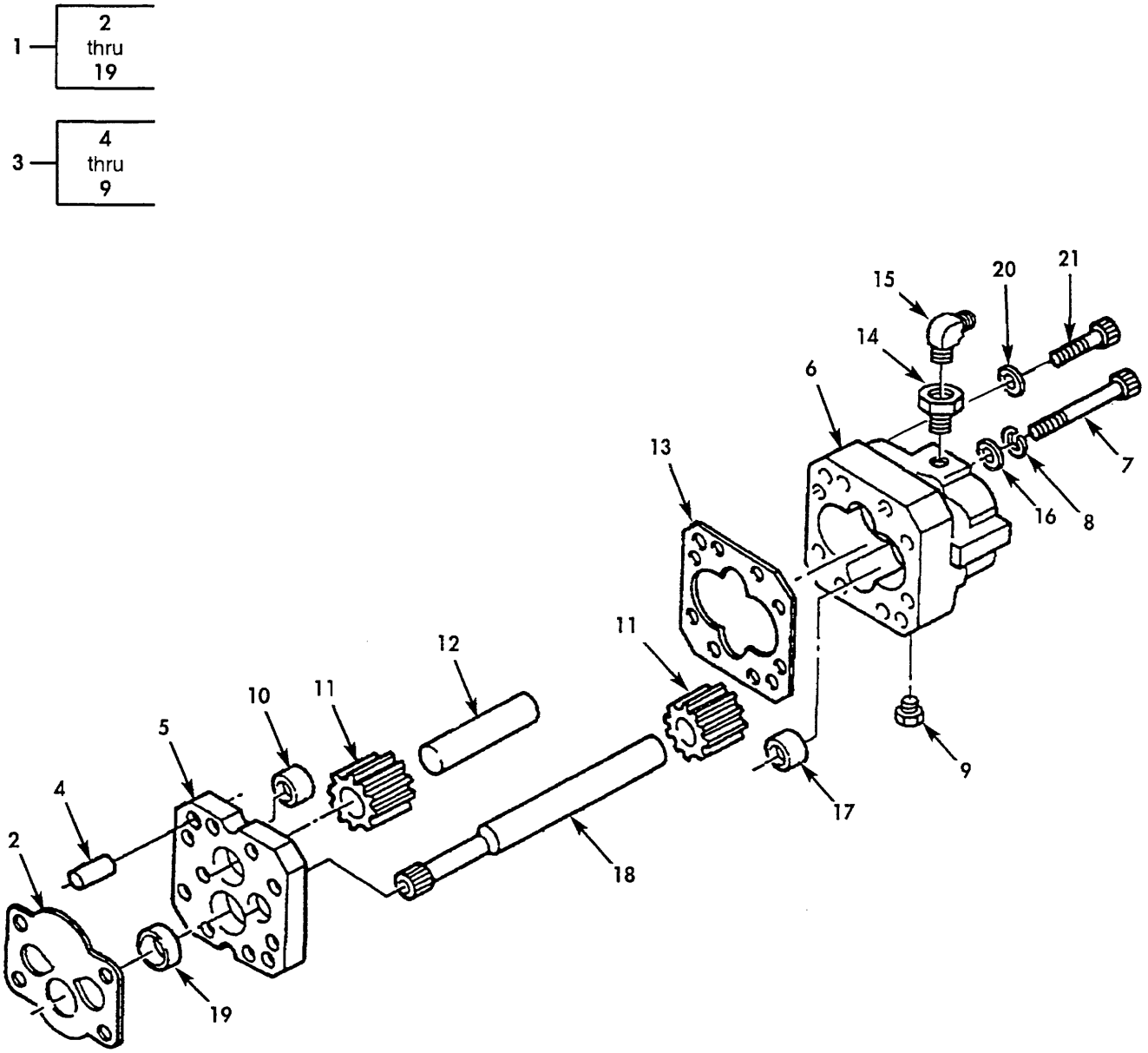


Figure 25. Fuel Gear Pump.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 0302 FUEL PUMP	
					FIG. 25 FUEL GEAR PUMP	
1	PAFHD	3020012915753	15434	3034243	GEAR, PUMP ASSEMBLY "BUSHED." CAN BE USED W/ALL DIESEL FUELS	1
2	PCHZZ	5330005673463	15434	110855	.GASKET PART OF KIT P/N 3010242	1
3	PAHHH	2910010969200	15434	BM97497	.HOUSING AND COVER	1
4	PAHZZ	5315000141244	24617	141244	..PIN, STRAIGHT, HEADLE 3/8 X 1.00	2
5	XAHZZ		15434	175867	..COVER	1
6	XAHZZ		15434	175860	..HOUSING	1
7	PAHZZ	5306004850790	15434	70790	..BOLT, MACHINE 1/4-20 X 2.50	2
8	PAHZZ	5310004841718	15434	181466	..WASHER, LOCK	4
9	PAHZZ	4730002782973	96906	MS27769U2	..PLUG, PIPE	1
10	PAHZZ	4820012422579	15434	3050624	.VALVE, REGULATING, FL	1
11	PAHZZ	3020007023882	15434	119363	.GEAR, SPUR	2
12	PAHZZ	3040009333012	15434	175864	.SHAFT, IDLER, GEAR PU	1
13	PCHZZ	5330011368569	15434	3026163	.GASKET PART OF KIT P/N 3010242	1
14	XDHZZ		15434	3045049	.PLUG	1
15	PAHZZ	4820011647002	15434	3033740	.VALVE, CHECK	1
16	PAOZZ	5310001411795	88044	AN960-416	.WASHER, FLAT	1
17	PAHZZ	3120012159157	15434	3033724	.BEARING, SLEEVE	4
18	PAHZZ	3040005674354	15434	100215	.SHAFT, SHOULDERED	1
19	PAHZZ	3120011858586	15434	3033719	.BUSHING, SLEEVE	1
20	PAOZZ	5310001411795	88044	AN960-416	WASHER, FLAT	4
21	PAFZZ	5305007213698	15434	100129	SCREW, CAP, SOCKET HE	4

END OF FIGURE

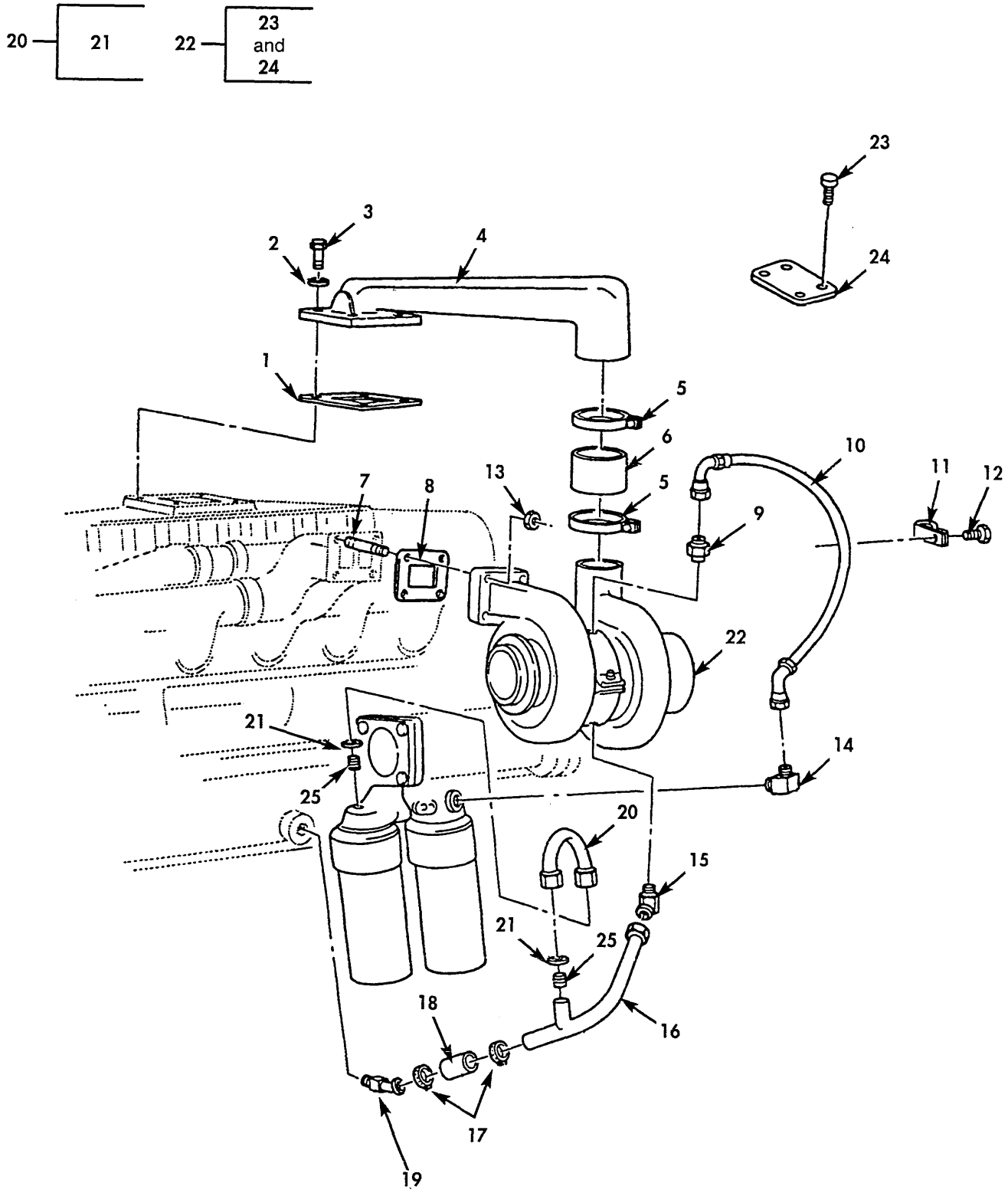


Figure 26. Turbocharger and Component Parts.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 0305 SUPERCHARGER, BLOWER, TURBOCHARGER, OR ALTITUDE COMPENSATOR	
					FIG. 26 TURBOCHARGER AND COMPONENT PARTS	
1	PCOZZ	5330010728998	15434	216487	GASKET CROSSOVER MOUNTING, PART OF KIT P/N 3804280 PART OF KIT P/N 3804275	1
2	PAOZZ	5310006843463	96906	MS51092-1	WASHER, FLAT	4
3	PAOZZ	5305000680511	80204	B1821BH038C125N	SCREW, CAP, HEXAGON H 3/8-16 X 1 1/4.	4
4	PAOZZ	4730012946019	15434	200488	ADAPTER, STRAIGHT, P1 M915 ONLY	1
4	PAOZZ	2815011461102	15434	3018686	MANIFOLD, INTAKE AIR CROSSOVER, M915A1 ONLY	1
5	PAOZZ	4730004774160	15434	208326	CLAMP, HOSE	2
6	PCOZZ	4720010708149	55683	851-202994	HOSE, PREFORMED	1
7	PAFZZ	5307009222626	15434	3006289	STUD, PLAIN TURBOCHARGER MOUNTING	4
8	PCFZZ	5330001948385	15434	190849	GASKET PART OF KIT P/N 3804280 PART OF KIT P/N 3804275	1
9	PAFZZ	4730011276104	15434	3014354	ADAPTER, STRAIGHT, PI	1
10	PCHZZ	4720010856293	15434	215195	HOSE ASSEMBLY, NONME M915 ONLY	1
10	PAFZZ	4720011461071	15434	209955	HOSE ASSEMBLY, NONME M915A1 ONLY	1
11	PAFZZ	4730005558263	53496	5561 1-2A	CLAMP, HOSE	2
12	PAHZZ	5305002301939	15434	S118A	SCREW M915 ONLY	1
12	PAFZZ	5305000680502	96906	MS90725-6	SCREW, CAP, HEXAGON H WITH CAPTIVE WASHER, 1/4-20 X 3/4, M915A1 ONLY	1
13	PAFZZ	5310012879737	15434	3056158	NUT, SLEEVE TURBOCHARGER MOUNTING, 3/8-24, M915A1 ONLY	4
14	PAFZZ	4730011463631	15434	3025611	ELBOW, TUBE OIL SUPPLY HOSE, M915A1 ONLY	2
15	PAFZZ	4730011467047	15434	3000560	ELBOW, PIPE TO TUBE M915A1 ONLY	1
16	PAHZZ	4710010793487	15434	3016456	TUBE ASSEMBLY, METAL. M915 ONLY	1
16	PAFZZ	4710011463167	15434	3035600	TUBE ASSEMBLY, METAL TURBOCHARGER DRAIN TUBE, M915A1 ONLY	1
17	PAHZZ	5340004003449	15434	108722	CLAMP, LOOP M915 ONLY	2
17	PAFZZ	4730005558263	53496	5561 1-2A	CLAMP, HOSE M915A1 ONLY	2
18	PCFZZ	4720010851316	15434	AC1600300NF	HOSE, NONMETALLIC	1
19	PAFZZ	4730010793274	15434	3003536	ELBOW, PIPE TO HOSE TURBOCHARGER DRAIN	1
20	PAFZZ	4710011587507	15434	3035595	TUBE ASSEMBLY, METAL M915A1 ONLY	1
21	PCFZZ	5365005985255	15434	S-1003-A	.BUSHING, NONMETALLIC	2
22	PAFHH	2990011557284	15434	3801904	TURBOCHARGER M915 ONLY MODEL T-50	1
22	PAFHH	2950011410844	15434	3029514	TURBOSUPERCHARGER, N ASSEMBLY, T46-B, M915A1 ONLY	1
22	PFFHH	2990011723005	15434	3801942	TURBOCHARGER, ENGINE M915 ONLY MODEL #NTC400	1
23	PAHZZ	5305008046318	15434	S2286	.SCREW	4
24	KFHZZ		15434	128936	.PLATE	1
25	PAFZZ	4730003652690	15434	S-1002-A	ADAPTER, STRAIGHT, TU BY-PASS FILTER TUBE	2

END OF FIGURE

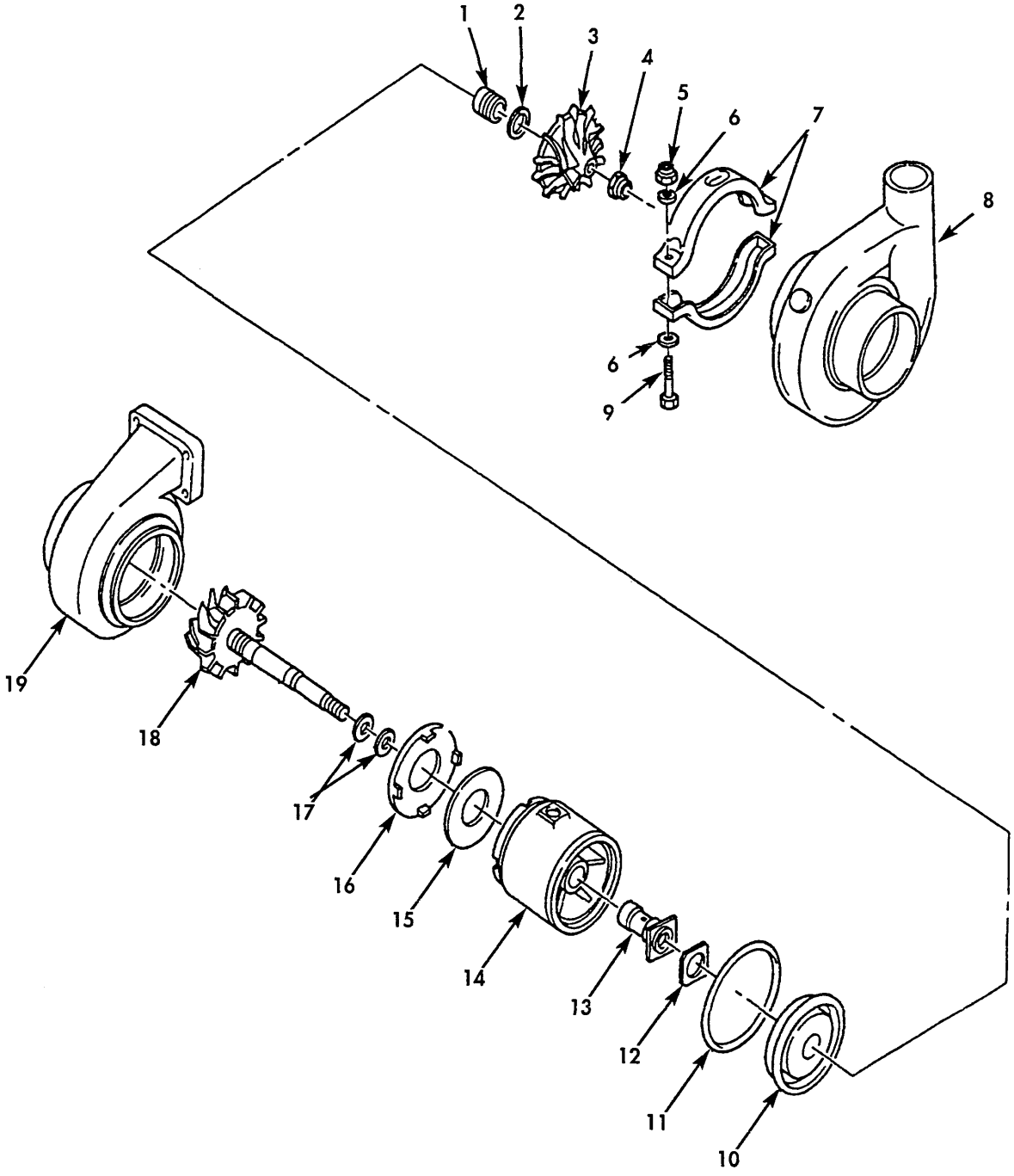


Figure 27. Turbocharger Assembly.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 0305 SUPERCHARGER, BLOWER, TURBOCHARGER, OR ALTITUDE COMPENSATOR	
					FIG. 27 TURBOCHARGER ASSEMBLY	
1	PAHZZ	5330010853580	15434	216802	SEAL, OIL, SLEEVE	1
2	KFHZZ		15434	156444	SEAL, TURBO PART OF KIT P/N 3801096.	1
3	PAHZZ	4140010852607	15434	3002731	IMPELLER, FAN, CENTRI M915 ONLY	1
3	PAHZZ	4140011461035	15434	3031980	IMPELLER, FAN, CENTRI TURBOCHARGER, M915A1 ONLY	1
4	XBHZZ		15434	S-222-A	NUT, SELF-LOCKING, HE	1
5	PAHZZ	5310006806874	15434	167299	NUT, SELF-LOCKING, HE PART OF KIT P/N 3801096	2
6	PAHZZ	5310005626560	15434	S-631	WASHER, FLAT PART OF KIT P/N 3801096.	4
7	XBHZZ		15434	156416	STRAP, RETAINING	2
8	PAHZZ	2990010854768	15434	3027308	HOUSING, COMPRESSOR M915 ONLY	1
8	XDHZZ		15434	201250	HOUSING, CENTRIFUGAL M915A1 ONLY	1
9	PAHZZ	5305004119340	15434	194010	SCREW, CAP, HEXAGON H HEXAGON HEAD CAP PART OF KIT P/N 3801096	2
10	KFHZZ		15434	217736	PLATE, DIFFUSER VANE , M915 ONLY PART OF KIT P/N 3801096	1
11	KFHZZ		15434	202456	PACKING, PREFORMED PART OF KIT P/N 3801096	1
12	KFHZZ		15434	170510	GASKET PART OF KIT P/N 3801096	1
13	PAHZZ	3120006827706	15434	156420	BEARING, SLEEVE	1
14	PAHZZ	3130012941400	15434	3038745	HOUSING, BEARING UNI M915 ONLY	1
14	PFHZZ	3130011466120	15434	3026034	HOUSING, BEARING UNI M915A1 ONLY	1
15	KFHZZ		15434	202377	PACKING, FLAT FIBER PART OF KIT P/N 3801096	1
16	PAHZZ	2990004776159	15434	171570	SHIELD, HEAT	1
17	KFHZZ		15434	3034736	SEAL, PLAIN PART OF KIT P/N 3801096	2
18	PAHZA	2835010861447	15434	214086	SHAFT, TURBINE, NONAI M915 ONLY	1
18	PAHZZ	2950011456822	15434	3032835	WHEEL AND SHAFT, IMP M915A1 ONLY	1
19	PAHZZ	3040010861448	15434	204244	HOUSING, MECHANICAL M915 ONLY	1
19	PFHZZ	2990011463911	15434	3026993	TURBINE HOUSING M915A1 ONLY	1

END OF FIGURE

4 — 5 thru 17

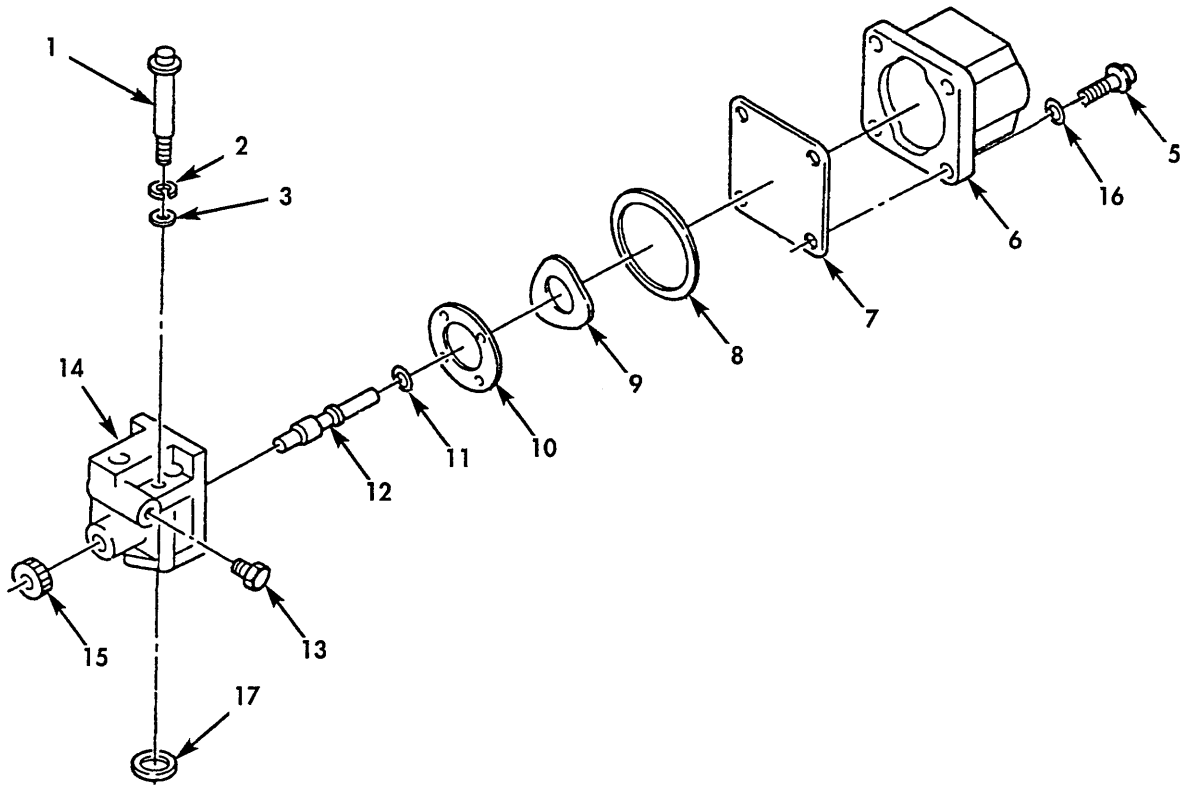


Figure 28. Solenoid Valve.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 0306 TANKS, LINES, FITTINGS AND HEADERS	
					FIG. 28 SOLENOID VALVE	
1	PAOZZ	5305005098106	15434	S189C	SCREW, CAP, SOCKET HE	2
2	PAFZZ	5310004841718	15434	181466	WASHER, LOCK	2
3	PAFZZ	5310002622986	15434	67684	WASHER, FLAT	2
4	PAFZZ	4810011874925	15434	3035362	VALVE, SOLENOID	1
5	PAFZZ	5305001389848	15434	187556	.SCREW, MACHINE SOLENOID MOUNTING	4
6	PAFZZ	2910000857436	15434	134074	.COIL ASSEMBLY, SHUT M915	1
6	PAFZZ	2920011218859	15434	302109000	.COIL, ELECTRICAL	1
7	PAFZZ	5340000847787	15434	129839	.COVER, ACCESS SHUT OFF VALVE	1
8	PCFZZ	5331000819299	15434	129888	.O-RING RECTANGULAR RING PART OF ..... KIT P/N 3010242	1
9	PAFZZ	5310000821888	15434	129768	.WASHER, SPRING TENSI SHUT OFF VALVE.....	1
10	PCFZZ	5331001320274	15434	190876	.O-RING PART OF KIT P/N 3010242	1
11	PAFZZ	4820011461048	15434	3030970	.DISK, VALVE	1
12	PAFZZ	3040010852616	15434	3000266	.SHAFT, SHOULDERED SHUT OFF VALVE, ...	1
13	PAFZZ	4730000113175	15434	70295	.PLUG, PIPE	1
14	PFFZZ	4820008295600	15434	129826	.BODY, VALVE.....	1
15	PAFZZ	5355000821189	15434	129838	.KNOB SHUT OFF VALVE.....	1
16	PAFZZ	5310009222017	30379	120217	.WASHER, LOCK	4
17	PCFZZ	5330009513538	15434	154087	GASKET RECTANGULAR RING PART OF KIT..... P/N 3010242.....	1

END OF FIGURE

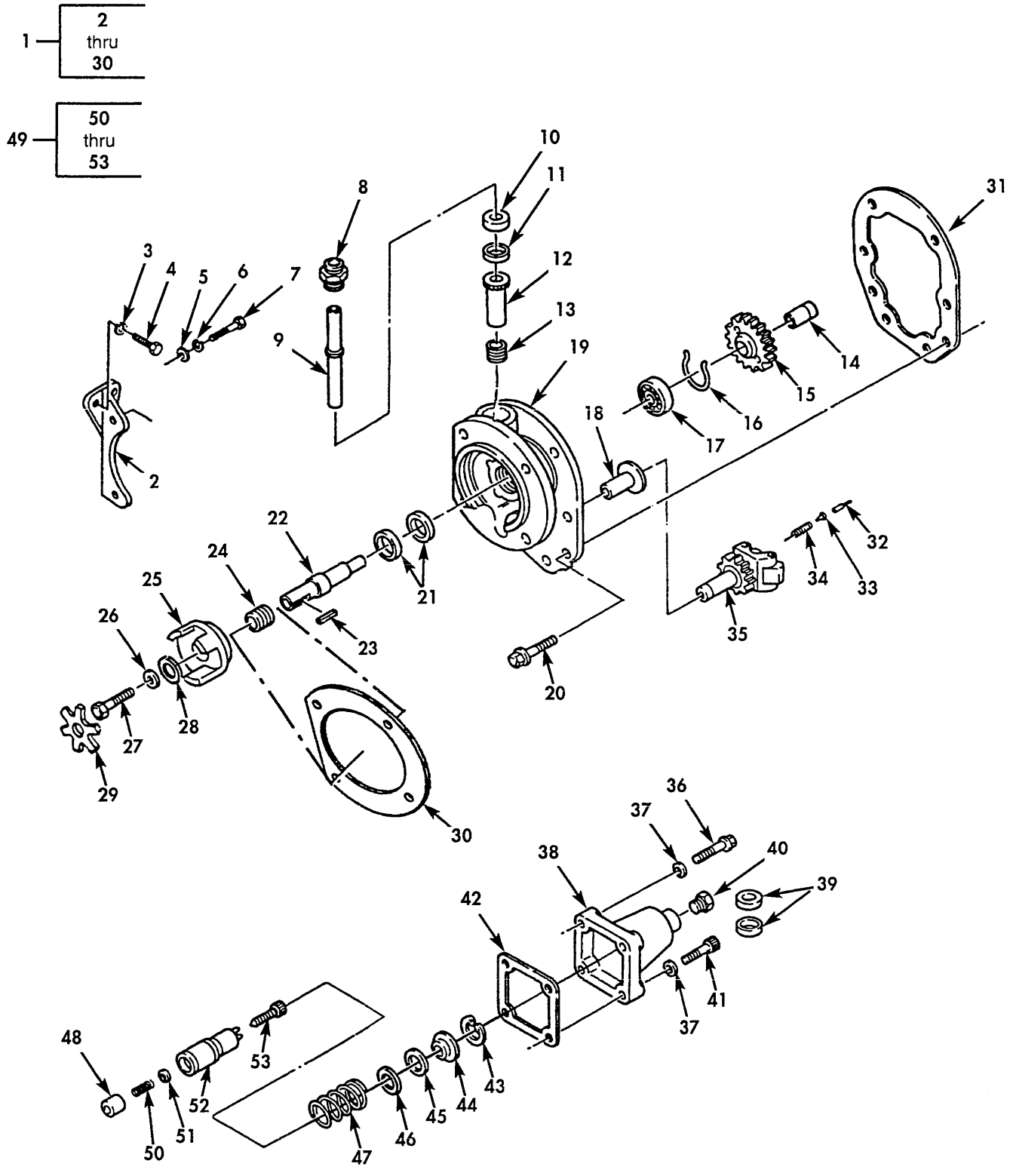


Figure 29. Fuel Pump Front Cover, Governor, and Tach Drive.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 0308 ENGINE SPEED GOVERNOR AND CONTROL	
					FIG. 29 FUEL PUMP FRONT COVER, GOVERNOR, AND TACH DRIVE	
1	PAHZZ	6680010852870	15434	3030267	COVER AND TACHOMETE M915 ONLY	1
1	PAHHH	2910011461999	15434	3030269	COVER ASSEMBLY, FRON FUEL PUMP FRONT, M915A1 ONLY	1
2	PFFZZ	5342010854153	15434	3001296	.BRACKET, AIR COMPRES	1
3	PAFZZ	5310002090965	96906	MS35338-47	.WASHER, LOCK COVER, GOVERNOR AND TACHOMETER DRIVE	4
4	XBFZZ		15434	S151	.SCREW COVER, GOVERNOR AND TACHOMETER DRIVE	4
5	PAFZZ	5310011124307	15434	69324	.WASHER, FLAT COVER, GOVERNOR AN .TACHOMETER DRIVE	1
6	PAHZZ	5310007278353	15434	144179	.WASHER, FLAT	1
7	PAFZZ	5305011131179	15434	206326	.SCREW, CAP, HEXAGON H	1
8	PAHZZ	2910010867715	15434	3002110	.HOUSING, DRIVE ASSEM	1
9	PAHZZ	3040010852871	15434	212607	.SHAFT, TACHOMETER DR M915 ONLY	1
9	PAHZZ	3040011519348	15434	216908	.SHAFT, TACHOMETER DR M915A1 ONLY	1
10	PCHZZ	5330010728828	15434	212603	.SEAL PART OF KIT P/N 3010242	1
11	PAHZZ	5365011263334	15434	3004724	.SPACER	1
12	PAHZZ	3120010872539	15434	212609	.BEARING, SLEEVE	1
13	PAHZZ	3020010868780	15434	212610	.GEAR, HELICAL	1
14	PAHZZ	3010010885727	15434	212639	.COUPLING, SHAFT, RIGI	1
15	PAHZZ	3020010709003	15434	212605	.GEAR, FUEL PUMP DRIV	1
16	PAHZZ	5325010810662	15434	212604	.RING, RETAINING	1
17	PAHZZ	3110005165289	15434	S-16052	.BEARING, BALL, ANNULA	1
18	PAHZZ	3120009049595	15434	163944	.BUSHING, SLEEVE	1
19	PAHZZ	6680010852870	15434	3030267	.COVER AND TACHOMETE M915 ONLY	1
19	PAHZZ	2910011414337	15434	3028368	.HOUSING, FUEL PUMP M915A1 ONLY	1
20	PAHZZ	5305010728831	15434	203619	.SCREW M915 ONLY	8
20	PAHZZ	5305011129110	15434	3017051	.SCREW, CAP, HEXAGON H M915A1 ONLY	8
21	XDHZZ		15434	3045173	.SEAL, OIL PART OF KIT P/N 3010242	2
22	PAHZZ	3040010709004	15434	212601	.SHAFT, SHOULDERED	1
23	PAHZZ	5315010870534	15434	212668	.KEY, MACHINE	1
24	PAHZZ	3020010864158	15434	212602	.GEAR, HELICAL	1
25	PAHZZ	3010010801529	15434	212613	.COUPLING HALF, SHAFT	1
26	PAHZZ	5310008093078	15434	146160	.WASHER, FLAT M915A1 ONLY	1
26	PAFZZ	5310008093078	96906	MS27183-11	.WASHER, FLAT M915 ONLY	2
27	PAHZZ	5305011149279	15434	S110	.SCREW, CAP, HEXAGON H 5/16-18 X 5/8.	1
28	PAHZZ	5310004079566	96906	MS35338-45	.WASHER, LOCK	1
29	PAFZZ	3010004479799	15434	162426	.INSERT, FLEXIBLE COU	1
30	PCHZZ	5330004710370	15434	200817	.GASKET	1
31	PCHZZ	5330005064866	15434	100764	GASKET PART OF KIT P/N 3010242	1
32	PAHZZ	5315000820448	15434	144178	PIN, SHOULDER, HEADLE	1
33	PAHZZ	5310000867859	15434	144179	SHIM, WEIGHT ASSIST	1
34	PAHZZ	5360010953661	15434	143848	SPRING, HELICAL, COMP	1
35	PAHZZ	2910010909346	15434	3024991	CARRIER ASSEMBLY	1
36	PAHZZ	5305011129110	15434	3017051	SCREW, CAP, HEXAGON H	3
37	PAHZZ	5310001411795	88044	AN960-416	WASHER, FLAT	4
38	PBHZZ	2910008583522	15434	44678	COVER, SPRING PACK	1

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
39	PAHZZ	5330010728830	15434	3003156	SEAL, SPECIAL	2
40	PAHZZ	5342011436046	15434	3025459	PLUG, COVER	1
41	PAHZZ	5305011261128	15434	3017052	SCREW, CAP, HEXAGON H M915A1 ONLY	1
41	PAHZZ	5305004264142	15434	S105	SCREW, CAP, HEXAGON H M915 ONLY	1
42	PCHZZ	5330005621176	15434	70705	GASKET PART OF KIT P/N 3010242	1
43	PAHZZ	5325008072636	96906	MS16625-1100	RING, RETAINING	1
44	PAHZZ	5340008981497	15434	70713	RING, RETAINING	1
45	PAHZZ	5365005073261	15434	70717A	SHIM V	
45	PAHZZ	5365005073261	15434	70717-A	SHIM V	
45	PAHZZ	5365005073262	15434	70717-B	SHIM V	
45	PAHZZ	5365004624504	15434	189800	SHIM V	
46	PAHZZ	5365005073260	15434	70717	SPACER, RING	1
47	PAHZZ	5360004615738	15434	143251	SPRING, HELICAL, COMP M915 ONLY	1
47	PAHZZ	5360009019644	15434	143253	SPRING, HELICAL, COMP M915A1 ONLY	1
48	PAHZZ	5340009078964	15434	137370	PLUNGER, DETENT IDLE SPRING	1
49	PAHZZ	2910008032631	15434	BM70796	SPRING GUIDE, ASSEMB	1
50	PAHZZ	5360011474846	15434	3018767	.SPRING, HELICAL, COMP	1
51	PAHZZ	5310005073259	15434	70715	.WASHER, FLAT	1
52	PAHZZ	2910001320769	15434	3038218	.GUIDE, CLIP	1
53	PAHZZ	5305005065722	15434	70716	.SETSCREW, IDLE ADJUS	1

END OF FIGURE

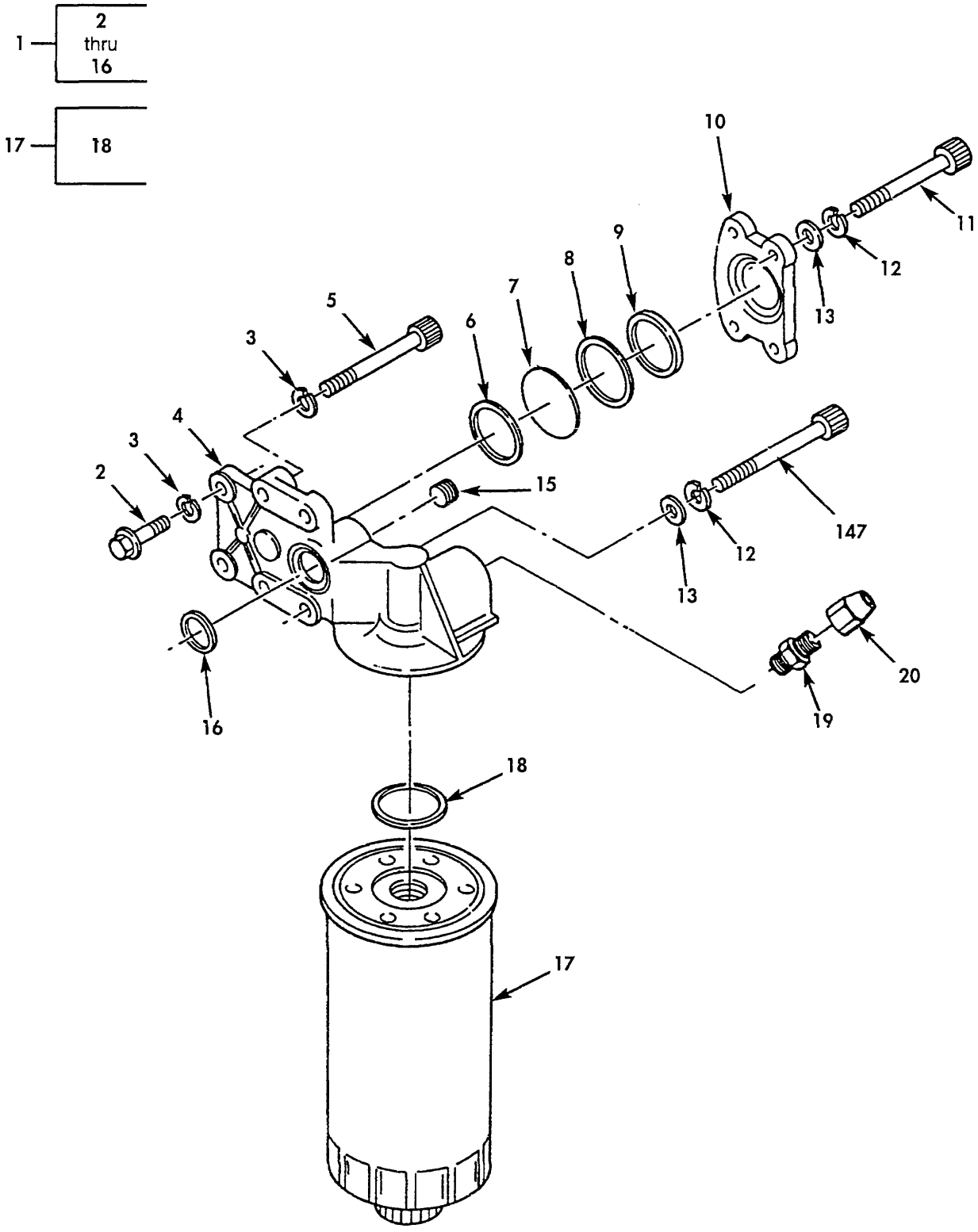


Figure 30. Fuel Pump Damper, Head, and Fuel Filter.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 0309 FUEL FILTER	
					FIG. 30 FUEL PUMP DAMPER, HEAD, AND FUEL FILTER	
1	PAFFF	2910010852570	15434	3026198	DAMPER AND HEAD ASSE	1
2	PAFZZ	5305000680509	96906	MS90728-10	.SCREW, CAP, HEXAGON H M915 ONLY	2
2	PAFZZ	5305011129110	15434	3017051	.SCREW, CAP, HEXAGON H M915A1 ONLY.....	2
3	PAFZZ	5310004841718	15434	181466	.WASHER, LOCK	4
4	XAFZZ		15434	215787	.HEAD, FILTER	2
5	PAFZZ	5305002072715	15434	S174C	.SCREW, CAP, SOCKET HE	2
6	PCFZZ	5331008093276	15434	139988	.O-RING RECTANGULAR RING PART OF ..... KIT P/N 3010242	1
7	PCFZZ	5340009513536	15434	202897	.DISK, SOLID, PLAIN FUEL PUMP DAMPER.....	1
8	PCFZZ	5331008092667	15434	100099	.O-RING RECTANGULAR RING PART OF ..... KIT P/N 3010242	1
9	PAFZZ	5365009650870	15434	160514	.SPACER, RING	1
10	PAFZZ	5340008295617	15434	153338	.COVER, ACCESS	1
11	PAFZZ	5305011332060	15434	133538	.SCREW, CAP, SOCKET HE	1
12	PAFZZ	5310001596209	96906	MS122032	.WASHER, LOCK	2
13	PAFZZ	5310001411795	88044	AN960-416	.WASHER, FLAT	2
14	PAFZZ	5305011478726	15434	153346	.SCREW, CAP, SOCKET HE	1
15	PAFZZ	4730011243762	15434	3025460	.PLUG, PIPE	1
16	PCFZZ	5330002528888	16954	691-10014	.GASKET RECTANGULAR RING PART OF..... KIT P/N 3010242	1
17	PAOZZ	2910011461099	33457	FS1212	FILTER ELEMENT, FLUI M915A1 ONLY.....	1
17	PAOZZ	2910003043427	15434	BM78793	FILTER ELEMENT, FLUI M915 ONLY	1
18	PCOZZ	5330010849068	15434	213079	.PACKING, PREFORMED DAMPER, FUEL ..... FILTER, M915 ONLY	1
18	PCOZZ	5330002860487	33457	255622	.PACKING, PREFORMED M915A1 ONLY	1
19	PAFZZ	4730011064700	15434	129866	ADAPTER, STRAIGHT, TU	1
20	PAFZZ		15434	AR12228	FITTING FUEL INLET	1

END OF FIGURE

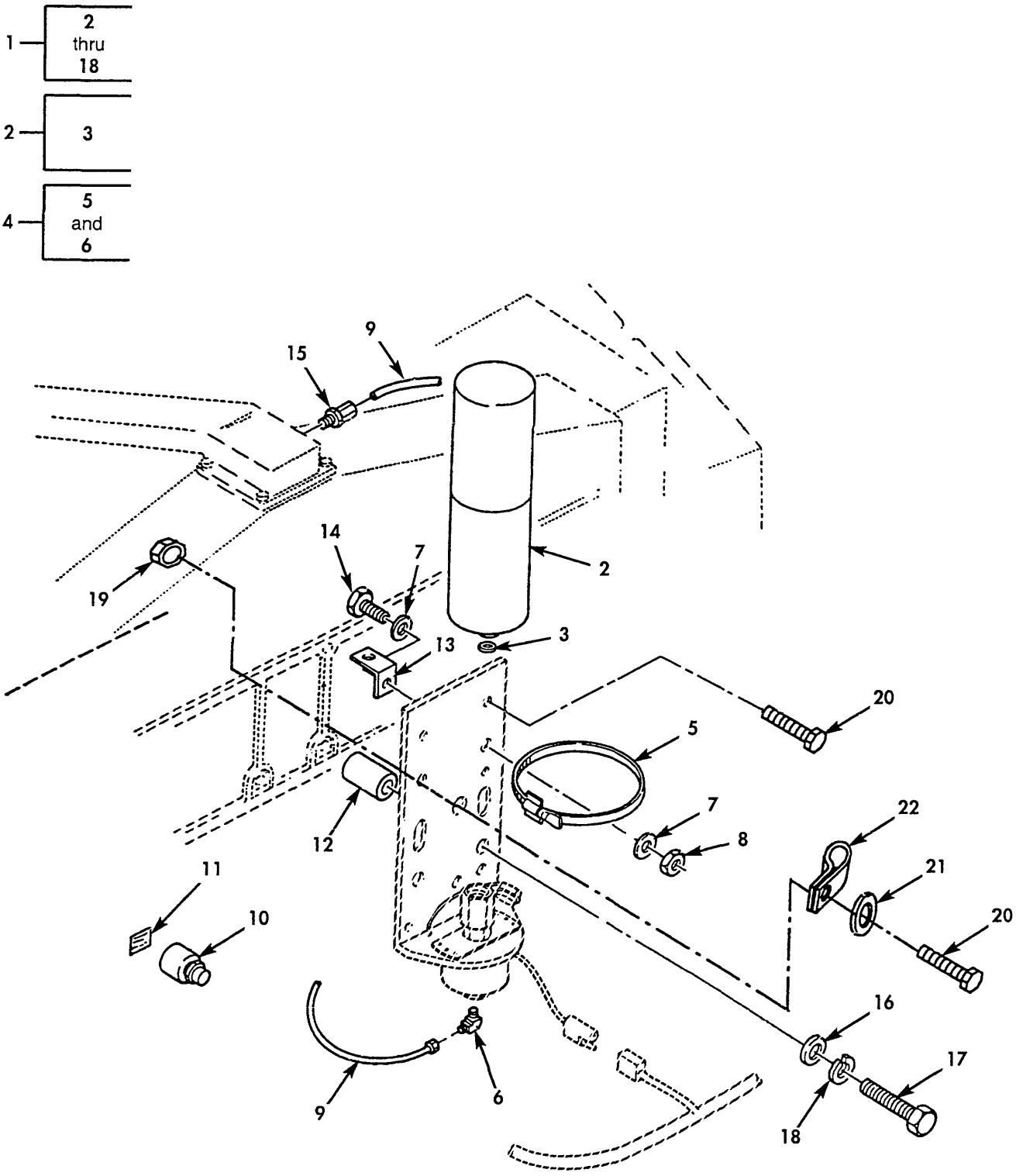
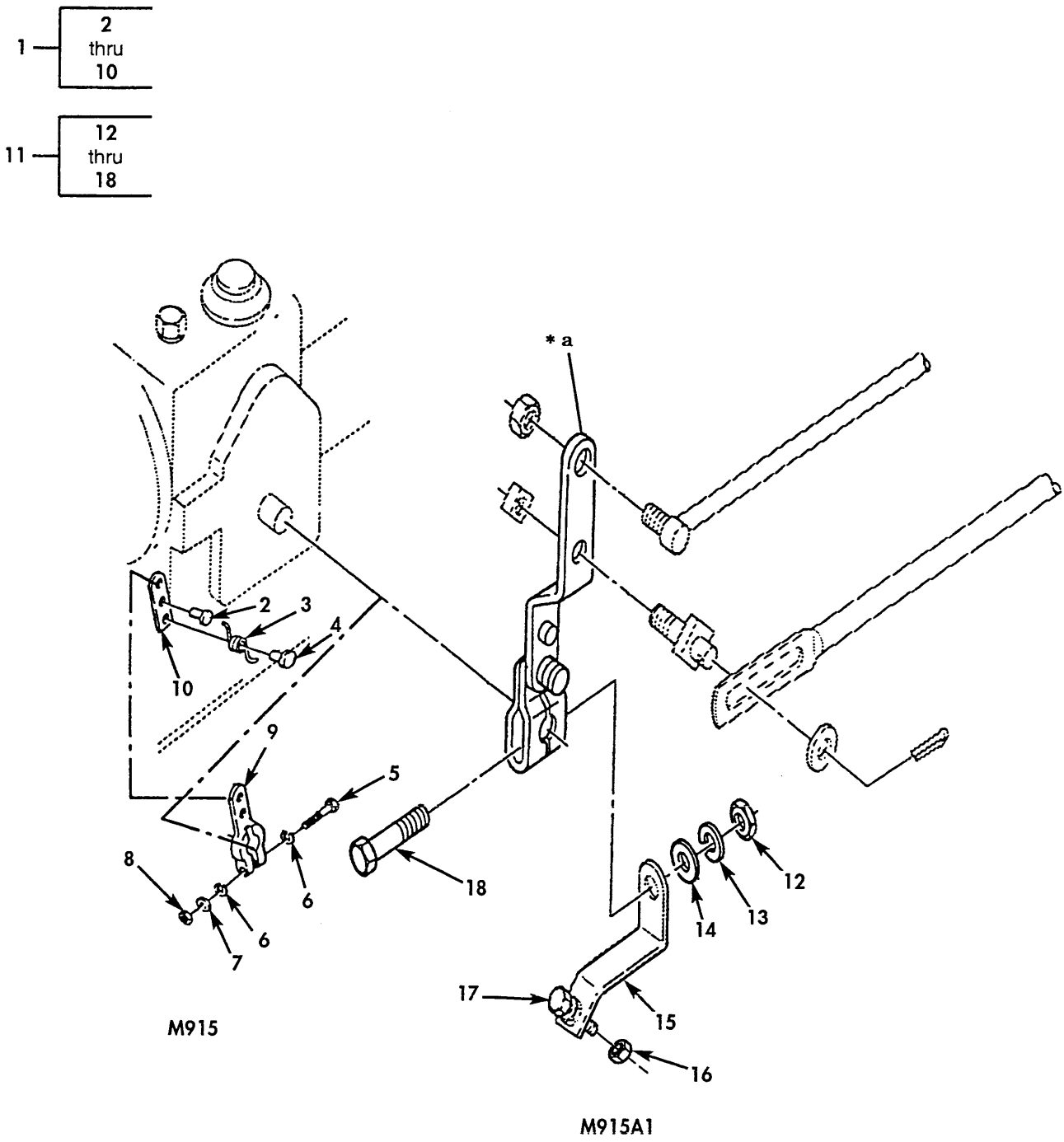


Figure 31. Ether Quick-Start Kit.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 0311 WHEEL ASSEMBLY	
					FIG. 31 ETHER QUICK-START KIT	
1	PFOOO	2815010874740	06991	8294151	QUICK START KIT ENGINE, SUPPRESSED	1
2	PAOZZ	2910006469727	53203	20000	.CYLINDER, ENGINE STA	1
3	PCOZZ	5330011478754	06991	111025	..GASKET	1
4	PAOZZ	2910010840243	6Y402	829-4151	.PARTS KIT, ETHER, STA ASSEMBLY	1
5	PAOZZ	5340011451181	06991	913020	..CLAMP, LOOP	1
6	PAOZZ	4730011461059	06991	125049	..ELBOW, PIPE TO TUBE	1
7	PAOZZ	5310011466150	06991	103031	.WASHER, FLAT	2
8	PAOZZ	5310011466147	06991	102030	.NUT, PLAIN, HEXAGON 5/16-18	1
9	PCOZZ	4720011464126	06991	501096-04	.TUBING, NONMETALLIC 24 INCHES	1
10	PAOZZ	5930012950912	6Y402	8293635	.SWITCH, THERMOSTATIC M915 ONLY	1
10	PAOZZ	5930010959823	06991	309015	.SWITCH, PUSH ETHER START, SEE TM9-2320-283-20P, M915A1 ONLY	1
11	PAOZZ	7690010807335	34623	M-A162-20018	.MARKER, IDENTIFICATI M915A1 ONLY	1
11	PAOZZ	7690010807335	34623	M-A162-20018	.MARKER, IDENTIFICATI M915 ONLY	1
12	PAOZZ	5365011450760	06991	501088-02	.SPACER, SLEEVE	2
13	PAOZZ	5342011469816	06991	108289	.CLAMP	1
14	PAOZZ	5306011511023	06991	101037-05	.BOLT, MACHINE 5/16-18 X 1.00	1
15	PAOZZ	2910011125797	06991	913024-06	.ATOMIZER, QUICK STAR	1
16	PAOZZ	5310011467303	34623	MB362-20001	.WASHER, FLAT	2
17	PAOZZ	5306004182276	24617	272547	.BOLT, MACHINE 3/8-16 X 6 1/2	2
18	PAOZZ	5310006379541	96906	MS35338-46	.WASHER, LOCK	2
19	PAOZZ	5310013123859	24617	9422273	NUT, SELF-LOCKING, CA	1
20	PAOZZ	5305010979886	24617	9419002	SCREW, CAP, HEXAGON H	2
21	PAOZZ	5310011023270	24617	2436161	WASHER, FLAT	1
22	PAOZZ	5340008091490	96906	MS21333-98	CLAMP, LOOP	1

END OF FIGURE



* a PART OF ITEM 12

Figure 32. Fuel Control Lever.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 0312 ACCELERATOR, THROTTLE OR CHOKE CONTROLS	
					FIG. 32 FUEL CONTROL LEVER	
1	PAOZZ	2910011462000	15434	218867	LEVER ASSEMBLY, THRO FUEL CONTROL	1
2	PAOZZ	2910004102268	34623	MA207-21-642	.STOP, THROTTLE LEVER	1
3	PAOZZ	5360004367340	15434	173717	.SPRING, HELICAL, TORS	1
4	XDOZZ		15434	173709	.LINK, THROTTLE LEVER	1
5	PAOZZ	5305004933959	15434	S-159-B	.SCREW, CAP, HEXAGON H 1/4-28 X 1 1/2	1
6	PAOZZ	5310005626552	15434	S600	.WASHER, LOCK	2
7	PAOZZ	2930003539164	15434	S2876	.WASHER, FLAT M915 ONLY	1
8	PAOZZ	5310000114492	15434	S251	.NUT, PLAIN, HEXAGON	1
9	PAOZZ	3120004933913	15434	166485	.SWIVEL, THROTTLE LEV	1
10	XDOZZ		15434	173708	.LEVER, THROTTLE	1
11	PAOZZ	2910004321945	15434	AR51323	LEVER, REMOTE CONTRO	1
12	PAOZZ	5310009717989	15434	MS35691-5	.NUT, PLAIN, HEXAGON	1
13	PAOZZ	5310001596209	15434	MS122032	.WASHER, LOCK	1
14	PAOZZ	5310001411795	15434	AN960416	.WASHER, FLAT	1
15	PBOZZ	5340012089319	34623	MB70-20107	.BRACKET, ACCELERATOR	1
16	PAOZZ	5310011027356	29617	9421077	.NUT, PLAIN	1
17	PAOZZ	5305010886019	15434	3010596	.SCREW, ASSEMBLED, WAS	1
18	PAOZZ	5306011023599	29617	9421196	.BOLT, MACHINE	1

END OF FIGURE

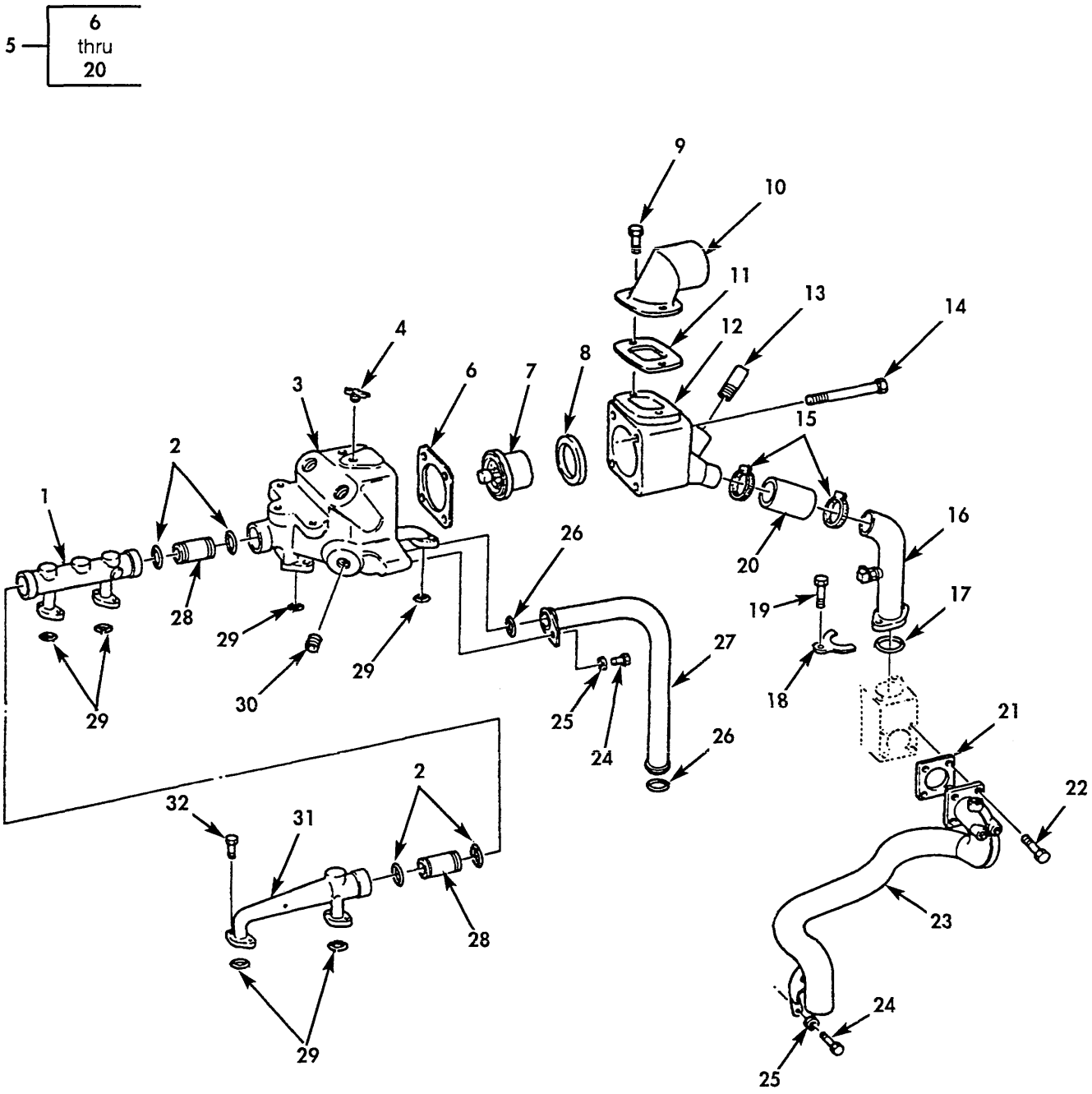


Figure 33. Thermostat Housing, Water Manifold, and Component Parts.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 05 COOLING SYSTEM	
					GROUP 0503 WATER MANIFOLD, HEADERS THERMOSTATS, AND HOUSING GASKET	
					FIG. 33 THERMOSTAT HOUSING, WATER MANIFOLD, AND COMPONENT PARTS	
1	PAOZZ	2930009283595	15434	130118	MANIFOLD, FLUID COOL WATER	1
2	PCOZZ	5331005064874	15434	70624	O-RING PART OF KIT P/N 3804280 PART OF KIT P/N 3804275	4
3	PAOZZ	2815010832123	15434	215042	MANIFOLD, WATER M915 ONLY	1
3	PAOZZ	2930011464212	15434	3015114	MANIFOLD, FLUID COOL M915A1 ONLY	1
4	PAOZZ	4820012109571	15434	214345	COCK, DRAIN	1
5	PBOZZ	2930010853579	15434	AR10124	HOUSING ASSEMBLY, TH	1
6	PFOZZ	5330010402087	15434	208128	.GASKET THERMOSTAT HOUSING PART OF KIT P/N 3804280 PART OF KIT P/N 3804275	1
7	PAOZZ	6685010472811	15434	204586	.THERMOSTAT, FLOW CON M915 ONLY	1
7	PAOZZ	6685011410907	15434	201737	.THERMOSTAT, FLOW CON M915A1 ONLY	1
8	PAOZZ	5330008645422	15434	186780	.SEAL, THERMO	1
9	PAOZZ	5305010858197	15434	3010595	.SCREW, MACHINE	2
10	XDOZZ		15434	3018764	.ELBOW, FLANGED TO BOSS M915 ONLY	1
10	PAOZZ	2930011461085	15434	3018764	.WATER OUTLET, ENGINE WATER OUTLET, M915A1 ONLY	1
11	PFOZZ	5330011455380	15434	3019158	.GASKET PART OF KIT P/N 3084280	1
12	PAOZZ	2930010846011	15434	211435	.WATER OUTLET, ENGINE M915 ONLY	1
12	PFOZZ	2930011507596	15434	3017748	.WATER OUTLET, ENGINE M915A1 ONLY	1
13	PAOZZ	4730010854156	15434	196282	.ELBOW, FLANGE TO HOS M915 ONLY	1
13	PAOZZ	4730011461060	15434	S-932-B	.ADAPTER, STRAIGHT, PI M915A1 ONLY	1
14	PAOZZ	5305010867036	15434	3010597	.SCREW WITH CAPTIVE WASHER, 3/8-16 X3-3/4	4
15	PAOZZ	4730009098627	96906	MS35842-13	.CLAMP, HOSE	2
16	PAOZZ	4710010793198	15434	213485	.TUBE, BENT, METALLIC M915 ONLY	1
16	PAOZZ	4710011461054	15434	3018098	.TUBE, BENT, METALLIC M915A1 ONLY	1
17	PCOZZ	5331001591464	15434	43463-A	.O-RING PART OF KIT P/N 3804280	1
18	PAOZZ	5340011357250	15434	214617	.CLAMP, RIM CLENCHING	1
19	PAOZZ	5306011198870	15434	3022589	.BOLT, MACHINE	1
20	PCOZZ	4720010856129	15434	102522	.HOSE, NONMETALLIC	1
21	PCOZZ	5330011467314	15434	3024960	GASKET WATER CONNECTION PART OF KIT P/N 3801235	1
22	PAOZZ	5305010858197	15434	3010595	SCREW, MACHINE	4
23	PAOZZ	2815010793317	15434	216467	CONNECTION, WATER TR M915 ONLY	1
23	PAOZZ	2930011463033	15434	3028281	HOUSING, WATER INLET WATER PUMP TO RADIATOR, M915A1 ONLY	1
24	PAOZZ	5305011149279	15434	S110	SCREW, CAP, HEXAGON H M915 ONLY	1
24	PAOZZ	5305011130408	15434	3012470	SCREW, ASSEMBLED WAS M915A1 ONLY	2
25	PAOZZ	5310000814219	96906	MS27183-12	WASHER, FLAT M915A1 ONLY	2
25	PAOZZ	5310004079566	96906	MS35338-45	WASHER, LOCK M915 ONLY	1
26	PCOZZ	5331010775228	15434	212161	O-RING M915A1 ONLY PART OF KIT P/N 3804280	2
27	PAOZZ	4710011463086	15434	3024666	TUBE, BENT, METALLIC	1

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
28	PAOZZ	4730004042906	15434	130394	COUPLING, MANIFOLD	2
29	PCOZZ	5330001438369	15434	148203	GASKET M915 ONLY PART OF KIT P/N 3804280	6
29	PCOZZ	5330011455381	15434	3024709	GASKET M915A1 ONLY PART OF KIT P/N 3804280 PART OF KIT P/N 3804275	6
30	PAOZZ	4730002212139	96906	MS20913-4S	PLUG, PIPE M915 ONLY	2
30	PAOZZ	4730011472223	15434	3008468	PLUG, PIPE M915A1 ONLY	1
31	PAOZZ	2930010878749	15434	3013000	MANIFOLD, FLUID COOL	1
32	PAOZZ	5305010886019	15434	3010596	SCREW, ASSEMBLED 3/8-16X1-1/4	5

END OF FIGURE

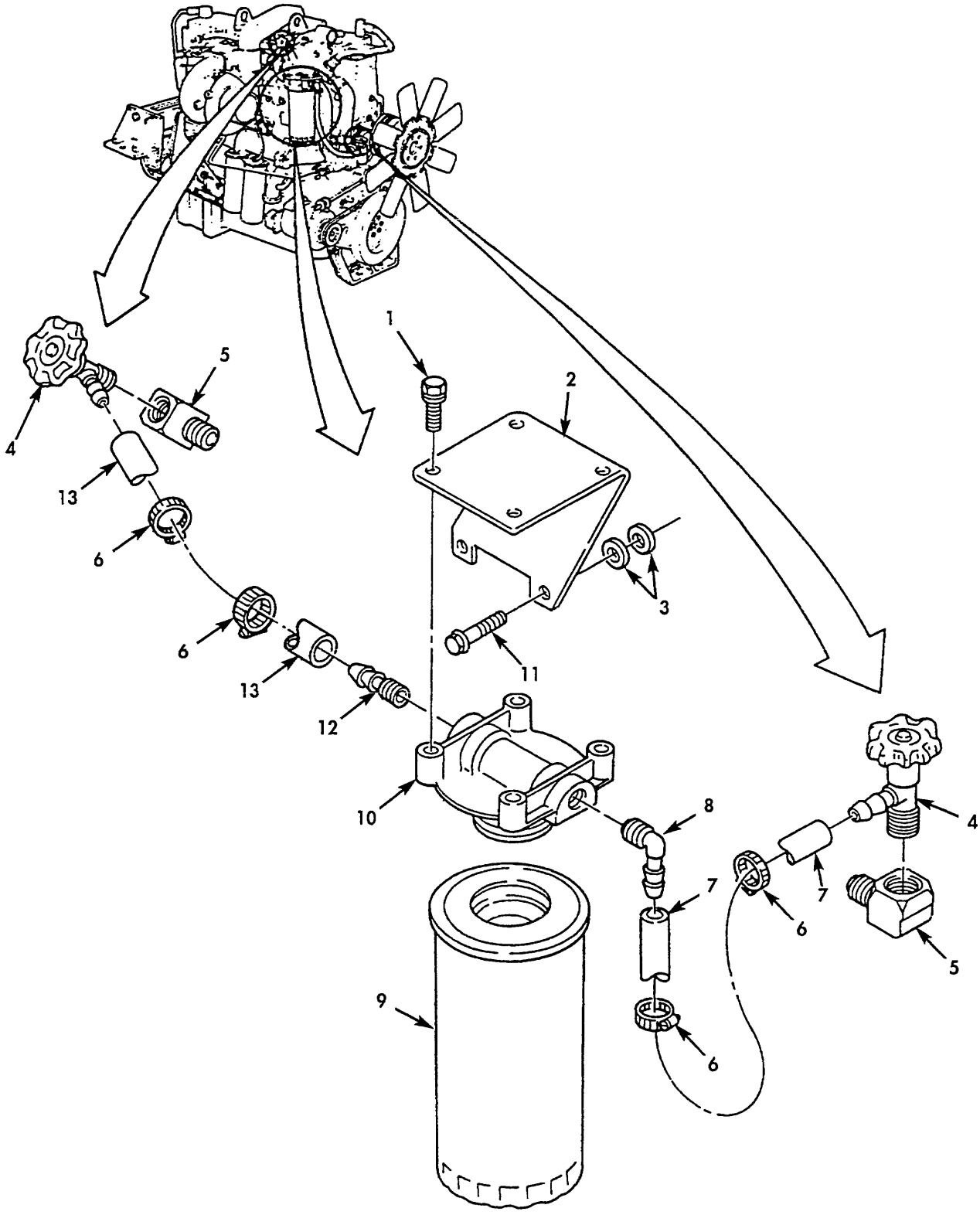
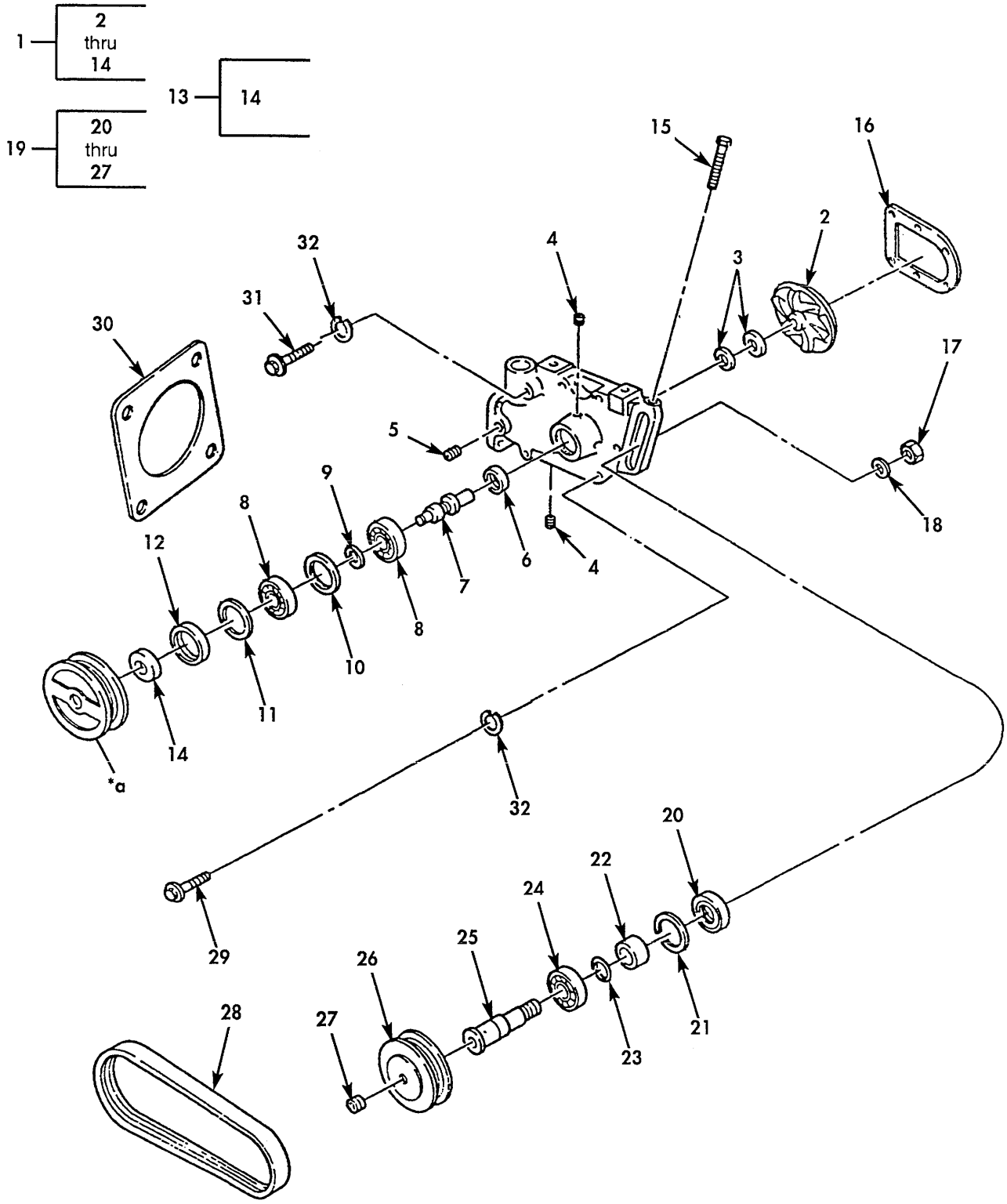


Figure 34. Water Filter and Component Parts.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 0503 WATER MANIFOLD, HEADERS THERMOSTATS AND HOUSING GASKET	
					FIG. 34 WATER FILTER AND COMPONENT PARTS	
1	PAOZZ	5305010886019	15434	3010596	SCREW, ASSEMBLED WAS HEXAGON HEAD WITH CAPTIVE WASHER, 3/8-16 X 1-1/4.	4
2	PAOZZ	5340011451597	15434	211448	BRACKET, ANGLE FILTER MOUNTING, M915A1 ONLY	1
2	PAOZZ	5340011451597	34623	5730758	BRACKET, ANGLE M915 ONLY PART OF KIT P/N 5739124	1
3	PAOZZ	3120010796527	15434	109594	BEARING, SLEEVE	4
4	PAOZZ	4820010456080	15434	179901	VALVE, ANGLE M915A1 ONLY	2
4	PAOZZ	4820012277141	34623	5730765	VALVE, ANGLE M915 ONLY	2
5	PAOZZ	4730011650749	15434	70470	ELBOW, TUBE	2
6	PAOZZ	4730009083195	96906	MS35842-10	CLAMP, HOSE M915 ONLY PART OF KIT P/N 5739124	4
6	PAOZZ	4730011464016	15434	179904	CLAMP, HOSE M915A1 ONLY	4
7	MOOZZ		15434	179912.	HOSE M915A1 ONLY, MAKE FROM HOSE P/N 2580-6, LENGTH TO SUIT	1
7	MOOZZ		34623	5710454	HOSE M915 ONLY, MAKE FROM HOSE, P/N 2580-6, LENGTH TO SUIT	1
8	PAOZZ	4730010453083	15434	179903	ELBOW, PIPE TO HOSE M915A1 ONLY	1
8	PAOZZ	4730011650749	34623	5730761	ELBOW, TUBE M915 ONLY	1
9	PAOZZ	4330002744712	33457	3305367	FILTER ELEMENT, FLUI	1
10	PAOZZ	4330010203666	15434	204163	HEAD, FLUID FILTER M915A1 ONLY	1
10	PAOZZ	2940012277445	34623	5730769	HEAD, FLUID FILTER M915 ONLY PART OF KIT P/N 5739124	1
11	PAOZZ	5305013199287	15434	3043649	SCREW, CAP, HEXAGON H	2
12	PAOZZ	4730009549510	03990	A3804	COUPLING HALF, QUICK M915A1 ONLY	1
13	MOOZZ		15434	179902	HOSE MAKE FROM HOSE, P/N 2580-6, LENGTH TO SUIT	1

END OF FIGURE



* **a** PART OF ITEM 13

Figure 35. Water Pump and Idler.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 0504 WATER PUMP	
					FIG. 35 WATER PUMP AND IDLER	
1	PAOFF	2930011463912	15434	3801708	PUMP, COOLING SYSTEM BOTH M915 AND M915A1	1
2	PAFZZ	4320010793454	15434	3000888	.IMPELLER, PUMP, CENTR 4.50" DIA. BOTH M915 AND M915A1	1
3	PCFZZ		15434	3071085	.PACKING WITH RETAIN	2
4	PAFZZ	4730000189566	15434	S-911-B	.PLUG, PIPE	2
5	PAFZZ	4730000103867	81348	WW-P-471AASBUC	.PLUG, PIPE M915 ONLY	1
5	PAFZZ	4730011615115	15434	3013786	.PLUG, PIPE M915A1 ONLY	1
6	PAFZZ	5330012401630	15434	3038997	.SEAL, PLAIN	1
7	PAFZZ	3040012879736	15434	3050394	.SHAFT, SHOULDERED	1
8	PAFZZ	3110001448828	24617	3305L1A	.BEARING, BALL, ANNULA	2
9	PAFZZ	5325004209696	15434	112302	.RING, RETAINING	1
10	PAFZZ	5365011321984	15434	196844	.SPACER	1
11	PAFZZ	2815008150355	15434	S16255	.RING, BEARING RETAIN	1
12	PCFZZ	5330010802992	15434	3038998	.SEAL, PLAIN ENCASED PART OF KIT P/N 3801235	1
13	PAFZZ	3020012416905	15434	302586100	.PULLEY, GROOVE 4-5/16 DIA. M915 ONLY	1
13	PAFZZ	3020010863417	15434	300550700	.PULLEY, GROOVE 4-11/16 DIA. BOTH M915 AND M915A1	1
14	PAFZZ	3120010836411	15434	203097	..BEARING, SLEEVE	1
15	PAOZZ	5305000586604	15434	182706	SCREW, CAP, HEXAGON H	1
16	PFOZZ	5330010665350	15434	3002385	GASKET PART OF KIT P/N 3801235	1
17	PAOZZ	5310007638920	96906	MS51967-20	NUT, PLAIN, HEXAGON	1
18	PAOZZ	5310011450762	15434	213082	WASHER, FLAT	1
19	PAOZZ	2930010969199	15434	3064919	IDLER ASSEMBLY, WATE	1
20	PCFZZ	5330010802992	15434	3038998	.SEAL, PLAIN ENCASED	1
21	PAFZZ	2815008150355	15434	S-16255	.RING, BEARING RETAIN	1
22	PAFZZ	5365010800409	15434	208120	.SPACER, SLEEVE	1
23	PCFZZ	5331010863991	15434	145506	.O-RING	1
24	PAFZZ	3110001448828	24617	3305L1A	.BEARING, BALL, ANNULA	1
25	PAFZZ	3040010793468	15434	208119	.SHAFT, SHOULDERED	1
26	PAFZZ	3020010794206	15434	215397	.PULLEY, GROOVE	1
27	PAFZZ	5365004042934	15434	S-965-E	.PLUG, MACHINE THREAD	1
28	PAOZZ	3030010659404	24161	K060436	BELT, V 45.50 INCHES LONG	1
29	PAOZZ	5305011294386	15434	3012468	SCREW, CAP, HEXAGON H WITH CAPTIVE WASHER, 3/8-24 X 2-1/4	5
30	PAHZZ	5330011467314	15434	3024960	GASKET PART OF KIT P/N 3801235	1
31	PAOZZ	5305011474035	15434	3012469	SCREW, CAP, HEXAGON H WITH CAPTIVE WASHER, 3/8-24 X 3-1/4	2
32	PAOZZ	5310002617340	15434	S604	WASHER, LOCK	7

END OF FIGURE

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 94 REPAIR KITS	
					GROUP 9401 REPAIR KITS	
					FIG. KIT	
	PAFZF	2815009132074	15434	AR-73350	RING SET, PISTON	1
					RING, COMPRESSION, (1) 20-23	
					RING, PISTON (1) 20-22	
					RING, PISTON (1) 20-24	
	PCHZZ	5330010750948	15434	3010242	GASKET SET FUEL PUMP GASKET	1
					GASKET (1) 24-8	
					GASKET (1) 25-2	
					GASKET (1) 25-13	
					GASKET (1) 29-31	
					GASKET (1) 29-42	
					GASKET (1) 28-17	
					GASKET (1) 30-16	
					O-RING (2) 24-14	
					O-RING (1) 24-52	
					O-RING (1) 28-8	
					O-RING (1) 28-10	
					O-RING (1) 30-6	
					O-RING (1) 30-8	
					PACKING, PREFORMED (2) 13-12	
					PACKING, PREFORMED (1) 24-19	
					PACKING, PREFORMED (1) 24-20	
					SEAL (1) 29-10	
					SEAL CAP (1) 24-32	
					SEAL, OIL (2) 29-21	
					SEAL, SPECIAL (1) 24-11	
	PAHZZ	5330010924143	15434	3018762	GASKET SET M915 ONLY	1
					GASKET (1) 11-39	
					GASKET (3) 7-8	
					GASKET (1) 11-26	
					GASKET (1) 11-16	
					GASKET (1) 11-48	
					GASKET (1) 13-2	
					GASKET (2) 11-3	
					PACKING, PREFORMED (2) 11-29	
					PACKING, PREFORMED (1) 11-49	
					SPACER, RING (1) 11-24	
	PAHZZ	4820011580555	15434	302112400	VALVE CHECK	1
					ADAPTER, STRAIGHT (1) 22-31	
					BODY, CHECK VALVE (1) 22-24	
					CLAMP (1) 22-28	
					CLAMP, HOSE (4) 22-23	
					HOSE (2) 22-10	
					SCREW, CAP, HEXAGON H (1) 22-27	
					SCREW, CAP, HEXAGON H (1) 22-29	
					TANK, AIR (1) 22-30	
					WASHER, PLAIN (2) 22-26	
					WASHER, LOCK (2) 22-25	
	PAHZZ	3120011329339	15434	3801260	BEARING SET, SLEEVE STANDARD	1

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)			(7) QTY
					BEARING HALF, SLEEVE	(3)	4-17	
					BEARING HALF, SLEEVE	(3)	4-18	
					BEARING HALF, SLEEVE	(1)	4-19	
					BEARING HALF, SLEEVE	(3)	4-20	
					BEARING HALF, SLEEVE	(3)	4-21	
					BEARING HALF, SLEEVE	(2)	4-22	
	PAHZZ	2815011650765	15434	3801056	RING SET, PISTON			6
					RING,	(6)	6-1	
					RING, PISTON,	(6)	6-4	
					RING, PISTON	(6)	6-3	
					RING, PISTON	(6)	6-2	
	PAHZZ	2990012710316	15434	3801096	PARTS KIT, SUPERCHAR M915A1 ONLY			V
					GASKET	(1)	27-12	
					NUT, SELF-LOCKING, HE	(2)	27-5	
					PACKING, PREFORMED	(1)	27-11	
					PACKING, FLAT FIBER	(1)	27-15	
					PLATE, DIFFUSER	(1)	27-10	
					SCREW, CAP, HEXAGON H	(2)	27-9	
					SEAL, TURBO	(1)	27-2	
					SEAL, PLAIN	(2)	27-17	
					WASHER, FLAT	(4)	27-6	
	PAHZZ	2815011683742	15434	3801058	PISTON, INTERNAL COM			6
					PIN, PISTON	(6)	6-7	
					PISTON	(6)	6-5	
					RING, RETAINING	(12)	6-6	
					PLATE, DIFFUSER VANE	(1)	27-10	
	PFHZZ	3120011552531	15434	3801106	BEARING SET, SLEEVE CAMSHAFT			1
					BEARING, SLEEVE	(1)	2-30	
					BUSHING, CAMSHAFT,	(4)	2-30	
					BUSHING, CAMSHAFT,	(2)	2-30	
	PAHZZ	5330011509812	15434	3801235	GASKET AND SEAL SET M915A1 ONLY			1
					GASKET	(1)	2-13	
					GASKET	(V)	4-1	
					GASKET	(3)	7-8	
					GASKET	(V)	7-8	
					GASKET	(V)	7-8	
					GASKET	(V)	7-8	
					GASKET	(V)	7-8	
					GASKET	(1)	10-22	
					GASKET	(1)	10-10	
					GASKET	(1)	10-9	
					GASKET	(1)	10-30	
					GASKET	(1)	12-1	
					GASKET	(1)	12-31	
					GASKET	(1)	13-2	
					GASKET	(1)	13-49	
					GASKET	(1)	13-34	
					GASKET	(1)	13-34	
					GASKET	(1)	16-11	
					GASKET	(1)	17-19	
					GASKET	(1)	33-21	
					GASKET	(1)	35-16	
					GASKET AND SEAL SET	(1)	35-30	

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)			(7) QTY
					O-RING	(1)	2-39	
					O-RING	(1)	10-5	
					O-RING	(1)	10-23	
					O-RING	(1)	10-18	
					O-RING	(1)	13-47	
					O-RING	(1)	16-5	
					SEAL	(1)	4-4	
					SEAL	(1)	4-10	
					SEAL, PLAIN ENCASED	(1)	16-6	
					SEAL, PLAIN ENCASED	(2)	35-12	
	PCFZZ	2815011529219	15434	3804275	PARTS KIT, CYLINDER SINGLE HEAD GASKET.....			1
					GASKET	(3)	3-23	
					GASKET	(3)	8-32	
					GASKET	(1)	14-3	
					GASKET	(3)	14-33	
					GASKET	(1)	14-8	
					GASKET	(6)	15-4	
					GASKET	(3)	21-9	
					GASKET	(1)	26-8	
					GASKET	(1)	26-1	
					GASKET	(6)	33-29	
					GASKET	(1)	33-6	
					O-RING	(12)	3-22	
					O-RING	(4)	33-2	
					PACKING, PREFORMED	(4)	14-7	
	PCFZZ	5330010867790	15434	3804280	GASKET SET UPPER ENGINE GASKET, VALVE GRIND			
					GASKET	(3)	3-23	
					GASKET	(3)	8-32	
					GASKET	(3)	14-33	
					GASKET	(6)	15-4	
					GASKET	(3)	21-9	
					GASKET	(1)	26-8	
					GASKET	(1)	26-1	
					GASKET	(1)	33-11	
					GASKET	(6)	33-29	
					GASKET	(1)	33-6	
					O-RING	(2)	3-6	
					O-RING	(12)	3-22	
					O-RING	(4)	33-2	
					O-RING	(1)	33-17	
					O-RING	(2)	33-26	
	PAHZZ	2940011841877	34623	5739124	FILTER, FLUID			1
					BRACKET, ANGLE	(1)	34-2	
					CLAMP, HOSE	(4)	34-6	
					HEAD, FLUID FILTER	(1)	34-10	

END OF FIGURE

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 95 GENERAL USE STANDARDIZED PARTS	
					GROUP 9501 BULK MATERIEL	
					FIG. BULK	
1	PCOZZ	4720005414243	24161	28430	HOSE, NONMETALLIC	V
2	PCOZZ	4720011147728	19207	8710557	HOSE, NONMETALLIC	V
3	PCOZZ	4720001874102	01276	2580-6	HOSE, NONMETALLIC	V

END OF FIGURE

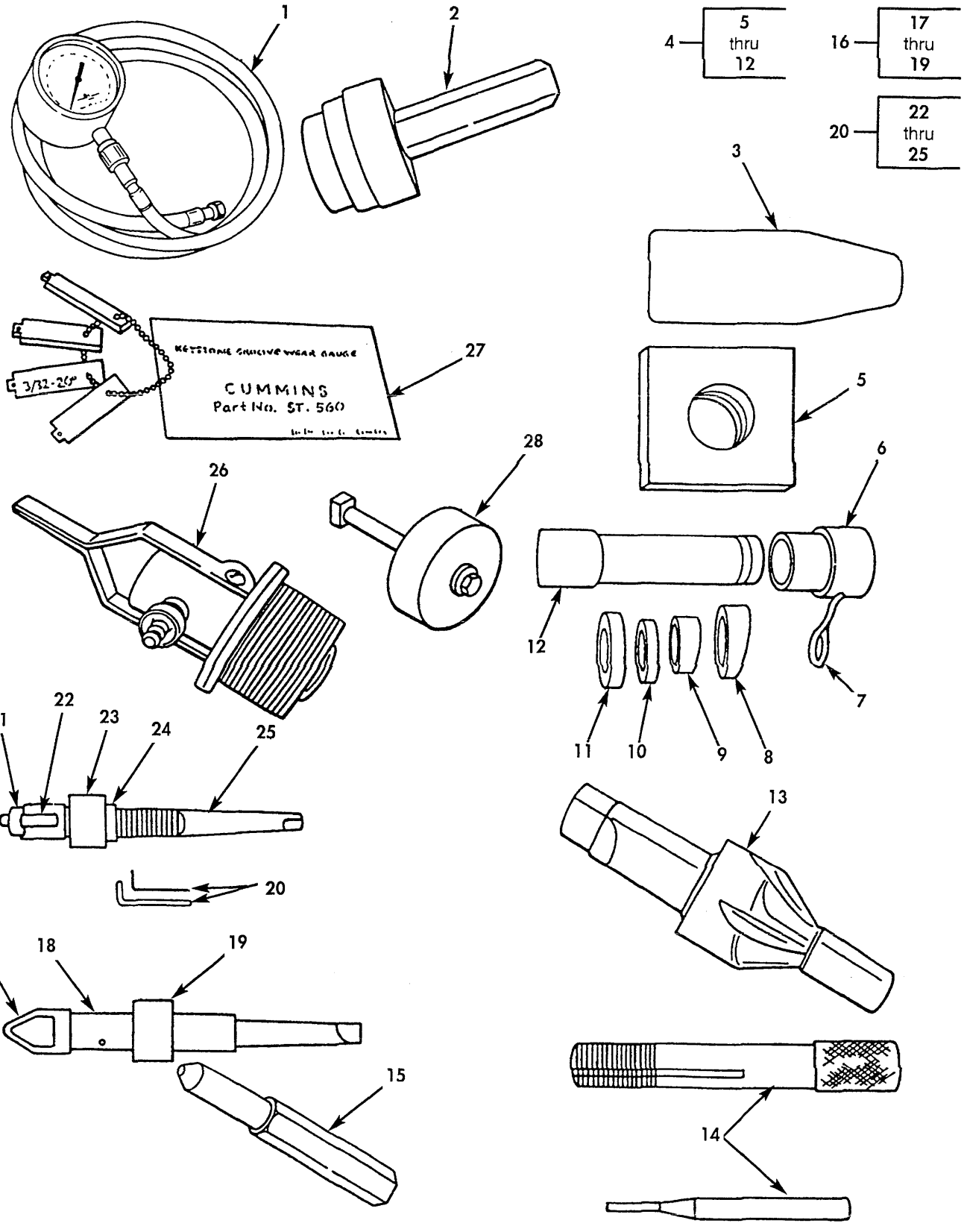


Figure 36. Direct Support Special Tools-1.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 26 SPECIAL TOOLS	
					GROUP 2604 SPECIAL TOOLS	
					FIG. 36 DIRECT SUPPORT SPECIAL TOOLS-1	
1	PEOZZ	6620011479954	15434	ST-1273	GAGE, PRESSURE, DIAL M915A2 ONLY PART OF KIT P/N 5704995	
2	PEOZZ	4910010976948	15434	ST-1225	MANDREL, SEAL, THERMO THERMOSTAT SEAL PART OF KIT P/N 5704990	
3	PEFZZ	5120008968097	15434	ST-419	FRONT SEAL ASSEMBLY PART OF KIT P/N 5704990	
4	PEFZZ	4910010981914	15434	ST-1242	PARTS KIT PUSHING D PART OF KIT P/N 5704990	
5	PEFZZ	4910011127509	15434	ST-1242-3	.TOOL, EMBEDDING BLOC	
6	PEFZZ	4910011131066	15434	ST-1242-2	.CUP, BUSHING DRIVER	
7	PEFZZ	5315011107835	15434	ST-1242-6	.PIN, COTTER	
8	PEFZZ	5120011192743	15434	ST-1242-4	.DRIVER, BEARING AND	
9	PEFZZ	4910010991487	15434	ST-1242-5	.KNOCK OUT RING TAPE	
10	PEFZZ	4910011174885	15434	ST-1242-7	.RING, KNOCK OUT	
11	PEFZZ	4910011182878	15434	ST-1242-8	.DRIVER, BEARING AND	
12	PEFZZ	4910011089130	15434	ST-1242-1	.MANDREL	
13	PEFZZ	5133009322089	15434	ST-788	CUTTING TOOL, BEAD PART OF KIT P/N 5704990	
14	PEFZZ	4910001505858	15434	3375425	EXTRACTOR, SLEEVE IN PART OF KIT P/N 5704990	
15	PEFZZ	5120009813108	15434	ST-1227	DRIVER PART OF KIT P/N 5704990	
16	PEFFZ	4910009813105	15434	ST-884	CUTTER, INJECTOR SLE PART OF KIT P/N 5704990	
17	PEFZA	4910010976957	15434	ST-884-1	.HOLDER	
18	PEFZA	4910010985088	15434	ST-884-3	.CUTTER PART	
19	PEFZA	4910010976958	15434	ST-884-6	.PILOT	
20	PEFFZ	3441009226699	15434	ST-880	EXPANDER, TUBE PART OF KIT P/N 5704990	
21	PEFZZ	5210010996339	15434	ST-880-1	.GAGE	
22	PEFZZ	4910010976955	15434	ST-880-2	.ROLL	
23	XAFZZ		15434	ST-880-3	.COLLAR	
24	PEFZZ	5310011044549	15434	ST-880-6	.NUT	
25	PEFZZ	4910010976956	15434	ST-880-7	.MANDREL	
26	PEFZZ	4910010859211	15434	3375150	CHECKING TOOL, BLOWB PART OF KIT P/N 5704990	
27	PEFZZ	5210009991209	15434	ST-560	GAGE, PISTON RING GR PART OF KIT P/N 5704990	
28	PEFZZ	5120001041795	15434	ST-1179	HOLDING TOOL, INJECT PART OF KIT P/N 5704990	

END OF FIGURE

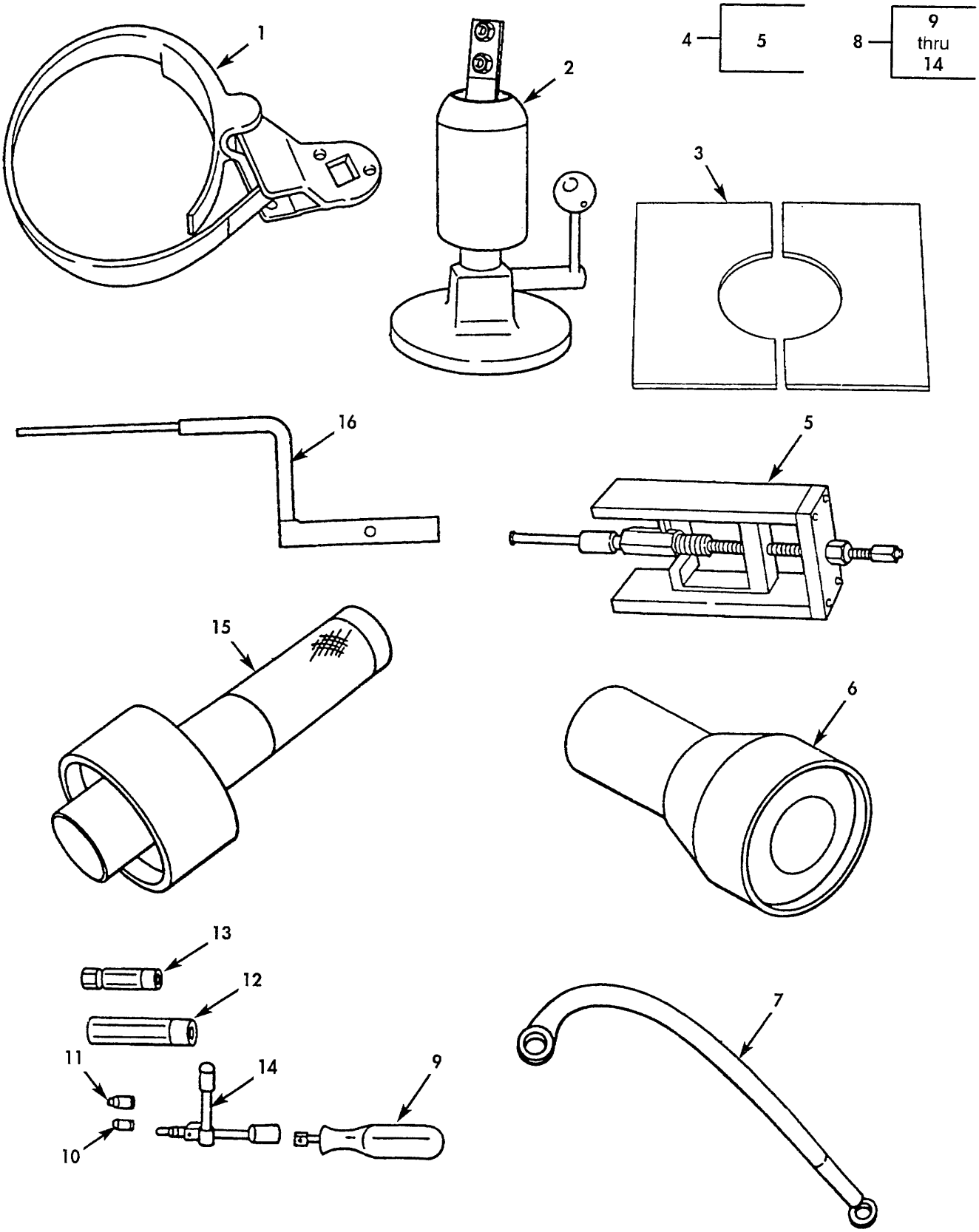


Figure 37. Direct Support Special Tools-2.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 2604 DS SPECIAL TOOLS	
					FIG. 37 DIRECT SUPPORT SPECIAL TOOLS-2	
1	PEOZZ	5120011608863	15434	3375049	WRENCH, OIL FILTER OIL AND FUEL FILTER, SPIN-ON PART OF KIT P/N 5704990	
2	PEFZZ	4910009991506	15434	ST-302	VISE, BALL JOINT PART OF KIT P/N 5704990	
3	PEFZZ	4910010976987	15434	ST-1114	FIXTURE BEARING PART OF KIT P/N 5704990	
4	PEFZZ	5120009991504	15434	ST-709	PULLER, MECHANICAL PART OF KIT P/N 5704990	
5	PEFZZ	4910010976930	15434	3375108	.PULLER BUSHING PART OF KIT P/N 5704990	
6	PEFZZ	4910010976989	15434	3375180	DRIVER WATER PUMP PART OF KIT P/N 5704990	
7	PEFZZ	5120010722952	15434	3376845	WRENCH, BOX AIR COMPRESSOR PART OF KIT P/N 5704990	
8	PEFFZ	5120001034687	15434	ST-669	ADAPTER, TORQUE WREN TORQUE WRENCH PART OF KIT P/N 5704990.....	
9	PEFZZ	5120002886514	15434	F-40A	.HANDLE, SOCKET WRENC	
10	PEFZZ	5120011226014	15434	ST-669-13	.SCREWDRIVER BIT.....	
11	PEFZZ	5120008650226	15434	TM-82	.BIT, SCREWDRIVER.....	
12	XAFZZ		15434	M-1302B-24	.SOCKET	
13	XAFZZ		15434	M1302B18	.SOCKET	
14	XAFZZ		15434	ST-6991	.DRIVER	
15	PEFZZ	4910010976988	15434	ST-1159	MANDREL, SEAL, SLEEVE SEAL-WEAR SLEEVE PART OF KIT P/N 5704990	
16	PEFZZ	4910010976972	15434	ST-1325	ATTACHMENT DIAL PART OF KIT P/N 5704990	

END OF FIGURE

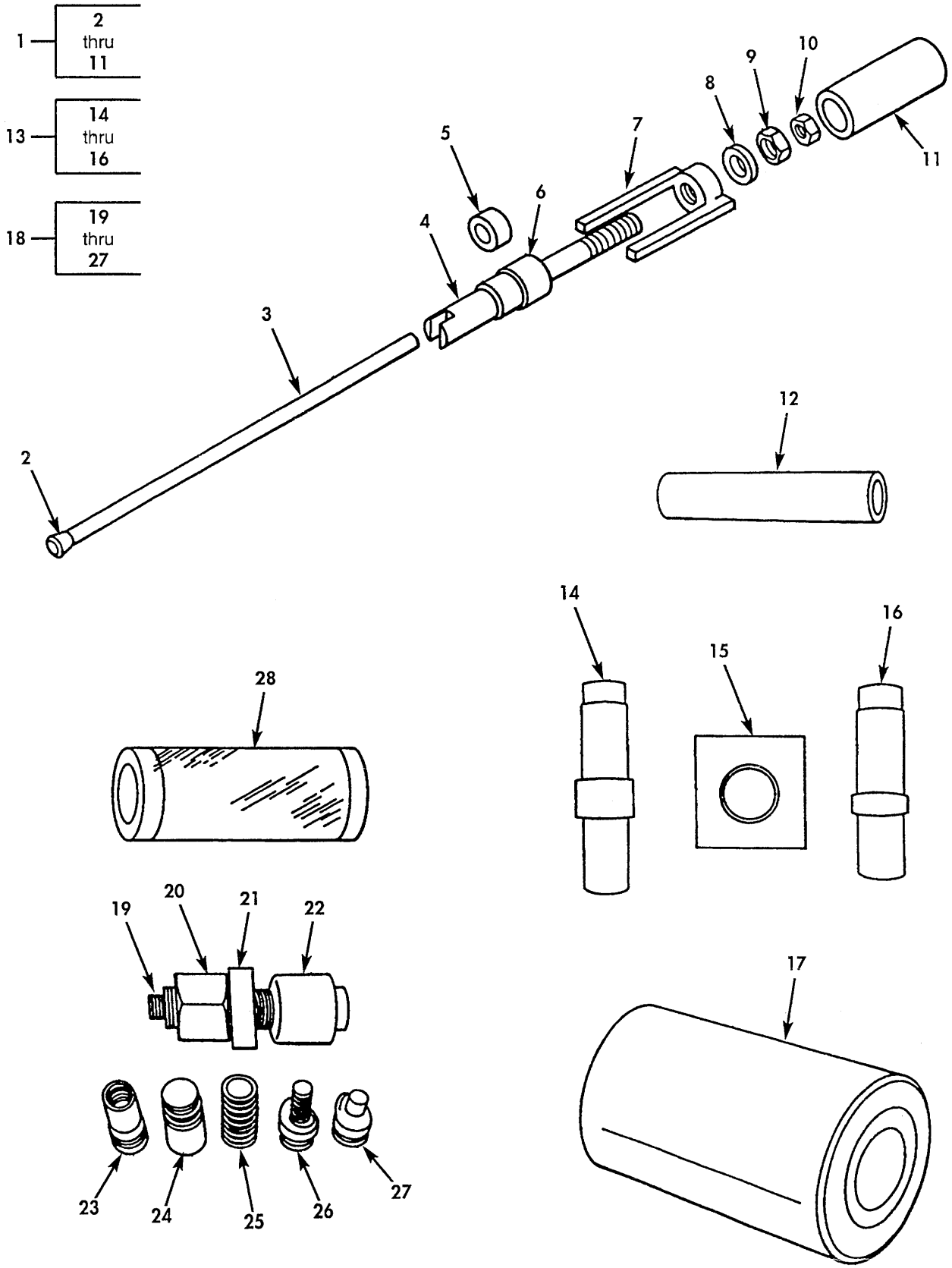


Figure 38. Direct Support Special Tools-3.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 2604 SPECIAL TOOLS	
					FIG. 38 DIRECT SUPPORT SPECIAL TOOLS-3	
1	PEFZZ	5120001135271	15434	ST-1244	PULLER, MECHANICAL PART OF KIT P/N 5704990	
2	PFFZZ	4910010976970	15434	3375825	.TIP EXTRACTOR	
3	PEFZZ	5120011203682	15434	3375616	.ROD, INJECTOR SLEEVE	
4	XAFZZ		15434	3375615	.COLLAR	
5	PEFZA	4910010976969	15434	3375614	.COLLAR FORMING	
6	PEFZZ	5365011037835	15434	ST-1244-9	.SPACER, RING	
7	XAFZZ		15434	ST-1244-1	.SUPPORT	
8	PEFZZ	3120011038752	15434	ST-1244-5	.BEARING, WASHER, THRU	
9	PEFZZ	5310011044550	15434	ST-1244-4	.NUT	
10	KFFZZ		15434	ST-1244-3	.NUT	
11	PEFZZ	5120010996341	15434	ST-1244-8	.HAMMER, HAND	
12	PEFZZ	4910010976971	15434	3375282	DRIVER VALVE GUIDE PART OF KIT P/N 5704990	
13	PEFFF	3460009991210	15434	ST-691	MANDREL SET, MACHINE PART OF KIT P/N 5704990	
14	XAFZZ		15434	ST-691-1	.MANDREL	
15	XAFZZ		15434	ST-691-2	.BLOCK	
16	XAFZZ		34623	MA326-21286	.MANDREL	
17	PEFZZ	4910010976986	15434	ST-658	MANDREL WATER PUMP PART OF KIT P/N 5704990	
18	PEFZZ	5120011564183	15434	3376326	PULLER, MECHANICAL PART OF KIT P/N 5704987	
19	PEFZZ	4910010976977	15434	ST-386-2	.ARBOR	
20	PEFZZ	5310010976978	15434	ST-386-3	.NUT, PLAIN, HEXAGON	
21	PEFZZ	4910010976984	15434	ST-386-11	.BALL THRUST BEARING	
22	PEFZZ	4910010976979	15434	ST-386-5	.SPACER	
23	PEFZZ	4910010976985	15434	3375205	.ADAPTER	
24	PEFZZ	4910010976983	15434	ST-386-10	.ADAPTER	
25	PEFZZ	4910010976982	15434	ST-386-9	.ADAPTER	
26	PEFZZ	4910010976981	15434	ST-386-8	.ADAPTER	
27	PEFZZ	4910010976980	15434	ST-386-6	.ADAPTER	
28	PEFZZ	4910001505797	15434	ST-633	HEAD, GUIDE, SPACER PART OF KIT P/N 5704990	
	PEFZZ	5180011419276	15434	5704990	TOOL KIT, GENERAL ME	

END OF FIGURE

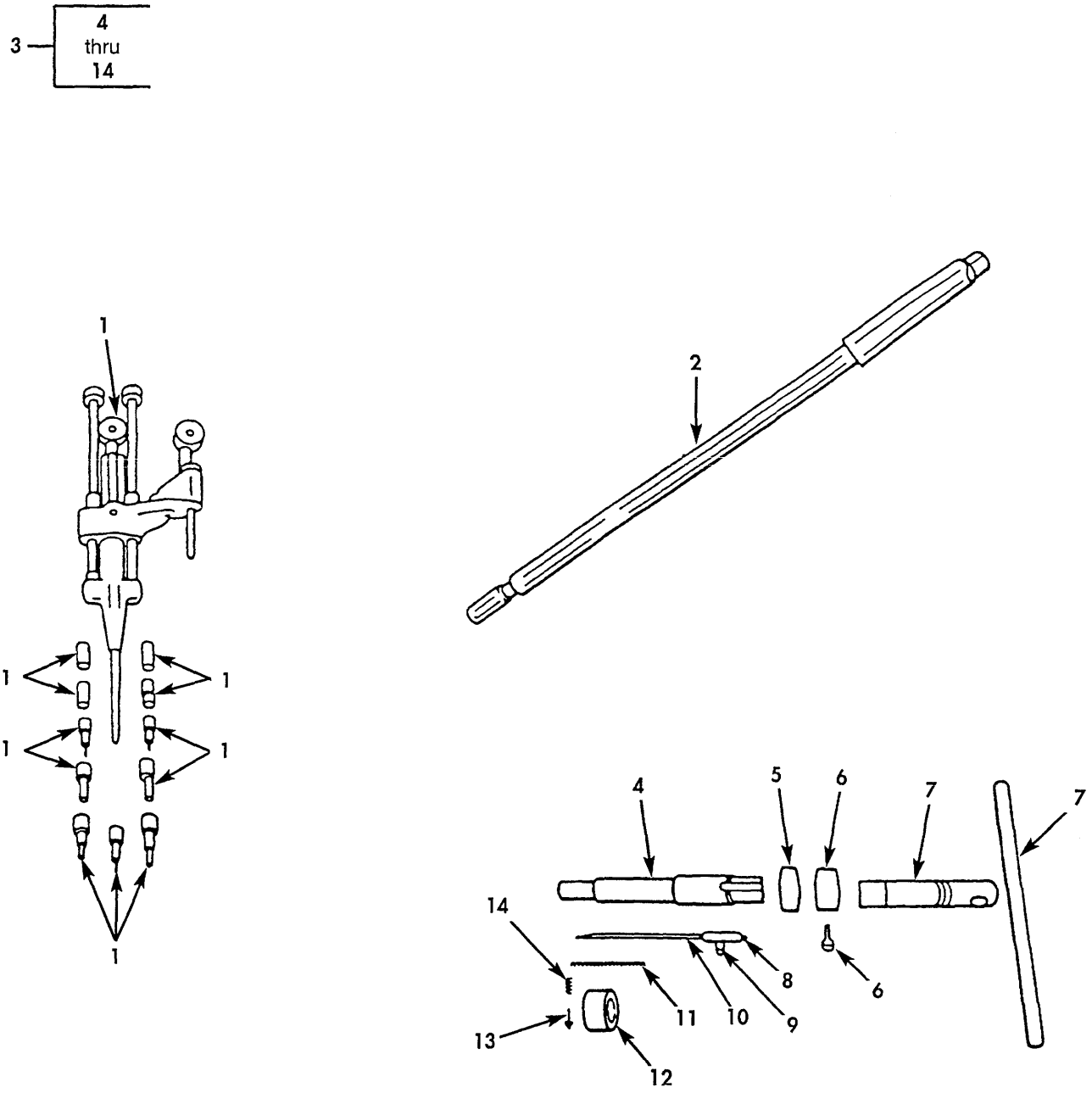


Figure 39. Direct Support Special Tools (Supplemental), (Sheet 1 of 2).

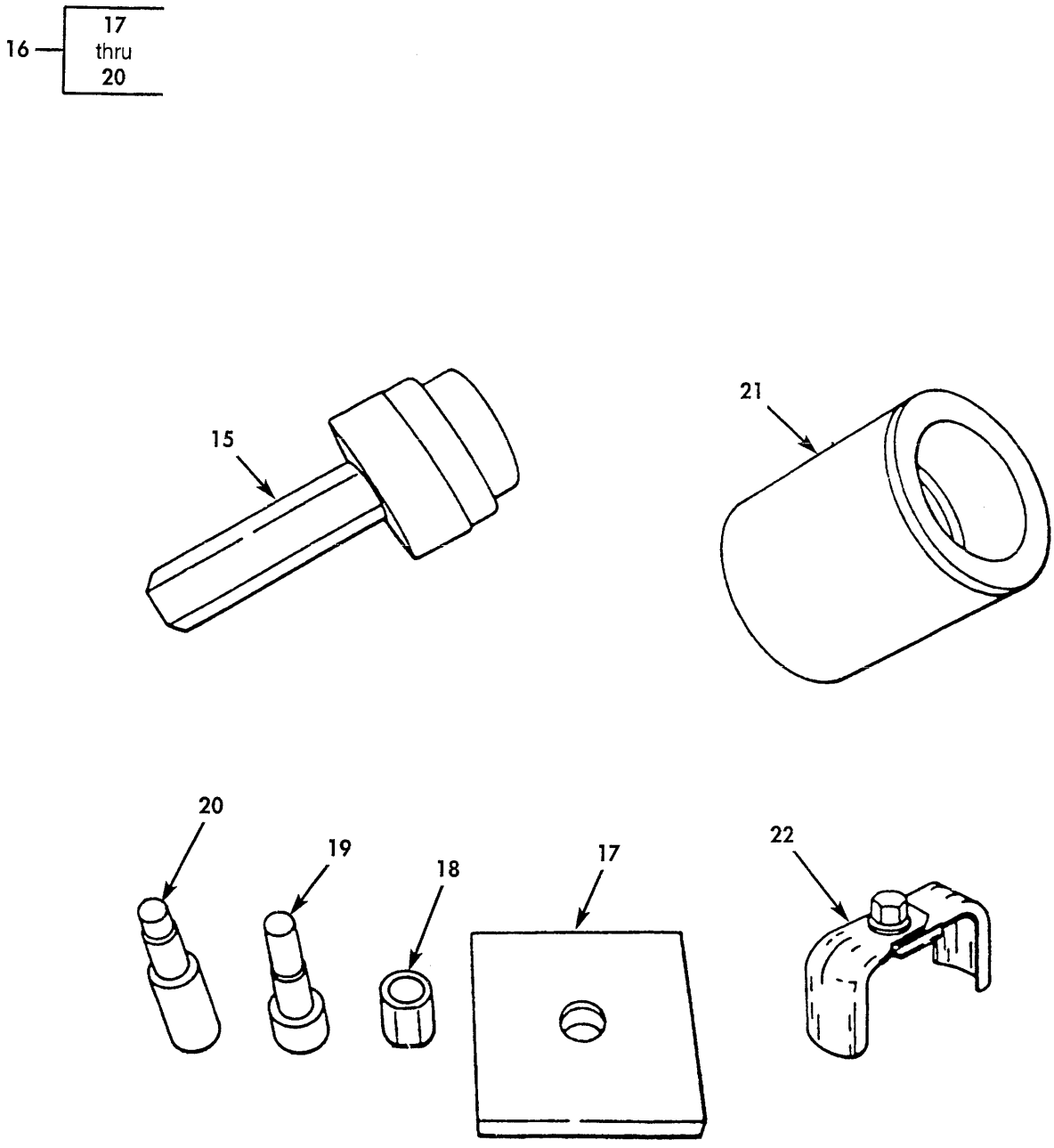


Figure 39. Direct Support Special Tools (Supplemental), (Sheet 2 of 2).

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 2604 SPECIAL TOOLS	
					FIG. 39 DIRECT SUPPORT SPECIAL TOOLS (SUPPLEMENTAL)	
1	PEFZZ	4910007120537	15434	ST593	INDICATOR, ENGINE TI M915 ONLY PART OF KIT P/N 5704993	
2	PEFZZ	5110009807347	15434	ST-646	REAMER M915 ONLY PART OF KIT P/N 5704993	
3	PEFZZ	5120001780948	15434	ST-1100	TOOL, GROOVING M915 ONLY PART OF KIT P/N 5704993	
4	PEFZZ	4910010976964	15434	ST-1100-10	.BODY M915 ONLY	
5	PEFZZ	5310010976961	15434	ST-1100-7	.NUT, PLAIN, KNURLED	
6	XAFZZ		15434	ST-1100-5	.NUT, PLAIN, KNURLED	
7	XAFZZ		15434	ST-1100-1	.BODY	
8	PEFZZ	4910010976962	15434	ST-1100-8	.SLEEVE ROD	
9	PEFZZ	4910010976960	15434	ST-1100-6	.CAPSCREW	
10	PEFZZ	4910010976965	15434	ST-1100-11	.ROD TOOL ADJUSTING	
11	PEFZZ	4910010976963	15434	ST-1100-9	.SPRING ROD PART	
12	PEFZZ	4910010976968	15434	ST-1100-14	.CAP TOOL SETTING	
13	PEFZZ	5130010976967	15434	ST-1100-13	.HONING UNIT, CYLINDR	
14	PEFZA	4910010976966	15434	ST-1100-12	.SPRING TOOL	
15	PEFZZ	4910010976976	15434	ST-1218	MANDREL O RING PART OF KIT P/N 5704993	
16	PEFZZ	5180009161813	15434	ST-249	MANDREL-BLOCK, CAM F PART OF KIT P/N 5704993	
17	XAFZZ		15434	ST-249-4	.BLOCK	
18	PEFZZ	5120011069174	15434	ST-249-3	.SLEEVE, MANDREL	
19	PEFZZ	5120010973204	15434	ST-249-2	.MANDREL	
20	PEFZZ	5120011069173	15434	ST-249-1	.MANDREL	
21	PEFZZ	5120001598916	15434	ST-659	INSERTER, SEAL PART OF KIT P/N 5704993	
22	PEFZZ	5120008650933	93389	2304	REMOVAL TOOL, OIL FI PART OF KIT P/N 5704993	
	PEFZZ	5180010710707	19207	5704993	TOOL KIT, GENERAL ME	

END OF FIGURE

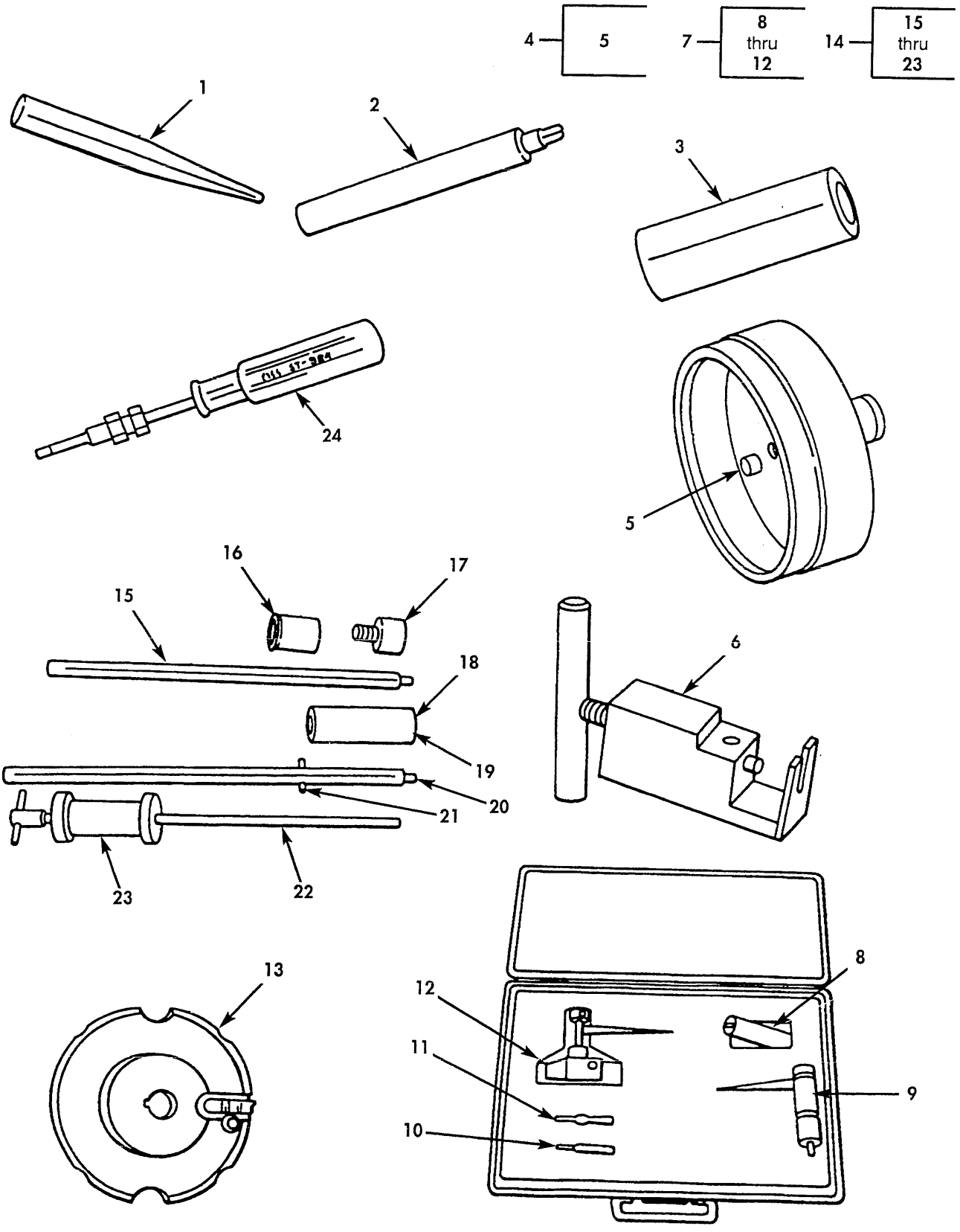


Figure 40. General Support Special Tools-1.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 2604 SPECIAL TOOLS	
					FIG. 40 GENERAL SUPPORT SPECIAL TOOLS-1	
1	PEHZZ	5120009991505	15434	ST-835	INSERTER, PREFORMED PART OF KIT P/N 5704991	
2	PEHZZ	4910001505801	15434	ST-853	DRIVER, GOVERNOR, CYL PART OF KIT P/N 5704991	
3	PEHZZ	5120008968087	15434	ST-1032	INSERTER, SEAL PART OF KIT P/N 5704991	
4	PEFZZ	5120001505810	15434	ST-997	DRIVER, SEAL CRANKSH PART OF KIT P/N 5704991	
5	PEHZZ	4910010976915	15434	ST-997-6	.PINS	
6	PEHZZ	4910011183747	15434	3375204	THROTTLE SHAFT BALL PART OF KIT P/N 5704991	
7	PEHZZ	5180011028418	15434	3375189	TOOL KIT, FUEL PUMP PART OF KIT P/N 5704991	
8	PEHZZ	4910010976943	15434	3375148	.INSTALLING TOOL	
9	PEHZZ	4910010976940	15434	3375140	.TOOL AFC NO AIR ADJ	
10	PEHZZ	4910010976941	15434	3375146	.INSTALLING TOOL	
11	XAHZZ		15434	3375147	.FORMING TOOL	
12	PEHZA	4910010976939	15434	3375137	.TOOL AFC ADJUSTING	
13	PEHZZ	5120001507489	15434	ST1065	HOLDER, TOOL PART OF KIT P/N 5704991	.
14	PEHHZ	5120000554013	15434	ST-1228	MANDREL, CAMSHAFT BU PART OF KIT P/N 5704991	
15	PEHZZ	4910010981917	15434	ST-1228-3	.MANDREL SHANK BUSHI PART OF KIT P/N 5704991	
16	PEHZZ	4910011006191	15434	ST-1228-9	.DRIVER PART OF KIT P/N ST-1228	
17	PEHZA	4910010976910	15434	ST-1228-13	.PULLEY ASSEMBLY BUS PART OF KIT P/N 5704991	
18	PEHZA	4910010981919	15434	ST-1228-5	.GUIDE BUSHING DRIVE	
19	PEHZZ	4910010976912	15434	3375154	.GUIDE	
20	PEHZA	4910010981918	15434	ST-1228-4	.SHAFT ASSEMBLY	
21	PEHZZ	4910010976911	15434	ST-1228-14	.ROLL PIN	
22	PEHZZ	4910010981916	15434	ST-1228-2	.ROD BUSHING DRIVER	
23	PEHZZ	4910010981915	15434	ST-1228-1	.HAMMER	
24	PEHZZ	4910001505805	15434	ST-984	ADJUSTING TOOL	
	PEHZZ	5120000554013	15434	ST-1228	MANDREL, CAMSHAFT BU	

END OF FIGURE

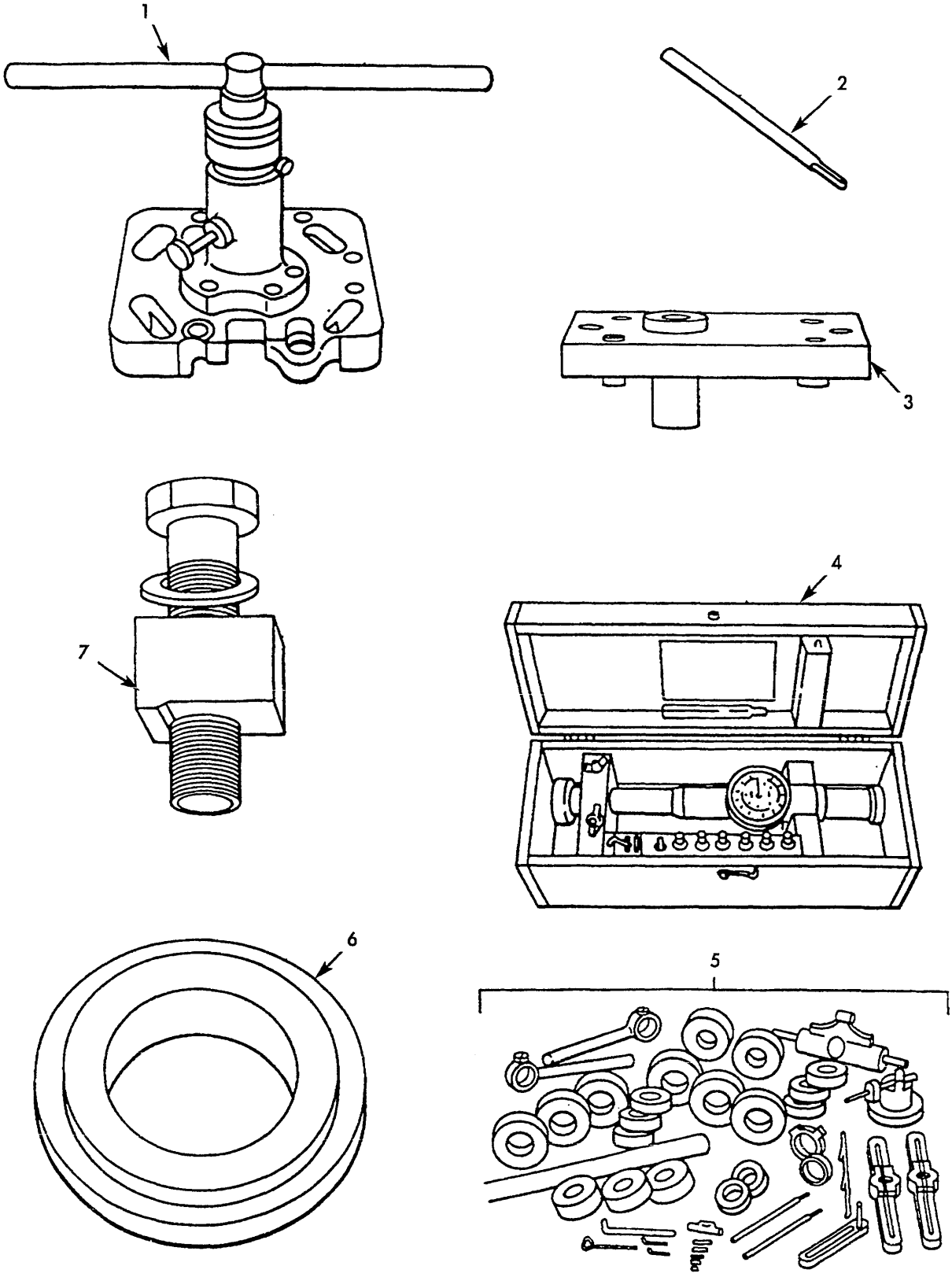


Figure 41. General Support Special Tools-2.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 2604 SPECIAL TOOLS	
					FIG. 41 GENERAL SUPPORT SPECIAL TOOLS-2	
1	PEHZZ	5120001507488	15434	ST-1295	TOOL, COUNTERBORE PART OF KIT P/N 5704991	
2	PEHZZ	5120011205760	15434	ST-1059-17	TOOL BIT, COUNTER	
3	PEHZZ	5110009813107	15434	3376903	REAM FIXTURE PART OF KIT P/N 5704991	
4	PEHZZ	6625012325469	15434	3376619	PARTS KIT, GAGE TEST PART OF KIT P/N 5704991	
5	XDHZZ		15434	ST-1177	GAGE, CHECKING BAR, M PART OF KIT P/N 5704991	
6	PEHZZ	5220011686878	15434	ST-903	GAGE, RING, PLAIN PART OF KIT P/N 5704991	
7	PEHZZ	5120001041816	15434	3376669	CLAMP, CYLINDER LINE PART OF KIT P/N 5704991	

END OF FIGURE

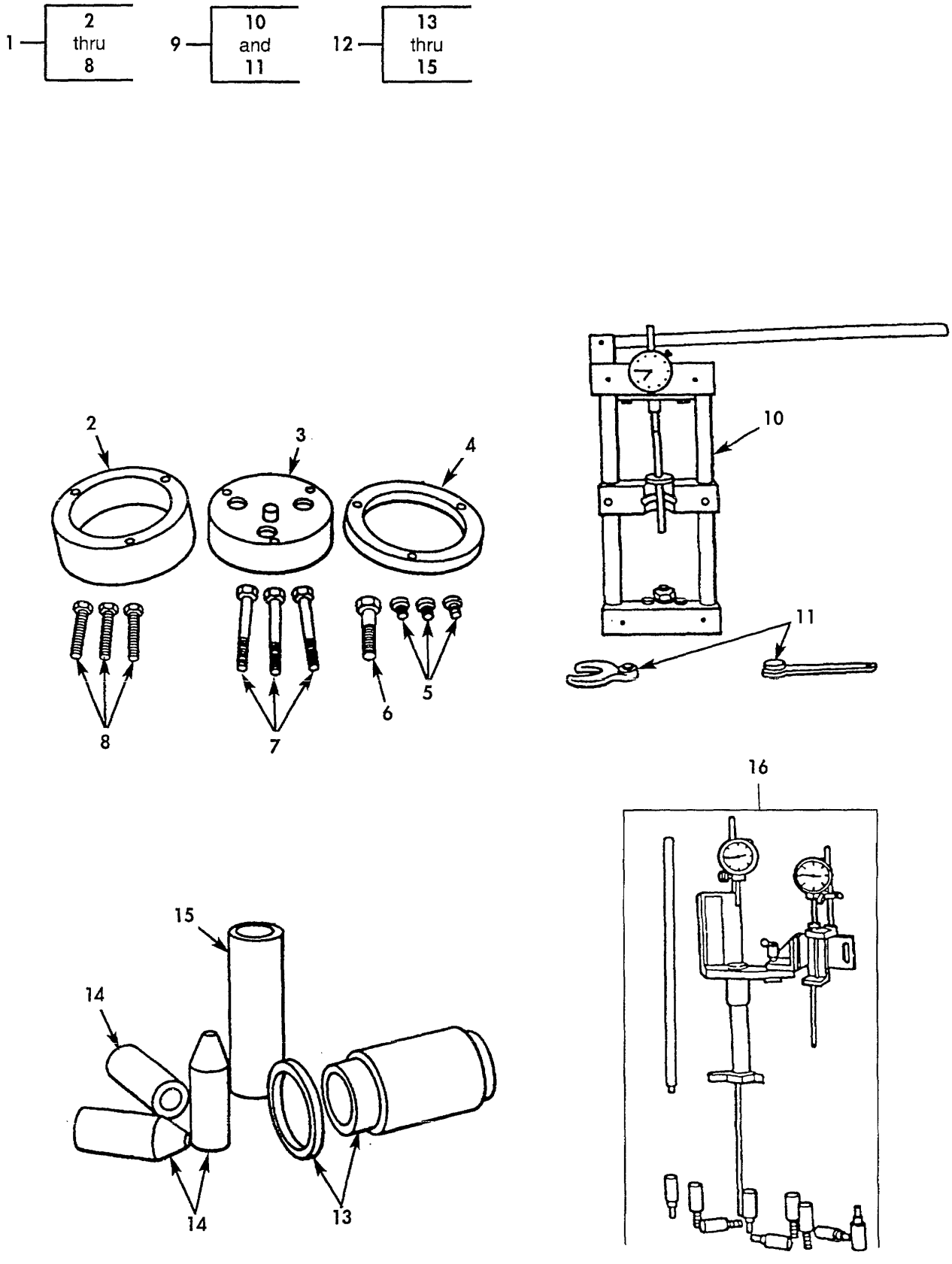


Figure 42. General Support Special Tools-3.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 2604 SPECIAL TOOLS	
					FIG. 42 GENERAL SUPPORT SPECIAL TOOLS-3	
1	PEHHH	4910011060492	15434	ST-1259	PULLER-INSTALLER PART OF KIT P/N 5704991	
2	PEHZZ	4910010976919	15434	ST-1259-4	.TOOL SPACER RING	
3	PEHZZ	4910010976916	15434	ST-1259-1	.PLATE TOP	
4	PEHZA	4910010976917	15434	ST-1259-2	.TOOL SPACER RING	
5	PEHZZ	5305010976918	15434	ST-1259-3	.SETSCREW	
6	PEHZZ	5305010981913	15434	ST-1259-7	.SCREW, CAP, HEXAGON H	
7	PEHZZ	5305010976920	15434	ST-1259-5	.SETSCREW	
8	PEHZZ	5305010976921	15434	ST-1259-6	.SCREW, CAP, HEXAGON H	
9	PEHZZ	4910010976926	15434	3375160	FIXTORE TOP STOP PART OF KIT P/N 5704991	
10	PEHZZ	4910010976927	15434	3375165	.TOOL ADJUSTING	
11	PEHZZ	4910010976928	15434	3375166	.WRENCH CROWSFOOT	
12	PEHZZ	5180010740019	15434	3376720	TOOL KIT, FUEL PUMP 5704991	
13	PEHZZ	4910010976936	15434	3375172	.INSTALLING TOOL	
14	KFHZZ	4910010976937	15434	3375173	.DRIVER MAIN SHAFT	
15	PEHZZ	4910010976938	15434	3375174	.DRIVER FRONT COVER	
16	PEHZZ	4910009991269	15434	3375522	TESTER, INTERNAL COM	
	PEHZZ	5180011419274	15434	5704991	TOOL KIT, GENERAL ME	

END OF FIGURE

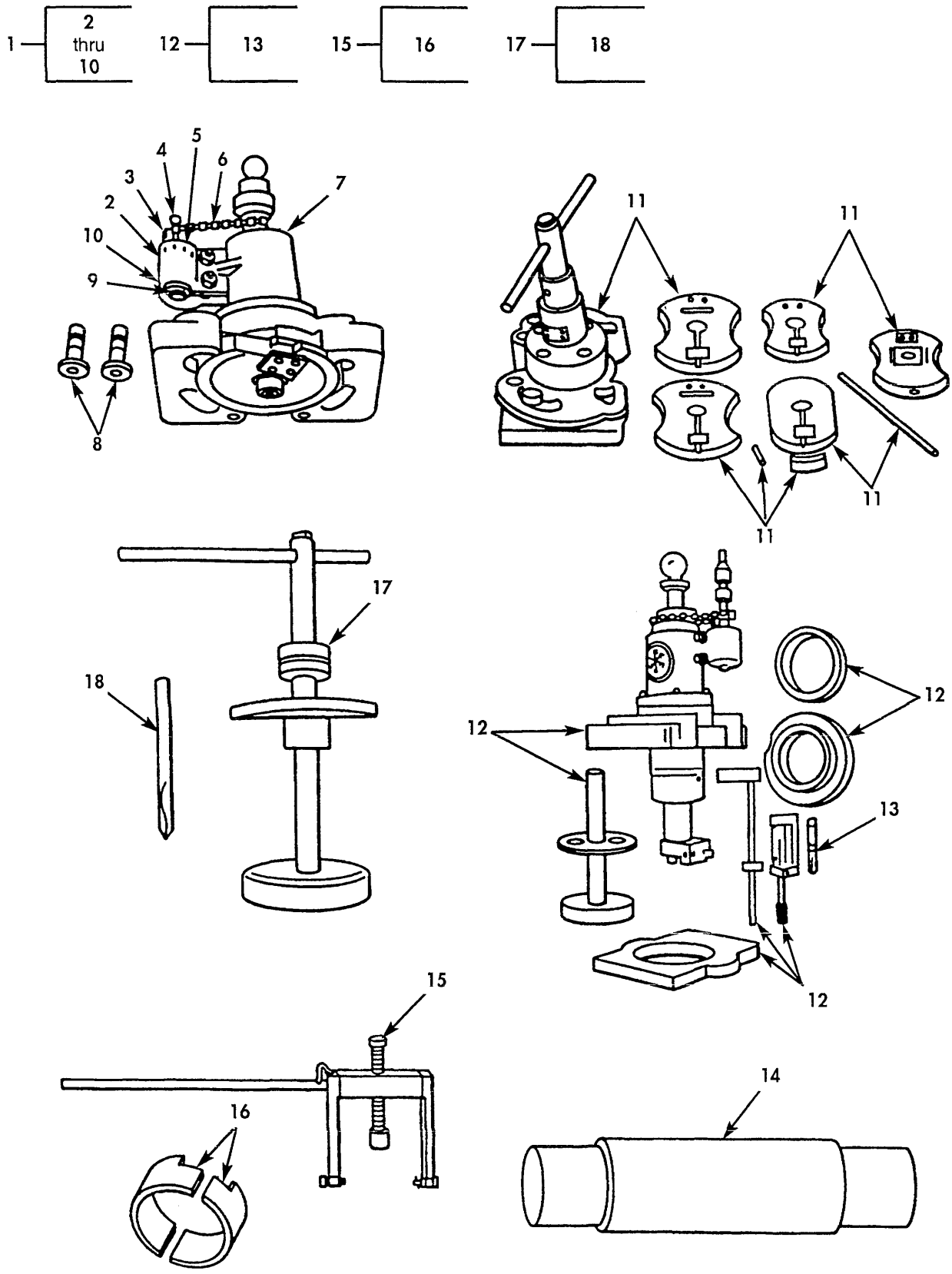


Figure 43. General Support Special Tools-1 (Supplemental).

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 2604 SPECIAL TOOLS	
					FIG. 43 GENERAL SUPPORT SPECIAL TOOLS-1 (SUPPLEMENTAL)	
1	PEHHH		15434	ST-1168	BORING TOOL LINER COUNTER BORE ..... PART OF KIT P/N 5704994.....	
2	PEHZZ	3120010850762	15434	ST-1168-4	.BEARING, DRIVE	
3	PEHZZ	5305010844596	15434	ST-1168-6	.SETSCREW	
4	PEHZZ	4910010850763	15434	ST-1168-3	.SHAFT, CHAIN DRIVE	
5	PEHZZ	3020010850761	15434	ST-1168-5	.SPROCKET WHEEL SEGM.....	
6	PEHZZ	3020010847007	15434	ST-1168-7	.CHAIN, ROLLER	
7	PEHZZ	3020010868269	15434	ST-1168-10	.SPROCKET, DRIVEN	
8	PEHZZ	4910010981912	15434	ST-1168-19	.TOOL BIT	
9	PEHZZ	4910010868268	15434	ST-1168-8	.SNAP RING, SHAFT	
10	PEHZZ	4910010887904	15434	ST-1168-9	.SNAP RING, BEARING	
11	PEHZZ	5120000651031	15434	ST-544	PULLER, MECHANICAL M915 ONLY PART OF..... KIT P/N 5704994	
12	PEHZZ	4910010850765	15434	3376904	BORING TOOL, CYLINDE PART OF KIT P/N..... 5704994	
13	PEHZZ	5133010846008	15434	ST-1287-10	.TOOL BIT	
14	PEHZZ	4910010976914	15434	ST-1158	BUSHING MANDREL PART OF KIT P/N..... 5704994	
15	PEHZZ	5120011205759	15434	3375834	GEAR PULLER ASSEMBL PART OF KIT P/N..... 5704994	
16	PEHZZ	4910010976909	15434	3375839	.PULLER JAW PART OF KIT P/N 5704994	
17	PEHZZ	4910010850766	15434	ST-1318	CHAMFER TOOL, LOWER PART OF KIT P/N 5704994	
18	PEHZZ	5133010846009	15434	ST-1318-23	.BIT, LOWER LINER.....	

END OF FIGURE

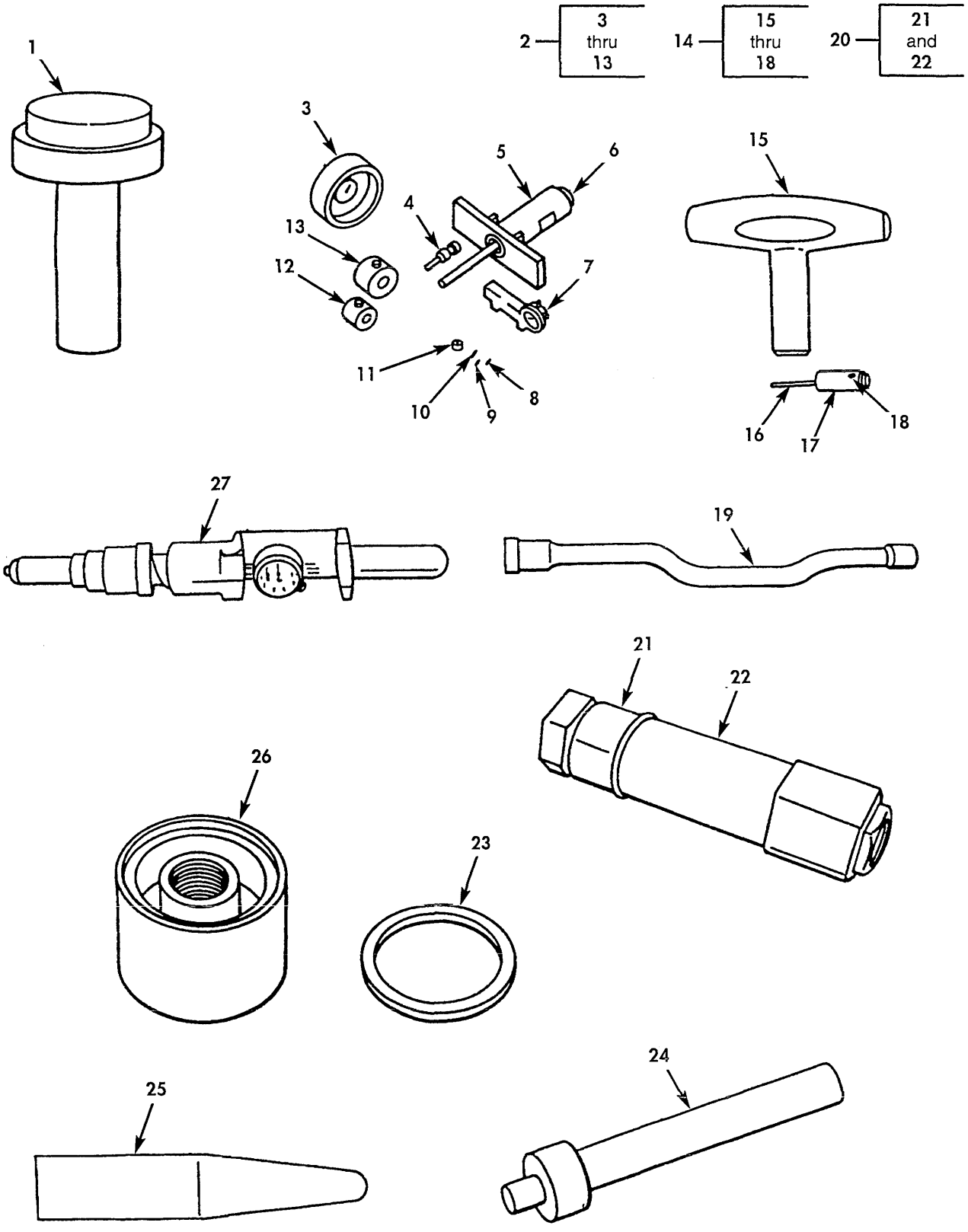


Figure 44. General Support Special Tools-2 (Supplemental).

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 2604 SPECIAL TOOLS	
					FIG. 44 GENERAL SUPPORT SPECIAL TOOLS-2 (SUPPLEMENTAL)	
1	PEHZZ	4910011059165	15434	3375153	DRIVER PART OF KIT P/N 5704994	
2	PEHHH		15434	3375206	BUSHING TOOL LUBRICATION PUMPBODY COVER PART OF KIT P/N 5704994	
3	PEHZZ	4910010850751	15434	3375223	.GUIDE, BUSHING BORIN	
4	PEHZZ	4910010846979	15434	3375229	.DRIVE ADAPTER, BORTO.	
5	PEHZZ	4930010853728	15434	3375220	.HOUSING, BORING	
6	PEHZZ	5355010977072	15434	3375228	.KNOB.	
7	PEHZZ	5355010970157	15434	3375227	.DIAL, INDICATOR	
8	PEHZZ	4910010857269	15434	3375226	.BIT, BORING TOOL, BUS	
9	PEHZZ	4910010847222	15434	3375225	.CUTTER BIT, BORING M	
10	PEHZZ	4910010847221	15434	3375207	.CUTTER BIT, BORING M	
11	PEHZZ	5355010845323	15434	3375224	.KNOB	
12	PEHZZ	4910010846977	15434	3375221	.GUIDE, BUSHING BORIN	
13	PEHZZ	4910010846978	15434	3375222	.GUIDE, BUSHING	
14	PEHZZ	5120011203681	15434	3376177	TORQUE WRENCH, INJEC PART OF KIT P/N 5704994	
15	PEHZZ	5120010722955	15434	ST-1090	.WRENCH, TORQUE	
16	PEHZZ	5305010976924	15434	ST-1090-4	.SET SCREW	
17	XAHZZ		15434	3376197	.SCREWDRIVER	
18	PEHZZ	4910010976923	15434	ST-1090-3	.WRENCH ALLEN	
19	PEHZZ	4910010976925	15434	ST-1145	TORQUING TOOL PART OF KIT P/N 5704994	
20	PEHHH	5120010976932	15434	ST-1326	PULLER SET, MECHANIC PART OF KIT P/N 5704994	
21	PEHZA	4910010976934	15434	ST-1326-2	.COLLAR PART OF KIT P/N 5704994	
22	PEHZZ	4910010976933	15434	ST-1326-1	.COLLET PART OF KIT P/N 5704994	
23	PEHZZ	5330011071841	15434	3375015	GASKET PART OF KIT P/N 5704994	
24	PEHZZ	4910010976944	15434	3375230	INSTALLING TOOL PART OF KIT P/N 5704994	
25	PEHZZ	5120008968089	15434	ST-422	INSERTER, PREFORMED	
26	PEHZA	4910010976935	15434	3375014	ADAPTER PLATE FUEL PART OF KIT P/N 5704994	
27	PEHZZ	4910000976931	15434	ST-1231	BLOCK WEIGHT	

END OF FIGURE

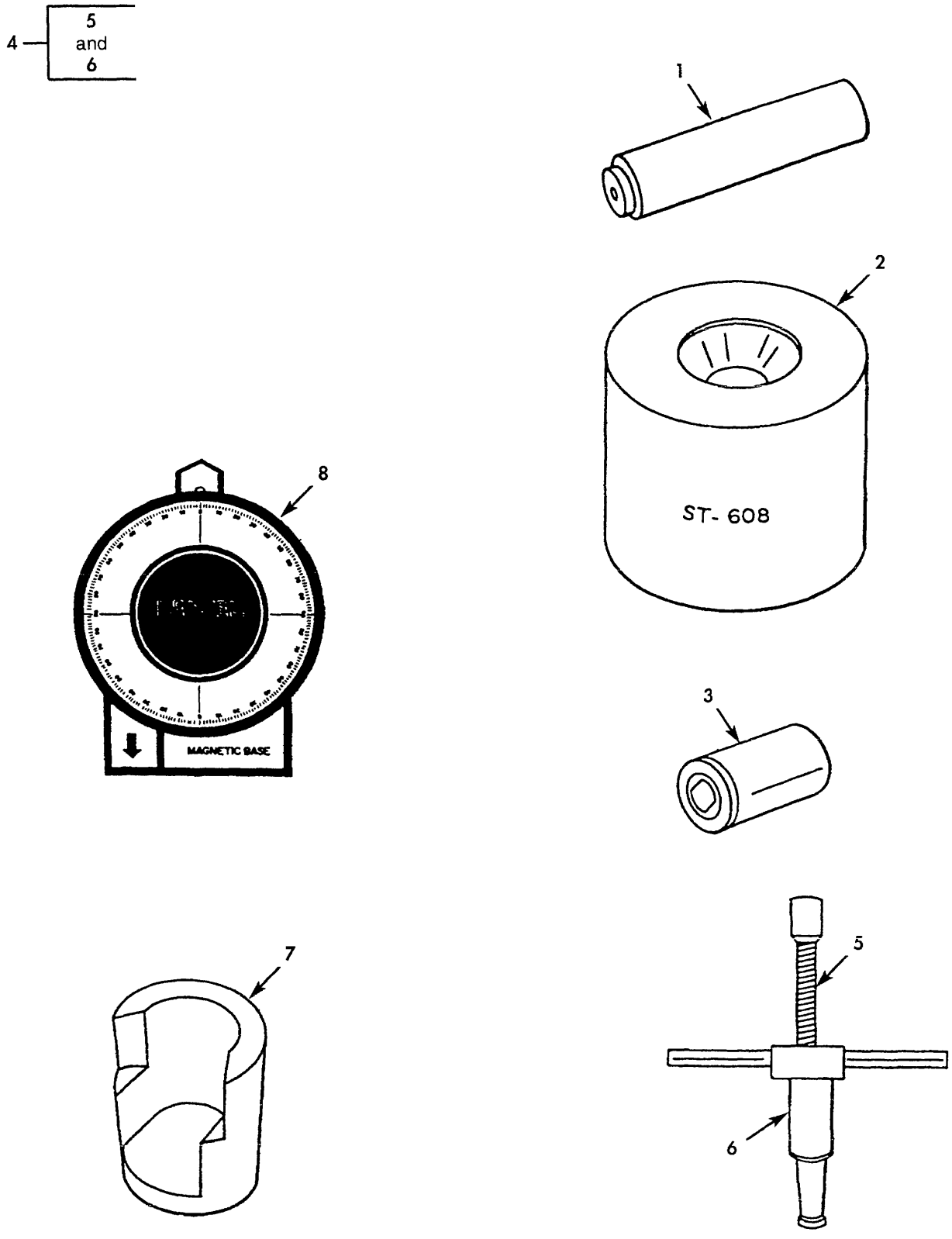


Figure 45. General Support Special Tools-3 (Supplemental).

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 2604 SPECIAL TOOLS	
					FIG. 45 GENERAL SUPPORT SPECIAL TOOLS-3 (SUPPLEMENTAL)	
1	PEHZZ	4910010976945	15434	3375271	MANDREL PART OF KIT P/N 5704994	
2	PEHZZ	4910010869766	15434	ST-608	TURBO SUPPORT BLOCK PART OF KIT P/N 5704994	
3	PEHZZ	5120001167625	15434	ST-1095	SOCKET, SOCKET WRENC PART OF KIT P/N 5704994	
4	PEHHH	5120000651031	15434	ST-544	PULLER ASSEMBLY PART OF KIT P/N 5740494	
5	XAHZZ		15434	ST-544-2	.SCREW VALVE	
6	PEHZZ	5120011000135	15434	ST-544-1	.REMOVER, BEARING AND	
7	PEHZZ	5120009230856	15434	ST-851	HOLDER PART OF KIT P/N 5704994	
8	PEHZZ	4910010740020	15434	3375855	TEMPLATE, FUEL PUMP PART OF KIT P/N 5704991	
	ADHHH	5180011419274	19207	5704991	TOOL KIT, GENERAL ME	
	ADHHH	5180010696998	19207	5704994	TOOL KIT, GENERAL ME	

END OF FIGURE

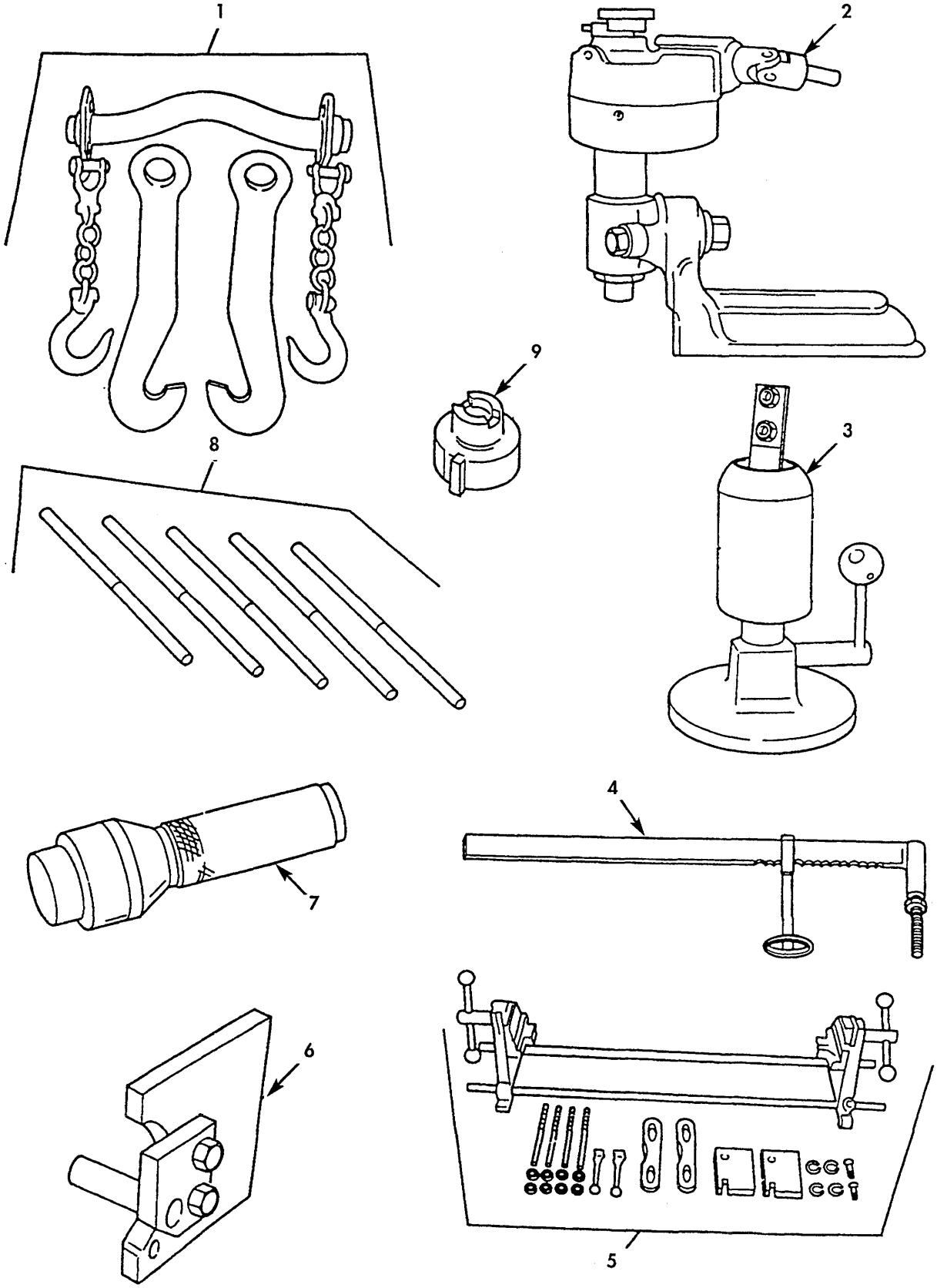


Figure 46. Direct and General Support Special Tools-1.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 2604 SPECIAL TOOLS	
					FIG. 46 DIRECT AND GENERAL SUPPORT SPECIAL TOOLS-1	
1	PEFZZ	2815003622042	15434	ST-125	FIXTURE ENGINE LIFTING PART OF KIT ..... P/N 5704987.....	
2	PEFZZ	4910003453708	15434	ST-257	INSERT KIT, VALVE SE PART OF KIT P/N..... 5704987	
3	PEFZZ	5120011457293	15434	ST-448	COMPRESSOR, VALVE SP PART OF KIT P/N..... 5704987	
4	PEFZZ	4920007119307	15434	ST583	FIXTURE, HOLDING, CYL PART OF KIT P/N 5704987	
5	PEHZZ	4910011509713	15434	3375455	BORING MACHINE, ENGI CYLINDER BLOCK..... COUNTERBORE.....	
6	PEFZZ	4910011598701	15434	ST-749	PLATE, MOUNTING, AIR AIR COMPRESSOR..... MOUNTING PART OF KIT P/N 5704987	
7	PEFZZ	5120011643265	15434	ST-1105	INSERTER AND REMOVE AIR COMPRESSOR ..... BUSHING PART OF KIT P/N 5704987	
8	PEFZZ	3460009991173	15434	ST-663	ARBOR SET, VALVE GUI PART OF KIT P/N 5704987	
9	PEFZZ	4910009991208	15434	ST662	CUTTER SET, COUNTERB PART OF KIT P/N..... 5704987	

END OF FIGURE

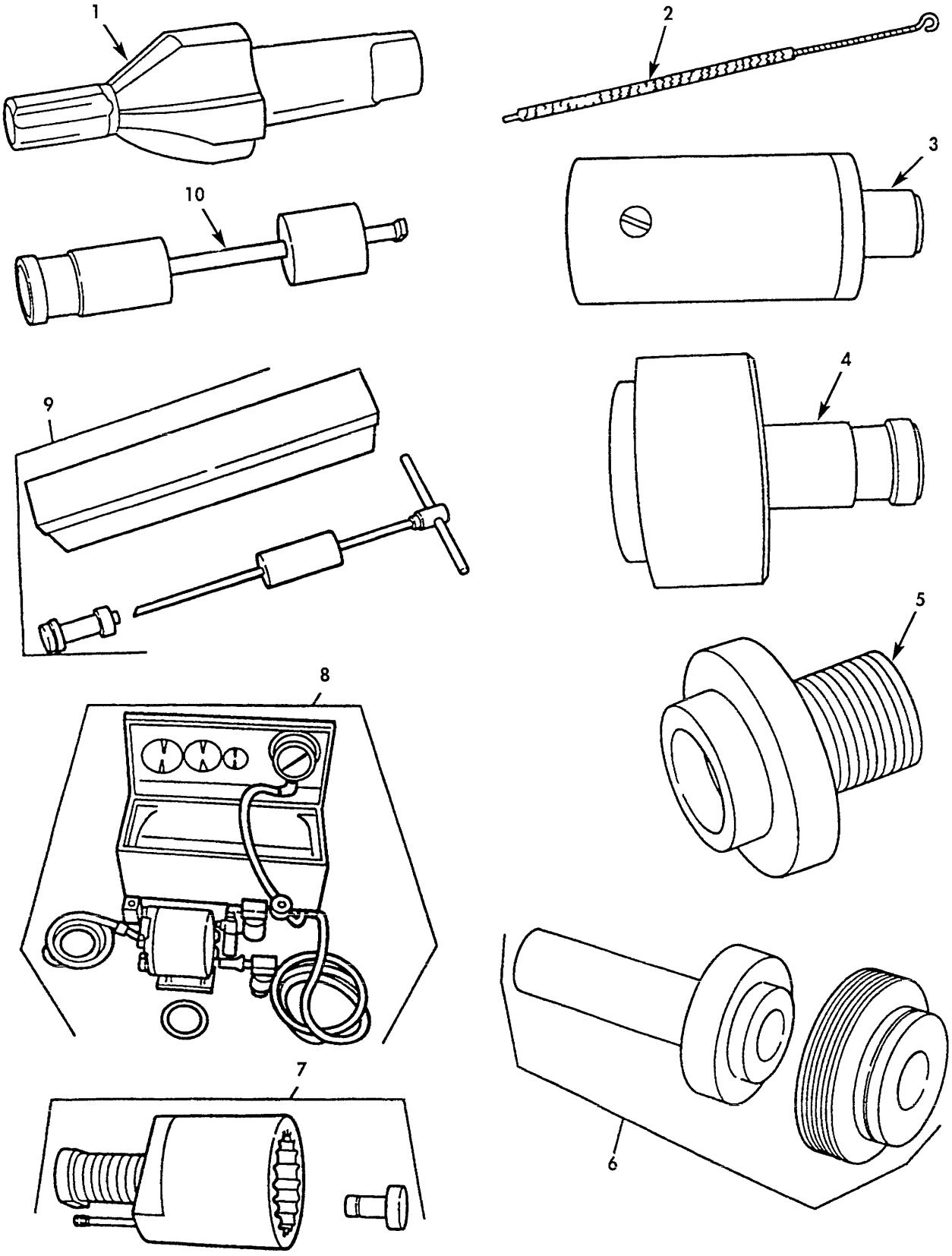


Figure 47. Direct Support Special Tools-2.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 2604 SPECIAL TOOLS	
					FIG. 47 DIRECT SUPPORT SPECIAL TOOLS-2	
1	PAFZA	4910009250755	15434	ST824	DEP REPORTED STK-NO INJECTOR SEAT CUTTING PART OF KIT P/N 5704987.....	
2	PEFZZ	7920001683244	15434	ST-876	BRUSH, FUEL PASSAGE FUEL PASSAGE CLEANING PART OF KIT P/N 5704987	
3	PEFZZ	4910001505843	15434	ST-1122	DRIVER, VALVE, INSERT VALVE SEAT INSERT STAKING TOOL PART OF KIT P/N 5704987	
4	PEFZZ	4910001505844	15434	ST-1124	DRIVER, ASSEMBLY, INS VALVE SEAT INSERT STAKING TOOL PART OF KIT P/N 5704987	
5	PEFZZ	4910011612115	15434	ST-1173	MANDREL, SEAL PART OF KIT P/N 5704987	
6	PEFZZ	5120011608867	15434	ST-1191	INSERTER, SEAL PART OF KIT P/N 5704987	
7	PEFZZ	5120011282678	15434	3376663	PULLER, COUPLING PART OF KIT P/N 5704987	
8	PEFZZ	4910011282691	15434	ST-1257-A	TESTER, VALVE VAC VALVE VACUUM PART OF KIT P/N 5704987.....	
9	PEFZZ	5120011282679	15434	ST-1279	EXTRACTOR, VALVE, SEA VALVE SEAT PART OF KIT P/N 5704987.....	
10	PEFZZ	5120001167604	15434	3376872	PULLER, INJECTOR, DIE PART OF KIT P/N 5704987	

END OF FIGURE

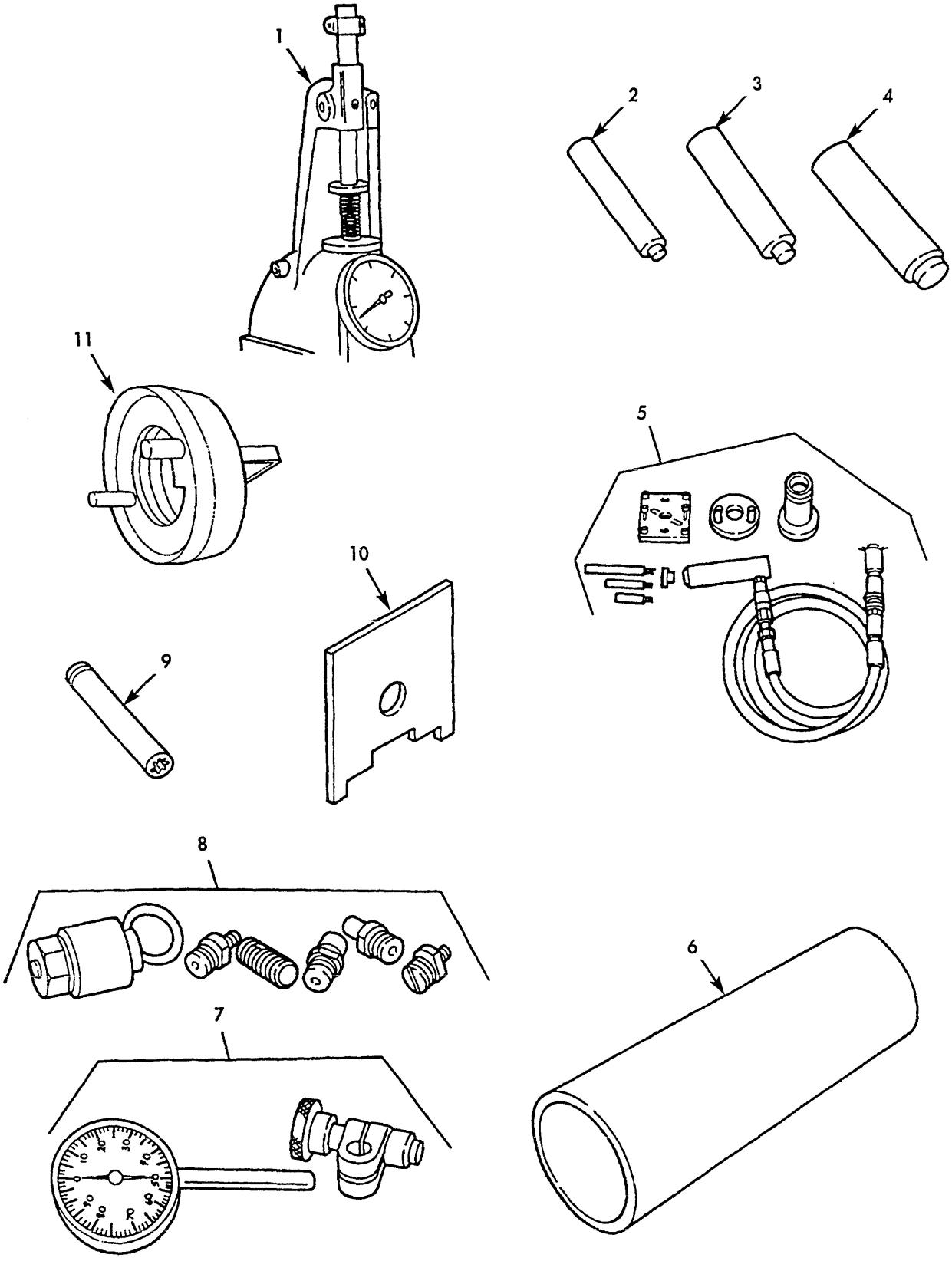


Figure 48. Direct Support Special Tools-3.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 2406 SPECIAL TOOLS	
					FIG. 48 DIRECT SUPPORT SPECIAL TOOLS-3	
1	PEFZZ	4910011424929	15434	3375182	TESTER VALVE SPRING PART OF KIT P/N 5704987	
2	PEFZZ	4910011432023	15434	3375192	EXPANSION PLUG DRIV 1 1/4 INCH PLUG PART OF KIT P/N 5704987.....	
3	PEFZZ	4910011433337	15434	3376816	EXPANSION PLUG DRIV EXPANSION PLUG, 1 INCH PLUG PART OF KIT P/N 5704987	
4	PEFZZ	4910011433336	15434	3376815	EXPANSION PLUG DRIV EXPANSION PLUG, 3/4 INCH PLUG PART OF KIT P/N 5704987	
5	PEFZZ	5120011553795	15434	3375265	PULLER, WATER PUMP I PART OF KIT P/N 5704987	
6	PEFZZ	5120011282675	15434	3375448	DRIVER, SEAL, WP PART OF KIT P/N 5704987	
7	PEFZZ	5210011572291	15434	3376050	INDICATOR, DIAL PART OF KIT P/N 5704987	
8	PEFZZ	5120011564183	15434	3376326	PULLER, MECHANICAL P.....	
9	PEFZZ	5130011558327	55719	SINL-200	SOCKET, SOCKET WRENC 5/8 INCH X 1/2 DRIVE PART OF KIT P/N 5704987	
10	PEFZZ	5120011631349	75078	011494	SOCKET, SOCKET WRENC SOLENOID VALVE PART OF KIT P/N 5704987.....	
11	PEFZZ	4910011654541	15434	3375151	EXPANDER, OIL SEAL PART OF KIT P/N 5704987	
	ADHHH		19207	5704987	TOOL KIT, GENERAL ME.....	

END OF FIGURE

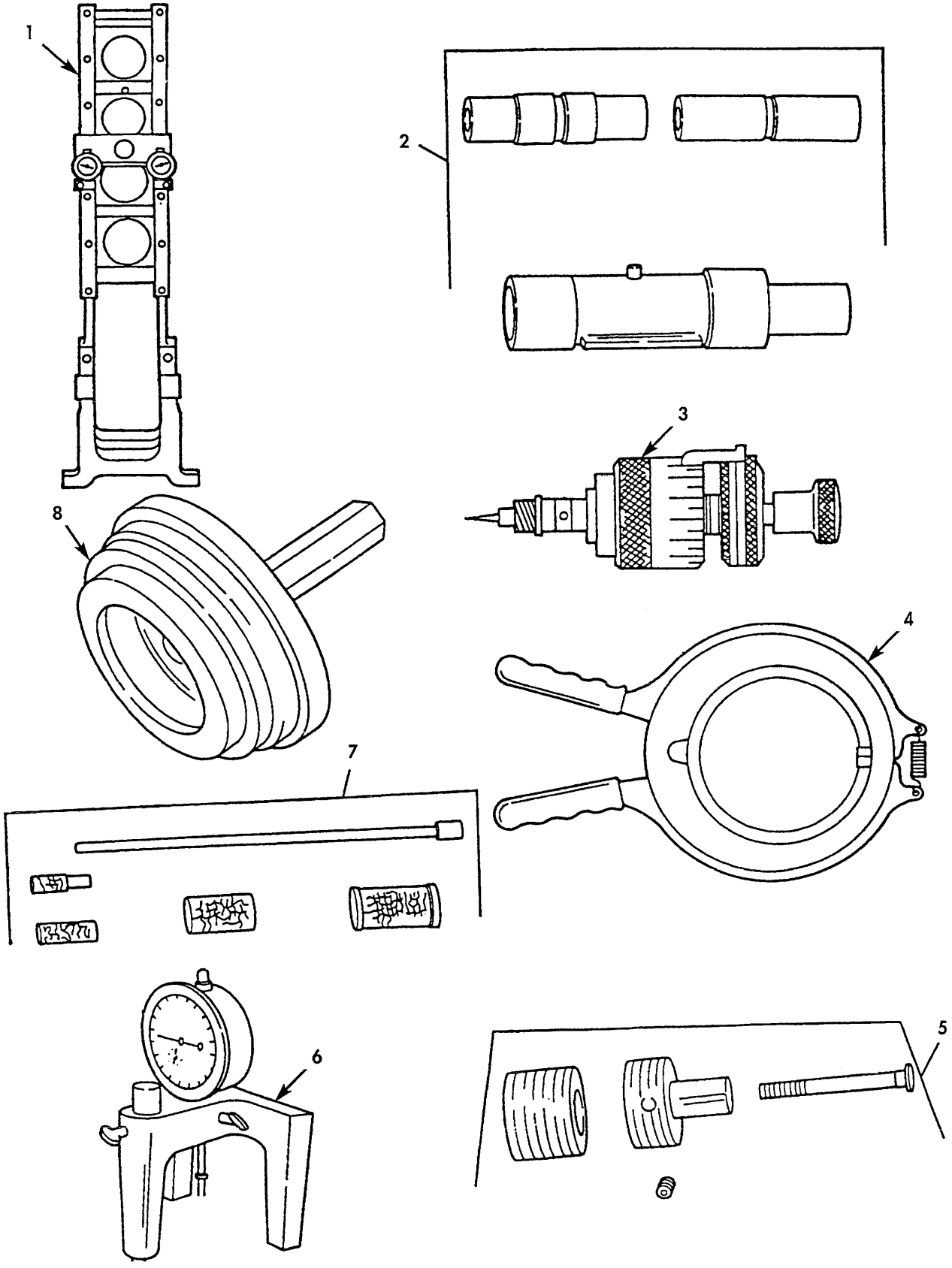


Figure 49. General Support Special Tools-1.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 2504 SPECIAL TOOLS	
					FIG. 49 GENERAL SUPPORT SPECIAL TOOLS-1	
1	PEHZZ	4910009777507	15434	ST-561	FIXTURE ASSEMBLY, CH CONNECTING ROD CHECKING PART OF KIT P/N 5704988.....	
2	PEHZZ	4910011467130	15434	ST-563	MANDREL PART OF KIT P/N 5704988	
3	PEHZZ	5120009991503	15434	ST-708	BURNISHER, AJDUSTABL PART OF KIT P/N 5704988	
4	PEHZZ	5120001507486	15434	ST-763	EXPANDER, PISTON RIN PISTON RING PART OF KIT P/N 5704988	
5	PEHZZ	4910011418388	15434	ST-1241	PLUNGER PROTUSION PLUNGER PROTRUSION CHECKING PART OF KIT P/N 5704988	
6	PEHZZ	4910001505819	15434	ST-1089	EXTENSION, INJECTOR PART OF KIT P/N 5704988	
7	PEHZZ	4910001505848	15434	ST-1134	EXTRACTOR, VALVE PIN DOWEL PIN PART OF KIT P/N 5704988.....	
8	PEHZZ	5120009991206	15434	ST-1229	DRIVER, CYLINDER LIN PART OF KIT P/N 5704988	

END OF FIGURE

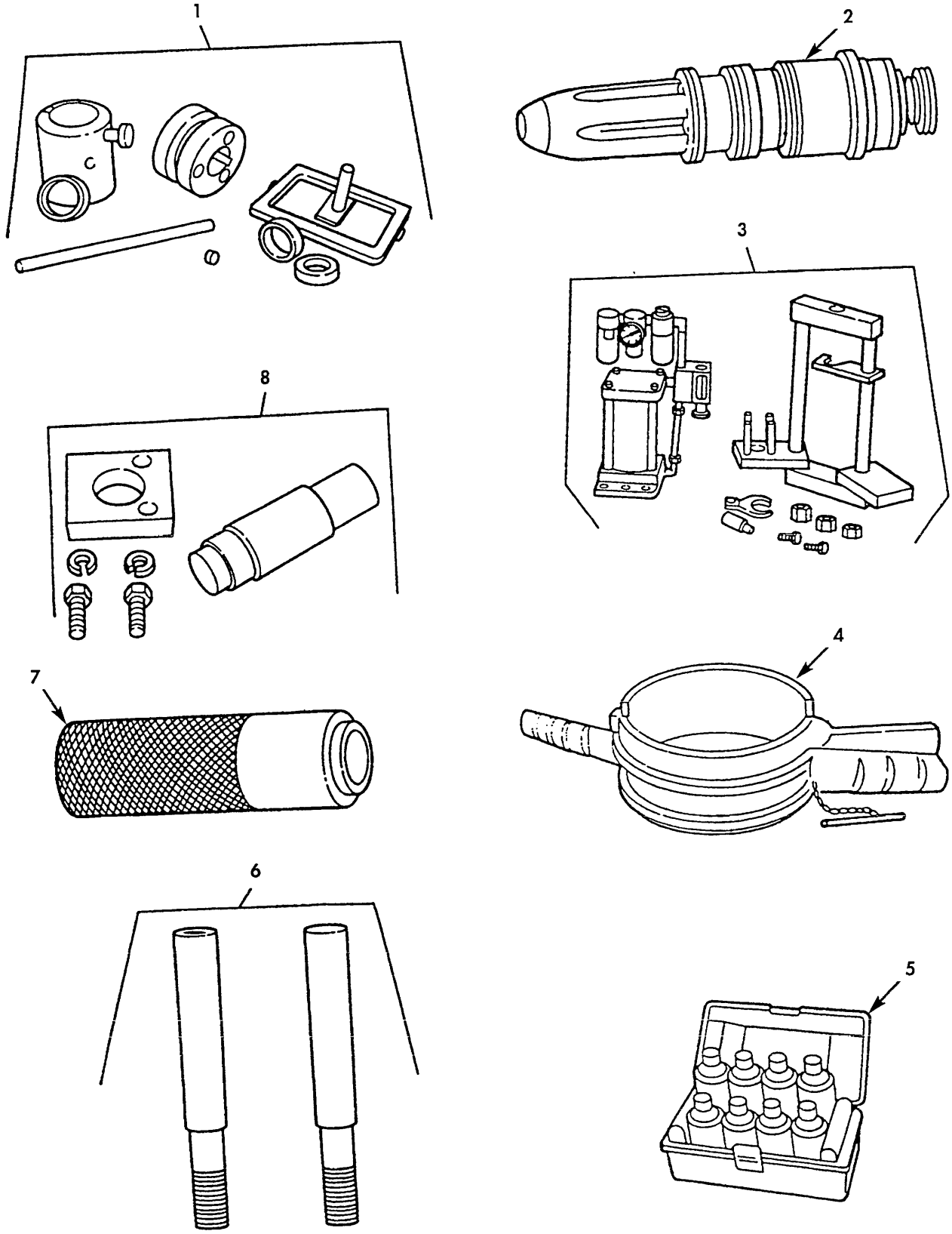


Figure 50. General Support Special Tools-2.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 2604 SPECIAL TOOLS	
					FIG. 50. GENERAL SUPPORT SPECIAL TOOLS-2	
1	PEHZZ	4910011477896	15434	ST-1261	CONVERSION KIT, INJE PART OF KIT P/N 5704988	
2	PEHZZ	4910011546406	15434	ST-1262	MASTER INJECTOR MASTER "K" PART OF KIT P/N 5704988	
3	PEHZZ	4910010821346	15434	ST-1298	STAND ASSEMBLY, INJE PART OF KIT P/N 5704988	
4	PEHZZ	5120011282758	15434	3375162	COMPRESSOR, PISTON R PISTON RING PART OF KIT P/N 5704988.....	
5	PEHZZ	6850001450255	15434	3375432	INSPECTION PENETRAN CRACK DETECTION PART OF KIT P/N 5704988	
6	PEHZZ	4910011656016	15434	3375601	GUIDE PIN, SPECIAL, C CONNECTING ROD GUIDE PART OF KIT P/N 5704988.....	
7	PEHZZ	4910011432034	15434	3375959	VALVE DRIVER PRESS PRESSURIZING VALVE PART OF KIT P/N 5704988.....	
8	PEHZZ	4910011522743	15434	3376011	FIXTURE, VALVE INSTA AFC PRESSURE VALVE PART OF KIT P/N 5704988.....	

END OF FIGURE

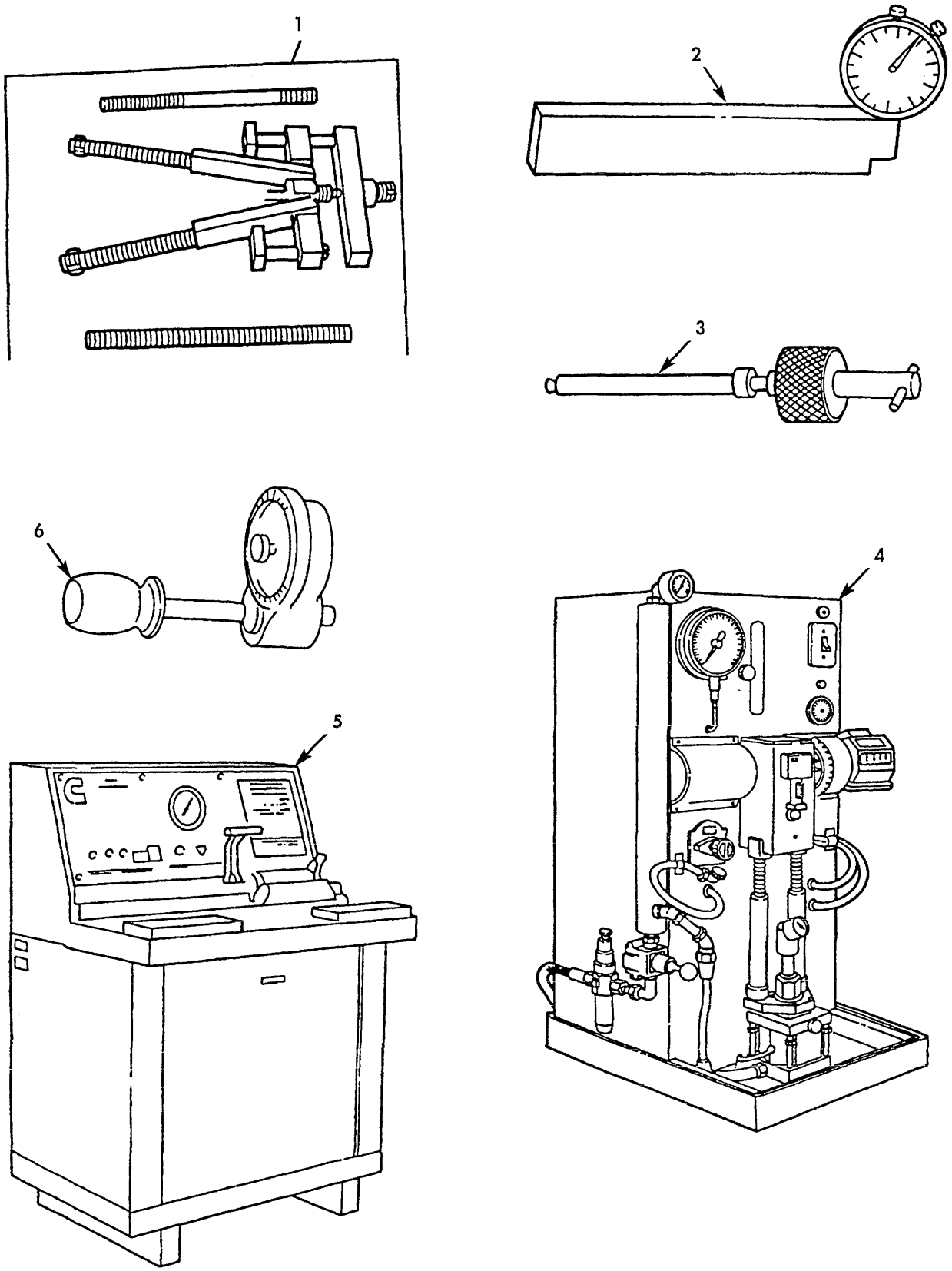


Figure 51. General Support Special Tools-3.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 2604 SPECIAL TOOLS	
					FIG. 51 GENERAL SUPPORT SPECIAL TOOLS-3	
1	PEHZZ	5120011432032	15434	3376015	PULLER, CYLINDER CYLINDER LINER, UNIVERSAL PART OF KIT P/N 5704988	
2	PEHZZ	5210011573091	15434	3376220	GAGE BLOCK PART OF KIT P/N 5704988	
3	PEHZZ	5120011282688	15434	3375599	PULLER, AFC BARREL PART OF KIT P/N 5704988	
4	PEHZZ	5120010296861	15434	ST-990	INJECTOR, LEAKAGE DE INJECTOR LEAKAGE PART OF KIT P/N 5704988.....	
5	PEHHH	4910011289810	05083	MODEL CD3	CALIBRATOR, INJECTOR INJECTOR TEST PART OF KIT P/N 5704988.....	
6	PEHZZ	4910010976929	15434	3375232	WRENCH TORQUE PART OF KIT P/N 5704988	

END OF FIGURE

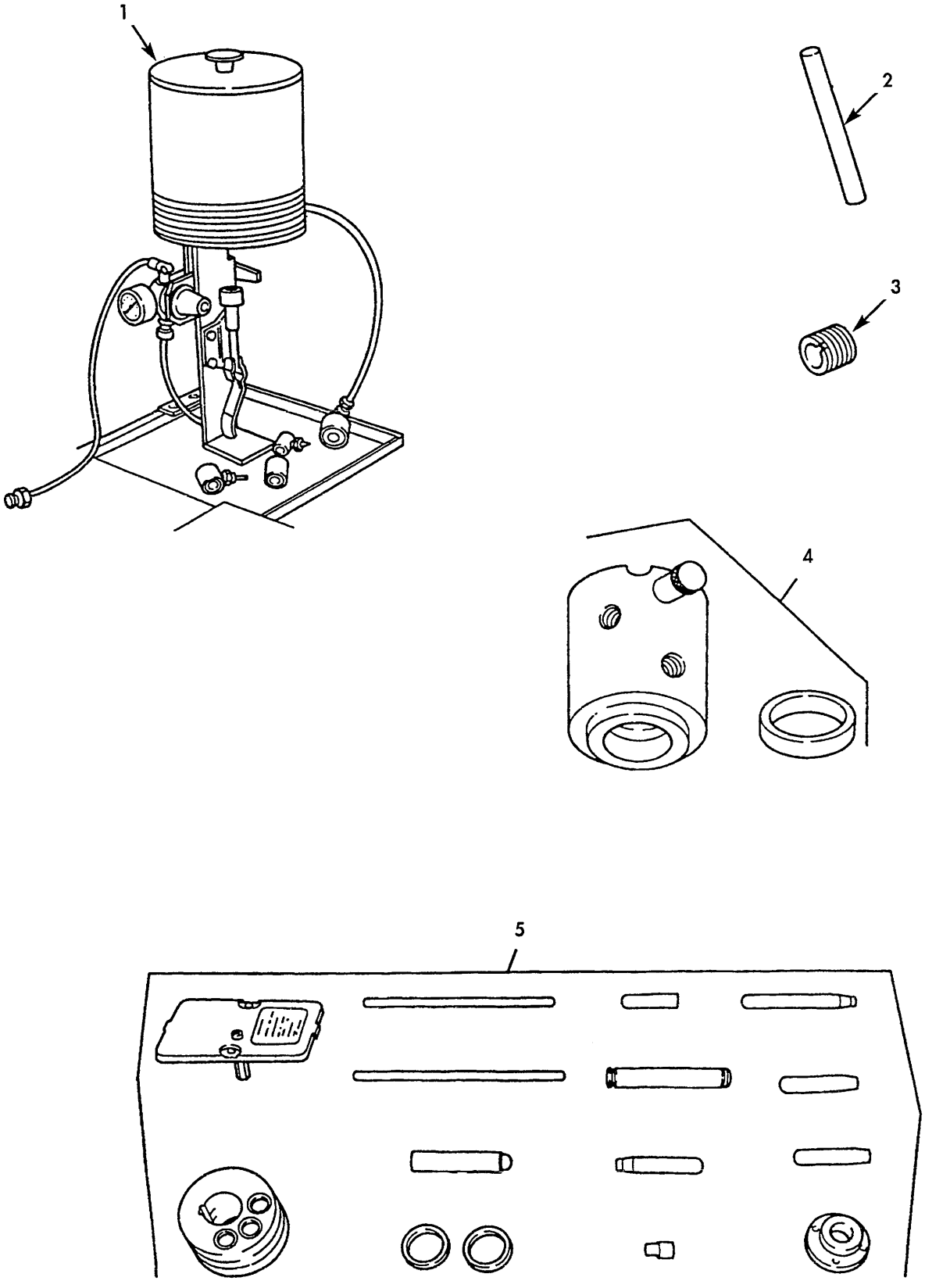


Figure 52. General Support Special Tools-4.

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					FIG. 52 GENERAL SUPPORT SPECIAL TOOLS-4	
1	PEHZZ	3465009991501	15434	ST-668	FIXTURE, HOLD-DOWN INJECTOR CUP SPRAY PART OF KIT P/N 5704988	
2	PEHZZ	4910011755215	15434	ST790-362	LINK, FUEL INJECTOR PART OF KIT P/N 5704988	
3	PEHZZ	4730011745944	15434	ST790-363	ORIFICE, FUEL INJECT PART OF KIT P/N 5704988	
4	PFHZZ	4910011698045	15434	ST-1254	INJECTOR, ADAPTER, PO PART OF KIT P/N 5704988	
5	PFHZZ	5180011774415	33287	J 33113	KIT, K-CAM PART OF KIT P/N 5704988.....	
	ADHHH		19207	5704988	TOOL KIT , GENERAL ME	

END OF FIGURE

CROSS-REFERENCE INDEXES

NATIONAL STOCK NUMBER INDEX

STOCK NUMBER	FIG.	ITEM
5330-00-003-1771	14	36
5330-00-005-0407	35	3
3120-00-005-0602	4	21
5330-00-005-0856	4	10
5330-00-005-0858	4	4
5310-00-005-6052	24	48
2815-00-005-7431	8	6
5360-00-009-9270	3	4
4730-00-010-3867	12	8
	16	13
	35	5
4730-00-011-3175	28	13
5310-00-011-4492	32	8
5310-00-011-6122	20	1
	23	2
2815-00-011-7786	2	1
5310-00-013-1245	31	21
5315-00-014-1195	2	18
5315-00-014-1244	25	4
5315-00-014-1284	5	22
4730-00-018-9566	2	27
	3	24
	5	23
	11	35
	14	40
	16	10
	17	31
	19	10
	35	4
5330-00-026-2931	17	19
4730-00-042-8988	10	6
	16	13
	24	30
5315-00-043-1787	13	22
4730-00-044-4715	12	10
5340-00-050-1600	2	15
5120-00-055-4013	40	14
4730-00-057-5555	10	7
5331-00-058-1767	2	5
5305-00-058-6604	35	15
5305-00-062-4378	3	17
5305-00-063-5043	24	66
5330-00-064-4399	2	3
5120-00-065-1031	43	11
5305-00-068-0502	26	12
5305-00-068-0509	30	2
5305-00-068-0511	10	31
	13	28
	13	35
	26	3
5305-00-071-2517	10	38
5360-00-079-1940	20	65
5310-00-080-6004	5	7
	10	27
	12	28
	13	36
	14	26
5310-00-081-4219	12	42
	33	18
5310-00-081-8500	4	14
	5	14
5331-00-081-9289	24	55
5310-00-081-9292	17	27
5331-00-081-9299	28	8
4730-00-081-9618	2	9
5315-00-082-0448	24	59
	29	32
5355-00-082-1189	28	15
5310-00-082-1882	2	21
5310-00-082-1888	28	9
5340-00-084-7787	28	7
2815-00-085-7434	3	10
2910-00-085-7436	28	6
2910-00-085-7442	3	7
5340-00-087-7486	14	19
3120-00-090-5504	4	19
5305-00-091-4006	10	2
5305-00-091-4009	5	13
5120-00-103-4687	37	8
5120-00-104-1795	36	30
5120-00-113-5271	38	1
5340-00-116-6767	20	74
5120-00-116-7604	47	10
5120-00-116-7625	45	3
2530-00-116-9953	20	75
5340-00-117-9102	20	72
4820-00-117-9103	20	66
5330-00-129-9389	20	31
5360-00-129-9415	20	44
5330-00-131-7072	20	13
2815-00-132-0240	3	10
5360-00-132-0245	21	7
5330-00-132-0247	21	15
5330-00-132-0248	11	49
5365-00-132-0273	6	9
5331-00-132-0274	28	10
5330-00-132-0276	21	8
2910-00-132-0769	29	52
5340-00-132-3203	15	9
5310-00-134-4168	5	17
5310-00-134-4169	14	38
5310-00-134-4171	5	8

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STOCK NUMBER	FIG.	ITEM	STOCK NUMBER	FIG.	ITEM
5310-00-134-4171	11	46	5365-00-197-9327	11	24
5330-00-135-6382	16	6		12	11
5305-00-137-3269	13	28	4730-00-202-8470	13	42
4730-00-138-3906	19	15	4730-00-203-0549	2	14
5305-00-138-9848	28	5	5305-00-207-2715	30	5
5310-00-141-1795	25	14		30	5
	25	16	5340-00-208-2083	8	11
	29	37	5310-00-209-0965	12	35
	30	13		13	27
	32	14		16	21
5310-00-143-5722	20	64		20	33
5330-00-143-8369	33	29		29	3
5330-00-143-8376	13	34	3120-00-219-5461	4	23
5331-00-143-8485	3	22	4730-00-221-2139	2	19
3110-00-144-8828	35	8		33	30
	35	24	4310-00-225-0706	20	69
6850-00-145-0255	50	5	5306-00-225-8499	14	37
4910-00-150-5797	38	28	5305-00-225-8507	20	9
4910-00-150-5801	40	2	5305-00-226-4831	19	5
5120-00-150-5810	40	4	5305-00-230-1939	26	12
4910-00-150-5819	49	6	5315-00-238-0882	16	9
4910-00-150-5843	47	3	5340-00-238-5435	21	1
4910-00-150-5844	47	4	5330-00-246-0309	12	31
4910-00-150-5848	49	7	5325-00-256-2846	24	24
4910-00-150-5858	36	14		24	46
5120-00-150-7486	49	4	5310-00-261-7340	2	34
5120-00-150-7488	41	1		7	9
5120-00-150-7489	40	13		10	3
5120-00-150-7492	36	29		11	17
5331-00-159-1464	33	20		11	40
5310-00-159-6209	10	36		12	17
	14	13		12	22
	22	2		13	27
	30	12		14	13
	32	13		14	25
				22	2
5120-00-159-8916	39	21		35	32
3020-00-160-9092	17	20	5310-00-262-2986	28	3
5305-00-165-8157	11	41	5305-00-269-3240	5	2
7920-00-168-3244	47	2	4330-00-274-4712	34	9
5330-00-171-7267	2	32	5340-00-276-5847	2	31
5305-00-177-5552	11	18	4820-00-276-9041	10	35
5120-00-178-0948	39	3		11	12
4720-00-187-4102	34	12	4730-00-277-8269	20	80
	34	13			
	BULK	3			
5330-00-194-8385	26	8	4720-00-278-4890	12	14
2815-00-195-5894	8	12	4730-00-278-9200	22	23
2815-00-195-5897	8	16	5315-00-281-7610	2	7
5310-00-197-5304	2	29	5330-00-286-0487	30	18

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STOCK NUMBER	FIG.	ITEM
5120-00-288-6514	37	9
2805-00-293-9699	3	2
5305-00-297-4022	8	24
2910-00-304-3427	30	17
4730-00-338-6839	12	49
5305-00-339-1415	7	15
4910-00-345-3708	46	2
3120-00-349-6444	4	17
3120-00-353-9164	32	7
5310-00-356-1447	2	21
5330-00-361-2955	4	1
2815-00-362-2042	46	1
4730-00-365-2690	10	42
	19	12
	26	25
5365-00-369-4729	20	38
2815-00-369-7846	20	20
4730-00-374-4282	19	16
5340-00-400-3449	26	17
5342-00-400-5178	24	37
2930-00-401-9531	17	18
5310-00-403-7731	20	70
5330-00-403-9896	24	21
5305-00-404-1388	10	32
5305-00-404-1390	14	30
4730-00-404-2906	33	28
4730-00-404-2909	2	33
5330-00-404-2920	5	27
5365-00-404-2934	35	27
5340-00-404-2940	8	10
5340-00-404-2944	7	1
5342-00-404-2946	1	5
2815-00-406-8936	13	45
5310-00-407-9566	12	41
	14	36
	19	6
	20	10
	29	28
	33	18
3130-00-408-9041	2	24
2910-00-410-2268	32	2
5305-00-411-9340	27	9
5340-00-417-5800	12	27
5306-00-418-2276	31	17
5331-00-420-9624	4	5
5325-00-420-9696	35	9
3020-00-424-9995	7	2
5310-00-426-3990	3	18
5305-00-426-4142	13	31
	29	41
5305-00-426-4146	24	25
5365-00-428-6201	4	9
2910-00-432-1945	32	5
	32	12
5360-00-436-7340	32	3
5331-00-441-0145	20	50
4730-00-444-1710	3	25
	22	13
4820-00-445-0610	20	40
3010-00-447-9799	23	9
	29	29
3040-00-449-7397	32	6
5310-00-451-6643	12	16
	24	6
5360-00-461-5738	29	47
5365-00-462-4504	29	45
5310-00-469-3998	5	21
5310-00-470-6154	17	6
5330-00-471-0370	29	30
9905-00-473-7260	20	27
5315-00-475-2574	13	21
5305-00-477-0395	15	7
4730-00-477-4160	26	5
2990-00-477-6159	27	16
5305-00-477-6769	3	20
2815-00-480-4347	6	7
5310-00-484-1718	24	26
	25	20
	28	2
	30	3
2815-00-484-8359	2	25
2815-00-484-8360	2	23
5306-00-485-0790	25	7
5340-00-485-0945	7	12
5310-00-486-2505	14	25
	22	3
5310-00-486-2507	17	25
5365-00-488-0799	2	40
3120-00-493-3913	32	9
5305-00-493-3959	32	5
2815-00-505-5119	7	24
5330-00-506-4866	29	31
5331-00-506-4874	33	2
5305-00-506-5722	29	53
5365-00-507-3224	24	64
5365-00-507-3225	24	64
5365-00-507-3254	16	4
5310-00-507-3259	29	51
5365-00-507-3260	29	46
	29	46
5365-00-507-3261	29	45

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STOCK NUMBER	FIG.	ITEM
5365-00-507-3261	29	45
5365-00-507-3262	29	45
5365-00-507-3271	24	31
5305-00-509-8106	28	1
3110-00-516-5289	29	17
5310-00-521-8595	13	40
	14	23
	22	1
3020-00-528-5053	5	12
5315-00-532-9388	2	20
5330-00-537-2382	2	13
	11	3
5365-00-543-3744	24	64
5305-00-543-4372	12	29
	12	32
	13	9
	13	48
	14	12
	14	24
5305-00-546-6698	2	35
	7	10
	12	23
4730-00-555-8263	14	1
	19	3
	19	3
	26	11
	26	17
4730-00-555-8292	24	30
5325-00-558-9412	24	18
5330-00-562-1176	29	42
5310-00-562-6557	13	36
5310-00-562-6552	32	6
5310-00-562-6558	12	4
	19	7
	20	11
5310-00-562-6560	10	40
	22	3
	24	3
	27	6
3120-00-566-0480	13	7
5330-00-567-3463	25	2
3040-00-567-4354	25	18
5310-00-584-5272	1	3
	5	20
	11	8
3120-00-589-3537	8	5
	8	15
	8	19
	8	23
2590-00-590-7378	9	1
3120-00-593-1507	4	22
5360-00-597-4570	24	33
5365-00-598-5255	19	14
	19	18
	26	21
5330-00-599-2962	24	21
4730-00-602-3707	20	56
5360-00-603-1518	20	73
2530-00-603-1532	20	61
3120-00-627-6697	13	4
	13	26
5340-00-632-6239	3	5
5310-00-637-9541	10	39
	12	47
	13	32
	22	25
	31	18
5305-00-638-8920	10	37
2910-00-646-9727	31	2
5310-00-650-0187	20	7
5330-00-659-3178	15	4
3120-00-659-7808	7	17
5360-00-664-5343	11	23
5310-00-680-6874	27	5
3120-00-682-7706	27	13
5310-00-684-3463	26	2
3120-00-695-1232	4	20
5365-00-695-1247	12	12
3020-00-702-3882	25	11
2815-00-705-2856	13	14
5365-00-708-3434	11	14
4920-00-711-9307	46	4
5340-00-716-4975	24	44
5365-00-716-5496	16	
5340-00-719-4601	22	8
5305-00-721-3698	25	21
5305-00-725-2317	10	26
	14	39
5310-00-727-8353	24	60
	29	6
5310-00-732-0560	8	3
	8	7
	8	13
	8	17
	8	21
9905-00-733-7622	24	28
5340-00-738-7552	20	68
5310-00-763-8920	35	17
5340-00-767-4012	15	11
2990-00-772-1778	24	63
2815-00-772-9434	16	8

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STOCK NUMBER	FIG.	ITEM
53Z5-00-777-3544	7	20
	7	26
5305-00-782-9489	10	29
2910-00-790-8736	24	34
3120-00-791-1440	7	23
2815-00-791-1453	11	22
3120-00-792-9834	17	32
5305-00-795-9336	4	13
	5	10
5305-00-795-9345	22	7
5305-00-795-9352	13	46
5340-00-799-0843	2	12
4730-00-801-8186	2	26
2910-00-803-2631	29	49
5306-00-804-2468	2	22
5325-00-804-2784	6	6
5305-00-804-6318	1	7
	20	28
	24	29
5325-00-807-2636	29	43
5340-00-809-1490	31	22
5331-00-809-2667	30	8
5310-00-809-3078	29	26
	29	26
5331-00-809-3276	30	6
5310-00-809-4085	12	36
3120-00-810-6032	24	41
2815-00-815-0355	35	11
	35	21
5365-00-815-1137	21	13
5310-00-820-6653	12	17
	14	21
5310-00-823-8803	12	18
2530-00-827-5934	20	54
5310-00-828-4827	12	3
2815-00-828-7013	13	44
2815-00-829-5227	15	6
	18	16
4820-00-829-5600	28	14
5365-00-829-5604	24	63
5340-00-829-5617	30	10
5340-00-839-0653	12	19
5305-00-839-6230	20	76
5315-00-844-0140	24	38
5330-00-852-7347	20	15
5342-00-858-3507	22	4
2910-00-858-3522	29	38
5330-00-861-8592	8	32
5330-00-864-5422	33	8
5120-00-865-0226	37	11
5120-00-865-0933	39	22
5315-00-866-5015	3	8
3120-00-877-2213	16	2
5310-00-887-8325	15	8
5360-00-895-3216	20	39
5120-00-896-8087	40	3
5120-00-896-8097	36	3
5340-00-898-1497	29	44
4730-00-900-3296	22	31
5360-00-901-9644	29	47
4310-00-903-7174	20	18
3120-00-904-9595	29	18
5331-00-905-2679	20	41
5340-00-907-8964	29	48
4730-00-908-3195	34	6
4820-00-909-4174	20	42
4820-00-909-4175	20	46
4730-00-909-8627	33	15
2815-00-913-2074	KIT	
5180-00-916-1813	39	16
4720-00-918-9634	19	2
2815-00-920-2073	15	3
5310-00-922-2017	28	16
5307-00-922-2626	15	13
	26	7
3441-00-922-6699	36	21
5325-00-922-9101	20	19
5120-00-923-0856	45	7
4910-00-925-0755	47	1
2910-00-928-3505	3	21
2930-00-928-3595	33	1
5133-00-932-2089	36	13
5340-00-933-3009	3	3
3040-00-933-3012	25	12
5331-00-941-3762	20	49
5305-00-942-2196	13	48
5305-00-944-8292	12	21
	14	20
5305-00-947-3437	8	4
	8	8
	8	14
	8	18
	8	22
5340-00-951-3536	30	7
5330-00-951-3538	28	17
4730-00-954-1281	2	10
4730-00-954-9510	34	12
3805-00-955-5320	20	45
5330-00-961-9470	24	32
2815-00-962-5623	3	12

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STOCK NUMBER	FIG.	ITEM
4730-00-964-7548	20	30
5365-00-965-0870	30	9
5331-00-970-3461	24	14
5310-00-971-7989	24	43
	32	12
4910-00-977-7507	49	1
5110-00-980-7347	39	2
4910-00-981-3105	36	16
5110-00-981-3107	41	3
5120-00-981-3108	36	15
5331-00-984-3756	8	28
2815-00-994-4427	6	1
2815-00-994-4429	6	4
3460-00-999-1173	46	8
5120-00-999-1206	49	8
4910-00-999-1208	46	9
5210-00-999-1209	36	28
3460-00-999-1210	38	13
3465-00-999-1501	52	1
5120-00-999-1503	49	3
5120-00-999-1504	37	4
5120-00-999-1505	40	1
4910-00-999-1506	37	2
5305-01-010-2362	13	9
3120-01-016-4883	20	26
2940-01-019-4513	10	33
	11	43
4330-01-020-3666	34	10
5305-01-028-8869	15	5
5305-01-029-1193	22	5
5120-01-029-6861	51	4
5305-01-032-2311	12	34
5360-01-038-4659	13	13
5330-01-040-2087	33	6
4730-01-045-3083	34	8
4820-01-045-6080	34	5
5330-01-046-1991	11	26
5330-01-046-3144	11	16
6685-01-047-2811	33	12
2815-01-048-6702	7	18
5330-01-049-0466	2	4
5330-01-051-4243	13	12
5330-01-051-4243	24	20
5310-01-056-1371	20	52
5315-01-058-4551	4	8
5330-01-060-9061	20	43
2910-01-065-3979	23	6
2940-01-065-7076	11	47
2930-01-065-7113	11	30
3030-01-065-9404	35	28
5340-01-066-2947	13	39
5330-01-066-3904	14	7
5330-01-066-3910	13	2
5330-01-066-5349	7	8
5330-01-066-5350	35	16
5330-01-066-5351	14	3
5330-01-066-5352	14	6
4720-01-070-8149	26	6
3020-01-070-9003	29	15
3040-01-070-9004	29	22
4820-01-070-9710	21	11
2910-01-070-9712	24	62
5120-01-072-2952	37	7
5120-01-072-2955	44	15
5331-01-072-4436	3	6
2930-01-072-8056	35	1
5305-01-072-8816	16	23
5305-01-072-8818	14	10
5305-01-072-8826	24	53
5330-01-072-8828	29	10
5330-01-072-8830	24	11
	29	39
	29	44
5305-01-072-8831	29	20
5330-01-072-8982	24	19
5331-01-072-8983	24	45
5330-01-072-8998	26	1
5180-01-074-0019	42	12
4910-01-074-0020	45	8
5330-01-075-0948	24	19
	KIT	
	KIT	
5310-01-075-0991	13	10
2910-01-076-8632	21	16
2815-01-077-1482	6	5
4730-01-077-2016	21	14
3020-01-077-2229	4	15
3020-01-077-4411	4	11
2815-01-077-4463	15	2
3040-01-077-4976	21	2
5331-01-077-5228	11	36
	33	26
4730-01-078-6364	24	58
2815-01-079-1632	4	12
3010-01-079-1788	13	30
3040-01-079-1799	8	29
4710-01-079-3198	33	16
4820-01-079-3241	24	4
4730-01-079-3273	19	1
4730-01-079-3274	26	19
4720-01-079-3285	13	33
2815-01-079-3317	33	23
4310-01-079-3319	20	25

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STOCK NUMBER	FIG.	ITEM
4820-01-079-3320	24	10
2815-01-079-3380	7	5
4320-01-079-3454	35	2
3010-01-079-3461	20	4
3040-01-079-3468	35	25
3040-01-079-3469	13	23
4710-01-079-3487	26	16
4710-01-079-3492	19	13
4710-01-079-3493	22	11
3020-01-079-4206	35	26
5342-01-079-4678	21	9
3120-01-079-5208	8	9
3120-01-079-5451	7	27
5315-01-079-6506	21	12
5330-01-079-6514	11	39
3120-01-079-6527	15	10
	34	3
5310-01-079-6529	21	6
5310-01-079-6708	21	17
5315-01-079-6740	4	16
3120-01-079-6823	2	30
	2	30
4310-01-079-6938	20	17
5306-01-079-7027	6	11
5305-01-079-7028	21	18
5340-01-079-8097	22	6
3110-01-079-8190	24	57
3120-01-079-8194	7	3
5365-01-079-8373	24	17
2815-01-079-9146	16	18
5365-01-080-0409	35	22
3010-01-080-1529	29	25
5330-01-080-2992	35	12
	35	20
2910-01-080-3149	24	49
3120-01-080-3275	24	36
5330-01-080-5021	3	23
2910-01-080-5570	24	63
7690-01-080-7335	31	11
	31	11
5325-01-081-0662	29	16
4910-01-082-1346	50	3
5330-01-082-6984	14	17
5330-01-082-6985	5	25
2815-01-083-2123	33	3
3120-01-083-6411	35	14
2910-01-084-0243	31	4
2815-01-084-3447	1	9
5305-01-084-4596	43	3
5355-01-084-5323	44	11
5133-01-084-6008	43	13
5133-01-084-6009	43	18
2930-01-084-6011	33	21
4910-01-084-6977	44	12
4910-01-084-6978	44	13
4910-01-084-6979	44	4
3020-01-084-7007	43	6
4310-01-084-7148	20	48
4910-01-084-7221	44	10
4910-01-084-7222	44	9
5325-01-084-9033	13	29
5360-01-084-9066	18	17
5330-01-084-9068	30	18
3020-01-084-9640	13	19
4910-01-085-0751	44	3
3020-01-085-0761	43	5
3120-01-085-0762	43	2
4910-01-085-0763	43	4
4910-01-085-0764	43	11
4910-01-085-0765	43	12
4910-01-085-0766	43	17
4720-01-085-1316	26	18
2815-01-085-1881	5	11
2815-01-085-2569	8	1
2910-01-085-2570	30	1
4720-01-085-2571	11	5
2815-01-085-2573	13	1
2815-01-085-2574	18	1
4140-01-085-2607	27	3
2815-01-085-2615	7	7
3040-01-085-2616	28	12
2815-01-085-2618	3	15
3010-01-085-2732	17	26
	20	36
6680-01-085-2870	29	1
	29	19
3040-01-085-2871	29	9
5331-01-085-3105	18	6
2930-01-085-3579	33	5
5330-01-085-3580	27	1
4930-01-085-3728	44	5
2815-01-085-3733	3	19
3020-01-085-3779	13	24
5342-01-085-4153	23	3
	29	2
4730-01-085-4156	19	9
	33	13
5940-01-085-4426	18	10

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5340-01-085-4439	18	16	5315-01-087-0534	29	23
2990-01-085-4768	27	8	5340-01-087-0681	3	9
2815-01-085-5190	7	6	5340-01-087-0682	3	13
2520-01-085-6128	18	13	3120-01-087-2539	29	12
4720-01-085-6129	33	20	3120-01-087-3004	6	12
4720-01-085-6131	14	11	2815-01-087-4740	31	1
4710-01-085-6132	14	35			
4710-01-085-6134	22	16	5325-01-087-8727	18	15
5340-01-085-6269	13	37	2930-01-087-8749	33	31
4720-01-085-6293	26	10	3010-01-088-5727	29	14
4910-01-085-7269	44	8	5305-01-088-6019	11	15
4730-01-085-7328	15	12		11	38
5305-01-085-8197	11	9		32	17
	12	29		33	29
	33	9		33	32
2815-01-085-8282	3	1		34	1
4910-01-085-9211	36	27	2815-01-088-7328	18	14
4710-01-085-9348	22	9	4910-01-088-7904	43	10
4710-01-085-9349	22	18	4810-01-089-0534	18	4
5331-01-086-1013	18	5	4820-01-089-3939	18	20
2835-01-086-1447	27	18	5360-01-089-9103	18	21
3040-01-086-1448	27	19	2520-01-090-4473	11	11
3040-01-086-1449	24	51	2910-01-090-9346	29	35
3040-01-086-1651	24	22			
3020-01-086-3417	35	13	5305-01-091-2498	17	5
5360-01-086-3480	20	47	2910-01-091-7507	24	47
5330-01-086-3523	14	33	4710-01-092-0109	12	44
2910-01-086-3974	21	10	5330-01-092-4143	KIT	
5331-01-086-3991	35	23	4310-01-092-9815	17	11
5330-01-086-3996	18	24	4310-01-092-9816	17	22
3020-01-086-4158	29	24	2530-01-093-0872	20	55
2815-01-086-4508	6	8	7690-01-094-6720	1	8
5330-01-086-6112	4	4	5360-01-095-3661	24	61
5306-01-086-6113	24	16			
5360-01-086-6114	24	65		29	34
5315-01-086-6187	7	4	5365-01-095-5666	17	9
5340-01-086-6193	3	14	4710-01-095-8683	19	13
5330-01-086-6196	18	7	5930-01-095-9823	31	10
5330-01-086-6197	11	29	2815-01-096-9198	8	2
5305-01-086-7036	11	42	2910-01-096-9200	25	3
	33	14	5120-01-097-3204	39	19
5305-01-086-7285	21	3	2930-01-097-6755	17	2
2910-01-086-7715	29	8	4910-01-097-6909	43	16
	29	8	4910-01-097-6910	40	17
5365-01-086-7788	16	4	4910-01-097-6911	40	21
5330-01-086-7790	KIT		4910-01-097-6912	40	19
	KIT			40	19
4910-01-086-8268	43	9	4910-01-097-6913	44	3
3020-01-086-8269	43	7	4910-01-097-6914	43	14
3020-01-086-8780	29	13	4910-01-097-6915	40	5
2910-01-086-9757	7	22	4910-01-097-6916	42	3
4910-01-086-9766	45	2	4910-01-097-6917	42	4

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5305-01-097-6918	42	5	4910-01-097-6984	38	21
4910-01-097-6919	42	2	4910-01-097-6985	38	23
5305-01-097-6920	42	7	4910-01-097-6986	38	17
5305-01-097-6921	42	8	4910-01-097-6987	37	3
4910-01-097-6923	44	18	4910-01-097-6988	37	15
5305-01-097-6924	44	16	4910-01-097-6989	37	6
4910-01-097-6925	44	19		38	2
4910-01-097-6926	42	9	5355-01-097-7072	44	6
4910-01-097-6927	42	10	5330-01-097£7791	20	77
4910-01-097-6928	42	11	5310-01-097-8039	20	78
4910-01-097-6929	51	6		20	78
			5305-01-097-9886	31	20
4910-01-097-6930	37	5	5342-01-098-0175	17	7
5120-01-097-6932	44	20	4910-01-098-1912	43	8
4910-01-097-6933	44	22	5305-01-098-1913	42	6
4910-01-097-6934	44	21	4910-01-098-1914	36	4
4910-01-097-6935	44	26	4910-01-098-1915	40	23
4910-01-097-6936	42	15	4910-01-098-1916	40	22
4910-01-097-6938	42	13	4910-01-098-1917	40	15
4910-01-097-6939	40	12	4910-01-098-1918	40	20
4910-01-097-6940	40	9	4910-01-098-1919	40	18
4910-01-097-6941	40	10	4910-01-098-5088	36	17
4910-01-097-6943	40	8	4320-01-098-5115	24	56
4910-01-097-6944	44	24	2910-01-098-5118	24	39
4910-01-097-6945	45	1	2815-01-098-6755	18	18
4910-01-097-6948	36	2		18	18
4910-01-097-6955	36	23	4910-01-099-1487	36	9
4910-01-097-6956	36	26	5210-01-099-6339	36	22
4910-01-097-6957	36	18	5120-01-099-6341	38	11
4910-01-097-6958	36	20	5120-01-100-0135	45	6
4910-01-097-6960	39	9	4910-01-100-6191	40	16
5310-01-097-6961	39	5	5310-01-102-3270	31	23
			5306-01-102-3599	32	18
			5310-01-102-7356	32	16
4910-01-097-6962	39	8	5180-01-102-8418	40	7
4910-01-097-6963	39	11	5365-01-103-7835	38	6
4910-01-097-6964	39	4	3120-01-103-8752	38	8
4910-01-097-6965	39	10	5310-01-104-4549	36	25
4910-01-097-6966	39	14	5310-01-104-4550	38	9
5130-01-097-6967	39	13	2815-01-105-8768	2	6
4910-01-097-6968	39	12	4910-01-105-9165	44	1
4910-01-097-6969	38	5	4730-01-106-0202	5	18
4910-01-097-6970	38	2		13	5
4910-01-097-6971	38	12	4910-01-106-0492	42	1
4910-01-097-6972	37	16	4730-01-106-4700	22	19
4910-01-097-6976	39	15		30	19
4910-01-097-6977	38	19	4710-01-106-8068	22	14
5310-01-097-6978	38	20	5120-01-106-9173	39	20
4910-01-097-6979	38	22	5120-01-106-9174	39	18
4910-01-097-6980	38	27	5330-01-107-1841	44	23
4910-01-097-6981	38	26	5306-01-107-6371	18	27
4910-01-097-6982	38	25	6680-01-108-7410	12	24
4910-01-097-6983	38	24		BULK	1

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4910-01-108-9130	36	12	5310-01-124-6463	17	14
5307-01-109-5972	18	27	5310-01-126-1045	17	13
4730-01-109-8501	22	17	5305-01-126-1128	29	41
5305-01-109-9307	24	45	5365-01-126-3334	29	11
5315-01-110-7835	36	7	2910-01-126-9053	24	15
5310-01-112-4306	16	16	5310-01-126-9404	12	26
5310-01-112-4307	20	6	2815-01-127-1060	3	10
	23	5	2815-01-127-3597	3	10
	29	5	2815-01-127-3598	3	10
2910-01-112-5797	31	15	4730-01-127-6104	26	9
4910-01-112-7509	36	5	5120-01-128-2675	48	6
2910-01-112-7712	21	4	5120-01-128-2678	47	7
5305-01-112-9021	2	11	5120-01-128-2679	47	9
	12	46	5120-01-128-2688	51	3
5305-01-112-9110	29	20	4910-01-128-2691	47	8
	30	2	5120-01-128-2758	50	4
5305-01-112-9698	5	9	4910-01-128-9810	51	5
5305-01-113-0408	33	24	5305-01-129-4214	13	6
4910-01-113-1066	36	6		19	8
5305-01-113-1179	23	10	5305-01-129-4218	24	2
	29	7	3040-01-129-4302	17	30
5305-01-114-6386	5	16	5305-01-129-4384	20	34
6150-01-114-7119	18	3		23	7
4720-01-114-7728	BULK	2	5305-01-129-4385	24	1
5305-01-114-9279	29	27	5305-01-129-4386	35	29
	33	8	5330-01-129-6541	17	16
	33	22	5305-01-129-6901	8	31
4910-01-117-4885	36	10	3120-01-129-7659	20	35
4910-01-118-2878	36	11	2530-01-130-2339	20	32
4910-01-118-3747	40	6	5305-01-130-6100	4	3
5305-01-118-4285	20	79	4730-01-131-4884	22	12
5305-01-118-8826	9	2	5365-01-132-1984	35	10
9999-01-119-2743	36	8	3120-01-132-9339	KIT	
5306-01-119-4271	17	24	5305-01-133-2060	30	11
5305-01-119-8621	17	29	2815-01-133-2445	12	2
5306-01-119-8870	33	22	5360-01-134-5602	24	23
2990-01-120-2883	4	2	5305-01-135-5344	11	1
5120-01-120-3681	44	14	5305-01-135-5446	24	50
5120-01-120-3682	38	3	5340-01-135-7250	33	21
	38	3	2910-01-136-3331	24	63
			5330-01-136-8569	25	13
5120-01-120-5759	43	15	5305-01-137-6706	14	24
			5360-01-138-6638	24	65
5120-01-120-5760	41	2	5325-01-139-6738	11	28
2920-01-121-8859	28	6	5342-01-140-7158	12	30
5120-01-122-6014	37	10	2950-01-141-0844	26	22
5340-01-122-8002	5	26	2815-01-141-0845	5	19
2815-01-124-0232	6	10	4310-01-141-0879	20	8
	17	23	6685-01-141-0907	33	7
4730-01-124-0293	8	27	2930-01-141-0918	10	1
4730-01-124-3762	24	27	2815-01-141-0919	12	2
	30	15	2815-01-141-3261	18	2

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2910-01-141-4028	24	42	5340-01-145-0802	13	14
2910-01-141-4029	24	7	5305-01-145-1113	12	39
2910-01-141-4337	29	19	5310-01-145-1114	21	6
2910-01-141-4967	24	5	5340-01-145-1181	31	5
2815-01-141-5299	13	1	5342-01-145-1549	24	62
5120-01-141-5777	44	4	5340-01-145-1597	34	2
4910-01-141-8388	49	5		34	2
2930-01-141-9277	14	34	5360-01-145-3974	10	15
2815-01-141-9370	2	6	5360-01-145-3975	10	17
2910-01-141-9372	23	6	5330-01-145-3983	7	8
4710-01-142-1667	12	25	5330-01-145-3984	7	8
2815-01-142-1732	9	4	5330-01-145-3985	9	6
2815-01-142-2745	1	9	5331-01-145-5377	2	39
5330-01-142-2784	24	8	5330-01-145-5380	33	11
5310-01-142-2812	24	13	5330-01-145-5381	33	29
4910-01-142-4929	48	1	5315-01-145-6080	7	4
2910-01-142-4953	24	22	5330-01-145-6083	8	25
2910-01-142-7455	24	12		18	12
4730-01-142-8524	13	51	5331-01-145-6085	10	5
	22	20	5331-01-145-6086	10	18
4910-01-143-2023	48	2	2950-01-145-6822	27	18
4910-01-143-2034	50	7	5330-01-145-6909	10	22
4910-01-143-3336	48	4	5330-01-145-6910	10	10
4910-01-143-3337	48	3	5330-01-145-6911	10	9
5342-01-143-6045	12	9	5330-01-145-6912	10	30
5342-01-143-6046	29	40	5330-01-145-6913	13	34
3120-01-143-9547	4	23	5330-01-145-6914	16	11
5310-01-144-6115	I	2	5360-01-145-7554	13	13
	17	3	5360-01-145-7555	18	22
	18	34	5360-01-145-7607	18	11
5305-01-144-6204	2	37	5305-01-145-8358	12	37
5305-01-144-6206	18	9	5305-01-145-8359	20	37
5310-01-144-6224	13	16	5305-01-145-8379	3	28
5305-01-144-6232	10	19	5305-01-145-8380	5	15
5305-01-144-6233	20	53	5305-01-145-8381	16	7
3120-01-144-7368	17	28	5305-01-145-8382	17	1
3120-01-144-8882	4	23	5305-01-145-8383	17	12
5342-01-145-0645	13	11	5305-01-145-8384	18	13
5342-01-145-0646	21	2	5310-01-145-8403	14	27
5340-01-145-0647	21	5	5310-01-145-8404	16	16
5331-01-145-0715	13	47	5310-01-145-8405	17	10
5331-01-145-0716	16	5		18	12
5365-01-145-0760	31	12	5307-01-145-8449	18	31
5310-01-145-0761	24	9		18	31
5310-01-145-0762	35	18	3020-01-145-8568	7	2
5340-01-145-0772	10	41	3120-01-145-9132	4	23
5340-01-145-0773	14	31	5340-01-145-9362	2	17
5305-01-145-0776	17	8	2940-01-145-9398	10	12
5305-01-145-0777	21	3	2940-01-145-9399	10	13
	23	6	2940-01-145-9400	10	14

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2815-01-145-9401	16	24	4710-01-146-1115	22	10
2815-01-145-9402	18	23	4710-01-146-1116	22	14
2910-01-145-9403	21	4	3130-01-146-1150	2	25
5340-01-145-9451	13	3	3130-01-146-1228	2	23
2940-01-145-9455	10	34	2940-01-146-1995	11	34
4820-01-145-9457	13	17		13	18
2930-01-145-9537	10	4	2930-01-146-1996	14	9
2930-01-145-9538	10	8	2815-01-146-1997	18	19
5342-01-145-9539	12	30	2910-01-146-1998	21	10
5342-01-145-9540	12	20	2910-01-146-1999	29	1
	14	22	2910-01-146-2000	32	1
3040-01-145-9637	13	20	2930-01-146-3033	33	17
3040-01-146-0028	5	3		33	23
2910-01-146-0048	3	7	4730-01-146-3040	22	22
4710-01-146-0049	12	15	4710-01-146-3085	19	4
4710-01-146-0050	13	33	4710-01-146-3086	11	37
3040-01-146-0075	7	13		33	27
2910-01-146-0093	22	21	4730-01-146-3109	14	16
2815-01-146-0102	5	5	4730-01-146-3111	12	13
3020-01-146-0107	4	15	2815-01-146-3159	15	2
3020-01-146-0108	13	8	3020-01-146-3163	17	17
3020-01-146-0109	13	19	4710-01-146-3167	26	16
2930-01-146-0111	14	32	4710-01-146-3168	19	17
2815-01-146-0112	15	3	4710-01-146-3169	22	18
3010-01-146-0113	13	30	4730-01-146-3631	26	14
2815-01-146-1024	9	5	4730-01-146-3633	22	15
4140-01-146-1035	27	3	3020-01-146-3773	17	15
2815-01-146-1041	7	6	4710-01-146-3779	22	9
4820-01-146-1048	28	11	2990-01-146-3911	27	19
2815-01-146-1049	7	5	2930-01-146-3912	35	1
4710-01-146-1052	12	6	4730-01-146-4016	34	5
4710-01-146-1053	14	35	4710-01-146-4083	14	14
4710-01-146-1054	33	16	4720-01-146-4126	31	9
4730-01-146-1059	31	6	4310-01-146-4155	20	51
4730-01-146-1060	33	13	2815-01-146-4164	3	26
4730-01-146-1064	14	18	2930-01-146-4212	33	3
4730-01-146-1065	14	2	3130-01-146-4504	2	24
4720-01-146-1071	26	10	4820-01-146-4593	18	20
2930-01-146-1081	10	28	2940-01-146-5846	10	25
4330-01-146-1082	10	24	4310-01-146-5921	20	12
2930-01-146-1083	14	4	2815-01-146-5925	4	2
2910-01-146-1084	24	35	3040-01-146-5935	13	25
			3130-01-146-6120	27	14
2930-01-146-1085	33	10	5310-01-146-6147	31	8
4310-01-146-1097	20	14	5310-01-146-6150	31	7
2815-01-146-1102	26	4	2815-01-146-7039	7	14
2815-01-146-1103	15	1	4730-01-146-7047	26	15
4710-01-146-1112	19	17	4910-01-146-7130	49	2
4710-01-146-1113	22	16	5330-01-146-7172	7	8
4710-01-146-1114	22	11	3120-01-146-7196	20	21

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STOCK NUMBER	FIG.	ITEM	STOCK NUMBER	FIG.	ITEM
5305-01-146-7285	14	29	5330-01-147-8754	31	3
5310-01-146-7302	18	8	5365-01-147-9802	2	40
			2910-01-147-9913	24	40
5310-01-146-7303	31	16	6620-01-147-9954	36	1
5330-01-146-7314	33	21	5360-01-148-0303	13	15
2815-01-146-7914	7	16	5365-01-148-8353	2	40
2910-01-146-7955	2	38	3120-01-149-5414	13	7
5330-01-146-9775	7	8	2815-01-150-2702	15	7
			3040-01-150-4926	24	54
5342-01-146-9816	31	13	5340-01-150-6248	12	38
5306-01-146-9866	16	19	5365-01-150-6257	2	28
5330-01-146-9928	7	8	2930-01-150-7596	33	12
5340-01-146-9992	12	5	4910-01-150-9713	46	5
5360-01-147-0054	24	16	5330-01-150-9812	35	30
5330-01-147-0748	12	1		KIT	
5365-01-147-0912	16	4	5306-01-151-1023	31	14
5365-01-147-0913	16	4	3040-01-151-9348	29	9
9905-01-147-0933	1	8	4720-01-152-0156	13	50
5305-01-147-1215	14	15	4910-01-152-2743	50	8
5330-01-147-1274	13	2	2815-01-152-9219	KIT	
5307-01-147-1316	18	29	5340-01-153-9425	12	45
	18	29	5331-01-154-4316	10	23
4730-01-147-2223	12	8	4910-01-154-6406	50	2
	33	30	3120-01-155-2531	KIT	
5305-01-147-2443	13	46	3120-01-155-4442	6	12
5305-01-147-2444	14	5	2990-01-155-7284	26	22
5305-01-147-2445	14	28	3120-01-155-8707	6	12
5365-01-147-2495	2	40	5120-01-156-4183	38	18
5365-01-147-2496	2	40	5210-01-157-2291	48	7
5365-01-147-2497	2	40	5210-01-157-3091	51	2
5307-01-147-2821	18	30	3120-01-157-3316	6	12
5305-01-147-4025	5	24	5310-01-157-3762	18	8
5305-01-147-4033	16	12	5310-01-157-7361	20	71
5305-01-147-4034	20	2	4710-01-158-7507	26	20
	23	1	2815-01-159-0872	16	1
5305-01-147-4035	35	31	2815-01-159-1737	9	3
5330-01-147-4071	13	49	2815-01-159-1789	3	16
5330-01-147-4072	14	8	4910-01-159-8701	46	6
5360-01-147-4846	29	50	4730-01-160-3579	11	21
5365-01-147-5030	1	4	2815-01-160-5820	5	19
	17	4	5120-01-160-8863	37	1
	18	33	5120-01-160-8867	47	6
5310-01-147-5072	18	28	4910-01-161-2115	47	5
3120-01-147-5275	17	21	4730-01-161-5115	2	16
5340-01-147-5389	12	33		13	5
4910-01-147-7896	50	1		35	5
3120-01-147-8118	5	6	5120-01-163-1349	48	10
5305-01-147-8726	30	14	5320-01-163-2277	8	11
5305-01-147-8729	14	30	5340-01-163-7118	8	26
5305-01-147-8730	15	5	4730-01-163-7192	11	4
5305-01-147-8731	16	17	5330-01-164-0944	11	48
5305-01-147-8732	23	4	5120-01-164-3265	46	7

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STOCK NUMBER	FIG.	ITEM
2815-01-164-6103	9	3
4820-01-164-7002	25	15
4730-01-165-0749	34	5
	34	8
2815-01-165-0765	KIT	
5305-01-165-3300	16	22
5305-01-165-3892	16	20
4910-01-165-4541	48	11
2930-01-165-4581	11	27
4910-01-165-6016	50	6
2815-01-166-3415	7	11
2815-01-168-3742	KIT	
5220-01-168-6878	41	6
2990-01-172-3005	26	22
4730-01-174-5944	52	3
4910-01-175-5215	52	2
5930-01-177-0346	10	21
5180-01-177-4415	52	5
5305-01-179-2380	2	22
5330-01-181-0630	19	11
5330-01-181-0631	20	5
4710-01-181-1956	11	6
3120-01-185-8586	25	19
5305-01-186-7042	18	9
4810-01-187-4925	28	4
3120-01-193-7083	4	23
5360-01-200-0323	11	32
6620-01-203-4301	31	16
5305-01-203-6444	11	7
5306-01-204-3297	22	7
4730-01-205-8587	25	9
3120-01-208-8102	2	30
3120-01-208-8103	2	30
5340-01-208-9319	32	15
4710-01-209-6742	16	3
5315-01-210-0616	7	19
4820-01-210-3573	10	16
2815-01-210-6947	8	30
4820-01-210-9571	33	4
3120-01-212-4472	7	21
5305-01-212-5210	12	37
3120-01-214-7779	4	7
4710-01-215-8158	12	15
3120-01-215-9157	25	17
4820-01-227-7141	34	5
2930-01-231-1661	11	13
6625-01-232-5469	41	4
5330-01-240-1630	35	6
5305-01-240-7155	16	12
5365-01-241-3903	9	7
5325-01-241-4318	6	6
2815-01-241-4719	11	31
2815-01-241-6580	6	2
2815-01-241-6581	6	3
3020-01-241-6905	35	13
4730-01-241-7258	11	2
5340-01-242-0805	11	10
4820-01-242-2579	25	10
2930-01-262-5153	0035	
2990-01-271-0316	KIT	
	KIT	
2930-01-287-9733	0035	
3040-01-287-9736	35	7
5310-01-287-9737	26	13
2815-01-291-5753	25	1
3130-01-294-1400	27	14
4730-01-294-6019	26	4
5930-01-295-0912	31	10
2815-01-303-4224	4	6
4730-01-309-3321	11	25
5310-01-312-3859	31	19
5305-01-319-9287	34	11
5340-01-342-3610.	11	19
2815-01-354-2702	3	11
2815-01-437-3901	1	1
2815-01-438-1517	1	1
8145-01-445-8271	1	10

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CAGEC	PART NUMBER	STOCK NUMBER	FIG.	ITEM
15434	AC1600300NF	4720-01-085-1316	26	18
88044	AN565F428H24	5305-00-063-5043	24	66
88044	AN737TW22	4730-00-278-9200	22	23
88044	AN960-416	5310-00-141-1795	25	14
			25	16
			29	37
			30	13
			32	14
15434	AR-09999	2930-01-165-4581	11	27
15435	AR-10922		20	29
15434	AR-2308	2815-00-005-7431	8	6
15434	AR-41010	2910-01-080-3149	24	49
15434	AR-45724	3040-01-129-4302	17	30
15434	AR-73350	2815-00-913-2074	KIT	
15434	AR01176	5365-00-716-5496	16	
15434	AR07110	3120-00-219-5461	4	23
15434	AR09832		13	25
15434	AR10124	2930-01-085-3579	33	5
15434	AR10172	2815-01-085-2573	13	1
15434	AR12228		30	20
15434	AR41010	2910-01-080-3149	24	45
15434	AR41022		24	35
15434	AR51323	2910-00-432-1945	32	5
			32	12
15434	AR8667		13	3
15434	AR9832		13	43
15434	AS0401100MS	4720-01-152-0156	13	50
70403	A11	4730-00-555-8263	19	3
03990	A3804	4730-00-954-9510	34	12
15434	BM70796	2910-00-803-2631	29	49
15434	BM78793	2910-00-304-3427	30	17
15434	BM95159	2815-00-195-5894	8	12
15434	BM95160	2815-00-195-5897	8	16
15434	BM95161	2815-01-096-9198	8	2
15434	BM96162		8	20
15434	BM97497	2910-01-096-9200	25	3
80204	B1821BH025C350N	5305-00-071-2517	10	38
80204	B1821BH031C150N	5305-00-226-4831	19	5
80204	B1821BH038C075N	5305-00-543-4372	12	29
			12	32
			13	9
			13	48
			14	12
			14	24
80204	B1821BH038C125N	5305-00-068-0511	10	31
			13	35
			14	10
			26	3
80204	B1821BH038C150N	5305-00-725-2317	10	26

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CAGEC	PART NUMBER	STOCK NUMBER	FIG.	ITEM
80204	B1821BH038C150N	5305-00-725-2317	14	39
80204	B1821BH038C200N	5305-00-782-9489	10	29
80204	B1821BH038C225N	5305-00-638-8920	10	37
80204	B1821BH038F150N	5305-00-269-3240	5	2
80204	B1821BH044C425N	5305-01-032-2311	12	34
64104	B2568	5315-00-532-9388	2	20
75272	COV-1109	5340-01-153-9425	12	45
79470	C3159X2	4730-00-081-9618	2	9
15434	F-40A	5120-00-288-6514	37	9
01637	FL797-A	2940-01-145-9455	10	34
33457	FS1212		30	17
77220	H231	2805-00-293-9699	3	2
33287	J 33113	5180-01-177-4415	52	5
24161	K060436	3030-01-065-9404	35	28
34623	M-A162-20018	7690-01-080-7335	31	11
			31	11
15434	M-1302B-24		37	12
34623	MA145B21000	4720-01-079-3285	13	33
34623	MA207-21-642	2910-00-410-2268	32	2
34623	MA207-21139	4730-00-338-6839	12	49
34623	MA326-21286		38	16
34623	MA87-21005	2815-01-084-3447	1	9
34623	MB320-20011	4710-01-092-0109	12	44
34623	MB362-20001	5310-01-146-7303	31	16
34623	MB70-20107	5340-01-208-9319	32	15
05083	MODEL CD3	4910-01-128-9810	51	5
96906	MS122032	5310-00-159-6209	10	36
			14	13
			22	2
			30	12
			32	13
96906	MS16625-1100	5325-00-807-2636	29	43
96906	MS16625-1200	5325-00-804-2784	6	6
96906	MS16629-1100	5325-00-558-9412	24	18
96906	MS16632-1050	5325-00-256-2846	24	24
			24	46
96906	MS18154-59	5305-01-010-2362	13	9
96906	MS18154-60	5305-00-942-2196	13	48
96906	MS20913-4S	4730-00-221-2139	2	19
			33	30
96906	MS21333-98	5340-00-809-1490	31	22
96906	MS27183-11	5310-00-809-3078	29	26
96906	MS27183-12	5310-00-081-4219	12	42
			33	18
96906	MS27183-14	5310-00-080-6004	5	7
			10	27
			12	28
			13	36

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CAGEC	PART NUMBER	STOCK NUMBER	FIG.	ITEM
96906	MS27183-14	5310-00-080-6004	14	26
96906	MS27183-16	5310-00-809-4085	12	36
96906	MS27183-21	5310-00-823-8803	12	18
96906	MS27769U2	4730-01-205-8587	25	9
96906	MS35308-458	5305-00-944-8292	12	21
96906	MS35338-45	5310-00-407-9566	12	41
			14	36
			19	6
			20	10
			29	28
			33	18
96906	MS35338-46	5310-00-637-9541	10	39
			12	47
			13	32
			22	25
			31	18
96906	MS35338-47	5310-00-209-0965	12	35
			13	27
			16	21
			20	33
			29	3
96906	MS35338-48	5310-00-584-5272	1	3
			5	20
			11	8
96906	MS35338-50		11	45
96906	MS35338-8	5310-00-261-7340	11	17
			11	40
96906	MS35648-8	5340-00-050-1600	2	15
96906	MS35691-5	5310-00-971-7989	24	43
			32	12
96906	MS35756-34	5315-00-043-1787	13	22
96906	MS35842-10	4730-00-908-3195	34	6
96906	MS35842-13	4730-00-909-8627	33	15
02978	MS49005-4	4730-00-954-1281	2	10
96906	MS51092-1	5310-00-684-3463	26	2
96906	MS51967-20	5310-00-763-8920	35	17
96906	MS51968-14	5310-00-732-0560	8	3
			8	7
			8	13
			8	17
			8	21
96906	MS90725-34	5306-00-225-8499	14	37
96906	MS90725-43	5305-00-225-8507	20	9
96906	MS90725-6	5305-00-068-0502	26	12
96906	MS90725-90		12	40
			20	3
96906	MS90728-10	5305-00-068-0509	30	2
96906	MS90728-62	5305-00-068-0511	13	28
15434	M1302B18		37	13
01212	M39807	5330-00-005-0858	4	4

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CAGEC	PART NUMBER	STOCK NUMBER	FIG.	ITEM
75272	PC0625	5340-00-208-2083	8	11
25511	P49787	4730-00-602-3707	20	56
15434	S-1002-A	4730-00-365-2690	10	42
			19	12
			26	25
15434	S-1003-A	5365-00-598-5255	19	14
			19	18
			26	21
15434	S-1005-A	4730-00-374-4282	19	16
15434	S-108-A	5305-00-137-3269	13	28
15434	S-109		22	27
15434	S-1097	4730-01-131-4884	22	12
15434	S-117	5305-01-029-1193	22	5
15434	S-119-C	5305-01-165-3300	16	22
15434	S-122-C	5305-01-147-4034	20	2
			23	1
15434	S-129	5305-00-546-6698	7	10
			12	23
15434	S-142-A	5305-01-147-2443	13	46
15434	S-151C		22	29
15434	S-159-B	5305-00-493-3959	32	5
15434	S-16052	3110-00-516-5289	29	17
15434	S-16255	2815-00-815-0355	35	21
15434	S-174-C	5305-00-207-2715	30	5
15434	S-189-B	5305-01-145-8380	5	15
15434	S-189-C	5305-00-509-8106	28	1
15434	S-190	5305-00-944-8292	14	20
15434	S-199-B	5305-00-404-1388	10	32
15434	S-213-A	5310-00-451-6643	12	16
			24	6
15434	S-217	5310-00-650-0187	20	7
15434	S-222-A		27	4
15434	S-223	5310-00-521-8595	14	23
			22	1
15434	S-2286	5305-00-804-6318	1	7
			20	28
			24	29
15434	S-285	5310-00-470-6154	17	6
15434	S-603	5310-00-820-6653	12	17
			14	21
15434	S-604	5310-00-261-7340	10	3
			12	22
			13	27
			14	13
			14	25
			22	2
15434	S-626	5310-00-562-6558	12	4
			19	7
			20	11
15434	S-631	5310-00-562-6560	10	40
			24	3

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CAGEC	PART NUMBER	STOCK NUMBER	FIG.	ITEM
15434	S-631	5310-00-562-6560	27	6
15434	S-908	4730-00-057-5555	10	7
15434	S-910-B	4730-01-160-3579	11	21
15434	S-911-B	4730-00-018-9566	3	24
			17	31
			19	10
			35	4
15434	S-915-A	4730-00-801-8186	2	26
15434	S-932-B	4730-01-146-1060	33	13
15434	S-965-E	5365-00-404-2934	35	27
15434	S-966E	4730-00-203-0549	2	14
55719	SINL-200		48	9
15434	ST-1032	5120-00-896-8087	40	3
15434	ST-1059-17	5120-01-120-5760	41	2
15434	ST-1089	4910-00-150-5819	49	6
15434	ST-1090	5120-01-072-2955	44	15
15434	ST-1090-3	4910-01-097-6923	44	18
15434	ST-1090-4	5305-01-097-6924	44	16
15434	ST-1095	5120-00-116-7625	45	3
15434	ST-1100	5120-00-178-0948	39	3
15434	ST-1100-1		39	7
15434	ST-1100-10	4910-01-097-6964	39	4
15434	ST-1100-11	4910-01-097-6965	39	10
15434	ST-1100-12	4910-01-097-6966	39	14
15434	ST-1100-13	5130-01-097-6967	39	13
15434	ST-1100-14	4910-01-097-6968	39	12
15434	ST-1100-5		39	6
15434	ST-1100-6	4910-01-097-6960	39	9
15434	ST-1100-7	5310-01-097-6961	39	5
15434	ST-1100-8	4910-01-097-6962	39	8
15434	ST-1100-9	4910-01-097-6963	39	11
15434	ST-1105	5120-01-164-3265	46	7
15434	ST-1114	4910-01-097-6987	37	3
15434	ST-1122	4910-00-150-5843	47	3
15434	ST-1124	4910-00-150-5844	47	4
15434	ST-1134	4910-00-150-5848	49	7
15434	ST-1145	4910-01-097-6925	44	19
15434	ST-1157	4910-01-097-6913	44	3
15434	ST-1158	4910-01-097-6914	43	14
15434	ST-1159	4910-01-097-6988	37	15
15434	ST-1168-10	3020-01-086-8269	43	7
15434	ST-1168-19	4910-01-098-1912	43	8
15434	ST-1168-3	4910-01-085-0763	43	4
15434	ST-1168-4	3120-01-085-0762	43	2
15434	ST-1168-5	3020-01-085-0761	43	5
15434	ST-1168-6	5305-01-084-4596	43	3
15434	ST-1168-7	3020-01-084-7007	43	6
15434	ST-1168-8	4910-01-086-8268	43	9
15434	ST-1168-9	4910-01-088-7904	43	10
15434	ST-1173	4910-01-161-2115	47	5
15434	ST-1177		41	5

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CAGEC	PART NUMBER	STOCK NUMBER	FIG.	ITEM
15434	ST-1178	5120-01-141-5777	44	4
15434	ST-1179	5120-00-104-1795	36	30
15434	ST-1191	5120-01-160-8867	47	6
15434	ST-1218	4910-01-097-6976	39	15
15434	ST-1225	4910-01-097-6948	36	2
15434	ST-1227	5120-00-981-3108	36	15
15434	ST-1228	5120-00-055-4013	40	14
15434	ST-1228-1	4910-01-098-1915	40	23
15434	ST-1228-13	4910-01-097-6910	40	17
15434	ST-1228-14	4910-01-097-6911	40	21
15434	ST-1228-2	4910-01-098-1916	40	22
15434	ST-1228-3	4910-01-098-1917	40	15
15434	ST-1228-4	4910-01-098-1918	40	20
15434	ST-1228-5	4910-01-098-1919	40	18
15434	ST-1228-9	4910-01-100-6191	40	16
15434	ST-1229	5120-00-999-1206	49	8
15434	ST-1241	4910-01-141-8388	49	5
15434	ST-1242	4910-01-098-1914	36	4
15434	ST-1242-1	4910-01-108-9130	36	12
15434	ST-1242-2	4910-01-113-1066	36	6
15434	ST-1242-3	4910-01-112-7509	36	5
15434	ST-1242-4	9999-01-119-2743	36	8
15434	ST-1242-5	4910-01-099-1487	36	9
15434	ST-1242-6	5315-01-110-7835	36	7
15434	ST-1242-7	4910-01-117-4885	36	10
15434	ST-1242-8	4910-01-118-2878	36	11
15434	ST-1244	5120-00-113-5271	38	1
15434	ST-1244-1		38	7
15434	ST-1244-3		38	10
15434	ST-1244-4	5310-01-104-4550	38	9
15434	ST-1244-5	3120-01-103-8752	38	8
15434	ST-1244-8	5120-01-099-6341	38	11
15434	ST-1244-9	5365-01-103-7835	38	6
15434	ST-125	2815-00-362-2042	46	1
15434	ST-1254		52	4
15434	ST-1255	4910-01-085-0764	43	11
15434	ST-1257-A	4910-01-128-2691	47	8
15434	ST-1259	4910-01-106-0492	42	1
15434	ST-1259-1	4910-01-097-6916	42	3
15434	ST-1259-2	4910-01-097-6917	42	4
15434	ST-1259-3	5305-01-097-6918	42	5
15434	ST-1259-4	4910-01-097-6919	42	2
15434	ST-1259-5	5305-01-097-6920	42	7
15434	ST-1259-6	5305-01-097-6921	42	8
15434	ST-1259-7	5305-01-098-1913	42	6
15434	ST-1261	4910-01-147-7896	50	1
15434	ST-1262	4910-01-154-6406	50	2
15434	ST-1273	6620-01-147-9954	36	1
15434	ST-1279	5120-01-128-2679	47	9
15434	ST-1287-10	5133-01-084-6008	43	13
15434	ST-1295	5120-00-150-7488	41	1

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CAGEC	PART NUMBER	STOCK NUMBER	FIG.	ITEM
15434	ST-1298	4910-01-082-1346	50	3
15434	ST-1318	4910-01-085-0766	43	17
15434	ST-1318-23	5133-01-084-6009	43	18
15434	ST-1325	4910-01-097-6972	37	16
15434	ST-1326	5120-01-097-6932	44	20
15434	ST-1326-1	4910-01-097-6933	44	22
15434	ST-1326-2	4910-01-097-6934	44	21
15434	ST-249	5180-00-916-1813	39	16
15434	ST-249-1	5120-01-106-9173	39	20
15434	ST-249-2	5120-01-097-3204	39	19
15434	ST-249-3	5120-01-106-9174	39	18
15434	ST-249-4		39	17
15434	ST-257	4910-00-345-3708	46	2
15434	ST-302	4910-00-999-1506	37	2
15434	ST-386-10	4910-01-097-6983	38	24
15434	ST-386-11	4910-01-097-6984	38	21
15434	ST-386-2	4910-01-097-6977	38	19
15434	ST-386-3	5310-01-097-6978	38	20
15434	ST-386-5	4910-01-097-6979	38	22
15434	ST-386-6	4910-01-097-6980	38	27
15434	ST-386-8	4910-01-097-6981	38	26
15434	ST-386-9	4910-01-097-6982	38	25
15434	ST-419	5120-00-896-8097	36	3
15434	ST-448		46	4
15434	ST-544	5120-00-065-1031	43	11
15434	ST-544-1	5120-01-100-0135	45	6
15434	ST-544-2		45	5
15434	ST-560	5210-00-999-1209	36	28
15434	ST-561	4910-00-977-7507	49	1
15434	ST-563	4910-01-146-7130	49	2
15434	ST-608	4910-01-086-9766	45	2
15434	ST-633	4910-00-150-5797	38	28
15434	ST-646	5110-00-980-7347	39	2
15434	ST-658	4910-01-097-6986	38	17
15434	ST-659	5120-00-159-8916	39	21
15434	ST-663	3460-00-999-1173	46	8
15434	ST-668	3465-00-999-1501	52	1
15434	ST-669	5120-00-103-4687	37	8
15434	ST-669-13	5120-01-122-6014	37	10
15434	ST-691	3460-00-999-1210	38	13
15434	ST-691-1		38	14
15434	ST-691-2		38	15
15434	ST-6991		37	14
15434	ST-708	5120-00-999-1503	49	3
15434	ST-709	5120-00-999-1504	37	4
15434	ST-749	4910-01-159-8701	46	6
15434	ST-763	5120-00-150-7486	49	4
15434	ST-788	5133-00-932-2089	36	13
15434	ST-835	5120-00-999-1505	40	1
15434	ST-851	5120-00-923-0856	45	7
15434	ST-853	4910-00-150-5801	40	2

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CAGEC	PART NUMBER	STOCK NUMBER	FIG.	ITEM
15434	ST-876	7920-00-168-3244	47	2
15434	ST-880	3441-00-922-6699	36	21
15434	ST-880-1	5210-01-099-6339	36	22
15434	ST-880-2	4910-01-097-6955	36	23
15434	ST-880-3		36	24
15434	ST-880-6	5310-01-104-4549	36	25
15434	ST-880-7	4910-01-097-6956	36	26
15434	ST-884	4910-00-981-3105	36	16
15434	ST-884-1	4910-01-097-6957	36	18
15434	ST-884-3	4910-01-098-5088	36	17
15434	ST-884-5		36	19
15434	ST-884-6	4910-01-097-6958	36	20
15434	ST-903	5220-01-168-6878	41	6
15434	ST-990	5120-01-029-6861	51	4
15434	ST-995	5120-00-150-7492	36	29
15434	ST-997	5120-00-150-5810	40	4
15434	ST-997-6	4910-01-097-6915	40	5
15434	ST1065	5120-00-150-7489	40	13
15434	ST583	4920-00-711-9307	46	4
15434	ST593		39	1
15434	ST662	4910-00-999-1208	46	9
15434	ST790-362	4910-01-175-5215	52	2
15434	ST790-363	4730-01-174-5944	52	3
15434	ST824	4910-00-925-0755	47	1
15434	S105	5305-00-426-4142	13	31
			29	41
15434	S105X	5305-00-426-4146	24	25
15434	S110	5305-01-114-9279	29	27
			33	8
			33	22
15434	S118A	5305-00-230-1939	26	12
15434	S126	5305-00-177-5552	11	18
15434	S129	5305-00-546-6698	2	35
15434	S1354		12	48
15434	S145	5305-01-203-6444	11	7
15434	S149A	5305-00-404-1390	14	30
15434	S151		29	4
15434	S152B		11	44
15434	S155	5305-01-028-8869	15	5
15434	S16255	2815-00-815-0355	35	11
15434	S174C	5305-00-207-2715	30	5
15434	S189C	5305-00-509-8106	28	1
15434	S190C	5305-00-795-9345	22	7
15434	S200	5310-00-469-3998	5	21
15434	S222A		27	4
15434	S223	5310-00-521-8595	13	40
15434	S2286		26	23
15434	S248	5310-00-005-6052	24	48
15434	S251	5310-00-011-4492	32	8
15434	S2876	3120-00-353-9164	32	7
15434	S600	5310-00-562-6552	32	6

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CAGEC	PART NUMBER	STOCK NUMBER	FIG.	ITEM
15434	S601	5310-00-134-4168	5	17
15434	S604	5310-00-261-7340	2	34
			7	9
			12	17
			35	32
15434	S622	5310-00-562-6557	13	36
15434	S631	5310-00-562-6560	22	3
15434	S684	5330-00-003-1771	14	36
15434	S689		22	26
15434	S719	5340-00-276-5847	2	31
15434	S911B	4730-00-018-9566	2	27
			5	23
			11	35
			14	40
			16	10
15434	S962	4730-00-044-4715	12	10
15434	TM-82	5120-00-865-0226	37	11
04998	WA1248	5310-00-143-5722	20	64
81348	WW-P-471AASBUC	4730-00-010-3867	35	5
75078	001022	5360-01-084-9066	18	17
75078	001023	5325-01-087-8727	18	15
75078	001026	5310-01-157-3762	18	8
75078	001030	5310-01-145-8405	17	10
			18	12
75078	001031	5305-01-186-7042	18	9
75078	001081	5331-01-086-1013	18	5
75078	001082	5331-01-085-3105	18	6
75078	001083	5330-01-086-6196	18	7
75078	001094	5310-01-144-6115	1	2
			17	3
			18	34
75078	001199	5307-01-145-8449	18	31
			18	31
75078	001232	5307-01-147-2821	18	30
75078	001234	5365-01-147-5030	1	4
			17	4
			18	33
75078	001484	2815-01-098-6755	18	18
75078	001492	5305-01-145-8384	18	13
75078	001519	5360-01-089-9103	18	21
75078	001521	4820-01-089-3939	18	20
75078	002299	5940-01-085-4426	18	10
75078	002390	6150-01-114-7119	18	3
75078	002514	5310-01-147-5072	18	28
75078	002856	5307-01-147-1316	18	29
75078	002969	2520-01-085-6128	18	13
75078	003251	5365-01-095-5666	17	9
75078	003678	5306-01-107-6371	18	27
75078	004089	2815-01-088-7328	18	14
75078	004136	2815-01-145-9402	18	23
75078	004205	4810-01-089-0534	18	4

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CAGEC	PART NUMBER	STOCK NUMBER	FIG.	ITEM
75078	007447	5360-01-145-7607	18	11
75078	007500	5360-01-145-7555	18	22
75078	007505	4820-01-146-4593	18	20
75078	007623	2815-01-098-6755	18	18
75078	007696	2815-01-146-1997	18	19
75078	008895	5340-01-085-4439	18	16
75078	009353	5310-01-146-7302	18	8
75078	009916	5305-01-144-6206	18	9
75078	009917	2815-01-141-3261	18	2
75078	010180	5330-01-145-6083	8	25
			18	12
75078	011494	5120-01-163-1349	48	10
75078	011573	2815-01-085-3733	3	19
75078	012647	5305-01-145-8382	17	1
75078	016053	2815-01-085-2574	18	1
6N299	0907859	4730-00-042-8988	10	6
15434	100099	5331-00-809-2667	30	8
15434	100129	5305-00-721-3698	25	21
15434	100193	3120-00-810-6032	24	41
15434	100215	3040-00-567-4354	25	18
15434	100475	5325-01-084-9033	13	29
15434	100478	5331-00-081-9289	24	55
15434	100764	5330-00-506-4866	29	31
06991	101037-05	5306-01-151-1023	31	14
15434	101322	2590-00-590-7378	9	1
15434	101841	5365-00-507-3224	24	64
15434	101842	5365-00-507-3225	24	64
15434	101843	5365-00-543-3744	24	64
15434	101996		10	20
06991	102030	5310-01-146-6147	31	8
15434	102522	4720-01-085-6129	33	20
06991	103031	5310-01-146-6150	31	7
06853	103840	2530-00-603-1532	20	61
77640	103879	4730-00-010-3867	12	8
15434	105182	5340-01-085-6269	13	37
15434	105199	2815-00-829-5227	15	6
			18	16
15434	105375	9905-00-733-7622	24	28
15434	105953	5306-00-804-2468	2	22
15434	106289	5305-00-091-4009	5	13
15434	107460	5340-00-087-7486	14	19
15434	107738	2815-00-505-5119	7	24
15434	107947	4820-00-276-9041	10	35
			11	12
06991	108289	5342-01-146-9816	31	13
15434	108330	5310-00-486-2505	14	25
			22	3
15434	108722	5340-00-400-3449	26	17
15434	109319	2815-00-406-8936	13	45

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CAGEC	PART NUMBER	STOCK NUMBER	FIG.	ITEM
15434	109333	2815-00-705-2856	13	14
15434	109594	3120-01-079-6527	15	10
			34	3
15434	110058	5340-00-716-4975	24	44
15434	110266	5305-00-477-0395	15	7
15434	110855	5330-00-567-3463	25	2
15434	110907	5365-00-708-3434	11	14
06991	111025	5330-01-147-8754	31	3
15434	112302	5325-00-420-9696	35	9
15434	114638	5310-00-887-8325	15	8
12204	116122	5310-00-011-6122	20	1
			23	2
15434	116391	3120-00-792-9834	17	32
19207	11669835	2815-01-142-2745	1	9
15434	116982	5340-00-767-4012	15	11
11862	117244	4730-00-042-8988	16	13
			24	30
15434	118227	5315-00-844-0140	24	38
15434	118377	3120-00-791-1440	7	23
15434	118378	3120-00-659-7808	7	17
15434	118939	5315-00-777-3544	7	20
			7	26
15434	119363	3020-00-702-3882	25	11
15434	119810	4310-00-903-7174	20	18
15434	119859	5325-00-922-9101	20	19
94135	12Z9026-5	5330-00-599-2962	24	21
30379	120217	5310-00-922-2017	28	16
15434	123558	5315-00-866-5015	3	8
19207	12389942-1	8145-01-445-8271	1	10
06991	125049	4730-01-146-1059	31	6
15434	126304	2815-00-828-7013	13	44
15434	127316	5310-00-081-8500	4	14
			5	14
15434	127558	2815-00-791-1453	11	22
15434	127936	5331-00-941-3762	20	49
15434	127940	4820-00-445-0610	20	40
15434	128080	5360-00-895-3216	20	39
15434	128085	5331-00-905-2679	20	41
15434	128086	5331-00-441-0145	20	50
15434	128936		26	24
15434	129768	5310-00-082-1888	28	9
15434	129826	4820-00-829-5600	28	14
15434	129838	5355-00-082-1189	28	15
15434	129839	5340-00-084-7787	28	7
15434	129866	4730-01-106-4700	22	19
			30	19
15434	129888	5331-00-081-9299	28	8
15434	130118	2930-00-928-3595	33	1
15434	130394	4730-00-404-2906	33	28
15434	131026	5331-00-143-8485	3	22

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CAGEC	PART NUMBER	STOCK NUMBER	FIG.	ITEM
15434	132019	5340-00-799-0843	2	12
15434	13264800	4730-00-404-2909	2	33
75078	13294	5330-01-086-3996	18	24
15434	133538	5305-01-133-2060	30	11
15434	134074	2910-00-085-7436	28	6
15434	134561	5340-01-147-5389	12	33
15434	135308	2815-01-146-4164	3	26
15434	136403	9905-00-473-7260	20	27
15434	137075	5331-00-420-9624	4	5
15434	137370	5340-00-907-8964	29	48
15434	137795	5305-00-091-4006	10	2
15434	137796	5306-01-204-3297	22	7
15434	138769	5360-01-086-6114	24	65
15434	139988	5331-00-809-3276	30	6
15434	140218	5310-00-082-1882	2	21
15434	140330	3120-00-589-3537	8	5
			8	15
			8	19
			8	23
24617	141244	5315-00-014-1244	25	4
24617	141284	5315-00-014-1284	5	22
15434	142110		11	20
15434	142689	3020-00-160-9092	17	20
15434	143251	5360-00-461-5738	29	47
15434	143253	5360-00-901-9644	29	47
15434	143848	5360-01-095-3661	24	61
			29	34
15434	144178	5315-00-082-0448	24	59
			29	32
15434	144179	5310-00-727-8353	24	60
			29	6
15434	144302	5365-00-829-5604	24	63
15434	144714	4820-00-909-4174	20	42
15434	144948	3805-00-955-5320	20	45
15434	145028	4820-00-909-4175	20	46
15434	145504	5330-01-051-4243	13	12
15434	145504	5330-01-051-4243	24	20
15434	145505	5330-01-072-8982	24	19
15434	145506	5331-01-086-3991	35	23
15434	146160	5310-00-809-3078	29	26
15434	146161	5310-01-075-0991	13	10
15434	146483	2910-00-790-8736	24	34
15434	147056	2910-00-085-7442	3	7
15434	147100	2910-00-928-3505	3	21
15434	147135	5342-00-858-3507	22	4
15434	147389	5305-00-062-4378	3	17
15434	147610	3120-01-016-4883	20	26
15434	148203	5330-00-143-8369	33	29
15434	149105PC183049	5331-00-058-1767	2	5
28265	14978	5310-01-056-1371	20	52
15434	151478	2815-00-920-2073	15	3
15434	153338	5340-00-829-5617	30	10

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CAGEC	PART NUMBER	STOCK NUMBER	FIG.	ITEM
15434	153346	5305-01-147-8726	30	14
15434	153964	4310-01-146-5921	20	12
15434	154018	5330-00-852-7347	20	15
15434	154087	5330-00-951-3538	28	17
15434	154088	5330-00-961-9470	24	32
15434	155789	4720-01-085-6131	14	11
15434	156416		27	7
15434	156420	3120-00-682-7706	27	13
15434	156444		27	2
15434	157088	5365-00-507-3271	24	31
15434	157281		4	7
15434	157282		4	7
15434	157551	5330-00-143-8376	13	34
15434	160514	5365-00-965-0870	30	9
15434	162426	3010-00-447-9799	23	9
			29	29
15434	163733	5342-00-400-5178	24	37
15434	163944	3120-00-904-9595	29	18
15434	165430	4310-01-079-6938	20	17
15434	166009	5360-00-132-0245	21	7
15434	166485	3120-00-493-3913	32	9
15434	166777	5305-01-091-2498	17	5
15434	167157	4820-01-070-9710	21	11
15434	167299	5310-00-680-6874	27	5
15434	168306	5305-00-947-3437	8	4
			8	8
			8	14
			8	18
			8	22
15434	168319	5305-00-297-4022	8	24
15434	170226	5342-00-404-2946	1	5
15434	170296	5340-00-933-3009	3	3
15434	170510		27	12
15434	170664	5310-00-486-2507	17	25
15434	170970		22	28
15434	171570	2990-00-477-6159	27	16
15434	172034	5340-00-632-6239	3	5
15434	172648	5330-00-404-2920	5	27
15434	173086	5330-00-132-0247	21	15
15434	173368	5330-00-132-0248	11	49
15434	173708		32	10
15434	173709		32	4
15434	173717	5360-00-436-7340	32	3
15434	174299	5365-00-815-1137	21	13
15434	175755	5325-01-241-4318	6	6
15434	175831	5340-00-485-0945	7	12
15434	175833	5305-01-145-8383	17	12
15434	175860		25	6
15434	175864	3040-00-933-3012	25	12
15434	175867		25	5

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CAGEC	PART NUMBER	STOCK NUMBER	FIG.	ITEM
15434	176027	5330-00-129-9389	20	31
75078	1764	5307-01-109-5972	18	27
15434	177419	3040-01-079-3469	13	23
15434	178074	5342-01-140-7158	12	30
15434	179063	2940-01-146-1995	11	34
			13	18
15434	179822	5360-01-147-0054	24	16
15434	179834		24	16
15434	179901	4820-01-045-6080	34	5
15434	179903	4730-01-045-3083	34	8
15434	179904	4730-01-146-4016	34	5
15434	179912		34	7
15434	180175	5305-01-112-9698	5	9
15434	180371	5340-01-079-8097	22	6
15434	180372	5340-00-719-4601	22	8
15434	180810		20	22
15434	181213	4730-00-444-1710	3	25
			22	13
15434	181466	5310-00-484-1718	24	26
			25	20
			28	2
			30	3
15434	182706	5305-00-058-6604	35	15
15434	183429	5365-00-369-4729	20	38
15434	183695		13	22
15434	185138	5342-01-079-4678	21	9
15434	185573	5365-01-086-7788	16	4
15434	185847	4310-01-146-4155	20	51
15434	186780	5330-00-864-5422	33	8
15434	187317	4730-00-138-3906	19	15
15434	187420	5365-00-132-0273	6	9
15434	1875350		20	23
15434	187556	5305-00-138-9848	28	5
15434	189800	5365-00-462-4504	29	45
15434	190334	5360-00-129-9415	20	44
15434	190397	2930-00-401-9531	17	18
15434	190849	5330-00-194-8385	26	8
15434	190876	5331-00-132-0274	28	10
8X479	191037	4310-01-084-7148	20	48
15434	191916	5340-00-238-5435	21	1
15434	191970	2815-00-480-4347	6	7
15434	193136	5310-01-124-6463	17	14
15434	193625	2815-01-133-2445	12	2
15434	193734	5330-00-403-9896	24	21
15434	193736	5330-00-132-0276	21	8
15434	194010	5305-00-411-9340	27	9
15434	194037	5340-00-404-2940	8	10
15434	195210		4	18
15434	195755	5305-01-109-9307	24	45
15434	195952	5330-01-066-3904	14	7
01212	1962CPA	3120-00-005-0602	4	21
15434	196282	4730-01-085-4156	19	9
			33	13

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CAGEC	PART NUMBER	STOCK NUMBER	FIG.	ITEM
15434	196844	5365-01-132-1984	35	10
15434	199349	3010-01-079-3461	20	4
15434	199586	3120-01-149-5414	13	7
15434	199587		13	20
15434	199589	3010-01-079-1788	13	30
28835	2CA647	4720-00-278-4890	12	14
53203	20000	2910-00-646-9727	31	2
15434	200064	5340-00-417-5800	12	27
15434	200488	4730-01-294-6019	26	4
15434	200566	2815-01-077-4463	15	2
15434	20063500	4730-01-078-6364	24	58
15434	200809	5330-00-026-2931	17	19
15434	200817	5330-00-471-0370	29	30
15434	200861	5310-00-134-4171	5	8
			11	46
15434	200919	5340-00-132-3203	15	9
15434	201250		27	8
15434	201737	6685-01-141-0907	33	7
15434	202069	5305-01-086-7285	21	3
01276	2021-20-20S	4730-00-202-8470	13	42
15434	202128	5360-01-200-0323	11	32
15434	202185	4710-01-146-1114	22	11
15434	202377		27	15
15434	202456		27	11
15434	202897	5340-00-951-3536	30	7
15434	202903	5315-01-058-4551	4	8
06853	202961	5310-00-403-7731	20	70
15434	203097	3120-01-083-6411	35	14
15434	203131	5310-00-426-3990	3	18
15434	203145	5330-01-066-3910	13	2
15434	203350	2910-01-080-5570	24	63
15434	203426	5315-01-079-6506	21	12
15434	203619	5305-01-072-8831	29	20
15434	203760	5310-01-112-4306	16	16
15434	204163	4330-01-020-3666	34	10
15434	204165	5305-00-795-9336	4	13
			5	10
15434	204244	3040-01-086-1448	27	19
15434	204586	6685-01-047-2811	33	12
15434	204832	3020-01-085-3779	13	24
15434	206326	5305-01-113-1179	23	10
			29	7
15434	208084	5320-01-163-2277	8	11
15434	208119	3040-01-079-3468	35	25
15434	208120	5365-01-080-0409	35	22
15434	208128	5330-01-040-2087	33	6
15434	208326	4730-00-477-4160	26	5
15434	208346	5305-01-179-2380	2	22
15434	208525	5310-01-079-6529	21	6
15434	208829	5342-01-098-0175	17	7
15434	209760	3120-01-080-3275	24	36

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CAGEC	PART NUMBER	STOCK NUMBER	FIG.	ITEM
15434	209919	2815-01-146-5925	4	2
15434	209955	4720-01-146-1071	26	10
15434	210179	5315-01-079-6740	4	16
15434	210416	4710-01-209-6742	16	3
15434	210707		11	33
15434	210884	5365-01-150-6257	2	28
15434	210915	2815-01-241-4719	11	31
15434	210966	5340-01-242-0805	11	10
15434	210967	5340-01-342-3610	11	19
15434	211222		14	9
15434	211255	5330-00-135-6382	16	6
15434	211315	5330-01-060-9061	20	43
15434	211435	2930-01-084-6011	33	21
15434	211448	5340-01-145-1597	34	2
15434	211662	3120-01-129-7659	20	35
15434	211918	3020-01-077-4411	4	11
15434	211939	5360-01-038-4659	13	13
15434	211999	5360-00-009-9270	3	4
15434	212161	5331-01-077-5228	11	36
			33	26
15434	212601	3040-01-070-9004	29	22
15434	212602	3020-01-086-4158	29	24
15434	212603	5330-01-072-8828	29	10
15434	212604	5325-01-081-0662	29	16
15434	212605	3020-01-070-9003	29	15
15434	212607	3040-01-085-2871	29	9
15434	212609	3120-01-087-2539	29	12
15434	212610	3020-01-086-8780	29	13
15434	212613	3010-01-080-1529	29	25
15434	212639	3010-01-088-5727	29	14
15434	212668	5315-01-087-0534	29	23
15434	212954	5305-01-079-7028	21	18
15434	213079	5330-01-084-9068	30	18
15434	213082	5310-01-145-0762	35	18
15434	213394	5340-01-087-0682	3	13
15434	213395	5340-01-087-0681	3	9
15434	213456	5305-01-147-8731	16	17
15434	213485	4710-01-079-3198	33	16
15434	213559	2815-01-048-6702	7	18
15434	213740		2	2
15434	213768	5331-01-072-8983	24	45
15434	213769	3110-01-079-8190	24	57
15434	214086	2835-01-086-1447	27	18
15434	214139	2910-01-141-4028	24	42
15434	214144	2910-01-091-7507	24	47
15434	214146	3040-01-086-1651	24	22
15434	214150	5310-01-145-0761	24	9
15434	214306	2815-01-079-9146	16	18
15434	214345	4820-01-210-9571	33	4
15434	214617	5340-01-135-7250	33	21
15434	214730	2815-01-241-6581	6	3
15434	214836		14	34

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CAGEC	PART NUMBER	STOCK NUMBER	FIG.	ITEM
15434	214950	3120-01-087-3004	6	12
15434	214951	3120-01-155-4442	6	12
15434	214952	3120-01-157-3316	6	12
15434	215041	4710-01-085-6132	14	35
15434	215042	2815-01-083-2123	33	3
15434	215044	5330-01-066-5351	14	3
15434	215045	5330-01-082-6984	14	17
15434	215090	5330-00-064-4399	2	3
15434	215195	4720-01-085-6293	26	10
15434	215233	3120-01-079-8194	7	3
15434	215397	3020-01-079-4206	35	26
15434	215587	4730-01-146-1064	14	18
15434	215705	5331-01-145-0716	16	5
15434	215787		30	4
15434	215965	3020-01-077-2229	4	15
15434	215966	3020-00-424-9995	7	2
15434	21609300	4710-01-095-8683	19	13
15434	216128	4710-01-079-3493	22	11
15434	216165	2990-01-120-2883	4	2
15434	216296	5340-01-163-7118	8	26
15434	216467	2815-01-079-3317	33	23
15434	216486	5330-01-066-5352	14	6
15434	216487	5330-01-072-8998	26	1
15434	216524	5340-01-086-6193	3	14
15434	216802	5330-01-085-3580	27	1
15434	216908	3040-01-151-9348	29	9
15434	217034	2930-01-097-6755	17	2
15434	217315	2930-01-231-1661	11	13
15434	21732300	2815-01-079-1632	4	12
15434	217632	4730-01-085-7328	15	12
15434	217736		27	10
15434	217798	2910-01-098-5118	24	39
15434	217929	2815-01-085-5190	7	6
15434	217932	4730-01-146-3109	14	16
15434	217933	4710-01-146-4083	14	14
15434	217934	5342-01-145-9540	12	20
			14	22
15434	217939	4710-01-146-3085	19	4
15434	218153	3120-01-079-5208	8	9
15434	218245	5330-01-046-1991	11	26
15434	218716		16	15
15434	218732	2815-00-994-4429	6	4
15434	218736	4730-01-124-0293	8	27
15434	218793	4310-01-146-1097	20	14
15434	218813	5340-01-150-6248	12	38
15434	218867	2910-01-146-2000	32	1
15434	219107		7	25
15434	219153	5306-01-079-7027	6	11
24617	219191	4730-00-010-3867	16	13
06853	230175		20	63

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CAGEC	PART NUMBER	STOCK NUMBER	FIG.	ITEM
93389	2304	5120-00-865-0933	39	22
06853	237303	5330-01-097-7791	20	77
06853	239658		20	60
06853	240331		20	62
06853	240334		20	59
06853	240336		20	58
06853	240338	5360-00-079-1940	20	65
06853	240339	4820-00-117-9103	20	66
06853	240340	5305-00-839-6230	20	76
06853	240341	5340-00-116-6767	20	74
06853	240342	2530-00-116-9953	20	75
06853	240343	5360-00-603-1518	20	73
06853	240344	5340-00-117-9102	20	72
06853	240345	5340-00-738-7552	20	68
06853	240346		20	57
06853	240347		20	67
24617	2436161	5310-01-102-3270	31	21
06853	246075	5310-01-157-7361	20	71
72983	248X4	4730-00-900-3296	22	31
33457	255622	5330-00-286-0487	30	18
01276	2580-6	4720-00-187-4102	34	12
			34	13
			BULK	3
24617	272547	5306-00-418-2276	31	17
06853	275202	4310-00-225-0706	20	69
06853	275230	2530-01-093-0872	20	55
06853	275707	2530-00-827-5934	20	54
75078	2856	5307-01-147-1316	18	29
15434	299670	2940-01-019-4513	10	33
			11	43
15434	3000082	5310-01-145-8404	16	16
15434	3000171	4310-01-092-9816	17	22
15434	3000173	5306-01-119-4271	17	24
15434	3000174	3010-01-085-2732	17	26
			20	36
15434	3000266	3040-01-085-2616	28	12
15434	3000446	4320-01-098-5115	24	56
15434	3000464	2910-01-076-8632	21	16
15434	3000465	5310-01-079-6708	21	17
15434	3000560	4730-01-146-7047	26	15
15434	3000888	4320-01-079-3454	35	2
15434	3000907	4710-01-181-1956	11	6
15434	3000926		3	11
15434	3001296	5342-01-085-4153	23	3
			29	2
15434	3001646	5305-01-147-4025	5	24
15434	3001707	5365-01-079-8373	24	17
15434	3001847	2910-01-147-9913	24	40
15434	3002048		24	57
15434	3002069		7	19
15434	3002074	4730-01-079-3273	19	1
15434	3002110	2910-01-086-7715	29	8

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CAGEC	PART NUMBER	STOCK NUMBER	FIG.	ITEM
15434	3002110	2910-01-086-7715	29	8
15434	3002385	5330-01-066-5350	35	16
15434	3002731	4140-01-085-2607	27	3
15434	3002901	3020-01-145-8568	7	2
15434	3003156	5330-01-072-8830	24	11
			29	39
			29	44
15434	3003480		1	6
15434	3003536	4730-01-079-3274	26	19
15434	3003682	3040-01-077-4976	21	2
15434	3003814	2520-01-090-4473	11	11
15434	3004724	5365-01-126-3334	29	11
15434	3005133	4310-01-092-9815	17	11
15434	3005152	2530-01-130-2339	20	32
15434	300550700	3020-01-086-3417	35	13
15434	3005508	5305-01-147-2444	14	5
15434	3006175	5305-01-072-8826	24	53
15434	3006182	5305-01-118-8826	9	2
15434	3006183	2815-01-142-1732	9	4
15434	3006187	2815-01-159-1737	9	3
15434	3006289	5307-00-922-2626	15	13
			26	7
15434	3006343	3040-01-086-1449	24	51
15434	3006344	5305-01-135-5446	24	50
15434	3006349	2815-01-164-6103	9	3
15434	3006350	3040-01-150-4926	24	54
15434	3006358	2815-01-146-1024	9	5
15434	3006456	2815-01-085-2618	3	15
15434	3006457		3	15
15434	3006458		3	15
15434	3006736	5330-00-005-0856	4	10
15434	3006738	5330-01-086-6112	4	4
15434	3006745	5325-01-139-6738	11	28
15434	3007442	5331-01-145-5377	2	39
15434	3007713	5330-01-086-6197	11	29
15434	3007759	5331-01-072-4436	3	6
15434	3008017	5330-01-079-6514	11	39
15434	3008047	3130-01-146-1150	2	25
15434	3008048	3130-01-146-4504	2	24
15434	3008049	3130-01-146-1228	2	23
15434	3008069	5305-01-212-5210	12	37
15434	3008425	2930-01-146-0111	14	32
15434	3008468	4730-01-147-2223	12	8
			33	30
15434	3008469		2	8
		4730-01-106-0202	5	18
			13	5
15434	3008470	5342-01-143-6045	12	9
15434	3008530	2815-01-145-9401	16	24
15434	3008591	5330-01-086-3523	14	33
15434	3008596	4730-01-146-3111	12	13

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CAGEC	PART NUMBER	STOCK NUMBER	FIG.	ITEM
15434	3008599	4710-01-215-8158	12	15
15434	3008690	4730-01-163-7192	11	4
15434	3008706	4730-01-077-2016	21	14
15434	3008947	5330-01-129-6541	17	16
15434	3008998	5330-01-049-0466	2	4
15434	3009213	5310-00-356-1447	2	21
15434	3009380	2910-01-136-3331	24	63
15434	3009848	4710-01-106-8068	22	14
15434	3010030	5330-01-046-3144	11	16
15434	3010042	2910-01-146-1084	24	35
			24	63
15434	3010146	5360-01-145-7554	13	13
15434	3010242	5330-01-075-0948	24	19
			KIT	
			KIT	
15434	3010589	5305-01-129-6901	8	31
15434	3010590	5305-01-119-8621	17	29
15434	3010594	5305-01-130-6100	4	3
15434	3010595	5305-01-085-8197	11	9
			12	29
			33	9
15434	3010596	5305-01-088-6019	11	15
			11	38
			32	17
			33	29
			33	32
			34	1
15434	3010597	5305-01-086-7036	11	42
			33	14
15434	3010810	5342-01-145-1549	24	62
15434	3011233	4730-01-241-7258	11	2
15434	3011342	5305-01-135-5344	11	1
15434	3011610	5310-01-145-8403	14	27
15434	3011711	5305-01-147-4033	16	12
15434	3011712	5305-01-240-7155	16	12
15434	3011713	5305-01-145-8381	16	7
15434	3011714	5305-01-165-3892	16	20
15434	3011715	5305-01-072-8816	16	23
15434	3011878	5330-01-066-5349	7	8
15434	3011934	2910-01-146-0048	3	7
15434	3011951	3120-01-079-6823	2	30
			2	30
15434	3011952	5340-01-145-9362	2	17
15434	3012328	5315-01-086-6187	7	4
15434	3012331	2815-00-994-4427	6	1
15434	301233200	2815-01-241-6580	6	2
15434	3012462	2815-01-146-1041	7	6
15434	3012468	5305-01-129-4386	35	29
15434	3012469	5305-01-147-4035	35	31
15434	3012470	5305-01-113-0408	33	24
15434	3012471	5305-01-072-8818	14	10

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CAGEC	PART NUMBER	STOCK NUMBER	FIG.	ITEM
15434	3012473	5305-01-137-6706	14	24
15434	3012479	5305-00-795-9352	13	46
15434	3012481	5305-01-147-8732	23	4
15434	3012483	5305-01-114-6386	5	16
15434	3012526	5310-01-126-1045	17	13
15434	3012529	5340-01-145-0802	13	14
15434	3012531		13	23
15434	3012532	3040-01-145-9637	13	20
15434	3012538	2910-01-086-3974	21	10
15434	3012558	5305-01-129-4218	24	2
15434	3012726	5342-01-145-0645	13	11
15434	3013000	2930-01-087-8749	33	31
15434	3013161	4710-01-146-1116	22	14
15434	3013295	4730-01-146-1065	14	2
15434	3013331	5315-01-210-0616	7	19
15434	3013336	3020-01-146-3773	17	15
15434	3013591	2910-01-146-7955	2	38
15434	3013623	5305-01-145-8379	3	28
15434	3013786	4730-01-161-5115	2	16
			13	5
			35	5
15434	3013810	2910-01-142-7455	24	12
15434	3013811	4820-01-079-3320	24	10
15434	3013904	5305-01-112-9021	2	11
			12	46
15434	3013909	2815-01-105-8768	2	6
15434	3013930	2815-01-086-4508	6	8
15434	3014103	5310-00-081-9292	17	27
15434	3014354	4730-01-127-6104	26	9
15434	3014397	4730-01-109-8501	22	17
15434	3014398	4730-01-146-3633	22	15
15434	3014614	3020-01-146-0107	4	15
15434	3014622	2815-00-132-0240	3	10
15434	3014623	2815-01-127-1060	3	10
15434	3014624	2815-01-127-3597	3	10
15434	3014625	2815-01-127-3598	3	10
15434	3014754	5310-01-144-6224	13	16
15434	3014755	4820-01-145-9457	13	17
15434	3014756	5360-01-148-0303	13	15
15434	3014778	5330-01-147-1274	13	2
15434	3014783	3020-01-084-9640	13	19
15434	3014787	3020-01-146-0109	13	19
15434	3014788	3020-01-146-0108	13	8
15434	3014798	3040-01-146-5935	13	25
15434	3014964	5340-01-145-9451	13	3
15434	3015114	2930-01-146-4212	33	3
15434	3015282	5305-01-129-4384	20	34
			23	7
15434	3015373	4710-01-085-9348	22	9
15434	3015375	4710-01-085-9349	22	18
15434	3015387	4710-01-146-3169	22	18

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CAGEC	PART NUMBER	STOCK NUMBER	FIG.	ITEM
15434	3015389	4710-01-146-1113	22	16
15434	3015393	4710-01-085-6134	22	16
15434	3015469	5310-01-145-1114	21	6
15434	3015520	2910-01-141-4967	24	5
15434	3015522	4820-01-079-3241	24	4
15434	3016456	4710-01-079-3487	26	16
15434	3016637	2815-01-160-5820	5	19
15434	3016887	2815-01-146-7039	7	14
15434	3017031	3040-01-146-0075	7	13
15434	3017049	5305-01-145-8358	12	37
15434	3017051	5305-01-112-9110	29	20
			30	2
15434	3017052	5305-01-126-1128	29	41
15434	3017292	6680-01-108-7410	12	24
			BULK	1
15434	3017748	2930-01-150-7596	33	12
15434	3017750	5330-00-861-8592	8	32
15434	3017759	2815-00-085-7434	3	10
15434	3018098	4710-01-146-1054	33	16
15434	3018099	4710-01-146-1053	14	35
15434	3018153	3120-01-146-7196	20	21
15434	3018488		20	16
15434	3018655	5360-01-134-5602	24	23
15434	3018686	2815-01-146-1102	26	4
15434	3018690		10	11
15434	3018692	2930-01-146-1081	10	28
15434	3018693	5330-01-145-6910	10	10
15434	3018695	5331-01-154-4316	10	23
15434	3018696	5330-01-145-6911	10	9
15434	3018697	5340-01-145-0772	10	41
15434	3018700	2940-01-146-5846	10	25
15434	3018762	5330-01-092-4143	KIT	
15434	3018764	2930-01-146-1085	33	10
15434	3018767	5360-01-147-4846	29	50
15434	3018889	4730-01-146-3040	22	22
15434	3019158	5330-01-145-5380	33	11
15434	3019180	3120-00-695-1232	4	20
15434	3019204	3120-00-593-1507	4	22
15434	3019218	3120-01-214-7779	4	7
15434	3019572	5305-01-147-1215	14	15
15434	3019573	5305-01-145-8359	20	37
15434	3019574	5305-01-145-0776	17	8
15434	3019955	5365-01-147-9802	2	40
15434	3019956	5365-00-488-0799	2	40
15434	3019957	5365-01-147-2496	2	40
15434	3019958	5365-01-147-2497	2	40
15434	3019959	5365-01-148-8353	2	40
15434	3019960	5365-01-147-2495	2	40
15434	3020718	2815-01-150-2702	15	7
15434	3020753		22	30
15434	3020754		22	24

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CAGEC	PART NUMBER	STOCK NUMBER	FIG.	ITEM
15434	3020760	2910-01-146-0093	22	21
15434	3020943	5330-00-659-3178	15	4
15434	3021068	2910-01-142-4953	24	22
15434	302109000	2920-01-121-8859	28	6
15434	3021470	5305-01-144-6233	20	53
15434	3021581	2930-01-065-7113	11	30
15434	3021596	5315-01-145-6080	7	4
15434	3021602		7	3
15434	3021656	4330-01-146-1082	10	24
15434	3021660	2815-01-085-1881	5	11
15434	3021676	2910-01-126-9053	24	15
15434	3021704	5330-01-145-6914	16	11
15434	3021735	5330-01-082-6985	5	25
15434	3022377	4710-01-142-1667	12	25
15434	3022589	5306-01-119-8870	33	22
15434	3022590	5305-01-129-4214	13	6
			19	8
15434	3022821	4710-01-146-3779	22	9
15434	3023088	5310-01-142-2812	24	13
15434	3023101	5360-01-086-3480	20	47
15434	3023171	2910-01-141-4029	24	7
15434	3023473	3020-01-146-3163	17	17
15434	3023506	3010-01-146-0113	13	30
15434	3023512	2930-01-145-9537	10	4
15434	3023556	2910-01-146-1998	21	10
15434	3023870	5330-01-142-2784	24	8
15434	3024165	3040-00-449-7397	32	6
15434	3024365	4310-01-141-0879	20	8
15434	3024442	2815-01-159-0872	16	1
15434	3024666	4710-01-146-3086	11	37
			33	27
15434	3024709	5330-01-145-5381	33	29
15434	3024960	5330-01-146-7314	33	21
15434	3024991	2910-01-090-9346	29	35
15434	3025459	5342-01-143-6046	29	40
15434	3025460	4730-01-124-3762	24	27
			30	15
15434	3025611	4730-01-146-3631	26	14
15434	302586100	3020-01-241-6905	35	13
15434	3026034	3130-01-146-6120	27	14
15434	3026163	5330-01-136-8569	25	13
15434	3026198	2910-01-085-2570	30	1
15434	3026556	3120-01-147-5275	17	21
15434	3026557	3120-01-144-7368	17	28
15434	3026733		24	64
15434	3026993	2990-01-146-3911	27	19
15434	3026999	4710-01-146-1112	19	17
15434	3027282	9905-01-147-0933	1	8
15434	3027308	2990-01-085-4768	27	8
15434	3027460	2930-01-145-9538	10	8
15434	3027496	5330-01-145-6909	10	22

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CAGEC	PART NUMBER	STOCK NUMBER	FIG.	ITEM
15434	3027653		15	8
15434	3028075	3120-01-208-8102	2	30
15434	3028171	5342-01-145-0646	21	2
15434	3028269	3120-01-208-8103	2	30
15434	3028279	5305-01-145-0777	21	3
			23	6
15434	3028281	2930-01-146-3033	33	17
			33	23
15434	3028282	2930-01-146-1996	14	9
15434	3028368	2910-01-141-4337	29	19
15434	3028642	4710-01-146-3168	19	17
15434	3028685		6	5
15434	3028967	5305-01-147-8729	14	30
15434	3028997	2930-01-141-9277	14	34
15434	3029514	2950-01-141-0844	26	22
15434	3029614	2815-01-146-3159	15	2
15434	3029846	5330-01-145-6913	13	34
15434	3029847	5331-01-145-0715	13	47
15434	3029852	3120-00-877-2213	16	2
15434	3030038	2815-01-159-1789	3	16
15434	3030257		12	7
15434	3030267	6680-01-085-2870	29	1
			29	19
15434	3030269	2910-01-146-1999	29	1
15434	3030286	5305-01-147-2445	14	28
15434	3030445	2910-01-145-9403	21	4
15434	3030803	5360-01-145-3974	10	15
15434	3030804	2940-01-145-9399	10	13
15434	3030805	4820-01-210-3573	10	16
15434	3030806	2940-01-145-9400	10	14
15434	3030808	5331-01-145-6086	10	18
15434	3030970	4820-01-146-1048	28	11
15434	3031005	5305-01-144-6232	10	19
15434	3031186	2815-01-146-1103	15	1
15434	3031187	2815-01-146-0112	15	3
15434	3031434	5330-01-147-4071	13	49
15434	3031560	4720-01-085-2571	11	5
15434	3031749	2815-01-146-0102	5	5
15434	3031750		5	4
15434	3031751		5	1
15434	3031752	3040-01-146-0028	5	3
15434	3031753	3120-01-147-8118	5	6
15434	3031858	5330-01-145-6912	10	30
15434	3031959	2815-01-141-0919	12	2
15434	3031962	4710-01-146-0050	13	33
15434	3031980	4140-01-146-1035	27	3
15434	3032307	2930-01-141-0918	10	1
15434	3032348	5330-01-147-4072	14	8
15434	3032674	5305-01-145-1113	12	39
15434	3032681	2815-01-085-2615	7	7
15434	3032707	4710-01-146-1052	12	6

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CAGEC	PART NUMBER	STOCK NUMBER	FIG.	ITEM
15434	3032708	5340-01-146-9992	12	5
15434	3032835	2950-01-145-6822	27	18
15434	3032861	5330-01-147-0748	12	1
15434	3033719	3120-01-185-8586	25	19
15434	3033724	3120-01-215-9157	25	17
15434	3033740	4820-01-164-7002	25	15
15434	3034243	2815-01-291-5753	25	1
15434	3034578	2940-01-145-9398	10	12
15434	3034579		10	43
15434	3034736		27	17
15434	3035028	5930-01-177-0346	10	21
15434	3035053		23	8
			29	46
15434	3035362	4810-01-187-4925	28	4
15434	3035595		10	44
		4710-01-158-7507	26	20
15434	3035600	4710-01-146-3167	26	16
15434	3035607	5340-01-145-0773	14	31
15434	3035961	2815-01-085-2569	8	1
15434	3036005	2815-01-141-0845	5	19
15434	3036285	2815-01-210-6947	8	30
15434	3036933	3120-01-212-4472	7	21
15434	3036934	3120-01-079-5451	7	27
15434	3036935	2815-01-146-7914	7	16
15434	3038035	4710-01-146-0049	12	15
15434	3038037	4710-01-146-1115	22	10
15434	3038060	4710-01-079-3492	19	13
15434	3038218	2910-00-132-0769	29	52
15434	3038745	3130-01-294-1400	27	14
15434	3038997	5330-01-240-1630	35	6
15434	3038998	5330-01-080-2992	35	12
			35	20
15434	3039070	2910-01-070-9712	24	62
15434	3039296	5360-01-145-3975	10	17
15434	3040180		3	23
15434	3041993	2815-01-085-8282	3	1
15434	3043647	5305-01-147-8730	15	5
15434	3043649	5305-01-319-9287	34	11
15434	3044514	5330-01-145-3985	9	6
15434	3045049		25	14
15434	3045173		29	21
15434	3045551	7690-01-094-6720	1	8
15434	3045979	5331-01-145-6085	10	5
15434	3046170	2930-01-146-1083	14	4
15434	3047159	5330-00-131-7072	20	13
15434	3047963	5340-01-145-0647	21	5
15434	3049024	2815-01-146-1049	7	5
15434	3050394	3040-01-287-9736	35	7
15434	3050624	4820-01-242-2579	25	10
15434	3051555	2815-01-077-1482	6	5
15434	3054071	2910-01-112-7712	21	4

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CAGEC	PART NUMBER	STOCK NUMBER	FIG.	ITEM
15434	3056158	5310-01-287-9737	26	13
15434	3056569	2910-01-086-9757	7	22
15434	3058664	5306-01-146-9866	16	19
15434	3060199-4128	2910-01-065-3979	23	6
15434	3060202-3894	2910-01-141-9372	23	6
15434	3060882	4730-01-309-3321	11	25
15434	3064919		35	19
15434	3066796	2815-01-166-3415	7	11
15434	3067616	5330-00-361-2955	4	1
15434	3071085	5330-00-005-0407	35	3
15434	3074400	5330-01-146-7172	7	8
15434	3074401	5330-01-145-3983	7	8
15434	3074402	5330-01-146-9775	7	8
15434	3074403	5330-01-146-9928	7	8
15434	3074404	5330-01-145-3984	7	8
15434	3076189	5330-01-080-5021	3	23
06991	309015	5930-01-095-9823	31	10
15434	320-1850	5330-01-181-0631	20	5
15434	3201386	5330-01-181-0630	19	11
06991	321030-02	6620-01-203-4301	31	16
33457	3300922S	2940-01-065-7076	11	47
24617	3305L1A	3110-00-144-8828	35	8
			35	24
33457	3305367	4330-00-274-4712	34	9
33457	3308958	5330-01-164-0944	11	48
15434	3375014	4910-01-097-6935	44	26
15434	3375015	5330-01-107-1841	44	23
15434	3375049	5120-01-160-8863	37	1
15434	3375108	4910-01-097-6930	37	5
15434	3375137	4910-01-097-6939	40	12
15434	3375140	4910-01-097-6940	40	9
15434	3375146	4910-01-097-6941	40	10
15434	3375147		40	11
15434	3375148	4910-01-097-6943	40	8
15434	3375150	4910-01-085-9211	36	27
15434	3375151	4910-01-165-4541	48	11
15434	3375153	4910-01-105-9165	44	1
15434	3375154	4910-01-097-6912	40	19
			40	19
15434	3375160	4910-01-097-6926	42	9
15434	3375162	5120-01-128-2758	50	4
15434	3375165	4910-01-097-6927	42	10
15434	3375166	4910-01-097-6928	42	11
15434	3375172	4910-01-097-6936	42	15
15434	3375173		42	14
15434	3375174	4910-01-097-6938	42	13
15434	3375180	4910-01-097-6989	37	6
			38	2
15434	3375182	4910-01-142-4929	48	1
15434	3375189	5180-01-102-8418	40	7
15434	3375192	4910-01-143-2023	48	2

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CAGEC	PART NUMBER	STOCK NUMBER	FIG.	ITEM
15434	3375204	4910-01-118-3747	40	6
15434	3375205	4910-01-097-6985	38	23
15434	3375207	4910-01-084-7221	44	10
15434	3375220	4930-01-085-3728	44	5
15434	3375221	4910-01-084-6977	44	12
15434	3375222	4910-01-084-6978	44	13
15434	3375223	4910-01-085-0751	44	3
15434	3375224	5355-01-084-5323	44	11
15434	3375225	4910-01-084-7222	44	9
15434	3375226	4910-01-085-7269	44	8
15434	3375227		44	7
15434	3375228	5355-01-097-7072	44	6
15434	3375229	4910-01-084-6979	44	4
15434	3375230	4910-01-097-6944	44	24
15434	3375232	4910-01-097-6929	51	6
15434	3375265		48	5
15434	3375271	4910-01-097-6945	45	1
15434	3375282	4910-01-097-6971	38	12
15434	3375425	4910-00-150-5858	36	14
15434	3375432	6850-00-145-0255	50	5
15434	3375448	5120-01-128-2675	48	6
15434	3375455	4910-01-150-9713	46	5
15434	3375522		42	16
15434	3375599	5120-01-128-2688	51	3
15434	3375601	4910-01-165-6016	50	6
15434	3375614	4910-01-097-6969	38	5
15434	3375615		38	4
15434	3375616	5120-01-120-3682	38	3
			38	3
15434	3375825	4910-01-097-6970	38	2
15434	3375834	5120-01-120-5759	43	15
15434	3375839	4910-01-097-6909	43	16
15434	3375855	4910-01-074-0020	45	8
15434	3375959	4910-01-143-2034	50	7
15434	3376011	4910-01-152-2743	50	8
15434	3376015		51	1
15434	3376050	5210-01-157-2291	48	7
15434	3376177	5120-01-120-3681	44	14
15434	3376197		44	17
15434	3376220	5210-01-157-3091	51	2
15434	3376326	5120-01-156-4183	38	18
15434	3376619	6625-01-232-5469	41	4
15434	3376663	5120-01-128-2678	47	7
15434	3376669		41	7
15434	3376720	5180-01-074-0019	42	12
15434	3376815	4910-01-143-3336	48	4
15434	3376816	4910-01-143-3337	48	3
15434	3376845	5120-01-072-2952	37	7
15434	3376872	5120-00-116-7604	47	10
15434	3376903	5110-00-981-3107	41	3
15434	3376904	4910-01-085-0765	43	12

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CAGEC	PART NUMBER	STOCK NUMBER	FIG.	ITEM
15434	3558653	4310-01-079-3319	20	25
15434	3558655	2815-00-369-7846	20	20
15434	3608833	2815-01-303-4224	4	6
01212	3725CP-30	3120-01-155-8707	6	12
15434	3801047	2815-01-079-3380	7	5
15434	3801048		2	36
15434	3801056	2815-01-165-0765	KIT	
15434	3801058	2815-01-168-3742	KIT	
15434	3801096	2990-01-271-0316	KIT	
			KIT	
15434	3801106	3120-01-155-2531	KIT	
15434	3801235	5330-01-150-9812	35	30
			KIT	
15434	3801260	3120-01-132-9339	KIT	
15434	3801261	3120-01-143-9547	4	23
15434	3801262	3120-01-144-8882	4	23
15434	3801263	3120-01-145-9132	4	23
15434	3801310	2815-01-141-9370	2	6
15434	3801433	3040-01-079-1799	8	29
15434	3801708	2930-01-146-3912	35	1
15434	380171000	2930-01-287-9733	0035	
15434	380171200	2930-01-262-5153	0035	
15434	3801788	2930-01-072-8056	35	1
15434	3801826	2815-00-011-7786	2	1
15434	3801904	2990-01-155-7284	26	22
15434	3801942	2990-01-172-3005	26	22
15434	3803512	2815-01-354-2702	3	11
15434	3803524	2815-00-962-5623	3	12
15434	3804275	2815-01-152-9219	KIT	
15434	3804280	5330-01-086-7790	KIT	
			KIT	
15434	3821572	2815-01-141-5299	13	1
79470	400X3	4730-00-277-8269	20	80
15434	41044	5342-01-145-9539	12	30
15434	42645	2815-00-484-8359	2	25
15434	42646	3130-00-408-9041	2	24
15434	42647	2815-00-484-8360	2	23
15434	43463-A	5331-00-159-1464	33	20
15434	44383	3120-00-349-6444	4	17
15434	44387	3120-00-090-5504	4	19
72582	444042	4730-00-278-4822	31	17
21450	444683	4730-00-964-7548	20	30
24617	444704	4730-00-555-8292	24	30
15434	44678	2910-00-858-3522	29	38
72582	450517	5305-00-165-8157	11	41
15434	4797	3020-00-528-5053	5	12
79470	49X6X2		11	50
06991	501088-02	5365-01-145-0760	31	12
06991	501096-04	4720-01-146-4126	31	9
01212	5116M40	3120-01-193-7083	4	23

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CAGEC	PART NUMBER	STOCK NUMBER	FIG.	ITEM
15434	538174		3	27
19207	5414243-20		22	10
53496	5561 1-2A	4730-00-555-8263	14	1
			19	3
			26	11
			26	17
19207	57K3602	2815-01-437-3901	1	1
19207	57K3603	2815-01-438-1517	1	1
19207	5704995		51	6
34623	5710454		34	7
34623	5730758	5340-01-145-1597	34	2
34623	5730761	4730-01-165-0749	34	8
34623	5730765	4820-01-227-7141	34	5
34623	5730769		34	10
34623	5731317	5305-01-144-6204	2	37
15434	5995177		32	7
15434	60408	5315-00-238-0882	16	9
15434	60575	5365-00-428-6201	4	9
15434	61554	4720-00-918-9634	19	2
15434	63842	5310-00-134-4169	14	38
15434	64709	5365-01-241-3903	9	7
15434	650330		20	24
15434	65259-A	5365-01-147-0912	16	4
15434	65259-B	5365-01-147-0913	16	4
15434	65259-C	5365-00-507-3254	16	4
15434	65274	5330-00-246-0309	12	31
15434	66292	5310-00-197-5304	2	29
15434	67684	5310-00-262-2986	28	3
15434	67946	5365-00-197-9327	11	24
			12	11
15434	67963	5330-00-171-7267	2	32
15434	68038	5340-01-066-2947	13	39
15434	68061-A	5331-00-970-3461	24	14
15434	68139	4730-01-142-8524	13	51
			22	20
15434	68193	5340-00-404-2944	7	1
15434	68274	5360-00-664-5343	11	23
15434	68365	3120-00-566-0480	13	7
15434	68425	5340-00-839-0653	12	19
15434	68445	5315-00-281-7610	2	7
15434	68585	5315-00-014-1195	2	18
15434	68803-A		3	29
15434	69047-A	5305-01-146-7285	14	29
16954	691-10014		30	16
15434	69324	5310-01-112-4307	20	6
			23	5
			29	5
15434	69519	5315-00-475-2574	13	21
15434	69521	3120-00-627-6697	13	4
			13	26

CROSS-REFERENCE INDEXES

PART NUMBER INDEX

CAGEC	PART NUMBER	STOCK NUMBER	FIG.	ITEM
15434	69736	5305-00-339-1415	7	15
15434	69832	5310-00-828-4827	12	3
15434	69962	5365-00-695-1247	12	12
15434	70089-1	5330-00-537-2382	2	13
			11	3
15434	70295	4730-00-011-3175	28	13
15434	70470	4730-01-165-0749	34	5
15434	70550	2815-01-124-0232	6	10
			17	23
15434	70624	5331-00-506-4874	33	2
15434	70653	2815-00-772-9434	16	8
15434	70657	5340-01-122-8002	5	26
15434	70690	2990-00-772-1778	24	63
15434	70700	5360-00-597-4570	24	33
15434	70705	5330-00-562-1176	29	42
15434	70713	5340-00-898-1497	29	44
15434	70715	5310-00-507-3259	29	51
15434	70716	5305-00-506-5722	29	53
15434	70717	5365-00-507-3260	29	46
			29	46
15434	70717-A	5365-00-507-3261	29	45
15434	70717-B	5365-00-507-3262	29	45
15434	70717A	5365-00-507-3261	29	45
15434	70772	5305-00-477-6769	3	20
15434	70772-B	5305-01-129-4385	24	1
15434	70790	5306-00-485-0790	25	7
19207	7374401	5331-00-984-3756	8	28
6Y402	829-4151	2910-01-084-0243	31	4
6Y402	8293635	5930-01-295-0912	31	10
06991	8294151	2815-01-087-4740	31	1
55683	851-202994	4720-01-070-8149	26	6
19207	8710557	4720-01-114-7728	BULK	2
19207	8710557-10		12	43
06991	913020	5340-01-145-1181	31	5
06991	913024-06	2910-01-112-5797	31	15
24617	9417953	5310-01-097-8039	20	78
			20	78
24617	9418993	5305-01-118-4285	20	79
24617	9419002		31	22
29617	9421077	5310-01-102-7356	32	16
29617	9421196	5306-01-102-3599	32	18
24617	9422273	5310-01-312-3859	31	19
24617	9422277	5310-01-126-9404	12	26
15434	9674F		13	38

APPENDIX C
EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

Section I. INTRODUCTION

C-1. SCOPE

This appendix lists expendable/durable supplies and materials you will need to maintain the NTC-400 Big Cam I or Big Cam III Diesel Engine. These items are authorized by CTA 50-970, Expendable Items (Except Medical, Class V, Repair Parts, and Heraldic Items).

C-2. EXPLANATION OF COLUMNS

a. Column (1) - Item Number. This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the material (e.g., "Use antiseize compound, Appendix C, Item 7").

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 (NSN). 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 Code (CAGEC) in parentheses followed by a part number.

e. Column (5) - Unit of Measure (U/C). 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.

EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) UNIT OF MEASURE
1	F		ACID: muriatic	PT
2	F		ACID: oxalic	PT
3	O		ANTIFREEZE, permanent	
			ethylene glycol -60°F inhibited, (0-A-548), type I, heavy duty, single package (58536) (A-A-52624)	
		6850-01-441-3218	1 gallon container	GAL.
		6850-01-441-3221	5 gallon can	
		6850-01-441-3223	55 gallon drum	
4	O		CLOTH, ABRASIVE (crocus): 9 in. x 11 in. sheets, (58536) A-A-1206	
		5350-00-221-0872	50 sheets/package	PG
5	F	5390-00-584-4554	CLOTH: emery, 290-grit A-A-1049	SH
6	O		CLOTH, CLEANING: lint-fee, general purpose, white, (81359) MIL-C-85043	
		7920-00-044-9281	10 pound box	LB
7	O		ANTISEIZE COMPOUND: temperature-resistant lubricant, MIL-A-907, Loctite antiseize, 200°F (93°C), with brush top (05972) 76764	
		8030-00-251-3980	1 pound can	LB
8	F	5350-00-224-6692	COMPOUND: lapping 280-grit SSL-1682	
			1 pound can	LB
9	F	6850-00-664-9067	COMPOUND: Prussian blue MIL-L-83795	
			1 pint can	PT
10	F	6850-01-241-0651	DEVELOPER: spotcheck, SKD-NF	
			1 pint can	PT
11	F	9150-00-698-2382	FLUID: automatic transmission, type A, AOATF1562A	
			1 quart can	QT
12	F	6850-00-974-3788	FLUID, CALIBRATION-INJECTOR TEST STAND, 45A	
			1 pint can	PT
13	C		GREASE, AUTOMOTIVE AND ARTILLERY: (MIL-G-10924) (81349)	
		9150-01-197-7698	2-1/4 oz tube	OZ
		9150-01-197-7690	1-3/4 pound can	LB
		9150-01-197-7689	6-1/2 pound can	LB
		9150-01-197-7692	35 pound can	LB
		9150-00-190-7369	120 pound drum	LB

EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST (Contd)

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) UNIT OF MEASURE
14	F	8030-00-081-2330	LOCTITE MIL-S-22473 (grade CV) 1 50 cubic centimeter bottle	 CC
15	F	9150-00-458-0075	LUBRICANT, high-pressure Brayco 300 1/16 ounce	 OZ
16	F	9150-00-231-9045	LUBRICANT: rust preventative 1 gallon can	 GAL.
17	F	8010-00-837-7969	MINERAL SPIRITS TT-T-291	 GAL.
18	F	 9150-00-265-9406	CUTTING FLUID: (81348) C-O-376 1 gallon can	 GAL.
19	C	 9140-00-286-5294 9140-00-286-5295 9140-00-286-5296 9140-00-256-5297	OIL, FUEL: diesel, regular DF-2, VV-F-800 bulk 5 gallon can 55 gallon drum, 16-gauge 55 gallon drum, 18-gauge	 GAL. GAL. GAL. GAL.
20	C	 9150-00-189-6727 9150-00-186-6668 9150-00-191-2772 9150-00-183-7807	OIL, LUBRICATING: OE/HDO 10 MIL-L-2104C 1 quart can 5 gallon drum 55 gallon drum, 18-gauge bulk	 QT GAL. GAL. GAL.
21	C	 9150-00-186-6681 9150-00-188-9858 9150-00-265-9476 9150-00-189-6729 9150-00-183-7808	OIL, LUBRICATING: OE/HDO 30 MIL-L-2104C 1 quart can 5 gallon drum 55 gallon drum, 16-gauge 55 gallon drum, 18-gauge bulk	 QT GAL. GAL. GAL. GAL.
22	O		OIL, LUBRICATING: gear 60-80/140, MIL-L-2105C 1 quart can 5 gallon drum 55 gallon drum	 QT GAL. GAL.
23	F	5350-00-543-3600	PAPER: aluminum oxide 240-grit ALOXGRIT 80 90 pound per ream	 LB
24	F	6810-00-227-0407	PYRIDINE 1 16 ounce bottle	 OZ

EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST (Contd)

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) UNIT OF MEASURE
25	F	8030-00-247-2524	SEALANT: gasket MIL-S-45180 2 ounce tube	OZ
26	O	8030-00-204-9149	SEALING COMPOUND, pipe sealant (05972) 59241 250-cubic centimeter bottle	CC
27	O	8030-01-104-5392	SEALING COMPOUND: liquid, type II, grade N, Loctite 242 (05972) 24221 10-cubic centimeter bottle	CC
28	F	6810-00-985-7129	SODIUM CARBONATE (5 percent solution) MIL-R-23679 2 ounce bottle	OZ
29	C	N/A	SOLUTION: soap	N/A
30	C	6850-01-277-0595 6850-01-244-3207	SOLVENT, DRYCLEANING, SD-3: type III, biodegradable (81348) 134 Hi-Solv 5 gallon 55 gallon drum	GAL. GAL.
31	O	5340-00-450-5718	CAP AND PLUG SET: (19207) 10935405 1 SET	EA

APPENDIX D
ILLUSTRATED LIST OF MANUFACTURED ITEMS

Section I. INTRODUCTION

D-1. GENERAL

a. This appendix includes complete instructions for authorizing items to be manufactured or fabricated at Direct Support and General Support maintenance levels.

b. A part number index in alphanumeric order is provided. The index cross-references the part number of the item to be manufactured to the figure. The figure covers fabrication criteria.

c. All bulk materials needed for manufacture of an item are listed by part number or specification number in a tabular list on the illustration.

D-2. MANUFACTURED ITEMS PART NUMBER INDEX

ITEM NO.	PART NO.	DESCRIPTION	FIGURE NO.
1	199453	Oil level dipstick	D-1
2	—	Vibration damper guide pin (Two required)	D-2
3	—	Flywheel housing guide pin (Two required)	D-3

Section II. ILLUSTRATED MANUFACTURING INSTRUCTIONS

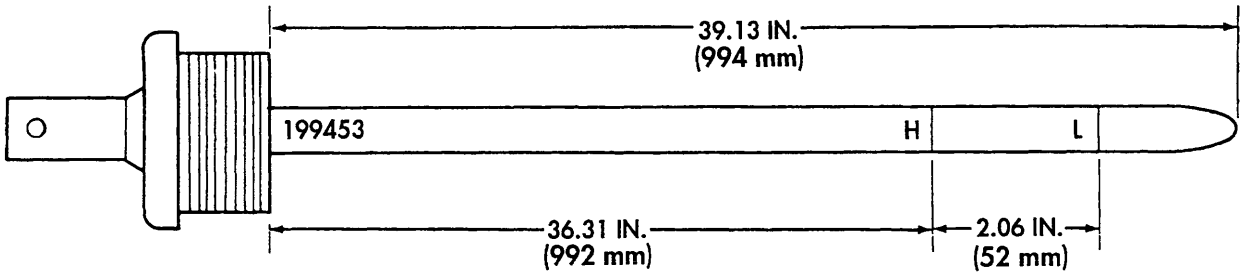


Figure D-1. Oil Level Dipstick.

INSTRUCTIONS:

1. Fabricate from NSN 6680-01-108-7410.
2. Measure 39.13 in. (994 mm) down dipstick from bottom of rubber stopper and cut dipstick. Round off tip of dipstick as shown above.

NOTE

Use an electric engraver to perform etching in steps 3, 4, and 5. Etch dipstick to a depth of 0.005 to 0.010 in. (0.127 to 0.254 mm).

3. Measure 36.31 in. (992 mm) down dipstick from bottom of rubber stopper and etch a line on dipstick at this length. Etch an "H" next to this line as shown above.
4. Measure 2.06 in. (52 mm) down dipstick from line etched in step 3 and etch another line at this length. Etch an "L" next to this line as shown above.
5. Etch part number "199453" on dipstick near rubber stopper as shown above.

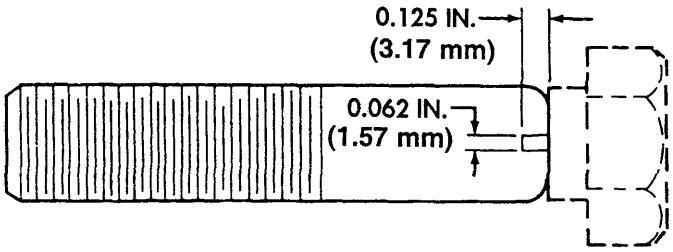


Figure D-2. Vibration Damper Guide Pin.

INSTRUCTIONS:

1. Fabricate from NSN 5305-00-795-9336.
2. Cut off head of screw.
3. Round off edge of nonthreaded end as shown above.
4. Cut a slit approximately 0.062 in. (1.57 mm) wide and 0.125 in. (3.17 mm) deep in nonthreaded end as shown above.
5. Remove any burrs after cutting.

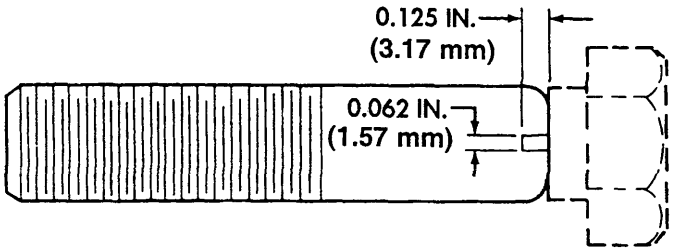
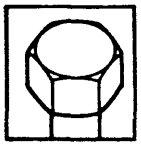
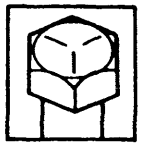
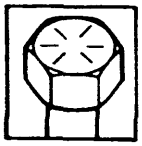


Figure D-3. Flywheel Housing Guide Pin.

INSTRUCTIONS:

1. Fabricate from NSN 5305-01-145-8380.
2. Cut off head of screw.
3. Round off edge of nonthreaded end as shown above.
4. Cut a slit approximately 0.062 in. (1.57 mm) wide and 0.0125 in. (3.17 mm) deep in non-threaded end as shown above.
5. Remove any burrs after cutting.

APPENDIX E
TORQUE LIMITS

USAGE	MUCH USED	MUCH USED	USED AT TIMES	USED AT TIMES
Capscrew diameter and minimum tensil strength (PSI)	To 1/2-69,000 (475,755 kPa) To 3/4-64,000 (441,280 kPa) To 1-55,000 (379,225 kPa)	To 3/4-120,000 (827,400 kPa) To 1-115,000 (792,925 kPa)	To 5/8-140,000 (965,300 kPa) To 3/4-133,000 (917,035 kPa)	150,000 (1,034,250 kPa)
QUALITY MATERIAL	**INDETERMINATE**	**MINIMUM COMMERCIAL**	**MEDIUM COMMERCIAL**	**BEST COMMERCIAL**
SAE GRADE NUMBER **CAPSCREW HEAD MARKINGS:** Manufacturer's marks may vary. These are all SAE Grade 5:	**1 OR 2**	**5**	**6 OR 7**	**8**
				
				

CAPSCREW BODY SIZE (INCHES) - (THREAD)	TORQUE (LB-FT)	(N•m)	TORQUE (LB-FT)	(N•m)	TORQUE (LB-FT)	(N•m)	TORQUE (LB-FT)	(N•m)
1/4 - 20	5	6.8	8	10.8	10	13.6	12	16.3
- 28	6	8.1	10	13.6			14	18.9
5/16 - 18	11	14.9	17	23.1	19	25.8	24	32.5
- 24	13	17.6	19	25.8			27	36.6
3/8 - 16	18	24.4	31	42.0	34	46.1	44	59.7
- 24	20	27.1	35	47.5			49	66.4
7/16 - 14	28	37.9	49	66.4	55	74.6	70	94.9
- 20	30	40.7	55	74.6			78	105.8
1/2 - 13	39	52.9	75	101.7	85	115.3	105	142.4
- 20	41	55.6	85	115.3			120	162.7
9/16 - 12	51	69.2	110	149.1	120	162.7	155	210.1
- 18	55	74.6	120	162.7			170	230.5
5/8 - 11	83	112.5	150	203.3	167	226.4	210	284.7
- 18	95	128.8	170	230.5			240	325.4
3/4 - 10	105	142.4	270	366.1	280	379.6	375	508.4
- 16	115	155.9	295	400.0			420	569.4
7/8 - 9	160	216.9	395	535.5	440	596.6	605	820.3
-14	175	237.3	435	589.8			675	915.2
1 - 8	235	318.6	590	799.9	660	894.8	910	1,233.8
- 14	250	339.0	660	894.8			990	1,342.2

Section I. STANDARD TORQUE SPECIFICATIONS

1. Always use the torque values listed on previous page when specifications are not available.

NOTE

Do not use listed values in place of those specified in this manual; special attention should be observed in case of SAE Grade 6, 7, and 8 screw.

2. Torques are based on use of clean and dry threads.

3. Reduce torque by 10 percent when oil is used as a lubricant.

4. Reduce torque by 20 percent if newly plated screws are used.

CAUTION

Screws threaded into aluminum may require reductions in torque of 30 percent or more unless inserts are used.

Section II. ENGINE ASSEMBLY TIGHTENING SPECIFICATIONS

PART NAME OR LOCATION	LB-FT	N•m
Main Bearing Capscrews		
Step 1 Torque to	85	115.3
Step 2 Torque to	250-260	339.0-352.5
Step 3 Loosen all	3 to 5 threads	
Step 4 Torque to	85	115.3
Step 5 Torque to	250-260	339.0-352.5
Connecting Rod Nut		
Step 1 Torque to	70-75	94.9-101.7
Step 2 Torque to	140-150	189.8-203.3
Step 3 Loosen all	Completely	
Step 4 Torque to	25-30	33.9-40.7
Step 5 Torque to	70-75	94.9-101.7
Step 6 Torque to	140-150	189.8-203.3
Vibration Damper Mounting Capscrews	180-200	244.0-271.2
Piston Cooling Nozzle Hex-Head Screw	**NOTE:** 100-140 lb-in.	11.3-15.8
Front Cover	45-55	61.0-74.6
Front Support	55	74.6
Cylinder Head Capscrews		
Step 1	20-25	27.1-33.9
Step 2	80-100	108.5-135.6
Step 3	265-305	359.3-413.5
Valve Crosshead Nuts with ST-669 Adapter	22-26	29.9-35.3
Fuel Fittings	**NOTE:** 150 lb-in.	16.9
Fuel Crossover Capscrews	**NOTE:** 34-38 lb-in.	3.8-4.3
Rocker Lever Housing Capscrews	55-65	74.6-88.1
Injector Adjusting Screw	**NOTE:** 72 lb-in.	8.1
Locknuts with ST-669 Adapter	30-35	40.7-47.5
Valve Locknuts	40-45	54.2-61.0
Rocker Cover Capscrews		
Cork Gasket	12-17	16.3-23.1
Cork and Rubber Gasket	**NOTE:** 75-95 lb-in.	8.5-10.7
Cam Follower Capscrews	30-35	40.7-47.5
Fuel Pump Front Cover Capscrews	9-11	12.2-14.9
Governor Spring Pack Capscrews	9-11	12.2-14.9
Brass Filter Fittings	30-40	40.7-54.2
Gear Pump Capscrews	11-13	14.9-17.6
Throttle Shaft Plug	**NOTE:** 40-55 lb-in.	4.5-6.2
Fuel Filter Bracket Capscrews	25	33.9
Fuel Pump Mounting Capscrews	30-35	40.7-47.5
Fuel Injector Orifice Plug	**NOTE:** 8-10 lb-in.	10.8-13.6
Oil Pan		
Captive Washer Screws	35-40	47.5-54.2
Hex-Head Screws	15-20	20.3-27.1

PART NAME OR LOCATION	LB-FT	N•m
Oil Pan Drainplug	60-70	81.4-94.9
Oil Suction Tube Mounting Capscrews	30-35	40.7-47.5
Oil Cooler Mounting Capscrew	30-35	40.7-47.5
Oil Pump Mounting Capscrews	35-45	47.5-61.0
Adjustable Water Pump Pulley		
Hex-Head Screw	12-15	16.3-20.3
Locknut	45-55	61.0-74.6
Water Header Plates	**NOTE:** 72-96 lb-in.	8.1-10.8
Hose Clamps		
Water Pump Mounting	30-35	40.7-47.5
Water Manifold	30-35	40.7-47.5
Exhaust Manifold		
7/16 in. Capscrews with Washer	40-45	54.2-61.0
3/8 in. Studs	20-25	27.1-33.9
ST-46 Turbocharger		
Band	**NOTE:** 32-36 lb-in.	3.6-4.1
Diffuser Plate	**NOTE:** 60-84 lb-in.	6.8-9.5
Air Crossover Hose Clamp	**NOTE:** 30-35 lb-in.	3.4-3.9
Oil Drain Fitting	50	67.8
Oil Inlet Fitting	20-25	27.1-33.9
Rotor Locknut	20-24	27.1 32.5
Mounting Locknut	22-48	29.9-65.1
Intake Manifold	20-25	27.1 33.9
Air Compressor		
Support	30-35	40.7-47.5
Compact Head Capscrews	15-19	20.3-25.8
Unloader Body Capscrews	**NOTE:** 96-120 lb-in.	10.8-13.6
Mounting Capscrews		
Flywheel Capscrews	190-200	257.6-271.2
Flywheel Capscrews with Hardened Washers	200-220	271.2-298.3
Flywheel Housing Capscrews	140-160	189.8-216.9
Accessory Drive Pulley Assembly	300-310	406.8-420.3
Accessory Drive Pulley	40-45	54.2-61.0
Aftercooler		
Cover Capscrews	25	33.9
Water Inlet and Outlet Flange Mounting Capscrews	27-32	36.6-43.4
Water Outlet Connection	15-20	20.3-27.1
Mounting Capscrews	20-25	27.1-33.9

APPENDIX F
WEAR LIMITS AND TOLERANCES

F-1. GENERAL

a. All parts, components, or assemblies which do not meet the minimum wear standards specified in this appendix will be replaced with new material.

b. All used parts, components, or assemblies considered for reuse must comply with the minimum wear, fit, and tolerance standards specified in this appendix. Parts must be closely inspected to ensure there is no damage in areas not listed in the wear limits, which would make them unfit for further use.

F-2. REPAIR STANDARDS

MEASUREMENT	WEAR LIMIT	NEW MINIMUM	NEW MAXIMUM
CYLINDER BLOCK SPECIFICATIONS			
Camshaft Bushing Inside Diameter	2.5023 (6.3558 cm)	2.4983 (6.3457 cm)	2.5013 (6.3533 cm)
Camshaft Bushing Bore Inside Diameter	2.6265 (6.6764 cm)	2.6245 (6.6662 cm)	2.6255 (6.6688 cm)
Cylinder Liner Counterbore Inside Diameter		6.5615 (16.6662 cm)	6.6255 (16.8288 cm)
Depth	0.412 (10.465 mm)	0.350 (8.89 mm)	0.352 (8.941 mm)
Liner to Block Clearance Lower Bore		0.002 (0.0508 mm)	0.006 (0.152 mm)
Lower Liner Bore Inside Diameter		6.124 (15.555 cm)	6.126 (15.560 cm)
Main Bearing Bore Inside Diameter	4.7505 (12.066 cm)	4.7485 (12.0612 cm)	4.750 (12.065 cm)
Block Height from Main Bearing Centerline	18.994 (48.245 cm)	19.003 (48.268 cm)	19.007 (48.278 cm)
Height from Installed Alignment	16.619 (42.212 cm)	16.628 (42.235 cm)	16.632 (42.245 cm)
Cylinder Liner Inside Diameter	5.505 (13.983 cm)	5.4995 (13.9687 cm)	5.501 (13.973 cm)

NOTE

New cylinder liner dimensions at 60°-70°F (16°-21°C); may be 0.0002-0.0006 in. (0.00508-0.01524 mm) smaller than indicated due to the lubricating oil coating.

Protrusion (installed)		0.003 (0.076 mm)	0.006 (0.152 mm)
Crankshaft Connecting Rod Journal Outside Diameter	3.122 (7.930 cm)	3.1235 (7.9337 cm)	3.125 (7.938 cm)
Main Bearing Journal Outside Diameter	4.4975 (11.4237 cm)	4.4985 (11.4262 cm)	4.500 (11.4 cm)
Thrust Bearing Surface-to-Rear Counterweight	3.006 (7.635 cm)	3.001 (7.623 cm)	3.003 (7.628 cm)

MEASUREMENT	WEAR LIMIT	NEW MINIMUM	NEW MAXIMUM
CYLINDER BLOCK SPECIFICATIONS (Contd)			
Main and Rod Journals Out-of-Round TIR*	0.002 (0.0508 mm)		
Main and Rod Journal Taper (Length of Journal)	0.005 (0.127 mm)		
Main Bearings			
Shell Thickness	0.1215 (3.0861 mm)	0.123 (3.124 mm)	0.1238 (3.1445 mm)
Journal Clearance	0.007 (0.1778 mm)	0.0015 (0.0381 mm)	0.005 (0.127 mm)
Rod Bearings Shell Thickness	0.093 (2.372 mm)	0.00942 (0.23927 mm)	0.0947 (2.4054 mm)
Crankshaft Thrust Ring 157280 Std Thickness (Measured Midway Between Oil Grooves)	**	0.245 (6.223 mm)	0.247 (6.274 mm)
Crankshaft End Clearance (Installed)	0.022 (0.559 mm)	0.007 (0.178 mm)	0.017 (0.432 mm)
Connecting Rod			
Crankpin Bore Inside Diameter		3.3157 (8.4219 cm)	3.3167 (8.4244 cm)
Center-to-Center Length		11.998 (30.475 cm)	12.000 (30.5 cm)
Piston Pin Bushing			
Inside Diameter	2.0022 (5.0856 cm)	2.0010 (5.0825 cm)	2.0015 (5.0838 cm)
Connecting Rod			
Bend (w/o bushing)	0.010 (0.254 mm)		0.010 (0.254 mm)
Bend (w/bushing)	0.004 (0.102 mm)		0.004 (0.102 mm)
Twist (w/o bushing)	0.020 (0.51 mm)		0.020 (0.51 mm)
Twist (w/bushing)	0.010 (0.25 mm)		0.010 (0.25 mm)
Connecting Rod Capscrew			
Minimum Outside Diameter	0.583 (14.808 mm)	0.584 (14.834 mm)	0.590 (14.99 mm)
Pilot Outside Diameter	0.637 (16.180 mm)	0.638 (16.205 mm)	0.643 (16.332 mm)
Dowel and Pilot (2-Capscrew Rod)			
Dowel Diameter		0.3127 (7.9426 mm)	
Rod Dowel Hole		0.3128 (7.9451 mm)	0.3133 (7.9578 mm)
Dowel Protrusion		0.220 (5.59 mm)	0.250 (6.35 mm)
Dowel Press Fit in Cap		0.0001 (0.0025 mm)	0.0006 (0.0152 mm)
Piston			
Skirt Diameter at 70°F	5.483 (13.972 cm)	5.487 (13.937 cm)	5.488 (13.930 cm)
Piston Pin Bore Inside Diameter at 70°F	2.0000 (5.08 cm)	1.9985 (5.0762 cm)	1.9990 (5.077 cm)
Piston Pin			
Outside Diameter	1.9985 (5.0762 cm)	1.99875 (5.07683 cm)	1.9990 (5.077 cm)
Gap in Ring Travel Area of Liner			
Piston Ring Part No. 3012331	**	0.023 (0.584 mm)	0.033 (0.838 mm)
Piston Ring Part No. 3012332	**	0.019 (0.483 mm)	0.029 (0.737 mm)
Piston Ring Part No. 214730	***	0.019 (0.483 mm)	0.029 (0.737 mm
Piston Ring Part No. 218732	***	0.01 (0.25 mm)	0.025 (0.635 mm)

* TIR = Total Indicated Runout
** Use Crankshaft End Clearance
*** Add 0.003-in. (0.076 mm) ring gap to new maximum limit for each 0.001-in. (0.025 mm) wear in cylinder liner wall

MEASUREMENT	WEAR LIMIT	NEW MINIMUM	NEW MAXIMUM
CYLINDER BLOCK SPECIFICATIONS (Contd)			
Camshaft Journal			
Outside Diameter	2.495 (6.337 cm)	2.496 (6.340 cm)	2.497 (6.342 cm)
Thrust Bearing Thickness	0.083 (2.108 mm)	0.093 (2.362 mm)	0.098 (2.489 mm)
Support Bushing			
Inside Diameter	1.370 (3.480 cm)	1.3725 (3.4862 mm)	1.3755 (3.4938 cm)
Outboard Bearing Support			
Inside Diameter	1.757 (4.463 cm)	1.751 (4.448 cm)	1.754 (4.455 cm)
Gear Case Cover Accessory Drive Bushing (132770) (Std)			
Inside Diameter	1.571 (3.990 cm)	1.565 (3.975 cm)	1.569 (3.985 cm)
Cylinder Head			
Height	4.430 (11.25 cm)	4.370 (11.100 cm)	4.380 (11.130 cm)
Valve Stem			
Outside Diameter	0.449 (11.405 mm)	0.450 (11.430 mm)	0.451 (11.455 mm)
Face Angle		30°	30°
Valve Guide			
Inside Diameter	0.455 (11.557 mm)	0.4525 (11.4935 mm)	0.4532 (11.5113 mm)
Assembled Height		1.270 (3.230 cm)	1.280 (3.250 cm)
Valve Seat Insert			
Outside Diameter		2.0025 (5.0864 cm)	2.0035 (5.0889 cm)
Cylinder Head			
Inside Diameter		1.9995 (5.0787 cm)	2.0005 (5.0813 cm)
Insert Height		0.278 (7.061 mm)	0.282 (7.163 mm)
Seat to Guide Bore Concentricity	0.002 (0.051 mm)		
Refaced Seat Width		0.063 (1.600 mm)	0.125 (3.175 mm)
Valve Spring			
Assembled Height			2.250 (5.720 cm)
Crosshead Guide			
Outside Diameter	0.432 (10.973 mm)	0.433 (10.998 mm)	0.4335 (11.0109 mm)
Assembled Height		1.860 (4.724 cm)	1.880 (4.780 cm)
Crosshead Bore	0.440 (11.180 mm)	0.434 (11.024 mm)	0.436 (11.074 mm)
Injector Tip			
Protrusion		0.060 (1.520 mm)	0.070 (1.780 cm)
ROCKER LEVER SPECIFICATIONS			
Bushing			
Inside Diameter	1.1286 (2.866 cm)	1.1245 (2.8562 cm)	1.1275 (2.8639 cm)
Shaft			
Outside Diameter	1.122 (2.850 cm)	1.123 (2.852 cm)	1.124 (2.855 cm)
Shaft			
Outside Diameter	0.748 (18.999 mm)	0.7485 (19.0119 mm)	0.7490 (19.0250 mm)

MEASUREMENT	WEAR LIMIT	NEW MINIMUM	NEW MAXIMUM
CYLINDER BLOCK SPECIFICATIONS (Contd)			
Bushing			
Inside Diameter	0.752 (19.101 mm)	0.7501 (19.0525 mm)	0.7511 (19.0779 mm)
Injector Cam Roller			
Inside Diameter	0.705 (17.907 mm)	0.703 (17.856 mm)	0.704 (17.882 mm)
Valve Cam Roller			
Inside Diameter	0.503 (12.776 mm)	0.5005 (12.7127 mm)	0.5015 (12.7381 mm)
Outside Diameter	1.2485 (3.1712 cm)	1.2495 (3.1737 cm)	1.2505 (3.1763 cm)
Cam Roller Pin Diameter			
Valve	0.497 (12.624 mm)	0.4997 (12.692 mm)	0.500 (12.7 mm)
Injector	0.697 (17.704 mm)	0.6997 (17.7724 mm)	0.700 (17.780 mm)
Diameter of Bore for Roller Pin			
Valve		0.4990 (12.6746 mm)	0.4995 (12.6873 mm)
Injector		0.6992 (17.7597 mm)	0.6997 (17.7725 mm)
LUBRICATING OIL PUMP SPECIFICATIONS			
Bushing			
Inside Diameter	0.8785 (22.3139 mm)	0.8765 (22.2631 mm)	0.8775 (22.2885 mm)
Idler and Drive Shaft			
Outside Diameter	0.8740 (22.1996 mm)	0.8745 (22.2123 mm)	0.8750 (22.2250 mm)
Idler Shaft Protrusion (Above Body to Cover Face)		0.705 (17.907 mm)	0.735 (18.669 mm)
Drive Shaft from Pump Body Protrusion		1.990 (5.055 cm)	2.010 (5.105 cm)
Drive Shaft from Pump Drive Gear		0.050 (1.27 mm)	0.070 (1.778 mm)
Piston Cooling Oil Tube Protrusion Above Body (Mounting Face)		2.970 (7.544 cm)	3.000 (7.620 cm)
Filter/Cooler Pressure Regulator Spring Free Length			3.410 (8.661 cm)
Recommended Oil Pressure (PSI)		35 (241 kPa)	45 (310 kPa)
COOLING SYSTEM SPECIFICATIONS			
Water Pump			
Impeller to Shaft Press-Fit		0.001 (0.025 mm)	
Pulley to Shaft Press-Fit		0.001 (0.025 mm)	
Impeller to Body Clearance (Phenolic)		0.030 (0.762 mm)	0.050 (1.27 mm)
DRIVE UNIT SPECIFICATIONS			
Shaft			
Outside Diameter	1.310 (3.327 cm)	1.3115 (3.3312 cm)	1.312 (3.332 cm)
Bushing			
Inside Diameter	1.321 (3.355 cm)	1.316 (3.343 cm)	1.319 (3.350 cm)

MEASUREMENT	WEAR LIMIT	NEW MINIMUM	NEW MAXIMUM
CYLINDER BLOCK SPECIFICATIONS (Contd)			
Accessory Drive			
End Clearance		0.002 (0.051 mm)	0.012 (0.305 mm)
Main Bearing			
Journal Clearance	0.007 (0.178 mm)	0.0015 (0.0381 mm)	0.005 (0.172 mm)
Connecting Rod Bearing			
Journal Clearance	0.007 (0.178 mm)	0.0015 (0.0381 mm)	0.0045 (0.1143 mm)
Crankshaft			
End Clearance	0.022 (0.559 mm)	0.007 (0.178 mm)	0.017 (0.432 mm)
Cylinder Liner			
Protrusion		0.003 (0.076 mm)	0.006 (0.152 mm)
Out-of-Round (Top 1 In.)			0.003 (0.076 mm)
Out-of-Round (Lower Packing Ring Area)			0.002 (0.051 mm)
Connecting Rod			
Side Clearance		0.0045 (0.1143 mm)	0.013 (0.330 mm)
Gear Train (Gear-to-Gear), Crankshaft, Camshaft, Accessory Drive, and Lubricating Oil Pump Backlash	0.020 (0.508 mm)	0.0045 (0.1143 mm)	0.0105 (0.2667 mm)
Camshaft			
End Clearance		0.008 (0.203 mm)	0.013 (0.330 mm)

GLOSSARY

Section I. LIST OF ABBREVIATIONS

AFC ..... Air Fuel Control

ASA ..... Air Signal Attenuator

C° ..... Celsius Degrees

CFM ..... Cubic Feet per Minute

EPA ..... Environmental Protection Agency

f ..... foot

ft alt ..... feet altitude

F° ..... Fahrenheit degrees

Hg ..... Mercury

hp ..... horsepower

kPa ..... kilopascal

in ..... inch

lb-ft ..... pound foot

lb-hr ..... pounds per hour

lb-in ..... pound inch

N•m ..... Newton meter

pph ..... pounds per hour

PSI ..... Pounds per Square Inch

PT ..... Pressure Timed

rpm ..... revolutions per minute

STE/ICE ..... Simplified Test Equipment for Internal Combustion Engines

Section II. DEFINITION OF UNUSUAL TERMS

Not applicable to this technical manual.

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RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS For use of this form, see AR 25-30; the proponent agency is ODISC4.	Use Part II *(reverse)* for Repair Parts and Special Tool Lists (RPSTL) and Supply Catalogs/Supply Manuals (SC/SM).	DATE

TO: *(Forward to proponent of publication or form) (Include ZIP Code)*	FROM: *(Activity and location) (Include ZIP Code)*
AMSTA-LC-CI/TECH PUBS, TACOM-RI 1 Rock Island Arsenal Rock Island, IL 61299-7630	125th Transportation Company ATTN: Motor SGT (SGT Wilson) Ft. Riley, KA 78665-4000

PART I - ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS

PUBLICATION/FORM NUMBER	DATE	TITLE
TM 9-2815-225-34&P	28 Aug 2001	M915/M915A1 DS/GS Maintenance Manual

ITEM	PAGE	PARA-	LINE	FIGURE NO.	TABLE	RECOMMENDED CHANGES AND REASON
	0020 00-2					Part number for item 4, detergent, is incorrect

** Reference to line numbers within the paragraph or subparagraph.*

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE
Johnny Wilson, E-5, MOTOR SGT	DSN 867-7967	

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PUBLICATION NUMBER	DATE	TITLE

PAGE NO.	COLM NO.	LINE NO.	NATIONAL STOC NUMBER	REFERENCE NO.	FIGURE NO.	ITEM NO.	TOTAL NO. OF MA OR ITEMS SUPPORTED	RECOMMENDED ACTION

PART III - REMARKS *(Any general remarks or recommendations, or suggestions for improvement of publications and blank forms. Additional blank sheets may be used if more space is needed.)*

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USAPA V3.01

By Order of the Secretary of the Army:

ERIC K. SHINSEKI
General, United States Army
Chief of Staff

Official:

JOEL B. HUDSON
Administrative Assistant to the
Secretary of the Army
0123313

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THE METRIC SYSTEM AND EQUIVALENTS

LINEAR MEASURE

1 Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches
1 Meter = 100 Centimeters = 1000 Millimeters = 39.37 Inches
1 Kilometer = 1000 Meters = 0.621 Miles

SQUARE MEASURE

1 Sq. Centimeter = 100 Sq. Millimeters = 0.155 Sq. Inches
1 Sq. Meter = 10,000 Sq. Centimeters = 10.76 Sq. Feet
1 Sq. Kilometer = 1,000,000 Sq. Meters = 0.386 Sq. Miles

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

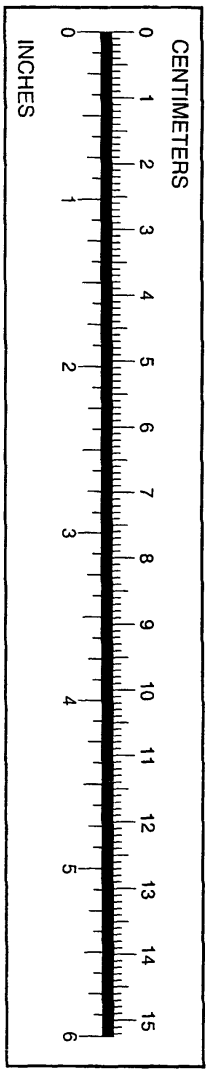
WEIGHTS

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

APPROXIMATE CONVERSION FACTORS

TO CHANGE	TO	MULTIPLY BY
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
Quarts	Liters	0.946
Gallons	Liters	3.785
Ounces	Grams	28.349
Pounds	Kilograms	0.45
Short Tons	Metric Tons	0.0907
Pound-Feet	Newton-Meters	1.356
Pounds per Square Inch	Kilopascals	6.895
Miles per Gallon	Kilometers per Liter	0.425
Miles per Hour	Kilometers per Hour	1.609

TO CHANGE	TO	MULTIPLY BY
Centimeters	Inches	0.394
Meters	Feet	3.280
Meters	Yards	1.094
Meters	Yards	1.094
Kilometers	Miles	0.621
Square Centimeters	Square Inches	0 155
Square Meters	Square Feet	10.764
Square Meters	Square Yards	1.195
Square Kilometers	Square Miles	0.386
Square Hectometers	Acres	2.471
Cubic Meters	Cubic Feet	35.315
Cubic Meters	Cubic Yards	1.308
Milliliters Fluid	Ounces	0.034
Liters	Pints	2.113
Liters	Quarts	1.057
Liters	Gallons	0.264
Grams	Ounces	0.035
Kilograms	Pounds	2 205
Metric Tons	Short Tons	1.102
Newton-Meters	Pound-Feet	0.738
Kilopascals	Pounds per Square Inch	0.145
Kilometers per Liter	Miles per Gallon	2.354
Kilometers per Hour	Miles per Hour	0.621



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