

*** ARMY TM 9-2320-361-34
AIR FORCE TO 36A12-1B-1094-12**

*This publication supersedes TM 9-2320-209-34-1, TM 9-2320-209-4-2-1, TM 9-2320-209-34-2-2, and TM 9-2320-209-34-2-3, 20 May 1981, applicable information to M44A2 series vehicles. Retain all TM 9-2320-209-34 publications for reference pertaining to M44 and M44A1 series trucks.

**TECHNICAL MANUAL
DIRECT SUPPORT AND GENERAL
SUPPORT MAINTENANCE
FOR
2-1 /2-TON, 6X6, M44A2
SERIES TRUCKS (MULTIFUEL)**

Model		NSN Without Winch	NSN With Winch
Truck, Cargo	M35A2	2320-00-077-1616	2320-00-077-1617
	M35A2C	2320-00-926-0873	2320-00-926-0875
	M36A2	2320-00-077-1618	2320-00-077-1619
TRUCK, Tank, Fuel	M49A2C	2320-00-077-1631	2320-00-077-1632
Truck, Tank, Water	M50A2	2320-00-077-1633	2320-00-077-1634
	M50A3	2320-00-937-4036	2320-00-937-5264
Truck, Van, Shop	M109A3	2320-00-077-1636	2320-00-077-1637
Truck, Instrument Repair Shop	M185A3	4940-00-077-1638	4940-00-077-1639
Truck, Tractor	M275A2	2320-00-077-1640	2320-00-077-1641
Truck, Dump	M342A2	2320-00-077-1643	2320-00-077-1644
Truck, Maintenance, Pipeline Construction	M756A2		2320-00-904-3277
Truck, Maintenance, Earth Boring and Polesetting	M764		2320-00-937-5980

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

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HEADQUARTERS, DEPARTMENT OF THE ARMY MAY 1992

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**TECHNICAL MANUAL
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**HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington D.C., 8 MAY 1992**

**TECHNICAL ORDER
NO. 36A12-1B-1094-12**

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(MULTIFUEL)**

Model		NSN Without Winch	NSN With Winch
Truck, Cargo	M35A2	2320-00-077-1616	2320-00-077-1617
	M35A2C	2320-00-926-0873	2320-00-926-0875
	M36A2	2320-00-077-1618	2320-00-077-1619
Truck, Tank, Fuel	M49A2C	2320-00-077-1631	2320-00-077-1632
Truck, Tank, Water	M50A2	2320-00-077-1633	2320-00-077-1634
	M50A3	2320-00-937-4036	2320-00-937-5264
Truck, Van, Shop	M109A3	2320-00-077-1636	2320-00-077-1637
Truck, Instrument Repair Shop	M185A3	4940-00-077-1638	4940-00-077-1639
Truck, Tractor	M275A2	2320-00-077-1640	2320-00-077-1641
Truck, Dump	M342A2	2320-00-077-1643	2320-00-077-1644
Truck, Maintenance, Pipeline Construction	M756A2		2320-00-904-3277
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<u>DISTRIBUTION STATEMENT A.</u> Approved for public release; distribution is unlimited.

REPORTING OF ERRORS

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

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HOW TO USE THIS MANUAL

ABOUT YOUR MANUAL

Spend some time looking through this manual. You'll find that it has a new look, different than most of the TM'S you've been using.

New features added to improve the convenience of this manual and increase your efficiency are:

- a. **Accessing Information** – These include features such as the bleed-to-edge locators on the cover and edge of the manual. Extensive troubleshooting guides for specific systems lead directly to step-by-step directions for problem solving and maintenance tasks.
- b. **Illustrations** – A variety of methods are used to make locating and fixing components much easier. Locator illustrations with keyed text, exploded views, and cut-away diagrams make the information in this manual easier to understand and follow.
- c. **Keying Text With Illustrations** - Illustrations/text are located on facing pages that show the specific task you are working on. In some cases, the task steps and illustrations are located side by side. Continue reading for an example of modular text and illustrations.
- d. **General Features** – Your TM is the best source available for providing information and data critical to vehicle operation and maintenance:
 - Safety warning summary (pages a through d)
 - General information, equipment descriptions, and data (chapter 1)
 - Mechanical troubleshooting (chapter 2, section II)
 - Detailed maintenance procedures (chapters 3 through 17)
 - References (appendix A)
 - Common and special tools list (appendix B)
 - Expendable/durable supplies and materials list (appendix C)
 - Illustrated list of manufactured items (appendix D)
 - Torque limits (appendix E)
 - Mandatory replacement items (appendix F)

A typical example of how to use this manual is provided on the following pages.

USING YOUR MANUAL: AN EXAMPLE

TASK The direct and general support maintenance mechanic of an M44A2 series vehicle reports that the engine will not crank. 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 edge indicators (black bars) that are aligned with the chapter/section bars on the cover. These are the locations of the chapter/section in the text.
3. Look for "SERVICE AND TROUBLESHOOTING INSTRUCTIONS" in the chapter list on the cover. This is where the troubleshooting information is located.
4. Turn to those pages with the edge indicator matching the black bar for service and troubleshooting instructions. Page numbers are also listed next to chapter/section titles.
5. One of the first pages having service and troubleshooting instructions edge indicators is the "MECHANICAL TROUBLESHOOTING INDEX."
6. Look down the list until you find "ENGINE." Beneath that heading you will find the symptoms noted by the maintenance mechanic: "Engine will not crank."
7. Turn to the page indicated: 2-6.
8. On page 2-6, steps/tests relating to resolving the problem of "Engine will not crank" are found.

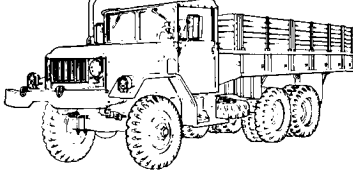
You inspect the oil pump and find that it is defective and must be replaced. Paragraph 3-12 is referenced.

The rest of the inspection shows no other cause for the problem.

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TECHNICAL MANUAL DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE FOR 2-1/2-TON, 6X6, M44A2 SERIES TRUCKS (MULTIFUEL)



TRUCK, CARGO: 2-1/2-TON, 6X6, M35A2, M35A2C, M36A2;
TRUCK, TANK, FUEL: 2-1/2-TON, 6X6, M49A2C;
TRUCK, TANK, WATER: 2-1/2-TON, 6X6, M50A2, M50A3;
TRUCK, VAN, SHOP: 2-1/2-TON, 6X6, M109A3;
TRUCK, INSTRUMENT REPAIR SHOP: 2-1/2-TON, 6X6, M185A3;
TRUCK, TRACTOR: 2-1/2-TON, 6X6, M275A2;
TRUCK, DUMP: 2-1/2-TON, 6X6, M342A2;
TRUCK, MAINTENANCE, PIPELINE
CONSTRUCTION: 2-1/2-TON, 6X6, M756A2;
TRUCK, MAINTENANCE, EARTH BORING AND POLESETTING:
2-1/2-TON, 6X6, M764

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DEPARTMENTS OF THE ARMY AND THE AIR FORCE

TM 9-2320-361-34

MECHANICAL SYSTEMS TROUBLESHOOTING SYMPTOM INDEX

MAJUNCTION NO.	MAJUNCTION	TROUBLESHOOTING PROCEDURE PAGE
ENGINE		
1.	Engine will not crank	2-6
2.	Starter cranks engine slowly	2-7
3.	Engine cranks but will not start	2-7
4.	Engine starts but stops when accelerator is operated	2-8
5.	Engine stops when accelerator is returned to idle position	2-8
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10.	Engine stops during normal operation	2-9

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Table 2-1. Mechanical Troubleshooting.

MAJUNCTION TEST OR INSPECTION	CORRECTIVE ACTION
ENGINE	
NOTE	
Engine should be test run after each completed action.	
1. ENGINE WILL NOT CRANK	
Step 1.	Check fuel injection pump for seizure. Remove drive gear access cover from engine timing gear cover (para. 5-4). Remove injection pump drive gear (para. 5-4). Manually turn injection pump shaft at center hub screw. If shaft will not rotate, replace (para. 5-4) and repair fuel injection pump (TM 9-2815-210-34-9-2).
WARNING	
• Ensure fuel shutoff valve and ignition switch are OFF before cranking engine. Failure to do so may result in injury to personnel. • All personnel must stand away from engine during crank test to clear fluid from cylinders. Eye protection is required during crank test. Failure to stand clear and wear eye protection may cause injury to personnel.	
Step 2.	Check engine cylinders for fluid-locked pistons. Remove all fuel injector nozzles (para. 5-2). Crank engine with starter. a. If crankshaft turns freely, identify any fluid expelled from cylinders. If fluid sample is identified as coolant, proceed to step 9. If fluid sample is identified as fuel, proceed to malfunction 21. b. If engine crankshaft will not turn or turns hard, check internal engine components for seizure. Remove oil pan (para. 3-11) and inspect crankshaft for nicks, burns, grooves, scuffs, or discoloration due to overheating. If nicked, burned, grooved, scuffed, or discolored, replace engine (para. 3-10).
Step 3.	Install fuel injector nozzles (para. 5-2).
Step 4.	Check oil pump for seizure. Remove oil pump (para. 3-12) and manually turn oil pump drive gear. If drive gear will not turn, replace oil pump (para. 3-12).
Step 5.	Check air intake manifold for presence of water. If water is present within air cleaner, disassemble and drain air intake manifold (para. 3-17).
CAUTION	
Starting engine after correcting piston fluid-locked condition must be done with care. When pistons have been fluid-locked within cylinders, connecting rods may have been damaged and can be identified during test run by abnormal vibration or noise. Do not operate engine when these conditions exist. Permanent engine damage may result.	
Step 6.	Test run engine if water was present and removed from air induction system. If engine operates with unusual sounds or vibrations, perform malfunction 16 and/or 17.

2-6

9. To locate paragraph 3-12 refer to the first page of chapter 3, section I (page 3-1). Find "Oil Pump Maintenance" in the "In-Vehicle Engine Maintenance Index." You are directed to page 3-36.

10. Turn to paragraph 3-12 on page 3-36. Here you will find the detailed procedure for removing the old oil pump and replacing it with a new one.

CHAPTER 3
ENGINE MAINTENANCE

Section I. In-Vehicle Engine Maintenance (page 3-1)
Section II. Engine Replacement (page 3-58)
Section I. IN-VEHICLE ENGINE MAINTENANCE

3-1. IN-VEHICLE ENGINE MAINTENANCE INDEX

PARA. NO.	TITLE	PAGE NO.
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3-16.	Air Compressor Support and Gasket Replacement	3-50
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3-2. ENGINE FRONT AND REAR MOUNTING BRACKETS REPLACEMENT

THIS TASK COVERS:

- a. Front Mounting Bracket Removal
b. Front Mounting Bracket Installation
c. Rear Mounting Bracket Removal
d. Rear Mounting Bracket Installation

INITIAL SETUP

APPLICABLE MODELS

All

TOOLS

General mechanic's tool kit (Appendix B, Item 1)
Torque wrench, 3/4-in. dr. (Appendix B, Item 6)
1-1/8-in. socket, 3/4-in. dr. (Appendix B, Item 36)
1-1/4-in. socket, 3/4-in. dr. (Appendix B, Item 40)
Breaker bar, 3/4-in. dr. (Appendix B, Item 37)

MATERIALS/PARTS

Three lock screws (front bracket) (Appendix F, Item 119)
Lock screw (front bracket) (Appendix F, Item 120)
Lock screw (front bracket) (Appendix F, Item 121)
Four locknuts (rear bracket) (Appendix F, Item 86)

PERSONNEL REQUIRED

Two

REFERENCES (TM)

TM 9-2320-361-10
TM 9-2320-361-20
TM 9-2320-361-34P

EQUIPMENT CONDITION

- Hood raised and secured (TM 9-2320-361-10).
- Wheels chocked (TM 9-2320-361-10).
- Battery ground cable disconnected (TM 9-2320-361-20).
- Primary fuel filter removed (right front side mount only) (TM 9-2320-361-20).
- Steering gear removed (left front mount only) (para. 12-2).

GENERAL SAFETY INSTRUCTIONS

- All personnel must stand clear during lifting operations.
- Do not detach lifting device from engine until all engine weight is equally distributed and engine is stable.
- Lifting device must have weight capacity greater than the weight of the engine and transmission.

3-12. OIL PUMP MAINTENANCE

THIS TASK COVERS:

- a. Removal
b. Inspection
c. Installation

INITIAL SETUP

APPLICABLE MODELS

All

TOOLS

General mechanic's tool kit (Appendix B, Item 1)
Mechanical puller kit (Appendix B, Item 23)
6-in. Extension, 3/8-in. dr. (Appendix B, Item 58)
Universal joint, 3/8-in. (Appendix B, Item 18)
Adapter, 1/2-in. male, 3/8-in. female (Appendix B, Item 18)

SPECIAL TOOLS

5/8-in. crowfoot adapter (Appendix B, Item 60)

MATERIALS/PARTS

Three lock screws (Appendix F, Item 128)
Gasket (Appendix F, Item 35)
Gasket (Appendix F, Item 36)
Gasket (Appendix F, Item 37)
Preformed packing (Appendix F, Item 193)
Thirteen lock washers (Appendix F, Item 130)
Cotter pin (Appendix F, Item 2)
Safety wire (Appendix C, Item 31)
Lubricating oil, OE/HDO 30 (Appendix C, Item 13)

REFERENCES (TM)

TM 9-2320-361-34P

EQUIPMENT CONDITION

Oil pan removed (para. 3-11).

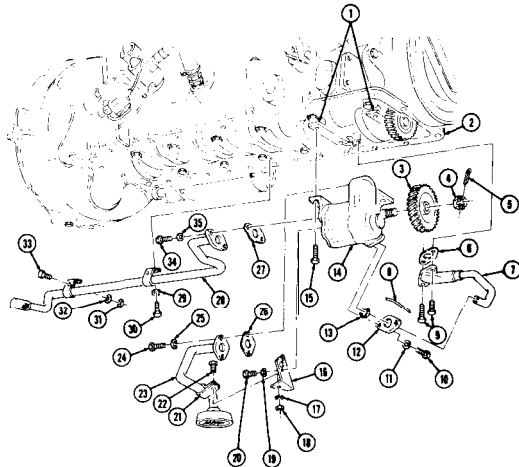
NOTE

Have drainage container ready to catch excess oil.

a. Removal

1. Remove safety wire (8) from two screws (9). Discard safety wire (8).
2. Remove two screws (9), outlet tube (7), and gasket (6) from engine block (2) and flange (12). Discard gasket (6).
3. Remove two screws (10), lock washers (11), flange (12), and packing (13) from oil pump (14). Discard lock washers (11) and packing (13).
4. Remove nut (18), lock washer (17), and screw (22) from pickup tube clamp (21) and brace (16). Discard lock washer (17).
5. Remove two screws (24), lock washers (25), pickup tube (23), and gasket (26) from oil pump (14). Discard lock washers (25) and gasket (26).
6. Remove two screws (30) and lock washers (29) from scavenger tube (28) and engine block (2). Discard lock washers (29).
7. Remove two screws (34), lock washers (35), scavenger tube (28), and gasket (27) from oil pump (14). Discard lock washers (35) and gasket (27).
8. Remove two screws (20), lock washers (19), and brace (16) from oil pump (14). Discard lock washers (19).
9. Remove three lock screws (15) and oil pump (14) from two bearing caps (1). Discard lock screws (15).
10. Remove cotter pin (5), nut (4), and gear (3) from pump (14). Discard cotter pin (5).
11. Remove gear (3) from pump (14) with mechanical puller.
12. Remove two nuts (31), lock washers (32), and screws (33) from scavenger tube (28). Discard lock washers (32).

3-12. OIL PUMP MAINTENANCE (Contd)



DETAILED MAINTENANCE PROCEDURES:

11. 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 paragraph 3-12: "Oil Pump Maintenance" includes: a. Removal, b. Inspection, and c. Installation.
 - b. The eight basic headings listed under "INITIAL SETUP" outline special tools, materials, personnel requirements, and special conditions. Headings will not be listed if there are no entries. The headings are:
 - **APPLICABLE MODELS** Any model(s) that require that particular maintenance task.
 - **TEST EQUIPMENT** Test equipment needed to complete the task.
 - **SPECIAL TOOLS** Special tools needed to complete the task.
 - **TOOLS** Common tools, not in the General Mechanic's Tool Kit, needed to complete the task.
 - **MATERIALS/PARTS** All parts or materials needed to complete the task.
 - **PERSONNEL REQUIRED** The number of personnel needed to perform the task. If only one mechanic is needed, this heading will not be used. If you think that you need more help to correctly or safely complete a task (perhaps as the result of unusual conditions, etc.), alert your supervisor and ask for help.
 - **REFERENCES (TM)** Additional manuals needed to complete the task.
 - **EQUIPMENT CONDITION** Notes the conditions that must exist before starting the task.
 - **GENERAL SAFETY INSTRUCTIONS** Summarizes all safety warnings for the maintenance task.
 - c. A step-by-step maintenance procedure follows the "INITIAL SETUP" and gives detailed instructions for the procedure. These instructions give part name and action performed. The numbers in parentheses correspond to the part's callout number in the accompanying illustration. Warnings, cautions, and notes give additional information.
 - **WARNINGS**- Indicate conditions, practices, or procedures which must be observed to avoid personnel injury, loss of life, or long-term health hazard.
 - **CAUTIONS**- Indicate conditions, practices, or procedures which must be observed to avoid damage to equipment or destruction of equipment.
 - **NOTES** - Include essential information of special importance, interest, or aid in job performance.
 - d. At the end of a procedure, "FOLLOW-ON TASK(S)" will list the additional task(s) that must be performed to complete the procedure.
12. You can also use the Table of Contents (page ii) to find more information about the vehicle.
13. Refer to TM 9-2320-361-34P, Direct Support and General Support Maintenance Repair Parts and Special Tools List for Truck, 2-1/2-Ton, 6x6, M44A2 Series, when requisitioning parts, special tools, and equipment for direct support and general support maintenance.
14. Your manual is easier to use once you understand its design. We hope it will encourage you to use it more often as an aid to maintenance support for M44A2 series vehicles.

CHAPTER 1

INTRODUCTION

Section I. General Information (page 1-1)
 Section II. Equipment Description and Data (page 1-2)

Section 1. GENERAL INFORMATION

a. This technical manual contains instructions for direct support and general support maintenance of 2-1/2-ton, 6x6, multifuel, M44A2 series vehicles.

b. The vehicle model numbers and equipment names are:

- (1) M35A2 Cargo Truck, WO/W and WIW
- (2) M35A2C Cargo Truck With Dropsides, WO/W and W/W
- (3) M36A2 Cargo Truck With Extra Long Wheel Base, WO/W and W/W
- (4) M49A2C Fuel Tank Truck, WO/W and W/W
- (5) M50A2 Water Tank Truck (400- and 600-Gallon Tanks), WO/W and W/W
- (6) M50A3 Water Tank Truck (Two 500-Gallon Tanks), WO/W and W/W
- (7) M109A3 Shop Van Truck, WO/W and W/W
- (8) M185A3 Instrument Repair Shop Truck, WO/W and W/W
- (9) M275A2 Tractor Truck, WO/W and W/W
- (10) M342A2 Dump Truck, WO/W and W/W
- (11) M756A2 Pipeline Construction Maintenance Truck, W/W
- (12) M764 Earth Boring and Polesetting Maintenance Truck, W/W

1-2. MAINTENANCE FORMS, RECORDS, AND REPORTS

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

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

Procedures for destruction of Army materiel to prevent enemy use are found in TM 750-244-6.

1-4. PREPARATION FOR STORAGE OR SHIPMENT

Storage and shipment instructions are in TM 9-2320-361-20. Additional information can be found in TM 746-10, Marking, Packaging and Shipment of Supplies and Equipment: General Packaging Instructions for Field Use.

1-5. OFFICIAL NOMENCLATURE, NAMES, AND DESIGNATIONS

The nomenclature, names, and designations used in this manual are in accordance with MIL-HDBK-63038-2.

1-6. REPORTING QUALITY DEFICIENCIES, IDEAS, AND EQUIPMENT IMPROVEMENT RECOMMENDATIONS

If your 2-1/2-ton, M44A2 series vehicle needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design. Put it on an SF 368 (Quality Deficiency Report). Mail in accordance with DA-PAM 738-750.

1-7. EQUIPMENT IMPROVEMENT REPORT AND MAINTENANCE DIGEST (EIR MD)

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

1-8. WARRANTY INFORMATION

The transfer case, transmission, transmission shaft, front axle assembly, rear axle assembly, differential carrier, air hydraulic cylinder, steering gear, cargo body, winch, power takeoff assembly, and delivery pump are warranted in accordance with TB 9-2320-209-14 for the M35A2 and M35A2C cargo trucks, M49A2C fuel tank truck, M50A3 water tank truck, and M275A2 tractor truck. The warranty starts on the date found in block 23, DA Form 2408-9, in the logbook. Report all defects in material or workmanship to your supervisor, who will take appropriate action.

Section II. EQUIPMENT DESCRIPTION AND DATA

1-9. EQUIPMENT DESCRIPTION AND DATA

Detailed descriptions covering the 2-1/2-ton, 6x6, M44A2 series vehicles are in TM 9-2320-361-10 and TM 9-2320-361-20.

CHAPTER 2

SERVICE AND TROUBLESHOOTING INSTRUCTIONS

- Section I. Repair Parts, Special Tools, Test, Measurement, and Diagnostic Equipment (TMDE), and Support Equipment (page 2-1)
 Section II. Troubleshooting (page 2-1)
 Section III. General Maintenance Instructions (page 2-32)

Section 1. REPAIR PARTS, SPECIAL TOOLS, TEST, MEASUREMENT, AND DIAGNOSTIC EQUIPMENT (TMDE), AND SUPPORT EQUIPMENT

2-1. COMMON TOOLS AND EQUIPMENT

Refer to Modified Table of Organization and Equipment (MTOE) for authorized common tools and equipment applicable to your unit.

2-2. SPECIAL TOOLS AND SUPPORT EQUIPMENT

Special tools and support equipment are listed and illustrated in TM 9-2320-361-34P.

2-3. TEST MEASUREMENT AND DIAGNOSTIC EQUIPMENT (TMDE)

Calibrate all measuring and test equipment used to determine equipment conformance in accordance with MIL-STD-120, MIL-C-45662, and MIL-L-45607.

2-4. FABRICATED TOOLS

Fabricated tools needed to maintain the equipment mentioned in this manual can be found in Appendix D. These tools are not available for issue; therefore, each one must be fabricated and applied by direct or general support personnel.

2-5. REPAIR PARTS

Repair parts are listed and illustrated in TM 9-2320-361-34P.

Section II. TROUBLESHOOTING

2-6. GENERAL TROUBLESHOOTING INSTRUCTIONS

WARNING

Do not operate a deadlined vehicle without preliminary inspection.
 Failure to do so may cause further damage to a disabled component
 and possible injury to personnel.

b. Do the easiest and most obvious troubleshooting and corrections first. Most malfunctions are easily corrected. For example:

- (1) Low power problems are generally caused by loose throttle linkage or dirty fuel filters.
- (2) Excessive oil consumption is generally caused by leaky gaskets or loose line connections.

2-6. GENERAL TROUBLESHOOTING INSTRUCTIONS (Contd)

c. Double check before disassembly. The source of most engine problems can be traced to more than one part in a system. For example:

(1) Excessive fuel consumption may not be caused by the fuel pump alone. In addition, the trouble could be a clogged air cleaner reducing air inflow or a restricted exhaust passage causing abnormally high back pressure.

(2) Engines often are disassembled in search of a complaint and the real evidence of the problem is destroyed. Check again to be sure an easier solution to the problem has not been overlooked.

(3) Check all tags, service request forms, and vehicle logbook for repair history. This may help lead to source of problems.

d. Before attempting to correct a problem, diagnose the cause of the problem. Do not allow the same failure to occur again.

e. This troubleshooting covers in-vehicle engine repair. For out-vehicle engine repair, refer to TM 9-2815-210-34-1,-2-1, 2-2, and -34P.

MECHANICAL SYSTEMS TROUBLESHOOTING SYMPTOM INDEX

MALFUNCTION NO.	MALFUNCTION	TRUBLESHOOTING PROCEDURE PAGE
ENGINE		
1.	Engine will not crank	2-6
2.	Starter cranks engine slowly	2-7
3.	Engine cranks but will not start	2-7
4.	Engine starts but stops when accelerator is operated	2-8
5.	Engine stops when accelerator is returned to idle position.	2-8
6.	Poor acceleration and/or lack of power.	2-8
7.	Engine delivers excessive black exhaust smoke	2-8
8.	Engine surges	2-8
9.	Engine misfires during operation.	2-9
10.	Engine stops during normal operation.	2-9
11.	Exhaust color blue during normal operation	2-9
12.	Exhaust color white during normal operation and idle	2-10
13.	Engine oil pressure low or zero at normal operating temperature.	2-11
14.	Engine oil pressure extremely high at normal operating temperature.	2-12
15.	Engine oil loss during normal operation	2-13
16.	Engine noise abnormal	2-13
17.	Engine vibration abnormal	2-14
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18.	No fuel at fuel injectors	2-14
19.	Low fuel supply at injector nozzles.	2-16
20.	Fuel injectors inoperative	2-16
21.	Fuel injectors deliver excess fuel into engine	2-16
COOLING SYSTEM		
22.	Coolant loss during normal operation	2-17
23.	Coolant temperature excessive.	2-17
CLUTCH		
24.	Vehicle will not move or engine stalls with clutch engaged.	2-17
25.	Burning odor evident with clutch engaged.	2-18
26.	Clutch noisy during engagement and disengagement	2-18
27.	Vibration during clutch engagement.	2-19
28.	Clutch pedal will not travel depress	2-19
TRANSMISSION		
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30.	Transmission leaks oil	2-19
31.	Transmission grinds and/or pops out of gear during shifting	2-20
TRANSFER CASE		
32.	Transfer case will not operate front differential	2-20
33.	Transfer case will not operate rear differential.	2-20
34.	Transfer case leaks oil	2-20
35.	Transfer case noisy	2-21
36.	Transfer case grinds or pops out of gear during normal vehicle operation	2-21

MECHANICAL SYSTEMS TROUBLESHOOTING SYMPTOM INDEX (Contd)

MALFUNCTION NO.	MALFUNCTION	TROUBLESHOOTING PROCEDURE PAGE
DIFFERENTIAL		
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38.	Differential clunks during turns or initial takeoff.	2-21
39.	Differential leaks oil	2-21
40.	Abnormal tirewear(front axle)	2-22
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44.	Steering wheel hard to turn	2-22
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47.	Transmission power takeoff leaks oil.	2-23
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50.	Dump body will not lower	2-25
51.	Dump body will not hold in raisedposition	2-25
FUEL TANK (M49A2C)		
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53.	Fuel will not gravity drain from selected compartments	2-26
54.	Fuel tank compartments cannot be suction filled	2-26
55.	Fuel mixed with water when dispensed.	2-26
WATER TANK (M50A2 AND M50A3)		
56.	Water will not pump from compartments or pumps slowly	2-26
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58.	Water tank compartments cannot be suction filled.	2-27
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61.	Earth boring machine brake inoperative	2-28
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MECHANICAL SYSTEMS TROUBLESHOOTING SYMPTOM INDEX (Contd)

MALFUNCTION NO.	MALFUNCTION	TROUBLESHOOTING PROCEDURE PAGE
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70.	Drum overruns cable or cable coils loosen when paying out cable.	2-30
71.	Winch does not hold load when power released	2-30
72.	Winch leaks oil	2-30
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73.	Heater fails to turn on	2-31
74.	Heater overheats – overheat switch is good	2-31
75.	Heater overheats –continues to run	2-31
76.	Heater output too low	2-31
77.	Heater smokes and bangs when starting.	2-31
78.	Blower will not stop after turn off.	2-31
79.	Odor of fuel in ventilating air.....	2-32
80.	Blower runs but heater fails to ignite	2-32
81.	Heater smokes during normal operation	2-32

Table 2-1. Mechanical Troubleshooting.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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ENGINE**NOTE**

Engine should be test run after each completed action.

1. ENGINE WILL NOT CRANK

Step 1. Check fuel injection pump for seizure. Remove drive gear access cover from engine timing gear cover (para. 5-4). Remove injection pump drive gear (para. 5-4). Manually turn injection pump shaft at center hub screw.

If shaft will not rotate, replace (para. 5-4) and repair fuel injection pump (TM 9-2815-210-34-2-2).

WARNING

- Ensure fuel shutoff valve and ignition switch are OFF before cranking engine. Failure to do so may result in injury to personnel.
- All personnel must stand away from engine during crank test to clear fluid from cylinders. Eye protection is required during crank test. Failure to stand clear and wear eye protection may cause injury to personnel.

Step 2. Check engine cylinders for fluid-locked pistons. Remove all fuel injector nozzles (para. 5-2). Crank engine with starter.

- If crankshaft turns freely, identify any fluid expelled from cylinders. If fluid sample is identified as coolant, proceed to step 9. If fluid sample is identified as fuel, proceed to malfunction 21.
- If engine crankshaft will not turn or turns hard, check internal engine components for seizure. Remove oil pan (para. 3-11) and inspect crankshaft for nicks, burns, grooves, scuffs, or discoloration due to overheating. If nicked, burned, grooved, scuffed, or discolored, replace engine (para. 3-18).

Step 3. Install fuel injector nozzles (para. 5-2).

Step 4. Check oil pump for seizure. Remove oil pump (para. 3-12) and manually turn oil pump drive gear.

If drive gear will not turn, replace oil pump (para. 3-12).

Step 5. Check air intake manifold for presence of water.

If water is present within air cleaner, disassemble and drain air intake manifold (para. 3-17).

CAUTION

Starting engine after correcting piston fluid-locked condition must be done with care. When pistons have been fluid-locked within cylinders, connecting rods may have been damaged and can be identified during test run by abnormal vibration or noise. Do not operate engine when these conditions exist. Permanent engine damage may result.

Step 6. Test run engine if water was present and removed from air induction system.

If engine operates with unusual sounds or vibrations, perform malfunction 16 and/or 17.

Table 2-1. Mechanical Troubleshooting (Contd).

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Step 7.	Check turbocharger housing for presence of water, identified by water on turbocharger fins or hub.	If water is present, replace turbocharger (para. 5-6).
Step 8.	Test run engine.	If engine operates with unusual sounds or vibrations, perform malfunction 16 and/or 17.
Step 9.	Check intake manifold and gasket. Remove intake manifold and gasket and inspect for defects (para. 3-17).	If intake manifold is defective, replace (para. 3-17).
Step 10.	Test run engine.	a. If engine operates with unusual sounds or vibrations, perform malfunction 16 and/or 17.
		b. If engine exhaust color remains white during test run, check cylinder heads and gaskets. Remove cylinder heads and gaskets and inspect for defects (para. 3-3).
		If cylinder heads or gaskets are defective, replace (para. 3-3).
Step 11.	Test run engine.	If engine exhaust color remains white during test run, replace engine (para. 3-18).

END OF TESTING!

2. STARTER CRANKS ENGINE SLOWLY

Step 1. Check electrical systems (TM 9-2320-361-20).

Step 2. Check fuel injection pump for seizure (malfunction 1, step 1).

Step 3. Check internal engine components for seizure (malfunction 1, steps 2b and 4).

END OF TESTING!

3. ENGINE CRANKS BUT WILL NOT START

Step 1. Check fuel delivery systems (malfunctions 18 through 21).

Step 2. Visually check valve train operation and that valve lash is within specifications (para. 3-7).

a. If valve train is not operating, check camshaft and crankshaft gears for damaged or missing teeth. Remove timing cover (para. 3-8) and replace both gears (TM 9-2815-210-34-2-1) if either gear is damaged.

b. If valve lash is not within specifications, adjust valve lash (para. 3-7).

c. If valve lash cannot be adjusted within specifications, check valve train components for wear or defects (para. 3-7). Replace worn or defective components.

Step 3. Check engine cylinders for low compression readings (malfunction 11, steps 1 and 2).

a. If compression readings are low or zero, perform wet compression check (malfunction 11, steps 1 and 2).

b. If wet compression readings increase 50 psi (345 kPa) or more, piston rings or cylinder bores may be worn. Replace engine (para. 3-18).

END OF TESTING!

Table 2-1. Mechanical Troubleshooting (Contd).

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
4. ENGINE STARTS BUT STOPS WHEN ACCELERATOR IS OPERATED Step 1. Check fuel leakage at inlet side of fuel supply pump (mounted on fuel injection pump) (malfunction 18, step 4). Step 2. Check fuel delivery systems (malfunction 18). END OF TESTING!
5. ENGINE STOPS WHEN ACCELERATOR IS RETURNED TO IDLE POSITION Check fuel delivery systems (malfunction 18). END OF TESTING!
6. POOR ACCELERATION AND/OR LACK OF POWER Step 1. Check vehicle clutch system for slippage (malfunction 25). Step 2. Perform fuel delivery malfunction 18, steps 1,2, and 3. Step 3. Check fuel injection pump timing is set within engine specifications (para. 5-4). If fuel injection pump timing is incorrect, adjust (para. 5-4). Step 4. Check turbocharger operation. Remove plug from top of inlet manifold. Install low pressure gage with adapter into plug opening. Start engine and accelerate engine to fill throttle and immediately decelerate. Observe pressure gage readings. If no gage movement or only a small pressure increase by gage is evident, replace defective turbocharger (para. 5-6). Step 5. Check turbocharger outlet hose, intake manifold elbow, and gasket for leaks (para. 5-6). Tighten base screws and clamps. Replace any missing screws or clamps (TM 9-2320-361-20). If no improvement during test run, remove and inspect turbocharger hoses, intake manifold elbow, and gasket for defects (para. 5-6). Replace defective components (para. 5-6 and TM 9-2320-361-20). Step 6. Check engine valve train operation and valve lash adjustment (malfunction 3, step 2). Step 7. Check engine cylinder compression (malfunction 11, steps 1 and 2). END OF TESTING!
7. ENGINE DELIVERS EXCESSIVE BLACK EXHAUST SMOKE Complete troubleshooting malfunction 21. END OF TESTING!
8. ENGINE SURGES Step 1. Check fuel supply pump (mounted on fuel injection pump) operation (malfunction 18, step 4). Step 2. Check fuel injector nozzles operation (malfunction 18, step 2). Step 3. Check fuel shutoff system for correct operation and adjustment (malfunction 18, step 1). END OF TESTING!

Table 2-1. Mechanical Troubleshooting (Contd).

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
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9. ENGINE MISFIRES DURING OPERATION

Step 1. Verify fuel injector nozzle feed lines are correctly installed in fuel injector pump hydraulic head (para. 5-3).

If fuel injector nozzle feed lines are incorrectly installed, remove and install in correct location (para. 5-3).

Step 2. Check fuel injector nozzle operation (malfunction **18**, step 2).

Step 3. Check fuel injection pump operation (malfunction **18**, step 6).

Step 4. Check engine valve train operation and valve lash adjustment (malfunction 3, step 2).

Step 5. Check engine cylinders compression readings (malfunction 11, steps 1 and 2).

END OF TESTING!

10. ENGINE STOPS DURING NORMAL OPERATION

Step 1. Perform engine troubleshooting malfunction 4.

Step 2. Perform engine troubleshooting malfunction 1, step 2.

END OF TESTING!

11. EXHAUST COLOR BLUE DURING NORMAL OPERATION**NOTE**

Blue exhaust indicates presence of excess engine oil in cylinder combustion chamber.

Step 1. Engine cylinder compression test,

- a. Preparation: Check for proper valve and rocker arms movement and ensure they are adjusted to specifications (para. 3-7); cutoff fuel supply at fuel pump (TM 9-2320-361-20); ensure batteries are fully charged and starter operates normally; and remove all plugs in cylinder heads.
- b. Connect compression gage and necessary adapter to plug port of number 1 cylinder. Crank engine through at least five compression strokes or until gage stops rising. Record cylinder number and maximum gage reading. Remove gage from number 1 cylinder. This is the "dry" test.
- c. Repeat step 1b for remaining cylinders.
- d. Add 1 to 1-1/2 oz (29-44 ml) of clean engine oil through plug port for each cylinder before connecting compression gage. Repeat steps 1b and 1c. This is the "wet" test. Record gage readings for "wet" test beside readings for "dry" test for each cylinder.

Step 2. Analysis of compression test results.

- a. Compute compression loss for "dry" test for each cylinder compared to cylinder with highest reading using the following formula:

$$\frac{\text{Highest Cylinder Reading} - \text{Sample Cylinder Reading}}{\text{Highest Cylinder Reading}} \times 100 = \% \text{ Compression Loss}$$

- b. If one or more cylinders has an 8-10% or greater compression loss in "dry" test, but improved to acceptable (less than 8%) loss in "wet" test, piston, piston rings, or cylinder liner problem is indicated. Remove head(s) and inspect pistons, piston rings, and cylinder liner for breaks, wear, and scoring. If damaged, replace engine (para. 3-18).

Table 2-1. Mechanical Troubleshooting (Contd).

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
		c. If one or more cylinders had an 8-10% or greater loss in both “wet” and “dry” tests, the compression loss is on top of engine. Remove head(s) and inspect valves, valve seats and guides, and cylinder head gasket(s). Repair (TM 9-2815-210-34-2-2) or replace defective parts (para. 3-3). d. If repairs of b and/or c do not sufficiently restore engine to normal operation, remove rocker arm covers (para. 3-6), inspect for camshaft, tappets, and pushrod defects. Repair (TM 9-2815-210-34-2-2) or replace defective parts (paras. 3-7,3-8, and 3-10). e. Replace valve seals and guides (para. 3-3 and TM 9-2815-210-34-2-2) if compression test readings are within limits for all cylinders and engine develops normal power but still shows blue exhaust.
	Step 3.	Perform engine oil consumption test. Operate vehicle and closely check engine oil level until oil level reaches one quart low. Stop vehicle operation.
	Step 4.	Record vehicle mileage. Calculate engine oil consumption by subtracting mileage when engine oil level was topped off from current mileage recorded when engine oil level was one quart low. The difference is the mileage using one quart of oil. a. If the mileage is less than 60 mi (96 km) check for and repair all oil leaks. b. If there were no oil leaks, proceed to step 7.
	Step 5.	Repeat steps 3 and 4 of engine oil consumption test except steps 4a and 4b. a. If engine oil consumption remains less than 60 mi (96 km) for a one quart oil, check all oil seals. b. If engine oil consumption is greater than or equal to 60 mi (96 km) for one quart oil, oil consumption is acceptable.
	Step 6.	Check valve seats, valve guides, and cylinder head gaskets for defects. Remove cylinder heads and disassemble (TM 9-2815-210-34-2-1,-2-2, and para. 3-3). If valve seats, valve guides, or cylinder heads are defective, replace (TM 9-2815-210-34-2-2 and para. 3-3).
	Step 7.	Repeat steps 4 and 5 of oil consumption test except steps 4a and 4b. a. If oil consumption remains more than one quart for every 60 mi (96 km), piston rings or cylinder bores may be worn or defective. b. Perform compression test of malfunction 11, steps 1 and 2. If the wet compression test, malfunction 11, step 1d, raises compression readings more than 50 psi (345 kPa), a piston ring or cylinder bore problem is indicated. Remove engine (para. 3-18), disassemble, and repair defective parts (TM 9-2815-210-34-2-1 and -2-2).

END OF TESTING!

12. EXHAUST COLOR WHITE DURING NORMAL OPERATION AND IDLE**CAUTION**

Thick white smoke indicates coolant is present in engine combustion chambers during operation. When this condition is evident, shut engine down immediately and determine cause. Continued engine operation may result in permanent engine damage.

Step 1. Check engine temperature. Ensure engine temperature is at specified level (TM9-2320-361-10).

If engine temperature is above operating level, perform malfunction 1, steps 9 and 10.