

**RESTRICTED****TM 9-1729A****\*C 1****EDITING****TECHNICAL MANUAL**

**ORDNANCE MAINTENANCE: LIGHT TANK M24, 105-MM  
HOWITZER MOTOR CARRIAGE M37, 155-MM HOWITZER  
MOTOR CARRIAGE M41, AND TWIN 40-MM GUN MOTOR  
CARRIAGE M19A1: ENGINES, COOLING SYSTEMS  
AND FUEL SYSTEMS**

CHANGES }  
No. 1 }

DEPARTMENT OF THE ARMY  
WASHINGTON 25, D. C., 9 April 1951

TM 9-1729A, 28 November 1944, is changed as follows:

The classification of this manual is changed to **RESTRICTED**.

The title of this manual is changed to: **ORDNANCE MAINTENANCE: LIGHT TANK M24, 105-MM HOWITZER MOTOR CARRIAGE M37, 155-MM HOWITZER MOTOR CARRIAGE M41, AND TWIN 40-MM GUN MOTOR CARRIAGE M19A1: ENGINES, COOLING SYSTEMS, AND FUEL SYSTEMS.**

## **1. Scope**

a. The instructions contained in this manual are for the information and guidance of personnel charged with the maintenance and repair of the Light Tank M24, and Motor Carriages M19A1, M37, and M41. These instructions are \* \* \* TM's or FM's.

b. This manual contains \* \* \* and fuel systems. Included are the 3G series engines used on M19A1, M24, M37, and M41 vehicles. All figures and references pertaining to the M5, M5A1, and M8 vehicles are deleted. 1G series engines will be converted for use in the M24 Light Tank. Instruction for the converted 1G series engines will be issued in a subsequent change.

\* \* \* \* \*

## **2. Field and Depot Maintenance Allocation** (Superseded)

The publication of instructions for complete disassembly and rebuild is not to be construed as authority for the performance by field maintenance units of those functions which are restricted to depots and arsenals. In general, the prescribed maintenance responsibilities are based upon availability of tools, parts, and

\* This change supersedes TB 9-1729A-2, 20 December 1945; TB 9-1729A-3, 19 February 1946; and portions of TB ORD 191, 15 September 1944; TB ORD 257, 26 February 1946, pertaining to the matériel contained herein.

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trained personnel and will apply as reflected in the allocation of maintenance parts listed in the appropriate columns of the current ORD 8 supply catalog pertaining to the Light Tank M24, and Motor Carriages, M37, M41, and M19A1. Instructions for depot maintenance are to be used by maintenance companies in the field only when the tactical situation makes the repair functions imperative. Provisions of parts listed in the depot guide column of ORD 8 supply catalogs will be made to field maintenance only when the emergency nature of the maintenance to be performed has been certified by a responsible officer of the requisitioning organization.

**2.1 Forms, Records, and Reports**

(Added)

*a.* **GENERAL.** Forms, records, and reports are designed to serve necessary and useful purposes. Responsibility for the proper execution of these forms rests upon commanding officers of all units maintaining this matériel. It is emphasized, however, that forms, records, and reports are merely aids. They are not a substitute for thorough practical work, physical inspection, and active supervision.

*b.* **AUTHORIZED FORMS.** The forms generally applicable to units maintaining this equipment are listed in the appendix. No forms other than those approved for the Department of the Army will be used. For a current and complete listing of all forms, see current SR 310-20-6. Additional forms applicable to the using personnel are listed in the operators manuals. For instructions on use of these forms, refer to FM 9-10.

*c.* **FIELD REPORT OF ACCIDENTS.** The reports necessary to comply with the requirements of the Army safety program are prescribed in detail in the SR 385-10-40 series of special regulations. These reports are required whenever accidents involving injury to personnel or damage to matériel occur.

*d.* **REPORT OF UNSATISFACTORY EQUIPMENT OR MATERIALS.** Any suggestions for improvement in design and maintenance of equipment, safety and efficiency of operation, or pertaining to the application of prescribed petroleum fuels, lubricants, and/or preserving materials, will be reported through technical channels, as prescribed in SR 700-45-5 to the Chief of Ordnance, Washington 25, D.C., ATTN: ORDFM, using DA AGO Form 468, Unsatisfactory Equipment Report. Such suggestions are encouraged in order that other organizations may benefit.

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**CHAPTER 1.1**

**TROUBLE SHOOTING**  
(Added)

**Section I. GENERAL**

**2.2 Purpose**

*Note.* Information in this chapter is for use of ordnance maintenance personnel in conjunction with and as a supplement to the trouble shooting section in the pertinent operator's manual. It provides the continuation of instructions where a remedy in the operator's manual refers to ordnance maintenance personnel for corrective action.

Operation of a deadlined vehicle without a preliminary examination can cause further damage to a disabled component and possible injury to personnel. By careful inspection and trouble shooting such damage and injury can be avoided and, in addition, the causes of faulty operation of a vehicle or component can often be determined without extensive disassembly.

**2.3 General Instructions and Procedures**

This chapter contains inspection and trouble shooting procedures to be performed while a disabled component is still mounted in the vehicle and after it has been removed.

a. The inspections made while the component is mounted in the vehicle are for the most part visual and are to be performed before attempting to operate the vehicle. The object of these inspections is to avoid possible damage or injury and also to determine the condition of and, when possible, what is wrong with the defective component.

b. The trouble shooting performed while the component is mounted in the vehicle is that which is beyond the normal scope of organizational maintenance. Check the trouble shooting sections of TM 9-717, TM 9-729, TM 9-744, and TM 9-757, then proceed as outlined in this chapter. These trouble-shooting operations are used to determine if the fault can be remedied without removing the component from the vehicle and also, when subsequent removal is necessary, to indicate when repair can be made without complete disassembly of the component.

c. Inspection after the component is removed from the vehicle is performed to verify the diagnosis made when the component was in the vehicle, to uncover further defects, or to determine

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faults if the component alone is received by the ordnance establishment. This inspection is particularly important in the last case because it is often the only means of determining the trouble without completely disassembling the component.

## Section II. ENGINE AND WATER PUMP

### 2.4 General

Most engine troubles are actually accessory troubles. The trouble-shooting section of TM 9-729, or of other pertinent operator's manuals, will normally cover trouble shooting of all engine accessories while mounted on the engine. This section covers only those troubles which can develop within the engine itself.

### 2.5 Procedures

*a. SEIZURE OF PARTS.* When an engine cannot be turned over by hand or with the starter, either seizure of parts or hydrostatic lock is the cause. See pertinent operator's manual for procedure if hydrostatic lock is present. Generally, if hydrostatic lock is not present, seizure can be isolated to the crankshaft and attached parts, or the camshaft and related parts, by removing the timing chain and sprockets (par. 6a(17)) and turning the crankshaft and camshaft by hand. Disassemble seized unit and perform necessary repair operations.

**Caution:** Exercise great care in deciding what inspection and repairs must be performed. Parts in the nonseized section may be strained or bent and require replacement, or presence of chips may require a complete disassembly and cleaning of the engine lubricating system.

*b. ENGINE OPERATES UNEVENLY.*

- (1) *Valves sticking, warped, or burned.* Perform compression test as explained in pertinent operator's manual. If compression isn't brought up to normal by injecting oil in the cylinder, improper valve action is indicated. Remove and inspect valves (par. 6a(14)), correct deficiencies (par. 7e(5)), and install (par. 15a(16)).
- (2) *Pistons, rings, or cylinders worn.* Perform compression test as explained in pertinent operator's manual. If pressure is nearly normal with oil sealing, it indicates that pistons, rings, or cylinders are worn or damaged. Disassemble engine and repair and/or replace any defective parts.

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c. **CLICKING NOISES SYNCHRONIZED WITH CAMSHAFT SPEED.** Check oil level and change oil if it is gritty or dirty. Blow out oil lines to valve lifter assemblies. If noise persists, remove (par. 6a(13)), clean, inspect (par. 11), and install hydraulic valve lifter assemblies (par. 15a(17)).

d. **HEAVY KNOCKS SYNCHRONIZED WITH CRANKSHAFT SPEED.**

(1) Crankshaft or connecting-rod bearings may be worn or burned out. Remove bearings (par. 6), inspect crankshaft (par. 9), install new and proper oversize bearings if needed, and assemble (par. 15).

(2) Pistons or rings may be broken or damaged. Remove piston assemblies (par. 6a(23)), clean, inspect, repair (par. 8), and install (par. 15a(8)).

e. **WORN OIL-PUMP GEARS.** Remove oil filter inlet pipe at front of cylinder block and install pressure gage. If pressure is below 12 psi, with engine idling, remove pump (par. 6a(21)), rebuild (par. 13), and install in engine (par. 15a(27)).

f. **DEFECTIVE WATER PUMP.** Rebuild water pump (par. 23).

## 6. Disassembly

a. **PROCEDURE.**

\* \* \* \* \*

(14) *Remove valves.* Delete NOTE pertaining to special tools at end of this subparagraph.

\* \* \* \* \*

## 7. Engine Block and Heads

\* \* \* \* \*

d. **INSPECTION.**

\* \* \* \* \*

(2) *Cylinder bores.* Visually inspect cylinder \* \* \* cylinder indicator gage. If cylinder is tapered more than 0.0127-inch for repair, and 0.0067 inch for engine rebuild, measured from top to bottom of ring travel, reboring or rehonng will be necessary. If bores are \* \* \* in subparagraph e.

(3) *Valve guides.* Inspect valve guides \* \* \* or hole gage. If guide diameter is worn beyond the serviceability standard dimensions (par. 16.04 f) measured 1/8-inch from bottom of counterbore, or is otherwise not in satisfactory condition, replace as outlined in subparagraph e.

\* \* \* \* \*

**RESTRICTED****e. REPAIR.****(1) Valve guide replacement.**

- (a) *Remove valve guides.* Insert valve guide replacer -41-D-2993 in valve guide and drive down into valve compartment, using a heavy hammer (fig. 35). Catch guide before \* \* \* 15 valve guides.

\* \* \* \* \*

**(3) Fitting pistons.**

\* \* \* \* \*

- (d) (Added.) *Use feeler gages.* For selective fit of new pistons, insert piston, without piston rings, in the cylinder with a  $\frac{1}{2}$ -inch wide feeler gage. The clearance is correct if a 6- to 8-pound pull is required to remove a feeler gage that is between 0.002 and 0.003 inches. For used pistons, use a  $\frac{1}{2}$ -inch feeler gage that runs the full length of the cylinder. Maximum clearance is 0.006-inch feeler stock with a 6- to 8-pound pull.

\* \* \* \* \*

**8. Piston and Connecting Rod Assemblies**

\* \* \* \* \*

**d. INSPECTION.**

\* \* \* \* \*

- (3) *Piston and rings.* Go over piston \* \* \* with feeler gage. Gap should not exceed 0.023 inch.

\* \* \* \* \*

**9. Crankshaft and Flywheel Assembly, and Camshaft**

\* \* \* \* \*

**d. INSPECTION AND REPAIR.**

- (1) *Crankshaft* (Superseded.) Mount crankshaft assembly between centers and measure the run-out on the center main bearing journal. If the run-out exceeds 0.001 inch, the shaft should be straightened. Before attempting to straighten the shaft, the approximate location of the bend should be determined. To determine this location, check the run-out at each edge of the machined surface of all main bearing journals. If the journals are out of round more than 0.00175, regrind to undersize as required.
- (2) *Camshaft.* Inspect camshaft carefully \* \* \* through 180°.

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If run-out of more than 0.004-inch total indicator reading is discovered, camshaft is sprung. **Straighten** camshaft.

**Caution:** Camshaft is \* \* \* or other damage.

\* \* \* \* \*

*e.* **ASSEMBLY.**

- (1) *Assemble flywheel to crankshaft.* If crankshaft is \* \* \* six cap screws. **Plastic type gasket cement must be used on the gasket and on the flywheel-to-crankshaft mounting screws.** Tighten screws to \* \* \* with lock wire.

## **11. Valve Lifters**

\* \* \* \* \*

*c.* (Superseded) **NORMAL SERVICING, SERVICE PRECAUTIONS, AND TOLERANCES.**

- (1) *Normal servicing.* Normal service will consist of removal for valve grinding or some other repair or replacement, in which case it is only necessary to wash the hydraulic lifters. When washing the hydraulic lifters, remove the plungers from the hydraulic cylinders one at a time to prevent interchanging, wash them thoroughly in clean dry-cleaning solvent or volatile mineral spirits paint thinner, and install them in the engine without making any attempt to fill them with oil before assembly. After assembly, check clearance, using a screwdriver to pry the plunger down. While running the engine, the units should become quiet within 45 minutes. The time required for any given unit to become quiet is not indicative of the quality but means only that the particular unit has to dispose of a larger amount of air. The engine should be run at the lowest speed which produces maximum oil pressure, until all valve lifters have become quiet.
- (2) *Sticking caused by carbon.* After considerable use in an engine, carbon may form on the inside of the cylinder bore (A, fig. 47.1) above travel of the plunger, making the plunger appear to be stuck in the cylinder. Removal of the valve stem from the top of the plunger allows the plunger to move upwards and the hydraulic unit to completely fill with oil (B, fig. 47.1). The carbon which has formed on the inside of cylinder above the shoulder on the plunger makes removal of the plunger very difficult and, since the unit has filled with oil, the plunger cannot be forced down because the oil is trapped by the check ball, giving the impression of a stuck unit. To free the unit, use the following procedure:



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- (a) Press the plunger all the way down while holding the check valve off its seat with a match stick (C, fig. 47.1) or other blunt instrument. This will allow the oil to escape and in most cases the carbon which has formed above the plunger can usually be broken by twisting the plunger and pulling outward at the same time.
- (b) If the carbon is built up considerably and cannot be removed easily, place the unit in carbon-remover solvent to dissolve the carbon ring. Once the plunger has been removed, any carbon remaining on the cylinder will be cleaned off with a rough cloth. Wash the cylinder and plunger thoroughly before assembling.

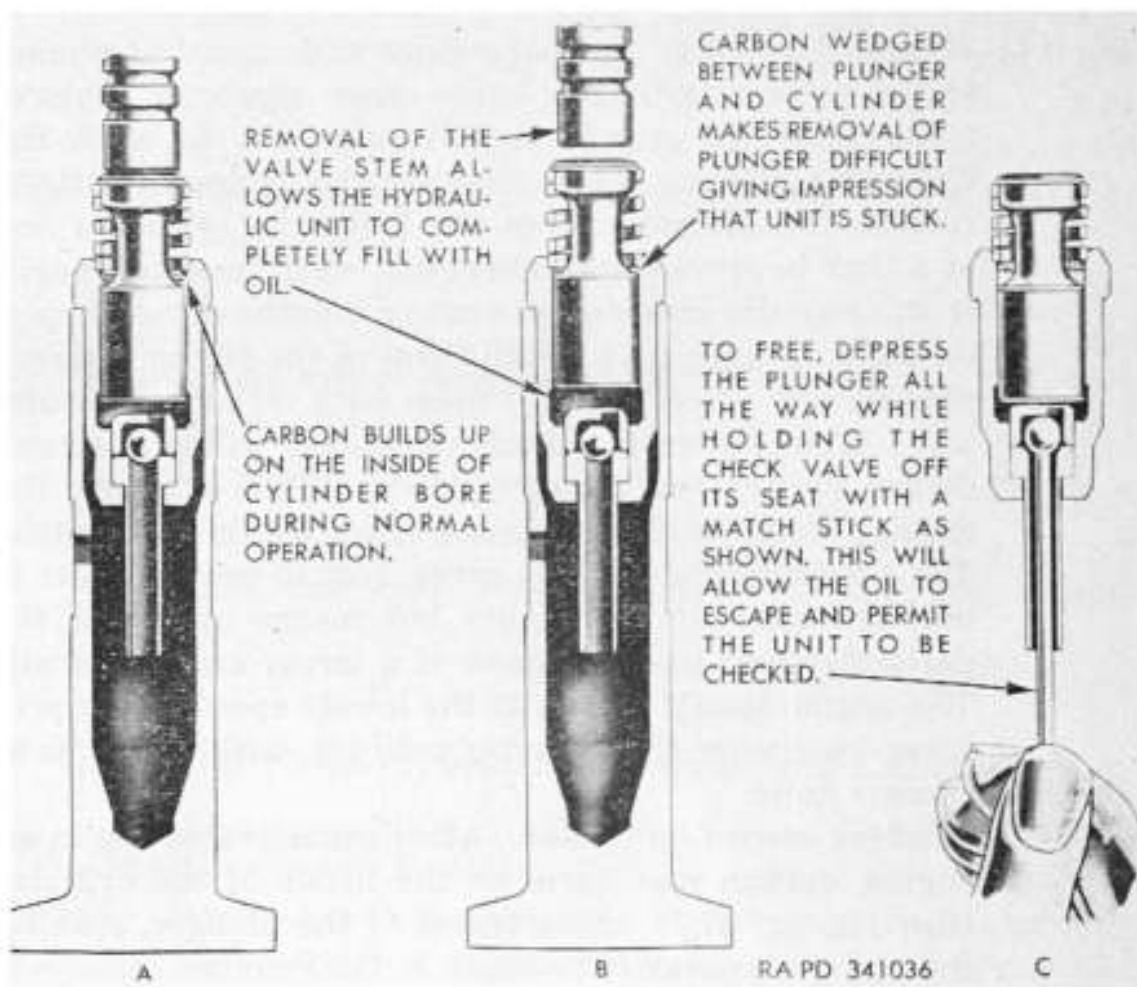


Figure 47.1 (Added) Cross-section views of hydraulic valve lifter.

(3) *Service precautions.*

- (a) The plunger (fig. 47) in the hydraulic unit is not interchangeable in the cylinder. Tests for the rate of leakdown are made after assembly and these tests, not the diametric clearances, determine the quality of the unit. Always install cylinder assembly as a unit.



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- (b) Any time the plunger is removed from the cylinder bore and installed, the plunger spring should be snapped into the counterbore of the hydraulic cylinder. This can readily be done by a slight counterclockwise twisting motion of the plunger.
  - (c) It is never permissible to do any kind of grinding or machining on the hydraulic units. In cases where valves have been reseated to a depth which would require increasing their mechanical clearance, grind off the valve stems to provide this clearance.
  - (d) Do not use shellac or gasket cement of any kind at any point where it will be possible for it to get into the hydraulic lifters, as this will glue the check ball to the seat and prevent its operation.
  - (e) If a bearing failure occurs in engine or one or more lifters are stuck because of dirty oil, the entire crankcase and all oil lines should be thoroughly cleaned and blown out with compressed air.
- (4) *Tolerances.*
- (a) The valve-lifter body itself (fig. 47) must be a free fit in the guide. A proper test for this is to insure that the tappet will drop of its own weight in the guide.
  - (b) The check valve and the fit between the plunger and the cylinder must be checked for excessive leakage. This is accomplished after cleaning by installing plunger in cylinder, pushing plunger all the way in to the point where plunger spring just clears but does not touch the cylinder, and releasing plunger quickly. Plunger should pop back out almost to the point it started from when pushed in. If this does not happen, either check valve is leaking, or plunger is leaking in cylinder. This test actually determines whether fit of plunger in cylinder will hold air pressure momentarily, and therefore care should be exercised that plunger spring is not permitted to help return the plunger to starting point.
  - (c) To determine if check valve is leaking, hold finger over end of pipe protruding from bottom of cylinder and again push plunger all the way into cylinder and release quickly. If plunger does not pop up, plunger is leaking in cylinder and entire cylinder assembly must be replaced. If plunger does pop out, it indicates check valve is leaking. Clean check valve thoroughly again

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by soaking in dry-cleaning solvent or volatile mineral spirits paint thinner and blowing out with compressed air. Again check by pushing plunger into cylinder and releasing quickly. If plunger still does not pop up, it indicates check valve or check valve seat is damaged or worn and entire cylinder assembly must be replaced.

\* \* \* \* \*

Figure 54. Compressing rear main bearing oil seal with compressor-41-C-2554.

## 15. Assembly Procedure

### a. ASSEMBLY PROCEDURE.

\* \* \* \* \*

- (8) *Install connecting rod and piston assemblies.* Lubricate pistons and \* \* \* in proper order. Tighten all connecting rod screws, using the connecting rod socket wrench-41-W-2598-500 and a torque wrench-(41-W-3631). Screws should be \* \* \* foot-pounds (fig. 58).

\* \* \* \* \*

- (12) *Install timing chain and sprockets.* Delete NOTE at the end of this subparagraph.

\* \* \* \* \*

- (16) *Install valves.* Position No. 1 cylinder \* \* \* gage-41-G-504 (fig. 64). This distance should be a minimum of 2.990 inches. Check gage before using. If tool will not slide freely between lower end of valve stem and heel of cam, end of valve stem should be ground off square until 2.990-to 3.010-inch clearance is obtained. Install valve stem \* \* \* *after hearing click.*

*Note.* If lifter 41-L-1408 is used, the valve stem locks must be installed by hand.

\* \* \* \* \*

The nomenclature in figure 64, is changed from "3.000" to "2.990."

The nomenclature in figure 69, is changed as follows: TORQUE WRENCH-41-W-3631.

## Section V. TEST AND ADJUSTMENT

(Superseded)

### 16. Preliminary Adjustments and Connections

a. BEFORE-TEST ADJUSTMENT. Before testing the engine, make the following adjustments in accordance with procedures in pertinent technical manuals.