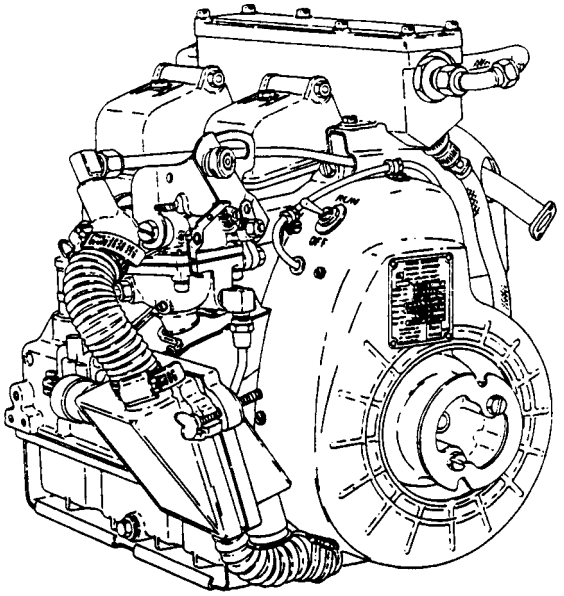
*ARMY TM 9-2805-257-14
AIR FORCE TO 38G2-103-2
NAVY NAVFAC P-8-612-14E

TECHNICAL MANUAL

**OPERATOR, UNIT, DIRECT SUPPORT,
GENERAL SUPPORT MAINTENANCE MANUAL**



ENGINE, GASOLINE, 3 HP,
MILITARY STANDARD MODELS
(MODEL 2A016-1, NSN 2805-00-601-5127)
(MODEL 2A016-2, NSN 2805-00-714-8553)
(MODEL 2A016-3, NSN 2805-00-072-4871)
(MODEL 2A016-4, NSN 2805-01-169-1100)

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**HEADQUARTERS, DEPARTMENT OF THE ARMY,
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15 AUGUST 1990

ARMY TM 9-2805-257-14
AIR FORCE TO 38G2-103-2
NAVY NAVFAC P-8-612-14E
C3

CHANGE

NO. 3

HEADQUARTERS, DEPARTMENTS OF ARMY
THE AIR FORCE, AND THE NAVY
WASHINGTON, D. C., 30 April 1997

Operator, Unit, Direct Support, General Support Maintenance Manual

ENGINE, GASOLINE, 3 HP MILITARY STANDARD MODELS
(MODEL 2A016-1, NSN 2805-00-601-5127)
(MODEL 2A016-2, NSN 2805-00-714-8553)
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AIR FORCE TO 38G2-103-2
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C2

CHANGE

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General Support Maintenance Manual

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4-3 through 4-6	4-3 through 4-6
4-43 and 4-44	4-43 and 4-44
5-15 and 5-16	5-15 and 5-16

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AIR FORCE TO 38G2-103-2
NAVFAC P-8612-14E
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Operator, Unit, Direct Support,
General Support Maintenance Manual

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MILITARY STANDARD MODELS
(MODEL 2A016-1, NSN 2805-00-601-5127)
(MODEL 2A016-2, NSN 2805-00-714-8553)
(MODEL 2A016-3, NSN 2805-00-72-4871)
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AIR FORCE TO 38G2-103-2
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WARNING

Dry cleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°F–138°F (38°C–60°C).

WARNING

Serious eye injury can result from the starter rope knot. Wear eye protection when pull starting engine.

Before starting engine or operating any of the components insure that no loose bars, tools, or parts are lying in or on any part of the equipment, as they could cause serious damage to equipment or bodily injury to personnel.

Never wear loose clothing, or hanging appendages from person or clothing, while inspecting running engine, moving shafts, or like machinery.

WARNING

If operating the engine or equipment indoors insure that proper ventilation is provided. Carbon monoxide fumes are a colorless, odorless and deadly gas. These gases could cause permanent brain damage or death, if highly concentrated in any certain area. The symptoms are headache, dizziness, loss of muscular control, apparent drowsiness and coma. If exposure symptoms exist, move afflicted person or personnel to properly ventilated area and provide artificial respiration, if necessary.

WARNING

Always provide metal-to-metal contact between fuel container and fuel tank, while refueling, to avoid igniting fuel vapors with a static spark.

Do not refuel while engine is in operation.

Before refueling, insure that adequate fire fighting equipment is serviceable and is standing by for immediate use in event of fire or explosion.

During engine operation, proper fire fighting equipment should be serviceable and kept near in the event that fire is developed by electrostatic spark or detonation of the gas fumes. Do not smoke or use an open flame in the vicinity of these gasoline vapor hazards.

WARNING

Never touch engine or engine accessories with bare hands during operation, or before they have cooled sufficiently. Severe burns can be caused through carelessness.

WARNING

Do not touch the ignition system harness during starting or while in operation. Severe shocks or burns could result, and personnel may be seriously injured.

Disconnect the spark plug cables prior to engine maintenance to prevent accidental starting and severe shock.

WARNING

Operation of the equipment presents a noise hazard to personnel in the area. The noise level exceeds the allowable limits for unprotected personnel. Wear ear muffs or ear plugs which were fitted by a trained professional.

WARNING

Use extreme care when removing coil clamps. Flying clamps can cause serious eye injury. Cover work area with rag or hand when removing clamps

TECHNICAL MANUAL 9- 2805-257-14
TECHNICAL ORDER 38G2-103-2
NAVFAC P-8-612-14E

HEADQUARTERS
DEPARTMENTS OF THE ARMY, AIR FORCE AND NAVY
WASHINGTON, D. C., 15 August 1990

Operator, Unit, Direct Support and General Support Maintenance Manual

ENGINE, GASOUNE, 3 HP MIUTARY STANDARD MODELS (MODEL 2A016-1, NSN 2805-00-60127) (MODEL 2A016-2, NSN *205-00-714* S553) (MODEL 2A016-3, NSN 2805-00-072871) (MODEL 2A016-4, NSN 2805-01-169-1100)

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes, or if you know of a way to improve these procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual directly to: Commander, US Army Aviation and Troop Command, ATTN: AMSAT-I-MP, 4300 Goodfellow Blvd., St. Louis, MO 63120-1798. You may also submit your recommended changes by E-mail directly to <mpmt%avma28@st-louis-emh7.army.mil>. A reply will be furnished directly to you. Instructions for sending an electronic 2028 may be found at the back of this manual immediately preceding the hard copy 2028.

For Air Force, submit AFTO Form 22 (Technical Order System Publication Improvement Report and Reply) in accordance with paragraph 6-5, Section VI, TO. 00-5-1. Forward direct to Commander, San Antonio Air Logistic Center, ATTN: SA-ALC-MMDDA, Kelly Air Force Base, Texas 78241-5000.

For Navy, mail comments to the Commander, Naval Construction Battalion Center, ATTN: Code 15741 F, Bldg. 43, Port Hueneme, CA 93043-5000.

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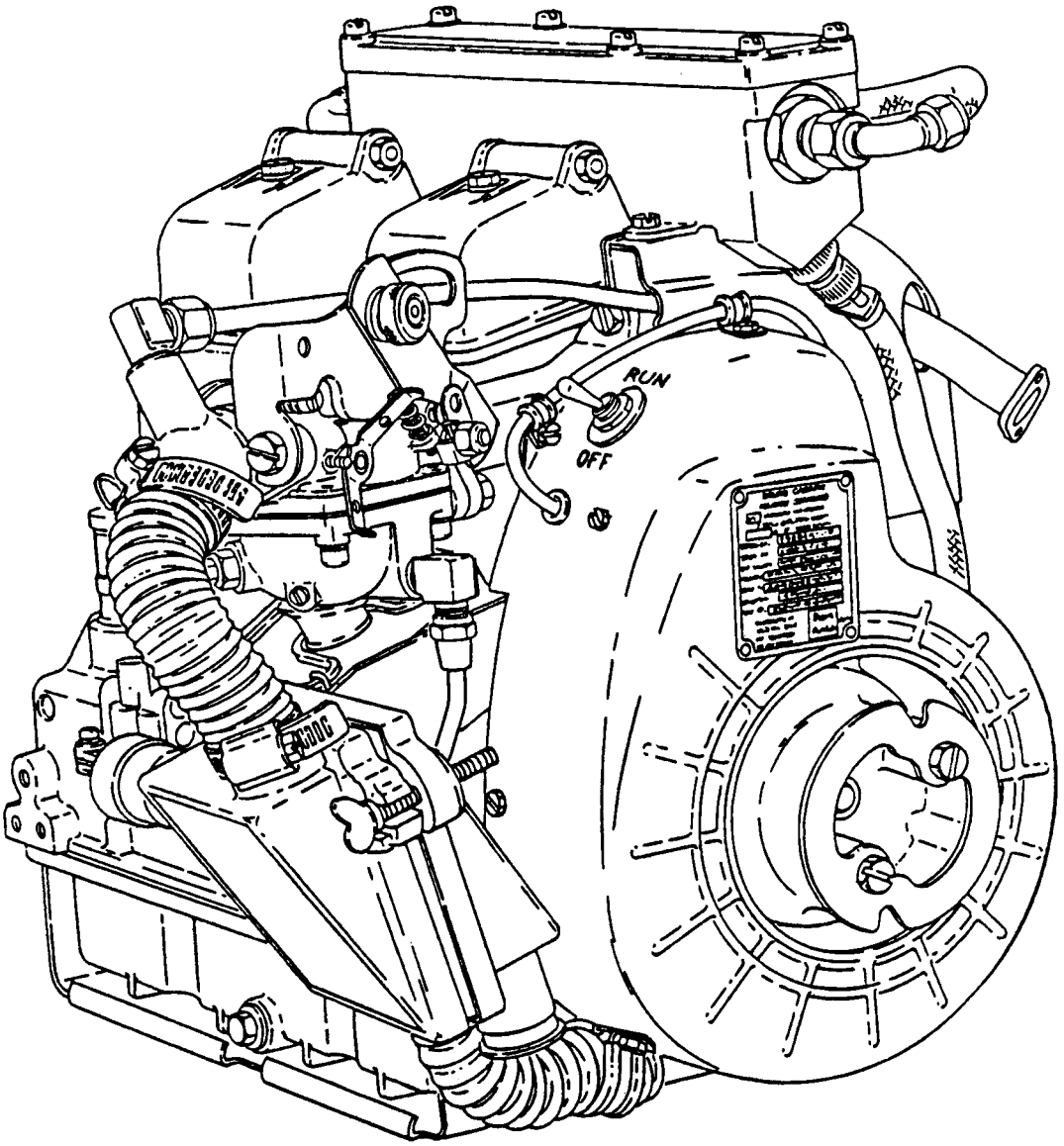

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Figure 1-1. Military Standard Engine.

CHAPTER 1

INTRODUCTION

Page

OVERVIEW 1-1
Section I. General Information 1-1
Section II. Equipment Description and Data. 1-2
Section III. Principles of Operation 1-8

OVERVIEW

This chapter contains general information pertaining to 3 HP Military Standard Engine and its components.

Section I. GENERAL INFORMATION

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1-3 Maintenance Forms, Records, and Reports 1-1
1-4 Reporting Equipment Improvement Recommendations (EIR's) 1-2
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1-6 Preparation for Storage and Shipment 1-2
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1-1. **Scope.** This manual contains operator, unit, direct support and general support maintenance for the 3 HP Military Standard Engine, Models 2A016-1, -2, -3, and -4 (figures 1-1, 1-2, and 1-3).

1-2. **Consolidated Index of Army Publications and Blank Forms.** Refer to the latest issue of DA PAM 25-30 to determine whether there are new editions, changes, or additional publications pertaining to the equipment

1-3. **Maintenance Forms, Records and Reports.**

a. *Reports of Maintenance and Unsatisfactory Equipment.* Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA Pam 738-750, as contained in Maintenance Management Update. Air Force personnel will use AFR 66-1 (Air Force Maintenance Management Policy) for maintenance reporting and TO-00-35D54 for unsatisfactory equipment reporting. Navy personnel will report maintenance performed utilizing the Maintenance Data Collection Subsystem (MDCS) IAW OPNAVINST 4790.2, Vol 3 and unsatisfactory material/conditions (UR submissions) IAW OPNAVINST 4790.2, Vol 2, chapter 17.

b. *Reporting of Item and Packaging Discrepancies.* Fill out and forward SF 364 (Report of Discrepancy (ROD)) as prescribed in AR 735-11-2/DLAR 414-.55/SECNAVINST 4355.18/AFR 400-54/MCO 4430.3J.

c. *Transportation Discrepancy, Report (TDR) (SF 361).* Fill out and forward Transportation Discrepancy Report (TDR) (SF 361) as prescribed in AR 55-28/NAVUSPINST 4610.33C/AFR 75-18/MCO P4610.19D/DLAR 4500.1 5.

1-4. Reporting Equipment Improvement Recommendations (EIR).

a. *Army.* If your Military Standard Engine needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design or performance. Put it on an SF 368 (Product Quality Deficiency Report). Mail it to us at: Commander, U.S. Army Aviation and Troop Command, A'TN: AMSATIMDO, 4300 Goodfellow Boulevard, St. Louis, MO 631201798. We will send you a reply.

b. *Air Force.* Air Force personnel are encouraged to submit EIR's in accordance with AFR 900-4.

c. *Navy.* Navy personnel are encouraged to submit EIR's through their local Beneficial Suggestion Program.

1-5. Destruction of Army Materiel to Prevent Enemy Use. Refer to TM 750-244-3 for procedures to destroy equipment to prevent enemy use.

1-6. Preparation for Storage or Shipment. RefertoChapter4, Section VI, andTB740-97-2 for procedure to place the equipment into storage.

1-7. Glossary. Not applicable.

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1-10 Location and Description of Major Components (Models 1A08-3, -4) 1-5
1-11 Equipment Data 1-7
1-12 Differences Between Models 1-8
1-13 Safety, Care, and Handling 1-8

1-8. Equipment Characteristics, Capabilities and Features. The Military Standard Engine is an air cooled, single cylinder, four cycle gasoline engine. The engine is capable of developing 3 HP at 3600 RPM.

1-9. **Location and Description of Major Components (Models 2A016-1, -2)** (figure 1-2).

1 Carburetor – Mixes air and fuel and delivers it to the engine

2 Air Cleaner – Cleans air going into the carburetor

3 Fuel Pump – Delivers fuel to carburetor

4 Crankshaft – Delivers power developed by engine to other external end items

5 Governor - Regulates maximum speed of engine

6 Spark Plug – Delivers spark to air fuel mixture

7 Flywheel - Provides air for cooling engine during operation

8 Oil Pan – Serves as a reservoir for engine oil

9 High Tension Cable – Delivers high voltage electrical charge to spark plug

10 Starter Flange - Provides area for starter rope to be attached to the engine when pull starting engine

11 Starter Rope - Used to pull start engine

12 Fuel Filter - Cleans fuel going to engine

13 Oil Gage and Filler Tube – Provides the means to check engine oil level and to add oil as needed.

14 Throttle Control (Model 2A016-2) – Adjusts engine speed from idle to full governed position.

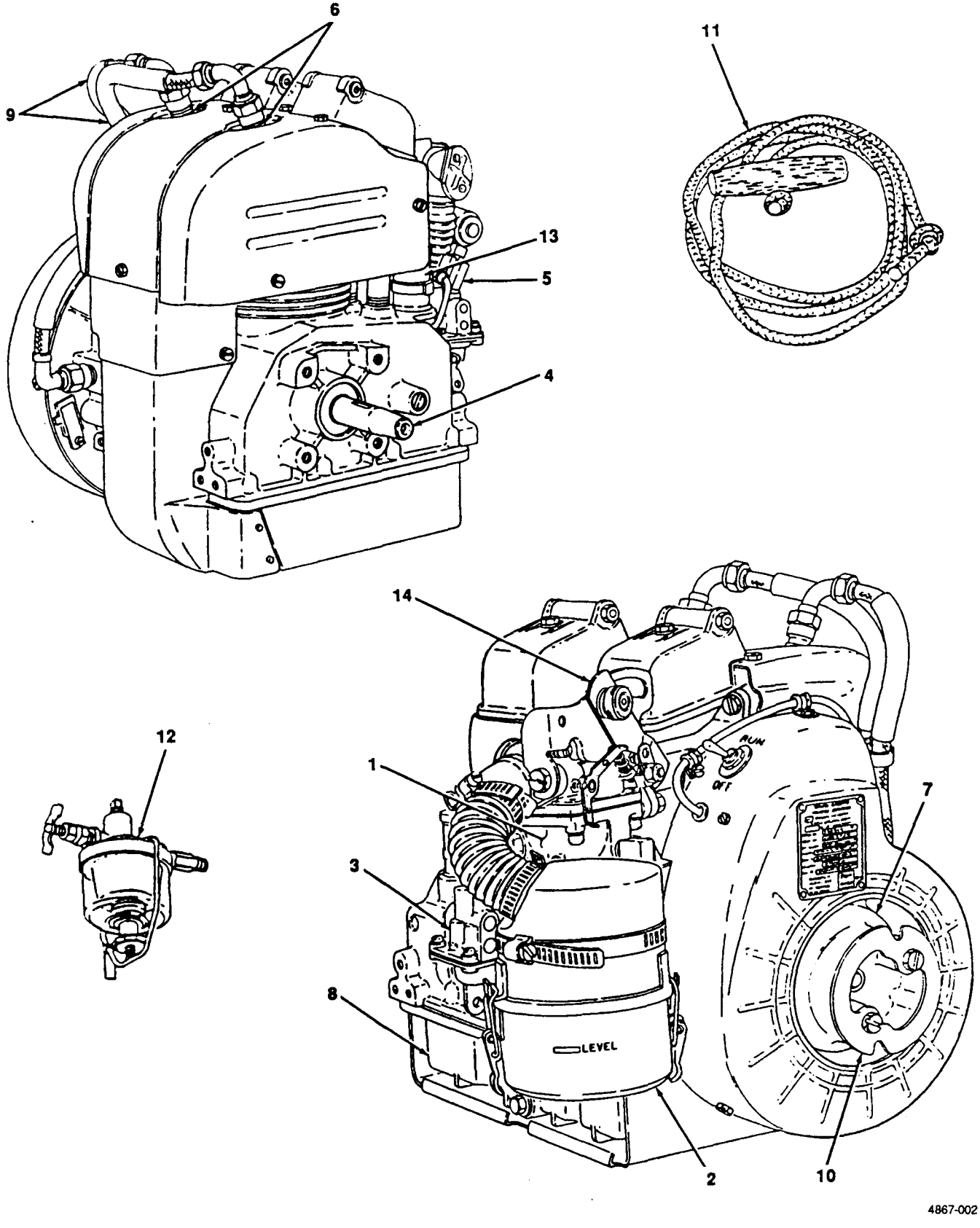

Figure 1-2. Location and Description of Major Components Models 2A016-1, -2.

1-10. Location and Description of Major Components (Models 2A016-3, -4) (figure 1-3).

1 Carburetor - Mixes air and fuel and delivers it to the engine

2 Air Cleaner- Cleans air going into the carburetor

3 Fuel Pump - Delivers fuel to carburetor

4 Crankshaft - Delivers power developed by engine to other external end items

5 Governor - Regulates maximum speed of engine

6 Ignition Control Unit (Model 2A016-4) – Regulates spark delivery to spark plug

7 Spark Plug - Delivers spark to air fuel mixture

8 Flywheel - Provides air for cooling the engine during operation

9 High Tension Cable – Delivers high voltage electrical charge to spark plug

10 Starter Rope - Used to pull start engine

11 Starter Flange - Provides area for starter rope to be attached to engine when pull starting engine

12 Fuel Filter – Cleans fuel going to engine

13 Low Voltage Cable – Delivers control voltage to ignition control unit

14 Service Indicator – Indicates when air cleaner assembly requires servicing

15 Throttle Control - Adjusts engine speed from idle to full governed position

16 Oil Pan – Serves as reservoir for engine oil

17 Oil Gage and Filler Tube - Provides the means to check engine oil level and to add oil as needed.

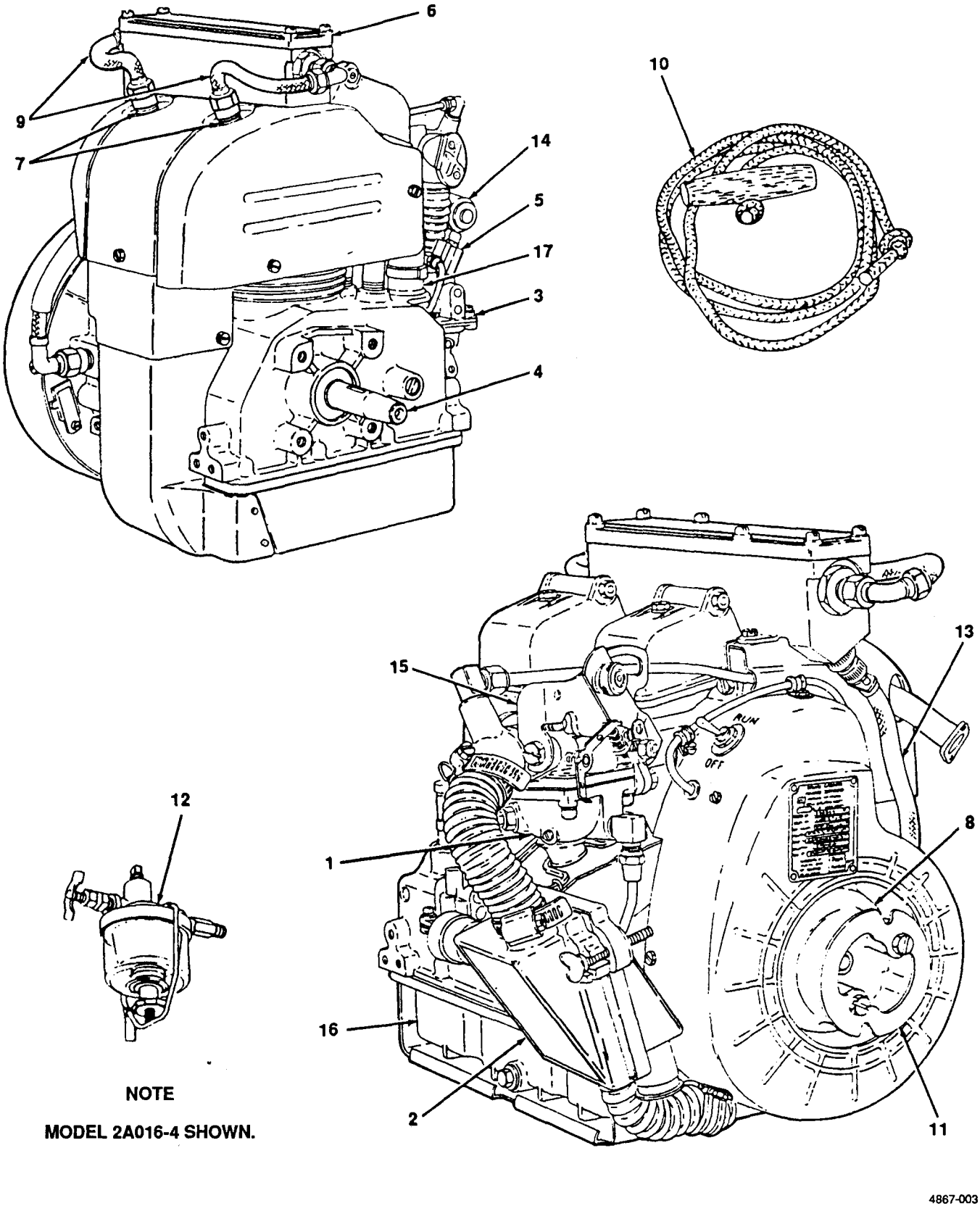

Figure 1-3. Location and Description of Major Components Models 2A016-3, -4.

1-11. **Equipment Data.**

a. General.

Engine model . . . . . 2A016-1, -2, -3, and -4
Type . . . . . 4 cycle gasoline powered air cooled
Number of cylinders 2
Horse power rating . . . . . 3 HP at 3600 r.p.m.
Fuel pump . . . . . Diaphragm 3.0-4.5 psi (20.7-31.0 Kpa) outlet pressure
Spark plug
Gap . . . . . .028-.033 in. (.071-.083 cm)
Breaker points
Gap . . . . . .016-.020 in. (.040-.050 cm) Models 2A016-1, -2, and -3
Valve tappet clearance cold
Intake and exhaust . . . . . .007-.009 in. (.017-.027 cm)
Governor
Type . . . . Centrifugal flyweights
Oil capacity
All models . . . . . 4/5 qt. (.77 L)

b. Dimensions and Weight Model 2A016-1.

Length . . . . . .16in. (40.64 cm)
Width . . . . . 16-3/4 in. (42.50 cm)
Height . . . .15-9/16 in. (39.55 cm)
Weight . . . . 45 lbs (20.43 kg)

c. Dimensions and Weight Model 2A016-2.

Length . . . . 16in. (40.64 cm)
Width . . . . . 16-3/4 in. (42.50 cm)
Height . . . .15-9/16in. (39.55 cm)
Weight . . . . 45 lbs (20.43 kg)

d. Dimensions and Weight Model 2A08-3.

Length . . . .18-3/4 in.(46.62 cm)
Width . . . . . 18-1/3 in. (46.56 cm)
Height . . . .17-1/2 in.(44.45 cm)
Weight . . . . 46 lbs (20.88 kg)

e. Dimensions and Weight Model 2A08-4.

Length . . . .18-3/4 in.(46.62 cm)
Width . . . . . 18-1/3 in. (46.56 cm)
Height . . . .17-1/2in.(44.45 cm)
Weight . . . . 49.9 lbs (22.65 kg)

1-12. **Differences Between Models.** All four models of the Military Standard are the same except for the following differences:

a. Models 2A016-1, -2 are equipped with wet air cleaners. Models 2A016-3, -4 have dry air cleaners with service indicators.

b. Model 2A016-1 is equipped with stop button. Models 2A016-2, -3, -4 are equipped with ignition switches.

c. Model 2A016-4 has a breakerless ignition system. Models 2A016-1, -2, -3 have a breaker point system with condenser.

d. Models 2A016-2, -3, -4 are equipped with throttle controls.

1-13. **Safety, Care, and Handling.** Observe all WARNINGS, CAUTIONS and NOTES in this manual. This equipment can be extremely dangerous if these instructions are not followed.

Section Ill. PRINCIPLES OF OPERATION

1-14. Principles of Operation.

a. General. The 3 HP Military Standard engine is a four cycle two cylinder, air cooled, gasoline powered internal combustion engine. The engine develops its full rated capacity at a governed 3600 r.p.m.

b. Simplified Principles of Operation. A starter flange, on the flywheel fan, provides a means to connect the starter rope for pull starting the engine. An inline fuel filter cleans the fuel supplied to the engine. The filter comes equipped with a fuel cutoff valve, that when closed, stops fuel flow to the engine. The engine comes equipped with either an oil bath or a dry element air cleaner. Both types of air cleaners provide the same amount of filtering, but the dry element air cleaner has two unique features, a built in service indicator and an air inlet control. The service indicator signals when the element requires cleaning. The inlet temperature control varies the amount of unheated air entering the air cleaner. On model 2A016-1 a stop button is used to terminate engine operation. On models 2A016-2, -3 and -4 a two position ignition switch is used. When the switch is in the RUN position the engine can be started. Setting the switch to OFF terminates engine operation

c. Detailed Principles of Operation.

(1) *Fuel system.* The fuel system is composed of a fuel filter, fuel pump, fuel line, and carburetor. The fuel filter is a bowl type with a filtering screen. The screen filters dirt and other foreign materials from the fuel. The fuel pump drains fuel from an external fuel supply through the fuel filter, and delivers it to the carburetor. The fuel pump, a diaphragm type, is driven by the camshaft. The fuel pump can be operated manually, using the priming lever. This allows the fuel system, between the pump and the carburetor, to be primed before starting the engine. The carburetor mixes the air, from the air cleaner, and the fuel. This is then delivered to the combustion chamber where it is compressed and burned.

(2) *Cooling system.* The flywheel fan draws cool air into the flywheel fan cover, where it is then directed by the cylinder head covers, and oil pan cover. The air flows around the cylinder and cylinder head assembly and cools the engine.

(3) *Air supply.* The air cleaner, whether oil bath or dry element, cleans the air going to the carburetor. The oil bath air cleaner uses oil to remove dirt from the air. The dry element air cleaner uses a dry fiber element to remove dirt from the air. As the element gets dirty, air flow through it decreases and creates a vacuum in the air cleaner. When air flow decreases too much, the service indicator shows a red signal and indicates the element requires cleaning.

(4) *Speed regulation.* All four models of the engine are equipped with a centrifugal flyweight governor connected to the carburetor by a control rod. The governor determines the fastest speed at which the engine will run. Model 2A016-1 has no speed regulation other than the adjustment of the governor. Model 2A016-2, -3 and -4 are equipped with throttle controls which overrides the function of the governor. The throttle control allows the engine speed to be adjusted between idle and full governed speed.

(5) *Ignition system.* There are two different types of ignition systems used on the engine. Model 2A016-1, -2, and -3, all use a breaker point ignition system. A set of breaker points triggers a condenser and coil to produce a high voltage electric charge. This charge is then delivered, through a shielded ignition cable, to the spark plug located in the cylinder head. This charge creates a spark at the spark plug electrode, and ignites the air/fuel mixture in the combustion chamber. Model 2A016-4 uses a breakerless ignition system. This system uses electronic components to generate the high voltage electric charge to ignite the air/fuel mixture.

(6) *Lubrication.* Lubrication of the rocker and valve assemblies is accomplished by drawing oil vapors from the crankcase into the cylinder head assembly. A breather line connects the cylinder head with the air intake elbow, mounted between the carburetor and air cleaner assembly. On Model 2A016-1, the breather line is connected directly to the air cleaner assembly. The vacuum in the breather line is sufficient to draw oil vapors from the crankcase, up through the push rod tubes, and into the cylinder head assembly.

CHAPTER 2

OPERATING INSTRUCTIONS

Page

OVERVIEW 2-1
Section I. Description and Use of Operator's Controls and Indicators 2-1
Section II. Preventive Maintenance Checks and Services (PMCS) 2-4
Section III. Operation Under Usual Conditions 2-7
Section IV. Operation Under Unusual Conditions 2-10

OVERVIEW

This chapter contains instructions and procedures required to operate the engine safely and efficiently.

Section I. DESCRIPTION AND USE OF OPERATORS' CONTROLS AND INDICATORS

Paragraph Page

2-1 General 2-1
2-2 Operator's Controls and Indicators 2-1

2-1. **General.** This section contains a list of operator controls and indicators and a description of their use.

2-2. **Operator's Control and Indicators.** The following is a list of operator controls and indicators for all models of the 3 HP Military Standard Engine. Although the appearance of the engine may vary between models the location and function of the controls and indicators are similar (figure 2-1).

Key	Control or Indicator	Function
1	Choke	Used during engine start-up to reduce airflow through carburetor, making starting easier.
2	Air Cleaner Service Indicator	Indicates to operator when air cleaner requires servicing.
3	Throttle Control Models 2A016-2, -3, and -4	Allows operator to regulate speed of engine between idle speed and full governed speed.
4	Oil Filler Tube and Gage	Allows operator to check oil level in engine, and provides means for adding oil as needed.
5	Ignition Switch Models 2A016-2, -3, and -4	Used to stop engine.

Key	Control or Indicator	Function
6	Engine Stop Button Models 2A016-1	Depressing button stops engine.
7	Starter Rope	Used to pull start engine.
8	Fuel Shutoff Valve	Stops fuel flow from fuel filter.
9	Starter Flange	Provides area for starter rope to be attached when pull starting engine.
10	Fuel Primer Lever	Used to prime fuel system.
11	Inlet Temperature Control	Used to adjust amount of cold air entering air cleaner.

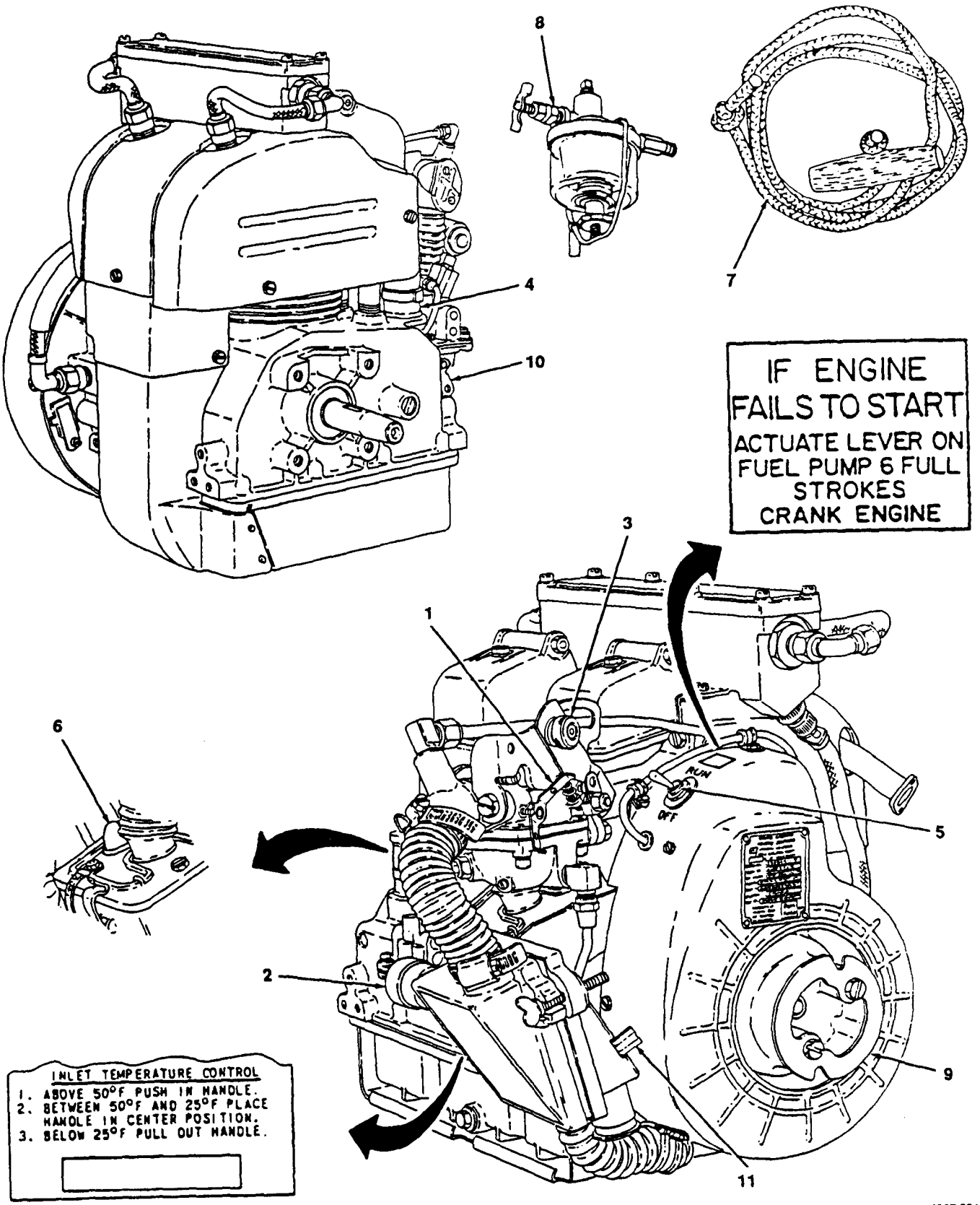

Figure 2-1. Operator's Controls and Indicators.

Section II. PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

Paragraph Page

2-3 General 2-4
2-4 Purpose of PMCS Table 2-4
2-5 Explanation of Columns 2-4
2-6 Equipment is Not Ready/Available If Column 2-4
2-7 Reporting Deficiencies 2-5
2-8 Special Instructions 2-5

2-3. **General.** Operator PMCS are performed to ensure that the engine is ready for operation at all times. Perform the checks and services at the specified intervals.

a. Before you operate, perform your before (B) PMCS. Observe all CAUTIONS and WARNINGS.

b. While you operate, perform your during (D) PMCS. Observe all CAUTIONS and WARNINGS.

c. After you operate, be sure to perform your after (A) PMCS.

d. If your equipment fails to operate, refer to paragraph 3-3.

2-4. **Purpose of PMCS Table.** The purpose of the PMCS table is to provide a systematic method of inspection and servicing the equipment. In this way, small defects can be detected early before they become a major problem causing the equipment to fail to complete its mission. The PMCS table is arranged with the individual PMCS procedures listed in sequence under assigned intervals. The most logical time (before, during, or after operation) to perform each procedure determines the interval to which it is assigned. Make a habit of doing the checks in the same order each time and anything wrong will be seen quickly. See paragraphs 2-5 and 2-6 for an explanation of the columns in table 2-1.

2-5. **Explanation Of Columns.** The following is a list of the PMCS table column headings with a description of the information found in each column.

a. Item No. This column shows the sequence in which the checks and services are to be performed, and is used to identify the equipment area on the Equipment Inspection and Maintenance Worksheet, DA Form 2404.

b. Interval. This column shows when each check is to be done.

c. Item to be Inspected/Procedures. This column identifies the general area or specific part where the check or service is to be done, and explains how to do them.

d. Equipment is Not Ready/Available If. See paragraph 2-6.

2-6. **Equipment is Not Ready/Available If Column.** This column lists conditions that make the equipment unavailable for use because it is unable to perform its mission, or because it would represent a safety hazard. Do not accept or operate equipment with a condition in the “Equipment is Not Ready/Available If” column.

NOTE

The terms ready/available and mission capable refer to the same status: Equipment is on hand and is able to perform its combat mission. Refer to DA Pam 738-750.

2-7. **Reporting Deficiencies.** If any problem with the equipment is discovered during PMCS or while it is being operated that cannot be corrected at the operator/crew maintenance level, it must be reported. Refer to DA Pam 738-750 and report the deficiency using the proper forms.

2-8. **Special Instructions.** Preventive maintenance is not limited to performing the checks and services listed in the PMCS table.

WARNING

Drycleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°F - 138°F (38°C - 60°C).

a. Keep it clean. Dirt, grease, oil, and debris get in the way and may cover up a serious problem. Clean as you work and as needed. Use drycleaning solvent on all metal surfaces. Use soap and water to clean rubber or plastic material.

b. Bolts. Nuts. and Screws. Check them all for obvious looseness, missing, bent, or broken condition. You can't try them all with a tool, but look for chipped paint, bare metal, or rust around boltheads. If you find one you think is loose, tighten it, or report it to unit maintenance if you can't tighten it.

c. Electrical Wires and Cable Connectors. Look for bare wires, and loose or broken connectors. Report defects to unit maintenance.

d. Fluid Lines. Look for wear, damage, and leaks. Make sure clamps and fittings are tight. Wet spots and stains around a fitting or connector can mean a leak. If a leak comes from a loose connector, tighten it. If something is broken or worn out, report it to unit maintenance.

e. Leakage Definitions. It is necessary for you to know how fluid leakage affects the status of your equipment. The following are definitions of the types/classes of leakage you need to know to be able to determine the status of your equipment. Learn and be familiar with them. When in doubt, NOTIFY YOUR SUPERVISOR!

Leakage Definitions:

Class I	Seepage of fluid (as indicated by wetness or discoloration) not great enough to form drops.
Class II	Leakage of fluid great enough to form drops but not enough to cause drops to drip from item being checked/inspected.
Class III	Leakage of fluid great enough to form drops that fall from the item being checked/inspected.

CAUTION

Equipment operation is allowable with minor leakage (Class I or II) of any fluid except fuel. Of course, consideration must be given to the fluid capacity in the item being checked/inspected. When in doubt, notify your supervisor.

When operating with Class I or II leaks, continue to check fluid level more often than required in the PMCS. Parts without fluid will stop working and/or cause equipment damage.

Class Ill leaks should be reported to your supervisor or unit maintenance.

f. Painting. Touch-up engine as needed. Refer to TM 43-0139 for specific painting procedures.

Table 2-1. Operator Preventive Maintenance Checks and Services (PMCS).

B - Before D – During A – After

Item No.	Interval B	Interval D	Interval A	Item to be Inspected Procedure	Equipment is Not Ready/Available If
1	•			ENGINE	
				a. Visually inspect engine for signs of damage or missing parts.	
	•	•		b. Inspect engine for evidence of fuel or oil leaks.	Class III oil leak, or Class I fuel leak is detected.
	•			c. Check fuel filter for evidence of contaminated fuel. Notify unit maintenance if fuel is contaminated.	Fuel filter contains contaminated fuel.
	•		•	d. Perform lubrication on engine. Refer to LO 9-2805-257-12 for lubrication instructions.	
		•		e. Listen to engine for unusual sounds, rough running, or excessive exhaust smoke.	
2	•	•	•	AIR CLEANER SERVICE INDICATOR	
				Check indicator, and notify unit maintenance when indicator is in the red area.	Indicator is in the red area.
3	•			STARTER ROPE ASSEMBLY	
				Inspect starter rope for cuts or signs of fraying.	Starter rope assembly is worn or damaged.

Section III. OPERATION UNDER USUAL CONDITIONS

Paragraph Page

2-9 Starting Procedure 2-7
2-10 Stopping Procedures 2-9

2-9. **Starting Procedures.** (figure 2-2)

a. Open fuel shutoff valve (1) on fuel filter (2).

b. Rotate choke control lever (3) counterclockwise and close choke.

c. On models 2A016 -2, 3, and -4, place throttle control (4) approximately 1/4 in. from idle position.

d. On models 2A016-2, 3, and -4, set ignition switch (5) to RUN position.

e. On models 2A016-3, -4, set inlet temperature control as follows:

(1) Above 50°F (10°C) push in handle (6).

(2) Between 50-25°F(10° (-4)°C), place handle (6) in center position.

(3) Below 25° (-4°C) pull out handle (6).

WARNING

Operation of the equipment presents a noise hazard to personnel in the area. The noise level exceeds the allowable limits for unprotected personnel. Wear ear muffs or ear plugs which were fitted by a trained professional.

Serious eye injury can result from the starting rope knot. Wear eye protection when pull starting engine.

f. Wind starter rope (7) clockwise around starter flange (8) and pull briskly.

g. When the engine has started, rotate the choke control lever (3) clockwise until the choke is fully opened, and the engine will continue to run.

NOTE

It maybe necessary on models 2A016-2, -3, and -4 to rotate the throttle control counterclockwise to obtain a smooth idle.

h. Allow engine to warm-up for at least 3 minutes.

i. On models 2A016-2, -3, and -4, after warm-up, move throttle control counterclockwise to the full governed position.

j. Apply end item load. Refer to End Item Operators Manual.

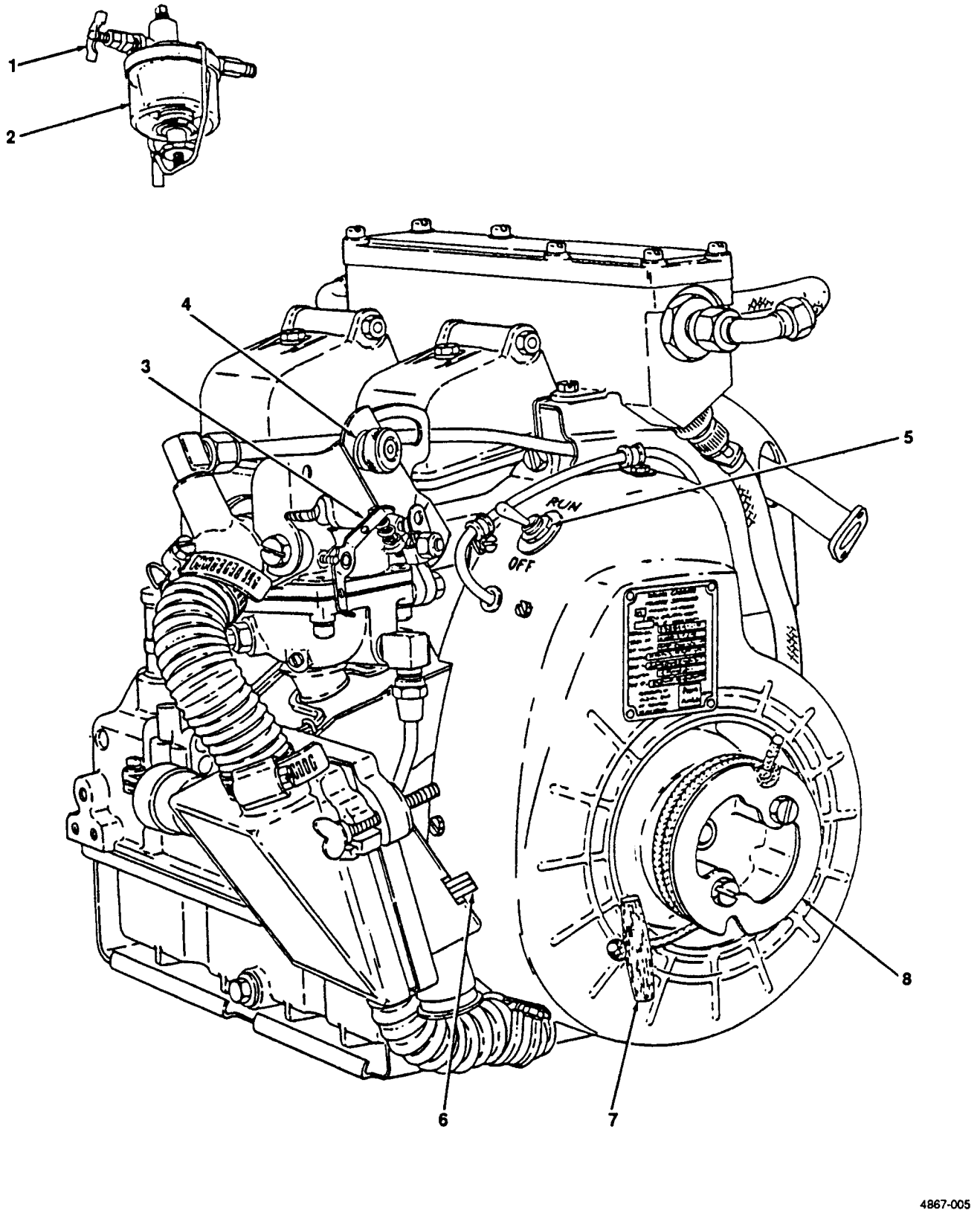

Figure 2-2. Starting Procedures.

2-10 **Stopping Procedures.** (figure 2-3)

a. Remove end item load. Refer to End Item Operators Manual.

b. Rotate throttle control (1) clockwise to idle position, and allow engine to idle for at least 2 minutes.

c. On models with stop button (2), stop engine by pushing button.

d. On models with ignition switch (3), set switch to OFF position.

e. Close fuel shutoff valve (4) on fuel filter (5).

f. Perform After Operation PMCS.

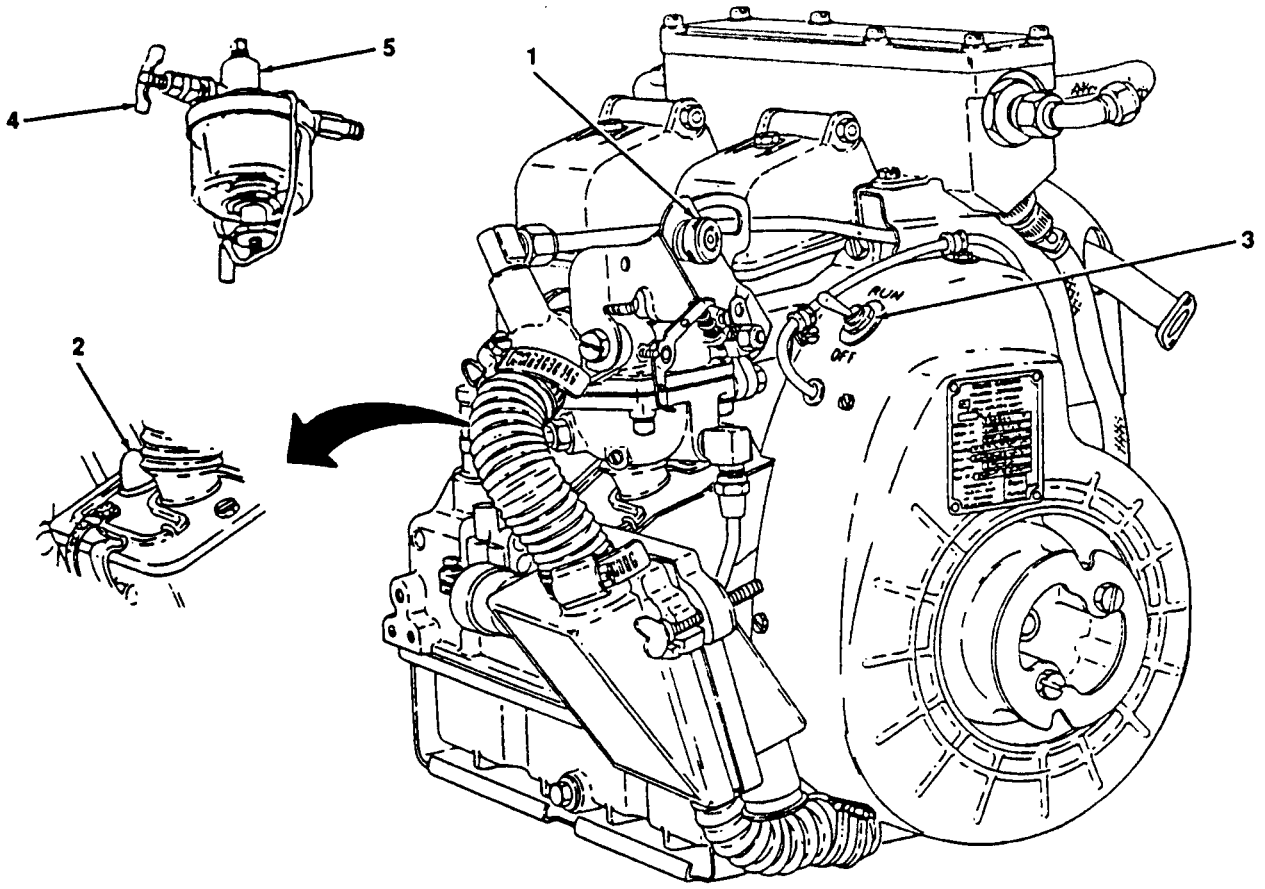

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Figure 2-3. Stopping Procedures.

Section IV. OPERATION UNDER UNUSUAL CONDITIONS

Paragraph Page

2-11 Operation in Dusty or Sandy Areas... 2-10
2-12 Operation in Rainy, Humid, or Salt Air Conditions 2-10
2-13 Operation in Extreme Heat 2-10
2-14 Operation at Different Altitudes 2-10
2-15 Operation in Extreme Cold 2-11

2-11. **Operation in Dusty or Sandy Areas.** The procedures for operating the engine are the same as under usual conditions except for the following special precautions:

a. Keep fuel, lubrication, ignition and cooling systems free of dust and sand.

b. Inspect air cleaner assembly more often when operating in dusty or sandy areas. Have unit maintenance service air cleaner element as needed.

c. In the event of severe dust or sand storms, provide a well protected sheltering device for the engine.

d. Remove all dust or sand from the engine and inspect for damage.

2-12. **Operation in Rainy, Humid, or Salt Air Conditions.** The procedures for starting and stopping the engine are the same as under usual conditions except for the following special precautions:

a. Remove all visible signs of corrosion as soon as possible.

b. Keep fuel lines, and ignition lines as dry as possible.

c. If possible, store engine indoors.

d. Use a thin layer of oil or desiccants to keep corrosion to a minimum.

2-13. **Operation in Extreme Heat.** The procedures for starting and stopping the engine are the same as under normal condition except for the following special precautions:

a. Check oil level more often when operating in extreme heat.

b. Allow engine to cool off longer after removing end item load.

c. In extreme hot temperatures, the engine will run efficiently but at a reduced horse power rating. For each 10°F (12.2°C) above 60°F(15.5°C) a 1 percent loss of power should be expected.

2-14. **Operation at Different Altitudes.** The procedures for starting and stopping the engine are the same as under usual conditions. The engine will operate at altitudes of up to 5000 feet above sea level but at a reduced horse power rating. For every 1000 feet above sea level, a 3.5 percent power loss should be expected.

2-15. **Operation in Extreme Cold.** The engine can be operated in temperatures a cold as -25°F (-32°C). The procedures for starting and stopping are the same as under usual conditions excepts for the following special precautions.

a. Protect the engine from icing. Remove ice and snow from engine as often as possible,

b. Allow engine sufficient warm-uptime before apply end item load.

CHAPTER 3

OPERATOR'S MAINTENANCE INSTRUCTIONS

Page

OVERVIEW 3-1
Section I. Lubrication Instructions 3-1
Section II. Operator Troubleshooting Procedures 3-1

OVERVIEW

This chapter contains operator level maintenance instructions.

Section I. LUBRICATION INSTRUCTIONS

Paragraph Page

3-1 General 3-1
3-2 Lubrication 3-1

3-1. **General.** This section contains operator lubrication instructions.

3-2. **Lubrication.** Refer to L0 9-2805-257-12 and perform operator level lubrication procedures. Operate the engine (para. 2-9) for at least 5 minutes, after lubrication. Stop the engine (para. 2-10) and perform operator level after operation Preventive Maintenance Checks and Services (PMCS).

Air Force personnel use applicable T.O. 35C2-3-1-426 work cards for lubrication instructions.

Section II. OPERATOR TROUBLESHOOTING

Paragraph Page

3-3 General 3-1
3-4 Operator Troubleshooting Procedures.. 3-1

3-3. **General.** This section contains troubleshooting procedures to determine the probable cause of observed equipment malfunctions. Inspections are provided to isolate the faulty component and corrective actions are provided to eliminate the malfunction.

3-4. **Operator Troubleshooting Procedures.** Refer to the Symptom Index to locate the troubleshooting procedure for the observed malfunction.

a. Table 3-1 lists the common malfunctions which you may find during operation of 3 HP Military Standard Gasoline Engine Models 2A016-1, -2, -3, and -4, and its components. Perform the test/inspections in the order listed.

b. This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not corrected by listed corrective actions, notify your supervisor.

SYMPTOM INDEX

Symptom — Page

Engine will not start 3-2
Engine runs excessively hot 3-2
Engine starts but fails to keep running 3-3

Table 3-1. Operator Troubleshooting Procedures.

Malfunction Test or Inspection Corrective Action

1. ENGINE WILL NOT START

Step 1. Check end item fuel supply.

Replenish fuel supply if low.

Step 2. Check fuel cutoff valve

Turn valve counterclockwise to open.

Step 3. Check choke position.

Choke should be in closed position for starting.

Step 4. Check ignition switch models 2A016-2, -3, -4.

Set ignition switch to RUN position.

2. ENGINE RUNS HOT

Step 1. Check oil level.

Replenish oil if low.

Step 2. Check that cooling system ducts, covers, and deflectors are present and serviceable.

Notify unit maintenance if there are damaged or missing items.

Table 3-1. Operator Troubleshooting Procedures (cont).

Malfunction Test or Inspection Corrective Action
3. ENGINE STARTS BUT FAILS TO KEEP RUNNING.
Step 1. Check choke position.
If engine is cold, close choke.
If engine is warm, close choke halfway.
Step 2. Check fuel cutoff valve.
Turn valve counterclockwise to open.

CHAPTER 4

UNIT MAINTENANCE

Page

OVERVIEW 4-1
Section I. Repair Parts; Special Tools; Test, Measurement, Diagnostic Equipment (TMDE); and Support Equipment 4-1
Section II. Service Upon Receipt 4-2
Section III. Unit Preventive Maintenance Checks and Services (PMCS) 4-2
Section IV. Unit Troubleshooting 4-3
Section V. Unit Maintenance Procedures.. 4-7
Section VI. Preparation for Shipment or Storage 4-81

OVERVIEW

This chapter contains those maintenance instructions that unit level maintenance is authorized to perform.

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

Paragraph Page

4-1 Common Tools and Test Equipment 4-1
4-2 Special Tools, TMDE, and Support Equipment 4-1
4-3 Repair Parts 4-1

4-1. **Common Tools and Equipment.** For authorized common tools and equipment, refer to the Modified Table of Organization and Equipment (MTOE) applicable to your unit.

4-2. **Special Tools, TMDE and Support Equipment.** For a listing of special tools, TMDE, and support equipment authorized for use on this equipment, refer to the Repair Parts and Special Tools List, TM 5-2805-257-24P, and the maintenance allocation chart (MAC), appendix B of this manual.

4-3. **Repair Parts.** Repair parts are listed and illustrated in the Repair Parts and Special Tools List for 3 HP Military Standard Engine TM 5-2805-257-24P.

Section II. SERVICE UPON RECEIPT

Paragraph Page

4-4 Inspection 4-2
4-5 Lubrication 4-2
4-6 Testing 4-2

4-4. Inspection.

a. Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, report the damage on SF Form 364, Report of Discrepancy (ROD).

b. Check the equipment against the packing slip to see if the shipment incomplete. Report all discrepancies in accordance with the instructions of DA PAM 738-750.

c. Check to see whether the equipment has been modified.

4-5. **Lubrication.** Refer to L0 9-2805-257-12 and perform unit level and operator level lubrication on engine.

4-6. **Testing.** Perform unit level PMCS, and operator Before (B) PMCS before starting engine. Start engine, para. 2-9, and run for at least 15 minutes. Observe the engine during operation. If any malfunctions arise, troubleshoot using table 4-2.

Section III. UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

Paragraph Page

4-7 General 4-2
4-8 PMCS Procedures 4-2

4-7. **General.** Unit level maintenance PMCS are done to ensure that the engine is in top operating condition. A comprehensive PMCS program reduces equipment downtime and increases the operational readiness of the engine.

4-8. **PMCS Procedures.** Unit level PMCS is contained in table 4-1. The numbers in the item No. column show the order in which the check or service should be done. These numbers should be used when recording deficiencies and shortcomings on DA Form 2404, Equipment Inspection and Maintenance Worksheet. The • in the Interval column indicates when a check or service should be done, as follows:

Table 4-1. Unit Preventive Maintenance Checks and Services (PMCS).

H – Hours D – Daily S – Semiannually (500 Hours)

Item No.	Interval H	D	S	Item to be Inspected	Procedures
1			•	Spark Plug	Clean, inspect, and regap. Refer to para. 4–19.
2			•	High Tension Cables	Clean, inspect, and test Refer to para. 4–18.
3			•	Breaker Points	Inspect, adjust breaker points Models 2A016-1, –2, and –3. Refer to para. 4–30.
4			•	Fuel Filter	Service fuel filter. Refer to para. 4-13.
5			•	Crankcase Ventilation System	Remove, clean, and inspect relief valve. Refer to para 4-24. Remove, clean, and inspect breather line. Refer to para. 4–32.
6		•		Air Cleaner	Service air cleaner daily in extreme heat, dusty, or sandy conditions. Refer to para. 4–20 and 4-21.
7	15			Crankcase Oil	Drain and refill crankcase oil, service oil filter in extreme heat, dusty, or sandy conditions. Refer to LO 5–2805–257–12.

Section IV. UNIT TROUBLESHOOTING

Paragraph Page

4-9 General 4–3
4-10 Troubleshooting 4–3

4-9. **General.** This section contains troubleshooting procedures to determine the probable cause of observed equipment malfunctions. Tests or inspections are provided to isolate the faulty component and corrective actions are provided to eliminate the malfunction.

4-10. **Unit Troubleshooting Procedures.** Refer to the symptom index to locate the troubleshooting procedure for the observed malfunction. The table lists the common malfunctions that may occur during the operation or maintenance of the engine. Perform the tests of inspections, and the recommended corrective action in the order listed in the troubleshooting table. If the malfunction is corrected by a specific correction action, do not continue with the remaining steps, if any, of the troubleshooting procedure. If the malfunction is not corrected by the listed corrective actions notify your supervisor.

SYMPTOM INDEX

Symptom Page

Engine fails to start 4–4
Engine starts but fails to keep running 4–5
Engine misses or runs erratically 4–6
Engine surges or overspeeds 4–6
Engine overheats 4–6

Table 4-2. Unit Troubleshooting Procedures.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

1. ENGINE FAILS TO START.

Step 1. Remove air cleaner cup on models 2A016-1, -2, or remove air cleaner element Model 2A016-3, -4. Start engine.

If engine starts, service air cleaner (par. 4-20).

Step 2. Check ignition switch models 2A016-2, -3, -4 for continuity (para 4-17).

Replace ignition switch if defective (para 4-17).

Step 3. Inspect spark plugs/High tention cable.

a. Clean regap or replace spark plug as necessary (para 4-19).

b. Replace a defective high tension cable (4-18).

Step 4. Check breaker point gap (para 4-30).

Adjust breaker point gap as needed (par. 4-30).

NOTE
This procedure may be performed with either a digital or analog multimeter.

Step 5. Check condenser as follows:

NOTE
The procedures to test the condenser are the same for both condensers. Perform the test on one condenser then repeat the procedures for second condenser.

a. Turn engine over so that breaker points (para. 4-30, figure 4-21) are in open position.

b. Connect positive lead of multimeter to condenser terminal lead.

c. Set multimeter to highest resistance setting and zero meter.

d. Connect second lead of multimeter to ground while observing meter.

If meter shows a deflection, then goes to infinity, then go to next step.

If no deflection occurs or does not go to infinity after deflection, replace condenser (para 4-31).

If meter doesn't return to infinity, remove connection between points and condenser and retest. If deflection occurs, replace points (para. 4-29).

Table 4-2. Unit Troubleshooting Procedures (cont).

Step 6. Check breaker points.

NOTE

The procedures to test breaker points are the same for both sets. Perform the test on one set then repeat procedure for second set.

a. Turn engine over so that breaker points (para. 4-30, figure 4-21) close.

b. Connect one lead of multimeter to condenser terminal.

c. Set multimeter to lowest resistance setting and zero meter.

d. Connect second lead of multimeter to ground while observing meter.

If meter shows full scale deflection, go to next step. If no deflection or partial deflection occurs, then replace breaker point (para. 4-29).

Step 7. Check fuel flow out of fuel filter.

Service fuel filter if fuel does not flow (para. 4-13).

Step 8. Check carburetor adjustments.

Adjust carburetor as needed (para. 4-34).

Step 9. Deleted.

2. ENGINE STARTS BUT FAILS TO KEEP RUNNING.

Step 1. Remove air cleaner cup on models 2A016-1, -2 or remove air cleaner element models 2A016-3, -4. Start Engine.

If engine stays running, service air cleaners (para. 4-20).

Step 2. Check fuel flow out of fuel filter assembly.

If fuel flow is not present or steady, service fuel filter assembly (para. 4-13).

Step 3. Check carburetor adjustments.

Adjust carburetor as needed (para. 4-34).

Table 4-2. Unit Troubleshooting Procedures (cont).

Malfunction Test or Inspection Corrective Action

Step 4. Check fuel pump pressure (para. 4-35).

Replace fuel pump if pressure is inadequate (para. 4-35).

3. ENGINE MISSES OR RUNS ERRATICALLY.

Step 1. Check spark plug.

Clean, regap, or replace worn spark plug (para. 4-19).

Step 2. Check breaker point gap.

Adjust or replace worn breaker points (para. 4-29).

Step 3. Check fuel flow out of fuel filter assembly.

If fuel flow is not present or steady, service fuel filter assembly (para. 4-13).

Step 4. Remove air cleaner cup on models 2A016-1, -2, or remove air cleaner element on models 2A016-3, -4 and start engine.

If engine runs properly, service air cleaner assembly (para. 4-20).

4. ENGINE SURGES OR OVERSPEED.

Step 1. Check Governor.

Adjust governor (para. 4-27).

Step 2. Check carburetor adjustments.

Adjust carburetor as needed (para 4-34).

5. ENGINE OVERHEATS.

Step 1. Check oil level.

Add oil as needed.

Step 2. Check cooling system.

Repair or replace a damaged or missing cooling system component (para. 4-14 thru 4-16).

Section V. UNIT MAINTENANCE PROCEDURES

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4-11. **General.** This section contains unit level maintenance procedures as authorized by the MAC in Appendix B of this manual. Refer to Appendix E, Torque Limits, when performing maintenance on engine. All maintenance procedures require only one person to perform.

4-12. **Painting.** Refer to TM 43-0139 for painting procedures.

4-13. **Fuel Filter Assembly.**

This task covers: a. Disassembly b. Cleaning c. Reassembly

INITIAL SETUP

Tools	*Materials/Parts*
General Mechanic's Tool Kit (Item 1, Appendix B)	Rags, Wiping (Item 6, Appendix D) Solvent, Drycleaning (Item 7, Appendix D)

a. Disassembly. (figure 4-1)

(1) Close fuel shutoff valve (1).

(2) Loosen thumbscrew (2) and swing bail (3) out of way.

(3) Remove bowl (4), gasket (5), and filter screen (6) from fuel filter head (7).

WARNING

Drycleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°F-138°F (38°C-60°C).

(1) Clean fuel filter head (7) using drycleaning solvent.

(2) Clean fuel filter screen (6) using drycleaning solvent and replace if torn or otherwise damaged.

c. Reassembly. (figure 4-1).

(1) Install gasket (5) and filter screen (6) in fuel filter head (7).

(2) Position bowl (4) on fuel filter head (7), swing bail (3) down and secure with thumbscrew (2).

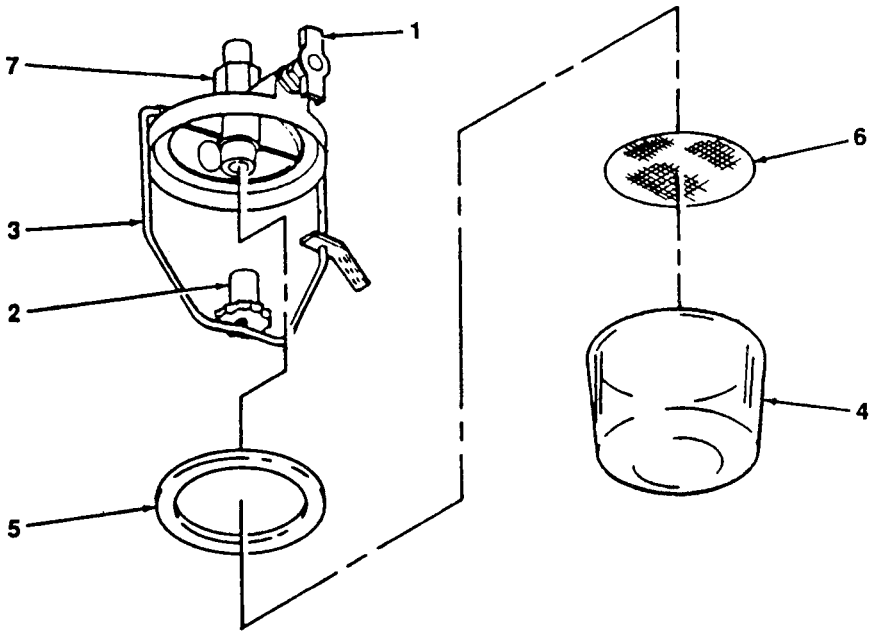

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Figure **4-1.** *Fuel Filter, Disassembly and Reassembly.*

4-14. Flywheel Cover.

This task covers: a. Removal b. Repair c. Installation

INITIAL SETUP

Tools	*Materials/Parts*
General Mechanic's Tool Kit (Item 1, Appendix B)	Rags, Wiping (Item 6, Appendix D) Solvent, Drycleaning (Item 7, Appendix D)

a. Removal. (figure 4-2)

NOTE

Location and quantity of cable clamps varies from model to model. Note location of cable clamps before removing flywheel cover.

(1) Remove seven screws (1) and washers (2) and pull flywheel cover (3) slightly away from engine (4).

NOTE

Step 2 applies to engines equipped with breaker point ignition.

(2) Remove screw (5), washer (6), and nut (7) and remove cable clamp (8) from ignition switch wiring (9).

(3) Tag and remove wiring from ignition switch (10) and remove wiring from flywheel cover (3).

b. Repair. (figure 4-2)

WARNING

Drycleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°F-138°F (38°C–60°C).

(1) Clean flywheel cover (3) with dry cleaning solvent and dry thoroughly.

(2) Remove all dents and repaint flywheel cover as needed.

(3) Inspect rubber grommet (11) and replace if torn or otherwise damaged.

c. Installation. (figure 4-2).

(1) Install ignition switch wiring (9) in flywheel cover (3) and secure with screw (5), washer (6), nut (7), and cable clamp (8).

NOTE

Step 2 applies to engines equipped with breakerless ignition.

(2) Install wiring in clamp (8) and secure with screw (5), washer (6) and nut (7).

(3) Connect wiring to ignition switch (10) as tagged.

NOTE

When installing flywheel cover, install cable clamps.

(4) Install flywheel cover (3) and secure with seven screws (1) and washers (2).

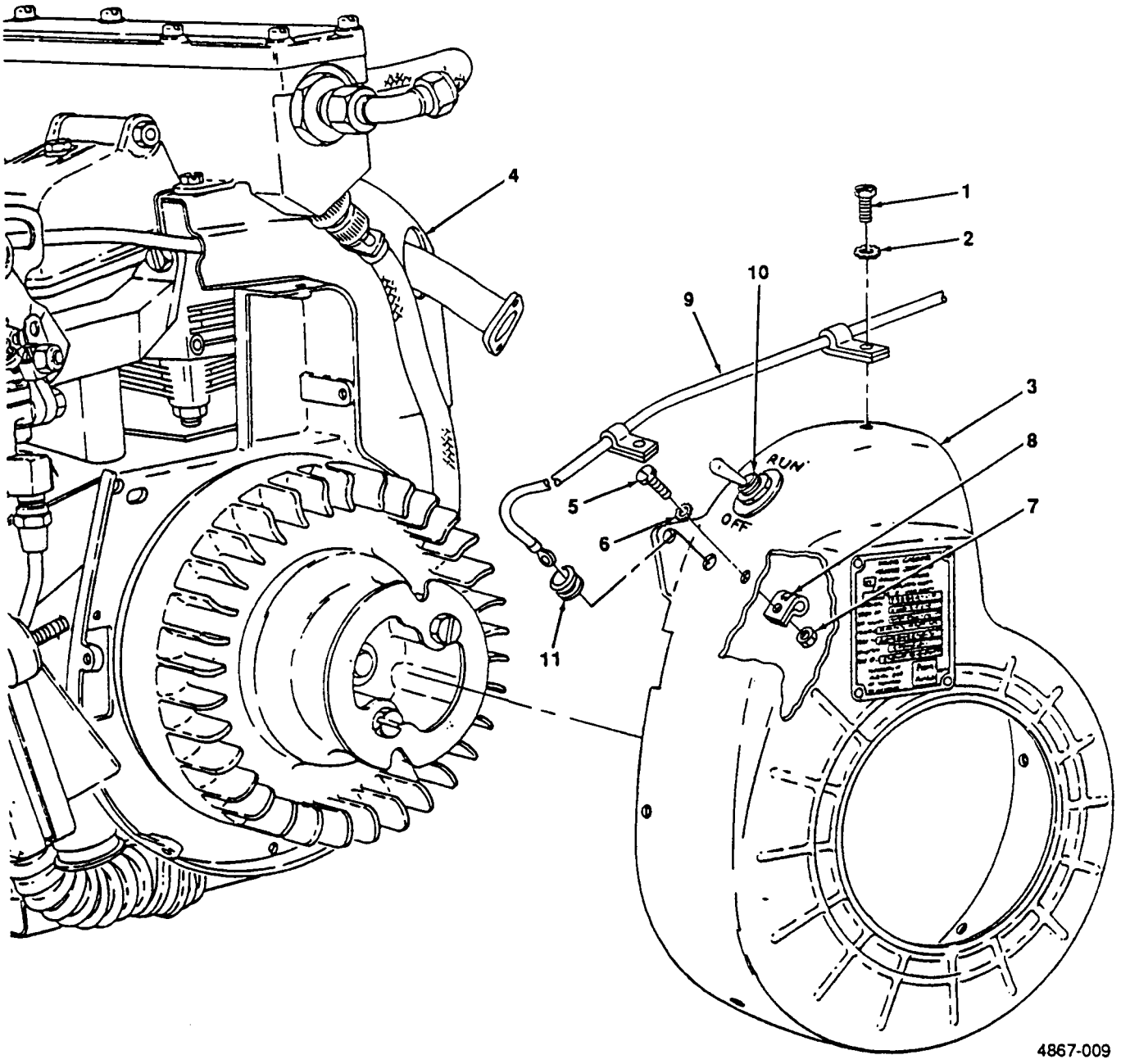

Figure 4-2. Flywheel Cover, Removal and Installation.

4-15. Cylinder Head Covers.

This task covers: a. Removal b. Repair c. Installation

INITIAL SETUP

Tools

General Mechanic's Tool Kit (Item 1, Appendix B)

Equipment Condition

Flywheel cover removed (para. 4-14).

Materials/Parts

Rags, Wiping (Item 6, Appendix D)
Solvent, Drycleaning (Item 7, Appendix D)

a. Removal. (figure 4-3)

NOTE

Step 1 applies to engines equipped with breakerless ignition.

(1) Remove two screws (1) and washers (2) and move ignition control unit (3) out of way.

(2) Remove three (only one on engines with breakerless ignition) screws (4) and washers (5) and remove center cylinder head cover (6) and manifold cover (7).

(3) Remove two (only one on engines with breakerless ignition) screws (8) and washers (9) and remove flywheel side cylinder head cover (10).

(4) Remove three screws (11)and washers (12) and remove crankshaft side cylinder head cover (13).

NOTE

It may be necessary to remove oil level gage to gain access to mounting hardware for the cylinder head cover.

(5) Remove two screws (14) and washers (15) and remove cylinder head cover (16).

b. Repair.

WARNING

Drycleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°F-138°F (38°C-60°C).

(1) Clean all parts in dry cleaning solvent and dry thoroughly.

(2) Repair all dents in cylinder head covers and repaint as necessary.

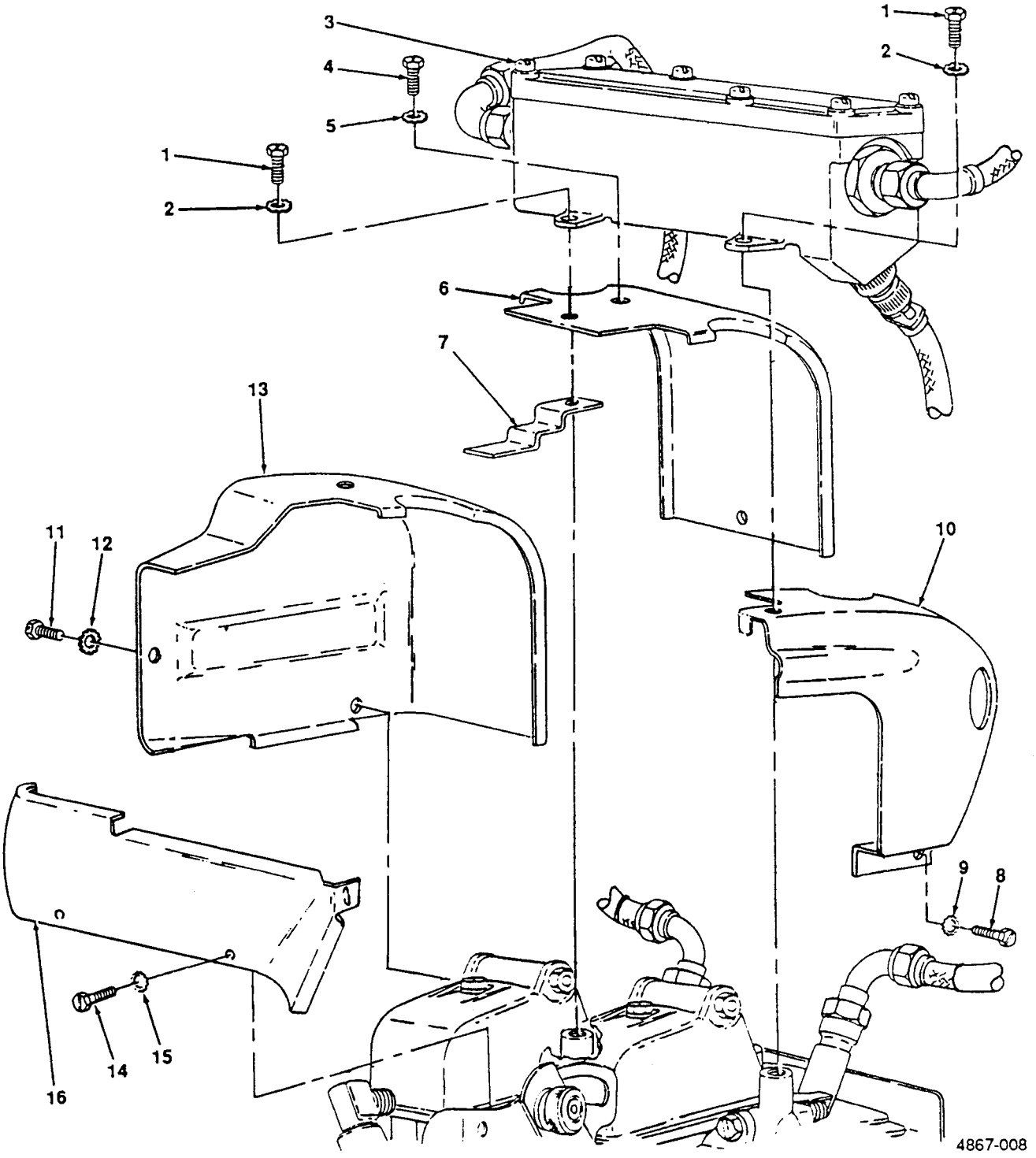

Figure 4-3. Cylinder Head Covers, Removal.

4-15. Cylinder Head Covers (cont).

c. *Installation.* (figure 4-4)

(1) Install cylinder head cover (16) and secure with two screws (14) and washers (15).

(2) Install crankshaft side cylinder head cover (13) and secure with screw (11) and washer (12).

(3) Install flywheel side cylinder head cover (10) and secure with screw (8) and washer (9).

(4) install center cylinder head cover (6) and manifold cover (7) and secure (only on engines equipped with breaker point ignition) with screw (4) and washer (5).

NOTE

Step 5 applies to engines equipped with breakerless ignition

(5) Install ignition control unit (3) and secure with two screws (1) and washers (2).

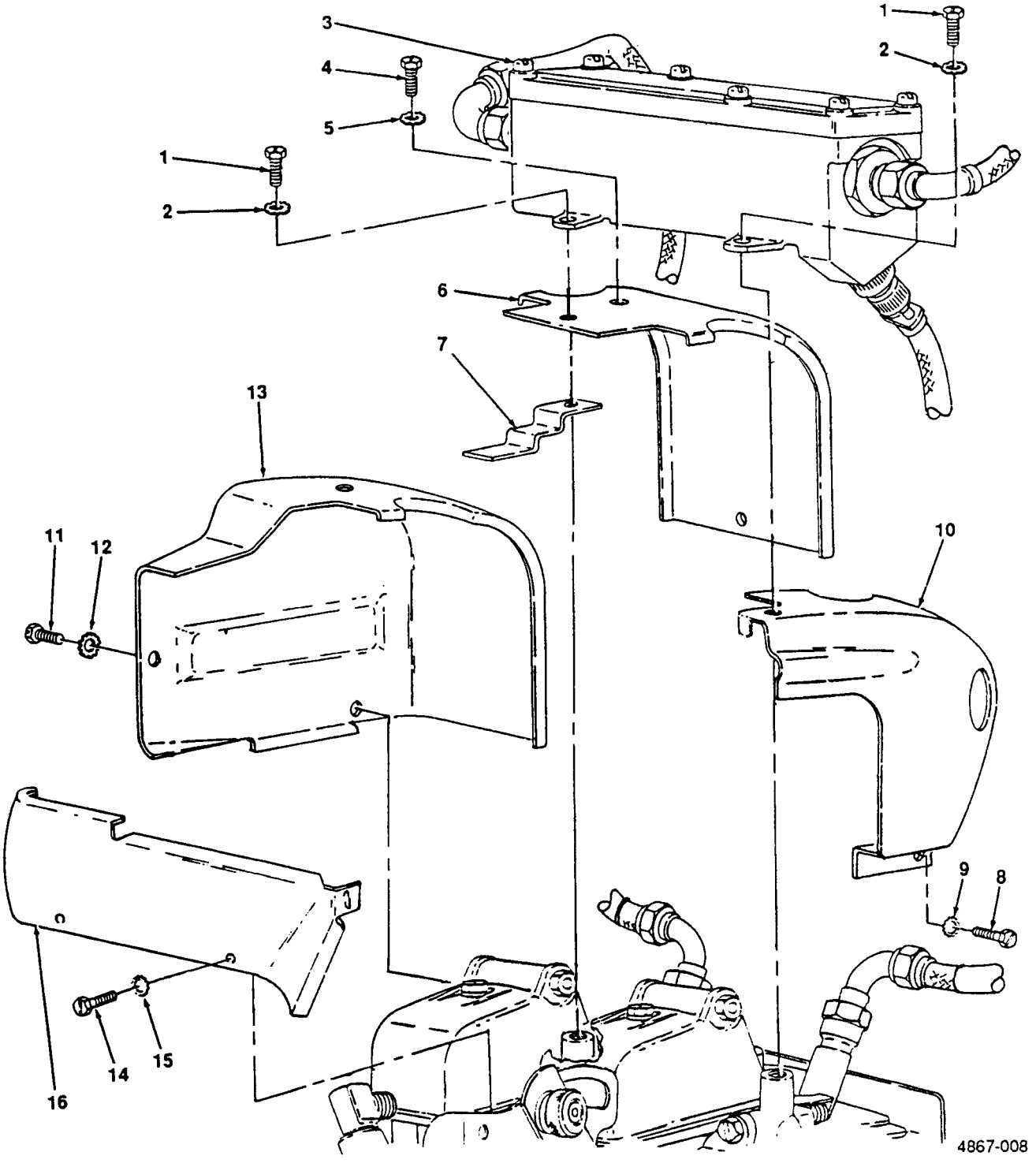

Figure 4-4. Cylinder Head Covers, Installation.

4-16. Lower Air Duct and Upper Air Duct.

This task covers: a. Removal b. Repair c. Installation

INITIAL SETUP

Tools	*Materials/Parts*
General Mechanic's Tool Kit (Item 1, Appendix B)	Rags, Wiping (Item 6, Appendix D) Solvent, Drycleaning (Item 7, Appendix D)

a. Removal. (figure 4-5)

(1) Remove four screws (1) and washers (2) securing lower air duct (3) to oil pan (4).

(2) Remove screw (5), washer (6) and nut (7) and remove lower air duct (3).

(3) Remove three screws (8) and washers (9) and remove upper air duct (10).

b. Repair. (figure 4-5)

WARNING

Drycleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°F–138°F (38°C–60°C).

(1) Clean lower air duct (3) and upper air duct (10) with dry cleaning solvent and dry thoroughly.

(2) Repair all dents and repaint as necessary.

c. Installation. (figure 4-5)

(1) Install upper air duct (10) and secure with three screws (8) and washers (9).

(2) Install lower air duct (3) and secure with screw (5), washer (6) and nut (7).

(3) Secure lower air duct (3) to oil pan (4) using four screws (1) and washers (2).

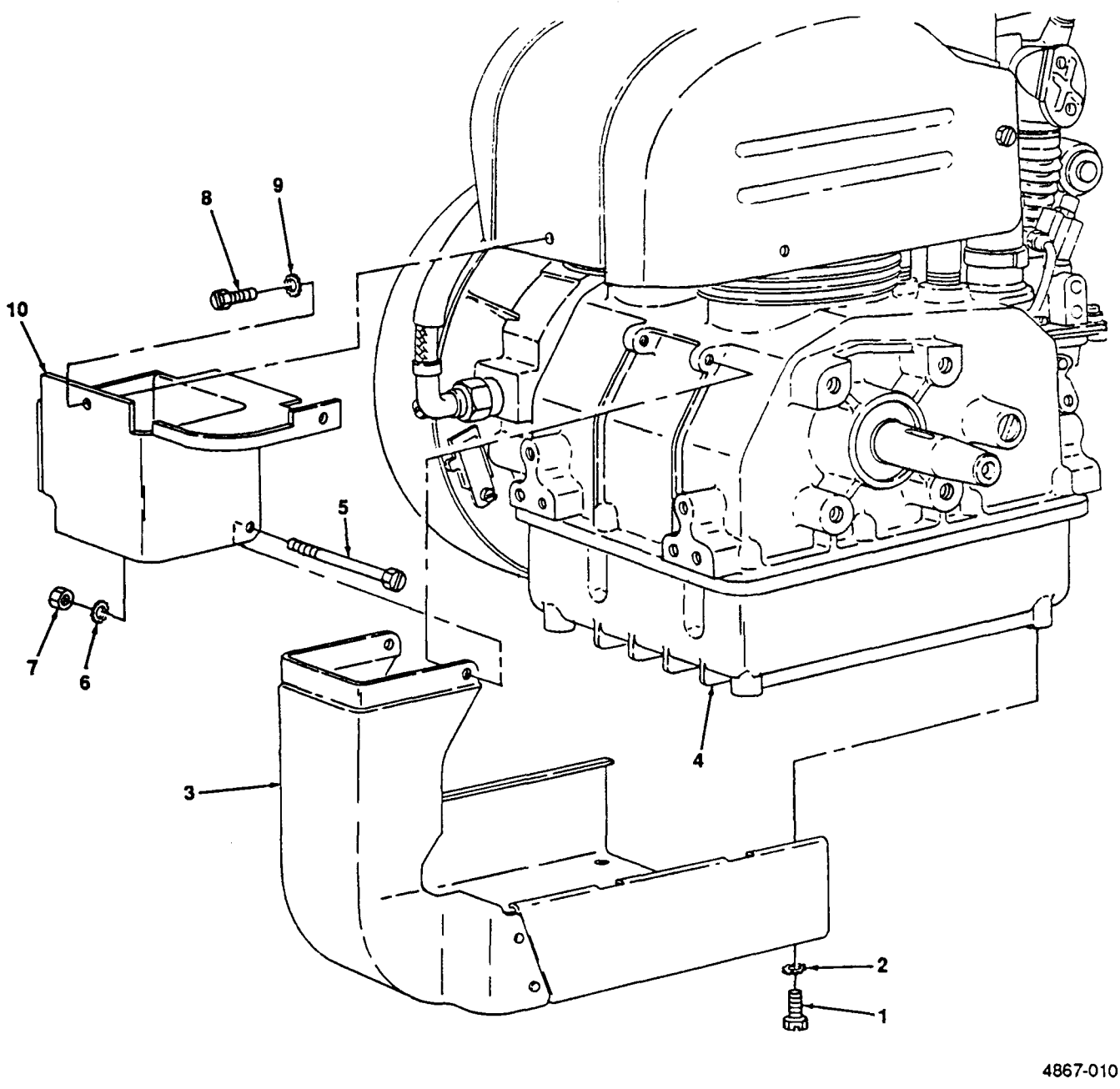

Figure 4-5. Lower Air Duct and Upper Air Duct, Removal and Installation.

4-17. Ignition Switch.

This task covers: a. Removal b. Test c. Installation

INITIAL SETUP

Tools	*Equipment Condition*
General Mechanic's Tool Kit (Item 1, Appendix B) Multimeter (NSN 6625-01-139-2512) (Item 2, Appendix B)	Flywheel cover removed from engine (para. 4-14).

a. Removal. (figure 4-6)

(1) Tag and remove wiring from ignition switch (1).

(2) Remove nut (2), lockwasher (3), flat washer (4) and remove ignition switch (1) from flywheel cover (5).

b. Test.

NOTE

The OFF position of the switch is the RUN position on flywheel cover.

(1) Check for continuity between terminals of ignition switch with ignition switch in OFF position. There should be no continuity present, if there is, replace switch.

(2) Check for continuity between terminals of ignition switch with switch in ON position. Continuity should be present. If continuity is not present, replace switch.

c. Installlation. (figure 4-6)

NOTE

When installing ignition switch, the OFF position of the switch is the RUN position on the flywheel cover.

(1) Position ignition switch (1) in flywheel cover (5) and secure using nut (2) flat washer (4) and lockwasher (3).

(2) Connect wiring to ignition switch (1) as tagged.

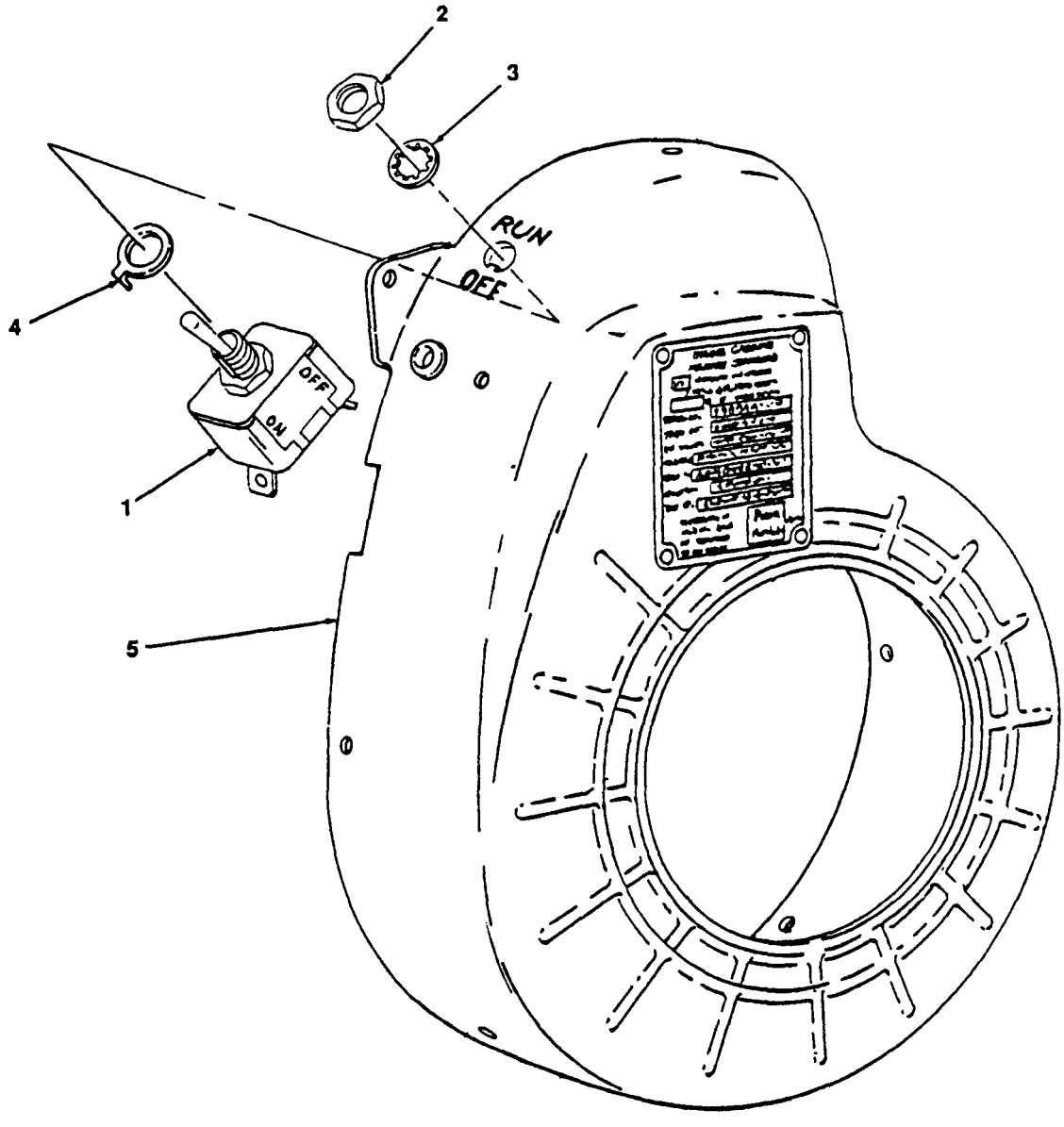

Figure 4-6. Ignition Switch, Removal and Installation.

4-18. **High Tension Cables.**

This task covers: a. Removal b. Test/Inspection c. Installation

INITIAL SETUP

Tools	*Equipment Condition*
General Mechanic's Tool Kit (Item 1, Appendix B) Multimeter (NSN 6625-01 -139-2512) (Item 2, Appendix B)	Flywheel cover removed when replacing flywheel side ignition cable on engines equipped with breaker point ignition (para. 4-14).

a. Removal. (figure 4-6)

NOTE

If removing high tension cables on engines with breakerless ignition system, perform step 3 only. The high tension cables are located between ignition control unit and spark plugs.

Perform step 1 only if flywheel cover is still installed.

(1) Remove screw (1) and washer (2) and remove cable clamp (3) securing high tension cables (4).

NOTE

Perform step 2 only if flywheel side high tension cable is being removed.

(2) Remove two screws (5) and washers (6) and remove high tension cable access plate (7).

(3) Loosen cable nuts (8) and remove high tension cable (4).

b. Test/Inspection.

(1) Perform continuity test between spring ends of cable. Replace cable if no continuity is found.

(2) Perform continuity test between metal cable ends of cable. Replace cable if continuity is not found.

(3) Perform continuity test between spring end and metal cable end. Replace cable if continuity is found.

(4) Replace cable if damaged.

c. Installation. (figure 4-7)

(1) Install high tension cables (4) and tighten cable nuts (8).

(2) Install high tension cable access plate (7) and secure with two screws (5) and washers (6).

(3) Install cable clamp (3) on high tension cables (4) and secure with screw (1) and washer (2).

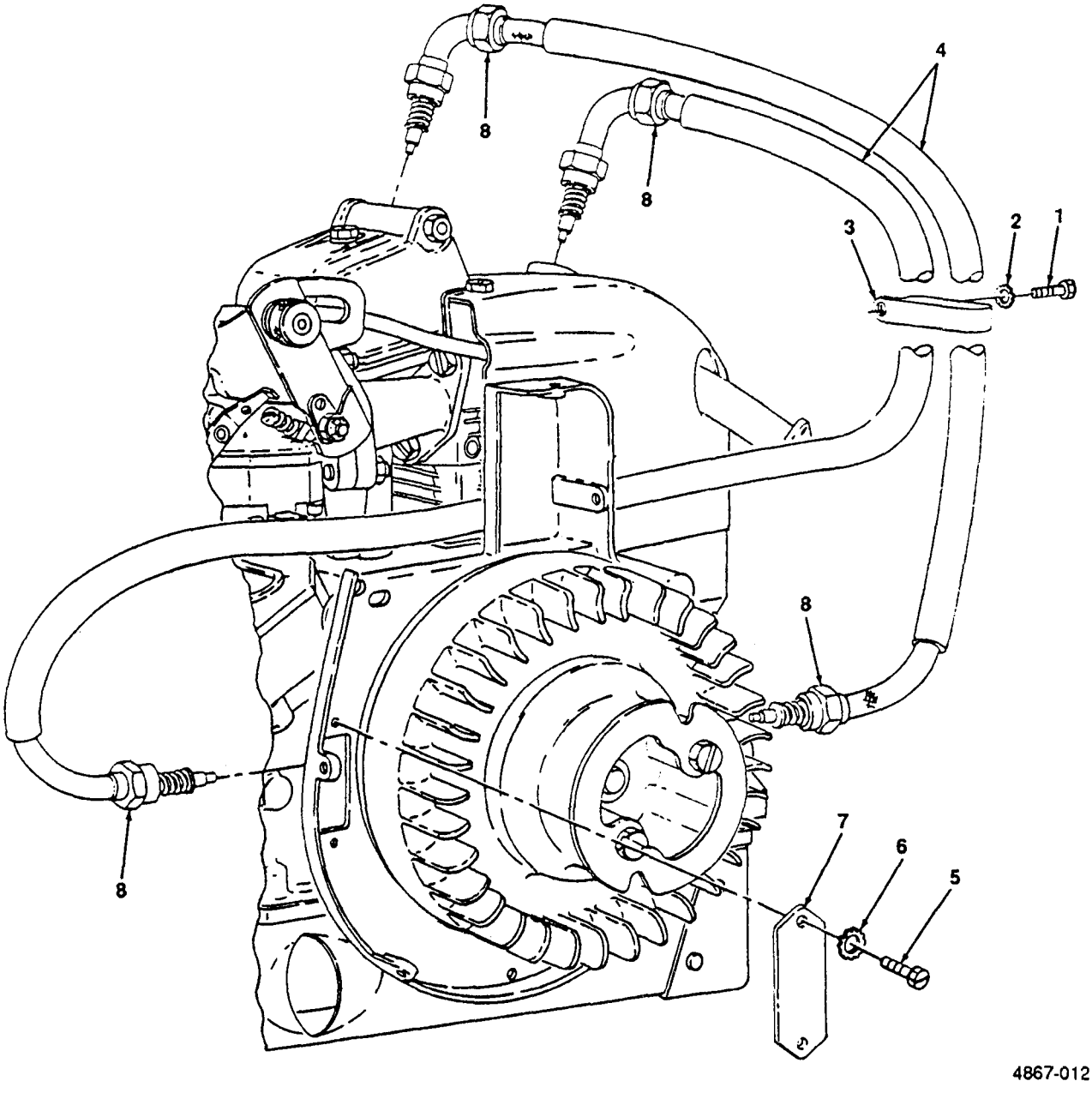

Figure 4-7. High Tension Cables, Removal and Installation.

4-19. Spark Plugs.

This task covers: a. Removal b. Inspection/Test c. Installation

INITIAL SETUP

Tools	*Materials/Parts*
General Mechanic's Tool Kit (Item 1, Appendix B)	Rags, Wiping (Item 6, Appendix D)
Wrench, Torque (NSN 5120-00-640-6364) (Item *2,* Appendix B)	Solvent, Drycleaning (Item 7, Appendix D)

NOTE

This engine has two spark plugs. Perform all procedures on one plug then the other.

a. Removal. (figure 4-8)

(1) Loosen connector nut (1) on high tension cable (2) and remove cable from spark plug (3).

(2) Remove spark plug (3) and washer (4).

b. Inspection/Test.

WARNING

Drycleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°F–138°F (38°C-60°C).

(1) Clean spark plug using drycleaning solvent, and inspect plug for burning, cracked or broken ceramic insulation, and damaged thread. Replace plug if damaged.

(2) Regap spark plug to .028 to .033 in. (.071 to .083 cm).

c. Installation. (figure 4-8)

(1) Install spark plug (3) and washer (4) and torque to 275-300 in.-lbs (49115-53580 gr cm).

(2) Install high tension cable (2) on spark plug (3) and tighten connector nut (1).

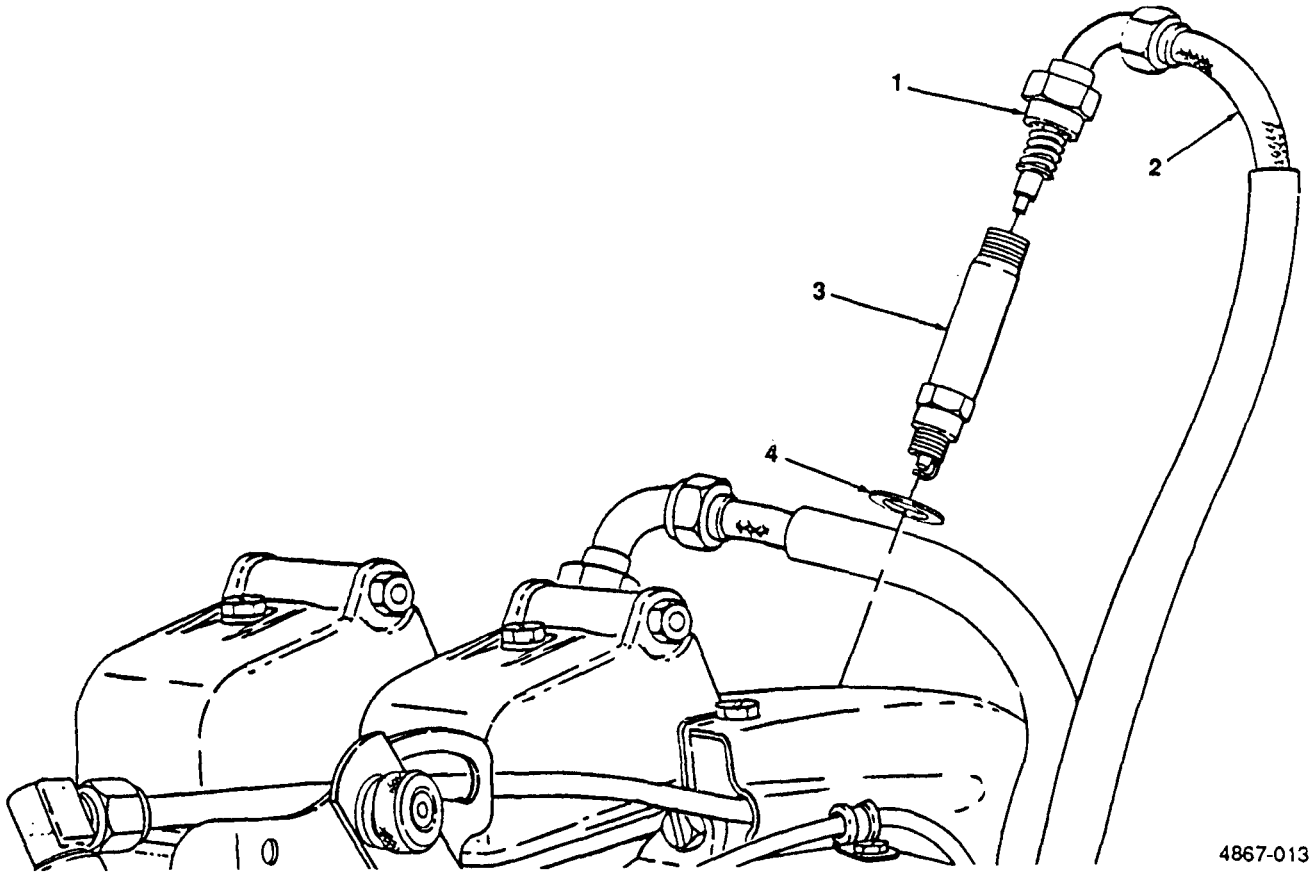

Figure 4-8. Spark Plugs, Removal and Installation.

4-20. Air Cleaner.

This task covers: a. Service (oil bath) b. Service (dry)

INITIAL SETUP

Tools	*Materials/Parts*
General Mechanic's Tool Kit (Item 1, Appendix B)	Rags, Wiping (Item 6, Appendix D) Solvent, Drycleaning (Item 7, Appendix D) Oil, OE/HDO 15W-40 (Item 2, Appendix D)

a. *Service. Oil Bath.* (figure 4-9)

(1) Unsnap two retaining clips (1) and remove lower cup (2) of air cleaner assembly.

(2) Pour oil into suitable container and remove element (3).

WARNING

Drycleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°F-138°F (38°C–60°C).

(3) Clean both halves of the air cleaner assembly and the element in drycleaning solvent.

(4) Dry everything thoroughly.

(5) Install element (3) in lower cup (2), and fill with oil to LEVEL line.

(6) Install lower cup (2) and secure with two retaining clips (1).

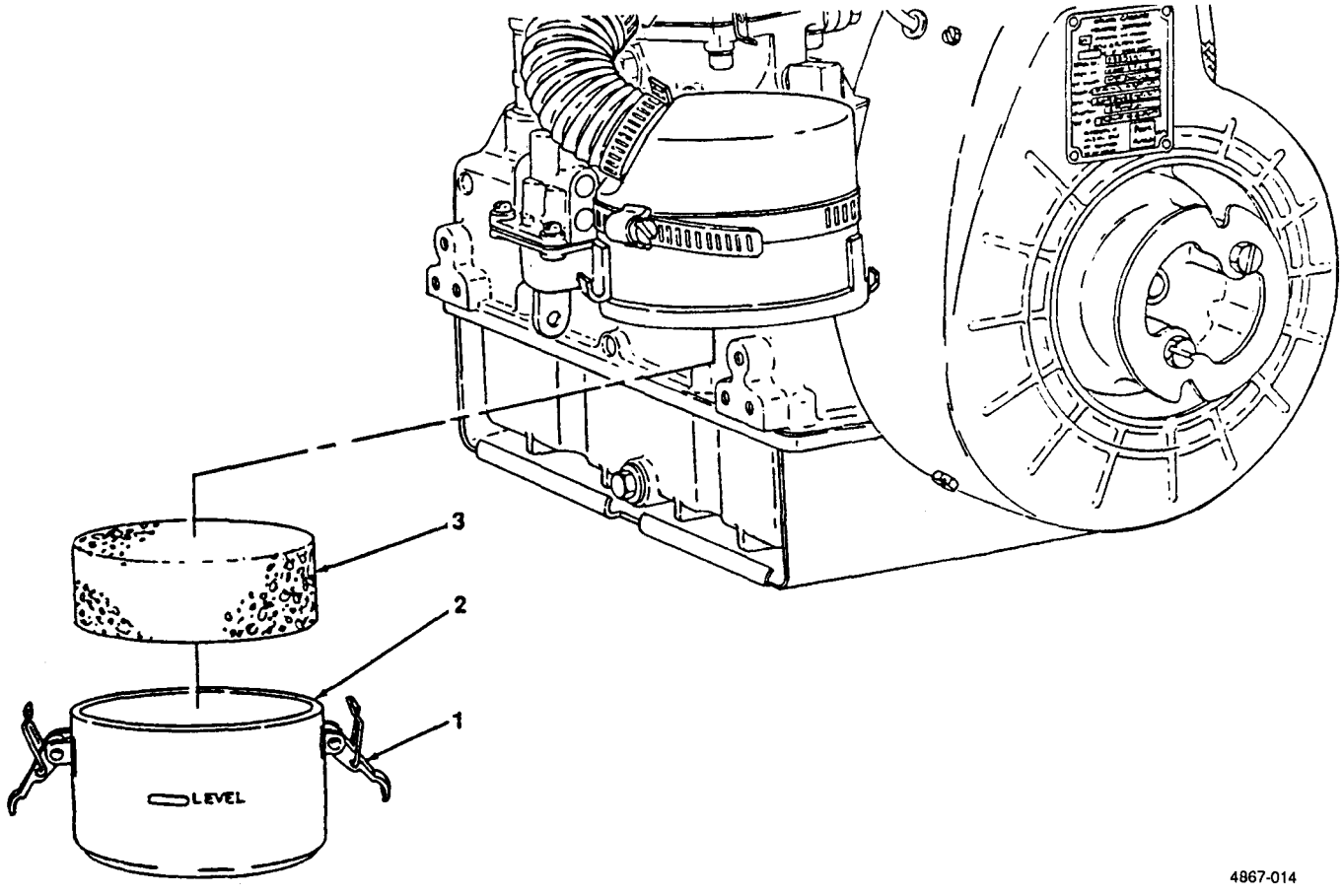

Figure 4-9. Air Cleaner Assembly Service (Oil Bath).

4-20. Air Cleaner (cont).

b. *Service.Dry.* (figure 4-10)

(1) Loosen two retaining screws (1), open air cleaner assembly (2), and remove element (3).

WARNING

Drycleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°F-138°F (38°C-60°C).

(2) Clean both halves of air cleaner assembly using drycleaning solvent.

(3) Clean element in detergent and water.

(4) Dry both halves of air cleaner assembly and element thoroughly.

(5) Position element (3) in air cleaner assembly (2) and secure with two retaining screws (1).

(6) Depress reset button (4) on service indicator (5).

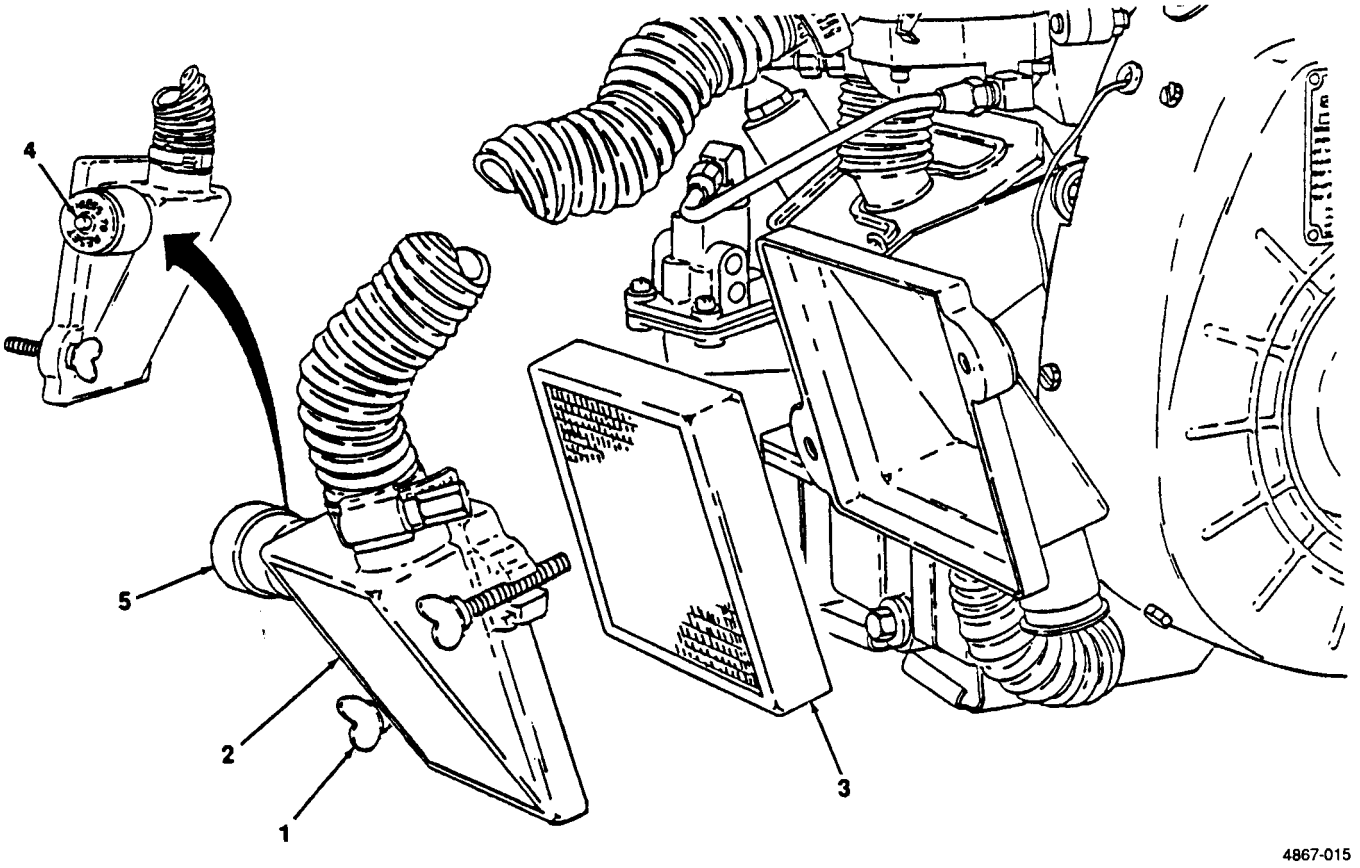

Figure 4-10. Air Cleaner Assembly Service (Dry).

4-21. Air Cleaner Assembly.

This task covers:	a. Removal (dry) b. Installation (dry)	c. Removal (oil bath) d. Installation (oil bath)

INITIAL SETUP

Tools	*Equipment Condition*
General Mechanic's Tool Kit (Item 1, Appendix B)	Flywheel cover removed for removal of dry air cleaner (para. 4-14).

a. *Removal. Dry.* (figure 4-11)

(1) Loosen clamp (1) and remove air cleaner duct (2) from intake elbow (3).

(2) Remove two screws (4) and washers (5) securing air cleaner assembly (6) and remove.

(3) Inspect service indicator (7) and replace if cracked or otherwise damaged.

b. *Installation. Dry.* (figure 4-11)

(1) Position air cleaner assembly (6) on engine and secure with two screws (4) and washers (5).

(2) Install air cleaner duct (2) on intake elbow (3) and tighten clamp (1).

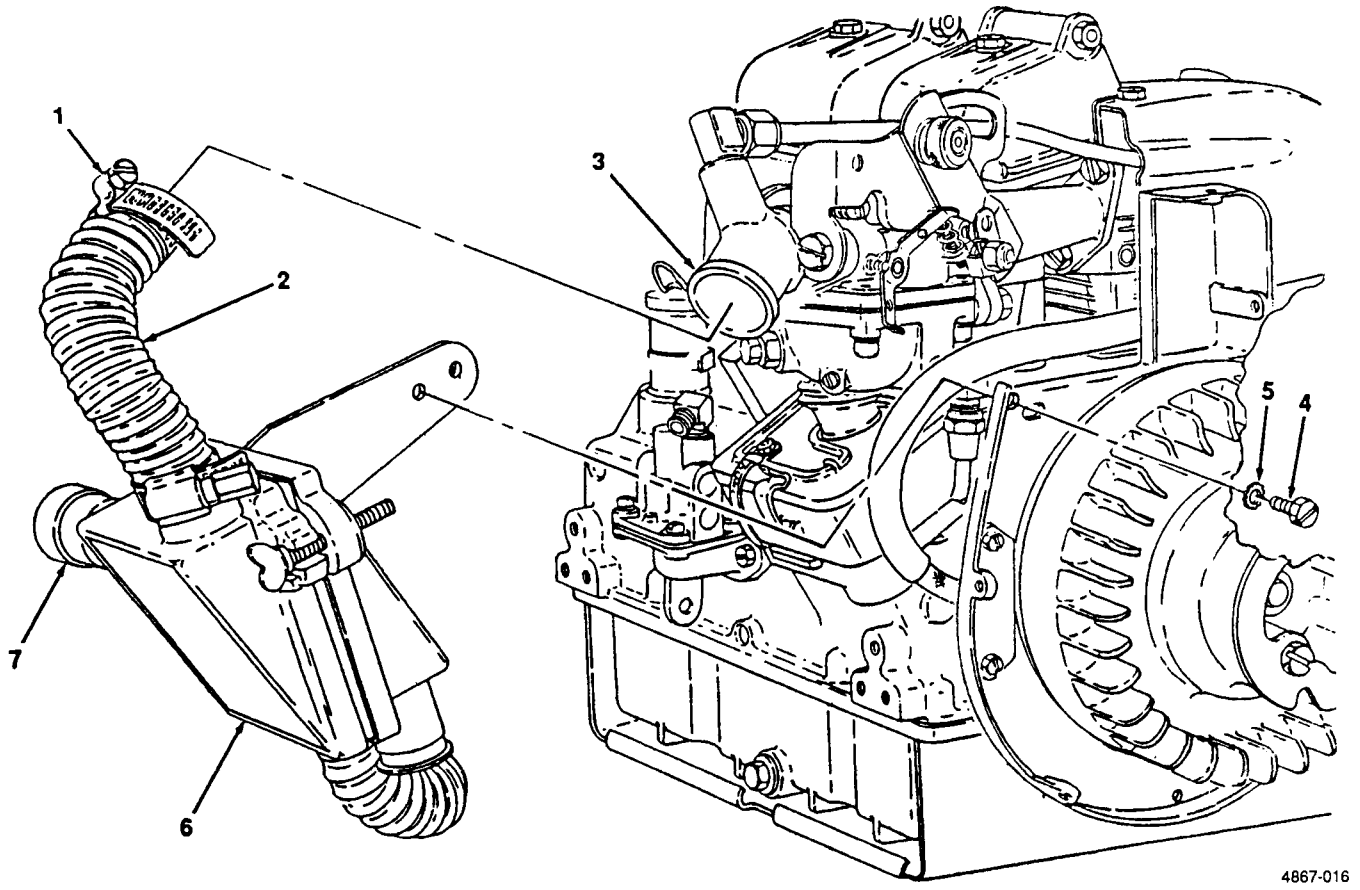

Figure 4-11. Air Cleaner Assembly (Dry), Removal and Installation.

4-21. Air Cleaner Assembly (cont).

c. *Removal. Oil Bath.* (figure 4-12)

(1) Disconnect breather line (1) from air cleaner assembly (2).

(2) Loosen clamp (3) and remove air cleaner duct (4) from intake elbow (5).

(3) Loosen mounting clamp (6) and remove air cleaner assembly (2).

d. Installation. Oil Bath. (figure 4-12)

(1) Position air cleaner assembly (2) on engine and secure with mounting clamp (6).

(2) Install air cleaner duct (4) on intake elbow (5) and tighten clamp (3).

(3) Connect breather line (1) to air cleaner assembly (2).

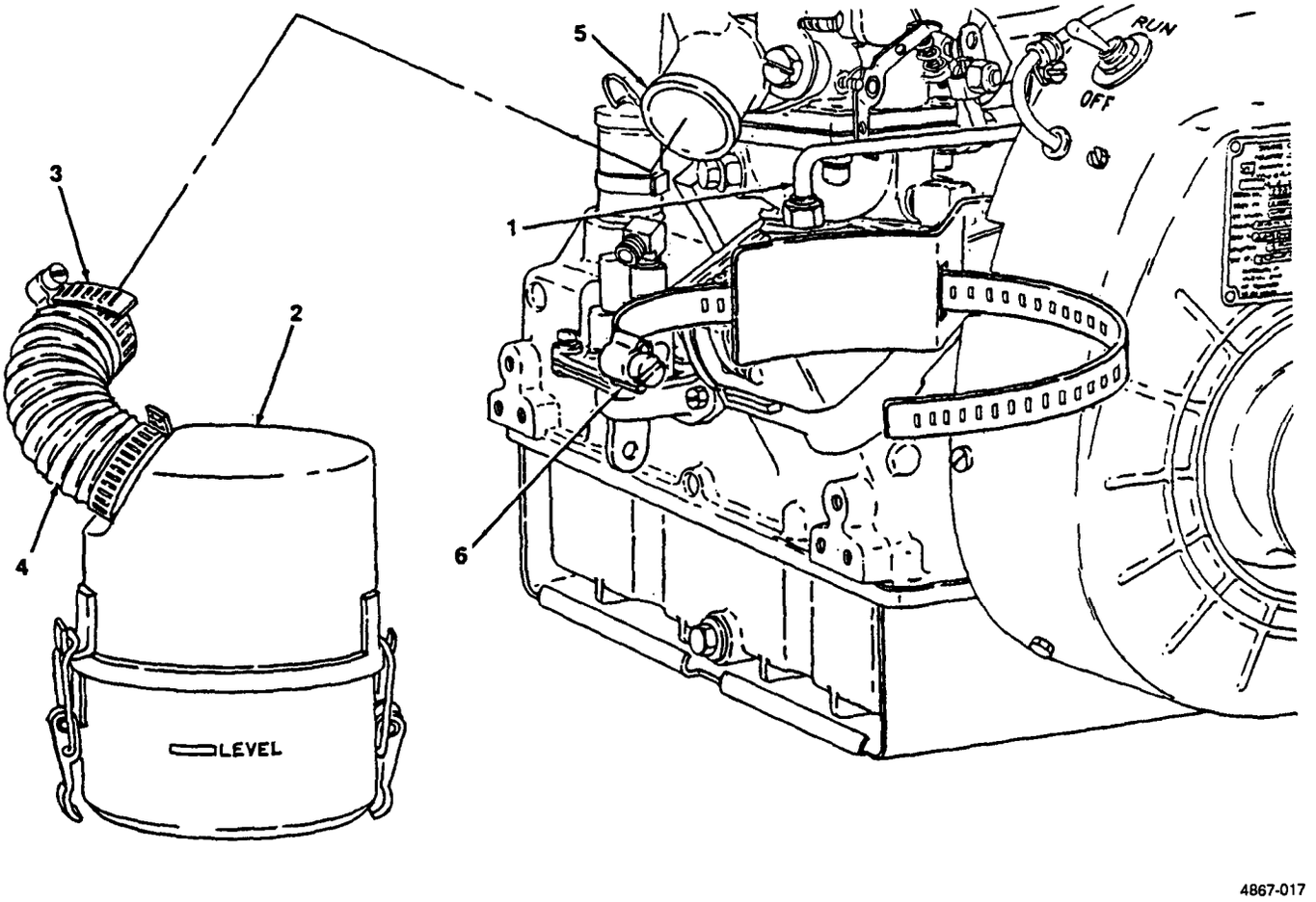

Figure 4-12. Air Cleaner Assembly (Oil Bath), Removal and Installation.

4-22. Clamps and Hoses.

This task covers: Replacement

INITIAL SETUP

Tools

General Mechanic's Tool Kit (Item 1, Appendix B)

a. *Relacement.* (figure 4-13)

NOTE

The procedures for replacing the hoses and clamps are the same for either dry element or oil bath air cleaners.

(1) Loosen clamp (1) and remove hose (2) from air intake elbow (3).

(2) Loosen clamp (4) and remove hose (2) from air cleaner (5).

(3) Loosen clamp (6) and remove hose (7) from air cleaner (5).

(4) Remove screw (8) and washer (9) and remove hose loop clamp (10) and hose (7).

(5) Inspect hoses and clamps for damage and replace as needed.

(6) Install hose loop clamp (10) and hose (7) and secure with screw (8) and washer (9).

(7) Install hose (7) on air cleaner (5) and secure with clamp (6).

(8) Install hose (2) on air cleaner (5) and secure with clamp (4).

(9) Install hose (2) on air intake elbow (3) and secure with clamp (1).

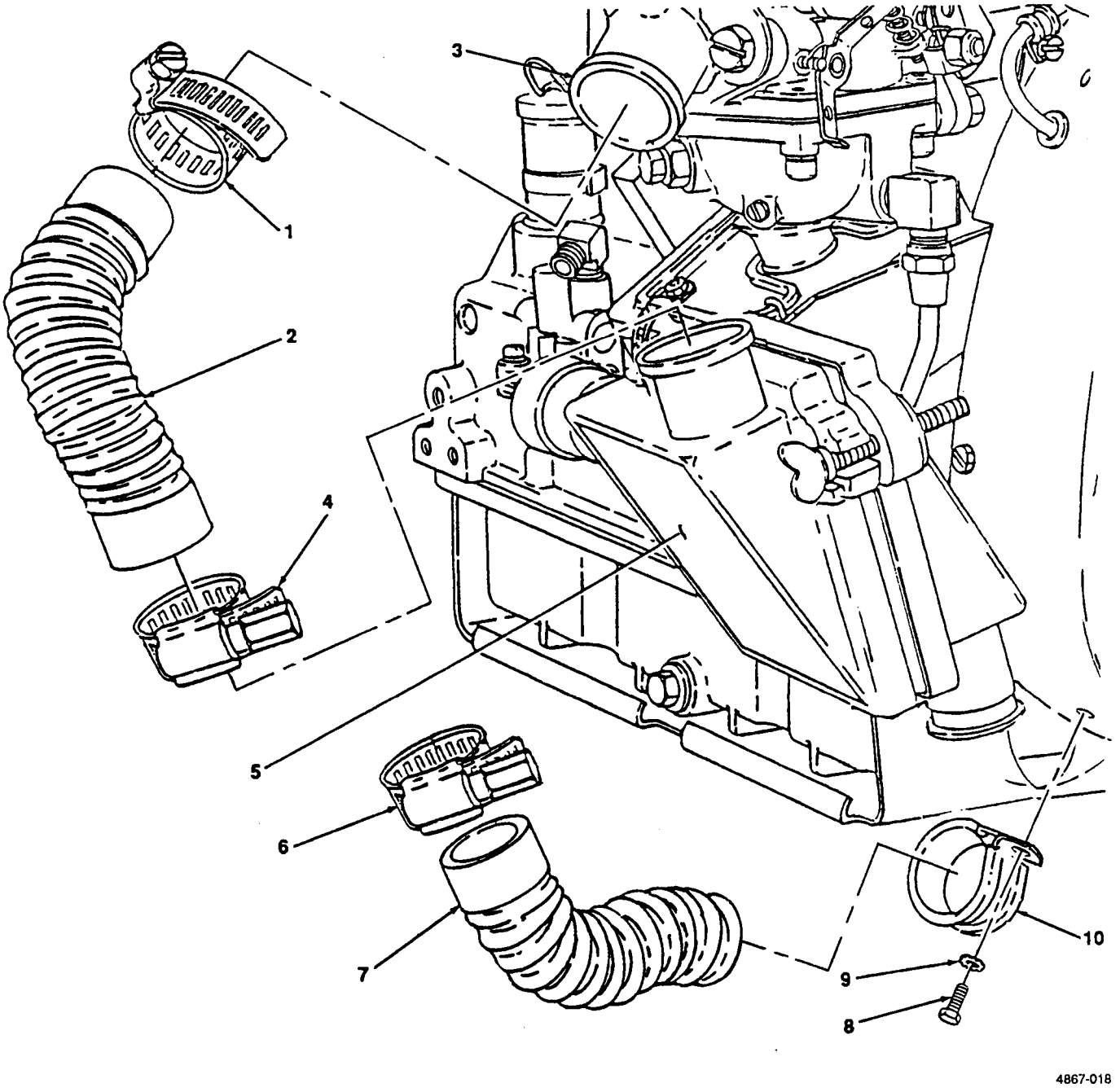

Figure 4-13. Clamps and I-loses, Replacement.

4-23. Air Cleaner Element.

This task covers:
a. Removal (oil bath)
b. Installation (oil bath)
c. Removal (dry)
d. Installation (dry)

INITIAL SETUP

Tools	*Materials/Parts*
General Mechanic's Tool Kit (Item 1, Appendix B)	Rags, Wiping (Item 6, Appendix D) Solvent, Drycleaning (Item 7, Appendix D) Oil, OH/HDO 15W-40 (Item 2, Appendix D)

a. *Removal. Oil Bath. (figure 4-14)*

(1) Open two retaining clips (1) securing lower cup *(2)* and remove.

(2) Pour out oil into suitable container and remove element (3) from lower cup (2).

WARNING

Drycleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°F-138°F (38°C–60°C).

(3) Clean lower cup with drycleaning solvent and dry thoroughly.

b. *Installation. Oil Bath.* (figure 4-14)

(1) Place element (3) into lower cup (2) and fill with oil to LEVEL line.

(2) Install lower cup (2) and secure with two retaining clips (1).

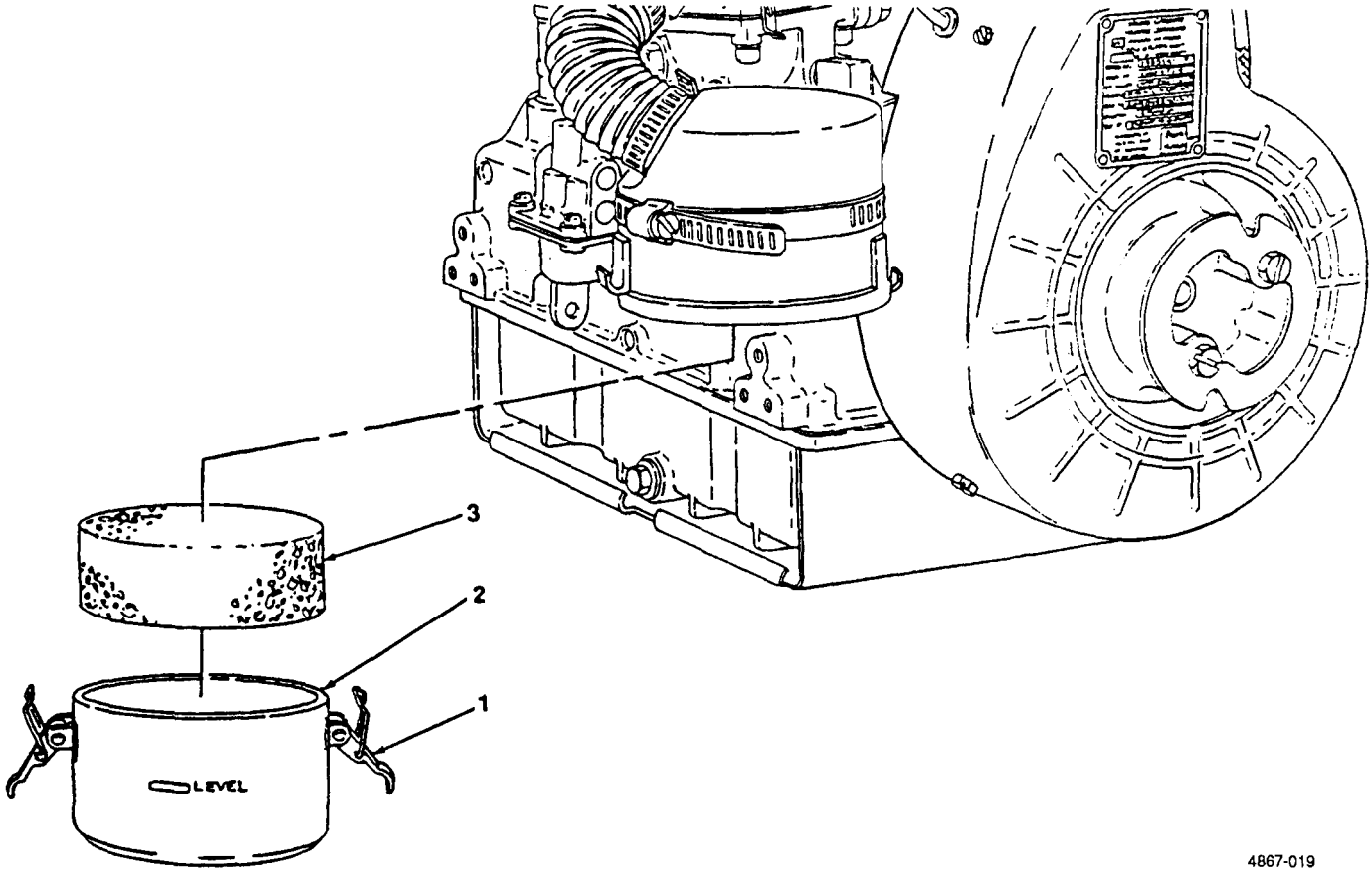

Figure 4-14. Air Cleaner Element (Oil Bath), Removal and Installation.

4-23. Air Cleaner Element (cont).

c. *Removal. Dry.* (figure 4-15)

(1) Loosen two retaining screws (1), open air cleaner assembly (2), and remove element (3).

WARNING

Drycleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°F–138°F (38°C-60°C).

(2) Clean both halves of air cleaner assembly using drycleaning solvent.

b. *Installation. Dry.* (figure 4-15)

(1) Position element (3) in air cleaner assembly (2) and secure with two retaining screws (1).

(2) Depress reset button (4) on service indicator (5).

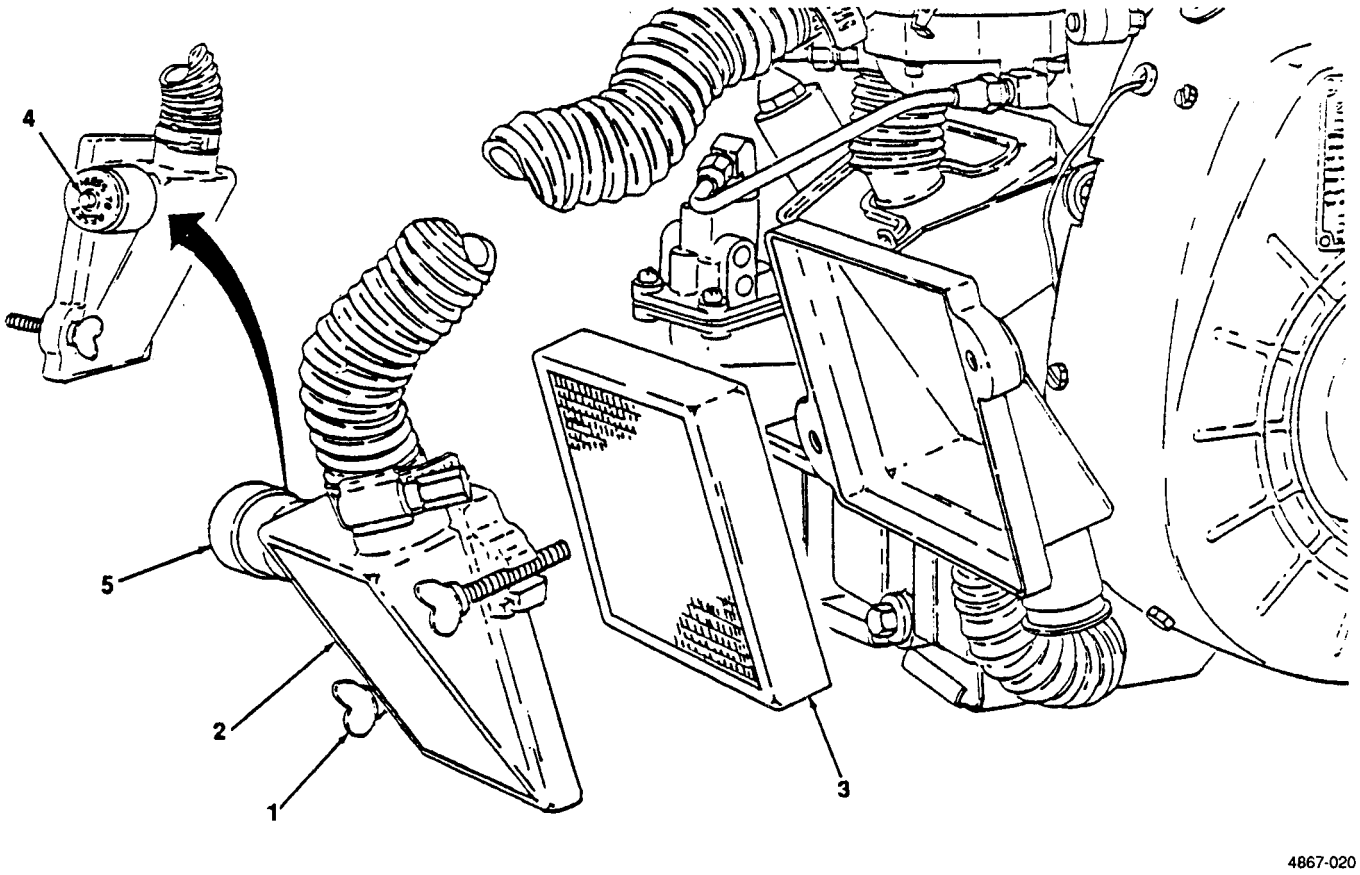

Figure **4-15.** *Element (Dry), Removal and Installation.*

4-24. Relief Valve.

This task covers: Replacement

INITIAL SETUP

Tools	*Materials/Parts*
General Mechanic's Tool Kit (Item 1, Appendix B)	Rags, Wiping (Item 6, Appendix D) Solvent, Drycleaning (Item 7, Appendix D)

Replacement. (figure 4-15)

(1) Remove any dirt or debris from around relief valve (1).

(2) Unscrew relief valve (1) from rocker cover (2)

WARNING

Drycleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°F-138°F (38°C-60°C).

(3) Clean relief valve (1) with drycleaning solvent and dry thoroughly.

(4) Ensure pin (3) moves in and out freely

(5) Replace relief valve (1) if damaged.

(6) Install relief valve (1) in rocker cover (2).

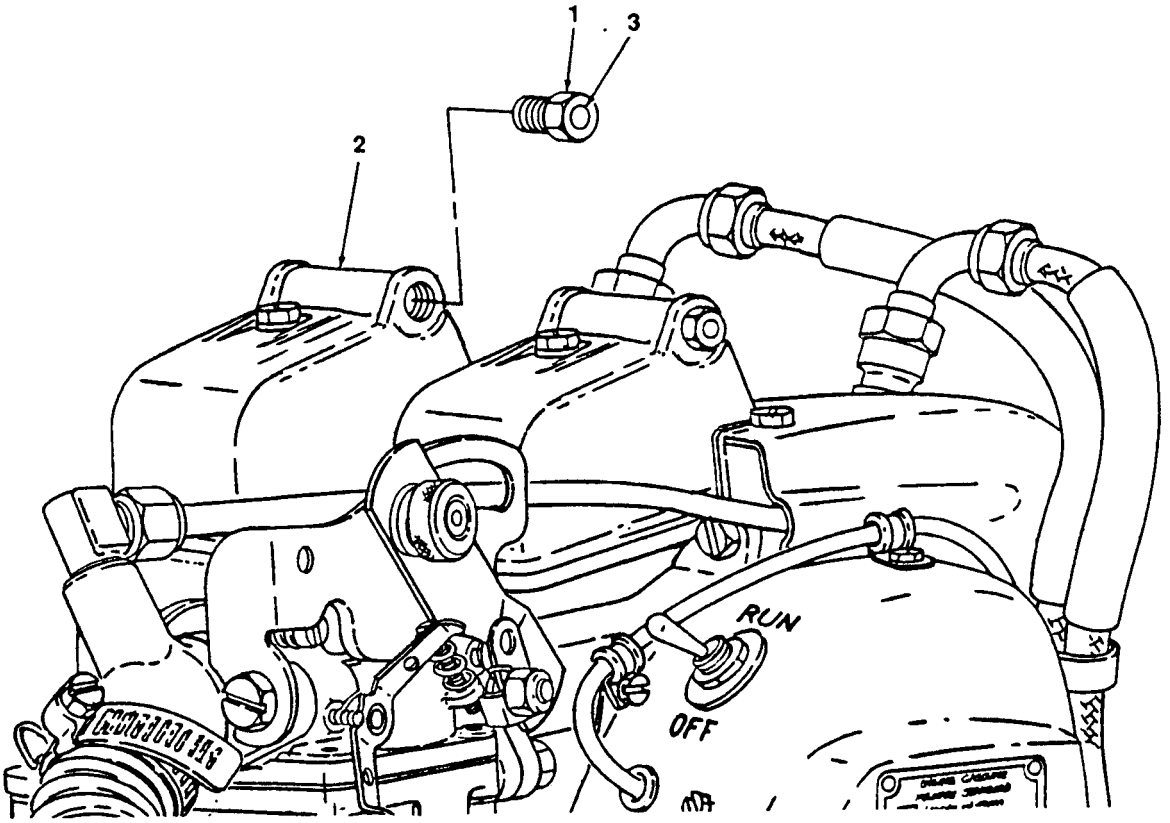

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Figure 4-16. Relief Valve, Replacement.

4-25. Rocker Cover.

This task covers: a. Removal b. Repair c. Installation

INITIAL SETUP

Tools

General Mechanic's Tool Kit (Item 1, Appendix B)

Equipment Condition

Cylinder head covers removed (para. 4-15).

Materials/Parts

Rags, Wiping (Item 6, Appendix D)
Solvent, Drycleaning (Item 7, Appendix D)
Gasket, Rocker Cover Mounting
(NSN 5330-00-797-4642)

a. Removal. (figure 4-16)

NOTE

There are two rocker covers on this engine, the removal, repair, and installation procedures are the same for both.

Remove screw (1) and plastic washer (2) and remove cover (3) and gasket (4).

b. Repair.

WARNING

Drycleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°F-138°F (38°C–60°C).

(1) Clean rocker cover using drycleaning solvent.

(2) Replace plastic washer (2) if cracked or otherwise damaged.

(3) Replace gasket (4) if torn or otherwise damaged.

(4) Repair all dents, and paint cover as necessary.

c. Installation. (figure 4-17)

Position rocker cover (3) and gasket (4) on engine, and secure with screw (1) and plastic washer (2).

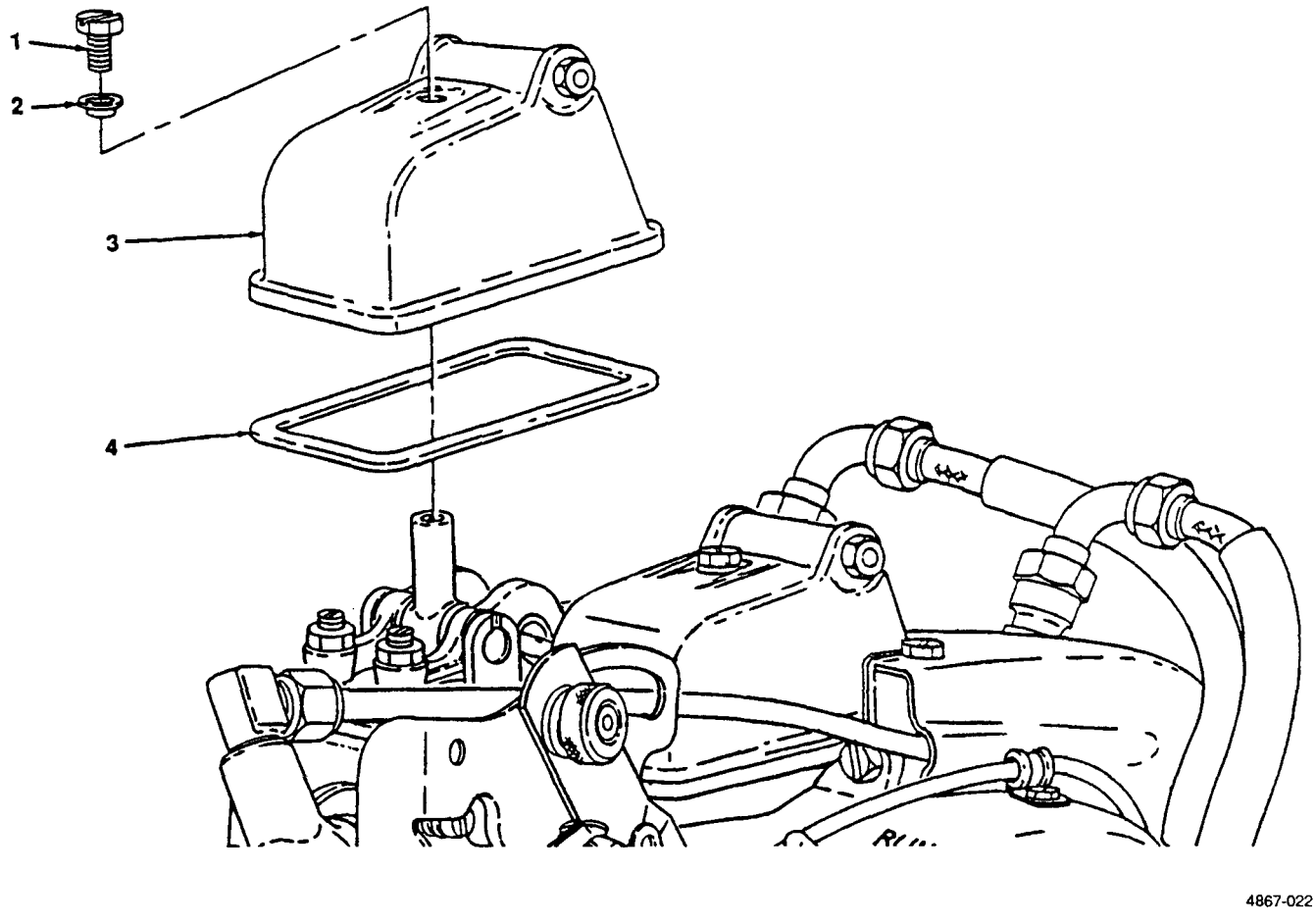

Figure 4-17. Rocker Cover, Removal and Installation.

4-26. Oil Fill Tube and Gage Assembly.

This task covers: a. Removal b. Installation

INITIAL SETUP

Tools

General Mechanic's Tool Kit (Item 1, Appendix B)

a. Removal. (figure 4-18)

(1) Lift locking cam (1) on oil fill tube (2) and remove oil fill gage (3) from tube.

NOTE

Remove oil fill tube only if it is damaged and needs to be replaced.

(2) Gently tap oil fill tube on either side to loosen it and remove it from crankcase (4).

(3) Inspect packing (5) on fill gage (3) and replace if torn or otherwise damaged.

b. Installation. (figure 4-18)

(1) Position oil fill tube (2) in crankcase (4) and gently tap tube straight into crankcase.

(2) Position oil fill gage (3) in fill tube (2) and secure with locking cam (1).

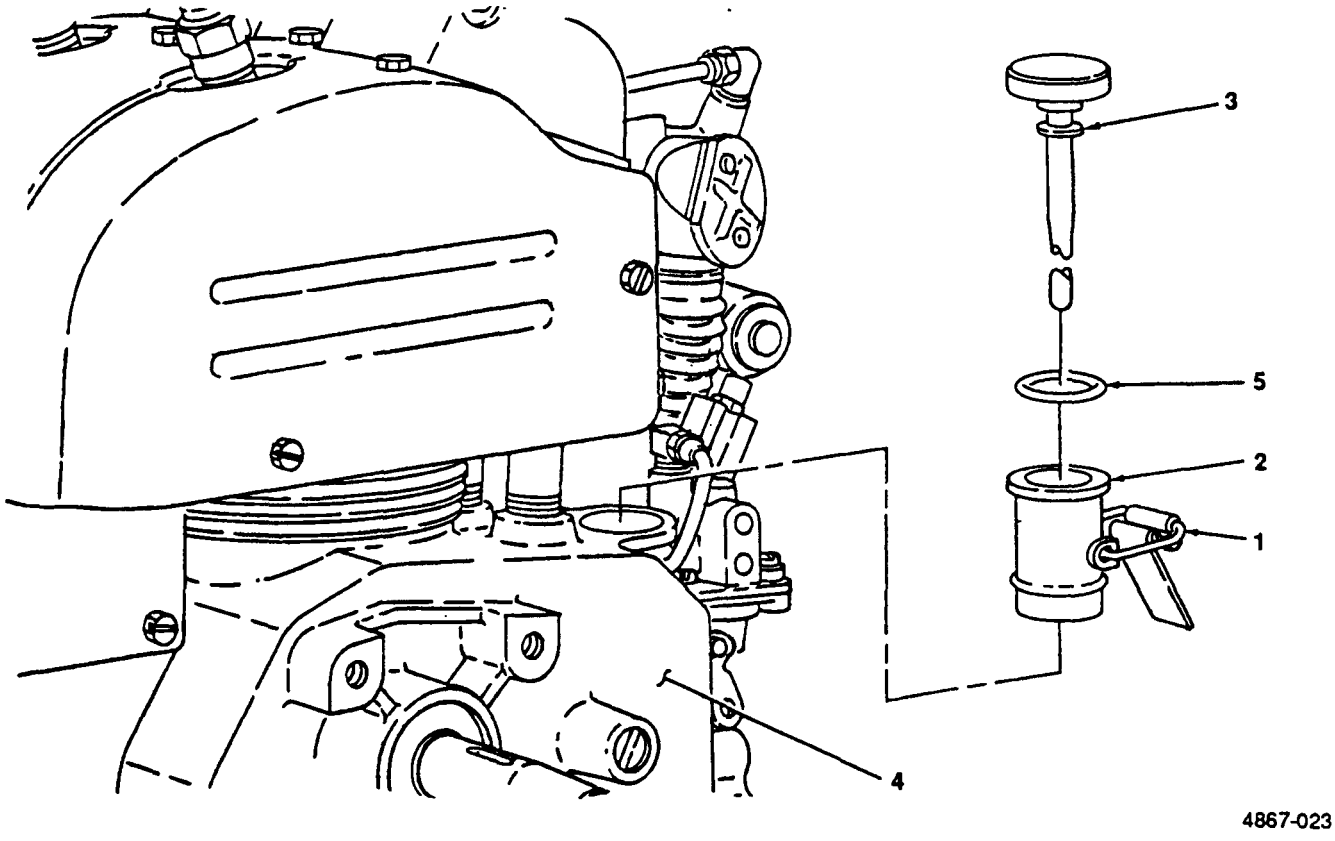

Figure 4-18. Oil Fill Tube and Gage Assembly, Removal and Installation.

4-27. Governor Assembly.

This task covers: Adjustment

INITIAL SETUP

Tools

General Mechanic's Tool Kit (Item 1, Appendix B)

Materials/Parts

Rags, Wiping (Item 6, Appendix D)
Solvent, Drycleaning (Item 7, Appendix D)

Materials/Parts (cont)

Gasket, Throttle Housing to Carburetor (P/N 9786E65-4)
Gasket, Throttle Housing Rear (PIN 9786E65-3)
Gasket, Throttle Housing Front (P/N 9786E64-6)

a. *Adjustment.* (figure 4-19)

(1) Remove two screws (1) and washers (2) securing throttle housing cover (3) and remove cover and gasket (4).

(2) Remove screw (5) and washer (6) securing throttle lever (7) to carburetor throttle rod (8) and remove lever from rod.

(3) Loosen clamp (9) on governor control rod housing (10) and remove control rod housing (10) from throttle housing (11).

(4) Remove two screws (12) and washers (13) securing throttle housing (11) to carburetor (14) and remove throttle housing (11), gasket (15) rear cover (16), and gasket (17).

(5) Hold carburetor throttle (18) 1/16 infrom the open position, loosen lock nut (19) on control rod (20), and adjust clevis (21) until throttle lever (7) fits onto carburetor throttle rod (8).

(6) Tighten lock nut (19).

(7) Install gasket (17), rear cover (16), gasket (15), throttle housing (11) and secure using two screws (12) and washers (13).

(8) Install governor control rod housing (10) on throttle housing (11) and secure with clamp (9).

(9) Install throttle lever (7) on carburetor throttle rod (8) and secure with screw (5) and washer (6).

(10) Install throttle housing cover (3) and gasket (4) on throttle housing (11) and secure with two screws (1) and washers (2).

(11) Start engine (para2-9).

(12) To regulate engine governed speed, turn nut (22) clockwise to increase engine speed or counterclockwise to decrease engine speed.

(13) Stop engine (para. 2-10).

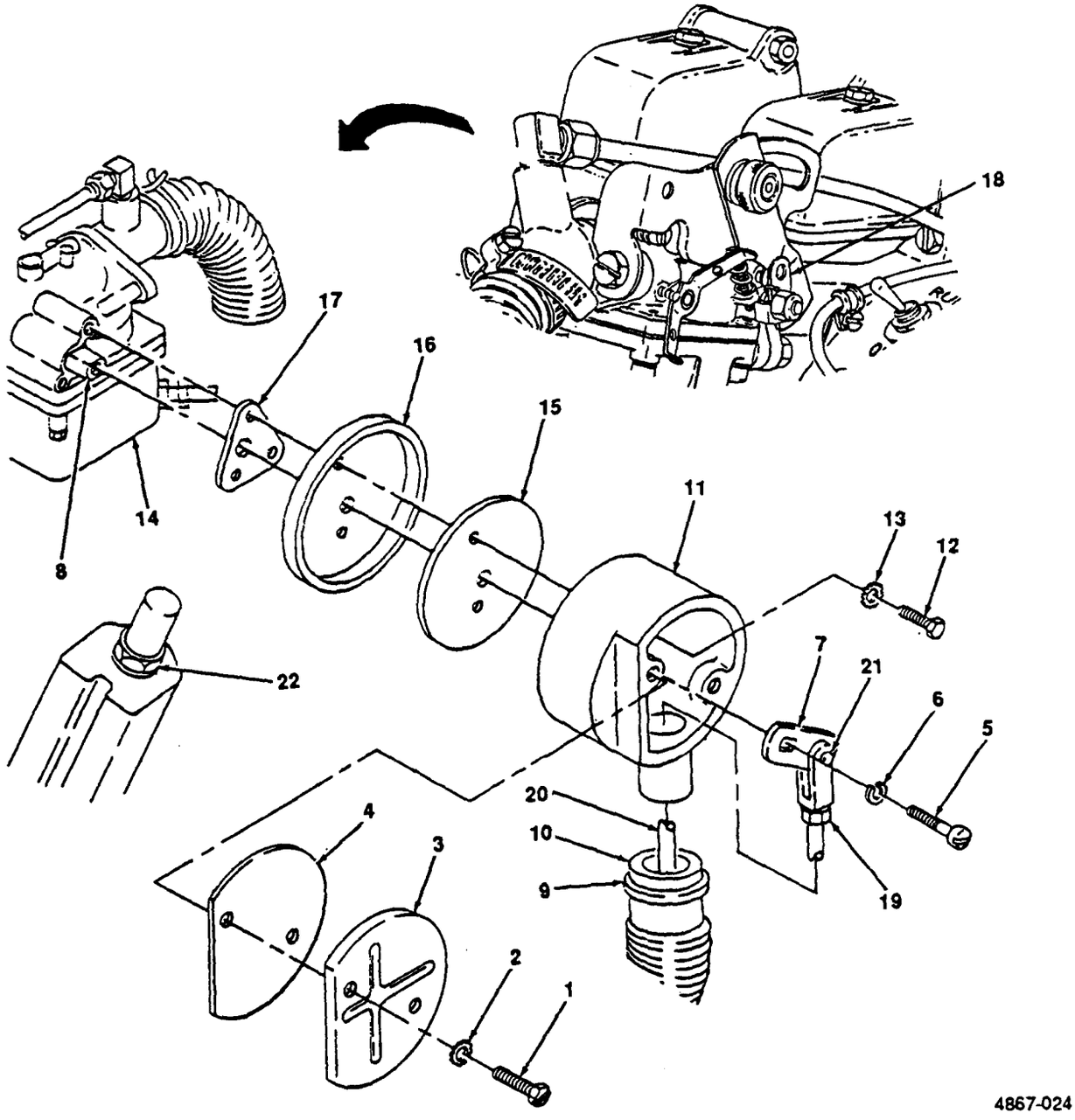

Figure 4-19. Governor, *Adjustment.*

4-28. Breaker Points Cover (Breaker Point Ignition).

This task covers: a. Removal b. Inspect c. Installation

INITIAL SETUP

Tools	*Materials/Parts*
General Mechanic's Tool Kit (Item 1, Appendix B)	Rags, Wiping (Item 6, Appendix D) Solvent, Drycleaning (Item 7, Appendix D) Gasket, Breaker Point Cover Mounting (NSN 5330-00-103-8793)

a. Removal. (figure 4-20)

(1) Unsnap two clips (1) securing breaker points cover (2) and remove cover (2) and gasket (3).

(2) Remove nut (4) and washer (5) securing ground strap (6) to cover.

(3) Remove screw (7) plastic washer (8), and nut (9).

b. Inspection.

(1) Inspect gasket (3) for wear or other damage and replace as needed.

(2) Inspect plastic washer (8) and replace if cracked or otherwise damaged.

c. Installation. (figure 4-20)

(1) Install screw (7), plastic washer (8), and nut (9) in cover (2).

(2) Install ground strap (6) on cover and secure with washer (5) and nut (4).

(3) Position cover (2) and gasket (3) on engine and secure with two clips (1).

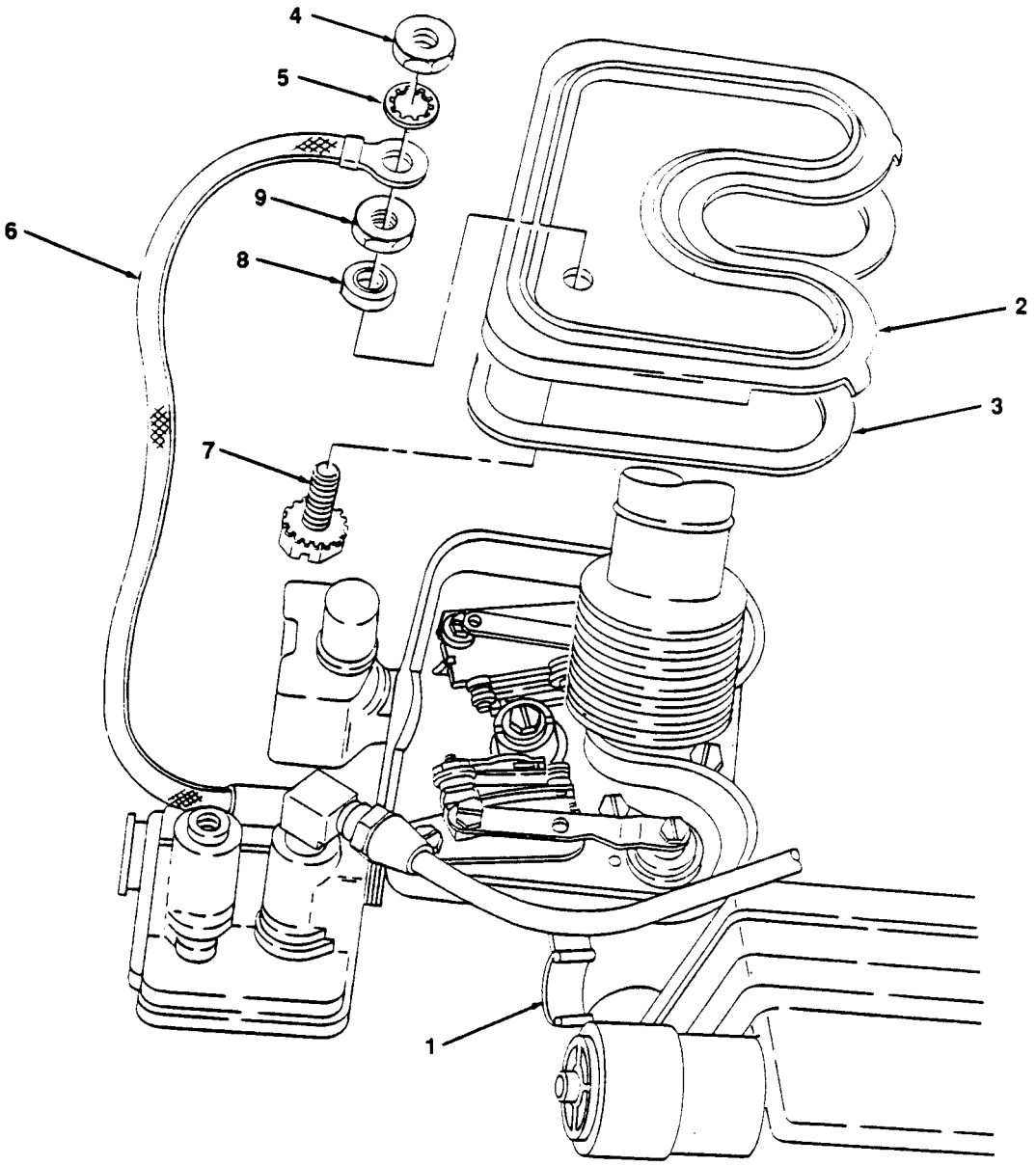

Figure 4-20. Breaker Point Cover, Removal and Installation.

4-29. **Breaker Points Assembly (Breaker Point Ignition).**

This task covers: a. Removal b. Inspection c. Installation

INITIAL SETUP

Tools	*Materials/Parts*
General Mechanic's Tool Kit (Item 1, Appendix B)	Rags, Wiping (Item 6, Appendix D) Oil, Engine 15W-40 (Item 2, Appendix D)

NOTE

This engine is equpped with two sets of breaker points. The following procedures are the same for both sets.

a. Removal. (figure 4-21)

(1) Unsnap two clips (1) securing breaker points cover (2) and move cover out of way.

(2) Remove screw (3) and Iockwasher (4) and move connector bar (5) out of way.

(3) Remove two screws (7) and washers (8) and remove breaker points (6).

b. Inspection. (figure 4-21)

(1) Inspect contacts (9) for pits or other signs of wear, and replace breaker points as needed.

(2) Inspect cam follower (10) for cracks or wear. Replace breaker points as needed.

c. Installation. (figure 4-21)

NOTE

Do not tighten right hand mounting screw fully at this time.

(1) Position breaker points (6) in governor housing (11) and secure with two screws (7) and washers (8).

(2) Rotate engine by hand until cam follower (10) is on highest point of ignition cam (12).

(3) Adjust point gap to .016 -0.20 in. (.040 -.050 cm) and tighten right hand screw.

(4) Recheck point gap and adjust as needed.

(5) Install connector bar (5) and secure with screw (3) and washer (4).

(6) Use clean engine oil and lubricate ignition cam wick (13) sparingly.

(7) Install breaker point cover (2) and secure with two clips (1).

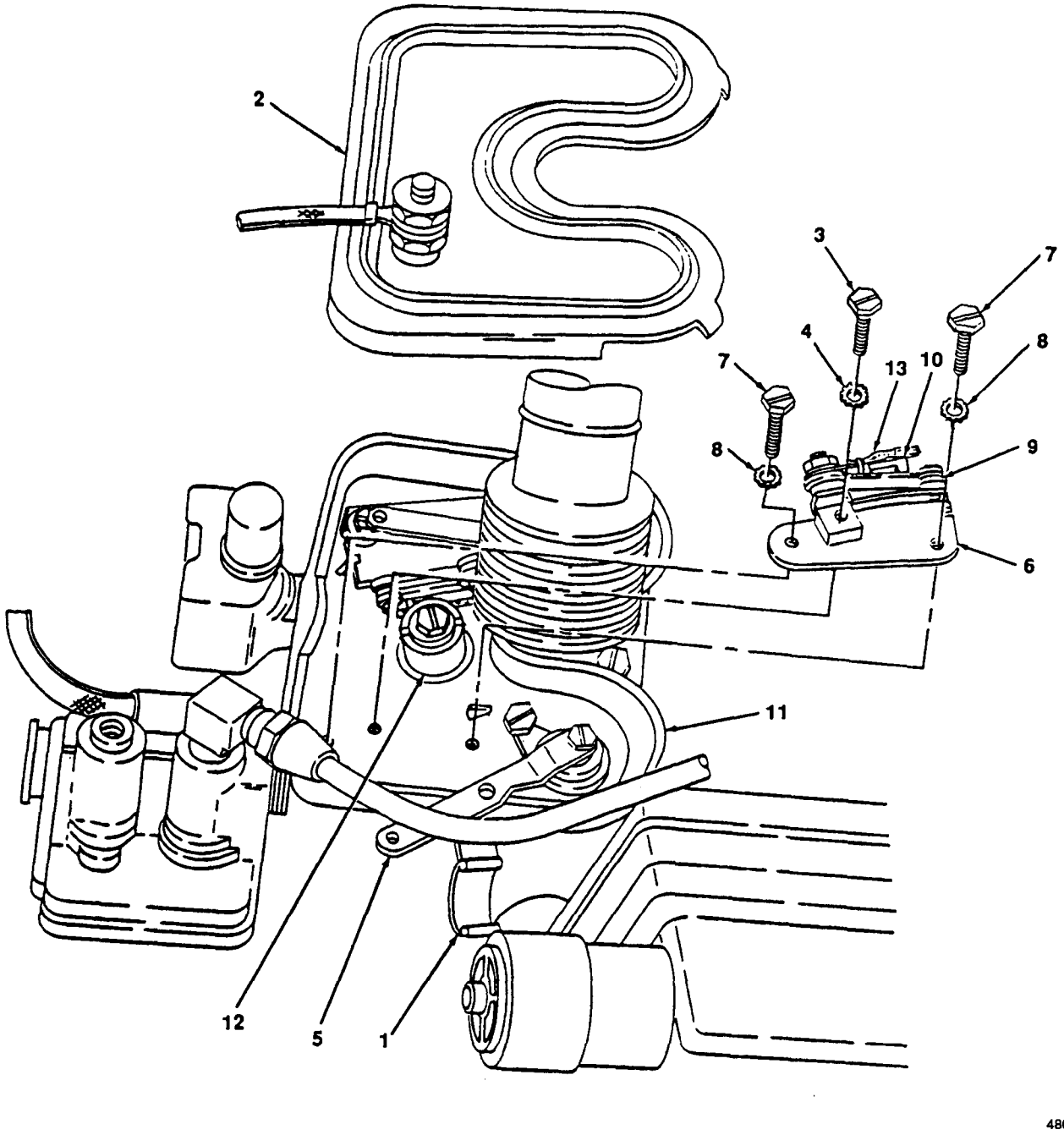

Figure 4-21. Breaker Points, Removal and Installation.

4-30. **Breaker Points (Breaker Point Ignition).**

This task covers: Adjustment

INITIAL SETUP

Tools	*Materials/Parts*
General Mechanic's Tool Kit (item 1, Appendix B)	Rags, Wiping (Item 6, Appendix D) Oil, Engine 15W-40 (Item 2, Appendix D)

Adjustment. (figure 4-21

(1) Unsnap two clips (1) securing breaker point cover (2) and move cover out of way.

(2) Rotate engine by hand until cam follower (3) is on highest point of ignition cam (4).

(3) Loosen screw (5).

(4) Remove screw (6) and washer (7) and move connector bar (8) out of way.

(5) Loosen screw (9) and adjust point gap to 0.16 to .020 in. (0.40 to 0.50 cm), and tighten screw (9).

(6) Recheck point gap and adjust as necessary.

(7) Position connector bar (8) and secure with screw (6) and washer (7).

(8) Tighten screw (5).

(9) Use clean engine oil and lubricate cam wick (10) sparingly.

(10) Install breaker point cover (2) and secure with two clips (1).

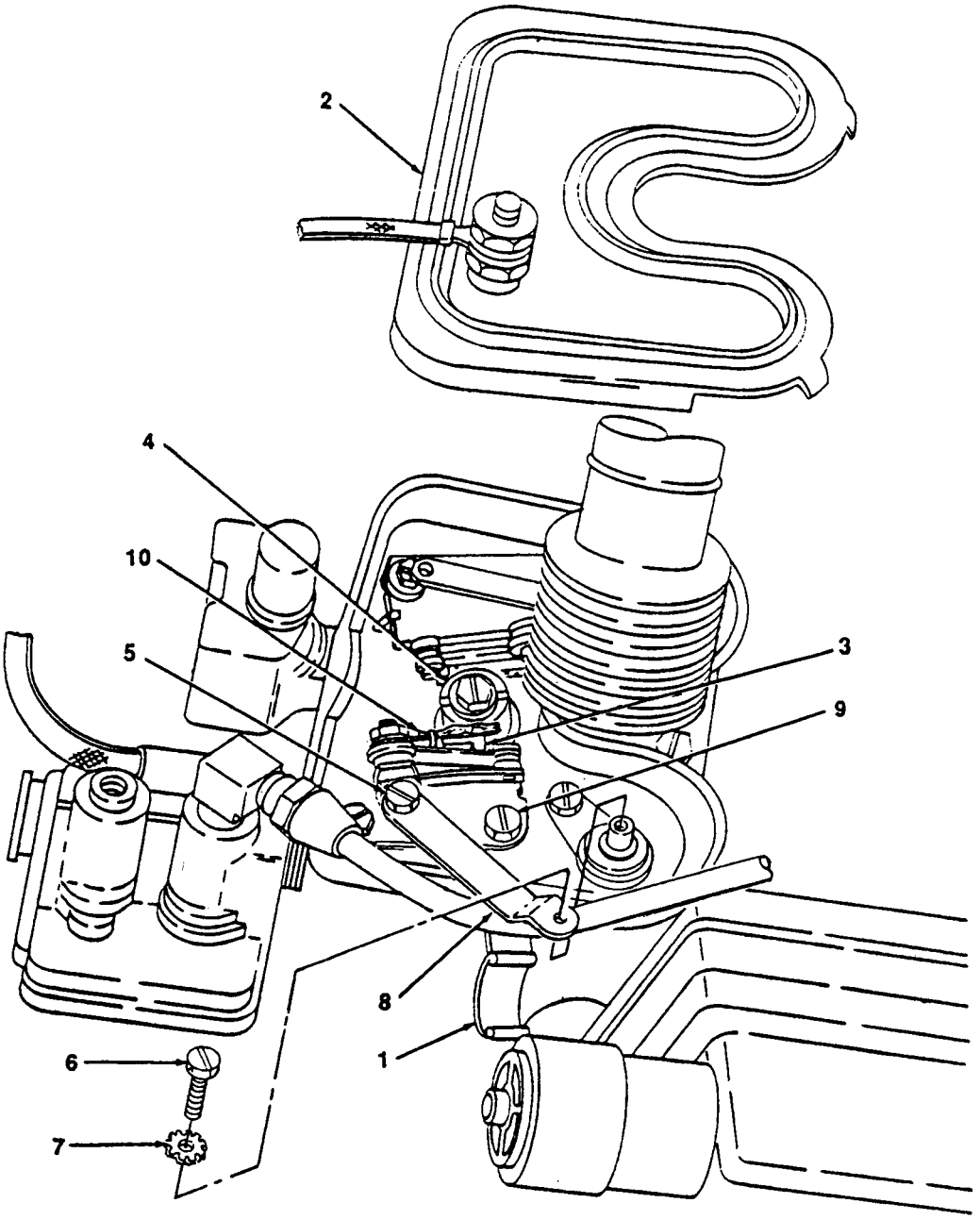

Figure 4-22. Breaker Points, Adjustment.

4-31. Condenser (Breaker Point Ignition).

This task covers: a. Removal b. Installation

INITIAL SETUP

Tools

General Mechanic's Tool Kit (Item 1, Appendix B)

NOTE

This engine is equipped with two condensers. The removal and installation procedures are the same for both condensers.

a. Removal. (figure 4-23)

(1) Unsnap two clips (1) securing breaker points cover (2) and move out of way.

(2) Remove screw (3) and washer (4) and remove connector bar (5) from top of condenser (6).

(3) Trace condenser lead (7) to suppression unit (8) and remove nut (9) and washer (10) and remove condenser lead (7).

(4) Remove screw (11) and washer (12) and remove condenser (6).

b. Installation. (figure 4-23)

(1) Install condenser (6) and secure with screw (11) and washer (12).

(2) Install condenser lead (7) on suppression unit (8) and secure with nut (9) and washer (10).

(3) Install connector bar (5) and secure with screw (3) and washer (4).

(4) Install breaker points cover (2) and secure with two clips (1).

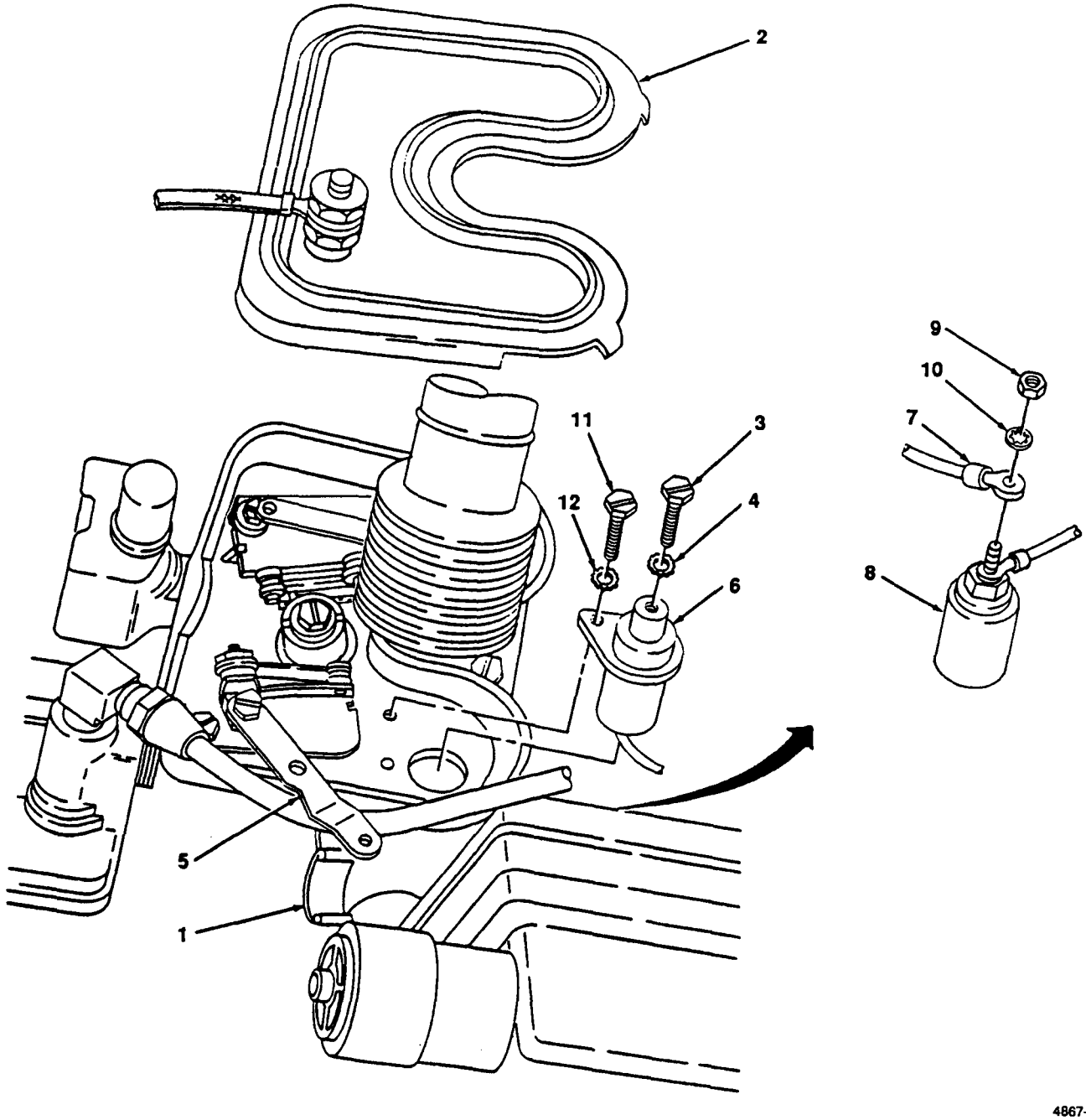

Figure 4-23. Condenser, Removal and Installation.

4-32. Breather Line.

This task covers:
a. Removal (oil bath)
b. Inspection (oil bath)
c. Installation (oil bath)
d. Removal (dry)
e. Inspection (dry)
f. Installation (dry)

INITIAL SETUP

Tools

General Mechanic's Tool Kit (Item 1, Appendix B)

Equipment Condition

Cylinder head covers removed (para. 4-15).

Materials/Parts

Rags, Wiping (Item 6, Appendix D)
Solvent, Drycleaning (Item 7, Appendix D)
Rubber Sleeve (NSN 5365-00-215-7421)

a. *Removal. Oil Bath.* (figure 4-24)

(1) Loosen coupling nut (1) on crankshaft side rocker cover (2).

(2) Loosen coupling nut (3) on flywheel side rocker cover (4).

(3) Loosen coupling nut (5) on air cleaner (6) and remove breather line (7).

(4) Remove coupling nut (5) and rubber sleeve (8) from breather line (7).

b. Inspection.

WARNING

Drycleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°F-138°F (38°C-60°C).

(1) Clean breather line and coupling nut with dry cleaning solvent and dry thoroughly

(2) Ensure there are no obstructions in breather line.

(3) Inspect coupling nuts (1), (3) and (5) for signs of stripped threads or other damage, and replace breather line if damage is found.

(4) Inspect rubber sleeve (8) replace if ripped or otherwise damaged.

c. Installation. Oil Bath. (figure 4-24)

(1) Install coupling nut (5) and rubber sleeve (8) on breather line (7).

(2) Install breather line (7) and finger tighten coupling nuts (1), (3), and (5).

(3) Tighten coupling nuts (1), (3), and (5).

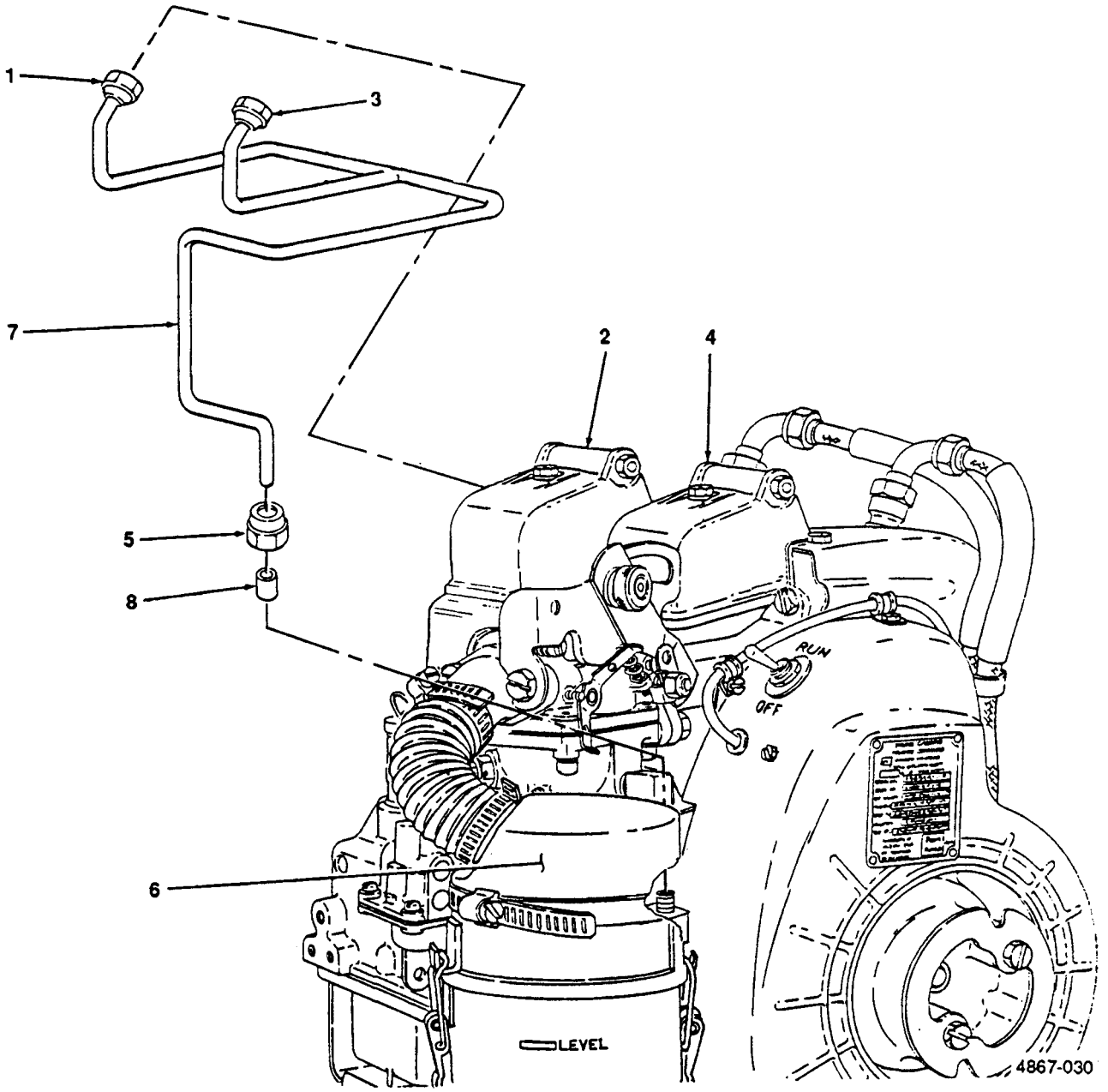

Figure 4-24. Breather Line (Oil Bath), Removal and Installation.

4-32. Breather Line (cont).

d. Removal. Dry. (figure 4-25)

(1) Loosen coupling nut (1) at crankshaft side cylinder head adapter fitting (2).

(2) Loosen coupling nut (3) at flywheel side cylinder head adapter fitting (2).

(3) Loosen coupling nut (4) at air intake elbow (5) and remove breather line (6).

(4) Remove coupling nut (4) and rubber sleeve (7) from breather line (6).

(5) Remove two adapter fittings (2) from cylinder heads (8).

(6) Remove an intake elbow (5).

e. Inspection.

WARNING

Drycleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°F-138°F (38°C-60°C).

(1) Clean breather line and coupling nut with dry cleaning solvent and dry thoroughly.

(2) Ensure there are no obstructions in breather line.

(3) Inspect coupling nuts (1), (3) and (4) for signs of stripped threads or other damage, and replace breather line if damaged.

(4) Inspect rubber sleeve (7) and replace if torn or damaged.

(5) Inspect adapter fittings (2) for signs of stripped threads or other damage, and replace if damaged.

f. Installation. Dry. (figure 4-25)

(1) install air intake elbow (5).

(2) Install two adapter fittings (2) into cylinder heads (8) and tighten.

(3) Install rubber sleeve (7) and coupling nut (4) onto breather line (6).

(4) Position breather line (6) on cylinder heads (8) and finger tighten coupling nuts (1) and (3).

(5) Position breather line (6) on air intake elbow (5) and finger tighten coupling nut (4).

(6) Tighten coupling nuts (1), (3), and (4).

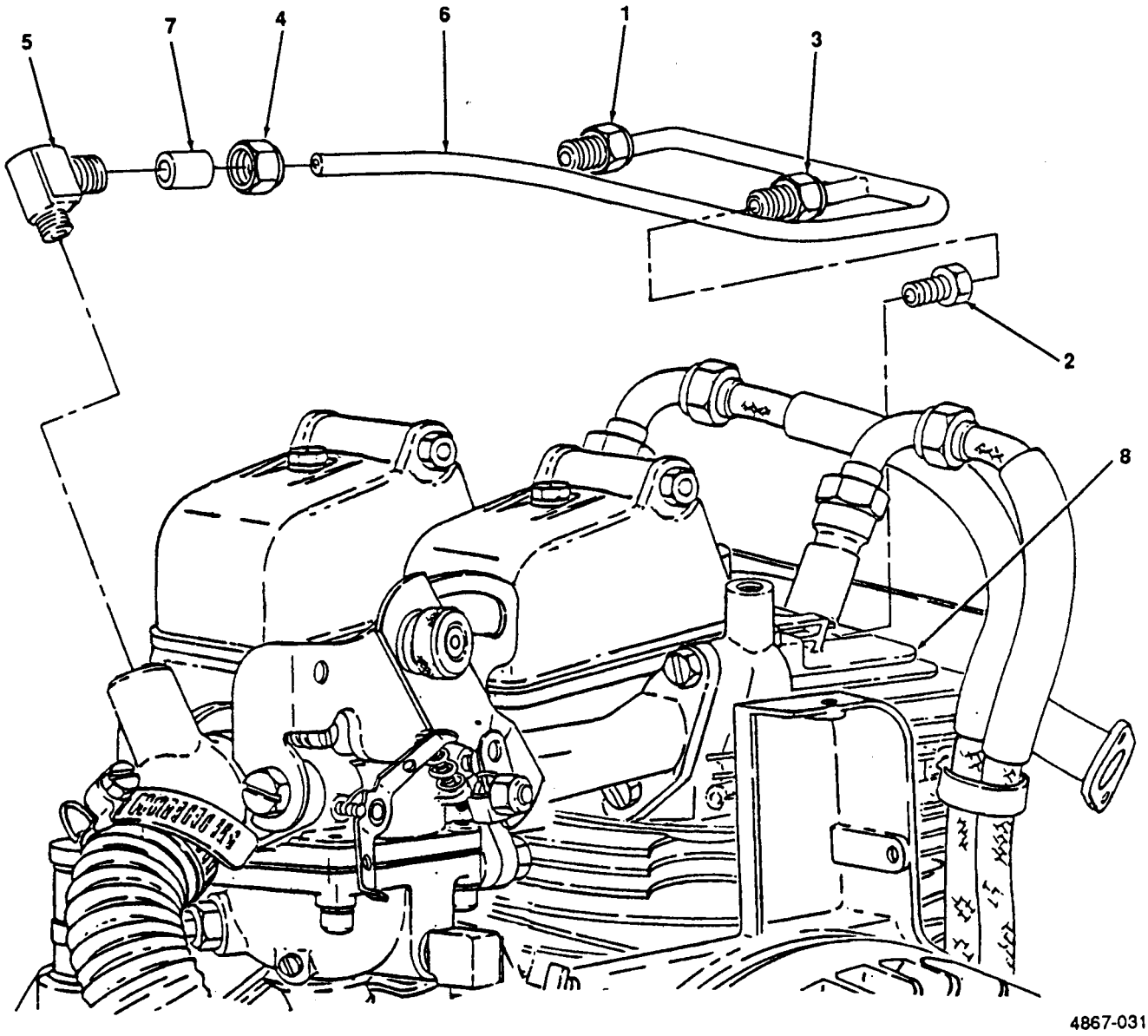

Figure 4-25. Breather Line (Dry Element), Removal and Installation.

4-33. Throttle Control.

This task covers: a. Removal b. Installation

INITIAL SETUP

Tools

General Mechanic's Tool Kit (Item 1, Appendix B)

a. Removal. (figure 4-26)

(1) Remove screw (1) and washer (2).

NOTE

Make note of spring placement before removal of throttle lever.

(2) Remove nut (3) and remove throttle lever (4) and spring (5).

(3) Remove screw (6) and remove throttle control (7).

b. Installation. (figure 4-26)

(1) Install spring (5) on throttle rod (9).

(2) Position throttle control (7) on carburetor (8) and secure with screw (6).

(3) Rotate spring (5) counterclockwise half turn and install throttle lever (4) on throttle rod (9) and secure with nut (3).

(4) Install screw (1) and washer (2).

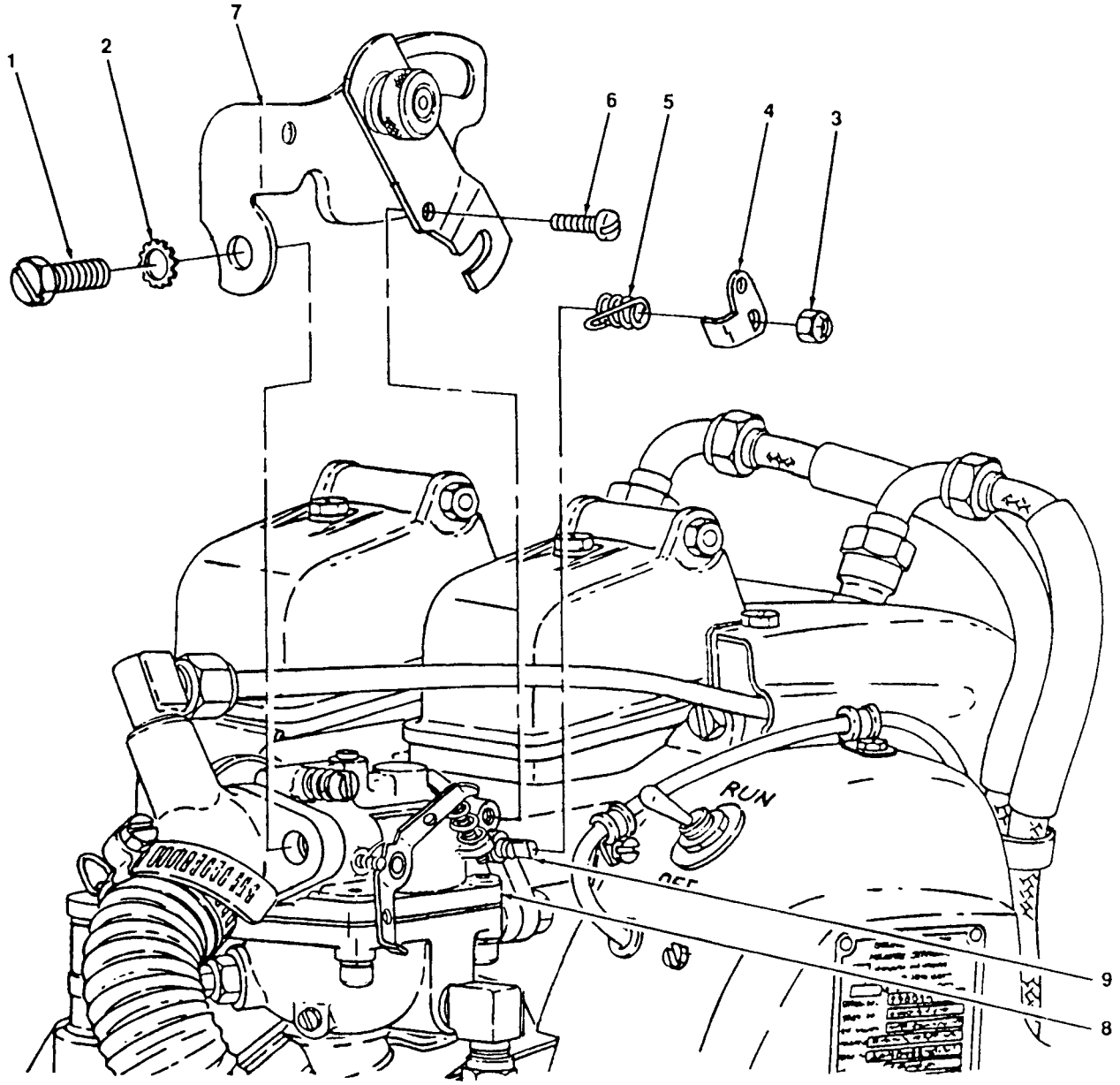

Figure 4-26. Throttle Control, Removal and Installation.

4-34. **Carburetor.**

This task covers:
a. Adjustment
b. Removal
c. Inspection
d. Installation

INITIAL SETUP

Tools

General Mechanic's Tool Kit (Item 1, Appendix B)
Wrench, Torque (NSN 5120-00-640-6364) (Item 2, Appendix B)

Materials/Parts

Rags, Wiping (Item 6, Appendix D)
Solvent, Drycleaning (Item 7, Appendix D)

Materials/Parts (cont)

Gasket, Carburetor Mounting (NSN 5330-00-819-8733)
Gasket, Throttle Housing Front (P/N 9786E64-6)
Gasket, Throttle Housing Rear (P/N 9786E65-3)
Gasket, Throttle Housing to Carburetor (P/N 9786E65-4)

a. Adjustment. (figure 4-27)

(1) Turn main adjustment needle (1) and idle adjustment needle (2) fully clockwise to stop.

(2) Turn main adjustment needle (1) 3/4 turns counterclockwise.

(3) Turn idle adjustment (2) 1/2 turns counterclockwise.

(4) Start and warm-up engine (para. 2-9).

(5) Apply end item load and observe exhaust.

(6) If exhaust is black, turn main adjustment needle (1) clockwise.

(7) If engine runs rough or lacks power, turn main adjustment needle (1) counterclockwise.

(8) To set idle speed, turn idle speed regulating screw (3) clockwise to increase idle or counterclockwise to decrease.

(9) Stop engine (para. 2-10).

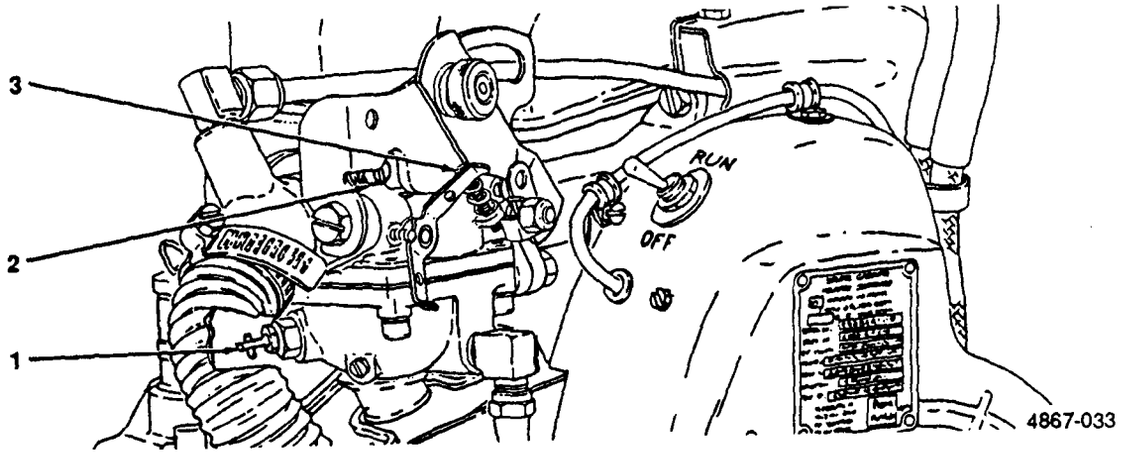

Figure 4-27. Carburetor, Adjustment.

4-34. Carburetor (cont).

b. Removal. (figure 4-28)

(1) Remove throttle control (para. 4-33).

(2) Disconnect breather line (1) from air intake elbow (2).

(3) Loosen clamp (3) and remove air cleaner duct (4) from air intake elbow (2).

(4) Remove screw (5) and washers (6) and remove air intake elbow (2) and gasket (7).

(5) Remove two screws (8) and washers (9) and remove throttle housing cover (10) and gasket (11).

(6) Remove screw (12) , washer (13) and remove throttle lever (14) from carburetor (15).

(7) Remove two screws (16), washers (17) and remove throttle housing (18), gasket (19), rear cover (20) and gasket (21).

(8) Disconnect fuel line (22) from carburetor (15).

(9) Remove two nuts (23) and washers (24) securing carburetor (15) to intake manifold (25) and remove carburetor (15) and gasket (26).

WARNING

Drycleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°F-138°F (38°C-60°C).

c. Inspection.

(1) Clean carburetor with drycleaning solvent, and dry thoroughly.

(2) Inspect carburetor for cracks, excessive wear, stripped threads or any other signs of damage and replace as needed.

(3) Clean all gasket surfaces and ensure that old gasket material is removed.

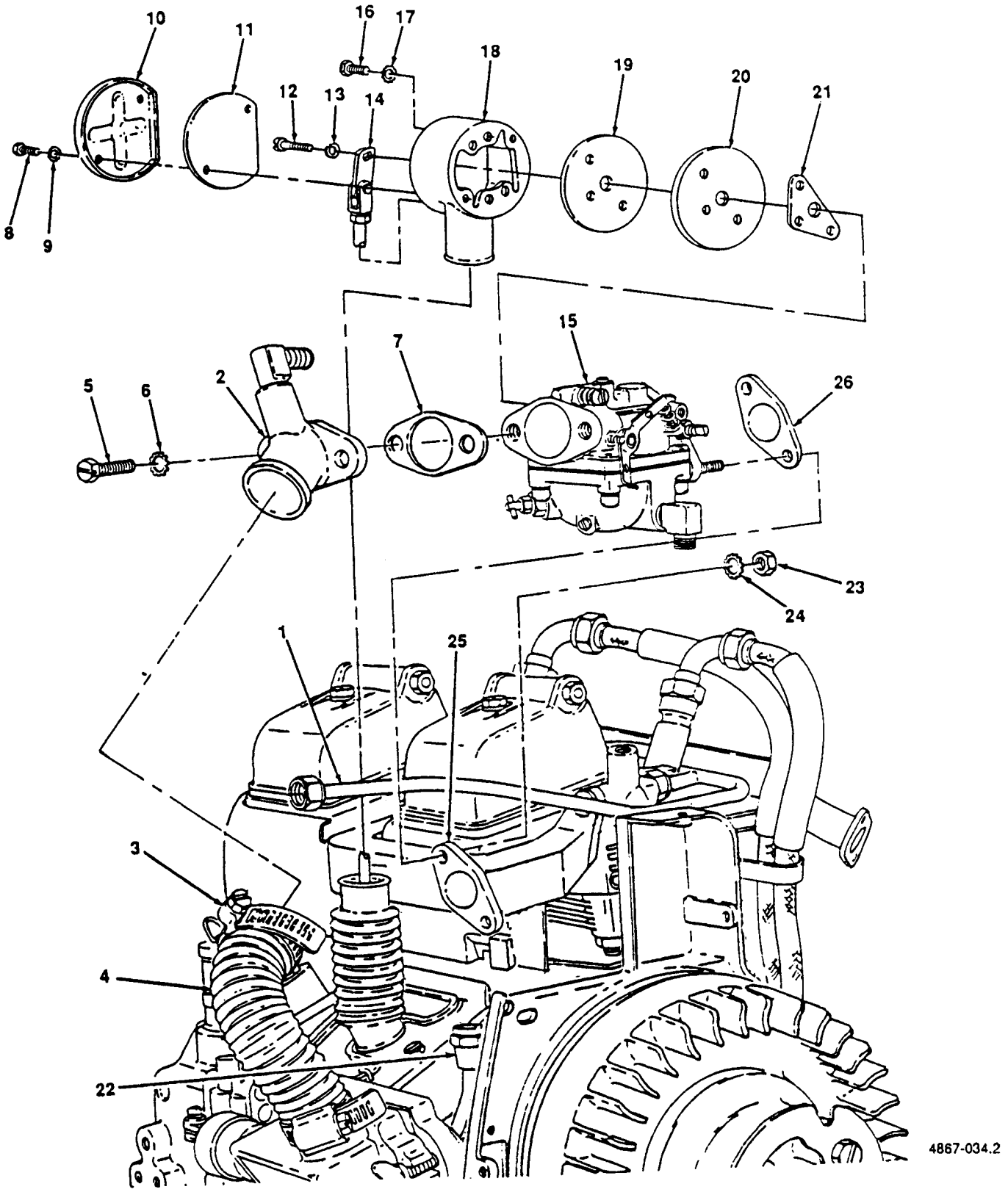

Figure 4-28. Carburetor, Removal.

4-34. Carburetor (cont).

d. Installation. (figure 4-29)

(1) Position carburetor (15) and gasket (26) on intake manifold (25) and secure with two nuts (23) and washers (24).

(2) Connect fuel line (22) to carburetor (15).

(3) Position gasket (21), rear cover (20), gasket (19) and throttle housing (18) on carburetor (15) and secure with two screws (16) and washers (17).

(4) Position throttle lever (14) on carburetor (15) and secure with screw (12) and washer (13).

(5) Position gasket (11) and throttle housing cover (10) on throttle housing (18) and secure with two screws (8) and washers (9).

(6) Position air intake elbow (2) and gasket (7) on carburetor (15) and secure with screw (5) and washer (6).

(7) Connect breather line (1) to air intake elbow (2).

(8) Install air cleaner duct (4) on air intake elbow (2) and secure with clamp (3).

(9) Install throttle control (para. 4-33).

(10) Adjust carburetor.

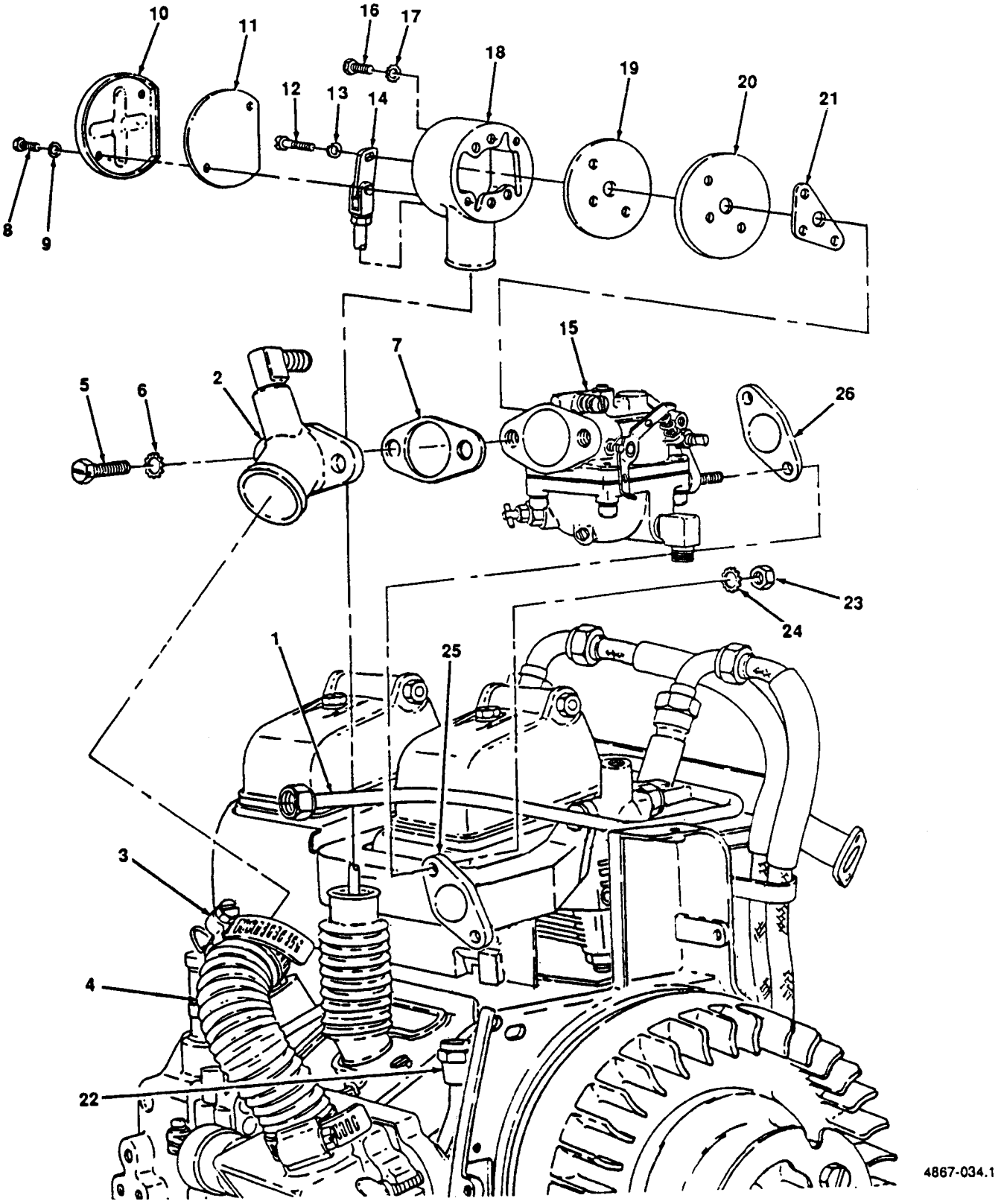

Figure 4-29. Carburetor, Installation.

4-35. **Fuel Pump.**

This task covers: a. Test b. Removal c. Installation

INITIAL SETUP

Tools

General Mechanic's Tool Kit (Item 1, Appendix B)
Test, Engine Vacuum and Pressure
(NSN 4910-00-253-8673) (Item 2, Appendix B)

Equipment Condition

Fuel supply removed from engine for removal of fuel pump.

Materials/Parts

Gasket, Fuel Pump Mounting (NSN 5330-00-756-1673)

a. Test. (figure 4-30)

(1) Disconnect fuel line (1) from fuel pump (2).

(2) Connect suitable fuel pressure gage (3) to fuel pump (2).

(3) Use starting rope to crank engine and check fuel pressure gage. Fuel pressure should be between 1 1/2-3 psi (10.34-20.69 Kpas).

(4) Replace fuel pump if actual reading does not match specifications.

(5) Remove pressure gage (3) and connect fuel line (1) to fuel pump (2).

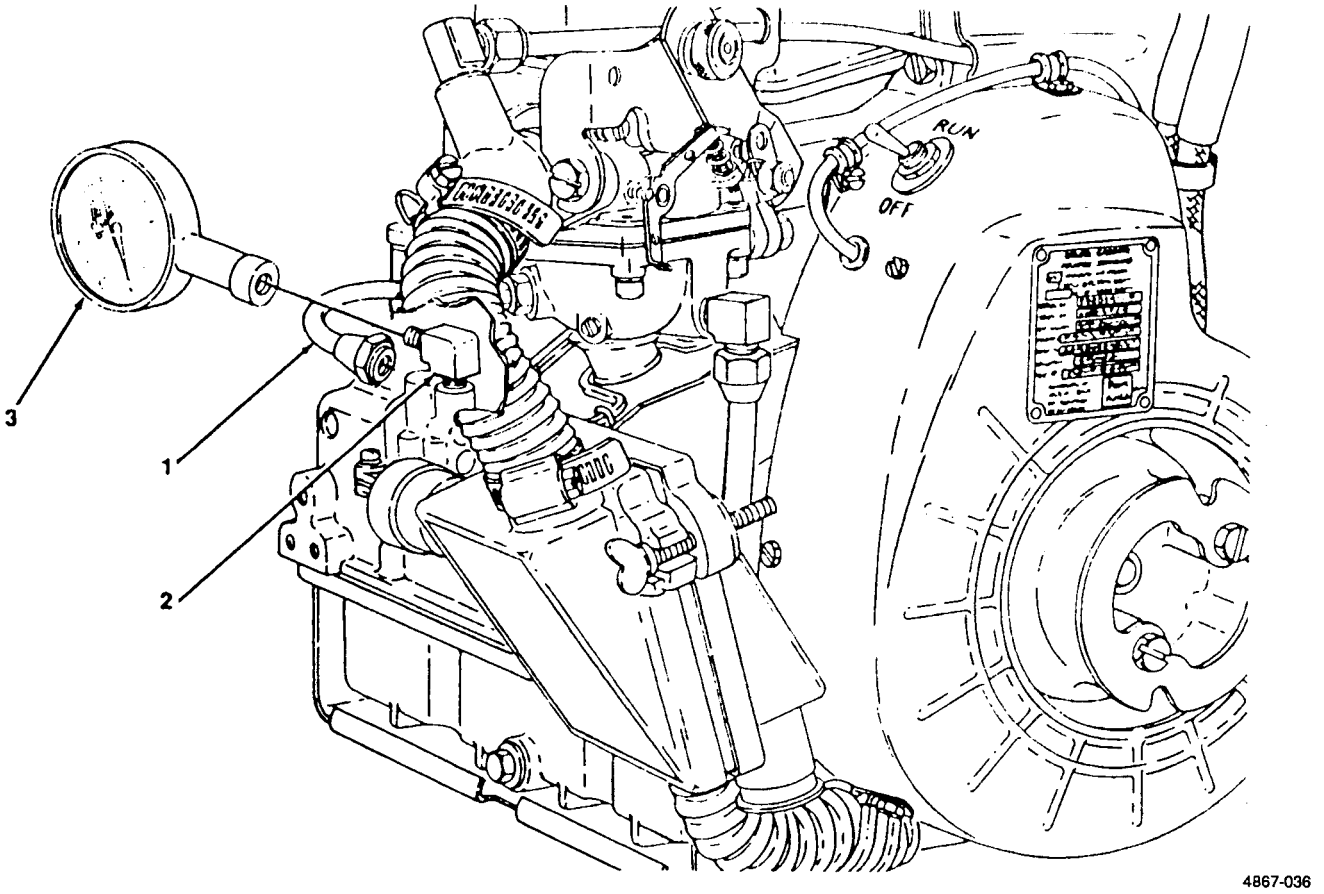

Figure 4-30. Fuel Pump Pressure Test.

4-35. Fuel Pump (cont).

b. *Removal.* (figure 4-31)

(1) Loosen fuel line (1) at elbow (2) on fuel pump (3).

NOTE

Perform step 2 only if fuel pump is being replaced.

(2) Remove elbow (2) from fuel pump (3).

(3) Remove two screws (4) and washers (5) securing fuel pump (3) and remove pump and gasket (6).

c. *Installation.* (figure 4-31)

(1) Clean mounting surface on engine and fuel pump.

(2) Position fuel pump (3) with gasket (6) on engine and secure with two screws (4) and washers (5).

(3) Install elbow (2) on fuel pump (3) and aline it with fuel line fitting (1).

(4) Connect fuel line (1) to elbow (2) on fuel pump (3).

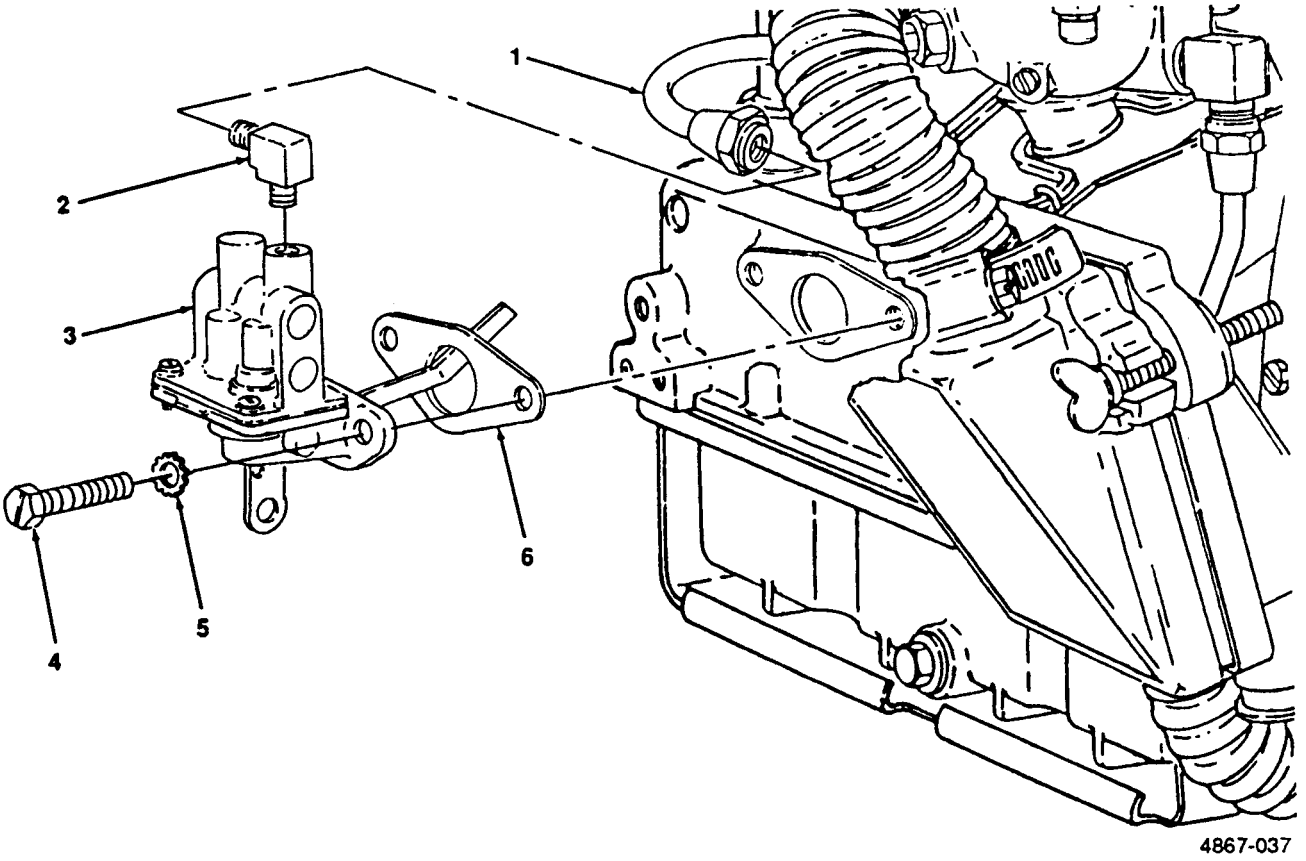

Figure 4-31. Fuel Pump, Removal and Installation.

4-36. **Fuel Line.**

This task covers: a. Removal b. Installation

INITIAL SETUP

Tools	*Equipment Condition*
General Mechanic's Tool Kit (Item 1, Appendix B)	Fuel pump removed (para. 4-35).

a. Removal. (figure 4-32)

Loosen fuel line fitting (1) at carburetor (2) and remove fuel line (3).

b. Installation. (figure 4-32)

Connect fuel line fitting (1) to carburetor (2) and tighten fitting (1).

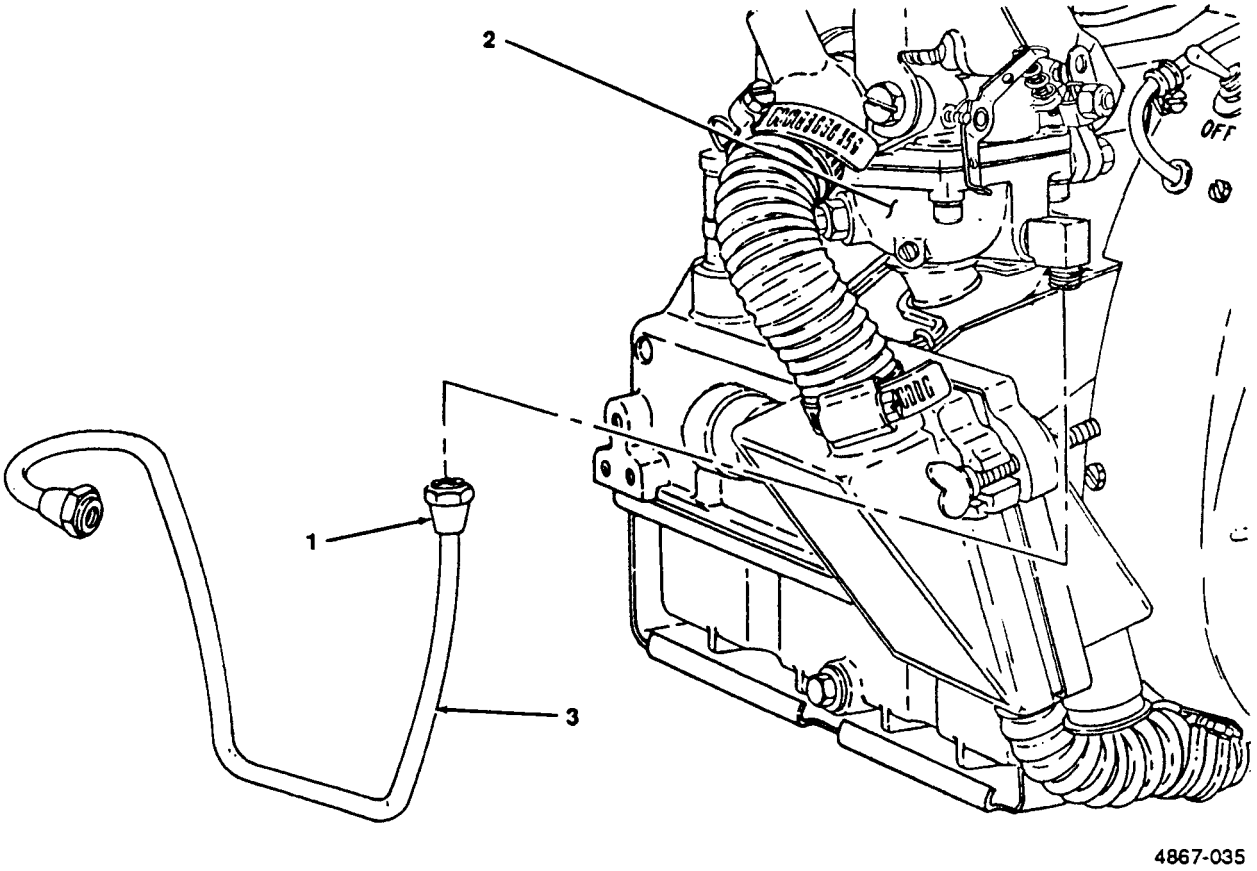

Figure 4-32. Fuel Line, Removal and Installation.

4-37. Starter Flange.

This task covers: a. Removal b. Installation

INITIAL SETUP

Tools

General Mechanic's Tool Kit (Item 1, Appendix B)

a. Removal. (figure 4-33)

Remove two screws (1) and washers (2) and remove starter flange (3) from flywheel (4).

b. Installation. (figure 4-33)

Position starter flange (3) on flywheel (4) and secure with two screws (1) and washers (2).

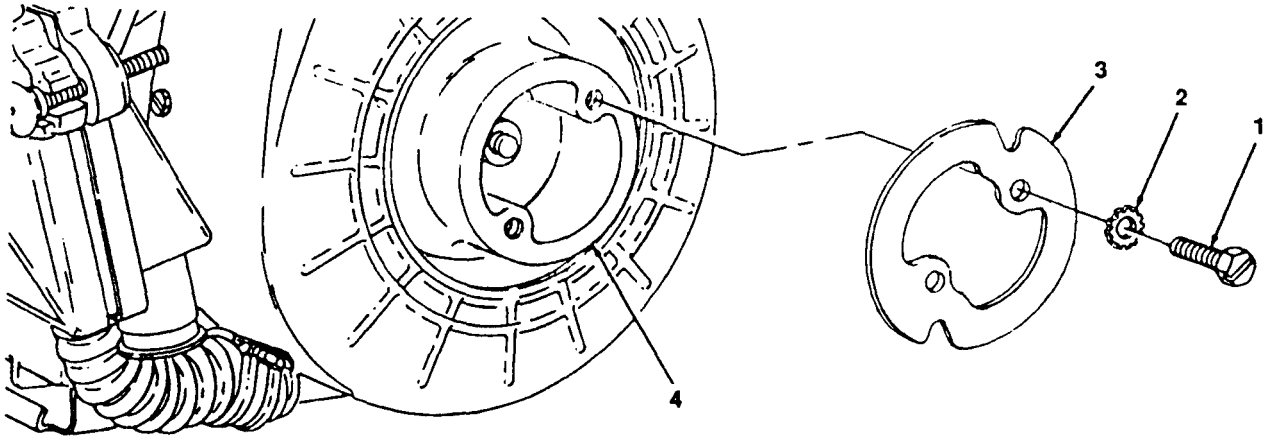

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Figure 4-33. Starter Flange, Removal and Installation.

4-38. Flywheel.

This task covers: a. Removal b. Inspection c. Installation

INITIAL SETUP

Tools	*Equipment Condition*
General Mechanic's Tool Kit (Item 1, Appendix B) Wrench, Torque (NSN 5120-00-640-6364) (Item 2, Appendix B) Puller (NSN 5120-00-313-9496) (Item 2, Appendix B)	Starter flange removed (para. 4-37). Flywheel cover removed (para. 4-14).

a. Removal. (figure 4-34)

(1) Remove nut (1) and washer (2) from crankshaft (3).

(2) Using suitable puller, remove flywheel (4) and key (5) from crankshaft (3).

b. Inspect.

(1) Inspect flywheel for cracks, bent or missing fins.

(2) Inspect starter flange mounting screw threads for signs of stripping or cross threading.

(3) Replace a damaged flywheel.

c. Installation. (figure 4-34)

(1) Position key (5) in crankshaft (3).

(2) Install flywheel (4) on crankshaft (3) and secure with nut (1) and washer (2). Torque nut to 240-300 in. lbs. (42864-53580 gr cm)

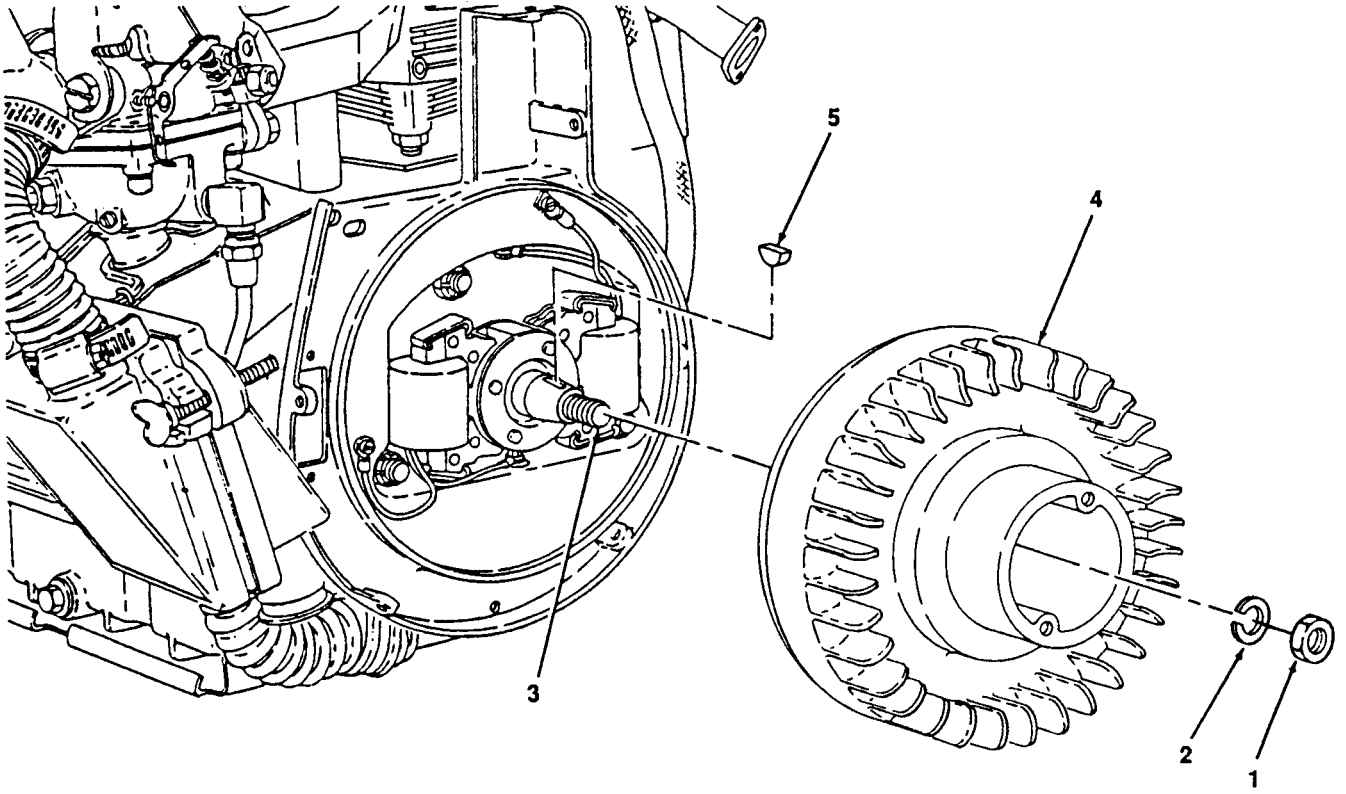

Figure 4-34. Flywheel, Removal and Installation.

4-39. Intake Manifold.

This task covers: a. Removal b. Installation

INITIAL SETUP

Tools

General Mechanic's Tool Kit (Item 1, Appendix B)
Wrench, Torque (NSN 5120-00-640-6364) (Item 2, Appendix B)

Equipment Condition

Carburetor removed (para. 4-34).
Cylinder head covers removed (para. 4-15).
Flywheel cover removed (para. 4-16).

Materials/Parts

Rags, Wiping (Item 6, Appendix D)
Solvent, Drycleaning (Item 7, Appendix D)
Gasket, Intake Manifold Mounting (P/N 9786E26-4)

a. Removal. (figure 4-35)

(1) Remove four screws (1) and washers (2) and remove intake manifold (3) and gaskets (4).

WARNING

Drycleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°F-138°F (38°C-60°C).

(2) Clean intake manifold (3) with drycleaning solvent and dry thoroughly.

(3) Inspect intake manifold for cracks or other signs of damage and replace if necessary.

b. Installation . (figure 4-35)

(1) Insure gasket surfaces are clean.

(2) Install intake manifold (3) and gaskets (4) and secure with four screws (1) and washers (2). Torque screws to 40-50 in. lbs (8037-8930 gr cm).

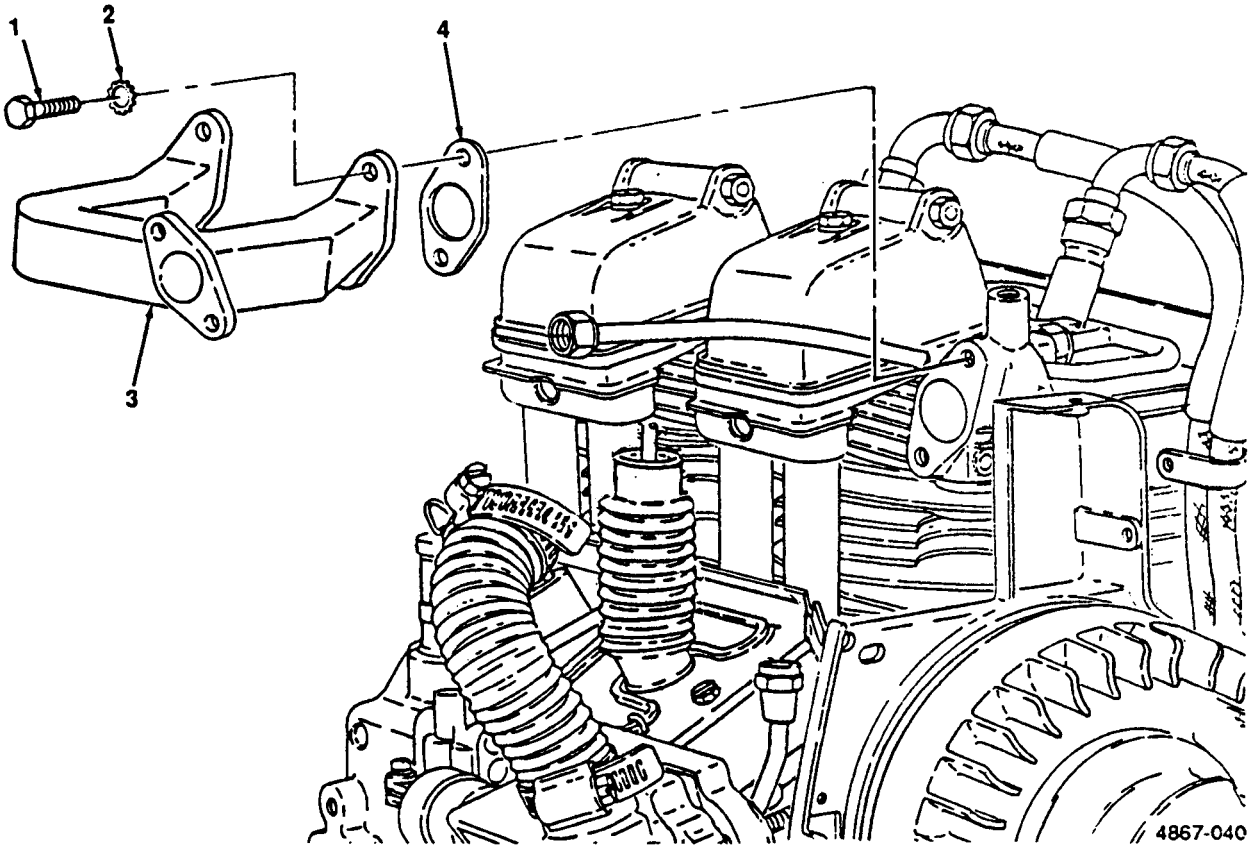

Figure 4-35. *Intake Manifold, Removal and Installation.*

4-40. Exhaust Manifold.

This task covers: a. Removal b. Installation

INITIAL SETUP

Tools

General Mechanic's Tool Kit (Item 1, Appendix B)
Wrench, Torque (NSN 5120-00-640-6364) (Item 2, Appendix B)

Equipment Condition

Cylinder head covers removed (para. 4-15).
Breather line removed (para. 4-32).

Materials/Parts

Rags, Wiping (Item 6, Appendix D)
Solvent, Drycleaning (Item 7, Appendix D)
Gasket, Exhaust Manifold Mounting (NSN 5330-00-797-3506)

a. Removal. (figure 4-36)

(1) Remove four nuts (1) and remove exhaust manifold (2) and gaskets (3).

WARNING

Drycleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°F-138°F (38°C-60°C).

(2) Clean exhaust manifold with drycleaning solvent and dry thoroughly.

(3) Inspect exhaust manifold for cracks or other signs of damage and replace as needed.

b. Installation . (figure 4-36)

(1) Ensure gasket surfaces are clean.

(2) Install exhaust manifold (2) and gaskets (3) and secure with four nuts (1). Tighten nuts to 60-85 in. lbs (10716-15181 gr cm).

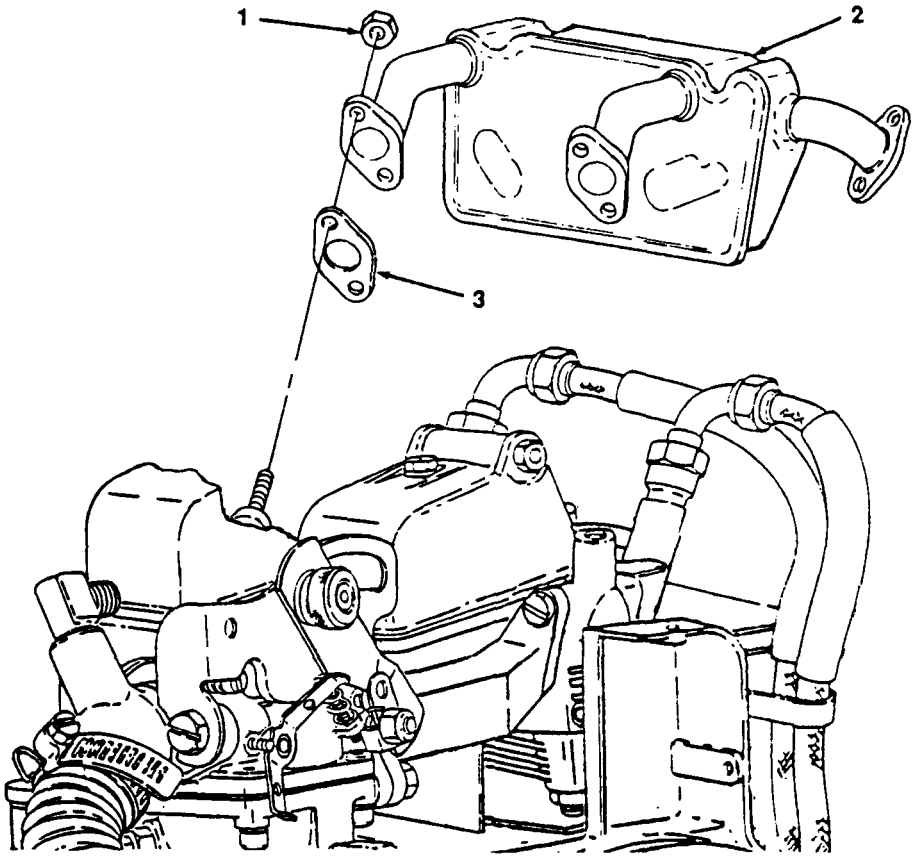

Figure 4-36. Exhaust Manifold, Removal and Installation.

4-41. Bearing Cap.

This task covers: Inspection

INITIAL SETUP

Tools	*Equipment Condition*
General Mechanic's Tool Kit (Item 1, Appendix B)	Flywheel removed (para. 4-38).

Inspection. (figure 4-37)

(1) Inspect bearing cap (1) for cracks or other signs of damage.

(2) Inspect bearing cap (1) for signs of oil seepage.

(3) Notify Direct Support maintenance of any defects.

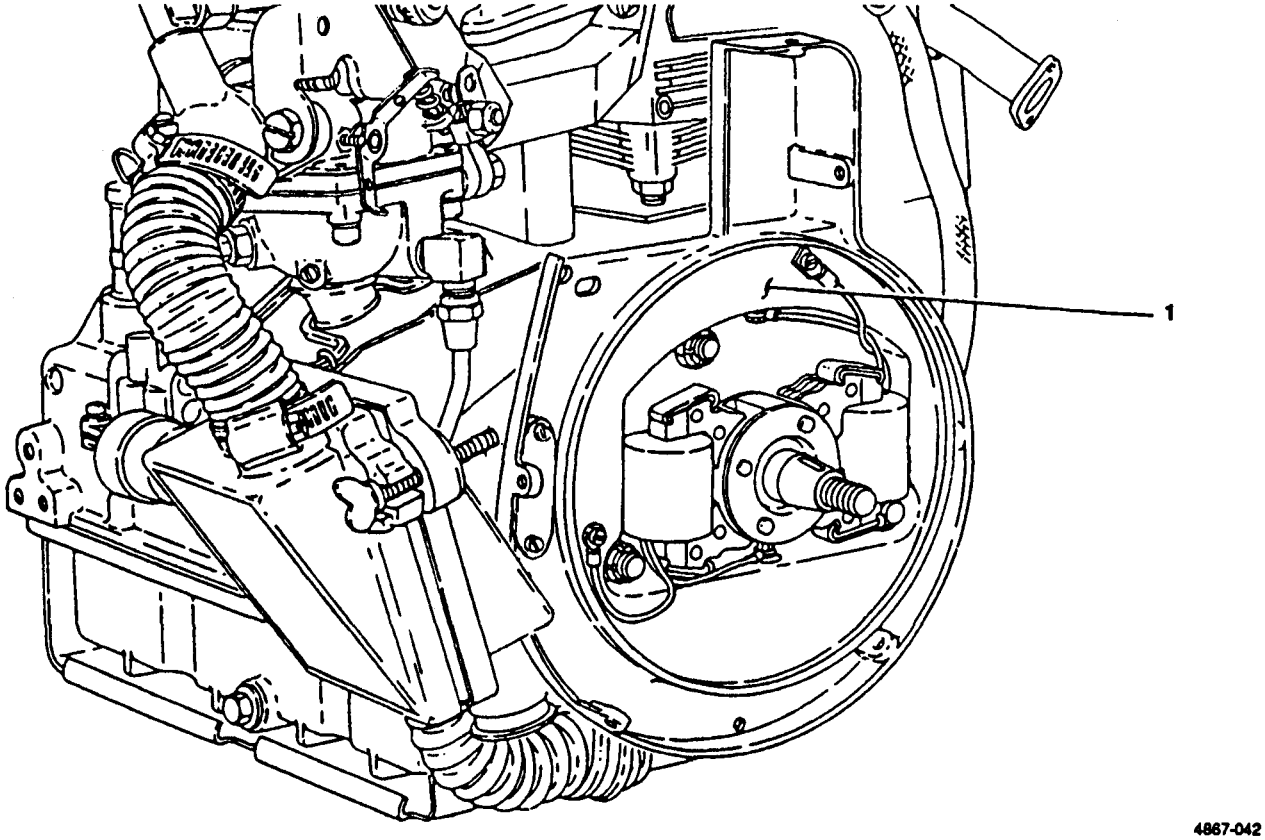

Figure 4-37. Bearing Cap Inspection.

Section VI. PREPARATION FOR SHIPMENT OR STORAGE

Paragraph Page

4-42 General 4-81
4-43 Short Term and Intermediate Storage Procedures 4-81
4-44 Administrative Storage 4-81

4-42. **General.** This section contains procedures to place the engine into either short term or intermediate storage.

NOTE

The procedures for placing the engine into either short term or intermediate storage are the same.

4-43. Short Term and Intermediate Storage Procedures.

a. Perform operator Before and After and Unit PMCS.

b. Remove end item fuel supply.

c. Drain fuel system.

d. Drain engine oil.

e. Secure fuel filter and starter rope to engine.

4-44. Administrative Storage.

a. Placement of equipment in administrative storage should be for short periods of time when a shortage of maintenance effort exists. Items should be in mission readiness within 24 hours or within the time factors determined by the directing authority. During the storage period appropriate maintenance records will be kept.

b. Before placing equipment in administrative storage, current maintenance services and equipment serviceable criteria (ESC) evaluations should be corrected, and all modification work orders (MWO'S) should be applied.

c. Storage site selection. Inside storage is preferred for items selected for administrative storage. If inside storage is not available, trucks, vans, conex containers and other containers may be used.

CHAPTER 5

DIRECT SUPPORT MAINTENANCE INSTRUCTIONS

Page

OVERVIEW 5-1
Section I. Repair Parts; Special Tools; Test, Measurement, Diagnostic Equipment (TMDE); and Support Equipment 5-1
Section II. Direct Support Troubleshooting.. 5-2
Section III. Direct Support Maintenance Procedures 5-5

OVERVIEW

This chapter contains information for troubleshooting and maintenance of the engine by Direct Support Maintenance personnel.

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

Paragraph Page

5-1 Common Tools and Test Equipment 5-1
5-2 Special Tools, TMDE, and Support Equipment 5-1
5-3 Repair Parts 5-1

5-1. **Common Tools and Equipment.** For authorized common tools and equipment, refer to the Modified Table of Organization and Equipment (MTOE) applicable to your unit.

5-2. **Special Tools, TMDE and Support Equipment.** For a listing of special tools, TMDE, and support equipment authorized for use on this equipment, refer to the Repair Parts and Special Tools List, TM 5-2805-257-24P, and the maintenance allocation chart (MAC), appendix B of this manual.

5-3. **Repair Parts.** Repair parts are listed and illustrated in the Repair Parts and Special Tools List for 3 HP Military Standard Engine, TM 5-2805-257-24P.

Section II. DIRECT SUPPORT TROUBLESHOOTING

Paragraph Page

5-4 General 5-1
5-5 Direct Support Troubleshooting Procedures 5-2

5-4. **General.** This section contains troubleshooting procedures to determine the probable cause of observed equipment malfunctions. Test or inspections are provided to isolate the faulty component and corrective actions are provided to eliminate the malfunction.

5-5. **Direct Support Troubleshooting Procedures.** Table 5-1 lists the common malfunctions that may be found during operation. Refer to symptom index to locate the troubleshooting procedures for the malfunction. This manual cannot list all malfunctions that may occur, nor all test or inspections and corrective actions. If a malfunction is not corrected by listed corrective actions, notify your supervisor.

SYMP TOM INDEX

Symptom — Page

Engine will not start 5-2
Engine misses or runs erratically 5-2
Engine oil consumption excessive 5-3
Engine runs excessively noisy 5-3
Engine will not start or runs erratically 5-4

Table 5-1. Direct Support Troubleshooting Procedures.

Malfunction Test or Inspection Corrective Action

1. ENGINE FAILS TO START.

Step 1. Inspect and test coils. Measure resistance of primary and secondary windings. Measurements should be as follows for breaker point coil:

Coil type	Primary windings	Secondary windings
Bendix Corp.	.512 ± .050 ohms	3,300 ± 400 ohms
Colt Industries	.370 ± .025 ohms	8,500 ± 700 ohms
Motor Parts. Inc.	.370 ± .025 ohms	8,500 ± 700 ohms

Step 2. Inspect rotating magnet for corrosion.

Replace rotating magnet if corroded or otherwise damaged (para. 5-19).

2. ENGINE MISSES OR RUNS ERRATICALLY.

Step 1. Check ignition timing (para. 5-9).

Adjust ignition timing (para 5-9).

Table 5-1. Direct Support Troubleshooting Procedures (cont).

Malfunction Test or Inspection Corrective Action

Step 2. Check valve adjustment.

Adjust valves as needed (para. 5-16).

Step 3. Inspect and test coil (para. 5-20).

Replace defective coil (para. 5-20).

Step 4. Check for cracked cylinder head and or leaky gasket.

Replace cracked or otherwise damaged cylinder head (para. 5-14).

Step 5. Check intake and exhaust valve for damage or excessive wear.

Replace damaged valve (para. 5-17).

Step 6. Check piston and piston rings for damage or excessive wear.

Replace damaged or worn piston or rings (para. 5-18).

3. ENGINE OIL CONSUMPTION EXCESSIVE.

Step 1. Check crankshaft side oil seal for seepage or leakage.

Replace faulty crankshaft side oil seal (para 5-23).

Step 2. Check flywheel side oil seal for seepage or leakage.

Replace faulty flywheel side oil seal (para 5-21).

Step 3. Check piston and piston rings for wear.

Replace worn or damaged piston and pinton rings (para. 5-18).

4. ENGINE RUNS EXCESSIVELY NOISY.

Step 1. Cheek valve mechanism for bent or otherwise damaged components.

Replace worn or damaged components (para 5-14).

Step 2. Check piston and connecting rod for wear.

Replace worn piston or connecting rod (para 5-18).

Table 5-1. Direct Support Troubleshooting Procedures (cont).

Malfunction Test or Inspection Corrective Action

5. ENGINE WILL NOT START OR RUNS ERRATICALLY MODEL 2A016-4.

NOTE

The following procedures can be performed with either a digital or analog multimeter refer to figure 5-26 for wiring diagram of electronic ignition system.

Step 1. Check low and high voltage cable ends for looseness.

Tighten any loose connections.

NOTE

There are two high voltage cables, repeat step for both cables.

Step 2. Remove high voltage cable from spark plug. Ground cable and hold spring approximately 1/4 in. (6 cm.) from engine. Pull start engine and check for spark.

If spark is present remove and inspect spark plug (para. 4-19).

Step 3. Remove ignition control unit cover and check for moisture or foreign material.

If moisture is present clean and dry terminals and connections and repeat step 2.

Step 4. Check low voltage cable end to end continuity.

If continuity is not present in all three lines replace low voltage cable (para. 5-13).

Step 5. Remove wiring from no. 1 terminal on ignition control unit module. Measure resistance between terminal no. 1 and ground.

If reading is less than 1 Megohm replace ignition module (para. 5-12).

Step 6. Remove wiring from terminals no. 5 and no. 6 and check resistance. Meter should show an initial deflection then a reading of 1 Megohm.

If final reading is not 1 Megohm then replace ignition control unit ignition module (para. 5-12).

NOTE

There are two transformers in the ignition control unit, repeat steps 7 and 8 for both transformers.

Table 5-1. Direct Support Troubleshooting Procedures (cont).

Malfunction Test or Inspection Corrective Action
Step 7. Check transformer resistance between white and brown wires. If resistance is more than 1 ohm replace transformer (para. 5-11).
Step 8. Check transformer resistance between white wire and spring on end of high voltage cable. If resistance is not between 1400 and 2500 ohms, replace transformer (para. 5-11).
Step 9. Check coil resistance between pins A and B of low voltage connector on engine. If resistance is not between 289 and 329 ohms replace coil (para. 5-20).

Section III. DIRECT SUPPORT MAINTENANCE PROCEDURE

Paragraph		Page
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5-7	Oil Pan	5-6
5-8	Governor Assembly	5-8
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5-11	Transformer (Breakerless Ignition)	5-20
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5-6. **General.** This section contains direct support maintenance procedures as authorized by the MAC in Appendix B of this manual. Table 5-2 located at the end of this section contains a list of engine components and their wear limits. Any item that does not meet the specified measurements must be replaced. Refer to Appendix E for torque values. All maintenance procedures require only one person to perform.

5-7. Oil Pan.

This task covers: a. Removal b. Installation

INITIAL SETUP

Tools	*Materials/Parts*
General Mechanic's Tool Kit (Item 1, Appendix B)	Rags, Wiping (Item 6, Appendix D)
Wrench, Torque (NSN 5120-00-230-6380) (Item 3, Appendix B)	Solvent, Drycleaning (Item 7, Appendix D)
	Gasket, Oil Pan Mounting (NSN 5330-00-797-3515)

a. Removal. (figure 5-1)

(1) Remove either drain plug (1) or (2) and drain oil into suitable container.

(2) Remove lower air duct and upper air duct (para. 4-16).

(3) Remove twelve screws (3) and washers (4) and remove oil pan (5) and gasket (6).

WARNING

Dry cleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°F -138°F (38°C-60°C).

(4) Clean oil pan (5) and drain plug (1) or (2) with dry cleaning solvent and dry thoroughly.

(5) Inspect oil pan and drain plugs for signs of damage. Replace as needed.

(6) Replace washer (7) on drain plug (1) or (2).

(7) Clean gasket surfaces and remove old gasket material.

b. Intallation. (figure 5-1)

(1) Install oil pan (5) and gasket (6) and secure with twelve screws (3) and washers (4). Torque screws to 25-30 in. lbs. (4465-5358 gr. cm.).

(2) Install drain plug (1) or (2) with washer (7).

(3) Install lower air duct and upper air duct (para. 4-16).

(4) Refill engine oil (refer to LO 9-2805-257-14 for proper grade of oil).

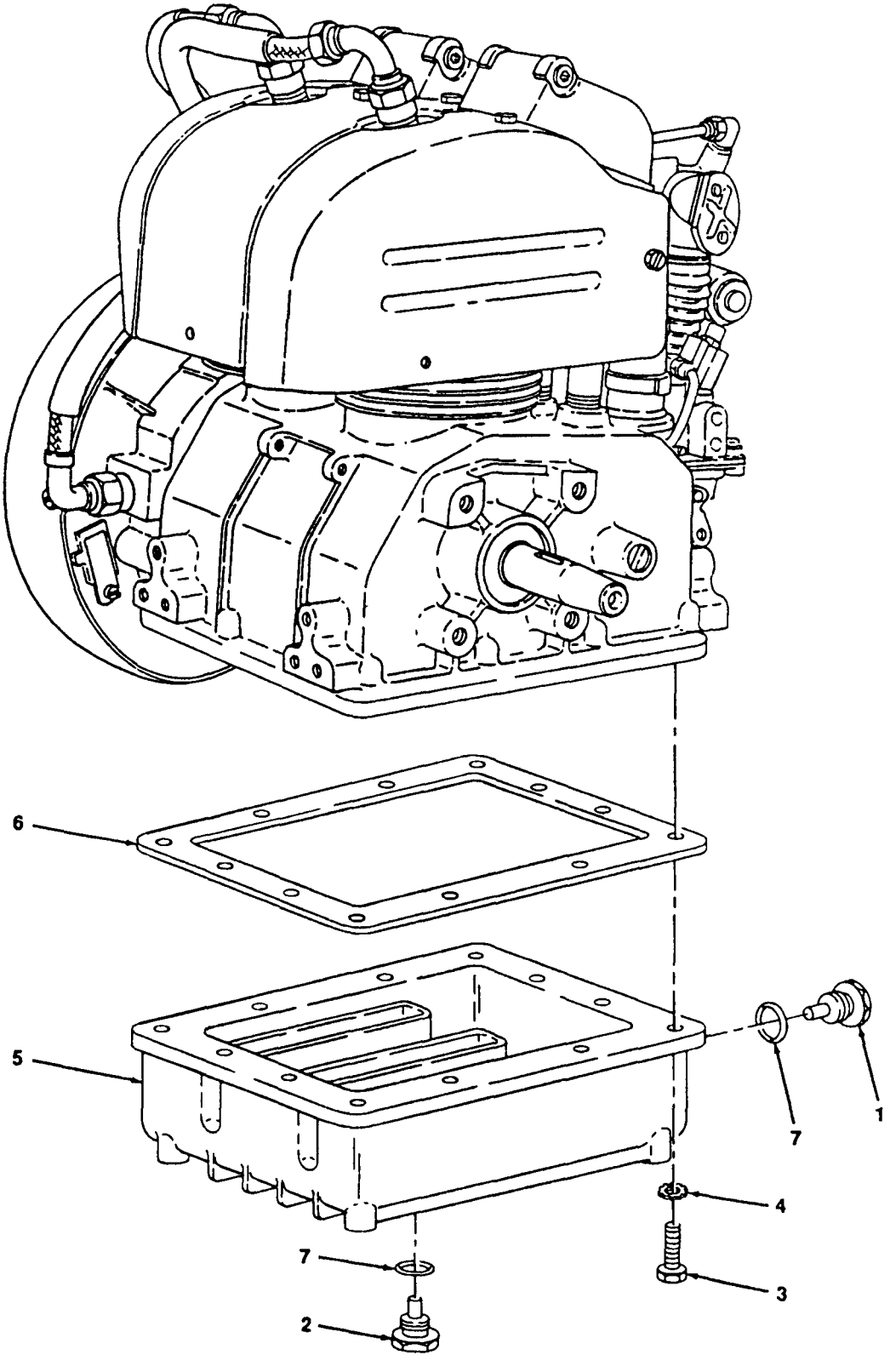

Figure 5-1. Oil Pan, Removal and Installation.

5-8. **Governor Assembly.**

This task covers:
a. Removal
b. Repair (breakerless ignition)
c. Repair (breaker point ignition)
d. Installation

INITIAL SETUP

Tools

General Mechanic's Tool Kit (Item 1, Appendix B)

Materials/Parts

Rags, Wiping (Item 6, Appendix D)
Solvent, Drycleaning (Item 7, Appendix D)

Materials/Parts (cont)

Gasket, Throttle Housing to Carburetor (P/N 9786E65-4)
Gasket, Throttle Housing Front (P/N 9786E64-6)
Gasket, Throttle Housing Rear (P/N 9786E65-3)

a. Removal. (figure 5-2)

(1) Loosen clamp (1) and remove control rod housing (2) from throttle housing (3).

(2) Remove two screws (4) and washers (5) securing throttle housing cover (6) and gasket (7) and remove.

(3) Remove screw (8) and washer (9) securing throttle lever (10) to throttle rod (11) and remove.

(4) Remove two screws (12) and washers (13) and remove throttle housing (3) gasket (14) rear cover (15) and gasket (16).

NOTE

On engines with breaker point ignitions make note of grounding strap placement before removing screws securing governor assembly.

(5) Tag and remove condenser leads (17) and (18) from noise suppression filters (19) and (20).

(6) Remove three screws (21) and washers (22) securing governor assembly (23) and gasket (24) and remove.

(7) Remove old gasket from mating surfaces.

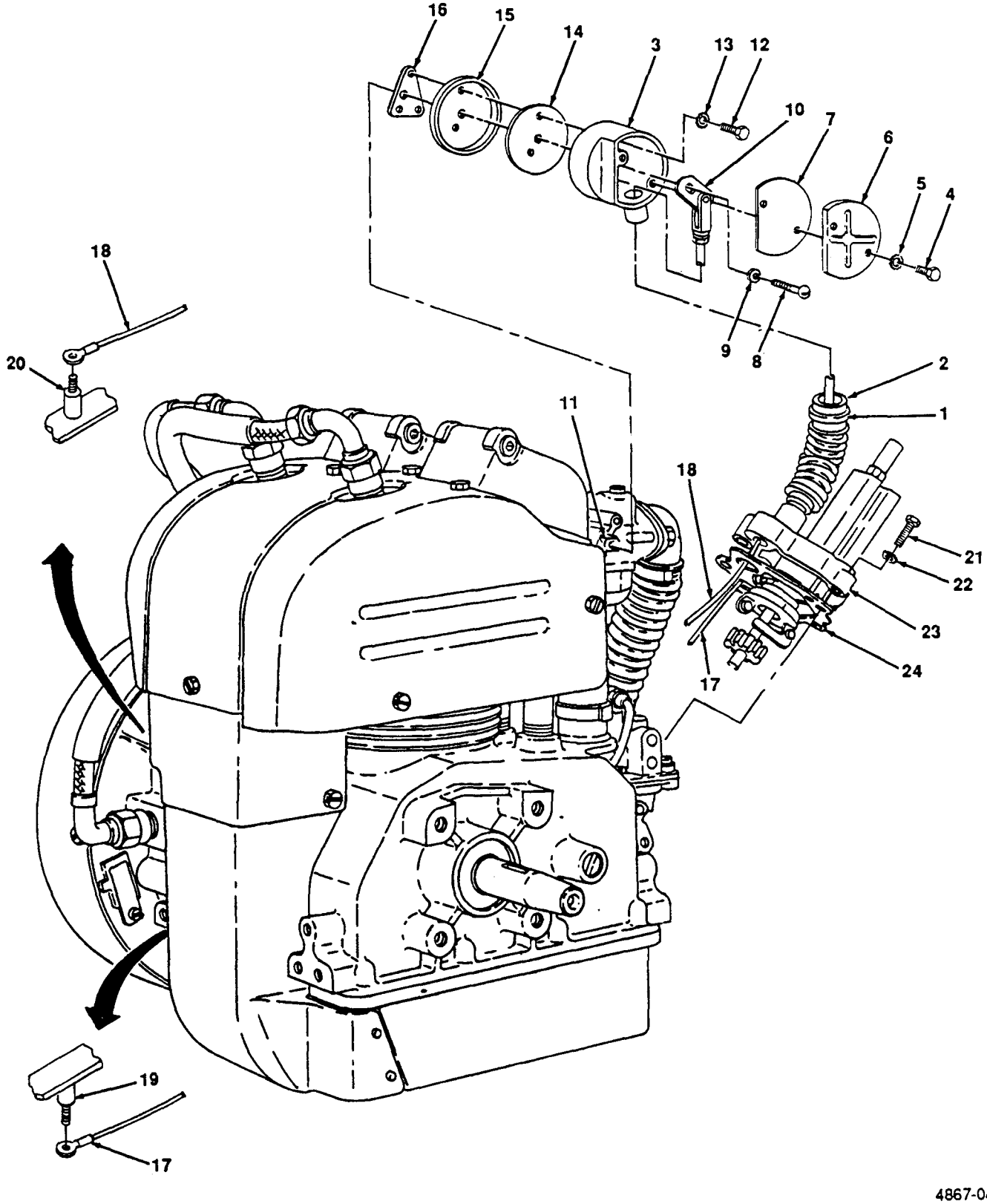

Figure 5-2. Governor Assembly, Removal.

5-8. Governor Assembly (cont).

b. Repair Breaker/ess Ignition. (figure 5-3)

(1) Using suitable punch, remove pin (1) and remove flyweight and carrier assembly (2) from shaft (3).

WARNING

Dry cleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°F–138°F (38°C-60°C).

(2) Clean flyweight and carrier assembly (2) with drycleaning solvent and dry thoroughly.

(3) Inspect flyweight and carrier assembly (2) for wear and replace if worn or otherwise damaged.

(4) Install flyweight and carrier assembly (2) on shaft (3) and secure with pin (1).

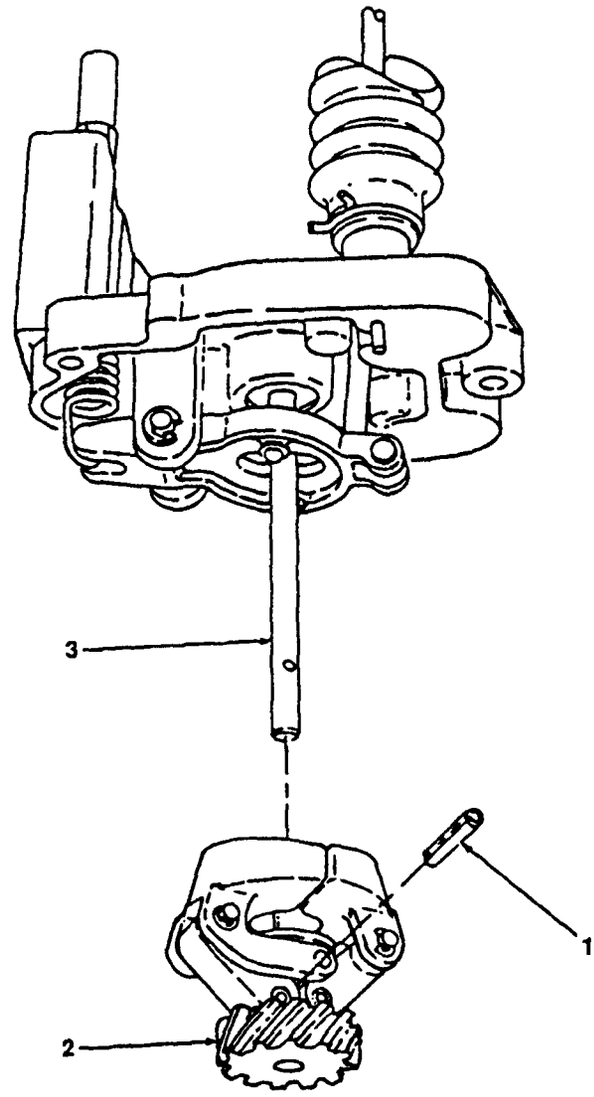

Figure **5-3.** *Governor Repair Breakerless Ignition.*

5-8. Governor Assembly (cont).

c. Repair. Breaker Point Ignition. (figure 5-4)

(1) Using suitable punch, remove pin (1) and remove flyweight and carrier assembly (2) from shaft (3).

WARNING

Dry cleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°F -138°F (38°C-60°C).

(2) Clean flyweight and carrier assembly (2) with drycleaning solvent and dry thoroughly.

(3) Inspect flyweight and carrier assembly (2) for wear and replace if worn or otherwise damaged.

(4) Install flyweight and carrier assembly (2) on shaft (3) and secure with pin (1).

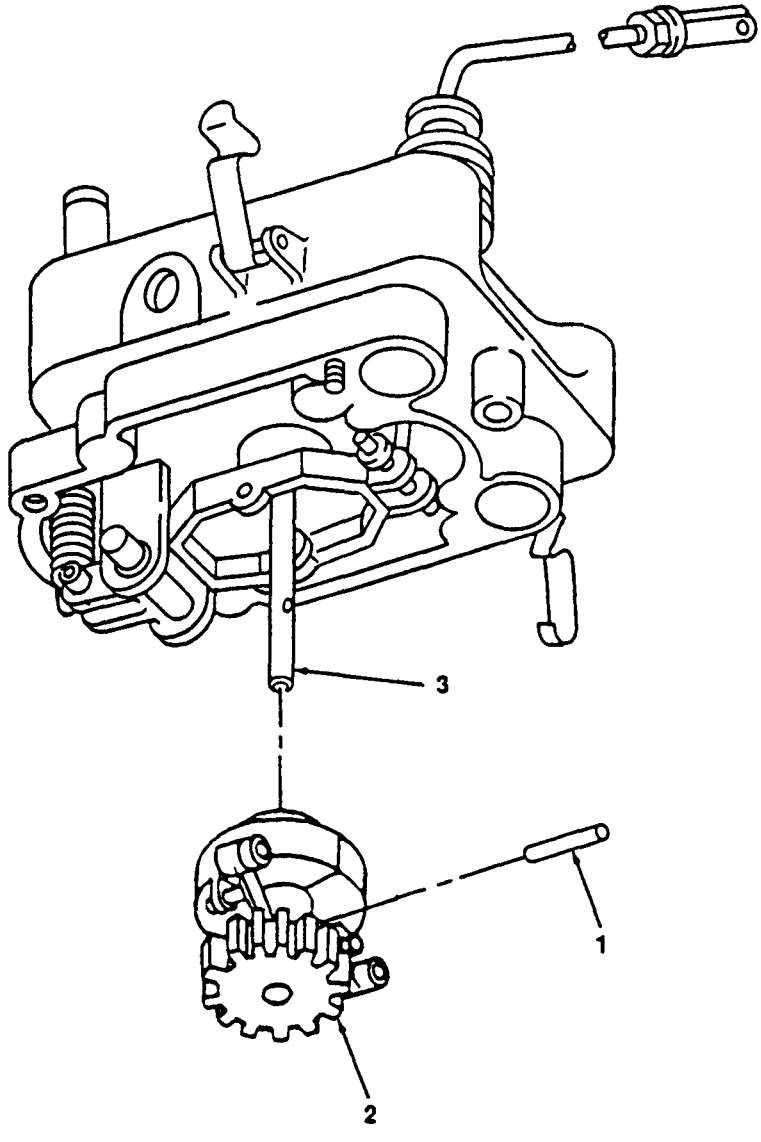

Figure 5-4. Governor Repair Breaker Point Ignition.

5-8. Governor Assembly (cont).

d. *Installation.* (figure 5-5)

NOTE

On engines with breaker point ignitions install grounding strap at lower left of governor assembly.

(1) Install governor assembly (23) and gasket (24) and secure with three screws (21) and washers (22).

(2) Connect condenser leads (17) and (18) to noise suppression filters (19) and (20) and remove tags.

(3) Install gasket (16), rear cover (15), gasket (14), and throttle housing (3) and secure with two screws (12) and washers (13).

(4) Position throttle lever (10) on throttle rod (11) and secure with screw (8) and washer (9).

(5) Install throttle housing cover (6) and gasket (7) and secure with two screws (4) and washers (5).

(6) Install control rod housing (2) on throttle housing (3) and secure with clamp (1).

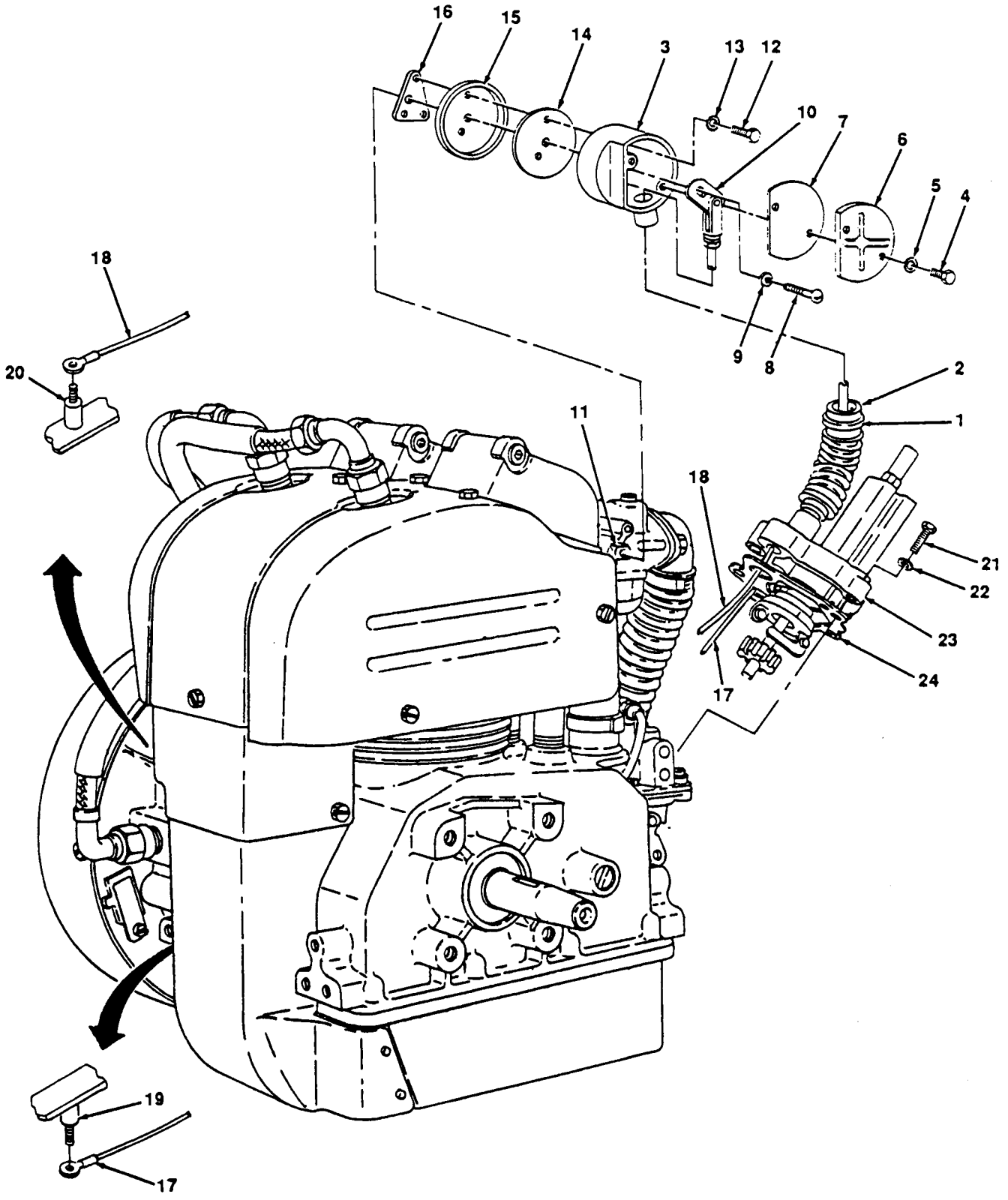

Figure 5-5. Governor Assembly, Installation.

5-9. Ignition Timing

This task covers: Adjustment

INITIAL SETUP

Tools	*Equipment Condition*
General Mechanic's Tool Kit (Item 1, Appendix B)	Breaker point gap set (para. 4-30). Flywheel side rocker cover removed (para. 4-25).

Adjustment. (figure 5-6)

(1) Unsnap two dips (1) and move breaker point cover (2) out of way.

(2) Loosen screw (3) and move ignition timing hole cover (4) to expose timing hole.

(3) Rotate flywheel clockwise until intake valve (5) doses, and stop when ignition timing mark on the fly-wheel alines with pointer.

(4) At this point the lower set of breaker points contacts (6) should just be starting to open. If they are not loosen screw (7) and turn ignition cam (8) counterclockwise until contacts (6) just start to open and tighten screw (7).

(5) Close ignition timing hole cover (4) and tighten screw (3).

(6) Install breaker points cover (2) and secure with two dips (1).

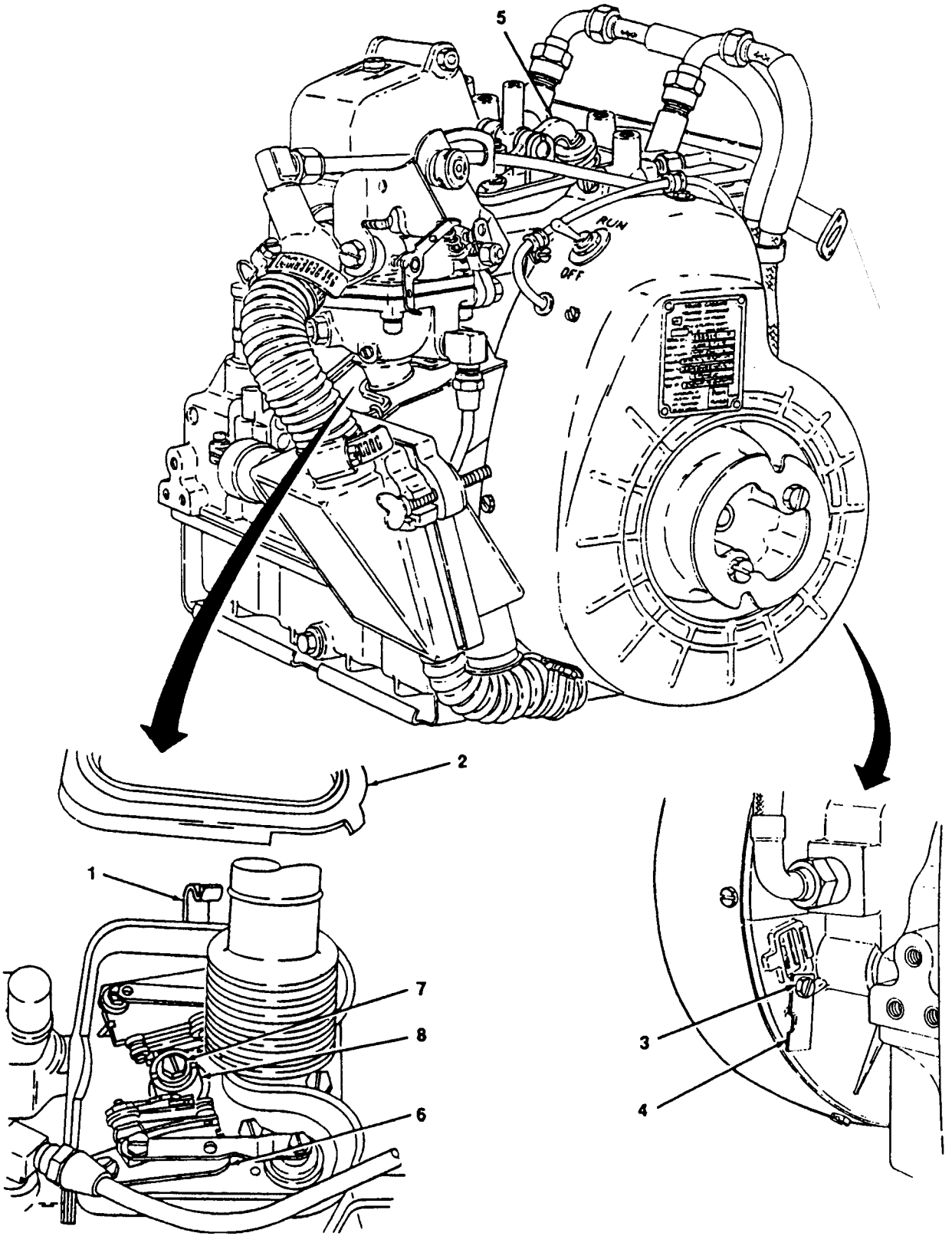

Figure 5-6. Ignition Timing.

5-10. Ignition Control Unit (Breakerless Ignition).

This task covers: a. Removal b. Installation

INITIAL SETUP

Tools

General Mechanic's Tool Kit (Item 1, Appendix B)

a. Removal. (figure 5-7)

(1) Disconnect low voltage cable (1) from ignition control unit (2).

(2) Loosen connector nut (3) and remove high tension cable (4) from ignition control unit (2).

(3) Loosen connector nut (5) and remove high tension cable (6) from ignition control unit (2).

(4) Remove two screws (7) and washers (8) and remove ignition control unit (2).

b. Installation. (figure 5-7)

(1) Install ignition control unit (2) and secure with two screws (7) and two washers (8).

(2) Connect low voltage cable (1) to ignition control unit (2).

(3) Install high tension cable (4), and tighten connector nut (3).

(4) Install high tension cable (6), and tighten connector nut (5).

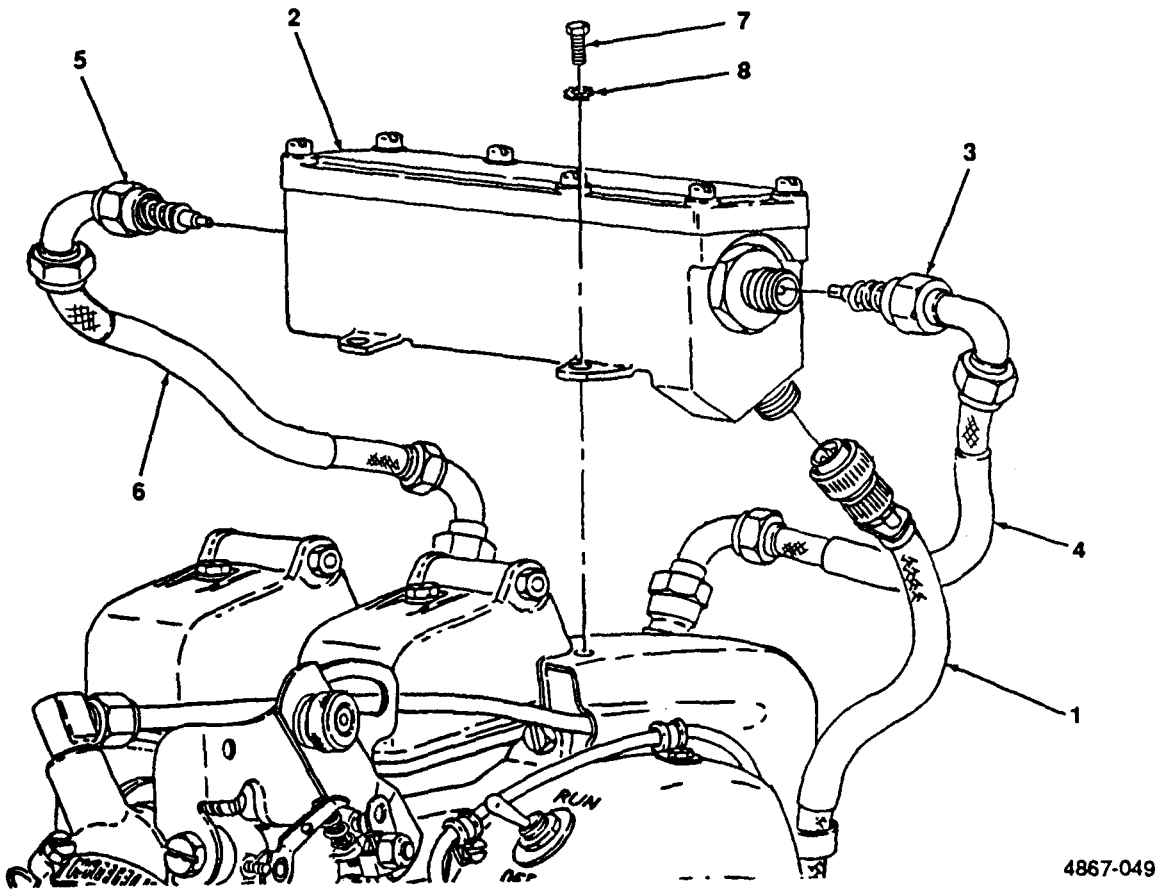

Figure 5-7. Ignition Control Unit, Removal and Installation.

5-11. Transformer (Breakerless Ignition).

This task covers: a. Removal b. Installation

INITIAL SETUP

Tools

General Mechanic's Tool Kit (Item 1, Appendix B)

NOTE

This engine is equipped with two transformers, the removal and installation procedures are the same for both.

a. Removal. (figure 5-8)

(1) Remove six screws (1) and remove cover (2).

(2) Tag and remove transformer leads from ignition control unit (3).

(3) Loosen connector nut (4) and remove ignition cable (5) from ignition control unit (3)

(4) Remove nut (6) and remove transformer (7) and O ring (8).

(5) Inspect O ring (8) and replace if ripped or otherwise damaged.

b. Installation. (figure 5-8)

(1) Install transformer (7) and O ring (8) and secure with nut (6).

(2) Connect transformer leads as tagged.

(3) Install cover (2) and secure with six screws (1).

(4) Install ignition cable (5) and tighten connector nut (4).

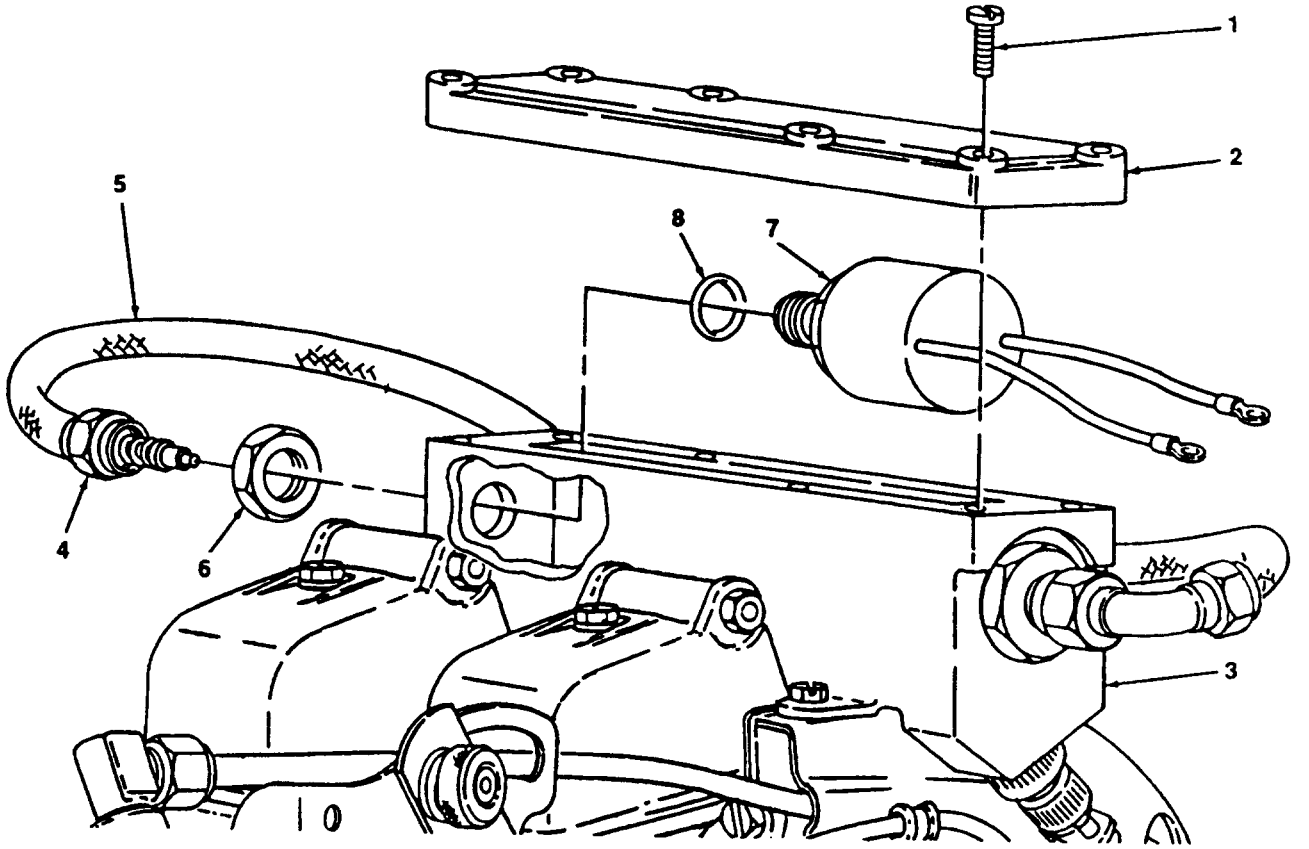

Figure 5-8. Transformer, Removal and Installation.

5-12. Ignition Module (Breakerless Ignition).

This task covers: a. Removal b. Installation

INITIAL SETUP

Tools

General Mechanic's Tool Kit (Item 1, Appendix B)

a. Removal. (figure 5-9)

(1) Remove six screws (1) and remove cover (2).

(2) Tag and remove wiring from terminals on ignition module (3).

(3) Tag wiring secured by ignition module mounting hardware.

(4) Remove two screws (4) and washers (5) and remove ignition module (3).

b. Installation. (figure 5-9)

NOTE

Install wiring as tagged to ignition module mounting screws before installing screws.

(1) Install ignition module (3) and secure with two screws (4) and washers (5).

(2) Connect wiring to ignition module terminals as tagged.

(3) Install cover (2) and secure with six screws (1).

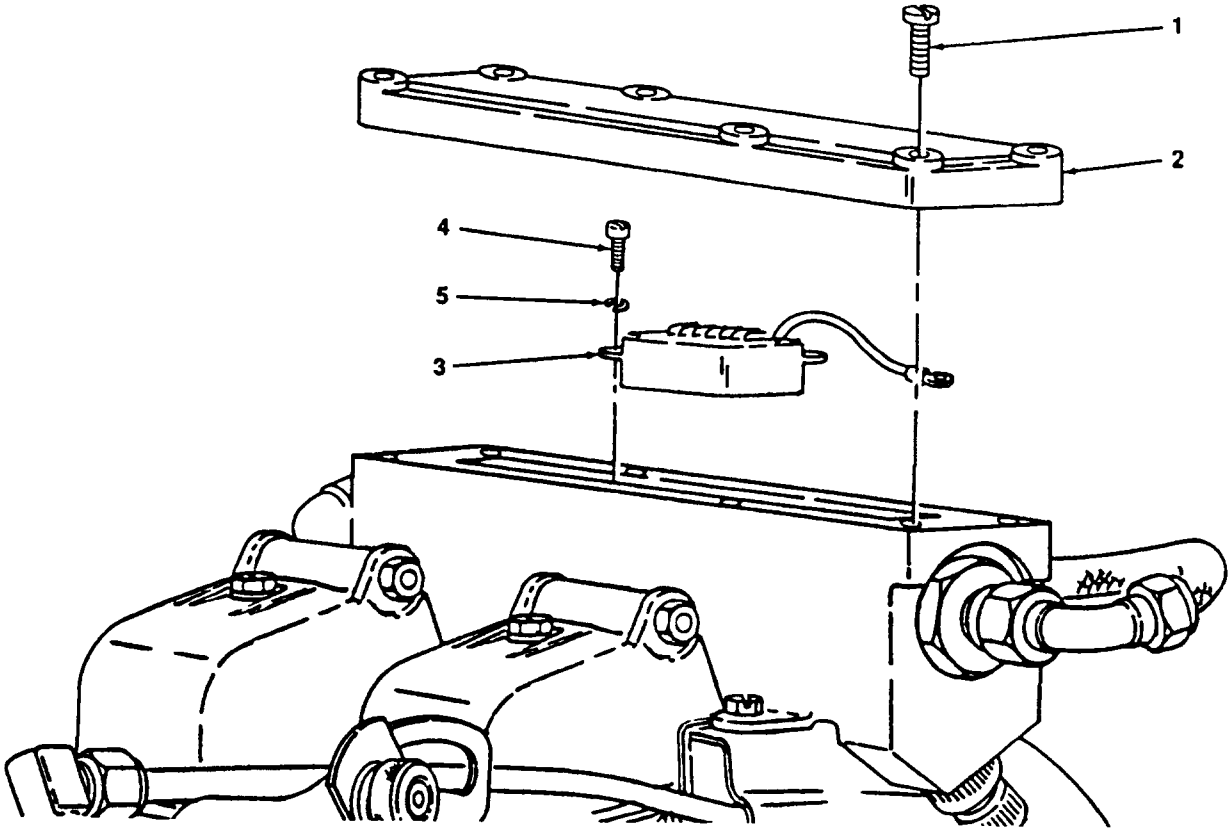

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Figure 5-9. Ignition Module, Removal and Installation.

5-13. Low Voltage Cable (Breakerless Ignition).

This task covers: a. Removal b. Installation

INITIAL SETUP

Tools	*Equipment Condition*
General Mechanic's Tool Kit (Item 1, Appendix B)	Flywheel Removed (para. 4-38)

a. Removal. (figure 5-10)

WARNING

Use extreme care when removing coil clamps. Flying clamps can cause serious eye injury. Cover work area with rag or hand when removing clamps.

NOTE

Before removing coil observe placement of coil leads.

(1) Remove two coil clamps (1) and move coil (2) slightly, tag and disconnect coil leads and remove coil (2).

(2) Disconnect low voltage cable (3) from ignition control unit (4).

(3) Remove two clamps (5), cable nut (6) and washer (7) and pull low voltage cable lead (8) through bearing cap (9).

(4) Loosen connector nut (10) and remove low voltage cable (3).

b. Installation. (figure 5-10)

(1) Install low voltage cable (3) and tighten connector nut (10).

(2) Route low voltage cable lead (8) through bearing cap (9) and install washer (7) and cable nut (6) and tighten cable nut (6).

(3) Install two clamps (5) on low voltage cable lead (8).

(4) Connect low voltage cable (3) to ignition control unit (4).

(5) Connect coil leads as tagged, and install coil (2) and secure with two coil clamps (1).

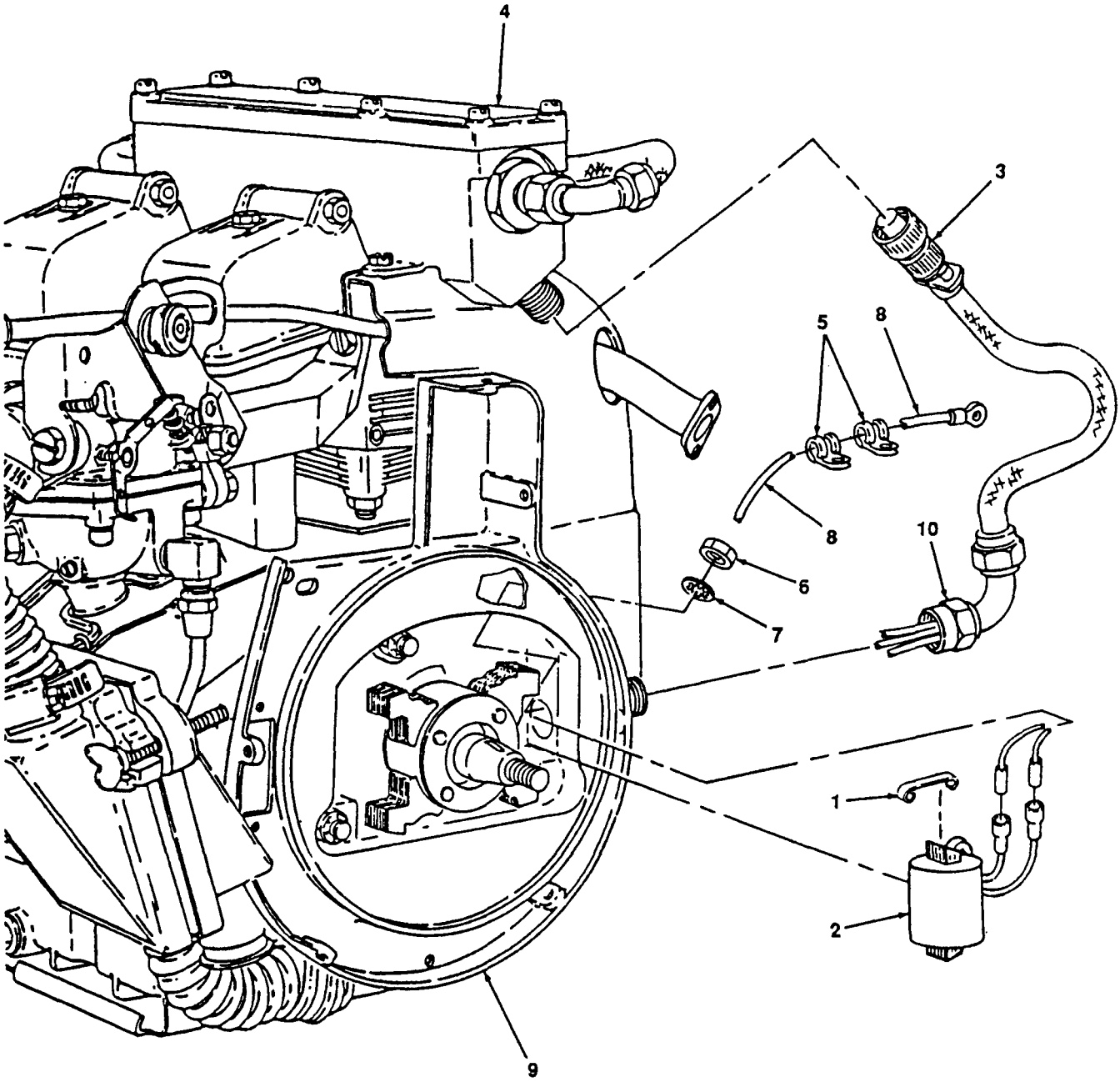

Figure 5-10. Low Voltage Cable, Removal and Installation.

5-14. Cylinder Head.

This task covers: a. Removal b. Repair c. Installation

INITIAL SETUP

Tools

General Mechanic's Tool Kit (Item 1, Appendix B)
Wrench, Torque (NSN 5120-00-230-6380) (Item 3, Appendix B)
Compressor, Valve Spring (NSN 5330-00-096-6677) (Item 3, Appendix B)

Materials/Parts

Rags, Wiping (Item 6, Appendix D)
Solvent, Drycleaning (Item 7, Appendix D)

Materials/Parts (cont)

Gasket, Cylinder Head Mounting (NSN 5330-00-819-8734)
Packing, Push Rod Housing (NSN 5330-00-797-3510)

Equipment Condition

Spark plugs removed (para. 4-19).
Intake manifold removed (para. 4-39).
Exhaust manifold removed (para. 4-40).
Rocker cover removed (para. 4-25).
Flywheel cover removed (para. 4-14).

NOTE

When removing cylinder heads, both heads must be removed at the same time.

a. Removal. (figure 5-11)

(1) Turn flywheel clockwise until both rockers (1), in cylinder heads (2) are closed.

(2) Remove eight nuts (3) and washers (4) and remove cylinder heads (2) and gaskets (5).

(3) Remove push rods (6), push rod housings (7), and preformed packings (8).

(4) Remove rear cylinder cover (9).

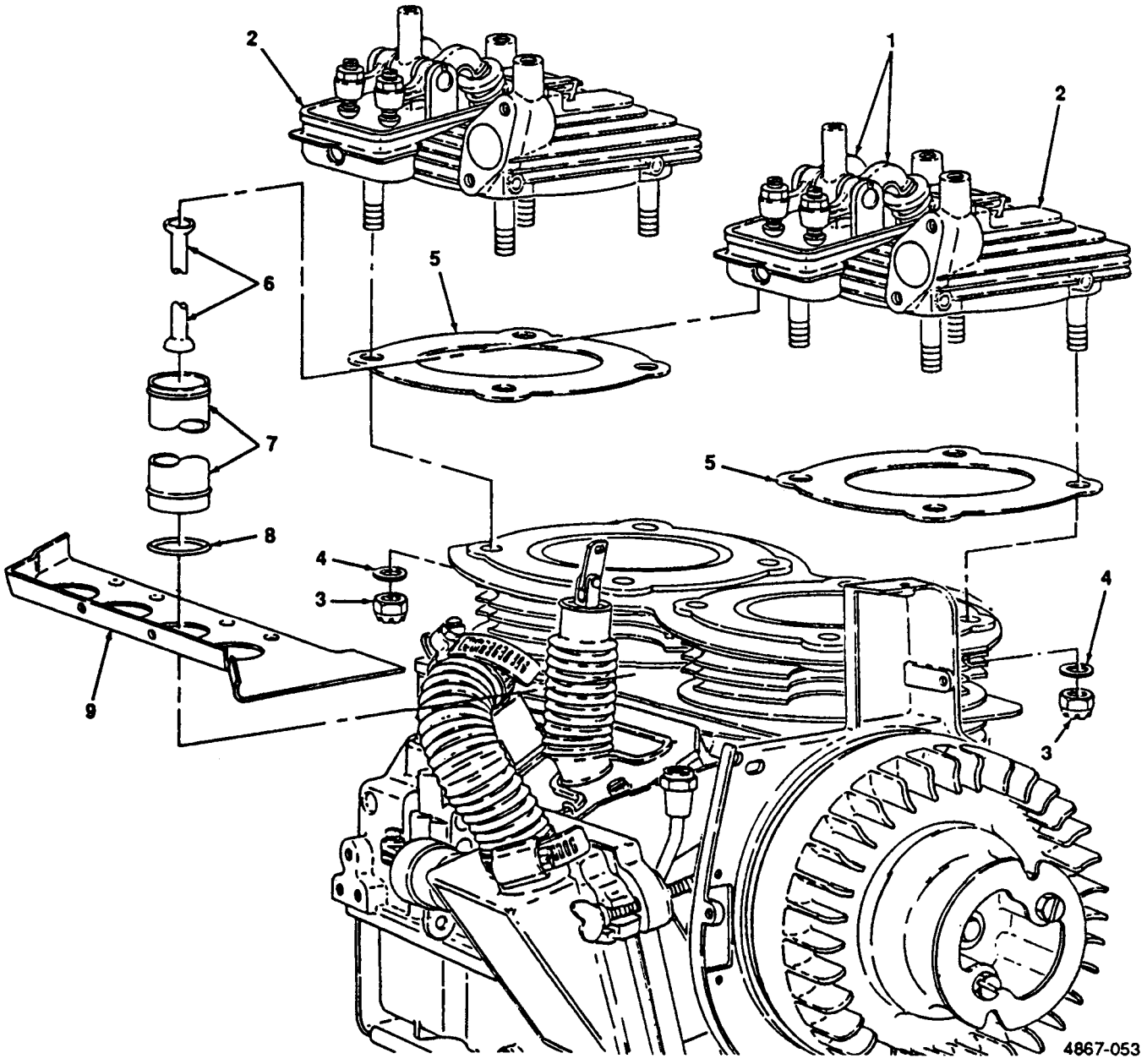

Figure 5-11. *Cylinder Head, Removal.*

5-14. Cylinder Head (cont).

b. *Repair.* (figure 5-12)

NOTE

The repair procedures are the same for both cylinder heads.

WARNING

Dry cleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°F -138°F (38°C-60°C).

(1) Clean cylinder head assembly with dry cleaning solvent and dry thoroughly.

(2) Remove clip (1) and remove rocker shaft (2).

(3) Remove two rocker arms (3) and take note of which rocker is for intake and exhaust.

(4) Remove two push rod packing screws (4) and preformed packing (5).

(5) Using a valve spring compressor, remove two retainer halves (6), rotocap (7) intake valve (8) and spring (9).

(6) Repeat step (5) for exhaust valve.

(7) Inspect all components of cylinder head assembly. Replace any component of cylinder head assembly which shows signs of excessive wear or other damaged. Refer to Table 5-2 for wear limits.

(8) Re-seat valves in cylinder head to ensure proper seal.

(9) Install intake valve (8), spring (9), and rotorcap (7).

(10) Use valve spring compressor and install two retaining halves (6).

(11) Repeat steps (9) and (10) for exhaust valve.

(12) Install two preformed packings (5) and push rod packing screws (4).

(13) Install both rocker arms (3), rocker shaft (2) and clip (1).

(14) Loosen two lock nuts (10) and unscrew adjusters (11) part way.

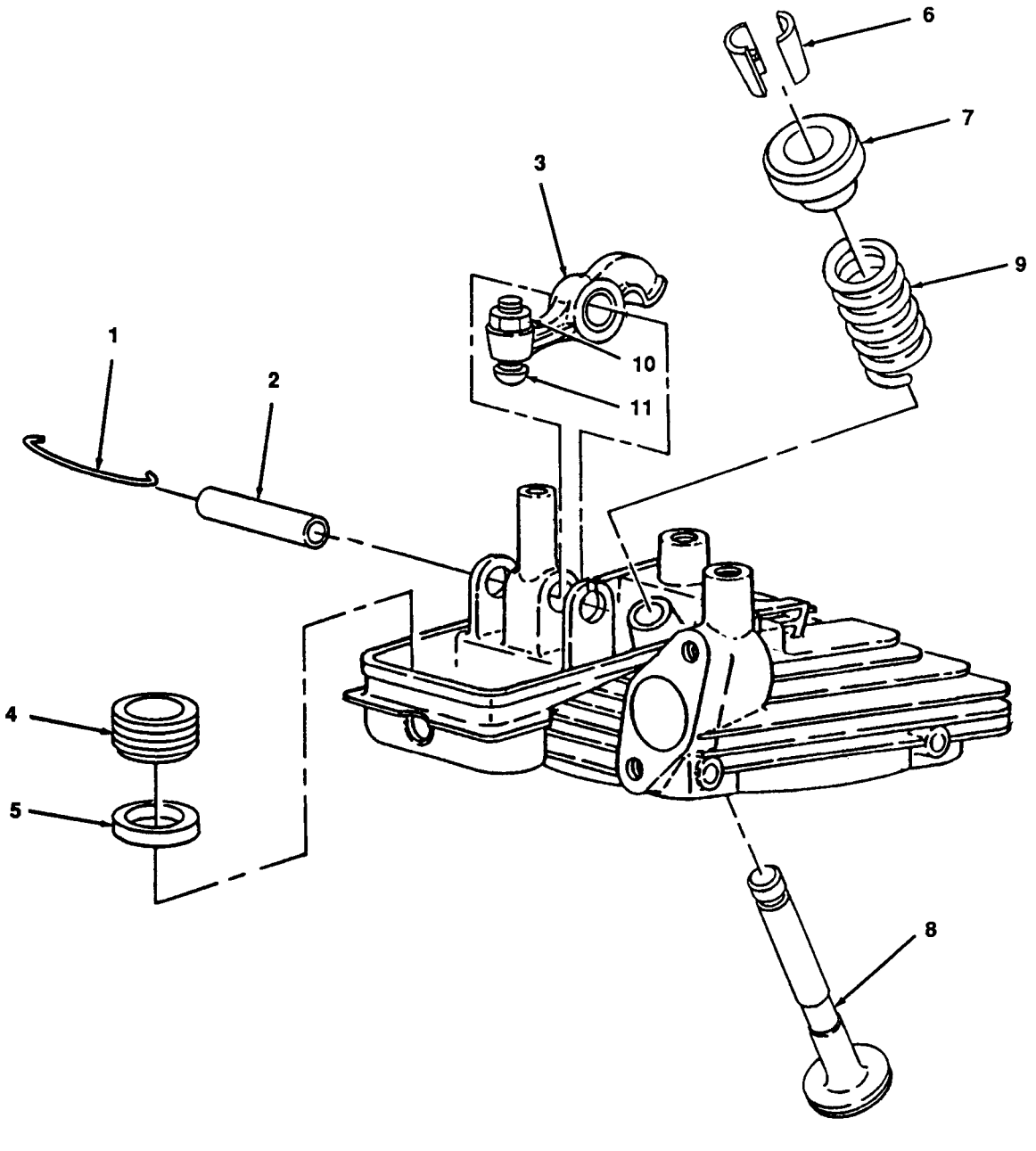

Figure 5-12. Cylinder Head Assembly, Repair.

5-14. Cylinder Head (cont).

c. *Installation.* (figure 5-13)

(1) Install rear cylinder cover (9), four preformed packings (8), push rod housings (7) and push rods (6).

(2) Ensure cylinder head gasket mating surface is clean and all old gasket material is removed.

(3) Install cylinder heads (2) and new gaskets (5) and secure with eight nuts (3) and washers (4). Torque nuts to 140 to 155 in. lbs (25000-27680 gr cm).

(4) Adjust valves (para. 5-16).

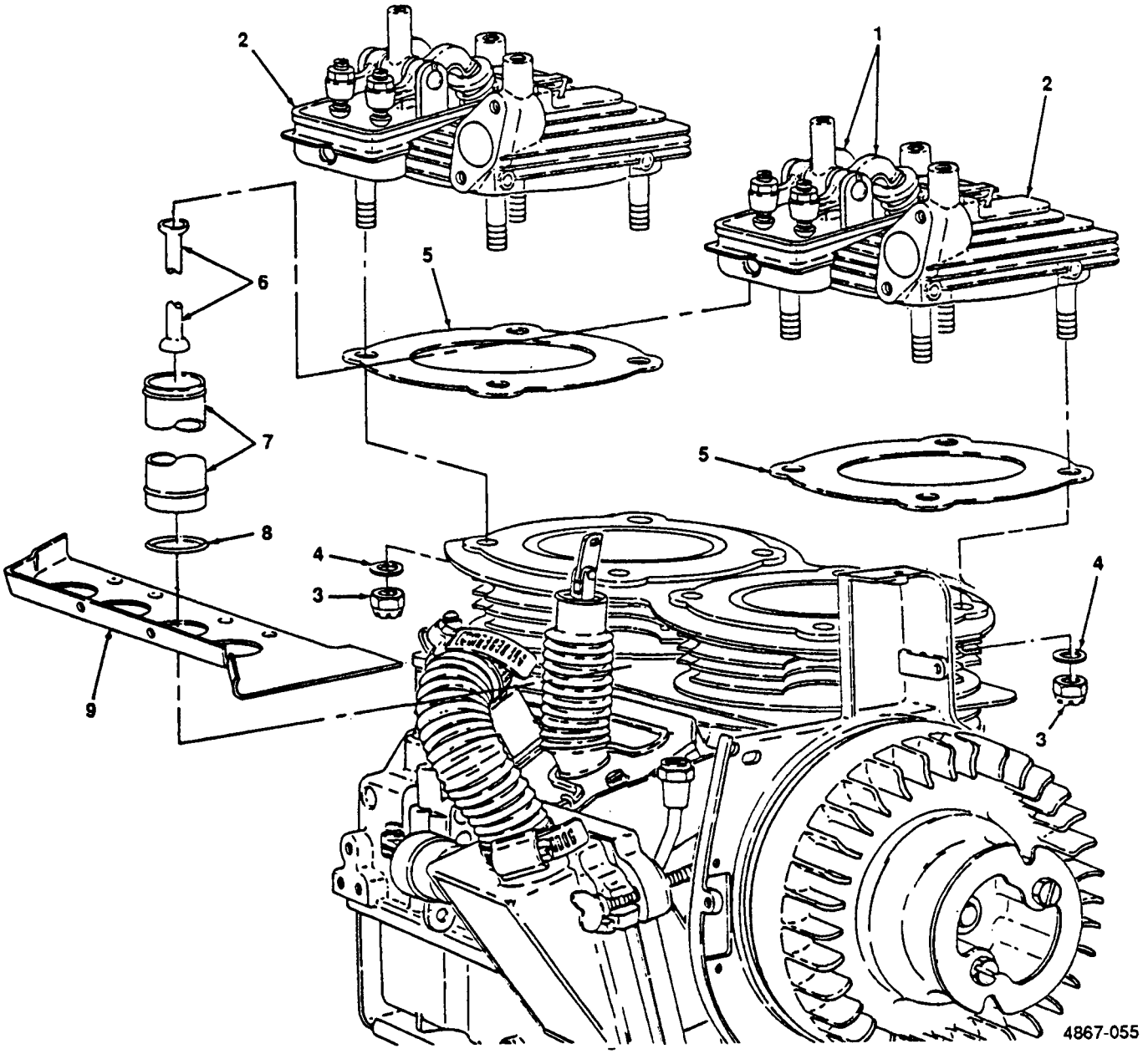

Figure 5-13. Cylinder Head, Installation.

5-15. Rockers.

This task covers: a. Removal b. Inspection c. Installation

INITIAL SETUP

Tools

General Mechanic's Tool Kit (Item 1, Appendix B)

Equipment Condition

Rocker cover removed (para. 4-25).

Materials/Parts

Rags, Wiping (Item 6, Appendix D)
Solvent, Drycleaning (Item 7, Appendix D)

NOTE

The following maintenance procedures are for the flywheel side cylinder head rockers. The maintenance procedures are the same for crankshaft side cylinder head rockers.

a. Removal. (figure 5-14)

(1) Loosen locknut (1) on both rockers (2) and (3) and loosen adjusting screws (4) until rockers (2) and (3) are loose.

(2) Remove clip (5) and remove rocker shaft (6).

(3) Remove rockers (2) and (3) from cylinder head (7).

b. Inspection. (figure 5-14)

WARNING

Dry cleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°F -138°F (38°C-60°C).

(1) Clean rockers in dry cleaning solvent and dry thoroughly.

(2) Inspect rockers and rocker shaft for cracks or other signs of wear. Refer to Table 5-2 for wear limits.

(3) Replace any component that is worn or otherwise damaged.

c. Installation. (figure 5-14)

(1) Position rockers (2) and (3) in cylinder head (7).

(2) Install rocker shaft (6) and secure with clip (5).

(3) Adjust valves (para. 5-16).

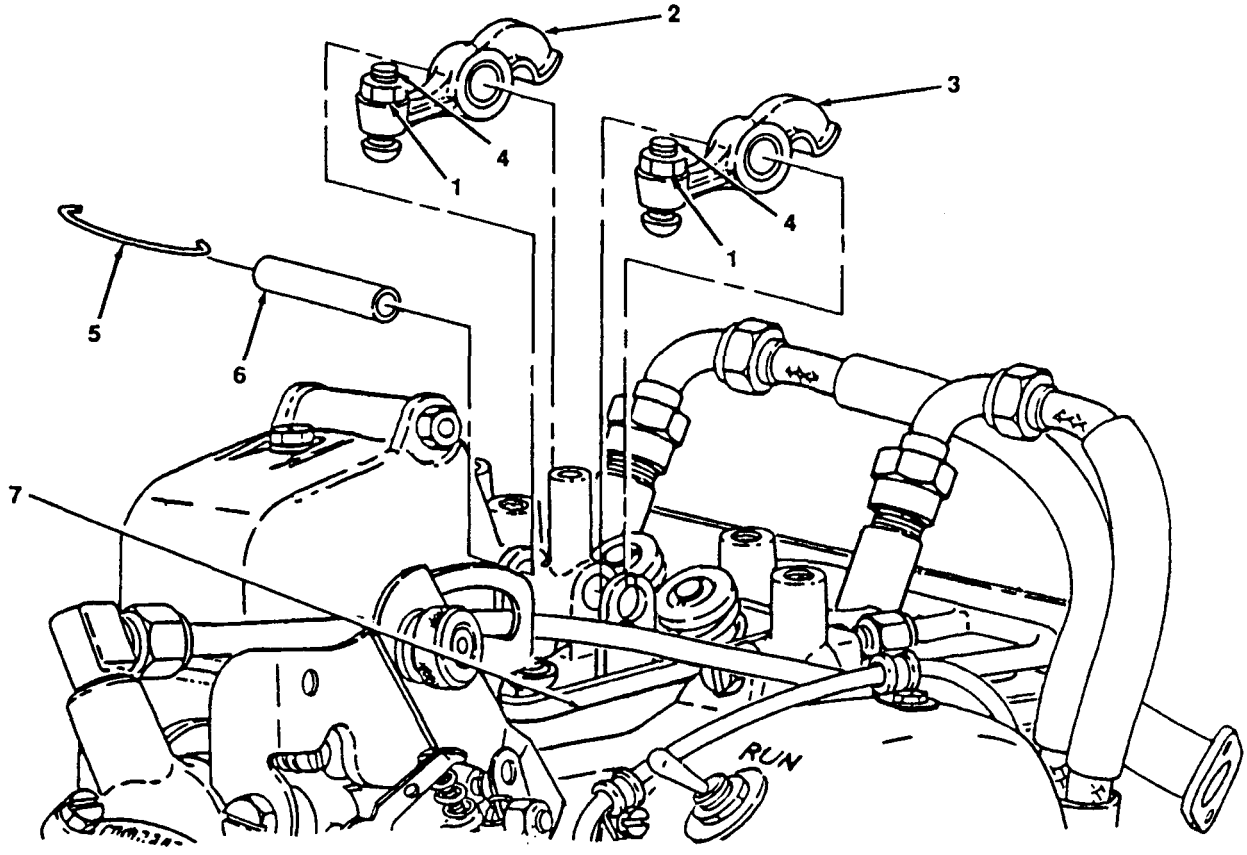

Figure 5-14. Rockers, Removal and Installation.

5-16. Valve Adjustment.

This task covers: Adjustment

INITIAL SETUP

Tools	*Equipment Condition*
General Mechanic's Tool Kit (Item 1, Appendix B)	Engine cold. Rocker cover removed (para. 4-25).

NOTE

Adjustment procedures are the same for both sets of valves.

Adjustment. (figure 5-15)

(1) Loosen screw (1) and move timing hole cover (2).

(2) Rotate flywheel clockwise until both valves (3) close and stop when ignition mark on flywheel alines with ignition timing pointer.

(3) Measure valve clearance, correct measurement should be .007 to .009 in. (0.17 to .022 cm).

(4) Loosen lock nut (4) and turn adjuster screw (5) until desired clearance is obtained and tighten lock nut (4).

(5) Reposition timing hole cover (2) over timing hole and tighten screw (1).

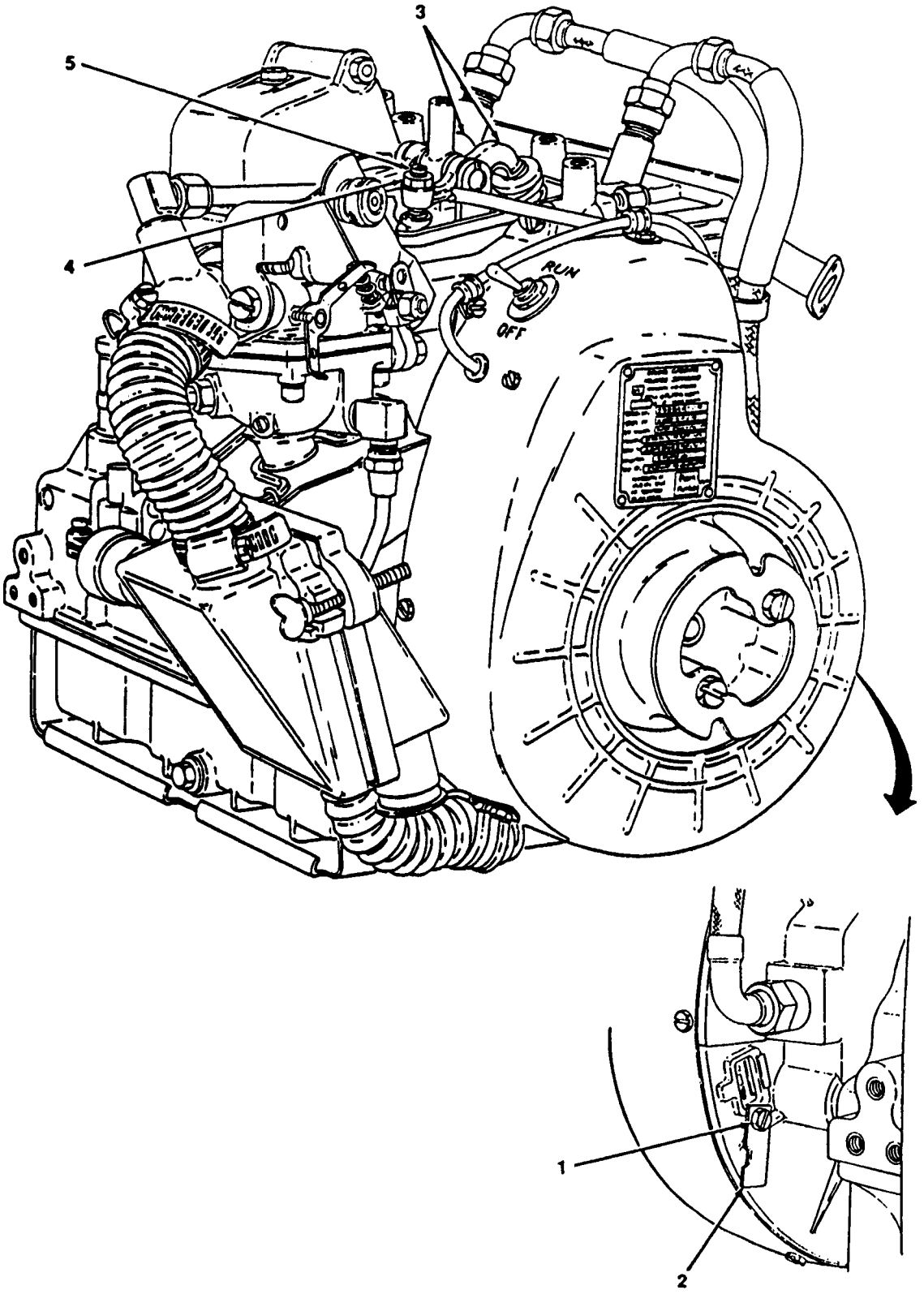

Figure 5-15. Valve Adjustment.

5-17. Intake and Exhaust Valves.

This task covers: a. Removal b. Installation

INITIAL SETUP

Tools	*Equipment Condition*
General Mechanic's Tool Kit (item 1, Appendix B) Compressor, Valve Spring (NSN 5330-00-096-6677) (Item 3, Appendix B)	Cylinder head assembly removed (para. 5-14).

a. Removal. (figure 5-16)

NOTE

The removal and installation procedures are the same for intake and exhaust valve.

(1) Remove rocker shaft clip (1) and remove rocker shaft (2).

(2) Remove rocker arm (3).

(3) Using suitable valve spring compressor, compress valve spring (4) and remove two retainers (5), valve (6), spring (4) and rotocap (7).

(4) Replace any damaged or defective parts. Refer to Table 5-2 for wear limits.

b. Instalation. (figure 5-16)

(1) Install valve (6), spring (4), rotocap (7) in cylinder head (8).

(2) Using suitable valve spring compressor compress spring (4) and install two retainers (5).

(3) Install rocker arm (3), rocker shaft (2) and rocker shaft clip (1).

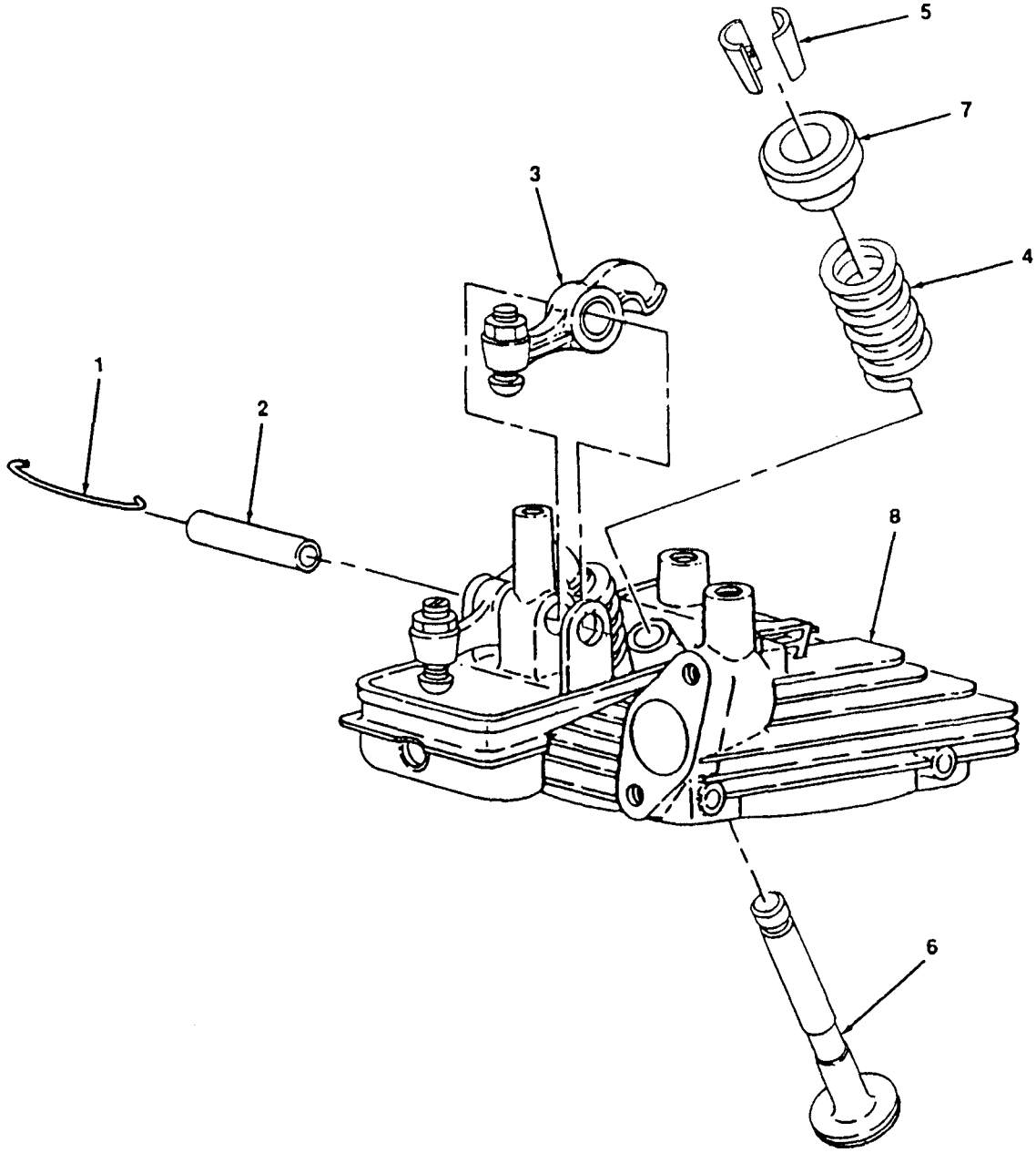

Figure 5-16. Intake and Exhaust Valve, Removal and Installation.

5-18. Piston and Connecting Rod Assembly.

This task covers: a. Removal b. Repair c. Installation

INITIAL SETUP

Tools

General Mechanic's Tool Kit (Item 1, Appendix B)
Wrench, Torque (NSN 5120-00-230-6380) (Item 3, Appendix B)
Compressor, Ring (NSN 5120-00-250-6055)

Materials/Parts

Rags, Wiping (Item 6, Appendix D)
Solvent, Drycleaning (Item 7, Appendix D)
Rings, Piston (NSN 2805-01-093-2392)

Materials/Parts (cont)

Lockwasher, Tab (NSN 2805-00-439-8116)
Ring, Retaining (NSN 5365-00-070-1928)

Equipment Condition

Cylinder head assembly removed (para. 5-14)
Oil pan removed (para 5-7).

a. Removal. (figure 5-17)

WARNING

Dry cleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°F -138°F (38°C-60°C).

NOTE

This engine is equipped with two piston and connecting rod assemblies, the removal and installation procedures are the same for both.

(1) Remove carbon deposits from top of piston (1) and cylinder wall (2) and clean with dry cleaning solvent.

(2) Bend tangs on lockwasher (3) out.

(3) Remove bearing cap bolt (4), dipper bolt (5), lockwasher (3) and remove connecting rod cap (6).

(4) Slide piston (1) out of cylinder (7).

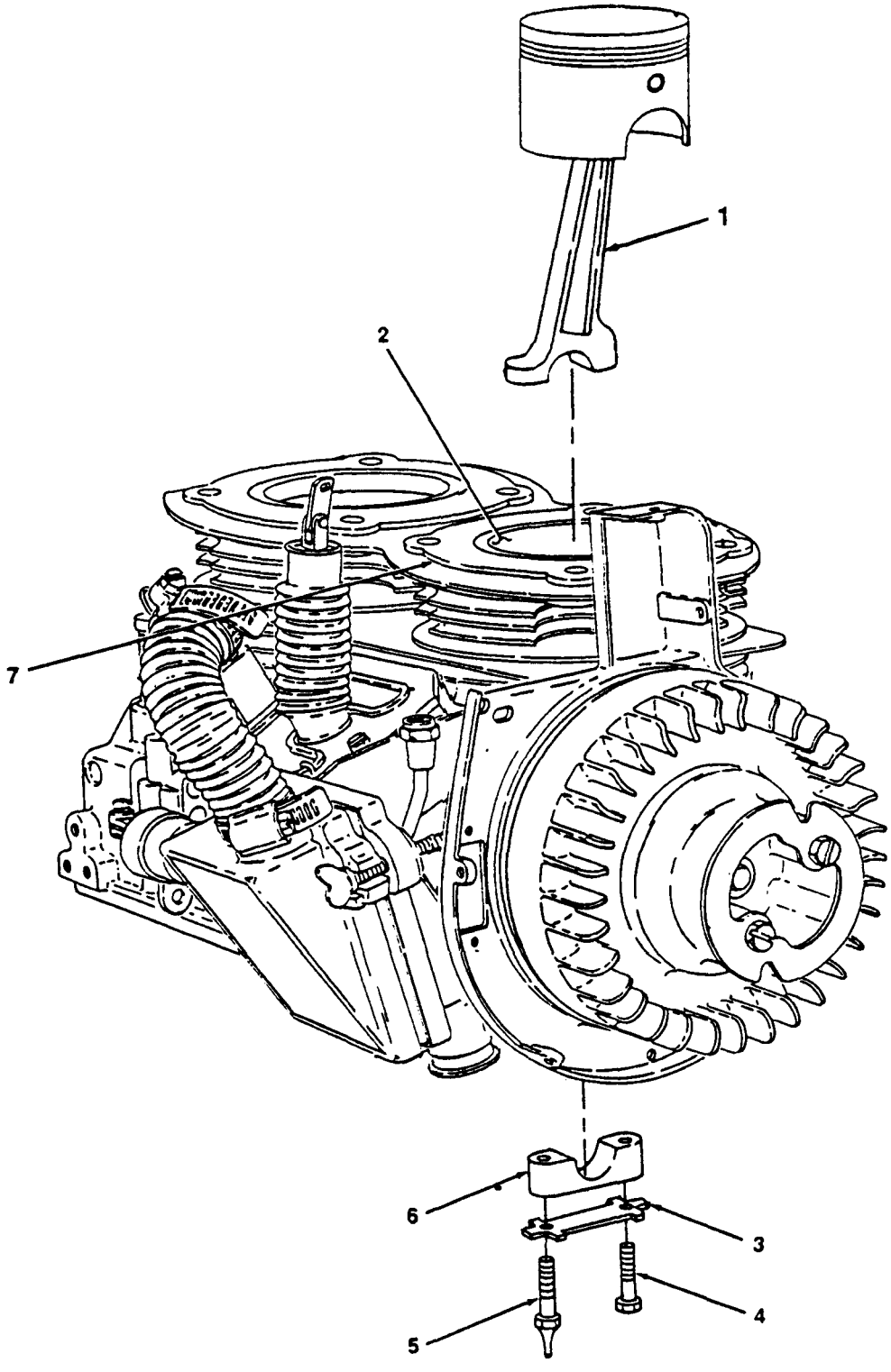

Figure 5-17. Piston and Connecting Rod, Removal.

5-18. Piston and Connecting Rod Assembly (cont).

NOTE

The repair procedures are the same for both piston and connecting rod assemblies.

b. Repair. (figure 5-18)

(1) Remove two retaining rings (1) and remove piston pin (2) from piston (3) and connecting rod (4).

(2) Remove spacer ring (5) and compression ring (6).

(3) Remove intermediate compression ring (7).

(4) Remove oil ring (8) and ring expander (9).

WARNING

Dry cleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°F–138°F (38°C-60°C).

(5) Clean all components of piston and connecting rod assembly with dry cleaning solvent and dry thoroughly. Remove all carbon deposit from top of piston and piston ring groves.

(6) Inspect piston (3), piston pin (2), connecting rod (4), connecting rod bearing cap (10), dipper bolt (11), and bolt (12) for cracks, excessive wear, or other signs of damaged and replace items as needed. Refer to Table 5-2 for wear limits.

NOTE

Do not reuse piston rings, retaining rings, or lockwasher (13). When installing piston rings stagger ring gaps.

(7) Install ring expander (9) and oil ring (8).

(8) Install intermediate compression ring (7).

(9) Install compression ring (6) and spacer ring (5).

(10) Position connecting rod (4) in piston (3) and install piston pin (2) and two retaining rings (1).

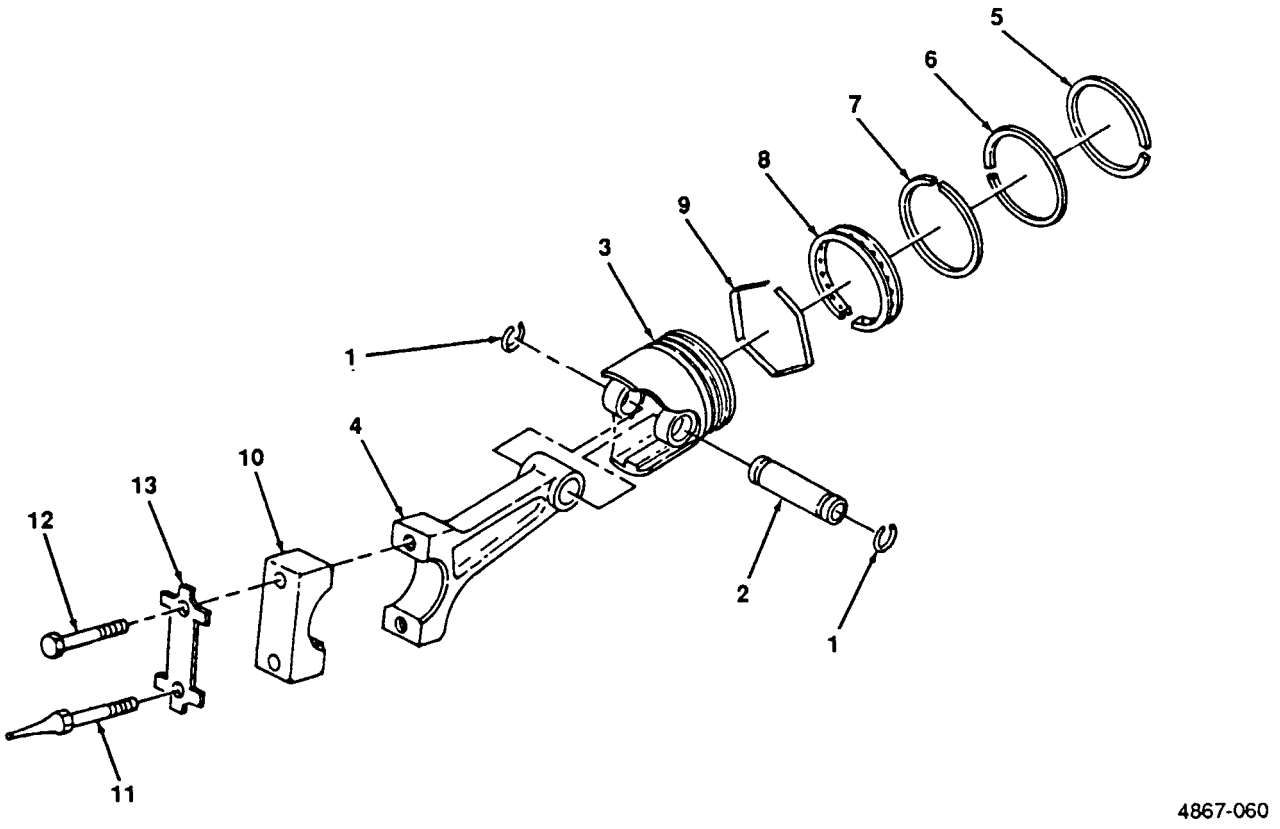

Figure 5-18. Piston and Connecting Rod, Repair.

5-18. Piston and Connecting Rod Assembly (cont).

c. *Installation.* (figure 5-19)

NOTE

Use a suitable ring compressor when installing piston in cylinder.

(1) Install piston and connecting rod assembly (1) in cylinder (7) and position the connecting rod on crankshaft (8).

NOTE

Install a new lockwasher. Do not reuse old lockwasher.

(2) Install connecting rod bearing cap (6) and lockwasher (3) and secure with dipper bolt (5) and bolt (4). Torque bolts to 90-100 in. lbs (10047-17860gm. cm.).

(3) Bend tangs on lockwasher (3) around bolt and dipper bolt head.

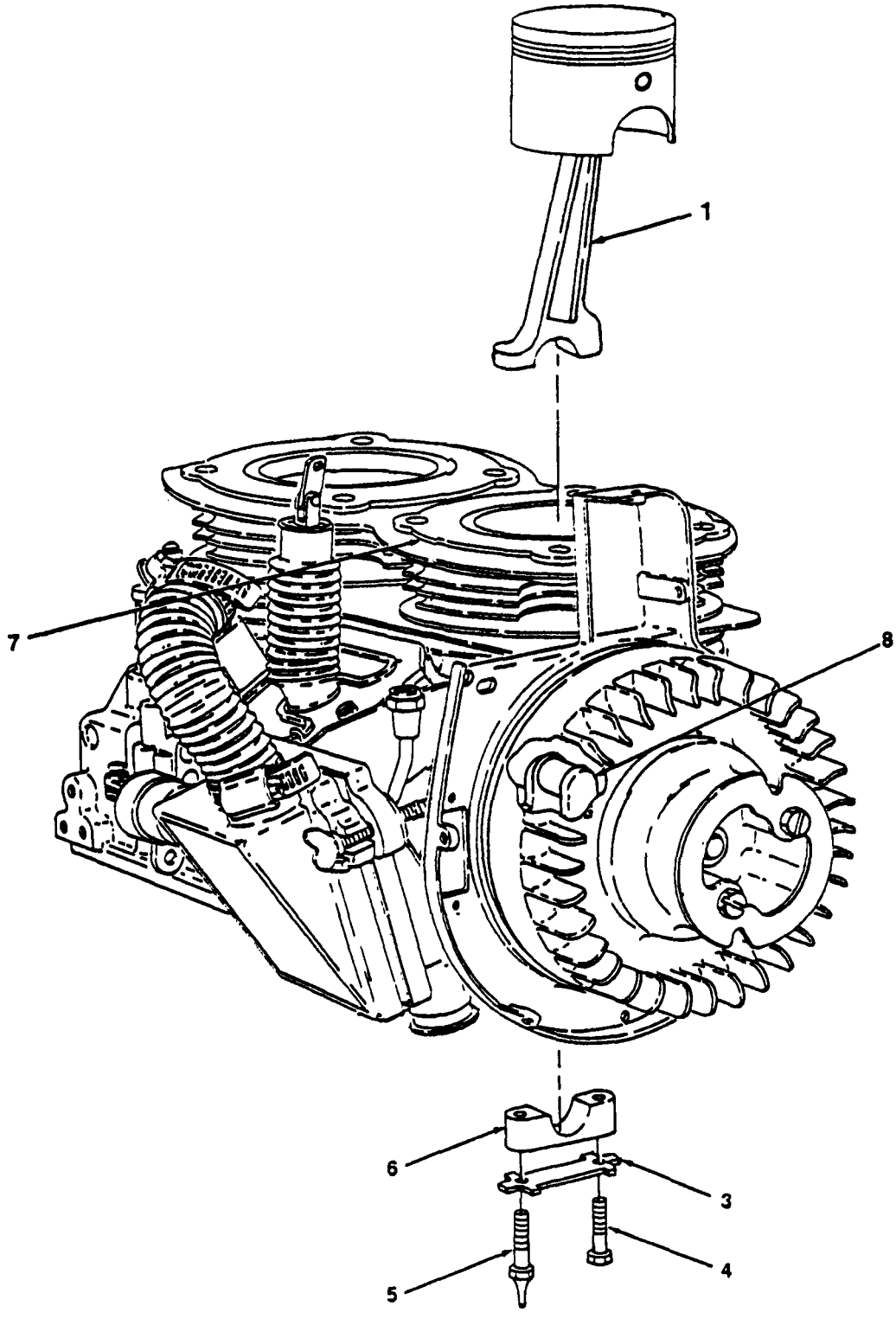

Figure 5-19. Piston and Connecting Rod Assembly, Installation.

5-19. Rotating Magnet.

This task covers: a. Removal b. Installation

INITIAL SETUP

Tools	*Equipment Condition*
General Mechanic's Tool Kit (item 1, Appendix B) Puller, Kit Mechanical (NSN 5120-00-423-1596) (Item 3, Appendix B)	Flywheel removed (para. 4-38).

a. Removal. (figure 5-20)

NOTE

In the event the rotating magnet cannot be removed as a single assembly, replace the entire rotating magnet.

(1) Mark the face of rotating magnet to ensure proper installation.

(2) Using suitable puller, remove rotating magnet (1) and key (2) from crankshaft (3).

b. Installation. (figure 5-20)

(1) Install key (2) on crankshaft (3).

(2) Ensure proper orientation of rotating magnet (1) and install it on crankshaft (3).

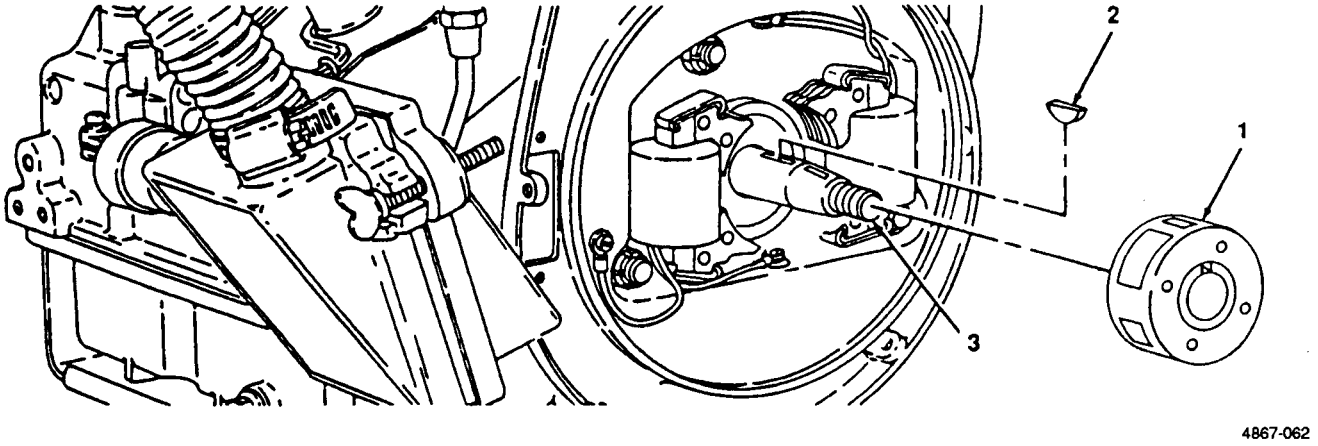

Figure 5-20. Rotating Magnet, Removal and Installation.

5-20. **Coil.**

This task covers: a. Removal b. Test c. Installation.

INITIAL SETUP

Tools	Equipment Condition
General Mechanic's Tool Kit (Item 1, Appendix B) Multimeter (NSN 6625-01-139-2512) (Item 2, Appendix B)	Flywheel removed (para. 4-38).

a. Removal. (figure 5-21)

WARNING

Use extreme care when removing coil clamps. Flying clamps can cause severe eye injury, cover work area with rag or hand when removing clamps.

NOTE

Make note of coil leads placement before removing coil.

Engines with breakerless ignition system have only one coil.

(1) Remove two coil clamps (1) securing coil (2) and remove.

(2) Tag and disconnect coil leads.

(1) Perform resistance test between leads of coil.

(2) Resistance for coil in breakerless ignition system should be 320 ± 20 ohms.

(3) Resistance of coils for breaker point ignition system areas follows:

Manufacturer	Primary windings (ohms)	Secondary windings (ohms)
Bendix Corp.	0.512 ± 0.050	3,300 ± 400
Colt Industries	0.370 ± 0.025	8,500 ± 700
Motor Parts. Inc.	0.370 ± 0.025	8,500 ± 700

(4) if the measured resistance does not match specified resistance then replace coil.

c. Installation. (figure 5-21)

(1) Connect coil leads as tagged.

(2) Install coil (2) and secure with two coil clamps (1).

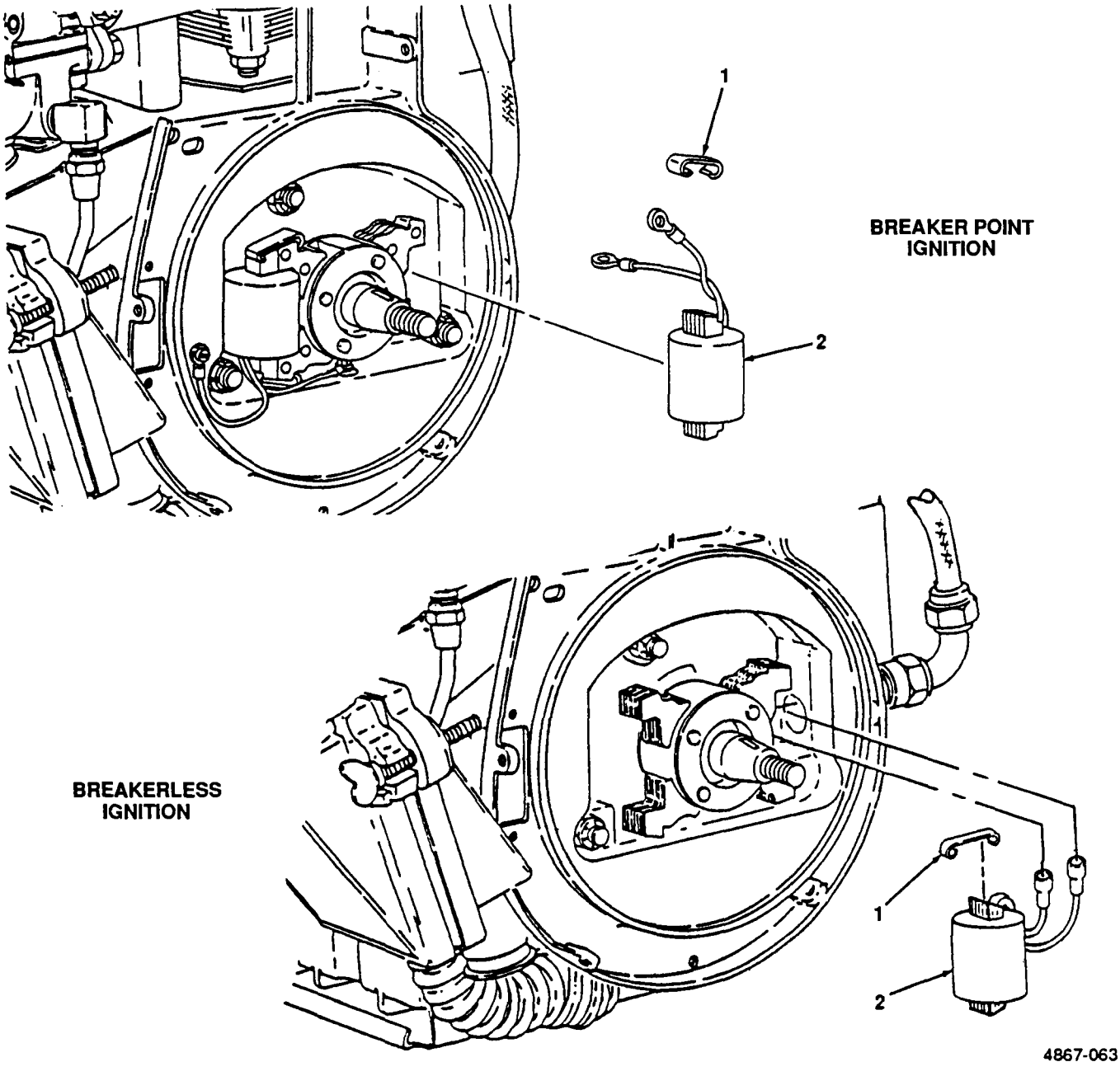

Figure 5-21. Coil, Removal and Installation.

5-21. Flywheel Side Oil Seal.

This task covers: a. Removal b. Installation.

INITIAL SETUP

Tools

General Mechanic's Tool Kit (Item 1, Appendix B)

Equipment Condition

Rotating Magnet Removed (para. 5-19)

Materials/Parts

Seal, Oil (P/N 13214E7063)

a. *Removal.* (figure 5-22)

(1) Clean area around oil seal (1).

(2) Using suitable tools, remove oil seal (1) from bearing cap (2).

b. *Installation.* (figure 5-22)

(1) Clean oil seal mounting surface on bearing cap (2)

(2) Install oil seal (1) in bearing cap (2).

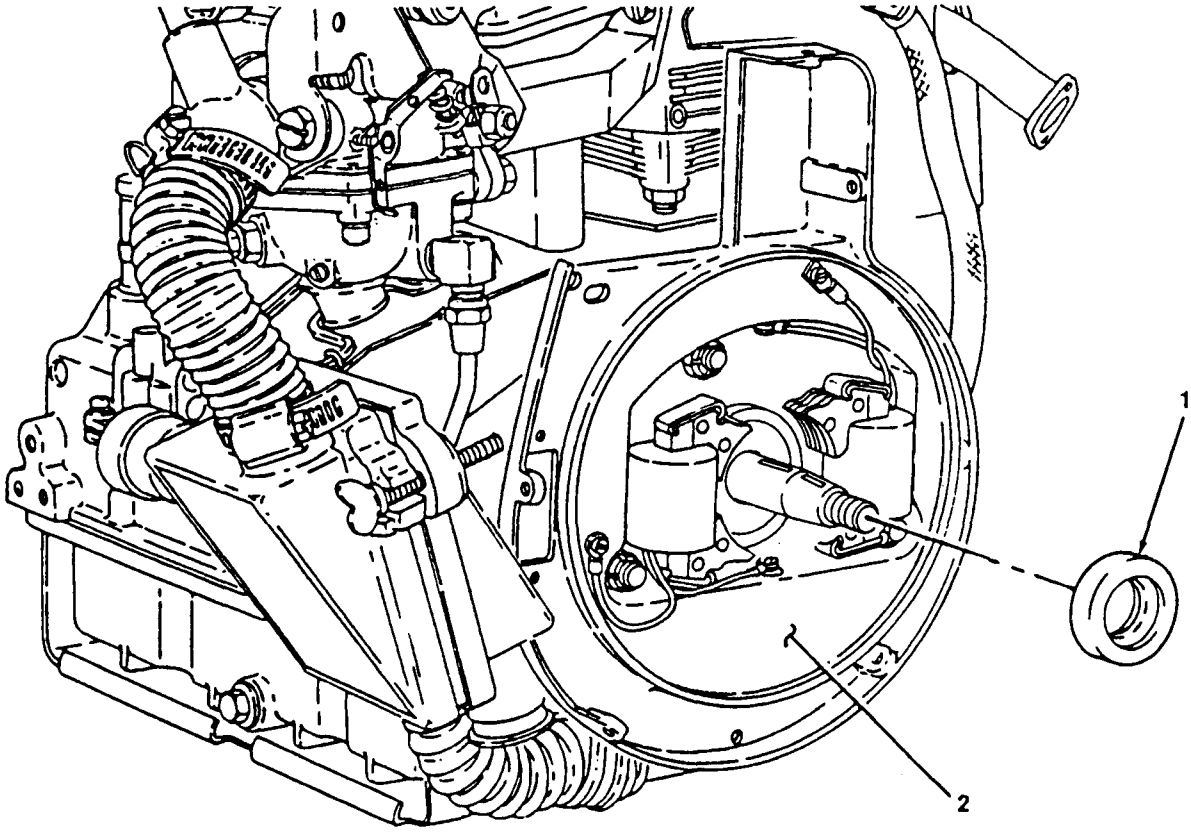

Figure 5-22. Flywheel Side Oil Seal, Removal and Installation.

5-22. Noise **Suppression Filter (Breaker Point Ignition).**

This task covers: a. Removal b. Test c. Installation.

INITIAL SETUP

Tools	*Equipment Condition*
General Mechanic's Tool Kit (Item 1, Appendix B) Multimeter (NSN 6625-01-139-2512)) (Item 2, Appendix B)	Flywheel removed (para. 4-38).

NOTE

This engine is equipped with two noise suppression filters, the removal and installation procedures are the same for each.

a. Removal. (figure 5-23)

(1) Tag and remove wiring from suppression filter (1).

(2) Remove nut (2) and washer (3) and remove suppression filter (1).

b. Test.

(1) Check for continuity between ends of noise suppression filter and replace if continuity is not present.

(2) Check for continuity between ends of noise suppression filter and body, and replace if continuity is present.

c. Installation. (figure 5-23)

(1) Position suppression filter (1) in bearing cap (4) and secure with nut (2) and washer (3).

(2) Connect wiring as tagged to suppression filter (1).

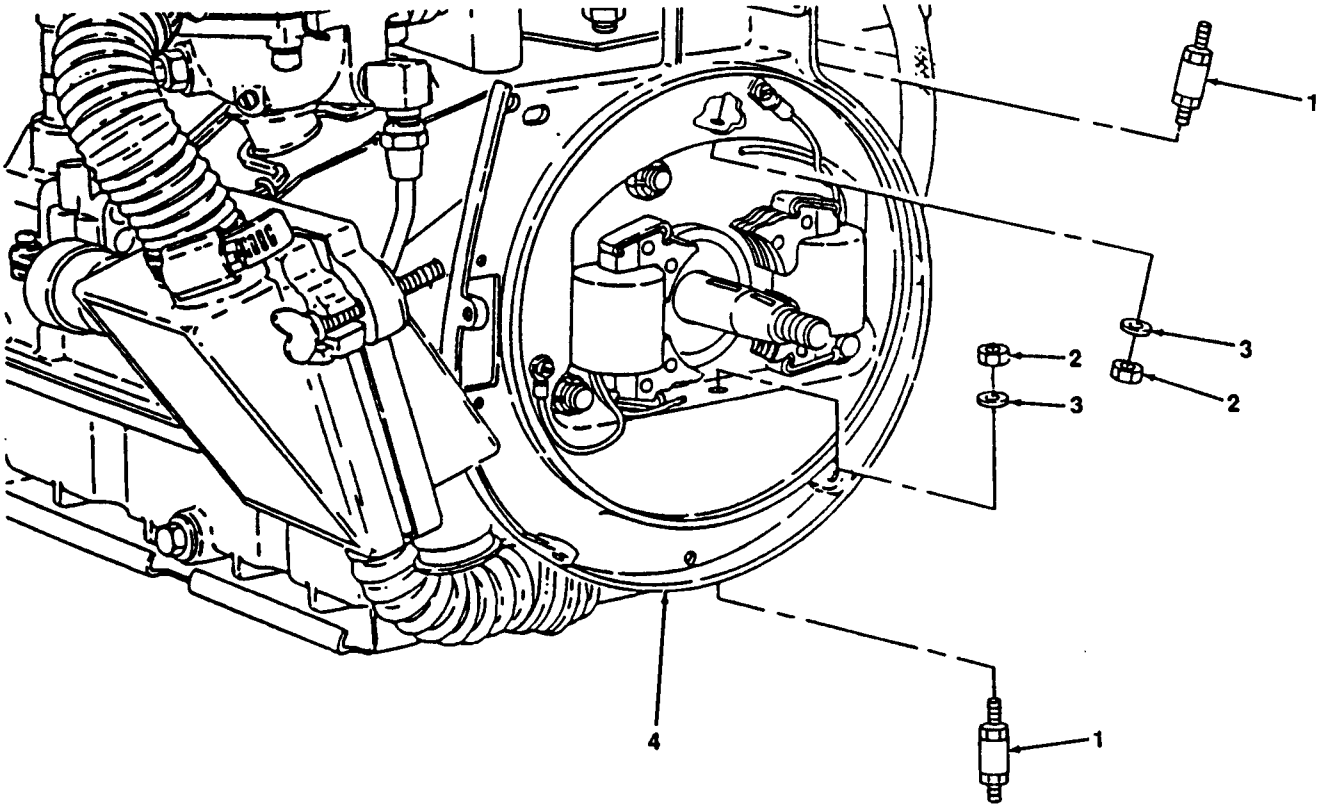

Figure 5-23. Noise Suppression Filter, Removal and Installation.

5-23. Crankshaft Side Oil Seal.

This task covers: a. Removal b. Installation.

INITIAL SETUP

Tools	*Materials/Parts*
General Mechanic's Tool Kit (Item 1, Appendix B)	Seal, Oil (P/N 13214E7063)

a. *Removal.* (figure 5-24)

(1) Clean area around oil seal (1).

(2) Using suitable tools, remove oil seal (1) from crankcase (2).

b. *Installation.* (figure 5-24)

(1) Clean crankcase mounting surface.

(2) Install oil seal (1) in crankcase (2).

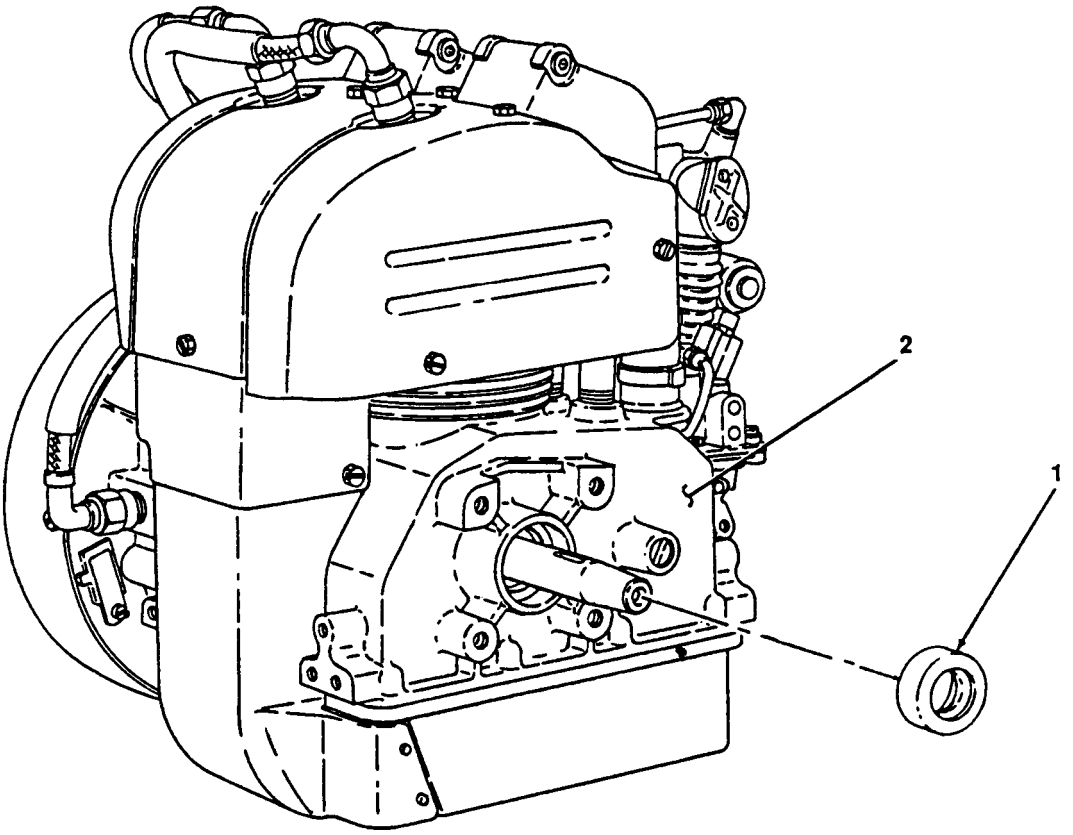

Figure 5-24. Crankshaft Side Oil Seal, Removal and Installation.

5-24. Compression Test.

This task covers: Test

INITIAL SETUP

Tools

General Mechanic's Tool Kit (Item 1, Appendix B)
Tester, Cylinder Compression (NSN 4910-00-250-2423)
(Item 2, Appendix B)

NOTE

This engine is equipped with two cylinders, the procedures for compression test is the same for both.

Test. (figure 5-25)

(1) Disconnect ignition cable (1) from spark plug (2).

(2) Remove spark plug (2) from engine (3).

(3) Install suitable pressure gage (4) in spark plug hole.

(4) Using starter rope crank engine several times, and check pressure gage.

NOTE

As altitude increases cylinder compression will decrease.

(5) Cylinder compression should be a minimum of 90 psi (63279 kpa) at sea level.

(6) Remove pressure gage (4).

(7) Install spark plug (2), and connect ignition cable (1).

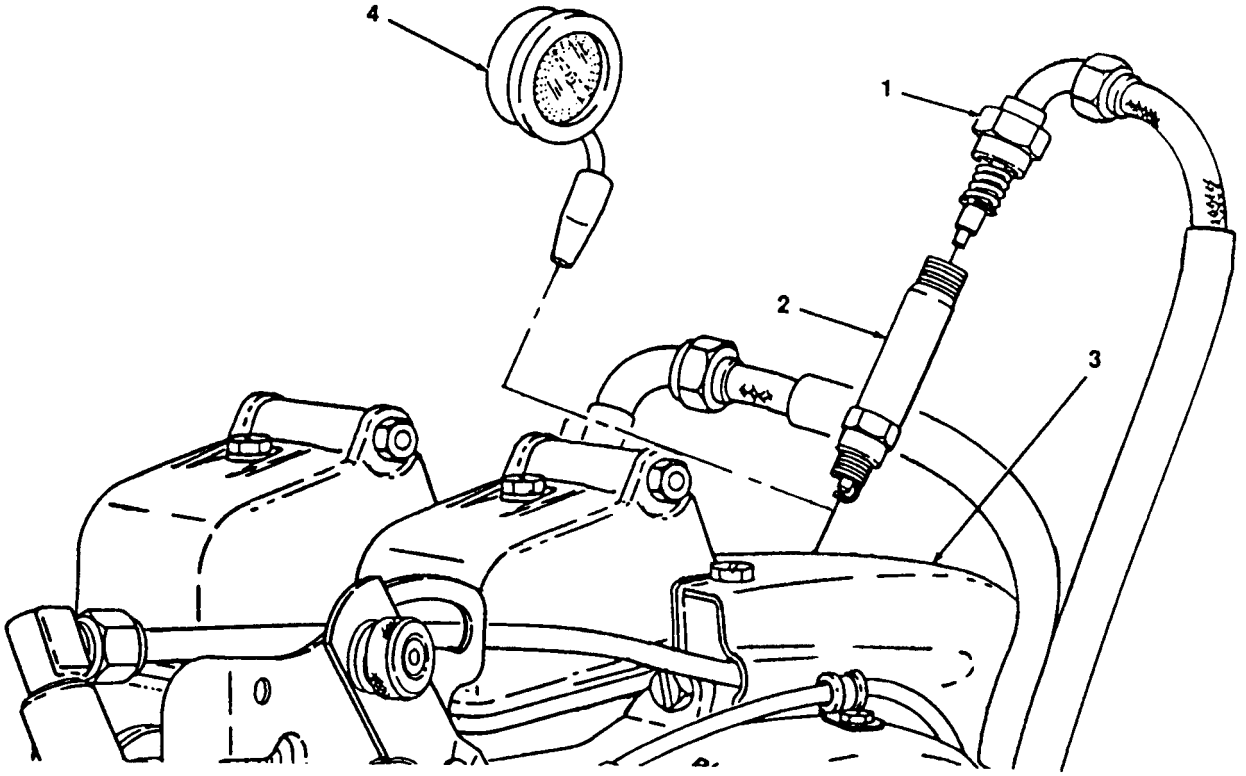

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Figure 5-25. Compression Test

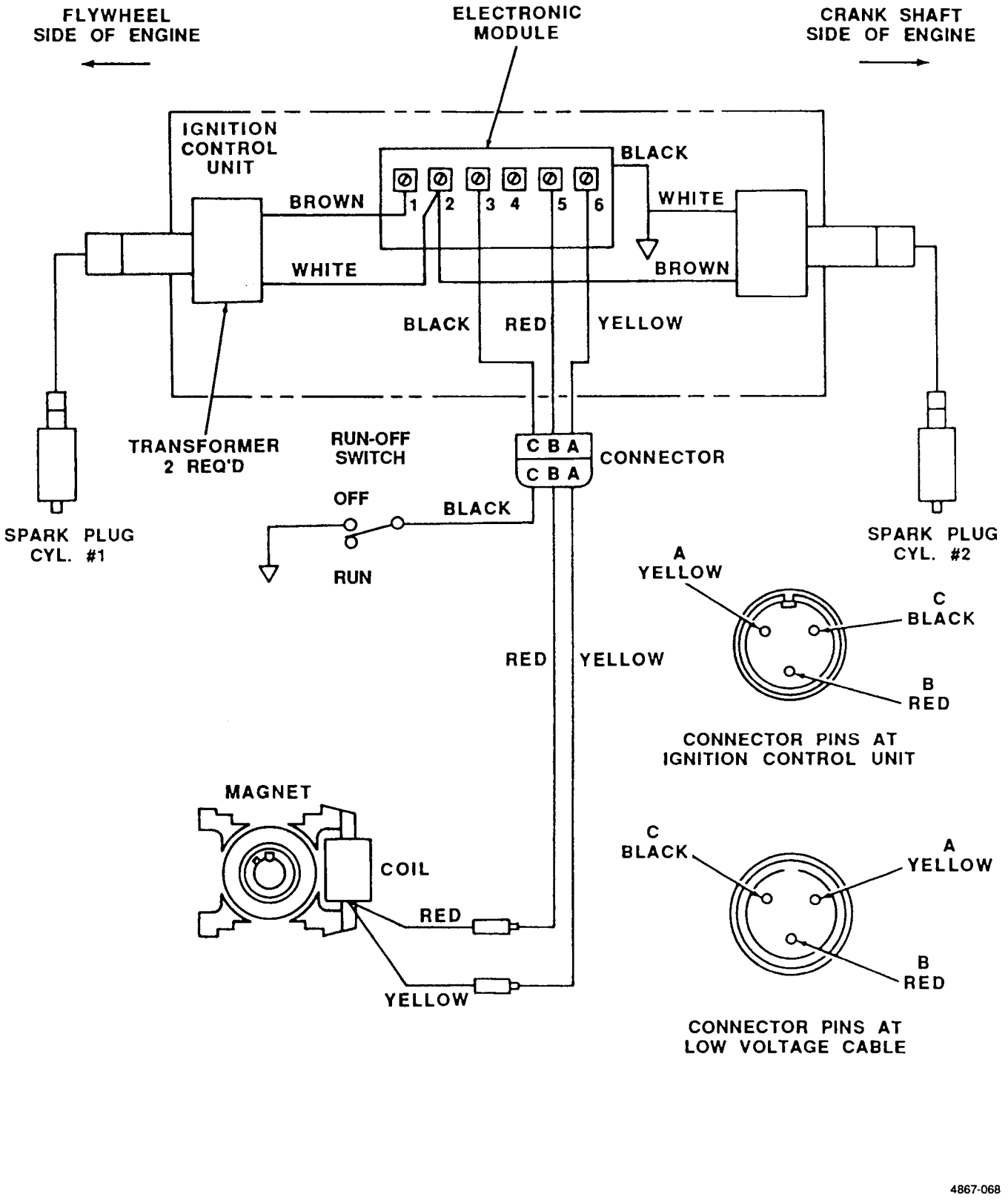

Figure 5-26. Breakerless Ignition System Wiring Diagram.

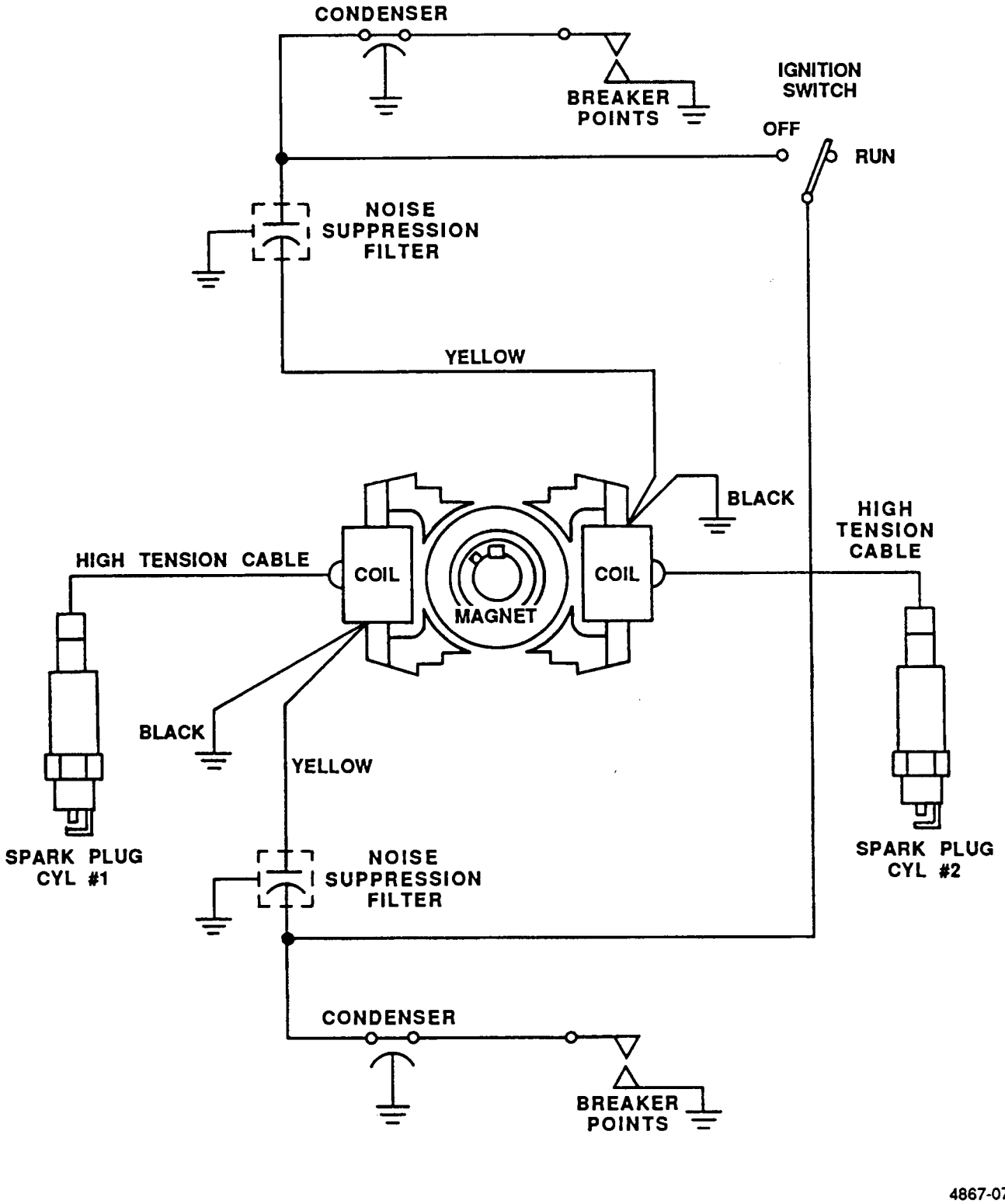

Figure 5-27. Breaker Point Ignition Wiring Diagram.

Table 5-2. Engine Repair and Replacements Limits.

Item	Measurements	
	Minimum	Maximum
VALVES		
Intake and Exhaust		
Length to gage point	2.7885 (7.0827)	2.7935 (7.0954)
Stem diameter	0.3100 (0.7874)	0.3105 (0.7876)
Head diameter	0.8390 (2.1310)	0.8490 (0.2156)
Seat angle	45° 45’	46° 0’
Stem to guide clear	0.0020 (0.0050)	0.0035 (0.0088)
Clearance valve to lift	0.0040 (0.0101)	0.0070 (0.0177)
Intake		
Length	2.7885 (7.0827)	2.7935 (7.0954)
Stem diameter	0.3100 (0.7874)	0.3105 (0.7876)
Head diameter	0.8390 (2.1310)	0.8490 (0.2156)
Seat angle	45° 45’	46° 0’
Stem to guide clear	0.0020 (0.0050)	0.0035 (0.0088)
Clearance valve to lift	0.0040 (0.0101)	0.0070 (0.0177)
VALVE SPRINGS		
Length (valve open)	0.880 (2.2352)	0.880 (0.2352)
Pounds load (valves open)	42 (19051.20 grams)	46 (20865.60 grams)
Length (valve closed)	1.095 (2.7813)	1.095 (2.7813)
Pounds load (valve closed)	1 0 (8618.4)	21 (9525.6)
VALVE GUIDE		
Exhaust and Intake		
Inside diameter	0.3125 (0.7937)	0.3135 (0.7962)

Table 5-2. Engine Repair and Replacements Limits (cont).

Item	Measurements	
	Minimum	Maximum
VALVE SEAT INSERTS		
Exhaust		
Outside diameter	0.876 (2.2250)	0.877 (2.2275)
Inside diameter	0.745 (1.8923)	0.750 (1.9050)
Seat angle	44° 45’	45° 0’
Intake		
Outside diameter	0.876 (2.2250)	0.877 (2.2275)
Inside diameter	0.745 (1.8923)	0.750 (1.9050)
Seat angle	44° 45’	45° 0’
CONNECTING RODS		
Large end i.d.	0.8789 (2.2324)	0.8798 (2.2346)
Small end i.d.	0.4200 (1.0668)	0.4205 (1.0680)
Side clearance	0.020 (0.0508)	0.036 (0.0914)
Piston pin diameter	0.4190 (1.1932)	0.4195 (1.0655)
PISTON		
Piston pin hole dia	0.4195 (1 .0655)	0.4200 (1.0668)
Skirt o.d.		
A-top	2.2475 (5.7086)	2.2480 (5.7099)
bottom	2.2485 (5.7111)	2.2490 (5.7124)
B-top	2.2480 (5.7099)	2.2485 (5.7111)
bottom	2.2490 (5.7124)	2.2495 (5.7137)
C-top	2.2485 (5.7111)	2.2490 (5.7124)
bottom	2.2495 (5.7137)	2.2500 (5.7150)
D-top	2.2490 (5.7124)	2.2495 (5.7137)
bottom	2.2500 (5.7150)	2.2505 (5.7162)

Table 5-2. Engine Repair and Replacements Limits (cont).

Item	Measurements	
	Minimum	Maximum
PISTON (cont)		
Piston ring groove		
Top	1.998 (5.0749)	2.008 (5.1003)
R-top	2.2470	2.2490
bottom	2.2480	2.2490
NOTE: For cylinder size 2.2495 to 2.2515		
O-top	2.2490	2.2500
bottom	2.2500	2.2510
NOTE: For cylinder size 2.2515 to 2.2535		
Second	1.950 (4.95300	1.960 (4.9784)
Third	1.950 (4.95300	1.960 (4.9784)
Piston ring groove width		
Top	0.1205 (0.3060)	0.1215 (0.3086)
Second	0.0995 (0.2527)	0.0965 (0.2451)
Third	0.1880 (.04775)	0.1890 (0.4800)
Piston rings		
Width: spacer	0.0235 (0.0596)	0.0245 (0.0622)
Top	0.0930 (0.2362)	0.0940 (0.2387)
Second	0.0930 (0.2362)	0.0940 (0.2387)
Third	0.1860 (0.4724)	0.1870 (0.4749)
Thickness: spacer	0.1110 (0.2819)	0.1150 (0.2921)
Top	0.0940 (0.2387)	0.1040 (0.2641)
Third	0.0940 (0.2387)	0.4040 (0.2641)

Table 5-2. Engine Repair and Replacements Limits (cont).

Item	Measurements	
	Minimum	Maximum
PISTON (cont)		
Gap clearance:	0.0005	0.0350
Spacer	(0.00120	(0.0889)
Top	0.0070	0.0170
	(0.0177)	(0.0431)
Second	0.0070	0.0170
	(0.0177)	(0.0431)
Third	0.0070	0.0170
	(0.0177)	(0.0431)
Side clearance:		
First	0.0020	0.0050
	(0.0050)	(0.0127)
Second	0.0015	0.0035
	(0.0038)	(0.0080)
Third	0.0010	0.0030
	(0.0025)	(0.0076)
Rotating magnet to pole shoes	0.002	0.016
	(0.005)	(0.0406)

CHAPTER 6

GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

Page

OVERVIEW 6-1
Section I. Repair Parts; Special Tools; Test, Measurement, Diagnostic Equipment (TMDE); and Support Equipment 6-1
Section II. General Support Troubleshooting 6-1
Section III. General Support Maintenance Procedures 6-3

OVERVIEW

This chapter provides procedures for troubleshooting and maintenance of the 3 HP Military Standard Engine by General Support maintenance personnel.

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

Paragraph Page

6-1 Common Tools and Test Equipment 6-1
6-2 Special Tools, TMDE, and Support Equipment 6-1
6-3 Repair Parts 6-1

6-1. **Common Tools and Test Equipment.** For authorized common tools and equipment, refer to the Modified Table of Organization and Equipment (MTOE) applicable to your unit.

6-2. **Special Tools, TMDE and Support Equipment.** For a listing of special tools, TMDE, and support equipment authorized for use on this equipment, refer to the Repair Parts and Special Tools List, TM 5-2805-257-24P, and the maintenance allocation chart (MAC), appendix B of this manual.

6-3. **Repair Parts.** Repair parts are listed and illustrated in the Repair Parts and Special Tools List for 3 HP Military Standard Engine TM 5-2805-257-24P.

Section II. GENERAL SUPPORT TROUBLESHOOTING

Paragraph Page

6-4 General 6-1
6-5 General Support Troubleshooting Procedures 6-2

6-4. **General.** This section contains troubleshooting procedures to determine the probable cause of observed equipment malfunctions. Tests or inspections are provided to isolate the faulty component and corrective actions are provided to eliminate the malfunction.

6-5. **General Support Troubleshooting Procedures.** Table 6-1 lists the common malfunctions that may be found during operation. Refer to Symptom Index to locate the troubleshooting procedures for the malfunction. This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not corrected by listed corrective actions, notify your supervisor.

SYMPTOM INDEX

Symptom Page

Engine Runs Excessively Noisy 6-2

Table 6-1. General Support Troubleshooting Procedures.

Malfunction Test or Inspection Corrective Action
ENGINE RUNS EXCESSIVELY NOISY.
Step 1. Check crankshaft end play.
Adjust crankshaft end play if needed (para. 6-7).
Step 2. Check bearing cap assembly bearing cup and bearing for excessive wear or damage.
Replace worn or otherwise damaged bearing cup and bearing (para. 6-7).
Step 3. Check crankcase bearing cup and bearing for excessive wear or damage.
Replace a worn or otherwise damaged crankcase bearing cup and bearing (para. 6-10).
Step 4. Check camshaft and gear for excessive wear.
Replace a worn or otherwise damaged camshaft (para. 6-9).
Step 5. Check crankshaft wear.
Replace a worn or otherwise damaged crankshaft (para. 6-8).

Section III. GENERAL SUPPORT MAINTENANCE PROCEDURES

Paragraph Page

6-6 General 6-3
6-7 Bearing Cap Assembly 6-4
6-8 Crankshaft Assembly 6-8
6-9 Camshaft Assembly 6-12
6-10 Crankcase Assembly 6-16

6-6. **General.** This section contains general support maintenance procedures as authorized by the MAC in Appendix B of this manual. Table 6-2 at the end of this section, contains wear limits for those items maintained by general support maintenance. Those items which to not meet the specified measurements must be replaced. Refer to Appendix E for torque values. All maintenance procedures require only one person to perform.

6-7. **Bearing Cap Assembly.**

This task covers: a. Removal b. Repair c. Installation

INITIAL SETUP

Tools

General Mechanic's Tool Kit (Item 1, Appendix B)
Wrench, Torque (NSN 5120-00-230-6380) (Item 3, Appendix B)

Materials/Parts

Rags, Wiping (Item 6, Appendix D)
Solvent, Drycleaning (Item 7, Appendix D)
Packing, Preformed (NSN 5330-00-608-6432)
Seal (P/N 13214E7063)

Equipment Condition

Air cleaner assembly removed (para. 4-21).
Ignition coils removed (para. 5-20).
Rotating magnet removed (para. 5-19).
Low voltage cable removed (para. 5-13).

a. Removal. (figure 6-1)

NOTE

Steps 1 through 4 are for engines equipped with breaker point ignition.

(1) Loosen connector nut (1) and tag and remove high tension cable (2) from bearing cap (3).

(2) Remove two screws (4) and washers (5) and remove high tension cable access plate (6).

(3) Loosen connector nut (7) and tag and remove high tension cable (8) from bearing cap (3).

(4) Tag and remove wiring from noise suppression filters (9).

(5) Remove three nuts (10) and remove bearing cap (3), shims (11) and O-ring (12).

b. Repair. (figure 6-1)

WARNING

Drycleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°F-138°F (38°C-60°C).

(1) Clean bearing cap (3) with dry cleaning solvent, and dry thoroughly.

(2) Inspect bearing cap (3) for cracks or other damage and replace if damage is found.

(3) Inspect flywheel side oil seal (15) for signs of wear and replace if damaged.

(4) Clean and inspect crankshaft bearing cup (13) and bearing (14) for wear, and replace if worn or otherwise damaged. Refer to Table 6-2 for wear limits.

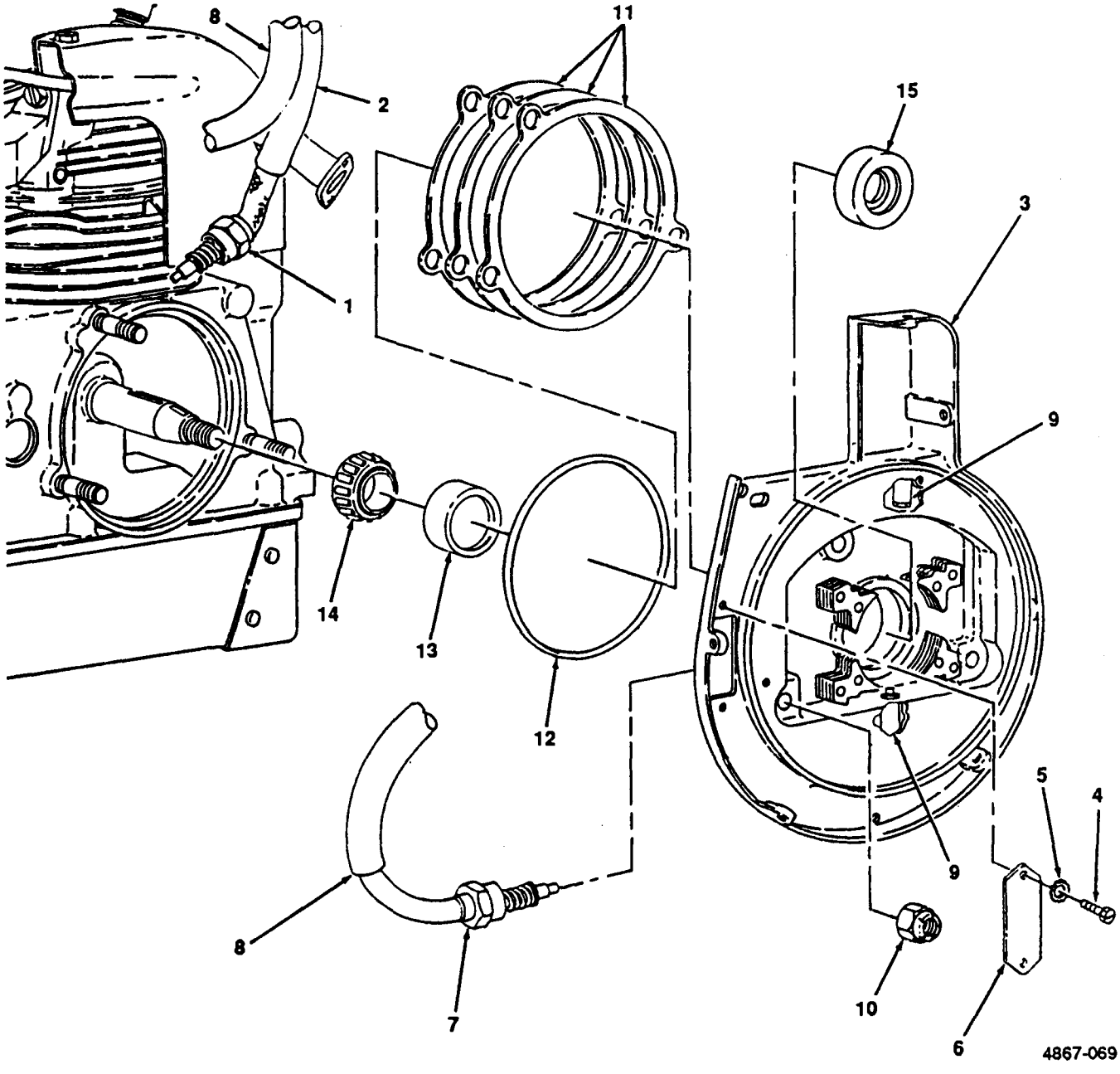

Figure 6-1. Bearing Cap, Removal and Repair.

NOTE

Crankshaft bearing cup (13) and seal (15) exploded out of bearing cap (3) in figure 6-1 for clarity.

6-7. **Bearing Cap Assembly (cont).**

c. *Installation.* (figure 6-2)

(1) Install bearing (14), O-ring (12), shims (11) and bearing cap (3) and secure with three nuts (10). Torque nuts to 100-125 in. lbs. (17860-22325 gr cm).

(2) Check crankshaft end-play. Remove or install shims (11), as necessary, to obtain crankshaft end-play of .000-.003 in. (.000-.007 cm).

Note

Steps 3 through 6 are for engines equipped with breaker point ignition.

(3) Connect wiring, as tagged to noise suppression filters (9).

(4) Install high tension cable (8) and tighten connector nut (7).

(5) Install high tension cable access plate (6) and secure with two screws (4) and washers (5).

(6) Install high tension cable (2) and tighten connector nut (1).

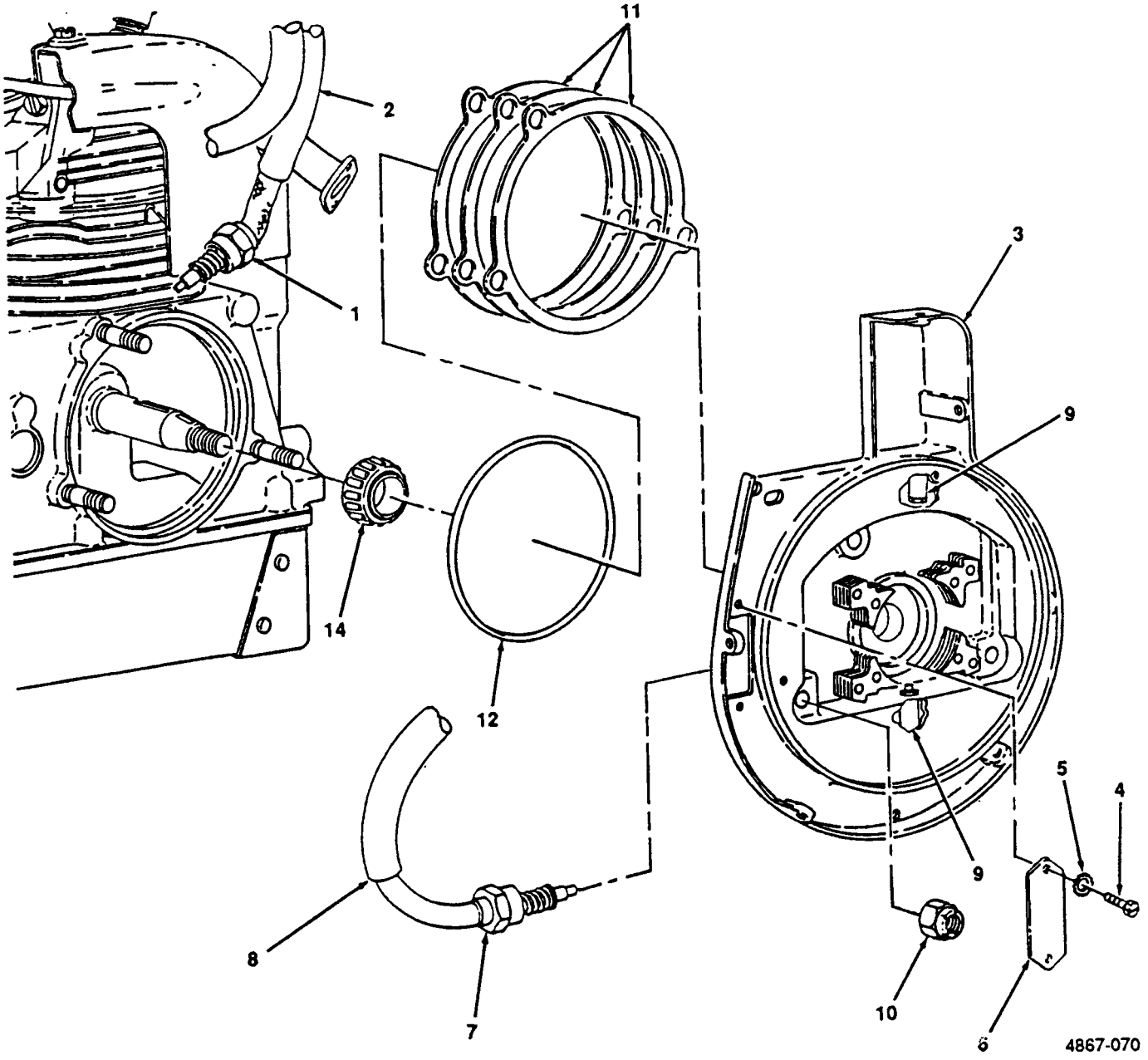

Figure 6-2. Bearing Cap, Installation.

6-8. **Crankshaft Assembly.**

This task covers: a. Removal b. Inspection c. Installation

INITIAL SETUP

Tools

General Mechanic's Tool Kit (Item 1, Appendix B)

Materials/Parts

Rags, Wiping (Item 6, Appendix D)
Solvent, Drycleaning (Item 7, Appendix D)

Equipment Condition

Pistons and connecting rod assembly removed (para. 5-18).
Bearing cap removed (para. 6-7).

a. Removal. (figure 6-3)

Remove crankshaft (1), and bearing (2) from crankcase (3).

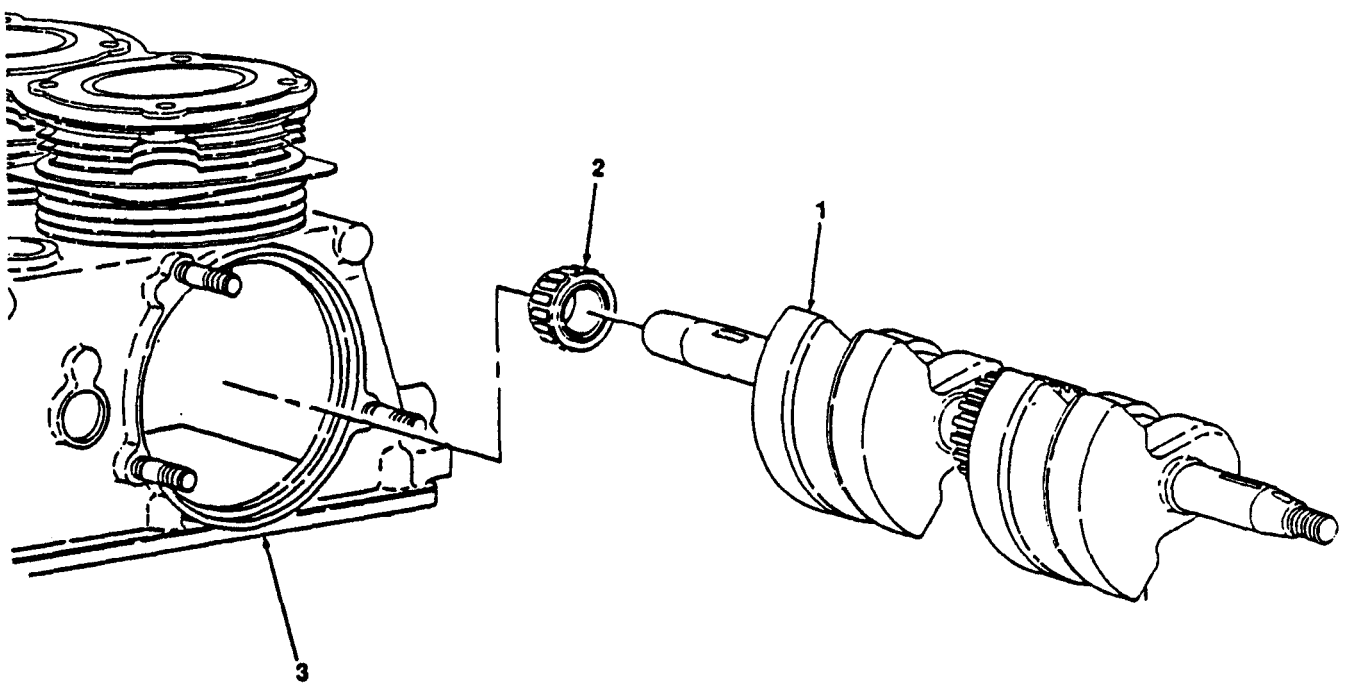

Figure 6-3. Crankshaft, Removal.

b. Inspection. (figure 6-4)

WARNING

Drycleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°F-138°F (38°C–60°C).

(1) Clean crankshaft (1) and bearing (2) with drycleaning solvent and dry thoroughly.

(2) Inspect crankshaft and bearing for signs of excessive wear or other damage and replace as needed. Refer to table 6-2 for wear limits.

(3) Inspect crankcase bearing cup (3) and replace if excessively worn or otherwise damaged. Refer to table 6-2 for wear limits.

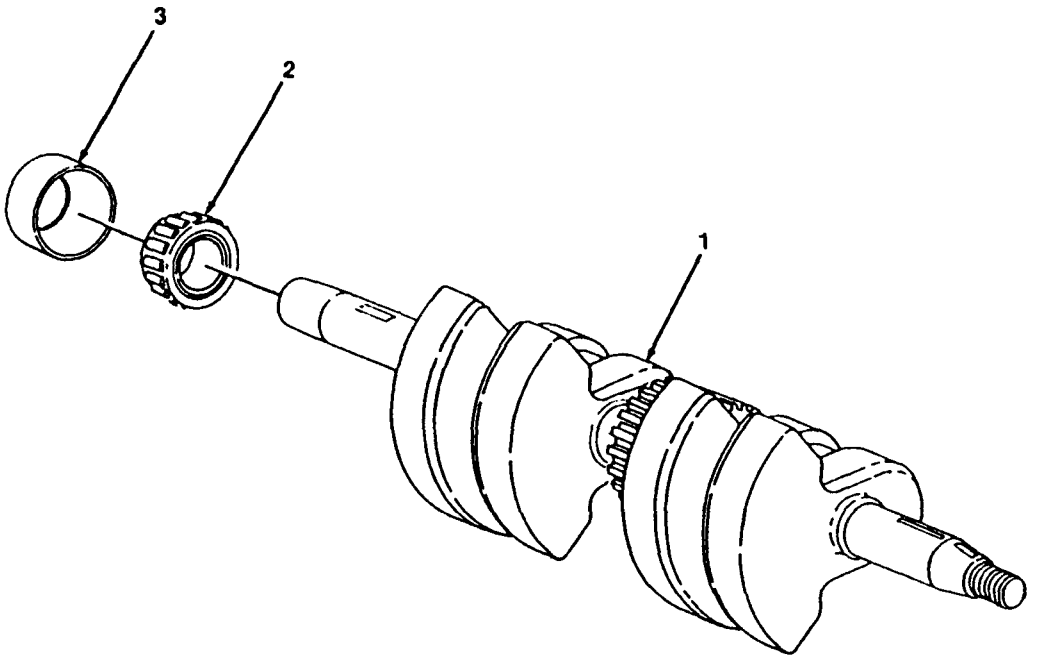

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Figure 6-4. Crankshaft Inspection.

6-8. Crankshaft Assembly (cont).

c. *Installation.* (figure 6-5)

Install bearing (2) and crankshaft (1) in crankcase (3) and aline timing marks on camshaft (4) and crankshaft (1).

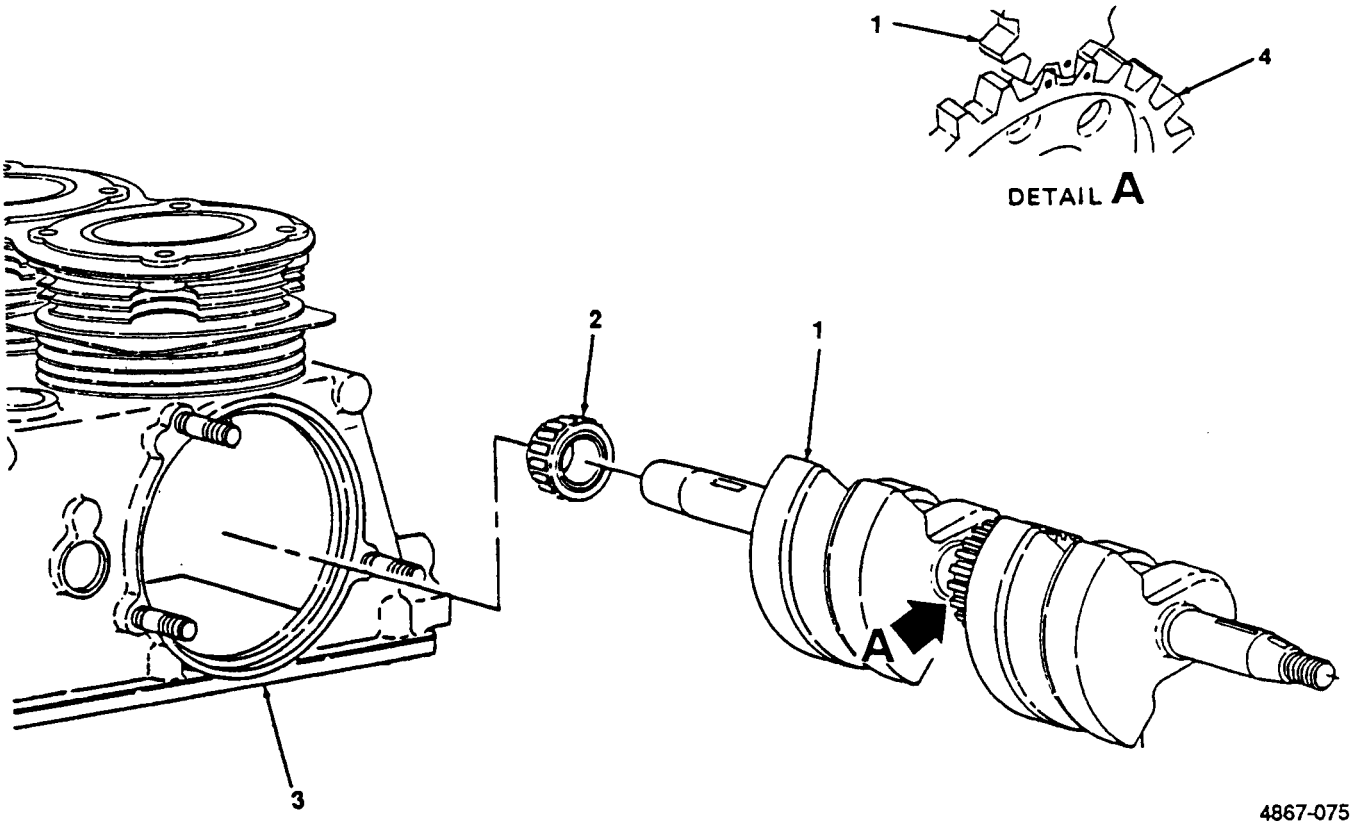


Figure **6-5.** *Crankshaft Installation.*

6-9. Camshaft, Camshaft Axle, and Tappets.

This task covers: a. Removal b. Inspection c. Installation

INITIAL SETUP

Tools

General Mechanic's Tool Kit (Item 1, Appendix B)
Puller, Kit Mechanical (NSN 5120-00-423-1596) (Item 4, Appendix B)

Equipment Condition

Crankshaft removed (para. 6-8).

Materials/Parts

Rags, Wiping (Item 6, Appendix D)
Solvent, Drycleaning (Item 7, Appendix D)
Seal, Camshaft Axle Plug (NSN 5330-00-797-4639)

a. Removal. (figure 6-6)

(1) Remove camshaft axle plug (1) and seal (2).

NOTE

To remove the camshaft axle install a long screw, with the same thread size as one of the screws that secures the oil pan, into the camshaft axle and remove the axle.

(2) Remove camshaft axle (3).

(3) Remove camshaft (4) and valve tappets (5).

(4) Remove C clip (6) from camshaft axle (3).

b. Inspection. (figure 6-6)

WARNING

Drycleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°F-138°F (38°C-60°C).

(1) Clean camshaft (4), camshaft axle (3), and valve tappets (5) in dry cleaning solvent and dry thoroughly.

(2) Inspect all components for signs of excessive wear and replace items that are worm or otherwise damaged. Refer to Table 6-2 for wear limits.

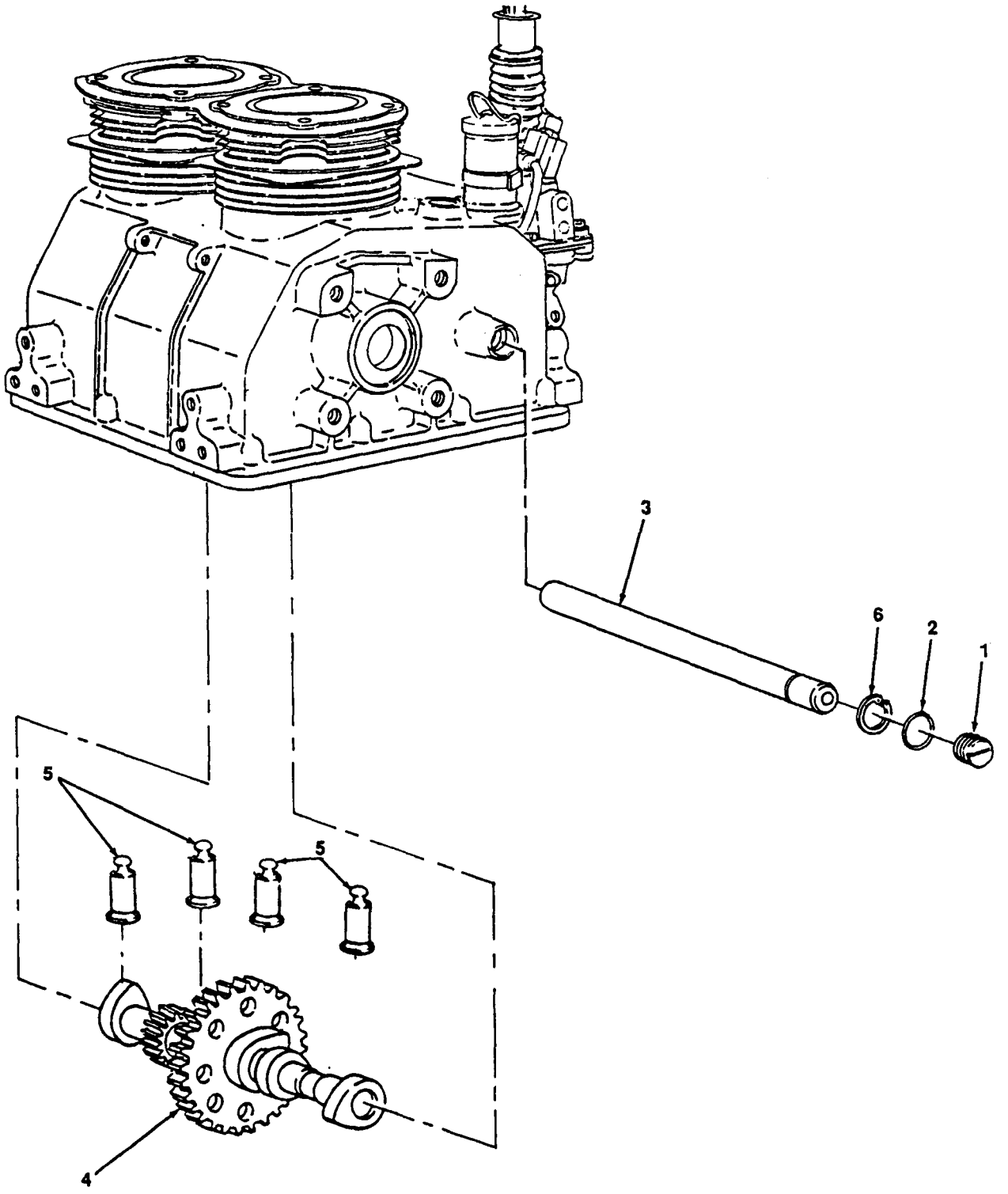


Figure 6-6. Camshaft, Removal and Inspection.

6-9. Camshaft, Camshaft Axle, and Tappets (cont).

c. *Installation.* (figure 6-7)

(1) Install C clip (6) on axle (3).

(2) Install valve tappets (5).

(3) Install camshaft (4).

(4) Install camshaft axle (3).

(5) Install seal (2) and camshaft axle plug (1).

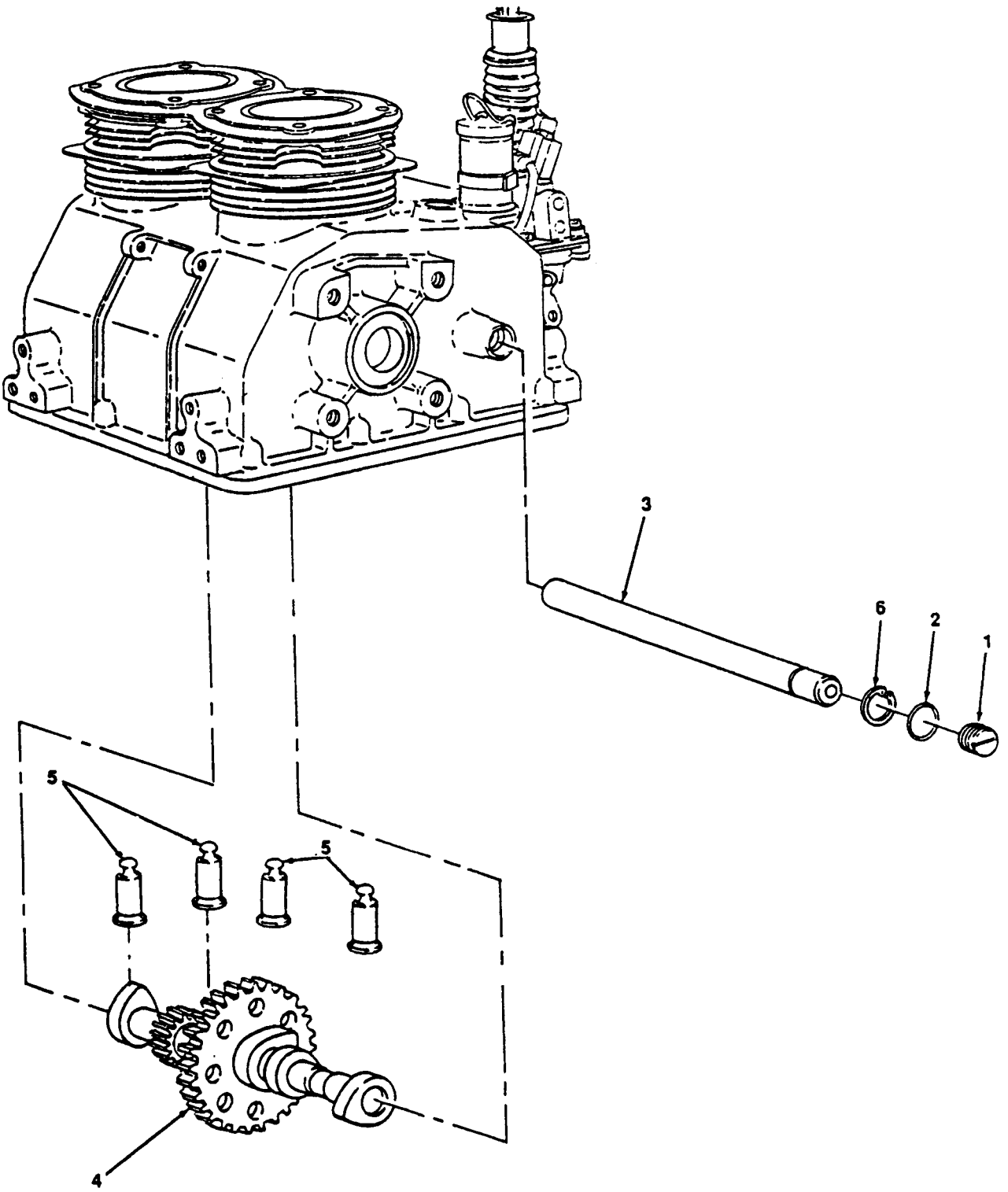


Figure **6-7.** *Camshaft, Installation.*

6-10. **Crankcase Assembly.**

This task covers: Repair

INITIAL SETUP

Tools	*Equipment Condition*
General Mechanic's Tool Kit (Item 1, Appendix B)	Piston and connecting rod assembly removed (para. 5-18)
Materials/Parts	Camshaft removed (para. 6-8).
	Crankshaft removed (para. 6-9).
Rags, Wiping (Item 6, Appendix D)	Fuel pump removed (para. 4-36).
Solvent, Drycleaning (Item 7, Appendix D)	
Seal (P/N 13214E7063)	

Repair. (figure 6-8)

WARNING

Drycleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°F-138°F (38°C-60°C).

(1) Clean crankcase (1) with drycleaning solvent and dry thoroughly.

(2) Inspect crankcase (1) and replace if worn or otherwise damaged. Refer to Table 6-2 for wear limits.

(3) Inspect bearing (2) and replace if worn, damaged or defective.

(4) Inspect cup (3) and replace if worn, damaged, or defective.

(5) Inspect bearing cap studs (4) and replace if threads are damaged.

(6) Inspect crankshaft side oil seal (5) and replace if worn, ripped, or defective.

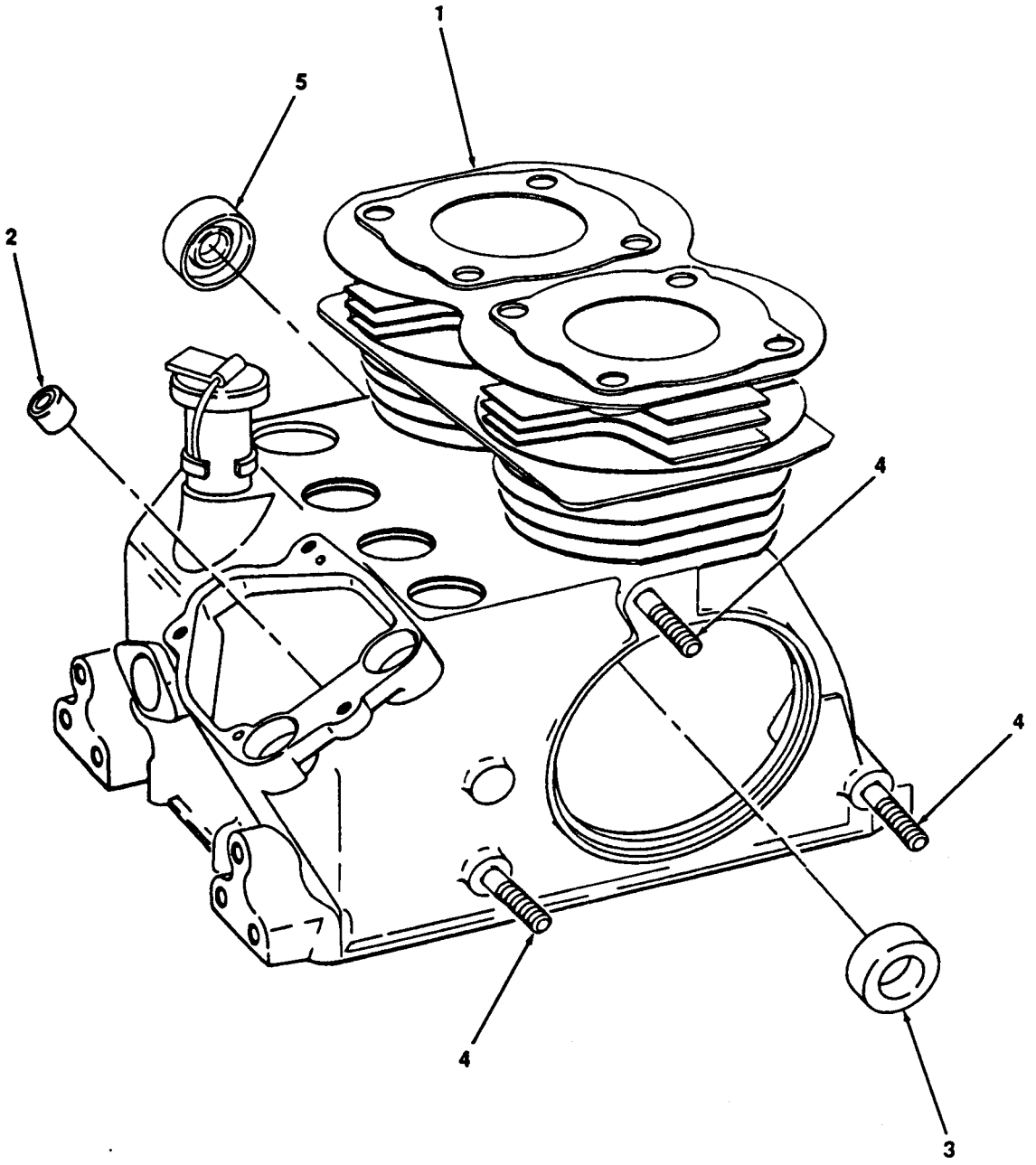


Figure 6-8. Crankcase, Repair.

Table 6-2. Engine Repair and Replacement Limits.

Item	Measurements	
	Minimum	Maximum
CYLINDERS		
A-Bore	2.2495 (5.1737)	2.2500 (5.7150)
B-Bore	2.2500 (5.7162)	2.2503 (5.7175)
C-Bore	2.2505 (5.7162)	2.2510 (5.7175)
D-Bore	2.2510 (5.7175)	2.2515 (5.7188)
Out-of-round	0.000 (0.000)	0.001R (0.0025R)
Taper	0.000 (0.000)	0.002 (0.005)
CAMSHAFT		
Bearing surface i.d.	03747 (0.9517)	0.3767 (0.9568)
Camshaft axle dia	0.3730 (0.9474)	0.3733 (0.9481)
Cam lift	0.1827 (0.4640)	0.1867 (0.4742)
Cam lobe wear	1.3247 (3.3647)	1.3287 (3.3748)
End play	0.002 (0.0050)	0.015 (0.0381)
CRANKSHAFT		
Main bearing journals		
Front	0.9385 (2.3837)	0.9395 (2.3863)
Rear	0.9385 (2.3837)	0.9395 (2.3863)
Connecting rod Journal o.d.	0.8745 (0.2212)	0.8750 (2.2225)
End play	0.0005 (0.0012)	0.0030 (0.0127)
Crankshaft bearings		
Bearing i.d. (cone)	0.9375 (2.3812)	0.9380 (2.3825)
Bearing o.d. (cup)	1.9687 (5.0004)	1.9697 (5.0030)

Table 6-2. Engine Repair and Replacement Limits (cont).

Item	Measurements	
	Minimum	Maximum
VALVE TAPPETS		
Outside dia.	0.4974 (0.2633)	0.4979 (0.2646)
Clearance in guide	0.0006 (0.0015)	0.0018 (0.0045)
Tappet guide i.d.	0.4987 (1.2666)	0.4992 (1.2679)
Rocker arms		
Rocker arm i.d.	0.6245 (1.5862)	0.6255 (1.5887)
Rocker shaft o.d.	0.4375 (1.1112)	0.4380 (1.1125)
Rocker arm bearing i.d. in rocker arm	0.4380 (1.1125)	0.4383 (1.1132)

APPENDIX A

REFERENCES

A-1. **Scope.** This appendix contains all forms, lubrication orders, pamphlets and technical manuals referenced in this manual.

A-2. Forms.

Air Force Maintenance Management Policy . . . . . AFR 66-1
Air Force Suggestion Program . . . . . AFR 900-4
Recommended Changes to Publications . . . . . DA Form 2028-2
Equipment Inspection and Maintenance Worksheet . . . . . DA Form 2404
Quality Deficiency Report (QDR) . . . . . SF 368
Transportation Discrepancy Report (TDR) . . . . . SC 361
Report of Discrepancy (ROD) . . . . . SF 364

A-3. Lubrication Order.

Lubrication Order, Gasoline Engine, 3 HP Military Standard
Models 2A016-1, -2, -3, and -4 . . . . . L0 9-2805-257-12

A-4. Pamphlets.

The Army Maintenance Management System (TAMMS) . . . . . DA Pam 738-750
Consolidated Index of Army Publications and Blank Forms . . . . . DA Pam 25-30

A-5. Technical Manuals.

Unit, Direct Support, General Support and Depot Maintenance
Repair Pads and Special Tool List. . . . . TM 5-2805-257-24P
TO 38G2-103-4
NAVFAC P-8-612-24P
Painting instructions for Army Materiel. . . . . TM 43-0139
Procedures for Destruction of Equipment to Prevent Enemy Use . . . . . TM 350-244-3

A-6. Field Manual.

Artificial Respiration . . . . . FM 21-11

A-7. Technical Bulletins.

Preservation of Mechanical Equipment for Shipment and Storage . . . . . TB 740-97-2

APPENDIX B

MAINTENANCE ALLOCATION CHART

Section I. INTRODUCTION

B-1. **Maintenance Allocation Chart (MAC).** This MAC assigns maintenance functions in accordance with the Three Level Maintenance Concept.

B-2. **Use of the Maintenance Allocation Chart, Section II.**

a. The MAC assigns maintenance functions based on the following considerations:

(1) Skills available.

(2) Work time required.

(3) Tools and test equipment required and/or available.

b. If a lower level of maintenance identified in column (4) of the MAC cannot perform all tasks of a single maintenance function (e.g., test, repair), then the higher level that can perform other tasks of that function is also indicated.

c. Higher maintenance levels are automatically authorized to perform maintenance functions assigned to a lower maintenance level.

d. Higher maintenance levels will perform the maintenance functions of lower maintenance levels when required or directed by the Commander who has authority to direct such tasking.

e. Assignment of a maintenance function in the MAC does not carry automatic authorization to carry the related spare or repair parts in stock. Information to requisition or secure parts will be as specified in the associated RPSTL.

f. Normally, there will be no deviation from the assigned level of maintenance. However, in cases of operational necessity, maintenance functions assigned a higher level may, at the request of the lower level, be assigned to the lower level on a one-time basis, if specifically authorized by the maintenance officer of the higher level to which the function is assigned. In such a case, the special tools, equipment, etc., required by the lower level to perform this function will be furnished by the higher level assigned the function. Also, transfer of a function to a lower level does not relieve the higher level of responsibility for the function, so the higher level will provide technical supervision and inspection of the function being performed at the lower level.

B-3. **Maintenance Functions.** Maintenance functions will be limited to and defined as follows:

a. Inspect. To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination (e.g., by sight, sound, or feel).

b. Test. To verify serviceability and detect incipient failure by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. Service. Operations required periodically to keep an item in proper operating condition, i.e., to clean (includes decontaminate), to preserve, to drain, or to replenish fuel, lubricants, hydraulic fluids, or compressed air supplies.

d. Adjust. To maintain within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to the specified parameters.

e. Aline. To adjust specified variable elements of an item to bring about optimum or desired performance.

f. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipment used in precision measurement. Consists of comparison of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy inn the accuracy of the instrument being compared.

g. Install. The act of emplacing, seating, or fixing into position an item, part, or module (component assembly) in a manner to allow the proper functioning of an equipment or system.

h. Replace. The act of substituting a serviceable like type part, a subassembly, or module (component or assembly) for an unserviceable counterpart.

i. Repair. The application of maintenance services (inspect, test, service, adjust, aline, calibrate, or replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining, or resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

j. Overhaul. That maintenance effort (service/action) necessary to restore an item to a completely serviceable operational condition as prescribed by maintenance standards in appropriate technical publications (i.e., DMWR). Overhaul does not normally return an item to a like new condition.

k. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours/miles, etc.) considered in classifying Army equipment/components.

B-4. **Explanation of Columns in the MAC, Section II.**

a. Column (1). Group Number. Column 1 lists functional group code numbers which are assigned to identify maintenance significant components, assemblies, subassemblies, and modules to their next higher assembly.

b. Column (2). Component/Assembly. Column 2 contains the item names of components, assemblies, subassemblies, and modules for which group numbers (column 1) are assigned and for which maintenance is authorized.

c. Column (3). Maintenace Function. Column 3 lists the functions to be performed on items listed in Column 2. (Function definitions are contained in paragraph A-3.)

d. *Column (4). Maintenance Level.* The maintenance levels, Unit, Intermediate, and Depot, are allotted separate subcolumns within column 4. Entry of a work time figure (such as 1.0, 0.2) in a subcolumn indicates that that level is authorized to perform the function listed in column 3, and the average time required to do the function is the work time figure. If the number or complexity of tasks within a maintenance function varies from one maintenance level to another, the applicable work time figure for each level will be entered for that function. The work time figure represents the average time it takes to restore a component/assembly to a serviceable condition under a typical field operating environment.

e. *Column (5). Tools and Equipment.* Column 5 specifies, by code, common tool sets (not individual tools from those sets), common TM DE, and special tools, TM DE, and support equipment required to perform a designated function. The code in Column 5 keys to the listing in Section Ill of the MAC.

f. *Column (6). Remarks.* This column when applicable, contains a letter code with is keyed to an explanation of the code contained in Section IV of the MAC.

B-5. **Explanation of Columns in the MAC, Section III.**

a. *Column (1). Tool or Test Equipment Reference Code.* The tool or test equipment reference code correlates with a code used in the MAC, Section II, Column 5.

b. *Column (2). Maintenance Category.* The lowest category of maintenance authorized to use the tool or test equipment.

c. *Column (3). Nomenclature.* Name or identification of the tool or test equipment.

d. *Column (4). National/NATO Stock Number.* The National stock number of the tool or test equipment.

e. *Column (5). Tool Number.* The manufacturer's part number.

B-6. **Explanation of Columns in the MAC, Section IV.**

a. *Column (1). Reference Code.* The code recorded in column 6, Section Il.

b. *Column (2). Remarks.* This column lists information pertinent to the maintenance function being performed as indicated in the MAC, Section II.

Section II. MAINTENANCE ALLOCATION CHART

(1) Group number	(2) Component/ assembly	(3) Maintenance function	(4) Maintenance level C	O	F	H	D	(5) Tools and eqpt.	(6) Remarks
00	Engine Assembly	Overhaul					16.0		
01	Fuel Filter Assembly								
	Fuel Filter	Inspect	0.1						
		Service		0.3				1	
		Install		0.1				1	
		Replace		0.3					
02	Cooling System								
	Flywheel Cover	Replace		0.2				1	
		Repair		1.0				1	
	Cylinder Head Covers	Replace		0.2				1	
		Repair		1.0				1	
	Lower Air Duct	Replace		0.2				1	
		Repair		1.0				1	
	Ignition Switch	Test		0.3				1,2	
		Install		0.3				1	
		Replace		0.6				1	
03	High Tension Cables and Spark Plugs								
	High Tension Cables	Inspect	0.1						
		Test		0.3				1,2	
		Install		0.2				1	
		Replace		0.4				1	
	Spark Plugs	Test		0.3				1	
		Adjust		0.2				1	
		Install		0.4				1	
		Replace		0.5				1	

Section II. MAINTENANCE ALLOCATION CHART (cont)

(1) Group number	(2) Component/ assembly	(3) Maintenance function	(4) Maintenance level C	O	F	H	D	(5) Tools and eqpt.	(6) Remarks
04	Air Cleaner Assembly								
	Air Cleaner	Inspect	0.1						
		Service		0.3				1	
		Install		0.3				1	
		Replace		0.5				1	
	Clamps and Hoses	Install		0.2				1	
		Replace		0.3				1	
	Element	Inspect	0.1						
		Install		0.2				1	
		Replace		0.3					
05	Rocker Arm Cover Assembly								
	Relief Valve	Inspect		0.1					
		Install		0.1				1	
		Replace		0.2				1	
	Rocker Cover	Inspect	0.1						
		Install		0.1				1	
		Replace		0.2				1	
		Repair		0.2				1	
06	Oil Fill Tube and Gage Assembly								
	Tube	Install		0.2				1	
		Replace		0.4				1	
	Gage	Install		0.1					
		Replace		0.1					
07	Oil Pan Assembly								
	Oil Pan	Install			0.2			1	
		Replace			0.4			1	

Section II. MAINTENANCE ALLOCATION CHART (cont)

(1) Group number	(2) Component/ assembly	(3) Maintenance function	(4) Maintenance level C	O	F	H	D	(5) Tools and eqpt.	(6) Remarks
08	Engine Speed Governor and Controls								
	Governor	Adjust		0.3				1	
		Install			0.5			1	
		Replace			0.9			1	
		Repair			0.5			1	
09	Ignition System								
	Breaker Points Cover	Inspect		0.1					
		Install		0.1				1	
		Replace		0.1				1	
	Breaker Points	Inspect		0.2					
		Adjust		0.2				1	
		Install		0.3				1	
		Replace		0.5				1	
	Condenser	Install		0.2				1	
		Replace		0.4				1	
	Ignition Control Unit	Test			0.4			1, 2	
		Replace			0.3			1	
	Transformer	Test			0.1			1, 2	
		Replace			0.2			1	
	Ignition Module	Test			0.2			1, 2	
		Replace			0.2			1	
	Low Voltage Cable	Test			0.1			1, 2	
		Replace			0.3			1	
10	Breather Line Assembly								
	Breather Line	Inspect		0.1					
		Install		0.2				1	
		Replace		0.4				1	

Section II. MAINTENANCE ALLOCATION CHART (cont)

(1) Group number	(2) Component/ assembly	(3) Maintenance function	(4) Maintenance level C	O	F	H	D	(5) Tools and eqpt.	(6) Remarks
11	Carburetor and Throttle Control								
	Throttle Control	Adjust	0.1						
		Install		0.2				1	
		Replace		0.4				1	
	Carburetor	Inspect		0.1					
		Adjust		0.1					
		Install		0.4				1	
		Replace		0.7				1	
12	Fuel Line and Fuel Pump Assembly								
	Fuel Pump	Test		0.2				1, 2	A
		Install		0.2				1	
		Replace		0.4				1	
	Fuel Line	Install		0.1				1	
		Replace		0.2				1	

Section II. MAINTENANCE ALLOCATION CHART (cont)

(1) Group number	(2) Component/ assembly	(3) Maintenance function	(4) Maintenance level C	O	F	H	D	(5) Tools and eqpt.	(6) Remarks
13	Flywheel Assembly								
	Starter Flange	Install		0.1				1	
		Replace		0.2				1	
	Flywheel	Inspect		0.1					
		Install		0.4				1	
		Replace		0.8				1	
14	Manifolds								
	Intake	Install		0.2				1	
		Replace		0.4				1	
	Exhaust	Install		0.2				1	
		Replace		0.4				1	
15	Cylinder Head Assembly	Install			0.3			1	
		Replace			0.6			1	
		Repair			1.0			1	
	Rockers	Install			0.2			1	
		Replace			0.4			1	
	Intake and Exhaust Valves	Adjust			0.1			1	
		Install			0.2			1	
		Replace			0.4			1	
16	Piston and Connecting Rod Assembly	Aline			0.1			1	
		Install			0.3			1	
		Replace			0.6			1	
		Repair			0.8				

Section II. MAINTENANCE ALLOCATION CHART (cont)

(1) Group number	(2) Component/ assembly	(3) Maintenance function	(4) Maintenance level C	O	F	H	D	(5) Tools and eqpt.	(6) Remarks
17	Bearing Cap Assembly								
	Rotating Magnet	Install			0.2			1, 3	
		Replace			0.4			1, 3	
	Coil	Test			0.2			1, 2	
		Install			0.2			1	
		Replace			0.4			1	
	Flywheel Side Oil Seal	Install			0.6			1	
		Replace			1.0			1	
	Noise Suppression Fitters	Install			0.3			1	
		Test			0.2			1, 2	
		Replace			0.3			1	
	Crankshaft Side Oil Seal	Install			0.6			1	
		Replace			1.0			1	
	Bearing Cap	Install				0.8		1	
		Replace				1.5		1	
		Repair				0.5		1	
	Bearing Cup	Install				0.2		1	
		Replace				0.4		1	
18	Crankshaft Assembly	Inspect				0.3			
		Install				0.4		1	
		Replace				0.8		1	
19	Camshaft, Axle, Valve Tappets	Inspect				0.2			
		Install				0.4		1	
		Replace				0.8		1	
20	Crankcase Assembly	Repair				0.5		1	

Section III. TOOLS AND TEST EQUIPMENT REQUIREMENTS FOR 3 HP MILITARY STANDARD ENGINE

Tool or test equipment ref code (1)	Maintenance category (2)	Nomenclature (3)	National/NATO stock number (4)	PN Tool number (5)
1	0	General Mechanic's Tool Kit	5180-00-699-5273	
2	0	Shop Equipment, Automotive Maintenance and Repair; Organizational Maintenance No. 1 Common, Less Power	4910-00-754-0654	
3	F	Shop Equipment, Automotive Maintenance and Repair; Field Maintenance, Wheeled Vehicles, Set A	4910-95-CL-A02 4910-00-348-7696	

Section IV. REMARKS

Reference code	Remarks
A	Test includes pressure test

APPENDIX C

COMPONENTS OF END ITEM AND BASIC ISSUE ITEMS LISTS

Section I. INTRODUCTION

C-1. Scope.

This appendix lists components of end item and basic issue items for the 3 HP Military Standard Engine to help you inventory items required for safe and efficient operation.

C-2. General.

The Components of End Item and Basic Issue Items Lists are divided into the following sections.

a. *Section II. Components of End Item.* This listing is for informational purposes only, and is not authority to requisition replacements. The items are part of the end item, but are removed and separately packaged for transportation or shipment. As part of the end item, these items must be with the end item whenever it is issued or transferred between properly accounts. Illustrations are furnished to assist you in identifying the items.

b. *Section III. Basic Issue Items.* These are the minimum essential items required to place the 3 HP Military standard engine in operation. The illustrations will assist you with hard-to-identify items. This manual is your authority to request/requisition replacement Bll, based on TO E/MTOE authorization of the end item.

C-3. Explanation of Columns.

The following provides an explanation of columns found in the tabular listings:

a. *Column (1), Illustration Number (Illus Number).* This column indicates the number of the illustration in which the item is shown.

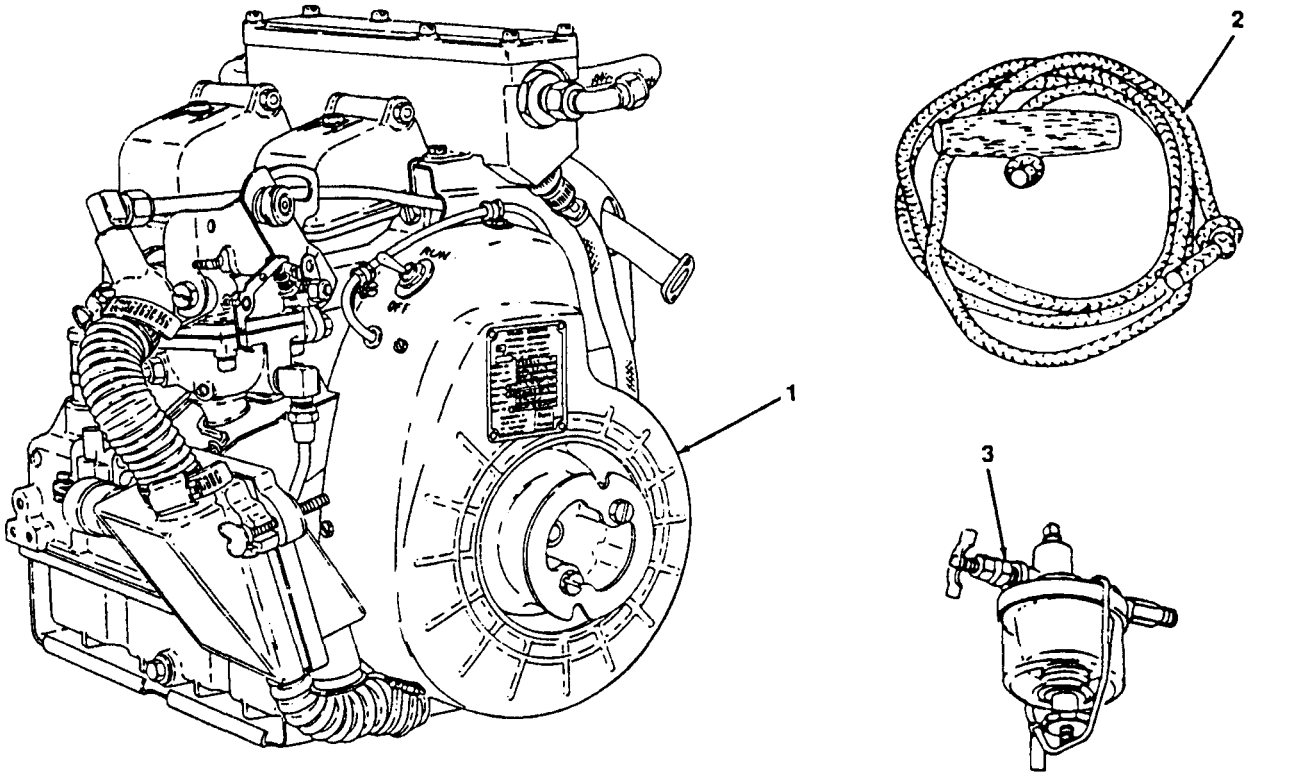
b. *Column (2). National Stock Number.* Indicates the National Stock Number assigned to the item and will be used for requisitioning purposes.

c. *Column (3). Description.* Indicates the Federal item name, and, if required, a minimum description to identify and locate the item. The last line for each item indicates the FSCM (in parentheses) followed by the part number.

d. *Column (4). Unit of Measure (U/M).* Indicates the measure used in performing the actual operational/ maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea, in., pr).

e. *Column (5). Quantity Required (QTY RQR).* Indicates the quantity of the item authorized to be used with/on the equipment.

Section II. COMPONENTS OF END ITEMS



4867-077

(1) Illus Number	(2) National Stock Number	(3) Description FSCM and Part Number	Usable On Code	(4) U/M	(5) Qty Rqr
1	2805-00-601-5127	Engine, Military Standard 3 HP Model 2A016-1		ea	1
1	2805-00-741-8553	Engine, Military Standard 3 HP Model 2A016-2		ea	1
1	2805-00-072-4871	Engine, Military Standard 3 HP Model 2A016-3		ea	1
1	2805-01-169-1100	Engine, Military Standard 3 HP Model 2A016-4		ea	1
2	2990-00-972-7950	Rope, Starter Cable Assembly		ea	1
3	2910-00-905-9792	Filter Assembly, Fuel		ea	1

Section III. BASIC ISSUE ITEMS

Not Applicable

APPENDIX D

EXPENDABLE/DURABLE SUPPLIES MATERIALS LIST

Section I. INTRODUCTION

D-1. **Scope.** This listing is for informational purposes only and is not authority to requisition the listed items. These items are authorized to you by CTA 50-970, Expendable/Durable Items (except medical, class V, repair parts, and heraldic items).

D-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 cleaning compound, item 5, appendix C)".

b. *Colunm (2) - Level.* This column identifies the lowest level of maintenance that requires the listed item.

C - Operator/Crew
O - Organizational Maintenance
F - Direct Support Maintenance
H - General Support Maintenance

c. *Column (3) - National Stock Number.* This is the National stock number assigned to the item; use it to request or requisition the item.

d. *Column (4) - Description.* Indicates the Federal item name, and, if required, a description to identify the item. The last line for each item indicates the Federal Supply code for Manufacturer (FSCM) in parentheses followed by the part number.

d. *Column (5) - Unit of Measure (U/M).* Indicates the measure used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., EA, IN., PR). If the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.

Section II. EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

(1) Item number	(2) Level	(3) National stock number	(4) Description	(5) U/M
1	c		Coating, Chemical Agent Resistant	gal.
2	c	9150-01-152-4117	Oil, Engine, OE/HDO 15W-40	qt.
		9150-01-152-4118	Oil, Engine, OE/HDO 15W-40	5 gal.
		9150-01-152-4119	Oil, Engine, OE/HDO 15W-40	55 gal.
3	c		Oil, Engine OE/HDO 30	qt.
4	c		Oil, Engine, OEA/APH-PD-1	qt.
5	c		Oil, Engine OEA/APG-PD-1	qt.
6	c	7920-00-205-1711	Rag, Wiping, 50/B (58536) A-A-531	ea
7	c	6850-00-664-5685	Solvent, Drycleaning, PD-680	gal.

APPENDIX E

TORQUE LIMITS

E-1. **General.** Table E-1 provides torque limits to be observed when installing attaching hardware or spark plugs.

Table E-7. Torque Limits.

Attaching Part	Range
Flywheel bolt	240-300 in. lb (42864-53580 gr cm)
Cylinder head nuts	140-155 in. lb (25004-27683 gr cm)
Rocker arm adjusting screw lock nuts	44-55 in. lb (7858-9823 gr cm)
Intake manifold to cylinder head bolts	45-50 in. lb (8037-8930 gr cm)
Muffler to cylinder head bolts	60-85 in. lb (10715-15181 gr cm)
Spark plugs	275-300 in. lb (49115-53580 gr cm)
Connecting rod bolts	90-100 in. lb (16074-17860 gr cm)
Oil pan screws	25-30 in. lb (4465-5358 gr cm)
Bearing cap nuts	100-125 in lb (17860-22325 gr cm)
Fuel pump bolts	45-50 in. lb (8037-8930 gr cm)
Governor housing screws	25-30 in. lb (4465-5358 gr cm)
Carburetor mounting bolts	60-85 in. lb (10715-15181 gr cm)

APPENDIX F
ADDITIONAL AUTHORIZATION LIST (AAL)

Section I. INTRODUCTION

D-1. SCOPE. This appendix lists additional items you are authorized for the Engine, Gasoline, 3 HP MILSTD.

D-2. GENERAL.. Section II identifies items that are not routinely used with the MILSTD and do not have to accompany it or be turned in with it.

D-3. EXPLANATION OF LISTING. National stock numbers, descriptions, and quantities are provided to help you identify and request the additional items you require to support this equipment The items are listed in alphabetical sequence by item name.

Section II. ADDITIONAL AUTHORIZATION LIST

(1) ITEM NO	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION, (FSCM) & PART NUMBER	USABLE ON CODE	(4) U/M	(5) QTY AUTH
1	2990-01 -32-0775	SPARK ARRESTER		EA	1

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By Order of the Secretaries of the Army, Air Force and Navy (Including the Marine Corps):

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To be distributed in accordance with DA Form 12-25A, Operator, Unit, Direct Support and General Support Maintenance requirements for Engine, Gasoline, 3 HP, Models 2AO16-1/2/3.

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BE EXACT. . . PIN-POINT WHERE IT IS

PAGE NO	PARA-GRAPH	FIGURE NO	TABLE NO
6	2-1 a		
B1		4-3	
125	line 20		

IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:

In line 6 of paragraph 2-1a the manual states the engine has 6 Cylenders. The engine on my set only has 4 Cylenders. Change the manual to show 4 Cylenders.

Callout 16 on figure 4-3 is pointing at a bolt. In key to figure 4-3, item 16 is called a shim - Please correct one or the other.

I ordered a gasket, item 19 on figure B-16 by NSN 2910-00-762-3001. I got a gasket but it doesn't fit. Supply says I got what I ordered, so the NSN is wrong. Please give me a good NSN

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The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigram = .035 ounce
1 dekagram = 10 grams = .35 ounce
1 hectogram = 10 dekagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	*To*	*Multiply by*	*To change*	*To*	*Multiply by*
inches	centimeters	2.540	ounce-inches	newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29,573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	newton-meters	1.356	metric tons	short tons	1.102
pound-inches	newton-meters	.11296			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

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