

TECHNICAL MANUAL

VOLUME 1 OF 2

TROUBLESHOOTING

DIRECT SUPPORT AND GENERAL SUPPORT LEVEL

ENGINE ASSEMBLY, DIESEL (MULTIFUEL):
NATURALLY ASPIRATED OR TURBOCHARGED,
FUEL-INJECTED, WATER-COOLED, 6-CYLINDER

MODELS: LD-465-1, NSN 2815-00-239-5824;
LD-465-1C, NSN 2815-00-134-4830; LDT-465-1C,
NSN 2815-00-103-2642; LDS-465-1, NSN 2815-00-075-0087;
LDS-465-1A, NSN 2815-00-239-5819; AND LDS-465-2,
NSN 2815-00-808-8011 AND CLUTCHES

NOTE:

THE STYLE OF THIS TM IS
EXPERIMENTAL. IT IS BEING TRIED
BY THE ARMY ONLY ON
A LIMITED BASIS

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Information

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Approach

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WARNING

EXHAUST GASES CAN BE DEADLY

Exposure to exhaust gases produces symptoms of headache, dizziness, loss of muscular control, apparent drowsiness, and coma. Permanent brain damage or death can result from severe exposure.

Carbon monoxide occurs in the exhaust fumes of internal combustion engines, and becomes dangerously concentrated under conditions of inadequate ventilation. The following precautions must be observed to insure the safety of personnel whenever the engine is operated for maintenance purposes or tactical use.

Do not operate engine in an enclosed area unless it is adequately ventilated.

Do not idle engine for long periods without maintaining adequate ventilation.

Be alert at all times during engine operation for exhaust odors and exposure symptoms. If either are present, immediately ventilate working area. If symptoms persist, remove affected personnel from area and treat as follows: expose to fresh air; keep warm; do not permit physical exercise; if necessary, administer artificial respiration.

If exposed, seek prompt medical attention for possible delayed onset of acute lung congestion. Administer oxygen if available.

The best defense against exhaust gas poisoning is adequate ventilation.

WARNING

SERIOUS OR FATAL INJURY TO PERSONNEL MAY RESULT IF
THE FOLLOWING INSTRUCTIONS ARE NOT COMPLIED WITH.

Diesel fuel is very flammable. Care must be used when choosing a place to work on fuel system. Keep engine about 50 feet away from an area where open flame, sparks, or smoking may cause a fire. Keep a fire extinguisher close by.

Fuel coming out of an injector nozzle under pressure can go through the skin. This can cause blood poisoning. Keep hands away from injector nozzle when doing test procedures.

Make sure engine has had at least an hour to cool down before working on cooling system. Due to high temperature of coolant, bad burns can occur if contact is made with skin.

* TM 9-2815-210-34-1

T.O.38G1-48-12-1

TECHNICAL MANUAL
NO. TM 9-2815-210-34-1
TECHNICAL ORDER
NO. 38G1-48-12-1

DEPARTMENTS OF THE ARMY
AND
THE AIR FORCE
WASHINGTON, DC, 3 April 1981

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REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedure, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual direct to: Commander, US Army Tank-Automotive Command, ATTN: DRSTA-MB, Warren, Michigan 48090. A reply will be furnished to you.

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*This manual together with TM 9-2815-210-34-2-1, 3 April 1981; and TM 9-2815-210-34-2-2, 3 April 1981, supersedes TM 9-2815-210-34, 16 June 1978.

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CHAPTER 1

GENERAL INFORMATION

1-1. SCOPE. This volume shows you how to do troubleshooting at the direct support and general support levels of maintenance. The amount of troubleshooting you can do is based on what the Maintenance Allocation Chart says you can fix. Because of this, the only trouble symptoms you will find here are those that could be caused by faulty things you can fix.

1-2. ORGANIZATION. This volume has the information you will need to troubleshoot the engine. Chapter 2 tells you how to use the information in the other chapters of this volume to find what is wrong with the truck, and what you must do to fix it. Chapter 7 has a procedure that takes you step-by-step through a sample troubleshooting procedure and shows you how to use the information to find the trouble and fix it.

1-3. TROUBLESHOOTING APPROACH. In order to find out what is causing the problem in the truck, you must use a good approach. A good approach just means a way of doing troubleshooting so you can find the problem and not get confused or lost. The following chapter describes how you can use the materials in this volume to troubleshoot with a good approach.

CHAPTER 2

TROUBLESHOOTING APPROACH

2-1. GENERAL APPROACH. This chapter gives you instructions on how to use the troubleshooting material to help you find and fix the trouble. In every system of the engine there can be faults or problems which will cause certain symptoms. Symptoms can be such things as unusual noise, vibration, or even complete failure of a system. This volume gives information for each system on which you can do troubleshooting to find faults and fix them. Before you troubleshoot a system, you should look at the troubleshooting indexes which will lead you to the information you need to help make your troubleshooting faster and easier. If you follow the instructions the right way, you will find those troubles you can fix. But, if you fix something and the trouble is still there, it means there is more than one trouble. If this happens, start all over again to find the other trouble.

2-2. TROUBLESHOOTING INDEX. The troubleshooting index, and instructions on how to use it are in chapter 3. Go to this index first because it tells you where to find troubleshooting roadmaps, fault symptom indexes, summary troubleshooting charts and support diagrams for each system.

2-3. TEST EQUIPMENT PROCEDURES INDEX. The test equipment procedures index, and instructions on how to use it are in chapter 4. This index tells you where to find tests which you can use to do your troubleshooting. It also tells you what equipment you will need to do the tests. If you have a STE/ICE (Simplified Test Equipment/Internal Combustion Engine) Set (NSN 4910-00-124-2554), you may use it, where applicable, to do your troubleshooting. Refer to TM 9-4910-571-34&P.

2-4. TROUBLESHOOTING ROADMAP. A troubleshooting roadmap is given in chapter 5. If the system is made up of subsystems, these subsystems are also on the roadmap. Under the subsystem is a list of things which are the most likely causes of a fault symptom in that subsystem. If you have enough skill, you can troubleshoot these things on the engine without using the detailed troubleshooting procedures. So if you know enough about the engine to work on your own, use the roadmap for the system with the problem before you check the fault symptom index.

2-5. FAULT SYMPTOM INDEX. Fault symptom indexes and instructions on how to use them are in chapter 6. For each system of the engine, there is an index which gives you a list of the fault symptoms for that system. The index also tells you where to find the detailed troubleshooting procedures and what resources (tools/people) you need to do each procedure.

2-6. SAMPLE TROUBLESHOOTING PROCEDURE. A sample troubleshooting procedure is in chapter 7. This sample procedure will help you see the way detailed troubleshooting procedures are to be used.

CHAPTER 3

TROUBLESHOOTING INDEX

3-1. **GENERAL.** This chapter has a troubleshooting index which covers every system of the engine on which you can do troubleshooting. The index tells you where to find all the other information you need to do your troubleshooting procedures.

3-2. **INDEX.** The troubleshooting index (figure 3-1) is divided into five columns that list the system, troubleshooting roadmap, fault symptoms, summary troubleshooting procedures, and system support diagrams. The following breakdown tells you what is in each column.

a. **System Column.** This column gives a list of systems on the engine for which troubleshooting can be done at the direct support and general support maintenance levels.

b. **Troubleshooting Roadmaps Column.** This column tells you where to find the troubleshooting roadmap for each listed system. These roadmaps are given in chapter 5.

c. **Fault Symptom Index Column.** This column tells you where to find the troubleshooting fault symptom index for each listed system. Fault symptom indexes are given in chapter 6.

d. **Summary Troubleshooting Procedures Column.** This column tells you where to find the summary troubleshooting procedure for each listed system. Some systems do not have summary troubleshooting procedures, so the column will be left blank for those systems.

e. **System Support Diagrams Column.** This column tells you where to find support diagrams for each listed system. Some systems do not have support diagrams, so the column will be left blank for those systems.

CHAPTER 4

TEST EQUIPMENT PROCEDURES INDEX

4-1. **GENERAL.** This chapter has a test equipment procedures index which tells you where to find the tests you need to do your troubleshooting.

4-2. **INDEX.** The test equipment procedures index is divided into three columns that list test equipment, tests, and figure numbers. The following breakdown tells you what is in each column.

a. Test Equipment Column. This column tells you what kind of equipment you need to do your troubleshooting tests.

b. Tests Column. This column tells you what tests are given in this manual. Next to each piece of test equipment are listed the tests that you can do with that equipment. This column also gives troubleshooting tests which can be done without using test equipment.

c. Figure Column. This column tells you where you can find the tests in this manual.

TEST EQUIPMENT		TESTS	FIGURE
1	_____	Fuel Injector Nozzle	10-1
2			
3			
4			
5			
6			
7			
8			

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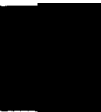
Figure 4-1. Test Equipment Procedures Index

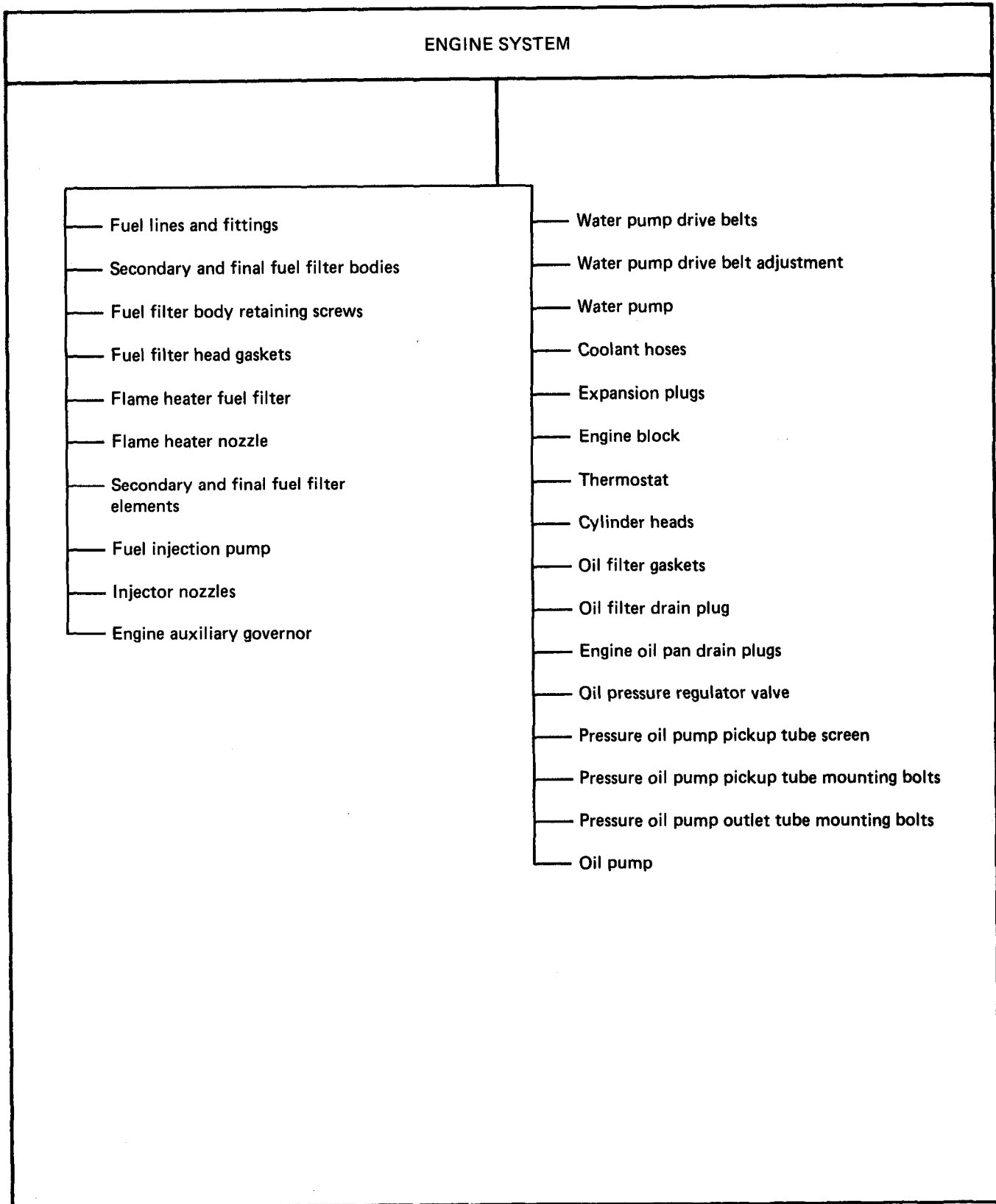
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TROUBLESHOOTING ROADMAP

5-1. GENERAL. This chapter gives a troubleshooting roadmap for the engine for which you have detailed troubleshooting procedures. Figure 5-1 covers the roadmap for the detailed procedures.

5-2. ROADMAP . The roadmap gives a list of things which are most likely to cause a fault symptom in a system or subsystem. At least one of the items listed will be found to be bad when you do the detailed troubleshooting procedures for that system.





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Figure 5-1. Troubleshooting Roadmap, Engine System

CHAPTER 6

FAULT SYMPTOM INDEX

6-1. GENERAL. This chapter gives a troubleshooting fault symptom index for every system of the engine for which you have detailed troubleshooting procedures. The index is in table form (table 6-1) which gives you a quick way to check what material you have to use to do your troubleshooting.

6-2. INDEX. The index is divided into columns which give you information you need to help you do troubleshooting procedures. The following breakdown tells you what is in each column.

- a. Subsystem Column. If the main system is divided into subsystems, the subsystems will be listed in this column.
- b. Symptom Column. This column lists the symptoms, or problems for which detailed troubleshooting procedures are given.
- c. Summary Column. This column tells you where to find the summary troubleshooting procedures for each symptom.
- d. Detailed Column. This column tells you where to find the detailed troubleshooting procedure for each symptom.
- e. Persons Column. This column tells you how many people are needed to do the troubleshooting procedure.
- f. Special Tools Column. Any tools needed to do the troubleshooting procedure which are not included in your common tool kit are listed in this column.
- g. Standard Tools Column. A dot in this column means that tools found in your common tool kit are needed to do the troubleshooting procedure.
- h. Materials Column. This column tells you what materials are needed to do the troubleshooting procedure. These materials and how they will be issued will be decided by your maintenance officer.
- i. Time Column. This column tells you how much time you will need to do the detailed troubleshooting procedure. The time will be decided by your maintenance officer.

FAULT SYMPTOM INDEX

TABLE 6-1. ENGINE SYSTEM								
SUBSYSTEM	SYMPTOM	TS PROCEDURE		RESOURCES REQ'D				
		SUMMARY	DETAILED	PERSONS	TEST EQUIPMENT		MATERIALS	TIME
					SPECIAL TOOLS	STANDARD TOOLS		
_____	1. Engine cranks but does not start	_____	Figure 8-1	2	_____	•		
_____	2. Engine runs too fast	_____	Figure 8-2	1	_____	•		
_____	3. Water temperature gage reads above 200°F while running	_____	Figure 8-3	1	_____	•		
_____	4. Low oil pressure	_____	Figure 8-4	1	_____	•		
_____	5. Engine lacks power	_____	Figure 8-5	1	_____	•		

CHAPTER 7

SAMPLE TROUBLESHOOTING PROCEDURE

7-1. GENERAL. This chapter gives a sample troubleshooting procedure. The purpose of the sample procedure is to help you see how detailed troubleshooting procedures, test equipment procedures, and summary troubleshooting procedures are used to find faults in a system.

7-2. SAMPLE DETAILED PROCEDURE. (See figure 7-1.) The sample detailed procedure given is the fuel system troubleshooting procedure for the symptom, STARTER MOTOR WILL NOT CRANK ENGINE. This symptom is one you will have when you try to start your truck and certain parts on the truck are not working correctly. In each numbered box, instructions are given which tell you what to do, and how to do it. A large dot is placed next to the "what-to-do" instructions, and small dots next to the "how-to-do-it" instructions.

a. Box number ① gives general instructions on getting the engine ready before you start to troubleshoot.

b. Box number ② gives fault isolation test instructions. In this case you are told to check starting system circuit for loose, burned, or broken leads and connections. These tests or checks are often referred to in detailed troubleshooting procedures to help you find the problem and fix it. After you do the tests or checks you read the question at the bottom of box number ②. If the starter system is not okay, the answer to the question is (NO), so you go to the next box.

c. Box number ③ gives you a corrective action. In this case the fault is burned or broken leads or connectors. The corrective action is what you do to fix the fault, which is to replace any burned or broken leads or connectors. If the engine still doesn't start after you do this, it could mean that there are other faults in the system. When this happens, go back to the beginning of the procedure and do each step again until you find the other faults.

d. Sometimes the corrective actions given for a fault will tell you what to do to fix the fault, but will not give you detailed instructions on how to fix it. Instead, you will be told to refer to another volume in this manual for these instructions. Box number ④ is an example of this.

Symptom

STARTER MOTOR WILL NOT CRANK ENGINE

FAULT SYMPTOM

NOTE
 Two soldiers are needed for some starter system check, and are noted as Soldier A and Soldier B
 When measuring voltage++24 volts DC, means a range of +23 to +26 volts DC

1

● Mount engine in test stand
 ● Refer to Vol 2, chapter 6, para 6-3

GENERAL INSTRUCTION

2

● Check starting system circuit for loose, burned or broken leads and connectors
 ● Refer to Vol 2, chapter 6, para 6-4
 OK?

WHAT TO DO

HOW TO DO IT

QUESTION

CORRECTIVE ACTION
 WHAT TO DO

3

NO

● Replace any burned or broken leads or connectors
 ● Refer to Vol 2, chapter 6, para 6-4

4

YES

● Replace starter
 ● Refer to Vol 2, chapter 5, para 5-39

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Figure 7-1. Sample Troubleshooting Procedure

CHAPTER 8

ENGINE SYSTEM TROUBLESHOOTING

8-1. EQUIPMENT ITEMS COVERED. This chapter gives equipment troubleshooting procedures for the engine system, for which there are authorized corrective maintenance tasks at the direct support and general support maintenance levels.

8-2. EQUIPMENT ITEMS NOT COVERED. All equipment items for which corrective maintenance is authorized at the direct support and general support maintenance levels are covered in this chapter.



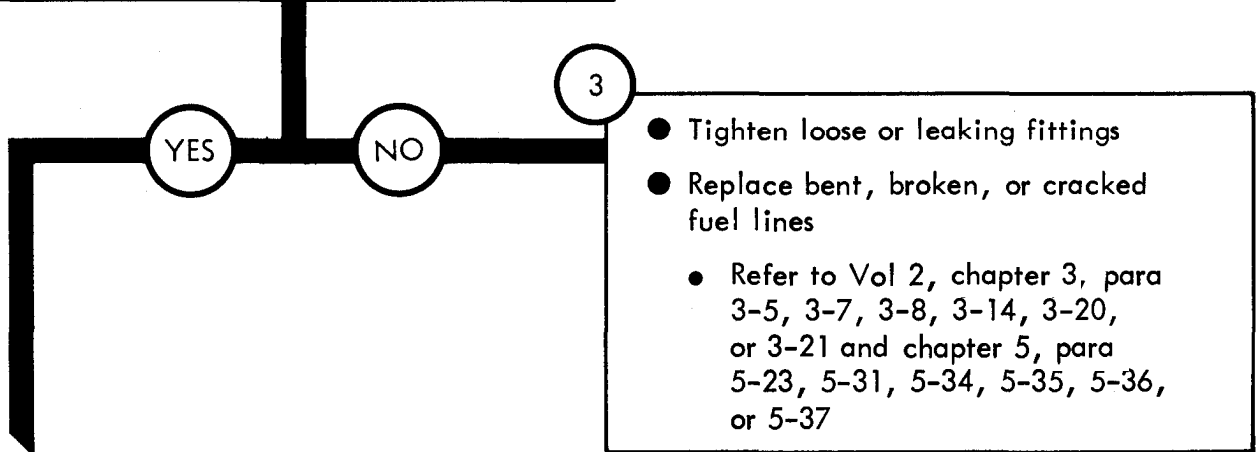
Symptom

1 ENGINE CRANKS BUT DOES NOT START

WARNING
 Diesel fuel is very flammable. Care must be used when choosing a place to work on fuel system. Keep engine about 50 feet away from an area where open flame, sparks, or smoking may cause a fire. Keep a fire extinguisher close by

- 1
- Mount engine in test stand
 - Refer to Vol 2, chapter 6, para 6-3

- 2
- Check all fuel lines and fittings
 - Look for a crushed or broken line. See figure 9-1, 9-2, 9-3, or 9-4
 - Look for signs of fuel leaking from lines or fittings
 - Feel for loose fittings
- Are all fuel lines and fittings OK?



- 3
- Tighten loose or leaking fittings
 - Replace bent, broken, or cracked fuel lines
 - Refer to Vol 2, chapter 3, para 3-5, 3-7, 3-8, 3-14, 3-20, or 3-21 and chapter 5, para 5-23, 5-31, 5-34, 5-35, 5-36, or 5-37

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Figure 8-1 (sheet 1 of 7)

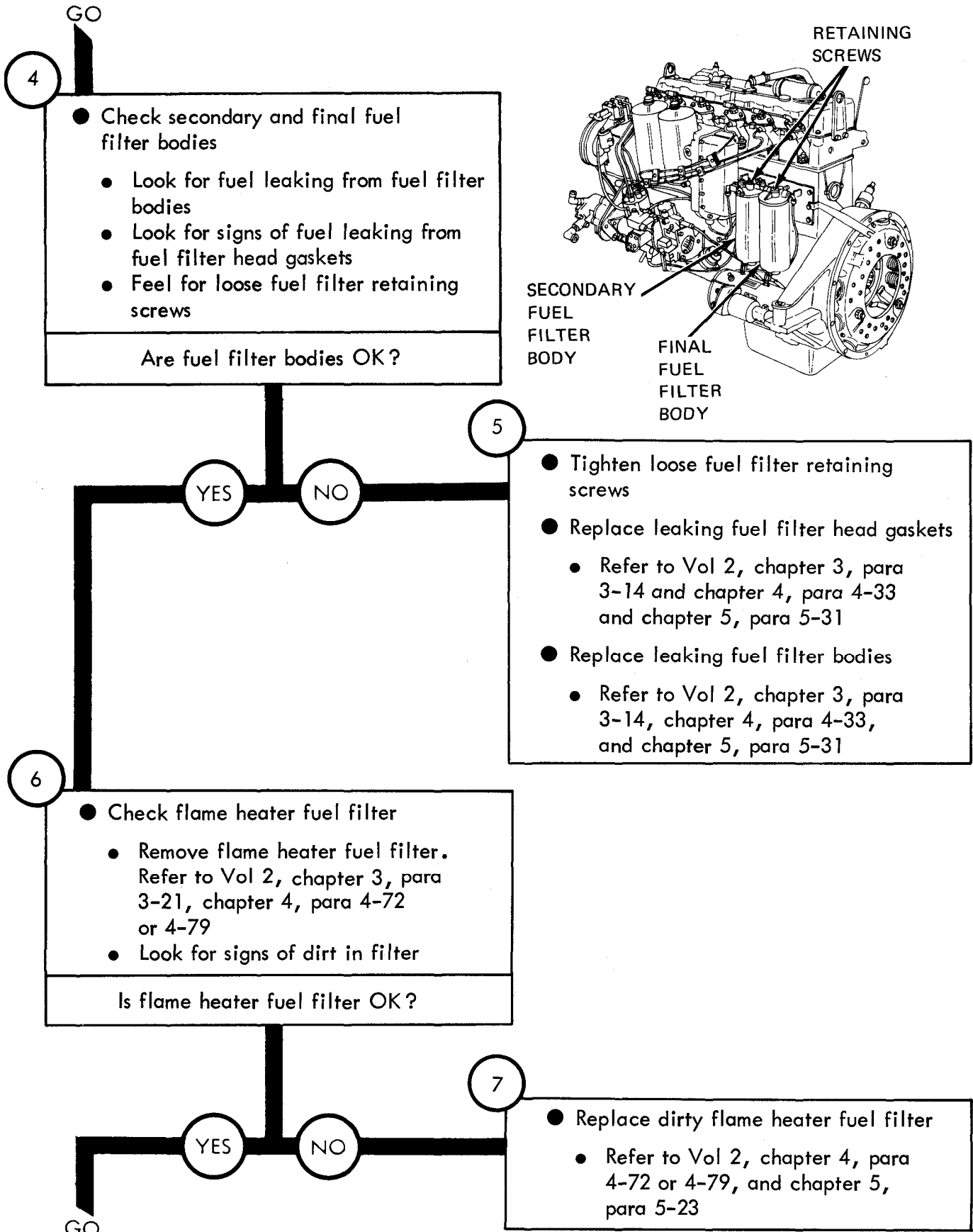


Figure 8-1 (sheet 2 of 7)

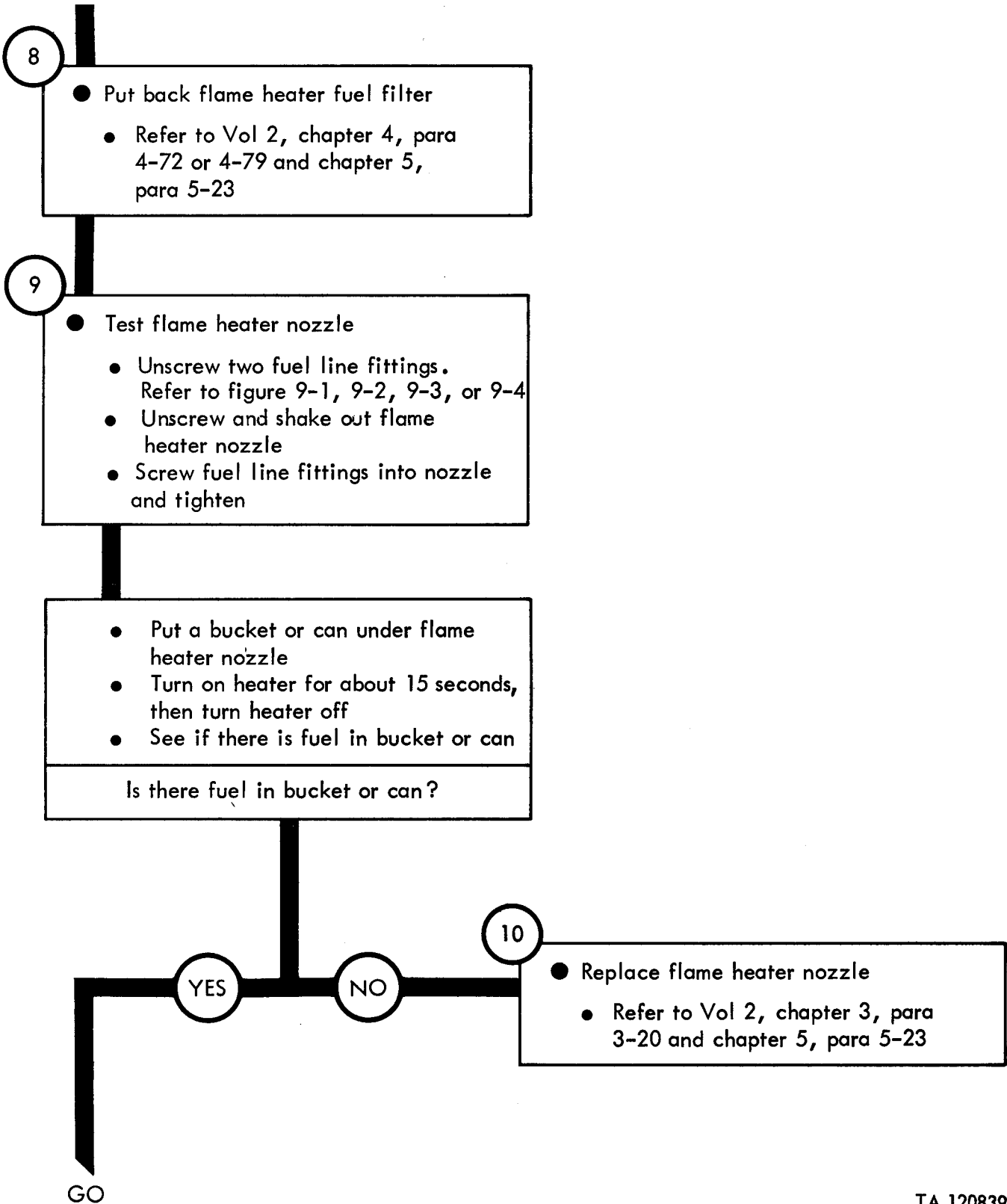


Figure 8-1 (Sheet 3 of 7)

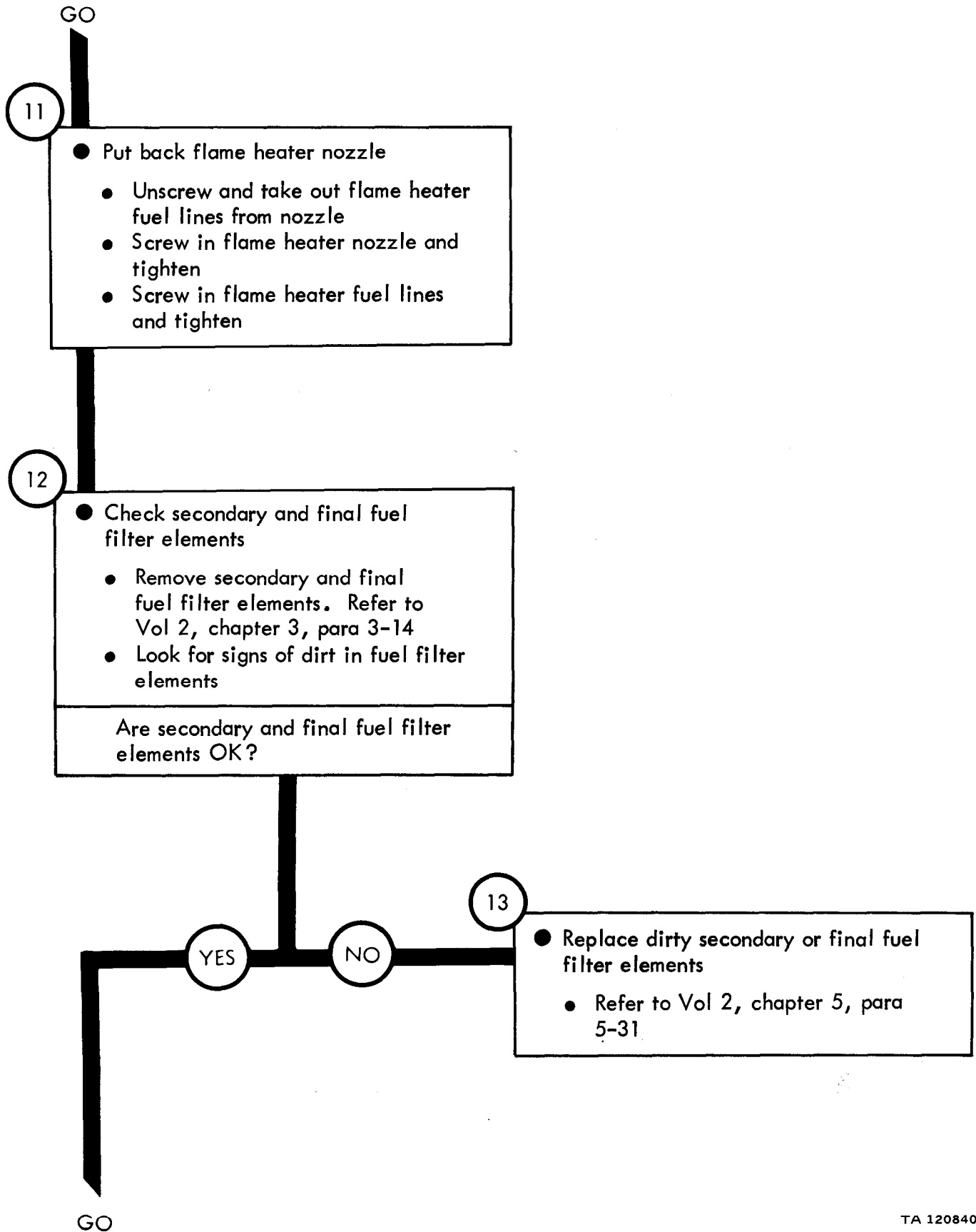


Figure 8-1 (Sheet 4 of 7)

GO

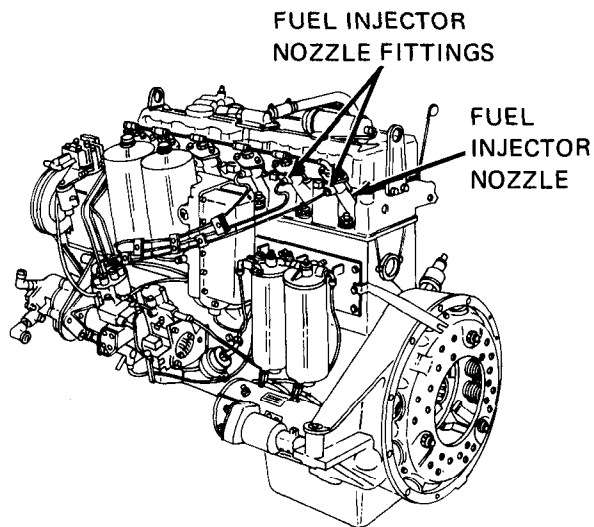
NOTE

The following procedure will need the use of two soldiers. The lead soldier will be called Soldier A. The helper will be called Soldier B

14

- Check for fuel supply from fuel injection pump
 - SOLDIER A: Loosen one fuel injector nozzle fitting but do not take it off
 - SOLDIER B: Crank engine for 5 seconds. Refer to Vol 2, chapter 6, para 6-6
 - SOLDIER A: See if fuel comes out of fuel injector nozzle fitting

Does fuel come out of fitting?



15

- Replace fuel injection pump
 - Refer to Vol 2, chapter 3, para 3-10, and chapter 5, para 5-33

YES

NO

16

- Take out all six injector nozzles
 - Refer to Vol 2, chapter 3, para 3-18
- Clean, inspect and repair all six injector nozzles
 - Refer to Vol 2, chapter 4, para 4-40

Are injector nozzles OK?

GO

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Figure 8-1 (Sheet 5 of 7)

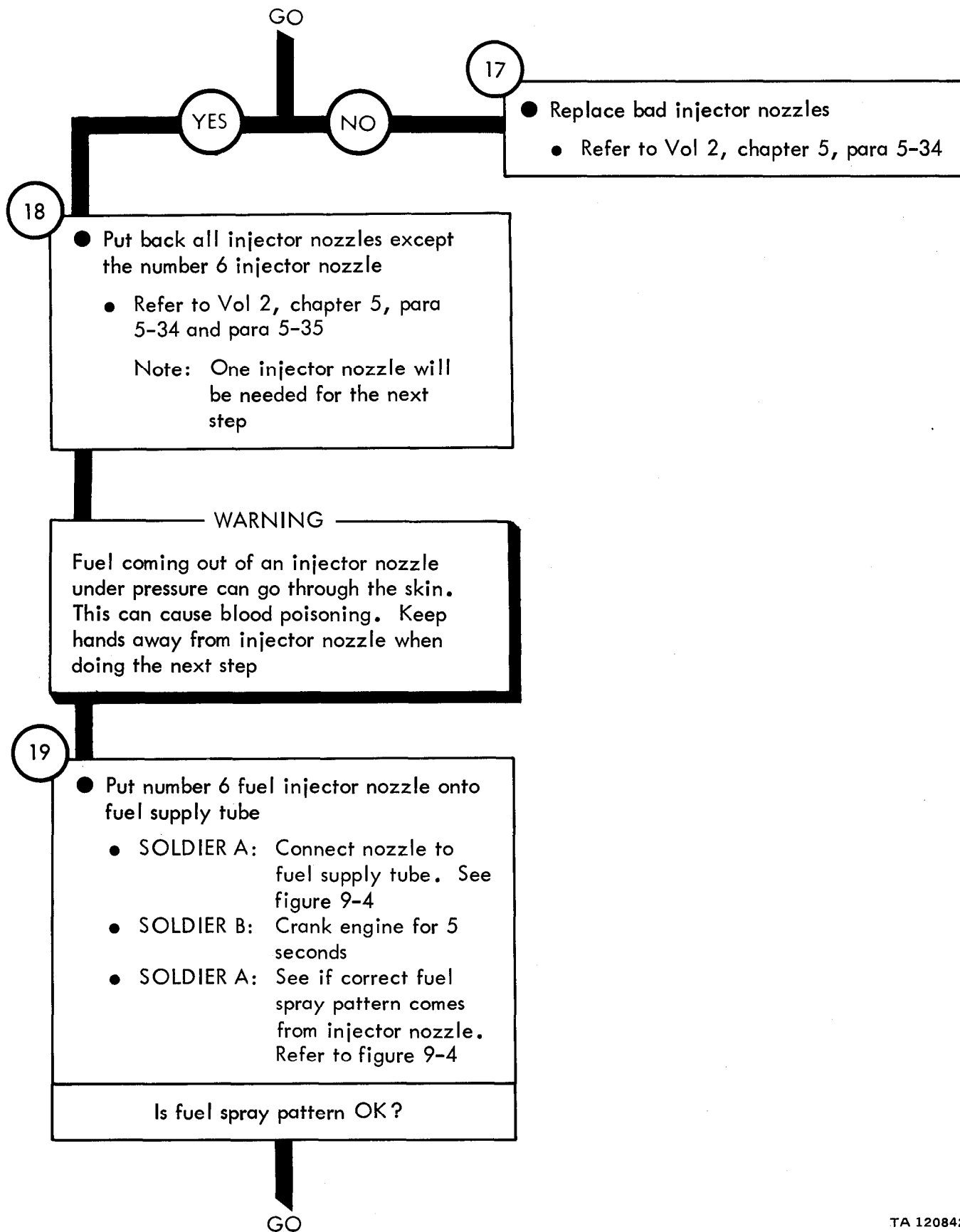


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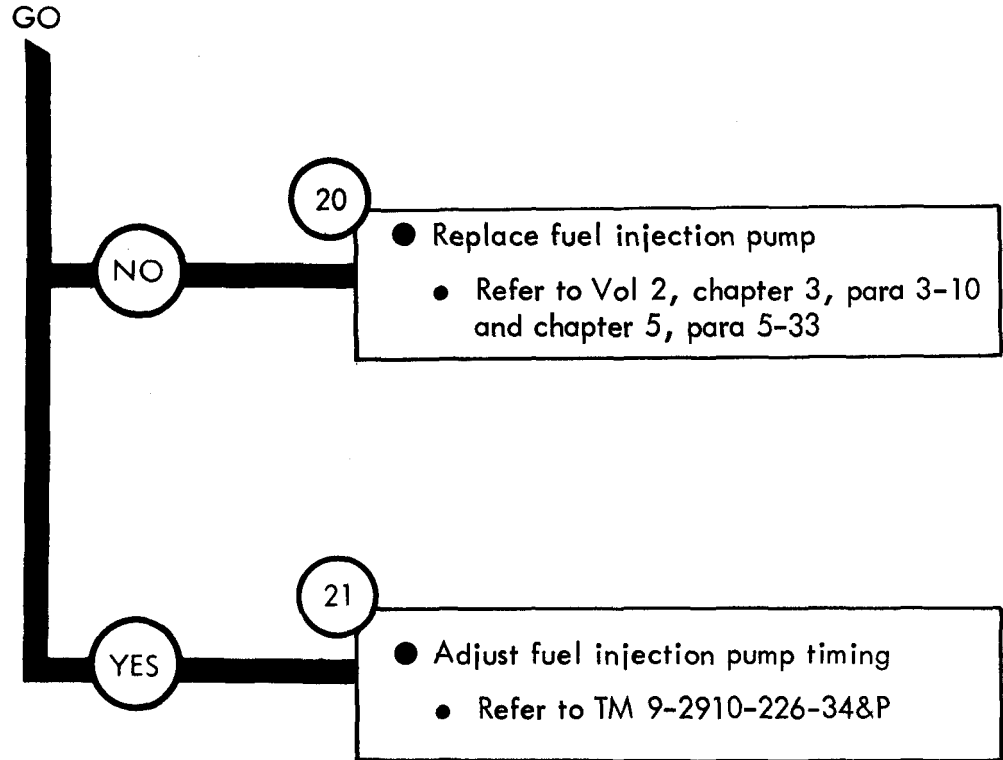
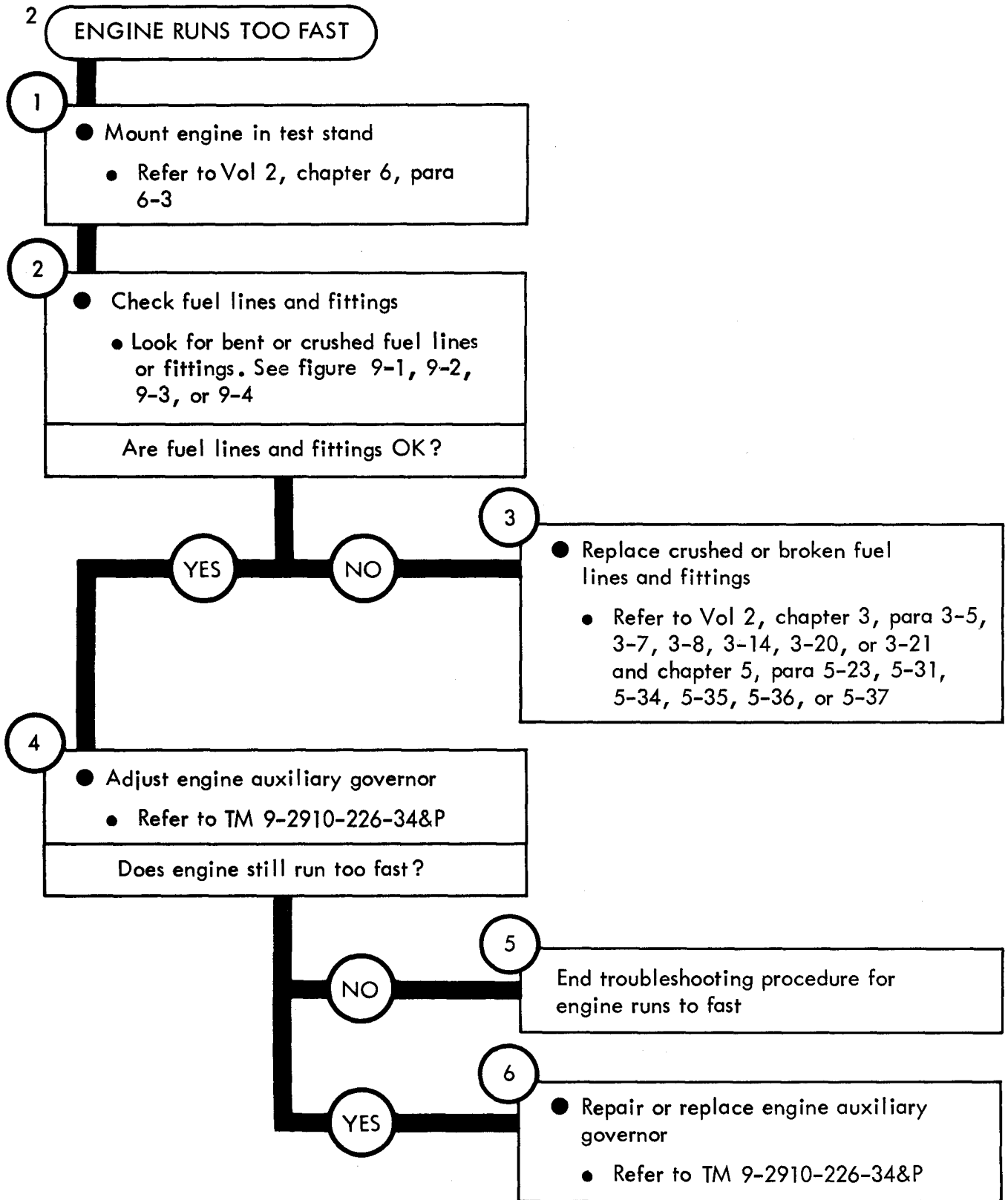


Figure 8-1 (Sheet 7 of 7)

Symptom



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Figure 8-2

Symptom

3 WATER TEMPERATURE GAGE READS ABOVE 200°F WHILE RUNNING

1

- Mount engine in test stand
 - Refer to Vol 2, chapter 6, para 6-3

2

- Check water pump drive belts
 - Look for broken belts
 - Check water pump drive belt adjustment
 - Refer to TM 9-2320-209-20 or TM 9-2320-211-20

Are water pump drive belt OK?

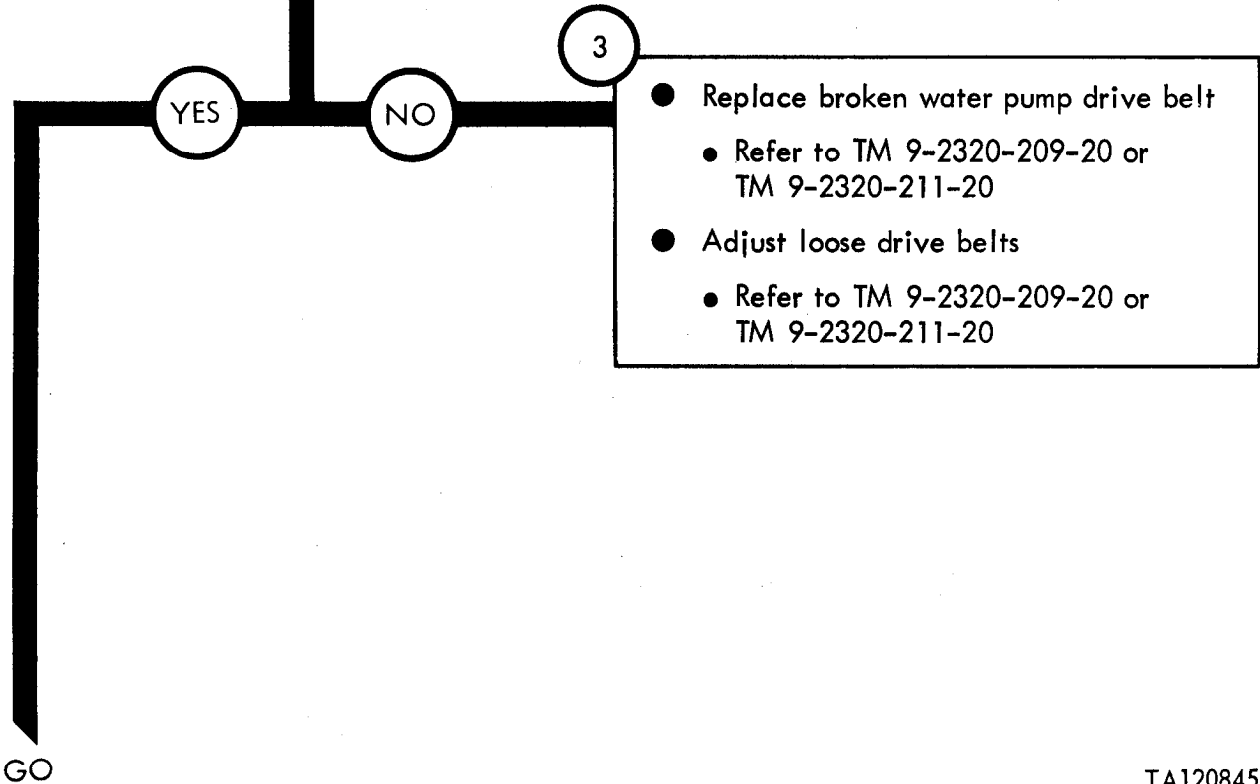
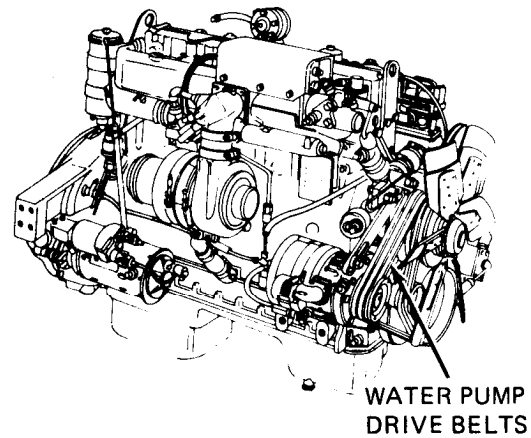
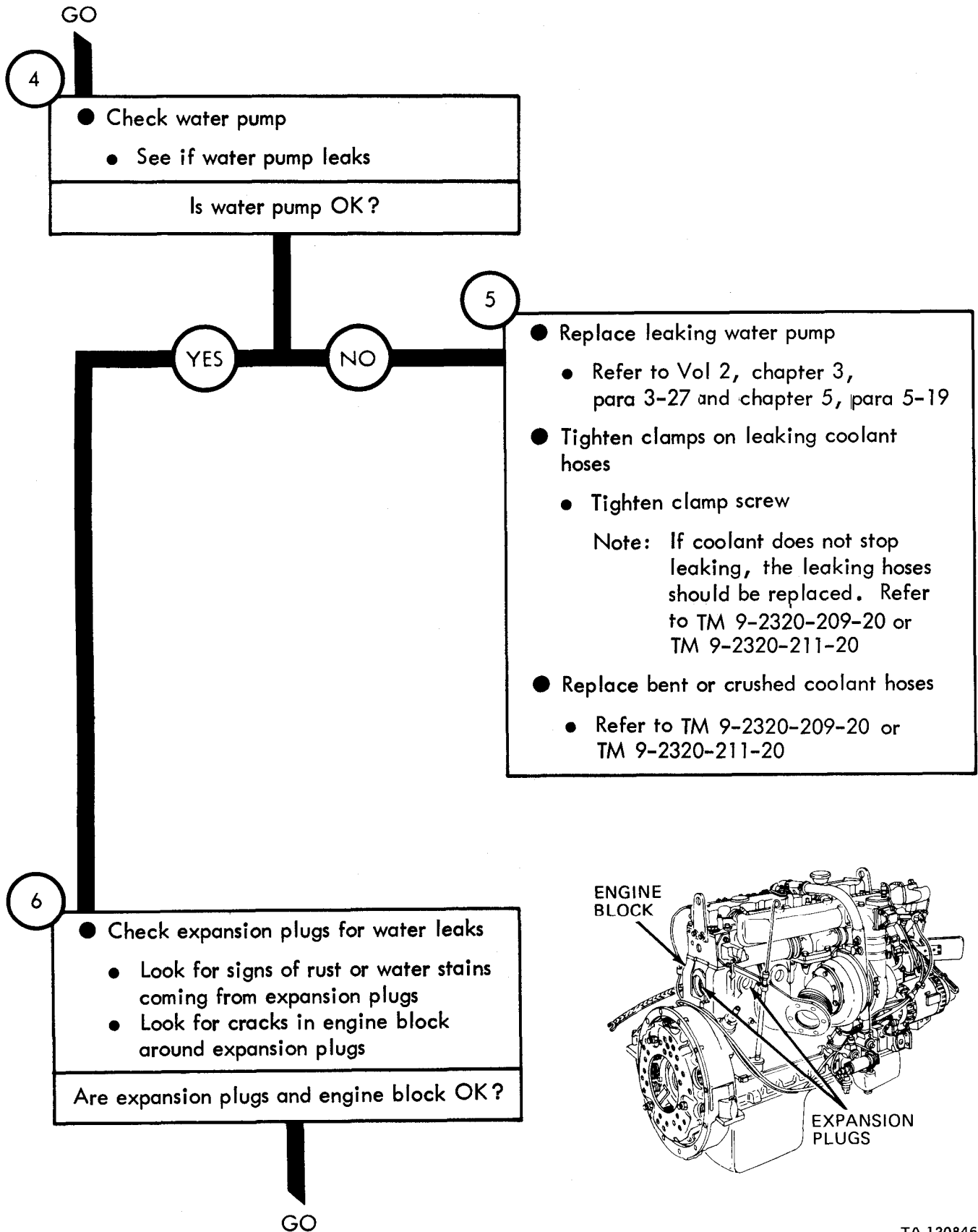
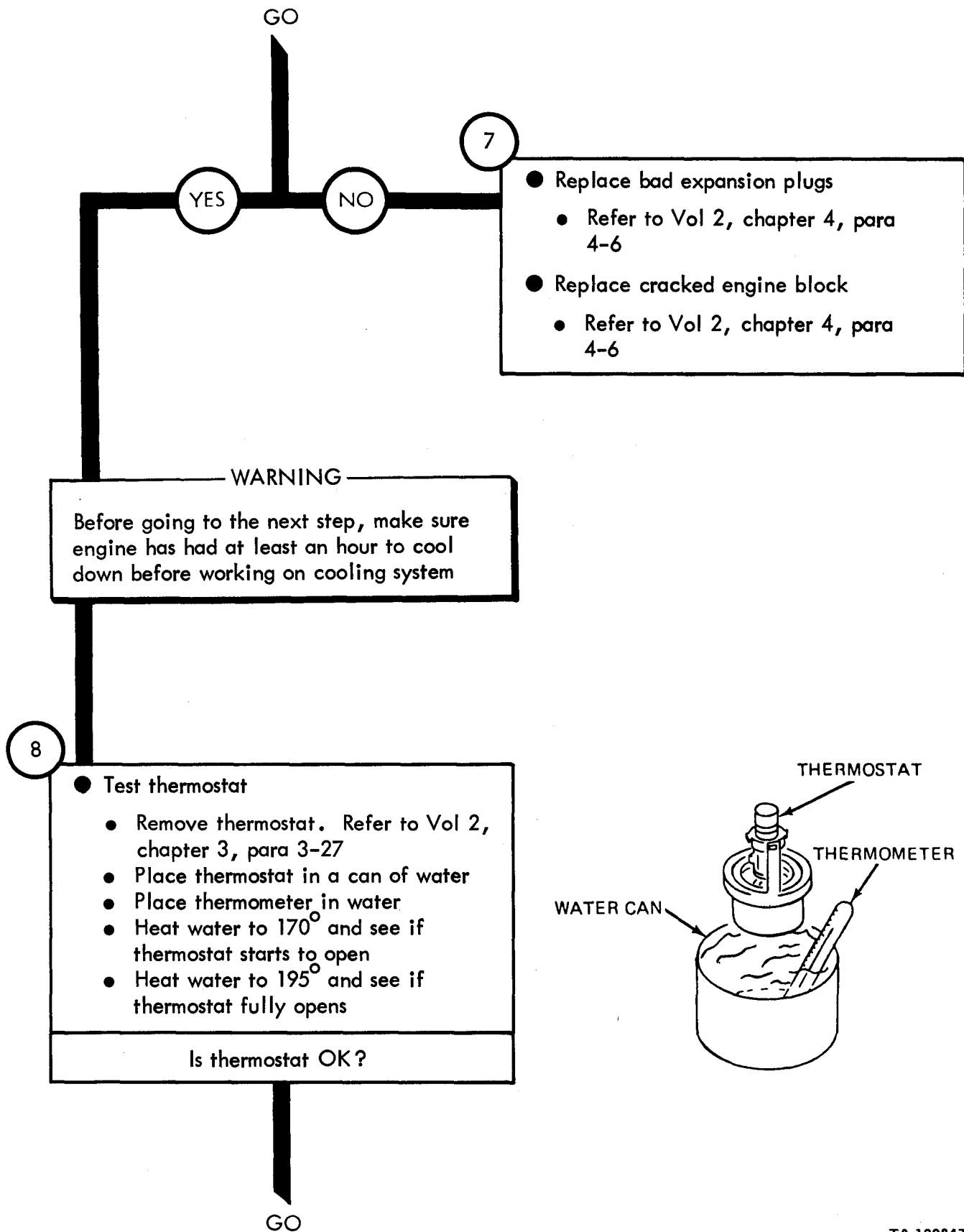


Figure 8-3 (Sheet 1 of 4)



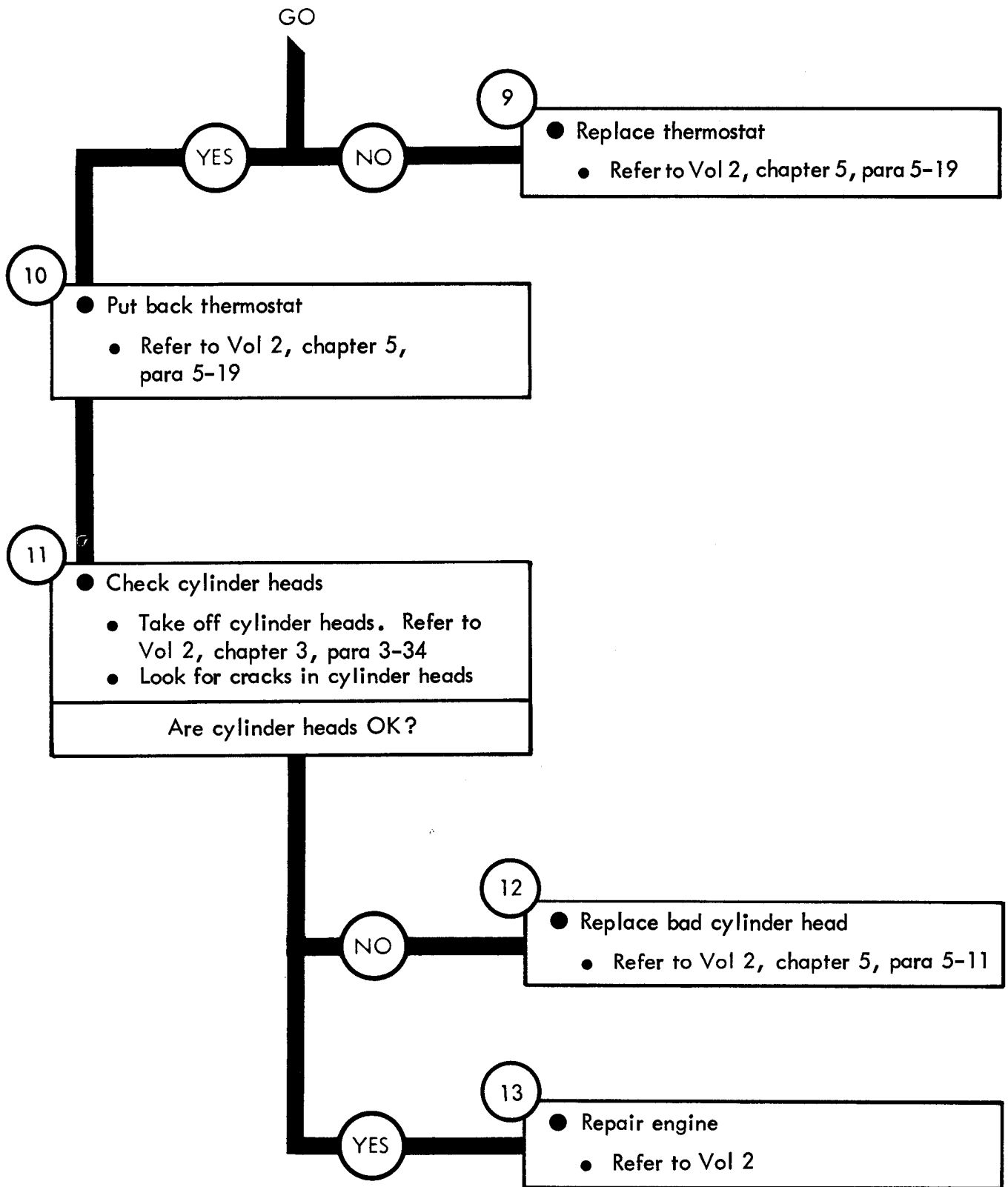
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Figure 8-3 (Sheet 2 of 4)



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Figure 8-3 (Sheet 3 of 4)



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Figure 8-3 (Sheet 4 of 4)

Symptom

4 **LOW OIL PRESSURE**

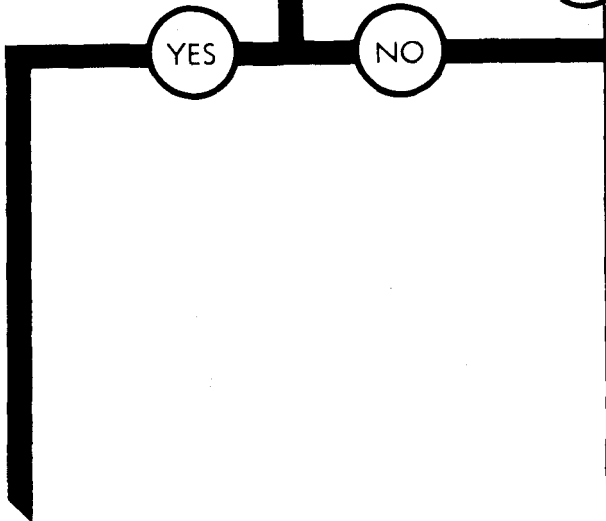
1

- Mount engine in test stand
 - Refer to Vol 2, chapter 6, para 6-3

2

- Check oil filter gaskets
 - Look for signs of oil leaks at bottom of oil filter body
 - Feel for loose center bolt
- Check oil filter drain plug
 - Look for signs of oil leaking from drain plug

Are oil filter gaskets and oil filter drain plug OK?



3

- Tighten loose oil filter center bolt
 - Tighten center bolt to 60 pound-feet
- Tighten loose oil filter drain plug
 - Refer to Vol 2, chapter 5, para 5-28

Note: If oil should still leak at bottom of oil filter body replace oil filter gasket. Refer to Vol 2, chapter 3, para 3-11 and chapter 5, para 5-28

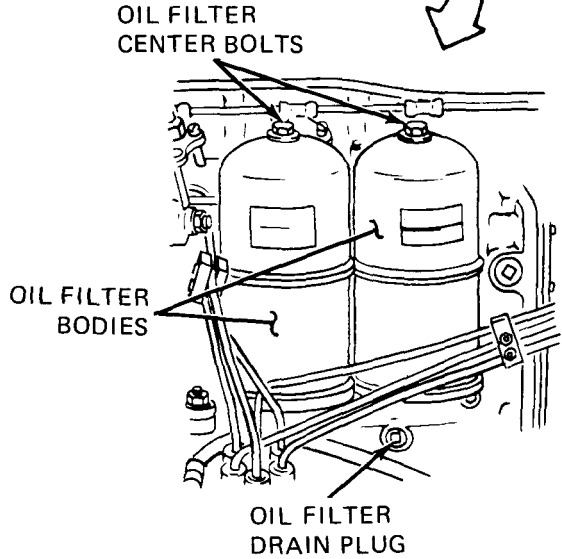
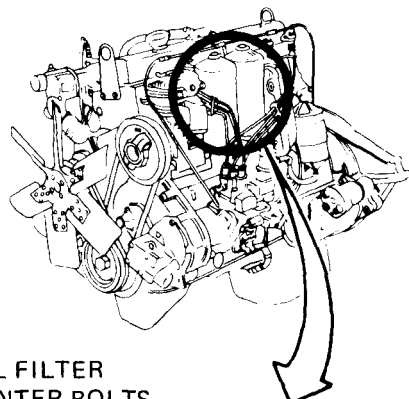


Figure 8-4 (Sheet 1 Of 5)

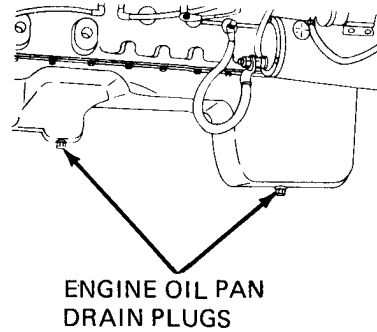
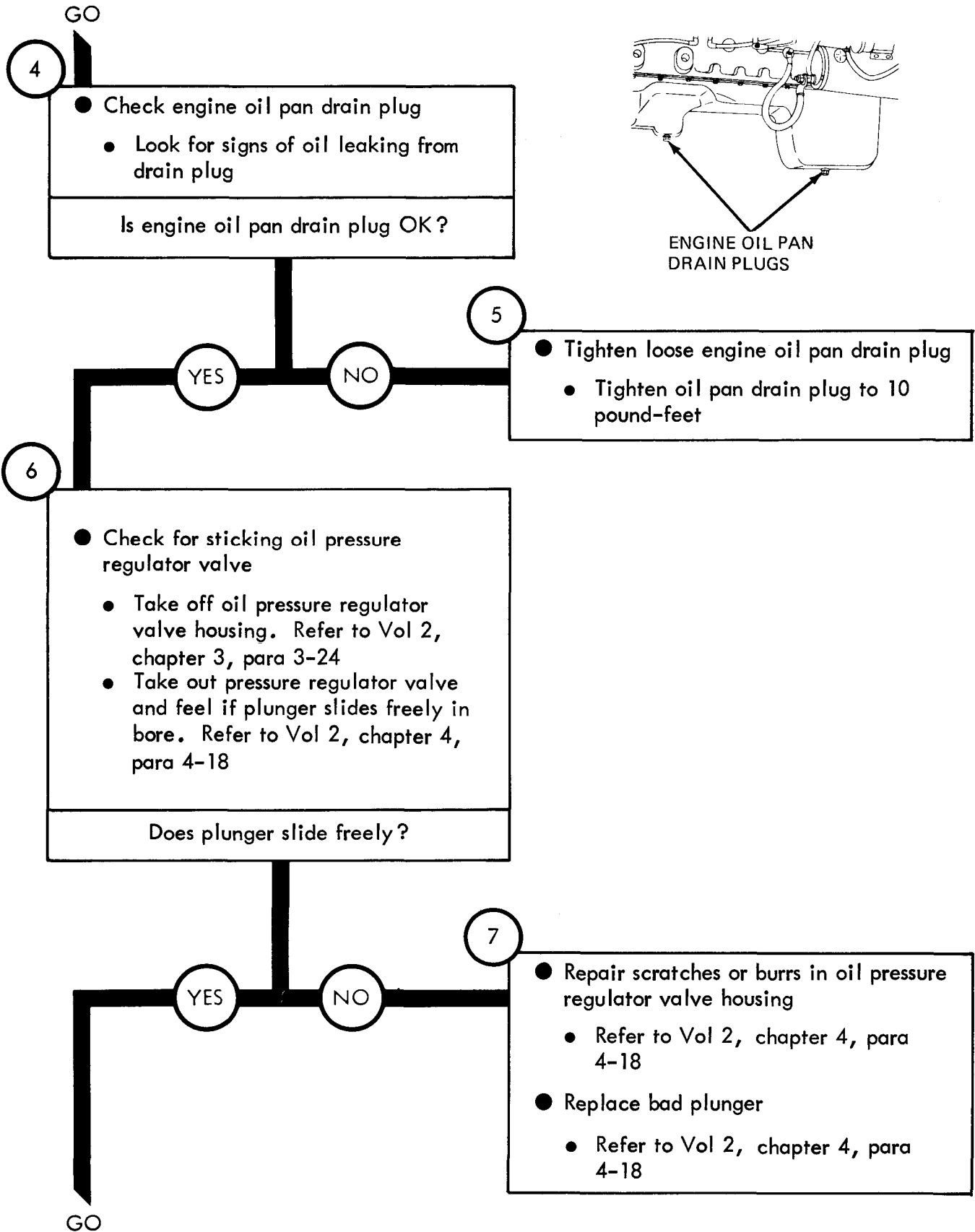
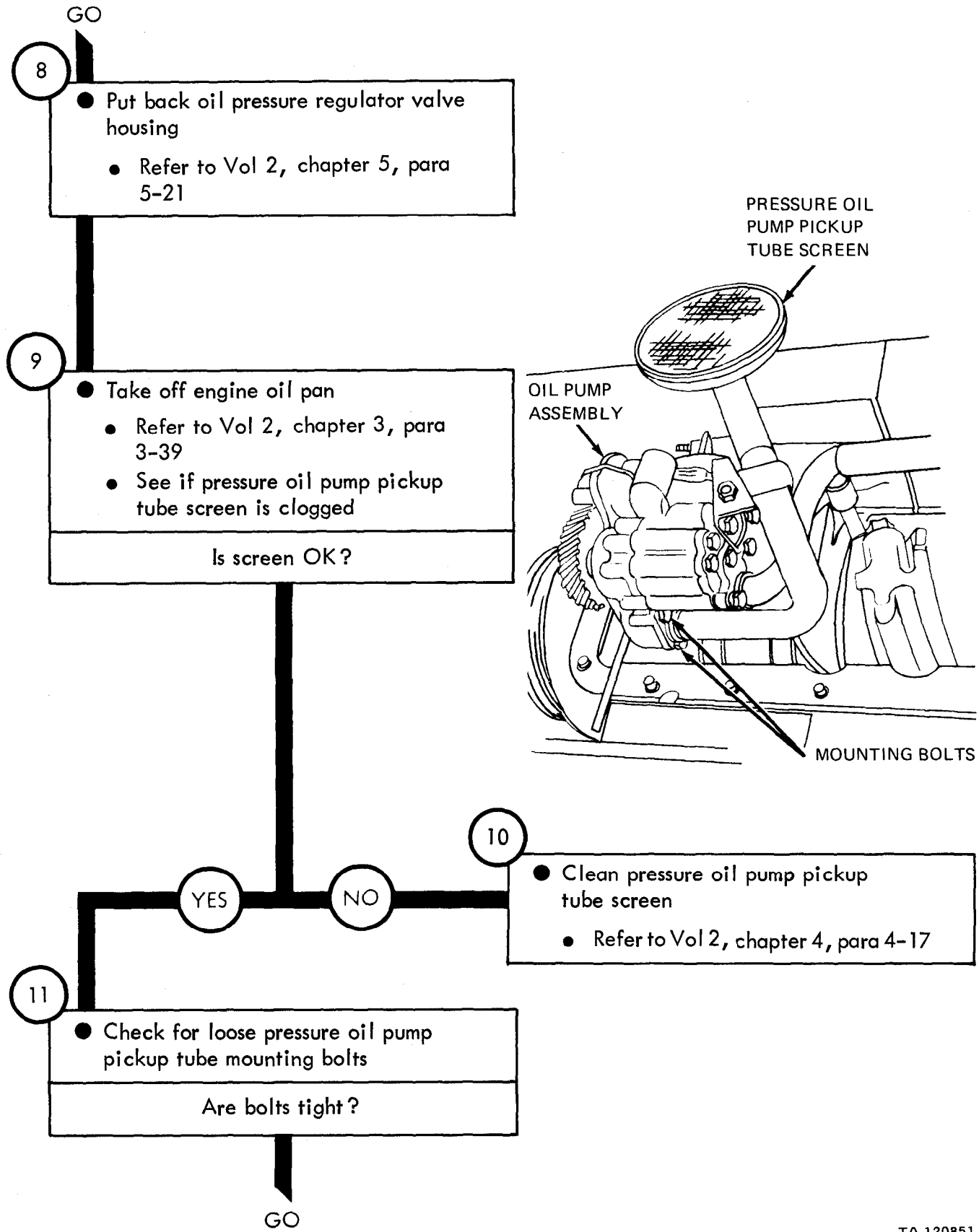


Figure 8-4 (Sheet 2 of 5)

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Figure 8-4 (Sheet 3 of 5)

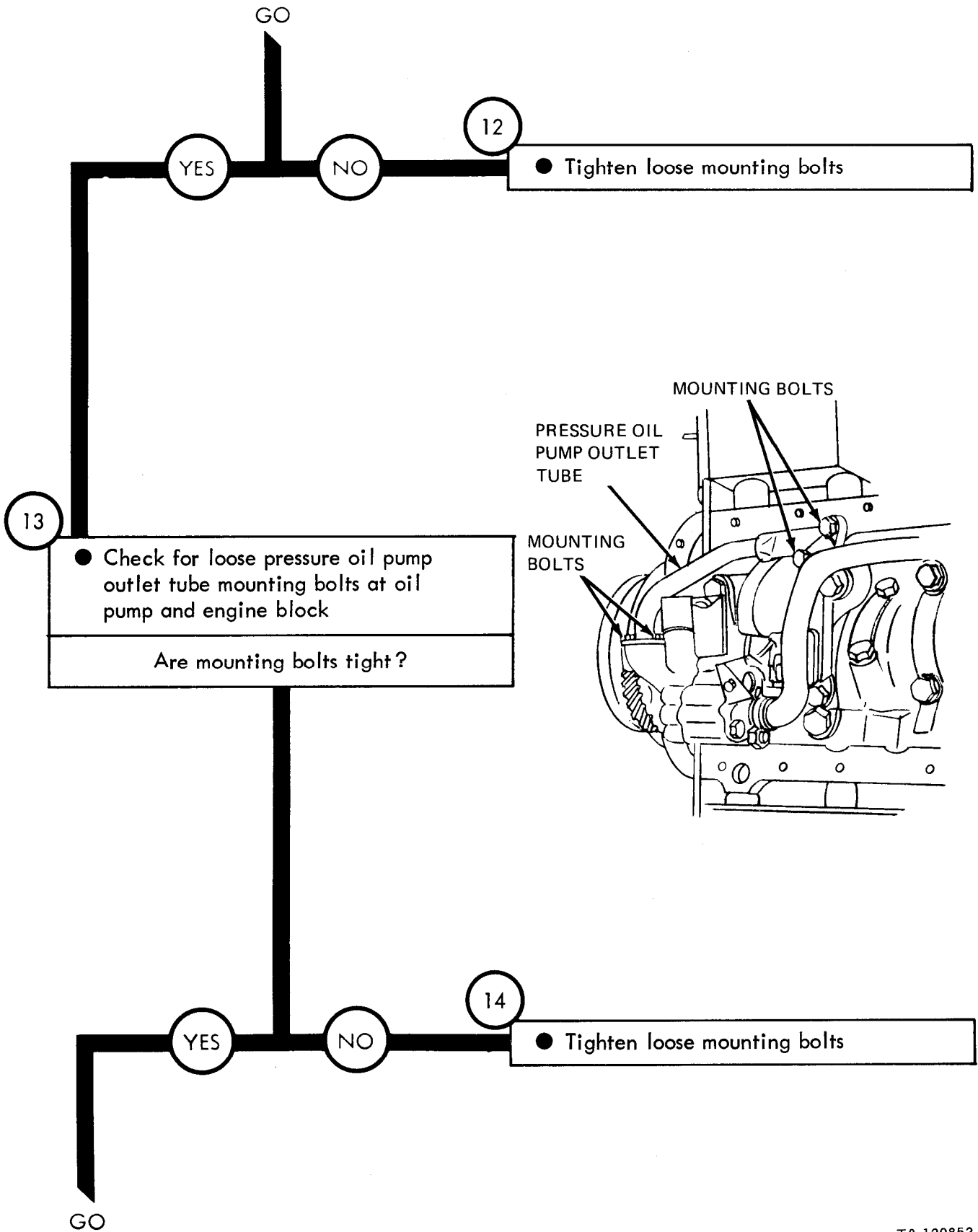


Figure 8-4 (Sheet 4 of 5)

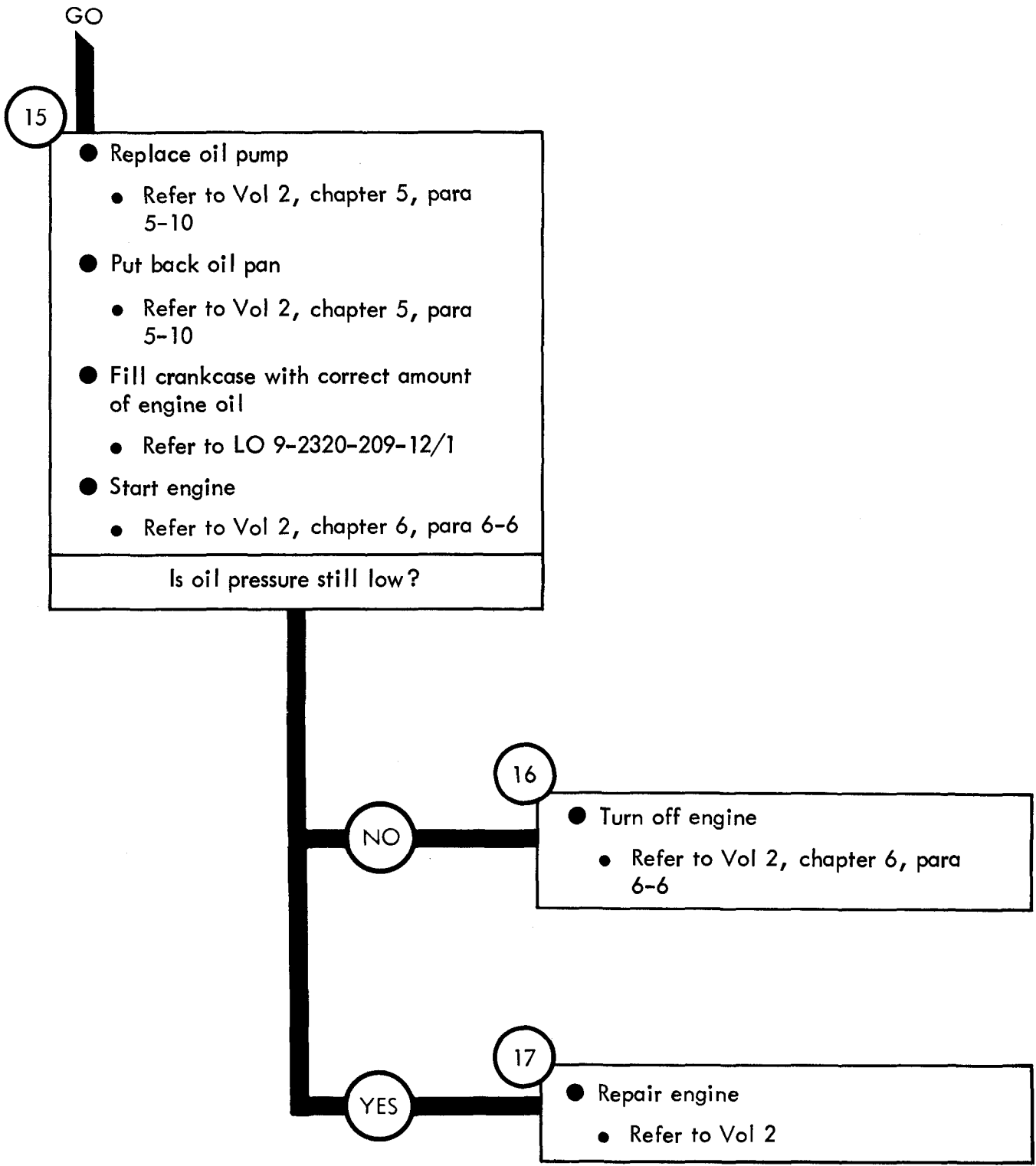


Figure 8-4 (Sheet 5 of 5)

Symptom

5

ENGINE LACKS POWER

WARNING

Diesel fuel is very flammable. Care must be used when choosing a place to work on fuel system. Keep engine about 50 feet away from an area where open flame, sparks, or smoking may cause a fire. Keep a fire extinguisher close by

1

- Mount engine in test stand
 - Refer to Vol 2, chapter 6, para 6-3

2

- Check secondary and final fuel filter bodies
 - Look for fuel leaking from fuel filter bodies
 - Look for signs of fuel leaking from fuel filter head gasket
 - Feel for loose retaining screw

Are fuel filter bodies OK?

YES

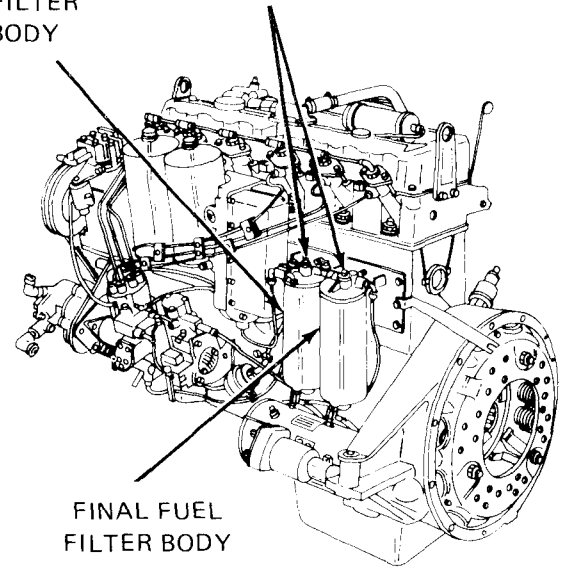
NO

GO

3

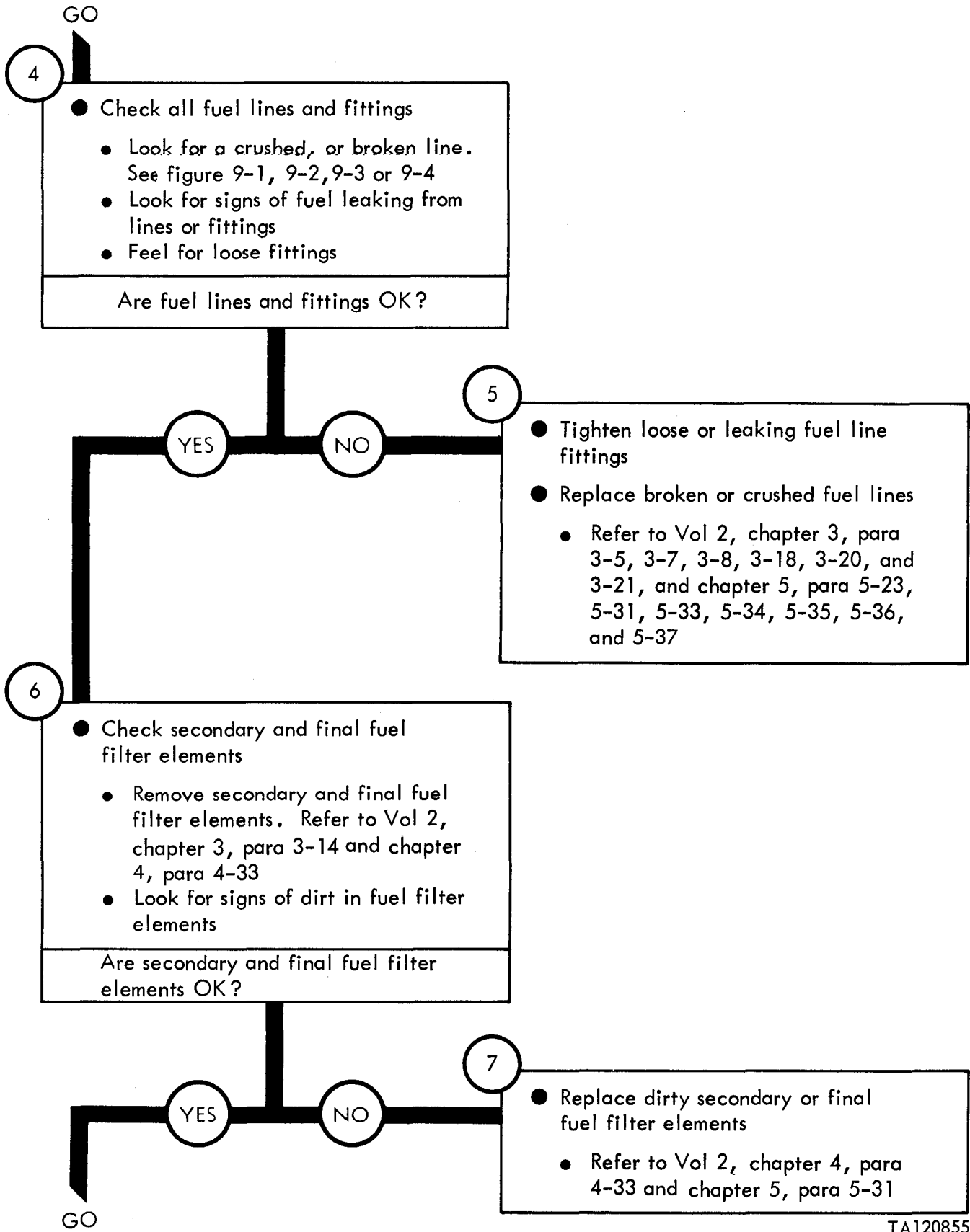
- Tighten fuel filter bodies
 - Tighten retaining screws
- Replace leaking fuel filter head gaskets
 - Refer to Vol 2, chapter 3, para 3-14 and chapter 4, para 4-33 and chapter 5, para 5-31
- Replace cracked or broken fuel filter bodies
 - Refer to Vol 2, chapter 3, para 3-14, chapter 4, para 4-33, chapter 5, para 5-31

SECONDARY FUEL FILTER BODY RETAINING SCREWS



FINAL FUEL FILTER BODY

Figure 8-5 (Sheet 1 of 3)



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Figure 8-5 (Sheet 2 of 3)

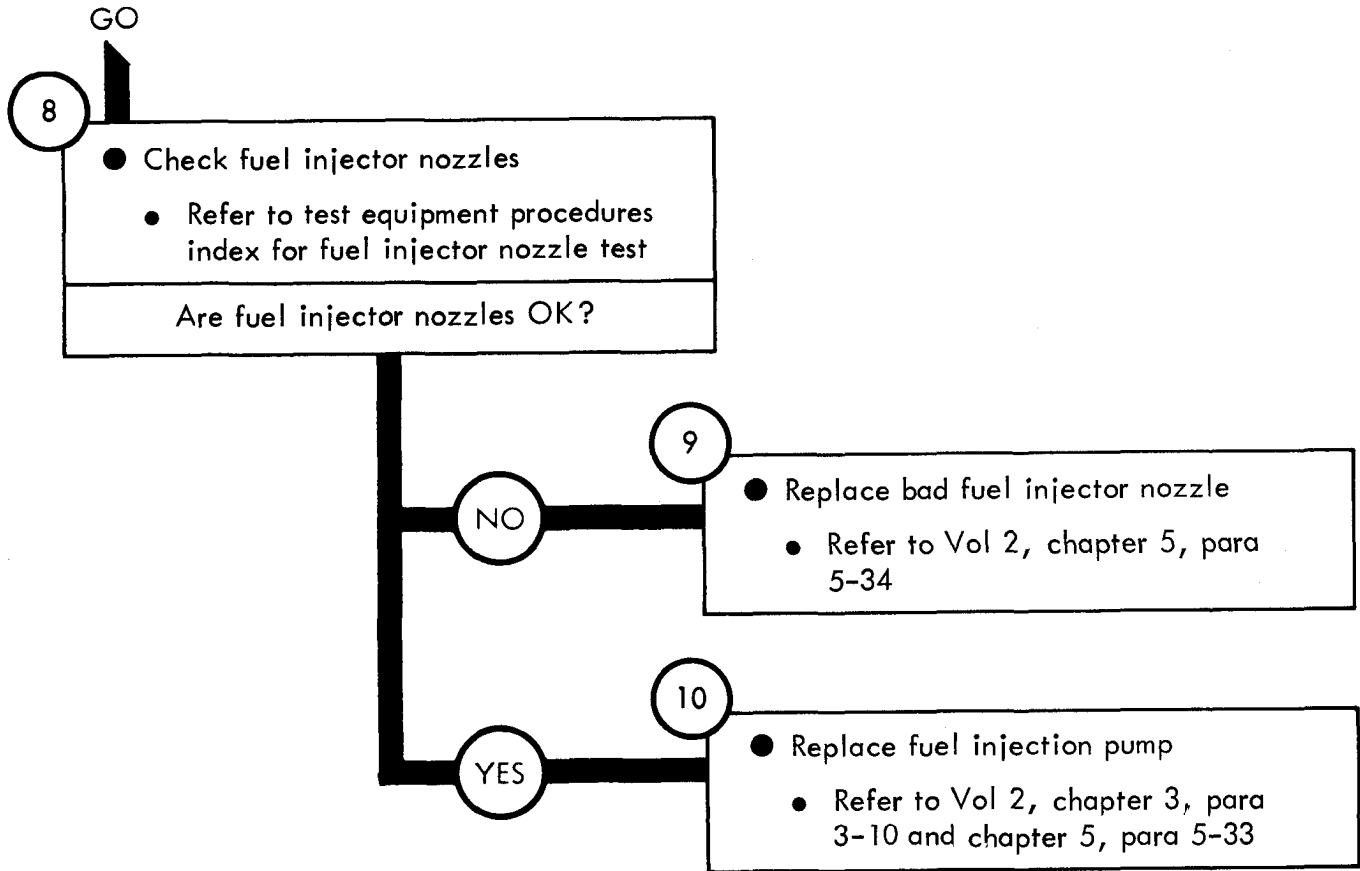
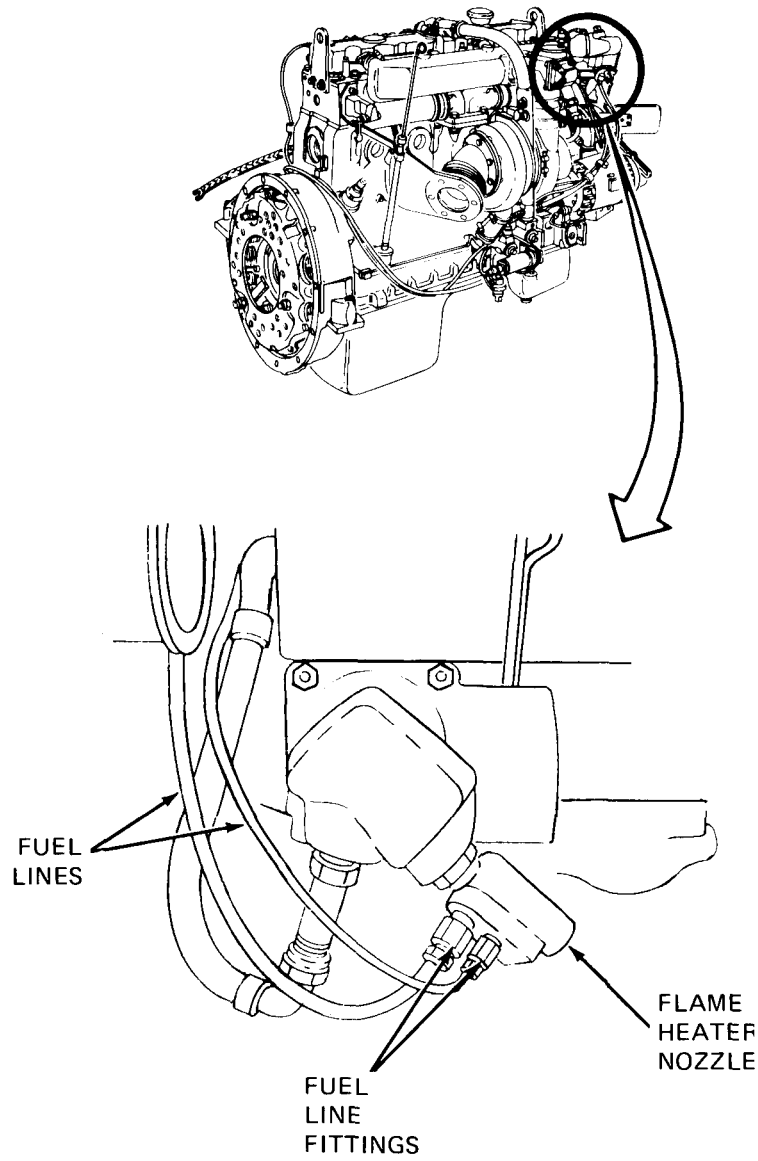


Figure 8-5 (Sheet 3 of 3)

CHAPTER 9

ENGINE SYSTEM SUPPORT DIAGRAMS

9-1.GENERAL. This chapter gives the diagrams you need when doing troubleshooting procedures in chapter 8. Figure 3-1 is a complete listing of all support diagrams used in this manual.



TA 120857

Figure 9-1. Flame Heater Nozzle, Fuel Lines, and Fittings for LD-465-1 and LD-465-1C

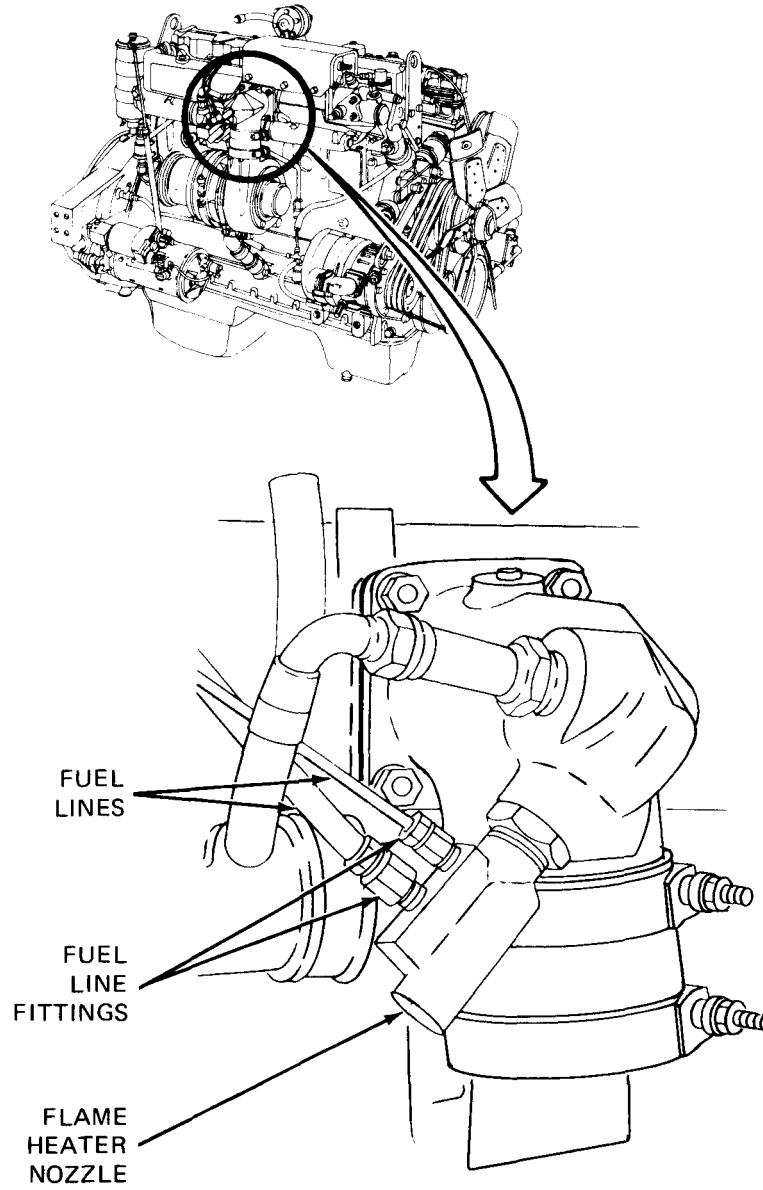


Figure 9-2. Flame Heater Nozzle, Fuel Lines, and Fittings for LDS-465-1, LDS-465-1A and LDS-465-2

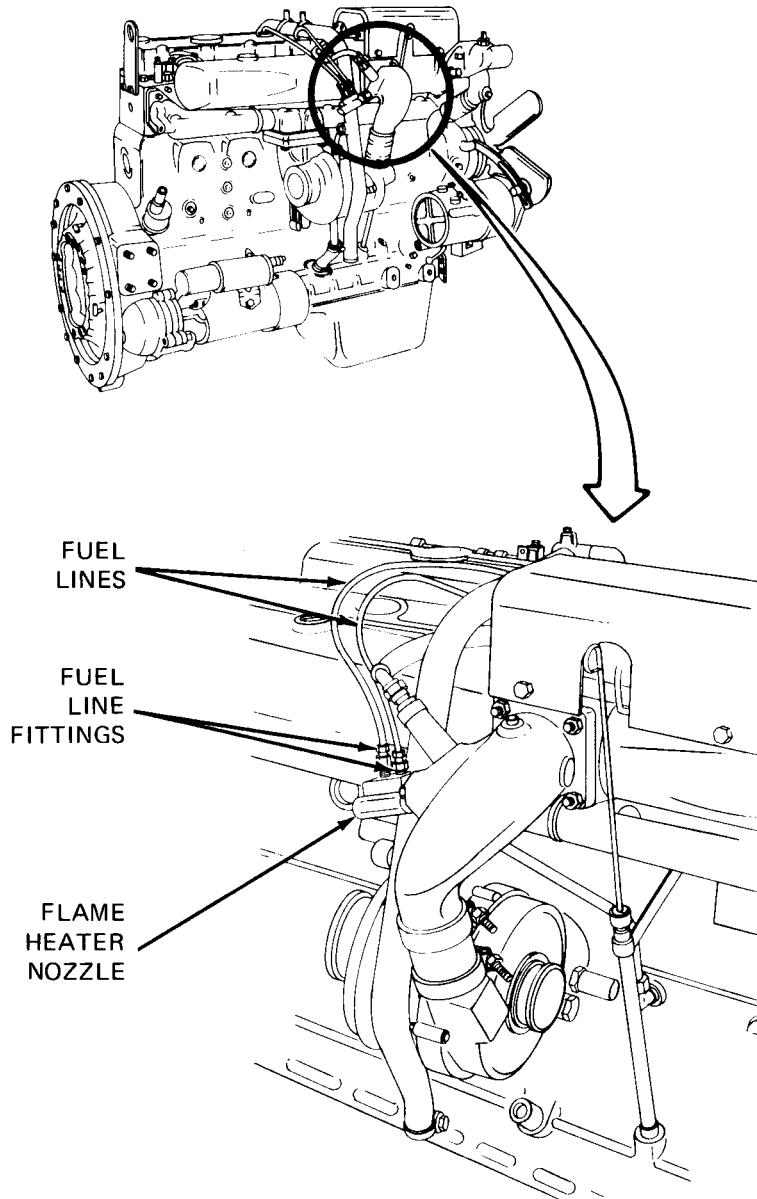


FIGURE 9-3. Flame Heater Nozzle, Fuel Lines, and Fittings for LDT-465-1

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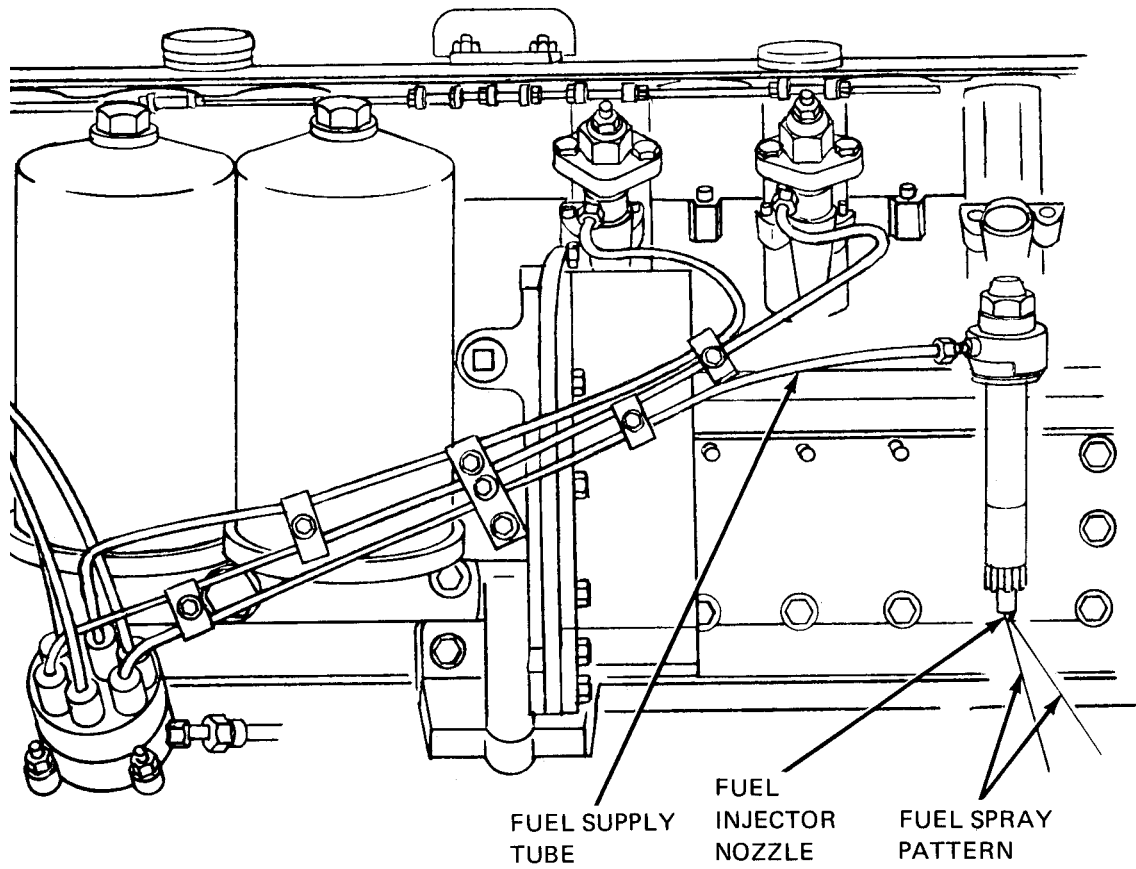


Figure 9-4. Fuel Injector Nozzle Spray Pattern

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9-5/(9-6 blank)

CHAPTER 10

ENGINE SYSTEM TEST PROCEDURE

10-1. GENERAL. This chapter gives test procedure for the tests given in chapter 8, for the engine system.

10-2. TEST SET-UP. Instructions for setup of test equipment and parts to be tested are given before the test procedures. Illustrations are used, when needed, to show you how to hook up the test equipment to the part to be tested.

10-3. TEST PROCEDURE. Detailed step-by-step instructions, in flow chart form, are given for each test. The procedure calls out the type of test and the condition of the engine system for each part of testing. The step-by-step test will lead you to the bad component or to a fault symptom within a related system. Reference is made to the fault symptom index, chapter 6, if the test shows a fault in another system.

FUEL INJECTOR NOZZLE TEST

1

- Start and warm up engine
 - Refer to Vol 2, chapter 6, para 6-6

— WARNING —

Diesel fuel is very flammable. Care must be used when choosing a place to work on fuel system. Keep engine about 50 feet away from an area where open flame, sparks, or smoking can cause a fire. Keep a fire extinguisher close by

— NOTE —

Put a rag under line fittings before loosening to catch any fuel which drips out

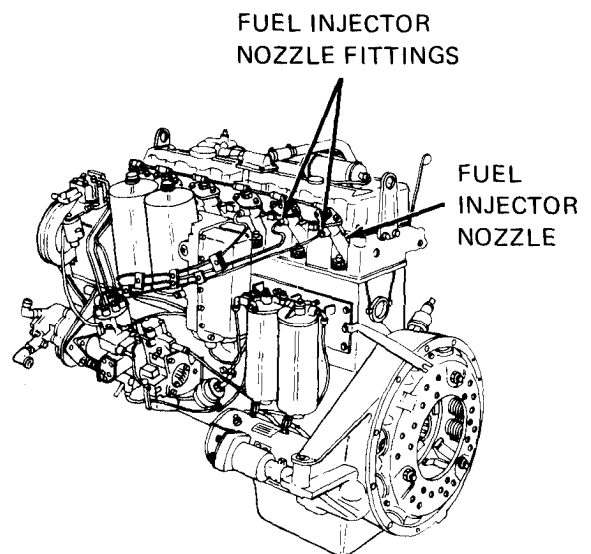
GO

Figure 10-1 (Sheet 1 of 2)

GO

2

- Check fuel injector nozzles
 - Loosen fuel injector nozzle fitting of one fuel injector nozzle and see if engine runs rougher
 - Note: If engine runs rougher the injector nozzle is OK
 - Tighten fuel injector nozzle fitting
 - Note: Do procedure for all six fuel injector nozzle fittings
- Stop engine
 - Refer to Vol 2, chapter 6, para 6-6



TA 120861

Figure 10-1 (Sheet 2 of 2)

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BE EXACT... PIN-POINT WHERE IT IS			
PAGE NO	PARA-GRAPH	FIGURE NO	TABLE NO
6-2			6-1
8-3		8-1 (Sheet 2 of 7)	
8-12		8-3 (Sheet 3 of 4)	

IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:

Symptom 1, detailed procedure refers to figure 8-3. Should refer to figure 8-1.

Change illustration callouts.
 Reason: callouts for SECONDARY FUEL FILTER BODY and FINAL FUEL FILTER BODY are reversed.

Box (7), sixth sentence reads "Heat water to 170° and see if thermostat opens." Should read "Heat water to 170° and see if thermostat starts to open"

SAMPLE

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TEAR ALONG PERFORATED LINE

THE METRIC SYSTEM AND EQUIVALENTS

LINEAR MEASURE

1 Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches
 1 Meter = 100 Centimeters = 1000 Millimeters = 39.37 Inches
 1 Kilometer = 1000 Meters = 0.621 Miles

SQUARE MEASURE

1 Sq Centimeter = 100 Sq Millimeters = 0.155 Sq Inches
 1 Sq Meter = 10,000 Sq Centimeters = 10.76 Sq Feet
 1 Sq Kilometer = 1,000,000 Sq Meters = 0.386 Sq Miles

WEIGHTS

1 Gram = 0.001 Kilograms = 1000 Milligrams = 0.035 Ounces
 1 Kilogram = 1000 Grams = 2.2 Lb
 1 Metric Ton = 1000 Kilograms = 1 Megagram = 1.1 Short Tons

CUBIC MEASURE

1 Cu Centimeter = 1000 Cu Millimeters = 0.06 Cu Inches
 1 Cu Meter = 1,000,000 Cu Centimeters = 35.31 Cu Feet

LIQUID MEASURE

1 Milliliter = 0.001 Liters = 0.0338 Fluid Ounces
 1 Liter = 1000 Milliliters = 33.82 Fluid Ounces

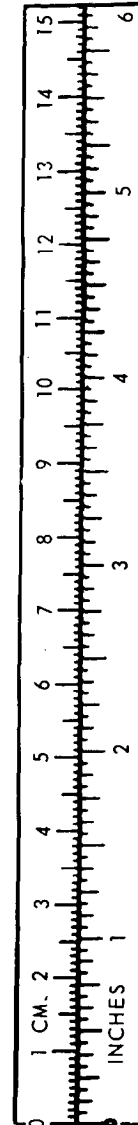
TEMPERATURE

$5/9 (^{\circ}\text{F} - 32) = ^{\circ}\text{C}$
 212^o Fahrenheit is equivalent to 100^o Celsius
 90^o Fahrenheit is equivalent to 32.2^o Celsius
 32^o Fahrenheit is equivalent to 0^o Celsius
 $9/5 \text{ C}^{\circ} + 32 = \text{F}^{\circ}$

APPROXIMATE CONVERSION FACTORS

<u>TO CHANGE</u>	<u>TO</u>	<u>MULTIPLY BY</u>
Inches	Centimeters	2.540
Feet	Meters	0.305
Yards	Meters	0.914
Miles	Kilometers	1.609
Square Inches	Square Centimeters	6.451
Square Feet	Square Meters	0.093
Square Yards	Square Meters	0.836
Square Miles	Square Kilometers	2.590
Acres	Square Hectometers	0.405
Cubic Feet	Cubic Meters	0.028
Cubic Yards	Cubic Meters	0.765
Fluid Ounces	Milliliters	29.573
Pints	Liters	0.473
Quarts	Liters	0.946
Gallons	Liters	3.785
Ounces	Grams	28.349
Pounds	Kilograms	0.454
Short Tons	Metric Tons	0.907
Pound-Feet	Newton-Meters	1.356
Pounds per Square Inch	Kilopascals	6.895
Miles per Gallon	Kilometers per Liter	0.425
Miles per Hour	Kilometers per Hour	1.609

<u>TO CHANGE</u>	<u>TO</u>	<u>MULTIPLY BY</u>
Centimeters	Inches	0.394
Meters	Feet	3.280
Meters	Yards	1.094
Kilometers	Miles	0.621
Square Centimeters	Square Inches	0.155
Square Meters	Square Feet	10.764
Square Meters	Square Yards	1.196
Square Kilometers	Square Miles	0.386
Square Hectometers	Acres	2.471
Cubic Meters	Cubic Feet	35.315
Cubic Meters	Cubic Yards	1.308
Milliliters	Fluid Ounces	0.034
Liters	Pints	2.113
Liters	Quarts	1.057
Liters	Gallons	0.264
Grams	Ounces	0.035
Kilograms	Pounds	2.205
Metric Tons	Short Tons	1.102
Newton-Meters	Pound-Feet	0.738
Kilopascals	Pounds per Square Inch	0.145
Kilometers per Liter	Miles per Gallon	2.354
Kilometers per Hour	Miles per Hour	0.621



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