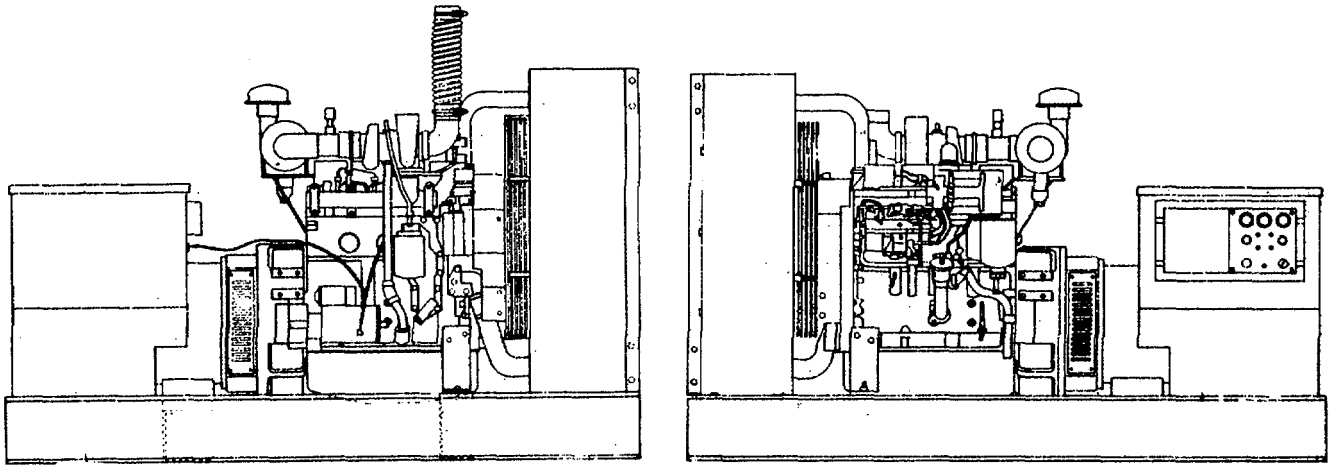
TECHNICAL MANUAL

UNIT, INTERMEDIATE DIRECT SUPPORT AND INTERMEDIATE GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

EMERGENCY GENERATOR SET

FOR
LANDING CRAFT UTILITY (LCU)
NSN 1905-01-154-1191



This copy is a reprint which includes current pages from Changes 1 through 4.

HEADQUARTERS, DEPARTMENT OF THE ARMY
17 JANUARY 1989

CHANGE

NO. 4

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 28 February 1994

Unit, Intermediate Direct Support and
Intermediate General Support Maintenance Instructions

EMERGENCY GENERATOR SET
for
LANDING CRAFT UTILITY (LCU)
NSN 1905-01-154-1191

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

TM 55-1905-223-24-4, 17 January 1989, is changed as follows:

1. Remove and insert pages as indicated below. New or changed text material is indicated by a vertical bar in the margin. An illustration change is indicated by a miniature pointing hand.

Remove pages	Insert pages
i and ii	i and ii
B-11 and B-12	B-11 and B-12

2. Retain this sheet in front of manual for reference purposes.

By Order of the Secretary of the Army:

GORDON R. SULLIVAN
General, United States Army
Chief of Staff

Official:

MILTON H. HAMILTON
Administrative Assistant to *the Secretary of the Army*
06459

DISTRIBUTION:
To be distributed in accordance with DA Form 12-25-E, block no. 4803, requirements for TM 55-1 905-223-24-4.

CHANGE
NO. 3

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 9 NOVEMBER 1992

Unit, Intermediate Direct Support and Intermediate General Support
Maintenance Instructions

EMERGENCY GENERATOR SET
FOR
LANDING CRAFT UTILITY (LCU)
NSN 1905-01-154-1191

Approved for public release; distribution is unlimited

TM 55-1905-223-24-4, 17 January 1989, is changed as follows:

1. Remove and insert pages as indicated below. New or changed text material is indicated by a vertical bar in the margin. An illustration change is indicated by a miniature pointing hand.

Remove pages	Insert pages
C-1 and C-2	C-1 and C-2

2. Retain this sheet in front of manual for reference purposes.

By Order of the Secretary of the Army:

GORDON R. SULLIVAN
General, United States Army
Chief of Staff

Official:

MILTON H. HAMILTON
Administrative Assistant to *the Secretary of the Army*
03020

DISTRIBUTION:
To be distributed in accordance with DA Form 12-25-E, block no. 4803, requirements for TM 55-1 905-223-24-4.

CHANGE

NO. 2

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 30 September 1991

Unit, Intermediate Direct Support
and Intermediate General Support
Maintenance Instructions

EMERGENCY GENERATOR SET
for
LANDING CRAFT UTILITY (LCU)
NSN 1905-01-154-1191

Approved for public release; distribution is unlimited

TM 55-1905-223-24-4, 17 January 1989, is changed as follows:

1. Remove and insert pages as indicated below. New or changed text material is indicated by a vertical bar in the margin. An illustration change is indicated by a miniature pointing hand.

Remove pages	Insert pages
2-7 AND 2-8	2-7 AND 2-8

2. Retain this sheet in front of manual for reference purposes.

By Order of the Secretary of the Army:

GORDON R. SULLIVAN
General, United States Army
Chief of Staff

Official:

PATRICIA P. HICKERSON
Brigadier General, United States Army
The Adjutant General

DISTRIBUTION:
To be distributed in accordance with DA Form 12-25-E, (qty rqr block no. 4803).

CHANGE

NO. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 11 August 1990

UNIT, INTERMEDIATE DIRECT SUPPORT
AND INTERMEDIATE GENERAL SUPPORT
MAINTENANCE INSTRUCTIONS

EMERGENCY GENERATOR SET
for
LANDING CRAFT UTILITY (LCU)
NSN 1905-01-154-1191

Approved for public release; distribution is unlimited

TM 55-1905-223-24-4, 17 January 1989, is changed as follows:

1. Remove and insert pages as indicated below. New or changed text material is indicated by a vertical bar in the margin. An illustration change is indicated by a miniature pointing hand.

Remove pages	Insert pages
2-1 through 2-6	2-1 through 2-
-	2-6. 1 /2-6.2
2-7 and 28	2-7 and 2-8
2-99 through 2-102	2-99 through 2-102
3-5 and 3-	3-5 and 3-6
3-61 and 3-62	3-61 and 3-62
3-65 and 3-66	3-65 and 3-66
3-79 and 3-80	3-79 and 3-80
4-5 and 4-6	4-5 and 4-6
4-23 and 4-24	4-23 and 4-24
4-57 and 4-58	4-57 and 4-58
B-5 through B-12	B-5 through B-12
	B-13/B14
-	

2. Retain this sheet in front of manual for reference purposes.

By Order of the Secretary of the Army:

CARL E. VUONO
General, United States Army
Chief of Staff

Official:

WILLIAM J. MEEHAN, II
Brigadier General, United States
The Adjutant General

DISTRIBUTION:

To be distributed in accordance with- DA Form 12-25E-, Unit and Direct Support and General Support Maintenance requirements for Landing Craft, Utility, LUC-1466, Type III.

WARNING

MODIFICATION HAZARD

Unauthorized modifications, alterations or installations of or to this equipment are prohibited and are in violation of AR 750-10. Any such unauthorized modifications, alterations or installations could result in death, injury or damage to the equipment

HIGH PRESSURE HYDRAULIC SYSTEM HAZARDS

Hydraulic systems can cause serious injuries if high pressure lines or equipment fail.

Never work on hydraulic systems or equipment unless there is another person nearby who is familiar with the operation and hazards of the equipment, and who can give first aid. A second person should stand by controls to turn off hydraulic pumps in an emergency. When the technicians are aided by the operators, the operators must be warned about dangerous areas.

MOVING MACHINERY HAZARDS

Be very careful when operating or working near moving machinery.

Running engines, rotating shafts, and other moving machinery parts could cause personal injury or death.

ELECTRICAL HAZARDS

Whenever possible, the power supply to the equipment must be shut off before beginning work on the equipment. Do not be misled by the term "low voltage." Potentials as low as 50 volts may cause death under adverse conditions.

Be careful not to contact 115-Vac input connections when installing or operating this equipment.

Whenever the nature of the operation permits, keep one hand away from the equipment to reduce the hazard of current flowing through the body.

For Artificial Respiration, refer to FM 21-11.

TECHNICAL MANUAL

No. 55-1905-223-24-4

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 17 January 1989

UNIT, INTERMEDIATE DIRECT SUPPORT AND INTERMEDIATE GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

EMERGENCY GENERATOR SET
FOR
LANDING CRAFT UTILITY (LCU)
NSN 1905-01-154-1191

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. A reply will be furnished directly to you.

TABLE OF CONTENTS

TABLE OF CONTENTS - Continued

CHAPTER 1

INTRODUCTION

Section I. GENRAL INFORMATION

1-1. **Scope**. The scope of this manual is as follows:

a. Type of Manual. Unit, intermediate direct support, and intermediate general support maintenance manual.

b. Model Number and Equipment Name. 4BT3.9CC Emergency Generator.

c. Purpose of Equipment. Used to supply electric power in the event of normal power failure.

1-2. **Maintenance Forms, Records, and Reports**. Department of the Army forms and procedures used for equipment maintenance are those prescribed by DA Pam 738-750, the Army Maintenance Management System.

1-3. **Destruction of Army Materiel.** Refer to TM 750-244-3 for instructions covering the destruction of Army materiel to prevent enemy use.

1-4. **Reporting Equipment Improvement Recommendations (EIRs).** If your equipment needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell 'us what you don't like about your equipment. Let us know why you don't like the design. Put it on an SF 368 (Quality Deficiency Report). Mail it to: Commander, U.S. Army Troop Support Command; ATTN: AMSTR-QX; 4300 Goodfellow Blvd.; St. Louis, Missouri 63120-1798. We'll send you a reply.

1-5. **Preparation for Storage or Shipment**. Administrative storage of equipment issued to and used by Army activities will have preventive maintenance performed in accordance with the Preventive Maintenance Checks and Services (PMCS) charts before storing. When removing the equipment from administrative storage, the PMCS should be performed to assure operational readiness. Repacking of equipment for shipment or short term storage is covered in paragraph 2-41.

Section II. EQUIPMENT DESCRIPTION AND DATA

1-6. **General Description**. The 4BT3.9GC emergency diesel generator set, illustrated in FIGURE 1-1, is a 4 cycle, 4 cylinder, radiator cooled unit. The generator is direct mounted to the engine for permanent alignment.. The in-line diesel engine covered in this manual is equipped with standard accessories such as water pump, governor, fuel pump etc. Full pressure lubrication is supplied to connecting rod, camshaft bearings and other moving parts. A gear-type pump draws oil from the oil pan and delivers it to the oil filter. Coolant is circulated through the engine by a water pump. This is a closed system with a radiator. Fuel is drawn from the fuel supply by a gear-type fuel pump. A turbocharger on top of the manifold feeds air for combustion in the cylinders. Engine starting is provided by a starter motor which is energized by a storage battery.

1-7. **Characteristics, Capabilities, and Features**. A very broad view of the emergency diesel generator is as follows:

a. Characteristics.

(1) Transfers mechanical energy, supplied by the engine, into electrical energy.

(2) Directly mounted to the engine for permanent alignment.

(3) Has control circuits that shut off the engine if an overspeed, high water temperature, or low oil pressure develops.

b. Capabilities and Features.

(1) Turbocharger added to increase horsepower, by increasing the air intake into the combustion chambers.

(2) Provides automatic transfer of electrical load from normal source when power failure occurs.

(3) Auto control provides one way of starting the engine automatically if power fails.

1-8. **Location and Description of Major Components**. The emergency diesel generator and diesel engine are both on a common chassis sub-base located on the center line of the ship, main deck, aft.

1-9. **Equipment Data**. Characteristics and reference data are provided in Table 1-1. Also see the equipment data given in the operator's manual, TM 55-1905-223-10.

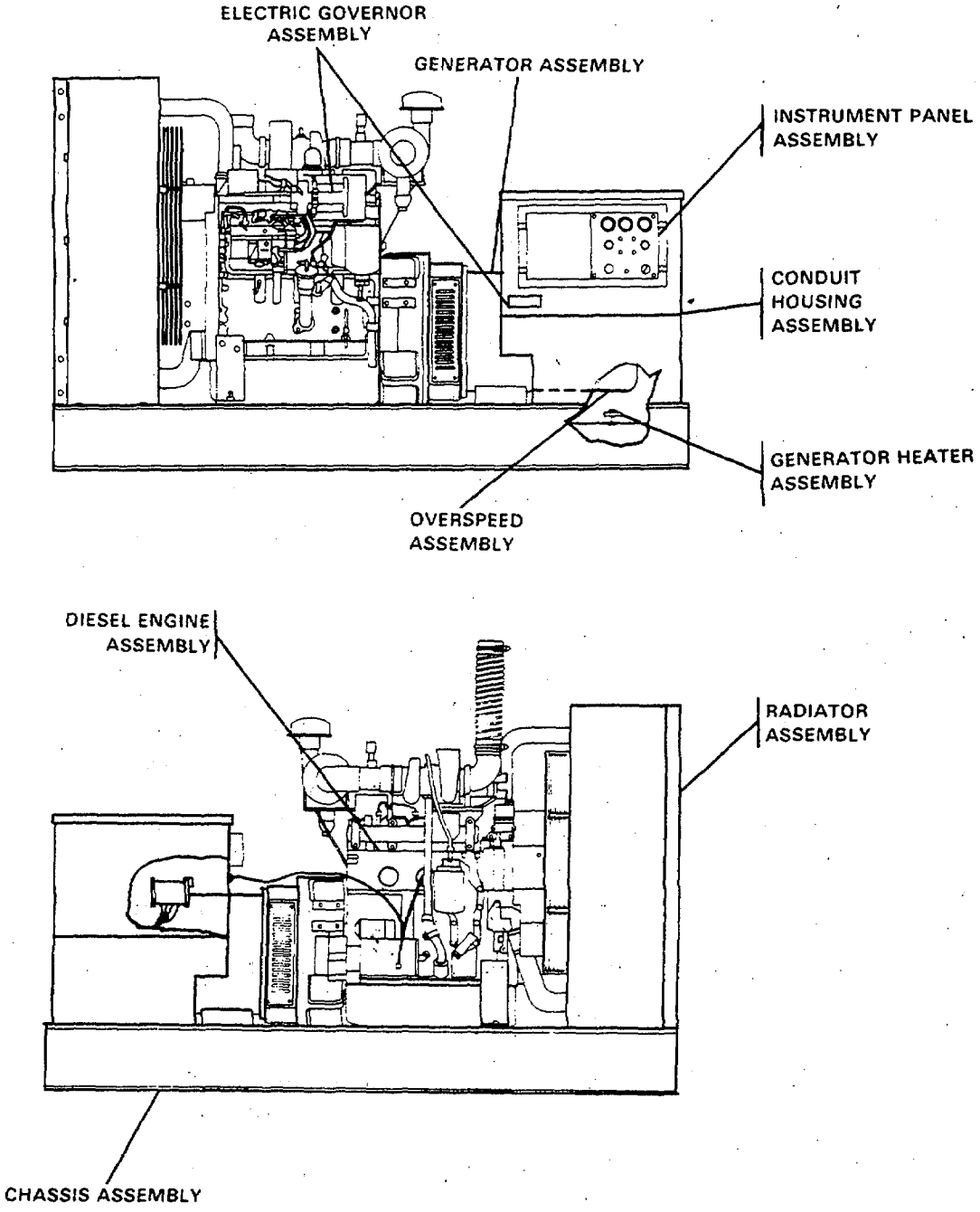


FIGURE 1-1. 4BT3.9GC Emergency Generator Set.

Table 1-1. Equipment Data

Characteristics	Reference Data
Model	4BT3.9GC
Manufacturer	Cummins Engine Co., Inc.
Type	4 cycle, 4 cylinder, diesel
Aspiration	Turbocharged
Rating	60 Hz, 240 V, 40 kW, 3 phase at 1800 rpm
Displacement	3.92 liters (239.3 in^3)
Bore and Stroke	102(4.02) x 120(4.72)
Weight	1514 lbs
Compression Ratio	18.5:1

Section III. PRINCIPLES OF OPERATION

Overview. The principles of operation section will give you overall description of how the emergency generator set works. Keep in mind that proper engine operation depends on two things: 1) compression for ignition, and 2) that fuel be measured and injected into cylinders in the proper quantity at the proper time.

1-10. Generator. The diesel engine is an internal combustion power unit, in which the heat of fuel is converted into work in the cylinder of the engine. Air alone is compressed in the cylinder. After the air has been compressed, a charge of fuel is sprayed into the cylinder and ignition is accomplished by the heat of the compression. The engine is electric started. The starting motor is energized by a storage battery. The generator function is to transform mechanical energy, supplied by the engine, into electrical energy. The following is a brief summary of the main generator components.

a. Right Hand Door Assembly. The right side door assembly of the emergency generator set contains the buttons and indicators necessary for manual operation and monitoring of the set. As conditions are indicated at this assembly, manual intervention of functions or repair may be obtained. This assembly consists of the the following:

(1) Time totalizing meter. Records the total generator set hours.
(2) Coolant temperature gauge. Indicates engine coolant temperature.
(3) Pressure indicator. Indicates engine oil pressure.
(4) Fault lamp. Lights to indicate a fault condition has occurred.

b. Automatic Transfer Switch. This automatically transfers the electrical load from the normal source of energy to the emergency generator set when power failure occurs. It also transfers the load back when power is returned to normal load.

c. Auto-Control Panel. Provides one way of starting the engine, automatically, if the power fails, or manually, for test and maintenance. In addition, the control circuits provide for shut off of the engine if an overspeed, high water temperature, or low oil pressure develops.

d. Automatic-Voltage Regulator. Controls the generator output voltage at a preset value regardless of the load.

e. Governor. The-governor assembly consists of three main components5, the actuator, assembly, the control unit and the magnetic sensor. It maintains the engine at a constant speed during varying loads. The unit contains all solid state electric circuits which sense speed from a magnetic sensor located in the flywheel housing. A pulse from the sensor is directly proportional to the engine speed. It is compared with the control speed set point. It then supplies the appropriate current output to the actuator to control the fuel pump throttle arm. During cranking, the speed control unit causes the actuator to move the fuel pump lever to the full ON position. The actuator will regulate the engine speed once the engine starts.

f. Circuit Breakers. The breakers are used to protect the system during an overload and certain short circuit conditions. They are installed between the voltage regulator and the generator.

1-11. Diesel Engine. The following is a brief summary of the operation of the systems which make up the diesel engine.

a. Combustion System (Diesel Cycle). Diesel Engines are different from spark-ignited engines in a number of ways. Compression ratios are higher, and the charge taken into combustion chamber during the intake stroke consists of air only, with no fuel mixture. Injectors receive low pressure fuel from the fuel pump and deliver it into individual combustion chambers at the proper time, in equal quantity and in an atomized. condition for burning. Ignition of fuel is caused by heat of compressed air in the combustion chamber. The four strokes and order in which they occur are shown in FIGURE 1-2 and described in the following paragraphs.

(1) Intake Stroke. During intake stroke, the piston travels downward; intake valve is open, and exhaust valve is closed. The downward travel of the piston allows air from the turbocharger to enter the cylinder.

(2) Compression Stroke. At the end of the intake stroke, intake valve closes and piston starts upward on compression stroke (exhaust valve remains closed). At the end of compression stroke, air in combustion chamber is compressed into a small space causing temperature of the air to rise to a point high enough for ignition of fuel. During last part of compression stroke and early part of power, stroke, a small metered charge of fuel is injected into combustion chamber. Almost immediately after fuel charge is injected into combustion chamber, fuel is ignited by the hot compressed air.

(3) Power Stroke. During the beginning of the power stroke, the piston is pushed downward by the burning and expanding gases; intake and exhaust valves are closed. As more fuel is added and burns, gases get hotter and expand more to further force piston downward and thus add driving force to crankshaft rotation.

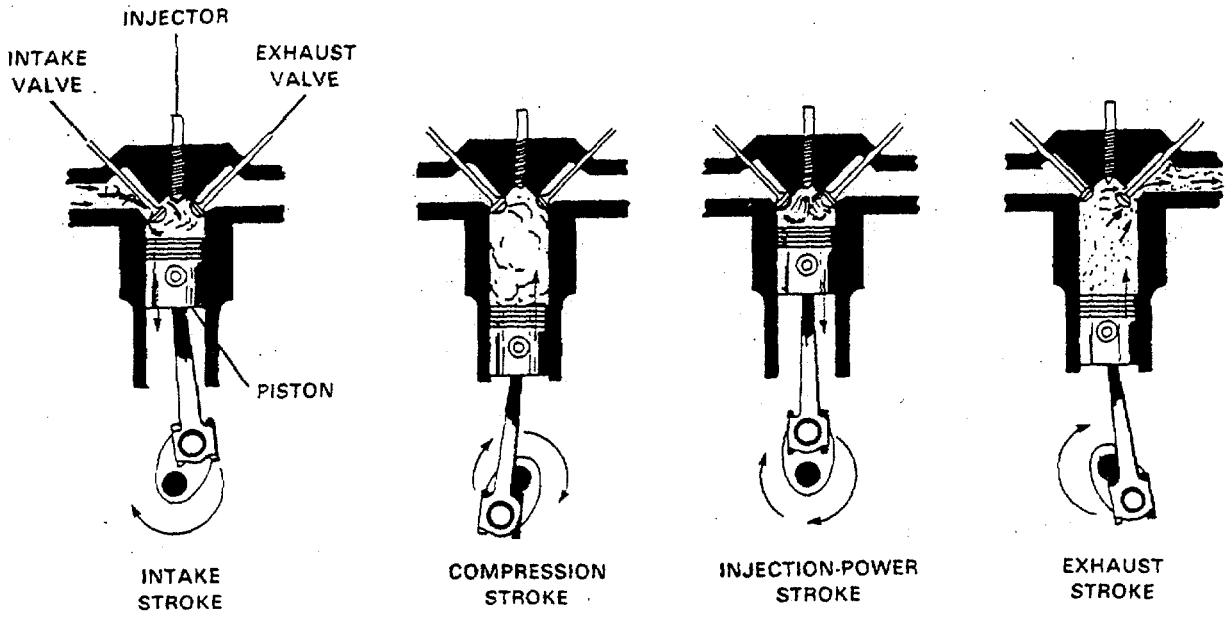


FIGURE 1-2. Four-Stroke Diesel Engine Cycles.

(4) Exhaust Stroke. During exhaust stroke, intake valve is closed, exhaust valve open, and piston on upstroke. Upward travel of piston forces burned gases out of combustion chamber through open exhaust valve port and into the exhaust manifold.

b. Cooling System. The radiator is filled with a 50% mixture of water and coolant, which is circulated through the engine by a centrifugal-type water pump. Heat is removed from the coolant by the radiator. Control of the temperature is accomplished by a thermostat.

c. Lubrication System. Tthe 4BT3.9GC engine is pressure lubricated by a gear-type oil pump at the-rear of the engine. The pump is mounted to the block, directly below the crankshaft, and is driven from the rear crankshaft gear. The pump draws the oil from the pan and forces it through the lubrication system in the following sequence:

(1) Oil is drawn from the pan to the oil cooler. A pressure regulating valve controls the oil pressure and passes excess oil back to the pan.

(2) The oil then passes through the oil cooler to the filter. A filter bypass valve ensures a supply of oil in the event the filter becomes plugged.

(3) From the filter, oil flows to the main oil passage in the engine block. This provides lubrication to all moving parts. At the same time oil is routed to the turbocharger through external lines.

(4) Oil is then returned from the turbocharger to the pan.

d. Fuel System. Diesel fuel is drawn in by a gear type fuel lift pump. It is then forced through a fuel water separator/filter to the injector pump which acts as a distributor. At this point excess fuel is returned to the supply. The injector pump supplies fuel to the injectors which spray fuel into the cylinder. The fuel is ignited by the heat of compressed air.

e. Air System. The diesel engine requires several hundred cubic feet of air for every gallon of fuel that burns. For the engine to operate efficiently, it must breathe freely. Air intake and exhaust systems must not be restricted.

(1) Intake air is routed through an air cleaner to the intake air inlet of turbocharger, through air crossover tube. The air then enters the intake manifold to the intake valve. this valve supplies the cylinder with air to be compressed. After fuel ignition the air escapes from the cylinder to the exhaust valve, through the exhaust manifold, enters the turbocharger and exits the turbocharger exhaust outlet.

(2) Turbocharger. The turbocharger forces more air intake into the combustion chambers. This added volume of air causes the engine to burn more fuel, thereby increasing horsepower. Without a turbocharger the engine would be naturally aspirated, supplying less air and producing less power.

CHAPTER 2

UNIT MAINTENANCE INSTRUCTIONS

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

2-1. Common Tools and Equipment. For authorized common tools and equipment, refer to the Modified Table of Organization and Equipment (MTOE) applicable to your organization.

2-2. Special Tools, TMDE, and Support Equipment. Special tools; test, measurement, and diagnostic equipment; and support equipment requirements are listed and illustrated in the Repair Parts and Special Tools List (RPSTL), TM 55-1905-223-24P. These items are also listed in the Maintenance Allocation Chart (MAC), Appendix B of this manual.

2-3. Repair Parts. Repair parts are listed and illustrated in the Repair Parts and Special Tools List (RPSTL), TM 55-1905-223-24P.

Section II. SERVICE UPON RECEIPT

2-4. Checking Unpacked Equipment.

a. Inspect the equipment for damage incurred during shipment. If the equipment has been damaged' report the damage in accordance with the instructions of DA Pam 738-750.

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

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

d. Remove protective caps, plugs,, inserts, wrappings, and tape when inspection/inventory is completed. Inspect piping openings for damage. Wipe off dirt, grease, or protective films at time of installation.

e. Remove chocks from resilient mounted components.

2-5. Installation Instructions.

WARNING

DO NOT lift the generator set using only the engine or generator lifting eyes.

NOTE

The approximate weight of the generator set is 1514 lbs (687 Kg).

a. Position the generator set for good service accessibility on all sides.

b. Lift the generator set into position by sliding two lifting bars into the base rail holes and connecting them to a spreader bar.

c. The generator is skid mounted and should be bolted to the deck. The engine comes equipped with resilient mounts.

d. When the generator set is properly mounted in position proceed as follows:

(1) Connect the exhaust outlet connection.

(2) Connect the fuel inlet connection.

(3) Connect the battery cable to the starter motor.

2-6. Preliminary Servicing and Adjustment. It is important that careful preparation be made before a diesel engine/generator set is started-after long idle periods. It must be ready for immediate use in the event of loss of normal service. Check all pipe connections to ensure that all systems are correctly connected.

a. Procedural steps to be taken to prepare the generator for starting are:

(1) Be sure the radiator has been filled with 50% mixture of water and antifreeze.

2-7. Initial Setup Procedure. Includes operational checks and inspections that are not performed for a routine startup. Direct support maintenance personnel will perform initial setup in accordance with the operator's manual, TM 55-1905-223-10.

2-8. Startup. Refer to Table 2-1, Item 4.

2-9. Shutdown Procedure. Refer to Table 2-1, Item 4.

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

2-10. **Explanation of PMCS Table**. PMCS is designed to keep the equipment in good working condition. This is accomplished by performing certain tests, inspections, and services. Table 2-1 lists items to be serviced and the procedures needed to accomplish the PMCS. The "'Interval" column tells you when to perform a check or service. If needed, PMCS may be performed more frequently than the indicated interval. The "Procedures" column tells you how to perform the required checks and services. If your equipment does not perform as required, see Table 2-2, Troubleshooting. Report any malfunctions or failures on DA Form 2404. In the Item Number column on DA Form 2404, record the appropriate Item Number from the PMCS table.

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

E - Every 20 hours W - Weekly Q - Quarterly S - Semiannually A - Annually B - Biennially

ITEM NO.	INTERVAL						ITEMS TO BE INSPECTED/SERVICED	Procedures
	E	W	Q	S	A	B		
1.	●						Oil level	Check the oil level with the dipstick. CAUTION Never operate the engine with the oil level below the "L" (low) mark or above the "H" (high) mark on the dipstick. a. Inspect for leaks. b. Add oil as necessary. Refer to LO 55-1905-223-12 for oil specifications.
2.	●						Fuel tank	Check the level of fuel. Check that the fuel valve(s) to the generator are open. **NOTE** Only good quality climatized diesel fuel should be used.
3.	●						Radiator	Check coolant level. If low, fill the radiator with required amount of coolant. Use a 50% mixture of water and antifreeze. Inspect the cooling system for leaks. Check the radiator fins for excessive dirt and debris.
4.		●					Generator set	Run the generator set for 1/2 hour, under load.

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

E - Every 20 hours W - Weekly Q - Quarterly S - Semiannually A - Annually B - Biennially

ITEM NO.	INTERVAL						ITEMS TO BE INSPECTED/SERVICED	Procedures
	E	W	Q	S	A	B		
4 CONT		●					Generator set - CONT	**NOTE** Operator should remain in attendance. **Emergency Generator/Switchboard start Procedure.** **NOTE:** This procedure provides a means to test automatic starting of Emergency Generator and allows the exercise of the Emergency Generator without disturbing the main switchboard. a. Place the Emergency Generator Run-Oft-Auto switch to Auto, and the Emergency Stop PB switch is pulled out. b. Place the Emergency Switchboard Mode Switch to Test. This will open P0201 (Main S.B. Bus Tie brkr), while also starting the Emergency Generator and energizing the Emergency Switchboard. **Emergency Generator/Switchboard Shutdown Procedures** **NOTE:** a. Place Emergency Switchboard MODE Switch to Man position. b. Place the Emergency Generator Circuit Breaker Switch to momentary TRIP position. The Emergency Generator Circuit Breaker will open and the Emergency Generator will stop. c. Close Main Switchboard Bus Tie Circuit Breaker (PO201). The Emergency Switchboard is now energized by the Main Switchboard.
5.			●				Battery	

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

E - Every 20 hours W - Weekly Q - Quarterly S - Semiannually A - Annually B - Biennially

ITEM NO.	INTERVAL						ITEMS TO BE INSPECTED/SERVICED	Procedures
	E	W	Q	S	A	B		
5. CONT			●				Battery - CONT	d. Place the Emergency Generator Run-Off-Auto Switch to Auto, and insure that the Emergency Stop PB Switch is Pulled out
6.			●				Oil filter	e. Place the Emergency Switchboard Mode Switch to Auto. **NOTE:** The Emergency System is now ready to energize the Emergency Switchboard in case of a main switchboard power failure. **CAUTION** When testing, run the generator at 25% to 100% load. Extended operation under very light or no load will result in more frequent maintenance. Check the specific gravity of the battery electrolyte in each cell. Remove the cell caps and check the electrolyte level in each cell. Add distilled water as required to bring the level to the split ring in each cell. Refer to TM 55-1905-223-24-18. Visually inspect the terminals for loose, broken, or corroded connections. a. Repair or replace broken cables or terminals (TM 55-1905-223-24-18). b. On corroded terminals, remove the cables and clean with a battery brush. Connect the cables and tighten.

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

E - Every 20 hours W - Weekly Q - Quarterly S - Semiannually A - Annually B - Biennially

ITEM NO.	INTERVAL						ITEMS TO BE INSPECTED/SERVICED	Procedures
	E	W	Q	S	A	B		
5. CONT			●				Battery - CONT	c. Install and tighten the battery cables (TM 55-1905-223-24-18).
6.			●				Oil filter	Check condition of used oil. Thin, black oil indicates fuel dilution. Milky discoloration indicates coolant dilution. **CAUTION** Diluted oil can cause severe damage to the engine. a. Send oil sample to the Army Oil Analysis Program (AOAP) lab. **NOTE** If oil is contaminated a sample must be sent to the AOAP lab for spectrometric analysis. b. If necessary, change lubricating oil. Refer to LO 55-1905-223-12. **NOTE** Allow time for the oil to settle in the pan after engine shutdown. c. Drain the oil as follows: (1) Open the suction valve for the sump pump.

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

E - Every 20 hours W - Weekly Q - Quarterly S - Semiannually A - Annually B - Biennially

ITEM NO.	INTERVAL						ITEMS TO BE INSPECTED/SERVICED	Procedures
	E	W	Q	S	A	B		
6. CONT			●				Oil filter - CONT	(2) Manually pump the old oil from the engine. (3) Close the sump pump suction valve. **INSPECT THE FILTER.** a. Inspect and service the filter at same intervals. Refer to LO 55-1905-223-12. b. Clean around the filter head. c. Remove the filter and clean the surface. d. Lubricate the oil seal with clean engine oil. e. Install the filter. **SERVICE THE OIL FILTER AS FOLLOWS:** Refer to LO 55-1905-223-12 a. Use high-quality multi-grade lubricating oil. b. Fill engine with 1 0 quarts (9.5 liters) of oil as follows: Ambient Temp — Grade 14°F (-10°C) — 15W40 or 20W40 -10°F(-23°C) — 10W30

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

E - Every 20 hours W - Weekly Q - Quarterly S - Semiannually A - Annually B - Biennially

ITEM NO.	INTERVAL						ITEMS TO BE INSPECTED/SERVICED	Procedures
	E	W	Q	S	A	B		
6. CONT			●				Oil filter - CONT	Operate the engine and inspect for leaks at the filter and sump pump suction line. To check the oil level: a. Shut off the engine. b. Allow oil to drain down (about 5 minutes). c. Check oil level.
7.			●				Air intake	Inspect the intake piping for damage, cracked hoses, and loose clamps. **CAUTION** Never operate engine without an air cleaner. For replacement of air cleaner (para. 2-25).
8.			●				Wiring	Overall inspection. Look for discolored connections that indicate heating due to poor electrical connection. The inspection should include: circuit breakers, transfer switch connections, and generator conduit box wiring.
9.			●				Engine mounts	Check the frame rail mounting bolts and the engine mounts for tightness.

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

E - Every 20 hours W - Weekly Q - Quarterly S - Semiannually A - Annually B - Biennially

ITEM NO.	INTERVAL						ITEMS TO BE INSPECTED/SERVICED	Procedures
	E	W	Q	S	A	B		
10.			●				Cooling system	Check the water hoses for cracks for cracks and loose clamps. Perform -the 20-hour radiator checks and services.
11				●			Fuel filter	Change the fuel filter. For remove and replace procedures (para. 2-29)
12.				●			Fuel .system	Bleed the-fuel system. Controlled venting is provided at the fuel pump through the fuel drain manifold. **NOTE** Small amounts of air introduced by changing the filters or fuel pump will be vented automatically, if fuel filter is changed correctly. Manual bleeding will be required if: a. The fuel filter is not filled prior to installation. b. Fuel pump is replaced. c. High pressure Fuel lines are replace.

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

E - Every 20 hours W - Weekly Q - Quarterly S - Semiannually A - Annually B - Biennially

ITEM NO.	INTERVAL						ITEMS TO BE INSPECTED/SERVICED	Procedures
	E	W	Q	S	A	B		
12. CONT				●			Fuel system-CONT	**NOTE** Air/fuel can be pumped from LP lines, fuel filter, and fuel pump using the hand lever on the lift pump is the fuel solenoid valve is energized to venting the low pressure (LP) lines and the fuel filter a. In order to bleed the fuel system, the shutoff must first connect jumperwires from the positive and negative battery cable on the starter to the fuel shutoff valve solenoid terminal b. Open the bleed crew, then operate the hand lever on the lift pump until the firs flowing from the fitting is free of air. Tighten the bleed screw. Venting at the fuel pump. a. Open the pump bleed screw. b. Follow the pump bleed procedures listed above. c. Air can also be vented through the fuel drain manifold line by operating the starting motor.

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

E - Every 20 hours W - Weekly Q - Quarterly S - Semiannually A - Annually B - Biennially

ITEM NO.	INTERVAL						ITEMS TO BE INSPECTED/SERVICED	Procedures
	E	W	Q	S	A	B		
12. CONT				●			Fuel system - CONT	**CAUTION** When using the starting motor to vent the system, do not engage it for more than 30 seconds at a time. Wait 2 minutes between engagements. **WARNING** It is necessary to put the engine in the RUN position. Because the engine may start, be sure to follow all, safety, precautions. Use the normal engine starting procedures. Venting the high pressure lines. a. Loosen the fittings at the injector. **WARNING** High pressure fuel could cause penetration of the skin. b. Crank the engine to allow entrapped air to bleed from the line. Tighten the fittings.

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

E - Every 20 hours W - Weekly Q - Quarterly S - Semiannually A - Annually B - Biennially

ITEM NO.	INTERVAL						ITEMS TO BE INSPECTED/SERVICED	Procedures
	E	W	Q	S	A	B		
12. CONT				●			Fuel system - CONT	**WARNING** Do not bleed a hot engine as this could cause fuel to spill onto a hot exhaust manifold creating a danger of fire. c. With the engine at idle vent one line at a time until the engine runs smoothly.
13.				●			Radiator	Check the antifreeze concentration.
14.				●			Generator	Inspect for dust. With the generator set secured, use dry compressed air to blow dust out of the generator.
15.		*		●			Exhaust	Drain the water out of the exhaust/silencer traps.
16.		*		●			Air cleaner	Inspect air cleaner hoses for cracks and loose clamps. Check the mounting capscrews for tightness. Replace the air cleaner element. a. Remove the air cleaner canister dust cover. b. Loosen the air filter element retaining wing nut and remove the element. c. Make sure air cleaner is clean.

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

E - Every 20 hours W - Weekly Q - Quarterly S - Semiannually A - Annually B - Biennially

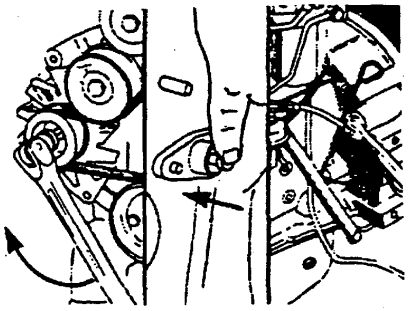
ITEM NO.	INTERVAL						ITEMS TO BE INSPECTED/SERVICED	Procedures
	E	W	Q	S	A	B		
16. CONT				●			Air cleaner - CONT	d. Install a new air filter element. **NOTE** Perform all quarterly and semiannual PMCS.
17.					●		Valves	Adjust the valves. a. Remove the valve covers. b. Locate Top Dead Center (TDC) for Cylinder No. 1 by barring the engine slowly while pressing on the engine timing pin.  **FIGURE 2-1**

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

E - Every 20 hours W - Weekly Q - Quarterly S - Semiannually A - Annually B - Biennially

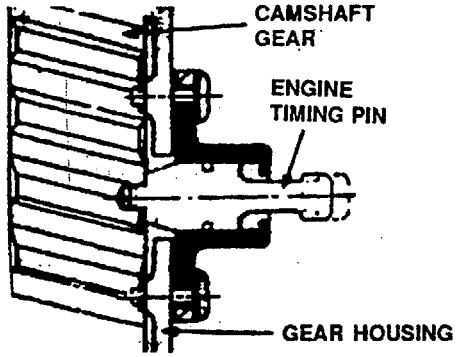
ITEM NO.	INTERVAL						ITEMS TO BE INSPECTED/SERVICED	Procedures
	E	W	Q	S	A	B		
17. CONT					●		Valves - CONT	**NOTE** When the pin engages the hole in the camshaft gear, Cylinder No. 1 is at TDC. **CAUTION** Be sure to disengage the pin after locating TDC.  **FIGURE 2-2** c. Check/set valves with engine cold. Below 140°F (60°C).

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

E - Every 20 hours W - Weekly Q - Quarterly S - Semiannually A - Annually B - Biennially

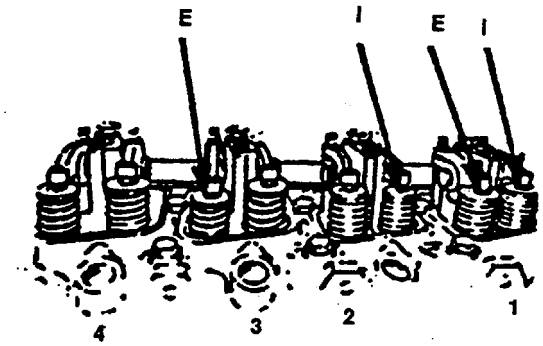
ITEM NO.	INTERVAL						ITEMS TO BE INSPECTED/SERVICED	Procedures
	E	W	Q	S	A	B		
17. CONT					●		Valves - CONT	Intake Clearance: 0.010 inch (0.254 mm) Exhaust Clearance: 0.020 inch (0.508 mm) **NOTE** The clearance is correct when some resistance is felt when the feeler gauge is slipped between the valve stem and the rocker lever. d. Check/adjust the valves indicated in FIGURE 2-3 (I = Intake; E = Exhaust)  FIGURE 2-3

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

E - Every 20 hours W - Weekly Q - Quarterly S - Semiannually A - Annually B - Biennially

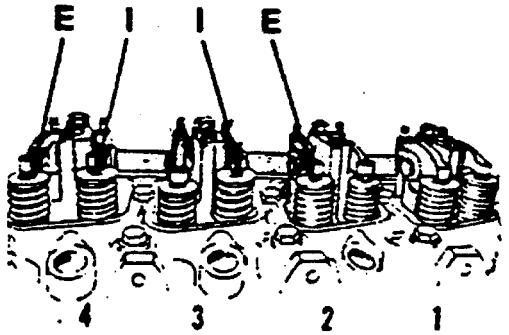
ITEM NO.	INTERVAL						ITEMS TO BE INSPECTED/SERVICED	Procedures
	E	W	Q	S	A	B		
17. CONT					●		Valves - CONT	e. Tighten the locknut 18 ft-lbs (24 N'm). f. Mark the pulley and rotate the crankshaft 360 degrees. Be sure that the timing pin is disengaged. g. Set the valves indicated in FIGURE 2-4. Tighten the locknut to 18 ft-lbs (24 N'm).  FIGURE 2-4 h. Install the valve covers (para. 2-37).

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

E - Every 20 hours W - Weekly Q - Quarterly S - Semiannually A - Annually B - Biennially

Item No.	Interval						Items To Be Checked/Serviced	Procedures
	E	W	Q	S	A	B		
18.						•	Drive belt	Measure the belt deflection (give) at the longest straight section of the belt. The maximum deflection allowance is 3/8 to 1/2 inch (9.5 to 12.7 mm). Inspect the belt for damage such as cracks. Check the tensioner pulley. It should spin freely with no rough spots detected under hand pressure. If not, check the tensioner bearing. Check the fan hub. It should spin freely without excessive end play. If not, check the fan hub bearing.
19.					•		Turbocharger	Check the turbocharger. a. Remove the air intake piping and exhaust pipe. b. Check for oil leakage into the crossover tube and exhaust pipe. c. Check for damaged compressor or turbine blades. Make sure the compressor spins freely. d. Measure bearing thrust clearance as follows: (1) Measure end play. Minimum: .001 inch (.25mm) Maximum: .006 inch (.16mm)

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

E - Every 20 hours W - Weekly Q - Quarterly S - Semiannually A - Annually B - Biennially

Item No.	Interval						Items To Be Checked/Serviced	Procedures
	E	W	Q	S	A	B		
19. CONT					•		Turbocharger - CONT	Minimum .012 inch (.03mm) Maximum .018 inch (.46mm)
20.					•		Coolant heaters	Check coolant heater as follows: a. Operate heater. b. Listen for audible sound from engine block heater. c. Make certain that the engine block is warm to the touch in the water jacket areas.
21.					•		Magnetic pickup	Remove and blow clean with compressed air the magnetic pickup.
22.						•		NOTE Perform all prior PMCS.
23.						•	Cooling system	Change the coolant. Flush the system.

Section IV. UNIT MAINTENANCE TROUBLESHOOTING

2-11. **Troubleshooting.** Both a symptom index and a troubleshooting table are provided. The symptom index will help you locate the information you need for troubleshooting.

SYMPTOM INDEX

Table 2-2 lists the common fault conditions that may be found during operation or maintenance of the equipment. Look for causes and do corrective actions in the order listed. This manual cannot list every symptom that may show up, and it cannot list all of the possible causes and corrective actions. If a symptom is not listed, or if it keeps up after you have performed the corrective actions, notify your supervisor.

Table 2-2. Troubleshooting

Malfunction
Test or Inspection
Corrective Action

1. Engine will not crank.

STEP 1. Check to see if incorrect start/reset procedures were used.
Resetting after a fault.
(1) Disconnect the generator set from the load by opening the circuit breaker.
(2) Move the OFF/RUN switch to the OFF position to reset the fault lamp.
(3) Determine the cause of the fault and correct.
(4) Restart, follow normal start-up procedures. Refer to TM 55-1905-223-10.

STEP 2. Check for loose or corroded battery cables.
Clean and tighten connections.

STEP 3. Check for loose or corroded connections in the starting circuit.
Clean and tighten connections.

STEP 4. Check for low battery charge.
a. Using a remote start connection, attempt to engage starter while observing the voltage.
b. If the voltage reads less than 10 volts dc, charge the battery (TM 55-1905-223-24-18).
c. If the voltage drops rapidly more than 2 volts dc, replace the battery. Refer to TM 55-1905-223-24-18.

STEP 5. Check constant battery charger for correct operation.

STEP 6. Check for blown fuse(s).
a. Check the fuse on the junction box.
b. Check the fuse(s) in the instrument panel.

NOTE

If fuses cannot be visually inspected, check for continuity to confirm condition.

Table 2-2. Troubleshooting - CONT

Malfunction Test or Inspection Corrective Action

STEP 7. Check for shorted wires.
a. Visually inspect for broken or bare wires.
b. Unaccessible wires can be verified by checking for continuity between the wire and ground.

STEP 8. Check for loose, broken or grounded wire to the remote start.

WARNING

To avoid electrical shock. Verify that the generator circuit breaker is in the off position and the battery is disconnected.

a. Remove the conduit box side covers and lid.
b. Remove the regulator protective cover.
c. Check for continuity between terminals 3 and 4.

STEP 9. Check to see if solenoid or starting motor is malfunctioning.
Temporarily connect the starter solenoid terminals. If engine cranking does not occur, replace the starter motor (para.2-20).

2. Engine cranks but will not start: no smoke from exhaust.

STEP 1. Check to see if incorrect start/reset procedures were used. (RUN/OFF switch must be in RUN position manual control only).
Use the, correct procedure.

STEP 2. Check fuel level in supply tank.
Replenish supply.

STEP 3. Check to see if fuel shutdown valve is closed. Check for loose wire and verify the valve is open.
a. Remove the valve.
b. Connect 12 Vdc to the terminal and ground the body.
c. Observe plunger movement.

STEP 4. Check to see if fuel filter is plugged, or contains water or other contamination (PMCS, Item 12).

Table 2-2. Troubleshooting - CONT

Malfunction Test or Inspection Corrective Action

STEP 5. Check to see if fuel pump is getting fuel or fuel is aerated.
a. Check fuel flow.
(1) Remove the inlet line to the lift pump.
(2) Operate the hand lever and check for suction.
(3) If suction is not detected, rotate engine crankshaft 90 degrees and repeat check.
(4) If there is suction, check for an obstruction in the fuel supply line. Clean or replace line as necessary.
b. Bleed fuel system (PMCS, Item 12).

STEP 6. Check for malfunctioning fuel pump.
a. Remove the tachometer drive cable from the fuel pump.
b. Crank the engine and make sure the tachometer drive shaft is turning.
c. If the tachometer drive shaft rotates, check the gear pump for rotation.
(1) Remove the fuel supply hose at the gear pump.
(2) Look into the gear pump and crank the engine. The gear pump must turn. If the gear pump gears do not turn, replace the fuel pump. (para. 2-32).
d. If the tachometer-drive shaft does not turn, remove the fuel pump. (para. 2-32)
(1) Crank the engine and check the accessory drive shaft for rotation.
(2) In the accessory drive shaft does not turn, replace accessory drive.
(3) If the shaft turns, the fuel pump is damaged and must be replaced (para. 2-32).

STEP 7. Check to see if exhaust is restricted.
a. Install a mercury manometer in the exhaust piping.

NOTE

The gauge adapter must be installed near the turbocharger or exhaust manifold in a straight section of pipe.

b. Operate the engine at rated RPM and load, and record the manometer reading.

NOTE

Exhaust pressure must not exceed 3 inches Hg (7.5 cm)

c. Remove test equipment.
d. If exhaust pressure exceeds the specifications, visually inspect the exhaust piping for damage.
e. Replace or repair damaged piping.

Table 2-2. Troubleshooting - CONT

Malfunction
Test or Inspection
Corrective Action

3. Engine difficult to start or will not start: Smoke from exhaust.

STEP 1. Check for excessive engine/generator resistance to rotation.
Bar the engine to check for excessive resistance.

STEP 2. Check to see if cranking speed is too slow.
a. Check the battery.
b. Inspect for loose or corroded wiring connections.

STEP 3. Check to see if block heater is working.
Check for correct operation refer to PMCS, Item 20.

STEP 4. Not enough intake air for the engine.
Inspect/replace air filter and check for obstructions in the air ducts (para. 2-25).

STEP 5. Check for air in the fuel system.
Bleed the fuel system. Refer to PMCS, Item 12.

STEP 6. Check to see if fuel pump timing is correct.
Visually verify pump marks are aligned (para. 2-33).

STEP 7. Check for contaminated fuel.
a. Drain and flush fuel supply tanks.
b. Replenish with clean fuel.

STEP 8. Check for incorrect valve adjustment.,
Adjust valves. Refer to PMCS, Item 17.

4. Engine starts but will not keep running.

STEP 1. Check for low level of fuel in supply tank.
Replenish the fuel.

STEP 2. Check to see if idle speed is too low.
Adjust the low idle screw (para. 3-12).

STEP 3. Check for restricted exhaust.
Correct exhaust piping.

STEP 4. Check for a fuel restriction in the suction side of the system.
Remove restriction. If weather has changed, check block heaters for proper operation. Refer to PMCS, Item 20.

Table 2-2. Troubleshooting - CONT

Malfunction Test or Inspection Corrective Action

STEP 5. Check for a restricted fuel drain manifold or return line.
Remove restriction.

STEP 6. Check for a fuel system leak/air in the fuel system.
Visually inspect for fuel leak/bleed the system. See PMCS, Item 12.

STEP 7. Check for contaminated fuel.
Drain tank and replenish with clean fuel.

STEP 8. Check to see if fuel pump is malfunctioning.
Refer to Malfunction 2, Item 6.

5. Engine surges at idle.

STEP 1. Check level of fuel in the supply tank.
Replenish fuel if low.

STEP 2. Check for cold engine.
Refer to "Engine running too cold," Malfunction 12.

STEP 3. Check to see if idle speed is too low.
Adjust low idle screw (para. 3-12).

STEP 4. Check for generator set engine mounts over torqued, damaged, or loose.
a. Verify condition of engine mounts. Check correct torque.
b. Torque to 120 ft-lb.

STEP 5. Check to see if fuel pump is getting sufficient fuel or fuel system is aerated.
a. Check the fuel flow. Refer to Malfunction 2, Item 6.
b. Bleed fuel system. Refer to PMCS, Item 12.

STEP 6. Check for malfunctioning injectors. Speed or power pr6blem with engine operating under load.
Replace injectors (para. 2-39).

STEP 7. Check to see if fuel pump is malfunctioning.
Refer to Malfunction 2, Item 6.

6. Engine misfiring.

STEP 1. Check to see if fuel injection lines are leaking.
Inspect/replace damaged lines (para. 2-39).

STEP 2. Check for air in the fuel system.
Bleed the fuel system, PMCS, Item 12.

Table 2-2. Troubleshooting - CONT

Malfunction Test or Inspection Corrective Action

STEP 3. Check for contaminated fuel.
a. Drain and flush fuel supply tanks.
b. Replenish with clean fuel.

STEP 4. Check for malfunctioning injectors.
Replace injectors (para. 2-39).

STEP 5. Check to see if valve adjustment is correct.
Adjust valves. Refer to PMCS, Item 17.

STEP 6. Check for defective fuel pump.
Refer to Malfunction 2, Step 7.

7. Low Engine Oil Pressure.

STEP 1. Check oil level.
Replenish oil (PMCS, Item 1).

STEP 2. Check to see if oil filter is plugged.
Change oil filter; review PMCS, Item 6.

STEP 3. Check to see if oil is diluted or has incorrect viscosity.
Change oil. Refer to LO 55-1905-223-12 and PMCS, Item 6.

STEP 4. Check for a malfunctioning pressure switch.
Replace pressure switch (para. 2-19).

a. To check, remove the pressure switch, install a gauge,start the engine and measure oil pressure. Minimum oil pressure: idle (675-725 rpm) -10 psi (69 kPa); full speed - 30 psi (207 kPa).

b. To replace, disconnect the wire from the sending unit. Remove oil sending unit with socket wrench. Replace with new oil sending unit, then reconnect the wire.

STEP 5. Check to see if suction tube is loose or seal is leaking.
a. Remove oil pan (para. 3-25).
b. Inspect suction tube and gasket, repair as necessary.
c. Replace oil pan (para. 3-25).

8. Fuel knock under load.

STEP 1. Check to see if fuel pump timing is correct.
Visually verify fuel pump timing marks are aligned (para. 2-33).

Table 2-2. Troubleshooting - CONT

Malfunction Test or Inspection Corrective Action

STEP 2. Check for air in the fuel system.
Bleed the fuel system. Refer to PMCS, Item 12.

STEP 3. Check for poor quality fuel.
a. Drain and flush the fuel supply tanks.
b. Replenish with clean fuel.

STEP 4. Check for overloaded engine.
Verify the generator output does not exceed rating. Refer to the generator set data tag for rating.

STEP 5. Check for malfunctioning injectors.
Replace injectors (para. 2-39).

9. Generator will not pull the load (low engine power).

STEP 1. Check for overloaded engine.
Verify that generator set rating is not being exceeded.

STEP 2. Check to see if fuel control lever is not moving to full speed.
Check for full stop-to-stop travel as follows:

a. Place-the run-off toggle switch in the "RUN" position and the idle normal toggle switch in the "IDLE" position.
b. Press in on the permissive start button to activate the solenoid to the "HIGH IDLE" position.

CAUTION

Make sure that the solenoid is allowed to move to its full travel position when activated, otherwise the pull coil will be damaged within 30-40 seconds.

NOTE

Pull in requires 19 amperes.
Hold in requires .5 amperes.

c. Loosen the locknut and adjust the linkage to obtain full stop-to-stop travel (para. 3-12).

STEP 3. Check to see if fuel pump timing is correct.
Visually verify fuel pump timing marks are aligned (para. 2-33).

Table 2-2. Troubleshooting - CONT

Malfunction
Test or Inspection
Corrective Action

STEP 4. Check for inadequate intake of air.
Replace air cleaner (para. 2-25); check ducts for obstruction, PMCS, Item 16.

STEP 5. Check for air/exhaust leak at turbocharger.
Correct leak, PMCS, Item 19.

STEP 6. Check for exhaust restriction.
Remove obstructions from exhaust piping.

STEP 7. Check to see if fuel pump is not getting adequate fuel or fuel being aerated.
a. Check fuel flow. Refer to Malfunction 2, Item 6.
b. Bleed fuel system. Refer to PMCS, Item 12.

STEP 8. Check for restricted fuel drain manifold.
a. Visually inspect return lines for obstructions or restrictions.
b. Clean or replace lines (para. 2-30).

STEP 9. Check for poor quality fuel.
Drain, clean and replenish with fuel.

STEP 10. Check to see if turbocharger malfunctioning.
Inspect/replace turbocharger (para. 2-26).

STEP 11. Check for incorrect valve set.
Adjust valves, PMCS, Item 17.

STEP 12. Check for malfunctioning injectors.
Replace injectors (para. 2-39).

STEP 13. Check for malfunctioning fuel pump.
Refer to Malfunction 2, Step 7.

10. Excessive exhaust smoke under load.

STEP 1. Check for excessive load on engine.
Verify that the rating of the generator set is not being exceeded.

STEP 2. Check to see if engine is running too cold (whitesmoke).
Refer to "Engine running too cold," Malfunction 12.

STEP 3. Check for correct fuel pump timing.
Verify fuel pump timing marks are aligned (para. 2-32).

Table 2-2. Troubleshooting - CONT

Malfunction Test or Inspection Corrective Action

STEP 4. Check to see if intake of air is adequate.
Change air cleaner (para. 2-25); check intake air ducts (PMCS, Item 16).

STEP 5. Check for air in the fuel system.
Bleed the fuel system, PMCS, Item 12.

STEP 6. Check for an air leak at the turbocharger.
Check/correct air leak, PMCS, Item 19.

STEP 7. Check to see if more than one sealing washer is under an injector.
Remove extra washer (para. 2-39).

STEP 8. Check for malfunctioning injectors.
Replace injectors (para. 2-39).

STEP 9. Check for a malfunctioning turbocharger.
Replace turbocharger (para. 2-26).

STEP 10. Check to see if (injection) fuel pump is overfueled.
a. Check fuel pressure and fuel rate (flow).
b. If pressure or rate is below specifications replace pump (para. 2- 32).

11. Engine running hot.

STEP 1. Check for low coolant level.
Replenish coolant.

STEP 2. Check for loose drive belt on water pump/fan.
Correct belt tension, PMCS, Item 18.

STEP 3. Check to see if air flow to the radiator is adequate.
Repair cooling air ducts and shutters.

STEP 4. Check to see if radiator fins are plugged.
Blow debris from fins.

STEP 5. Check for an incorrect/malfuncti6ning pressure cap.
Replace cap with one rated at-15 psi (103 kPa).

STEP 6. Check for a collapsed radiator hose.
Replace hose (para. 2-18).

STEP 7. Check for a malfunctioning temperature sensor.
Replace temperature sensor (para. 2-19).

STEP 8. Check for generator set overloaded.
Verify that the generator output does not exceed the rating.

Table 2-2. Troubleshooting - CONT

Malfunction Test or Inspection Corrective Action

STEP 9. Check for a malfunctioning water pump.
Replace the water pump (para. 2-35).

STEP 10. Check to see if fuel pump timing is correct. Bar engine to TDC. Verify the scribe marks on the injection pump flange and the gear housing are aligned. If replacing with new or rebuilt fuel pump without scribe marks, take up gear lash by rotating the pump opposite the direction of drive rotation (para. 2-32).

STEP 11. Check for a malfunctioning or incorrect thermostat (para. 2-23).

WARNING

Make sure engine coolant temperature is below 120°F (50°C). Hot steam can cause serious personal injury.

a. Remove the upper radiator hose from the thermostat housing.
b. Install a hose of the same size on the thermostat housing outlet long enough to reach a remote dry container used to collect coolant.
c. Install and tighten a hose clamp on the housing outlet.
d. Install the end of the hose in a dry container.
e. Operate the engine at rated RPM for one (1) minute.
f. Shut the engine off, and measure the amount of coolant collected in the container.
g. The amount of coolant collected must not be more than 3.3 fluid ounces (100 cc).
h. If more than 3.3 fluid ounces (100 cc) is collected, the thermostat or thermostat seal is leaking.
i. Replace thermostat (para. 2-23).

STEP 12. Check to see if fuel pump is overfueled.
a. Check fuel pressure and fuel rate (flow).
b. If pressure or rate is below specifications replace pump (para. 2-31).

12. Engine running too cold.

STEP 1. Check to see if cold operation aids are malfunctioning or if they are needed.
Check shutters, and enclosure heaters.

STEP 2. Check for incorrect thermostat or broken thermostat jiggle pin (para. 2-23).

Table 2-2. Troubleshooting - Cont

Malfunction Test or Inspection Corrective Action

13. Generator set not producing voltage.

STEP 1. Check to see if circuit breaker is open. Correctly apply load.

a. Verify frequency and voltage are correct. Close circuit breaker and apply load
b. Refer to operator's manual, TM 55-1905-223-24-10 for automatic transfer.

STEP 2. Check for malfunctioning voltmeter. Measure line voltage at the generator circuit breaker as follows:

WARNING

Line voltage is present at the regulator board and the terminal strip when the generator is running.

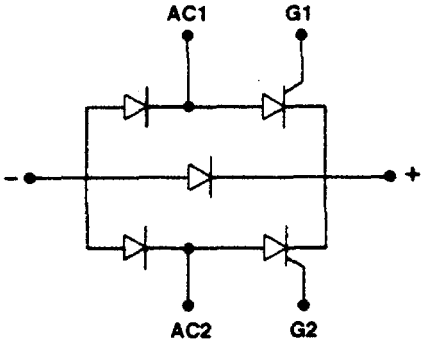
a. Connect a frequency meter to terminals V7 and VO (120 volts AC).
b. Start the generator set.
c. Verify that the generator set output frequency is correct (63 Hz or 53 Hz for droop; 60 Hz or 50 Hz for isochronous). Adjust the frequency if necessary.
d. If the frequency is correct, turn off the generator set.
e. Disconnect the frequency meter from terminals V7 and VO and connect a voltmeter to terminals L1 and L2 on the generator set circuit breaker.
f. Start the generator set.
g. Carefully rotate the VOLTAGE adjustment to obtain the desired line voltage output (clockwise to increase).
h. If voltmeter gauge readings are still incorrect. Replace defective gauge. (Refer to TM 55-1905-223-24-18.)

STEP 3. Check for defective voltage regulation on SCR module.
Check SCR module as follows:

a. Check SCR Module on RX1 scale.
b. Connect ohmmeter from (=) to (-). You should read high resistance in one direction and low resistance in the other.
c. Connect ohmmeter from AC1 to (+). You should read high resistance in both directions. Repeat for AC2.
d. Connect ohmmeter from AC1 to (-). You should read high resistance in one direction and low resistance in the other. Repeat for AC2.
e. C1 to (+) should see low resistance in one direction and high resistance in the other. Repeat for G2.

Table 2-2. Troubleshooting - CONT

Malfunction Test or Inspection Corrective Action

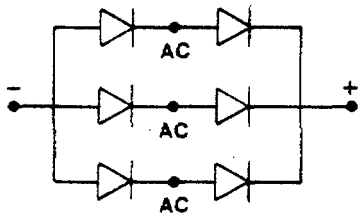


f. If any of the above checks indicates a faulty SCR module, replace module.

STEP 4. Check for defective mini-bridge rectifier as follows:

a. Connect an ohmmeter from each AC terminal to (-) terminal. You should see low resistance in one direction and high resistance in the other direction.

b. Connect an ohmmeter from each AC terminal to (+) terminal. You should see low resistance in one direction and high resistance in the other direction.



c. If any of the above checks indicate a faulty rectifier. Replace rectifier. (Refer to TM 55-1905-223-24-18.)

14. Generator set output voltage high or low.

WARNING

Avoid electrical shock. Line voltage is present.

Table,2-2. Troubleshooting - CONT

Malfunction Test or Inspection Corrective Action

STEP 1 Check for a malfunctioning voltmeter.

Using a voltmeter, check across the circuit breaker to determine phase loading:
Line 1 - Line 2
Line 2 - Line 3
Line 1 - Line 3

If the voltage drop between any two legs is more than 1O%, the load must be reconnected to the generator set phases.

STEP 2. Check for incorrect voltage regulator adjustment.

a. Using a multimeter check for generator output.

Maximum	Minimum
43 KW	33 KW

b. If output is not within specified range'.

c. Adjust the voltage regulator for proper voltage output, dampening and stability as follows:

WARNING

To avoid electrical shock. Make sure the generator set is off and the circuit breaker is on open.

(1) Secure generator set, then carefully remove the insulating sealant from the dampening, voltage, and stability potentiometers on the regulator board.
(2) Rotate the voltage adjustment fully counterclockwise.
(3) Rotate the dampening adjustment fully clockwise.
(4) Adjust the remote rheostat to approximately mid-position.
(5) Connect a frequency meter to terminals V7 and VO (120 volts AC).
(6) Start the generator set.
(7) Verify that the generator set output frequency is-correct (60 Hz or 50 Hz for isochronous). Adjust the frequency if necessary.
(8) If the frequency is correct, turn off the generator set.
(9) Disconnect the frequency meter from terminals V7 and VO and connect a voltmeter to terminals L1 and L2 on the generator set circuit breaker.

Table 2-2. Troubleshooting - CONT

Malfunction Test or Inspection Corrective Action

(10) Start the generator set.
(11) Carefully rotate the voltage adjustment to obtain the desired line voltage output (clockwise to increase).
(12) Observe the regulator board LED.
(13) If the LED flickers, adjust the dampening and stability potentiometers to approximately mid-positions.
(14) Alternately adjust each potentiometer until the LED glows steadily.
(15) Turn off the generator set.
(16) Disconnect the voltmeter and reseal the voltage, dampening, and stability potentiometers with RTV sealant.

15. Generator set output frequency high or low.

Check for fuel control lever not going to full speed position.
Correct lever travel. Refer to Malfunction 9, Item 2.

16. Generator set output fluctuating (frequency or voltage).

STEP 1. Check for unstable load on set.
Open the generator set circuit breaker to see if engine speed is stable.

STEP 2. Check for unstable engine speed.
Refer to "Generator set will not pull the load (low engine power), Malfunction 9.

17. Engine will not shut down.

Check to see if engine is running on fumes drawn into the air intake.
Check the air intake ducts for the source of the fumes.

18. Fault lights illuminated; overtemperature shut down.

STEP 1. Check coolant level.
Replenish coolant.

STEP 2. Check to see if not enough air flows across radiator.
Check fan and belt. Look for obstructions that would prevent air flow across radiator.

STEP 3. Check for a malfunctioning temperature sensor.
Check for continuity across the temperature sensor. Should have continuity only when coolant temperature is above 107°C.

Table 2-2. Troubleshooting - CONT

Malfunction Test or Inspection Corrective Action

19. Fault lights illuminated; low oil pressure shut down.

    STEP 1. Check to see if oil level is low.
    a. Replenish oil.
    b. Remove oil pressure sensor (Malfunction 7, "Low Engine Oil Pressure," and Malfunction 1, "Engine will not crank."

20. Fault lights illuminated; over-crank.

    STEP 1. Check if engine is hot starting, or starts but shuts down within 30 seconds. Reset the fault or light and attempt to start engine. Refer to Malfunctions 2 and 3.

21. Resistor in instrument panel assembly fails. Check using multimeter.

Section V. UNIT MAINTENANCE PROCEDURES

MAINTENANCE OF EMERGENCY GENERATOR SET

2-12. Replace/Repair Instrument Panel Assembly. (FIGURE 2-5)

This task covers: a. Inspection b. Removal, c. Repair, d Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's
rail and marine diesel engines,
5180-00-629-9783

Materials/Parts

Instrument panel assembly
P/N 612-6459
Warning tags, Item 21, Appendix C

Equipment Condition

Starter motor disconnected from battery
(para. 2-20).
Equipment secured and tagged
"Out of Service" (TM 55-1905-223-10).

INSPECTION

Inspect the gauges for broken lenses, knobs, and burned out lamps. Replace as required.

REMOVAL

a. Remove machine screws and washers (1).

b. Partially slide instrument panel (2) from housing.

c. Tag and disconnect 'wiring. Remove instrument panel.

REPAIR

Repair at Unit Maintenance level is to replace resistor assembly. Reference paragraph 2-13.

REPLACEMENT

a. Slide the instrument panel (2) into housing.

b. Connect electrical wiring as tagged.

c. Install screws and washers (1) to secure instrument panel to housing.

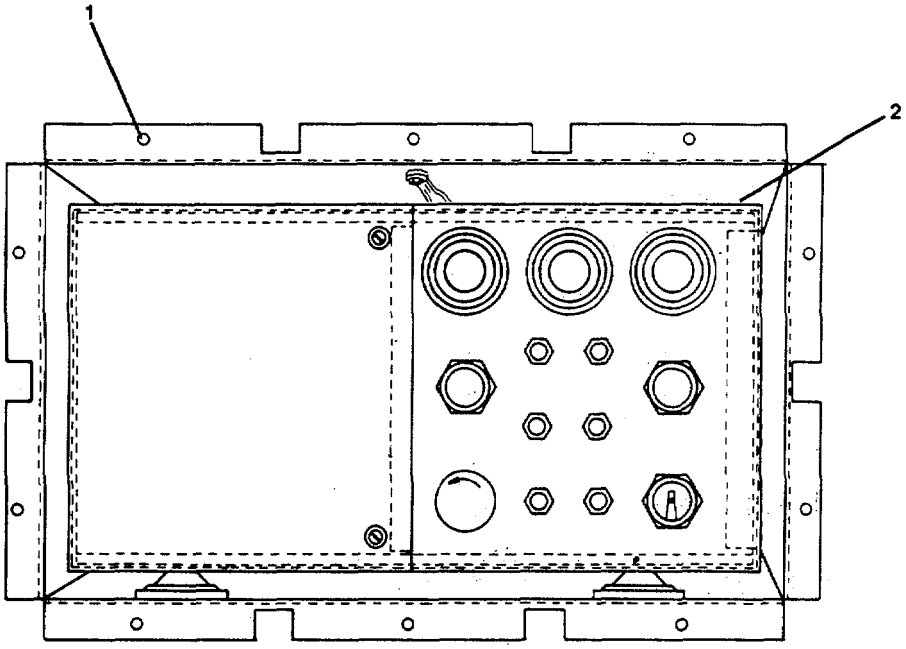


FIGURE 2-5. Instrument Panel Assembly.

2-13. Replace/Repair Resistor Assembly. (FIGURE 2-6)

This task covers: a. Removal, b. Repair, c. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's rail and marine diesel engines, 5180-00-629-9783

Equipment Condition

Generator set power disconnected.
Equipment tagged "Out of Service."
Remove instrument panel (para. 2-12).

Materials/Parts

Resistor Assembly P/N 304-0790
Resistor P/N 304-0789-02
Warning tags, Item 21, Appendix C

REMOVAL

a. Remove four machine screws (5) and lockwashers (6) from the resistor assembly (1) on the back of instrument panel assembly.

b. Remove resistor bracket (4) from instrument panel assembly.

REPAIR

a. Remove machine screws.(7) and assembled nut washers (2).

b. Remove resistor (3).

c. Install new resistor.

d. Install assembled nut washers (2) and machine screws (7).

REPLACEMENT

a. Install resistor bracket (4) on back of control box.

b. Install four lockwashers (6) and four machine screws (5) to secure the resistor assembly (1) to back of instrument panel assembly.

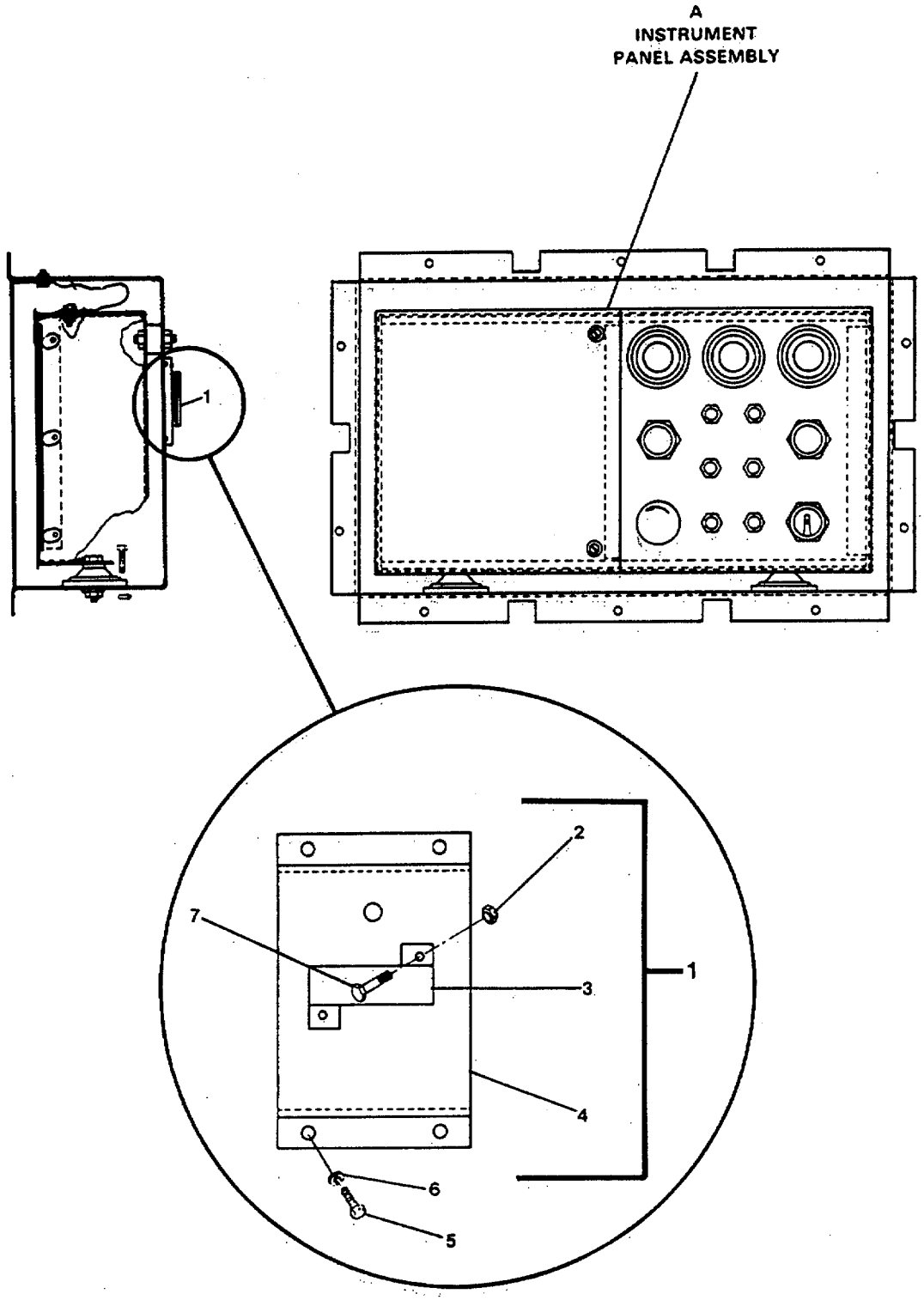


FIGURE 2-6. Resistor Assembly.

2-14. Replace/Repair Door Assembly (Left Hand). (FIGURE 2-7)

This task covers: a. Removal, b. Repair, c. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's rail and marine diesel engines, 5180-00-629-9783

Equipment Condition

Equipment secured and tagged "Out of Service" (TM 55-1905-223-10).
Starter disconnected (para. 2-20).

Materials/Parts

Warning tags, Item 21, Appendix C

REMOVAL

a. Unscrew two latch screws (2).

b. Remove three screws (3) and three lockwashers (4) on inside hinge.

c. Remove left hand door (1).

REPAIR

Repair of left hand door assembly is accomplished by replacement.

REPLACEMENT

a. Position door (1) on instrument panel.

b. Install lockwashers (4) and screws (3) on inside hinge.

c. Close door; secure latch screws (2).

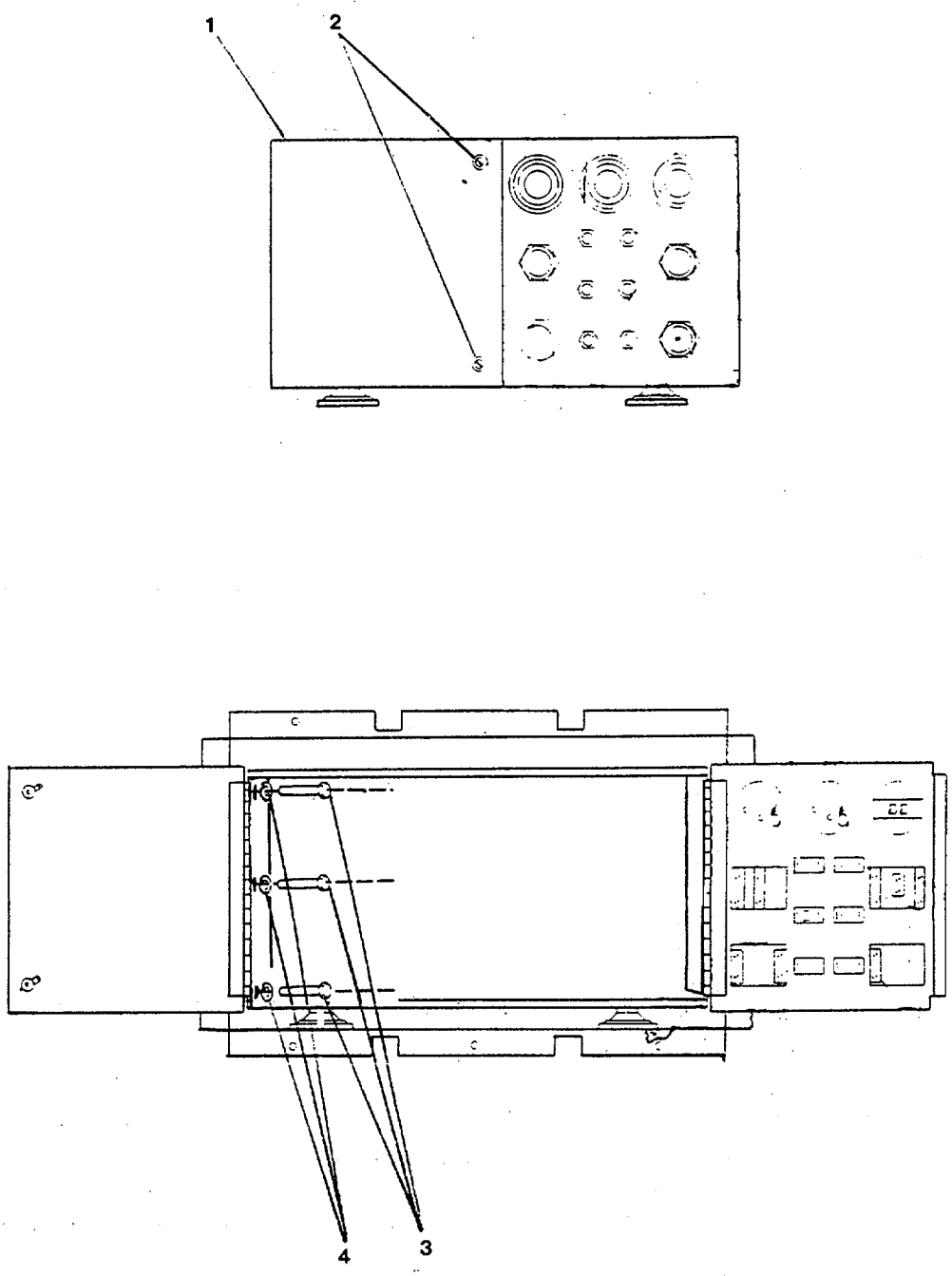


FIGURE 2-7. Door Assembly (Left hand).

2-15. Replace/Repair Door Assembly (Right Hand). (FIGURE 2-8)

This task covers: a. Removal, b. Repair, c. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's rail and marine diesel engines, 5180-00-629-9783

Equipment Condition

Equipment secured and tagged "Out of Service" (TM 55-1905-223-10)
Starter disconnected (para. 2-20).

Materials/Parts

Red lens P/N 308-0561
Yellow lens P/N 308-0563
Door assembly, RH P/N 319-0049
Warning tags, Item 21, Appendix C
Zenor diode P/N 359-0082
Lamp Module P/N 308-0546

REMOVAL

a. Remove retaining nuts (6).

b. Remove yellow lens (4), red lens (5), and lamp module (3) from push switch (2).

c. Use a flat head screwdriver to open the door. Insert into screws (1) and turn counterclockwise to release latches inside instrument panel. Swing both doors open.

d. Disconnect electrical lead (8) and ground wire (10) from terminal board (7).

e. Remove machine screw (13) and hexagon nut (14). Remove electrical lead (15) connecting zenor diode (12) to resistor (9).

f. Unscrew retaining nut (11) and remove zenor diode (12).

g. Remove three machine screws (18) and lockwashers (17).

h. Remove right hand door assembly (16).

REPAIR

Repair at this level of maintenance is by replacement of: Red lens (5), yellow lens (4), zenor diode (12), lamp module (3), and door assembly (16).

REPLACEMENT

a. Position right hand door assembly (16) on right side of instrument panel. Secure door assembly to instrument panel with three machine screws (18) and lockwashers (17).

b. Position zenor diode (12) in hole and secure with retaining nut (11).

c. Secure electrical lead (15) to end of zenor diode with machine screw (13) and hexagon nut (14).

d. Connect ground wire (10) and electrical lead (8) to terminal board (7).

e. Close both doors and secure by using a flat head screwdriver to turn screws (1) clockwise to latch doors.

f. Position push switch (2) in holes and install lamp module (3), yellow lens (4) and red lens (5). Secure with retaining nuts (6).

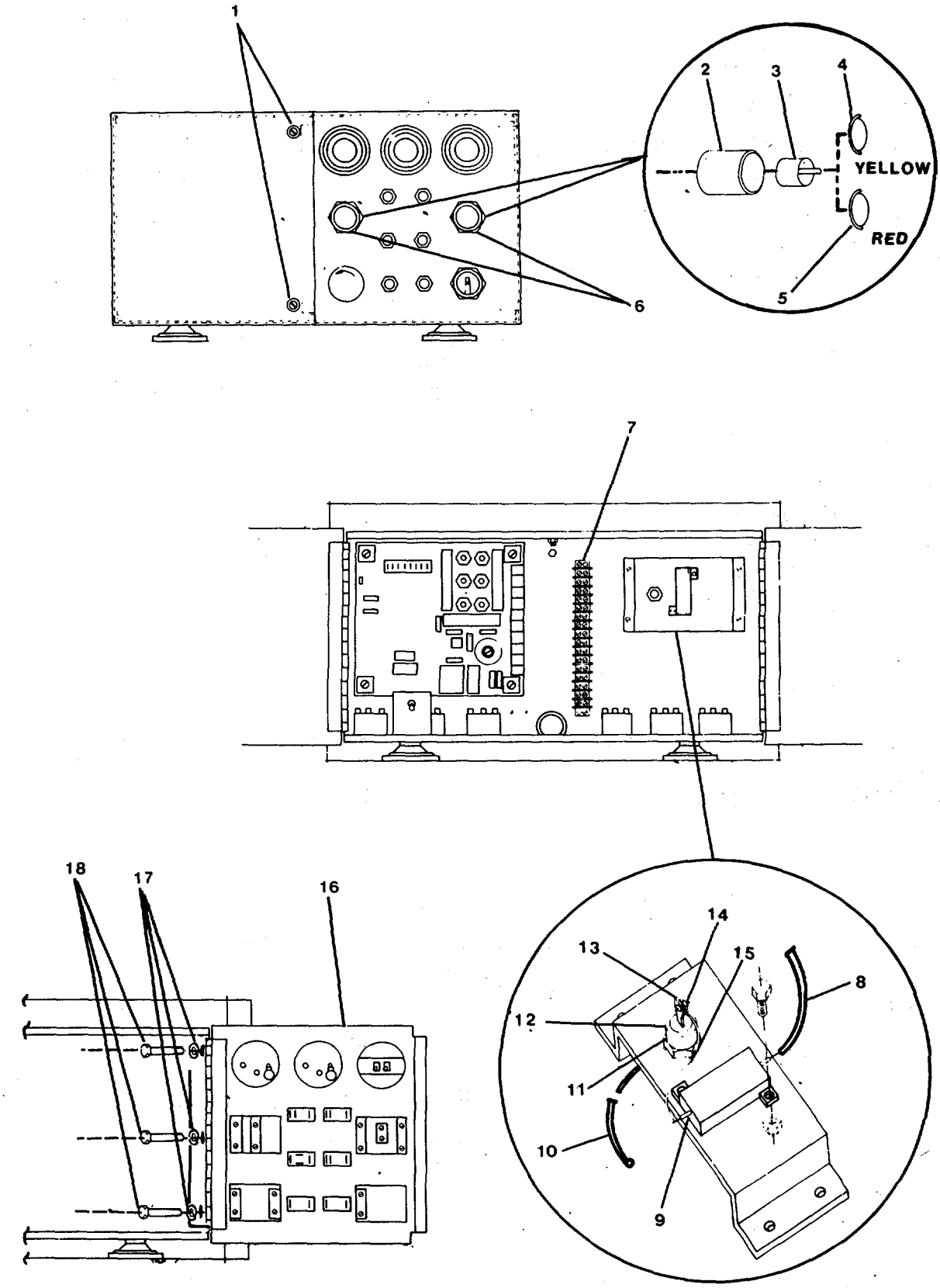


FIGURE 2-8. Door Assembly (Right hand).

2-16. Replace/Repair Generator Heater Assembly. (FIGURE 2-9)

This task covers: a. Removal, b. Repair, c. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's rail and marine diesel engines, 5180-00-629-9783

Equipment Condition

Emergency generator set secured (TM 55-1905-223-10).
Power to generator heater assembly OFF.

Materials/Parts

Flow control thermostat P/N 309-0258
Heater assembly P/N 179-2264
Heater element P/N 333-0192
Warning tags, Item 21, Appendix C
Cable assembly P/N 335-0143

REMOVAL

a. Remove hex head capscrews (2) and remove top cover (1).

b. Remove hex head capscrews (4) and remove front cover (3).

c. Remove hex head capscrews (20) and remove grille (21).

d. Remove cable locking ties (5).

e. Remove self-locking screw (7), hex nut (6) and J clamp (8).

f. Remove hex nuts (14) and cable assembly (9).

g. Remove nut (16), lockwasher (15) and capscrew (19).

h. Remove flat washers (17) and heater element (18).

i. Remove nonmetallic grommets (10), connector (11), and insulation sleeve (12).

j. Remove flow control thermostat (13).

REPAIR

Repair at this level of maintenance is by replacement of: Cable assembly (9), flow control thermostat (13), and heater element (18).

REPLACEMENT

a. Install flow control thermostat (13) and replace insulation sleeve (12), connector (11) and nonmetallic grommets (10).

b. Install flat washers (17) and heater element (18).

c. Secure with hex head capscrew (19), 1ockwasher (15) and nut (16).

d. Install cable assembly (9) on heater element (18) and secure with hex nuts (14).

e. Position cable assembly (9) in J clamp (8) and secure with self-locking screw (7) and hex nut (6)

f. Install cable locking ties (5).

g. Replace grille (21) and secure with hex head capscrews (20).

h. Replace front cover (3) and secure with hex head capscrews (4).

i. Replace top cover (1) and secure with hex head capscrews (2).

j. Restore power to emergency generator set, (TM 55-1905-223-10).

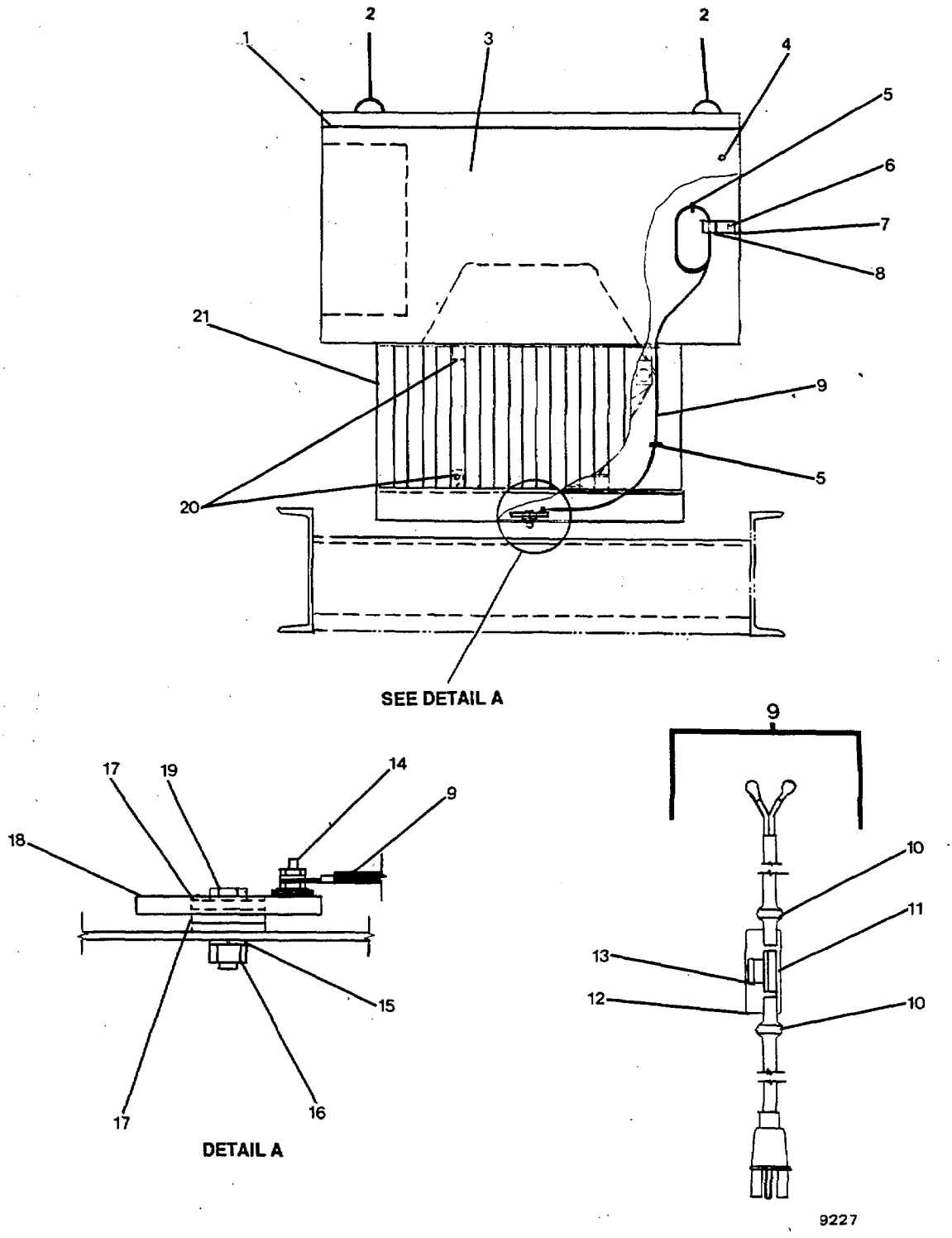


FIGURE 2-9. Generator Heater Assembly.

2-17. Replace Overspeed Assembly., (FIGURE 2-10)

This task covers: a. Removal, b. Replacement.

INITIAL SETUP

Tools

Tool kit, electrician's,
5180-00-391-1087

Equipment Condition

Control housing removed by Direct Support personnel.
Generator, secured and tagged "Out of Service" (TM 55-1905-223-10).

Materials/Parts

Overspeed assembly
P/N 539-0922
Warning tags, Item 21, Appendix C

REMOVAL

a. Disconnect and tag wiring from point assembly (4).

b. Remove screws (1, 2) from mounting brackets (3).

c. Remove overspeed assembly.

REPLACEMENT

a. Install overspeed assembly.

b. Connect wiring as tagged to point assembly (4).

c. Install screws (1, 2) to mounting brackets (3).

d. . Notify Direct Support personnel to replace control housing.

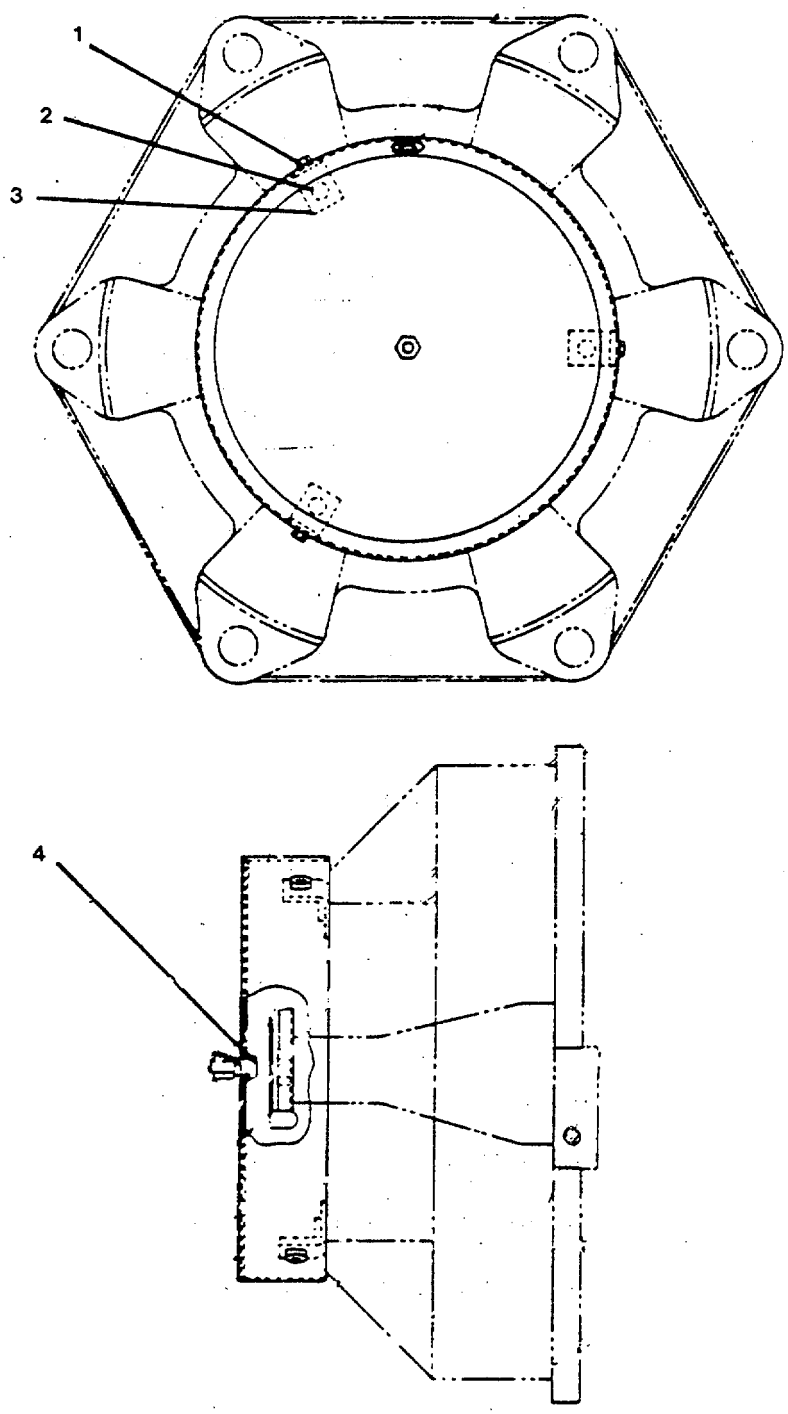


FIGURE 2-10. Overspeed Assembly.

2-18. Repair Radiator Assembly. (FIGURE'2-11)

This task covers: a. Disassembly, b. Repair, c. Assembly.

INITIAL SETUP

Tools

Tool kit, general mechanic's rail and marine diesel engines, 5180-00-629-9783

Equipment Condition

Engine secured and tagged "Out of Service" (TM 55-1905-223-10).
Coolant drained.

Materials/Parts

Nonmetallic hose P/N 503-1931-01
Coolant, Item 4, Appendix C
Warning tags, Item 21, Appendix C
Nonmetallic hose P/N 503-1379-01

DISASSEMBLY

a. Remove hose clamps to engine.

b. Remove hose clamps (2, 6, 9) to radiator.

c. Remove inlet tube (1) and nonmetallic hose (3, 8).

d. Remove outlet tube (5) and nonmetallic hose (4, 7).

REPAIR

Repair at this level of maintenance is by replacement of: Nonmetallic hoses (3, 4, 7, and 8).

ASSEMBLY

a. Install nonmetallic hoses (7) and (4), and outlet tube (5).

b. Install nonmetallic hoses (8) and (3) and inlet tube (1).

c. Install hose clamps (2, 6, 9) to radiator.

d. Install hose clamps to engine.

NOTE

For coolant mixture, refer to TB 55-1900-207-24.

e. Replace coolant in radiator.

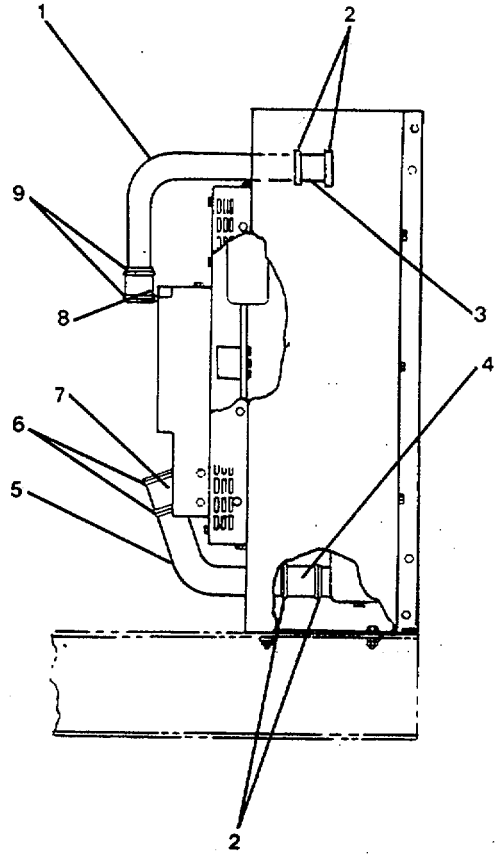


FIGURE 2-11. Radiator Hose Assemblies.

2-19. Repair Diesel Engine.. (FIGURE 2-12)

This task covers: Repair.

INITIAL SETUP

Tools

Tool kit, general mechanic's
rail and marine diesel engines,
5180-00-629-9783
Torque wrench kit P/N 3377216
Combination wrench set, metric 10mm
thru 24mm, 5120-01-046-4979

Equipment Condition

Diesel, engine shut down and tagged
"Out of Service" (TM 55-1905-223-10).
Battery banks disconnected.

Materials/Parts

Engine electric starter P/N 3904057.
Temperature transmitter P/N 193-0375
Pressure transmitter P/N 193-0244
Pressure switch P/N 309-0557
Oil pressure gauge, Item 15, Appendix C
Warning tags, Item 21, Appendix C

REPAIR

a. Remove pressure switch (5) from nipple (3).

(1) Install oil pressure gauge.

(2) Start engine and measure oil pressure.

(3) Minimum oil pressure:

At idle: 10 psi
At full speed: 30 psi

b. Replace pressure switch (5).

c. Remove pressure transmitter (4) by unscrewing from nipple (3).

d. Remove temperature transmitter (1) by removing the nut, lockwasher and flat washer, securing it to the engine (2).

e. Tag and disconnect wires to electric starter (6); remove two bolts (7) and remove starter.

f. Replace pressure transmitter (4) by screwing on to nipple (3).

g. Replace temperature transmitter (1) by securing to engine (2) with flat washer, lockwasher and nut.

h. Install starter (6) and secure to engine with two bolts (7), torque 32 ft- lbs (43 N-m). Remove tags and connect wires.

i. Reconnect batteries.

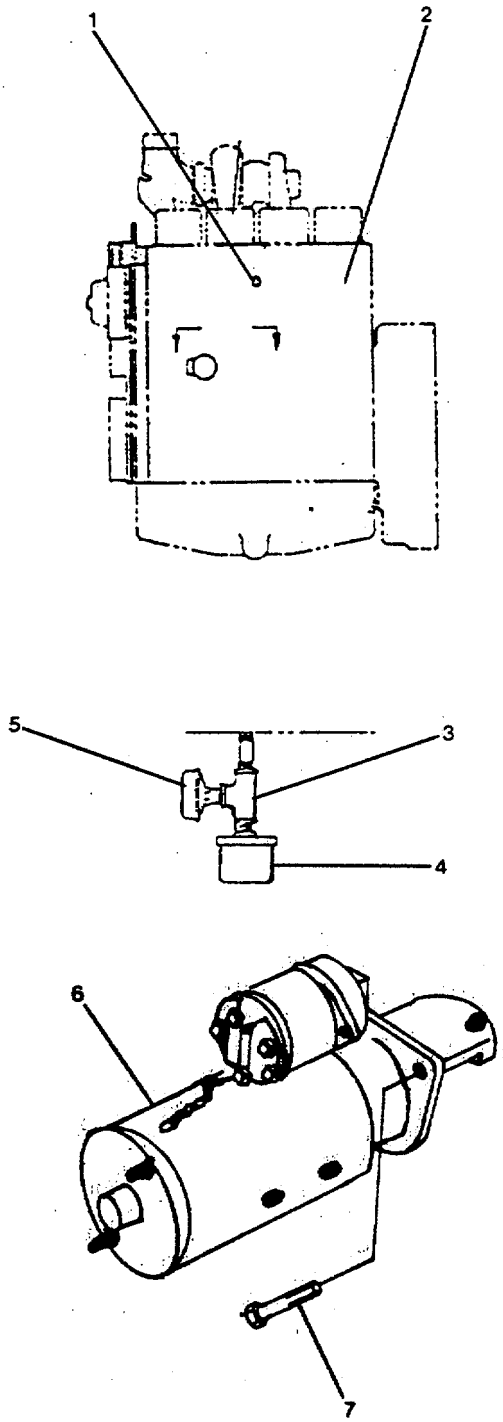


FIGURE 2-12. Diesel Engine Repair.

2-20. Replace/Repair Starting Motor Group. (FIGURE 2-13)

This task covers: a. Removal, b. Repair, c. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's rail and marine diesel engines, 5180-00-629-9783
Torque wrench kit P/N 3377216

Equipment Condition

Engine secured (TM 55-1905-223-10).
Power supply disconnected and tagged "Out of Service".
Battery banks disconnected.

Materials/Parts

Starting motor P/N 3904057
Warning tags, Item 21, Appendix C

REMOVAL

a. Disconnect ground cable from the battery terminal.

b. Tag each electrical wire to indicate locations.

c. Use 15 mm closed wrench, remove two bolts (1) from mounting.

d. Remove starting motor (2) from block.

REPAIR

Repair at this level of maintenance is by replacement of: Starting motor (2).

REPLACMENT

a. Install starting motor.

b. Secure by installing bolts (1). Torque to 32 ft-lbs (43 N-m).

c. Connect ground cables to battery terminal in the proper location as identified by tag.

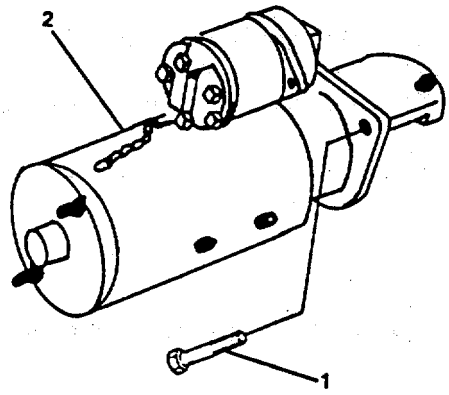


FIGURE 2-13. Starting Motor.

2-21. Replace/Repair Alternator Mounting Croup. (FIGURE 2-14)

This task covers: a. Removal, b. Repair, c. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's
rail and marine diesel engines,
5180-00-629-9783
Torque wrench kit P/N 3377216
Belt tension gauge P/N ST-1293

Equipment Condition

Engine shut down and tagged "Out of Service" (TM 55-1905-223-10).
Right side protective cover removed.

Materials/Parts

V belt P/N 3903090
Warning tags, Item 21, Appendix C

REMOVAL

a. Tag alternator electrical wires and remove.

b. Loosen belt tensioner (2).

c. Remove V belt (3).

d. Remove capscrew (1) and belt tensioner (2).

e. Remove screws (4) from bracket (5).

f. Remove alternator bracket (5).

REPAIR

a. Inspect the V-belt for cracks, stretching or breaks.

b. Discard the V-belt if damaged.

REPLACMENT

a. Install the alternator bracket (5) with screws (4).

b. Replace the belt tensioner (2) install capscrew (1)..

c. Replace-V Belt (3), and torque capscrew (1) to 32 ft-lbs (43 N•m).

d. Using a belt tension gauge, measure the belt deflection at the longest span of the belt. Maximum Deflection: 9.5 - 12.7 mm (3/8 - 1/2 inch).

e. Replace electrical wires as tagged.

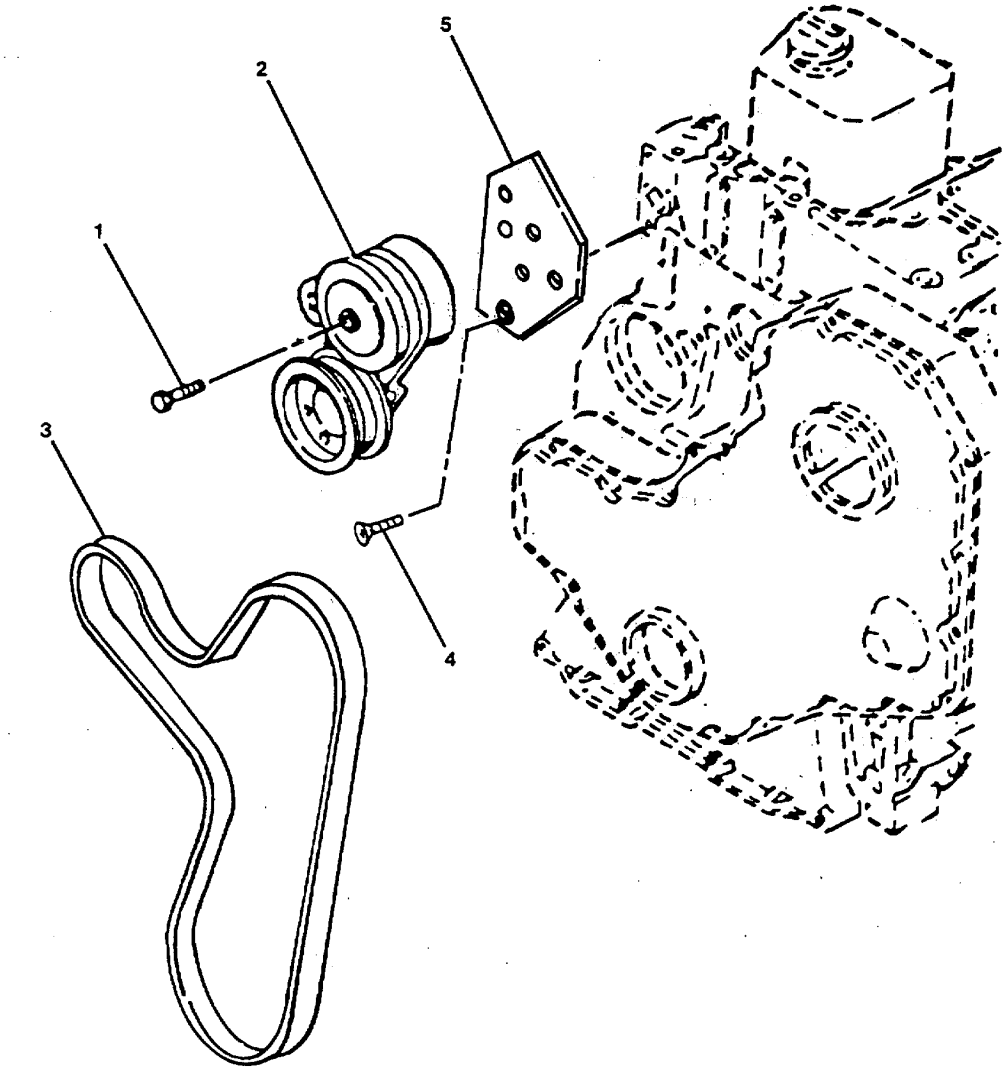


FIGURE 2-14. Alternator Mounting Group.

2-22. Replace Alternator Support Group and Alternator. (FIGURE 2-15)

This task covers: a. Removal, b. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's
rail and marine diesel engines,
5180-00-629-9783
Torque wrench-kit P/N 3377216

Equipment Condition

Engine shutdown and tagged "Out of Service"
(TM 55-1905-223-10).
Alternator mounting group removed
(para. 2-21).

Materials/Parts

Alternator support group
P/N 13.02.03
Alternator
P/N 3911462
Warning tags, Item 21, Appendix C

REMOVAL

a. Remove bolt (4), spacer (2) and screw (1).

b. Remove alternator support (3).

c. Hold the alternator (9) for-support.

d. Remove capscrews (5) and alternator brace (6).

e. Remove pulley retainer (7) and pulley (8).

f. Remove alternator.

REPLACEMENT

a. Position alternator (9) in place.

b. Install pulley (8) and pulley retainer (7).

c. Install alternator brace (6) with capscrews (5). Torque to 18 ft-lb (24 N-m).

d. Install alternator support (3).

e. Install screw (1), spacer (2) and bolt (4).

f. Install alternator mounting group (para. 2-21).

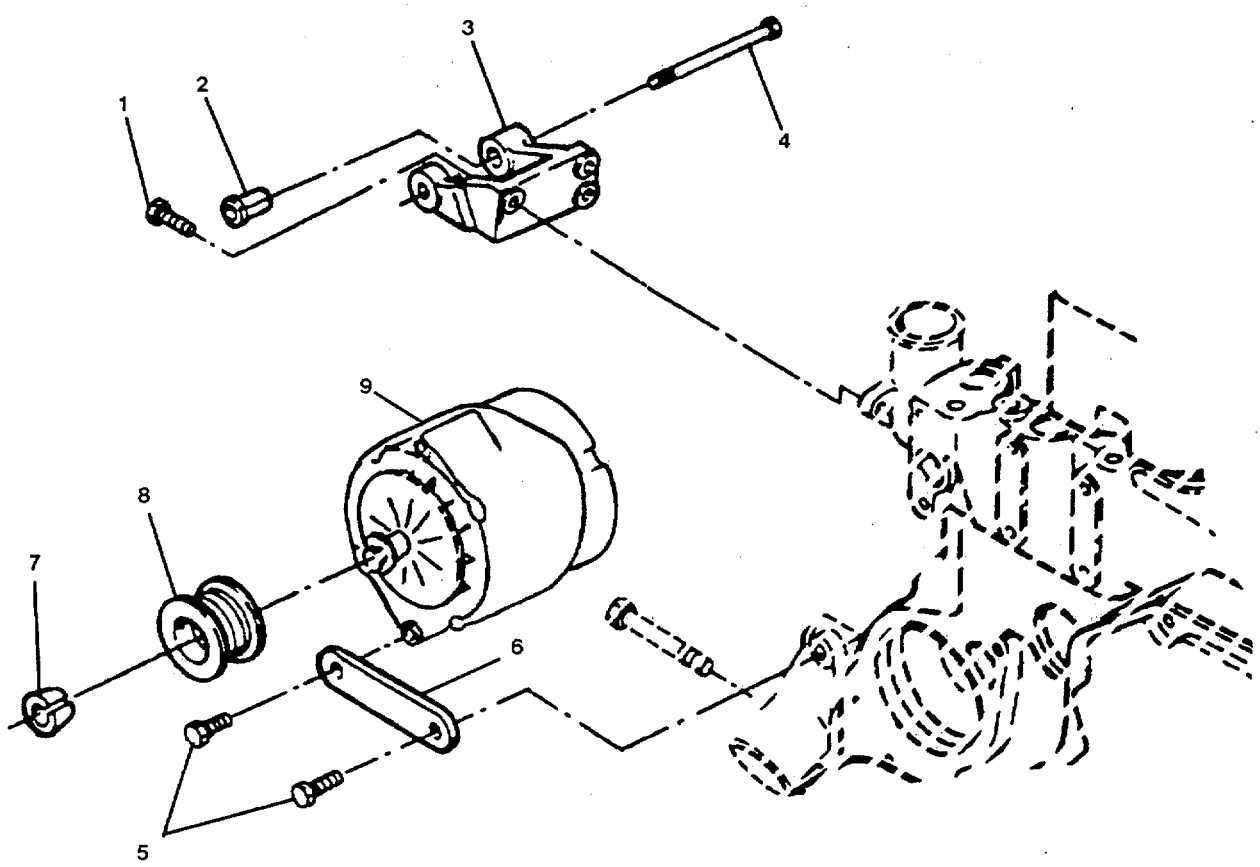


FIGURE 2-15. Alternator Support Group and Alternator.

2-23. Replace/Repair Thermostat and Housing Group. (FIGURES 2-16 and 2-17)

This task covers: a. Removal, b. Inspection, c. Repair, d. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's
rail and marine diesel engines,
5180-00-629-9783
Torque wrench kit P/N 3377216

Equipment Condition

Engine shut down and tagged "Out of Service" (TM 55-1905-223-10).
Coolant drained.
Battery banks disconnected.

Materials/Parts

Flow control thermostat P/N 3912587
Gasket P/N 3903301
Coolant, Item 4, Appendix C
Warning tags, Item 21, Appendix C

REMOVAL

a. Remove the V belt (para. 2-21) from the alternator pulley.

b. Disconnect the negative (-) battery cable.

c. Loosen the alternator capscrew. Remove the alternator mounting capscrew and lower the alternator to gain access to the thermostat. Refer to para. 2-22.

d. Remove two bolts (1) and capscrew (2).

e. Carefully, remove water outlet (3), thermostat (4), gasket (5) and lifting bracket (6).

INSPECTION

a. Verify that the "jiggle" pin (1, FIGURE 2-17) is securely in place.

b. Make sure the vent notch (2) is open and free of corrosion.

c. Check the thermostat for correct operation. Requirements: It should start to open at 181°F (83°C); fully open at 203°F (95°C).

d. Put the thermostat and a thermometer into a container of water. Use a wire to hold the thermostat the thermometer so that they will not touch the container.

e. Heat the water. Write down the temperature at which the thermostat begins to open and when it is fully open.

f. The thermostat must begin to open at 181°F ± 2° (83° ± 1°C). The thermostat must fully open to at least a .375-inch (9.5 mm) space between the seal sleeve and the brass part of the thermostat.

g. Replace the thermostat if it does not operate as described.

REPAIR

Repair at this level of maintenance is by replacement of: Thermostat (4) and gasket (5).

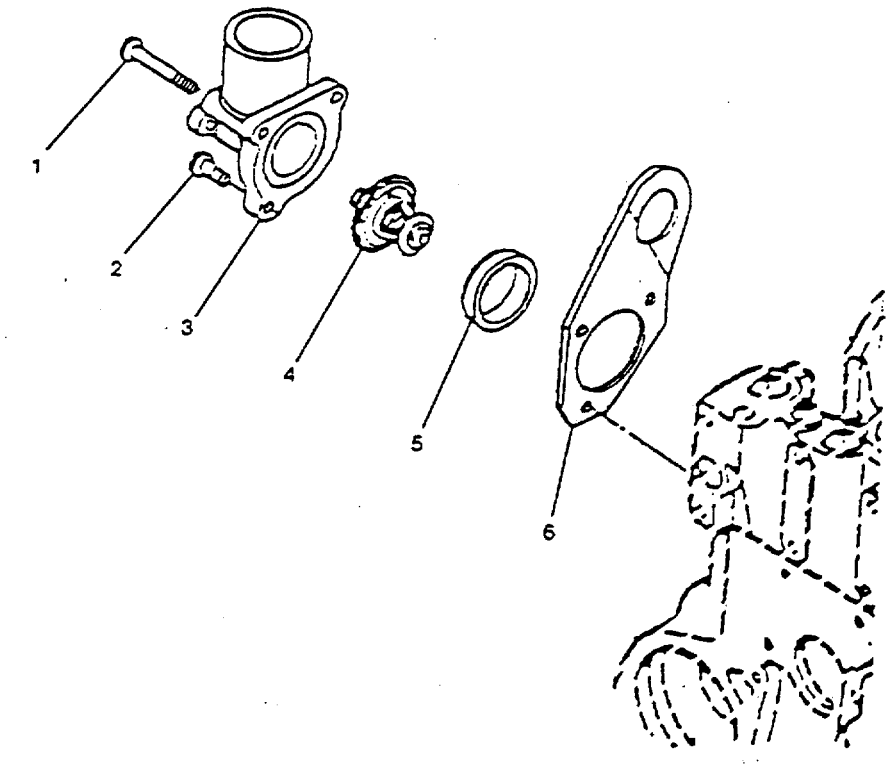


FIGURE 2-16. Thermostat Housing.

REPLACEMENT

a. Position the thermostat, make sure the rounded "point" on the thermostat aligns with the notch on the housing.

b. Make sure that the "jiggle" pin (1, FIGURE 2-17) is in its notch (2) and the tang (3) is in the slot (4) in the housing.

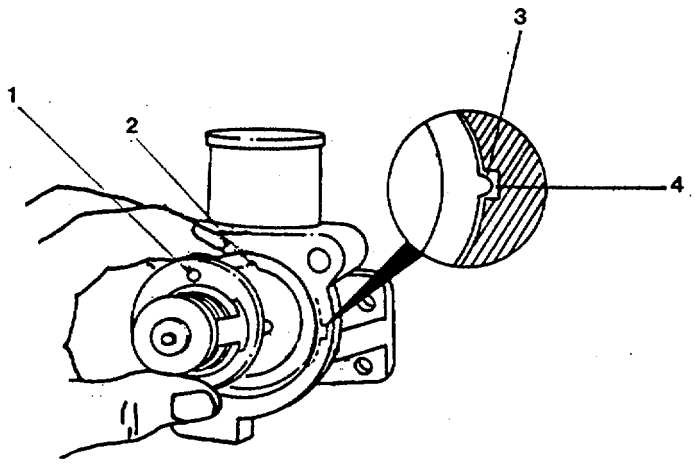


FIGURE 2-17. Thermostat Alignment.

c. "Package" the lifting bracket (6, FIGURE 2-16) and gasket (5) to the thermostat (4) and housing (3). Install capscrew (2) and bolts (1). Torque to 18 ft-lb (24 N-m).

d. Replace alternator (para. 2-22).

e. Connect the negative (-) battery cable and replace V belt (para. 2-21) on the alternator pulley.

NOTE

For coolant mixture, refer to TB 55-1900-207-24.

f. Replace coolant.

2-24. Replace/Repair Water Inlet Connection Group. (FIGURE 2-18)

This task covers: a. Removal, b. Repair, c. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's
rail and marine diesel engines,
5180-00-629-9783
Combination wrench set, metric
10mm thru 24mm, 5120-01-046-4976
Torque wrench kit P/N 3377216

Equipment Condition

Engine secured and tagged "Out of Service" (TM 55-1905-223-10).
Battery cable disconnected.
Coolant drained.
Right side protective cover removed.

Materials/Parts

Preformed packing P/N 3906697
Coolant, Item 4, Appendix C
Warning tags, Item 21, Appendix C

REMOVAL

a. Remove drive belt and alternator group (para. 2-21).

b. Locate water inlet connection (2).

c. Remove three bolts (1). Remove hose clamp off radiator.

d. Remove water inlet connection (2) and preformed packing (3). Discard preformed packing.

REPAIR

Repair of the water inlet connection consists of replacement of preformed packing (3).

REPLACEMENT

a. Position water inlet connection (2) and preformed packing (3) on engine.

b. Install three bolts (1). Torque to 32 ft-lb (43 N•m). Install hose clamp on radiator.

c. Install alternator group (para. 2-21).

d. Install protective cover.

NOTE

For coolant mixture, refer to TB 55-1900-207-24.

e. Replace coolant.

f. Connect battery cable before startup of generator set.

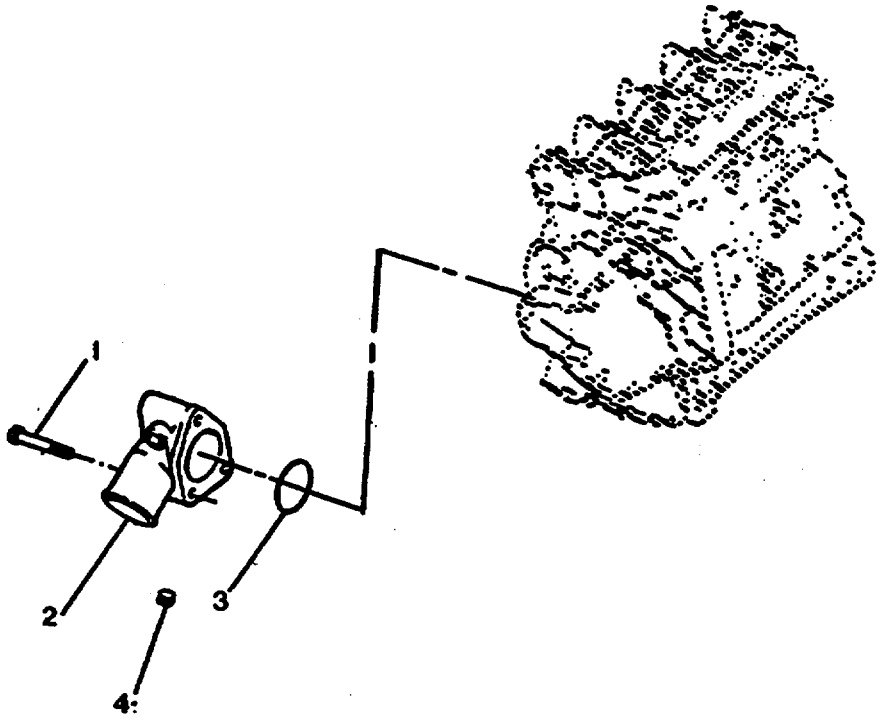


FIGURE 2-18. Water Inlet Connection.

2-25. Replace/Repair Air Cleaner Assembly. (FIGURE 2-19)

This task covers: a. Inspection, b. Service, c. Removal, d. Disassembly, e. Repair, f. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's rail and marine diesel engines, 5180-00-629-9783
Combination wrench set, metric 10mm thru 24mm, 5120-01-046-4979

Equipment Condition

Generator set secured and tagged "Out of Service" (TM 55-1905-223-10).

Materials/Parts

Air cleaner assembly P/N 140-2169
Intake filter element P/N 140-2158
Preformed hose P/N 503-1543
Detergent, Item 7, Appendix C
Warning tags, Item 21, Appendix C

INSPECTION

a. Inspect intake filter.

(1) Green color indicates air cleaner is working.

(2) Red color indicates air cleaner needs cleaning and/or repair.

b. Inspect fluid flow restrictor (3) for dirt and debris accumulation.

c. Remove wing nut (16) and take off air cleaner intake cover (15).

d. Loosen the air filter element retaining nut (14) and remove element (13).

e. Inspect air filter element for dirt and debris accumulation.

SERVICE

a. Wash element in warm water and detergent.

WARNING

High pressure compressed air tank, piping systems and air operated devices possess potential for serious injury to eyes and exposed areas of skin due to escaping air pressure.

b. Blow dry the element with compressed air.

c. Install air cleaner element in canister.

REMOVAL

a. Remove bolt (6) and self-locking nut (5) from lower bracket (7).

b. Remove bolt and lockwasher (9) from upper bracket (8).

c. Remove hose clamp (11).

d. Remove air cleaner assembly (4).

DISASSEMBLY

a. Remove hose clamp (12) connecting preformed hose (10) to metal tube assembly (1). Remove preformed hose (10).

b. Remove filter warning indicator (2) from fluid flow restrictor (3).

c. Remove wing nut (16) and air cleaner intake cover (15).

d. Remove filter retaining nut (14).

e. Remove intake filter element (13) from canister (17).

REPAIR

Repair at this level of maintenance is by replacement of: Preformed hose (10), filter warning indicator (2), and intake filter element (13).

ASSEMBLY

a. Place intake filter element (13)'inside canister (17).

b. Secure with filter retaining nut (14).

c. Replace air cleaner intake cover (15) and secure with wing nut (16).

d. Install filter warning indicator (2) on fluid flow restrictor (3).

e. Secure preformed hose (10) to metal tube assembly (1) with hose clamp (12).

REPLACEMENT

a. Position air cleaner assembly (4) on engine.

b. Connect hose clamp (11).

c. Secure air cleaner assembly to engine with upper bracket (8) and bolt and lockwasher (9).

d. Secure air cleaner assembly to engine with lower bracket (7), bolt (6) and self-locking nut (5).

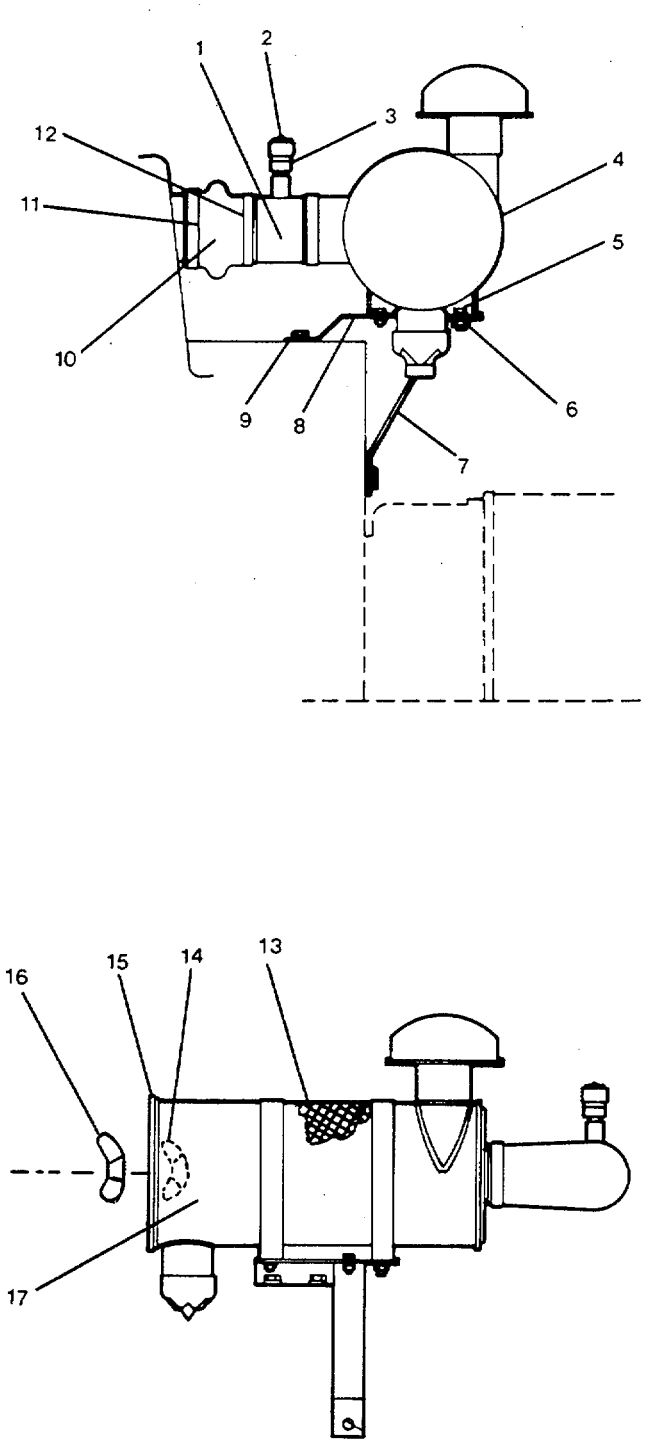


FIGURE 2-19. Air Cleaner Assembly.

2-26. Replace/Repair Turbocharger Group. (FIGURE 2-20)

This task covers: a. Removal, b. Repair, c. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's
rail and marine diesel engines,
5180-00-629-9783
Combination wrench set, metric
10mm thru 24mm,
5120-01-046-4979
Torque wrench kit P/N 3377216

Equipment Condition

Equipment secured and tagged "Out of Service" (TM 55-1905-223-10).
Air cleaner assembly removed (para. 2-25).

Materials/Parts

Nonmetallic hose P/N 3901804
Metallic bent tube P/N 3906623
Flexible tube P/N 3909546
Metallic tube P/N 3903740
Nonmetallic hose P/N 3903745
Bent metallic tube P/N 3903744
Oil drain gasket P/N 3901805
Turbocharger gasket P/N 3901356
Water manifold gasket P/N 3905443
Gasket P/N 3901999
Turbosupercharger, non-aircraft
P/N 3802113
Liquid teflon sealant, Item 10, Appendix C
Lubricating oil, Item 14, Appendix C
Warning tags, Item 21, Appendix C

REMOVAL

a. Disconnect hose clamps (1) and remove nonmetallic hoses (2) and bent metallic tube (3).

b. Remove straight pipe to tube adapter (5) and remove flexible tube (4).

c. Remove hose clamps (7), bent metallic tube (10), and nonmetallic hose (9).

d. Remove hex head capscrews (6), metallic tube (8) and gasket (11). Discard gasket.

e. Remove plain hexagon nuts (12) from plain studs (13).

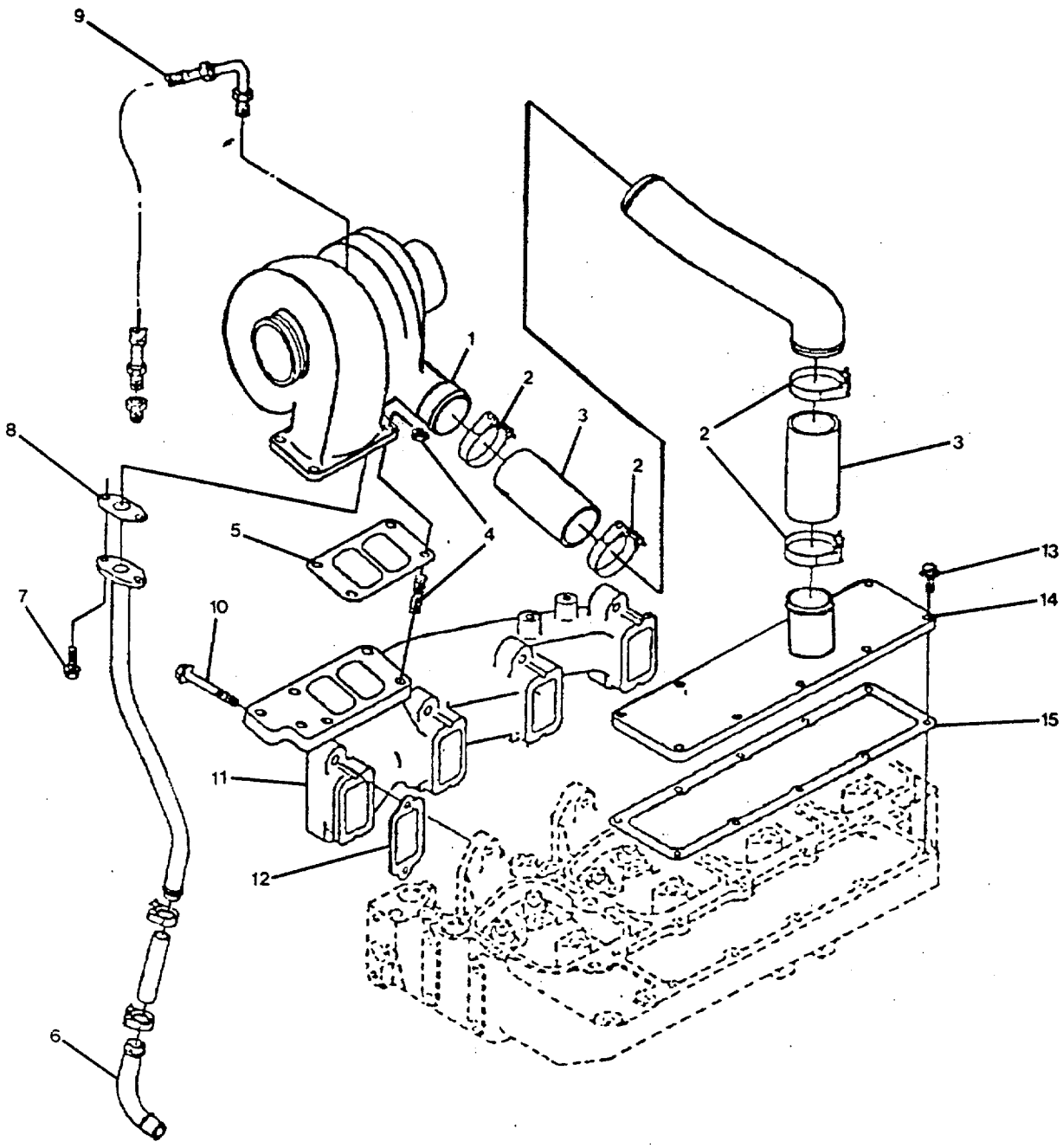


FIGURE 2-20. Turbocharger Assembly.

f. Remove turbosupercharger (21).

g. Remove gasket (14) from exhaust manifold (16). Discard gasket.

h. Remove eight hex head capscrews (15) and exhaust manifold (16).

i. Remove water manifold gaskets (17).

j. Remove eight hex head capscrews (18) and remove access cover (19).

k. Remove gasket (20). Discard gasket.

CAUTION

After removal of turbocharger, cover the openings to prevent material from falling into the manifold.

REPAIR

Repair-at this level of maintenance is by replace of: Nonmetallic hose (2), bent metallic tube (3), flexible tube (4), metallic tube (8), nonmetallic hose (9), bent metallic tube (10), gaskets (11, 14, 17, and 20), and non-aircraft turbosupercharger (21).

REPLACEMENT

a. Install access cover.

(1) Clean mounting surface. Replace gasket (20).

(2) Install access cover (19). Secure with eight capscrews (18).

b. Install exhaust manifold.

(1) Clean mounting surface. Replace water manifold gaskets (17).

(2) Install exhaust manifold (16). Secure with eight capscrews (15). Torque to 32 ft-lb (43 N-m).

c. Clean mounting surface. Replace gasket (14) on exhaust manifold and apply liquid teflon sealant to plain studs (13).

d. Replace turbosupercharger (21) and secure to plain studs (13) with hexagon nuts (12).

e. Clean mounting surface. Replace gasket (11).

f. Secure metallic tube (8) to turbocharger with hex head capscrews (6).

g. Secure nonmetallic hose (9) to metallic tube (8) and bent metallic tube (10) with hose clamps (7).

h. Pour 2 to 3 ounces of lubricating oil into supply fitting and rotate turbine wheel to allow oil to enter the turbocharger.

i. Install flexible tube (4) and replace straight pipe to tube adapter (5).

j. Secure bent metallic tube (3) to nonmetallic hoses (2) with hose clamps (1).

CAUTION

New turbocharger must be prelubricated before startup.

k. Operate engine to check for leaks (TM 55-1905-223-10).

2-27. Replace Exhaust Connection Group. (FIGURE 2-21)

This task covers: a. Removal, b. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's
rail and marine diesel engines,
5180-00-629-9783
Combination wrench set,
metric 10mm thru 24mm,
5120-01-046-4979

Equipment Condition

Air cleaner assembly removed
(para. 2-25).

Materials/Parts

Exhaust outlet connection
P/N 3910992

REMOVAL

a. Remove U-bolt (6) from exhaust flex hose (8).

b. Remove loop clamp (1) which connects exhaust outlet to turbocharger.

c. Remove exhaust connection outlet (7).

d. Remove screws (2) from heat shield (3) and angle bracket (4).

e. Lift angle bracket (4) from exhaust manifold.

f. Remove pipe plug (5).

REPLACEMENT

a. Install pipe plug (5).

b. Install angle bracket (4) on exhaust manifold.

c. Replace exhaust connection outlet (7).

d. Attach heat shield (3) to angle bracket (4). Secure to exhaust outlet (7) with screws (2).

e. Install loop clamp (1) to connect exhaust outlet to turbocharger.

f. Connect exhaust connection outlet (7) to exhaust flex hose (8) with U-bolt (6).

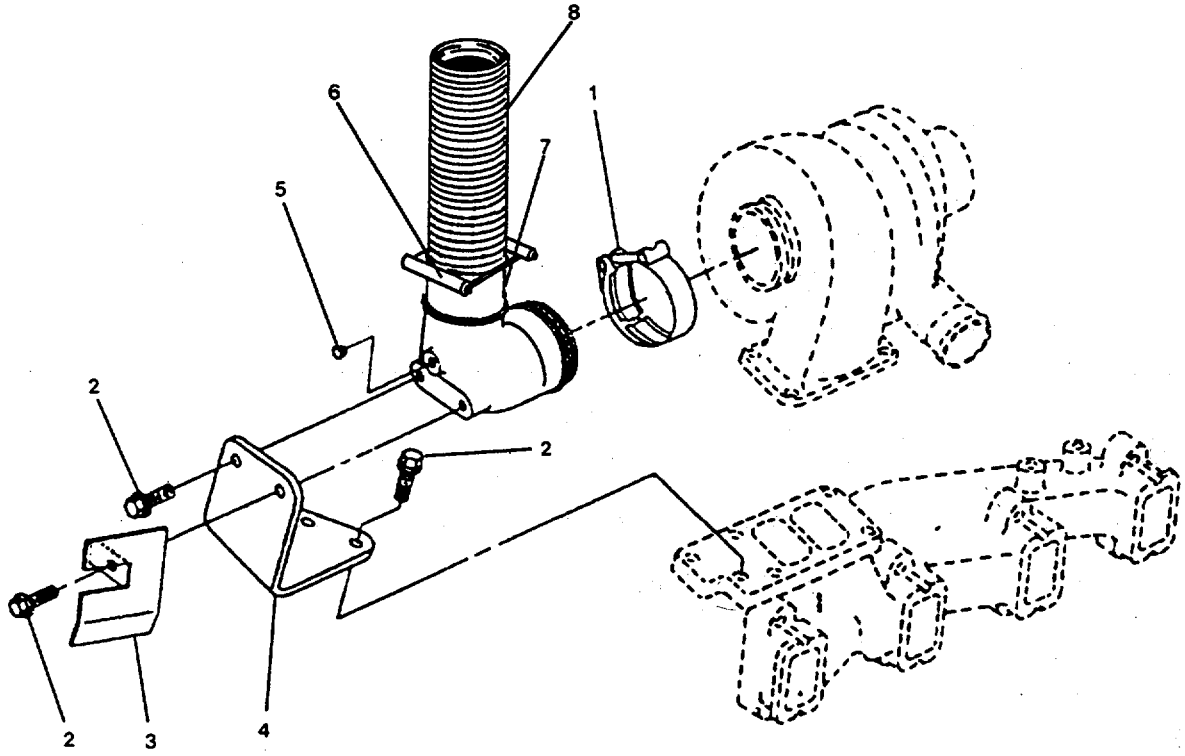


FIGURE 2-21. Exhaust Connection Group.

2-28. Replace/Repair Fan Drive Group. (FIGURE 2-22)

This task covers: a. Removal, b. Repair, c. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's
rail and marine diesel engines,
5180-00-629-9783
Combination wrench set, metric
10mm thru 24mm,
5120-01-046-4979

Equipment Condition

Engine secured and tagged "Out of Service"
(TM 55-1905-223-10).
Battery bank disconnected.
Coolant drained.
Radiator enclosure and fan removed
by Direct Support personnel.

Materials/Parts

Clamping plate P/N 3904690
Groove pulley P/N 3902709
Fan support P/N 3909888
Cleaning solvent, Item 7, Appendix C
Lubricating Oil, Item 14, Appendix C
Warning tags, Item 21, Appendix C
Coolant, Item 4, Appendix C

REMOVAL

a. Remove screws (1), clamping plate (2) and groove pulley (3).

b. Remove screws (4) from fan support (5).

c. Remove fan support (5).

REPAIR

a. Clean clamping plate and groove pulley in cleaning solvent.

b. Wipe lubricant lightly over plate and pulley.

REPLACEMENT

a. Install fan support (5), secure with screws (4).

b. Install groove pulley (3) and clamping plate (2), secure with screws (1).

c. Replace the right side protective-cover.

d. Contact Direct Support personnel for replacement of radiator.

NOTE

For coolant mixture, refer to TB 55-1900-207-24.

e. Add coolant.

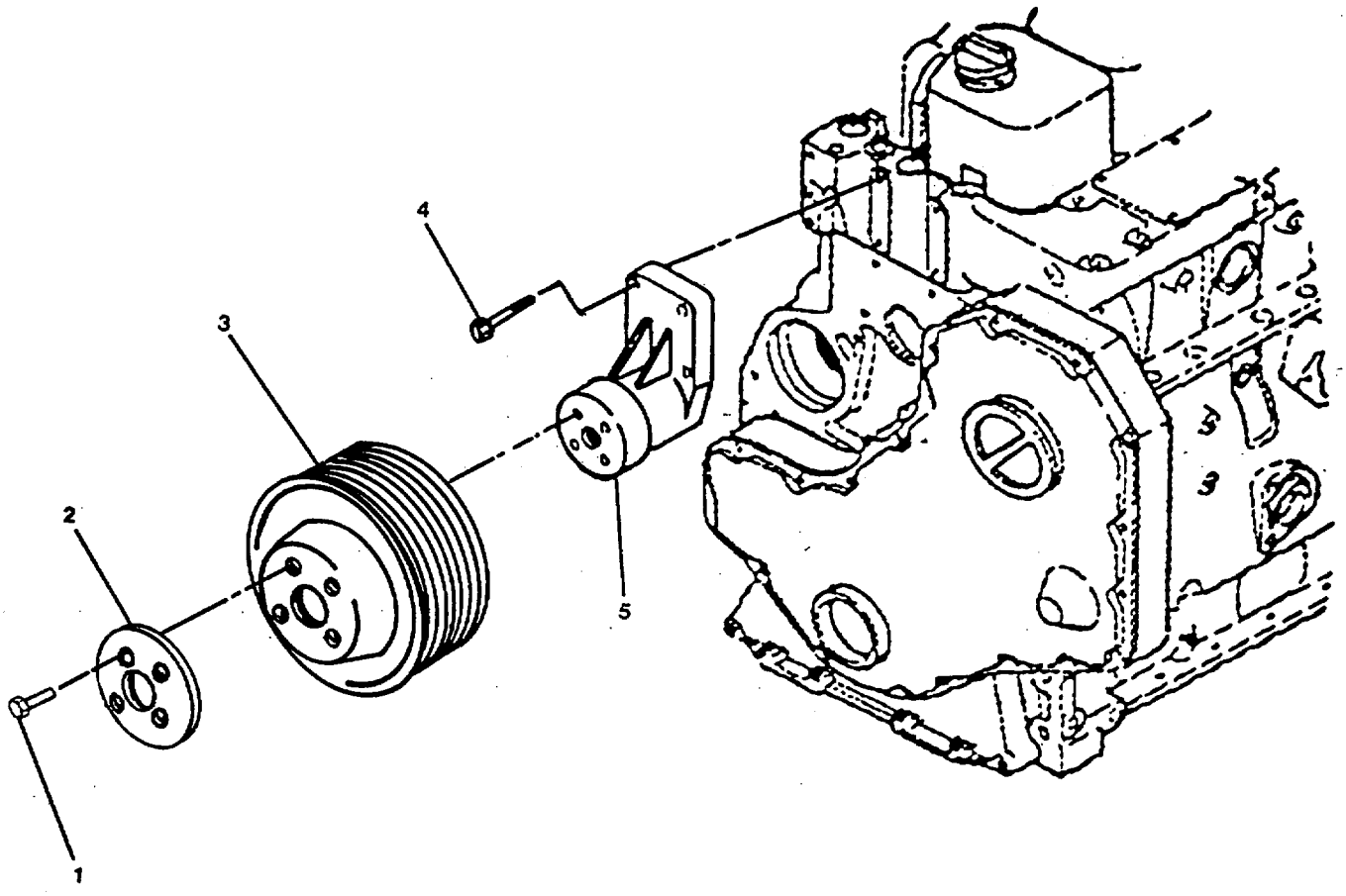


FIGURE 2-22. Fan Drive Group.

2-29. Replace/Repair Fuel Filter Group. (FIGURE 2-23)

This task covers: a. Inspection, b. Service, c. Removal, d. Repair, e. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's
rail and marine diesel engines,
5180-00-629-9783
Combination wrench set, metric 10mm
thru 24mm,
5120-01-046-4979

Equipment Condition

Equipment secured and tagged "Out of Service" (TM 55-1905-223-10).
Fuel supply shutoff valve closed.

Materials/Parts

Grommet seal P/N 3905351
Fluid filter P/N 3903202
Diesel fuel, Item 8, Appendix C
Warning tags, Item 21, Appendix C

INSPECTION

a. Check the fuel filter for clogging.

b. Check tube assembly for crimps or corrosion.

SERVICE

a. If filter is clogged upon inspection; replace filter.

b. Put clean diesel fuel in filter before replacement.

REMOVAL

a. Remove screw (10), restrictor (7), flat washer (6), and tube nut (5).

b. Disconnect tube nuts (9) from injection pump.

c. Remove tube nut (11) and grommet seal (12)

d. Lift off tube assembly (8), (13), (2) and (1).

e. Remove fluid filter (4) from filter head adapter (3).

REPAIR

a. Replace the three grommet seals (12) on the tube ends.

b. Replace the fluid filter (4) if clogged.

REPLACEMENT

a. Install fluid filter (4) on filter head adapter (3). Tighten 1/2 turn after gasket makes contact.

b. Connect tube assembly (8), (13), (2) and (1).

c. Install grommet seal (12) and tube nut (11).

d. Install tube nuts (9) on injection pump.

e. Install tube nut (5), flat washer (6), restrictor (7) and screw (10).

f. Open fuel supply valve before startup of unit.

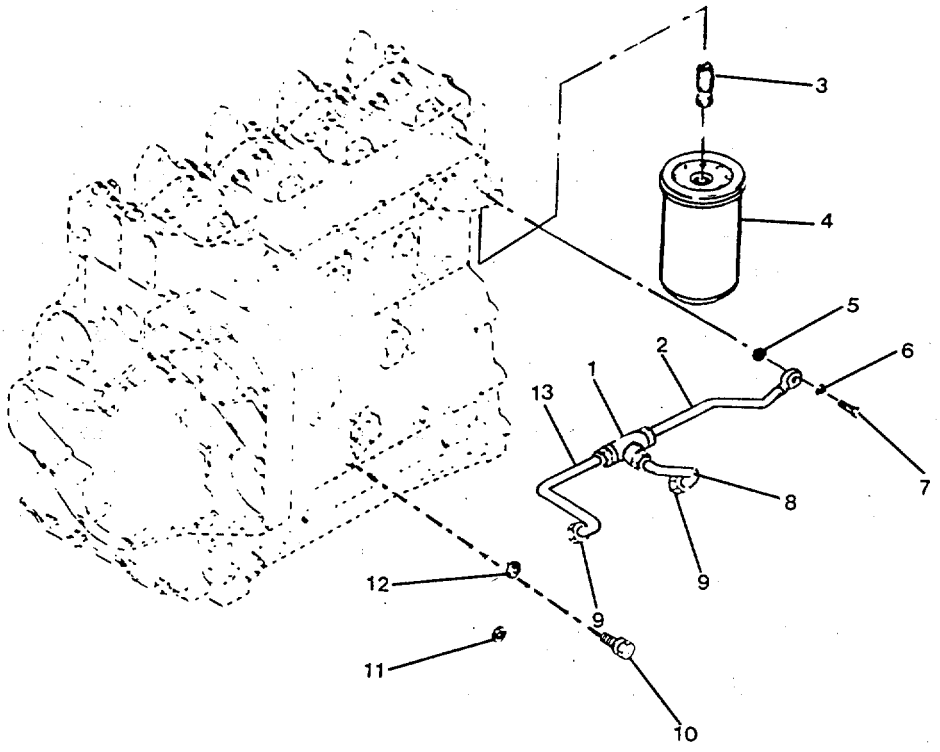


FIGURE 2-23. Fuel Filter Group.

2-30. Replace/Repair Fuel Plumbing Group. (FIGURE 2-24)

This task covers: a. Removal, b. Repair, c. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's
rail and marine diesel engines,
5180-00-629-9783
Combination wrench set, metric
10mm thru 24mm,
5120-01-046-4979

Equipment Condition

Engine secured and tagged "Out of Service" (TM 55-1905-223-10).
Fuel drained from engine.
Fuel supply shutoff valve closed.

Materials/Parts

Grommet seal P/N 3905391
Preformed packing P/N 3900267
Warning tags, Item 21, Appendix C

REMOVAL

a. Remove machine bolt (8) and preformed packing (9). Discard packing.

b. Remove machine bolt (6) and preformed packing (5). Discard packing.

c. Disconnect metal tube assembly (1) from the tube tee (3). Remove seal grommet (2) and discard.

d. Disconnect metal tube assembly (7) from tube tee (3). Remove seal grommet (4) and discard.

e. Disconnect metal tube assembly (10) from tube tee (3). Remove seal grommet (11) and discard.

REPAIR

a. Replace the three grommet seals (4, 11, 2).

b. Replace two preformed packings (9, 5).

REPLACEMENT

a. Install seal grommet (11) and secure tube assembly (10) to tube tee (3).

b. Install seal grommet (4) and secure tube assembly (7) to tube tee (3).

c. Install seal grommet (2) and secure tube assembly (1) to tube tee (3).

d. Install preformed packing (5) and secure with machine bolt (6).

e. Install preformed packing (9) and secure with machine bolt (8).

f. Open fuel supply shutoff valve.

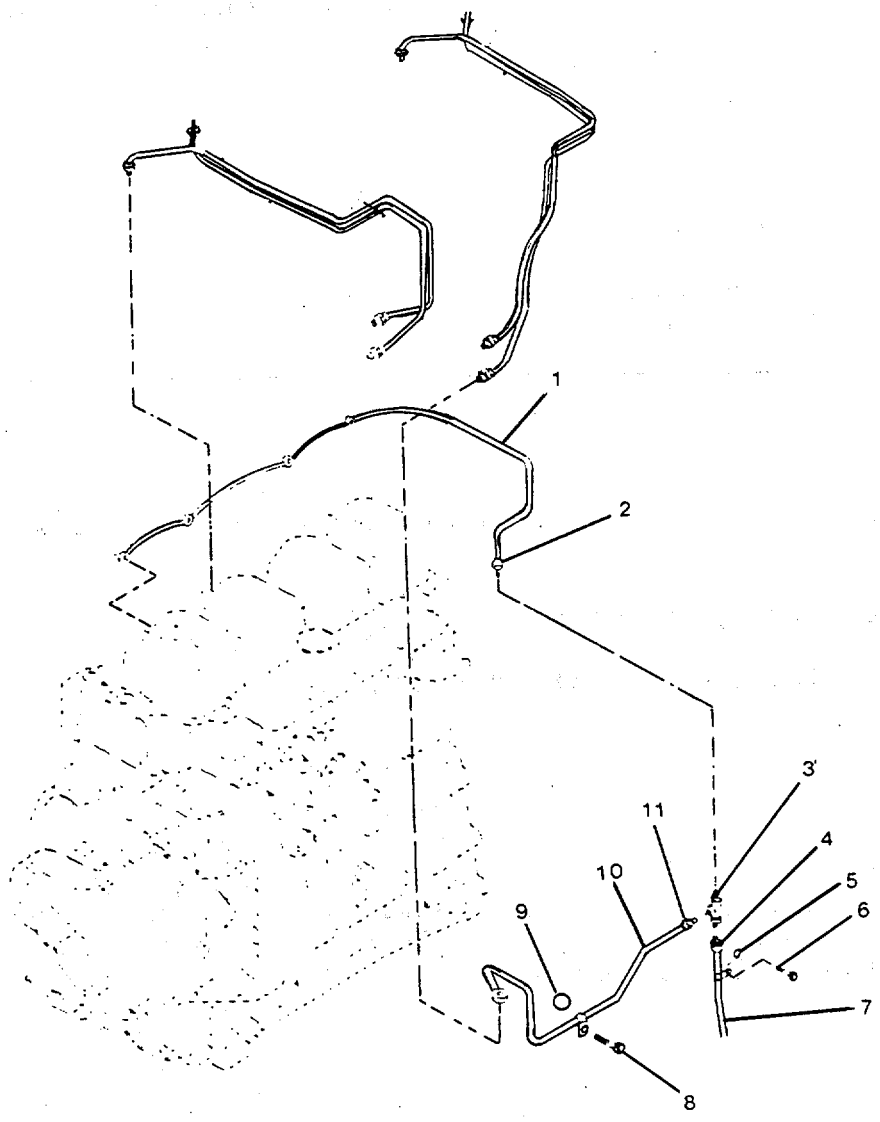


FIGURE 2-24. Fuel Plumbing Group.

2-31. Replace/Repair Fuel System Accessory Group. (FIGURE 2-25)

This task covers: a. Removal, b. Repair, c. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's
rail and marine diesel engines,
5180-00-629-9783
Combination wrench set, metric 10mm
thru 24mm,
5120-01-046-4979
Torque wrench kit P/N 3377216

Equipment Condition

Engine secured and tagged "Out of
Service" (TM 55-1905-223-10).
Fuel drained.
Fuel supply shutoff valve closed.

Materials/Parts

Mineral spirits, Item 14, Appendix C
Casket P/N 3904044
Cam actuated fuel pump P/N 3904374
Warning tags, Item 21, Appendix C

REMOVAL

a. Remove fluid passage bolt (1), flat washers (2), and metal tube assembly (3).

b. Remove capscrew (4), while holding pump (6).

c. Remove pump (6) and gasket (5). Discard gasket.

WARNING

High pressure compressed air tanks, piping system, and air operated devices possess potential for serious injury to the eyes and exposed areas of the skin due to escaping air pressure.

REPAIR

a. Clean the pump with mineral spirits.

b. Blow dry with compressed air.

c. Inspect the diaphragm by blocking the fuel inlet line with finger and operating the priming lever.

d. A good pump will have suction until the inlet is unblocked.

e. Replace gasket (5) and cam actuated fuel pump (6).

REPLACEMENT

a. Clean the pump mounting surface on the block.

b. Replace gasket (5).

c. Install lift pump (6) and secure with two capscrews (4). Torque to 18 ft-lbs (24 N•m)

d. Replace metal tube assembly (3).

e. Install fluid passage bolt (1) and flat washers (2).

f. Replace fuel plumbing (para. 2-30).

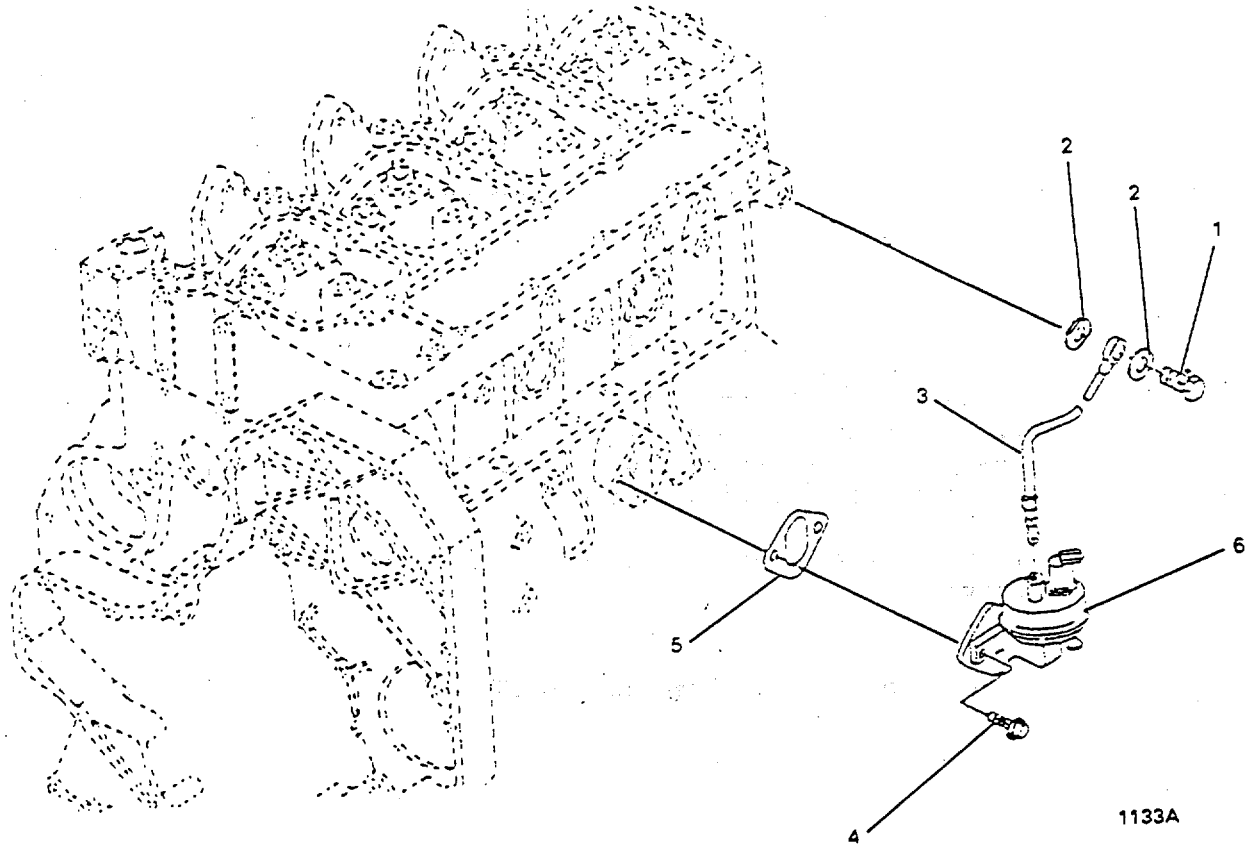


FIGURE 2-25. Fuel System Accessory Group.

2-32. Replace Fuel Pump Metering and Distributing Assembly. (FIGURES 2-26 through 2-31)

This task covers: a. Removal, b. Replacement.

INITIAL SETUP

Tools

Barring tool
5120-01-262-7307
Tool kit, general mechanic's
rail and marine diesel engines,
5180-00-629-9783
75mm t-bar puller P/N ST-647
Torque wrench kit P/N 3377216
Dial indicator,
5120-00-277-8840

Materials/Parts

Warning tags, Item 21, Appendix C
Fuel pump metering and
distributing assembly
P/N 3912852-1890
Loctite, Item 11, Appendix C

Equipment Condition

Engine secured and tagged "Out of Service" (TM 55-1905-223-10).
Fuel supply lines removed (para. 2-30).
Radiator assembly and front gear cover group removed by Direct Support personnel only.

REMOVAL

CAUTION

The keyway in the shaft of new or reconditioned pumps will be locked in a position corresponding to the keyway in the drive gear when cylinder number 1 is at TDC on the compression stroke.

All pumps must also be locked in this position before removal.

a. Remove capscrews from support bracket. (FIGURE 2-26)

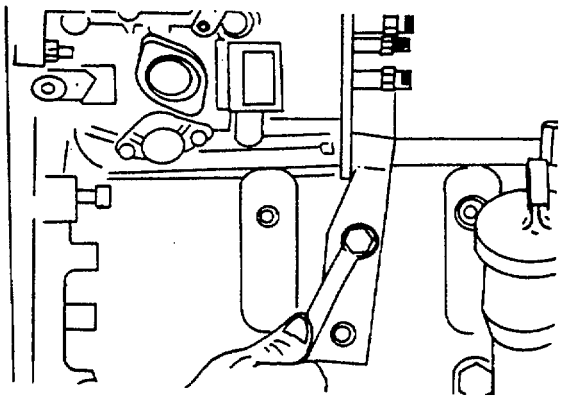


FIGURE 2-26. Support Bracket Removal.

b. Remove gear cover.

c. Check the gear lash. Position an indicator on the tooth of the injection pump drive gear. Mark the pump drive gear for further analysis if backlash exceeds limits (FIGURE 2-27).

LIMITS

A = 0.003 to 0.013 inch, 0.08 to 0.33 mm

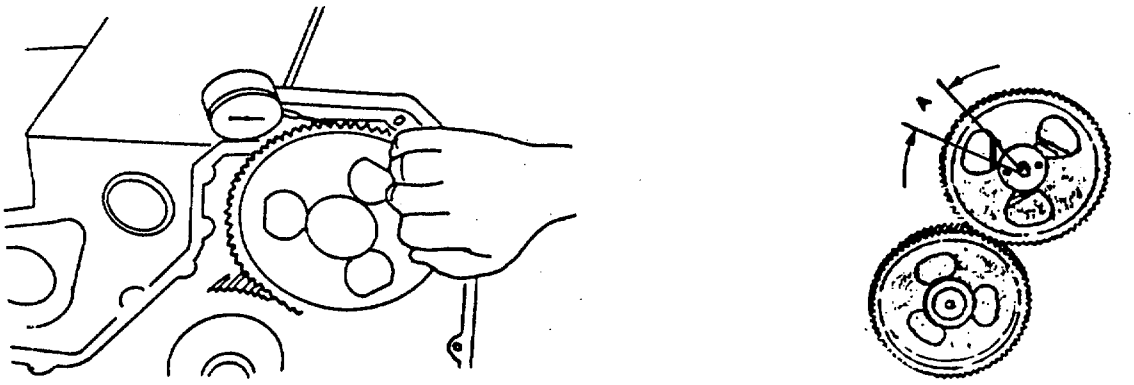


FIGURE 2-27. Gear Lash Measurement.

NOTE

Hold adjoining gear from moving when checking backlash or the reading will be the total of both gears.

d. Locate Top Dead Center (TDC) for Cylinder Number 1 by barring engine slowly while pushing in on TDC pin. Disengage the pin after locating TDC. (FIGURE 2-28).

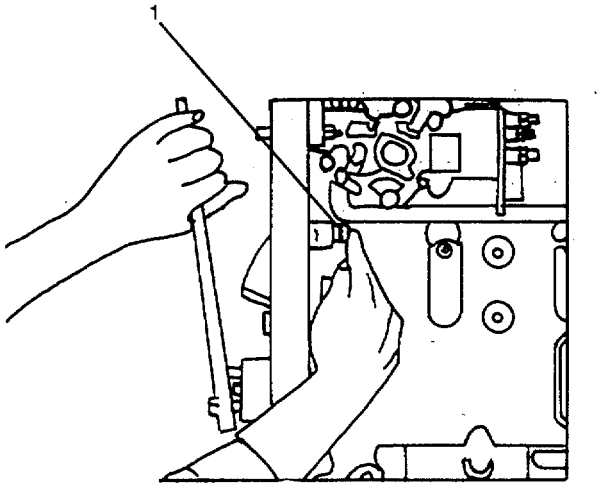


FIGURE 2-28. Cylinder 1, Top Dead Center Pin.

e. Drive gear must be removed. Remove the mounting nut and lockwasher from the pump drive shaft. (FIGURE 2-29)

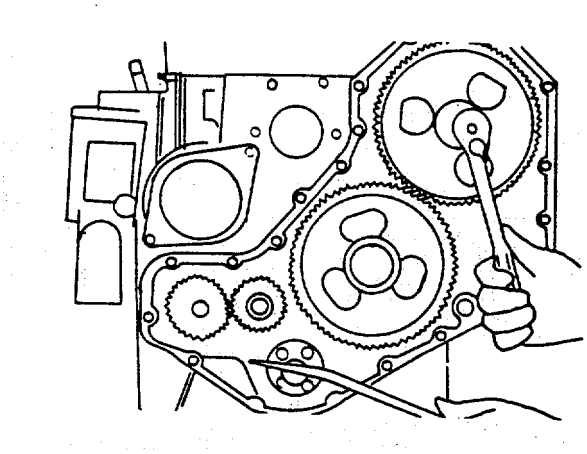


FIGURE 2-29. Fuel Pump Drive Gear Mounting Nut and Lockwasher Removal.

CAUTION

Hold the crankshaft to prevent the locked injection pump from rotating.

f. Use a 75mm T-Bar Puller; pull the pump drive gear loose from the drive shaft. The puller hole threads are M8 x 1.25. (FIGURE 2-30).

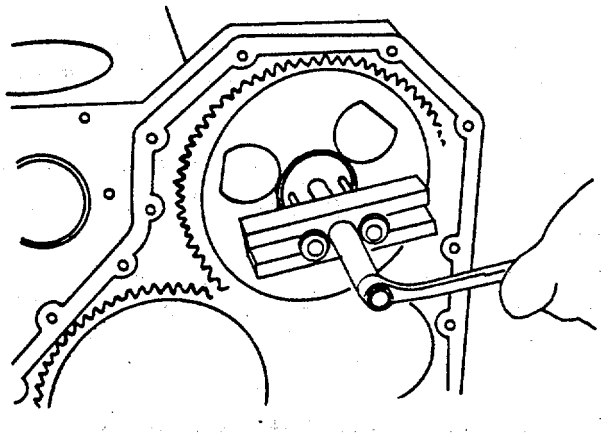


FIGURE 2-30. Fuel Pump Drive Gear Removal.

CAUTION

Pump must be locked before removing.

g. Remove the three capscrews (1), washers (2) and gasket (3). Remove pump (4).

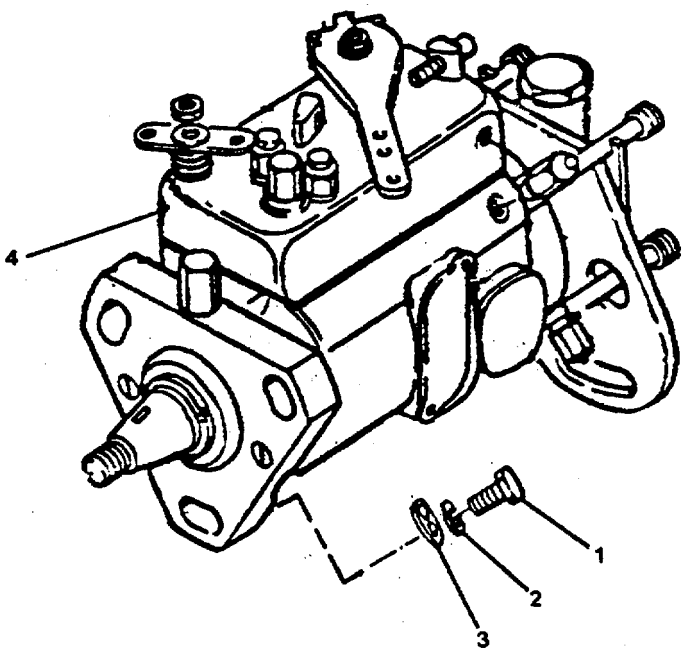


FIGURE 2-31. Fuel Pump Removal.

REPLACEMENT

a. Position pump (4) and secure to engine with capscrews (1), washers (2), and gaskets (3).

b. Locate Top Dead Center (TDC) for cylinder number 1 by barring the engine while pushing in on the timing pin until it engages.

CAUTION

The timing pin is to be used only for locating TDC for Cylinder No. 1. Do NOT use for locking engine.

c. The pump drive gear has a tapered bore. Orient the wide end of the taper toward the engine (timing marks away). Align the timing marks and set the gear into the housing.

d. Install the pump. Make sure the key does not fall into the gear housing.

CAUTION

Disengage the timing pin before tightening the mounting nuts.

e. Attach the pump by finger tightening the three capscrews. The pump must be free to move.

f. Install the pump drive and washer shaft nut. (FIGURE 2-29).

NOTE

The pump can rotate slightly due to gear helix and clearance. This is acceptable providing the pump is free to move on the flange slots and the crankshaft does not move.

g. Rotate the pump to align the scribe marks and tighten the three mounting nuts torque 18 ft lbs. If installing new or rebuilt pump without scribe marks, take up the gear lash by rotating the pump against the direction of drive rotation. Make sure the engine is at TDC.

h. Torque shaft nut to 11-15 ft-lb and unlock fuel pump.

i. Replace fuel plumbing (para. 2-30).

j. Replace protective cover to gears. Refer to Equipment Conditions.

2-33. **Replace/Repair Fuel Pump Coupling**. (FIGURE 2-32)

This task covers: a. Removal, b. Repair, c. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's
rail and marine diesel engines,
5180-00-629-9783
Combination wrench set, metric
10mm thru 24mm,
5120-01-046-4979

Equipment Condition

Engine shut down and tagged "Out of Service" (TM 55-1905-223-10).
Fuel drained from engine.
Fuel pump removed (para. 2-31).

Materials/Parts

Spur gear P/N 3911331
Gasket P/N.3905685
Warning tags, Item 21, Appendix C

REMOVAL

a. Remove two capscrews (1) from fuel pump brace (2).

b. Remove fuel pump brace (2).

c. Remove stud (3) and nut (4).

d. Remove spur gear (5) and gasket (6) from pump. Discard gasket.

REPAIR

a. Replace gasket (6).

b. Check the spur gear for cracks and gear tooth wear.

c. Replace spur gear (5) if cracks are present.

REPLACEMENT

a. Install new gasket (6) and replace spur gear (5).

b. Install stud (3) and nut (4).

c Install pump brace (2) on pump.

d. Secure brace by installing capscrews (1).

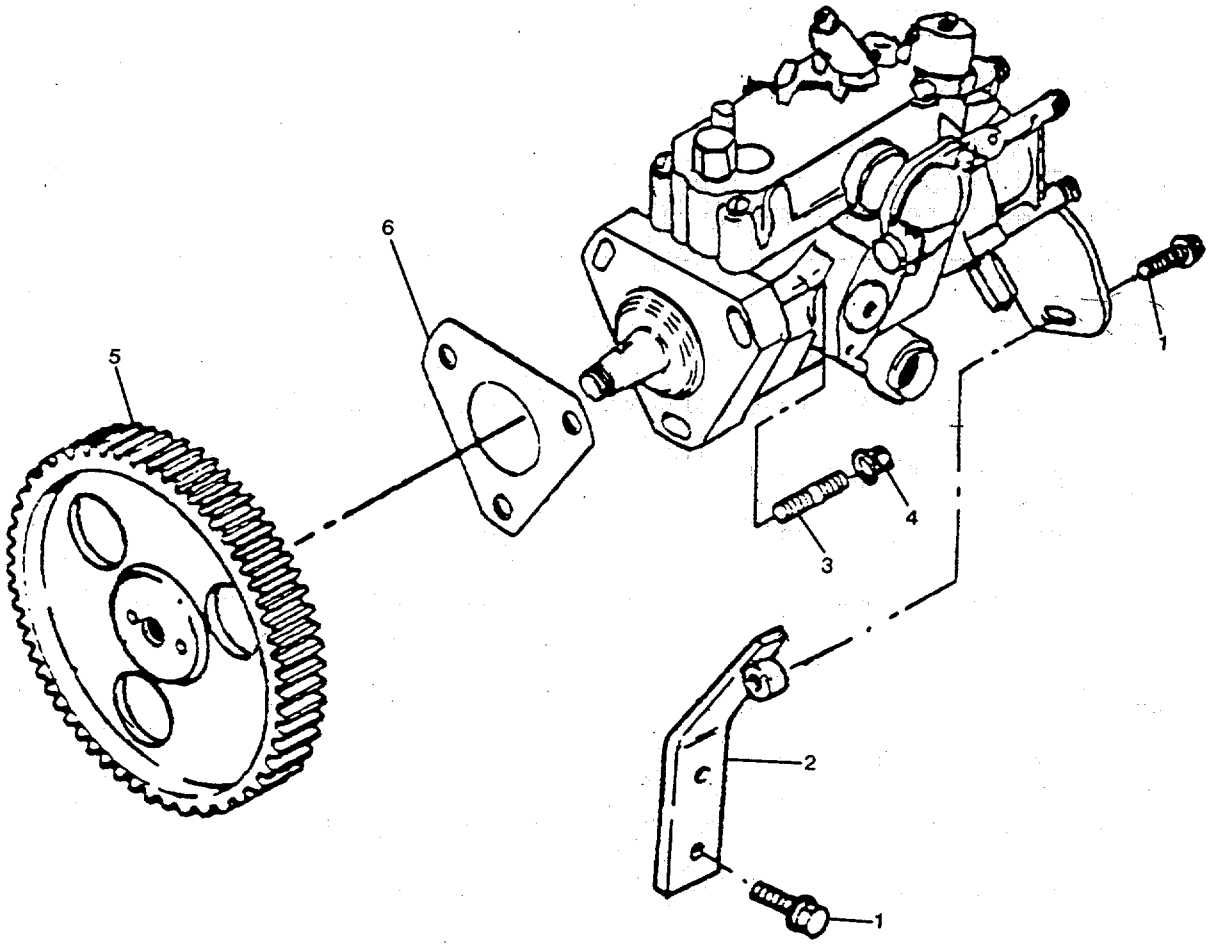


FIGURE 2-32. Fuel Pump and Coupling.

2-34. **Replace/Repair Sump Pump Assembly.** (FIGURE 2-33)

This task covers: a. Removal, b. Repair, c. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's
rail and marine diesel engines,
5180-00-629-9783
Combination wrench set, metric
10mm thru 24mm,
5120-01-046-4979

Equipment Condition

Engine secured and tagged "Out of Service" (TM 55-1905-223-10).

Materials/Parts

Sump pump assembly P/N 539-0953
Gasket P/N 102-1147
Nonmetallic hose assembly P/N 501-0532
Warning tags, Item 21, Appendix C

REMOVAL

a. Remove pipe to hose adapter (3) and gasket (4) from nonmetallic hose assembly (5). Discard gasket.

b. Remove clamps (2) from belt guard of engine.

c. Remove sump pump assembly (1).

REPAIR

Replace gasket (4) and sump pump assembly (1).

REPLACEMENT

a. Install pipe to hose adapter (3) and new gasket (4) to nonmetallic hose assembly (5).

b. Install clamps (2) to sump pump assembly.

c. Attach sump pump assembly, to belt guard of engine.

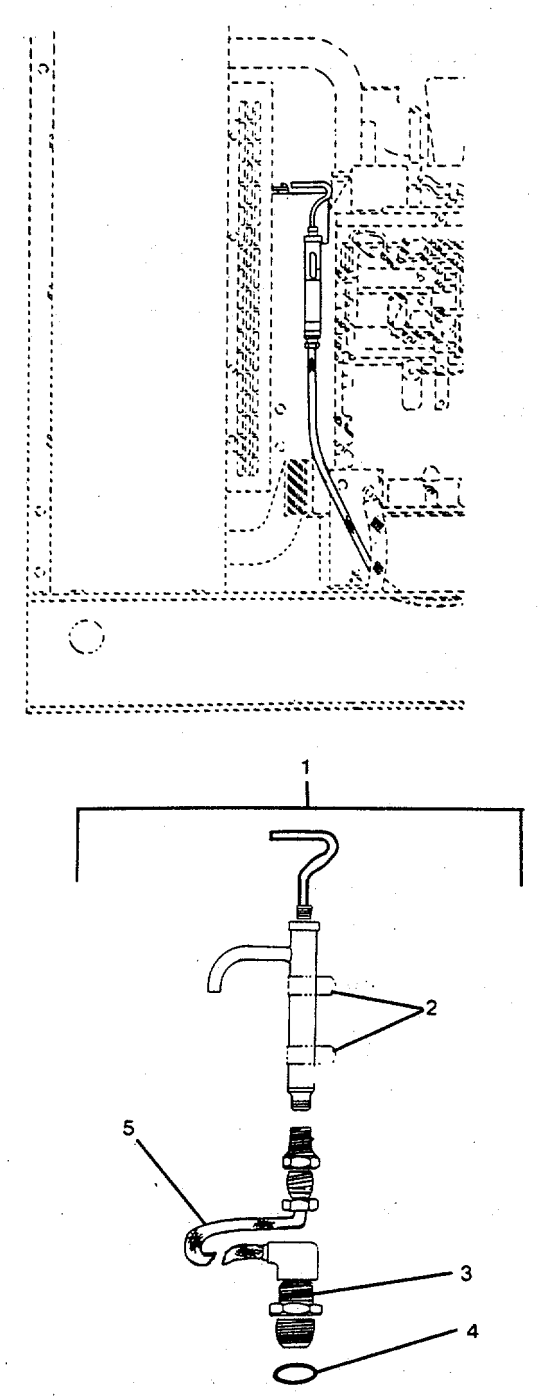


FIGURE 2-33. Sump Pump Assembly.

2-35. **Replace/Repair Water Pump Group.** (FIGURE 2-34)

This task covers: Repair.

INITIAL SETUP

Tools

Tool Kit, general mechanic's
rail and marine diesel engines,
5180-00-629-9783
Combination wrench set, metric
10mm thru 24mm,
5120-01-046-4979
Torque wrench kit P/N 3377216

Equipment Condition

Engine shut down and tagged "Out of Service" (TM 55-1905-223-10).
Coolant drained.
Radiator assembly removed by Direct Support personnel.

Materials/Parts

Engine water pump P/N 3802004
Preformed packing
P/N 3906698
Coolant, Item 4, Appendix C
Warning tags, Item 21, Appendix C

REPAIR

a. Remove the right side protective cover.

b. Lift the tensioner and remove drive belt from the water pump pulley.

c. Remove two capscrews (1).

d. Remove water pump (2) and preformed packing (3). Discard preformed packing.

e. Inspect pump.

(1) Inspect the impeller blades for wear or corrosion.

(2) Inspect for free rotation of the pump.

(3) Check the weep hole for seal leakage.

f. Clean the sealing surface on the cylinder block.

g. Position the new preformed packing (3) into the groove in the water pump housing.

h. Install the water pump (2) with capscrews (1). Installation torque is 18 ft-lb (24 N-m).

i. Lift the tensioner and replace drive belt to water pump pulley.

j. Replace right side protective cover.

NOTE

Replacement of radiator assembly authorized in the Direct Support Maintenance level only.

k. Replace radiator assembly.

NOTE

For coolant mixture, refer to TB 55-1900-207-24.

l. Install coolant.

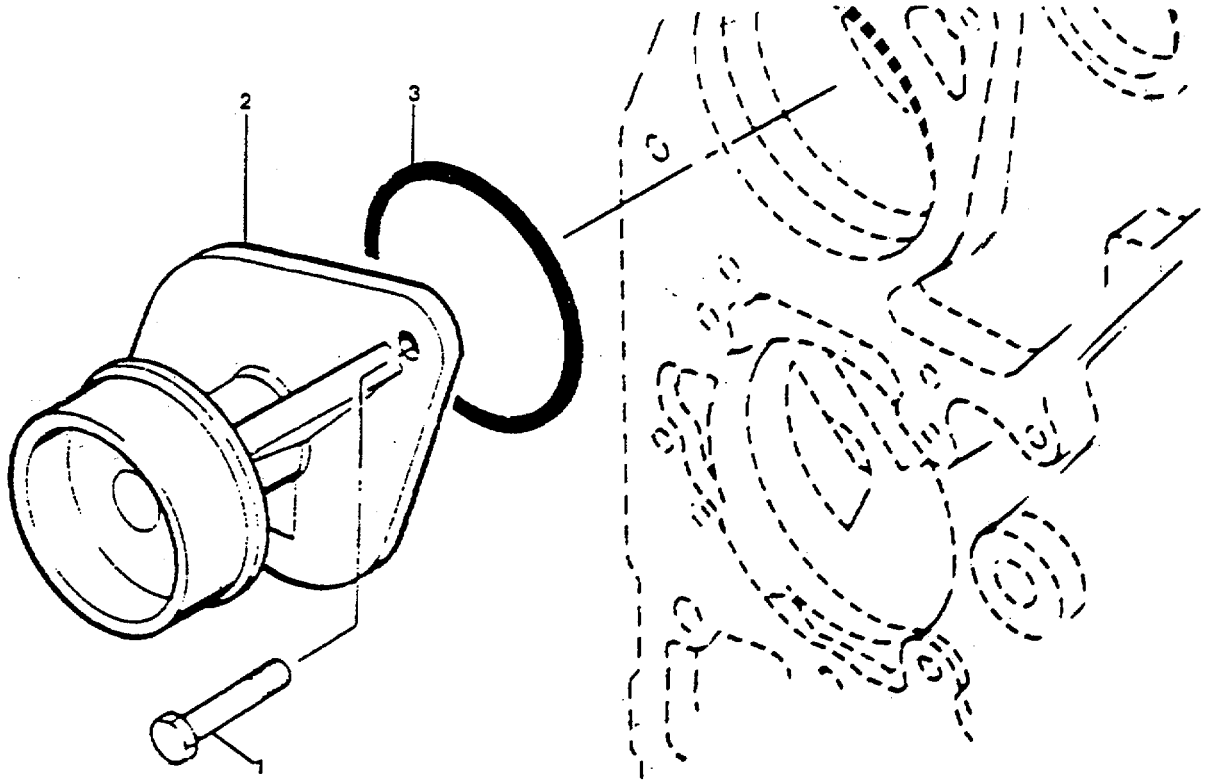


FIGURE 2-34. Water Pump Group.

2-36. **Replace Lube Oil Cooler Group.** (FIGURE 2-35)

This task covers: a. Removal, b. Inspection/Service, c. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's rail and marine diesel engines, 5180-00-629-9783
Oil filter wrench P/N 3375049
Combination wrench set, metric 10mm thru 24mm, 5120-01-046-4979
Torque wrench kit P/N 3377216

Materials /Parts

Lube oil cooler group P/N 07.03-04
Fluid filter element P/N 3908616
Coolant, Item 4, Appendix C
Cleaning solvent, Item 20, Appendix C
Warning tags, Item 21, Appendix C

Equipment Condition

Engine secured and tagged "Out of Service" (TM 55-1905-223-10).
Oil drained.
Remove alternator (para. 2-22).
Remove turbocharger oil supply line (para. 2-26).

REMOVAL

a. Remove oil filter (1).

b. Remove thirteen capscrews (2).

c. Remove the lube oil assembly (3).

INSPECTION/SERVICE

a. Plug the cooler and soak in a cleaning solvent to remove coolant deposits.

b. Remove plugs and soak cooler in hot water.

WARNING

COMPRESSED AIR HAZARD. High pressure compressed air tanks piping systems and air operated devices possess potential for serious injury to eyes and exposed areas of skin due to escaping air pressure.

c. Back flush the oil passages with clean solvent and use compressed air to dry.

d. Inspect the soldered joints for corrosion or cracks.

WARNING

COMPRESSED AIR HAZARD. High pressure compressed air tanks, piping systems and air operated devices possess potential for serious injury to eyes and exposed areas of skin due to escaping air pressure.

e. Using compressed air, pressurize the cooler to 70 psi (483kPa) and check for leaks by submersing in water.

REPLACEMENT

a. Secure lube oil assembly (3) to engine with thirteen capscrews (2). Torque to 18 ft-lb (24 N-m).

b. Replace oil filter (1).

c. Install the turbocharger oil supply line (para. 2-26)..

NOTE

For coolant mixture, refer to TB 55-1905-223-10.

d. Fill the system with coolant.

e. Operate the engine to check for leaks.

f. Shut down engine and check oil level with dipstick.

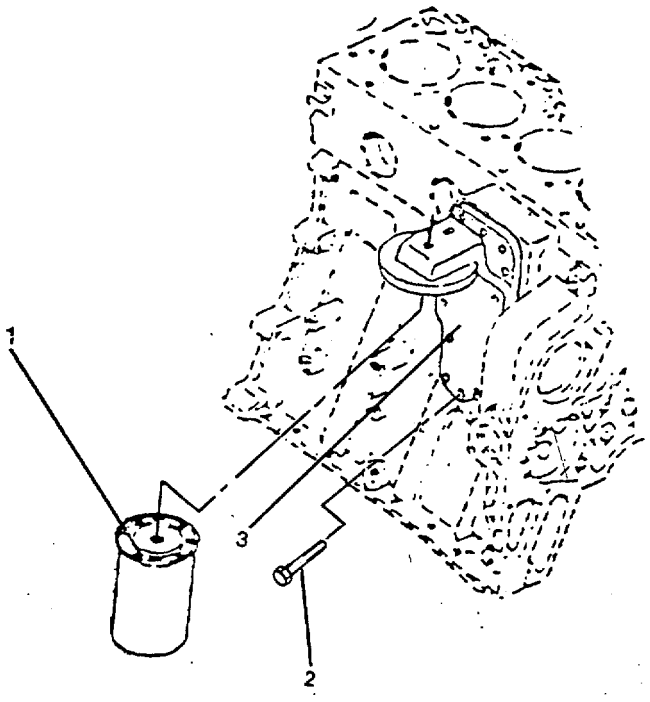


FIGURE 2-35. Lube Oil Cooler Group.

2-37. **Replace/Repair Valve Cover Group.** (FIGURE 2-36)

This task covers: a. Removal, b. Repair, c. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's rail and marine diesel engines, 5180-00-629-9783
Combination wrench set, metric 10mm thru 24mm, 5120-01-046-4979

Equipment Condition

Engine secured and tagged "Out of Service" (TM 55-1905-223-10).
Power disconnected.
Remove air crossover tube (para. 2-22).

Materials/Parts

Preformed packing P/N 3910824
Gasket P/N 3902666
Warning tags, Item 21, Appendix C

REMOVAL

a. Remove capscrew (1).

b. Remove preformed packing (2). Discard preformed packing.

c. Lift off valve cover (4) and gasket (3). Discard gasket.

REPAIR

Repair of the valve cover group is accomplished by replacement of preformed packing (2) and gasket (3).

REPLACEMENT

a. Install new gaskets (3) and valve covers (4).

b. Replace preformed packing (2).

c. Replace capscrews (1).

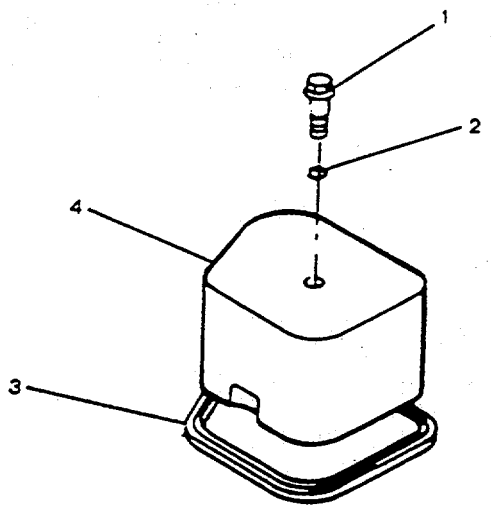


FIGURE 2-36. Valve Cover Assembly.

2-38. **Replace Rocker Lever Group**. (FIGURE 2-37)

This task covers: a. Removal, b. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's
rail and marine diesel engines,
5180-00-629-9783
Combination wrench set, metric
10mm thru 24mm,
5120-01-046-4979
Torque wrench kit P/N 3377216

Equipment Condition

Engine secured and tagged "Out of Service" (TM 55-1905-223-10).
Battery banks disconnected.
Turbocharger assembly removed (para. 2-26).
Valve covers removed (para. 2-37).

Materials/Parts

Lubricating oil, Item 14, Appendix C
Warning tags, Item 21, Appendix C

REMOVAL

a. Loosen nuts (4) on rocker lever adjustment screws (5) and loosen screws until they stop.

b. Remove capscrews (2) from support (1).

c. Remove support/head bolts (3) from shaft support (1).

d. Lift off the support and rocker lever assemblies.

e. Remove push rods (6).

REPLACEMENT

a. Position push rods (6) into the valve tappets.

b. Lubricate push rod sockets with engine oil.

c. Lubricate valve stems with engine oil.

d. Completely loosen the rocker lever adjusting screws (5).

e. Align rocker lever support (1). Install support and capscrews (2).

f. Lubricate the support bolt threads and under the capscrew heads with engine oil. Install capscrews finger tight.

g. Tighten support bolts (3). Torque to 18 ft-lb (24 N-m).

h. Replace valve covers (para. 2-37).

i. Replace turbocharger assembly (para. 2-26).

j. Reconnect power at batteries.

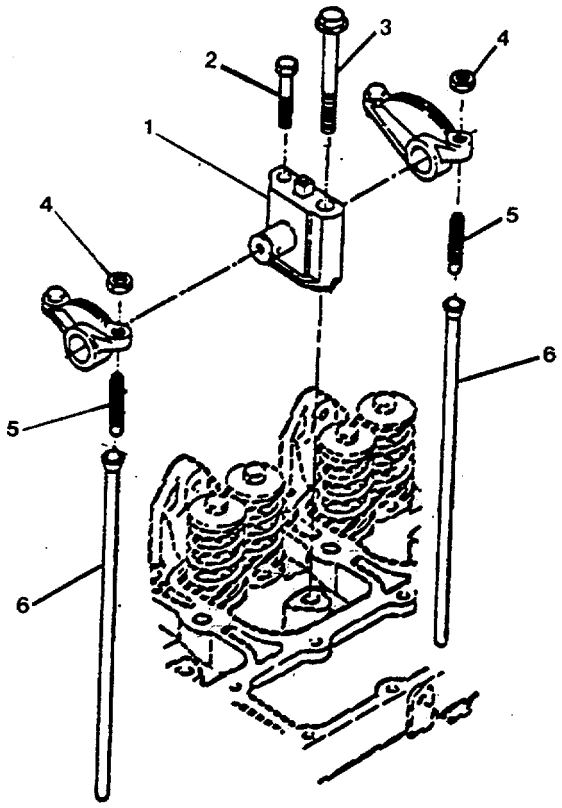


FIGURE 2-37. Rocker Lever Group.

2-39. **Replace/Repair Fuel Injector Group.** (FIGURES 2-38 and 2-39)

This task covers: a. Removal, b. Repair, c. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's rail and marine diesel engines, 5180-00-629-9783
Injector puller PIN 3822482
Deepwell socket 5120-01-113-8087
Torque wrench kit P/N 3377216

Equipment Condition

Engine secured and tagged "Out of Service" (TM 55-1905-223-10).
Battery banks disconnected.
Fuel drained from lines.

Materials/Parts

Banjo connector seal P/N 3903380
Fuel injector assembly P/N 3911185
Injector P/N 3802061
Gasket P/N 3909356
Sealing washer P/N 3900808
Warning tags, Item 21, Appendix C

REMOVAL

a. Clean around the injectors.

b. Remove the clamps to the air crossover tube. Remove tube from turbocharger (para. 2-26).

c. Disconnect the fuel supply lines (para. 2-30).

d. Disconnect the fuel drain manifold banjo connector seal (5, FIGURE 2-38).

e. Loosen hold down nut (2) using a 24mm deep well socket, remove injector (3).

f. Remove and discard gasket (1).

g. Remove and discard sealing washer (4).

NOTE

When rust has formed on the hold down nut, the injector can turn in the bore when nut is loosened. This will cause severe damage to the head by the injector locating ball cutting a groove in the bore. Soak the hold down nut with rust penetrating solvent for a minimum of 3 minutes.

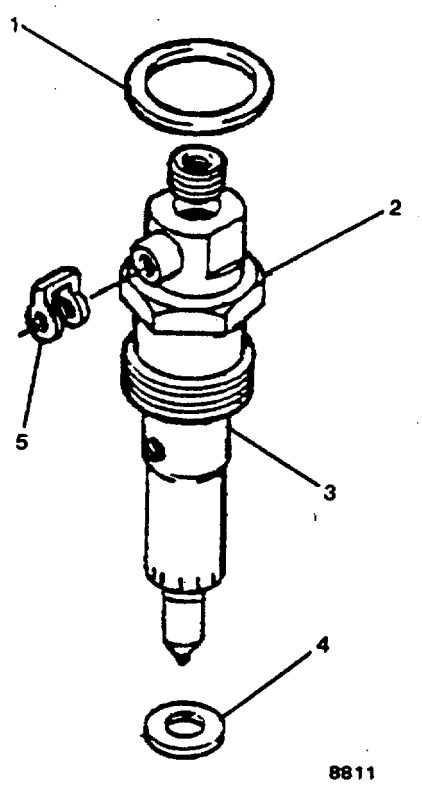


FIGURE 2-38. Fuel Injector Group.

REPAIR

Repair at this level of maintenance is by replacement of: gasket (1), injector assembly (3), sealing washer (4) and banjo connector seal (5).

REPLACEMENT

a. Replace new gasket (1).

b. Apply a coat of anti-seize compound to the threads of the injector holddown nut and between the top of the nut and injector body.

c. Replace injector (3) and sealing washer (4).

d. The protrusion on the side of the nozzle fits into a notch in the head to orient the injector. (FIGURE 2-39).

CAUTION

Some sockets can damage the fuel drain outlet sealing surface.

e. Use a 24mm deep well socket to tighten the hold-down nut to 44 ft-lb (60 N·m) torque.

f. Install fuel drain manifold banjo connector seal (5).

g. Install fuel supply lines (para. 2-30).

h. Install air crossover tube to turbocharger (para. 2-26).

i. Power reconnected at battery bank.

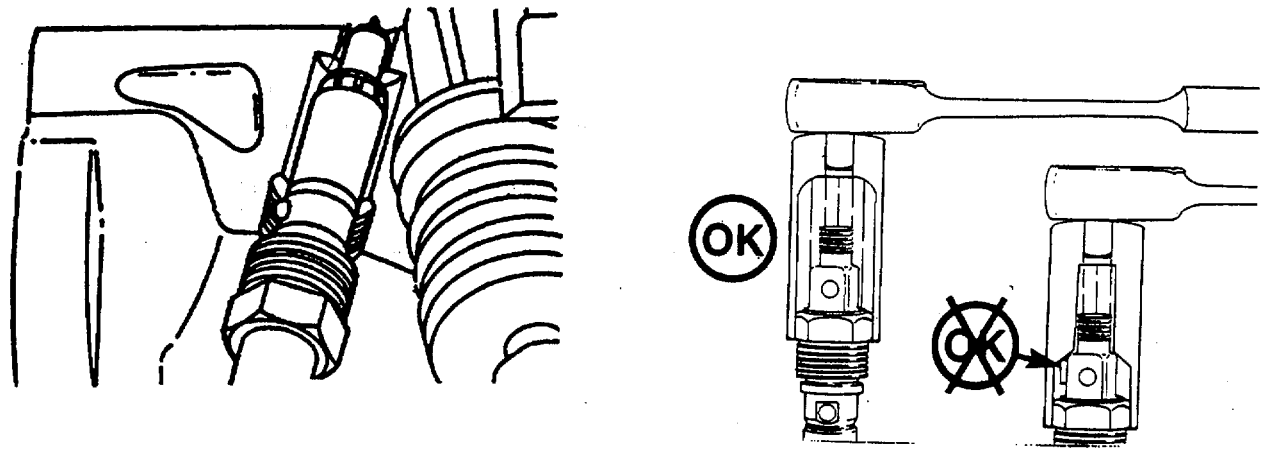


FIGURE 2-39. Fuel Injector Group (Replacement).

2-40. **Replace/Repair Cylinder Head Group.** (FIGURES 2-40 and 2-41)

This task covers: a. Removal, b. Repair, c. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's
rail and marine diesel engines,
5180-00-629-9783
Torque wrench kit P/N 3377216
Lifting sling P/N 3375958
Combination wrench set, metric
10mm thru 24mm,
5120-01-046-4979

Materials/Parts

Fuel injectors removed (para. 2-39).
Gasket P/N 3907054
Warning tags, Item 21, Appendix C
Coolant, Item 4, Appendix C

Equipment Condition

Power supply disconnected and tagged "Out of Service".
Starter motor cable disconnected.
Fuel supply shut off. Fuel drained.
Coolant drained.
Air cleaner removed (para. 2-25).
Turbocharger removed (para. 2-26).
Fuel plumbing removed (para. 2-30).
Valve covers removed (para. 2-37).
Rocker levers removed (para. 2-38).

WARNING

This procedure requires two soldiers.

REMOVAL

a. Remove the remaining 14 head bolts (1, 2, FIGURE 2-41) working from the center to the ends of the cylinder head.

b. Remove cylinder head (3). Weight 80 lb (36 kg).

c. Remove cylinder head gasket (4) from the block. Discard gasket.

REPLACEMENT

CAUTION

Make sure the cylinder head and block surface are clean and not nicked or gouged.

a. Position the head gasket (4) over holes on block. Gasket is marked "TOP."

CAUTION

Be sure the gasket is correctly aligned with holes in the block.

b. Carefully put the. cylinder head (3) on the block and seat it onto the gasket.

c. Replace capscrews (1, 2.) finger tight.

d. Install rocker levers, paragraph 2-38.

e. Tighten capscrews in sequence as illustrated in FIGURE 2-40. Torque in three steps as follows.

STEP	TORQUE VALUE
1	29 ft-lb (40 N·m)
2	62 ft-lb (85 N·m)
3	92 ft-lb (126 N·m)

NOTE

For coolant mixture, refer to TB 55-1900-207-24.

f. Replace coolant.

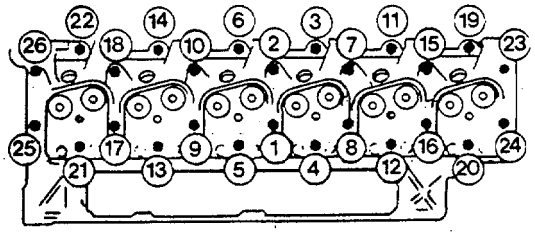


FIGURE 2-40. Torque Sequence.

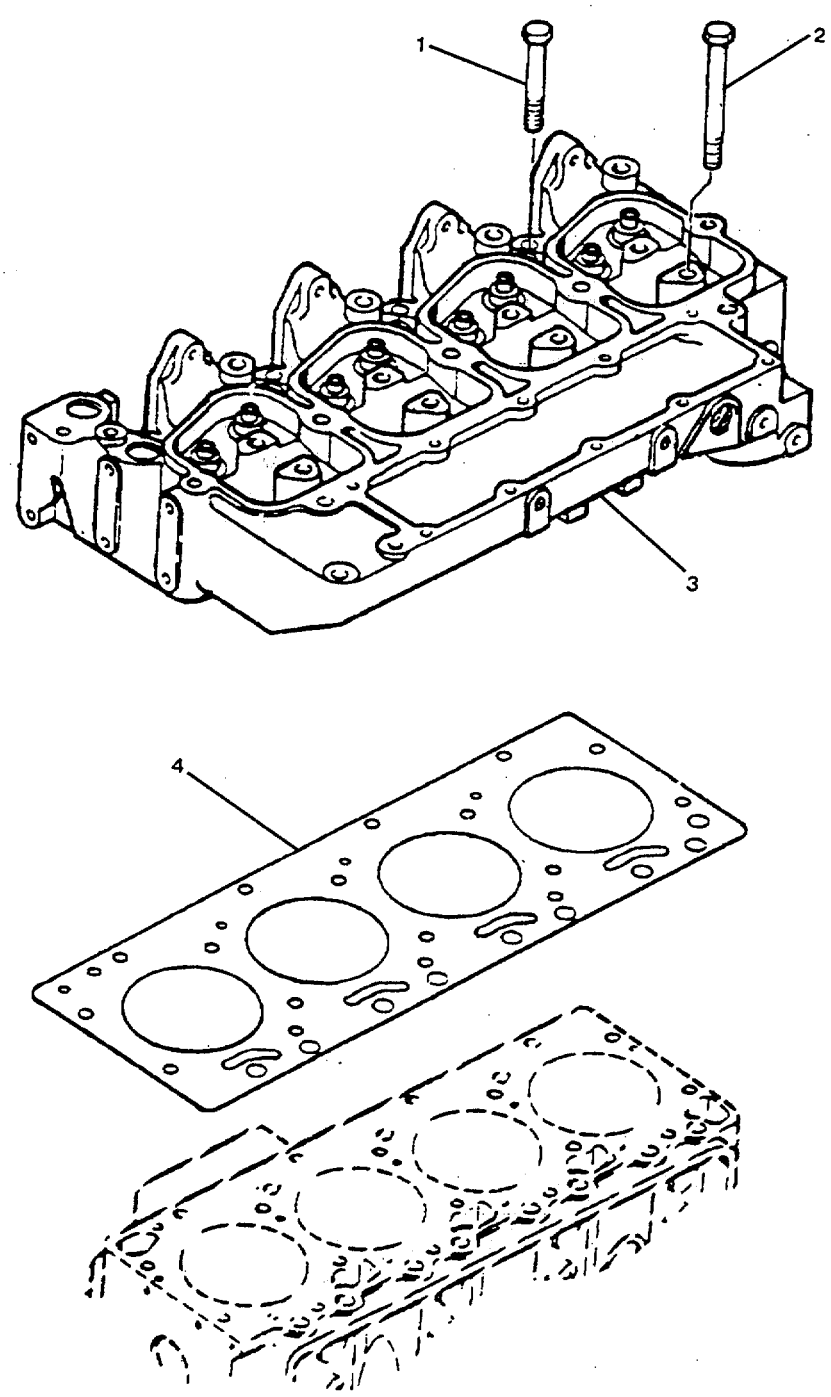


FIGURE 2-41. Cylinder Head.

Section VI. PREPARATION FOR STORAGE OR SHIPMENT

2-41. **Special Preservation and Packaging.** Used engines which are to be stored indefinitely require extensive corrosion preventive measures and careful packaging.

a. Corrosion Prevention.

(1) Drain fuel and water systems completely.

(2) Fill freshwater system with preservative by connecting a supply line to the drain connection for the system. Cause system to overflow from expansion tank vent to ensure that all surfaces are coated. Drain compound from the system and close the drain connection.

(3) Drain the lubricating oil system. Remove oil filter elements, clean and wipe down interiors of filter containers. Install new filter elements.

(4) Break open a fitting in the lubricating oil piping system and connect the discharge side of a separately-driven pump to the disconnected engine lubricating oil system fitting.

(5) Use a separately-driven pump to circulate preservative throughout the lubricating oil system of the engine while the engine is being jacked or barred over. The discharge pressure of the separately-driven pump should approximate the operating pressure of the engine lubricating oil system. Where possible, access plates should be removed to determine that the compound reaches all points of the lubricating oil system.

(6) The interior surfaces of the engine should be sprayed with preservative. This should include all internal parts such as the crankcase, connecting rods, crankshaft, and lower cylinder bores.

(7) Remove inspection and access covers and spray all gears, rockers, linkage, cams, and push rods with preservative while the engine is being jacked or barred over with the turning gear. Spray all surfaces, bearings linkages, and working parts of dry type clutches and reverse mechanism. (No harm will be done if compound comes in contact with friction surfaces.)

(8) Circulate MIL-L-21260, Type 1, Grade 10 or 30 through injectors, fuel lines, booster pump, and filters. Drain all compound from the fuel system. (Do not use Grade 2 preservative in injection pumps or nozzles.)

(9) Spray or brush preservative on internal surfaces of fuel tanks.

(10) Disconnect separately-driven pump, installed in step 5.

(11) Remove excess by draining of compound from all pockets.

(12) Replace access plates and covers.

(13) Seal all openings into engine to prevent entrance of dirt or water.

(14) Using Grade 2 compound, spray or brush over all external unpainted areas. If the engine is to be exposed to the weather, Grade 1 compound should be used. When engines are preserved and stored in a dehumidified space in a warehouse or aboard ship, no external preservation need be applied.

(15) Tag the engine to indicate that the fluid systems have been treated with a rust preventive compound. The tag must include:

(a) The date on which the engine was treated.

(b) The statement that the engine is not to be turned over until ready to be put into operation (because this may impair the protective film).

(c) The statement that the procedure as specified in TB 55-1900-207-24 must be followed before placing the engine in service.

(d) The statement that the lubrication, cooling, and fuel systems must be filled before operating.

b. Packaging.

(1) Cover with tape all openings such as air intake, exhaust headers and fluid system flanges.

(2) Containerize in a plywood crate or encase in zipper type plastic bag with a waterproof bag of desiccant.

CHAPTER 3

INTERMEDIATE DIRECT SUPPORT MAINTENANCE INSTRUCTIONS

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

3-1. **Common Tools and Equipment.** For authorized common tools and equipment, refer to the Modified Table of Organization and Equipment (MTOE) applicable to your organization.

3-2. **Special Tools**, **TMDE, and Support Equipment.** Special tools; test, measurement, and diagnostic equipment; and support equipment requirements are listed and illustrated in the Repair Parts and Special Tools List (RPSTL), TM 55-1905-223-24P. These items are also listed in the Maintenance Allocation Chart (MAC), Appendix B of this manual.

3-3. **Repair Parts**. Repair parts are listed and illustrated in the Repair Parts and Special Tools List (RPSTL), TM 55-1905-223-24P.

Section II. SERVICE UPON RECEIPT

3-4. **Checking Unpacked Equipment.**

a. Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, report the damage in accordance with the instructions of DA Pam 738-750.

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

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

3-5. **Deprocessing Unpacked Equipment.**

a. Remove protective caps, plugs, inserts, wrappings, and tape when inspection/inventory is completed. Inspect piping openings for, damage. Wipe off dirt, grease, or protective films at time of installation.

b. Remove chocks from resilient mounted components.

3-6. **Operational Procedures.**

a. Initial Setup Procedure. Includes operational checks and inspections that are not performed for a routine startup. Direct support maintenance personnel will perform initial setup in accordance with the operator's manual, TM 55-1905-223-10.

b. Normal Startup. Refer to the operator's manual, TM 55-1905-223-10.

c. Shutdown Procedure (Usual or Unusual). Refer to the operator's manual, TM 55-1905-223-10.

Section III. INTERMEDIATE DIRECT SUPPORT PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

There is no PMCS at the Intermediate Direct Support level. See Chapter 2, Section III.

Section IV. INTERMEDIATE DIRECT SUPPORT TROUBLESHOOTING

3-7. Troubleshooting. Both a symptom index and a troubleshooting table are provided. The symptom index will help you locate the information you need for troubleshooting.

SYMPTOM INDEX

	Troubleshooting Procedure (Table 3-1)
ENGINE	
Low oil pressure	Item 1
Will not shutdown	Item 2

SYMPTOM INDEX (Continued)

	Troubleshooting Procedure (Table 3-1)
GENERATOR	
Output voltage high or low	Item 3
Output frequency high or-low	Item 4
FAULT LIGHTS ILLUMINATED	
Overspeed shutdown	Item 5

Table 3-1 lists the common fault conditions that may be found during operation or maintenance of the equipment. Look for causes and do corrective actions in the order listed. This manual cannot list every symptom that may show up, and it cannot list all of the possible causes and corrective actions. If a symptom is not listed, or if it keeps up after you have performed the corrective actions, notify your supervisor.

Table 3-1. Troubleshooting.

Malfunction Test or Inspection Corrective Action
1. Low engine oil pressure. STEP 1. Check to see if regulator valve is stuck open. Replace valve (para. 3-12).
2. Engine Will Not Shutdown. STEP 1. Check to see if fuel shutdown valve inoperative. Shutdown the engine mechanically with lever on the fuel pump. Replace sealing washer, piston, and spring (para. 3-12).
3. Generator Set Output Voltage High or Low. STEP 1. Check to see if engine speed is incorrect. Verify/adjust electric governor (para. 3-12).
4. Generator set output frequency high or low. STEP 1. Check for correct engine speed. Adjust the fuel pump high speed screw (para. 3-12).
5. Fault lights illuminated; overspeed shut down. STEP 1. Generator output frequency too high. Measure and adjust frequency between pins V7 and V8 (para. 3-12). STEP 2. Overspeed potentiometer set too low. Adjust the overspeed potentiometer as follows: a. Carefully remove the insulating sealant from the overspeed potentiometer on the voltage regulator board. b. Rotate the overspeed potentiometer fully clockwise. c. Connect a frequency meter to terminals VO and V7. d. Start the generator set. e. Adjust the engine speed until the frequency meter reads 70 Hz. f. Slowly rotate the overspeed adjustment counterclockwise until the generator set shuts off. g. The overspeed fault shut down is now set. h. Adjust the frequency (para. 3-12). i. Turn off the generator set. j. Reset the fault lamp and start the generator set. k. Adjust the engine speed for proper frequency output (50 to 60 Hz). Refer to paragraph 3-12 for procedures. l. Turn off the generator set. m. Disconnect the frequency meter and reseal the overspeed potentiometer with RTV. NOTE **Do Not** disturb the potentiometer setting when sealing.

Section V. INTERMEDIATE DIRECT SUPPORT MAINTENANCE PROCEDURES

MAINTENANCE OF EMERGENCY GENERATOR SET

3-8. **Replace Emergency Generator Set.** (FIGURE 3-1)

This task covers: a. Removal, b. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's rail and marine diesel engines, 5180-00-629-9783
Tool kit, electrician's, 5180-00-391-1087
Lifting fixture P/N 3822512
Combination wrench set, metric 10mm thru 24mm, 5120-01-046-4979

Materials/Parts

Emergency generator set P/N S.O. 41727-4BT3.9A15434-CC
Warning tags, Item 21,,Appendix C
Lubricating oil, Item 14, Appendix C
Coolant, Item 4, Appendix C
Lifting bars, Item 11, Appendix C

Equipment Condition

Power disconnected. Unit tagged "Out of Service" (TM 55-1905-223-10).
Battery bank disconnected.

REMOVAL

a. Close the shutoff valves to the fuel supply (TM 55-1905-223-24-18).

b. Disconnect the starter from the battery.

c. Disconnect all external wiring and tag.

d. Disconnect the fuel supply from the fuel inlet connection.

e. Drain all the fuel, oil and coolant from the engine.

NOTE

The radiator, engine and generator are mounted on a common skid. They are removed as a unit.

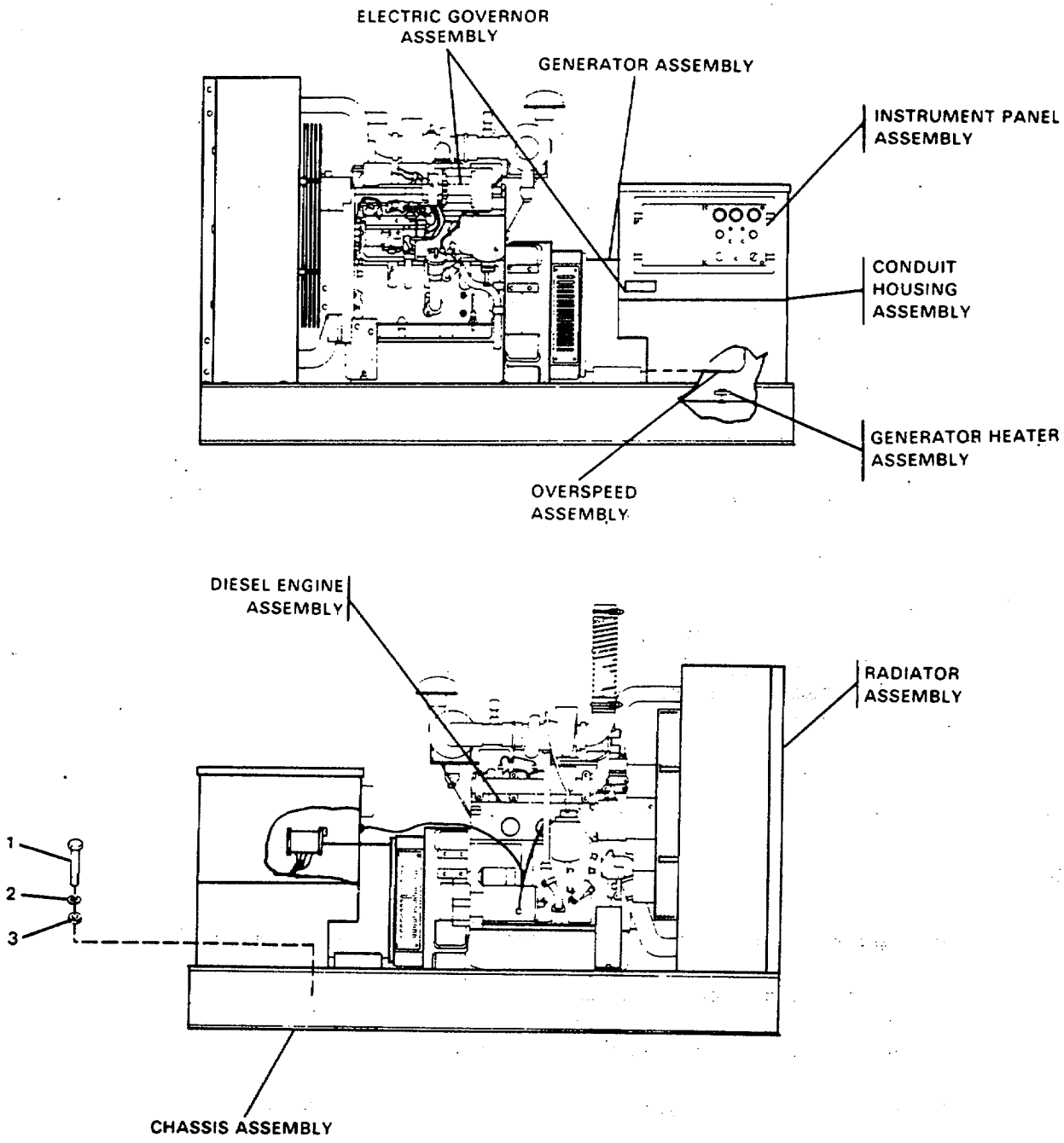


FIGURE 3-1. Emergency Generator Set.

f. Disconnect the exhaust connection from the exhaust outlet.

g. Remove the anchor bolts (1), lockwashers (2), and nuts (3) which secure the base to the deck.

h. Slide two lifting bars into the base rail holes and connect to a lifting fixture.

CAUTION

Do not lift the generator set using only the engine or generator lifting eyes.

NOTE

The generator set weighs approximately 1514 lbs.

i. Lift the generator set up and out of position.

j. Reference Chapter 2, Section VI, preparation for storage.

REPLACEMENT

a. Attach lifting fixture to-generator set.

b. Lift the generator set and move into position.

c. When properly positioned, lower the generator set down.

d. Install anchor bolts (1), lockwashers (2), and nuts (3) to rail securing generator set to the deck and torque to 120 ft-lbs.

e. Connect the exhaust connection to the exhaust outlet.

f. Connect all external wiring as tagged.

g. Supply 10 quarts of SAE 30W lubricating oil into the oil fill location.

h. Put coolant in the radiator; 50% water and 50% antifreeze.

i. Connect the fuel supply line to the fuel inlet connection.

j. Open the shut off valves to the fuel supply.

k. Connect the starter to the battery.

l. Before start-up of unit reference the PMCS tables.

3-9. **Replace/Repair Control Housing Assembly.** (FIGURE 3-2)

This task covers: a. Removal, b. Repair, c. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's rail and marine diesel engines', 5180-00-629-9783

Equipment Condition

Equipment shut down and tagged "Out of Service" (TM 55-1905-223-10).

Materials/Parts

Warning tags, Item 21, Appendix C

REMOVAL

a. Remove capscrews from blank panel (7) and remove panel.

b. Remove capscrews from access covers-(2, 4); Remove access covers.

c. Remove capscrews from grille (5) remove grille.

d. Remove grommet (9).

e. Remove capscrews from remaining panels (1, 3, 6); Remove panels.

f. Remove capscrews from control housing (8); remove control housing.

REPAIR

Repair of control housing assembly is by replacement.

REPLACEMENT

a. Install control housing (8) secure with capscrews.

b. Install blank panels (1, 3, 6, & 7); secure with-capscrews.

c. Install grommet (9).

d. Install access covers (2, 4) secure with capscrews.

e. Install grille (5); secure with capscrews.

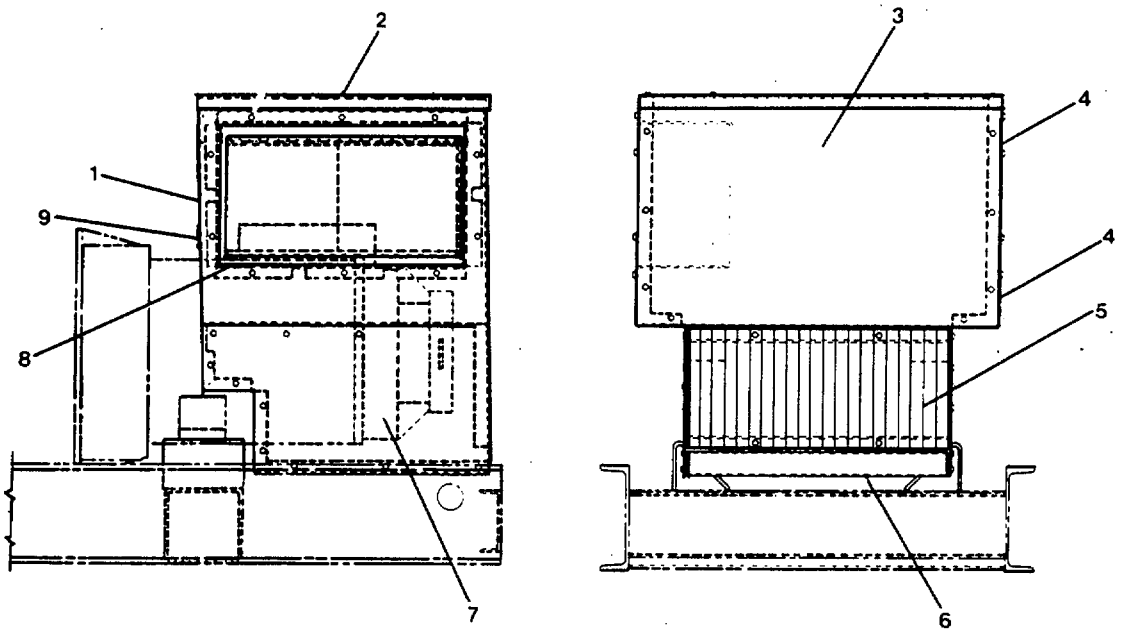


FIGURE 3-2. Control Housing Assembly.

3-10. **Repair Instrument Panel Assembly**. (FIGURE 3-3)

This task covers: a. Disassembly, b. Repair, c. Assembly.

INITIAL SETUP

Tools

Tool kit, electrician's,
5180-00-391-1087
Digital multimeter,
6625-01-139-2512

Equipment Condition

Equipment secured and tagged "Out of Service" (TM 55-1905-223-10).
Door assemblies removed (Para. 2-14 and 2-15).
Instrument panel removed (Para. 2-12).

Materials /Parts

Rubber grommet P/N 508-0117
Relay, 24 Vdc P/N 307-2613
Relay, 24 Vdc P/N 307-2612
Toggle switch P/N 308-0069
Burden resistor P/N 304-0787
Transformer P/N 302-1837
Relay, 24 Vdc P/N 307-2615
Relay, 24 Vdc P/N 307-2614
DC control harness P/N 338-2202
AC control harness P/N 338-2203
Engine harness P/N 338-2182
Relay, 240V P/N 307-2611
Voltage regulator P/N 305-0770
Resistor P/N 304-0789-01
Resistor assembly P/N 304-0788
Warning tags, Item 21, Appendix C

DISASSEMBLY

a. Tag and disconnect all wiring harnesses from terminal board (4).

   (1) Check wiring for burns, discoloring or breaks.

   (2) Check for corrosion.

b. Remove panhead screws (10).

c. Remove relays (8, 9, 12, 13, 14) from control box assembly (15).

d. Remove paralleling module.

   (1) Remove toggle switch (22).

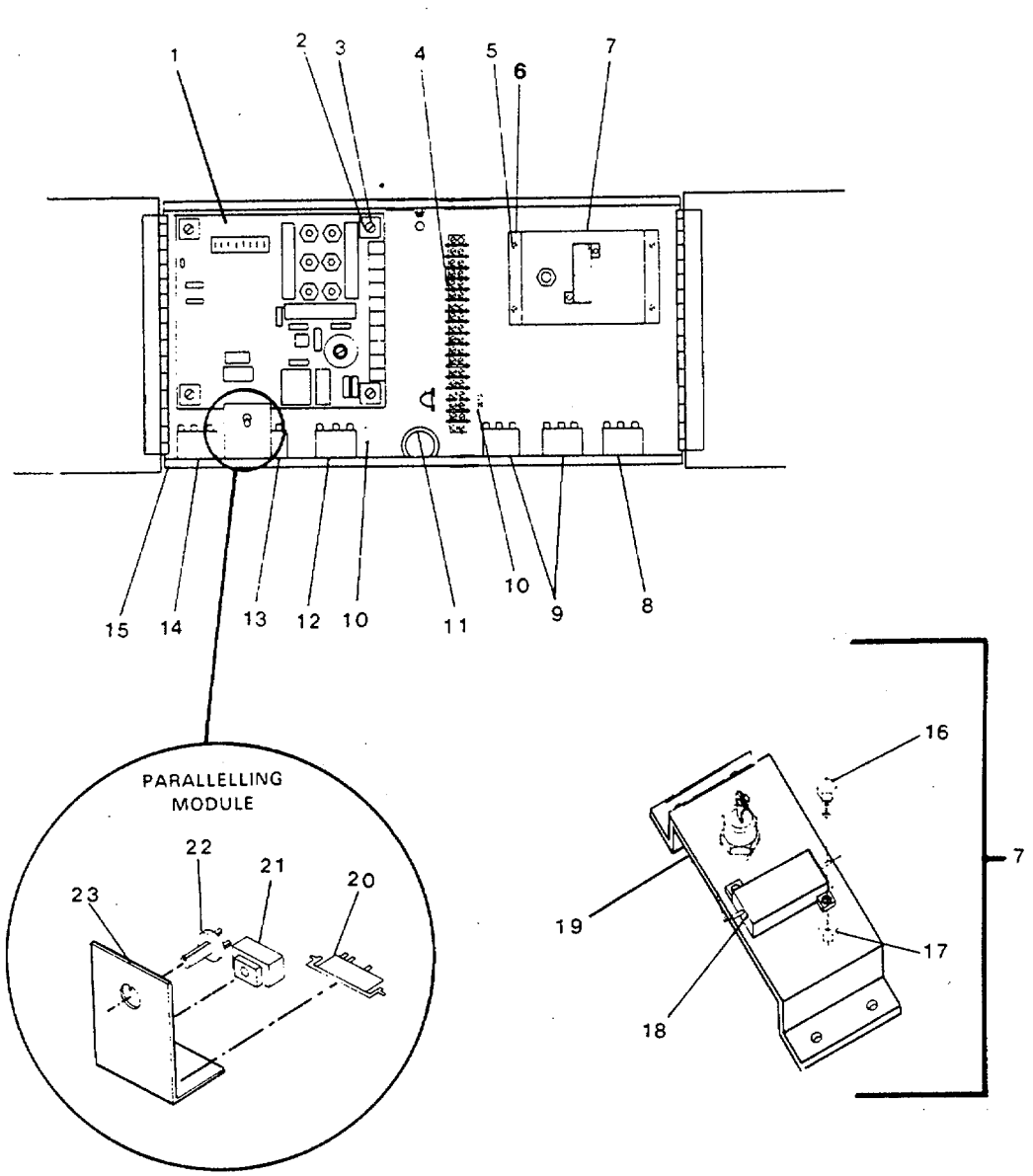


Figure 3-3. Instrument Panel Assembly.

(2) Remove burden resistor (20).

(3) Remove transformer (21).

(4) Remove cross-current bracket (23).

e. Remove voltage regulator (1).

(1) Remove four machine screws (2) and lockwashers (3).

(2) Carefully move out voltage regulator for access to back.

(3) Tag and disconnect wiring.

(4) Remove regulator.

f. Remove rubber grommet (11).

g. Tag and disconnect electrical leads to resistor assembly-(7).

h. Remove machine screws (5) and lockwashers (6).

i. Remove resistor assembly (7).

j. Remove bolts (16) and nuts (17).

k. Remove resistor (18) from mounting bracket (19).

REPAIR

Repair is accomplished by replacement of rubber grommet (11), relays (8, 9, 12, 13, 14), toggle switch (22) burden resistor (20), transformer (21) resistor assembly (7), resistor (18), voltage regulator (1) and wiring harnesses.

ASSEMBLY

a. Replace rubber grommet (11).

b. Replace voltage regulator (1).

(1) Position voltage regulator in place.

(2) Connect wiring as tagged.

(3) Install machine screws (2) and lockwashers (3).

c. Replace paralleling module.

(1) Install cross-current bracket (23).

(2) Replace transformer (21).

(3) Replace burden resistor (20).

(4) Replace toggle switch (22).

d. Replace relays (8, 9, 12, 13, & 14) in control box assembly (15).

e. Install panhead screws (10).

f. Install resistor (18) on mounting bracket (19).

g. Secure with bolts (16) and nuts (17).

h. Install resistor assembly (7) in instrument panel assembly.

i. Secure with machine screws (5) and lockwashers (6).

j. Connect all wiring harnesses as tagged to terminal board (4).

k. Replace door assemblies (para. 2-14 and 2-15).

l. Replace instrument panel (para. 2-12).

m. Remove "Out of Service" tags and restore equipment to operation (TM 55-1905-223-10).

3-11. **Repair Door Assembly (Right Hand).** (FIGURE 3-4)

This task covers: a. Disassembly, b. Repair, c. Assembly.

INITIAL SETUP

Tools

Tool kit, electrician's,
5180-00-629-1087

Materials/Parts

Contact block P/N 308-0566
Circuit breaker (.4 amp) P/N
320-1586
Pressure indicator P/N 193-0352
Coolant temperature gage P/N
193-0351
Resistor P/N 193-0250
Time totalizing meter P/N 302-1836
Switch P/N 308-0569
Contact block P/N 308-0579 (2)
Circuit breaker (20 amp) P/N
320-1588
Circuit breaker (5 amp) P/N
320-1587
Circuit breaker (.5 amp) P/N
320-1442
Switch P/N 308-0813-01
Contact block P/N 308-0580
Lamp module P/N 308-0546
Push switch P/N;.308-0578 (2)
Warning tags, Item 21, Appendix C

Equipment Condition

Power disconnected. Unit tagged "Out of Service" (TM 55-1905-223-10).
Door assembly removed (para. 2-15).

DISASSEMBLY

a. Tag and disconnect all electrical wiring to components in door assembly (1).

b. Disconnect and remove resistors (2) from back of time totalizing meter (7) and coolant temperature gage (9).

c. Remove time totalizing meter (7), coolant temperature gage (9) and pressure indicator (10) from door (3).

d. Remove retaining nuts and remove circuit breakers (8, 12, 14, and 15).

e. Remove retaining nuts and remove push switches (11) and switch (13) and lamp module (17).

f. Remove switch (16).

g. Remove mounting hardware and remove contact blocks (4, 5, and 6).

REPAIR

Repair at this level of maintenance is by replacement of: contact blocks (4, 5, 6), switches, (13, 16), push switches (11), circuit breakers (8, 12, 14, 15), coolant temperature gage (9), time totalizing meter (7), resistors (2), and pressure indicator (10).

ASSEMBLY

a. Install contact blocks (4, 5, and 6) and secure mounting hardware.

b. Install switches (13, 16) and push switches (11). Secure with retaining nuts. Install lamp module (17).

c. Install circuit breakers (8, 12, 14, and 15) and secure with retaining nuts.

d. Install coolant temperature gage (9), time totalizing meter (7) and pressure indicator (10) in door (3).

e. Connect resistors (2) to back of meter (7) and gage (9).

f. Connect electrical wiring to all components in door assembly (1) and remove tags.

g. Replace door assembly (1) (para. 2-14).

h. Remove "Out of Service" tags and restore equipment to operation (TM 55-1905-223-10).

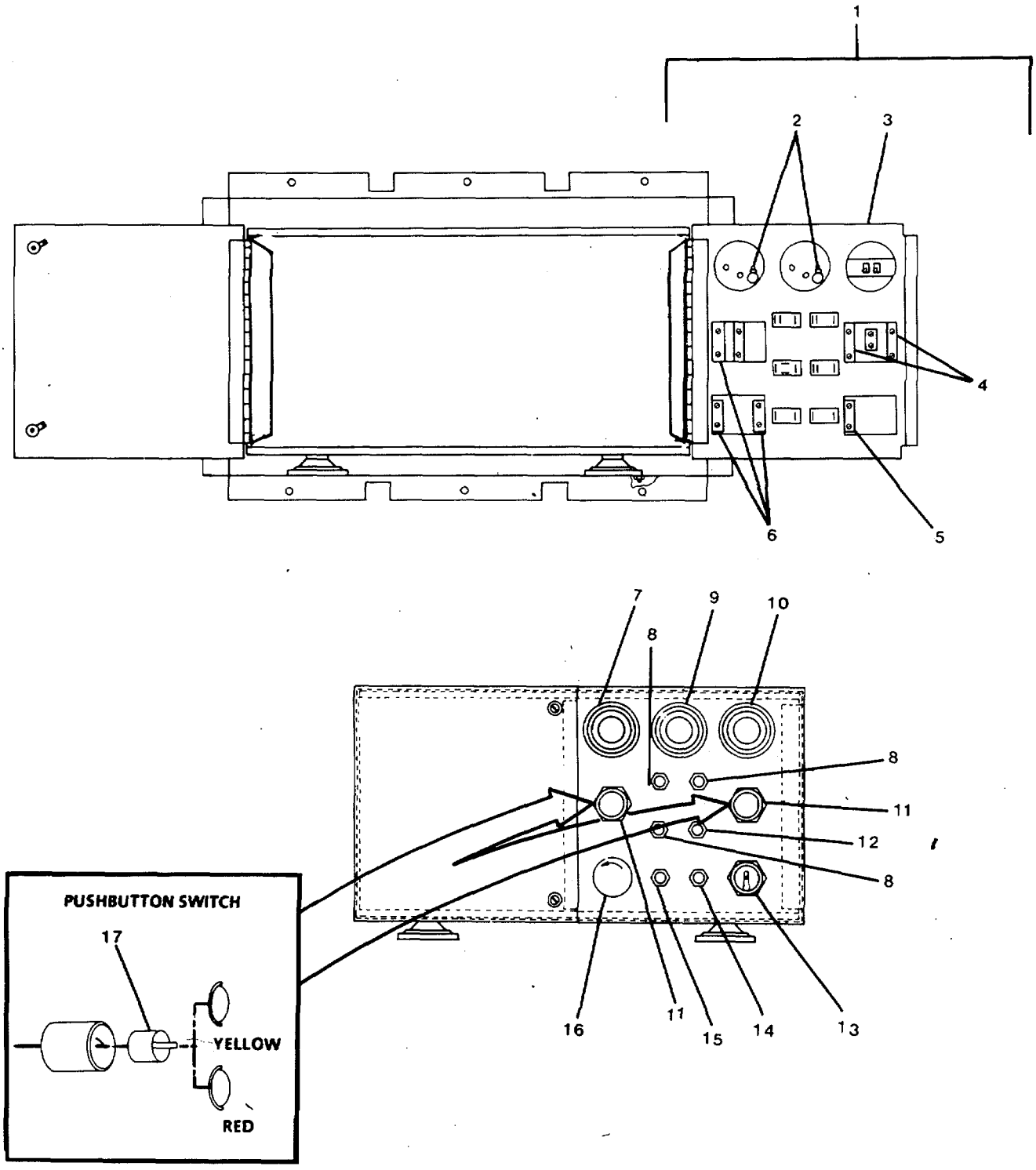


FIGURE 3-4. Door Assembly (Right Hand).

3-12. **Replace/Repair Electric Governor Assembly.** (FIGURES 3-5 through 3-23)

This task covers: a. Removal, b. Disassembly c. Test, d. Repair, e. Assembly, f. Replacement, g. Adjustment.

INITIAL SETUP

Tools

Tool kit, electrician's,
5180-00-391-1087
Digital multimeter
6625-01-139-2512

Equipment Condition

Secure engine and tag "Out of Service"
(TM 55-1905-223-10).
Disconnect battery bank.

Materials/Parts

Warning tags, Item 21, Appendix C
Lead P/N 226-3290
Lead P/N 226-3705-01
Magnetic speed sensor
P/N 150-2201
Diesel engine governor P/N 151-0611
Governor actuator P/N 151-0632
Governor actuator lever P/N 150-2203

REMOVAL

a. Tag and disconnect the lead (10) from the governor actuator (6), and leads (12) from magnetic speed sensor (11).

b. Disconnect actuator rod assembly (1) from the fuel pump (22) and actuator (6).

(1) Remove machine screw (18), nut (20) and flat washers (21) from rod end (19).

(2) Remove stud (17) from actuator (6).

c. Pull spring (16) from, actuator lever (15).

d. Remove capscrews (4), lockwashers (3) and flat washers (2).Remove governor bracket (5).

e. Remove capscrew (7), lockwasher (8) and nut (9).Remove actuator (6).

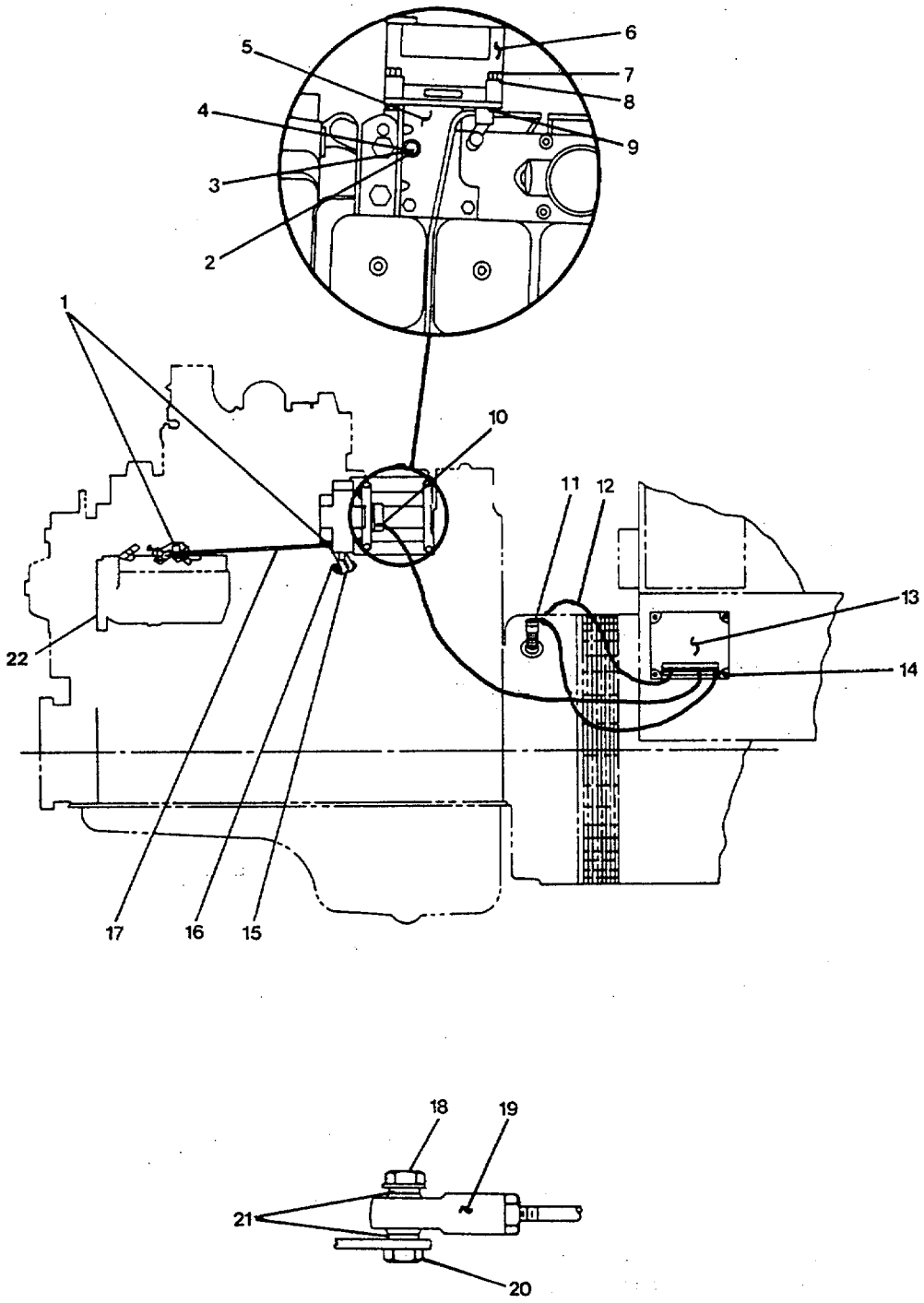


FIGURE 3-5. Repair Electric Governor.

DISASSEMBLY

a. Remove four machine screws (14), slowly pulling the diesel engine governor (13) from housing.

b. Tag and disconnect internal wiring. Remove diesel engine governor (13).

c. Remove magnetic speed sensor (11) by unscrewing counterclockwise.

d. Inspect governor and speed sensor for cracks, rust or corrosion.

TEST

a. Speed Sensor Test. (FIGURE 3-6)

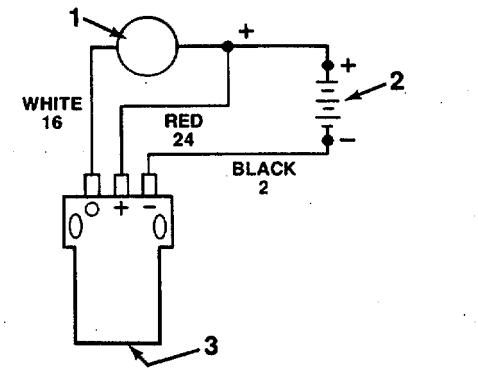
(1) To determine if the signal from the speed sensor is being received at the controller, follow the procedure outlined below:

(a) Connect DC voltmeter between P5 connector, pin 5 on circuit board, and ground-voltmeter should read battery voltage on 12 volt systems, or 16 volts on 24 volt system.

(b) With generator set running, connect DC voltmeter between P5 connector, pin 8 on the circuit board, and ground-voltage reading should equal voltage read in step (a) minues approximately 2 volts.

(2) If the speed sensor signal is not being received at the generator set controller, test speed sensor:

(a) Connect speed sensor, voltmeter and DC voltage source as shown.



1. DC Voltmeter
2. 12 Volt DC Power Supply
3. Sensing Surface

FIGURE 3-6. Speed Sensor Test Hookup.

(b) Touch sensing surface with a flat piece of iron or steel - at least 1/4 cubic inch (4.1 cu3).

(c) Test voltmeter reading should equal voltage source volts.

(d) Remove iron or steel from sensing surface and observe NO test voltmeter reading.

REPAIR

Repair at this level of maintenance is by replacement of: Leads (10) to governor actuator (6), magnetic speed sensor (11), and diesel engine governor (13), governor actuator (6), and governor actuator lever (15).

ASSEMBLY

a. Replace magnetic speed sensor (11) by screwing in clockwise. Refer to FIGURE 3-6 for adjustment procedure.

b. Position diesel engine governor (13) to housing.

c. Connect internal wiring as tagged. Secure governor to housing with four screws (14).

d. Replace leads (10) and (12).

REPLACEMENT

a. Replace actuator (6), secure with nut (9), lockwasher (8) and capscrew (7).

b. Replace governor bracket (5). Secure with flat washers (2), lockwashers (3), and capscrews (4).

c. Replace actuator rod assembly (1) to fuel pump (22) and actuator (6).

(1) Install flat-,(21), nut (20), and machine screw (18) to rod end (19),

(2) Install actuator lever (15) and spring (16).

d. Connect leads to actuator (6) and magnetic speed sensor (11).

ADJUSTMENT

a. Adjust Magnetic Speed Sensor. (FIGURE 3-7)

(1) Loosen lock nut and screw sensor in until it makes contact with the gear tooth.

(2) Back off sensor +F turn. Secure lock nut. A=7.71 to 1.067mm (0.28 to .042 inch).

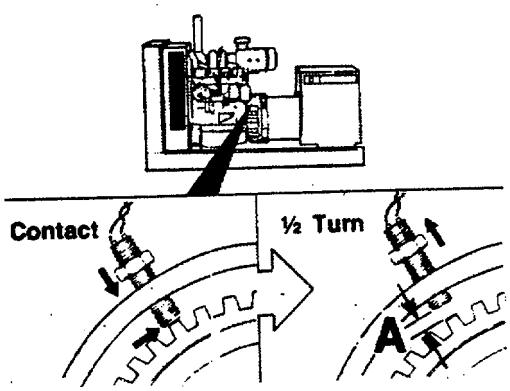


FIGURE 3-7. Magnetic Speed Sensor Adjustment.

b. Adjust Governor Actuator Lever.

(1) Position fuel pump throttle lever in the full throttle position and the actuator in the idle position. Install the linkage and start the generator set. (TM 55-1905-223-10) (FIGURE 3-8)

(2) While holding the actuator arm in the idle position, adjust the linkage to obtain the following: (FIGURE 3-8)

60 Hz Operation -
approximately 58 Hz, 1740 RPM

50 Hz Operation -
approximately 48 Hz, 1440 RPM

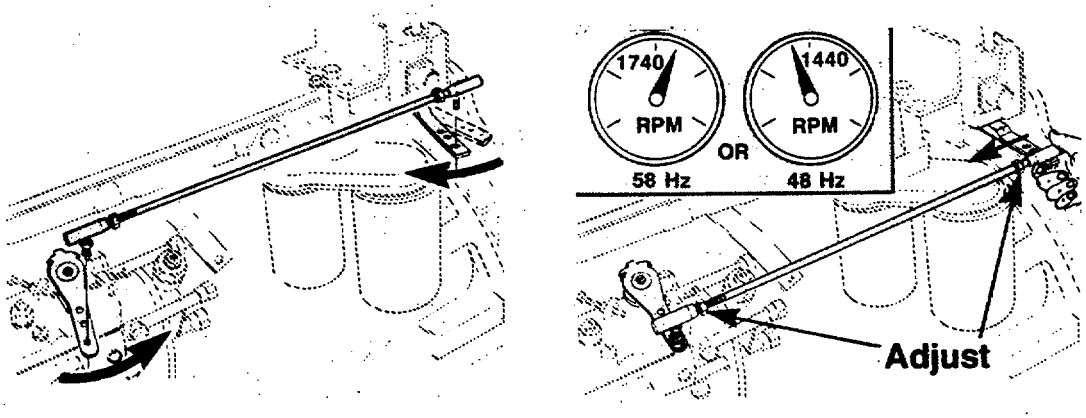


FIGURE 3-8. Install Linkage/Adjust Actuator Lever.

(3) Adjust the high idle adjusting screw to allow for the excessive travel needed to maintain the maximum power required.(FIGURE 3-9)

A=.635mm (0.25 inch)

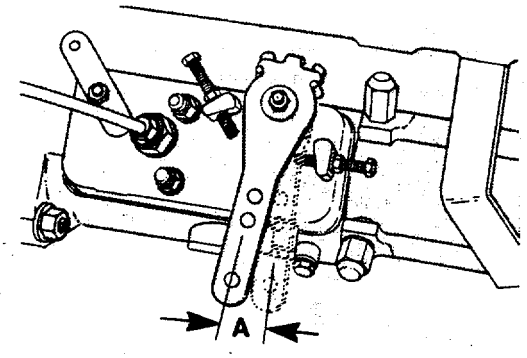


FIGURE 3-9. High Idle Adjustment.

(4) Ensure all linkage and levers are securely tightened. (FIGURE 3-10)

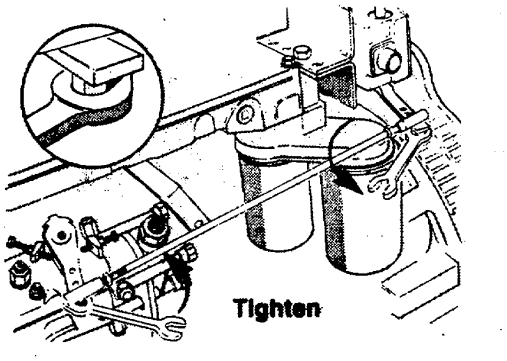


FIGURE 3-10. Tighten Linkage and Levers.

(5) Manually push the actuator to the full position. When released, it should return to the low idle position without binding or obstructions. (FIGURE 3-11)

(6) Stop generator set.(TM 55-1905-223-10)

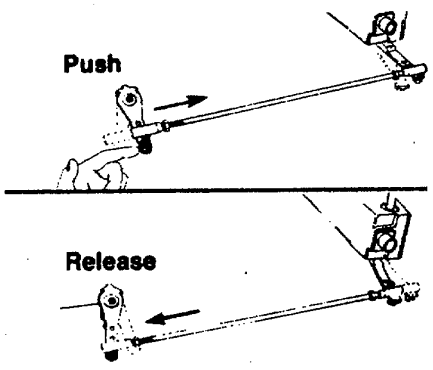


FIGURE 3-11. Low Idle Position Check.

c. Adjust Diesel Engine Governor.

(1) Connect the wiring harness to the actuator. (FIGURE 3-12)

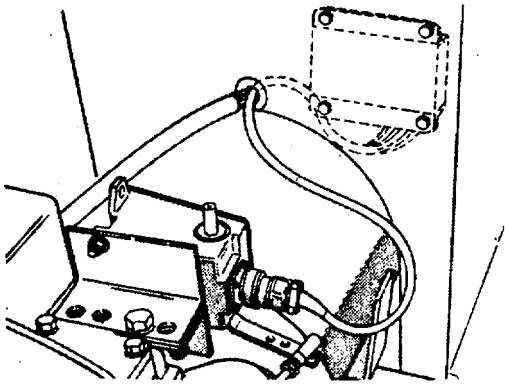


FIGURE 3-12. Wiring Harness.

(2) Connect wiring to diesel engine governor. (FIGURE 3-13)

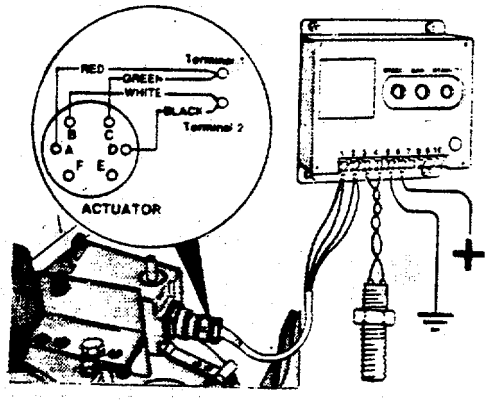


FIGURE 3-13. Wiring Connections to Governor.

d. Adjust the Speed Control Unit.

(1) Remove speed control unit access plug. (FIGURE 3-14)

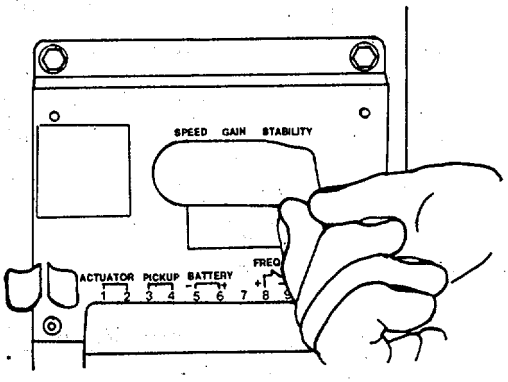


FIGURE 3-14. Remove Speed Control Unit Access Plug.

(2) Set the STABILITY and GAIN controls to approximately midpoint. (FIGURE 3-15)

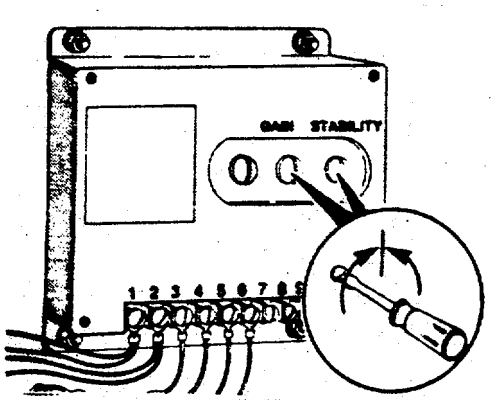


FIGURE 3-15. Stability and Gain Control Adjustment.

(3) Set the FREQUENCY TRIM CONTROL (if used) to approximately midpoint. (FIGURE 3-16)

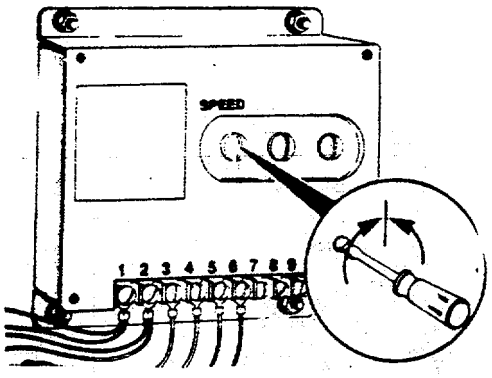


FIGURE 3-16. Frequency Trim Control Adjustment Setting.

(4) Connect a frequency meter to terminals V0 and V7. (FIGURE 3-17)

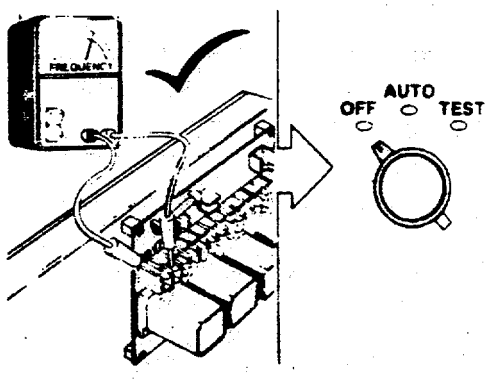


FIGURE 3-17. Frequency Meter Hook-up.

(5) Start the generator set. (FIGURE 3-18)

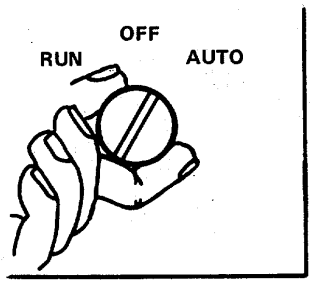


FIGURE 3-18. Generator Set Start-up.

(6) Frequency adjustment (speed) (FIGURE 3-19).Adjust to the desired frequency (50 or 60 Hz) by adjusting the speed potentiometer (pot) (clockwise to increase)-

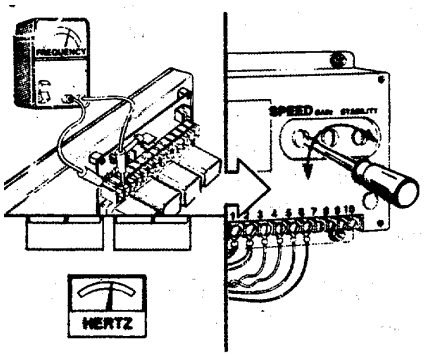


FIGURE 3-19. Frequency Adjustment (Speed).

(7) Performance adjustments.

(a) Once the desired frequency is obtained (50 or 60 Hz), the two performance adjustments, GAIN and STABILITY, can be made as follows.

1 At no load, slowly rotate the GAIN adjustment on the SPEED CONTROL unit slowly clockwise until the engine surges. IF SURGING DOES NOT OCCUR WITH THE GAIN ADJUSTMENT IN THE FULLY CLOCKWISE DIRECTION, MOVE THE FUEL LEVER TO INDUCE SURGING. Rotate the screw counterclockwise 30 degrees to retain stability. (FIGURE 3-20)

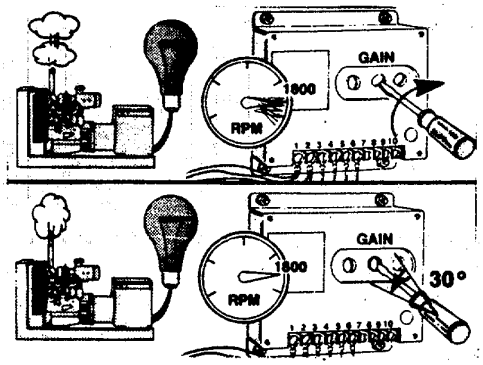


FIGURE 3-20. Gain Adjustment.

2 Slowly rotate the STABILITY adjustment clockwise until surging returns. Rotate the screw counterclockwise 30 degrees to regain stability. (FIGURE 3-21)

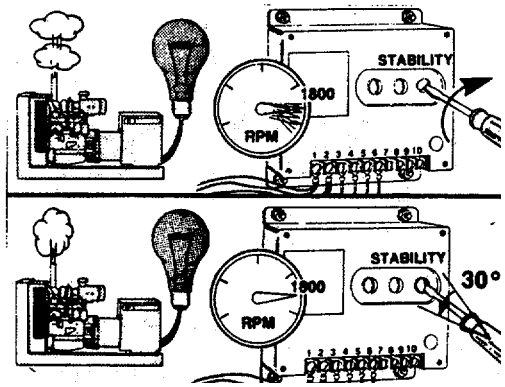


FIGURE 3-21. Stability Adjustment.

(b) Load may now be applied to the generator set. If necessary, repeat steps 1 and 2 until optimum performance is obtained. Normally, the critical condition for CAIN and STABILITY adjustment is at NO load. (FIGURE 3-22)

(c) Optimum adjustment.(FIGURE 3-23)

1 The optimum adjustment of both controls is in the maximum clockwise position where the best response and stability are obtained under all operating conditions.

2 Backing off slightly from this position well allow for changing conditions that may affect the dynamic response of the engine.

3 If a load bank and recorder are available, refer to the Troubleshooting Procedures in Chapter 2, Section III of this manual.

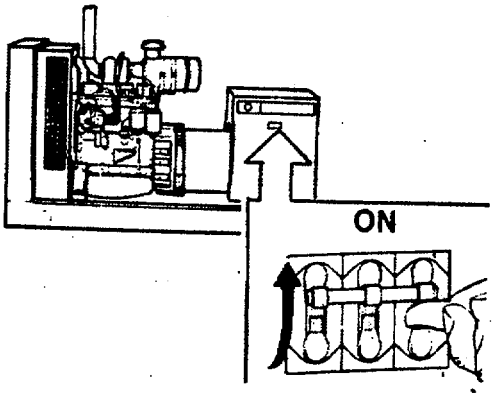


FIGURE 3-22. Applying a Load to the Generator Set.

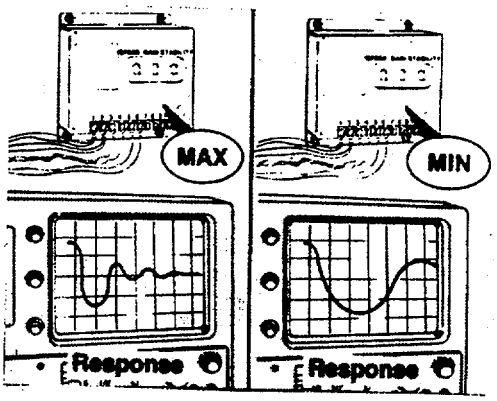


FIGURE 3-23. Optimum Adjustment.

3-13. **Repair Overspeed Assembly.** (FIGURE 3-24)

This task covers: a. Disassembly, b. Repair, c. Assembly.

INITIAL SETUP

Tools

Tool kit, electrician's,
5180-00-391-1087

Equipment Condition

Power disconnected tagged "Out of Service" (TM 55-1905-223-10).
Control housing assembly removed (para. 3-9).
Overspeed assembly removed (para. 2-17).

Materials/Parts

Point assembly P/N 150-0723
Pressure switch P/N 150-0716
Warning tags, Item 21, Appendix ,C

DISASSEMBLY

a. Remove capscrews (2) and cover (3) from overspeed assembly (1).

b. Remove hex nut (6), lock washer (5), and insulating nut (7).

c. Remove point assembly (8).

d. Remove pressure switch (4).

e. Remove lock washer (9).

REPAIR

Repair at this level of maintenance is by replacement of: Point assembly (8) and pressure switch (4).

ASSEMBLY

a. Install pressure switch (4) and lock washer (9) in overspeed assembly (1).

b. Install point assembly (8) and secure with insulating nut (7), lock washer (5), and hex nut (6).

c. Secure cover (3) to overspeed assembly (1) with capscrews (2).

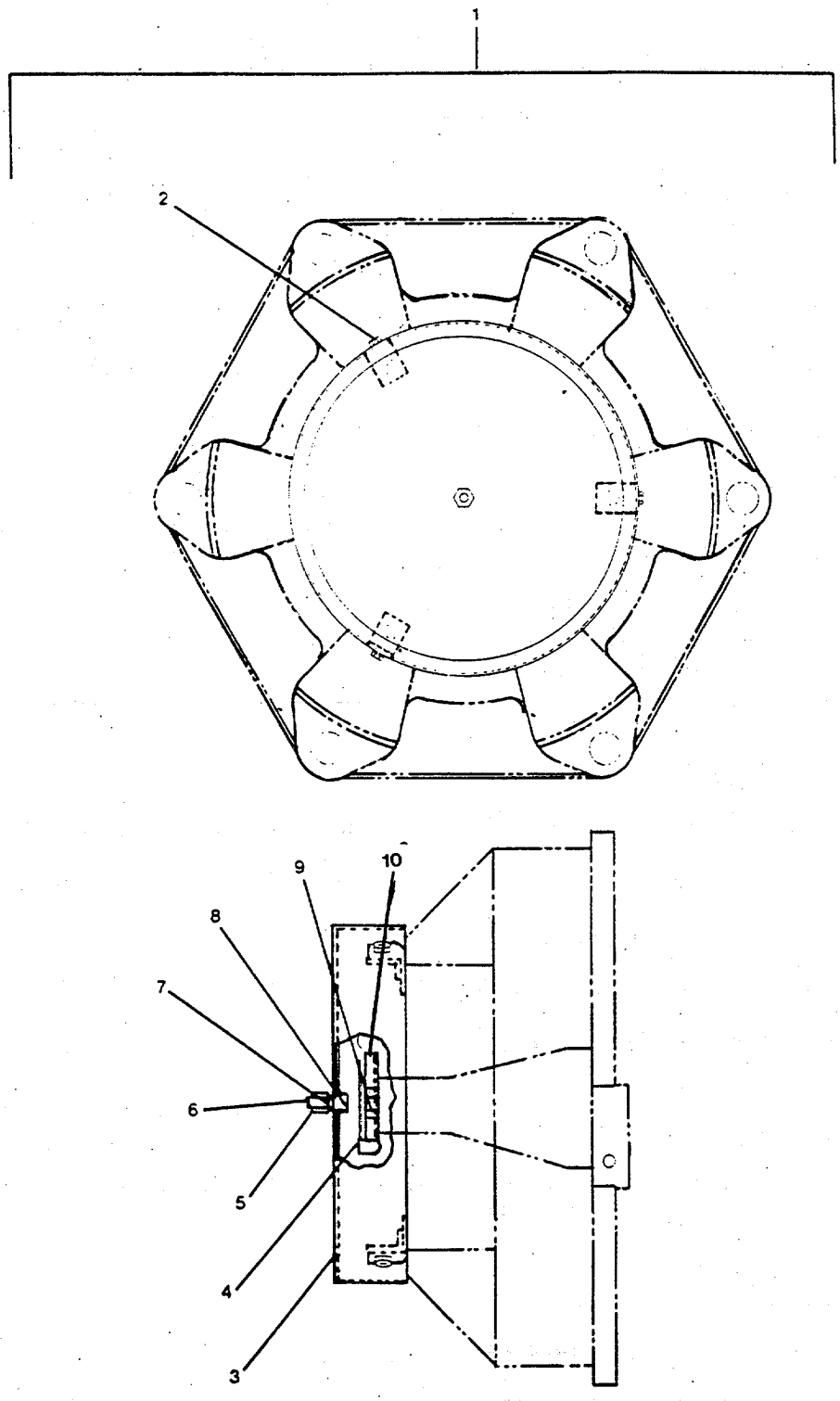


FIGURE 3-24. Repair Overspeed Assembly.

3-14. **Replace/Repair Radiator Assembly**. (FIGURE 3-.25)

This task covers: a. Removal, b. Repair, c. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's
rail and marine diesel engines,
5180-00-629-9783
Combination wrench set, metric
10mm thru 24mm
5120-01-046-4979
Torque wrench kit P/N 3377216

Equipment Condition

Engine secure and tagged "Out of Service"
(TM 55-1905-223-10).
Battery bank disconnected.
Hose assemblies removed (para. 2-18).

Materials/Parts

Nonmetallic hose P/N 503-1391-01 (qty 2)
Drain cock P/N 504-0028
Radiator P/N 130-3064
Coolant, Item 4, Appendix C
Bristle brush, Item 1, Appendix C
Warning tags, Item 21, Appendix C
Utility pail, Item 23, Appendix C

REMOVAL

a. Remove drain cock (8) and drain coolant into utility pail.

b. Remove self-locking hex head nuts (14) and remove grille assembly (15).

c. Remove hex head capscrews (3) and remove grille support (4).

d. Remove four hose clamps (2, 12) at end of inlet tube (13).Disconnect tube (13).

e. Remove two hose clamps (9, 11) at either end of outlet tube (10). Disconnect tube (10).

f. Remove four self-locking nuts (6), bevel washers (7) and capscrews (5).

CAUTION

More than one soldier is required to remove radiator assembly.

g. Remove radiator (1) from base.

REPAIR

Repair at this level of maintenance is by replacement of: drain cock (8) and radiator (1).

REPLACEMENT

a. Replace radiator.

b. Replace screws (5), bevel washers (7) and nuts (6) to base. Torque 75 ft-lbs.

c. Connect inlet (13) and outlet (10) tubes.

d. Replace hose clamps to tubes.

e. Replace drain cock (8).

f. Replenish coolant. Use 50% coolant and 50% water.

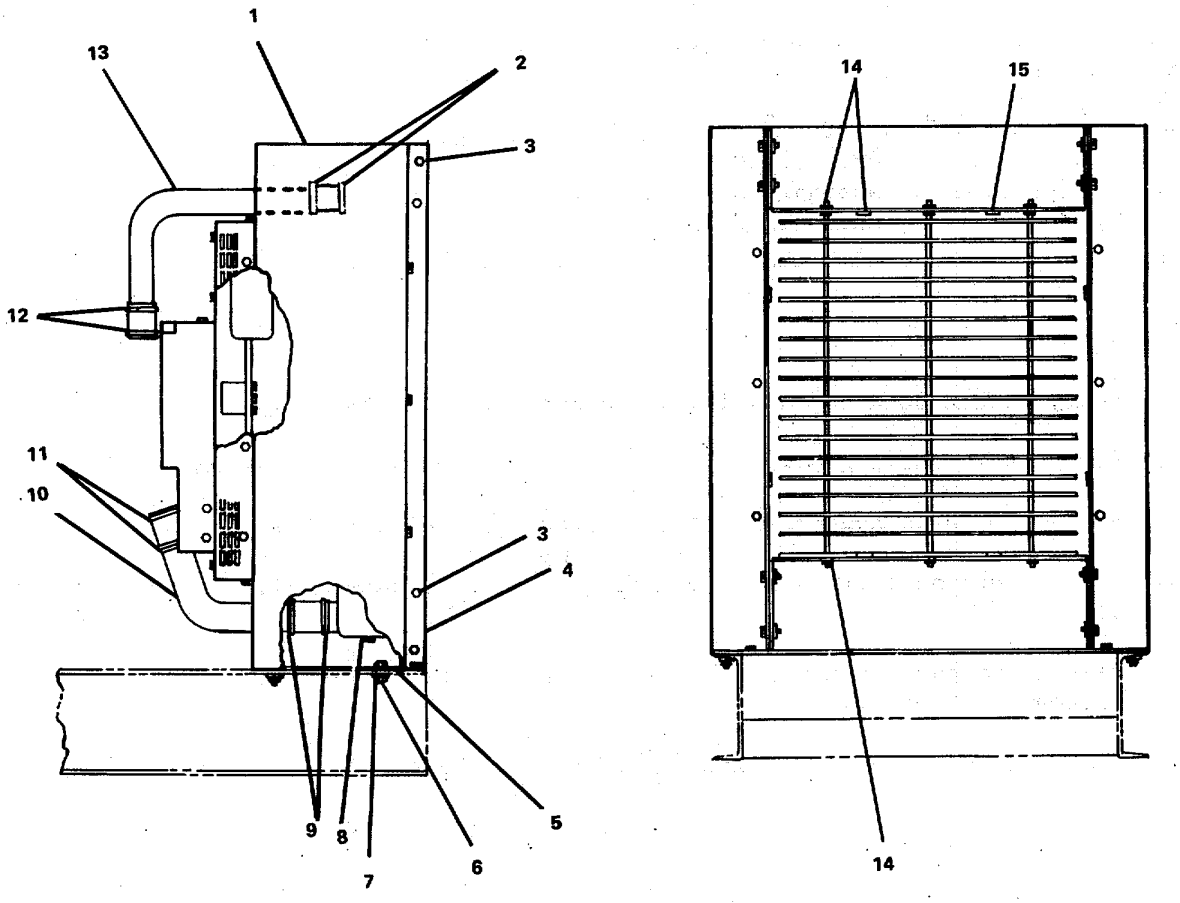


FIGURE 3-25. Radiator Assembly.

3-15. **Replace/Repair Generator Assembly.** (FIGURES 3-26 through 3-36)

This task covers: a. Disassembly, b. Repair, c. Assembly.

INITIAL SETUP

Tools

Tool kit, general mechanic's rail and marine diesel engines, 5180-00-629-9783
Digital multimeter, 6625-01-139-2512
Lifting fixture P/N 3822512
Torque wrench kit P/N 3377216

Materials/Parts

Terminal link P/N 354-13460
Voltage regulator P/N 350-11700
Varistor P/N 073-08059
Reverse rectifier P/N 210-1068
Reverse polarity diode P/N 210-10143/3
Forward rectifier P/N 210-1067
Forward polarity diode P/N 210-10142/3
Warning tags, Item 21, Appendix C
Guide studs, Item 24, Appendix C

Equipment Condition

Engine shutdown and tagged "Out of Service" (TM 55-1905-223-10).
Cables removed from battery.
Control housing assembly removed (para. 3-9).

WARNING

Before attempting any work on the generator make sure the starter and battery are disconnected to avoid injury to personnel. Tag the equipment "Out of Service".

REMOVAL

Remove Generator. (FIGURE 3-26)

(a) Tag and disconnect all electrical wiring to generator (1)..

WARNING

Generator is heavy. Two soldiers are required for removal. Make sure lifting fixture is secure before removal.

(b) Attach lifting fixture to generator (1).

(c) Remove machine bolts (4), (2) and lockwashers (3, 5) securing generator and adapter plate (6) to engine.

(d) Lift generator off of mounting platform and place on a suitable work bench or the deck.

DISASSEMBLY

(a) Remove machine bolt (7, FIGURE 3-27) from end of generator shaft (31).

(b) Remove capscrew (6), lockwasher (5), and clamp (4).

(c) Remove stator (3) and rotor (2) from excitor stator (1).

(d) Remove machine key (12) from end of shaft (31).

(e) Remove terminal link (8) from main terminal panel (9).

(f) Remove voltage regulator (10).

(g) Remove machine screws (26) and pressure plate (25).

(h) Remove capscrews (24), lockwashers (23), and coupling disk (27) from adapter (28).

(i) Remove capscrew (22) and lockwasher (21) securing adapter to pad eye (20). Remove adapter (28).

(j) Remove fan (29) and rotor assembly (30) from stator assembly (11).

(k) Remove reverse polarity diode (13) and reverse rectifier (14).

(l) Remove forward rectifier (15) and forward polarity diode (16) nut and lockwasher (19).

(m) Remove capscrews (17) and remove varistor (18).

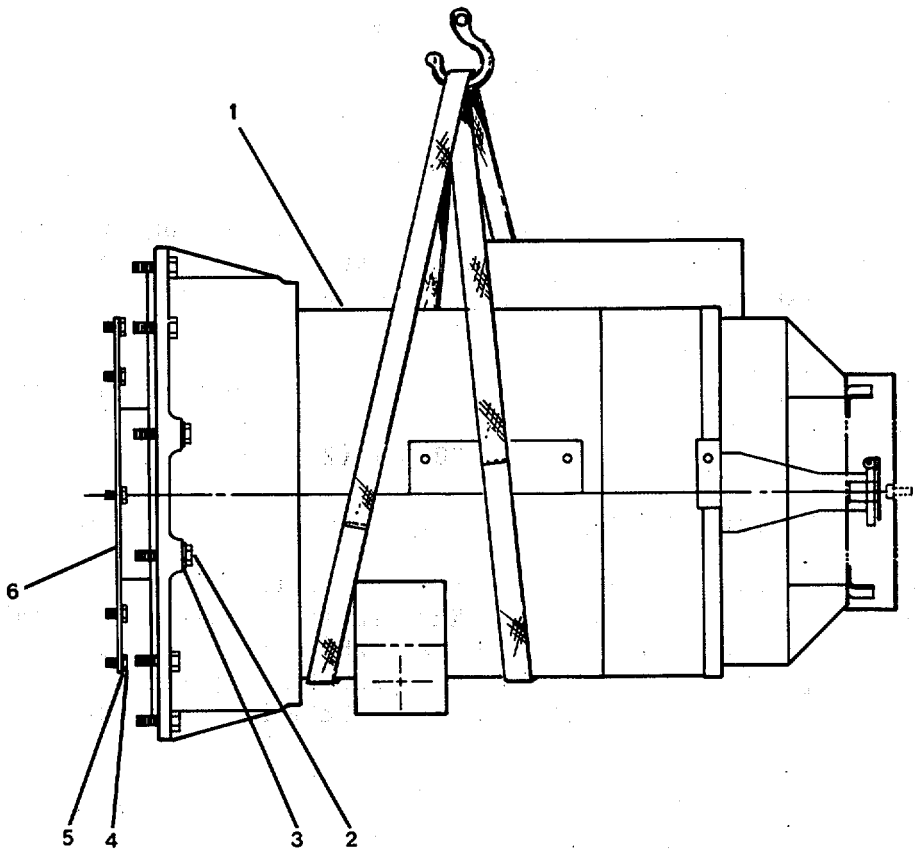


FIGURE 3-26. Generator Assembly Removal.

REPAIR

Repair at this level of maintenance is by replacement of: Terminal link (8), voltage regulator (10), reverse polarity diode (13), reverse rectifier (14), forward rectifier (15), forward polarity diode (16), and varistor (18).

a. Clean Internal Parts and Windings

(1) Dry dust and dirt may be removed by brushing with bristle brushes followed by vacuum cleaning. Do not use wire brushes. Vacuum cleaning is an effective and desirable method of removing dry and loose dirt since it does not scatter dirt.

(2) Cleaning with a dry cloth is satisfactory when the components are small, the surfaces to be cleaned accessible and only dry dirt is to be removed.

WARNING

High pressure compressed air tanks, piping systems and air operated devices possess potential for serious injury to eyes and exposed areas of skin due to escaping air pressure.

(3) Blowing out dirt with compressed air is usually effective, particularly when the dirt has collected in places which cannot be reached with a cloth. Use clean dry air at 30 psi (206 kPa).

b. Check for Faulty Diodes and Varistor.

(1) With the generator set shut down and cool, and electrical power OFF, check the rectifier diodes. The rectifier assembly is split into two plates, positive and negative, and the main rotor is connected across these plates. The positive plate has three positive diodes (semiconductors), and the negative plate has three negative diodes semiconductors).

CAUTION

Care must be taken to ensure that the correct polarity diodes are fitted to each respective plate.

(2) Check the tightness of the diodes to ensure good mechanical and electrical, connection. Tighten the diodes to 42 in-lb. (4.74 N-m).

(3) Use a multimeter on the 10,000 ohms scale and check the diode resistance. Disconnect the flexible lead to each diode and check the forward and reverse resistance.

(4) A good diode will give a high resistance (infinity) in the reverse direction, and a low resistance (full deflection) in the forward direction.

(5) A faulty diode will give a high resistance reading in both forward and reverse directions, or a low resistance reading in both directions.

(6) Use the multimeter and check the varistor (surge suppresser). The varistor is connected across the two rectifier plates to prevent reverse voltages from damaging the diodes.

(7) A good varistor will show a high resistance reading in both directions.

(8) A defective varistor will show a low resistance reading in both directions.

NOTE

Normally, a defective varistor will show signs of burning and can be detected by visible inspection.

9) Replace defective diodes and varistor as necessary (refer to DISASSEMBLY and ASSEMBLY steps of this procedure).

ASSEMBLY

a Install varistor (18, FIGURE 3-27) and secure with capscrews (17).

b. Install forward rectifier (15) and forward polarity diode (16); torque nut and lockwasher (19) to 42 in-lb. (4.74 N-m).

c. Install reverse polarity diode (13) and reverse rectifier (14); torque nut and lockwasher (19) to 42 in-lb. (4.74 N-m).

d. Install rotor assembly (30) and fan (29) into stator assembly (11).

e. Install adapter (28) to pad eye (20), secure with capscrew (22) and lockwasher (21).

f. Install coupling disk (27) and secure with capscrews (24) and lockwashers (23).

g. Install pressure plate (25) and secure with machine screws (26).

h. Install voltage regulator (10).

i. Install terminal link (8) on main terminal panel (9).

j. Install machine key (12) in end of shaft (31).

k. Install rotor (2) and stator (3) in exciter stator (1). Secure to exciter stator with clamp (4), lockwasher (5), capscrews (6), and bolt (7).

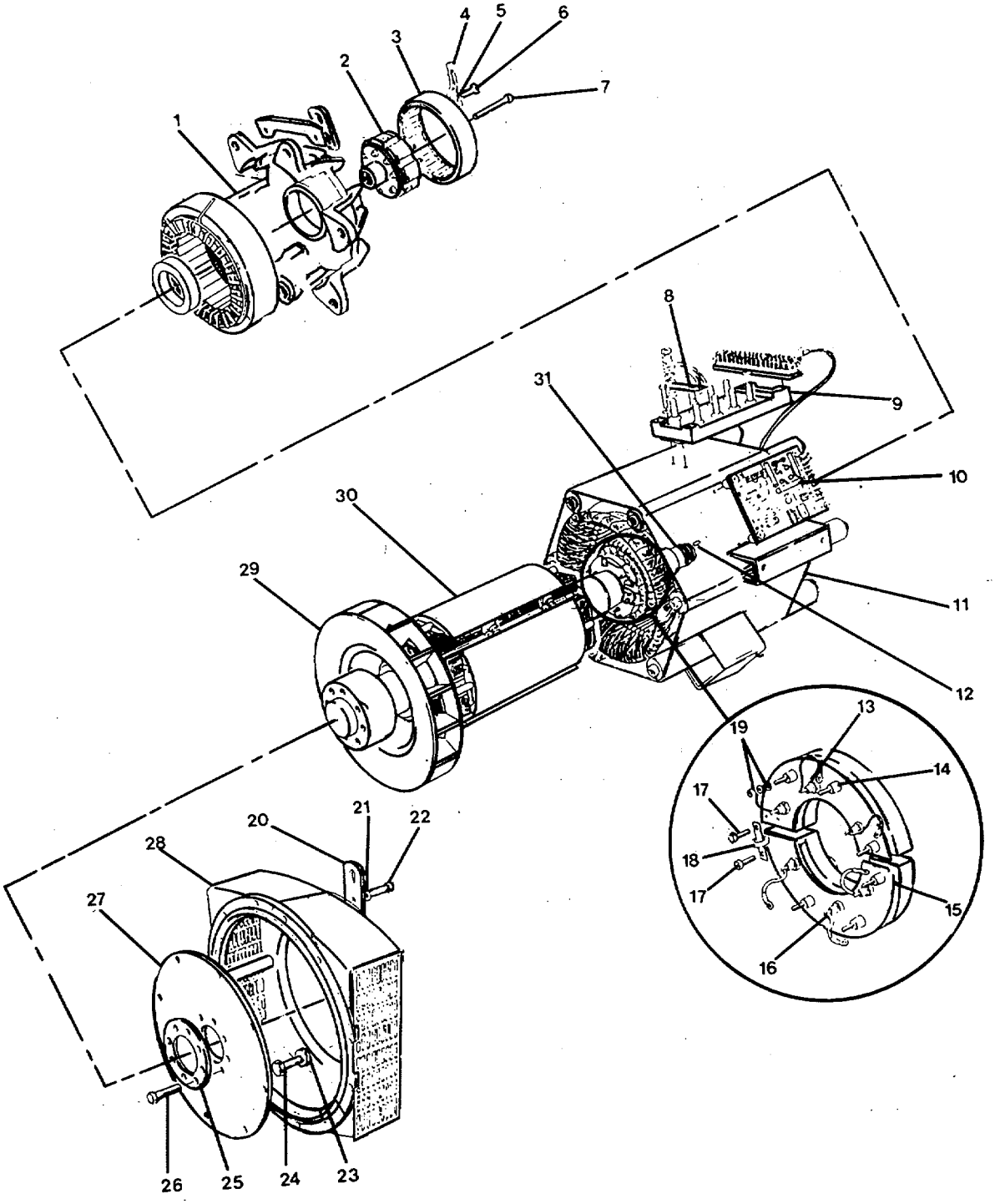


FIGURE 3-27. Generator Repair.

l. Install two guide studs into the flywheel and two in the flywheel housing.

m. Lift the generator into position so that the mounting holes in the coupling disc (27, FIGURE 3-27) and adapter (6, FIGURE 3-26) slide over the guide studs.

CAUTION

Do not force the alignment of the generator. Move the generator from side to side or up and down.

REPLACEMENT (FIGURE 3-26)

a. Guide the generator into the flywheel.

b. Install machine bolts (4) and lockwashers (5) through the coupling disc into the flywheel. Torque 45 ft-lb.

c. Install machine bolts (2) and lockwashers (3) through the generator frame adapter into the flywheel housing. Torque 35 ft-lb.

d. Remove guide studs and install remaining capscrews.

e. Remove lifting fixture from generator.

f. Connect all electrical wiring and remove tags.

g. Test generator set by starting up.

(1) Open generator set circuit breaker. (FIGURE 3-28).

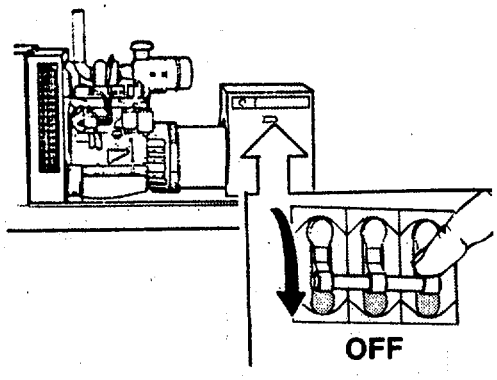


FIGURE 3-28. Set Circuit Breaker.

(2) Place the generator set control switch to the RUN position to start the generator set (FIGURE 3-29)-

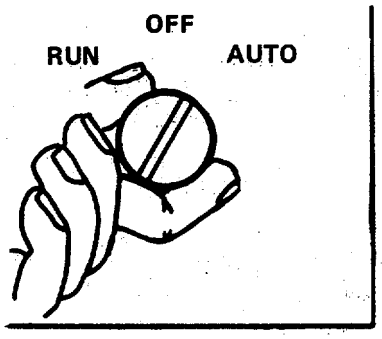


FIGURE 3-29. Idle Position.

(3) Observe the water temperature and oil pressure meter gauges and indicators for proper indications. Coolant temperature must not exceed 1040C (2200F).Minimum oil pressure required are 10 psi at idle and 30 psi at full speed and load (FIGURE 3-30).

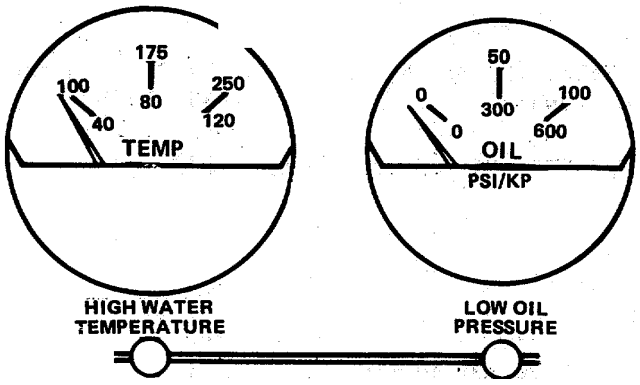


FIGURE 3-30. Off/Run Position.

(4) Perform a visual inspection of the generator set while it is idling. Look for oil/water leaks and loose connections (FIGURE 3-31).

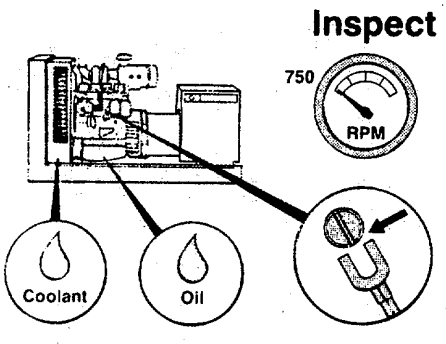


FIGURE 3-31. Visual Inspection.

(5) Place the generator set control switch to the AUTO position. (FIGURE 3-31).

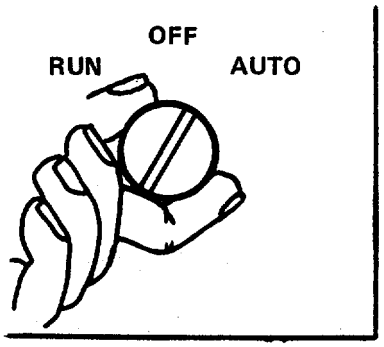


FIGURE 3-32. Generator Set Start-up.

(6) Close the generator set circuit breaker (FIGURE 3-33).

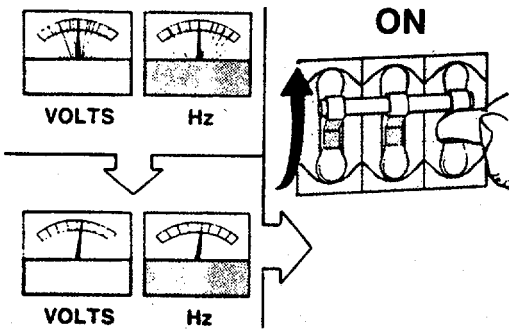


FIGURE 3-33. Secure Circuit Breaker.

3-16. **Replace/Repair Diesel Engine**. (FIGURE 3-34)

This task covers: a. Removal, b. Repair, c. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's rail and marine diesel engines, 5180-00-629-9783
Lifting fixture P/N 3822512
Torque wrench kit P/N 3377216

Materials/Parts

Diesel engine P/N 4BT3.9
Coolant, Item 4, Appendix C

Equipment Condition

Emergency generator set shut down.
Fuel supply line disconnected from fuel inlet connection.
External wiring disconnected (TM 55-1905-223-10).
Coolant drained.
Oil drained.

REMOVAL

a. Disconnect exhaust outlet (para. 2-27).

b. Disconnect starting motor (para. 2-20).

c. Remove radiator assembly (para. 3-14).

d. Remove generator assembly (para. 3-15).

e. Remove five hex head screws (1) and lockwashers (2) from engine mounts.

WARNING

Engine is very heavy. Four crew members are required to move engine.

f. Attach lifting fixture to diesel engine. (FIGURE 3-34)

WARNING

Before moving engine, ensure lifting fixture is secured.

WARNING

Before moving engine, remove and/or secure all overhead piping and electrical wiring. Electric shock can cause serious injury or DEATH.

g. Move diesel engine out of position.

REPAIR

Repair at this level of maintenance is by replacement of the diesel engine.

REPLACEMENT

a. With the use of the lifting fixture, move the diesel engine into position.

b. Lower the engine mount and secure with five hex head screws (1) and lockwashers (2). Torque to 120 ft-lbs.

c. Install the generator assembly (para. 3-15).

d. Install the radiator assembly (para 3-14).

e. Connect the exhaust outlet (para. 2-27).

f. Connect the starting motor (para. 2-20).

g. Fill the engine in accordance with LO 55-1905-223-12.

h. Fill radiator with 17 quarts of coolant (50% water).

i. Reference equipment condition of this task to ready generator set for operation.

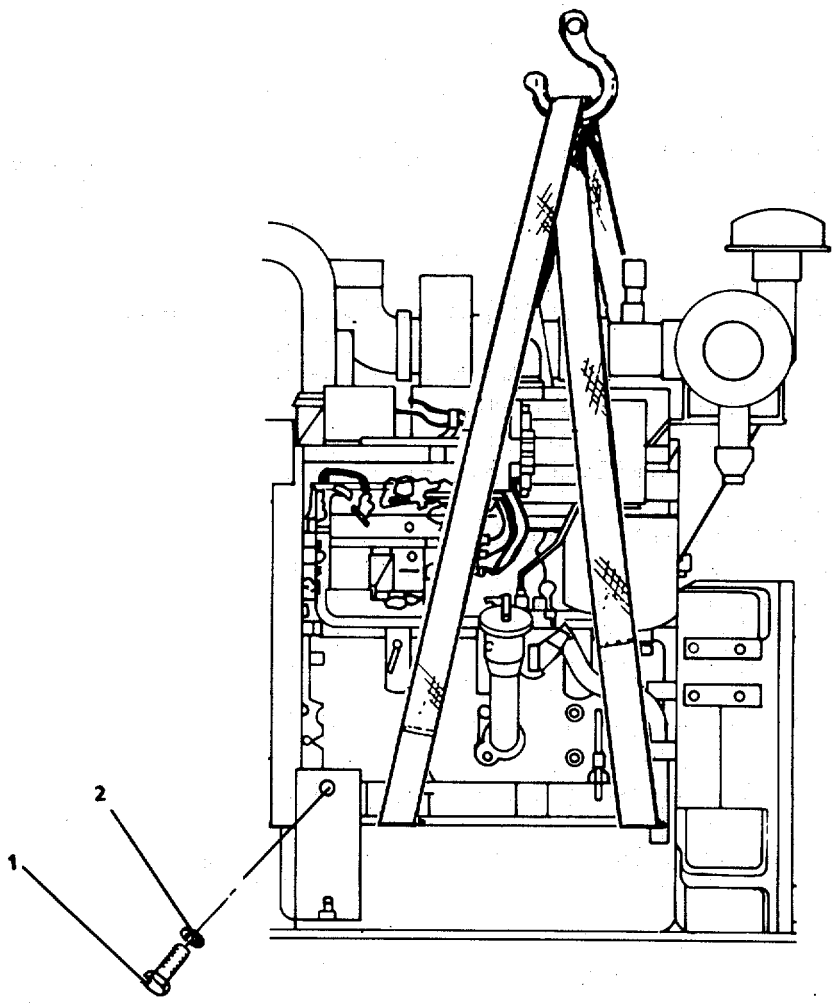


FIGURE 3-34. Diesel Engine.

3-17. Repair Alternator Mounting Group.

This task covers: Repair.

REPAIR

Repair of the alternator mounting group consists of replacing the V belt. Reference paragraph 2-21.

3-18. Repair Alternator Support Group.

This task covers: Repair.

REPAIR

Repair of the alternator support group is by replacement. Reference paragraph 2-22.

3-19. **Repair Alternator Group**. (FIGURE 3-35)

This task covers: a. Disassembly, b. Repair, c. Assembly.

INITIAL SETUP

Tools

Tool kit, general mechanic's rail and marine diesel engines, 5180-00-629-9783
Combination wrench set, metric 1O0mnm- thru 24mm, 5120-01-046-4979
3-leg puller, P/N 3375834

Equipment Condition

Power disconnected and tagged "Out of Service" (TM 55-1905-223-10).

Materials/Parts

Engine accessory generator P/N 3911462
Warning tags, Item 21, Appendix C.

DISASSEMBLY

a. Remove alternator mount, support and alternator. Reference paragraph 2-21, 2-22.

b. Use a 3-leg puller to remove alternator fan (1) from engine accessory generator (2).

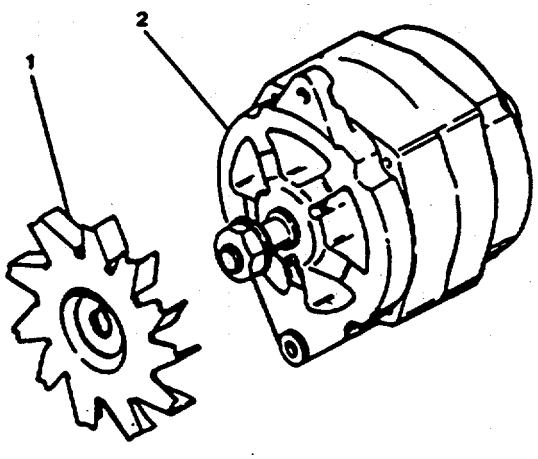
REPAIR

Repair at this level of maintenance is by replacement of: Engine accessory generator (2).

ASSEMBLY

a. Replace fan (1) on engine accessory generator (2).

b. Replace alternator, alternator support and bracket. Reference paragraph 2-21, 2-22.



FICURE 3-35. Engine Accessory Generator.

3-20. Repair Exhaust Connection.

REPAIR

Repair is accomplished by replacement. Reference unit maintenance (para. 2-27).

3-21. Repair Lube Oil Cooler Group. (FIGURE 3-36)

This task covers: a. Disassembly, b. Repair, c. Assembly.

INITIAL SETUP

Tools

Tool kit, general mechanic's rail and marine diesel engines, 5180-00-629-9783
Combination wrench set, metric 10mm thru 24mm, 5120-01-046-4979
Oil filter wrench P/N 3375049
Filter cutter P/N 3376579
Torque wrench kit P/N 3377216
Pressure manometer 6685-01-107-6875

Equipment Condition

Engine secured and tagged "Out of Service" (TM 55-1905-223-10)
Oil drained.
Lube oil cooler group removed (para. 2-36).
Turbocharger oil supply line removed (para. 2-26).
Fluid filter element removed (para. 2-29).

Materials/Parts

Coolant, Item 4, Appendix C
Cleaning solvent, Item 20, Appendix C
Cooler core P/N 3904320
Gasket P/N 3904427
Bypass valve P/N 3902338
Warning tags, Item 21, Appendix C
Gasket P/N 3912638
Helical compression spring P/N 3903261
Detent plunger P/N 3909376
Detergent, Item 7, Appendix C

DISASSEMBLY

a. Remove capscrews (8) and remove fluid filter head (1).

b. Remove machine thread plug (9) flat washer (10) helical compression spring (11) and detent plunger (12).

c. Remove bypass valve (4).

d. Remove gasket (5).

e. Remove cooler core (6).

f. Remove oil gasket (7).

REPAIR

Repair at this level of maintenance is by replacement of: bypass valve (4), gasket (5), cooler core (6), oil cooler gasket (7), helical compression spring (11), and detent plunger (12). Pressurize the cooler to 70 psi and check for leaks by submerging in water.

a. Plug the cooler and soak in a cleaning solution of detergent and hot water.

b. Remove plugs (2, 3) and soak in a solvent.

NOTE

The cooler can be cleaned in a hot tank.

c. Back flush the oil passages with cleaning solvent and use compressed air to dry.

d. Inspect the soldered joints for corrosion or cracks.

e. Inspect the plunger bore for nicks or scratches. The plunger must move freely in the bore.

f. Check the spring using a pressure manometer.

Limits

Valve Open		Assembled	
Height:	1.574 inches (39.98 mm)	Height:	1.77 inches (44.98 mm)
Load:	20.5 lbs. (91 N)	Load:	13.5 lbs. (60 N)

ASSEMBLY

a. Replace detent plunger (12).

b. Install the spring (11), washer (10) and plug (9) in the fluid filter head (1). Torque to 60 ft-lb(80 N-m).

c. Install bypass valve (4). Drive in valve until it bottoms against the step in the bore.

d. Install oil cooler gasket (7), cooler core (6), and gasket (5).

e. Secure fluid filter head with capscrews (8). Torque 18 ft-lb(24 N-m).

f. Connect turbocharger oil supply lines (para. 2-26).

g. Fill oil to proper level (PMCS Table 2-1, Item 6).

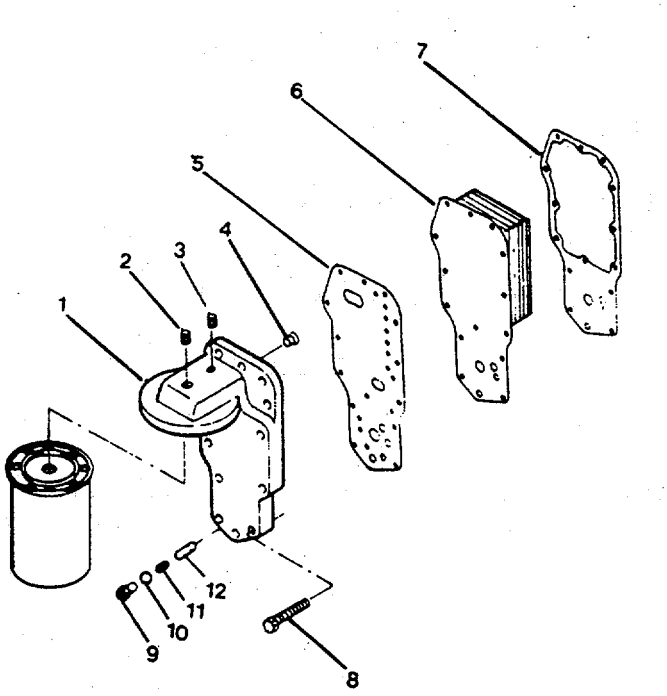


FIGURE 3-36. Repair Lube Oil Cooler.

3-22. Repair Rocker Lever Group. (FIGURES 3-37 through 3-45)

This task covers: a. Disassembly, b. Repair, c. Assembly.

INITIAL SETUP

Tools

Tool kit, general mechanic's rail and marine diesel engines, 5180-00-629-9783
Combination wrench set, metric 10mm thru 24mm 5120-01-046-4979
Torque wrench kit P/N 3377216
Measuring tool set, machinists, set no. 6, 5280-00-278-9919

Materials/Parts

Adjusting screw P/N 3900706
Lubricant (engine oil), Item 14, Appendix C
Rocker levers P/N 3910811
Lock nut P/N S-205
Warning tags, Item 21, Appendix C

Equipment Condition

Engine secured (TM 55-1905-223-10).
Power disconnected and tagged "Out of Service."
Rocker lever group removed (para. 2-38).
Turbocharger assembly removed (para. 2-26).

DISASSEMBLY

a. Remove valve covers. (FIGURE 3-37)

(1) Remove capscrews (1) and preformed packing (2).

(2) Remove valve covers (4) and gaskets (3).

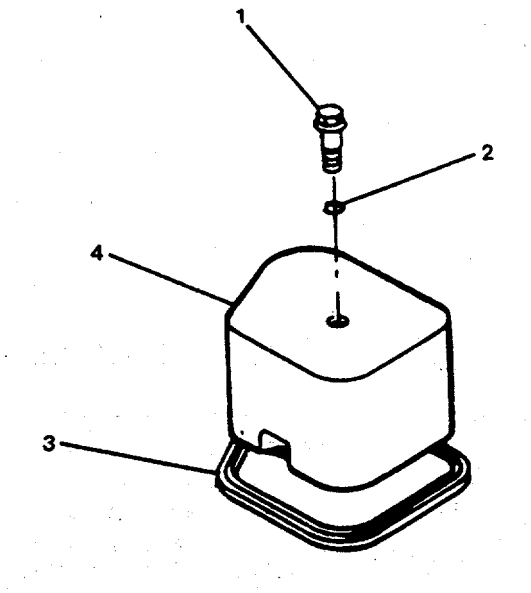


FIGURE 3-37. Valve Cover Removal.

b. Remove Rocker Levers. (FIGURE 3-38)

(1) Loosen lock nuts (4) on rocker lever adjusting screws (8) and loosen screws until they stop.

(2) Remove capscrews (1) from the support (11).

(3) Remove support/head bolts (2) from the shaft support.

(4) Remove expansion plugs (5), retaining rings (6), and flat washer (7).

(5) Remove rocker lever (10, 3) nuts (4), and machine screws (8) from push rods (9).

REPAIR

Repair at this level of maintenance is by replacement of: Lock nuts (4), adjusting screws (8), and rocker lever (10).

a. Inspect for cracks and wear in the bore and the surface whichmakes contact with the valve stem (FIGURE 3-39).

b. Measure the bore with gauge (FIGURE 3-40).

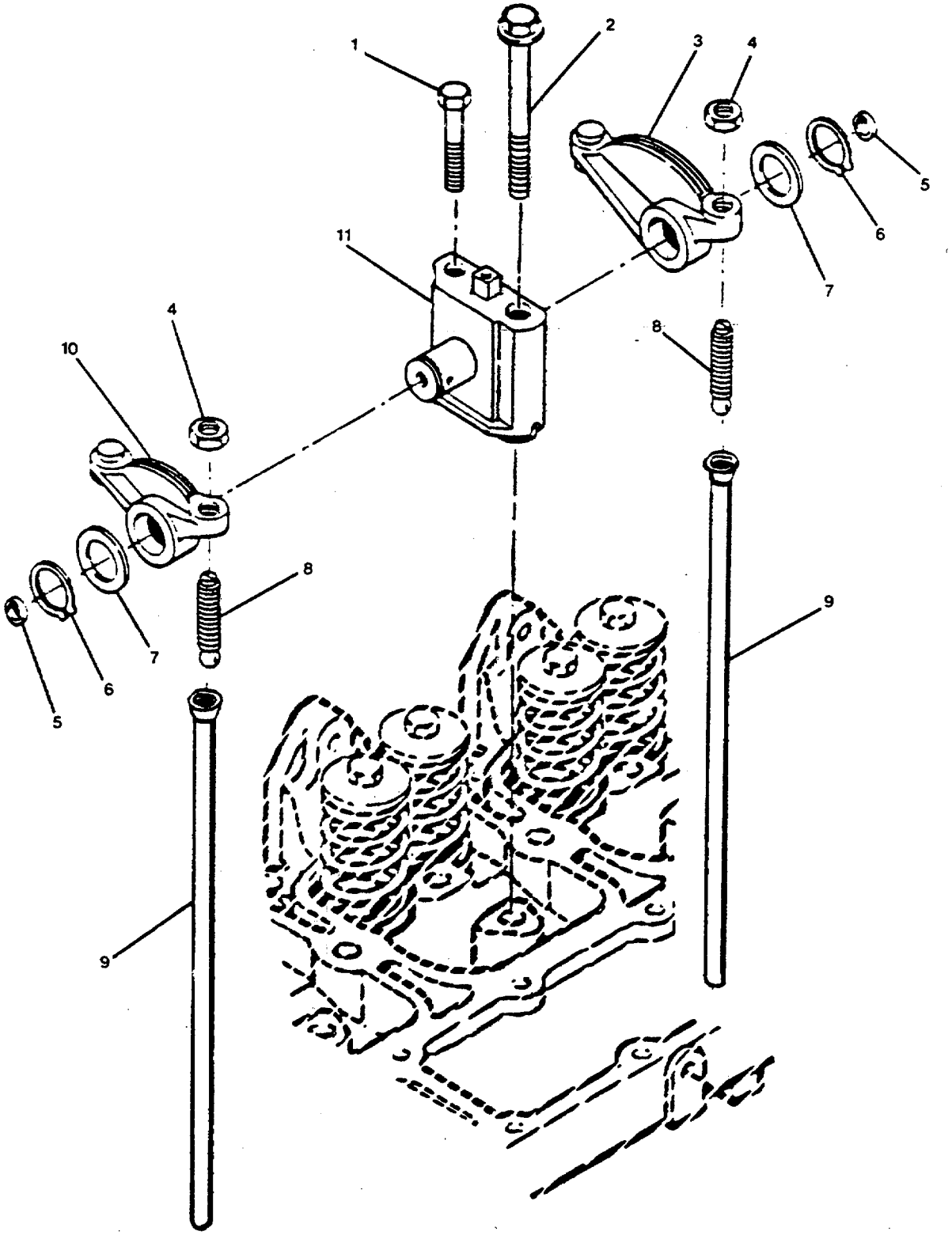


FIGURE 3-38. Rocker Lever Repair.

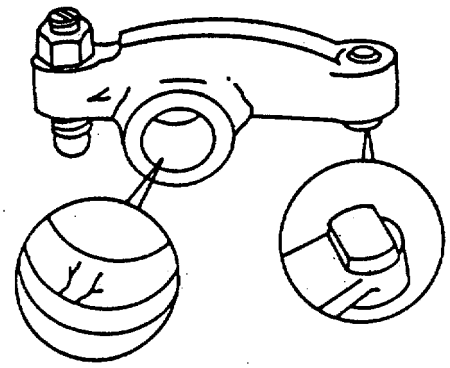


FIGURE 3-39. Valve Stem Check.

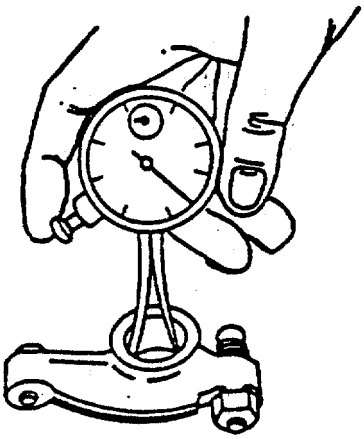


FIGURE 3-40. Bore Gauge Measurement.

ASSEMBLY

a. Replace Rocker Lever.

(1) Install adjusting screws (8, FIGURE 3-38), and lock nuts (4) in rocker levers (3, 10).

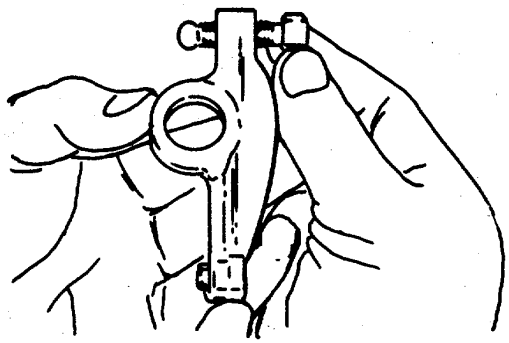


FIGURE 3-41. Adjusting Screw and Lock Nut.

CAUTION

Be sure to assemble the intake and exhaust rocker levers in the correct location.

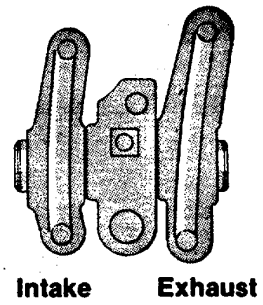


FIGURE 3-42. Intake and Exhaust Rocker Lever Location.

(2) Lubricate shaft with engine oil. (FIGURE 3-43)

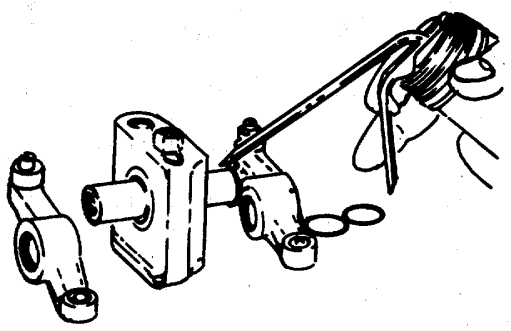


FIGURE 3-43. Shaft Lubrication.

(3) Lubricate push rod sockets and valve stems with engine oil. (FIGURE 3-44)

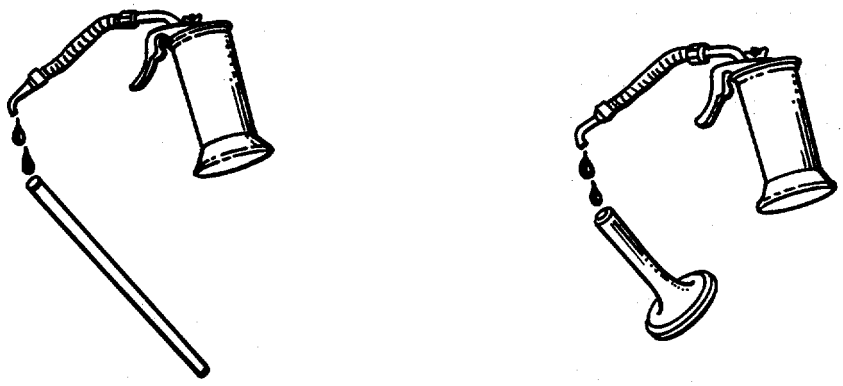


FIGURE 3-44. Push Rod and Valve Stem Lubrication.

Diameter		
in		mm
0.7480	MIN	(19.000)
0.7500	MAX	(19.051)

c. Inspect the pedestal and shaft. Measure the shaft diameter (FIGURE 3-48).

Diameter		
in		mm
0.7456	MIN	(19.938)
0.7470	MAX	(18.975)

(4) Install rocker levers on support (11, FIGURE 3-38). Replace washers (7), retaining rings (6), and expansion plugs (5).

(5) Install rocker levers and support in housing and secure with capscrews (1)and support bolts (2). Torque support bolts to 18 ft-lb (24 N-m).

b. Replace Valve Covers. (FIGURE 3-37).

(1) Install gaskets (3) and valve covers (4).

(2) Install preformed packing (2) and capscrews (1).

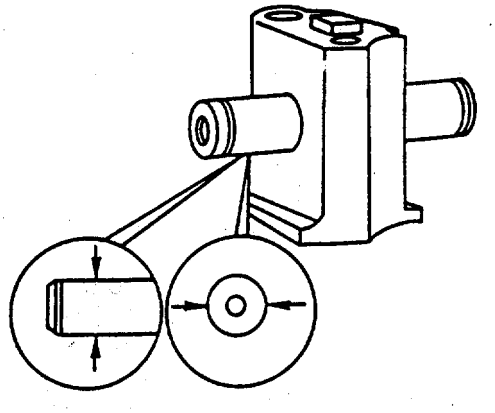


FIGURE 3-45. Shaft Diameter Measurement.

3-23. Replace/Repair Camfollower Cover Group.

This task covers: a. Removal, b. Repair, c. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's rail and marine diesel engines, 5180-00-629-9783
Combination wrench set, metric 10mm thru 24mm, 5120-01-046-4979
Torque wrench kit P/N 3377216

Equipment Condition

Power disconnected and tagged "Out of Service" (TM 55-1905-223-10).
Fuel shutoff valve closed.
Fuel system accessory (lift pump) removed, (para. 2-31).

Materials/Parts

Casket P/N 3904056
Sealant, Item 18, Appendix C
Preformed Packing P/N 3900267 (qty 2)
Engine airflow baffle P/N 3907586
Preformed hose P/N 3906593
Warning tags, Item 21, Appendix C

REMOVAL (FIGURE 3-47)

a. Remove capscrew (4) and loop clamp (5).

b. Remove hose clamp (2) and preformed hose (3).

c. Remove capscrews (6) and preformed packing (7). Discard packing.

d. Lift off cover (8) and cover gasket (9). Discard gasket.

e. Remove engine airflow baffle (1).

REPAIR (FIGURE 3-47)

Repair at this level of maintenance is by replacement of: preformed hose (3), preformed packing (7), cover gasket (9), and engine airflow baffle (1).

REPLACEMENT

a. Install engine airflow baffle (1).

CAUTION

° The tappet gasket has an adhesive back. Pull off the protective cover on the gasket to expose the adhesive surface.

° If a rubber tappet cover gasket is used, it must be installed on the cover as shown in the illustration. (FIGURE 3-46)

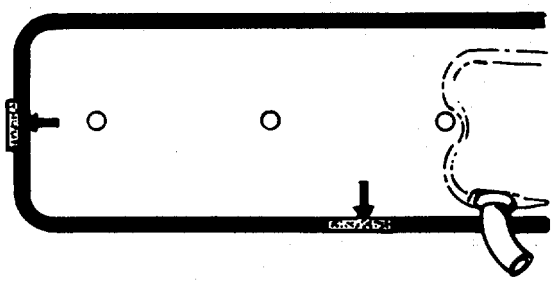


FIGURE 3-46. Rubber Tappet Gasket.

b. Apply K&W copper coat gasket sealant to the block side of thegasket. Replace cover gasket (9).

c. Replace the cover (8) and secure with the mounting capscrews (6) and new packing (7). Torque 18 ft-lbs (24 N-m).

d. Install preformed hose (3) and secure with hose clamp (2).

e. Replace loop clamp (5) and secure with capscrew (4).

f. Replace fuel system accessory (lift pump) (para. 2-31).

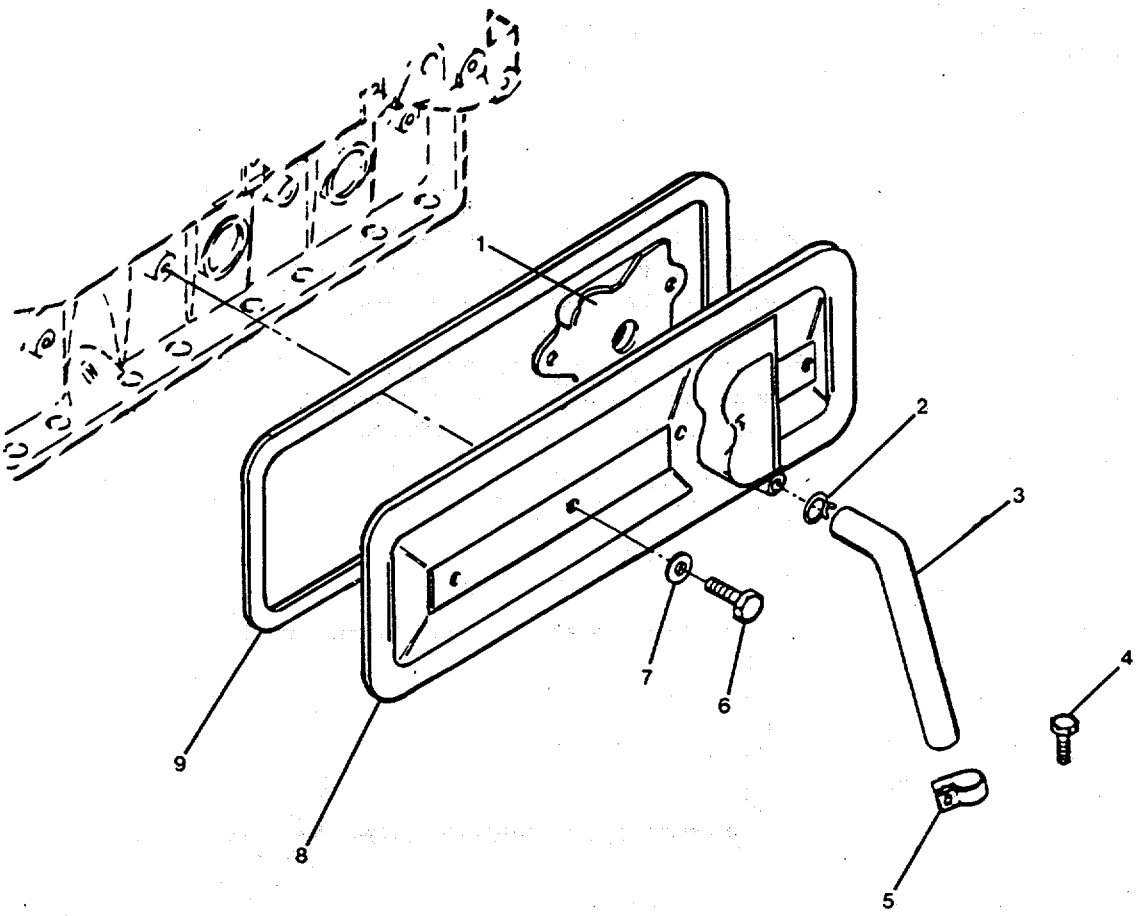


FIGURE 3-47. Camfollower Cover Group.

3-24. Replace/Repair Front Gear Cover Assembly.

This task covers: a. Removal, b. Repair, c. Replacement.

INITIAL SETUP

Tools
Tool kit, general mechanic's rail
Tool kit, general mechanic's rail and marine diesel engines, 5180-00-629-9783
Combination wrench set, metric 10mm thru 24mm, 5120-01-046-4979
Electric drill, 5130-00-889-8994

Material/Parts
#10 metal screw
Drill bit, 3mm (1/8")
Seal P/N 3904353
Gasket P/N 3903475
Gear housing gasket P/N 3910500
Gasket P/N 3907836
Gasket P/N 3906693
Packing retainer P/N 3903927
Engine timing pin P/N 3903924
Warning tags, Item 21, Appendix C
Loctite, Item 11, Appendix C
Coolant, Item 4, Appendix C

Equipment Condition

Power disconnected and tagged "Out of Service"
Coolant drained.
Radiator assembly removed (para. 3-14).
V belt removed (para. 2-21).

REMOVAL

a. Remove crankshaft pulley. (FICURE 3-48)

(1) Remove four hex head screws (1) and remove crankshaft pulley (2)

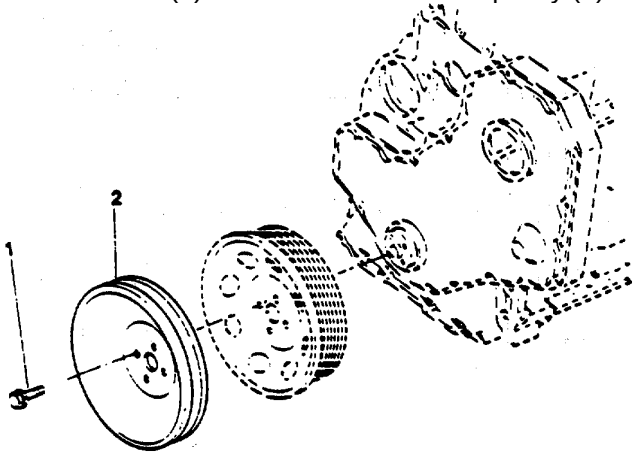


FIGURE 3-48. Crankshaft Pulley.

(2) Drill two 1/8" holes 180° apart in seal (FIGURE 3-49).

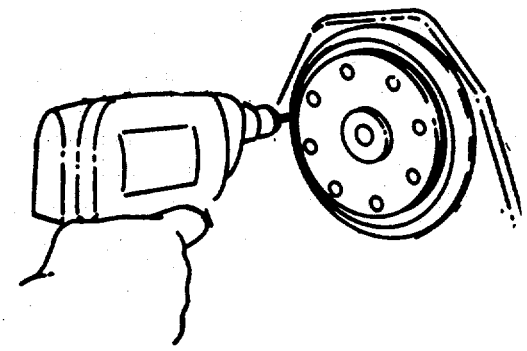


FIGURE 3-49. Drilling Front Crankshaft Seal.

(3) Install #10 metal screws in holes drilled. Use slide hammer to extract seal (FIGURE 3-50) and discard.

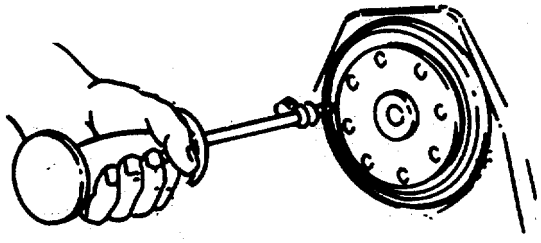


FIGURE 3-50. Seal Removal.

b. Remove cover access (1, FIGURE 3-51) and gasket (2). Discard gasket.

c. Remove capscrew (17) and belt retainer (16).

d. Remove bolts (15, 14) from gear housing (3).

e. Remove gear cover (13) and cover gasket (12). Discard gasket.

f. Remove machine bolts (11) from gear housing (3).

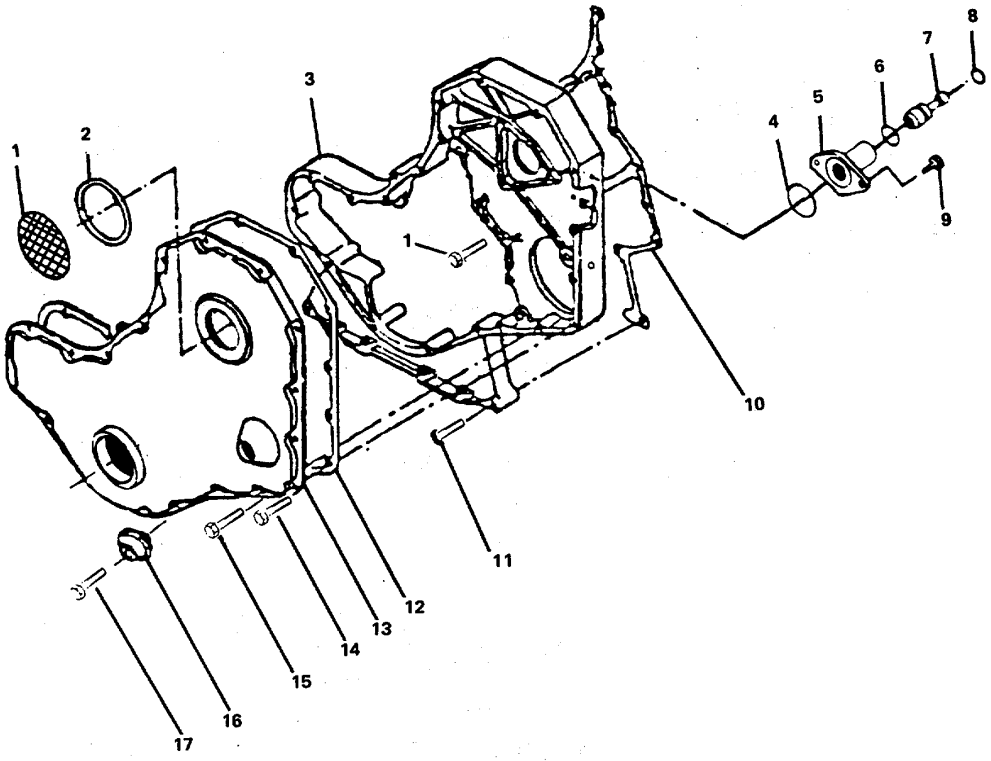


FIGURE 3-51. Front Gear Cover Assembly.

g. Remove camshaft (para. 3-27).

h. Remove, waterpump Gear and fuel pump gear (para. 2-32).

i. Remove the gear housing (3) and gear housing gasket (10). Discard gasket.

j. Remove screws (9) from timing pin housing. Remove timing pin housing (5) and gasket (4). Remove retaining ring (8), timing pin (7) and retainer packing (6). Discard retainer packing.

REPAIR

Repair at this level of maintenance is by replacement of: gaskets (4, 10, 12, 2) seal (1, FIGURE 3-48), engine timing pin (12) andretainer packing (11).

REPLACEMENT

a. Install timing pin housing (5, FIGURE 3'-48) and gasket (4) secure with screws (9).

b. Install packing (6), timing pin (7) and retaining ring (8) to timing pin housing.

c. Install gear housing gasket (10) and gear housing (3) secure with machine bolts (11).

d. Install gear cover gasket (12) and gear cover (13), secure with bolts (14, 15). Torque to 18 ft-lb (24 N-m).

e. Install belt retainer (16) and capscrew (17).

f. Install gasket (2) and cover access (1).

CAUTION

Teflo seals must be installed on a clean, dry surface.

g. Clean and dry the sealing surface. (FIGURE 3-52)

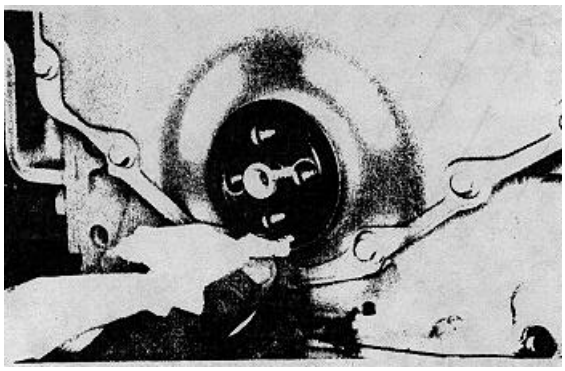


FIGURE 3-52. Cleaning Seal Surface.

h. Coat the O.D. of the seal with Loctite 277. (FIGURE 3-53)

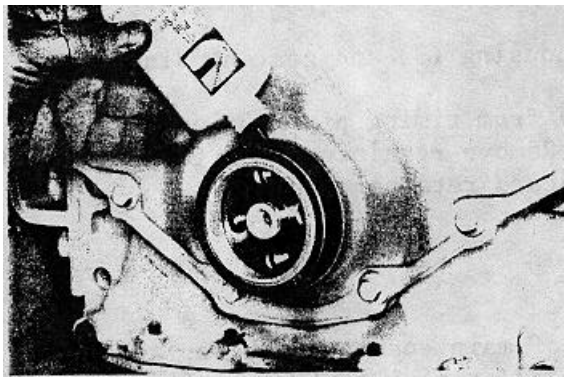


FIGURE 3-53. Coating Seal with Loctite.

CAUTION

Use the pre-packaged seal starter ring to install the seal over the crankshaft.

i. Install the seal with the pre-packaged seal driver. (FIGURE 3-54)

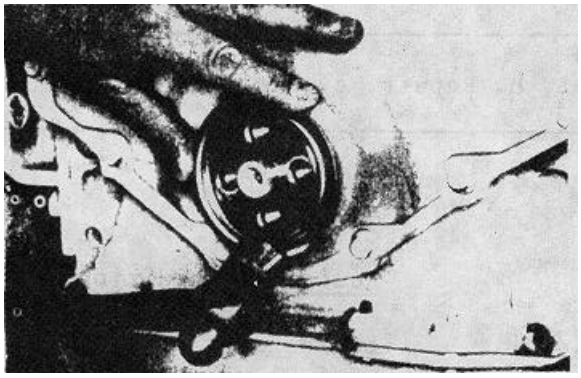


FIGURE 3-54. Install the Seal.

j. Install crankshaft pulley (2, FIGURE 3-51) and secure with four hexhead screws (1). Torque to 101 ft-lb (137 Nom).

k. Replace radiator assembly, para. 3-13.

l. Replace V-belt, para. 2-21.

NOTE

For coolant mixture, refer to TB 55-1900-24-7.

m. Refill coolant.

n. Restore power to assembly, TM 55-1905-223-10. Remove tags.

o. Operate the engine to check for leaks. (FIGURE 3-55)

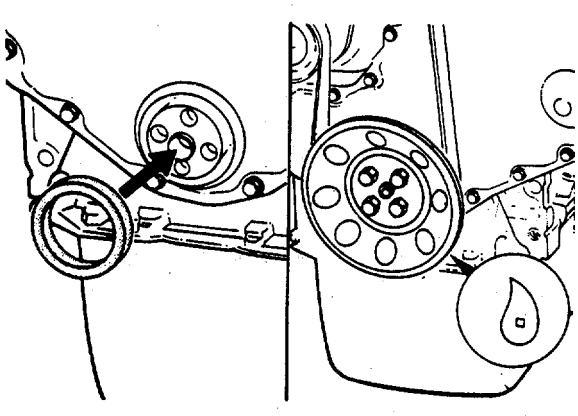


FIGURE 3-55. Check for Leaks.

3-25. Replace/Repair Oil Pan Croup. (FIGURE 3-56)

This task covers: a. Removal, b. Repair, c. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's rail and marine diesel engines, 5180-00-629-9783
Combination wrench set, metric 10mm thru 24mm, 5120-01-046-4979
Torque wrench kit P/N 3377216
Lifting sling P/N 3375958

Equipment Condition

Engine shut down and tagged "Out of Service" (TM 55-1905-223-10).
Oil drained; coolant drained.
Radiator assembly removed (para. 3-14).
Generator assembly removed (para. 3-15).

Materials/Parts

Liquid seals, Item 19, Appendix C
Sealant, Item 18, Appendix C
Oil pan gasket P/N 3911535
Flange gasket P/N 3905468
Warning tags, Item 21, Appendix C

REMOVAL

a. Remove oil pan mounting capscrews (6) and lockwashers (5) from oil pan (11).

b. Raise engine to relieve pressure-from the front engine mounts.

NOTE

Raise engine high enough to allow removal of the oil pan and access to suction tube.

c. Remove machine bolts (2, 4), gasket (1), and metal tube and fittings (3). Discard gasket.

d. Remove machine thread plug (7) and washer (8).

e. Remove machine thread plug (9) and washer (10).

f. Remove oil pan (11) and gasket (12). Discard gasket.

REPAIR

Repair at this level of maintenance is by replacement of: oil pan gasket (12) and flange gasket (1).

REPLACEMENT

a. Clean the sealing surfaces before replacement.

   (1) Place 1/8-inch wide level of liquid sealer on rear gear cover housing and pan rail.

   (2) Ensure permatex faces the block.

   (3) Apply "K&W Copper Coat" sealant to both sides of the gasket.

b. Replace gasket (12) on oil pan (11).

c. Replace metal tube (3) and fittings. Replace gasket (1) and secure with machine bolts (2, 4). Torque to 18 ft-lb (24 Nom).

d. Replace washer (10) and machine thread plug (9).

e. Replace washer (8) and machine thread plug (7)

f. Replace oil pan (11) and secure with capscrews (6) and lockwashers (5). Torque to 18 ft-lb (24 N-m).

g. Lower the engine and install the front mounting capscrews.

h. Replace the radiator assembly (paragraph 3-14).

i. Replace generator assembly (paragraph 3-15).

j. After filling the engine with oil and coolant, operate it to check for leaks.

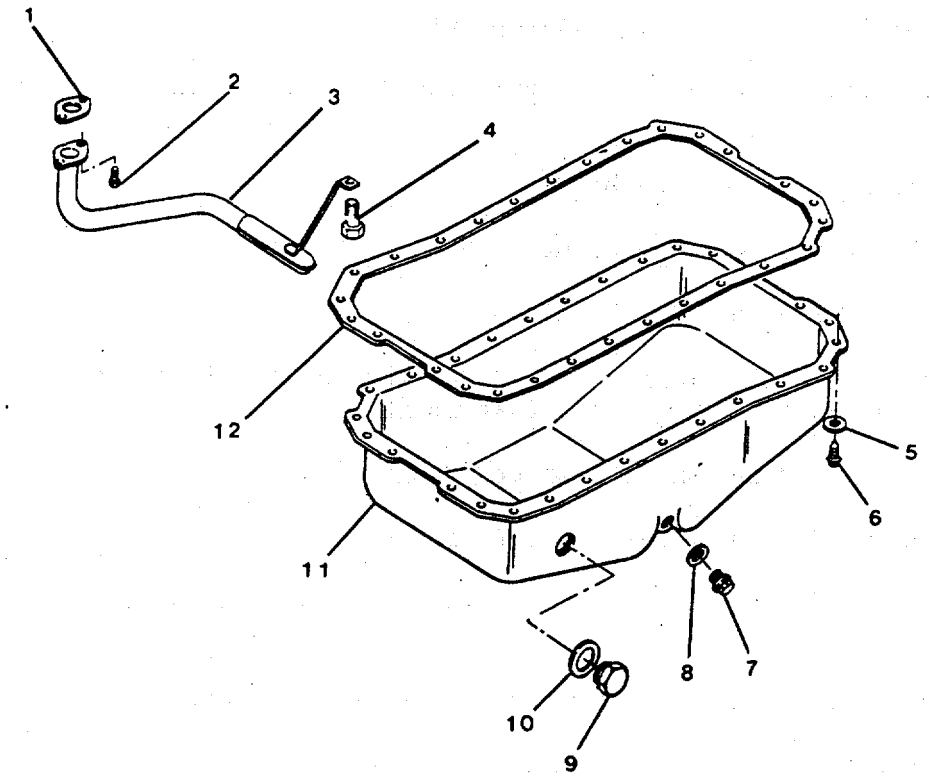


FIGURE 3-56. Oil Pan Assembly.

3-26. Replace/Repair Lube Oil Pump Group. (FIGURES 3-57 through 3-71)

This task covers: a. Removal, b. Repair, c. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's rail and marine diesel engines, 5180-00-629-9783
Torque wrench kit P/N 3377216
Dial indicator, 5210-00-277-8840
Combination wrench set, metric 10mm thru 24mm, 5120-01-046-4979

Materials/Parts

Solvent, Item 20, Appendix C
Engine oil pump assembly P/N 3906413
Warning tags, Item 21, Appendix C

Equipment Condition

Power disconnected and tagged "Out of Service."
Front gear cover removed (para. 3-24).
Oil drained.
Radiator assembly removed (para. 3-14).
Crankshaft pulley removed (para. 3-24).

REMOVAL (FIGURE 3-71; for callouts)

Perform the following tasks for gear backlash and removal of lube oil pump.

a. After front gear cover assembly is removed, measure gear backlash as follows:

(1) Position the indicator on a tooth of the lube oil gear.

NOTE

Hold the adjoining gear from moving when checking backlash.

(2) Note the lube pump gear backlash. (FIGURE 3-67)

(3) Mark the lube pump gear and the idler gear if the limits are exceeded.

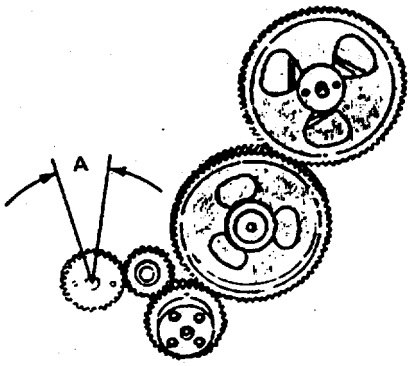


FIGURE 3-57. Lube Oil Pump Gear Backlash.,

LIMITS

A - 0.003 to 0.010 inch (0.08 to 0.25 mm)

(4) Position the indicator on a tooth of the idler gear.

(5) Note the idler gear backlash (FICURE 3-58). Limits are the same as lube oil pump gear.

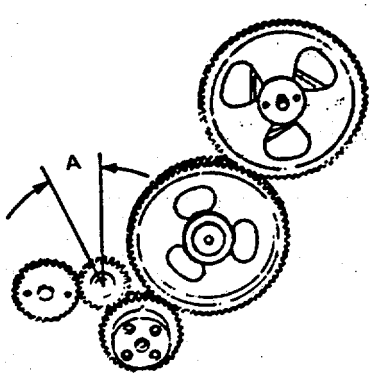


FIGURE 3-58. Idler Gear Backlash.

b. Remove the hex head capscrews (2).

c. Remove the lube oil pump (1).

REPAIR

a. Visually inspect gears for cracks, chips or excessive wear. (FICURE 3-59)

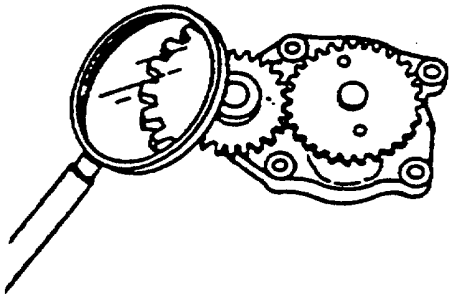


FIGURE 3-59. Gear Inspection.

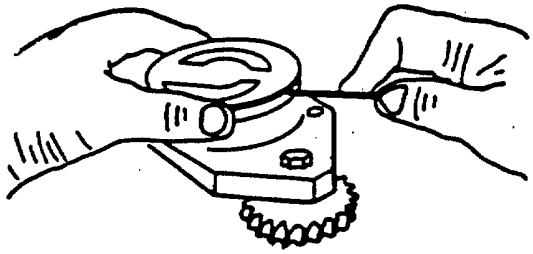


FIGURE 3-60. Remove Sealing Plate.

b. Turn pump over. Remove the sealing plate (FIGURE 3-60). Mark "TOP" (FIGURE 3-61) on gerator planetary.

c. Remove the gerator planetary and inspect for excessive wear or scoring (FIGURE 3-62).

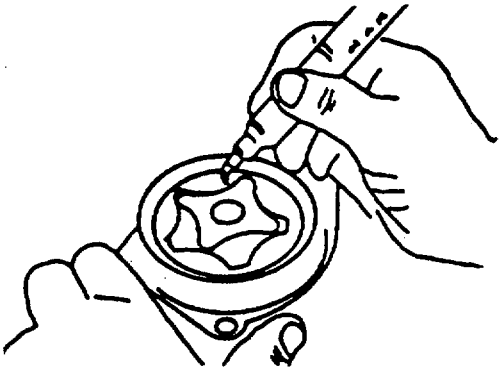


FIGURE 3-61. Mark Gerator Top.

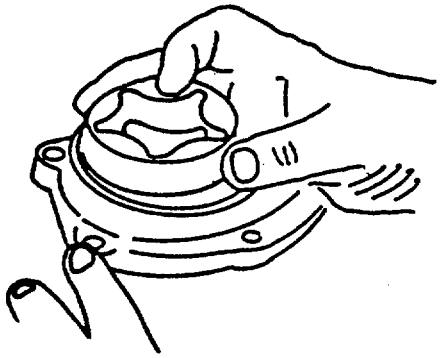


FIGURE 3-62. Inspect Gerator Planetary.

d. Inspect the pump housing (FIGURE 3-63) and gerator drive for damage and excessive wear.

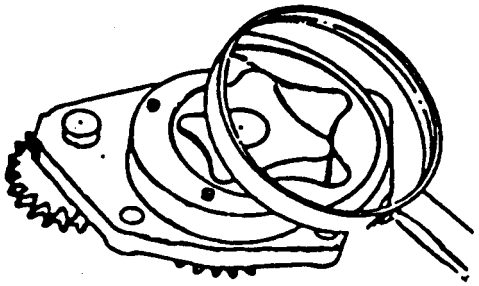


FIGURE 3-63. Pump Housing Inspection.

e. Clean all parts in solvent; use compressed air to dry.

f. Replace the gerator planetary.

CAUTION

Ensure the gerator planetary is replaced in the original position.

g. Measure the tip clearance (FIGURE 3-64). Maximum: 0.007 inch (0.1678 mm).

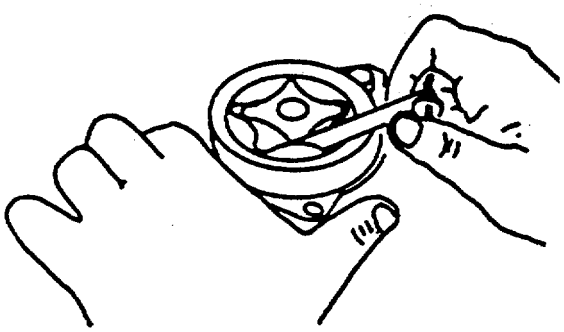


FIGURE 3-64. Tip Clearance Measurement.

h. Measure the clearance of the gerator drive/gerator planetary to port plate (FIGURE 3-65). Maximum: 0.005 inch (0.127 mm).

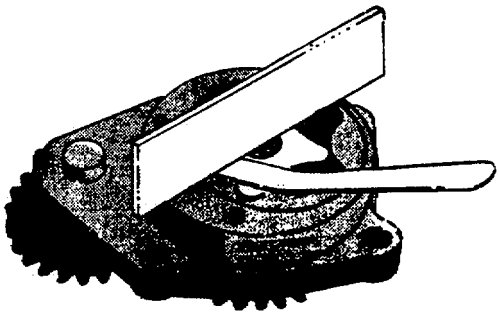


FIGURE 3-65. Drive/Planetary to Port Plate Measurement.

i. Measure the clearance of the gerator planetary to the body bore (FIGURE 3-66). Maximum: 0.015 inch (0.381 mm).

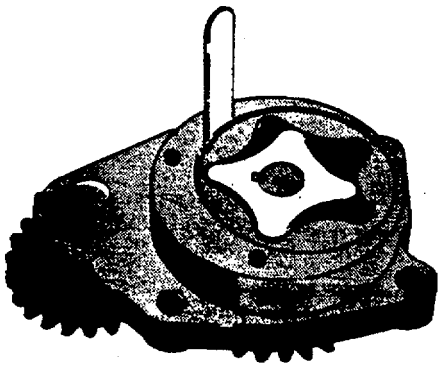


FIGURE 3-66. Body Bore Clearance Measurement.

j. Measure gear backlash. (FIGURE 3-57)

k. Discard pump if clearances and backlash are not as specified.

REPLACEMENT (FIGURE 3-71 for callouts)

NOTE

Filling the lube oil pump before installation will aid priming during engine startup.

a. Lubricate pump with clean engine oil. (FIGURE 3-67)

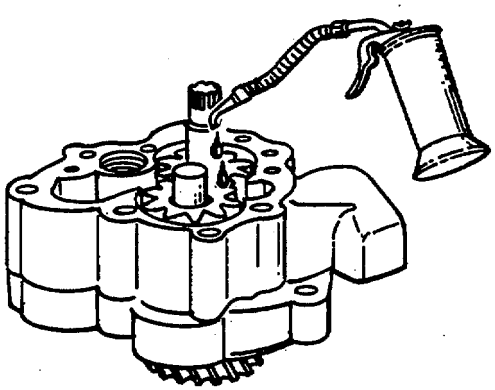


Figure 3-67. Lubricating Pump.

CAUTION

Make sure the correct pump is installed (FIGURE 3-68), Four Cylinder gerator size. 12.947mm (0.516 inch)

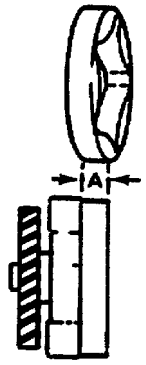


FIGURE 3-68. Four Cylinder Gerator Size.

CAUTION

Make sure the idler gear pin fits into a location bore in the cylinder block. (FIGURE 3-69)

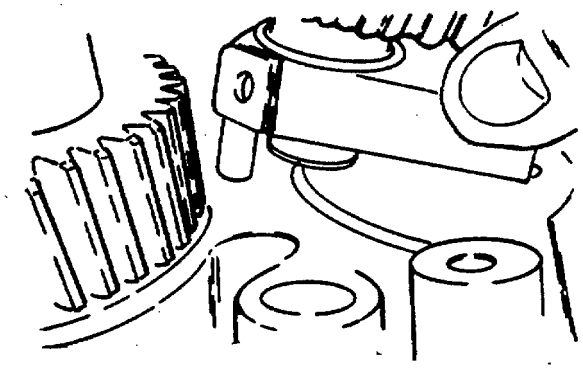


FIGURE 3-69. Idler Gear Pin Location.

Make sure the sealing plate on the back of the pump seats on the cylinder block and the capscrews do not draw the flange up to the block. (FIGURE 3-70)

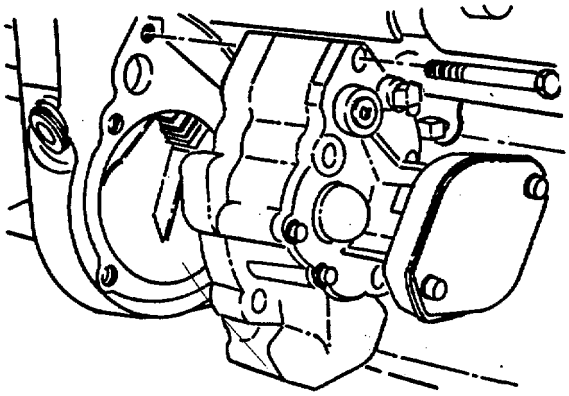


FIGURE 3-70. Sealing Plate.

b. Install lube oil pump (1, FIGURE 3-71).

c. Using capscrews (2), secure the lube oil pump. Torque to 18 ft-lb (24 Nm).

d. Replace the front gear cover (para. 3-24).

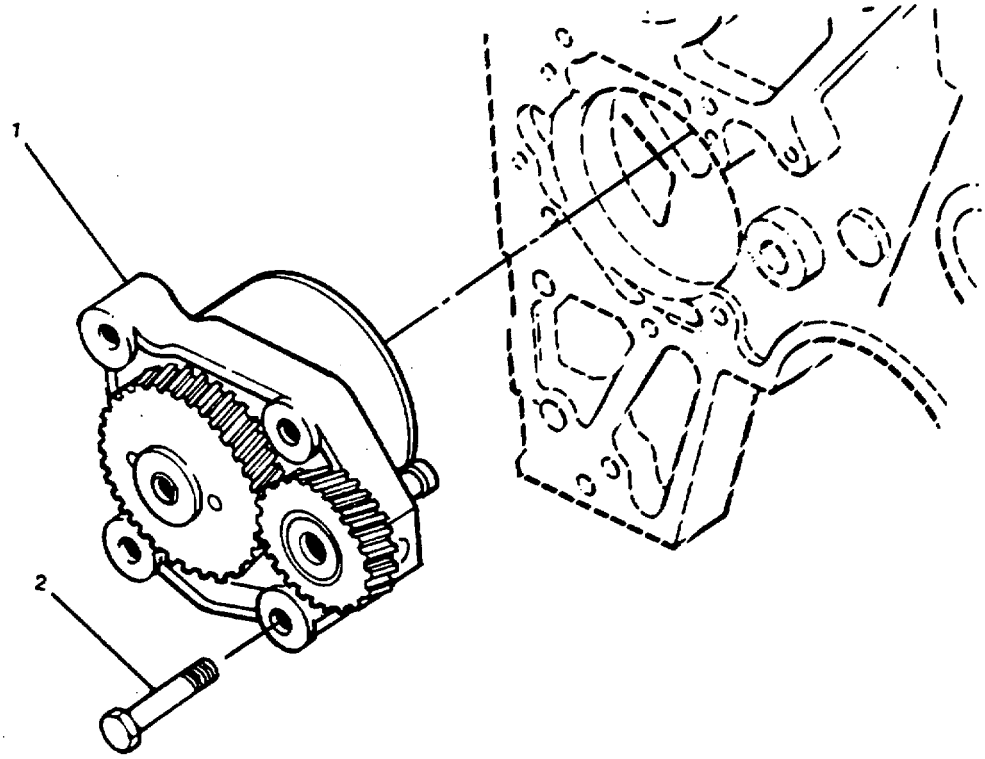


FIGURE 3-71. Lube Oil Pump.

3-27. Replace Camshaft Gear Group.

This task covers: a. Removal, b. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's rail and marine diesel engines, 5180-00-629-9783
Combination wrench set, metric 10mm thru 24mm, 5120-01-046-4979
Torque wrench kit P/N 3377216

Equipment Condition

Engine secured and tagged "Out of Service."
Front gear cover assembly removed (para. 3-24).
Radiator assembly removed (para. 3-14).

Materials/Parts

Lubriplate 105, Item 12, Appendix C
Camshaft P/N 3907446
Gear P/N 3907431
Warning tags, Item 21, Appendix C

REMOVAL

a. Before removal of camshaft, measure the gear lash.

(1) Position an indicator on a tooth of the camshaft gear (FIGURE 3-72).

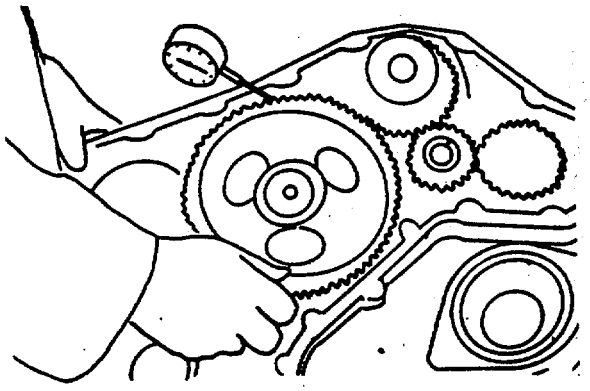


FIGURE 3-72. Camshaft Gear Indicator.

NOTE

Hold adjoining gear from moving when checking backlash or the reading will be the total of both gears.

(2) Note the camshaft gear backlash. Mark the camshaft gear and crankshaft gear for further analysis if backlash exceeds limits (FIGURE 3-73).

A = 0.003 to 0.013 inch, 0.08 to 0.33 mm

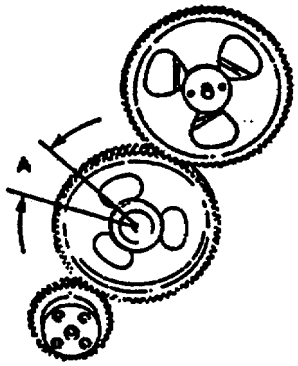


FIGURE 3-73. Gear Backlash.

b. Remove spur gear (1, FIGURE 3-74).

c. Remove thrust support capscrews.

d. Remove camshaft from cylinder block.

e. Put woodruff (1, FIGURE 3-75) aside for replacement.

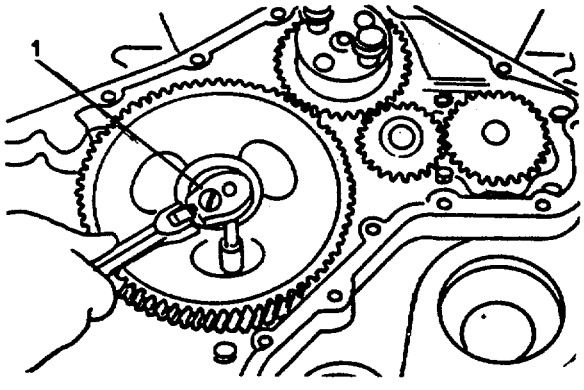


FIGURE 3-74. Spur Gear Removal.

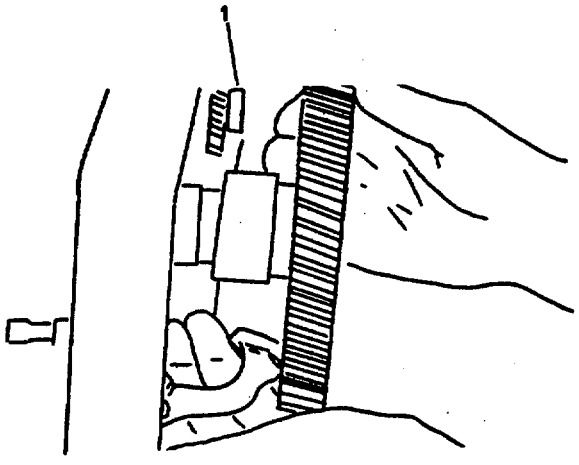


FIGURE 3-75. Woodruff Key.

REPLACEMENT

a. Lubricate bores, journals, and lobes with lubriplate 105.

b. Position the camshaft into the cylinder block up to the last journal. Replace woodruff key.

CAUTION

Be sure the timing marks are aligned.

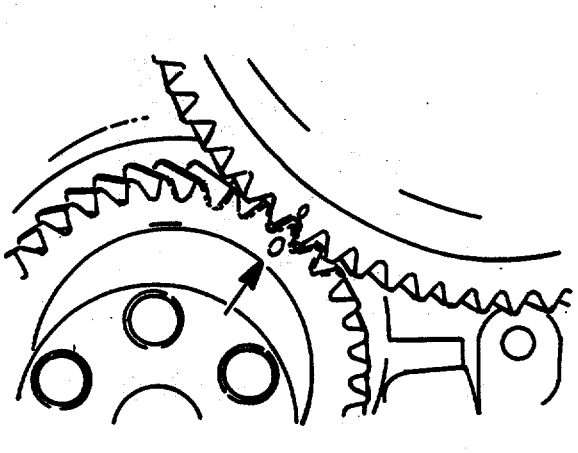


FIGURE 3-76. Timing Marks.

c. Lubricate the thrust support and install.

d. Push the camshaft into the cylinder block and replace thrust support capscrews. Torque to 18 ft-lb (24 Nm).

e. Replace spur gear.

f. Measure camshaft end play.

g. Use a feeler gauge to check the clearance between the camshaft flange and the gear. The clearance must not be more than 0.0015 inch (0.038mm).

h. Reference paragraph 3-24 for replacement of front gear housing.

3-28. Replace Connecting Rod and Piston Group.

This task covers: a. Removal, b. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's
rail and marine diesel engines,
5180-00-629-9783
Torque wrench kit P/N 3377216
Lifting sling P/N 3375958
Lifting fixture P/N 3822'512
Piston Ring Compressor P/N ST-755
Ridge Reamer P/N ST-1255
Combination wrench set, metric
10mm thru 24mm, 5120-046-4979

Material/Parts

Warning tags, Item 21, Appendix C
Piston set P/N 3802100
Ring set P/N 3802050
Cleaning solvent, Item 20, Appendix C
Lubricating oil, Item 14, Appendix C
Lubriplate 105, Item 12, Appendix C
Coolant, Item 4, Appendix C

Equipment Condition

Power disconnected and tagged "Out of Service."
Oil, coolant and fuel drained.
Radiator assembly removed (para. 3-14).
Generator assembly removed (para. 3-15).
Cylinder head removed (para. 2-40).
Oil pan removed (para. 3-25).

REMOVAL

a. Move engine to work bench using a lifting fixture and sling.

CAUTION

Be sure the ridge reamer does not gouge into the cylinder bore or remove more metal than needed.

b. Rotate the engine to a vertical position. Cut the ridge from the top of the cylinders.

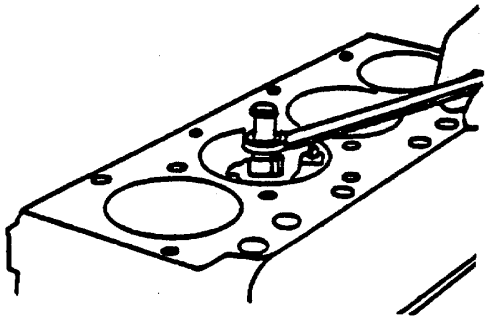


FIGURE 3-77. Remove Ridge from Top of Cylinder.

c. Mark each rod cap according to cylinder.

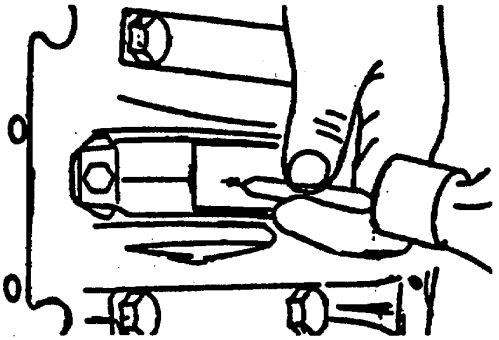


FIGURE 3-78. Mark Rod Caps By Cylinder.

d. Mark each position according to the cylinder.

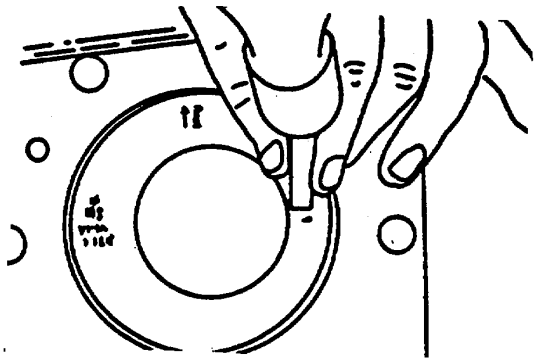


FIGURE 3-79. Mark Positions By Cylinder.

e. Remove the capscrews, rod cap and rod bearing (FIGURE 3-93).

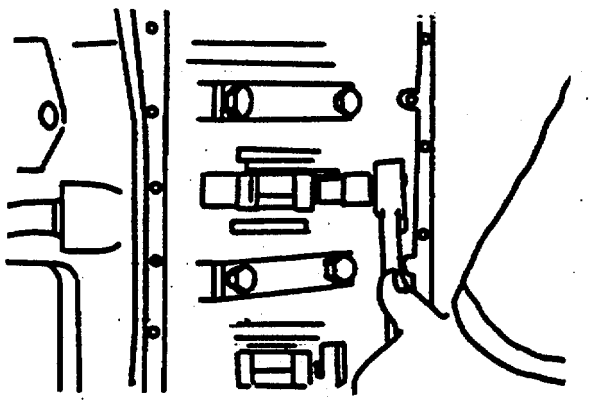


FIGURE 3-80. Rod Cap and Bearing Removal.

f. Catch the piston with one hand while pushing the rod and piston assembly out of each cylinder bore. Care must be taken not to mutilate the connecting rod or bearing.

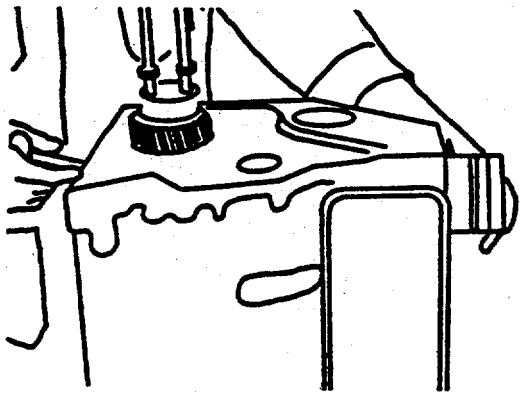


FIGURE 3-81. Remove Rod and Piston Assembly from Bore.

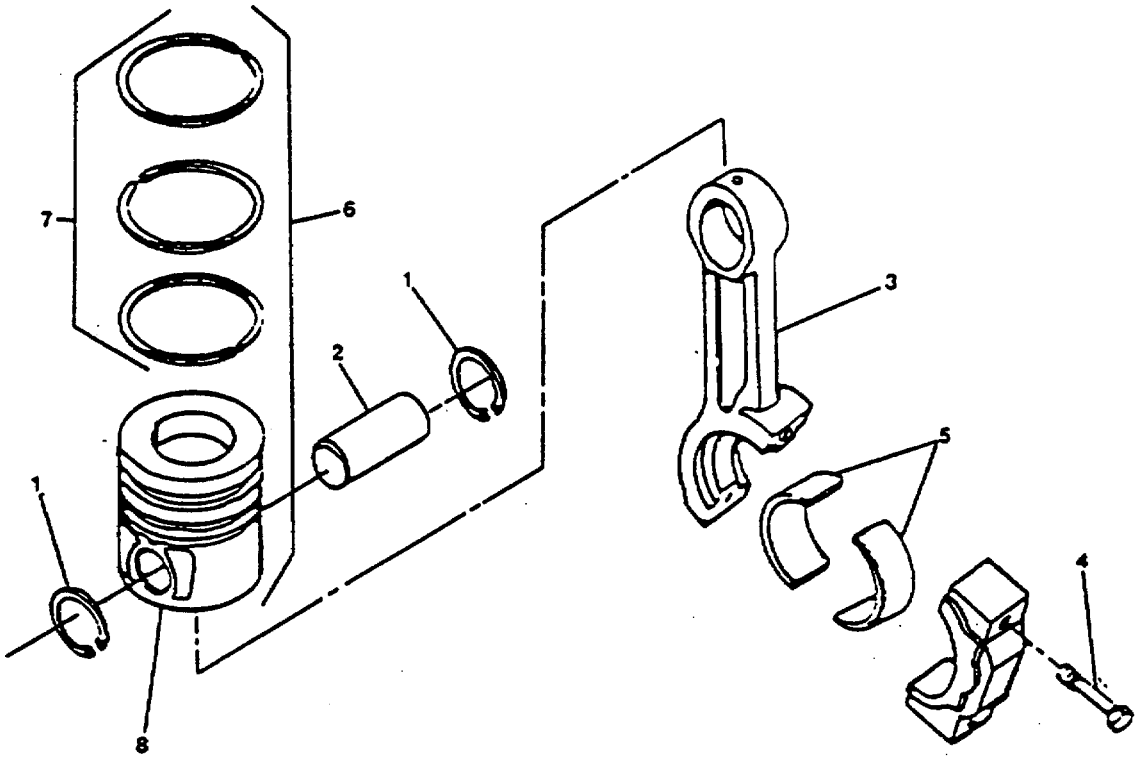


FIGURE 3-82. Piston and Connecting Rod Assembly.

REPLACEMENT

a. Rotate the engine until the crankshaft is vertical.

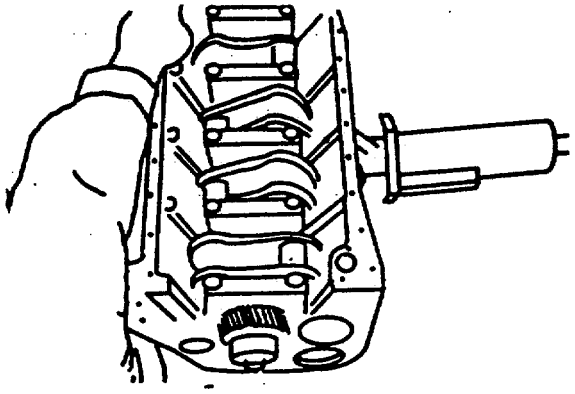


FIGURE 3-83. Engine Rotation.

CAUTION

If the engine is rotated more than 90°, the tappets can fall out.

b. Install the bearing sleeves (5, FIGURE 3-82) into both the rod (3) and the cap (9). Make sure the tang on the bearing/sleeves are in the slot of the cap and rod.

c. Lubricate the rod bearings with a light film of Lubriplate 105.

d. Lubricate the rings and piston skirts with clean engine oil.

e. Check rings for position, FIGURE 3-84, and use a piston ring compressor to compress rings.

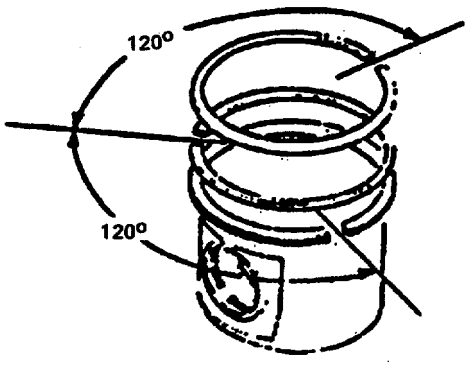


FIGURE 3-84. Piston Ring Position.

f. Lubricate the cylinder bore with clean engine oil. Position the rod journal for the piston to be installed to bottom dead center (BDC).

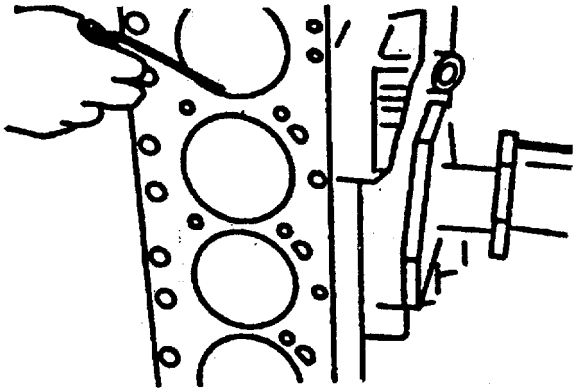


FIGURE 3-85. Lubricate Cylinder Bore.

CAUTION

Take care not to damage the cylinder wall when inserting the connecting rod.

g. Carefully push the piston into the bore while guiding the connecting rod to the crankshaft journal.

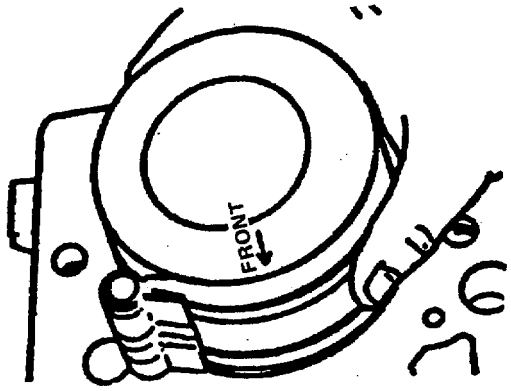


FIGURE 3-86. Install Piston into Bore.

h. Lubricate the threads and underside of the connecting rod capscrew heads with engine oil.

CAUTION

The four digit number stamped on the rod and cap at the parting line must match and be installed on the oil cooler side of the engine.

i. Install the rod cap and capscrews to the connecting rod. Alternately, tighten the two capscrews.

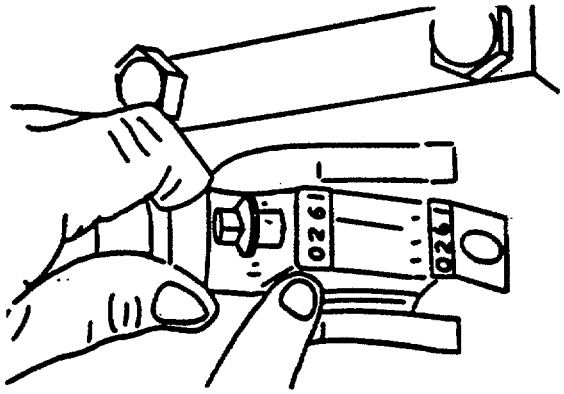


FIGURE 3-87. Install Rod Caps.

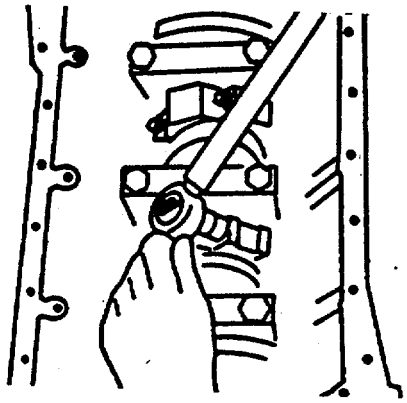


FIGURE 3-88. Tighten Capscrews Sequence

STEP	TORQUE
1	26 ft-lb (35 N•m)
2	51 ft-lb (70 N•m)
3	73 ft-lb (100 N•m)

j. Measure the side clearance between the connecting rod and crankshaft. The side clearance limits are 0.0004 to 0.012 inch (0.1 to 0.3 mm).

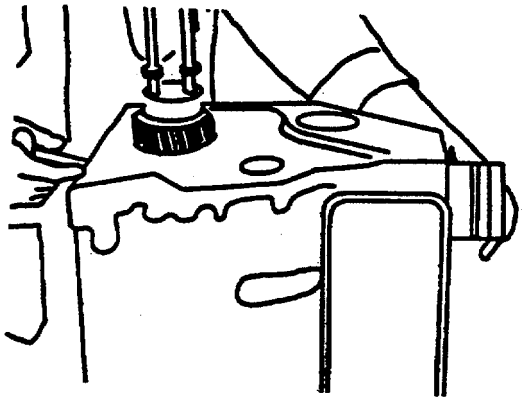


FIGURE 3-89. Measure Side Clearance.

k. Check that crankshaft rotates freely as the rod caps are installed.

l. Reference equipment conditions for further assembly replacements.

3-29. Replace Flywheel Housing Group. (FIGURES 3-90 through 3-92)

This task covers: a. Removal, b. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's
rail and marine diesel engines,
5180-00-629-9783
Torque wrench kit P/N 3377216
Combination wrench set, metric
10mm thru 24mm, 5120-01-046-4979

Equipment Condition

Engine secured (TM 55-1905-223-10).
Remove external wiring and tagged "Out of Service."
Remove generator assembly (para. 3-15).

Materials/Parts

Engine flywheel P/N 3905831
Warning tags, Item 21, Appendix C

REMOVAL

a. Hold the flywheel to prevent rotation. Hold a wrench on the bearing nut behind the flywheel housing to prevent crankshaft rotation.

b. Install two 1/2-13 x 1 1/2 puller capscrews which have a minimum of 1 1/4-inch threaded area at (1 and 2, FIGURE 3-90).

c. Remove capscrews and washer (3) and (4), and install two 5/8-18 x 6-inch guide studs.

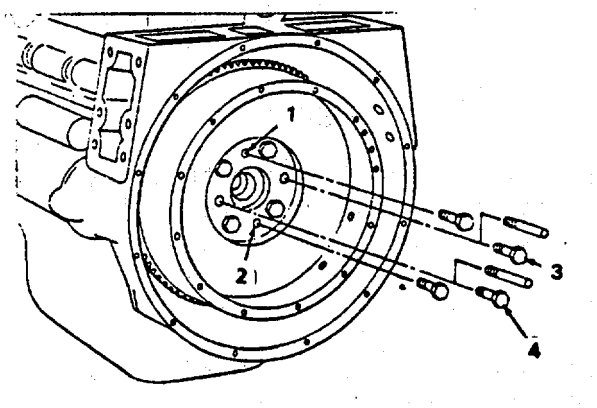


FIGURE 3-90. Flywheel Removal.

d. Install two T-handles in the flywheel (4 and 5, FIGURE 3-91).

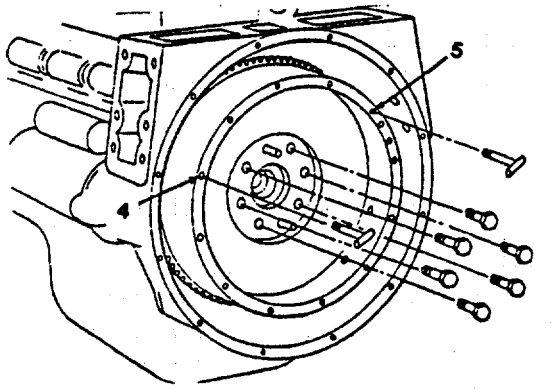


FIGURE 3-91. Flywheel Installation.

e. Remove the remaining six flywheel mounting capscrews.

WARNING

Because this part weights more than 50 lbs (23 kg), two soldiers or a hoist will be required to lift the flywheel to avoid personal injury.

f. Tighten puller capscrews (1 and 2, FIGURE 3-90) in alternating sequence to loosen the flywheel. Remove the flywheel.

g. Remove the guide studs, puller capscrews, and T-handles.

REPLACEMENT (FIGURE 3-90)

a. Install two 5/98-18 x 6-inch guide studs in the crankshaft flange (1 and 2, FIGURE 3-90).

b. Install two t-handles in the flywheel (4 and 5, FIGURE 3-91).

WARNING

Because this part weighs more than 50 lbs (23 kg), two soldiers or a hoist will be required to lift the flywheel to avoid personal injury.

c. Install the flywheel on the guide studs.

d. Lubricate the threads of the capscrews and the surface of the washers with lubricating oil from the engine.

e. Install the six capscrews.

f. Remove the T-handles and the guide studs.

g. Install the remaining two capscrews in the holes from which the guide studs were removed.

h. Refer to FIGURE 3-92 for tightening sequence.

i. Torque the capscrews to 101 ft-lbs (137 N•m).

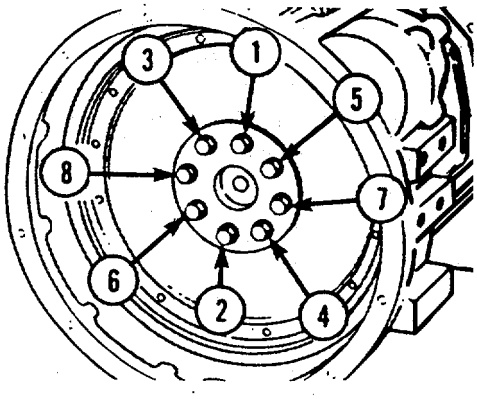


FIGURE 3-92. Tightening Sequence.

3-30. Replace Cylinder Block Group. (FIGURE 3-93)

This task covers: a. Removal, b. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's
rail and marine diesel engines,
5180-00-629-9783
Combination wrench set, metric
10mm thru 24mm 5120-01-046-4979
Lifting fixture P/N 3822512
Lifting sling P/N 3375958

Materials/Parts

Cylinder block assembly
P/N 3901735
Warning tags, Item 21, Appendix C
Coolant, Item 4, Appendix C
Lubricating oil, Item 14, Appendix C

Equipment Condition

Coolant drained.
Oil drained.
Fuel shut off valve closed. Fuel supply line disconnected from fuel inlet connection.
Electrical wiring disconnected and tagged "Out of service."
Exhaust outlet disconnected (para. 2-27)
Radiator assembly removed (para. 3-14).
Fuel plumbing removed (para. 2-30).
Generator assembly removed (para. 3-15).
Components from the cylinder block removed (para. 2-40).

REMOVAL

a. Through the process of removing all assemblies and components, the block assembly should now be free from its mounts and supported by the lifting fixture.

NOTE

External obstructions may have to be moved or removed to provide clearance for removing the block assembly from the area.

REPLACEMENT

a. Install the following.

   (1) Connecting rod and piston assembly (para. 3-28).

   (2) Camshaft gear assembly (para. 3-27).

   (3) Oil pan assembly (para. 3-25).

b. Attach the slings around block assembly.

c. Attach lifting fixture and hoist the block assembly into place.

d. Lower into position on engine mounts.

e. Install components and assemblies as referenced in the equipment conditions.

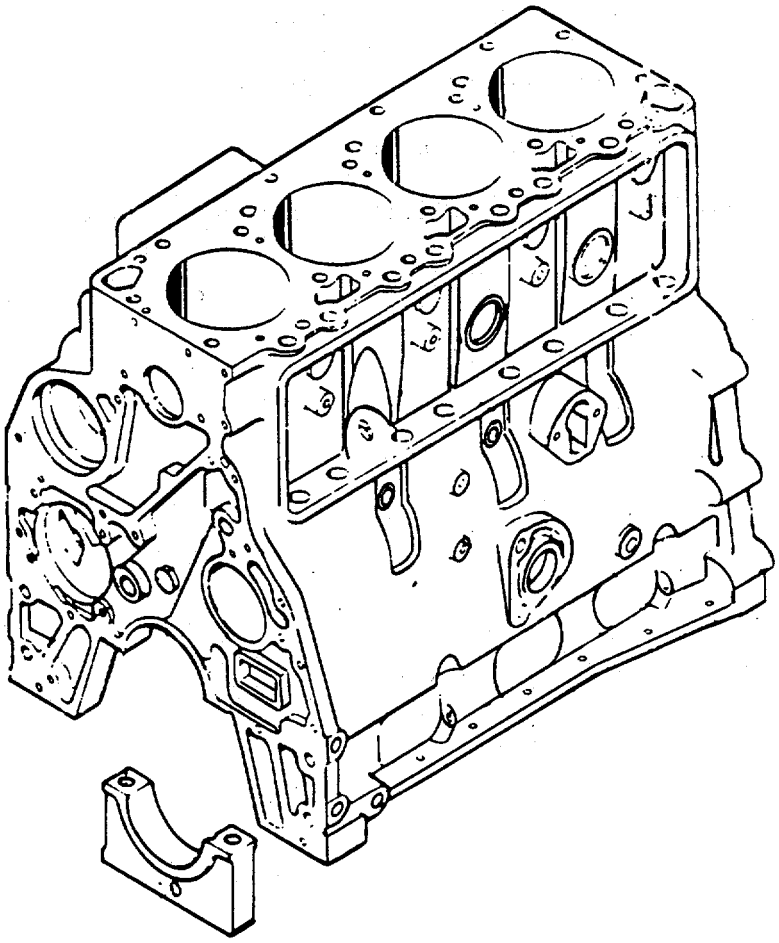


FIGURE 3-93. Cylinder Block Assembly.

3-31. Replace/Repair Chassis Assembly. (FIGURE 3-94)

This task covers: a. Removal, b. Repair, c. Replacement.

INITIAL SETUP

Tools

Tool kit, general mechanic's
rail and marine diesel engines
5180-00-629-9783
Combination wrench set, metric
10mm thru 24mm,
5120-01-046-4979

Equipment Condition

All components and assemblies completely removed. Reference cylinder block assembly removal and equipment condition (para. 3-30).

Materials/Parts

Chassis assembly P/N 403-2632
Lifting fixture P/N 3822512

REMOVAL

a. Remove hex head bolts (1), flat washers (2), lockwashers (3), and nuts (4).

b. Remove resilient mounts (5).

c. Remove hex head bolts (6), lockwashers (7), and nuts (9).

d. Remove electrical strap (8).

e. Remove hex head bolts (10), lockwashers (11),, and nuts (12).

f. Remove solderless lug (13).

g. Remove hex head bolts (14), lockwashers (15), and bracket (16).

h. Remove chassis bolts (17), nuts (21), flat washers (18), lockwashers (20), and bracket (19).

i. Attach lifting fixture to chassis.

j. Lift chassis off foundation.

REPAIR

a. Inspect resilient mounts for cracks.

b. Inspect bolts for rust and cracks.

c. Inspect chassis for cracks or warping.

REPLACEMENT

a. Replace new chassis in position with aid of lifting fixture.

b. Remove lifting fixture.

c. Install bracket (19) and secure chassis to foundation with bolts (17), flatwashers (18), lockwashers (20), and nuts (21).

d. Install bracket (16) and secure with lockwashers (15), and bolts (14).

e. Install solderless lug and secure with lockwashers (11), bolts (10), and nuts (12).

f. Install electrical strap (8) and secure with lockwashers (7), bolts (6), and nuts (9).

g. Install resilient mounts (5) and secure with flat washers (2), lockwashers (3), bolts (1), and nuts (4).

h. Refer to Equipment Condition, paragraph 3-30.

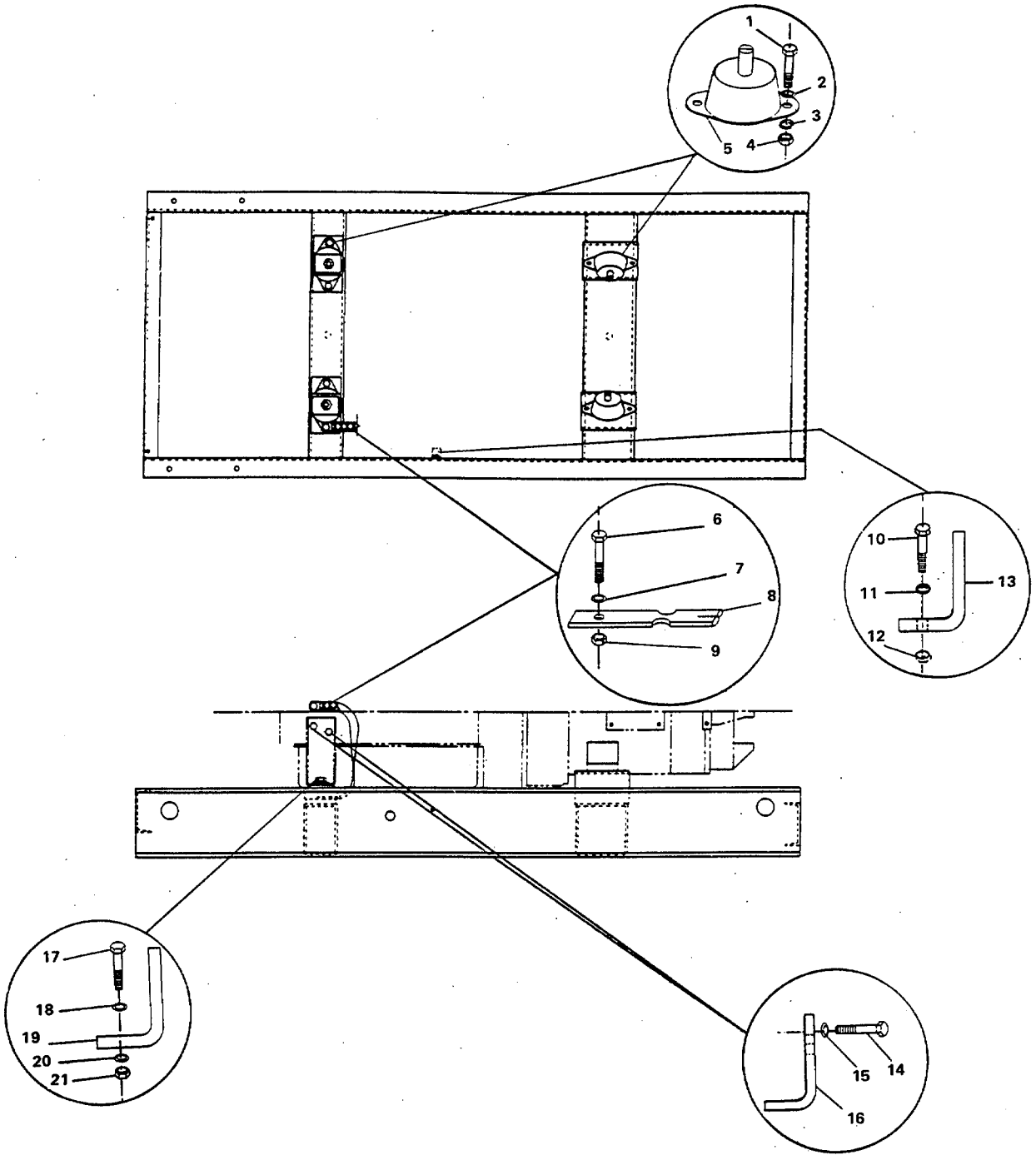


FIGURE 3-94. Chassis Assembly.

Section VI. PREPARATION FOR STORAGE OR SHIPMENT

Refer to Chapter 2, Section VI.

CHAPTER 4

INTERMEDIATE GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

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

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 organization.

4-2. **Special Tools, TMDE, and Support Equipment**. Special tools; test, measurement, and diagnostic equipment; and support equipment requirements are listed and illustrated in the Repair Parts and Special Tools List (RPSTL), TM 55-1905-223-24P. These items are also listed in 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 (RPSTL), TM 55-1905-223-24P.

Section II. SERVICE UPON RECEIPT

4-4. **Checking Unpacked Equipment.**

a. Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, report the damage in accordance with the instructions of DA Pam 738-750.

b. Check the equipment against the packing slip to see if the shipment is complete. 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. **Deprocessing Unpacked Equipment.**

a. Remove protective caps, plugs, inserts, wrappings, and tape when inspection/inventory is completed. Inspect piping openings for damage. Wipe off dirt, grease, or protective films at time of installation.

b. Remove chocks from resilient mounted components.

4-6. **Operational Procedures.**

a. Initial Setup Procedure. Includes operational checks and inspections that are not performed for a routine startup. Direct support maintenance personnel will perform initial setup in accordance with the operator's manual, TM 55-1905-223-10.

b. Normal Startup. Refer to the operator's manuals TM 55-1'905-223-10.

c. Shutdown Procedure (Usual or Unusual). Refer to the operator's manual, TM 55-1905-223t10.

Section III. INTERMEDIATE GENERAL SUPPORT PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

There is no PMCS at the general support level. See Chapter 2, Section III.

Section IV. INTERMEDIATE GENERAL SUPPORT TROUBLESHOOTING

There is no troubleshooting at the general support level. See Chapter 2, Section IV.

Section V. INTERMEDIATE GENERAL SUPPORT MAINTENANCE PROCEDURES

MAINTENANCE OF EMERGENCY GENERATOR SET

4-7. **Repair Generator Assembly.** (FIGURE 4-1)

This task covers: Repair.

INITIAL SETUP

Tools

Tool kit, general mechanic's
rail marine diesel engines,
5180-00-629-9783
Digital multimeter,
6625-01-139-2512

Materials/Parts

Stator P/N 450-17200
Rotor P/N 210-10442
Exciter stator P/N 051-1032
Annular ball bearing P/N 051-01032
Main rotor P/N 210-1036
Rotor assembly P/N 224CRO1S21R11A
Stator assembly P/N 224C111F1501A
Warning tags, Item 21, Appendix C

Equipment Condition

Engine secured (TM 55-1905-223-10).
Power to generator OFF and tagged "Out of Service."
Generator removed (para. 3-15).
Stator removed (para. 3-15).
Rotor removed (para. 3-15).
Rotor assembly removed (para. 3-15).

REPAIR

a. Remove hex head capscrews (4) and lockwashers (5) and flat washers (6), securing exciter stator (7) to mounting brackets (1, 2), pad eye (3) and stator assembly (9).

b. Remove exciter stator (7) and annular ball bearing (8).

c. Remove stator assembly (9).

d. Remove main rotor (10).

e. Install main rotor (10).

f. Install stator assembly (9).

g. Install annular ball bearing (8) and exciter stator (7). Secure to stator assembly with pad eye (3), mounting brackets (1, 2), flat washers (6), lockwashers (5), and capscrews (4).

h. Rotor assembly replaced (para. 3-15).

i. Rotor replaced (para. 3-15).

j. Stator replaced (para. 3-15).

k. Generator replaced (para. 3-15).

l. Turn power to generator ON, remove "Out of Service" tags.

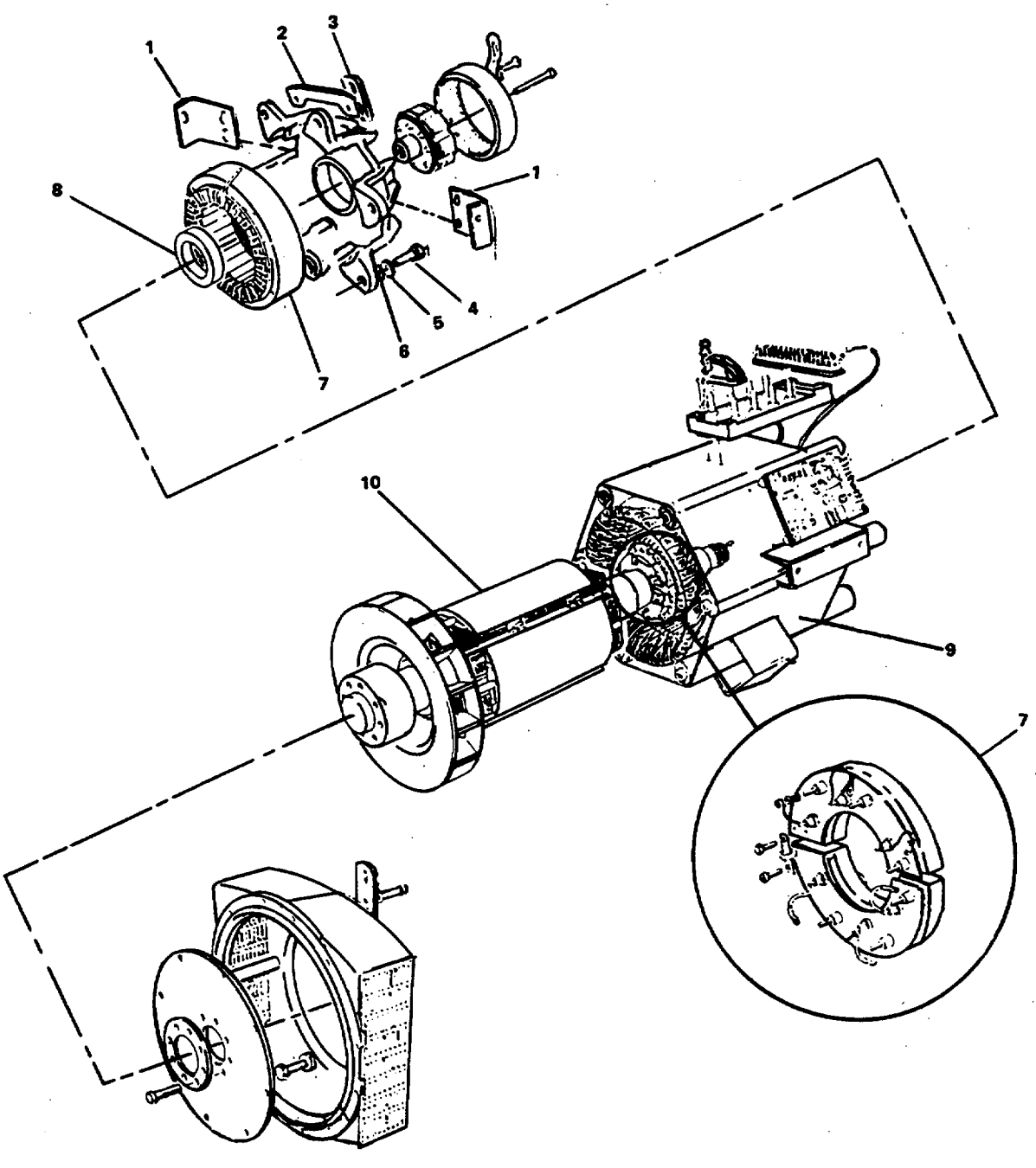


FIGURE 4-1. Repair Generator Assembly.

4-8. Repair Cylinder Head Group. (FIGURES 4-2 through 4-27)

This task covers: a. Disassembly, b. Cleaning and Inspection, c. Repair, d. Assembly.

INITIAL SETUP

Tools

Tool kit, general mechanic's rail and marine diesel engines, 5180-00-629-9783
Valve spring compression tester, 4910-01-142-4929
Combination wrench set, metric 10mm thru 24mm 5120-01-046-4979
Lifting sling P/N 3375958
Measuring tool set, machinist's, Set No. 6, 5280-00-278-9918
Valve spring compressor P/N ST-448

Equipment Condition

Emergency generator set secured and tagged "Out of Service" (TM 55-1905-223-10.
Cylinder head removed, (para. 2-40).

Materials/Parts

Compressed air
Nylon brush, Item 2, Appendix C
400 grit paper, Item 16, Appendix C
Crocus cloth, Item 6, Appendix C
Valve spring retainer P/N 3900299
Helical compression spring P/N 3900276
Valve stem seal P/N 3901097
Engine poppet valve P/N 3802005
Valve collet P/N 3900250
Engine poppet valve P/N 3802006
Hot water
Detergent, Item 7, Appendix C
Wire brush, Item 22, Appendix C
Warning tags, Item 21, Appendix C
Lapping compound, Item 5, Appendix C

DISASSEMBLY

a. Mark valve seats that have been previously re-ground (FIGURE 4-2).

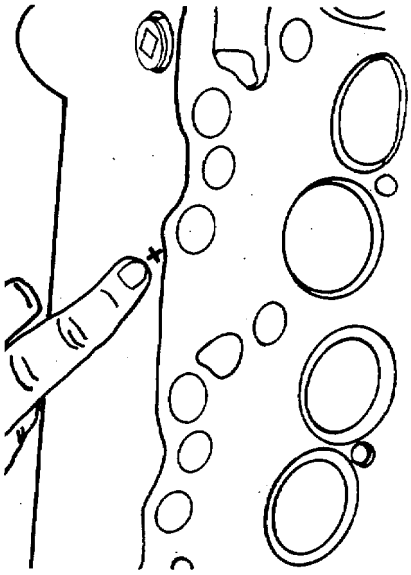


FIGURE 4-2. Marking Seats.

b. Mark the valves to identify their position. (FIGURE 4-2).

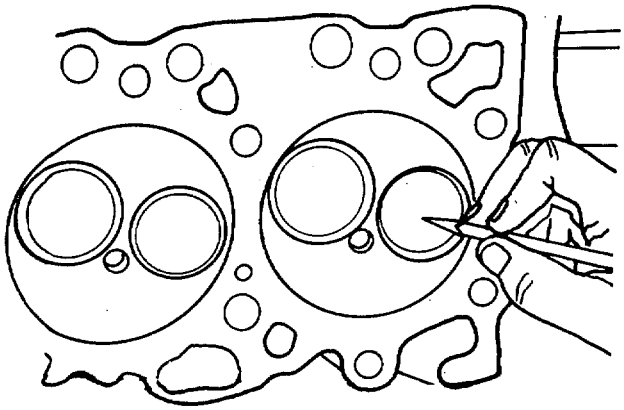


FIGURE 4-3. Marking Valves.

c. Compress the valve spring (3, FIGURE 4-8) and remove the valve stem collets (1) as shown in FIGURE 4-4.

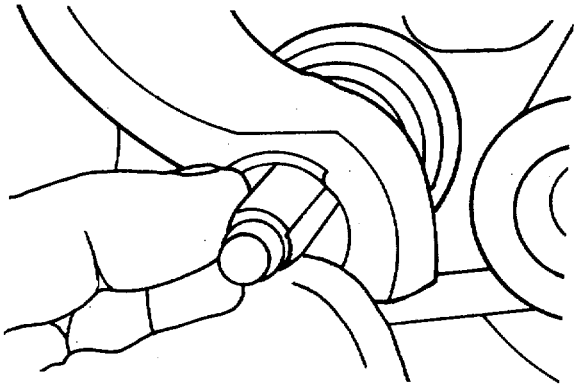


FIGURE 4-4. Removing Valve Stem Collets.

d. Release valve spring and remove the retainer (2, FIGURE 4-8) spring (3) and valve (10) as shown in FIGURE 4-8.

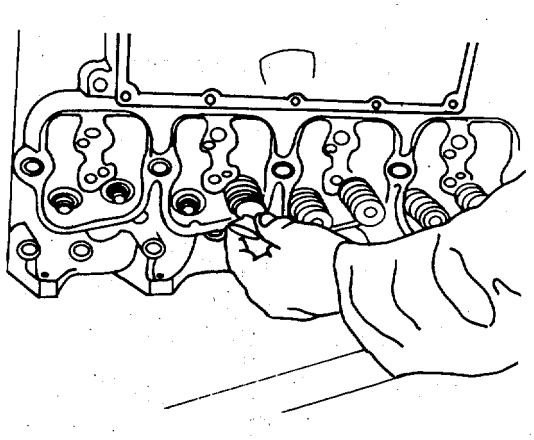


FIGURE 4-5. Removing Retainer.

e. Remove the remaining collets (1, FIGURE 4-8), retainers (2), springs and valves (10).

CAUTION

Keep the valves in a labeled rack.

f. Remove the valve stem seals (4, FIGURE 4-8) as shown in FIGURE 4-6.

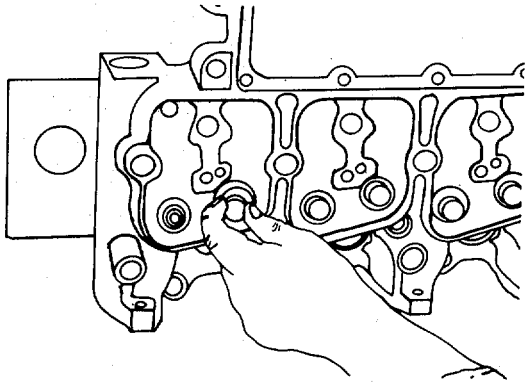


FIGURE 4-6. Removing Valve Stem Seals.

g. Remove pipe plugs (6, 7, 8, 9, and 11, FIGURE 4-8).

CLEANING AND INSPECTING

a. Clean the carbon from injector nozzle seat with nylon or brass brush as shown in FIGURE 4-7.

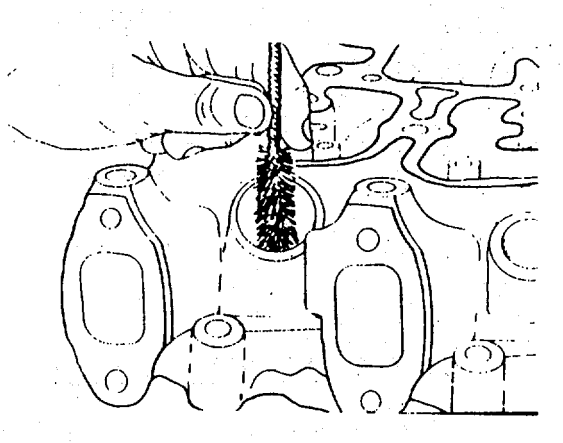


FIGURE 4-7. Cleaning Injector Nozzle Seat.

b. Scrape gasket residue from all gasket surfaces.

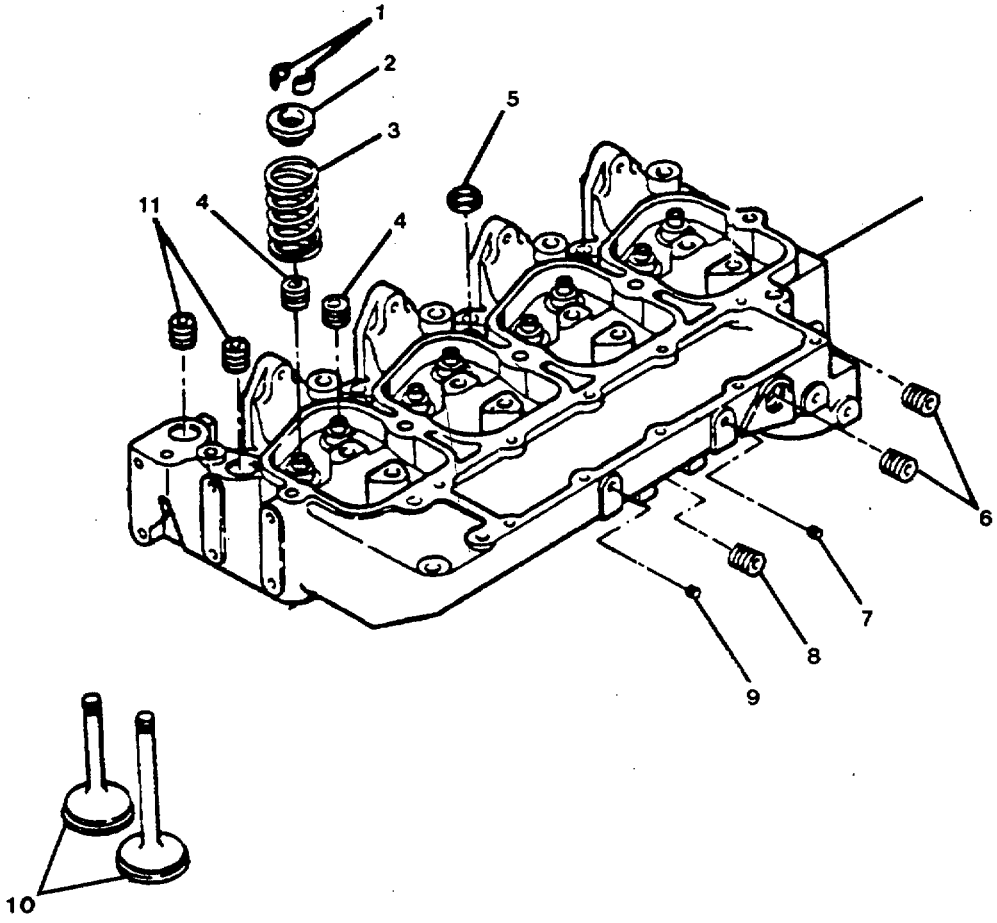


FIGURE 4-8. Cylinder Head.

c. Wash the cylinder head in hot soapy water. Let set for 30 minutes with water temperature 190°F (88°C). See FIGURE 4-9.

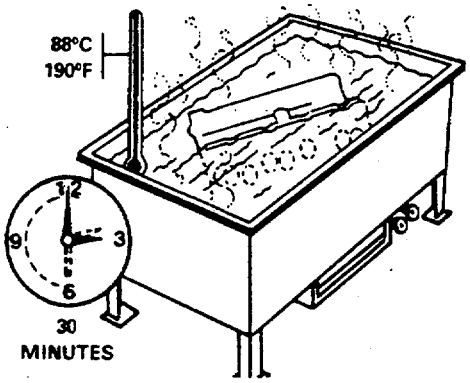


FIGURE 4-9. Washing Cylinder Head

WARNING

High pressure compressed air tanks, piping systems, and air operated equipment has a potential for serious injury to eyes and exposed areas of skin due to escaping air pressure.

d. After rinsing, use compressed air to dry.

e. Polish the gasket surfaces with 400 grit paper. Use sanding block to maintain a flat surface.

f. Inspect the valve guides for scuffing or scoring. Measure the valve guide bore as shown in FIGURE 4-10. Minimum (MIN) and Maximum (MAX) diameters are shown in Table 4-1.

Table 4-1.

Diameter		
in		mm
0.3157	MIN	(8.019)
0.3185	MAX	(8.089)

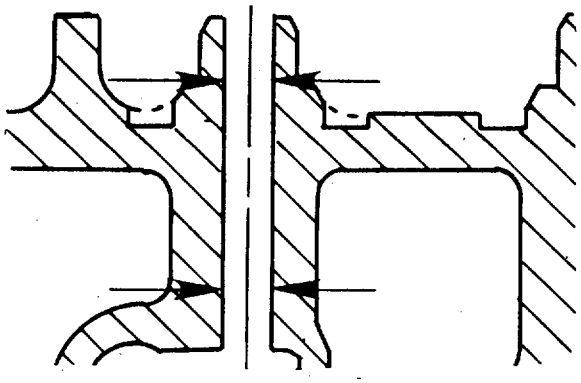


FIGURE 4-10 . Measuring Valve Guide Bore.

g. Inspect the head surface for nicks, erosion, etc. Check the head for distortion.

	Limit
Variation:	0.0039 inch (0.010 mm) within a 2.0 inch (50.8 mm) diameter area. 0.003 inch (0.075 mm) overall end to end or side to side.

h. Clean and Inspect the Valves.

(1) Clean the valve heads with a soft wire wheel.

(2) Polish the valve stem with crocus cloth.

CAUTION

Re-mark the valves according to head location.

(3) Inspect for abnormal wear on valve heads and stems. Measure the valve stem diameter as shown in FIGURE 4-11. Table 4-2 gives minimum (MIN) and maximum (MAX) diameter.

Table 4-2.

Diameter		
in		mm
0.3126	MIN	(7.94)
0.3142	MAX	(7.98)

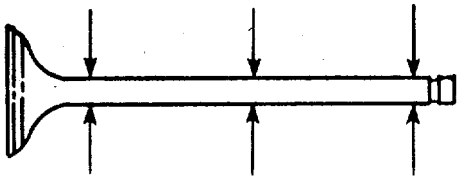


FIGURE 4-11. Measuring Valve Stem Diameter.

i. Clean pipe plugs with a wire brush.

REPAIR

a. Grind the face of the valves to be reused. Check for and replace bent valves.

b. Check the seat angle (FIGURE 4-12). Intake: 30 degrees, Exhaust: 45 degrees.

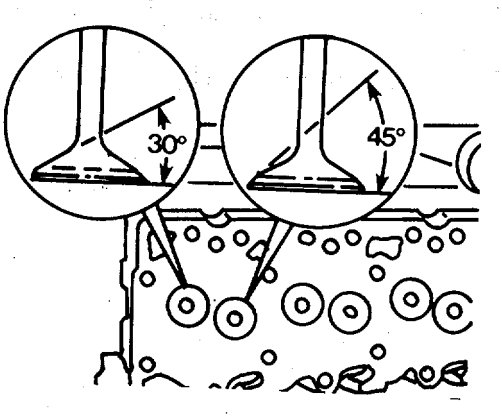


FIGURE 4-12. Checking Seat Angle.

c. Measure rim thickness (T) limit as shown in FIGURE 4-13.

Limit
Minimum Thickness: 0.031 inch (0.79 mm)

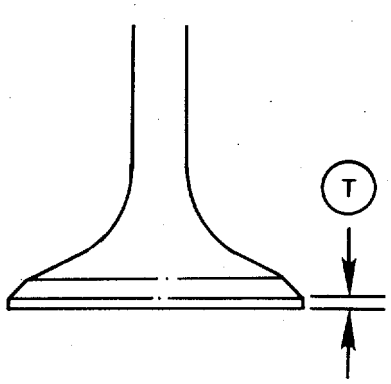


FIGURE 4-13. Measuring Rim Thickness.

d. Check valve stem tip for flatness as shown in FIGURE 4-14.

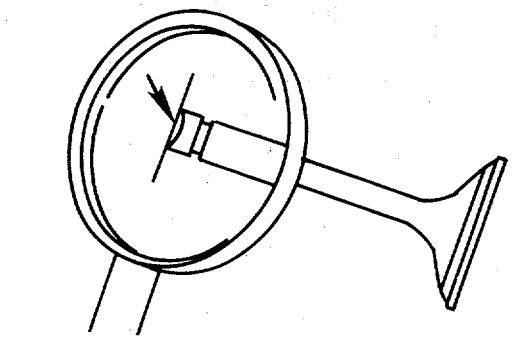


FIGURE 4-14. Checking Valve Stem Flatness.

e. Grinding Seats. Previously re-ground seats can be replaced with service seats. The marked illustration indicates a previously ground valve seat.

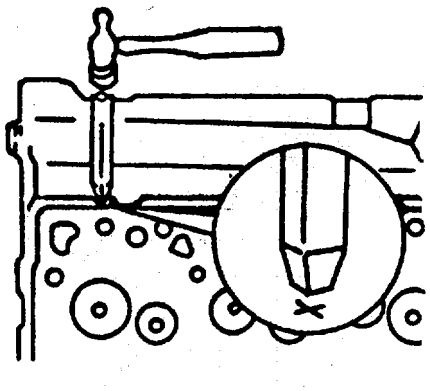


FIGURE 4-15. Grinding Valve Seats.

(1) Install the valves in their designated location and measure valve depth. The depth is the distance from the valve face to the head deck as shown in FIGURE 4-16.

(2) Record the depth of each valve as (A). Table 4-3 gives minimum (MIN) and maximum (MAX) depth.

Table 4-3. Valve Depth

in		mm
0.039	MIN	(0.99)
0.060	MAX	(1.52)

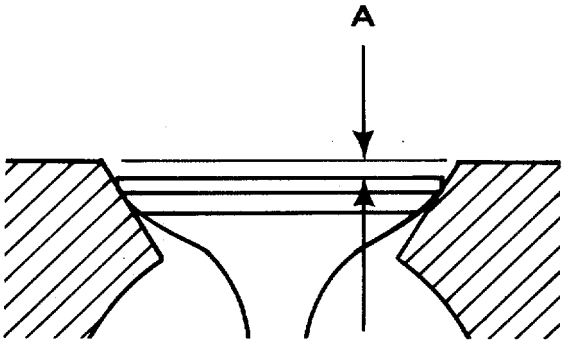


FIGURE 4-16. Checking Valve Depth (A).

(3) Grind the valve seat to remove scores, scratches and burns.

(4) Check seat angle as shown in FIGURE 4-17. Intake: 30 degrees; Exhaust: 45 degrees.

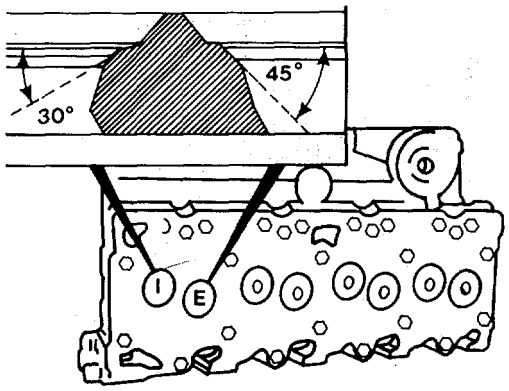


FIGURE 4-17. Checking Seat Angle.

(5) Install the valves in their respective bores and measure depth again.

(6) Record the depth of each valve as (B) (See FIGURE 4-18). Calculate grinding depth (GD) as follows: CD = (B) -(A).

CAUTION

Replace the valve if the depth exceeds the limit.

Limit: CD: 0.010 inch (0.254 mm)

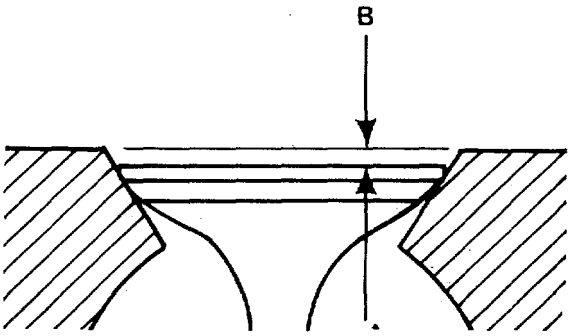


FIGURE 4-18. Calculate Grinding Depth (B).

(7) Check valve depth (C). (FIGURE 4-19)

VALVE DEPTH

mm		inch
0.99	min	O.039
1.52	max	0.060

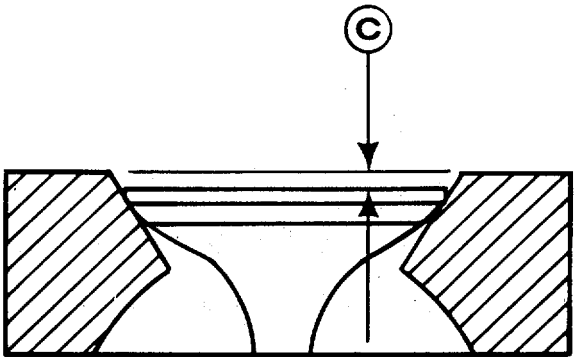


FIGURE 4-19. Check Valve Depth (C).

(8) Apply a light coat of valve lapping compound to each valve and lap each valve to its companion seat. (FIGURE 4-20)

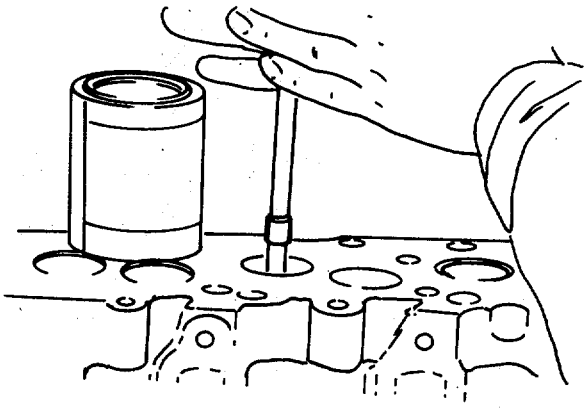


FIGURE 4-20. Apply Lapping Compound.

(9) Remove the valves and clean lapping compound from the valves and seats. (FIGURE 4-21)

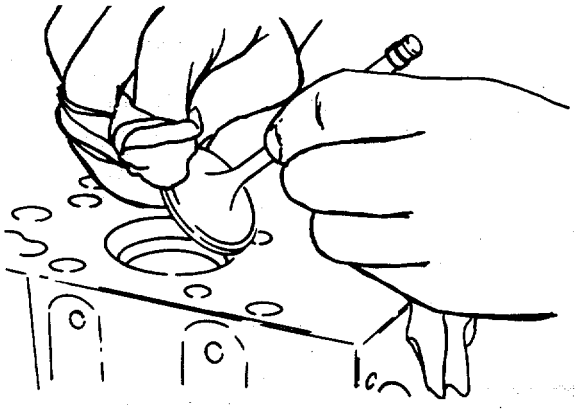


FIGURE 4-21. Clean Off Lapping Compound.

(10) Measure the valve seat width indicated by the lapped surface. (FIGURE 4-22)

Valve Seat Width Limit

Minimum (1): 1.5mm (0.060 inch)
Maximum (2): 2.0mm (0.080 inch)

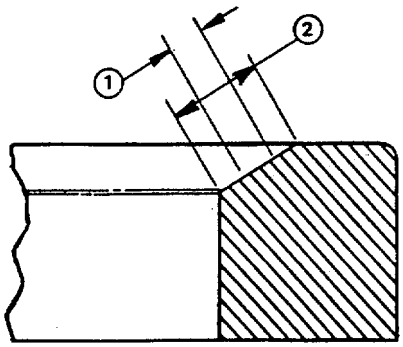


FIGURE 4-22. Valve Seat Width Measurement.

(11) If required, grind area (A) with a 60 degree stone and (B) with a 15 degree stone to center the seat on the valve face. (FIGURE 4-23). Maintain the valve seat width limits.

Limits

Minimum (1): 1.5mm (0.060 inch)
Maximum (2): 2.0mm (0.080 inch)

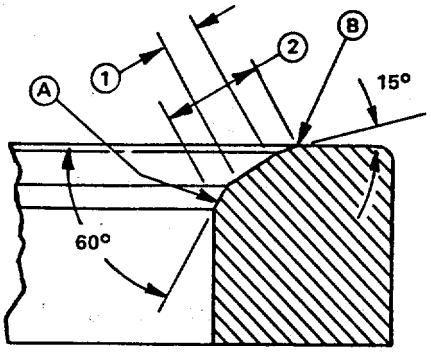


FIGURE 4-23. Grinding Valve Seats.

(12) Mark the cylinder head to identify the re-ground valve seats (FIGURE 4-24).

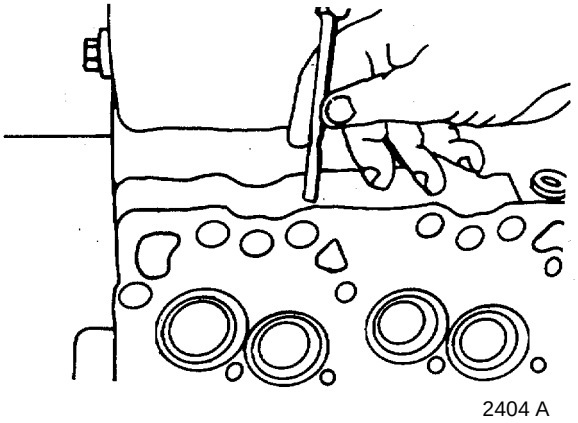


FIGURE 4-24. Marking Re-ground Valve Seats.

f. Inspect valve springs (3, FIGURE 4-7).

(1) Measure each valve spring.

Limits

Approximate Free Length: 2.190 inch (55.63 mm)
Maximum Inclination: 0.039 inch (1.0 mm)

(2) Using valve spring compression tester, check Valve Spring Tension. A minimum load of 65.0-72.2 lb (289.32 N.) is required to compress the spring to a height of 1.94 inches (49.25mm).

ASSEMBLY

NOTE

Clean all cylinder head components before assembling.

a. Apply anti-seize compound to pipe plugs (6, 7, 8, 0 and 11, FIGURE 4-8). Install pipe plugs.

b. Install the valve stem seals (4) as shown in FIGURE 4-25.

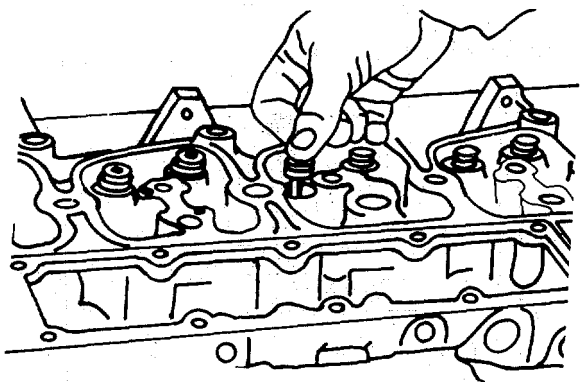


FIGURE 4-25 . Installing Valve Stem Seals.

CAUTION

Lube stems with SAE 90 weight oil.

NOTE

The intake and exhaust seals are the same.

c. Compress the valve spring using valve spring compressor (3, FIGURE 4-8) after assembling the spring (3) and retainer (2) as shown in FIGURE 4-26).

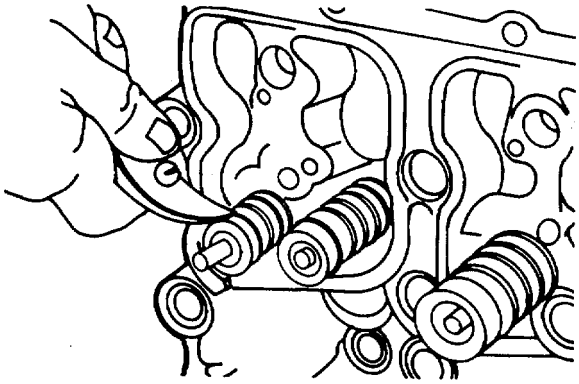


FIGURE 4-26. Compressing Valve Spring.

d. Install new valve collets (1, FIGURE 4-8) and release the spring tension as shown in FIGURE 4-27.

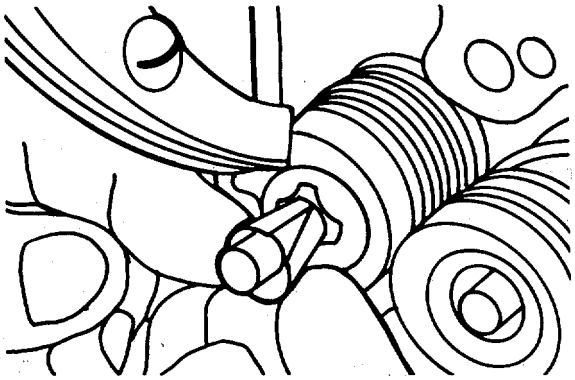


FIGURE 4-27. Installing New Valve Collets.

e. After assembly, use plastic hammer: tap valve stems to be sure the collets are seated.

f. To replace cylinder head refer to (para. 2-40).

4-9. Repair Camshaft Gear Group. (FIGURES 4-28 through 4-32)

This task covers: a. Cleaning/Inspection, b. Repair.

INITIAL SETUP

Tools

Tool kit, general mechanic's
rail and marine diesel engines,
5180-00-629-9783
Combination wrench set, metric
10mm thru 24mm,
5120-01-046-4979
Hydraulic press P/N 200913
Tool set, measuring, machinist, No. 6,
5280-00-278-9919

Equipment Condition

Emergency generator set secured and
tagged "Out of Service."
(TM 55-1905-223-10)
Cylinder head removed, (para. 2-40).
Camshaft removed, (para. 3-27).

Materials/Parts

Lubriplate 105, Item 14, Appendix C
Spur gear P/N 3907431
Oven
Protective gloves, Item 19, Appendix C
Cleaning solvent, Item 7, Appendix C
Lint free cloth, Item 18, Appendix C
Engine camshaft P/N 3907446
Warning tags, Item 21, Appendix C

CLEANING/INSPECTION

a. Clean with solvent and a lint free cloth.

b. Inspect the lobes and journals of the shaft for cracking, pitting or scoring.

c. Inspect the gear teeth for pitting. Check for cracks at root of gear teeth. (FIGURE 4-28).

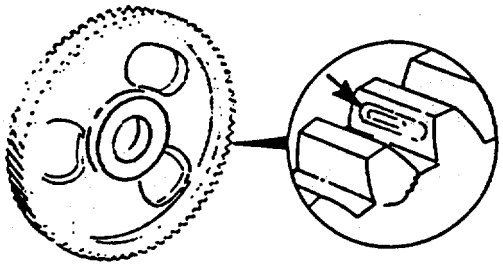


FIGURE 4-28. Inspecting Spur Gear.

d. Measure the valve lobes and lift pump lobe with micrometer. Refer to FIGURE 4-24 and Table 4-4.

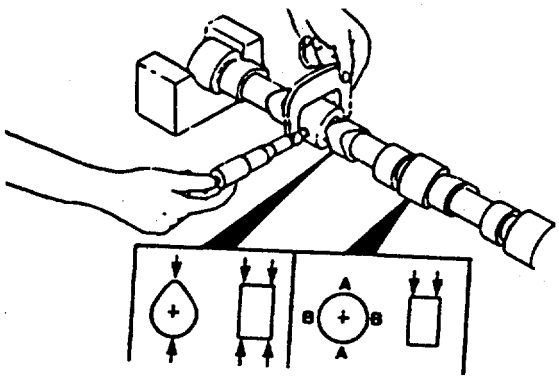


FIGURE 4-29. Measuring Valve and Lift Pump Lobes.

Table 4-4. Diameter at Peak of Lobe

	in		mm
Intake	1.861	MIN	47.265
	1.866	MAX	47.395
Exhaust	1.850	MIN	46.994
	1.855	MAX	47.124
Lift Pump	1.410	MIN	35.814
	1.422	MAX	36.130

e. Measure the bearing journals. Refer to FIGURE 4-29 and Table 4-5.

Table 4-5. Diameter of Journal

in		mm
2.1245	MIN	53.962
2.1265	MAX	54.013

REPAIR

a. Remove the spur gear (1) with a hydraulic press (FIGURE 4-30).

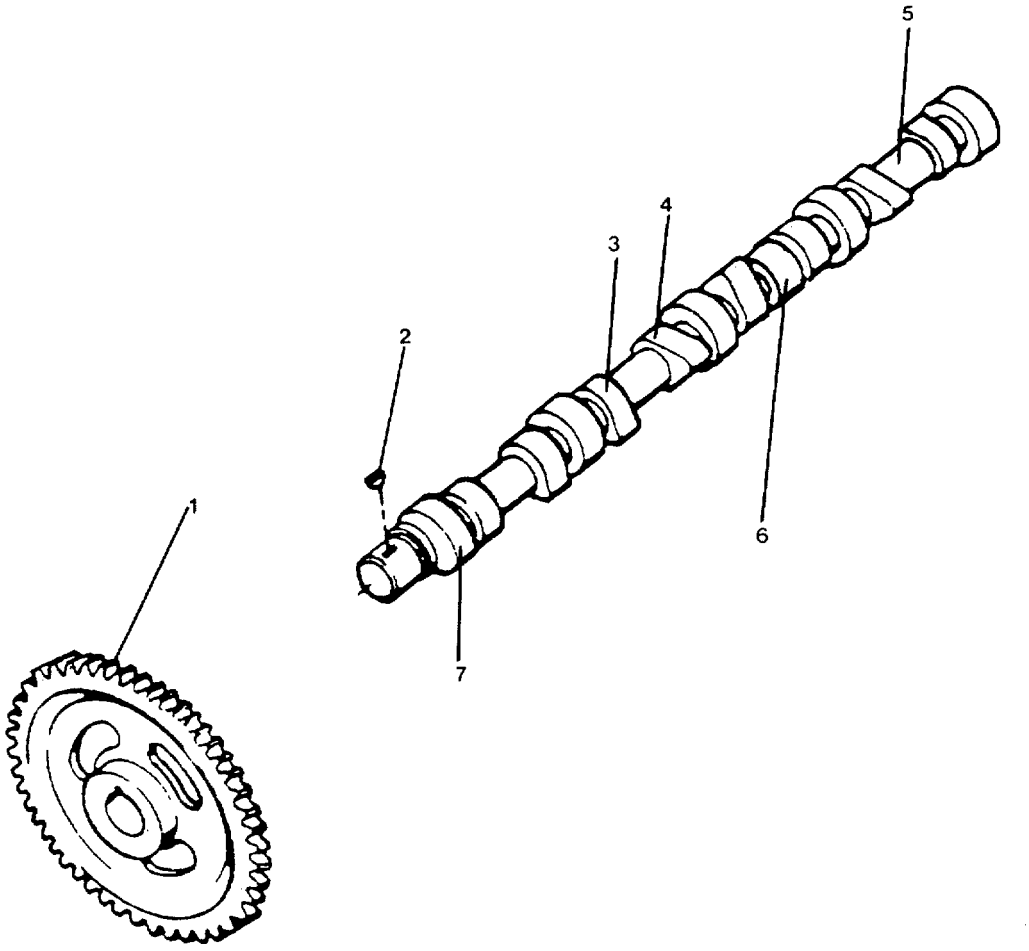


FIGURE 4-30. Camshaft and, Gear Assembly.

b. Remove all burrs from camshaft (5). Smooth any rough surfaces caused by removing the gear. Replace camshaft if required.

c. Install woodruff key (2) which comes out in process of removing gear (FIGURE 4-31).

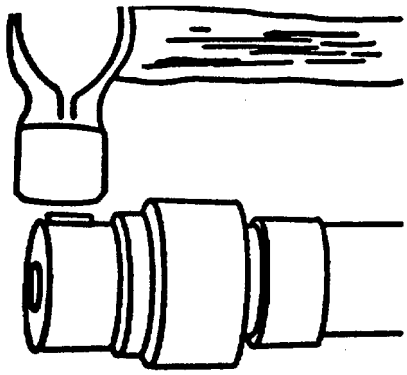


FIGURE 4-31. Installing Woodruff Key.

d. Lubricate the camshaft (5) surface with Lubriplate 105.

e. Heat the spur gear (1) in an oven at 250°F (121°C) for 45 minutes as shown in FIGURE 4-32.

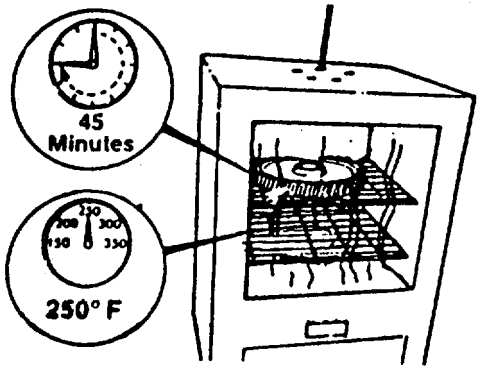


FIGURE 4-32. Heating Spur Gear.

WARNING

Wear protective gloves to handle the hot gear.

f. Remove spur gear from oven and install the gear with the timing marks away from the camshaft. Be sure it is seated against camshaft shoulder.

g. Refer to paragraph 3-27 for replacement procedures.

4-10. Repair Connecting Rod and Piston Group. (FIGURES 4-33 through 4-53)

This task covers: a. Disassembly, b. Cleaning, c. Inspection, d. Assembly.

INITIAL SETUP

Tools

Tool kit, general mechanic's rail and marine diesel engines 5180-00-629-9783
Combination wrench set, metric 10mm thru 24mm, 5120-01-046-4979
Piston ring compressor, 5120-00-116-7676
Torque wrench kit P/N 3377216
Tool kit, measuring, machinists, 5820-00-278-9919
Piston ring expander P/N ST-763

Equipment Condition

Emergency generator set secured and tagged "Out of Service" TM 55-1905-223-10.
Cylinder head removed (para. 2-40).
Connecting rod and piston group removed (para. 3-28).

Materials/Parts

Retaining rings (16) P/N 3901706
Piston pin (4) P/N 3901793
Engine connecting rod (4) P/N 3901569
Screw (8) P/N 3900910
Sleeve bearing (8) P/N 3901170
Engine piston assembly (4) P/N 3802100
Piston ring set P/N 3802050
Cleaning solvent, Item 20, Appendix C
Lubricating oil, Item 14, Appendix C
Detergent, Item 7, Appendix C
Warning tags, Item 21, Appendix C

DISASSEMBLY

a. Remove retaining rings (1, FIGURE 4-34).

b. Remove piston pin (2, FIGURE 4-33).

c. Using snap ring pliers remove the piston rings (7).

d. Repeat steps (a) thru (c) above for disassembly of the three remaining pistons.

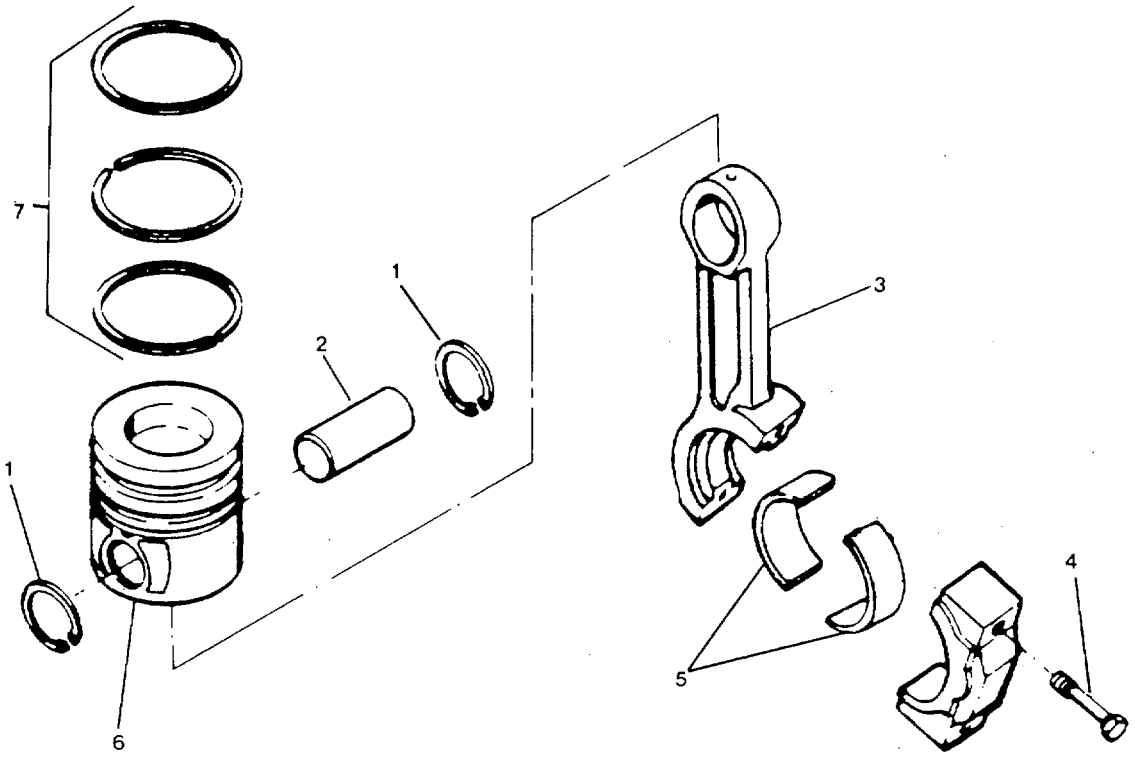


FIGURE 4-33. Piston and Connecting Rod Assembly.

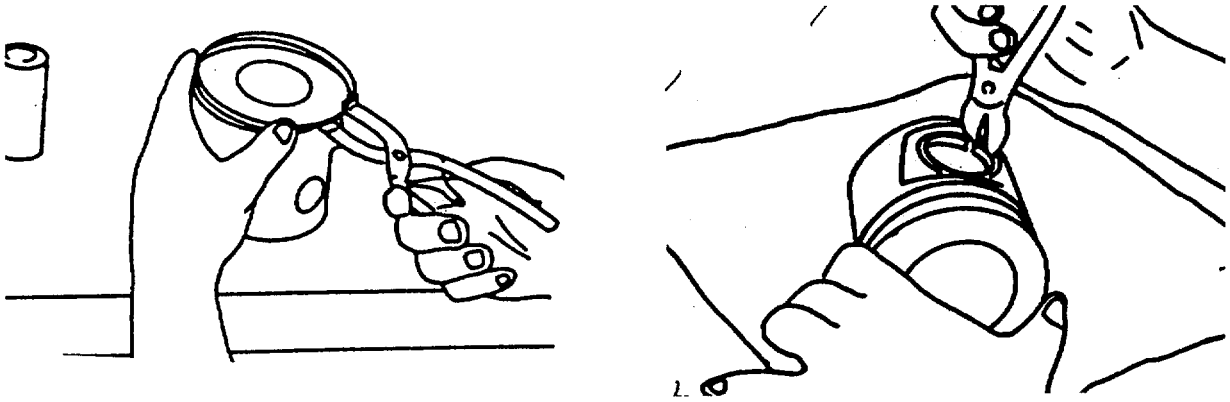


FIGURE 4-34. Removing Piston and Retaining Rings.

CLEANING

a. Soak pistons over night in cleaning solvent to loosen carbon deposits.

b. Wash pistons and rods in a strong solution of laundry detergent in hot water.

CAUTION

Do not clean pistons and rods in an acid tank or use bead blaster.

c. Clean remaining deposits from the ring grooves with the square end of a broken ring.

CAUTION

Do NOT use a ring groove cleaner and be sure not to scratch the ring sealing surface in the piston groove.

WARNING

COMPRESSED AIR HAZARD. High pressure compressed air tanks, piping systems and air operated devices can cause serious injury to eyes and exposed areas of skin due to escaping air pressure.

d. Wash pistons again in a detergent solution or solvent. Rinse, then use compressed air to dry.

INSPECTION

a. Inspect pistons for damage and excessive wear. Check the top (1, FIGURE 4-35), ring grooves (2). skirt (3) and pin bore (4).

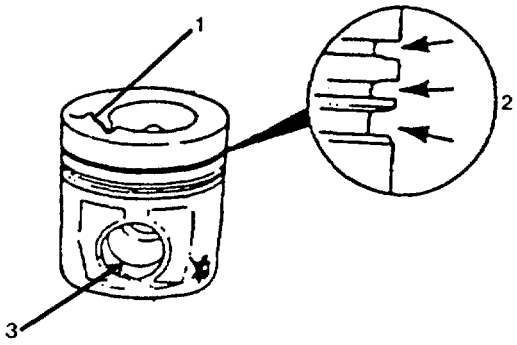


FIGURE 4-35. Inspecting Pistons.

b. Measure each piston skirt diameter as illustrated in FIGURE 4-36.

Minimum - 4.0088 inch (101.823 mm)
Maximum - 4.0117 inch (101.896 mm)

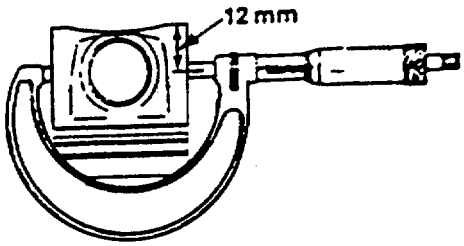


FIGURE 4-36. Measuring Piston Skirt Diameter.

c. Use a new piston ring to measure the clearance in the ring groove as shown in FIGURE 4-37.

RING CLEARANCE

TOP:	Use Keystone Gauge
INTERMEDIATE:	Minimum 0.003 inch (0.075 mm) Maximum 0.0059 inch (0.150 mm)
OIL CONTROL:	Minimum 0.0016 inch (0.040 mm) Maximum 0.0051 inch (0.130 mm)

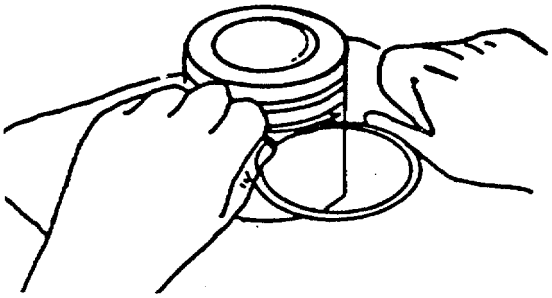


FIGURE 4-37. Measuring Piston Ring Clearance

d. Measure pin bore in each piston as shown in FIGURE 4-33.

Diameter: minimum 1.5750 inch (40.006 mm)
maximum 1.5758 inch (40.025 mm)

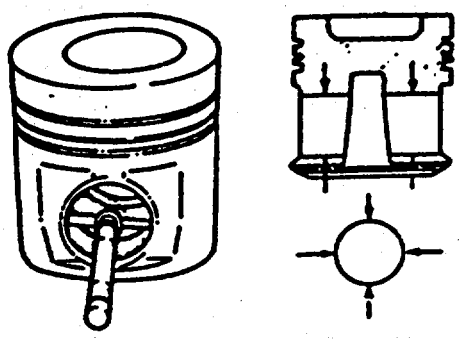


FIGURE 4-38. Measuring Piston Pin Bore.

e. Inspect piston pins for nicks, gouges and excessive wear. Measure each pin diameter as shown in FIGURE 4-39.

Diameter: minimum 1.5744 inch (39.990 mm)
maximum 1.5749 inch (40.0032 mm)

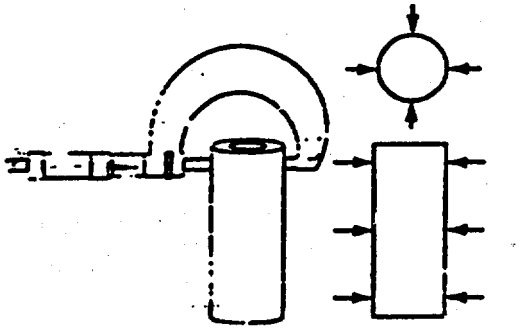


FIGURE 4-39. Measuring Piston Pin Diameter.

f. Inspect each rod for damage and wear.

CAUTION

The I-Beam section cannot have dents or other damage. Damage to this part can cause stress risers which will progress to breakage.

g. Measure pin bore in each rod as shown in FIGURE 4-40.

Diameter: minimum 1.5769 inch (40.053 mm)
maximum 1.5784 inch (40.092 mm)

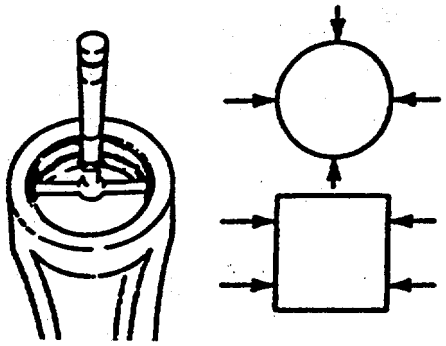


FIGURE 4-40. Measuring Pin Bore.

h. Determine rod bearing clearance as shown in FIGURE 4-41.

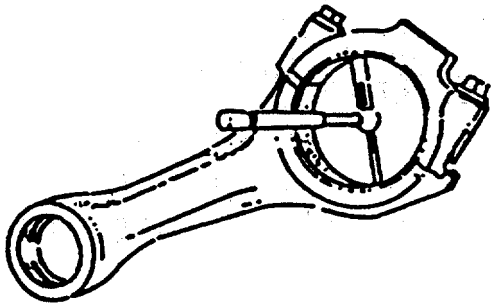


FIGURE 4-41. Rod Bearing Clearance.

(1) Measure and record the crankshaft bore with the bearings (5, Figure 4-33) installed and the capscrews (4) tightened to 73 ft-lbs (99 N-m).

(2) Measure and record the mean diameter of rod journal on the crankshaft (FIGURE 4-42).

Diameter: minimum 2.7150 inch (68.962 mm)
maximum 2.7170 inch (69.013 mm)

Out of Roundness: 0.002 inch (0.050 mm)
Taper: 0.0005 inch (0.013 mm)
Clearance: 0.0035 inch (0.089 mm)

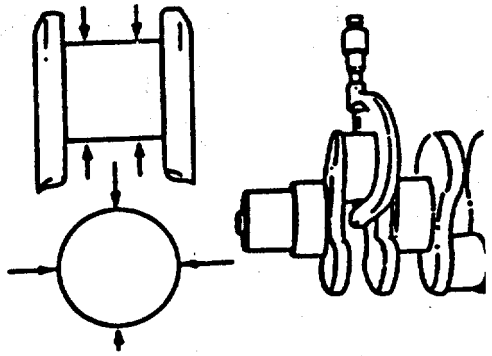


FIGURE 4-42. Measuring Mean Diameter of Rod Journal.

NOTE

Bearing clearance can be determined with plastigage during assembly.

ASSEMBLY

CAUTION

Be sure "FRONT" marking on piston and the numbers on the rod and cap are oriented as illustrated in FIGURE 4-43.

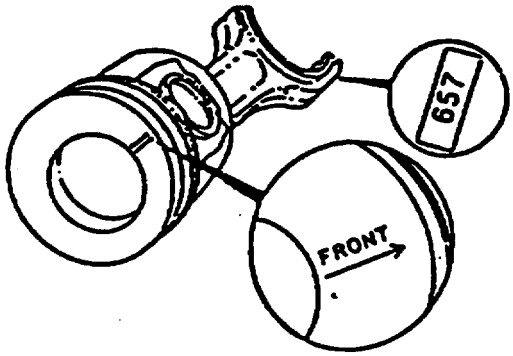


FIGURE 4-43. Orienting Piston and Rod.

a. Install retaining ring in the pin groove on the "FRONT" side of the piston as shown in FIGURE 4-44.

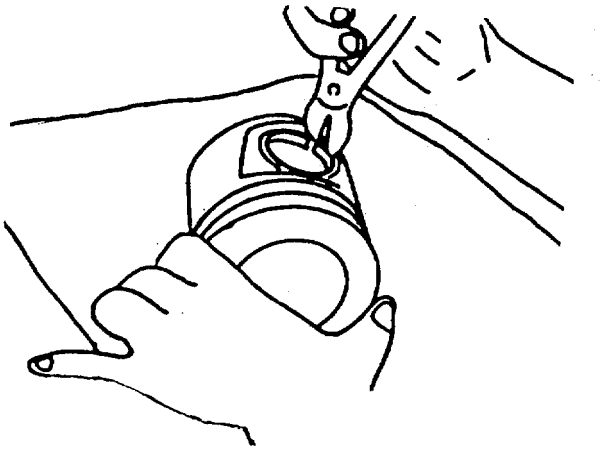


FIGURE 4-44. Install Retaining rings.

CAUTION

Pistons do not require heating to install piston pin.

b. Lubricate the pin and pin bores with engine oil (FIGURE 4-45). Install the pin (FIGURE 4-46).

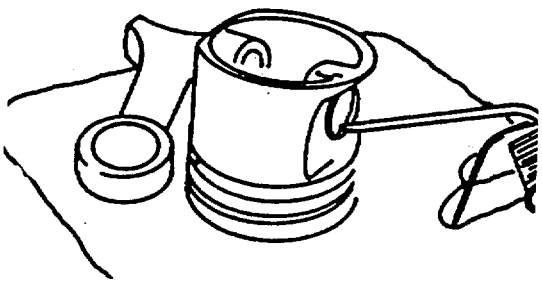


FIGURE 4-45. Lubricating Pin and Bore.

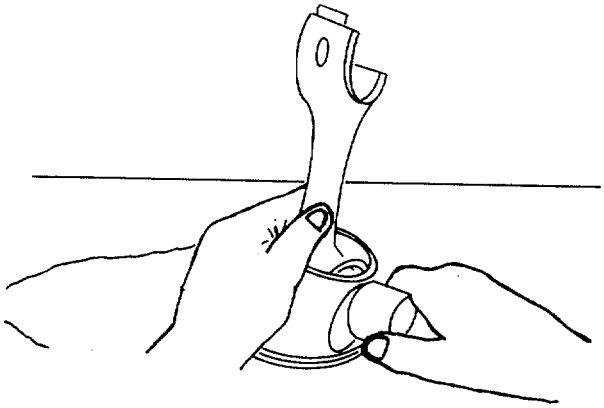


FIGURE 4-46. Installing Pin.

c. Install second retaining ring.

d. Check piston ring gap.

(1) Position each ring in the cylinder and use a piston to square it with the bore as shown in FIGURE 4-47.

A = 3.5 inches (89 mm)

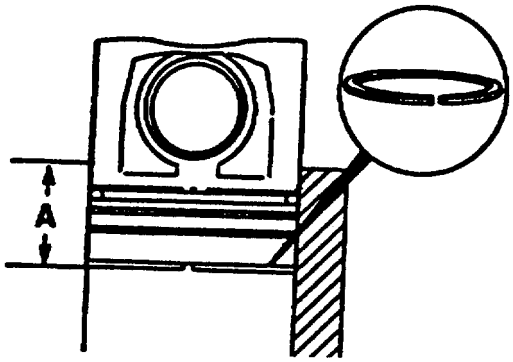


FIGURE 4-47. Checking Piston Ring Cap.

(2) Use a feeler gauge to measure the gap as shown in FIGURE 4-48.

RING GAP

Top:	Minimum 0.0160 inch (0.40 mm) Maximum 0.0275 inch (0.70 mm)
Intermediate:	Minimum 0.0100 inch (0.25 mm) Maximum 0.0215 inch (0.55 m*m)*
Oil Control:	Minimum 0.100 inch (0.25 mm) Maximum 0.215 inch (0.55 mm)

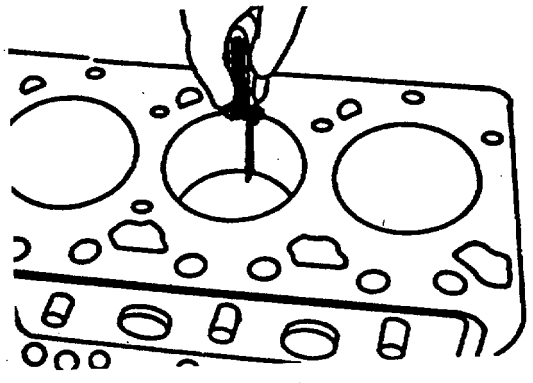


FIGURE 4-48. Measuring Piston Ring Gap.

e. Install the piston rings. The top surface of all the rings are identified by the word "TOP" as shown in FIGURE 4-49.

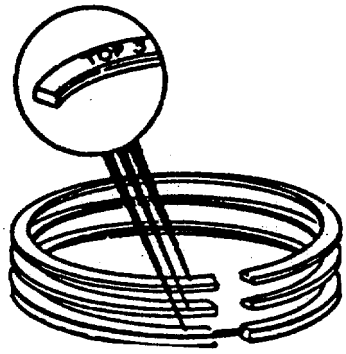


FIGURE 4-49. Installing Piston Rings.

CAUTION

If a ring expander is being used, be careful not to over expand the ring.

(1) Position the oil ring expander in the control ring groove as shown in FIGURE 4-50.

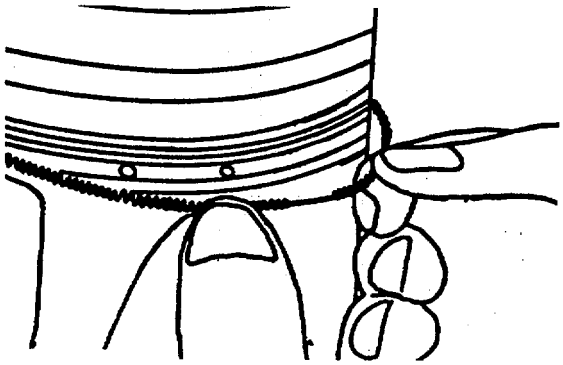


FIGURE 4-50. Positioning Oil Ring Expander.

(2) Install the oil control ring with the end gap 180° from the ends of the expander as shown in FIGURE 4-51.

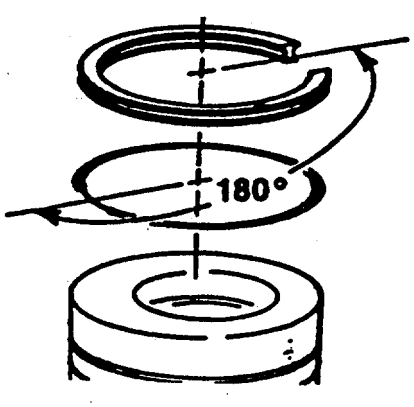


FIGURE 4-51. Installing Oil Control Ring.

(3) Install the intermediate ring as shown in FIGURE 4-52.

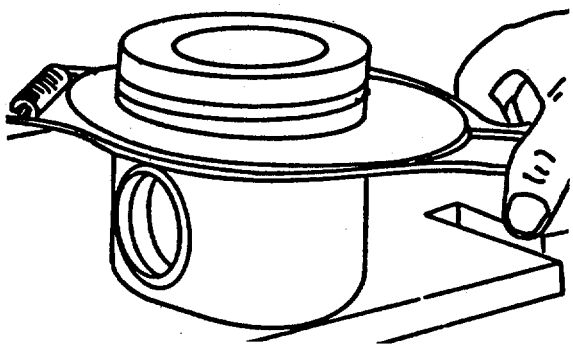


FIGURE 4-52. Installing Intermediate Ring.

(4) Install the top ring as shown in FIGURE 4-53.

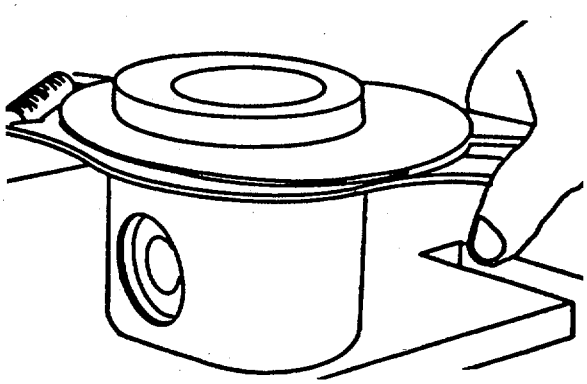


FIGURE 4-53. Installing Top Ring.

(5) Repeat steps (1) thru (5) above for assembly of the remaining three pistons.

4-11. Repair Flywheel Housing Group. (FIGURE 4-54)

This task covers: Repair.

INITIAL SETUP

Tools

Tool kit, general mechanic's
rail and marine diesel engines,
5180-00-629-9783
Combination wrench set,
metric 10 mm thru 24mm,
5120-01-046-4979

Equipment Condition

Emergency generator set secured and
tagged "Out of Service"
(TM 55-1905-223-10).
Flywheel group removed (para. 3-29).

Materials/Parts

Preformed packing P/N 3912473
Gasket P/N 3901019
Preformed packing P/N 3910260
Oil seal P/N 3909410
Warning tags, Item 21, Appendix C

REPAIR (FIGURE 4-54)

a. Replace gasket (1).

CAUTION

Do Not use Loctite on new oil seal.

b. Replace oil seal (2).

c. Replace preformed packing (3).

d. Replace preformed packing (4).

e. Replace flywheel housing group (para 3-29).

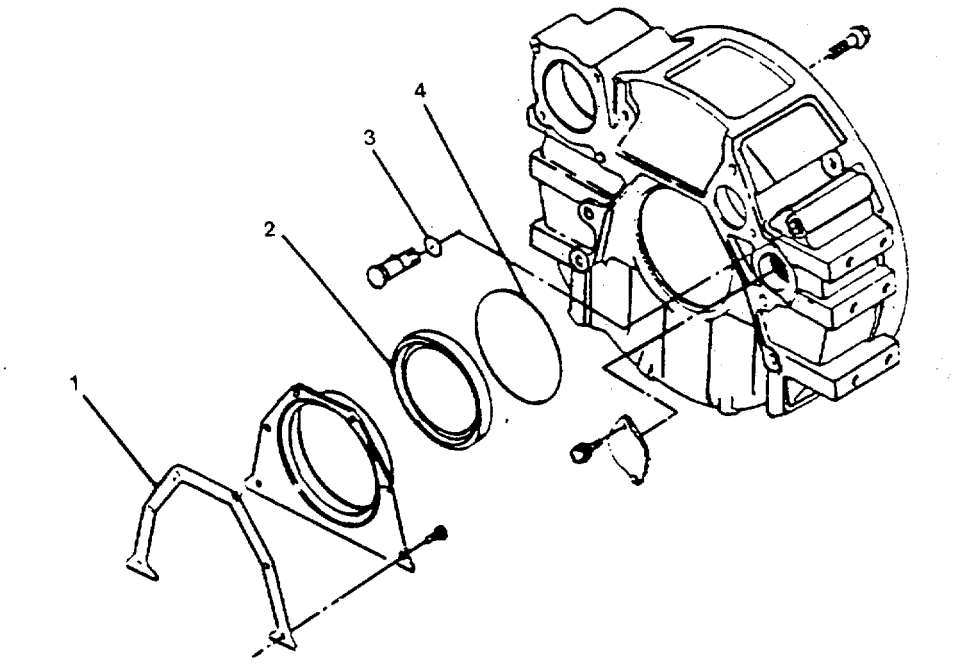


FIGURE 4-54. Flywheel Housing Group

4-12. Repair Flywheel Group. (FIGURE 4-55)

This task covers: Repair.

INITIAL SETUP

Tools

Tool kit, general mechanic's
rail and marine diesel engines,
5180-00-629-9783
Combination wrench set,
metric 10 mm thru 24mm,
5120-01-046-4979

Equipment Condition

Emergency generator set secured and
tagged "Out of Service"
(TM 55-1905-223-10).
Flywheel housing group removed
(para. 3-29).

Materials/Parts

Internal gear P/N 3901774
Warning tags, Item 21, Appendix C

REPAIR (FIGURE 4-55)

a. Inspect engine flywheel (2) for cracks, rust or corrosion. Replace if necessary. Refer to paragraph 3-29.

b. Inspect internal gear (1) for cracks, corrosion or broken gear teeth. Replace as necessary.

CAUTION

Do not use a cutting torch to heat internal gear. The flywheel can be damaged.

(1) Heat outside diameter of internal gear (1) with a heating torch.

(2) Use a blunt chisel and hammer to remove gear from the flywheel (2).

NOTE

If an oven is not available, use a heating torch to heat inside diameter of gear to 600°F (316°C). Use tempil stick crayon or equivalent to check the gear temperature step (3).

CAUTION

Do not overheat gear. Metal hardness will change.

(3) Heat new internal gear (1) in an oven heated to 600°F (316°C) for a minimum of 1 hour.

WARNING

Wear protective gloves when hauling heated parts to avoid injury.

(4) Remove gear (1) from the oven, and install it on the flywheel (2) before it cools.

c. Replace flywheel group (para. 3-29).

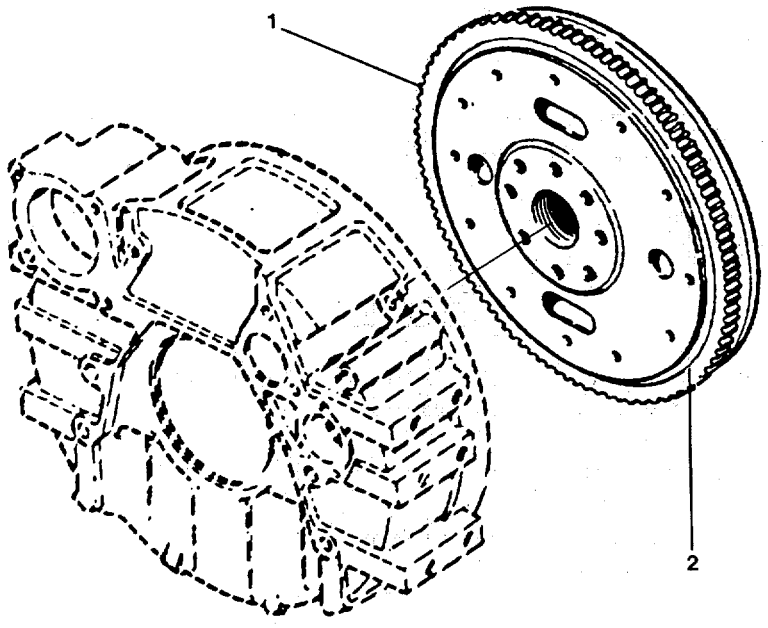


FIGURE 4-55. Flywheel Group.

4-13. Replace/Repair Crankshaft and Main Bearing Group. (FIGURE 4-56)

This task covers: a. Disassembly, b. Cleaning and Inspection, c. Repair, d. Assembly.

INITIAL SETUP

Tools

Tool kit, general mechanic's rail and marine diesel engines, 5180-00-629-9783
Combination wrench set, metric 10 mm thru 24mm, 5120-01-046-4979
Heavy duty gear puller P/N ST-647
Tool kit, measuring, machinists 5280-00-278-9919
Torque wrench kit P/N 3377216

Equipment Condition

Engine removed from vessel to a shop location.

Materials/Parts

Solvent, Item 20, Appendix C
Crankshaft P/N 3908031
Nylon brush, Item 2, Appendix C
Sleeve bearing half set P/N 3802010
Lubricating oil, Item 14, Appendix C

DISASSEMBLY

a. Rotate the engine to a horizontal position and remove the main cap bolts as shown in FIGURE 4-56.

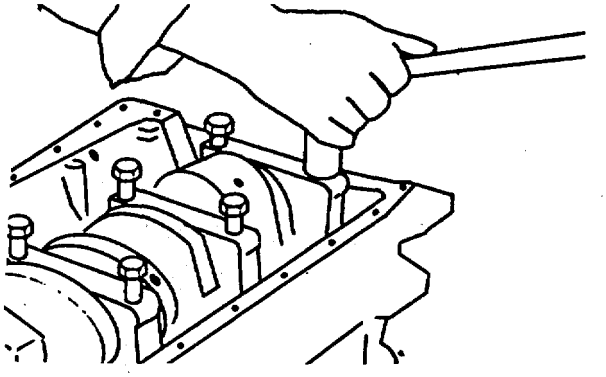


FIGURE 4-56. Main Cap Bolt Removal.

b. The main caps should be numbered. If they are not, be sure to mark them with the correct number as shown in FIGURE 4-57.

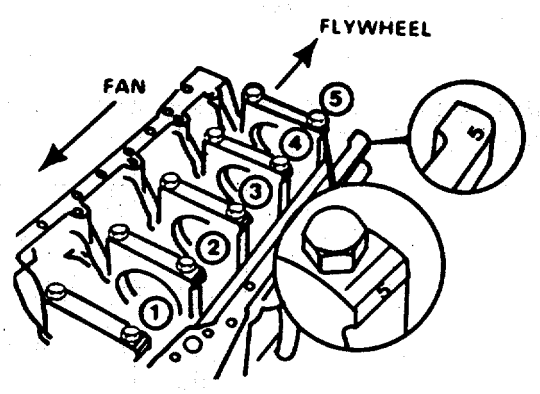


FIGURE 4-57. Numbering Main Caps.

CAUTION

Do not pry the main caps to free them from the cylinder block.

c. Remove the main caps. Use two of the main cap bolts to "wiggle" the main cap base, being careful not to damage the bolt threads.

WARNING

To prevent injury, be sure to have assistance with heavy lifting. Crankshaft weighs 80 pounds (36 Kg).

d. Lift the crankshaft and gear from the cylinder block as shown in FIGURE 4-58.

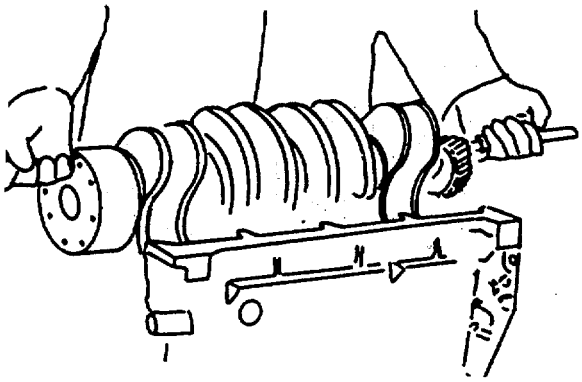


FIGURE 4-58. Removing Crankshaft.

e. Remove the sleeve bearing half sets (1, and 3, FIGURE 4-68) (main bearings) from the block and the main caps as shown in FIGURE 4-59.

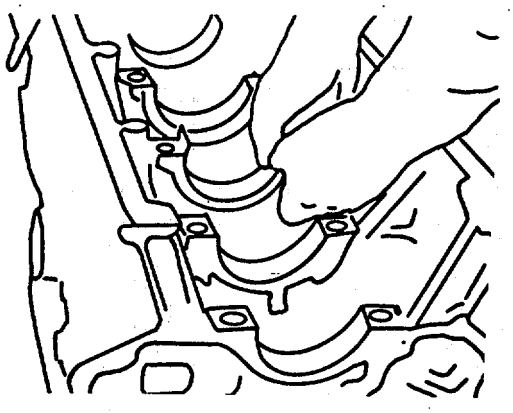


FIGURE 4-59. Removing Sleeve Bearing Half Sets.

f. Using a 3/16 inch pin punch, remove the piston cooling nozzles as shown in FIGURE 4-60.

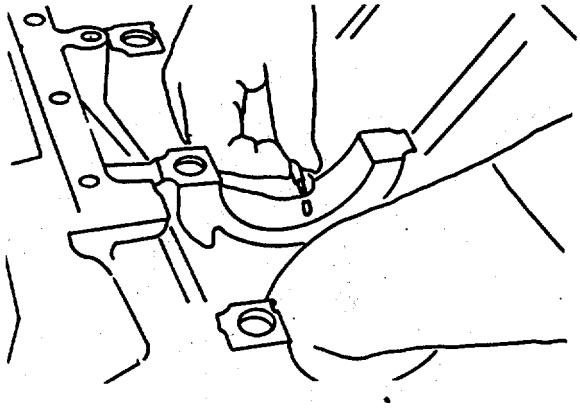


FIGURE 4-60. Removing Piston Cooling Nozzles.

NOTE

No. 1 main cap is to the front of the block.

g. Install the main caps in their corresponding position as shown in FIGURE 4-61.

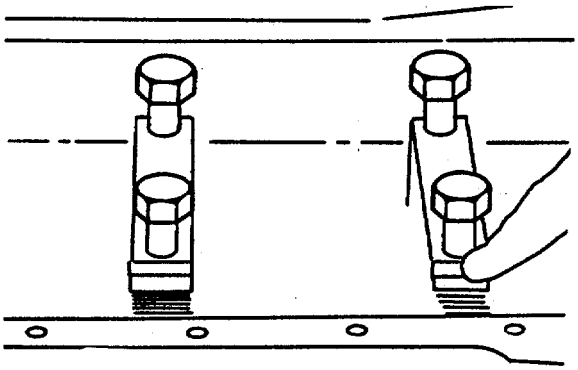


FIGURE 4-61. Installing Main Caps.

CLEANING AND INSPECTION

a. Clean the crankshaft oil drillings with a nylon brush as shown in FIGURE 4-62.

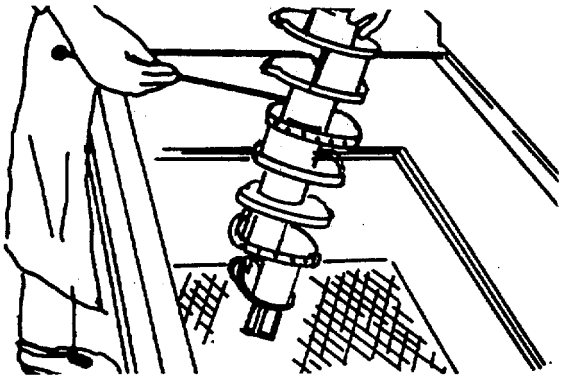


FIGURE 4-62. Cleaning Oil Drillings.

WARNING

High pressure compressed air tanks, piping systems, and air operated equipment has a potential for serious injury to eyes and exposed areas of skin due to escaping air pressure.

b. Rinse in cleaning solvent. Use compressed air to dry.

c. Inspect the crankshaft seals wear surfaces for scratches or grooving as shown in FIGURE 4-63.

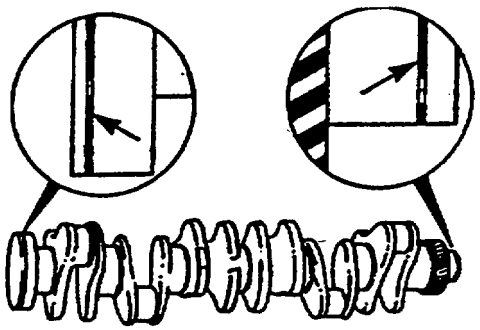


FIGURE 4-63. Inspecting Seal Surfaces.

NOTE

Wear sleeves are available for worn surfaces.

d. Inspect the rod and main journals for deep scoring, overheating, etc. As shown in FIGURE 4-64.

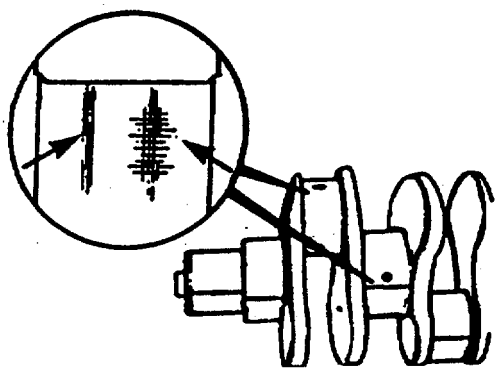
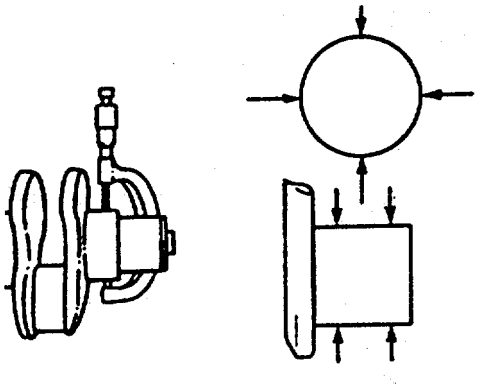


FIGURE 4-64. Inspecting Rod and Main Journals

e. Determine main bearing clearance as shown in FIGURE 4-65.

Measure the main journal diameters and determine main bearing clearance.



Diameter:	Minimum - 3.2662 inch (82.962)
-Maximum -	3.2682'inch (83.013)
Out-of-Roundness:	0.002 inch (0.050mm)
Taper:	0.0005 inch (0.013mm)

FIGURE 4-65. Measuring Main Journal.

Bearing Clearance = Main Bore Diameter with bearing installed - Crank Main journal diameter.

Bearing Clearance Maximum: 0.00475 inch (0.119mm)

REPAIR

a. Remove bearing sleeves (2, and 5, FIGURE 4-69) and straight pin (7).

b. Use a heavy duty puller to remove the spur gear (1) as shown in FICURE 4-67.

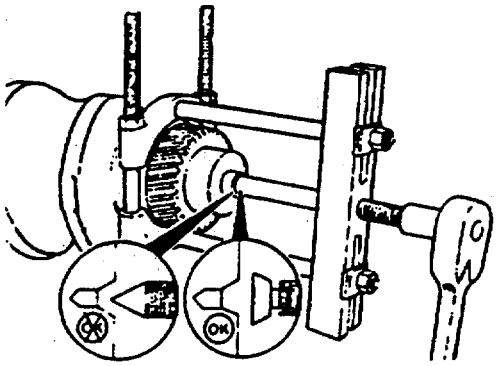


FIGURE 4-66. Using Puller.

b. Remove all burrs and make sure the gear surface on the end of the crankshaft is smooth.

CAUTION

The gear will be permanently distorted if heated for longer than 45 minutes.

c. Heat the crankshaft gear for 45 minutes at 250°F (121°c) as shown in FIGURE 4-67.

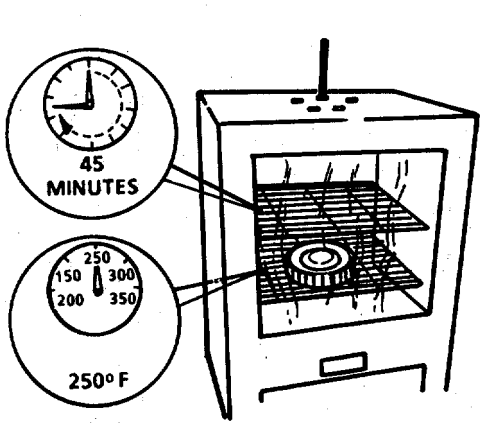


FIGURE 4-67. Heating Crankshaft Gear.

WARNING

Wear Protective gloves.

d. Install the hot gear up to the crankshaft shoulder with the timing mark out.

e. Replace straight pin (7, FIGURE 4-68) and bearing sleeves (2 and 5).

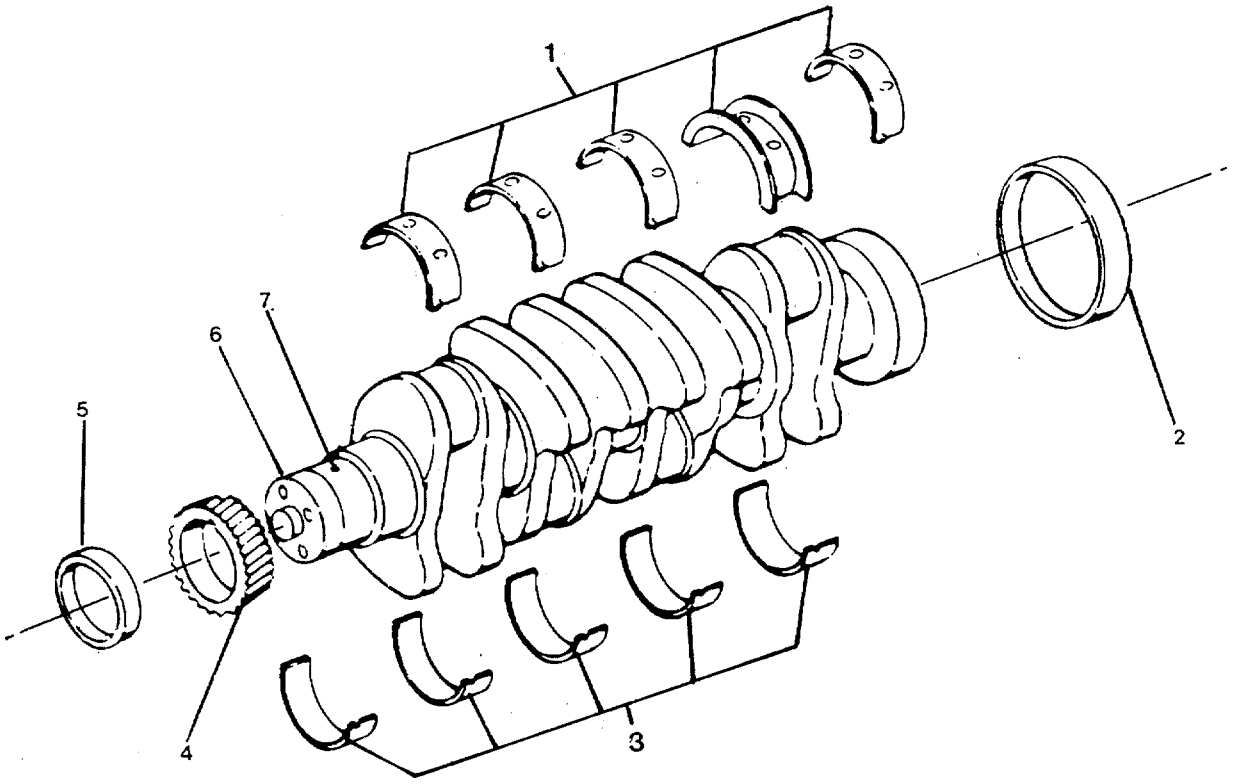


FIGURE 4-68. Crankshaft.

ASSEMBLY

a. Remove the main bearing caps (1 and 3, FICURE 4-63) as shown in FICURE 4-69.

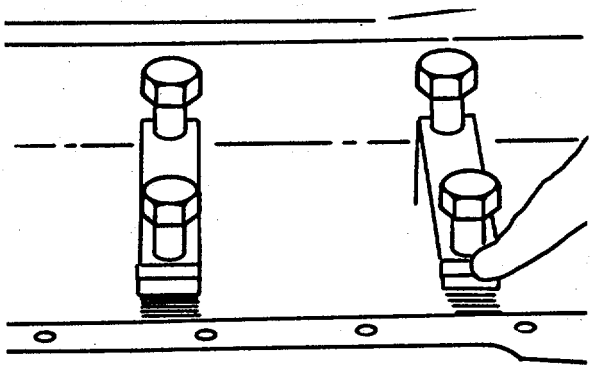


FIGURE 4-69. Removing Main Bearing Caps.

b. Install the piston cooling nozzles even with or below the bearing saddle surface as shown in FIGURE 4-70.

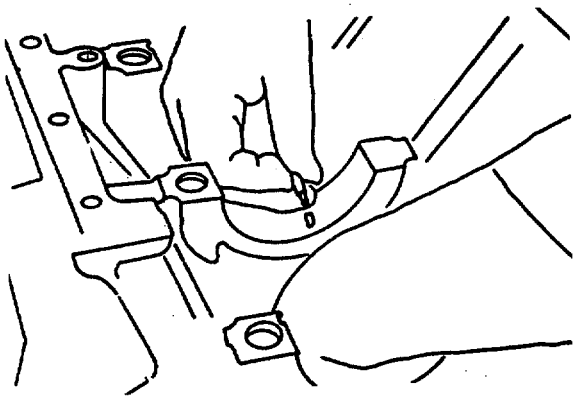


FIGURE 4-70. Installing Piston Cooling Nozzles

CAUTION

Be sure spray holes are clean and open.

c. Install the sleeve bearing half set (1, FIGURE 4-68) (upper main bearings); being certain to install the combination thrust/main bearing in the second journal from the rear.

d. Lubricate the bearings.

WARNING

Be sure to get assistance with heavy lifting. The crankshaft weighs 80 pounds (36 Kg).

e. Install the crankshaft (6, FICURE 4-68).

CAUTION

Make sure bearing caps are numbered for location. Number 1 starts with the front of the block, and the numbers face the oil cooler side of the engine. (FIGURE 4-71)

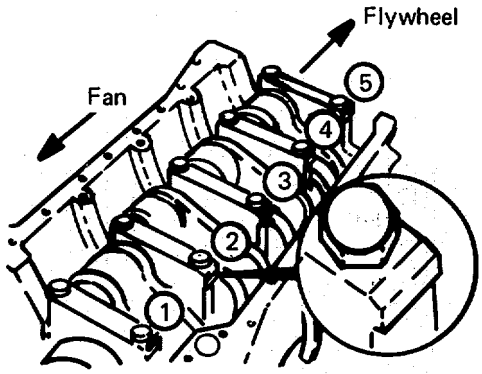


FIGURE 4-71. Bearing Cap Location Numbers.

CAUTION

Make sure the ring dowels have been installed into the caps. (FIGURE 4-72)

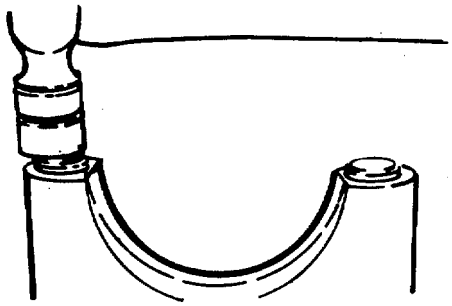


FIGURE 4-72. Install Ring Dowels.

f. Install the sleeve bearing half set (3) (lower main bearings) into the caps. (FIGURE 4-73)

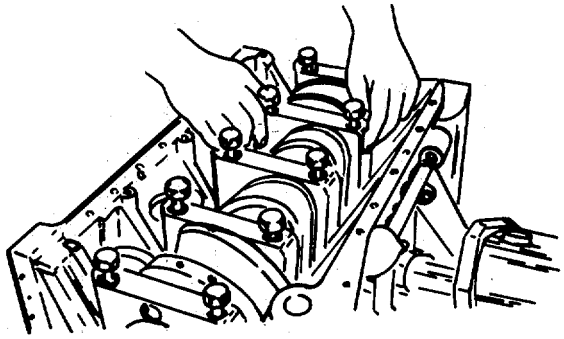


FIGURE 4-73. Install Main Bearings.

g. Lubricate the main bearing capscrew threads and underside of the head with clean engine oil. (FIGURE 4-74)

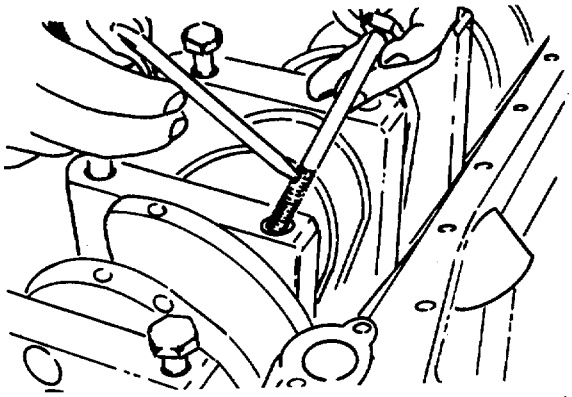


FIGURE 4-74. Lubrication.

h. Tighten the capscrews evenly following the illustrated sequence. (FIGURE 4-75)

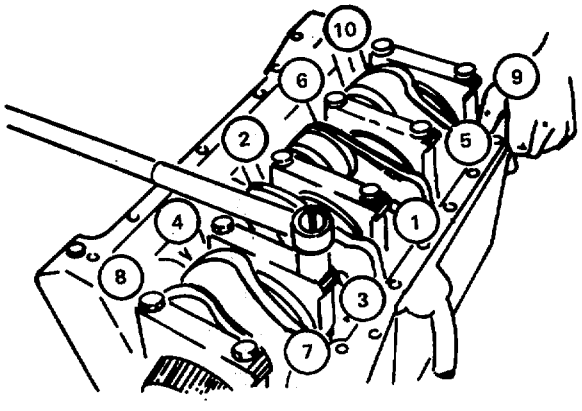


FIGURE 4-75. Capscrew Tightening Sequence

i. Torque capscrews to the values as shown in the following steps. (FIGURE 4-76)

Step	Torque Value
1	60 N•m [44 ft-lbs]
2	119 N•m [88 ft-lbs]
3	176 N•m [129 ft-lbs]

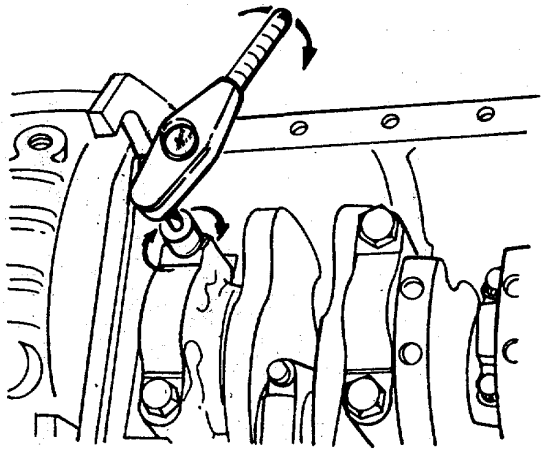


FIGURE 4-76. Torque Steps.

CAUTION

Ensure the crankshaft rotates freely.

j. Check the bearing installation and the size of the bearings if the crankshaft does not rotate freely. (FIGURE 4-77)

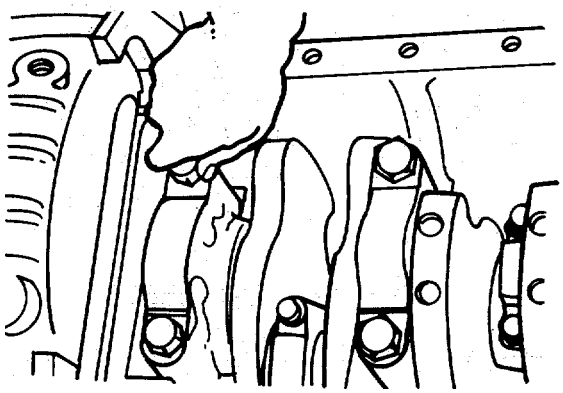


FIGURE 4-77. Check Crankshaft Rotation.

k. Measure the crankshaft end play using a dial indicator. (FIGURE 4-78)

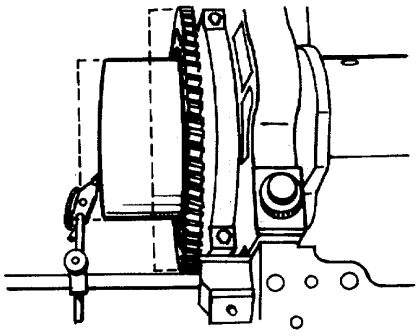


FIGURE 4-78. Measure Crankshaft End Play.

4-14. Repair Cylinder Block Croup. (FIGURES 4-79 through 4-103)

This task covers: a. Inspection, b. Repair.

INITIAL SETUP

Tools

Tool kit, general mechanic's
rail and marine diesel engines,
5180-00-629-9783
Combination wrench set, metric
-1Omm thru 24mm,
5120-01-046-4979
Variable speed drill,
5130-00-889-8994
Dial indicator w/depth gauge
P/N 3376050 and ST-1325
Universal bushing set
P/N 3376495
Metric allen wrench set,
5120-01-087-8616

Equipment Condition

Cylinder head removed (para. 2-40).
Flywheel removed (para. 3-29).
Crankshaft removed (para. 4-13).

Materials/Parts
Loctite, Item 11, Appendix C
Solvent, Item 20, Appendix C
Detergent, Item 7, Appendix C
Lubricating oil, Item 14, Appendix C
Lint free cloth, Item 3, Appendix C
Headless straight pin P/N 3900068
Cam bearing P/N 3901306
Lube nozzle P/N 3901020
Preformed packing P/N 3906704
Coolant heater P/N 3330293
Liquid teflon sealant, Item 10, Appendix C
Fine grit flexi hone

INSPECTION

a. Inspect the cylinder bores for damage or excessive wear. Refer to FIGURE 4-79.

b. Measure the cylinder bores as shown in FIGURE 4-79 and 4-80.

Diameter:	Minimum 4.0157 inch (102.000mm)
Out-of-Roundness:	Maximum 4.0203 inch (102.116mm)
Taper:	0.003 inch (0.76mm)

c. Check the top surface for flatness between each cylinder (FICURE 4-81).
Variance Limit: 0.002,inch (O.050mm).

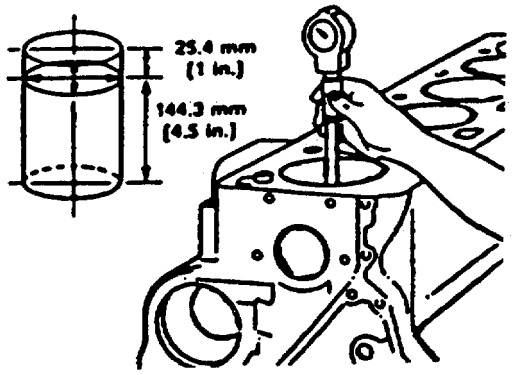


FIGURE 4-79. Inspecting Cylinder Bore.

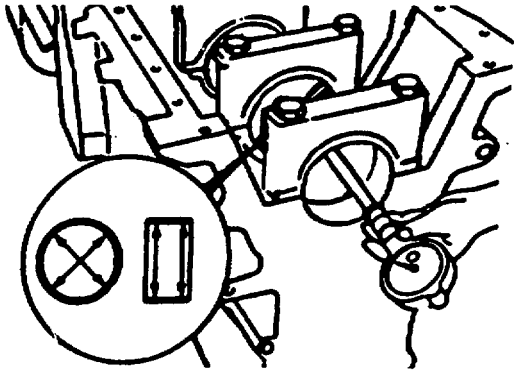


FIGURE 4-80. Measuring Cylinder Bore.

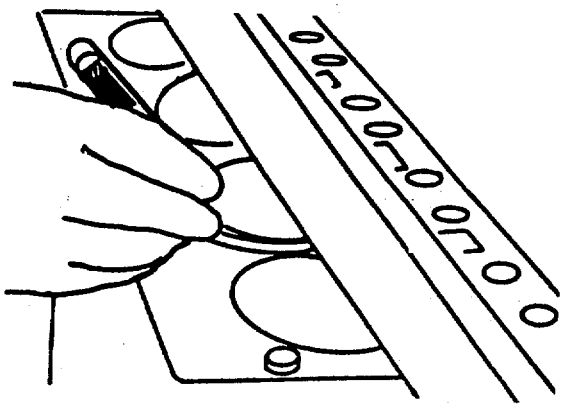


FIGURE 4-81. Checking Top Surface.

d. Inspect the main bearing bores for damage or abnormal wear.

e. Inspect the camshaft bores for scoring or excessive wear.

f. Measure the camshaft bores (FIGURE 4-82). Diameter: maximum 2.1324 inch (54.164mm). The limit for number one bore applies to the ID of the bushing.

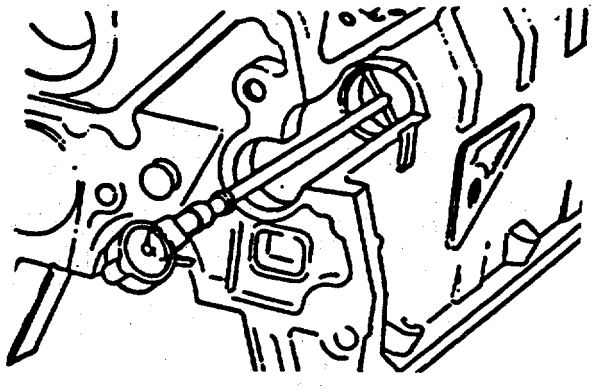


FIGURE 4-82. Measuring Camshaft Bores.

g. Using a universal bushing installation tube, drive the cam bushing from the cylinder block. Inspect the tappet bores for scoring or excessive wear (FIGURE 4-83).

Diameter: Minimum 0.630 inch (16.000mm)
Maximum 0.632 inch (16.055mm)

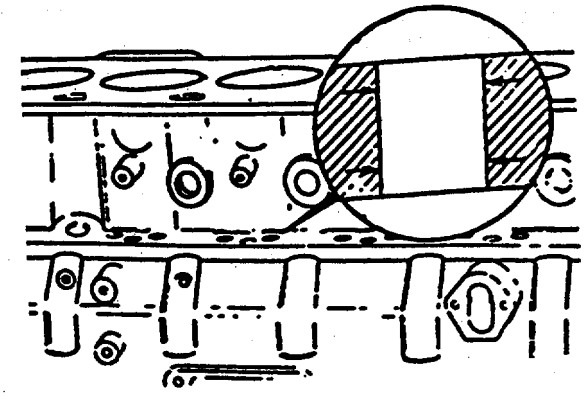


FIGURE 4-83. Inspecting Tappet Bores.

REPAIR

a. Perform the following steps for cleaning of the cylinder block and deglazing the bores.

NOTE

Use variable speed drill to remove plugs.

b. Remove the pipe plugs (FIGURE 4-84).

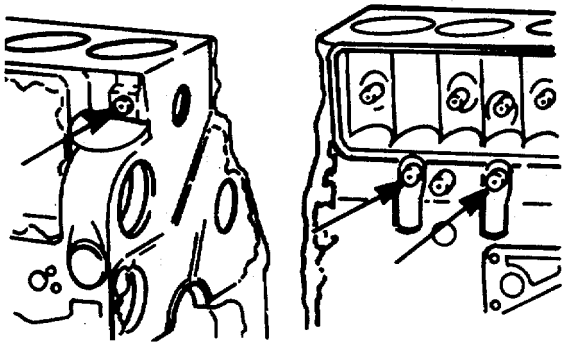


FIGURE 4-84. Removing Pipe Plugs.

(1) Remove the cup plugs from the oil passages; then from the coolant passages (FIGURE 4-85).

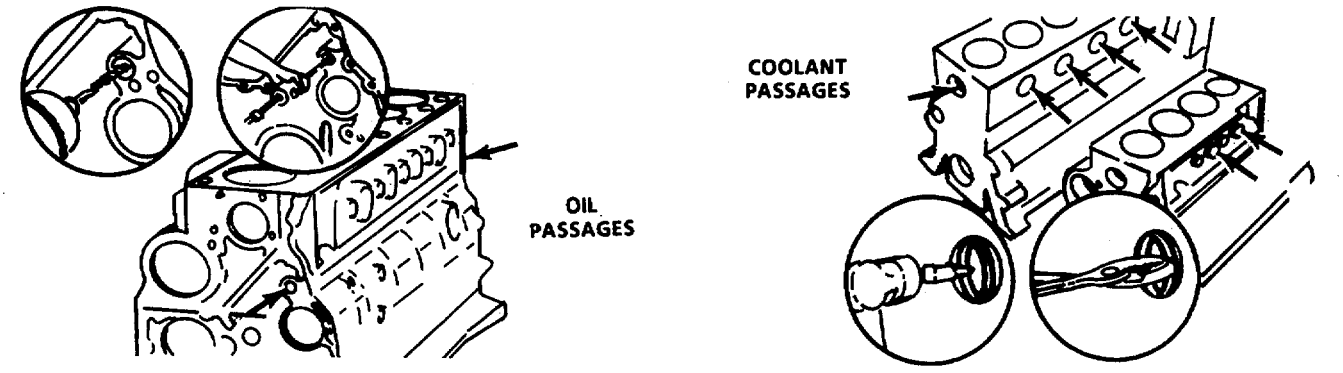


FIGURE 4-85. Removing Cup Plugs.

CAUTION

Be careful not to damage camshaft bore.

(2) Drive the expansion plug from the camshaft bore (FIGURE 4-86).

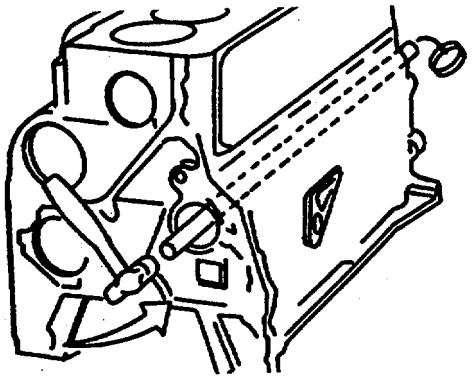


FIGURE 4-86. Driving Expansion Plugs.

c. Inspect coolant passages (FIGURE 4-87) for deposit build up. Excessive deposits may be cleaned in an acid tank. Be sure cam bushings are first removed.

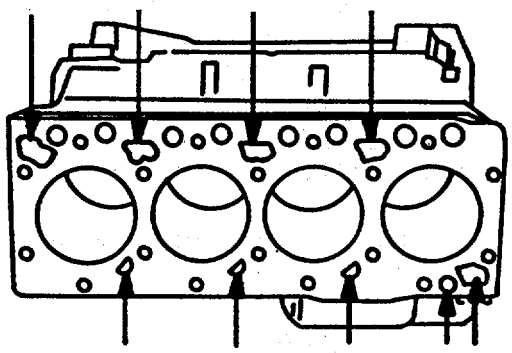


FIGURE 4-87. Inspecting Coolant Passages

NOTE

The block may be cleaned in a hot tank for 30 minutes using a detergent and water solution without removing the cam bushing. Water temperature should be 190OF (880 c).

d. De-glazing makes the bore "rough" to help seat the rings. The size of the bore is not changed by proper de-glazing.

CAUTION

New piston rings may not seat in glazed cylinder bores.

A correctly de-glazed surface (FICURE 4-88) will have a crosshatched appearance with the lines at 15 to 25-degree angles with the top of the cylinder block, 30 to 50-degree included angles on crosshatch.

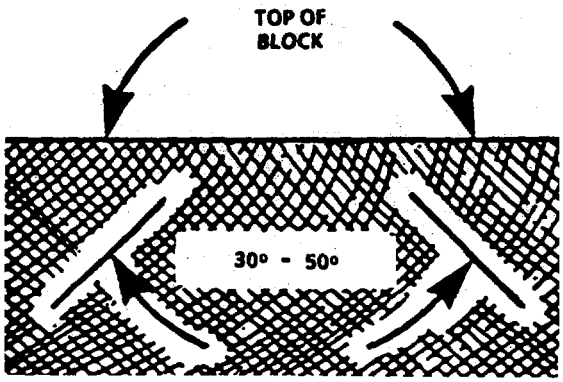


FIGURE 4-88. Correctly De-Glazed Surface.

e. Use a drill, a fine grit flexi hone and a mixture of equal parts of solvent and SAE 30W engine oil to de-glaze the bores.

(1) Make vertical strokes, 1 stroke per second. Drill 300 to 400 RPM. The crosshatch angle is a function of fill speed and how fast the bore is moved vertically (FIGURE 4-89).

(2) Inspect bore after 10 strokes. The degree of angle should be 15 ° to 25°.

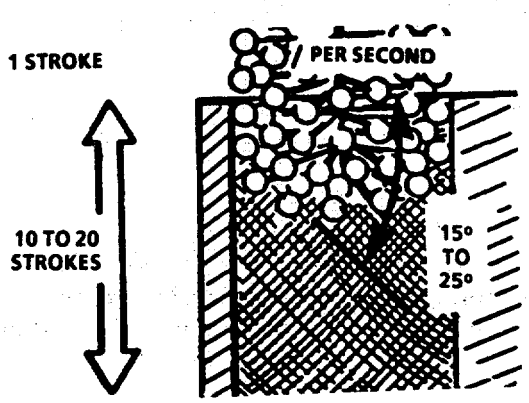


FIGURE 4-89. De-Glazing Bores.

(3) A sizing bore can be used to remove minor grooves or to correct minor out-of-taper (FIGURE 4-90). Taper should be 0.003 inch (0.076mm).

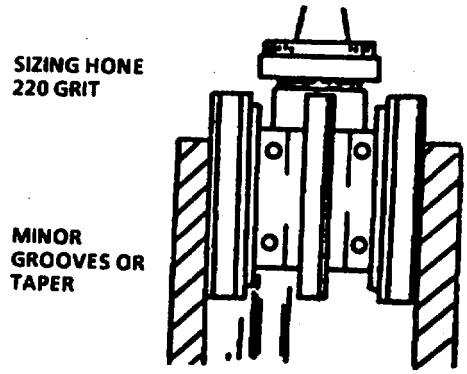


FIGURE 4-90. Removing Minor Grooves/Correcting Minor Out of Taper.

CAUTION

Be extremely careful not to hone the bore out of specification. Inspect at 10 second intervals.

(4) Immediately clean the cylinder bores with a strong solution of laundry detergent and hot water.

(5) Check the bore cleanliness by wiping with a white, lint free, lightly oiled cloth. If grit residue is still present, re-clean.

WARNING

High pressure compressed air tanks, piping systems, and air operated equipment has a potential for serious injury to eyes and exposed areas of skin due to escaping air pressure.

f. Wash the cylinder block with solvent. Dry the block using compressed air.

g. Install cam bushing, mark the cam bushing and block to align the oil hole. (FIGURE 4-91)

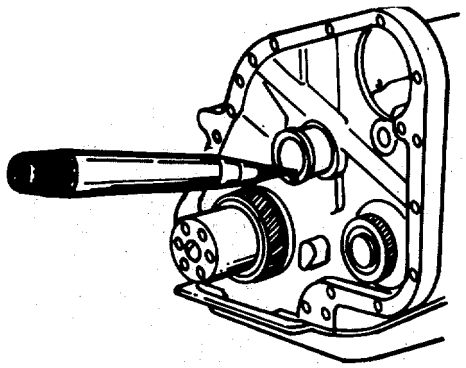


FIGURE 4-91. Cam Bushing Installation.

h. Using a universal bushing installation tool, install the cam bushing flush with the block. (FIGURE 4-92)

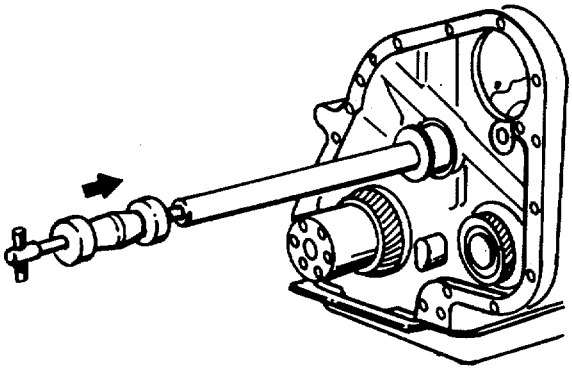


FIGURE 4-92. Using Installation Tool.

CAUTION

Make sure the oil hole is aligned.

i. A 3.2mm (0.128") diameter rod must be able to pass through the oil hole. (FIGURE 4-93)

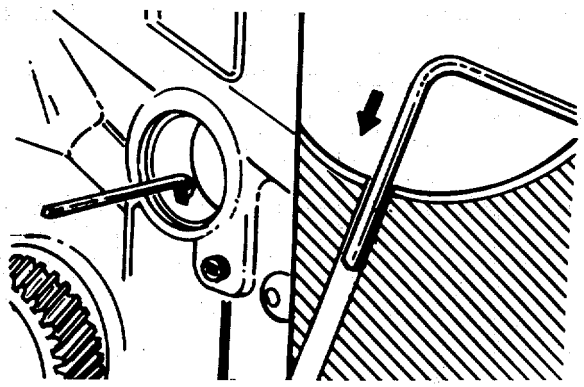
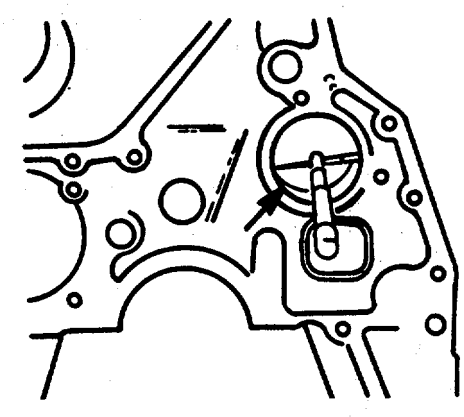


FIGURE 4-93. Check Oil Hole Alignment.

j. Use an inside dial bore gauge to measure the installed cam bushing. (FIGURE 4-94)

DIAMETER		
mm		inch
54.089	min	2.1295
54.139	max	2.1314



FICURE 4-94. Measure Installed Cam Bushings

k. Apply a bead of loctite 277 around the outside diameter of the oil passage cup plugs. (FIGURE 4-95)

FIGURE 4-95. Applying Loctite.

l. Drive the three cup plugs in until they are even with the countersink in the block. (FIGURE 4-96)

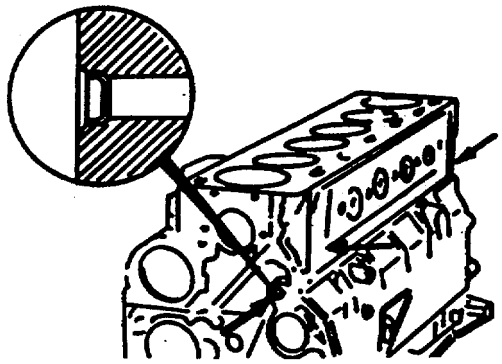


FIGURE 4-96. Install Oil Cup Plugs.

m. Apply a bead of loctite 277 to the coolant passage cup plugs. (FIGURE 4-97).

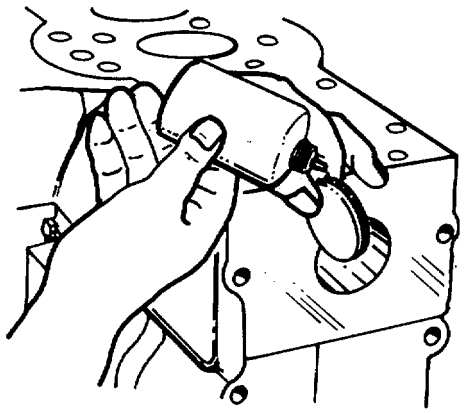


FIGURE 4-97. Applying Loctite.

n. Drive the coolant passage plugs in until the outer edge is flush with the countersink in the block. (FIGURE 4-98)

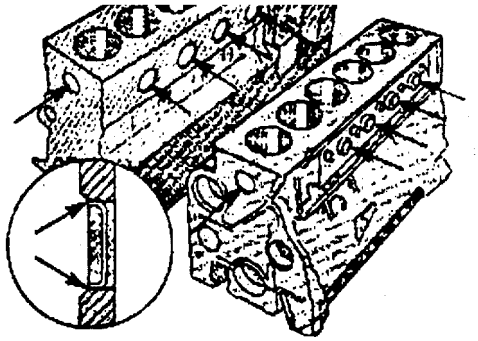


FIGURE 4-98. Install Coolant Passage Cup Plugs

o. Install a bead of liquid teflon sealant to the pipe plugs; install pipe plugs. (FIGURE 4-99)

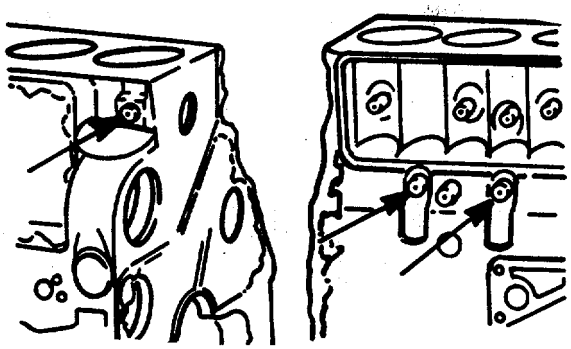


FIGURE 4-99. Install Pipe Plugs.

PIPE PLUG TORQUE VALUES

Size in Inches	Torque in Cast Iron or Steel	Torque in Aluminum
1/8	14 N-•m (10 ft-lbs)	7 N•m (5 ft-lbs)
1/4	20 N•m (15 ft-lbs)	14 N•m (10 ft-lbs)
½	47 N•m (35 ft-lbs)	27 N•m (20 ft-lbs)
¾ (	68 N•m 50 ft-lbs)	41 N•m (30 ft-lbs)

p. Apply a bead of loctite 227 around the outside diameter of the camshaft expansion plug. (FIGURE 4-100)

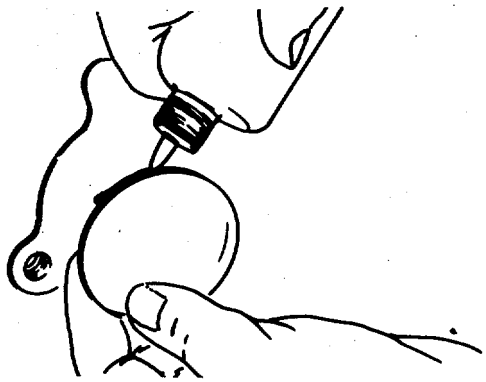


FIGURE 4-100. Applying Loctite.

CAUTION

Position the plug with the convex side out. (FIGURE 4-101)

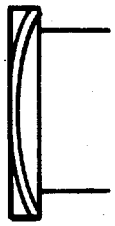


FIGURE 4-101. Plug Position.

CAUTION

Do not drive the plug more than flush with the cylinder block. (FIGURE 4-102)

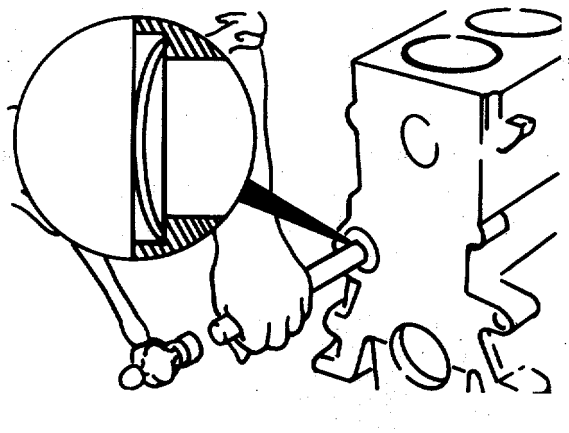


FIGURE 4-102. Install Expansion Plug.

q. Expand the plug with a large drift and hammer. (FIGURE 4-102)

CAUTION

If the block is not to be used immediately, lubricate the cylinder bores to prevent rusting.
(FIGURE 4-103)

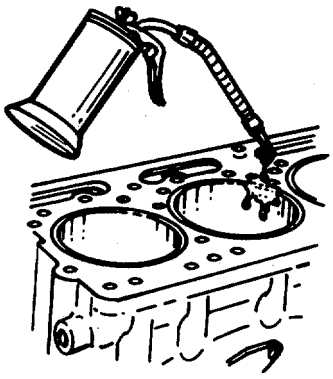


FIGURE 4-103. Lubricating Cylinder Bores.

r. For installation of Cylinder Block Group, refer to paragraphs 4-13, crankshaft; 3-28, flywheel; and 2-40, cylinder head.

Section VI. PREPARATION FOR STORAGE OR SHIPMENT

Refer to Chapter 2, Section VI.

APPENDIX A

REFERENCES

A-1. Scope. This paragraph lists the manuals, bulletins, specifications, and miscellaneous publications referenced in this manual or required for maintenance activities.

A-2. Field Manuals.

FM 21-11	First Aid for Soldiers
FM 31-70	Basic Cold Weather Manual
FM 55-501	Marine Crewman's Handbook

A-3. Technical Manuals.

TM 43-0139	Painting Instructions for Field Use
TM 55-1905-223-10	Operator's Manual for Landing Craft, Utility (LCU)
TM 55-1905-223-24-18	LCU 2000 Class Basic Craft Maintenance Manual
TM 55-1905-223-24P	Repair Parts and Special Tools List for the LCU 2000 Class Watercraft
TM 750-244-3	Destruction of Army Materiel to Prevent Enemy Use

A-4. Technical Bulletins.

TB 43-0144	Painting of Vessels
TB 55-1900-207-24	Treatment of Cooling Water in Marine Diesel Engines
TB 740-97-4	Preservation of Vessels for Storage

A-5. Military Specifications.

MIL-C-16173C	Rust Preventive, Type P-1
MIL-L-644	Preservative Oil, Type P-9
MIL-L-21260	Preservative Oil, Type P-10

A-6. Miscellaneous Publications.

DA Pam 738-750	The Army Maintenance Management System
LO 55-1905-223-12	Lubrication Order for the LCU 2000 Class Watercraft
*AMC-R 750-11	Use of Lubricants, Fluids, and Associated Products

A-7. Forms.

DA Form 2028 and DA Form 2028-2	Recommended Changes to Publications and Blank Forms
DA Form 2404	Equipment Maintenance and Inspection Worksheet
DA Form 2408-16	Logsheet
DA Form 2410	Logsheet
SF Form 368	Quality Deficiency Report

*Supersedes Darcom-R 750-11

APPENDIX B

MAINTENANCE ALLOCATION CHART

Section I. INTRODUCTION

B-1. General.

a. This section provides a general explanation of all maintenance and repair functions authorized at various maintenance categories (levels).

b. The Maintenance Allocation Chart (MAC) in Section II designates overall authority and responsibility for the performance of maintenance functions on the identified end item or component. The application of the maintenance functions to the end item or component will be consistent with the capacities and capabilities of the designated maintenance categories.

c. Section III lists the tools and test equipment (both special tools and common tool sets) required for each maintenance function as referenced from Section II.

d. Section IV contains supplemental instructions and explanatory notes for a particular maintenance function.

B-2. 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 (for example, by sight, sound, or feel).

b. Test. To verify serviceability by measuring the mechanical, pneumatic, hydraulic, 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, that is, to clean (includes decontaminate, when required), to preserve, to drain, to paint, or to replenish fuel, lubricants, chemical fluids, or gases.

d. Adjust. To maintain or regulate, within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to specified parameters.

e. Align. 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 equipments used in precision measurement. Consists of comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. Remove/Install. To remove and install the same item when required to perform service or other maintenance functions. Install may be the act of emplacing, seating, or fixing into position a spare, repair part, or module (component or assembly) in a manner to allow the proper functioning of an equipment or system.

h. Replace. To remove an unserviceable item and install a serviceable counterpart in its place.. "Replace" is authorized by the MAC and is shown as the third position code of the SMR code.

i. Repair. The application of maintenance services', including fault location/troubleshooting, removal/installation, and disassembly/assembly procedures, and maintenance actions' to identify troubles and 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 required by maintenance standards in appropriate technical publications [i.e., Depot Maintenance Work Requirements (DMWR)]. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to 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 equipments/components.

B-3. Explanation of Columns in the MAC, Section II .

a. Column 1, Group Number. Column 1 lists functional group code numbers, the purpose of which is to identify maintenance-significant components, assemblies, subassemblies, and modules with the next higher assembly. End item group number shall be ""00."

---

[1]Services - inspect, test, service, adjust, align, calibrate, and/or replace.
[2]Fault locate/troubleshoot - The process of investigating and detecting the cause of equipment malfunctioning; the act of isolating a fault within a system or unit under test (UUT).
[3]Disassemble/assemble - encompasses the step-by-step taking apart (or breakdown) of a spare/functional group coded item to the level of its least componency identified as maintenance significant (that is, assigned an SMR code) for the category of maintenance under consideration.
[4]Actions - welding, grinding, riveting, straightening, facing, remachinery, and/or resurfacing.

b. Column 2, Component/Assembly. Column 2 contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3, Maintenance Function. Column 3 lists the functions to be performed on the item listed in Column 2. (For detailed explanation of these functions, see paragraph B-2.)

d. Column 4, Maintenance Category. Column 4 specifies, by the listing of a work time figure in the appropriate subcolumn(s), the category of maintenance authorized to perform the function listed in Column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number or complexity of the tasks within the listed maintenance function vary at different maintenance categories, appropriate work time figures will be shown for each category. The work time figure represents the average time required to restore an item (assembly, subassembly, component, module, end item or system) to a serviceable condition under typical field operating conditions. This time includes preparation time (including any necessary disassembly/assembly time), troubleshooting/fault location time, and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. The symbol designations for the various maintenance categories are as follows:

UNIT	C - Operator or Crew
	O - Organizational Maintenance
INTERMEDIATE	F - Direct Support Maintenance
	H - General Support Maintenance
DEPOT	D - Depot

e. Column 5, Tools and Equipment. Column 5 specifies, by code, those common tool sets (not individual tools) and special tools, TMDE, and support equipment required to perform the designated function.

f. Column 6, Remarks. This column shall, when applicable, contain a letter code, in alphabetic order, which shall be keyed to the remarks contained in Section IV.

B-4. Explanation of Columns in Tool and Test Eq uipment Requirements, Section III.

a. Column 1, Reference Code. The tool and 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 Stock Number. The National stock number of the tool or test equipment.

e. Column 5, Tool Number. The manufacturer's part number.

B-5. Explanation of Columns in Remarks, Section IV.

a. Column 1, Reference Code. This code recorded in Column 6, Section II.

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
FOR
EMERGENCY GENERATOR SET

GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL					TOOLS AND EQUIP	REMARKS
			UNIT		INTERMEDIATE		DEPOT		
			C	O	F	H	D		
04	GENERATOR SET, EMERGENCY	INSPECT	0.5					1-14	A-O
		TEST	0.8						
		SERVICE	1.0					1-3,6,7	
		ADJUST	0.5					1,2,3	
		REPLACE			30.O			1-4	
		REPAIR	1.5	2.0	7.0	60.0		1-29	
		OVERHAUL		*					A
0401	HOUSING ,ASSEMBLY, CONTROL	REPLACE			0.5			2	
		REPAIR			1.0				
0402	PANEL ASSEMBLY, INSTRUMENT	INSPECT	1.0						
		REPLACE		1.0					
		REPAIR		1.5	2.0			2,15	L
040201	RESISTOR ASSEMBLY	REPLACE		0.2				2	
		REPAIR		0.5					
040202	DOOR ASSEMBLY	REPLACE		0.2				2	
		REPAIR		0.5				1,2	
040203	DOOR ASSEMBLY	REPLACE		0.5				2	
		REPAIR			1.5			1,2	
040204	RESISTOR ASSEMBLY	REPLACE			0.2			1	
		REPAIR		0.5	0.5				
0403	ELECTRIC GOVERNOR	REPLACE				0.5		1,15	
		ASSEMBLY				1.5			
		REPAIR							
0404	HEATER ASSEMBLY, GENERATOR	REPLACE		0.5				2	
		REPAIR		1.0					
040401	CABLE ASSEMBLY	REPLACE			0.2			1	
		REPAIR		0.5					
0405	OVERSPEED ASSEMBLY	REPLACE		0.5				2	D
		REPAIR	0.5		1.0			1,2	

Section II. MAINTENANCE ALLOCATION CHART FOR EMERGENCY GENERATOR SET

GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL					TOOLS AND EQUIP	REMARKS
			UNIT		INTERMED DEPOT				
			C	O	F	H	D		
0406	RADIATOR ASSEMBLY	REPLACE			1.5			2,3	
		REPAIR	0.5	2.0	2.0			2,3,12	M
0407	GENERATOR ASSEMBLY	REPLACE			1.0			1,15	B
		REPAIR			2.5	16.0		2,4,12, 15	
0408	ENGINE, DIESEL	INSPECT	0.5					2-14	
		SERVICE	1.0					2	
		ADJUST	0.5					2	
		REPLACE			25.0			2,4,12	
		REPAIR	1.2	1.5	2.5	50.0		2-14	
040801	STARTING MOTOR GROUP	REPLACE	1.0					2,12	C,N,O
		REPAIR		0.5					
040802	ALTERNATOR MOUNTING GROUP	REPLACE	1.0					2,12,20	
		REPAIR	0.5		1.5				
1040803	ALTERNATOR SUPPORT GROUP	REPLACE	1.0					2,12	
		REPAIR			1.5				
040804	ALTERNATOR GROUP	REPLACE	1.0					2,3	C,D
		REPAIR			2.5			2,4,23	
040805	THERMOSTAT AND HOUSING GROUP	INSPECT	0.5					2,3	
		REPLACE	1.0					2,12	
		REPAIR		1.0					
040806	WATER INLET CONNECTION GROUP	REPLACE	1.0					2,3,12	
		REPAIR		1.0					
040807	AIR CLEANER ASSEMBLY	INSPECT	0.5					2,3	
		SERVICE	0.5						
		REPLACE		0.5					
		REPAIR		1.5					
040808	TURBOCHARGER GROUP	REPLACE	0.7					2,3,12	C
		REPAIR	2.0		4.0				

Section II. MAINTENANCE ALLOCATION CHART FOR EMERGENCY GENERATOR SET

GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL					TOOLS AND EQUIP	REMARKS
			UNIT		INTERMED		DEPOT		
			C	O	F	H	D		
040809	EXHAUST CONNECTION GROUP	REPLACE REPAIR	0.5 0.5		 2.0			2,3	
040810	FAN DRIVE GROUP	REPLACE REPAIR		0.5 1.0				2,3	
040811	FUEL FILTER GROUP	INSPECT SERVICE REPLACE REPAIR	0.1 0.5 0.2	 0.7 0.5				2,3	
040812	FUEL PLUMBING GROUP	REPLACE REPAIR		2.0 0.5				2,3	E
040813	FUEL SYSTEM ACCESSORY GROUP	REPLACE REPAIR	0.5	 0.5				2,3,12	
040814	PUMP, FUEL, METERING AND DISTRIBUTING ASSEMBLY	REPLACE	0.5					2,12,13, 21,22	A,C,N.
040815	FUEL PUMP COUPLING GROUP	REPLACE REPAIR		0.5 0.5				2,3	
040816	SUMP PUMP ASSEMBLY	REPLACE REPAIR		0.5 1.0				2,3	
040817	WATER PUMP GROUP	REPLACE REPAIR	1.0	 0.5				2,3,12	
040818	LUBE OIL COOLER GROUP	INSPECT SERVICE REPLACE REPAIR	0.2 0.2	 1.0	 1.0			2,3,6,12 2,3,6,8, 12,16	
040819	VALVE COVER GROUP REPAIR	REPLACE	0.2	 0.5				2,3	

Section II. MAINTENANCE ALLOCATION CHART FOR EMERGENCY GENERATOR SET

GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL					TOOLS AND EQUIP	REMARKS
			UNIT		INTERMED DEPOT				
			C	O	F	H	D		
040820	ROCKER LEVER GROUP	REPLACE	0.2					2,3,12	
		REPAIR	0.2		0.5			2,3,12, 24	
040821	FUEL INJECTOR GROUP	REPLACE	0.5					2,9,12, 19	F
		REPAIR		0.5					
040822	CYLINDER HEAD GROUP	REPLACE	1.0					2,3,11, 12	G,C
		REPAIR	1.0			3.0		2,3,11, 12,18, 24,27	
04082201	CYLINDER HEAD ,DIESEL	REPLACE	1.0					2,3,11	
		REPAIR				3.0		-13	
040823	CAMFOLLOWER COVER GROUP	REPLACE			1.0			2,3,12	
		REPAIR			1.0				
040824	FRONT GEAR COVER GROUP	REPLACE			1.0			2,3,25	H
		REPAIR			1.5				
040825	OIL PAN GROUP	REPLACE			1.0			2,3,4,12	
		REPAIR			0.5				
040826	LUBE OIL PUMP GROUP	REPLACE			0.5			2,3,12, 22	C
		REPAIR			1.0			2,3,24, 28	
040827	CAMSHAFT GEAR GROUP	REPLACE			3.0			2,3,12	
		REPAIR				0.5			
040828	CONNECTING ROD AND PISTON GROUP	REPLACE			1.5			2-4,11, 12,14, 26	I
		REPAIR				0.5		2,3,12, 14,24,29	
040829	FLYWHEEL HOUSING GROUP	REPLACE			2.5			2,3,12	J
		REPAIR				1.0		2,3	

Section II. MAINTENANCE ALLOCATION CHART FOR EMERGENCY GENERATOR SET

GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL					TOOLS AND EQUIP	REMARKS
			UNIT		INTERMED DEPOT				
			C	O	F	H	D		
040830	FLYWHEEL GROUP	REPLACE REPAIR			2.5 1.5	 1.0		2,3 2,3	J
04083001	FLYWHEEL, ENGINE	REPLACE REPAIR			1.5	 1.0			
040831	CRANKSHAFT AND MAIN	REPLACE				3.0		2,3,12, 17,22	K
	BEARING GROUP	REPAIR				3.5			
04083101	CRANKSHAFT	REPLACE REPAIR				3.0 0.5		2,3	K
040832	CYLINDER BLOCK GROUP	REPLACE REPAIR			3.0 0.5	 6.0		2,3,4,11 2-5,7, 10,22,25	
0409	CHASSIS ASSEMBLY	REPLACE REPAIR			0.5 1.0			2,3	

SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENTS
FOR
EMERGENCY GENERATOR SET

TOOL OR TEST EQPT REF CODE	MAINT. LEVEL	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
1	O,F	Toot kit, electrician	5180-00-391-1087	(80064) 9000S6202-73125ALT2
2	O,F,H	Toot kit general mechanics rail and marine diesel engines	5180-00-629-9783	(50980) SC-5180-CL-N55
3	O,F,H	Combination wrench set, metric 10 mm thru 24 mm	5120-01-046-4979	
4 *	F	Lifting fixture		(15434) 3822512
5	H	Allen wrench set	5120-01-087-8616	
6	C,F	oil filter wrench	5120-01-160-8863	(15434) 3375049
7	N	Bushing set		(15434) 3376495
8	F	Filter cutter	5120-o1-262-7305	(15434) 3376579
9	0	Injector puller		(15434) 3822482
10	H	Depth gauge		(15434) ST-1325
11	O,F,H	Lifting sling	3940-01-183-9412	415434) 3375958
12	O,F	Torque wrench kit		(15434) 3377216
13	0	Barring toot	5120-01-262-7307	(15434) 3377321
14	F,H	Piston ring compressor	5120-00-116-7676	(15434) ST-755
15	F,H	Digital multimeter	6625-01-139-2512	(80058) AN/PSM-45
16	F	Pressure manometer	6685-01-107-6875	(23582)

SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENTS
FOR
EMERGENCY GENERATOR SET

TOOL OR TEST EQPT REF CODE	MAINT. LEVEL	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
				PVS-2
17	H	Gear Puler		(15434) ST-1 257
1 8	H	Valve spring compression tester	4910-01-142-4929	(15434)3375182
19	0	Dep well sockets, 12" drive, 12 pt, 10 mm thru 27 mm	5120-01-113-8087	
20	0	Belt tension group		(15434) ST-1 293
21	0	T-bar puller, 75 mm		(15434) ST-647
22	O, F	Dial Indicator	5120-00-277-8840	(15434)3376050
23	F	3-leg puller		(15434)3375834
24	F, H	Machinist measuring set	5280-00-278-9919	
25	F, H	Electric drill	5130-00-889-8994	
26	F	Ridge reamer		(15434) ST-1255
27	H	Valve spring compressor		(15434) ST-488
28	H	Hydraulic press		(68225) 200913
29	H	Piston ring expander		(15434) ST-763

SECTION IV. REMARKS
EMERGENCY GENERATOR SET

REFERENCE CODE	REMARKS
A	Depot maintenance will be performed on a case by case basis subject to approval and funding by the National Maintenance Point (NMP).
B	Upon failure, determination should be made to evacuate for rewind or to salvage at general support level.
C	This item is a candidate for direct exchange with the vendor.
D	Keep hands out of the path of the spring loaded tensioner.
E	Hold the fuel pump delivery valves securely when loosening the high pressure lines. Be sure the lift pump connection and fuel pump connection is held securely when loosening the low pressure and fuel supply lines.
F	When rust has formed on the hold down nut, the injector can turn in the bore when nut is loosened. This will cause severe damage to the head by the, injector locating ball cutting a groove in the bore. Soak the hold down nut with rust penetrating solvent for a minimum of 3 minutes.
G	If honing or grinding is required on valve or cylinder walls, evacuate to general support level.
H	Do not remove the timing pin assembly unless a new gear housing assembly is to be installed.
I	Mark each rod cap and piston according to the cylinder.
J	Lock the acrankshaft before removing the flywheel.
K	The main caps should-be numbered.
L	Repair at O level is to replace resistor assembly. Repair at F level is total repair to unit.
M	Repair at C level is to replace hoses and damps. Repair at O level is to replacetubes and guards. Repair at F level is total repair.
N	Repair of this item is by replacement.
O	The starting motor is a candidate for direct exchange with the vendor.

SECTION IV. REMARKS
EMERGENCY GENERATOR SET

REFERENCE CODE	REMARKS
M	Repair at C level is to replace hoses and clamps. Repair at O level is to replace tubes and guards. Repair at F level is total repair.
N	Repair of this item is by replacement.
O	The starting motor is a candidate for direct exchange with the vendor.

APPENDIX C

EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

SECTION I. INTRODUCTION

C-1. Scope. This appendix lists expendable supplies and materials needed to operate and maintain the LCU 2000 Class Watercraft. These items are authorized by CTA 50-970, Expendable/Durable Items (except Medical, Class V, Repair Parts and Heraldic Items), or CTA 8-100, Army Medical Department Expendable Items.

C-2. Explanation of Columns.

a. Column (1) - Item Number. This number is assigned to the entry in, the listing and is referenced in the narrative instructions to identify the material (for example, "Use cleaning compound, Item 5, App. C").

b. Column (2) - Level. This column identifies the lowest level of maintenance that requires the listed item.

As applicable:

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 Manufacturers (FSCM) in parentheses followed by the part number.

e. 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 (for example, 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 IL. EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
1	F	7920-00-205-2401	Bristle Brush	
2	H	7920-00-205-2401	Brush, Nylon	EA
3	H	7920-00-044-9281	Cloth, Lint-free	EA
4	0		Coolant,	GL
5	F		Compound, Lapping	LB
6	0	5350-00-221-0872	Crocus Cloth, Fine	EA
7	O, H	6508-00-727-2941	Detergent	GL
8	0		Diesel Fuel	GL
9	F		Lifting Bars	EA
10	F	6640-00-315-3022	Liquid Teflon Sealant	TU
11	O, F	8030-00-680-0889	Loctite (or equivalent)	CN
12	O, F	7050-00-961-7663	Lubriplate 105 (or equivalent)	
130		8010-00-441-3931	Mineral Spirits	GL
14	O, F, H	9150-00-240-2251	Oil, Lubricating	CN
15	O		Oil Pressure Gauge	EA
16	H	5350-00-264-3485	Paper, Abrasive	PG
17	H	1680-01-194-9799	Protective Gloves	EA
18	F	8030-00-999-6313	Sealant, Cup Plug	LB
19	F	4940-01-123-4843	Sealer, Liquid	GL
20	O, F, H	6850-01-078-9117	Solvent, Cleaning (PD 680)	BT
21	O, F, H	2835-00-015-0246	Tags, Warning	EA
22	O, H		Wire Brush	EA
23	F		Utility Pail	EA
24	F		Guide Studs	EA

APPENDIX D

TORQUE LIMITS

Socket Or Wrench Size Inch (MM)		Torque + Tol. N•m		Ft-Lbs
(10)	Aftercooler Mounting	24	± 3	18
5/16	Aftercooler Water Hose Clamp	5	± 1	4
15/16	Air Compressor (Bendix) Gear Nut	125	±13	93
(18)	Air Compessor (Bendix) Mtg. Nut	77	± 7	57
15/16	Alternator Pulley	80	± 8	59
(13)	Alternator Link (Delco 10-15 SI)	24	± 3	18
3/4	Alternator Link (Delco 20-27 SI)	43	± 4	32
(15)	Alternator Mtg. Bolt 10-15 SI	43	± 4	32
(18)	Alternator Mtg. Bolt 27 SI	77	± 7	57
(10)	Alternator Support (Upper)	24	± 3	18
(15)	Belt Tensioner Mounting	43	± 4	32
(13)	Cam Thrust Plate	24	± 3	18
(12)	Connecting Rod (Alternately Tighten in Three Steps)	Step 1 - 35 Step 2 - 70 Step 3 - 100		26 51 73
(12)	Crankshaft Damper & Pulley	137	± 7	101
5/8	Crankshaft Front Drive Adapter	95	± 6	70
5/16	Crossover Clamp	5	± 1	4
7/16	Tee Bolt Type Clamp	8	± 1	4
(15)	Exhaust Manifold	43	± 4	32
(15)	Exh. Outlet Pipe Mtg. Bracket	43	± 4	32
7/16	Exh. Outlet Pipe, V Band Clamp.	8	± 1	6
(10)	Fan Bracket Mounting	24	± 3	18

Socket Or Wrench Size Inch (MM)		Torque ± Tol. N•m		Ft-Lbs
(13)	Fan Pulley . .	24	± 3	18
(19)	Flywheel ..	l37	± 7	101
(18)	Flywheel Housing	60	± 6	45
(13)	Flywheel Housing Cover.	24	± 3	18
--	Front Cover Clamp Access Cap	Hand Tighten		
(18)	Front Engine Support.	77	± 7	57
(17)	Fuel Banjo Screw (In Fuel Pump)	15	± 2	11
(17)	Fuel Banjo Screw (In Head)	32	± 3	24
(10)	Fuel Vent Screw (In Banjo)	8	± 1	6
(10)	Fuel Banjo Screw (Injector).	8	± 1	6
(24)	Fuel Filter Adapter Nut	32	± 3	24
(17)	Fuel Line Fitting (High Press).	24	± 3	18
(22)	Fuel Pump Drive Gear (With Pump Unlocked)	65	± 6	48
(10)	Fuel Pump Lock (Bosch)	30	± 3	22
	Fuel Pump Unlock (Bosch)	13	± 3	10
(14)	Fuel Pump Lock (CAV) .	8	± 1	6
	Fuel Pump Unlock (CAV) .	20	± 3	15
(13)	Fuel Pump Mtg. Nuts.	24	±'3	18
(13)	Fuel Pump Support Bracket	24	± 3	18
(10)	Gear Cover .	24	± 3	18
(13)	Gear Housing-to-Block.	24	± 3	18
(18)	Head Cylinder ... Step 1 -	40		29
	Step 2 -	85		62
	Step 3 -	126		92

Socket Or Wrench Size Inch (MM)			Torque ± Tol. N•m		Ft-Lbs
(24)	Injector Retaining Nut..		60	±, 5	44
(13)	Intake Manifold Cover		24	± 3	18
(10)	Lift Pump/Cover Plate		24	± 3	18
(18)	Lifting Bracket (Rear)		77	± 6	57
(23)	Main Bearing Cap	Step 1 -	24		88
		Step 2 -	119		88
		Step 3 -	176		129
(18)	Oil Fill Tube		43	± 4	32
(10)	Oil Cooler Assembly		24	± 3	18
(17)	Oil Pan Drain Plug		80	± 3	60
(27)	Oil Pan Heater Plug.		80	±12	60
(10)	Oil Pan...		24	± 3	18
(19)	Oil Pressure Regulator Plug		80	±12	60
(13)	Oil Pump.		24	± 3	18
(13)	Oil Suction Tube		24	± 3	18
(18)	PTO Adapter		77	± 7	57
(15)	PTO Adapter Cover Plate (A Drive)		43	± 4	32
(18)	PTO Adapter Cover Plate (B Drive)		77	± 7	57
3/4	PTO Gear Nut A Drive		100	±10	74
15/16	PTO Gear Nut B Drive		134	±13	100
11/16	PTO Flange Companion		85	± 8	63
(10)	Rear Seal Housing		9	± 1	7
(13)	Rocker Support		24	± 3	18
(14)	Rocker Lever Nut		24	± 3	18

Socket Or Wrench Size Inch (MM)		Torque ± Tol. N•m		Ft-Lbs
(10)	Starter Mounting	43	± 4	32
(10)	Tach Drive Retainer	3	± 3	2
(10)	Tappet Cover/fuel Drain Line Supports	24	± 3	18
(10)	Thermostat Housing	24	± 3	18
T-25 Torx	Timing Pin Flange Mounting	5	± 1	4
1/2	Turbine Housing	11	± 2	8
(10)	Turbo Compressor Housing Clamp	6	± 1	5
(15)	Turbo Mounting Nuts	32	± 3	24
(13)	Turbo Oil Drain Tube	24	± 3	18
(16)	Turbo Oil Supply (Both Ends)	24	± 3	18
(15)	Water Inlet Connection	43	± 4	32
(13)	Water Pump Mounting	24	± 3	18
(15)	Valve Cover	24	± 3	18
--	Valve Cover Oil Fill	Hand Tighten		
(13)	WABCO Air Compressor Gear C/S	24	± 3	18
(27)	WABCO Gear Hub Mounting Nut	180	±18	133

GLOSSARY

ABBREVIATIONS

ac	alternating current
ATDC	after top dead center
BDC	bottom dead center
BTDC	before top dead center
cm	centimeter
dc	direct current
EIR	Equipment Improvement Recommendations
ft-lb	foot-pound
HP	Horsepower
hz	Hertz
id	inside diameter
in3	cubic inch
in-lb	inch-pound
kg	kilogram
kPa	Kilos Pascal (metric equivalent to psi)
kw	kilowatt
mm	millimeter
Nom	Newtons-metric (equivalent to ft-lb)
od	outside diameter
psi	pounds per square inch
rpm	revolutions per minute
TDC	top dead center
TIR	total indicator reading
VAC	volts, alternating current
Vs	variable speed

GLOSSARY - CONT

DEFINITIONS

AMBIENT TEMPERATURE	-	The atmospheric temperature of the immediate surrounding area.
ANODES	-	Active metals such as zinc and magnesium which, when attached to steel or other metal in a water environment, prevent the corrosion of the metal. The anodes corrode and are sacrificed instead of the steel.
ANTIFREEZE	-	A solution which, when mixed with water, lowers the freezing point.
ALTERNATING CURRENT	-	Electrical current which repeatedly varies from zero to a positive maximum value to zero to a negative maximum value and back to zero at a periodic -rate. Since the applied voltage continually reverses polarity, the resultant current flow alternates in direction within the circuit.
AIR GAP	-	The radial space between the rotating and the stationary elements of a generator. The magnetic field passes through this space.
AMMETER	-	An instrument designed to measure electric current.
AMP -	-	An abbreviation for the term Ampere.
AMPERE-	-	The unit of measure of electrical current flow. One ampere of current will flow when one volt of electrical potential is applied across one ohm of resistance.
CAPACITOR	-	A device possessing the property of capacitance. A typical capacitor consists of two conducting surfaces separated by an insulating material. A capacitor stores electrical energy, blocks the flow of dc, and permits the flow of ac to a degree largely dependent on the capacitance and the frequency of the applied ac.
CIRCUIT	-	An electrical path through which an electric current may flow from a voltage supply to a load and return. A closed or complete circuit is one where current is flowing. An open circuit is one

GLOSSARY - CONT

DEFINITIONS - CONT

CIRCUIT CONT	-	where the path has been disrupted, such as an open switch or circuit breaker, thus stopping current flow.
CIRCUIT BREAKER	-	A protective device for opening a circuit when current flow exceeds a predetermined value.
COOLANT	-	The circulating element, generally fresh water, which carries away the heat generated by the friction of moving parts of an engine.
CONDUCTOR	-	A wire, cable, bus, or other device intended to distribute current from the supply to the load. Technically, a conductor is any device which will permit the flow of current.
CONTACTOR	-	A device for opening and closing an electric circuit. Contactors are normally used in motor circuit where large amounts of current are controlled.
CURRENT	-	The flow of electrons in a circuit forced by an applied voltage potential (See Alternating Current and Direct Current).
CYCLE	-	A complete set of events before repetition occurs. In alternating current or voltage, a cycle starts at zero, continues to a maximum positive value, returns to zero, continues to a maximum negative value, and is completed at zero.
DIODE	-	A two terminal solid-state device which permits current to flow in one direction, but not in the other. In alternating current circuits, a diode will permit one half cycle to flow but will resist the flow of the opposite half cycle of current. Thus, alternating current is converted to direct current by a diode.
EXCITATION	-	The direct current input to the field coils of a generator which produces the magnetic flux required for inducing voltage into the generator stator coils.
EXCITER	-	An electrical device used for supplying the excitation to the generator field (see Exciter Rotor and Exciter Stator).

GLOSSARY - CONT

DEFINITIONS - CONT

EXCITER CURRENT	-	The direct current supplied to the exciter field coils which is controlled by the voltage regulator.
EXCITER ROTOR	-	The rotating member of the exciter into which a three-phase alternating voltage is induced. The resulting ac is then rectified into direct current and applied to the rotating generator field windings.
EXCITER STATOR	-	The stationary member of the exciter which serves as the exciter field producing the magnetic field from the direct current supplied by the automatic voltage regulator.
FIELD	-	That part of the generator and exciter which, when supplied with direct current, will produce a magnetic field. The exciter stator serves as the exciter field while the main generator rotor serves as the generator field.
FREQUENCY	-	The number of complete cycles of alternating current per unit of time. Typically, frequency is expressed in cycles per second or Hertz (Hz).
GENERATOR ROTOR	-	The rotating member of the generator.
GENERATOR STATOR	-	The stationary member of the main generator which supplies the three-phase output power to the load.
GOVERNOR	-	A device which controls engine speed and thus the generator output frequency.
GROUND	-	A connection, either accidental or intentional, between an electrical potential and the earth or some conducting body serving in place of the earth.
HEAT SINK	-	A device which absorbs heat from electrical devices such as diodes and SCRs and dissipates the heat to the surrounding air.
HERTZ	-	A term equivalent to cycles per second (See Frequency).
HUNTING	-	Oscillation in frequency or in voltage where steady-state conditions are not reached, particularly after a load transient change.

GLOSSARY - CONT

DEFINITIONS - CONT

INSULATION	-	A non-conductive material such as rubber or plastic intended to prevent current from flowing. Technically, insulation is any material which resists the flow of current.
INSULATION RESISTANCE	-	A measure of the ability of insulation to prevent current from flowing. A megohmmeter is used to measure the resistance in millions of ohms between the windings and metal frame of a generator to determine the insulation resistance of the windings.
ISOCHRONOUS	-	As it applies to engine governors, maintaining constant steady-state speed regardless of the load within the rating of the engine. Thus, a generator set is said to be isochronous if the frequency remains the same regardless of load.
LINE-TO-LINE-VOLTAGE	-	The voltage between any two phases of a multiphase system.
MEGOHMMETER	-	A high range high voltage ohmmeter. By measuring the current flow caused by the applied voltage, insulation resistance can be determined.
OHM	-	The unit of measure of electrical resistance. One ohm of resistance will allow a current of one ampere to flow with an applied potential of one volt.
OHMMETER	-	An instrument for measuring electrical resistance.
PARALLEL OPERATION	-	The method by which two or more generators having the same voltage and frequency characteristics are connected to a common load.
PHASE	-	The windings or an ac generator into which a voltage is induced. In a three-phase system, there are three sets of windings, each set having a voltage alternating within it exactly one-third of a cycle after the one ahead of it because of the physical arrangement of the coils.
PITTING	-	Corrosion attack in localized areas, resulting in the formation of tiny cavities.

GLOSSARY - CONT

DEFINITIONS - CONT

POLARITY	-	An electrical term which indicates the direction in which current flows in a conductor. In a direct current system, current constantly flows in the same direction. In an alternating current system, current changes direction as the polarity of the ac voltage source changes.
RECTIFIER	-	A device used to convert alternating current to direct current. A diode is one of several devices which act as rectifiers.
RELAY	-	An electromechanical device having a magnetic coil which, when energized, opens or closes several sets of contacts.
RESISTANCE	-	Opposition to the flow of current.
RESISTOR	-	A component which possesses resistance.
RHEOSTAL	-	A variable resistor.
ROTOR	-	The rotating part of a generator.
SCALE	-	Insoluble materials that settle out of cooling water and adhere to the metallic surfaces; buildup of hard materials which interfere with the transfer of heat.
SOLENOID	-	An electromechanical device which, when energized, acts on a movable core or plunger in the center of the energizing coil to perform mechanical work.
STABILITY	-	A condition which describes engines governor and generator voltage regulator. These systems provide frequency and voltage stability if they can maintain or quickly re-establish steady- state, regulation after a load change,
STATOR	-	The stationary part of a generator or exciter.
SURGE SUPPRESSOR	-	A device capable of conducting current in either direction in the presence of high transient voltages, thus protecting devices that could otherwise be damaged.
VARISTOR	-	A surge suppressor.

GLOSSARY - CONT

DEFINITIONS - CONT

VOLTAGE REGULATOR	-	A device which controls the voltage output of a generator at a preset value regardless of the amount of load applied (see Firing Circuit).
VOLTMETER	-	-An instrument designed to measure electrical potential or voltage.

INDEX

Subject; Paragraph

Subject; Paragraph

INDEX - CONT

INDEX - CONT

INDEX - CONT

By Order of the Secretary of the Army:

CARL E. VUONO
General United States Army
Chief of Staff

Official:

WILLIAM J. MEEHAN, II
Brigadier General United States Army
The Adjutant General

DISTRIBUTION:
To be distributed in accordance with DA Form 12-25A, Unit and Direct Support and General Support Maintenance requirements for Landing Craft, Utility, LUC-1466,Type III

*U. S. GOVERNMENT PRINTING OFFICE: 1995 0 - 388-421 (42272)

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS

THEN...JOT DOWN THE DOPE ABOUT IT ON THIS FORM. CAREFULLY TEAR IT OUT, FOLD IT AND DROP IT IN THE MAIL.

SOMETHING WRONG WITH PUBLICATION

FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS)

DATE SENT

PUBLICATION NUMBER	PUBLICATION DATE	PUBLICATION TITLE

BE EXACT PIN-POINT WHERE IT IS

PAGE NO.	PARA-GRAPH	FIGURE NO.	TABLE NO.

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

PRINTED NAME, GRADE OR TITLE AND TELEPHONE NUMBER	SIGN HERE

TEAR ALONG PERFORATED LINE

DA FORM 1 JUL 79 2028-2

PREVIOUS EDITIONS ARE OBSOLETE.

P.S.--IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

PIN: 065785 000