TECHNICAL MANUAL

UNIT, INTERMEDIATE DIRECT SUPPORT AND INTERMEDIATE GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

SHIP'S SERVICE GENERATOR

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

This copy is a reprint which includes current pages from Changes 1 through 5.

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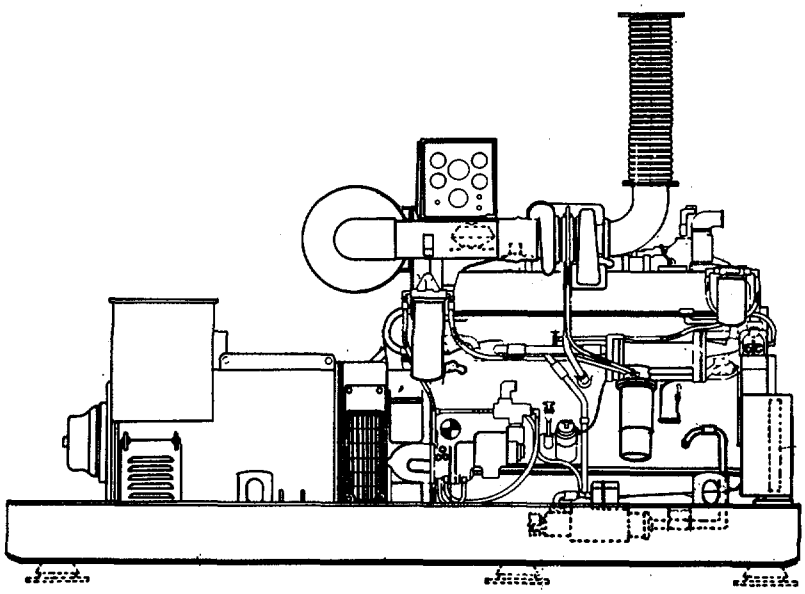

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UNIT, INTERMEDIATE DIRECT SUPPORT AND INTERMEDIATE GENERAL SUPPORT MAINTENANCE INSTRUCTIONS SHIP'S SERVICE GENERATOR FOR LANDING CRAFT UTILITY (LCU) NSN 1905-01-154-1191

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.

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CHAPTER 1
INTRODUCTION

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SECTION I. GENERAL 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. NTA 855-GC Ship's Service Generator Set.

c. Purpose of Equipment. Used to supply primary electric power for vessel services, under normal operation.

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(EIR). 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 Aviation and Troop Support Command; ATTN: AMSAT-I-MDO; 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 2-44.

SECTION II. EQUIPMENT DESCRIPTION AND DATA

1-6. General Description. The ship's service generator sets are made up of a 300 hp engine and a 250 kW power unit. Elements of the generator sets include the following: the air induction system, lubrication system, cooling system, exhaust system (air piping and water cooled manifold), fuel system, fuel check valves, and the electrical system. An electric starting motor supports one generator set, while an air starter is provided for the second.

1-7. Characteristics, Capabilities, and Features. A very broad view of the ship's service generator set is as follows:

a. Characteristics.

(1) Characteristics. The NTA 855-GC is a 300 HP, in-line, 6 cylinder, water cooled diesel engine designed for marine use.

(2) Capabilities and Features.

(a) Prime mover for ship's service generator.

(b) Cooling system designed for keel cooling.

(c) Equipped with remote and local control stations.

(d) Aftercooled intake manifold.

b. Generator.

(1) Characteristics. Each ship's service generator is a 250 kilowatt, 240 volt, 60 Hertz, 3 phase mechanically (engine) driven power unit.

(2) Capabilities and Features.

(a) Brushless exciter.

(b) Continuous use.

(c) Remote, automatic synchronization controls.

(d) Provides the ship's primary electrical power.

(e) Self-ventilating cooling.

1-8. Location and Description of Major Components. Figure 1-1 shows views of each side of the generator set with the locations of major components indicated. Refer to Figure 1-1 and the reference number key for the description of these components.

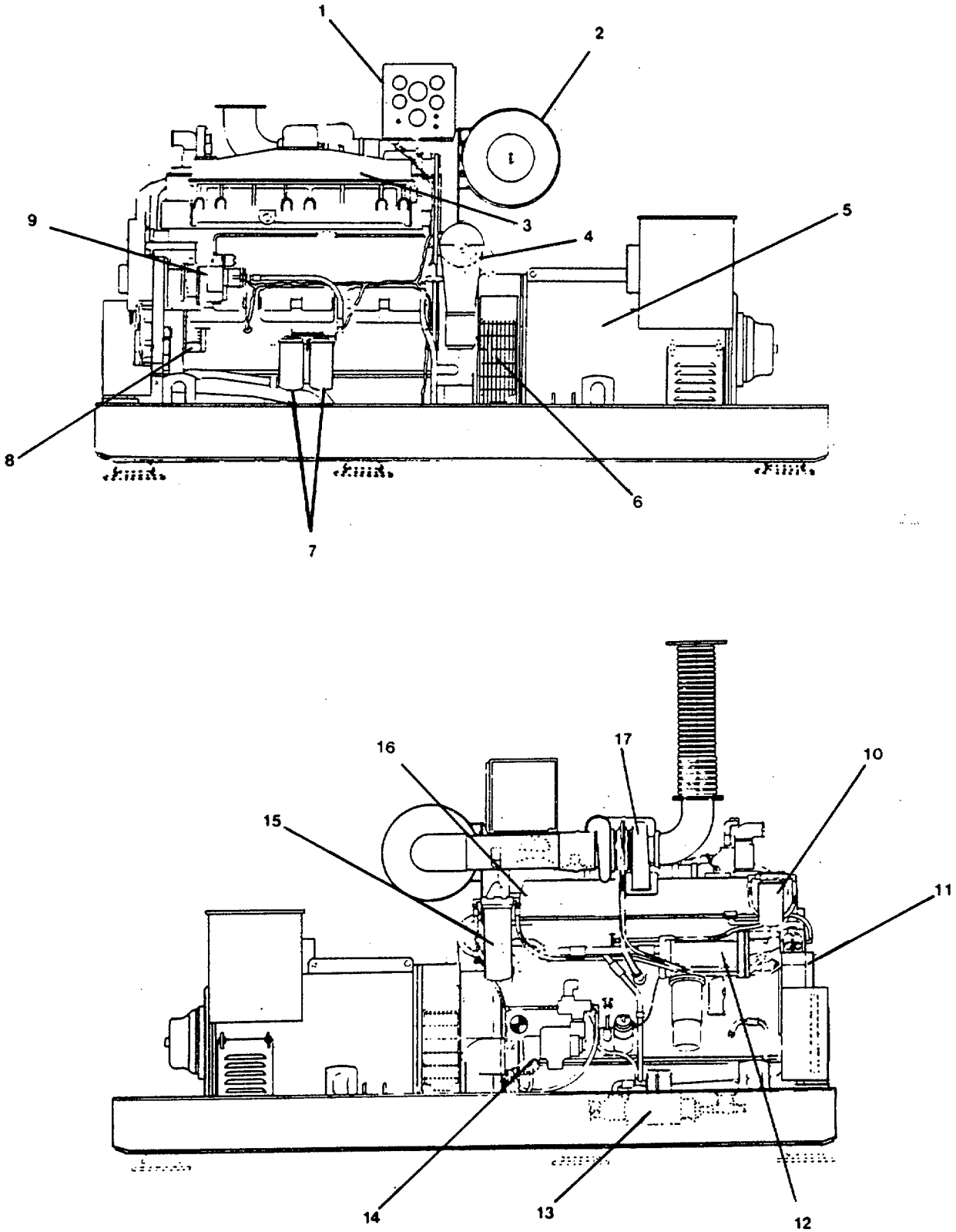

FIGURE 1-1. Location of Major Components.

a. Instrument Panel (1). An electrical panel on top of the engine that contains the local display of operational gauges and the switches for local control of the engine.

b. Air Cleaner Assembly (2). The filter canister and cover assembly, located on the top, front end of the engine.

c. Aftercooler (Intake Manifold) (3). The intake air cooling and distribution tank, and piping (assembly), on the right side of the engine.

d. Rotary Sump Pump (4). The manually operated oil pump, located on the front, right side of the engine.

e. Generator Assembly (5). The electric power producing assembly, connected to the flywheel housing on the front of the engine.

f. Flywheel Housing (6). The housing, located between the engine and the generator assembly containing the engine flywheel.

g. Fuel Filters (7). Two spin-on type filters, located together on the lower right side of the engine.

h. Lube Oil Pump (8). A gear driven pump, located on the right, rear corner of the engine.

i. Fuel Pump (9). A PT (type G) pump and throttle assembly with a 24-volt shutoff valve and electric governor actuator located on the right, rear end of the engine.

j. Water Filter (10). A spin-on filter containing diesel coolant additive (DCA), located on the left side near the rear end of the engine.

k. Fresh Water Pump (11). The belt driven pump, located on rear end of the engine.

l. Lube Oil Filter/Cooler (12). The spin-on filter and cooling core assembly, located on the left side-near the rear-of the engine.

m. Coolant Heater (13). The engine jacket water heater, located at the bottom of the engine on the left side. It is mounted to the subbase frame.

n. Starter (14). The electrical (starboard engine) or air (port engine) controlled starter motor, located on the left, front corner of the engine.

o. Bypass Oil Filter (15). A spin-on filter, located on the left, front corner near the top of the engine.

p. Exhaust Manifold (16). The water cooled exhaust air assembly, on the left side of the engine. The turbocharger is mounted on this manifold.

q. Turbocharger (17). A turbine wheel unit, mounted on the exhaust manifold on the left side of the engine.

1-9. Difference Between Models. The only difference in the two ship's service generator sets (NTA 855-GC) is in the engine starting motors.

a. Starboard Engine. The generator engine on the starboard (right) side of the vessel is equipped with an electric starter motor and solenoid.

b. Port Engine. The generator engine on the port (left) side of the vessel is equipped with an air starter.

1-10. Engine Identification Data. For model identification of an engine, check the data or serial number plate. The following example shows how the engines are identified.

NTA 855-GC

N = Model Identification (In-Line)
T = Turbocharged
A = Aftercooled
855 = Cubic Inch Displacement
GC = Generator/Continuous

a. Engine Dataplate. The engine dataplate shows specific information about your engine. The engine serial number and the Control Parts List (CPL) provide information for ordering parts and service needs (Figure 1-2).

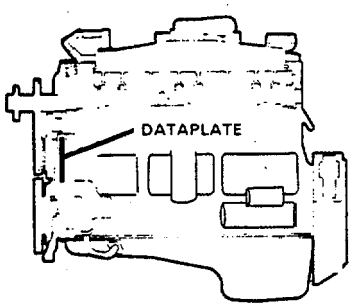

FIGURE 1-2. Engine Dataplate Location.

b. Serial Number and Control Parts List. Always record the serial number (1) of the engine, the CPL (Control Parts List) number (2), and the engine model number (3) on all orders for parts. This information is important for fuel pump calibration and correct identification of parts (Figure 1-3).

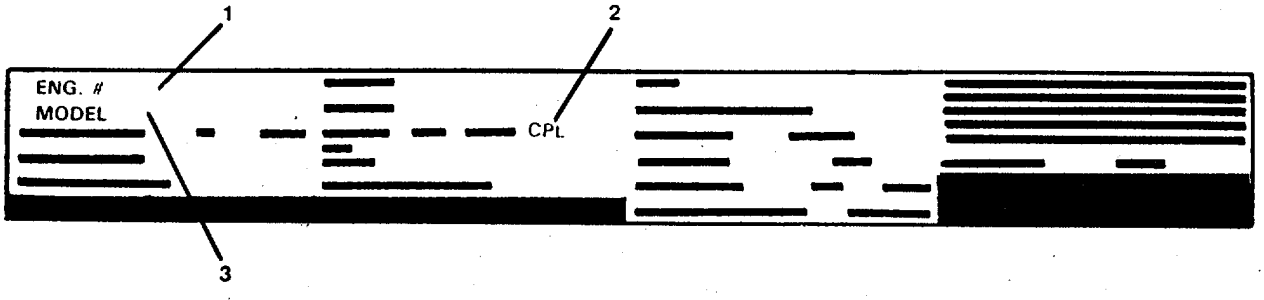

FIGURE 1-3. Dataplate Information to Record.

c. Fuel Pump Dataplate (Nameplate). The fuel pump dataplate is located on the top of the fuel pump. It provides information for fuel pump calibration (Figure 1-4).

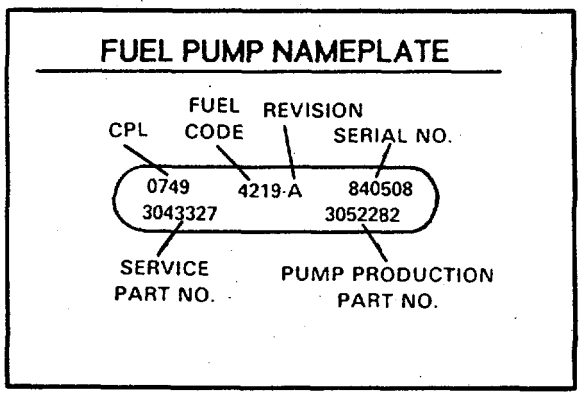

FIGURE 1-4. Fuel Pump Dataplate.

d. Generator Dataplate. The generator dataplate is located on the generator housing. Figure 1-5 shows a typical dataplate.

KW	KVA	PF 0.8	PHASE
RPM	HZ	DUTY CONTINUOUS	
VOLTAGE			
AMP			
VOLTAGE			
AMP			
OVERLOAD	% FOR	HRS. CLASS OF INSULATION F	
FIELD AMP		FIELD VOLTAGE	
PART NO.		FRAME	
MODEL NO.		SERIAL NO.	
VOLTAGE REGULATOR MODEL NO.			
LR 2025	BS 2613 1957		NEMA MG1

PART NO. _____

MODEL NO. _____

SERIAL NO. _____

FIGURE 1-5. Generator Dataplate.

1-11. 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.

Table 1-1. Equipment Data

Characteristics	Reference Data
GENERAL ENGINE DATA	
Horsepower	300 hp
Engine speed @ maximum output	1800 rpm
Bore and stroke	5.5 in (140 mm) x 6.0 in (152 mm)
Displacement	855 in^3 (14.0 litres)
Firing order	1-5-3-6-2-4
Compression ratio	13.5:1 to 17.2:1
Engine Weight (without generator and subbase):	
Dry weight	2690 lb (1221 kg)
Wet weight	2810 lb (1276 kg)
Engine dimensions overall (without generator):	
Length	71.6 in (1819 mm)
Width	36.1 in (917 mm)
Height	65.0 in (1651 mm)
Overall dimensions (including generator and subbase):	
Length	115.3 in (2928 mm)
Width	36.8 in (935 mm)
Height	65.0 in (1651 mm)
Overall weights (including generator and subbase):	
Dry weight	5760 lbs (2613 kg)
Wet weight	5876 lbs (2665 kg)
AIR INDUCTION SYSTEM	
Maximum allowable turbocharged intake restriction	25 in H2O (64 cm H_20)
LUBRICATION SYSTEM	
Oil pressure at idle (minimum allowable)	10 psi (70 kPa) minimum
At no load speed	35-45 psi (240-310 kPa)
At full load speed	50 psi (350 kPa) minimum
Oil capacity of engine:	
Bypass filter	0.75 U.S. gal (2.8 litres)
Full flow filter	0.93 U.S. gal (3.5 litres)
Oil pan capacity (high-low)	9 to 7 U.S. gal (26-21 litres)
Total system cap. (including filters)	11 U.S. gal

Table 1-1. Equipment Data - CONT

Characteristics	Reference Data
COOLING SYSTEM	
Coolant capacity (engine only)	22 U.S. quarts (21 litres)
Standard modulating thermostat range	180-200ºF (82-93ºC)
Maximum coolant cylinder block pressure (pressure cap removed)	40 psi (275 kPa)
Maximum allowable top tank temperature	212ºF (100ºC)
Minimum recommended top tank temperature	158ºF (70ºC)
Minimum recommended pressure cap (on remote tank)	7 psi (50 kPa)
EXHAUST SYSTEM	
Maximum allowable back pressure imposed by piping and silencer	3 in Hg (75 mm Hg)
Exhaust pipe size (normally acceptable inside diameter)	5 in (127 mm)
FUEL SYSTEM	
Engine idle speed	650 to 750 rpm
Maximum allowable restriction to pump:	
With clean filter	4 in Hg (100 mm Hg)
With dirty filter	8 in Hg (200 mm Hg)
Maximum allowable fuel return line restriction	2.5 in Hg (63 mm Hg)
With check valves and/or overhead tanks	6.5 in Hg (165 mm Hg)
Fuel check valve between fuel filter and fuel pump:	
minimum opening pressure	0.3 psi (2.1 kPa)
Fuel check valve between fuel pump and cylinder head:	
opening pressure	3 to 8 psi (21 to 55 kPa)
Fuel check valve in fuel drain line:	
opening pressure	.25 to .50 psi (13 to 25 mm Hg)
Derate engine fuel rate for hot weather	1% per 10º above 100ºF (2% per 11ºC above 38ºC)
Coil resistance shutoff valve solenoid:	
24 volts (dc)	28-32 ohms

Table 1-1. Equipment Data - CONT

Characteristics	Reference Data
ELECTRICAL SYSTEM	
Generator Assembly (Manufacturer-Newage):	
Rated at	250 kW, 240 volts, 3 phase, 60 Hz
rpm	1800
Power factor	0.8
Continuous at	122F (50C) ambient air temperature
Weight of generator only	1909 lbs (866 kg)
Manual voltage regular:	
Connections required to the generator	Exciter windings (X and XX) Permanent magnet windings (P2, P3, and P4)
Connections required to the automatic voltage regulator	Exciter output (X and XX) Permanent magnet supply (P2, P3, and P4)
Starter motor, electric (STBD engine only):	
Maximum allowable resistance of starting circuit with 24-volt starter	0.002 ohms
STARTING AIR SYSTEM	
Minimum operating pressure	60 psig
Maximum operating pressure	150 psig

1-12. Safety, Care, and Handling. Safety precautions must be observed at all times while performing maintenance. General WARNINGS and first-aid data appear in the front of this manual. Review all safety information before starting any task. Carefully read through an entire maintenance procedure before performing any maintenance function. Make sure the task can be done safely. All WARNINGS, CAUTIONS, and NOTES are of great importance to your safety and the safety of the equipment.

SECTION III. PRINCIPLES OF OPERATION

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

1-13. Diesel Engine Operation. Diesel engines are different from spark-ignited engines in a number of ways. Compression ratios are higher and the charge taken into combustion chambers 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.

a. Diesel Engine Cycles. It is easier to understand the function of engine parts if you know what happens in the combustion chamber during each of the four piston strokes of the cycle. The four strokes and order in which they occur are: intake stroke, compression stroke, power stroke, and exhaust stroke (Figure 1-6). In order for the four strokes to function properly, valves and injectors must act in direct relation to each of the four strokes of the piston. The intake valves, exhaust valves, and injectors are camshaft actuated, linked by tappets or cam followers, push rods, rocker levers and valve crossheads. The camshaft is driven by the crankshaft gear, and that means rotation of the crankshaft directs the action of the camshaft, which controls the opening and closing sequence of the valves and the injection timing (fuel delivery).

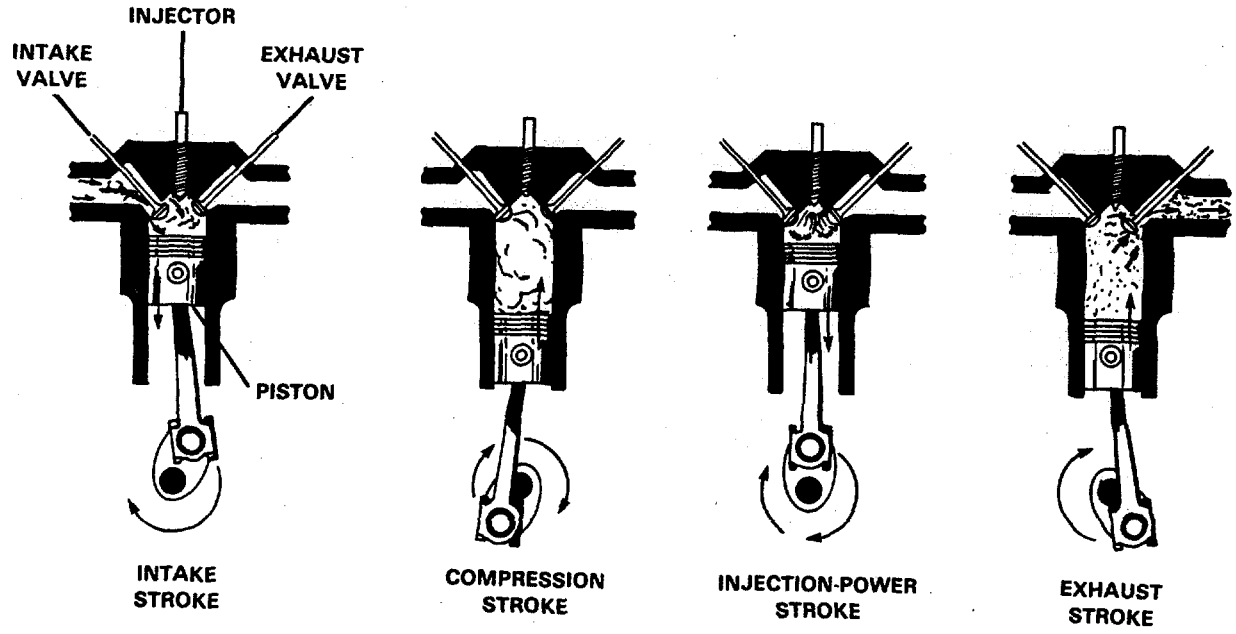

FIGURE 1-6. Diesel Engine Cycles.

(1) Intake Stroke. During intake stroke, the piston travels downward, intake valves are open, and exhaust valve are closed. The downward travel of the piston allows air from the atmosphere to enter the cylinder. On turbocharged engines the intake manifold is pressurized as the turbocharger forces more air into the cylinder through the intake manifold. The intake charge consists of air only, with no fuel mixture.

(2) Compression Stroke. At the end of the intake stroke, intake valves close and piston starts upward on compression stroke. The exhaust valves remain closed. At end of compression stroke, air in combustion chamber has been forced by the piston to occupy a smaller space than it occupied at the beginning of stroke. Thus, compression ratio is the direct proportion in the amount of air in the combustion chamber before and after being compressed. Compressing air into a small space causes temperature of that 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 the combustion chamber. Almost immediately after fuel charge is injected into combustion chamber, fuel is ignited by the existing hot compressed air.

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

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

b. Fuel System. The "Pressure Time" (PT) Fuel System used on this engine consists of the fuel pump, supply lines, drain lines, fuel passages, and injectors.

(1) Fuel Pump. The fuel pump is coupled to the fuel pump drive which is driven from the engine gear train. Fuel pump main shaft in turn drives the gear pump.

(a) Gear Pump and Pulsation Damper. The gear pump is driven by the pump main shaft and contains a single set of gears to pick up and deliver fuel throughout the fuel system. Inlet is at the rear of the gear pump. A pulsation damper mounted to the gear pump contains a steel diaphragm which absorbs pulsations and smooths fuel flow through the fuel system. From gear pump, fuel flows through the filter screen.

(b) Electric Fuel Control (EFC) Governor/Actuator. The EFC governor contains a magnetic pickup, a remote automatic governor control, and an actuator. The magnetic pickup senses the flywheel rotation and sends an electrical signal to the remote governor control. The governor control compares the electrical signal, or pulse, from the magnetic pickup with a preset reference point. The control then changes the current going to the actuator on the fuel pump. When the control current changes, the actuator shaft turns. When the shaft turns, the engine speed changes.

(c) Magnetic Pickup. The magnetic pickup is an electromagnetic device that is mounted in the flywheel housing. When the flywheel gear teeth pass the pickup, an alternating current (ac) voltage is induced, one cycle for each gear tooth. The pickup then sends the electrical signal to the remote governor control.

(d) Governor Control and Overspeed Switch. The governor control is an all electric solid-state module that compares the pulses from the magnetic pickup, which are directly proportional to the engine speed, with the speed control reference set point. A current output is supplied to the actuator on the fuel pump that controls the fuel flow to the engine. The overspeed switch will shut down the generator set when maximum rated rpm is exceeded.

(e) Shut Down Valve. An electric solenoid operated shutdown valve with manual override is used on the fuel pump.

(2) PT Injectors. The injector provides a means of introducing fuel into each combustion chamber. It combines the acts of metering, timing and injection.

(3) Fuel Lines and Connections. Fuel is supplied through lines to the cylinder heads. A common drain line returns fuel not injected to the supply tank. Fuel connectors are used between the inline engine cylinder heads to bridge the gap between each supply and drain passage.

c. Lubricating System. The diesel engine is pressure lubricated. Pressure is supplied by a gear-type oil pump located on the side of the engine.

(1) System Operation. Oil is drawn into the pump through an external oil line connected to the oil pan sump. A screen in the sump filters the oil. Oil is drawn from the pan by the pump, out through a full-flow filter and circulates back into the block.

(2) Lubricating Oil Flow. Oil flows from the pump to the filter/cooler, then flows to an oil header through internal drillings in the gear case. The oil header, drilled full length of block, delivers oil to moving parts within the engine. Oil pipes carry oil from the camshaft to upper rocker housings. Drillings through the block, crankshaft, connecting rods, and rocker levers complete the oil circulating passages.

d. Cooling System. The primary function of the cooling system is to remove the heat created by the engine and its support components. The excess heat energy that is not removed by the cooling system is carried away by exhaust gases and radiated into the atmosphere.