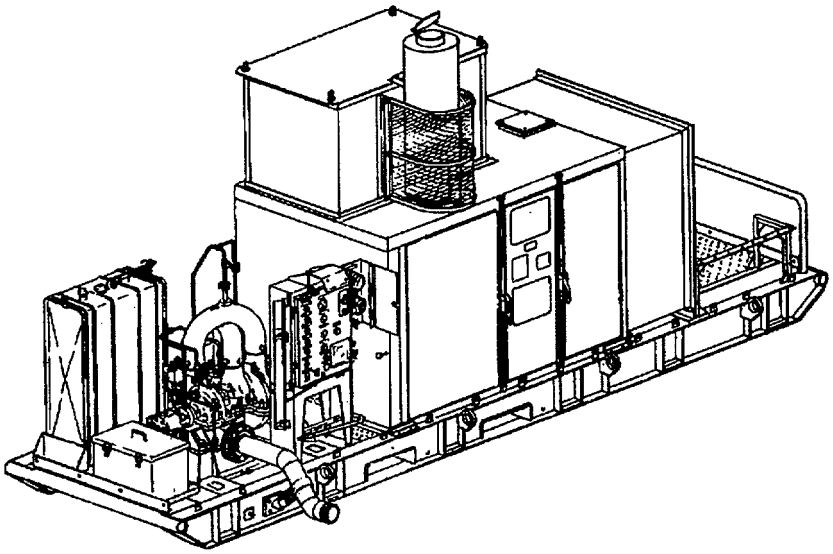
**OPERATOR'S MANUAL**





**PUMPING ASSEMBLY (MAINLINE)**
**DIESEL ENGINE DRIVEN, 800 GPM**
**NSN 4320-01-193-3430**



This manual supersedes TM 5-4320-307-10, dated 14 August 1989, including all changes.

**HEADQUARTERS, DEPARTMENT OF THE ARMY**
**26 FEBRUARY 1993**

**WARNING**

**HEALTH HAZARD**

exists if pump is used to pump water after it has been used to pump fuel. Do not pump water after the pump has been contaminated by pumping fuel.

**SERIOUS INJURY**

may result if the engine is not turned off during service or maintenance.

may result if engine is not shut down when inspecting alternator.

could occur if you attempt to pump any liquids for which this pumping unit has not been designed. The pumping unit has been designed to pump water or petroleum-based fuels with specific gravities between 0.72 and 1.0.

**SEVERE INJURY**

may result from contact with the rotating cooling blower or V-belt. When it is necessary to make inspections in this area, be aware of the blower and V-belt position, or turn engine off.

**EXPLOSION HAZARD**

exists when smoking or using open flame or spark-producing equipment in the vicinity of battery.

exists within 50 feet (15.2 m) of an operating pump unit. Smoking within this area creates a fire and explosion hazard.

exists when handling ether cylinder. Ether is highly flammable. Do not use near sparks or open flames. Do not inhale fumes. Do not actuate ether start kit more than once. Overloading the engine air housing with this highly explosive fluid (ether) could result in an explosion.

**CAUSTIC CHEMICALS IN BATTERIES**

may cause serious injury if battery electrolyte (acid) or storage batteries are handled carelessly. If acid is splashed on the skin, wash the affected area immediately with plenty of clean water. If acid is splashed in the eyes, wash immediately with plenty of clean water and get medical attention.

**DEATH OR SERIOUS INJURY**

could occur if diesel fuel is not handled carefully. Use in a well-ventilated area away from open flame, arcing equipment, ignition sources, heaters, or excessive heat. Be certain that fuel lines and connections are secure. Do not inhale vapor. Do not overfill fuel tank. Engine must be turned off and cooled before refueling. Use proper refueling procedures and equipment to avoid spillage. Do not run engine near open fuel containers. DO NOT SMOKE.

**SEVERE BURNS**

can be caused by turbocharger and exhaust system heated during operation of the engine. If the engine has been running, do not touch the turbocharger or exhaust system components until they have cooled.

**CARBON MONOXIDE (EXHAUST GAS) CAN KILL YOU**

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

Fumes from engine become concentrated with poor ventilation. Operate engine in a ventilated area only. While running engine, be alert for fumes. If someone is overcome, expose to fresh air; keep warm and still; give artificial respiration if needed. (Refer to FM21-11.) Seek medical attention. Administer oxygen, if available.

**GOOD VENTILATION IS THE BEST DEFENSE AGAINST EXHAUST POISONING.**

**NOISE HAZARD**

exists for all personnel within 15 feet (4.57 m) of an operating pumping unit. Personnel must wear approved ear protection equipment. Failure to do so may result in impairment or loss of hearing.

TECHNICAL MANUAL

NO. 10-4320-307-10

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 26 February 1993

**OPERATOR'S MANUAL**

# PUMPING ASSEMBLY (MAINLINE) DIESEL ENGINE DRIVEN, 800 GPM NSN 4320-01-193-3430

**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-MTS, 4300 Goodfellow Blvd., St. Louis, MO 63120-1798. A reply will be furnished directly to you.



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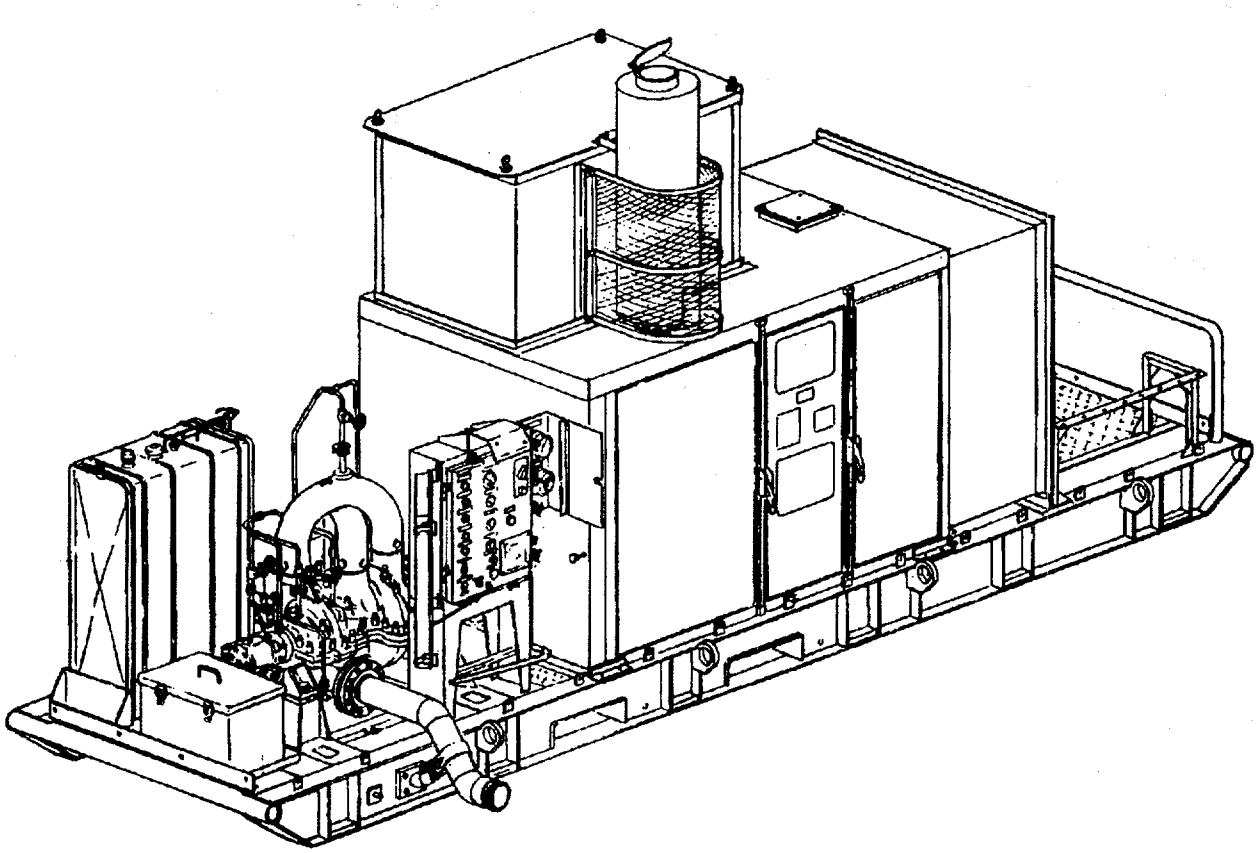
*This manual supersedes TM 5-4320-307-10, dated 14 August 1989, including all changes.

**Pumping Assembly, Mainline, 800 GPM, Diesel Engine Driven, PN 0053009500**



# CHAPTER 1
# INTRODUCTION

## SECTION I. GENERAL INFORMATION

**1-1 SCOPE.**

a. Type of Manual: Operator's Manual

b. Model Number and Equipment Name: Pumping Assembly, Mainline, 800 GPM, Diesel Engine Driven, Part Number 0053009500.

c. Purpose of Equipment: Pumps petroleum-based fuels or water with specific gravities between 0.72 and 1.0.

**1-2 MAINTENANCE FORMS AND RECORDS**. Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA PAM 738-750, The Army Maintenance Management System (TAMMS).

**1-3 REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR'S).** If your pumping assembly needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design or performance. Put it on an SF 368 (Quality Deficiency Report). Mail it to us at U.S. Army Aviation and Troop Command, ATTN: AMSAT-I-MDO, 4300 Goodfellow Blvd., St. Louis, MO 63120-1798. We'll send you a reply.

**1-4 WARRANTY INFORMATION.** The pumping assembly is warranted by S. P A. Termomeccanica Italiana, C/O The Crenshaw Company, 1199 North Fairfax Street, Alexandria, VA 22314 for a period of 2 years. It starts on the date found in block 23, DA Form 2408-9, in the logbook Report all defects in material or workmanship to your supervisor who will take appropriate action.

**1-5 NOMENCLATURE CROSS-REFERENCE LIST**. This listing includes nomenclature cross-references used in this manual.

| Common Name | Official Nomenclature |
|---|---|
| Engine | Engine Assembly, Dual Turbocharged Diesel, NTTA-855-P450 |
| Gear Box | Speed Increaser w/Clutch, PN 0053020200 |
| Power Takeoff | Speed Increaser w/Clutch, PN 0053020200 |
| Pump | Pump Assembly, PN 0053000100 |
| Pumping Assembly | Pumping Assembly, Mainline, Diesel Engine Driven, 800 GPM |

**1-6 LIST OF ABBREVIATIONS**.

| | |
|---|---|
| AR | Army Regulation |
| °C | Degree Celsius |
| cm | Centimeter |
| cu ft | Cubic feet |
| cu m | Cubic meter |
| do | Direct current |
| DED | Diesel-Engine-Driven |
| EIR | Equipment Improvement Recommendations |
| °F | Degree Fahrenheit |
| ft | Foot; feet |
| gal | Gallon |

## 1-6 LIST OF ABBREVIATIONS (CONT).

| | |
|---|---|
| gpm | Gallons per minute |
| hp | Horsepower |
| in. | Inch |
| kg | Kilogram |
| kPa | Kilopascal |
| L/min | Liters per minute |
| lb | Pound |
| m | Meter |
| mm | Millimeter |
| NBC | Nuclear, Biological and Chemical |
| NPT | National pipe thread |
| PAM | Pamphlet |
| PMCS | Preventive maintenance checks and services |
| psi | Pounds per square inch |
| qt | Quart |
| rpm | Revolutions per minute |
| TAMMS | The Army Maintenance Management System |
| V | Volts |

## 1-7 GLOSSARY

| | |
|---|---|
| Abraded | To wear away due to rubbing action. |
| Abrasion | A scraped or scuffed area. A hose may become abraded if an unshielded portion of it rubs against a piece of bracket or another hose. |
| Acoustical | Sound deadening. |
| Actuate | To cause an action. When electric power is applied to a solenoid, it actuates a valve, causing a part in the valve to move. |
| Align | To arrange in a line vertically and/or horizontally. |
| Ambient | The temperature surrounding an object. |
| Approved | Permitted to be used for a specific purpose by the person or group who is authorized to grant approval. |
| Assembly | A combination of parts that may be taken apart without destruction, which has no application or use of its own but is needed for the completeness of a more complex item with which it is combined, or to which it is attached. |
| Capacity | The volume, amount, or quantity that can be held or contained. |
| Carbon Monoxide | A poisonous gas that is made while a fuel is burning, especially if there is not quite enough air. The gas is colorless, odorless, and tasteless, but it can cause illness or death. See the warnings on the Warning page at the front of manual. |

| | |
|---|---|
| Cavitation | Condition caused when engine speed is increased beyond point of maximum suction vacuum. Cavitation is indicated by loud cracking noise in pump housing and is harmful to the pump unit. |
| Combustion | A chemical change, especially oxidation, accompanied by the production of heat and light. A combustion engine functions by burning fuel to produce heat, i.e., energy. |
| Component | A part or a combination of parts that together accomplish a function. |
| Compressed Air | Air that is under pressure. When the compressed air in a hose or pipe is allowed to escape (such as Air when you use an air gun), the air moves very fast and is used to blow away dirt and chips for cleaning. |
| Condensation | A liquid formed from a vapor. Moisture carried in warm air will condense when it reaches a cold area, such as the surface of a fuel tank in subzero weather. |
| Corrosion | A gradual wearing away caused by chemical action. Metals exposed to salt water are likely to corrode. |
| Deteriorate | A worsening of condition usually as a result of age or hostile environment, as opposed to mechanical damage. |
| Distortion | The bending, twisting, or any other dynamic change of a surface. |
| Dunnage | Padding or loose material placed in a shipping container to prevent damage to contents. |
| Exhaust | The gases that leave the engine through the tailpipe while the engine is running. |
| Expendable | An item that is not repairable and is discarded if damaged. |
| Exposure | Being in the presence of something, or in contact with something. Skin is exposed to cleaning solvent when the solvent contacts the skin during cleaning operations. |
| Filter | A device that removes dirt from the air or a fluid. |
| Flash Point | The lowest temperature at which the vapors of a solvent will ignite and burn. |
| Fluid | A substance that can flow; that is, either a gas or a liquid. |
| Frayed | Something that has been worn away or unraveled, usually by rubbing. |
| Gasket | A seal or packing used between matched machine parts or around pipe joints to prevent the escape of gas or fluid. |
| Goggles | A device used to protect the eyes from dust, dirt, flying chips, etc. |
| Immerse | To completely cover by fluid. |
| Inhalation | The act of breathing in. The breathing in or inhalation of carbon monoxide can cause illness or death. |
| Initial | The first or starting condition. |
| Legible | Capable of being read. A legible nameplate can be read; an illegible plate cannot. |
| Malfunction | Occurs when a unit fails to operate normally. |
| Manufacturer | The company that makes an item or piece of equipment for sale. |
| Materiel | Equipment, apparatus, and supplies of an organization such as an army. |
| Obstruction | An obstacle. |
| Pivot | A short rod or shaft about which a related part rotates; the act of turning on or as if on a pivot. |
| Port | A threaded hole through which fluid may pass, or pressure may be measured. Ports on the pump are used to connect hoses, and to measure pressure. |
| Prime | The act of introducing a liquid into a pump to increase the pump's ability to over come negative head pressure. |
| Recommen-dations | Suggestions for change; advice given usually to make an improvement. |

## 1-7 GLOSSARY (CONT).

| | |
|---|---|
| Require | To demand or need. |
| Respiration | The process of breathing; inhaling and exhaling. |
| Scope | The extent of an activity or concept; the amount of information covered as in a book. |
| Specific Gravity | Ratio of the weight of a liquid to the weight of an equal volume of water. Specific gravity of water is 1. |
| Symptom | The external sign or indication of a condition. |
| Tiedown | Strap or fastening device used to hold an object in position. |
| Valve | A device used to control the flow of a fluid. |
| Vapor | The gaseous form of any substance which is usually a liquid; vapors are present in the air around the substance. |
| Ventilate | To provide with a source of fresh or uncontaminated air. |
| Visual | Visible; detected by the unaided eye. |
| Volute | Housing into which impeller discharges water. |

## Section II. EQUIPMENT DESCRIPTION AND DATA

## 1-8 EQUIPMENT CHARACTERISTICS, CAPABILITIES. AND FEATURES.

a. Design pumping rate of 800 gpm at 1800 feet of head (fluids with specific gravity of 0.85)

b. Automatic shutdown for high temperature, low lube oil pressure, overspeed, and low suction pressure

c. Operates in surrounding temperature between 250 and 135°F

d. Operates at altitudes between sea level and 9000 feet (2743.2 m) above sea level

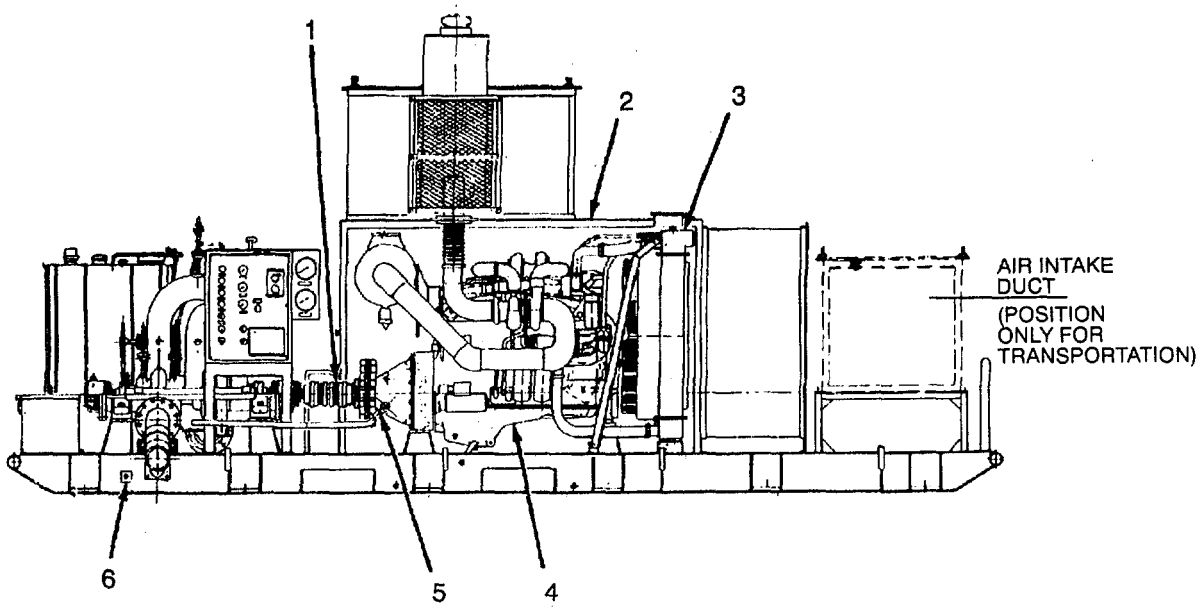
e. Continuous operation during periods of blowing sand

f. Cold weather starting aid

g. Skid mounted for transport

h. Unit designed to limit damage caused by severe handling expected to be encountered in a battlefield environment

## 1-9 LOCATION AND DESCRIPTION OF MAJOR COMPONENTS.




RIGHT SIDE VIEW

FLEXIBLE COUPLING (1). The flexible coupling is used to connect the speed increaser to the pump.

ENGINE ENCLOSURE (2). The enclosure boxes the engine along its sides, top, and ends. Four hinged doors and two removable side panels provide accessibility to the engine. The air intake duct on top and the muffler are removable for transportation.

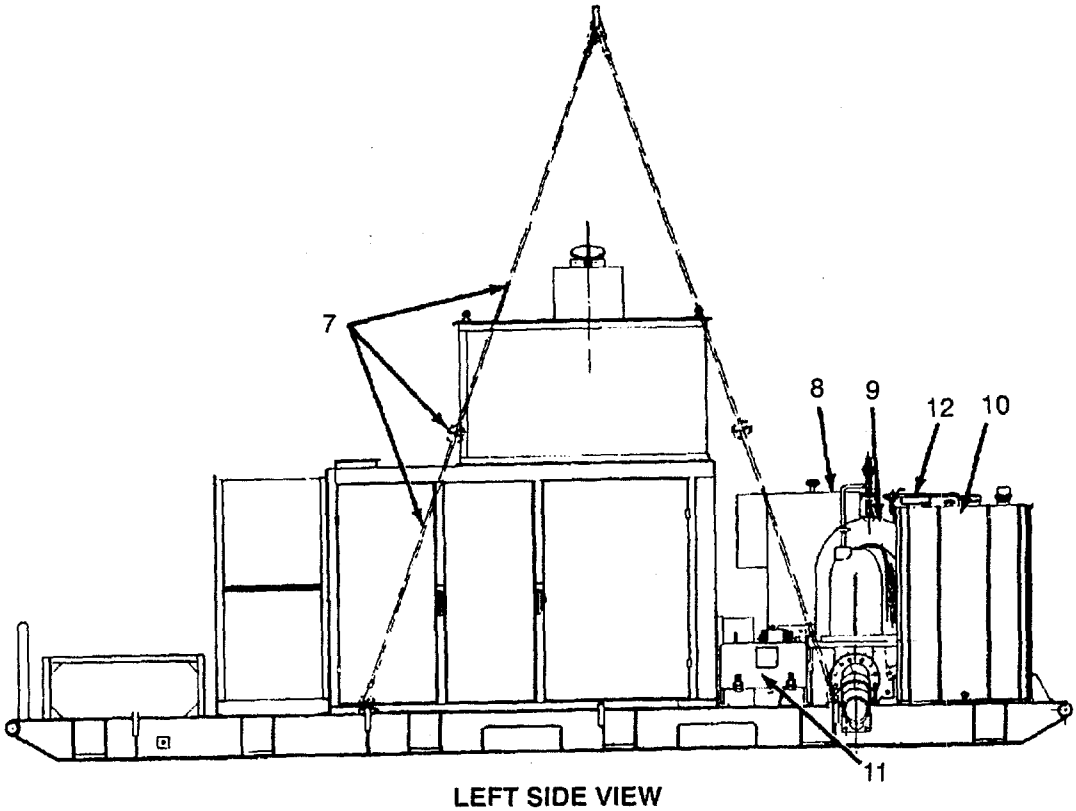
COOLANT RADIATOR (3). The radiator is part of the engine cooling system that maintains the engine coolant at specified temperature during operation.

ENGINE ASSEMBLY (4). The engine is a dual turbocharged diesel engine capable of providing 450 hp at 2100 rpm while in continuous operation.

SPEED INCREASER (5). The speed increaser is used to increase engine speed to optimum pump speed of 3458 rpm. A clutch lever extends from the speed increaser gear box to a position in front of the control panel.

GROUNDING ROD CONNECTION POINT (6). The grounding rod connection point provides a connection point for the grounding rod cable assemblies.

## 1-9 LOCATION AND DESCRIPTION OF MAJOR COMPONENTS (CONT).




**LEFT SIDE VIEW**

LIFTING BAIL ASSEMBLY (7). A lifting bail assembly is provided to lift the pumping assembly into position. The lifting bail assembly is connected to four locations on the skid when in use; otherwise, stored on the skid. Spreader bars are attached between lifting bail assembly to prevent damage to pumping assembly when lifting.

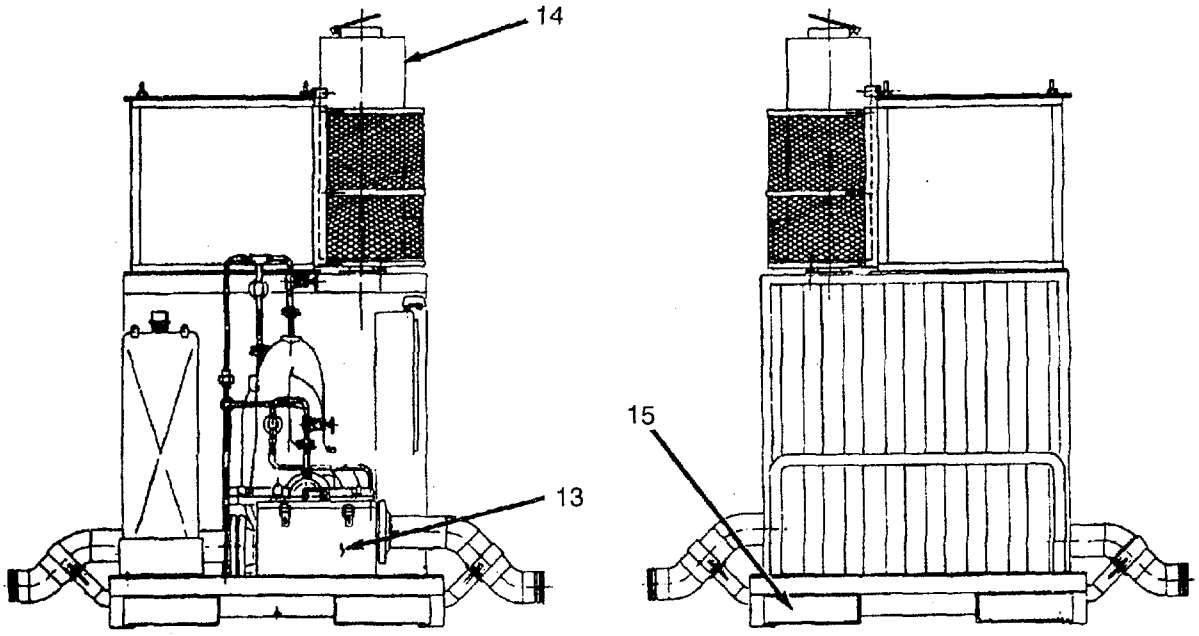
CONTROL PANEL (8). The control panel encloses the pumping assembly controls and indicators, which include a tachometer/hourmeter, lube oil pressure gauge, coolant water temperature gauge, suction pressure gauge, discharge pressure gauge, on/off switches, malfunction lights, test switch, start/stop switch, auto/manual switch, and engine speed/pump discharge pressure potentiometer. A work light is mounted to the top of the control panel. The light switch and dimmer control are also mounted on the panel face.

PUMP (9). The installed pump is a three-stage centrifugal pump with a design capacity of 800 gpm.

FUEL TANK (10). The fuel tank is mounted to the skid. The fuel tank has a capacity of 110 gallons and is designed to provide 4 hours of operation at maximum continuous power without refueling. The fuel level in the tank is indicated by a mechanical liquid level gauge graduated from empty to full.

BATTERY BOX (11). The battery box contains four lead acid 12-volt batteries, two in series and two in parallel.

FUEL FEEDING SYSTEM (12). The fuel feeding system consists of a precleaner, hand pump, fuel feed pump, injection pump, injectors, and dual fuel filters. The primary filter is a water separating type. Two 3-way valves with corrosion resistant tags marked OFF, UNIT TANK, and AUXILIARY are connected in line to a 110-gallon fuel tank.




STORAGE BOX (13). A storage box is mounted to the rear of the skid. Items stored in the box are: technical manuals, cotton duck bag, air cleaner rain cap, auxiliary fuel hoses, flange gaskets, nozzle mounting bolts, shims for engine, allen wrench, ground cables, and enclosure lifting eyes.

ENGINE EXHAUST SYSTEM (14). The engine is equipped with a spark arresting exhaust muffler. The muffler is fitted with a guard and is installed in the vertical position. The muffler may be easily removed and stored on the front end of the skid during transportation of the pumping assembly.

SKID ASSEMBLY (15). The skid measures approximately 23 by 6 1/2 feet. The ends of the skid are beveled upward and forklift pockets are in its base (front and back) to allow four-way entry by forklift. The size of the forklift entry pockets are 6 by 20 inches. Side pockets penetrate the width of the skid. End pockets penetrate 75 inches. The skid runners are furnished with 12 mounting holes for anchoring the assembly to a foundation. The skid has four tiedown devices and four multipurpose devices (tiedown and lifting). A grounding system allows all noncurrent metallic parts of the pumping assembly to be connected to two grounding pads at the opposite corners of the skid. Items stored on the skid during storage and transportation are: muffler, muffler guard, grounding rods, air intake duct, lifting bail assembly, nozzle adapters, coupling, and battery electrolyte.

**1-10 DIFFERENCES BETWEEN MODELS**. This technical manual covers only the Mainline Pumping Assembly, 800 GPM, Diesel Engine Driven, Part Number 0053009500. No known differences exist for this model number.

**1-11 EQUIPMENT DATA.**

a. Pump.

| | |
|---|---|
| Manufacturer | Termomeccanica |
| Model number | PF3-150/150 |
| Part number | 0053009500 |
| Type | Centrifugal |
| Primary service | Fuel |
| Secondary service | Water |
| Output | 800 gpm, 1800 Ft of Head (fluids with specific gravity of 0.85) |
| Rated driven speed | 2100 rpm |
| Suction (intake) port | 6-inch ANSI 300 RF flange |
| Discharge port | 6-inch ANSI 300 RF flange |
| Priming method | Manually prime |
| Rotation | Counterclockwise (facing control panel) |

b. Engine.

| | |
|---|---|
| Manufacturer | Cummins Engine Co. |
| Model | NTTA-855-P450 |
| Type | Dual turbocharged diesel |
| Number of cylinders | 6 |
| Bore | 5 1/2 inches |
| Stroke | 6 inches |
| Total displacement | 855 inches |
| Horsepower | 450 @ 2100 rpm |
| Direction of rotation (facing flywheel) | Counterclockwise |

c. Capacities.

| | |
|---|---|
| Engine cooling system capacity | 22 gal. |
| Engine oil capacity | 11.0 gal. |
| Fuel tank capacity | 110 gal. |

d. Dimensions and weight.

| | |
|---|---|
| Overall height (prepared for shipment) | 76.7 inches |
| Overall length | 282 inches |
| Overall width | 79.50 inches |
| Overall height assembled | 131.7 inches |
| Gross Weight | 14,227 16 uncrated, 17,000 16 crated |
| Wet Weight | 18,281 lbs |

## SECTION III. TECHNICAL PRINCIPLES OF OPERATION

**1-12 GENERAL**.

a. This section provides a functional description of the pumping assembly for the operator.

b. The pumping assembly is a skid-mounted diesel engine driven centrifugal mainline pump. The operational output is 800 gpm at 1800 feet of head when pumping liquids with a specific gravity of 0.72. It is designed to pump petroleum products or water at a maximum operational output of 800 gpm. The pumping assembly is directly coupled to a turbocharged diesel engine. Controls are contained in the control panel mounted on the side of the assembly. The pump and engine are mounted on a skid assembly. The pumping assembly consists of the following five major functional units.

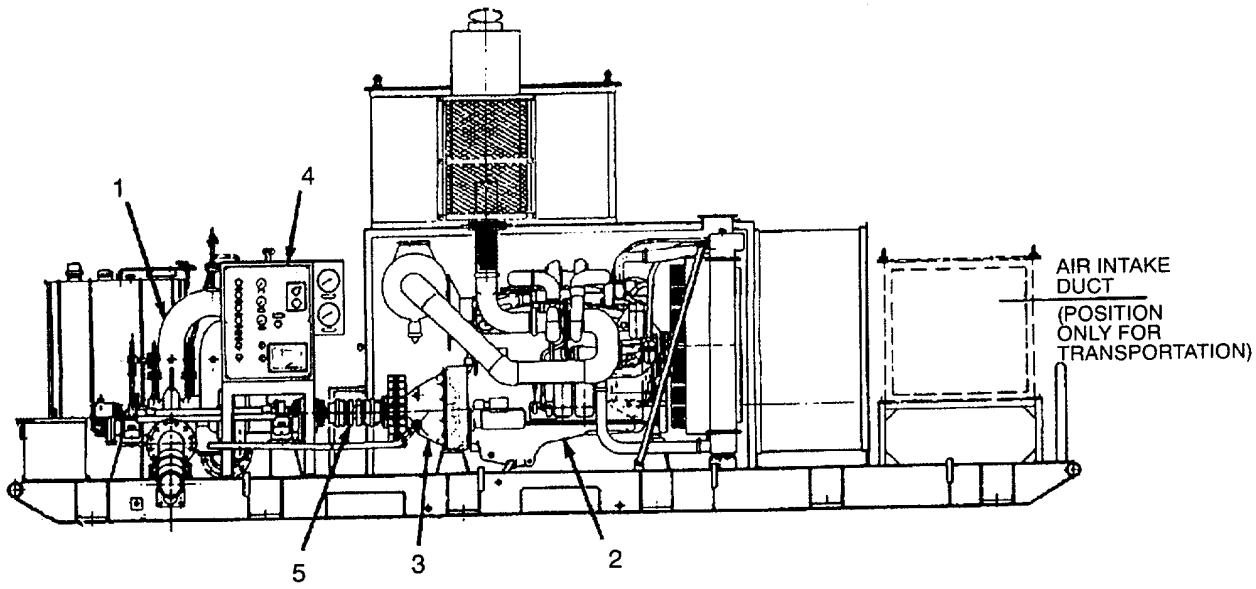
(1) Pump Assembly (1)

(2) Engine and Engine Systems (2)

(3) Speed Increaser with Clutch (3)

(4) Control Panel (4)

(5) Coupling Assembly (5)




**RIGHT SIDE VIEW**

**1-13 PUMP ASSEMBLY.**

a. Operation. The pump is of the centerline supported design having an axially split casing with suction and discharge manifolds cast into the lower casing. This design allows ready access to rotating assemblies without removal of suction and discharge piping or disconnecting the pump shaft from the speed increasing gear. The pump has a double suction first stage impeller and opposed second and third stage impellers that provide the pump with balanced thrust. This arrangement of three stages minimizes hydraulic pressure against the mechanical seals while also providing axial hydraulic balance. The double volute design of the pump maintains radial hydraulic balance. After the pump is primed and pumping begins, fluid flow is as follows:

(1) Fluid in the supply piping enters the suction manifold.

(2) The fluid enters the pump casing and the double suction first stage impeller.

(3) The impeller rotating at high speed throws the fluid outward from the center of the impeller. This creates a partial vacuum at the center of the impeller, drawing additional fluid from the suction manifold.

(4) The fluid forced out by the first stage impeller passes through a crossover to the second stage impeller.

(5) As fluid passes to the second stage impeller, two cyclone separators divert pumped fluid to the pump seals. The cyclone separators supply the mechanical seals with clean fluid and at the same time return contaminated fluid to the pump suction manifold.

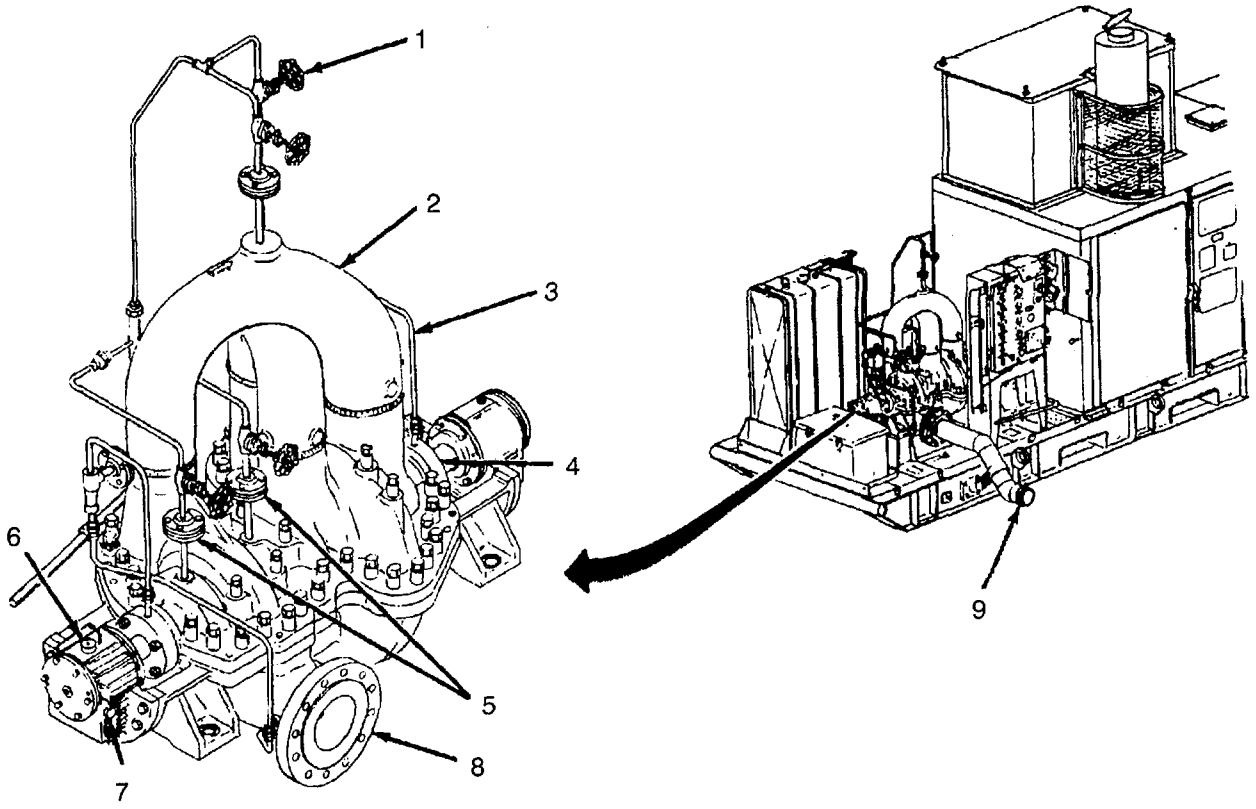
(6) The fluid passes to the second stage impeller and is forced outward from the center of the impeller into a cross-over to the third stage impeller.

(7) From the third stage (center) impeller, the fluid is forced through the discharge manifold into the discharge piping.

(8) As the sequence continues, pump speed may be adjusted between 1270 and 3459 rpm by varying engine speed from 770 to 2100 rpm.

(9) With a fixed piping system, increasing pump speed will increase pump capacity and head. At a fixed pump/engine speed, partially closing the discharge valve will reduce capacity and increase head.

b. Description.




AIR VENT VALVE (1). Four pump air vent valves are used to eliminate trapped air within the pump.

CROSSOVERS (2). Allow pumped fluid to move from the first to the second and from the second to the third stages of the pump.

CYCLONE SEPARATOR (3). Two cyclone separators clean diverted pumped fluid and then direct it to the mechanical seal for lubrication and cooling.

MECHANICAL SEAL (4). Forms a leakproof seal between rotating components and casing preventing high pressure leakage of the pumped fluid.

AUXILIARY PIPING FLANGES (5). Provides an interface between pump case and auxiliary piping of pump vent valves.

OIL FILL INLET (6). Used to partially fill oil sump.

OIL SIGHT GLASS (7). Oil level is indicated by a sight glass.

SUCTION FLANGE (8). Provides a flanged connection between pump suction pipe and suction adapter pipe.

SUCTION NOZZLE ADAPTER PIPE (9). Provides interface between pump suction flange connection and double grooved pipe connection. The same is true for discharge side of pump.

**1-14 ENGINE AND ENGINE SYSTEMS.**

a. Operation. The engine provides turning force to the pump rotor. The engine is bolted to the skid frame. The pumping assembly engine is a Cummins Model NTTA-855-P450 industrial dual turbocharged diesel capable of providing 450 hp at 2100 rpm while in continuous operation. The engine is equipped with the following major engine subsystems.

(1) Air Intake System. The engine is equipped with a heavy-duty reusable air cleaner. The air cleaner has a primary filter, an ejector valve, and a restriction indicator on its suction piping. The primary filter element, which may be reused, is easily removed and may be cleaned with air or water.

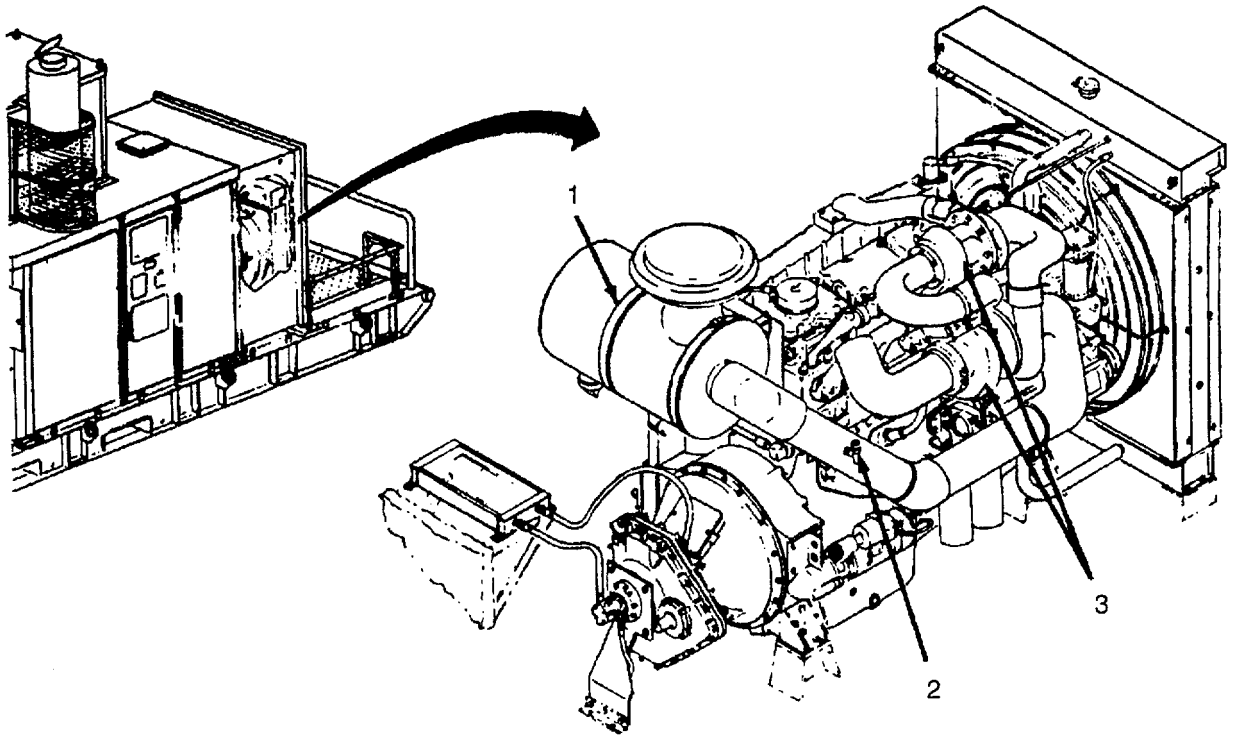
(2) Lubricating System. The engine lubrication system is provided with a pressure relief safety valve to prevent damage to various engine parts and seals. The engine is also provided with a port to sample oil for testing and an oil sump with a plug and drain tube. Under normal conditions, prelubrication of the turbocharger bearings is not required since there is an oil residual in the turbo bearing that will lubricate the turbo on startup. After long storage or following emergency hot shutdown, lubrication is required for all turbocharger and engine bearings. Lubrication of the turbocharger bearings is accomplished using the normal engine lubrication system without tools or disassembly.

(3) Fuel System. The fuel system consists of a precleaner, hand pump, fuel feed pump, injection pump, injectors, and dual fuel filters. The primary filter is a water separating type. Two 3-way valves with corrosion resistant tags marked OFF, UNIT TANK, and AUXILIARY are connected by the fuel supply and return line to a 110-gallon fuel tank.

(4) Cooling System. The engine is equipped with a water pump and heavy duty radiator capable of maintaining the specified coolant temperature during maximum operating conditions. The radiator may be cleaned from the front using compressed air.

(5) Electrical System. The 24-volt electric power necessary to start the engine is provided by four lead acid 12-volt batteries. Pressing the START switch on the control panel activates the engine starter motor and simultaneously opens the fuel system solenoid. A three-phase alternator provides automatic charging of the batteries through a voltage regulator. An auxiliary charging receptacle is provided to charge the batteries from a remote power source.

b. Description.
(1) Air Intake system.



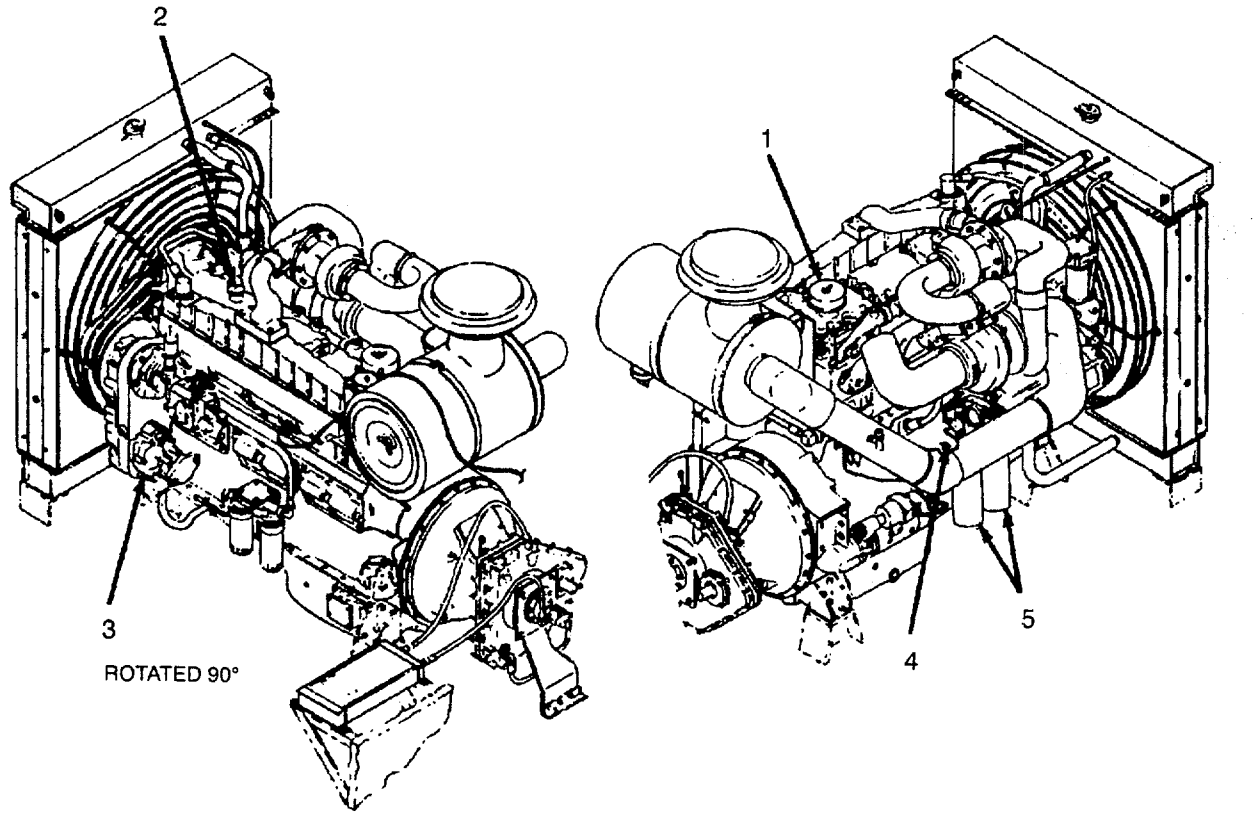

AIR CLEANER (1). Heavy duty dual-element air cleaner combines centrifugal with element filtering before air enters engine.

AIR RESTRICTION INDICATOR (2). As indicator cartridge becomes clogged with dirt, a red flag in indicator window appears indicating a dirty filter element.

DUAL TURBOCHARGER (3). Uses engine exhaust gases to drive a compressor with a turbine wheel. Ambient air is drawn in, compressed, and forced into the engine cylinder increasing combustion air pressure and engine power.

**1-14 ENGINE AND ENGINE SYSTEMS (CONT).**

(2) Lubricating System.




CRANKCASE BREATHER (1). Allows crankcase venting which reduces the concentration of acids and water in the oil. A clogged breather element will cause an increase in crankcase pressure.

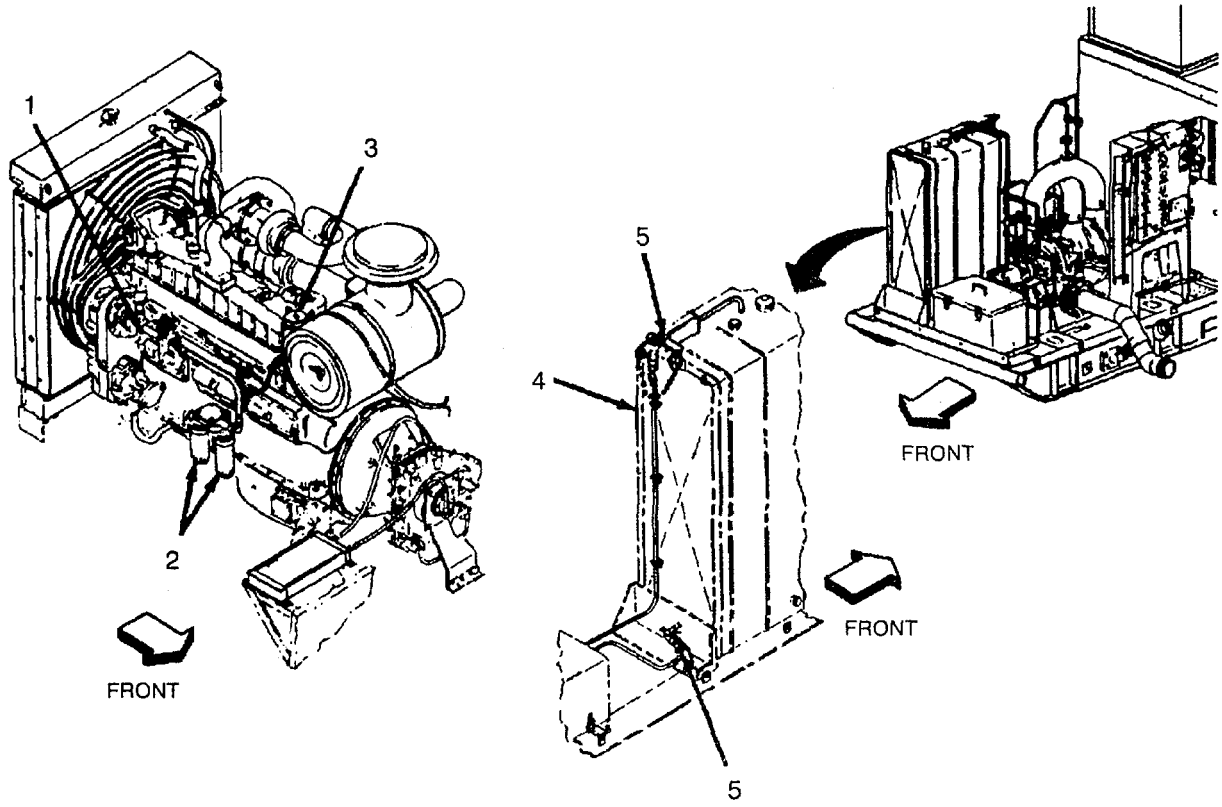
OIL FILL INLET (2). Inlet for adding lubricating oil to engine.

LUBE OIL PUMP (3). A gear type pump used to distribute oil from the oil pan to the oil filters and then distributed throughout the engine to lubricate moving parts.

OIL DIPSTICK (4). Allows measurement of oil level in engine crankcase when the engine is not running.

OIL FILTERS (5). Removes metal particles and products of heat decomposition from circulating oil.

(3) Fuel System.




FUEL PUMP (1). Draws fuel from fuel tank through fuel filters and delivers it to injectors.

FUEL FILTERS (2). Removes foreign particles and moisture from fuel prior to delivery to fuel pump.

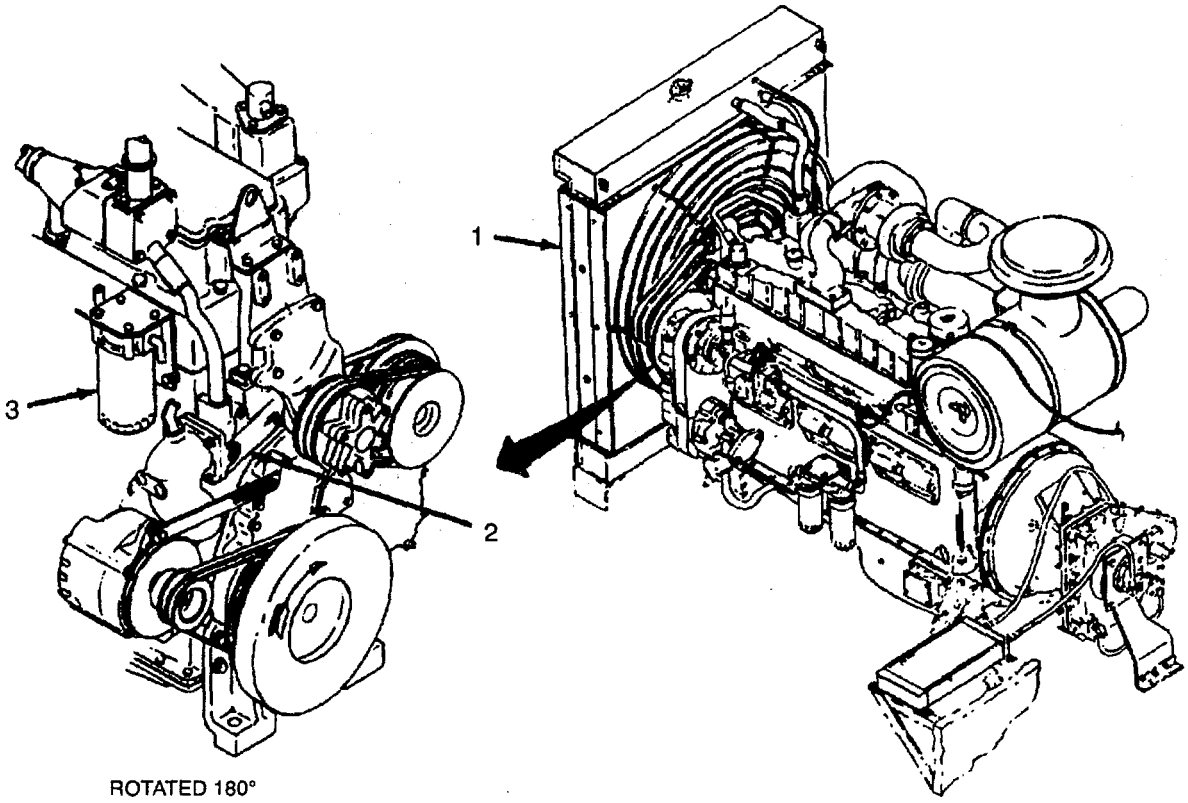
COLD WEATHER STARTING AID (3). An ether charge that is injected into the engine through an atomizer by operating a pull handle on the control cable located on the engine enclosure near the control panel.

FUEL TANK (4). Stores 110 gallons of fuel for engine.

3-WAY FUEL VALVE SUPPLY (5). Allows operator to turn fuel supply and return line valves on or off or select an alternate fuel supply source for the engine.

**1-14 ENGINE AND ENGINE SYSTEMS (CONT).**

(4) Cooling System.

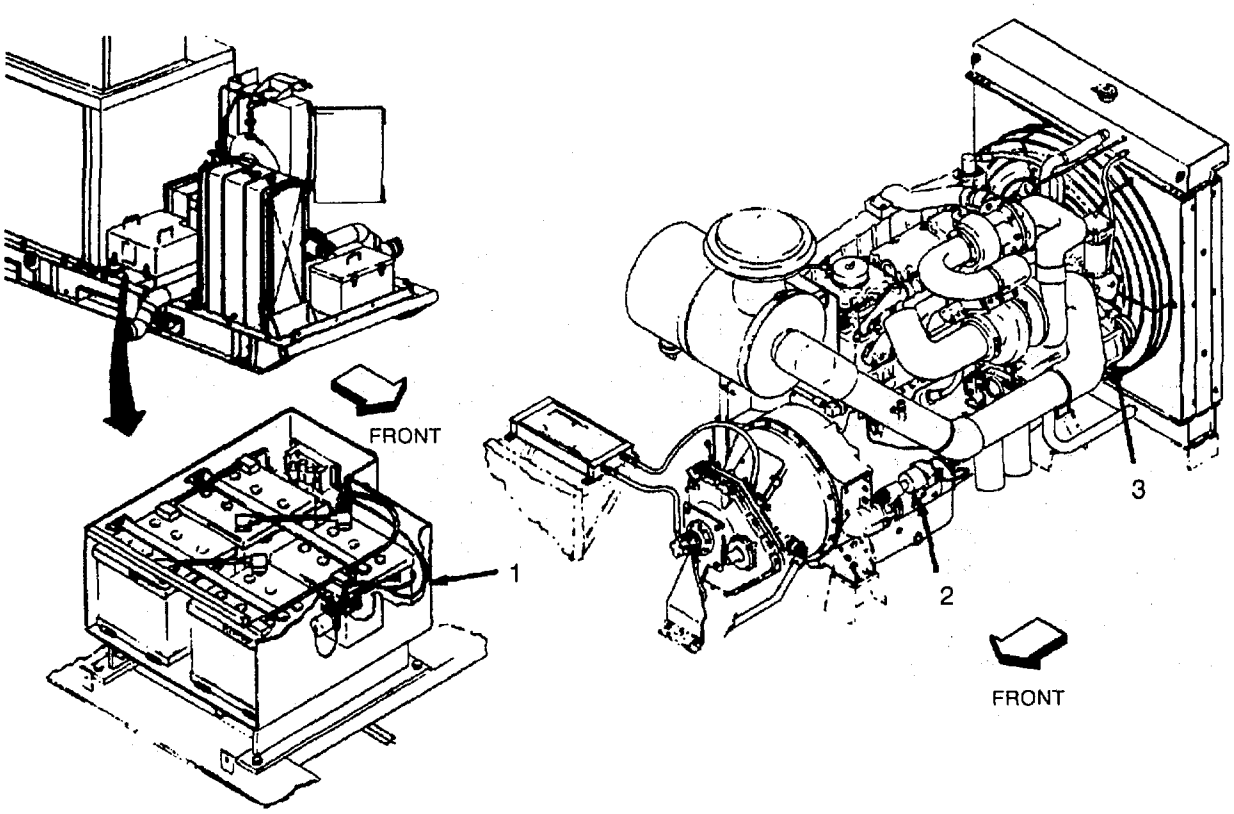



RADIATOR AND RADIATOR FAN (1). Removes heat collected by the engine coolant and discharges it to the atmosphere.

WATER PUMP (2). Circulates engine coolant throughout engine cooling system.

COOLANT FILTER (3). Removes foreign particles from engine coolant.

(5) Electrical System.




BATTERIES (1). Four lead acid 12-volt (6TM) batteries provide the necessary power to start the engine.

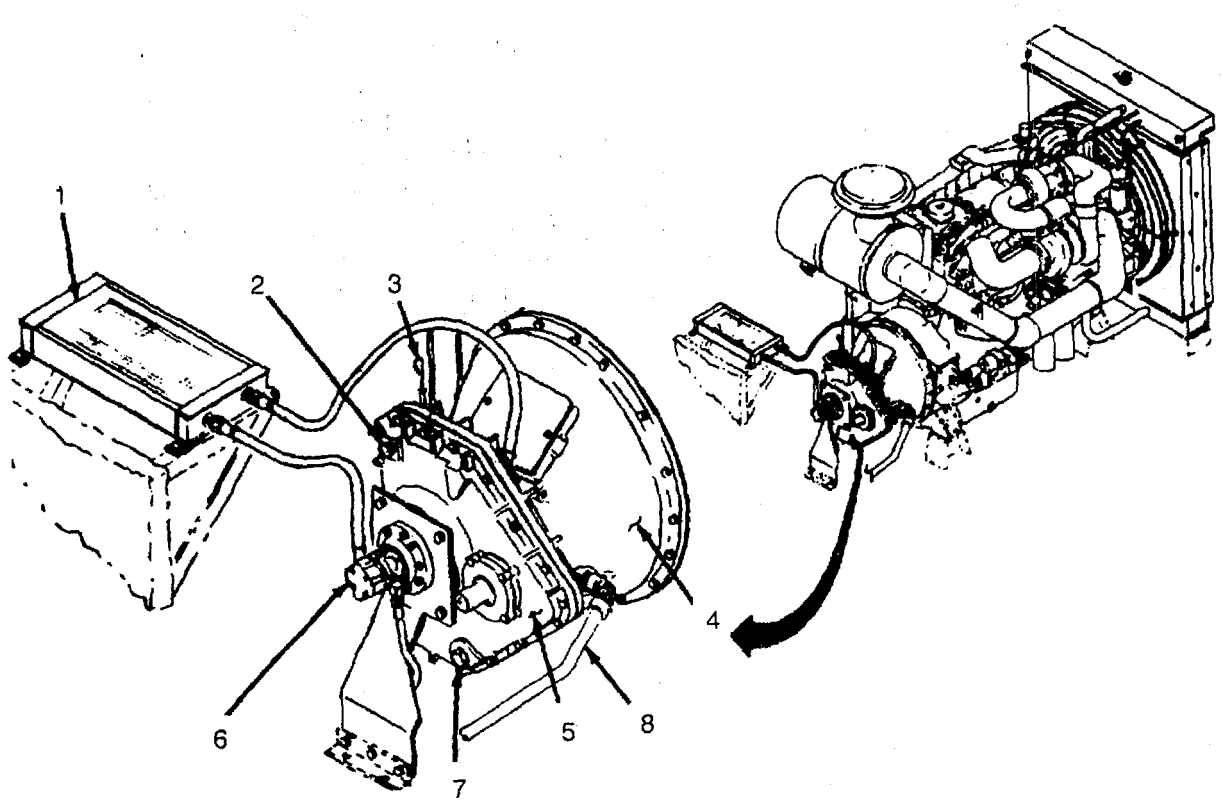
STARTER MOTOR (2). Provides initial cranking of engine.

ALTERNATOR (3). Provides automatic charging of batteries through a voltage regulator when the engine is running.

**1-15 SPEED INCREASER WITH CLUTCH.**

a. Operation. The pump shaft is connected to the engine by the speed increaser. The output shaft of the speed increaser gear box is coupled to the pump shaft using a flexible coupling. The gear box takes its input from the splined shaft of the clutch. The clutch power ring is flange-mounted to the engine flywheel. When the clutch is engaged, power is transmitted from the engine flywheel to the pump shaft allowing optimum pump speed to be attained using optimum engine speed.

b. Description.




HEAT EXCHANGER (1). Oil to air heat exchanger.

OIL FILL INLET (2). Inlet for adding lubricating oil to gear box.

DIPSTICK (3). Allows measurement of oil level in gear box oil sump.

POWER TAKEOFF (4). Houses a two-plate clutch that mates the engine flywheel to the gear box.

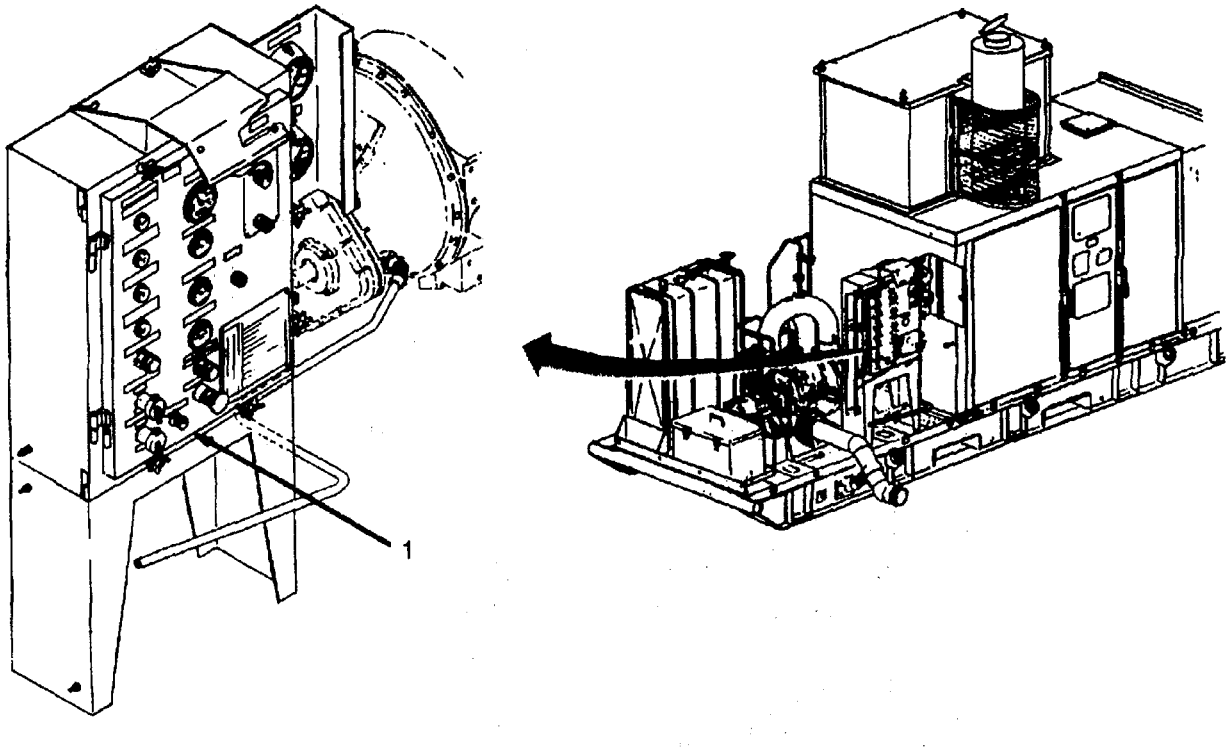
GEAR BOX (5). Houses one-stage step up gears and bearings.

GEAR LUBE OIL PUMP (6). Circulates lubrication oil from the gear box through a heat exchanger for cooling.

OIL DRAIN PLUG (7). Outlet for removing lubricating oil from gear box.

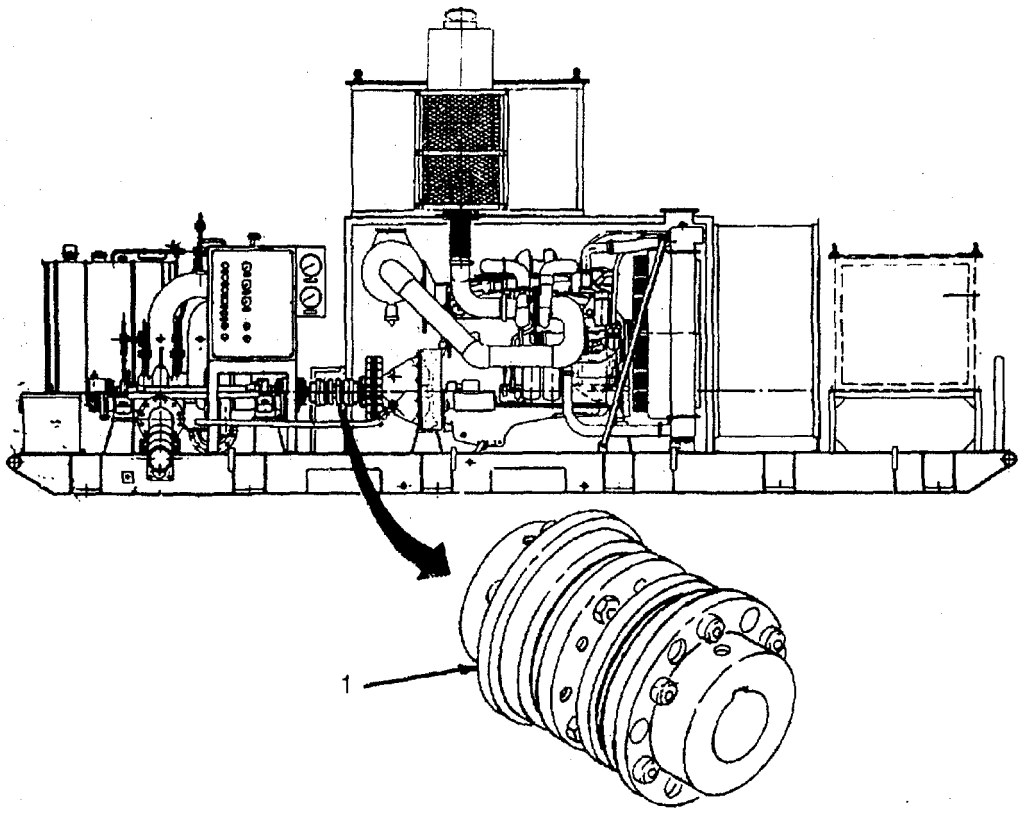
CLUTCH OPERATING LEVER (8). When engaged, the speed increasing gear transmits power from the engine flywheel to the pump shaft, matching optimum engine speed to optimum pump speed.

**1-16 CONTROL PANEL.**




CONTROL PANEL. The control panel (1) is used to start up, operate, and shut down the pumping assembly. The control panel is mounted on the right side of the skid assembly. The control panel houses a tachometer, voltmeter, lube oil pressure gauge, coolant water temperature gauge, suction pressure gauge, discharge pressure gauge, on/off switches, auto/manual switch, test switch, reset switch, start/stop switch, and engine speed/discharge pressure potentiometer. The control panel is lighted for use in total darkness. Control panel layout is grouped by function and component application.

**1-17 COUPLING ASSEMBLY.**




COUPLING ASSEMBLY (1). The engine provides the turning force to the pumping unit through the speed increaser and coupling assembly. The coupling assembly is used to connect the speed increaser to the pump.

# CHAPTER 2
# OPERATING INSTRUCTIONS

## Section I. DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS

### 2-1 CONTROLS AND INDICATORS.

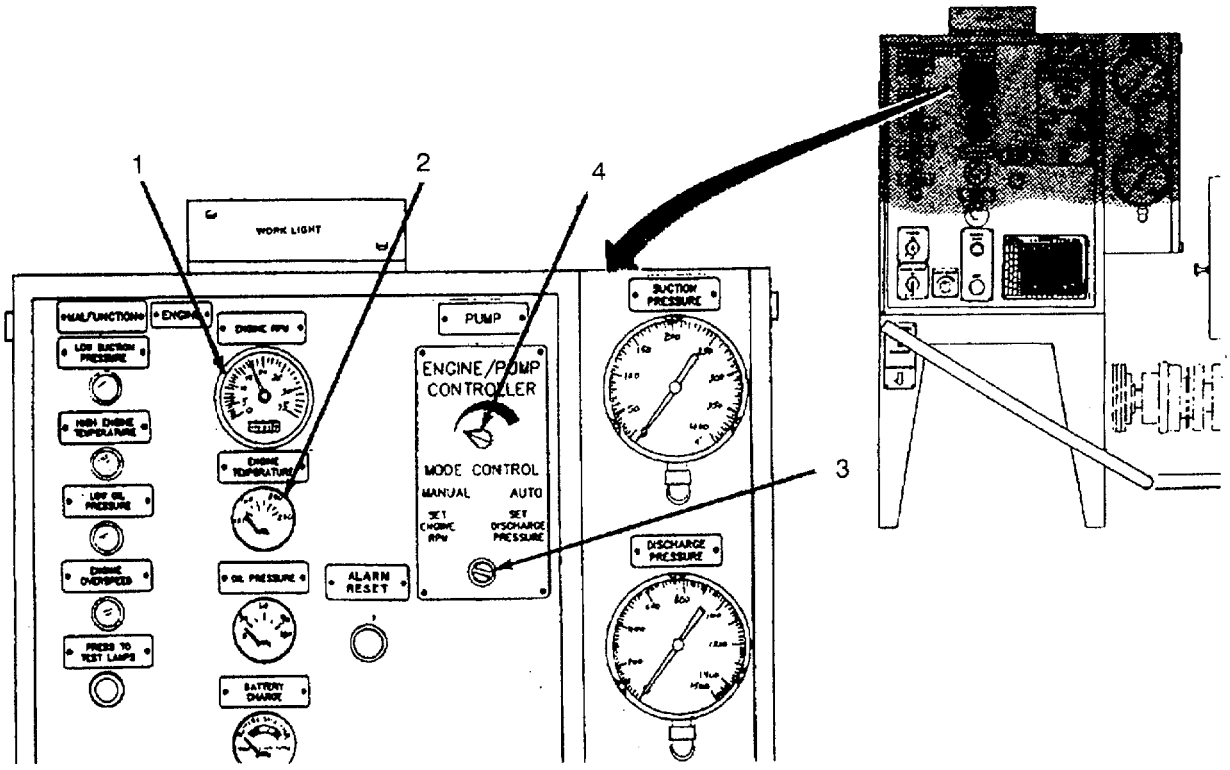
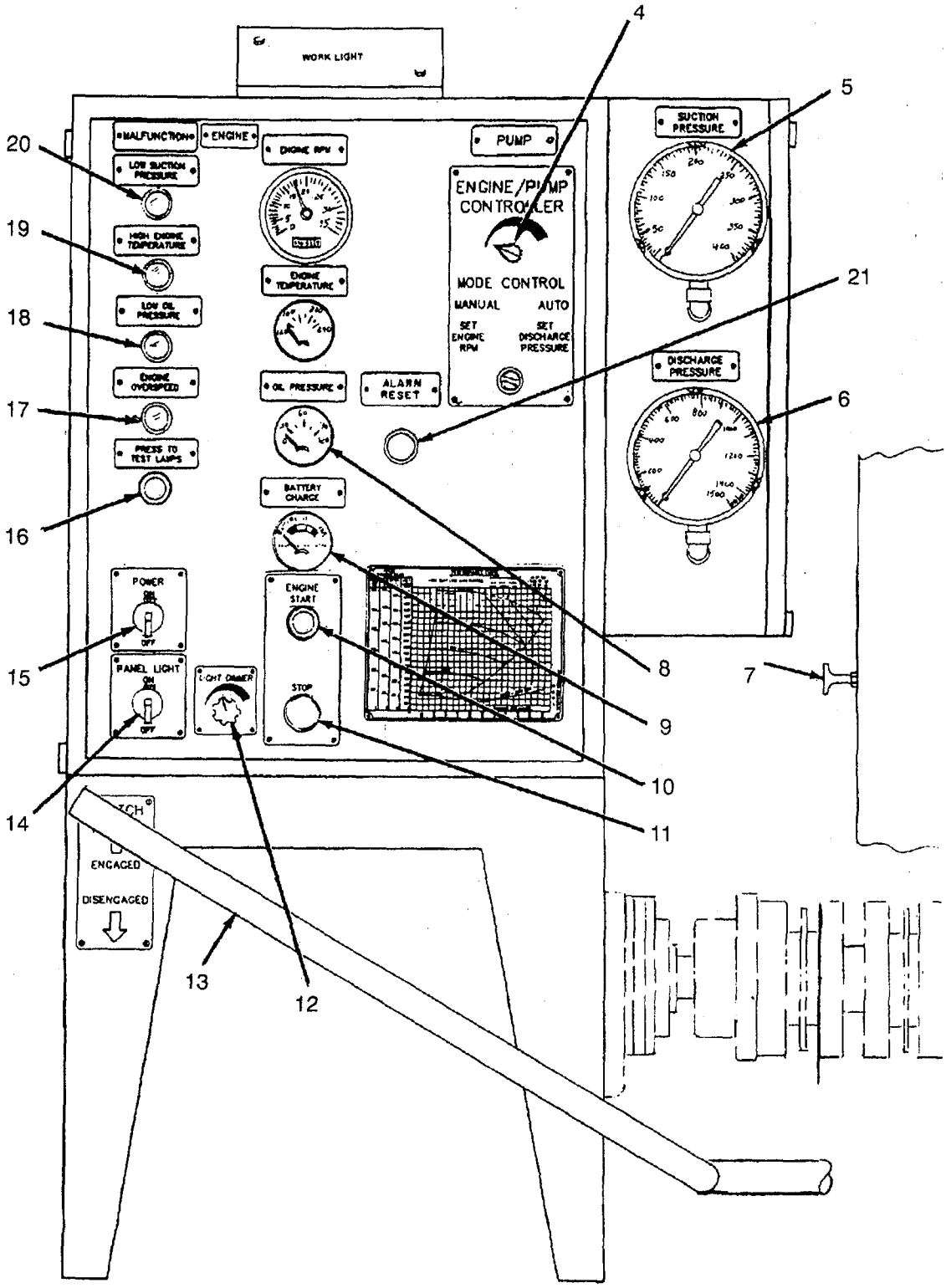



**Table 2-1. Operator's Controls and Indicators**

| Key | Control or Indicator | Function |
|---|---|---|
| 1 | ENGINE RPM tachometer/hourmeter | Indicates engine rpm up to 3500 rpm and has an hourmeter to indicate hours of engine operation. |
| 2 | ENGINE TEMPERATURE gauge | Displays coolant water temperature from 120° - 240°F. |
| 3 | MANUAL SET ENGINE RPM/AUTO SET DISCHARGE PRESSURE | When pump is in MANUAL mode, engine speed may be controlled by rotating ENGINE/PUMP CONTROLLER knob. When pump is In AUTO mode, pump discharge pressure may be controlled by rotating ENGINE/PUMP CONTROLLER knob. |
| 4 | ENGINE/PUMP CONTROLLER MODE CONTROL | Allows operator to select either MANUAL or AUTO modes of control. AUTO should be selected only after normal engine operating temperature is reached, lube oil pressure and suction pressure are available, and clutch is engaged. |

**Table 2-1. Operator's Controls and Indicators (Cont)**

| Key | Control or Indicator | Function |
|---|---|---|
| 5 | SUCTION PRESSURE gauge | Displays pump suction pressure from 0 to 400 psig. |
| 6 | DISCHARGE PRESSURE gauge | Displays pump discharge pressure from 0 to 1500 psig |
| 7 | Cold Weather Starting Aid | Pulling handle out will inject ether through an atomizer directly into the engine intake manifold. |
| 8 | OIL PRESSURE gauge | Displays lube oil pressure from 0 to 120 psig. |
| 9 | BATTERY-CHARGE voltmeter | Indicates state of battery charge. |
| 10 | ENGINE START switch | When pressed, activates engine starter motor and opens fuel system solenoid valve. |
| 11 | ENGINE STOP switch | When pulled, closes fuel system solenoid valve. |
| 12 | LIGHT DIMMER | When PANEL LIGHT ON/OFF switch is in ON position, adjusts brightness of worklight with a potentiometer. |
| 13 | Clutch lever | When engaged, the speed increasing gear transmits power from the engine flywheel to the pump shaft, matching optimum engine speed to optimum pump speed. |
| 14 | PANEL LIGHT ON/OFF switch | When in ON position, control panel lights come on. When in OFF position, control panel lights turn off. |
| 15 | POWER ON/OFF switch | When in ON position, power is applied to control panel. When in OFF position, power is disconnected from control panel. |
| 16 | PRESS TO TEST LAMPS switch | When pressed, tests all four malfunction lamps on control panel. |
| 17 | ENGINE OVERSPEED lamp | Lights when control system overspeed switch measures excessive engine rpm and causes engine shutdown. |
| 18 | LOW OIL PRESSURE lamp | Lights when low engine oil pressure is measured by oil pressure switch and causes engine shutdown except during startup. |
| 19 | HIGH ENGINE TEMPERATURE lamp | Lights when high coolant water temperature is measured by coolant temperature switch and causes engine shutdown. |
| 20 | LOW SUCTION PRESSURE lamp | Lights when low pump suction pressure is measured on suction pressure transducer and causes engine shutdown. |
| 21 | ALARM RESET switch | Allows operator to reset control panel after automatic shutdown caused by engine overspeed and low suction pressure. |


WORK LIGHT
MALFUNCTION
ENGINE
ENGINE RPM
PUMP
LOW SUCTION PRESSURE
HIGH ENGINE TEMPERATURE
LOW OIL PRESSURE
ENGINE OVERSPEED
PRESS TO TEST LAMPS
ENGINE TEMPERATURE
OIL PRESSURE
ALARM RESET
BATTERY CHARGE
ENGINE/PUMP CONTROLLER
MODE CONTROL
MANUAL
AUTO
SET ENGINE RPM
SET DISCHARGE PRESSURE
SUCTION PRESSURE
DISCHARGE PRESSURE
POWER
ON
OFF
PANEL LIGHT
LIGHT DIMMER
ENGINE START
STOP
ENGAGED
DISENGAGED
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## 2-1 CONTROLS AND INDICATORS (CONT).

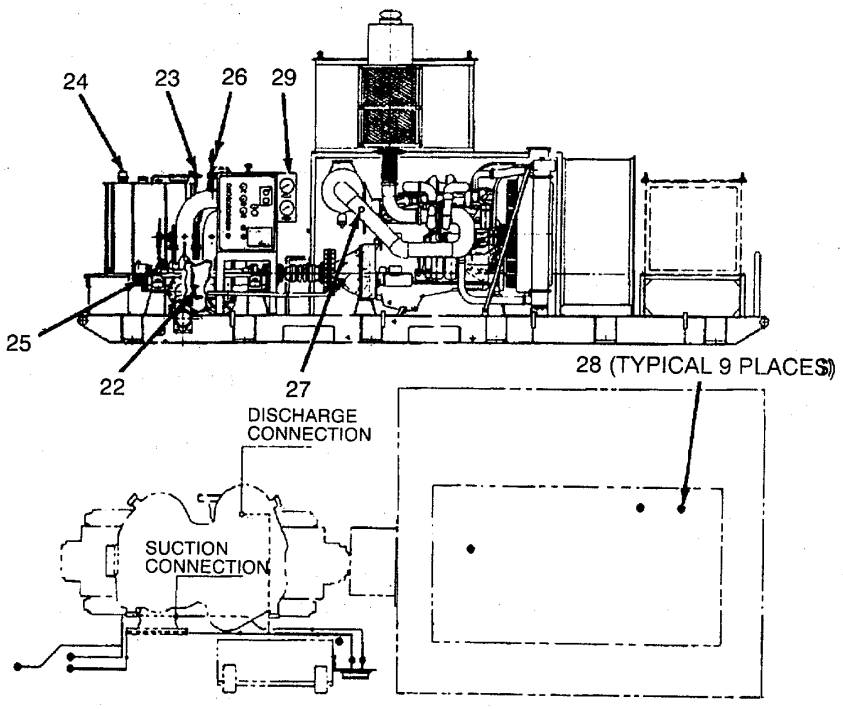



**Table 2-1. Operator's Controls and Indicators (Cont)**

| Key | Control or Indicator | Function |
|---|---|---|
| 22 | Supply 3-way fuel valve | Allows operator to select the fuel supply from the pumping assembly fuel tank (UNIT TANK position) or from an exterior source (AUXILIARY position). There is also an OFF position. |
| 23 | Return 3-way fuel valve | Allows operator to select a fuel return to the pumping assembly. fuel tank (UNIT TANK position) or to an exterior tank (AUXILIARY position). There is also an OFF position. |
| 24 | Fuel tank level gauge | Allows operator to check fuel quantity. |
| 25 | Pump oil sight gauges (bullseyes) | Allows operator to check pump oil level. |
| 26 | Pump vent valves | Allows operator to bleed air from pump during initial startup. |
| 27 | Air cleaner D/P indicator | Allows operator to check for a clogged inlet filter element. |
| 28 | Lamps and transducer isolation | Transducer measures key engine and pumping functions. Valves. When specifications are exceeded or not met transducer lamp indicates area of trouble and shuts down pumping unit. |
| 29 | Discharge suction vent valves | Located in the back of gauges, allows operator to bleed air from gauge piping prior to initial operation. |

## Section II. OPERATOR/CREW PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

### 2-2 GENERAL.

a. Before you operate. Always keep in mind the WARNINGS and CAUTIONS. Perform your before PMCS.

b. While you operate. Always keep in mind the WARNINGS and CAUTIONS. Perform your during PMCS.

c. After you operate. Be sure to perform your after PMCS.

d. Weekly. Be sure to perform your weekly PMCS.

e. If your equipment fails to operate. Troubleshoot with proper equipment. Report any deficiencies using the proper forms. See DA PAM 738-750.

### 2-3 PREVENTIVE MAINTENANCE CHECKS AND SERVICES.

a. Table 2-2 lists the preventive maintenance checks and services which shall be performed at specified intervals by the operator/crew.

b. Item numbers are assigned to each check or service task. These numbers are to be used as a source of item numbers for the TM Item Number column on DA Form 2404, Equipment Inspection and Maintenance Worksheet, in recording results of PMCS.

c. The service intervals are divided into four categories: Before Operation, During Operation, After Operation and Weekly.

d. The ITEM TO BE INSPECTED column lists the item to be checked or serviced. This column is combined with the PROCEDURE column.

e. The PROCEDURE column describes the procedure by which the check or service is to be performed. Illustrations are included to assist in locating that part of the equipment requiring the check or service. When instructions for removal of assemblies or equipment are required in order to perform PMCS, they are listed and illustrated in the PROCEDURE column.

f. The EQUIPMENT IS NOT FULLY MISSION CAPABLE IF: column contains the criteria that will cause the equipment to be not ready/available for service because it is unable to perform its primary mission. If equipment is found to be NOT FULLY MISSION CAPABLE, the operator should notify unit maintenance personnel.

g. Leakage categories for operator/crew PMCS shall be classified as follows:

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

**CAUTION**

Equipment operation is allowable with minor leakage's (Category Class I or II). Of course, you must consider the fluid capacity in the item/system being checked/inspected. When in doubt, notify your supervisor.

When operating with Category Class I or Category Class II leaks, continue to check fluid levels as required in your PMCS.

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

**Table 2-2. Preventive Maintenance Checks and Services**
**NOTE**

If the equipment must be kept in continuous operation, check and service only those items that can be checked and serviced without disturbing operation. Make the complete checks and services when the equipment can be shut down.

Perform weekly as well as before operation PMCS if:

(1) You are the assigned operator and have not operated the item since the last weekly.

(2) You are operating the item for the first time.

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services - (Cont)**

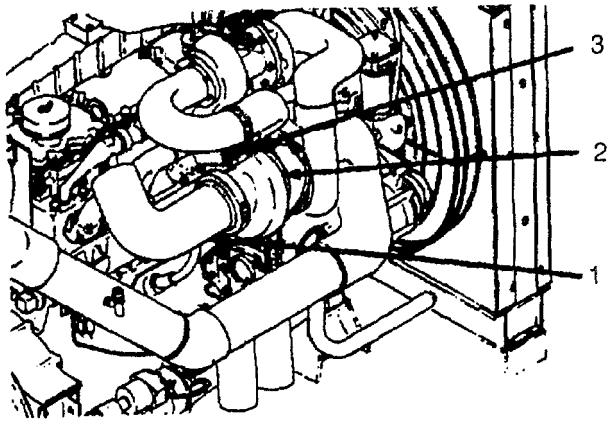
| Item No. | Interval | Location / Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 1 | Before | Exhaust System | **WARNING**<br>**Severe burns can be caused by exhaust system components heated during operation of the engine. It the engine has been running, do not touch any components of the exhaust system until they have cooled.**<br><br>Check that spark arrestor and exhaust guard are securely mounted.<br><br>Inspect muffler pipes (1) between muffler and turbocharger (2) for loose connections, holes, or other damage.<br>Inspect flange (3) connection at turbocharger (2). The flange must be secured with all mounting bolts and show no indications of cracks or leaks.<br><br>  <br> | Exhaust system is leaking or components are loose. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services - (Cont)**

| Item No. | Interval | Location / Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 2 | Before | Grounding Assembly pad (3). | Check that grounding rod (1) is securely inserted into ground.<br>Check that grounding wire (2) is secured to skid grounding cure.<br>Check grounding wire (2) for broken or frayed insulation or wires.<br>Check connectors (4) for tight electrical connection. | Grounding assembly is not se- |

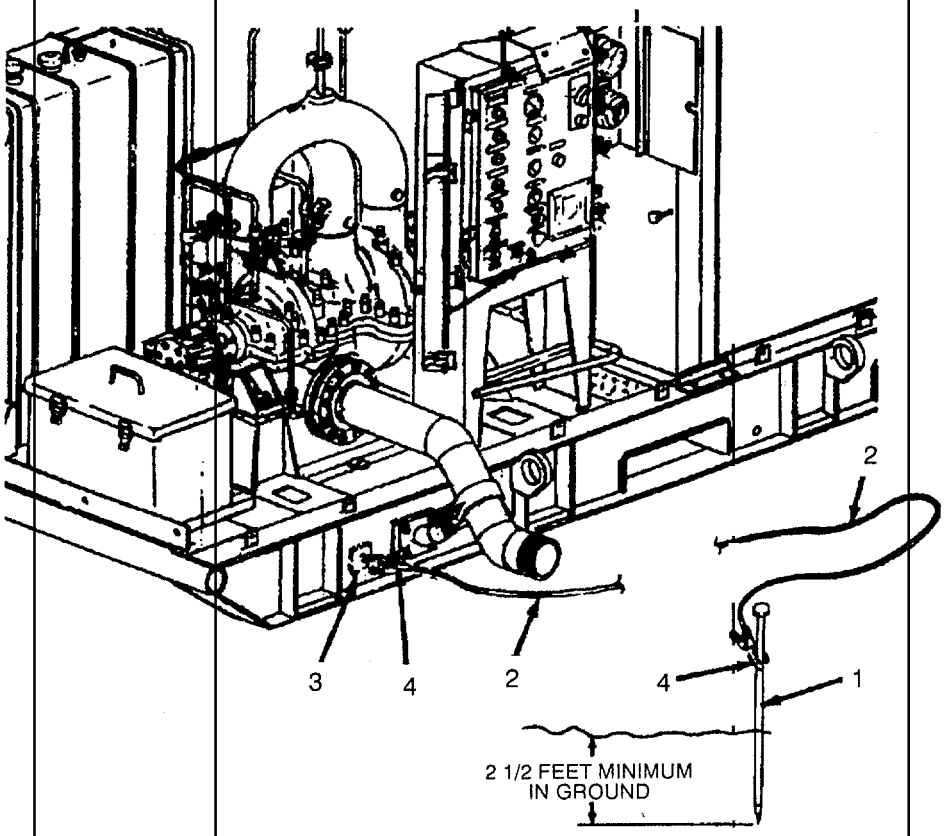


**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services - (Cont)**

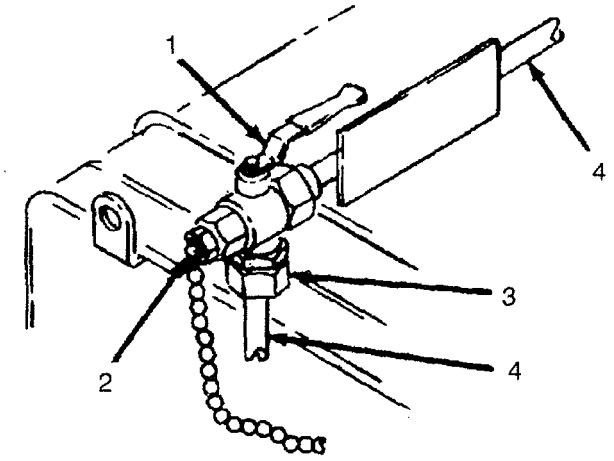
| Item No. | Interval | Location / Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 3 | Before | 3-Way Selector Valve and Fuel Line Assembly | **WARNING**<br>**Death or serious injury could occur if diesel fuel is not handled carefully. Use in a well-ventilated area away from open flame, arcing equipment, ignition sources, heaters, or excessive heat. Be certain that fuel lines and connections are secure. Do not inhale vapor. Do not overfill fuel tank. Engine must be turned off and cooled before refueling. Use proper refueling procedures and equipment to avoid spillage. Do not run engine near open fuel containers. DO NOT SMOKE.**<br><br>**CAUTION**<br>**Both supply and return 3-way fuel valves must be aligned to the same selected fuel supply (auxiliary or unit tank). Alignment to different supplies could cause engine overheating, shutdown from rapid fuel exhaustion, or fuel system overflow and the associated fire hazards.**<br><br>Visually check for fuel leaks at 3-way valve stems (1), cap plugs for auxiliary lines (2), connectors (3), and fuel line assemblies (4).<br><br>  <br> | Category Class III fuel leaks or fire hazard leakage are found. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services - (Cont)**

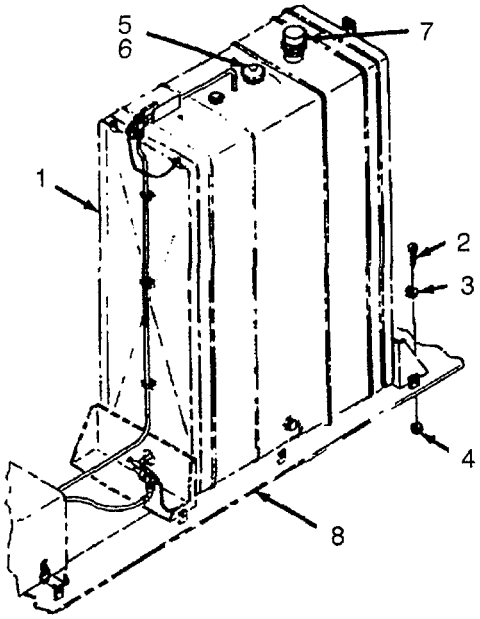
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 4 | Before | Fuel Tank Assembly | **WARNING**<br>**Death or serious injury could occur if diesel fuel is not handled carefully. Use in a well-ventilated area away from open flame, arcing equipment, ignition sources, heaters, or excessive heat. Be certain that fuel lines and connections are secure. Do not inhale vapor. Do not overfill fuel tank. Engine must be turned off and cooled before refueling. Use proper refueling procedures and equipment to avoid spillage. Do not run engine near open fuel containers. DO NOT SMOKE.**<br>**CAUTION**<br>**Condensed moisture in the fuel tank is harmful to engine operation. Keep fuel tank filled between periods of operation to reduce condensation.**<br><br>Inspect fuel tank (1) for loose screws (2), washers (3), or nuts (4), and for dents, leaks, and other damage.<br>Visually check fuel tank (1) for physical damage that could cause leaks or contamination of fuel supply.<br>Remove fuel tank cap (5) and check operation of valve inside fuel tank cap. Check that gasket (6) is present and in good condition. Insure that the valve is open during operation.<br>Check that liquid level gage (7) is legible and accurately registers level of fuel in tank.<br>Check fuel tank assembly (1) and surrounding area of skid frame (8) for corrosion.<br>  <br> | Category Class III fuel leakage or fire hazard leakage is found.<br>Tank cap missing. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services - (Cont)**

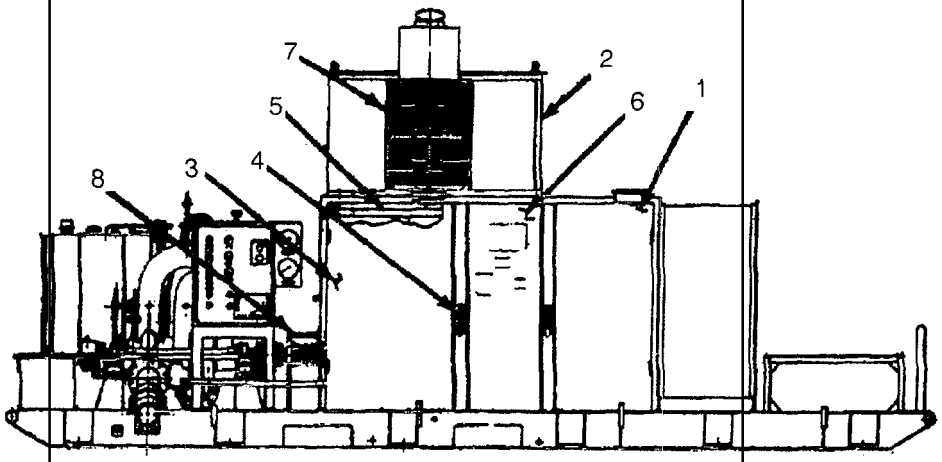
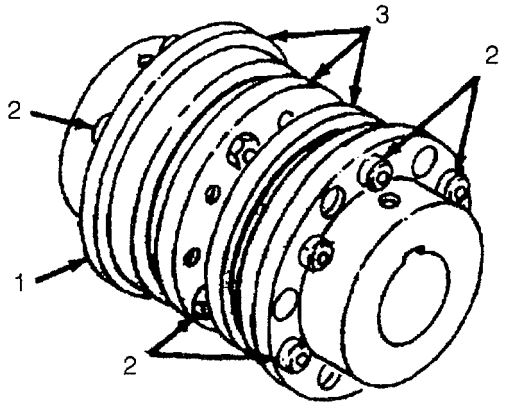
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 5 | Before | Engine Enclosure | Wipe all oily dirt, grease, and diesel fuel oil from engine enclosure components (1).<br>Inspect engine enclosure for secure mounting to the skid.<br>Check intake duct (2) for secure mounting to top of engine enclosure and distortion.<br>Check doors (3), handles (4), and hold opening devices (5) for proper operation.<br>Check removable side panels (6) for distortion.<br>Check muffler guard (7) for distortion.<br>Check coupling guard (8) for secure mounting and distortion.<br>  | Enclosure loose and/or panels not fitting correctly. |
| 6 | Before | Flexible Coupling | Check flexible coupling (1) for loose or missing hardware (2).<br>Check for cracks at bolt flanges (3).<br>  | Flexible coupling Hardware is loose or missing or coupling is cracked. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services - (Cont)**

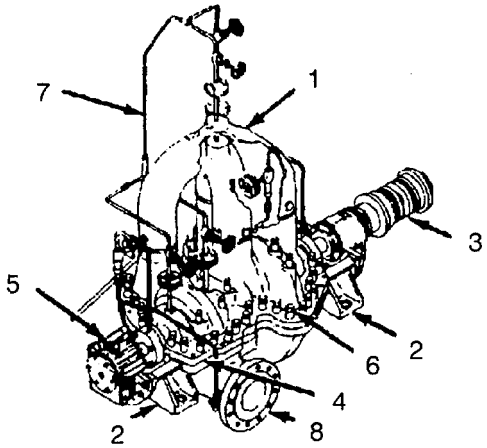
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 7 | Before | Pump Assembly | Check that pump assembly (1) is securely mounted to skid (2) and flexible coupling (3).<br>Check that pump body (4) and mechanical seal housings (5) are securely fastened together.<br><br>Check that all nuts and lockwashers (6) are tight and free of damage and corrosion.<br>Check piping assembly (7) for cracks and secure attachment<br><br>Check pump body (4) for cracks at mounting feet (2).<br>Check suction and discharge flanges (8) for cracks and distortion.<br>  <br> | Pump assembly or mounting hardware is loose or broken. There is evidence of Category Class III leaks or there are cracks.<br>to pump. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services - (Cont)**

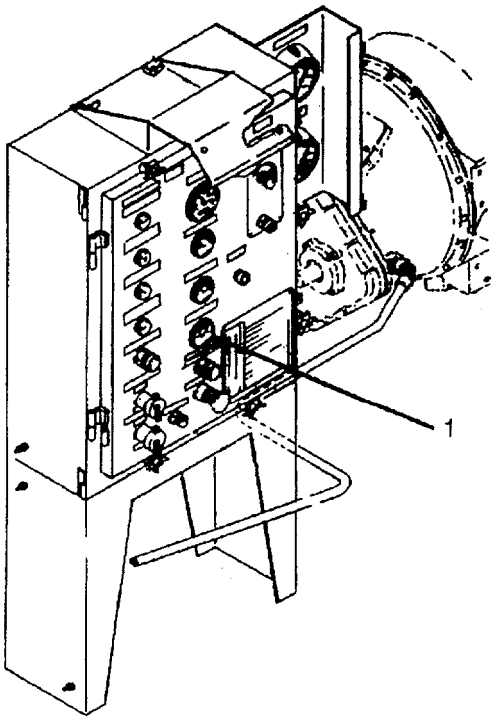
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 8 | Before | Battery System | Check the overall operation of the battery system by observing the control panel during startup and operation<br>Check the battery voltage. After switching on the control panel, observe BATTERY VOLTMETER (1) reading. The reading should be in the green.<br>  <br> | Voltmeter indicates other than green. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services - (Cont)**

| Item No. | Interval | Location<br>Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 9 | Before | Battery Cables | **WARNING**<br>**Do not smoke or use open flame or spark-producing equipment in the vicinity of battery.**<br>**CAUSTIC CHEMICALS IN BATTERIES**<br>**Serious injury could occur from the careless handling of storage batteries or battery electrolyte (acid). If acid is splashed on the skin, wash the affected area immediately with plenty of clean water. If acid is splashed in the eyes, wash immediately with plenty of clean water and get medical attention.**<br>**CAUTION**<br>**Avoid making contact across the two battery posts. This can result in severe arcing.**<br>**Damage to insulation of positive battery cable that would allow conductor to contact any metallic surface of the pump will cause battery charge to be drained.**<br>**Inspect for abraded or worn insulation of positive battery cable (10) and negative battery cable (11) and for worn or missing terminal covers (12).**<br>**Inspect for loose stud (13) and nut (14).** | There are signs of arcing.<br>Positive cable has damaged insulation. |

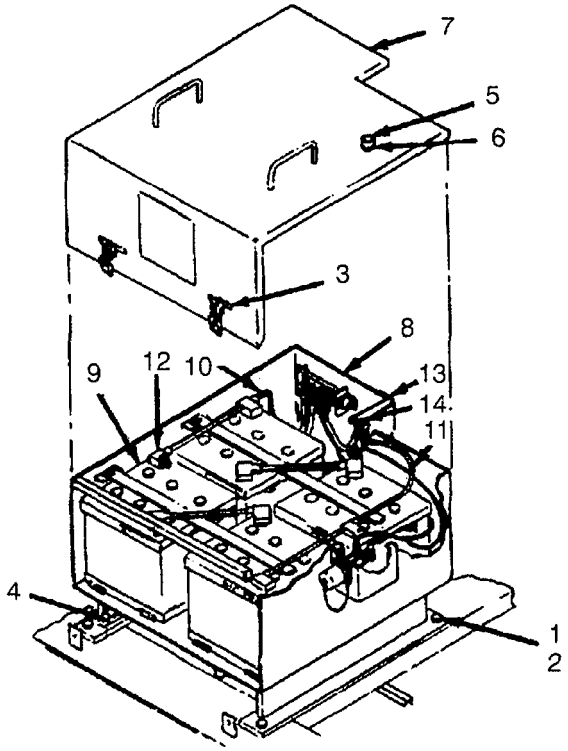


**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services - (Cont)**

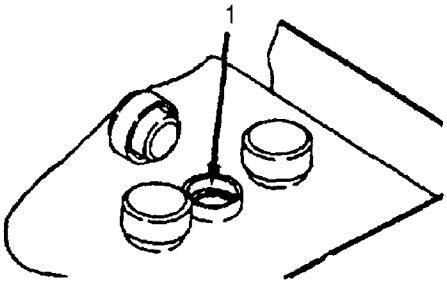
| Item No. | Interval | Location<br>Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 10 | Before | Batteries | **WARNING**<br>**Do not smoke or use open flame or spark-producing equipment in the vicinity of battery.**<br>**CAUSTIC CHEMICALS IN BATTERIES**<br>**Serious injury could occur from the careless handling of storage batteries or battery electrolyte (acid). If acid is splashed on the skin, wash the affected area immediately with plenty of clean water. If acid is splashed in the eyes, wash immediately with plenty of clean water and get medical attention.**<br>**CAUTION**<br>Avoid making contact across the two battery posts. This can result in severe arcing.<br>**NOTE**<br>Use distilled water or a good grade of drinking water (excluding mineral water).<br>Check electrolyte level. If low, add water up to split rings (1).<br>  <br> | Batteries are not properly secured. Electrolyte level is low. |
| 11 | Before | Conduit Layout | Visually inspect the conduit runs for security of all connectors and wiring.<br>Check for loose or missing conduit clamps and damaged or broken cable ties.<br>Check conduit for frayed or broken insulation. | Loose or missing conduit clamps. |
| 12 | Before | Junction Box | Check junction boxes for secure attachment to mountings.<br>Visually inspect for cracks in welds around the junction box assembly.<br>Check connectors mounted to junction box for security of attachment. | Cracked or loose mounting, loose connectors. |
| 13 | Before | Network Cable | Check network cables for frayed insulation, broken wires, and other damage.<br>Check for loose connections. | Bare or broken wires are found. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services (Cont)**

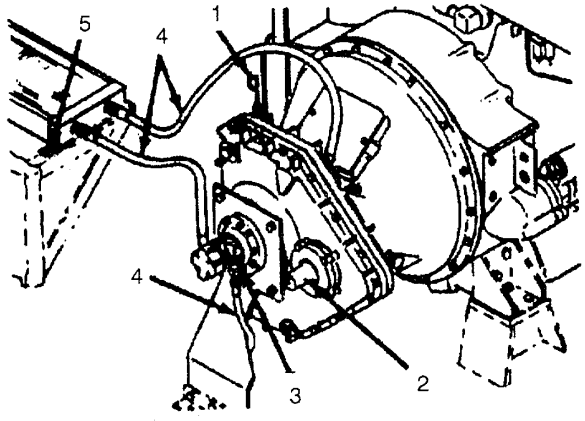
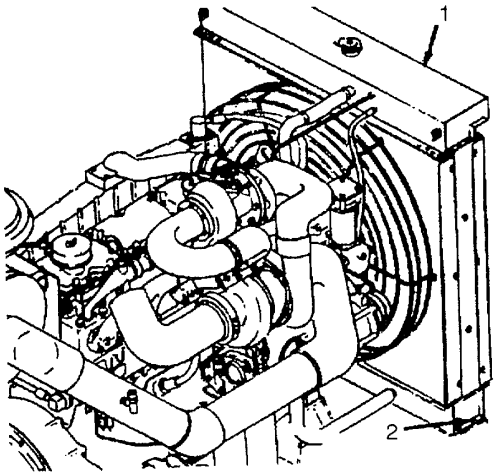
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 14 | Before | Speed Increaser | Check oil level using dipstick (1).<br><br>Check oil seal (2), pump gasket (3), and hoses (4) for signs of leakage.<br><br>Check heat exchanger for secure attachment (5) and signs of leakage.<br><br>  <br> | Low oil indication. Loose or dam aged components. |
| 15 | Before | Radiator As-sembly (1) | Check radiator for loose or missing mounting low hardware (2) coolant level.<br><br>  <br> | Low coolant Level. Loose or damaged components. Category Class III coolant leaks. |

**Table 2-1. Operator/Crew Preventive Maintenance Checks and Services**

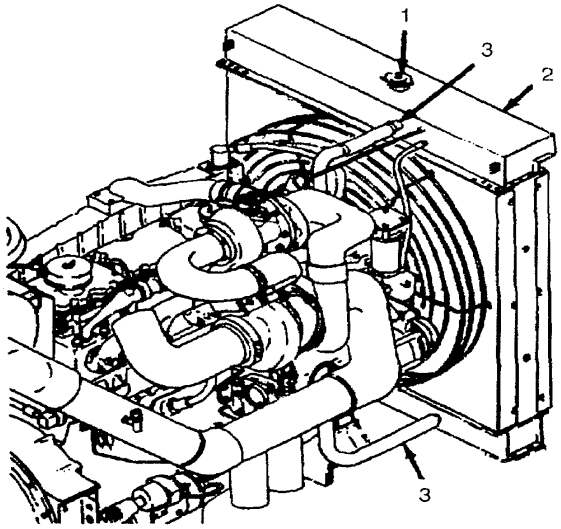
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| | | Radiator Assembly (Cont) | **WARNING**<br>Care should be taken when removing radiator cap. Steam or hot coolant under pressure may cause injury to personnel.<br><br>Check coolant level (1). Coolant level should be up to the bottom of the fill neck in the radiator fill tank (2).<br><br>Check for leaks around radiator assembly and attaching hoses (3).<br><br>  <br> | |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services (Cont)**

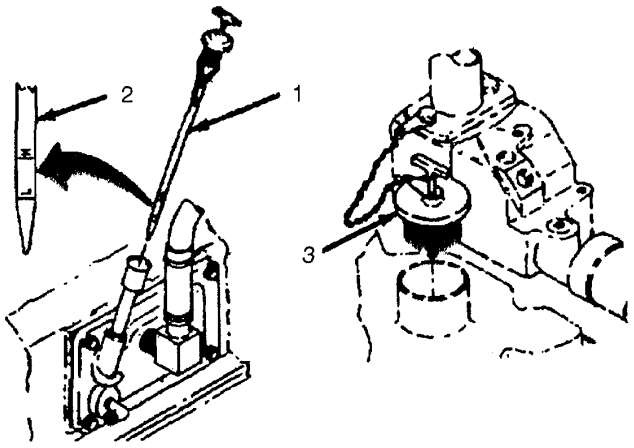
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 16 | Before | Lubrication System- Oil Level | With engine level and not operating, check oil level Pull out oil dipstick (1) and wipe with clean lint free cloth.<br><br>Insert oil dipstick (1) as far as it will go into engine, then pull it out again.<br><br>Engine oil should coat oil dipstick (1 to the) second mark "H" (high) (2).<br><br>**CAUTION**<br>**Do not overfill crankcase with oil. Oil will be blown out through the crankcase breather if crankcase is overfilled.**<br><br>If oil coating is below second mark, "H" (high), immediately add oil to bring level up to second mark on the oil dipstick. Again check oil level and be sure oil coats oil dipstick to second mark, “H" (high) Check that oil cover (3) is tight.<br><br>  <br> | Oil level is low or Category Class III oil leak is present. |

**Table 2-1. Operator/Crew Preventive Maintenance Checks and Services**

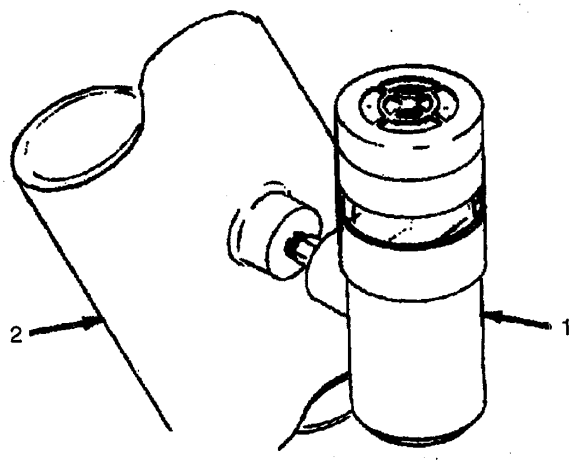
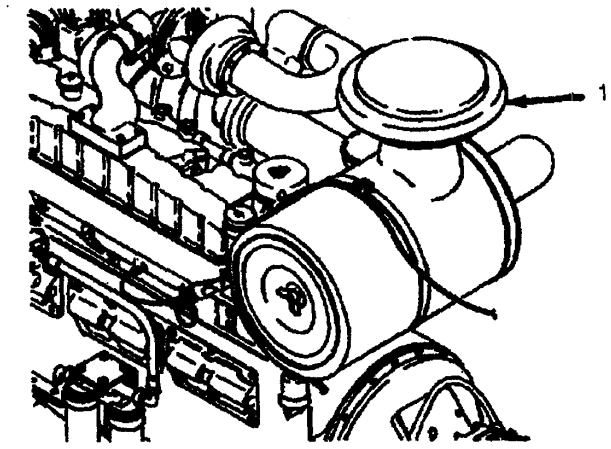
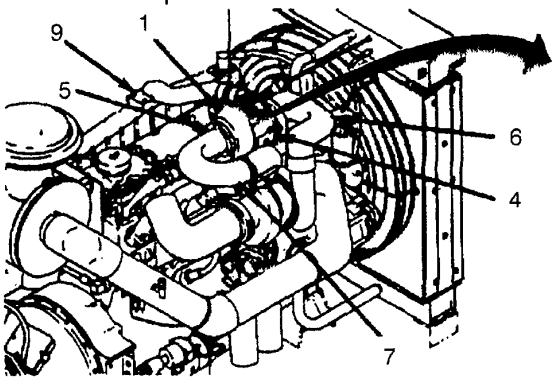
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 17 | Before | Air Cleaner Assembly | Check air cleaner restriction indicator (1) located on the air inlet tube assembly (2). If red band appears in window press and release reset button. If red band reappears refer to Table 3 -1, Troubleshooting.   | Air cleaner as sembly is clogged or re stricted. |
| 18 | Before | Rain Cap | Check rain cap (1) for damage or blockage.   | Rain cap missing. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services (Cont)**

| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 19 | Before | Turbo charger HC-3 (1) | **WARNING**<br>Severe burns can be caused by turbo- charger and exhaust system heated present. during operation of the engine. If the engine has been running, do not touch the turbocharger or exhaust system components until they have cooled.<br><br>Inspect turbocharger intake oil line (2) and return oil line (3) for leaks, wear, and damage.<br><br>Inspect turbocharger air flanges (4) and exhaust flanges (5) for cracking or looseness at the connections to the suction pipe (6) and exhaust pipe (7).<br><br>Inspect exhaust manifold flange (8) and intake manifold flange (9) for secure mounting to the engine block If they are loose, vibration will damage the turbocharger. | Category Class III oil leak is present.<br>Broken or loose flanges or connections. |



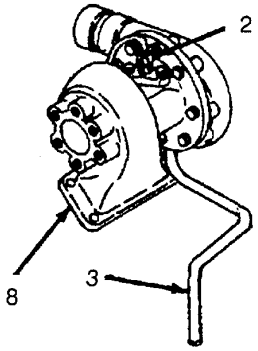



**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services (Cont)**

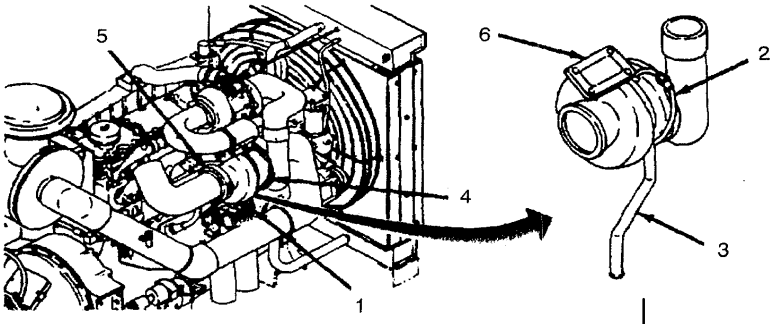
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 20 | Before | Turbocharger T-18A (1) | **WARNING**<br>**Severe burns can be caused by turbocharger and exhaust system heated during operation of the engine. If the engine has been running, do not touch the turbocharger or exhaust system components until they have cooled.**<br><br>Inspect turbocharger intake oil line (2) and return oil line (3) for leaks, wear, and damage.<br><br>Inspect turbocharger air connection (4) and exhaust connection (5) for looseness and broken clamps.<br><br>Inspect exhaust flange (6) for secure mounting. If loose, vibration will damage the turbocharger.<br><br>  <br> | Category Class III oil leak is present.<br>Broken or loose flanges or connections. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services (Cont)**

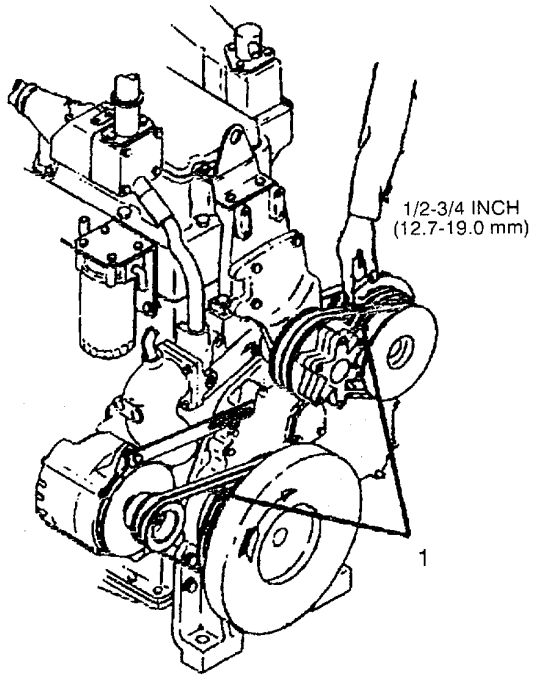
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 21 | Before | V-Belts | Visually inspect V-belts (1) for cuts, tears, and frayed edges, and for shiny surfaces of V portion of belt which indicate belt is slipping.<br><br>With unit shut down, check V-belt tension. When V-belt is pressed with forefinger at the midpoint between pulleys, it should deflect 1/2 to 3/4 inch (12.7 to 19.0 mm).<br><br>  <br> | V-belt is broken, excessively loose, or slipping. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services (Cont)**

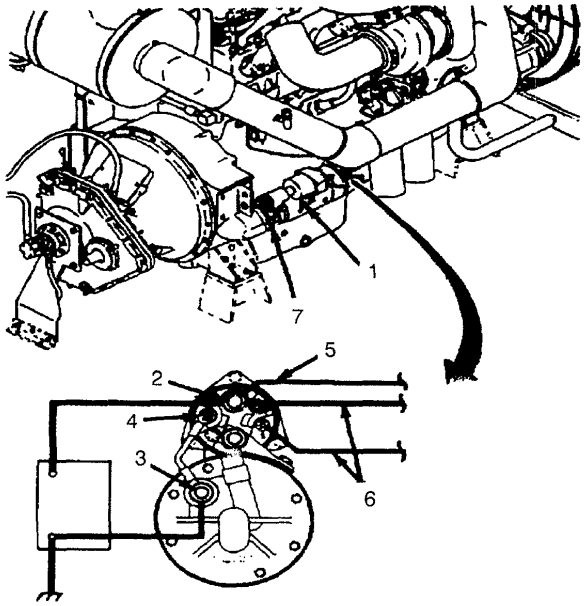
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 22 | Before | Starter Assembly (1) | Visually inspect positive (2) and negative (3) starter posts for loose connections.<br>.<br>Visually inspect ground return terminals (4), starter switch terminals (5), and magnetic switch terminals (6) for loose ring terminals and connections.<br><br>Visually inspect starter (1) for loose mounting screws (7).<br><br>Visually inspect all wire for burned or melted insulation and frayed or worn spiral wrap tubing.<br><br>  <br> | Starter connections or mounting screws are loose.<br>Burned or melted insulation. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services (Cont)**

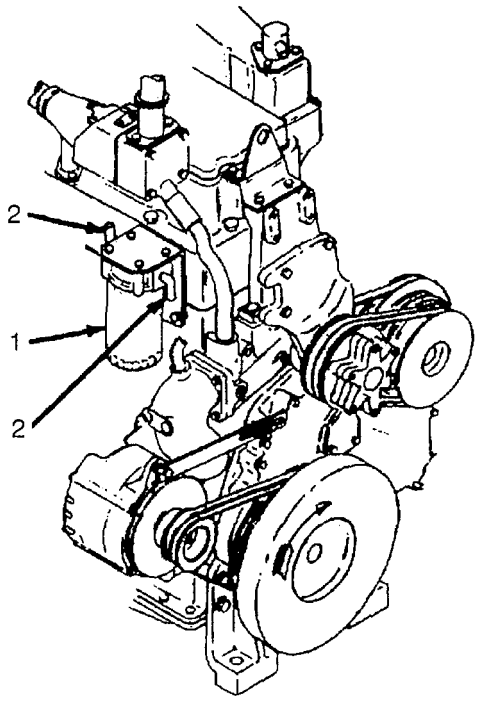
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 23 | Before | Corrosion Resistor Assembly | Check filter (1) for leaks.<br><br>Check elbows (2) for signs of leaks.<br><br>  <br> | Category Class III leakage is present. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services (Cont)**

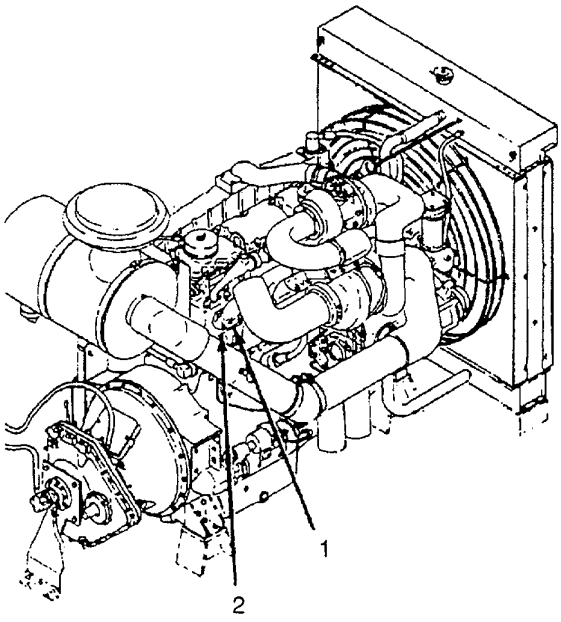
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 24 | Before | Exhaust Manifold Assembly | Check exhaust manifold (1) for loose or missing hardware.<br><br>Check for cracks in exhaust manifold(1).<br><br>Check for exhaust leakage between exhaust manifold (1) and cylinder head (2).<br><br>  <br> | Missing hardware cracks, or leaks are present. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services (Cont)**

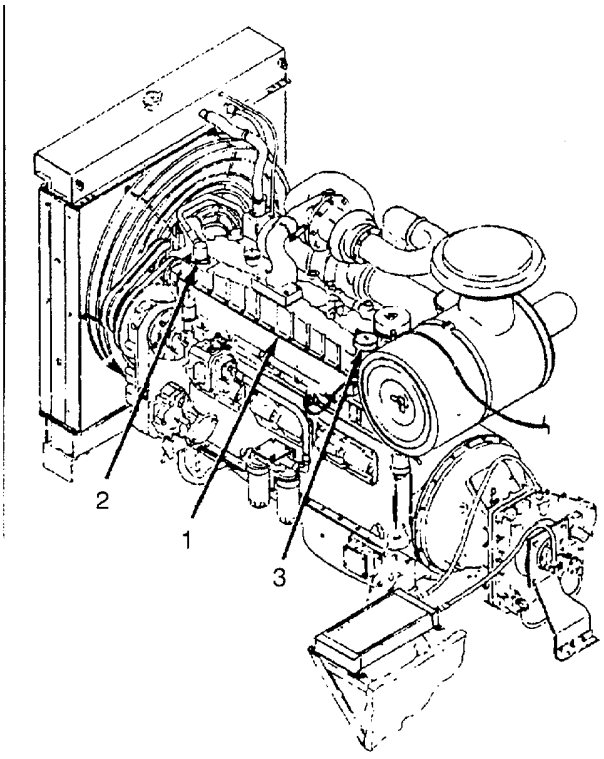
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 25 | Before | After Cooler | Check after cooler (1) for loose or missing hardware.<br><br>Check for cracks in after cooler (1).<br><br>Check for coolant leaks at coolant inlet (2) and outlet (3) to after cooler.<br><br>  | Loose or missing hardware or Category Class III leaks are found. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services (Cont)**

| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 26 | Before | Idler Assembly | Check idler assembly (1) for loose or missing hardware.<br><br>Check pulley (2) for excessive wear and cracks. | Evidence of cracks or missing hardware is found. |
| 27 | Before | Water Pump Assembly | Check water pump assembly (3) for loose or missing hardware<br><br>Check for coolant leaks. | Category Class III leakage or missing hardware is found. |

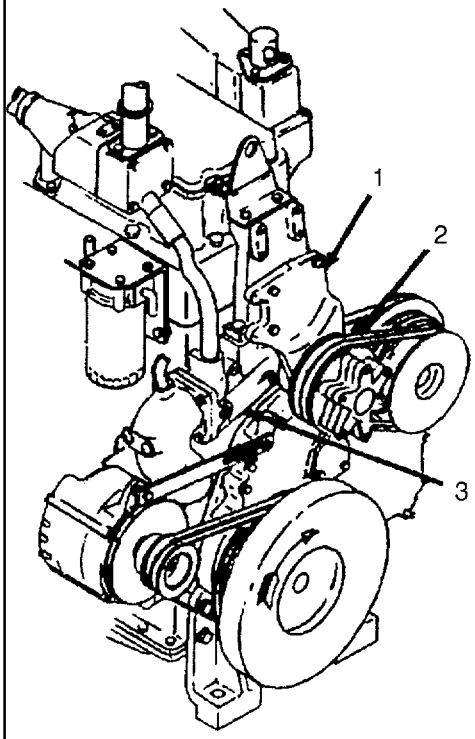


**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services (Cont)**

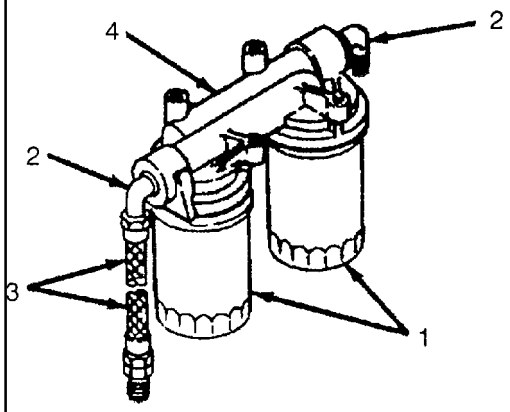
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 28 | Before | Fuel Filters (1) | **WARNING**<br>Death or serious injury could occur if diesel fuel is not handled carefully.<br><br>Use in a well-ventilated area away from open flame, arcing equipment, ignition sources, heaters, or excessive heat. Be certain that fuel lines and connections are secure. Do not inhale vapor. Do not overfill fuel tank. Engine must be turned off and cooled before refueling. Use proper refueling procedures and equipment to avoid spillage. Do not run engine near open fuel containers. DO NOT SMOKE.<br><br>Check fuel filters (1) for leaks.<br><br>Check elbows (2) flexible hose (3), and fuel filter head (4) for signs of leaks.<br><br>  <br> | Indications of fuel leakage or fire hazard exists. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services (Cont)**

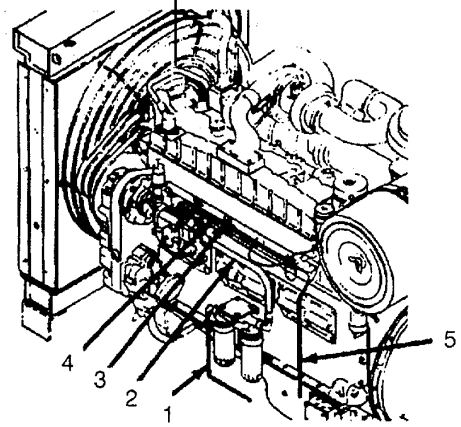
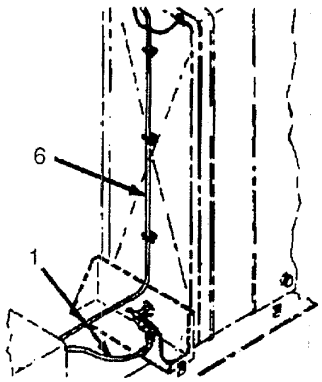
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 29 | Before | Fuel Lines and Fittings | **WARNIN**G<br>Be certain that fuel lines and connections are secure. Do not inhale vapor. Do not overfill fuel tank. Engine must be turned off and cooled before refueling. Use proper refueling procedures and equipment to avoid spillage. Do not run engine near open fuel containers. DO NOT SMOKE.<br><br>Inspect the following fuel lines for leaks along the length of each line for holes, cracks, worn spots, kinks or looseness, and other damage that would cause deterioration during operation resulting in fuel leaks or restricted fuel flow. Check that each line is securely mounted and during operation would be free of vibration that would cause wear or abrasion.<br><br>Fuel supply line (1)<br>Filter to pump line (2)<br>Fuel rail pressure line (3)<br>Injector fuel drain return line (4)<br>Back leakage line (5)<br>Fuel return line (6)<br><br>  <br><br>  <br> | Indications of fuel leakage or fire hazard exist. Damaged fuel lines or components may fail. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services (Cont)**

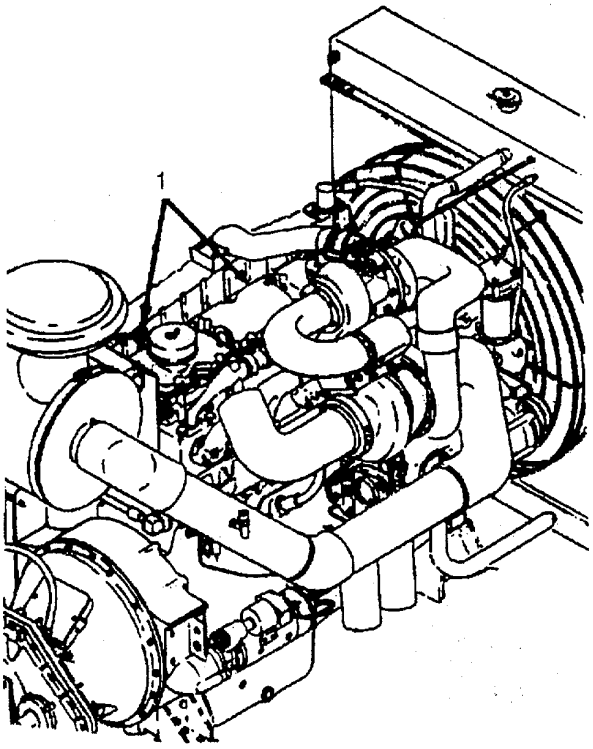
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 30 | Before | Rocker Lever Cover Assembly (1) | Check rocker lever cover assemblies (1) for loose or missing hardware.<br><br>Check for cracks in rocker lever covers.<br><br>Check for leaks at mounting surfaces.<br><br>  | Cracks or Category Class III leaks are present. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services (Cont)**

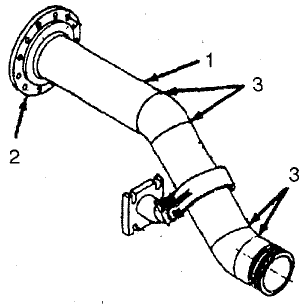
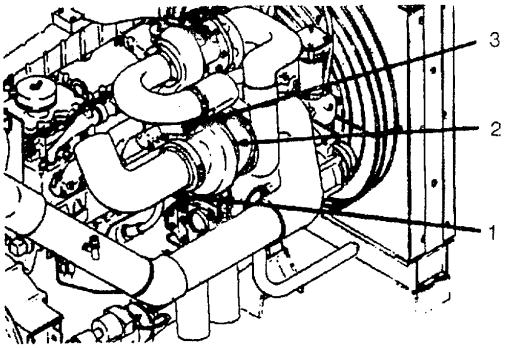
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 31 | Before | Suction and Discharge Pipe Adapter (1) | Check for fluid leaks or cracks in flanges (2).<br><br>Check for cracked welds (3).<br><br>Check for loose or missing hardware.<br>  | Category Class III fluid leaks or cracks are present. |
| 32 | During | Exhaust System | **WARNING**<br>Severe burns can be caused by exhaust system components heated during operation of the engine. If the engine has been running, do not touch any components of the exhaust system until they have cooled.<br><br>Check that spark arrestor and exhaust guard are securely mounted.<br><br>Inspect muffler pipes (1) between muffler and turbocharger (2) for loose connections, holes, or other damage.<br><br>Inspect flange (3) connection at turbocharger (2). The flange must be secured with all mounting bolts and show no Indications of cracks or leaks.<br>  | Exhaust system is leaking or components are loose. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services (Cont)**

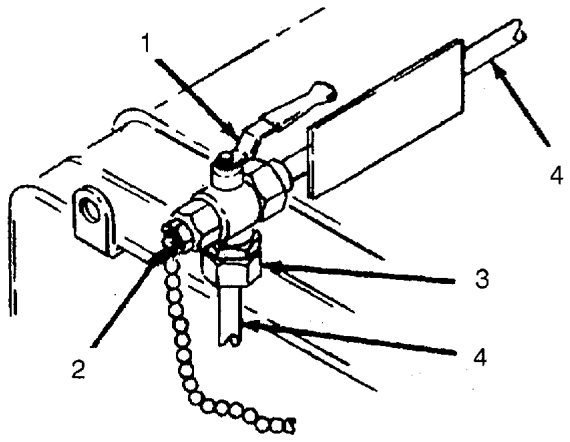
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 33 | During | 3-Way Selector Valve and Fuel Line Assembly. | **WARNING**<br>Death or serious injury could occur if diesel fuel is not handled carefully. Use in a well-ventilated area away from open flame, arcing equipment, ignition sources, heaters, or excessive heat. Be certain that fuel lines and connections are secure. Do not inhale vapor. Do not over fill fuel tank. Engine must be turned off and cooled before refueling. Use proper refueling procedures and equipment to avoid spillage. Do not run engine near open fuel containers. DO NOT SMOKE.<br><br>**CAUTION**<br>Both supply and return 3-way fuel valves must be aligned to the same selected fuel supply (auxiliary or unit tank). Alignment to different supplies could cause engine overheating, shutdown from rapid fuel exhaustion, or fuel system overflow and the associated fire hazards.<br><br>Visually check for fuel leaks at 3-way valve stems (1), cap plugs for auxiliary lines (2), connectors (3), and fuel line assemblies (4).<br><br>  <br> | Category Class III fuel leaks or fire hazard leakage are found. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services (Cont)**

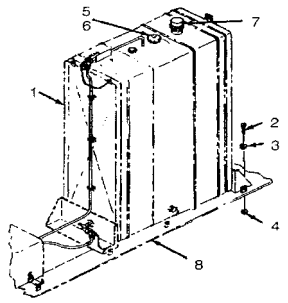
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 34 | During | Fuel Tank Assembly | **WARNING**<br>Death or serious injury could occur if diesel fuel is not handled carefully. Use in a well-ventilated area away from open flame, arcing equipment, ignition sources, heaters, or excessive heat. Be certain that fuel lines and connections are secure. Do not inhale vapor. Do not over fill fuel tank. Engine must be turned off and cooled before refueling. Use proper refueling procedures and equipment to avoid spillage. o not run engine near open fuel containers. DO NOT SMOKE.<br><br>**CAUTION**<br>Condensed moisture in the fuel tank is harmful to engine operation. Keep fuel tank filled between periods of operation to reduce condensation.<br><br>Inspect fuel tank (1) for loose screws (2), washers (3), or nuts (4), and for dents, leaks, and other damage. Visually check fuel tank (1) for physical damage that could cause leaks or contamination of fuel supply. Remove fuel tank cap (5) and check operation of valve inside fuel tank cap. Check that gasket (6) is present and in good condition.<br><br>Check that liquid level gage (7) is legible and accurately registers level of fuel in tank.<br><br>Check fuel tank assembly (1) and surrounding area of skid frame (8) for corrosion.<br><br>  <br> | Category Class III fuel leakage or fire hazard leakage is found.<br><br>Tank cap missing. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services (Cont)**

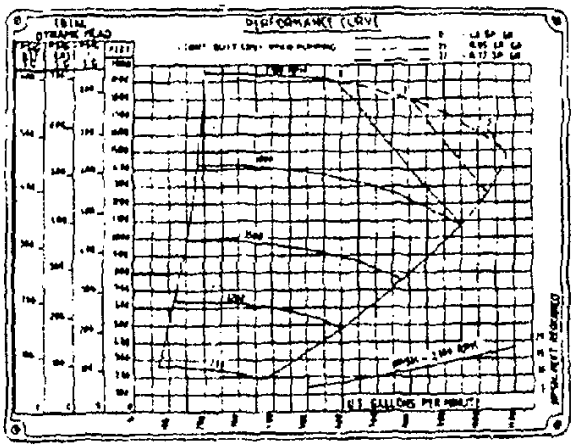
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 35 | During | Pump Assembly | While unit is operating, listen to the pump assembly components.<br><br>Excessive noise in the pump body may indicate impeller binding or misalignment. A banging noise in the pump body may be impeller cavitation. This is corrected by reducing engine speed; check that the suction gate valve is fully open. If cavitation occurs, consult the performance data plate for proper engine speed for the specific gravity liquid being pumped.<br><br>Excessive vibration may be caused by flexible coupling misalignment.<br><br>Inspect all pumping assembly fittings and flanges for leakage.<br><br>  | Equipment damage is indicated by continuous, excessive noise There is evidence Category Class III leaks. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services (Cont)**

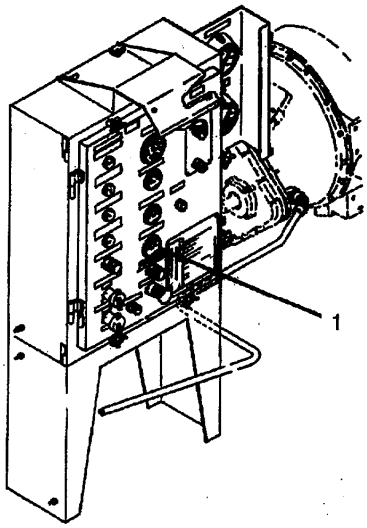
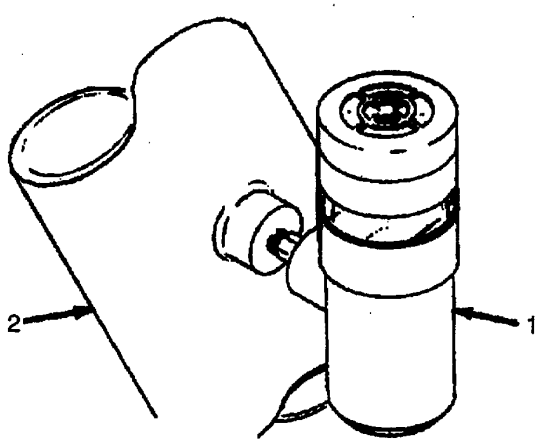
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 36 | During | Battery System | Check the overall operation of the battery system by observing the control panel during operation.<br><br>Check the battery voltage. Observe BATTERY VOLTMETER (1) reading. The reading should be in the green.<br>  <br> | Voltmeter indicates other. than green |
| 37 | During | Air Cleaner Assembly | Check air cleaner restriction indicator (1) located on the air inlet tube assembly (2). If red band appears in window, press and release reset button. If red band reappears, refer to Table 3-1, Troubleshooting.<br>  <br> | Air cleaner is clogged assembly or restricted. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services - (Cont)**

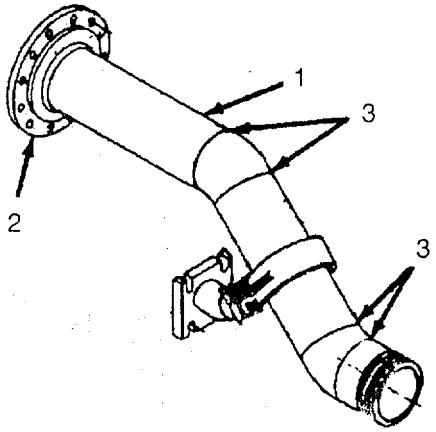
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 38 | During | Suction and Discharge Pipe Adapters (1) | Check for fluid leaks or cracks in flanges (2).<br>Check for cracked welds (3).<br><br>Check for loose or missing hardware.<br><br>  <br> | Category Class III fluid leaks or cracks are present. |
| 39 | After | 3-Way Selector Valve and Fuel Line Assembly | **WARNING**<br>Death or serious injury could occur if diesel fuel is not handled carefully. Use in a well-ventilated area away from open flame, arcing equipment, ignition sources, heaters, or excessive heat. Be certain that fuel lines and connections are secure. Do not inhale vapor. Do not overfill fuel tank. Engine must be turned off and cooled be- fore refueling. Use proper refueling procedures and equipment to avoid spillage. Do not run engine near open fuel containers. DO NOT SMOKE.<br><br>**CAUTION**<br><br>Both supply and return 3-way fuel valves must be aligned to the same selected fuel supply (auxiliary or unit tank). Alignment to different supplies could cause engine overheating, shut- down from rapid fuel exhaustion, or fuel system overflow and the associated fire hazards. | Category Class III fuel leaks or fire hazard leakage are found. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services - (Cont)**

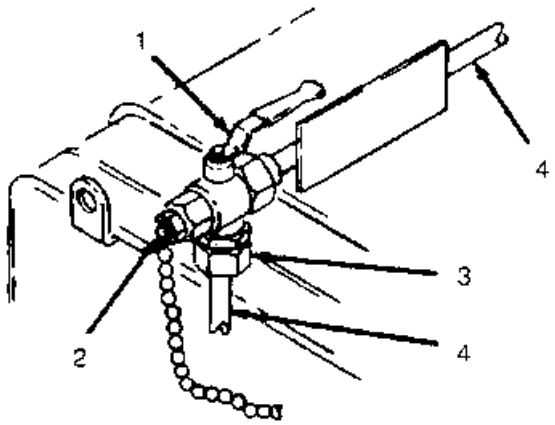
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| | | 3-Way Selector Valve and Fuel Line Assembly (Cont) | Visually check for fuel leaks at 3-way valve stems (1), cap" plugs for auxiliary lines (2), connectors (3), and fuel line assemblies (4).   | |
| 40 | After | Fuel Tank Assembly | **WARNING**<br>Death or serious injury could occur if diesel fuel is not handled carefully. Use in a well-ventilated area away from open flame, arcing equipment, ignition sources, heaters, or excessive heat. Be certain that fuel lines and connections are secure. Do not inhale vapor. Do not overfill fuel tank. Engine must be turned off and cooled before refueling. Use proper refueling procedures and equipment to avoid spillage. Do not run engine near open fuel containers. DO NOT SMOKE.<br>**CAUTION**<br>Condensed moisture in the fuel tank is harmful to engine operation. Keep fuel tank filled between periods of operation to reduce condensation. | Category Class III fuel leakage or fire hazard leakage is found. Tank cap missing. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services - (Cont)**

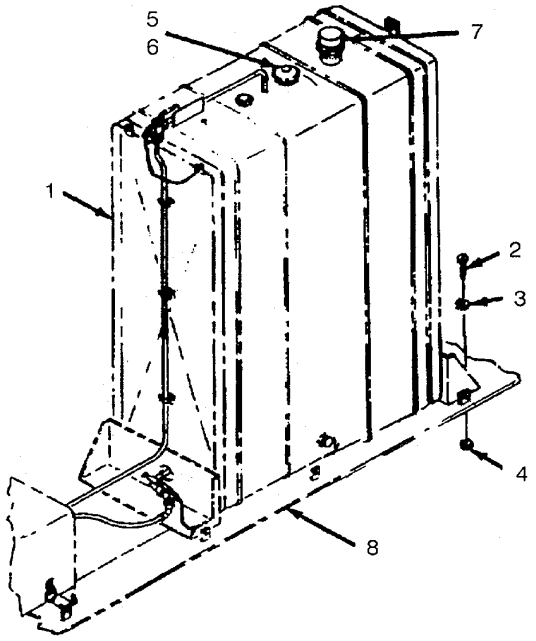
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| | | Fuel Tank Assembly (Cont) | Inspect fuel tank (1) for loose screws (2), washers (3), or, nuts (4), and for dents, leaks, and other damage.<br>Visually check fuel tank (1) for physical damage that could cause leaks or contamination of fuel supply.<br>Remove fuel tank cap (5) and check operation of valve inside fuel tank cap. Check that gasket (6) is present and in good condition.<br>Check that liquid level gage (7) is legible and accurately registers level of fuel in tank.<br>Check fuel tank assembly (1) and surrounding area of skid frame (8) for corrosion.<br>  <br> | |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services - (Cont)**

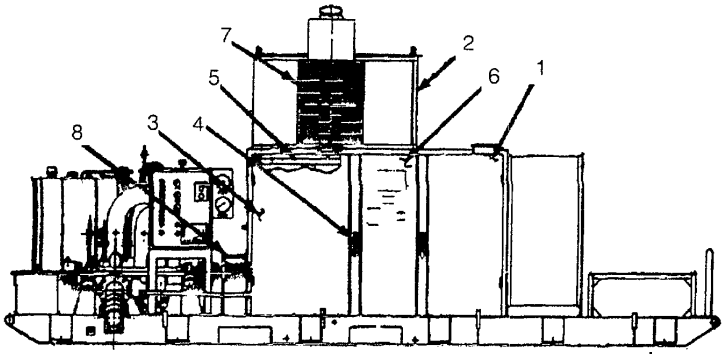
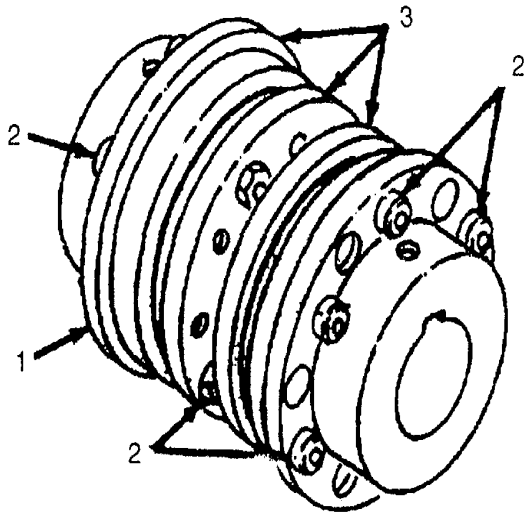
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 41 | After | Engine Enclosure | Wipe all oily dirt, grease, and diesel fuel oil from engine enclosure components (1).<br>Inspect engine enclosure for secure mounting to the skid.<br>Check intake duct (2) for secure mounting to top of engine enclosure and distortion.<br>Check doors (3), handles (4), and hold opening devices (5) for proper operation.<br>Check removable side panels (6) for distortion.<br>Check muffler guard (7) for distortion.<br>Check coupling guard (8) for secure mounting and distortion.<br>  | Enclosure loose. Panels not fitting correctly. |
| 42 | After | Flexible Coupling | Check flexible coupling (1) for loose or missing hardware (2).<br>Check for cracks at bolt flanges (3).<br>  | Flexible coupling hardware is loose or missing or coupling is cracked. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services - (Cont)**

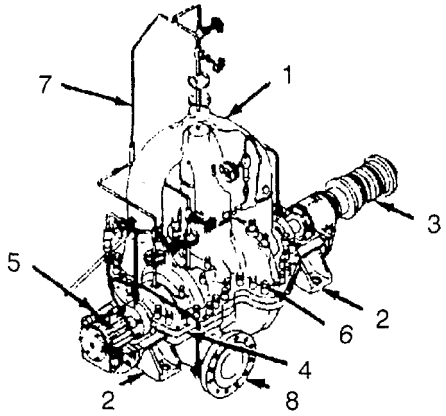
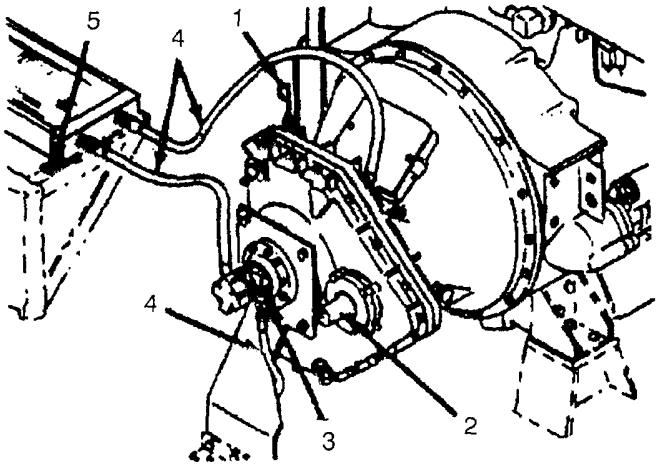
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 43 | After | Pump Assembly | Check that pump assembly (1) is securely mounted to skid (2) and flexible coupling (3).<br>Check that pump body (4) and mechanical seal housings (5) are securely fastened together.<br>or broken. There<br>Check that all nuts and lockwashers (6) are tight and free of damage and corrosion.<br>Check piping assembly (7) for cracks and secure attachment to pump.<br>Check pump body (4) for cracks at mounting feet (2).<br>Check suction and discharge flanges (8) for cracks and distortion.<br>  <br> | Pump assembly or bearing housing mounting hardware is loose<br><br>is evidence of Category Class III leaks or there are cracks. |
| 44 | After | Speed Increaser | Check oil level using dipstick (1).<br>Check oil seal (2), pump gasket (3), and hoses (4) for signs of leakage.<br><br>Check heat exchanger for secure attachment (5) and signs of leakage.<br>  <br> | Low oil indication.<br>Loose or damaged. components.<br><br>Class III leakage. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services - (Cont)**

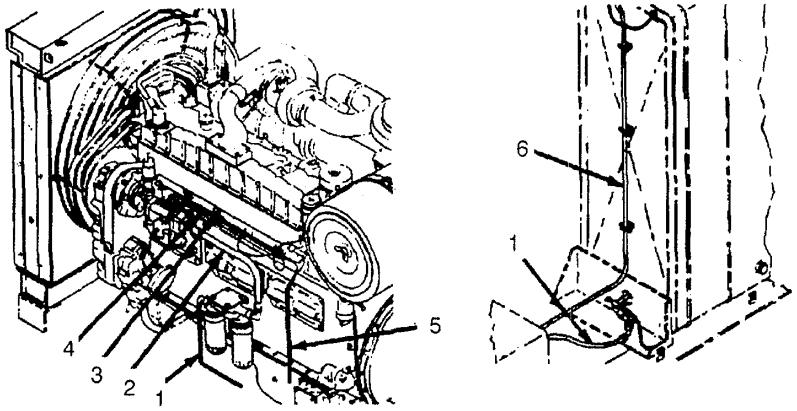
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 45 | After | Fuel Lines and Fittings | **WARNING**<br>**Be certain that fuel lines and connections are secure. Do not inhale vapor. Do not overfill fuel tank. Engine must be turned off and cooled before refueling. Use proper refueling procedures and equipment to avoid spillage. Do not run engine near open fuel containers. DO NOT SMOKE.**<br><br>Inspect the following fuel lines for leaks along the length of each line for holes, cracks, worn spots, kinks or looseness, and other damage that would cause deterioration during operation resulting in fuel leaks or restricted fuel flow. Check that each line is securely mounted and during operation would be free of vibration that would cause wear or abrasion.<br><br>Fuel supply line (1)<br>Filter to pump line (2)<br>Fuel rail pressure line (3)<br>Injector fuel drain return line (4)<br>Back leakage line (5)<br>Fuel return line (6)<br><br>  | Indications of fuel leakage or fire hazard exist. Damaged fuel lines or components may fail. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services - (Cont)**

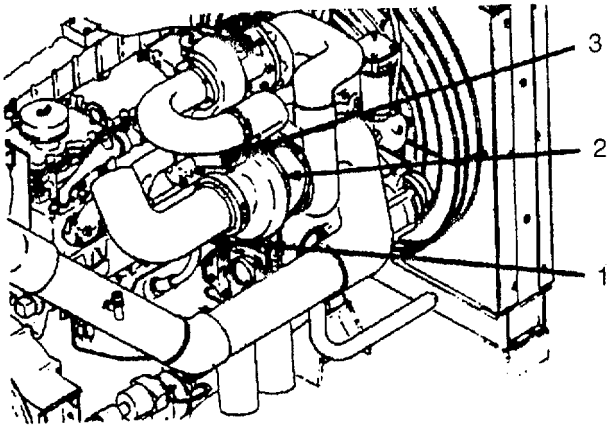
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 46 | Weekly | Exhaust System | **WARNING**<br>**Severe burns can be caused by exhaust system components heated during operation of the engine. It the engine has been running, do not touch any components of the exhaust system until they have cooled**.<br><br>Check that spark arrestor and exhaust guard are securely mounted.<br><br>Inspect muffler pipes (1) between muffler and turbocharger (2) for loose connections, holes, or other damage.<br><br>Inspect flange (3) connection at turbocharger (2). The flange must be secured with all mounting bolts and show no indications of cracks or leaks.<br><br>  <br> | Exhaust system is leaking or components are loose. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services - (Cont)**

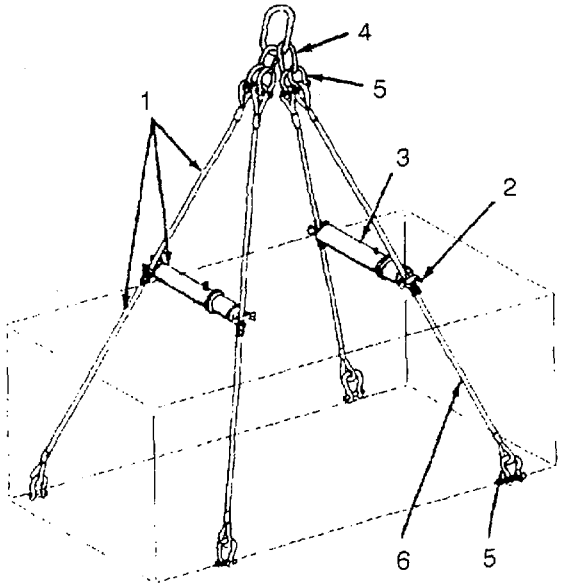
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 47 | Weekly | Lifting Bail Assembly | Check that nuts (2) are not loose or corroded.<br>Check for cracks in skid base metal and/or welds.<br>Check spreader bar (3) for wear, cracks, and general overall condition.<br>Check triple ring (4) for overall condition.<br>Check shackles (5) for overall condition.<br>Check wire (6) for corrosion, fraying and overall condition.<br>  | Loose hardware.<br>Worn, frayed or corroded wire cable.<br>Damaged components. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services - (Cont)**

| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 48 | Weekly | Grounding Assembly | Check that grounding rod (1) is securely inserted into ground.<br>Check that grounding wire (2) is secured to skid grounding pad (3).<br>Check grounding wire (2) for broken or frayed insulation or wires.<br>Check connectors (4) for tight electrical connection. | Grounding assembly is not secure. |

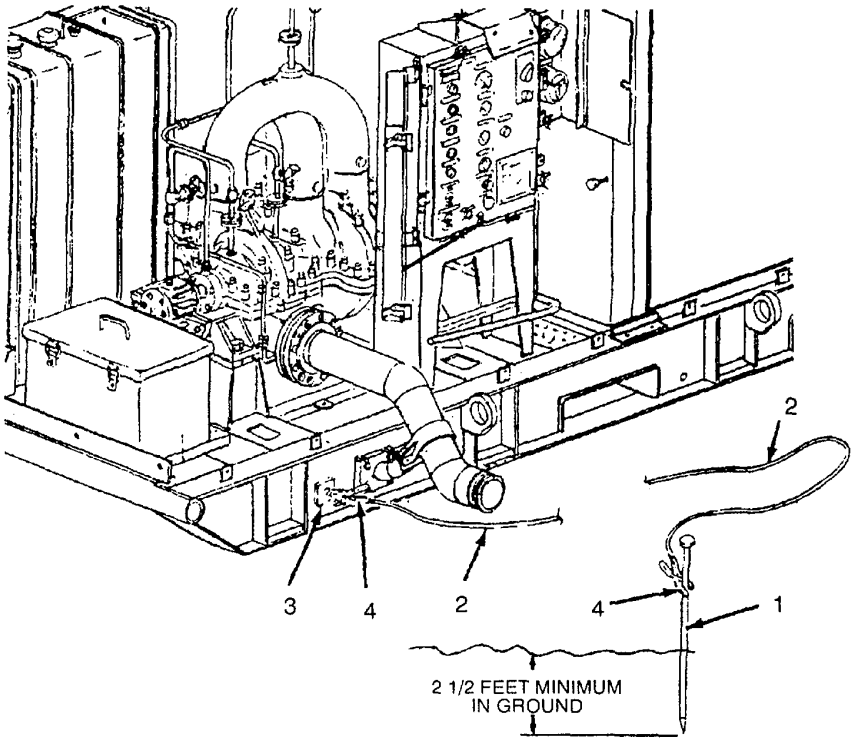


**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services - (Cont)**

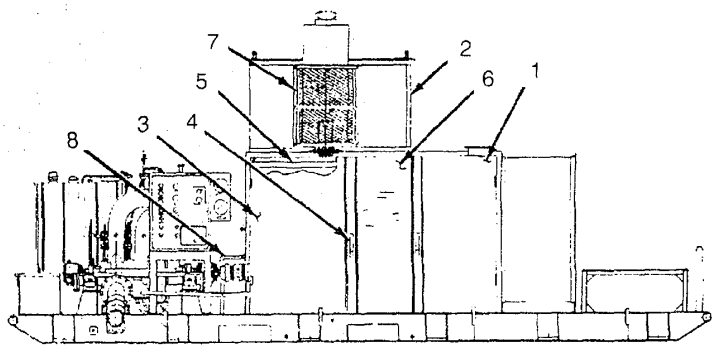
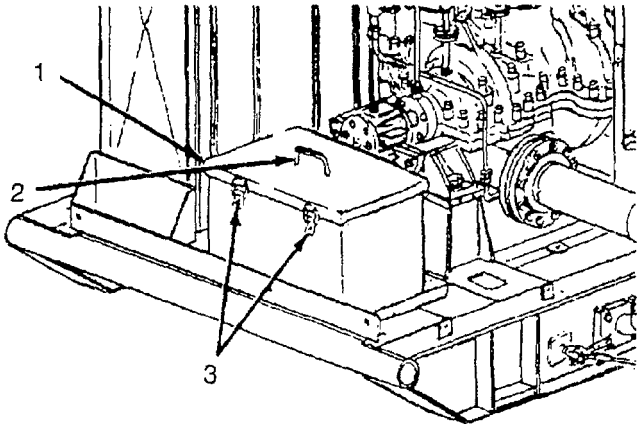
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 49 | Weekly | Engine Enclosure | Wipe all oily dirt, grease, and diesel fuel oil from engine enclosure components (1).<br>Inspect engine enclosure for secure mounting to the skid<br>Check intake duct (2) for secure mounting to top of engine enclosure and distortion.<br>Check doors (3), handles (4), and hold opening devices (5) for proper operation.<br>Check removable side panels (6) for distortion.<br>Check muffler guard (7) for distortion.<br>Check coupling guard (8) for secure mounting and distortion.<br>  | Enclosure loose.<br>Panels not fitting correctly. |
| 50 | Weekly | Storage Box and Cover | Wipe all oily dirt, grease, and diesel fuel oil from storage box and cover (1).<br>Check storage box and cover (1) for secure mounting to the skid.<br>Check handle (2) and latches (3) for proper operation.<br>Check sides of storage box and cover (1) for distortion.<br>  | Loose or damaged storage box. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services - (Cont)**

| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 51 | Weekly | Battery Box | Visually inspect for:<br>Loose, damaged, or corroded screws (1) or washers (2).<br>Damaged or corroded catches (3) or latches (4).<br>Obstructed Breather (5).<br>Check for presence and condition of gasket (6).<br>Physical damage to either battery box top (7) or bakery box (8) that would indicate possible damage to enclosed batteries (9).<br>Corrosion or acid leakage at drain holes in bottom of battery box. | There are signs of battery acid leaks. |
| 52 | Weekly | Battery Cables | **WARNING**<br>**Do not smoke or use open flame or spark-producing equipment in the vicinity of battery.**<br>**CAUSTIC CHEMICALS IN BATTERIES**<br>**Serious injury could occur from the careless handling of storage batteries or battery electrolyte (acid). If acid is splashed on the skin, wash the affected area immediately with plenty of clean water. If acid is splashed in the eyes, wash immediately with plenty of clean water and get medical attention.**<br>**CAUTION**<br>**Avoid making contact across the two battery posts This can result in severe arcing.**<br>**Damage to insulation of positive battery cable that would allow conductor to contact any metallic surface of the pump will cause battery charge to be drained.** | There are signs of arcing. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services - (Cont)**

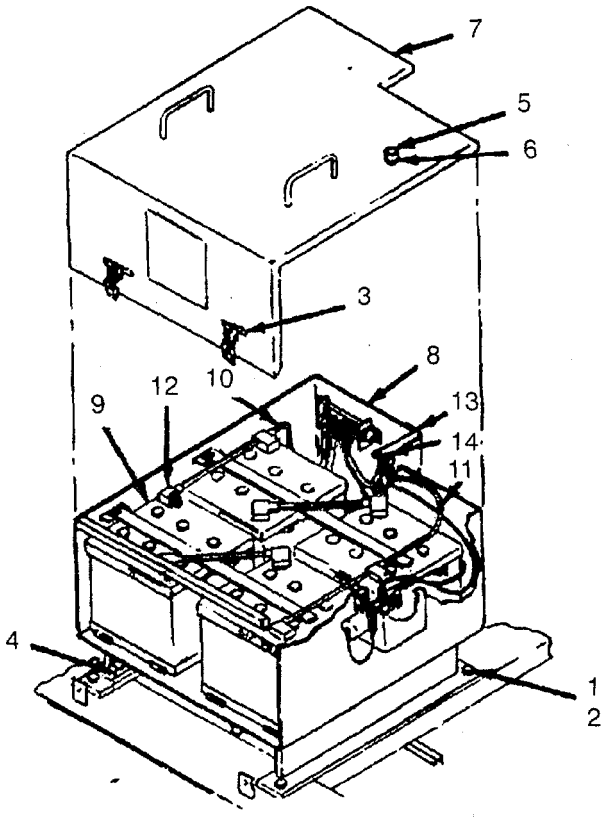
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| | | Battery Cables (Cont) | Inspect for abraded or worn insulation of positive battery cable (10) and negative battery cable (11) and for worn or missing terminal covers (12).<br>Inspect for loose stud (13) and nut (14).<br>  <br> | |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services - (Cont)**

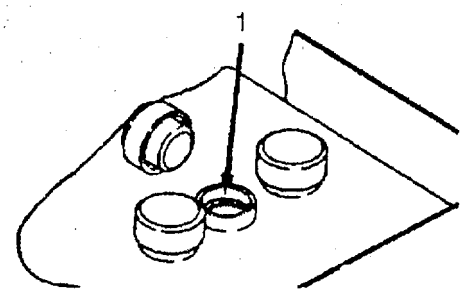
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 53 | Weekly | Batteries | **WARNING**<br>**Do not smoke or use open flame or spark-producing equipment in the vicinity of battery.**<br><br>**CAUSTIC CHEMICALS IN BATTERIES**<br><br>**Serious injury could occur from the careless handling of storage batteries or battery electrolyte (acid). If acid is splashed on the skin, wash the affected area immediately with plenty of clean water. If acid is splashed in the eyes, wash immediately with plenty of clean water and get medical attention.**<br><br>**CAUTION**<br>**Avoid making contact across the two battery posts. This can result In severe arcing.**<br><br>**NOTE**<br>Use distilled water or a good grade of drinking water (excluding mineral water).<br><br>Check electrolyte level. If low, add water up to split rings (1).<br><br>  <br> | Electrolyte level low. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services - (Cont)**

| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 54 | Weekly | Charging Receptacle | Check that charging receptacle (1) is securely mounted.<br>Check cables (2) between the receptacle and the batteries for corrosion wear, and signs of shorts or improper grounding.<br>Check that the receptacle is connected and grounded according to battery circuit schematic (3) and plate (4) located on the outside of the battery box cover.<br>Check the receptacle for damage that would prevent connection to the charging cable connector. | Signs of shorts (arcing) or loose connections. |

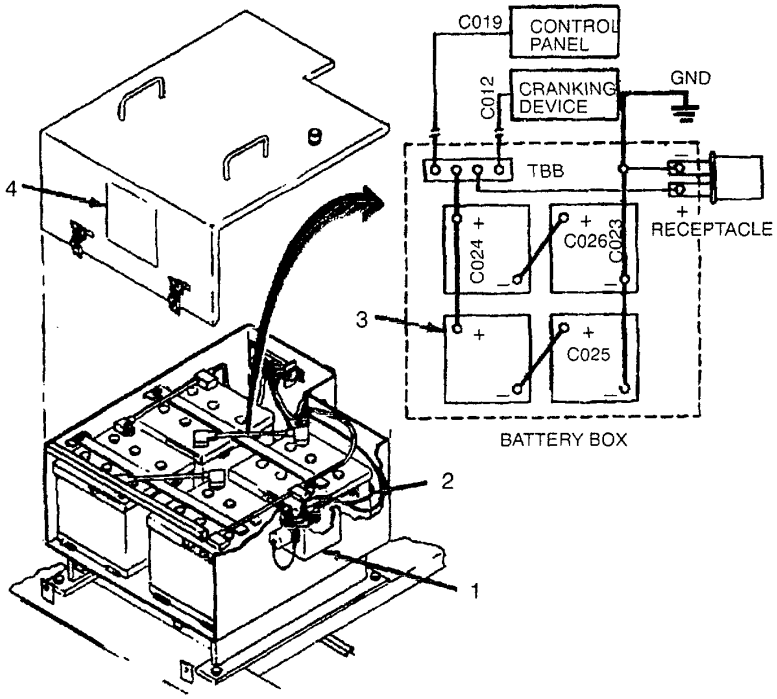


**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services - (Cont)**

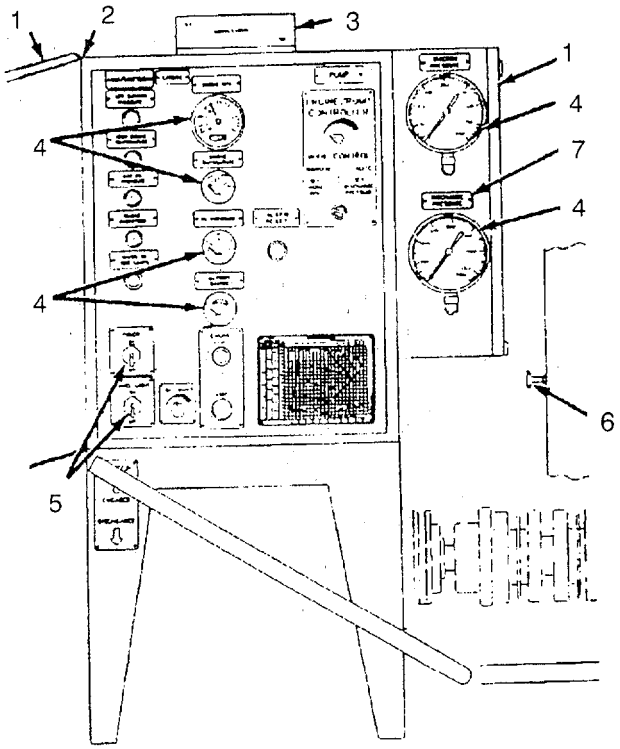
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 55 | Weekly | Control Panel Assembly | Visually inspect doors (1) and hinges (2) for security of attachment.<br>Visually inspect for cracks in welds around the control panel assembly.<br>Check work light (3) for operation and security of attachment<br>Inspect gauges (4) for broken glass, legibility or other damage. Clean gauge faces by wiping with a damp cloth.<br>Inspect switches (5) for damage or loose mountings. Check switches for smooth operation.<br>Inspect ether start knob (6) for general condition.<br>Inspect for legibility of all markings and security of all descriptive plates (7).<br>  | Damage to the assembly indicates internal components are damaged. |
| 56 | Weekly | Wiring Control Panel and Instrument Hoses | Visually inspect the interior of the control panel assembly for security of all connectors and wiring, frayed or worn oil pressure electrical wire, leaking suction hose assembly, frayed or worn tachometer cable, and damaged or broken cable ties.<br>Visually inspect all main wiring harnesses on the engine for secure attachment, or broken or frayed insulation or wires. found. | Category Class III leakage, arcing, or evidence of arcing is found. Bare or broken wires are |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services - (Cont)**

| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 57 | Weekly | Conduit Layout | Visually inspect the conduit runs for security of all connectors and wiring.<br>Check for loose or missing conduit clamps and damaged or broken cable ties.<br>Check conduit for frayed or broken insulation. | Loose or missing conduit clamps. |
| 58 | Weekly | Junction Box | Check junction boxes for secure attachment to mountings.<br>Visually inspect for cracks in welds around the junction box assembly.<br>Check connectors mounted to junction box for security of attachment. | Cracked or loose mounting, loose connectors. |
| 59 | Weekly | Network Cable | Check network cables for frayed insulation, broken wires, and other damage.<br>Check for loose connections. | Bare or broken wires are found. |
| 60 | Weekly | Radiator Assembly (1) | Check radiator assembly for loose or missing mounting hardware (2) and coolant level. | Low coolant level. Loose or damaged components. Category Class II coolant leaks. |

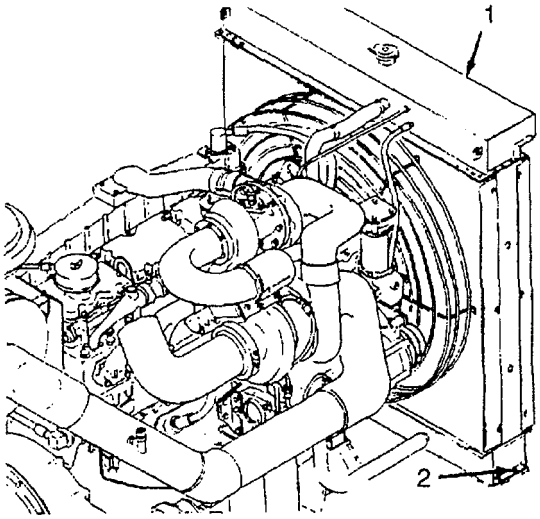


**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services - (Cont)**

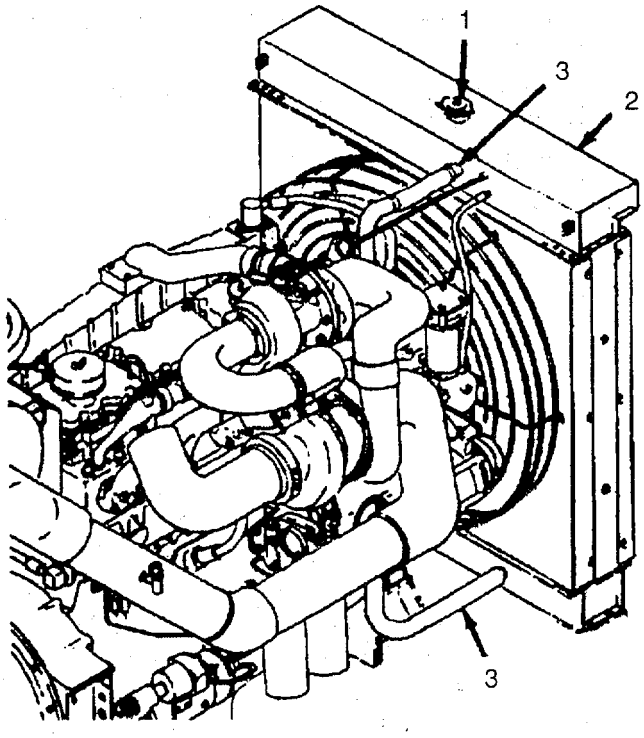
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| | | Radiator Assembly (Cont) | **WARNING**<br>**Care should be taken when removing radiator cap. Steam or hot coolant under pressure may cause injury to personnel**.<br><br>Check coolant level (1). Coolant level should be up to the bottom of the fill neck in the radiator fill tank (2).<br><br>Check for leaks around radiator assembly and attaching hoses (3).<br><br>  | |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services - (Cont)**

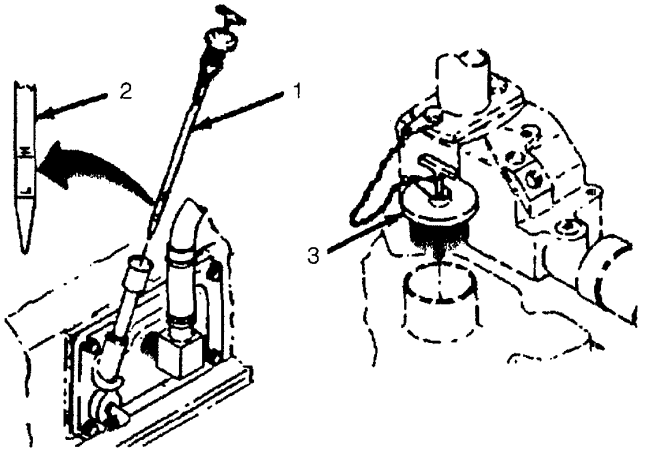
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 61 | Weekly | Lubrication System - Oil Level | With engine level and not operating, check oil level. Pull out oil dipstick (1) and wipe with clean, lint-free cloth.<br>Insert oil dipstick (1) as far as it will go into engine, then pull it out again.<br>Engine oil should coat oil dipstick (1) to the second mark "H' (high) (2).<br><br>**CAUTION**<br><br>**Do not overfill crankcase with oil. Oil will be blown out through the crankcase breather if crankcase is overfilled.**<br><br>If oil coating is below second mark, "H" (high), immediately add oil to bring level up to second mark on the oil dipstick.<br>Again check oil level and be sure oil coats oil dipstick to second mark, "H" (high).<br>Check that oil cover (3) is tight.<br><br>  <br> | Oil level is low or Category Class III oil leak is present. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services - (Cont)**

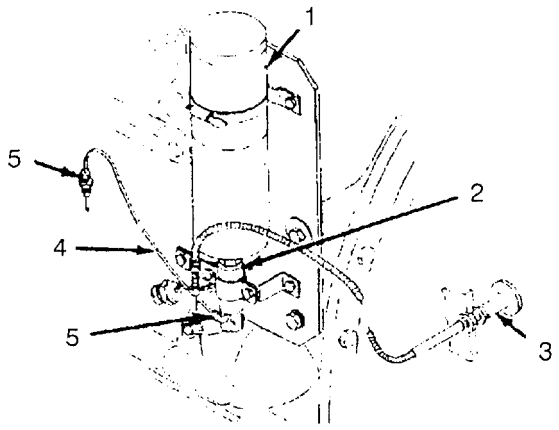
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 62 | Weekly | Ether Start Kit | **WARNING**<br>**Ether is highly flammable. Do not use near sparks or open flames. Do not inhale fumes. Do not actuate ether start kit more than once. Overloading the engine air housing with this highly explosive fluid (ether) could result in an explosion.**<br><br>Check that ether cylinder (1) is firmly in place. The cylinder should be finger tight in valve (2).<br><br>Inspect cylinder (1) and valve (2) for dents, corrosion, or other damage.<br><br>Inspect the valve assembly (2) for corrosion or other damage. Verify valve operation by pulling knob (3) for 3 seconds or less. If the valve operates freely but no ether is released, replace the cylinder (1) and test the valve again.<br><br>Inspect hose (4) for leaks or cracks. The hose should be secured to fitting (5) at both ends.<br><br>  <br> | (At 32°F (0°C) or lower) valve does not operate. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services - (Cont)**

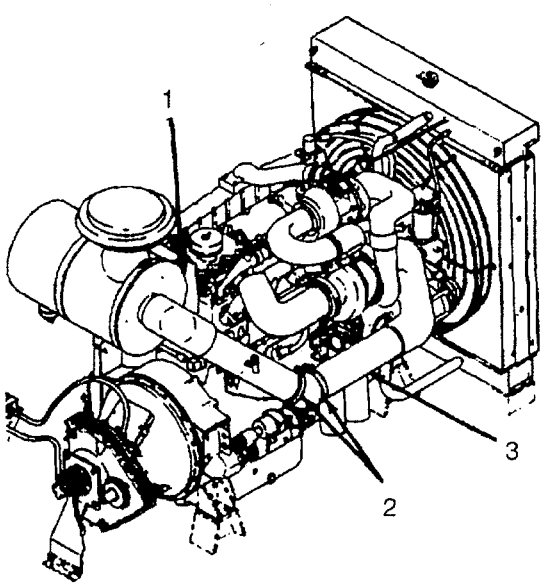
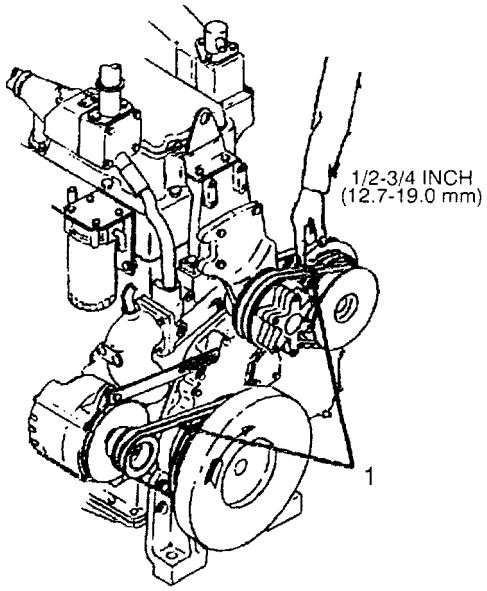
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 63 | Weekly | Air Inlet System | Check mounting screw (1), clamps (2), air intake pipe (3) for damage, corrosion, or blockage.<br>  | Damage or blockage prevents air flow to engine. |
| 64 | Weekly | V-Belts | Visually inspect V-belts (1) for cuts, tears, and frayed edges, and for shiny surfaces of V portion of belt which indicate belt is slipping.<br>With unit shut down, check V-belt tension. When V-belt is pressed with forefinger at the midpoint between pulleys, it should deflect 1/2 to 3/4 inch (12.7 to 19.0 mm).<br>  | V-belt is broken, excessively loose, or slipping. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services (Cont)**

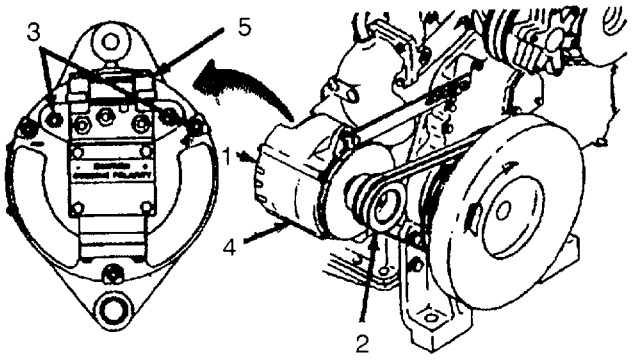
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 65 | Weekly | Alternator | **WARNING**<br>Engine must be shut down when inspecting alternator (1) otherwise death or injury may result.<br>**CAUTION**<br>Avoid grounding or shorting the alternator, otherwise damage may occur.<br>Inspect alternator (1) for looseness.<br>Listen for noisy operation.<br>Check alternator (1) operation for evidence of binding or V-belt (2) slip.<br>Visually inspect wire for loose ring terminals, loose connections at alternator posts (3), corrosion at ring terminals or alternator posts, burn marks at connections (arcing), damaged insulation, burned or melted insulation (overheating), and frayed or worn spiral wrap tubing.<br>Visually inspect alternator bearing support (4) for cracks or discoloration due to overheating.<br>Visually inspect voltage regulator (5) for looseness.<br>  <br> | There is evidence of arcing, overheating, binding, or cracking. Alternator light stays on at startup or lights during operation. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services (Cont)**

| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 66 | Weekly | Starter Assembly (1) | Visually inspect positive (2) and negative (3) starter posts for loose connections.<br>Visually inspect ground return terminals (4), starter switch terminals (5), and magnetic switch terminals (6) for loose ring terminals and connections.<br>Visually inspect starter (1) for loose mounting screws (7).<br>Visually inspect all wire for burned or melted insulation and frayed or worn spiral wrap tubing. | Starter connections or mounting screws are loose.<br>Burned or melted insulation. |

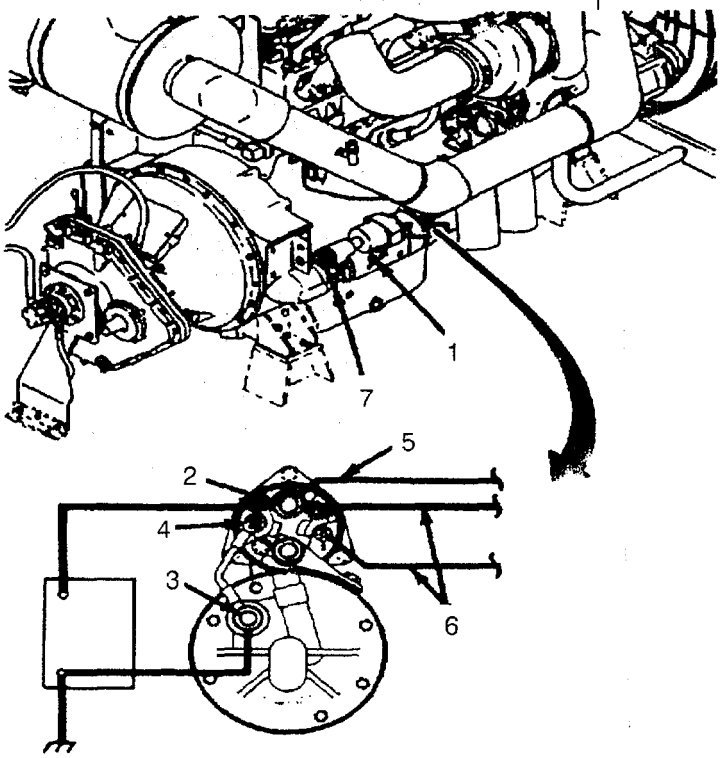


**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services (Cont)**

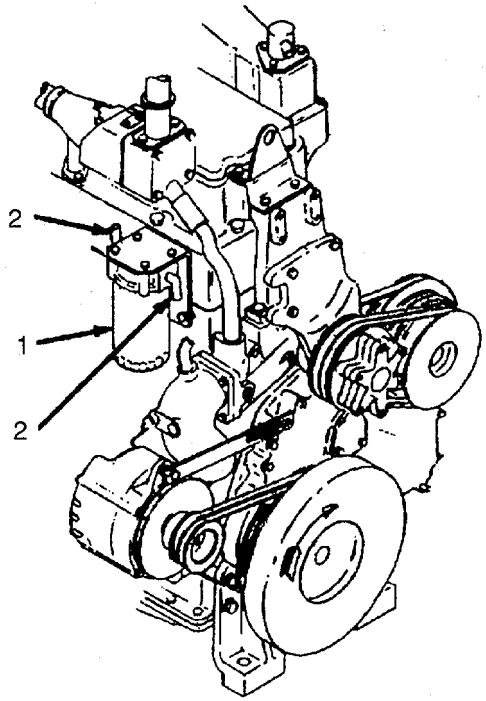
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 67 | Weekly | Corrosion Resistor Assembly | Check filter (1) for leaks.<br>Check elbows (2) for signs of leaks.<br>  | Category Class III leakage is present. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services (Cont)**

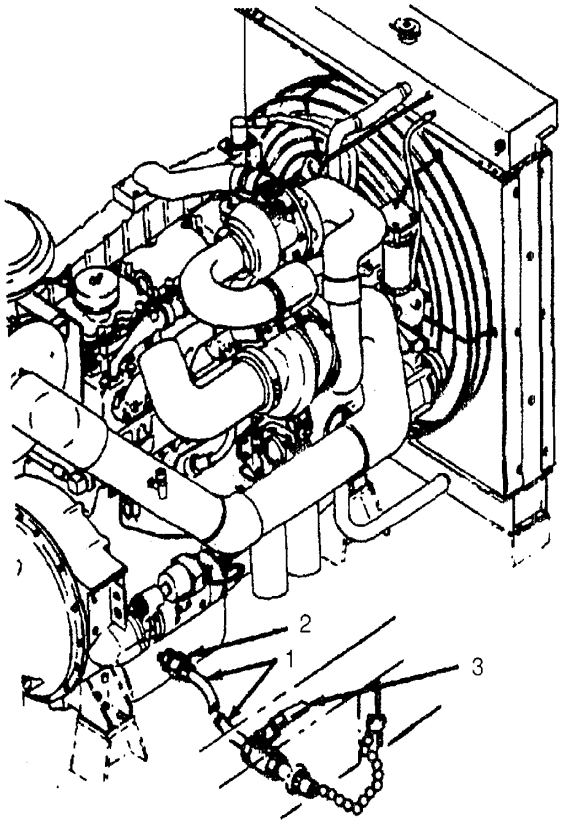
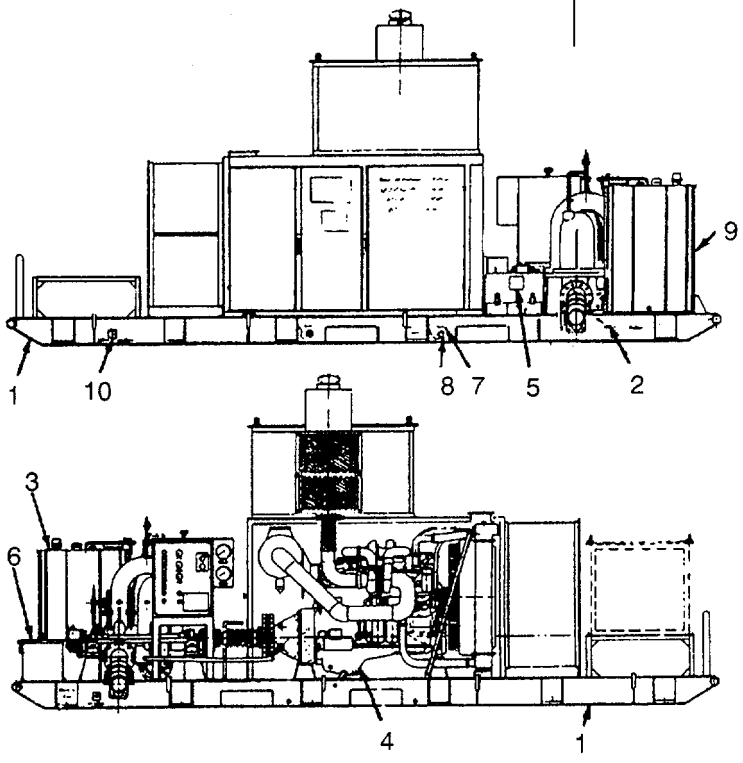
| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 68 | Weekly | Oil Drain Assembly | Inspect oil drain hose (1), nipple (2) for leaks and damage. Inspect oil drain hose (1), nipple (2), and 2-way valve (3) for leaks and obvious damage.   | Category Class III oil leakage is present. |

**Table 2-2. Operator/Crew Preventive Maintenance Checks and Services (Cont)**

| Item No. | Interval | Location Item to Check/Service | Procedure | Not Fully Mission Capable if: |
|---|---|---|---|---|
| 69 | Weekly | Skid (1) | Check that the following components are securely mounted to the skid, and that attaching areas are free of corrosion and damage.<br>All identification plates (2)<br><br>Fuel tank (3)<br>Engine (4)<br>Battery box (5)<br>Tool box (6)<br><br>Visually inspect all skid welds for cracks. Report all cracks immediately to supervisor.<br>Check that stencils (7) can be read.<br>Check that plug and chain assemblies (8) for drains are securely fastened to skid.<br>Check for indications of corrosion on skid around fuel tank assembly (9).<br>Check condition of grounding plates and rod (10).<br>Check for indications of corrosion in areas between all mated parts.<br>Check condition of paint. Paint shall be in good condition with no bare metal or corrosion. | Engine or pump and bearing housing assembly are loose. |



## Section III. OPERATION UNDER USUAL CONDITIONS

### 2-4 ASSEMBLY AND PREPARATION FOR USE.

a. The pumping assembly comes fully assembled, ready for use after attaching the suction and discharge hoses.

b. The operator must know how to perform every operation of which the unit is capable. The following paragraphs contain Instructions on starting and stopping the unit, operation of the pump assembly, and coordinating the basic motions to perform the specific tasks for which the equipment is designed. Since nearly every job presents a different problem, the operator may have to vary given procedures to fit an individual job.

### 2-5 OPERATING PROCEDURE.

**WARNING**

Smoking is prohibited within 50 feet (15 meters) of an operating pump unit. Smoking within this area may create a fire and explosion hazard.

All personnel within 25 feet (7.5 meters) of an operating pump unit must wear approved ear protection equipment. Failure to do so may result in impairment or loss of hearing.

NOTE

The operator must know how to perform every operation of which the unit is capable. The following paragraphs contain instructions on starting and stopping the unit, operation of the pump assembly, and coordinating the basic motions to perform the specific tasks for which the equipment is designed. Since nearly every job presents a different problem, the operator may have to vary given procedures to fit an individual job.

a. Setup instructions. Proper selection of an operating site is important for efficient and trouble free pump operation. Since the pumping assembly is self-contained, it can be removed to the most favorable operating site. Select an operating site with the following characteristics.

(1) Locate unit as close as possible to the liquid to be pumped with the suction (inlet) side toward the source.
Keep both the length of the suction piping and the height of the suction lift as short as possible.

(2) The operating site should be located on a flat prepared surface (concrete, wooden platform or gravel bed) and be within 5 degrees of level in any direction.

(3) Keep the suction and discharge piping within the pump station assembly as short and straight as possible.

(4) Allow adequate space to permit support of the suction and discharge piping where they enter the pump.

b. Grounding. Ensure the mainline pumping assembly is properly grounded.

c. Perform before operation PMCS in accordance with Table 2-2.

**WARNING**

Do not pump water after the pump has been contaminated by pumping fuel. Failure to comply could cause a health hazard.

**CAUTION**

Do not attempt to pump any liquids for which this pumping assembly has not been designed. The pumping assembly has been designed to pump water or petroleum-based fuels with specific gravities between 0.72 and 1.0. Failure to comply could cause damage to the pump.

d. Discharge Piping Installation. Ensure the discharge piping is properly installed. Notify unit maintenance if discharge piping is not installed properly or is leaking.

e. Suction Piping Installation. Ensure the suction piping is installed properly. Notify unit maintenance if suction piping is not installed properly or is leaking.

f. Preparation for Starting.

(1) With the clutch disengaged, turn pump shaft manually using the coupling to the gearbox. Ensure all rotating components are free to rotate.

**WARNING**

Both supply and return 3-way fuel valves must be aligned to the same selected fuel supply (auxiliary or unit tank). Alignment to different supplies could cause engine overheating, shutdown from rapid fuel exhaustion, or fuel system over-flow and the associated fire hazards.

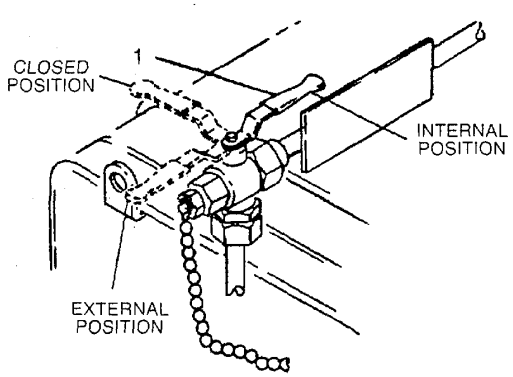
**CAUTION**

If it is necessary to fill the fuel tank, clean any moisture or dirt from around fuel tank filler cap.

(2) Align the two 3-way fuel valves (1) to the selected fuel supply.

**CAUTION**

Never operate the pumping assembly unless the pump casing is filled to the top of the suction port. The pump will not prime when dry. Extended operation of a dry pump will destroy the seal assembly and cause overheating which could seriously damage the pump.



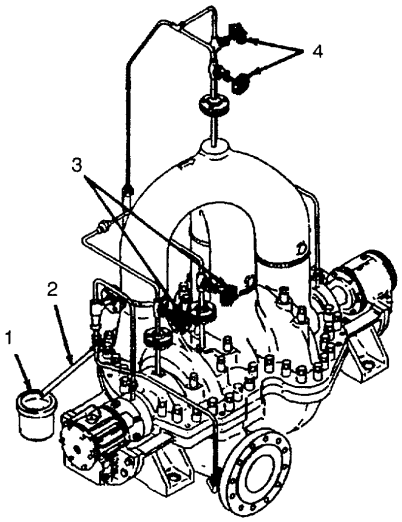

**NOTE**

Ensure pump body is filled to top of suction port so pump will prime properly during startup.

**2-5 OPERATING PROCEDURE (CONT).**

g. Priming.
   (1) Ensure drain plugs are tightened, suction valve is open, and discharge valve is closed.
   (2) Place a catch basin (1) beneath air vent discharge piping (2) located between tool box and fuel tank.
   (3) Fully open two lower pump air vent valves (3).
   (4) Prime pump with fluid to be pumped.
   (5) When fluid exits air vent discharge piping (2), close two lower pump air vent valves (3).
   (6) Fully open two upper pump air vent valves (4).
   (7) When fluid exits air discharge piping (2), close two upper pump air vent valves (4).

h. Starting Instructions.




**WARNING**

CARBON MONOXIDE (EXHAUST GAS) CAN KILL YOU
Exposure to exhaust gases produces symptoms of headache, dizziness, loss of muscular control, drowsiness, or coma. Brain damage or death can result from severe exposure.
Fumes from engines become concentrated with poor ventilation. Operate engine in a ventilated area only.
While running engine, be alert for fumes. It someone is overcome, expose to fresh air; keep warm and still; give artificial respiration if needed. (Refer to FM21-11.) Seek medical attention. Administer oxygen, if available.
GOOD VENTILATION IS THE BEST DEFENSE AGAINST EXHAUST POISONING.
Do not smoke within 50 feet (15.2 m) of an operating pump unit. Smoking within this area creates a fire and explosion hazard.
All personnel within 15 feet (4.57 m) of an operating centrifugal pump unit must wear approved ear protection equipment. Failure to do so may result in impairment or loss of hearing.

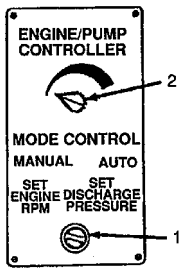
**CAUTION**

Be sure the pump is primed with liquid before starting the engine. Extended operation of a dry pump will destroy the seal assembly and cause overheating which could seriously damage the pump.

**CAUTION**

Do not use ether start kit except in extremely cold weather when engine will not start. See paragraph 2-8.
To prevent starter from overheating, do not crank engine with starter for more than 10 seconds. Battery life will be lengthened if 60 seconds is allowed to elapse between starting attempts.
Under any condition, if engine does not start on initial attempt, allow engine rotation to stop completely before again engaging starter.

(1) Engage and then disengage clutch lever.
(2) Set MODE CONTROL switch (1) to MANUAL. Ensure suction pressure is at least 20 psig.
(3) Turn engine ENGINE/PUMP CONTROLLER knob (2) fully counterclockwise.




(4) Place ENGINE STOP switch in push position.
(5) Set POWER ON/OFF switch to ON.
(6) Switch panel light to ON (if required).
(7) Press PRESS TO TEST LAMPS switch and release. Alarm lights should come on and then go off.
(8) Press ALARM RESET switch.
(9) Verify clutch is DISENGAGED (down).

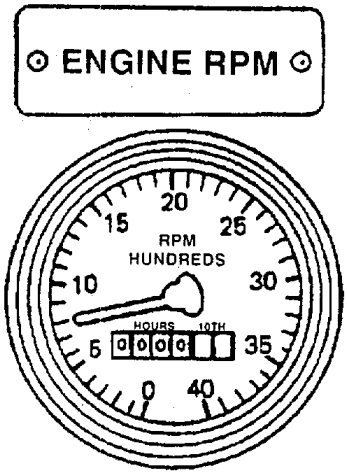
**CAUTION**

If engine fails to start within 10 seconds, release STARTER switch; do not attempt starting again until starter motor stops turning. Failure to comply with this rule may result in serious damage to the starter motor.

(10) Press ENGINE START switch. Keep switch depressed until engine starts. If the engine fails to start after four periods of cranking see troubleshooting procedures in Table 3-1.

**2-5 OPERATING PROCEDURE (CONT).**

(11) After engine starts, observe ENGINE RPM gauge (3) to verify engine is idling at its set point (approximately 800 rpm).

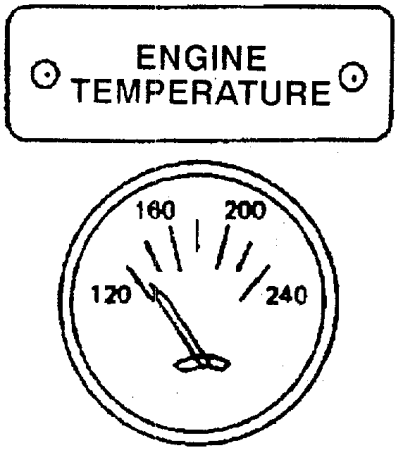



(12) Observe SUCTION pressure gauge remains at least 20 psig. If suction pressure is less than 20 psig, refer to troubleshooting procedures in Table 3<#106>1.

**CAUTION**

Maintain engine idle speed until (800-1000 rpm) engine warmup cycle is complete. Failure to do so could damage equipment.

(13) Allow engine to run at idle speed for an engine warmup cycle (engine coolant temperature must be a minimum of 140 F). When engine is ready for full RPM, adjust pump for full operation (paragraph 2-5i).




i. Operating Mode.

**CAUTION**

Ensure step h procedures are strictly complied with before beginning these procedures. Failure to do so could damage equipment.

(1) Engage clutch.
(2) Slowly open pump discharge valve.
(3) Set MODE CONTROL switch to AUTO.
(4) Control discharge pressure by turning ENGINE/PUMP CONTROLLER knob clockwise as required to maintain required discharge pressure.

**CAUTION**

Impeller cavitation occurs when engine speed is increased beyond the point of maximum suction vacuum. Cavitation is harmful to the pump unit and should be avoided at all times. Cavitation is indicated by a very loud cracking noise in the pump housing.

**NOTE**

Engine speed and pump discharge will vary in accordance with the output demand. When there is no increase in vacuum (suction) as indicated on the suction gauge, maximum pumping capacity has been reached.

In case of automatic shutdown due to low suction pressure turn off POWER ON/OFF switch, close discharge valve and recheck priming procedures.

In case of automatic shutdown due to overspeed, close discharge valve, turn off POWER ON/OFF switch and follow starting procedures.

j. Operational Checks.

**CAUTION**

Pump overheating can occur if valves in the discharge lines are closed, or if lines are otherwise blocked while pump is operating. Operating against blocked discharge lines can bring fluid in the pump to a boil, build pressure, and cause pump to rupture or explode. If overheating occurs, stop pump and allow to cool before servicing.

(1) Check for engine overheating by monitoring control panel gauges for proper readings. See Table 2-3

**Table 2-3. Gauge Readings/Normal Operation**

| Gauge | Normal Operating Range |
|---|---|
| ENGINE RPM | 700 to 2100 rpm |
| ENGINE TEMPERATURE | (160 to 2000F) or (71 to 93°C) |
| ENGINE OIL PRESSURE | |
| - At Rated RPM | (40 to 70 psi) or (276 to 483 KPa) |
| - At Min. RPM | (8 psi or 55 KPa) |
| BATTERY CHARGE | Within yellow and/or green band |
| SUCTION PRESSURE | (50 to 300 psig) or (345 to 2,069 KPa) |
| DISCHARGE PRESSURE | 100 to 750 psig or (690 to 5,171 KPa) |

(2) Check entire pumping assembly for leaks. Stop operation in case of a Category Class III leak; make necessary correction and report it to proper authority. If leaks are found that do not seriously affect operation of the pumping assembly and if continued operation will not cause damage to pump or engine, make note of the deficiency and see that it is corrected as soon as possible. Examine suction and discharge piping assemblies, and check valve connections for leaks.

## 2-5 OPERATING PROCEDURE (CONT)

k. Stopping/Shutdown Procedure.

**NOTE**

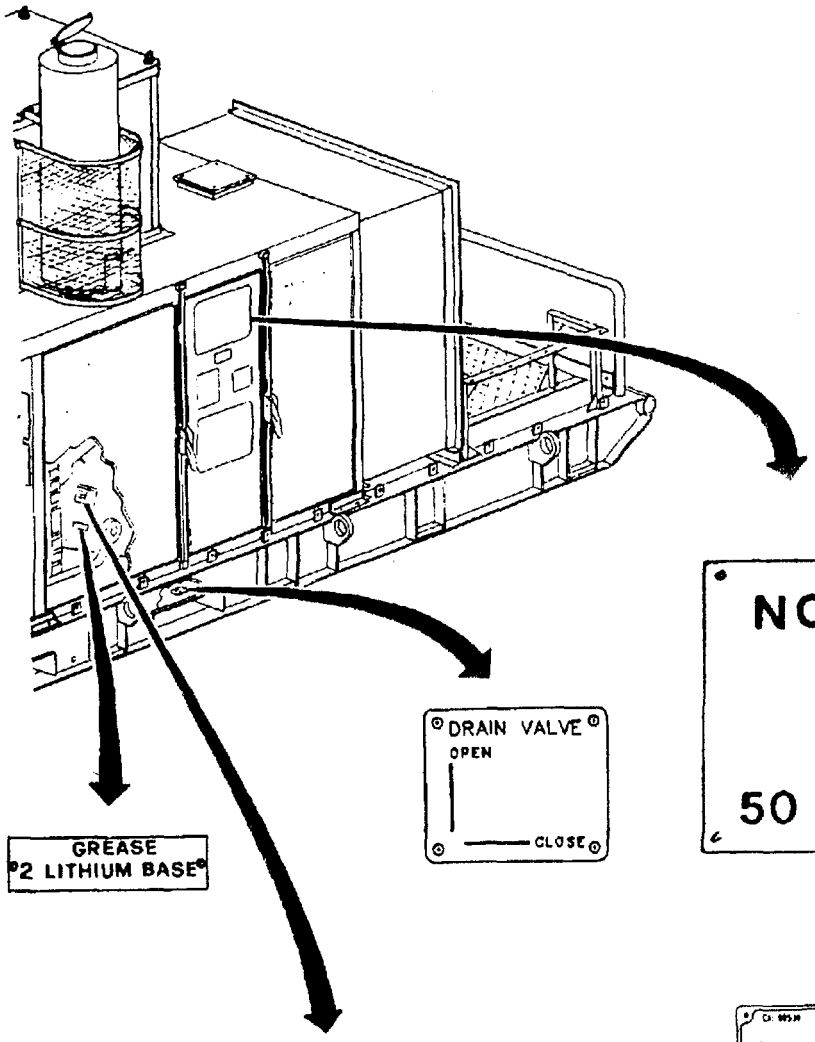
Instructions for stopping operation are located on the control panel assembly.

(1) Gradually reduce discharge pressure to idle by turning ENGINE/PUMP CONTROLLER knob counterclockwise.
(2) Allow engine to idle for 30 seconds.
(3) Set MODE CONTROL switch to MANUAL.
(4) Disengage clutch (down position).
(5) Close discharge and suction valves.
(6) Wait one minute and then pull ENGINE STOP switch.
(7) Set POWER ON/OFF switch to OFF.
(8) Set PANEL LIGHT ON/OFF switch to OFF.
(9) Perform operator PMCS (Table 2-2).

## 2-6 PREPARATION FOR MOVEMENT.

a. Shut down pumping assembly in accordance with paragraph 2-5k.
b. Be sure discharge and suction valves are closed.
c. Drain the discharge pipe into a suitable container and remove discharge pipe from pump flange.
d. Drain the suction pipe into a suitable container and remove suction pipe from pump flange.
e. Cover the pump discharge and suction flanges to keep debris from entering the pump.
f. Disconnect ground rod cables and remove ground rods from earth. Stow cable assemblies in storage box. Stow ground rods.
g. Be sure that battery box and storage box are securely closed.

## 2-7 OPERATING INSTRUCTIONS ON DECALS AND INSTRUCTION PLATES



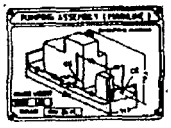
GREASE
#2 LITHIUM BASE

DRAIN VALVE
OPEN
CLOSE

| OIL TYPE | | |
|---|---|---|
| OPERATING TEMP RANGE | -25°F TO +30°F | +30°F TO +135°F |
| MIL SPEC | MIL L-46167 | MIL L-2104 |
| SYMBOL | OE-A | OE/HDO-15/40 |
| GRADE | ARCTIC | 15W-40 |

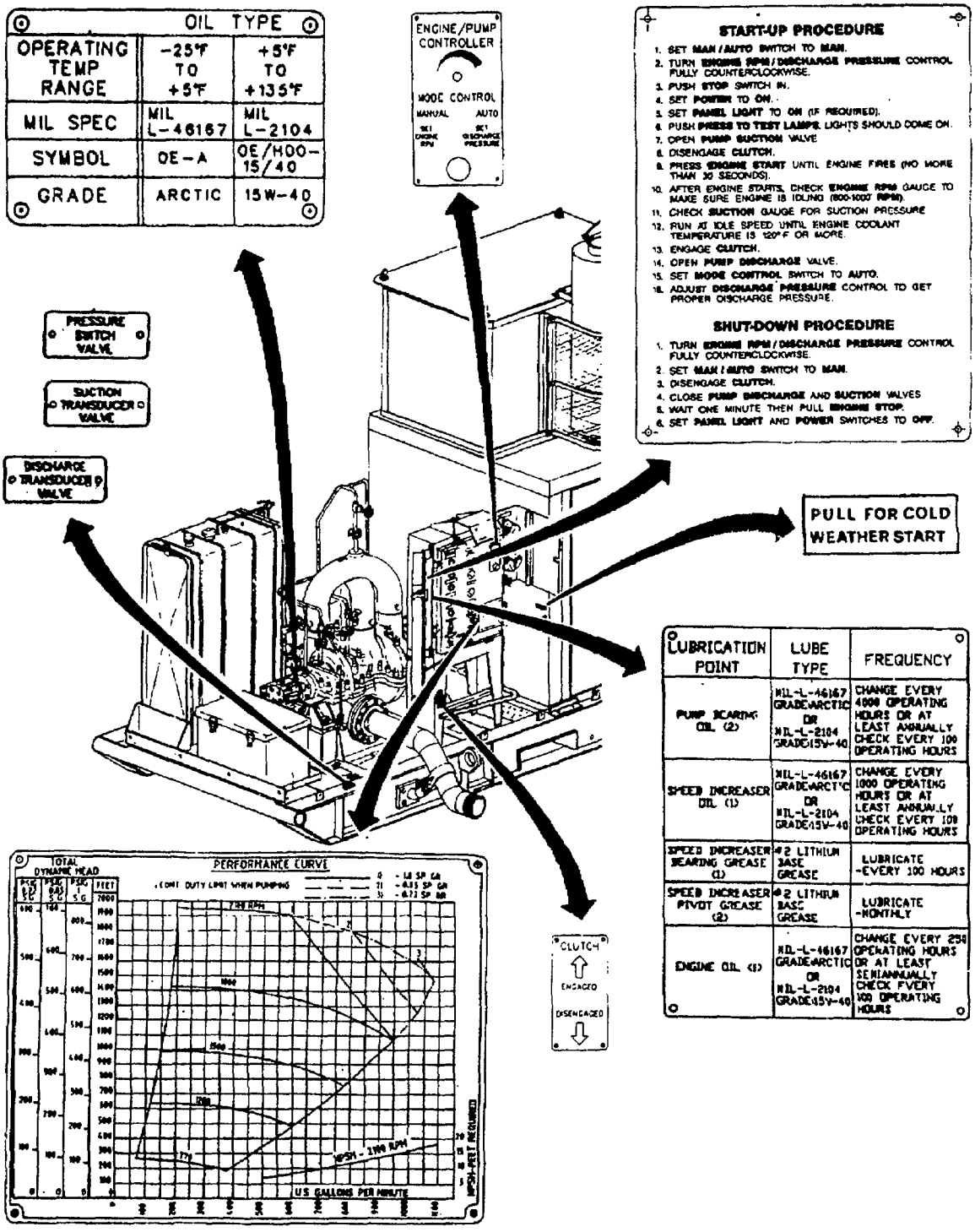
NO SMOKING
WITHIN
50 FEET (15.2 M)

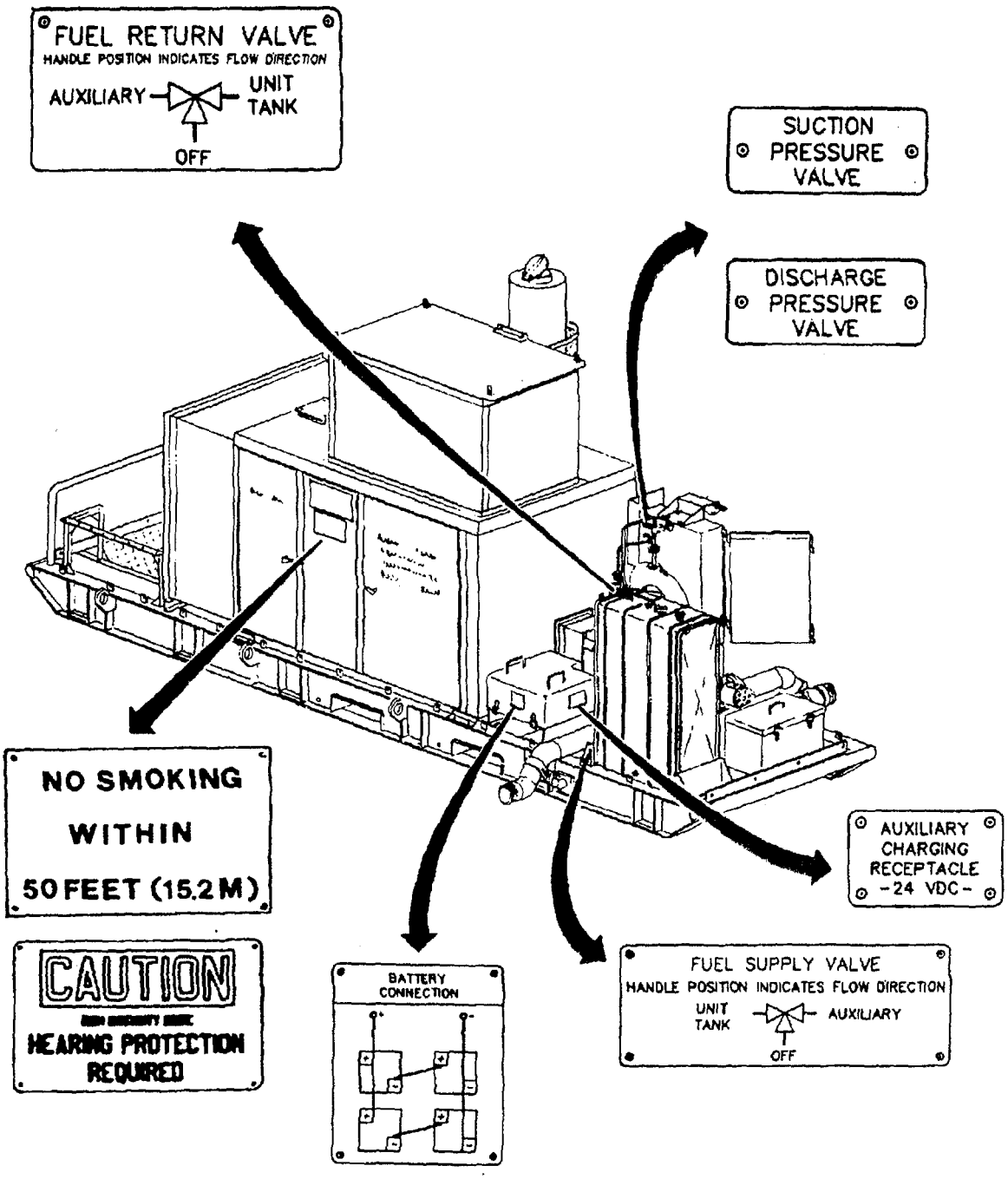
WARNING
TURBOCHARGER AND EXHAUST PIPING WITHIN THIS ENCLOSURE ARE IN EXCESS OF 120 °F



CAUTION
HIGH INTENSITY NOISE
HEARING PROTECTION
REQUIRED

## 2-5 OPERATING INSTRUCTIONS ON DECALS AND INSTRUCTION PLATES (CONT).




FUEL RETURN VALVE
HANDLE POSITION INDICATES FLOW DIRECTION
AUXILIARY
UNIT TANK
OFF
SUCTION PRESSURE VALVE
DISCHARGE PRESSURE VALVE
NO SMOKING WITHIN 50 FEET (15.2 M)
AUXILIARY CHARGING RECEPTACLE -24 VDC-
CAUTION
HEARING PROTECTION REQUIRED
BATTERY CONNECTION
FUEL SUPPLY VALVE
HANDLE POSITION INDICATES FLOW DIRECTION
UNIT TANK
AUXILIARY
OFF

## Section IV. OPERATION UNDER UNUSUAL CONDITIONS

### 2-8 OPERATION IN EXTREME COLD.

a. Use proper engine oil for cold weather. Notify unit maintenance if pumping assembly will be operated in extreme cold weather.

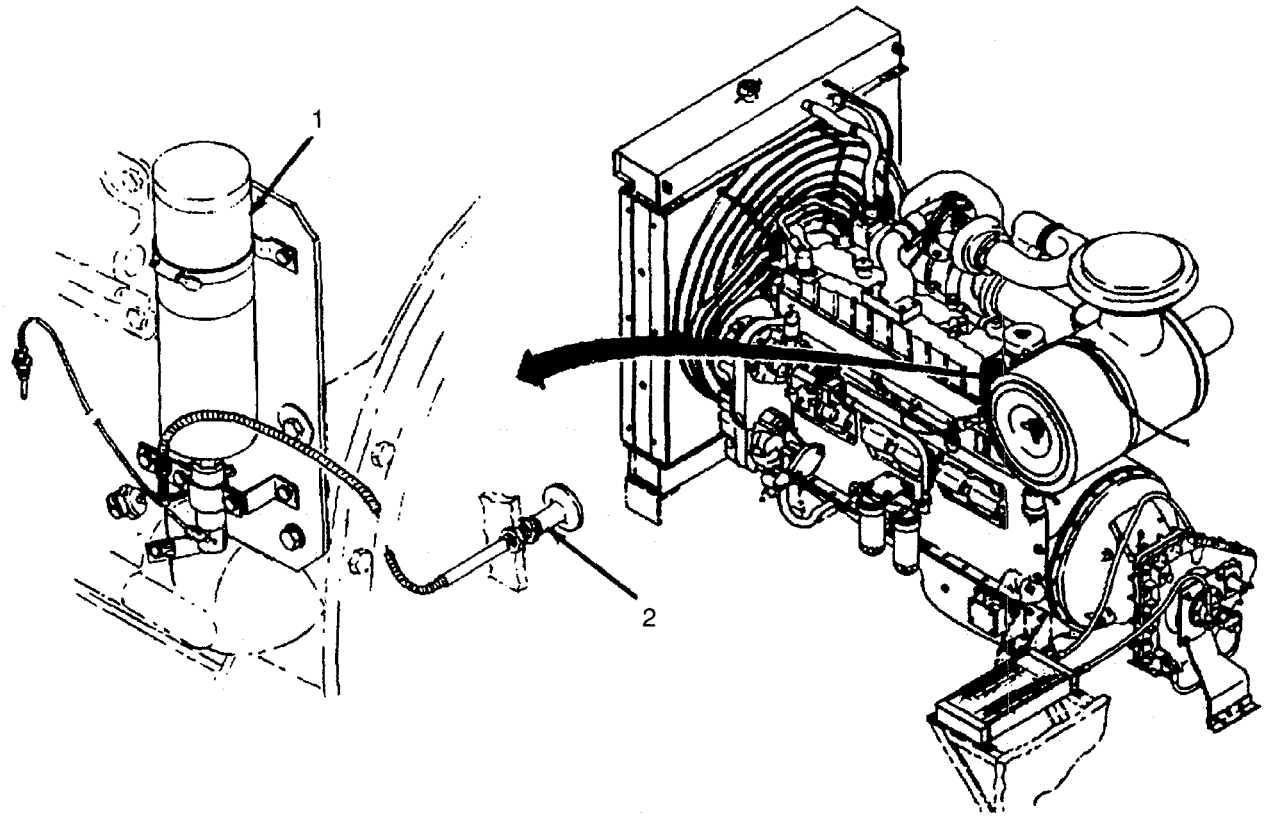
**WARNING**

Ether is highly flammable. Do not use near sparks or open flames. Do not inhale fumes. Do not actuate ether start kit more than once. Overloading the engine air housing with this highly explosive fluid (ether) could result in an explosion.

b. Use ether start kit to help start the engine in extremely cold temperatures. The ether cylinder (1) is located on the left side of the engine assembly. The control knob (2) is located on the right of the control panel.

(1) Just before starting engine, pull out for 2 or 3 seconds and then release ETHER CYLINDER CONTROL knob. This will inject a small amount of ether into the engine air intake.

(2) If engine does not start, do not use the ether start kit again until all fumes have evaporated at least 5 minutes.



**WARNING**

Death or serious injury could occur if diesel fuel is not handled carefully. Use in a well-ventilated area away from open flame, arcing equipment, ignition sources, heaters, or excessive heat. Be certain that fuel lines and connections are secure. Do not inhale vapor. Do not overfill fuel tank. Engine must be turned off and cooled before refueling. Use proper refueling procedures and equipment to avoid spillage. Do not run engine near open fuel containers. DO NOT SMOKE.

c. Keep fuel tank full to prevent condensation. Condensation can freeze and clog lines, filters, and injectors.
d. Before filling the fuel tank, clear any snow, ice, or moisture from the area around the fuel tank cap and the drive plate area at the engine flywheel.
e. Keep fuel tank filler cap tight to prevent foreign matter from entering the engine fuel tank.

**CAUTION**

Drain the pump volute after operation to prevent freezing.

f. If pump is stopped for long periods of time in below freezing conditions, remove four drain plugs and drain pump. Crank engine briefly to complete draining. Replace drain plugs.
g. Cover pumping assembly with weather cover when not in use and shelter from weather, if possible.

## 2-9 OPERATION IN EXTREME HEAT.

**CAUTION**

Poor air filtering and restrictions to air and exhaust flows are harmful to engine.

Heat is removed from the engine through engine exhaust, engine oil, and the engine cooling system. When operating in high temperature, observe the following.

a. Air Cleaner. High ambient temperatures change density of air used by the engine in combustion. Monitor engine's ability to breathe using the air cleaner intake restriction indicator. Notify unit maintenance at first indication of unacceptable restriction of air flow.

**WARNING**

Death or serious injury could occur If diesel fuel is not handled carefully. Use in a well-ventilated area away from open flame, arcing equipment, ignition sources, heaters, or excessive heat. Be certain that fuel lines and connections are secure. Do not Inhale vapor. Do not overfill fuel tank. Engine must be turned off and cooled before refueling. Use proper refueling procedures and equipment to avoid spillage. Do not run engine near open fuel containers. DO NOT SMOKE.

b. Fuel. Fill the fuel tank at the end of each day of operation in order to prevent an accumulation of vapor in the fuel tank. However, do not overfill. Allow room for fuel expansion.

**WARNING**

Severe injury may result from contact with the cooling fan or fan belt. When it is necessary to make an inspection in this area be aware of the fan and fan belt position, or turn engine off.

**2-8 OPERATION IN EXTREME COLD (CONT).**

c. Fan Belt. Check that the fan belt is property adjusted and drives the cooling fan without slipping. Contact unit maintenance if fan belt needs to be serviced.
d. Batteries. Increase battery PMCS frequency. Use distilled water or a good grade of drinking water (excluding mineral water).

**2-10 OPERATION IN RAINY OR HUMID CONDITIONS.**

**WARNING**

Death or serious injury could occur if diesel fuel is not handled carefully. Use in a well-ventilated area away from open flame, arcing equipment, ignition sources, heaters, or excessive heat. Be certain that fuel lines and connections are secure. Do not inhale vapor. Do not overfill fuel tank. Engine must be turned off and cooled before refueling. Use proper refueling procedures and equipment to avoid spillage. Do not run engine near open fuel containers. DO NOT SMOKE.

a. Check that valve inside filler cap is open, fuel tank filler cap is tight, and gasket is not torn. Fill fuel tank immediately after every operating period to prevent condensation.
b. Take special care to prevent rust and corrosion. Coat machined surfaces with oil. Remove any rust or corrosion, and cover the exposed surfaces with paint.

**2-11 OPERATION IN HIGH ALTITUDES**. The mainline pumping assembly will operate normally at elevations up to 9000 feet (2743.2 m) above sea level. Above 9000 feet (2743.2 m), the operating efficiency of the engine is reduced approximately 4 percent for every 1000 feet. Total discharge head will be reduced, and allowance will have to be made in the placement of booster pump stations and pressure regulators by the pipeline design to account for the increase in altitude.

**2-12 OPERATION IN SANDY OR DUSTY AREAS**. The pumping assembly's doors and covers are designed to protect the engine during periods of blowing sand. When operating the pump unit in this type of environment, observe the following precautions.

a. Protect the unit from blowing sand and dust as much as possible.

**CAUTION**

Closely monitor air cleaner intake restriction indicator in sandy or dusty locations. At first sign of restriction, change filter elements. Inadequate air filtering and excessive restrictions to air and exhaust flows will adversely affect turbo- charger life and performance.

b. Frequently check the air cleaner restriction indicator. If red band appears in window of air cleaner restriction indicator and no damage to system components is found, contact unit maintenance.
c. Frequently check oil to be sure it is not contaminated. Contact unit maintenance if oil is contaminated.

**WARNING**

Death or serious injury could occur if diesel fuel is not handled carefully. Use in a well-ventilated area away from open flame, arcing equipment, ignition sources, heaters, or excessive heat. Be certain that fuel lines and connections are secure. Do not inhale vapor. Do not overfill fuel tank. Engine must be turned off and cooled before refueling. Use proper refueling procedures and equipment to avoid spillage. Do not run engine near open fuel containers. DO NOT SMOKE.

d. During fueling and PMCS, do not allow sand or dust to enter fuel or lubrication system.
e. Check that valve inside filler cap is open, fuel tank filler cap is tight, and gasket is not torn. Keep cap tight to prevent foreign matter from entering the engine fuel tank.
f. Keep stores of fuel and oil tightly sealed to prevent contamination.
g. Close control panel cover whenever possible to limit damage to gage faces from blowing sand or grit.
h. When pumping assembly is not in use and suction or discharge piping is not installed, cover the suction flange (intake) and check valve assembly body port (discharge).

**2-13 OPERATION IN SALT WATER AREAS**. When the centrifugal pump unit is operated near salt water. notify unit maintenance.

# Chapter 3
# OPERATOR MAINTENANCE INSTRUCTIONS

## SECTION I. LUBRICATION INSTRUCTIONS

**3-1 REFER TO LUBRICATION CHART BELOW.**

| Lubrication Point | Lubrication Type |
|---|---|
| Pump Bearing Oil | MIL-L-46167 Grade Arctic or MIL-L-2104 Grade 15W40 |
| Speed Increaser Oil | MIL-L-46167 Grade Arctic or MIL-L-2104 Grade 15W40 |
| Speed Increaser Bearing Grease | No. 2 Lithium Base Grease |
| Speed Increaser Pivot Grease | No. 2 Lithium Base Grease |
| Engine Oil | MIL-L-46167 Grade Arctic or MIL-L-2104 Grade 15W40 |

## SECTION II. TROUBLESHOOTING PROCEDURES

**3-2 GENERAL**. Troubleshooting at the operator level requires you to locate any trouble as quickly as possible. Once trouble is located, repair or replace the part if you are authorized to do so or determine if a higher category of maintenance is required. Repairs at the operator level are limited by tools, test equipment, and replacement parts allocated to that level.

**WARNING**

**Troubleshooting procedures may require that checks be made while the engine is running. Use extreme care to prevent contact with high temperature exhaust electrical or moving parts. Proper care must be taken to provide efficient ventilation when running the engine indoors; exhaust gases contain carbon monoxide which is odorless and a deadly poison. Spilling diesel fuel on or about a hot engine may cause an explosion and serious injury.**

**3-3 TROUBLESHOOTING.**

a. Table 3-1 lists common problems that may occur during operation or maintenance of the pumping assembly. Follow these steps to use Table 3-1.
   (1) Find the problem under MALFUNCTION.
   (2) Check for possible causes of the problem under TEST OR INSPECTION.
   (3) Use the procedures under CORRECTIVE ACTION to correct the problem.

b. This manual cannot list all troubles that may occur, nor everything to check, nor all possible procedures to correct troubles listed. If trouble is not listed in Table 3-1 or is not corrected by procedures under CORRECTIVE ACTION, notify unit maintenance.

**Table 3-1. Operator/Crew Troubleshooting**

**MALFUNCTION**
**TEST OR INSPECTION**
**CORRECTIVE ACTION**

**1. ENGINE FAILS TO CRANK OR CRANKS AT LOW SPEED**

**WARNING**

**Overfilling will cause battery electrolyte to surface. Serious injury or blindness could occur from careless handling of batteries or battery electrolyte (acid). If acid is splashed on the skin, wash the affected area immediately with plenty of clean water. If acid is splashed in the eyes, wash immediately with plenty of clean water and get medical attention.**

Step 1. Read the BATTERY VOLTMETER gage.
a. If the reading is in the green, notify unit maintenance of the engine malfunction.
b. If the reading is not in the green, proceed to Step 2.
Step 2. Remove filler caps and check fluid level in battery.

**NOTE**

Use distilled water or a good grade drinking water (excluding mineral water).
a. If fluid level is low, add water up to split ring. Replace filler caps and wipe excess fluid from battery.
b. If the battery fluid level is not low, or the battery voltage fails to increase within an hour of adding water, notify unit maintenance of the engine malfunction.

**2. ENGINE CRANKS BUT FAILS TO START**

**WARNING**

**Death or serious injury could occur if diesel fuel is not handled carefully. Use in a well-ventilated area away from open flame, arcing equipment, ignition sources, heaters, or excessive heat. Be certain that fuel lines and connections are secure. Do not inhale vapor. Do not overfill the tank. Engine must be turned off and cooled before refueling. Use proper refueling procedures and equipment to avoid spillage. Do not run engine near open fuel containers. DO NOT SMOKE.**

Step 1. Check for insufficient fuel supply.
Refill low tank. Perform the checks and services of Table 2-2, item 4.
Step 2. Check starting procedures for prevailing conditions.
If procedures have been performed as described, notify unit maintenance.
Step 3. Check for alignment of 3-way fuel valves.
Align valves to proper fuel supply.
Step 4. Check for loose connections or restricted or damaged fuel lines.
Perform the checks and services of Table 2-2, item 45. Report damaged lines or loose connections to unit maintenance.

**Table 3-1. Operator/Crew Troubleshooting (Cont)**

| MALFUNCTION<br>TEST OR INSPECTION<br>CORRECTIVE ACTION |
|---|

Step 5. Ambient temperature too cold.
Use cold weather start aid.
Step 6. Inspect for leakage around the fuel filter gaskets.
Hand tighten leaking filter. If filter continues to leak, notify unit maintenance.
Step 7. Check engine air cleaner restriction indicator.
If indicator shows red, notify unit maintenance.

**3. UNEVEN RUNNING OR FREQUENT STALLING**

**WARNING**

**Death or serious injury could occur if diesel fuel is not handled carefully. Use in a well-ventilated area away from open flame, arcing equipment, ignition sources, heaters, or excessive heat. Be certain that fuel lines and connections are secure. Do not inhale vapor. Do not overfill fuel tank. Engine must be turned off and cooled before refueling. Use proper refueling procedures and equipment to avoid spillage. Do not run engine near open fuel containers. DO NOT SMOKE.**

**CAUTION**

**Low air density of high altitude operation will tend to make the engine run hotter. A high temperature condition may cause abnormal engine operation.**

Step 1. Check for insufficient fuel supply.
Refill low tank. Perform the checks and services of Table 2-2, item 4.
Step 2. Check for alignment of 3-way fuel valves
Align valves to proper fuel supply.
Step 3. Check for loose connections or restricted or damaged fuel lines
Perform the checks and services of Table 2-2, item 45. Report damaged lines or loose connections to unit maintenance.
Step 4. Check altitude.
Engine outputs will be de-rated when operated at altitudes above 9000 feet (2743.2 m).
Step 5. Check engine air cleaner restriction indicator.
If indicator shows red with engine shut off, notify unit maintenance.

**Table 3-1. Operator/Crew Troubleshooting (Cont)**

| MALFUNCTION<br>TEST OR INSPECTION<br>CORRECTIVE ACTION |
|---|

**4. LACK OF POWER**

**WARNING**

**Death or serious injury could occur if diesel fuel is not handled carefully. Use in a well-ventilated area away from open fame, arcing equipment, ignition sources, heaters, or excessive heat. Be certain that fuel lines and connections are secure. Do not inhale vapor. Do not overfill fuel tank. Engine must be turned off and cooled before refueling. Use proper refueling procedures and equipment to avoid spillage. Do not run engine near open fuel containers. DO NOT SMOKE.**

**CAUTION**

**Low air density of high altitude operation will tend to make the engine run hotter. A high temperature condition may cause abnormal engine operation.**

Step 1. Check for insufficient fuel supply.
Refill low tank. Perform the checks and services of Table 2-2, item 4.

Step 2. Check engine air cleaner restriction indicator.
If indicator shows red with engine shut off, notify unit maintenance

Step 3. Check for malfunctioning turbocharger and leaking turbocharger oil lines.
Perform the checks and services of Table 2-2, items 19 and 20.

Step 4. Check for loose connections or a restricted or damaged line between fuel pump and tank, and between fuel pump and engine.
Report damaged lines or loose connections to unit maintenance.

Step 5. Check for restrictions in suction and discharge assemblies and hoses or hose end.
a. Perform the checks and services of Table 2-2, item 38, and clean away debris.
b. Be sure that suction and discharge gate valves are open.

**5. ENGINE STOPS RUNNING**

**WARNING**

**Death or serious injury could occur if diesel fuel is not handled carefully. Use in a well-ventilated area away from open flame, arcing equipment, ignition sources, heaters, or excessive heat. Be certain that fuel lines and connections are secure. Do not inhale vapor. Do not overfill fuel tank. Engine must be turned off and cooled before refueling. Use proper refueling procedures and equipment to avoid spillage. Do not run engine near open fuel containers. DO NOT SMOKE.**

**Table 3-1. Operator/Crew Troubleshooting (Cont)**

| MALFUNCTION<br>TEST OR INSPECTION<br>CORRECTIVE ACTION |
|---|

Step 1. Check control panel malfunction indicator, coolant temperature, suction pressure, low lube oil pressure, and overspeed.
If malfunction is cited, take corrective action by referring to operating procedures.

Step 2. Check for insufficient fuel supply.
Refill low tank. Perform the checks and services of Table 2-2, item 4.

Step 3. Check for alignment of three-way valve.
Align valve to proper fuel supply.

Step 4. Check engine air cleaner restriction indicator.
If indicator shows red, notify unit maintenance.

Step 5. Check that crankcase is filled with oil to the correct level.

**CAUTION**

**Do not overfill. Oil will be blown out through crankcase breather if crankcase is overfilled.**

a. If oil level is low, fill to proper level.
b. Start engine and observe lube oil pressure gauge. If no lube oil pressure shows on gauge, notify unit maintenance.

Step 6. Check for broken or damaged V-belts.
a. Perform the checks and services of Table 2-2, item 21.
b. If V-belts are damaged or broken, contact unit maintenance.

Step 7. Inspect intake duct assembly.
Perform the checks and services of Table 2-2, Item 5.

**6. EXCESSIVE LUBRICATING OIL CONSUMPTION**

Step 1. Check that engine speed is correct for the specific gravity of liquid being pumped. Refer to pump performance data plate.
Adjust ENGINE PUMP CONTROLLER knob until engine is running at correct speed (paragraph 2-5).

Step 2. Check exhaust. If exhaust discharge contains oil, excessive oil is being burned In engine cylinders or around cylinder valve stems.
Notify unit maintenance.

Step 3. With engine not running, check oil cartridge, drain tube fitting, drain tube, oil cooler, turbocharger feed line, and turbocharger return line for oil leaks.
If leaking, notify unit maintenance.

**Table 3-1. Operator/Crew Troubleshooting (Cont)**

| MALFUNCTION<br>TEST OR INSPECTION<br>CORRECTIVE ACTION |
|---|

**7. LOW LUBE OIL PRESSURE**

Step 1. Check the lube oil pressure sensing line for leaks. Leaks will cause false gauge reading. If leaking, notify unit maintenance.

Step 2. Check that crankcase is filled to the correct level.

**CAUTION**

**Do not overfill. Oil will be blown out through crankcase breather if crankcase is overfilled.**

a. If oil level is low, fill to proper level.

b. Start engine and observe oil pressure gauge. If oil pressure is still low, notify unit maintenance.

**8. ENGINE OVERHEATS**

**CAUTION**

**Low air density of high altitude operation will tend to make the engine run hotter. A high temperature condition may cause abnormal engine operation.**

Step 1. Check cooling system for leaks.
If cooling system leaks, notify unit maintenance.

Step 2. Check lube oil level.
If lube oil level is low, fill to proper level.

Step 3. Check for proper ventilation.
Ensure enclosure doors are closed for proper air flow.

Step 4. Check for loose or damaged belts.
Notify unit maintenance to tighten or replace belt.

Step 5. Check for dirty crankcase oil.
If crankcase oil is dirty, notify unit maintenance.

Step 6. Check exhaust for restrictions.
Clear restrictions as required.

**9. COLD WEATHER START AID FAILS TO WORK**

Step 1. Check for loose ether cylinder.
If ether cylinder is loose, tighten as required.

Step 2. Check for full cylinder.
If ether cylinder is full, tighten as required.

**Table 3-1. Operator/Crew Troubleshooting (Cont)**

| MALFUNCTION<br>TEST OR INSPECTION<br>CORRECTIVE ACTION |
|---|

**10. PUMP FAILS TO PRIME**

Step 1. Check for loose connections causing air leaks.
If connections are loose, notify unit maintenance.

Step 2. Check that engine speed is correct for the specific gravity of liquid being pumped. Refer to pump performance data plate.
Adjust ENGINE/PUMP CONTROLLER knob until engine is running at correct speed (paragraph 2-5).

Step 3. Check for restrictions in flow through suction and discharge piping.
Perform the checks and services of Table 2-2, item 38. Notify unit maintenance of severely damaged piping.

Step 4. Check gasket in suction pipe.
Replace gasket if required.

Step 5. Check for obstruction in suction pipe.
If there is an obstruction, remove.

Step 6. Ensure pump is not air or vapor locked.
Vent pump casing using air vent valves.

Step 7. Ensure engine is running at rated speed.
Adjust engine speed (paragraph 2-5).

Step 8. Check for leaking seals.
If seals leak, notify unit maintenance.

**11. PUMP FAILS TO DELIVER CAPACITY**

Step 1. Check that engine speed is correct for the specific gravity of liquid being pumped. Refer to pump performance data plate.
Adjust ENGINE/PUMP CONTROLLER knob until engine is running at correct speed (paragraph 2-5).

Step 2. Check that suction and discharge gate valves are fully open.
Open gate valves.

Step 3. Check that suction pipe (intake) is properly connected to fluid supply.
If connection to liquid supply is leaking, tighten flange bolts and/or replace coupling gasket.

Step 4. Check for damaged suction pipe.
If suction pipe is damaged, replace.

**Table 3-1. Operator/Crew Troubleshooting (Cont)**

| MALFUNCTION<br>TEST OR INSPECTION<br>CORRECTIVE ACTION |
|---|

Step 5. Check for sufficient suction pressure.
Increase suction pressure if necessary.
Step 6. Check discharge pressure.
Adjust discharge pressure as required.

**12. NOISY PUMP OPERATION**

Step 1. Check that pump is securely mounted to skid.
If pump is loose, tighten bolts.
Step 2. Check that engine speed is not set too high causing pump cavitation.
Reduce engine speed to meet suction capability.
Step 3. Check adequate suction pressure to prevent cavitation.
Increase suction pressure if necessary.
Step 4. Check pump free rotation by hand.
Stop pump and notify unit maintenance if cause of problem cannot immediately be identified.

**13. PUMP OVERHEATS**

Step 1. Check discharge pressure.
Open discharge and suction valves.
Step 2. Check suction pipe for obstruction.
If there is an obstruction, remove.
Step 3. Check for leaks that cause loss of suction.
If leaks are present, replace gasket and/or piping.

**14. PUMP DISCHARGE PRESSURE LOW**

Step 1. Check that engine is running at rated speed.
Increase engine speed.
Step 2. Check that suction valve is fully open.
Open suction valve.
Step 3. Check adequate suction pressure.
Step 4. Check for leaks in piping.
If a Category Class III leak is detected, replace gasket and/or piping.
Step 5. Check for loose connection in suction pipe.
Tighten loose connections.

**Table 3-1. Operator/Crew Troubleshooting (Cont)**

| MALFUNCTION<br>TEST OR INSPECTION<br>CORRECTIVE ACTION |
|---|

**15. PUMP BEARING RUNS TOO HOT**

Step 1. Check suction and discharge piping for proper support.
Notify unit maintenance if support bushings are loose.

Step 2. Check lube oil.
If low, fill to proper level. If contaminated, notify unit maintenance.

**16. PUMP LEAKS BETWEEN SEAL SURFACES**

Step 1. Check for loose bolts.
Notify unit maintenance of loose bolts.

Step 2. Check for seal deterioration.
Notify unit maintenance of seal deterioration.

Step 3. Check for flange misalignment.
Notify unit maintenance of flange misalignment.

**17. PUMP LEAKS FROM SHAFT SEALS**

Step 1. Check for leaks.
If a Category Class III leakage is detected, notify unit maintenance.

**18. SPEED INCREASER GEARING HOT**

Step 1. Check oil level.
If oil level is low, fill to proper level.

**19. SPEED INCREASER CLUTCH NOISY**

Step 1. Check lube oil level.

Step 2. Check lubrication points.
If lube oil level is low and lubrication point is dry, fill to proper level.

**20. SPEED INCREASER LEAKS GEAR OIL**

Step 1. Check for leaks.
If a Category Class III leakage is detected, notify unit maintenance.

**21. SPEED INCREASER CLUTCH SLIPS, HEATS, OR OPERATING LEVER JUMPS OUT FROM LOCKED POSITION**

Step 1. Check clutch adjustment.
If clutch is out of adjustment, notify unit maintenance.

**22. CONTROL SYSTEM MALFUNCTION**

Step 1. Check control system.
If control system appears to be faulty, notify unit maintenance.

## SECTION III. MAINTENANCE PROCEDURES

**3-4 INTRODUCTION.**

a. This section contains maintenance procedures that are the responsibility of the operator.

b. Operator maintenance is performed by operating personnel before, during, and after pump operation. These activities are limited to replenishment of lubricating oil and engine fuel, inspection of visible operating components, cleaning, and correction of minor deficiencies requiring only simple, readily available tools.

**3-5 LUBRICATION.** Notify unit maintenance if lubrication is required.

**3-6 CLEANING**.

a. General. The following cleaning instructions apply to all components of the pumping assembly. Special cleaning instructions required for inspection or repair of a particular part are included as cleaning procedures for that part.

**WARNING**

**Cleaning solvent is flammable and potentially dangerous to people and property. Do not use near open flame, sparks, excessive heat, or on hot surfaces. Flash point of P-D-680 solvent is 100° to 138°F (38° to 59°C). Use solvent in a well-ventilated area, and avoid inhaling fumes. If repeatedly exposed to fumes, seek fresh air and immediate medical help. Avoid prolonged exposure of skin to solvent. Wash exposed skin immediately and thoroughly.**

**CAUTION**

**Nonmetallic parts fabricated from rubber, plastic, fabric, and other organic materials cannot be haphazardly cleaned with solvent. Solvent will deteriorate some parts containing organic materials sufficiently to render further use of such parts undesirable. Where solvent cleaning is recommended for such parts, application must be brief, and solvent must not be allowed to remain on the surface.**

b. Cleaning Processes and Materials. Cleaning procedures for parts of this equipment are relatively simple and a high degree of surface cleanliness is not required for most parts. The usual process specified is hand cleaning in solvent. The solvent required is a neutral clear petroleum distillate, free of undissolved water and other matter, and known commonly as dry cleaning solvent (P-D-680). Check the solvent periodically for dirt, and replace the solvent whenever contamination causes unsatisfactory cleaning or reaches two percent by volume of the solvent. Parts for which solvent cleaning is not recommended are usually wiped clean with a cloth or washed with a solution of mild soap and water. Immediately after any cleaning process employing a liquid, parts must be thoroughly dried to prevent corrosive action by residual cleaning liquid. Dry the parts with filtered, oil-free, moisture-free, compressed air.

c. Standard Cleaning Procedures. The following standard procedures are to be followed in cleaning similar parts in the equipment.

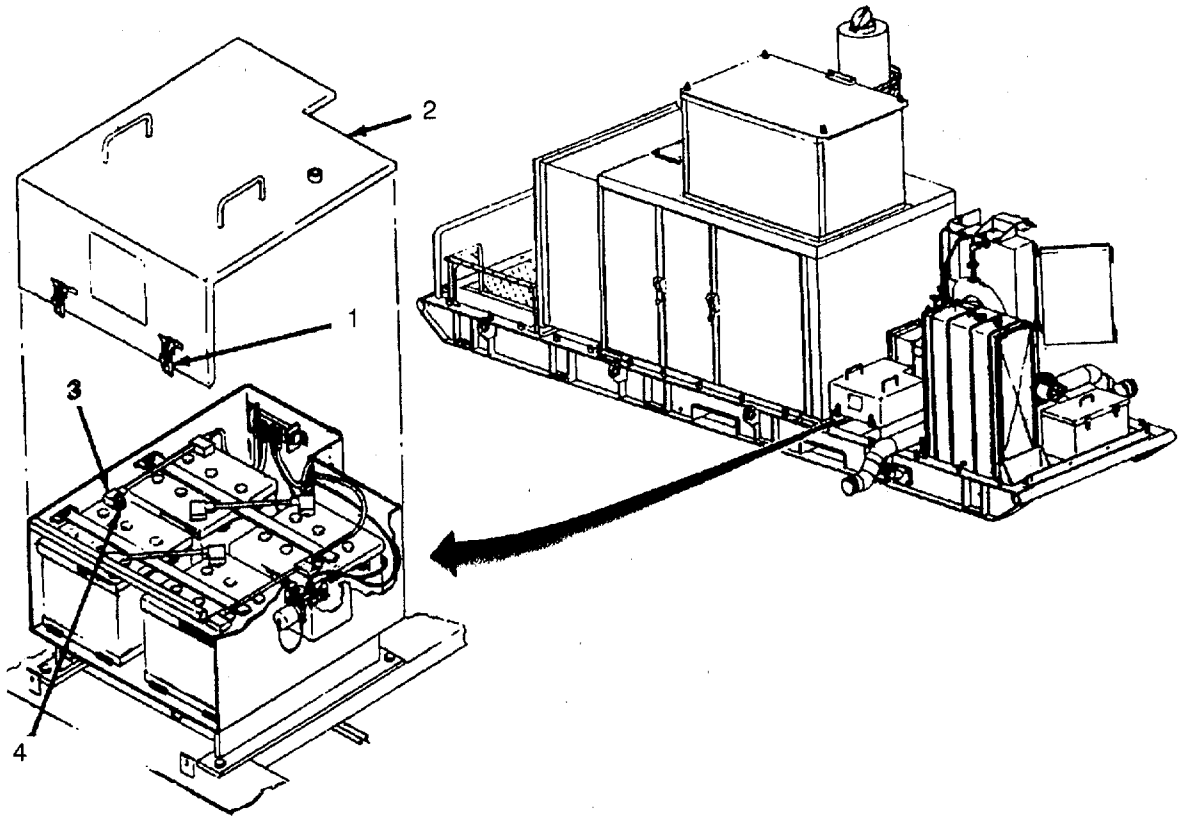
**WARNING**

**Use approved personnel protective equipment to protect eyes and face when using compressed air for cleaning, cooling, or drying. Do not direct airstream toward yourself or toward another person. Maximum allowable air pressure is 30 psi.**

(1) Small Metal Parts. Clean small metal parts by placing them in a fine mesh wire basket and immersing and agitating them in solvent for at least 1 minute. If excessively dirty parts resist cleaning by immersion, brush with a stiff bristle brush in solvent. Remove basket from solvent, drain off excess solvent, and blow dry with compressed air.

(2) Large Metal Parts. Clean large metal parts by wiping with solvent-saturated cloths and, if necessary, scrubbing with a stiff bristle brush. Clean parts that are exceptionally dirty by emulsion soak or emulsion spray methods. Dry parts by blowing with compressed air.

**3-6.1 Cleaning Battery Cables.**




**WARNING**

**Do not smoke or use open flame or spark-producing equipment in the vicinity of battery.**

**CAUSTIC CHEMICALS IN BATTERIES**

Serious injury could occur from the careless handling of storage batteries or battery electrolyte (acid). If acid is splashed on the skin wash, the affected area immediately with plenty of clean water. If acid is splashed in the eyes, wash immediately with plenty of clean water and get medical attention.

**CAUTION**

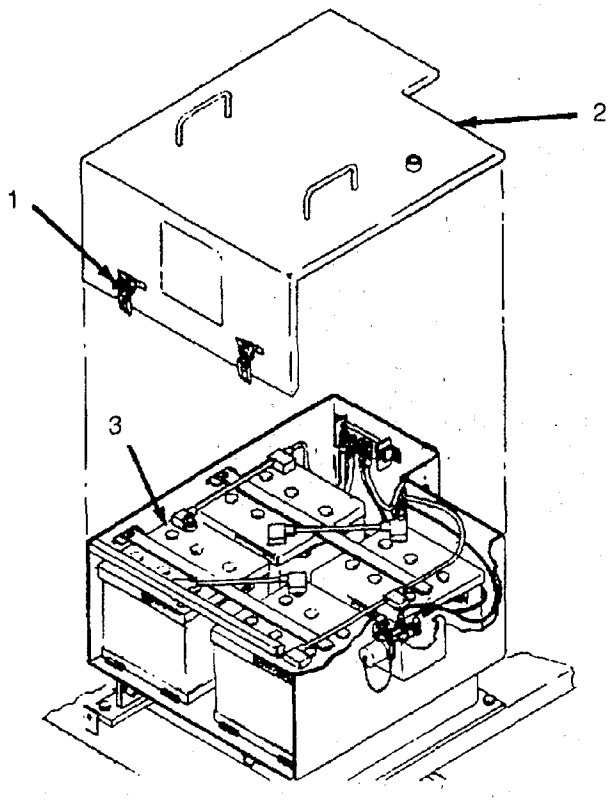
**Avoid making contact across the two battery posts. This can result in severe arcing.**

1. Open battery box clips (1).
2. Remove battery box cover (2).
3. Lift and rotate battery terminal covers (3) to expose terminal (4).
4. Use a wire brush to gently remove visible corrosion on outside of cable terminal lugs (4). Use grease to coat the battery terminals to prevent corrosion

**3-6.1. Cleaning Battery Cables (Cont).**

5. Rotate battery terminal covers (3) onto terminals (4).
6. Install and close battery box cover.

**3-6.2 Cleaning Battery.**




**WARNING**

**Do not smoke or use open flame or spark-producing equipment in the vicinity of battery.**

**CAUSTIC CHEMICALS IN BATTERIES**

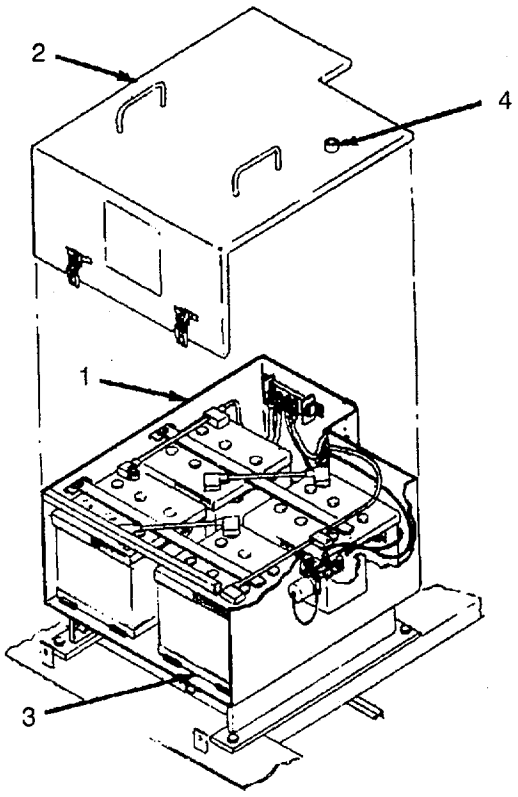
**Serious injury could occur from the careless handling of storage batteries or battery electrolyte (acid). If acid is splashed on the skin, wash the affected area immediately with plenty of clean water. If acid is splashed in the eyes, wash immediately with plenty of clean water and get medical attention.**

**CAUTION**

**Avoid making contact across the two battery posts. This can result in severe arcing.**

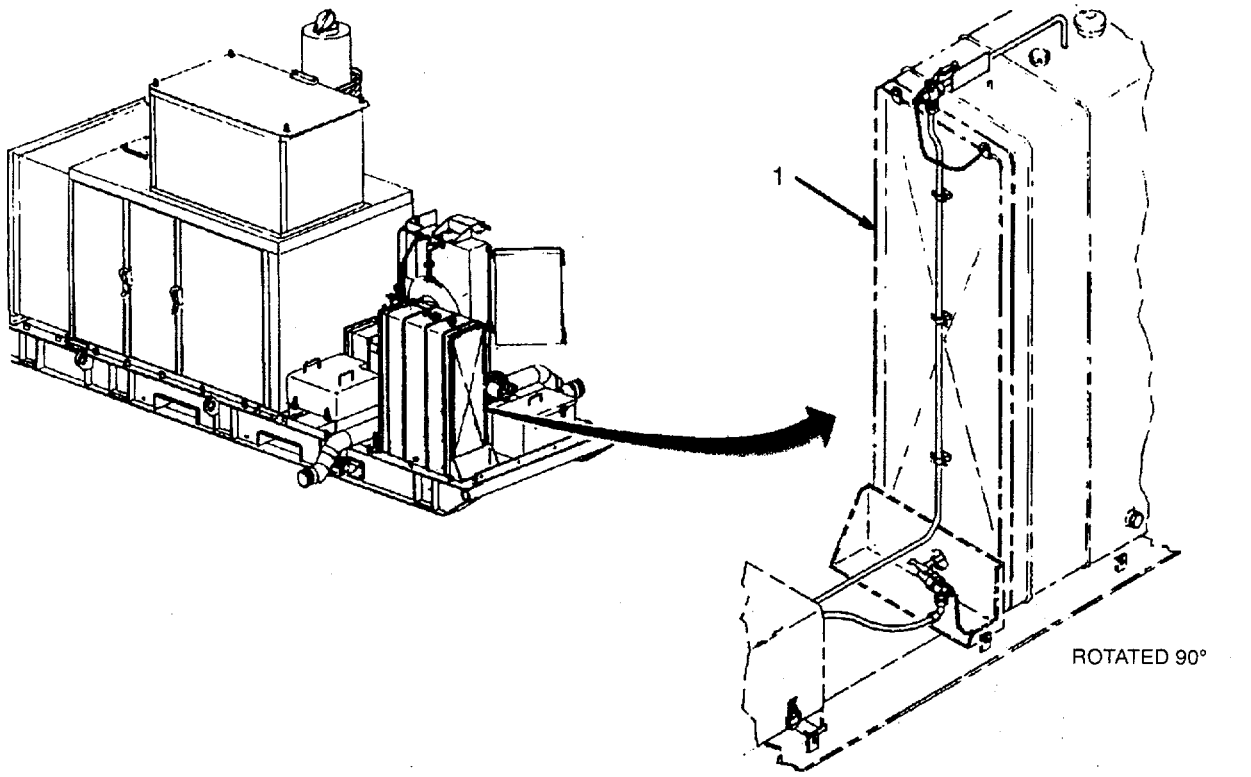
1. Open battery box clips (1).
2. Remove battery box cover (2).
3. Use a clean dry cloth to wipe dirt or excess fluid from the top surface of batteries (3).
4. Install and close battery box cover.

### 3-6.3 CLEANING BATTERY BOX




1. Wipe dirt from exterior of battery box (1) and battery box cover (2) with a clean, dry cloth.
2. Examine the exterior bottom of the battery box to be sure that drain holes (3) are open.
3. If drain holes are obstructed, gently brush them clean with a wire brush.
4. Remove dirt or debris in or around battery box vent (4).

**3-6.4 CLEANING FUEL TANK ASSEMBLY.**




1. Wipe dirt from exterior of fuel tank (1) and fuel lines with a clean, dry cloth.

# Appendix A
# REFERENCES

**A-1 PUBLICATIONS INDEX**. The following index should be consulted frequently for latest changes or revisions of references given in this appendix and for new publications relating to material covered in this manual. Index of Administrative Publications..... DA PAM 25-30

**A-2 FORMS AND RECORDS.**

Equipment Inspection and Maintenance Worksheet..... DA Form 2404
Quality Deficiency Report..... SF 368
Recommended Changes to Publications and Blank Forms..... DA 2028-2

**A-3 FIELD MANUALS.**

First Aid Manual..... FM 21-11
Operation and Maintenance of Ordnance Materiel in Cold Weather (0° to -65°F)..... FM 9-207

**A-4 TECHNICAL MANUALS.**

Hand Portable Fire Extinguishers for Army Users..... TM 5-4320-200-10
Unit, Direct Support and General Support Maintenance Manual, Pumping Assembly (Mainline) Diesel Driven 800 GPM..... TM 10-4320-307-24
Unit, Direct Support and General Support Maintenance Repair Parts and Special Tools List, Pumping Assembly (Mainline) Diesel Driven 800 GPM..... TM 10-4320-307-24P
Destruction of Army Materiel to Prevent Enemy Use..... TM 750-244-3
Military Petroleum Pipeline Systems..... TM 5-343

**A-5 MISCELLANEOUS PUBLICATIONS.**

Fuels, Lubricants, Oils, and Waxes..... C910011
Consolidated Index of Army Publications and Blank Forms..... DA PAM 25-30
The Army Maintenance Management System (TAMMS)..... DA PAM 738-750

# Appendix B
# COMPONENTS OF END ITEMS AND BASIC ISSUE ITEMS LISTS

## SECTION I. INTRODUCTION

**B-1 SCOPE.** This appendix lists Components of End Item and Basic Issue Items (BII) for the pumping assembly to help you inventory items required for safe and efficient operation.

**B-2 GENERAL**. The Components of End Item and Basic Issue Items are divided into the following sections:

a. Section II. Components of End Item. This listing is for informational purposes only, and is not authority to requisition replacements. These items are part of the end item, but are removed and separately packaged for transportation or shipment. As part of the end item, these items must be with the end item whenever it is issued or transferred between property accounts. Illustrations are furnished to assist you in identifying the items.

b. Section III. Basic Issue Items. These are the minimum essential items required to place the pumping assembly in operation, to operate it, and to perform emergency repairs. Although shipped separately packaged, BII must be with the pumping assembly during operation and whenever it is transferred between property accounts. The illustrations will assist you with hard-to-identify items. This manual is your authority to request/requisition replacement Bll, based on TOE/MTOE authorization of the end item.

**B-3 EXPLANATION OF COLUMNS**. The following provides an explanation of columns found in the tabular listings:

a. Column (I) - Illustration Number (Illus Number). This column indicates the number of the illustration in which the item is shown.

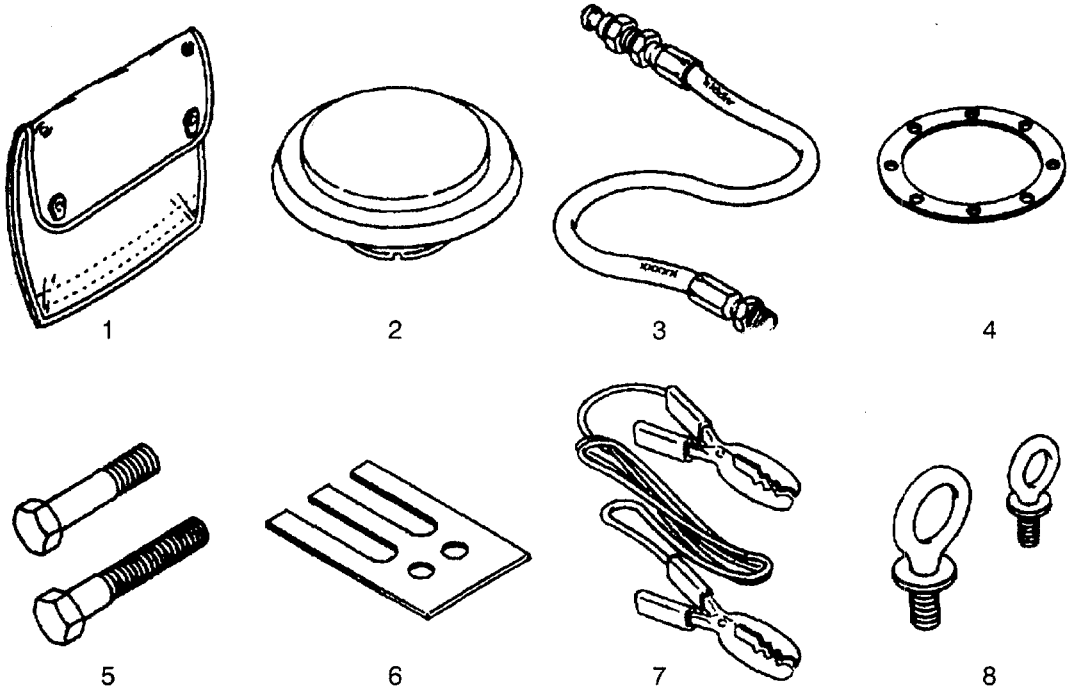
b. Column (2) - National Stock Number. Indicates the National stock number assigned to the item and will be used for requisitioning purposes.

c. Column (3) - Description. Indicates the Federal item name and, if required, a minimum description to identify and locate the item. The last line for each item indicates the FSCM (in parentheses) followed by the part number.

d. Column (4) - Unit of Measure (U/M). Indicates the measure used in performing the actual operational/ maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea, in., pr).

e. Column (5) - Quantity required (Qty Rqr). Indicates the quantity of the item authorized to be used with/on the equipment.

## SECTION II. COMPONENTS OF END ITEM




| (1) ILLUS NO. | (2) NATIONAL STOCK NUMBER | (3) DESCRIPTION CAGEC AND PART NUMBER USABLE ON CODE | (4) U/M | (5) QTY RQR |
|---|---|---|---|---|
| 1 | | COTTON DUCK BAG (storage box) | EA | 1 |
| 2 | | AIR CLEANER RAIN CAP (storage box)<br>(15434) 3013238 | EA | 1 |
| 3 | | AUXILIARY FUEL HOSES (storage box)<br>3/4" FITTING (00624) 212-8<br>3/4" ROTATING FITTING (00624) 411-12<br>HOSE, MIL-H-8794 (00624) 303-12 | EA | 2 |
| 4 | | FLANGE GASKETS (storage box)<br>(A2683) 530.10093 | EA | 2 |
| 5 | | NOZZLE MOUNTING BOLTS (storage box)<br>BOLT 1/2" UNC (A2683) 222304416<br>NUT (A2683) 282230150<br>WASHER (A2683) 333200140 | EA | 2 |
| 6 | | SHIMS (storage box)<br>(A2683) 530.50001 | EA | 6 |
| 7 | | GROUND CABLES (storage box)<br>(A2683) 530.02005 | EA | 1 |
| 8 | | ENCLOSURE LIFTING EYES (storage (box)<br>(A2683) 530.20007 | EA | 4 |

## SECTION III. BASIC ISSUE ITEMS

| (1) ILLUS NO. | (2) NATIONAL STOCK NUMBER | (3) DESCRIPTION CAGEC AND PART NUMBER USABLE ON CODE | (4) U/M | (5) QTY RQR |
|---|---|---|---|---|
| 1 | | TM 10-4320-307-10, Operators manual for Pumping Assembly (Mainline) Diesel Engine Driven, 800 GPM NSN 4320-01-193-3430 | EA | 1 |

# Appendix C
# ADDITIONAL AUTHORIZATION LIST

## Section I. INTRODUCTION

C-1. SCOPE. This appendix lists additional items you are authorized for the support of the pumping unit.

C-2. GENERAL. This list identifies items that do not have to accompany the pumping unit and that do not have to be turned in with it. These items are all authorized to you by CTA, MTOE, TDA, or JTA.

C-3. EXPLANATION OF LISTING. National stock numbers, descriptions, and quantities are provided to help you identify and request the additional items you require to support this equipment. The items are listed in alphabetical sequence by item name under the type document (i.e., CTA, MTOE, TDA, or JTA) that authorizes the item(s) to you.

## Section II. ADDITIONAL AUTHORIZATION LIST

| (1)<br>National Stock Number | (2)<br>Description<br>CAGEC and Part Number | Usable<br>On Code | (3)<br>U/M | (4)<br>Qty<br>Rqr |
|---|---|---|---|---|
| | ( ) AUTHORIZED ITEMS | | | |
| 4240-00-022-2946 | Protector, Aural | | PR | 1 |

# Appendix D
# EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

## Section I. INTRODUCTION

D-1. SCOPE. This appendix lists expendable/durable supplies and materials you will need to operate and maintain the pumping unit. These items are authorized to you by CTA 50-970, Expendable Items (Except Medical, Class V, Repair Parts, and Heraldic Items).

D-2 EXPLANATION OF COLUMNS.

a. Column (1) - Item Number. This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the material (e.g., Fuel Oil Diesel, Item 1, Appendix D).

b. Column (2) - Level. This column identifies the lowest level of maintenance that requires the listed item.

C - Operator/Crew

c. Column (3) - National Stock Number. This is the National stock number assigned to the item; use it to request or requisition the item.

d. Column (4) - Description. Indicates the Federal item name and, if required, a description to identify the item. The last line for each item indicates the Federal Supply Code for Manufacturer (FSCM) in parentheses followed by the part number.

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 (e.g., ea, in., pr). If the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.

## Section II. EXPENDABLE SUPPLIES AND MATERIALS LIST

| (1) ITEM NO. | (2) LEVEL | (3) NATIONAL STOCK NUMBER | (4) DESCRIPTION | (5) U/M |
|---|---|---|---|---|
| 1 | C | | Fuel Oil, Diesel, W-F-800 | GL |
| 2 | C | 9150-00-186-6681 | Oil, Lubricating, Internal Combustion Engine, MIL-L-2104 | GL |
| 3 | C | | Cleaning Solvent | GL |
| 4 | C | | Paint Brush | EA |
| 5 | C | | Soft Cloth | EA |
| 6 | C | | Wire Brush | EA |

## ALPHABETICAL INDEX

## ALPHABETICAL INDEX (CONT)

## ALPHABETICAL INDEX (CONT)

## ALPHABETICAL INDEX (CONT)

**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*
03686

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# The Metric System and Equivalents

### *Linear Measure*

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

### *Weights*

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigram = .035 ounce
1 dekagram = 10 grams = .35 ounce
1 hectogram = 10 dekagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

### *Liquid Measure*

1 centiliter = 10 milliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

### *Square Measure*

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

### *Cubic Measure*

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

# Approximate Conversion Factors

| *To change* | *To* | *Multiply by* | *To change* | *To* | *Multiply by* |
|---|---|---|---|---|---|
| inches | centimeters | 2.540 | ounce-inches | newton-meters | .007062 |
| feet | meters | .305 | centimeters | inches | .394 |
| yards | meters | .914 | meters | feet | 3.280 |
| miles | kilometers | 1.609 | meters | yards | 1.094 |
| square inches | square centimeters | 6.451 | kilometers | miles | .621 |
| square feet | square meters | .093 | square centimeters | square inches | .155 |
| square yards | square meters | .836 | square meters | square feet | 10.764 |
| square miles | square kilometers | 2.590 | square meters | square yards | 1.196 |
| acres | square hectometers | .405 | square kilometers | square miles | .386 |
| cubic feet | cubic meters | .028 | square hectometers | acres | 2.471 |
| cubic yards | cubic meters | .765 | cubic meters | cubic feet | 35.315 |
| fluid ounces | milliliters | 29,573 | cubic meters | cubic yards | 1.308 |
| pints | liters | .473 | milliliters | fluid ounces | .034 |
| quarts | liters | .946 | liters | pints | 2.113 |
| gallons | liters | 3.785 | liters | quarts | 1.057 |
| ounces | grams | 28.349 | liters | gallons | .264 |
| pounds | kilograms | .454 | grams | ounces | .035 |
| short tons | metric tons | .907 | kilograms | pounds | 2.205 |
| pound-feet | newton-meters | 1.356 | metric tons | short tons | 1.102 |
| pound-inches | newton-meters | .11296 | | | |

# Temperature (Exact)

| | | | | |
|---|---|---|---|---|
| °F | Fahrenheit temperature | 5/9 (after subtracting 32) | Celsius temperature | °C |

**PIN: 071077-000**