

**TECHNICAL MANUAL**  
**OPERATOR'S, UNIT, DIRECT SUPPORT,**  
**AND GENERAL SUPPORT MAINTENANCE MANUAL**

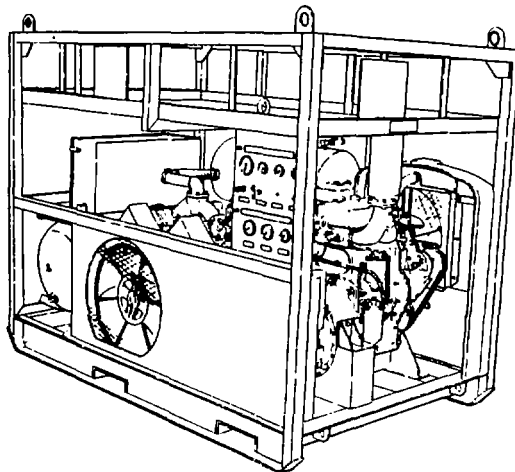
**COMPRESSOR, DIVING AIR,**

**DIESEL ENGINE DRIVEN**

**88.5 SCFM, 200 PSI**

**(MODEL HII-271-5120)**

**NSN 4310-01-113-8271**



Approved for public release; Distribution is unlimited.

This manual, together with TM 5-4310-379-24P, supersedes TM 5-4310-379-12&P dated 14 March 1986, in its entirety.

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**18 JANUARY 1991**

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NO. 3

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and General Support Maintenance Manual

**COMPRESSOR, DIVING AIR,  
DIESEL ENGINE DRIVEN  
88.5 SCFM, 200 PSI  
(MODEL HII-271-5120)  
NSN 4310-01-113-8271**

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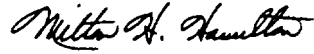
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Operator's, Unit, Direct Support and General Support  
Maintenance Manual

**COMPRESSOR, DIVING AIR, DIESEL ENGINE DRIVEN  
88.5 SCFM, 200 PSI, (MODEL HII-271-5120)  
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Maintenance Manual

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**WARNING**

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

**WARNING**

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

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

**WARNING**

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

Do not refuel while engine is in operation.

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

During engine operation, proper fire fighting equipment should be serviceable and kept near in the event that fire develops.

**WARNING**

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

**WARNING**

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

**WARNING**

Lead acid batteries contain a strong acid. This acid can cause severe skin burns. Handle battery only with proper lifting strap. Wear protective clothing and eye protection.

**WARNING**

The breathing air hose connections should be thoroughly inspected prior to servicing and any trace of oil, grease, or foreign material carefully removed. Use only those air hoses supplied and designed for this equipment. All air system openings, hoses, fittings, etc, must be taped shut or double bagged with polyurethane to prevent contamination from foreign materials.

Permit only qualified personnel to use this equipment. Complete familiarity is a basic prerequisite to safe operation techniques. The operator must always be in attendance when the equipment is in use.

To prevent contamination of breathing air use separate, clean rags and funnels for engine and compressor oil level checks and filling, as oils are not compatible.

**WARNING**

Wear faceshield and clear immediate area of personnel when using low pressure air for maintenance procedures.

**WARNING**

Repair or replace worn or damaged parts immediately with authorized parts. Failure of a component during equipment usage could result in injury or death to the operator.

**WARNING**

Do not attempt to disassemble diving system components while pressurized. Failure to observe this warning may result in injury or death to personnel.

**WARNING**

Cleanliness is imperative in maintaining and handling diving air system components. All tools and parts must be kept free of oil, grease, rust, or other contamination in accordance with accepted Army diving cleaning procedures. Foreign substances within an assembly could result in equipment failure and possible injury or death to personnel.

**WARNING**

Remove all traces of lacquer thinner with nonionic detergent (NID) solution and rinse with fresh water. Residual lacquer thinner will contaminate breather atmosphere and may cause injury or death to personnel.



**WARNING**

Do not use trichloroethylene or methyl chloroform in cleaning operations associated with any diving system. Use of either chemical, or similar contaminants, can result in death when operator's/divers are exposed to these contaminants under pressure. The contaminants are not water soluble. If contamination or suspected contamination occurs, immediately discontinue all equipment/diving operations and notify the Army diving safety office, AUTOVON 927-1329/Commercial (804) 878-1329. The only acceptable cleaning agents are tribasic sodium phosphate (tsp.) and nonionic soaps, liquid Joy and liquid Ivory.

**WARNING**

If in doubt about the serviceability of part, repair or replace it immediately. Use only approved replacement parts. Failure of a component part during a dive may result in injury or death to the diver.

**WARNING**

Ensure that all air lines and components removed or openings into the air system that provides breathing air are covered with a plastic bag and secured with a rubber band or taped shut. Small components should be stored in a plastic bag and sealed. Failure to do so will cause air system to become contaminated and could result in injury or death to the diver.

**WARNING**

Leave 1 1/2 threads exposed on fitting when applying teflon tape. This will ensure that no teflon tape will hang down inside the air system. Teflon tape should be wrapped in such a manner that when the fitting is tightened the tape will not loosen. Failure to wrap teflon tape correctly may result in contamination or blockage of the air system and subsequent possible injury or death to the diver.

**WARNING**

Blow down air system from air compressor out to diver when setting up for diving operations. Failure to do so may result in foreign material in the breathing system and subsequent injury or death to the diver.

**NOTE**

This manual is not intended to dictate safe diving operation or procedures. Diving supervisors are ultimately responsible for conducting safe diving operations in accordance with FM 20-11, Military Diving Manual and all other applicable military diving safety and operational references.

**WARNING**

Trisodium Phosphate (TSP) must be handled with extreme care.

**WARNING**

It is the diving supervisor's responsibility to ensure that exhaust fumes do not enter the air intake on the compressor. Engine exhaust should always be down wind, elevated, or piped overboard. Failure to prevent this may result in injury or death to diver.

Operator's, Unit, Direct Support, and General Support Maintenance Manual  
for  
**COMPRESSOR, DIVING, AIR, DIESEL ENGINE DRIVEN**  
**88.5 SCFM, 200 PSI**  
**(MODEL HII-271-5120)**  
**NSN 4310-01-113-8271**

**REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS**

You can help improve this manual. If you find any mistakes or if you know of a way to improve these procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual directly to: Commander, US Army Aviation and Troop Command, ATTN: AMSAT-I-MP, 4300 Goodfellow Blvd., St. Louis, MO 63120-1798. A reply will be furnished directly to you.

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\*This manual, together with TM 5-4310-379-24P, supersedes TM 5-4310-379-1 2&P dated 14 March 1986, in its entirety.

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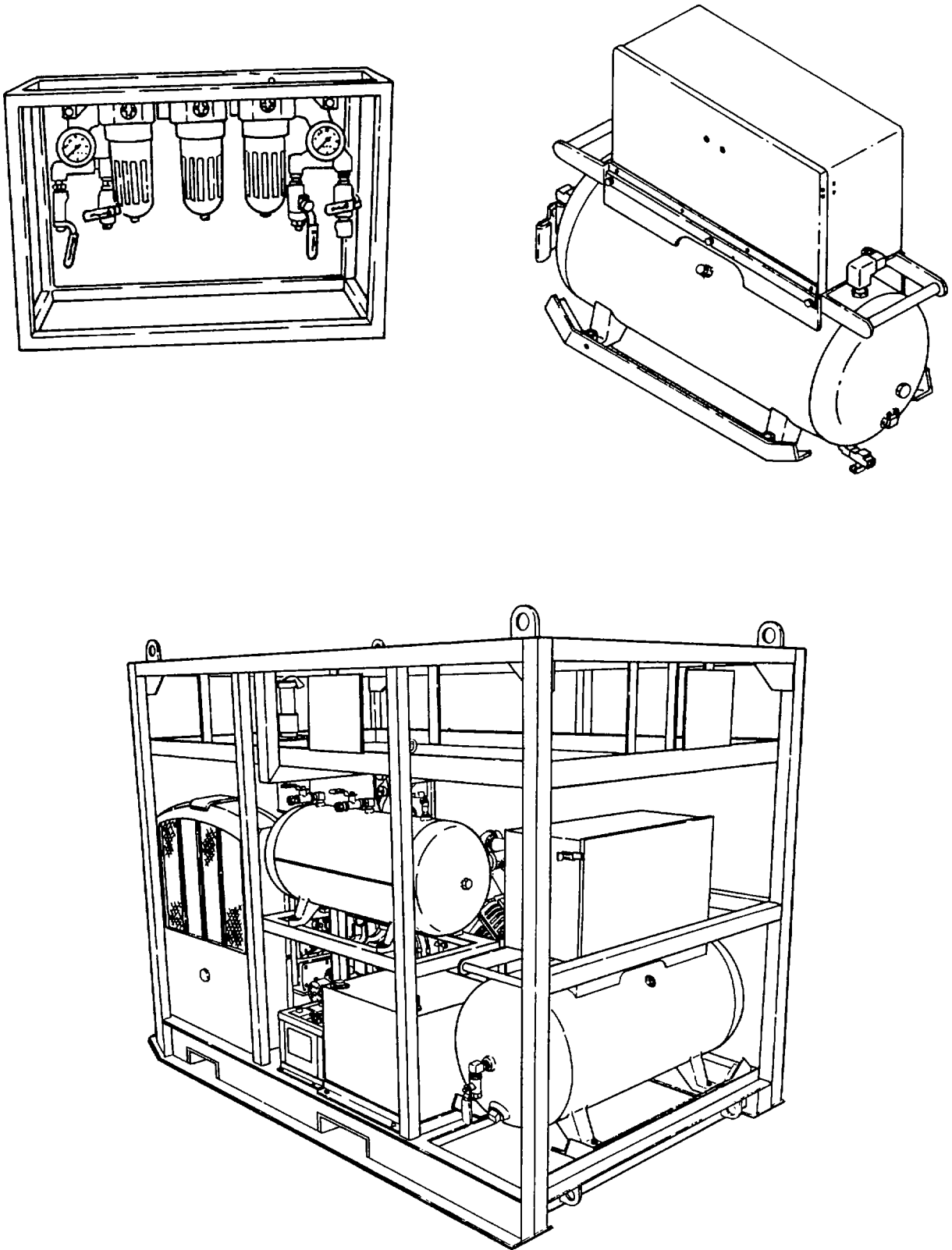


Figure 1-1. Diving Air Compressor.

**CHAPTER 1  
INTRODUCTION**

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OVERVIEW .....	1-1
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**OVERVIEW**

This chapter contains general information pertaining to Diving Air Compressor, Diesel Engine Driven, 88.5 Standard Cubic Feet per Minute (SCFM), Model HIII-271 -5120, and its components.

**Section I. GENERAL INFORMATION**

Paragraph		Page
1-1	Scope .....	1-1
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1-1. **Scope.** This manual contains operator's, unit, direct support and general support maintenance for Compressor, Diving Air, Model HII-271 -5120.

1-2. **Maintenance Forms, Records and Reports.** Department of the Army forms and procedures used for equipment maintenance will be those prescribed in DA PAM 738-750, The Army Maintenance Management System (TAMMS).

1-3. **Destruction of Army Materiel to Prevent Enemy Use.** Refer to TM 750-244-3 for procedures to destroy Diving Air Compressor to prevent enemy use.

1-4. **Preparation for Storage or Shipment.** Refer to Chapter 3, Section VI, and TM 38-230 for procedures to place the equipment into storage and prepare equipment for shipment.

1-5. **Reporting Equipment Improvement Recommendations (EIR).** If your Diving Air Compressor needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design or performance. Put it on an SF 368 Product Quality Deficiency Report). Mail it to us at: Commander, U.S. Army Troop Support Command, ATTN: MSTR-MOF, 4300 Goodfellow Boulevard, St. Louis, Missouri 63120-1798. We will send you a reply.

1-6. **List of Abbreviations.**

- AC alternating current
- AH ampere/hour

AMP	ampere
ASME	American Society of Mechanical Engineers
BTU	British Thermal Unit
DC	direct current
GPH	gallons per hour
FSW	feet of sea water
NEDU	Navy Experimental Diving Unit
NM	newtons per square meter
PSI	pounds per square inch
RPM	revolutions per minute
SCFM	standard cubic feet per minute
TSP	trisodium phosphate
V	volt

## Section II. EQUIPMENT DESCRIPTION AND DATA

Paragraph		Page
1-7	Equipment Characteristics, Capabilities and Features.....	1-2
1-8	Location and Description of Major Components .....	1-2
1-9	Equipment Data .....	1-4
1-10	Safety, Care and Handling .....	1-5

1-7. **Equipment Characteristics Capabilities, and Features.** The Diving Air Compressor is a diesel engine driven compressor capable of providing compressed air to 200 psi and flow rates to 88.5 SCFM. The diesel engine and accessories, air compressor, and two air receivers are all mounted on a single frame assembly which allows for rapid deployment. A control panel, mounted to the frame, allows the operator to monitor the diesel engine and air compressor during operations.

### 1-8. Location and Description of Major Components.

DIESEL ENGINE (1). Two cylinder two cycle diesel engine capable of producing 56 Hp at 2000 RPM.

AIR COMPRESSOR (2). Two-stage reciprocating air compressor capable of producing 250 psi and a flow rate of 88.5 SCFM at 200 psi, at engine speed of 1800 rpm.

AIR RECEIVER (3). 30 gallon air tank mounted to frame assembly.

PORTABLE AIR RECEIVER (4). 60 gallon air tank mounted on skid which is removable from frame assembly.

PNEUMOFATHOMETER (5). Indicates water depths from 0-250 FSW (0-76 m).

CONTROL PANEL (6). Contains controls and indicators needed to start, monitor, and terminate engine and compressor operations.

BATTERIES (7). Two 12-volt (V) batteries wired in parallel supply power for starting the diesel engine.

FUEL TANK (8). A 30 gallon fuel tank supplies fuel for diesel engine.

PORTABLE AIR FILTRATION SYSTEM (9). Provides filtered air to the divers through a 3-stage filter assembly.

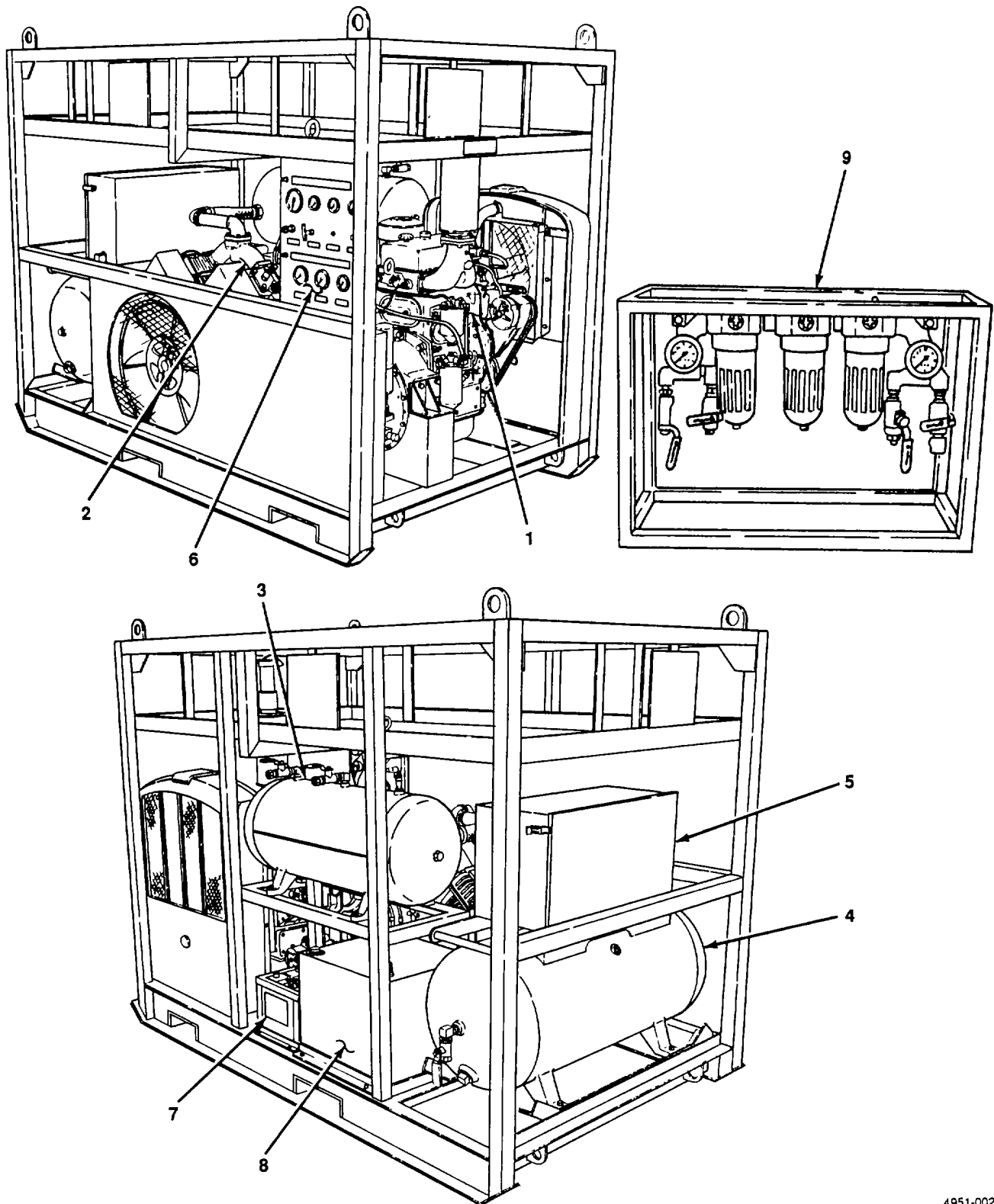


Figure 1-2. Location and Description of Major Components.

1-9. **Equipment Data.**

a. Diving Air Compressor.

Weight.....	4660 lb. (dry)
Length .....	96.50 in.
Width .....	57.75 in.
Height .....	77.00 in. (w/o exhaust ext.)

b. Diesel Engine.

Manufacturer .....	Detroit Diesel Allison
Engine type .....	Two-cycle diesel
Model .....	Series 71
Identification number .....	1023-5100
Displacement .....	142 cu. in.
Bore .....	4.25 in.
Stroke .....	5 in.
Horsepower .....	56 at 2000 rpm
Compression ratio .....	17:1
Cooling .....	Radiator coolant
Coolant Capacity .....	12 qt (11.31 l)
Injectors .....	Cam-operated unit type
Starting system .....	12 volt, Sprag clutch
Oil capacity .....	10 qt (9.46 l)
Height .....	41 in.
Length .....	55 in.
Width .....	29 in.
Weight .....	1180 lb. (dry)

c. Compressor.

Manufacturer .....	Quincy Compressors, Colt Ind.
Type .....	Two-stage reciprocating
Model .....	5120
Configuration .....	VEE
High-pressure cylinders .....	2
Low-pressure cylinders .....	2
Stroke .....	4 in.
Bore, high-press.cylinder .....	3.25 in.
Bore, low-press.cylinder .....	6.0 in.
Piston displacement .....	123 cfm at 940 rpm
Oil capacity .....	10.50 qt (9.93 l)
Maximum operating pressure .....	250 psig
Rated flow .....	88.5 scfm at 940 rpm and 200 psig
Length .....	28.5 in.
Width .....	35 in.
Height .....	31 in.
Weight .....	970 lb.

d. Portable Air Reliever.

Volume .....	60 gal.
Height .....	41.5 in. (105.5 cm)
Width .....	21 in. (53.3 cm)
Length .....	54 in. (136.1 cm)
Weight .....	130 lbs (286 kg)

e. Air Receiver.

Volume .....	30 gal.
--------------	---------

1-10. **Safety, Care, and Handling.** When operating or doing maintenance on Diving Air Compressor take necessary precautions to ensure the safety of others as well as yourself. Avoid careless operating or maintenance habits which cause accidents to personnel and damage to the equipment. Observe all WARNING's, CAUTION's and NOTE's in this manual. This equipment can be extremely dangerous if these instructions are not followed.

**Section III. TECHNICAL PRINCIPLES OF OPERATION**

Paragraph		Page
1-11	General .....	1-5
1-12	Detailed Principles of Operation, Diesel Engine .....	1-7
1-13	Detailed Principles of Operation, Air Compressor .....	1-9
1-14	Detailed Principles of Operation, Air Filtration System .....	1-11
1-15	Detailed Principles of Operation, Portable Air Receiver .....	1-11

1-11. **Technical Principles of Operation.**

a. General. Figure 1-3 provides a block diagram of the Diving Air Compressor. The Diving Air Compressor provides medium pressure air at about 200 psi. The diesel engine is electrically started by a 12-volt battery, mounted on frame assembly. Air for combustion of the fuel enters through an oil bath air cleaner which filters the air. The diesel engine is water cooled by a radiator. Coolant is circulated through the engine by hoses connected to a water pump mounted on the diesel engine. The compressor is air cooled by means of a fan mounted in the front of the unit. Fuel for combustion is drawn into the engine from a fuel tank. The internal moving parts of the engine are lubricated by a rotor-type pump which draws oil from the oil pan. The oil passes through gallery passages in the block, through the filter to the cooler. Exhaust gases are expelled from the engine through the exhaust manifold and out of the muffler exhaust pipe. The engine is equipped with a direct drive power take-off which is controlled by a clutch mechanism. A hand lever is used to engage or disengage the clutch. When the clutch is engaged, with the engine running, power is transferred from the engine to the compressor, through a pulley and fan belt arrangement. When the compressor is operating, ambient air is taken in through two filters into the compressor. Air in the compressor is compressed to 200 psig and routed to the receiver. The compressed air is then supplied to portable filtration system where it is filtered. After being filtered, the compressed air is then delivered to a portable air receiver, where up to three divers can be supported.



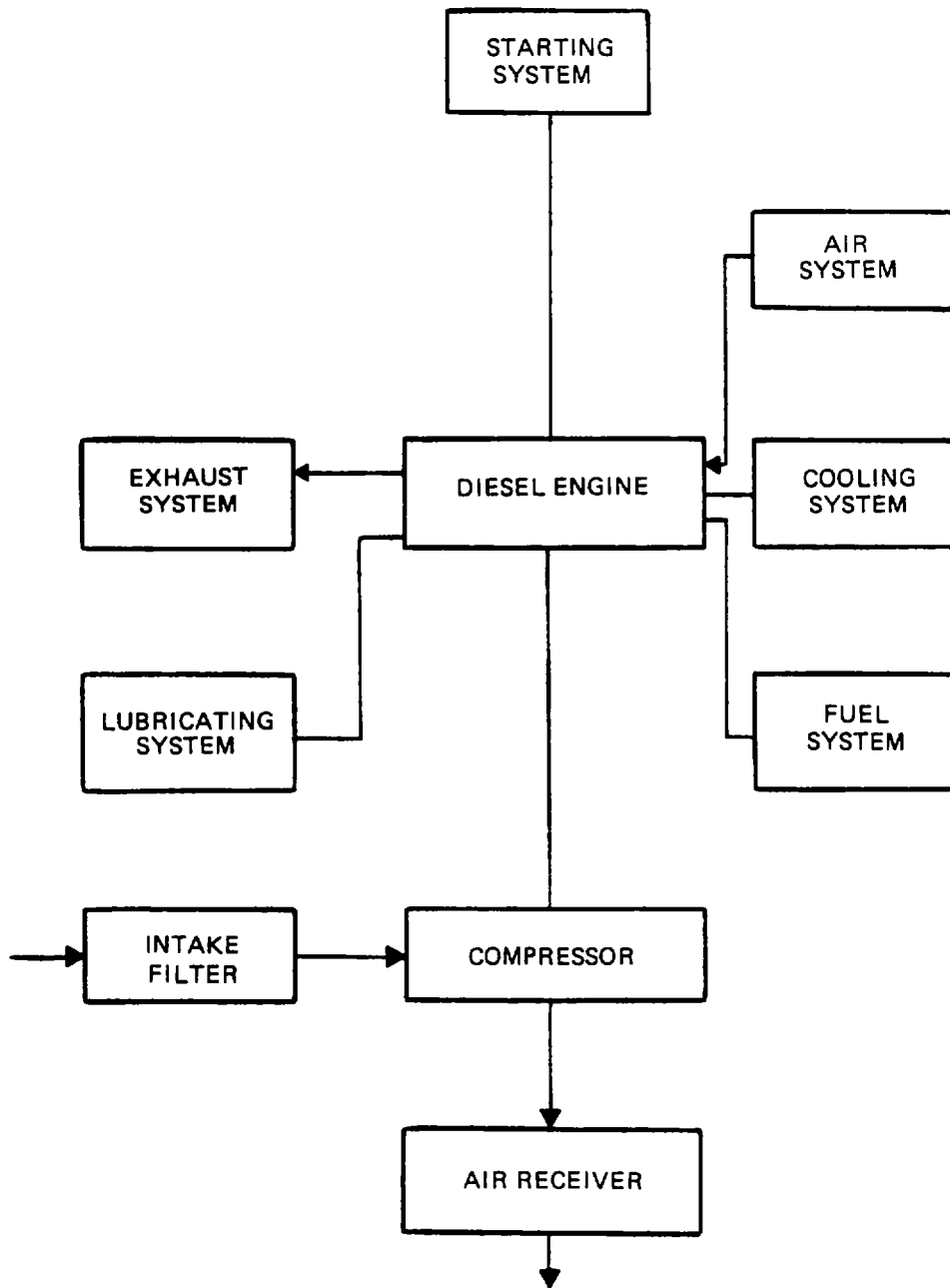


Figure 1-3. Diving Air Compressor, Block Diagram.

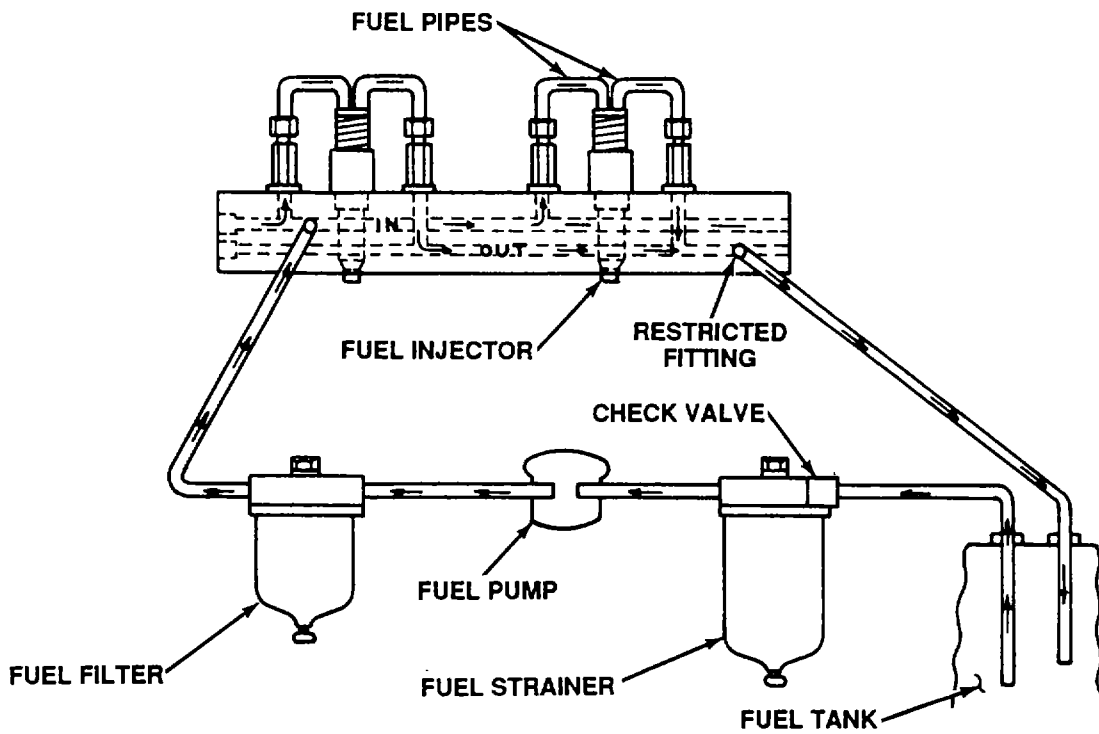
## 1-12. Detailed Principles of Operation, Diesel Engine.

a. Starting System. The starting system for the diesel engine is comprised of two 12-volt lead-acid storage batteries, a starting motor, starter switch, voltage regulator and alternator. In starting the engine, the starter switch is depressed, battery current energizes the starter motor, which causes the armature to turn. Cranking torque is transmitted by a Sprag clutch from the starting motor armature to the engine flywheel gear. The Sprag clutch will keep the starter pinion in mesh with the flywheel until starting is assured or the start circuit is interrupted. When the diesel engine is running, a belt arrangement drives the alternator which has an electrical output that maintains the battery. The regulator regulates the voltage and current output of the alternator and maintains the battery in a fully charged condition.

b. Diesel Engine. In the diesel engine, air alone is compressed in the cylinder; after the air has been compressed, a charge of fuel is sprayed into the cylinder and ignition is accomplished by the heat of compression. A blower is provided to force air into the cylinders for expelling the exhaust gases and to supply the cylinders with fresh air for combustion. The cylinder wall contains a row of ports which are above the piston when it is at the bottom of its stroke. These ports admit the air from the blower into the cylinder as soon as the rim of the piston uncovers the ports. The unidirectional flow of air toward the exhaust valves produces a scavenging effect, leaving the cylinders full of clean air when the piston again covers the inlet ports. As the piston continues on the upward stroke, the exhaust valves close and the charge of fresh air is subjected to compression. Shortly before the piston reaches its highest position, the required amount of fuel is sprayed into the combustion chamber by the fuel injector. The intense heat generated during the high compression of the air ignites the fine fuel spray immediately. The combustion continues until the injected fuel has been burned. The resulting pressure forces the piston downward on its power stroke. The exhaust valves are again opened when the piston is about halfway down, allowing the burned gases to escape into the exhaust manifold. Shortly thereafter, the downward moving piston uncovers the inlet ports and the cylinder is again swept with clean scavenging air. This entire combustion cycle is completed in each cylinder for each revolution of the crankshaft, or, in other words, in two strokes; hence, it is a "two-stroke cycle."

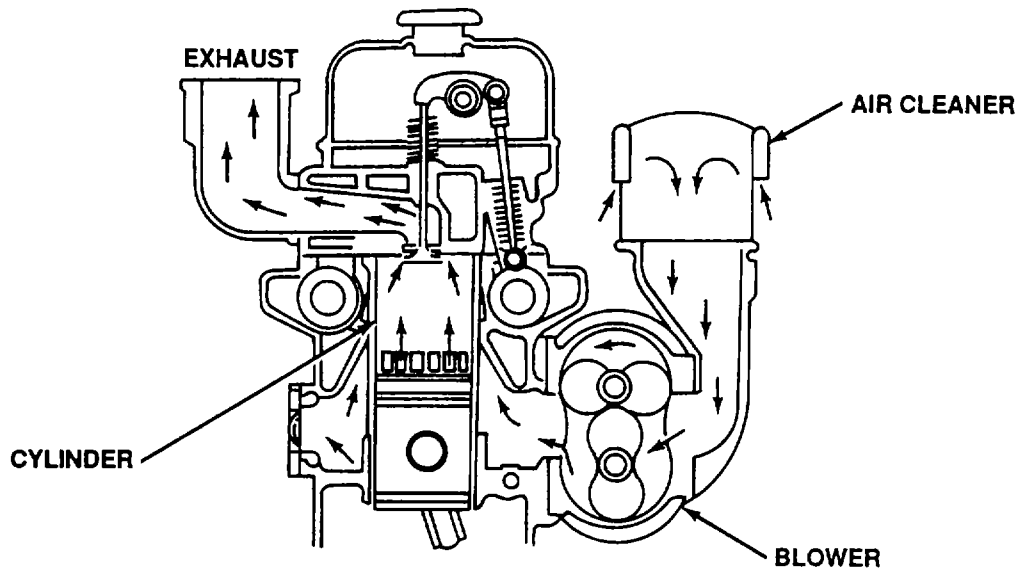
c. Fuel System. The fuel system, schematically illustrated in Figure 1-4, is comprised of a 30-gallon fuel tank, injectors, pipes, manifolds, pump, strainer, filter, and connecting fuel lines. When the engine is started by the starting motor, fuel is drawn from the fuel tank through the strainer by a gear driven fuel pump. The fuel then enters the fuel pump. Upon leaving the pump under pressure, fuel is forced through the filter and into the inlet manifold in the cylinder head, where it passes through pipes into the injectors. The fuel is filtered through elements in the injectors and atomized through small spray tip orifices into the combustion chamber. Excess fuel from the injectors returns through the fuel outlet manifold and connecting fuel lines to the fuel tank. Since the fuel is constantly circulating through the injectors, it serves to cool the injectors and to carry off any air in the fuel system.

d. Air System. Air enters the engine through an oil bath air cleaner, which is designed to remove foreign matter from the air and pass the required volume of air for proper combustion and scavenging. In the intake system illustrated in Figure 1-5, a charge of air is forced into the cylinders by the blower and thoroughly sweeps out all of the burned gases through the exhaust valve ports. This air also helps to cool the internal engine parts, particularly the exhaust valves. At the beginning of the compression stroke, each cylinder is filled with fresh clean air which provides for efficient combustion. The air, entering the blower from the air cleaner, is picked up by the lower rotor lobes and carried to the discharge side of the blower. The continuous discharge of fresh air from the blower enters the air chamber of the cylinder block and sweeps through the intake ports of the cylinder liners. The angle of the ports in the cylinder liner creates a uniform swirling motion to the intake air as it enters the cylinder. This motion persists throughout the compression stroke and facilitates scavenging and combustion.



4951-004

Figure 1-4. Fuel System, Schematic



4951-005

Figure 1-5. Air Intake System.

e. Cooling System. The cooling system consists of a radiator, fan, centrifugal-type water pump, and thermostat. The water pump directs a flow coolant circulating through the engine. Engine coolant is drawn from the bottom of the radiator core by the water pump and is forced through the oil cooler and into the water manifold and thermostat housing. From the thermostat housing, the coolant returns to the radiator where it passes down a series of tubes and is cooled by the air stream created by the fan. When starting a cold engine, or when the coolant is below operating temperature, the coolant is restricted at the thermostat housing and a bypass provides water circulation within the engine during the warm-up period.

f. Exhaust System. The exhaust system consists of a unitized muffler and exhaust pipe, designed to decrease the noise of combustion and to carry the combustion gases up and away from the air intake area. The exhaust pipe is covered with a hinged, spring-loaded cap to exclude rain. The muffler is threaded for insertion into the engine manifold.

g. Lubrication System. The lubrication system provides lubrication to all moving parts within the engine. A gear-type pump draws oil from the oil pan, through an intake screen. The oil is then pumped through the oil cooler. After leaving the oil cooler the flow is divided. A portion of the oil flow is directed to crankshaft front main and connecting rod bearings, front camshaft and balance shaft bearings, through the oil filter and back to oil pan, and the remainder travels to cylinder head where it supplies lubrication to valve operation mechanisms, center and rear camshaft, balance shaft, main, and connecting rod bearings. Oil draining back down from cylinder head also provides lubrication to front and rear blower bearings and gear train. An oil by-pass valve allows excess oil to by-pass the oil cooler during warm up periods and in the event the oil cooler becomes stopped up.

### 1-13. Detailed Principles of Operation, Air Compressor.

a. Compressor Pulley. The pulley is mounted at front of compressor unit. It is connected to the end of the crankshaft and held in place with a keyway and two bolts. The pulley provides a means of receiving power from a diesel engine through a belt arrangement. The rotation of the pulley turns the crankshaft of the compressor to develop compressed air.

b. Air System. Figure 1 illustrates the compressor air system. Air at atmospheric pressure is drawn into the low pressure cylinder by having the intake valve open on the down-stroke of the piston. On the compression stroke of the first stage piston, air is forced through the first stage discharge valve and into the high pressure cylinder. The compressed air from the first stage enters the second stage through an intake valve and is drawn in by the down-stroke of the second stage piston. On the compression stroke the air is compressed to its final stage and then leaves the high pressure cylinder by the open discharge valve. The compressed air leaves the compressor through the discharge manifold. In the event the air supplied by the compressor is greater than the demand, a variable differential pilot valve in the system will route excess air to the air unloader valves. The air unloader valves receive the excess air pressure on a diaphragm which drives a pin which in turn opens the intake valves. This action prevents the intake valves from closing and thereby does not allow compression of air. When the air demand becomes greater than the supply, the variable differential pilot valve will shut off the air supply to the air unloaders which will in turn allow the intake valves to close, and the compressor to load.

c. Interstage Safety Valve. The compressor is equipped with two safety valves which are installed in each cylinder head. The valve will relieve pressure at 100 psi in the event of an obstruction blockage in the passages of the head, between the high and low pressure stages.

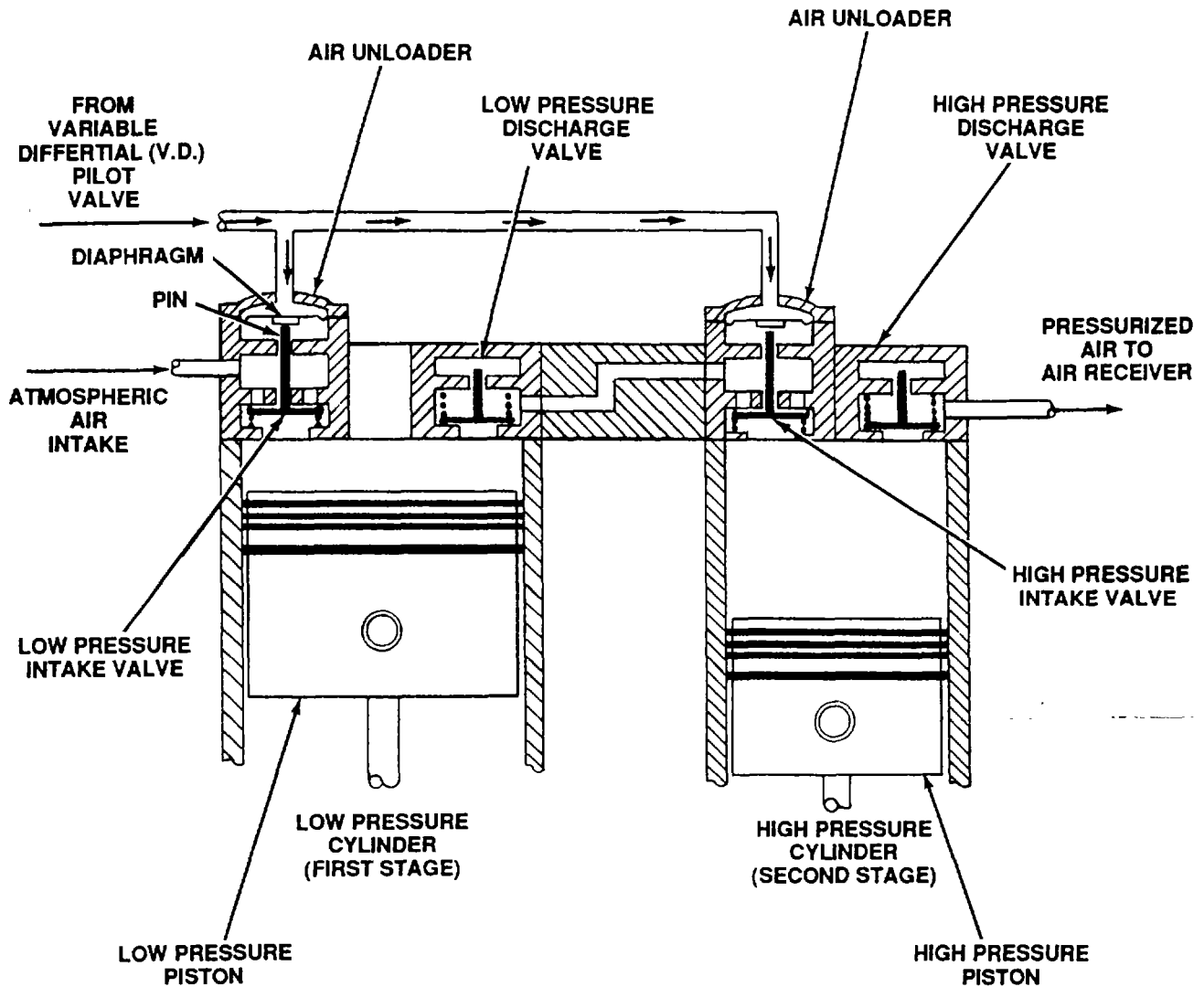


Figure 1-6. Air System Diagram.

d. Lubrication System. The lubrication system for the compressor is a pressure type system. A rotary oil pump located in the carrier bearing assembly pumps oil from the oil pan through a screen assembly and forces oil through the rifle-drilled crankshaft. This provides lubrication to the connecting rod bearings and piston pin bushings. The main bearings at each end of the crankshaft are splash lubricated by the action of the crankshaft. This allows oil pressure to build up. When the compressor slows down the spill valve opens and oil pressure drops. When the spill valve opens, oil drains from the crankshaft back into the oil pan. The oil pressure is regulated by a spring-loaded ball mounted in the bearing carrier. Spring pressure is controlled by an adjusting screw. Turning the screw clockwise increases the oil pressure, turning it counterclockwise decreases the oil pressure. After an adjustment has been made, the adjustment screw locknut must be tightened.

e. Cooling System. The air compressor is air cooled by a flow of air generated by a fan built into compressor pulley.

1-14. **Detailed Principles of Operation, Portable Air Filtration System.** The system provides filtered air to the divers through a 3-stage filter. The first filter is a 10 micron pre-filter, the second a 5 micron intermediate filter, and the third a coalescing filter which removes 99.9999 percent of all mist and particulates from the diving air. Each filter has an automatic drain valve. The inlet to the portable filters is provided with two ball valves, one for connecting primary air, and the other for a backup air supply from another source. The outlet of the portable filters is provided with two ball valves for connecting the portable air receiver.

1-15. **Detailed Principles of Operation, Portable Air Reliever.** The air receiver provides connections for three divers air hoses and three pneumo hoses. Each connection has an on-off valve. The pneumo hoses are provided with gages which indicate sea water depths from 0-250 FSW (0-76 m).

**CHAPTER 2  
OPERATING INSTRUCTIONS**

	Page
OVERVIEW .....	2-1
Section I Description and Use of Operator's Controls and Indicators .....	2-1
Section II Operator's Preventive Maintenance Checks and Services (PMCS) .....	2-5
Section III Operation Under Usual Conditions .....	2-8
Section IV Operation Under Unusual Conditions .....	2-13

**OVERVIEW**

This chapter provides information and procedures required by the operator to operate the Diving Air Compressor safely and efficiently.

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

Paragraph		Page
2-1	General .....	2-1
2-2	Control Panel .....	2-2
2-3	Diesel Engine .....	2-3
2-4	Air Compressor .....	2-4

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

2-2. Control Panel.

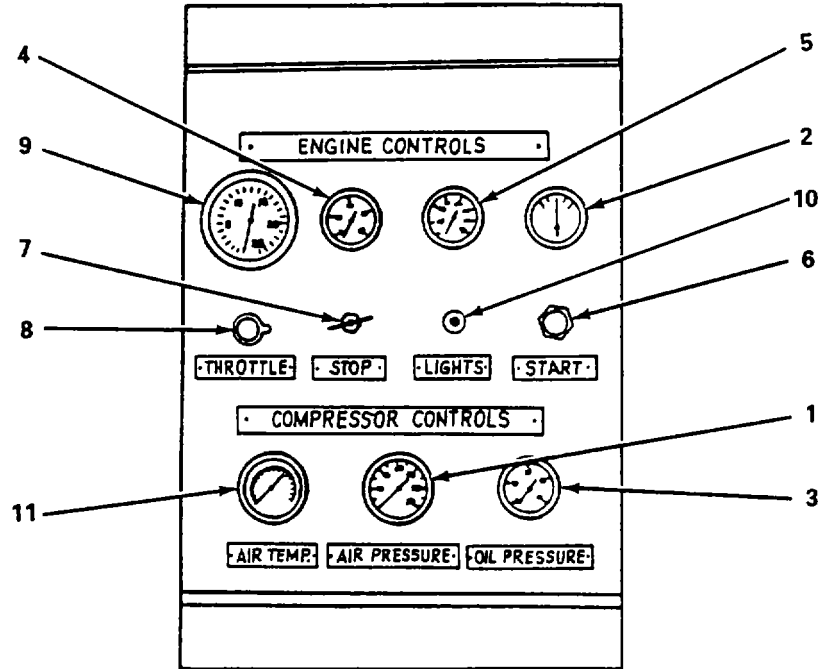


Figure 2-1. Control Panel Controls and Indicators.

Key	Control or Indicator	Function or Use
1	Air Pressure Gage	The gage indicates the pressure of compressed air in the receiver.
2	Engine Ammeter	The ammeter shows the amount of current flow to and from the battery After starting the engine, the ammeter should register a high charge. This should decline as engine continues to operate, and will maintain a slight charge.
3	Compressor Oil Pressure Gage	The oil pressure gage indicates the pressure of lubricating oil in the compressor, when the compressor is activated.
4	Engine Oil Pressure Gage	The engine oil pressure gage registers the lubricating oil pressure in the diesel engine when it is operating.
5	Engine Coolant Temperature Gage	The temperature gage indicates coolant temperature in the water manifold.



Key	Control or Indicator	Function or Use
6	Engine Start Button	Depressing the start button, energizes the starting motor.
7	Engine Stop Control	Pulling on the stop knob, manually places the injector racks in the no-fuel position. Knob should be held out until engine stops running, then pushed back in place.
8	Engine Throttle Control	Controls engine speed. Turning control counterclockwise increases speed, turning clockwise decreases speed.
9	Engine-Speed/Operating-Time Gage	The tachometer, driven by the engine, indicates the speed of the engine in revolutions per minute (rpm), and registers elapsed operating time, of the engine in hours and minutes.
10	Lights	Operates panel lights.
11	Air Temperature Gage	The gage indicates the temperature of the compressed air in the receiver.

2-3. Diesel Engine.

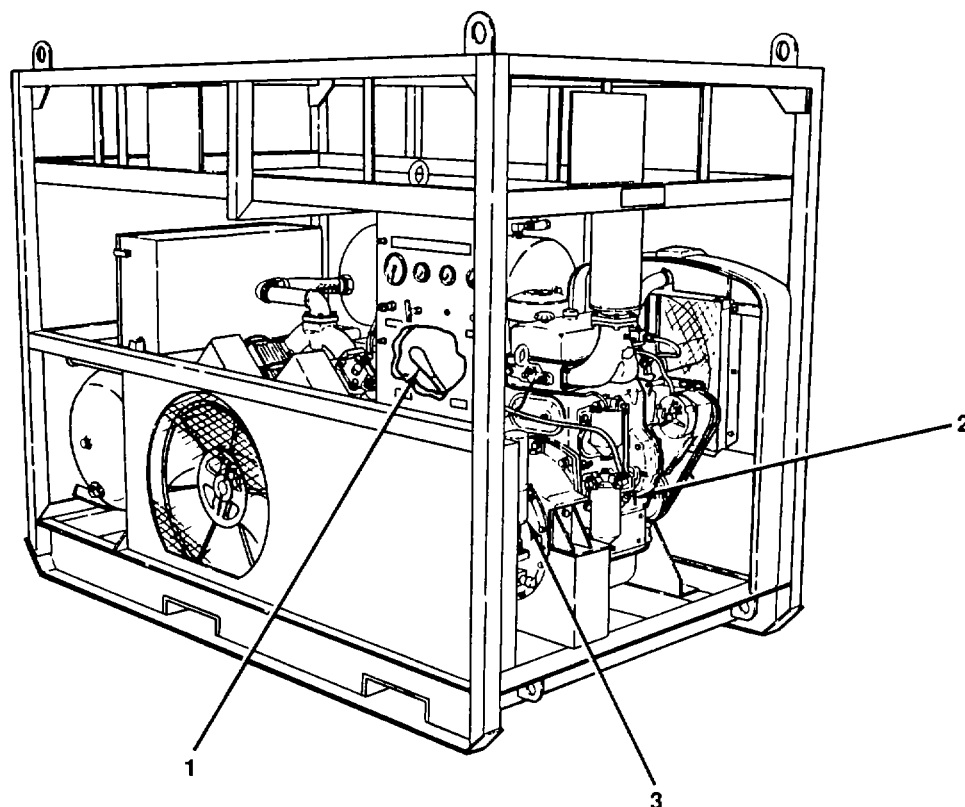
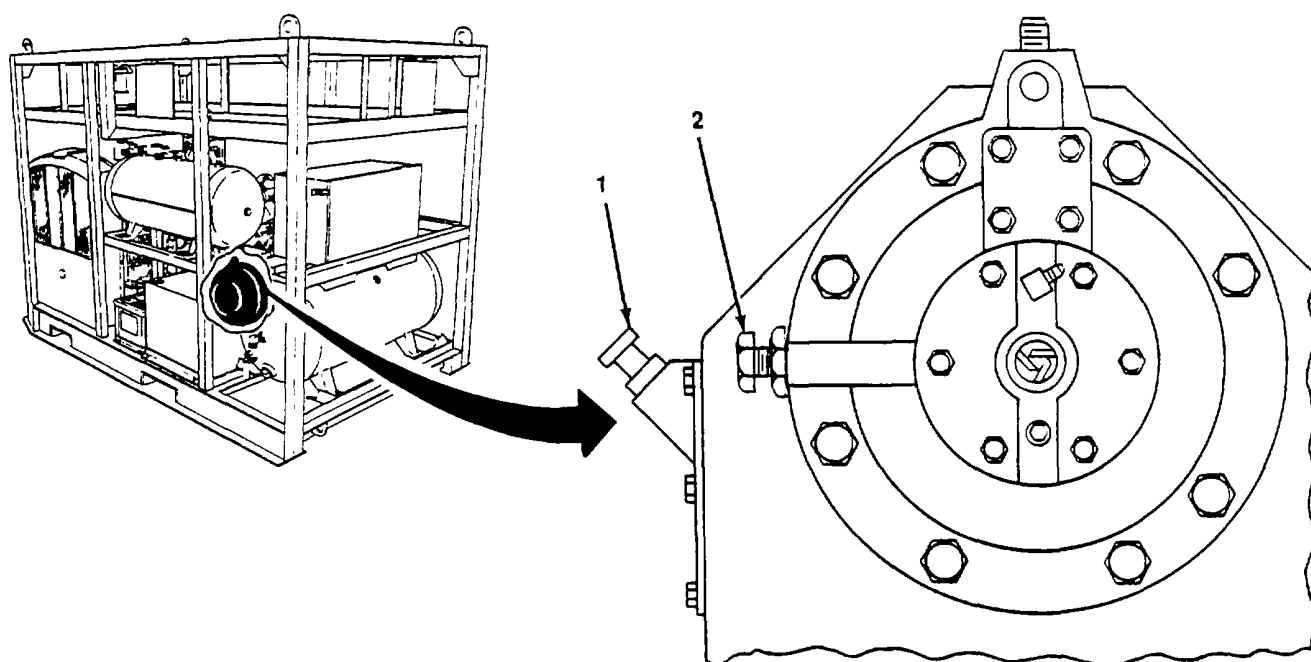


Figure 2-2. Diesel Engine Controls and Indicators.

Key	Control or Indicator	Function or Use
1	Power Take-Off Control Lever	Engages clutch and transmits power to air compressor.
2	Dipstick	Indicates the quantity of oil in the crankcase.
3	Starting Aid Valve Lever	Activating lever releases starting fluid into diesel engine to help start the engine in cold weather conditions.

2-4. Air Compressor.



4951-009

Figure 2-3. Air Compressor Controls and Indicators.

Key	Control or Indicator	Function or Use
1	Dipstick	Indicates the quantity of oil in the compressor crankcase, by markings on a bayonet type stick.
2	Oil Pressure Adjusting Screw	Regulates the oil pressure by manual adjustment of the screw. A locking ring is provided to lock the screw in position.

**Section II. OPERATOR PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)**

Paragraph		Page
2-5	General .....	2-5
2-6	Purpose of PMCS Table .....	2-5
2-7	Explanation of Columns .....	2-5
2-8	Reporting Deficiencies .....	2-6
2-9	Equipment is Not Ready/Available If Column .....	2-6
2-10	Special Instructions .....	2-6

2-5. **General.** Operator PMCS are performed to ensure that the diving air compressor is ready for operation at all times. Perform the checks and services at the specified intervals.

a. Before you Operate. Always keep in mind the CAUTIONS and WARNINGS. Perform your before (B) PMCS prior to the equipment leaving its containment area or performing its intended mission.

b. While you Operate. Always kept in mind the CAUTIONS and WARNINGS. Perform your during (D) PMCS when the equipment is being used in its intended mission.

c. After you Operate. Be sure to perform your after (A) PMCS after the equipment has been taken out of its mission mode or returned to its containment area.

d. If your Equipment Fails to Operate. Troubleshoot with proper equipment. Report any deficiencies using the proper forms. See DA Pam 738-750.

2-6. **Purpose of PMCS Table.** The purpose of the PMCS table is to provide a systematic method of inspecting and servicing the equipment. In this way, small defects can be detected early before they become a major problem causing the equipment to fail to complete its mission. The PMCS table is arranged with the individual PMCS procedures listed in sequence under assigned intervals. The most logical time (before, during, or after operation) to perform each procedure determines the interval to which it is assigned. Make a habit of doing the checks in the same order each time and anything wrong will be seen quickly. See paragraphs 2-7 and 2-8 for an explanation of the columns in table 2-1.

2-7. **Explanation of Columns.** The following is a list of the PMCS table column headings with a description of the information found in each column.

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

b. Interval. This column shows a dot (.) when each check is to be done.

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

d. Equipment is Not Ready/Available If. See paragraph 2-9.

2-8. **Reporting Deficiencies.** If your equipment does not perform as required, refer to Chapter 3 under Troubleshooting for possible problems. Report any malfunctions or failures on DA Form 2404, or refer to DA Pam 738-750.

2-9. **Equipment Is Not Ready/Available If Column.** This column lists conditions that make the equipment unavailable for use because it is unable to perform its mission, or because it would represent a safety hazard. Do not accept or operate equipment with a condition in the "Equipment is Not Ready If" column.

**NOTE**

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

2-10. **Special Instructions.** Preventive maintenance is not limited to performing the checks and services listed in the PMCS table.

**WARNING**

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

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

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

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

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

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

Leakage Definitions:

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

Class III Leakage of fluid great enough to form drops that fall from the item being checked/inspected.

**CAUTION**

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

When operating with Class I or II leaks, continue to check fluid level more often than required in the PMCS.

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

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

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

**NOTE**

Within designated intervals, these checks are to be performed in the order listed.

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.

Item No.	Interval				Item To Be Inspected Procedure	Equipment is not Ready/ Available if:
	B	D	A	W		
1	●		●		Fuel tank. Check fuel supply, add diesel oil as required to keep fuel tank full. Ensure strainer is clean.	
2	●		●		Engine crankcase. Check oil level. Add oil as required.	
3	●		●		Check the coolant level and maintain near top of radiator.	
4.	●		●		Give compressor overall visual check.	
					<b>CAUTION</b> Do not overfill compressor oil tank.	
5	●		●		Compressor crankcase. Check oil level. Add oil as required.	

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

Item No.	Interval				Item To Be Inspected Procedure	Equipment is not Ready/ Available if:
	B	D	A	W		
6		●			Check compressor oil pressure - maintain approximately 17 psi.	
7	●	●	●		Gages. Inspect for damaged pointers, cracked lenses, liquid fill leaks, loose tube connections or loose wires, loose wires, loose hardware, plus proper operation and normal readings during operation.	Gages damaged or inoperative. Do not operate until repaired.
8	●	*	●		Switches, controls and valves. Inspect for proper operation. Check for looseness, damage and missing parts.  WARNING Examine hoses before pressurizing. Worn or frayed hose may explode.	Switches damaged or inoperative.
9	●	.	●		Air hose and fittings. Inspect for wear, cracks, cuts, fraying, leaks and loose connections.	Air hose fittings damaged Do not operate with damaged hose or fittings.
10	.	●			Check the compressor air distribution system for air leaks.	
11	●	●	●		Open drain valves on air receiver (30 gal.) and portable air receiver (60 gal.) while in use momentarily to expel condensation/ water from tanks every 15 minutes.	

**Section III. OPERATION UNDER USUAL CONDITIONS**

Paragraph		Page
2-11	General .....	2-8
2-12	Starting Procedures .....	2-9
2-13	Stopping Procedures .....	2-13

2-11. **General.** The Diving Air Compressor must be located in a well ventilated area to allow sufficient clearance in order to prevent overheating of the diesel engine. Whenever possible, the radiator side of the diesel engine should be pointed leeward, to minimize the possibility of exhaust gases entering the air intake on the air compressor.

**2-12. Starting Procedures.**a. *Diesel Engine.* (figure 2-4)

- (1) Ensure power take-off control lever (1) is in position closest to engine.
- (2) Ensure STOP control (2) is fully in.

**WARNING**

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

It is the diving supervisor's responsibility to ensure that exhaust fumes do not enter the air intake on the compressor. Engine exhaust should always be down wind, elevated, or piped overboard. Failure to prevent this may result in injury or death to diver.

**CAUTION**

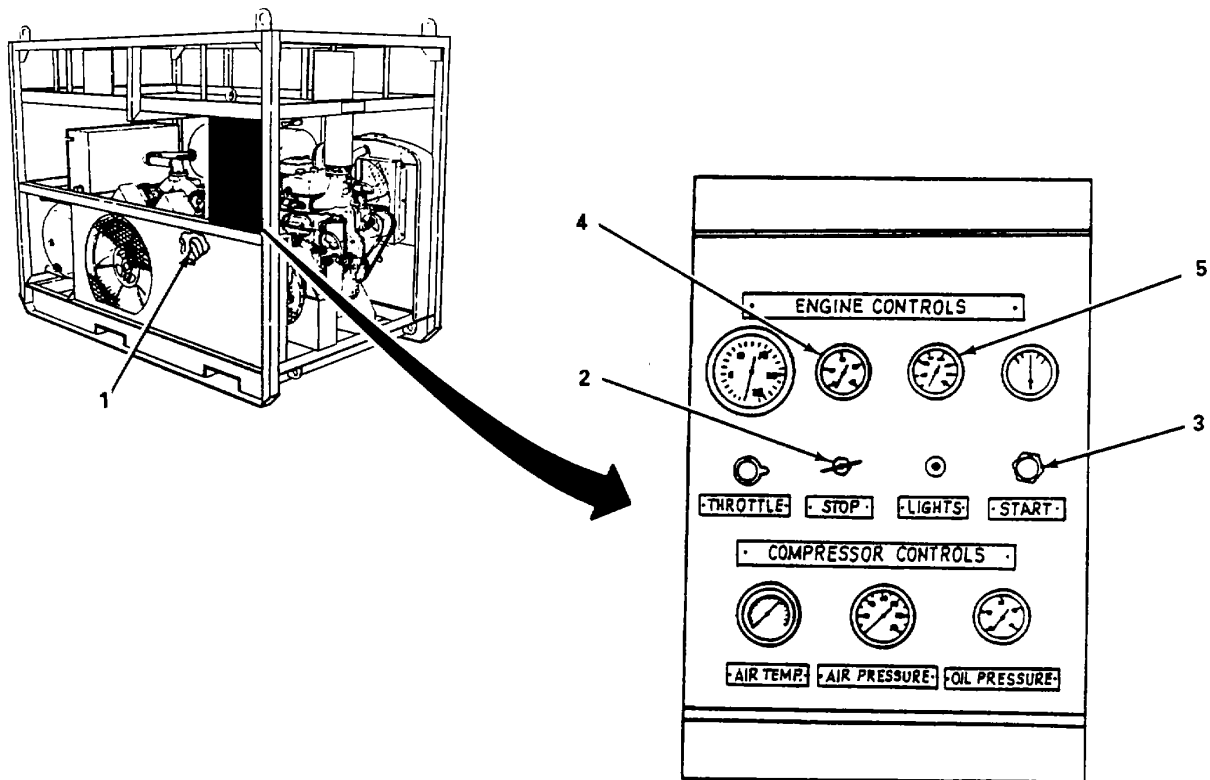
If engine fails to start within 30 seconds, release the start button. Allow the starting motor to cool a few minutes before starting again. If the engine fails to start after four attempts, an inspection should be made to determine the cause.

- (3) Depress START button (3) and release when engine starts.
- (4) Check engine oil pressure gage (4) after engine starts. Oil pressure should be at least 18 psi at 1200 rpm.

**CAUTION**

Avoid unnecessary engine idling. When prolonged idle is necessary, maintain at least 800 rpm. Long periods of idle allow the water coolant temperatures to drop below normal which causes incomplete fuel combustion, which in turn causes dilution in the crankcase, this also allows formation of lacquer or gummy deposits on valves, pistons and rings. There is also a rapid accumulation of sludge in the engine.

- (5) Allow engine to run at part throttle and no-load for approximately five minutes to warm up engine.
- (6) Check engine coolant temperature gage (5). Normal operating temperature is 160-185°F.



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**Figure 2-4. Engine Operating Procedures.**

*b. Air Compressor.* (figure 2-5)

- (1) Set engine speed to 800 rpm.
- (2) Move power take-off control lever (1) away from engine to engage clutch.
- (3) Set engine speed to 1800 rpm.
- (4) Check air compressor oil pressure gage (2). Oil pressure should be at least 17 psi when air compressor delivers 200 psi. Adjust oil pressure as follows:
  - (a) Loosen locknut (3).
  - (b) Turn adjusting screw (4) clockwise to raise pressure or counterclockwise to lower pressure.
  - (c) Tighten locknut (3) when desired pressure is obtained.



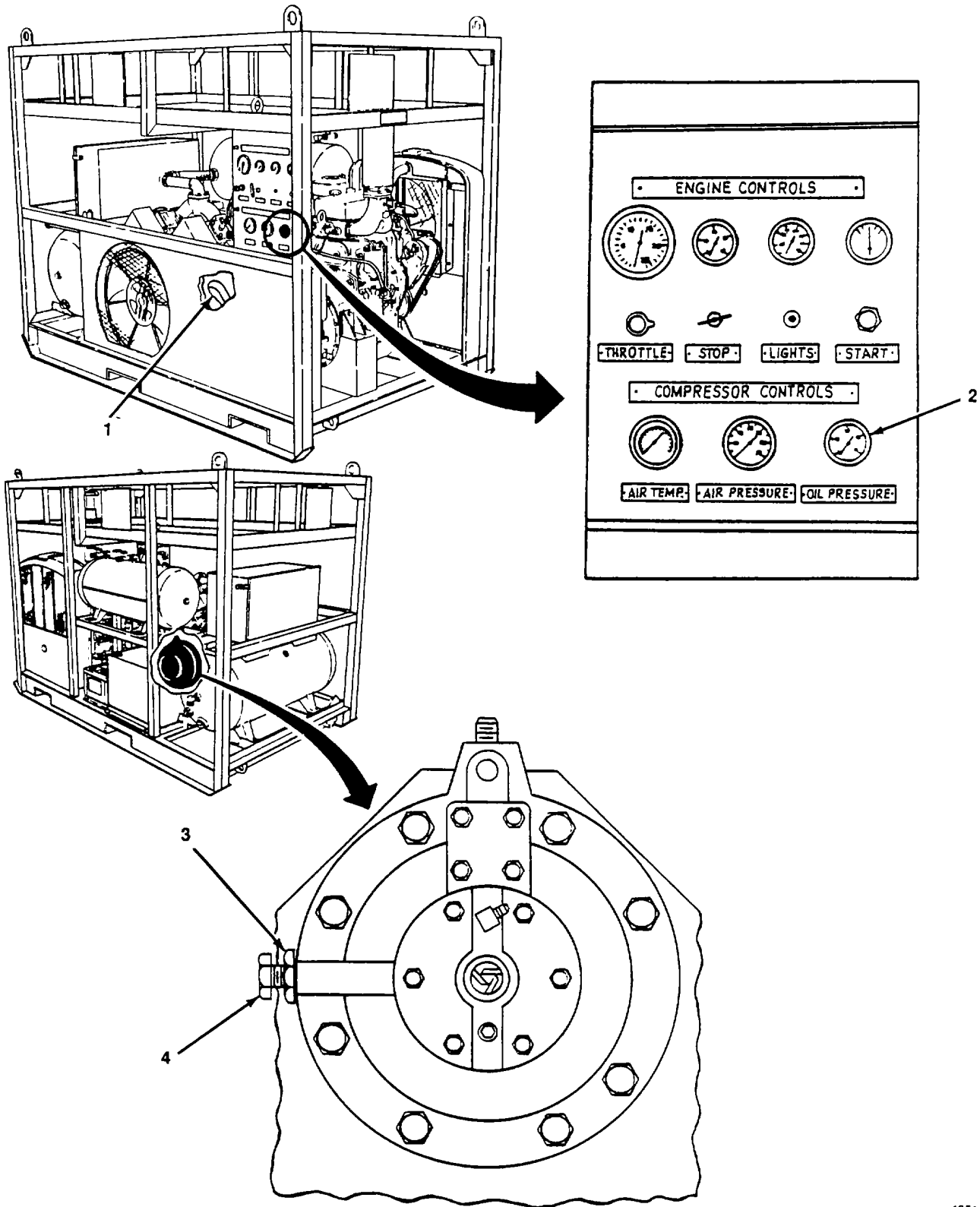
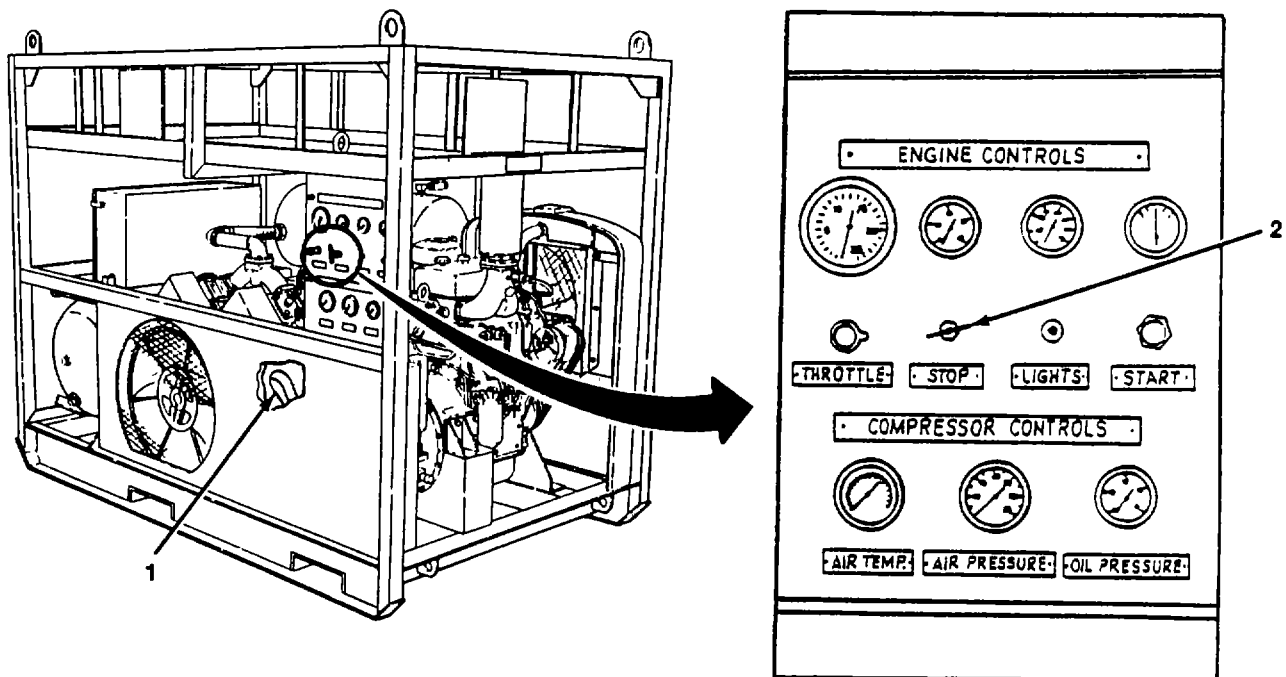


Figure 2-5. Air Compressor Operating Procedures.

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2-13. **Stopping Procedures.** (figure 2-6)

- a. Set engine speed to 800 rpm.
- b. Move power take-off control lever (1) towards engine to disengage clutch.
- b. Allow engine to run at 950 rpm or less for five minutes.
- d. Pull engine STOP control (2) out fully until engine stops completely.
- e. Push engine STOP control (2) in fully.
- f. Perform after operation PMCS.



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Figure 2-6. Stopping Procedures.

**Section IV. OPERATION UNDER UNUSUAL CONDITIONS**

Paragraph	Page
2-14 Operation in Dusty or Sandy Areas .....	2-13
2-15 Operation in Rainy, Humid or Salt Air Conditions .....	2-13
2-16 Operation in Extreme Heat .....	2-13
2-17 Operation in Different Altitudes .....	2-14
2-18 Operation in Extreme Cold .....	2-14

2-14. **Operation in Dusty or Sandy Areas.** The procedures for operating the Diving Air Compressor are the same as under usual conditions including the following special instructions.

- a. Protect the equipment from dust and sand. Take advantage of all natural barriers which could protect the equipment from blowing dust or sand. Install a canvas cover when the unit is not in operation.
- b. Keep fuel clean. Strain the fuel before adding it to the tank. Make sure fuel storage and transfer cans are clean.
- c. Check and service the engine and compressor air cleaners often.
- d. Clean the engine, compressor and compressor cooling fan often. Wipe with clean cloth dampened with an approved cleaning solvent.

2-15. **Operation in Rainy, Humid, or Salt Air Conditions.** The procedures for operating the Diving Air Compressor are the same as under usual conditions including the following special instructions.

- a. Store equipment in a sheltered area when it is not in use.
- b. Keep fuel clean and free of water. Keep fuel tank full when the unit is not in use to minimize condensation.
- c. Whenever possible protect the equipment from direct rainfall when it is operating. Cover the equipment with a tarpaulin suspended about 3 feet above the equipment.
- d. Avoid direct contact with salt water. If salt water does come in contact with the equipment, rinse the equipment with clean fresh water.
- e. Repair any paint damage, such as cracks and chips. Apply standard issue rustproofing material to all exposed ferrous metal (steel) surfaces. If rustproofing material is not available, apply a light film of oil or grease to all exposed metal surfaces.

2-16. **Operation in Extreme Heat.** The procedures for operating the Diving Air Compressor are the same as under usual conditions including the following special instructions.

- a. Do not operate the equipment if the ambient temperature exceeds 125°F (50°C).
- b. When possible, provide shade to protect the equipment from direct sunlight.
- c. A slight power loss will be experienced as temperature increases.

2-17. **Operation in Different Altitudes.** The procedures for operating the Diving Air Compressor are the same as under usual conditions including the following special instructions.

- a. Engine power output will decrease by about 3 1/2 percent for each 1000 feet above sea level. The compressor will have a similar loss of operation efficiency.
- b. Service the engine/compressor air cleaner often to minimize this loss of efficiency.

2-18. **Operation in Extreme Cold.**

- a. Keep fuel tank full to minimize moisture.
- b. Check hoses and lines for cracks or other cold weather damage.
- c. Service engine with oil conforming to MIL-L-46167, Grade Arctic.
- d. Service compressor with oil conforming to MIL-H-17672, MIL SYM 2135-TH (below 20°F (-7 °C)).
- e. When pressing START button, activate the valve lever on starting aid for two seconds.

**CHAPTER 3**  
**UNIT MAINTENANCE**

	Page
OVERVIEW .....	3-1
Section I Repair Parts; Special Tools; Test, Measurement, Diagnostic Equipment (TMDE); .....	3-1
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**OVERVIEW**

This chapter contains information for troubleshooting and maintenance of the Diving Air Compressor by unit level maintenance personnel.

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

Paragraph	Page
3-1 Common Tools and Test Equipment .....	3-1
3-2 Special Tools, TMDE, and Support Equipment .....	3-1
3-3 Repair Parts .....	3-1

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

3-2. **Special Tools, TMDE and Support Equipment.** For a listing of special tools, TMDE, and support equipment authorized for use on this equipment, refer to the Repair Parts and Special Tools List, TM 5-4310-379-24P and the maintenance allocation chart (MAC), Appendix B of this manual.

3-3. **Repair Parts.** Repair parts are listed and illustrated in the Repair Parts and Special Tools List for Diving Air Compressor, TM 5-4310-379-24P.

**Section II. SERVICE UPON RECEIPT**

Paragraph	Page
3-4 General .....	3-2
3-5 Site and Shelter Requirements .....	3-2
3-6 Service Upon Receipt .....	3-2

3-4. **General.** This section contains information required by maintenance personnel to insure the equipment will be adequately inspected, serviced and operationally tested before it is subjected to normal use. These procedures include site and shelter requirements, service upon receipt of material, and preliminary servicing and adjustment.

3-5. **Site and Shelter Requirements.** The usage site for the Diving Air Compressor should be selected so as to avoid excessive dust, mud, rain, snow, heat or cold. The Diving Air compressor must be kept as level as possible. The Diving Air Compressor must never be operated if it is tilted at an angle in excess of 15° in any direction.

Make sure all loose trash is removed from the area of the equipment because refuse can be drawn into the cooling air inlets. Diving Air Compressor should not be operated inside closed rooms or buildings. If such operation is mandatory, connect extension pipe to engine exhaust, and pipe exhaust fumes outside.

Diving Air Compressor should be protected from rain, wind, snow, dust and tropical or desert sun. Temporary shelter should be provided by tarpaulins or other means. Maximum usage of natural shelter such as trees, hills, outcroppings and rock formation should be used.

**3-6. Service Upon Receipt.**

*a. Unpacking Procedures.*

- (1) Remove all tarpaulins or covers from equipment and store.
- (2) Remove wax or rust preventive compound.
- (3) Remove plastic bags from filter housings and gages on filtration system.
- (4) Remove plastic bags from valves on filtration system.
- (5) Remove plastic bags from gages, relief valves, and valve on portable air receiver.
- (6) Remove coverings from openings on air compressor and engine.
- (7) Remove paper strips from between pulleys and belts.

*b. Checking Unpacked Equipment.*

- (1) Inspect the equipment for damage incurred during shipment.

- (2) Check the equipment against the packing slip to see if the shipment is complete. Report all discrepancies in accordance with the instructions of DA PAM 738-750.
- (3) Check to see whether the equipment has been modified.

c. Preliminary Service and Adjustment.

- (1) Inspect engine alternator and compressor belt drive for proper tension. Adjust belt tension so that a firm push with the thumb, at a point midway between the two pulleys, will depress the belt 1/2" to 3/4".
- (2) Check engine crankcase oil and compressor oil for proper level. Add oil as necessary.
- (3) Connect battery cables to proper terminals on battery. Inspect for proper electrolyte level, add water as necessary.
- (4) Perform operator before and after PMCS.
- (5) Perform unit level PMCS.

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

Paragraph	Page
3-7 General .....	3-3
3-8 PMCS Procedures .....	3-3

3-7. **General.** Unit level maintenance PMCS are done to ensure that the Diving Air Compressor is in top operating condition. A comprehensive PMCS program reduce equipment downtime and increases the operational readiness of the equipment.

3-8. **PMCS Procedures.** Unit level PMCS are in table 3-1. The numbers in the Item No. column show the order in which the checks or services should be performed. These numbers should be used when recording deficiencies and shortcomings on DA Form 2404, Equipment Inspection and Maintenance Worksheet. The dot (•) in the interval column indicates when a check or service should be performed.

**Table 3-1. Unit Preventive Maintenance Checks and Services (PMCS).**

**W - Weekly                      M - Monthly                      Q - Quarterly                      H - Hourly**

Item No.	Interval				Item to be Inspected	Procedures
	W	M	Q	H		
1	•				Diving air compressor	Inspect for loose, damaged, or missing parts.
2	•				Diesel engine Inspect	Inspect for cracks, loose, damaged or missing parts. Check compressor drive belts for cracks, wear, and tension.
				150	Service	Service engine. Refer to para. 3-13.
3		•			Muffler and pipes	Inspect for leaks, holes and cracked seams, loose or missing parts. Replace damaged parts. Refer to para. 3-14.
4		•			Exhaust manifold	Inspect for cracks, leakage around gasket, loose, damaged or missing parts. Replace damaged parts. Refer to para. 3-15.
5	•				Cooling system	Inspect for cracks, bent guards, shroud, and shell, leakage from radiator or water connections and water pump, loose, damaged or missing parts. Inspect fan and pulley for damage. Replace damaged parts. Refer to para. 3-18 through 3-23.
6			•		Fuel lines and fittings	Inspect for leakage, crimped tubing, fitting tightness and seal, and for damaged fitting threads. Replace damaged parts. Refer to para. 3-24.
7				300	Fuel filter assembly	Service fuel filter. Refer to para. 3-25.
8				300	Fuel strainer assembly	Service fuel strainer. Refer to para. 3-26.
9			•		Governor assembly	Inspect governor for broken or cracked actuating arm, bent or missing linkage. Notify direct support and general support maintenance of damaged parts.
10				500	Air cleaner assembly	Service air cleaner assembly. Refer to para. 3-28.
11			•		Air box drains	Inspect for damage and missing parts.



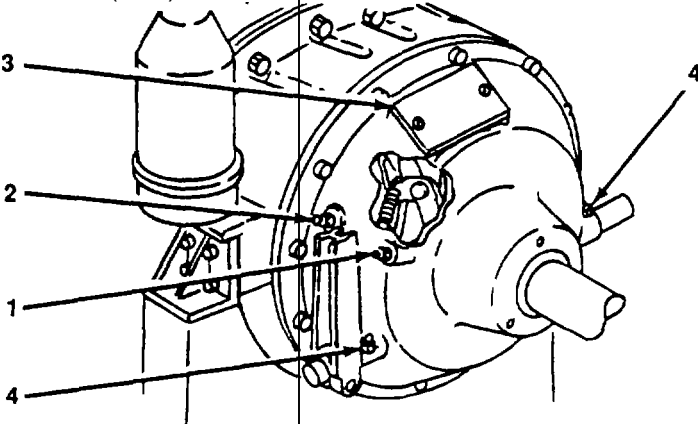
**Table 3-1. Unit Preventive Maintenance Checks and Services (PMCS) (Cont).**

**W - Weekly                      M - Monthly                      Q - Quarterly                      H - Hourly**

Item No.	Interval				Item to be Inspected	Procedures
	W	M	Q	H		
12			•		Starter	Inspect for cracks, loose, damaged or missing parts. Test starter and replace. Refer to para. 3-31.
13			•		Starting aid	Inspect starting aid for cracked brackets, loose, damaged or missing parts. Replace damaged parts. Refer to para. 3-32.
14			•		Battery charging alternator	Inspect for cracks, loose, damaged or missing parts. Test alternator and replace if defective. Refer to para. 3-33.
15			•		Wiring harness	Inspect wiring harness for frayed or burnt wires. Replace damaged parts. Refer to para. 3-34.
16		•			Battery, holddown and cables	Inspect battery and hold for loose, damaged or missing parts. Inspect cables for cracks, or signs of burnt wires. Check electrolyte level. Add distilled water if level is low. Refer to para. 3-35.
17				150	Oil filter assembly	Service oil filter. Refer to para. 3-37.
18			•		Crankcase breather pipe	Inspect breather pipe and replace if damaged or missing. Refer to para. 3-40.
19				8	Power take-off	a. Lubricate clutch release bearing (1) with all purpose grease.
				50		b. Lubricate power take-off main bearing (2) with all purpose grease.
				500		c. Lubricate clutch release levers and link pins (3).
				500		d. Lubricate clutch release shaft bearings (4) through grease fittings.

Table 3-1. Unit Preventive Maintenance Checks and Services (PMCS) (Cont).

W - Weekly                      M - Monthly                      Q - Quarterly                      H - Hourly

Item No.	Interval				Item to be Inspected	Procedures
	W	M	Q	H		
19					Power take-off (cont) 	
20		•			Air compressor	Inspect air compressor for oil leaks, cracks, loose, damaged or missing parts.
21		•			Compressor air and oil lines	Inspect air and oil lines for cracks, holes, or loose fittings. Notify direct support maintenance of damaged parts.
22			•		Air compressor shroud	Inspect shroud and notify direct support maintenance of any damage.
23				200	Air cleaner intake	Inspect air cleaner intake for cracks, loose, damaged or missing parts. Replace damaged parts. Refer to para. 3-43.
24		•			Manifold group	Inspect manifold group for damage and notify direct support maintenance of any damage.
25		•			Crankcase breather	Inspect crankcase breather for cracks, loose, damaged or missing parts. Replace damaged parts. Refer to para. 3-44.

**Table 3-1. Unit Preventive Maintenance Checks and Services (PMCS) (Cont).**

**W - Weekly                      M - Monthly                      Q - Quarterly                      H - Hourly**

Item No.	Interval				Item to be Inspected	Procedures
	W	M	Q	H		
26			•		Air receiver tank	<p>Inspect a receiver for cracks, loose, damaged, or missing parts. Inspect for cracks or loose fittings. Notify direct support maintenance of damaged parts. Inspect receiver tank label plate data for current hydrostatic test date stamp. In accordance with American Society of Mechanical Engineers (ASME) standards for boilers and unfired pressure vessels, the interval between visual inspection is not to exceed two years. Notify general support maintenance as required.</p> <p style="text-align: center;"><b>NOTE</b></p> <p>Necessity of a hydrostatic test will be determined by a certified ASME inspector.</p>
27			•		Portable air receiver tank	<p>Inspect portable air receiver for loose, damaged, or missing parts or corrosion. Inspect pressure gage and pneumofathometers for damaged or missing parts. Notify direct support maintenance of damaged parts. Inspect receiver tank label plate data for current hydrostatic test date stamp. In accordance with American Society of Mechanical Engineers (ASME) standards for boilers and unfired pressure vessels, the interval between visual inspection is not to exceed two years. Notify general support maintenance as required.</p> <p style="text-align: center;"><b>NOTE</b></p> <p>Necessity of a hydrostatic test will be determined by a certified ASME inspector.</p>
28		•			Portable air filtration system	<p>Inspect portable air filtration system for loose, damaged, or missing parts. Inspect pressure gages and filters for damage or missing parts. Service portable air filtration system. Notify direct support maintenance.</p>

**Table 3-1. Unit Preventive Maintenance Checks and Services (PMCS) (Cont).**

**W - Weekly                      M - Monthly                      Q - Quarterly                      H - Hourly**

Item No.	Interval				Item to be Inspected	Procedures
	W	M	Q	H		
29			•		Frame assembly	Inspect frame for cracks or broken welds. Notify general support maintenance of damaged parts.
30		•			Controls panel	Inspect control panel for loose, damaged or missing parts. Check that panel and gage lights are operational. Replace damaged or missing parts. Refer to para. 3-46.
31				•	Fuel tank, filler cap and fuel	Inspect fuel tank, filler cap and fuel level gage for level gage cracks, loose, damaged, or missing parts. Replace damaged parts. Refer to para. 3-48.

**Section IV. UNIT TROUBLESHOOTING**

Paragraph	Page
3-9    General .....	3-8
3-10   Unit Troubleshooting Procedures .....	3-8

3-9. **General.** This sections contains troubleshooting procedures to determine the probable cause of observed equipment malfunctions. Tests or inspections are provided to isolate the faulty component and corrective actions are provided to eliminate the malfunction.

3-10. Unit Troubleshooting Procedures. Refer to the symptom index to locate the troubleshooting procedure for the observed malfunction. Table 3-2 lists the common malfunctions that may occur during the operation or maintenance of the engine. Perform the tests or inspections, and the recommended corrective action in the order listed in the troubleshooting table. If the malfunction is corrected by a specific correction action, do not continue with the remaining steps, if any, of the troubleshooting procedure. If the malfunction is not corrected by the listed corrective actions notify your supervisor or Direct Support Maintenance.

**SYMPTOM INDEX**

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2.    Engine runs rough or erratically .....	3-10
3.    Engine overheats .....	3-10
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SYMPTOM INDEX (Cont)

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8. Air receiver will not load .....	3-12
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10. Excessive Drive belt wear .....	3-13
11. Power take-off will not engage .....	3-13
12. Compressor oil in the discharge air .....	3-13

**Table 3-2. Unit Troubleshooting Procedures.**

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<b>MALFUNCTION</b>	<b>TEST OR INSPECTION</b>	<b>CORRECTIVE ACTION</b>
<b>1. ENGINE WILL NOT START.</b>		
Step 1. Check battery connections.		Tighten loose connections.
Step 2. Test battery.		Replace a discharged battery (para. 3-35).
Step 3. Check fuel level.		Add fuel as needed.
Step 4. Fuel filter dirty.		Service fuel filter (para. 3-25)
Step 5. Fuel strainer dirty.		Service fuel strainer (para. 3-26)
Step 6. Test fuel pump flow.		Replace a defective fuel pump (para. 3-27).

Table 3-2. Unit Troubleshooting Procedures (Cont).

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
2. ENGINE RUNS ROUGH OR ERRATICALLY.		
Step 1. Air cleaner dirty.		Service air cleaner (para. 3-28).
Step 2. Alternator defective.		Replace a damaged alternator (para. 3-33).
Step 3. Fuel filter dirty.		Service fuel filter (para. 3-25).
Step 4. Fuel strainer dirty.		Service fuel strainer (para. 3-26).
3. ENGINE OVERHEATS.		
Step 1. Coolant level low.		Add coolant as needed.
Step 2. Water connections damaged.		Replace a dented or damaged water connection (para 3-20).
Step 3. Crankcase oil low.		Check oil level and add oil as needed.
Step 4. Alternator fan belts loose.		Tighten fan belts (para. 3-33)
Step 5. Water pump defective.		Replace water pump (para. 3-23).

Table 3-2. Unit Troubleshooting Procedures (Cont).

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
4. LOW ENGINE OIL PRESSURE.	Step 1. Crankcase oil level low.	Check oil level and add oil as needed.
	Step 2. Oil filter dirty.	Service oil filter (para. 3-37)
	Step 3. Oil pressure gage defective.	Replace oil pressure gage (para. 3-46).
5. LOW COMPRESSOR OIL PRESSURE.	Step 1. Check compressor oil level.	Add oil as needed.
	Step 2. Oil pressure regulating screw improperly adjusted.	Adjusted oil pressure regulating screw.
	Step 3. Oil pressure gage line leaking.	Check fittings and tighten if loose.
	Step 4. Oil pressure gage defective.	Replace a defective oil pressure gage (para. 3-46).
6. LOW COMPRESSOR OUTPUT.	Step 1. Check air intake filters.	Service air intake filters.
	Step 2. Drive belts.	Adjust drive belt tensions (para. 3-12 ).

Table 3-2. Unit Troubleshooting Procedures (Cont).

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
6. LOW COMPRESSOR OUTPUT (Cont).	Step 3. Check air system fittings for leaks.	Tighten loose fittings.
7. COMPRESSOR KNOCKING.	Step 1. Check oil level.	Add oil as needed.
	Step 2. Check compressor pulley.	Tighten a loose pulley.
	Step 3. Check safety relief valve.	Close if open.
	Step 4. Check receiver for leaks at fittings.	Tighten loose fittings.
8. AIR RECEIVER WILL NOT LOAD.	Step 1. Check manual drain valve.	Close manual drain valve.
	Step 2. Check valves.	Close valves if open.
	Step 3. Check receiver for leaks at fittings.	Tighten fittings.



Table 3-2. Unit Troubleshooting Procedures (Cont).

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
9. COMPRESSOR OVERHEATS.	Step 1. Check oil level.	Add oil as needed.
	Step 2. Drive belts loose.	Adjust drive belts (para. 3-12).
	Step 3. Intercooler dirty.	Clean intercooler fins.
10. EXCESSIVE DRIVE BELT WEAR.	Step 1. Check drive belt tension.	Adjust drive belt tension (para 3-12).
	Step 2. Check alinement of pulley.	Adjust alinement of compressor pulley.
	Step 3. Check pulley bolts.	Tighten loose pulley bolts.
11. POWER TAKE-OFF WILL NOT ENGAGE.	Step 1. Check clutch adjustment.	Notify direct support maintenance.

Table 3-2. Unit Troubleshooting Procedures (Cont)

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<b>MALFUNCTION</b>	<b>TEST OR INSPECTION</b>	<b>CORRECTIVE ACTION</b>
--------------------	---------------------------	--------------------------

---

## 12. COMPRESSOR OIL IN THE DISCHARGE AIR.

Step 1. Check air intake filter

Service dirty air intake filter (para. 3-43)

Step 2. Check crankcase breather

Replace a defective crankcase breather (para. 3-44).

Step 3. Check oil level

Service air compressor (para. 3-42 ) or drain out excess oil.

Step 4. Check oil grade

Service air compressor (para. 3-42)

## Section V. UNIT MAINTENANCE PROCEDURES

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3-11. **General.** This section contains unit level maintenance procedures as authorized by the maintenance allocation chart in Appendix B of this manual.

---

**3-12. Diving Air Compressor**

---

**This task covers:****a. Adjust****b. Repair**

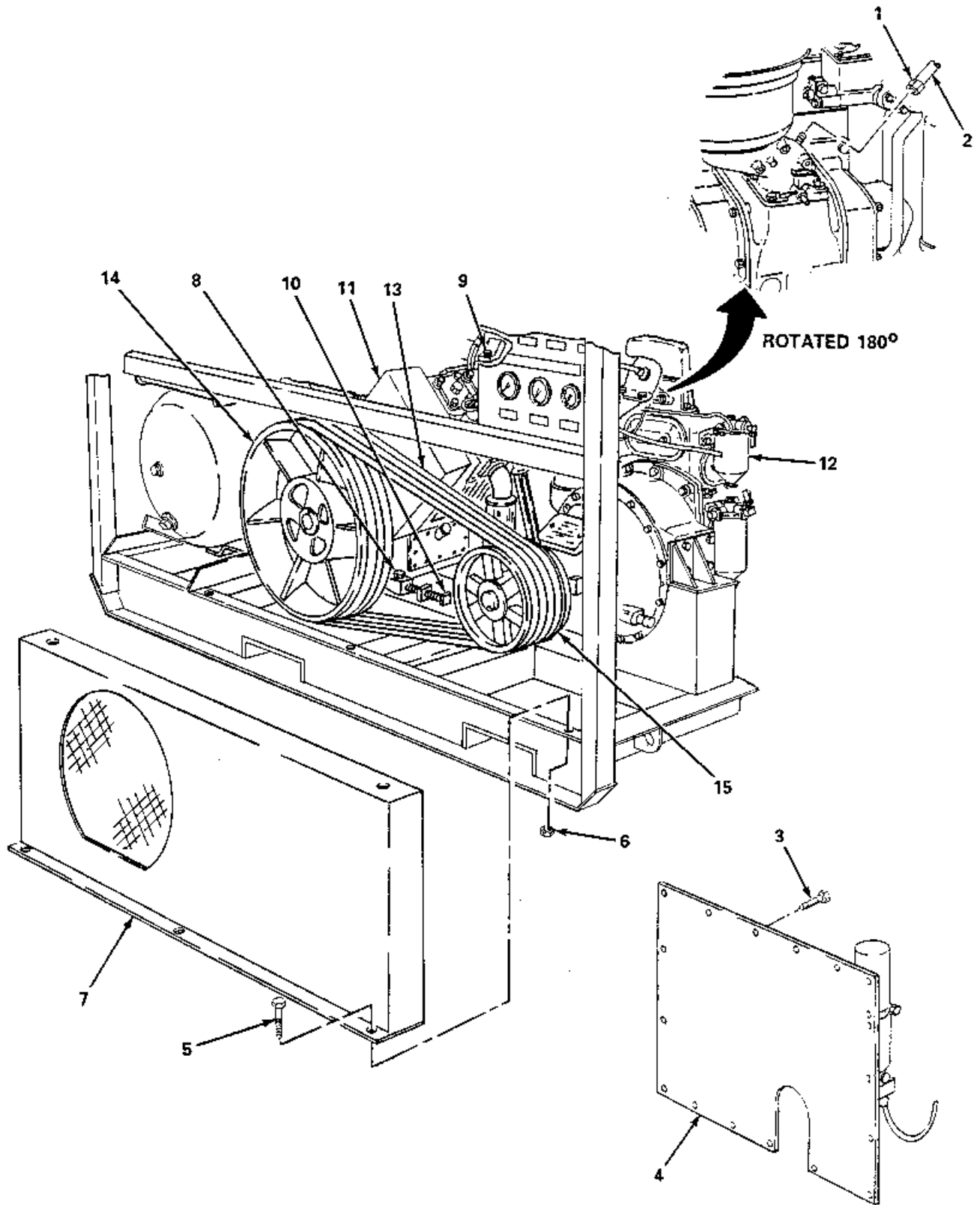
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**INITIAL SETUP:***Tools:**Materials/Parts:*General Mechanics Tool Kit  
(NSN 5180 00-177-7033)Belt Drive

---

**a. Adjust.****(1) Drive belts (figure 3-t)**

- (a) Loosen fitting nut (9) and disconnect starting fluid line (2)
- (b) Remove 12 screws (3) and remove cover (4).
- (c) Remove five screws (5) and nuts (6) and remove drive bed shroud (7).
- (d) Loosen four air compressor mounting bolts (8).
- (e) Loosen four air receiver mounting bolts (9).
- (f) Loosen two adjusting screws (10) and move compressor (11) either toward engine (12) or away so that a firm push on belts (13) halfway between compressor pulley (14) and PTO pulley (15) will depress belts (13) 0.50-0.75 in. (1-27-1-92 cm)
- (g) Tighten four air receiver mounting bolts (9).
- (h) Tighten four air Compressor mounting bolts (6)
- (i) install drive bed shroud (7) and secure with five screws (5) and nut (6)
- (j) Install cover (4) and secure with 12 screws (3).
- (k) install starting fluid line (2) and tighten firing nut (1).

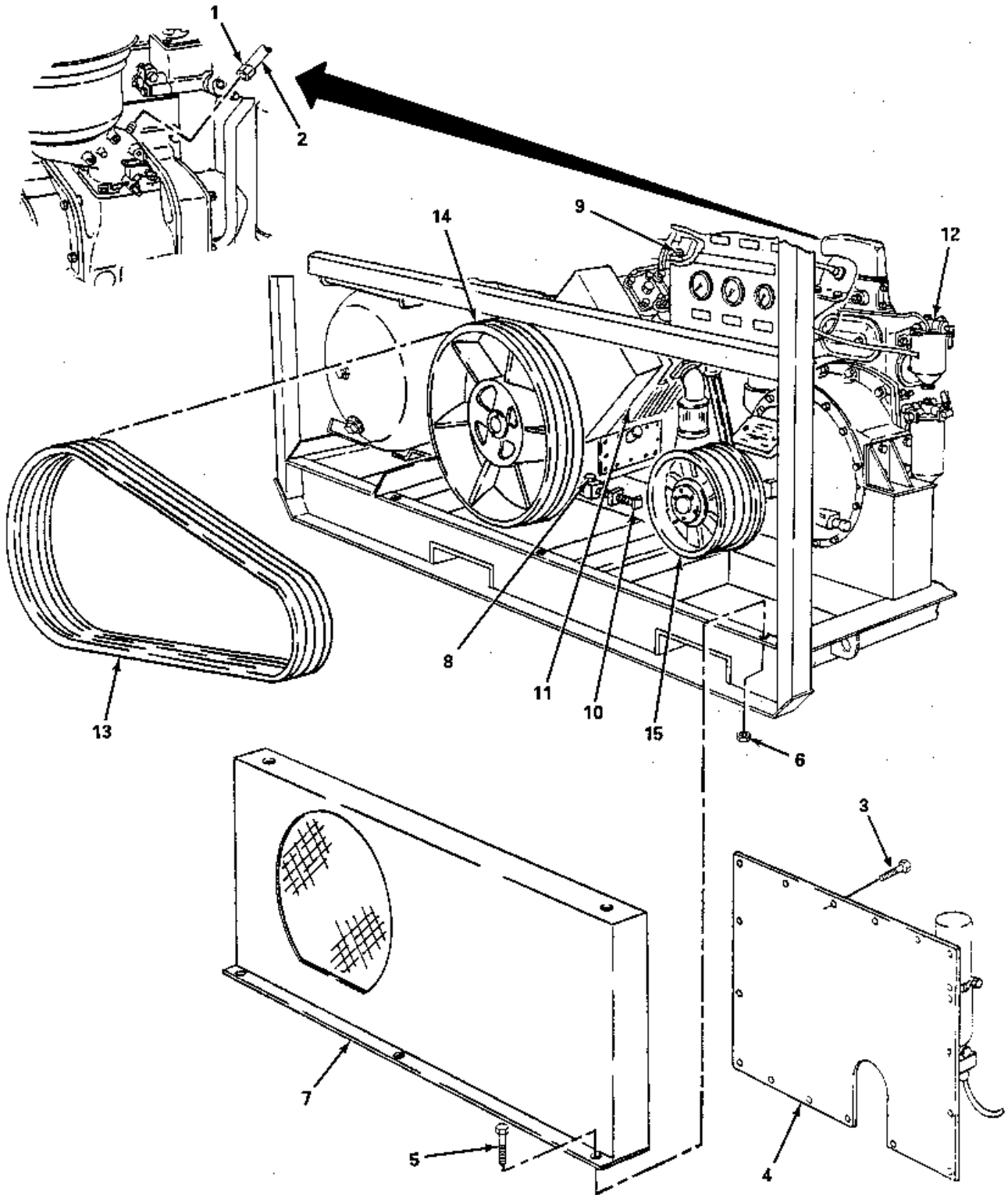


4951-013

Figure 3-1. Drive Belts, Adjust.

**3-12. Diving Air Compressor (Cont).****b. Replace Drive Belt.** (figure 3-2)

- (1) Loosen fitting nut (1 ) and remove starting fluid line (2)
- (2) Remove 12 screws (3) and remove cover (4)
- (3) Remove five screws (6) and nuts (6) and remove drive bed shroud (7).
- (4) Loosen four air compressor mounting bolts (8).
- (5) Loosen four air receiver mounting bolts (9)
- (6) Loosen two adjusting screw (10) and move compressor (11) toward engine (12) and remove four drive bells (13).
- (7) Install four drive beds (13) and tighten adjusting screws (10) so that a firm push at a point runway between compressor pulley (14) and PTO pulley (15) will depress the belts (13) 0.50-0.75 in. (1.27-1.92 cm).
- (8) Tighten four air receiver mounting bobs (9)
- (9) Tighten four air compressor mounting bolts (8).
- (10) Install drive belt shroud (7) and secure with five screws (5) and nuts (6)
- (11) Install cover (4) and secure with 12 screws (3)
- (12) Install starting fluid line (2) and tighten fitting nut (1).



4951-014

Figure 3-2. Drive Belts, Replace

---

**3-13. Engine Assembly.**

---

**This task covers:****a. Service****b. Replace**

---

**INITIAL SETUP:***Tools*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)

*Materials/Parts*Oil, Engine (Item 18, Appendix D)

---

**a. Service.** (figure3-3)

- (1) Remove drain plug (1 ) and drain oil into suitable container. (See para. 1-9 for capacity.)
- (2) Clean off drain plug (1).
- (3) Install drain plug (1).
- (4) Remove filler cap (2) and fill engine with proper grade and viscosity oil to F mark on dipstick (3).



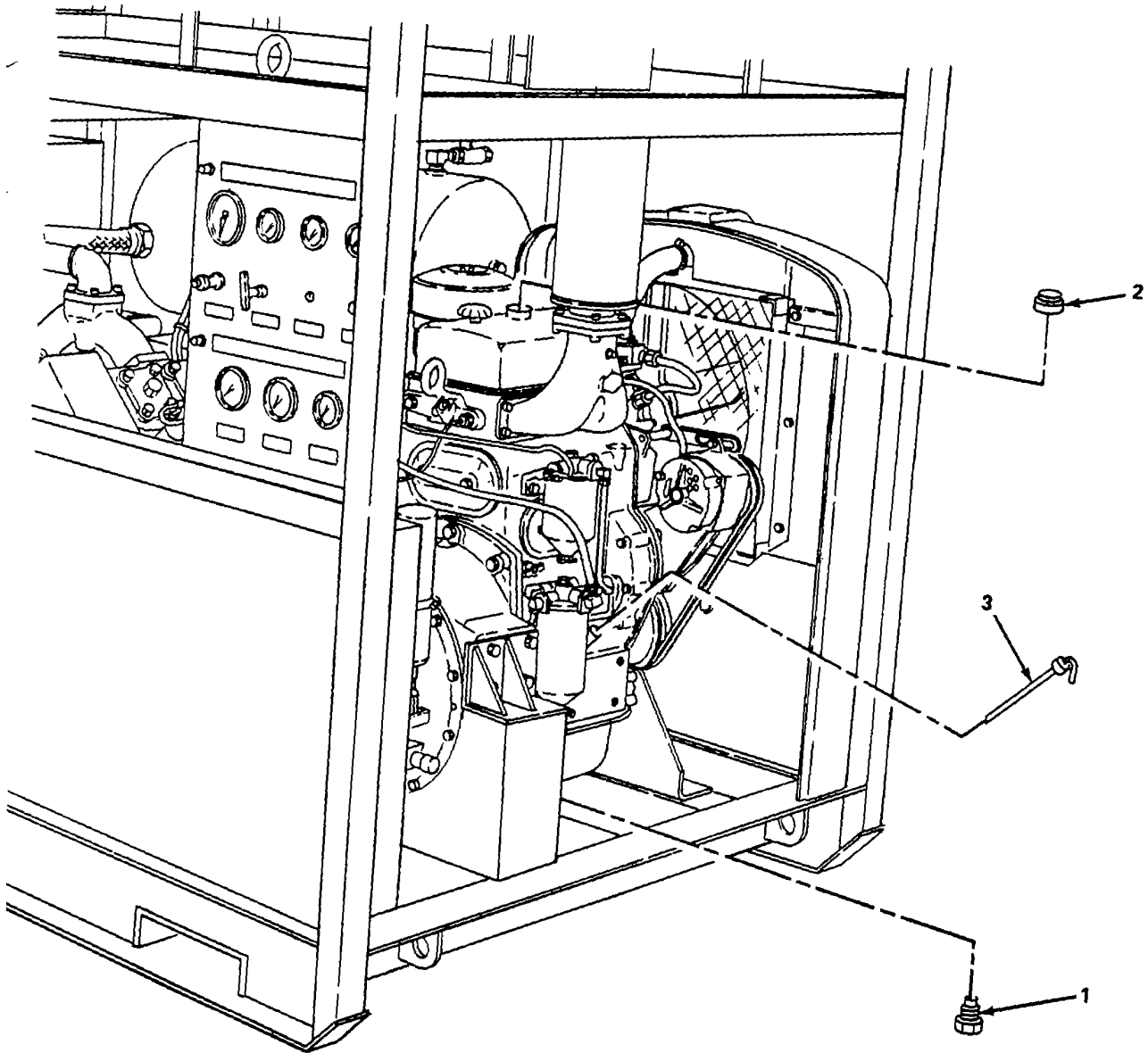


Figure 3-3. Engine Assembly, Service

**3-13. Engine Assembly (Cont).****b. Removal.** (figure 3-4)

- (1) Remove nut (1) and lockwasher (2) and tag and remove negative cable (3) from starter (4).
- (2) Remove nut (5) and tag and remove positive cable (6) from starter (4).
- (3) Open pet cock (7) and drain coolant into suitable container.
- (4) Loosen clamp (8) and remove hose (9) from radiator neck (10).
- (5) Loosen clamp (11) and remove hose (12) from water pump (13).
- (6) Remove ten screws (14) and remove two fan guards (15).
- (7) Remove four screws (16) and nuts (17) and remove shell (18).
- (8) Disconnect tachometer cable (19) from adapter (20).
- (9) Loosen fitting nut (21) and remove starting fluid line (22).
- (10) Remove 12 screws (23) and remove cover (24).
- (11) Remove five screws (25) and nuts (26) and remove drive belt shroud (27).
- (12) Loosen four screws (28).
- (13) Loosen four screws (29), and loosen adjusting screw (30) and move compressor (31) toward engine (32) enough to remove four drive belts (33).
- (14) Tag and remove wiring from starter (4), alternator (34), and low oil pressure shutdown switch (35) and move wiring harness (36) out of way.
- (15) Loosen fitting nut (37) and disconnect oil line (38).
- (16) Loosen fitting nut (39) and remove coolant temperature sensor (40).
- (17) Disconnect fuel line (41) from strainer (42).
- (18) Disconnect fuel line (43) from cylinder head (44).
- (19) Loosen screw (45).
- (20) Loosen two screws (46) and disconnect stop control cable (47).
- (21) Loosen screw (48).
- (22) Loosen two screws (49) and disconnect throttle cable (50).
- (23) Remove four screws (51) and nuts (52).
- (24) Remove four nuts (53) and remove exhaust muffler (54) and gasket (55).
- (25) Connect suitable lifting device to lifting eyes (56) and remove engine (32).

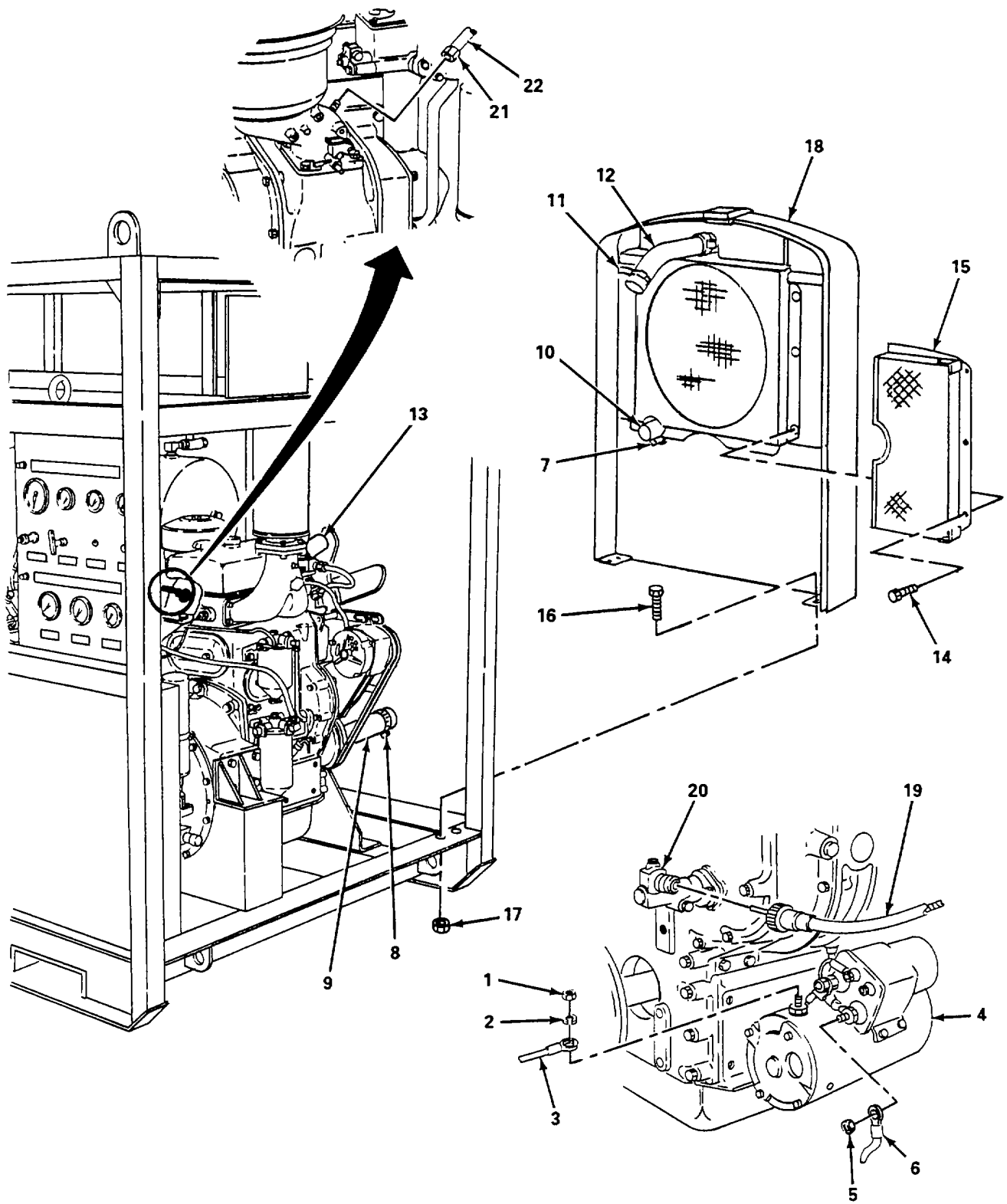


Figure 3-4. Engine Assembly, Removal (Sheet 1 of 4).

4951-174, 1

3-13. Engine Assembly (Cont).

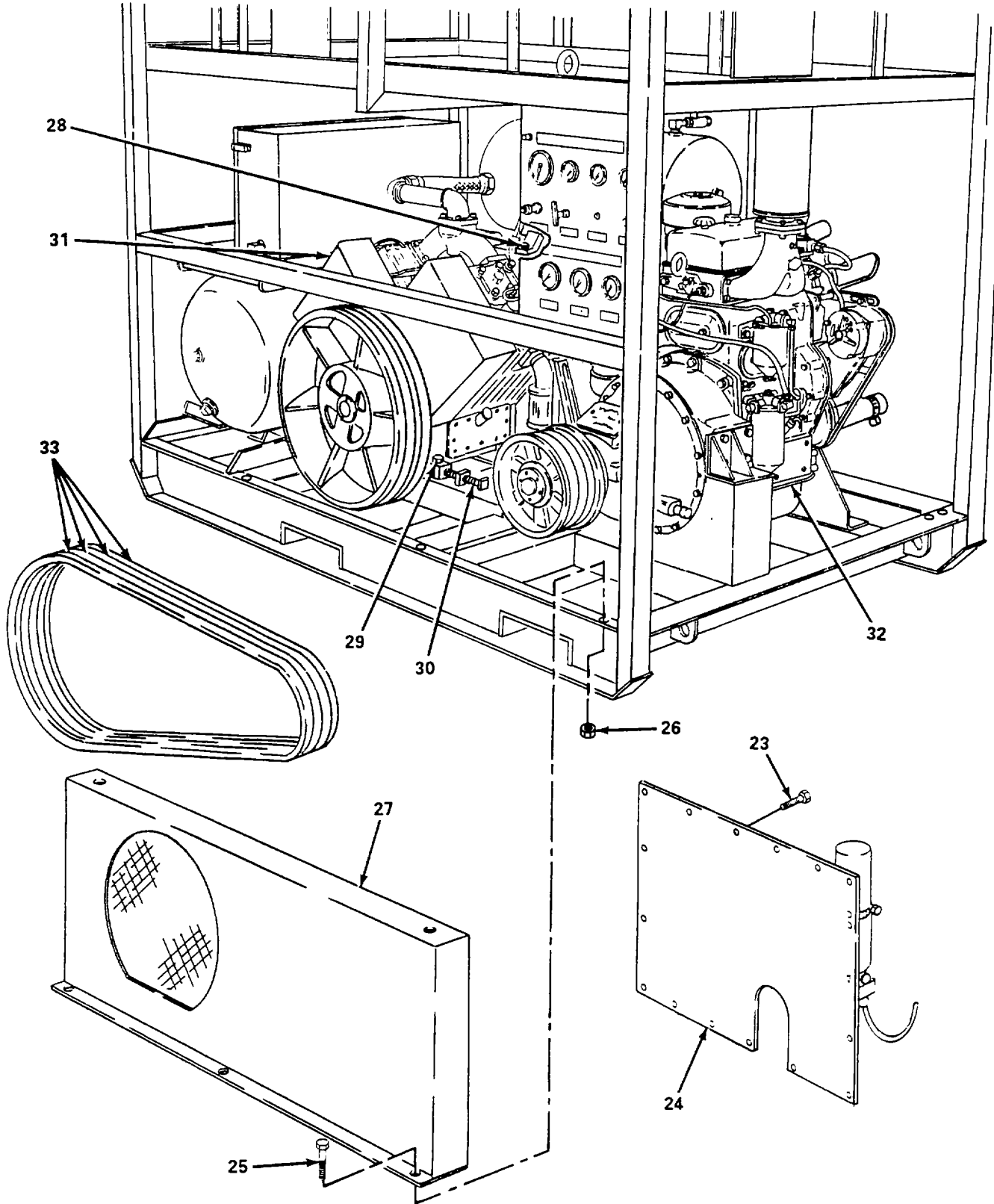


Figure 3-4. Engine Assembly, Removal (Sheet 2 of 4).

4951-174.2

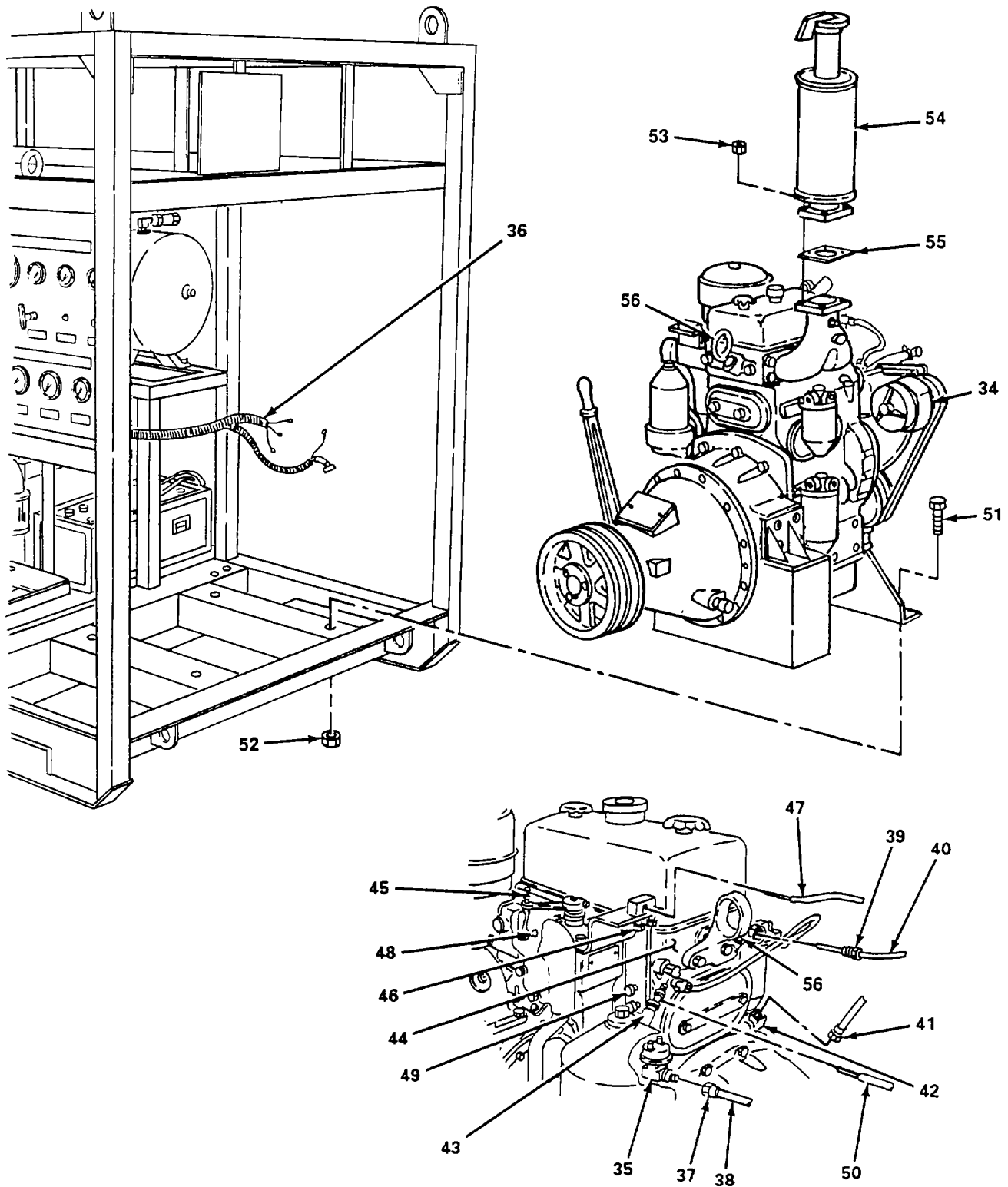
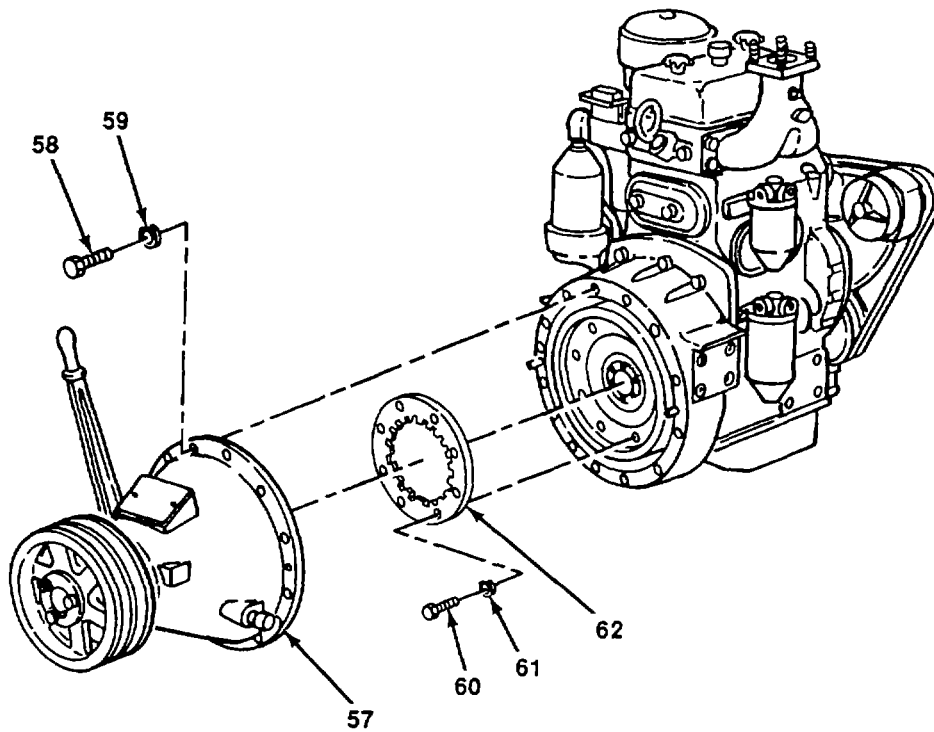


Figure 3-4. Engine Assembly, Removal (Sheet 3 of 4).

4951-174.3

**3-13. Engine Assembly (Cont).**

- (26) Engage PTO and clutch assembly (57).
- (27) Connect suitable lifting device to PTO and clutch assembly (57).
- (28) Remove 12 screws (58) and lockwashers (59) and remove PTO and clutch assembly (57).
- (29) Remove eight screws (60) and lockwashers (61) and remove drive ring (62).



4951-175

**Figure 3-4. Engine Assembly, Removal (Sheet 4 of 4).**

c. Installation. (figure 3-5)

- (1) Install drive ring (62) and secure with eight screws (60) and lockwashers (61).
- (2) Install PTO and clutch assembly (57) and secure with 12 screws (58) and lockwashers (59).

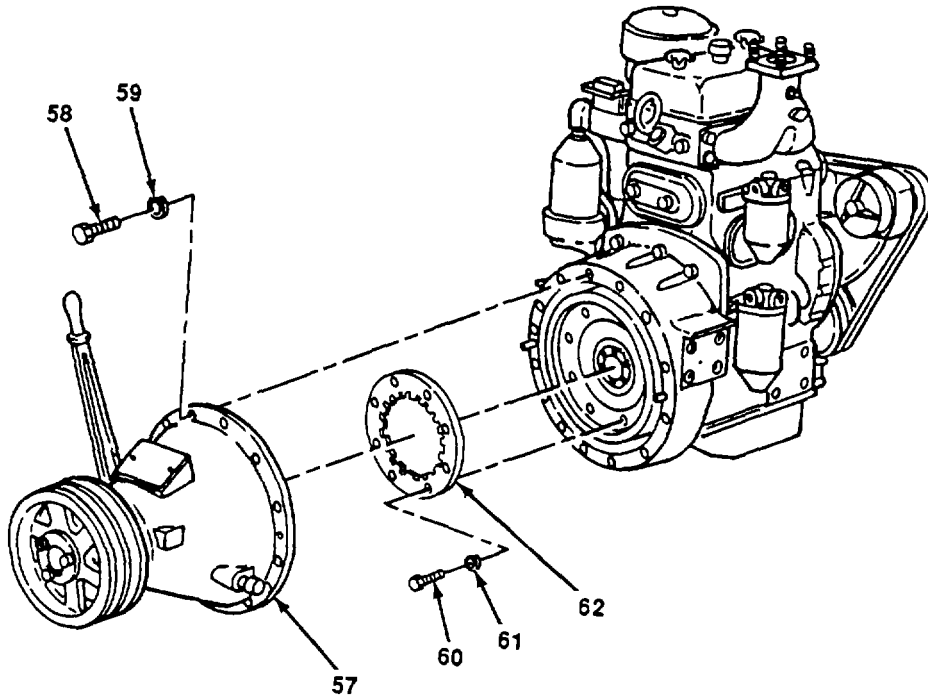
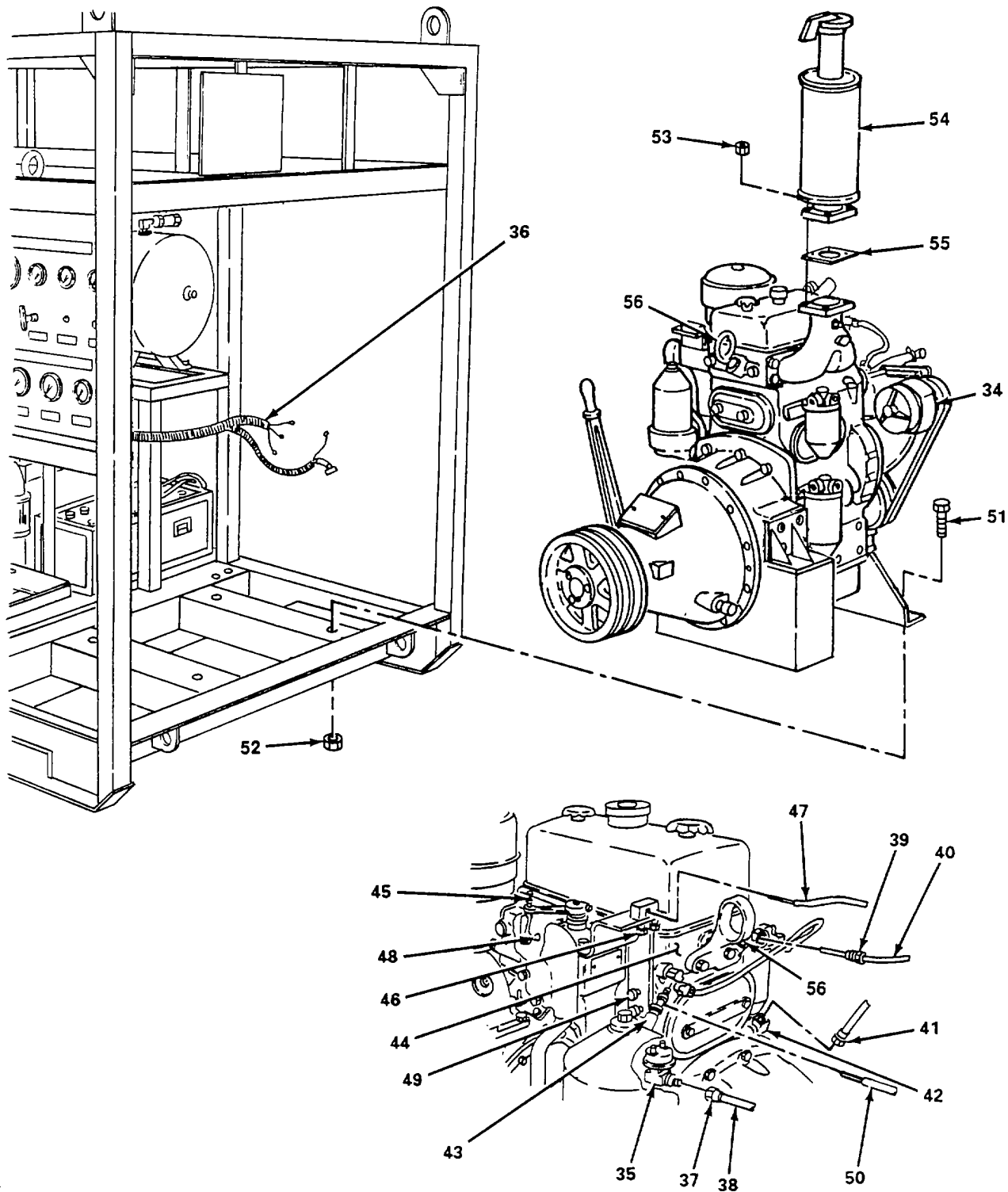


Figure 3-5. Engine Assembly, Installation (Sheet 1 of 4).

3-13. Engine Assembly (Cont).



4951-174\_3

Figure 3-5. Engine Assembly, Installation (Sheet 2 of 4).



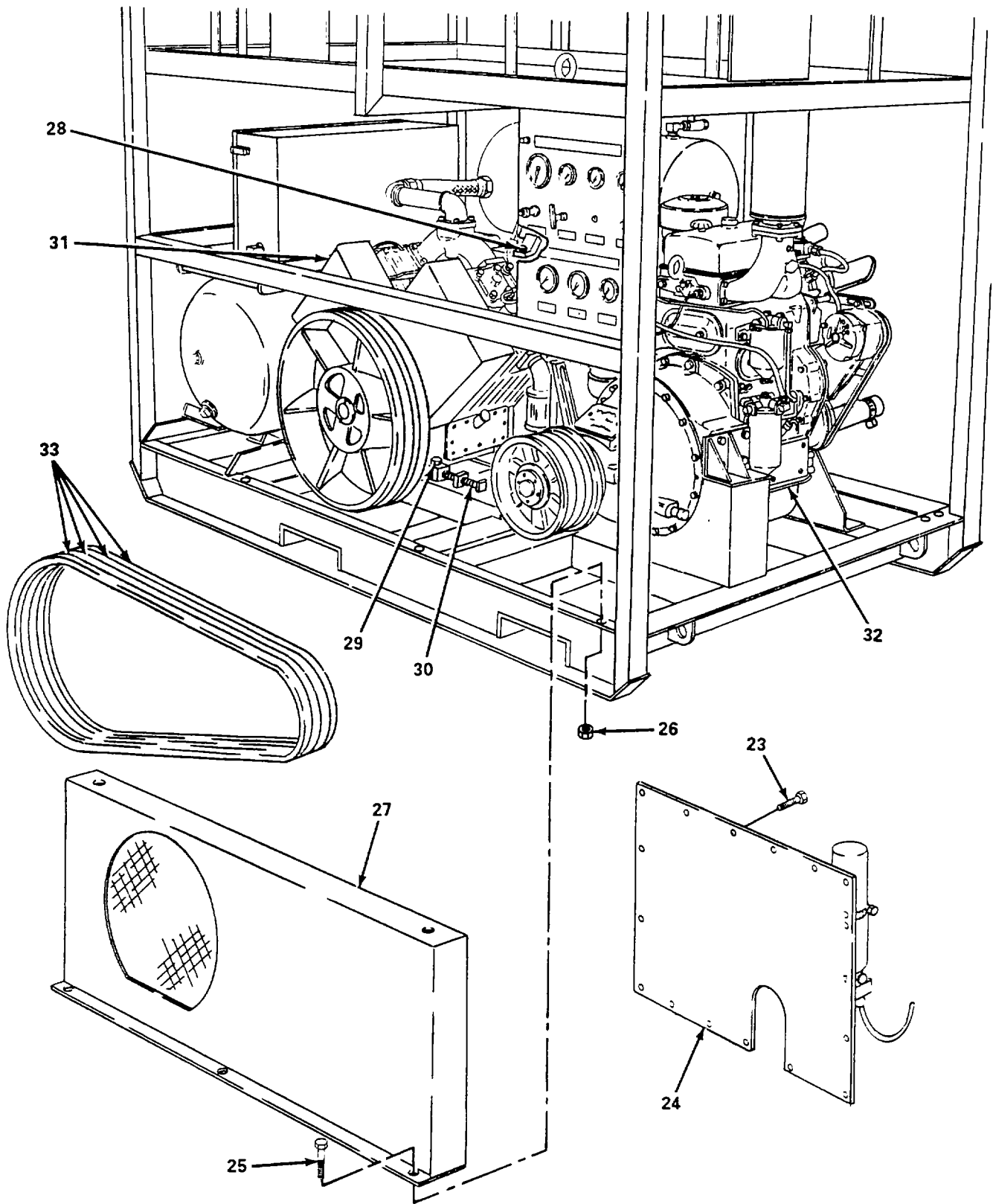
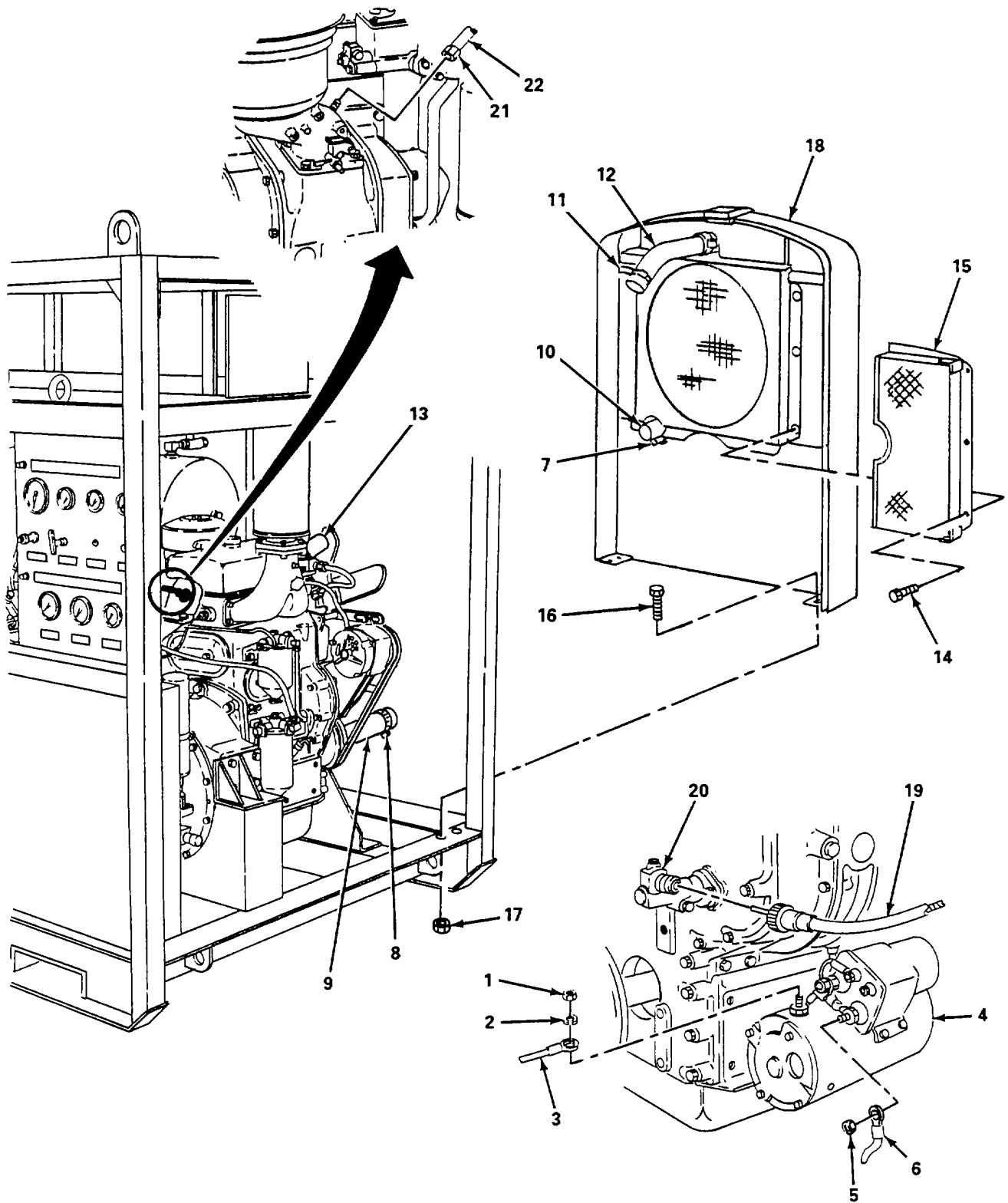


Figure 3-5. Engine Assembly, Installation (Sheet 3 of 4).

4951-174.2



4951-174, 1

Figure 3-5. Engine Assembly, Installation (Sheet 4 of 4).

- (3) Install engine (32) and secure with four screws (51) and nuts (52).
- (4) Install exhaust muffler (54) and gasket (55) and secure with four nuts (53).
- (5) Install throttle cable (50) and tighten two screws (49) and screw (48).
- (6) Install stop control cable (47) and tighten two screws (46) and screw (45).
- (7) Connect fuel line (43) to cylinder head (44).
- (8) Connect fuel line (41) to strainer (42).
- (9) Install coolant temperature sensor (40) and tighten fitting nut (39).
- (10) Connect oil line (38) and tighten fitting nut (37).
- (11) Connect wiring harness (36) to starter (4), alternator (34), and low oil pressure shutdown switch (35) as tagged.
- (12) Install four drive belts (33) and tighten adjusting screw (30) until a firm push midway between PTO pulley (63) and compressor pulley (64) deflects drive belts 0.50-0.75 in (1.27-1.90 cm).
- (13) Tighten four screws (28).
- (14) Tighten four screws (29).
- (15) Install drive belt shroud (27) and secure with five screws (25) and nuts (26).
- (16) Install cover (24) and secure with 12 screws (23).
- (17) Install starting fluid line (22) and tighten fitting nut (21).
- (18) Connect tachometer cable (19) to adapter (20).
- (19) Install shell (18) and secure with four screws (16) and nuts (17).
- (20) Install fan guards (15) and secure with ten screws (14).
- (21) Install hose (12) on water pump (13) and tighten clamp (11).
- (22) Install hose (9) on radiator neck (10) and tighten clamp (8).
- (23) Close pet cock (7).
- (24) Remove radiator cap (65) and fill radiator (66) with coolant and install radiator cap (65).
- (25) Remove fill cap (67) and fill engine with oil to F mark on dipstick (68).
- (26) Install positive cable (6) and secure with nut (5).
- (27) Install negative cable (3) and secure with nut (1) and lockwasher (2).

---

**3-14. Muffler and Pipes.**

---

**This task covers:****Replace**

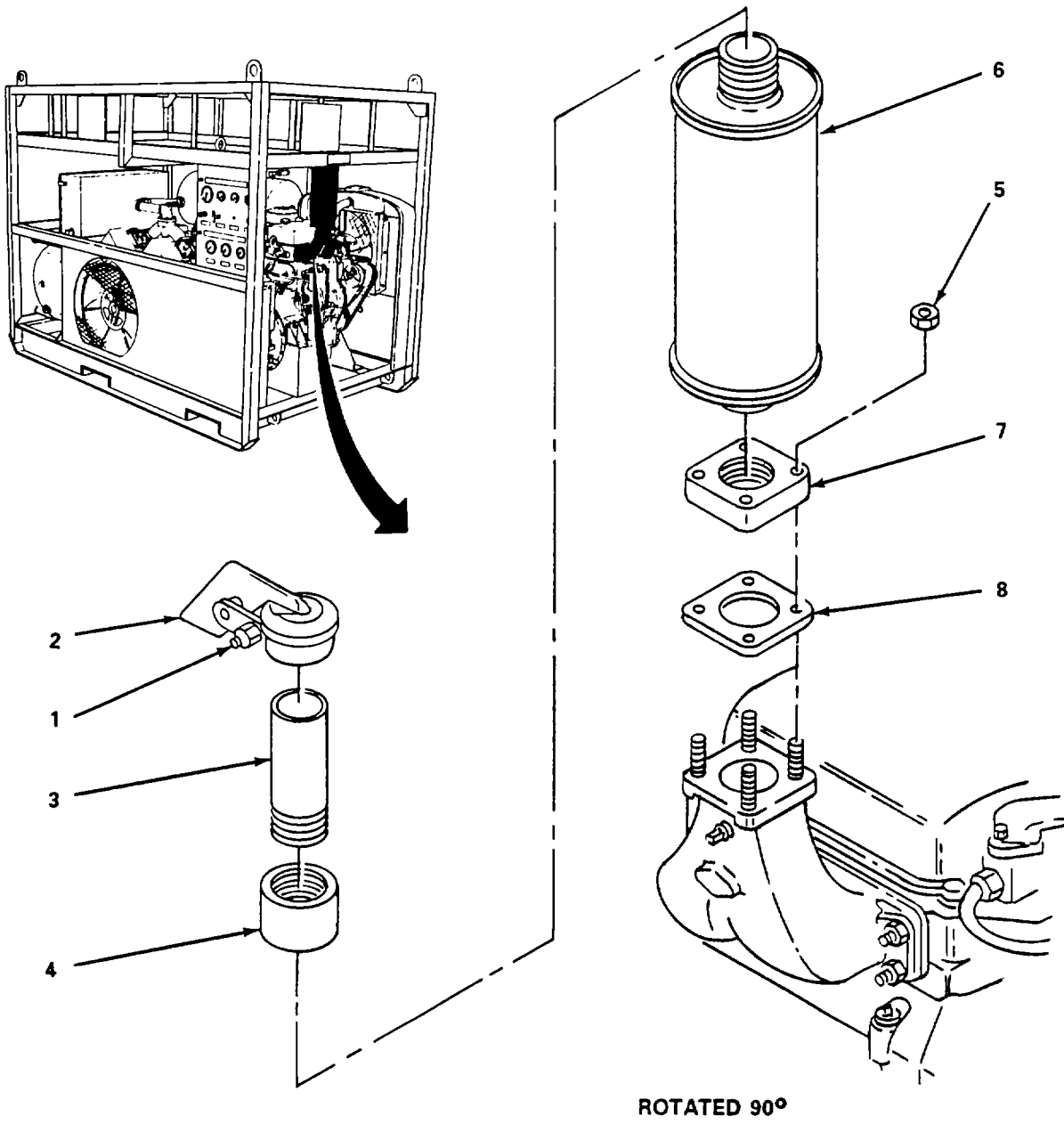
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**INITIAL SETUP:***Tools*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)

*Materials/Parts*Muffler  
Exhaust Pipe  
Gasket, Adapter PlateReplace. (figure 3-6)

- (1) Loosen nut (1) and remove exhaust rain cap (2).
- (2) Remove exhaust pipe (3) and exhaust pipe coupling (4).
- (3) Remove four nuts (5) and remove muffler (6), adapter plate (7) and gasket (8).
- (4) Remove adapter plate (7) from muffler (6).
- (5) Install adapter plate (7) on muffler (6).
- (6) Ensure all gasket surfaces are clean and old gasket material removed.
- (7) Install gasket (8), adapter plate (7), and muffler (6) and secure with four nuts (5). Torque nuts to 20-25 lb-ft (27-34 Nm)
- (8) Install exhaust pipe coupling (4) and exhaust pipe (3).
- (9) Install exhaust rain cap (2) and tighten nut (1).



4951-015

Figure 3-6. Muffler and Pipes, Replace.

---

**3-15. Exhaust Manifold.****This task covers:****Replace**

---

**INITIAL SETUP:***Tools**Equipment Condition*

General Mechanic's Tool Kit (NSN 5180-00-177-7033) Muffler and pipes removed (para. 3-14).  
Wrench, Torque (NSN 5120-00-554-7292)

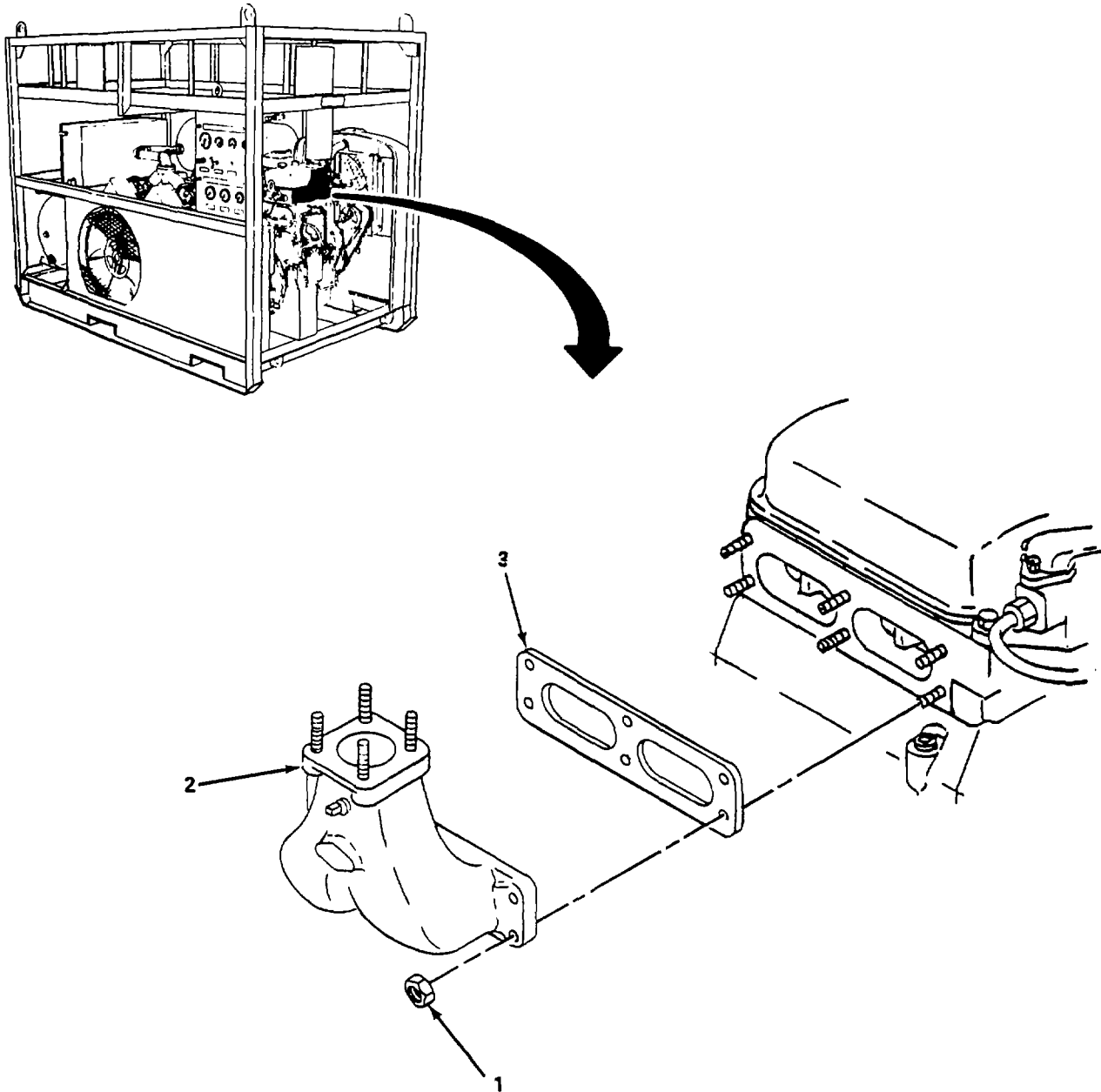
*Materials/Parts*

Exhaust Manifold  
Gasket, Exhaust Manifold

---

Replace. (figure 3-7)

- (1) Remove six nuts (1) and remove exhaust manifold (2) and gasket (3).
- (2) Ensure gasket surfaces are clean and old gasket material removed.
- (3) Install gasket (3) and exhaust manifold (2) and secure with six nuts (1). Torque nuts to 35-39 lb-ft (47-53 Nm)



4951-016

**Figure 3-7. Exhaust Manifold, Replace.**

**FOLLOW-ON MAINTENANCE:**  
Install muffler and pipes (para. 3-14).

---

**3-16. Fan Guards.**

---

This task covers:      Replace

---

**INITIAL SETUP***Tools**Materials/Parts*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)	Guard Fan Right Hand
	Guard Fan Left Hand

---

**Replace.** (figure 3-8)

- (1) Remove five screws (1) and remove left fan guard (2).
- (2) Remove five screws (3) and remove right fan guard (4).
- (3) Install right fan guard (4) and secure with five screws (3).
- (4) Install left fan guard (2) and secure with five screws (1).



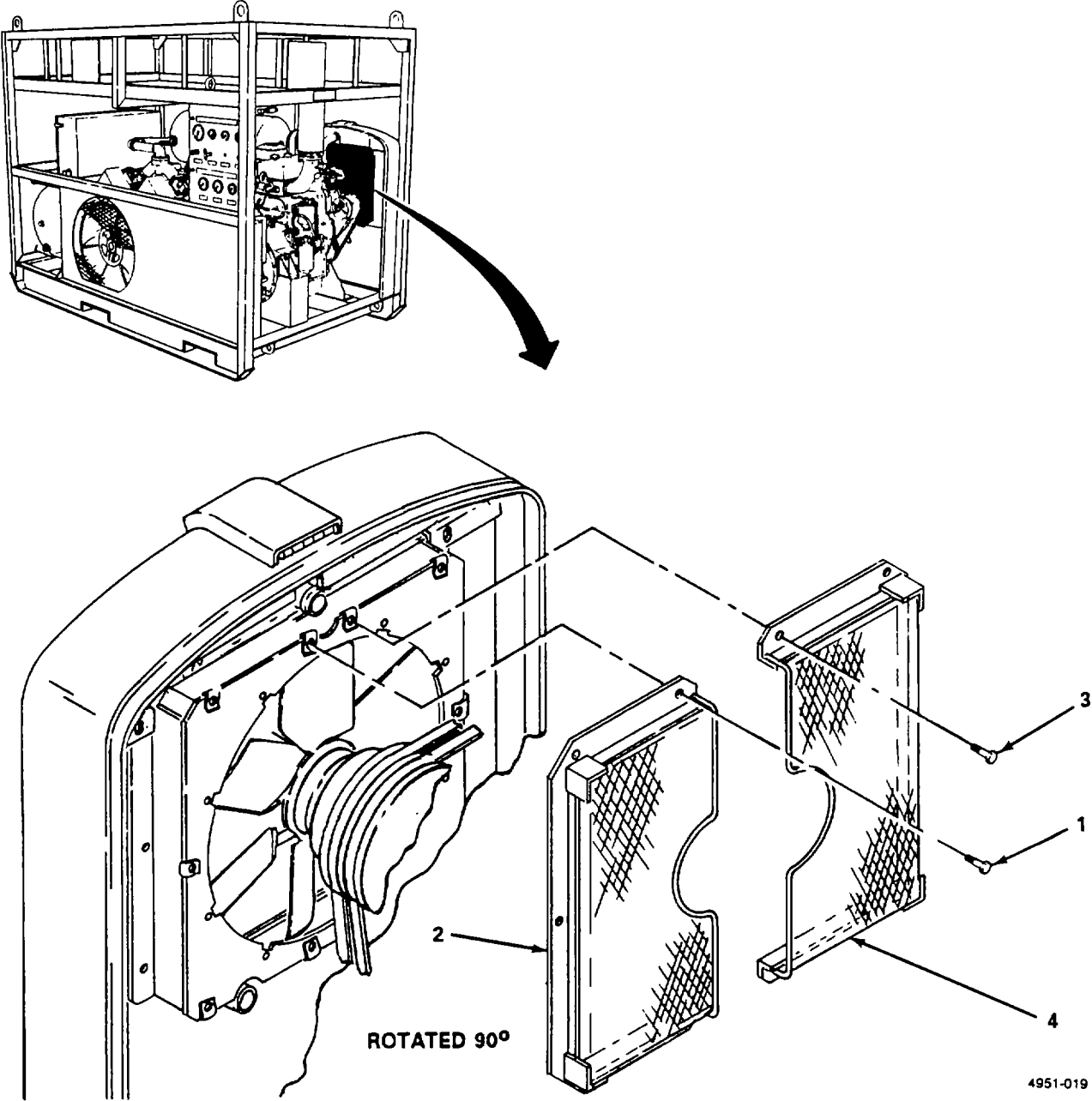


Figure 3-8. Fan Guards, Replace.

---

**3-17. Shell Assembly.**

---

This task covers:      Replace

---

**INITIAL SETUP***Tools**Equipment Condition*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)      Fan guards removed (para. 3-16).

*Materials/Parts*

Shell Assembly  
Engine Coolant (Item 2, Appendix D)

---

Replace. (figure 3-9)

- (1) Open radiator cap (1) and pet cock (2) and drain coolant into suitable container and close pet cock (2).
- (2) Loosen clamp (3) and remove upper outlet hose (4) from radiator (5).
- (3) Loosen clamp (6) and remove lower inlet hose (7).
- (4) Remove four screws (8) and nuts (9) and remove shell assembly (10).
- (5) Remove four screws (11), washers (12), and lockwashers (13) and remove baffle (14).
- (6) Remove four screws (15), washers (16), and lockwashers (17) and remove shroud (18) and radiator (5).
- (7) Install radiator (5) and shroud (18) and secure with four screws (15), washers (16) and lockwashers (17). Torque screws to 15-19 lb-ft (20-26 Nm).
- (8) Install baffle (14) and secure with four screws (11), washers (12), and lockwashers (13). Torque screws to 15-19 lb-ft (20-26 Nm).
- (9) Install shell assembly (10) and secure with four screws (8) and nuts (9). Torque screws to 30-35 lb-ft (41-47 Nm).
- (10) Install lower inlet hose (7) and tighten clamp (6).
- (11) Install upper outlet hose (4) and tighten clamp (3).
- (12) Fill radiator with coolant and install radiator cap (1).

FOLLOW-ON MAINTENANCE:  
Install fan guards (para. 3-16).

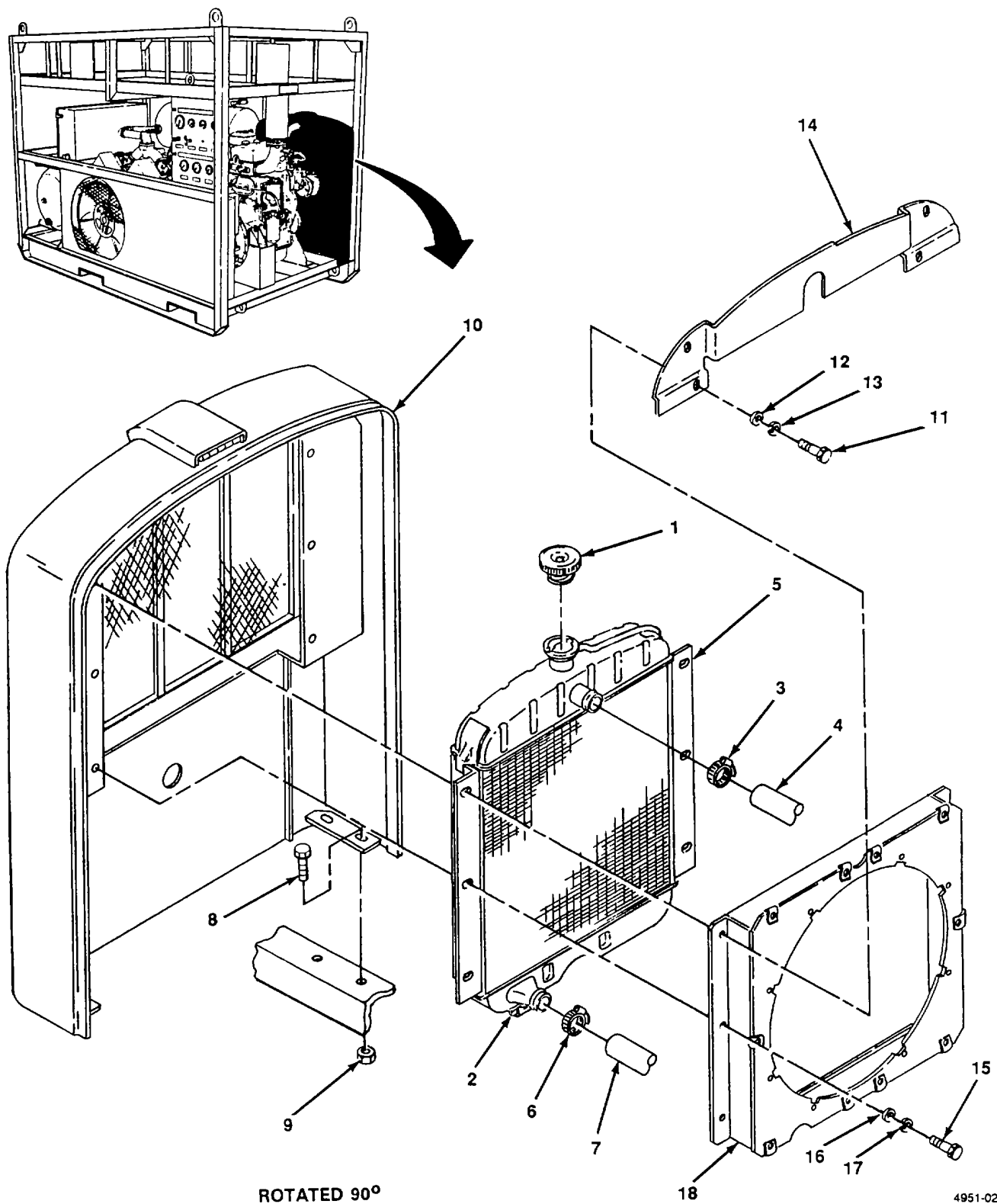


Figure 3-9. Shell Assembly, Replace.

---

**3-18. Shroud.**

---

This task covers:      Replace

---

**INITIAL SETUP***Tools**Equipment Condition*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)      Fan guards removed (para. 3-16).

*Materials/Parts*

## Shroud

Engine Coolant (Item 2, Appendix D)

---

Replace. (figure 3-10)

- (1) Open radiator cap (1) and pet cock (2) and drain coolant into suitable container and close pet cock (2).
- (2) Loosen clamp (3) and remove hose (4) from radiator (5).
- (3) Loosen clamp (6) and remove hose (7).
- (4) Remove four screws (8) and nuts (9) and remove shell assembly (10).
- (5) Remove six screws (11), washers (12), and lockwashers (13) and remove shroud (14) and radiator (5).
- (6) Install radiator (5) and shroud (14) and secure with six screws (11), washers (12), and lockwashers (13). Torque screws to 15-19 lb-ft (20-26 Nm).
- (7) Install shell assembly (10) and secure with four screws (8) and nuts (9). Torque screws to 30-35 lb-ft (41-47 Nm).
- (8) Install hose (7) and tighten clamp (6).
- (9) Install hose (4) and tighten clamp (3).
- (10) Fill radiator with coolant and install radiator cap (1).

FOLLOW-ON MAINTENANCE:  
Install fan guards (para. 3-16).

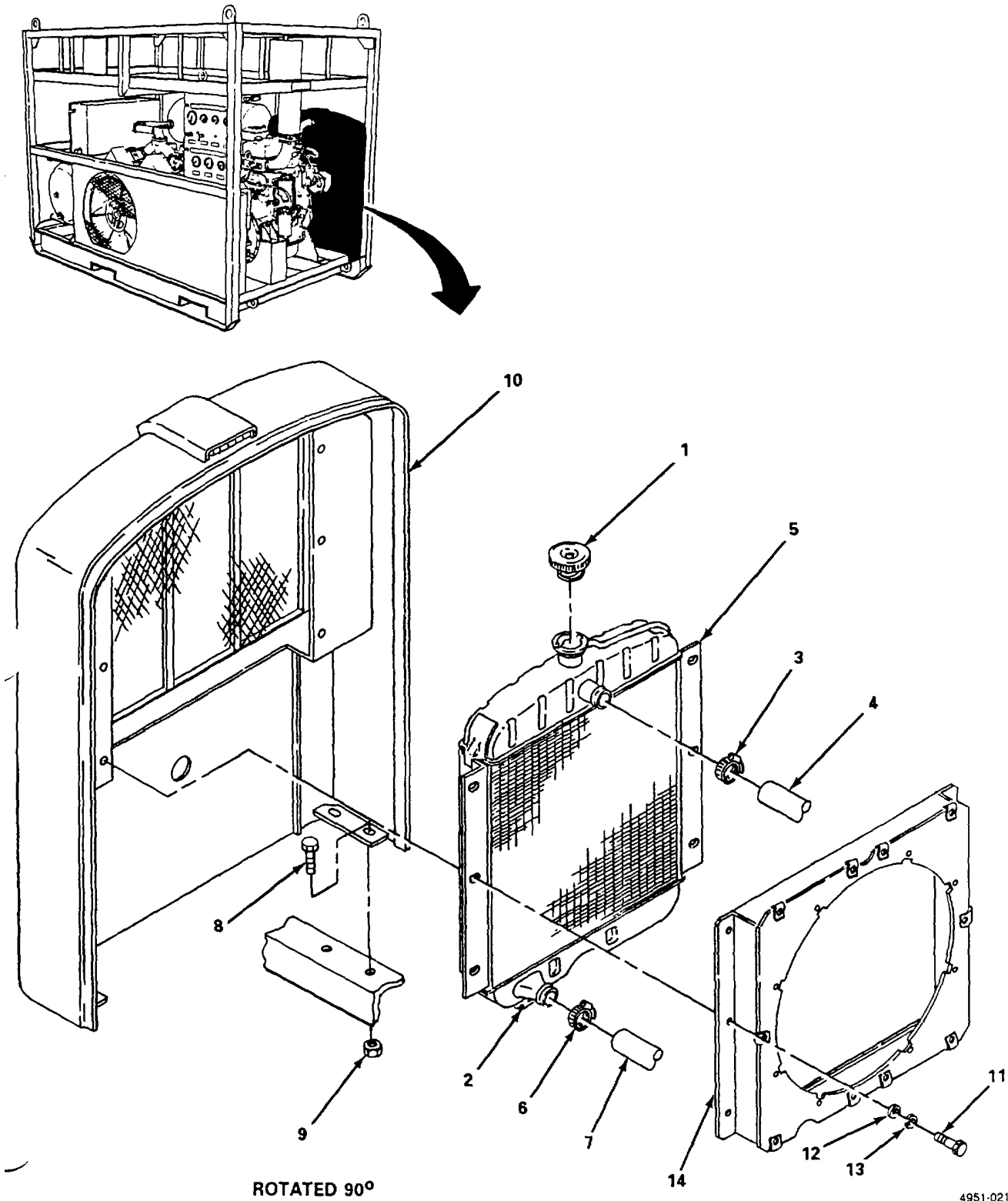


Figure 3-10. Shroud, Replace.

---

**3-19. Radiator Assembly.**

---

This task covers:      Replace

---

**INITIAL SETUP***Tools**Equipment Condition*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)      Fan guards removed (para. 3-16).

*Materials/Parts*

Radiator Assembly  
Engine Coolant (Item 2, Appendix D)

---

**Replace.** (figure 3-11)

- (1) Open radiator cap (1) and pet cock (2) and drain coolant into suitable container and close pet cock (2).
- (2) Loosen clamp (3) and remove hose (4) from radiator (5).
- (3) Loosen clamp (6) and remove hose (7).
- (4) Remove four screws (8) and nuts (9) and remove shell assembly (10).
- (5) Remove six screws (11), washers (12), and lockwashers (13) and remove shroud (14) and radiator (5).
- (6) Install radiator (5) and shroud (14) and secure with six screws (11), washers (12), and lockwashers (13). Torque screws to 15-19 lb-ft (20-26 Nm).
- (7) Install shell assembly (10) and secure with four screws (8) and nuts (9). Torque screws to 15-19 lb-ft (20-26 Nm).
- (8) Install hose (7) and tighten clamp (6).
- (9) Install hose (4) and tighten clamp (3).
- (10) Fill radiator with coolant and install radiator cap (1).

**FOLLOW-ON MAINTENANCE**

Install fan guards (para. 3-16).

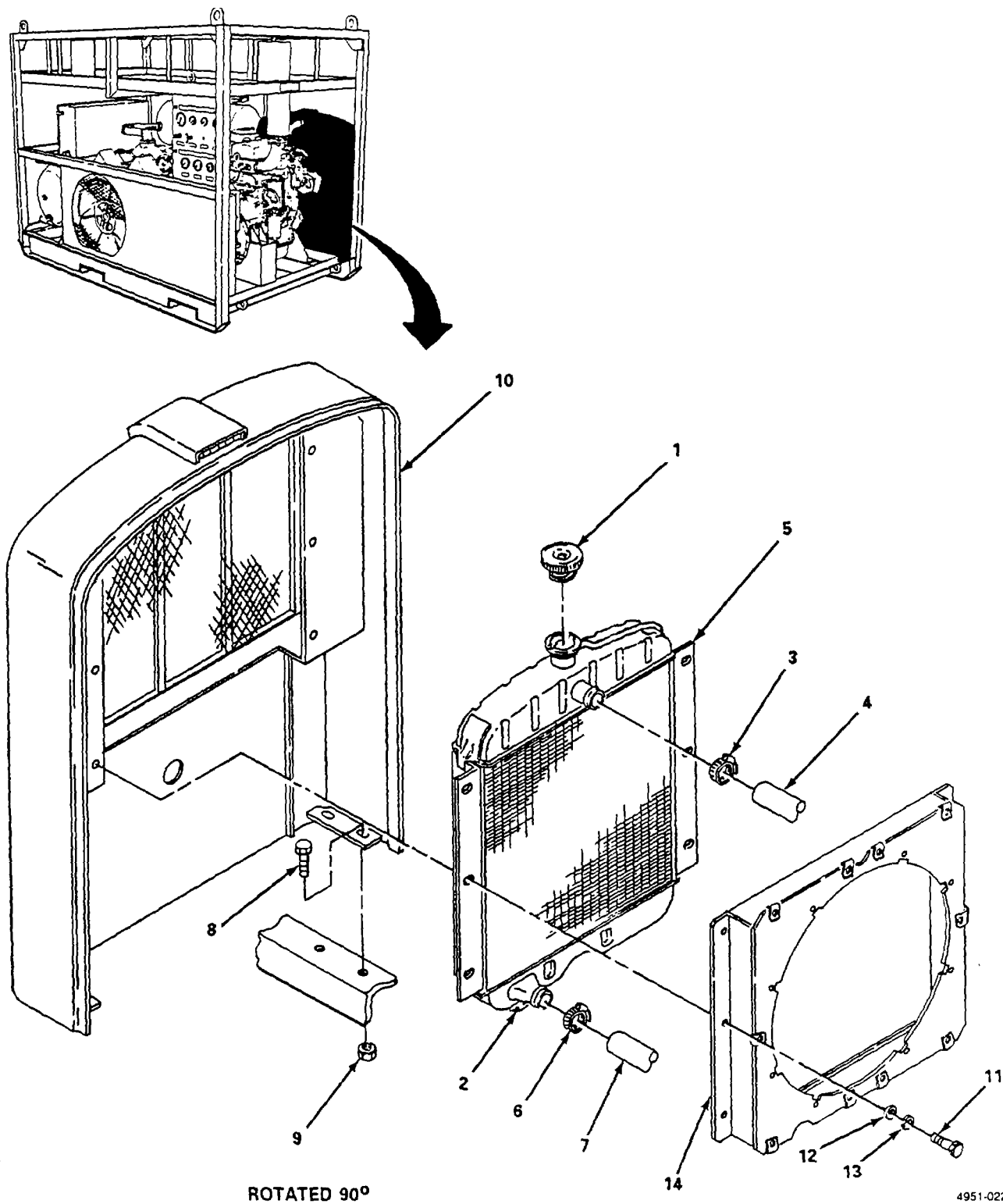


Figure 3-11. Radiator Assembly, Replace.

---

**3-20. Water Connections.**

---

This task covers:      Replace

---

**INITIAL SETUP****Tools**

General Mechanic's Tool Kit (NSN 5180-00-177-7033)

**Materials/Parts**

Radiator inlet hose  
Radiator outlet pipe  
Adapters  
Engine Coolant (Item 2, Appendix D)

---

Replace.

- (1) *Radiator hose.* (figure 3-12)
  - (a) Open radiator cap (1) and pet cock (2) and drain coolant into suitable container.
  - (b) Loosen clamp (3) and (4) and remove radiator hose (5).
  - (c) Install radiator hose (5) and tighten clamp (3) and clamp (4).
  - (d) Close pet cock (2).
  - (e) Fill radiator (6) with coolant and install radiator cap (1).



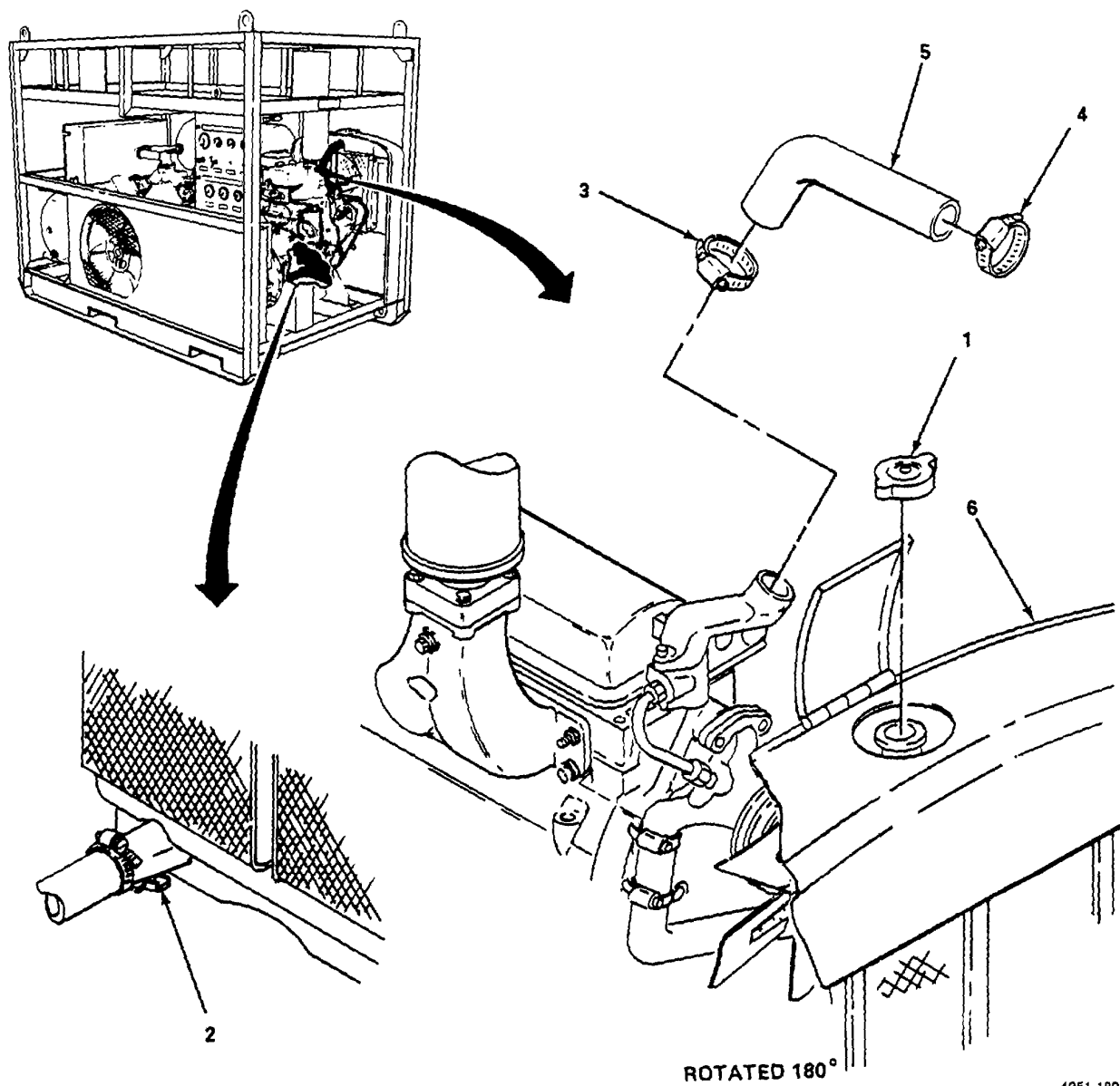


Figure 3-12. Radiator Hose, Replace.

4951-189

**3-20. Water Connections (Cont).**

- (2) *Lower water connections.* (figure 3-13)
- (a) Open radiator cap (1) and pet cock (2) and drain coolant into suitable container.
  - (b) Loosen clamp (3) and clamp (4) and remove pipe (5).
  - (c) Loosen clamp (6) and remove adapter (7).
  - (d) Loosen clamp (8) and remove adapter (9).
  - (e) Install adapter (9) and tighten clamp (8).
  - (f) Install adapter (7) and tighten clamp (6).
  - (g) Install pipe (5) and tighten clamp (3) and clamp (4).
  - (h) Close pet cock (2).
  - (i) Fill radiator (10) with coolant and install radiator cap (1).

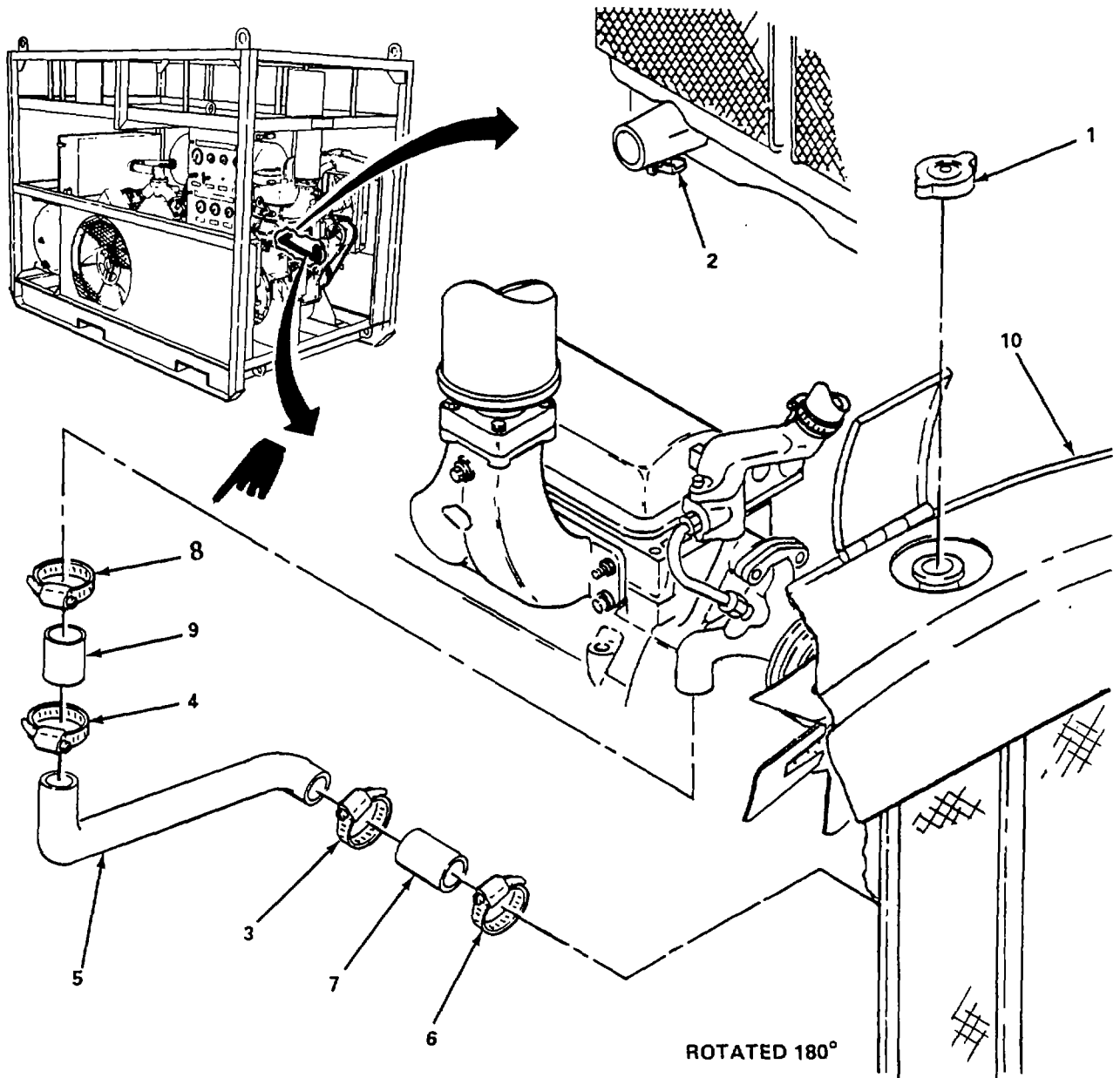


Figure 3-13. Lower Water Connections, Replace.

**3-21. Thermostat and Housing Assembly.**


---

This task covers:    a. Test                            b. Replace                            c. Repair

---

## INITIAL SETUP

*Tools*

General Mechanic's Tool Kit  
(NSN 5180-00-177-7033)  
Thermometer (NSN 6685-00-373-3436)  
Torque Wrench (NSN 5120-00-554-7292)

*Materials/Parts*

Thermostat and Housing Assembly  
Gasket

---

a. Test.**NOTE**

Thermostat removed for test. See para. c. below.

- (1) Place thermostat in container of heated water.

**NOTE**

Agitate water to maintain even temperature in container. Do not allow thermometer to touch bottom of container.

- (2) Place thermometer in water to check temperature at which thermostat starts to open.
- (3) Thermostat should start to open at approximately 170°F (770 C).
- (4) Thermostat should be fully open at approximately 1920 F (890 C)
- (5) Replace a thermostat that does not perform to specification.
- (6) Install thermostat. See para. c. below.

b. Replace. (figure 3-14)

- (1) Open radiator cap (1) and pet cock (2) and drain coolant into suitable container and close pet cock (2).
- (2) Loosen clamp (3) and remove hose (4).
- (3) Loosen two fitting nuts (5) and remove by-pass line (6).
- (4) Remove fitting (7).
- (5) Remove three screws (8) and lockwashers (9), and remove thermostat and housing assembly (10) and gasket(11 ).
- (6) Ensure gasket surfaces are clean and old gasket material is removed.
- (7) Install gasket (11) and thermostat and housing assembly (10) and secure with three screws (8) and lockwashers
- (9). Torque screws to 46-50 lb-ft (62-68 Nm).

- (7) Install fitting (7).
- (8) Install by-pass line (6) and tighten two fitting nuts (5).
- (9) Install hose (4) and tighten clamp (3).
- (10) Fill radiator with coolant and install radiator cap (1).

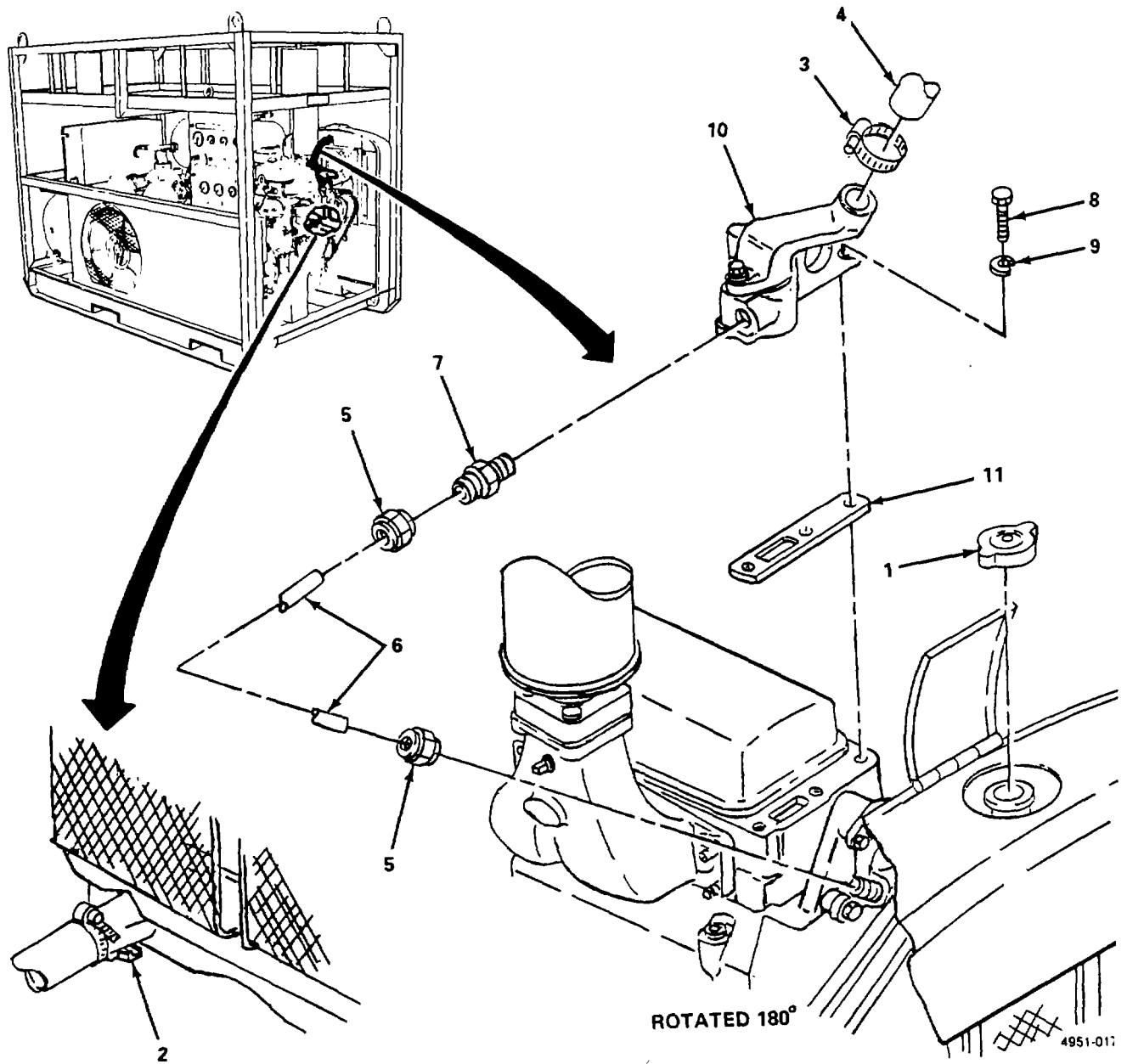


Figure 3-14. Thermostat and Housing Assembly, Replace.

**3-21. Thermostat and Housing Assembly (Cont).**c. Repair. (figure 3-15)

- (1) Open pet cock (1) and drain coolant into suitable container and close pet cock (1).
- (2) Remove two screws (2) and lockwashers (3) and remove upper housing (4) gasket (5) and thermostat (6).
- (3) Ensure gasket surfaces are clean and old gasket material is removed.
- (4) Install thermostat (6), gasket (5), and upper housing (4) and secure with two screws (2) and lockwashers (3). Torque screws to 13-17 lb-ft (18-23 Nm).
- (5) Refill radiator coolant.

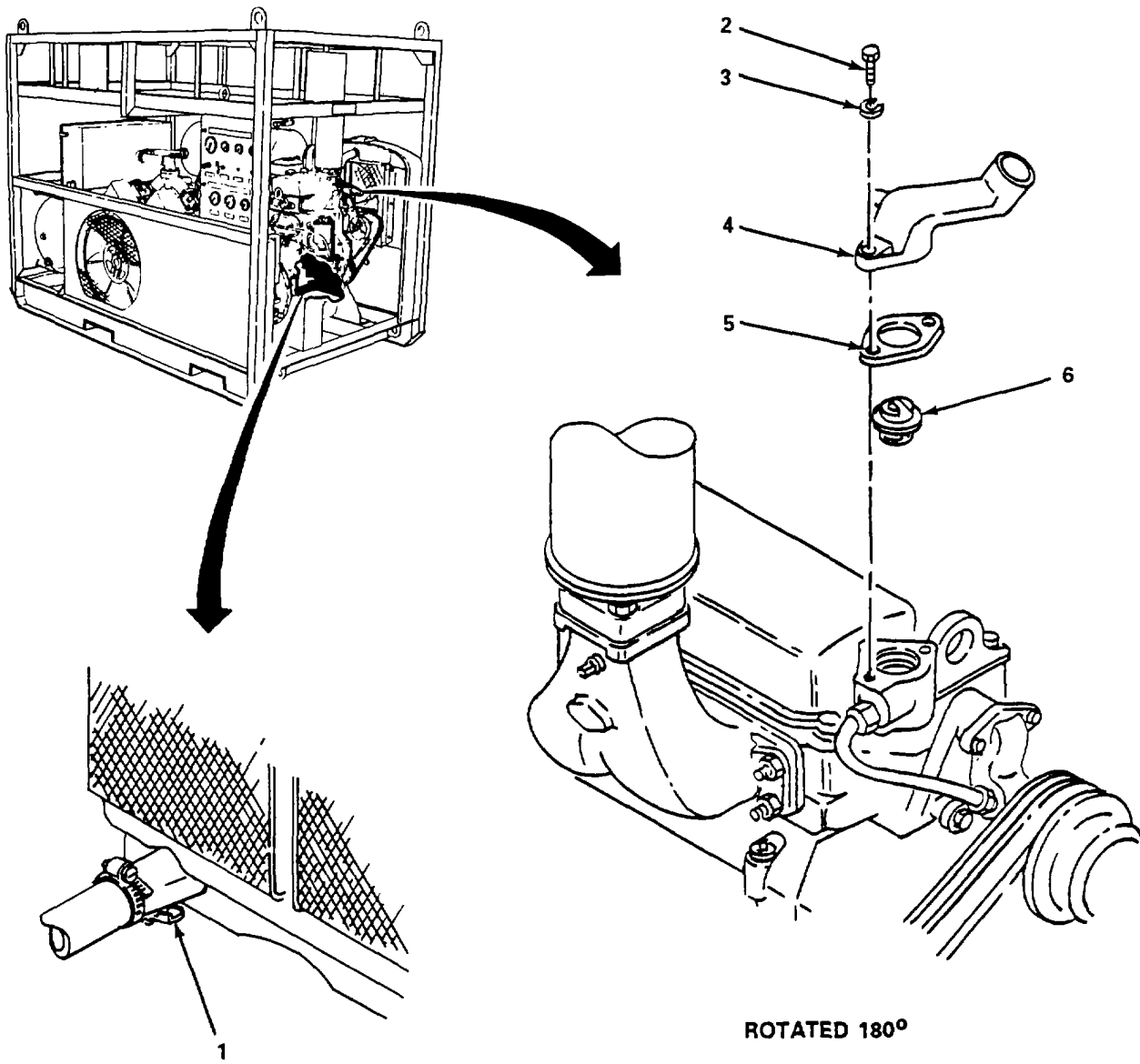


Figure 3-15. Thermostat and Housing Assembly, Repair.

4951-018

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**3-22. Fan, Pulley, and Belts.**

---

This task covers:      Replace

---

**INITIAL SETUP***Tools**Equipment Condition*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)    Shell assembly removed (para. 3-17).  
Torque Wrench (NSN 5120-00-554-7292)

*Materials/Parts*

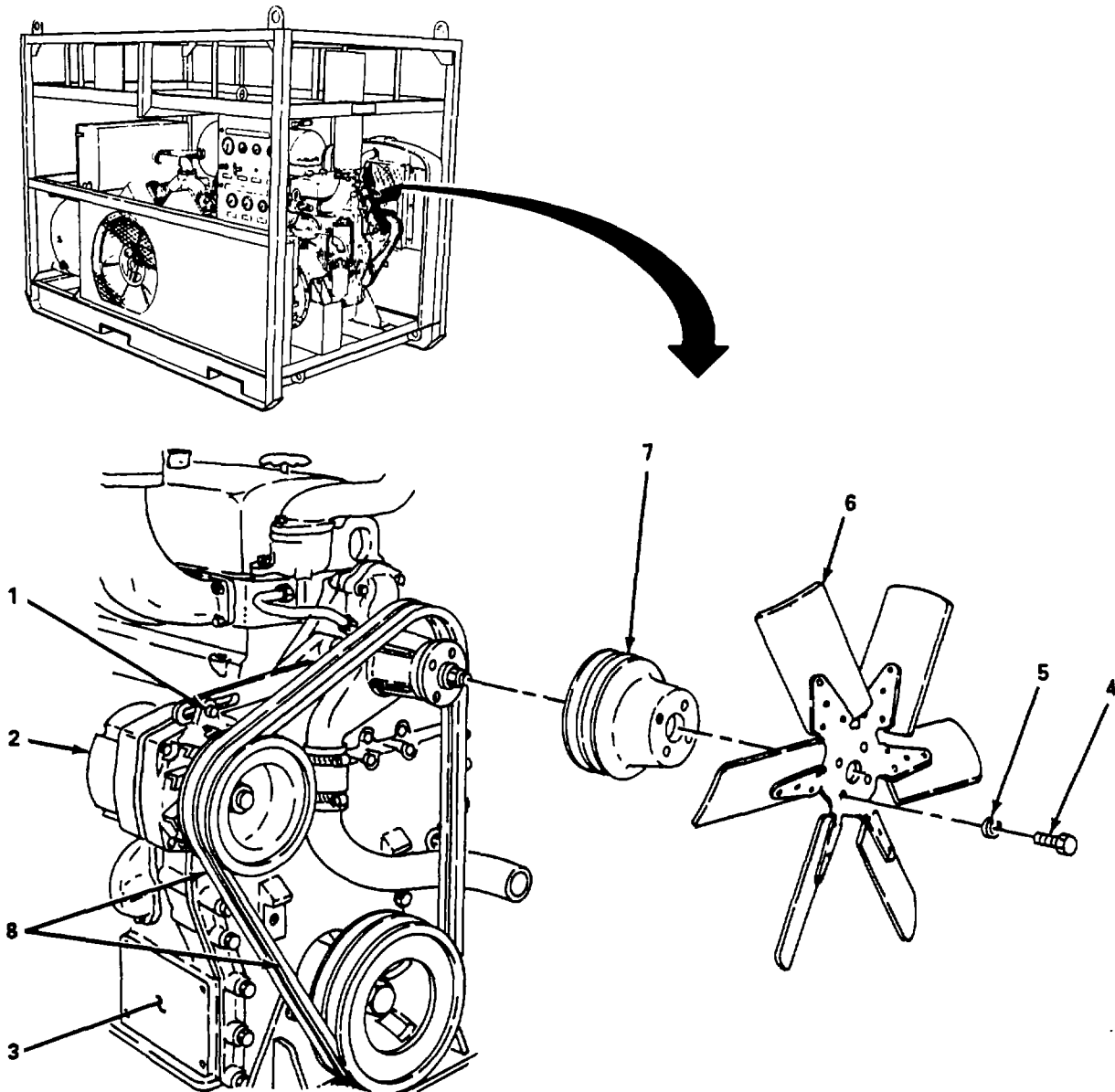
Fan  
Pulley  
Engine Coolant (Item 2, Appendix D)  
Belts

---

**Replace.** (figure 3-16)

- (1) Loosen screw (1) and move alternator (2) toward engine (3).
- (2) Remove four screws (4) and washers (5) and remove fan (6) and pulley (7).
- (3) Inspect belts (8) and replace if worn, cracked or otherwise damaged.
- (4) Install pulley (7) and fan (6) and secure with four screws (4) and washers (5). Torque screws to 15-19 lb-ft (20-26 Nm).
- (5) Ensure belts (8) are properly installed and adjust belt tension so that a firm push midway between fan pulley (7) and alternator (2) deflects the belts approximately 0.50-0.75 in. (1.27-1.90 cm) and tighten screw (1).





4951-023

**Figure 3-16. Fan, Pulley, and Belts, Replace.**

**FOLLOW-ON MAINTENANCE**

- (1) Install fan guards (para. 3-16).
- (2) Install shell assembly (para. 3-17).

---

**3-23. Water Pump.**

---

This task covers:      Replace

---

**INITIAL SETUP:****Tools****Equipment Condition**

General Mechanic's Tool Kit (NSN 5180-00-177-7033)      Fan and pulley removed (para. 3-22).  
Torque, Wrench (NSN 5120-00-554-7292)

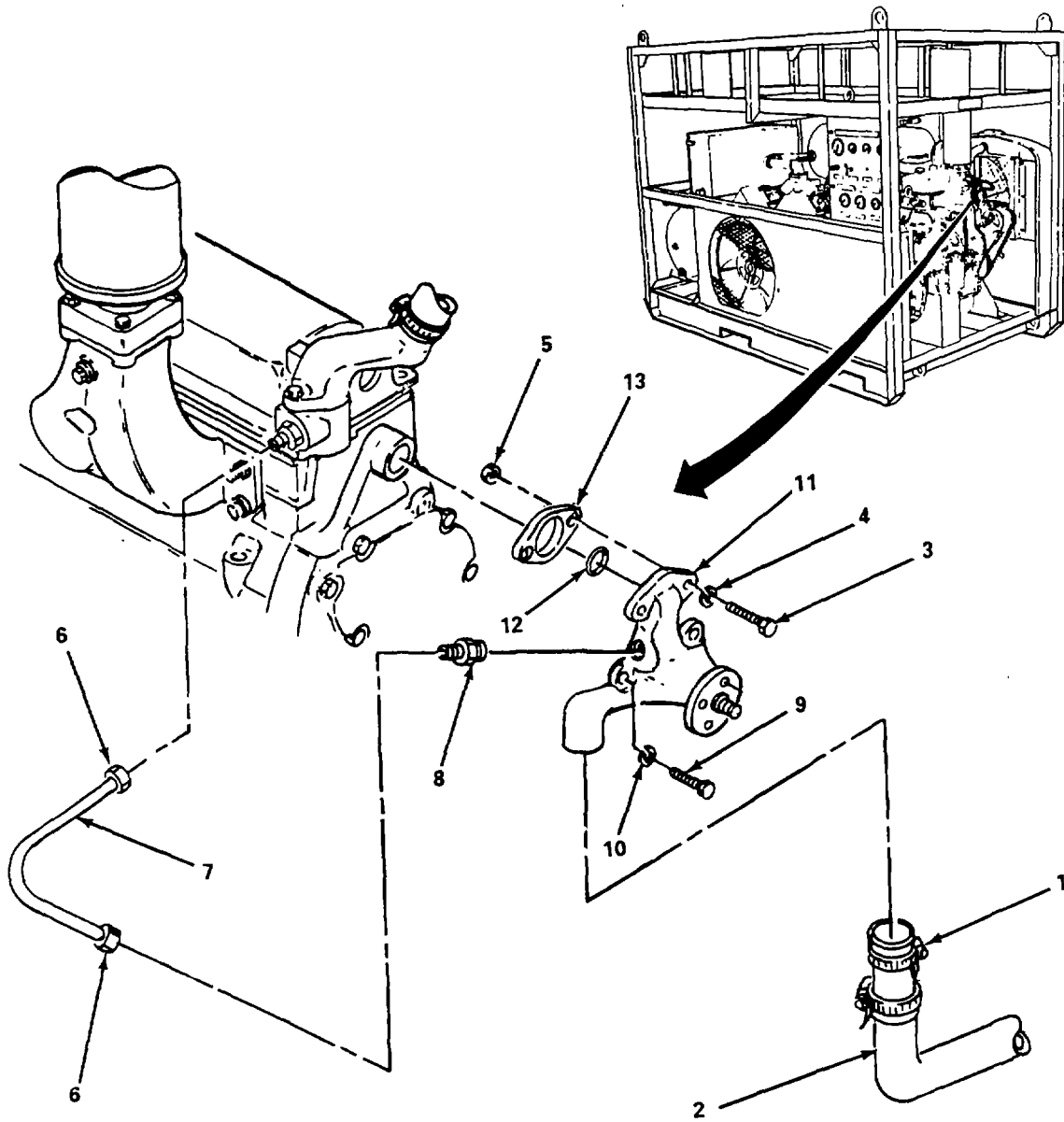
**Materials/Parts**

Water Pump  
O-Ring

---

**Replace.** (figure 3-17)

- (1) Loosen clamp (1) and remove hose (2).
- (2) Remove two screws (3), washers (4), and nuts (5).
- (3) Loosen two fitting nuts (6) and remove by-pass line (7).
- (4) Remove fitting (8).
- (5) Remove three screws (9), washers, (10) and remove water pump (11), o-ring (12), and flange (13).
- (6) Install flange (13), o-ring (12), and water pump (11) and secure with three screws (9) and washers (10). Torque screws to 46-50 lb-ft (62-68 Nm).
- (7) Install fitting (8).
- (8) Install by-pass line (7) and tighten two fitting nuts (6).
- (9) Install two screws (3), washers (4) and nuts (5).
- (10) Install hose (2) and tighten clamp (1).



**Figure 3-17. Water Pump, Replace.**

FOLLOW-ON MAINTENANCE  
 Install fan and pulley (para. 3-22).

---

**3-24. Lines and Fittings.**

---

This task covers:      Replace

---

**INITIAL SETUP:****Tools**

General Mechanic's Tool Kit  
(NSN 5180-00-177-7033)

**Materials/Parts**

Teflon Tape (Item 25, Appendix D)  
Fuel Supply Line  
Fuel Pump Line

**Materials/Parts (Cont)**

Fuel Filter Supply Line  
Fuel Manifold Supply Line

Fuel Return Line

---

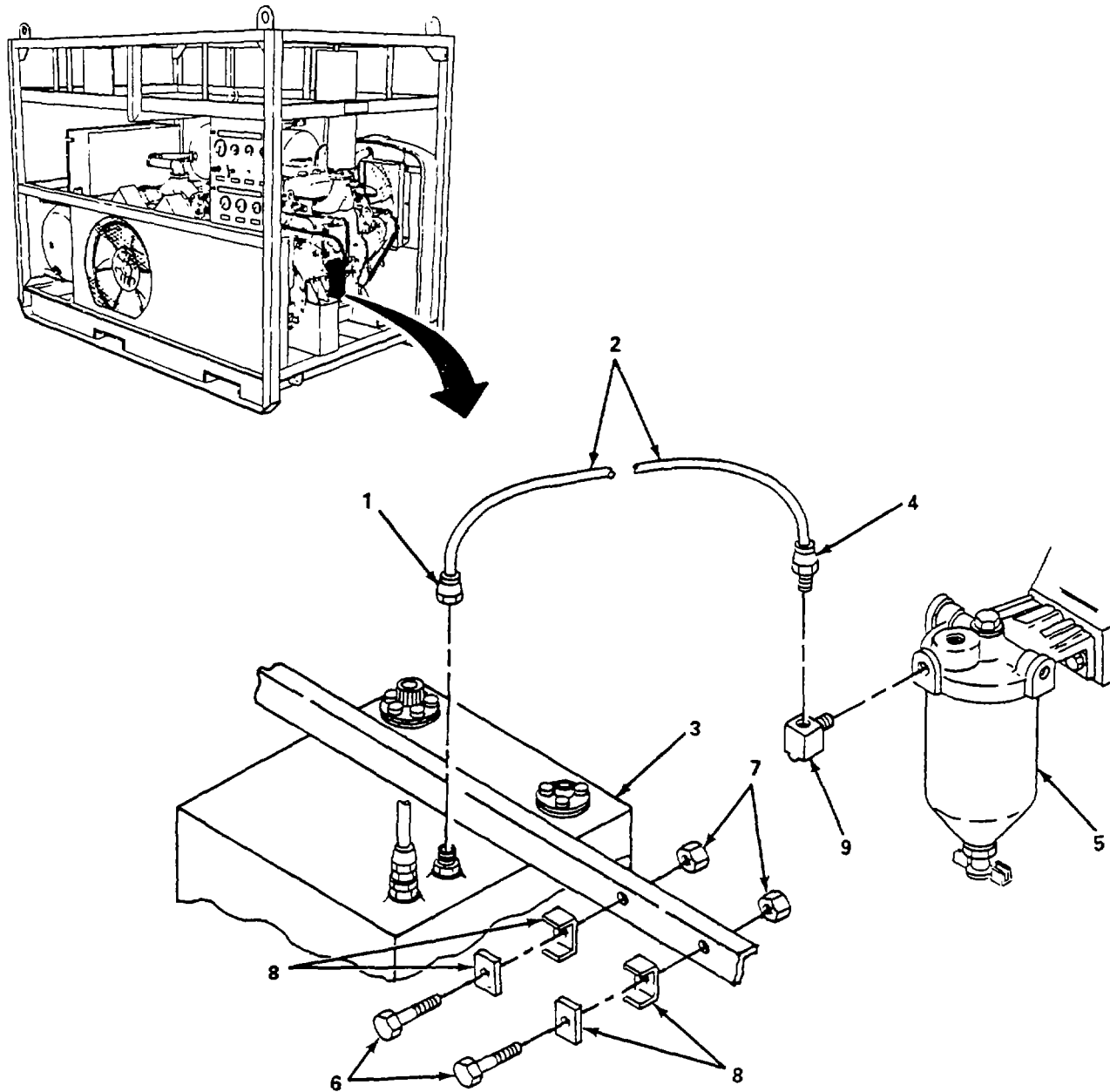
**Replace.**

- (1) Fuel supply line. (figure 3-18)
  - (a) Loosen fitting nut (1) and remove fuel line (2) from fuel tank (3).
  - (b) Loosen fitting nut (4) and remove fuel line (2) from fuel strainer (5).
  - (c) Remove two bolts (6) and nuts (7) and remove two clamps (8) securing fuel line (2) and remove fuel line.
  - (d) Remove elbow (9).

**NOTE**

Leave 11/2 threads exposed when applying teflon tape. Wrap teflon tape in the direction that will not unwrap as fitting is tightened. Failure to wrap teflon tape properly or having it extend past the end of the fitting may cause a blockage in the fuel system.

- (e) Apply teflon tape to elbow (9) and install.
- (f) Apply teflon tape to threads on fitting nut (4).
- (g) Install fuel line (2) and tighten fitting nuts (1) and (4).
- (h) Install two clamps (8) and secure with two bolts (6) and nuts (7).



4951-025

Figure 3-18. Fuel Supply Line, Replace.

**3-24. Lines and Fittings (Cont).**

(2) *Fuel pump line.* (figure 3-19)

- (a) Loosen fitting nut (1).
- (b) Loosen fitting nut (2) and remove fuel line (3).
- (c) Remove elbows (4) and (5).

**NOTE**

Leave 1 1/2 threads exposed when applying teflon tape. Wrap teflon tape in the direction that will not unwrap as fitting is tightened. Failure to wrap teflon tape properly or having it extend past the end of the fitting may cause a blockage in the fuel system.

- (d) Apply teflon tape on elbows (4) and (5) and install.
- (e) Install fuel line (3) and tighten fitting nuts (1) and (2).

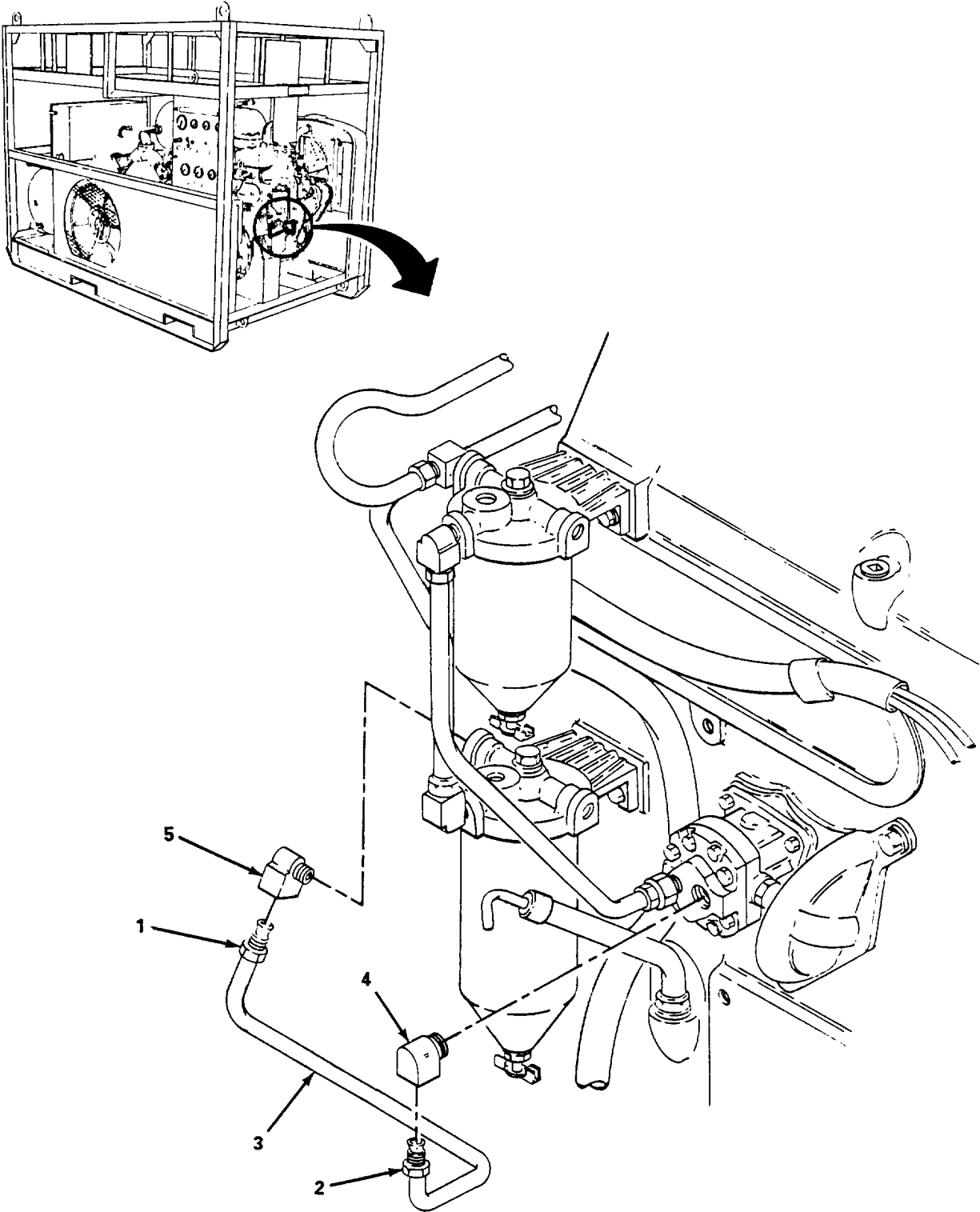


Figure 3-19. Fuel Pump Supply Line, Replace.

4951-028

**3-24. Lines and Fittings (Cont).**

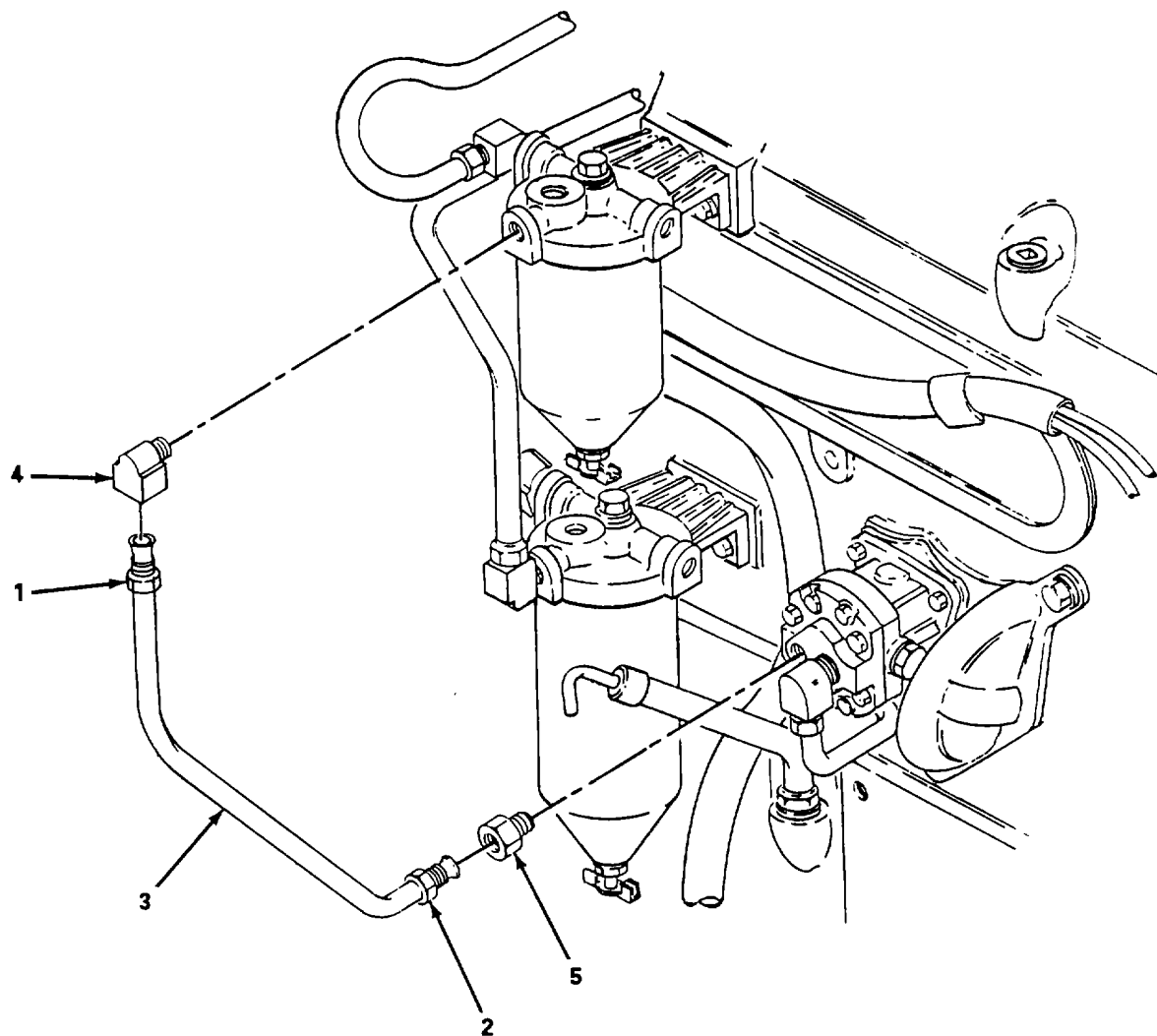
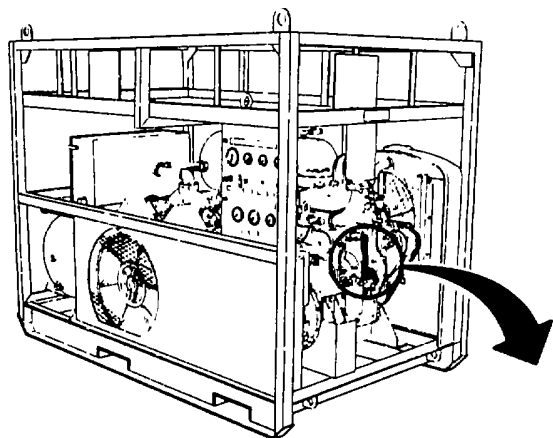
- (3) *Fuel filter supply line* (figure 3-20).
  - (a) Loosen fitting nut (1).
  - (b) Loosen fitting nut (2) and remove line (3).
  - (c) Remove elbow (4) and reducer (5).

**NOTE**

Leave 1 1/2 threads exposed when applying teflon tape. Wrap teflon tape in the direction that will not unwrap as fitting is tightened. Failure to wrap teflon tape properly or having it extend past the end of the fitting may cause a blockage in the fuel system.

- (d) Apply teflon tape to reducer (5) and elbow (4) and install.
- (e) Install line (3) and tighten fitting nuts (1) and (2).





4951-027

Figure 3-20. Fuel Filter Supply Line, Replace.

**3-24. Lines and Fittings (Cont).**

- (4) Fuel manifold supply line. (figure 3-21)
  - (a) Loosen fitting nut (1).
  - (b) Loosen fitting nut (2) and remove line (3).
  - (c) Loosen fitting nut (4) and remove fuel return line (5)
  - (d) Remove elbows (6), (7), and (8).

**NOTE**

Leave 1 1/2 threads exposed when applying teflon tape. Wrap teflon tape in the direction that will not unwrap as fitting is tightened. Failure to wrap teflon tape properly or having it extend past the end of the fitting may cause a blockage in the fuel system.

- (e) Apply teflon tape to elbows (6), (7), and (8) and install.
- (f) Install fuel return line (5) and tighten fitting nut (4).
- (g) Install line (3) and tighten fitting nuts (1) and (2).

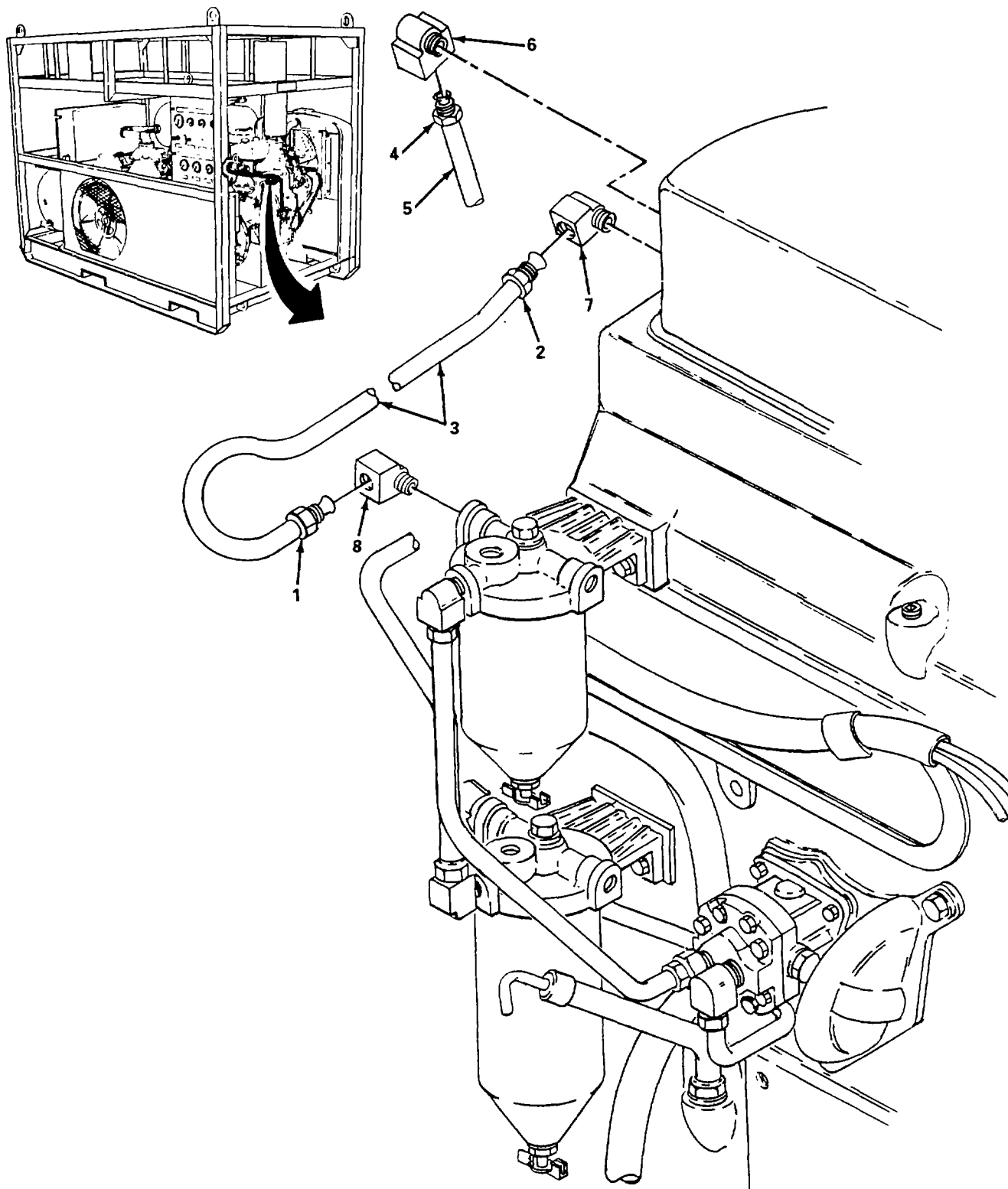


Figure 3-21. Fuel Manifold Supply Line, Replace.

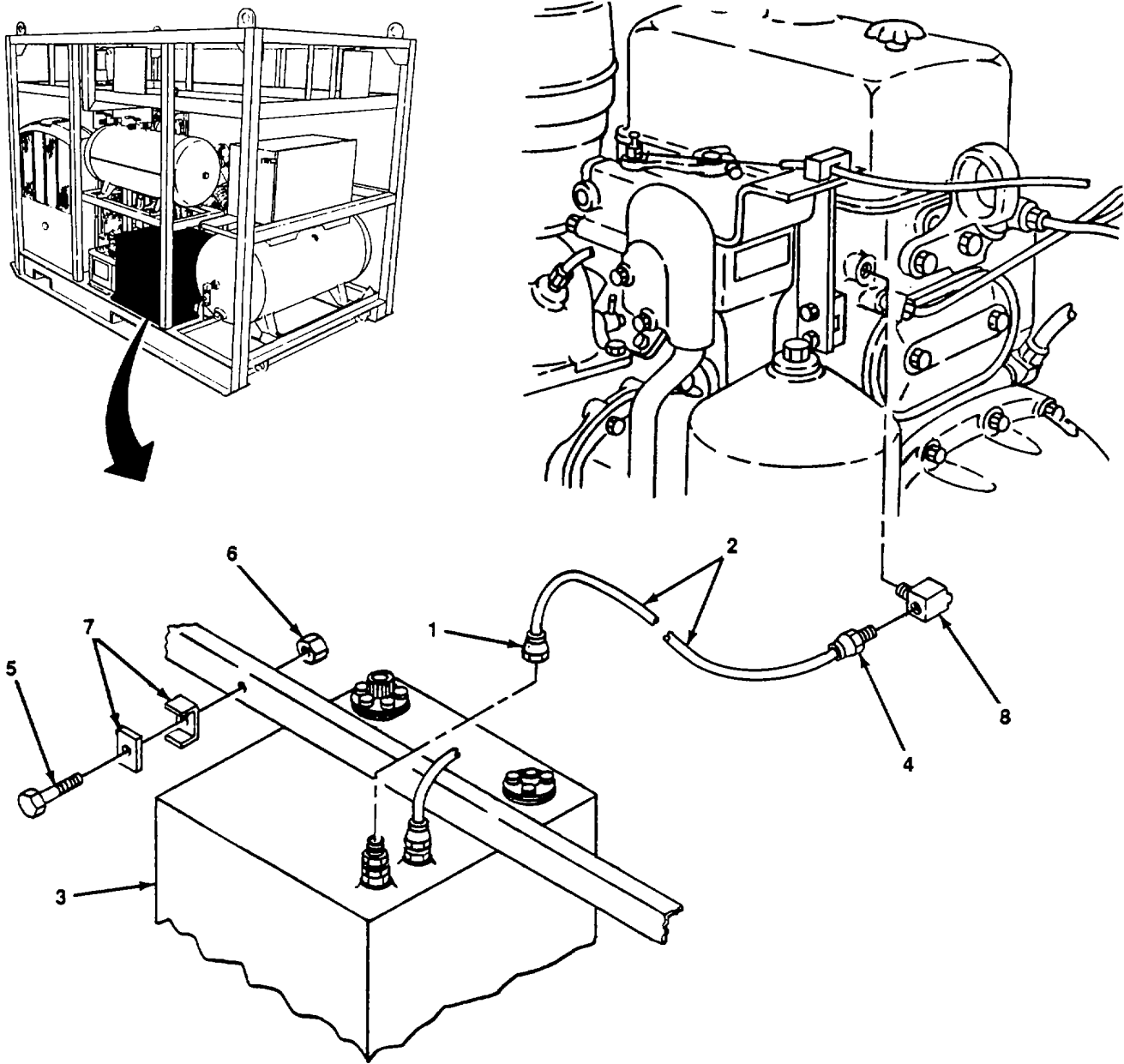
**3-24. Lines and Fittings (Cont).**

- (5) Fuel return line. (figure 3-22)
  - (a) Loosen fitting nut (1) and remove line (2) from fuel tank (3).
  - (b) Loosen fitting nut (4) and remove line (2).
  - (c) Remove two bolts (5) and nuts (6) and remove two clamps (7) securing fuel line (2).
  - (d) Remove elbow (8).

**NOTE**

Leave 1 1/2 threads exposed when applying teflon tape. Wrap teflon tape in the direction that will not unwrap as fitting is tightened. Failure to wrap teflon tape properly or having it extend past the end of the fitting may cause a blockage in the fuel system.

- (e) Apply teflon tape to elbow (8) and install.
- (f) Apply teflon tape to threads on fitting nut (4).
- (g) Install line (2) and tighten fitting nuts (1) and (4).
- (h) Install two clamps (7) and secure with two bolts (5) and nuts (6).



4951-029

Figure 3-22. Fuel Return Line, Replace.

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**3-25. Fuel Filter Assembly**

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**This task covers:****a. Service****b. Replace****c. Repair**

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**INITIAL SETUP:***Tools**Materials/Parts*General Mechanic's Tool Kit (NSN 5180-00-177-7033)  
Torque, Wrench (NSN 5120-00-554-7292)Fuel Filter Assembly  
Solvent, Dry Cleaning (Item 23, Appendix D)  
Rags, Wiping (Item 21, Appendix D)

---

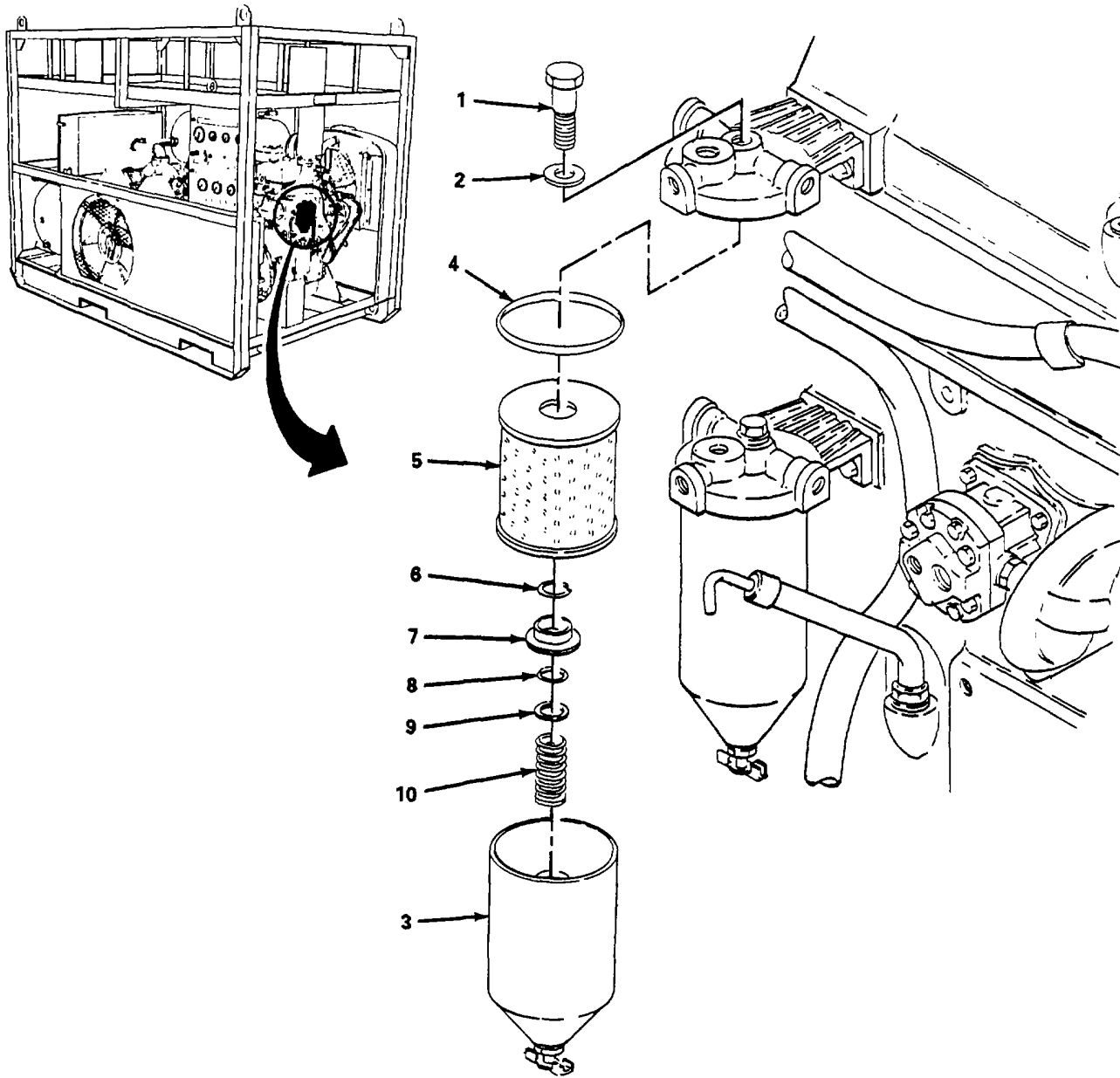
**a. Service** (figure 3-23)

- (1) Remove bolt (1) and gasket (2) and remove shell (3) and gasket (4).
- (2) Pour fuel from shell (3) into suitable container.
- (3) Remove element (5), retainer (6), seat (7), seal (8), seat (9), and spring (10).

**WARNING**

**Dry cleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100-1380F (38-600C).**

- (4) Clean all items, except seals and gasket, with dry cleaning solvent and dry thoroughly.
- (5) Install spring (10), seat (9), seal (8), seat (7), retainer (6), and element (5).
- (6) Install shell (3) and gasket (4) and secure with bolt (1) and gasket (2). Tighten bolt (1) just enough to prevent fuel leakage.



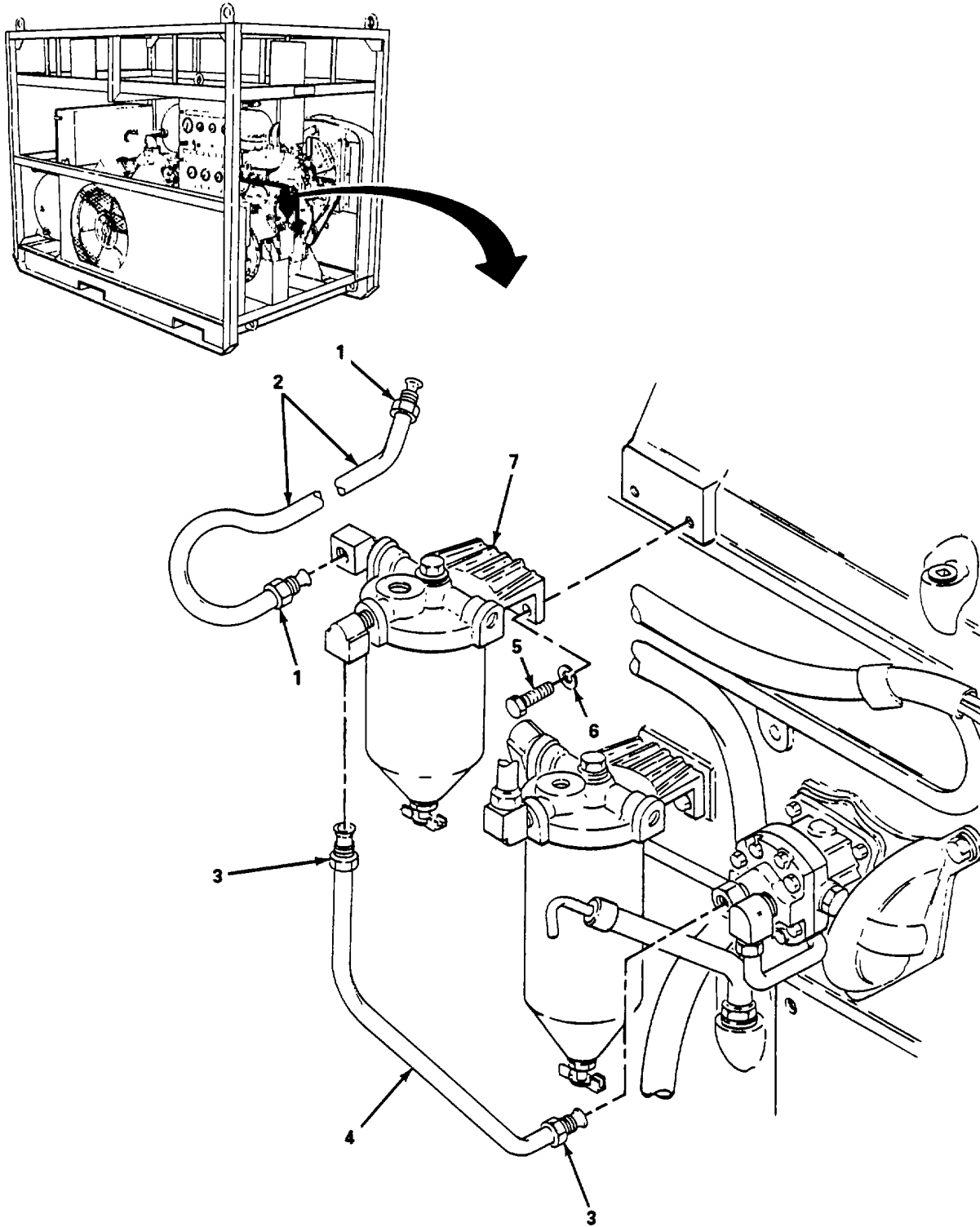
4951-030

Figure 3-23. Fuel Filter Assembly, Service.

**3-25. Fuel Filter Assembly (Cont).***b. Replace.* (figure 3-24)

- (1) Loosen two fitting nuts (1) and remove line (2).
- (2) Loosen two fitting nuts (3) and remove line (4).
- (3) Remove two screws (5), washers (6) and remove fuel filter assembly (7).
- (4) Install fuel filter assembly (7) and secure with two screws (5) and washers (6).
- (5) Install fuel line (4) and tighten two fitting nuts (3).
- (6) Install fuel line (2) and tighten two fitting nuts (1).





4951-031

Figure 3-24. Fuel Filter Assembly, Replace.

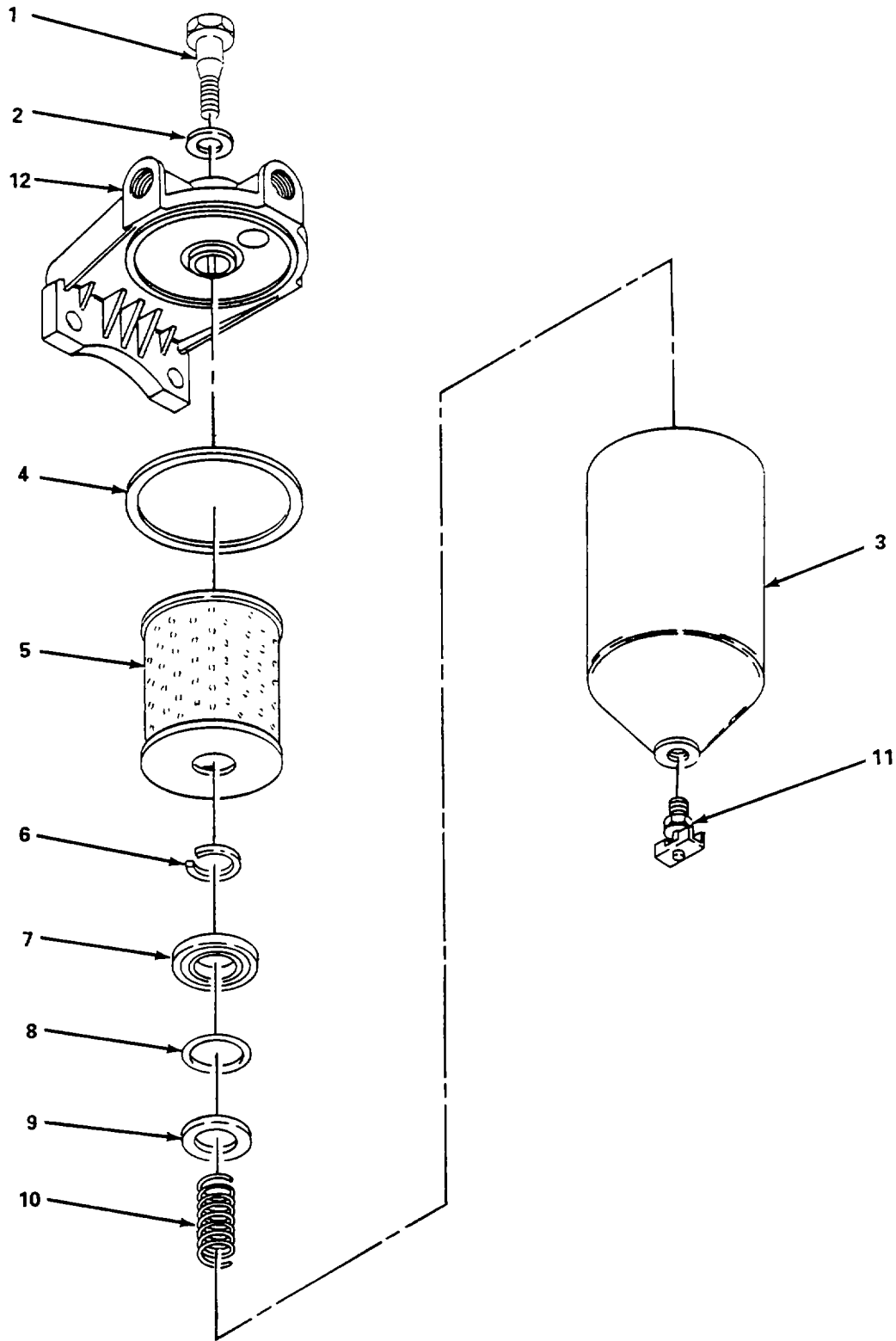
**3-25. Fuel Filter Assembly (Cont).**c. Repair. (figure 3-25)

- (1) Remove bolt (1) and gasket (2) and remove shell (3) and gasket (4).
- (2) Pour excess fuel from shell (3).
- (3) Remove filter (5), retainer (6), seat (7), seal (8), seat (9), and spring (10).
- (4) Remove drain cock (11).

**WARNING**

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

- (5) Clean all items with dry cleaning solvent and dry thoroughly.
- (6) Inspect all items including filter head (12) and replace all items that are bent, cracked or otherwise damaged.
- (7) Install drain cock (11).
- (8) Install spring (10), seat (9), seal (8), seat (7), retainer (6), and filter (5) in shell (3).
- (9) Install shell (3) and gasket (4) and secure with bolt (1) and gasket (2). Tighten bolt (1) just enough to prevent fuel leakage.



4951-032

Figure 3-25. Fuel Filter Assembly, Repair.

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**3-26. Fuel Strainer Assembly**

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**This task covers:****a. Service****b. Replace****c. Repair**

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**INITIAL SETUP:***Tools**Materials/Parts*General Mechanic's Tool Kit (NSN 5180-00-177-7033)  
Torque, Wrench (NSN 5120-00-554-7292)Fuel Strainer Assembly  
Solvent, Dry Cleaning (Item 23, Appendix D)  
Rags, Wiping (Item 21, Appendix D)  
Teflon Tape (Item 25, Appendix D)

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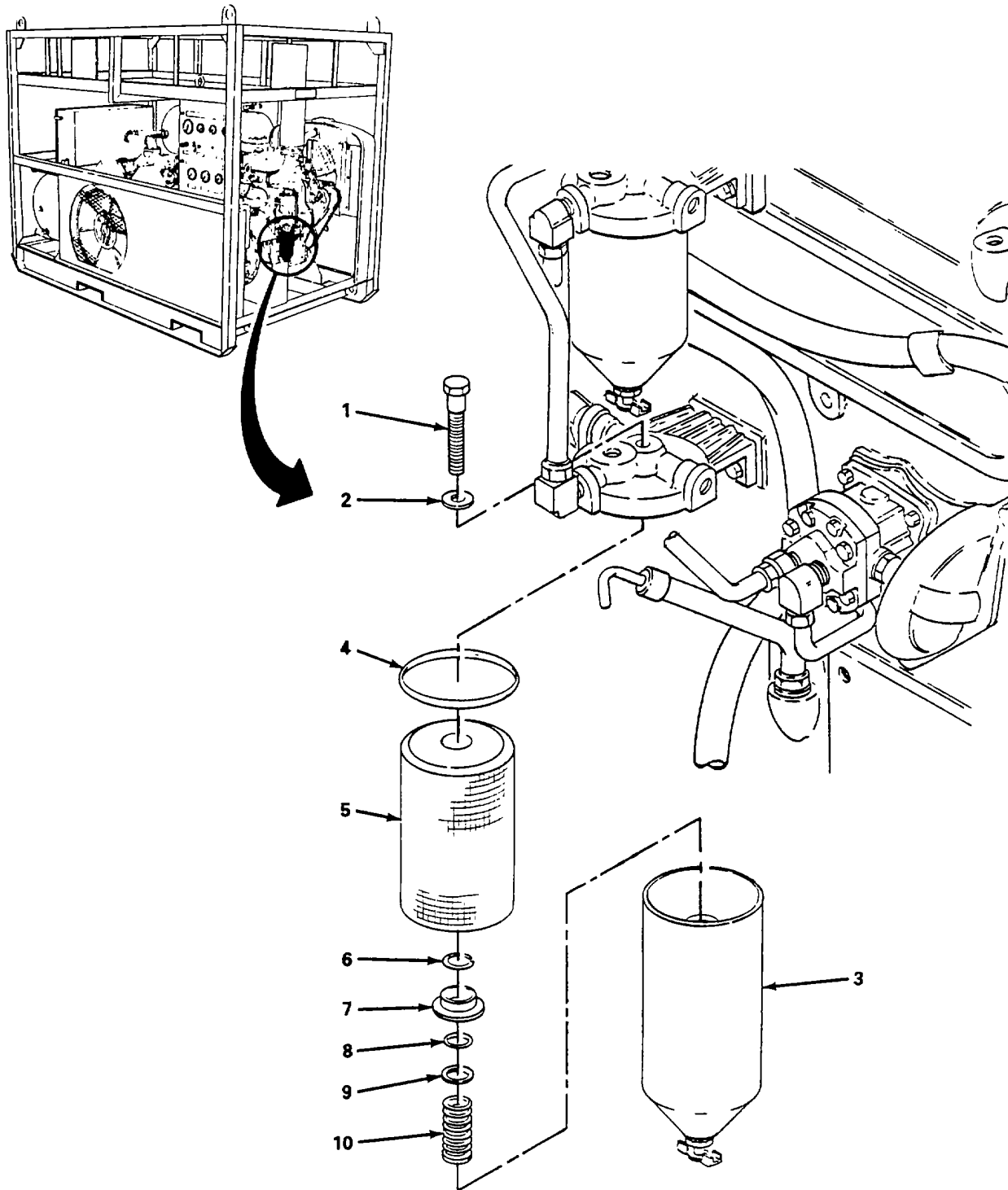
**a. Service** (figure 3-26)

- (1) Remove screw (1) and gasket (2), and remove shell (3) and gasket (4).
- (2) Pour excess fuel into suitable container.
- (3) Remove element (5), retainer (6), seat (7), seal (8), seat (9), and spring (10).

**WARNING**

**Dry cleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100-138°F (38-600C).**

- (4) Clean all items, except seals and gasket, with dry cleaning solvent and dry thoroughly.
- (5) Install spring (10), seat (9), seal (8), seat (7), retainer (6), and element (5).
- (6) Install shell (3) and gasket (4) and secure with screw (1) and gasket (2). Tighten screw (1) just enough to prevent fuel leakage.



4951 033

Figure 3-26. Fuel Strainer Assembly, Service.

**3-26. Fuel Strainer Assembly (Cont).***b. Replace.* (figure 3-27)

- (1) Loosen fitting nut (1) and remove line (2).
- (2) Loosen two fitting nuts (3) and remove line (4).
- (3) Remove bolt (5) and washer (6) and remove shell (7) and gasket (8).
- (4) Pour excess fuel in shell (7) into suitable container.
- (5) Remove two screws (9) and lockwashers (10) and remove strainer head (11).
- (6) Install strainer head (11) and secure with two screws (9) and lockwashers (10).
- (7) Install shell (7) and gasket (8) and secure with bolt (5) and gasket (6). Tighten bolt (5) just enough to prevent fuel leakage.
- (8) Install line (4) and tighten two fitting nuts (3).

**NOTE**

**Leave 1 1/2 threads exposed when applying teflon tape. Wrap teflon tape in the direction that will not unwrap as fitting is tightened. Failure to wrap teflon tape properly or having it extend past the end of the fitting may cause a blockage in the fuel system.**

- (9) Apply teflon tape to threads on fitting nut (1).
- (10) Install line (2) and tighten fitting nut (1).

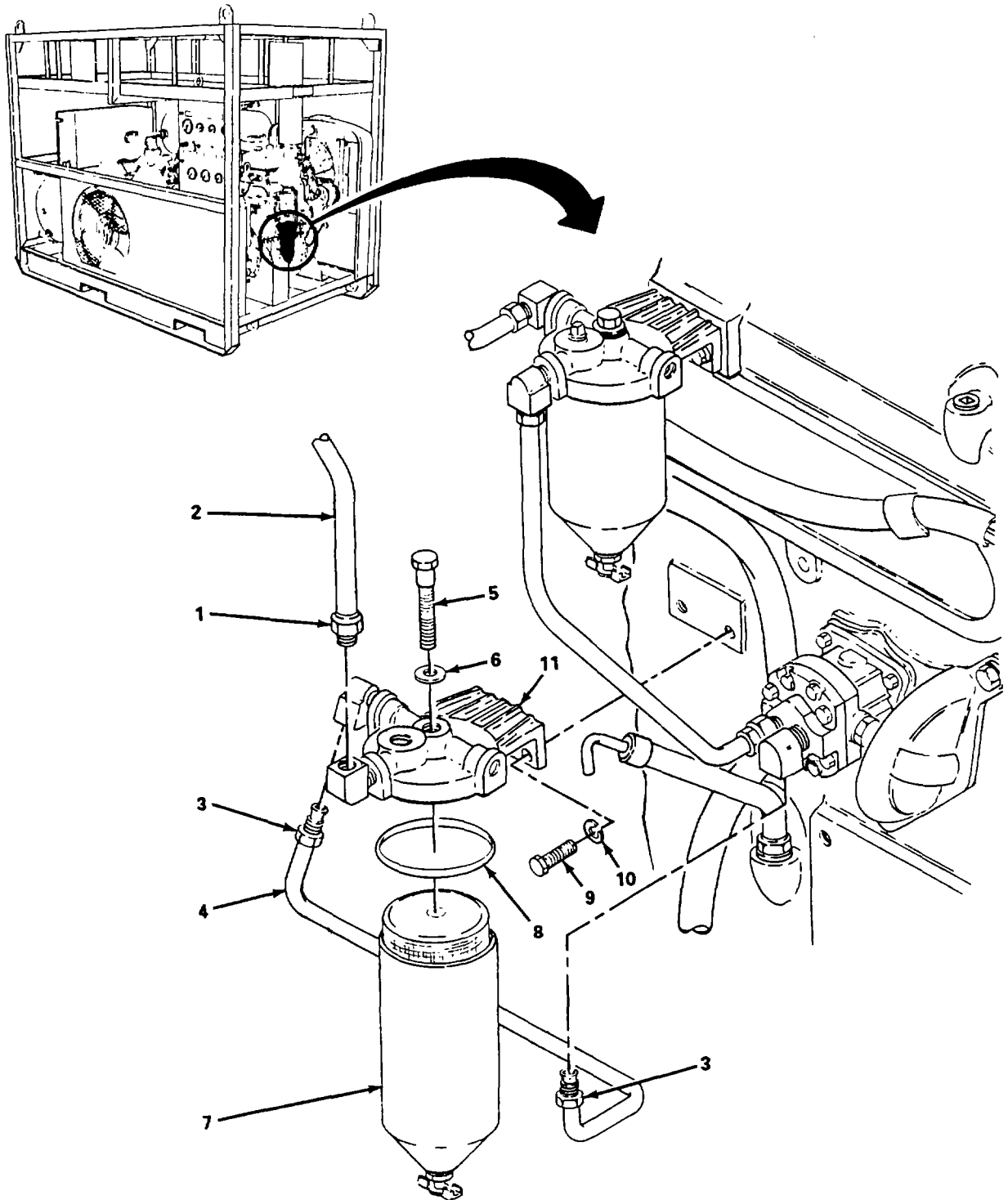


Figure 3-27. Fuel Strainer Assembly, Replace.

**3-26. Fuel Strainer Assembly (Cont).**c. Repair. (figure 3-28)

- (1) Remove fuel strainer assembly, see para. b. above.
- (2) Remove strainer (1), retainer (2), seat (3), seal (4), seat (5), and spring (6).
- (3) Remove pet cock (7).

**WARNING**

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

- (4) Clean all items with dry cleaning solvent, and dry thoroughly.
- (5) Inspect shell (8) and strainer head (9) and replace if cracked or otherwise damaged.
- (6) Inspect strainer (1) and replace if torn or excessively dirty.
- (7) Inspect retainer (2), seat (3), seat (5) and spring (6) and replace if bent, cracked, or otherwise damaged.
- (8) Inspect pet cock (7) and bolt (10), and replace if threads are stripped or otherwise damaged.
- (9) Inspect gasket (11), seal (4), and gasket (12) and replace if cracked or otherwise damaged.
- (10) Install spring (6), seat (5), seal (4), seat (3), retainer (2), and strainer (1).
- (11) Install pet cock (7).
- (12) Install fuel strainer assembly, see para. b above.



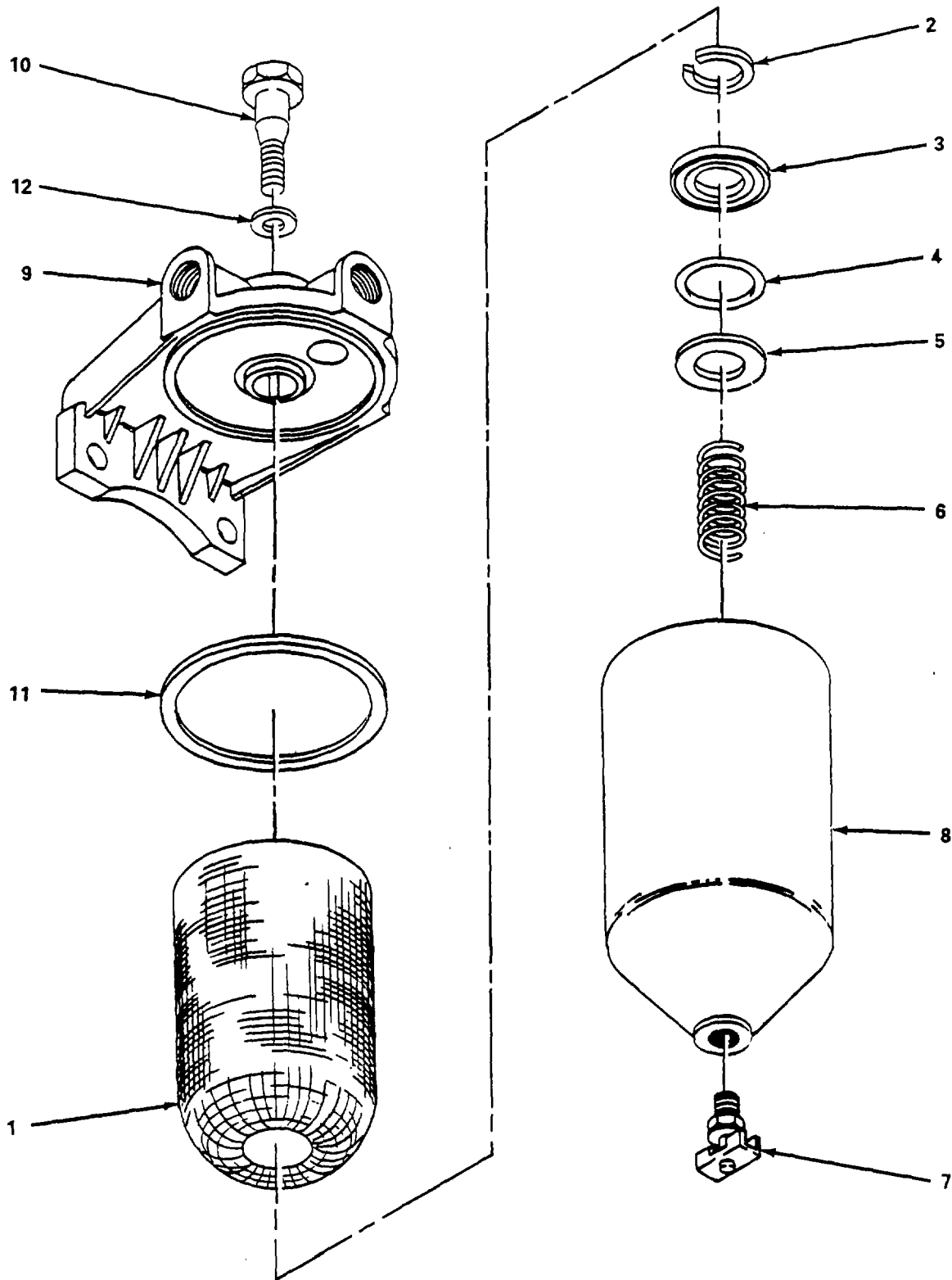


Figure 3-28. Fuel Strainer Assembly, Repair.

4951-035

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**3-27. Fuel Pump and Drive**


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This task covers:

a. Test

b. Replace

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**INITIAL SETUP:**
*Tools*
*Materials/Parts*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)  
Wrench, Torque (NSN 5120-00-554-7292)

Drive, Fuel Pump  
Fuel Pump  
Gasket, Fuel Pump Mounting  
Gasket, Fuel Pump Drive Mounting  
Teflon Tape (Item 25, Appendix D)

---

a. *Test*. (figure 3-29)

- (1) Loosen fitting nut (1) and remove fuel return line (2).
- (2) Place fuel return line (2) in suitable container.
- (3) Start engine (para. 2-6) and run at 1200 rpm.
- (4) Fuel flow should be 0.5 gallons per min.
- (5) Stop engine (para. 2-7).
- (6) If fuel flow is not as specified, replace fuel pump.

**NOTE**

**Leave 1 1/2 threads exposed when applying teflon tape. Wrap teflon tape in the direction that will not unwrap as fitting is tightened. Failure to wrap teflon tape properly or having it extend past the end of the fitting may cause a blockage in the fuel system.**

- (7) Apply teflon tape to threads on fitting nut (1).
- (8) Install fuel return line (2) and tighten fitting nut (1).

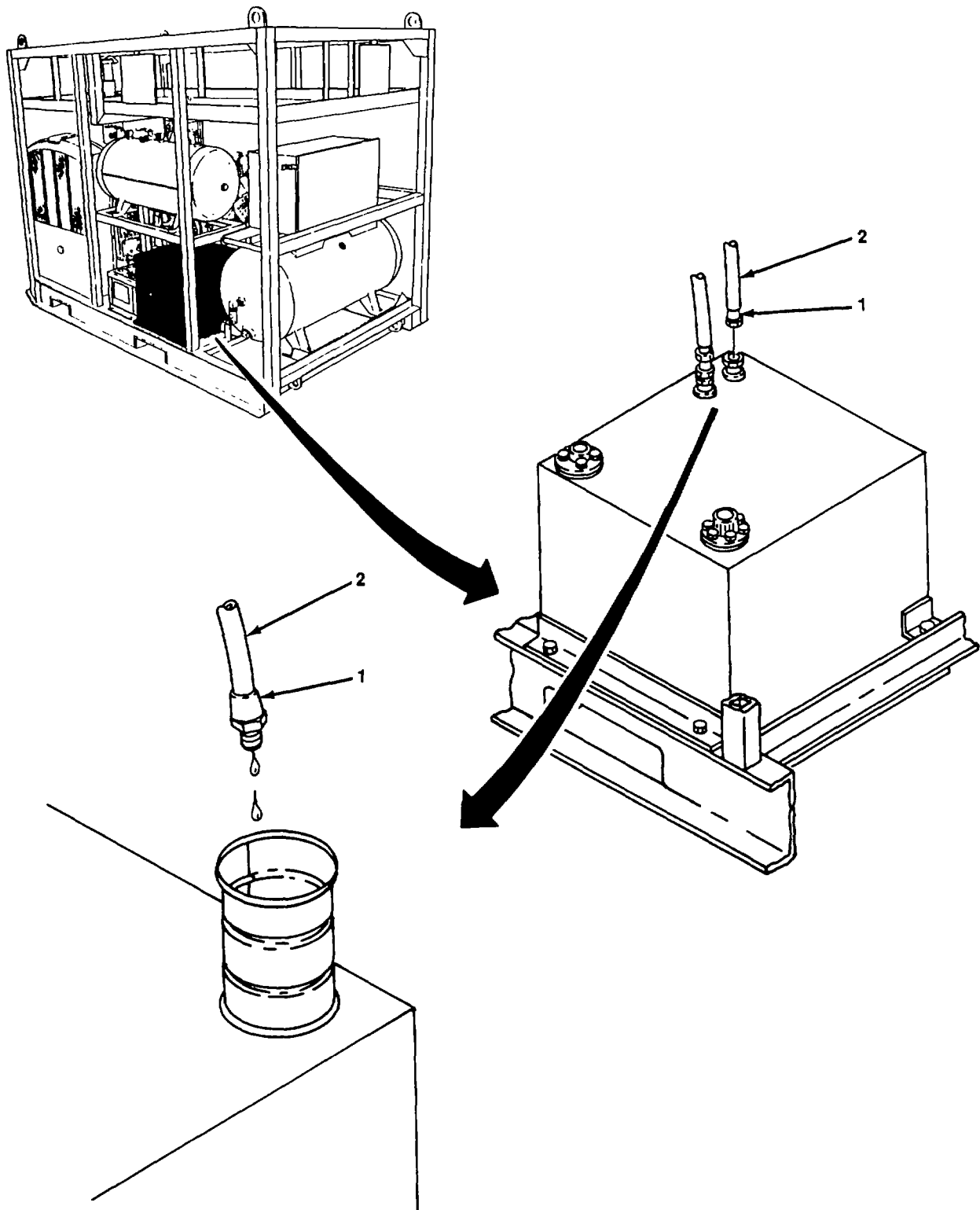


Figure 3-29. Fuel Pump, Test.

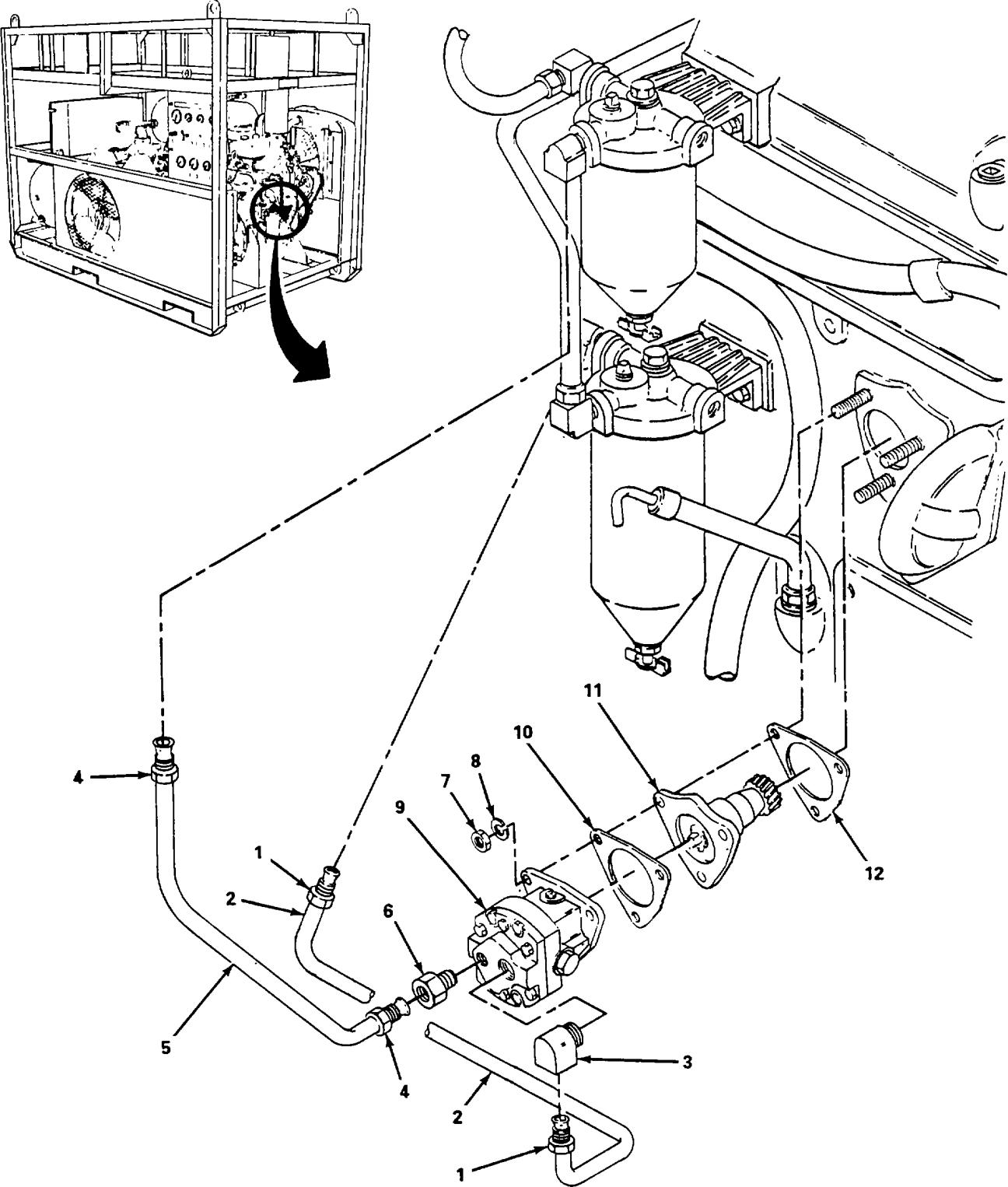
**3-27. Fuel Pump (Cont).***b. Replace.* (figure 3-30)

- (1) Loosen two fitting nuts (1) and remove fuel line (2).
- (2) Remove elbow (3).
- (3) Loosen two fitting nuts (4) and remove fuel line (5).
- (4) Remove fitting (6).
- (5) Remove three nuts (7) and washers (8) and remove fuel pump (9), gasket (10), fuel pump drive (11), and gasket (12).
- (6) Ensure all gasket surfaces are clean and free of old gasket material.
- (7) Install fuel pump drive (11), gasket (12), new fuel pump (9), and gasket (10) and secure with three nuts (7) and washers (8). Torque nuts to 10-13 lb-ft (14-18 Nm).

**NOTE**

**Leave 1 1/2 threads exposed when applying teflon tape. Wrap teflon tape in the direction that will not unwrap as fitting is tightened. Failure to wrap teflon tape properly or having it extend past the end of the fitting may cause a blockage in the fuel system.**

- (8) Apply teflon tape to fitting (6) and elbow (3) and install.
- (9) Install fuel line (5) and tighten two fitting nuts (4).
- (10) Install fuel line (2) and tighten fitting nuts (1).



4951-037

Figure 3-30. Fuel Pump, Replace.

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**3-28. Air Cleaner Assembly**

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**This task covers:****a. Service****b. Replace****c. Repair**

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**INITIAL SETUP:***Tools*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)

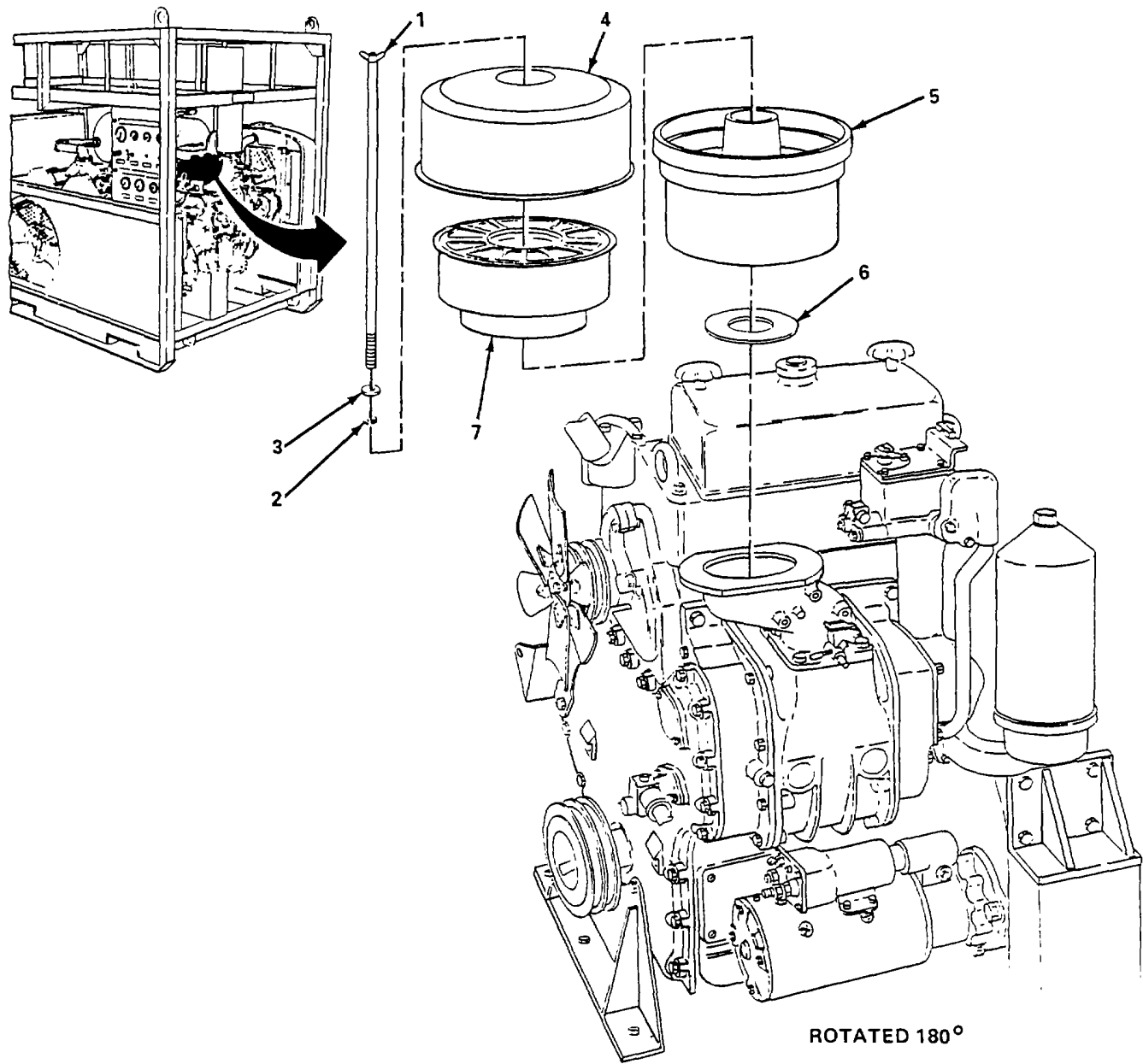
*Materials/Parts*Air Cleaner Assembly  
Gasket, Air Cleaner Assembly*Materials/Parts (Cont)*Element, Air Cleaner Assembly  
Solvent, Drycleaning (Item 23, Appendix D)  
Rags, Wiping (Item 21, Appendix D)  
Lubricating Oil Ground Equipment (Item 18,  
Appendix D)**a. Service.** (figure 3-31)

- (1) Remove wingnut screw (1), seal (2) and retainer (3) and remove air cleaner cover (4), body (5) and gasket (6).
- (2) Remove air cleaner element (7) from body (5).
- (3) Pour oil from air cleaner body into suitable container.

**WARNING**

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

- (4) Clean element (7), body (5) and cover (4) with dry cleaning solvent and thoroughly.
- (5) Fill body (5) with oil to LEVEL line.
- (6) Install element (7) in body (5).
- (7) Install gasket (6), body (5) and cover (4) and secure with wing nut screw (1), seal (2), and retainer (3).



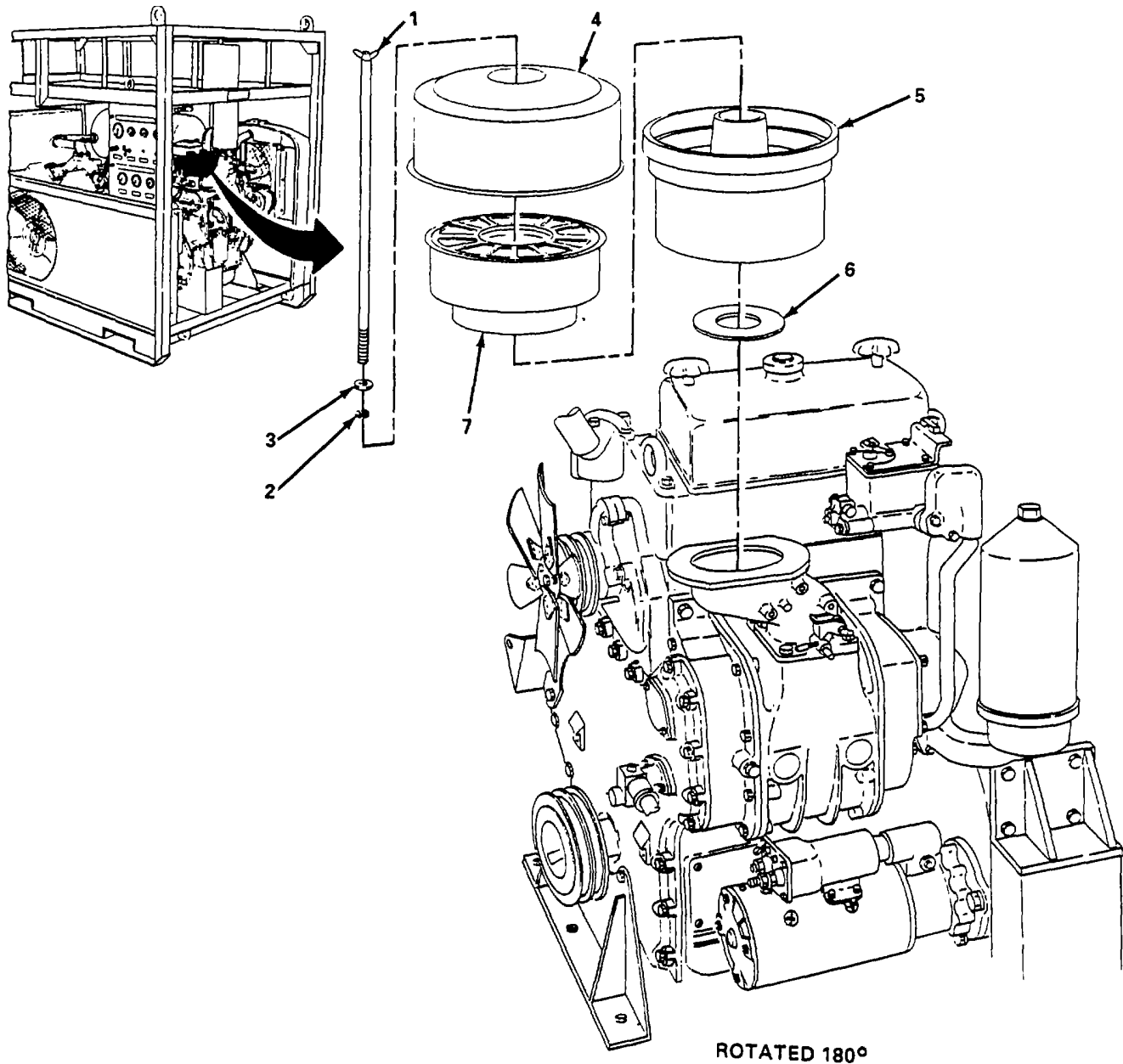
4951-038

Figure 3-31. Air Cleaner Assembly, Service.

**3-28. Air Cleaner Assembly (Cont).***b. Replace.* (figure 3-32)

- (1) Remove wingnut screw (1), seal (2) and retainer (3) and remove air cleaner cover(4), body (5) and gasket (6).
- (2) Remove element (7) from body (5).
- (3) Pour oil In body (5) into suitable container.
- (4) Fill body (5) with engine oil to LEVEL line.
- (5) Install element (7).
- (6) Install gasket (6), body (5), and cover (4) and secure with wingnut screw (1), retainer (3) and seal (2).





4951-039

Figure 3-32. Air Cleaner Assembly, Replace.

**3-28. Air Cleaner Assembly (Cont).**c. Repair. (figure 3-33)

- (1) Remove wingnut screw (1), seal (2) and retainer (3) and remove air cleaner cover (4), body (5) and gasket (6).
- (2) Pour excess oil from body (5) into suitable container.
- (3) Remove element (7).

**WARNING**

**Dry cleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point solvent is 100-138 °0F (38-60°C).**

- (4) Clean all items, except seal, with dry cleaning solvent and dry thoroughly.
- (5) Inspect wing nut screw (1), and replace if threads are stripped or otherwise damaged.
- (6) Inspect cover (4) and gasket (8) and replace a cover that is dented or cracked, or a gasket (8) that is cracked or otherwise damaged.
- (7) Inspect element (7) and gasket (9). Replace element (7) that is unserviceable or a gasket (9) that is cracked or otherwise damaged.
- (8) Inspect body (5) and gasket (6). Replace a body (5) that is dented or cracked, or a gasket (6) that is cracked or otherwise damaged.
- (9) Inspect seal (2) and replace if ripped or otherwise damaged.
- (10) Inspect retainer (3) and replace if bent or otherwise damaged.
- (11) Fill body (5) with engine oil to LEVEL line.
- (12) Install element (7).
- (13) Install gasket (6), body (5), cover (4) and secure with wing nut screw (1), retainer (3) and seal (2).

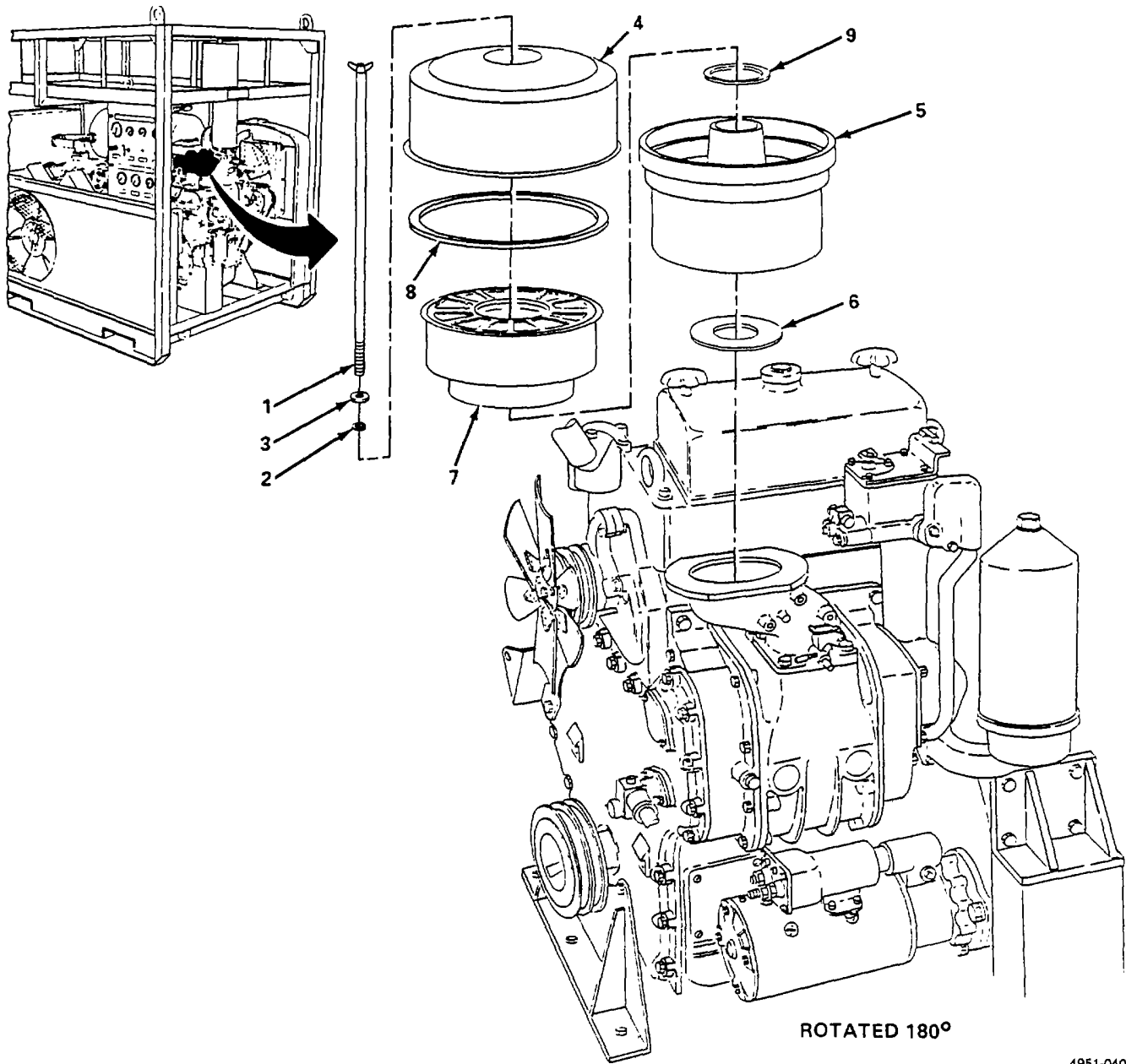


Figure 3-33. Air Cleaner Assembly, Repair.

4951-040

---

**3-29. Air Shutdown Housing Assembly**

---

**This task covers:**

**Replace**

---

**INITIAL SETUP:**

Tools

Equipment Condition

General Mechanic's Tool Kit (NSN 5180-00-177-7033) Air cleaner assembly removed (para. 3-28).  
Torque, Wrench (NSN 5120-00-554-7292)

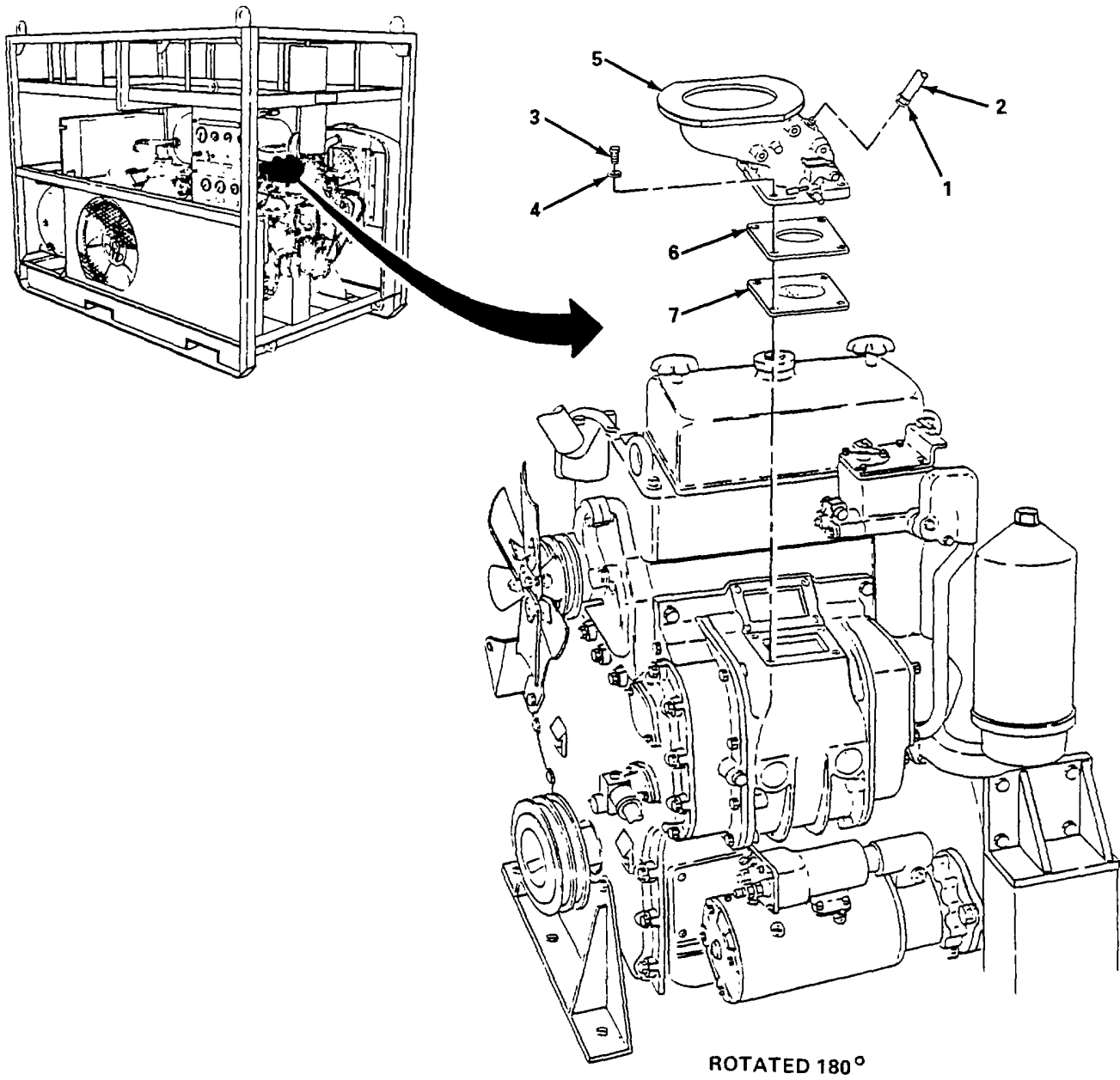
*Materials/Parts*

Air Shutdown Housing  
Gasket, Air Shutdown Housing

---

Replace. (figure 3-34)

- (1) Loosen fitting nut (1) and remove starting fluid line (2).
- (2) Remove four bolts (3), washers (4) and remove air shutdown housing (5), gasket (6), and screen (7).
- (3) Ensure gasket surfaces are clean and old gasket material removed.
- (4) Install screen (7), gasket (6) and air shutdown housing (5) and secure with four bolts (3) and washers (4). Torque bolts to 16-20 lb-ft (22-27 Nm).
- (5) Install starting fluid line (2) and tighten fitting nut (1).



4951-041

**Figure 3-34. Air Shutdown Housing, Replace.**

**FOLLOW-ON MAINTENANCE**

Install air cleaner assembly (para. 3-28).

---

**3-30. Air Box Drains**

---

**This task covers:****Repair**

---

**INITIAL SETUP:***Tools**Materials/Parts*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)

Air Box Drain (Fuel Pump Side)

Air Box Drain (Blower Side)

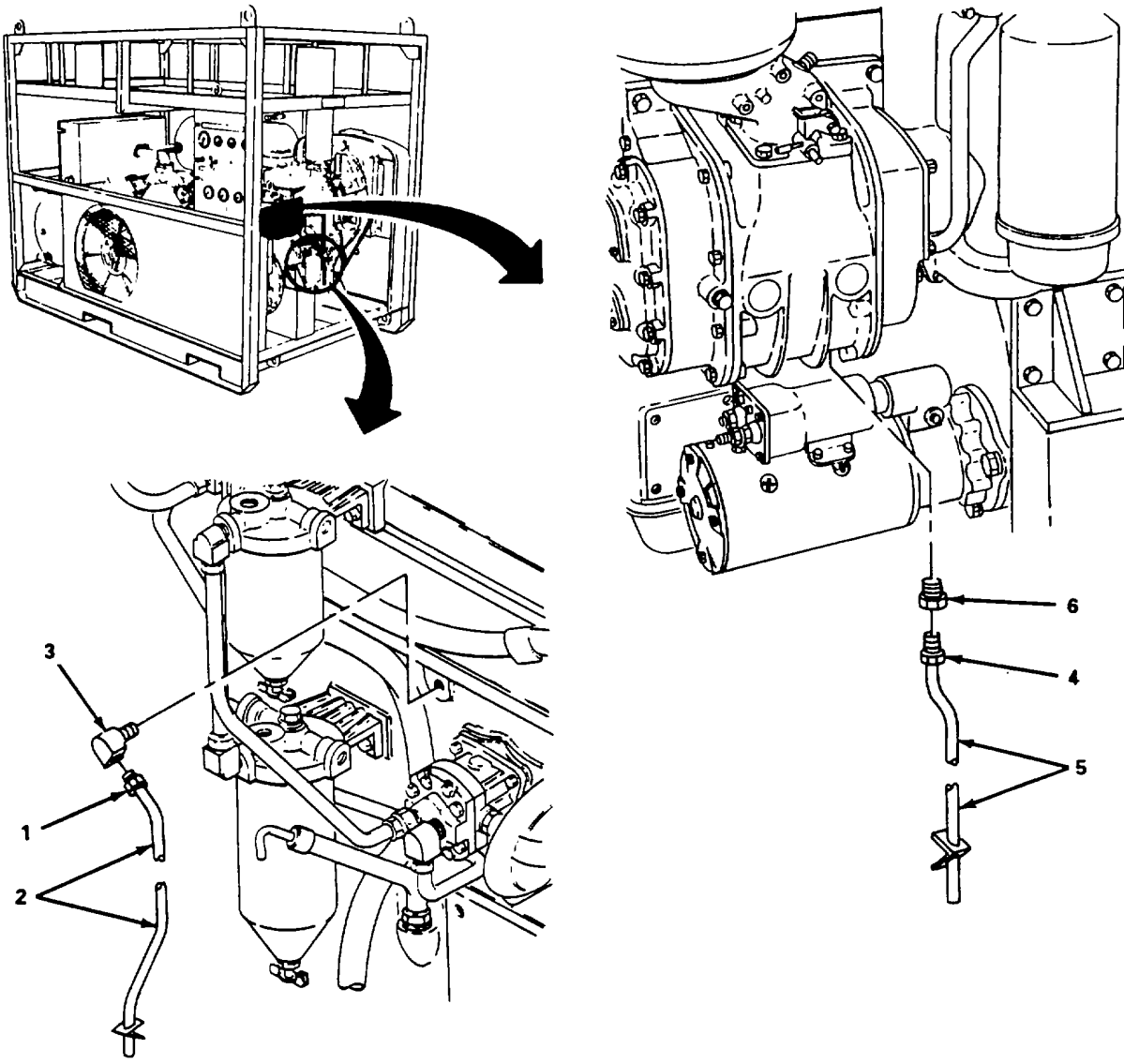
Elbow

Reducer

---

*Replace.* (figure 3-35)

- (1) Loosen fitting nut (1) and remove line (2).
- (2) Remove elbow (3).
- (3) Loosen fitting nut (4) and remove line (5).
- (4) Remove reducer (6).
- (5) Install reducer (6).
- (6) Install line (5) and tighten fitting nut (4).
- (7) Install reducer (3).
- (8) Install line (2) and tighten fitting nut (1).



4951-192

Figure 3-35. Air Box Drains, Replace.

---

**3-31. Starter**

---

**This task covers:****a. Test****b. Replace**

---

**INITIAL SETUP:**Tools:

General Mechanics Tool Kit (NSN 5180-00-177-7033)  
Torque Wrench (NSN 5120-00-247-2540)  
Multimeter (NSN 6625-01-139-2512)

Equipment Condition

Shell assembly removed (para. 3-17).  
Air cleaner assembly removed (para.3-28)

Materials/PartsStarter

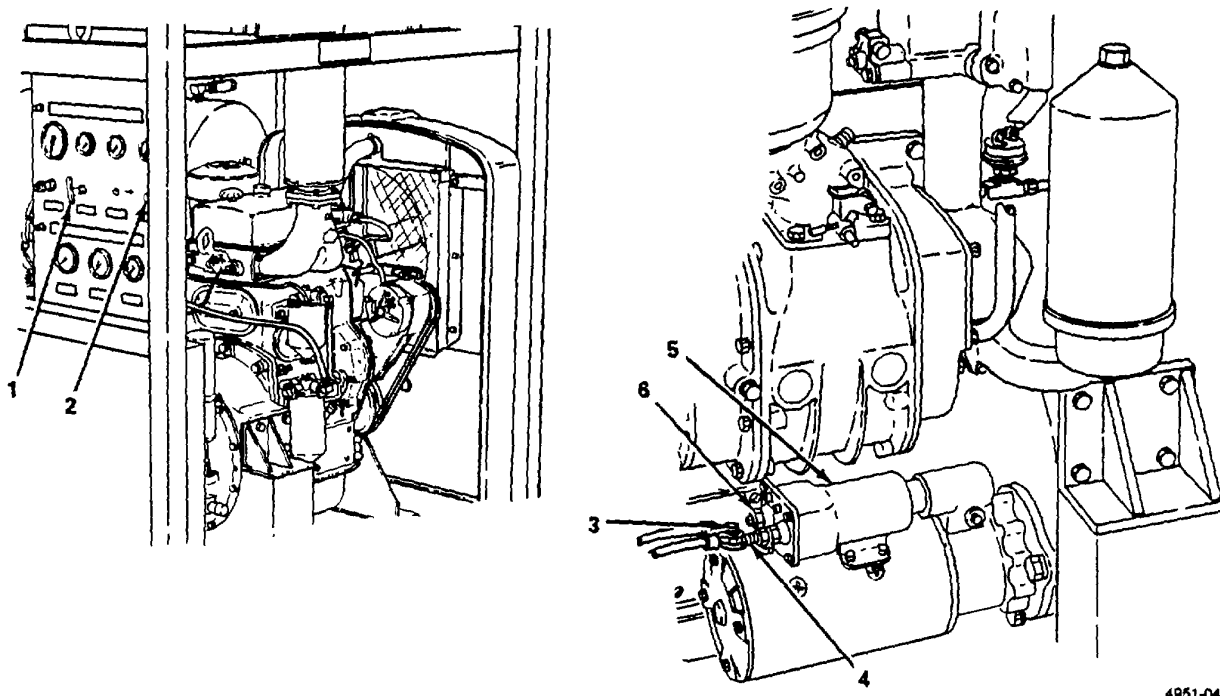
---

**a. Test.** (figure 3-36)

- (1) Pull STOP control (1) out.
- (2) Depress START pushbutton (2) and ensure starter motor engages engine flywheel and turns engine over.
- (3) Connect positive lead of multimeter to terminal (3).
- (4) Set multimeter to at least 12 V scale and connect negative lead to ground. Meter reading should be 12 V. If less than 12 V the battery, or wiring may be defective.
- (5) Connect positive lead of multimeter to terminal (4).
- (6) Set multimeter to at least 12 V scale and connect negative lead to good ground.
- (7) Press START pushbutton (2) and check meter reading. Replace starter (5) if voltage is present and starter does not run.
- (8) Connect positive lead of multimeter to terminal (6).
- (9) Set multimeter to at least 12 V scale and connect negative lead to good ground.
- (10) Press START pushbutton (2) and check meter reading. Replace starter (5) if voltage is present and starter does not run.
- (11) If voltage was not present in steps (7) and/or (10) check wiring harness and START switch.

**3-92 Change 2**





4951-042

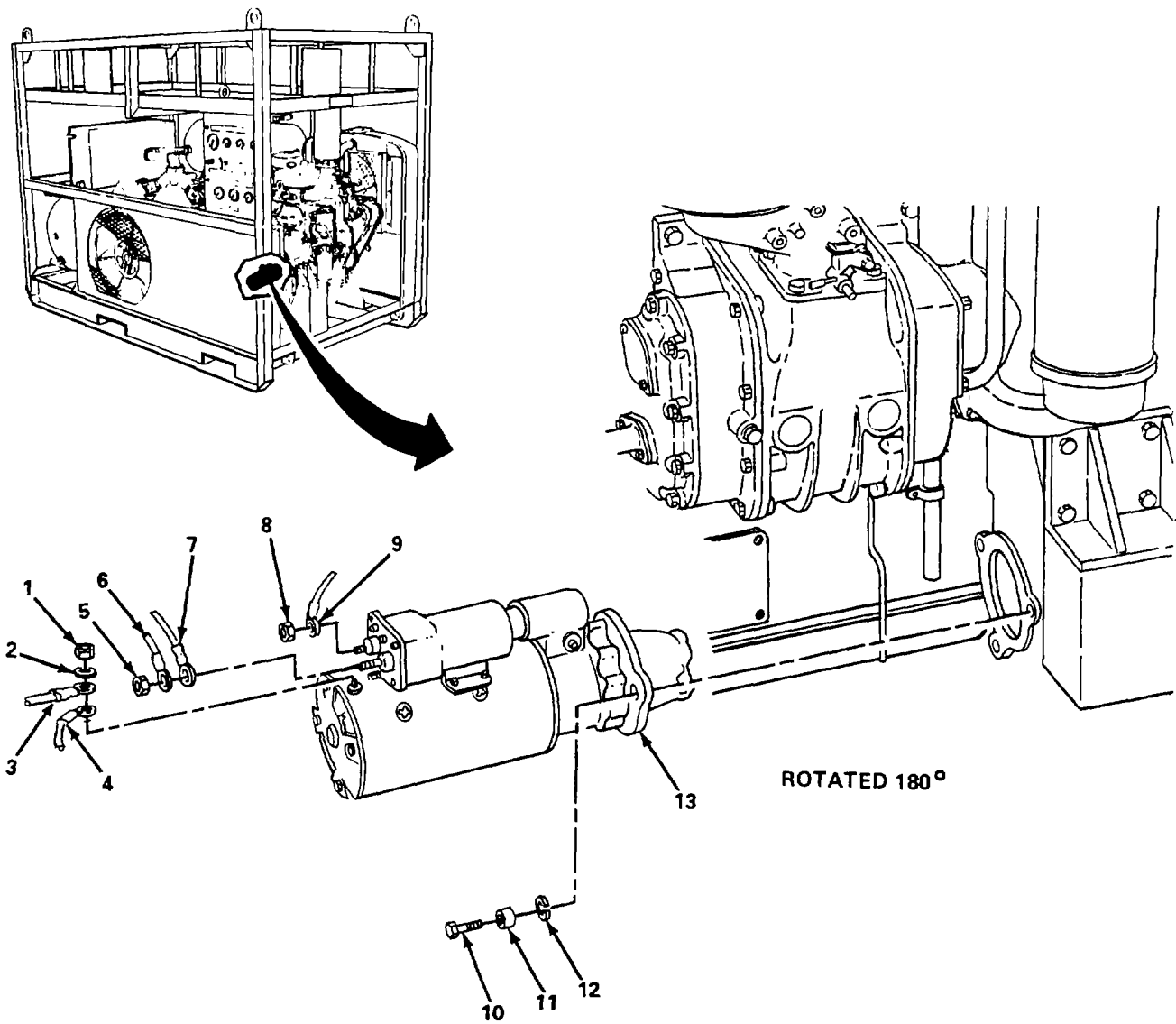
**Figure 3-36. Starter, Test.**

**FOLLOW-ON MAINTENANCE**

- (1) Install air cleaner assembly (para. 3-28).
- (2) Install shell assembly (para. 3-17).

**3-31. Starter (Cont).***b. Replace.* (figure 3-37)

- (1) Remove nut (1) and lockwasher (2) and tag and remove negative cable (3) and black wire (4).
- (2) Remove nut (5) and tag and remove positive cable (6) and blue wire (7).
- (3) Remove nut (8) and tag and remove blue wire (9).
- (4) Remove three screws (10), spacers (11), and lockwashers (12) and remove starter (13).
- (5) Install starter (13) and secure with three screws (10), spacers (11) and lockwashers (12). Torque screws to 137-147 lb-ft (186-200 Nm).
- (6) Install blue wire (9) and secure with nut (8).
- (7) Install positive cable (6) and blue wire (7) as tagged, and secure with nut (5).
- (8) Install negative cable (3) and blue wire (4) as tagged and secure with lockwasher (2) and nut (1).



**Figure 3-37. Starter, Replace.**

4951-043

**FOLLOW-ON MAINTENANCE**

- (1) Install air cleaner assembly (para. 3-28).
- (2) Install shell assembly (para. 3-17).

---

**3-32. Starting Aid.**

---

**This task covers:****a. Replace****b. Repair**

---

**INITIAL SETUP:***Tools**Materials/Parts*

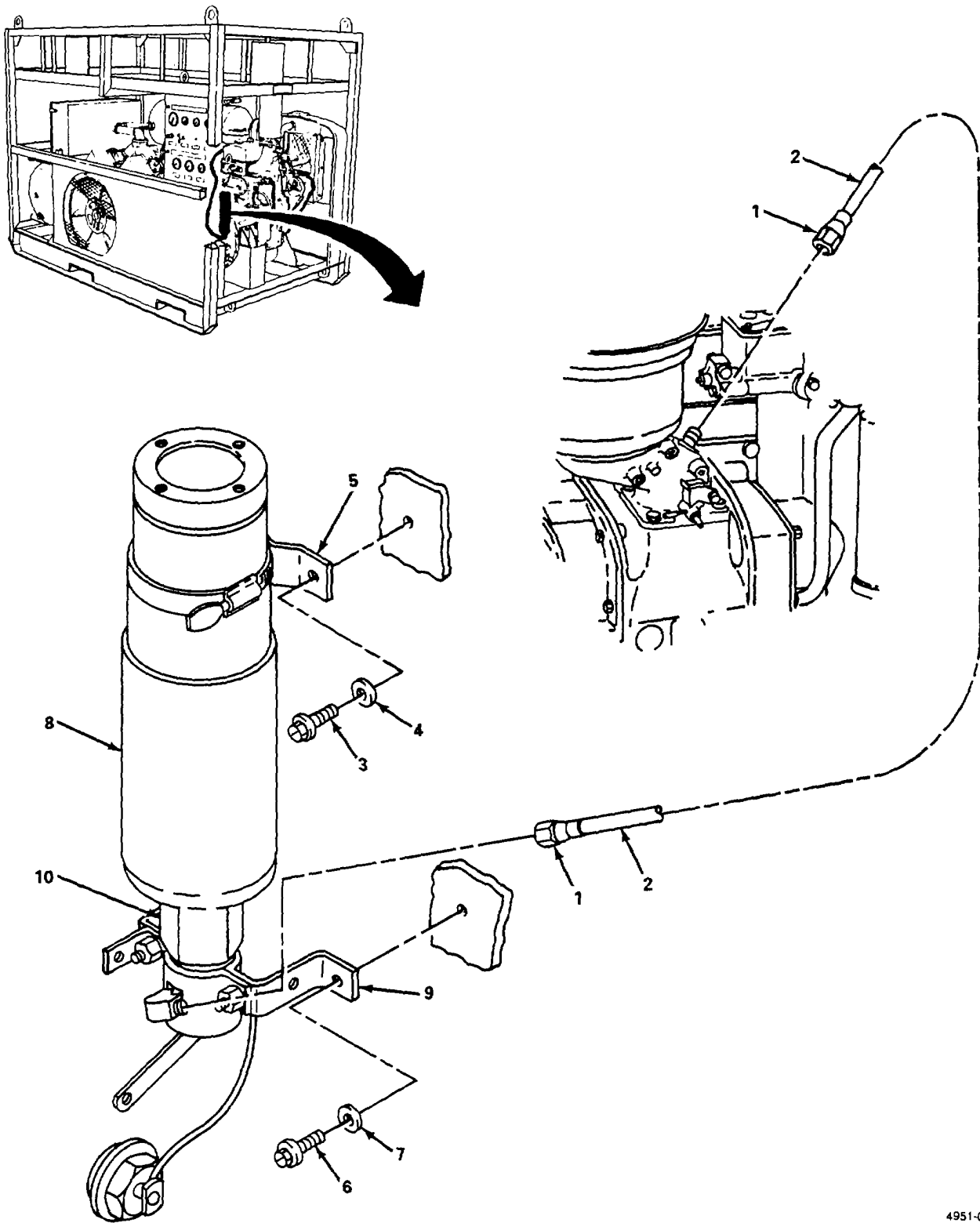
---

General Mechanic's Tool Kit (NSN 5180-00-177-7033) Starting Aid

---

*a. Replace.* (figure 3-38)

- (1) Loosen two fitting nuts (1) and remove starting fluid line (2)
- (2) Remove two screws (3) and washers (4) securing bracket (5).
- (3) Remove two screws (6) and washers (7) and remove tank (8), bracket (9), valve (10) and bracket (5).
- (4) Install bracket (5), valve (10), bracket (9), and tank (8) and secure with two screws (6) and washers (7).
- (5) Install two screws (3) and washers (4).
- (6) Install starting fluid line (2) and tighten two fitting nuts (1).



4951-044

Figure 3-38. Starting Aid, Replace.

**3-32. Starting Aid (Cont).***b. Repair.* (figure 3-39)

- (1) Remove starting aid, see para. a. above.
- (2) Loosen clamp (1) and remove clamp (1) and bracket (2).
- (3) Unscrew tank (3) from valve (4).
- (4) Remove two screws (5) and nuts (6) and remove bracket (7) from valve (4).
- (5) Inspect tank (3) and replace if empty.
- (6) Inspect clamp (1), bracket (2) and bracket (7) and replace if bent, cracked, or otherwise damaged.
- (7) Inspect valve (4) and replace if cracked or otherwise damaged.
- (8) Inspect gasket (8) and replace if cracked or otherwise damaged.
- (9) Inspect line (9) and replace if cracked, or fittings are stripped or otherwise damaged.
- (10) Install valve (4) on tank (3).
- (11) Install bracket (7) and secure with two screws (5) and nuts (6).
- (12) Install bracket (2) and tighten clamp (1).

FOLLOW-ON MAINTENANCE  
Install starting aid (para. a.)

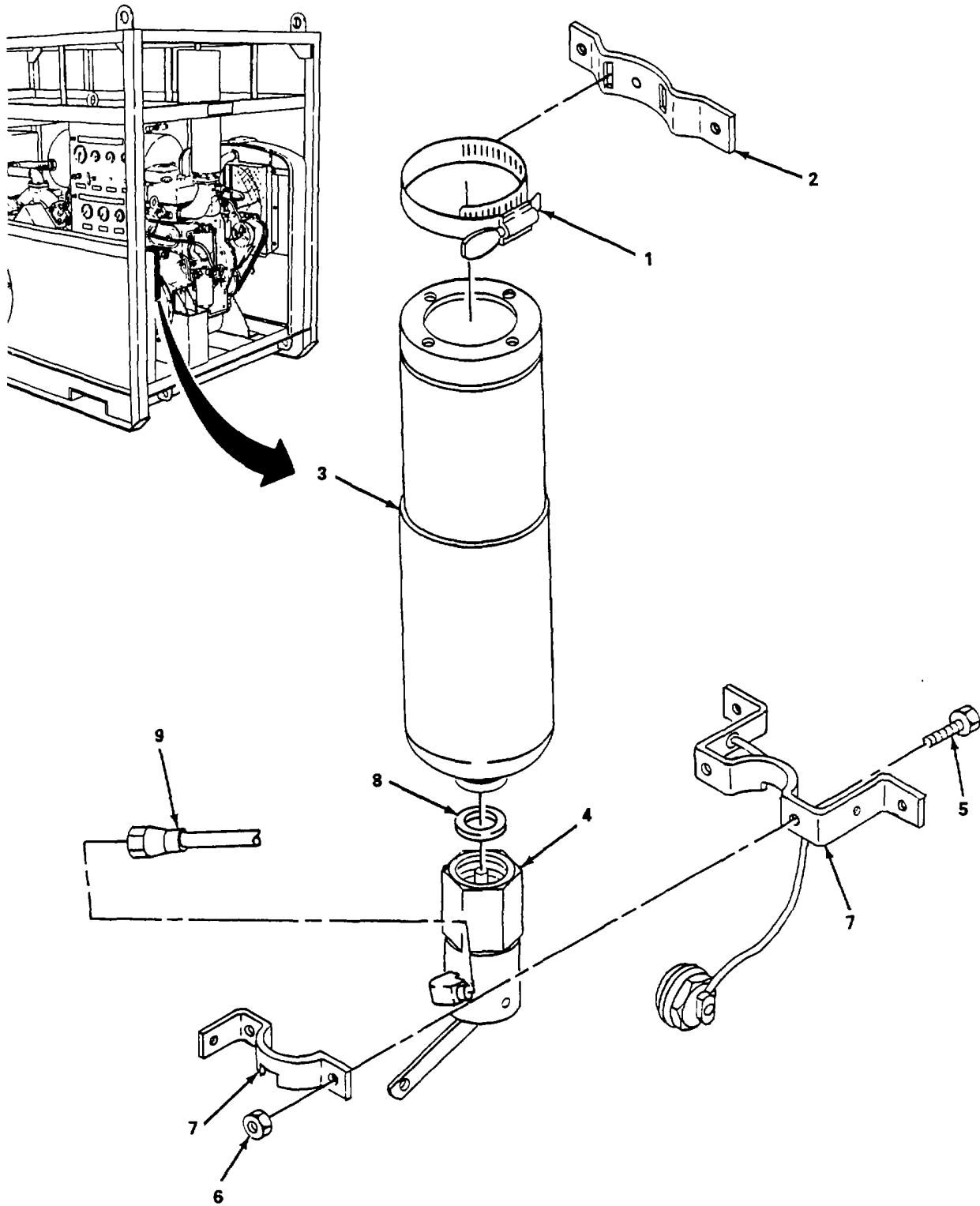


Figure 3-39. Starting Aid, Repair.

---

**3-33. Battery Charging Alternator.**

---

**This task covers:**

**a. Test**

**b. Adjust**

**c. Replace**

---

**INITIAL SETUP:**

*Tools*

*Materials/Parts*

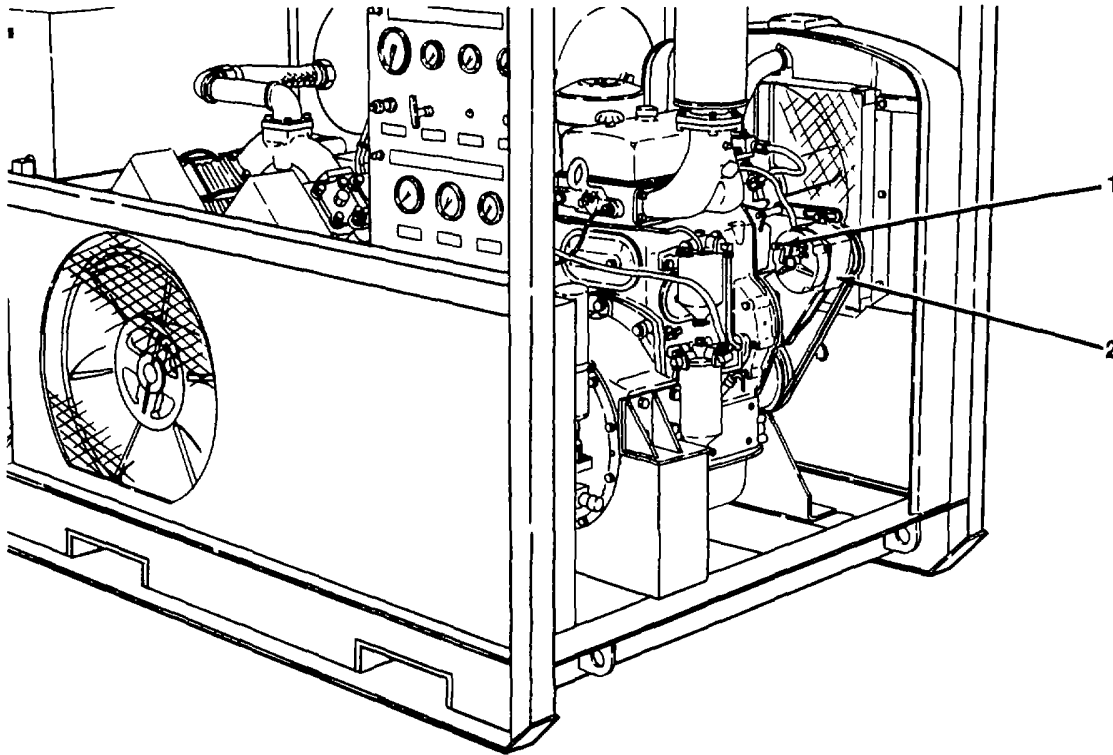
General Mechanic's Tool Kit (NSN 5180-00-177-7033) Battery Charging Alternator  
Multimeter (NSN 6625-01-139-2512))

---

a. Test. (figure 3-40)

- (1) Start engine, para. 2-6, and run at 1200 rpm.
- (2) Connect positive lead of multimeter to BAT terminal (1) on alternator (2).
- (3) Connect negative lead of multimeter to case of alternator (2).
- (4) Voltage reading should be 12-14 volts. If reading is less than or more than specified, replace alternator.
- (5) Disconnect leads
- (6) Stop engine, para. 2-7.





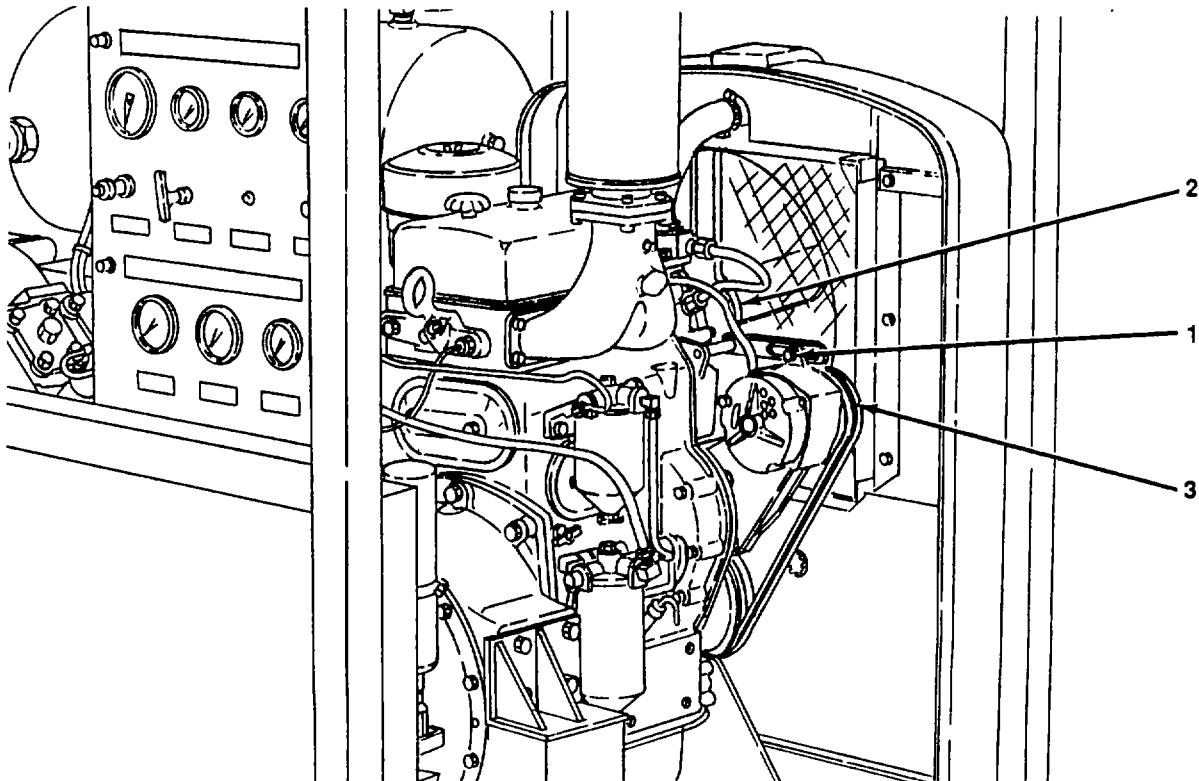
4951-048

Figure 3-40. Battery Charging Alternator, Test.

## 3-33. Battery Charging Alternator (Cont).

b. *Adjust.* (figure 3-41)

- (1) Loosen screw (1).
- (2) Adjust belt tension so that a firm push midway between fan pulley (2) and alternator pulley (3) will depress belts approximately 0.50-0.75 in. (1.27-1.90 cm).
- (3) Tighten screw (1).



4951-047

Figure 3-41. Alternator, Adjust.

c. *Replace.* (figure 3-42)

- (1) Loosen nut (1) and remove negative cable (2).
- (2) Tag and remove wiring from alternator (3).
- (3) Remove screw (4), spacer (5), and lockwasher (6).
- (4) Remove screw (7), nut (8), and lockwasher (9) and remove alternator (3).
- (5) Install alternator (3) and secure with screw (7), nut (8), and lockwasher (9).
- (6) Ensure belts (10) are properly positioned.

- (7) Install screw (4), spacer (5) and lockwasher (6) but do not fully tighten.
- (8) Adjust belt tension so that a firm push midway between alternator (3) and fan pulley (11) will depress belts (10) approximately 0.50-0.75 in. (1.27-1.90 cm).
- (9) Tighten screw (4).
- (10) Connect wiring as tagged to alternator (3).
- (11) Install negative cable (2) and tighten nut (1).

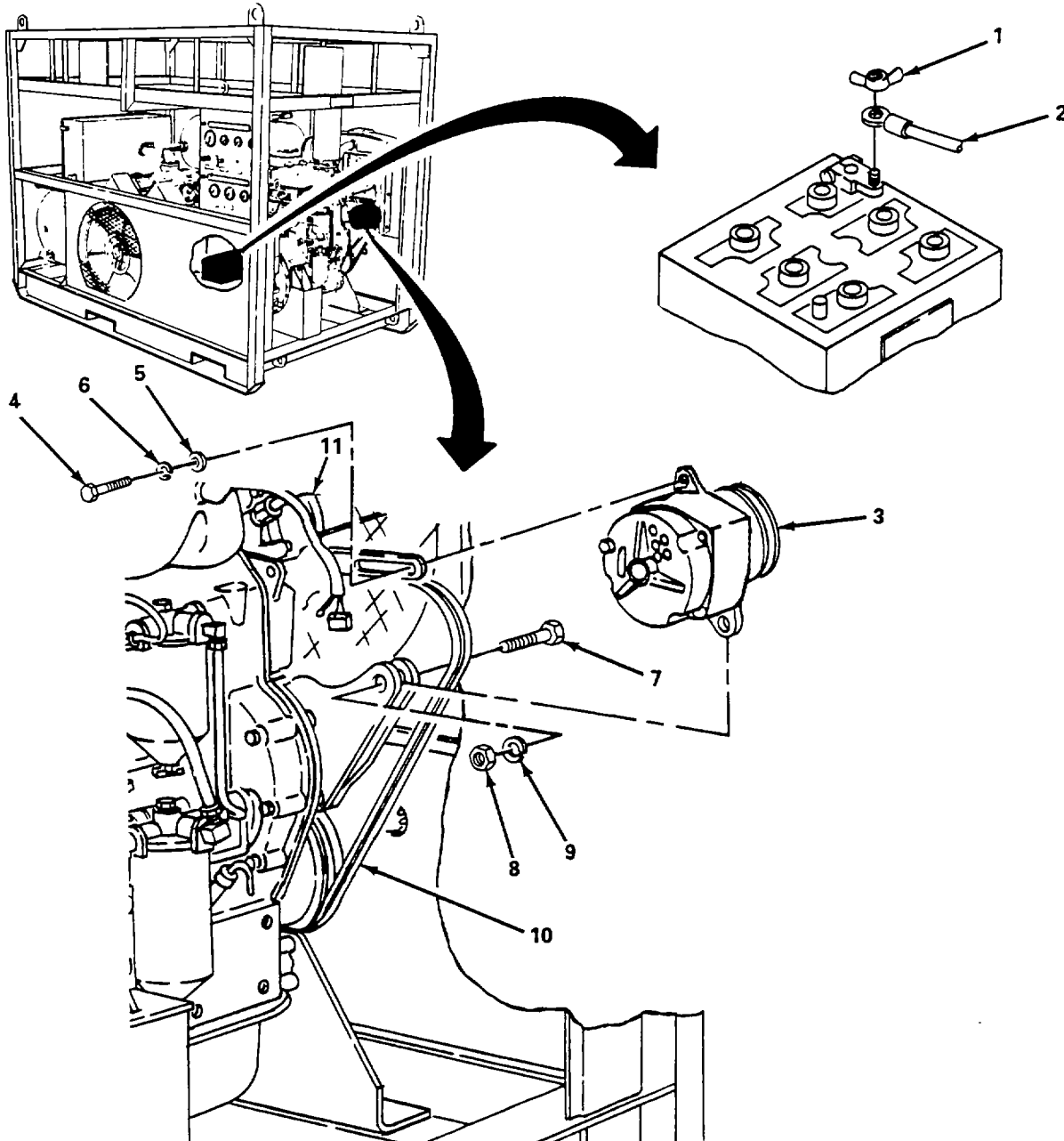


Figure 3-42. Alternator, Replace.

---

**3-34. Wiring Harness.**

---

**This task covers:****a. Test****b. Replace****c. Repair**

---

**INITIAL SETUP:***Tools**Materials/Parts*

General Mechanic's Tool Kit (NSN 5180-00-177-7033) Wiring Harness  
Multimeter (NSN 6625-01-139-2512)

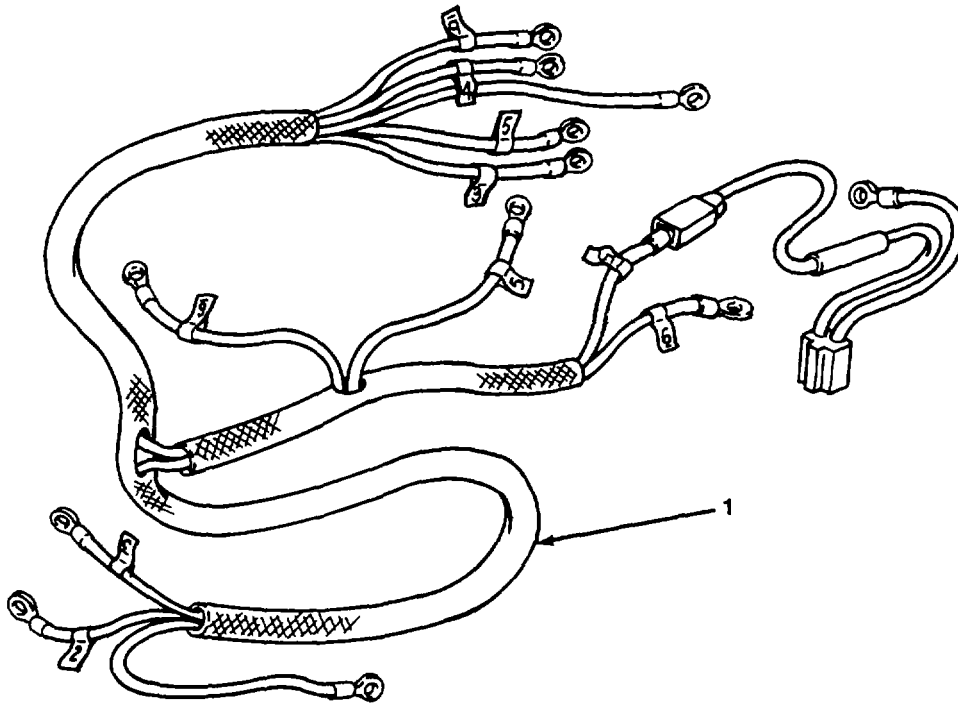
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a. Test. (figure 3-43)

**NOTE**

Wiring harness removed for test. See para. b.

- (1) Perform point to point continuity test on wiring harness (1).
- (2) Replace or repair a defective wiring harness (1).



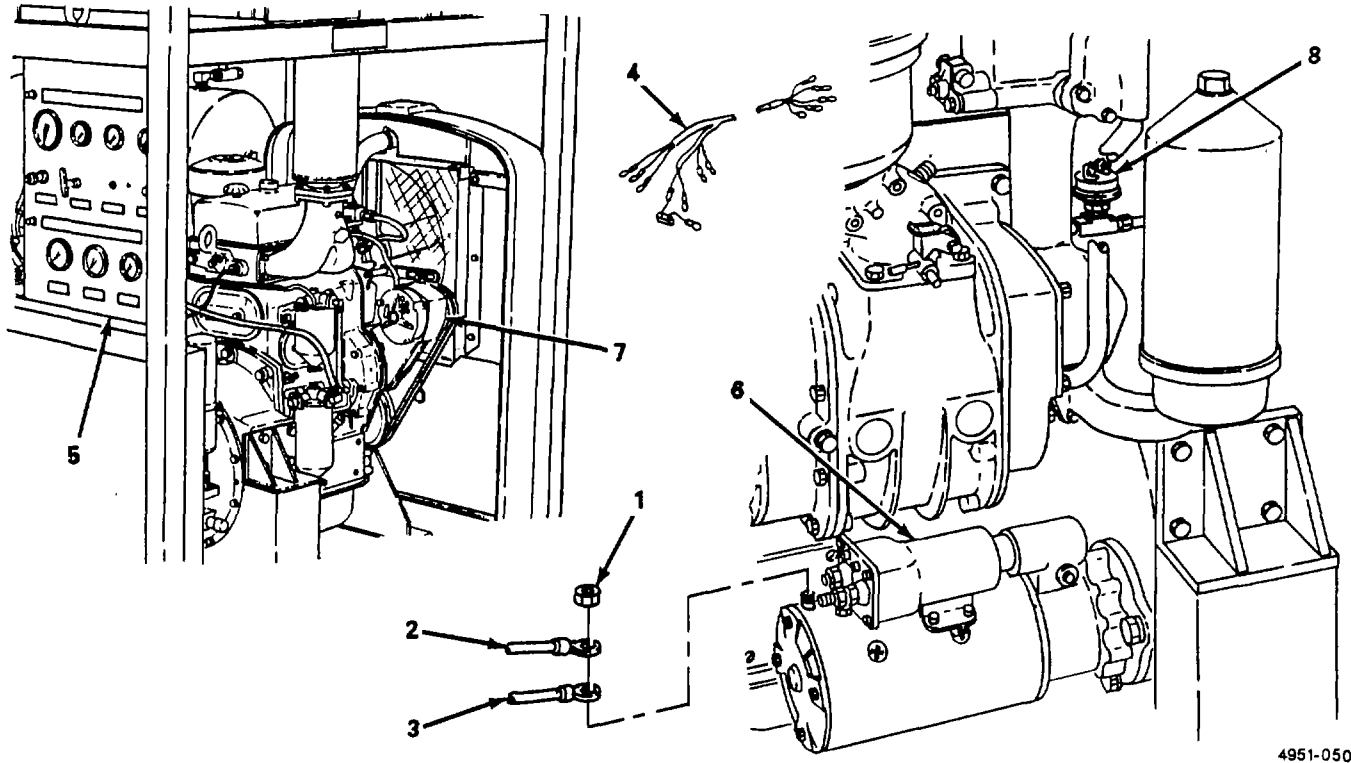
4951-049

Figure 3-43. Wiring Harness, Test.

**3-34. Wiring Harness (Cont).**

b. *Replace.* (figure 3-44)

- (1) Loosen nut (1) and remove negative cable (2) and black wire (3).
- (2) Tag and remove wiring harness (4) from control panel (5), starter (6), alternator (7), and oil pressure sender (8).
- (3) Inspect wiring on back of control panel (5). Refer to Appendix F for procedures to manufacture control panel wiring.
- (4) Install wiring harness (4) as tagged to oil pressure sender (8), alternator (7), starter (6) and control panel (5).
- (5) Install black wire (3) and negative cable (2) and tighten nut (1).



4951-050

**Figure 3-44. Wiring Harness, Replace.**

*c. Repair.*

- (1) Inspect wiring harness.
- (2) Refer to Appendix F for procedures to manufacture wiring harness.
- (3) Replace any terminal lugs or connectors that are missing or damaged.
- (4) Replace any wire that has burnt, cracked, or otherwise damaged insulation.

---

**3-35. Battery and Cables.**

---

**This task covers:****a. Test****b. Replace**

---

**INITIAL SETUP:***Tools**Materials/Parts*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)

Battery

Water, Distilled (Item 11, Appendix D)

---

*a. Test* (figure 3-45)**WARNING**

Lead acid batteries contain a strong acid. This acid can cause severe skin burns. Handle battery only with proper lifting strap. Wear protective clothing and eye protection.

- (1) Remove cap (1) and check electrolyte condition with hydrometer.
- (2) Check level of electrolyte, and add distilled water if level is low.
- (3) Install cap (1).
- (4) Repeat steps 1 and 2 for remaining battery cells.



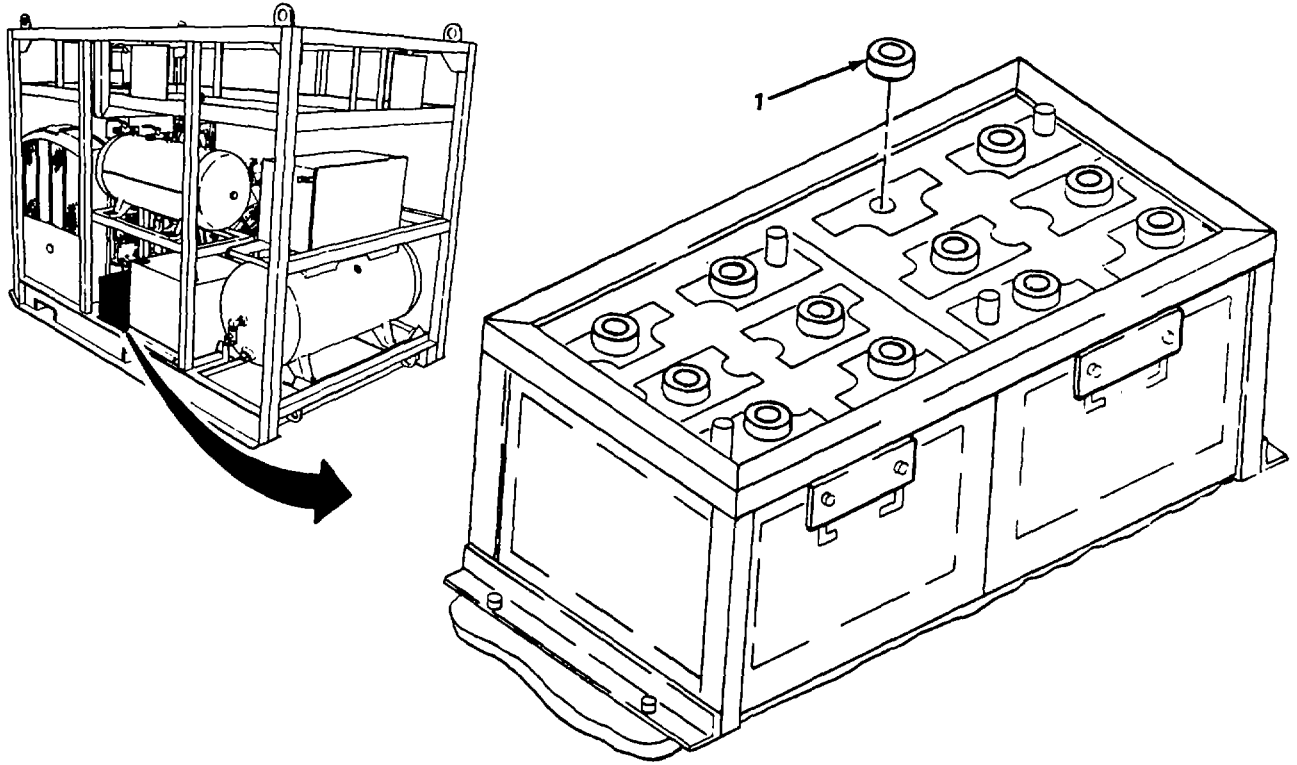


Figure 3-45. Battery, Test.

**3-35. Battery and Cables (Cont).***b. Replace. (figure 3-46)*

- (1) Remove wing nut (1) and tag and remove negative cable (2).
- (2) Remove wing nut (3) and tag and remove positive cable (4).
- (3) Loosen nut (5) and remove terminal (6).
- (4) Loosen nut (7) and remove terminal (8).
- (5) Remove four screws (9) and lockwashers (10) and remove battery holddown (11).

**WARNING**

Lead acid batteries contain a strong acid. This acid can cause severe skin burns. Handle battery only with proper lifting strap. Wear protective clothing and eye protection.

- (6) Remove battery (12).
- (7) Inspect cables on batteries and refer to Appendix F for procedures to manufacture new cables as needed.
- (8) Install battery (12).
- (9) Install battery holddown (11) and secure with four screws (9), and lockwashers (10).
- (10) Install terminal (8) and tighten nut (7).
- (11) Install terminal (6) and tighten nut (5).
- (12) Install positive cable (4) and secure
- (13) Install negative cable (2) and secure with wing nut (1).

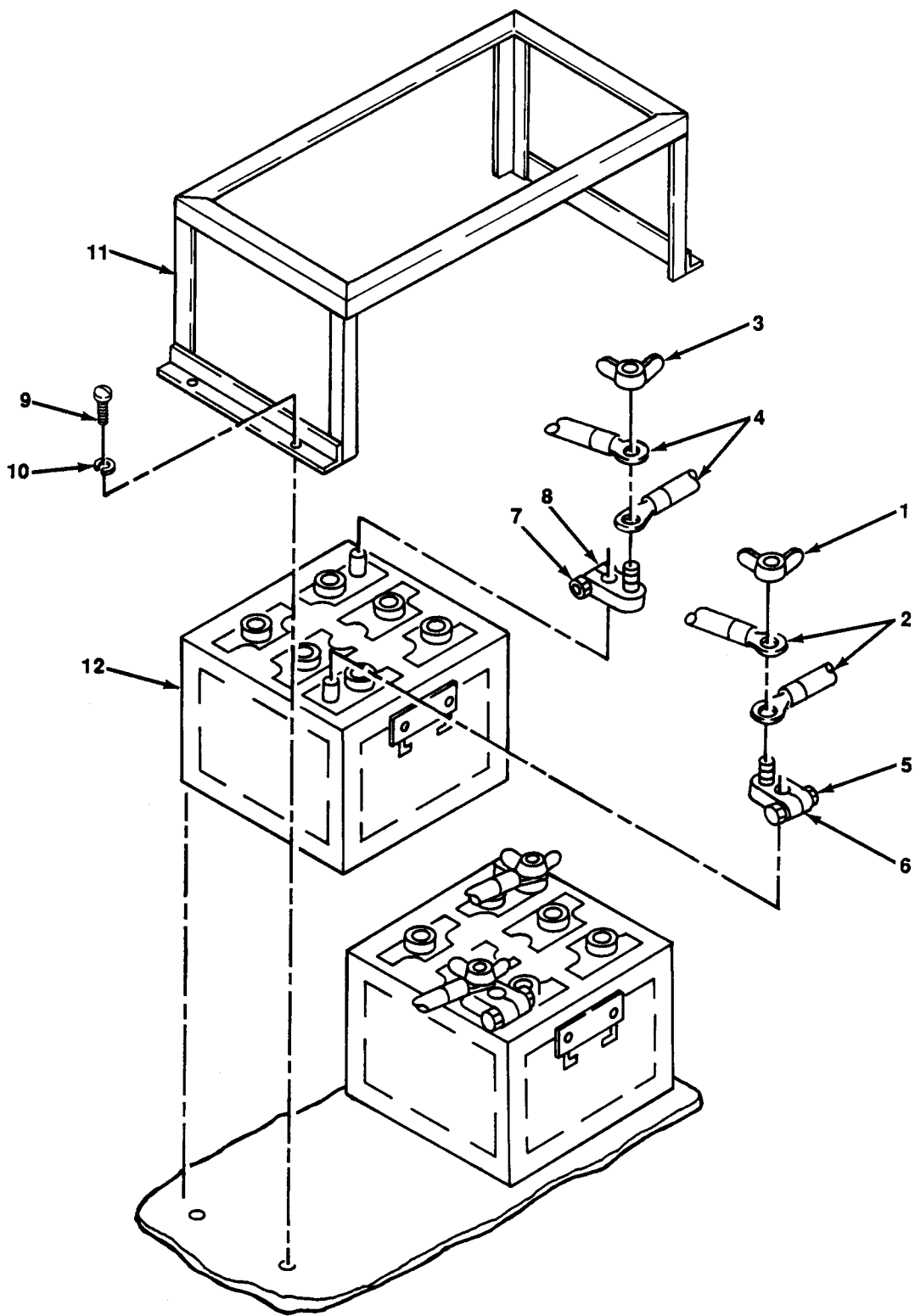


Figure 3-46. Battery and Cables, Replace.

4951-052

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**3-36. Low Oil Pressure Shutdown Switch.**

---

**This task covers: Replace**

---

**INITIAL SETUP:***Tools**Materials/Parts*

General Mechanic's Tool Kit (NSN 5180-00-177-7033) Switch, Low Oil Pressure Shutdown  
Tape, Teflon (Item 25, Appendix D)

---

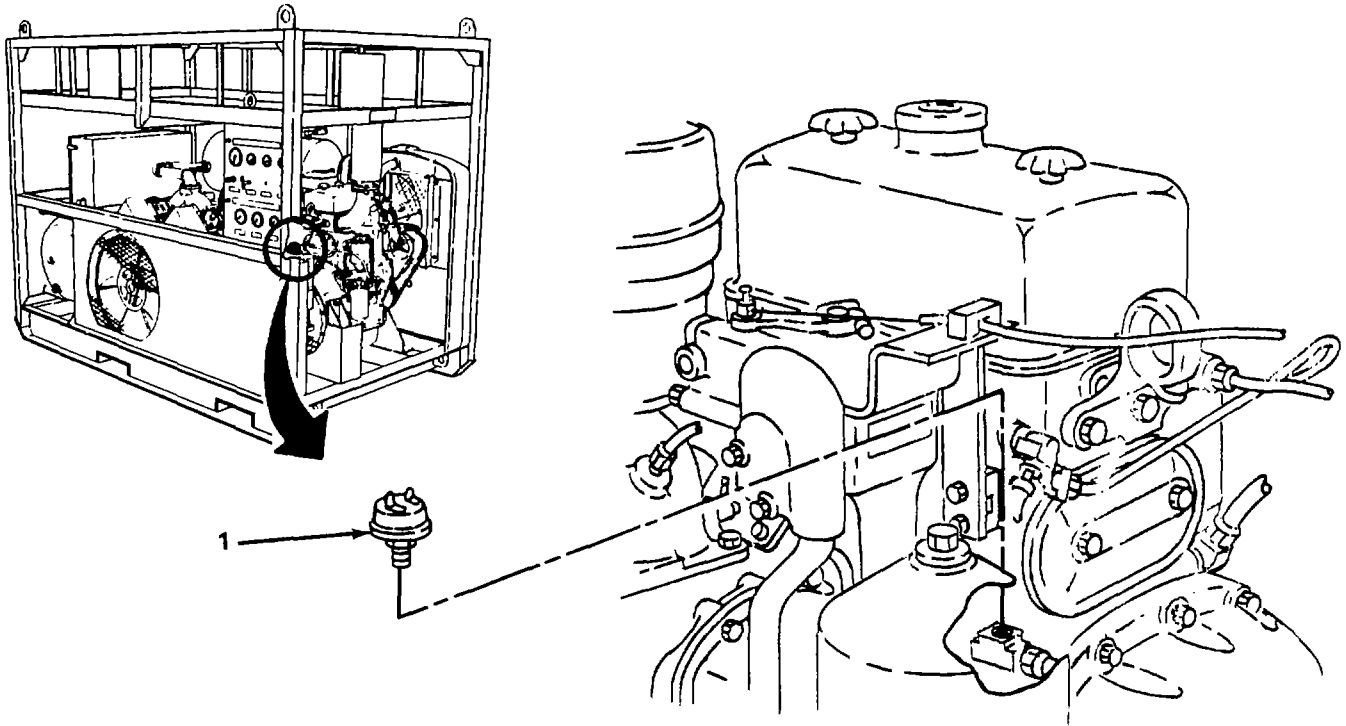
Replace. (figure 3-47)

- (1) Tag and remove wiring from low pressure shutdown switch (1).
- (2) Remove switch (1).

**NOTE**

Leave 1 1/2 threads exposed when applying teflon tape. Wrap teflon tape in the direction that will not unwrap as fitting is tightened. Failure to wrap teflon tape properly or having it extend past the end of the fitting may cause a blockage in the oil system.

- (3) Apply teflon tape to threads of switch (1).
- (4) Install switch (1).
- (5) Connect wiring as tagged to switch (1).



4951-193

Figure 3-47. Low Oil Pressure Shutdown Switch, Replace.

**3-37. Oil Filter Assembly.****This task covers:****a. Service****b. Replace****c. Repair****INITIAL SETUP:***Tools**Materials/Parts*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)  
Wrench, Torque (NSN 5120-00-554-7292)

Oil Filter Assembly  
Gasket, Oil Filter Assembly  
Solvent, Dry Cleaning (Item 23, Appendix D)  
Rags, Wiping (Item 21, Appendix D)

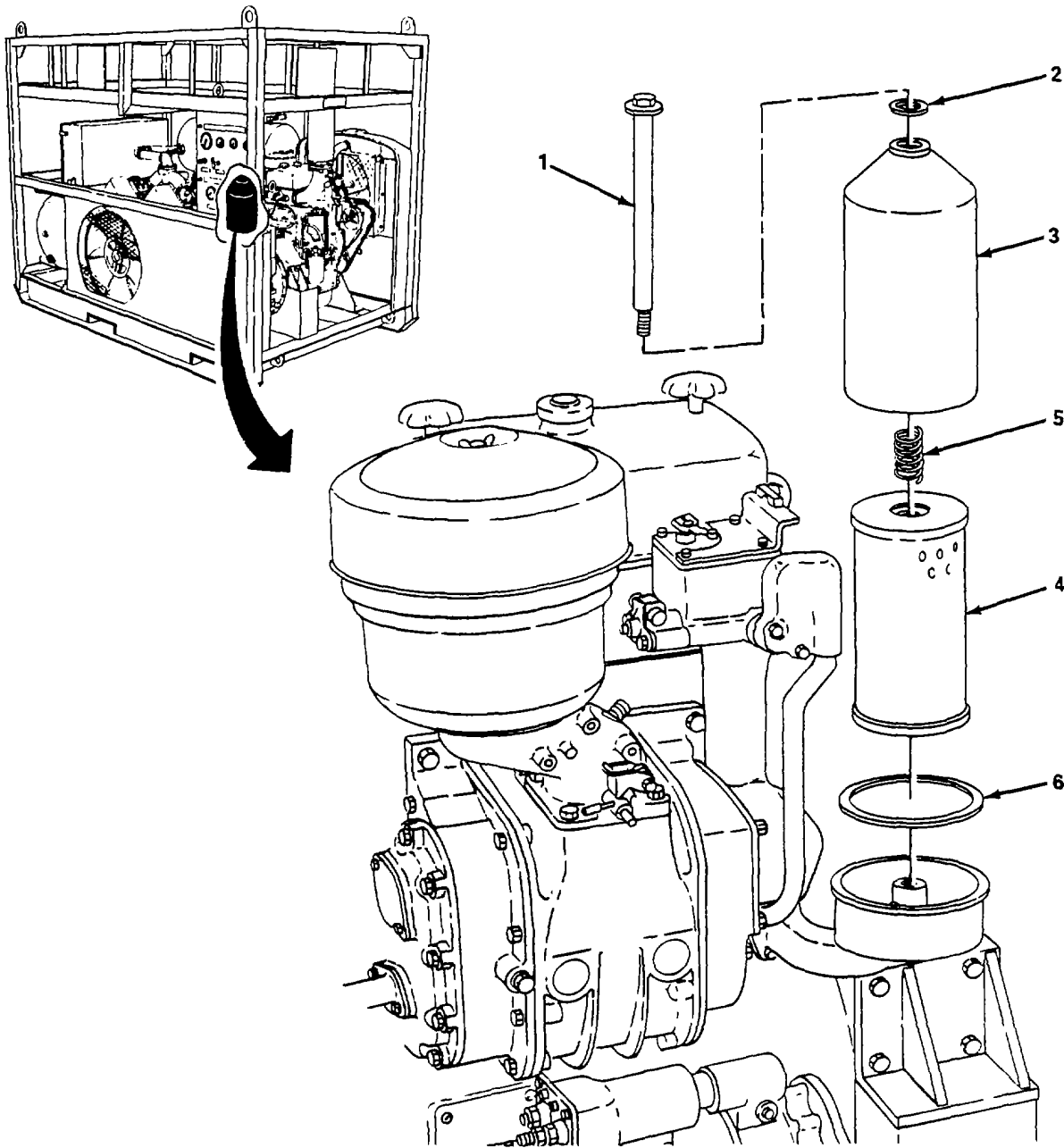
**a. Service.** (figure 3-48)

- (1) Remove screw (1), washer (2), shell (3), filter (4), spring (5) and gasket (6).

**WARNING**

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

- (2) Clean all items, except gasket and filter, with dry cleaning solvent and dry thoroughly.
- (3) Install screw (1) and washer (2) in shell (3).
- (4) Install spring (5) and new filter (4).
- (5) Install shell (3) and gasket (6) and tighten screw (1). Torque screw to 50-60 lb-ft (68-81 Nm).



4951-053

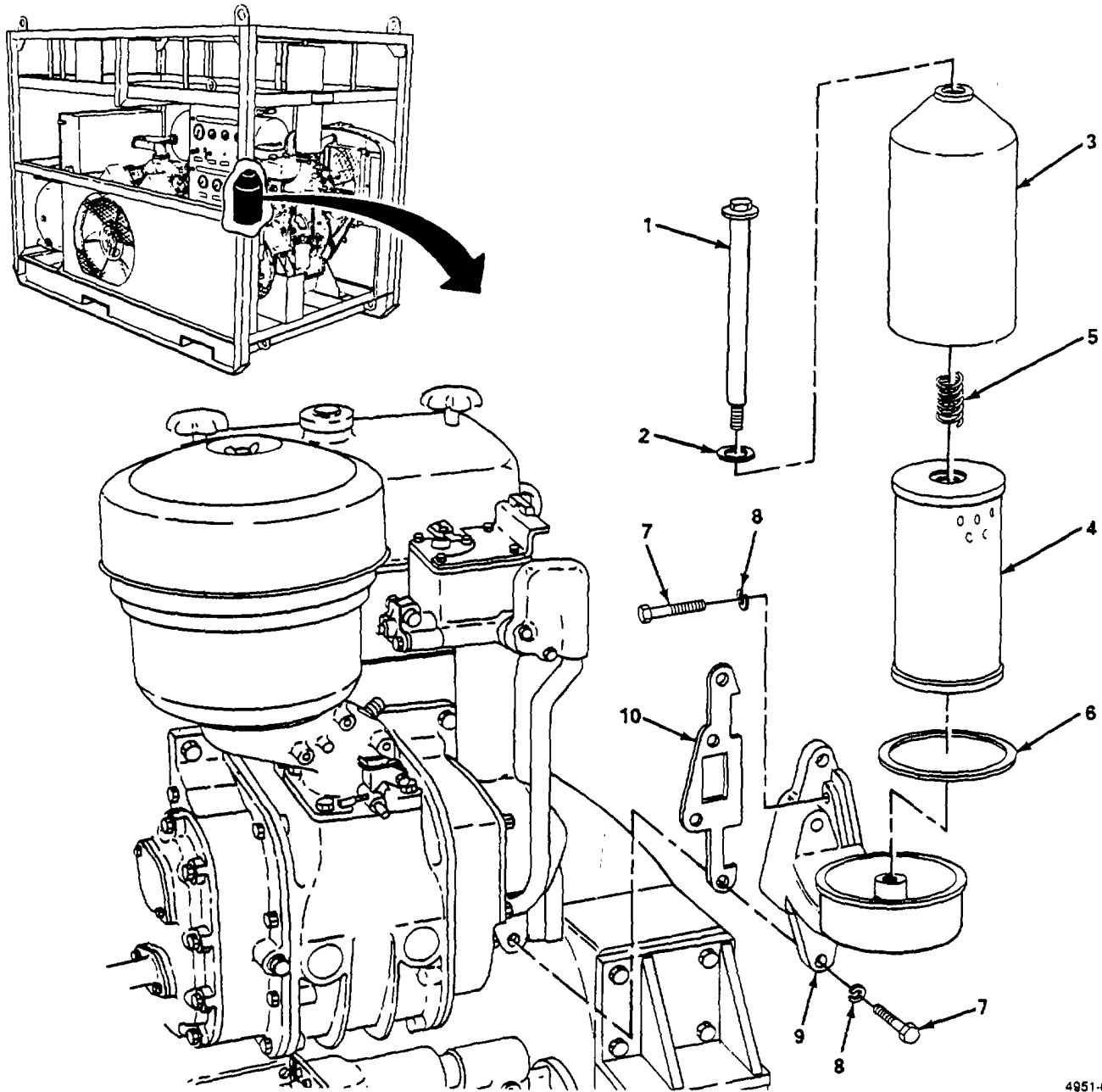
Figure 3-48. Oil Filter Assembly, Service.

**3-37. Filter Assembly (Cont).**

b. *Replace.* (figure 3-49)

- (1) Remove screw (1), washer (2) and remove shell (3), filter (4), spring (5), and gasket (6).
- (2) Remove six screws (7), washers (8) and remove oil filter base (9) and gasket(10).
- (3) Ensure all gasket surfaces are clean and free of old gasket material.
- (4) Install oil filter base (9) and gasket (10) and secure with six screws (7) and washers (8). Torque screws to 23-26 lb-ft (31-35 Nm).
- (5) Install screw (1) and washer (2) in shell (3).
- (6) Install spring (5) and filter (4).
- (7) Install shell (3) and gasket (6) and tighten screw (1). Torque screw to 50-60 lb-ft (68-81 Nm).





4951-054

Figure 3-49. Oil Filter Assembly, Replace.

c. Repair. (figure 3-50)

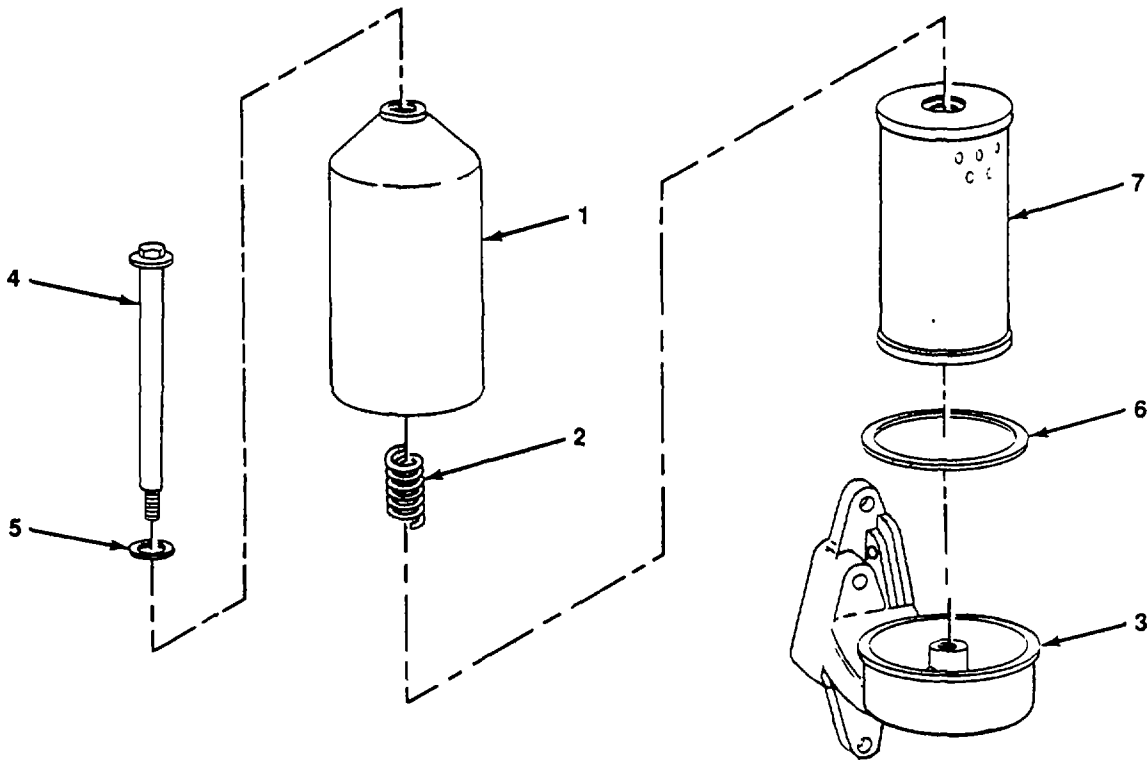
**NOTE**

Oil filter assembly removed for repair. See para. b above.

**WARNING**

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

- (1) Clean all items with dry cleaning solvent and dry thoroughly.
- (2) Inspect shell (1) and replace if cracked or other damaged.
- (3) Inspect spring (2) and replace if bent, cracked or otherwise damaged.
- (4) Inspect base (3) and replace if cracked or otherwise damaged.
- (5) Inspect bolt (4) and replace if threads are stripped or bolt is otherwise damaged.
- (6) Inspect washer (5) and replace if cracked or otherwise damaged.
- (7) Inspect gasket (6) and replace if cracked, torn, or otherwise damaged.
- (8) Replace oil filter (7).



4951-214

Figure 3-50. Oil Filter Assembly, Repair.

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**3-38. Dipstick and Guide Tube.**

---

**This task covers:**    **Replace**

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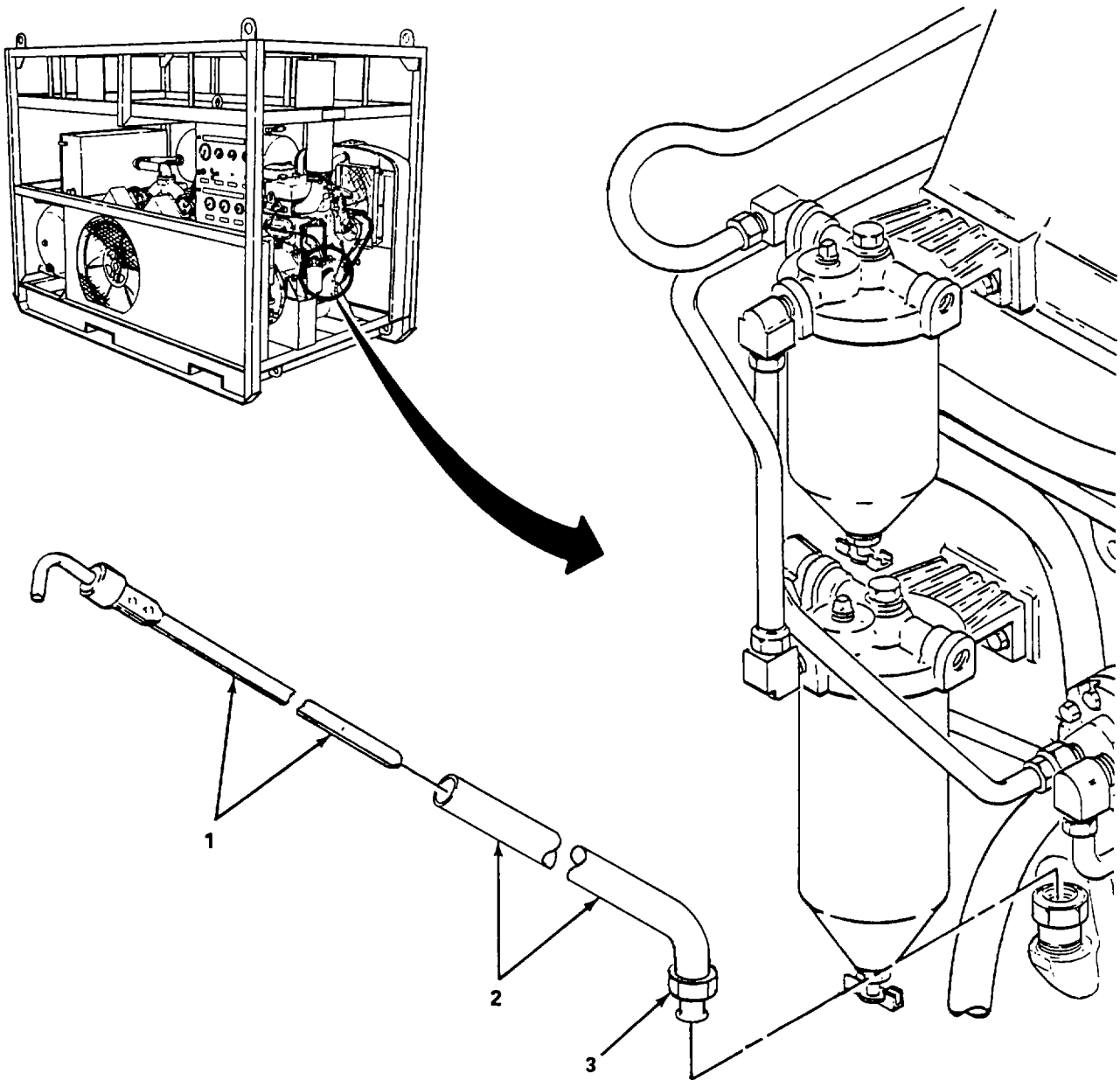
**INITIAL SETUP:***Tools**Materials/Parts*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)    Dipstick  
Guide Tube

---

Replace. (figure 3-51)

- (1) Pull dipstick (1) out of guide tube (2).
- (2) Loosen nut (3) and remove guide tube (2).
- (3) Install guide tube (2), and tighten nut (3).
- (4) Install dipstick (1).



4951-055

Figure 3-51. Dipstick and Guide Tube, Replace.

---

**3-39. Rocker Cover.**

---

**This task covers:****a. Replace****b. Repair**

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**INITIAL SETUP:***Tools**Materials/Parts*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)

Rocker Cover

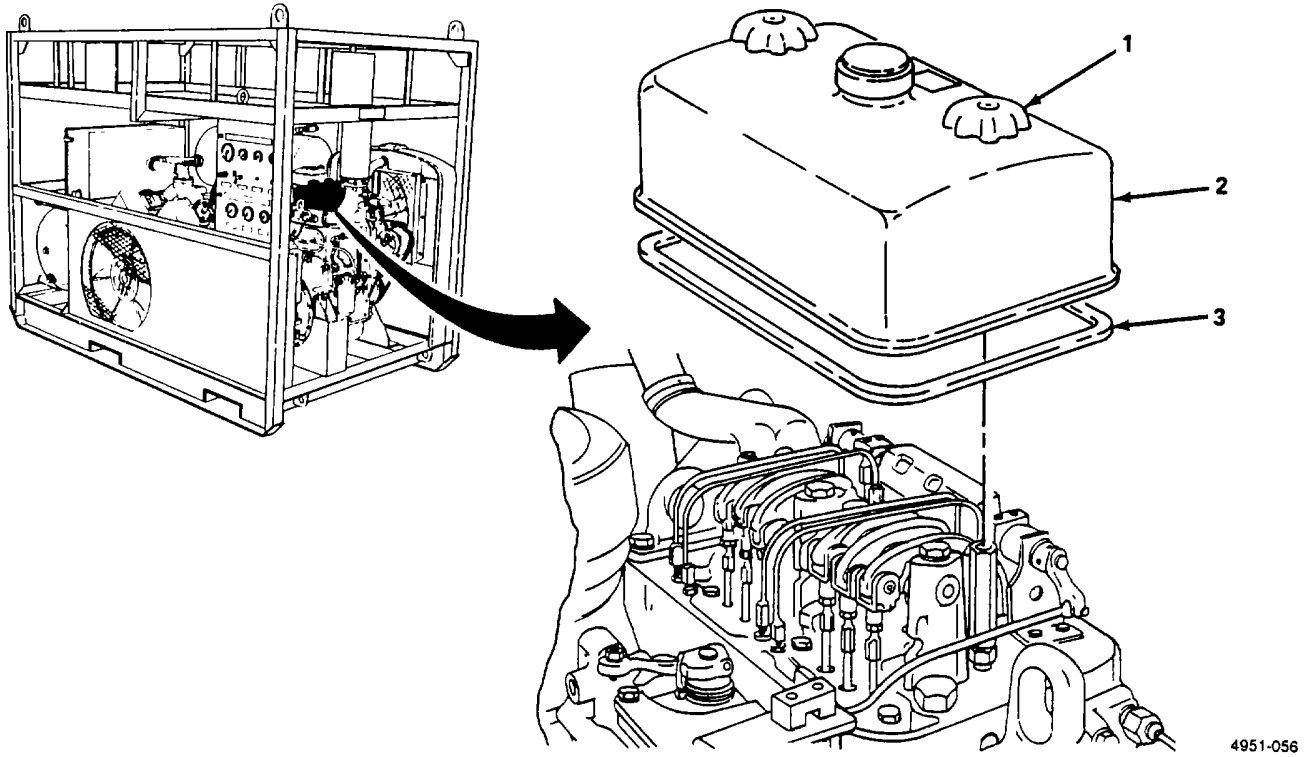
Gasket, Rocker Cover

Solvent, Dry Cleaning (Item 23, Appendix D)

Rags, Wiping (Item 21, Appendix D)

*a. Replace.* (figure 3-52)

- (1) Loosen two hold down screws (1) and remove rocker cover (2) and gasket (3).
- (2) Ensure gasket surfaces are clean and old gasket material removed.
- (3) Install rocker cover (2) and gasket (3) and tighten hold down screws (1).



4951-056

Figure 3-52. Rocker Cover, Replace.

3-39. **Rocker Cover (Cont).**

b. Repair. (figure 3-53)

**NOTE**

Rocker cover removed for repair. See para. a. above.

**WARNING**

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

- (1) Clean all items, except gasket, with dry cleaning solvent, and dry thoroughly.
- (2) Inspect rocker cover (1), hold down screws (2) and oil fill cap (3).
- (3) Replace a cracked or otherwise damaged rocker cover (1).
- (4) Remove spring pin (4) and remove hold down screw (2) and gasket (5).
- (5) Inspect hold down screw (2) and replace if threads are stripped or hold down screw (2) is bent or otherwise damaged.
- (6) Inspect gasket (5) and replace if cracked or otherwise damaged.
- (7) Install hold down screw (2) and gasket (5) and secure with spring pin(4).
- (8) Repeat steps 4 through 7 for remaining hold down screw.
- (9) Inspect oil filler cap gasket (6) and replace if cracked or otherwise damaged.



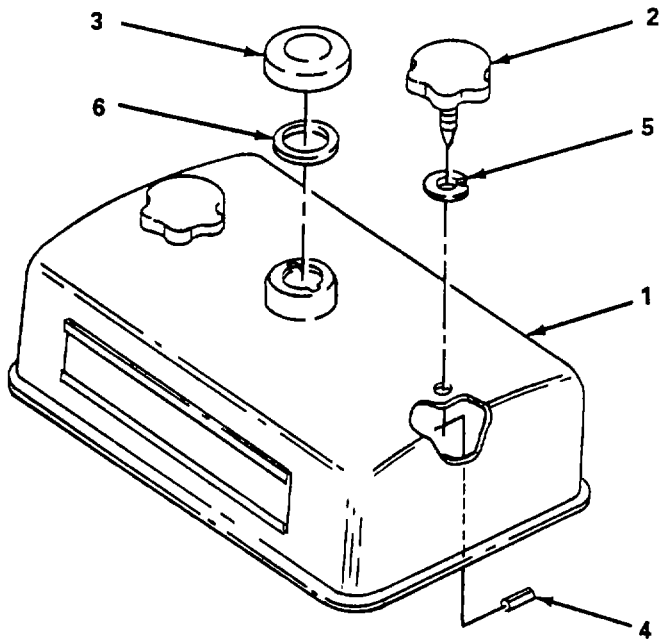


Figure 3-53. Rocker Cover, Repair.

4951-057

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**3-40. Breather Pipe.**

---

**This task covers:    Replace**

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**INITIAL SETUP:**

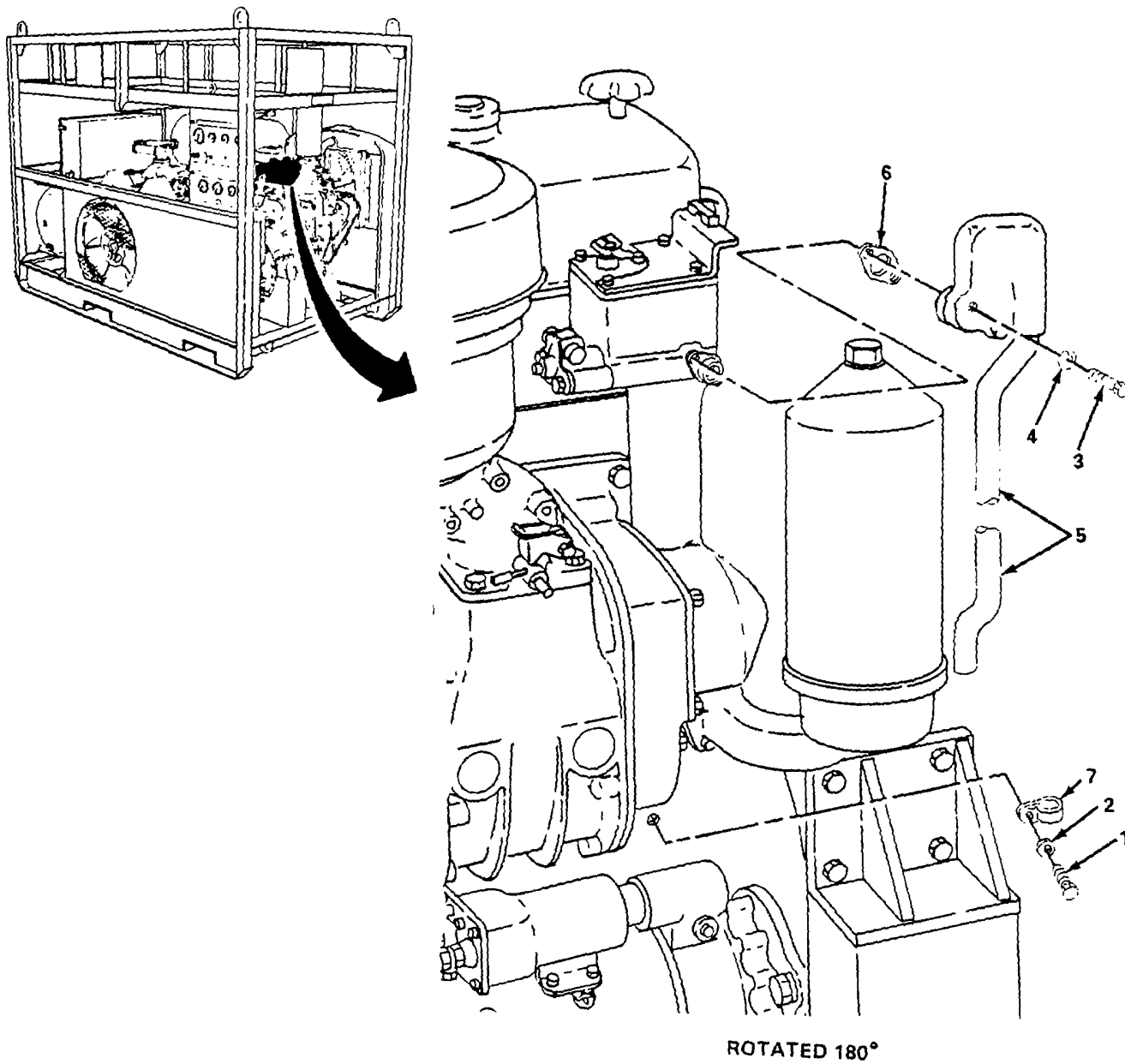
*Tools    Materials/Parts*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)    Breather Pipe  
Wrench, Torque (NSN 5120-00-554-7292)                      Gasket, Breather Pipe

---

Replace. (figure 3-54)

- (1) Remove screw (1) and washer (2).
- (2) Remove two screws (3), lockwashers (4) and remove breather pipe (5) and gasket (6).
- (3) Remove clamp (7).
- (4) Install clamp (7).
- (5) Install breather pipe (5) and gasket (6) and secure with two screws (3) and lockwashers (4). Torque screws to 5-7 lb-ft (7-9 Nm).
- (6) Secure clamp (7) with screw (1) and washer (2).



4951-058

Figure 3-54. Breather Pipe, Replace.

---

**3-41. Air Compressor Assembly.**

---

This task covers:

Service

---

**INITIAL SETUP***Tools**Materials/Parts*

General Mechanic's Tool Kit (NSN 5180-00-177-7033) Oil, Lubricating Steam Turbine (Item 19, Appendix D)  
Detergent, Nonionic (Item 10, Appendix D)

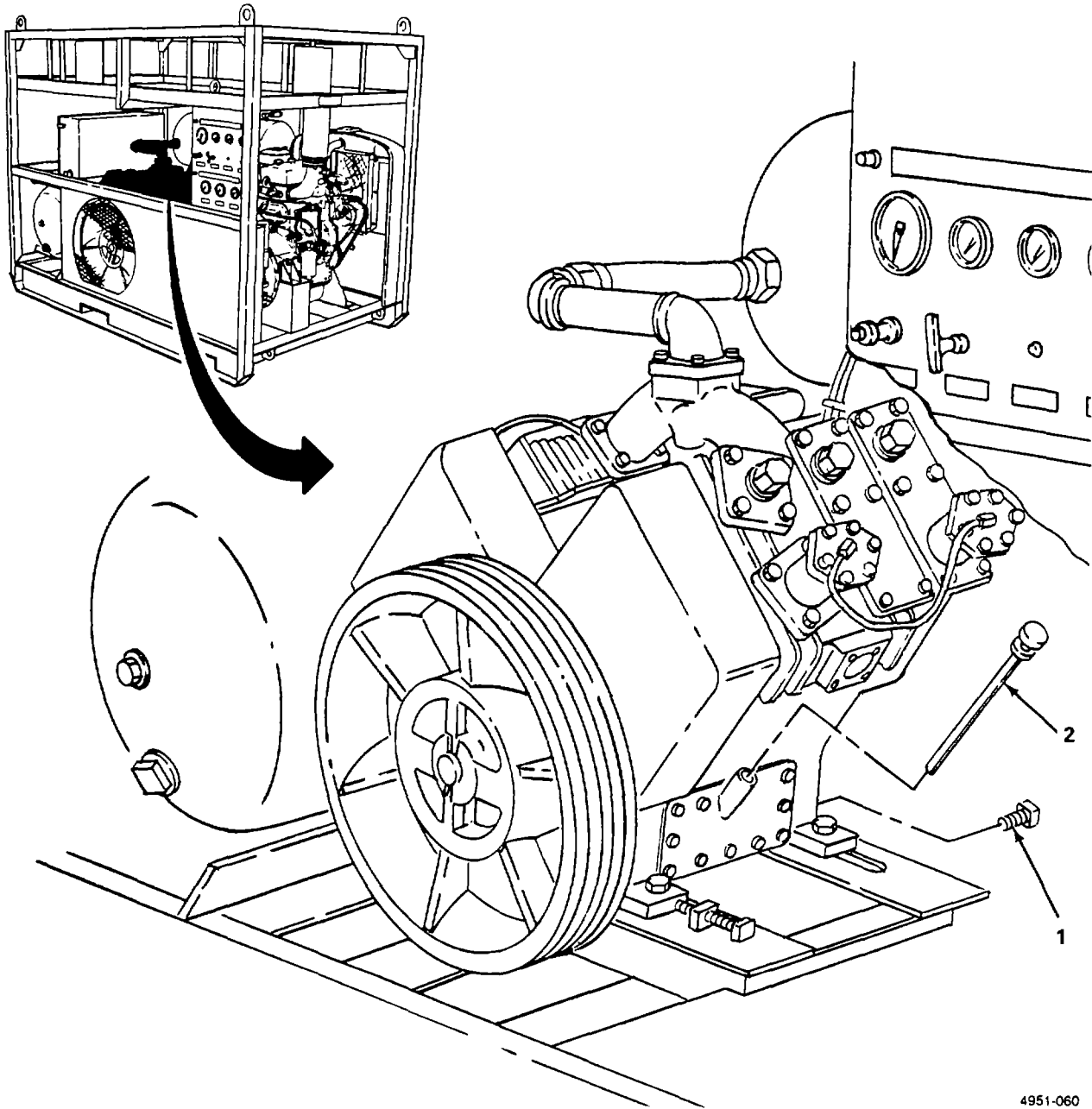
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*Service.*

(1) *Oil change.* (figure 3-55)

(a) Remove oil drain plug (1) and drain oil into suitable container.

(b) Install oil drain plug (1) and fill with oil (Item 18, Appendix D) to full line on dipstick (2).

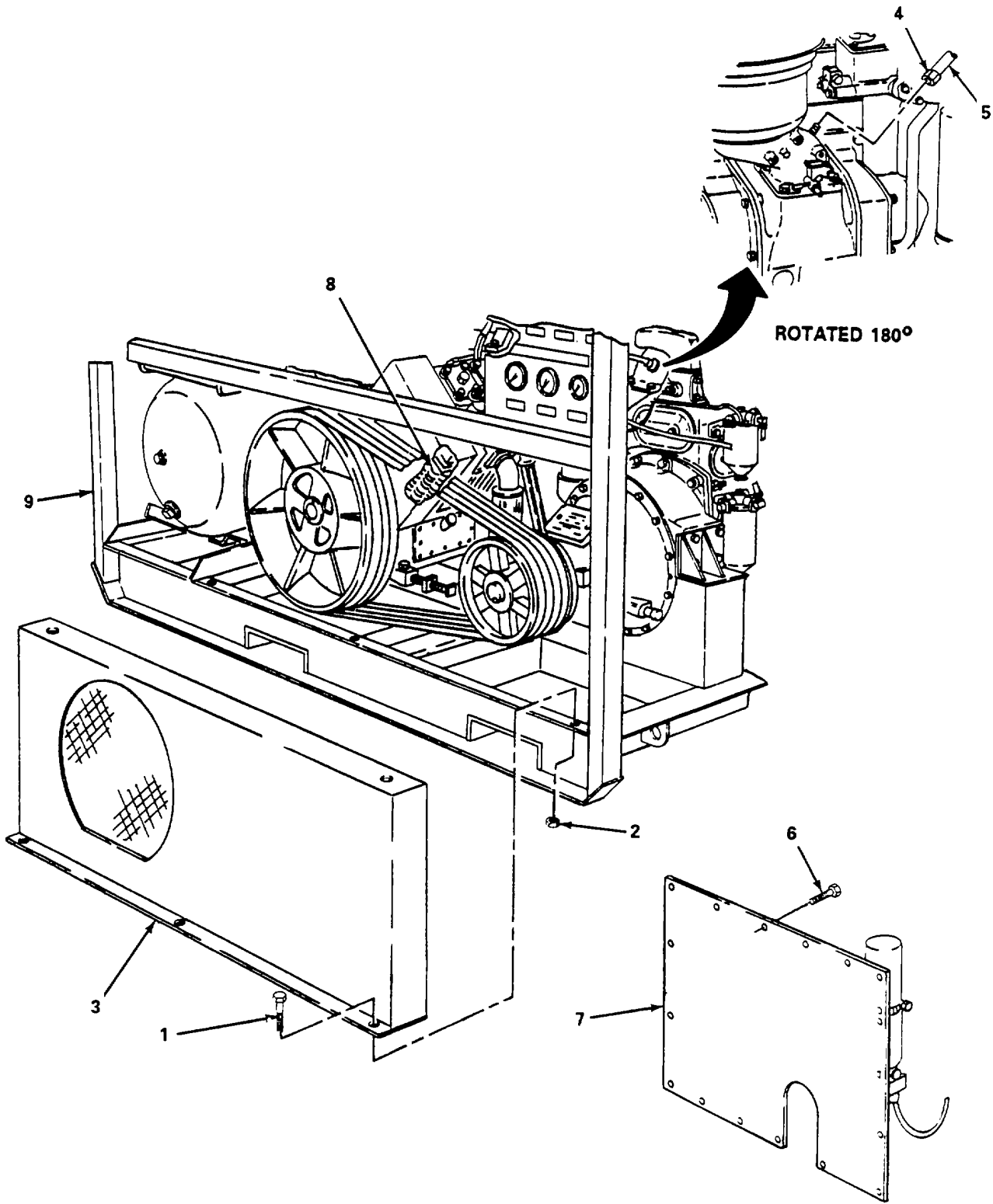


4951-060

Figure 3-55. Air Compressor Assembly, (Oil Change), Service.

**3-41. Air Compressor Assembly (Cont).**

- (2) *Intercooler.* (figure 3-56)
  - (a) Remove three screws (1) and nuts (2) securing shroud (3).
  - (b) Loosen coupling nut (4) and remove line (5).
  - (c) Remove twelve screws (6) securing cover (7) to shroud (3) and remove shroud and cover.
  - (d) Clean intercooler (8) of all dirt.
  - (e) Install cover (7) on shroud (3) and secure with twelve screws (6).
  - (f) Install shroud (3) with cover (7) attached on frame (9) and secure with three screws (1) and nuts (2).
  - (g) Install line (5) and tighten coupling nut (4).



4951-061

Figure 3-56. Air Compressor Assembly (Intercooler), Service.





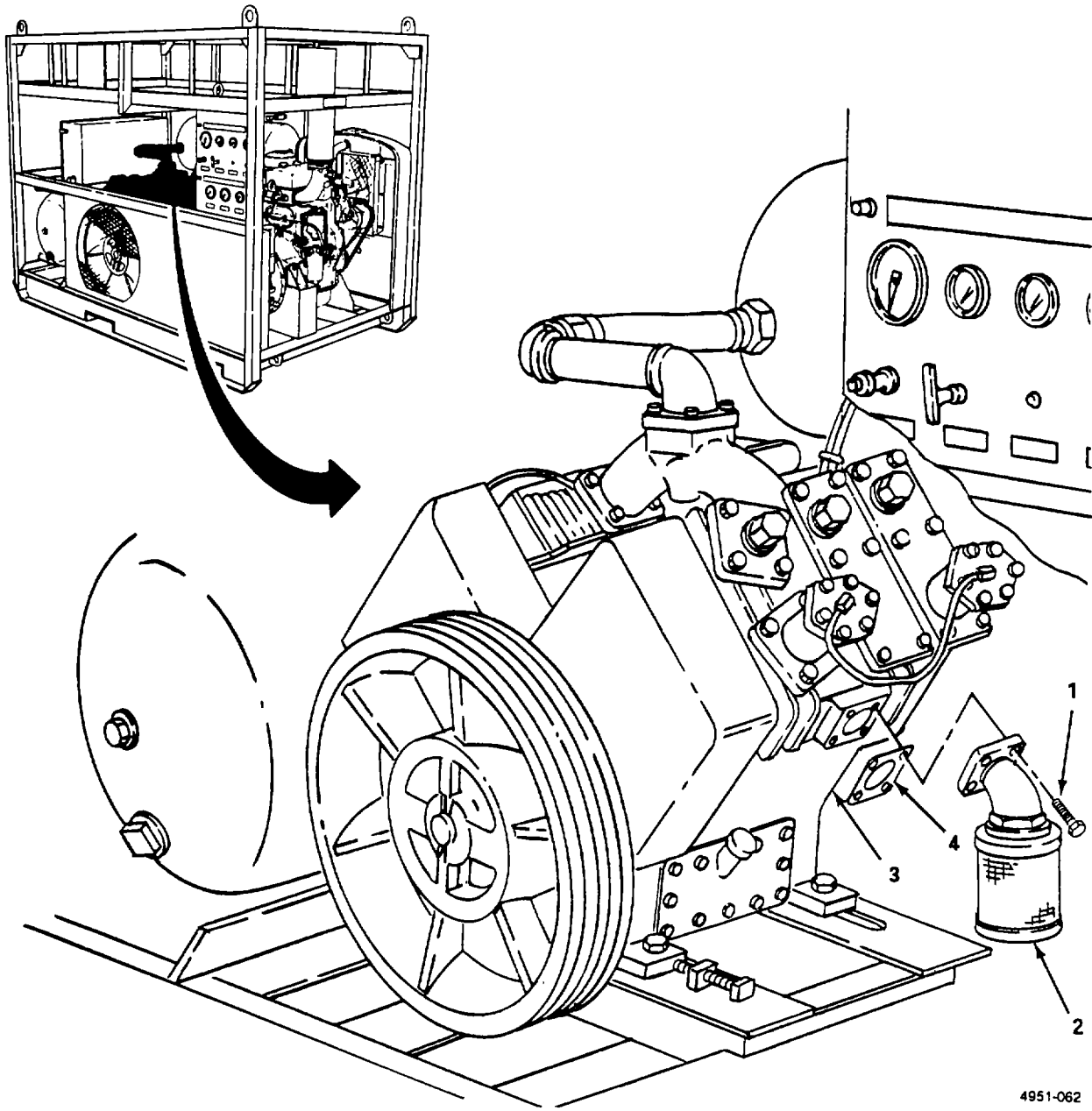


Figure 3-57. Air Cleaner Intake, Replace.

**3-42. Compressor Air Cleaner Intake (Cont).**

- b. Repair. (figure 3-58)

**NOTE**

There are two air cleaner intakes, repair of each is the same.

- (1) Remove wing nut (1) and remove cap (2) and air filter (3).
- (2) Remove nut cap (4) from elbow (5).
- (3) Clean elbow (5), nut cap (4), air filter (3), and cap (2) using nonionic detergent cleaner and rinse with clean distilled water.
- (4) Inspect elbow (5) and plastic nut cap (4) for cracks.
- (5) Inspect air filter (3) and cap (2) for dents, cracks, worn or other signs of damage.
- (6) Replace any component that is worn, cracked or otherwise damaged.
- (7) Install nut cap (4) on elbow (5).
- (8) Install air filter (3) and cap (2) on nut cap (4) and secure with wing nut (1).

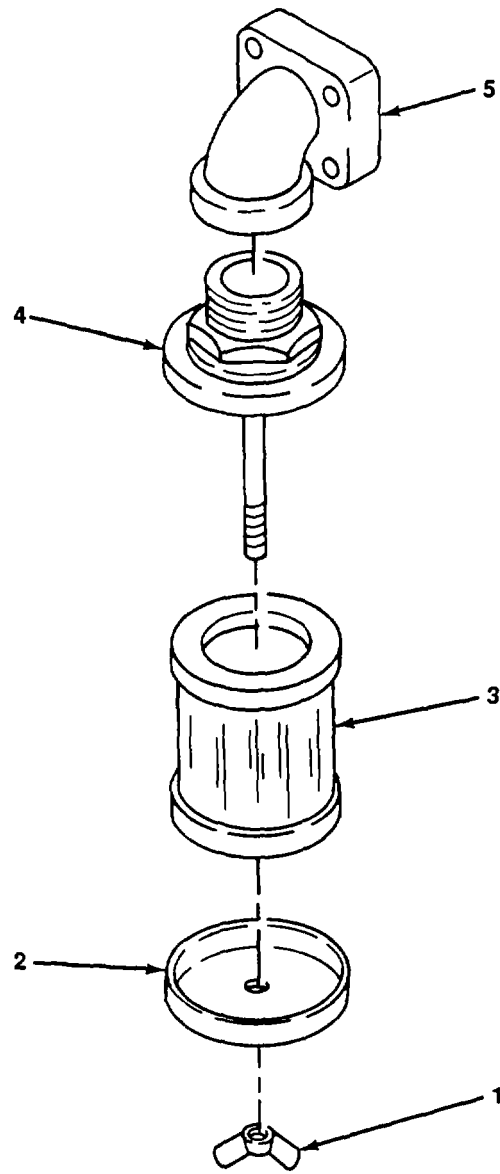


Figure 3-58. Air Cleaner Intake, Repair.

---

**3-43. Compressor Crankcase Breather.**

---

This task covers:

- a. Replace                                  b. Repair
- 

## INITIAL SETUP

*Tools**Materials/Parts*

General Mechanic's Tool Kit (NSN 5180-00-177-7033) Compressor Crankcase Breather  
Detergent, Nonionic (Item 6, Appendix D)  
Water, Distilled (Item 11, Appendix D)

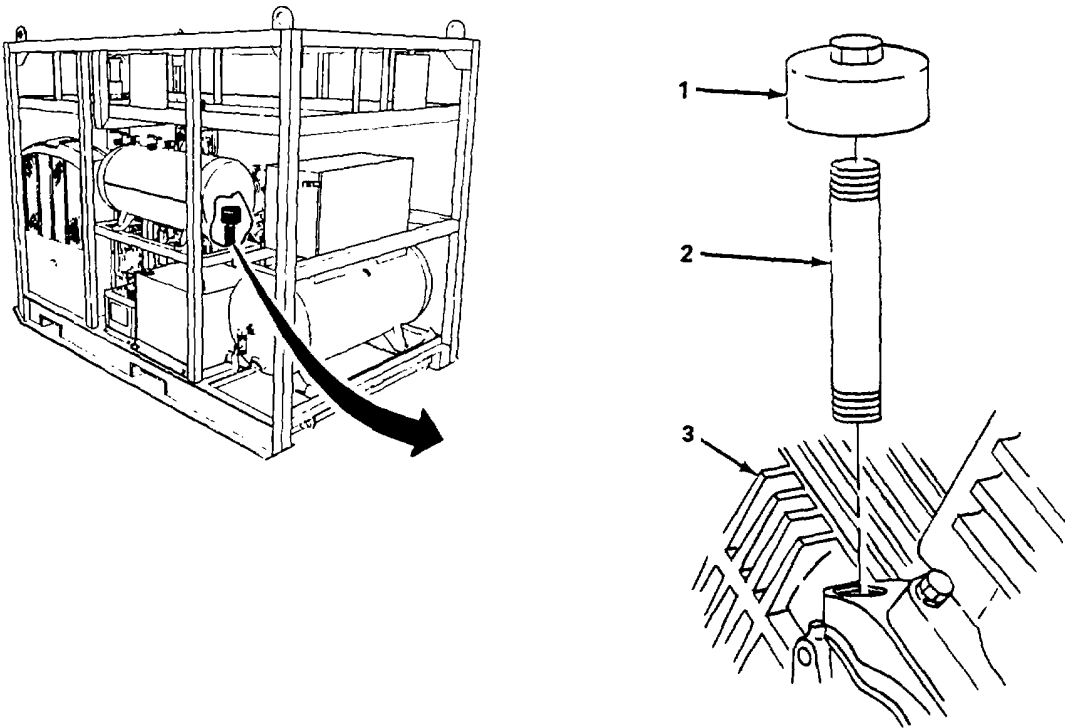
---

a. Replace. (figure 3-59)

- (1) Remove breather cap (1) from pipe nipple (2).
- (2) Remove pipe nipple (2) from crankcase (3).
- (3) Install pipe nipple (2) on crankcase (3).
- (4) Install breather cap (1) on pipe nipple (2).

b. Repair. (figure 3-60)

- (1) Clean breather cap (1) and pipe nipple (2) using nonionic detergent cleaner and rinse with clean distilled water.
- (2) Inspect breather cap (1) and pipe nipple (2) for cracks, dents or other damage.
- (3) Replace breather cap or nipple pipe if cracked, dented or otherwise damaged.



4951-064

Figure 3-59. Crankcase Breather, Replace and Repair.

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**3-44. Air Receiver, 30 Gallon, Fixed.**

---

This task covers:

Service

---

INITIAL SETUP

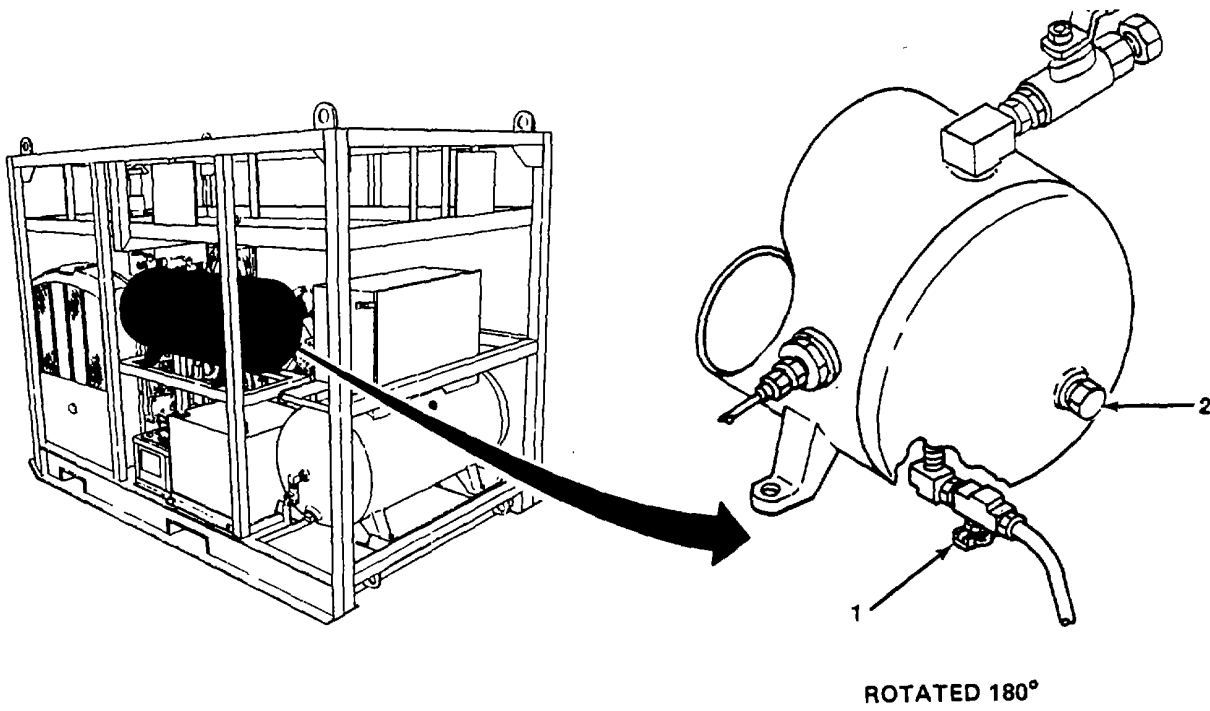
*Tools*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)

---

Service. (figure 3-60)

- (1) Open pet cock (1) and drain condensation from air receiver (2).
- (2) Close pet cock (1).



4951-059

Figure 3-60. Air Receiver, Service.

---

**3-45. Portable, 60 Gallon Air Receiver Tank.**

---

This task covers:

- a. Service                      b. Replace
- 

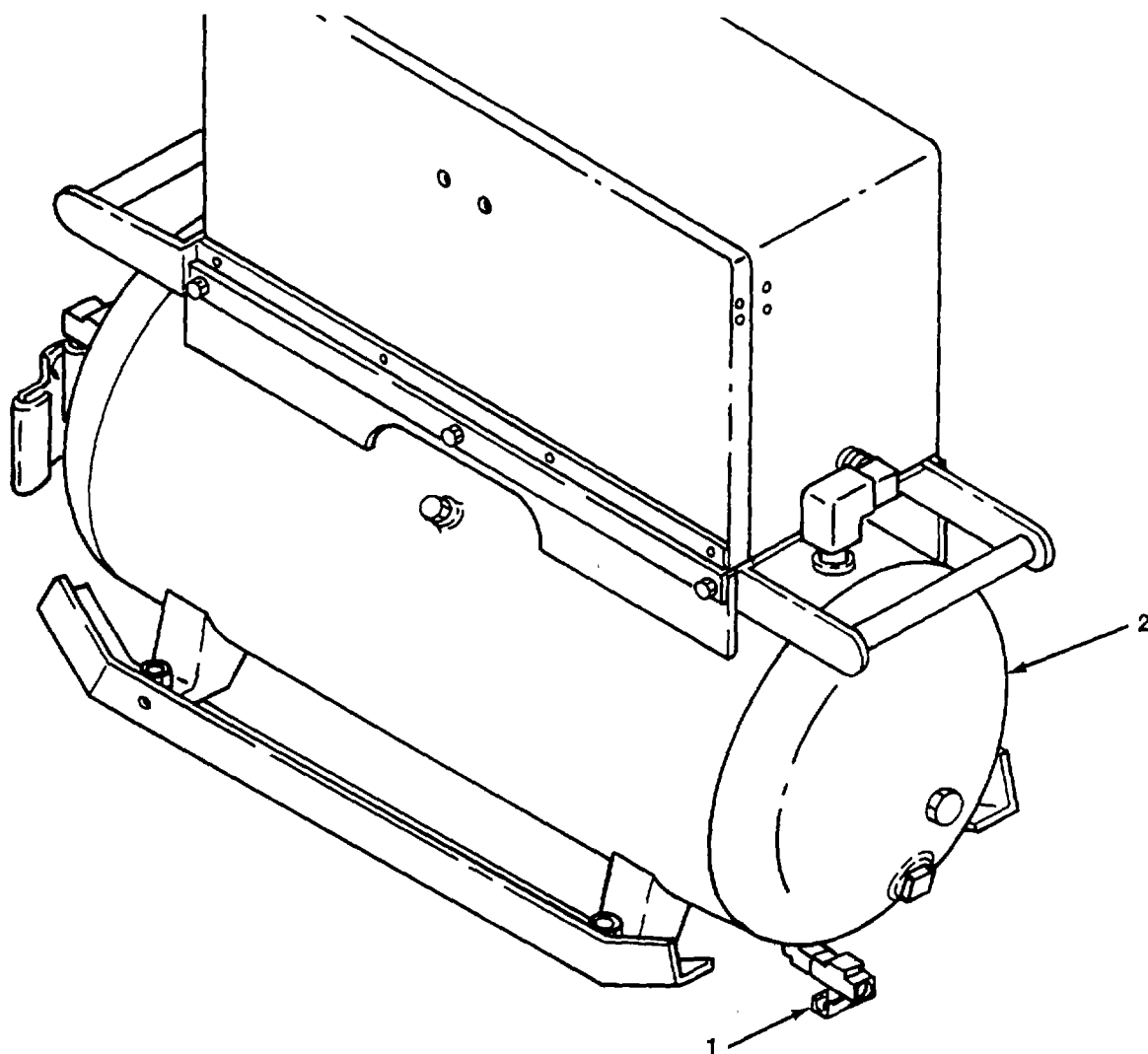
**INITIAL SETUP***Tools*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)

---

a. Service. (figure 3-61)

- (1) Open drain valve (1) on receiver tank (2) and drain condensation out of tank.
- (2) Close drain valve (1).



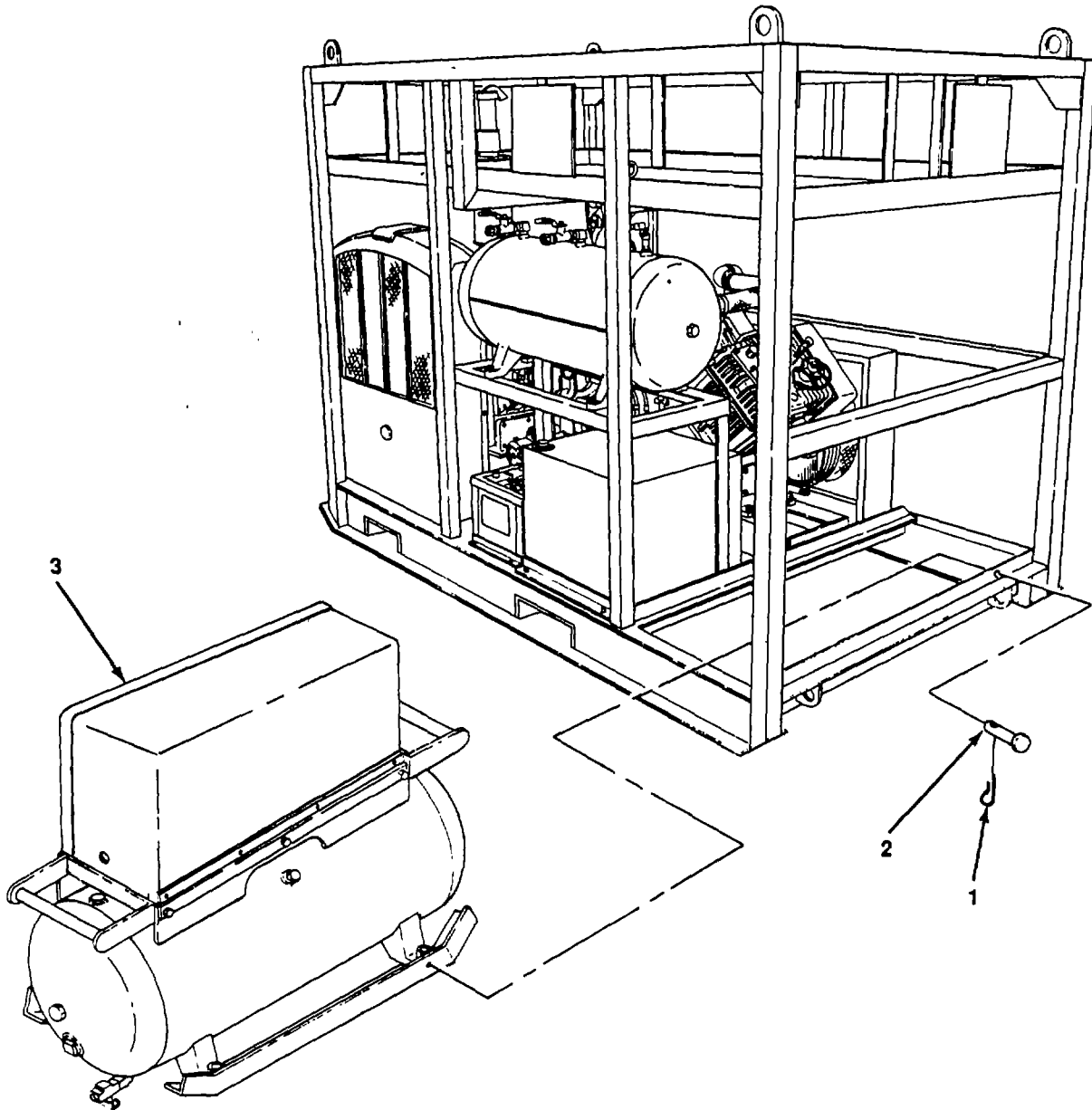
4951-138

Figure 3-61. Portable 60 Gallon Air Receiver Tank, Service.



b. *Replace.* (figure 3-62)

- (1) Remove two clips (1) and pins (2) and remove portable air receiver (3).
- (2) Install portable air receiver (3) and secure with two pins (2) and clips (1).



4951-137

**Figure 3-62. Portable Air Receiver, Replace.**

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**3-46. Controls and Indicators.**

---

This task covers:

Replace

---

## INITIAL SETUP

*Tools*

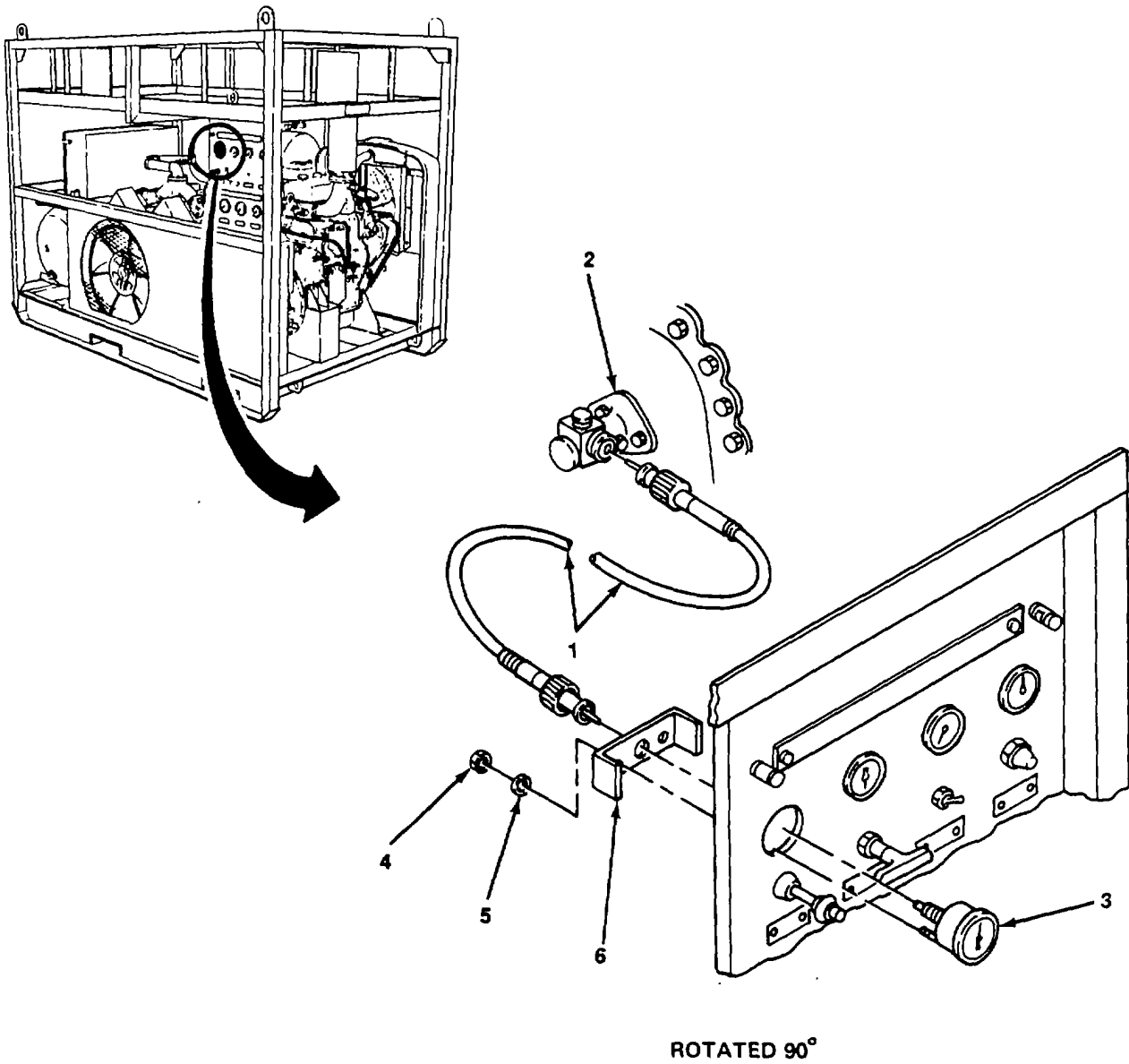
General Mechanic's Tool Kit (NSN 5180-00-177-7033)

*Materials/Parts*RPM/Time Indicator  
Tachometer Cable  
Oil Pressure Gage  
Line, Oil Pressure Gage  
Water Temperature Gage  
Amp Meter*Materials/Parts (Cont)*Throttle Control  
Stop Control  
Switch, Light  
Button, Start  
Oil Pressure Gage Compressor  
Line, Oil Pressure Gage Compressor  
Light, Panel  
Tape, Teflon (Item 25, Appendix D)

---

Replace.

- (1) *Engine speed and time indicator.* (figure 3-63)
  - (a) Disconnect cable (1) at adapter (2).
  - (b) Disconnect cable (1) at gage (3) and remove cable (1).
  - (c) Remove two nuts (4), washers (5), bracket (6), and remove gage (3).
  - (d) Install gage (3) and secure with bracket (6), washers (5), and nuts (4).
  - (e) Connect cable (1) to gage (3).
  - (f) Connect cable (1) to adapter (2).



4951-065

Figure 3-63. Engine Speed and Time Indicator.

**3-46. Controls and Indicators (Cont).**

- (2) *Oil pressure gage.* (figure 3-64).
  - (a) Loosen fitting nut (1) and disconnect oil line (2).
  - (b) Loosen fitting nut (3) and disconnect oil line (2) and remove.
  - (c) Remove two nuts (4), washers (5), and bracket (6) and remove oil pressure gage (7).
  - (d) Remove elbow (8).

**NOTE**

Leave 1 1/2 threads exposed when applying teflon tape. Wrap teflon tape in the direction that will not unwrap as fitting is tightened. Failure to wrap teflon tape properly or having it extend past the end of the fitting may cause a blockage in the oil distribution system.

- (e) Apply teflon tape to threads on oil pressure gage (7).
- (f) Install elbow (8) on gage (7).
- (g) Install gage (7) and secure with bracket (6), two washers (5) and nuts (4).
- (h) Install oil line (2) and tighten fitting nuts (1) and (3).

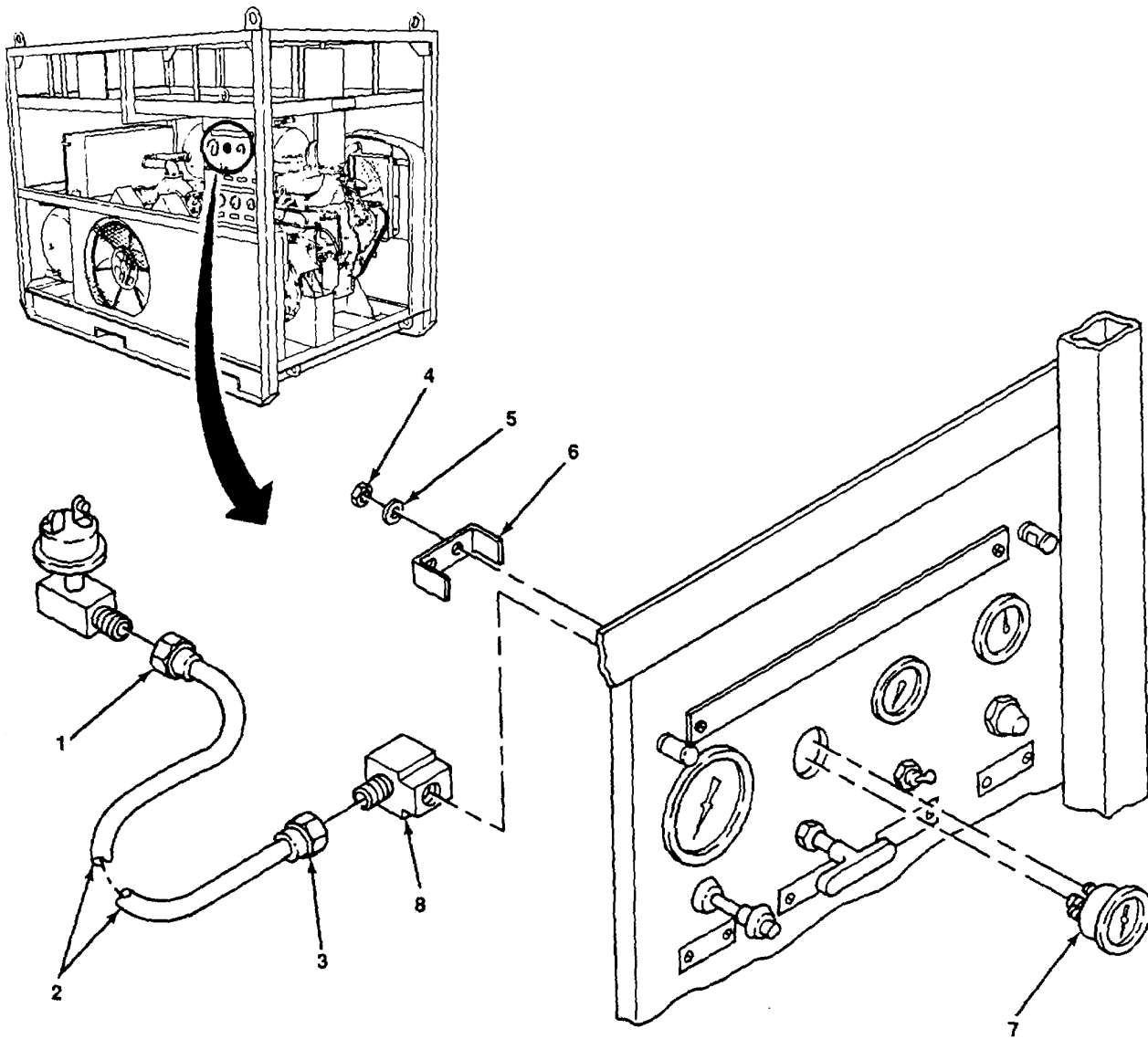


Figure 3-64. Oil Pressure Gage, Replace.

**3-46. Controls and Indicators (Cont).**

- (3) *Water temperature gage.* (figure 3-65)
  - (a) Loosen nut (1) and remove cable (2).
  - (b) Remove nut (3), washer (4), and tag and remove two leads (5).
  - (c) Remove two nuts (6), washer (7), and brackets (8) and remove gage (9).
  - (d) Install gage (9) and secure with two brackets (8) and nuts (6) and washer (7).
  - (e) Install two leads (5) as tagged and secure with washer (4), and nut (3).
  - (f) Install cable (2) and tighten nut (1).

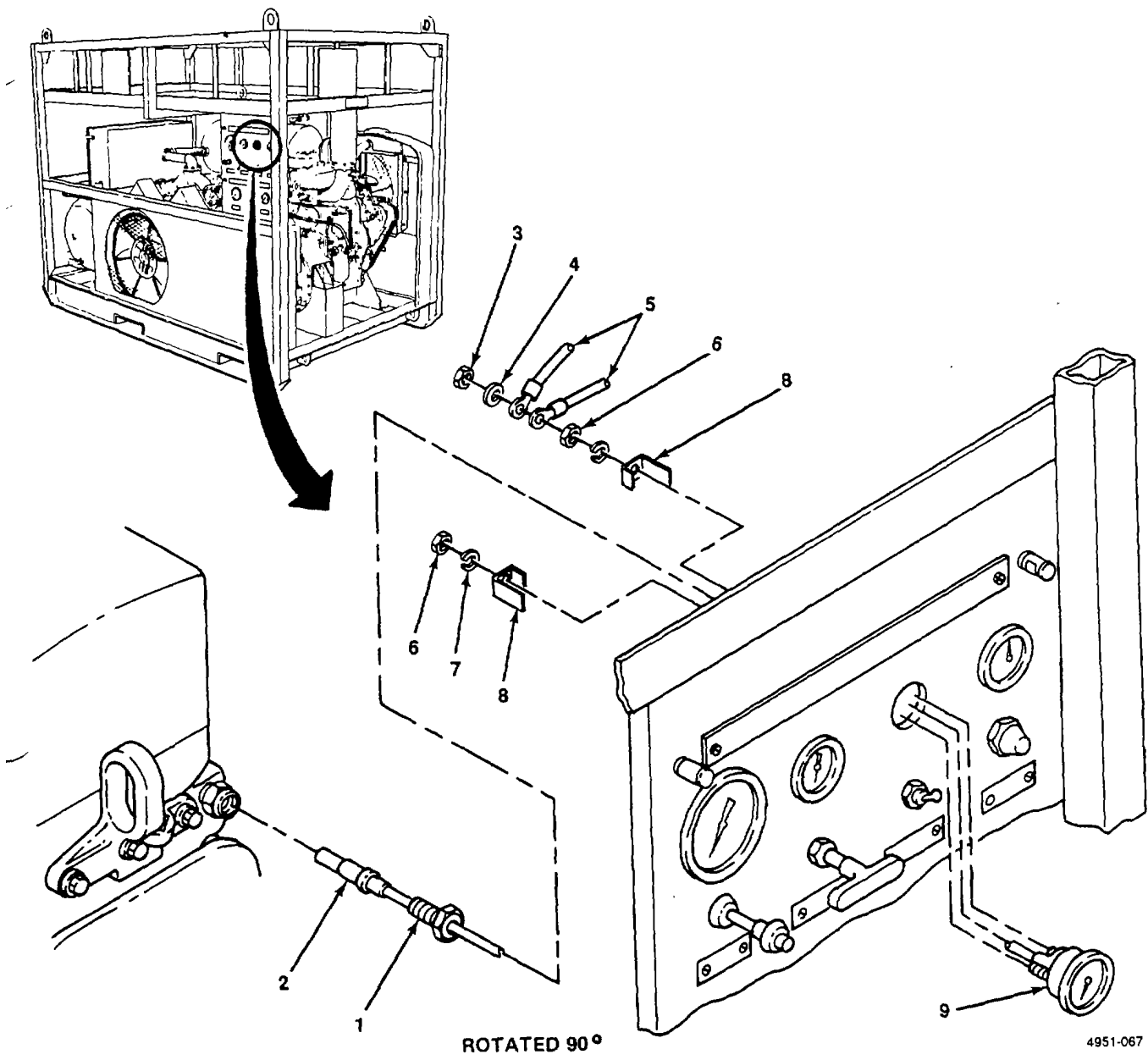
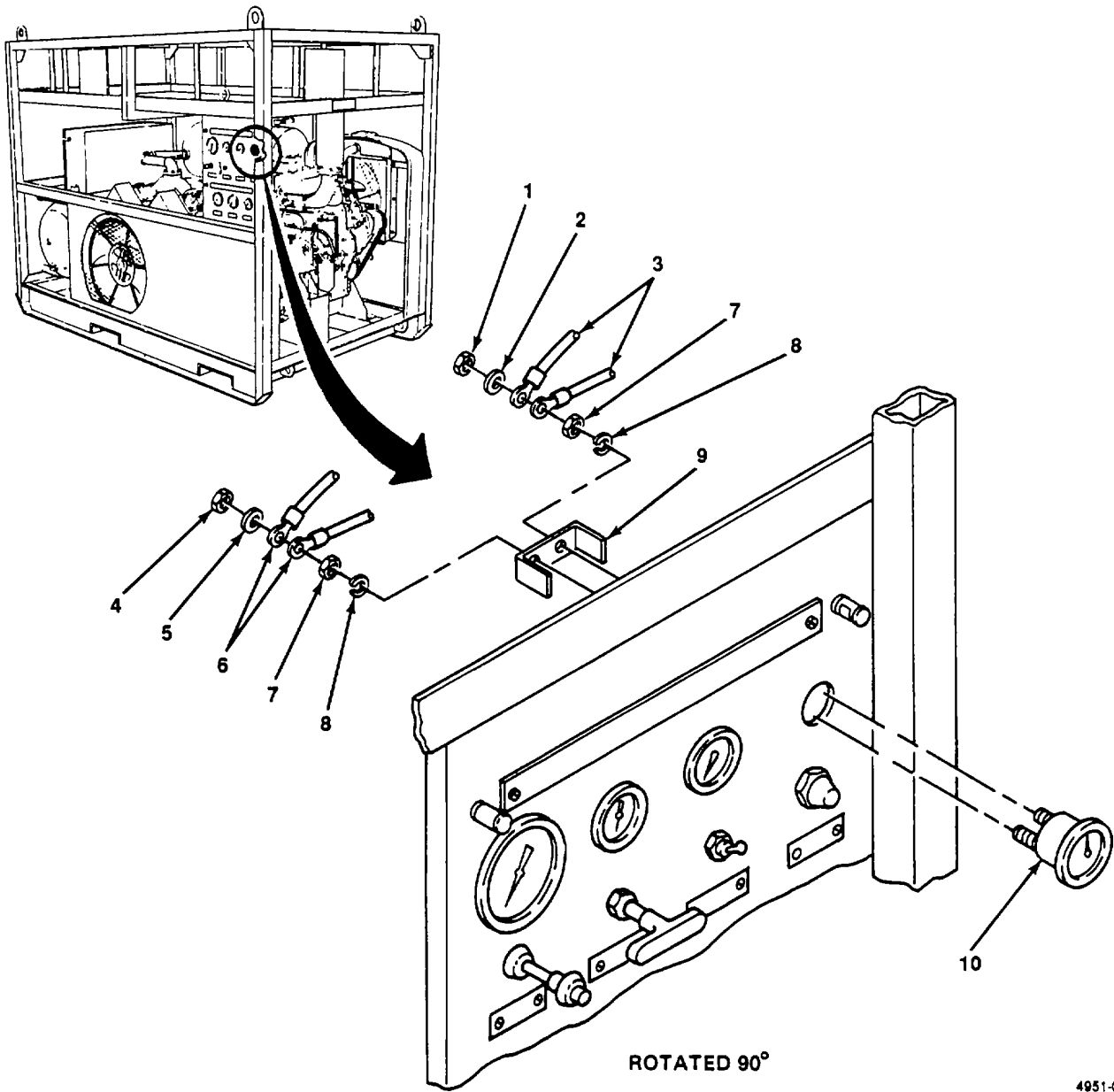


Figure 3-65. Water Temperature Gage, Replace.

**3-46. Controls and Indicators (Cont).**

- (4) *Amp meter.* (figure 3-66)
  - (a) Remove nut (1) and lockwasher (2) and tag and remove two leads (3).
  - (b) Remove nut (4) and lockwasher (5) and tag and remove two leads (6).
  - (c) Remove two nuts (7), plastic washers (8), bracket (9), and remove gage (10).
  - (d) Install gage (10) and secure with bracket (9), two plastic washers (8), and nuts (7).
  - (e) Connect two leads (6) as tagged and secure with lockwasher (5) and nut (4).
  - (f) Connect two leads (3) as tagged, and secure with lockwasher (2) and nut (1).





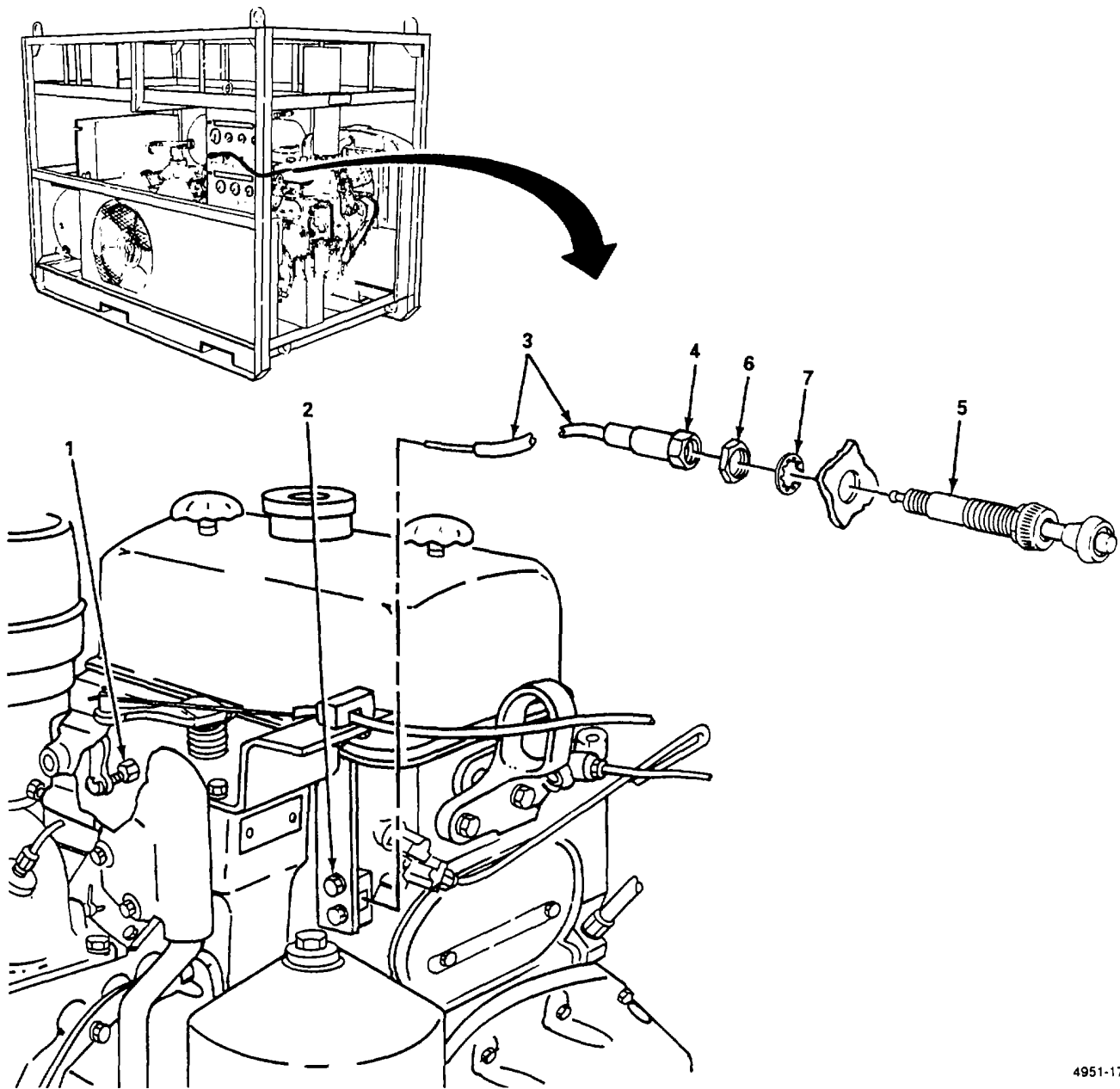
4951-088

Figure 3-66. Amp Meter, Replace.

**3-46. Controls and Indicators (Cont).**

(5) *Throttle control.* (figure 3-67)

- (a) Loosen screw (1).
- (b) Loosen two screws (2) and remove throttle cable (3).
- (c) Loosen connector nut (4) and remove throttle cable (3) from throttle control (5).
- (d) Remove nut (6) and lockwasher (7) and remove throttle control (5).
- (e) Install throttle control (5) and secure with lockwasher (7) and nut (6).
- (f) Install throttle cable (3) and throttle control (5) and tighten connector nut (4).
- (g) Install throttle cable (3) and tighten two screws (2).
- (h) Tighten screw (1).



4951-179

Figure 3-67. Throttle Control, Replace.

**3-46. Controls and Indicators (Cont).**

(6) *Stop control.* (figure 3-68)

(a) Loosen screw (1).

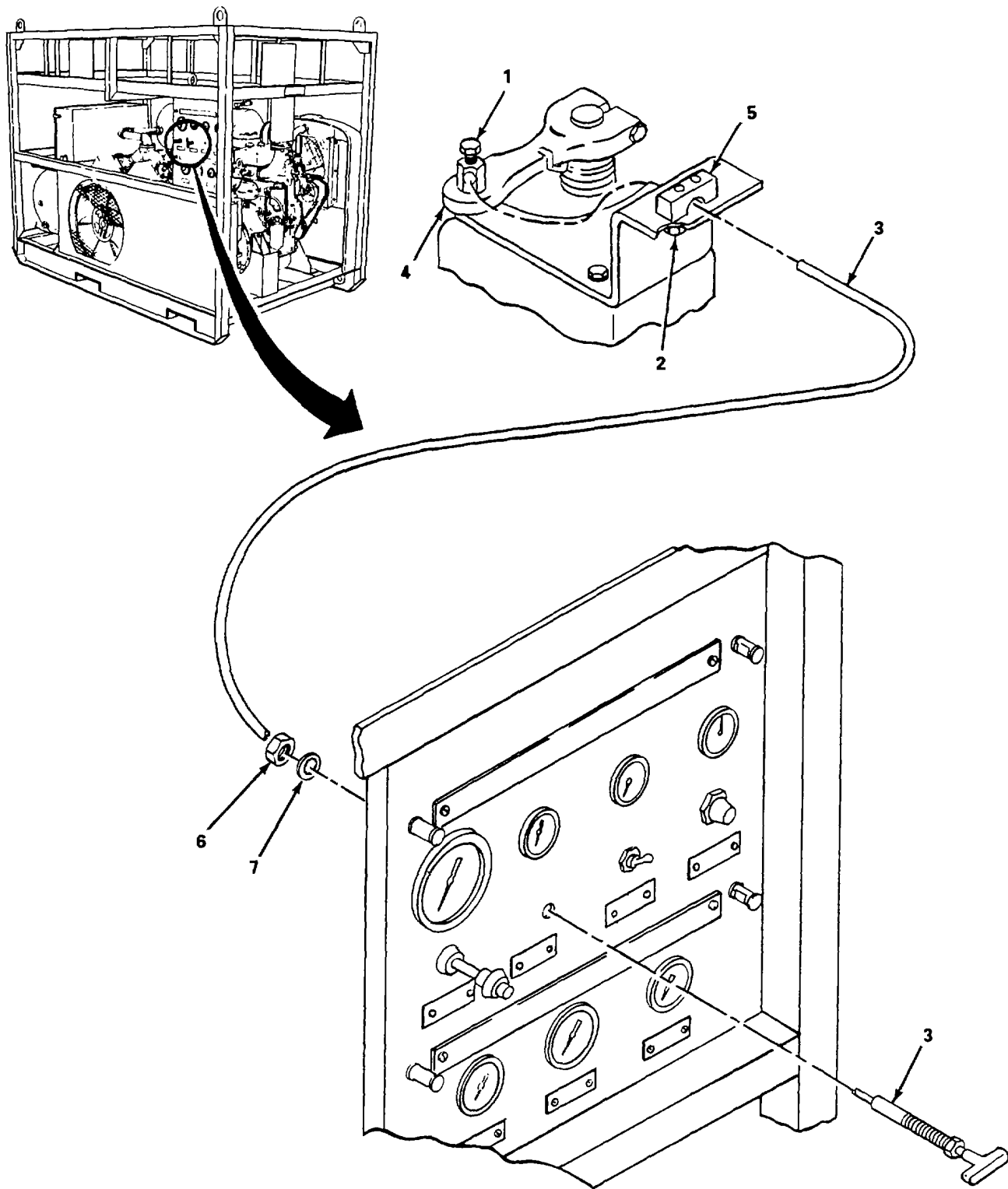
(b) Loosen two screws (2) and remove stop control (3) from stop control lever (4) and block (5).

(c) Remove nut (6) and lockwasher (7) and remove stop control (3).

(d) Install stop control (3) and secure with lockwasher (7) and nut (6).

(e) Install stop control (3) in block (5) and stop control lever (4).

(f) Tighten screw (1).



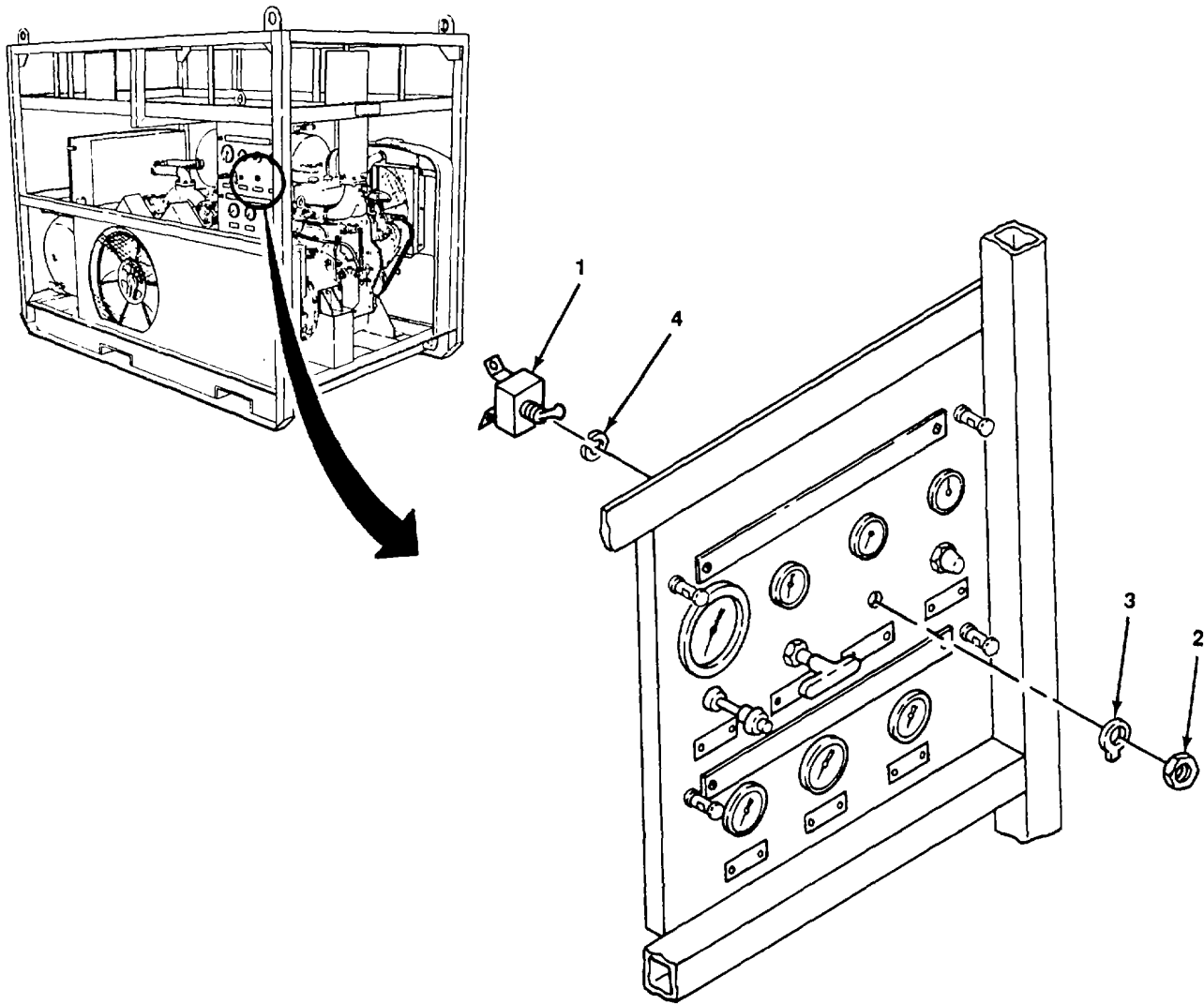
4951-180

Figure 3-68. Stop Control, Replace.

**3-46. Controls and Indicators (Cont).**

(7) *Light switch.* (figure 3-69)

- (a) Tag and remove wiring from switch (1).
- (b) Remove nut (2) and washer (3) and remove switch (1) and lockwasher (4).
- (c) Install switch (1) and lockwasher (4) and secure with washer (3) and nut (2).
- (d) Connect wiring to switch (1) as tagged.



ROTATED 90°

4951-069

Figure 3-69. Light Switch, Replace.

**3-46. Controls and Indicators (Cont).**

(8) *Start button.* (figure 3-70)

- (a) Remove nut (1) and lockwasher (2) and tag and remove lead (3).
- (b) Remove nut (4) and lockwasher (5) and tag and remove leads (6).
- (c) Remove cap nut (7), washer (8), and remove switch (9) and lockwasher (10).
- (d) Install switch (9) and lockwasher (10) and secure with cap nut (7) and washer (8).
- (e) Connect leads (6) as tagged and secure with lockwasher (5) and nut (4).
- (f) Connect lead (3) and secure with lockwasher (2) and nut (1).



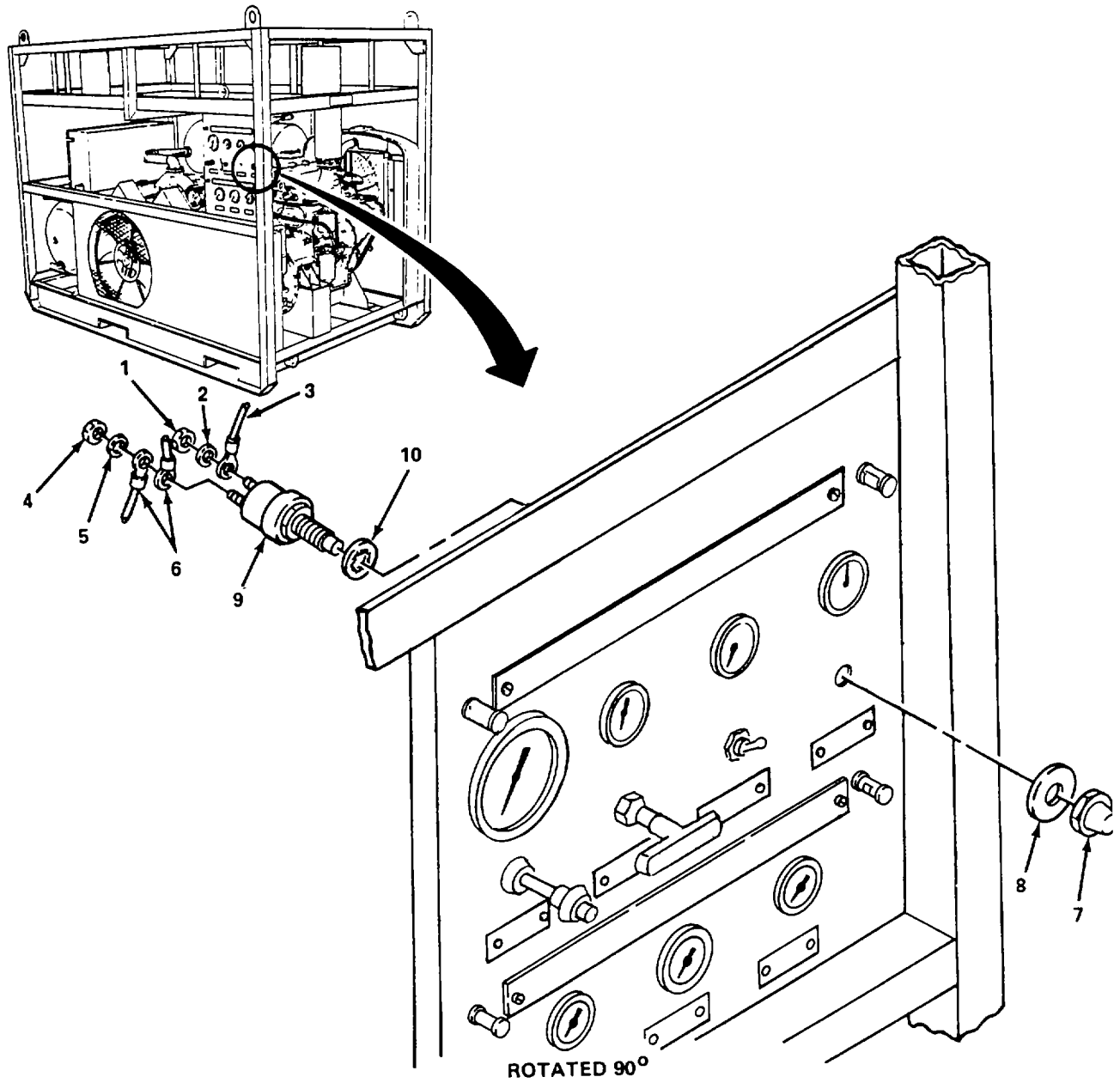


Figure 3-70. Start Button, Replace.

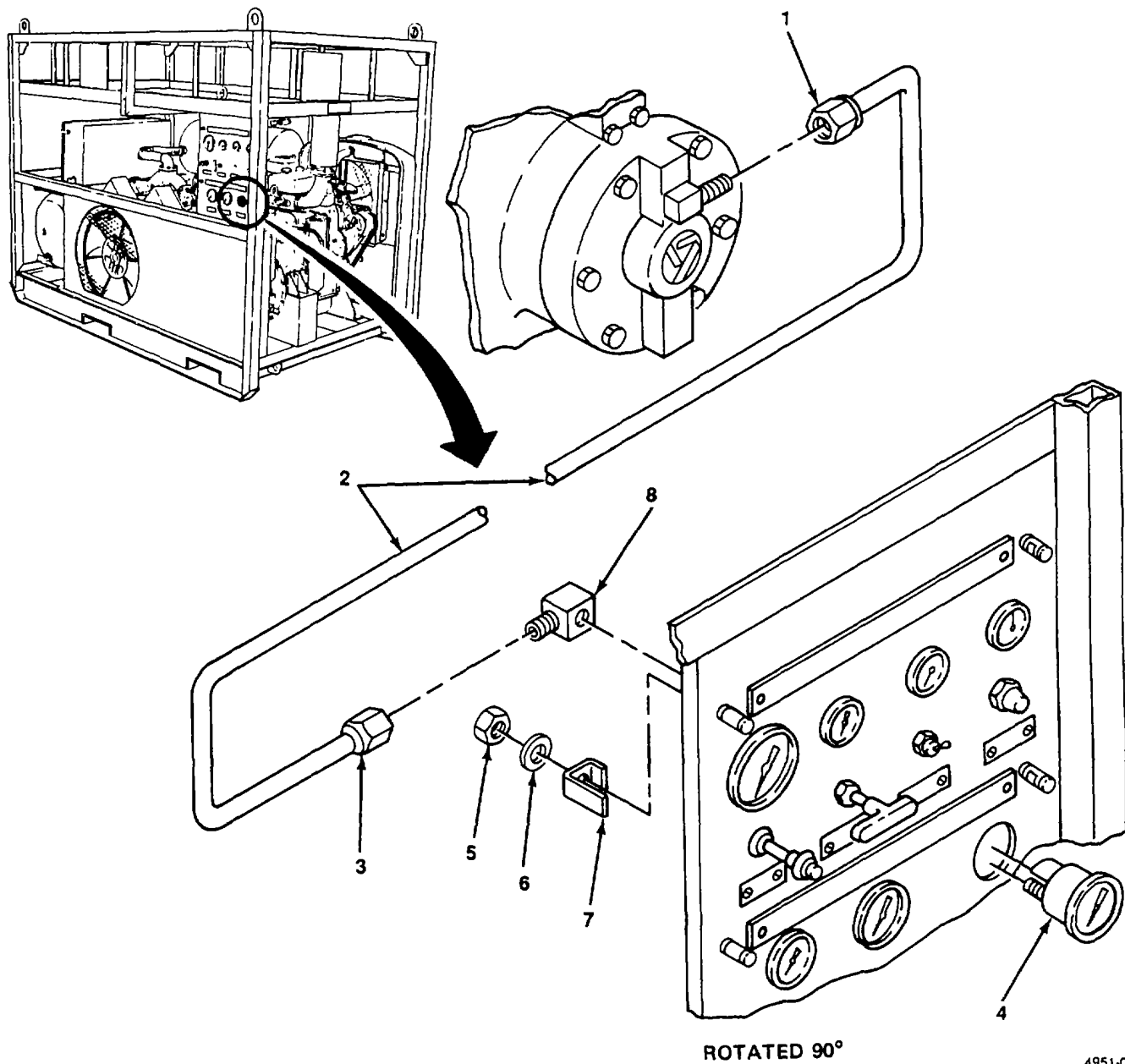
**3-46. Controls and Indicators (Cont).**

- (9) *Oil pressure gage (compressor)*. (figure 3-71)
  - (a) Loosen fitting nut (1) and remove oil line (2).
  - (b) Loosen fitting nut (3) and remove oil line (2) from elbow (4).
  - (c) Remove two nuts (5), washers (6), and brackets (7) and remove gage (4).
  - (d) Remove elbow (8) from gage (4).

**NOTE**

Leave 1 1/2 threads exposed when applying teflon tape. Wrap teflon tape in the direction that will not unwrap as fitting is tightened. Failure to wrap teflon tape properly or having it extend past the end of the fitting may cause a blockage in the fuel system.

- (e) Apply teflon tape to threads on gage (4).
- (f) Install elbow (8) on gage (4).
- (g) Install gage (4) and secure with bracket (7), two washers (6) and nuts (5).
- (h) Install oil line (2) and tighten fitting nut (3).
- (i) Install oil line (2) and tighten fitting nut (1).



4951-071

Figure 3-71. Oil Pressure Gage Compressor, Replace.

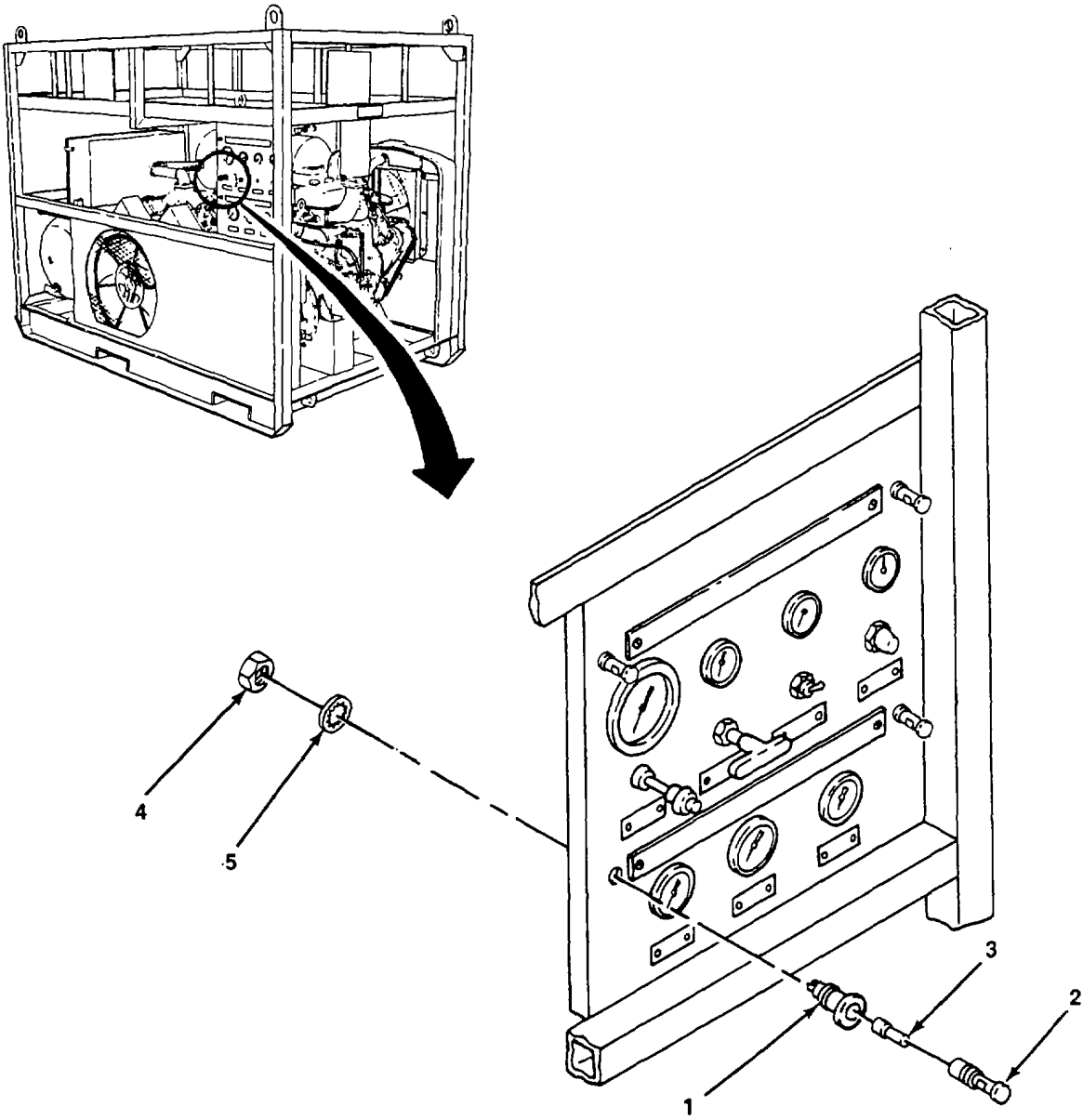
3-46. **Controls and Indicators (Cont).**

(10) *Panel lights.* (figure 3-72)

**NOTE**

The procedures are the same for all panel lights.

- (a) Tag and remove wiring from socket (1).
- (b) Remove cover (2).
- (c) Press bulb (3) in and turn counterclockwise and remove bulb (3).
- (d) Remove nut (4) and lockwasher (5) and remove socket (1).
- (e) Install socket (1) and secure with lockwasher (5) and nut (4).
- (f) Install bulb (3), press in and turn clockwise.
- (g) Install cover (2).
- (h) Connect wiring as tagged.



4951-072

Figure 3-72. Panel Lights, Replace.

3-46. **Controls and Indicators (Cont).**

(11) *Panel markers.* (figure 3-73)

**NOTE**

The following procedures are the same for all panel markers.

- (a) Remove two screws (1) and nuts (2) and remove marker (3).
- (b) Install marker (3) and secure with two nuts (2) and screws (1).

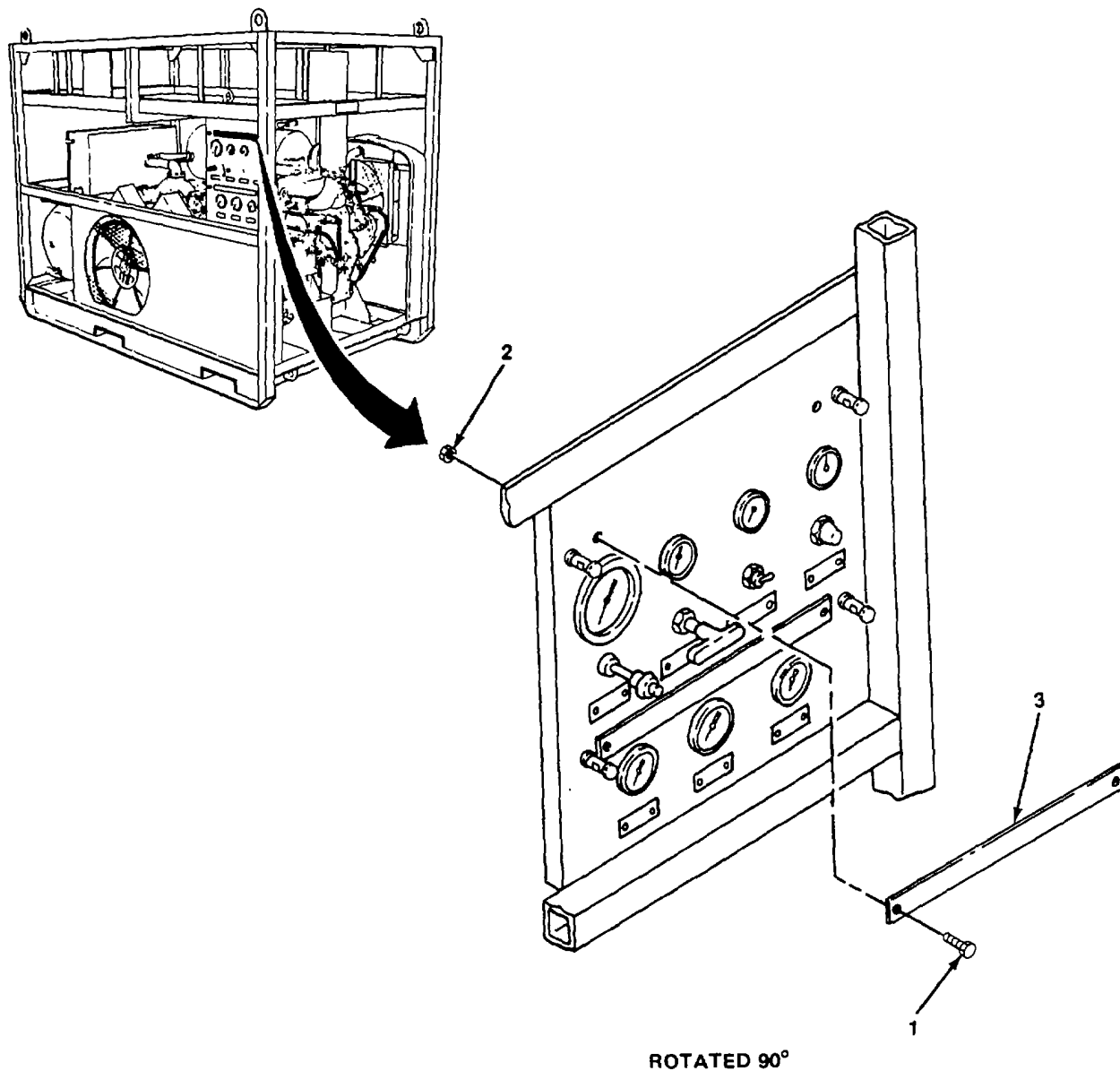


Figure 3-73. Panel Markers, Replace.

---

**3-47. Engine Mounts.**

---

**This task covers:****a. Replace (Front)****b. Replace (Rear)**

---

**INITIAL SETUP:***Tools*General Mechanics Tool Kit  
(NSN 5180-00-177-7033)*Equipment Condition*Drive belts removed when removing rear engine  
mount (para. 3-12b).*Materials/Parts*Front Engine Mount  
Rear Engine Mount

---

**a. *Replace (Front).*** (figure 3-74)

- (1) Support engine (1) using suitable lifting device in lifting eye (2) and block in place.
- (2) Remove four screws (3) and lockwashers(4).
- (3) Remove three bolts (5) and nuts (6), and remove front engine mount (7).
- (4) Install front engine mount (7) and secure with three bolts (5) and nuts (6).
- (5) Install four screws (3) and lockwashers (4).
- (6) Remove blocking.



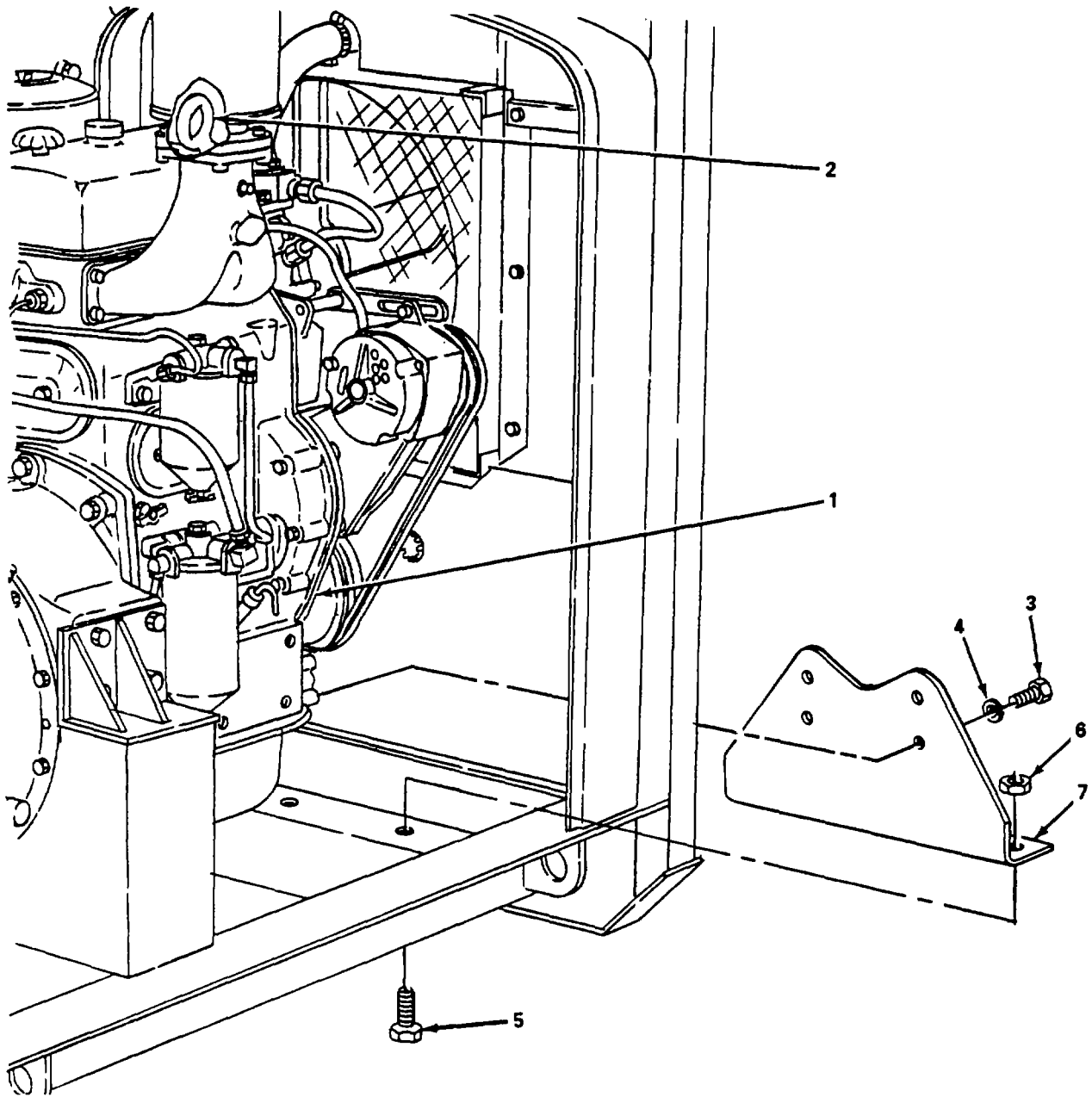


Figure 3-74. Front Engine Mount, Replace

**3-47. Engine Mounts (Cont).***b. Replace (Rear).* (figure 3-75)

- (1) Support engine (1) using suitable lifting device in lifting eye (2) and block in place.
- (2) Remove eight screws (3) and lockwashers (4).
- (3) Remove two bolts (5) and nuts (6), and remove rear engine mount (7).
- (4) Install engine mount (7) and secure with two bolts (5) and nuts (6).
- (5) Install eight screws (3) and lockwashers (4).
- (6) Remove blocking.

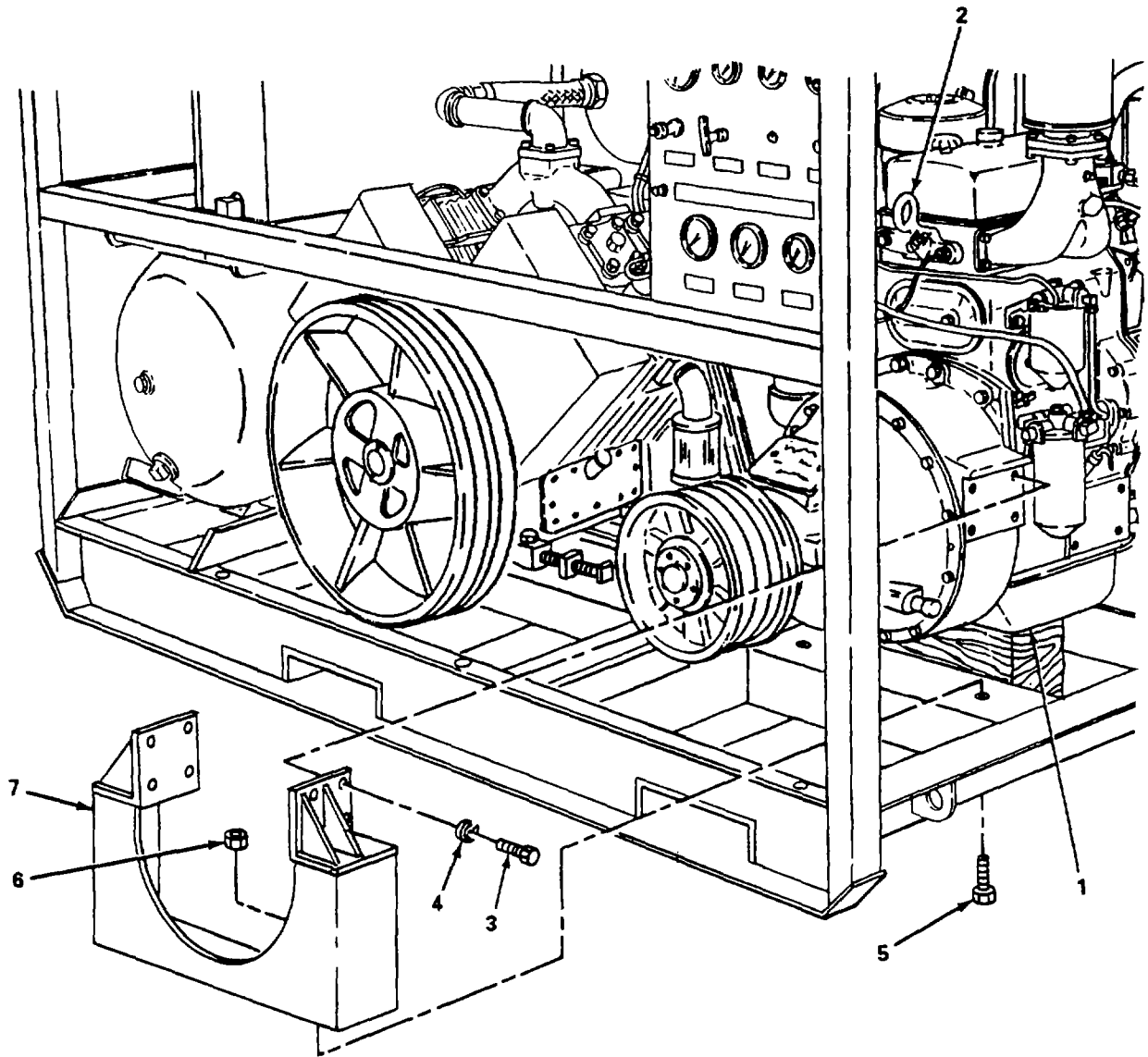


Figure 3-75. Rear Engine Mount, Replace.

**FOLLOW-ON MAINTENANCE:**  
Install drive belts (para. 3-12b).

---

**3-48. Fuel Tank.**

---

**This task covers:****a. Replace****b. Repair**

---

**INITIAL SETUP:***Tools*

General Mechanics Tool Kit  
(NSN 5180-00-177-7033)  
Tape, Teflon (Item 25, Appendix D)  
Cap, Filler and Strainer

*Materials/Parts*

Fuel Tank  
Gage, Fuel

**a. Replace.** (figure 3-76)

- (1) Drain fuel in tank (1) into suitable container.
- (2) Loosen fitting nut (2) and tag and remove fuel line (3) and tag.
- (3) Loosen fitting nut (4) and tag and remove fuel line (5).
- (4) Remove four screws (6) and lockwashers (7) and remove fuel tank (1).
- (5) Install fuel tank (1) and secure with four screws (6) and washers (7).

**NOTE**

Leave 1 1/2 threads exposed when applying teflon tape. Wrap teflon tape in the direction that will not unwrap as fitting is tightened. Failure to wrap teflon tape properly or having it extend past the end of the fitting may cause a blockage in the fuel system.

- (6) Apply teflon tape to threads of fitting nut (2).
- (7) Connect fuel line (5) as tagged and tighten fitting nut (4).
- (8) Connect fuel line (3) as tagged and tighten fitting nut (2).
- (9) Fill fuel tank (1) with diesel fuel.

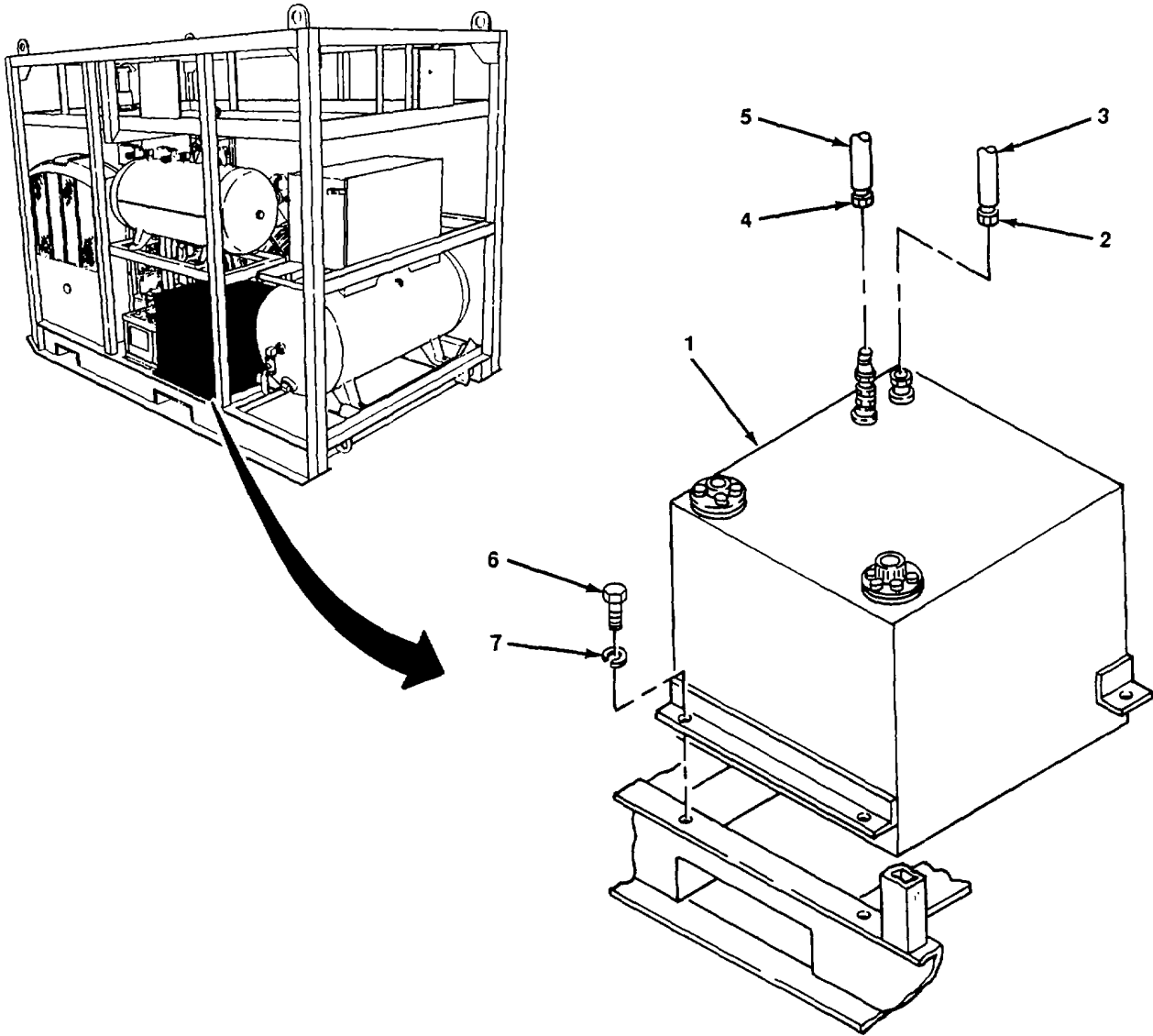


Figure 3-76. Fuel Tank, Replace.

4951-076

3-48. **Fuel Tank (Cont).**

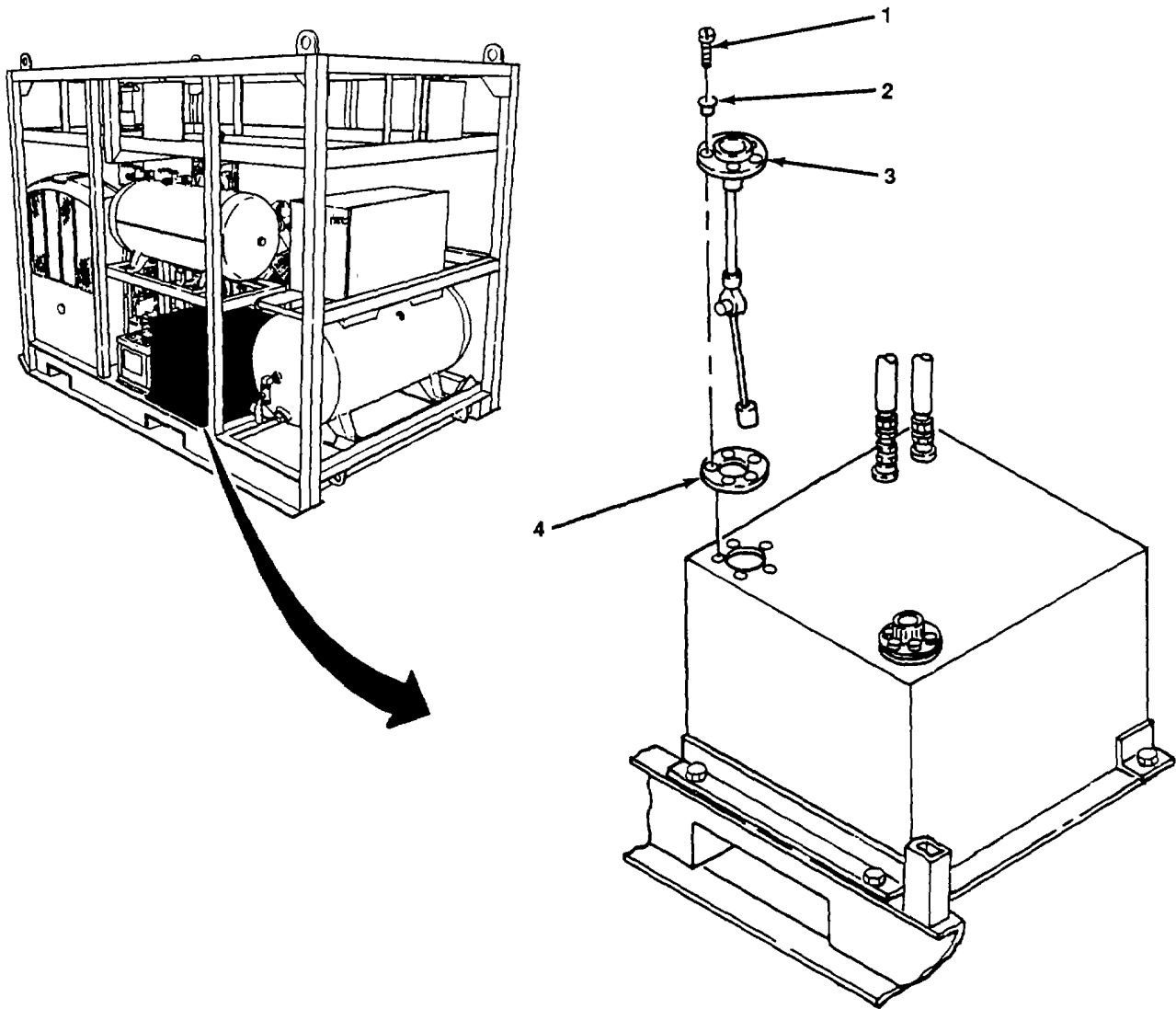
b. Repair.

(1) *Replace fuel gage.* (figure 3-77)

(a) Remove six screws (1) and plastic washers (2) and remove gage(3) and gasket (4).

(b) Ensure gasket mounting surfaces are clean and old gasket material is removed.

(c) Install gasket (4) and gage (3) and secure with six screws (1) and plastic washers (2).



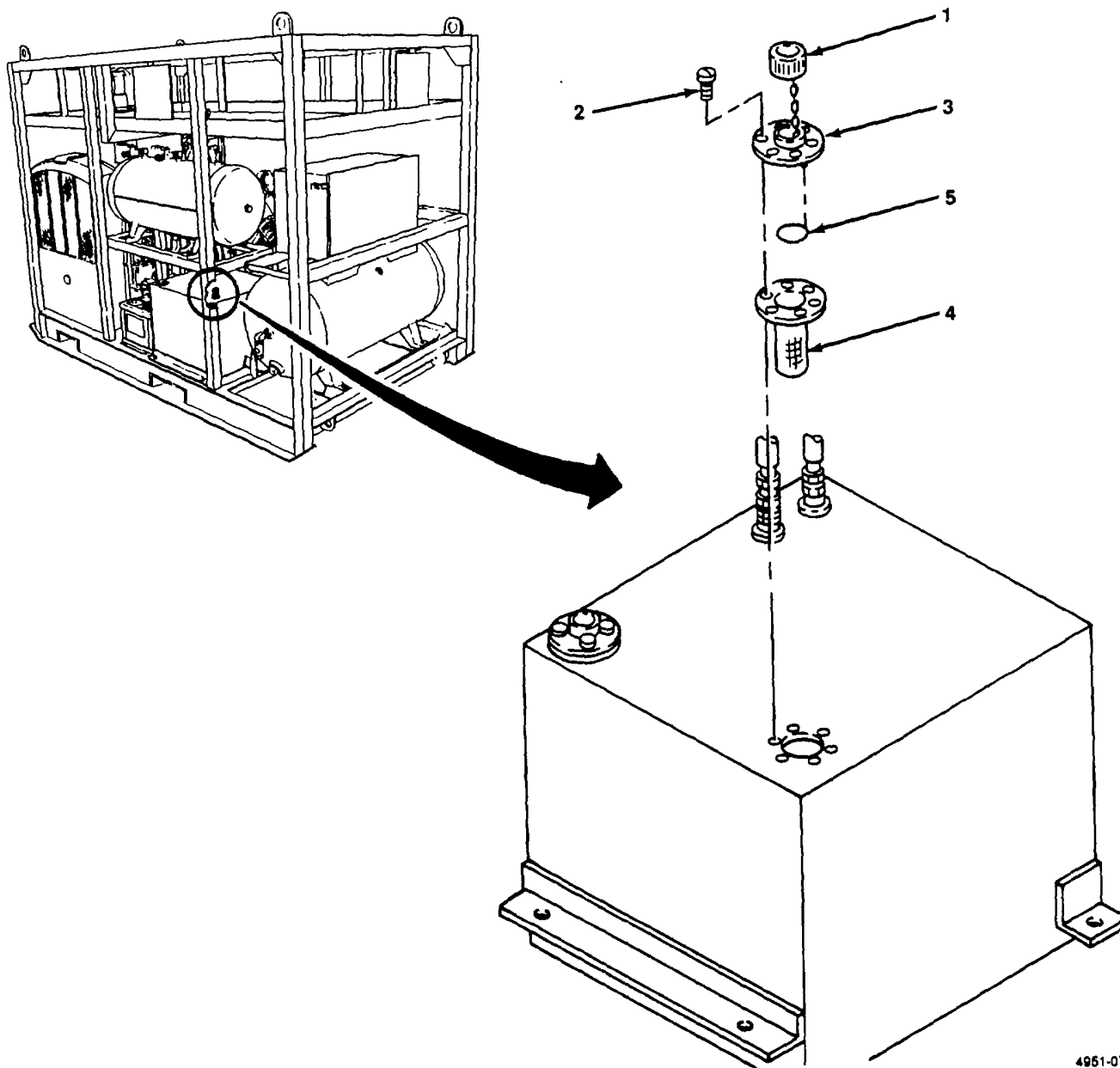
4951-078

Figure 3-77. Fuel Gage, Replace.

**3-48. Fuel Tank (Cont).**

- (2) *Replace filter cap and strainer.* (figure 3-78)
  - (a) Turn filler cap (1) counterclockwise and remove.
  - (b) Remove six screws (2) and remove retainer (3) and strainer (4).
  - (c) Remove filler cap retainer (5) from retainer (3).
  - (d) Install filler cap retainer (5) in retainer (3).
  - (e) Install retainer (3) and secure with six screws (2).
  - (f) Install filler cap (1) and turn clockwise to secure.





4951-079

Figure 3-78. Fuel Tank, Replace.

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**3-49. Battery Holddown.**

---

**This task covers:**

**a. Replace**

---

**INITIAL SETUP:**

*Tools*

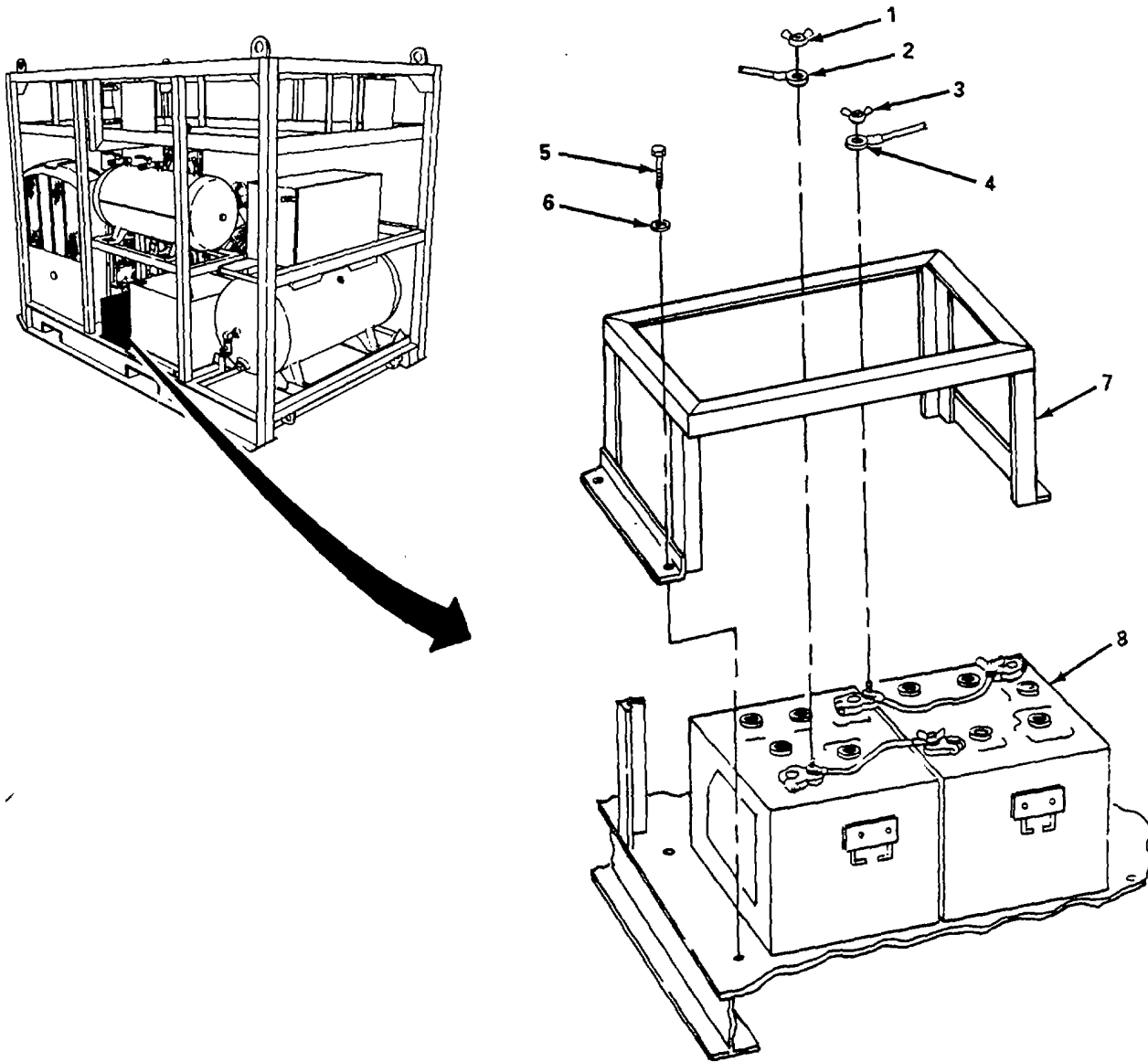
*Materials/Parts*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)      Holddown, Battery

---

Replace. (figure 3-79)

- (1) Remove wing nut (1) and tag and remove negative cable (2).
- (2) Remove wing nut (3) and tag and remove positive cable (4).
- (3) Remove four screws (5) and lockwashers (6) and remove battery holddown (7).
- (4) Install battery holddown (7) and secure with four screws (5) and lockwashers (6).
- (5) Connect positive cable (4) to battery and secure with wing nut (3).
- (6) Connect negative cable (2) to battery (8) and secure with wing nut (1).



4951-080

Figure 3-79. Battery Holddown, Replace.

---

**3-50. Frame.**

---

**This task covers:          Repair**

---

**INITIAL SETUP:***Tools**Materials/Parts*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)

Deck Material

---

**Repair.** (figure 3-50)

- (1) Remove four screws (1), washers (2) and nuts(3) and remove two brackets (4).
- (2) Remove eight screws (5), washers (6) and nuts (7) and remove deck (8).
- (3) Remove two screws (9) and nuts (10) and remove placard (11).
- (4) Repeat step 3 for three remaining placards.
- (5) Install placard (11) and secure with two screws (9) and nuts (10).
- (6) Repeat step 5 for remaining three placards.
- (7) Install deck (8) and secure with eight screws (5), washers (6) and nuts (7).
- (8) Position two brackets (4) on frame and secure with four screws (1), washers (2) and nuts (3).

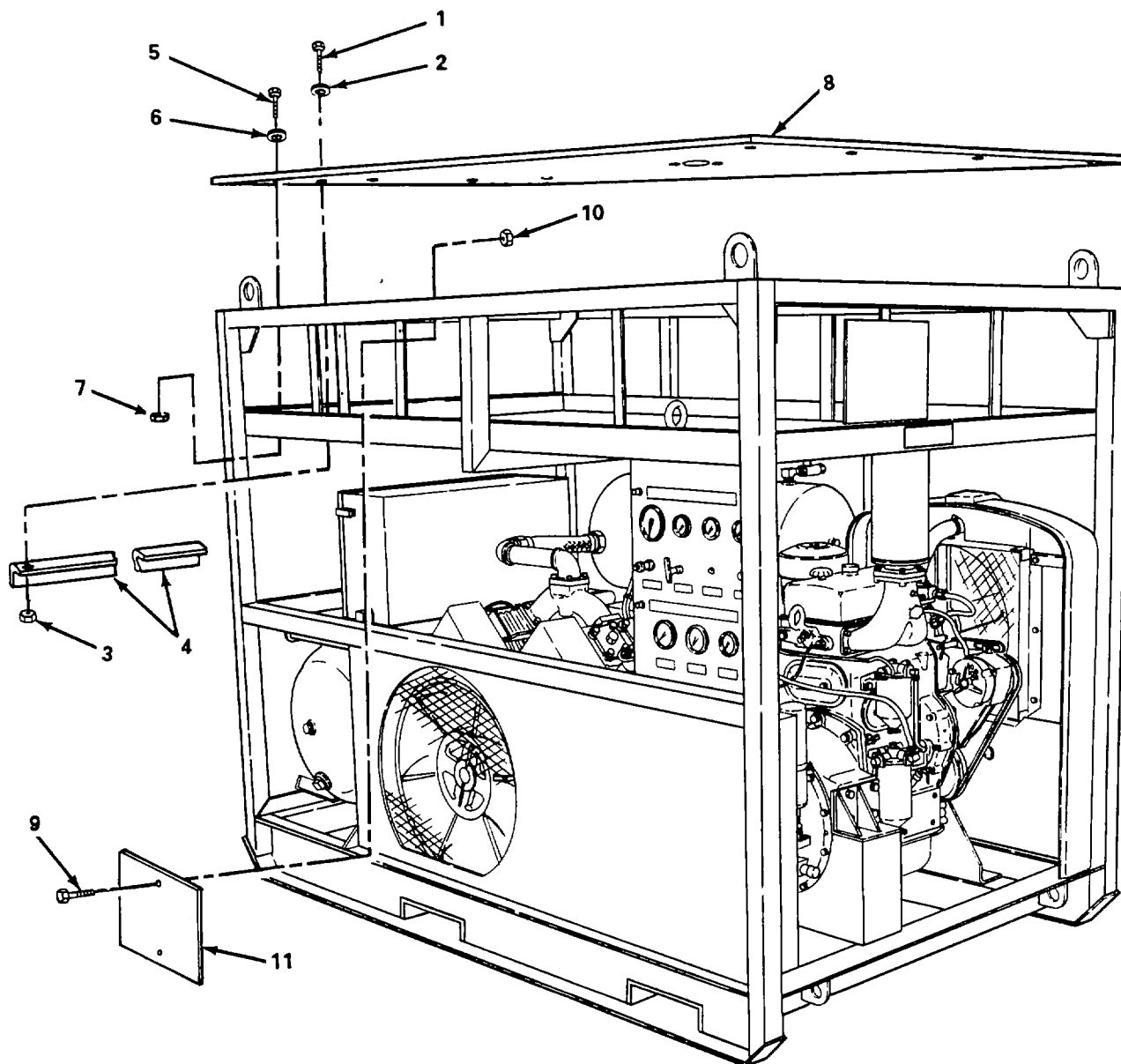


Figure 3-80. Frame, Repair.

4951-188

**Section VI. PREPARATION FOR SHIPMENT OR STORAGE**

Paragraph	Page
3-51 General .....	3-178
3-52 Short Term Storage .....	3-178
3-53 Long Term Storage .....	3-179

3-51. **General.** This section contains procedures to place the Diving Air Compressor into either short or long term storage.

**3-52. Short Term Storage.**

- a. Drain the engine and compressor crankcase.
- b. Fill the engine and compressor crankcase to the proper level with the recommended viscosity and grade oil.
- c. Fill fuel tank with the recommended grade of fuel oil. Operate the engine for two minutes at 1200 rpm and no load.

**NOTE**

Do not drain fuel system or crankcases after this run.

- d. Service the engine and compressor air cleaners.
- e. If freezing weather is expected during storage period, add a high boiling point type antifreeze solution to radiator assembly.

**WARNING**

Wear faceshield and clear immediate area of personnel when using low pressure air for maintenance procedures.

- f. Clean the entire exterior of the engine (except the electrical system) with fuel oil and dry with compressed air.
- g. Clean the compressor and air receiver tanks with nonionic detergent and rinse with clean distilled water.
- h. Any exterior rust should be removed and painted with non toxic paint in accordance with accepted army diving practices.
- i. Seal all of the engine and compressor openings. The materials used must be waterproof, vaporproof and possess sufficient physical strength to resist puncture and damage from the expansion of entrapped air.

**3-53. Long Term Storage.**

- a. Drain cooling system and flush with clean, soft water.
- b. Refill cooling system with clean, soft water.
- c. Add a rust inhibitor to cooling system.
- d. Circulate the coolant through the entire system by operating the engine until normal operating temperature is reached (160°-185°F or 71°-85°C).
- e. Stop the engine.
- f. Drain engine and compressor crankcase.
- g. Fill the crankcases to the proper level with 30-weight preservative lubricating oil.
- h. Drain the engine fuel tank.
- i. Refill the fuel tank with enough rust preventive fuel oil, to enable the engine to operate for about 10 minutes.
- j. Drain the fuel filter and strainer.
- k. Remove the retaining bolts, shells and elements. Discard the elements and gaskets. Wash shells in clean fuel oil and install new elements.
- l. Fill the cavity between the element and shell about two-thirds full of rust preventive fuel oil, and reinstall the shell.
- m. Operate the engine for five minutes to circulate the rust preventive fuel oil throughout the engine.
- n. Service the engine and compressor air cleaners.
- o. Lubricate the clutch throwout bearing, clutch pilot bearing, drive shaft main bearing and the clutch release shaft.
- p. Remove the inspection hole cover on the clutch housing and lubricate release lever and link pins
- q. Apply rust preventive compound to all exposed parts and flywheel.
- r. Drain the engine cooling system.
- s. Drain the engine and compressor crankcases.
- t. The air compressor system shall be bled down.

**NOTE**

Do not allow soda solution to enter the battery.

- u. Remove and clean the batteries and battery cables with a baking soda solution and rinse them with clean water.

**WARNING**

Lead acid batteries contain a strong acid. This acid can cause severe skin burns. Handle battery only with proper lifting strap. Wear protective clothing and eye protection.

- v. Add distilled water to the electrolyte, if necessary, and fully charge the battery. Store the batteries in a cool (never below 32°F or 0°C) dry place. Keep the batteries fully charged and check the level and the specific gravity of the electrolyte regularly.
- w. Insert heavy paper strips between the pulleys and belts to prevent sticking.
- x. Seal all of the openings in the engine and compressor.
- y. Valves on receiver tank shall be shut and plugged and covered with clear heavy plastic bags and sealed with tape.
- z. The gages and relief valves on the portable receiver tank shall be shut and plugged and covered with clear heavy plastic bags and sealed with tape.
  - aa. Service the portable filtration system filters.
  - ab. The valves on filtration system shall be shut and plugged and sealed with clear heavy plastic bags and sealed with tape,
  - ac. The gages and filter housings on filtration system shall be sealed with clear heavy plastic bags and sealed with tape.

**WARNING**

Wear faceshield and clear immediate area of personnel when using low pressure air for maintenance procedures.

- ad. Clean the entire exterior of the engine (except the electrical system) with fuel oil and dry with compressed air.
- ae. Clean the compressor and the rest of the compressor unit with nonionic detergent and rinse with clean distilled water.
- af. Any rust should be removed and painted with non toxic paint in accordance with accepted Army diving practices.
- ag. Spray the surfaces with a suitable liquid automobile body wax, or a rust preventive compound.
- ah. Cover the unit with a weather-resistant tarpaulin or other cover if it must be stored outdoors.
- ai. Store the unit in a clean, dry, environmentally controlled area, if available.



## Section VII. ORGANIZATIONAL LEVEL CLEANING PROCEDURE FOR DIVING LIFE SUPPORT AIR SYSTEMS

Paragraph		Page
3-54	General	3-181
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3-56	Clean Area	3-181
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3-58	Pre-Cleaning of Components or Piping	3-182
3-59	Cleaning Method - Non-Ionic Detergent	3-182
3-60	Cleaning Method - Trisodium Phosphate (TSP)	3-184
3-61	Cleaning Component Soft Goods	3-186
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3-54. **General.** This section covers the cleaning procedures for hyperbaric and diving life support air systems. The importance of maintaining a diver's air breathing system in a clean and operable condition cannot be over emphasized. This procedure provides basic steps and methods for removing and installing components and piping; provides the simplified methods for cleaning small components, pipes and hoses for air systems and methods for cleaning component soft goods.

3-55. **Determining System Cleanliness.** A periodic inspection of the air system will verify system cleanliness. If a system is suspected of contamination, a hydrocarbon analysis, a particulate sample may be taken or a gas sample may be drawn to determine the level of system cleanliness. These samples can be coordinated through the U.S. Army Troop Support Command, ATTN: AMSTR-S, 4300 Goodfellow Blvd., St. Louis, Missouri 63120-1798.

3-56. **Clean Area.** All cleaning for life support air systems to be performed on components and piping shall be cleaned in a "clean area." This area shall be isolated from oil, grease, paper, lint particles and other airborne contaminants. It shall be as free as possible of dust and debris. Work benches shall be covered with easily cleaned surfaces such as stainless steel, synthetic rubber, vinyl linoleum or formica. Floor shall be non-dusting. Walls and ceiling shall be covered with washable vinyl, latex paint or polyurethane-based paint.

3-57. **Removing and Installing System Components or Piping .** The following steps are guidelines for the removal and installation of piping or components from or into a clean system. In general, common sense and clean work habits must prevail at all times to maintain system cleanliness. Prior to the removal of any pipe or component, appropriate maintenance forms are to be completed and approved.

a. **Removal.** Extreme care shall be used in the removal of any component or pipe from a clean system to avoid introducing any contamination. To eliminate any chance of contamination, the following steps shall be adhered to:

- (1) Secure the system by closing valves and controls both upstream and downstream of the component or pipe to be removed. The components shall be tagged to insure that gas is not brought on line.
- (2) Removal of all debris from the intended area of assembly or disassembly such as dirt, dust, loose paint, and grease is mandatory. This includes cleaning the pipe or component which is to be removed and the adjacent components or piping.

- (3) Wipe all of the external surfaces of components and piping with detergent to remove grease or dirt.
- (4) All personnel shall have clean hands.
- (5) All tools used in the removal must be clean and grease-free.
- (6) Remove component or piping.
- (7) Immediately bag or seal all exposed ends of system with plastic.

b. Installation or Reinstallation.

- (1) The new component or cleaned pipe shall be wrapped or double-bagged. If not, the item shall be returned for cleaning.
- (2) The component or piping shall be removed from bagging and shall be inspected for damage at the mating surfaces, threads, or connecting surfaces and any primary surface. Inspect for dust or minor particle contamination, and remove with lint-free rag.
- (3) Mating components and pipe shall have protection materials or plugs removed.
- (4) Mating surfaces, O-rings and threads shall be coated lightly with an approved lubricant. Threaded surfaces must be coated to prevent galling of threads at assembly.
- (5) A pressure test shall be performed to verify there are not leaks and the correct fittings have been installed in the system.

3-58. **Pre-cleaning of Components or Piping.** Upon receipt of new components not cleaned or components and pipe removed from the system for cleaning, the item shall be pre-cleaned. Doing this shall prepare the component for final cleaning. Pre-cleaning will be accomplished in an area separate from the clean area. The pre-cleaning will include but is not limited to the following:

- a. All wrapping shall be removed.
- b. Loose paint, rust, brackets, panels, tags, supports and other items shall be removed.
- c. If hydrocarbons and/or other contaminants are known to have been introduced into the component or piping, a thorough degreasing procedure shall be initiated. Trisodium phosphate (TSP) or non-ionic detergent (NID) may be used.
- d. Visually inspect the pre-cleaned articles under a bright light to ensure that all gross contamination has been removed.
- e. Bag all components and ends of pipe with plastic to await cleaning.

3-59. **Cleaning Method Non-Ionic Detergent.** This method outlines the cleaning procedures for oil-free cleaning of metallic/nonmetallic components or assemblies using non-ionic detergent. This procedure is only to be used if there is no equipment available to conduct the TSP cleaning method.

## a. Cleaning Components or Assemblies (excluding hose assemblies).

**CAUTION**

Chemical protective gloves should be worn to prevent skin irritation from detergent and hot water.

- (1) Disassemble components down to the smallest parts. Separate soft goods and clean as specified in paragraph 3-61.
- (2) Clean each component by scrubbing with a non-ionic detergent solution (1/2 teaspoon (2.4 mL) detergent to 1 gallon (3.8 l) water) using a nylon bristle brush and clean cloths.
- (3) Rinse with distilled water at 125 degrees F (54 degrees C) until effluent shows no visible signs of detergent.
- (4) Collect some of the water rinsed over the items in a flask that can be fitted with a rubber stopper. Shake the flask for a few seconds and if any bubbles form and remain on the surface of the water in the flask, continue to rinse item until no bubbles form and remain in the sample flask.
- (5) Purge with dry, oil-free nitrogen until visually dry, or allow to air dry. The following dated and signed records shall be maintained:
  - (a) Identification of all parts cleaned.
  - (b) Results of shake test.
- (6) Reassemble as outlined on assembly or component drawing.
- (7) Double bag all components in plastic and close securely.

b. Cleaning Hose Assemblies.

- (1) Clean hose assemblies in accordance with the following steps using the specific materials and utilizing proper equipment. Pre-clean hose assemblies outside the clean area by rinsing externally with distilled water.
- (2) Most hose assemblies will not lend themselves to disassembly. Disassemble to maximum extent without removing fittings or clamps.
- (3) The cleaning solution shall be made by adding 1/2 ounce (14.7 mL) non-ionic detergent to each 80 gallons (302.8 l) of distilled water.
- (4) Heat the cleaning solution to 120 degrees F (49 degrees C) and circulate through the hose assembly for 30 minutes at a flow rate of not less than 1 gallon (3.8 l) per minute.
- (5) Rinse the hose assembly with distilled water heated to 125 degrees F (52 degrees C) for 30 minutes minimum at a flow rate of not less than 1 gallon (3.8 l) per minute. Do not recirculate the water.

- (6) Perform a shake test by collecting a 1000 ml sample of rinse water in a flask that can be fitted with a rubber stopper. Shake the flask for a few seconds and if any bubbles form and remain on the surface of the water in the flask, continue to rinse the hose until no bubbles form and remain in the sample flask.
- (7) Purge hose assembly with clean, dry, oil-free nitrogen (preferably heated to 200 degrees F (93 degrees C)) until all visible signs of water are absent. Continue drying process for 1 to 2 hours after initial purge.

**NOTE**

At no time shall the upstream purge pressure for all hose assemblies exceed 100 psig (6895 millibars).

- (8) After drying, cover each hose end with a clean plastic bag to maintain internal cleanliness. Secure the bag with 1 inch (2.5 cm) wide tape.
- (9) When components and systems have been reassembled an air sample shall be taken to verify cleanliness.

3-60. **Cleaning Method -Trisodium Phosphate (TSP)**. This method is the preferred method if all equipment is available. A steam/hot water cleaner that has adjustable siphon control for cleaning applications works well.

a. For components the following steps should be followed:

**WARNING**

The TSP cleaning solution is harmful to eyes and skin. Wear chemical protective apron, gloves and goggles/face shield when handling or working with the solution.

- (1) Prepare a solution consisting of 2 pounds (0.9 kg) TSP, 0.5 ounces (14.7 mL) non-ionic detergent and 80 gallons (302.8 l) of distilled or deionized water.
- (2) Heat solution to 165 degrees F (74 degrees C) mixing occasionally during the heating.
- (3) Disassemble components down to the smallest parts (separate and clean soft goods and aluminum parts as specified in paragraph 3-61) and soak in the solution for 10 minutes minimum, 30 minutes maximum.
- (4) After soaking, clean the parts in the ultrasonic cleaner until all visible traces of contaminate dirt or grease are gone.
- (5) For components too large for an ultrasonic cleaner, scrub the parts with a nylon bristle brush until all visible traces of contaminate dirt or grease are gone.
- (6) Rinse all parts in running hot distilled water or deionized water until all visual traces of cleaning solution are removed.
- (7) Draw 10 ml sample. Agitate or rinse water to observe for soap bubbles. If any soap bubbles are present, repeat steps (6) and (7) until no bubbles are observed.

- (8) Blow dry components with clean air, nitrogen or helium.
- (9) Reassemble components using an approved lubricant.
- (10) Bag and seal or tape closed all components and ends of pipe or hoses with plastic until ready for reinstallation.

b. For cleaning pipe or tubing the following procedures should be followed:

- (1) Determine the volume of cleaning solution estimating the length of pipe or hose to be cleaned and the size of the pipe to be cleaned. Look up the appropriate pipe/tube size and then the corresponding volume per one foot length in Table 3-3. Multiply that volume by the estimated length to be cleaned. After the total volume is calculated, multiply the answer in cubic inches by .0433 to obtain the number of gallons to fill the system. Determine applicable flow rate from Table 3-4 and multiply flow rate by thirty (30) to compute number of gallons required to pump through the system. Add volume required to fill system and the volume required to pump through the system for the total volume of cleaning solution required.

Table 3-3. TSP Cleaning Solution Volume

PIPE/TUBE SIZE (inches)	VOLUME OF 1 FOOT (0.3 m) LENGTH
1/4 (0.6 cm)	0.6 cubic inches (9.8 cm <sup>3</sup> )
3/8 (0.9 cm)	1.4 cubic inches (22.9 cm <sup>3</sup> )
1/2 (1.2 cm)	2.4 cubic inches (39.3 cm <sup>3</sup> )
3/4 (1.9 cm)	5.4 cubic inches (88.4 cm <sup>3</sup> )
1 (2.5 cm)	9.5 cubic inches (1.5 m <sup>3</sup> )
1-1/2 (3.8 cm)	21.2 cubic inches (3.4 m <sup>3</sup> )
2 (5.2 cm)	37.7 cubic inches (6.1 m <sup>3</sup> )

- (2) Prepare a solution at a ratio of 2 pounds (0.9 kg) of TSP, 0.5 ounces (14.7 mL) non-ionic detergent for each 80 gallons (302.8 l) of distilled or deionized water as determined.
- (3) Heat solution to 165 degrees F (74 degrees C) mixing occasionally during the heating.
- (4) Pump the cleaning solution through the pipe/tubing for 30 minutes at a rate listed in Table 3-4 using the solution pump, and maintain constant temperature at all time. It may be necessary with some piping configurations to cap or plug some openings and alternate with others to maintain even flow of cleaning solution to all segments of the pipe. If you run out of cleaning solution prior to the 30 minutes listed, prepare another volume of cleaning solution.
- (5) Pump hot distilled or deionized water through the system to rinse until all visible traces of cleaning solution are removed.

- (6) Draw 10 ml sample. Agitate to observe for soap bubbles. If any soap bubbles are present, repeat step (5) until no bubbles are observed.
- (7) Blow dry parts or components with clean, dry, oil-free nitrogen (preferably heated to 200 degrees F (93 degrees C)) until all visible signs of water are absent. Maintain process for 1 to 2 hours after initial purge.
- (8) Double bag and seal or tape closed all components and ends of pipe or hoses with plastic until ready for reinstallation.

c. Hoses shall be cleaned as specified in paragraph 3-59.

Table 3-4. Cleaning Solution Flow Rate

TUBE SIZE (inches)	GPM	PIPE SIZE (inches)	GPM
1/4 (0.6 cm)	1/2	1/4 (0.6 cm)	2
3/8 (0.9 cm)	2	3/8 (0.9 cm)	3
1/2 (1.2 cm)	3 3/4	1/2 (1.2 cm)	5 1/2
3/4 (1.9 cm)	6 3/4	3/4 (1.9 cm)	9 1/2
1 (2.5 cm)	12 1/2	1 (2.5 cm)	15 1/2
		1 1/4 (3.1 cm)	23
		1 1/2 (3.8 cm)	35
		2 (5.2 cm)	50

3-61. **Cleaning Component Soft Goods.** The following isopropyl alcohol method is provided for the cleaning of the soft goods and aluminum parts of system components. The method for non-ionic detergent is the same procedure as that in paragraph 3-59.

**CAUTION**

Ensure ventilation is adequate and avoid breathing vapors.

Personnel should wear chemical protective gloves to prevent skin irritation when contact with isopropyl alcohol is necessary.

Isopropyl alcohol shall be maintained in a covered container to preclude excess concentrations in the air for fire protection. The cover should be removed only for placement or removal of soft goods.

**NOTE**

Table 3-5 lists all compatible cleaning agents for general soft goods used in the Army diving and systems. Only the isopropyl alcohol procedure is listed below.

- a. Soak component soft goods or aluminum parts in a tray of isopropyl alcohol for 10 minutes maximum.

- b. Wipe each piece of soft good individually with wipes soaked in isopropyl alcohol. Do this until all dirt and foreign matter is visually removed.
- c. Rinse software with fresh isopropyl alcohol.
- d. Blow dry with air, nitrogen, or helium.

**Table 3-5. Cleaning Agents Compatible with Soft Goods**

SOFT GOODS	FREON PCA MIL-C-81 302B	TSP O-S-642	NID MIL-D-16791	IA TI-I-735A
Adiprene C	X		X	
Adiprene L	X		X	
Buna N	X	X	X	X
Buna S	X	X	X	X
Butyl			X	X
Delrin	X	X	X	
Epoxy Resin	X		X	
Kel-f	X	X	X	X
Hypalon 40	X		X	
Kralartic	X		X	
Lexan	X		X	
Lucite	X		X	
Neoprene W	X		X	
Nylon		X		X
Polyethylene 7050	X	X	X	X
Polyethylene 9140	X	X	X	X
Polyvinyl Chloride	X	X	X	X
Surlyn A	X		X	
Teflon TFE	X	X	X	X
Teflon FEP	X	X	X	X
Thiokol FA	X		X	X
Viton A	X	X	X	X
Viton B	X	X	X	X
Zytel 101	X		X	
Ethylene Propylene		X	X	X

X - Solvent is compatible with soft goods.  
 Blank - Solvent is not compatible with soft goods.

**3-62. Hydrocarbon Inspection and Analysis.**

a. Visual Method. By definition, visibly clean is the absence of all particulate and non-particulate matter visible to the normal unaided (except for corrected vision) eye. Particulate is identified as matter of miniature size with observable length, width and thickness. Non-particulate is film matter without definite dimension. Examples of visual inspection are:

- (1) A clean cloth placed over the discharge end may collect particulates and debris when air or nitrogen is blown through the system.

(2) A component that has been "in service" may have visible signs of grease, dirt, etc.

(3) Absorption of oil or grease on a clean filter paper from a surface swipe.

b. Ultraviolet Light Method. The ultraviolet method for detecting hydrocarbons may be employed in several different ways.

#### **WARNING**

MOST ULTRAVIOLET LAMPS CONTAIN MERCURY. EXTREME CAUTION SHOULD BE TAKEN NOT TO BREAK THE MERCURY VAPOR LAMP WHICH WILL CONTAMINATE THE COMPONENT OR PIPE BEING INSPECTED AND MAY ALSO CAUSE HUMAN INJURY.

(1) Direct Inspection: The component may be examined directly with the ultraviolet light. By passing the component under the ultraviolet light, hydrocarbon surface contamination may exhibit fluorescence where some hydrocarbons exist.

(2) Inspection of Cleaning Solution When Detergent is Used: Used cleaning solution collected in a clean beaker when agitated will form bubbles. These bubbles, under ultraviolet light, may exhibit fluorescence.

#### **3-63. Documentation and Record Keeping.**

a. All diving systems currently involved in U. S. Army diving operations require that they be certifiable. It is with this requirement understood, that a diving system must retain certain records and documents to substantiate safety standards. The individual operating the clean area being directly involved with system maintenance should therefore be required to maintain records documenting cleaning operations in a systematic manner.

b. The purpose of this section is to set forth a guide for documentation and record keeping involved in cleaning operations and in no way intends to impose restrictions on the amount of paperwork a unit feels it requires to operate safely.

c. A sequential record maintained of components cleaned (i. e. regulators, pipe, and/or any component) affecting re-entry into a certified system. It should include a written record of all cleaning analysis and testing accomplished as per this procedure. A data sheet should be completed for items cleaned and tested per this procedure. All other information which pertains to the cleaning and/or testing of a particular item shall be attached to or referenced on the data sheet. Such information should include, but not limited to outside laboratory reports, vendor data, etc.

d. It is possible that certain data and results will apply to more than one data sheet. For example, it is possible that a sample for gaseous contaminants will be taken by sampling an entire system. This system will consist of numerous items, each having its own data sheet. To assure complete documentation, reference the results of the gaseous contamination analysis on each affected data sheet.

e. As a minimum the data sheet should reflect the following information:

(1) Unit

(2) Date



- (3) Name of Point of Contact
- (4) Description of Cleaning Performed
- (5) Person Performing the Cleaning
- (6) Results of any Analysis
- (7) Description of Item Being Cleaned
- (8) Part Number/NSN
- (9) Remarks

**3-189/(3-190 Blank)**

CHAPTER 4

DIRECT SUPPORT MAINTENANCE

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OVERVIEW .....	4-1
Section I Repair Parts; Special Tools; and Support Equipment.....	4-1
Section II Direct Support Troubleshooting.....	4-1
Section III Direct Support Maintenance Procedures.....	4-4

**OVERVIEW**

This chapter contains information for troubleshooting and maintenance of the Diving Air Compressor by direct support maintenance personnel.

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

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

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

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

**4-3. Repair Parts.** Repair parts are listed and illustrated in the Repair Parts and Special Tools List for Diving Air Compressor, TM 5-4310-379-24P.

**Section II. DIRECT SUPPORT TROUBLESHOOTING**

Paragraph		Page
4-4	General .....	4-1
4-5	Direct Support Troubleshooting procedures.....	4-2

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

**4-5. Direct Support Troubleshooting Procedures.** Table 4-1 lists the common malfunctions that may be found during operation. Refer to symptom index to locate the troubleshooting procedures for the malfunction. This manual cannot list all malfunctions that may occur, nor all test or inspections and corrective actions. If a malfunction is not corrected by listed corrective actions, notify your supervisor.

**SYMPTOM INDEX**

Symptom	Page
1. Engine will not start.....	4-2
2. Engine runs rough or erratically.....	4-2
3. Engine overheats.....	4-3
4. Low pressure output pressure.....	4-3
5. Power take-off will not engage.....	4-3

**Table 4-1. Direct Support Troubleshooting Procedures.**

---

<b>MALFUNCTION</b>
<b>TEST OR INSPECTION</b>
<b>CORRECTIVE ACTION</b>

---

1. ENGINE WILL NOT START.

Check fuel injectors.

Replace defective fuel injector (para. 4-10).

2. ENGINE RUNS ROUGH OR ERRATICALLY.

Step 1. Governor out of adjustment.

Adjust governor (para. 4-11).

Step 2. Valve operating mechanism out of adjustment.

Adjust valve operating mechanism (para. 4-21).

Step 3. Fuel injectors out of timing.

Adjust fuel injectors (para. 4-10).

Step 4. Injector controls out of adjustment.

Adjust injector controls (para. 4-9).

Table 4-1. Direct Support Troubleshooting Procedures (Cont).

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MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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---

## 3. ENGINE OVERHEATS.

Step 1. Oil cooler clogged.

Replace oil cooler (para. 4-17).

Step 2. Oil cooler by-pass valve defective.

Replace oil cooler by-pass valve (para. 4-18).

## 4. LOW COMPRESSOR OUTPUT PRESSURE.

Step 1. Inspect air lines and fittings on compressor.

Tighten loose connections and replace damaged items.

Step 2. Check V-D pilot valve.

Replace a defective valve (para. 4-26).

Step 3. Check manifold group.

Replace a damaged manifold (para. 4-30).

## 5. POWER TAKE-OFF WILL NOT ENGAGE.

Check power take-off.

Adjust or replace power take-off (para. 4-22).

### Section III. DIRECT SUPPORT MAINTENANCE PROCEDURES

**4-6. General.** This section contains direct support maintenance procedures as authorized by the maintenance allocation chart in Appendix B of this manual. When performing maintenance on air compressor, keep all tools and work area as clean as possible. Remove all oil, grease, rust or other contaminants in accordance with acceptable army diving cleaning practices. All compressor components must be cleaned with nonionic detergent solution and rinsed thoroughly with fresh distilled water. Tools should be thoroughly cleaned after performing maintenance on diesel engine and before performing maintenance on air compressor.

Paragraph		Page
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4-42	Controls and Indicators.....	4-160
4-43	Control Panel .....	4-164
4-44	Engine Mount.....	4-166

---

**4-7. Radiator Assembly**

---

**This task covers:**

---

**a. Repair**

## INITIAL SETUP

*Tools*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)  
Torch Outfit, Cutting and Welding Oxy Acetylene  
(NSN 3433-00-026-4718)

*Equipment Condition*

Radiator assembly removed (para. 3-19)

*Materials/Parts*

Radiator Assembly  
Solvent, Dry Cleaning (Item 23, Appendix D)  
Rags, Wiping (Item 21, Appendix D)

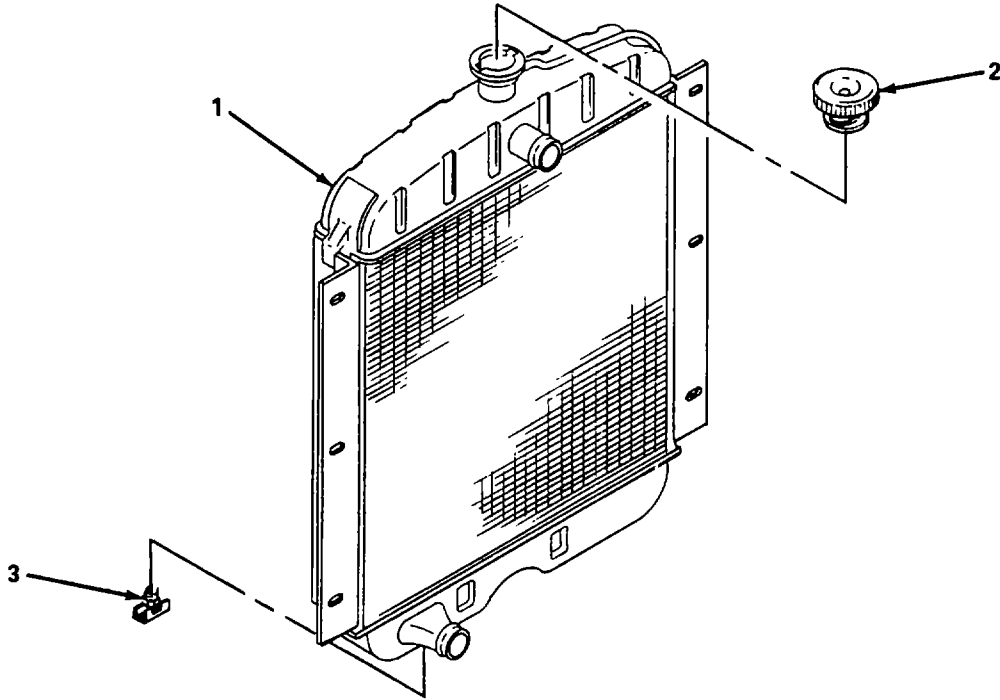
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Repair. (figure 4-1)

**WARNING**

Dry cleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100-138°F (38-600C).

- (1) Clean radiator (1) with dry cleaning solvent and dry thoroughly.
- (2) Inspect radiator (1) and repair by brazing cracks or replace an excessively damaged radiator.
- (3) Inspect cap (2) and replace if worn or otherwise damaged.
- (4) Inspect pet cock (3) and replace if damaged.



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**Figure 4-1. Radiator Assembly, Repair.**

FOLLOW-ON MAINTENANCE  
Install radiator assembly (para. 3-19).

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**4-8. Fuel Manifold Connections.**

---

**This task covers: a. Replace**

---

## INITIAL SETUP

*Tools*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)  
Nut Wrench (P/N J 8932-01)  
Wrench, Torque (NSN 5120-00-554-7292)

*Equipment Condition*

Rocker cover removed (para. 3-39)

*Materials/Parts*

Fuel Manifold Connections  
Connection Fitting  
Washer

---

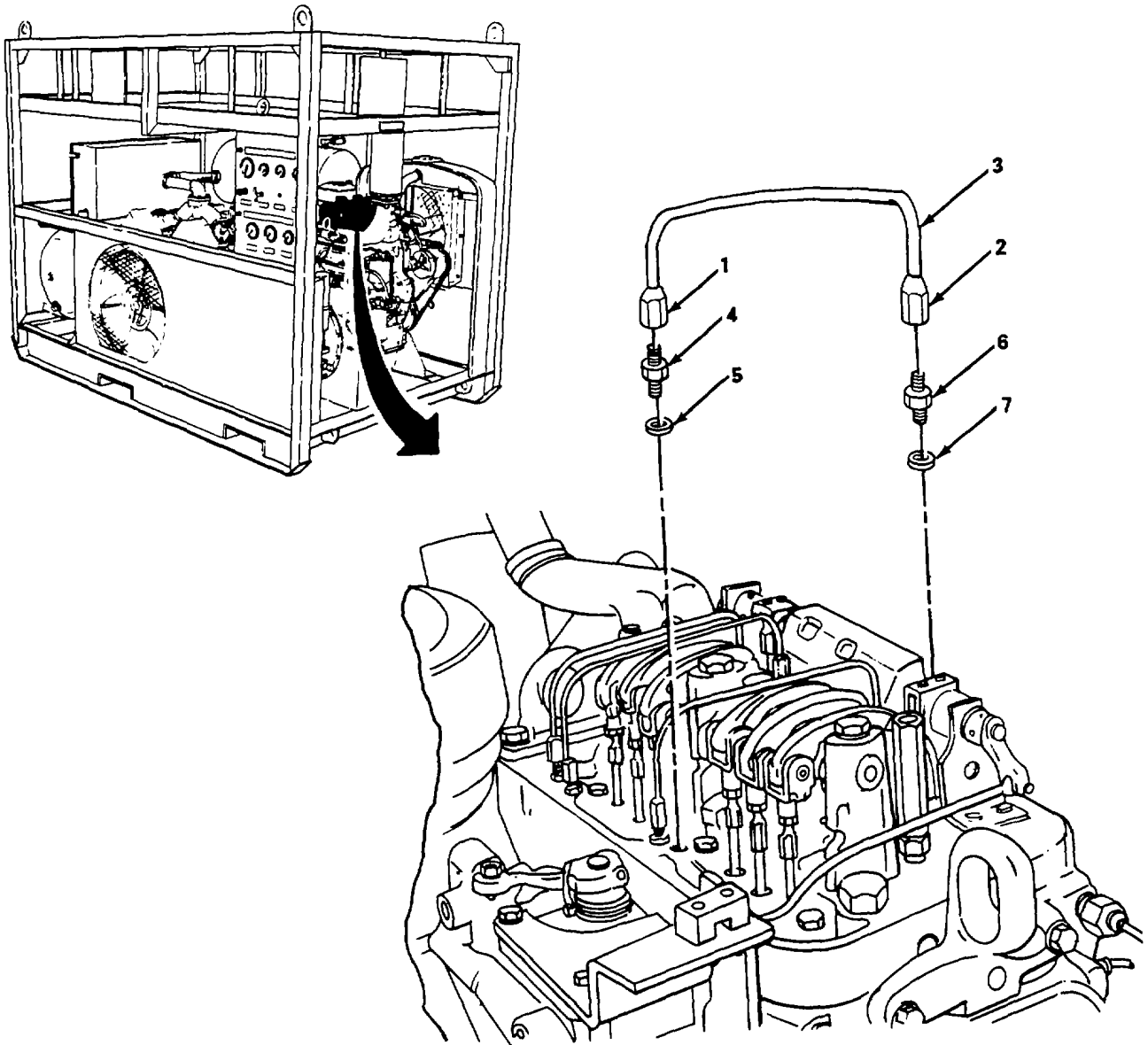
**NOTE**

There are four fuel manifold lines. The maintenance procedures are the same for all fuel manifold lines.

**Replace.** (figure 4-2)

- (1) Loosen fitting nut (1).
- (2) Loosen fitting nut (2) and remove fuel manifold line (3).
- (3) Remove connection fitting (4) and washer (5).
- (4) Remove connection fitting (6) and washer (7).
- (5) Install connection fitting (4) and washer (5). Torque connection fitting (4) to 65-75 lbs-ft (88-102 Nm).
- (6) Install connection fitting (6) and washer (7). Torque connection fitting (7) to 65-75 lbs-ft (88-102 Nm).
- (7) Install fuel manifold line (3) and finger tighten fitting nut (2).
- (8) Tighten fitting nuts (1) and (2) fully. Using nut wrench, torque fuel manifold fitting nuts (1) and (2) to 12-15 lb-ft (16-20 Nm).





**Figure 4-2. Fuel Manifold Connections, Replace.**

FOLLOW-ON MAINTENANCE  
Install rocker cover (para. 3-39).

---

**4-9. Injector Control.**

---

**This task covers:**    **a. Adjust**                      **b. Replace**                      **c. Repair**

---

**INITIAL SETUP***Tools*

General Mechanic's Tool Kit  
(NSN 5180-00-177-7033)  
Wrench, Torque (NSN 5120-00-554-7292)  
¼ in. Star 12 Point Socket (NSN 5120-00-817-1187)

*Equipment Condition*

Rocker cover removed (para. 3-39)

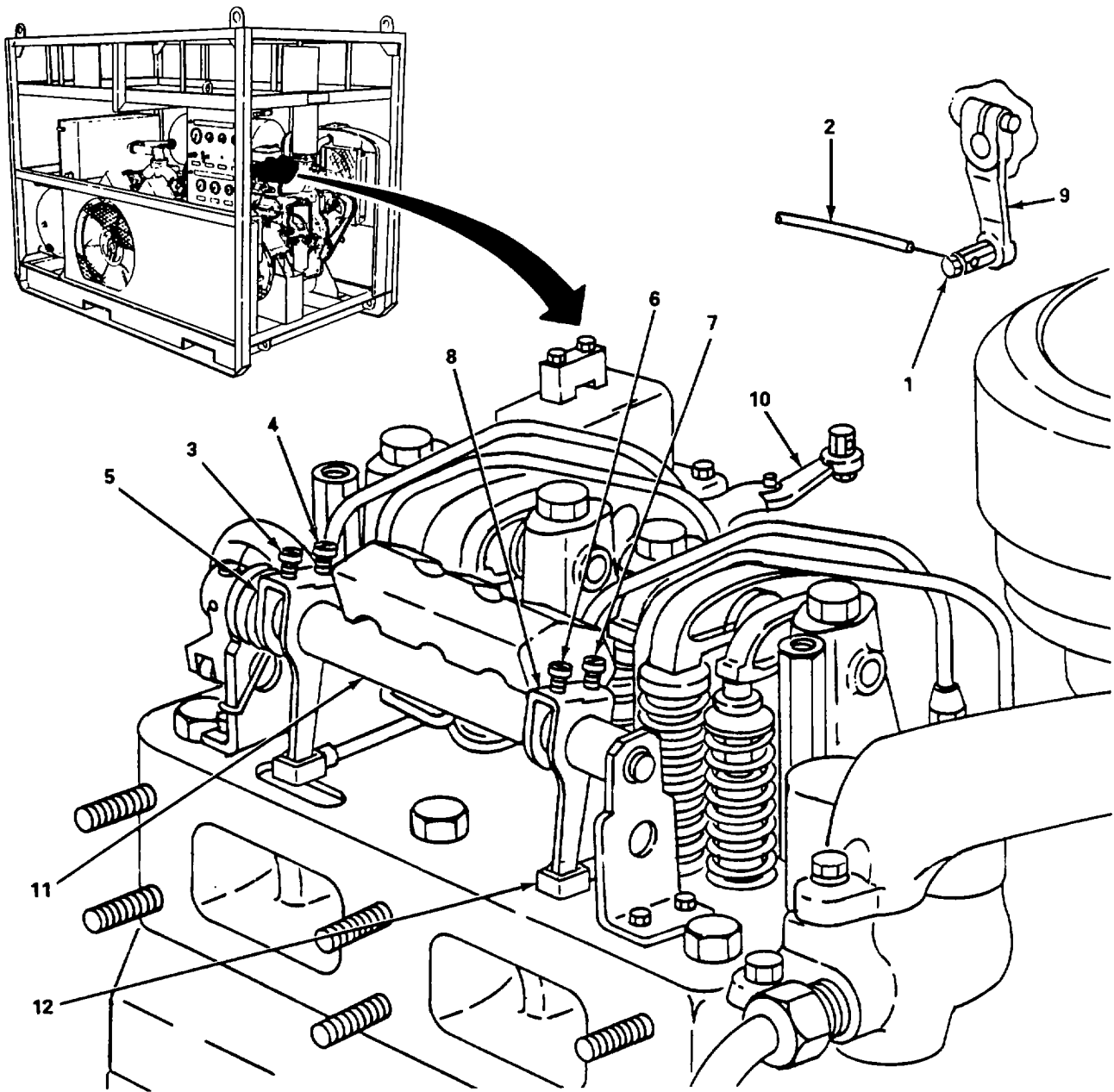
*Materials/Parts*

Injector Control  
Solvent, Dry Cleaning (Item 23, Appendix D)  
Rags, Wiping (Item 21, Appendix D)

---

**a. *Adjust.*** (figure 4-3)

- (1) Loosen screw (1) and disconnect throttle cable (2).
- (2) Loosen two adjusting screws (3) and (4) on front rack control lever (5).
- (3) Loosen two adjusting screws (6) and (7) on rear rack control lever (8).
- (4) Move speed control lever (9) to maximum speed position.
- (5) Move stop lever (10) to run position and hold in place.
- (6) Tighten adjusting screw (6) until it comes into contact with control tube (11).
- (7) Tighten adjusting screw (7) until it bottoms on control tube (11).
- (8) Fully tighten both adjusting screws (6) and (7) evenly.
- (9) The adjuster rack (12) should move back to its original position when properly adjusted.
- (10) Hold rear rack control (8) to full fuel position.
- (11) Tighten adjusting screw (3) until front rack control lever(5) is in full fuel position.
- (12) Tighten adjusting screw (4) until it bottoms lightly on control tube (11).
- (13) Tighten both adjusting screws (3) and (4) evenly.
- (14) Install throttle cable (2) and tighten screw (1).



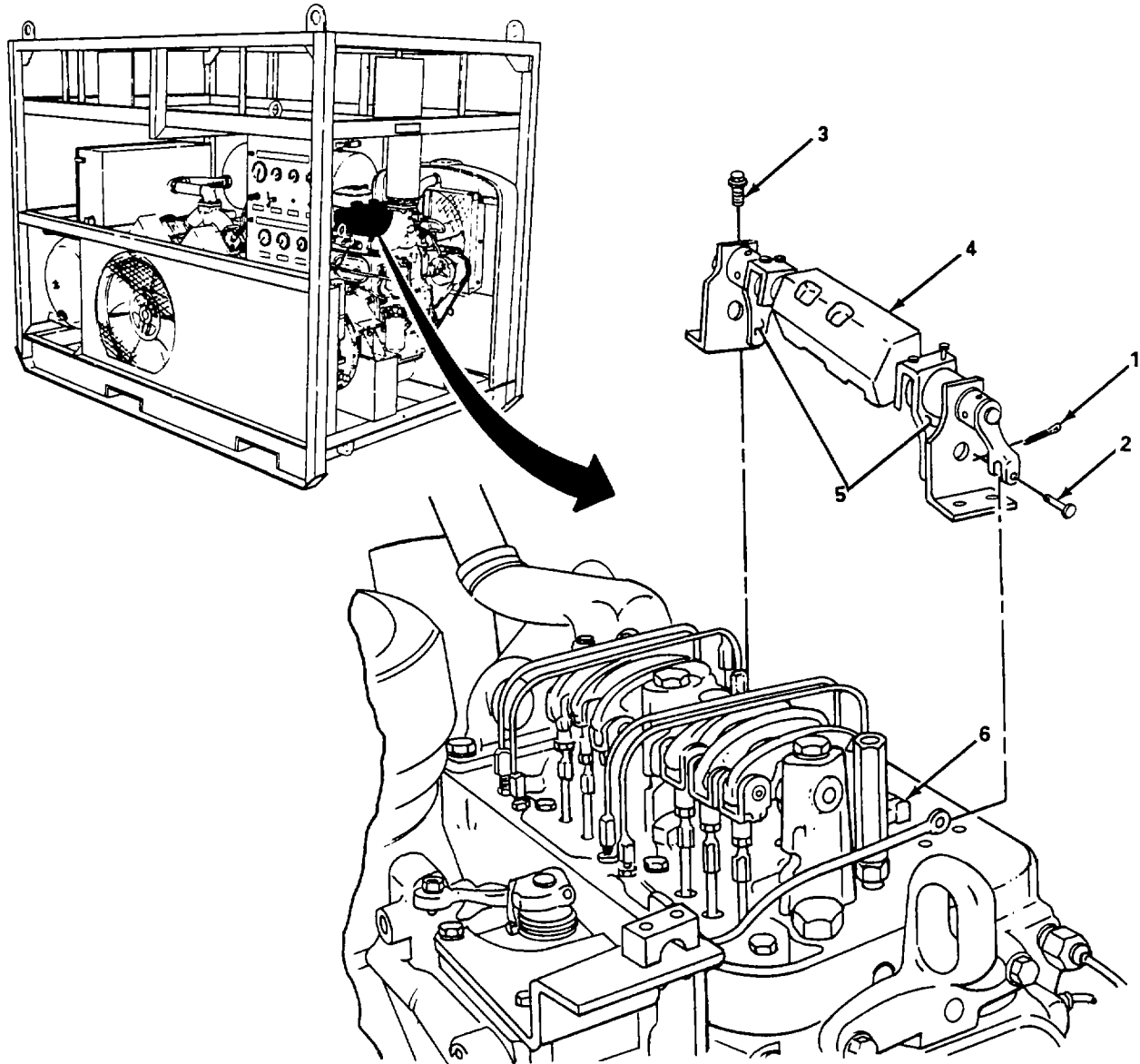
**Figure 4-3. Fuel Injector Control Rack, Adjust.**

**FOLLOW-ON MAINTENANCE:**  
Install rocker cover (para. 3-39).

**4-9. Injector Control (Cont).**

b. Replace. (figure 4-4)

- (1) Remove cotter pin (1) and remove pin (2).
- (2) Remove four screws (3) and remove injector control (4).
- (3) Install injector control (4), ensure arms (5) align with injector arms (6) and secure with four screws (3). Torque screws to 10-12 lb-ft (14-16 Nm).
- (4) Install pin (2) and secure with cotter pin (1).
- (5) Adjust **control rack as per para. a. above.**



**Figure 4-4. Injector Control, Replace.**

FOLLOW-ON MAINTENANCE  
Install rocker cover (para. 3-39)

**4-9. Injector Control (Cont).**

- c. Repair. (figure 4-5)

**NOTE**

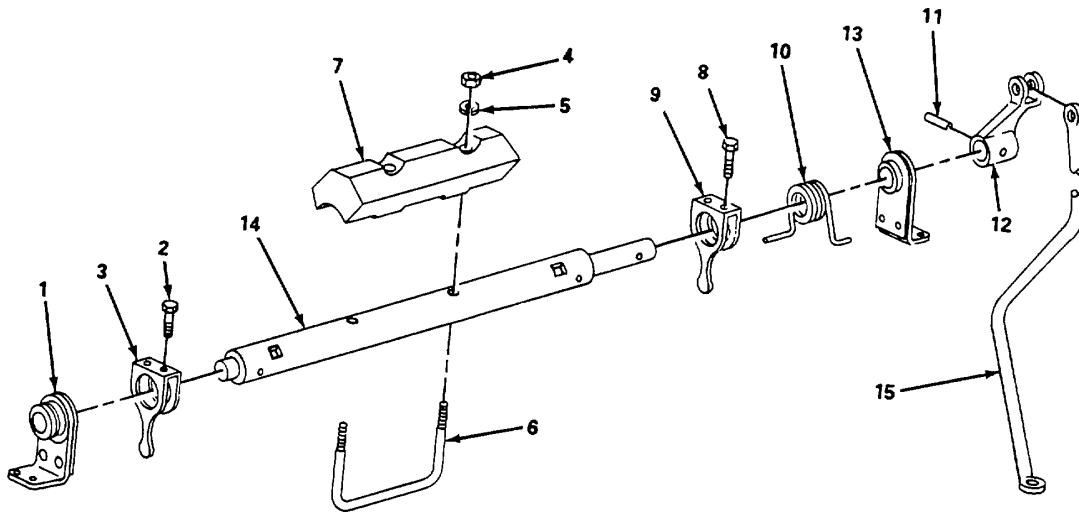
**Injector control rack removed for repair, see para. b. above.**

- (1) Remove support (1).
- (2) Loosen two screws (2) and remove arm (3)
- (3) Remove two nuts (4) and lockwashers (5) and remove u-bolt (6) and weight (7).
- (4) Loosen two screws (8) and remove arm (9) and spring (10).
- (5) Remove pin (11) and remove control arm (12) and support (13).

**WARNING**

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

- (6) Clean all parts with dry cleaning solvent and dry thoroughly.
- (7) Inspect supports (1) and (13) and replace if bent, cracked or bushing is worn or otherwise damaged.
- (8) Inspect weight (7) and replace if cracked or otherwise damaged.
- (9) Inspect control arm (12) and replace if cracked or otherwise damaged.
- (10) Inspect control tube (14) and replace if cracked, bent, or otherwise damaged.
- (11) Inspect arms (3) and (12) and replace if bent, cracked, or otherwise damaged.
- (12) Inspect spring (10) and replace if bent or otherwise damaged.
- (13) Inspect linkage (15) and replace if bent or otherwise damaged.
- (14) Install support (13) and control arm (12) and secure with pin (11).
- (15) Install spring (10) and arm (9) and finger tighten two screws (8).
- (16) Install u-bolt (6) and weight (7) and secure with two nuts (4) and lockwashers (5).
- (17) Install arm (3) and finger tighten two screws (2).
- (18) Install support (1).



**Figure 4-5. Injector Control Repair.**

FOLLOW-ON MAINTENANCE  
Install injector control rack (para. b.)

**Change 1 4-15**

---

**4-10. Fuel Injectors.**

---

**This task covers: a. Replace**

---

## INITIAL SETUP

*Tools*

General Mechanic's Tool Kit  
(NSN 5180-00-177-7033)  
Wrench, Torque (NSN 5120-00-554-7292)

*Equipment Condition*

Fuel injector control removed (para. 4-9)  
Fuel manifold connections removed (para. 4-8)

*Materials/Parts*

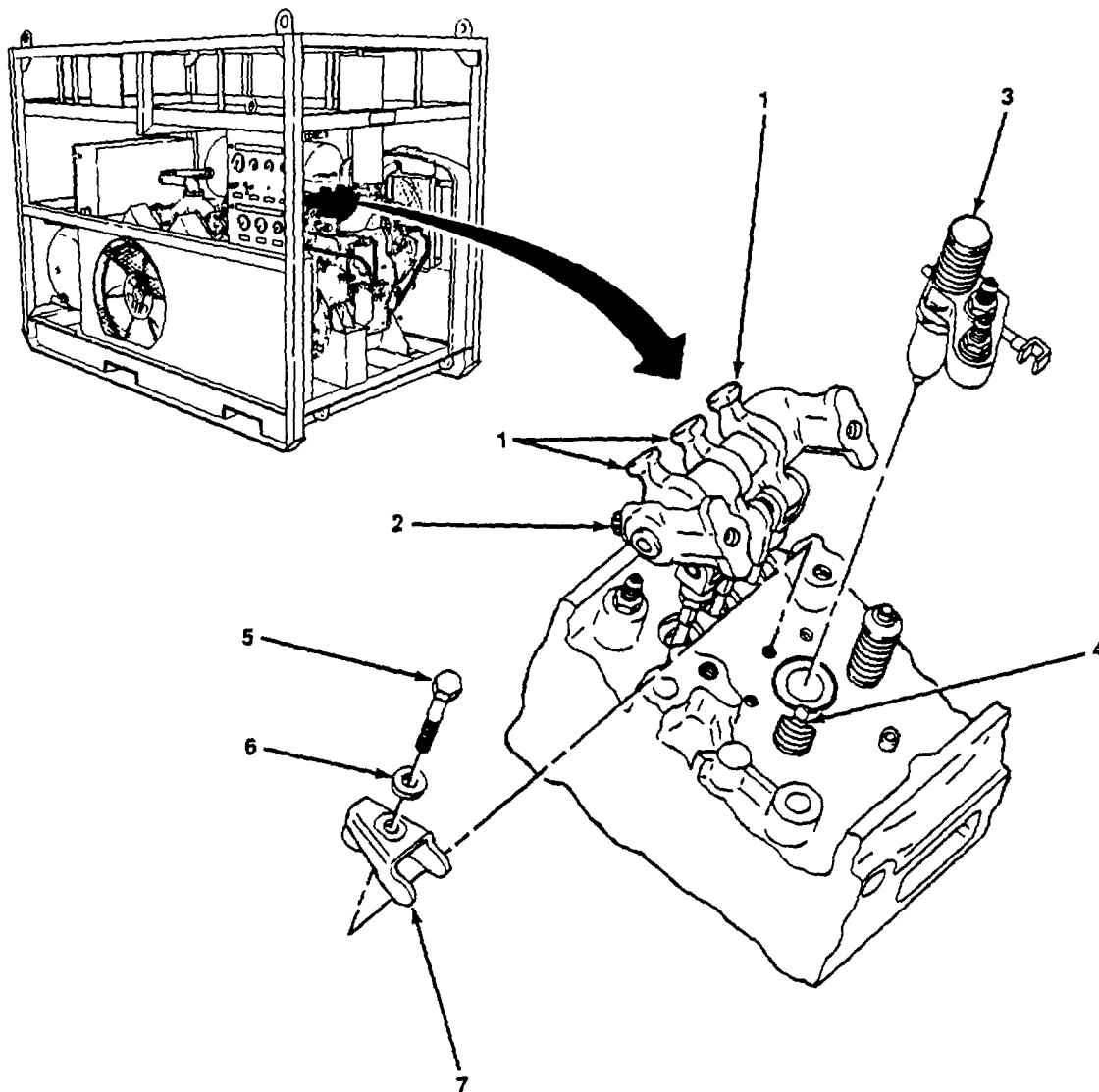
Fuel Injector

---

Replace. (figure 4-6)

- (1) Turn engine over until rockers (1) are in their upper most positions.
- (2) Remove two bolts (2) and rotate rockers (1) away from injector (3) and valves (4).
- (3) Remove bolt (5) and washer (6) and remove injector clamp (7).
- (4) Remove injector (3).
- (5) Install injector (3) and secure with injector clamp (7), bolt (5) and washer (6). Torque bolt to 20-25 lb-lt (27-34 Nm).
- (6) Rotate rockers (1) into position and secure with two bolts (2). Torque bolts to 90-100 lb-ft (122-136 Nm).





**Figure 4-6. Fuel Injector Replace.**

**FOLLOW-ON MAINTENANCE**

- (1) Adjust injector control (para. 4-9).
- (2) Install injector control (para. 4-9).

---

**4-11. Governor Assembly**

---

**This task covers:    a. Adjust                    b. Replace**

---

## INITIAL SETUP

*Tools*

General Mechanic's Tool Kit  
(NSN 5180-00-177-7033)

*Equipment Condition*

Breather pipe removed (para. 3-40).  
Rocker cover removed (para. 3-39).  
Oil filter removed (para. 3-37).

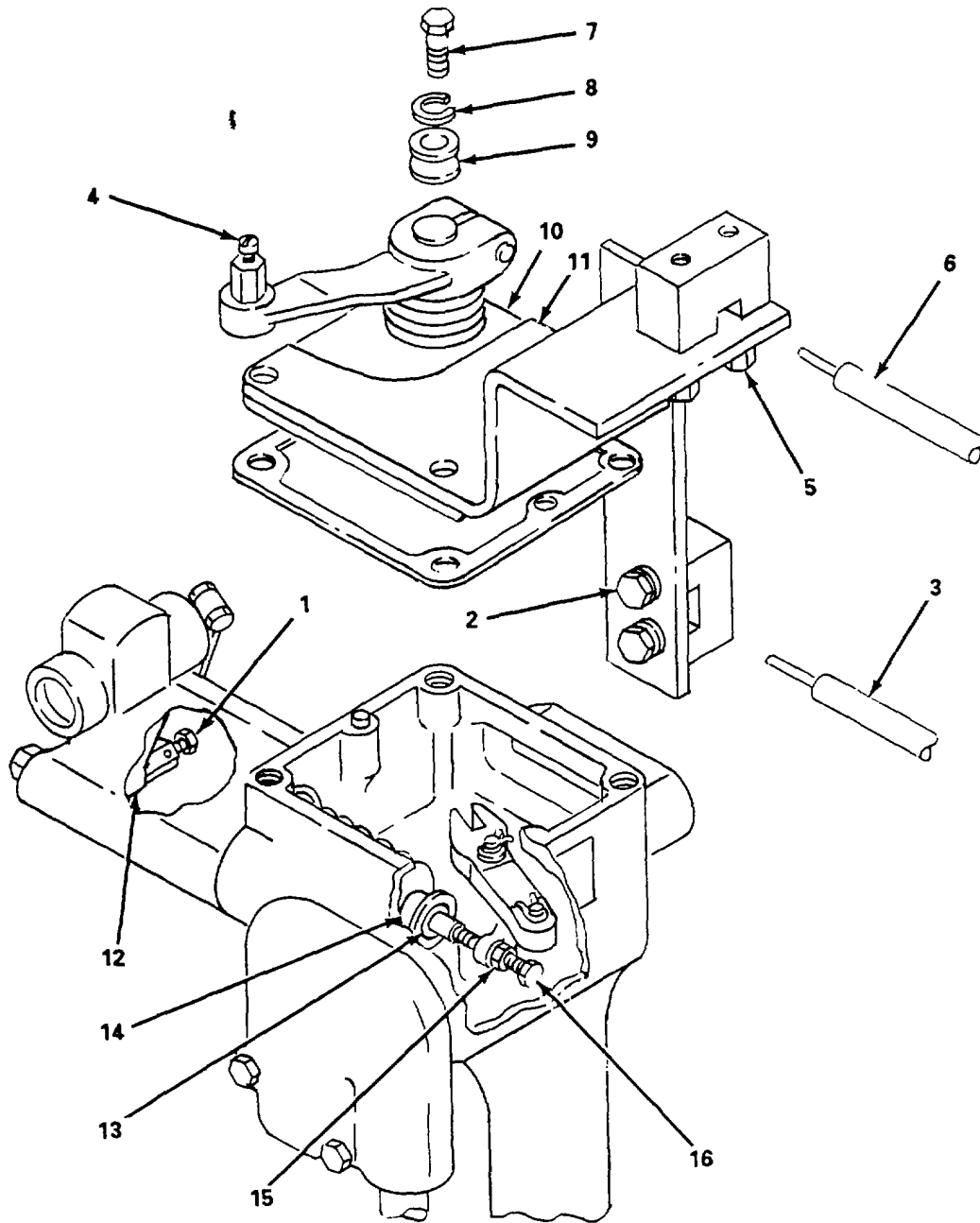
*Materials/Parts*

Governor  
Gasket, Governor Mounting  
Gasket, Governor to Cylinder Head Mounting

---

a. Adjust. (figure 4-7)

- (1) Loosen screw (1).
- (2) Loosen two screws (2) and remove throttle cable (3).
- (3) Loosen screw (4).
- (4) Loosen two screws (5) and remove stop cable (6).
- (5) Remove four screws (7), lockwashers (8), spacer (9) and remove cover (10) and bracket (11).
- (6) Hold speed control lever (12) in maximum speed position.
- (7) Measure gap between plunger guide (13) and spring plunger (14). Gap should be 0.0096 in. Gauge (0.01524 cm). Loosen nut (15) and adjust screw (16) until proper gap is achieved and tighten nut (15).
- (8) Install cover (10) and bracket (11) and secure with four screws (7), lockwashers (8), and spacer (9).
- (9) Install stop cable (6) and tighten two screws (5) and screw (4).
- (10) Install throttle cable (3) and tighten two screws (2) and screw (1).



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Figure 4-7. Governor, Adjust (Sheet 1 of 2).

4-11. Governor Assembly (Cont).

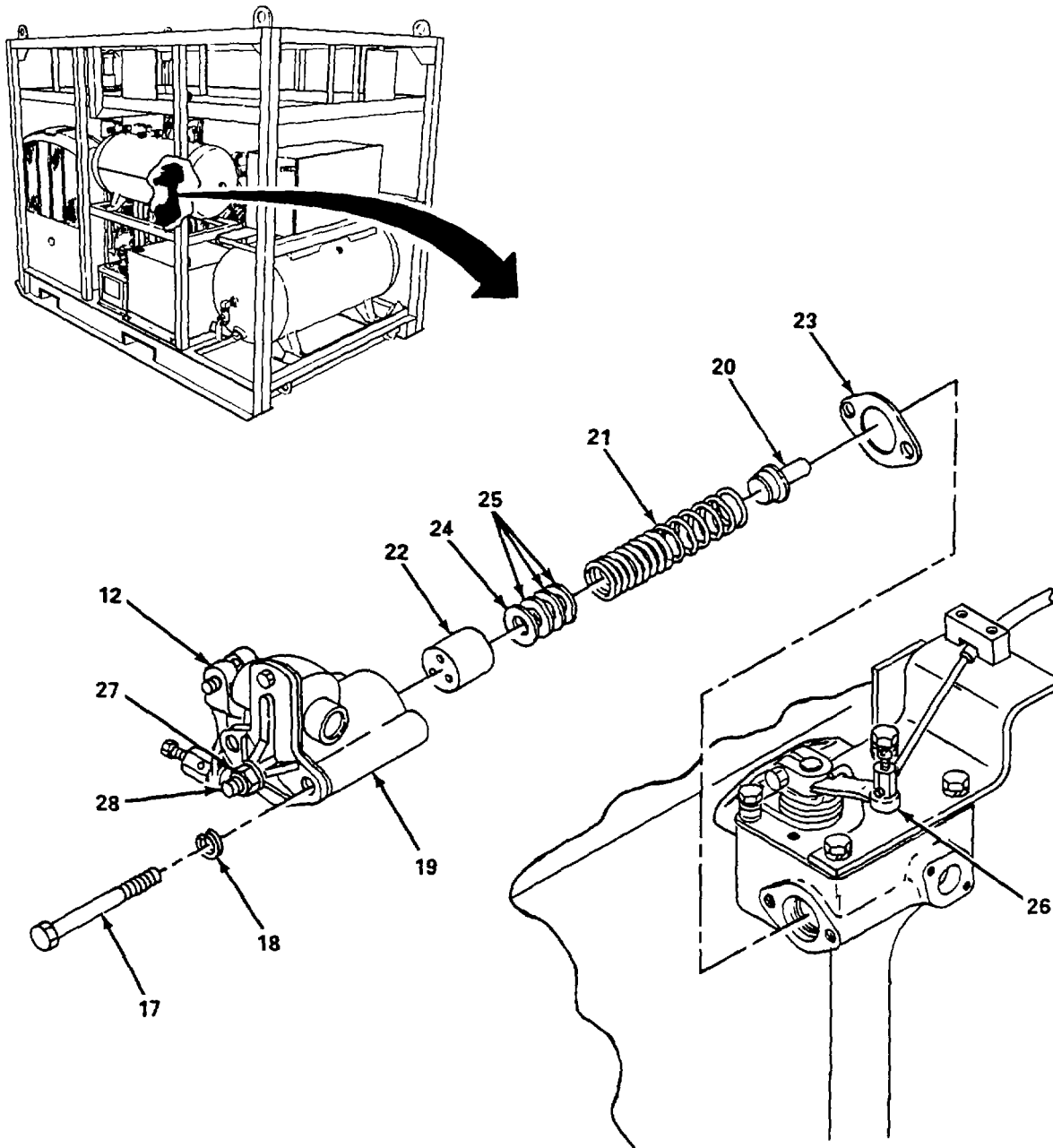


Figure 4-7. Governor Assembly, Adjust (Sheet 2 of 2).

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- (11) Start engine (para. 2-5) and measure maximum no-load engine speed. Engine speed should be 2140 rpm.
- (12) Stop engine (para. 2-8).
- (13) Refer to table 4-2 and determine the number of shims or stops required.
- (14) Remove two screws (17) and lockwashers (18) and remove variable spring housing (19), plunger (20), spring (21), spring retainer (22), and gasket (23).
- (15) Add or remove shims (24) or stops (25) as needed to obtain proper maximum no-load speed.
- (16) Install spring retainer (22), spring (21), gasket (23), plunger (20), and housing (19) and secure with two screws (17) and lockwashers (18).
- (17) Start engine (para. 2-5).
- (18) Place stop lever (26) in run position and speed control lever (12) in idle position and check engine speed. Engine speed should be 500-900 rpm.
- (19) Loosen locknut (27) and turn speed adjusting screw (28) until proper speed is obtained and tighten locknut (27).
- (20) Stop engine (para. 2-8)

**Table 4-2. Governor Shims and Stops Requirements.**

No Load Speed	Stops	Shims
1200 to 1425 rpm	2	Up to .325"
1426 to 1825 rpm	1	Up to .325"
1826 to 2000 rpm	0	Amount required to get necessary speed.

**4-11. Governor Assembly (Cont).**b. *Replace.* (figure 4-8)

- (1) Remove cotter pin (1) and remove pin (2).
- (2) Loosen screw (3).
- (3) Remove two screws (5), lockwashers (4), and block (6) and remove cable (7) from governor assembly (8).
- (4) Loosen screw (9).
- (5) Remove two screws (10), lockwashers (11) and block (12) and remove cable (13) from governor assembly (8).
- (6) Remove two screws (14) and lockwashers (15) securing governor assembly (8) to cylinder block (16).
- (7) Remove four screws (17) and lockwashers (18) and remove governor assembly (8) and gaskets (19) and (20).
- (8) Ensure gasket surfaces are clean and old gasket material is removed.
- (9) Install governor assembly (8) and gaskets (19) and (20) and secure with four screws (14) and lockwashers (15).
- (10) Install two screws (14) and lockwashers (15).
- (11) Install cable (13) and secure with two screws (10), lockwashers (11), and block (12) and tighten screw (9).
- (12) Install cable (7) and secure with two screws (5), lockwashers (4), and block (6) and tighten screw (3).
- (13) Position rod (21) in control rack and secure with pin (2) and cotter pin (1).
- (14) Adjust governor assembly.

## FOLLOW-ON MAINTENANCE:

- Install oil filter (para. 3-37).
- Install rocker cover (para. 3-39).
- Install breather pipe (para. 3-40).

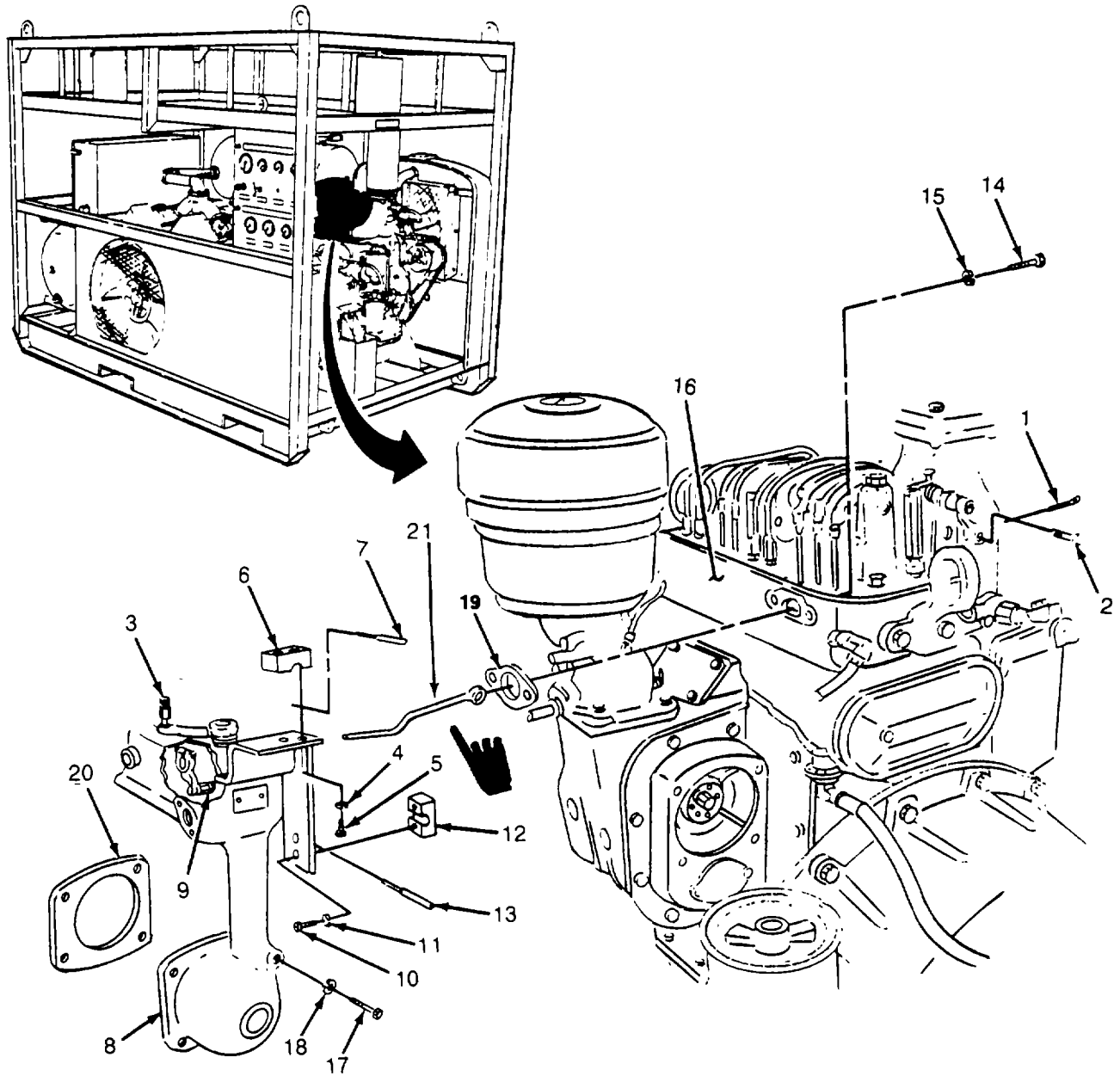


Figure 4-8. Governor Assembly, Replace.

---

**4-12. Air Shutdown Housing.**

---

**This task covers: a. Repair**

---

## INITIAL SETUP

*Tools*

General Mechanic's Tool Kit  
(NSN 5180-00-177-7033)  
Torch Outfit, Cutting and Welding Oxy Acetylene  
(NSN 3433-00-026-4718)

*Equipment Condition*

Air shutdown housing removed (para. 3-29).

---

*Repair.* (figure 4-9)

- (1) Remove two screws (1) and lockwashers (2) and remove valve plate (3).
- (2) Remove screw (4), lockwasher (5), washer (6) and remove bracket (7), spring (8), and spacer (9).
- (3) Remove spring pin (10) and remove spring (11), washer (12), shaft (13), and seal (14).
- (4) Remove pin (15) and remove cam (16), washer (17), and seal (18).
- (5) Remove fittings (19) and (20).
- (6) Inspect all parts and replace any item that is cracked, bent, or otherwise damaged.
- (7) Repair cracks in air shutdown housing (21) by welding.
- (8) Inspect valve (3) and straighten if bent or replace if cracked or otherwise damaged.
- (9) Install fittings (19) and (20).

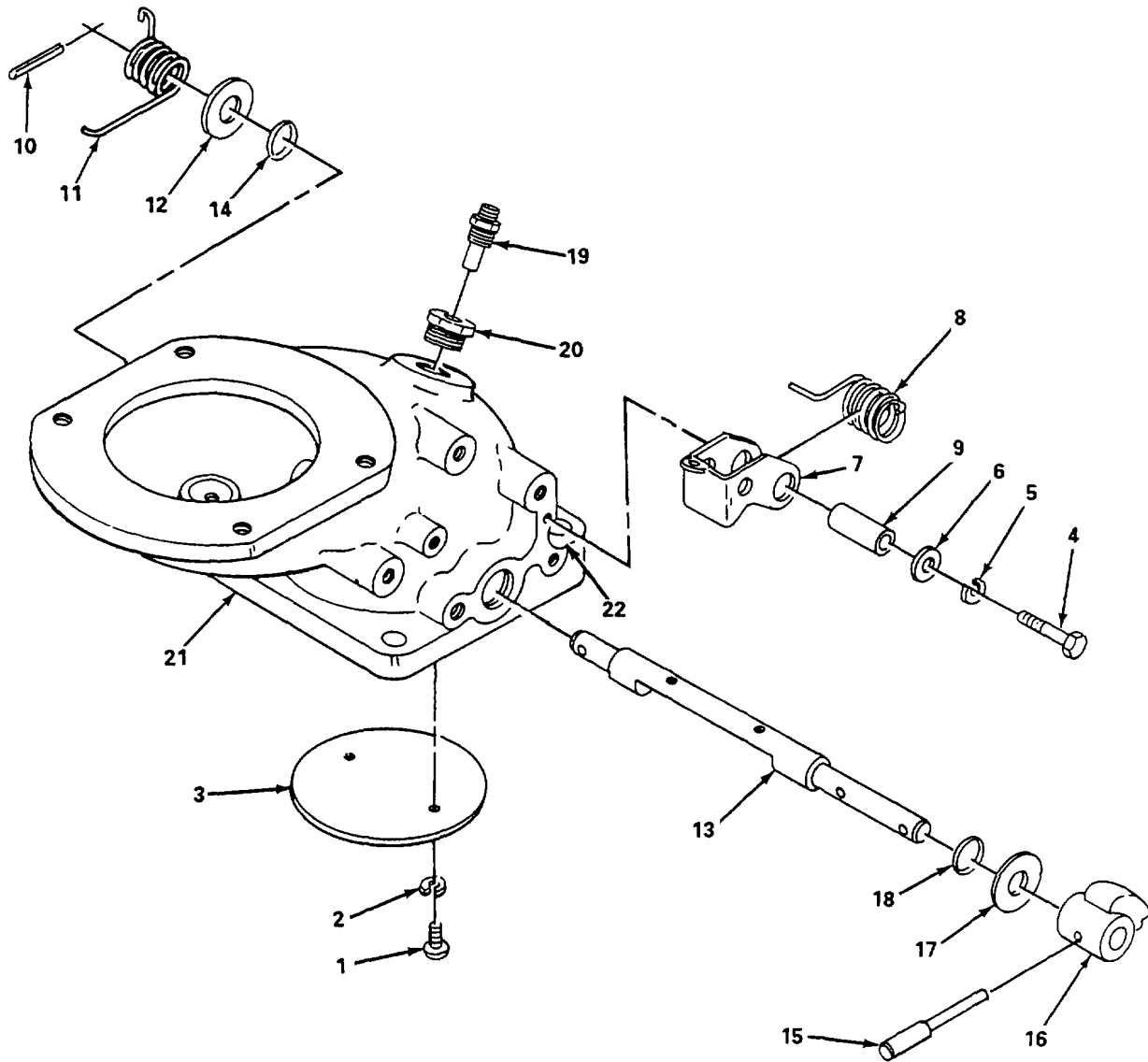
**NOTE**

Ensure seals (14) and (18) are seated in counterbores of housing.

- (10) Install shaft (13), seal (14), washer (12), spring (11), and spring pin (10).
- (11) Install seal (18), washer (17), and cam (16) and secure with pin (15).
- (12) Install spring (8) in bracket (7).
- (13) Install spacer (9) in bracket (7).
- (14) Install bracket (7), ensure spring (8) aligns with notch (22) in housing (21) and rotate bracket (7) ½ turn clockwise, and secure with screw (4), lockwasher (5), and washer (6).
- (15) Ensure bracket (7) has spring tension on it and is tight against cam (16).



(16) Install valve plate (3) and secure with two screws (1) and lockwashers (2).



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**Figure 4-9. Air Shutdown Housing, Repair.**

FOLLOW-ON MAINTENANCE  
Install air shutdown housing (para. 3-29).

---

**4-13. Blower Assembly**

---

**This task covers: a. Replace**

---

## INITIAL SETUP

*Tools*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)  
Wrench, Torque (NSN 5120-00-554-7292)  
Governor assembly removed (para. 4-11)

*Equipment Condition*

Radiator assembly removed (para. 3-19)  
Air shutdown housing removed (para. 3-29).

*Materials/Parts*

Blower Assembly  
Gasket, Blower Mounting

---

Replace. (figure 4-10)

- (1) Loosen nut (1) and remove negative cable (2) from battery (3).
- (2) Loosen fitting nut (4).
- (3) Disconnect cable (5) from tachometer adapter (6).
- (4) Remove two screws (7) and lockwashers (8) and remove tachometer adapter (6), gasket (9), and drive (10).
- (5) Remove eight bolts (11) and lockwashers (12) securing front cover (13) to blower assembly (14).
- (6) Remove 12 screws (15) and lockwashers (16) securing blower assembly (14) to block (17).

**NOTE**

Use care when loosening the blower from the cylinder block so as not to damage the gasket between the engine front cover and the blower end plate. If the gasket is damaged, the engine front cover must be removed and a new gasket installed.

- (7) Remove bolt (18) and lockwasher (19) and remove blower assembly (14) and gasket (20).
- (8) Ensure all gasket surfaces are clean and old gasket material is removed.

**NOTE**

Do not fully tighten bolts at this time.

- (9) Install blower assembly (14) and gasket (20) and secure with 12 screws (15) and lockwashers (16).
- (10) Install eight bolts (11) and lockwashers (12).

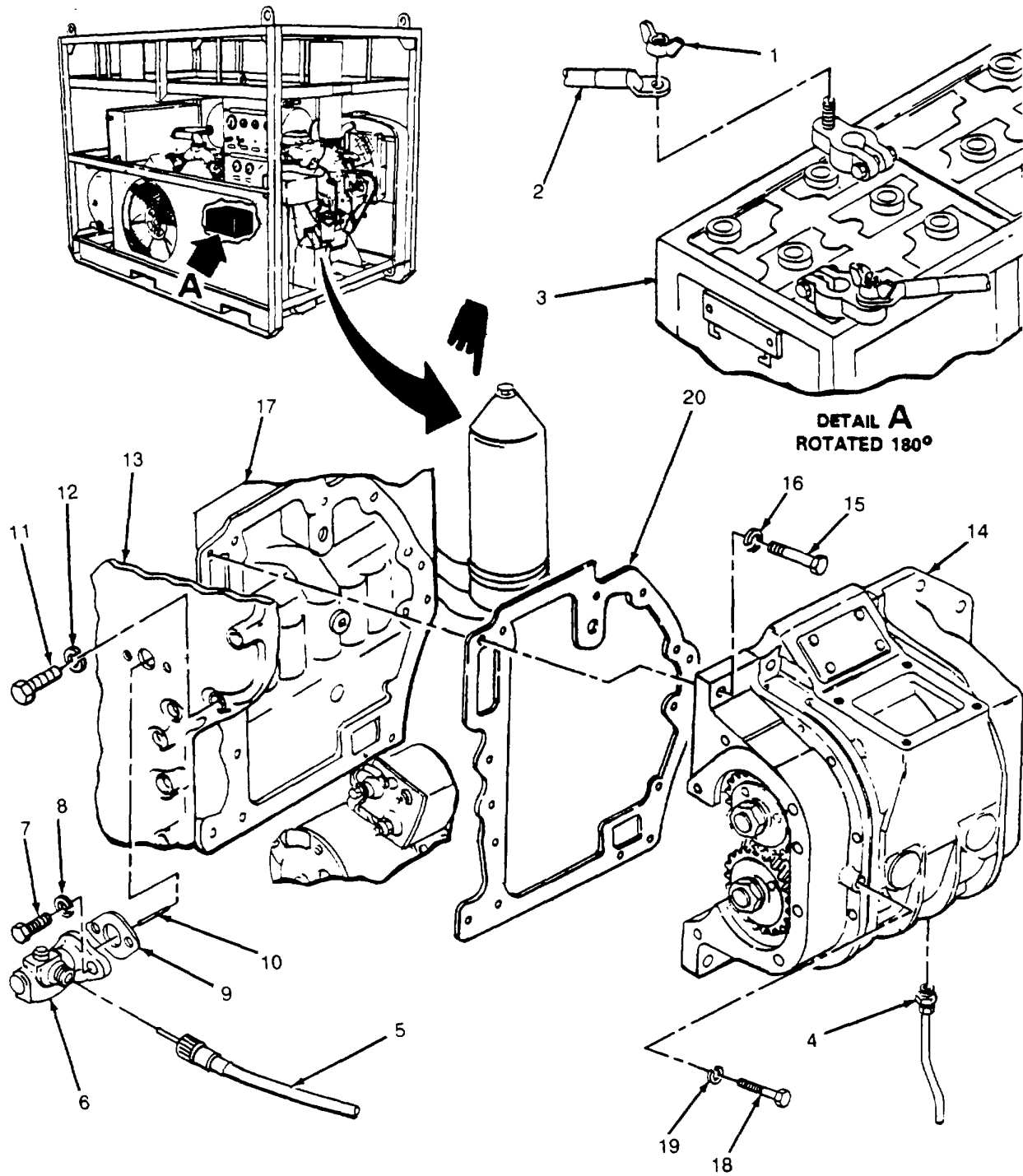


Figure 4-10. Blower Assembly, Replace.

Change 14-27/(4-28 blank)

**4-13. Blower Assembly (Cont).**

- (11) Install bolt (18) and lockwasher (19).
- (12) Torque eight front cover to blower bolts (11) to 13-17 lb-ft (18-23 Nm).
- (13) Torque 12 blower to crankcase bolts (15) to 30-35 lb-ft (41-47 Nm).
- (14) Torque blower to crankcase bolt (18) to 46-50 lb-ft (62-68 Nm).
- (15) Install drive (10), tachometer adapter (6), and gasket (9) and secure with two screws(7) and washers (8).
- (16) Connect cable (5).
- (17) Tighten fitting nut (4).
- (18) Install negative cable (2) on battery (3) and tighten nut (1).

**FOLLOW-ON MAINTENANCE**

- (1) Install governor assembly (para. 4-11).
- (2) Install air shutdown housing (para. 3-30).
- (3) Install radiator assembly (para. 3-19).

---

**4-14. Oil Pan.**

---

**This task covers: a. Replace**

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## INITIAL SETUP

*Tools*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)  
Wrench, Torque (NSN 5120-00-554-7292)

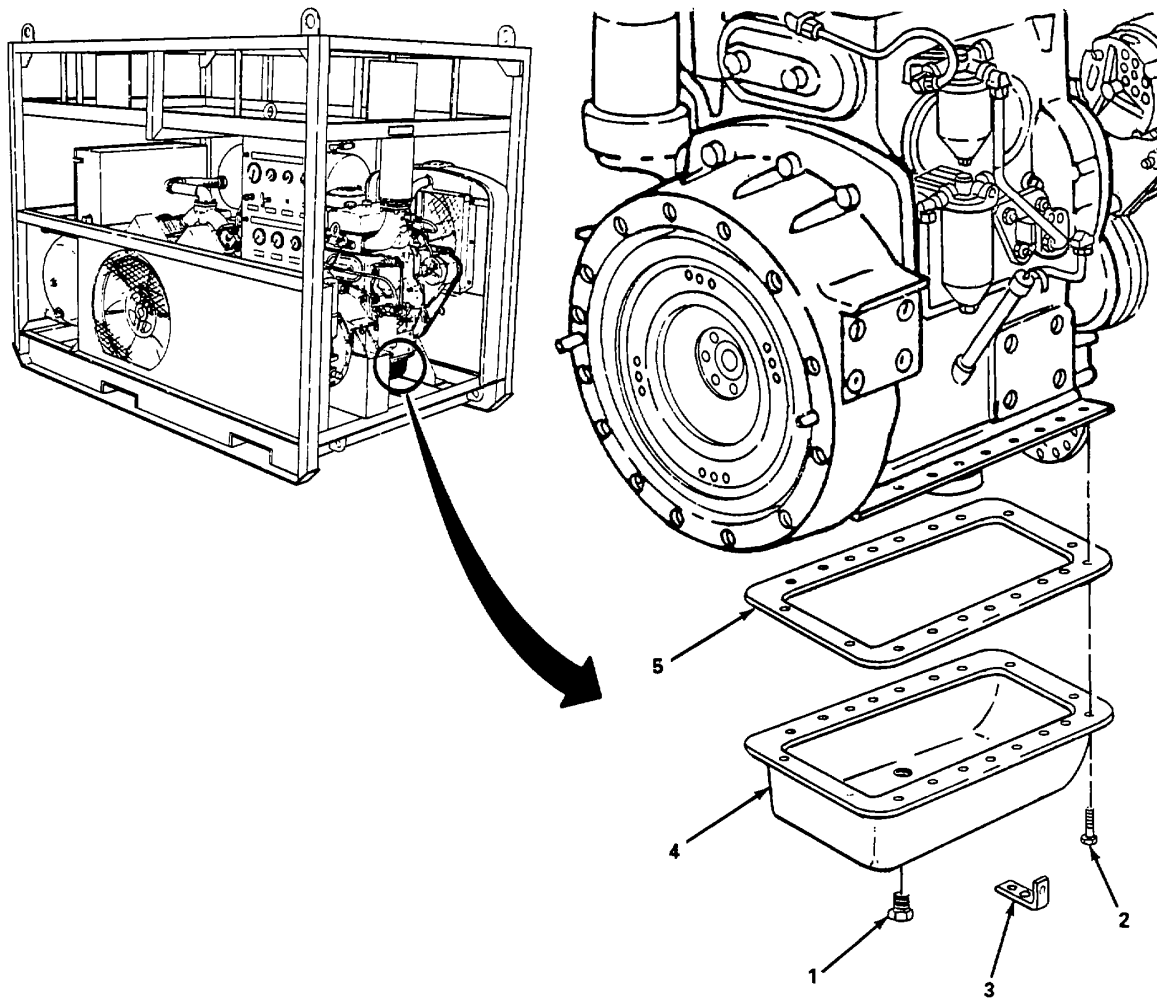
*Materials/Parts*

Oil Pan  
Gasket, Oil Pan Mounting  
Rags, Wiping (Item 21, Appendix D)  
Lubricating Oil (Item 18, Appendix D)

---

Replace. (figure 4-11)

- (1) Remove drain plug (1) and drain oil into suitable container.
- (2) Remove 20 screws (2), two clips (3), and remove oil pan (4) and gasket (5).
- (3) Ensure all gasket surfaces are clean and free of old gasket material.
- (4) Install oil pan (4) and gasket (5) and secure with 20 screws (2) and two clips (3). Torque screws to 13-17 lb-ft (18-23 Nm).
- (5) Install drain plug (1).
- (6) Add oil and bring oil to proper level on dipstick.



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Figure 4-11. Oil Pan, Replace.

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**4-15. Oil Distribution System.**


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**This task covers:    a. Replace                    b. Repair**

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## INITIAL SETUP

*Tools*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)  
 Wrench, Torque (NSN 5120-00-554-7292)  
 Rags, Wiping (Item 21, Appendix D)

*Materials/Parts (Cont)*

Gasket, Pipe Support Mounting  
 Solvent, Dry Cleaning (Item 23, Appendix D)

*Materials/Parts*

Oil Distribution System  
 Gasket, Pipe Mounting

*Equipment Condition*

Oil pan removed (para. 4-14).

---

a. Replace. (figure 4-12)

- (1) Remove retainer (1) and remove screen (2).
- (2) Remove two screws (3) and lockwashers (4) and remove pipe support (5), cover (6), and gasket (7).
- (3) Remove two screws (8) and lockwashers (9) and remove pipe (10) and gasket (11).
- (4) Ensure all gasket surfaces are clean and old gasket material is removed.
- (5) Install pipe (10) and gasket (11) and secure with two screws (8) and lockwashers (9). Torque screws to 13-17 lb-ft (18-23 Nm).
- (6) Install cover (6), gasket (7), and pipe support (5) and secure with two screws (3) and lockwashers (4). Torque screws to 13-17 lb-ft (18-23 Nm).
- (7) Install screen (2) and secure with retainer (1).

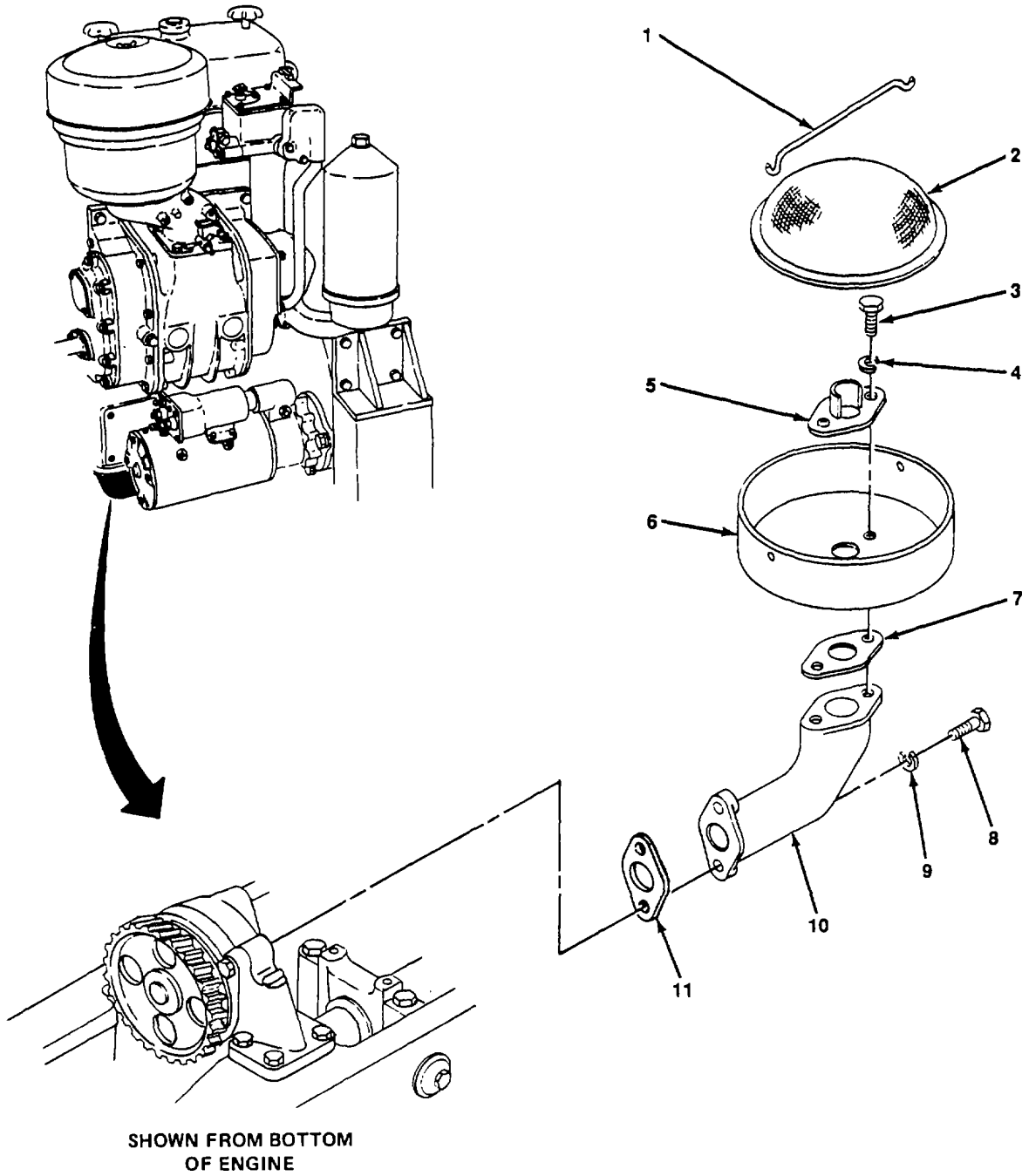


Figure 4-12. Oil Distribution System, Replace.



**4-15. Oil Distribution System (Cont).**

- b. *Repair.* (figure 4-13).

**NOTE**

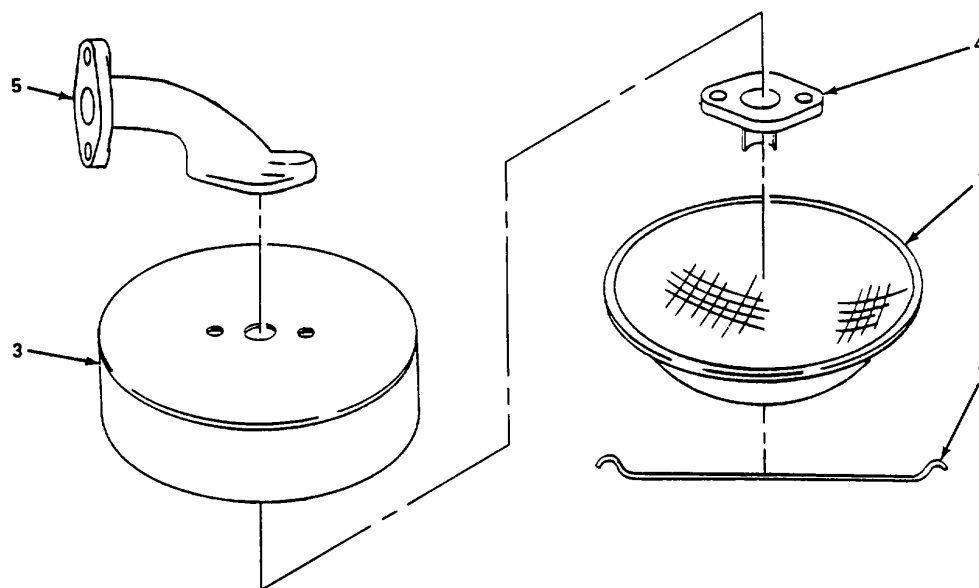
Oil distribution system removed for repair, see para. a. above.

**WARNING**

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

- (1) Clean all parts with dry cleaning solvent, and dry thoroughly.
- (2) Inspect retainer (1) and replace if bent or otherwise damaged.
- (3) Inspect screen (2) and replace if ripped or otherwise damaged.
- (4) Inspect cover (3) and replace if dented or otherwise damaged.
- (5) Inspect pipe (5) and pipe support (4) and replace if cracked or otherwise damaged.

FOLLOW-ON MAINTENANCE  
Install oil pan (para. 4-14).



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**Figure 4-13. Oil Distribution System, Repair.**

FOLLOW-ON MAINTENANCE  
Install oil distribution system (para. a. above).

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**4-16. Oil Pump.**

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**This task covers: a. Replace**

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## INITIAL SETUP

*Tools*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)  
Wrench, Torque (NSN 5120-00-554-7292)

*Equipment Condition*

Oil distribution system removed (para. 4-15).

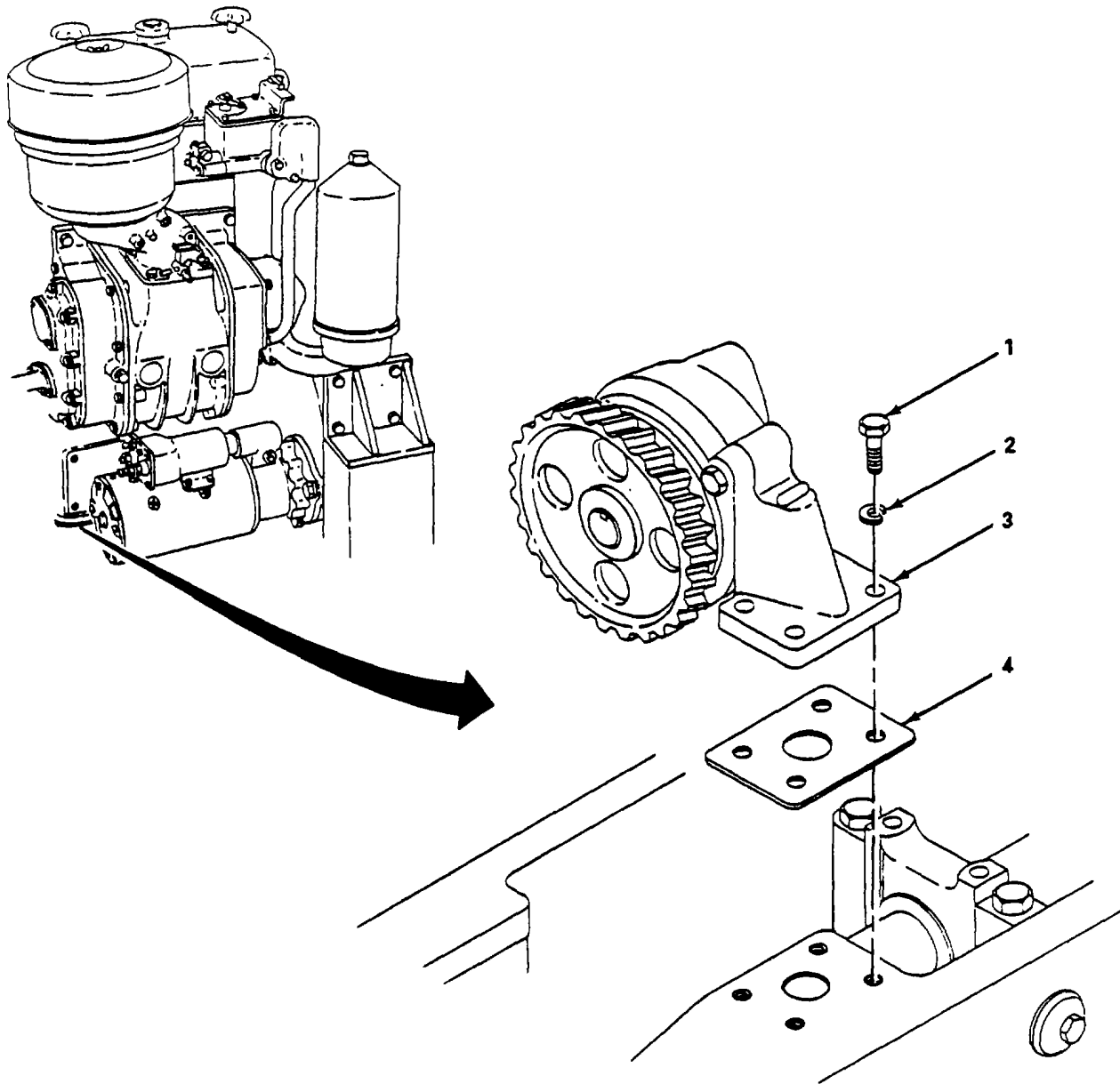
*Materials/Parts*

Rags, Wiping (Item 21, Appendix D)  
Oil Pump  
Gasket, Oil Pump Mounting

---

Replace. (figure 4-14)

- (1) Remove four screws (1) and lockwashers (2) and remove oil pump (3) and gasket (4).
- (2) Ensure all gasket surfaces are clean and old gasket material is removed.
- (3) Install oil pump (3) and gasket (4) and secure with four screws (1) and lockwashers (2). Torque screws to 13-17 lb-ft (18-23 Nm).



SHOWN FROM BOTTOM OF ENGINE

Figure 4-14. Oil Pump, Replace.

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FOLLOW-ON MAINTENANCE  
Install oil distribution system (para. 4-15).

**4-17. Oil Cooler Assembly.**

This task covers:

## a. Repair

## INITIAL SETUP:

*Tools*General Mechanic's Tool Kit (NSN 5180-00-177-7033)  
Wrench, Torque (NSN 5120-00-554-7292)*Materials/Parts (Cont)*Gasket, Element-to-Housing  
Gasket, Housing-to-Block  
2 Studs (7/16-14 x 2-3/4")*Materials/Parts*Oil Cooler  
Gasket, Cover-to Core*Equipment Condition*

Water pump removed (para. 3-23).

Repair. (figure 4-15)

- (1) Remove two bolts (1) and lockwashers (2).
- (2) Install two studs 7/16-14 x 2-3/4 in. in bolt holes.
- (3) Remove four bolts (3) and lockwashers (4).
- (4) Remove two bolts (5) and lockwashers (6) and remove oil cooler cover (7), gasket (8), cooler (9) and gasket (10).
- (5) Remove bolt (11) and lockwasher (12) and remove spacer (13) and move bracket (14) out of way.
- (6) Remove two bolts (15) and lockwashers (16) and remove housing (17) and gasket (18).
- (7) Ensure all gasket surfaces are clean and old gasket material removed.
- (8) Install gasket (18) and housing (17) and install only finger tight two bolts (15) and lockwashers (16) in lower outside bolt holes.
- (9) Install gasket (10), and oil cooler (9). Ensure all bolt holes and oil passage holes are alined.
- (10) Install gasket (8) and oil cooler cover (7) and install finger tight four bolts (3) and lockwashers (4).
- (11) Remove two studs and install two bolts (1) and lockwashers (2), finger tight
- (12) Install two bolts (5) and lockwashers (6).

**NOTE**

Tighten oil cooler attaching bolts gradually and uniformly to ensure a good seal.

(13) Torque all mounting bolts to 46-50 lb-ft (62-68 Nm).

(14) Install bracket (14) and spacer (13) and secure with bolt (11) and lockwasher (12).

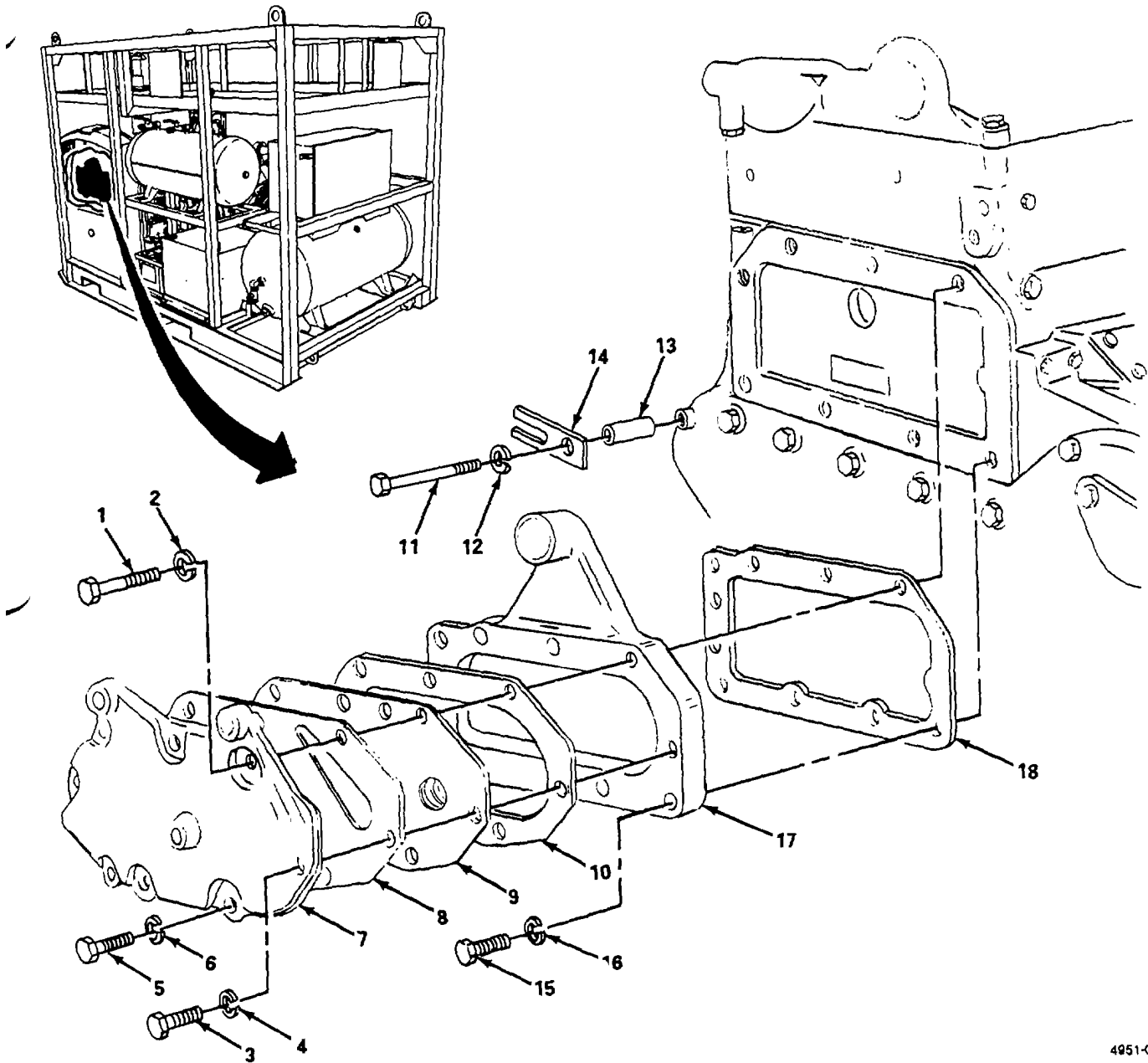


Figure 4-15. Oil Cooler Assembly, Repair.

FOLLOW-ON MAINTENANCE  
Install water pump (para. 3-23).

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**4-18. Oil Cooler By-Pass Valve.**

---

This task covers:

- a. Repair
- 

**INITIAL SETUP***Tools**Materials/Parts*

General Mechanic's Tool Kit (NSN 5180-00-177-7033) Oil Cooler By-Pass Valve

Wrench, Torque (NSN 5120-00-554-7292)

Gasket, Oil Cooler By-Pass Valve Mounting

---

**Replace.** (figure 4-16)

- (1) Remove two screws (1) and lockwashers (2), and remove oil cooler by-pass valve (3) and gasket (4).
- (2) Ensure all gasket surfaces are clean and old gasket material is removed.
- (3) Install oil cooler by-pass valve (3) and gasket (4) and secure with two screws (1) and lockwashers (2). Torque screws to 46-50 lb-ft (62-68 Nm).

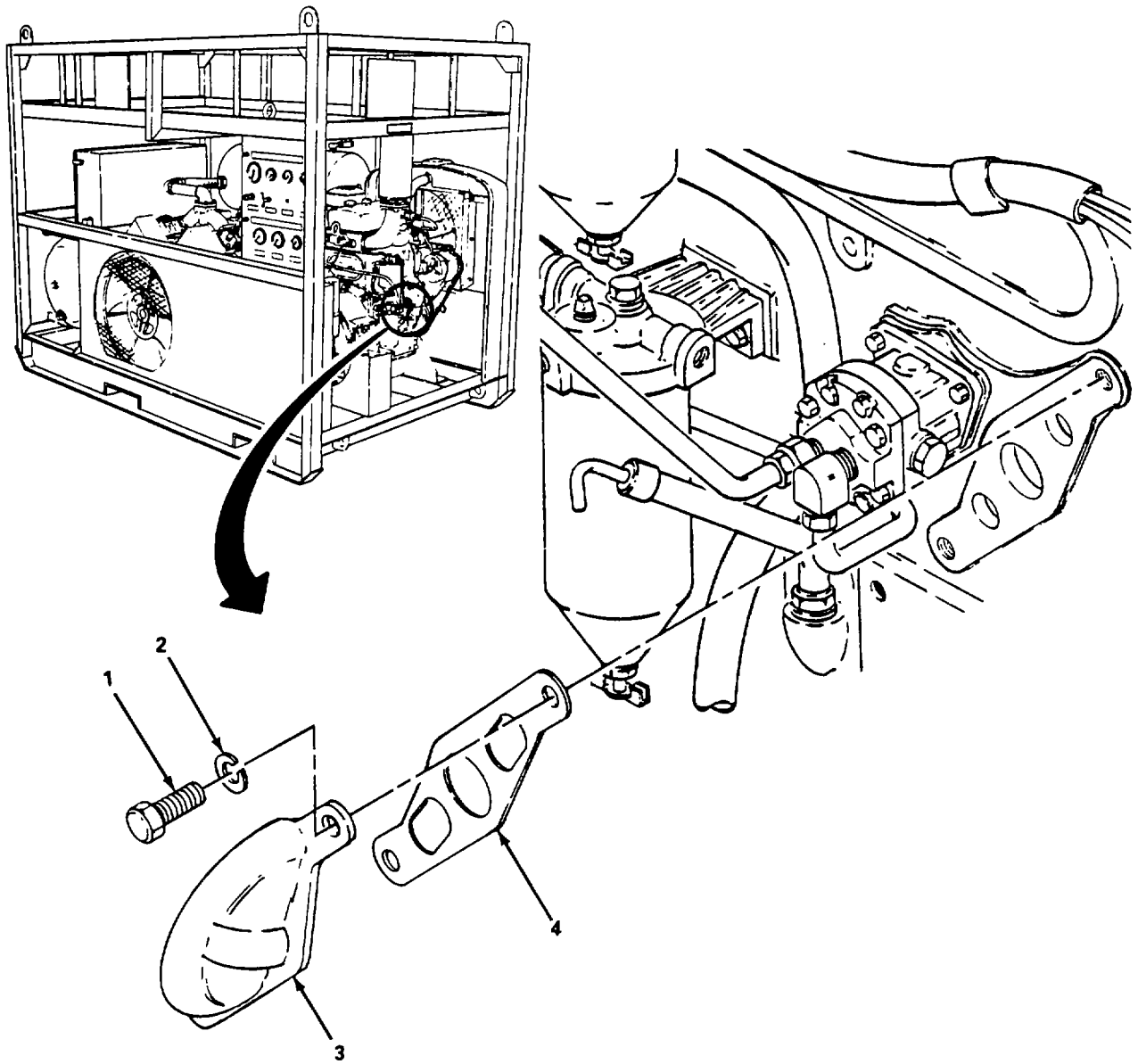


Figure 4-16. Oil Cooler By-Pass Valve, Replace



---

**4-19. Flywheel Assembly.**

---

This task covers:

- a. Replace                                  b. Repair
- 

INITIAL SETUP:

*Tools*

General Mechanic's Tool Kit  
(NSN 5180-0-177-7033)  
Wrench, Torque (NSN 5120 00-247-2540)  
Flywheel Lifting Tool (PN J 6361-01)

Torch Outfit, Cutting and Welding Qxy Acetylene  
(NSN 3433-0-026-4718)

*Materials/Parts*

Temperature Indicating Compound (Item 26,  
Appendix D)  
Flywheel Assembly

*Equipment Condition*

Drive belts removed (para. 3-12).

---

a. Removal. (figure4-17)

- (1) Connect suitable lifting device to power take-off (1).
- (2) Remove 12 screws (2) and lockwashers (3) and remove power take-off (1).
- (3) Remove eight screws (4) and lockwashers (5) and remove drive ring (6).

**NOTE**

Crankshaft of engine must be prevented from turning prior to removing screw (7).

- (4) Remove six screws (7) and scuff plate (8).
- (5) Connect flywheel lifting tool to flywheel assembly (9) using two 7/16--14bolts of suitable length.

**WARNING**

Flywheel assembly is very heavy. Failure to use correct tools may result in injury to personnel.

- (6) Connect suitable lifting device to flywheel lifting tool to support flywheel.
- (7) Move upper end of flywheel lifting tool in and out to loosen the flywheel assembly (9) and remove flywheel assembly (9) from flywheel housing (10).
- (8) Remove flywheel assembly (9) from flywheel lifting tool.

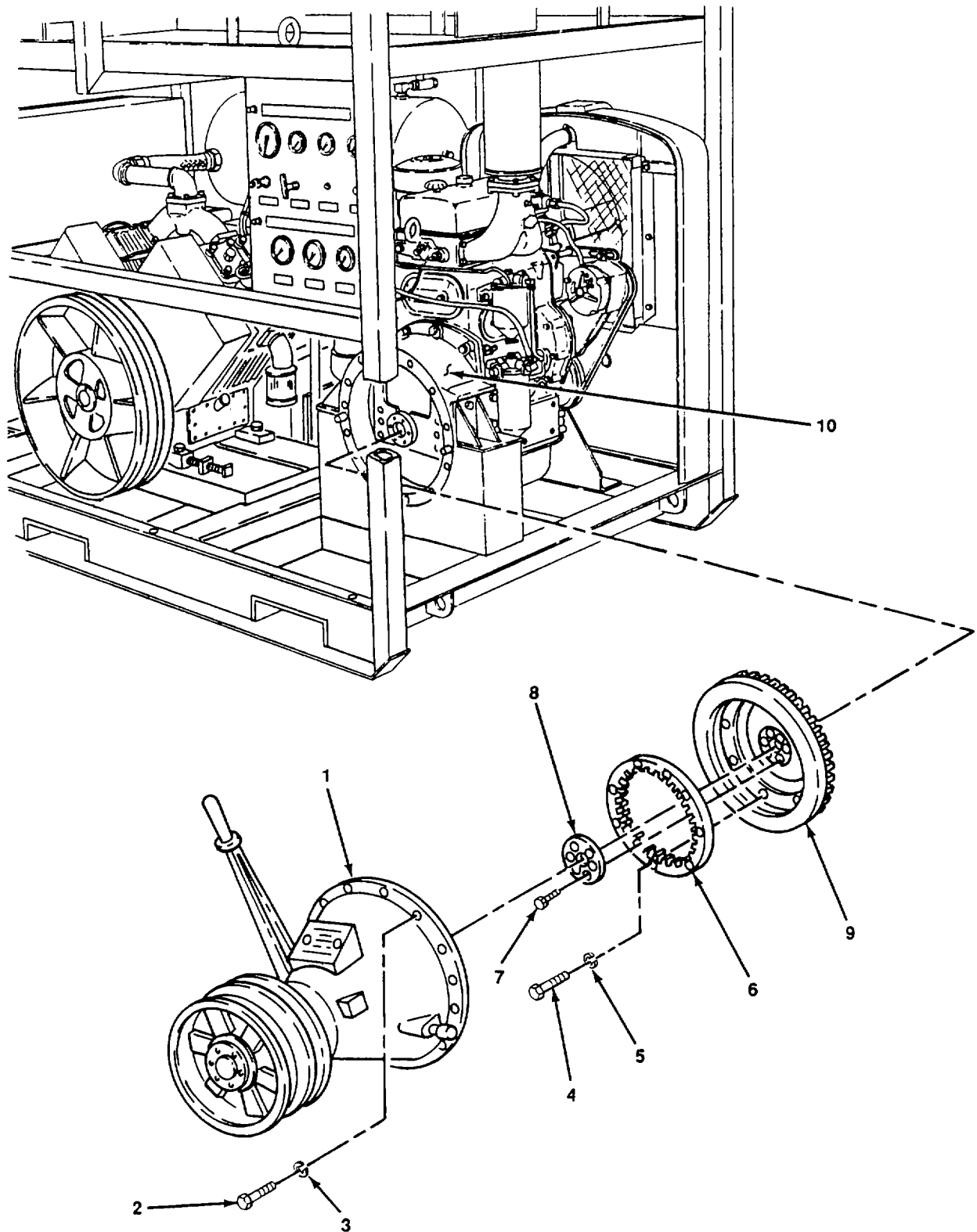


Figure 4-17. Flywheel Assembly, Removal.

**4-19. Flywheel Assembly (Cont).**b. *Repair.* (figure 4-18)

- (1) Inspect clutch pilot bearing (1 ) and replace if needed as follows:

**NOTE**

If pilot bearing is replaced, the inner face of the old bearing must be removed from clutch shaft. Notify general support maintenance

- (a) Support flywheel (2) on two wood blocks on bed of arbour press with ring gear side up.
  - (b) Use short round steel bar on outer race of bearing (1 ) and press bearing (1 ) and oil seal (3) out of flywheel (2).
  - (c) Apply thin coating of engine oil on outside face of bearing (1).
  - (d) Support flywheel (2) on two wood blocks on arbour press with ring gear side up.
  - (e) Start bearing (1), numbered end of race up, straight into bore on flywheel (2).
  - (f) Press bearing (1 ) straight into and flush with forward face of flywheel (2).
  - (g) Turn flywheel (2) over.
  - (b) Apply sealing compound to outside diameter of oil seal (3).
  - (i) Press oil seal (3) straight into and flush with rear face of flywheel (1 ) with lip of oil seal (3) facing pilot bearing (1).
- (2) Inspect ring gear (4) and replace if teeth are worn, missing, or otherwise damaged. Replace ring gear as follows:
- (a) Support flywheel (2), ring gear side down, on two blocks of wood that are slightly smaller than the inside diameter of ring gear (4).

**NOTE**

Work around circumference of ring gear to avoid binding the gear on flywheel.

- (b) Drive the ring gear (4) off flywheel (2) using a suitable drift and hammer.
- (3) Install ring gear (4) as follows:
- (a) Place flywheel (2), ring gear side facing up, on a flat, solid surface.
  - (b) Place ring gear (4) on flat metal surface.

**CAUTION**

Do not heat ring gear over 400°F (204°C) under any circumstances. Heating ring gear over 400°F (204°C) may destroy the original heat treatment.

- (c) Heat ring gear (4) uniformly using torch. Move torch completely around ring gear to avoid hot spots. Use heat indicating compound to determine temperature of ring gear.
- (d) Use tongs to place ring gear (4) on flywheel (1).
- (e) Tap the ring gear (4) in place against the shoulder on the flywheel (2).

**NOTE**

If ring gear can not be readily tapped into place, remove it and apply more heat, observing the above caution.

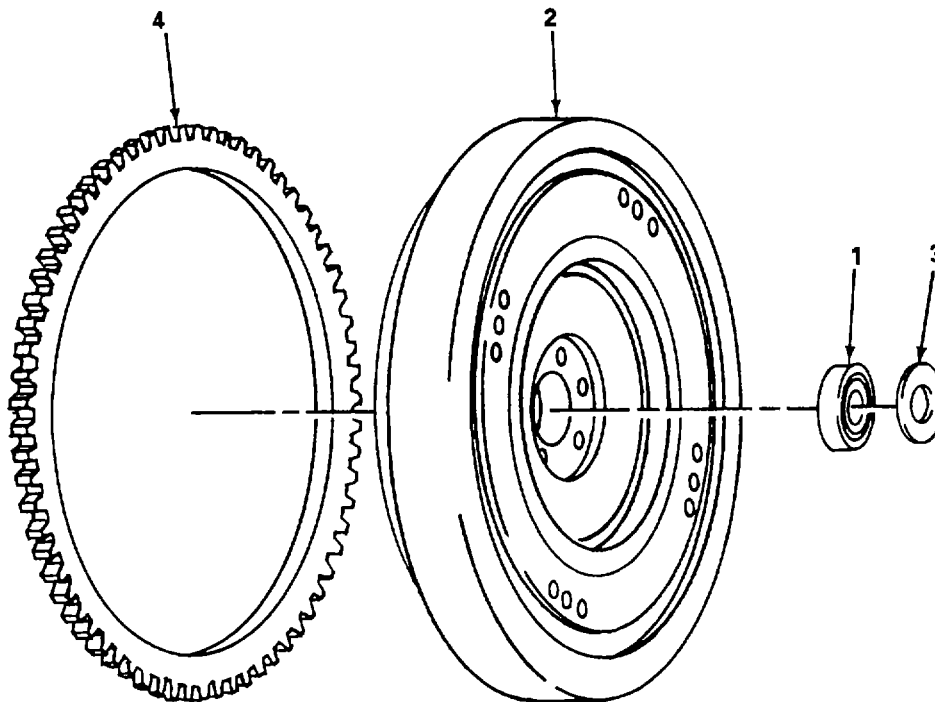


Figure 4-18. Flywheel Assembly, Repair.

**4-19. Flywheel Assembly (Cont).**c. *Installation.* (figure 4-19)

- (1) Install new flywheel assembly (9) on flywheel lifting tool.
- (2) Check crankshaft dowel pins (11). The dowel pins must not extend more than 1/2 in. (1.27 cm).

**NOTE**

One bolt hole is offset so the flywheel can only be installed one way.

- (3) Install flywheel assembly (9) and remove flywheel lifting tool.
- (4) Apply antiseize compound to flywheel bolt threads and under head and remove excess.

**NOTE**

It may be necessary to prevent crankshaft from turning in order to properly torque the bolts.

- (5) Install scuff plate (8) and bolts (7) and torque bolts to 50 lb-ft (68 Nm).
- (6) Turn each bolt an additional 90-1200 to obtain proper clamping.
- (7) Install drive ring (6) and secure with eight screws (4) and lockwashers (5).
- (8) Install power take-off (1) and secure with 12 screws (2) and lockwashers (3).

**FOLLOW-ON MAINTENANCE**  
Install drive belts (para. 3-12).

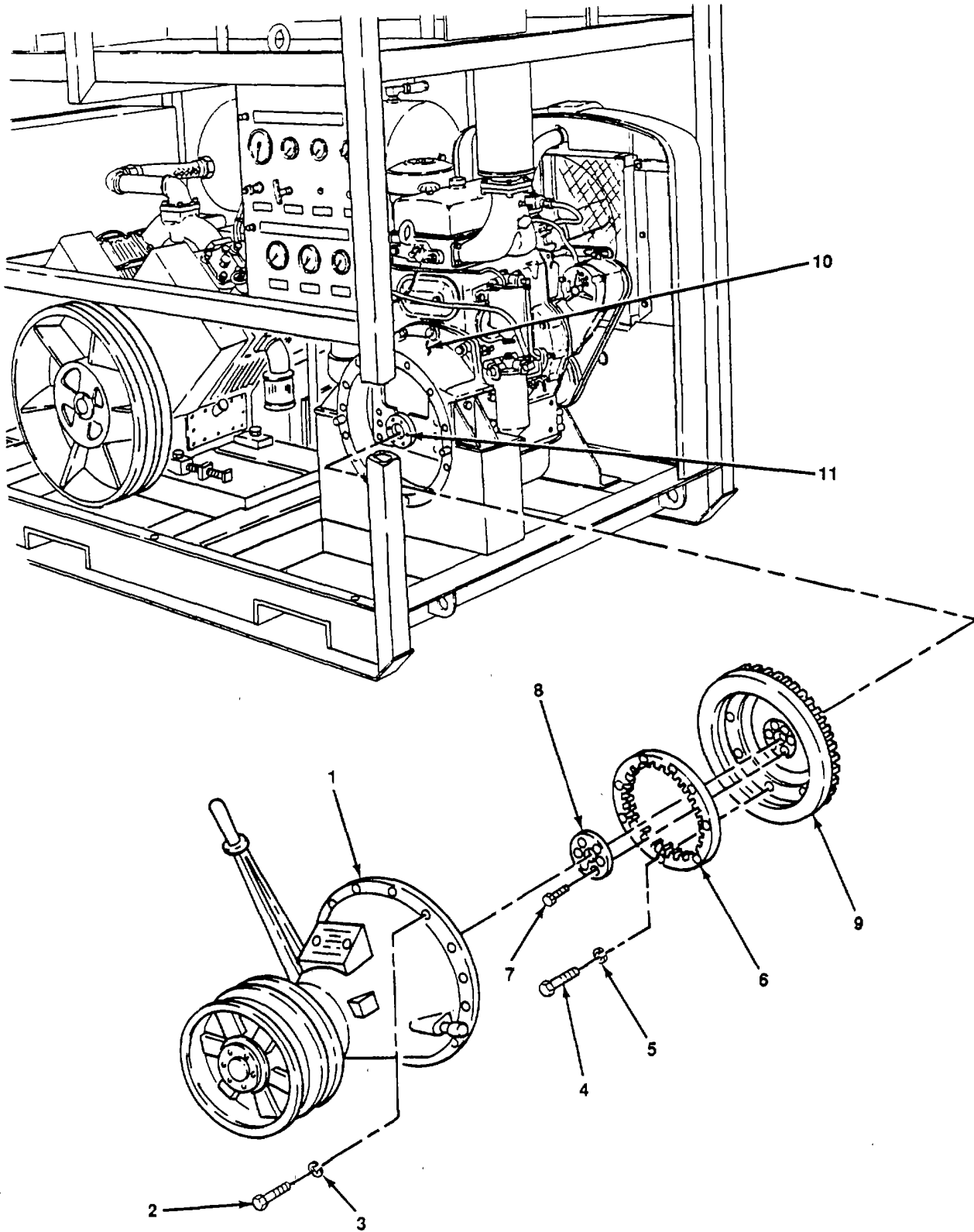


Figure 4-19. Flywheel Assembly, Installation.



- (16) Using flywheel housing concentricity checking tool, check flywheel housing concentricity. The maximum total indicator reading must not exceed .013 in. (.033 cm). If readings are out of tolerance, remove flywheel housing assembly (7) and check for dirt or old gasket material between flywheel housing assembly and cylinder block (10). Reinstall flywheel housing assembly and recheck concentricity. Replace flywheel housing assembly (7) if still out of tolerance.

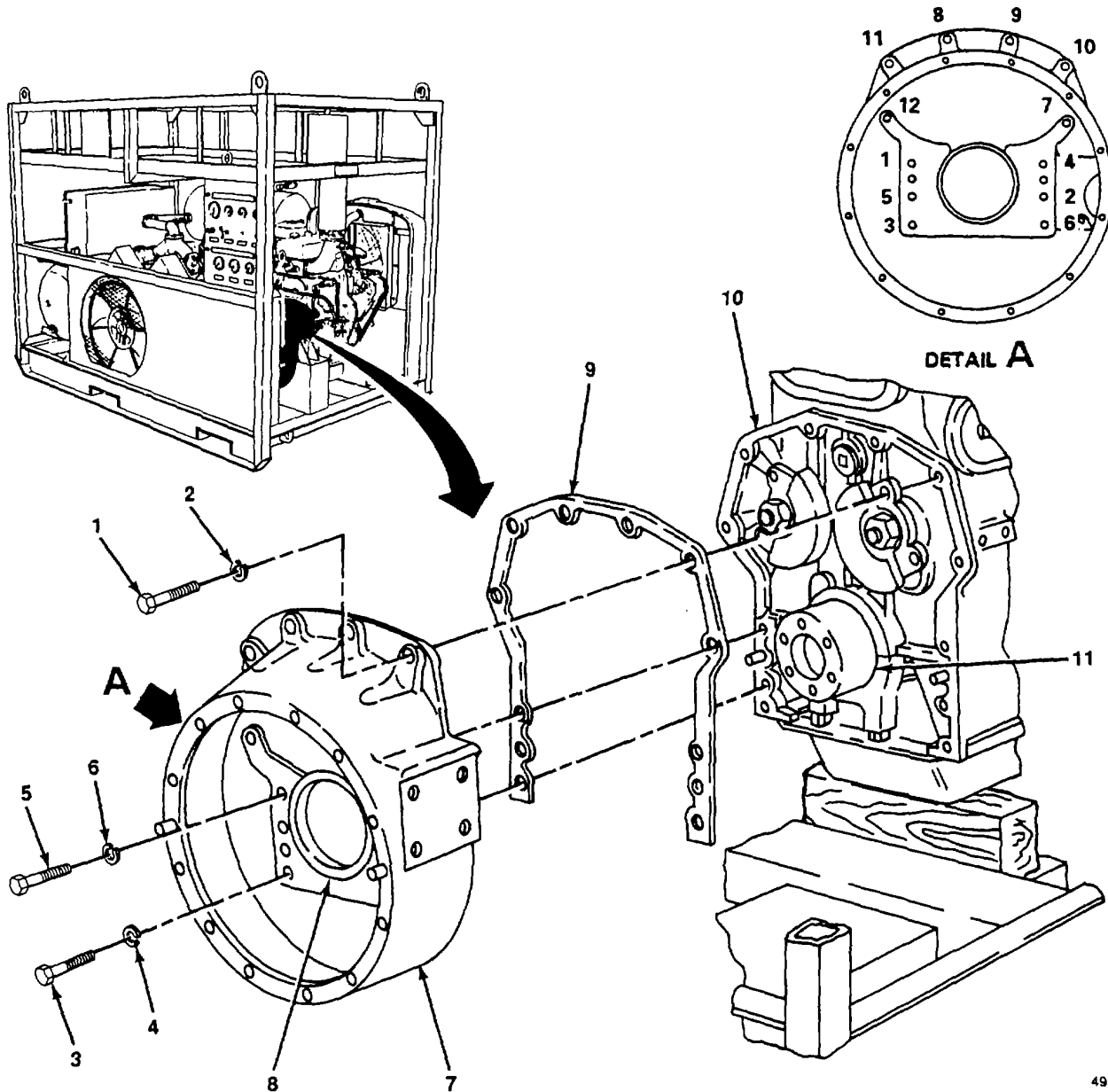


Figure 4-20. Flywheel Housing, Replace.

FOLLOW-ON MAINTENANCE

- (1) Install flywheel assembly (para. 4-19).
- (2) Install oil pan (para. 4-14).
- (3) Install starter (para. 3-31).
- (4) Install rear engine mount (para. 3-46).



**4-20. Flywheel Housing Assembly (Cont).**

## b. Repair. (figure 4-21)

- (1) Remove flywheel housing assembly, see para. a. above.

**WARNING**

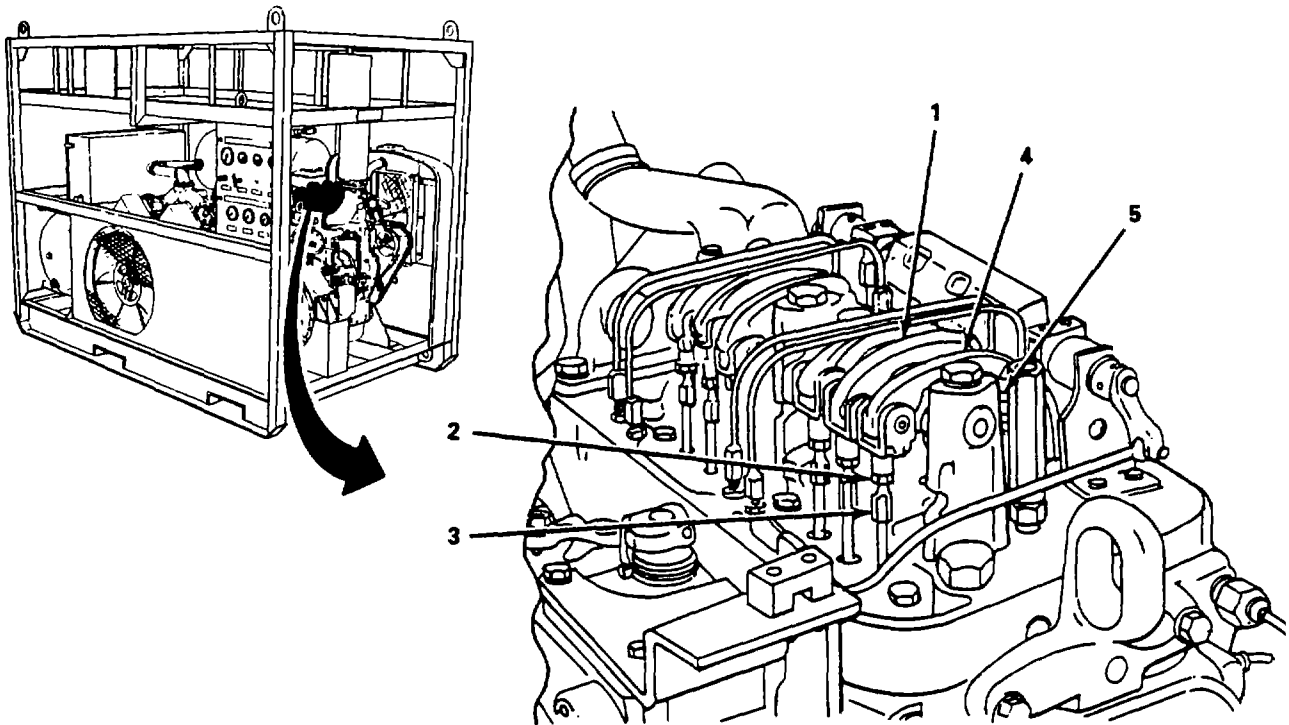
Dry cleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100-138°F (38-60°C).

- (2) Clean flywheel housing assembly (1) with dry cleaning solvent and dry thoroughly.
- (3) Inspect flywheel housing (1) and repair minor cracks by welding. Replace a flywheel housing (1) that is excessively cracked or otherwise damaged.
- (4) Inspect plug (2) and replace if missing or otherwise damaged.
- (5) Inspect oil seal (3) and replace if ripped, torn, or otherwise damaged. Replace oil seal as follows:
  - (a) Support rear face of flywheel housing assembly (1) on two blocks of wood.
  - (b) Drive the oil seal out of flywheel housing assembly (1), and clean seal bore.
  - (c) Turn flywheel housing assembly (1) over.

**NOTE**

There is a plastic coating on the outside diameter of the current oil seal, do not remove this coating. Apply a non-hardening sealer to the outside diameter of the oil seal if one is not already present.

- (d) Position oil seal (3) with lip pointed toward inner face straight into bore in flywheel housing assembly (1).
- (e) Using oil seal installer and handle, install oil seal (3) until seated against shoulder in bore.



**Figure 4-22. Valve Operating Mechanism, Adjust.**

**FOLLOW-ON MAINTENANCE**

- (1) Install blower (para. 4-13).
- (2) Install fuel manifold connections (para. 4-8).
- (3) Install fuel manifold supply line (para. 3-24).
- (4) Install thermostat and housing assembly (para. 3-21).
- (5) Install exhaust manifold (para. 3-15).
- (6) Install rocker cover (para. 3-39).

**4-21. Valve Operating Mechanism (Cont).****NOTE**

There are two valve operating mechanisms. The following procedures are the same.

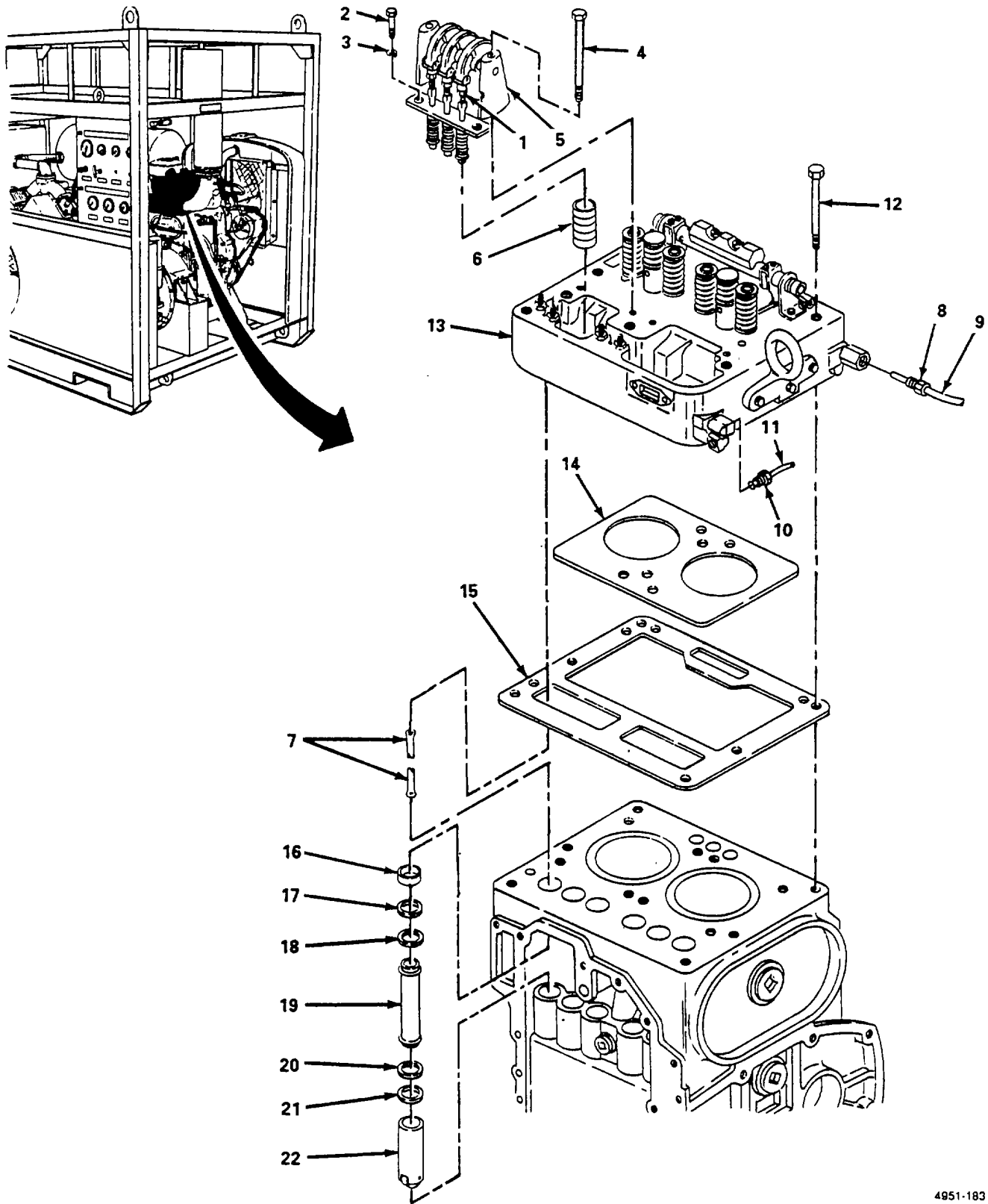
b. *Removal.* (figure 4-23).

- (1) Loosen three locknuts (1).
- (2) Remove two screws (2) and lockwashers (3).

**NOTE**

Tag parts as they are removed to ensure they are installed in their original location.

- (3) Remove two bolts (4) and remove valve operating mechanism (5).
- (4) Remove three push rod seats (6).
- (5) Remove three lower push rods (7).
- (6) Repeat steps 1 through 5 for second valve operating mechanism.
- (7) Loosen fitting nut (8) and remove temperature sensor (9).
- (8) Loosen fitting nut (10) and remove fuel line (11).
- (9) Remove six bolts (12) and remove cylinder head (13), gasket (14), and oil seal (15).
- (10) Using a puller with a 3/4"-16 thread, remove six push rod housing retainers (16), washers (17), upper seals (18), and push rod housings (19).
- (11) Remove six seals (20) and washers (21).
- (12) Remove six cam followers (22).



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Figure 4-23. Valve Operating Mechanism, Removal.

**4-21. Valve Operating Mechanism (Cont).**

- c. *Repair*. (figure 4-24).

**NOTE**

Tag parts as they are disassembled to ensure they are installed in their original location.

- (1) Remove two bolts (1) from brackets (2) and remove shaft (3).
- (2) Unscrew upper push rods (4) from rocker arms (5) and separate upper push rods (4) from retainer (6), springs (7), and push rod spring seats (8).

**WARNING**

Dry cleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100-138°F (38-600C).

- (3) Clean all items with dry cleaning solvent and dry thoroughly.
- (4) Clean out oil passages in bolts (1) and shaft (3).

**NOTE**

The current push rods have milled wrench flats and a bright turned finish. The lower spring seats are serrated along the push rod contact surface. When replacing a push rod or spring seat, do not use a former type spring seat with a current type push rod. All other combinations are permissible.

- (5) Inspect upper push rods (4) and push rod spring seats (8) for wear, and replace if worn, scored or otherwise damaged.
- (6) Inspect ends of lower push rods (9) for wear and scuff marks, and replace if worn or otherwise damaged.
- (7) Inspect push rod springs (7) for defects and check spring with spring tester. Replace a spring (7) when a load of less than 172 lbs compresses the spring to a length of 2 1/8 in. (5.39 cm) or less.
- (8) Inspect push rod seats (10). Measure outside diameter of push rod seats (10). Diameter of push rod seat (10) should be 1.0580-1.0585 in. (2.7873-2.6835 cm). Replace a worn or otherwise damaged push rod seat (10).
- (9) Inspect rocker arm shaft (3). Measure diameter of shaft (3) at points where rocker arms (5) ride on shaft (3). Measurement should be .08735-.8740 (2.2187-2.2189 cm). Replace a worn or otherwise damaged shaft (3).
- (10) Inspect rocker arms (5). Measure inside diameter of rocker arm bushings (11). Diameter should be .8650-.8660 in. (2.222-2.2250 cm). Replace a worn rocker arm.

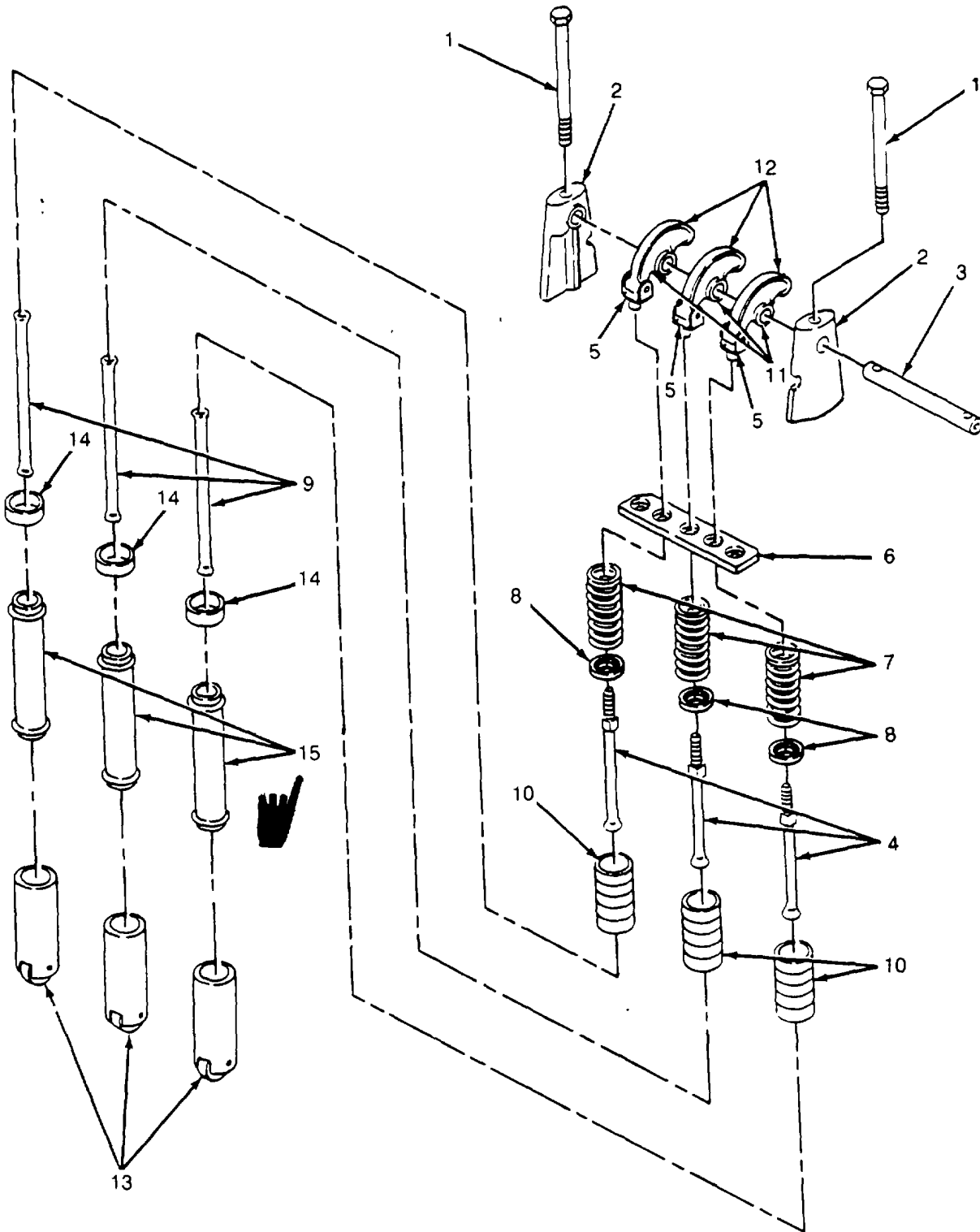


Figure 4-24. Valve Operating Mechanism, Repair.

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**4-21. Valve Operating Mechanism (Cont).**

- (11) Inspect pallets (12) on rocker arm (5) for excessive wear. The pallets may be refaced up to a maximum depth of .010 in. (.0254 cm). Be careful not to overheat the rocker arm (5) when surface grinding.
- (12) Inspect cam follower (13). Measure outside diameter of cam follower (13). Measurement should be 1.0600-1.0610 in. (2.6924-2.6949 cm). Measure the total clearance between roller bushing and pin. Clearance should be less than .0100 in. (.0254 cm). Replace a cam follower that is worn or otherwise damaged.
- (13) Inspect retainer (6) and replace if cracked, bent or otherwise damaged.
- (14) Inspect brackets (2) and replace if cracked or otherwise damaged.
- (15) Inspect push rod housing retainers (14) and replace if worn or otherwise damaged.
- (16) Inspect push rod housing (15) and replace if dented, cracked or otherwise damaged.
- (17) Inspect seats (8) and replace if worn or otherwise damaged.
- (18) Lubricate rocker arm bushings (11) with clean engine oil.
- (19) Install seats (8), springs (7), retainers (6), on upper push rods (4).
- (20) Install rocker arms (5) on shaft (3).
- (21) Install retainer (6) on upper push rods (4).
- (22) Install upper push rods (4) in rocker arms (5) and screw upper push rods (4) in fully.
- (23) Install brackets (2) on shaft (3) and install two bolts (1).

**4-21. Valve Operating Mechanism (Cont).**

d. *Install.* (figure 4-25)

**NOTE**

Perform steps 1 and 2 for new cam followers only.

- (1) Clean new cam followers (22) with clean Cindol 1705 and wipe dry.
- (2) Perform initial lubrication on new cam followers (22) as follows:
  - (a) Soak cam followers (22) in clean Cindol 1705 heated to 100-125°F (38-52°C) for at least one hour to ensure initial lubrication.
  - (b) Rotate the cam rollers during soaking to purge air from the bushing/roller area.
  - (c) Keep cam followers (22) from resting on the bottom of container to avoid possible contamination.
- (3) Install six cam followers (22) in cylinder block (23) with hole in cam followers (22) closest to pistons (24).

**NOTE**

Rotate the cam followers slightly to make sure the cam follower roller is in the notch of the guide and resting on the camshaft.

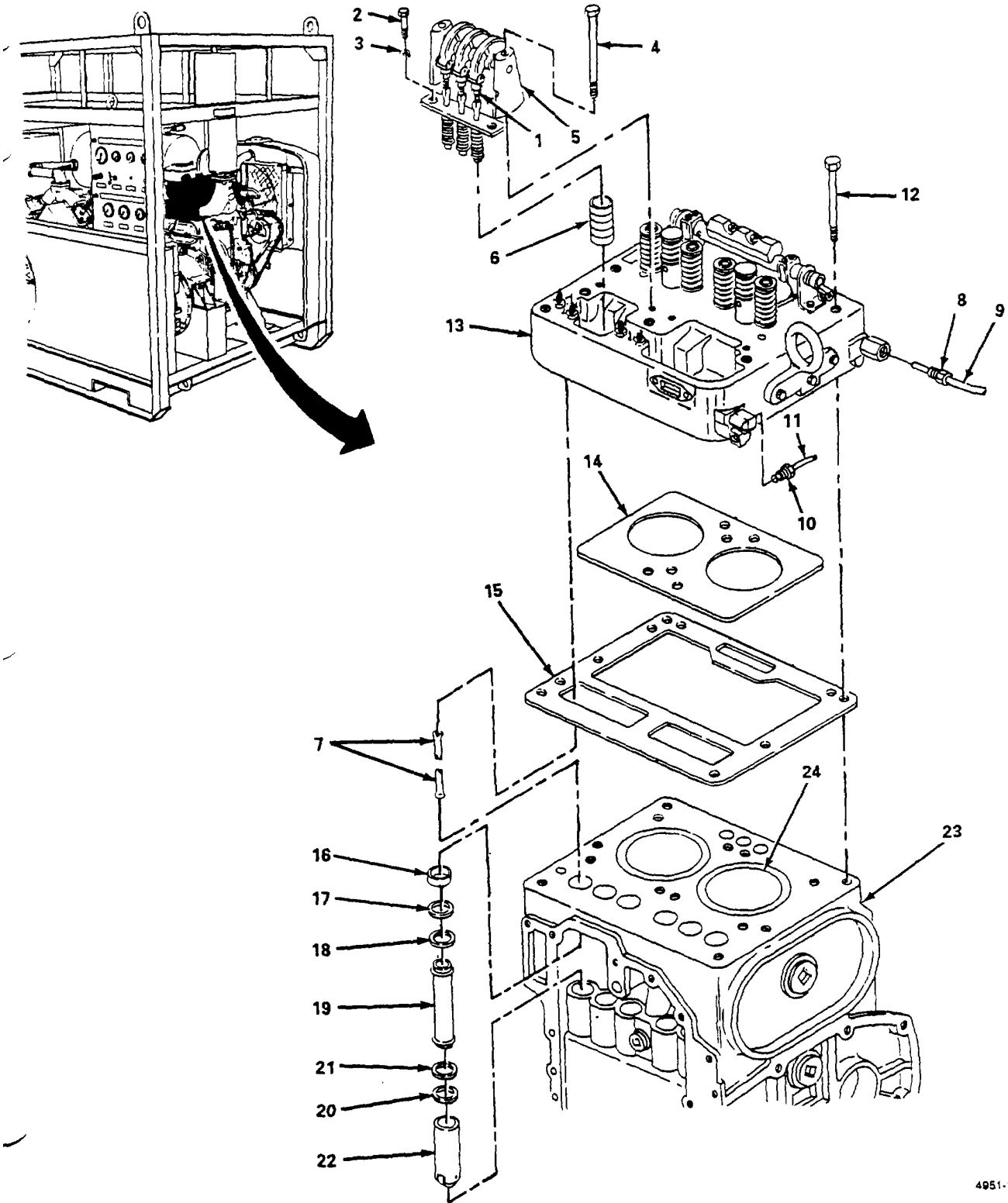
- (4) Install six washers (20).
- (5) Install seals (18) and (21) on push rod housing (19) and install push rod housings (19) and washers (17).
- (6) Lubricate outside diameter of push rod housing retainers (16) and install, threaded end up, straight into bore in cylinder block (23) and tap it down until push rod housing (19) is just held securely.
- (7) Install lower push rods (7), rounded end down, and seated in cam follower (22).

**CAUTION**

If gasket and oil seal are not installed properly, the lubricating oil passages to the cylinder head will be blocked and serious damage to the engine will result.

- (8) Install oil seal (15) and cylinder head gasket (14).
- (9) Install two studs 5/8"-11 x 6 into two diagonally opposite bolt holes in cylinder block (23).
- (10) Ensure that there is no foreign material on top of pistons (24).
- (11) Ensure cylinder head gasket surface is clean, and install cylinder head (13).
- (12) Apply anti-seize compound to cylinder head bolt threads and bolt head contact area.





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Figure 4-25. Valve Operating Mechanism, Install

4-61/(4-62 blank)

**4-21. Valve Operating Mechanism (Cont).**

- (13) Install four cylinder head bolts (12) and draw cylinder head (13) down slightly.
- (14) Remove two studs and install remaining two cylinder head bolts (12).
- (15) Torque bolts (12), in the sequence shown, 1/2 turn at a time until all bolts are torqued to 170-180 lb-ft (231-244 Nm).
- (16) Install temperature sensor (9) and tighten fitting nut (8)

**NOTE**

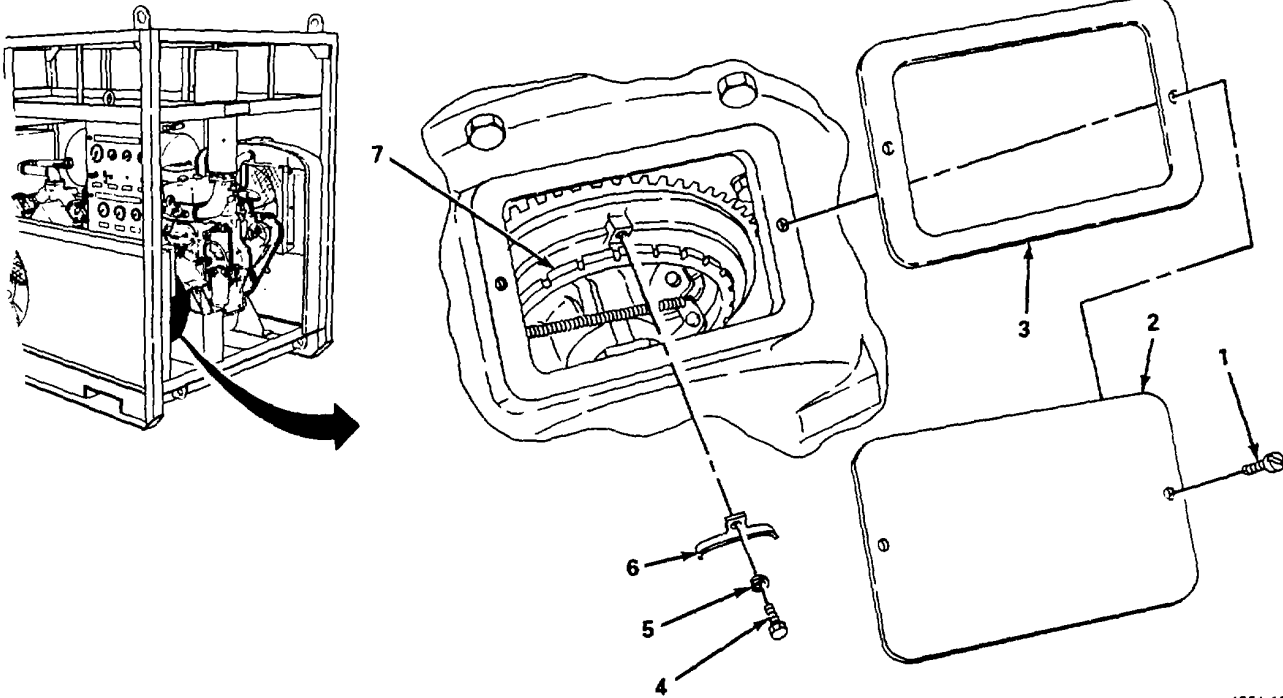
Leave 1 1/2 threads exposed when applying teflon tape. Wrap teflon tape in the direction that will not unwrap as fitting is tightened. Failure to wrap teflon tape properly or having it extend past the end of the fitting may cause a blockage in the fuel system.

- (17) Apply teflon tape to threads on fitting nut (10).
- (18) Install fuel line (11) and tighten fitting nut (10).
- (19) Lubricate the outside diameter, lower end, and inside seating surface of push rod seats (6).
- (20) Install valve operating mechanism (5) and install two bolts (2) and lockwashers (3). Torque bolts to 30-35 lb-ft (41-47 Nm).
- (21) Thread bolts (4) into cylinder head (13) and torque bolts to 90-100 lb-ft (122-136 Nm).
- (22) Repeat steps 8 through 20 for remaining valve operating mechanism.
- (23) Adjust valve operating mechanism. See para. a. above.

**FOLLOW-ON MAINTENANCE**

- (1) Install rocker cover (para. 3-39).
- (2) Install blower assembly (para. 4-13).
- (3) Install fuel manifold supply line (para. 3-24).
- (4) Install thermostat and housing assembly (para. 3-21).
- (5) Install exhaust manifold (para. 3-15).
- (6) Install fuel manifold connections (para. 4-8).





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Figure 4-26. PTO Clutch, Adjust.

**4-22. Power Take-off Assembly (Cont).**

b. *Removal.* (figure 4-27)

- (1) Mark location of collet (1) and remove three screws (2) and washers (3).
- (2) Install one screw (2) into threaded hole (4) and tighten screw (2) to press pulley (5) off collet (1) and remove collet (1) and pulley (5).
- (3) Connect suitable lifting device to PTO (6).
- (4) Remove 12 screws (7) and lockwashers (8) and remove PTO (6) and clutch assembly (9) and three clutch discs (10).
- (5) Using puller, remove pilot bearing (11).
- (6) Loosen two fitting nuts (12) and remove grease line (13).
- (7) Bend out lockwasher (14) and remove nut (15), lockwasher (14), and clutch assembly (9).
- (8) Loosen screw (16) and remove handle (17).
- (9) Loosen two screws (18).
- (10) Move shaft (19) either right or left and remove two keys (20), shaft (19), and yoke (21).

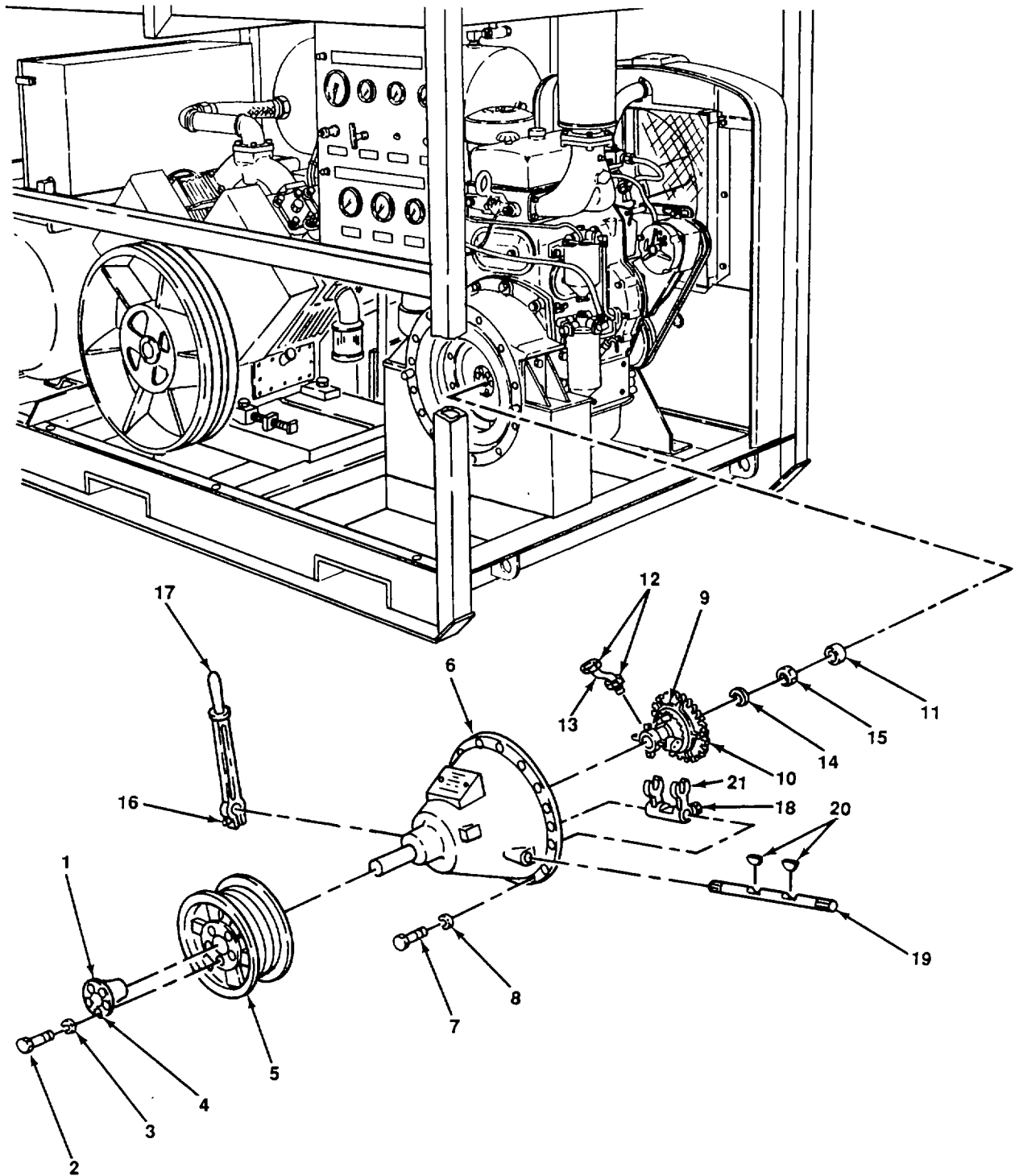


Figure 4-27. PTO, Removal.

**4-22. Power Take-off Assembly (Cont).**

c. Installation. (figure 4-28)

- (1) Install yoke (21), shaft (19), and two keys (20).
- (2) Aline yoke (21) on shaft (19) and tighten two screws (18).
- (3) Install handle (17) and tighten screw (16).
- (4) Install clutch assembly (9) and secure with lockwasher (14) and nut (15).
- (5) Install grease line (13) and tighten two fitting nuts (12).
- (6) Install PTO (6) and clutch assembly (9) and secure with 12 screws (7) and lockwashers (8).
- (7) Install pulley(5).
- (8) Install collet (1), as noted during removal, and position pulley (5) on collet (1) and secure with three screws (2) and washers (3).

FOLLOW-ON MAINTENANCE  
Install drive belts (para. 3-12).

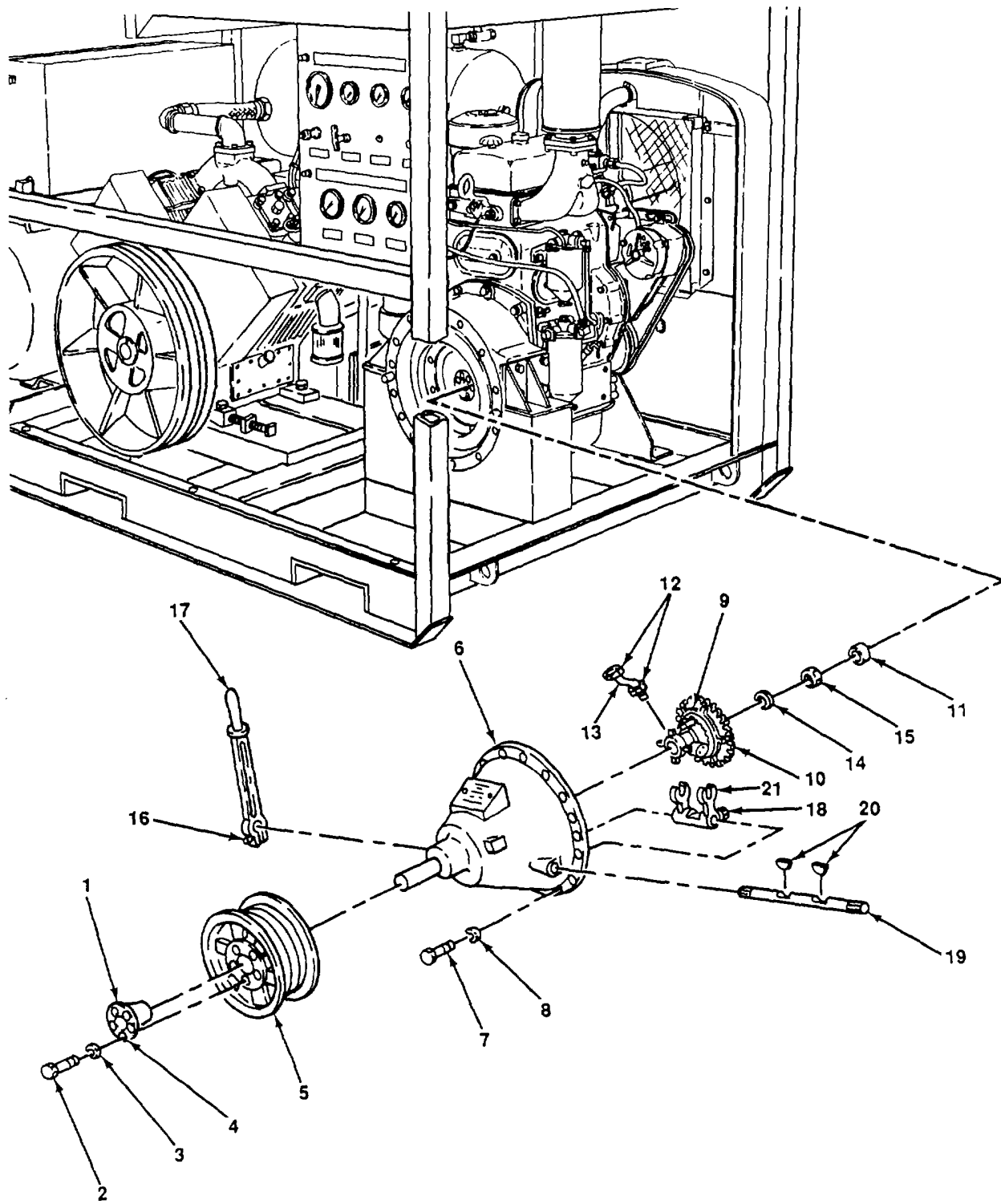


Figure 4-28. PTO, Installation.



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**4-23. Clutch Assembly.**

---

This task covers:

Replace

---

**INITIAL SETUP***Tools**Equipment Condition*

General Mechanic's Tool Kit (NSN 5180-00-177-7033) Drive belt removed (para. 3-12).  
Puller Kit, Mechanical (NSN 5120-00-033-5606)

*Materials/Parts*

Clutch Assembly  
Solvent, Dry Cleaning (Item 23, Appendix D)  
Rags, Wiping (Item 21, Appendix D)

---

- a. Remove. (figure 4-29)
  - (1) Connect suitable lifting device to PTO housing (1).
  - (2) Remove 12 screws (2) and lockwashers (3) and remove PTO housing (1) and three clutch discs (4).
  - (3) Using puller, remove pilot bearing (5).
  - (4) Loosen two fitting nuts (6) and remove grease line (7).
  - (5) Bend out lockwasher (8) and remove nut (9), lockwasher (8), and clutch assembly (10).
  - (6) Loosen screw (11) and remove handle (12).
  - (7) Remove two screws (13) and lockwashers (14).
  - (8) Slide shaft (15) either right or left and remove two keys (16) and remove shaft (15) and yoke (17).
  - (9) Remove eight screws (18) and lockwashers (19) and remove drive ring (20).

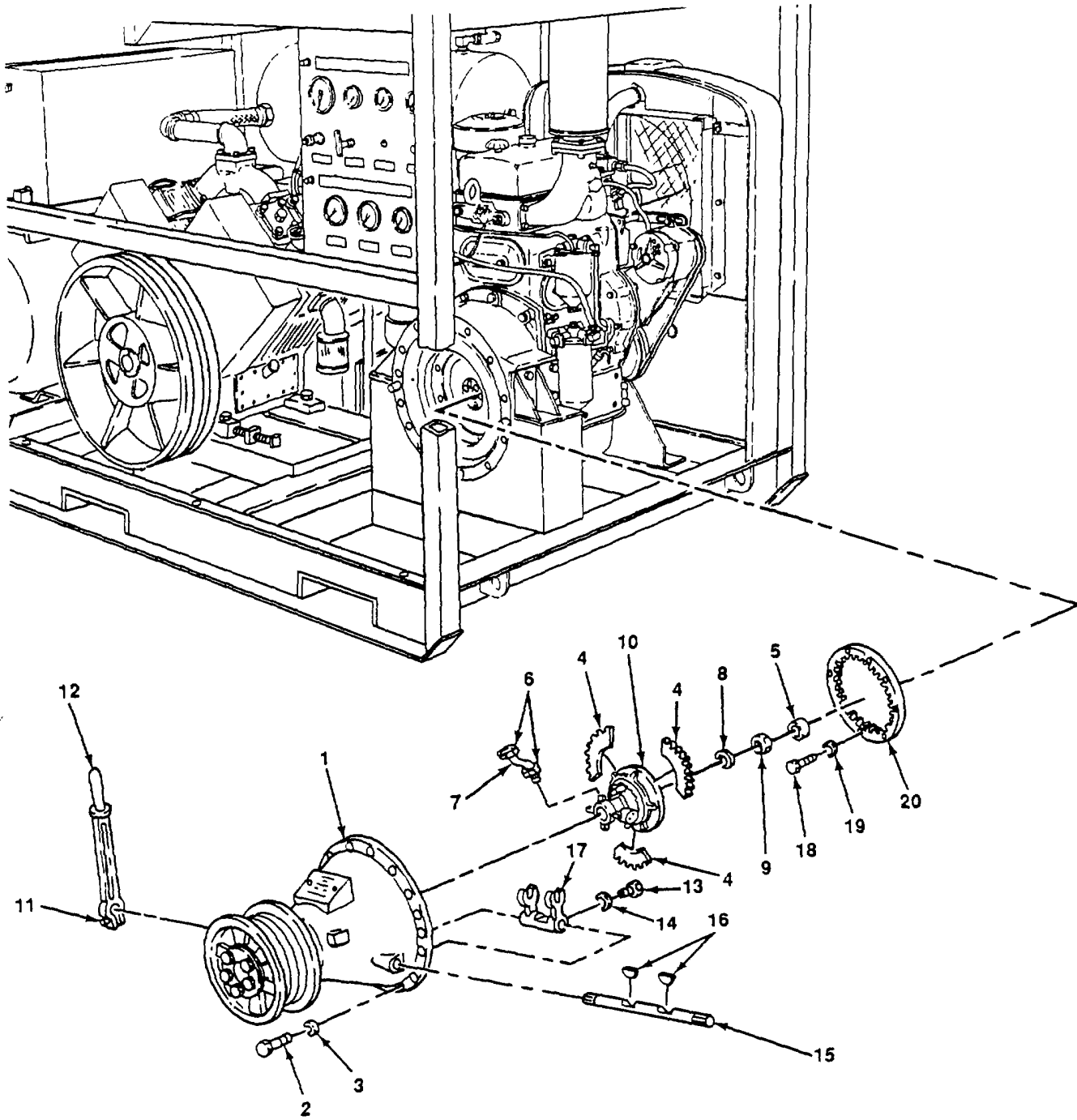


Figure 4-29. Clutch Assembly, Removal.

**4-23. Clutch Assembly (Cont).**b. *Install.* (figure 4-30)

- (1) Install yoke (17), shaft (15), two keys (16) and secure with two screws (13) and lockwashers (14).
- (2) Install handle (12) and tighten screw (11).
- (3) Install clutch assembly (10) and secure with lockwasher (8) and nut (9) and bend up lockwasher (8).
- (4) Install three clutch discs (4) in clutch assembly (10) and install drive ring (20) on clutch assembly (10).
- (5) Center drive ring (20) on clutch assembly (10) and engage clutch and remove drive ring (10).
- (6) Install drive ring (20) and secure with eight screws (18) and lockwashers (19).
- (7) Install grease line (7) and tighten two fitting nuts (6).
- (8) Install pilot bearing (5).
- (9) Install PTO housing (1) and secure with 12 screws (2) and lockwashers (3).

FOLLOW-ON MAINTENANCE  
Install drive belts (para. 3-12).

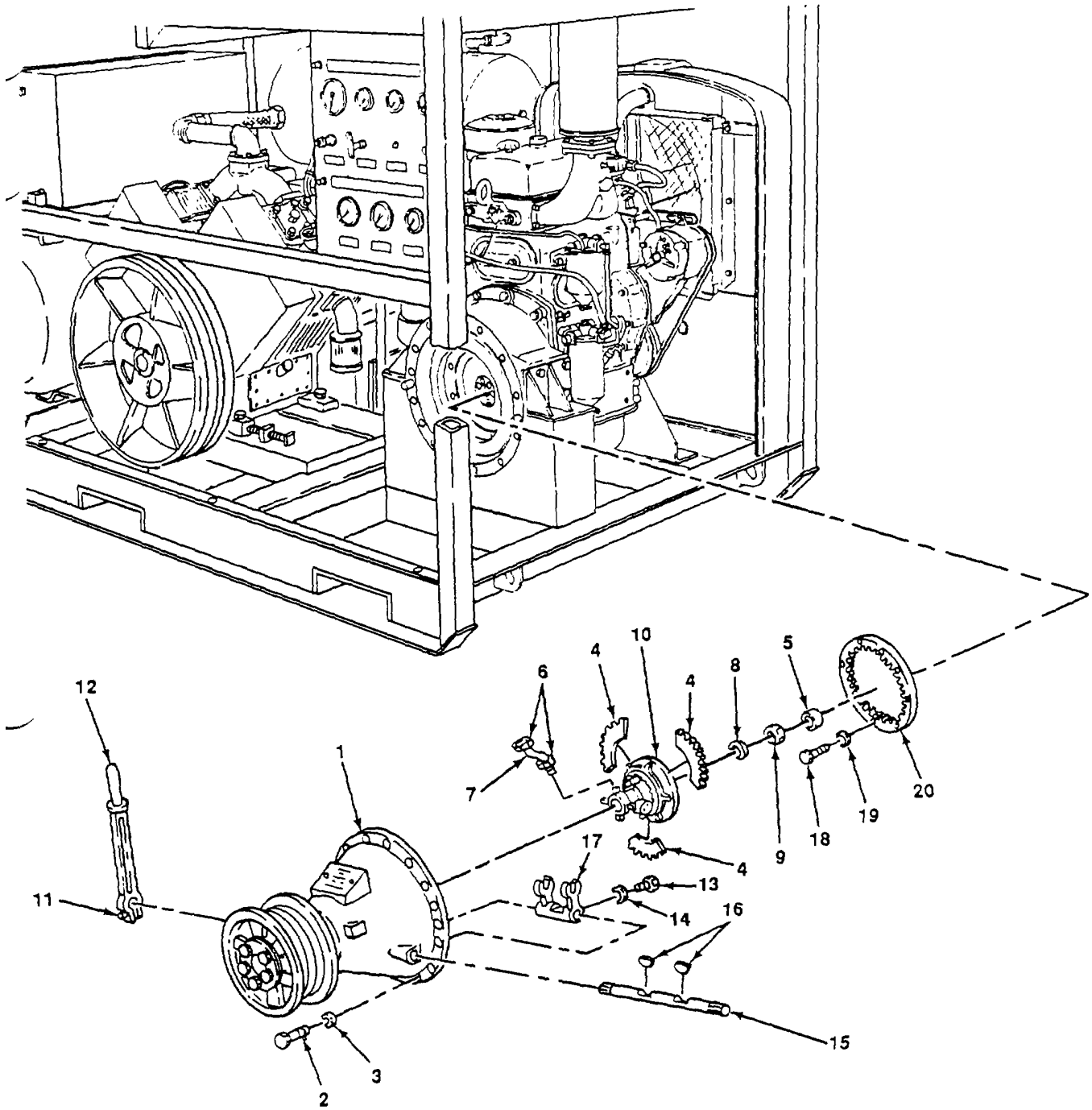


Figure 4-30. Clutch Assembly, Installation.

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**4-24. Air Compressor Assembly.**

---

This task covers:

- a. Test
  - c. Replace
- 

**INITIAL SETUP**

*Tools*

*Materials/Parts*

General Mechanic's Tool Kit (NSN 5180-00-177-7033) Air Compressor Assembly  
Bands, Rubber (Item 5, Appendix D)  
Bags, Plastic (Item 4, Appendix D)  
Gasket, Manifold

---

a. Test.

Test air compressor output for air purity standards in accordance with FM 20-11-1.

b. Removal. (figure 4-31).

**WARNING**

Cleanliness is imperative in maintaining and handling diving air system components. All tools and parts must be kept free of oil, grease, rust, or other contamination in accordance with accepted army diving cleaning procedures. Foreign substances within an assembly could result in equipment failure and possible injury or death to personnel.

Ensure that all air lines and components removed or openings into the air system that provides breathing air are covered with a plastic bag and secured with a rubber band or taped shut. Small components should be stored in a plastic bag and sealed. Failure to do so will cause air system to become contaminated and could result in injury or death to the diver.

- (1) Remove four bolts (1), washers (2) and nuts (3) securing two brackets (4) to frame (5)
- (2) Remove eight bolts (6), washers (7) and nut (8) securing plywood deck (9) to frame (5). Remove plywood deck.
- (3) Remove five screws (10) from shroud (12).
- (4) Loosen coupling nut (13) and remove starting fluid line (14).
- (5) Remove twelve screws (15) securing cover (16) to shroud (12) and remove shroud and cover.

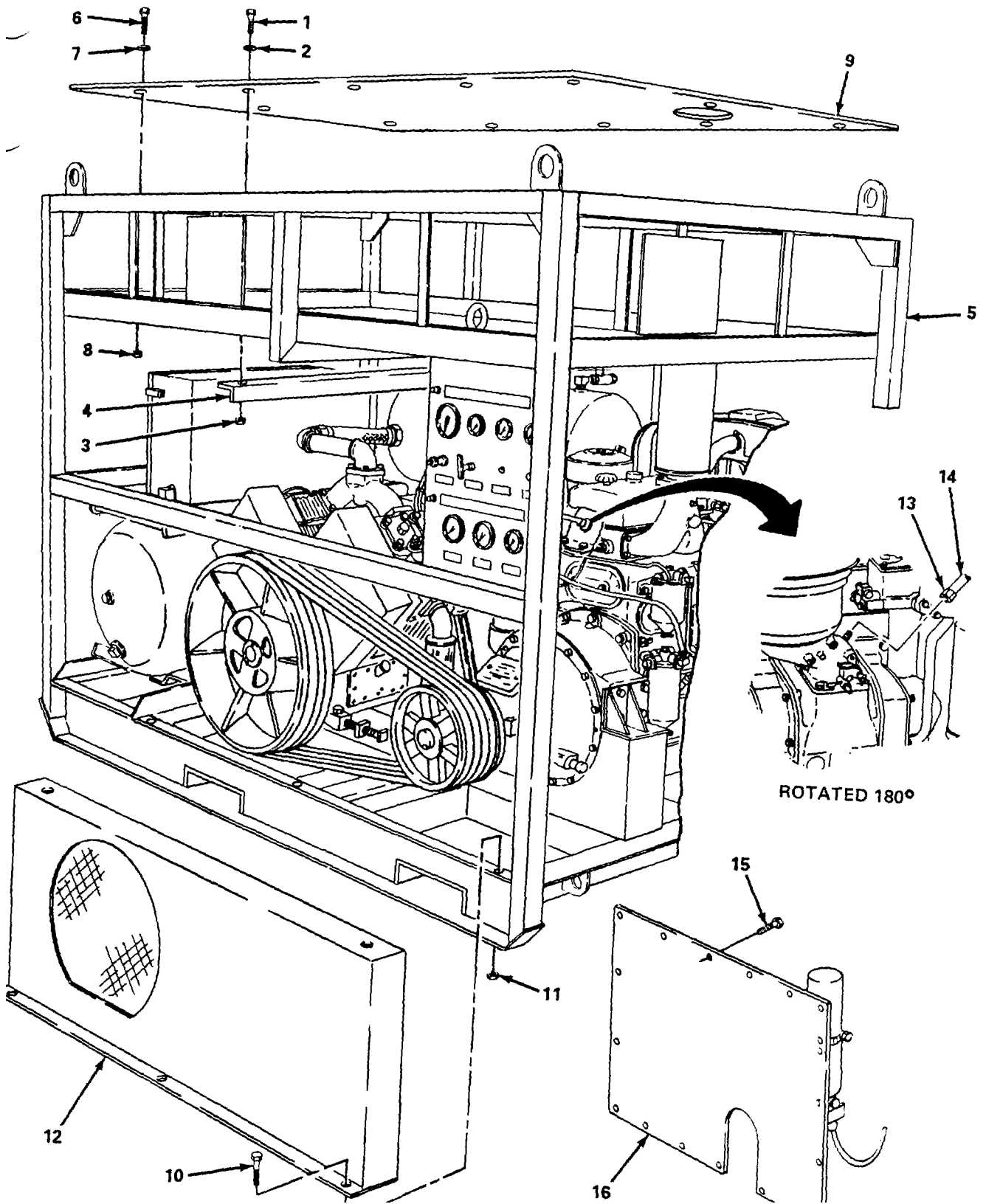


Figure 4-31. Air Compressor, Removal (Sheet 1 of 2).

4-24. Air Compressor Assembly (Cont).

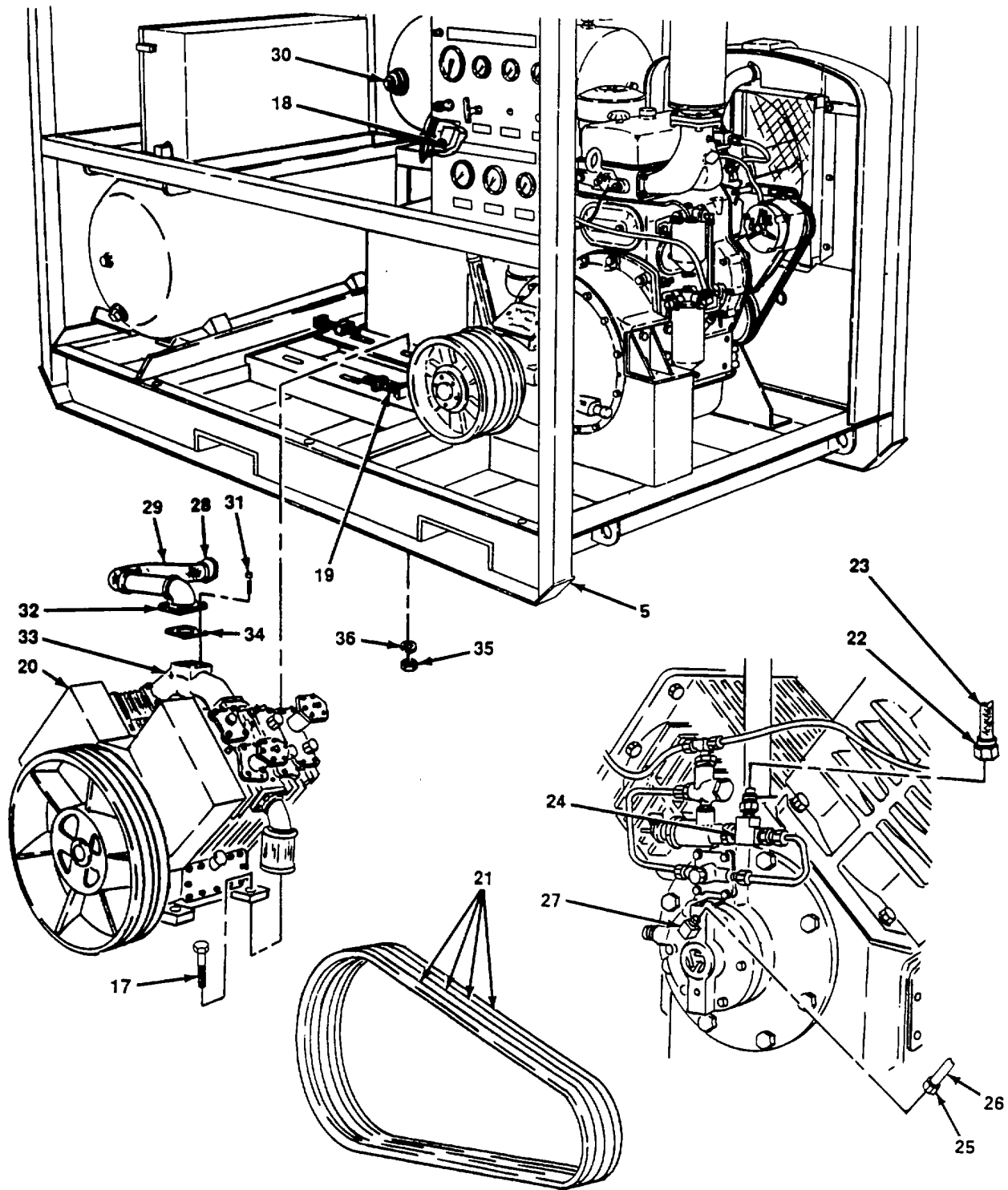


Figure 4-31. Air Compressor, Removal (Sheet 2 of 2).

- (6) Loosen four bolts (17) and (18) and adjusting screw (19) and slide compressor (20) towards engine.
- (7) Remove four belts (21) from compressor (20).
- (8) Loosen coupling nut (22) securing air pressure line (23) to VD pilot tee (24).
- (9) Loosen coupling nut (25) securing oil pressure line (26) to oil pump fitting (27).
- (10) Loosen coupling nut (28) securing flex pipe (29) to air receiver tank fitting (30).
- (11) Remove four screws (31) securing flange (32) to discharge manifold (33) and remove flange and gasket (34) with flex pipe (29).
- (12) Remove four nuts (35), washers (36), and bolts (17) securing compressor (20) to frame (5).

**WARNING**

Before lifting compressor ensure that lifting device and slings have the needed capacity to support weight of compressor. Do not sling compressor by the manifold. Failure to follow these instructions may result in serious injury or death to personnel.

**CAUTION**

Before lifting compressor, ensure that all air lines, hoses and parts are clear of obstructions. Failure to do so will result in damage to the compressor.

- (13) Attach lifting device to compressor and remove compressor.
- (14) Set compressor on suitable wood blocking to prevent flywheel pulley from hitting ground.



**4-24. Air Compressor Assembly (Cont).**

- c. *Installation.* (figure 4-32)

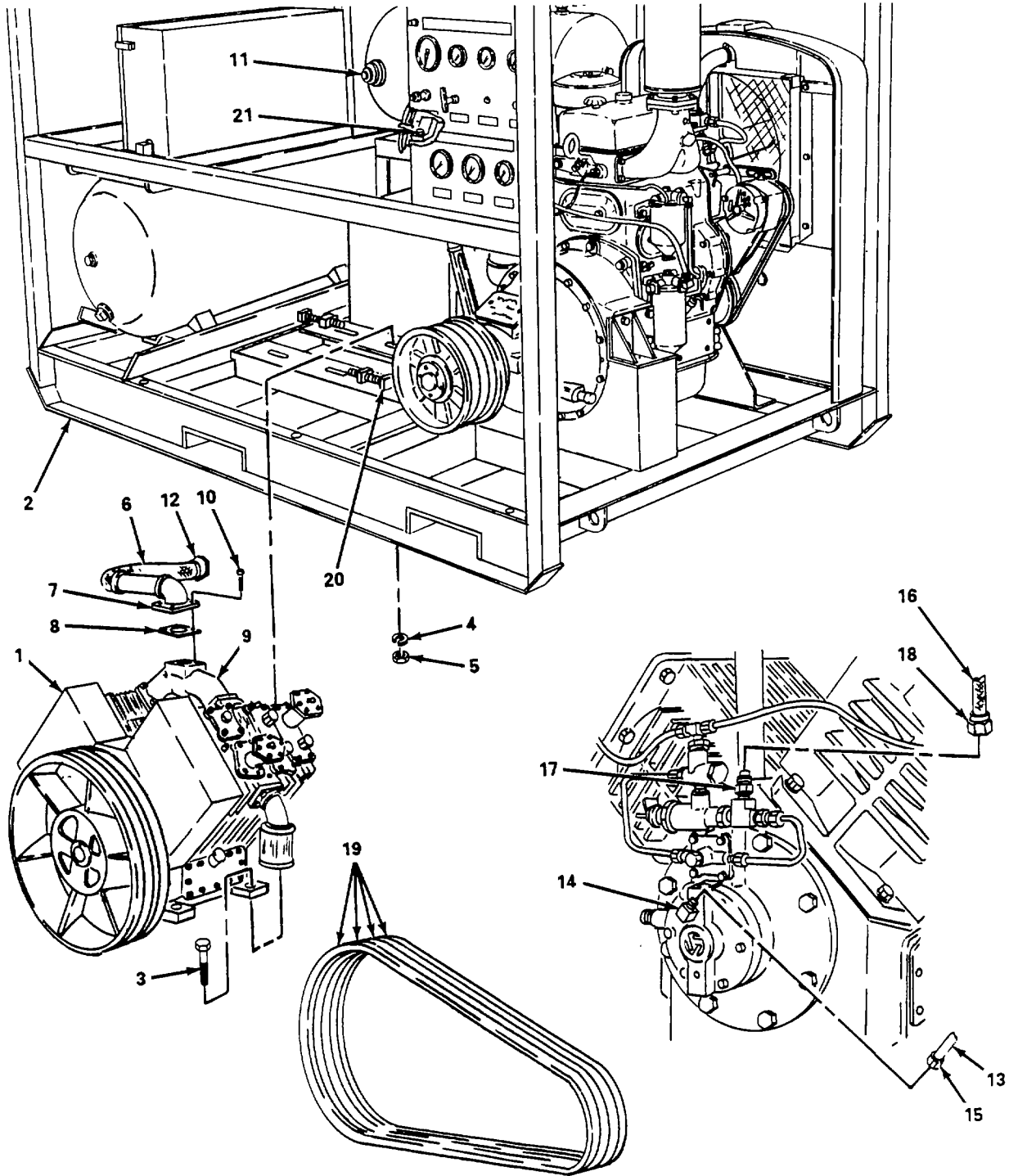
**WARNING**

Before lifting compressor ensure that lifting device and slings have the needed capacity to support weight of compressor. Do not sling compressor by the manifold. Failure to follow these instructions may result in serious injury or death to personnel.

**CAUTION**

As compressor is lowered into frame, ensure that compressor does not come into contact with the frame. Failure to do so could result in damage to compressor.

- (1) Attach lifting device to compressor (1) and install compressor on frame (2).
- (2) Loosely install four bolts (3), washers (4), and nuts (5) securing compressor to frame (2).
- (3) Install flex pipe (6) with flange (7) and gasket (8) on discharge manifold (9) and secure with four screws (10).
- (4) Install flex pipe (6) on receiver tank fitting (11) and tighten coupling nut (12).
- (5) Install oil pressure line (13) on oil pump fitting (14) and tighten coupling nut (15).
- (6) Install air pressure line (16) on VD pilot tee (17) and tighten coupling nut (18).
- (7) Install belts (19) on compressor (1) and slide compressor away from engine by tightening adjusting screw (20).
- (8) Tighten four bolts (3) and (21).



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Figure 4-32. Air Compressor, Installation (Sheet 1 of 2).

4-24. Air Compressor Assembly (Cont).

4-24. Air Compressor Assembly (Cont).

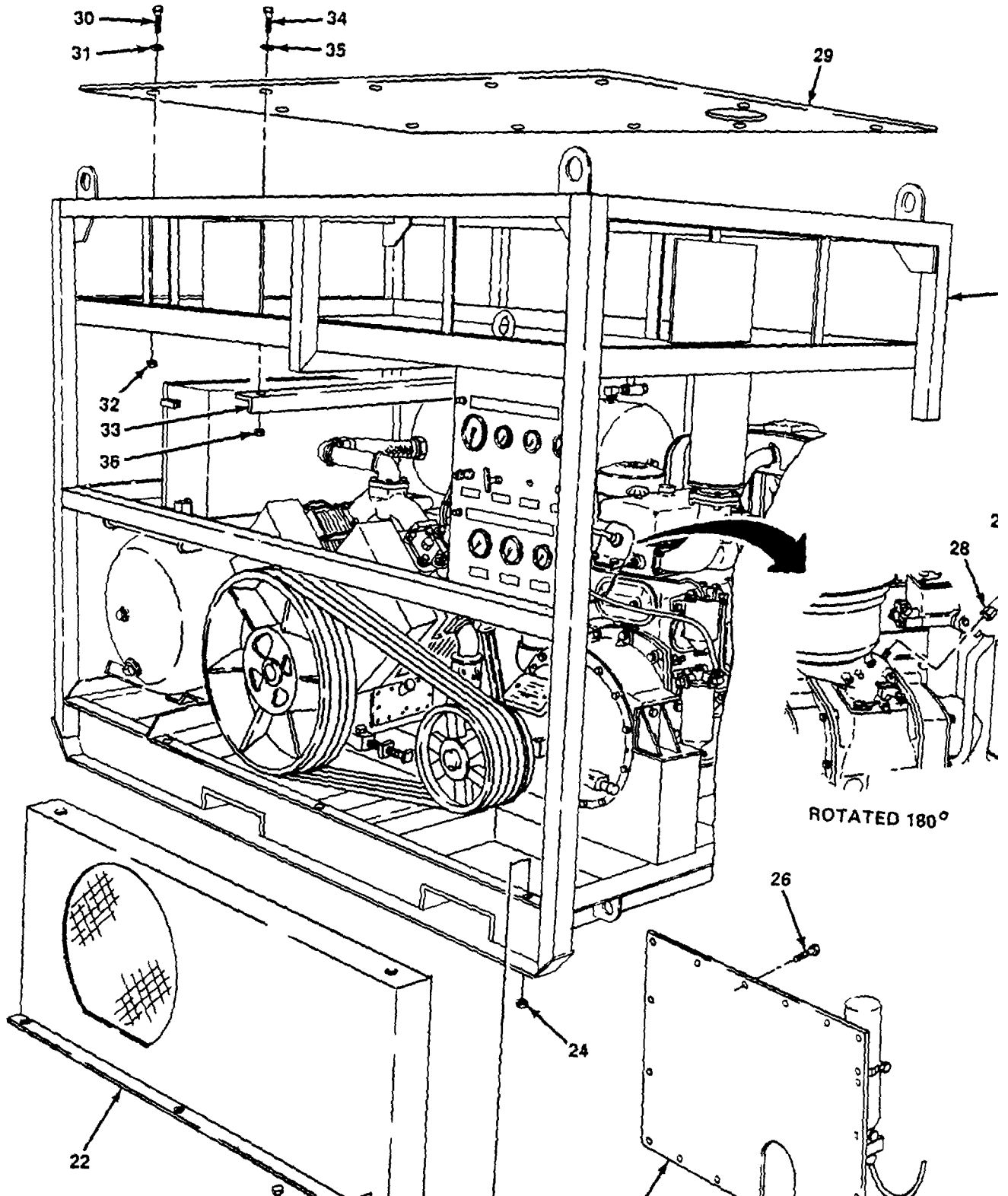


Figure 4-32. Air Compressor, Installation (Sheet 2 of 2).

- (9) Install shroud (22) and secure with five screws (23), and nuts (24).
- (10) Install cover (25) and secure with 12 screws (26).
- (11) Install line (27) and tighten coupling nut (28).
- (12) Install plywood deck (29) and secure with eight bolts (30), washers (31) and nuts (32).
- (13) Position two brackets (33) on frame (2) and secure with four bolts (34), washers (35) and nuts (36).

---

**4-25. Compressor Lines and Fittings.**

---

This task covers:

- a. Replace
- 

**INITIAL SETUP:***Tools*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)

*Materials/Parts*

Tape (Item 24, Appendix D)  
Bands, Rubber (Item 5, Appendix D)  
Bags, Plastic (Item 4, Appendix D)

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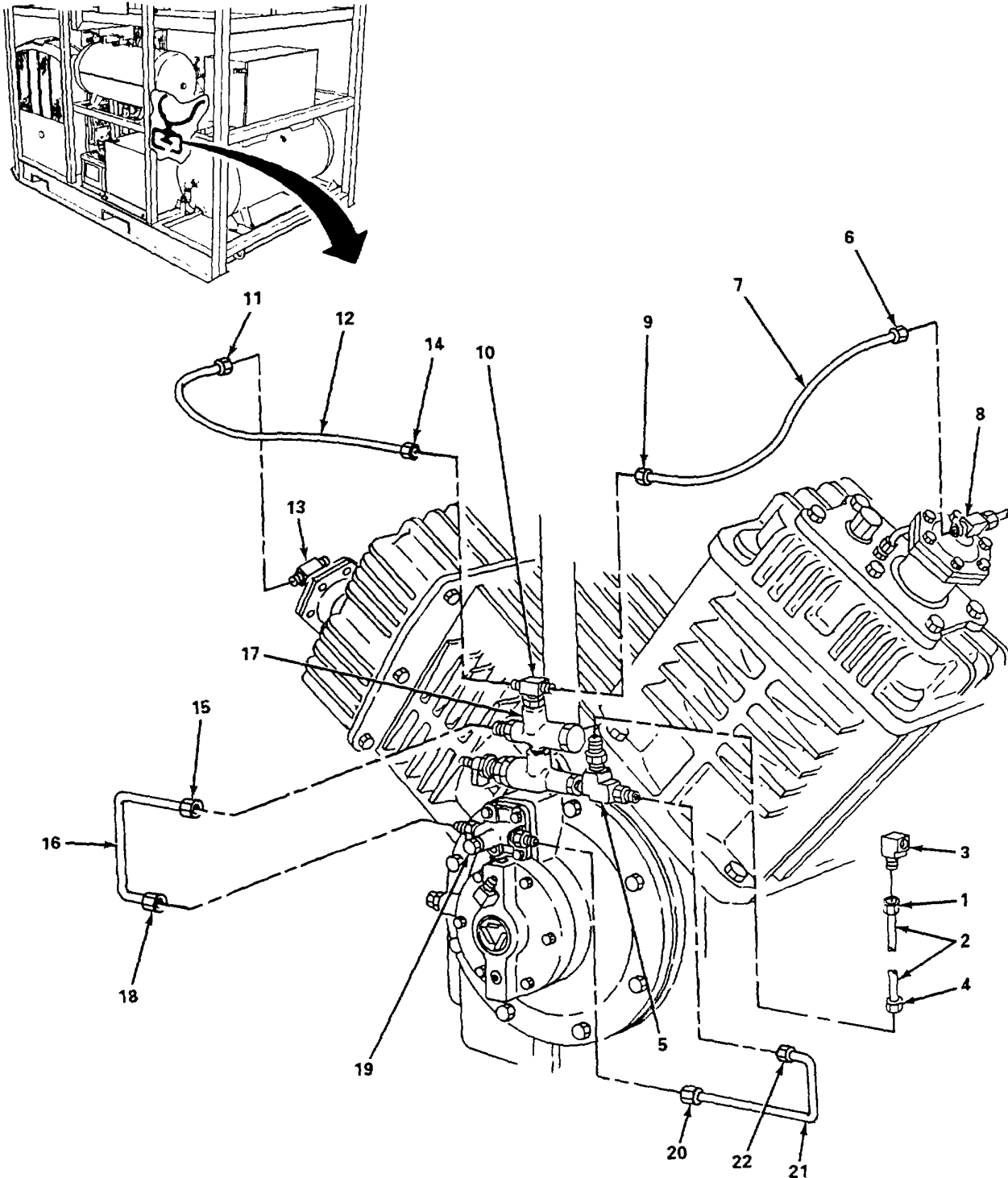
- a. Removal. (figure 4-33)

**WARNING**

Cleanliness is imperative in maintaining and handling diving air system components. All tools and parts must be kept free of oil, grease, rust, or other contamination in accordance with accepted army diving cleaning procedures. Foreign substances within an assembly could result in equipment failure and possible injury or death to personnel.

Ensure that all air lines and components removed or openings into the air system that provides breathing air are covered with a plastic bag and secured with a rubber band or taped shut. Small components should be stored in a plastic bag and sealed. Failure to do so will cause air system to become contaminated and could result in injury or death to the diver.

- (1) Loosen coupling nut (1) securing line (2) to air receiver tank fitting (3).
- (2) Loosen coupling nut (4) securing line (2) to VD pilot valve tee (5) and remove line.
- (3) Loosen coupling nut (6) securing line (7) to right unloader (8).
- (4) Loosen coupling nut (9) securing line (7) to check valve tee (10) and remove line.
- (5) Loosen coupling nut (11) securing line (12) to left unloader (13).
- (6) Loosen coupling nut (14) securing line (12) to check valve tee (10) and remove line.
- (7) Loosen coupling nut (15) securing line (16) to dual control check valve (17).
- (8) Loosen coupling nut (18) securing line (16) to hydraulic unloader assembly (19) and remove line.
- (9) Loosen coupling nut (20) securing line (21) to hydraulic unloader assembly (19).
- (10) Loosen coupling nut (22) securing line (21) to VD pilot tee (5) and remove line.



4951-108

Figure 4-33. Lines and Fittings, Removal.

**4-25. Compressor Lines and Fittings (Cont).***b. Installation.* (figure 4-34)

- (1) Install line (1) on VD pilot tee (2) and tighten coupling nut (3).
- (2) Install line (1) on hydraulic unloader assembly (4) and tighten coupling nut (5).
- (3) Install line (6) on hydraulic unloader assembly (4) and tighten coupling nut (7).
- (4) Install line (6) on dual control check valve (8) and tighten coupling nut (9).
- (5) Install line (10) on check valve tee (11) and tighten coupling nut (12).
- (6) Install line (10) on left unloader (13) and tighten coupling nut (14).
- (7) Install line (15) on check valve tee (11) and tighten coupling nut (16).
- (8) Install line (15) on right unloader (17) and tighten coupling nut (18).
- (9) Install line (19) on VD pilot valve tee (2) and tighten coupling nut (20).
- (10) Install line (19) on air receiver tank fitting (21) and tighten coupling nut (22).

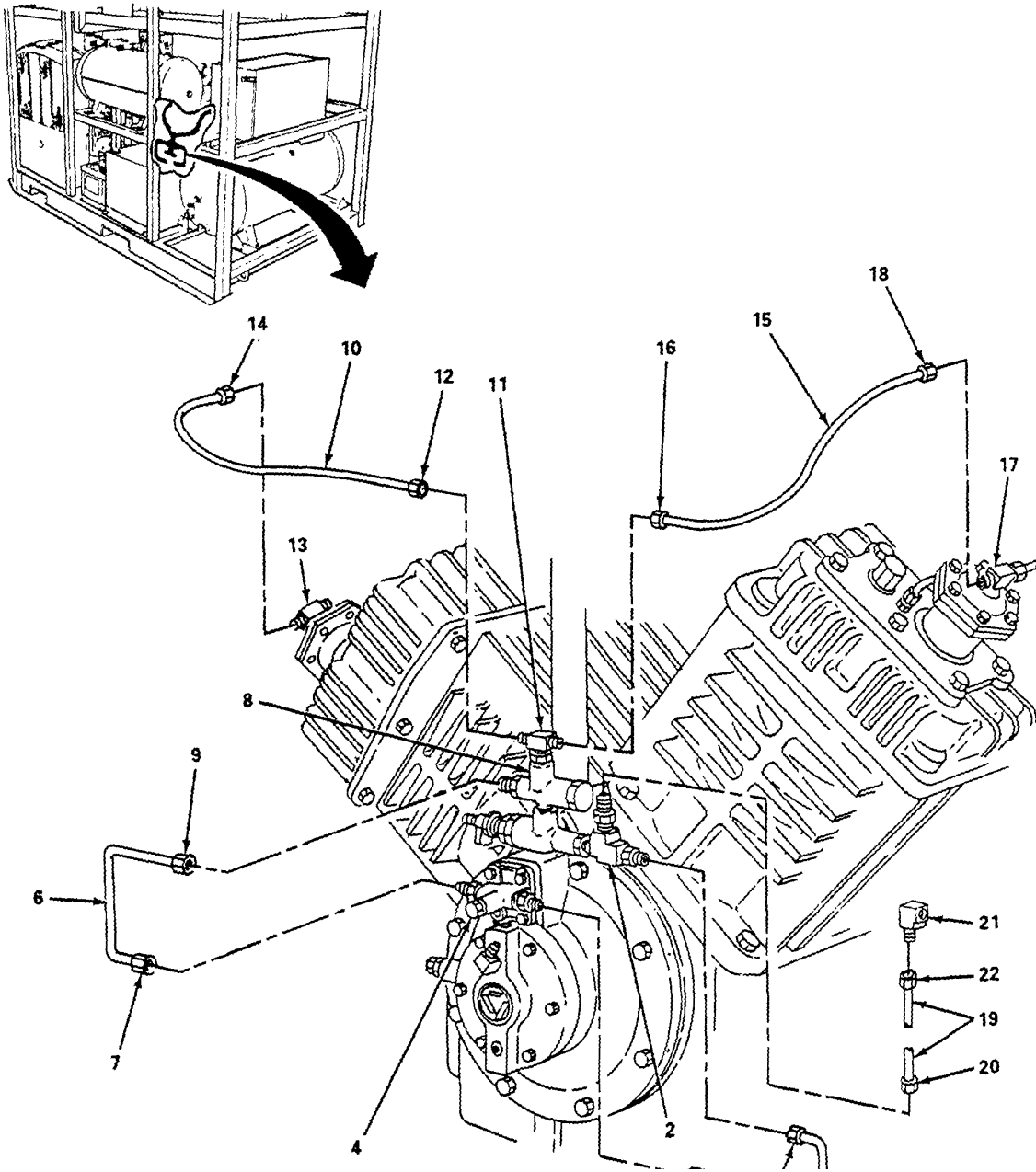


Figure 4-34. Lines and Fittings, Installation.



**4-26. Compressor VD Pilot Valve.**

This task covers:

- a. Replace
- b. Repair

INITIAL SETUP:

*Tools*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)

*Materials/Parts*

VD Pilot Valve  
Tape (Item 24, Appendix D)

*Materials/Parts (Cont)*

Bands, Rubber (Item 5, Appendix D)  
Bags, Plastic (Item 4, Appendix D)  
Tape, Teflon (Item 25, Appendix D)

*Equipment Condition*

Lines and fittings removed (para. 4-25).

- a. Replace. (figure 4-35)

**WARNING**

Cleanliness is Imperative in maintaining and handling diving air system components. All tools and parts must be kept free of oil, grease, rust, or other contamination in accordance with accepted army diving cleaning procedures. Foreign substances within an assembly could result in equipment failure and possible injury or death to personnel.

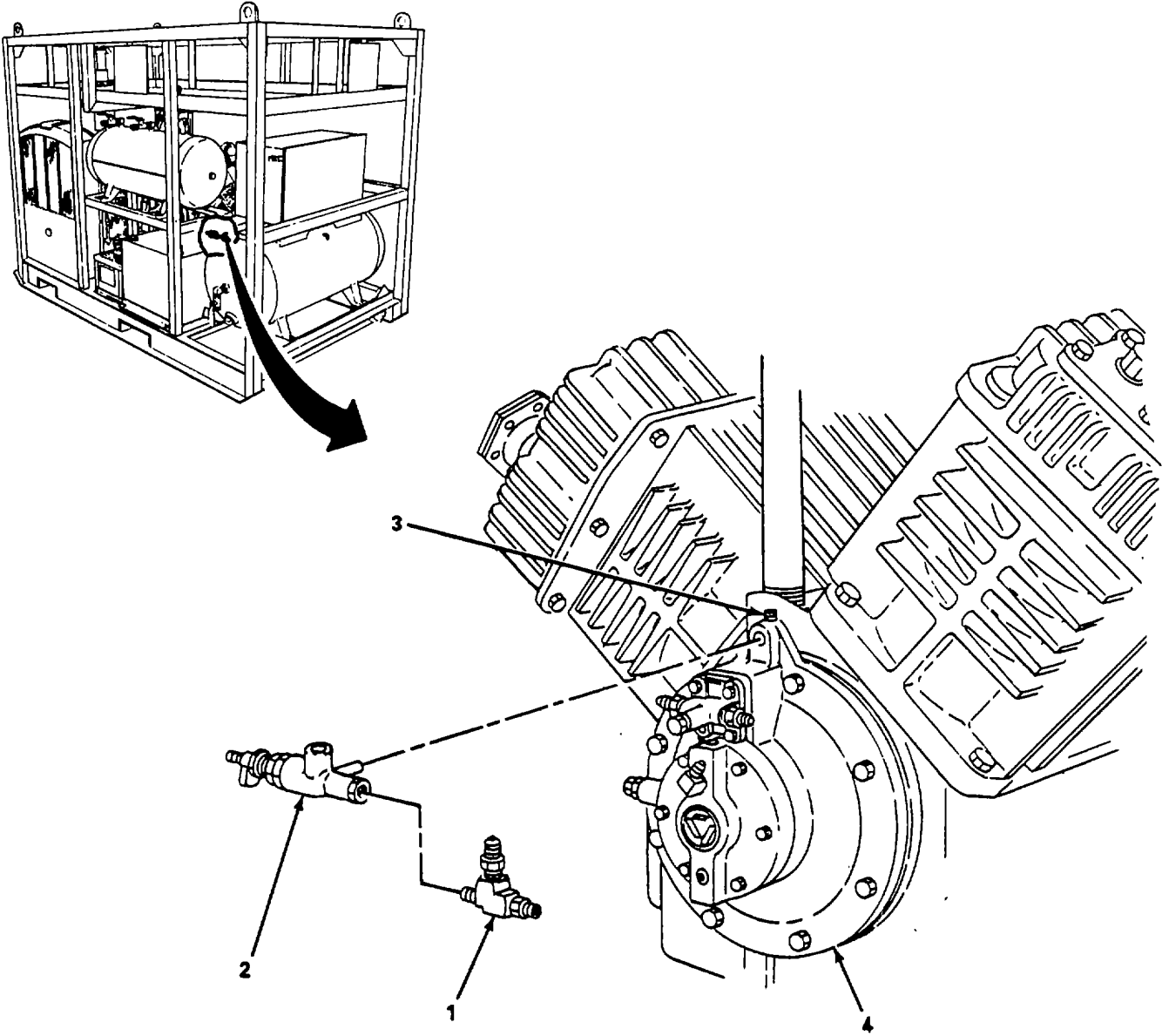
Ensure that all air lines and components removed or openings into the air system that provides breathing air are covered with a plastic bag and secured with a rubber band or taped shut. Small components should be stored in a plastic bag and sealed. Failure to do so will cause air system to become contaminated and could result in injury or death to the diver.

- (1) Remove VD pilot valve tee (1) from VD pilot valve (2).
- (2) Loosen allen set screw (3) and remove VD pilot valve.
- (3) Position VD pilot valve on bearing carrier (4) and tighten alien set screw (3).

**WARNING**

Leave 1 1/2 threads exposed on fitting when applying teflon tape. This will ensure that no teflon tape will hang down inside the air system. Teflon tape should be wrapped in such a manner that when the fitting is tightened the tape will not loosen. Failure to wrap teflon tape correctly may result in contamination or blockage of the air system and subsequent possible injury or death to the diver.

- (4) Apply teflon tape and install VD pilot valve tee (1) on VD pilot valve (2).

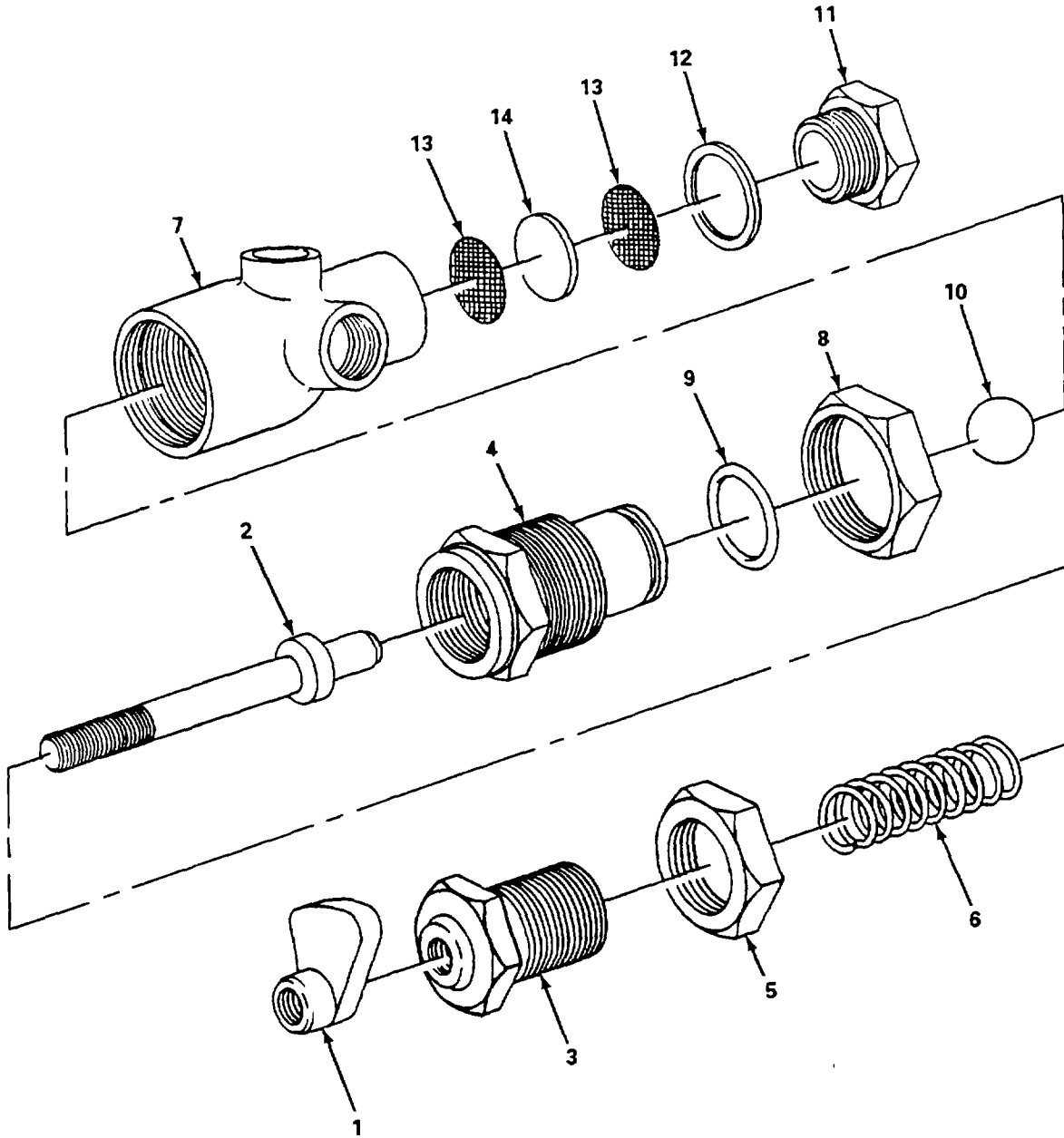


4951-110

Figure 4-35. VD Pilot Valve, Replace.

**4-26. Compressor VD Pilot Valve (Cont).***b. Repair.* (figure 4-36)

- (1) Remove trigger rod wing nut (1) from trigger rod (2)
- (2) Remove pressure adjusting screw (3) from differential adjusting screw (4).
- (3) Remove pressure adjusting screw lock nut (5) from pressure adjusting screw (3).
- (4) Remove trigger rod (2) and spring (6) from pressure adjusting screw (3).
- (5) Remove differential adjusting screw (4) from body (7).
- (6) Remove differential screw lock nut (8) and o-ring (9) from differential adjusting screw (4).
- (7) Remove ball (10) from body (7).
- (8) Remove cap (11), gasket (12), two screens (13), and felt filter (14) from body (7).
- (9) Install felt filter (14), two screens (13), gasket (12), and cap (11) on body (7).
- (10) Install ball (10) in body (7).
- (11) Install screw lock nut (8) and o-ring (9) on differential adjusting screw (4).
- (12) Install differential adjusting screw (4) on body (7).
- (13) Install spring (6) and trigger rod (2) in pressure adjusting screw (3).
- (14) Install pressure adjusting screw lock nut (5) on pressure adjusting screw (3).
- (15) Install pressure adjusting screw (3) in differential adjusting screw (4).
- (16) Install trigger rod wing nut (1) on trigger rod (2).



4951-111

**Figure 4-36. VD Pilot Valve, Repair.**

FOLLOW-ON MAINTENANCE  
Install lines and fittings (para. 4-25).

**4-27. Compressor Hydraulic Unloader Assembly.**

This task covers:

- a. Replace
- b. Repair

INITIAL SETUP:

*Tools*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)  
TSP Ultrasonic Cleaner w/Heater (Item 35, Appendix B)

*Materials/Parts*

Hydraulic Unloader Assembly  
Detergent, Nonionic (Item 11, Appendix D)  
Tape (Item 24, Appendix D)

*Materials/Parts (Cont)*

Bands, Rubber (Item 5, Appendix D)  
Bags, Plastic (Item 4, Appendix D)  
Tape, Teflon (Item 25, Appendix D)  
Water, Distilled (Item 11, Appendix D)

*Equipment Condition*

Lines and fittings removed (para. 4-25).

- a. Replace. (figure 4-37)

**WARNING**

Cleanliness is imperative in maintaining and handling diving air system components. All tools and parts must be kept free of oil, grease, rust, or other contamination in accordance with accepted army diving cleaning procedures. Foreign substances within an assembly could result in equipment failure and possible injury or death to personnel.

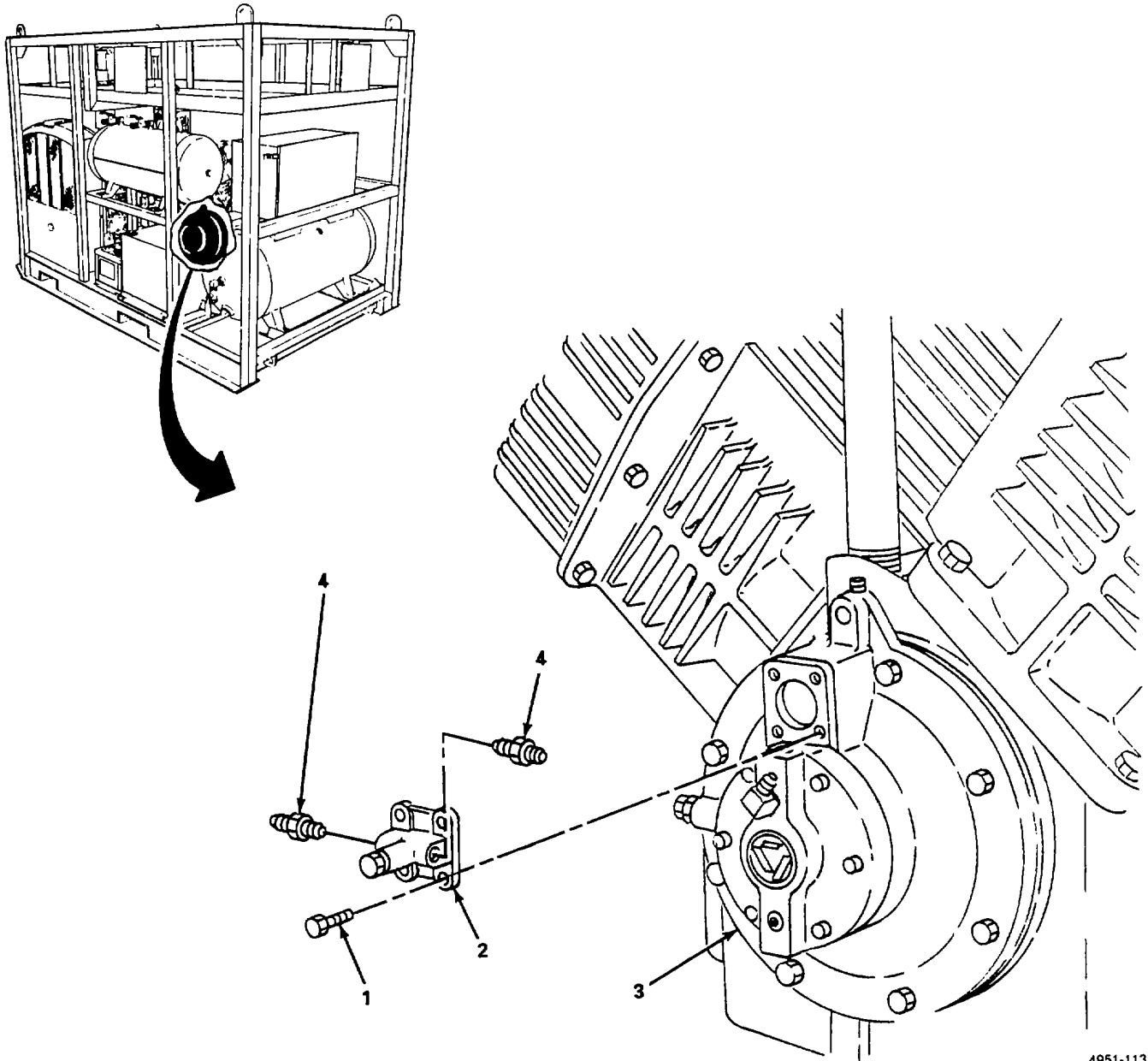
Ensure that all air lines and components removed or openings into the air system that provides breathing air are covered with a plastic bag and secured with a rubber band or taped shut. Small components should be stored in a plastic bag and sealed. Failure to do so will cause air system to become contaminated and could result in injury or death to the diver.

- (1) Remove four screws (1) securing hydraulic unloader assembly (2) to bearing carrier assembly (3) and remove hydraulic unloader assembly.
- (2) Remove two straight tube connectors (4) from hydraulic unloader assembly (2).

**WARNING**

Leave 1 1/2 threads exposed on fitting when applying teflon tape. This will ensure that no teflon tape will hang down inside the air system. Teflon tape should be wrapped in such a manner that when the fitting is tightened the tape will not loosen. Failure to wrap teflon tape correctly may result in contamination or blockage of the air system and subsequent possible injury or death to the diver.

- (3) Apply teflon tape and install two straight tube connectors (4) in hydraulic unloader assembly (2).
- (4) Install four screws (1) securing hydraulic unloader assembly (2) to bearing carrier assembly (3).



4951-113

Figure 4-37. Hydraulic Unloader Assembly, Replace.

**4-27. Compressor Hydraulic Unloader Assembly (Cont).***b. Repair.* (figure 4-38)

- (1) Remove retaining ring (1) securing spring retainer (2) and spring (3) to body (4) and remove spring retainer and spring.
- (2) Remove v-ring (5) from piston (6).
- (3) Remove roll pin (7) securing piston (6) to body (4) and remove piston.
- (4) Remove piston (8), ball (9), and push rod (10) from body (4).
- (5) Remove quad ring (11) from body (4).
- (6) Remove three screens (12) and two filters (13) from body (4).
- (7) Remove cap (14) securing spring (15) and outer valve (16) to body (4) and remove spring and outer valve.
- (8) Clean hydraulic unloader assembly using TPS ultrasonic cleaner w/heater following cleaning instructions in Chapter 3. Clean components soft goods in accordance with Chapter 3.
- (9) Inspect hydraulic unloader assembly components for cracks, bent or broken parts, worn or other signs of damage.
- (10) Replace any component that is worn, bent, broken, cracked or otherwise damaged.
- (11) Install outer valve (16), spring (15), and secure with cap (14).
- (12) Install three screens (12) and two filters (13) in body (4).
- (13) Install quad ring (11) on body (4).
- (14) Install push rod (10), ball (9) and piston (8) in body (4).
- (15) Install piston (6) on body (4) and secure with roll pin (7).
- (16) Install v-ring (5) on body (4).
- (17) Install spring (3), spring retainer (2) and secure with retaining ring (1).

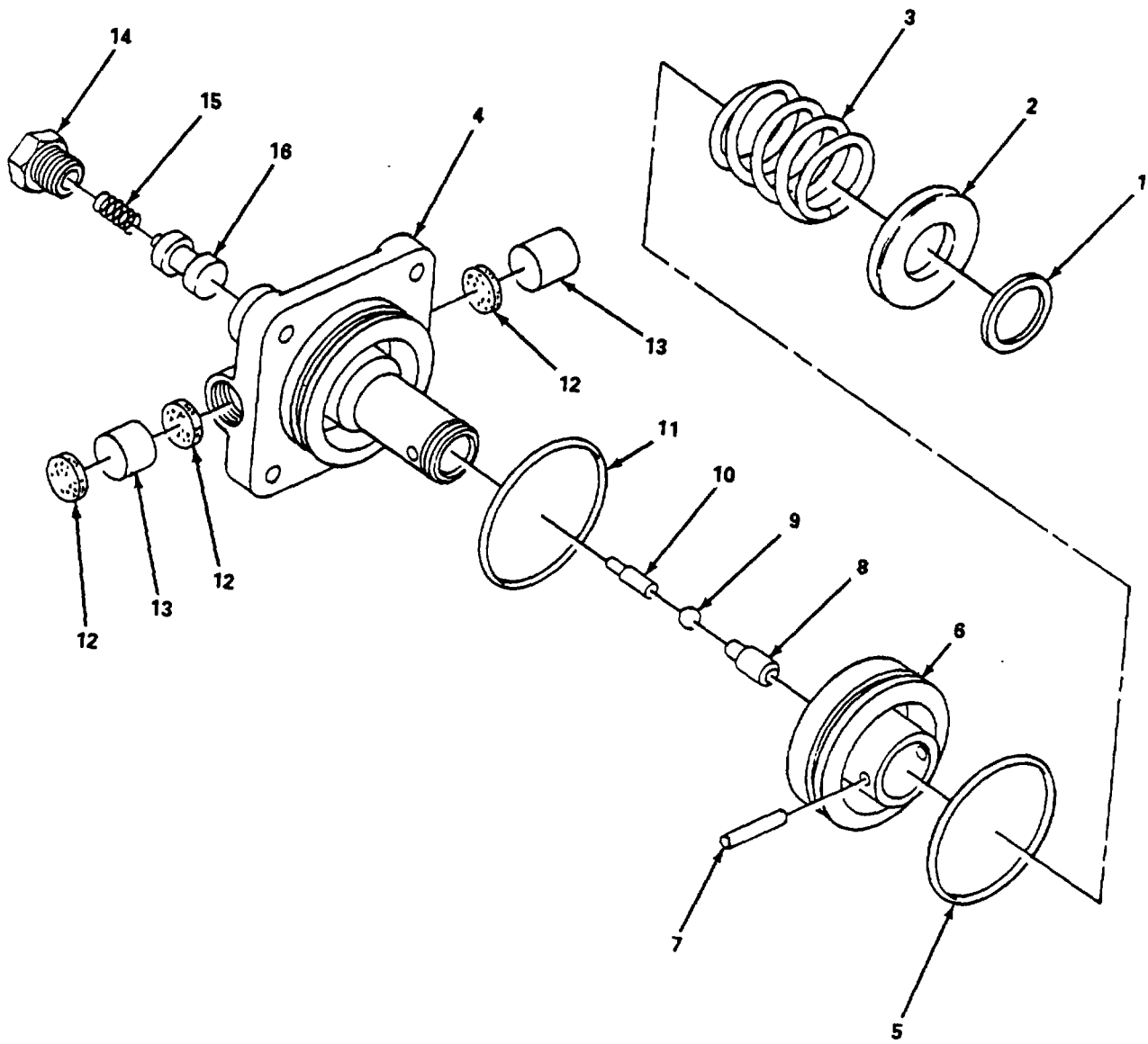
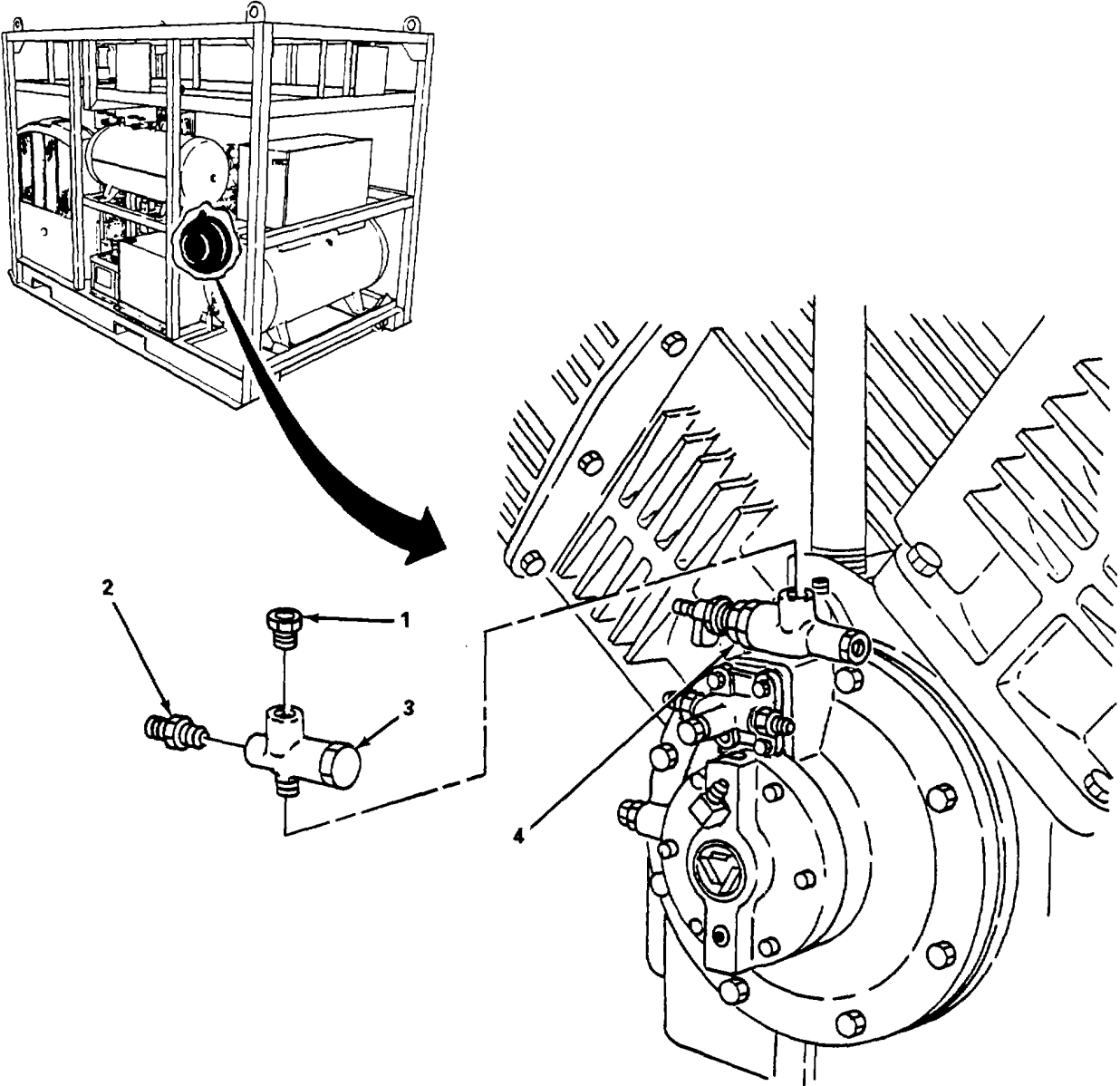


Figure 4-38. Hydraulic Unloader Assembly, Repair.







4951-112

Figure 4-39. Dual Control Check Valve Assembly, Replace.

4-95/(4-96 blank)

**4-28. Compressor Dual Control Check Valve Assembly (Cont)****WARNING**

Leave 1 1/2 threads exposed on fitting when applying teflon tape. This will ensure that no teflon tape will hang down inside the air system. Teflon tape should be wrapped in such a manner that when the fitting is tightened the tape will not loosen. Failure to wrap teflon tape correctly may result in contamination or blockage of the air system and subsequent possible injury or death to the diver.

- (3) Apply teflon tape and install dual control check valve assembly (3) on VD pilot valve (4).
- (4) Apply teflon tape to install reducing bushing (1) and straight tube connector (2) and install in dual control check valve assembly (3).

FOLLOW-ON MAINTENANCE  
Install lines and fittings (para. 4-25).

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**4-29. Compressor Shroud.**

---

This task covers:

- a. Replace
- 

**INITIAL SETUP:****Tools**

General Mechanic's Tool Kit (NSN 5180-00-177-7033)

**Materials/Parts**

Shroud, Left Hand  
 Shroud, Right Hand  
 Shroud, Center

---

**Replace.** (figure 4-40)

- (1) Loosen fitting nut (1) and disconnect line (2).
- (2) Remove 12 screws (3) and remove cover (4).
- (3) Remove three screws (5) and nuts (6) and remove drive belt shroud (7).
- (4) Remove two screws (8), lockwashers (9), and washers (10) securing top shroud (11) to brackets (12).
- (5) Remove ten screws (13) securing top shroud (11) to left shroud (14) and right shroud (15) and remove top shroud.
- (6) Remove two screws (16), washers (17), and nuts (18) securing left shroud (14) and right shroud (15) to cross brace (19).
- (7) Remove two screws (20), lockwasher (21), and washers (22) securing left shroud (14) and right shroud (15) to brackets (23) and remove left and right shrouds.
- (8) Install left shroud (14) and right shroud (15) and secure to brackets (23) with two screws (20) and lockwasher (21) and washer (22).
- (9) Install two screws (16), washers (17), and nuts (18) securing left shroud (14) and right shroud (15) to cross brace (19).
- (10) Install top shroud (11) and secure to left shroud (14) and right shroud (15) with ten screws (13).
- (11) Install two screws (8), lockwashers (9), and washers (10) securing top shroud (11) to brackets (12).
- (12) Install drive belt shroud (7) and secure with three screws (5) and nuts (6).
- (13) Install cover (4) and secure with 12 screws (3).
- (14) Install line (2) and tighten fitting nut (1).

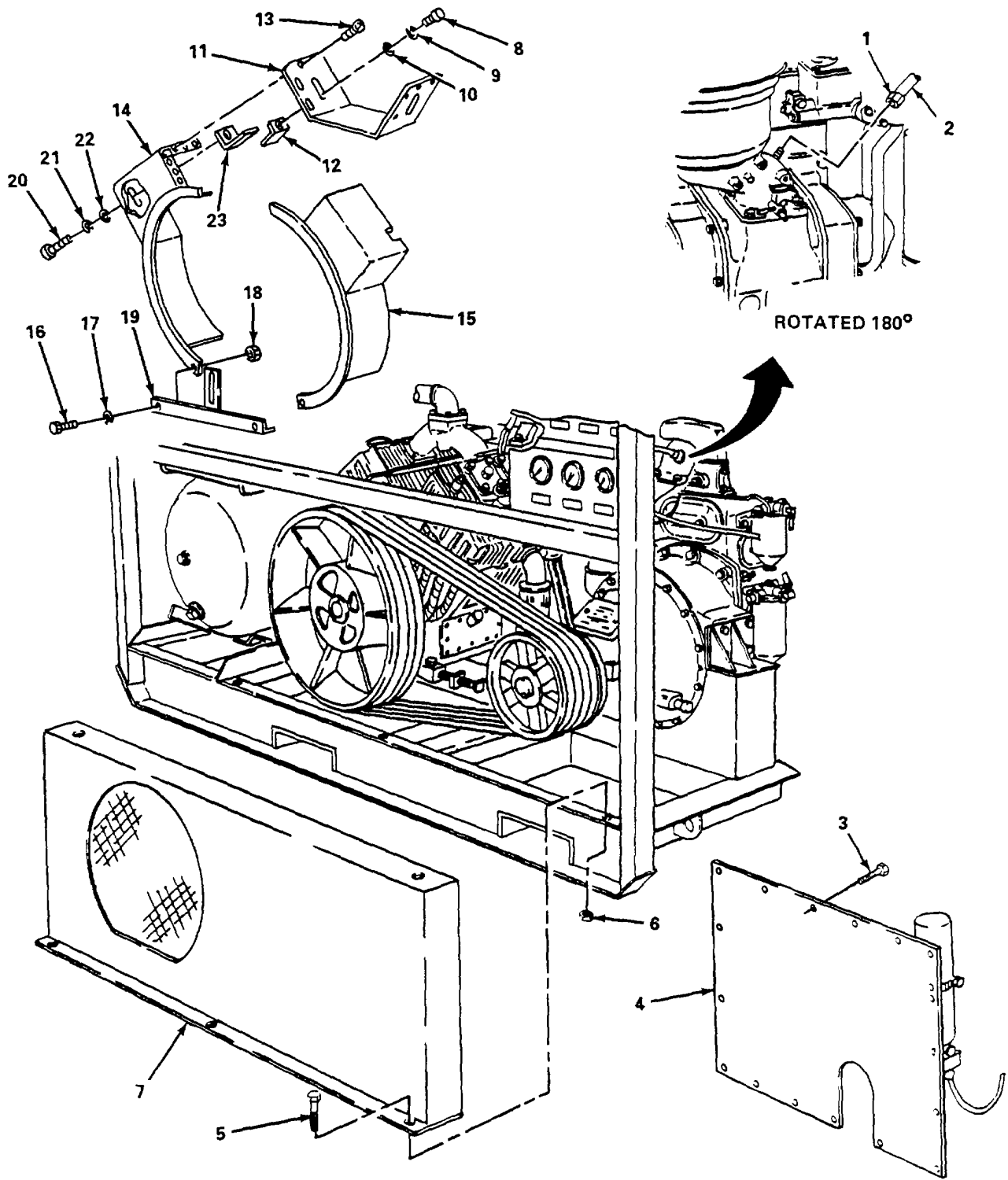


Figure 4-40. Shroud, Replace.

**4-30. Compressor Manifold.**

This task covers:

- a. Repair

## INITIAL SETUP:

*Tools*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)  
TSP Ultrasonic Cleaner w/Heater (Item x, Appendix B)  
24 in. Pipe Wrench (NSN 5120-00-277-1480)

*Materials/Parts*

Manifold, Compressor  
Gasket, Manifold

*Materials/Parts (Cont)*

Bands, Rubber (Item 5, Appendix D)  
Bags, Plastic (Item 4, Appendix D)  
Water, Distilled (Item 11, Appendix D)  
Detergent, Nonionic (Item 10, Appendix D)  
Teflon Tape (Item 25, Appendix D)

Repair. (figure 4-41)

**WARNING**

Cleanliness is imperative in maintaining and handling diving air system components. All tools and parts must be kept free of oil, grease, rust, or other contamination in accordance with accepted army diving cleaning procedures. Foreign substances within an assembly could result in equipment failure and possible injury or death to personnel.

Ensure that all air lines and components removed or openings into the air system that provides breathing air are covered with a plastic bag and secured with a rubber band or taped shut. Small components should be stored in a plastic bag and sealed. Failure to do so will cause air system to become contaminated and could result in injury or death to the diver.

- (1) Remove eight screws (1) securing discharge manifold (2) to header assembly (3).
- (2) Remove four screws (4) securing flange (5) to discharge manifold (2).
- (3) Remove and discard three gaskets(6) from discharge manifold (2).
- (4) Remove flange (5) from elbow (7).

**WARNING**

Leave 1 1/2 threads exposed on fitting when applying teflon tape. This will ensure that no teflon tape will hang down inside the air system. Teflon tape should be wrapped in such a manner that when the fitting is tightened the tape will not loosen. Failure to wrap teflon tape correctly may result in contamination or blockage of the air system and subsequent possible injury or death to the diver.

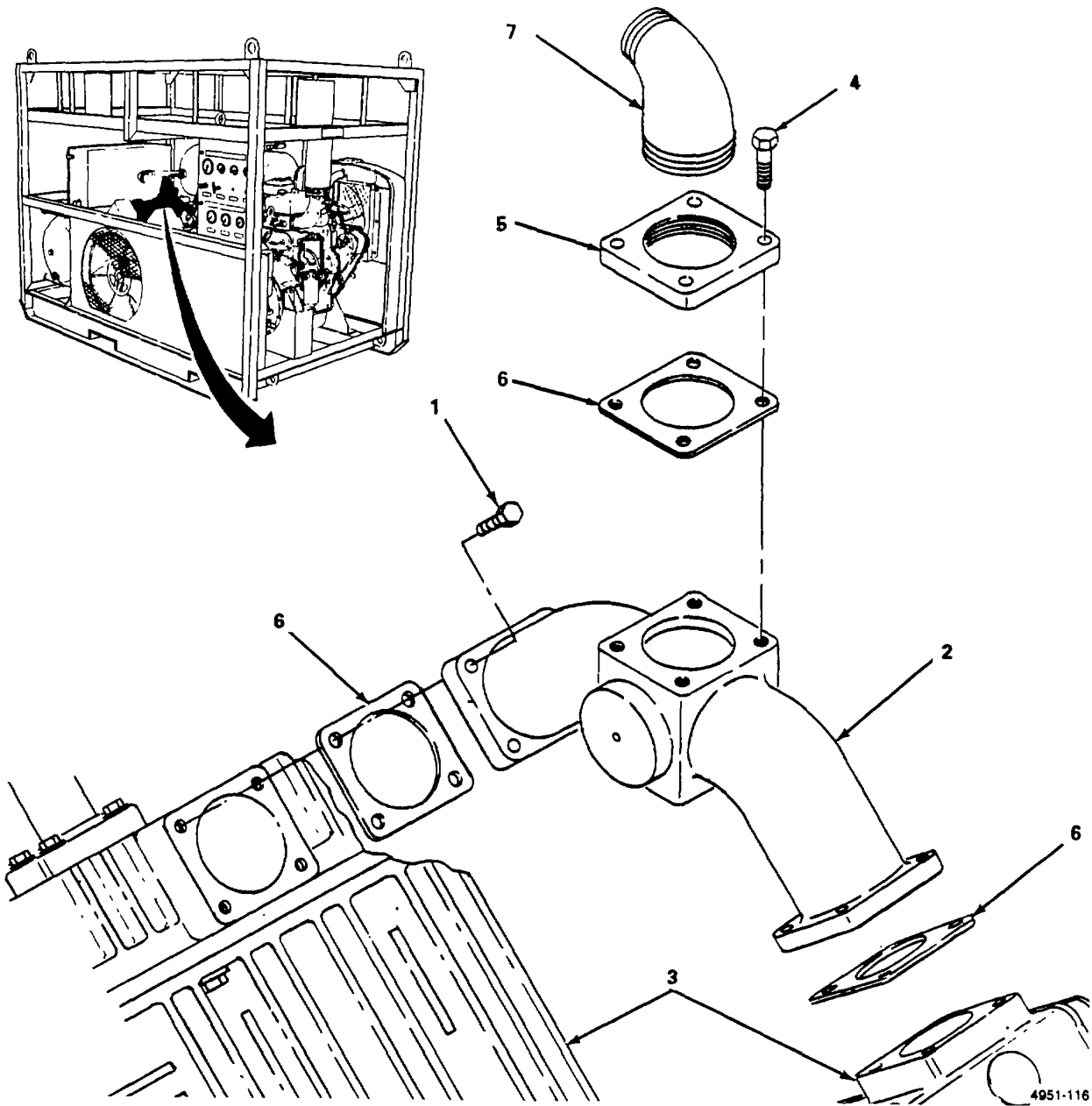


Figure 4-41. Manifold, Repair.

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**4-30. Compressor Manifold (Cont).**

- (5) Clean manifold (1) using TSP ultrasonic cleaner w/heater following cleaning instructions in Chapter 3.
- (6) Inspect manifold for cracks, stripped threads, or other damage.
- (7) If manifold is cracked, replace.
- (8) Install teflon tape on elbow (7) and install flange (5) on elbow.
- (9) Ensure all flanges are clean and free of gasket material.
- (10) Position discharge manifold (2) with two gaskets (6) on header assembly (3) and secure with eight screws (1).
- (11) Position gasket (6) on manifold (2).
- (12) Install four screws (4) in flange (5) securing flange to discharge manifold (2).



---

**4-31. Portable Air Filtration System.**

---

This task covers:

- a. Replace    b. Repair
- 

## INITIAL SETUP:

*Tools*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)

*Materials/Parts*

Portable Air Filtration System  
Tape (Item 24, Appendix D)  
Bands, Rubber (Item 5, Appendix D)  
Bags, Plastic (Item 4, Appendix D)  
Tape, Teflon (Item 25, Appendix D)

---

- a. Replace. (figure 4-42)

**WARNING**

Cleanliness is imperative in maintaining and handling diving air system components. All tools and parts must be kept free of oil, grease, rust, or other contamination in accordance with accepted army diving cleaning procedures. Foreign substances within an assembly could result in equipment failure and possible injury or death to personnel.

Ensure that all air lines and components removed or openings into the air system that provides breathing air are covered with a plastic bag and secured with a rubber band or taped shut. Small components should be stored in a plastic bag and sealed. Failure to do so will cause air system to become contaminated and could result in injury or death to the diver.

- (1) Remove two straps (1) securing portable air filtration system (2) and remove.
- (2) Install portable air filtration system (2) and secure with two straps (1).

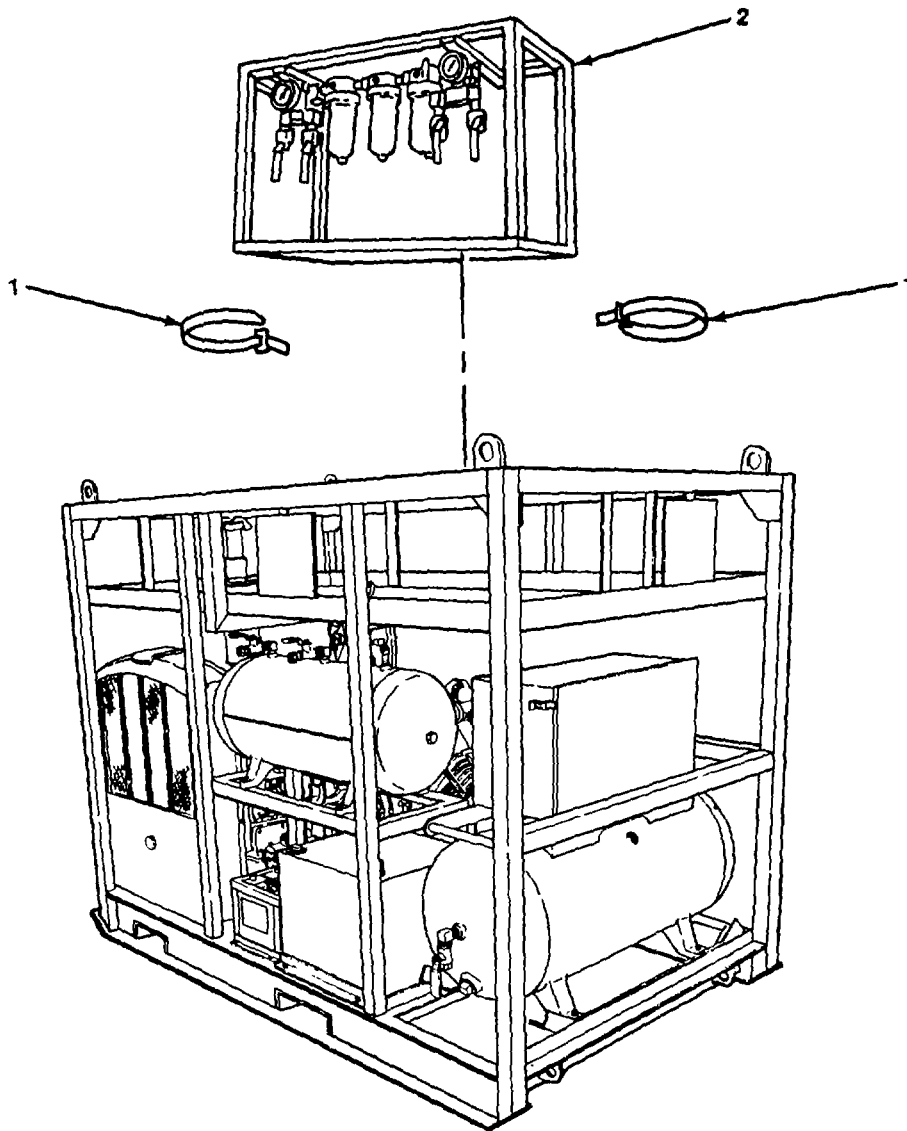


Figure 4-42. Portable Air Filtration System, Replace.

**4-31. Portable Air Filtration System (Cont).***b* Repair. (figure 4-43)

- (1) Remove four valves (1).
- (2) Remove four hex nipples (2).
- (3) Remove four elbows (3) and two tee's (4).
- (4) Remove two pressure gages (5) and reducers (6).
- (5) Remove two tee's (7).
- (6) Remove four screws (8), brackets (9), clamps (10), and two plates (11).
- (7) Remove two elbows (12), nipples (13), elbows (14), and reducers (15).
- (8) Remove filter assembly (16), nipple (17), filter assembly (18), nipple (19), and filter assembly (20).
- (9) Inspect frame (21) for cracks or broken welds and repair by welding.
- (10) Inspect valves (1) and replace if cracked or otherwise damaged.
- (11) Inspect hex nipples (2), elbows (3), tee's (4), reducers (6), tee's (7), elbows (12), nipples (13), elbows (14), reducers (15), nipple (17), and nipple (19), and replace if cracked or threads are stripped.
- (12) Inspect filter assemblies (16), (18), and (20) and replace if cracked or otherwise damaged.
- (13) Inspect clamps (10) and replace if cracked or otherwise damaged.
- (14) Inspect brackets (9) and replace if bent or otherwise damaged.
- (15) Inspect screws (8) and plates (11) and replace if bent or threads are stripped

**WARNING**

Leave 1 1/2 threads exposed on fitting when applying teflon tape. This will ensure that no teflon tape will hang down inside the air system. Teflon tape should be wrapped in such a manner that when the fitting is tightened the tape will not loosen. Failure to wrap teflon tape correctly may result in contamination or blockage of the air system and subsequent possible injury or death to the diver.

- (16) Apply teflon tape to all pipe threads.
- (17) Install nipple (19), filter assembly (18), nipple (17), and filter assemblies (16) and (20).
- (18) Install two reducers (15), elbows (14), nipples (13), and elbows (12).
- (19) Install two plates (11), four clamps (10), brackets (9) and secure with four screws (8).
- (20) Install two tee's (7), reducers (6), and pressure gages (5).
- (21) Install two tee's (4), four elbows (3), hex nipples (2), and valves (1).

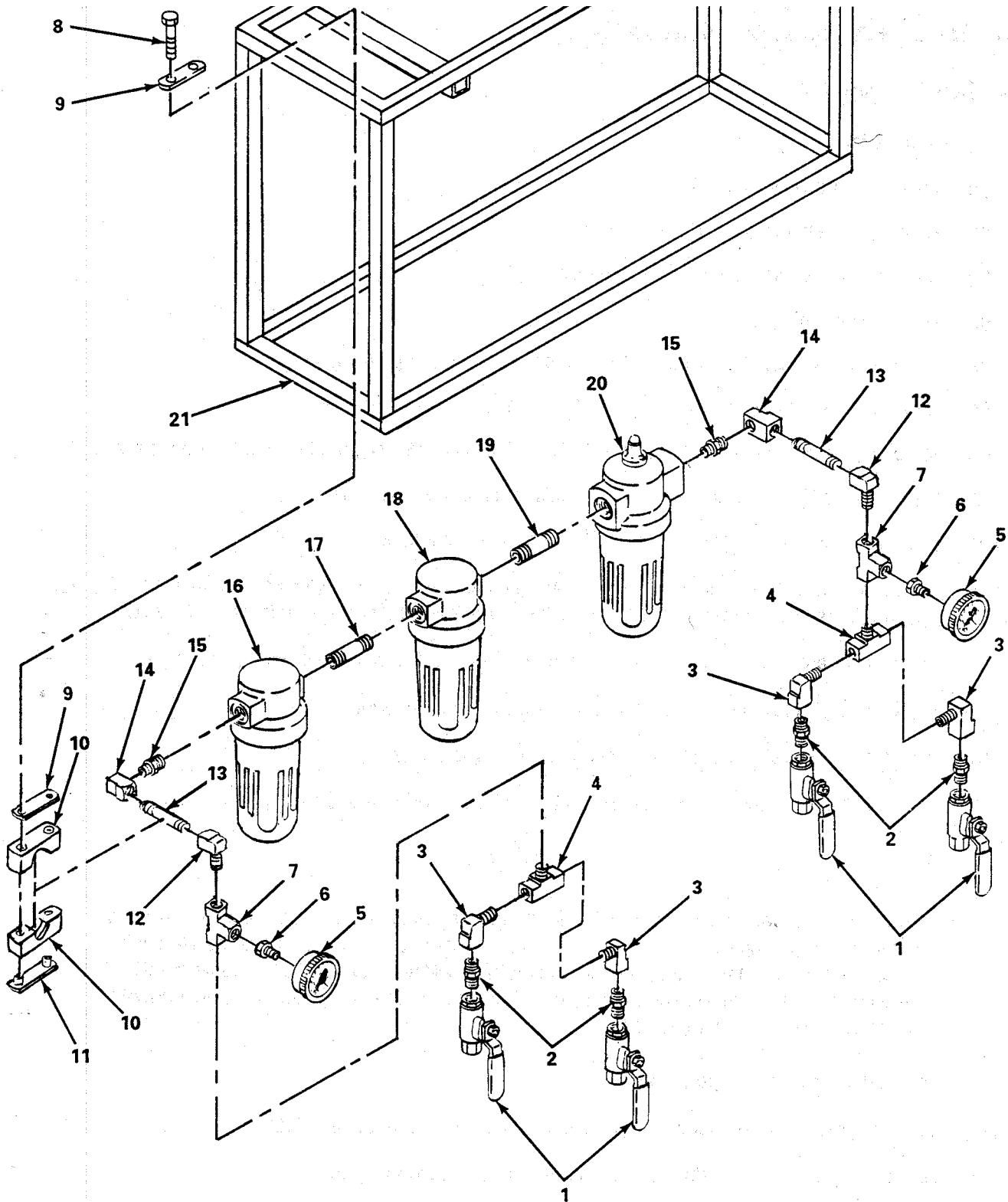


Figure 4-43. Portable Filtration System, Repair.

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**4-32. Portable Air Filtration System Valves.**

---

This task covers:

- a. Replace
- 

**INITIAL SETUP:***Tools*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)

*Materials/Parts*

Valve  
Tape (Item 24, Appendix D)  
Band, Rubber (Item 5, Appendix D)  
Bags, Plastic (Item 4, Appendix D)  
Teflon Tape (Item 25, Appendix D)

---

Replace. (figure 4-44)

**WARNING**

Cleanliness is imperative in maintaining and handling diving air system components. All tools and parts must be kept free of oil, grease, rust, or other contamination in accordance with accepted army diving cleaning procedures. Foreign substances within an assembly could result in equipment failure and possible injury or death to personnel.

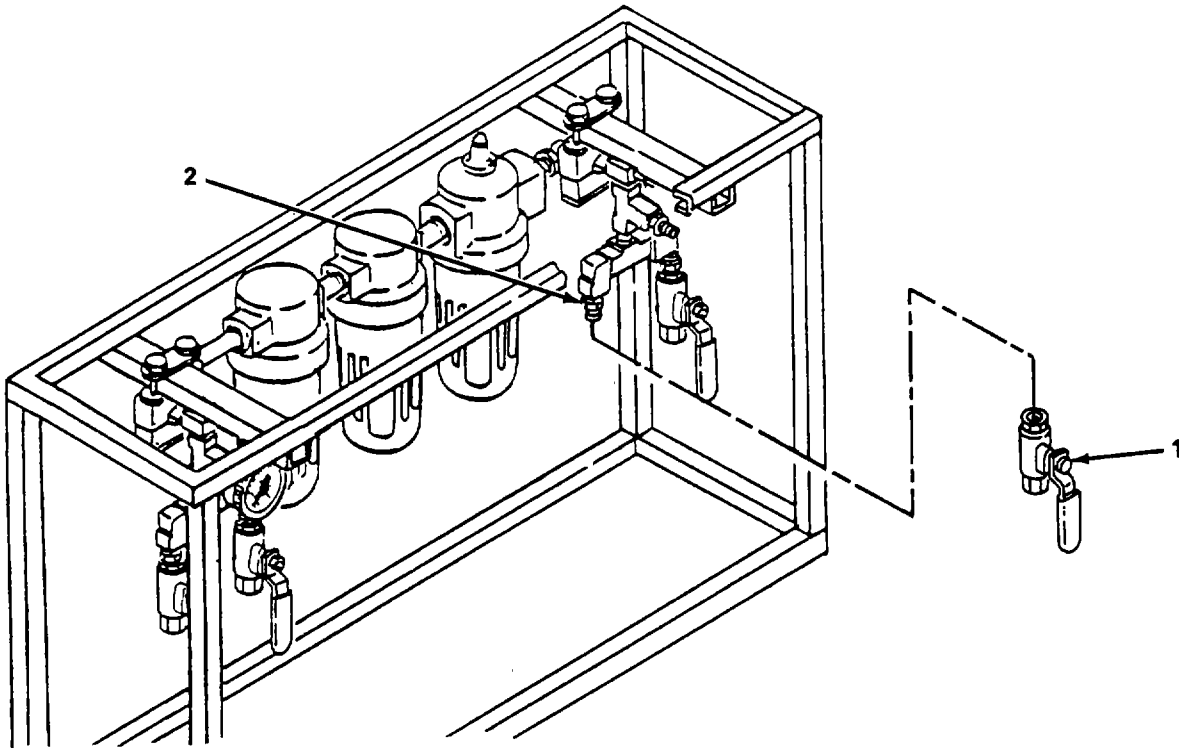
Ensure that all air lines and components removed or openings into the air system that provides breathing air are covered with a plastic bag and secured with a rubber band or taped shut. Small components should be stored in a plastic bag and sealed. Failure to do so will cause air system to become contaminated and could result in injury or death to the diver.

- (1) Remove valve (1)

**WARNING**

Leave 1 1/2 threads exposed on fitting when applying teflon tape. This will ensure that no teflon tape will hang down inside the air system. Teflon tape should be wrapped in such a manner that when the fitting is tightened the tape will not loosen. Failure to wrap teflon tape correctly may result in contamination or blockage of the air system and subsequent possible injury or death to the diver.

- (2) Apply teflon tape to threads on fitting (2).
- (3) Install valve (1).



4951-118

Figure 4-44. Valves, Replace.

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**4-33. Portable Air Filtration System Gages.**

---

This task covers:

- a. Replace
- 

**INITIAL SETUP:***Tools**Materials/Parts*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)

Gages  
Teflon Tape (Item 25, Appendix D)

---

Replace. (figure 4-45)

**WARNING**

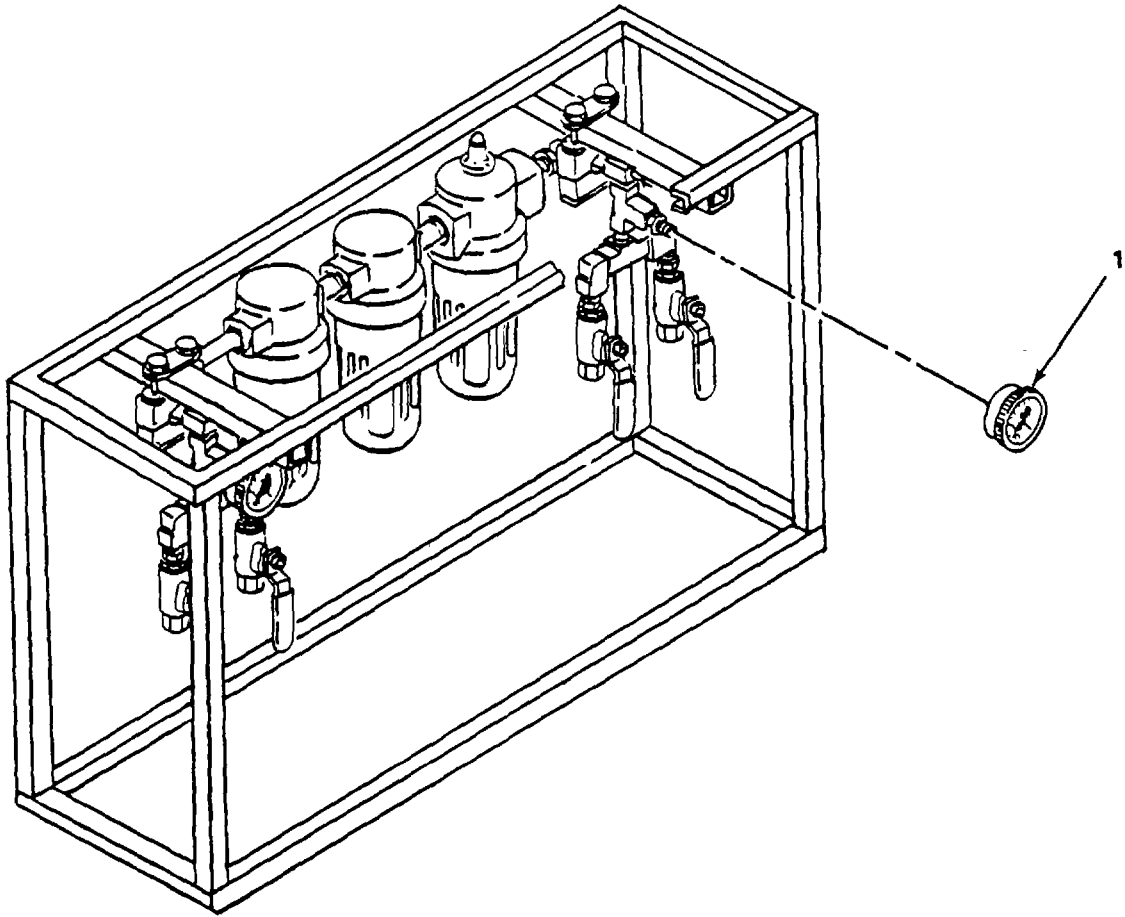
Ensure that all air lines and components removed or openings into the air system that provides breathing air are covered with a plastic bag and secured with a rubber band or taped shut. Small components should be stored in a plastic bag and sealed. Failure to do so will cause air system to become contaminated and could result in injury or death to the diver.

- (1) Remove gage (1).

**WARNING**

Leave 1 1/2 threads exposed on fitting when applying teflon tape. This will ensure that no teflon tape will hang down inside the air system. Teflon tape should be wrapped in such a manner that when the fitting is tightened the tape will not loosen. Failure to wrap teflon tape correctly may result in contamination or blockage of the air system and subsequent possible injury or death to the diver.

- (2) Apply teflon tape to threads on gage (1).
- (3) Install gage (1).



4951-120

Figure 4-45. Gage, Replace.



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**4-34. Portable Air Filtration System Filter Assemblies**


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**This task covers:**

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>a. Service (5 and 10 micron)</li> <li>b. Service (Coalescing)</li> <li>c. Replace</li> </ul> | <ul style="list-style-type: none"> <li>d. Repair (5 and 10 micron)</li> <li>e. Repair (Coalescing)</li> </ul> |
|---|---|
- 

**INITIAL SETUP:***Tools*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)  
 TSP Ultrasonic Cleaner w/Heater (Item 35, Appendix B)

*Materials/Parts*

Filter Assembly (5 Micron)  
 Filter Assembly (10 Micron)  
 Filter Assembly (Coalescing)

*Materials/Parts (Cont)*

Tape (Item 23, Appendix D)  
 Bands, Rubber (Item 5, Appendix D)  
 Bags, Plastic (Item 4, Appendix D)  
 Water, Distilled (Item 11, Appendix D)  
 Teflon Tape (Item 24, Appendix D)  
 Nonionic Detergent (Item 10, Appendix D)  
 Phosphate, Trisodium (Item 20, Appendix D)

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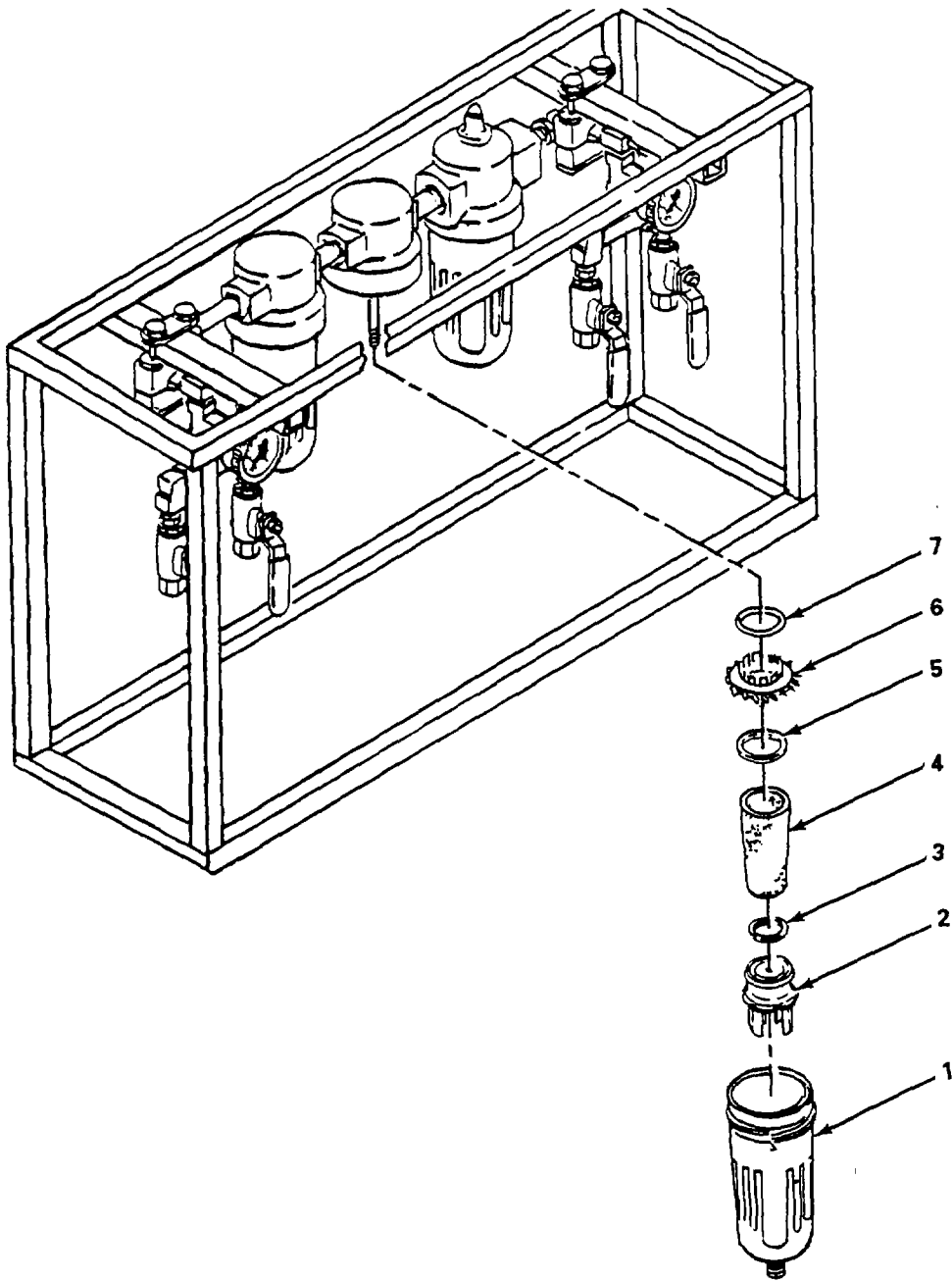
- a. Service 5 and 10 Micron Air Filter Assemblies. (figure 4-46)

**WARNING**

**Cleanliness is imperative in maintaining and handling diving air system components. All tools and parts must be kept free of oil, grease, rust, or other contamination in accordance with accepted army diving cleaning procedures. Foreign substances within an assembly could result in equipment failure and possible injury or death to personnel.**

**Ensure that all air lines and components removed or openings into the air system that provides breathing air are covered with a plastic bag and secured with a rubber band or taped shut. Small components should be stored in a plastic bag and sealed. Failure to do so will cause air system to become contaminated and could result in injury or death to the diver.**

- (1) Unscrew shell (1) and remove.
- (2) Unscrew base (2) and remove gasket (3), filter (4), gasket (5), top (6), and o-ring (7).
- (3) Clean shell (1), base (2), and top (6) with TSP ultrasonic cleaner w/heater following cleaning instructions in Chapter 3. Clean components soft goods in accordance with Chapter 3.
- (4) Install o-ring (7) on top (6) and install top (6), gasket (5), filter (4), gasket (3), and base (2).
- (5) Install shell (1).



4951-121

Figure 4-46. Filter Assemblies, Service (5 and 10 Micron).

**4-34. Portable Air Filtration System Filter Assemblies (Cont).***b. Service Coalescing Air Filter Assembly. (figure 4-47)*

- (1) Unscrew shell (1) and remove.
- (2) Unscrew filter (2) and remove filter (2) and o-ring (3).
- (3) Clean shell (1) with TSP ultrasonic cleaner w/heater following cleaning instructions in Chapter 3. Clean components soft goods in accordance with Chapter 3.
- (4) Install o-ring (3) and filter (2).
- (5) Install shell (1).

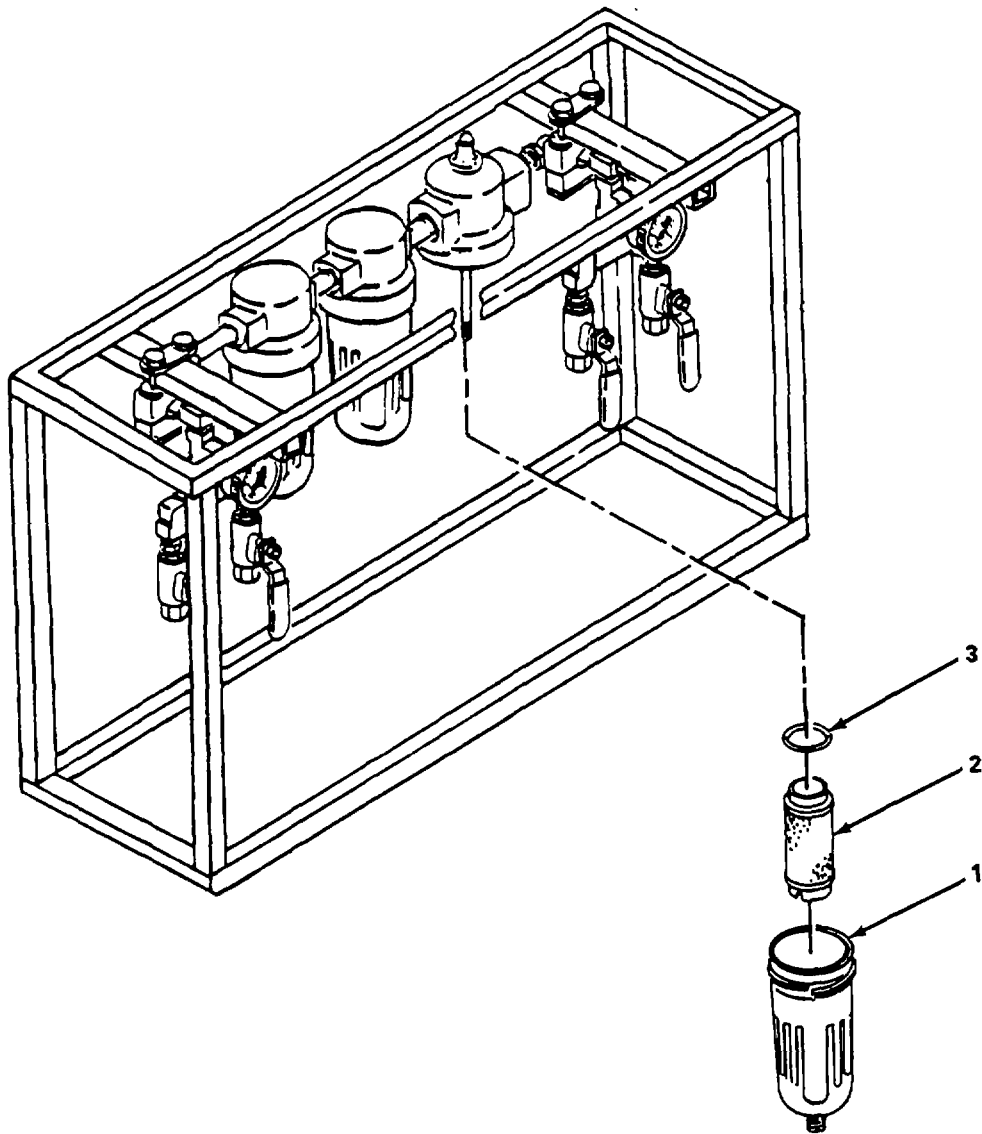


Figure 4-47. Filter Assembly, Service (Coalescing).

4-34. **Portable Air Filtration System Filter Assemblies (Cont).**

- c. Replace. (figure 4-48)

**WARNING**

**Cleanliness is imperative in maintaining and handling diving air system components. All tools and parts must be kept free of oil, grease, rust, or other contamination in accordance with accepted army diving cleaning procedures. Foreign substances within an assembly could result in equipment failure and possible injury or death to personnel.**

**Ensure that all air lines and components removed or openings into the air system that provides breathing air are covered with a plastic bag and secured with a rubber band or taped shut. Small components should be stored in a plastic bag and sealed. Failure to do so will cause air system to become contaminated and could result in injury or death to the diver.**

- (1) Remove four screws (1), brackets (2), blocks (3), and two bases (4).
- (2) Remove elbow (5) from nipple (6).
- (3) Remove nipple (6) from filter assembly (7).
- (4) Remove filter assembly (7) from nipple (8).
- (5) Remove nipple (8) from filter assembly (9).
- (6) Remove filter assembly (9) from nipple (10).
- (7) Remove nipple (10) from filter assembly (11).

**WARNING**

**Leave 11/2 threads exposed on fitting when applying teflon tape. This will ensure that no teflon tape will hang down inside the air system. Teflon tape should be wrapped in such a manner that when the fitting is tightened the tape will not loosen. Failure to wrap teflon tape correctly may result in contamination or blockage of the air system and subsequent possible injury or death to the diver.**

- (8) Apply teflon tape to threads on all fittings.
- (9) Install nipple (10) in filter assembly (11).
- (10) Install filter assembly (9) on nipple (10).
- (11) Install nipple (8) in filter assembly (9).
- (12) Install filter assembly (7) on nipple (8).
- (13) Install nipple (6) on filter assembly (7).
- (14) Install elbow(5) on nipple (6).
- (15) Install two bases (4), four blocks(3), brackets (2) and secure with four screws.

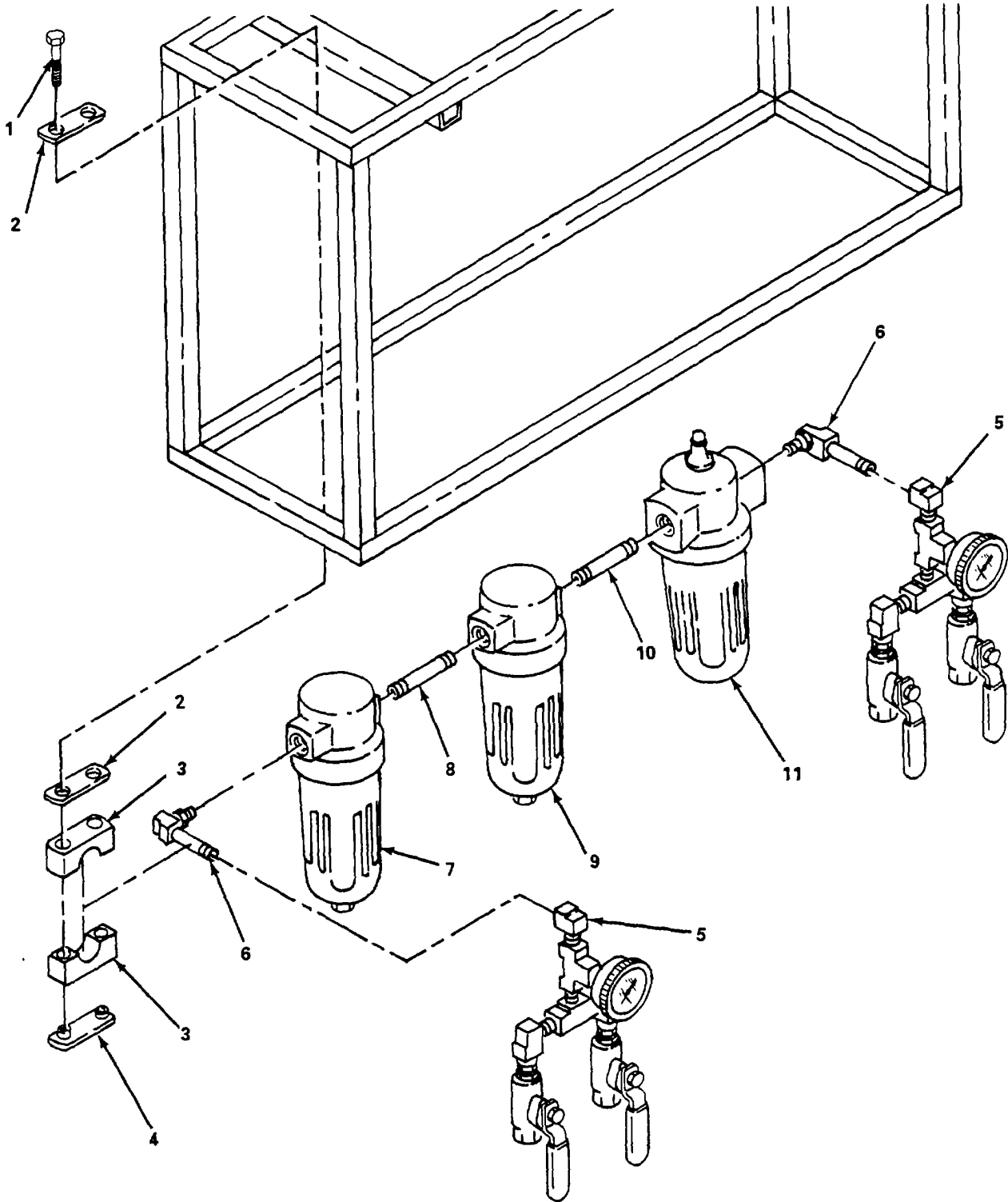


Figure 4-48. Filter Assemblies, Replace.

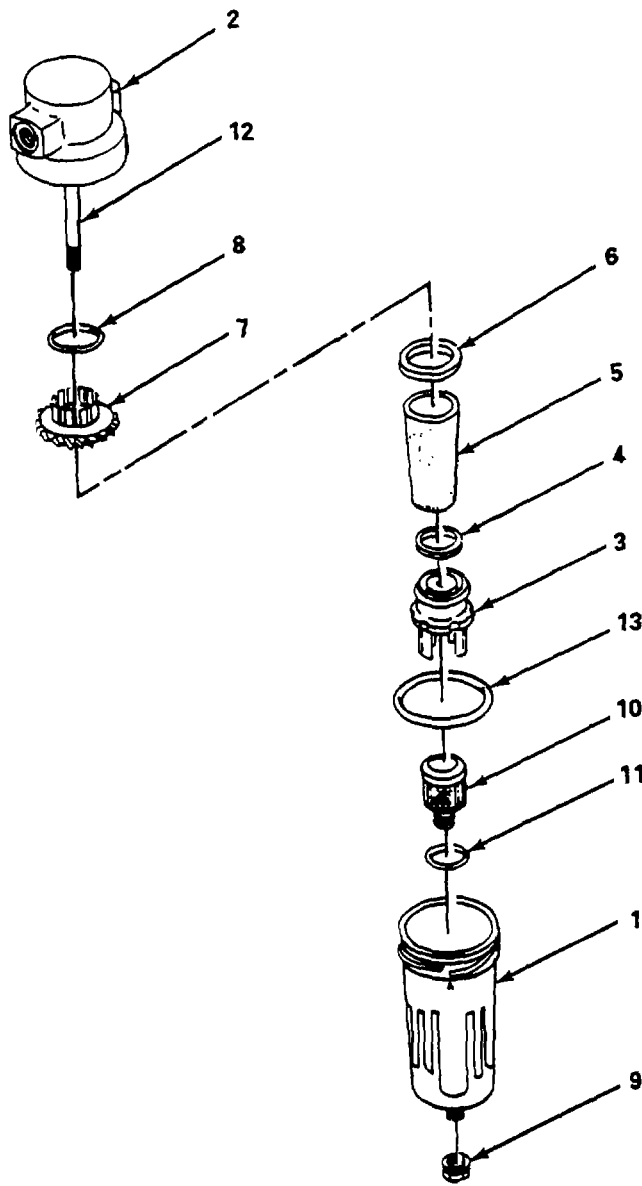
**4-34. Portable Air Filtration System Filter Assemblies (Cont).***d. Repair 5 and 10 Micron Air Filter Assemblies. (figure 4-49)*

- (1) Remove filter assembly. See para. c. above.

**WARNING**

**Ensure that all air lines and components removed or openings into the air system that provides breathing air are covered with a plastic bag and secured with a rubber band or taped shut. Small components should be stored in a plastic bag and sealed. Failure to do so will cause air system to become contaminated and could result in injury or death to the diver.**

- (2) Unscrew shell (1) from cover (2).
- (3) Unscrew base (3) and remove gasket (4), filter (5), gasket (6), top (7), and gasket (8).
- (4) Remove nut (9) and remove automatic drain (10) and gasket (11).
- (5) Clean all items with TSP ultrasonic cleaner w/heat following deaning instructions In Chapter 3. Clean components soft goods in accordance with Chapter 3.
- (6) Inspect shell (1) and cover (2) and replace if cracked or otherwise damaged.
- (7) Inspect base (3) and top (4) and replace if cracked or otherwise damaged.
- (8) Inspect automatic drain (10) and replace If cracked or otherwise damaged.
- (9) Inspect stud (12) and replace if bent, stripped or otherwise damaged.
- (10) Inspect gasket (4), gasket (6), gasket (8), gasket (11), and o-ring (13) and replace If cracked,om, or otherwise damaged.
- (11) Install gasket (8), top (7), gasket (6), filter (5), gasket (4) and secure with base (3).
- (12) Install automatic drain (10) and gasket (11) and secure with nut (9).
- (13) Install shell (1) and o-ring (13).
- (14) Install filter assemblies. See para. c. above.



4951-124

Figure 4-49. Filter Assemblies, Replace (5 and 10 Micron).



4-34. **Portable Air Filtration System Filter Assemblies (Cont).**e. Repair Coalescing Air Filter Assembly. (figure 4-50)

- (1) Remove filter assembly. See para. c. above.

**WARNING**

**Ensure that all air lines and components removed or openings into the air system that provides breathing air are covered with a plastic bag and secured with a rubber band or taped shut. Small components should be stored in a plastic bag and sealed. Failure to do so will cause air system to become contaminated and could result in injury or death to the diver.**

- (2) Unscrew shell (1) from cover (2).
- (3) Remove filter (3) and o-ring (4).
- (4) Remove nut (5) and remove automatic drain (6) and gasket (7).
- (5) Remove two screws (8) and remove differential pressure indicator (9) and o-ring (10).
- (6) Clean all items with TSP ultrasonic cleaner w/heater following cleaning instructions in Chapter 3. Clean components soft goods in accordance with Chapter 3.
- (7) Inspect shell (1) and cover (2) and replace if cracked or otherwise damaged.
- (8) Inspect filter (3) and replace if ripped or otherwise damaged.
- (9) Inspect o-ring (4), gasket (7), o-ring (10), and o-ring (11) and replace if torn, cracked, or otherwise damaged.
- (10) Inspect differential pressure indicator (9) and replace if cracked or otherwise damaged.
- (11) Inspect stud (12) and replace if bent, stripped or otherwise damaged.
- (12) Install filter (3) and o-ring (4).
- (13) Install differential pressure indicator (9) and o-ring (10) and secure with two screws (8).
- (14) Install automatic drain (6) and gasket (7) and secure with nut (5).
- (15) Install shell (1) and o-ring (11).
- (16) Install filter assembly. See para. c. above.

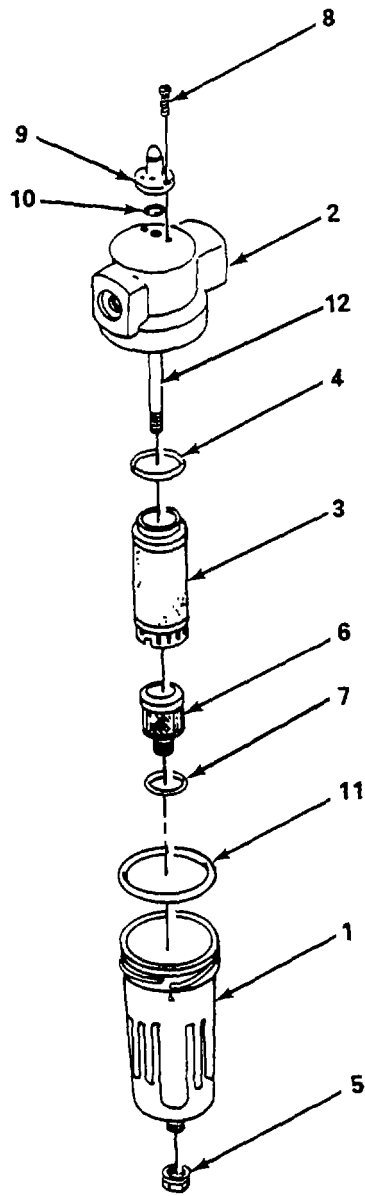


Figure 4-50. Filter Assemblies, Repair (Coalescing.)

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**4-35. Fixed 30 Gallon Air Receiver.**

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**This task covers:**      **a. Test**                      **b. Replace**

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**INITIAL SETUP***Tools*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)

*Materials/Parts*Air Receiver  
Tape (Item 24, Appendix D)  
Bands, Rubber (Item 5, Appendix D)  
Bags, Plastic (Item 4, Appendix D)  
Nonionic Detergent (Item 10, Appendix D)

---

*a. Test. (figure 4-51)***WARNING**

**Cleanliness is imperative in maintaining and handling diving air system components. All tools and parts must be kept free of oil, grease, rust, or other contamination in accordance with accepted army diving cleaning procedures. Foreign substances within an assembly could result in equipment failure and possible injury or death to personnel.**

**Ensure that all air lines and components removed or openings into the air system that provides breathing air are covered with a plastic bag and secured with a rubber band or taped shut. Small components should be stored in a plastic bag and sealed. Failure to do so will cause air system to become contaminated and could result in injury or death to the diver.**

- (1) Start engine and engage compressor (para. 2-6).
- (2) Ensure there is at least 150 psi (1034 Kpas) and terminate engine and compressor operation (para. 2-7).
- (3) Cover air receiver (1) with soap solution and check for leaks around valves, fittings, and on receiver surface.
- (4) If leaks are present, replace valves and fittings on air receiver (1) as needed.
- (5) Clean receiver tank (1) with nonionic detergent and rinse with clean distilled water.

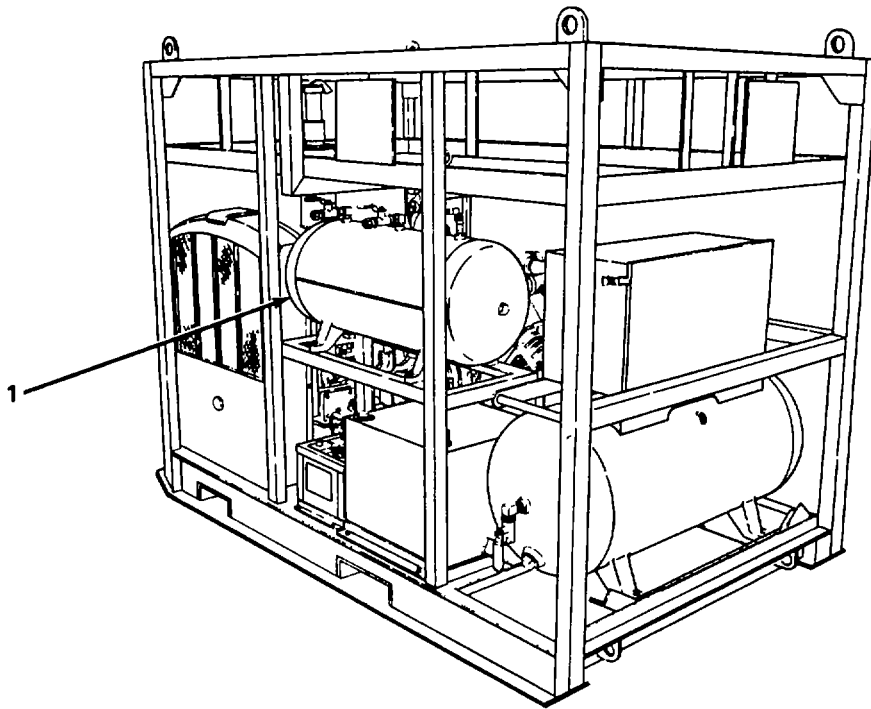
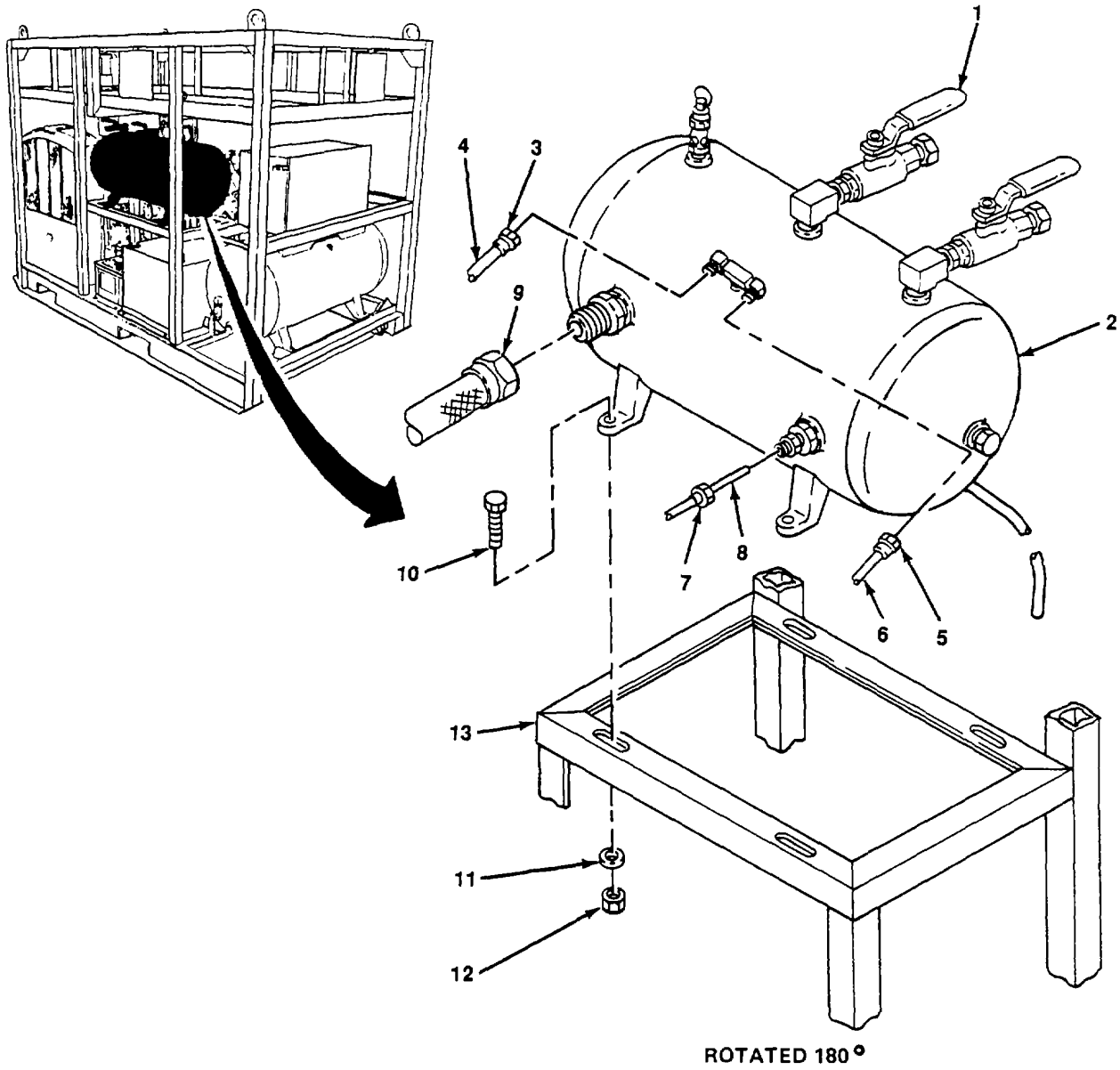


Figure 4-51. Air Receiver Test.

**4-35. Fixed 30 Gallon Air Receiver (Cont).***b. Replace.* (figure 4-52)

- (1) Open valve (1) and release air pressure in receiver (2).
- (2) Loosen fitting nut (3) and tag and remove line (4).
- (3) Loosen fitting nut (5) and tag and remove line (6).
- (4) Loosen fitting (7) and remove temperature sensor (8).
- (5) Loosen fitting nut (9).
- (6) Remove four screws (10), nuts (12), and washers (11) and remove air receiver (2).
- (7) Position air receiver (2) on frame (13).
- (8) Tighten fitting nut (9).
- (9) Install four screws (10), washers (12), and nuts (11).
- (10) Install temperature sensor (8) and tighten fitting nut (7).
- (11) Connect line (6) as tagged and tighten fitting nut (5).
- (12) Connect line (4) as tagged and tighten fitting nut (3).



4951-126

Figure 4-52. Air Receiver, Replace.

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**4-36. Fixed 30 Gallon Air Receiver Fittings and Valves.**


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This task covers:        Replace

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**INITIAL SETUP**
*Tools*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)

*Materials/Parts*

Tape (Item 24, Appendix D)  
 Bands, Rubber (Item 5, Appendix D)  
 Bags, Plastic (Item 4, Appendix D)  
 Reducer  
 Valve  
 Nipple, Hex

*Materials Parts (Cont)*

Elbow  
 Plug  
 Elbow  
 Tee  
 Safety Valve  
 Adapter  
 Drain Valve  
 Elbow  
 Teflon Tape (Item 25, Appendix D)

---

*Replace.*

- (1) *Reducer.* (figure 4-53)

**WARNING**

**Cleanliness is imperative in maintaining and handling diving air system components. All tools and parts must be kept free of oil, grease, rust, or other contamination in accordance with accepted army diving cleaning procedures. Foreign substances within an assembly could result in equipment failure and possible injury or death to personnel.**

**Ensure that all air lines and components removed or openings into the air system that provides breathing air are covered with a plastic bag and secured with a rubber band or taped shut. Small components should be stored in a plastic bag and sealed. Failure to do so will cause air system to become contaminated and could result in injury or death to the diver.**

- (a) Remove reducer (1).

**WARNING**

**Leave 1 1/2 threads exposed on fitting when applying teflon tape. This will ensure that no teflon tape will hang down inside the air system. Teflon tape should be wrapped in such a manner that when the fitting is tightened the tape will not loosen. Failure to wrap teflon tape correctly may result in contamination or blockage of the air system and subsequent possible injury or death to the diver.**

- (b) Apply teflon tape to threads on reducer (1).  
 (c) Install reducer (1).

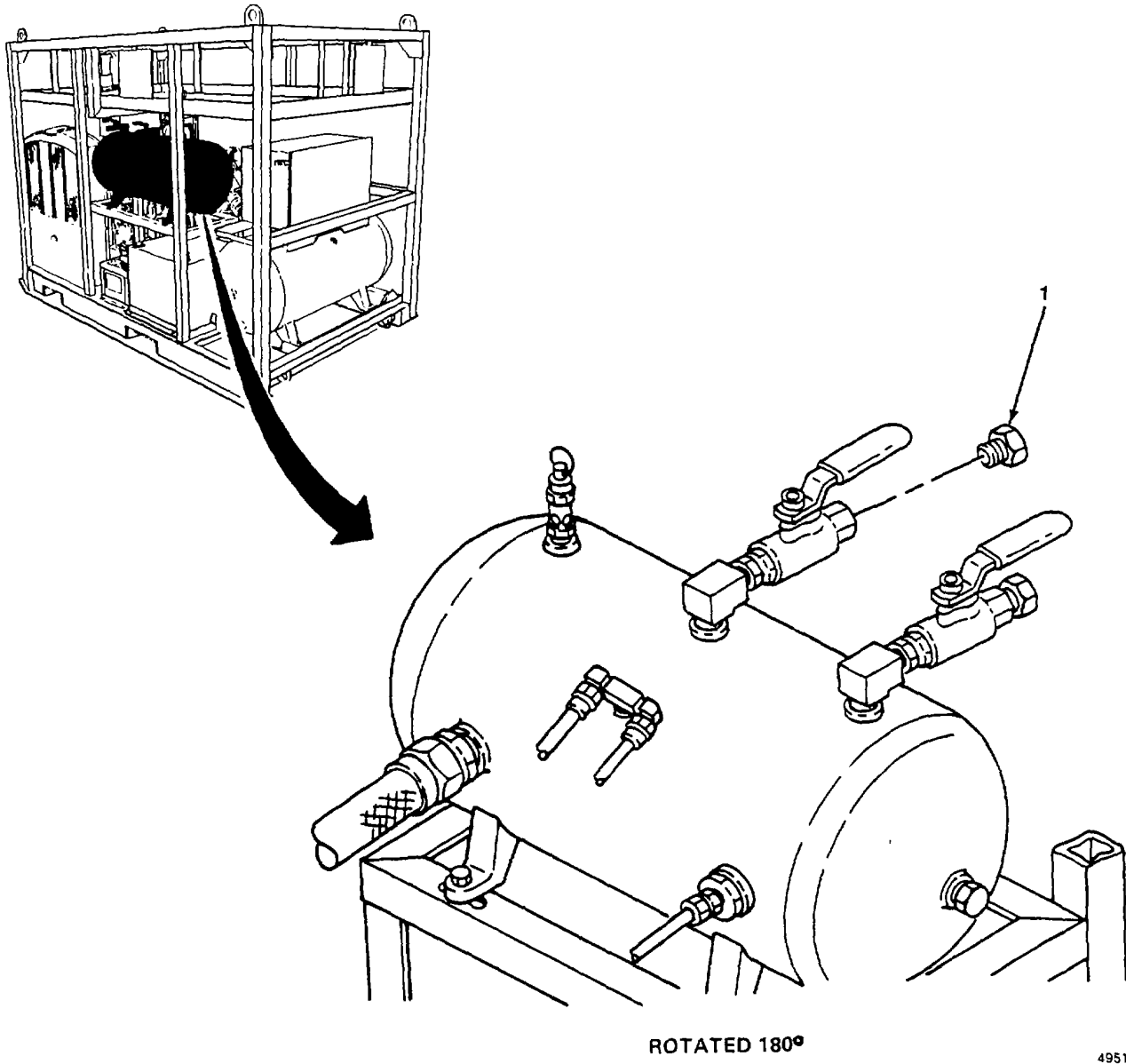


Figure 4-53. Reducer, Replace.



**4-36. Fixed 30 Gallon Air Receiver Fittings and Valves (Cont)**

- (2) Valve. (figure 4-54)
  - (a) Remove reducer. See para. 1 above.
  - (b) Open valve (1) and release air pressure in receiver (2).

**WARNING**

**Cleanliness is imperative in maintaining and handling diving air system components. All tools and parts must be kept free of oil, grease, rust, or other contamination in accordance with accepted army diving cleaning procedures. Foreign substances within an assembly could result in equipment failure and possible injury or death to personnel.**

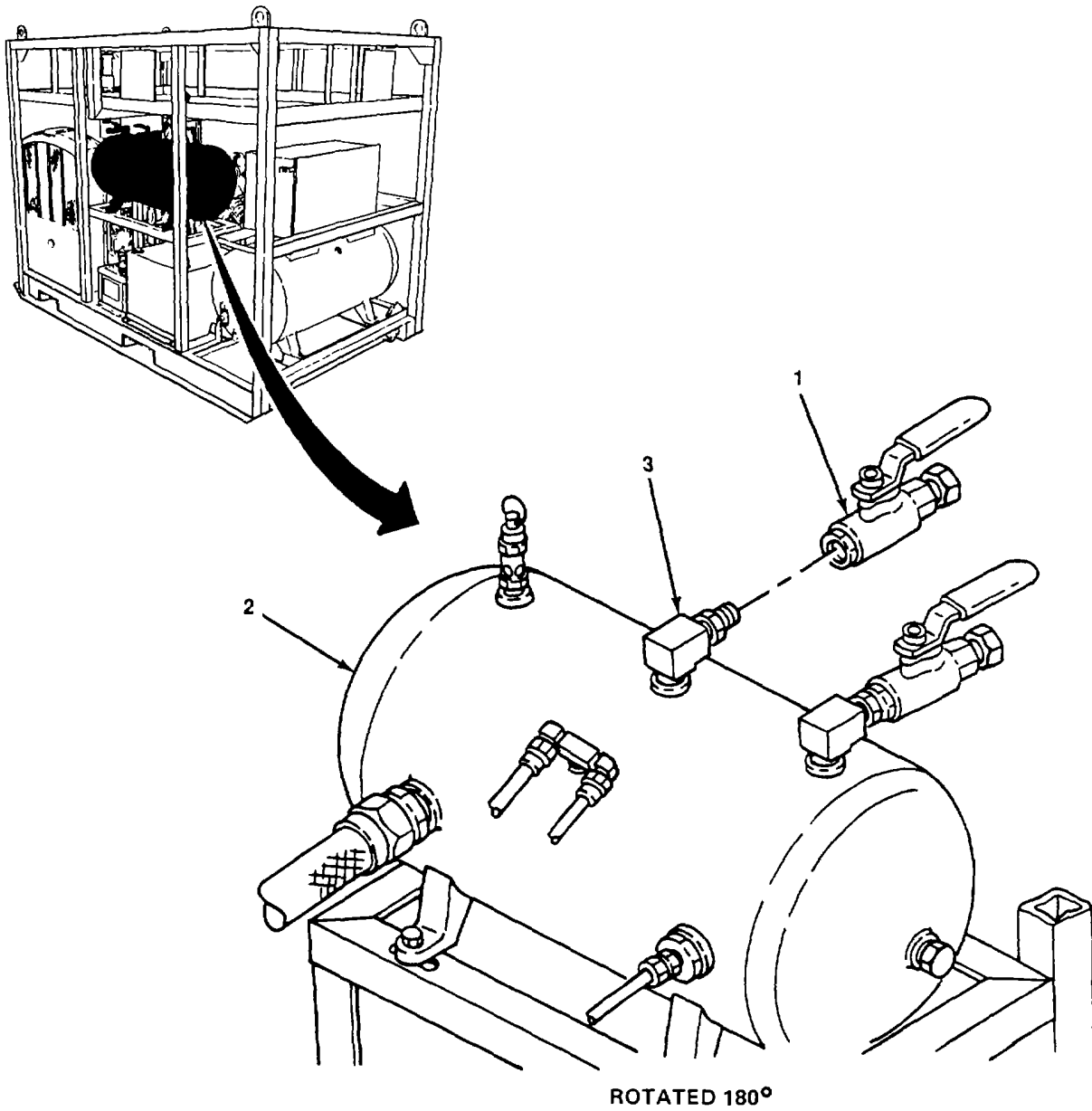
**Ensure that all air lines and components removed or openings into the air system that provides breathing air are covered with a plastic bag and secured with a rubber band or taped shut. Small components should be stored in a plastic bag and sealed. Failure to do so will cause air system to become contaminated and could result in injury or death to the diver.**

- (c) Remove valve (1).

**WARNING**

**Leave 1 1/2 threads exposed on fitting when applying teflon tape. This will ensure that no teflon tape will hang down inside the air system. Teflon tape should be wrapped in such a manner that when the fitting is tightened the tape will not loosen. Failure to wrap teflon tape correctly may result in contamination or blockage of the air system and subsequent possible injury or death to the diver.**

- (d) Apply teflon tape to threads on nipple (3).
- (e) Install valve (1).
- (f) Close valve (1).
- (g) Install reducer. See para. 1 above.



4951-128

Figure 4-54. Valve, Replace.

## 4-36. Fixed 30 Gallon Air Receiver Fittings and Valves (Cont).

(3) *Hex nipple.* (figure 4-55)

(a) Remove valve. See para. 2 above.

**WARNING**

Cleanliness is imperative in maintaining and handling diving air system components. All tools and parts must be kept free of oil, grease, rust, or other contamination in accordance with accepted army diving cleaning procedures. Foreign substances within an assembly could result in equipment failure and possible injury or death to personnel.

Ensure that all air lines and components removed or openings into the air system that provides breathing air are covered with a plastic bag and secured with a rubber band or taped shut. Small components should be stored in a plastic bag and sealed. Failure to do so will cause air system to become contaminated and could result in injury or death to the diver.

(b) Remove hex nipple (1).

**WARNING**

Leave 1 1/2 threads exposed on fitting when applying teflon tape. This will ensure that no teflon tape will hang down inside the air system. Teflon tape should be wrapped in such a manner that when the fitting is tightened the tape will not loosen. Failure to wrap teflon tape correctly may result in contamination or blockage of the air system and subsequent possible injury or death to the diver.

(c) Apply teflon tape to threads on hex nipple (1).

(d) Install hex nipple (1).

(e) Install valve. See para. 2 above.

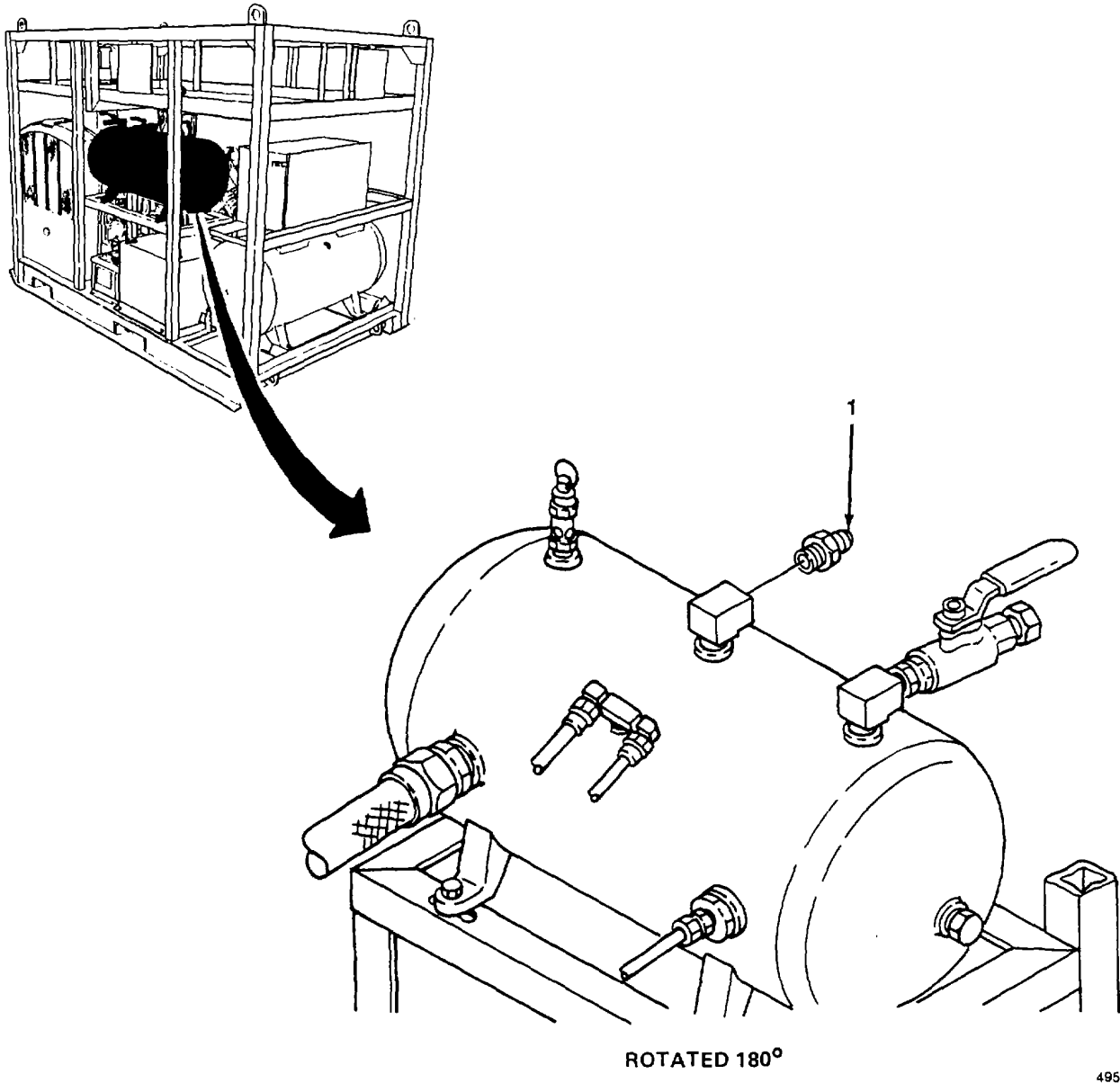


Figure 4-55. Hex Nipple, Replace.

**4-36. Fixed 30 Gallon Air Receiver Fittings and Valves (Cont).**

(4) *Elbow.* (figure 4-56)

(a) Hex nipple removed. See para. 3 above.

**WARNING**

**Cleanliness is imperative in maintaining and handling diving air system components. All tools and parts must be kept free of oil, grease, rust, or other contamination in accordance with accepted army diving cleaning procedures. Foreign substances within an assembly could result in equipment failure and possible injury or death to personnel.**

**Ensure that all air lines and components removed or openings into the air system that provides breathing air are covered with a plastic bag and secured with a rubber band or taped shut. Small components should be stored in a plastic bag and sealed. Failure to do so will cause air system to become contaminated and could result in injury or death to the diver.**

(b) Remove elbow (1).

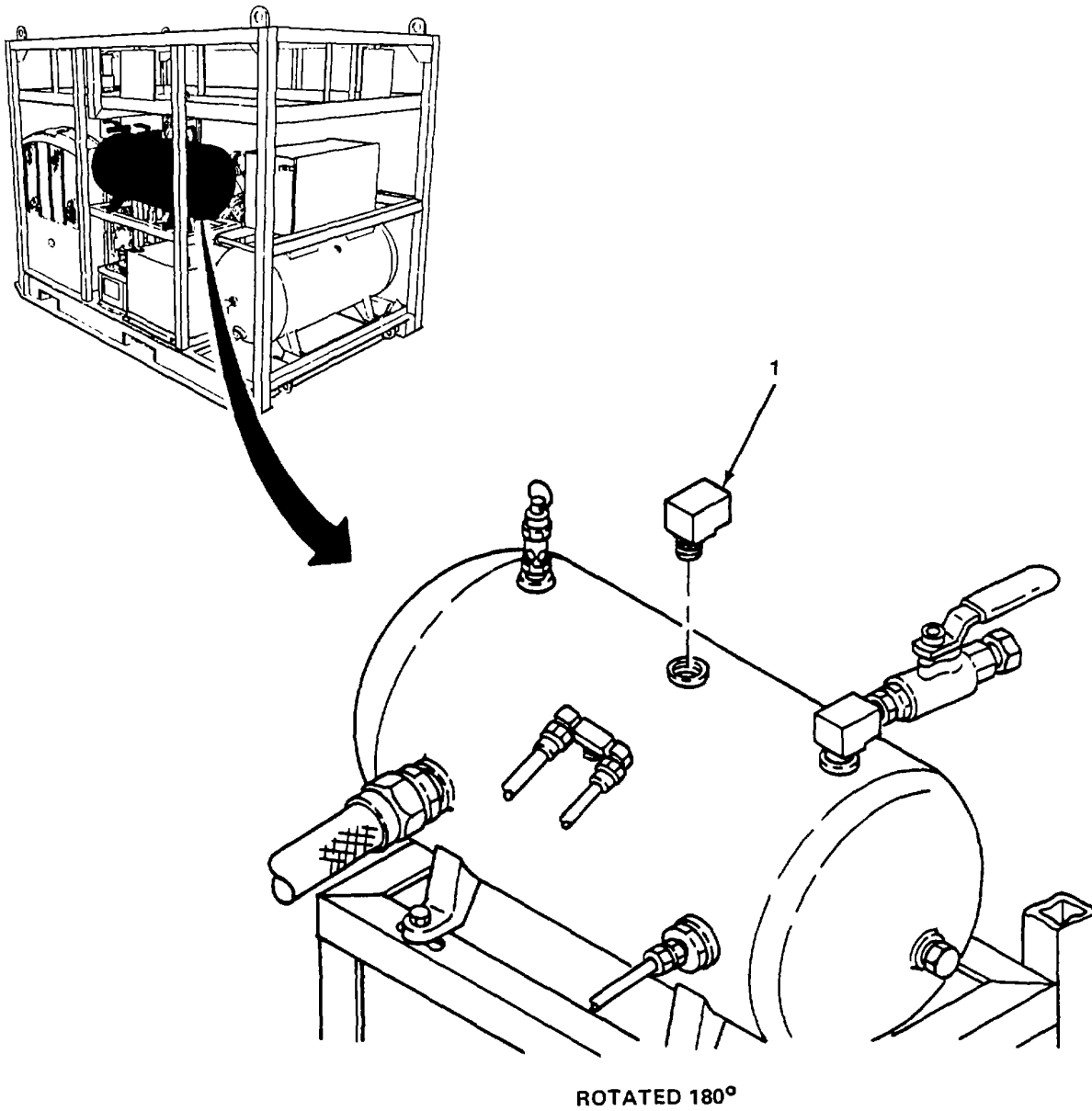
**WARNING**

**Leave 1 1/2 threads exposed on fitting when applying teflon tape. This will ensure that no teflon tape will hang down inside the air system. Teflon tape should be wrapped in such a manner that when the fitting is tightened the tape will not loosen. Failure to wrap teflon tape correctly may result in contamination or blockage of the air system and subsequent possible injury or death to the diver.**

(c) Apply teflon tape to threads on elbow (1).

(d) Install elbow (1).

(e) Install hex nipple. See para. 3 above.



ROTATED 180°

4951-130

Figure 4-56. Elbow, Replace.

**4-36. Fixed 30 Gallon Air Receiver Fittings and Valves (Cont).**

- (5) Plug. (figure 4-57)
  - (a) Open valve (1) and release air pressure in receiver (2).

**WARNING**

**Cleanliness is imperative in maintaining and handling diving air system components. All tools and parts must be kept free of oil, grease, rust, or other contamination in accordance with accepted army diving cleaning procedures. Foreign substances within an assembly could result in equipment failure and possible injury or death to personnel.**

**Ensure that all air lines and components removed or openings into the air system that provides breathing air are covered with a plastic bag and secured with a rubber band or taped shut. Small components should be stored in a plastic bag and sealed. Failure to do so will cause air system to become contaminated and could result in injury or death to the diver.**

- (b) Remove plug (3).

**WARNING**

**Leave 1 1/2 threads exposed on fitting when applying teflon tape. This will ensure that no teflon tape will hang down inside the air system. Teflon tape should be wrapped in such a manner that when the fitting is tightened the tape will not loosen. Failure to wrap teflon tape correctly may result in contamination or blockage of the air system and subsequent possible injury or death to the diver.**

- (c) Apply teflon tape to threads on plug (3).
- (d) Install plug (3).
- (e) Close valve (1).

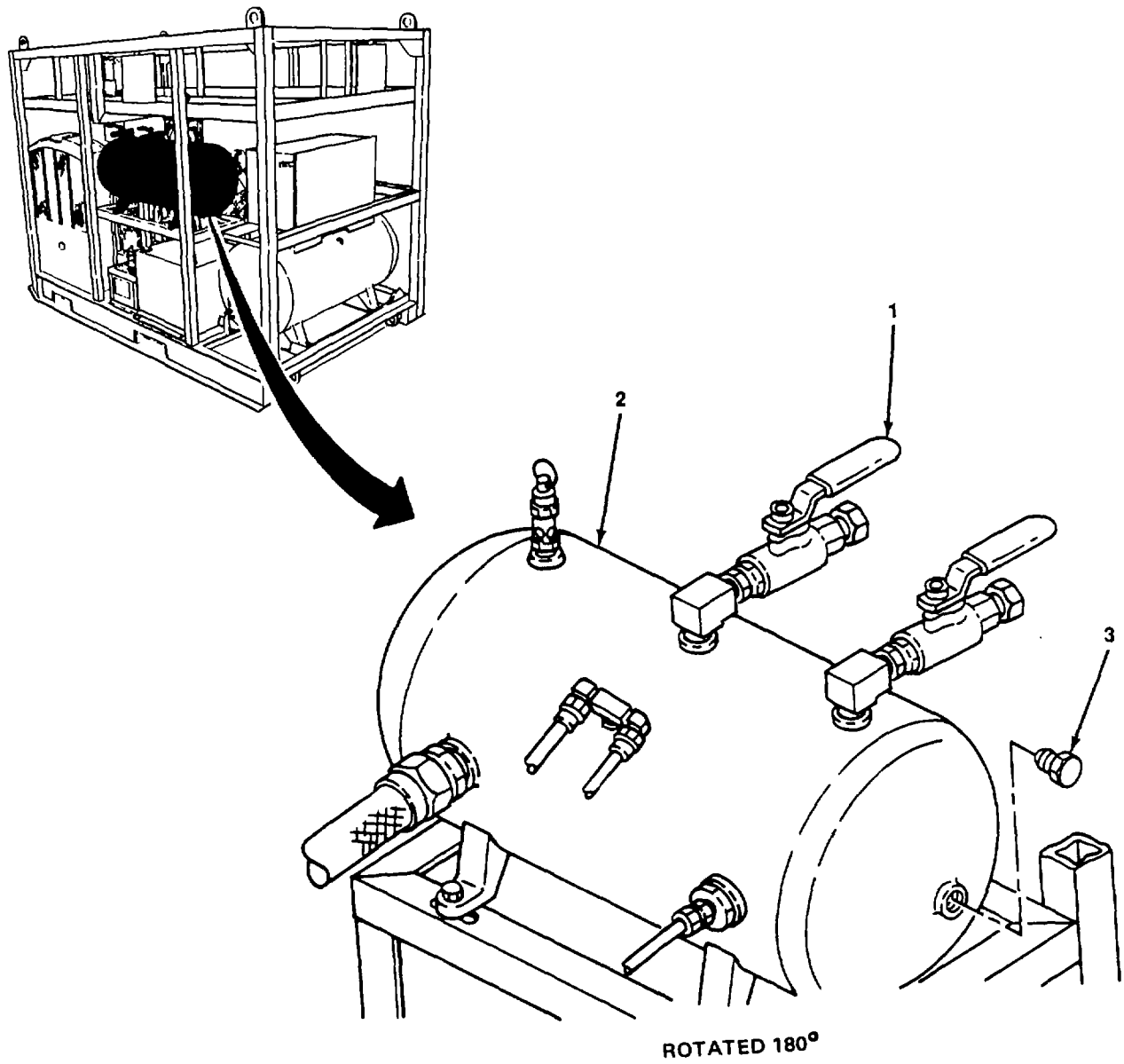


Figure 4-57. Plug, Replace.



## 4-36. Fixed 30 Gallon Air Receiver Fittings and Valves (Cont).

- (6) *Elbows and tee.* (figure 4-58).
- (a) Open valve (1) and release air pressure in receiver (2).

**WARNING**

**Cleanliness is imperative in maintaining and handling diving air system components. All tools and parts must be kept free of oil, grease, rust, or other contamination in accordance with accepted army diving cleaning procedures. Foreign substances within an assembly could result in equipment failure and possible injury or death to personnel.**

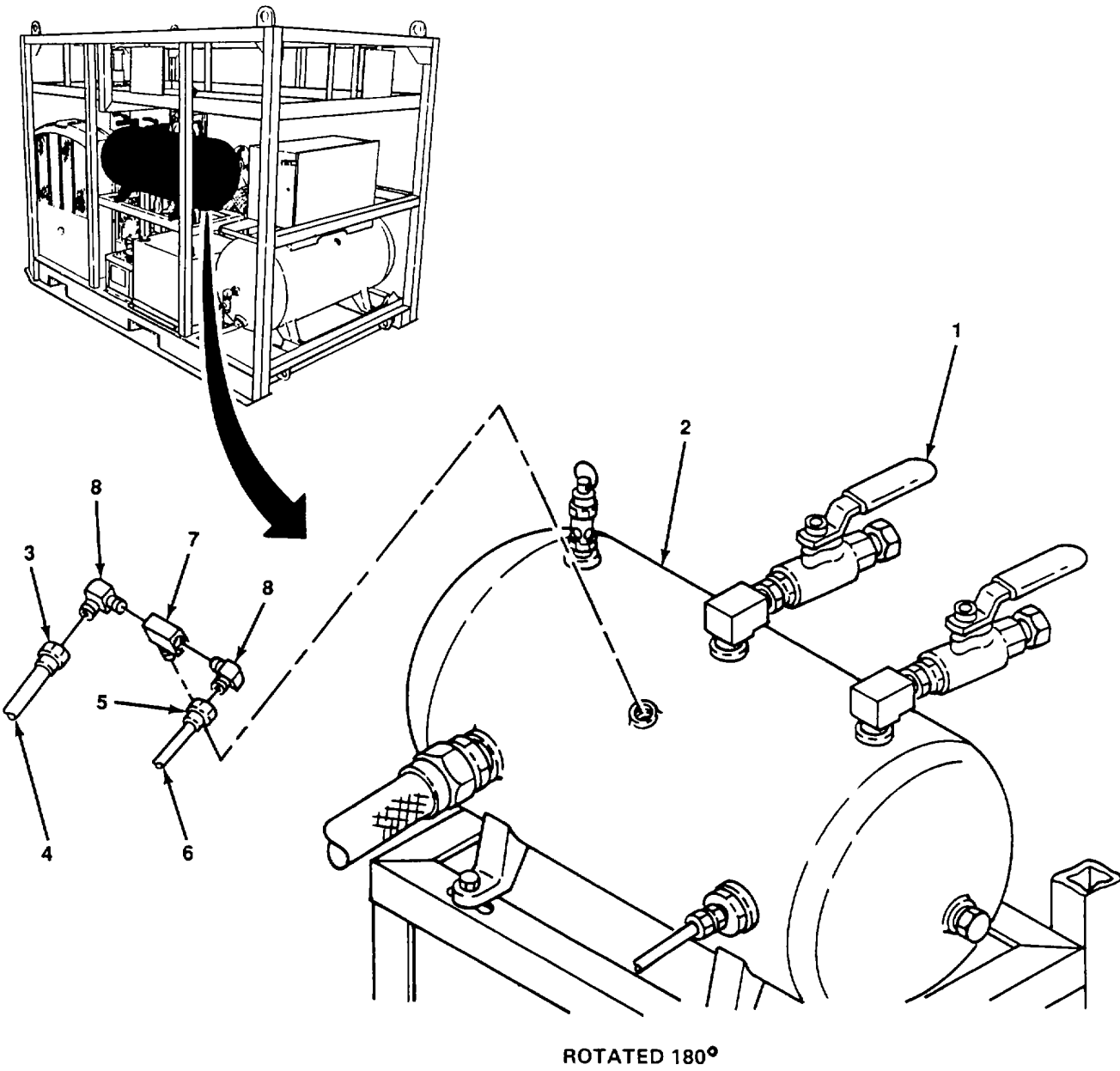
**Ensure that all air lines and components removed or openings into the air system that provides breathing air are covered with a plastic bag and secured with a rubber band or taped shut. Small components should be stored in a plastic bag and sealed. Failure to do so will cause air system to become contaminated and could result in injury or death to the diver.**

- (b) Loosen fitting nut (3) and tag and remove line (4).
- (c) Loosen fitting nut (5) and tag and remove line (6).
- (d) Remove tee (7).
- (e) Remove two elbows (8) from tee (7).

**WARNING**

**Leave 1 1/2 threads exposed on fitting when applying teflon tape. This will ensure that no teflon tape will hang down inside the air system. Teflon tape should be wrapped in such a manner that when the fitting is tightened the tape will not loosen. Failure to wrap teflon tape correctly may result in contamination or blockage of the air system and subsequent possible injury or death to the diver.**

- (f) Apply teflon tape to threads on elbows (8).
- (g) Install elbows (8) to tee (7).
- (h) Install tee (7) to air receiver (2).
- (i) Connect line (6) as tagged and tighten fitting nut (5).
- (j) Connect line (4) as tagged and tighten fitting nut (3).
- (k) Close valve (1).



ROTATED 180°

4951-132

Figure 4-58. Elbow and Tee, Replace.

**4-36. Fixed 30 Gallon Air Receiver Fittings and Valves (Cont).**

- (7) Safety valve. (figure 4-59)
- (a) Open valve (1) and release air pressure in receiver (2).

**WARNING**

**Cleanliness is imperative in maintaining and handling diving air system components. All tools and parts must be kept free of oil, grease, rust, or other contamination in accordance with accepted army diving cleaning procedures. Foreign substances within an assembly could result in equipment failure and possible injury or death to personnel.**

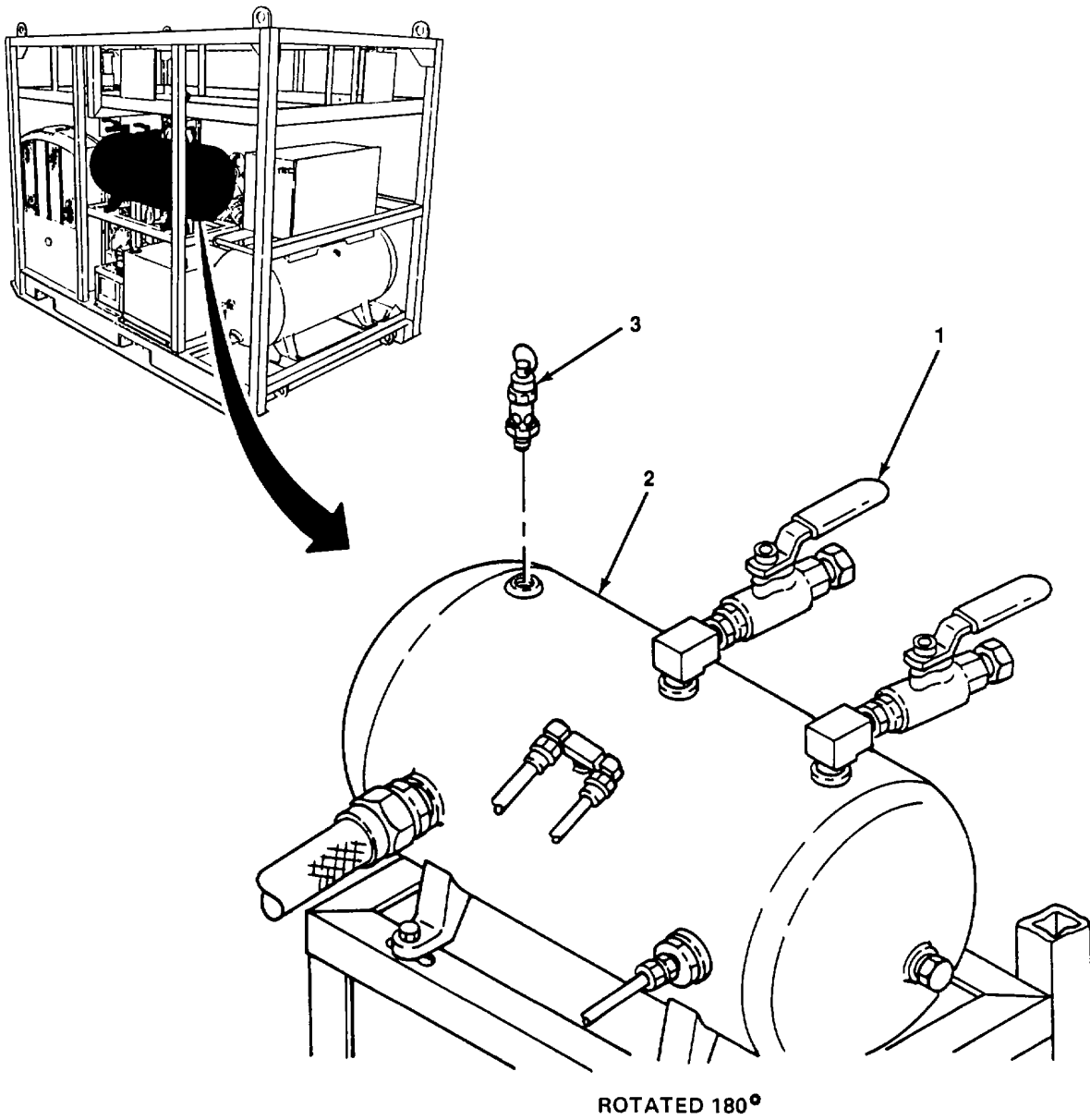
**Ensure that all air lines and components removed or openings into the air system that provides breathing air are covered with a plastic bag and secured with a rubber band or taped shut. Small components should be stored in a plastic bag and sealed. Failure to do so will cause air system to become contaminated and could result in injury or death to the diver.**

- (b) Remove safety valve (3).

**WARNING**

**Leave 1 1/2 threads exposed on fitting when applying teflon tape. This will ensure that no teflon tape will hang down inside the air system. Teflon tape should be wrapped in such a manner that when the fitting is tightened the tape will not loosen. Failure to wrap teflon tape correctly may result in contamination or blockage of the air system and subsequent possible injury or death to the diver.**

- (c) Apply teflon tape to threads on safety valve (3).
- (d) Install safety valve (3).
- (e) Close valve (1).



ROTATED 180°

4951-133

Figure 4-59. Safety Valve, Replace.

**4-36. Fixed 30 Gallon Air Receiver Fittings and Valves (Cont).**

- (8) *Adapter.* (figure 4-60)
- (a) Open valve (1) and release air pressure in receiver (2).

**WARNING**

**Cleanliness is imperative in maintaining and handling diving air system components. All tools and parts must be kept free of oil, grease, rust, or other contamination in accordance with accepted army diving cleaning procedures. Foreign substances within an assembly could result in equipment failure and possible injury or death to personnel.**

**Ensure that all air lines and components removed or openings into the air system that provides breathing air are covered with a plastic bag and secured with a rubber band or taped shut. Small components should be stored in a plastic bag and sealed. Failure to do so will cause air system to become contaminated and could result in injury or death to the diver.**

- (b) Loosen coupling nut (3) and move condenser (4) out of way.
- (c) Remove adapter (5).

**WARNING**

**Leave 1 1/2 threads exposed on fitting when applying teflon tape. This will ensure that no teflon tape will hang down inside the air system. Teflon tape should be wrapped in such a manner that when the fitting is tightened the tape will not loosen. Failure to wrap teflon tape correctly may result in contamination or blockage of the air system and subsequent possible injury or death to the diver.**

- (d) Apply teflon tape to threads on adapter (5).
- (e) Install adapter (5).
- (f) Install condenser (4) and tighten coupling nut (3).
- (g) Close valve (1).

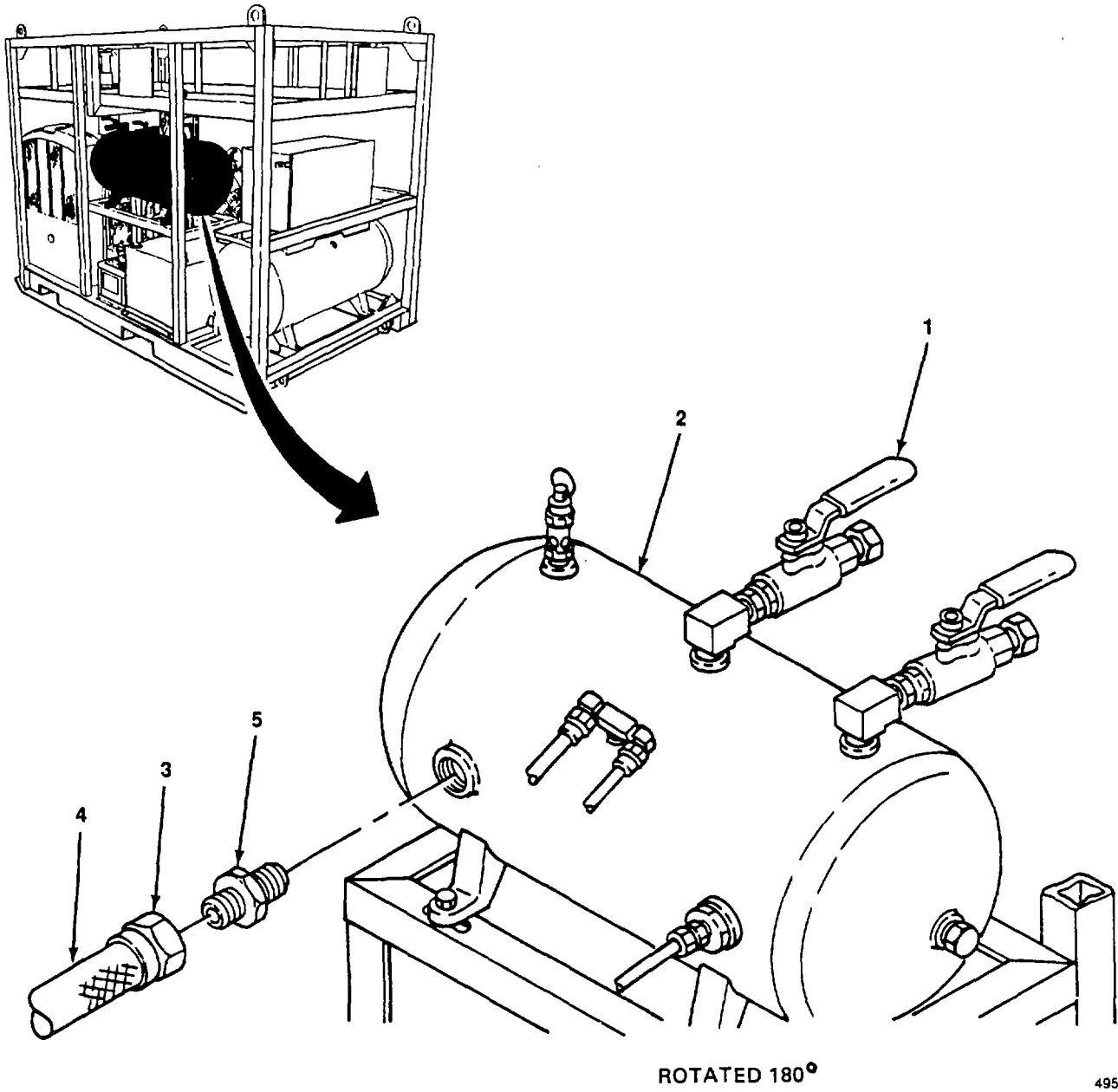


Figure 4-60. Adapter, Replace.

4-36. **Fixed 30 Gallon Air Receiver Fittings and Valves (Cont).**

(9) *Drain valve and elbow.* (figure 4-61)

(a) Open valve (1) and release air pressure in receiver (2).

**WARNING**

Cleanliness is imperative in maintaining and handling diving air system components. All tools and parts must be kept free of oil, grease, rust, or other contamination in accordance with accepted army diving cleaning procedures. Foreign substances within an assembly could result in equipment failure and possible injury or death to personnel.

Ensure that all air lines and components removed or openings into the air system that provides breathing air are covered with a plastic bag and secured with a rubber band or taped shut. Small components should be stored in a plastic bag and sealed. Failure to do so will cause air system to become contaminated and could result in injury or death to the diver.

(b) Loosen fitting nut (3) and remove drain hose (4).

(c) Remove elbow (5)

(d) Remove elbow (5) from hex nipple (6).

(e) Remove hex nipple (6) from shutoff valve (7).

**WARNING**

Leave 1 1/2 threads exposed on fitting when applying teflon tape. This will ensure that no teflon tape will hang down inside the air system. Teflon tape should be wrapped in such a manner that when the fitting is tightened the tape will not loosen. Failure to wrap teflon tape correctly may result in contamination or blockage of the air system and subsequent possible injury or death to the diver.

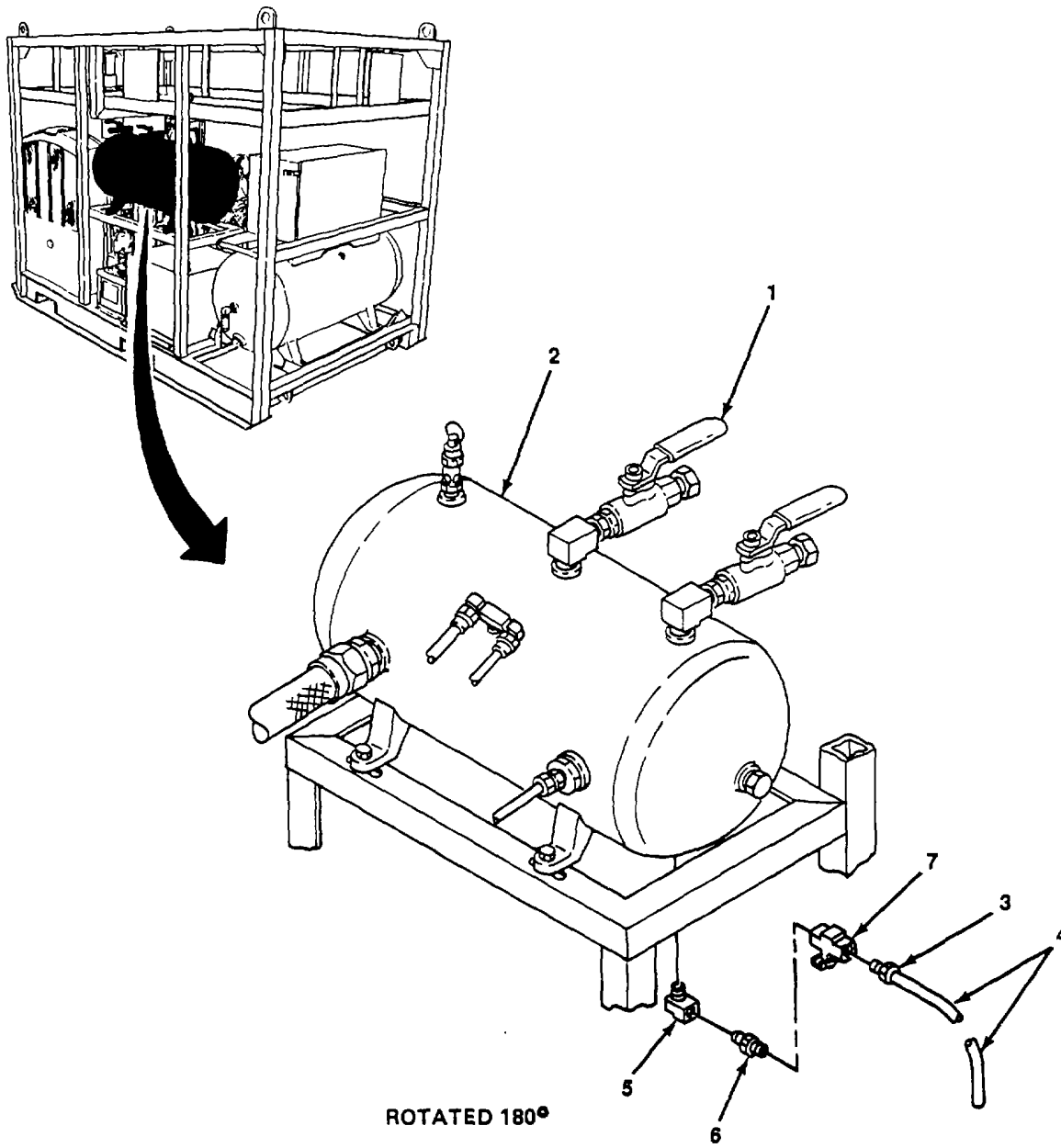
(f) Apply teflon tape to all threads.

(g) Install hex nipple (6) in shutoff valve (7).

(h) Install elbow (5) on hex nipple (6).

(i) Install drain hose (4) and tighten fitting nut (3).

(j) Close valve (1).



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Figure 4-61. Shutoff Valve and Elbow, Replace.



4-37. **Fixed 30 Gallon Air Receiver Tank.**


---

**This task covers:            Replace**

---

**INITIAL SETUP:***Tools*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)

*Materials/Parts*Tank, Receiver  
Tape (Item 24, Appendix D)*Materials/Parts (Cont)*Bands, Rubber (Item 5, Appendix D)  
Bags, Plastic (Item 4, Appendix D)*Equipment Condition*

Valves and fittings removed (para. 4-36)

---

Replace. (figure 4-62)

**WARNING**

Cleanliness is imperative in maintaining and handling diving air system components. All tools and parts must be kept free of oil, grease, rust, or other contamination in accordance with accepted army diving cleaning procedures. Foreign substances within an assembly could result in equipment failure and possible injury or death to personnel.

Ensure that all air lines and components removed or openings into the air system that provides breathing air are covered with a plastic bag and secured with a rubber band or taped shut. Small components should be stored in a plastic bag and sealed. Failure to do so will cause air system to become contaminated and could result in injury or death to the diver.

- (1) Loosen fitting nut (1) and remove temperature sensor (2).
- (2) Connect suitable lifting device to receiver tank (3).
- (3) Remove four screws (4), washers (5) and nuts (6) and remove receiver tank (3).

**WARNING**

Volume tank installed must be in accordance with accepted ASME boiler and unfired pressure vessels code standard.

- (4) Install receiver tank (3) and secure with four screws (4), washers (5), and nuts (6).
- (5) Install temperature sensor (2) and tighten fitting nut (1).

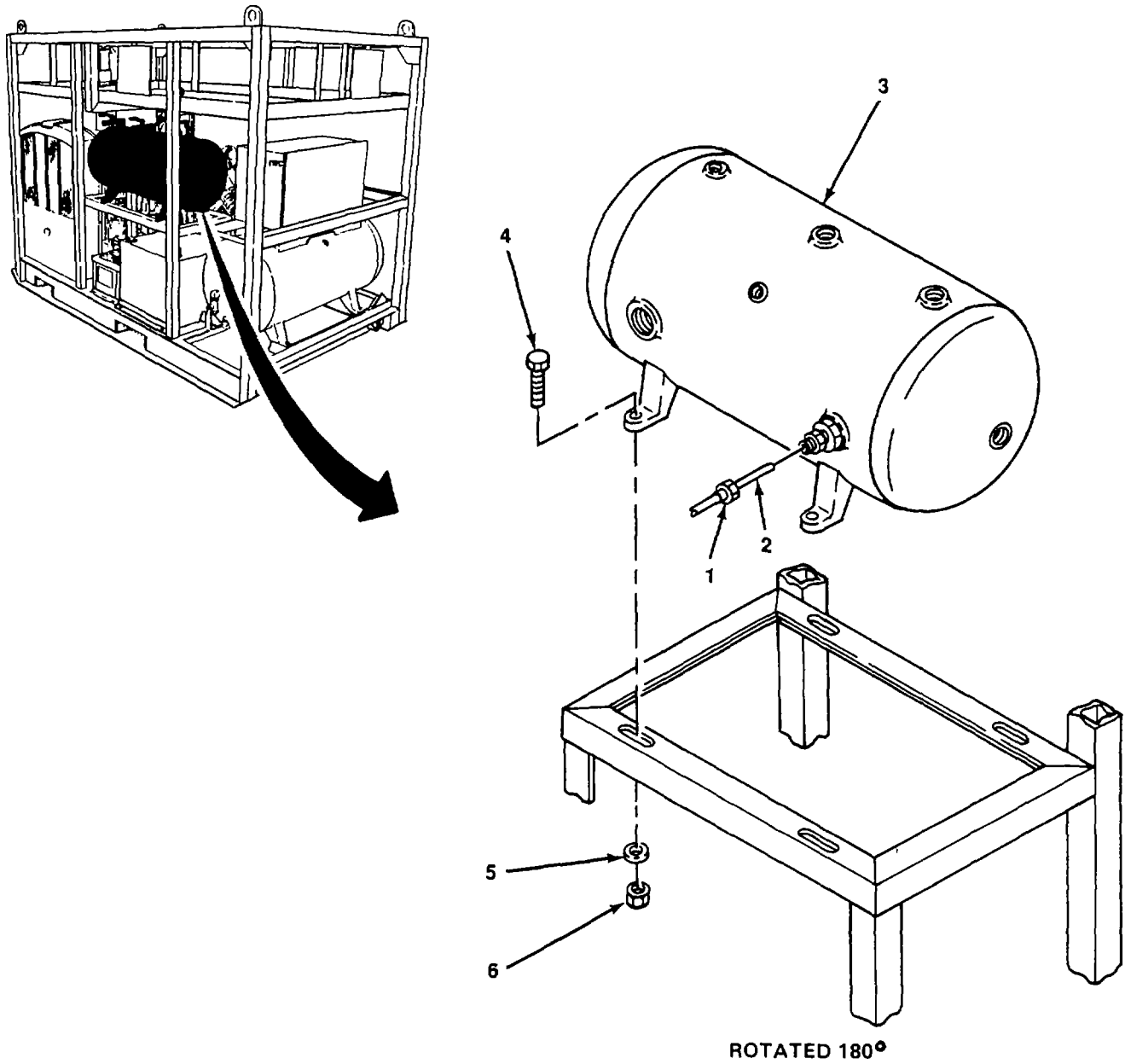


Figure 4-62. Receiver Tank, Replace.

---

**4-38. Portable 60 Gallon Air Receiver.**

---

This task covers:      Test

---

**INITIAL SETUP***Tools**Materials/Parts*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)

Portable Air Receiver  
Detergent, Nonionic (Item 6, Appendix D)

---

Test. (figure 4-63)

- (1) Pressurize air receiver (1) to at least 150 psi (1034 kpas).
- (2) Coat air receiver (1) with soap solution.
- (3) Check air receiver (1) for leaks.
- (4) Replace an air receiver (1) that is defective.

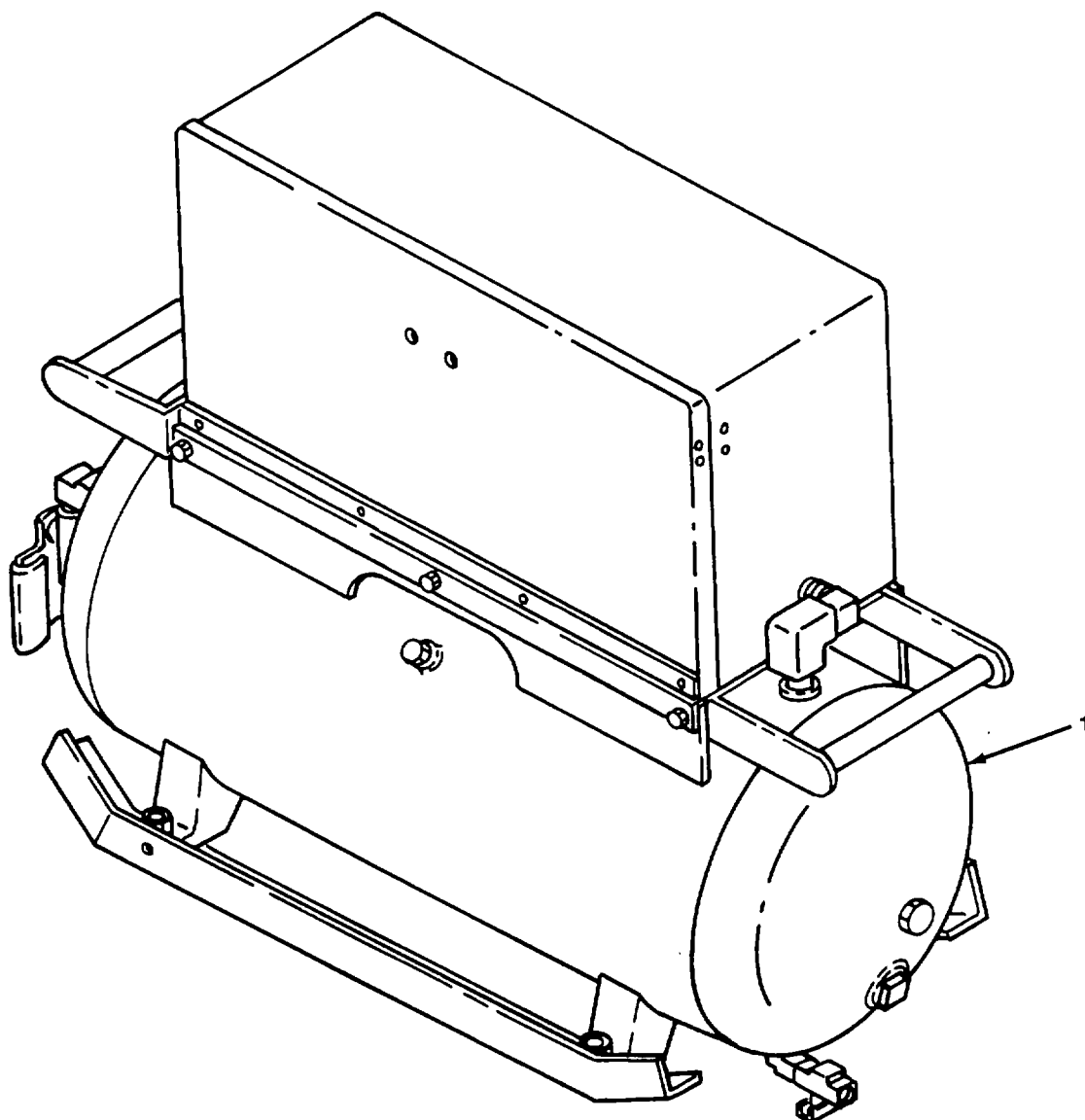


Figure 4-63. Portable Air Receiver Test.

4-39. **Portable 60 Gallon Air Receiver Fittings and Valves.**


---

This task covers:        Replace

---

## INITIAL SETUP

*Tools*

General Mechanic's Tool Kit  
(NSN 5180-00-177-7033)

*Materials/Parts*

Tape (Item 24, Appendix D)  
Bands, Rubber (Item 5, Appendix D)  
Bags, Plastic (Item 4, Appendix D)  
Copper Tube  
Street Elbow  
Union Elbow  
Nipple Pipe  
Flare  
Teflon Tape (Item 25, Appendix D)  
Detergent, Nonionic (Item 10, Appendix D)

*Materials/Parts (Cont)*

Union Tee  
Three Ball Brass Valve  
Brass Nipple  
Brass Tee Street  
Hex Nipple  
Brass Bushing Reducer  
Reducer  
Valve  
Safety Valve

*Equipment Condition*

Gages removed (para. 4-33).

---

a. Removal. (figure 4-64)

- (1) Remove three screws (1) securing case (2) to case support (3).
- (2) Remove three screws (4) and nuts (5) securing case (2) to case support (3) and remove case.
- (3) Remove ten bolts (6) securing steel plates (7) and plastic clamps (8) to case support (3) and remove plates and clamps.

**WARNING**

Cleanliness is imperative in maintaining and handling diving air system components. All tools and parts must be kept free of oil, grease, rust, or other contamination in accordance with accepted army diving cleaning procedures. Foreign substances within an assembly could result in equipment failure and possible injury or death to personnel.

Ensure that all air lines and components removed or openings into the air system that provides breathing air are covered with a plastic bag and secured with a rubber band or taped shut. Small components should be stored in a plastic bag and sealed. Failure to do so will cause air system to become contaminated and could result in injury or death to the diver.

- (4) Remove hex nipple (9) from elbow (10) and valve (11) from receiver tank (12).
- (5) Remove hex nipple (9) from elbow (10).

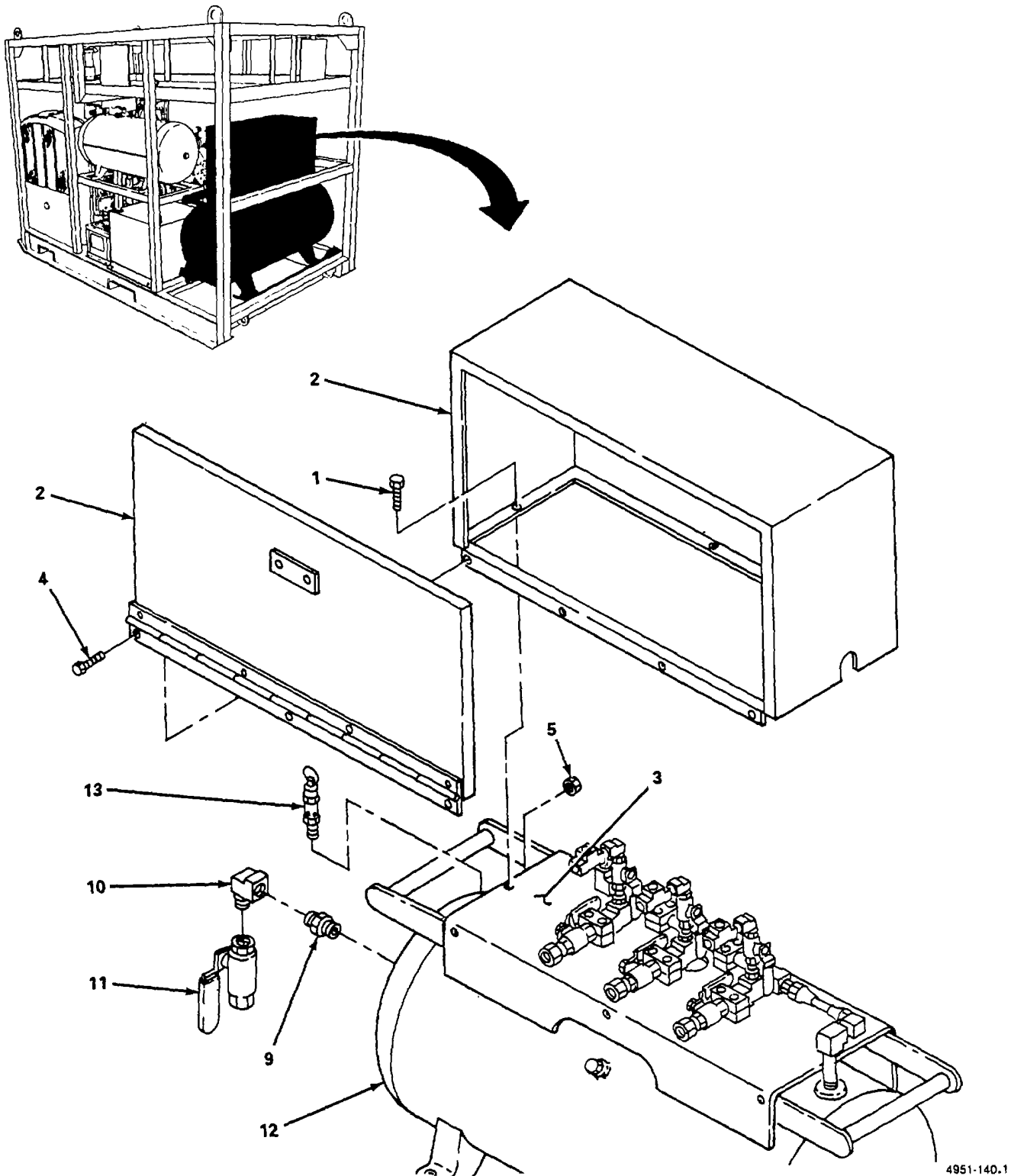


Figure 4-64. Fittings and Valves, Removal (Sheet 1 of 2).

4-39. Portable 60 Gallon Air Receiver Fittings and Valves (Cont).

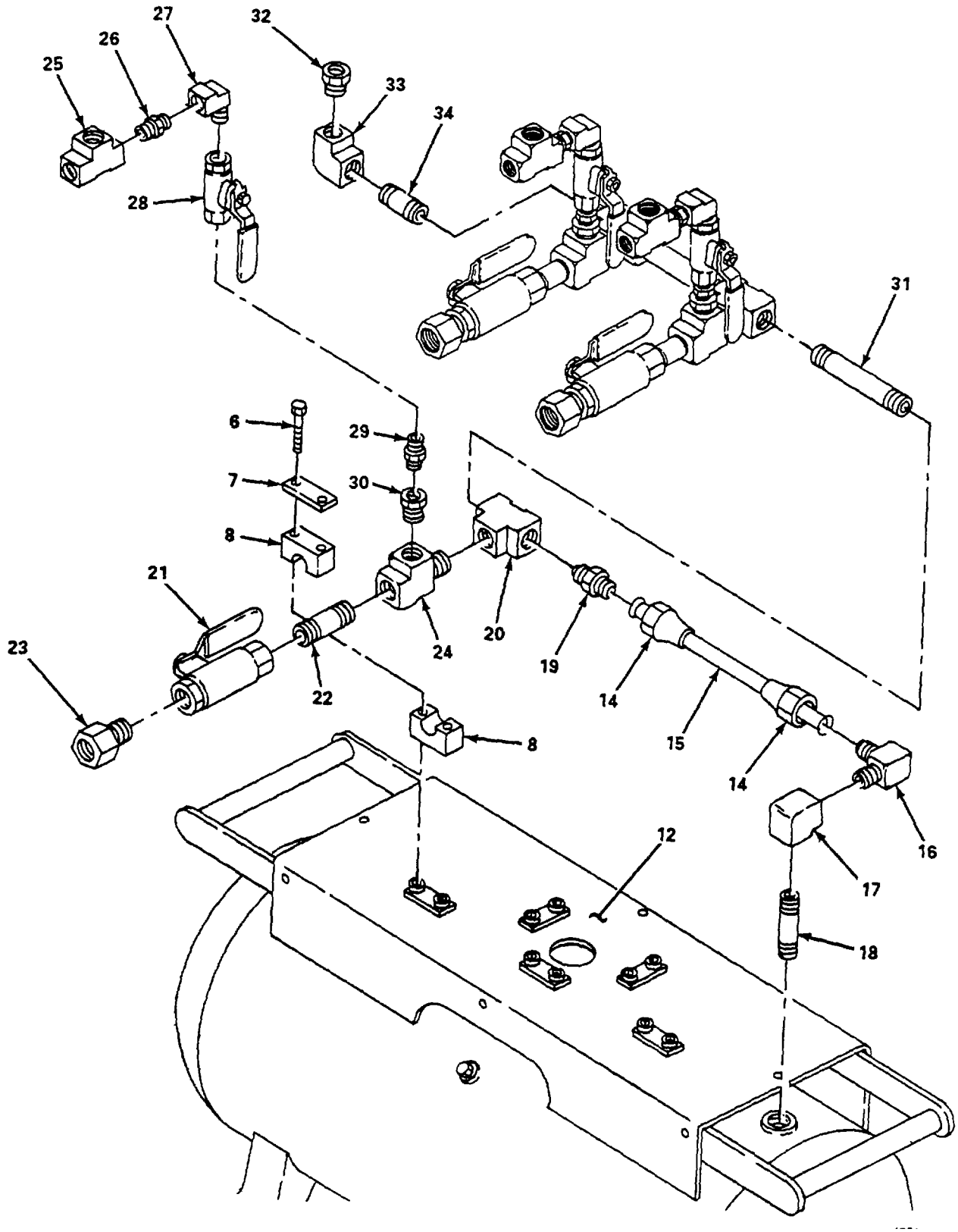


Figure 4-64. Fittings and Valves, Removal (Sheet 2 of 2).

- (6) Remove elbow (10) from valve (11).
- (7) Remove safety valve (13) from receiver tank (12).
- (8) Loosen two flare nuts (14) and remove copper tube (15).
- (9) Remove street elbow (16) from union elbow (17).
- (10) Remove union elbow (17) from nipple pipe (18).
- (11) Remove nipple pipe (18) from receiver tank (12).
- (12) Remove flare (19) from brass union tee (20).
- (13) Remove brass ball valves (21) from brass nipples (22).
- (14) Remove three reducers (23) from brass ball valves (21).
- (15) Remove three brass nipples (22) from brass tee street (24).
- (16) Remove three tees (25) from hex nipples (26).
- (17) Remove three hex nipples (26) from street elbow (27).
- (18) Remove three street elbows (27) from brass ball valves (28).
- (19) Remove three brass ball valves (28) from hex nipples (29).
- (20) Remove three hex nipples from brass bushing reducers (30).
- (21) Remove three brass bushing reducers (30) from brass tee street (24).
- (22) Remove three brass tee street (24) from brass union tees (20).
- (23) Remove three union tees (20) from two copper nipples (31).
- (24) Remove reducer (32) from brass union elbow (33).
- (25) Remove brass union elbow (33) from brass nipple pipe (34).
- (26) Remove brass nipple pipe (34) from brass union tee (20).



4-39. **Portable 60 Gallon Air Receiver Fittings and Valves (Cont).**

- b. Installation. (figure 4-65)

**WARNING**

Leave 1 1/2 threads exposed on fitting when applying teflon tape. This will ensure that no teflon tape will hang down inside the air system. Teflon tape should be wrapped in such a manner that when the fitting is tightened the tape will not loosen. Failure to wrap teflon tape correctly may result in contamination or blockage of the air system and subsequent possible injury or death to the diver.

**NOTE**

Install teflon tape on all fittings and valve threads.

**WARNING**

Cleanliness is imperative in maintaining and handling diving air system components. All tools and parts must be kept free of oil, grease, rust, or other contamination in accordance with accepted Army diving cleaning procedures. Foreign substances within an assembly could result in equipment failure and possible injury or death to personnel.

- (1) Install brass nipple pipe (34) in brass union tee (20).
- (2) Install brass nipple pipe (34) in brass union elbow (33).
- (3) Install reducer (32) in brass union elbow (33).
- (4) Install two copper nipples (31) in three union tees (20).
- (5) Install three brass tee street (24) in brass union tees (20).
- (6) Install three brass bushing reducers (30) in brass tee street (24).
- (7) Install three hex nipples (29) in brass bushing reducers (30).
- (8) Install three brass ball valves (28) on hex nipples (29).
- (9) Install three street elbows (27) in brass ball valves (28).
- (10) Install three hex nipples (26) in street elbows (27).
- (11) Install three tee (25) on hex nipples (26).
- (12) Install three reducers (23) in brass ball valves (21).
- (13) Install three brass nipples (22) in brass tee street (24).
- (14) Install three brass ball valves (21) on brass nipples (22).
- (15) Install flare (19) in brass union tee (20).

- (16) Install nipple pipe (18) in receiver tank (12).
- (17) Install union elbow (17) on nipple pipe (18).

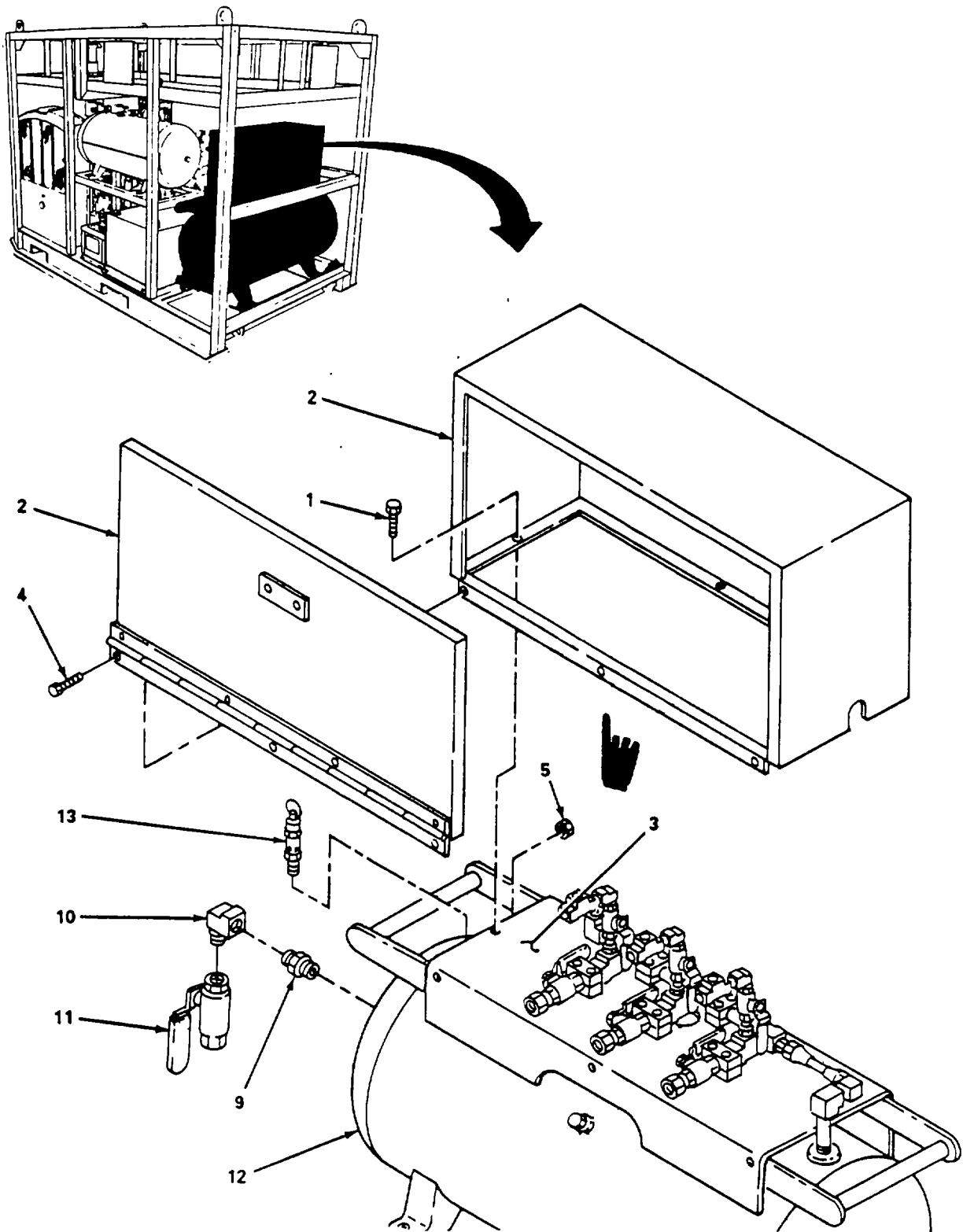


Figure 4-65. Fittings and Valves, Installation (Sheet 1 of 2).

4-39. Portable 60 Gallon Air Receiver Fittings and Valves (Cont).

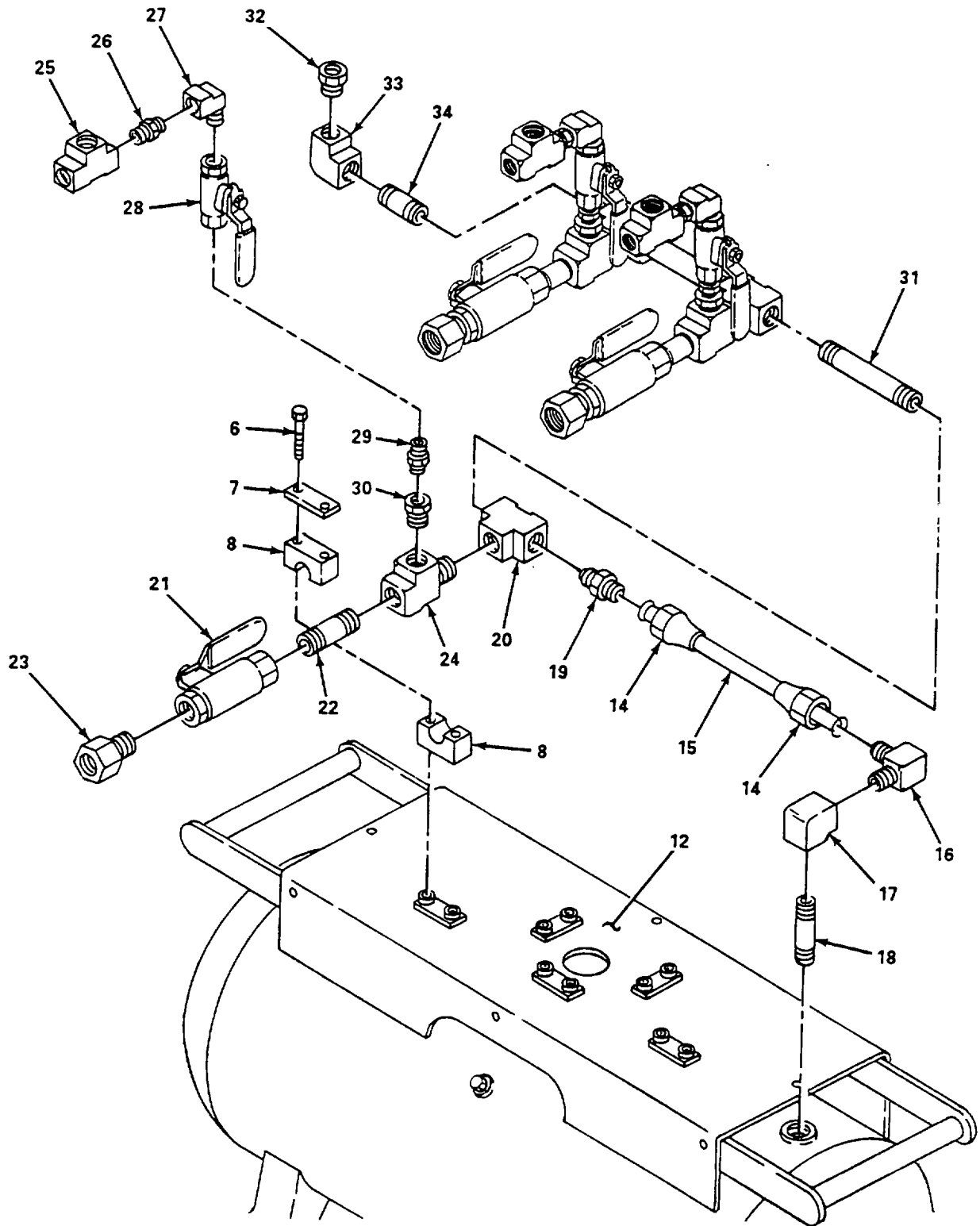


Figure 4-65. Fittings and Valves, Installation (Sheet 2 of 2).

- (18) Install street elbow (16) in union elbow (17).
- (19) Install copper tube (15) on flare (19) and street elbow (16) and tighten two flare nuts (14).
- (20) Install five plastic clamps (8) and steel plates (7) and secure with ten bolts (6).
- (21) Install case (2) on case support (3) and install three bolts (4) and nuts (5).
- (22) Install three screws (1) securing case (2) to case support (3).
- (23) Install safety valve (13) on receiver tank (12).
- (24) Install valve (11) on elbow (10).
- (25) Install elbow (10) on hex nipple (9).
- (26) Install hex nipple (9) with elbow (10) and valve (11) attached in receiver tank (12).

---

**4-40. Portable 60 Gallon Air Receiver Gages.**

---

This task covers:        Replace

---

**INITIAL SETUP***Tools*

General Mechanic's Tool Kit  
(NSN 5180-00-177-7033)

*Materials/Parts*

Gage, Pressure  
Pneumofathometer

*Materials/Parts (Cont)*

Tape (Item 24, Appendix D)  
Bands, Rubber (Item 5, Appendix D)  
Bags, Plastic (Item 4, Appendix D)  
Tape, Teflon (Item 25, Appendix D)

---

Replace. (figure 4-66)

**WARNING**

Cleanliness is imperative in maintaining and handling diving air system components. All tools and parts must be kept free of oil, grease, rust, or other contamination in accordance with accepted army diving cleaning procedures. Foreign substances within an assembly could result in equipment failure and possible injury or death to personnel.

Ensure that all air lines and components removed or openings into the air system that provides breathing air are covered with a plastic bag and secured with a rubber band or taped shut. Small components should be stored in a plastic bag and sealed. Failure to do so will cause air system to become contaminated and could result in injury or death to the diver.

**NOTE**

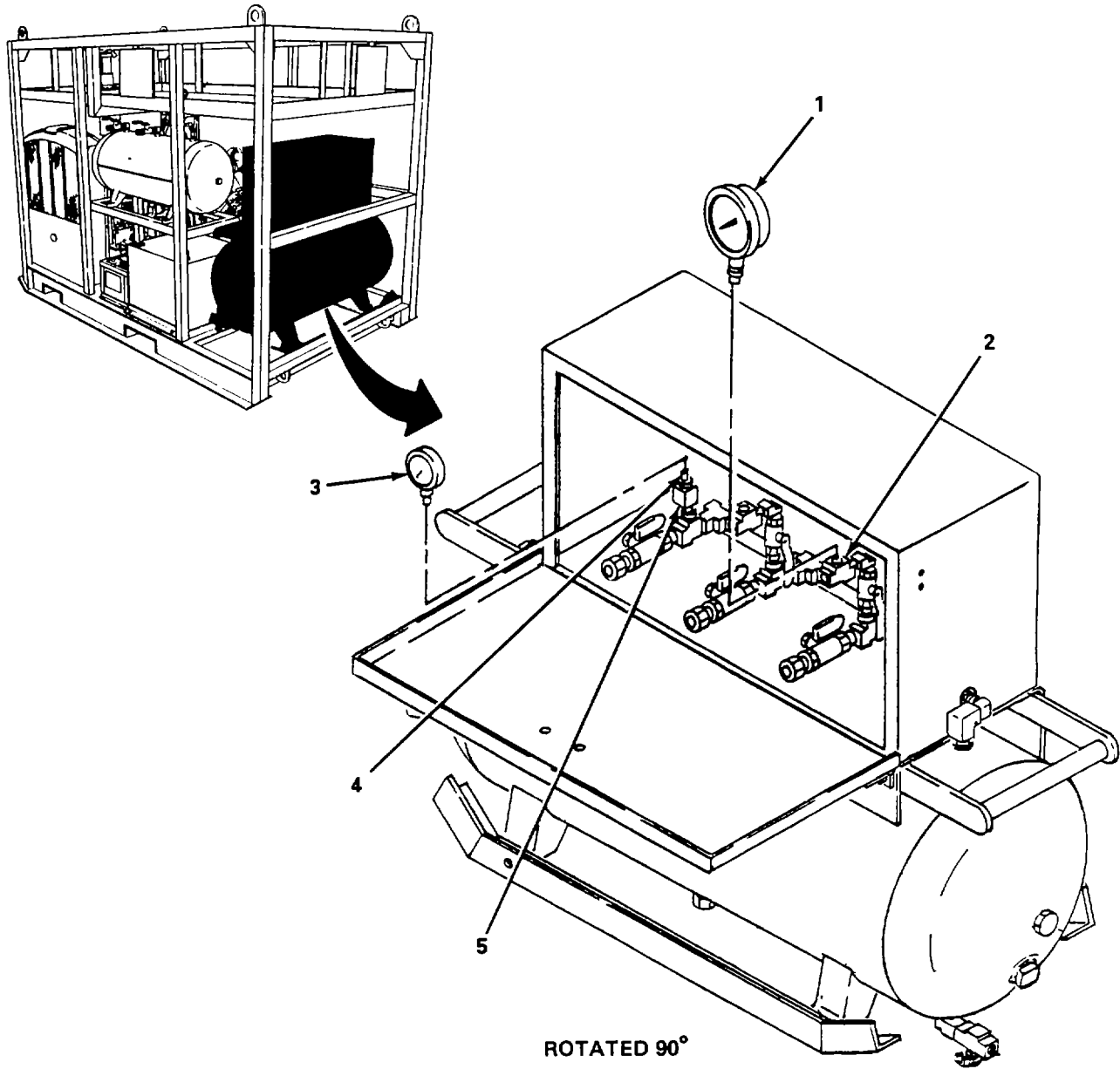
There is one pressure gage and three depth gages. Replacement of each depth gage is the same.

- (1) Remove depth gage (1) from tee (2).
- (2) Remove pressure gage (3) from reducer (4) on union elbow (5).

**WARNING**

Leave 11/2 threads exposed on fitting when applying teflon tape. This will ensure that no teflon tape will hang down inside the air system. Teflon tape should be wrapped in such a manner that when the fitting is tightened the tape will not loosen. Failure to wrap teflon tape correctly may result in contamination or blockage of the air system and subsequent possible injury or death to the diver.

- (3) Install teflon tape on threads of pressure gage  $\beta$  and install in reducer (4) on union elbow (5).
- (4) Install teflon tape on threads of depth gage (1) .
- (5) Install gage (1).



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Figure 4-66. Gages, Replace.

---

**4-41. Portable 60 Gallon Air Receiver, Tank.**

---

This task covers:        Replace

---

**INITIAL SETUP***Tools*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)

*Materials/Parts*

Tank, Receiver

---

*Equipment Condition*

Fittings and valves removed (para. 4-36).  
Gages removed (para. 4-33)

a. Replace. (figure 4-67)

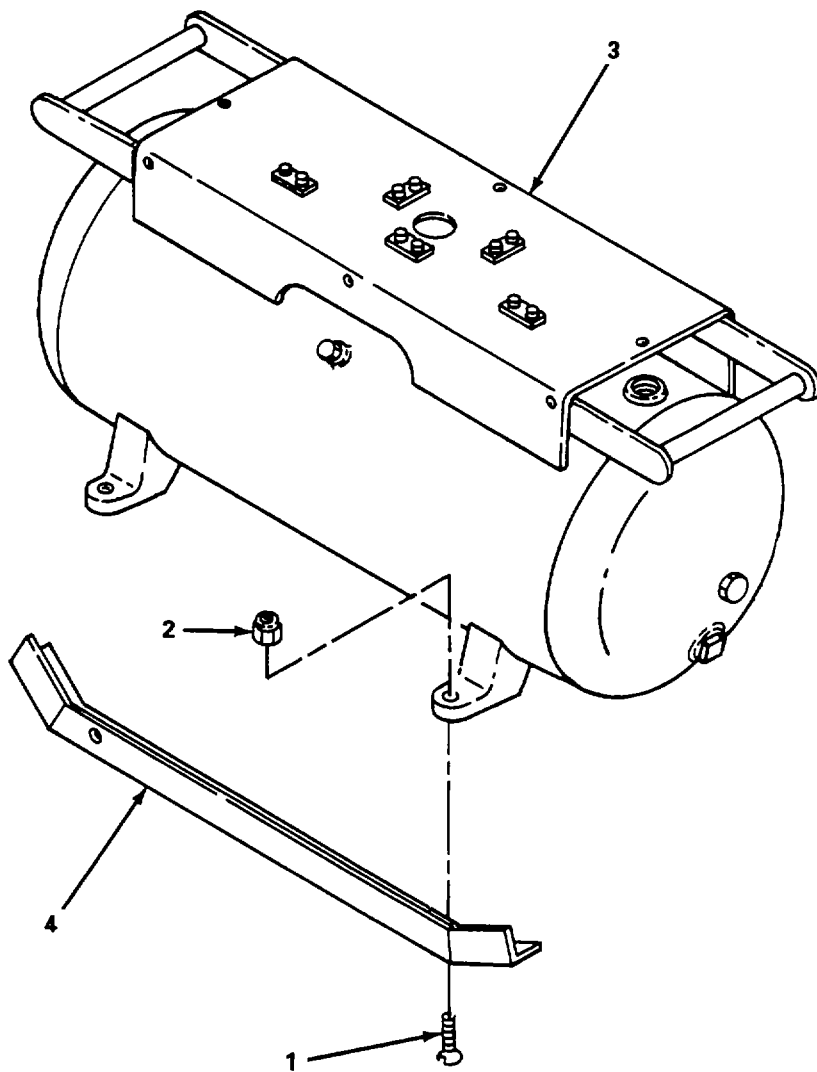
- (1) Remove four bolts (1) and nuts (2) securing receiver tank (3) to skids (4).
- (2) Remove receiver tank (3) from skids (4).

**WARNING**

Volume tank installed must be in accordance with accepted ASME boiler and unfired pressure vessels code standard.

- (3) Install receiver tank (3) on skids (4) and secure with four bolts (1) and nuts (2)





**Figure 4-67. Receiver Tank, Replace.**

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**FOLLOW-ON MAINTENANCE**

- (1) Install fittings and valves (para. 4-36).
- (2) Install gages (para. 4-33).

---

**4-42. Controls and Indicators.**

---

This task covers:        Replace

---

**INITIAL SETUP**

<i>Tools</i>	<i>Materials/Parts</i>
General Mechanic's Tool Kit (NSN 5180-00-177-7033)	Tape, Pressure Sensitive Adhesive (Item 24, Appendix D) Bands, Rubber (Item 5, Appendix D) Bag, Plastic (Item 4, Appendix D) Tape, Teflon (Item 25, Appendix D)

---

*Replace.*

- (1) *Air pressure gage.* (figure 4-68)
  - (a) Open valve (1) and release air pressure in receiver tank (2).

**WARNING**

Cleanliness is imperative in maintaining and handling diving air system components. All tools and parts must be kept free of oil, grease, rust, or other contamination in accordance with accepted army diving cleaning procedures. Foreign substances within an assembly could result in equipment failure and possible injury or death to personnel.

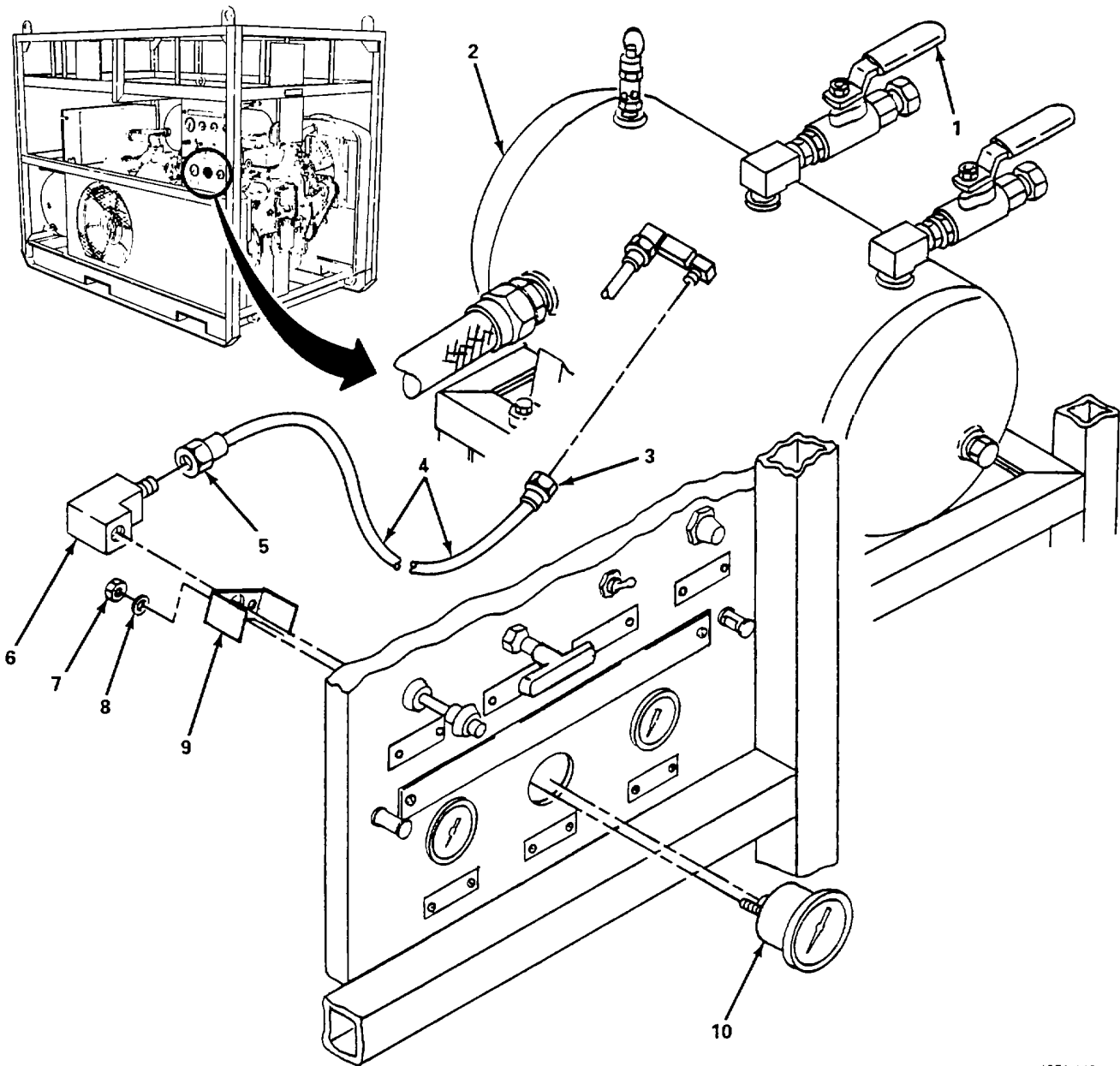
Ensure that all air lines and components removed or openings into the air system that provides breathing air are covered with a plastic bag and secured with a rubber band or taped shut. Small components should be stored in a plastic bag and sealed. Failure to do so will cause air system to become contaminated and could result in injury or death to the diver.

- (b) Loosen fitting nut (3) and tag and remove line (4).
- (c) Loosen fitting nut (5) and tag and remove line (4).
- (d) Remove elbow (6).
- (e) Remove two nuts (7), lockwashers (8), and bracket (9) and remove gage (10).
- (f) Install gage (10) and secure with bracket (9), two lockwashers (8), and nuts (7).

**WARNING**

Leave 1 1/2 threads exposed on fitting when applying teflon tape. This will ensure that no teflon tape will hang down inside the air system. Teflon tape should be wrapped in such a manner that when the fitting is tightened the tape will not loosen. Failure to wrap teflon tape correctly may result in contamination or blockage of the air system and subsequent possible injury or death to the diver.

- (g) Apply teflon tape to threads on elbow (6) and install elbow (6).
- (h) Connect line (4) as tagged and tighten fitting nut (5).
- (i) Connect line (4) as tagged and tighten fitting nut (3).



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Figure 4-68. Air Pressure Gage, Replace.

4-42. **Controls and Indicators (Cont).**

(2) *Air temperature gage.* (figure 4-69)

(a) Open valve (1) and release air pressure in air receiver (2).

**WARNING**

Cleanliness is imperative in maintaining and handling diving air system components. All tools and parts must be kept free of oil, grease, rust, or other contamination in accordance with accepted army diving cleaning procedures. Foreign substances within an assembly could result in equipment failure and possible injury or death to personnel.

Ensure that all air lines and components removed or openings into the air system that provides breathing air are covered with a plastic bag and secured with a rubber band or taped shut. Small components should be stored in a plastic bag and sealed. Failure to do so will cause air system to become contaminated and could result in injury or death to the diver.

(b) Loosen fitting nut (3) and remove air temperature sensor (4).

(c) Remove two nuts (5), lockwashers (6), and brackets (7) and remove air temperature gage (8).

(d) Install air temperature gage (8) and secure with two brackets (7), lockwashers (6), and nuts (5).

(e) Install temperature sensor (4) and tighten fitting nut (3).

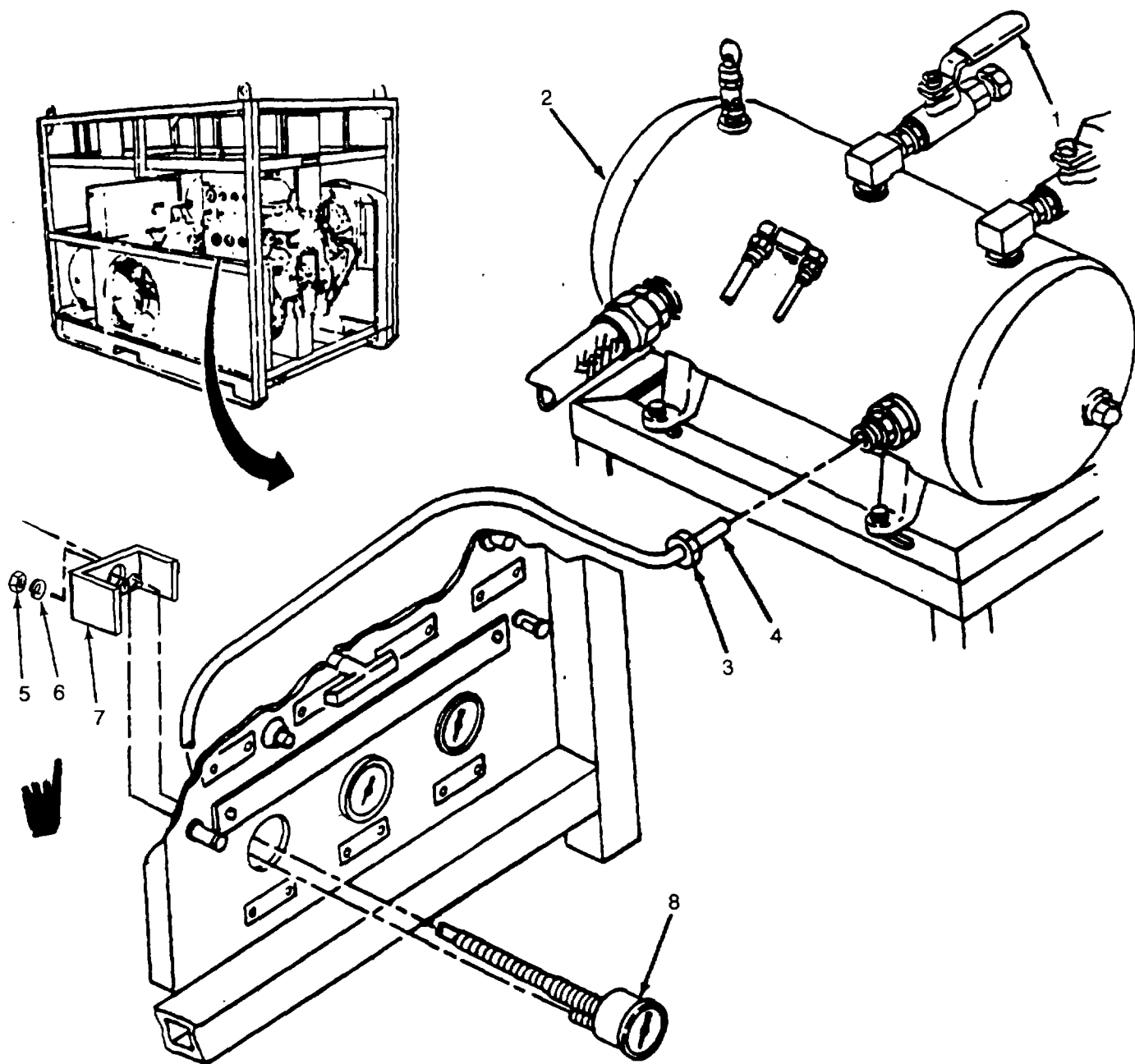


Figure 4-69. Air Temperature Gage, Replace

---

**4-43. Control Panel.**

---

This task covers:        Replace

---

**INITIAL SETUP***Tools*

General Mechanic's Tool Kit  
(NSN 5180-00-177-7033)

Torch Outfit, Cutting and Welding Oxy Acetylene  
(NSN 3433-00-026-4718)

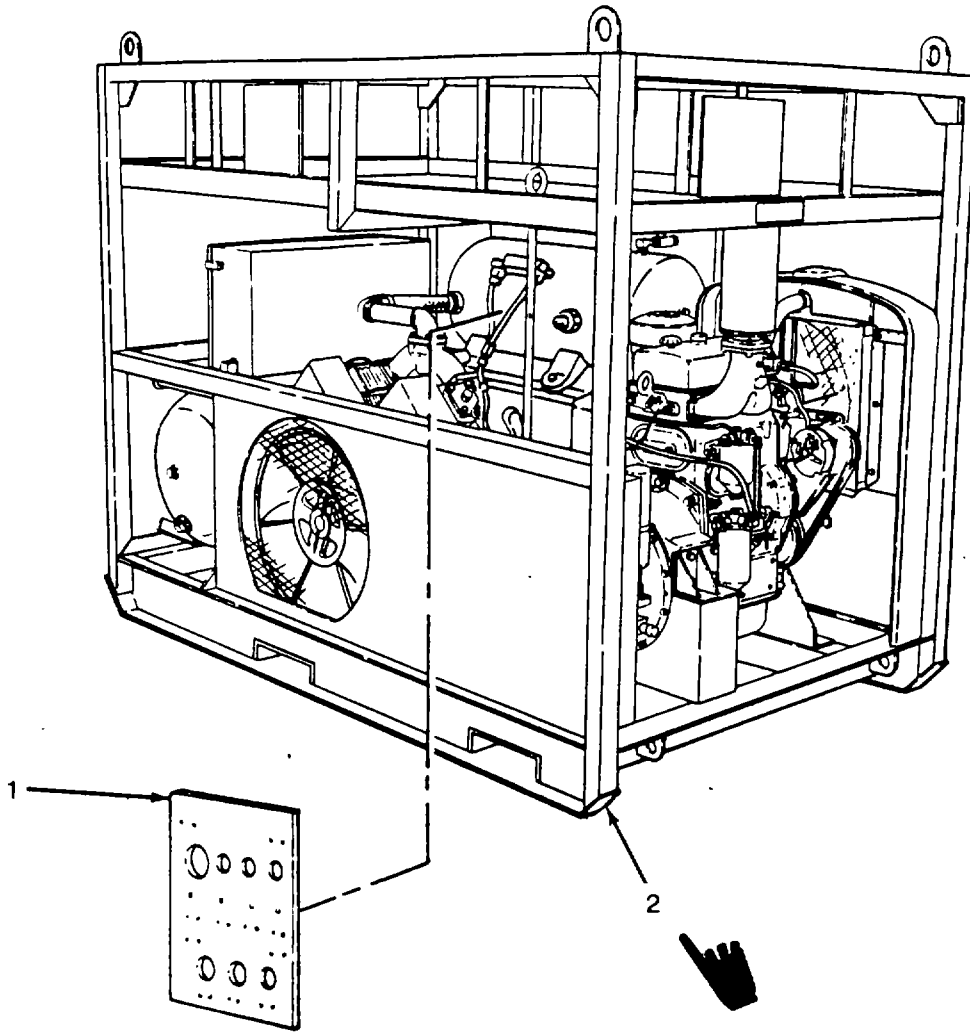
*Equipment Condition*

Controls and indicators removed (para. 3-45) and  
(para. 4-42).

---

Replace. (figure 4-70).

- (1) Cut control panel (1) from frame (2).
- (2) Install new control panel (1) and weld in accordance with TM 9-237.



**Figure 4-70. Control Panel Replace.**

FOLLOW-ON MAINTENANCE  
Install controls and indicators (para. 3-45 and 4-42).

---

**4-44. Engine Mount.**

---

This task covers:      a. Repair (Front)      b. Repair (Rear)

---

**INITIAL SETUP***Tools*

General Mechanic's Tool Kit  
(NSN 5180-00-177-7033)  
Torch Outfit, Cutting and Welding Oxy Acetylene  
(NSN 3433-00-026-4718)

*Equipment Condition*

Engine mounts removed (para. 3-46).

*Materials/Parts*

Solvent, Dry Cleaning (Item 23, Appendix D)  
Rags, Wiping (Item 21, Appendix B)

---

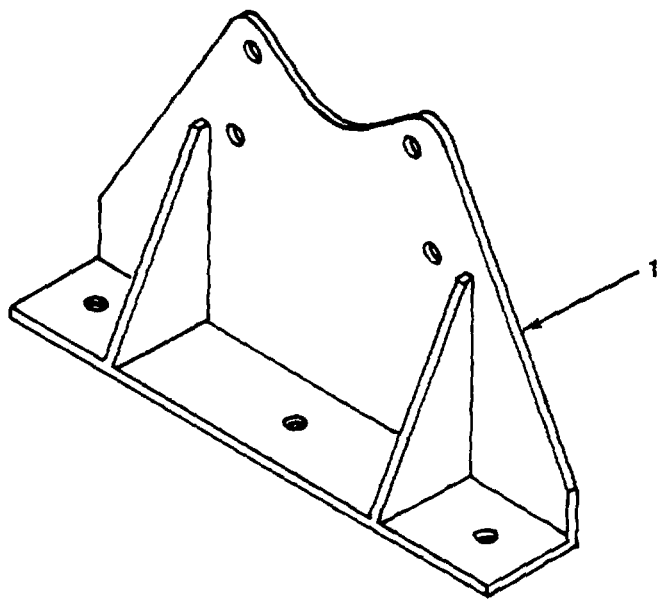
- a. *Repair.* (figure 4-71)

**WARNING**

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

- (1) Clean engine mount (1) with dry cleaning solvent and dry thoroughly.
- (2) Inspect engine mount (1) and repair minor cracks by welding.
- (3) Replace an engine mount (1) that is bent or otherwise damaged.





**Figure 4-71. Front Engine Mount, Repair.**

FOLLOW-ON MAINTENANCE  
Install engine mount (para. 3-46)

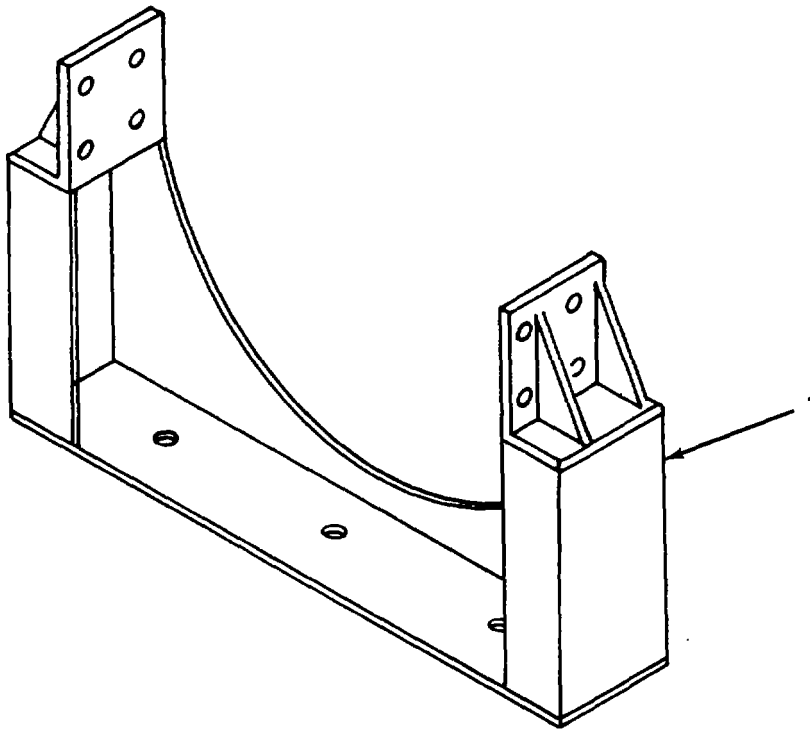
4-44. **Engine Mount (Cont).**

- b. Repair. (figure 4-72)

**WARNING**

Dry cleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 1000-138°F (38-60°C).

- (1) Clean engine mount (1) with dry cleaning solvent and dry thoroughly.
- (2) Inspect engine mount (1) and repair minor cracks by welding.
- (3) Replace a bent or otherwise damaged engine mount (1).



**Figure 4-72. Rear Engine Mount, Repair.**

FOLLOW-ON MAINTENANCE  
Install engine mount (para. 3-46).

**CHAPTER 5  
GENERAL SUPPORT MAINTENANCE INSTRUCTIONS**

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

**OVERVIEW**

This chapter provides procedures for troubleshooting and maintenance of the diving air compressor by general support maintenance personnel.

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

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

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

**5-2. Special Tools and Support Equipment.** For a listing of special tools, TMDE, and support equipment authorized for use on this equipment, refer to the Repair Parts and Special Tools List, TM 5-4310-379-24P, and the maintenance allocation chart (MAC), Appendix B of this manual.

**5-3. Repair Parts.** Repair parts are listed and illustrated in the Repair Parts and Special tools List for Diving Air Compressor, TM 5-4310-379-24P.

**Section II. GENERAL SUPPORT TROUBLESHOOTING**

Paragraph	Page
5-4 General .....	5-1
5-5 General Support Troubleshooting Procedures.....	5-2

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

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

**SYMPTOM INDEX**

Symptom	Page
1. Low compressor oil pressure.....	5-2
2. Low compressor output pressure.....	5-2
3. Compressor knocking.....	5-3
4. Compressor oil in discharge air.....	5-3

**Table 5-1. General Support Troubleshooting Procedures.**

---

Malfunction

Test or Inspection

Corrective Action

---

1. LOW COMPRESSOR OIL PRESSURE.

Step 1. Check oil pump.

Replace a defective oil pump (para. 5-35).

Step 2. Check intercooler

Replace a damaged intercooler (para. 5-27).

Step 3. Check oil screen.

Clean oil screen with solvent and dry with compressed air.

2. LOW COMPRESSOR OUTPUT PRESSURE.

Step 1. Check intake valves.

Replace or repair defective valves (para. 5-30).

Step 2. Check discharge valves.

Replace or repair defective valves (para. 5-30).

Step 3. Check unloader valves.

Replace or repair defective valves (para. 5-28).

Step 4. Check cylinder head gasket for leaks.

Replace cylinder head (para. 5-29)

**Table 5-1. General Support Troubleshooting Procedures.**

## MALFUNCTION

## TEST OR INSPECTION

## CORRECTIVE ACTION

**2. LOW COMPRESSOR OUTPUT PRESSURE (Cont).**

Step 5. Check pistons for wear.

Replace or repair worn or damaged pistons (para. 5-31).

Step 6. Check cylinders for wear.

Replace worn or damaged cylinders (para. 5-32).

**3. COMPRESSOR KNOCKING.**

Step 1. Check oil pump.

Replace or repair a defective oil pump (para. 5-35).

Step 2. Check piston and connecting rods.

Replace or repair worn or damaged piston and connecting rods (para. 5-31).

Step 3. Check cylinders.

Replace worn or damaged cylinders (para. 5-32).

Step 4. Check crankshaft.

Replace a worn or otherwise damaged crankshaft (para. 5-33).

**4. COMPRESSOR OIL IN DISCHARGE AIR.**

Step 1. Check piston and connecting rod.

Replace or repair worn piston and connecting rods (para. 5-31).

Step 2. Check cylinders.

Replace worn or damaged cylinders (para. 5-32).

## Section III. GENERAL SUPPORT MAINTENANCE PROCEDURES

Paragraph		Page
5-6	General	5-5
5-7	Exhaust Manifold	5-6
5-8	Thermostat and Housing Assembly	5-8
5-9	Water Pump	5-10
5-10	Fuel Pump and Drive	5-14
5-11	Fuel Injectors	5-17
5-12	Governor Assembly	5-28
5-13	Blower Assembly	5-36
5-14	Starter	5-42
5-15	Battery Charging Alternator	5-50
5-16	Oil Pump	5-56
5-17	Oil Cooler By-Pass Valve	5-58
5-18	Exhaust Valve	5-60
5-19	Cylinder Head	5-64
5-20	Pistons and Connecting Rods	5-72
5-21	Cylinder Liners	5-80
5-22	Camshaft, Balance Shaft, and Bearings	5-86
5-23	Crankshaft Group	5-94
5-24	Cylinder Block and Front Cover Assembly	5-100
5-25	Power Take Off Assembly	5-106
5-26	Clutch Assembly	5-110
5-27	Compressor Intercooler	5-114
5-28	Compressor Unloader Assembly	5-118
5-29	Compressor Cylinder Head	5-128
5-30	Compressor Intake and Discharge Valves	5-132
5-31	Compressor Pistons, Connecting Rods, and Bearings	5-140
5-32	Compressor Cylinders	5-146
5-33	Compressor Crankshaft	5-148
5-34	Compressor Crankcase	5-154
5-35	Compressor Bearing Carrier and Oil Pump	5-156
5-36	Portable Air Filtration System	5-160
5-37	Portable 60 Gallon Air Receiver Gages	5-161
5-38	Fuel Tank	5-162
5-39	Frame	5-164

5-6. **General.** This section contains general support maintenance procedures as authorized by the maintenance allocation chart in Appendix B of this manual. Ensure all tools and parts are clean and free of oil, grease, rust, or other contaminants when performing maintenance on air compressor.

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**5-7. Exhaust Manifold.**

---

This task covers: Repair

---

**INITIAL SETUP***Tools*

General Mechanic's Tool Kit  
(NSN 5180-00-1 77-7033)  
Torch Outfit, Cutting and Welding Oxy Acetylene  
(NSN 3433-00-26-4718)

*Equipment Condition*

Exhaust manifold removed (para. 3-15).

*Materials/Parts*

Solvent, Dry Cleaning (Item 23, Appendix D)  
Rags, Wiping (Item 21, Appendix D)

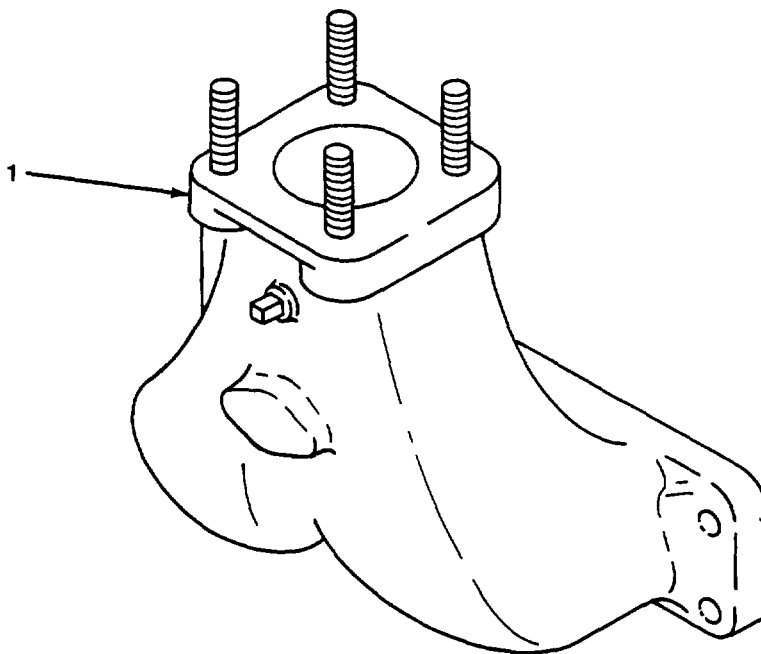
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Repair. (figure 5-1)

**WARNING**

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

- (1) Clean all items with dry cleaning solvent and dry thoroughly.
- (2) Inspect exhaust manifold (1) for cracks and weld minor cracks' in accordance with TM 9-237.
- (3) Replace an exhaust manifold that is excessively cracked or otherwise damaged.



**Figure 5-1. Exhaust Manifold, Repair.**

FOLLOW-ON MAINTENANCE  
Install exhaust manifold (para. 3-15).



## 5-8. Thermostat and Housing Assembly.

---

This task covers: Repair

---

### INITIAL SETUP

#### *Tools*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)  
Torch Outfit, Cutting and Welding  
(NSN 3433-00-026-4718)  
Wrench, Torque (NSN 5120-00-554-7292)

#### *Equipment Condition*

Thermostat and housing assembly removed  
(para. 3-21).

#### *Materials/Parts*

Thermostat Housing Gasket  
Solvent, Dry Cleaning (Item 23, Appendix D)  
Rags, Wiping (Item 21, Appendix D)

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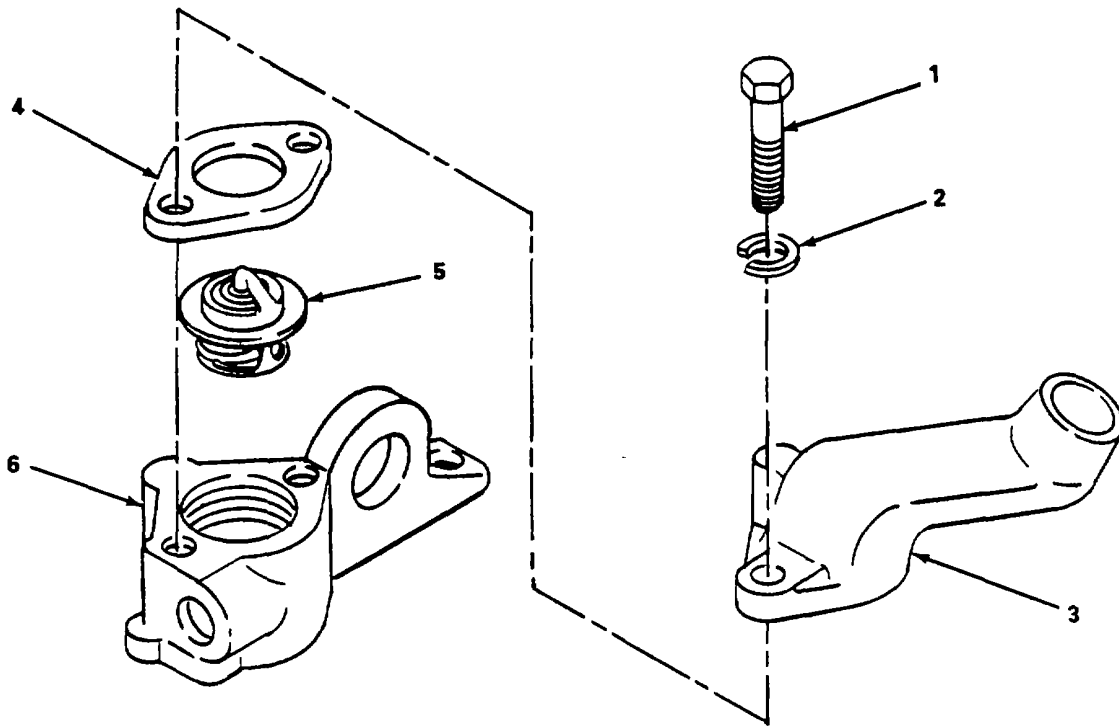
#### Repair. (figure 5-2)

- (1) Remove two screws (1) and lockwashers (2) and remove upper thermostat housing (3), gasket (4), and thermostat (5).

#### **WARNING**

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

- (2) Clean all items with dry cleaning solvent and dry thoroughly.
- (3) Inspect thermostat (5) and replace if cracked, bent, or otherwise damaged.
- (4) Inspect upper thermostat housing (3) and lower thermostat housing (6) and repair minor cracks by welding or replace a damaged item.
- (5) Ensure all gasket surfaces are clean and old gasket material removed.
- (6) Install thermostat (5), gasket (4), and upper thermostat housing (3) and secure with two screws (1) and lockwashers (2). Torque screws to 13-17 lb-ft (18-23 Nm).



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**Figure 5-2. Thermostat and Housing Assembly, Repair.**

**FOLLOW-ON MAINTENANCE**

Install thermostat and housing assembly (para. 3-21).

5-9. **Water Pump.**


---

 This task covers:      Repair
 

---

**INITIAL SETUP***Tools*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)  
 Cir Clip Pliers (NSN 5120-00-789-0492)  
 Puller, Kit Mechanical (NSN 5120-00-357-6917)

*Materials/Parts*

Gasket, Water Pump Cover Mounting  
 Solvent, Dry Cleaning (Item 23, Appendix D)

*Materials/Parts (Cont)*

Rags, Wiping (Item 21, Appendix D)  
 Grease, Automotive and Artillery (Item 15  
 Appendix D)  
 Lubricating Oil (Item 18, Appendix D)

*Equipment Condition*

Water pump removed (para. 3-23)

---

Repair. (figure 5-2)

- (1) Remove nut (1).
- (2) Using puller, remove hub (2) and key (3).
- (3) Remove retaining ring (4).
- (4) Remove six screws (5) and washers (6) and remove cover (7) and gasket (8).
- (5) Press shaft (9) and bearings (10) and (11) out of body (12) and impeller (13).
- (6) Press shaft (9) out of bearings (10) and (11) and sleeve (14).
- (7) Remove retainer (15) and two bearing shoulder rings (16).
- (8) Remove ring (17) and remove seal assembly (18) from impeller (13).

**WARNING**

Dry cleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100-138°F (38-600C).

**NOTE**

Shielded bearings must not be washed or dipped in solvent.

- (9) Clean all items, except bearings, with dry cleaning solvent and dry thoroughly.

- (10) Inspect body (12) and replace if cracked or otherwise damaged.
- (11) Inspect bearings (10) and (11) by holding inner race and turning outer race, and replace if worn or rough spots are present.
- (12) Inspect seal assembly (18) and impeller (13). Replace seal assembly (18) and impeller (13) if either the seal assembly (18) is worn or otherwise damaged or impeller (13) is worn, cracked, or otherwise damaged.

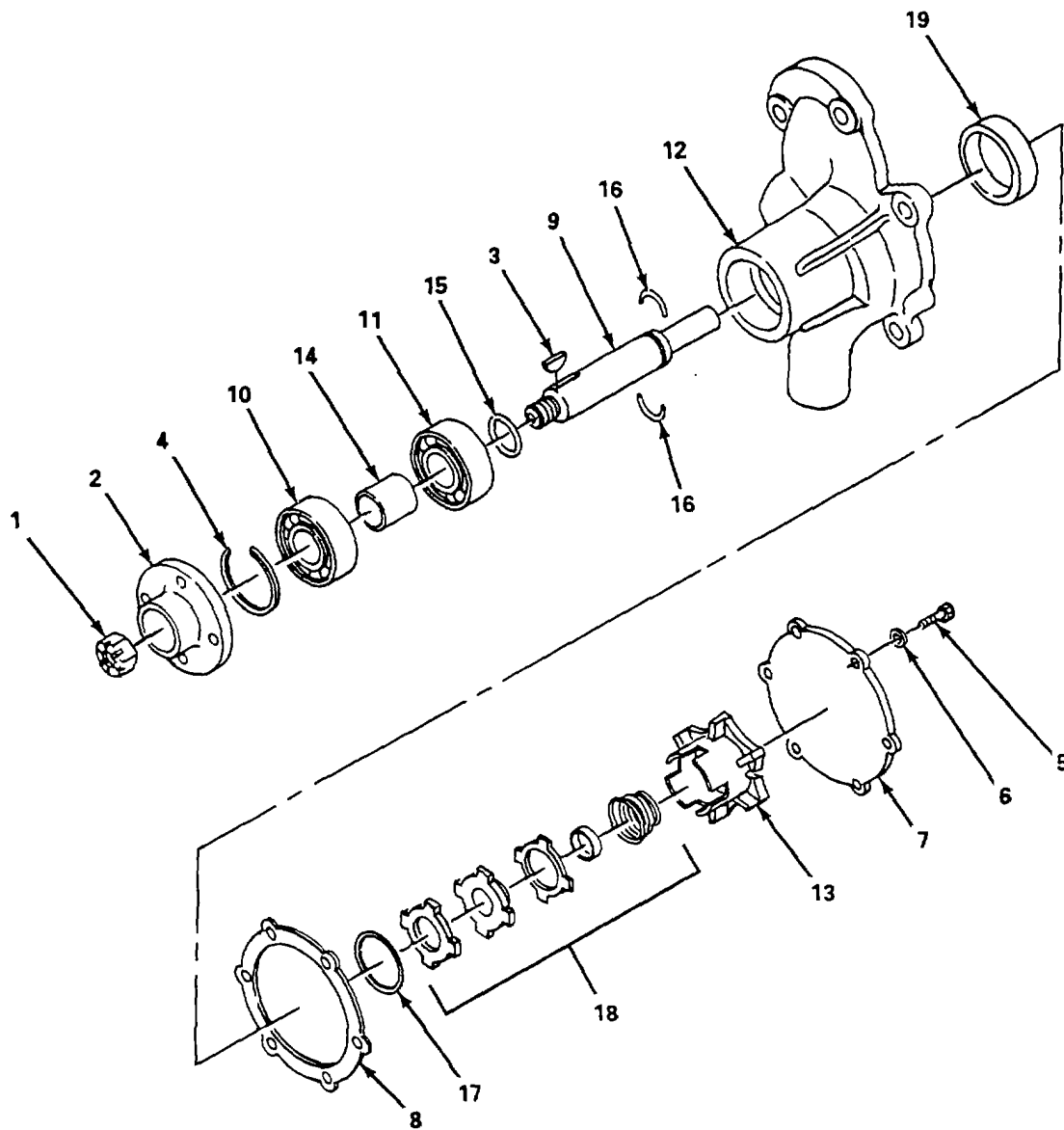


Figure 5-3. Water Pump, Repair.

- (13) Inspect insert (19) and replace if worn or scored excessively.
- (14) Inspect shaft (9) and replace if scored, worn, or otherwise damaged.
- (15) Install two halves of bearing shoulder ring (16) and install retainer (15).
- (16) Lubricate inside diameter of bearing (11) and install bearing (11) on shaft (9) from threaded end.
- (17) Piece a 13/16 in. diameter sleeve, approximately 3 in. long, on top of bearing (11) inner race, and press bearing (11) onto shaft (9) until bearing (11) is seated on retainer (15).
- (18) Install sleeve (14) on shaft (9).
- (19) Lubricate inside diameter of bearing (10).
- (20) Install bearing (10), numbered side up, straight onto threaded end of shaft (9).
- (21) Place a 13/16 in. diameter sleeve against inner race of bearing (11) and press bearing onto shaft (9) until seated against sleeve (14).
- (22) Pack the area between bearings (10) and (11) with grease.
- (23) Position shaft (9) in body (12) with threaded end up.
- (24) Press shaft (9) with bearings (10) and (11) into body until bearing (11) is fully seated in body.
- (25) Install seal assembly (18) in impeller (13), and secure with ring (17).
- (26) Lubricate inside diameter of impeller (13).
- (27) Press impeller (13), seal side down, straight onto shaft (9), until impeller (13) is flush with end of shaft (9).

#### NOTE

**A support must be placed under the impeller end of shaft so that the pump body will clear the bed of press when installing pulley hub.**

- (28) Install key (3) in shaft (9).
- (29) Lubricate inside diameter of hub (2) and install on shaft (9). Press hub (2) onto shaft (9) until seated against bearing (10) inner race.
- (30) Install nut (1) and torque to 55-65 lb-ft (75-88 Nm).
- (31) Install cover (7) and gasket (8) and secure with six screws (5) and washers (6). Torque screws to 7-9lb-ft (10-12 Nm).

FOLLOW-ON MAINTENANCE  
Install water pump (para. 3-23).

---

**5-10. Fuel Pump and Drive.**


---

**This task covers:    Repair**


---

**INITIAL SETUP:***Tools*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)  
 Caliper Set, Micrometer, Outside  
 (NSN 5210-00-554-7134)  
 Puller Kit, Mechanical (NSN 5120-00-357-6917)  
 Oil Seal Installer Handle (PN J 1508-8)  
 Oil Seal Installer (PN J 1508-9)  
 Oil Seal, Remover (PN J 1508-13)

*Materials/Parts*

Relief Valve Gasket  
 Solvent, Dry Cleaning (Item 23, Appendix D)  
 Rags, Wiping (Item 21, Appendix D)

*Equipment Condition*

Fuel pump removed (para. 3-27).

---

Repair. (figure 5-4)

- (1) Remove eight screws (1) and lockwashers (2) and remove cover (3).
- (2) Remove shaft (4) and gear (5) together.
- (3) Press gear (5) onto shaft (4) slightly and remove ball (6).
- (4) Press gear (5) off round end of shaft (4).
- (5) Remove drive gear and shaft (7).
- (6) Remove plug (8), gasket (9), spring (10), pin (11) and relief valve (12).

**NOTE**

**Note orientation of lips on oil seal before removing to ensure proper orientation during installation.**

- (7) Using oil seal remover, remove two oil seals (13) and (14).
- (8) Using puller, remove gear (15) and key (16).
- (9) Remove shaft (17) from adapter (18).
- (10) Remove bearings (19) and (20) from adapter (18).

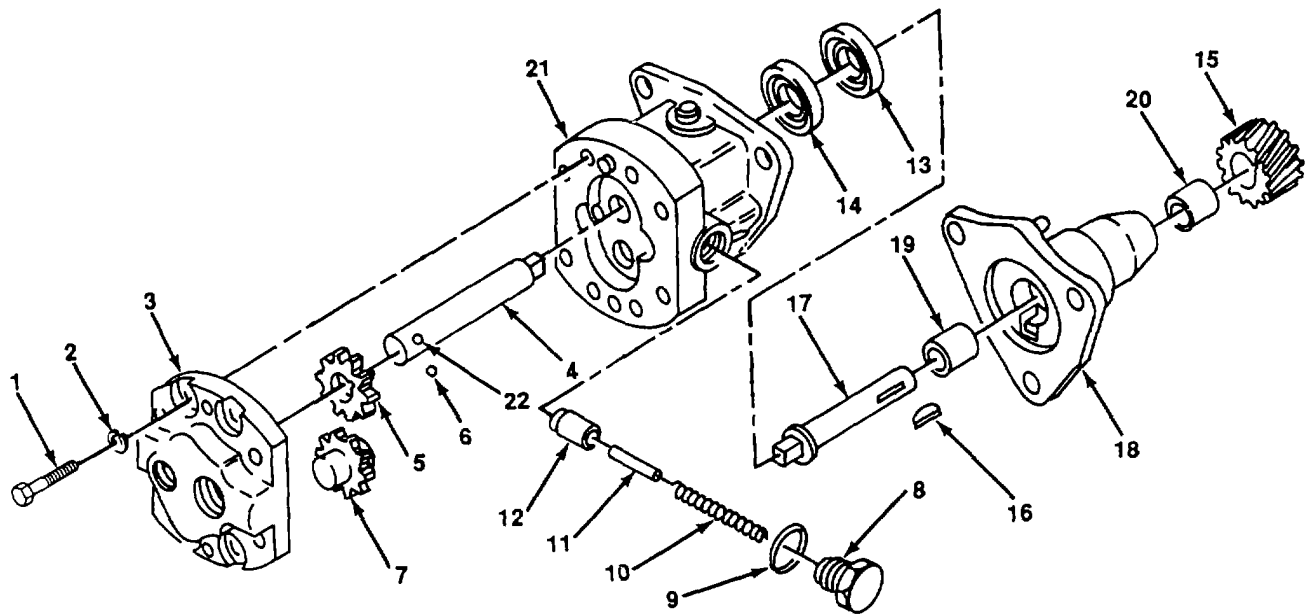


Figure 5-4. Fuel Pump, Repair.

**WARNING**

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

- (11) Clean all items, except oil seals, with dry cleaning solvent and dry thoroughly.
- (12) Inspect body (21), cover (3), and adapter (18) and replace any if cracked or otherwise damaged.
- (13) Inspect gear(5) and replace if teeth are chipped or worn, or gear(5) is otherwise damaged.
- (14) Inspect gear (15) and replace if teeth are chipped or worn or gear (15) is otherwise damaged.
- (15) Inspect driven gear and shaft (7) and replace if teeth on gear are chipped worn or otherwise damage, or shaft is scored or excessively worn.
- (16) Inspect shaft (17) and replace if scored or excessively worn.
- (17) Inspect plug (8), gasket (9), spring (10), pin (11) and valve (12) and replace if any item is worn, bent, cracked or otherwise damaged. Ensure valve (12) fits its seat and is free of burrs and scores.

**5-10. Fuel Pump and Drive (Cont).**

- (18) Inspect bushings (19) and (20). Measure inside diameter of each bushing. The measurement should be 0.4975-0.4980 in. (1.2636-1.2649 cm). Replace bushings if worn, scored or otherwise damaged.
- (19) Install valve (12), pin (11), spring (10), gasket (9) and plug (8).
- (20) Using oil seal installer and handle, install two oil seals (13) and (14).
- (21) Install driven gear and shaft (7).
- (22) Press gear (5) onto shaft (4) past retaining ball hole (22).
- (23) Install ball (6) and press gear (5) over ball (6).
- (24) Install shaft (4) and gear (5).
- (25) Install cover (3) and secure with eight screws (1) and lockwashers (2).
- (26) Install bushing (20) flush to 0.010 in. (.0254 cm) below end of adapter (18).
- (27) Install bushing (19) to .0625 in. (.0673 cm) below shoulder in adapter (18).
- (28) Install shaft (17), key (16), and gear (15). End play between gear (15) and adapter (18) should be .004-.006 in. (.010-.015cm).

FOLLOW-ON MAINTENANCE  
Install fuel pump (para. 3-27).



---

**5-11. Fuel Injectors.**

---

**This task covers:****a. Test****b. Repair**

---

**INITIAL SETUP:***Tools*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)  
 Polishing Stick Set (PN J 22964)  
 Lapping Block Set (PN J 22090)  
 Lapping Plate Set (PN J 21200)  
 Wrench, Torque (NSN 5120-00-554-7292)  
 Injector Vise and Rack Freeness Tester (PN J 22396)  
 Clamping Heads (PN J 23010-A)  
 Injector Tester (PN J 9787)  
 Tip Test Adapter (PN J 23010-129)  
 Auxiliary Tester (PN J 22640)  
 Threaded Coupling Nut (PN J 23010-20)  
 Tubing (PN J 23010-75)  
 Adapter (PN J 23010-167)  
 Spray Tip Gage (PN 9462-02)  
 Injector Calibrator (PN J 22410)  
 Injector Seat (PN J 22410-226)  
 Injector Nut Removal Tool (PN J 4983-01)  
 Spray Tip Removal Tool (PN J 1291-02)  
 Injector Nut Spray Tip Seating Tool (PN J 9418-1)  
 Injector Nut Spray Tip Seating Tool (PN J 9418-5)  
 Pin Vise (PN J 4298-1)  
 Polishing Compound (PN J 23038)

*Tools (Cont)*

Injector Spray Tip Cleaning Tool (PN J 24838)  
 Fuel Hole Cleaning Brush (PN J 8152)  
 Spray Tip Cleaning Tool (PN J 1243-01)  
 Rack Hole Cleaning Brush (PN J 8150)  
 Reamer (PN J 21089)  
 Spring Tester (PN J 22738-02)  
 Injector Nut Seal Ring Protector (PN J 29197)  
 Injector Tip Concentricity Gage (PN J 5119)  
 Plunger and Bushing/Tip Flow Gage (P/N J 25600-B)

*Materials/Parts*

Solvent, Dry Cleaning (Item 23, Appendix D)  
 Rags, Wiping (Item 21, Appendix D)  
 Injector Test Oil  
 Polishing Compound  
 Lapping Grain

*Equipment Condition*

Fuel injector removed (para. 4-10)

---

**5-11. Fuel Injectors (Cont).**a. Test. (figure 5-5)

- (1) Using injector fixture and rack freeness tester check for freeness of rack. If the rack (1) does not fall freely it may be necessary to loosen injector nut (2), turn spray tip (3), and retighten injector nut to 75-85lb-ft (102-115 Nm). If rack still binds, repair fuel injector.
- (2) Depress follower (4), raise spring (5) above stop pin (6) and remove pin (6) and allow spring (5) to raise gradually.
- (3) Remove follower (4), spring (5), and plunger (7).
- (4) Inspect plunger (7) and repair fuel injector if plunger is chipped, scored, or otherwise damaged.
- (5) Place stop pin (6) in injector body (8).
- (6) Install spring (5) on injector body (8) so that spring (5) rests on narrow flange of stop pin (6).
- (7) Aline slot in follower (4) with stop pin (6).
- (8) Aline flat side of plunger (7) with slot in the follower (4).
- (9) Install plunger (7) in injector body (8).
- (10) Press on follower (4) while pressing on stop pin (6). When follower (4) is in place, the spring (5) will hold stop pin (6).
- (11) Install fuel injector in fuel injector tester.
- (12) Test spray pattern and valve opening operations. Observe the spray pattern to see that all orifices are open and test fluid is dispersed evenly. The test oil should be finely atomized with no drops of test oil forming on the end of the tip. The acceptable pressure readings are 127-146 psi (876-1007 kPa).
- (13) Perform high pressure test on injector. Pump up pressure to 1600-2000 psi (11,024-13,780 kPa). Check for leakage at injector filter caps (9), body plugs (10), and nut seal ring (11). Repair a fuel injector that leaks.
- (14) Perform pressure holding test. Pressurize fuel injector to 700 psi (4,823 kPa). Time the pressure drop from 450-down to 250 psi (3, 100 down to 1, 723 kPa). If the pressure drop occurs in less than 15 seconds, leakage is excessive. Repair a fuel injector that has excessive leakage.

**NOTE**

**Needle valve tip test and spray tip leakage test can also be performed using injector tester and auxiliary tester.**

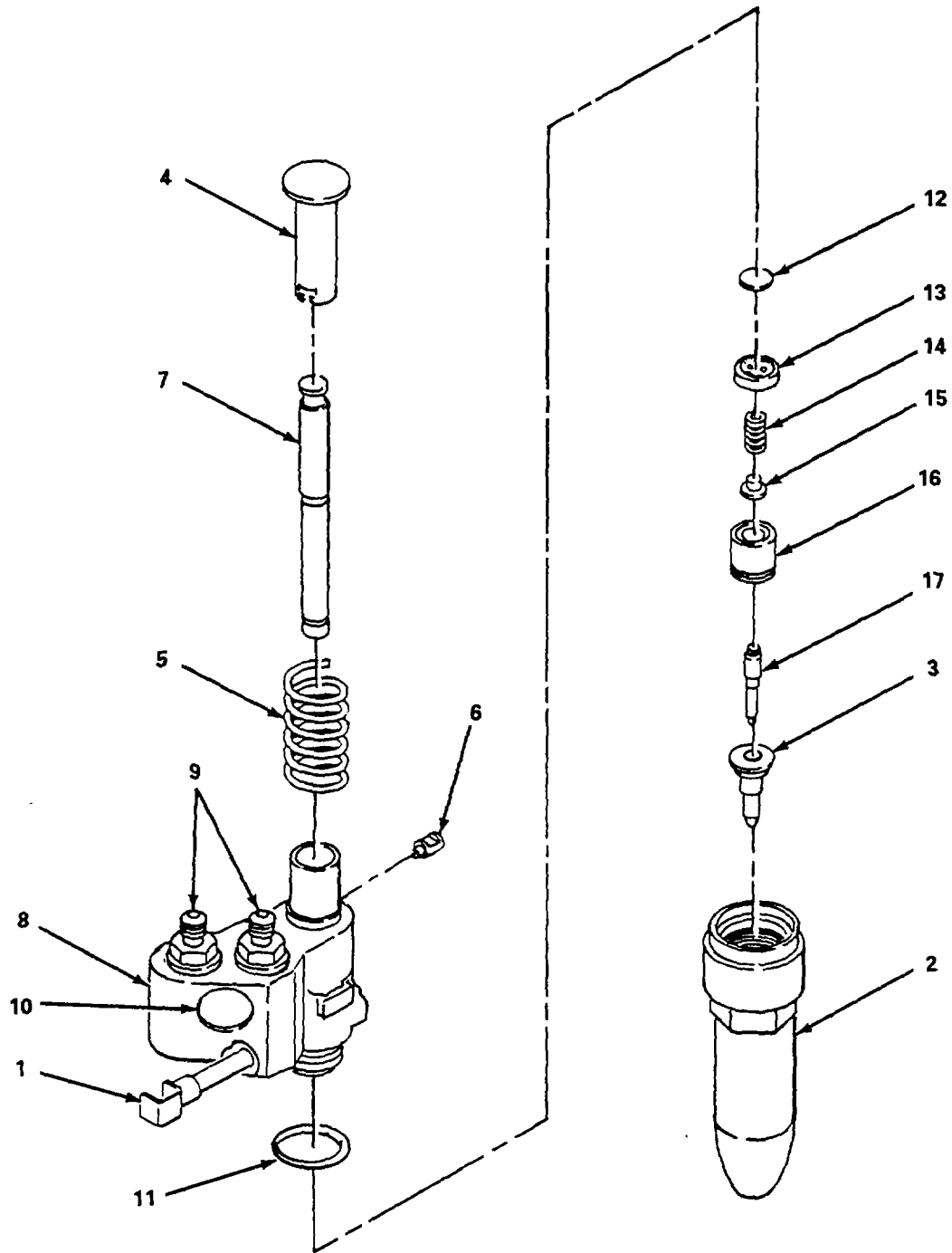


Figure 5-5. Fuel Injectors, Test.

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## 5-11. Fuel Injectors (Cont).

- (15) Install check valve (12), check valve cage (13), spring (14), spring seat (15), spring cage (16), needle valve (17), and spray tip (3) on test adapter and secure with injector nut (2). Install adapter in tester and perform needle valve tip test. Note the pressure at which the valve opens. The valve should open between 2200-3300 psi (15,158-22,737 kPa). Repair a fuel injector that does not meet specifications.
- (16) Perform spray tip leakage test. Pressurize fuel injector to 1500 psi (10,335 kPa) and hold for 15 seconds. Inspect spray tip for leakage. There should be no fuel droplets, although a slight wetting at the spray tip is permissible.
- (17) Perform needle valve lift test using spray tip gage. The lift should be .008-.018 in. (.020-.045 cm). If lift is greater than .018 in. (.045 cm), replace spray tip (3) and needle valve (17). If lift is less than .008 in. (.020 cm) check for foreign material between needle valve (17) and spray tip (3).
- (18) Perform fuel output test using injector calibrator. The output should be between 57-52 units. If output is more or less than tolerance, repair fuel injector.
- (19) If the fuel injector passes all the above tests, the fuel injector can be reinstalled. Any fuel injector which fails any of the above tests must be repaired.

b. Repair.

- (1) Disassemble. (figure 5-6)
  - (a) Install injector assembly in injector vise.

**NOTE**

**Discard gaskets and filter. Do not reuse.**

- (b) Remove two filter caps (1), gaskets (2) and filter (3).
- (c) Compress follower spring (4) slightly, and raise spring (4) over stop pin (5) and remove stop pin (5).
- (d) Allow spring (4) to rise gradually and remove plunger follower (6), plunger (7), and spring (4) as an assembly.
- (e) Invert the fixture holding the injector assembly.
- (f) Using injector nut removal tool, remove injector nut (8) and seal (9).

**NOTE**

**If spray tip stays in injector nut, use spray tip removal tool to remove it.**

- (g) Remove spray tip (10), needle valve (11), spring cage (12), spring seat (13), valve spring (14), check valve cage (15), and check valve (16) and place them in a suitable container.
- (h) Remove spill deflector (18) and bushing (19) from injector body (20).

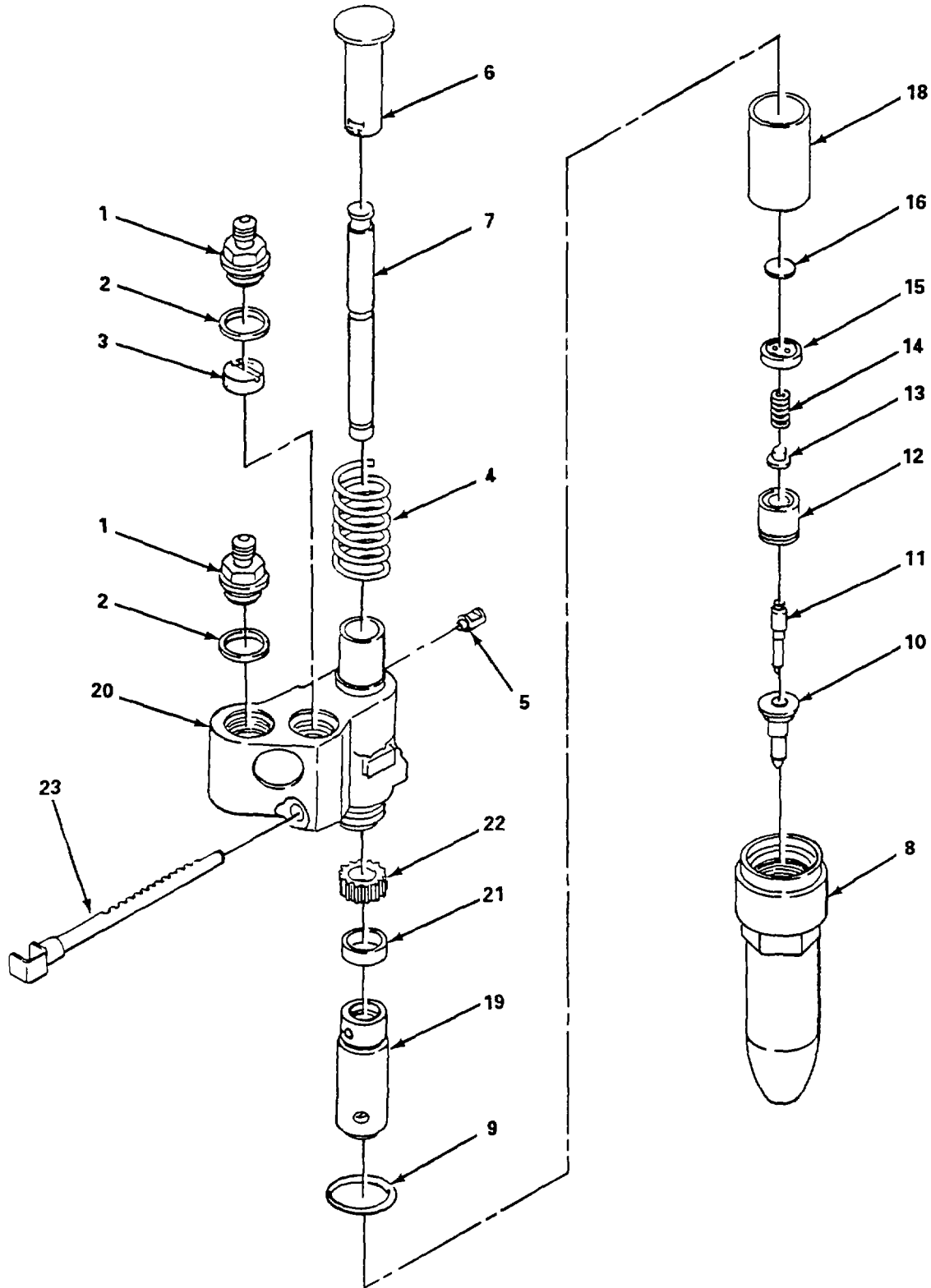


Figure 5-6. Fuel Injector, Dissemble.

## 5-11. Fuel Injectors (Cont).

- (i) Turn injector body (20) upside down and remove gear retainer (21) and gear (22).
- (j) Remove control rack (23).

**WARNING**

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

- (k) Clean all items, except seal, in dry cleaning solvent and dry thoroughly.
- (l) Ensure all passages, drilled holes, end slots in injector parts are cleaned.

**NOTE**

**Care must be used when cleaning spray tip. Do not damage any internal surfaces. Do not buff external surfaces excessively. Do not use a steel wire wheel or spray tip may be distorted.**

- (m) Inspect spray tip (10). Use spray tip tool, wire brush, and pin vise and clean spray tip (10).
- (n) Use fuel hole cleaning tool and rack hole cleaning brush and clean injector body (20).
- (o) Using reamer, clean up both sides of ring surface in injector body (20).
- (p) Use a .375 in. reamer and clean up ring bore in injector body (20).
- (q) Using injector nut and spray tip seating tools and clean up spray tip seating surface in injector nut (8).

**CAUTION**

**Do not touch the finished plunger surfaces with your fingers.**

- (r) Ensure the high pressure bleed hole in the side of the bushing (19) is not plugged. If the hole is plugged, fuel will leak out of injector and cause serious dilution problem.

**NOTE**

**Keep bushing and plunger together, they are mated parts.**

- (s) Inspect the teeth on gear (22) and rack (23) for excessive wear, missing teeth, or other damage. Inspect the bore of the gear (22) for excessive wear. Replace a worn or otherwise damaged gear (22) or rack (23).
- (t) Inspect gear retainer (21) and replace if excessively worn or otherwise damaged.

- (u) Inspect both ends of spill deflector (18) for sharp edges or burrs. Remove burrs with 500 grit stone.
- (v) Inspect spring (4) for visual defects and replace if cracked or otherwise damaged.

**NOTE**

**It is recommended that at repair both injectors be converted over to current spring configuration having a wire diameter of .142 in. (.360 cm).**

- (w) Test spring (4) using spring tester. Replace spring (4) that compresses to 1.028 in. (2.611 cm) or less when a load of 70 lbs (154 kg) is applied. The spring (4) has a free length of approximately 1.504 in. (3.820 cm) and a diameter of .142 in. (.360 cm).
- (x) Check the seal ring area on injector body (20) for burrs or scratches and remove minor defects with 500 grit stone.
- (y) Inspect contact area between injector body (20) and bushing (19). Lap area on body (20) to remove minor surface imperfections.
- (z) Inspect injector plunger (7) and bushing (19) for scoring, erosion, chipping or wear. Check for sharp edges on the plunger (7) where it contacts the gear (22), and remove any sharp edges with 500 grit stone. Check port holes in the diameter of bushing (19) for cracks or chipping. Insert plunger (7) into bushing (19) and check for free movement. If any damage is present on either the plunger (7) or bushing (19), both pieces must be replaced since they are a matched set.

**NOTE**

**The sealing surface of current spray tips is precision lapped by a new process which leaves the surface with a dull satin-like finish; the lapped surface on former tips was bright and shiny. It is not recommended to lap the surface of the current spray tip.**

- (aa) Inspect the sealing surfaces of bushing (19), check valve (16), check valve cage (15), spring cage (12) and spray tip (10) with a magnifying glass. Check for inspections, burrs, nicks, erosion, cracks, chipping, and excessive wear. Minor imperfections on spray tip (10), check valve cage (15), check valve (16) and valve spring cage (15) can be removed by lapping. The minimum thickness of parts is as follows:

Spray Tip (Shoulder)	.199 in. (.505 cm)
Check Valve Cage	.163-.165 in. (.414-.419 cm)
Check Valve	.022 in. (.055 cm)
Valve Spring Cage	.602 in. (1.529 cm)

Replace any item that is worn or otherwise damaged.

- (ab) Inspect seating area and needle quill of needle valve (11) for wear or damage and replace if worn or damaged.

## 5-11. Fuel Injectors (Cont).

**NOTE**

**Be sure that no compound is accidentally placed on the lapped surfaces located higher up in the spray tip. The slightest lapping action on these surfaces can alter the near-perfect fit between needle valve and tip.**

- (ac) Inspect the needle valve seat area in spray tip (10) for dirt or foreign material. Polish the seat area with polishing stick.
- (2) Assemble. (figure 5-7)

**NOTE**

**The sealing surfaces on all used injector parts should be lapped before installation.**

- (a) Install fuel filter (1), two gaskets (2) and two filter caps (3).
- (b) Purge filter after installation by directing compressed air or fuel through the filter caps.
- (c) Install clean shipping caps on filter caps.
- (d) Install rack (4) in injector body (5). Look through bottom bore of injector body (5) until two marked teeth are visible and install gear (6) so that marked tooth on gear (6) is engaged between two marked teeth on rack (4).
- (e) Install gear retainer (7).
- (f) Using injector nut seal ring protector, install seal ring (8) on injector body (5).
- (g) Install bushing (9) in injector body (5).
- (h) Install spill deflector (10) over barrel of bushing (9).
- (i) Install check valve (11) centrally on top of bushing (9).
- (j) Install check valve cage (12) over check valve (11) and against bushing (9).
- (k) Install spring seat (13) in spring (14) and install spring (14) in spring cage (15).

**NOTE**

**Install new spring seat when using a new design spray tip.**

- (l) Install spring cage (15) on bushing (9).

**NOTE**

**If installing a new design spray tip, a new valve spring seat must also be installed.**



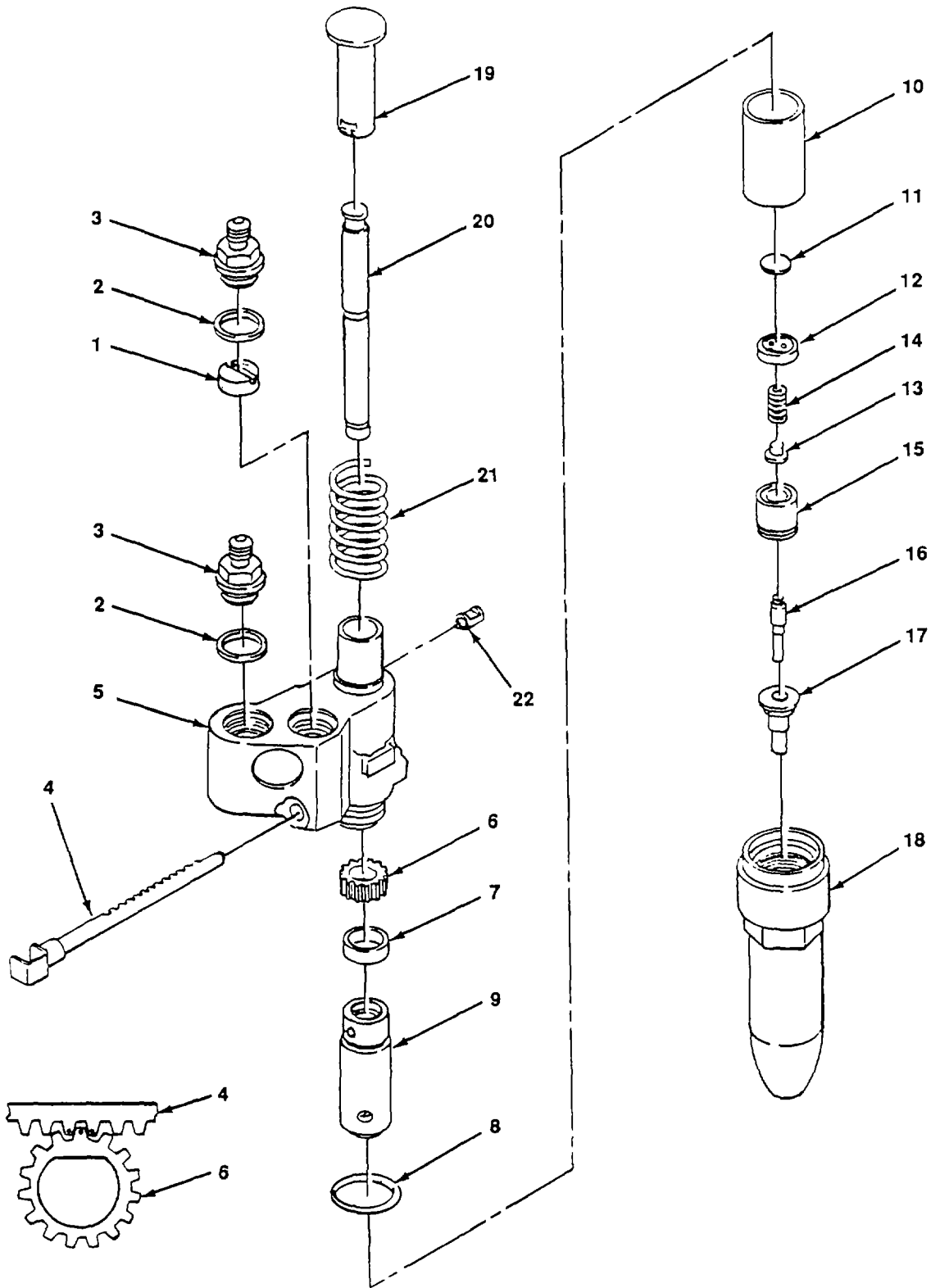


Figure 5-7. Fuel Injector, Assemble.

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- (m) Install needle valve (16) in spray tip (17) and install spray tip (17) on spring cage (15). Ensure needle valve (16) seats in hole in spring cage (15).
- (n) Lubricate threads in injector nut (18) and carefully thread the injector nut (18) on the injector body (5) by hand. Rotate spray tip (17) while threading the injector nut (18) on the injector body(5).
- (o) Torque injector nut (18) to 75-85 lb-ft (102-115 Nm).
- (p) Inspect area between injector nut (18) and injector body (5). If seal ring (8) is still visible, try another injector nut.
- (q) Install follower (19) on plunger (20).
- (r) Push rack (4) all the way in.
- (s) Install follower spring (21) on injector body (5).
- (t) Install stop pin (22) in injector body so that follower spring (21) rests on narrow flange of stop pin (22).
- (u) Aline slot in follower (19) with the stop pin (22).
- (v) Aline the flat side of the plunger (20) with the slot in follower (19).
- (w) Install plunger (20) in injector body (5) and press down on follower (19) and press in on stop pin (22). When in place, the spring (21) will hold stop pin (22) in place.
- (x) Using concentricity gage, check concentricity of spray tip (17). The total run out must not exceed .008 in. (.020 cm). If concentricity exceeds tolerance, loosen injector nut (18) and center spray tip (17) and retorque injector nut (18). If after several attempts the spray tip cannot be positioned satisfactorily, replace injector nut (18).
- (y) Retest reconditioned fuel injector. See para. a. above.

FOLLOW-ON MAINTENANCE  
Install fuel injector (para. 4-10)

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**5-12. Governor Assembly.**

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**This task covers:****Repair**

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**INITIAL SETUP:***Tools*

General Mechanic's Tool Kit  
(NSN 5180-00-177-7033)  
Bearing Remover (PN J 21967-1)  
Governor Cover and Bearing Installer (PN J 21068)  
Governor Housing Bearing Installer (PN J 9196)  
Micrometer (NSN 5210-00-554-7134)  
Wrench, Torque (NSN 5120-00-554-7292)

*Materials/Parts*

Housing Gasket  
Solvent, Dry Cleaning (Item 23, Appendix D)

*Materials/Parts (Cont)*

Rags, Wiping (Item 20, Appendix D)  
Grease, Automotive and Artillery (Item 15,  
Appendix D)

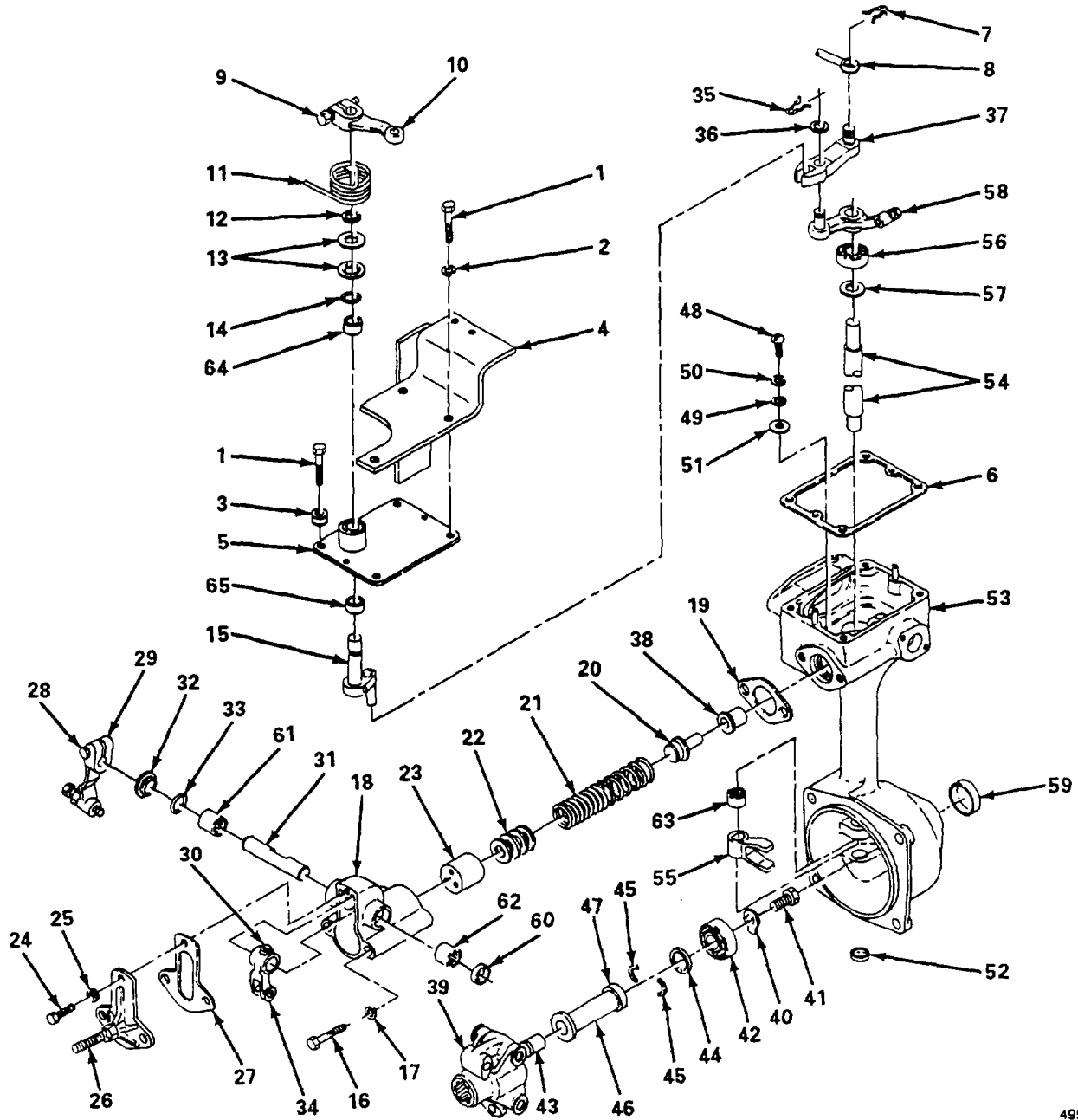
*Equipment Condition*

Governor assembly removed (para. 4-11).

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**(1) Disassemble.** (figure 5-8)

- (a) Remove four screws (1), three lockwashers (2), spacer (3) and remove bracket (4), cover (5), and gasket (6).
- (b) Remove clip (7) and remove rod (8).
- (c) Loosen screw (9) and remove lever (10) and spring (11).
- (d) Remove retainer (12) and remove washers (13), o-ring (14), and shaft (15).
- (e) Remove two screws (16) and washers (17) and remove housing (18), gasket (19), plunger (20), spring (21), shims (22) and spring retainer (23).
- (f) Remove screw (24) and lockwashers (25) and remove cover (26) and gasket (27).
- (g) Loosen screw (28) and remove lever (29).
- (h) Loosen set screw (30) and remove shaft (31), washer (32), o-ring (33), and spring lever (34).
- (i) Remove clip (35) and washer (36) and remove arm (37).
- (j) Remove plunger guide (38).
- (k) Remove flyweight carrier assembly (39).
- (l) Bend out tab on lockwasher (40) and remove screw (41) and lockwasher (40).



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Figure 5-8. Governor Assembly, Disassemble.

5-12. **Governor Assembly (Cont).**

- (m) Support inner race of bearing (42) and press weight shaft (43) from bearing (42).
- (n) Remove thrust key retainer (44) and two thrust keys (45).
- (o) Remove riser (46) and thrust bearing (47).
- (p) Remove screw (48), washer (49), lockwasher (50) and flat washer (51).
- (q) Remove expansion plug (52) from governor housing (53).
- (r) Press shaft (54) out of fork (55) and remove fork (55) from governor housing (53).
- (s) Remove shaft (54) with bearing (56), washer (57) and lever (58) installed.
- (t) Press shaft (54) out of lever (58) and bearing (56) and remove washer (57).
- (u) Remove plug (59).
- (v) Remove plug (60).
- (w) Using bearing remover, remove bearing (61) from housing (18).
- (x) Using bearing remover, remove bearing (62) from housing (18).
- (y) Press bushing (63) out of housing (53).
- (z) Press bearing (64) and bearing (65) out of cover (5).

**WARNING**

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

- (aa) Clean all parts with dry cleaning solvent and dry thoroughly.
- (ab) Inspect governor housing (53) if cracked or otherwise damaged, replace governor housing (53).
- (ac) Inspect cover (5) and replace if cracked, bent, or otherwise damaged.
- (ad) Inspect rod (8) and replace if bent or otherwise damaged.
- (ae) Inspect levers (10), (29), and (34) and replace all items that are cracked, bent, or otherwise damaged.
- (af) Inspect shaft (15) and replace if worn, bent, or otherwise damaged.
- (ag) Inspect housing (18) and cover (26) and replace items that are cracked or otherwise damaged.

- (ah) Inspect plunger (20), spring (21), shims (22) and retainer (23) and replace items that are cracked, worn, scored, or otherwise damaged.
- (ai) Inspect shaft (31) and replace if worn, scored, or otherwise damaged.
- (aj) Inspect arm (37) and replace if bent, cracked, or otherwise damaged.
- (ak) Inspect flyweight carrier assembly (39) and replace if any item in the assembly is cracked, worn, bent, or otherwise damaged.
- (al) Inspect fork (55) and replace if cracked, bent, or otherwise damaged.
- (am) Inspect bearing (42). Hold inner race of bearing (42) and rotate outer race. Replace bearing if rough spots are felt or signs of wear are present.
- (an) Inspect shaft (43) and replace if bent, scored, or otherwise damaged.
- (ao) Inspect riser (46) and thrust bearing (47) and replace if riser (46) is bent, dented, cracked, or thrust bearing (47) has rough spots or other signs of damage or either part is otherwise damaged.
- (ap) Inspect thrust key retainer (44) and two thrust keys (45) and replace items that are worn, bent, cracked or otherwise damaged.
- (aq) Inspect bearing (56). Hold inner race of bearing (56) and turn outer race. Replace bearing (56) if rough spots are felt or other signs of wear are present.
- (ar) Inspect bearings (61), (62), (64), and (65). Inspect needle bearings in bearings. If needles are not free in bearings, replace bearing.
- (as) Inspect plunger guide (38) and replace if cracked, worn, or otherwise damaged.
- (at) Inspect bushing (63) and replace if scored, cracked, worn, or otherwise damaged.

## 5-12. Governor Assembly (Cont).

(2) Assemble. (figure 5-9)

- (a) Using bearing installer, install bearings (1) and (2). Bearing (1) is pressed into cover (3) until bottom end is flush with lower end of bearing boss in cover (3). Bearing (2) is pressed into cover (3) until upper end of bearing (2) is approximately .1406 in. (.3571 cm) below upper end of bearing boss in cover (3).
- (b) Pack bearings (1) and (2) with grease.
- (c) Using bearing installer, install bearings (4) and (5). The bearing installer sets the bearings (4) and (5) to the proper depth during installation.
- (d) Pack bearings (4) and (5) with grease.
- (e) Install washer (6) on shaft (7) and press bearing (8), numbered side up, tight against washer (6) and shoulder on shaft (7).
- (f) Press lever (9), with pin pointed up, tight against bearing(8).
- (g) Press bushing (9) into governor housing (10). Measure diameter of bearing (9). Diameter should be .5022-5042 in. (1.2755-1.2806 cm). If diameter is not correct use a burnishing tool of correct diameter, to increase bearing diameter to proper size.

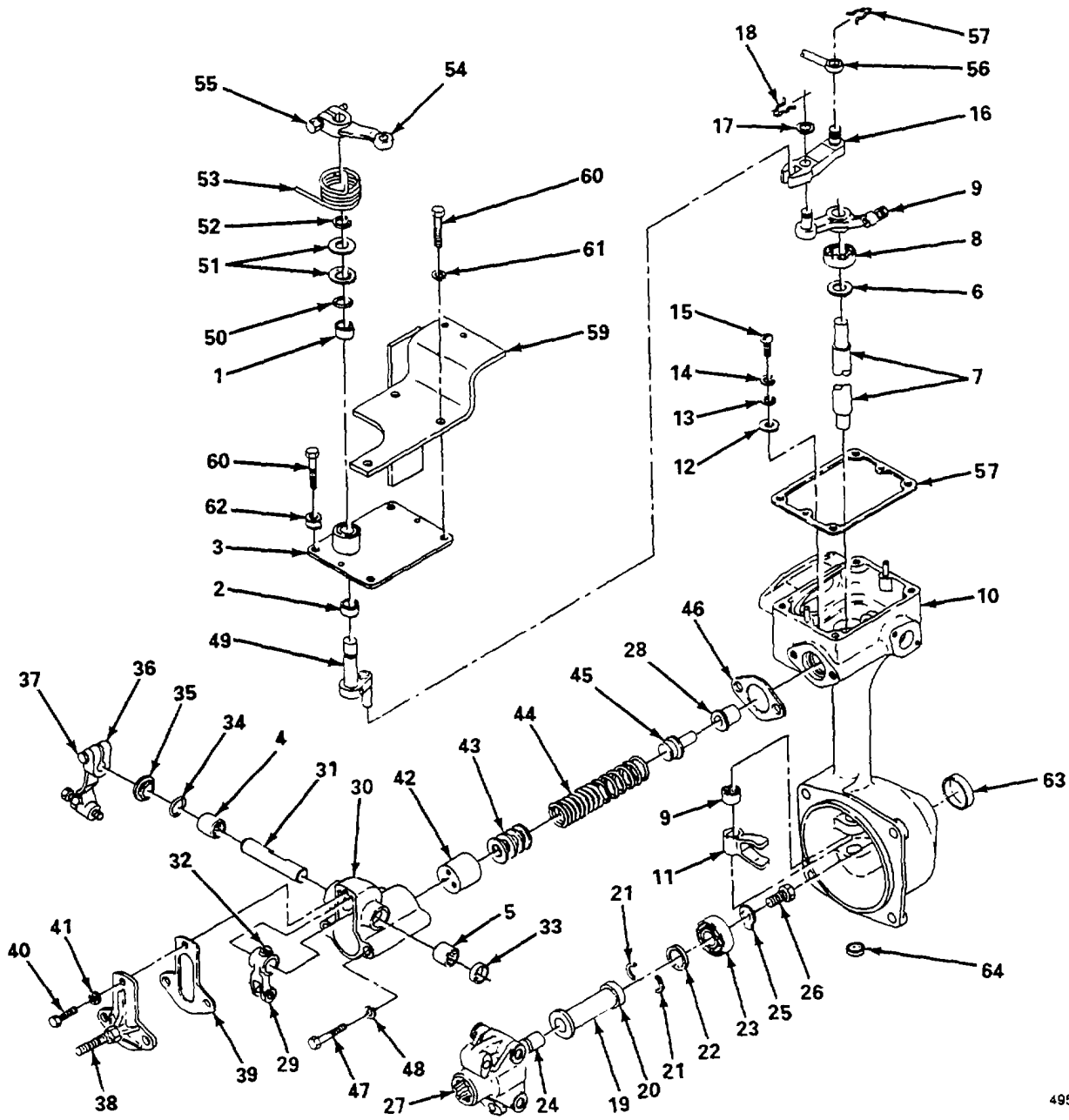
**NOTE**

**Do not use a reamer to increase bushing diameter.**

- (h) Install shaft (7) with lever (9), bearing (8) and washer (6) installed, in governor housing (10).
- (i) Position fork (11) in governor housing (10), with finished face of fork (11) pointed toward closed end of governor housing (10).
- (j) Aline fork (11) with shaft (7) and press fork (11) onto shaft (7) until tight against shoulder on shaft (7).
- (k) Install flat washer (12), washer (13), lockwasher (14) and secure with screw (15).
- (l) Install arm (16) and secure with washer (17) and clip (18).
- (m) Install riser (19) and thrust bearing (20).
- (n) Install two thrust keys (21) and thrust key retainer (22).
- (o) Press bearing (23) onto weight shaft (24).

**NOTE**

**Install new lockwasher upon reassembly.**



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Figure 5-9. Governor Assembly, Assemble.

5-33/(5-34 blank)



- (p) Install lockwasher (25) and screw (26) and bend down tab on lockwasher (25).
- (q) Install flyweight and carrier assembly (27), with the machined surfaces of fork (11) bearing against the outer surface of thrust bearing (20).
- (r) Install plunger guide (28).
- (s) Position spring lever (29) in housing (30).
- (t) Install shaft (31) in housing (30) and spring lever (29).
- (u) Ensure set screw (32) on spring lever (29) aligns with flat on shaft (31) and tighten set screw (32). Torque set screw (32) to 12-15 lb-ft (16-20 Nm).
- (v) Stake the edge of the spring lever set screw hole to retain the set screw (32) in the spring lever (29).
- (w) Install plug (33).
- (x) Install O-ring (34) and ensure it seats in bearing bore and up against bearing (4).
- (y) Install washer (35) and lever (36) and tighten screw (37).
- (z) Install cover (38) and gasket (39) and secure with screw (40) and lockwasher (41).
- (aa) Install spring retainer (42), shims (43), spring (44), plunger (45) in housing (30), and install gasket (46) and housing (30) and secure with two screws (47) and lockwashers (48).
- (ab) Install shaft (49) in cover (3).
- (ac) Install O-ring (50) on shaft (49) and ensure it seats in bearing bore and up against bearing (1).
- (ad) Install washers (51) and retainer (52).
- (ae) Install spring (53) and lever (54) and tighten screw (55).
- (af) Install rod (56) and secure with clip (57).
- (ag) Install cover (3) and ensure pin on shaft (49) aligns with slot in arm (16) and install gasket (57), and bracket (59) and secure with four screws (60), three lockwashers (61), and one spacer (62).
- (ah) Loosen screw (55) and turn lever (54) one full turn counterclockwise to provide initial spring pressure to lever (54) and tighten screw (55).
- (ai) Install plugs (63) and (64).

FOLLOW-ON MAINTENANCE

Install governor assembly (para. 4-11).

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**5-13. Blower Assembly.**

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**This task covers:****Repair**

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**INITIAL SETUP:***Tools*

General Mechanic's Tool Kit  
(NSN 5 180-00-177-7033)  
Micrometer (NSN 5210-00-554-7134)  
Installer, Bearing (PN J 1682-9)  
Pilot, Oil Seal (PN J 1682-10)  
Puller, Timing Gear (PN J 1682-27)  
Remover, Oil Seal (PN J 1682-32)  
Tool Set, Remover and Replacer (PN J 3154-04)  
Blower Clearance Feeler Gage Set (PN J 1698-02)  
Wrench, Torque (NSN 5120-00-554-7292)

*Materials/Parts*

Gasket, Rear Cover Plate  
Gasket, Air Heater Cover  
Solvent, Dry Cleaning (Item 23, Appendix D)  
Rags, Wiping (Item 21, Appendix D)

*Equipment Condition*

Blower Assembly Removed (para. 4-13)

---

*Repair.*

- (1) *Disassemble.* (figure 5-10)
  - (a) Place a clean folded towel between the rotors and a towel between rotor and the housing to prevent the rotors from turning.
  - (b) Remove two timing gear retaining nuts (1) and lockwashers (2).
  - (c) Using timing gear pullers, remove simultaneously the two rotor timing gears (3) from the rotor shafts (4).
  - (d) Remove shims (5) from both rotor shaft (4).
  - (e) Remove six screws (6) and lockwashers (7) securing bearing retainers (8) to front end plate (9) and remove retainers.
  - (f) Remove one long bolt (10) and lockwasher (11).
  - (g) Remove four bolts (12) and lockwashers (13) securing front end plate (9) to blower housing (14).
  - (h) Remove towel between the blower rotors and housing.
  - (i) Using pullers, remove simultaneously the front end plate (9) and bearings (15) from housing and rotor shaft.
  - (j) Press rotor shafts (4) out of rear bearings (16) and slide rotors out of blower housing.
  - (k) Remove five bolts (17) and lockwasher (18) securing rear end plate (19) to blower housing (14) and remove end plate.
  - (l) Remove the two bearing retaining rings (20) from rear end plate (19).
  - (m) Press bearings (15) and (16) and oil seals (21) out of end plates (9) and (19).

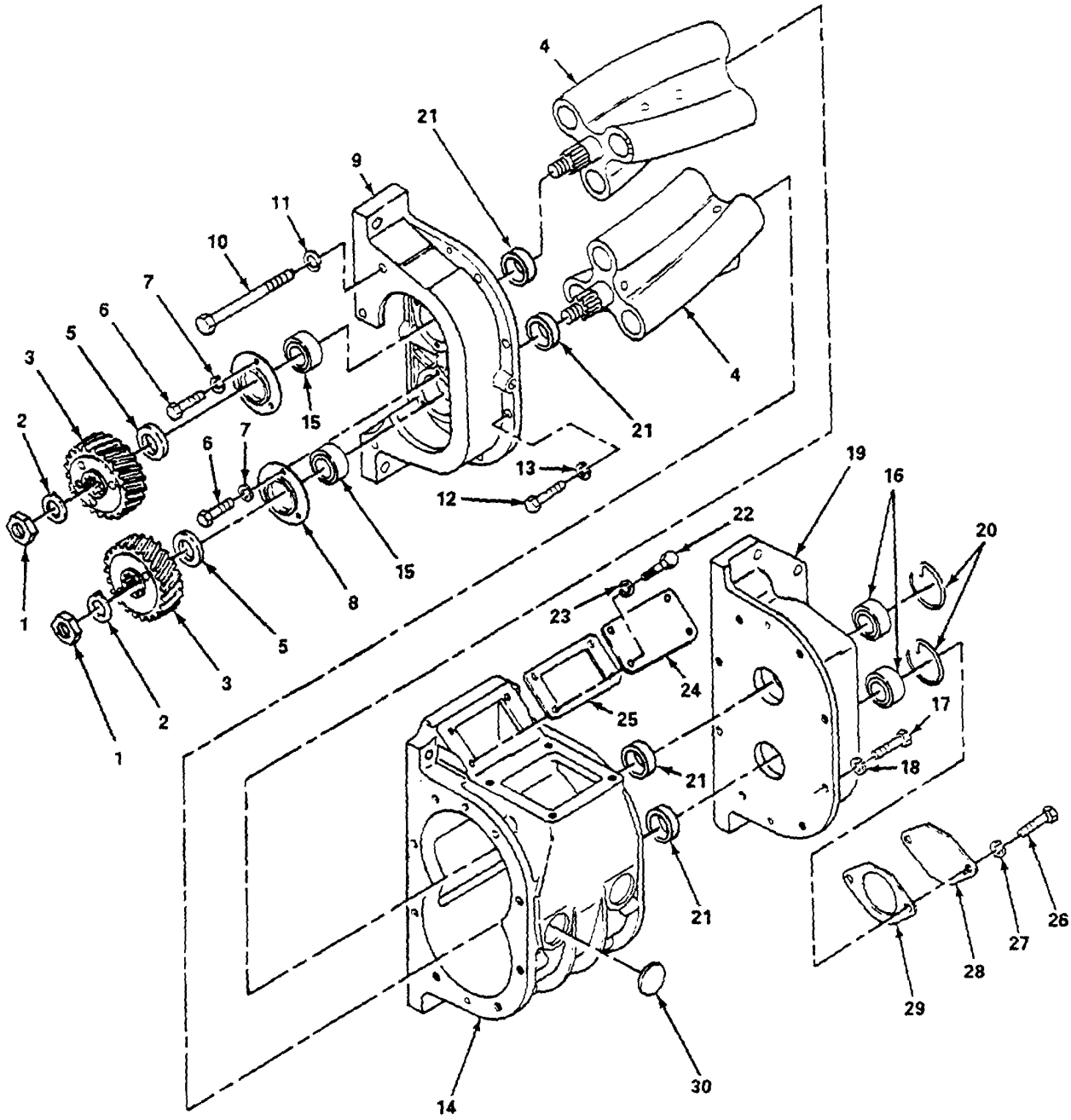


Figure 5-10. Blower Assembly, Disassemble.

5-13. **Blower Assembly (Cont).**

- (n) Remove four bolts (22) and lockwashers (23) securing the air heater pad cover (24) and remove cover and gasket (25).
- (o) Remove two bolts (26) and lockwasher (27) securing rear end plate cover (28) and remove cover and gasket (29).
- (p) Remove two plugs (30) from blower housing.

**WARNING**

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

- (q) Clean all items, except bearing, with dry cleaning solvent and dry thoroughly.
  - (r) Inspect rotor shaft oil seal (21) and replace if rough or hard or otherwise damaged.
  - (s) Inspect bearings (15) and (16) for any corrosion or pitting and replace if worn or otherwise damaged.
  - (t) Inspect rotor shafts (4) serrations for wear, burrs or peening and replace if scored, worn, or otherwise damaged.
  - (u) Inspect housing (14) and end plates (9) and (19) for scoring or burred and replace if cracked or otherwise damaged.
  - (v) Inspect gears (3) and replace if worn, teeth chipped or otherwise damaged.
- (2) *Assemble.* (figure 5-11)
- (a) Install rear end plate cover (1) and gasket (2) and secure with two bolts (3) and lockwashers (4).
  - (b) Install air heater pad cover (5) and gasket (6) and secure with four bolts (7) and lockwashers (8).
  - (c) Press oil seals (9) in end plates (10) and (11).
  - (d) Install rear end plate (11) on housing (12) and secure with five bolts (13) and lockwashers (14). Torque bolts to 13-17 lb-ft (18-23 Nm).

**CAUTION**

**Care must be taken when installing rotor shaft not to damage oil seals.**

- (e) Install oil seal pilot on short end of rotor shaft and install rotor shafts (15) simultaneously through oil seals (9) and into rear end plate (11). Then remove oil seal pilot.
- (f) Install oil seal pilot on end of rotor shaft and then install front end plate (10) on housing (12) and secure with four bolts (16) and lockwashers (17). Torque bolts to 13-17 lb-ft (18-23 Nm). Remove oil seal pilot.
- (g) Install one long bolt (18) and lockwasher (19). Torque bolt to 13-17 lb-ft (18-23 Nm).

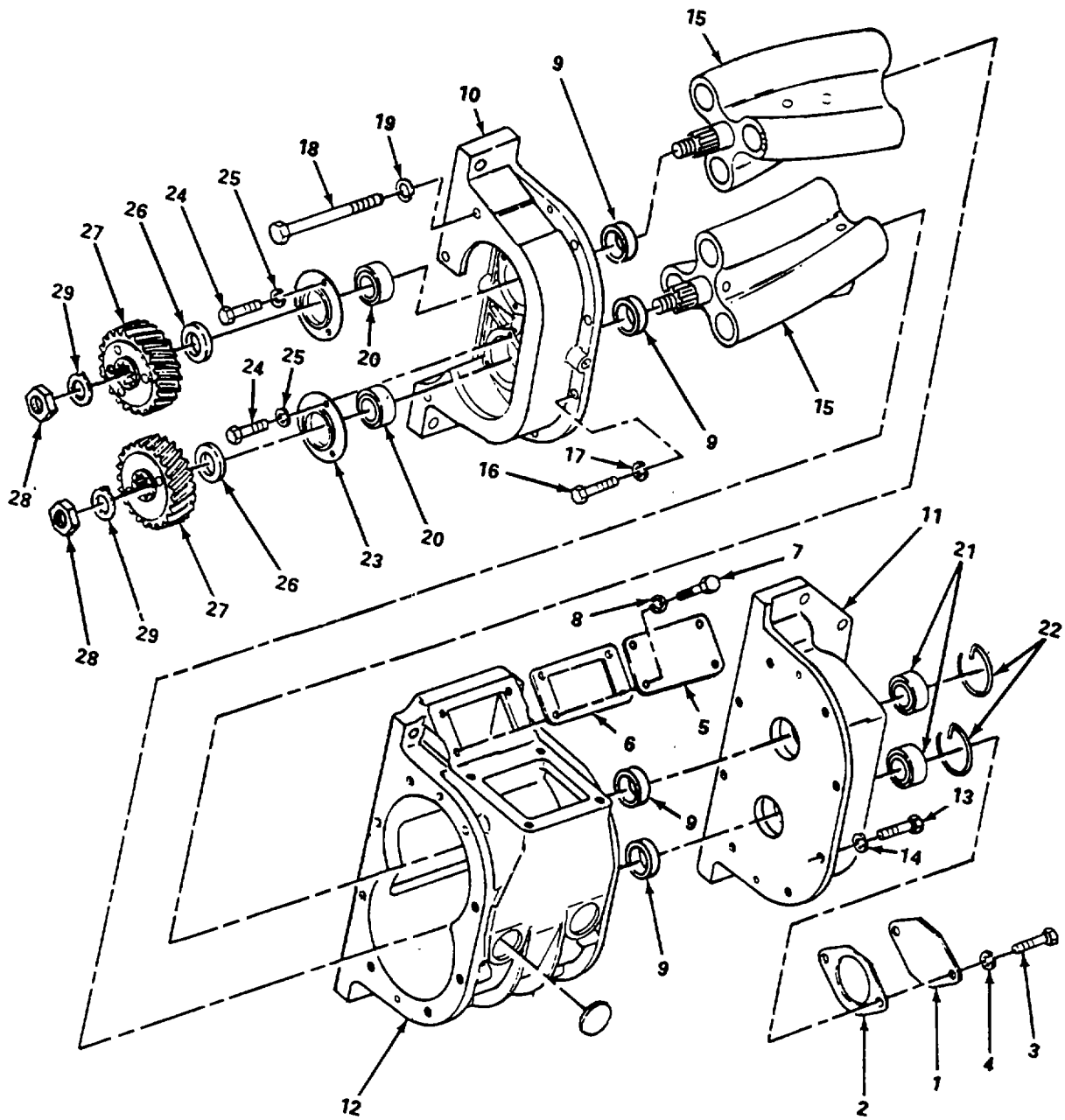


Figure 5-11. Blower Assembly, Assemble.

**5-13. Blower Assembly (Cont)**

- (h) Place grease on bearings (20) and (21).
- (i) Using bearing installer, install bearings (21) over rear end of rotor shaft and into rear end plate (11).
- (j) Install bearing retaining rings (22) in rear end plate (11).
- (k) Using bearing installer, install bearings (20) over front end of rotor shaft and into front end plate (10).
- (l) Install bearing retainers (23) and secure with six screws (24) and lockwashers (25).
- (m) Install clean folded towel between the rotors and a towel between rotor and the housing to prevent the rotors from turning.
- (n) Install shims (26) and two rotor timing gears (27) simultaneously on rotor shafts (15) and secure with two timing gear retaining nuts (28) and lockwashers (29). Torque nuts to 60-80 lb-ft (81-108 Nm).
- (o) Remove towels from rotor and housing.
- (p) Aline blower assembly as follows (figure 5-12):

**NOTE**

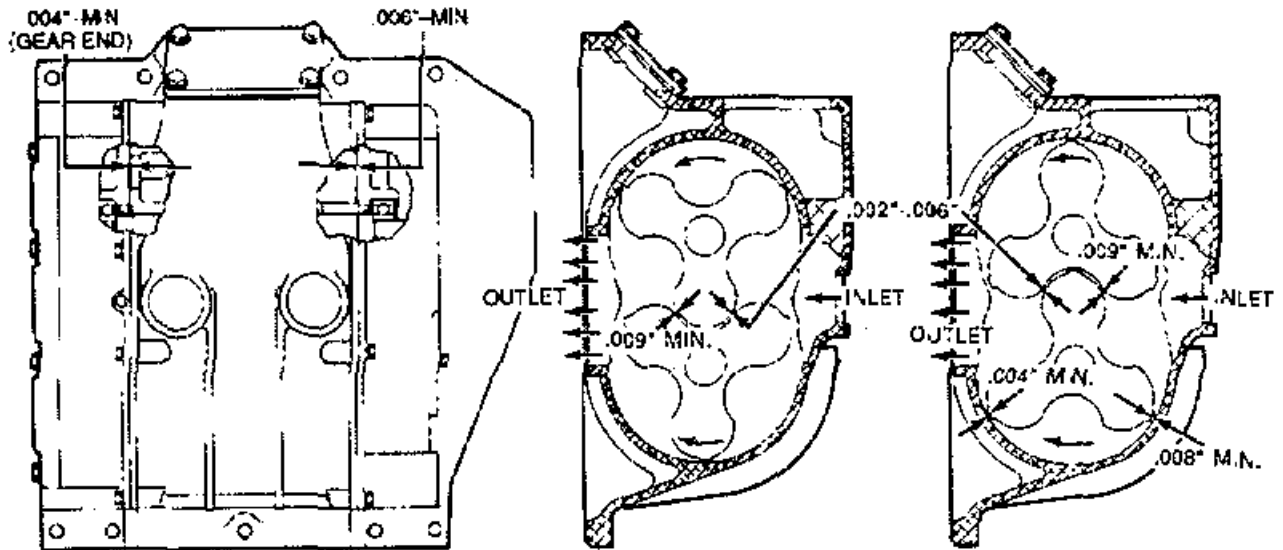
**When measuring clearances of more than .005 in. (.012 cm), laminated feeler gages that are made up of .002 in. (.005 cm), .003 in. (.007 cm) or .005 in. (.012 cm) are more practical and suitable than a single feeler gage.**

- 1 Using feeler gages, check clearances between rotor lobes from both inlet and outlet side of blower as follows:

**NOTE**

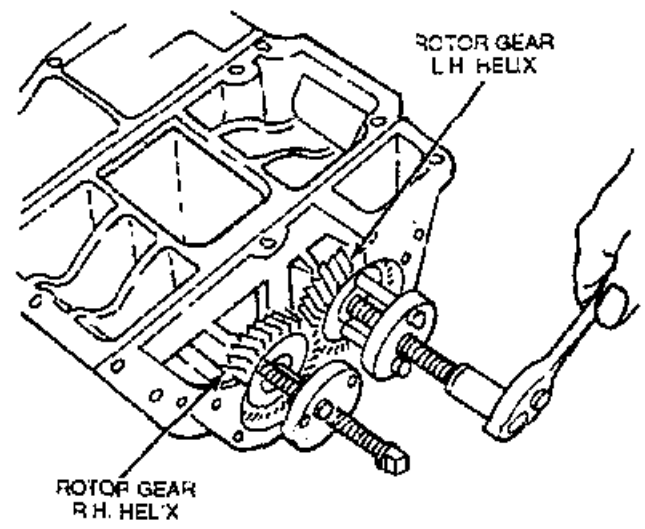
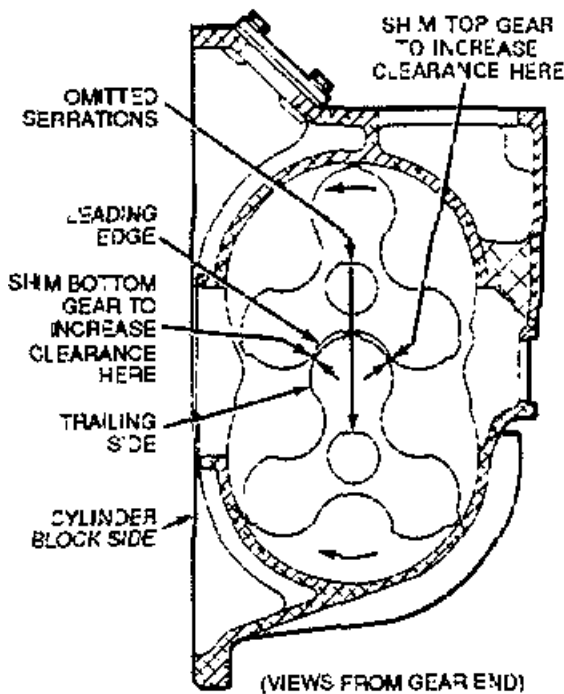
**If more or less shims are required, both gears must be removed from rotors. Placing a .003 inch shim in back rotor gear will revolve rotor .001 in. (.002 cm).**

- a The clearance between the leading edge of the upper rotor lobe and trailing edge lobe of the lower rotor lobe should be between .002--.006 in. (.005-.015 cm), add shims on rotor shaft between gears and bearings.
  - b The clearance between trailing edge of upper and leading edge of lower rotor should be a minimum clearance of .009 in. (.023 cm). If the clearance is not a minimum of .009 in. (.023 cm), add shims on rotor shaft between gear and bearings.
- 2 Recheck the clearances between the rotor lobes.
  - 3 Check clearance between the end of each rotor lobe and the end plate, twelve measurements in all. Refer to figure 5-12 for the minimum clearance.
  - 4 Check clearance between each rotor lobe and the blower housing at both inlet and outlet side, twelve measurements in all. Refer to figure 5-12 for the minimum clearance.
  - 5 Install two new plugs in blower housing rotor adjusting holes



NOTE: TIME ROTORS TO DIMENSIONS SHOWN FOR CLEARANCE BETWEEN LEADING SIDE OF UPPER ROTOR AND TRAILING SIDE OF LOWER ROTOR (.002 TO .008) AT CLOSEST POINT FROM BOTH OUTLET AND INLET SIDES OF BLOWER.

**ROTOR LOBE CLEARANCES**



**MEASURING END CLEARANCE BETWEEN BLOWER ROTORS AND END PLATE**

**DIAGRAM SHOWING PROPER LOCATION OF SHIMS FOR CORRECT ROTOR LUBE CLEARANCES**

Figure 5-12. Blower Assembly, Aline.

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**5-14. Starter.**

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**This task covers:****Repair**

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**INITIAL SETUP:***Tools*

General Mechanic's Tool Kit  
(NSN 5180-00-177-7033)  
Pliers, Retaining Ring Set  
(NSN 5120-00-789-0492)

*Equipment Condition*

Starter removed (para. 3-31).

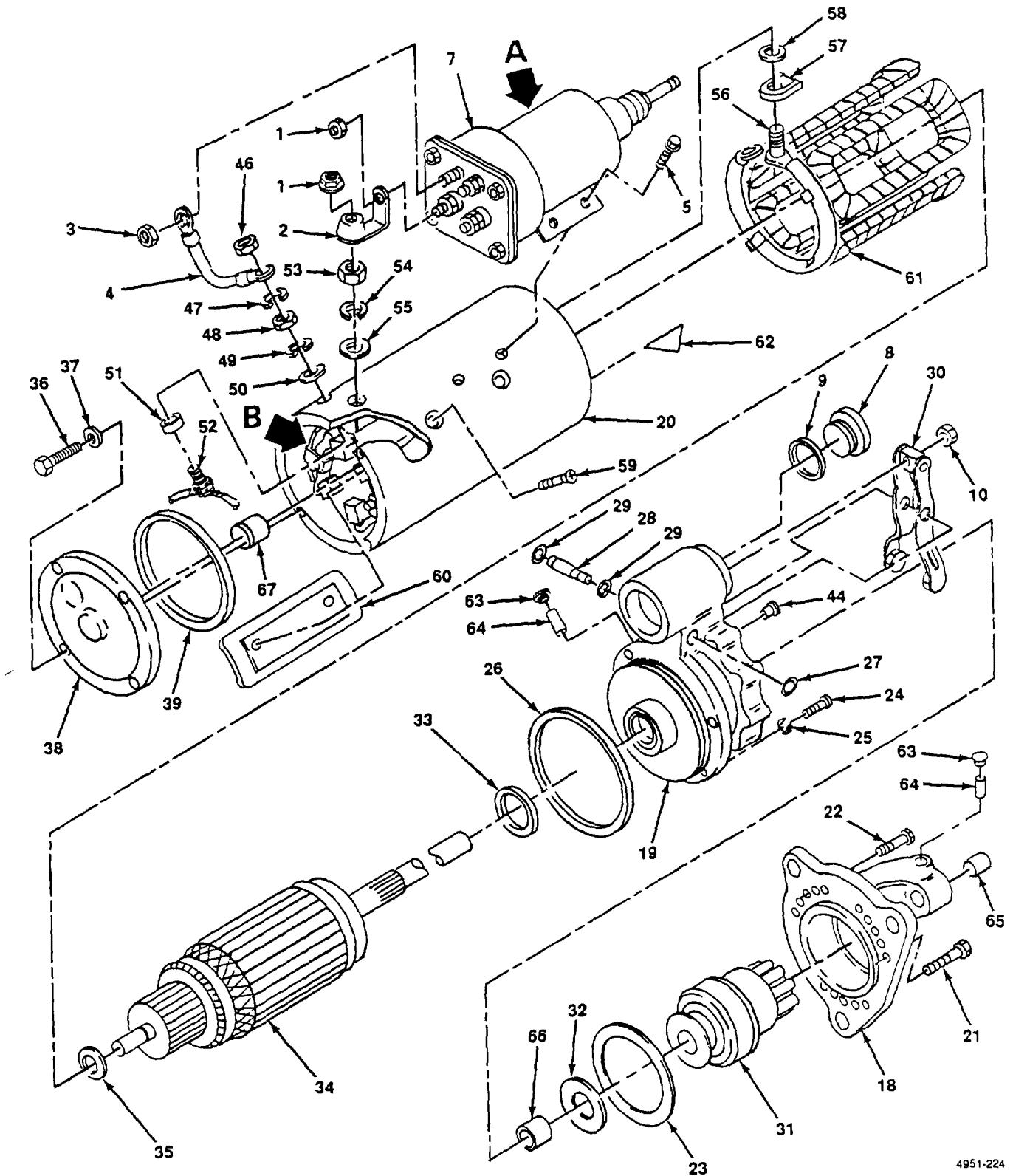
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*Repair.*

(1) *Disassemble.* (figure 5-13)

- (a) Remove two nuts (1) and remove connector (2).
- (b) Loosen nut (3) and remove lead (4).
- (c) Remove four screws (5) and bracket (6) and remove solenoid (7).
- (d) Remove plug (8) and gasket (9).
- (e) Remove nut (10) and remove plunger (11), washer (12), boot (13), retainer (14), spring (15), retainer (16), and snap ring (17) as an assembly.
- (f) Remove snap ring (17), and remove retainer (16), spring (15), retainer (14), boot (13), and washer (12) from plunger (11).
- (g) Mark housing drive (18), lever housing (19), and body (20).
- (h) Remove five long screws (21) and one short screw (22) and remove housing drive (18) and gasket (23).
- (i) Remove five screws (24) and lockwasher (25) and remove housing (19) and O-ring (26).
- (j) Remove snap ring (27), pin (28), two O-rings (29), lever (30), driver assembly (31), and drive washer (32).
- (k) Remove washer (33).
- (l) Remove armature (34) and washer (35) from body (20).
- (m) Remove four screws (36) and lockwashers (37) and remove cover (38) and O-ring (39).
- (n) Remove pin (40) securing brushes (41) and remove brush spring (42).
- (o) Remove pin (43) securing brushes (44) and remove brush spring (45).





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Figure 5-13. Starter, Disassemble (Sheet 1 of 2).

5-14. Starter (Cont).

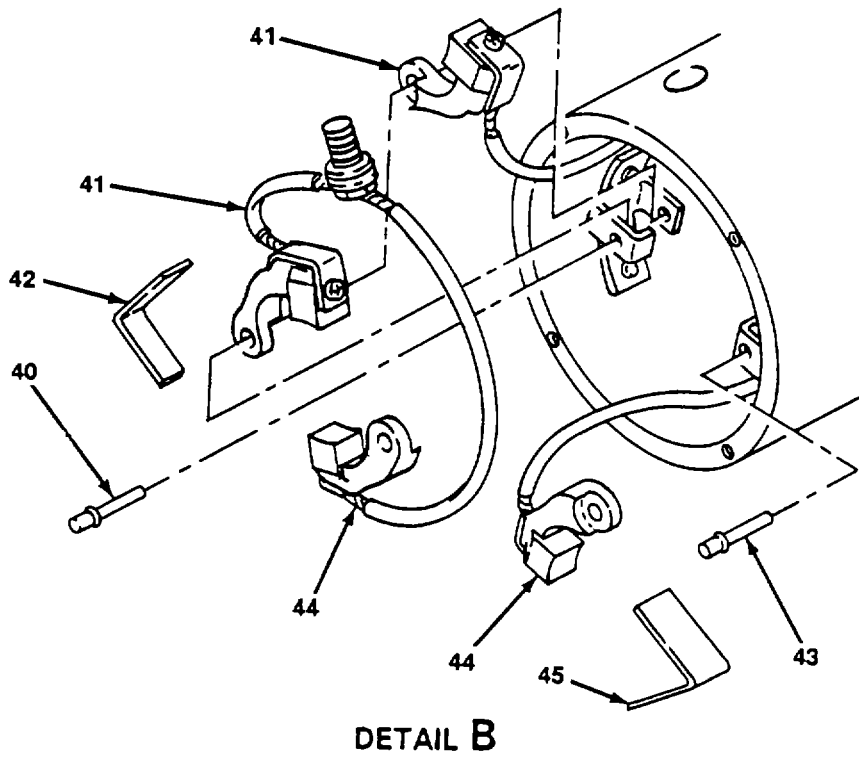
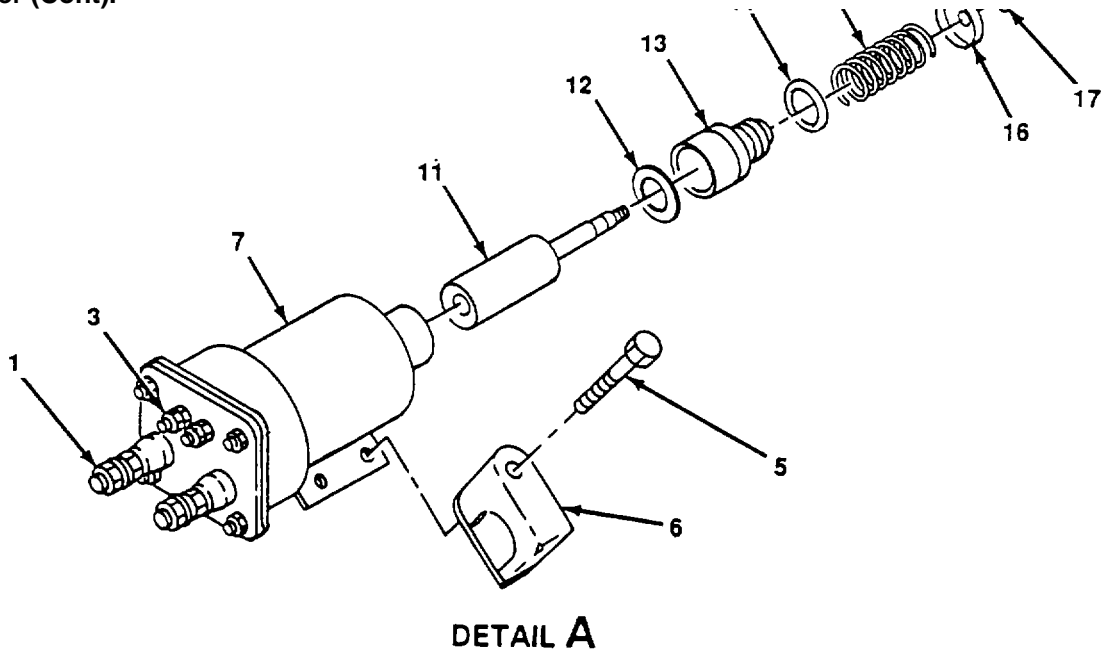


Figure 5-13. Starter, Disassemble (Sheet 2 of 2).

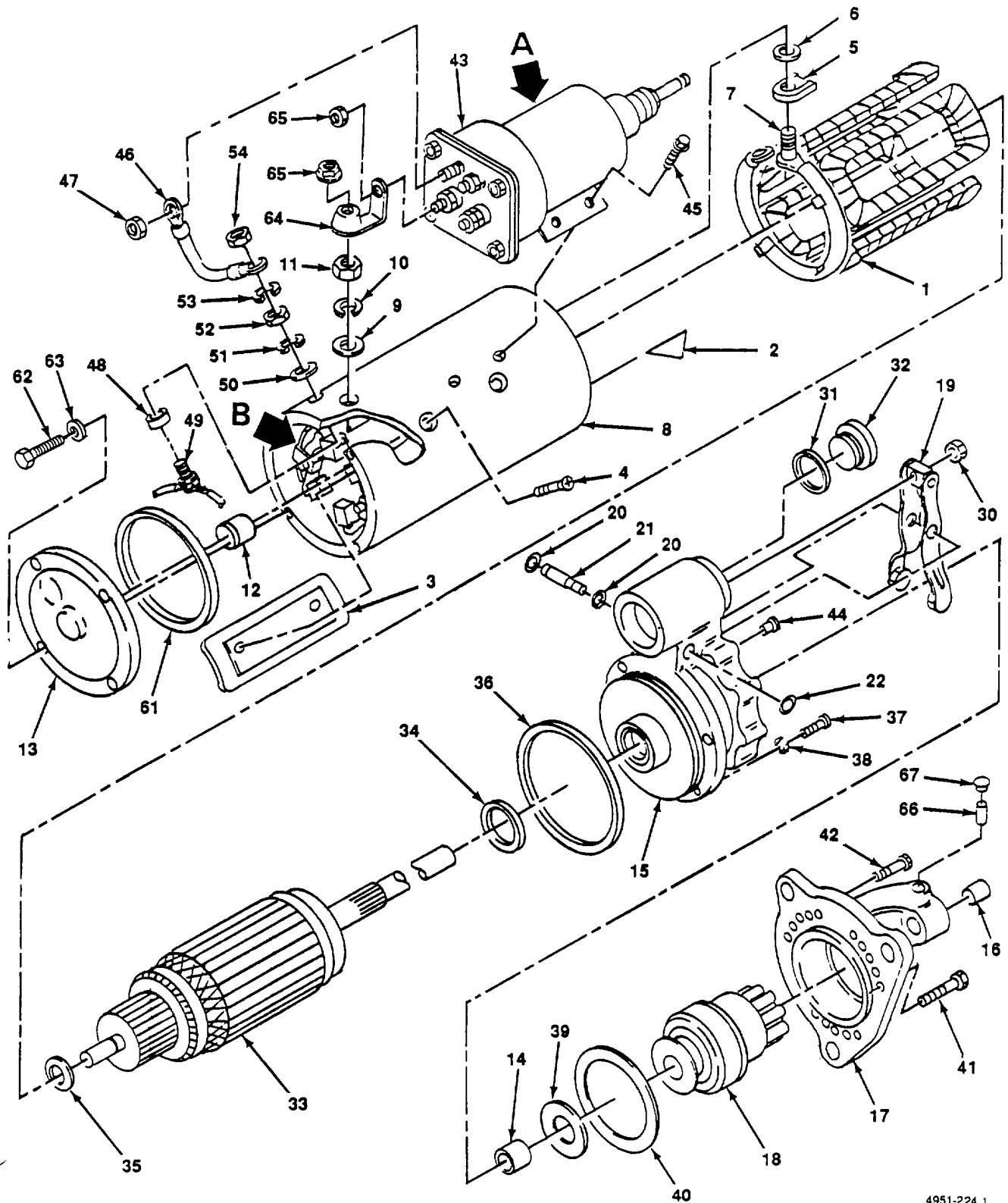
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Figure 5-13. Starter, Disassemble (Sheet 2 of 2).

- (p) Remove nut (46), lead (4), lockwasher (47), nut (48), washer (49), spacer (50), and remove plastic bushing (51) and lead (52) with brushes (41).
- (q) Inspect brushes (41) and replace if worn, cracked or otherwise damaged.
- (r) Remove nut (53), washer (54), and insulator (55) and push stud (56) into body (20) and remove insulator (57) and bushing (58).
- (s) Inspect brushes (44) and replace if worn, cracked or otherwise damaged.
- (t) Remove eight screws (59) and four pole shoes (60), and remove field coil (61) and insulating pad (62).
- (u) Remove brass plug (63) and lubricating wick (64) from housing drive (18).
- (v) Using punch, remove bushing (65).
- (w) Using punch, remove bushing (66).
- (x) Remove bushing (67) from cover (38).
- (y) Inspect body (20), housing drive (18), lever housing (19), and cover (38) and replace all items that are cracked or otherwise damaged.
- (z) Inspect armature (34) and replace if wires are burnt or armature (34) is otherwise damaged.
- (aa) Inspect drive (31) and replace if teeth are worn, chipped, missing or drive (31) is otherwise damaged.
- (ab) Inspect bushings (65), (66), and (67) and replace if cracked, worn, or otherwise damaged.
- (ac) Inspect lever (30) and replace if cracked, bent, or otherwise damaged.
- (ad) Inspect solenoid (7) and replace if damaged.
- (ae) Inspect plunger (11), washer (12), boot (13), retainer (14), spring (15), retainers (16), and snap ring (17) and replace any item that is bent, cracked, worn, or otherwise damaged.
- (af) Inspect pin (28) and replace if bent, worn, or otherwise damaged.

5-14. **Starter (Cont).**

- (2) *Assemble.* (figure 5-14)
- (a) Install field coil (1) and insulating pad (2) and secure with four pole shoes (3) and eight screws (4).
  - (b) Install insulator (5) and bushing (6) and insert stud (7) through body (8) and secure with insulator (9), washer (10), and nut (11).
  - (c) Install bushing (12) in cover (13).
  - (d) Install bushing (14) in lever housing (15).
  - (e) Install bushing (16) in housing drive (17).
  - (f) Install drive assembly (18) and lever (19) in housing drive (17), and secure with two O-rings (20), pin (21), and snap ring (22).
  - (g) Install washer (23), boot (24), retainer (25), spring (26), and retainer (27) on plunger (28) and secure with snap ring (29).
  - (h) Install plunger (28) in lever (19) and secure with nut (30).
  - (i) Install gasket (31) and plug (32).
  - (j) Install armature (33).
  - (k) Install seal (34) and washer (35).
  - (l) Install housing (15) as marked and O-ring (36) and secure with five screws (37) and lockwashers (38).
  - (m) Install brake washer (39), gasket (40), and housing drive (17) as marked, and secure with five long screws (41) and one short screw (42).
  - (n) Install solenoid (43) and bracket (44), and secure with four screws (45).
  - (o) Install lead (46) and tighten nut (47).
  - (p) Install spacer (48), lead (49), washer (50), lockwasher (51), and nut (52). Install lockwasher (53) and lead (46) and secure with nut (54).
  - (q) Install brush spring (55) and brushes (56) and secure with pin (57).
  - (r) Install brush spring (58) and brushes (59) and secure with pin (60).
  - (s) Install cover (13) and O-ring (61) and secure with four screws (62) and lockwasher (63).



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Figure 5-14. Starter, Assemble (Sheet 1 of 2).

5-14. Starter (Cont).

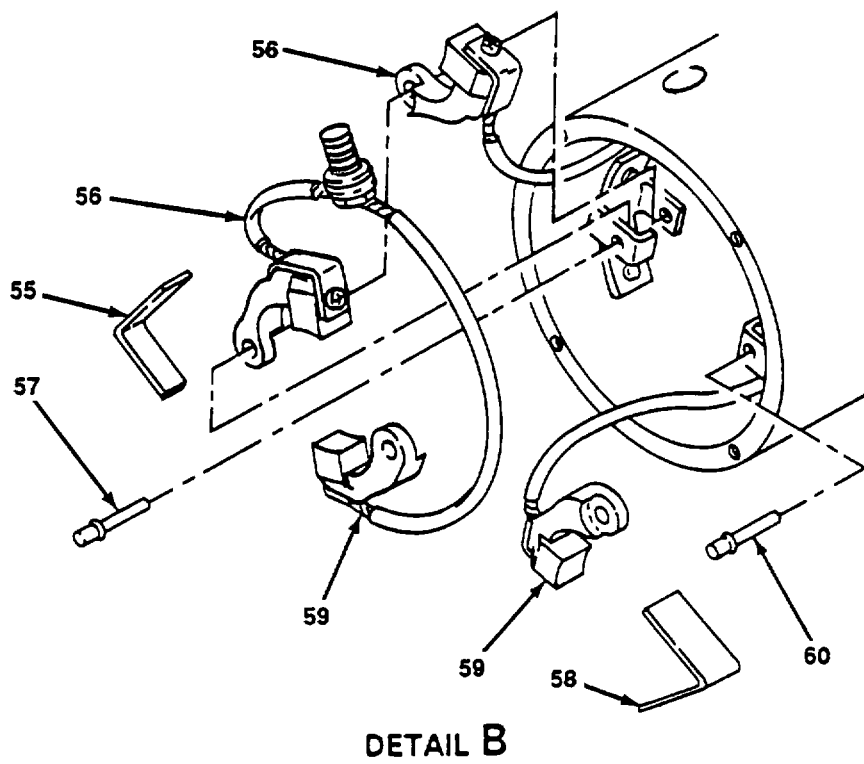
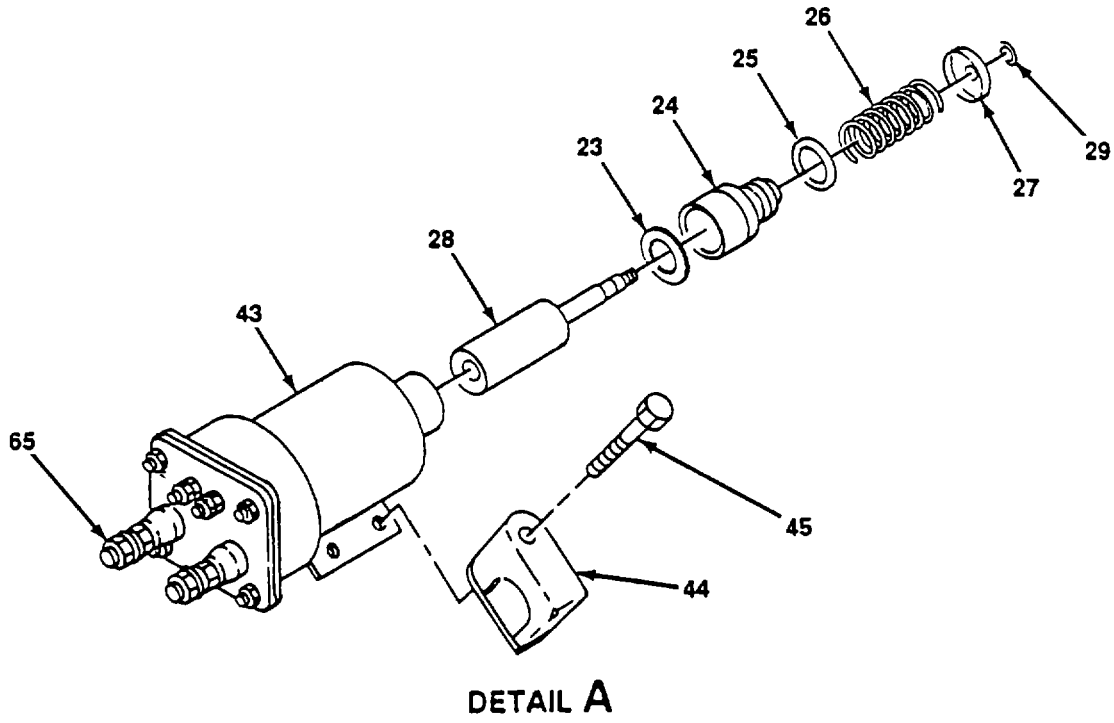


Figure 5-14. Starter, Assemble (Sheet 2 of 2).

- (t) Install connector (64) and secure with two nuts (65).
- (u) Install lubricating wick (66) and brass plug (67).

FOLLOW-ON MAINTENANCE  
Install starter (para. 3-31).

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**5-15. Battery Charging Alternator.**

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**This task covers:****Repair**

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**INITIAL SETUP:***Tools**Equipment Condition*

General Mechanic's Tool Kit (NSN 5180-00-177-7033) Alternator removed (para. 3-33).  
Puller Kit Mechanical (NSN 5120-00-033-5606)

---

*Repair.*

- (1) *Disassemble.* (figure 5-15).
  - (a) Hold pulley (1) and remove nut (2) and washer (3).
  - (b) Using puller, remove pulley (1).
  - (c) Remove fan (4) and outside collar (5).
  - (d) Remove four screws (6) and remove front housing (7).
  - (e) Tag and disconnect stator assembly leads and remove stator assembly (8).
  - (f) Remove rotor assembly (9).
  - (g) Remove screw (10) and tag and remove capacitor lead (11).
  - (h) Remove screw (12) and remove capacitor (13).
  - (i) Remove three nuts (14) and remove diode set (15).
  - (j) Remove two screws (16) and remove rectifier bridge (17).
  - (k) Remove two screws (18) and tag and disconnect lead (19).
  - (l) Remove screw (20) and remove brush and holder (21).
  - (m) Remove two screws (22) and remove regulator (23) and lead (19).
  - (n) Remove nut (24), washer (25), insulator (26), spacer (27), spacer (28), and stud (29) from housing (30).
  - (o) Press bearing (31) out of housing (30).
  - (p) Remove three screws (32) and remove bearing retainer (33).



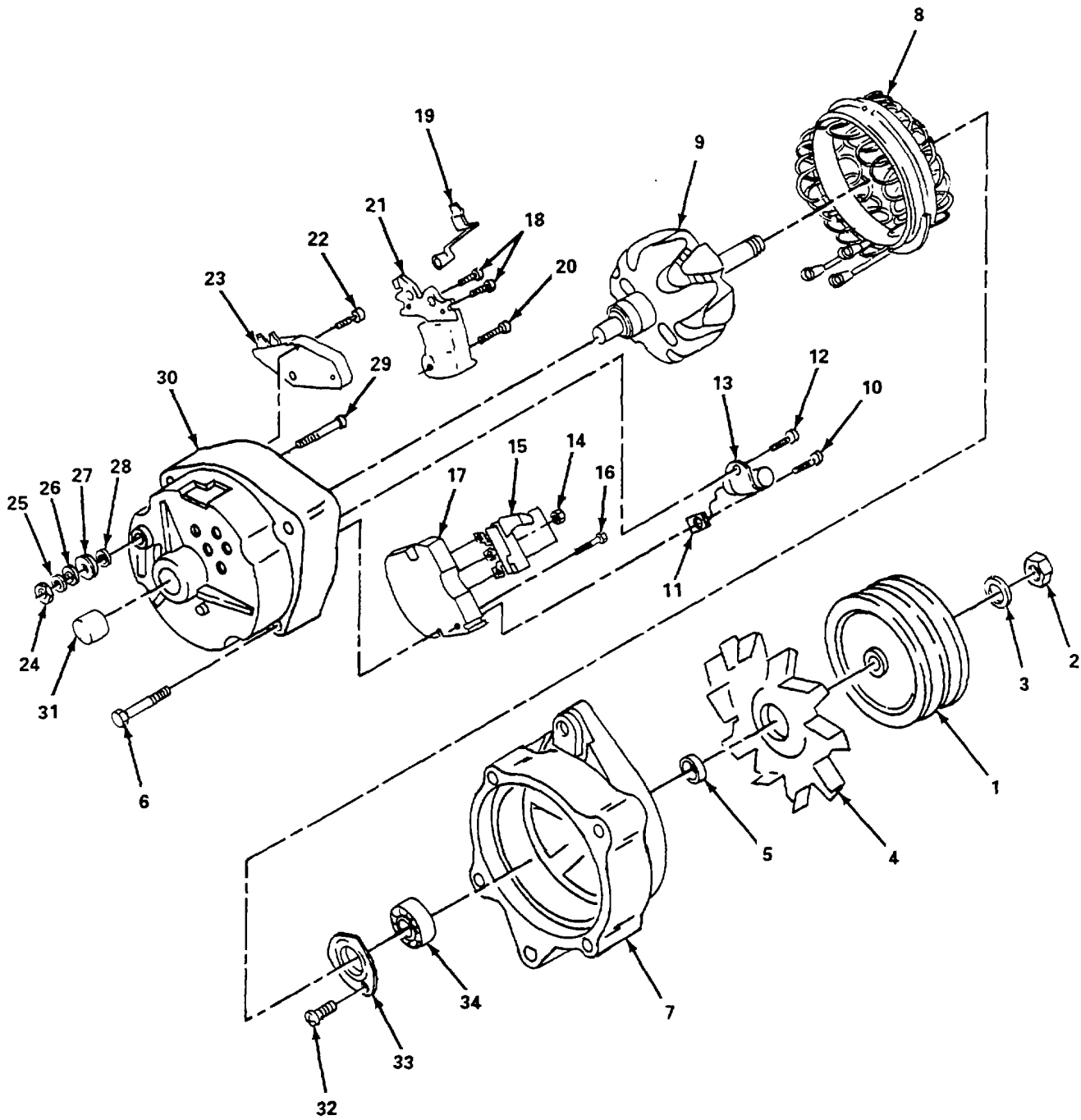


Figure 5-15. Battery Charging Alternator, Disassemble.

4951-225

**5-15. Battery Charging Alternator (Cont).**

- (q) Press bearing (34) out of front housing (7).
  - (r) Inspect housing (30) and front housing (7) and replace entire alternator if either housing is cracked or otherwise damaged.
  - (s) Inspect stator assembly (8) and replace if wiring is burnt or stator assembly (8) is otherwise damaged.
  - (t) Inspect rotor assembly (9) and replace if wiring is burnt or rotor assembly is otherwise damaged.
  - (u) Inspect capacitor (13), diode set (15), rectifier bridge (17), brush and holder (21), and regulator (23) and replace any item that has signs of burnt wires, body is cracked, or item is otherwise damaged.
  - (v) Inspect bearing (31) and replace if worn or otherwise damaged.
  - (w) Inspect bearing (32) and replace if worn or otherwise damaged.
  - (x) Inspect fan (4) and pulley (1), and replace any item that is bent, cracked or otherwise damaged.
  - (y) Inspect stud (29), spacer (28), spacer (27), insulator (26), washer (25), and nut (24) and replace all items if any one is cracked, worn, stripped or otherwise damaged.
- (2) *Assemble.* (figure 5-16)
- (a) Press bearing (1) into front housing (2) and install bearing retainer (3) and secure with three screws (4).
  - (b) Press bearing (5) into housing (6).
  - (c) Install stud (8) in housing (6) and secure with spacer (7), spacer (9), insulator (10), washer (11), and nut (12).
  - (d) Install regulator (13) and lead (14) and secure with two screws (15).
  - (e) Install brush and holder (16) and secure with screw (17).
  - (f) Install lead (14) as tagged and install two screws (18).
  - (g) Install rectifier bridge (19) and secure with two screws (20).
  - (h) Install diode set (21) and secure with three nuts (22).
  - (i) Install capacitor (23) and secure with screw (24).
  - (j) Install capacitor lead (25) and secure with screw (26).
  - (k) Install rotor assembly (27).

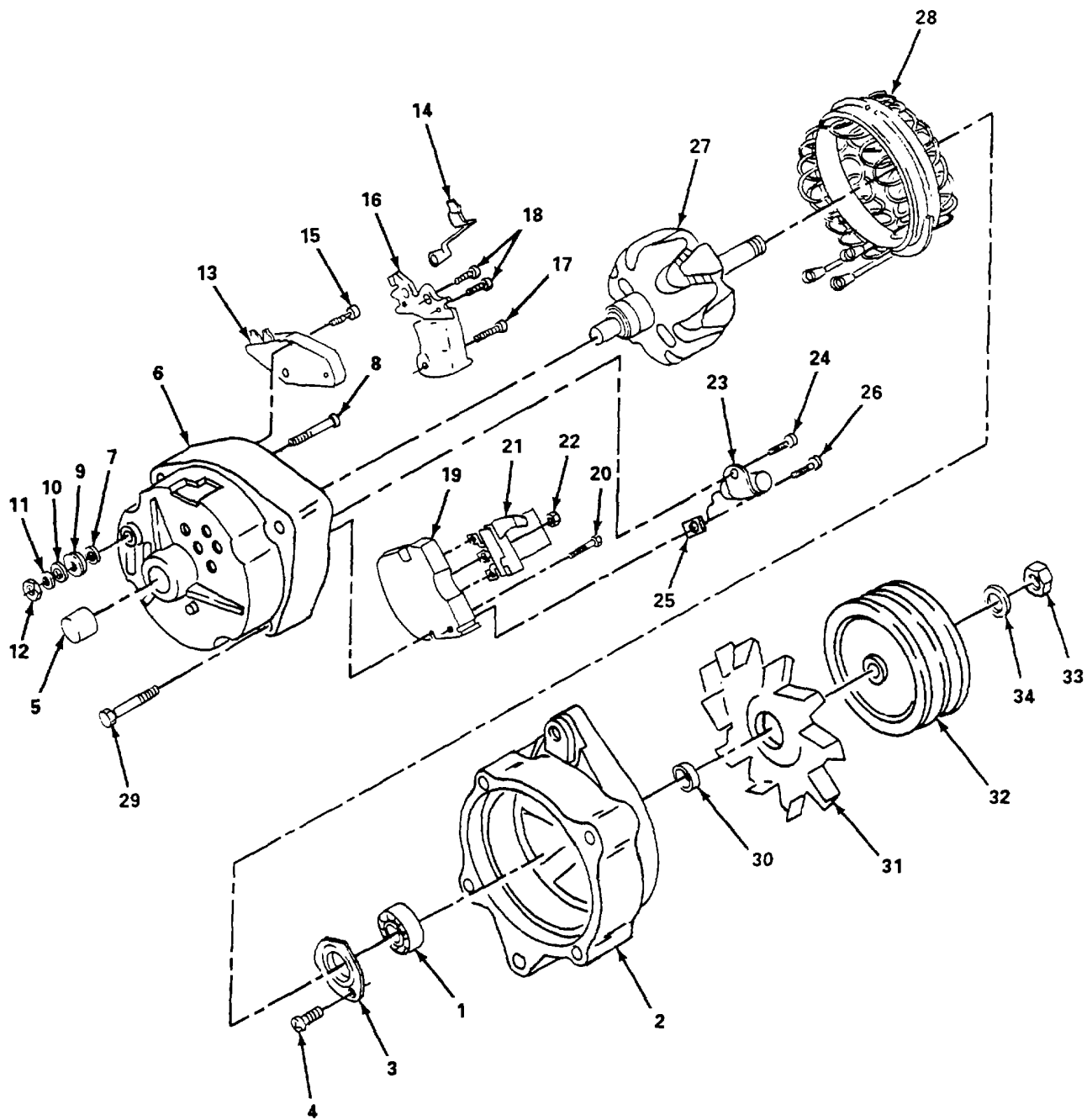


Figure 5-16. Battery Charging Alternator, Assemble.

4951-225.1

- (l) Install stator assembly (28) and connect stator assembly leads as tagged.
- (m) Install front housing (2) and secure with four screws (29).
- (n) Install outside collar (30), fan (31), and pulley (32) and secure with nut (33) and washer (34).

FOLLOW-ON MAINTENANCE

Install battery charging alternator (para. 3-33)

## 5-16. Oil Pump.

**This task covers:****Repair****INITIAL SETUP***Tools**Equipment Condition*

General Mechanic's Tool Kit (NSN 5180-00-177-7033) Oil pump removed (para. 4-16).

Caliper Set, Micrometer Outside

(NSN 5210-00-554-7134)

Puller, Gear, 3 Jaw (NSN 5120-00-516-3120)

Wrench, Torque (NSN 512-00-554-7292)

*Materials/Parts*

Solvent, Dry Cleaning (Item 23, Appendix D)

Rags, Wiping (Item 21, Appendix D)

Lubricating Oil (Item 18, Appendix D)

Repair. (figure 5-17)

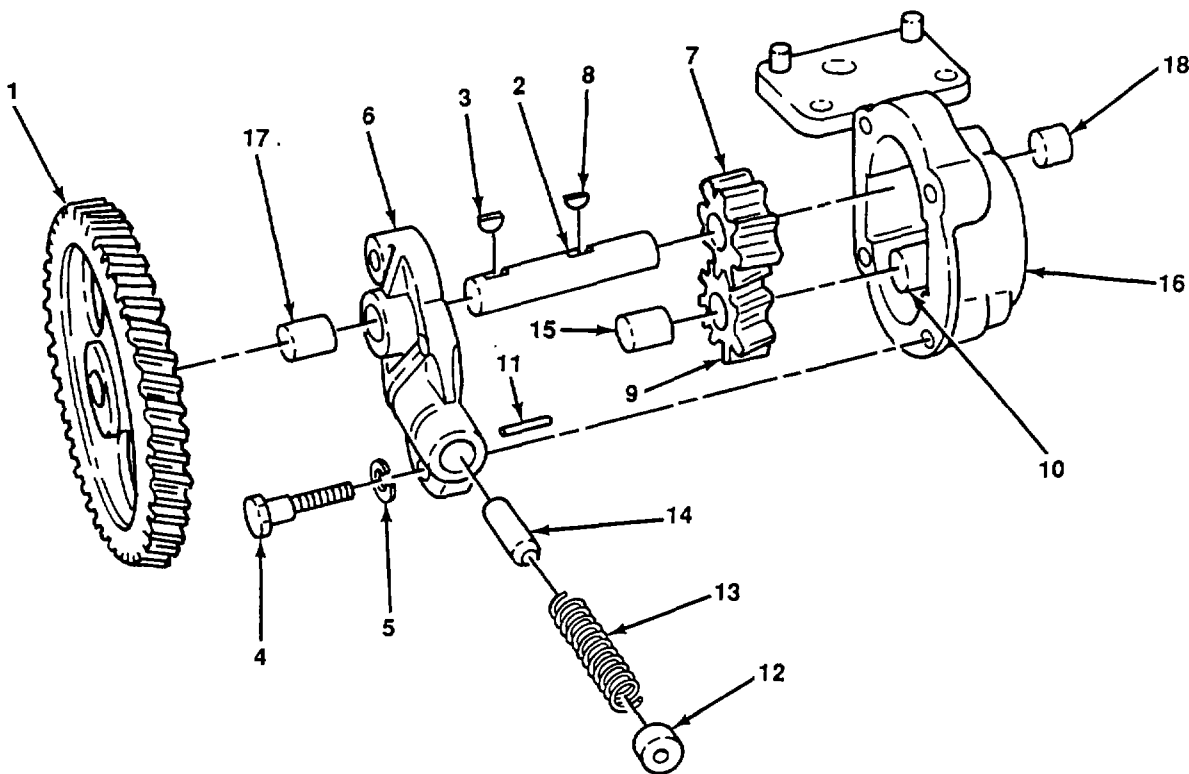
- (1) Using puller, remove gear (1) from shaft (2) and remove key (3).
- (2) Remove four screws (4), lockwashers (5), and remove cover (6).
- (3) Remove gear (7) and shaft (2) together.
- (4) Press gear (7) off shaft (2) and remove key (8).
- (5) Remove gear (9) from shaft (10).
- (6) Using punch, remove pin (11) half way, apply pressure to cup (12) and remove pin (11), release pressure slowly and remove cup (12), spring (13), and valve (14).

**WARNING**

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

- (7) Clean all parts with dry cleaning solvent, and dry thoroughly.
- (8) Inspect gears (7) and (9) and replace if teeth are missing, damaged or bushing (15) is excessively worn. The diameter of bushing (15) should be .6245-.6255 in. (1.5300-1.5324 cm).
- (9) Inspect cover (6) and replace if bushing (17) is excessively worn or cover (6) is cracked. The inside diameter of bushing should be .6268-.6278 in. (1.5920-1.5946 cm).
- (10) Inspect body (16) and replace if body is cracked or bushing (18) is excessively worn. The inside diameter of bushing should be .6213-.6225 in. (1.5221-1.5251 cm).

- (11) Inspect shaft (2) and replace if worn or otherwise damaged. The diameter of shaft (2) should be .6200-.6205 (1.5748-1.5761 cm) at body end, and .6253-.6258 in. (1.5982-1.5946 cm) at cover end.
- (12) Inspect valve (14), spring (13), and cup (12) and replace any item that is cracked, worn or otherwise damaged. Ensure valve (14) moves freely in pump cover (6).
- (13) Install valve (14), spring (13), and cup (12). Apply pressure to cup (12) and install pin (11).
- (14) Lubricate inside diameter of gear (9) and install gear (9).
- (15) Install key (8) in shaft (2). Lubricate outside diameter of shaft (2), and press shaft (2), small diameter end first, into gear (7) until forward face of gear is 1.433-1.443 in. (3.639-3.665 cm) from large diameter end of shaft (2).
- (16) Lubricate shaft (2) and install shaft (2).
- (17) Install cover (6) and secure with four screws (4) and lockwashers (5). Torque screws to 13-17 lb-ft (18-23 Nm).
- (18) Rotate shaft (2) and ensure shaft turns freely. If shaft does not turn freely, loosen four screws (4) slightly, tap body (16) lightly and retorque screws.
- (19) Install key (3) and press gear (1) onto shaft (2) until end of shaft (2) is flush with face of gear (1). Recheck pump for freeness.



4951-191

Figure 5-17. Oil Pump, Repair.

FOLLOW-ON MAINTENANCE  
Install oil pump (para. 4-16).

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**5-17. Oil Cooler By-Pass Valve.**

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**This task covers:****Repair**

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**INITIAL SETUP***Tools**Equipment Condition*

General Mechanic's Tool Kit (NSN 5180-00-177-7033) Oil cooler by-pass valve removed (para.4-18).

*Materials/Parts*

Solvent, Dry Cleaning (Item 23, Appendix D)

Rags, Wiping (Item 21, Appendix D)

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*Repair.* (figure 5-18)

- (1) Remove plug (1) and remove spring (2) and ball (3).

**WARNING**

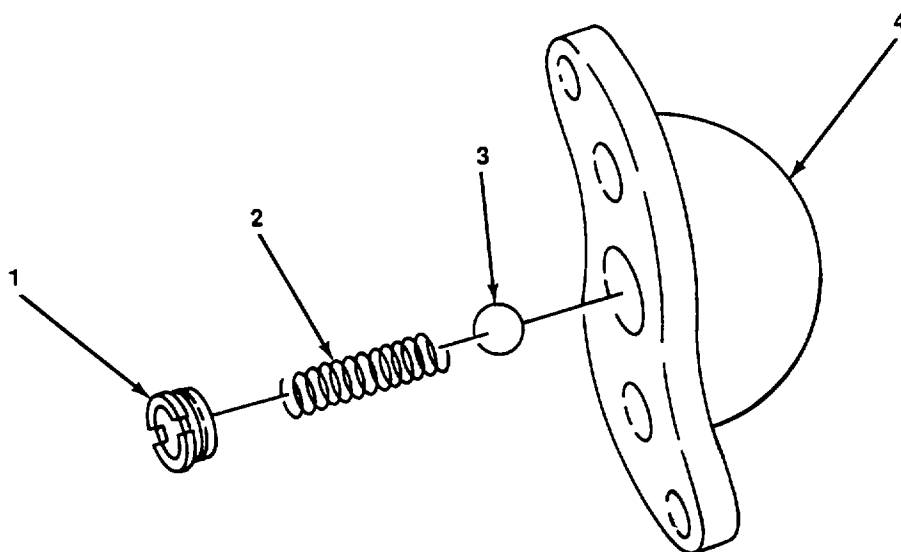
Dry cleaning solvent PD-680 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100-138°F (38-60°C).

- (2) Clean all items with dry cleaning solvent and dry thoroughly.
- (3) Inspect housing (4) and replace if cracked or otherwise damaged.
- (4) Inspect spring (2) and replace if cracked or otherwise damaged.
- (5) Inspect ball (3) and replace if scored, pitted, or otherwise damaged.
- (6) Inspect plug (1) and replace if threads are stripped.

**NOTE**

The plug should be flush with a slightly below face of housing when fully seated.

- (7) Install ball (3), and spring (2) and secure with plug (1).



**Figure 5-18. Oil Cooler By-Pass Valve, Repair.**

4951-154

FOLLOW-ON MAINTENANCE  
Install oil cooler by-pass valve (para. 4-18).



## 5-18. Exhaust Valve.

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**This task covers:**

**Replace**

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**INITIAL SETUP***Tools*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)  
 Compressor, Valve Spring (PN J 7455)  
 Remover, Valve Guide (PN J 267)  
 Installer, Valve Guide (PN J 9530)  
 Remover, Valve Seat Insert (PN J 4824-03)  
 Driver, Valve Seat Insert (PN J 1736)  
 Tester, Valve Spring (PN J 22738-02)  
 Cleaner, Valve Guide (PN J 5437)  
 Checking Gage, Valve Spring (PN J 25076-B)  
 Valve Seat Grinder (PN J 7040)  
 Spring Tester (PN J 9666)

*Materials/Parts*

Valve, Exhaust  
 Solvent, Dry Cleaning (Item 23, Appendix D)  
 Rags, Wiping (Item 21, Appendix D)

*Equipment Condition*

Cylinder head assembly removed (para. 5-19).

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Replace. (figure 5-19)

**NOTE**

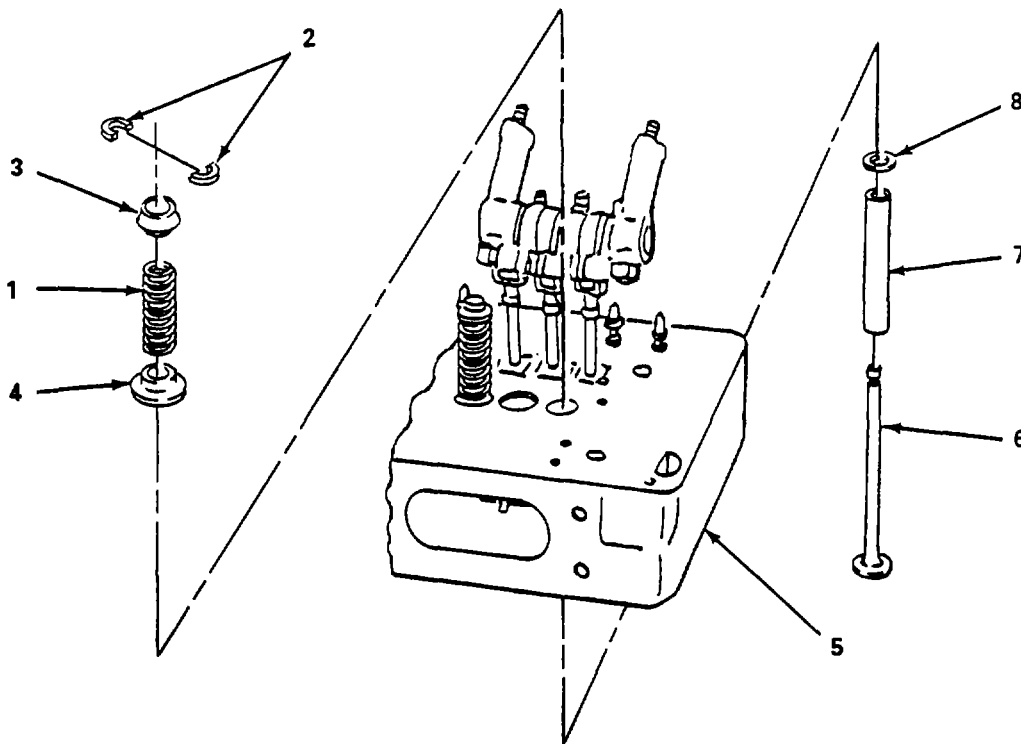
There are four exhaust valves. Replacement of each one is the same.

- (1) Using spring compressor, compress the spring (1) and remove the two-piece valve lock (2).
- (2) Release spring compressor and remove the valve spring cap (3), spring (1), and spring seat (4).
- (3) Turn the cylinder head (5) over and remove valve (6).
- (4) Using valve guide tool, remove the valve guide (7) out from the bottom of the cylinder head (5).
- (5) Using valve seat insert tool, remove valve seat insert (8) from cylinder head (5).

**WARNING**

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

- (6) Clean all items with dry cleaning solvent and dry thoroughly.
- (7) Check spring (1) using spring tester and replace when load of less than 25 lbs will compare it to a length of 2.20 in. (5.6 Nm).
- (8) Inspect spring (1) and replace if pitted or fractured coils.
- (9) Inspect spring seats (4) and cap (3) and replace if worn.
- (10) Inspect valve (6) and replace if valve face has ridges, cracks or is pitted.



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**Figure 5-19. Exhaust Valve, Replace.**

**NOTE**

Inside diameter of new guide is .3445-.3455 in. (.8750-.8775 cm) which produce a valve stem-to-guide clearance with valve of .002-.0038 in. (.005-.009 cm). Replace guide if clearance exceeds .006 in. (.001 cm).

- (11) Clean inside diameter of exhaust valve with valve guide cleaner.
- (12) Inspect valve guide (7) and replace if fractured, chipped, scored or worn.

**NOTE**

The proper angle for the seating face of the valve is  $30^\circ$  and the insert is  $31^\circ$ .

- (13) Inspect valve seat insert (8) and replace if pitted, cracked, worn or an improper seat angle.

**NOTE**

Counterbores have a diameter of 1.626-1.627 in. (4.130-4.132 cm) and a depth of .372-.383 in. (.944-.972 cm). Counterbores must be concentric with the valve guides within .003 in. (.007 cm) total indicator reading.

- (14) Using insert driver, press valve seat insert (8) into cylinder head (5).

**NOTE**

Use care not to bend valve guides during installation. Do not use valve guides as a means of turning the cylinder head over or in handling the cylinder head. (15) Using guide installer, press valve guide (7) into cylinder head (5).

- (16) Install valves (6) into valve guide (7).
- (17) Hold valves in place with a strip of masking tape and turn cylinder head right side up.
- (18) Install spring seat (4), spring (1) and spring cap (3).
- (19) Using spring compressor, compress the spring (1) and install the two-piece valve lock (2).

**NOTE**

Minimum pressure required to start to open the exhaust valve must not be less than 15 pounds.

- (20) Using spring checking gage, note gage reading the moment the exhaust valve starts to open. If reading is less than 15 pounds, replace valve springs (1).

**FOLLOW-ON MAINTENANCE**

Install cylinder head assembly (para. 5-19).

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**5-19. Cylinder Head.**


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**This task covers:****Replace****INITIAL SETUP***Tools*

General Mechanic's Tool Kit  
(NSN 5180-00-177-7033)  
Wrench, Torque (NSN 5120-00-554-7292)  
Sled Gage (PN J 22273-01)  
Injector Tube Kit (PN J 22525)  
Magnetic Crack Detector (NSN 6635-01-128-2676)  
Wrench, Torque (NSN 5120-00-554-7292)

*Equipment Condition*

Upper water connection removed (para. 3-20).  
Injector control removed (para. 4-9)  
Injectors removed (para. 4-9)  
Governor removed (para. 4-11)

*Materials/Parts*

Cylinder Head  
Lifting Bracket Gasket  
Tape, Teflon (Item 25, Appendix D)  
Oil Seal Gasket  
Cylinder Head Gasket

---

a. Remove. (figure 5-20)

- (1) Loosen fitting nut (1) and remove temperature sensor (2).
- (2) Loosen fitting nut (3) and remove fuel line (4).
- (3) Loosen two fitting nuts (5) and remove line (6).
- (4) Remove two bolts (7) and lockwashers (8) and remove upper valve operating mechanism (9) and three push rod seats (10).
- (5) Remove two bolts (11) and washers (12) and remove upper valve operating mechanism (13) and three push rod seats (14).
- (6) Connect lifting device to lifting eyes (15).
- (7) Remove six bolts (16) and remove cylinder head (17), gasket (18), and oil seal gasket (19).
- (8) Remove three bolts (20) and lockwashers (21) and remove rear lifting bracket (22) and gasket (23).
- (9) Remove three bolts (24) and lockwashers (25) and remove thermostat housing assembly (26) and gasket (27).
- (10) Remove two elbows (28).
- (11) Remove two valve cover studs (29).

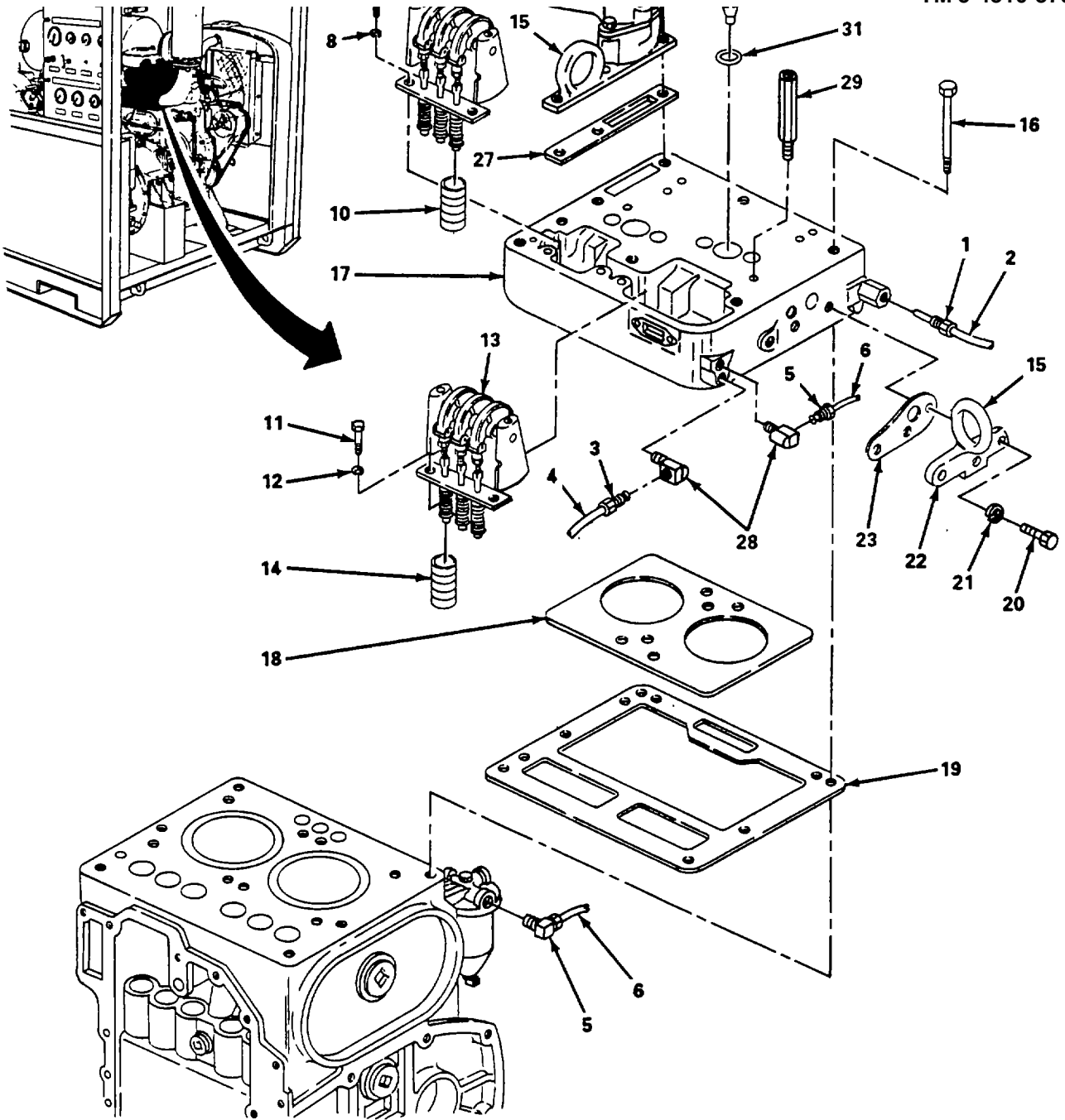


Figure 5-20. Cylinder Head, Remove.

Figure 5-20. Cylinder Head, Remove.

5-19. **Cylinder Head (Cont).**

- (12) Remove exhaust valves (para. 5-18).

**NOTE**

Cylinder head should be steam cleaned before any testing is performed.

- (13) The cylinder head (17) should be inspected and checked for cracks before it can be reused. A cylinder head which has cracks should not be reused. The cylinder head should be checked using the magnetic crack detector.
- (14) Perform pressure test on cylinder head (17) as follows:

**WARNING**

Do not perform pressure test of cylinder head that has cracks visible.

- (a) Close off water passages with steel plates and rubber gaskets and secure with bolts.
- (b) Install old or dummy fuel injectors in cylinder head (17) and secure with injector clamps and bolts. Torque bolts to 20-25 lb-ft (27-34 Nm).
- (c) Drill and tap one of the plates covering water passages for an air hose connection, and apply 40 psi (276 kPa) air pressure to water jacket.
- (d) Immerse the cylinder head in a tank of water heated to 180-200°F (82-93°C) for 20 minutes.
- (e) Leaks will be detected by air bubbles. Check for leaks at bottom and top of injector tubes, oil gallery, cylinder head stud holes, exhaust ports, and top, bottom, and sides of cylinder head.
- (f) Remove air pressure.
- (g) Dry cylinder head completely.
- (h) Remove plates and gaskets.
- (i) Remove fuel injectors.

(15) If leaks were present around injector tubes (30), replace them as follows:

- (a) Using injector tube service kit, remove injector tube (30) and seal (31).

**WARNING**

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

- (b) Clean out injector tube hole and dry thoroughly.
- (c) Inspect injector tube hole and replace head if cracks are present.
- (d) Lubricate seal (31) with engine oil and install in counter bore in cylinder head (17).
- (e) Using installers from injector tube service kit, install cylinder injector tube (30) in cylinder head (17).
- (f) Using upsetting die from injector tube service kit, flare bottom end of injector tube. Apply 30 lb-ft (41 Nm) of torque to upsetting die.
- (g) Using reamer from injector tube service set, ream injector tube (30) for injector nut and spray tip.
- (h) Using pilot cutting tool from injector tube service set, remove excess stock from injector tube (30) until it is from .000-.005 in. (.000-.013 cm) below the finished surface of the cylinder head (17).
- (i) Using reamer from injector tube service set, ream the bevel seat until gage is flush  $\pm$ .014 in. (.034 cm) from fire deck of cylinder head (17).

**WARNING**

Dry cleaning solvent PD-80 used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100-138°F (38-60°C).

- (j) Clean inside of injector tube (30) with dry cleaning solvent and dry thoroughly.
- (k) Inspect valve seats and valve guides (para. 5-18) and replace damage items.

5-19. **Cylinder Head (Cont).**b. *Install.* (figure 5-21)

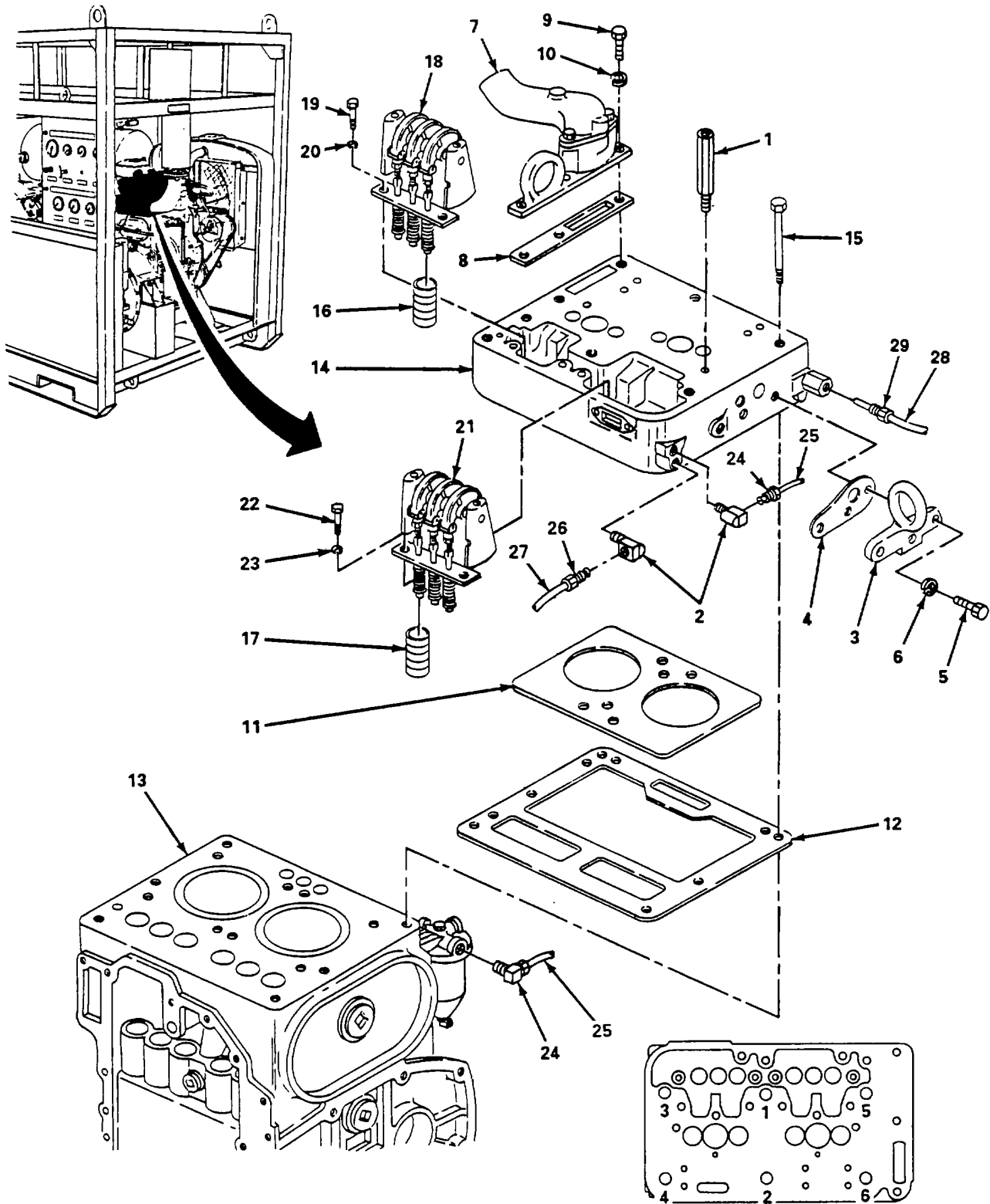
- (1) Ensure all gasket surfaces are clean and old gasket material removed.
- (2) Install exhaust valves (para. 5-18).
- (3) Install two valve cover studs (1).

**NOTE**

Leave 1 1/2 threads exposed when applying teflon tape. Wrap teflon tape in the direction that will not unwrap as fitting is tightened. Failure to wrap teflon tape properly or having it extend past the end of the fitting may cause a blockage in the fuel system.

- (4) Apply teflon tape on threads on elbows (2).
- (5) Install two elbows (2).
- (6) Install lifting bracket (3) and gasket (4) and secure with three screws (5) and lockwashers (6).
- (7) Install thermostat housing (7) and gasket (8) and secure with three screws (9) and lockwashers (10). Torque screws to 46-50 lb-ft (62-68 Nm).
- (8) Install compression gasket (11) and oil seal gasket (12) on cylinder block (13).
- (9) Install two studs, approximately 6 in. (15.24 cm) long, into two diagonally opposite bolt holes in cylinder block (13).
- (10) Connect lifting device to cylinder head (14) and install on cylinder block (13) being careful not to move gaskets (11) and (12).
- (11) Install four bolts (15) and finger tighten.
- (12) Remove two studs and install remaining two bolts (15).
- (13) Tighten six bolts (15) one half turn at a time in the order shown in figure 5-21 until all bolts (15) are torqued to 170-180 lb-ft (231-244 Nm).
- (14) Install six push rod seats (16) and (17).
- (15) Install valve operating mechanism (18) and secure with two bolts (19) and lockwashers (20). Torque bolts to 30-35 lb-ft (41-47 Nm).
- (16) Install valve operating mechanism (21) and secure with two bolts (22) and lockwashers (23). Torque bolts to 30-35 lb-ft (41-47 Nm).





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Figure 5-21. Cylinder Head, Install.

5-69/(5-70 blank)

**NOTE**

Leave 1 1/2 threads exposed when applying teflon tape. Wrap teflon tape in the direction that will not unwrap as fitting is tightened. Failure to wrap teflon tape properly or having it extend past the end of the fitting may cause a blockage in the fuel system.

- (17) Apply teflon tape to threads on fitting nuts (24) and install line (25).
- (18) Apply teflon tape to threads on fitting nut (26) and install fuel line (27).
- (19) Install temperature sensor (28) and tighten fitting nut (29).

**FOLLOW-ON MAINTENANCE**

- (1) Install governor (para. 4-11).
- (2) Install injector controls (para. 4-9).
- (3) Install injectors (para. 4-9).
- (4) Install exhaust manifold (para. 3-15)
- (5) Install upper water connection (para. 3-20).
- (6) Adjust exhaust valves (para. 4-21).
- (7) Adjust fuel injector timing (para. 4-10).
- (8) Start engine, para. 2-6, and check for leaks.
- (9) Stop engine, para. 2-7, and re-torque cylinder head bolts.

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**5-20. Pistons and Connecting Rods.**


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**This task covers:****a. Replace****b. Repair****INITIAL SETUP***Tools*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)  
 Wrench, Torque (NSN 5120-00-247-2540)  
 Installer and Remover, Piston and Connecting Rod  
 Bushing (PN J 1513-02)  
 Reamer Set, Connecting Rod Bushing (PN J 1686-D)  
 Detector, Leak (PN J 2398)  
 Reamer Set, Piston Pin Bushing (PN J 3071-01)  
 Ball Attachment, Micrometer (PN J 4757)  
 Installer, Piston Pin Retainer (PN J 23762-A)  
 Fixture, Piston Bushing Reamer (PN J 5273)  
 Set, Feeler Gage (PN J 5438)  
 Holder, Connecting Rod (PN J 7632)  
 Assembly Tool, Piston Ring (PN J 8128)  
 Nozzle Remover, Connecting Rod (PN J 8995)  
 Piston Ring Compressor (NSN 5120-00-250-6055)  
 or (PN J 3272-03)

*Materials/Parts*

Assembly, Piston  
 Assembly, Rod  
 Rags, Wiping (Item 21, Appendix D)  
 Solvent, Dry Cleaning (Item 23, Appendix D)

*Equipment Condition*

Cylinder head assembly removed (para. 5-18).  
 Oil pan removed (para. 4-14).  
 Oil pump removed (para. 4-16).

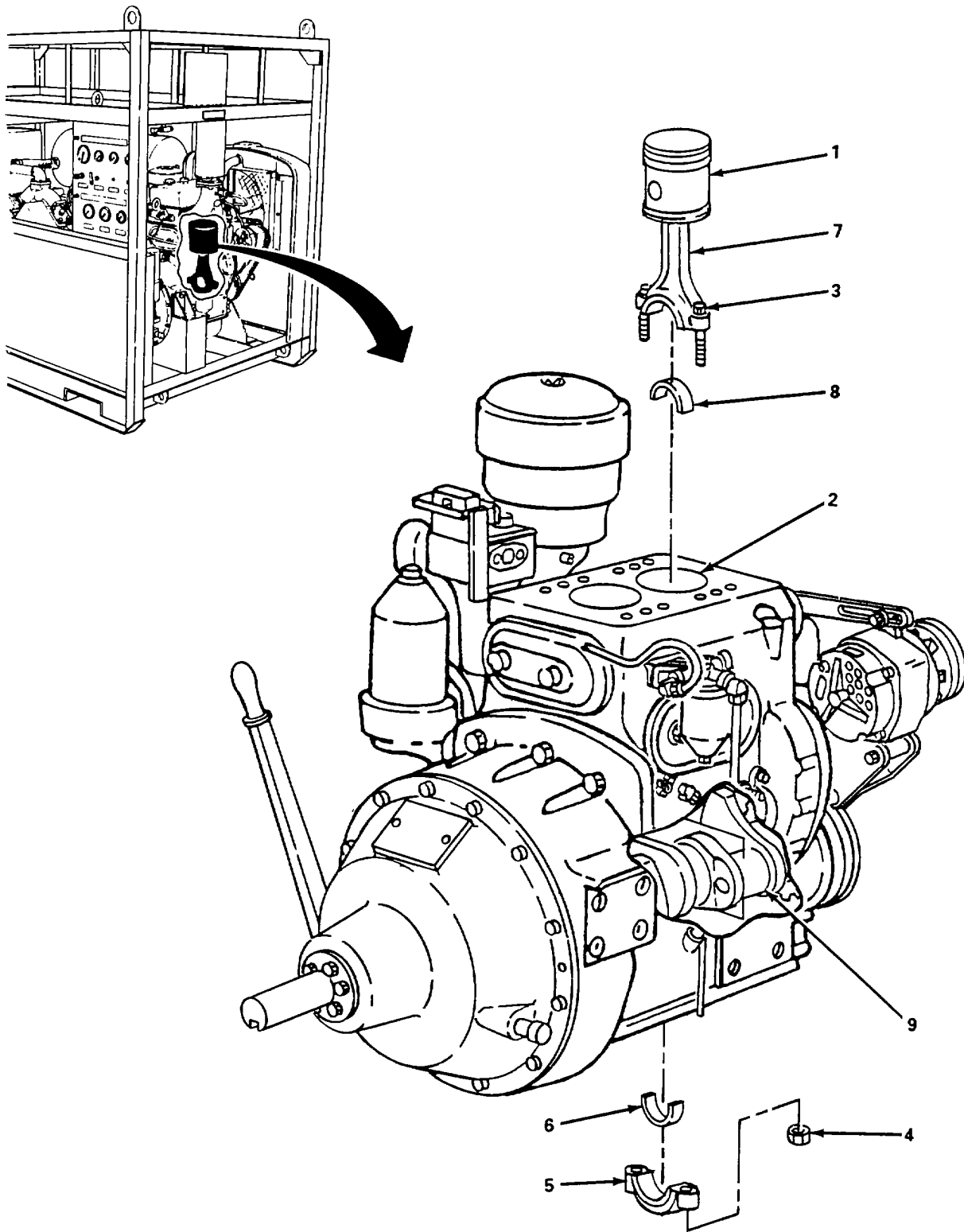
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a. *Replace.* (figure 5-22)

**NOTE**

The engine is equipped with two pistons and connecting rods, replacement of each one is the same.

- (1) Remove all carbon deposits from top of piston (1) and cylinder (2).
- (2) Remove two connecting rod bolts (3) and nuts (4) and remove bearing cap (5) and lower bearing shell (6).
- (3) Slide piston (1) with connecting rod (7) out of cylinder (2).
- (4) Remove upper bearing shell (8) from connecting rod (7).
- (5) Install upper bearing shell (8) in connecting rod (7).
- (6) Using suitable ring compressor, install connecting rod (7) with piston (1) in cylinder (2).
- (7) Position connecting rod (7) on crankshaft (9).
- (8) Install lower bearing shell (6) and bearing cap (5) and secure with two connecting bolts (3) and nuts (4). Torque nuts to 60-70 lb-ft (81-95 Nm).



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Figure 5-22. Pistons and Connecting Rods, Replace.

5-20. **Pistons and Connecting Rods (Cont).**

- b. *Repair.* (figure 5-23)

**NOTE**

Do not reuse piston rings or retaining rings. It may be necessary to punch a hole in retainer to remove.

- (1) Remove two retainers (1) and slide piston pin (2) out of piston (3) and connecting rod (4).
- (2) Using piston and connecting rod bushing remover, remove bushing (5) from piston (3).
- (3) Using piston and connecting rod bushing remover, remove bushing (6) from connecting rod (4).
- (4) Using piston ring assembly tool, remove four compression rings (7), two expanders (8), two oil control rings upper half (9), and two oil control rings lower half (10) and discard rings.

**WARNING**

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

- (5) Clean all items with dry cleaning solvent, and dry thoroughly.
- (6) Inspect piston (3) for score marks, cracks, ring groove lands, or indications of overheating. Replace piston if severely scored or overheated.
- (7) Inspect piston for cracks, using the magnetic particle inspection (refer to para. 5-19a). If piston is cracked, replace piston.

**NOTE**

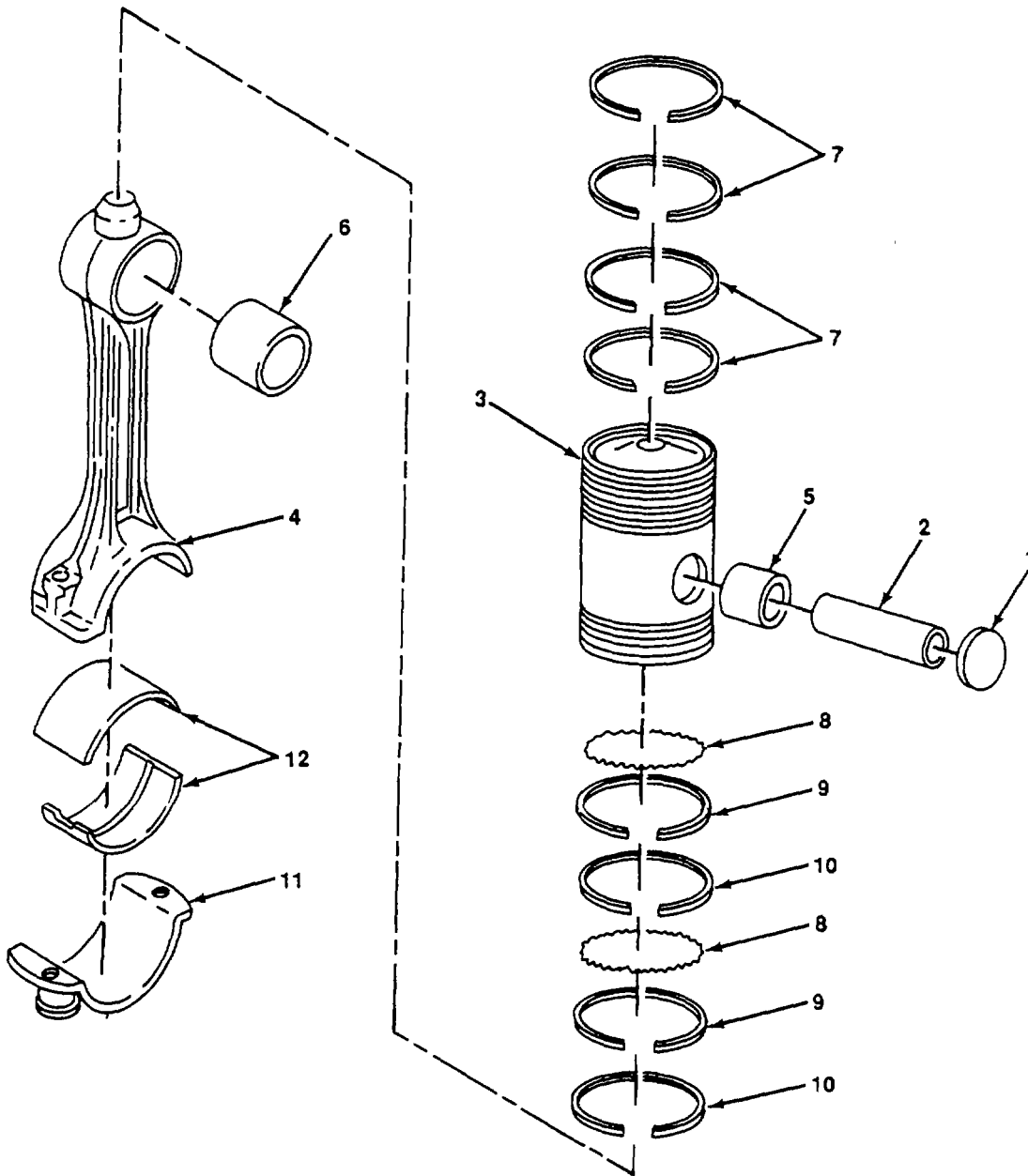
Taper and out-of-round, measured from a point approximately 1.88 in. (4.77 cm) from top of piston to bottom of piston, must not exceed .0005 in. (.0012 cm).

- (8) The piston skirt diameter must be measured lengthwise and crosswise of the piston pin bore.

**NOTE**

Inside diameter of bushing in piston is 1.5025-1.5030 in. (3.8163-3.8176 cm) and outside diameter of piston pin is 1.4996-1.5000 in. (3.8089-3.8100 cm). Piston pin-to-bushing clearance is .0025-.0034 in. (.0063-.0086 cm). A maximum clearance of .010 in. (.025 cm) is allowable with worn parts.

- (9) Check piston pin-to-bushing clearance, if clearance is larger than allowable to tolerance, replace piston pin.



**Figure 5-23. Piston and Connecting Rod, Repair.**

**FOLLOW-ON MAINTENANCE**

- (1) Install cylinder head assembly (para. 5-19).
- (2) Install oil pan (para. 4-14).
- (3) Install oil pump (para. 4-16).

5-20. **Pistons and Connecting Rods (Cont).**

- (10) Hold piston upside down in the cylinder liner and check the piston-to-liner clearance. Check the clearance in four places, 90° apart using feeler-gage set as follows:

**NOTE**

The spring scale, attached to the appropriate feeler gage, is used to measure the amount force in pounds required to draw the feeler gage from between piston and liner. The piston-to-liner clearance will be .001 in. (.002 cm) greater than thickness of feeler gage used.

- (a) Select a feeler gage with a thickness that will require a pull of six pounds to remove. Feeler gage must be perfectly flat and free of nicks and bends.
- (11) Insert one ring at a time inside cylinder liner and far enough down in the bore to be within normal area of ring travel.
- (12) Use piston to push ring down to be sure it is parallel with top of liner, then measure ring gap with feeler gage. Refer to table 1 for specified ring gaps.

**Table 5-2.**

Piston Ring	Ring Gap
Upper Compression .....	018-.043 in. (.045-.109 cm)
Second Compression .....	018-.043 in. (.045-.109 cm)
Third Compression .....	01 8-.043 in. (.045-. 109 cm)
Lower Compression .....	01 8-.043 in. (.045-. 109 cm)
Oil Control (Upper) .....	008-.023 in. (.020-.058 cm)
Oil Control (Lower) .....	008-.023 in. (.020-.058 cm)

- (13) Check piston ring clearance in the piston ring grooves as shown in Table 5-2.
- (14) Inspect connecting rod for cracks by using the magnetic particle method.
- (15) Inspect spray nozzle at upper end of connecting rod to make sure holes are open and replace if damaged.
- (16) Using connecting rod nozzle remover and press, press nozzle out of connecting rod.
- (17) Inspect connecting rod bushings for indications of scoring, overheating or other damage.

**NOTE**

Diameter of new piston pin is 1.4996-1.500 in. (3.8089-3.8100 cm). Worn piston pin clearances up to .010 in. (.002 cm) are satisfactory.

- (18) Measure outside diameter of piston pin to determine the amount of wear. If wear of piston pin is greater than specified limits, replace piston pin.

**NOTE**

Inside diameter of new connecting rod bushing is 1.5015-1.5020 in. (3.8138-3.8150 cm). Clearance between piston pin and connecting rod bushing is .0015-.0024 in. (.0038-.0060 cm).

- (19) Measure inside diameter of connecting rod bushing, and replace if the amount of wear is greater than specified clearance.
- (20) Inspect bearing shells for scoring, pitting, flaking, dipping, cracking, loss of babbit or signs of overheating. Replace bearing shells if any of these defects are present.
- (21) Inspect back of bearing shells for bright spots, if spots are present, replace bearing shells.

**NOTE**

Bearing-to-crankshaft journal maximum clearance is .006 in. (.015 cm).

- (22) Using a micrometer ball attachment, measure the shell thickness, and replace bearing shell if less than minimum thickness shown in Table 5-3 or clearance exceed .006 in. (.015 cm).

**Table 5-3.**

Nominal Size of Bearing	Minimum Worn Bearing Shell Thickness	Crankshaft Connecting Rod Journal Diameters
Standard	.153 in. (.388 cm)	2.749 -2.750 in. (6.982-6.985 cm)
.002 in. Undersize	.154 in. (.391 cm)	2.747-2.748 in. (6.977-6.979 cm)
.010 in. Undersize	.158 in. (.401 cm)	2.739-2.740 in. (6.957-6.959 cm)
.020 in. Undersize	.163 in. (.414 cm)	2.729-2.730 in. (6.931-6.934 cm)
.030 in. Undersize	.168 in. (.426 cm)	2.719-2.720 in. (6.906-6.908 cm)

- (23) Using piston and connecting rod bushing installer, install bushings (6) and (5).
- (24) Using piston pin bushing reamer set and reaming fixture, ream bushing until inside diameter of 1.5025-1.5030 in. (3.8163-3.8176 cm) is achieved.
- (25) Using connecting rod bushing reamer set and holder, ream bushing until a inside diameter of 1.5015-1.5020 in. (3.8138-3.8150 cm) is achieved.

**WARNING**

Wear faceshield and clear immediate area of personnel when using low pressure air for maintenance procedures.



- (26) Clean bushings of chips with compressed air.
- (27) Position connecting rod (4) in piston (3) and install piston pin (2) and secure two retainers (1) using piston pin retainer installer.

**NOTE**

A drop in the gage reading indicates air leakage at the retainer.

- (28) Place suction cup of leak detector over the retainer and hand operate lever to pull vacuum of 10 inches on the gage. If leakage exist, replace retainer.

**NOTE**

New piston rings must be used when piston is removed.

- (29) Using piston ring assembly tool, install two oil control rings lower half (10), two oil control rings upper half (9), two expanders (8), and four compression rings (7).

5-21. **Cylinder Liners.****This task covers:****a. Inspect****b. Replace****INITIAL SETUP***Tools*

General Mechanic's Tool Kit  
(NSN 5180-00-177-7033)  
Remover, Cylinder Liner (PN J 1918-02) or  
(PN J 6410)  
Hold-down Clamp, Cylinder Liner (PN 21793-B)  
Depth Gage, Cylinder Liner (PN J 22273-01)  
Master, Setting (PN J 23059-01)  
Checking Gage, Cylinder (PN J 5347-01)  
Ring Gage, Master (PN J 8386-01)  
Rod and Sleeve Calipers (NSN 5210-00-221-1921)

*Materials/Parts*

Liner, Cylinder  
Solvent, Dry Cleaning (Item 23, Appendix D)  
Rags, Wiping (Item 21, Appendix D)

*Equipment Condition*

Pistons and connecting rods removed (para. 5-20).

- a. *Inspect.* (figure 5-24)

**NOTE**

Cylinder liners remove for inspection, refer to para. b. below.

- (1) Inspect liners for excessive liner-to-block clearance, which may be indicated by stains or low pressure areas on outer surface of liner.
- (2) Inspect liners outside diameter for fretting, which is materials from block adhering to liners during slight movement of liner during engine operations.

**NOTE**

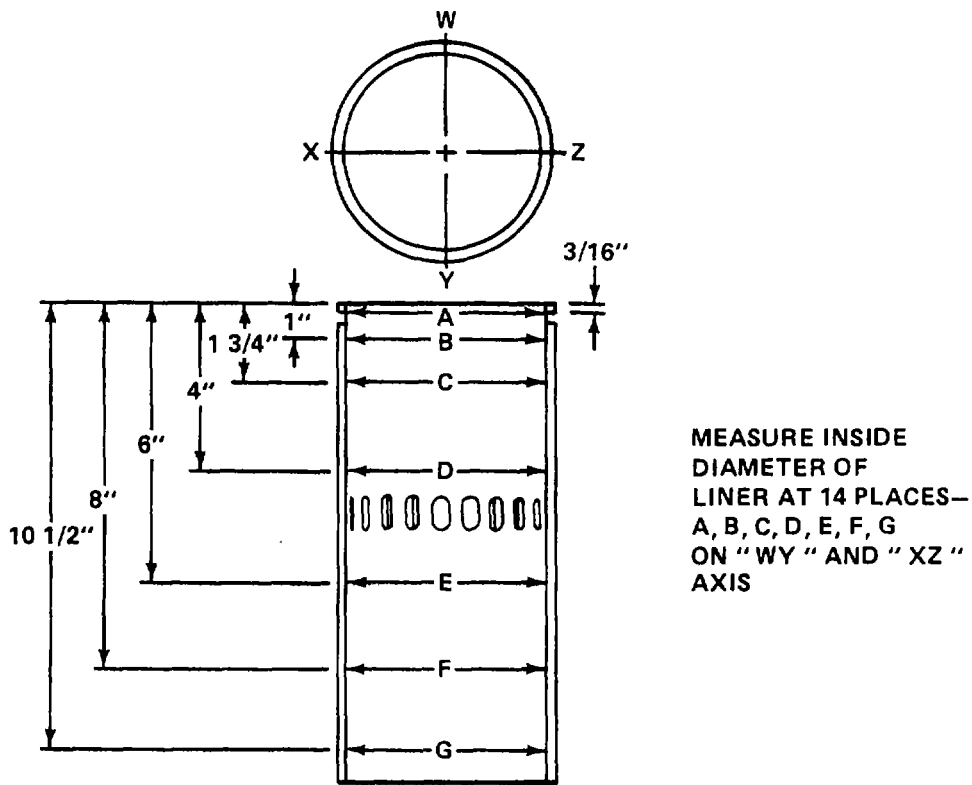
Liner-to-block clearance must not exceed .003 in. (.007 cm).

- (3) Measure the block bore and the outside diameter of the liner. If measurement exceed specified limit, replace liner.
- (4) Install liner in proper bore of cylinder block.

**NOTE**

Dial bore gage setting master fixture J 23059-01 may be used in place of master ring gage.

- (5) Using cylinder check gage, set dial indicator to zero in master ring gage, and measure inside diameter of liner at various points indicated in figure 5-24.



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Figure 5-24. Cylinder Liner, Inspect.

**NOTE**

Taper must not exceed .002 in. (.005 cm) and the out-of-round not to exceed .003 in. (.007 cm).

- (6) Check liner for taper and out-of-round. If out-of-rounds exceeds .003 in. (.007 cm), rotate liner 90° in the block, bore and recheck.
- (7) If liner is cracked, excessively score, damage or out of tolerance between outside diameter of liner and cylinder bore, replace with new or oversize liner as indicated in Tables 5-4 and 5-5.

5-21. Cylinder Liners (Cont).

Table 5-4.

NEW CYLINDER LINER TO NEW CYLINDER BLOCK BORE FITS				
Classification Number Stamped Adjacent to Each Cyl. Bore	Cylinder Bore Classification Diameter (I.D.)	Standard Cylinder Liner Diameters and Liner-to-Block Clearances When Properly Matched		
		Liner (O.D.) Classification	Liner (O.D.) Diameter	Liner/Block Clearance
CAST IRON BLOCK				
#0	4.6256in./4.6259 in.	#1	4.6250 in./4.6255 in.	.0001 in./0.0009 in.
#1	4.6260 in./4.6265 in.	#1	4.6250 in./4.6255 in.	.0005 in./0.0015 in.
		#2	4.6256 in./4.6260 in.	.0000 in./0.0009 in.
#2	4.6266 in./4.6270 in.	#2	4.6256 in./4.6260 in.	.0006 in./0.0016 in.
		#3	4.6261 in./4.6265 in.	.0001 in./0.0009 in.
#3	4.6271 in./4.6275 in.	#3	4.6261 in./4.6265 in.	.0006 in./0.0014 in.
METRIC				
#0	117.490/117.498 mm	#1	117.475/117.488 mm	.002/.023 mm
#1	117.500/117.513 mm	#1	117.475/117.488 mm	.012/.038 mm
		#2	117.490/117.500 mm	.000/.023 mm
#2	117.516/117.526 mm	#2	117.490/117.500 mm	.016/.036 mm
		#3	117.503/117.513 mm	.003/.023 mm
#3	117.528/117.539 mm	#3	117.503/117.513 mm	.015/.036 mm

Table 5-5.

OVERSIZE SERVICE CYLINDER LINERS			
Service Liner Oversize	Liner Outside Diameter		Liner/Block Clearance Req'd After Boring Block
	inches	mm	
.001 in. (0.0254 mm)	4.6280	117.551	.0005 in./0.015 in. (.013/.038 mm)
	4.6265	117.513	
.005 in. (0.172 mm)	4.6315	117.640	.0005 in./0.015 in. (.013/.038 mm)
	4.6300	117.602	
.010 in. (0.254 mm)	4.6365	117.767	.0005 in./0.015 in. (.013/.038 mm)
	4.6350	117.729	
.020 in. (0.508 mm)	4.6465	118.021	.0005 in./0.015 in. (.013/.038 mm)
	4.6450	117.983	
.030 in. (0.762 mm)	4.6565	118.275	.0005 in./0.015 in. (.013/.038 mm)
	4.6550	118.237	

5-21. **Cylinder Liners (Cont).**

b. *Replace.* (figure 5-25)

- (1) Using cylinder liner tool, remove cylinder liner (1) from cylinder block (2).

**WARNING**

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

- (2) Clean cylinder liner with dry cleaning solvent, and dry thoroughly.
- (3) Inspect liner for cracks, scoring, flange irregularities, out-of-round, taper, inside diameter and outside diameter.
- (4) If liner is cracked or excessively scored, replace liner.

**NOTE**

After removing liners from block and prior to installing liners, always store them in an upright position until ready for use. Liners left on their side for any length of time can become egg-shaped and distorted, making installation in cylinder bores difficult or impossible.

Counterbore must be .247-.248 in. (.627-.629 cm) in depth and must not vary more than .001 in. (.002 cm) in depth.

- (5) Wipe inside and outside of liner, clean and make sure block bore and counterbore are clean.
- (6) Install cylinder liner (1) in cylinder block (2).
- (7) Clamp liner in place with hold-down clamp.

**NOTE**

Top of liner flange must be .002-.005 in. (.005-.012 cm) above top surface of block. Liner height above the block between the liners must not be over .001 in. (.002 cm).

- (8) Measure distance from top of liner flange to top of cylinder block, if measurement is not within the specified limits, shim liner.

**NOTE**

Liner shims .0015 and .003 in. (.0038 and .007 cm) thick are used to adjust the height of liners to specified .002-.005 in. (.005-.012 cm) above block.

Liner must be raised only enough to permit installation of shim under liner flange.

(9) Install shims over bottom of liner or cut shim and insert under liner flange.

(10) Remove hold-down clamp.

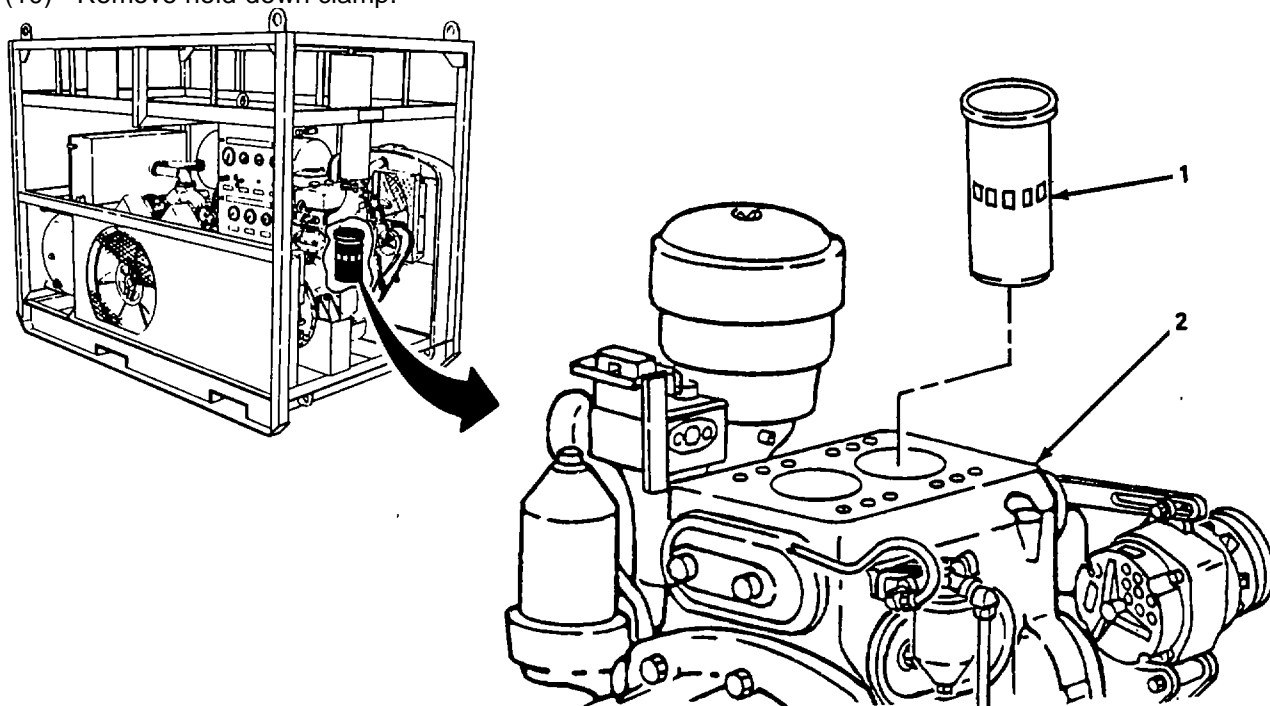


Figure 5-25. Cylinder Liner, Replace.

FOLLOW-ON MAINTENANCE  
 Install piston and connecting rods (para. 5-19).

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**5-22. Camshaft, Balance Shaft and Bearings.**


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**This task covers:****Repair****INITIAL SETUP:***Tools*

General Mechanic's Tool Kit  
(NSN 5180-00-177-7033)  
Torque Wrench (NSN 5120-00-221-7983)  
Puller (PN J 24420-A)  
Remover and Installer Tool, Bearing (PN J 7593-03)  
Caliper Set, Micrometer (NSN 5210-00-554-7134)  
Feeler Gage Set (PN J 5438)  
Wrench, Torque (NSN 5120-00-554-7292)

*Materials/Parts*

Camshaft  
Balance Shaft  
Bearings

*Materials/Parts (Cont)*

Lubricating Oil, Grd Equipment (Item 18,  
Appendix D)  
Solvent, Dry Cleaning (Item 23, Appendix D)  
Rags, Wiping (Item 21, Appendix D)

*Equipment Condition*

Engine removed (para. 3-13).  
Fuel pump removed (para. 3-27).  
Oil pan removed (para. 4-14).  
Flywheel housing removed (para. 4-20).  
Valve operating mechanism removed (para. 4-21).

---

*Repair.*

- (1) *Removal.* (figure 5-26)
  - (a) Remove bolt (1) and washer (2).
  - (b) Using puller, remove crankshaft pulley (3).
  - (c) Remove eighteen bolts (4) and lockwashers (5) and remove engine front cover (6) and gasket (7).
  - (d) Wedge a wood block between the balance weights at the rear of the engine to prevent the shafts from turning.
  - (e) Remove two balance weight locknuts (8).
  - (f) Using puller remove two balance weights (9) and keys (10).
  - (g) Remove two gear locknuts (11).
  - (h) Rotate the gears (12) as required to reveal thrust plate bolts (13) and remove six bolts and lockwashers (14).
  - (i) Remove balance shaft (15) and camshaft (16).
  - (j) Press gears (12) off of balance shaft (15) and camshaft (16).
  - (k) Remove two thrust plate (17) and keys (18).
  - (l) Using bearing removal tool, remove balance and camshaft bearings (19).



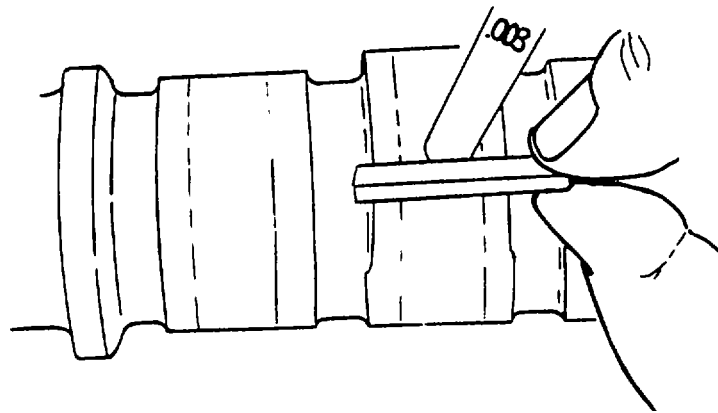
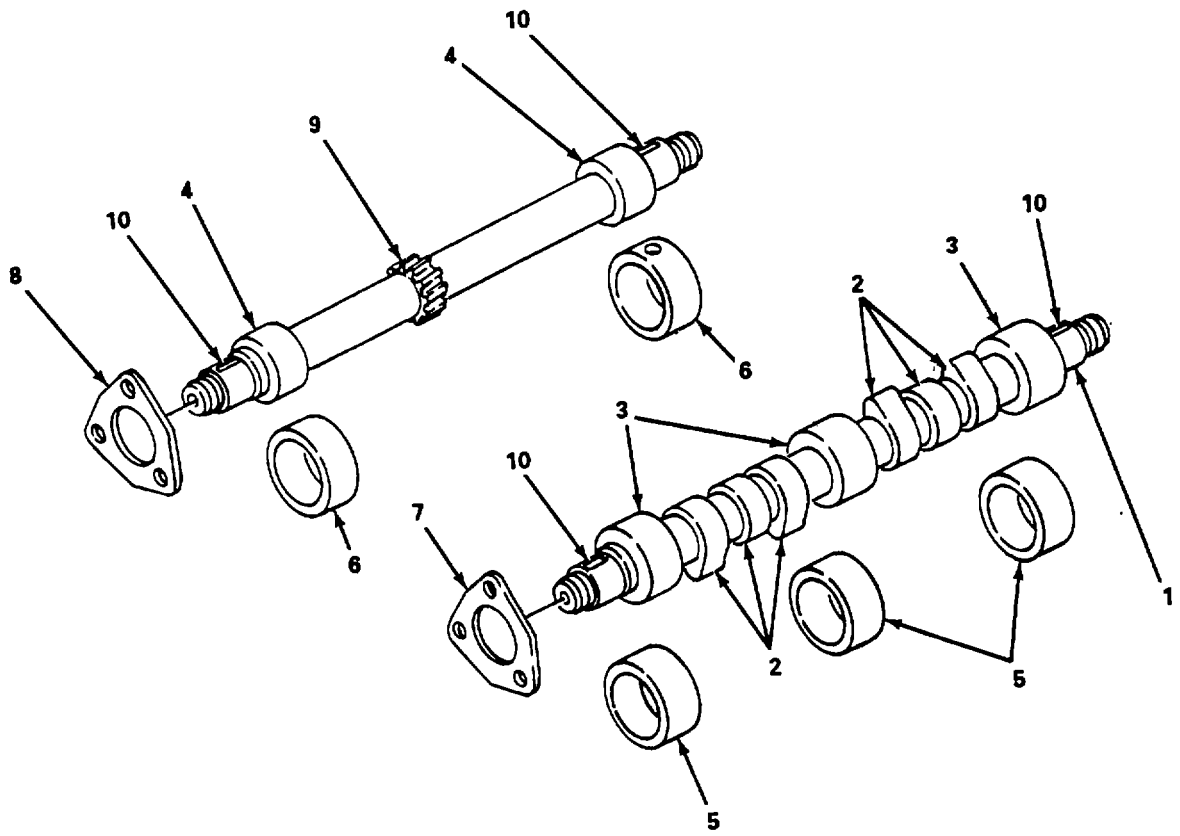
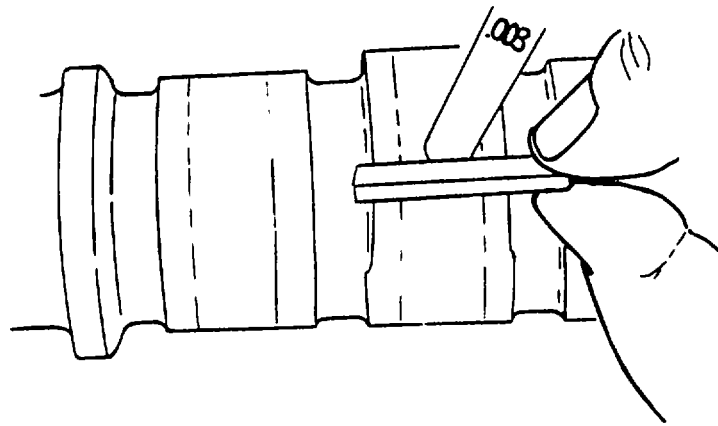
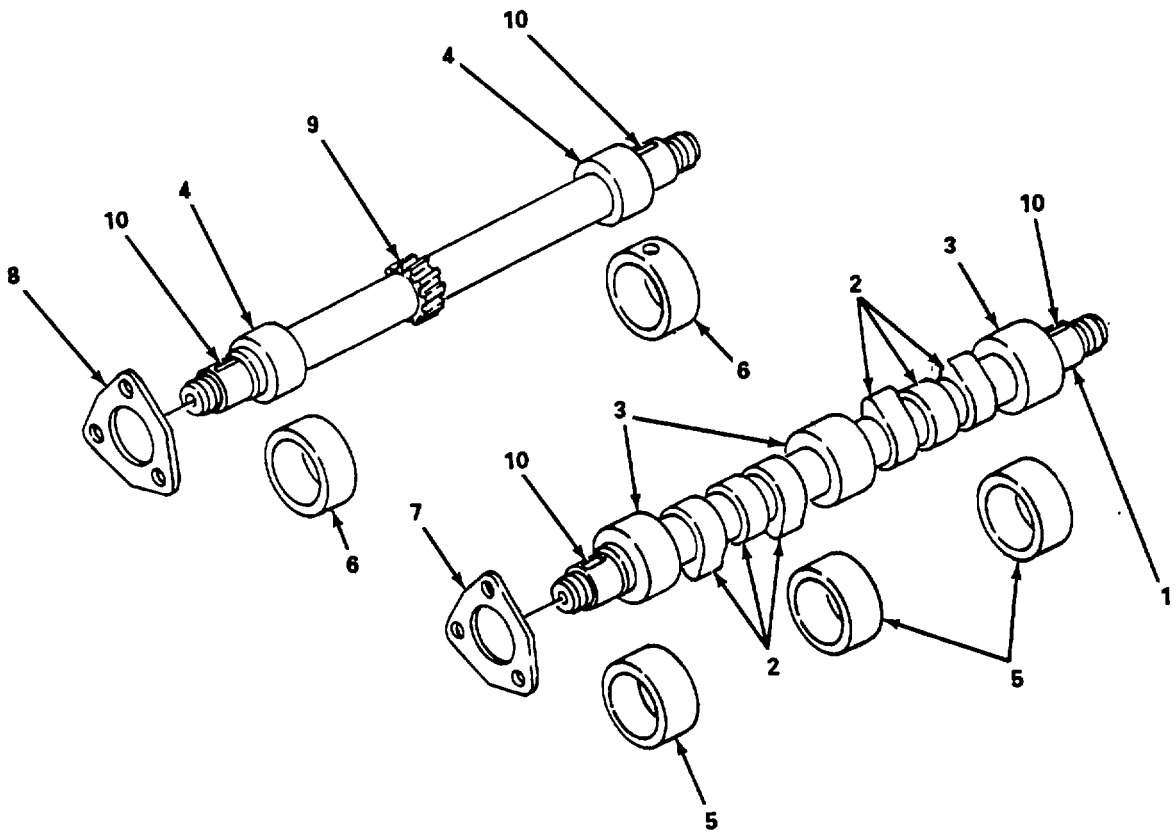


Figure 5-27. Camshaft, Balance Shaft and Bearings, Inspection.

**5-22. Camshaft, Balance Shaft and Bearings (Cont).****(3) Installation.** (figure 5-28)

- (a) Install balance and camshaft bearings (1).
- (b) Install two thrust plates (2).
- (c) Install gears (3) on balance shaft (4) and camshaft (5).
- (d) Rotate cylinder block until the top of block faces down, then lubricate balance and camshaft lobes and journals with engine oil.
- (e) Slide camshaft (5) into cylinder block until camshaft gear (3) is within .125 in. (.317 cm) of camshaft gear
- (f) Rotate camshaft gear (3) until the "O" timing marks on the two gears are correctly aligned, then push camshaft in place in the block.
- (g) Rotate gears (3) as necessary to install thrust plate bolts (6).
- (h) Install six thrust plate bolts (6) and lockwashers (7). Torque bolts to 13-17 lb-ft (18-23 Nm).
- (i) Rotate cylinder block over until top of block faces up, then lubricate balance shaft (4) bearing journals with engine oil.
- (j) Slide balance shaft (4) into cylinder block until balance shaft gear (3) is within .125 in. (.317 cm) of camshaft gear.
- (k) Rotate balance shaft gear (3) until the 'X' on each gear is correctly aligned, then push balance shaft in place in block.
- (l) Rotate gear (3) as necessary to install thrust plate bolt (8).
- (m) Install three thrust plate bolts (8) and lockwashers (9) on balance shaft. Torque bolts to 13-17 lb-ft (18-23 Nm).
- (n) Install two keys (10) in the keyway at front end of both shafts and gear locknuts (11). Torque locknuts to 250-275 lb-ft (339-373 Nm).
- (o) Install two balance weights (12) and keys (13).
- (p) Install two balance weight locknuts (14).
- (q) Wedge a wood block between the balance weights and torque locknuts to 250-275 lb-ft (339-373 Nm).
- (r) Install engine front cover (15) with gasket (16) and secure with eighteen bolts (17) and lockwashers (18) to 13-17 lb-ft (18-23 Nm).

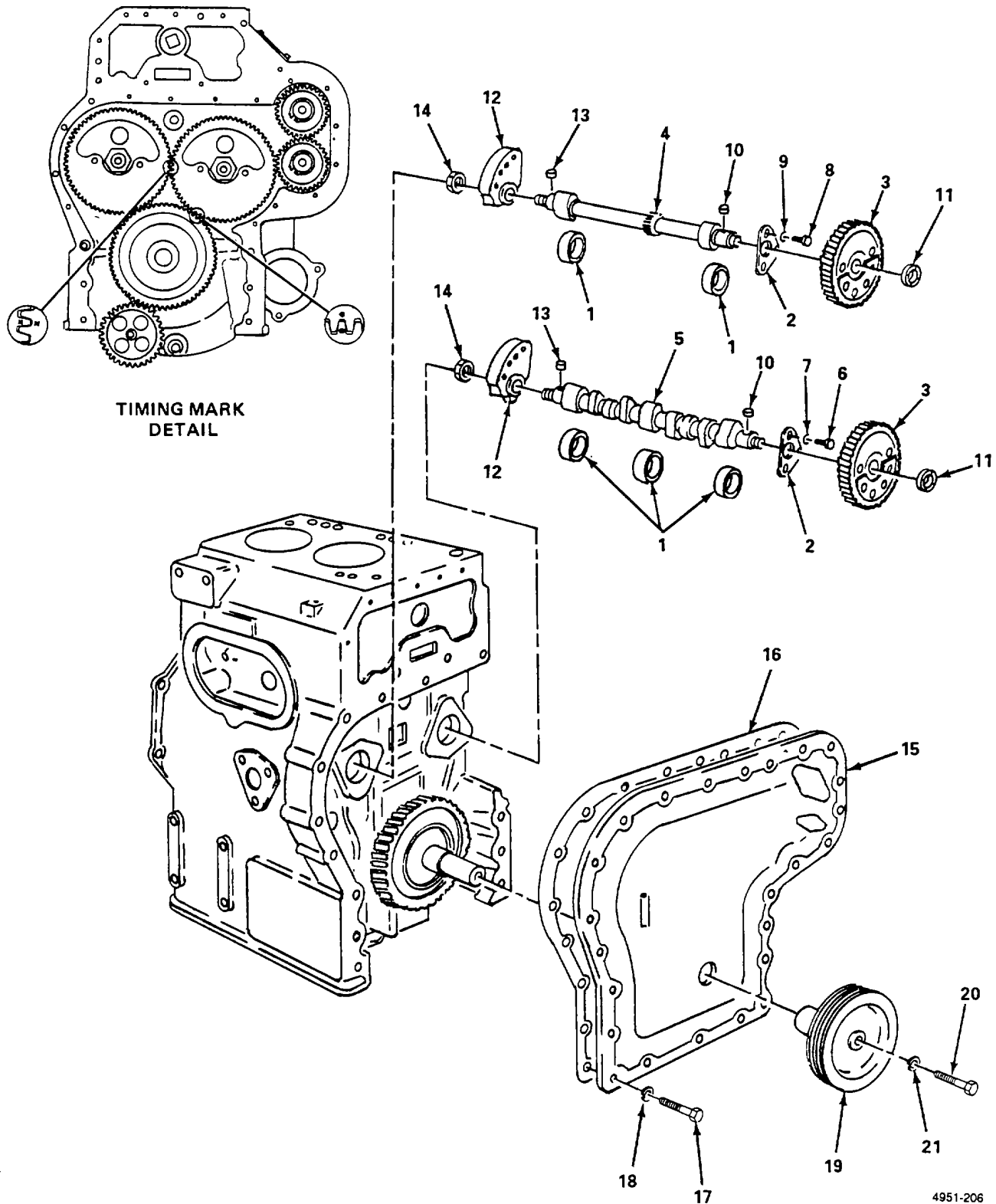


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Figure 5-27. Camshaft, Balance Shaft and Bearings, Inspection.

**5-22. Camshaft, Balance Shaft and Bearings (Cont).****(3) Installation.** (figure 5-28)

- (a) Install balance and camshaft bearings (1).
- (b) Install two thrust plates (2).
- (c) Install gears (3) on balance shaft (4) and camshaft (5).
- (d) Rotate cylinder block until the top of block faces down, then lubricate balance and camshaft lobes and journals with engine oil.
- (e) Slide camshaft (5) into cylinder block until camshaft gear (3) is within .125 in. (.317 cm) of camshaft gear
- (f) Rotate camshaft gear (3) until the "O" timing marks on the two gears are correctly aligned, then push camshaft in place in the block.
- (g) Rotate gears (3) as necessary to install thrust plate bolts (6).
- (h) Install six thrust plate bolts (6) and lockwashers (7). Torque bolts to 13-17 lb-ft (18-23 Nm).
- (i) Rotate cylinder block over until top of block faces up, then lubricate balance shaft (4) bearing journals with engine oil.
- (j) Slide balance shaft (4) into cylinder block until balance shaft gear (3) is within .125 in. (.317 cm) of camshaft gear.
- (k) Rotate balance shaft gear (3) until the "X" on each gear is correctly aligned, then push balance shaft in place in block.
- (l) Rotate gear (3) as necessary to install thrust plate bolt (8).
- (m) Install three thrust plate bolts (8) and lockwashers (9) on balance shaft. Torque bolts to 13-17 lb-ft (18-23 Nm).
- (n) Install two keys (10) in the keyway at front end of both shafts and gear locknuts (11). Torque locknuts to 250-275 lb-ft (339-373 Nm).
- (o) Install two balance weights (12) and keys (13).
- (p) Install two balance weight locknuts (14).
- (q) Wedge a wood block between the balance weights and torque locknuts to 250-275 lb-ft (339-373 Nm).
- (r) Install engine front cover (15) with gasket (16) and secure with eighteen bolts (17) and lockwashers (18).



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Figure 5-28. Camshaft, Balance Shaft and Bearings, Installation.

- (s) Install crankshaft pulley (19) and secure with bolt (20) and washer (21). Torque bolt to 290-310 lb-ft (393-421 N•m).

**FOLLOW-ON MAINTENANCE:**

Install valve operating mechanism (para. 4-21).

Install flywheel housing (para. 4-20).

Install oil pan (para. 4-14). Install fuel pump (para. 3-27).

Install engine (para. 3-13).

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**5-23. Crankshaft Group.**

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**This task covers:****Repair**

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**INITIAL SETUP:***Tools*

General Mechanic's Tool Kit  
(NSN 5180-00-177-7033)  
Indicator, Dial (PN J 5959-01)  
Micrometer Ball Attachment (PN J 4767)  
Caliper Set Micrometer (NSN 5120-00-554-7134)  
Wrench, Torque (NSN 5120-00-221-7983)

*Equipment Condition*

Engine assembly removed (para. 3-13).  
Flywheel housing removed (para. 4-20).  
Pistons and connecting rod removed (para. 5-20).  
Alternator removed (para. 3-33).

*Materials/Parts*

Crankshaft  
Solvent, Dry Cleaning (Item 23, Appendix D)  
Rags, Wiping (Item 21, Appendix D)

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*Repair.*

- (1) *Remove.* (figure 5-29)
  - (a) Remove bolt (1) and washer (2) from crankshaft (3).
  - (b) Using puller, remove pulley (4) and key (5).
  - (c) Remove eighteen bolts (6) and lockwashers (7) and remove front cover (8) and gasket (9).
  - (d) Remove six bolts (10) and three bearing caps (11).
  - (e) Remove three lower bearing shells (12) from the three bearing caps (11).
  - (f) Remove two lower thrust washers (13) from bearing cap (11).
  - (g) Remove crankshaft (3).
  - (h) Remove two upper thrust washers (14) and three upper bearing shells (15).
  - (i) Remove oil seal (16), oil seal spacer (17) and oil slinger (18).
  - (j) Using gear puller, remove crankshaft gear (19) and key (20).

**WARNING**

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

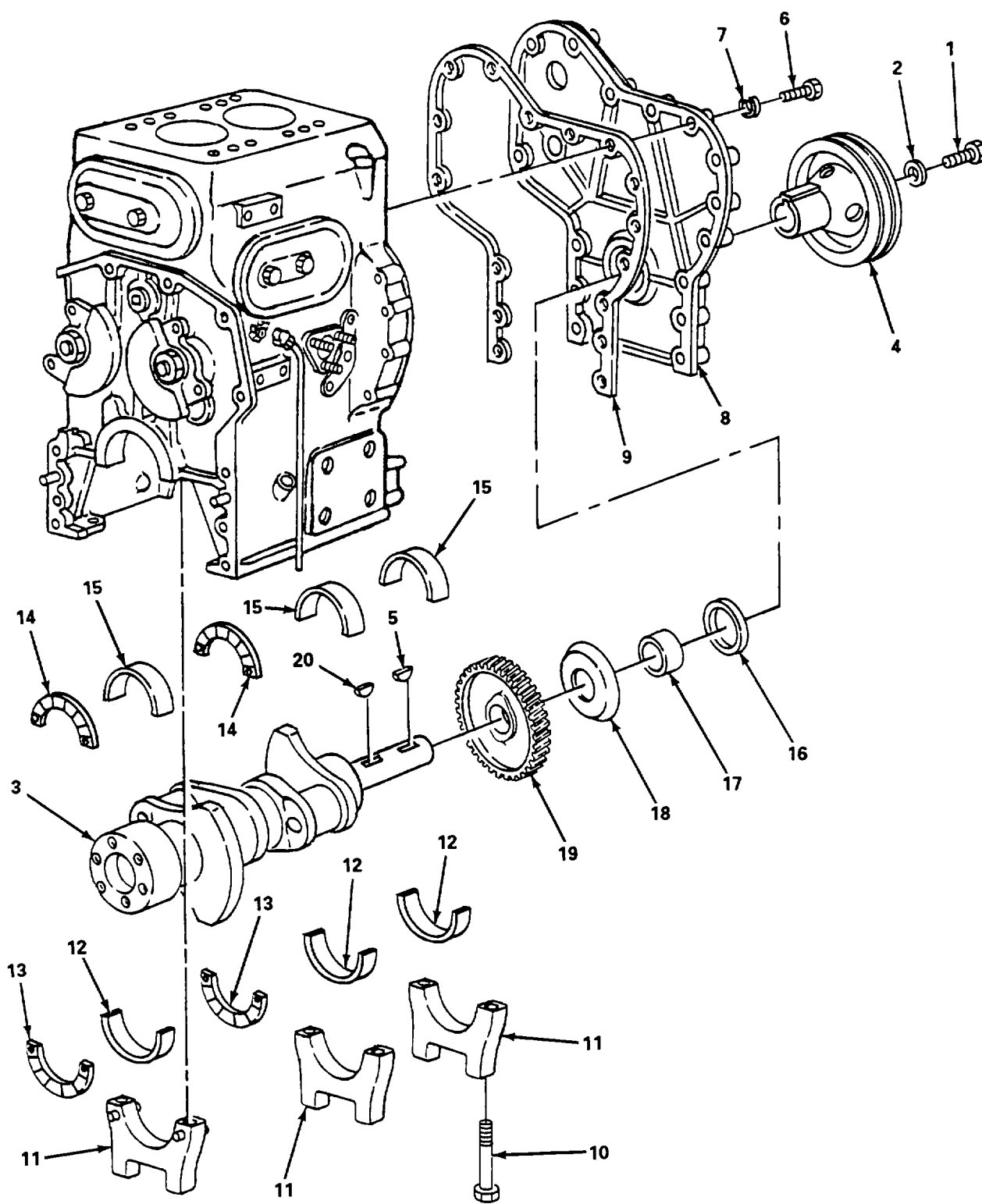


Figure 5-29. Crankshaft, Removal.



- (k) Clean crankshaft (3) with dry cleaning solvent and dry thoroughly.
- (l) Inspect keyway and replace crankshaft if cracked or worn.

**NOTE**

**Maximum runout on the intermediate journal must not exceed .003 in. (.007 cm).**

- (m) Using a dial indicator, check the main journal runout. If the runout exceeds .003 in. (.007 cm), replace the crankshaft.

**NOTE**

**The main bearing journal diameter is 3.499-3.500 in. (8.887-8.8900 cm) and diameter of connecting rod journal is 2.749-2.750 in. (6.982-6.985 cm). Taper on journals of used shaft should not exceed .0015 in. (.0038 cm), and out-of-round should not exceed .0010 in. (.0025 cm). The maximum taper on new crankshaft is .0005 in. (.0012 cm) and maximum out-of-round is .00025 in. (.00063 cm).**

- (n) Measure the main and connecting rod bearing journals. If measurements exceed the specified limits, replace crankshaft.
- (o) Inspect crankshaft for cracks by using the magnetic particle method, fluorescent magnetic particle method or fluorescent penetrant method.
- (p) Inspect oil seal for wear or damage.
- (q) Inspect bearing shells for scoring, pitting, flaking, chipping, cracking, loss of babbitt, or signs of overheating. If any of these defects are present, replace bearing shells.
- (r) Inspect back of bearing shells for bright spots which indicate they have been moving in caps or cylinder block. If these spots are present, replace bearing shells.

**NOTE**

**Minimum thickness of a worn main bearing shell is .153 in. (.388 cm).**

- (s) Using micro meter ball attachment, measure the bearing shells, and if dimension is not within specified dimension, replace shell.

**NOTE**

**Clearance between main bearing journals and inside diameter of bearing shells, when installed, shall not exceed .006 in. and .0014-.0044 in. (.0035-.0111 cm) for new parts.**

- (t) Measure clearance between main bearing journals and inside diameter of bearing shells, if clearance exceeds specified dimension, replace bearing shells.

**5-23. Crankshaft Group (Cont).**

(2) *Installation.* (figure 5-30).

- (a) Install key (1), crankshaft gear (2) and oil slinger (3) on crankshaft (4).
- (b) Install two upper thrust washers (5) and three upper bearing shells (6).
- (c) Aline the timing marks "X" on the camshaft and balance shaft gears.
- (d) Lubricate crankshaft journals and install crankshaft (4) in place so that timing mark "O" on crankshaft timing gear aligns with timing mark "O" on camshaft gear.
- (e) Install two lower thrust washers (7) on bearing cap (8).
- (f) Install three lower bearing shells (9) in bearing caps (8).

**NOTE**

**If the bearings have been installed properly, the crankshaft will turn freely with all of main bearing cap bolts drawn to the specified torques.**

**End play should be .004-.014 in. (.010-.035 cm) with new parts or a maximum of .018in. (.045 cm) with used parts.**

- (g) Install three bearing caps (8) and secure with six bolts (10). Torque bolts to 180-190 lb-ft (244-258 Nm).
- (h) Using dial indicator, check the crankshaft end play by moving crankshaft toward gage with a pry bar. Keep constant pressure on pry bar and set dial indicator to zero. Then remove and insert pry bar on other side of bearing cap. Force crankshaft in opposite direction and note the amount of end play on dial.
- (i) Install front cover (11) with gasket (12) and secure with eighteen bolts (13) and lockwashers (14).
- (j) Slide oil seal spacer (15) over end of crankshaft and push through oil seal (16) and against oil slinger (3).
- (k) Install pulley (17) and key (18) and secure with bolt (19) and washer (20). Torque bolt to 290-310 lb-ft (393-421 Nm).

**FOLLOW-ON MAINTENANCE**

- (1) Install alternator (para. 3-33).
- (2) Install piston and connecting rod (para. 5-20).
- (3) Install flywheel housing (para. 4-20).
- (4) Install engine assembly (para. 3-13).

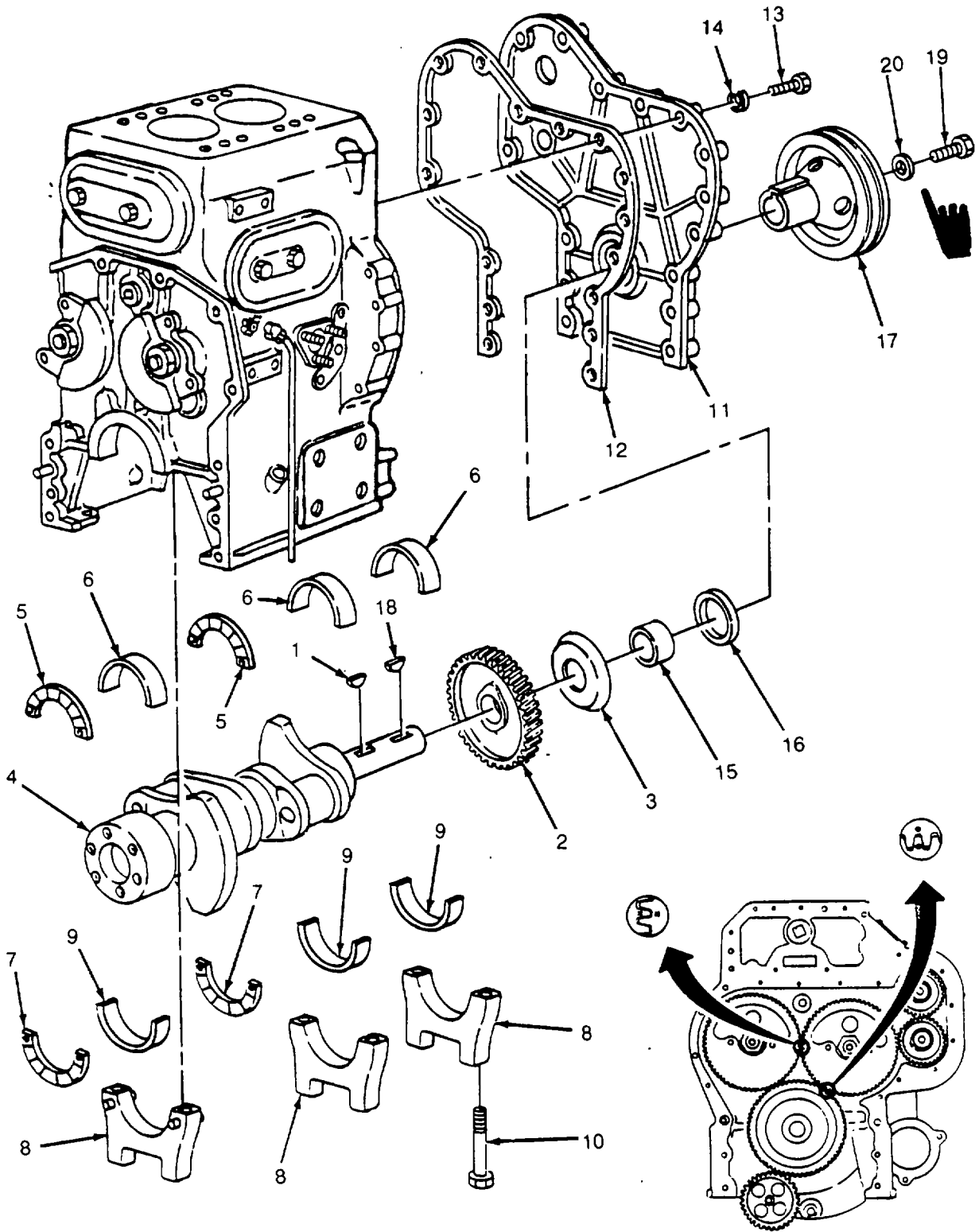


Figure 5-30. Crankshaft, Installation.

Change 1 5-99

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**5-24. Cylinder Block and Front Cover Assembly.**

---

**This task covers:****Replace**

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**INITIAL SETUP:***Tools*

General Mechanic's Tool Kit  
(NSN 5180-00-177-7033)  
Gage, Cylinder Checking (PN J 5347-01)  
Gage, Master Ring (PN J 838601)  
Master Setting (PN J 23059-01)  
Oil Seal Installer (PN J 21209)  
Wrench, Torque (NSN 5120-00-221-7983)

*Materials/Parts*

Block, Cylinder  
Solvent, Dry Cleaning (Item 23, Appendix D)  
Rags, Wiping (Item 21, Appendix D)  
Grease Automotive and Artillery (Item 15, Appendix D)

*Equipment Condition*

Fuel filter assembly removed (para. 3-25).  
Fuel strainer assembly removed (para. 3-26).  
Fuel pump and drive removed (para. 3-27).  
Valve operating mechanism removed (para. 4-21).  
Camshaft, balance shaft and bearings removed  
(para. 4-22)  
Crankshaft removed (para. 5-23).

Replace. (figure 5-31)

- (1) Remove two screws (1) and remove side air box cover (2) and gasket (3).
- (2) Remove two screws (4) and remove rear air box cover (5) and gasket (6).

**WARNING**

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

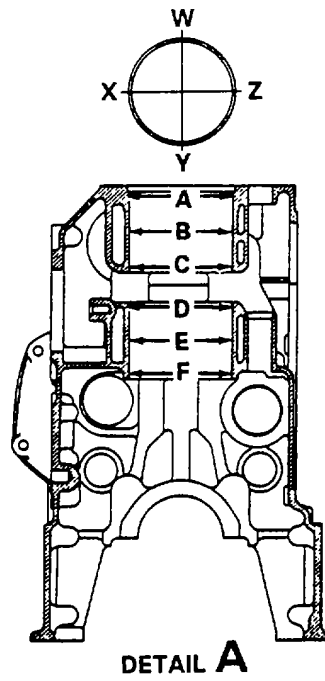
- (3) Clean cylinder block and front cover (7) with dry cleaning solvent and dry thoroughly.

**NOTE**

**Pressure test cylinder block using a large enough water tank with block completely stripped of all parts. If tank is not available, perform test in step (8).**

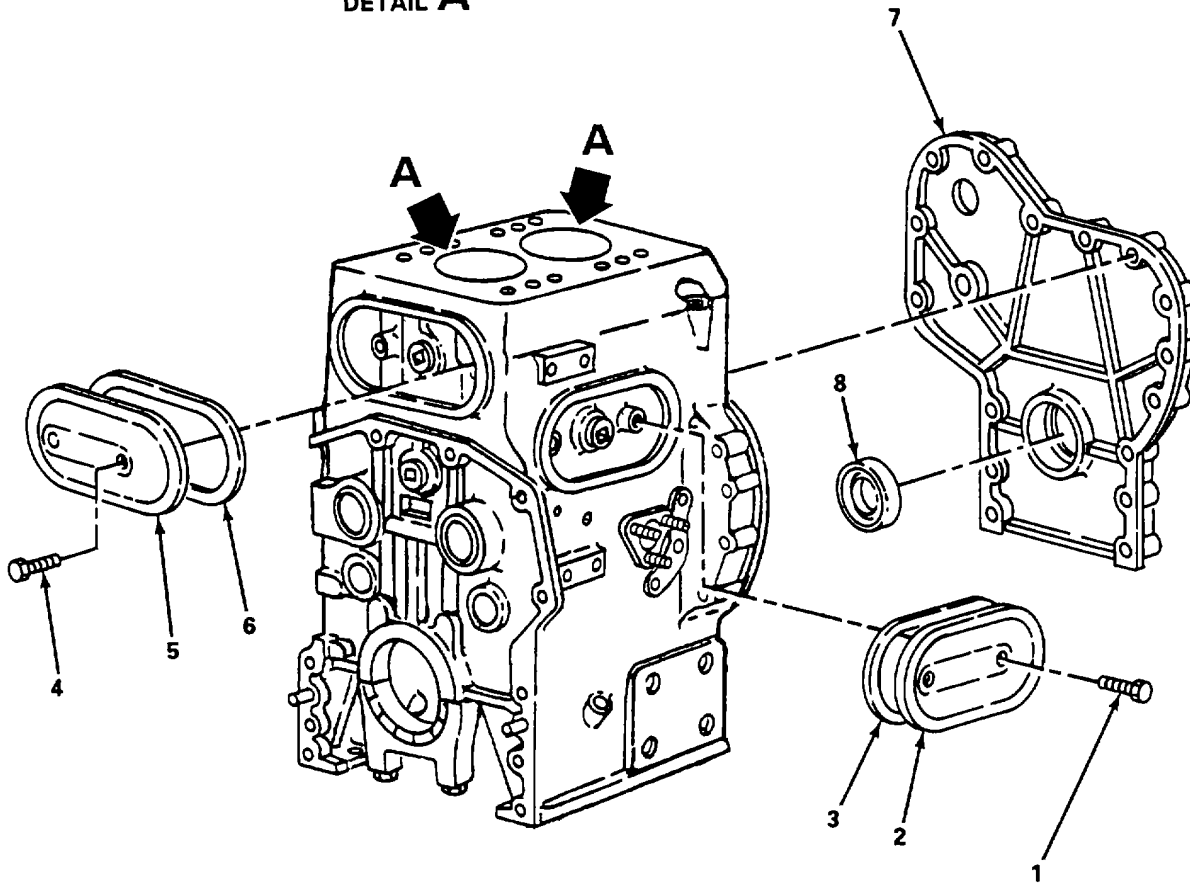
- (4) Seal all inlet and outlet openings with steel plates and gaskets, and drill and tap one cover plate to provide connection for an air line.
- (5) Connect air line to cover plate and immerse block for twenty minutes in tank of water heated to 180 to 200°F (82° to 93° C).

- (6) Apply 40 psi (276 kPa) air pressure to water jacket and observe the water in tank for bubbles, which indicates the presence of cracks or leaks in block.



MEASURE INSIDE DIAMETER OF BLOCK BORE AT PLACES A, B, C, D, E AND F ON "XZ" AND "WY" AXIS.

DETAIL A



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Figure 5-31. Cylinder Block and Front Cover Assembly, Replace.

**5-24. Cylinder Block and Front Cover Assembly (Cont).**

- (7) After pressure test is completed, remove plates and gaskets and dry block thoroughly.

**NOTE****Pressure test without the use of water tank.**

- (8) Seal all inlet and outlet openings with steel plates and gaskets. However, before attaching last plate, fill water jacket with a mixture of water and one gallon of antifreeze.
- (9) Install remaining sealing plate and tighten it securely.
- (10) Apply 40 psi (276 kPa) air pressure to water jacket and maintain pressure at least two hours.
- (11) At end of test period, examine cylinder bores, air box, oil passages, crankcase and exterior of block for presence of water and antifreeze mixture which indicates presence of cracks. If cracks are found, replace block.
- (12) After test is completed, remove all plates, and drain water jacket and blow out all the passages in block with compressed air.

**NOTE**

**Top face of block must not vary over .003 in. (.007 cm) transversely and not over .005 in. longitudinally.**

- (13) Check cylinder block for flatness using an accurate straight edge.

**NOTE**

**Master ring gage has an I. D. of 4.6270 in. (11.7525 cm) with dial set at zero.**

- (14) Using cylinder checking gage, placed in master ring gage, check bore as follows:
- (a) Rotate dial clockwise to .001 in. (.002 cm) to give a zero dial Indicator setting of 4.6260 in. (11.7500 cm).
- (b) Take measurements on surfaces at positions A, B, C, D, E and F in the bores axes 90° apart. Read measurements from the zero mark on the gage.

**NOTE**

**Standard size block bore is 4.6260-4.6270 in. (11.7500-11.7525 cm). Liner-to-block clearance, with new liner is .0005-.0025 in. (.0012-.0063 cm), and used parts, the maximum liner-to-block clearance is .003 in. (.007 cm). The out-of-round must not exceed .003 in. (.007 cm) or taper must not be more than .002 in. in each bore. Cylinder liners are available in .005, .010, .020, and .030 in. (.012, .025, .050, and .076 cm) oversize on the outside diameter.**

- (c) If measurements of block bores do not meet specifications for diameter, taper and out-of-round or if liner-to-block clearance is greater than .003 in. (.007 cm), the bores must be increased for oversize liners as shown in table 5-6.

**Table 5-6.**

Cylinder Block Bores for Various Liners		
Liner O.D.	Max. Allowable Block Bore	Block Boring Dimensions
	<u>CAST IRON BLOCK</u>	
4.626-.001 in. (11.750-.002 cm)	4.627 in. (11.752 cm)	4.627 ± .0005 in. (11.750 ± .0012 cm)
4.627-.001 in. (11.752-.002 cm)	4.628 in. (11.755 cm)	4.628 ± .0005 in. (11.755 ± .0012 cm)
4.631-.001 in. (11.762-.002 cm)	4.632 in. (11.765 cm)	4.632 ± .0005 in. (11.765 ± .0012 cm)
4.636-.001 in. (11.775-.002 cm)	4.637 in. (11.777 cm)	4.637 ± .0005 in. (11.777 ± .0012 cm)
4.646-.001 in. (11.800-.002 cm)	4.647 in. (11.803 cm)	4.647 ± .0005 in. (11.803 ± .0012 cm)
4.656-.001 in. (11.826-.002 cm)	4.657 in. (11.828 cm)	4.657 ± .0005 in. (11.828 ± .0012 cm)

- (15) Check main bearing bores as follows:

- (a) Install main bearing caps in their original position and torque bolts to 165-175 lb-ft (224-238 Nm).

**NOTE**

**Bearing bores must be 3.812-3.813 in. (9.682-9.685 cm).**

- (b) Measure bearing bores, if bores do not fall within these limits, replace cylinder block.
- (c) Check main bearing bores for alinement. Bearing bores may be considered properly alined with one another if a crankshaft with standard size journals can be rotated freely by hand, after new main bearing shells have been installed and lubricated.
- (d) If a main bearing bore is more than .001 in. (.002 cm) out of alinement, block must be replaced.
- (16) Inspect camshaft and balance shaft bearings in block for signs of scoring and wear. If bearings are scored or worn excessively, the bearings must be replaced.
- (17) Inspect cylinder block surfaces and thread holes.
- (18) Inspect all the mating surfaces, or mounting pads, for flatness, nicks, and burrs.
- (19) Check dowels at the rear of block. Dowels must extend 5/8 inches from face of block.
- (20) Check that dowels used to retain crankshaft thrust washers on the rear main bearing cap extend .110-.120 in. (.279-.304 cm) from surface of bearing cap.



- (21) Inspect front cover (7) for cracks and replace if cracked or otherwise damaged.
- (22) Inspect oil seal (8) and replace if ripped or otherwise damaged. Replace oil seal (8) as follows:
  - (a) Support front cover (7) forward face on wooden blocks.
  - (b) Drive oil seal (8) out of front cover (7).

**NOTE**

**On new oil seals there is a plastic coating on the outside diameter, do not remove this coating.**

- (c) Apply a non-hardening sealant to the outside diameter of the metal casing.
- (d) Apply grease to the sealing lip.

**NOTE**

**The oil seal spacer used with older oil seals should be removed from the cover.**

- (e) Start the seal (8) straight into the bore of the front cover (7), with the lip of the seal facing toward the inner face of the front cover (7).
  - (f) Using oil seal installer, press the oil seal (8) into front cover (7) until flush with outside face of front cover (7).
- (23) Install rear air box cover (5) and gasket (6) and secure with two screws (4).
  - (24) Install side air box cover (2) and gasket (3) and secure with two screws (1).

**FOLLOW-ON MAINTENANCE**

- (1) Install crankshaft (para. 5-23).
- (2) Install camshaft, balance shaft and bearings (para. 5-22).
- (3) Install valve operating mechanism (para. 4-21).
- (4) Install fuel pump and drive (para. 3-27).
- (5) Install fuel strainer assembly (para. 3-26).
- (6) Install fuel filter assembly (para. 3-25).

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**5-25. Power Take-Off Assembly.**

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**This task covers:**

**Repair**

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**INITIAL SETUP:**

*Tools*

General Mechanic's Tool Kit  
(NSN 5180-00-177-7033)  
Mechanical (NSN 5120-00-033-5606)

*Equipment Condition*

Power take-off removed (para. 4-22). Puller Kit,

*Materials/Parts*

Solvent, dry cleaning (Item 23, Appendix D)  
Rags, Wiping (Item 21, Appendix D)

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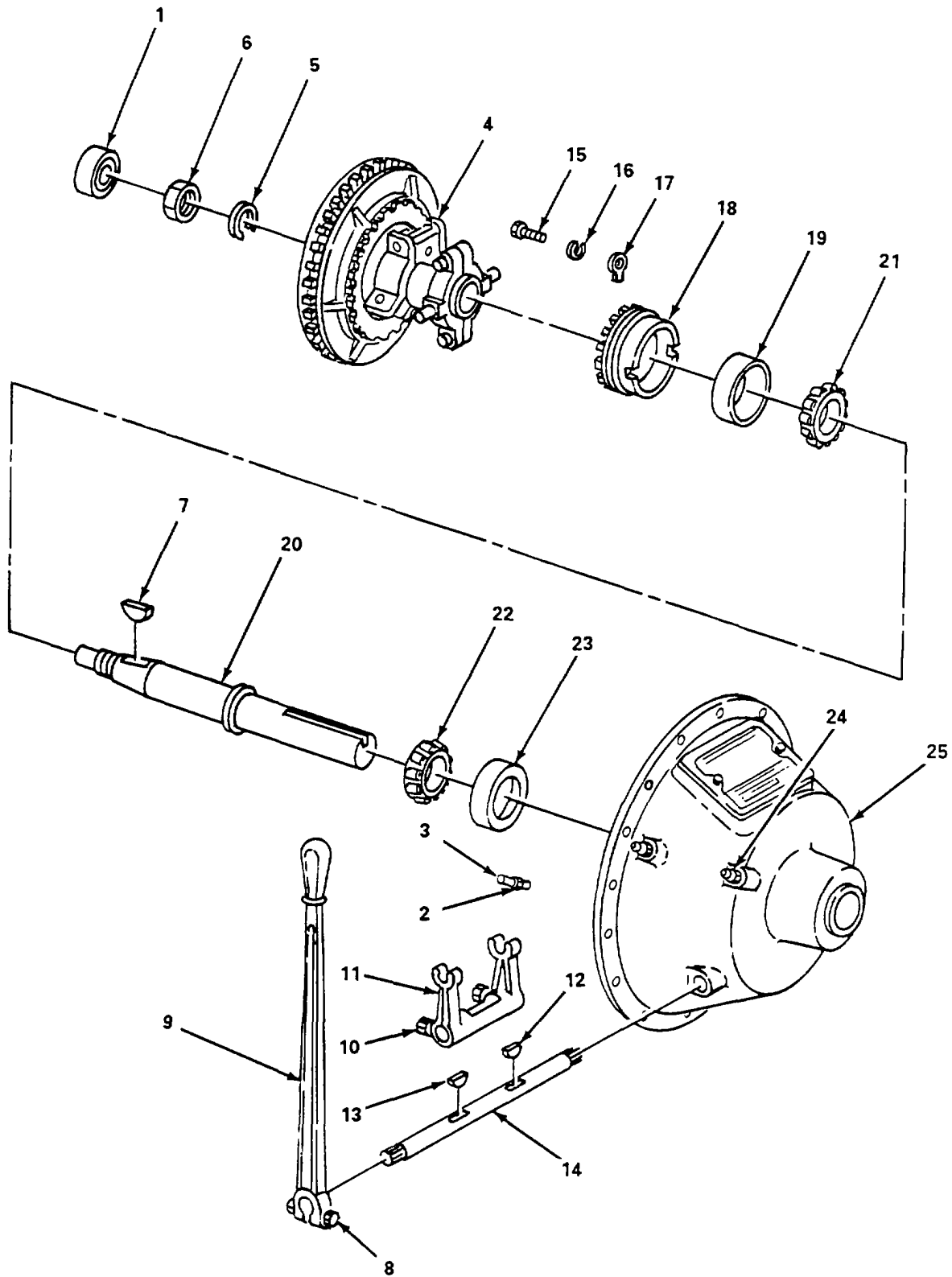
Repair. (figure 5-32)

- (1) Remove pilot bearing (1).
- (2) Loosen fitting nut (2) and remove grease line (3) from clutch assembly (4).
- (3) Bend lockwasher (5) away from nut (6) and remove nut (6), lockwasher (5), clutch assembly (4) and drive key (7).
- (4) Loosen bolt (8) and remove handle (9).
- (5) Loosen two bolts (10) and slide yoke (11) to left or right and remove two keys (12) and (13) and remove shaft (14) and yoke (11).
- (6) Remove screw (15) and lockwasher (16) and remove lock (17).
- (7) Remove bearing retainer (18) and bearing cup (19).
- (8) Remove output shaft (20) with bearings (21) and (22) installed.

**NOTE**

**There are 3 holes at rear of housing for removal of inner bearing cup. Insert a punch in houses and tap alternately at three points to remove inner bearing cup.**

- (9) Remove inner bearing cup (23).



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Figure 5-32. Power Take-Off Assembly, Repair.

**5-25. Power Take-Off Assembly (Cont).****WARNING**

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

- (10) Clean all parts with dry cleaning solvent, and dry thoroughly.
- (11) Inspect yoke (11) and replace if cracked, worn, or otherwise damaged.
- (12) Inspect shaft (14) and replace if bent, worn or otherwise damaged.

**NOTE**

**Bearings can be checked while still on output shaft. Use a split type bearing remover to remove bearings from output shaft.**

- (13) Inspect bearings (21) and (22) and bearing cups (19) and (23). Coat bearings with light oil, and while holding inner race, rotate the bearing and outer race slowly. Replace bearing if rough or sticking spots are present.
- (14) Inspect output shaft (20) and replace if bent, worn, threads are stripped, keyway ground is worn, or shaft (20) is otherwise damaged.
- (15) Inspect pilot bearing (1) and replace if worn, scored or otherwise damaged.
- (16) Install bearings (21) and (22) as follows:
  - (a) Lubricate inside diameter of inner race of bearing (21).
  - (b) Start bearing (21) on output shaft (20) with wide side of bearing (21) facing shoulder on output shaft (20).

**CAUTION**

**The ring must bear up against the inner race of bearing to prevent damage to bearing.**

- (c) Place a .250 in. (.655 cm) thick steel ring over end of shaft and rest is on inner bearing race of bearing (21).
- (d) Press output shaft (20) onto bearing (21) until inner race is seated against shoulder on output shaft (20).
- (e) Repeat steps (a) through (d) for remaining bearings.

**NOTE**

**Perform step 16 only if bearings were removed from output shaft bearings were removed from output shaft.**

- (17) Lubricate outside diameter of inner bearing cup (23) and using block of wood or mallet, tap bearing cup (22) into housing (25) fully.
- (18) Install output shaft (20) with bearings (21) and (22) installed, bearing cup (19) and secure with bearing retainer (18).
- (19) Check output shaft end play. Output shaft end play should be 0.004-0.006 in. (0.0101 -0.0152 cm). Loosen or tighten bearing retainer (18) until proper end play is obtained.
- (20) Install lock (17) and secure with screw (15) and lockwasher (16).
- (21) Install grease gun on fitting (24) and fill bearing cavity while rotating output shaft (20), with grease until grease appears between output shaft (20) and PTO housing (25).
- (22) Install yoke (11), shaft (12), and two keys (12) and (13) and tighten two bolts (10).
- (23) Install handle (9) and tighten screw (8).
- (24) Install key (7) and clutch (4) and secure with lockwasher (5) and nut (6) and bend lockwasher(5) over nut (6).
- (25) Install grease line (3) and tighten fitting nut (2).
- (26) Install pilot bushing (1).

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**5-26. Clutch Assembly.**

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**This task covers:****Repair**

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**INITIAL SETUP:***Tools*

General Mechanic's Tool Kit  
(NSN 5180-0-1 77-7033)  
Caliper Set, Micrometer (NSN 5210-00-554-7134)

*Equipment Condition*

Clutch assembly removed (para. 4-23).

*Materials/Parts*

Solvent, Dry Cleaning (Item 23, Appendix D)  
Rags, Wiping (Item 21, Appendix D)

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Repair. (figure 5-33)

**NOTE**

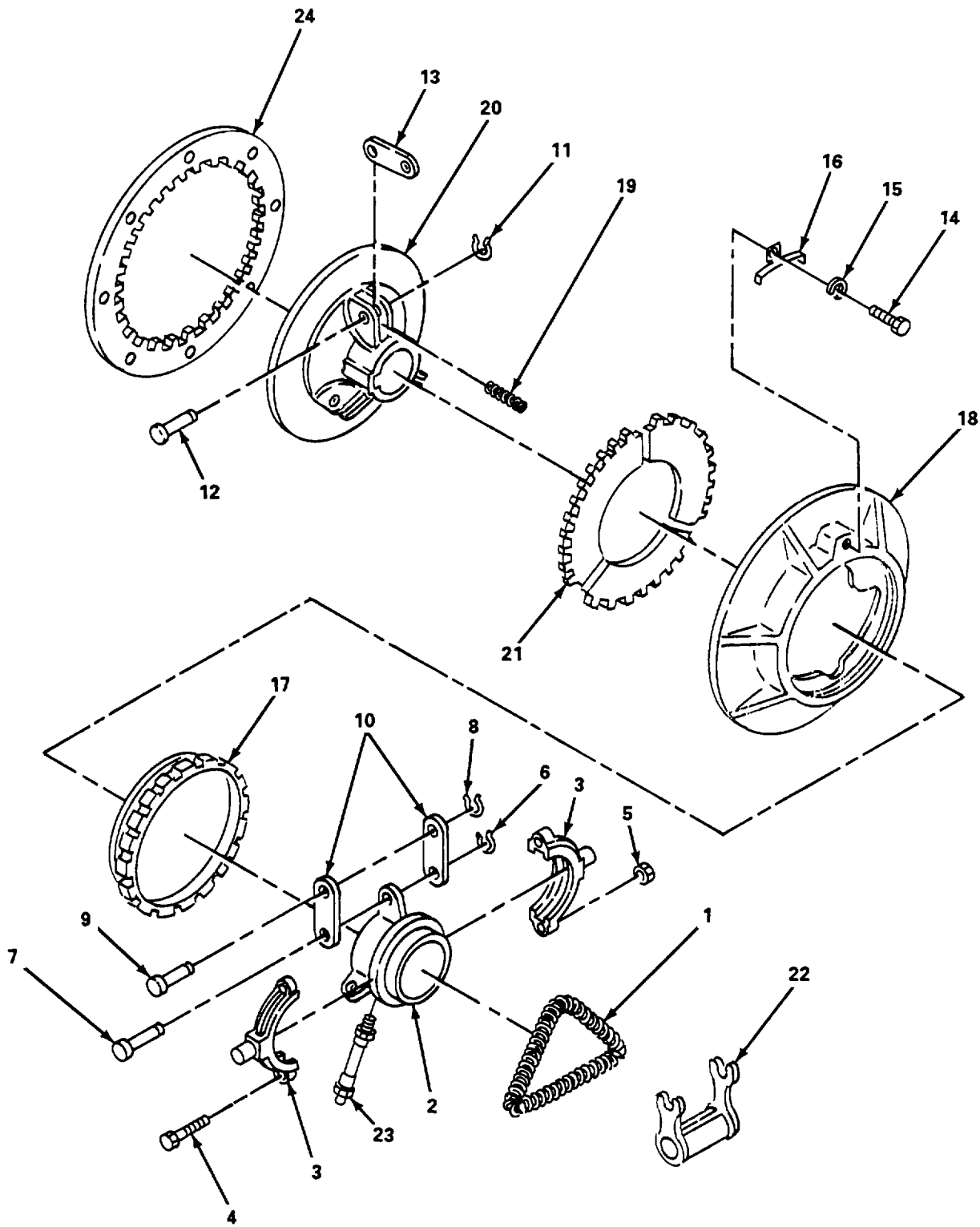
**The clutch assembly is partially disassembled for removal.**

- (1) Remove clutch release spring (1) from clutch release sleeve (2).
- (2) Mark release sleeve collar (3) and release sleeve (2) and remove two screws (4) and nuts (5) and remove release sleeve collar (3) from release sleeve (2).
- (3) Remove three retaining rings (6) and pins (7) and remove release sleeve (2).
- (4) Remove three retaining rings (8) and pins (9) and remove six links (10).
- (5) Remove three retaining rings (11) and pins (12) and remove three levers (13).
- (6) Remove screw (14) and lockwasher (15) and remove lock (16).
- (7) Remove adjusting ring (17) from pressure plate (18).
- (8) Remove pressure plate (18) and three springs (19) from clutch body (20).

**WARNING**

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

- (9) Clean all items except clutch discs (21) with dry cleaning solvent and dry thoroughly.



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Figure 5-33. Clutch Assembly, Repair.

**5-26. Clutch Assembly (Cont).**

- (10) Inspect three clutch discs (21) and replace if worn, cracked, excessively scored, or missing teeth. Replace any clutch disc that is less than .3125 in. (.7947 cm) thick.
- (11) Inspect face of clutch body (20) and replace clutch body (20) if face is cracked, worn, warped, or clutch body (20) is otherwise damaged.
- (12) Inspect pressure plate (18) and replace if worn, cracked, warped, or otherwise damaged.
- (13) Inspect the adjusting ring (17) and replace if threads are stripped or ring (17) is otherwise damaged.
- (14) Inspect clutch release sleeve (2) and collar (3) mating surfaces and replace if either piece is cracked, shows excessive wear, or are otherwise damaged.
- (15) Inspect yoke (22) and replace if cracked, bent, worn, or otherwise damaged.
- (16) Inspect grease line (23) and replace if line is cracked or fittings are stripped or otherwise damaged.
- (17) Inspect drive ring (24) and replace if cracked, teeth are worn, chipped, missing or ring (24) is otherwise damaged.
- (18) Inspect all other items and replace all items that are worn or otherwise damaged.
- (19) Check springs (19). Spring pressure should be 15 to 20 lbs (33-44 kg) when spring is compressed to 1.8125 in. (2.072 cm). Replace a spring which does not meet the specification.
- (20) Install three springs (19) and pressure plate (18) on clutch body (20).
- (21) Install adjusting ring (17) in pressure plate (18) fully.
- (22) Install lock (16) and secure with screw (14) and lockwasher (15).

**NOTE****Install pins with head of pin in direction of rotation of clutch.**

- (23) Install three levers (13) and secure with three pins (12) and retaining rings (11).
- (24) Install six links (10) and secure with three pins (9) and retaining rings (8).
- (25) Install release sleeve (2) and position six links (10) and secure with three pins (7) and retaining rings (6).
- (26) Lubricate two halves of release sleeve collar (3).
- (27) Install release sleeve collar (3) and secure with two screws (4) and nuts (5).



- (28) Ensure release sleeve collar (3) spins freely around release sleeve (2). Place shims between halves of release sleeve collar (3) as needed.
- (29) Install clutch release spring (1).

**FOLLOW-ON MAINTENANCE**  
Install clutch assembly (para. 4-23)

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**5-27. Compressor Intercooler.**

---

**This task covers:****Replace**

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**INITIAL SETUP:***Tools*

General Mechanic's Tool Kit  
(NSN 5180-00-177-7033)  
Puller, Mechanical (NSN 5120-00-313-9496)  
Torque Wrench (NSN 5120-0-554-7292)

*Materials/Parts*

Intercooler  
Gasket, Intercooler  
Tape (Item 24, Appendix D)

*Materials/Parts (Cont)*

Bands, Rubber (Item 5, Appendix D)  
Bags, Plastic (Item 4, Appendix D)  
Detergent, Nonionic (Item 10, Appendix D)

*Equipment Condition*

Air compressor assembly removed (para. 4-24).  
Shroud removed (para. 4-29).

---

Replace. (figure 5-34)

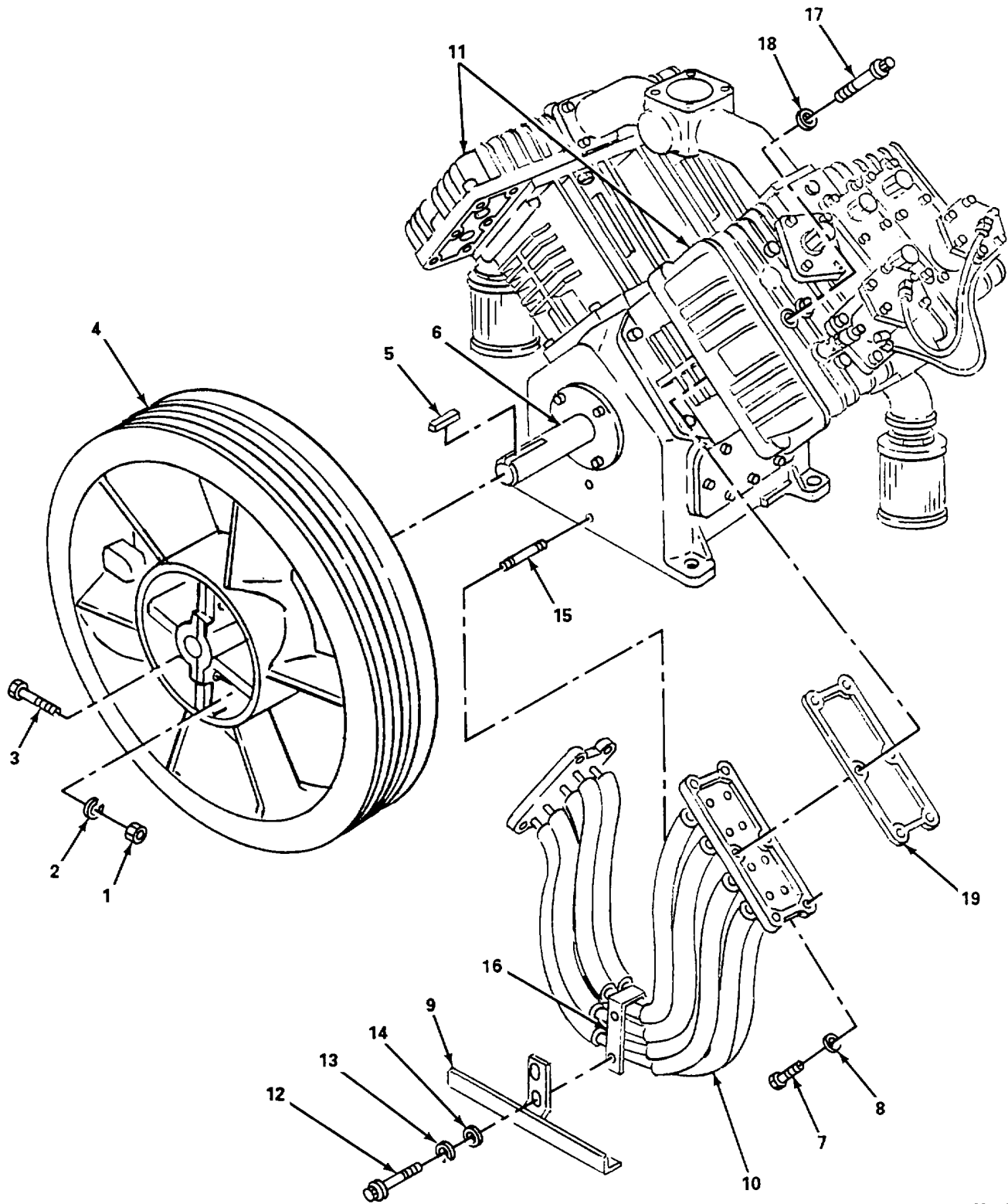
- (1) Remove two nuts (1), washers (2), and pulley hub clamp bolts (3).
- (2) Using suitable puller, remove pulley (4) and pulley key (5), from crankshaft (6).

**WARNING**

**Cleanliness is imperative in maintaining and handling diving air system components. All tools and parts must be kept free of oil, grease, rust, or other contamination in accordance with accepted army diving cleaning procedures. Foreign substances within an assembly could result in equipment failure and possible injury or death to personnel.**

**Ensure that all air lines and components removed or openings into the air system that provides breathing air are covered with a plastic bag and secured with a rubber band or taped shut. Small components should be stored in a plastic bag and sealed. Failure to do so will cause air system to become contaminated and could result in injury or death to the diver.**

- (3) Remove ten screws (7), lockwashers (8) and four bracket (9) securing intercooler (10) to head assemblies (11).
- (4) Remove two screws (12), lockwashers (13), washers (14), and spacers (15) securing intercooler sleeve assembly (16).
- (5) Remove screw (17) and washer (18) from each cylinder head securing intercooler.
- (6) Remove intercooler (10) and two gaskets (19).



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Figure 5-34. Compressor Intercooler, Replace.

- (7) Position intercooler (10) and two gaskets (19) on cylinder head (11) and secure with ten screws (7), lockwashers (8), and four brackets (9). Torque screws to 30 lb-ft (40 Nm).
- (8) Install screw (17) and washer (18) in each cylinder head securing intercooler. Torque screws to 30 lb-ft (40 Nm).
- (9) Install two screws (12), lockwashers (13), washers (14), and spacers (15) securing intercooler sleeve assembly (16).
- (10) Install pulley key (5) in keyway of crankshaft (6) and install pulley (4).
- (11) Install two pulley hub clamp bolts (3), washers (2), and nuts (1) on pulley and secure.
- (12) Air compressor installed, refer to para. 4-24.
- (13) Shroud installed, refer to para. 4-29.

**FOLLOW-ON MAINTENANCE**

- (1) Air compressor assembly installed (para. 4-24).
- (2) Shroud installed (para. 4-29).

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**5-28. Compressor Unloader Assembly.**

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**This task covers:****a. Replace****b. Repair**

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**INITIAL SETUP:***Tools*

General Mechanic's Tool Kit  
(NSN 5180-00-177-7033)  
Ultrasonic Cleaner W/Heater (Item 35, Appendix B)  
Tape (Item 24, Appendix D)

*Materials/Parts (Cont)*

Gasket, Unloader Plate  
Detergent, Nonionic (Item 6, Appendix D)

*Materials/Parts*

Bags, Plastic (Item 4, Appendix D)  
Unloader Assembly  
Gasket, Unloader Body

Bands, Rubber (Item 5, Appendix D)

Water, Distilled (Item 11, Appendix D)

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**a. Replace.**

- (1) Removal of unloader with 6 bolt flange. (figure 5-35)

**WARNING**

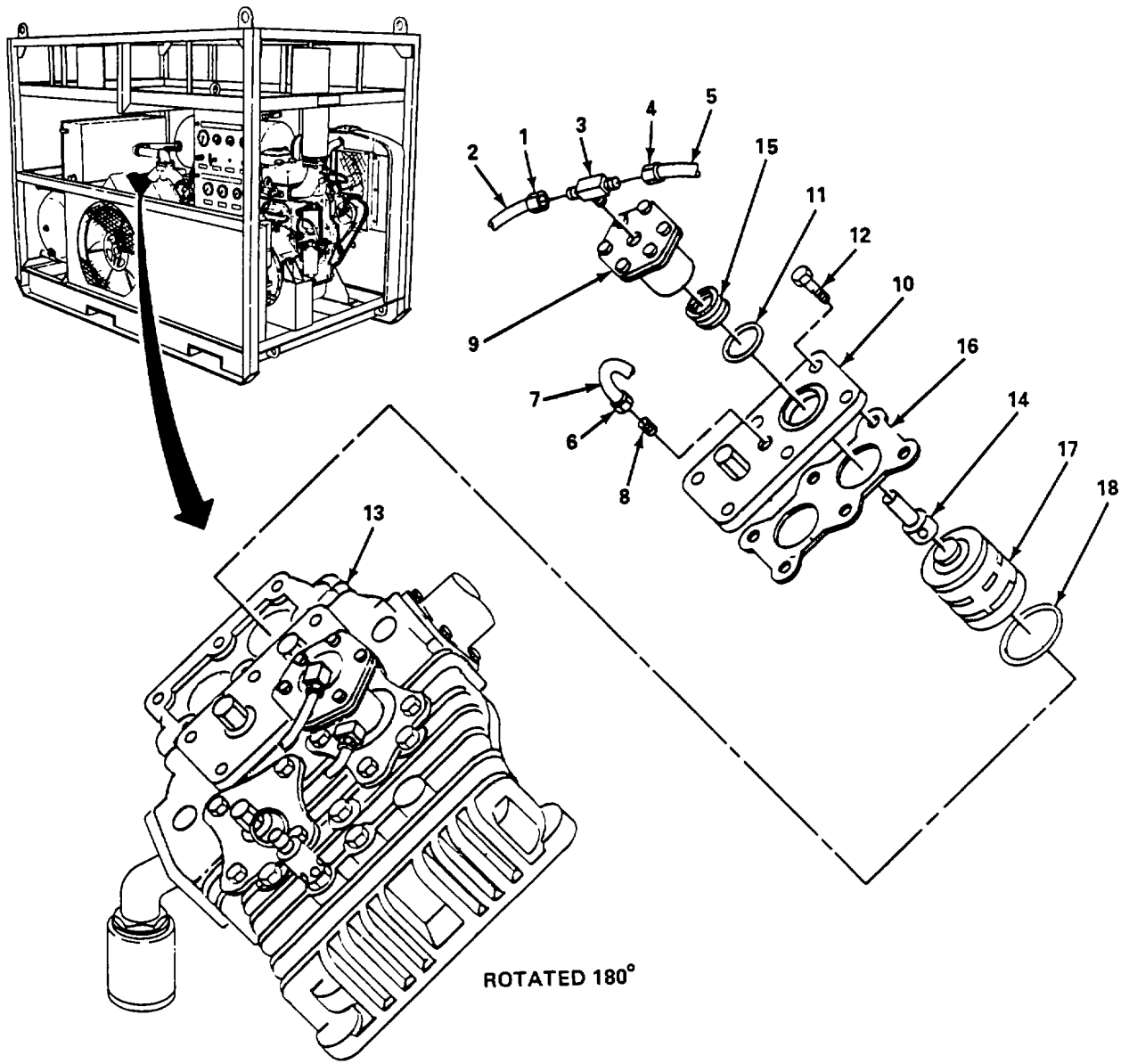
**Cleanliness is imperative in maintaining and handling diving air system components. All tools and parts must be kept free of oil, grease, rust, or other contamination in accordance with accepted army diving cleaning procedures. Foreign substances within an assembly could result in equipment failure and possible injury or death to personnel.**

**Ensure that all air lines and components removed or openings into the air system that provides breathing air are covered with a plastic bag and secured with a rubber band or taped shut. Small components should be stored in a plastic bag and sealed. Failure to do so will cause air system to become contaminated and could result in injury or death to the diver.**

**NOTE**

**Removal of the left or right cylinder head unloader assemblies are the same.**

- (a) Loosen coupling nut (1) securing copper tube (2) to tee (3).  
(b) Loosen coupling nut (4) securing copper tube (5) to tee (3).  
(c) Loosen coupling nut (6) securing copper tube (7) to fitting (8).  
(d) Remove tee (3) from unloader (9).  
(e) Using diaphragm body removal tool, remove unloader (9) from cover plate (10).

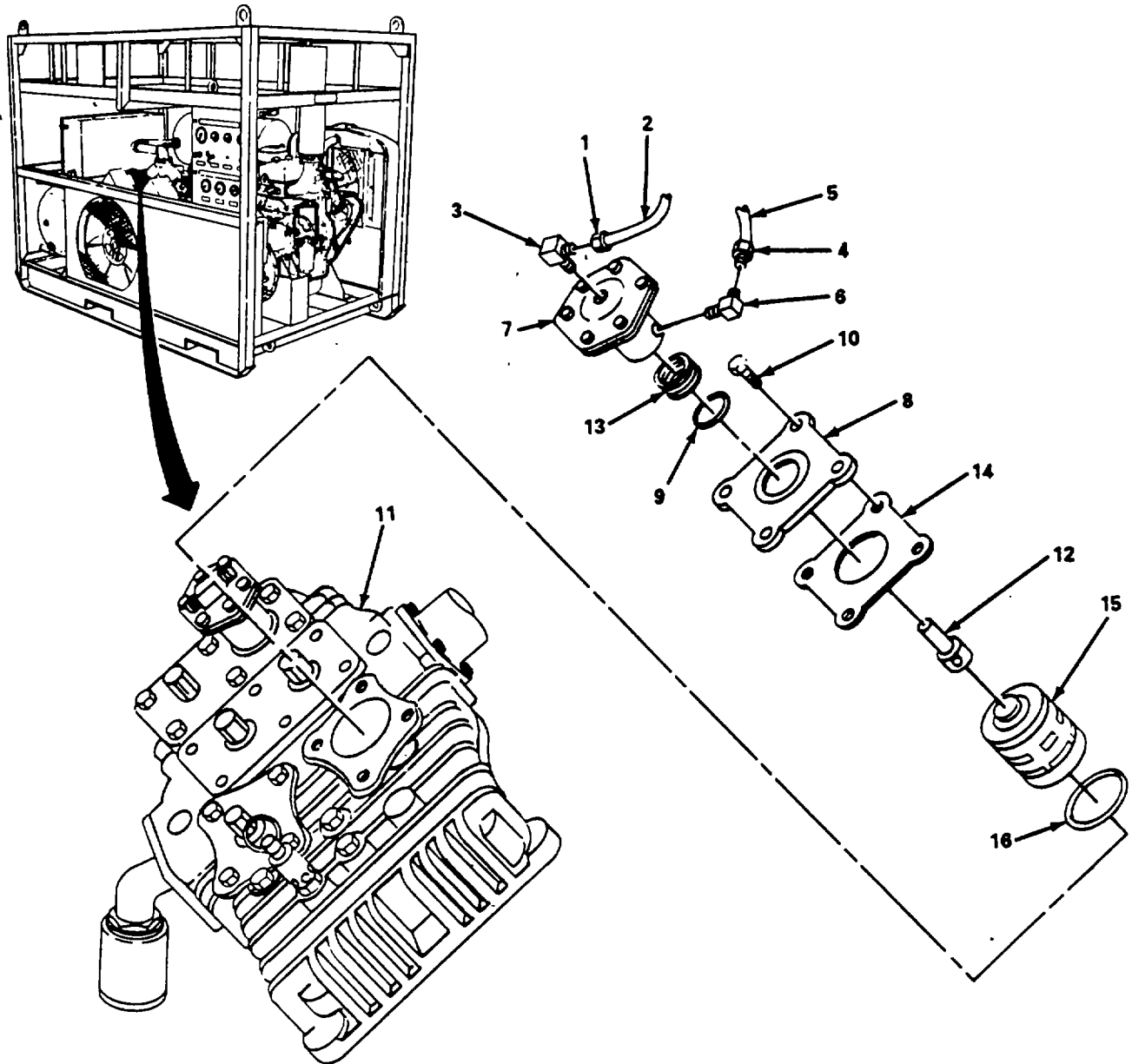


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Figure 5-35. Compressor Unloader Assembly With 6 Bolt Flange, Removal.

**5-28. Compressor Unloader Assembly (Cont).**

- (f) Remove and discard unloader body gasket (11).
  - (g) Remove six screws (12) securing cover plate (10) to cylinder head (13) and remove cover plate (10).
  - (h) Remove piston unloader (14) from unloader (9).
  - (i) Remove insert (15) from cover plate (10).
  - (j) Remove and discard cover plate gasket (16).
  - (k) Remove unloader valve (17) and gasket (18) from cylinder head (13).
- (2) *Removal of unloader with 4 bolt flange.* (figure 5-36)
- (a) Loosen coupling nut (1) securing copper tube (2) to elbow (3).
  - (b) Loosen coupling nut (4) securing copper tube (5) to unloader fitting (6).
  - (c) Remove elbow (3) from unloader (7).
  - (d) Using diaphragm body removal tools, remove unloader (7) from cover plate (8).
  - (e) Remove and discard unloader body gasket (9).
  - (f) Remove four screws (10) securing cover plate (8) to cylinder head (11) and remove cover plate .
  - (g) Remove piston unloader (12) from unloader (7).
  - (h) Remove insert (13) from cover plate (8).
  - (i) Remove and discard cover plate gasket (14).
  - (j) Remove unloader valve (15) and gasket (16) from cylinder head (11).



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Figure 5-36. Compressor Unloader Assembly With 4 Bolt Flange, Removal.



**5-28. Compressor Unloader Assembly (Cont).**

b. Repair. (figure 5-37)

**NOTE**

**Unloader assembly removed for repair per para. (1) and (2) above. There are four unloader assemblies, repair of each is the same.**

- (1) Remove six screws (1) and washers (2) securing unloader diaphragm cover (3) to unloader body (4).
- (2) Remove unloader diaphragm cover (3) and unloader diaphragm (5) from unloader body (4).
- (3) Remove unloader piston cap (6) from unloader body (4).
- (4) Remove unloader piston (7) from unloader body (4).
- (5) Remove pin unloader (8) from spacer valve retainer (9).
- (6) Remove spacer valve retainer (9) from spacer valve kickoff (10).
- (7) Remove platform unloader (11) from spacer valve kickoff (10).
- (8) Remove pin valve kickoff (12) and spring valve kickoff pin (13) from spacer valve kickoff (1\*0).
- (9) Remove stud (14) from spacer valve kickoff (10).
- (10) Remove valve intake (15) spring (16) and bumper intake valve (17) from spacer valve kickoff (10).
- (11) Clean unloader assembly using TSP ultrasonic cleaner w/heater following cleaning instructions in Chapter 3. Clean components soft goods in accordance with Chapter 3.
- (12) Inspect unloader assembly components for cracks or other signs of wear.
- (13) Replace any component that is worn or otherwise damaged.
- (14) Install bumper intake valve (17), spring (16), and valve intake (15) and secure with stud (14).
- (15) Install pin valve kickoff (12) and spring valve kickoff pin (13) in spacer valve kickoff (10).
- (16) Install platform unloader (11) and spacer valve retainer (9) on spacer valve kickoff (10).
- (17) Install pin unloader (8) in spacer valve retainer (9).
- (18) Install unloader piston (7) in unloader body (4).
- (19) Install unloader piston cap (6) in unloader body (4).
- (20) Install unloader diaphragm cover (3) with unloader diaphragm (5) on unloader body (4) and secure with six screws (1) and washers (2).

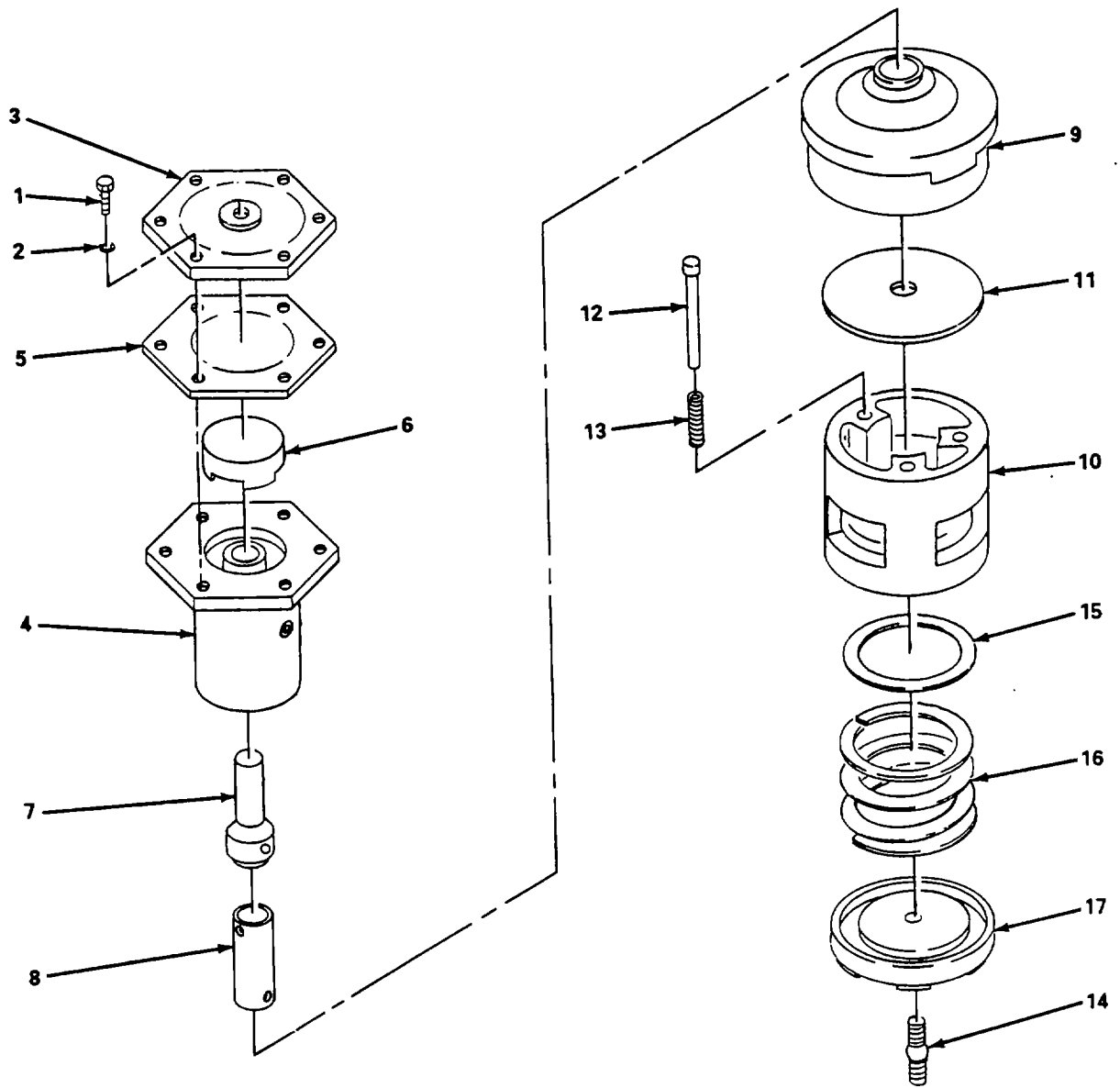


Figure 5-37. Compressor Unloader Assembly, Repair.

**5-28. Compressor Unloader Assembly (Cont).**c. *Installation Unloader with 4 Bolt Flange.* (figure 5-38)

- (1) Install unloader valve (1) with gasket (2) in cylinder head (3).
- (2) Install insert (4) into cover plate (5).
- (3) Install cover plate (5) with gasket (6) and secure with four screws (7). Torque screws to 50 lb-ft (68 Nm).
- (4) Install piston unloader (8) into unloader (9).
- (5) Install unloader (9) with gasket (10) and secure using diaphragm body removal tool.
- (6) Install elbow (11) on unloader (9).
- (7) Install copper tube (12) on unloader fitting (13) and tighten coupling nut (14).
- (8) Install copper tube (15) on elbow (11) and tighten coupling nut (16).

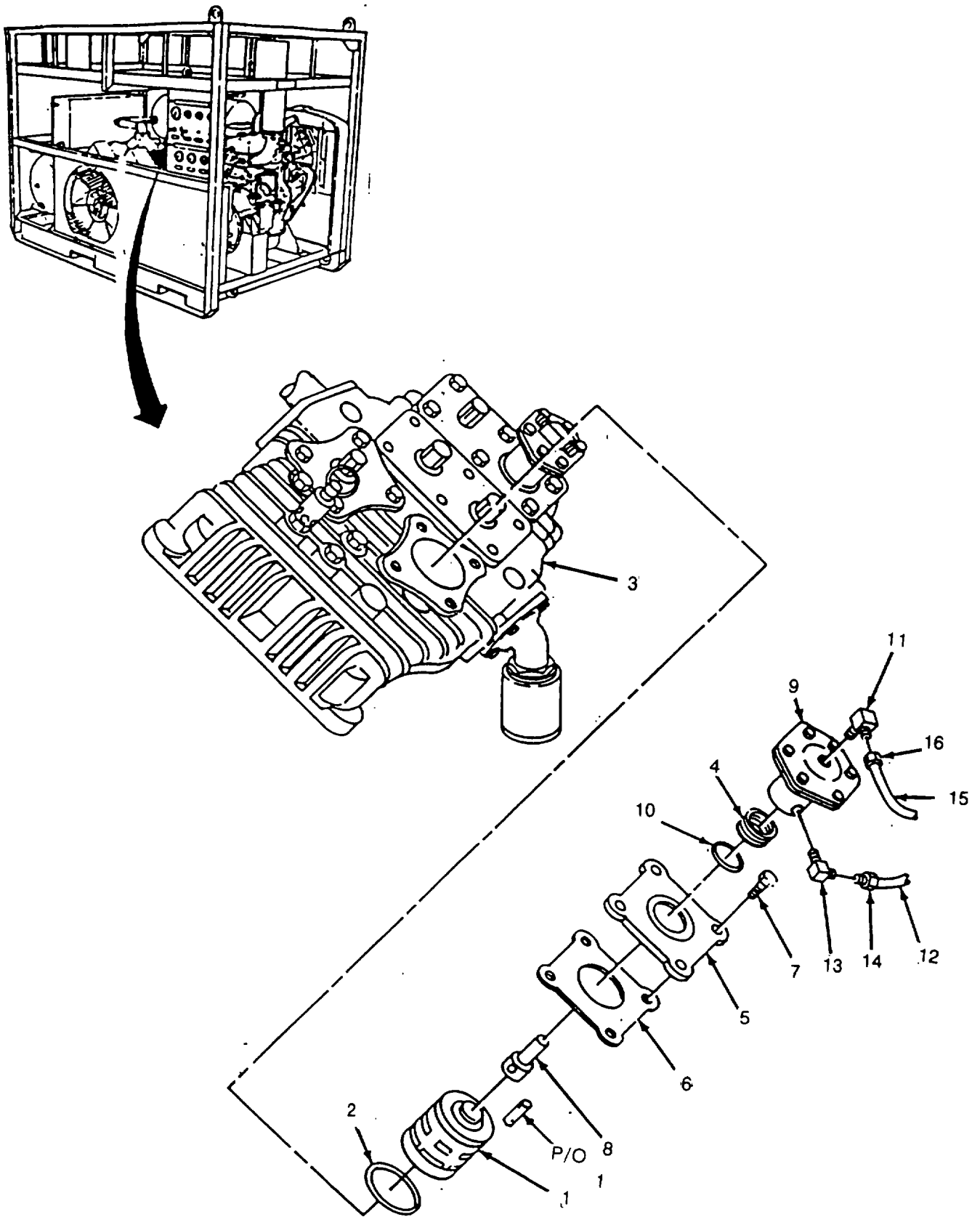


Figure 5-38. Compressor Unloader Assembly with 4 Bolt Flange, Installation.

**5-28. Compressor Unloader Assembly (Cont).**

- d. *Installation Unloader with 6 Bolt Flange.* (figure 5-39)
- (1) Install unloader valve (1) with gasket (2) in cylinder head (3).
  - (2) Install insert (4) into cover plate (5).
  - (3) Install cover plate (5) with gasket (6) and secure with six screws (7). Torque screws to 50 lb-ft (68 Nm).
  - (4) Install piston unloader (8) into unloader (9).
  - (5) Install unloader (9) with gasket (10) and secure using diaphragm body removal tool.
  - (6) Install tee (11) on unloader (9).
  - (7) Install copper tube (12) on fitting (13) and tighten coupling nut (14).
  - (8) Install copper tube (15) on tee (11) and tighten coupling nut (16).
  - (9) Install copper tube (17) on tee (11) and tighten coupling nut (18).

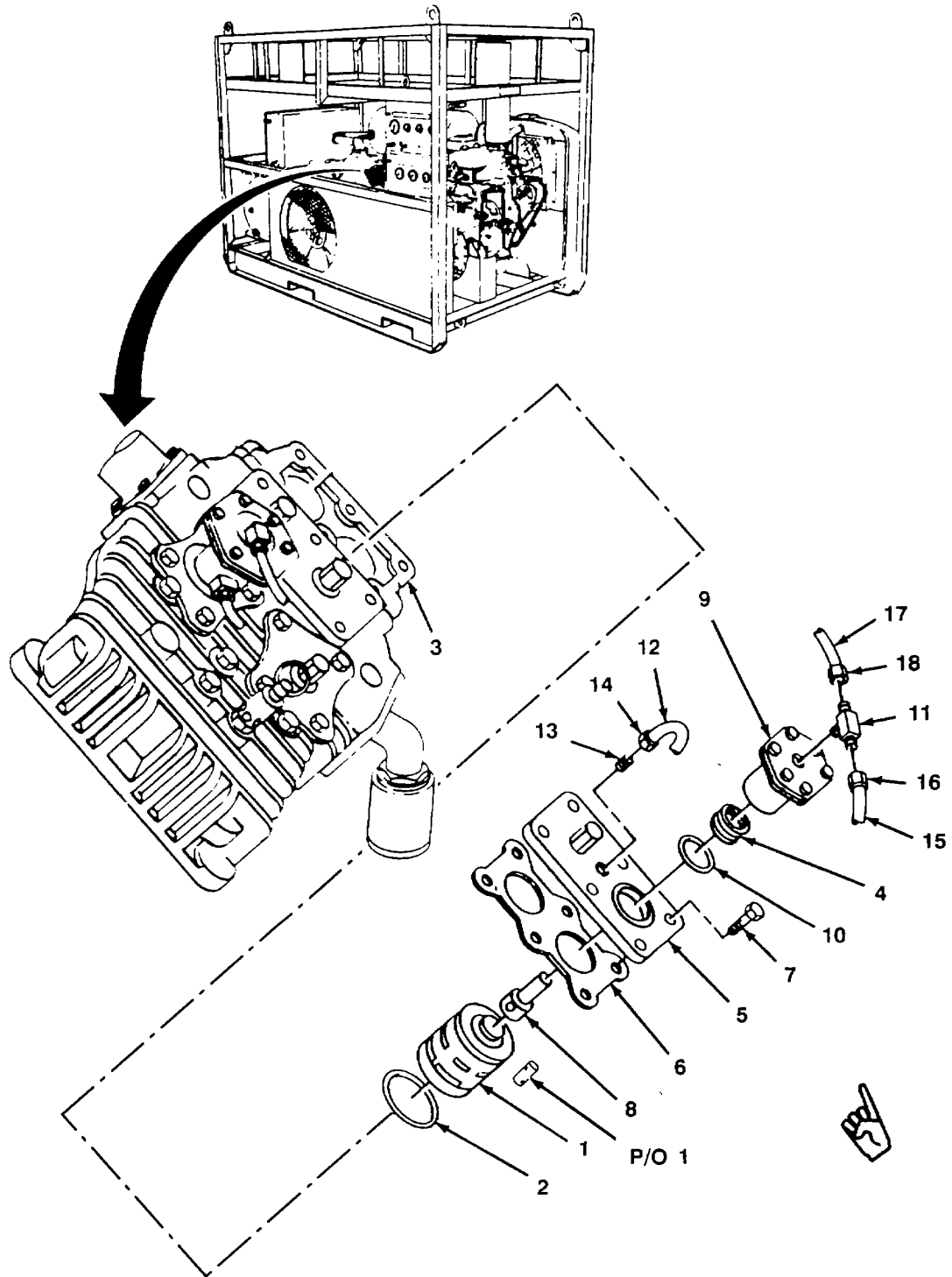


Figure 5-39. Compressor Unloader Assembly With 6 Bolt Flange, Installation.

---

**5-29. Compressor Cylinder Head.**

---

**This task covers:****a. Replace****b. Repair**

---

**INITIAL SETUP:***Tools*

General Mechanic's Tool Kit  
(NSN 5180-00-177-7033)  
Wrench, Torque (NSN 5120-00-554-7292)

*Materials/Parts*

Cylinder Head, Compressor  
Gasket, Compressor Cylinder Head  
Detergent, Nonionic (Item 10, Appendix D)  
Tape (Item 24, Appendix D)  
Bands, Rubber (Item 5, Appendix D)  
Bags, Plastic (Item 4, Appendix D)

*Equipment Condition*

Shroud removed (para. 4-29).  
Air cleaner intake removed (para. 3-28).  
Intake and discharge valves removed (para. 5-30).  
Unloaders removed (para. 5-28).  
Intercooler removed (para. 5-27).  
Manifold removed (para. 4-30).

a. Replace. (figure 5-40)

**WARNING**

**Cleanliness is imperative in maintaining and handling diving air system components. All tools and parts must be kept free of oil, grease, rust, or other contamination in accordance with accepted army diving cleaning procedures. Foreign substances within an assembly could result in equipment failure and possible injury or death to personnel.**

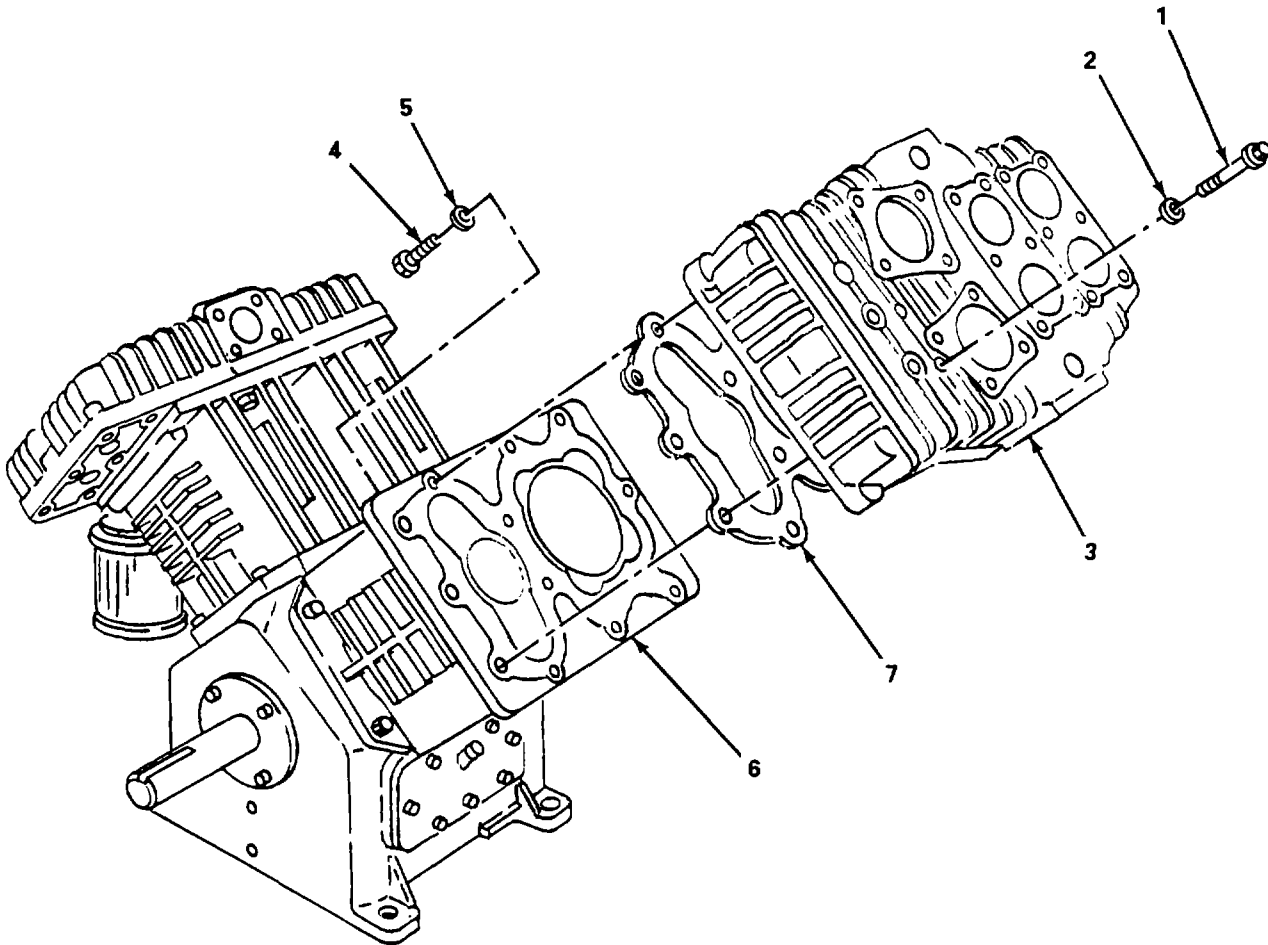
**Ensure that all air lines and components removed or openings into the air system that provides breathing air are covered with a plastic bag and secured with a rubber band or taped shut. Small components should be stored in a plastic bag and sealed. Failure to do so will cause air system to become contaminated and could result in injury or death to the diver.**

**NOTE**

**There are two head assemblies. Remove of each one is the same.**

- (1) Remove six screws (1) and washers (2) from cylinder head (3).
- (2) Remove six screws (4) and washers (5) from cylinder head (3).
- (3) Remove cylinder head (3) from cylinder (6).
- (4) Remove and discard cylinder head gasket (7).

- (5) Install cylinder head (3) and gasket (7) on cylinder (3).
- (6) Install six screws (4) and washers (5) and six screws (1) and washers (2) in cylinder head (3). Torque screws to 30 lb-ft (40 Nm).



4951-164

Figure 5-40. Compressor Cylinder Head, Replace and Repair.



b. Repair.

**NOTE**

**Cylinder head removed for repair. See para. a. above.**

- (1) Clean cylinder head using nonionic detergent cleaner and rinse with clean distilled water.
- (2) Inspect cylinder head for cracks, stripped threads or other damage.
- (3) If cylinder head is cracked, replace cylinder head.

**FOLLOW-ON MAINTENANCE**

- (1) Install manifold (para. 4-30).
- (2) Install intercooler (para. 5-27).
- (3) Install unloaders (para. 5-28).
- (4) Install intake and discharge valves (para. 5-30).
- (5) Install air cleaner intake (para. 3-28).
- (6) Install shroud (para. 4-29).

---

**5-30. Compressor Intake and Discharge Valves**


---

This task covers:

a. Replace

b. Repair

---

**INITIAL SETUP:**
*Tools*

General Mechanic's Tool Kit  
(NSN 518--00-177-7033)  
Ultrasonic Cleaner W/Heater (Item 35, Appendix B)  
Torque Wrench (NSN 5120--00-554-7292)

*Materials/Parts*

Intake Valve  
Discharge Valve  
Intake Unloader Valve  
Gasket, Cover Plate 4 Bolt Flange

*Materials/Parts (Cont)*

Gasket, Cover Plate 6 Bolt Flange  
Tape (Item 24, Appendix D)  
Bands, Rubber (Item 5, Appendix D)  
Bags, Plastic (Item 4, Appendix D)  
Water, Distilled (Item 11, Appendix D)  
Detergent, Nonionic (Item 10, Appendix D)

Equipment Condition

Compressor, Unloader Assembly  
removed (para p528).

---

a. Replace.

(1) Intake valve. (figure 5-41)

**WARNING**

**Cleanliness is imperative in maintaining and handling diving air system components. All tools and parts must be kept free of oil, grease, rust, or other contamination in accordance with accepted army diving cleaning procedures. Foreign substances within an assembly could result in equipment failure and possible injury or death to personnel.**

**Ensure that all air lines and components removed or openings into the air system that provides breathing air are covered with a plastic bag and secured with a rubber band or taped shut. Small components should be stored in a plastic bag and sealed. Failure to do so will cause air system to become contaminated and could result in injury or death to the diver.**

**NOTE**

**Same procedure is done to other side of compressor.**

- (a) Remove six screws (1) securing valve cover (2) to head assembly (3).
- (b) Remove valve cover (2) and gasket (4) from head assembly (3).
- (c) Remove intake valve (5) and gasket (6) from head assembly (3).
- (d) Install intake valve (5) with gasket (6).
- (e) Install valve cover (2) with gasket (4) and secure with six screws (1). Torque screws to 37lb-ft (50 Nm).

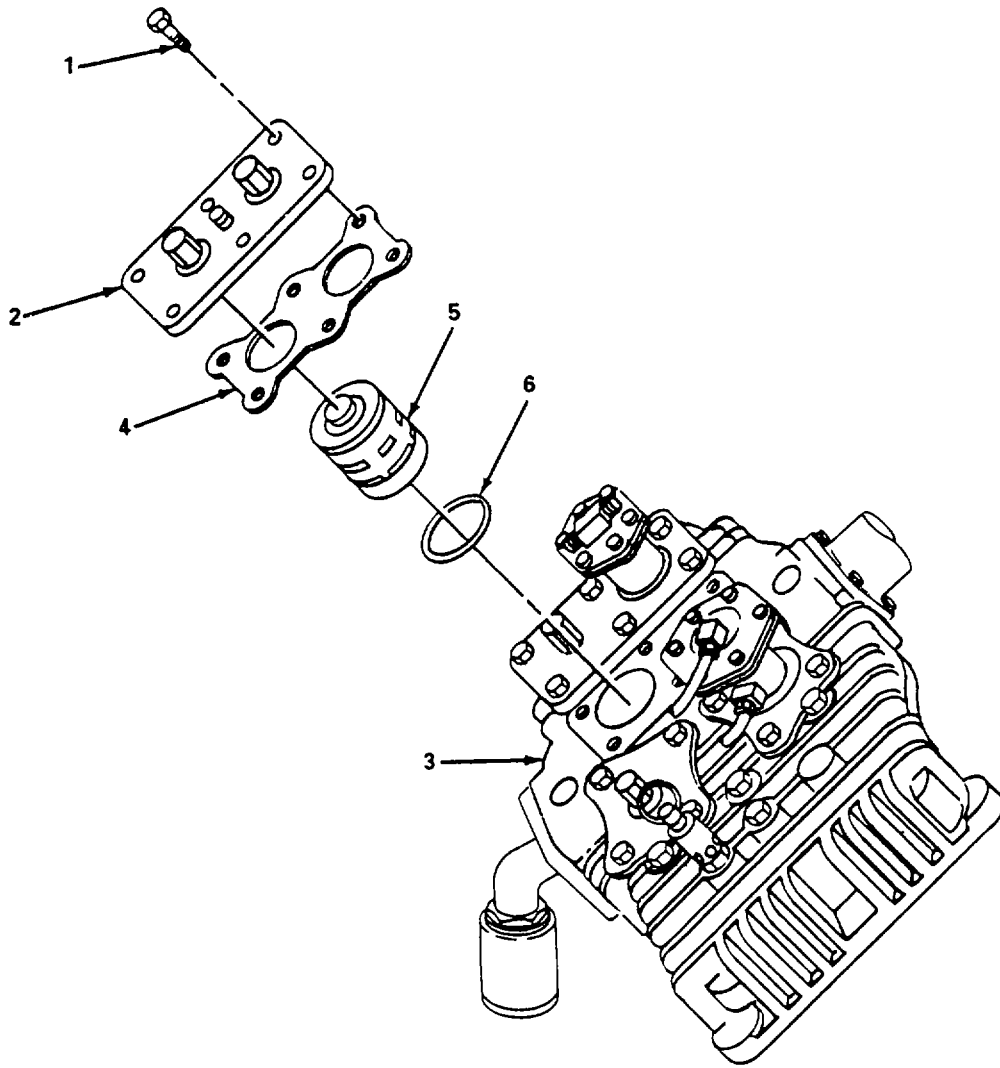


Figure 5-41. Compressor Intake Valve, Replace.

**5-30. Compressor Intake and Discharge Valves (Cont).**

- (2) Discharge valve (under 4 bolt flange). *(figure 5-42)*
  - (a) Remove four screws (1) securing valve cover (2) to head assembly (3).
  - (b) Remove valve cover (2) and gasket (4) from head assembly (3).
  - (c) Remove discharge valve (5) and gasket (6) from head assembly (3).
  - (d) Ensure flanges are clean and free of gasket materials.
  - (e) Install discharge valve (5) with gasket (6).
  - (f) Install valve cover (2) with gasket (4) and secure with four screws (1). Torque screws to 50lb-ft (68 Nm).
- (3) Discharge valve (under 6 bolt flange, plain). *(figure 5-42)*
  - (a) Remove six screws (7) securing valve cover (8) to head assembly (3).
  - (b) Remove valve cover (8) and gasket (9) from head assembly (3).
  - (c) Remove discharge valve (10) and gasket (11) from head assembly (3).
  - (d) Ensure flanges are clean and free of gasket materials.
  - (e) Install discharge valve (10) with gasket (11).
  - (f) Install valve cover (8) with gasket (9) and secure with six screws (7). Torque screws to 50lb-ft (68 Nm).
- (4) Discharge valve (under 6 bolt flange with unloader). *(figure 5-42)*
  - (a) Loosen coupling nuts (17) and (18) securing copper tube (19) to tee (15) and fitting (20) and remove tube.
  - (b) Loosen coupling nuts (21) and (22) securing copper tube (23) to fitting (24) and (25) and remove tube.
  - (c) Remove six screws (26) that secures cover plate (27) to head assembly (3) and remove cover plate and gasket (28).
  - (d) Remove discharge valve (29) and gasket (30) from head assembly (3).
  - (e) Ensure flanges are clean and free of gasket materials.

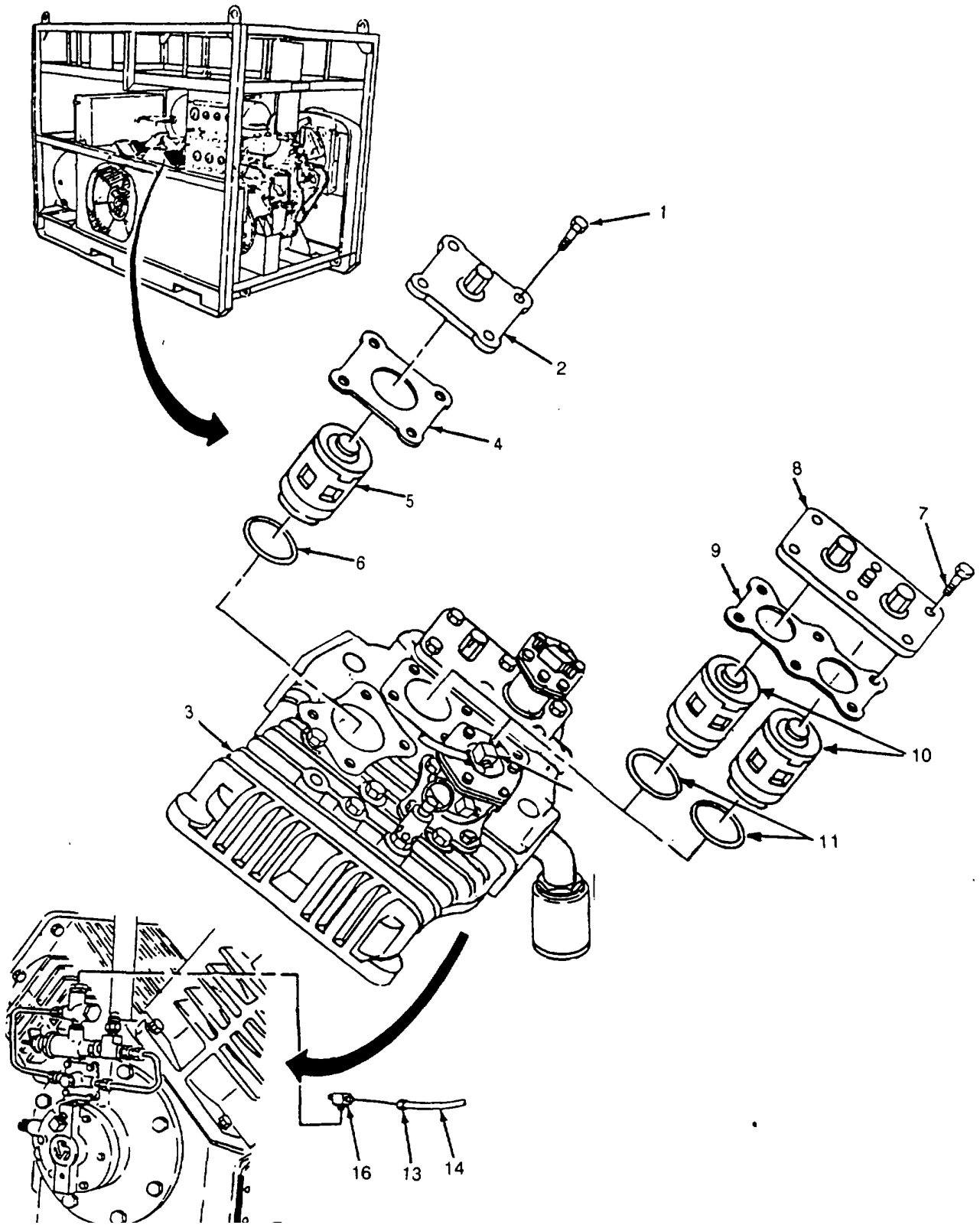


Figure 5-42. Compressor Discharge Valves, Replace.

Change 1 5-135

**5-30. Compressor Intake and Discharge Valves (Cont).**

- (g) Install discharge valve (29) with gasket (30) in head assembly (3).
  - (h) Install cover plate (27) with gasket (28) and secure with six screws (26). Torque screws to 37lb-ft (50 Nm).
  - (i) Install copper tube (23) on fittings (24) and (25) and tighten coupling nuts (21) and (22).
  - (j) Install copper tube (19) on tee (15) and fitting (20) and tighten coupling nuts (17) and (18).
  - (k) Install copper tube (14) on tees (15) and (16) and tighten coupling nuts (12) and (13).
- (4) Intake unloader valves. (*figure 543*).
- (a) Loosen coupling nuts (1) and (2) securing copper tube (3) to tees (4) and (5) and remove tube.
  - (b) Loosen coupling nuts (6) and (7) securing copper tube (8) to tee (4) and fitting (9) and remove tube.
  - (c) Loosen coupling nuts (10) and (11) securing copper tube (12) to fittings (13) and (14) and remove tube.
  - (d) Remove six screws (15) that secures cover plate (20) to head assembly (17) and remove cover plate (16) and gasket (18).
  - (e) Remove intake unloader valve (19) and gasket (20) from head assembly (17).
  - (f) Remove four screws (21) that secures cover plate (22) to head assembly (17) and remove cover plate and gasket (23).
  - (g) Remove intake unloader valve (24) and gasket (25) from head assembly (17).
  - (h) Ensure flanges are clean and free of gasket material.
  - (i) Install intake unloader valve (24) with gasket (25) in head assembly (17).
  - (j) Install cover plate (22) with gasket (23) and secure with four screws (21). Torque screws to 50lb-ft (68 Nm).
  - (k) Install intake unloader valve (19) with gasket (20) in head assembly (17).
  - (l) Install cover plate (16) with gasket (18) and secure with six screws (15). Torque screws to 50 lb-ft (68 Nm).
  - (m) Install copper tube (12) on fittings (13) and (14) and tighten coupling nuts (10) and (11).
  - (n) Install copper tube (8) on tee (4) and fitting (9) and tighten coupling nuts (6) and (7).
  - (o) Install copper tube (3) on tees (4) and (5) and tighten coupling nuts (1) and (2).

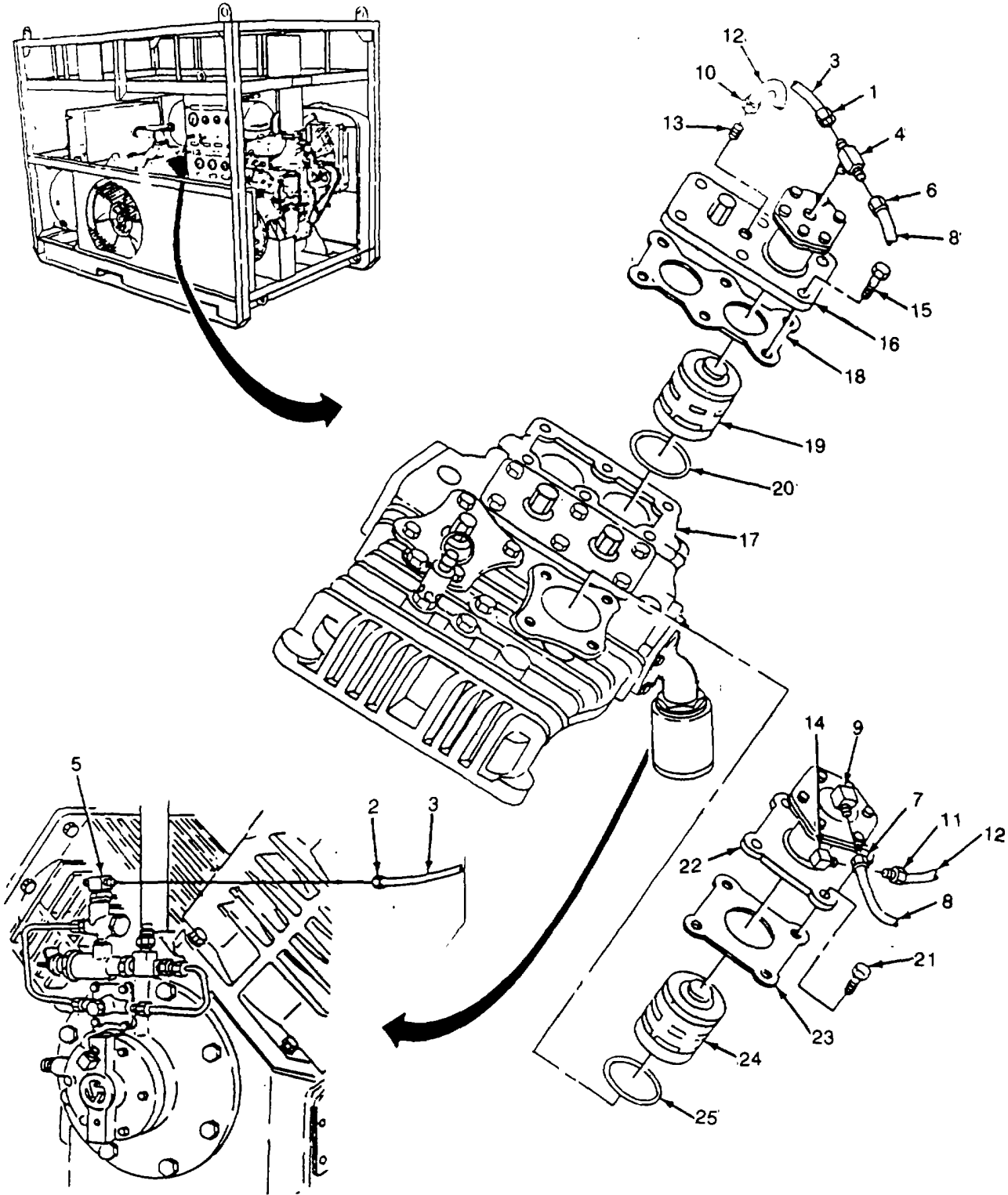


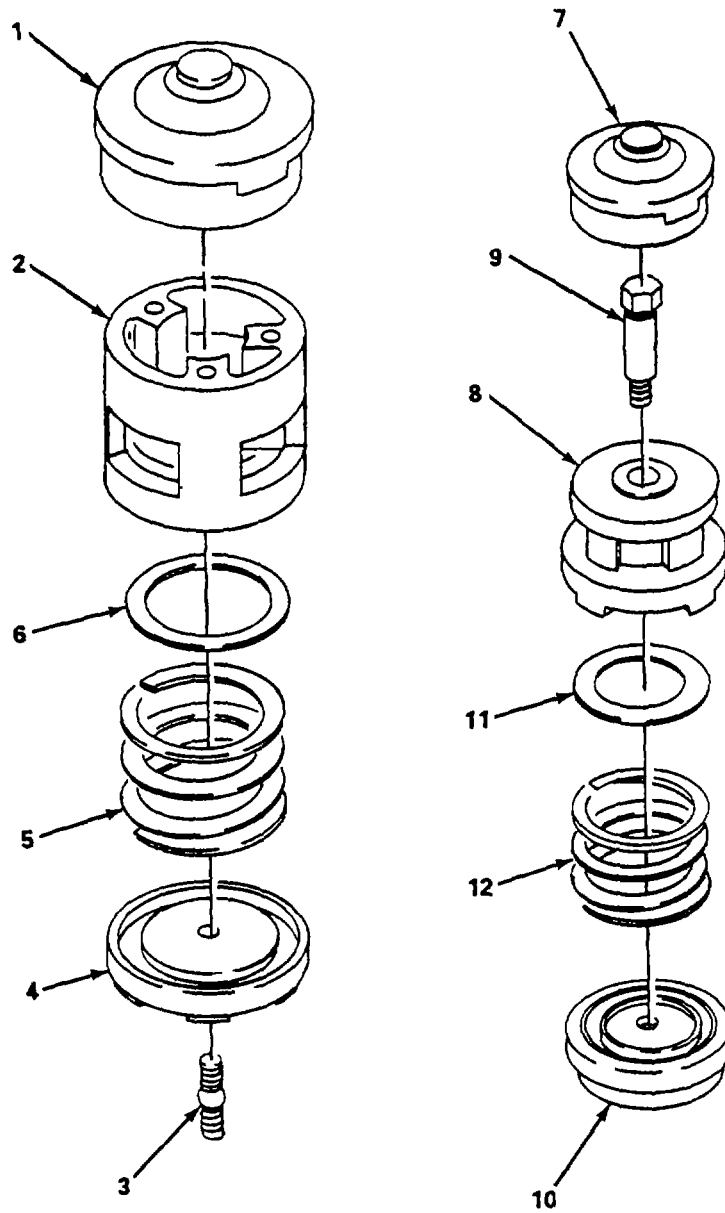
Figure 5-43. Compressor Intake Unloader Valves, Replace.

Change 1 5-137

**5-30. Compressor Intake and Discharge Valves (Cont).***b. Repair Intake and Discharge Valves. (figure 5-44).*

- (1) Remove spacer (1) from intake valve seat (2).
- (2) Remove stud (3) securing bumper intake valve (4) to seat intake valve (2).
- (3) Remove bumper intake valve (4), spring (5) and valve (6) from seat intake valve.
- (4) Clean intake valve using TSP ultrasonic cleaner w/heater following cleaning instructions in Chapter 3. Clean components soft goods in accordance with Chapter 3.
- (5) Inspect intake valve components for cracks, bent stud, worn or other signs of damage.
- (6) Replace any component that is worn, cracked or otherwise damaged.
- (7) Install valve (6), spring (5), and bumper intake valve (4) on seat intake valve (2) and secure with stud (3).
- (8) Install spacer (1) on seat intake valve (2).
- (9) Remove spacer (7) from bumper (8).
- (10) Remove stud (9) securing bumper (8) to seat discharge valve (10).
- (11) Remove bumper (8), valve (11), and spring (12) from seat discharge valve (10).
- (12) Clean discharge valve using TSP ultrasonic cleaner w/heater following cleaning instructions in Chapter 3. Clean components soft goods in accordance with Chapter 3.
- (13) Inspect discharge valve components for cracks, bent stud, worn or other signs of damage.
- (14) Replace any component that is worn, cracked or otherwise damaged.
- (15) Install spring (12), valve (11), and bumper (8) on seat discharge valve (10) and secure with stud (9)
- (16) Install spacer (7) on bumper (8).





**Figure 5-44. Compressor Intake, Discharge, and Intake Unloader, Repair.**

FOLLOW-ON MAINTENANCE:  
 Install compressor unloader assembly. (para 5-28).

---

**5-31. Compressor Pistons, Connecting Rods, and Bearings**


---

This task covers:

a. Replace

b. Repair

---

**INITIAL SETUP:**
*Tools*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)  
 Caliper Set, Micrometer (NSN 5210-00-554-7134)  
 Cir-Clip Pliers (NSN 5120-00-789-0492)  
 Ring Compressor (NSN 5120-00-223-8848)  
 Torque Wrench (NSN 5120-00-554-7292)  
 TSP Ultrasonic Cleaner W/Heater (Item 35,  
 Appendix B)

*Materials/Parts*

Piston, Low Pressure  
 Piston, High Pressure

*Materials/Parts (Cont)*

Detergent, Nonionic (Item 10, Appendix D)  
 Connecting Rod, Low Pressure  
 Connecting Rod, High Pressure  
 Gasket, Cylinder  
 Tape (Item 24, Appendix D)  
 Bands, Rubber (Item 5, Appendix D)  
 Bags, Plastic (Item 4, Appendix D)  
 Water, Distilled (Item 11, Appendix D)

*Equipment Condition*

Cylinder head removed (para. 5-29).

---

a. Removal. (figure 5-45)

**WARNING**

**Cleanliness is imperative in maintaining and handling diving air system components. All tools and parts must be kept free of oil, grease, rust, or other contamination in accordance with accepted army diving cleaning procedures. Foreign substances within an assembly could result in equipment failure and possible injury or death to personnel.**

**Ensure that all air lines and components removed or openings into the air system that provides breathing air are covered with a plastic bag and secured with a rubber band or taped shut. Small components should be stored in a plastic bag and sealed. Failure to do so will cause air system to become contaminated and could result in injury or death to the diver.**

**NOTE**

**There are two pistons and connecting rods in each cylinder. Removal of each is the same.**

- (1) Remove drain plug (1) and drain oil into suitable container.
- (2) Remove ten screws (2) securing handhole plate (3) on side, opposite the cylinder head being removed.
- (3) Remove and discard handhole plate gasket (4).
- (4) Turn pulley (5) as necessary to allow removal of connecting rod nuts (6), washers (7), and bolts (8).

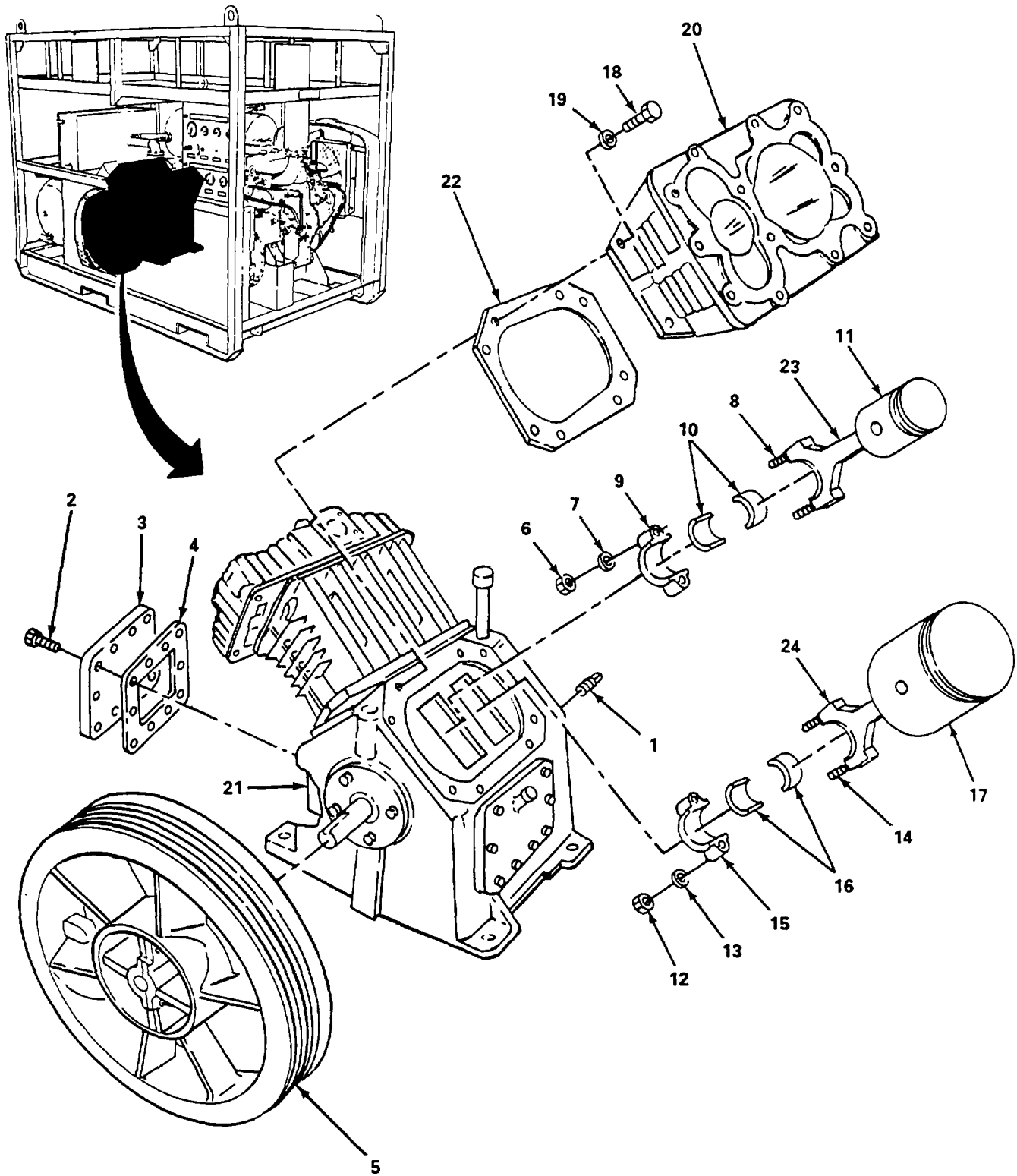


Figure 5-45. Compressor Pistons, Connecting Rods, and Bearings, Removal.

5-31. **Compressor Pistons, Connecting Rods, and Bearings (Cont).**

- (5) Remove two nuts (6), washers (7), connecting rod bolts (8), bearing cap (9) and two bearing halves (10) from high-pressure piston assembly (11).
- (6) Remove two nuts (12), washers (13), connecting rod bolts (14), bearing cap (15) and two bearing halves (16) from low-pressure piston assembly (17).
- (7) Remove eight screws (18) and lockwashers (19) securing cylinder (20) to crankcase (21) and remove cylinder from pistons (11) and (17) and crankcase (21).
- (8) Remove gasket (22) from cylinder (20).
- (9) Remove piston assemblies (11) and (17) and connecting rods (23) and (24) from crankcase (21).

b. Repair. (figure 5-46)

- (1) Remove two snap rings (1) securing high-pressure piston pin (2).
- (2) Remove high-pressure piston pin (2) and connecting rod (3) from piston (4).
- (3) Remove three compression rings (5) and oil rings (6) from high-pressure piston (4).
- (4) Using cir-clip pliers, remove two retaining rings (7) securing low-pressure piston pin (8).
- (5) Remove low-pressure piston pin (8) and connecting rod (9) from piston (10).
- (6) Remove three compression rings with seals (11) and oil ring (12) from low-pressure piston (10).
- (7) Clean pistons and connecting rod components with TSP following procedures in Chapter 3.
- (8) Inspect pistons and connecting rods for cracks, scuff marks, ridges or other signs of wear.

**NOTE**

**High pressure piston outside diameter is 3.246-3.249 in.(8.244-8.252 cm) and low pressure piston outside diameter outside diameter is 5.996-5.999 in.(15.229-15.237 cm). A maximum clearance of .005 in.(.012 cm) is allowable.**

- (9) Measure outside diameter of low and high pressure piston and replace diameters not within specified limits.
- (10) Replace any component that is worn or otherwise damaged.
- (11) Install three compression rings (11) and oil ring (12) on low-pressure piston (10).
- (12) Install connecting rod (9) and piston pin (8) and using cir-clip pliers, secure with two retaining rings (7).
- (13) Install three compression rings (5) and oil ring (6) on high-pressure piston (4).

(14) Install connecting rod (3) and piston pin (2) and using cir-clip pliers, secure with two snap rings (1).

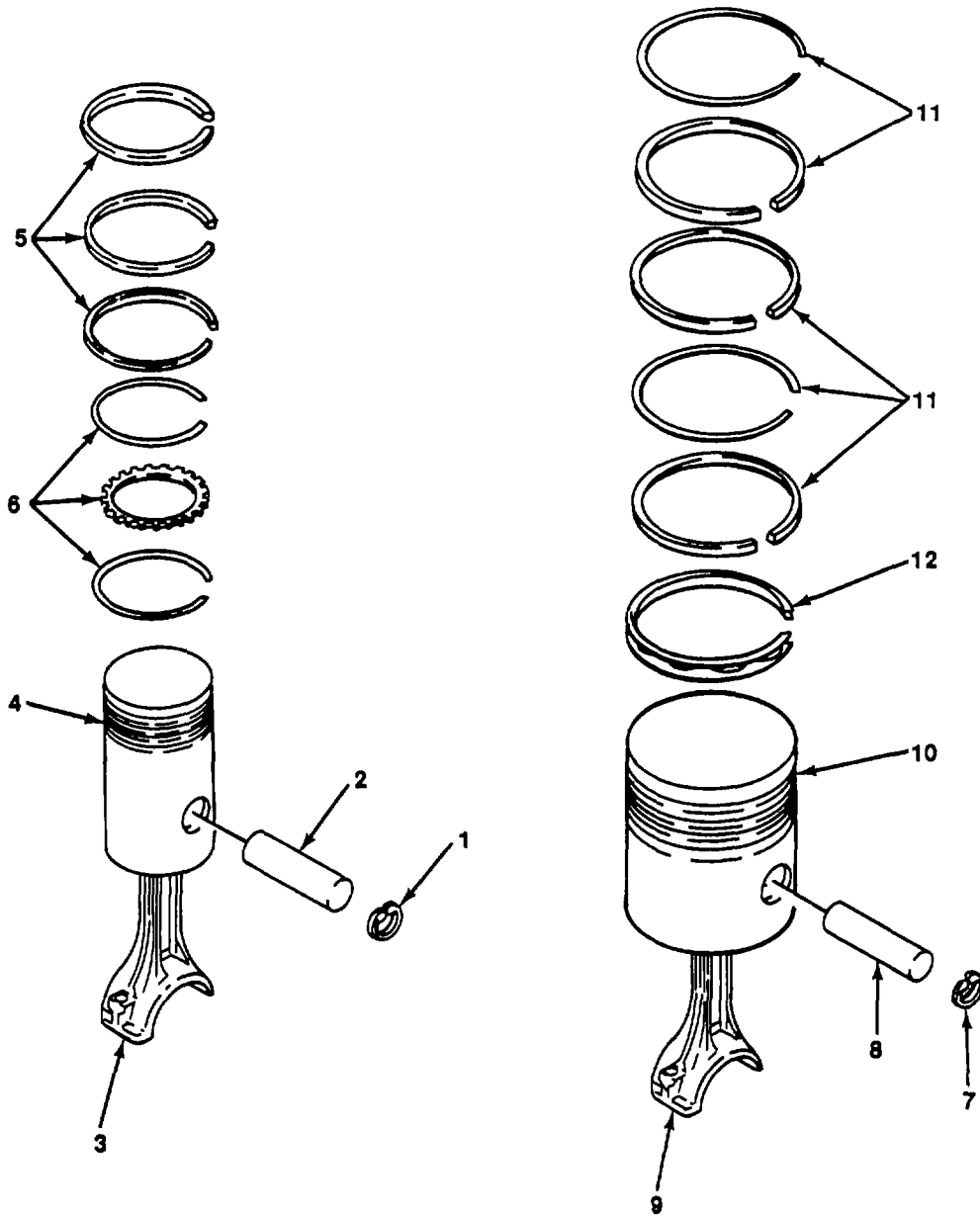


Figure 5-46. Compressor Pistons, Connecting Rods, Repair.

5-31. **Compressor Pistons, Connecting Rods, and Bearings (Cont).**

c. Install. (figure 5-47)

**CAUTION**

**Extreme care must be taken when installing the pistons into the cylinders. Both the rings and pistons are brittle and will break if forced, even if using a ring compressor.**

**NOTE**

**High pressure piston must be installed into the cylinder prior to installing the cylinder onto the crankcase. The high pressure piston connecting rod will not fit through the cylinder.**

- (1) Install low-pressure piston assembly (1) and connecting rod (2) in cylinder (3) .
- (2) Install high-pressure piston assembly (4) and connecting rod (5) in cylinder (3).
- (3) Ensure all flanges are free of gasket materials and clean.
- (4) Install cylinder (3) with gasket (6) on crankcase (7) while aligning connecting rods (2) and (5) in position over crankshaft journals, and secure with eight screws (8) and lockwashers (9). Torque screws to 40 lb-ft (54 Nm).
- (5) Turn pulley (10) as necessary to allow installing of connecting rod nuts (11), washers (12), and bolts (13).
- (6) Install two bearing halves (14), bearing cap (15), connecting rod bolts (13), washers (12) and nuts (11). Torque bolts to 40 lb-ft (54 Nm).
- (7) Turn pulley (10) as necessary to allow installing of connecting rod nuts (16), washers (17), and bolts (18). Torque bolts to 40 ft-lbs (54 Nm).
- (8) Install two bearing halves (19), bearing cap (20), connecting rod bolts (18), washers (17), and nuts (16).
- (9) Install handhole plate (21) with handhole plate gasket (22) and secure with ten screws (23). Torque screws to 9 ft-lbs (1220 Nm).
- (10) Install drain plug (24) and refill oil.

**FOLLOW-ON MAINTENANCE**  
Install cylinder head (para. 5-29).

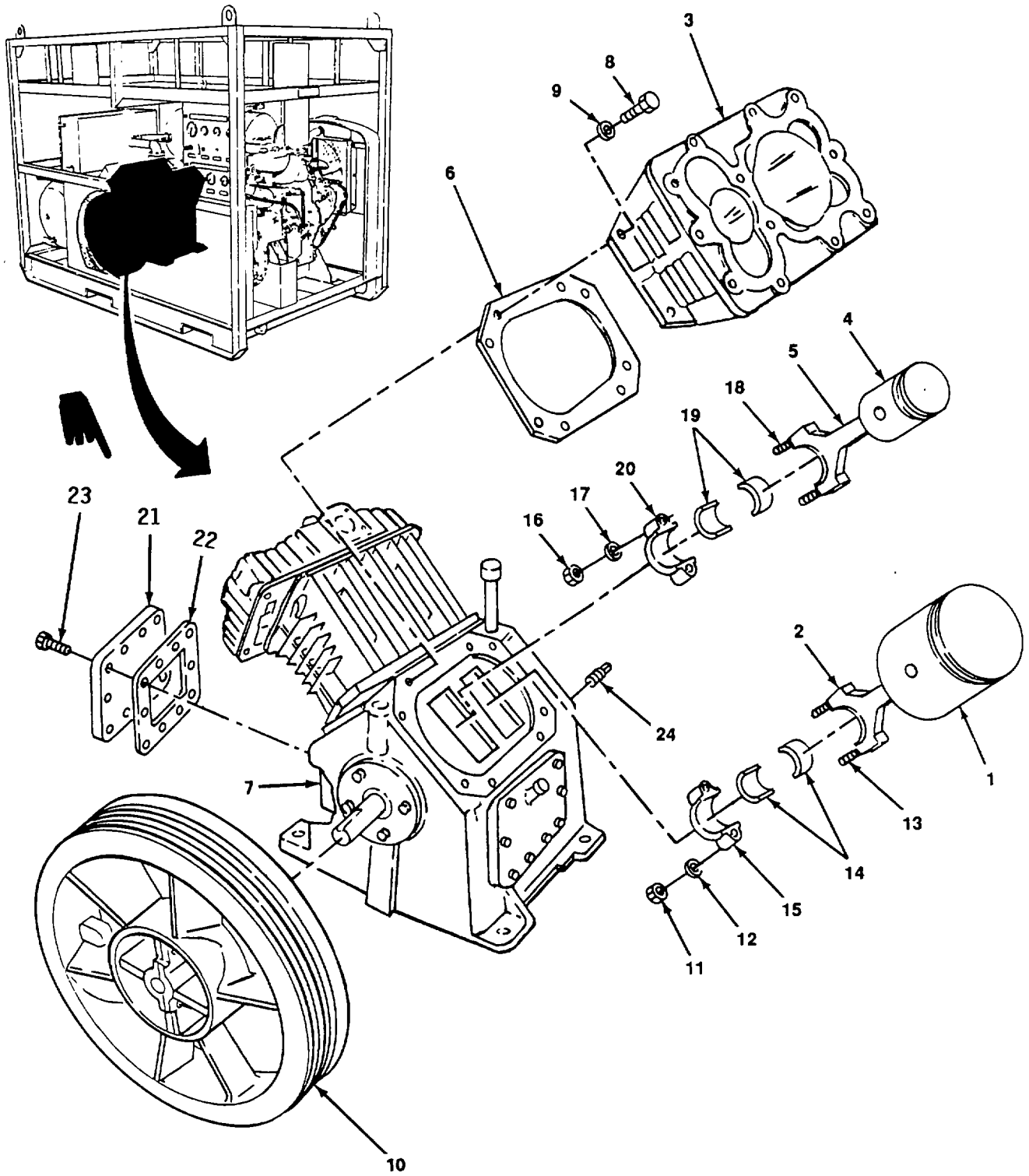


Figure 5-47. Compressor Pistons, Connecting Rods and Bearings, Installation.

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**5-32. Compressor Cylinders**


---

**This task covers:**

**Repair**

---

**INITIAL SETUP:**

*Tools*

General Mechanic's Tool Kit  
(NSN 5180-00-177-7033)  
Wrench, Torque (NSN 512-00-554-7292)  
Gage, Cylinder Bore (NSN 5210-00-494-1774)

*Materials/Parts*

Cylinder, Compressor  
Detergent, Nonionic (Item 10, Appendix D)  
Gasket, Crankcase

*Materials/Parts (Cont)*

Tape (Item 24, Appendix D)  
Bands, Rubber (Items, Appendix D)  
Bags, Plastic (Item 4, Appendix D)

*Equipment Condition*

Pistons, connecting rods and bearings removed  
(para 5-31).

---

Repair. (figure 5-48)

**NOTE**

**There are two cylinders. Removal of each cylinder is the same.**

- (1) Remove eight screws (1) and lockwashers (2) securing cylinder (3) to crankcase (4) and remove cylinder.
- (2) Remove and discard cylinder to crankcase gasket (5).

**WARNING**

**Cleanliness is imperative in maintaining and handling diving air system components. All tools and parts must be kept free of oil, grease, rust, or other contamination in accordance with accepted army diving cleaning procedures. Foreign substances within an assembly could result in equipment failure and possible injury or death to personnel.**

- (3) Clean cylinders using nonionic detergent cleaner and rinse with clean distilled water.
- (4) If cylinder has any cracks, replace cylinder. Magnaflux cylinder and check for cracks or other damage.
- (5) Inspect cylinder for out-of round, if cylinder is out-of-round, replace cylinder.

**NOTE**

**Cylinder bore for high pressure piston is 3.250-3.251 in. (8.255-8.257 cm) and bore for low pressure piston is 6.000-6.001 in. (15.2400-15.2425 cm).**

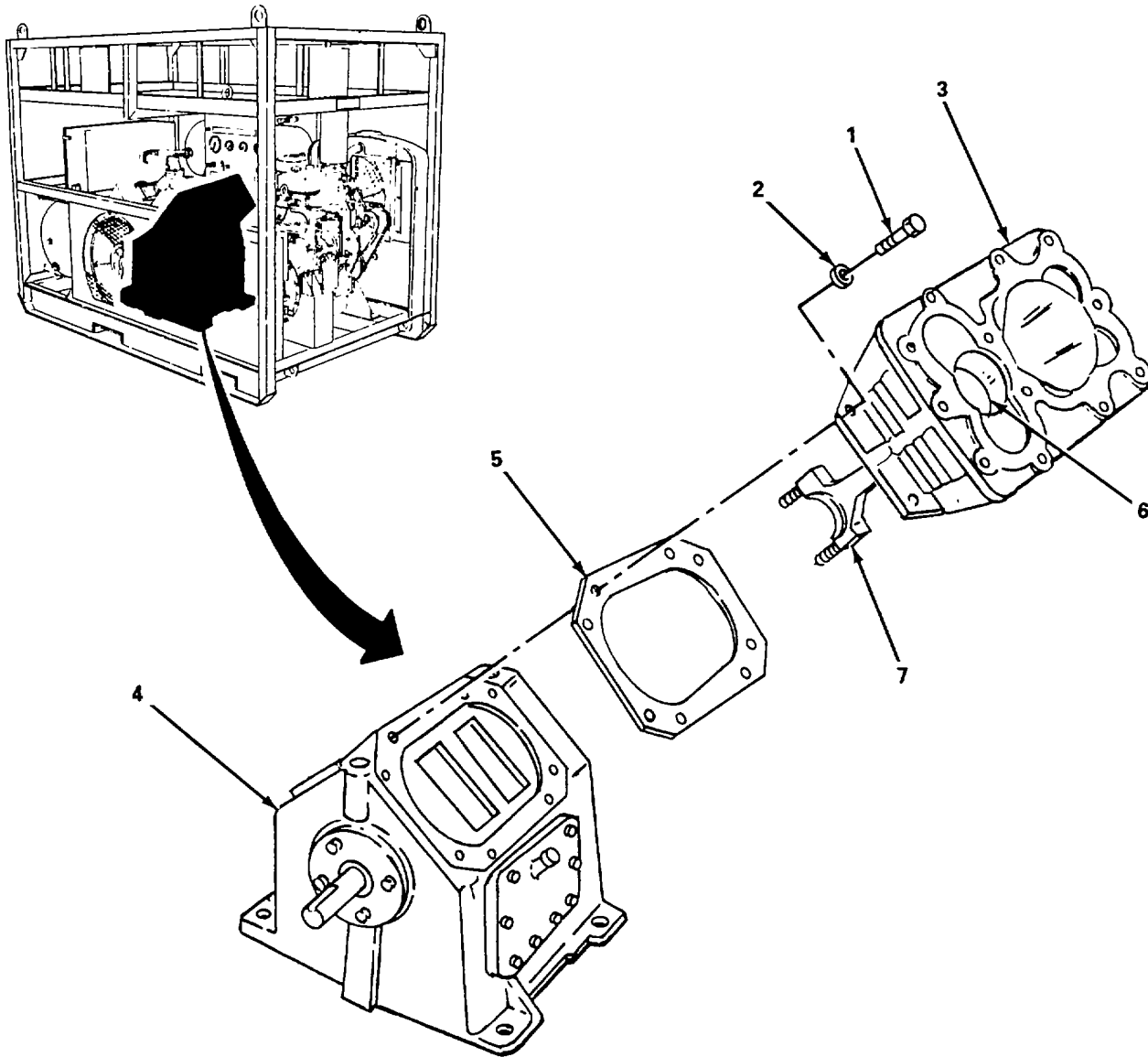
- (6) Measure cylinder bore eight places 900 apart. Maximum variance is 0.002 inch, if variance exceeds maximum, replace cylinder.



**NOTE**

The high pressure pistons must be installed in the cylinder before attaching cylinders to crankcase. The low pressure pistons can be installed after cylinders are attached to crankcase.

- (8) Ensure all flanges are free of gasket materials and clean.
- (9) Install cylinder (3) with gasket (5) on crankcase (4). While aligning connecting rod (7) in position over crankshaft journal, secure with eight screws (1) and lockwashers (2). Torque screws to 40b-ft (54 Nm).



**Figure 5-48. Compressor Cylinder, Repair.**

**FOLLOW-ON MAINTENANCE**

Install pistons connecting rods and bearings (para 5-31).

---

**5-33. Compressor Crankshaft**

---

**This task covers:****a. Replace****b. Repair**

---

**INITIAL SETUP:***Tools**Equipment Condition*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)    Cylinders removed (para 5-32).  
Wrench, Torque (NSN 5120-00-554-7292)

*Materials/Parts*

Crankshaft, Compressor  
Detergent, Nonionic (Item 10, Appendix D)

---

**a. Removal.** (figure 5-49)**WARNING**

**Cleanliness is imperative in maintaining and handling diving air system components. All tools and parts must be kept free of oil, grease, rust, or other contamination in accordance with accepted army diving cleaning procedures. Foreign substances within an assembly could result in equipment failure and possible injury or death to personnel.**

- (1) Remove oil intake bracket mounting screw (1), lockwashers (2) and remove oil intake bracket (3) with oil intake screen (4) attached.
- (2) Remove and discard oil intake bracket gasket (5).
- (3) Place a support under front end of crankshaft to prevent it from dropping when removing adjustment plate (6).
- (4) Remove four screws (7) securing bearing adjustment plate (6) and remove bearing adjustment plate and shim (8) from crankcase.
- (5) Place support under crankshaft (9), inside the crankcase (10).
- (6) Loosen coupling nut (11) securing oil pressure line (12) to oil pump cover plate (13).
- (7) Remove six screws (14) securing oil pump cover plate (13).
- (8) Remove oil pump assembly and o-ring (15).
- (9) Remove eight screws (16) from carrier assembly (17).
- (10) Remove carrier assembly (17) and bearing carrier gasket (18) and discard gasket.
- (11) Remove race (19) from crankshaft (9), while removing the crankshaft through rear of crankcase (10).
- (12) With crankshaft in suitable support, remove roller bearings (20) and (21).
- (13) Press bearing race (22) out of crankcase (10).

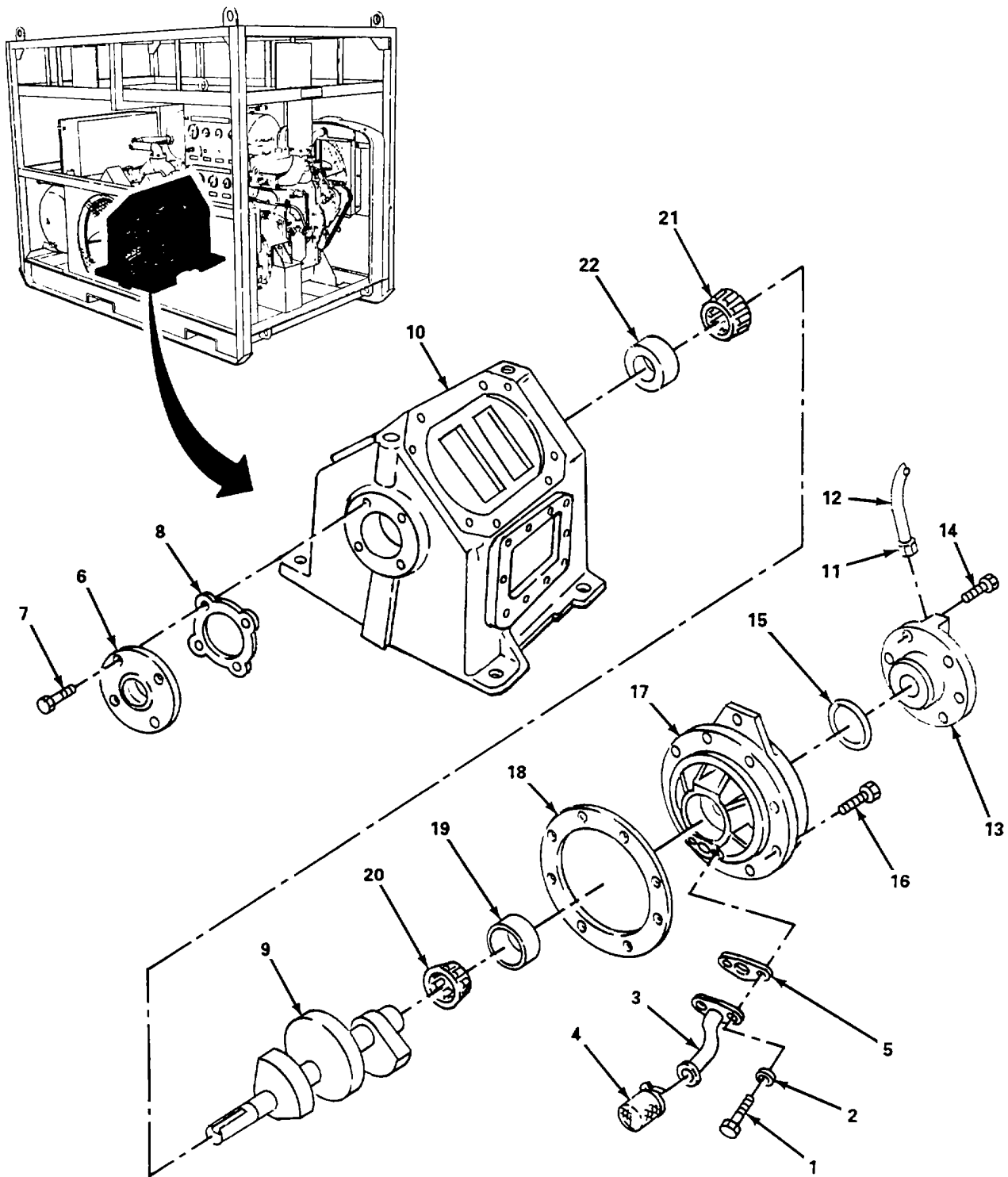


Figure 5-49. Compressor Crankshaft, Removal.

5-33. **Compressor Crankshaft (Cont).**

b. Repair. (figure 5-50)

**NOTE**

**Crankshaft removed for repair. See para. a. above.**

- (1) Clean crankshaft using nonionic detergent cleaner and rinse with clean distilled water.
- (2) Inspect crankshaft (1) for cracks, bent or broken shafts.
- (3) Inspect crankshaft to ensure that oil seal surfaces are not grooved and ball bearing seats (2) are not worn.
- (4) Inspect ends of crankshaft for damage to keyway (3).
- (5) If crankshaft is worn, bent, or cracked, replace crankshaft.

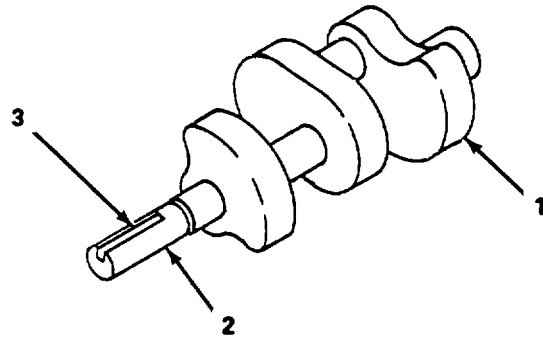


Figure 5-50. Compressor Crankshaft, Repair.

**5-33. Compressor Crankshaft (Cont).****c. Installation.** (figure 5-51)

- (1) Install front roller bearing (1) and rear roller bearing (2) on crankshaft (3).
- (2) Install race (4) in crankcase (5).
- (3) Install race (6) in bearing carrier (7).
- (4) Install crankshaft (3) in crankcase (5) and place a support under crankshaft to hold it in proper alignment, also place support under front end of crankshaft.
- (5) Install carrier assembly (7) with bearing carrier gasket (8) and secure with eight screws (9). Torque screws to 40 lb-ft (54 Nm).
- (6) Install bearing shim (10) with bearing adjustment plate (11) and secure with four screws (12). Torque screws to 40 lb-ft (54 Nm).
- (7) Remove supports from crankshaft at front end in crankcase.
- (8) Install oil pump cover plate (13) with o-ring (14) in carrier bearing housing and secure with six screws (15).
- (9) Install oil pressure line (16) on oil pump cover plate (13) and tighten coupling nut (17).
- (10) Install oil intake bracket gasket (18) and oil intake bracket (19) with oil intake screen (20) attached and secure with oil intake bracket mounting screws (21) and lockwasher (22).

FOLLOW-ON MAINTENANCE  
Install compressor cylinders (para 5-32).

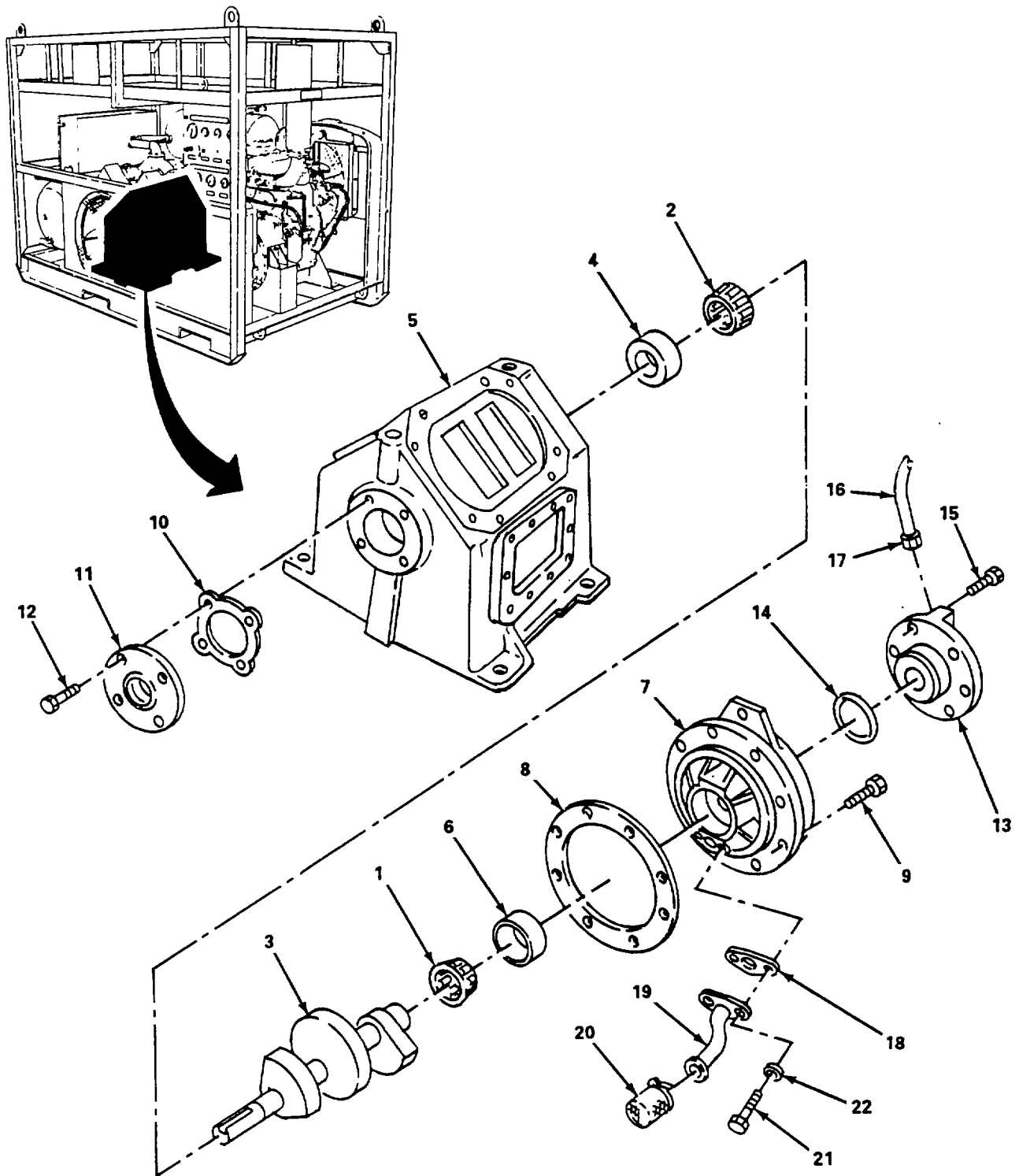


Figure 5-51. Compressor Crankshaft, Installation.



---

**5-33.1 Compressor Oil Screen**

---

**This task covers:****Replace**

---

**INITIAL SETUP:**

Tools

Equipment Condition

General Mechanic's Tool Kit  
(NSN 5180-0-177-7033)

Oil drained.

*Materials/Parts*Solvent, Dry Cleaning (Item 23, Appendix D)  
Gasket (NSN 5330-01-101-8414)

---

a. Replace. (figure 5-51.1)

- (1) Remove ten bolts (1) from the hand hole cover (2). Remove cover and discard gasket (3).
- (2) Loosen screw (4) and nut (5) and remove screen (6) from bracket (7).
- (3) Clean screen (6) with solvent and dry with compressed air.
- (4) Install screen (6) on bracket (7) and tighten screw (4) and nut (5).
- (5) Install hand hole cover (2) using a new gasket (3) and tighten ten bolts (1).

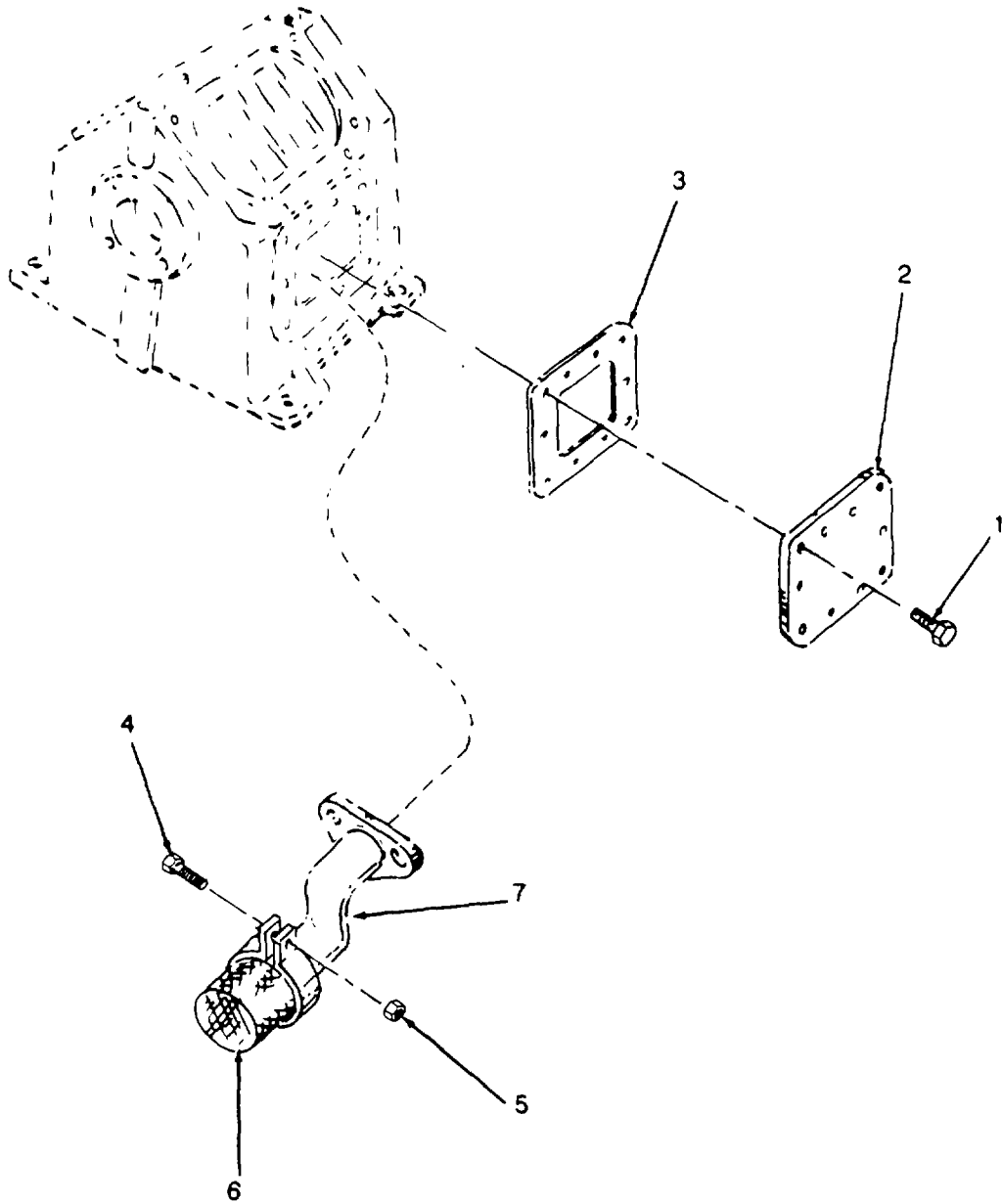


Figure 5-51.1 Compressor Oil Screen.

Change 1 5-154.1

---

**5-34. Compressor Crankcase**

---

**This task covers:****Replace**

---

**INITIAL SETUP:***Tools*General Mechanic's Tool Kit  
(NSN 5180-00-177-7033)*Equipment Condition*

Crankshaft removed (para 5-33).

*Materials/Parts*Crankcase, Compressor  
Detergent, Nonionic (Item 10, Appendix D)

---

*Replace.* (figure 5-52)**WARNING**

**Cleanliness is imperative in maintaining and handling diving air system components. All tools and parts must be kept free of oil, grease, rust, or other contamination in accordance with accepted army diving cleaning procedures. Foreign substances within an assembly could result in equipment failure and possible injury or death to personnel.**

- (1) Loosen two adjusting bolts (1).
- (2) Remove four bolts (2), washers (3), and nuts (4) securing crankcase (5) to frame (6) and remove crankcase.
- (3) Clean crankcase using nonionic detergent cleaner and rinse with clean distilled water.
- (4) Inspect crankcase for any cracks or other damage.
- (5) Replace crankcase if any cracks are found.
- (6) Position crankcase (5) on frame (6) and secure with four bolts (2), washers (3), and nuts (4).
- (7) Tighten two adjusting bolts (1).

FOLLOW-ON MAINTENANCE  
Install crankshaft (para 5-33).

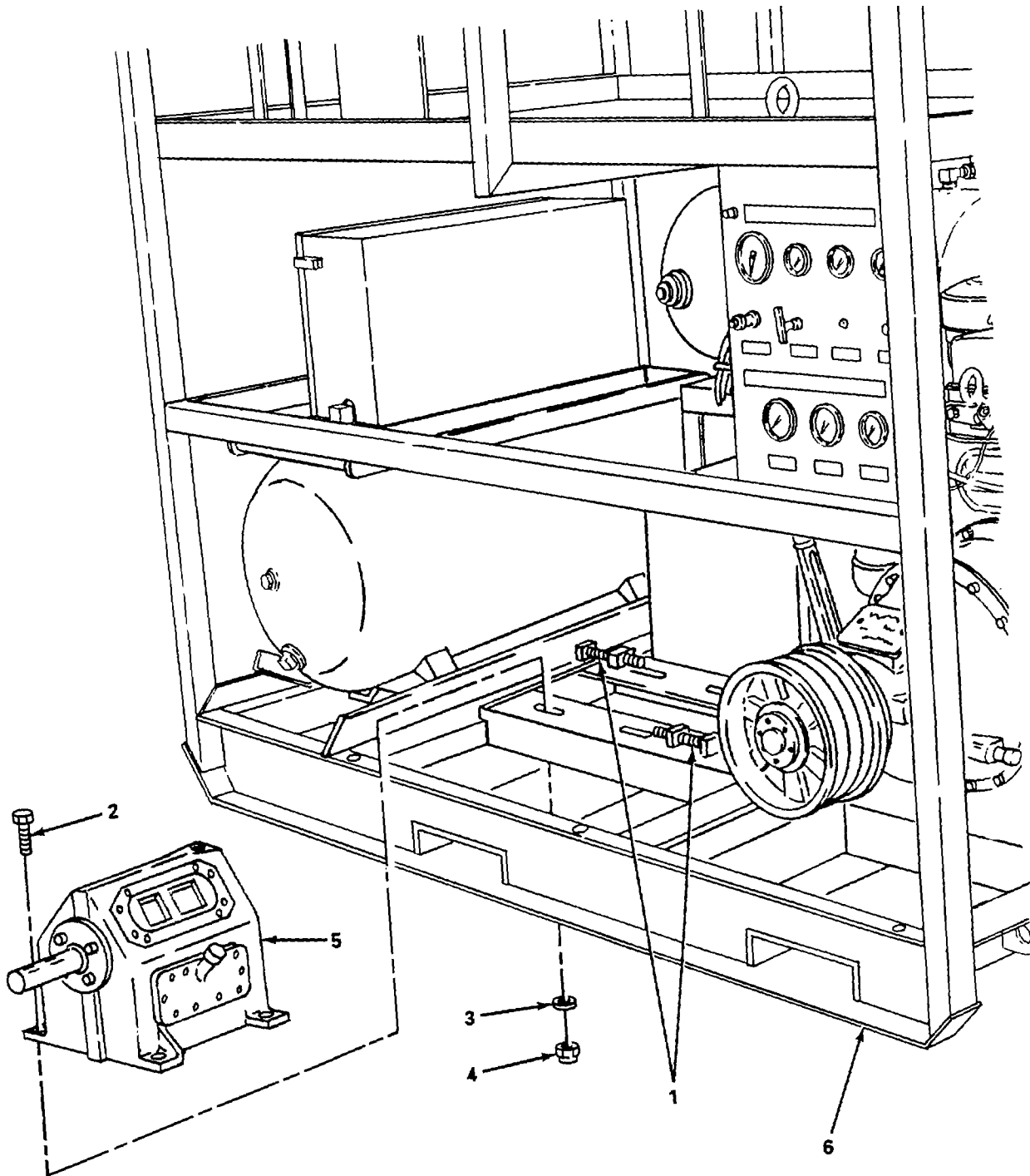


Figure 5-52. Compressor Crankcase, Replace.

---

**5-35. Compressor Bearing Carrier and Oil Pump**

---

**This task covers:****a. Replace****b. Repair**

---

**INITIAL SETUP:***Tools**Equipment Condition*

General Mechanic's Tool Kit (NSN 5180-00-177-7033) Fuel tank removed (para. 3-47).  
Lines and fittings removed (para. 4-36).

*Materials/Parts*

Bearing Carrier and Oil Pump, Compressor  
Gasket, Compressor Bearing Carrier and Oil Pump

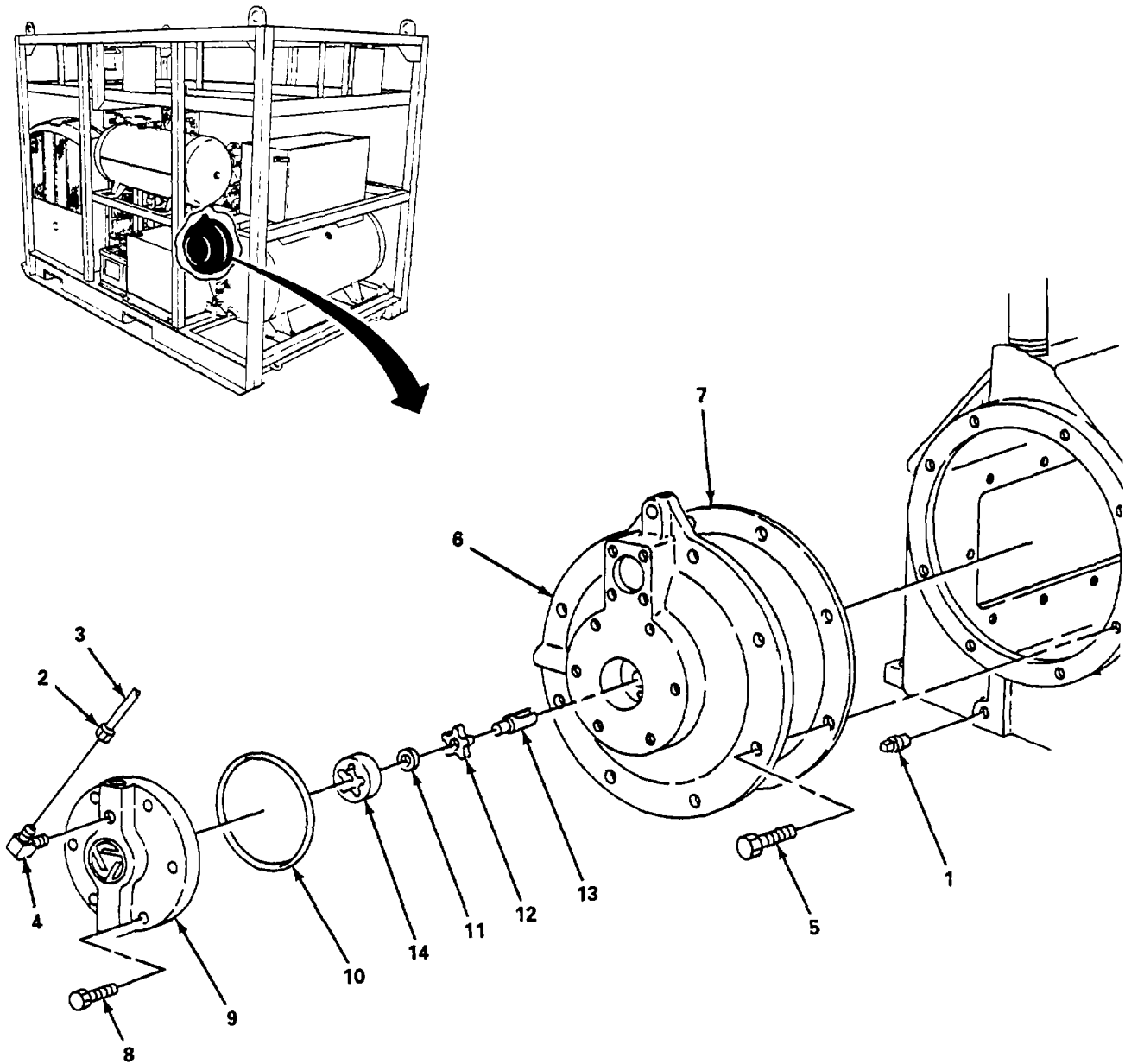
---

- a. Replace. (figure 5-53)

**WARNING**

**Cleanliness is imperative in maintaining and handling diving air system components. All tools and parts must be kept free of oil, grease, rust, or other contamination in accordance with accepted army diving cleaning procedures. Foreign substances within an assembly could result in equipment failure and possible injury or death to personnel.**

- (1) Remove drain plug (1) and drain oil into suitable container.
- (2) Loosen coupling nut (2) securing oil pressure line (3) to oil pump cover plate fitting (4).
- (3) Remove eight screws (5) securing carrier (6) and remove bearing carrier and gasket (7).
- (4) Remove six screws (8) securing oil pump cover plate (9) and remove cover plate and o-ring (10).
- (5) Remove retaining ring (11) and remove gear (12) from oil pump rotor drive pin (13).
- (6) Remove gear (14) from oil pump cover plate (9).
- (7) Install gear (14) into oil pump cover plate (9).
- (8) Install gear (12) on oil pump rotor drive pin (13) and secure with retaining ring (11).
- (9) Install oil pump cover plate (9) with o-ring (10) on bearing carrier (6) and secure with six screws (8).
- (10) Install bearing carrier (6) and secure with eight screws (5).
- (11) Install oil pressure line (3) on oil pump cover plate fitting (4) and tighten coupling nut (2).
- (12) Install drain plug (1) and refill oil.



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**Figure 5-53. Compressor Bearing Carrier and Oil Pump, Replace.**

**FOLLOW-ON MAINTENANCE**

- (1) Install fuel tank (para. 3-47).
- (2) Install lines and fittings (para. 4-36).

**5-35. Compressor Bearing Carrier and Oil Pump (Cont).***b. Repair.* (figure 5-54).

- (1) Remove compressor bearing carrier and oil pump (para. a).
- (2) Inspect oil pump cover plate (1) and replace if cracked, or bore for gear (2) is excessively worn.
- (3) Inspect gears (2) and (3) and replace if outside bore of gear (2), inside bore of gear (2), or outside bore of gear (3) is excessively worn or scored.
- (4) Inspect rotor drive pin (4) and replace if, bent, scored, or excessively worn.
- (5) Inspect bearing carrier (5) and replace if cracked, or gear bore is excessively worn or scored.
- (6) Install compressor bearing carrier and oil pump (para. a).

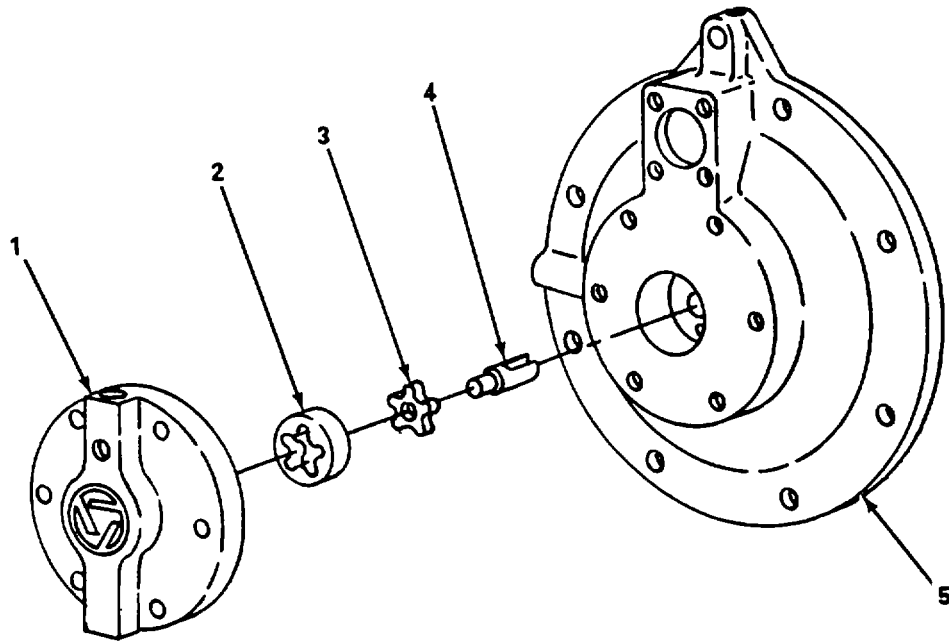


Figure 5-54. Compressor Bearing Carrier and Oil Pump, Repair.



---

**5-36. Portable Air Filtration System Gages**

---

**This task covers:**

**Calibrate**

---

**INITIAL SETUP:**

*Tools*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)

---

Calibrate.

Calibrate gages in accordance with TB 9-4220-216-35.

---

**5-37. Portable 60 Gallon Air Receiver Gages.**

---

**This task covers:**

**Calibrate**

---

**INITIAL SETUP:**

*Tools*

General Mechanic's Tool Kit (NSN 5180-00-177-7033)

---

Calibrate.

Calibrate gages in accordance with TB 9-4220-216-35.

---

**5-38. Fuel Tank.**

---

**This task covers:****Repair**

---

**INITIAL SETUP:***Tools**Equipment Condition*General Mechanic's Tool Kit  
(NSN 5180-00-177-7033)Torch Outfit, Cutting and Welding  
(NSN 34330-026-4718)

Fuel tank removed (para. 3-48).

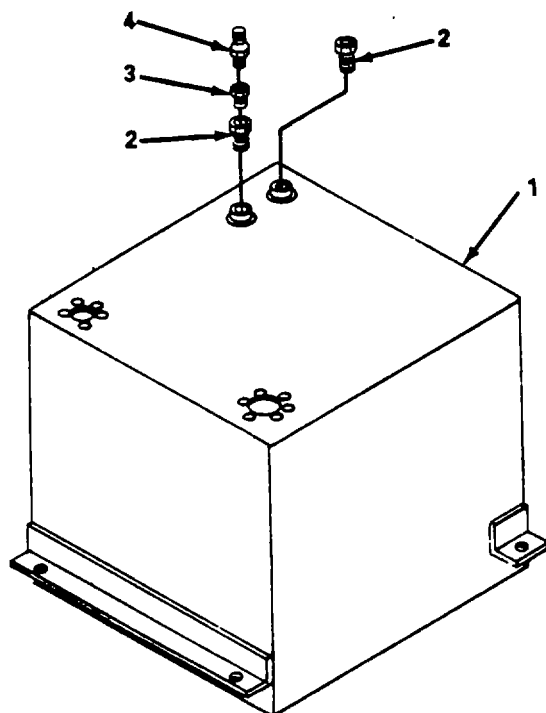
Fuel gage removed (para. 3-48).

Filler cap and strainer removed (para. 3-48).

---

a. *Repair.* (figure 5-55)

- (1) Repair cracks in fuel tanks (1) by welding. Refer to TM 9-237 for welding instructions.
- (2) Inspect fittings (2), (3), and (4) and replace if threads are stripped or fittings are otherwise damaged.



**Figure 5-55. Fuel Tank, Repair.**

**FOLLOW-ON MAINTENANCE**

- (1) Install fuel tank (**para. 3-48**).
- (2) Install gage (**para. 3-48**).
- (3) Install filler cap and strainer (**para. 3-48**).

---

**5-39. Frame**

---

**This task covers:****a. Replace****b. Repair**

---

**INITIAL SETUP:***Tools*

General Mechanic's Tool Kit  
(NSN 5180-00-177-7033)

*Equipment Condition*

Engine assembly removed (para. 3-13).  
Air compressor assembly removed (para. 4-35).

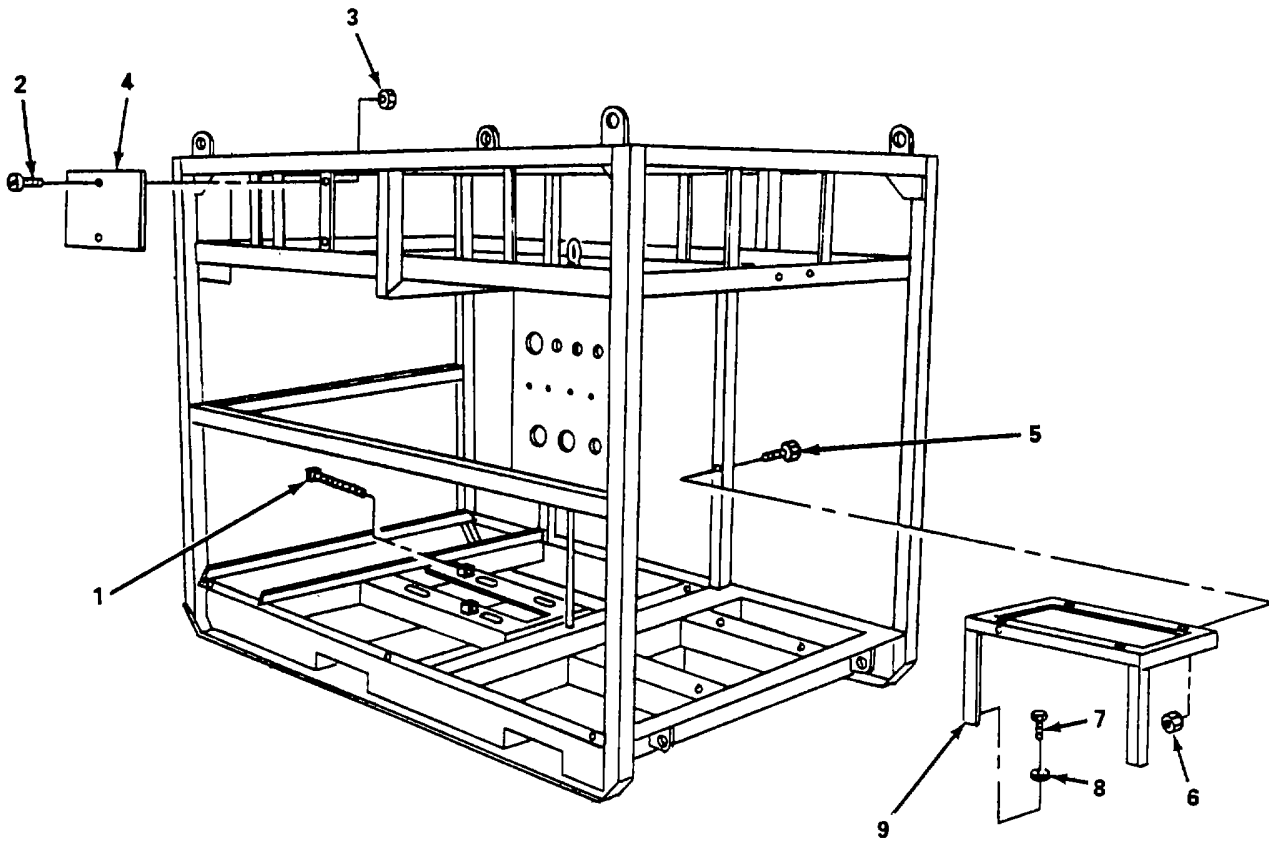
*Equipment Condition (Cont)*

Battery removed (para. 3-35).  
Fuel tank removed (para. 3-47).  
Portable air receiver removed (para. 3-41).  
Air receiver removed (para. 3-41).  
Portable air filtration system removed (para. 4-31).

---

*a. Replace.* (figure 5-56)

- (1) Remove two adjusting screws (1).
- (2) Remove two screws (2) and nuts (3) and remove placard (4).
- (3) Repeat step 2 for three remaining placards.
- (4) Remove two screws (5) and nuts (6).
- (5) Remove two screws (7) and lockwashers (8) and remove air receiver frame (9).
- (6) Install air receiver frame (9) and secure with two screws (7) and lockwashers (8).
- (7) Install two screws (5) and nuts (6).
- (8) Install placard (4) and secure with two screws (2) and nuts (3).
- (9) Repeat step 5 for remaining three placards.
- (10) Install two adjusting screws (1).



**Figure 5-56. Frame Assembly, Replace.**

**FOLLOW-ON MAINTENANCE:**

- (1) Install engine assembly (para. 3-13).
- (2) Install air compressor assembly (para. 4-35).
- (3) Install battery (para. 3-35).
- (4) Install fuel tank (para. 3-47).
- (5) Install portable air receiver (para. 3-41).
- (6) Install air receiver (para. 4-41).
- (7) Install portable air filtration system (para. 3-31).

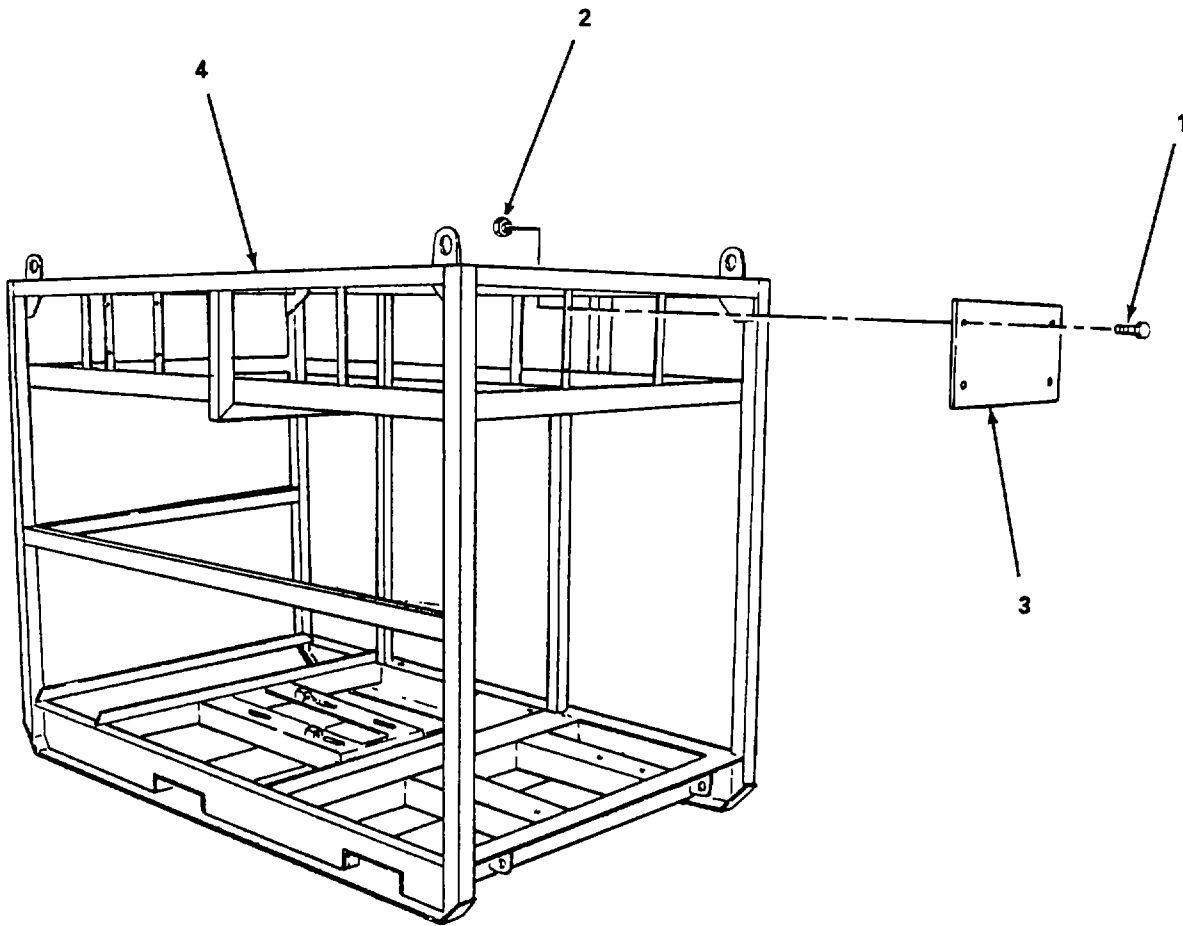
5-39. **Frame (Cont).**b. *Repair.* (figure 5-57)

- (1) Remove two screws (1) and nuts (2) and remove placard (3).
- (2) Repeat step 1 for three remaining placards.

**WARNING**

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

- (3) Clean all items with dry cleaning solvent and dry thoroughly.
- (4) Inspect frame (4) for cracks, broken welds or other damage.
- (5) Repair minor cracks and broken welds by welding.
- (6) Replace frame (4) if excessively damaged.
- (7) Install placard (3) and secure with two screws (1) and nuts (2).
- (8) Repeat step 7 for remaining three placards.



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Figure 5-57. Frame Assembly, Repair.



**APPENDIX A**

**REFERENCES**

A-1. **Scope.** This appendix contains all forms, lubrication orders, pamphlets and technical manuals referenced in this manual

A-2. **Forms.**

Equipment Inspection and Maintenance Worksheet .....	DA Form 2404
Recommended Changes to Publications .....	DA Form 2028-2
Transportation Discrepancy Report (TDR) .....	SF 361
Report of Discrepancy (ROD) .....	SF 364
Quality Deficiency Report (QDR) .....	SF 368

A-3. **Pamphlets.**

The Army Maintenance Management System (TAMMS) .....	DA Pam 738-750
Consolidated Index of Army Publications and Blank Forms .....	DA Pam 25-30

A-4. **Technical Manuals.**

Operator's Manual for Welding Theory and Application .....	TM 9-237
Preservation, Packaging, and Packing of Military Supplies and Equipment .....	TM 38-230
Procedures for Destruction of Equipment to Prevent Enemy Use .....	TM 750-244-3

A-5. **Technical Bulletins.**

Calibration Procedure for Pressure Gages used with Driving Equipment (General) .....	TB 9-4220-216-35
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A-6. **Other Publications.**

Military Diving .....	FM 20-11-1
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## APPENDIX B

## MAINTENANCE ALLOCATION CHART

## Section I. INTRODUCTION

B-1. **Maintenance Allocation Chart (MAC)**. This MAC assigns maintenance functions in accordance with the Three Level Maintenance Concept.

B-2. **Use of the Maintenance Allocation Chart, Section II.**

a. The MAC assigns maintenance functions based on the following considerations:

- (1) Skills available.
- (2) Work time required.
- (3) Tools and test equipment required and/or available.

b. If a lower level of maintenance identified in column (4) of the MAC cannot perform all tasks of a single maintenance function (e. g. , test, repair), then the higher level that can perform other tasks of that function is also indicated.

c. Higher maintenance levels are automatically authorized to perform maintenance functions assigned to a lower maintenance level.

d. Higher maintenance levels will perform the maintenance functions of lower maintenance levels when required or directed by the Commander who has authority to direct such tasking.

e. Assignment of a maintenance function in the MAC does not carry automatic authorization to carry the related spare or repair parts in stock. Information to requisition or secure parts will be as specified in the associated RPSTL.

f. Normally, there will be no deviation from the assigned level of maintenance. However, in cases of operational necessity, maintenance functions assigned a higher level may, at the request of the lower level, be assigned to the lower level on a one-time basis, if specifically authorized by the maintenance officer of the higher level to which the function is assigned. In such a case, the special tools, equipment, etc. , required by the lower level to perform this function will be furnished by the higher level assigned the function. Also, transfer of a function to a lower level does not relieve the higher level of responsibility for the function, so the higher level will provide technical supervision and inspection of the function being performed at the lower level.

B-3. **Maintenance Functions**. Maintenance functions will be limited to and defined as follows:

a. *Inspect*. To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination (e.g., by sight, sound, or feel).

b. *Test*. To verify serviceability and detect incipient failure by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. Service. Operations required periodically to keep an item in proper operating condition, i.e., to clean (includes decontaminate), to preserve, to drain, or to replenish fuel, lubricants, hydraulic fluids, or compressed air supplies.

d. Adjust. To maintain within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to the specified parameters.

e. Aline. To adjust specified variable elements of an item to bring about optimum or desired performance.

f. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipment used in precision measurement. Consists of comparison of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. Install. The act of emplacing, seating, or fixing into position an item, part, or module (component assembly) in a manner to allow the proper functioning of an equipment or system.

h. Replace. The act of substituting a serviceable like type part, a subassembly, or module (component or assembly) for an unserviceable counterpart.

i. Repair. The application of maintenance services (inspect, test, service, adjust, aline, calibrate, or replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining, or resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

j. Overhaul. That maintenance effort (service/action) necessary to restore an item to a completely serviceable operational condition as prescribed by maintenance standards in appropriate technical publications (i. e. , DMWR). Overhaul does not normally return an item to a like new condition.

k. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours/miles, etc. ) considered in classifying Army equipment/components.

#### B-4. Explanation of Columns in the MAC, Section II.

a. Column (1), Group Number. Column 1 lists functional group code numbers which are assigned to identify maintenance significant components, assemblies, subassemblies, and modules to their next higher assembly.

b. Column (2), Component/Assembly. Column 2 contains the item names of components, assemblies, subassemblies, and modules for which group numbers (column 1) are assigned and for which maintenance is authorized.

c. Column (3), Maintenance Function. Column 3 lists the functions to be performed on items listed in Column 2. (Function definitions are contained in paragraph A-3.)

d. Column (4). Maintenance Level. The maintenance levels, Unit, Intermediate, and Depot, are allotted separate subcolumns within column 4. Entry of a work time figure (such as 1. 0, 0. 2) in a subcolumn indicates that that level is authorized to perform the function listed in column 3, and the average time required to do the function is the work time figure. If the number or complexity of tasks within a maintenance function varies from one maintenance level to another, the applicable work time figure for each level will be entered for that function. The work time figure represents the average time it takes to restore a component/assembly to a serviceable condition under a typical field operating environment.

e. Column (5). Tools and Equipment. Column 5 specifies, by code, common tool sets (not individual tools from those sets), common TMDE, and special tools, TMDE, and support equipment required to perform a designated function. The code in Column 5 keys to the listing in Section III of the MAC.

f. Column (6). Remarks. This column when applicable, contains a letter code which is keyed to an explanation of the code contained in Section IV of the MAC.

#### B-5. Explanation of Columns in the MAC, Section III .

a. Column (1). Tool or Test Equipment Reference Code. The tool or test equipment reference code correlates with a code used in the MAC, Section II, Column 5.

b. Column (2). Maintenance Category. The lowest category of maintenance authorized to use the tool or test equipment.

c. Column (3). Nomenclature. Name or identification of the tool or test equipment.

d. Column (4). National/NATO Stock Number. The National stock number of the tool or test equipment.

e. Column (5). Tool Number. The manufacturer's part number.

#### B-6. Explanation of Columns in the MAC, Section IV.

a. Column (1). Reference Code. The code recorded in column 6, Section II.

b. Column (2). Remarks. This column lists information pertinent to the maintenance function being performed as indicated in the MAC, Section II.

Section II. MAINTENANCE ALLOCATION CHART

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Level				(5) Tools and Eqpt.	(6) Remarks	
			Unit		Direct Support	General Support			Depot
			C	O	F	H			D
00	Compressor Diving Air, Diesel/Engine 88.5 SCFM, 200 Psi Model HII-271-5120	Inspect		0.2					
		Test		0.5					
		Service		0.8				1	
		Adjust		0.5				1	
		Replace		1.0				1	
		Repair		36	40	56		1-111	
01	Engine Assembly (2-71 Series Detroit Diesel Model 10235100)	Inspect		0.2					
		Test		0.5					
		Service		0.3					
		Adjust		0.4	0.5			1	
		Replace		2.0				1	
		Repair		10.0	12.0	15.0		1-111	
0101	Exhaust System	Muffler and Pipes							
		Inspect		0.1					
		Replace		0.3				1	
0101	Exhaust Manifold	Inspect		0.1					
		Replace		0.4				1, 2	
		Repair				0.3		1,22	
0102	Cooling System	Fan Guards		0.1					
		Replace		0.4				1	
		Shell Assembly		0.1					
		Replace		0.6				1	
		Shroud		0.1					
		Replace		0.4				1	
		Radiator Assembly		0.4					
Repair		0.4				1			
0102	Water Connections	Inspect		0.1					
		Replace		0.6				1	
								22	D, E

MAINTENANCE ALLOCATION CHART (cont)

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Level				(5) Tools and Eqpt.	(6) Remarks	
			Unit		Direct Support	General Support			Depot
			C	O	F	H			D
0103	Thermostat and Housing Assembly	Test		0.4				1,2,19	D, E
		Replace		0.3				1,2	
	Fan, Pulley, and Belts	Repair		0.3		0.4		1,2,22	
		Inspect		0.1					
	Water Pump	Replace		0.5				1,2	
		Inspect		0.1					
		Replace		0.5				1,2	
	Fuel System	Repair				1.5		1,5,24,11	
	Lines and Fittings	Inspect		0.1					
		Replace		0.3				1	
	Fuel Filter Assembly	Service		0.3					
		Replace		0.3				1,2	
		Repair		0.4				1	
	Fuel Strainer Assembly	Service		0.3					
		Replace		0.3				1,2	
		Repair		0.4				1	
	Fuel Pump and Drive	Test		0.3					
		Replace		0.3				1,2	
		Repair		1.0				1,5,12	
	Fuel Manifold Connections	Replace				0.5		1,2,25,36,37,38	
Injector Controls	Adjust				0.4		1		
	Replace				0.3		1,2,26		
	Repair				0.4				
Fuel Injectors	Test					1.0			
	Replace				0.5		1,2,104		
	Repair					1.5	1,2,39-65		

MAINTENANCE ALLOCATION CHART (cont)

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Level				(5) Tools and Eqpt.	(6) Remarks	
			Unit		Direct Support	General Support			Depot
			C	O	F	H			D
0104	Governor	Inspect		0.1					
		Adjust			0.3			1	
0105	Air System Air Cleaner Assembly	Replace			0.5			1	
		Repair				2.0		1,2,12, 66-68	
		Service		0.3				1	
		Replace		0.2				1	
	Air Shutdown Housing Assembly Blower Assembly	Repair		0.3				1	
		Replace		0.5				1,2	
		Repair			1.0			1,22	
		Replace			1.3			1,2	
	0106	Air Box Drains	Repair				2.5		1,24 69-72 106
			Inspect		0.1				1
0107	Starting System Starter	Replace		0.3					
		Inspect		0.1					
		Test		0.3				1,3,18	
		Replace		0.5				1,3	
0107	Starting Aid	Repair				2.0		1	
		Inspect		0.1					
		Replace		0.4				1	
0107	Electrical System Battery Charging Alternator	Repair		0.4				1	
		Inspect		0.1					
		Test		0.3				18	
		Adjust		0.2				1	
		Replace		0.3				1	
		Repair		1.5			1,6	F	

MAINTENANCE ALLOCATION CHART (cont)

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Level				(5) Tools and Eqpt.	(6) Remarks	
			Unit		Direct Support	General Support			Depot
			C	O	F	H			D
0108	Wiring Harness	Inspect		0.1					
		Test		0.2				18	
		Replace		0.4				1	
		Repair		0.3				1	
	Battery and Cables	Inspect		0.1					
		Test		0.2				15	
		Replace		0.4				1	
	Low Oil Pressure Shutdown Switch	Replace		0.3				1	
	Lubrication System Oil Pan	Replace			0.5			1,2	
	Oil Distribution System	Replace			0.6			1,2	
Repair				0.4			1		
Oil Pump	Replace			0.7			1,2		
	Repair				1.0		1,2,8,12		
Oil Filter Assembly	Service		0.3				1		
	Replace		0.7				1,2		
	Repair		0.4				1,2		
Dipstick and Guide Tube	Replace		0.3				1		
0109	Oil Cooler Assembly	Repair			1.0		1		
	Oil Cooler By-Pass Valve	Replace			0.4		1,2		
	Repair				0.3		1		
	Flywheel Assembly	Replace			0.9		1,3,27		
	Repair				0.4		1,22		



MAINTENANCE ALLOCATION CHART (cont)

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Level				(5) Tools and Eqpt.	(6) Remarks	
			Unit		Direct Support	General Support			Depot
			C	O	F	H			D
0110	Flywheel Housing Assembly	Replace			1.0			1,2, 28-31	
		Repair			0.4			1, 32 33, 103	
0111	Rocker Cover	Replace		0.3				1	
		Repair		0.4				1	
0112	Cylinder Head Group								
	Valve Operating Mechanism	Adjust			0.4			1	
		Replace			1.5			1,2,3 19	
		Repair			1.0			1, 12 63	
	Valve, Exhaust	Replace				1.5		1,63, 73-79, 107,108	
	Cylinder Head Assembly	Test				1.0		23	H
		Replace				2.0		1,2,9 100,101	
0113	Pistons and Connecting Rods	Replace				2.5		1,3,9	
		Repair				1.0		1,80- 90.109	D
0114	Cylinder heads	Inspect				1.5		13,92, 96	
		Replace				2.5		1,91, 93,94, 110	
0115	Crankshaft, Balance Shaft, and Bearings	Repair				3.0		1,2,4,12, 94, 97, 98	
0116	Crankshaft Group	Repair				3.0		1,4,12, 85,99	
0117	Cylinder Block and Front Cover Assembly	Replace				4.0		1,4,94, 95,96, 102	

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MAINTENANCE ALLOCATION CHART (cont)

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Level					(5) Tools and Eqpt.	(6) Remarks
			Unit		Direct Support	General Support	Depot		
			C	O	F	H	D		
0118	Breather Pipe	Inspect Replace		0.1 0.3				1, 2	
02	Power Take-Off Assembly	Service Adjust Replace Repair		0.2	0.3 0.9	1.2		1 1,6 1,6	
0201	Clutch Assembly	Replace Repair			1.0	1.0		1,6 1,12	
03	Air Compressor Assembly	Inspect Service Test Replace Repair		0.1 0.3	0.4 1.5	0.4 3.5		1 1 1, 2, 7, 16, 35, 10,11, 12	
0301	Lines and Fittings	Inspect Replace		0.1	0.3			1	
0302	VD Pilot Valve	Replace Repair			0.6 0.5			1 1	
0303	Hydraulic Unloader Assembly	Replace Repair			0.7 0.6			1 35	
0304	Dual Control Check Valve Assembly	Inspect Replace			0.5 0.7			1,35	
0305	Shroud	Inspect Replace		0.1	0.4			1	
0306	Air Cleaner Intake	Inspect Replace Repair		0.1 0.3 0.3				1 1	
0307	Intercooler	Replace				1.0		1,2, 7	

MAINTENANCE ALLOCATION CHART (cont)

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Level					(5) Tools and Eqpt.	(6) Remarks
			Unit		Direct Support	General Support	Depot		
			C	O	F	H	D		
0308	Manifold Group	Inspect Repair		0.1	0.7			1, 16, 35	
0309	Compressor Unloader Assembly	Replace Repair				1.0 0.8		1 1,35	
0310	Cylinder Head, Compressor	Replace Repair				1.3 1.0		1,2 1	
0311	Valves, Intake and Discharge	Replace Repair				1.0 0.8		1,2 1	
0312	Pistons, Connecting Rods, and Bearings	Replace Repair				1.5 1.0		1, 2, 10 11, 12	
0313	Cylinders, Compressor	Repair				2.0		1,2	
0314	Crankshaft Group, Compressor	Replace Repair				2.0 1.0		1,2 1	E
0315	Crankcase, Compressor	Replace				3.0		1	
0316	Crankcase Breather, Compressor	Inspect Replace Repair		0.1 0.2 0.3				1 1	
0317	Bearing Carrier and Oil Pump	Replace Repair				0.8 0.5		1	
04	Portable Air Filtration System Model HII-F46	Inspect Service Replace Repair		0.1 0.5	1.0 1.2			1 1 1	G
0401	Valves	Replace			0.4			1	
0402	Gages	Calibrate Replace			0.3	0.3		1	

MAINTENANCE ALLOCATION CHART (cont)

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Level					(5) Tools and Eqpt.	(6) Remarks
			Unit		Direct Support	General Support	Depot		
			C	O	F	H	D		
0403	Filter Assemblies	Service Replace Repair			0.3 1.0 1.0			1, 35 1 1, 35	
05	Receiver, Air 30 Gallon, Fixed Assembly	Inspect Test Service Replace		0.1  0.1	0.5  0.6			  1 1	
	Fitting and Valves	Replace			0.5			1	
	Receiver Tank	Replace			0.5			1	
06	Air Receiver Tank, 60 Gallon, Portable Assembly	Inspect Test Service Replace		0.1  0.1 0.3	0.5   			1 1	G
	Fitting and Valves	Replace			0.5			1	
	Gages	Calibrate Replace			0.5	0.1		1	
	Receiver Tank	Replace			0.7			1	
07	Frame Assembly, Diving Compressor	Inspect Repair		0.1 1.0					C
0701	Controls and Indicators	Replace		0.6	0.6			1	
0702	Control Panel	Inspect Replace		0.1 1.0				22	
0703	Engine Mount	Replace Repair		0.7 0.5				1 22	

**MAINTENANCE ALLOCATION CHART (cont)**

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Level					(5) Tools and Eqpt.	(6) Remarks
			Unit		Direct Support	General Support	Depot		
			C	O	F	H	D		
0704	Fuel Tank	Inspect Replace Repair		0.1 0.5 0.6		0.5		1, 2 1,22	D, E
0705	Battery Hold Down	Replace		0.4				1	
0706	Frame	Replace Repair		0.5		2.0 1.0		1 1,22	

**SECTION III TOOL AND TEST EQUIPMENT REQUIREMENTS**

Tool or test Equipment ref code (1)	Maintenance Category (2)	Nomenclature (3)	National NATO Stock Number (4)	PN Tool Number (5)
1	O	General Mechanic's Tool Kit	5180-00-177-7033	
2	O	Torque Wrench, 0-75 lb-ft	5120-00-554-7292	
3	O	Torque Wrench, 1/2 in. sq dr, 0-150 lb-ft	5120-00-247-2540	
4	H	Torque Wrench, 3/4 in. sq dr, 0-600 lb-ft	5120-00-221-7983	
5	H	Puller Kit, Mechanical (with Taps)	5120-00-357-6917	
6	F	Puller Kit, Mechanical (25 Pc)	5120-00-033-5606	
7	H	Puller Kit, Mechanical	5120-00-313-9496	
8	H	Puller, Gear 3 Jaw	5120-00-516-3120	
9	H	Piston Ring Compressor	5120-00-250-6055	

## TOOL AND TEST EQUIPMENT REQUIREMENTS FOR DIVING AIR COMPRESSOR

Tool or test Equipment ref code (1)	Maintenance Category (2)	Nomenclature (3)	National NATO Stock Number (4)	PN Tool Number (5)
10	H	Piston Ring Compressor (3 1/2-7 in.)	5120-00-223-8848	
11	H	Pliers, Retaining Ring Set (sizes 1-9)	5120-00-789-0492	
12	H	Caliper Set, Micrometer, Outside Type 1, Class 1, 6 in. C/O: 0-1, 1-2, 2-3, 3-4 4-5, 5-6	5210-00-554-7134	
13	H	Rod and Sleeve Calipers, 1-2 2-12	5210-00-221-1919 5210-00-221-1921	
14	H	Gage, Cylinder Bore, 2 1/2 in. - 9 in.	5210-00-494-1774	
15	O	Battery Hydrometer	6630-00-171-5126	
16	H	Pipe Wrench (24 in.)	5120-00-277-1480	
17		Wrench Set, Socket, 3/4 in. dr, 21 pc, 7/8 in. - 2 in.	5120-00-204-1999	
18	O	Multimeter, Digital	6625-01-139-2512	
19	O	Thermometer, Self Indicating, Bimetallic 0-220°F (°F Grad)	6685-00-373-3436	
20	O	Tester, Antifreeze Solutions	6630-00-247-2968	
21		Lapping Plate, Cast Iron	3460-00-606-7141	
22	F	Torch Outfit, Cutting and Welding Oxy Acetylene	3433-00-026-4718	
23	H	Magnetic Crack Detector	6635-01-128-2676	ST-1166
24	H	Installer, Bearing		J 1682-9
25	F	Nut, Wrench	5120-00-019-5232	J 8932-01

## TOOL AND TEST EQUIPMENT REQUIREMENTS FOR DIVING AIR COMPRESSOR

Tool or test Equipment ref code (1)	Maintenance Category (2)	Nomenclature (3)	National NATO Stock Number (4)	PN Tool Number (5)
26	F	1/4 in. Star 12 Point Socket	5120-00-817-1187	VL-8
27	F	Flywheel Lifting Tool	4910-00-722-3877	J 6361-01
28	F	Oil Seal Expander	5120-00-443-2508	J 22425
29	F	Handle, Drive	5120-00-677-2259	J 8092
30	F	Oil Seal Expander (Oversized Seal)		J 4195
31		Flywheel Housing Runout Gage	5210-00-937-7284	J 9737-C
32	F	Flywheel Housing Seal Installer	5120-00-999-8619	J 9727
33	F	Handle, Driver	5120-00-808-5082	J 3154-1
34	O	Engine stand Adapter Plate		J 6388
35	F	TSP Ultrasonic Cleaner with Heater	4940-00-164-8997	
36	F	Oil Seal Remover		J 1508-13
37	F	Oil Seal Installer		J 1508-9
38	F	Oil Seal Installer Handle		J 1508-8
39	H	Polishing Stick		J 22964
40	H	Lapping Block Set		J 22090
41	H	Lapping Plate Set		J 21200
42	H	Injector Vise and Rack Freeness Tester		J 22396
43	H	Polishing Compound		J 23038
44	H	Injector Tester		J 9787
45	H	Tip Test Adapter		J 23010-129

## TOOL AND TEST EQUIPMENT REQUIREMENTS FOR DIVING AIR COMPRESSOR

Tool or test Equipment ref code (1)	Maintenance Category (2)	Nomenclature (3)	National NATO Stock Number (4)	PN Tool Number (5)
46	H	Auxiliary Tester		J 22640
47	H	Threaded Coupling Nut		J 23010-20
48	H	Tubing		J 23010-75
49	H	Adapter	4910-01-174-5943	J 23010-167
50	H	Spray Tip Gage		J 9642-02
51	H	Injector Calibrator		J 22410
52	H	Injector Seat		J 22410-226
53	H	Injector Nut Removal Tool		J 4983-01
54	H	Spray Tip Removal Tool		J 1291-02
55	H	Injector Nut Spray Tip Seating Tool	5110-00-937-7630	J 9418-1
56	H	Injector Nut Spray Tip Seating Tool	5110-00-937-7629	J 9418-5
57	H	Pin Vise		J 4298-1
58	H	Injector Spray Tip Cleaning Tool		J 24838
59	H	Fuel Hole Cleaning Brush		J 8152
60	H	Spray Tip Cleaning Tool		J 1243-01
61	H	Rack Hole Cleaning Brush		J 8150
62	H	Reamer		J 21089
63	H	Spring Tester		J 22738-02
64	H	Injector Nut Seal Ring Protector		J 29197
65	H	Injector Tip Concentricity Gage		J 5119



## TOOL AND TEST EQUIPMENT REQUIREMENTS FOR DIVING AIR COMPRESSOR

Tool or test Equipment ref code (1)	Maintenance Category (2)	Nomenclature (3)	National NATO Stock Number (4)	PN Tool Number (5)
66	H	Bearing Remover		J 21967-01
67	H	Governor Cover and Bearing Installer		J 21068
68	H	Governor Housing Bearing Installer		J 9196
69	H	Oil Seal Pilot Tool		J 1682-10
70	H	Timing Gear Puller		J 1682-27
71	H	Oil Seal Remover		J 1682-31
72	H	Remover and Replacer Tool (Plate) Set		J 3154-04
73	H	Valve Spring Compressor		J 7455
74	H	Valve Guide Remover		J 267
75	H	Valve Guide Installer		J 9530
76	H	Valve Seat Insert Remover		J 4824-03
77	H	Valve Seat Insert Driver		J 1238
78	H	Valve Guide Cleaner		J 5437
79	H	Valve Spring Checking Gage		J 25026-B
80	H	Piston Ring Assembly Tool		J 8128
81	H	Piston and Connecting Rod Bushing Installer and Remover		J 1513-02
82	H	Connecting Rod Bushing Reamer Set	4910-00-218-8392	J 1686-D
83	H	Leak Detector	J 23987	
84	H	Piston Pin Bushing Reamer Set	J 3071-01	

## TOOL AND TEST EQUIPMENT REQUIREMENTS FOR DIVING AIR COMPRESSOR

Tool or test Equipment ref code (1)	Maintenance Category (2)	Nomenclature (3)	National NATO Stock Number (4)	PN Tool Number (5)
85	H	Micrometer Ball Attachment	5210-00-494-1738	J 4737
86	H	Piston Pin Retainer Installer	5120-00-859-6260	J 23762-A
87	H	Piston Bushing Reamer Fixture		J 5273
88	H	Feeler Gage Set		J 5438
89	H	Connecting Rod Holder		J 7632
90	H	Connecting Rod Nozzle Remover		J 8995
91	H	Cylinder Liner Remover	5120-00-387-9615	J 1918-02
92	H	Cylinder Liner Hold-down Clamp		J 21793-8
93	H	Cylinder Liner Depth Gage		J 22273-01
94	H	Setting Master		J 23059-01
95	H	Cylinder Checking Gage		J 5347-01
96	H	Master Ring Gage		J 8386-01
97	H	Puller		J 24420-A
98	H	Bearing Remover and Installer	5120-00-166-1881	J 7593-03
99	H	Dial Indicator and Attachment Set		J 5959-01
100	H	Sled Gage		J 22273-01
101	H	Injector Tube Service Kit		J 22525
102	H	Oil Seal Installer		J 21209
103	F	Guide Studs		J 25002

**SECTION III TOOL AND TEST EQUIPMENT REQUIREMENTS**

Tool or test Equipment ref code (1)	Maintenance Category (2)	Nomenclature (3)	National NATO Stock Number (4)	PN Tool Number (5)
104	H	Plunger and Bushing/Tip Flow Gage		J 25600-B
105	O	Universal Engine Stand		J 29109
106	H	Blower Clearance Feeler Gage Set		J 1698-02
107	H	Valve Seat Grinder		J 7040
108	H	Spring Tester		J 9666
109	H	Piston Ring Compressor		J 3272-03
110	H	Cylinder Liner Remover		J 6410
111	O	Engine Parts Rack		J 6387

**Section IV. REMARKS**

Reference Code	Remarks/Notes
A	Test for air purity standards in accordance with FM 20-11-1.
B	Adjustment is limited to adjustment of subcomponents.
C	Repair is limited to replace or repair of major assemblies.
D	Repair is by welding/brazing.
E	Repair is by replacement of subcomponent.
F	Adjust is limited to belt adjustment.
G	Service is limited to service of filter assemblies.
H	Test in accordance with Magnetic Crack Detector Kit.

## APPENDIX C

## COMPONENTS OF END ITEM AND BASIC ISSUE ITEMS LISTS

## Section I. INTRODUCTION

## C-1. Scope.

This appendix lists components of end item and basic issue items for the Diving Air Compressor to help you inventory items required for safe and efficient operation.

## C-2. General.

The Components of End item and Basic Issue Items Lists are divided into the following sections.

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

b. Section III. Basic Issue Items. These are the minimum essential items required to place the Diving Air Compressor in operation. The illustrations will assist you with hard-to-identify items. This manual is your authority to request/requisition replacement Bill, based on TOE/MTOE authorization of the end item.

## C-3. Explanation of Columns.

The following provides an explanation of columns found in the tabular listings:

a. Column (1). Illustration Number (Illus Number). This column indicates the number of the illustration in which the item is shown.

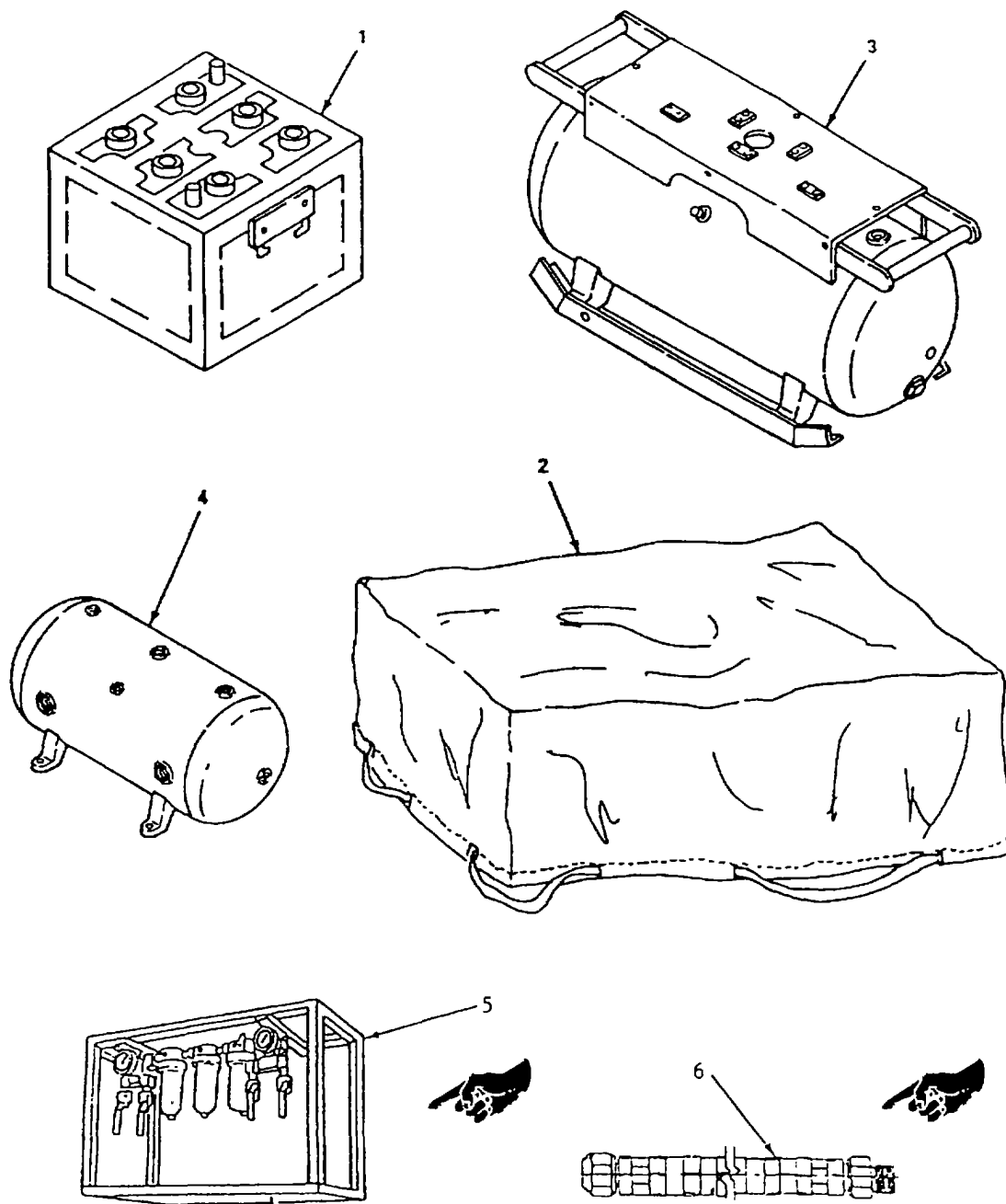
b. Column (2). National Stock Number. Indicates the National Stock Number assigned to the item and will be used for requisitioning purposes.

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

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

e. Column (5). Quantity Required (QTY RQR). Indicates the quantity of the Item authorized to be used with/on the equipment.

Section II. COMPONENTS OF END ITEM

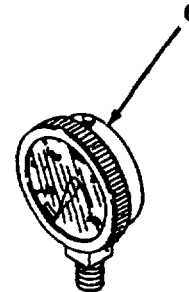
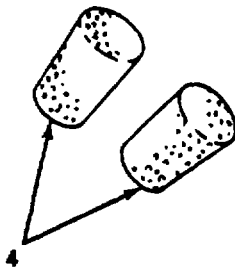
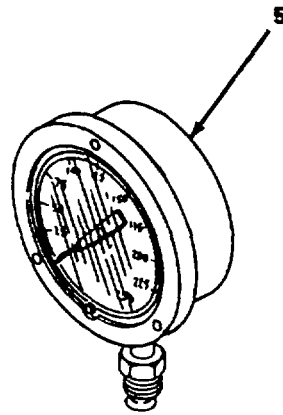
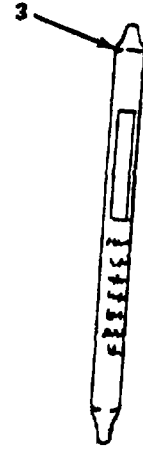
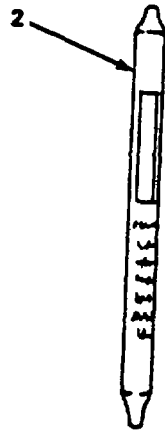
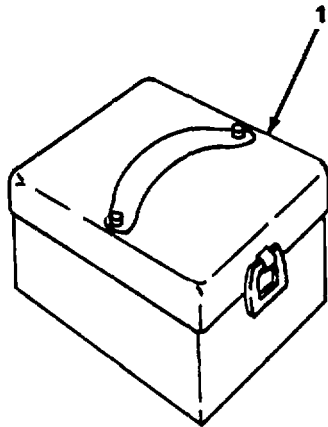


APPENDIX C

Section II. COMPONENTS OF END ITEM ITEM

(1) Illus Number	(2) National Stock Number	(3) Description CAGEC and Part Number	(4) Usable on Code U/M	(5) Qty rqr
1	6140-01-210-1964	BATTERY, 12 Volt	EA	2
2		TARP, (66330) NPN-	EA	1
3		60 Gallon Volume Tank (66330) NPN-	EA	1
4		30 Gallon Volume Tank (53731) CRN F 1165	EA	1
5	4720-01-044-0864	FILTER ASSEMBLY (66330) HII-F46	EA	1
6		HOSE ASSEMBLY (81349) MIL-H-2815	EA	5

Section III. BASIC ISSUE ITEMS



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(1) Illus Number	(2) National Stock Number	(3) Description CAGEC and Part Number	(4) Usable on Code U/M	(5) Qty rqr
1	6665-00-567-0221	Multi Gas Detector Kit	ea	1
2	4220-01-006-1629	CO2 Test Tubes	ea	1
3	4220-01-005-8733	CO Test Tubes	ea	1
4	4240-00-022-2946	Hearing Protectors	ea	2
5		Gages, Pressure 0-300 (38056) 02L0300 PSI	ea	2
6		Gages, Pnemo 0-250 FSW (59018) 201 FTM59A23	ea	2
7		Safety Relief 100 psi	ea	1
8		Safety Relief, 200 psi (75336) 112C-1-4-220 PSI	ea	2
9	TM 5-4310-379-14,	Operator's, Unit, DS and GS Maintenance Manual, Compressor Diving Air, DED, 88.5 SCFM	ea	1



## APPENDIX D

## EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

## Section I. INTRODUCTIONS

D-1. **Scope.** This appendix lists expendable supplies and materials you need to operate and maintain the 100-Foot Diameter Cargo Parachute. 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., "Use Cloth, Abrasive Item 2, App. D").

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

C	-	Operator/Crew
O	-	Organizational Maintenance - Unit Maintenance
F	-	Direct Support Maintenance - Intermediate Maintenance
H	-	General Support Maintenance - Intermediate Maintenance
D	-	Depot Maintenance

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

d. Column (4) - Description. Indicates the Federal item name, and, if required, a description to identify the item.

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 / DURABLE SUPPLIES AND MATERIAL LIST

(1) Item Number	(2) Level	(3) National Stock Number	(4) Description	(5) U/M
1	O	6810-00-286-5435	Alcohol, Isopropyl (81348) TT1735	gal.
	O	6810-00-983-8551	Alcohol, Isopropyl (81348) TT1735	qt
2	O	6850-00-181-7929	Antifreeze, Permanent, Glycol, Inhibited (MIL-A-46153) (81349)	gal.
3	O	8415-00-281-7813	Apron, Rubber, Small (81349) MIL-A-2334	ea
	O	8415-00-281-7814	Apron, Rubber, Medium (81349) MIL-A-2334	ea
	O	8415-00-281-7815	Apron, Rubber, Large (81349) MIL-A-2334	ea
4	O	8105-00-837-7757	Bag, Plastic, 12 in. x 12 in. Interlocking Seal (58536) A-A-1 779	bx
5	O	7510-00-243-3434	Bands, Rubber (81349) ZZ-R-1415	bx
6	O		Book, Record	ea
7	O		Brush, Soft Bristle	ea
8	O	7920-00-292-9204	Cloth, Cleaning, Disp, Xtr Heavy 12 in. x 15 in. (58536) A-A-1 62	mx
9	O	7920-00-044-9281	Cloth, Lint Free (81349) MIL-C-85043	bx
10	O	7930-00-282-9699	Detergent, Nonionic, MIL-D-16791, Type 1 (80244)	gl
	O	7930-00-985-6911	Detergent, Nonionic, MIL-D-16791, Type 1 (80244) 5-Gal Can	cn
11	O	6810-00-297-9540	Distilled Water, Technical (96906) MS36300-5	5 gal.
12	O	9140-00-286-5294	Fuel, Diesel (81348) VV-F-800 Grade F2RE	Gal
13	O		Funnel, 1 qt, Strainer, 8 in. Flex Spout	ea
14	O	8415-00-266-8677	Gloves, Rubber (81349) ZZ-G-381 Size 10	pr
15	O	9150-00-190-0905	Grease, Automotive and Artillery (6.5 lb) MIL-G-10924 (81349)	cn

## SECTION II. EXPENDABLE / DURABLE SUPPLIES AND MATERIAL LIST

(1) Item Number	(2) Level	(3) National Stock Number	(4) Description	(5) U/M
16	O	9150-00-754-2760	Grease, Halo Carbon	lb
17	O	9150-00-985-7237	Lubricating Oil, Light Turbine, Noncorrosive, MIL-L-17672 (Arctic Temp) (2135-TH) (81349)	5 gal.
18	O	9150-00-188-9858	Lubricating Oil, Grd Equipment, MIL-L-2104 (81348)	5 gal.
19	O	9150-00-235-9061	Lubricating Oil, Steam Turbine, Noncorrosive, Normal Temp (2190-TEP), MIL-L-17331 (81348)	5 gal.
	O	9150-00-235-9062	Lubricating Oil, Steam Turbine, Noncorrosive, Normal Temp (2190-TEP), MIL-L-17331 (81348)	55 gal
20	O	6810-00-141-6078	Phosphate, Trisodium (81348) 0-S-642	lb
21	O	7920-00-205-1711	Rag, Wiping, 50/G (58536) A-A-531	ea
22	O	4240-00-240-5141	Shield, Face, MIL-S-3126 (81349)	ea
23	O	6850-00-281-1985	Solvent, Drycleaning, PD-680 (81348)	
24	O	Tape, Pressure Sensitive Adhesive		gal.
25	O	8030-00-889-3535	Tape, Teflon, MIL-T-27730 (81349), 1/2 In.	
	O	8030-00-889-3534	Tape, Teflon, MIL-T-27730 (81349), 1/4 In.	ea
26	F	6685-00-275-9000	Temperature Indicating Compound "	ea

## APPENDIX E

## TORQUE LIMITS

E-1. **General.** Table E-1 provides torque limits to be observed when installing attaching hardware.

Table E-1. Torque Limits.

Attaching Parts	Torque Range
Exhaust Manifold Adapter Plate Nuts	20-25 lb-ft (27-34 Nm)
Exhaust Manifold Nuts	35-39 lb-ft (47-53 Nm)
Radiator Screws	15-19 lb-ft (20-26 Nm)
Shroud Screws	15-19 lb-ft (20-26 Nm)
Baffle Screws	15-19 lb-ft (20-26 Nm)
Shell Assembly Screws	30-35 lb-ft (41-47 Nm)
Thermostat Housing Assembly Screws	46-50 lb-ft (62-68 Nm)
Thermostat Housing Screws	13-17 lb-ft (18-23 Nm)
Fan and Pulley Screws	15-19 lb-ft (20-26 Nm)
Water Pump Screws	46-50 lb-ft (62-68 Nm)
Fuel Pump and Drive Nuts	10-13 lb-ft (14-18 Nm)
Air Shutdown Housing Assembly Screws	16-20 lb-ft (22-27 Nm)
Starter Screws	137-147 lb-ft (186-200 Nm)
Oil Filter Shell Screw	50-60 lb-ft (68-81 Nm)
Oil Filter Assembly Screws	23-26 lb-ft (31-35 Nm)
Breather Pipe Screws	5-7 lb-ft (7-9 Nm)
Fuel Connection Fitting	65-75 lb-ft (88-102 Nm)
Injector Control Screws	10-12 lb-ft (14-16 Nm)
Injector Clamp Bolt	20-25 lb-ft (27-34 Nm)
Rocker Shaft Bracket to Cylinder Head Bolts	90-100 lb-ft (122-136 Nm)
Blower Rear End Plate Bolts	13-17 lb-ft (18-23 Nm)
Blower Front End Plate Bolts	13-17 lb-ft (18-23 Nm)
Timing Gear Retaining Nuts	60-80 lb-ft (81-108 Nm)
Oil Pump Cover Bolts	13-17 lb-ft (18-23 Nm)

Table E-1. Torque Limits (Cont).

Attaching Parts	Torque Range
Injector Control Screws	10-12 lb-ft (14-16 Nm)
Front Cover to Blower Screws	13-17 lb-ft (18-23 Nm)
Blower to Crankcase Bolts	30-35 lb-ft (41-47 Nm)
Blower to Crankcase Bolt	46-50 lb-ft (62-68 Nm)
Oil Distribution System Bolts	13-17 lb-ft (18-23 Nm)
Oil Pump Bolts	13-17 lb-ft (18-23 Nm)
Oil Cooler Bolts	46-50 lb-ft (62-68 Nm)
Oil Cooler By-Pass Valve	46-50 lb-ft (62-68 Nm)
Flywheel Housing Screws	46-50 lb-ft (62-68 Nm)
Cylinder Head Bolts	170-180 lb-ft (231-244 Nm)
Valve Operating Mechanism Bolts	30-35 lb-ft (41-47 Nm)
Valve Operating Mechanism Support Bracket Bolts	90-100 lb-ft (122-136 Nm)
Water Pump Cover bolts	7-9 lb-ft (10-12 Nm)
Water Pump Shaft Nut	55-65 lb-ft (75-88 Nm)
Injector Nut	75-85 lb-ft (102-115 Nm)
Fuel Injector Filter Caps	65-75 lb-ft (88-102 Nm)
Rotor Timing Gears	60-80 lb-ft (81-108 Nm)
Connecting Rod Bearing Cap Nuts	60-70 lb-ft (81-95 Nm)
Thrust Plate Bolts	13-17 lb-ft (18-23 Nm)
Timing Gear and Camshaft Gear Nuts	250-275 lb-ft (339-373 Nm)
Balance Weight Nuts	250-275 lb-ft (339-373 Nm)
Crankshaft Pulley Bolt	290-310 lb-ft (393-421 Nm)
Main Bearing Cap Bolts	165-175 lb-ft (224-238 Nm)
Intercooler Bolts	30 lb-ft (40 Nm)
Unloader Assembly Cover Plate Bolts	37 lb-ft (50 Nm)
Compressor Cylinder Head Bolts	30 lb-ft (41 Nm)
Intake Unloader Valve Cover	37 lb-ft (50 Nm)
Bearing Carrier Assembly Bolts	40 lb-ft (54 Nm)
Bearing Adjustment Plate Bolts	40 lb-ft (54 Nm)

APPENDIX F

ILLUSTRATED LIST OF MANUFACTURED ITEMS

This appendix includes complete instructions for making items authorized to be manufactured or fabricated at unit maintenance.

A part number index in alphanumeric order is provided for cross-referencing the part number of the item to be manufactured to the figure which covers fabrication criteria.

All bulk material needed for manufacture of an item are listed by part number or specification number in a tabular list on the illustration.

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Parts Needed: Terminal lug (PN MS35425-40) (96906) 2 ea, Wire (PN M13486/1-2) (96906) 18 in. (45.72 cm), Tubing, heat shrink 2 pieces 1 in. (2.54 cm) long.

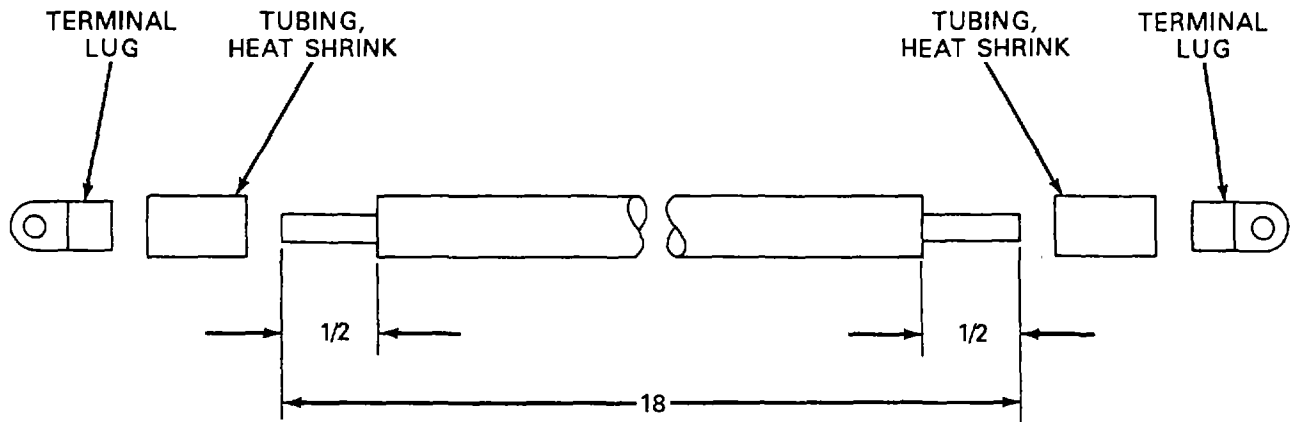
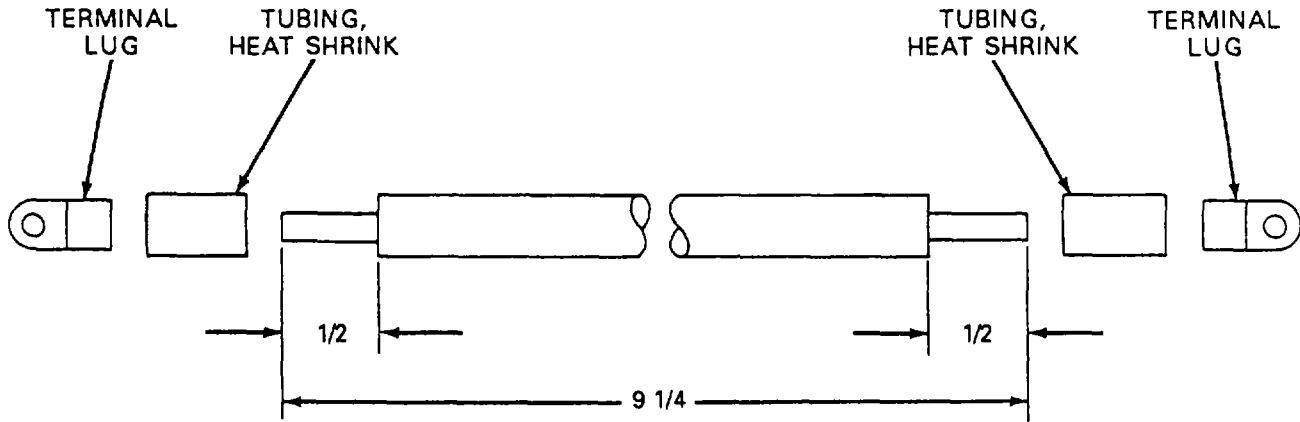


Figure F-1. Negative Battery Cable.

NOTES

1. All dimensions in inches.
2. Cut wire to length.
3. Strip off insulation.
4. Install terminal lugs and crimp.
5. Install heat shrink tubing on terminals to cover gap between terminals and insulation.

Parts Needed: Terminal lug (PN MS35425-40) (96906) 2 ea, Wire (PN M13486/1-2) (96906) 9.25 in. (23.50 cm), Tubing, heat shrink 2 pieces 1 in. (2.54 cm) long.



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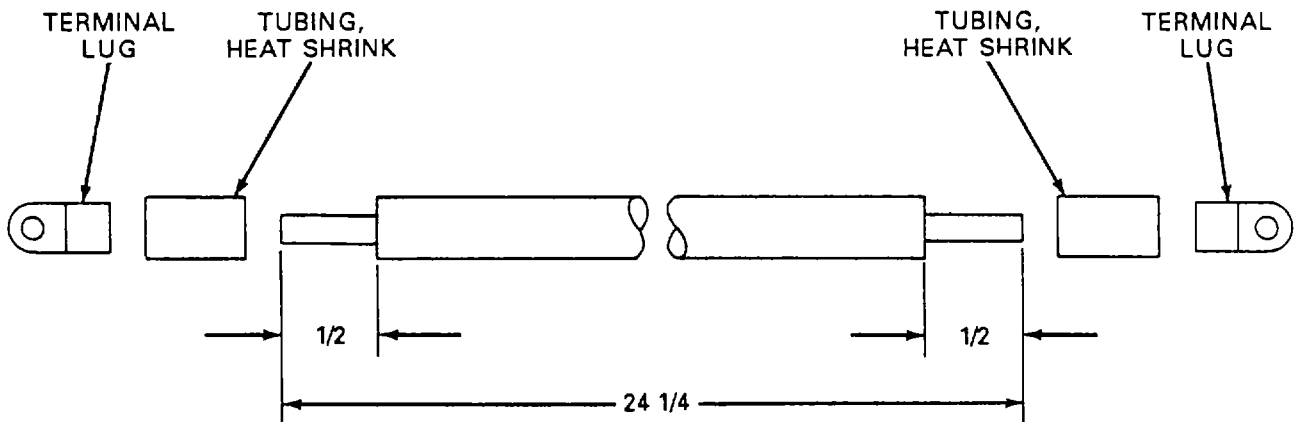
Figure F-2. Battery Jumper Cable.

NOTES

1. All dimensions in inches.
2. Cut wire to length.
3. Strip off insulation.
4. Install terminal lugs and crimp.
5. Install heat shrink tubing on terminals to cover gap between terminals and insulation.



Parts Needed: Terminal lug (PN MS35425-40) (96906) 2 ea, Wire (PN M13486/1-2) (96906) 24.50 in. (62.23 cm), Tubing, heat shrink 2 pieces 1 in. (2.54 cm) long.



4951-231

Figure F-3. Positive Battery Cable.

#### NOTES

1. All dimensions in inches.
2. Cut wire to length.
3. Strip off insulation.
4. Install terminal lugs and crimp.
5. Install heat shrink tubing on terminals to cover gap between terminals and insulation.

Parts Needed: Terminal lug (PN 10476-103) (74025) 4 ea, Terminal lug (PN MS25036-153) (96906), Wire (PN M5086/1-16-0) (96906) 13 in. (33.02 cm) 2 ea, Wire (PN M5086/1-16-0) (96906) 16 in. (40.64 cm), Wire (PN M5086/1-16-0) (96906) 10 in. (25.40 cm).

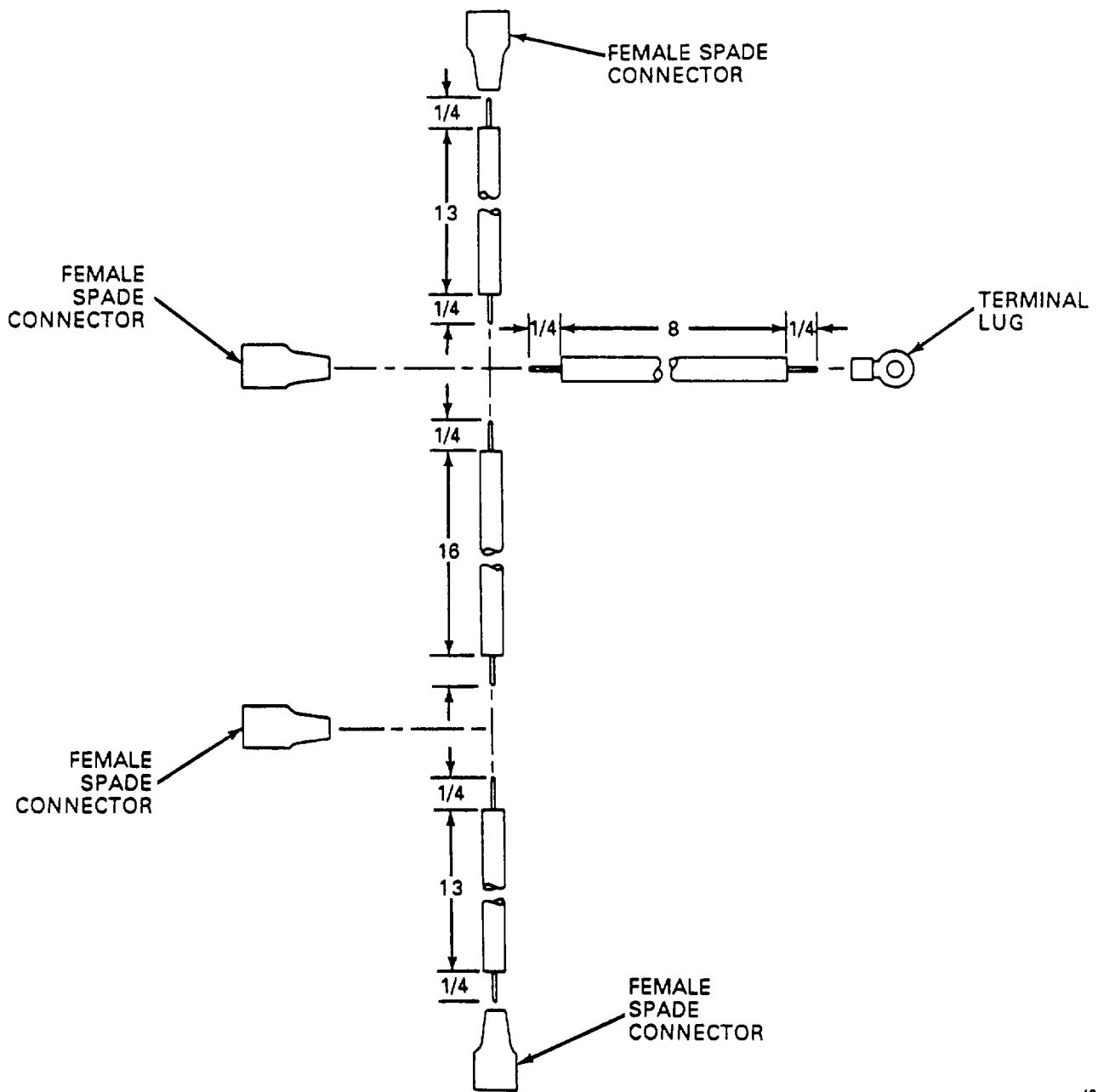


Figure F-4. Positive Panel Light Wiring.

4951-233

NOTES

1. All dimensions in inches.
2. Cut all wires to length.
3. Strip off insulation.
4. Install connectors and terminal lugs on wiring and crimp.

Parts Needed: Terminal lug (PN 10476-103) (74025) 4 ea, Terminal lug (PN MS25036-153) (96906), Wire (PN M5086/1,16-0) (96906) 13 in. (33.02 cm) 2 ea, Wire (PN M5086/1-16-0) (96906) 8 in. (20.32 cm), Wire (PN M5086/1-16-0) (96906) 16 in. (40.64 cm).

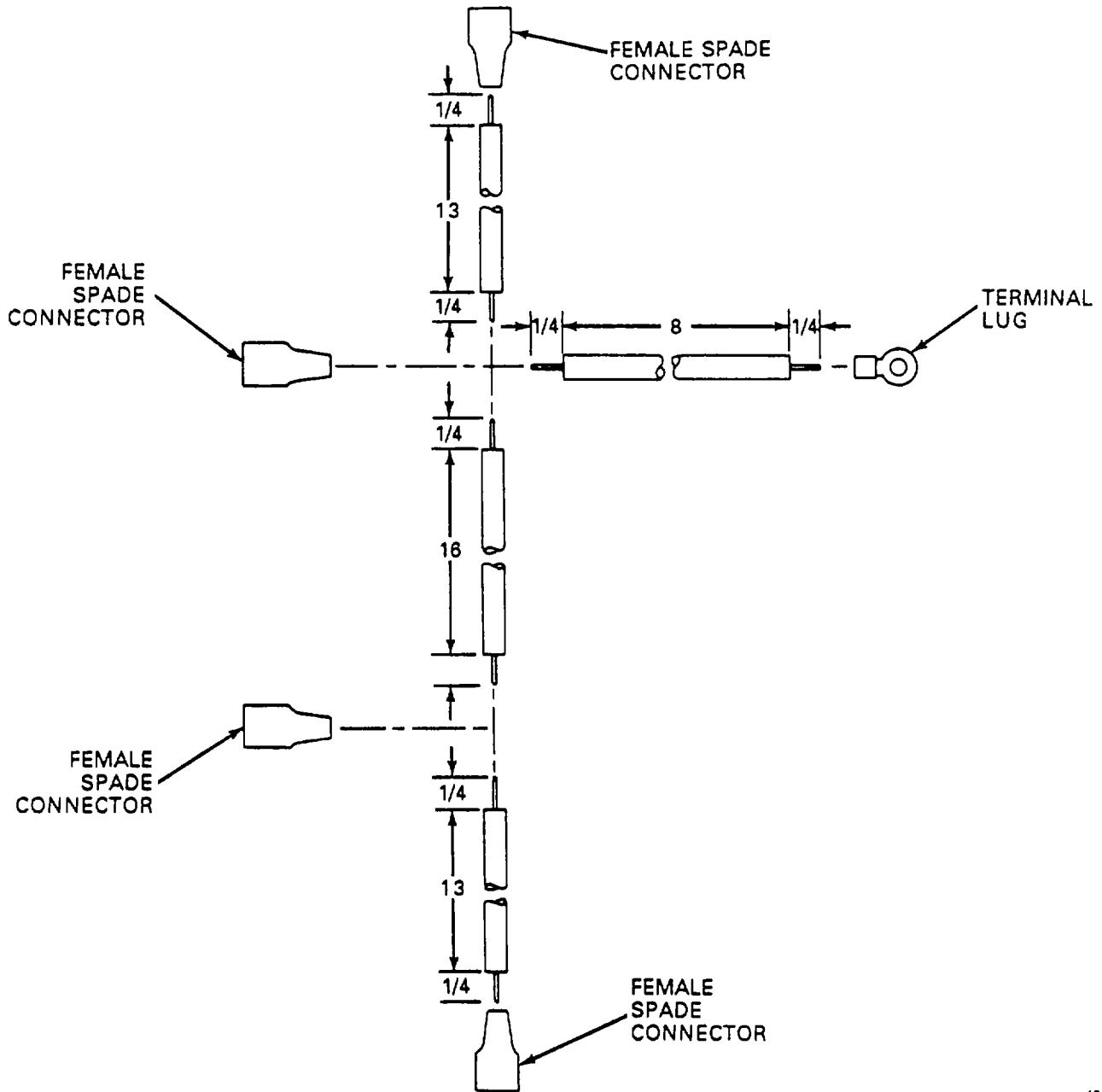


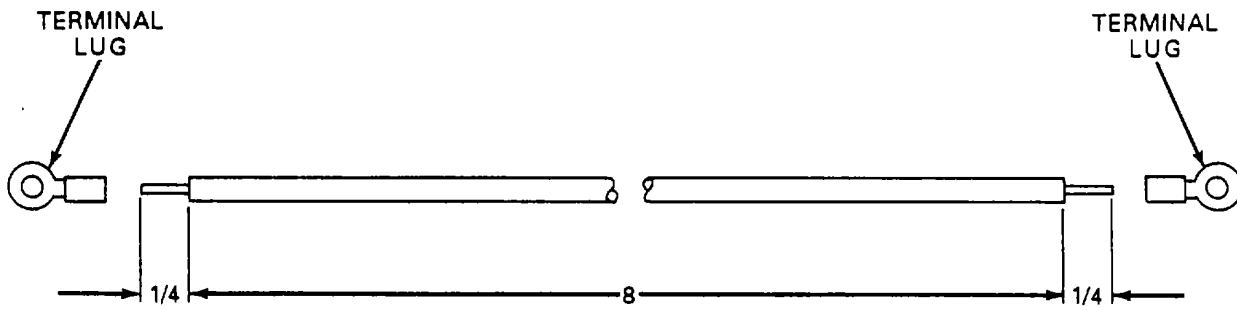
Figure F-5. Negative Panel Light Wiring.

4951-233

NOTES

1. All dimensions in inches.
2. Cut all wires to length.
3. Strip off insulation.
4. Install connectors and terminal lugs on wiring and crimp.

Parts Needed: Terminal lug (PN MS25036-153) (96906) 2 ea, Wire (PN M5086/1-16-0) (96906) 8 in. (20.32 cm)



4951-234

Figure F-6. Start Switch to Amp Meter Wiring.

**NOTES**

1. All dimensions in inches.
2. Cut wire to length.
3. Strip off insulation.
4. Install terminal lugs and crimp.

Parts Needed: Terminal lug (PN MS25036-153) (96906) 2 ea, Wire (PN M5086/1-12-2) (96906) 10 in. (25.40 cm)

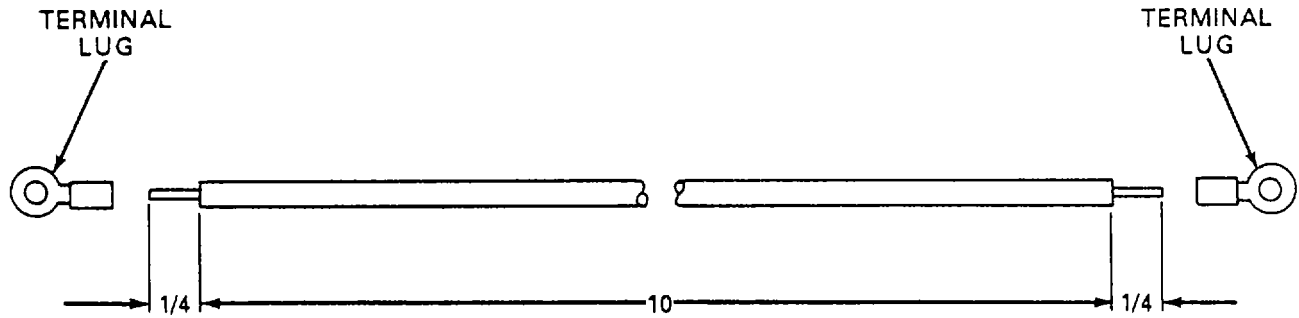
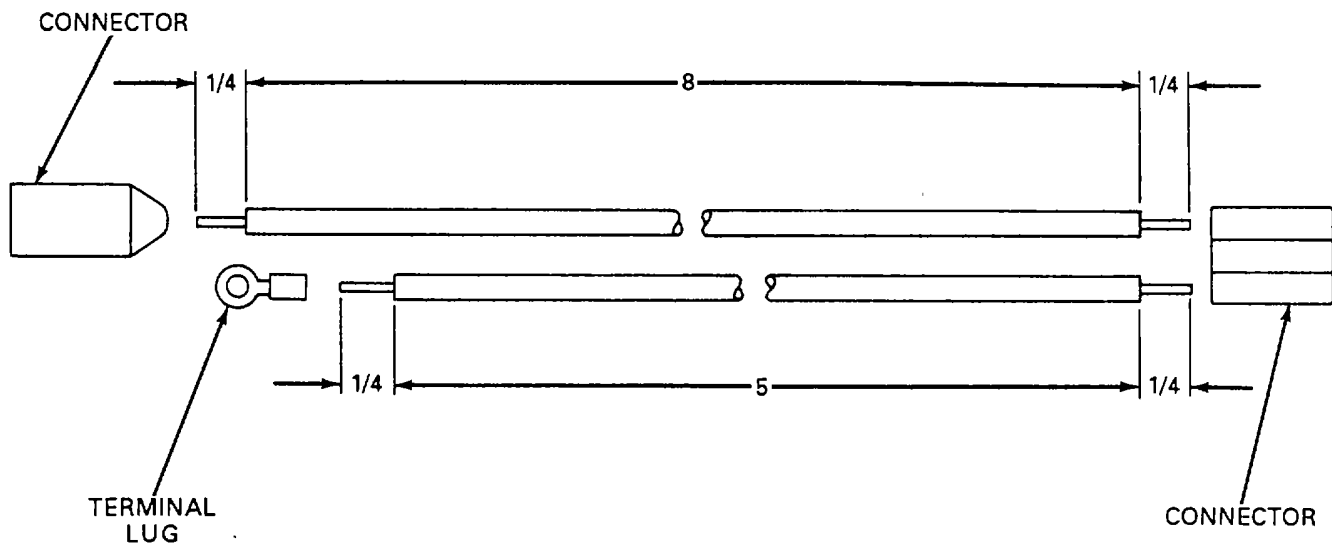


Figure F-7. Light Switch to Amp Meter Wiring.

NOTES

1. All dimensions in inches.
2. Cut wire to length.
3. Strip off insulation.
4. Install terminal lugs and crimp.

Parts Needed: Connector (PN NPN-24) (19099) Connector (PN NPN-25) (19099), Wire (PN M5086/1-14-9) (96906) 8 in. (20.32 cm), Wire (PN M5086-1-14-2) (96906) 5 in. (12.70 cm), Terminal Lug (PN MS25036-156) (96906)



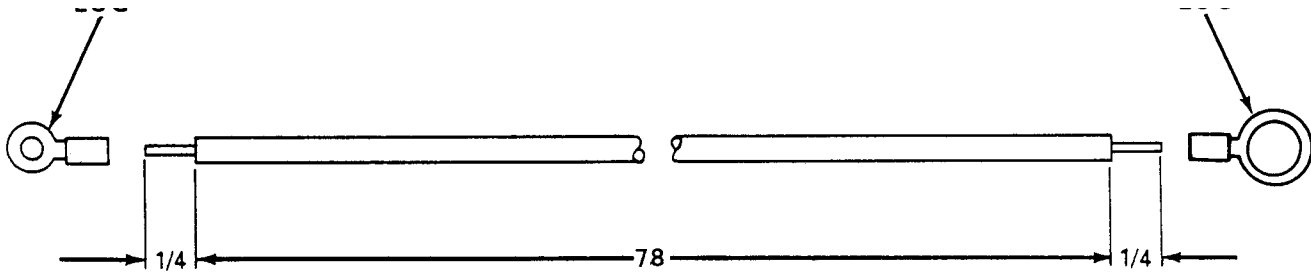
4951-236

Figure F-8. Alternator Wiring.

**NOTES**

1. All dimensions in inches.
2. Cut all wires to length.
3. Strip off insulation.
4. Install terminal lug and crimp.
5. Install connectors and secure wires to connectors.

Parts Needed: Terminal lug (PN MS25036-114) (96906) 2 ea, Wire (PN M5086/1-10-0) (96906 78 in. (198.12cm), Terminal Lug (PN MS25036-156) (96906)



4951-237

Figure F-9. Starter Wiring.

Figure F-9. Starter Wiring.

**NOTES**

1. All dimensions in inches.
2. Cut wire to length.
3. Strip off insulation.
4. Install terminal lugs and crimp.

Parts Needed: Terminal lug (PN MS25036-156) (96906) 2 ea, Wire (PN M5086/1-10-6) (96906) 72 in. (182.88 cm)

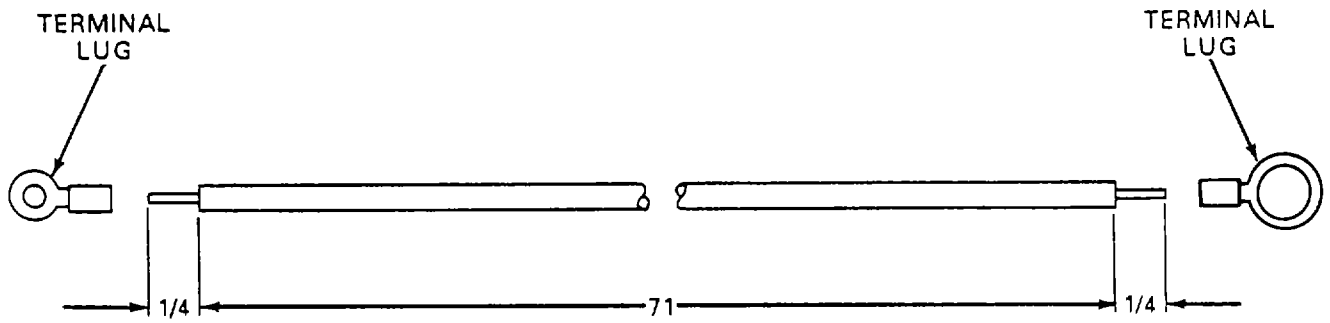


Figure F-10. Wire Assembly #2

**NOTES**

1. All dimensions in inches.
2. Cut wire to length.
3. Strip off insulation.
4. Install terminal lugs and crimp.



Parts Needed: Terminal lug (PN MS25036-114) (96906) 2 ea, Wire (PN M5086/1-10-2) (96906) 78 in. (198.12 cm), Terminal Lug (PN MS25036-156) (96906)

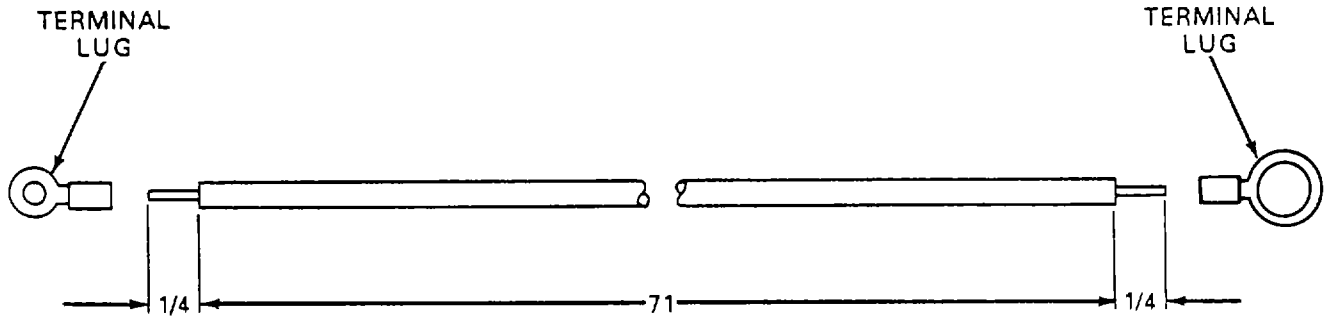


Figure F-11. Wire Assembly #3.

**NOTES**

1. All dimensions in inches.
2. Cut wire to length.
3. Strip off insulation.
4. Install terminal lugs and crimp.

Parts Needed: Terminal lug (PN MS25036-156) (96906) 2 ea, Wire (PN M5068/1-10-2) (96906) 52 in. (132.08 cm)

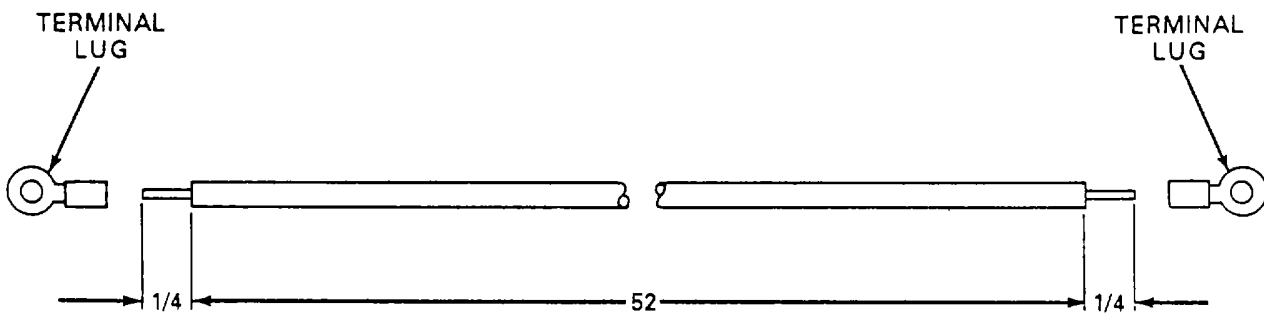


Figure F-12. Wire Assembly #4.

NOTES

1. All dimensions in inches.
2. Cut wire to length.
3. Strip off insulation.
4. Install terminal lugs and crimp.

Parts Needed: Terminal lug (PN 61198-1) (96906) 1 ea, Terminal lug (PN MS25036-156) (96906), Wire (PN M5086/1-10-2) (96906) 38 in. (96.52 cm)

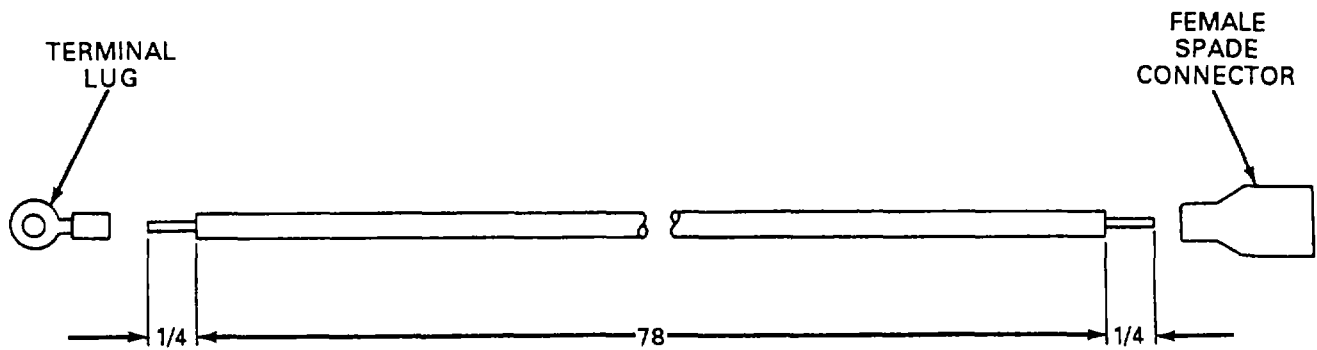
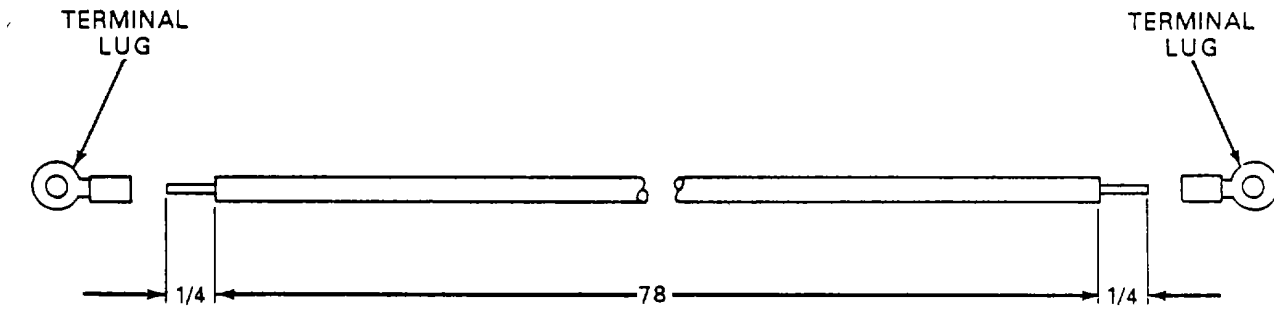


Figure F-13. Wire Assembly #5.

NOTES

1. All dimensions in inches.
2. Cut wire to length.
3. Strip off insulation.
4. Install terminal lugs and connector and crimp.

Parts Needed: Terminal lug (PN MS25036-156) (96906) 2 ea, Wire (PN M5086/1-10-2) (96906) 72 in. (182.88 cm)



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Figure F-14. Wire Assembly #6.

NOTES

1. All dimensions in inches.
2. Cut wire to length.
3. Strip off insulation.
4. Install terminal lugs and crimp.

Parts Needed: Wiring harness sleeving (PN NPN (54 in.)) (19099) 54 in. (137.16 cm).

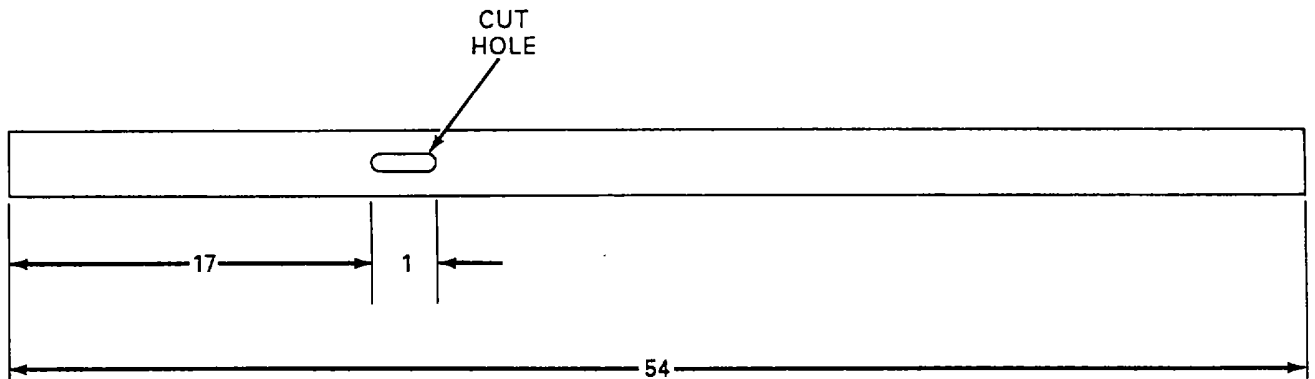
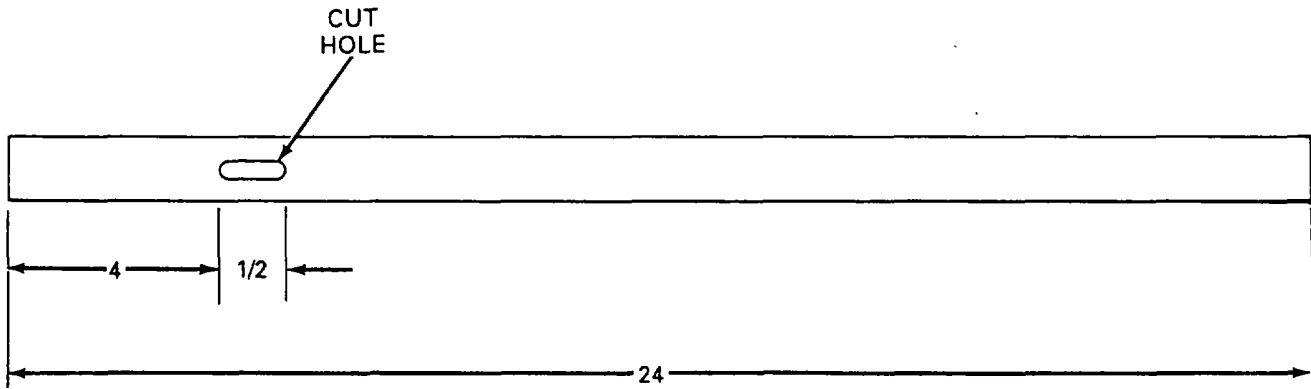


Figure F-15. Wire Harness Covering.

**NOTES**

1. All dimensions in inches.
2. Cut sleeving to length.
3. Cut one inch hole in sleeving.

Parts Needed: Wiring harness sleeving (PN NPN (24 in.)) (19099) 24 in. (60.96 cm).



4951-244

**Figure F-16. Wire Harness Covering.**

**NOTES**

1. All dimensions in inches.
2. Cut sleeving to length.
3. Cut one half inch hole in sleeving.

Parts Needed: Plywood (PN MIL-P18066) (81349)

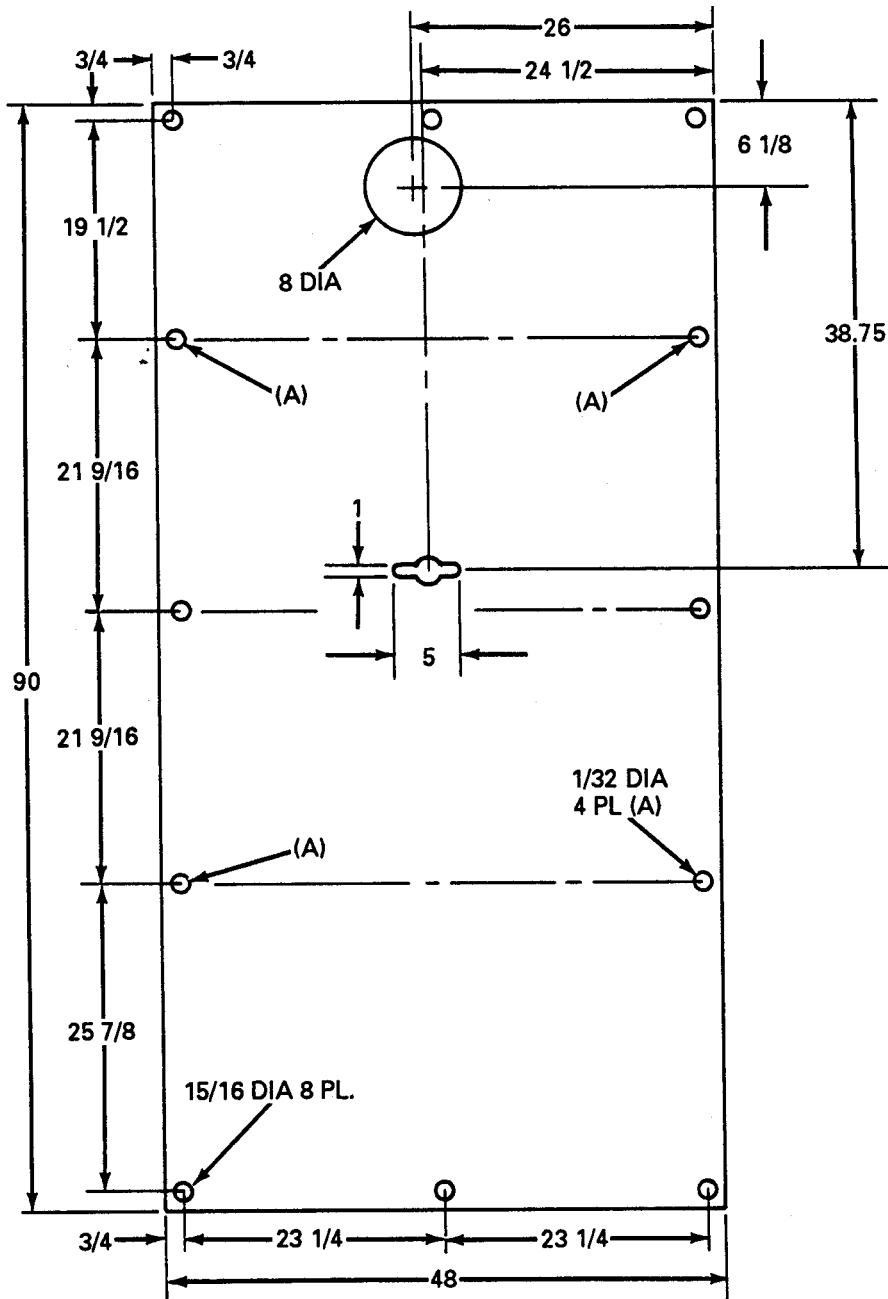


Figure F-17. Plywood Decking.

NOTES

1. All dimensions in inches.
2. Cut plywood to size.
3. Cut holes in plywood as indicated.

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**By Order of the Secretary of the Army:**

**CARL E. VUONO**  
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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 decigrams = .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

### Cubic Measure

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

### Square measure

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

### Liquid Measure

1 dekaliter = 10 liters = 2.64 gallons  
 1 hectoliter = 10 dekaliters = 26.42 gallons  
 1 kiloliter = 10 hectoliters = 264.18 gallons  
 1 liter = 10 deciliters = 33.81 fl. ounces  
 1 centiliter = 10 milliliters = .34 fl. ounce  
 1 deciliter = 10 centiliters = 3.38 fl. ounces  
 1 metric ton = 10 quintals = 1.1 short tons

### Approximate Conversion Factors

To change	To	Multiply by	To change	To	Multiply by
inches	centimeters	2.540	ounce inches	newton-meters	.0070062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
sq. inches	sq. centimeters	6.451	kilometers	miles	.621
sq. feet	sq. meters	.093	sq. centimeters	sq. inches	.155
sq. yards	sq. meters	.836	sq. meters	sq. yards	10.764
sq. miles	sq. kilometers	2.590	sq. kilometers	sq. miles	1.196
acres	sq. hectometers	.405	sq. hectometers	acres	2.471
cubic feet	cubic meters	.028	cubic meters	cubic feet	35.315
cubic yards	cubic meters	.765	milliliters	fluid ounces	.034
fluid ounces	milliliters	29.573	liters	pints	2.113
pints	liters	.472	liters	quarts	1.057
quarts	liters	.946	grams	ounces	.035
gallons	liters	3.785	kilograms	pounds	2.205
ounces	grams	28.349	metric tons	short tons	1.102
pounds	kilograms	.454	pound-feet	newton-meters	1.356
short tons	metric tons	.907			
pound inches	newton-meters	.11296			

### Temperature (Exact)

°F Fahrenheit temperature

5/9 ( after subtracting 32)

Celsius Temperature °C

