

OPERATION AND MAINTENANCE INSTRUCTIONS

FOR

MJ-1 DIESEL ENGINE DRIVEN HYDRAULIC  
SYSTEM PORTABLE TEST STAND

APS SYSTEMS (FSCM 60984)

1 MAY 1985

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## SECTION I

### INTRODUCTION AND GENERAL INFORMATION

1-1. INTRODUCTION. This publication is the basic manual of Operation and Maintenance Instructions for the MJ-1 Aircraft Hydraulic System Test Stand, Diesel Engine Driven, manufactured by APS Systems, Port Hueneme, CA 93041 (FSCM 60984). The Aircraft Hydraulic System Test Stand will be referred to as Test Stand throughout this manual.

1-2. SCOPE OF MANUAL. This manual is divided into eight sections as follows:

a. Section I, Introduction and General Information. Contains the information pertaining to the scope of the manual, and a simplified description of the equipment.

b. Section II, Tools and Test Equipment. Contains the list of tools and test equipment required to operate and maintain the Test Stand.

c. Section III, Preparation for Use and Shipment. Contains the instructions for set-up and check-out prior to operation and to prepare the unit for shipment.

d. Section IV, Operation Instructions. Contains the theory of operation and detailed instructions for operating the Test Stand.

e. Section V, Maintenance Instructions. Contains inspection, maintenance, troubleshooting, repair, disassembly, cleaning, assembly and testing instructions.

f. Section VI, Diagrams. Contains the electrical and hydraulic diagrams required to operate and maintain the Test Stand.

g. Section VII, Recommended List of Spares.

h. Section VIII, Detroit Diesel Operators Manual.

1-3. RELATED PUBLICATIONS.

a. Detroit Diesel series 53 operators manual.

1-4. PURPOSE OF EQUIPMENT. The Test Stand (See Figure 1-1) is a trailer mounted mobile testing unit, for rapidly and accurately determining the performance and operating characteristics of aircraft hydraulic systems. The Test Stand incorporates systems to perform the following test and service operations without the necessity of starting the aircraft engines.

a. Test function and operation of aircraft hydraulic systems components.

b. Test the aircraft systems for internal and external leakages.

c. Drain, flush, and refill the aircraft hydraulic systems with micronically-filtered hydraulic fluid.

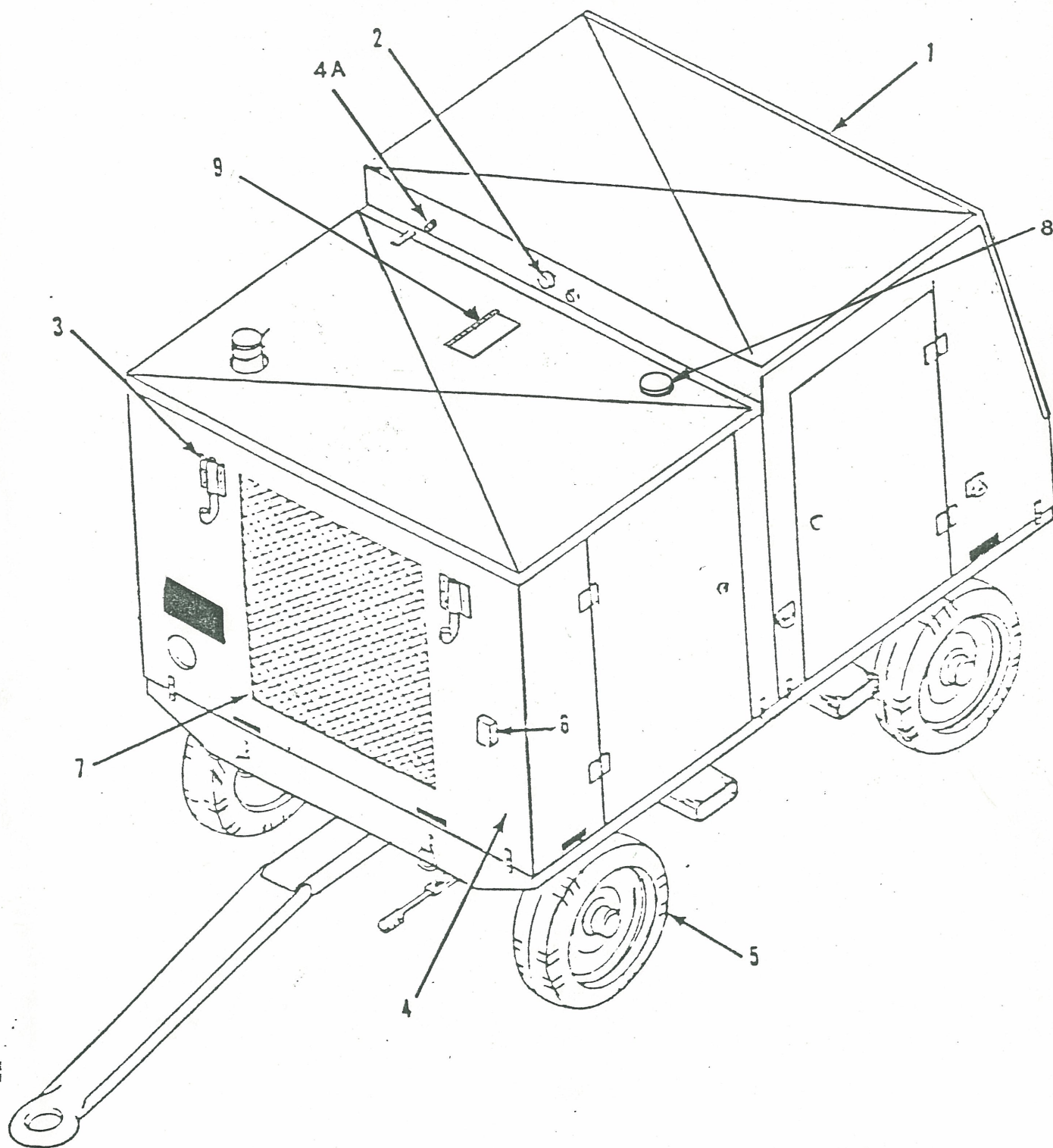
d. Bleed air from aircraft hydraulic systems.

1-5. GENERAL DESCRIPTION.

NOTE

The terms "left side" and "right side" as used below are as viewed from the control panel at the rear of the test stand facing towards the towbar at the front.

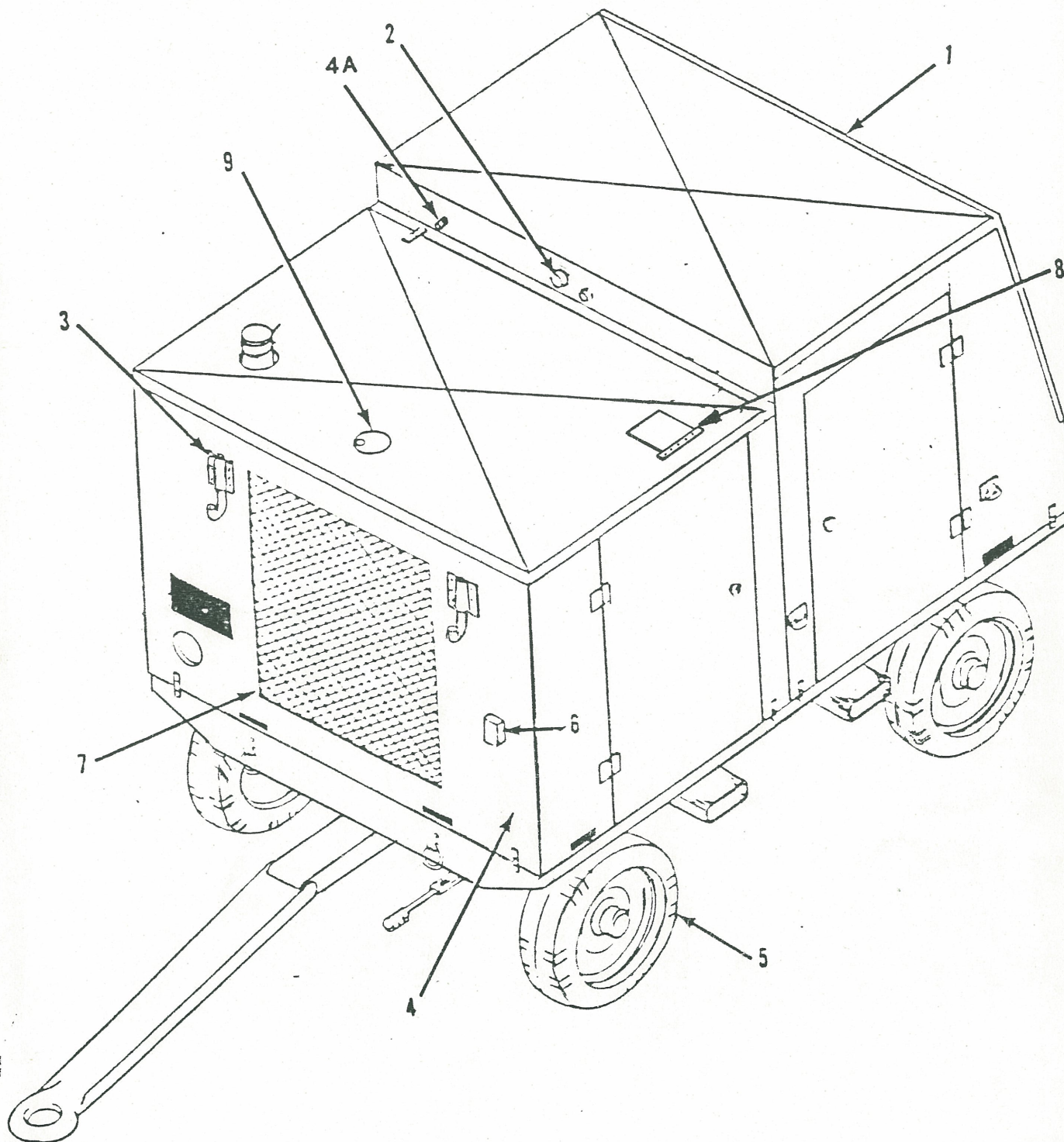




- 1. Controls and Instruments
- 2. Test Connections
- 3. Hose Retainer Hooks
- 4. Housing
- 4A. Air Outlet

- 5. Trailer
- 6. Runaround Block
- 7. Air Inlet Panel
- 8. Reservoir Access Door
- 9. Radiator Access Door

Figure 1-1. Aircraft Hydraulic System Test Stand, Diesel Engine Driven, Type MJ-1



- 1. Controls and Instruments
- 2. Test Connections
- 3. Hose Retainer Hooks
- 4. Housing
- 4A. Air Outlet

- 5. Trailer
- 6. Runaround Block
- 7. Air Inlet Panel
- 8. Reservoir Access Door
- 9. Radiator Access Door

Figure 1-1. Aircraft Hydraulic System Test Stand, Diesel Engine Driven, Type MJ-1



Operator's controls and instruments (1, Figure 1-1) are located at the rear of the Test Stand. External test connections (2) are located on top of the Test Stand to the rear of the control panel. Hoses are supplied with the Test Stand for connection to the aircraft. Hose retainer hooks (3) are provided on the front of Test Stand to store the hoses. Run around connections (6) are provided at the front of the unit to allow checkout without connecting to an aircraft.

The Test Stand operating components, including the control panels, are enclosed in a steel, weather-resistant housing (4), mounted on a four wheel trailer (5), capable of being towed by a vehicle at speeds up to 20 miles per hour. Hand-operated, mechanical-type parking brakes which act upon the rear wheels, hold the Test Stand in a fixed position while in operation or when parked on a grade. The unit may be fork lifted by inserting fork lift under the frame at market channels. The major components and systems of the Test Stand are as follows: trailer and running gear, housings, diesel engine, gearbox, main hydraulic pump, oil cooler, fill pump, and bleed system, fuel reservoir, hydraulic reservoir, hydraulic filters, instruments and controls and the electrical system.

1-6, 1-7. NOT USED

1-8. DETAILED DESCRIPTION.

1-9. TRAILER AND RUNNING GEAR ASSEMBLY. The trailer frame (1, Figure 1-2) is of welded steel construction. The trailer rolls easily on four steel wheels equipped with 6.0 x 9.00 inch, 6 ply tires. Individual leaf springs for each wheel give the Test Stand good cushioning against road shocks and rough terrain, protecting the components of the Test Stand. A hinged towbar (2) permits ease of positioning of the conventional type with steering knuckles, tie rods, and king pins. A hand lever (3) sets the rear wheel brakes, holding the Test Stand in a fixed position during test operation or in parking on a grade. Two tie-down rings (4) are provided on both the front and rear of the trailer frame to permit tiedown of the Test Stand for storage or shipment.



1-10. HOUSING. (4, Figure 1-1) Hinged doors on the sides of the cabinet permit access to all internal components. A hinged instrument panel cover protects the controls when the Test Stand is not in use. A screened air inlet panel (7) is provided for both radiators. A reservoir access door (8) is installed for servicing the reservoir and radiator access is provided by door (9).

1-11. DIESEL ENGINE. (24, Figure 1-2) A 4 cylinder in-line Detroit Diesel engine, from the Series 53N family provides power for test stand operation. The engine is mounted on a base attached to the test stand frame assembly. Power is transmitted from the engine to the gearbox and from the gearbox to the hydraulic pump.

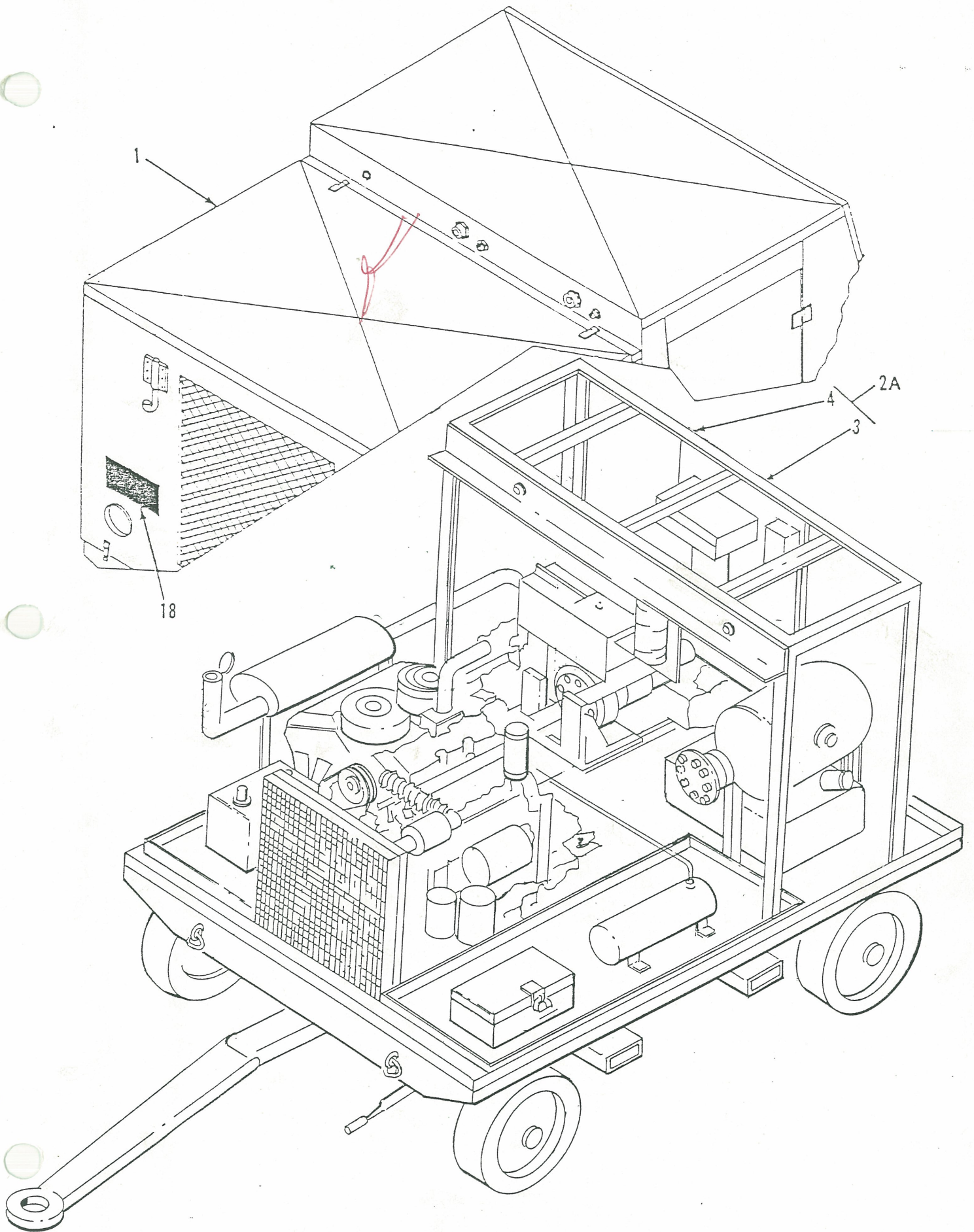
1-12. MAIN HYDRAULIC PUMP. (25, Figure 1-2). The main hydraulic pump supplies fluid at high pressure for testing of aircraft hydraulic systems. The pump consists of a high pressure pump section and integral boost pump section. The pump contains a manual volume control (13) for varying the output volume and a compensator control (14) to regulate the output volume by changing the stroke length of the pumping pistons. Change in piston stroke length is controlled by system pressure so that when the pump is operating at a pressure less than the maximum setting of the compensator control, the pump delivers full volume. When the system pressure reaches the compensator control setting, the pump output is automatically reduced to the amount of flow required to maintain this pressure throughout the systems. The compensator control provides an adjustable range of 500 to 5000 psig with flow varying to 35 gpm maximum. The volume control permits regulation of maximum volume output by limiting the angle of a cam plate through a hydraulic piston within the pump. The return line for the test system also includes a flowmeter (2) to monitor fluid flow.

The flowmeter (26) is a transparent tube type equipped with a metal float. The flowmeter scale is calibrated for 3 to 35 gpm of hydraulic oil at 100 degrees F. A calibration curve is mounted on the control and instrument panel access door. This calibration curve is used for converting flowmeter indications at fluid temperatures other than 100 degrees F.

KEY TO FIGURE 1-2

1. Trailer and Running Gear Assembly
2. Hinged Towbar
3. Hand Lever
4. Tie Down Rings
5. Oil Cooler Radiator
6. Bleed Valve
7. Radiator
8. Level Indicator
9. HP Filter
10. LP Filter
11. Fill Pump
12. Filter
- 13-20 Not Used
21. Reservoir
22. Filler
23. Cover
24. Diesel Engine
25. Main Pump
26. Flowmeter
27. Selector Valve







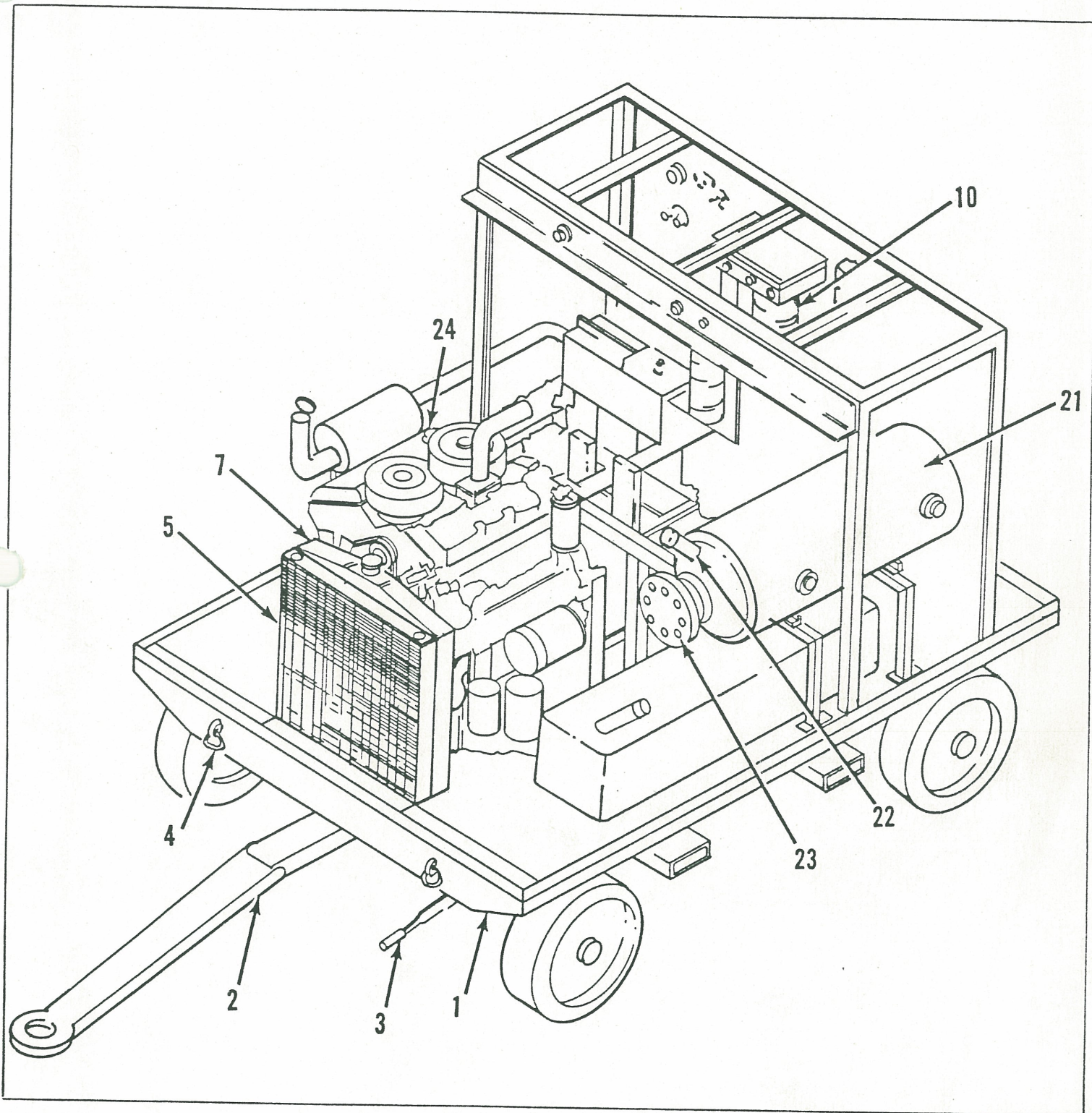


Figure 1-2. Major Components. (Sheet 1 of 2)

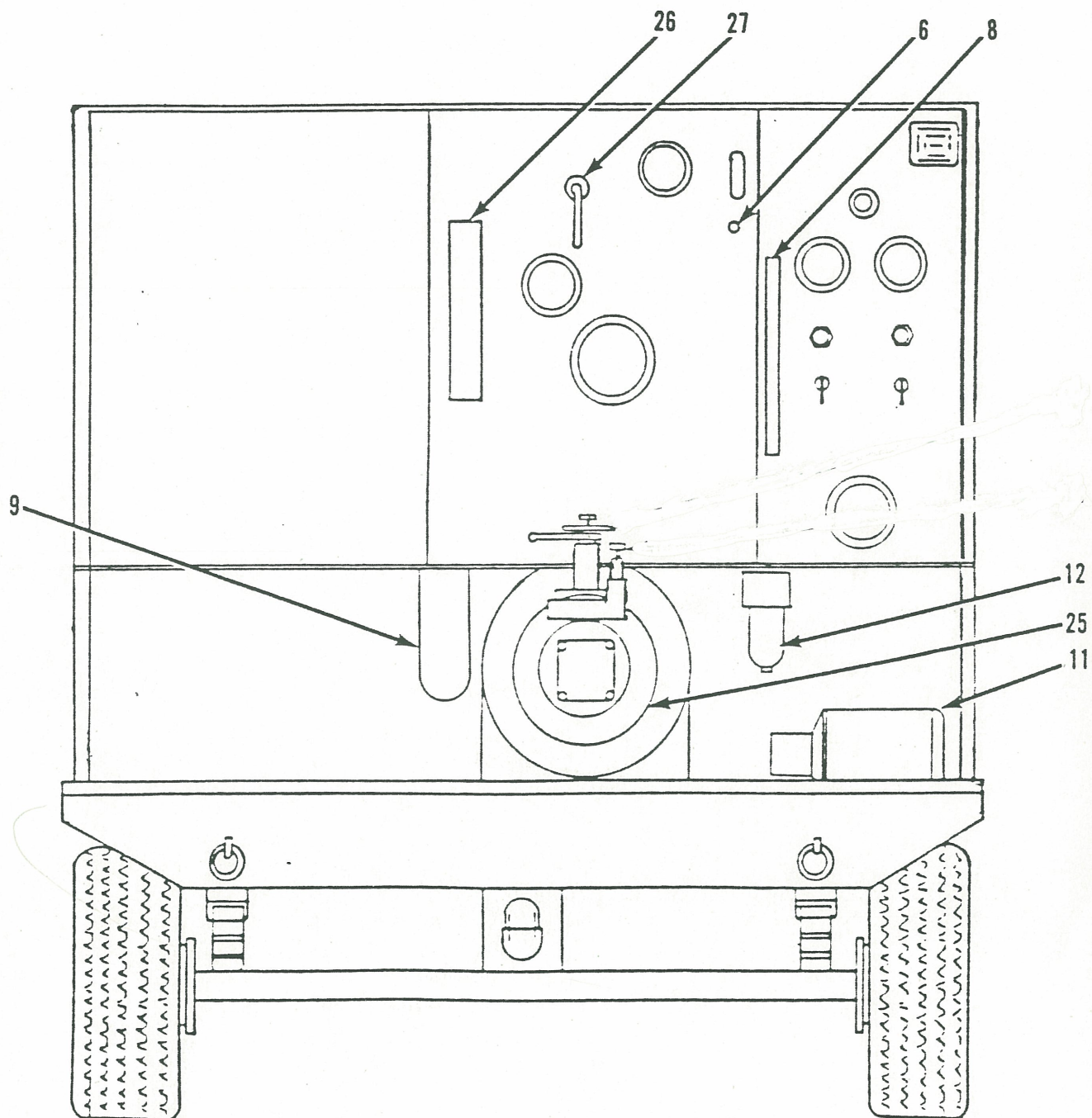


Figure 1-2. Major Components, Rear View. (Sheet 2 of 2)



1-13.       HYDRAULIC FLUID RESERVOIR. (21, Figure 1-2). The pressurized reservoir is designed to supply fluid to the systems during operation in "Stand" position of the reservoir selector valve (27) and to supply fluid to the fill systems. A filler neck (22) and cleanout cover (23) is located on the end of the reservoir allowing manual filling. A fluid level indicator (8) of the sight glass type is also provided on the control panel.

1-14.       OIL COOLER. (5, Figure 1-2). The oil cooler consists of a heat exchanger type cooler in front of the radiator (7). The radiator an draws air through the cooler to cool the hydraulic oil.

1-15.       HIGH PRESSURE FILTER. (9, Figure 1-2). A filter is located in the output line of the system. A five-micron filter element gives the pressurized fluid a final cleaning before outlet to the aircraft. The filter bowl is incorporated into the high pressure manifold assembly.

1-16.       LOW PRESSURE FILTER. (10, Figure 1-2). A 10 micron low pressure filter in the outlet line from the boost pump is incorporated to clean hydraulic fluid of contamination before entering the high pressure pump section. The filter bowl is incorporated into the low pressure manifold assembly. Both filters are readily maintained through access doors. A drain is provided for the low pressure filter.

1-17.       FILL PUMP SYSTEM. (See Figure 1-2). This system is used to fill the Test Stand hydraulic systems with fluid in the preparatory operation of readying the Test Stand for scheduled operation. It also functions to fill the aircraft reservoir with pressurized fluid from the Stand reservoir. The system includes an electric motor driven fill pump (11) with filter (12), system actuating valves, relief valve and check valve.

#### NOTE

Reservoir selector valve must be in  
"Aircraft" reservoir position when  
performing filling operating



1-18. BLEED SYSTEM. (See Figure 1-2). The Test Stand hydraulic system incorporates a pushbutton bleed valve (6) to bleed air from the system. Air and oil is bled from the low pressure filter (10) in the system and routed to the reservoir (21). The bleed system is incorporated into the low pressure manifold assembly.

1-19. PROTECTIVE DEVICES AND INSTRUMENTATION. Protective devices and instrumentation are provided as follows:

a. Relief valve (10, Figure 6-1) in the low pressure section protects the oil cooler (6) and flowmeter (1) from over pressurization.

b. Thermoswitch (11) in the high pressure pump inlet circuit actuates to sound a warning horn when the fluid temperature reaches 160-170 degrees F.

c. Low pressure switch (17) protects the high pressure pump against cavitation due to low inlet pressure or boost pump failure. If the pressure drops below 40 psig, the horn will sound.

d. Check valve (10) allows fluid to bypass the boost pump in the event of pump failure, preventing fluid starvation of high pressure pump.

e. Differential pressure switch (23) across high pressure filter ports illuminates a red warning light on the control panel to indicate clogged filter element. A duplex gage (15) across the fill system filter (35) monitors inlet and outlet pressures at all times. Low pressure filter is monitored with selector valve (25) positions of boost pump outlet and HP pump inlet.

f. Check valve (14, 34) are located in the hydraulic lines to prevent any back flow between hydraulic circuits.

g. Relief valves (40) protects the air receiver (38) and the aircraft reservoir respectively from overpressurization by the air compressor (37).

h. Circuit breakers (Figure 6-2) are provided for overload protection of various circuits.

i. Low engine oil pressure switch sounds warning horn.

j. High water temperature switch sounds warning horn.

k. Low fuel level switch in fuel tank sounds warning horn.

l. Complete instrumentation and controls are located on the control panels. Refer to Section IV for description of function and location of all controls.

1-20 ELECTRICAL SYSTEM. (See Figure 6-2). The Electrical system provides the circuits and controls for Test Stand functioning of electrical components. The electrical system's controls are mounted on the inside of the upper front outlet panel at the front of the Test Stand, with a hinged access door to permit facility of maintenance and inspection. Two 24-vdc batteries connected in parallel provide power for test stand engine starting and operation of the fill system motor. The main power switch turns on the ignition and the start button cranks over the diesel. A Tachometer/Hourmeter is mounted on the instrument panel to record engine speed and Test Stand operating hours. A warning horn (AH1) provides audible warning in the event of high fluid temperatures low boost pressure in either system and in the event of low engine oil pressure, high temperature and low fuel level. A single switch (33) is provided on the auxiliary control panel to turn on panel lights and the lights at the back of the Test Stand (PL3 thru PL5).

1-21. ENGINE. The engine is a four cylinder Detroit Diesel Engine of the 53N Series which generates 125 hp at 2500 rpm. The engine provides power for operating the high-pressure pump. Panel controls include a manual THROTTLE control, engine START switch, and ENGINE SHUTDOWN control. Panel indicators include a Tachometer/hourmeter, Oil pressure gage indicator, Ammeter gage, Oil temperature gage, and Water temperature gage. Pulling the handle of the ENGINE SHUTDOWN control,



mechanically linked to the fuel injector system, fully closes the fuel injectors, starving the engine of fuel at each cylinder.

Accessories to the engine include a governor, an oil-bath type air cleaner, a cooling system, a fuel tank, and a gearbox.

a. Governor. The governor is a constant speed, rotary drive type. It is set for a maximum no-load speed of 2650 rpm and full-load speed of 2500 rpm. Idle is set for 550 rpm.

b. Cooling System. The cooling system has an 11 gallon capacity. The system has a filler port, a drain cock, a temperature gage, and an over temperature switch.

c. Fuel Tank. The fuel tank has a 42.5 gallon capacity. The tank is fitted with external filler port, a drain plug, a fuel level transmitter, and a low level switch.

d. Gearbox. The gearbox is connected to the engine drive shaft and the hydraulic pump is connected to the gear box.

1-22. TABLE OF LEADING PARTICULARS. Refer to Table 1-1 for the table of leading particulars.

1-23. CONSUMABLE MATERIAL LIST. Refer to table 1-2 for the list of consumable materials required to operate, service and maintain the test stand.

Table 1-1. Leading Particulars

|                                          |                                                                                                                        |
|------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| CAPABILITIES                             |                                                                                                                        |
| Temperature Conditions                   |                                                                                                                        |
| Operating . . . . .                      | -40 degrees F to +125<br>degrees F.                                                                                    |
| Storage . . . . .                        | -65 degrees F to +160<br>degrees F.                                                                                    |
| Relative Humidity . . . . .              | 100 percent                                                                                                            |
| Inclination . . . . .                    | 8-1/2 degrees maximum in<br>any direction from hori-<br>zontal operating plane.                                        |
| HYDRAULIC SYSTEMS                        |                                                                                                                        |
| Fluid Reservoir                          |                                                                                                                        |
| Capacity (at incline of 8-1/2 degrees) . | 30 Useable U.S. Gallons                                                                                                |
| Material . . . . .                       | Stainless steel                                                                                                        |
| Hydraulic Fluid . . . . .                | MIL-H-5606                                                                                                             |
| Hydraulic Pump                           |                                                                                                                        |
| Type . . . . .                           | High-pressure, axial-position,<br>variable-stroke, pressure<br>compensated with integral<br>low pressure boost section |
| Capacity . . . . .                       | 0-35 gpm up to 3000 psig<br>0-15 gpm up to 5000 psig                                                                   |



Table 1-1. Leading Particulars - Continued

|                                       |                                                                                        |
|---------------------------------------|----------------------------------------------------------------------------------------|
| Discharge pressure . . . . .          | 3000 $\pm$ 50 psig when delivering 35 gpm with zero flow pressure setting at 3000 psig |
| Boost pump capacity . . . . .         | 40 gpm at 200 psig                                                                     |
| Fill Pump                             |                                                                                        |
| Type . . . . .                        | Motor driven internal gear                                                             |
| Capacity . . . . .                    | 2 gpm at 150 psig                                                                      |
| High Pressure Filter                  |                                                                                        |
| Rating . . . . .                      | 35 gpm at 5000 psig                                                                    |
| Size of element . . . . .             | 5 micron                                                                               |
| Specification . . . . .               | MIL-F-27656                                                                            |
| Low Pressure Filter                   |                                                                                        |
| Low Pressure Filter Element . . . . . | 10 micron, two element filter AN 6236-3                                                |
| Fill/Filter Element . . . . .         | 10 micron, single element filter AN6235-4A                                             |
| Oil Cooler                            |                                                                                        |
| Type . . . . .                        | Air-to-oil, fan cooled                                                                 |
| Drive Unit                            |                                                                                        |
| Engine . . . . .                      | 125 hp at 2500 rpm, 4 cylinder in-line, 24 vdc electrical system                       |

Table 1-1. Leading Particulars - Continued

|                                                                          |                                                             |
|--------------------------------------------------------------------------|-------------------------------------------------------------|
| Crankcase Capacity . . . . .                                             | 16 liters (17 quarts, plus<br>2 quarts for new oil filter)  |
| Cooling Capacity . . . . .                                               | 41.6 liters (11 gallons)                                    |
| Main Gearbox Capacity . . . . .                                          | 2 quarts lubricant                                          |
| Lubrication                                                              |                                                             |
| Running Gear (Wheel Bearings) . . . . .                                  | MIL-G-10924                                                 |
| Miscellaneous (Door Hinges, Steering and<br>Braking Mechanism) . . . . . | MIL-L-15016A                                                |
| Gearbox . . . . .                                                        | SAE 30 wt. MIL-L-2104<br>or MIL-10295                       |
| Trailer and Cabinet                                                      |                                                             |
| Construction . . . . .                                                   | Welded steel                                                |
| Wheels . . . . .                                                         | Four pneumatic tires, 6.90<br>x 9 inch                      |
| Springs . . . . .                                                        | Leaf type                                                   |
| Brake . . . . .                                                          | Hand operated, mechanical<br>type on rear wheels            |
| Steering . . . . .                                                       | Knuckle type on front wheels<br>with towbar and pintle hook |

Table 1-1. Leading Particulars - Continued

|                   |                                                                                              |
|-------------------|----------------------------------------------------------------------------------------------|
| Cabinet . . . . . | Metal enclosure with access panels; hinged doors; hose storage; weather-resistant properties |
|-------------------|----------------------------------------------------------------------------------------------|

Physical Data

Dimensions (Approximate)

|                  |               |
|------------------|---------------|
| Length . . . . . | 108 inches    |
| Width . . . . .  | 70 1/2 inches |
| Height . . . . . | 74 inches     |

|                        |             |
|------------------------|-------------|
| Weight (dry) . . . . . | 4000 pounds |
|------------------------|-------------|



Table 1-2. Consumable Materials

| Nomenclature                   | Part Number                                                |
|--------------------------------|------------------------------------------------------------|
| Adhesive (stud-lock)           | Loctite Corp. Cat. No. 73-31                               |
| Agent, degreasing              | MIL-D-12491                                                |
| Compound, corrosion-preventive | MIL-C-6529A                                                |
| Compound, silicone             | MIL-S-8660                                                 |
| Desiccant, activated           | MIL-D-3464                                                 |
| Fluid, hydraulic               | MIL-H-5606 or MIL-H-83282                                  |
| Fuel, Diesel                   | VV-F-800 or MIL-F-5624 (RP-5),<br>MIL-F-5624 (JP4 or JP5)  |
| Glue, Epxoy                    | Devcon 5 Minute Epoxy<br>Devcon Corp.<br>Danvers, MA 01923 |
| Grease                         | MIL-G-18790                                                |
| Grease, automotive             | MIL-G-10924                                                |
| Lubricant                      | MIL-L-2105 or MIL-L-10324                                  |
| Oil, Engine                    | MIL-L-2104 or MIL-L-10295                                  |
| Paint, external enamel         | MIL-STD-808, Code No. DG                                   |
| Paint, exterior enamel         | STD-595, color 31136 (Red)                                 |
| Hydraulic control panel        |                                                            |
| Paint, interior enamel         | MIL-STD-808, Code No. LG                                   |
| Paint, pre-treat               | MIL-C-15328                                                |
| Paint, primer, epoxy           | MIL-P-23377                                                |
| Paint, primer, zinc chromate   | MIL-P-6889                                                 |
| Paper, emery                   | P-P-105                                                    |
| Powder, lapping                | MIL-L-17862                                                |
| Preservative                   | MIL-H-6083                                                 |
| Element, engine oil filter     |                                                            |
| element, engine fuel filters   |                                                            |
| Element, fill system filter    | AN6235-4A                                                  |

Table 1-2. Consumable Materials - Continued

| Nomenclature                                 | Part Number                            |
|----------------------------------------------|----------------------------------------|
| Element, boost system filter                 | AN6236-3                               |
| Element, high-pressure filter                | MIL-F-27656                            |
| Sealant                                      | VC-3                                   |
| Solvent, cleaning                            | P-D-680, Type II                       |
| Solvent, mineral spirits                     | MIL-C-12491                            |
| Tape, water resistant,<br>pressure sensitive | PPD-T-60                               |
| Tape, teflon                                 | MIL-T-22730                            |
| Solder                                       | QQ-S-571                               |
| Lubricant, gearbox                           | SAE 30 wt., MIL-L-2104<br>or MIL-10295 |
| Preservative, crankcase & fuel tank          | MIL-L-21260                            |

## SECTION II

### SPECIAL TOOLS AND TEST EQUIPMENT

2-1. SPECIAL TOOLS AND TEST EQUIPMENT. There are no special tools or testing equipment required for the installation, maintenance and testing of the MJ-1 Test Stand.



## SECTION III

### PREPARATION FOR USE AND SHIPMENT

3-1. INTRODUCTION. The information contained in this section describes the installation functional testing, adjustment, and procedures necessary to prepare the MJ-1 for use. Also, included, are procedure for removal of the test stand if required.

#### NOTE

Refer to the troubleshooting information given in Section V if an abnormal indication is obtained while testing the system for operation.

3-2. PREPARATION FOR USE.

3-3. UNPACKING AND INSTALLATION. The Test Stand is shipped completely assembled on fully inflated tires and requires no major assembly of components prior to preparing the Stand for use other than the following procedures:

a. Strip the waterproof tape from seams, doors and other openings of the cabinet, and strip masking tape from all glass gage faces.

b. Open all cabinet doors and thoroughly inspect interior of the Test Stand to remove all extraneous packing or cushioning material used to protect internal components during shipment. Small areas of normally exposed metal surfaces may be wrapped with protective covering or tape during shipment. Be certain all such coverings are removed.

3-4. INITIAL INSPECTION. It is important to carefully inspect the complete Test Stand for possible damage which may have occurred during shipment. The following initial inspection procedures are recommended:

a. Check the data appearing on the Test Stand nameplates to verify it is the type of unit designated in paragraph 1-1 of this manual. If there is any doubt, do not attempt to operate the Test Stand in accordance with the instructions contained in this manual.

b. Remove the hose assemblies from the top of the Test Stand. Inspect the hose assemblies carefully for evidence of damage, breaks or loose fittings.

#### WARNING

The output hose assemblies are subjected to extremely high pressure. Repair any defective hose assembly before using the hose assembly during operation of the Test Stand.

c. Open the control and instrument panel access door. Inspect all gages, indicators, and controls for evidence of shipping damage. Check that all parts are securely mounted. Check that all manually operated switches and controls operate freely.

d. Open access doors. Inspect the plumbing installation for damaged tube assemblies, fittings and hose assemblies. Check that all fittings are securely connected and hoses are not deteriorated.

e. Carefully inspect the electrical wiring for broken wires or frayed insulation. Check that all electrical connections are secure.

f. Inspect engine for evidence of shipping damage. Check that engine mounting bolts are securely tightened.

g. Inspect fuel tank and hydraulic reservoir for evidence of physical damage. Check fuel system carefully for evidence of leakage.

h. Check tires for proper inflated pressure. Normal tire pressure should be 60 pounds with tires cold. Inspect tire treads and casing for cuts or abrasions and remove any imbedded objects from treads.



i. Check the tow and steering assemblies. Make certain that tie rods have not been bent or damaged and that the steering apparatus swings freely.

j. Check hand brake assembly by setting the hand brake and testing rear wheels for braking action.

k. Inspect the Test Stand trailer and cabinet for any damage, making certain that all bolts and screws are secured. Check doors and door latches for proper closing and locking.

### 3-5        SERVICING ENGINE

a. Servicing Engine After Temporary Storage (30 days or less) To service the engine after temporary storage, proceed as follows:

- (1) Visually inspect engine to make certain all accessories are in place and securely mounted. Check electrical connections to engine.
- (2) Remove all sealing materials from engine openings.
- (3) Open fuel tank drain plug (located under fuel tank and drain until water-free fuel is evident. Close drain cock
- (4) Check level of diesel fuel in fuel tank (fuel level gage located on control panel) and, if necessary, add diesel fuel (MIL-L-5624 or equivalent).
- (5) Check level of lubricating oil in crankcase. Add lubricating oil (MIL-L-2014) to bring oil level to FULL mark on dipstick. Use grade 30 above 0°C (32°F) or grade 10 below 0°C (+32°F).

b. Servicing Engine After Long-term Storage (30 days or more). To service the engine after long-term storage, proceed as follows:



- (1) Visually inspect engine to make certain all accessories are in place and securely mounted. Check electrical connections to engine.
- (2) Remove all sealing material from engine openings, fuel tank, electrical equipment, and exhaust outlet.

#### WARNING

Use cleaning solvents, P-D-680, Type II, in a well ventilated area. Do not inhale solvent vapor or allow solvent to contact skin. Keep solvent away from open flame. Failure to comply may result in injury to personnel.

- (3) Remove rust preventative from external surfaces of engine with solvent Federal Specification P-D-680, Type II, or equivalent.
- (4) Remove paper strips from between pulleys and belts.
- (5) Remove crankcase drain plug and drain preservative oil into suitable container.
- (6) Replace crankcase drain plug and torque 25 - 35 ft-lbs. Fill crankcase with 11 quarts (plus 2 quarts if new oil filter is installed) of lubricating oil MIL-L-2104.
- (7) Open fuel tank drain plug (located under fuel tank) and drain until water-free fuel is evident. Close drain cock.
- (8) Fill the fuel tank with diesel fuel.
- (9) close coolant drain cock (located on engine radiator) and fill engine cooling system with 5 gallons of mixture of 50 percent distilled water and 50 percent coolant O-A-548

NOTE

If engine will be exposed to freezing temperatures, check cooling system specifications and add coolant O-A-548 in accordance with manufacturer's specifications.

c. Servicing Hydraulic System. Service the hydraulic system, prior to use, as follows:

WARNING

Depressurize hydraulic system prior to servicing. Failure to comply may result in injury to personnel.

- (1) Check hydraulic fluid reservoir for preservative fluid. If present, remove outlet cap and open reservoir drain drain valve and drain reservoir. Close drain valve and replace outlet cap.
- (2) Remove drain plugs at boost pump system filter and drain preservative fluid (if necessary). Replace plugs.
- (3) Remove cap on filler neck and fill test stand reservoir with hydraulic fluid MIL-H-5606, or MIL-H-82382, until reservoir level indicator indicates 3/4 to 7/8 full. Set system power to OFF position.

d. Servicing Batteries. Two 24-vdc storage batteries connected in parallel are furnished with the test stand and in located in battery compartment.

WARNING

When handling batteries, use face shield or goggles, rubber gloves and apron.

- (1) Remove battery compartment cover. Disconnect and remove batteries.
- (2) Check electrolyte level. Fill battery cells with distilled water to level indicated or approximately 3/8 inch over battery plates.
- (3) Charge each battery using a 24-vdc battery charger at a rate of approximately 2-1/4 amperes for at least 18 hours. Check each cell, using a hydrometer, for a specific gravity reading of 1.275 to 1.285.
- (4) Install and connect batteries.

e. Servicing Gearbox. Remove drain plug from gearbox to allow corrosion-preventive compound, if present, to drain out. Replace drain plug and fill gearbox with two quarts of lubricant.

3-6. PRELIMINARY LUBRICATION. Carefully inspect the Test Stand lubricating points referred to in Figure 3-1. Be sure the initial lubrication exists at all specified points.

3-7. PREPARATION FOR STORAGE. Prepare the Test Stand for storage as follows:

a. Drain the reservoir (21, Figure 1-2) by opening the reservoir drain valves. Make certain drain valves are closed after reservoir has been completely drained.

b. Drain hydraulic fluid from the hydraulic system at the low pressure filter drain (10, Figure 1-2). When completely drained, replace drain cap.

c. Drain the fluid from the high pressure pump, (9, Figure 1-2) by removing the drain plug located in the bottom of the pump case. When completely drained, replace plug. Refill pump case with MIL-H-6083A.



d. Fill the Test Stand reservoir at the filler neck with preservative fluid specifications MIL-H-6083A, until the reservoir level gage indicates 7/8 full.

e. Operate Test Stand (Section IV) for approximately 10 minutes. Operate system fill valves to fill each hydraulic system with preservative oil.

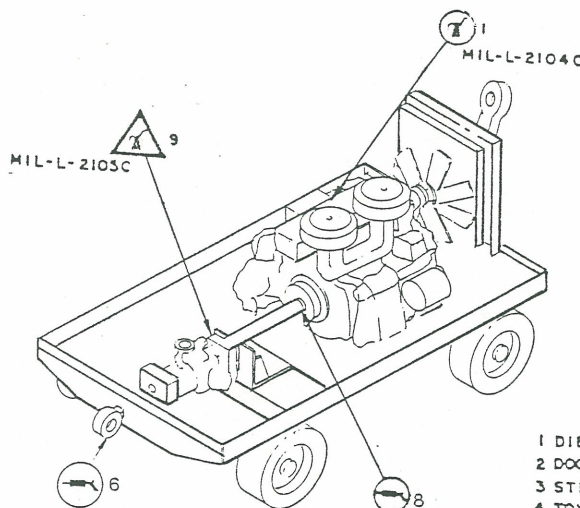
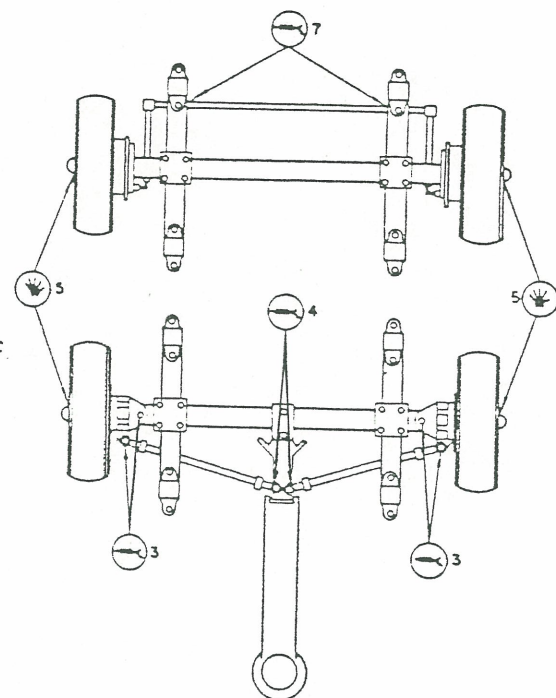
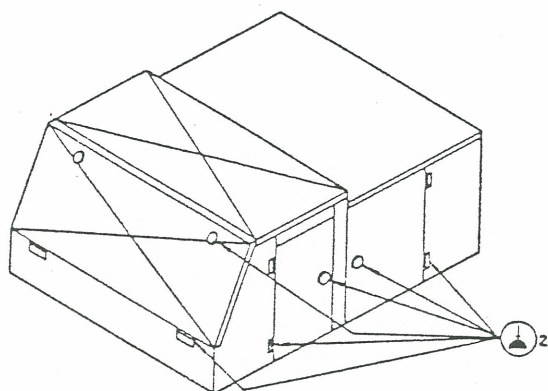
f. Drain fuel reservoir by opening reservoir drain valve. Make certain drain valve is closed after reservoir has been completely drained.

g. Place several bags of activated desiccant MIL-D-3464 inside Test Stand cabinet and near electrical components

h. Fasten doors and latches securely; tape seams and openings with pressure-sensitive, water resistant tape, Specification PPP-T-60.

j. Secure hoses on retainer hooks. Be sure all external hydraulic connections are capped.

3-8. PREPARATION FOR SHIPMENT. The Test Stand does not require an external packing container. For shipment, prepare the Test Stand in the same way as for storage, paragraph 3-7, steps at through j.



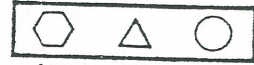
- 1 DIESEL ENGINE
- 2 DOOR LATCHES, HINGES
- 3 STEERING LINKAGE
- 4 TOW BAR
- 5 WHEEL BEARINGS
- 6 PINTLE HOOK
- 7 BRAKE CROSS SHAFT
- 8 U JOINTS
- 9 GEAR BOX

APPLICATION SYMBOLS



PACKING GREASE OIL OIL  
GUN CAN CAN CAN

FREQUENCY SYMBOLS



500 HOURS 250 HOURS 100 HOURS

m5-1

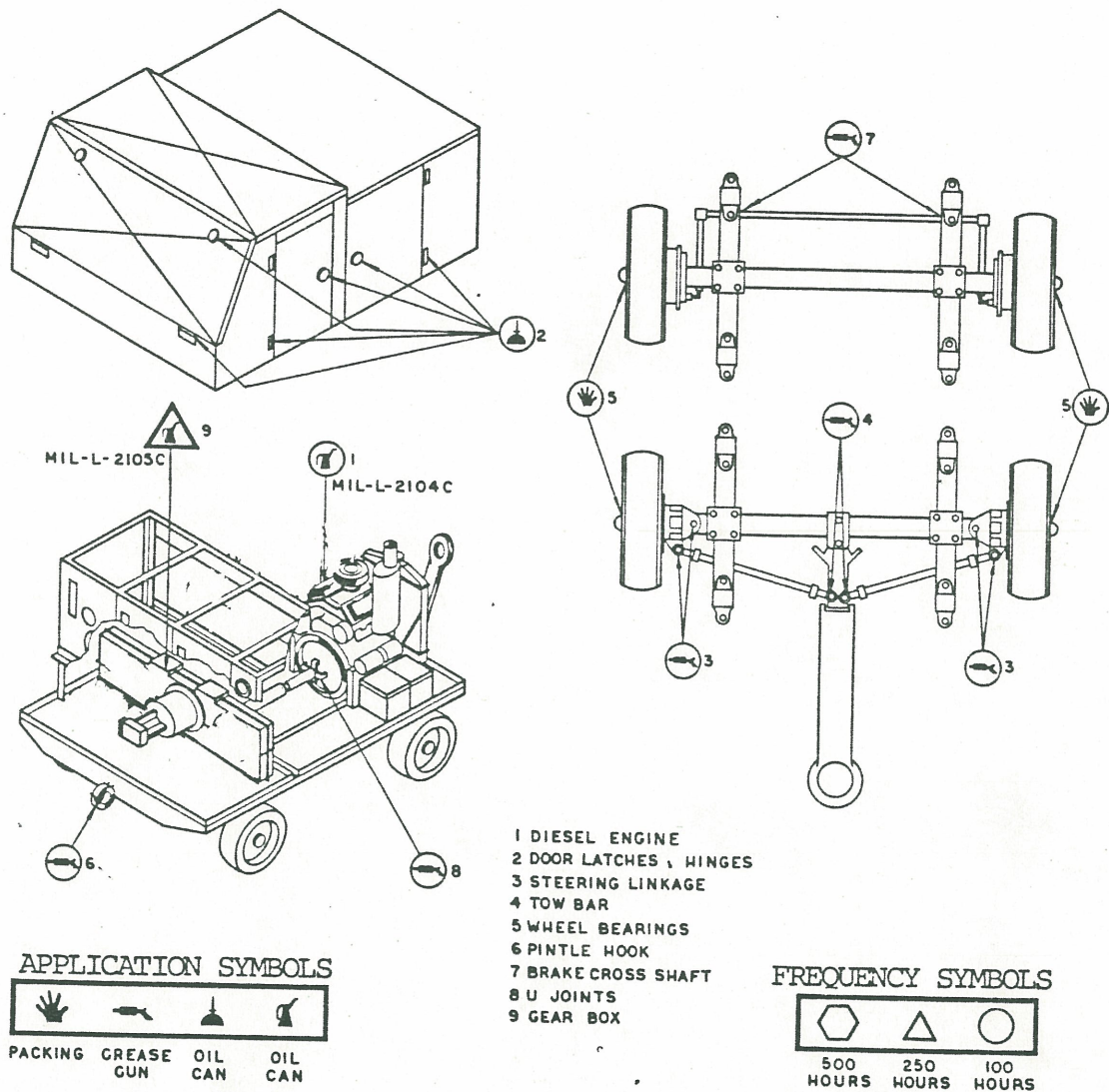


Figure 3-1. Lubrication Chart



## SECTION IV

### OPERATION INSTRUCTIONS

4-1. GENERAL. This section provides theory of operation and operational procedures for the MJ-1 Test Stand. Operational procedures outlined in this section shall not contradict established technical orders of the aircraft and aircraft components being tested.

4-2. THEORY OF OPERATION.

4-3. WITH RESERVOIR SELECTOR VALVE IN "AIRCRAFT RESERVOIR" POSITION.

The boost pump (2, Figure 6-1) draws fluid from the aircraft through the suction return port and flowmeter (1) into the boost pump. The output of the boost pump is passed through the cooler (6) and low pressure filter (7) to the suction side of the high pressure pump (13). The boost pump pressure is controlled by the boost relief valve (10). The output of the high pressure pump is passed through the high pressure check valve (34), the high pressure filter (22), the flow control valve (24), and the pressure out to the aircraft. The output pressure is controlled by the high pressure relief valve (31) and the compensator control on the high pressure pump. The output volume is regulated by the flow control valve (24) and the volume control on the high pressure pump.

4-4. WITH RESERVOIR SELECTOR VALVE IN "STAND RESERVOIR" POSITION.

Boost pump (2) draws fluid from the Test Stand reservoir (27) and follows the same route as in paragraph 4-3. Fluid returning to the suction return port passes through the reservoir selector valve (32) into the Test Stand reservoir.

4-5. FILL AND BLEED SYSTEM. The fill and bleed system can be operated in either the fill or bleed mode. In the fill mode of operation, the fill pump motor (29) and pump (28) are engaged by the fill

pump pushbutton (20). When the fill valve (30) is opened, the fill pump then draws fluid from the oil reservoir (27) and passes fluid through the fill pump filter (35) low pressure check valve (14) and the fill valve (30) to the hydraulic system.

In the bleed mode of operation, when the bleed valve (4) pushbutton is depressed, fluid flows from the low pressure filter (7) through the bleed valve (4) to the oil reservoir (27). The sight tube is a transparent tube that provides a means of checking the air bleed operation.

4-6.        OPERATING CONTROLS AND INSTRUMENTS. All controls and instruments are identified and described in Figures 4-1 thru 4-3 and Tables 4-1 thru 4-3.





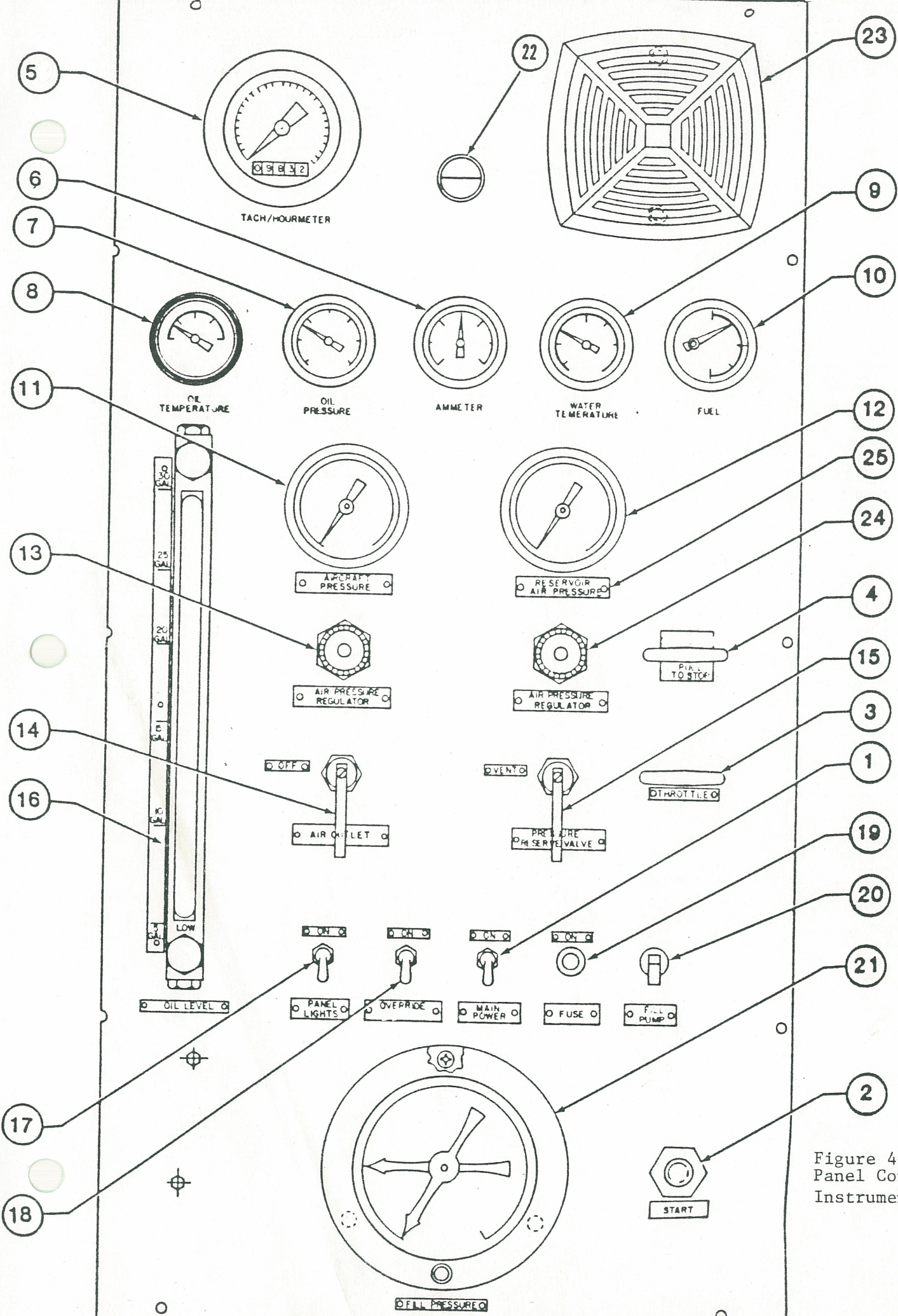


Figure 4-1. Auxiliary Panel Controls and Instruments

Table 4-1. Auxilary Panel Controls and Instruments

| Index No<br>Figure<br>4-1 | Control or<br>Instrument   | Description &<br>Location             | Function or<br>Operation                                                                |
|---------------------------|----------------------------|---------------------------------------|-----------------------------------------------------------------------------------------|
| 1                         | MAIN POWER<br>Switch       | Off-On toggle type<br>switch on panel | Energizes battery<br>electrical system                                                  |
| 2                         | Engine START<br>Button     | Push button on<br>panel               | Starts engine                                                                           |
| 3                         | THROTTLE Control           | Pull handle on<br>panel               | Sets output speed of<br>engine (Push throttle<br>to decrease; pull to<br>increase)      |
| 4                         | ENGINE SHUTDOWN<br>Control | Pull handle on<br>panel               | Stops engine by cut-<br>ting off fuel supply                                            |
| 5                         | TACHOMETER/HOUR<br>METER   | 3-3,500 and 0-<br>9,999 on panel      | Indicates speed of<br>engine in rpm and<br>indicates total hours<br>of engine operation |
| 6                         | AMMETER Gage               | 60-0-60 gage<br>on panel              | Indicates charge and<br>discharge of test<br>stand batteries                            |
| 7                         | OIL PRESSURE<br>Gage       | 0-80 gage on<br>panel                 | Indicates engine oil<br>pressure                                                        |
| 8                         | OIL TEMPERATURE<br>Gage    | 0-320 gage on<br>panel                | Indicates engine oil<br>temperature                                                     |



Table 4-1. Auxiliary Panel Controls and Instruments (Continued)

| Index No<br>Figure<br>4-1 | Control or<br>Instrument           | Description &<br>Location     | Function or<br>Operation                                                               |
|---------------------------|------------------------------------|-------------------------------|----------------------------------------------------------------------------------------|
| 9                         | WATER TEMPERATURE<br>Gage          | 0-265 gage on<br>panel        | Indicates temperature<br>of water in engine<br>coolant system                          |
| 10                        | FUEL gage                          | 0, 1/2, 4/4,<br>full on panel | Indicates amount of<br>fuel in fuel tank                                               |
| 11                        | AIRCRAFT AIR<br>PRESSURE gage      | 0-160 psig gage<br>on panel   | Indicates air pressure<br>at aircraft reservoir                                        |
| 12                        | RESERVOIR AIR<br>PRESSURE gage     | 0-160 psig gage<br>on panel   | Indicates air pressure<br>in Test Stand reservoir                                      |
| 13                        | AIR PRESSURE<br>REGULATOR          | Knob adjustment<br>on panel   | Adjusts air pressure<br>output to aircraft<br>reservoir                                |
| 14                        | AIR OUTLET<br>Selector Valve       | Handle on panel               | Air ON or OFF to<br>aircraft reservoir                                                 |
| 15                        | PRESSURE RESERVOIR<br>VALVE (Vent) | Handle on panel               | Selects air pressure<br>to pressurize stand<br>reservoir or vents<br>air to atmosphere |
| 16                        | RESERVOIR LEVEL<br>Indicator       | 0 to 30 gal on<br>panel       | Indicates level<br>(amount) of fluid in<br>Test Stand Reservoir.                       |
| 17                        | PANEL LIGHTS ON<br>Switch          | Off-On toggle type<br>switch  | Turns panel illuminat-<br>ing lights on and off                                        |



Table 4-1. Auxiliary Panel Controls and Instruments (Continued)

| Index No<br>Figure<br>4-1 | Control or<br>Instrument  | Description &<br>Location        | Function or<br>Operation                                                                                                                  |
|---------------------------|---------------------------|----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| 18                        | Override                  | Switch on panel                  | Horn disable                                                                                                                              |
| 19                        | CIRCUIT BREAKER           | 10 amps                          | Protects aux panel<br>circuits                                                                                                            |
| 20                        | CB, FILL PUMP             | Off-On toggle<br>switch on panel | Protects fill pump<br>motor (must be on to<br>fill pump)                                                                                  |
| 21                        | FILL SYSTEM<br>gage       | Duplex 0-200 psig<br>on panel    | Indicates pressure on<br>both sides of fill<br>system filter simulta-<br>neously. Difference<br>indicates pressure<br>drop across filter. |
| 22                        | Panel Light               | One clear<br>incandescent        | Illuminate control<br>panel                                                                                                               |
| 23                        | WARNING HORN              | On panel                         | Audio warning of mal-<br>function                                                                                                         |
| 24                        | AIR PRESSURE<br>REGULATOR | Knob adjustment<br>on panel      | Adjusts air pressure<br>to reservoir                                                                                                      |

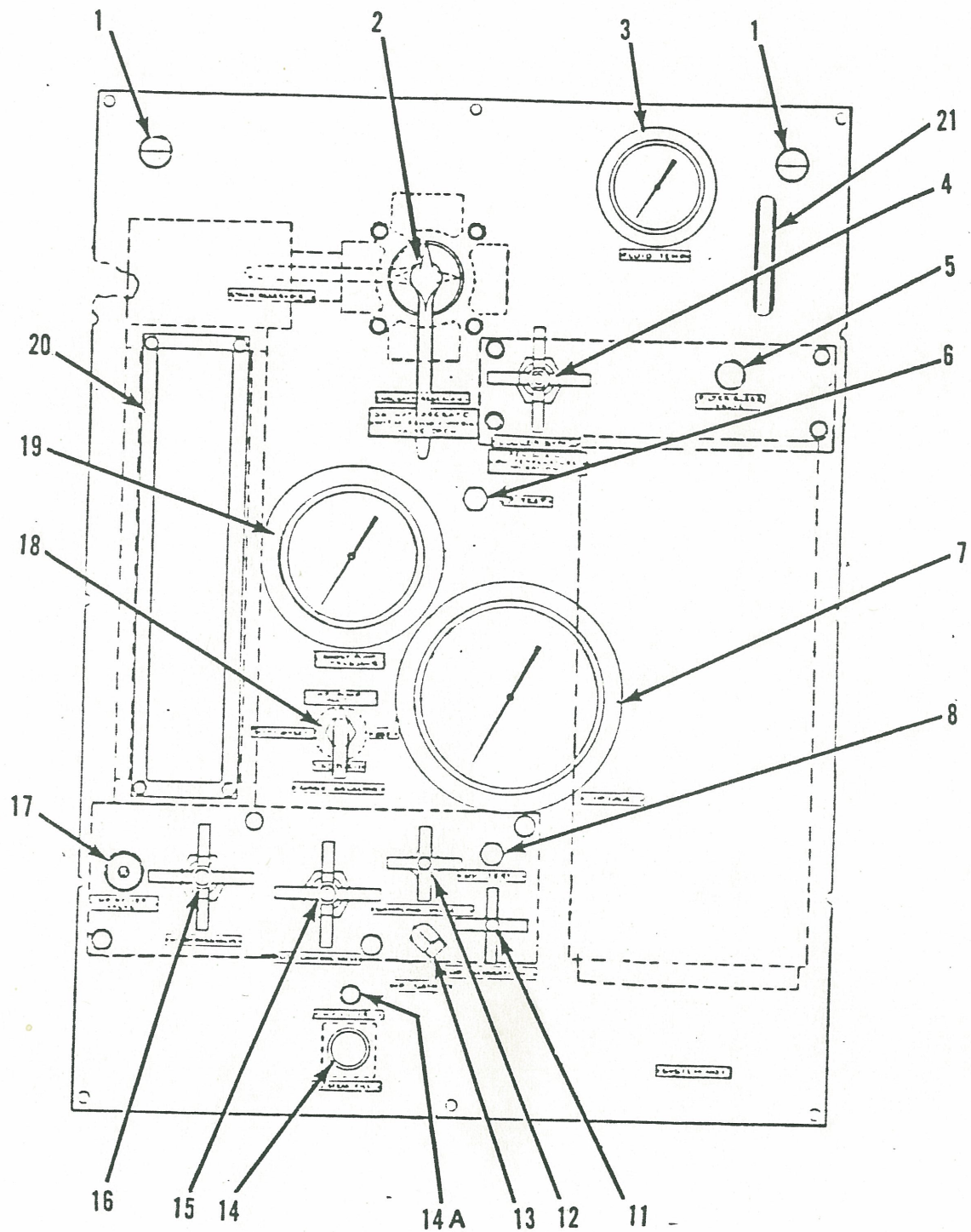


Figure 4-2. Control Panel Controls and Instruments

Table 4-2. Hydraulic Control Panel and Instruments

| Index No<br>Figure<br>4-2 | Control or<br>Instrument | Description &<br>Location                           | Function or<br>Operation                                                                  |
|---------------------------|--------------------------|-----------------------------------------------------|-------------------------------------------------------------------------------------------|
| 1                         | Panel Lights             | Two clear incandescent lamps<br>across top of panel | Illuminate control panel                                                                  |
| 2                         | Reservoir Selector valve | Handle at top of control panel                      | Selects Test Stand or Aircraft reservoir                                                  |
| 3                         | Fluid Temperature gage   | -20° to 200°F temperature indicator on panel        | Indicates fluid temperature at high pressure pump inlet.                                  |
| 4                         | COOLER BYPASS            | Throttling Valve on Panel                           | Allows fluid to bypass oil cooler, to allow fluid to warm up during cold water operation. |
| 5                         | FILTER BLEED Valve       | Spring loaded push-button valve                     | Bleeds air in cooler and filter. Bleed flow is visible at top in sight glass.             |
| 6                         | LP TEST                  | Test connection on panel                            | External calibration of low pressure gage.                                                |
| 7                         | HP Gage Output Pressure  | 0 - 6,000 psig located on panel                     | Indicates systems pressure of fluid at Stand outlets.                                     |
| 8                         | HP TEST                  | Test connection on panel                            | External calibration of high pressure gage                                                |



Table 4-2. Hydraulic Control Panel and Instruments - Continued

| Index No<br>Figure<br>4-2 | Control or<br>Instrument | Description &<br>Location                                | Function or<br>Operation                                                                                        |
|---------------------------|--------------------------|----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| 9                         | NOT USED                 |                                                          |                                                                                                                 |
| 10                        | NOT USED                 |                                                          |                                                                                                                 |
| 11                        | HP GAGE SHUTOFF<br>valve | Needle type on<br>panel                                  | Isolates fluid pressure<br>gage (7) from system<br>outlets for positive<br>reading and external<br>calibration. |
| 12                        | Fluid SAMPLING<br>VALVE  | Needle valve on<br>panel                                 | Permit taking sample<br>of pressurized fluid<br>at output if desired.                                           |
| 13                        | HP SAMPLE                | Port on Panel                                            | Allows taking of fluid<br>samples.                                                                              |
| 14                        | SYSTEM FILL<br>Valve     | Valve on panel                                           | Permits filling of<br>system from reservoir.                                                                    |
| 14A                       | HP Filter<br>Lamp        | Red lamp on panel                                        | Lights in event of<br>high differential<br>pressure accross high<br>pressure filter.                            |
| 15                        | FLOW CONTROL<br>Valve    | Plug type throttl-<br>ing valve on main<br>control       | Control flow of fluid<br>to Test Stand outlets.                                                                 |
| 16                        | HP BY PASS<br>Valve      | Plug type throttl-<br>ing valve on main<br>control panel | Bypasses fluid from<br>pressure outlet to<br>suction return line                                                |

Table 4-2. Hydraulic Control Panel and Instruments - Continued

| Index No<br>Figure<br>4-2 | Control or<br>Instrument    | Description &<br>Location                                    | Function or<br>Operation                                                                                                                                 |
|---------------------------|-----------------------------|--------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 17                        | HP RELIEF VALVE             | Adjustable pilot-<br>operated type with<br>lock nut on panel | Selects pressure at<br>which high pressure<br>fluid is bypassed to<br>suction return line.                                                               |
| 18                        | GAGE SELECTOR<br>Valve      | 4 way selector<br>valve on panel                             | Selects pressure<br>reading at boost<br>pump outlet, HP pump<br>inlet, suction return<br>line (boost pump in-<br>let) and OFF (used<br>for calibration). |
| 19                        | BOOST PUMP<br>PRESSURE Gage | Compound gage;<br>0-30 in hg vacuum<br>0-300 psig on panel   | Indicates pressure at<br>point selected by<br>pressure selector<br>valve (18).                                                                           |
| 20                        | Flowmeter                   | Tubular type; 0-35<br>gpm capacity; panel                    | Indicates the volume<br>of fluid returning to<br>the system(s) circuit.                                                                                  |
| 21                        | Filter Bleed<br>Sight Tube  | Tubular type;<br>on Panel                                    | Indicates bleed oil<br>flow past filter<br>bleed valve                                                                                                   |

Table 4-3. Miscellaneous Controls

| Index No<br>Figure<br>4-3 | Control or<br>Instrument          | Description &<br>Location                                                    | Function or<br>Operation                                                                 |
|---------------------------|-----------------------------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| 1                         | VOLUME CONTROL                    | Manual control on<br>high pressure pump<br>on lower sub-panel                | Regulates maximum<br>pressure fluid<br>from 0-35 gpm.                                    |
| 2                         | PRESSURE CONTROL<br>(Compensator) | Screw shaft adjustment<br>on high pressure pump<br>on low sub-panel.         | Maintains constant<br>pressure in hydraulic<br>system as delivered<br>by pump            |
| 3                         | HAND BRAKE                        | Hand lever operated<br>brake system, at<br>front lower right<br>hand corner. | Operates brake on<br>rear wheels, when<br>stand in no in use                             |
| 4                         | Air Connection                    | To aircraft, behind<br>auxiliary panel                                       | Provides air to<br>pressuring aircraft<br>reservoir                                      |
| 5                         | Hydraulic<br>Connector            | To aircraft, behind<br>main control panels                                   | To provide return port<br>from aircraft hydraulic<br>system under test-<br>System No. 1. |
| 6                         | Hydraulic<br>Connector            | To aircraft, behind<br>control panel                                         | To provide pressure<br>port to aircraft<br>hydraulic system under<br>test-System No. 1.  |



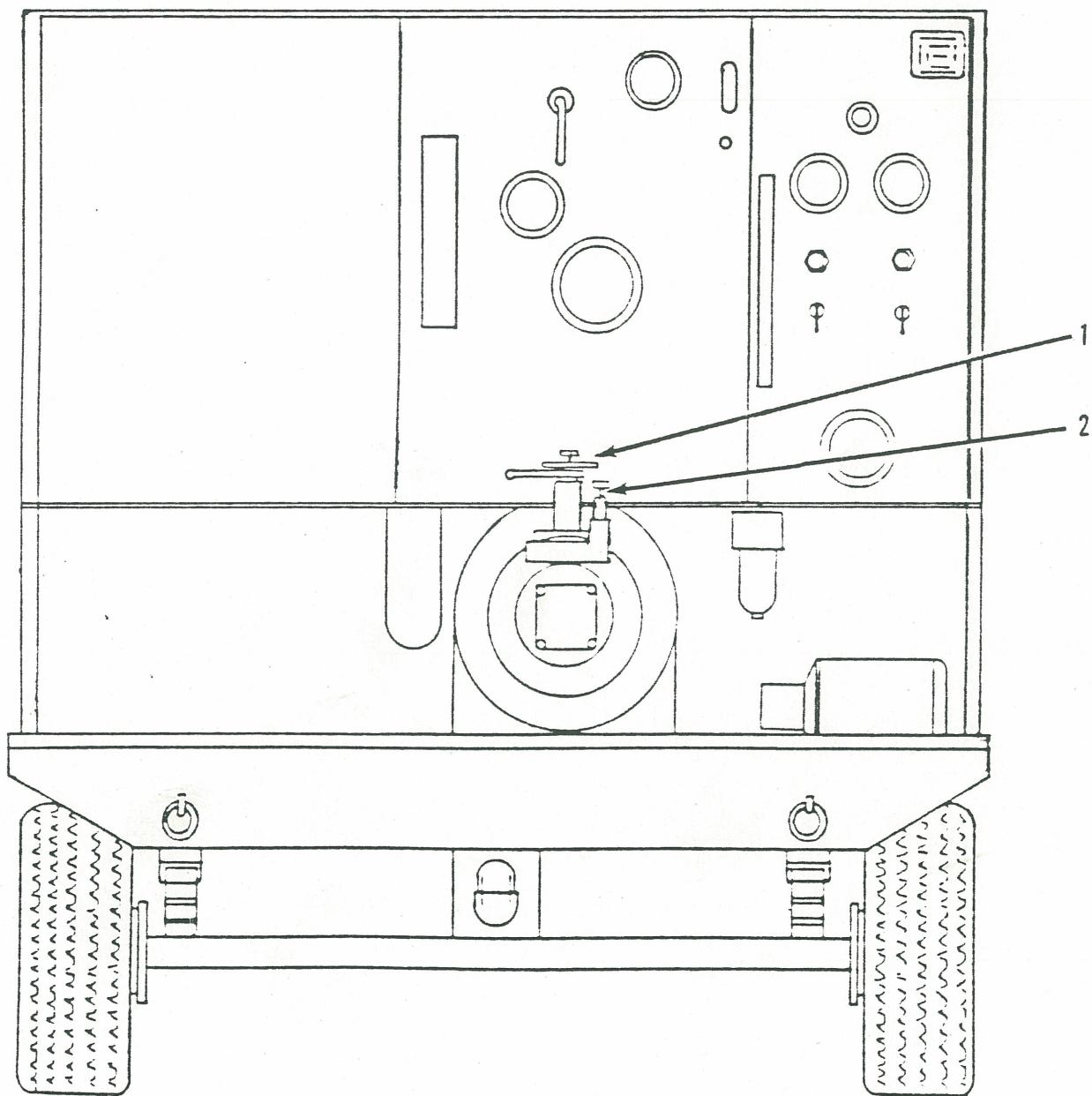


Figure 4-3. Miscellaneous Controls (Sheet 1 of 2)

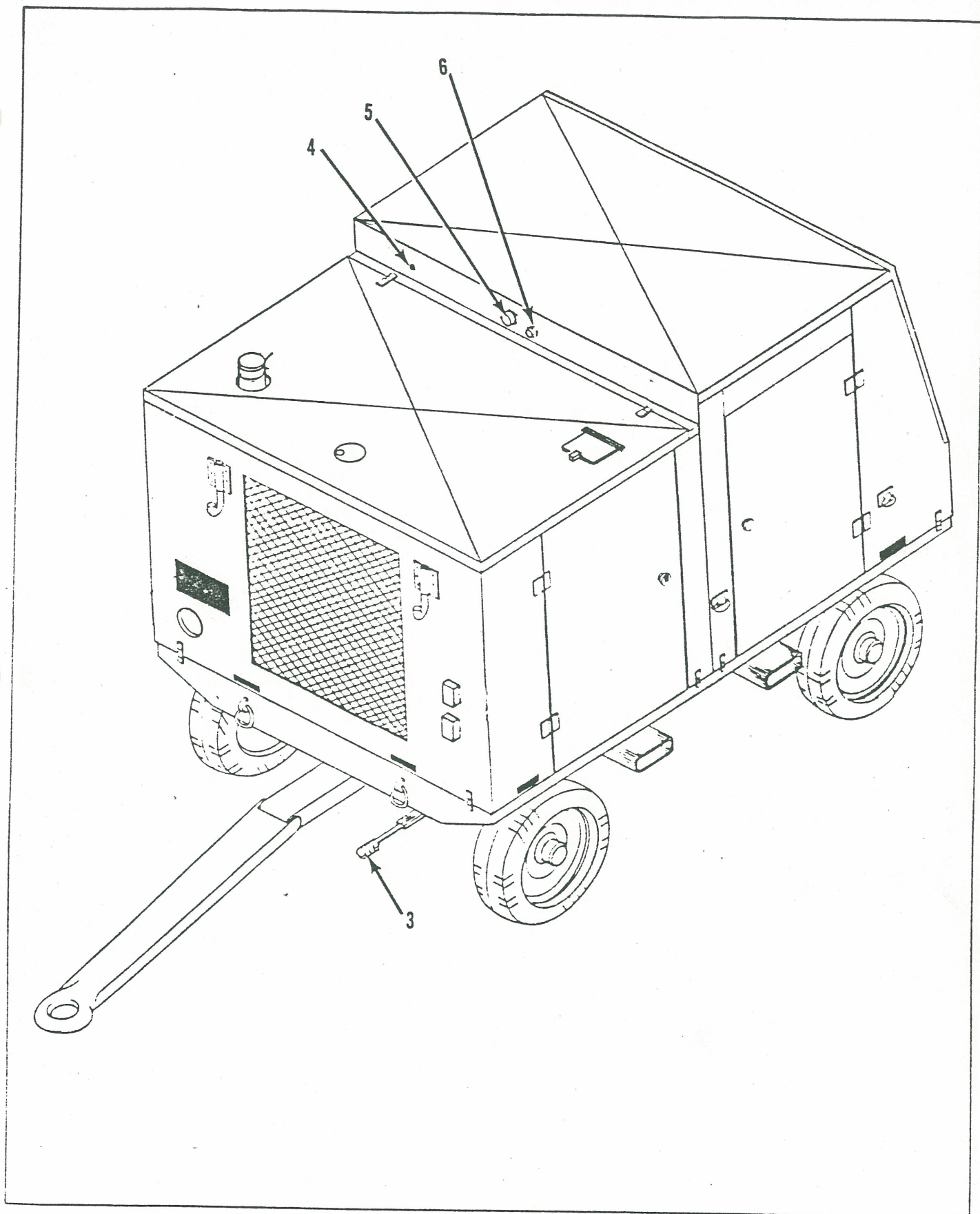


Figure 4-3. Miscellaneous Controls (Sheet 2 of 2)

4-7. OPERATING INSTRUCTIONS.

4-8. PRELIMINARY PROCEDURES. Make the following checks before operating the Test Stand.

- a. Housing doors shall be closed. Open control panel door.
- b. Ensure fuel tank contains adequate fuel supply.
- c. Check hydraulic reservoir fluid level. For proper operation of Test Stand maintain hydraulic fluid level in reservoir 3/4 full minimum.

4-9. PRE-OPERATION CONTROL SETTING. Place the controls listed below in the positions indicated.

CAUTION

With pressure and return hoses disconnected from aircraft RESERVOIR SELECTOR VALVE must be in STAND RESERVOIR position prior to operation or unit will be damaged. When operation through run around block RESERVOIR SELECTOR VALVE must be in STAND RESERVOIR position or damage to unit will result.

| Control                                      | Position                          | Method                         |
|----------------------------------------------|-----------------------------------|--------------------------------|
| a. H.P. GAGE SHUT-OFF valve (11, Figure 4-2) | 1/4 turn from full closed         | CW to close then CCW 1/4 turn. |
| b. GAGE SELECTOR valve (18, Figure 4-2)      | HP pump inlet                     | Select                         |
| c. PRESSURE CONTROL (2, Figure 4-3)          | Opened to lowest pressure setting | Rotate CCW                     |



|    | <u>Control</u>                              | <u>Position</u>                                      | <u>Method</u> |
|----|---------------------------------------------|------------------------------------------------------|---------------|
| d. | FLOW CONTROL Valve<br>(15, Figure 4-2)      | Closed                                               | Rotate CCW    |
| e. | HP RELIEF VALVE<br>(17, Figure 4-2)         | Lowest pressure<br>setting                           | Rotate CCW    |
| f. | VOLUME CONTROL<br>(1, Figure 4-3)           | To be set to<br>'zero' flow                          | Rotate CCW    |
| g. | HP BYPASS Valve<br>(16, Figure 4-2)         | Open                                                 | Rotate CW     |
| h. | RESERVOIR SELECTOR<br>Valve (2, Figure 4-2) | "Stand Reservoir"                                    | Select        |
| i. | Engine Shutdown Control                     | Fully In                                             | Select        |
| j. | Engine Throttle Control                     | Full out and then<br>push in to 1/4<br>open position | Select        |

4-10. PRE-OPERATION FILL AND BLEED PROCEDURE. With controls set in the positions specified in paragraph 4-9, proceed as follows:

- a. Remove the hoses from the top of Test Stand.
- b. Check that the connector fittings on the hoses and outlet and return fittings on the top of the Test Stand are clean. If the fittings are dirty, wash the fittings with solvent, Federal Specification P-D-680 Type II.
- c. Connect hoses to corresponding outlet and return fittings. Connect high pressure hose to low pressure hose using run around connections at front of stand.

- d. Set reservoir selector valve (2) to AIRCRAFT RESERVOIR position to perform fill and bleed procedures.
- e. Turn on MAIN POWER Switch (1, Figure 4-1).
- f. Push FILL PUMP ON push button (14, Figure 4-2)
- g. Press and hold FILTER BLEED valve (5) until system is free of air (bubbles) as shown on sight gage.
- h. Release FILL PUMP ON pushbutton (14) when L.P. Gage indicates approximately 80 psi.
- i. When the hydraulic systems have been prefilled, check OIL LEVEL Indicator (16, Figure 4-1). Refill the oil reservoir, if necessary, with hydraulic oil, Military Specification MIL-H-5606.

#### 4-11. DIESEL ENGINE STARTING PROCEDURE.

##### CAUTION

Do not impose a load of high pressure pumps when starting engine. HP BYPASS VALVE (16, Figure 4-2) shall be open at starting.

- a. Perform preliminary procedures (paragraph 4-8, 4-9, and 4-10).
- b. Push START Switch (2, Figure 4-1) until engine starts.

##### CAUTION

Do not press start switch for periods longer than 15 seconds or damage to engine or starter may result.

c. After engine starts, observe oil pressure gage. If pressure is not indicated in 10 seconds, pull out ENGINE SHUTDOWN CONTROL (4) to stop engine and set MAIN POWER switch to OFF. Refer to Section V for trouble-shooting procedures.

#### CAUTION

Do not impose load on engine at speeds less than 1500 rpm. Damage to engine may result.

d. After proper engine startup, allow engine to warm up. Observe TACHOMETER/HOURMETER (5), and adjust THROTTLE control (3) to set engine speed to 1000 rpm.

e. After warmup adjust THROTTLE control (3) to 2500 rpm.

#### NOTE

If warning horn sounds continuously, shut down engine by pulling ENGINE SHUT-DOWN control (4) and refer to Section V for troubleshooting procedure.

With engine running perform fill and bleed operation.

f. Press FILTER BLEED valve (5, Figure 4-2) to free system of trapped air.

#### NOTE

Any fluid bled from systems must be replaced using fill pump and fill valve. Monitor system pressure on compound gage (21, Figure 4-1) with gage selector valve (18, Figure 4-2)



in HP PUMP INLET position. Pressure shall not exceed 140 psi.

4-12. ADJUSTING VOLUME AND PRESSURE SETTINGS.

CAUTION

Before hydraulic fluid passes through high pressure filters, warm fluid to 80 degrees F minimum, per FLUID TEMP gage (3), by circulating fluid within the Test Stand. HP RELIEF VALVE (17) shall be partially closed (do not exceed 2500 psi) per HP GAGE (7) and HP BYPASS VALVE (16) shall be closed. When the fluid temperature reaches 80 degrees F, flow fluid through high pressure filters by partially opening HP BYPASS VALVE (16) until filter housing is warmed. At fluid temperatures below 80 degrees F the high viscosity of the hydraulic fluid will cause excessive differential pressure which actuate the differential pressure switch and may rupture the primary filter elements. During this warm-up operation the HP FILTER LAMP (14A) may come on. Lamp should go out when fluid warms up. If lamp does not go out after 5 minutes, replace filter element.

- a. Perform preliminary procedures (paragraphs 4-8, 4-9, 4-10, and 4-11).
- b. Open FLOW CONTROL valve (15, Figure 4-2).
- c. Slowly close HP BYPASS valve (16).

- d. Repeat paragraph 4-10f until entire system is free of air.
- e. Observe output pressure HP GAGE (7), for reading of 100 to 500 psig.
- f. Check condition of flow in flowmeter (20). If air is still present, bleed system per preceeding step d.
- g. Adjust VOLUME CONTROL valve (1, Figure 4-3) to desired rate of flow.

NOTE

Flowmeter readings are correct at fluid temperature or 100 degrees F. For operating temperatures other than 100 degrees F refer to Figure 4-4 to obtain corrected flow.

- h. Slowly close FLOW CONTROL valve (15, Figure 4-2) to check or reset HP RELIEF VALVE (17, Figure 4-2) and/or set PRESSURE CONTROL (2, Figure 4-3).
- i. Reset HP RELIEF valve (17, Figure 4-2) setting to 200/250 psig above desired PRESSURE CONTROL setting.
- j. Adjust PRESSURE CONTROL (2, Figure 4-3) setting to desired value. Readjust flow if necessary.

4-13. STOPPING THE TEST STAND.

- a. Reduce VOLUME CONTROL setting (1, Figure 4-3) to minimum.
- b. Open HP BYPASS VALVE, (16, Figure 4-2).
- c. Close FLOW CONTROL valve (15).



# TEMPERATURE CORRECTION CURVES

NUMBERS ON CURVES ARE TUBE SCALE READINGS

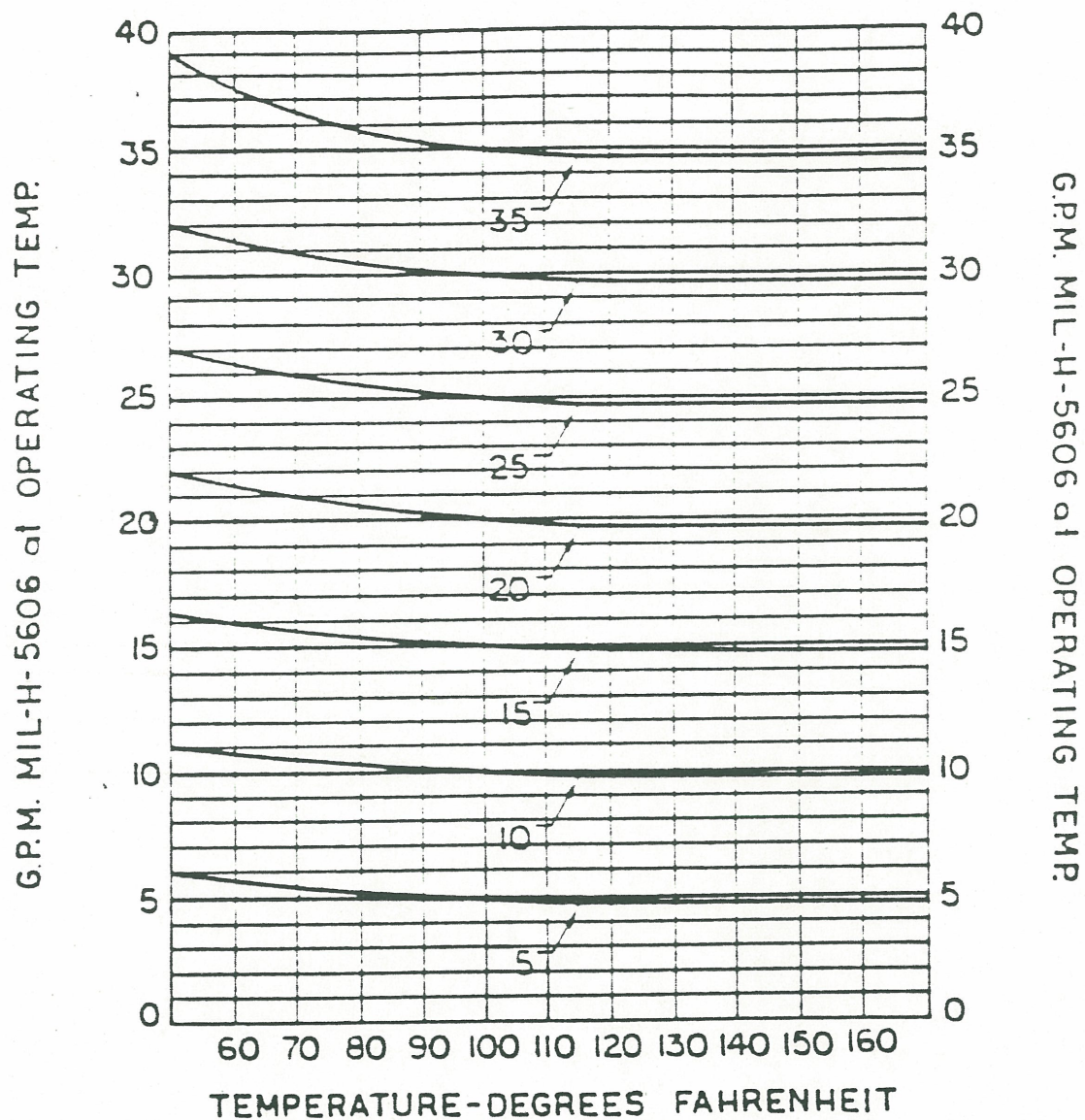


Figure 4-4. Temperature Correction Curve



- d. Position RESERVOIR SELECTOR valve (2) to Test Stand reservoir.
- e. Adjust THROTTLE control for engine speed of 1000 rpm.
- f. Allow engine to idle for 3 minutes.
- g. Pull out engine SHUTDOWN control.
- h. Disconnect hoses and place on hose retainer hooks. Cap all external connections. Do not disconnect hoses from Test Stand, unless necessary.
- i. Place MAIN POWER SWITCH (1, Figure 4-1) in OFF position.

4-14. EMERGENCY STOP. Perform emergency stop procedures as follows:

- a. Open HP BYPASS valve (16, Figure 4-2).
- b. Pull out engine SHUTDOWN control.
- c. Place MAIN POWER Switch in OFF position.

4-15. FLUID SAMPLING. Needle-valve type sampling valves are provided in each system to aid in taking samples for fluid contamination analysis. The valves are located on the control panel. To take fluid samples, operate the unit with the HP BYPASS valve (16, Figure 4-2) open and open sample valve (12), and tube sample of fluid from HP SAMPLING port (13).

4-16. AIRCRAFT FILL AND TEST PROCEDURES.

4-17. POSITIONING AND CONNECTING THE TEST STAND TO AIRCRAFT. Position and connect the Test Stand for aircraft test as follows:

- a. Move the Test Stand to the operating site using a suitable towing vehicle.

b. Position the Test Stand with respect to the aircraft so that the hoses can be connected between the aircraft and the Test Stand without sharp bends or kinks.

c. Set the brakes by pulling up on the hand brake lever. (3, Figure 4-3).

d. Raise the tow bar and secure it in its vertical position using the tow bar latch.

e. Remove the hoses from the front of the Test Stand.

f. Check that the connector fittings on the hoses and the outlet and return fittings on the top of the Test Stand are clean. If the fittings are dirty, wash the fittings with solvent, Federal Specification P-D-680, Type II.

g. Make the necessary hose connections between the aircraft and the aircraft and the outlet and return fittings on the top of the Test Stand. Accessory fittings and adapters for use in making aircraft connections are supplied with the Test Stand.

4-18. FILLING THE AIRCRAFT RESERVOIR. The following procedure can be used to fill an aircraft reservoir or to replace any fluid lost when connecting the hoses. To completely fill and bleed an aircraft system that has been drained, refer to paragraph 4-20.

#### NOTE

Refer to the applicable aircraft publication for proper fill procedures.

a. Turn the applicable PRESSURE SELECTOR valve (18, Figure 4-2) to the BOOST OUTLET position.

b. Position Reservoir Selector valve (2) to AIRCRAFT RESERVOIR.

c. Start fill pump, by pushing the pushbutton (14).

d. Fill the aircraft reservoir and leave the system fill valve opened until the filling operation is complete.

#### NOTE

The fill system output pressure can be monitored by observing the BOOST PUMP PRESSURE gage (19).

e. Bleed the air from the system by pressing the FILTER BLEED valve (5). Observe the sight tube and hold the FILTER BLEED valve depressed until clear fluid flows through the sight tube with no evidence of air bubbles.

#### WARNING

Always set PRESSURE RESERVOIR VALVE (15, Figure 4-1) to VENT prior to removing reservoir fill cap. Failure to comply may result in injury to personnel.

#### NOTE

Any fluid bled from systems must be replaced using fill pump and appropriate SYSTEM FILL valve. Monitor system pressure on compound FILL PRESSURE gage (21, Figure 4-1) with GAGE SELECTOR VALVE (18, Figure 4-2) in HP PUMP INLET position. Pressure shall not exceed 140 psi.

f. After the bleeding operation is complete, check the Test Stand fluid level. Refill the Test Stand reservoir by removing reservoir fill cap.



4-19. AIRCRAFT FILL/BLEED PROCEDURE. If the aircraft system has been drained, fill and air bleed the aircraft system as follows:

CAUTION

Do not exceed the rated gpm of the individual system aircraft pumps. Refer to applicable aircraft publication for flow capacities of the respective systems.

NOTE

Two persons are required for this operation: one to operate the Test Stand and one the aircraft to observe the filling operation.

- a. perform all procedures described in paragraph 4-6 through 4-10
- b. Open FLOW CONTROL valve (15, Figure 4-2).
- c. Slowly close HP BYPASS valve (16).
- d. with fill system operating press FILTER BLEED VALVE (5) while continually cycling the aircraft controls until all the air is bled from the aircraft system.

NOTE

When the pressure indicated by the BOOST PUMP PRESSURE gage (19) drops below 45 psig, release the filter bleed valve and allow pressure to build up to at least 50 psig before again pressing the FILTER BLEED valve.

e. Slowly increase the volume output of the Test Stand system and repeat the air bleed operation at one-quarter turn increments of the pump volume control until the rated flow of the aircraft system has been reached.

4-20. AIRCRAFT TESTING PROCEDURE. To test an aircraft hydraulic system, proceed as follows:

#### CAUTION

If the warning horn sounds, refer to Section V for trouble shooting before attempting to operate the Test Stand for testing and aircraft system.

Do not let BOOST OUTLET PRESSURE fall below 50 psig when operating Test Stand in open loop (Test Stand reservoir).

a. Perform all procedures described in paragraph 4-7 through 4-11. If the aircraft system has been drained, fill and air bleed the aircraft system as described in paragraph 4-19.

b. Open the FLOW CONTROL valve (15, Figure 4-2).

c. Slowly close the HP BYPASS valve (16).

d. Position Reservoir Selector valve (2) as required per the applicable aircraft publication.

e. Proceed with tests in accordance with the applicable aircraft publication.

f. System output pressure is indicated by the output pressure HP gage (7) for each system. To vary the output pressure, refer to paragraph 4-9.

g. System volume is indicated by the flowmeter (20). To vary the output volume, refer to paragraph 4-12.

h. Fluid temperature is indicated by the FLUID TEMPERATURE gage (3).

i. To check the return pressure from the aircraft, set the PRESSURE SELECTOR valve (18) to the RETURN position.

j. Shut down Test Stand after test (paragraph 4-13).

4-21. RESERVOIR PRESSURIZING PROCEDURE. The following procedure can be used to pressurize either the Stand or Aircraft reservoir when required by aircraft T.O.

a. The AIR COMPRESSOR in part of the diesel engine and will self-engage to maintain a pressure of 85-100 psi.

b. Close AIR OUTLET selector valve (14).

c. (Deleted)

d. Air pressure at air outlet is controlled by AIR PRESSURE REGULATOR (13) and read on AIRCRAFT AIR PRESSURE gage (11).

e. To pressurize reservoir, set PRESSURE RESERVOIR VALVE (15) to the PRESSURIZE position, adjust AIR PRESSURE REGULATOR (24) to the required pressure on reservoir air pressure gage (12).

f. If pressurization of reservoir is not required. PRESSURE RESERVOIR VALVE (15) should be place in VENT position and AIR PRESSURE REGULATOR (24) backed out to it lowest pressure position.



a. Make certain all hydraulic pressure is completely relieved before removing hydraulic system components.

b. Do not attempt to remove or repair any electrical component unless input power is disconnected (battery cable)

c. If it is necessary to remove system lines connected to hydraulic components, loosen fitting at end of each line, and remove attaching parts securing component to structure. Do not bend system lines on removal, as thread damage or misalignment may result. Cap or plug open lines or ports with protective closures, Military Specification MIL-C-5501, or equivalent.

d. When removing electrical components, disconnect electrical leads from terminals and tag each for ease of identification during reassembly.

5-3. PREVENTATIVE MAINTENANCE. Maintenance is generally limited to cleaning, service adjustments, and minor repair or replacement of parts and components that require attention through normal service use. Generally, instructions for minor repair or replacement consist essentially of carefully noting method of installation when removing defective parts, performing the necessary repair or adjustment, and installing parts in reverse order of removal. Change oil and air filters every six months.

5-4. ENGINE MAINTENANCE.

a. General Engine Maintenance. For additional information consult Operators Manual in Section 8.

(1) Check fuel level. Add fuel as required. If fuel level is satisfactory, check low fuel level warning switch. Replace if defective.

(2) Check engine coolant temperature gage. Normal engine

## SECTION V

### MAINTENANCE INSTRUCTIONS

5-1. GENERAL. Maintenance of the Test Stand consist of periodic inspection, cleaning, service adjustment, minor repairs or replacement of parts and components, and lubrication of main motor. The procedures described in this section must be performed regularly and thoroughly, even though Test Stand is operating satisfactorily. Through proper inspection, maintenance, and lubrication, equipment that is not in continuous use is kept ready for operation when necessary, and the Test Stand is maintained at peak performance levels for the maximum life of the equipment.

5-2. COMPONENT REMOVAL. When it is necessary to remove any component of the Test Stand, observe the following precautions and general practices:

#### WARNING

Release all system pressures prior to removal of components from hydraulic systems, and ensure that the input power to the Test Stand is disconnected to avoid possible injury to personnel.

#### CAUTION

Do not use adjustable jaw-type wrenches on hydraulic tube fittings. Slippage may result in damage to hexagonal fitting surfaces.



coolant temperature is 160-185°F. Consult Table 5-1 if limits are exceeded.

(3) Check engine oil pressure gage. Minimum oil pressure should be 18 psi at 1200 rpm. The oil pressure at normal operating speed should be 40-60 psi. Consult Table 5-1 if limits are exceeded.

5-5. CHECKING CRANKCASE OIL LEVEL. To check the crankcase oil level proceed as follows:

- a. Check oil level on dipstick.
- b. Add lubricating oil (Table 1-2) as required to bring the oil level up to FULL mark on the dipstick.

NOTE

Do not add more oil than required to bring oil level to FULL mark.

- c. Replace dipstick. Push firmly to reseal.

5-6. CHANGING ENGINE LUBRICATING OIL. To change engine lubricating oil proceed as follows:

- a. Remove crankcase drain plug and drain oil into a suitable container.
- b. Service engine oil filter in accordance with paragraph 5-7.
- c. Install drain plug. Torque to 25 to 35 ft.-lbs.
- d. Remove filler cap on left valve cover and fill crankcase with 11 quarts of MIL-L-2104 lubricating oil (Table 1-2). If engine oil filter is replaced, add 13 quarts of oil.



e. Replace filler cap.

f. Start engine (Section IV) and check for oil leaks around crankcase drain plug and engine oil filter.

5-7. Servicing Oil Filter. The oil filter (1, Figure 5-1) may be serviced as follows:

a. With the engine stopped place a container underneath the oil filter.

b. With a spin-on element remover tool, carefully remove element (2, Figure 5-2) and clean cover bottom (1) with a rag.

c. Lightly moisten new element rubber gasket with clean oil.

d. Install element and firmly hand tighten. Do not overtighten as element may warp.

e. When refilling crankcase allow two extra quarts of oil for oil filter.

5-8. SERVICING FUEL STRAINER/FUEL FILTER. The procedure for replacing the element is the same for the fuel strainer and fuel filter (2,3 Figure 5-1).

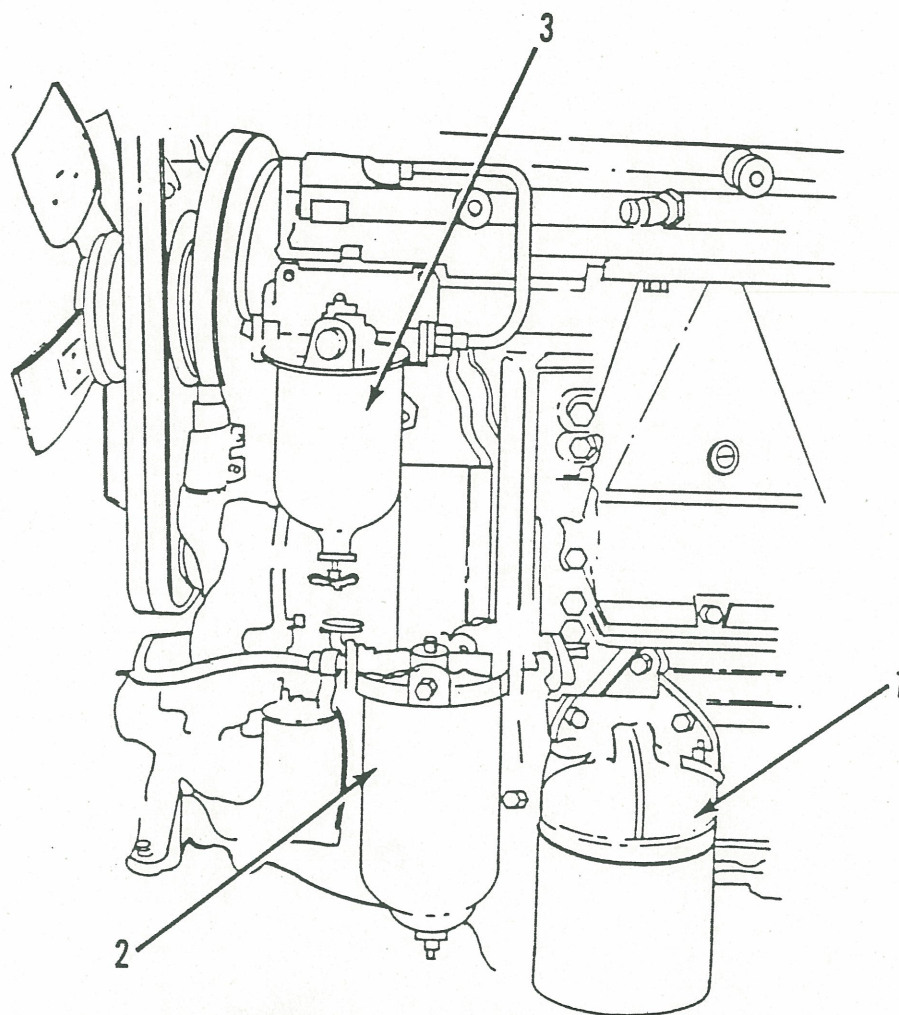
a. With the engine stopped, place a container under the fuel strainer or fuel filter.

b. With a spin-on element remover tool, carefully remove element (2, Figure 5-2) and clean cover bottom (1) with a clean rag.

c. Fill new spin on filter with clean fuel.

d. Lightly moisten new element rubber gasket with clean oil.

e. Install element and firmly hand tighten. Do not overtighten as element may warp.



- Key: 1. Oil Filter  
2. Fuel Strainer  
3. Fuel Filter

Figure 5-1. Fuel/Oil Filters

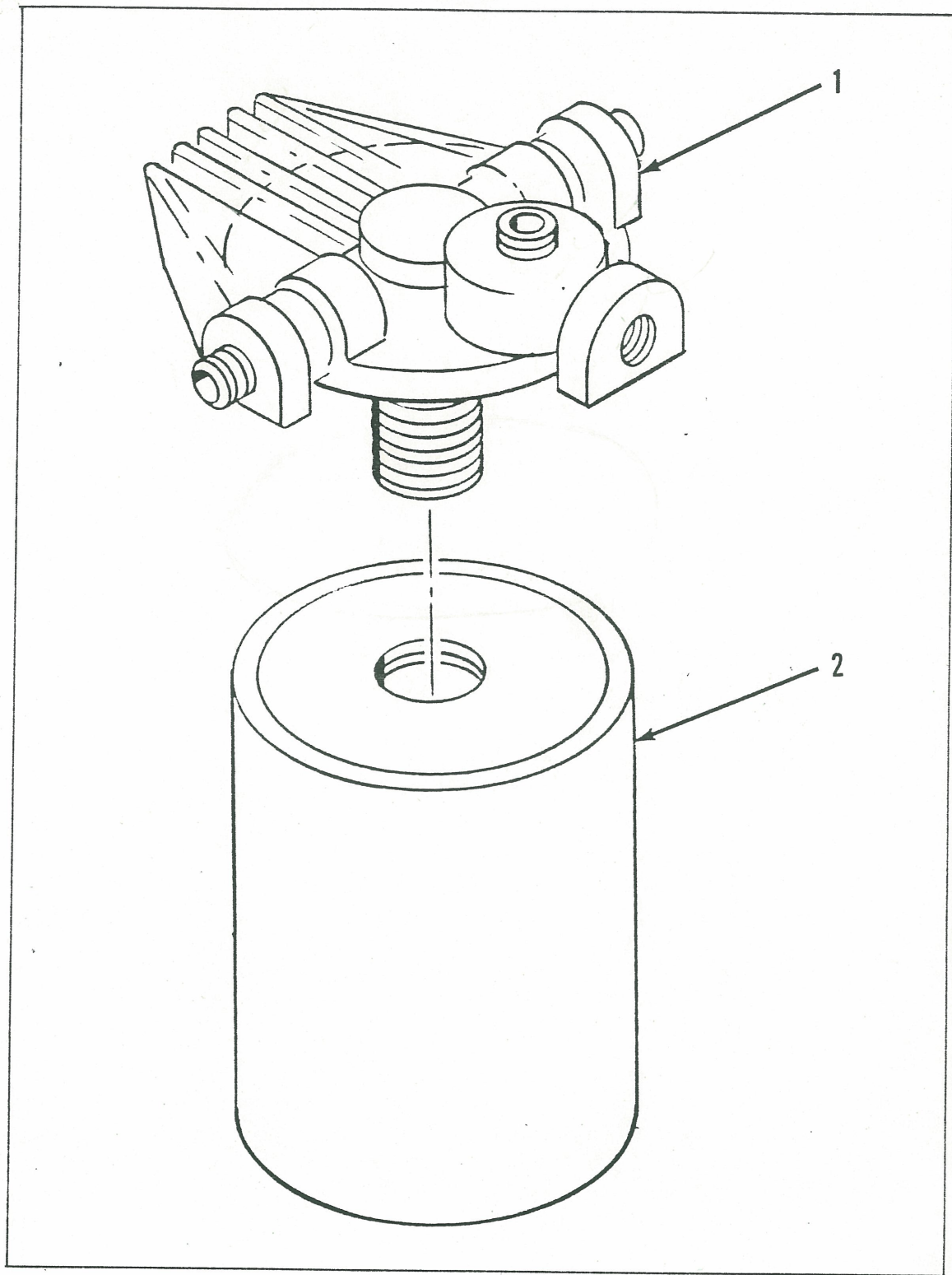


Figure 5-2. Fuel/Oil Filters (Typical)



5-9.        AIR CLEANER. The air cleaner is designed to remove foreign matter from the air, pass the required volume of air for proper combustion and scavenging, and maintain efficient operation for a reasonable period of time before requiring service.

The importance of keeping dust and grit-laden air out of the engine cannot be over-emphasized, since clean air is so essential to satisfactory engine operation and long engine life. Should dust in the air supply enter the engine, it would be carried directly into the cylinders and, due to its abrasive properties, cause premature wear of the moving parts. Dirt, which is allowed to build-up in the air cleaner passages, will eventually restrict the air supply to the engine and result in heavy carbon deposits on the valves and pistons due to incomplete combustion. The air cleaner sump must have a capacity large enough to retain the material separated from the air to permit operation for a reasonable length of time before cleaning is required.

Although the air cleaner is highly efficient, this efficiency depends upon proper maintenance and periodic servicing.

Damaged gaskets, loose hose connections or leaks in the duct work, which permit dust-laden air to completely by-pass the cleaner and enter the engine directly, will lower the efficiency of the air cleaner. If the air cleaner is not serviced periodically, the engine will not receive a sufficient amount of clean air. An air cleaner operating in severe dust will require more frequent service than an air cleaner.

5-10.        OIL BATH AIR CLEANER. The oil bath air cleaner (Fig. 5-3) consists of a metal wool cleaning element supported inside a housing beneath which is contained a bath of oil. The lower portion of the housing incorporates a chamber which serves as a silencer for the incoming air to the blower.

Air drawn into the cleaner by the blower passes over the top of the oil bath, where a major portion of the dirt is trapped, then up through the metal wool where the finer particles are removed, then down the central duct to the blower.

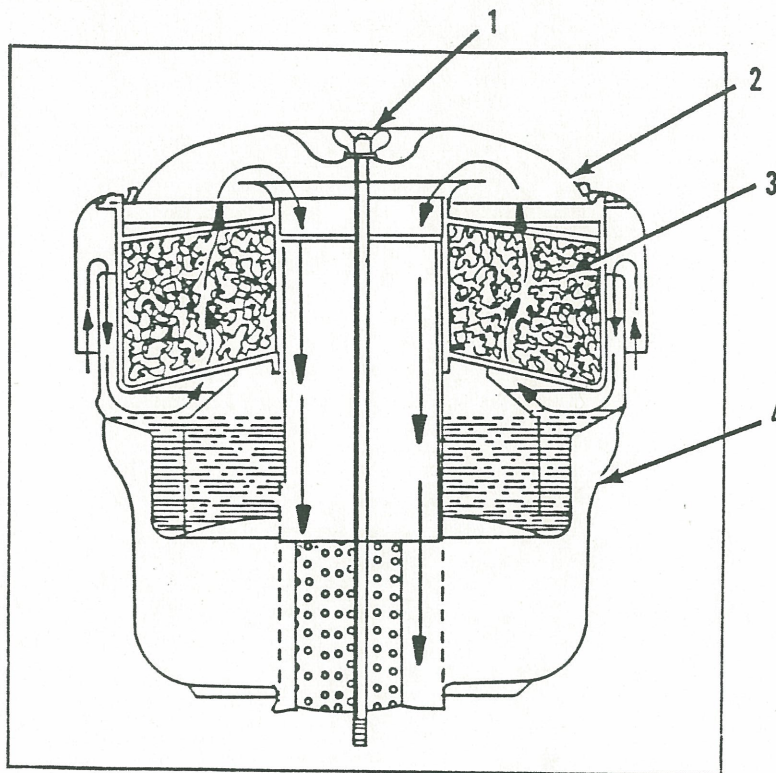


Fig. 5-3. Oil Bath-Type Air Cleaner

a. SERVICE. Service the oil bath air cleaner as follows (see Figure 5-3).

(1) Loosen the wingbolt (1) and remove the cleaner from the air inlet housing. the cleaner may then be separated into three sections: the upper section (2) the metal wool element (3), and the lower section (4) containing the oil sump.

(2) Soak the element in fuel oil to loosen the dirt; then flush the element with clean fuel oil and allow it to drain thoroughly.

(3) Empty the sump and clean it with fuel oil to remove all sediment.

(4) Push a lint-free cloth through the center tube to remove dirt or oil from the walls.

(5) Clean and check all gaskets and sealing surfaces to insure air tight seals.



(6) Refill the sump to the oil level mark ONLY, with the same grade of oil used in the engine.

(7) Before installing the air cleaner on the engine, check the air inlet housing for dirt. If the service period has been too long, or if dust-laden air has been leaking past the air cleaner to the air inlet housing seals, the inlet will be dirty. This will serve as a good check on the servicing of the air cleaner. When installing the cleaner (and its seal) on the inlet housing, be sure the cleaner seats properly, then tighten the wingbolt securely until the cleaner is rigidly mounted.

5-11. Servicing Fuel Tank. Locate drain plug under fuel tank and drain off any water or sediment prior to starting engine.

5-12. SERVICING COOLING SYSTEM.

#### WARNING

Always remove radiator cap slowly and carefully to avoid a possible flash of hot coolant. Failure to comply may result in injury to personnel.

a. Coolant Level. maintain coolant level near top of radiator expansion chamber accessible from top of test stand. Check prior to use and add clean water as required.

b. Hoses. Inspect hoses at least once every 500 hours for signs of deterioration. Replace as needed.

#### WARNING

Use cleaning solvent P-D-680, Type II, in a well ventilated area. Do not inhale



solvent vapor or allow solvent to contact skin. Keep solvent away from open flame. Failure to comply may result in injury to personnel.

c. Radiator. Inspect exterior of radiator at least once every week. Clean with solvent P-D-680, Type II, and dry with clean, dry compressed air at 5-15 psi maximum. It may be necessary to clean the radiator more frequently, if the test stand is being operated in an extremely dusty or dirty area. Clean the cooling system in accordance with paragraph 5-13.

5-13. CLEANING COOLING SYSTEM. The cooling system should be flushed and refilled every six months with fresh coolant. Scale and/or rust may be removed with a cleaner and the system reverse-flushed as soon as any scale or rust is detected.

5-14. FLUSHING THE COOLING SYSTEM. To flush the cooling system and renew the coolant, proceed as follows:

#### WARNING

Always remove the radiator cap slowly and carefully to avoid a possible flash of hot coolant. Failure to comply may result in injury to personnel.

a. Remove Radiator Cap at Expansion Chamber. Open coolant drain-cock located on engine oil cooler. Drain coolant into a suitable container.

b. Close drain-cock and refill coolant system with clean water.

#### CAUTION

If engine is hot, refill slowly to prevent cooling and distortion of engine casting.

c. Operate engine for fifteen minutes to circulate water thoroughly.

d. Stop engine and drain water completely.

e. Close drain-cock and refill system with a 50-50 mixture.

f. Install radiator cap and operate engine until normal operating temperature is reached.

g. Slowly and carefully remove radiator cap and loosen vent plugs in thermostat housing. Add coolant solution to radiator to bring the coolant level to within two inches of the radiator filler neck. Tighten vent plugs in thermostat housing when all air is expelled.

h. Install radiator cap and operate engine for 30 minutes repeat steps (g) and (h).

5-15. REMOVING SCALE AND/OR RUST FROM THE COOLING SYSTEM. Rust and scale are removed from the cooling system by first cleaning system with a descaling solvent and then reverse-flushing the radiator and engine block(if equipment available). To use descaling solvent, proceed as follows:

a. Open coolant drain-cock and drain coolant into a suitable container.

b. Close coolant drain-cock and fill cooling system with clean water.

c. Use descaling solvent in accordance with manufacturer's instructions.

d. Re-fill system with a 50-50 mix of anti-freeze and water.

5-16. REVERSE-FLUSHING THE COOLING SYSTEM. If possible, the engine and radiator should be reverse-flushed separately to prevent dirt and



scale deposits from clogging the radiator or being forced through the water pump. After the radiator and engine have been thoroughly cleaned proceed as follows:

- a. Insure radiator and engine are drained.
- b. Reverse-flush the radiator by first removing radiator inlet and outlet hoses. Install radiator cap.
- c. Reverse-flush the radiator by attaching a hose to the radiator inlet to direct water away from engine.
- d. Attach a hose and flushing gun to the radiator outlet.
- e. Connect a water hose and compressed air hose to flushing gun.

#### CAUTION

Apply air gradually, Do not exceed 30 psi air pressure. To great a pressure may rupture a radiator tube.

- f. Turn on water and, when radiator is full, turn on air in short blasts, allowing the radiator to fill between air blasts.
- g. Continue flushing until only clean water is expelled from the radiator. Remove flushing gun and hoses and allow radiator to drain.
- h. Reverse-flush the engine by first removing thermostats.
- i. Remove hose from water inlet fitting.
- j. Attach a hose to the water inlet of the cylinder block to drain water away from engine.



k. Attach a hose and flushing gun to water outlet at the top of the cylinder block.

#### CAUTION

Excessive pressure may damage components.

Do not exceed 30 psi.

- l. Connect a water hose and compressed air hose to flushing gun.
- m. Turn on water and, when water jackets are filled, turn on air in shorts blasts, allowing the engine to fill with water between air blasts.
- n. continue flushing until only clear water is expelled from the engine block. Remove flushing gun and hoses and allow block to drain.
- o. Reinstall thermostats.
- p. Install new radiator inlet and outlet hoses.
- q. Close drain-cock and fill cooling system with a 50-50 mixture of clean water and anti-freeze.
- r. Install radiator cap and operate engine (Section IV) until normal operating temperature is reached.
- s. Slowly and carefully remove radiator cap. Loosen vent plugs in thermostat housing and add coolant solution to bring coolant level to within two inches of the radiator filler neck. Tighten vent plugs when all air is expelled.
- t. Install radiator cap and operate engine for 30 minutes. Repeat step (i).

5-17. BATTERY MAINTENANCE. Engine batteries are serviced as follows:

CAUTION

When handling batteries, use face shield or goggles, rubber gloves and apron.

a. Maintain electrolyte level approximately three-eighths inch over plates. Check level daily and add distilled water as necessary.

CAUTION

To prevent battery damage, keep soda solution out of cells.

b. Keep top of battery clean. When necessary, wash with a baking soda solution and rinse with fresh water.

c. Inspect cables, clamps, and holddown bracket every 100 hours. Clean and apply to coat of grease when needed. Replace corroded or damaged parts.

d. Check condition of battery every 300 hours with a hydrometer. Specific gravity of a fully charged battery should be 1.275 to 1.285. Charge battery if specific gravity goes below 1.150. Check electrical system if battery becomes discharged repeatedly.

5-18. SERVICING STARTING MOTOR. Service starter motor as follows:

a. Remove pipe plugs.

b. Lubricate the starting motor with five or six drops of engine oil at each oiling hole.

c. Install pipe plug.

5-19. Servicing Drive Belts.

CAUTION

Too much tension on belt may damage bearings of the driven part. A loose belt will slip and wear out belt.

NOTE

When installing or adjusting drive belt, ensure that bolt at the adjusting pivot point is properly tightened.

- a. Adjust belt tension. Adjust belt tension so that a firm push with the thumb, at a point midway between the two pulleys, will press the belt one-half to three-quarters inch.

| <u>Belt(s)</u>   | <u>Tension (lbs/belt)</u> |
|------------------|---------------------------|
| Alternator drive | 40-50                     |
| Water pump       | 40-50                     |

NOTE

Replace all belts in a matched set when one is worn. Do not substitute a single belt of similar in a matched set.

- b. Run engine for 15 minutes and re-tension belts.

5-20. TROUBLESHOOTING. Table 5-1 provides a quick check list of possible trouble, which may be encountered in the operation of the Test Stand, their probable cause and suggested remedy.



Table 5-1. Troubleshooting

| TROUBLE                                     | PROBABLE CAUSE                                                                                                                                                      | REMEDY                                                                                                              |
|---------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| Fluid temperature too high                  | Heat exchanger clogged<br><br>Defective pump compensator                                                                                                            | Flush and clean<br><br>Replace                                                                                      |
| Reservoir level indicator does not indicate | Hydraulic lines plugged or damaged<br><br>Blocked tubing connection<br><br>Reservoir empty                                                                          | Replace<br><br>Clean or replace<br><br>Fill                                                                         |
| Pump fails to deliver sufficient volume     | Insufficient fluid supply (Test stand will shut down)<br><br>Air in suction line<br><br>Dirty, clogged boost pressure filter<br><br>Pump volume control set too low | Fill Reservoir; fill systems<br><br>Tighten connections, bleed lines<br><br>Clean or replace elements<br><br>Adjust |
| Pump Fails to deliver sufficient pressure   | Low boost pump pressure (Test Stand will shut-down)<br><br>Clogged low pressure and high pressure filters<br><br>Pump Compensator not set properly                  | Check boost pump pressure<br><br>Clean and replace<br><br>Reset                                                     |

Table 5-1 Troubleshooting - Continued

| TROUBLE                                   | PROBABLE CAUSE                                                                                    | REMEDY                                                                                                                                                                                  |
|-------------------------------------------|---------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Pump fails to deliver sufficient pressure | High pressure relief valve set too low (dumping before compensator setting)                       | Reset                                                                                                                                                                                   |
|                                           | Defective pressure gauge                                                                          | Inspect and replace, if necessary                                                                                                                                                       |
| Noisy operation                           | Pump cavitating; insufficient fluid supply<br>low boost pressure, pump case not filled with fluid | Check for adequate fluid supply<br>boost pressure check boost pressure check boost pressure filter; fill pump case with pressure filter, fill system filters; use clean, filtered fluid |
|                                           | Air in system<br>Defective boost pump if necessary                                                | Fill and bleed<br>Check and replace.                                                                                                                                                    |
|                                           | Defective check valve in high pressure line                                                       | Inspect and replace, if necessary                                                                                                                                                       |
|                                           | Pressure outlet closed or flow control valve and bypass valves closed                             | Open bypass valve                                                                                                                                                                       |
|                                           | Chattering high pressure relief valve                                                             | Remove valve assembly clean and replace worn or defective parts                                                                                                                         |
|                                           | Defective pump compensator                                                                        | Repair or replace                                                                                                                                                                       |
| Excessive back-pressure                   | Check valve fail(closed)                                                                          | Repair or replace                                                                                                                                                                       |

Table 5-1 Troubleshooting - Continued

| TROUBLE                                           | PROBABLE CAUSE                     | REMEDY                                                |
|---------------------------------------------------|------------------------------------|-------------------------------------------------------|
| Control circuit inoperative                       | Control circuit breakers off       | Reset circuit breakers                                |
|                                                   | Power on switch off                | Switch to on                                          |
|                                                   | Faulty control circuit transformer | Test and replace, if necessary                        |
|                                                   | Defective relays                   | Test and replace, if necessary                        |
| Indicating light fails to flow on "press to test" | Defective lamps                    | Test and replace                                      |
|                                                   | Defective lamps                    | Test and replace                                      |
|                                                   | Defective lamps                    | Test, repair/replace                                  |
| Hourmeter does not register                       | Deffective wire leads              | Repair or replace                                     |
|                                                   | Defective instrument               | Replace                                               |
| Fill pump motor fails to start                    | Control power off                  | Connect power lines properly.<br>Depress push button  |
|                                                   | Circuit breaker open               | Close circuit breaker                                 |
| Fill pump does not pump                           | Pump suction is dry, lost it prime | Introduce fluid to pump inlet                         |
|                                                   | Pump worn or damaged               | Repair or replace                                     |
|                                                   | Air leaks insuction line           | Tighten all connections                               |
|                                                   | Motor rotation wrong               | Check rotation and correct wiring for proper rotation |



Table 5-1 Troubleshooting - Continued

| TROUBLE                         | PROBABLE CAUSE                    | REMEDY                                                                                                                                       |
|---------------------------------|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| No power to high pressure pumps | Defective gearbox                 | Check gearbox, replace if defective.                                                                                                         |
|                                 | Defective high pressure pumps     | Check high pressure pumps, repair/replace if defective                                                                                       |
| Engine will not start           | Engine shutdown handle            | Ensure shutdown handle is fully in.                                                                                                          |
|                                 | Defective starter button          | Replace.                                                                                                                                     |
|                                 | Low battery charge                | Test and recharge battery. Replace battery if it will not hold a charge.                                                                     |
|                                 | Battery connection dirty or loose | Clean battery cable terminals and battery posts. Tighten.                                                                                    |
|                                 | Starter connection dirty or loose | Clean starter connections and tighten.                                                                                                       |
|                                 | Defective starter solenoid        | Replace starter solenoid.                                                                                                                    |
|                                 | Insufficient fuel                 | Fill tank above suction line and bleed system if necessary in accordance with engine technical order.                                        |
|                                 | Air leaks                         | Tighten joints and replace gaskets if necessary at fuel leakage points. Bleed system if necessary in accordance with engine technical order. |

Table 5-1 Troubleshooting - Continued

| TROUBLE                           | PROBABLE CAUSE                    | REMEDY                                                                                                                                      |
|-----------------------------------|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| Engine will not start-continued   | Dirty fuel filters                | Check filters and replace elements if necessary in accordance with engine technical order.                                                  |
|                                   | Starter worn                      | Inspect starter commutator and brushes for wear. Replace brushes and overhaul starter if commutator is damaged. See engine technical order. |
|                                   | Improper grade of oil             | Drain crankcase and refer to engine technical order for proper grade of oil for existing condition.                                         |
|                                   | Ambient temperatures too cold     | Apply heat to engine.                                                                                                                       |
|                                   | Exhaust valves sticking or burned | Remove cylinder head and recondition exhaust valves.                                                                                        |
|                                   | Faulty fuel pump                  | Replace defective pump.                                                                                                                     |
|                                   | Cylinder head gasket leaking      | Replace damaged cylinder head gasket or cylinder head if cracked.                                                                           |
|                                   | Internal seizure                  | Disassemble engine and replace damaged parts.                                                                                               |
| Engine starting motor inoperative | Batteries giving low output       | Check and recharge batteries.                                                                                                               |
|                                   | Poor ground connection            | Check, clean and tighten.                                                                                                                   |
|                                   | Broken starter pinion             | Replace starter motor.                                                                                                                      |



Table 5-1 Troubleshooting - Continued

| TROUBLE                                          | PROBABLE CAUSE          | REMEDY                                                                                          |
|--------------------------------------------------|-------------------------|-------------------------------------------------------------------------------------------------|
| Engine starting motor inoperative<br>- continued | Faulty switch           | Replace switch.                                                                                 |
|                                                  | Fuse blown              | Check fuse. Investigate cause of overload.                                                      |
|                                                  | Faulty starter solenoid | Replace solenoid.                                                                               |
|                                                  | Internal starter fault  | Replace starter motor.                                                                          |
| Engine runs unevenly or stalls                   | Fuel filters dirty      | Check fuel filters and replace elements if necessary in accordance with engine technical order. |
|                                                  | Insufficient fuel       | Fill tank above fuel suction line. Check for line leaks.                                        |
|                                                  | Low coolant temperature | Thermostat not closing. Inspect and replace if necessary.                                       |
|                                                  | Engine governor         | Check governor linkage for binding.                                                             |
|                                                  | Leaking fuel injector   | Replace faulty injector.                                                                        |
|                                                  | Low compression         | Check cylinder compression and                                                                  |
|                                                  | Low compression-cont'd  | Consult engine technical order if pressures are low.                                            |
|                                                  | Insufficient air        | Check for damaged or dirty air cleaners and clean or replace damaged parts.                     |
|                                                  | Needs a tune-up         | Tune engine in accordance with engine technical order.                                          |



Table 5-1 Troubleshooting - Continued

| TROUBLE             | PROBABLE CAUSE                       | REMEDY                                                             |
|---------------------|--------------------------------------|--------------------------------------------------------------------|
| Detonation          | Low coolant temperature              | Thermostat not closing. Inspect and replace if necessary.          |
|                     | Faulty injector                      | Replace faulty injectors.                                          |
| Engine runs to fast | Excessive governor spring tension    | Adjust governor spring.                                            |
| Engine runs to slow | Insufficient governor spring tension | Adjust governor spring.                                            |
| Engine overheats    | Insufficient heat transfer           | Clean and flush cooling system.                                    |
|                     |                                      | Clean radiator core to unplug air passages.                        |
|                     |                                      | Adjust fan belts to proper tension.                                |
|                     |                                      | Check coolant level.                                               |
|                     |                                      | Inspect for collapsed or disintegrated hoses. Replace faulty hose. |
|                     |                                      | Thermostat not opening. Replace thermostat if faulty.              |
| Engine runs cold    | Thermostat not closing               | Check water pump for damaged impeller. Replace if necessary.       |
|                     |                                      | Remove and inspect thermostat. Replace if necessary.               |

Table 5-1 Troubleshooting - Continued

| TROUBLE                          | PROBABLE CAUSE                               | REMEDY                                                                                       |
|----------------------------------|----------------------------------------------|----------------------------------------------------------------------------------------------|
| Engine emits grey or black smoke | High exhaust back pressure                   | Check exhaust piping or muffler for obstruction. Check exhaust back pressure with manometer. |
|                                  | Restricted air inlet                         | Check cylinder lines parts, air cleaner and blower screen. Clean these items.                |
|                                  | Improperly timed injectors                   | Time the fuel injector in accordance with engine technical order.                            |
|                                  | Improper grade of fuel                       | Drain and fill system with proper fuel grade. See engine technical order.                    |
| Engine emits blue smoke          | Lubricating oil not fully burned in cylinder | Replace oil control rings.                                                                   |
|                                  | Excessive oil in crankcase                   | Fill crankcase to proper level.                                                              |
| Engine emits white smoke         | Misfiring cylinders                          | Check for faulty injectors and replace as necessary.                                         |
|                                  | Low compression                              | Consult engine technical order for proper values and actions.                                |
|                                  | Improper grade of fuel                       | Drain fuel tank and fill with proper fuel grade.                                             |
| Air leaks                        | Loose fuel connections or cracked fuel line  | Replace all damaged connectors and damaged fuel lines. Tighten.                              |
|                                  | Filters leaks                                | Inspect fuel filters gasket and replace if necessary.                                        |



Table 5-1 Troubleshooting - Continued

| TROUBLE                 | PROBABLE CAUSE                                  | REMEDY                                                                              |
|-------------------------|-------------------------------------------------|-------------------------------------------------------------------------------------|
| Fuel obstruction        | Clogged fuel filters                            | Replace clogged or faulty filters.                                                  |
|                         | Clogged or bent fuel lines                      | Disconnect fuel lines and remove obstruction. Replace damaged fuel lines.           |
|                         | Faulty fuel pump                                | Replace fuel pump.                                                                  |
| High oil consumption    | Loose connection                                | Tighten connections and replace defective connection.                               |
|                         | Oil filter gaskets leaking                      | Tighten and replace oil filter gasket if necessary..                                |
| Oil in coolant          | Oil cooler core leaks                           | Replace oil cooler core and flush cooling system to remove oil from cooling system. |
| Low engine oil pressure | Low oil supply                                  | Refill engine crankcase to full mark.                                               |
|                         | Low oil viscosity                               | Drain engine oil sump; refill with fresh oil of specified grade.                    |
|                         | Clogged oil filter                              | Remove and clean or replace.                                                        |
|                         | Engine bearings worn                            | Remove and replace engine.                                                          |
|                         | Internal oil leaks                              | Remove and replace engine.                                                          |
|                         | Oil pressure gage and/or sensing unit defective | Replace gage and/or sensing unit.                                                   |



Table 5-1 Troubleshooting - Continued

| TROUBLE       | PROBABLE CAUSE                                 | REMEDY                                    |
|---------------|------------------------------------------------|-------------------------------------------|
| Engine knocks | Engine operating under heavy load at low speed | Increase engine rpm.                      |
|               | Improper fuel                                  | Use specified grade of fuel.              |
|               | Defective valve lifter                         | Remove engine; replace valve lifter.      |
|               | Scored valve stems                             | Remove engine, replace cylinder assembly. |
|               | Warped valves                                  | Remove engine; replace cylinder assembly. |
|               | Loose or burned connecting rod bearing         | Remove engine.                            |
|               | Worn or loose piston pin                       | Remove engine; replace cylinder assembly. |
|               | Carbon or lead deposits in cylinder head       | Remove engine; replace cylinder assembly. |

TABLE 5-2

## LUBRICATION AND PREVENTIVE MAINTENANCE CHART

| Item Operation               | Hours | TIME INTERVAL |   |    |     |     |     |     |       |       |  |
|------------------------------|-------|---------------|---|----|-----|-----|-----|-----|-------|-------|--|
|                              |       | Daily         | 8 | 50 | 100 | 200 | 300 | 500 | 1,000 | 2,000 |  |
| 1. Engine Oil*               |       | X             |   |    |     |     |     |     |       |       |  |
| 2. Oil Filter **             |       |               |   |    |     |     |     |     |       |       |  |
| 3. Coolant and Filter        |       | X             |   |    |     |     |     | X   | X     |       |  |
| 4. Hoses                     |       |               |   |    |     |     |     | X   |       |       |  |
| 5. Radiator                  |       |               |   |    |     |     |     |     | X     |       |  |
| 6. Heat Exchanger Electrodes |       |               |   |    |     |     |     |     |       |       |  |
| and Core                     |       |               |   |    |     |     |     | X   | X     |       |  |
| 7. Raw Water Pump            |       | X             |   |    |     |     |     |     |       |       |  |
| 8. Fuel Tank                 |       | X             |   |    |     |     |     | X   |       |       |  |
| 9. Fuel Strainer and Filter  |       |               |   |    |     |     | X   |     |       |       |  |
| 10. Air Cleaner              |       |               | X |    |     |     |     | X   |       |       |  |
| 11. Air Box Drains           |       |               |   |    |     |     |     | X   | X     |       |  |
| 12. Ventilating System       |       |               |   |    |     |     |     |     | X     |       |  |
| 13. Blower Screen            |       |               |   |    |     |     |     |     | X     |       |  |
| 14. Starting Motor***        |       |               |   |    |     |     |     |     |       |       |  |
| 15. Battery-Charging         |       |               |   |    |     |     |     |     |       |       |  |
| Generator                    |       |               |   |    | X   | X   |     | X   |       | X     |  |
| 16. Battery                  |       |               |   |    | X   |     |     |     |       |       |  |
| 17. Tachometer Drive         |       |               |   |    | X   |     |     |     |       |       |  |
| 18. Throttle                 |       |               |   |    |     | X   |     |     |       |       |  |
| 19. Drive Belts              |       |               |   |    |     | X   |     |     |       |       |  |
| 20. Overspeed Governor       |       |               |   |    |     |     |     | X   |       |       |  |
| 21. Shut-Down System         |       |               |   |    |     |     | X   |     |       |       |  |

\* Change oil every 100 hours for new engines, then establish an interval based on experience with engine.

\*\* Change filters with oil changes.

\*\*\* When removed from engine.



5-21. COMPONENT REPAIR. Component repair consists of performing any repair or part replacement necessary to restore the component to a serviceable condition. The operator shall limit repair to only the procedures detailed herein.

5-22. CLEANING. The Test Stand should be cleaned whenever there is an accumulation of dust or dirt on the exterior of the cabinet or control panel, or whenever grease, oil, or similar foreign matter is inadvertently spilled within the Stand. Clean the Test Stand in accordance with T.O. 35-1-12, and common shop practices.

#### WARNING

Use solvent in well ventilated area.  
Avoid contact with open flames and  
avoid inhalation of fumes, as injury  
could result.

a. Clean all disassembled components, except electrical parts and prelubricated bearings, with solvent, Federal Specification P-D-680. Use a stiff-bristle, non-metallic brush to ensure that all orifices, packing grooves, and ports are thoroughly clean.

b. Dry all cleaned parts using compressed air at approximately 15 psig, or a clean, lint-free cloth.

c. After cleaning, inspect all parts for wear and defects, such as nick, burrs, scoring, cracks, corrosion, or similar defects. Inspect all threaded area for stripped, crossed, or broken threads. Inspect mounting holes for elongation which would effect component performance.

#### CAUTION

Do not use abrasive cloth, Federal  
Specification P-C-458, on aluminum



or magnesium alloy parts, as is contains an iron oxide which causes rapid oxidation of these metals.

d. Polish out minor defects from noncritically dimensioned surfaces, using abrasive cloth, Federal Specification P-C-458, for ferrous alloy parts and abrasive cloth, Federal Specification P-C-451, for aluminum and magnesium alloy parts. Ensure that precision fits, and seating or sealing surfaces are not destroyed. Reclean any repaired parts.

e. Replace all performed packings, back rings, gaskets, and seals regardless of condition, each time a component is required.

f. During reassembly or hydraulic components, assemble parts dripping wet, dipping them in hydraulic fluid, Military Specification MIL-H-5606.

g. Perform hydraulic component tests using a clean source of hydraulic fluid, Military Specification MIL-H-5606, filtered to 10 microns, or better.

5-23. REPAIR or REPLACEMENT.

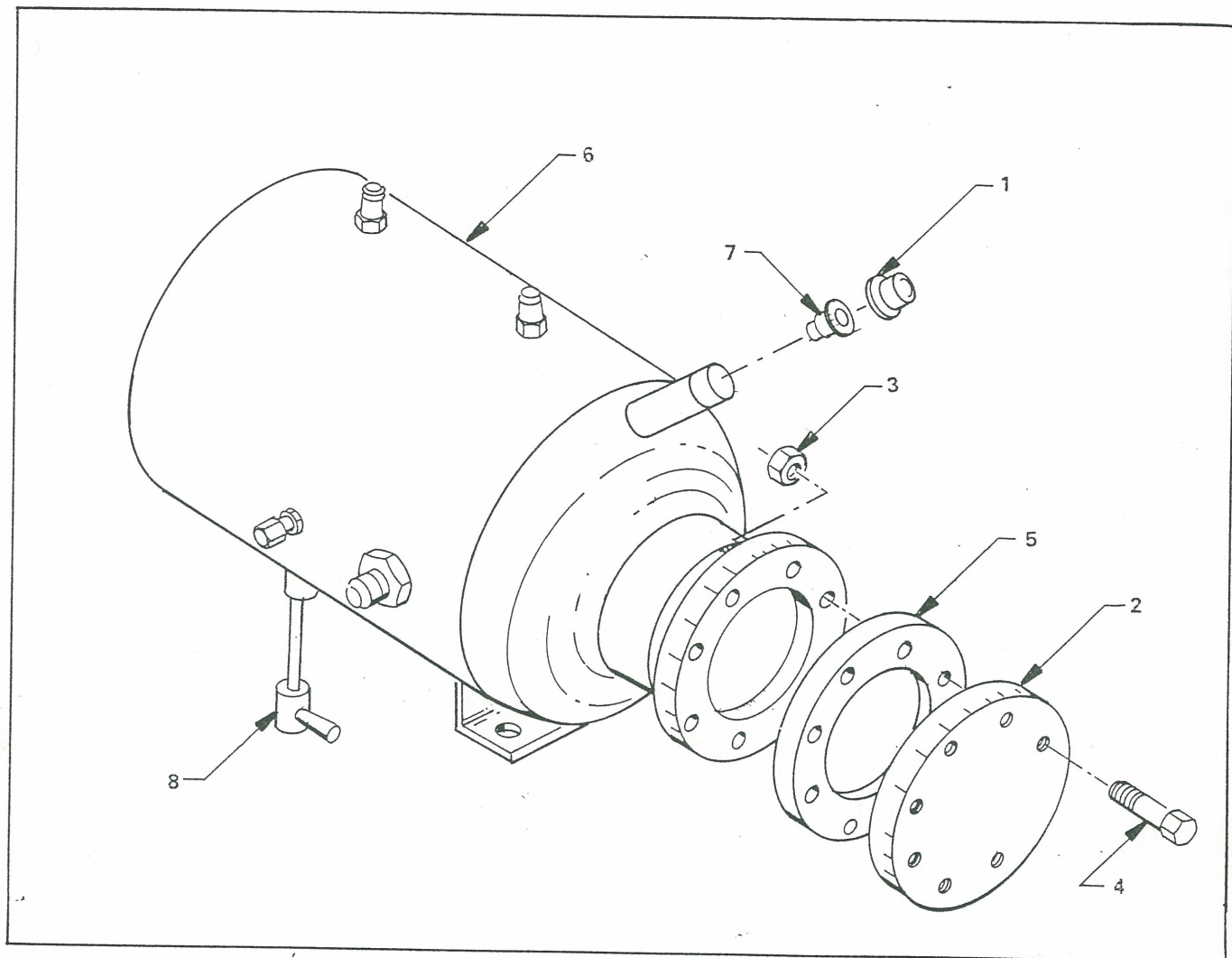
5-24. FILTERS. All systems filters have been covered in this section. Replace any damaged parts on these filters, especially o-rings. Do not attempt repair.

5-25. INSPECTION.

5-26. HYDRAULIC RESERVOIR INSPECTION. Refer to figure 5-4 and inspect the hydraulic reservoir as follows:

#### WARNING

Hydraulic system and reservoir must be depressurized before performing maintenance



or servicing of system. Failure to comply may result in injury to personnel.

a. Remove reservoir filler cap (1) and drain hydraulic fluid from reservoir by opening the drain valve (8) at the end of the drain tube. Empty into a suitable container. Close drain valve.

b. Remove reservoir access cover (2), and gasket (5) from reservoir (6) by removing bolts (4) and nuts (3).

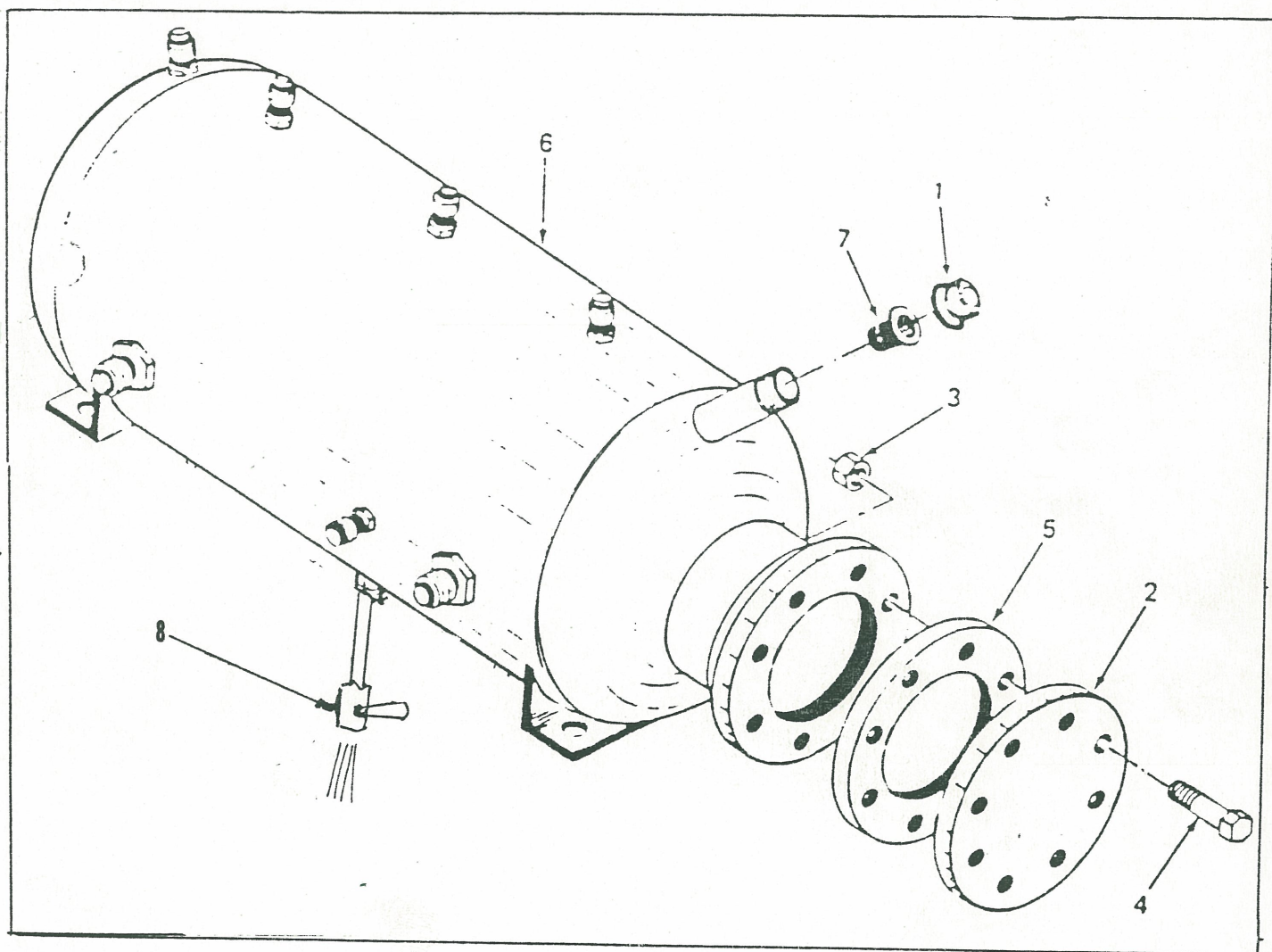


Figure 5-4. Hydraulic Reservoir



- c. Inspect interior of reservoir for contaminants.

WARNING

Use cleaning solvent, P-D-680, type II, in a well ventilated area. Do not inhale solvent vapors or allow solvent to contact skin. Keep solvent away from open flame. Failure to comply may result in injury to personnel.

- d. Clean interior of reservoir, if required, by flushing and draining with cleaning solvent, Federal Specification P-D-680, Type II.

- e. Install reservoir access cover (2), gasket (5), to reservoir with bolts (4) and nuts (3).

- f. Fill reservoir with hydraulic fluid, Federal Specifications MIL-H-5606 or MIL-H-83282. Replace filler cap.

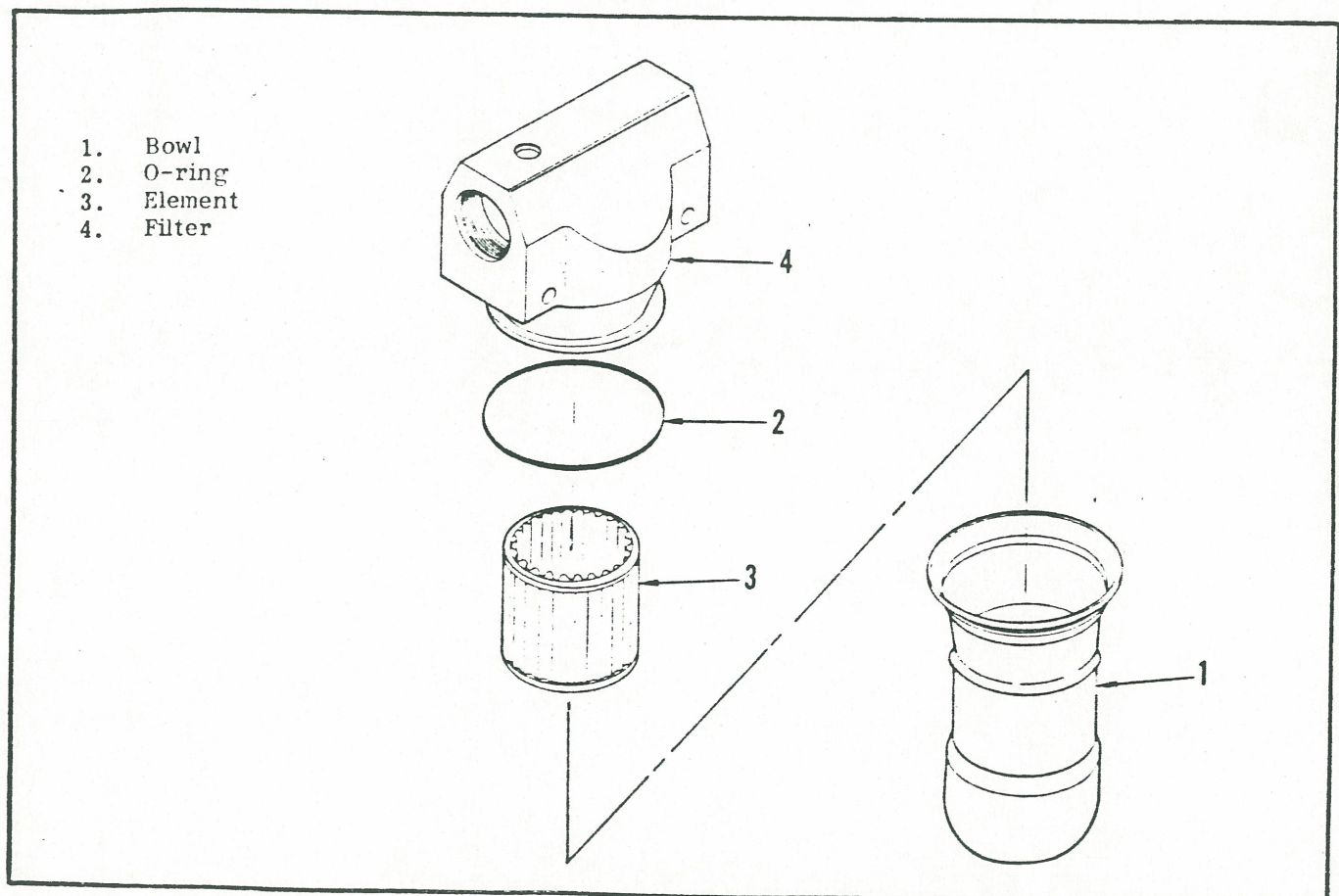


Figure 5-5. Fill System Filter

5-27. FILL SYSTEM FILTER INSPECTION. Check fill system filter for excessive pressure drop as follows:

- a. Press the SYSTEM FILL valve (14, Figure 4-2).
- b. Determine pressure drop by noting FILL PRESSURE gage (21, Figure 4-1). The difference between the readings of the red and black gage needles is the pressure drop across the filter.
- c. When pressure drop reaches 50 psig, cleaner replace filter element (3, Figure 5-5) by unscrewing bowl (1) and removing the element.

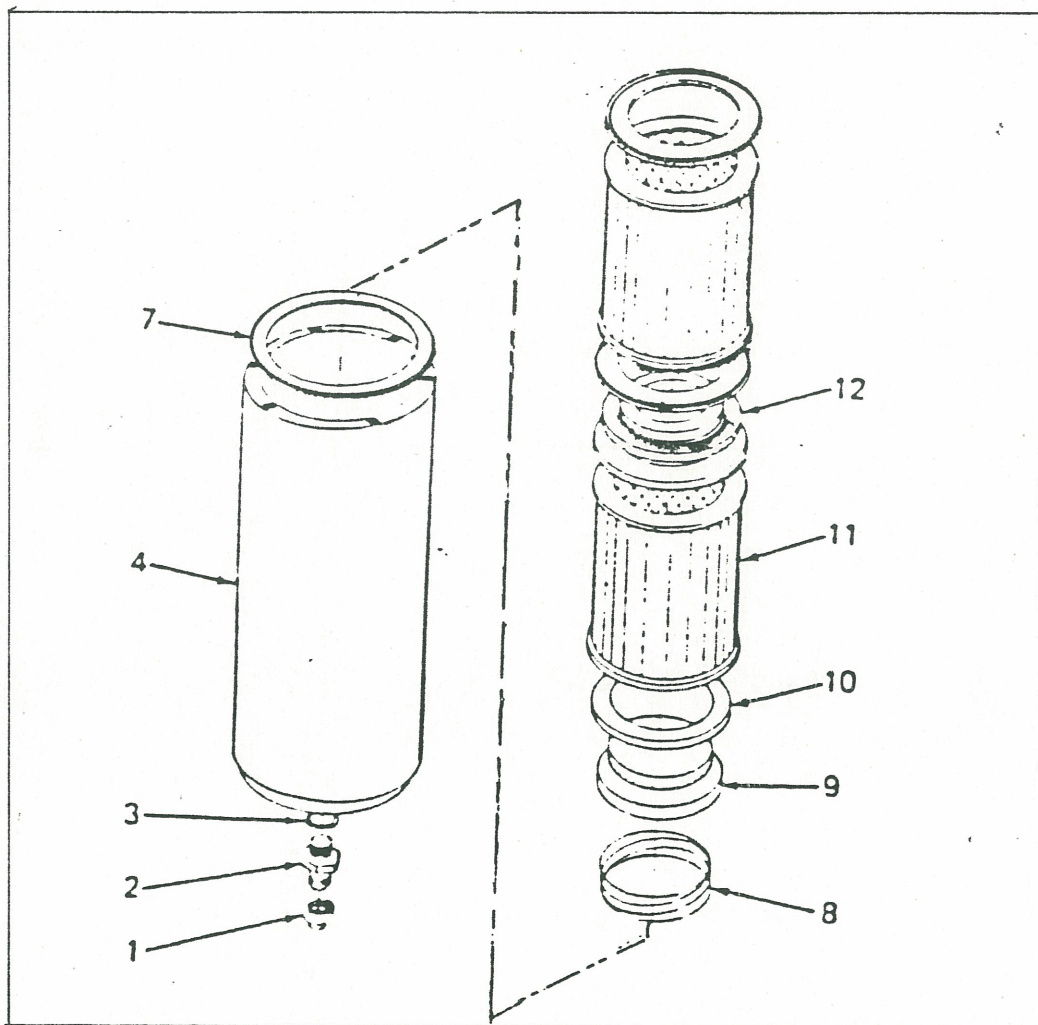


Figure 5-6. Low Pressure Filter Assembly



5-28. BOOST SYSTEM FILTER INSPECTION. Check boost system filter (7, Figure 6-1) for excessive pressure drop as follows:

- a. Start the test stand. Ensure that engine is operating at 2500 rpm.
- b. Turn GAGE SELECTOR valve (14, Figure 4-3) to boost outlet position and note reading of LOW PRESSURE gage (11).
- c. Turn GAGE SELECTOR valve (14, Figure 4-3) to return and note reading of LOW PRESSURE gage (11).
- d. Subtract pressure of step 3 from pressure of step 2 to determine pressure drop across filter element.
- e. When pressure drop reaches 30 psig, replace filter elements as follows (see Figure 5-6).

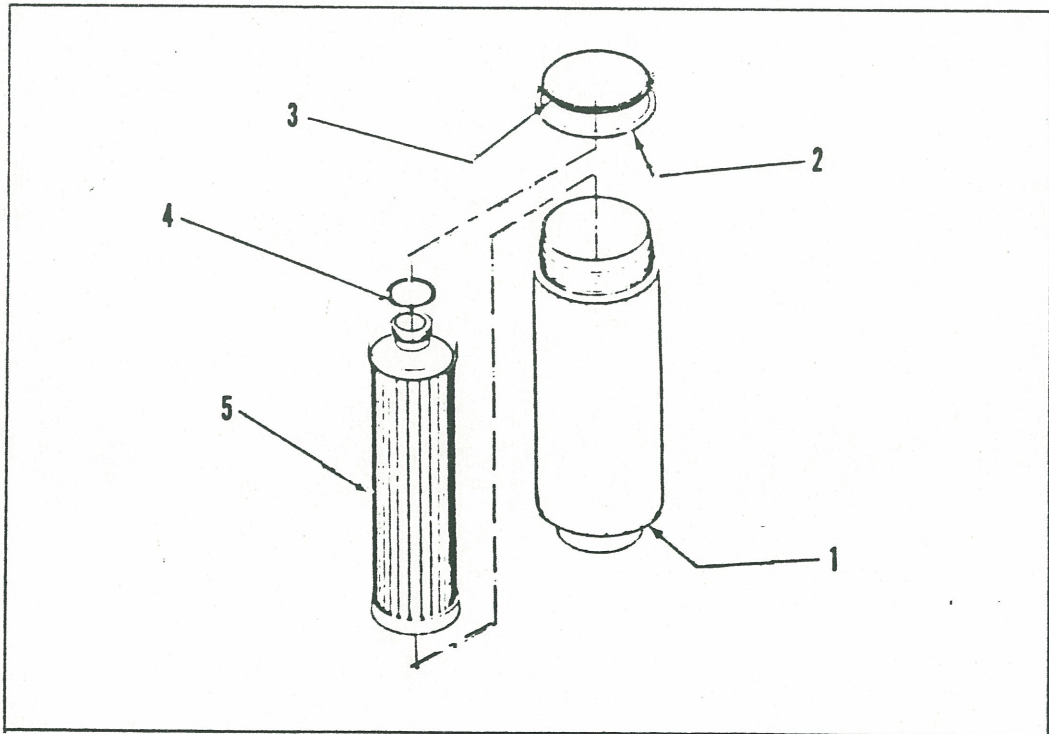


Figure 5-7. High Pressure Filter



(1) Unscrew the six bolts on top of the low pressure manifold that secure the low pressure filter shell (4) to the manifold.

(2) Remove filter elements (11).

(3) Wash shell in fuel oil and dry.

(4) Insert spring (8), spring retainer (9), rubber gasket (10), filter (11), gasket (10), spacer (12), gasket (10), filter (11), gasket (10) into filter shell (4).

(5) Place gasket (7) on filter shell and match boiler.

(6) Insert filter assembly into low pressure manifold and screw with six bolts.

5-29. HIGH-PRESSURE FILTERS INSPECTION. If the HP DIRTY indicator (14A, Figure 4-2) illuminates replace high-pressure filter (22, Figure 6-1) as follows (see Figure 5-7).

a. Unscrew filter shell (1) from high pressure HP manifold. (The shell is threaded at the top).

b. Unscrew filter element (5) from HP manifold.

c. Remove gasket (2), (3), (4) and discard.

d. Wash filter shell in fuel oil and dry thoroughly.

e. Install new gaskets (2) and (3) into HP manifold.

f. Install new gasket (4) on element. Screw element into HP manifold.

g. Screw filter shell (1) into HP manifold.

5-30. WARNING HORN. If the warning horn sounds during operation, isolate trouble as follows:

a. Check temperature gage (3). If fluid temperature exceeds +71°C (+160°F) proceed as follows:

NOTE

If fluid temperature is below +71°C (+160°F), skip to step b.

- (1) Verify that cooler bypass valve (21) is closed.
- (2) Verify that SYSTEM RELIEF (17) valve is properly adjusted.
- (3) Open system BYPASS valve (21).
- (4) Press SYSTEM FILL valve (14) to introduce cool fluid from stand reservoir into the system.
- (5) Operate system with SYSTEM FILL VALVE (14) open until fluid temperature drops below +54°C (+130°F).
- (6) Release SYSTEM FILL valve (14) and proceed with tests.

b. Check boost pressure in both systems as follows:

- (1) Turn GAGE SELECTOR valve (14, Figure 4-3) to boost outlet position.
- (2) Check boost PRESSURE gage (19). If boost pressure is below 75 psig, immediately shut down the stand and troubleshoot the applicable system.

c. Check fuel level. Add fuel as required. If fuel level is



satisfactory, check low fuel level warning switch. Replace if defective.

d. Check engine coolant temperature gage. If gage reads above 220°F, refer to Table 5-1 Troubleshooting.

e. Check engine oil pressure gage. If gage reads 4 psi or less, refer to Table 5-1 Troubleshooting.

f. If all gage reading are within limits, check the faulty switches. Refer to Fig. 4-4.

5-31. CALIBRATION. Calibration of the entire Test Stand is not possible. Instruments which appear inaccurate or erratic during operation shall be individually calibrated as described in 5-20 thru 5-25 paragraphs.

5-32. HIGH PRESSURE GAGE. This output pressure gage can be zero adjusted with an adjusting screw on the face of the gage. Loosen knob on bottom of gage face to open front ring. Calibration shall be as follows:

a. Connect suitable 0-6000 psig standard test gage to high pressure test port on control panel.

b. Operate Test Stand and compare Stand gage and testing gage readings at various pressures. The Test Stand gage must agree with the test gage within 1 percent full scale plus standard gage tolerance. If Test Stand gage readings are inaccurate or erratic, replace gage.

c. The gage may also be checked by connecting a test gage and hydraulic pressurizing equipment to the test port. The high pressure gage shutoff valve must be closed to isolate the stand gage and test gage from the hydraulic system. Thus hydraulic pressure may be applied to the gages to compare readings for calibration.



5-33. LOW PRESSURE GAGE. This gage shall be zero-adjusted and calibrated in the same manner as the high pressure gage (paragraph 5-18). Use low pressure test port on control panel. Isolate low pressure gage by turning selector valve on control panel to OFF position. Gage shall read within two percent full scale of test gage, plus test gage tolerance.

5-34. FLOWMETER. Calibration of the flowmeter, is not required as it is used for indication, only. However, the accuracy of the fluid volume indicated on the flowmeter may be confirmed by connecting a calibrated test flowmeter in the suction return line of the Test Stand. Operate Stand accordingly.

5-35. FLUID TEMPERATURE GAGE. This gage is equipped with five-foot capillary tube and a sensing bulb. To calibrate, proceed as follows:

- a. Disconnect sensing bulb at thermowell.
- b. Place bulb and a test thermometer of known accuracy in a well agitated constant-temperature bath. Place bulb and thermometer as close together as possible.
- c. The bath must be situated at an elevation relative to that of the thermowell, with the bath temperature approximating the mid-point reading of the gage.
- d. Allow approximately five minutes before comparing the temperature reading of the gage with that of the test thermometer.
- e. If readings do not agree, remove face of gage and adjust-pointer to indicate the correct temperature.
- f. Calibration is not required, provided reading is compared with and instrument of known accuracy.

5-36. HOURMETER. To verify the accuracy of the hourmeter, record a

specific period of operating time and compare the reading on the hour-meter with that of a standard meter of known accuracy. Replace hour-meter if not correct. Calibration is not required.

5-37. TEST. Bench Testing of individual components is not applicable to this equipment.

## SECTION VI

### DIAGRAMS

6-1.       GENERAL.   This section provides the diagrams and wire lists necessary for troubleshooting, maintenance and repair of the Test Stand. The Diagram for the Test Stand are as follows:

|                   |            |
|-------------------|------------|
| Hydraulic Diagram | Figure 6-1 |
|-------------------|------------|

|                    |            |
|--------------------|------------|
| Electrical Diagram | Figure 6-2 |
|--------------------|------------|



Key to Figure 6-2

|      |                            |      |                                       |
|------|----------------------------|------|---------------------------------------|
| 1AH  | Horn                       | PL4  | Panel Light                           |
| AMP  | Ammeter                    | PL5  | Panel Light                           |
| 1BT  | Battery, 24 VAC            | PL6  | Light, Panel, Filter, High<br>Delta P |
| 2BT  | Battery, 24 VAC            | PS1  | Pressure Switch, Filter               |
| CB1  | Circuit Breaker, 30A       | PS4  | Pressure Switch, Low Boost            |
| CB2  | Circuit Breaker, 10A       | PS7  | Pressure Switch, Engine Oil           |
| G1   | Gage, Fuel Level           | R1   | Relay                                 |
| G2   | Gage, Oil Temperature      | S1   | Switch, Main Power                    |
| LS1  | Level Switch, Low Fuel     | S2   | Switch, Panel Light                   |
| MTR1 | Motor Starter              | S3   | Override (Horn Disable)               |
| MTR2 | Fill Motor                 | SOL1 | Solenoid, Starter                     |
| PB1  | Pushbutton Switch, Starter | SOL2 | Solenoid, Fill                        |
| PB2  | Pushbutton Switch, Fill    | SU1  | Sending Unit, Fuel Level              |
| PL1  | Panel Light                | SU2  | Sending Unit, Oil Temperature         |
| PL2  | Panel Light                | TS1  | Temperature Switch, High Oil          |
| PL3  | Panel Light                | TS4  | Temperature Switch, Engine            |



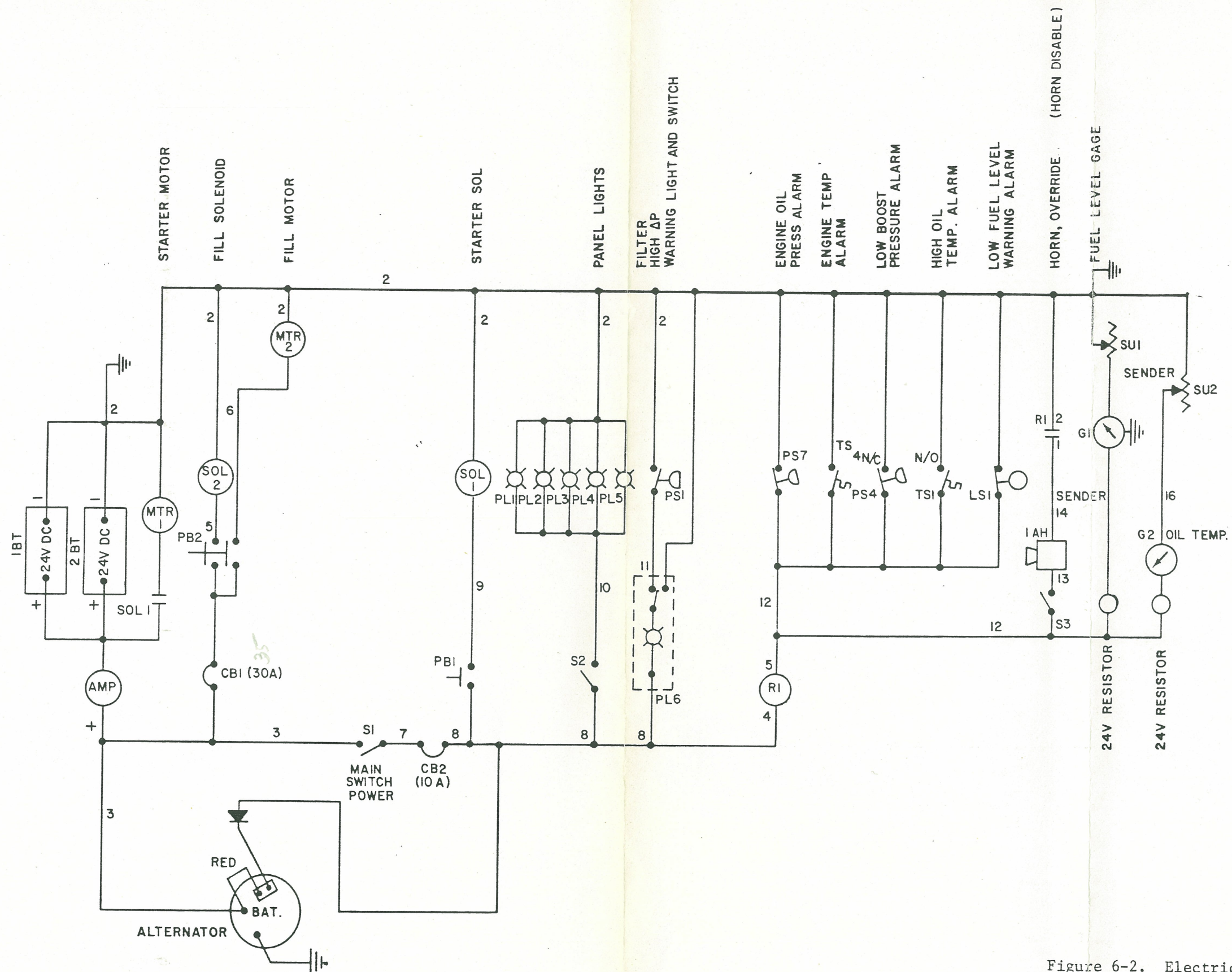


Figure 6-2. Electrical Schematic



## SECTION VII

### RECOMMENDED LIST OF SPARES

7-1. The following provides a listing of spare parts recommended to support the MJ-1 test stand in normal service.

| <u>Part Number</u> | <u>Description</u>            |
|--------------------|-------------------------------|
| AC-9516F-1         | H.P. Filter Software Kit      |
| AN 6235-4A         | Element, Fill Filter          |
| AN 6236-2          | Filter Element, L.P.          |
| B-43ZF2            | Gage, Selector Valve          |
| DB-1296            | Core, Oil Cooler              |
| D43920-3           | Cable, Throttle               |
| D43920-3           | Cable, Shutdown               |
| G605-12-A-1        | Gage, Liquid Level, Hydraulic |
| KD1-10             | Fuse                          |
| MS 25331-6         | Light, Filter Warning         |
| MS 35058-22        | Switch, Toggle                |
| T-553              | Fuel Filter                   |
| Z210S1             | Valve, Fluid Sampling         |
| 1A30-R-60S         | Relief Valve, H.P.            |
| 10250T101-2        | Pushbutton Switch, Fill       |
| 109-CP-04          | Selector Valve, Reservoir     |
| 1300103            | Solenoid Motor                |
| 150-906            | Relay, Horn                   |
| 1582149            | Cable, Tachometer             |
| 17390              | Fan Belts (2)                 |
| 20313              | Solenoid Valve, Fill          |
| 25010971           | Oil Filter                    |
| 284-K              | Gage, Oil Temperature         |
| 3C60-S             | Check Valve, Fill             |



Part NumberDescription

|           |                               |
|-----------|-------------------------------|
| 50053-1   | Seal Kit, Pump                |
| 5237-347  | Tire                          |
| 5658116   | Tach/Hourmeter                |
| 60007-1   | Light Bulb, D.C.              |
| 60008-1   | Light Bulb, D.C.              |
| 60016-1   | Circuit Breaker, D.c.         |
| 6426397   | Sender, Fuel                  |
| 7-50-10   | Inner Tube                    |
| 8223704-1 | Gasket, Filter Element        |
| 8223706-1 | Gasket, Filter Housing        |
| 8223714-1 | Relief Valve, L.P.            |
| 8223715-1 | Relief Valve, Thermal         |
| 8223717-1 | Valve, Bleed                  |
| 8223718-1 | Sight Glass, Sight, Oil       |
| 8223719-1 | Valve, Throttling             |
| 8223720-1 | Check Valve, Low Pressure     |
| 8223722-1 | Pressure Switch, Boost        |
| 8223723-1 | Switch, Temperature           |
| 8223725-1 | Gage, L.P.                    |
| 8223726-1 | Gage, H.P.                    |
| 8223727-1 | Gage, Temperature, Hydraulic  |
| 8223740-1 | Flowmeter Glass, Float, Guide |
| 8223762-1 | Pressure Gage, Duplex         |
| 8223769-1 | Pressure Switch, Differential |
| 8224616-1 | Switch, Low Fuel Level        |
| 82304     | Gage, Oil Pressure, Engine    |
| 82712     | Gage, Fuel                    |
| 829525-2  | Resistor                      |
| 8923909   | Sender, Oil Pressure, Engine  |
| 924789D2  | Water Temperature Gage        |



# MJ-X DRAWINGS

| DWG # | TITLE                           |
|-------|---------------------------------|
| 10016 | Internal Components             |
| 10017 | Gearbox/Pump Assembly           |
| 10018 | Diesel Engine Assembly          |
| 20023 | Frame, Lower, Mod               |
| 20024 | Frame, Mod                      |
| 30042 | Panel, Aux, Inst                |
| 30043 | Panel, Hyd, Inst                |
| 30044 | Control Panel Assembly          |
| 40184 | Bracket Gear Box                |
| 40185 | Drive Shaft Assembly            |
| 40187 | Panel, Aux (holes)              |
| 40188 | Bracket, Hyd Res                |
| 40189 | Bracket, Engine Support (rear)  |
| 40190 | Beam, Engine Support (front)    |
| 40191 | Braces, Radiator Support        |
| 40192 | Braces, Muffler                 |
| 40193 | Bracket, Fuel Tank              |
| 40194 | Beam, Engine Support (rear)     |
| 40195 | Flywheel Adapter                |
| 50068 | Fill Manifold/Solenoid Assembly |
| 50069 | Manifold Assembly               |
| 60022 | Pan Battery                     |
| 70008 | Electrical Schematic            |

The MJ-X was a one shot affair;  
one unit (mk-3 electric) converted to diesel. Went  
to Asia somewhere. Because it was <sup>only</sup> ~~one~~ one unit  
~~not~~ complete, methodical, record were not kept.  
~~made~~ made it out of spare parts lying around.





# APS Systems

July 1, 1985

FPI Industries, Inc.  
5333 McConnell Avenue  
Los Angeles, California 90066

FPI Industries:

On May 20, 1985, a customer of yours picked up an MJ-1 Hydraulic Test Stand Unit from APS Systems in Port Hueneme, California (reference your P.O. #11525C).

At the time of delivery, the Illustrated Parts Manuals were not ready. We would appreciate it very much if you would please forward the enclosed parts manuals to your customer, as the manuals are required to order parts.

Cordially,

ROBERT CHEVERES  
Technical Data Department

Enclosures

RC/pa