T.O. 33A2-2-30-111

TECHNICAL MANUAL

OPERATION AND MAINTENANCE INSTRUCTIONS ELECTRIC MOTOR DRIVEN DUAL HYDRAULIC SYSTEM PORTABLE TEST STAND – 440 VAC

TYPE MK-3A-1, MODEL 10001-10
PART NUMBER 8223450-1
NSN 4920-01-126-2039

TYPE MK-3A-3, MODEL 10001-30
PART NUMBER 8223450-3
NSN 4920-01-192-5527

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SECTION I
INTRODUCTION AND GENERAL INFORMATION

1-1. INTRODUCTION. This publication is the base manual of Operation and Maintenance Instructions for the Aircraft Hydraulic System (Double) Test Stand, Electric Motor Driven, designated by the USAF as Type MK-3A-1, NSN 4920-01-126-2039, Part Number 8223450-1 and the MK-3A-3, NSN 4920-01-192-5527, Part Number 8223450-3. Both systems are manufactured by APS Systems, California 93030(FSCM 6094).

The MK-3A-3 is a modified version of the MK-3A-1 with the capacity to produce higher hydraulic pressures. The operating procedures remain the same for both. User should check unit identification plate to confirm the model of Test Stand being used.

The Hydraulic System (Double) 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, there are no special tools or test equipment required.

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.

NOTE
For detailed disassembly and assembly instructions refer to instructions contained in T.O. 33A2-2-30-113 Overhaul Instruction Manual.

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

g. Section VII, Illustrated Parts Breakdown, refer to T.O. 33A2-2-30-114.

h. Section VIII, Difference Data Sheets, are not applicable to this manual.

i. Alphabetical Index is not applicable to this manual.

1-3. RELATED PUBLICATIONS. The following publications are applicable to the instructions in this manual.

a. T.O. 33A2-2-30-113, Overhaul Instructions, Aircraft Hydraulic System Test Stand, Electric Motor Driven.

b. T.O. 33A2-2-30-114, Illustrated Parts Breakdown, Aircraft Hydraulic System Test Stand, Electric Motor Driven.

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 aircraft systems for internal and external leakages.

c. Drain, flush, and refill 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 rear of Test Stand facing toward the tow bar at front.

1-6. The Test Stand (refer to Figure 1-1), incorporates two independently operated and separately controlled hydraulic systems designated as system No. 1 (Red) and No. 2 (Yellow). Each system has the same capabilities. Power for the MK-3A-1 is supplied by individual 75 HP electric motors and for the MK-3A-3 by individual 93 HP electric motors.

Operator’s controls and instruments (1) are located at the rear of the Test Stand. These controls and instruments are functionally grouped, and color coded on the control panel as follows:
No. 1 – red (left side)
No. 2 – yellow (right side)
External test connections (2) are located on top of the Test Stand for connection to the aircraft. Hose retainer hooks (3) are provided on front of Test Stand to store hoses. Run around connections (6) are provided at front of unit to allow checkout without connecting to an aircraft.

1-7. 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 lifted by inserting a forklift under the unit frame at marked channels. The major components and systems of the Test Stand are as follows: trailer and gear, housings, electric motors, main hydraulic reservoir, hydraulic filters, instruments and controls and the electrical system.

1-8. DETAILED DESCRIPTION. (See Figure 1-2)

1-9. TRAILER AND RUNNING GEAR ASSEMBLY (1). The trailer frame is of welded steel construction. The trailer rolls easily on four steel wheels equipped with 6.90 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 Test Stand and towing.

The front wheel steering is of the conventional type with steering knuckles, tie rods, and kingpins. 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 in both the front and rear of the trailer frame to permit tie-down 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 also provided for the oil cooler (5, Figure 1-2). The tool box (6) is at the left front side of the Test Stand.

1-11. ELECTRIC MOTORS. (See Figure 1-2). Power for each Test Stand system is supplied as follows:

a. MK-3A-1. The MK-3A-1 power is supplied by a 75 HP, 440-volt, 3 phase, 60 cycle. 1760 rpm electric motor (24) directly coupled to main pump (25).

b. MK-3A-3. The MK-3A-3 power is supplied by a 93 HP, 440-volt, 3 phase, 60 cycle, 1760 rpm electric motor (24) with a two-step start split winding (see Electrical System paragraph 1-21). The motor is directly coupled to a main pump (25).

1-12. MAIN HYDRAULIC PUMPS. (25, Figure 1-2) The main hydraulic pump supplies fluid at high pressure for testing of aircraft hydraulic circuits. Each pump consists of a high-pressure pump section and integral boost pump section. The pump contains a manual volume control for varying the output volume and a compensator control 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 system. 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 threaded mechanism within the pump. The return line for the test system also includes a flowmeter (26) 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 (see figure 4-5) is mounted on the pump control panel. This calibration curve is used for converting flowmeter indications at fluid temperatures other than 100 degrees F.

1-13. HYDRAULIC FLUID RESERVOIR. (21, Figure 1-2) The 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 system. A filler neck (22) and cleanout cover (23) is located on the end of the reservoir allowing manual filling. A fluid level indicator (28) of the sight glass type is also provided on the control panel.

CAUTION

(MK-3A-3) For B-1 bomber operations do not fill hydraulic reservoir pass the 30-gallon mark. The airspace is required for fluid recovery.

1-14. OIL COOLER. (5. Figure 1-2) The oil cooler consists of a heat exchanger type cooler with a cooling fan (7). The cooling fan is driven by an electric motor (8). The fan draws air through the cooler for cooling the hydraulic oil. Air is exhausted through openings in the cabinet. The oil cooler has separate heat exchanger sections for each hydraulic system.

1-15. HIGH PRESSURE FILTERS. (9, Figure 1-2) A filter is located in each output line of the system. Five-micron filter elements give 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 FILTERS. (10, Figure 1-2) A 10-micron low pressure filter in the outlet line from each 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. The filters are readily maintained through the access doors for replacement of their filtering elements. Drains are provided for the low-pressure filters.

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 operating 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 filing operations.

1-18. BLEED SYSTEM. (See Figure 1-2) Each Test Stand hydraulic system incorporates a pushbutton bleed valve (29) to bleed air from the system. Air and oil are 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.

NOTE

Remove caps on manifold valve high-pressure connections prior to operating valve. Caps have been installed to protect against spool wear when valve is not in use. Install caps under steel tubing nuts and safety wire manifold valve handle in OFF position when valve is not in use.

1-19. MANIFOLD VALVE SYSTEM. With the manifold valve in the ON position the flow of the pressure lines of both systems is connected and so is the flow of the return lines with total flow being available at either of the stand outlet and return connections.

1-20. 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. Thermo switch (11) in the high-pressure pump inlet circuit actuates to sound a warning horn when the fluid temperature reaches 160-

170 degrees F. Either of the two thermo-switches will energize the warning horn. Thermal relief valve (5) relieves line pressure (after shutdown) caused by hot outside temperature. The valves open at 250 psi for the MK-3A-1 and 275 psi for the MK-3A-3.

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 motor will shut off.

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 valves (20, 34, 47) 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 over-pressurization by the air compressor (37).

KEY TO FIGURE 1-2

1. Trailer and Running Gear Assembly	13. Air Compressor	25. Main Pump
2. Hinged Tow-bar	14. Motor, Compressor	26. Flow Meter
3. Hand Brake Lever	15. Air Receiver	27. Selector Valve
4. Tie Down Rings	16. Unloader Valve	28. Level Indicator
5. Oil Cooler	17. Pressure	29. Valve, Filter Bleed
6. Toolbox	18. Pressure Gage	30. Warning Horn
7. Cooling Fan	19. Relief Valve	31. Electrical Controls
8. Fan Motor	20. Air Filter	32. Tire and Wheel
9. HP Filter	21. Reservoir, Hydraulic	
10. LP Filter	22. Filler, Hydraulic	
11. Fill Pump	23. Cover, Reservoir	
12. Filter, Fill	24. Main Motor	

h. Circuit breakers (Figure 6-2/MK-3A-1 and Figure 6-2A/MK-3A-3) are provided for overload protection of various circuits. Motor starters are provided with thermal overloads to protect against overcurrent.

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

1-21. ELECTRICAL SYSTEM. (See Figure 6-2/MK-3A-1 and Figure 6-2A/MK-3A-3) The Electrical system provides the circuits and controls for Test Stand functioning of electrical components. The electrical system's controls are mounted on a panel at the side of the Test Stand with a hinged access door to permit facility of maintenance and inspection. The Test Stand is designed to operate on 440 volts AC, 3 phase, 60 cycle. Circuit breakers (CB1, CB2, CB3, CB4, and CB5) are incorporated in the line power circuit for motor protection.

The main pump motor (B1 and B2) are designed for across-the-line starting on the MK-3A-1 and for two-step part winding start on the MK-3A-3. Magnetic contractors M1 and M2 directly start the motors on the MK-3A-1 unit. On the MK-3A-3-unit magnetic contractors M11 and M21 energize part of the motor windings at the start. After a three second time delay (initiated by time delay relays (K1 and K2) contractors M12 and M22 are automatically energized to power the remainder of the motor windings. During full load operation of the main motors current is equally shared by the two sets of contractors. The cooler fan motor (B3), air compressor motor (B4) and fill pump motor. (B5) are started by magnetic contractors (M3, M4, and M5) across the line.

All contractors are furnished with overload heater coils and automatic resets. A reverse phase relay (RP) is incorporated in the circuit to protect the motors from damage by improper wiring. A control transformer (T1) is used to provide 110-volts to the motor control circuits. Motor start pushbutton and switches are mounted on the instrument and control panel at the rear of the Test Stand. An elapsed time meter (HM1) is mounted on the instrument panel to record Test Stand Operating hours. A warning horn (AH1) provides audible warning in the event of high fluid temperatures in either system. 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 PL9).

1-22. PNEUMATIC SYSTEM (See Figure 6-1) The pneumatic system consists of an air compressor (37), motor (36) and air receiver (38) with a drain valve (39). The system includes an unloader relief valve (40), for unloading the air compressor when receiver is fully charged, a pressure regulator (41), shut-off valve (42), pressure gage (43), relief valve (40) set at 100 psig for the outlet, and 60 psig for the reservoir, and an air filter (45).

1-23. TABLE OF LEADING PARTICULARS. Refer to Table 1-1 for the table of leading particulars.

1-24. CONSUMABLE MATERIAL LIST. Refer to Table 1-1-2 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 degrees F
Storage . . . . . -65 degrees F to 160 degrees F
Relative Humidity . . . . . 100 percent
Inclination . . . . . .8 ½ degrees maximum in any direction
From horizontal operating plane
HYDRAULIC SYSTEMS
Fluid Reservoir
Capacity (at incline of 8 ½ degrees) . . . . . 30 Usable U.S. gallons (MK-3A-1)
60 Useable U.S. gallons (MK-3A-3)
Material . . . . . Stainless Steel
Hydraulic Fluid MIL-H-5606/MIL-H-83282
Type. . . . . High-pressure, axial position, variable-stroke, pressure
Compensated with integral low pressure boost section.

MK-3A-1
Capacity (each). . . . . 0-35 gpm up to 3000 psig
0-15 gm up to 5000 psig
Capacity (2 system running). . . . . 70 gpm up to 3000 psig
30 gpm up to 5000 psig
Discharge pressure (each). . . . . 2700 $\pm$ 50 psig when delivering 35 gpm with zero flow.
pressure setting at 3000 psig.
MK-3A-3
Capacity (each). . . . . 0-35 gpm up to 5000 psig
0-15 gpm up to 5000 psig
Capacity (2 system running) . . . . . 70 gpm up to 4000 psig
30 gpm up to 5000 psig
Discharge Pressure (each). . . . . 3600 $\pm$ 50 psig when delivering 35 gpm with zero flow.
Pressure setting at 4000 psig.
Boost pump capacity . . . . . 40 gpm up to 200 psig
Fill Pump
Type. . . . . Motor driven internal gear.
Capacity (MK-3A-1). . . . . 2 gpm at 150 psig
Capacity (MK-3A-3). . . . . 2.5 gpm at 250 psig
High Pressure Filters
Rating. . . . . 35 gpm at 5000 psig
Size of element. . . . . 5 microns
Specification MIL-F-27656

Table 1-1. Leading Particulars – Continued

Low Pressure Filters	
Element	10-micron, two element filter AN6236-3
Fill/Filter Element	10-micron, single element filter AN6235-4A
Oil Cooler	
Type	Air-to-oil, fan cooled, electric motor driven.
Capacity	Two section 140 degrees F maximum with 35 gpm at 750 psig and 100 degrees F ambient air temperature
Power Plant	
Main Pump Motor (2) (MK-3A-1)	75 HP, 1760 rpm, 440-volt, 3 phase, 60 Hz AC
Main Pump Motor (2) (MK-3A-3)	93 HP, 1760 rpm, 440-volt, 3 phase, 60 Hz AC
Controls and Instrumentation	Panel mounted convenient to operate, identified by name plates.
Pneumatic System	
Compressed Air System Pressurizing	
Aircraft Reservoir	150 psig
Test Stand Reservoir	100 psig
Capability	3 scfm at 150 psig
Air Pressure Gages	0-100 psig $\pm$ 5%
Relief Valve	
Outlet	110 psig
Reservoir	60 psig
Air Receiver	0.25 Cu. ft.
Capacity Pressure	150 psig
Working Proof Pressure	300 psig
Filter Element	AN6235-4A
Compressor Motor	440-volt, 3 phase, 60 Hz
Lubrication	
Running Gear (Wheel Bearings)	MIL-G-10924
Miscellaneous (Door Hinges, Steering and Braking Mechanism)	MIL-L-15016A
Air Compressor	MIL-L-2104
Trailer and Cabinet	
Construction	Welded steel
Wheels	Four pneumatic tires, 6.90 X 9 inch
Springs	Leaf Type
Brake	Hand operated, mechanical type on rear wheels
Steering	Knuckle type on front wheels; with tow-bar and pintle hook
Cabinet	Metal enclosure with access panels; hinged doors; hose storage; weather-resistant properties

Table 1-1. Leading Particulars – Continued

Physical Data
Dimensions (Approximate)
Length . . . . . 108 inches
Width . . . . . 70 ½ inches
Height . . . . . 74 inches
Weight (dry) (MK-3A-1) . . . . . 5100 pounds
Weight (dry) (MK-3A-3) . . . . . 5500 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
Glue, Epoxy	Devcon 5 Minute Epoxy Devcon Corp., Danvers, MA 01923
Grease	MIL-G-18790
Grease, automotive	MIL-G-10924
Lubricant	MIL-L-2104 or MIL-L-10324
Paint, external enamel	MIL-STD-808, Code No. DG
Paint, exterior enamel Control panel No.1	FED-STD-595, color 31135 (Red)
Paint, exterior enamel Control panel No. 2	FED-STD-595, color 33538 (Yellow)
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, fill system filter	AN6235-4A
Element, boost system filter	AN6236-3
Sealant	VC-3
Solvent, cleaning	P-D-680, Type II
Solvent, mineral spirits	MIL-C-12491
Tape, water resistant, pressure sensitive	PPD-T-60
Tape, Teflon	MIL-T-27730
Solder	QQ-S-571

SECTION II

SPECIAL TOOLS AND TEST EQUIPMENT

2-1. SPECIAL TOOLS AND TEST EQUIPMENT. There are no special tools or test equipment required.

SECTION III

PREPARATION FOR USE AND SHIPMENT

3-1. INTRODUCTION. The information contained in this section describes the installation functional testing, adjustments, and procedures necessary to prepare the Test Stand for use. Also, included, are procedures 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 waterproof tape from seams, doors and other openings of cabinet, and strip masking tape from all glass gage faces.

b. Open all cabinet doors and thoroughly inspect interior of Test Stand. 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 complete Test Stand for possible damage which may have occurred during shipment. The following initial inspection procedures are recommended:

a. Check data appearing on 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 hose assemblies from inside of Test Stand. Inspect 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 Test Stand.

c. Open 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 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 electrical wiring for broken wires or frayed insulation. Check that all electrical connections are secure.

f. Inspect oil reservoir for evidence of physical damage during shipment.

g. Check tires for proper inflated pressure. Normal tire pressure should be 60 ±5 psi with tires cold. Inspect tire treads and casings for cuts or abrasions and remove any imbedded objects from treads.

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

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

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

3-5. SERVICING HYDRAULIC SYSTEM. To service the hydraulic system for use, proceed as outlined in the following steps.

a. Position Test Stand convenient to a 440-volt, 3 phase, 60 Hz power outlet.

b. If hydraulic fluid reservoir (21, Figure 1-2) has been filled with a preservative fluid for shipment, drain reservoir by opening reservoir drain valve at bottom of reservoir. Make certain drain valve is closed after reservoir has been completely drained.

c. Drain preservative fluid (if necessary) from hydraulic system at each filter drain for low pressure filters. When completely drained, replace drain caps.

d. If necessary, drain preservative fluid from each high-pressure pump (25) by removing drain plug located in bottom of pump case. When completely drained, replace plug. Refill pump case with hydraulic fluid, Military Specification MIL-H-5605/MIL-H-83282.

e. Connect power cord plug to a 440-volt, 3 phase, 60 Hz outlet. Place master switch and power-on switch, located on auxiliary control panel, in ON position.

f. Fill Test Stand reservoir at filler neck with hydraulic fluid, Military Specification MIL-H-5606/MIL-H-83282, until reservoir level gage indicates 3/4 to 7/8 full.

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

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

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

b. Drain hydraulic fluid from hydraulic system at low pressure filter drains (10). When completely drained, replace drain cap.

c. Drain fluid from high pressure pumps (25) by removing drain plug located in bottom of

each pump case. When completely drained, replace plug. Refill pump case with preservative fluid MIL-H-6083A.

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

e. Operate Test Stand (Section IV) for approximately 10 minutes. Operate systems
3-2 fill valves to fill each hydraulic system with preservative fluid MIL-H-6083A.

f. Disconnect input power cable from external power source and coil over hooks at front of stand.

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

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

i. Secure hoses on retainer hooks. Be sure all external hydraulic connections are capped.
Figure 3-1. Lubrication Chart

3-8. PREPARATION FOR SHIPMENT. The Test Stand does not require an external packing container.

SECTION V

MAINTENANCE INSTRUCTIONS

5-1. GENERAL. Maintenance of the Test Stand consist of periodic inspection, cleaning, service adjustments, 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. OPERATIONAL CHECKOUT. Check operation of Test Stand as follows:

a. Refer to paragraphs 4-8 through 4-12 and accomplish the preliminary operating procedures.

5-3. INSPECTION AND PREVENTATIVE MAINTENANCE. The complete inspection consists of periodic visual and operational checks together with all necessary minor adjustments to assure proper performance and coordination of assemblies, subassemblies, and component parts. Inspection requirement intervals are daily 100 hours and special. The service inspection shall be conducted in accordance with the Service Inspection Work-cards T.O. 33A2-2-1-166WC-2. The periodic inspection shall be conducted in accordance with the Periodic Inspection Work-cards T.O. 33A2-2-1-166WC-1.

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.

5-4. SERVICE INSPECTION. Service inspection shall be performed in accordance with Service Inspection Work-cards T.O. 33A2-2-1-166WC-1.

5-5. PERIODIC INSPECTION. Periodic inspection shall be performed in accordance with Service Inspection Work-cards T.O. 33A2-2-1-166WC-1.

5-6. PREVENTIVE 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.

5-7. LUBRICATION. Perform in accordance with Periodic Inspection Work-cards T.O. 33A2-2-1-166WC-1.

5-8 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
Main pump motor will not start	Power cable not connected	Reconnect properly
	Circuit breakers tripped to OFF/MAIN POWER/CONTROL POWER OFF	Rest switches to ON
	Incorrect power line phasing, causing reverse phase relay to remain inoperative	Correct power line phasing – red neon light on relay should come on (RPI, Figure 6-2)
	Wrong voltage applied; starters will not respond	Connect to specified power source 440-volt, 3 phase, 60 Hz. Reset starter buttons.
	Defective control circuit wiring components	Repair or replace defective wiring/components.
	HP pump inlet pressure bellow 40 psig	Press and hold pump start button until pressure builds up to 40 psig.
Main pump motors stop during operation	Overload; starters tripped off	Wait 30 seconds; press starter reset buttons, motor start button. If cut out, check for cause of overload condition; check heater coils in starter.
	Low boost pressure to high pressure pump	Check cause of pressure failure to high pressure pump.
		Filter element clogged. Fluid level indication low
	Defective low boost pressure switch (17, Figure 6-1)	Replace
Pump fails to deliver sufficient volume	Insufficient fluid supply. (Test Stand will shut down)	Fill reservoir to 25 gallons (minimum) level. Fill systems.

Table 5-1. Troubleshooting – Continued

Trouble	Probable Cause	Remedy
Pump fails to deliver sufficient volume – continued	Air in suction line	Tighten connections; bleed lines.
	Dirty, clogged boost pressure filter	Clean or replace elements.
	Pump volume control set too low	Adjust clockwise to increase volume.
Pump fails to deliver sufficient pressure	Low boost pump pressure (Stand will shut down)	Check boost pump pressure.
	Clogged low pressure and high-pressure filters	Check pressure difference between boost outlet and HP pump inlet gages for low pressure filter pressure drop. Check filter warning light for high pressure filter. Replace elements if necessary
	Pump compensator not set properly.	Reset
	High pressure relief valve set too low (dumping before compensator setting)	Reset
	High pressure bypass valve open	Close valve
	Defective high-pressure gage	Inspect and replace, if necessary
Noisy operation	Pump cavitating; insufficient fluid supply, low boost pressure, pump case not filled with fluid.	Check for adequate fluid supply boost pressure, check boost pressure filter; fill pump case with fluid. Use clean, filtered fluid

Table 5-1. Troubleshooting – Continued

Trouble	Probable Cause	Remedy
Noisy Operation – Continued	Air in system	Fill and Bleed
	Defective boost pump	Check and replace, if necessary
	Defective check valve (34, Figure 6-1) in high pressure line	Inspect and replace, if necessary
	Chattering high pressure relief valve (31, Figure 6-1)	Remove valve assembly, clean and replace worn or defective parts.
	Defective pump compensator	Repair or replace.
Control circuit inoperative	Control circuit fuse blown (FU1, Figure 6-2)	Replace fuse.
	Control Power switch off	Switch to ON.
	Main Power switch off	Switch to ON.
	Faulty control circuit transformer (XT1, Figure 6-1)	Test and replace, if necessary
	Incorrect power line phasing	Correct power line phasing, red neon light on relay should come on (RP1, Figure 6-2)
	Time relay faulty	Replace

Table 5-1. Troubleshooting – Continued

Trouble	Probable Cause	Remedy
HP filter warning light fails. Reflective lamps fail to light on “press to test”	Defective lamps	Replace
Hour meter does not register	Defective wire leads	Repair or replace.
	Defective instrument	Replace
Fill pump motor fails to start	Control power off	Connect power lines properly. Depress pushbutton.
	Circuit breaker overloads open or tripped (M5, Figure 6-2) (CB5, Figure 6-2)	Close circuit breaker and reset overloads.
Fill pump does not pump	Pump suction is dry, lost its prime	Introduce fluid to pump inlet
	Pump worn or damage	Repair or replace.
	Air leaks in suction line	Tighten all connections.
Fluid temperature too high	Fan motor not on	Turn on fan motor.
	Cooler bypass valve (47, Figure 6-1) open	Close valve clockwise
	Cooler clogged	Flush and clean
	Cooler fins clogged	Clean
Trailer does not track properly when being towed	Damaged or misadjusted steering apparatus, probably tie rods and tie rods ends	Adjust or replace tie rods and tie rod ends if there is evidence of damage. Keep wheels, wheel spindles, and steering apparatus lubricated.
Trailer does not brake properly	Worn brake linings	Adjust brakes for wear. Replace lining excessively

5-9. REPAIR. Refer to T.O. 33A2-2-30-113

5-10. GENERAL. This section contains essential repair and replacement instructions for using personnel.

5-11. DISASSEMBLY. Refer to T.O. 33A2-2-30-113.

5-12. COMPONENT REMOVAL AND INSTALLATION. When it is necessary to remove any component of the Test Stand, observe the following precautions and general practices: Refer to T.O. 33A2-2-30-113.

CAUTION

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

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 cable is disconnected from AC power source.

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.

e. After performing the necessary repairs, reinstall components in Test Stand in reverse order of removal.

f. After reinstalling components, perform a functional test as described in Section IV.

5-13. 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. For repair procedures not detailed here refer to Overhaul Manual T.O. 33A2-2-30-113.

Instructions for complete overhaul of components will be found in T.O. 33A2-2-30-113. Perform only those procedures necessary to make the required repair or part replacement.

5-14. 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.

Use approved personnel protective equipment (goggles, face shield) when using compressed air. Provide protection from flying particles. Do not direct airstream toward self or other personnel.

a. Clean all assembled components, except electrical parts and pre-lubricated bearings, with solvent, Federal Specification P-D-680, Type II. Use a stiff-bristle, non-metallic brush to ensure that all orifices, packing grooves, and ports are 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 areas for stripped, crossed, or broken threads. Inspect mounting holes for elongation which would affect component performance.

CAUTION

Do not use abrasive cloth, Federal Specification P-C-458, on aluminum or magnesium alloy parts, as it 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 preformed packings, back-up rings, gaskets, and seals, regardless of condition, each time a component is replaced.

f. During reassembly of hydraulic components, assemble parts dripping wet, dipping them in hydraulic fluid, Military Specification MIL-H-5606/MIL-H-83282.

g. Perform hydraulic component tests using a clean source of hydraulic fluid, Military Specification MIL-H-5606/MIL-H-83282 filtered to 10 microns or better.

5-15. REPAIR OR REPLACEMENT.

5-16. FILTERS. All systems filters are detailed in this section. Replace any damaged parts on these filters, especially O-rings. Do not attempt repair.

5-17. HIGH PRESSIRE PUMPS. Refer to T.O. 33A2-2-30-113 for overhaul instructions on this pump. If pump fails, return to depot for overhaul.

5-18. INSPECTION.

5-19. HYDRAULIC RESERVOIR INSPECTION.

NOTE

Inspection is required per Periodic Inspection Work cards, T.O. 33A2-2-1-166WC-1. Do not operate Test Stand for one hour or more prior to inspection of the hydraulic reservoir.

a. Remove reservoir drain cap and drain out approximately one gallon of fluid. This will remove water and/or other contaminates collected in reservoir sump. If fluid still shows visible evidence after draining a minimum of one gallon of fluid, flush system, drain and clean reservoir.

b. Refill with hydraulic fluid conforming to Military Specification MIL-H-5606/MIL-H-83282.

NOTE

If Test Stand is operated in a hot humid climate, remove reservoir drain cap and check for water every 15 days.

5-6

5-20. REPAIR OF MOTOR STARTERS. Repair of motor starters and contactors should be generally limited to replacement of contact coils, overload relays, and heaters. Coils should be replaced if they show evidence of overheating or other defects that may cause eventual failure during operation. Contacts are silver plated and are still serviceable even though discolored or pitted. Replacement of contacts is necessary only when silver contact surface has worn thin. Contacts are supplied in kits. Replace all contacts contained in kit at one time. Observe the following during starter repair:

CAUTION

Do not file contacts as contact material and correct alignment will be destroyed.

a. Remove coils by removing coil leads and magnet screws, then remove magnet assembly and slip out coil; replace in reverse order.

b. Remove heaters by removing attaching screws and withdrawing from starter; replace in reverse order.

c. Remove contacts by first removing arc box and cross bar, then twisting out moving contacts and unscrewing stationary contacts. Replace in reverse order.

5-21. CALIBRATION. Calibration of the entire Test Stand as a unit is not possible. However, when testing aircraft system or functionality testing the unit, gages and instruments shall be checked for operation. Gages or instruments appearing inaccurate or erratic during operations shall be individually verified with an instrument of known accuracy. The use of an AFTO form 108 is not required.

5-7

5-22. 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.

5-23. LOW PRESSURE GAGE. This gage shall be zero-adjusted and calibrated in the same manner as the high-pressure gage (paragraph 5-22). Use low pressure test port on control panel. Isolate low-pressure gage by turning gage selector valve on control panel to OFF position. Gage shall read within two percent full scale of test gage, plus test gage tolerance.

5-24. FLOWMETER. Calibration of 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.

5-25. FLUID TEMPERATURE GAGE. This gage is equipped with a 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 midpoint readings of the gage.

d. Allow approximately five minutes before comparing temperature reading of gage with that of test thermometer.

e. If readings do not agree, remove face of gage, and adjust pointer to indicate correct temperature.

f. Calibration is not required, provided reading is compared with an instrument of known accuracy.

5-26. 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. Diagrams for the Test Stand are as follows:

Hydraulic Diagram	Figure 6-1
Electrical Diagram	Figure 6-2 (MK-3A-1)
Electrical Diagram	Figure 6-2A (MK-3A-3)

KEY TO FIGURE 6-2 (MK-3A-1)

1. Warning Horn
2. Main Pump Motor, System No. 1
3. Main Pump Motor, System No. 2
4. Cooler Fan Motor
5. Air Compressor Motor
6. Fill Pump Motor
7. Circuit Breaker, System No. 1
8. Circuit Breaker, System No. 2
9. Circuit Breaker, Fan Motor
10. Circuit Breaker, Air Compressor
11. Circuit Breaker, Air Compressor
12. Filter Pressure Switch, No. 1
13. Filter Pressure Switch, No. 2
14. Fuse, Transformer
15. Hour meter
16. Motor Starter, No. 1
17. Motor Starter, No. 2
18. Motor Starter, Fan Motor
19. Motor Starter, Fill Pump
20. Motor Starter, Fill Pump
21. Overload, Main Motor, No. 1
22. Overload, Main Motor, No. 2
23. Overload, Fan Motor
24. Overload, Air Compressor Motor
25. Overload, Fill Pump Motor
26. Pushbutton, Main Motor Start No. 1
27. Pushbutton, Main Motor Start No. 2
28. Pushbutton, Main Motor Stop No. 1
29. Pushbutton, Main Motor Stop No. 2
30. Pushbutton, Fill, System No. 1
31. Pushbutton, Fill, System No. 2
32. Pressure Switch, Low Boost No. 1
33. Pressure Switch, Low Boost No. 2
34. Light, Filter Warning, System 1
35. Light, Filter Warning, System 2
36. Light, Panel
37. Relay, Phase Reverse
38. Switch, Fan Motor
39. Switch, Air Compressor
40. Switch, Panel Lights
41. Switch, Main Power
42. Solenoid, Fill, System No. 1
43. Solenoid, Fill, System No. 2
44. Temperature Switch, No. 1
45. Temperature Switch, No. 2
46. Control Transformer

KEY TO FIGURE 6-2A (MK-3A-3)

1. Warning Horn
2. Main Pump Motor, System No. 1
3. Main Pump Motor, System No. 2
4. Cooler Fan Motor
5. Air Compressor Motor
6. Fill Pump Motor
7. Circuit Breaker, System No. 1
8. Circuit Breaker, System No. 2
9. Circuit Breaker, Fan Motor
10. Circuit Breaker, Air Compressor
11. Circuit Breaker, Fill Pump
12. Filter Pressure Switch, No. 1
13. Filter Pressure Switch, No. 2
14. Fuse, Transformer
15. Hour meter
16. Motor Starter, No. 11
17. Motor Starter, No. 12
18. Motor Starter, No. 21
19. Motor Starter, No. 22
20. Motor Starter, Air Compressor
21. Motor Starter, Fill Pump
22. Motor Starter, Fill Pump
23. Overload, Main Motor, No. 11
24. Overload, Main Motor, No. 12
25. Timer Relay K1
26. Overload, Main Motor, No. 21
27. Overload, Main Motor, No. 22
28. Timer Relay K2
29. Overload, Fan Motor
30. Overload, Air Compressor Motor
31. Overload, Fill Pump Motor
32. Pushbutton, Main Motor Start No. 1
33. Pushbutton, Main Motor Start No. 2
34. Pushbutton, Main Motor Stop No. 1
35. Pushbutton, Main Motor Stop No. 2
36. Pushbutton, Fill System No. 1
37. Pushbutton, Fill System No. 2
38. Pressure Switch, Low Boost No. 1
39. Pressure Switch, Low Boost No. 2
40. Light, Filter Warning, System 1
41. Light, Filter Warning, System 2
42. Light, Panel
43. Relay, Phase Reverse
44. Switch, Fan Motor
45. Switch, Air Compressor
46. Switch, Panel Lights
47. Switch, Main Power
48. Solenoid, Fill System No. 1
49. Solenoid, Fill System No. 2
50. Temperature Switch, No. 1
51. Temperature Switch, No. 2
52. Control Transformer

SECTION VII

ILLUSTRATED PARTS BREAKDOWN

Refer to T.O. 33A2-2-30-114 for the Illustrated Parts Breakdown for the MK-3A-1 Test Stand.

7-1 (7-2 blank)