TECHNICAL MANUAL

OPERATOR'S, UNIT AND DIRECT SUPPORT MAINTENANCE MANUAL (INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST) FOR

JET FUEL THERMAL OXIDATION TESTER

JFTOT MODEL 215

This technical manual is an authentication of the manufacturer's commercial literature and does not conform with the format and the content requirements normally associated with Army technical manuals This technical manual does, however, contain all essential Information required to operate and maintain the equipment

Approved for public release; distribution is unlimited.

HEADQUARTERS, DEPARTMENT OF THE ARMY
28 SEPTEMBER 1990

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SUPPLEMENTARY INTRODUCTORY MATERIAL

1-1 Maintenance Forms and Records

Department of the Army forms and procedures used for equipment maintenance will be those described by DA Pam 738-750, The Army Maintenance Management System

1-2 Reporting Errors and Recommending Improvements.

You can help Improve this manual. If you find any mistakes or If you know of a way to Improve the procedures, please let us know. Mail your letters, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located In the back of this manual, directly to Commander, U.S Army Troop Support Command, ATTN AMSTR-MCTS, 4300 Goodfellow Blvd., St. Louis, MO 63120-1798 A reply will be furnished to you

1-3 Destruction of Army Material to Prevent Enemy Use.

Refer to TM 750-244-3 for Instructions covering the destruction of Army Material to prevent enemy use

1-4 Administrative Storage of Equipment.

a Placement of equipment in administrative storage should be for short periods of time when a shortage of maintenance effort exists. Items should be in mission readiness within 24 hours or within the time factors as determined by the directing authority. During the storage period appropriate maintenance records will be kept.

b. Before placing equipment In administrative storage, current preventive maintenance checks and services should be completed. Shortcomings and deficiencies should be corrected, and all modification work orders (MWO's) should be applied

c Storage site selection Inside storage is preferred for Items selected for administrative storage. IfInside storage is not available, trucks, vans, conex containers and other containers may be used

REPORT NO. 75-168, REV. A

MAINTENANCE MANUAL
ALCOR Jet Fuel Thermal Oxidation Tester (JFTOT)

ASTM Designation D-3241-86T

10130 Jones Maltsberger Road * San Antonio, Texas 78284 * Tel 512/ 349-3771 * TLX 767470

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LIST OF FIGURES

1. INTRODUCTION

1 1 This manual presents detailed information on the function of the various systems to aid in the maintenance of the ALCOR Jet Fuel Thermal Oxidation Testers (JFTOT) Model 215 with electronic pressure transducer.

1.2 Incorporated in ALCOR JFTOT's are standard commercial items such as the temperature indicator-controller, SCR power control, timer, recorder, transducer, etc. The manufacturers of these standard items furnish information on the maintenance and repair of their items in their publications, which are also furnished together with each new JFTOT. For example, Honeywell, the manufacturer of the JFTOT temperature indicator-controller, offers international service and therefore their local office can be contacted for repair and maintenance assistance when required.

1 3 Additional information on maintenance is given in the Appendix of the ASTM Test Method for the JFTOT, ASTM, D-3241. Specifically, paragraph A.5.1 autocall Calibrator Tin Replacement and A.5 2 Thermocouple Replacement and Position Adjustment will be found useful.

1.4 All maintenance required for the JFTOT is primarily on the "as required" basis, except for the lubrication of the gear drive of the fuel pump as per Section 3 2 1, which is required once a year The silica gel in the fuel aeration system requires replacement when the dryer Indicator changes color from blue to pink.

1.5 Experience has shown that most difficulties with maintenance of the JFTOT result from lack of knowledge of the systems and their functions Therefore, people responsible for maintenance of the JFTOT should become fully knowledgeable of all the Information in this Manual and ASTM Method D-3241 before attempting any maintenance 1.6 ALCOR, the sole manufacturer of the JFTOT, should be contacted for assistance on questions or problems that are not covered by this Manual

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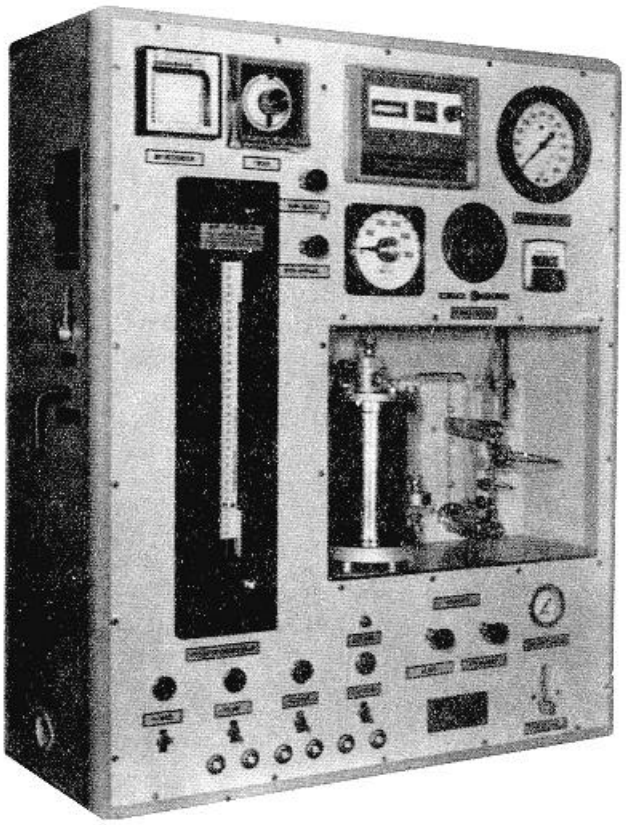


Old Model JFTOT

P/N JFTOT-202, 202-3, 203, 203-3

New Model JFTOT with
Electronic Pressure Transducer

P/N JFTOT-215, 215-3

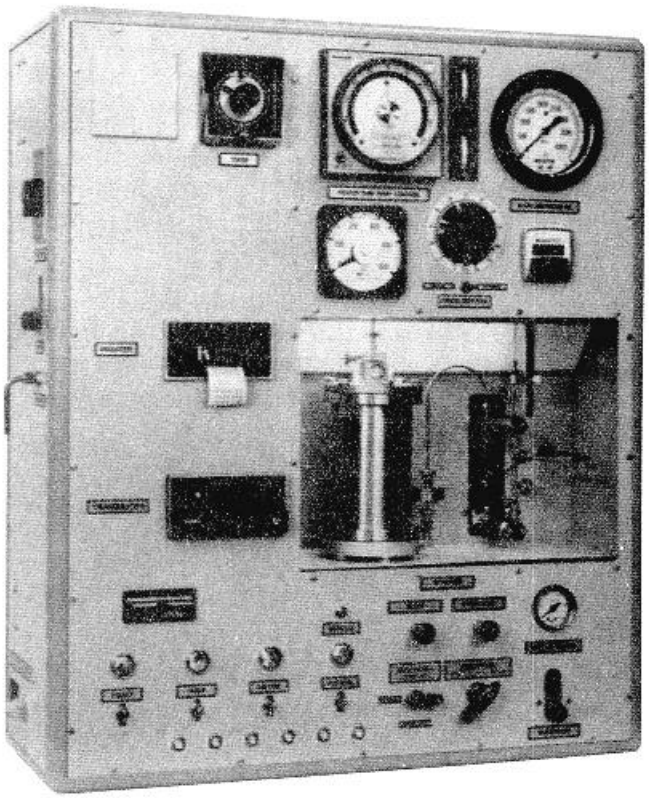


Figure M1-1 ALCOR Jet Fuel Thermal Oxidation Testers

2. GENERAL DESCRIPTION

2 1 The JFTOT is a closed-loop fuel system as shown In Figure M2-1 with pump circulation and nitrogen pressurization The fuel reservoir as shown Is so arranged that the returning fuel is kept separated from the test fuel by a free piston The heater tube test section contains a heater tube maintained at a specified temperature and a test filter located downstream from the heater tube Figure M2-2 shows schematically the method used for heating the heater tube

2 2 The test results are heater tube deposits and pressure drop across the test filter

2.3 Two models of the JFTOT are available, 115V 60 Hz and 115/220V 50 Hz

2 4 Figure M2-3 is a front view of the JFTOT and Figure M2-4 shows a rear view of the JFTOT. Each component item visible In these views can be located and identified by part number.

2 5 More detailed information Is given in the sections that follow

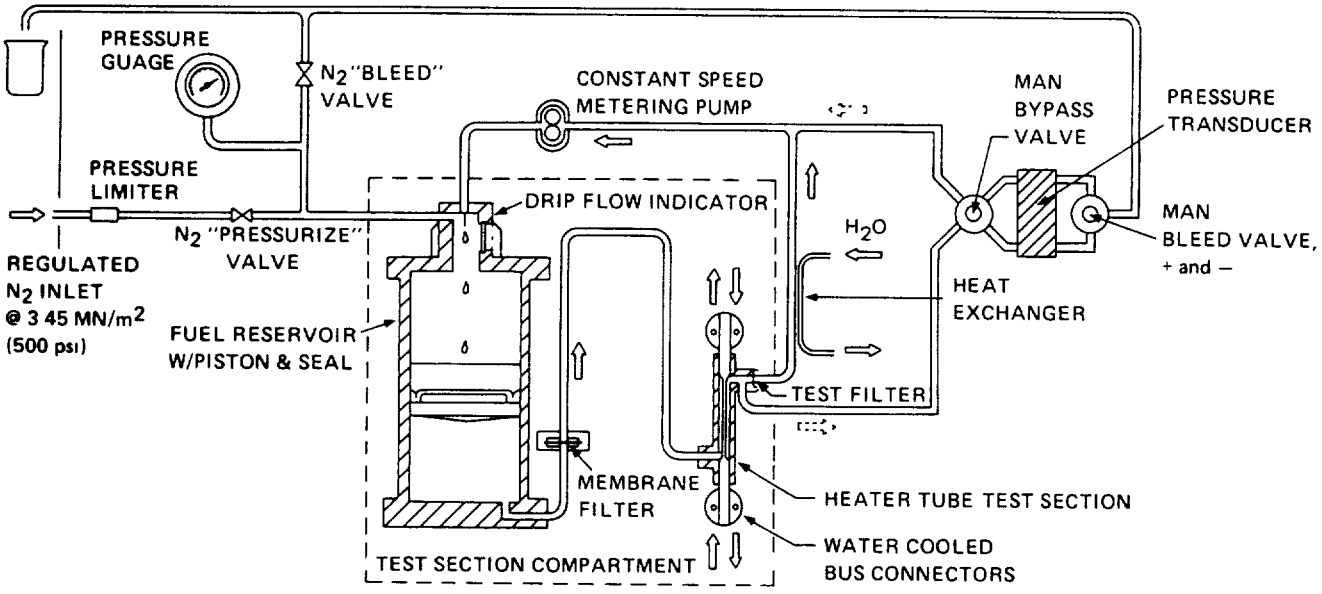


Figure M2-1 JFTOT Fuel-Nitrogen System Schematic

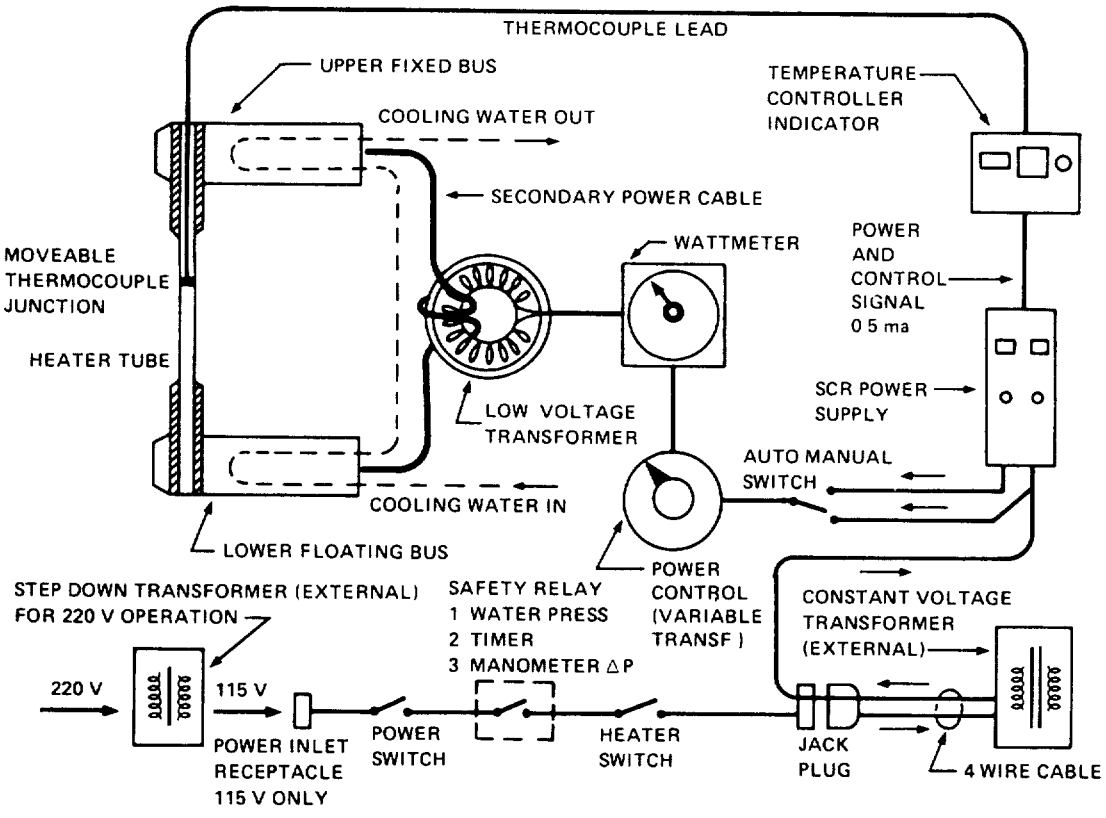
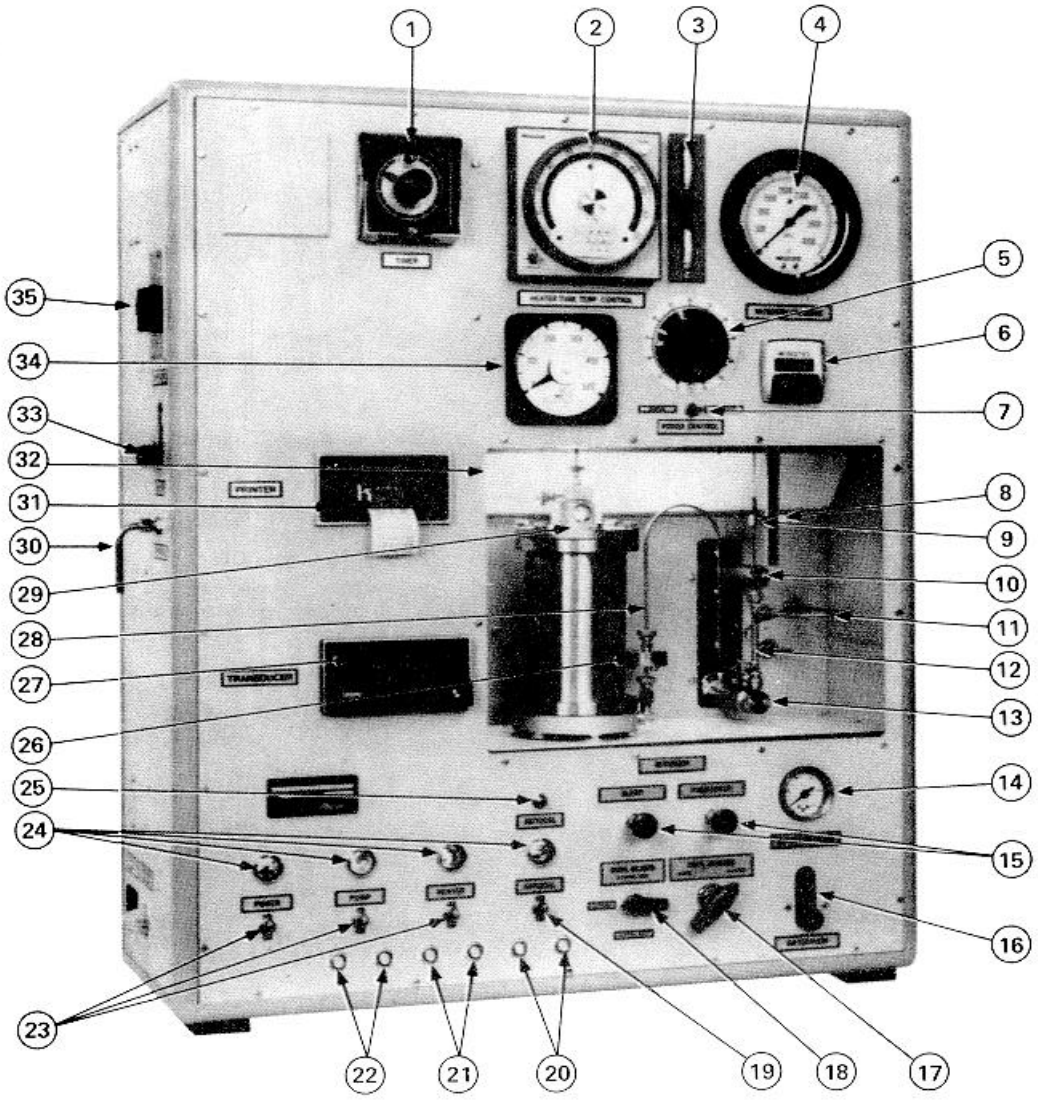


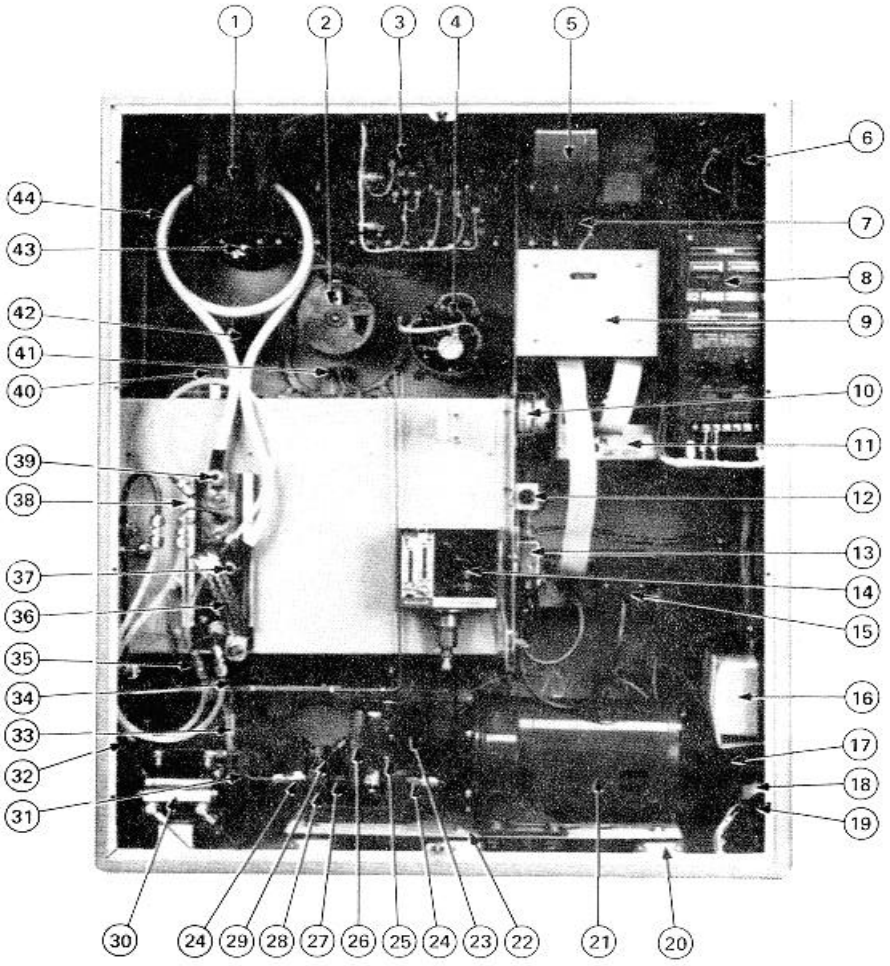
Figure M2-2 Heater Tube Power and Temperature Control Schematic



	P/N	DESCRIPTION
1.	88261	Timer, Cutoff, 50 Hz
	88262	Timer, Cutoff, 60 Hz
2.	83153	Temperature Controller, 0-537 °C, 50/60 Hz
3.	45884	Milliammeter
	45883	Millivoltmeter
4.	57968	Pressure Gage, 0—4 MPa (0-600 psi)
5.	90656	Power Control (variable transformer) 50/60 Hz
6.	88263	Elapsed Time Indicator, 50 Hz
	88264	Elapsed Time Indicator, 60 Hz
7.	80803	Toggle Switch, Manual—Automatic
8.	45001	Position Indicator Ass'y, Thermocouple
9.	86196	Thermocouple Assembly
10.	10774	Upper Bus, Assembly
11.	43765	Outlet Line Assembly
12.	35291	Heater Test Section Assembly
13.	10781	Lower Bus, Assembly
14.	57984	Water Pressure Gage
15.	93063	Valve, Bleed or Pressurize (2)
16.	57985	Water Flow Meter (Sub-Ass'y)

	P/N	DESCRIPTION
17.	93081	Man. Bypass Valve
18.	93082	Man. Bleed Valve
19.	80801	Toggle Switch, AutoCal
20.	29687	Circuit Breaker, 3 amp
21.	29688	Circuit Breaker, 6 amp
22.	29689	Circuit Breaker, 8 amp
23.	80800	Toggle Switches-Power, Pump, Heater
24.	41313	Indicator Pilot Light Assembly
25.	80802	Push Button Switch AutoCal
26.	27042	Prefilter Assembly
27.	45008	Transducer Indicator
28.	43763	Inlet Line Assembly
29.	63251	Reservoir Assembly
30.	43754	Aeration Discharge Tube
31.	45011	Printer
32.	23838	Horn
	80849	Horn Switch
33.	57962	Aerator Flow Meter (Sub-Ass'y)
34.	95991	Wattmeter, 50/60 Hz
35.	88265	Aeration Timer

Figure M2-3 Front View of JFTOT



	P/N	DESCRIPTION
1.	90657	Low Voltage Transformer
2.	90656	Power Control (variable transformer) 50/60 Hz
3.	83153	Temperature Controller, 0-537° C 50/60 Hz
4.	95991	Wattmeter, 50/60 Hz
5.	47440	Blower, 50/60 Hz
6.	90675	Power Transformer
7.	88261	Timer, Cutoff, 50 Hz
	88262	Timer, Cutoff, 60 Hz
8.	83172	SCR Power Supply, 50/60 Hz
9.	88268	Timer Board (Brackets not included)
10.	41316	Socket, Test Section Light
11.	45011	Printer
12.	29706	Fuse-2 AMP, 250V
13.	24520	EMF Filter
14.	80799	Water Pressure Switch
15.	45008	Transducer Indicator
16.	60086	Aeration Pump
17.	62439	Power Cutoff Relay, 50/60 Hz
18.	28092	Receptacle, Power Inlet
19.	28093	Receptacle, Const. Voltage Transf.
20.	37165	Vibration Isolator (6)
21.	47463	Gear Motor 115V—50 Hz
	47434	Gear Motor 115V—60 Hz
22.	12836	Base Plate
23.	31258	Pinion Gear, 14 teeth (60 Hz)
	31260	Pinion Gear, 17 teeth (50 Hz)
24.	28068	Fitting, Inlet or Outlet
25.	93083	Man. Bleed (3-way) Valve
26.	60055	Metering Pump
27.	28099	Inlet Trunnion w/fitting
	28100	Outlet Trunnion w/fitting
28.	28098	Saddle Assembly
29.	93081	Man. Bypass (4-way) Valve
30.	45009	Transducer
31.	57985	Flowmeter w/fittings, Assy. (Water)
32.	93058	Pressure Limiter w/fittings, Assy.
33.	27045	Water Filter
34.	93060	Water Cutoff Solenoid, 50 Hz/60 Hz
35.	28031	Reducer Unions (4) ⅛-¼
36.	23706	Flex Power Strap
37.	84064	Lug Connector, water cooled
38.	10778	Base Plate Assembly
39.	28095	Lug Connector for power cable
40.	86196	Thermocouple Assembly
41.	80803	Toggle Switch, Manual—Automatic
42.	88263	Elapsed Time Indicator, 50 Hz
	88264	Elapsed Time Indicator, 60 Hz
43.	57968	Pressure Gage, 0—4 MPa (0-600 psi)
44.	96722	Secondary Power Cable

Figure M2-4 Rear View of JFTOT

3. FUEL SYSTEM

3 1 Description

3 1 1 Figure M3-1 shows a schematic of the fuel system including the part number and description of each component Figure M3-2 gives the details of the test section compartment and Figure M3-3 and M3-4 give the details of the Heater Tube Test Section and the Reservolr-Prefilter Assembly, respectively

3 1 2 Referring to Figure M3-1, test fuel contained In the Reservoir (Is circulated through the Heater Tube Test Section (by a constant speed Metering Pump O located downstream of the Heater Tube Test Section to preclude contamination by pump wear particles The pump is driven by a constant speed gear motor to yield a fuel flow of 3 0 ml/min

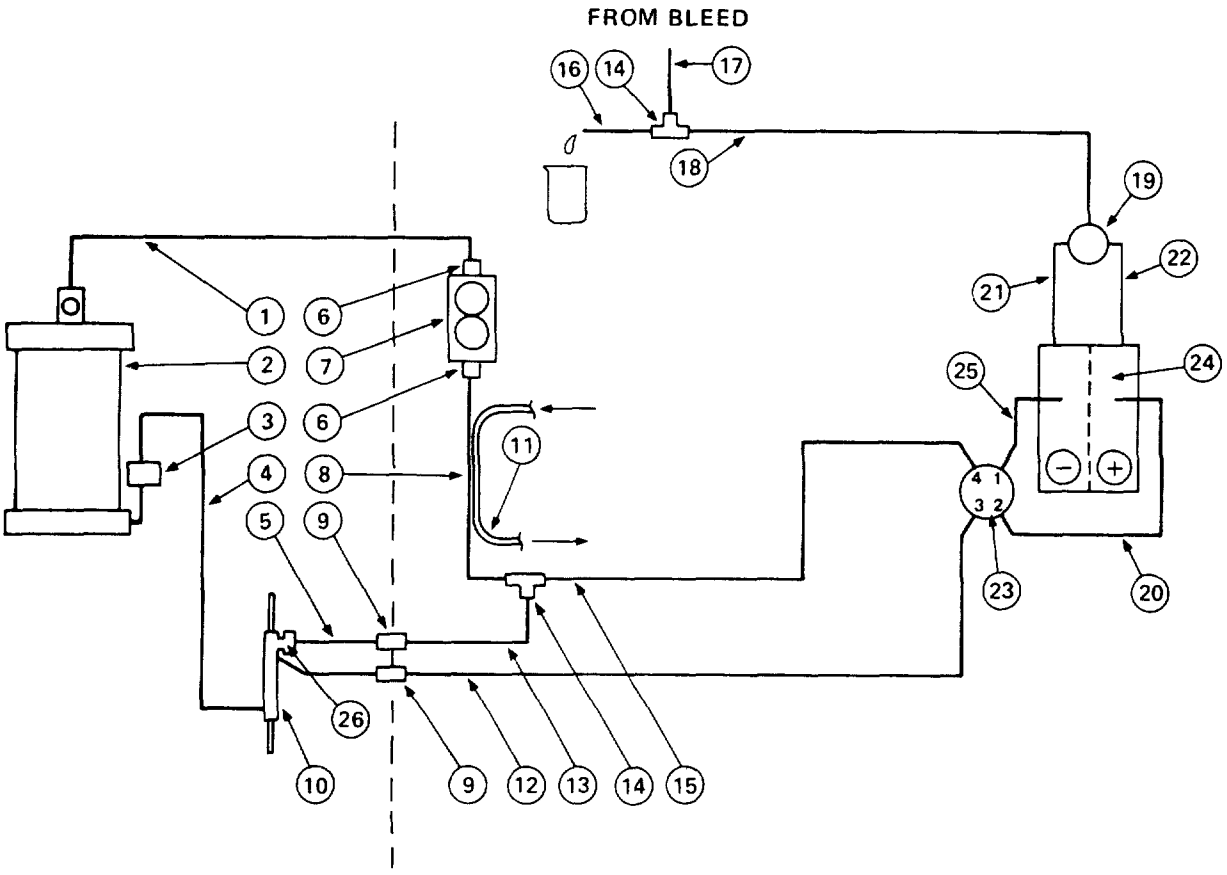
3 1 3 From the Reservoir outlet, the fuel flows through a Prefilter Assembly 0 which contains a 0 45-pm membrane type filter, thence to the lower (inlet) part of the Heater Tube Test Section The fuel rises vertically In the annular space between the aluminum heater tube and its outer stainless steel housing Exiting the Heater Tube Test Section, the fuel passes through a test filter (a (in the Heater Test Section Housing) having an element made from stainless steel cloth with a rated porosity of 17 pm

3 1 4 A differential pressure measurement is made across the test filter If products of thermal degradation have been created during the heating of the sample In the test section these products may leave the heater section and become trapped on the test filter As such particles build up, a differential pressure will occur across the filter The test filter can be bypassed and usually is when the AP across the filter exceeds about 25 mm

3 1 5 By either path (bypass or not) the fuel next goes to a cooler ¢ which removes the residual heat from the test just before the fuel enters the pump

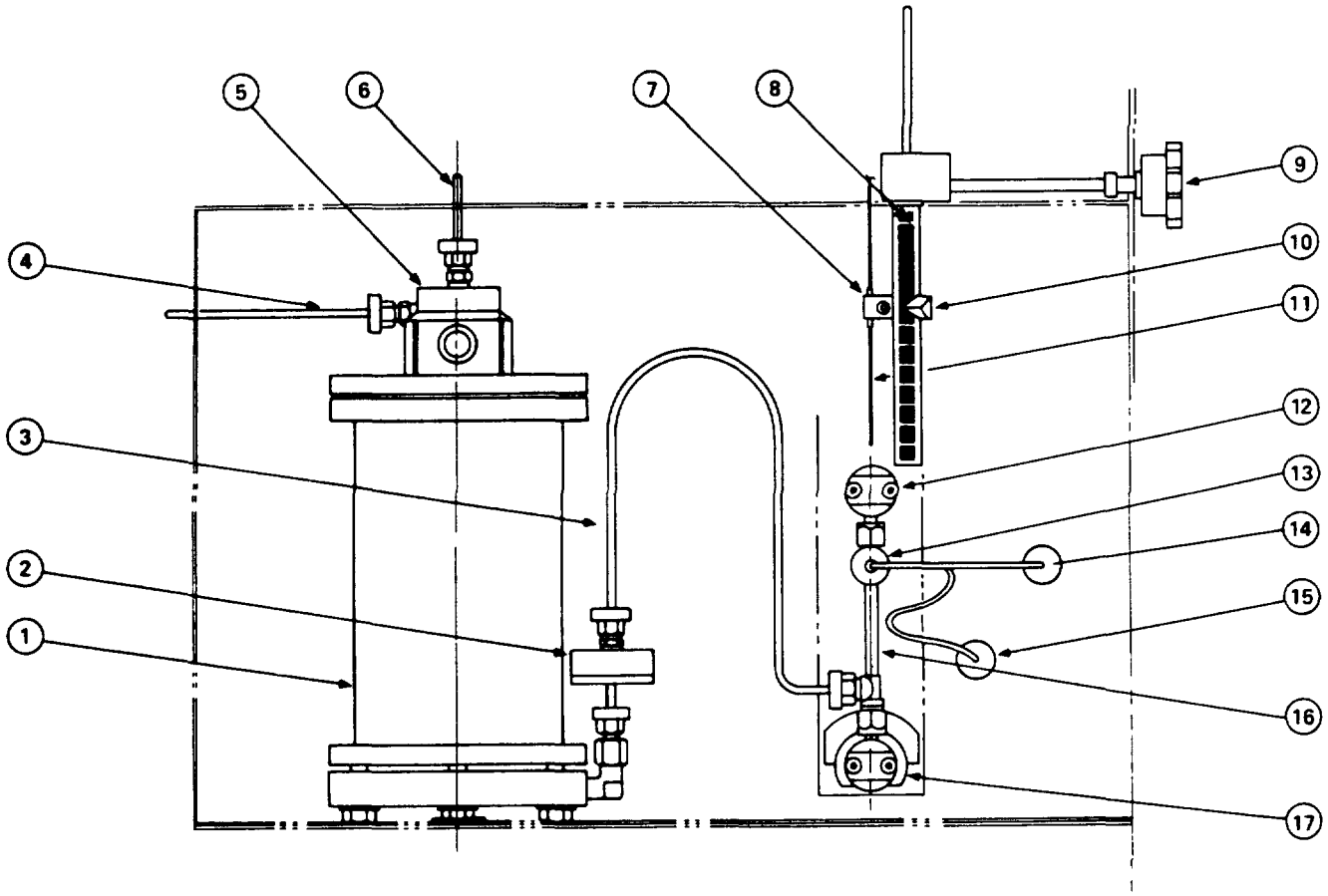
3 1.6 Referring to Figure M3-4, the metering pump pushes the fuel to the reservoir drip housing (where the fuel drops In such a manner that it can be monitored visually by the drop (in order to provide a convenient check of flow rate The fuel ends where it began, In the reservoir, but separated from the new fuel by a floating piston O with a lip seal At the end of the test the test fuel lies on top of the piston and typically very little untested fuel remains below the piston.

3.2 Metering Pump The metering pump is an ALCOR modification of a Zenith precision pump that has very close tolerances Ordinarily, no attempt should be made to take the pump apart to make repairs When pump malfunction is apparent such as seizure, shaft seal leakage, or low flow rate due to wear; the pump should be replaced with a new or ALCOR rebuilt pump. A standard Zenith pump Is not usable because it will leak fuel under test conditions. The life of the pump is dependent on the lubricity and wear characteristics of the test fuels involved and therefore can vary from less than 100 tests to
over 500 tests.



	P/N	DESCRIPTION		P/N	DESCRIPTION
1	43739	Line Ass'y, ⅛ ss (Fuel)	14	28048	Tee, Fitting, ⅛ T
2	63251	Reservoir Ass'y	15	43888	Line Ass'y, ⅛ ss (Fuel)
3	27042	Prefilter Ass'y	16	43723	Line Ass'y, ⅛ Copper
4	43763	Inlet Line Ass'y	17	43720	Line Ass'y, ⅛ ss
5	43765	Outlet Line Ass'y	18	43885	Line Ass'y, ⅛ ss (Fuel)
6	28068	Fitting, Inlet or Outlet	19	93082	Valve, Manometer Bleed (3-way)
7	60055	Metering Pump	20	43887	Line Ass'y, ⅛ ss (Fuel)
8	43740	Line Ass'y, ⅛ ss (Fuel)	21	43892	Line Ass'y, ⅛ ss (Fuel)
9	28026	Bulkhead Union — ⅛ T	22	43889	Line Ass'y, ⅛ ss (Fuel)
10	35291	Heater Tester Section Housing Ass'y	23	93081	Valve, Manometer Bypass
11	43751	Line Ass'y, ¼ Copper (Water)	24	57977	Transducer
12	43891	Line Ass'y, ⅛ ss (Fuel) Bulkhead Fitting to 4-way valve	25	43890	Line Ass'y, ⅛ ss (Fuel) 4-way valve to Transducer
13	43748	Line Ass'y, ⅛ ss (Fuel)	26	27039	Test Filter

Figure M3-1 Fuel Schematic



1 Reservoir
2 Pre-filter
3 Inlet Line Assembly
4 N_2 Inlet Line
5 Drip Flow Indicator Housing
6 Spent Fuel Return Line
7 Thermocouple Clamp
8 Thermocouple Reference Line
9 Thermocouple Position Control
10 Thermocouple Position Indicator
11 Thermocouple
12 Upper Fixed Bus
13 Test Filter Housing
14 Heater Tube Fuel Outlet Line
15 Filter Bypass Line
16 Heater Test Section
17 Lower Floating Bus

Figure M3-2 Test Section Compartment

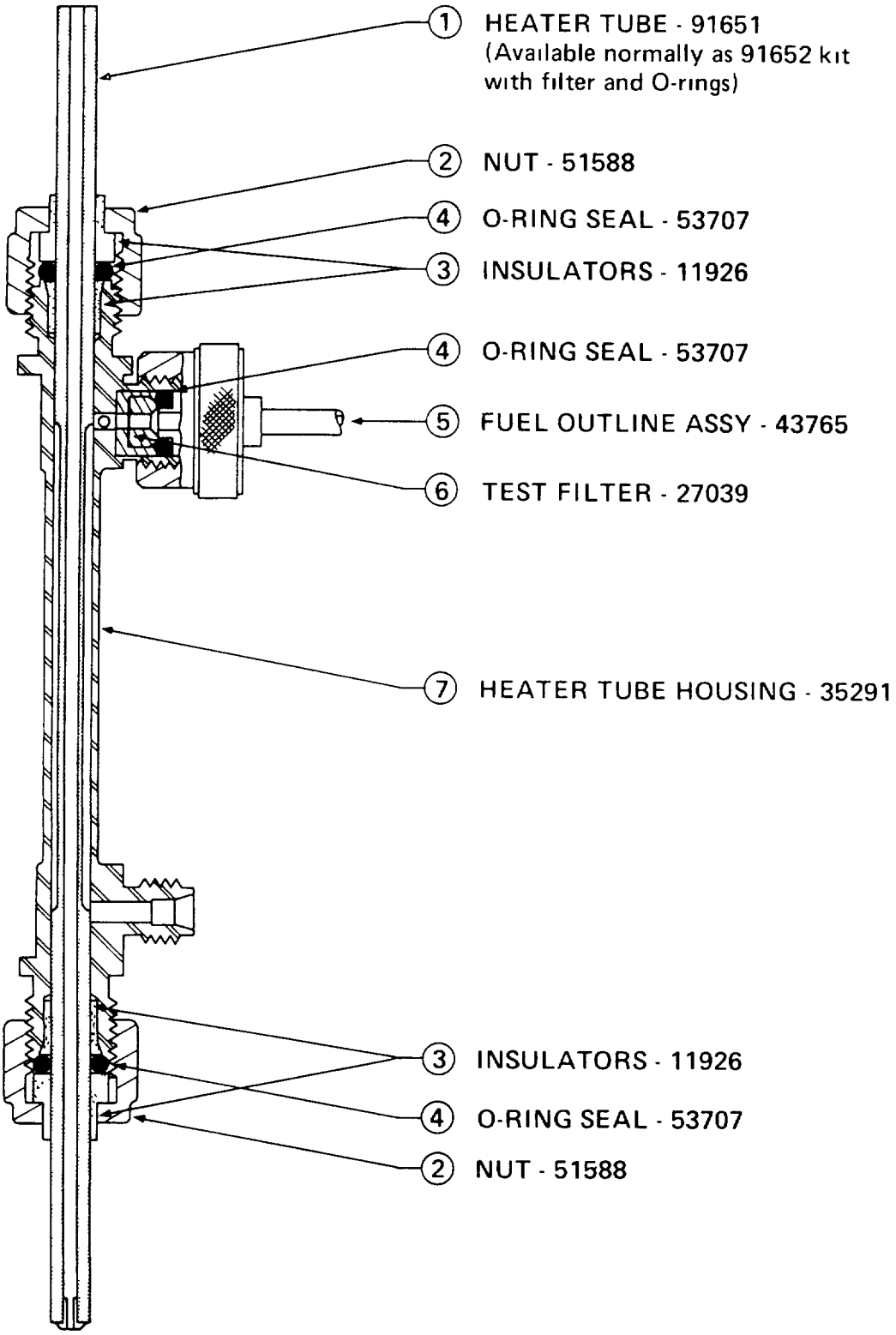
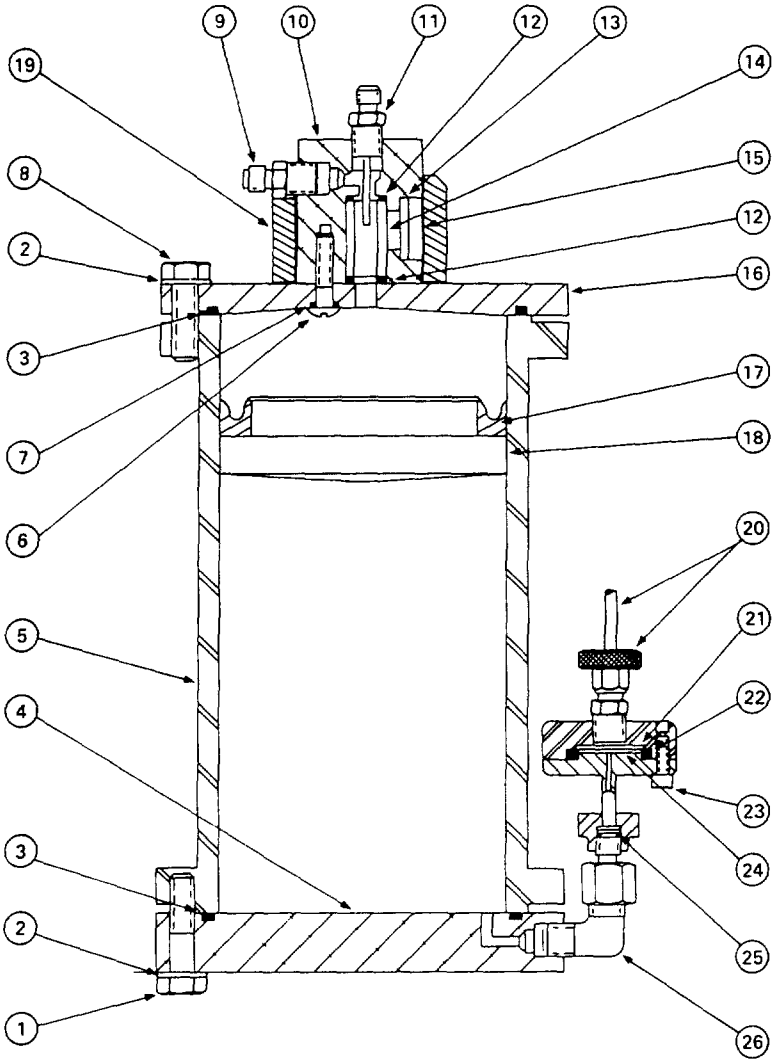


Figure M3-3 Heater Tube Test Section Assembly



	P/N	DESCRIPTION		P/N	DESCRIPTION
1	65231	Cap Screw, Hex Head	14	32171	Sight Glass
2	94675	Washer	15	32170	Window Glass
3	53714	O-Ring Seal, Reservoir	16	63253	Cover
4	63256	Base	17	53709	Lip Seal
5	63254	Cylinder	18	63255	Piston
6	65233	Screw, Truss Head	19	63257	Protector, Drip Flow Indicator
7	53707	O-Ring Seal, Ret Screw	20	43763	Heater Tube Fuel Supply Line Ass'y
8	65232	Cap Screw, Hex Head	21	27051	Filter Backup Screen
9	28069	Nitrogen Inlet Fitting	22	53708	O-Ring Seal, Pre-filter
10	36343	Housing, Drip Flow Indicator	23	66662	Cap Screw, Allen Head
11	63252	Drip Tube Fitting	24	27050	Membrane Filter
12	53713	O-Ring Seal, Sight Glass	25	53706	O-Ring Seal
13	25883	Retaining Ring	26	28174	Reservoir Fuel Outlet Fitting

Note Parts I to 19 included In Reservoir Ass y 63251, parts 21 to 26 in Prefilter Ass j' 27042

Figure M3-4 Reservoir and Prefilter Assembly

3 2 1 Lubrication - A grease fitting is provided on the drive end of the pump for lubrication of the gear drive The pump should be lubricated with a grease gun at least once a year or after every 300 tests (750 hours), whichever occurs first

3 2 2 Performance Testing - To check for deterioration of pump performance due to wear, a fuel flow check must be performed with a pressure differential of 120 mm Hg applied across the pump To accomplish this, the following procedure and steps are used

(1) Install in place of the outlet line assembly the special Valve/line assembly (ALCOR P/N 43915) together with any old or used Heater Tube m the test section Add a used test filter with the screen punctured Refer to Figure M3-5

(2) clean filtered fuel under normal pressurized operating conditions with Valve fully opened but no heat applied

(3) After steady flow is established, close and adjust Valve to maintain a steady

(4) Determine fuel flow rate with a stop watch, measuring time for 20 drops

(5) The time for a properly performing pump Is 9 + 1 second Pumps which measure above 10 seconds should be replaced, especially if the unit is utilized in research and development work where the full range of AP capacity of the JFTOT manometer is required

(6) For JFTOT units used strictly for specification testing where the maximum ΔP required is only 25mm, a flow check at 50 mm ΔP and within the 9 + 1 seconds for 20 drops would substantiate and assure adequate pump performance for that purpose

3 2 3 Pump Replacement (Reference Figure M3-6)

3 2 3 1 Depressurize system - Disconnect the outlet line from the Trunnion(27) Using a 3/4-inch open end wrench, loosen the outlet Trunion (27) from the Pump Saddle (28) and screw out approximately 3/4-inch to remove Pump (26)

3 2 3.2 Install new Pump. Finger tighten the Trunnion; check gear alignment and backlash. Temporarily place a piece of paper (writing, towel) between gear teeth of drive gear meshed with pump gear Tighten Trunnion (27) with wrench sufficiently tight to prevent leakage while holding pump In position squeezing paper between teeth of gears (this helps assure approximately 3/64-inch backlash.) Reinstall outlet line and tighten Apply a small amount of grease to the gear teeth Turn on pump to remove paper. Circulate fuel and remove trapped air. Pressurize system and check for leaks

3 3 Removal of Air from System

3.3 1 As delivered, the JFTOT fuel system has been de-aerated. However, a small amount of air enters the system every time a test is initiated or whenever fuel system maintenance is performed, such as pump change. This air must be removed periodically If air is suspected in the transducer, it can be eliminated by opening the MAN. BLEED valve alternately to + and while the system is under slight (23 MPa) pressure. Trapped air in the vertical passages of the fuel rhetering pump can be eliminated by running the pump and circulating fuel for

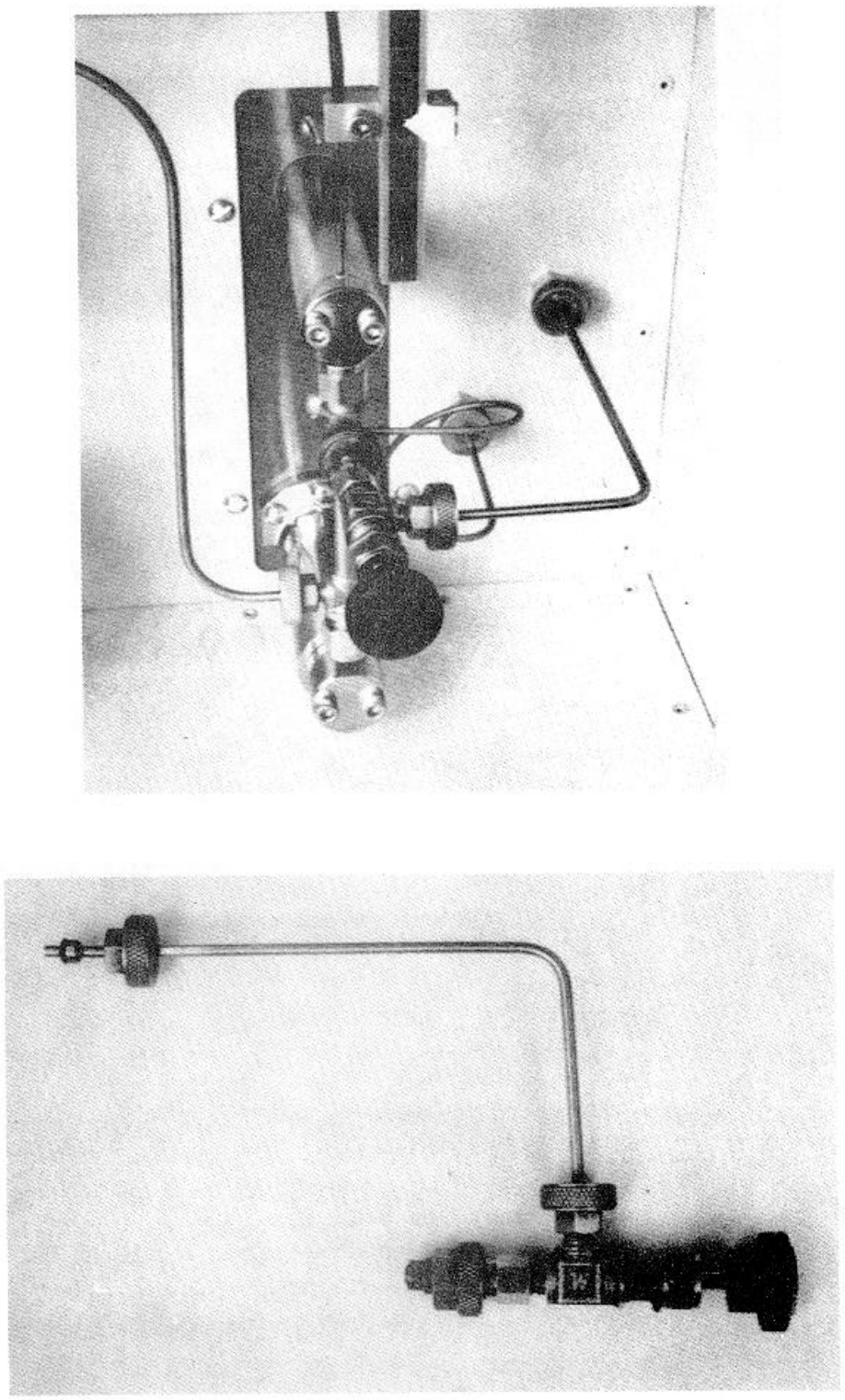
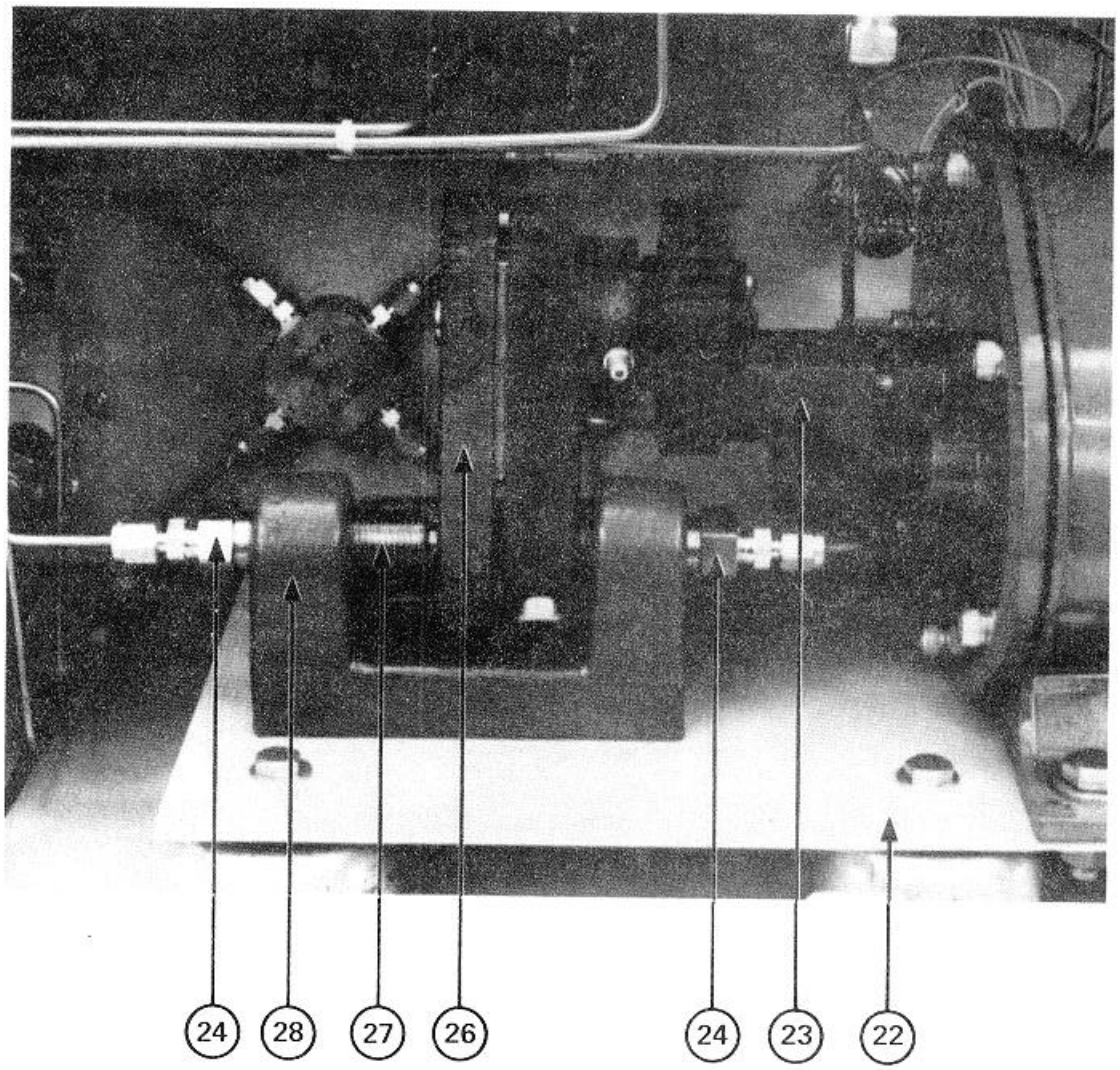


Figure M3-5 Special Valve/Line Assembly for Testing Pump Performance



	P/N	DESCRIPTION
22.	12836	Base Plate
23.	31258	Pinion Gear, 14 teeth (60 Hz)
	31260	Pinion Gear, 17 teeth (50 Hz)
24.	28068	Fitting, Inlet or Outlet
26.	60055	Metering Pump
27.	28099	Inlet Trunnion w/fitting
	28100	Outlet Trunnion w/fitting
28.	28098	Saddle Assembly

Figure M3-6 Pump Detail, (Enlarged View of Figure M2-4)

approximately five minutes with no pressure. Observe Drip Flow Indicator for steady drip flow rate. Slowly pressurize system to 1.4 MN,, $_{m2}$ (200 psig) followed by slow bleed of system. Repeat several times until there is little or no change in the drip flow rate during the pressurizing or bleed off cycle.

3.4 Sight Glass Replacement for Drip Housing (Reference Figure M3-4)

3.4.1 Remove cover @ from Reservoir. Remove two screws **O** from underside of cover. This will remove drip flow indicator. Remove old Sight Glass (14) and O-rings (12).Remove old O-rings (7) from screws (6) and discard. While holding drip flow indicator inverted, install new sight glass with O-Ring on top and bottom. Replace plastic protector (19), if removed, and reattach assembly to cover. Use new O-Rings (7) under each screw (6) and tighten evenly.

3.5 ΔP System The ΔP system consists of an electronic pressure transducer with related components to determine accurately the differential pressure across the test filter. As shown in figure M3-1 the fuel has two paths, through or around the test filter, which are controlled by the two-way MAN BYPASS valve (23). When the valve is in RUN position the valve connects the high pressure side (12) of the filter (26) to one side of the transducer (24) via the (+) line (20) and the low pressure side (13) of the filter to the other side of the transducer via the return line (15) and the (-) line (25). When the valve is turned one quarter turn to BYPASS, the transducer is isolated and line (12) is connected to the return line (15). In bypass mode the fuel, therefore, can flow through and around the filter simultaneously.

3.5.1 Venting the transducer In order to run properly the transducer must be liquid full. To assure this do the following: with fluid running through the system, close the MAN BYPASS valve, set the system pressure to about 345 Pa (50 psig) and carefully vent the transducer by turning the NM,&N BLEED valve to + and in any sequence. Hold until all trapped gas is vented. Once done, this should not be needed normally unless the system is run dry for an extended period or a leak occurs, particularly in the lower part of the fuel transducer system.

3.5.2 Transducer Operation & Data

(1) ΔP Bias When the change was made in method of pressure differential measurement from the mercury manometer to the transducer, it was discovered that there has always been a slight bias in the manometer measurement due to the manometer being a mercury-fuel manometer rather than a mercury-air manometer. The presence of fuel on the mercury makes the manometer a little more sensitive; thus the pressure differential readings are greater than would result from an absolute device such as the transducer. The difference, which can be calculated and verified by experiment, is about 6"6. The transducer has been calibrated with a 6%'. bias so its readings will be the same as with the old mercury manometer. This translates to about 1.5 mm at 25 mm. If, for example, the true AP reading were about 23.5 mm, then with the 6% bias included the transducer will indicate 25 mm just as the mercury manometer will.

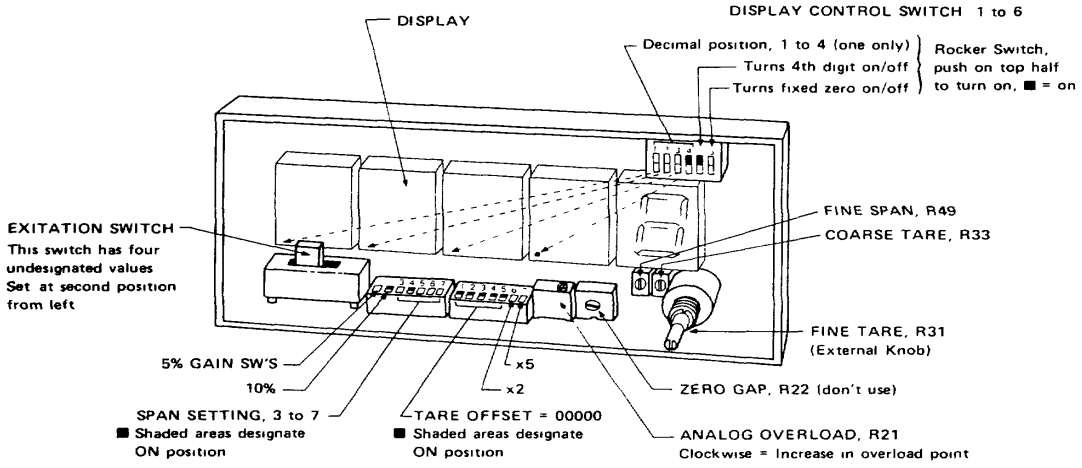
(2) Calibration of the Indicator-the indicator is the electronic device that takes the + and signals from the transducer, looks at the difference and calculates and shows on a digital readout the actual AP reading in mm of mercury equivalent. In order to get the correct readings the indicator is calibrated by the following procedure:

(a) Obtain millivolt source; remove plug from DPT Cell, place pins or wires into pin holes E and F of the plug. Attach Plus (red) to F and Negative (black) to E from millivolt source.

(b) Expose switches on inside front of Doric by removing front cover.

Remove two screws and knob to do this. (This requires a 0.050 inch Allen wrench).

(c) Place fine tare (knob) in approximate middle of range and set switches as follows:



. **Note cw = clockwise. ccw = counterclockwise**

(d) For gain try to use 10% if over, use 5"%,; if under, use both (15%).

(e) Set millivolt source to 0.0 mv. Adjust coarse tare (cw) until display reads 0.0; if not possible, change gain as needed.

(f) Set millivolt source to value specified for DPT cell, e.g. 19.86 mv. Adjust fine span (ccw) until display reads 275.0 (for JFTOT 215 to include the

ASTM required +6% bias).

(g) Return to step "e" and repeat thru step "g" until no change is needed.

(h) Set display on about 300 using millivolt source to drive. Turn analog overload (ccw) until blank display screen just occurs.

(i) Final check: when millivolt source is zero, screen should be zero; when millivolt source is at spec for cell, screen should be 275.0.

(j) Remove millivolt source hookup and replace plug in DPT cell socket. Set temp control at 260 deg C, start heater and allow system to come to temperature at normal running pressure (500 psi).

(k) Adjust coarse tare until screen reads zero. Replace cover and knob.

(3) High pressure alarm In the old JFTOT models a high pressure alarm was included to indicate that the differential pressure was in excess of 125 mm. The transducer has this same indication which is monitored by the control system of the transducer. The alarm is armed by a small switch near the alarm in the test cavity. The level (125 mm) cannot be changed since it is permanently installed in the control program.

3.5.3 Printer Operation and Data

(1) Timer Board - There is a small microprocessor board used to connect the transducer indicator to the printer. This board has certain timing and control functions that are designed and preprogrammed into the system to allow some versatility in operating the printer. Whenever unusual prints occur these are likely due to electrical noise entering the microprocessor via the timing board. Restarting the system can remedy the effects of such noise and electronic interference. If the trouble persists, contact Alcor Engineering for help.

(2) Printer instructions - The printer is a 16 column alphanumeric impact printer. The unit is set to print transducer data as follows:

Print formats:

heading: DIFF.P H MN SEC

data print +nnn.n. h:mm:ss*

where h is hours

mm is minutes

ss is seconds and

* = "T" for timed print, or

= "A" for print when over 125 mm and return.

The data may be printed in other units, but the indicator is factory preset to calculate in mm of Hg pressure. Other configurations can be set; consult the Doric manual for details.

error print: Enxxxx h:mm:ss*

where n is the error number (1 to 4), xxxx is error message,
h = hours, mm = minutes, ss = seconds, and * is a code corresponding to error number:
T = invalid time, D = invalid data from Doric,
C = invalid ROM checksum, O = data over range from Doric.
Contact Alcor if T, D, C error occurs and persists.

(3) Setting the interval time - Open the back of the JFTOT. On the panel above the printer at about eye level is a small opening with three rotary 0-9 switches. Read these left to right as number of minutes between timed print. The switches can be set with a small screw driver. The small white arrow points to the number set on each switch. If, for example, if" O 1 5" is set then this would yield a timed print every 15 minutes once the test has started.

3.5.4 Other Components

The other important components of the transducer system are the power supply, electronic filter and system fuse. These are located near the back of the transducer indicator below the timing board. Normally these will not require service or adjustment unless some electronic indication suggests they are faulty.

4. AERATION SYSTEM

4.1 Description (Reference -- Figure M4-1)

4.1.1 The aeration system of the JFTOT provides a metered quantity of dry and filtered air to completely saturate the fuel sample with air prior to the start of the test.

4.1.2 Figure M4-1 shows the schematic of the aeration system including the respective part numbers and description of each component.

4.1.3 Air is pumped by Aeration Pump (, through an Air Filter and Dryer Assembly (which contains indicating Silica Gel C) retained by wads of cotton on each end which act as filter media. The dry and filtered air then passes through a metering Flowmeter (0 and is then discharged through the Aeration Tube) which is immersed into the test fuel.

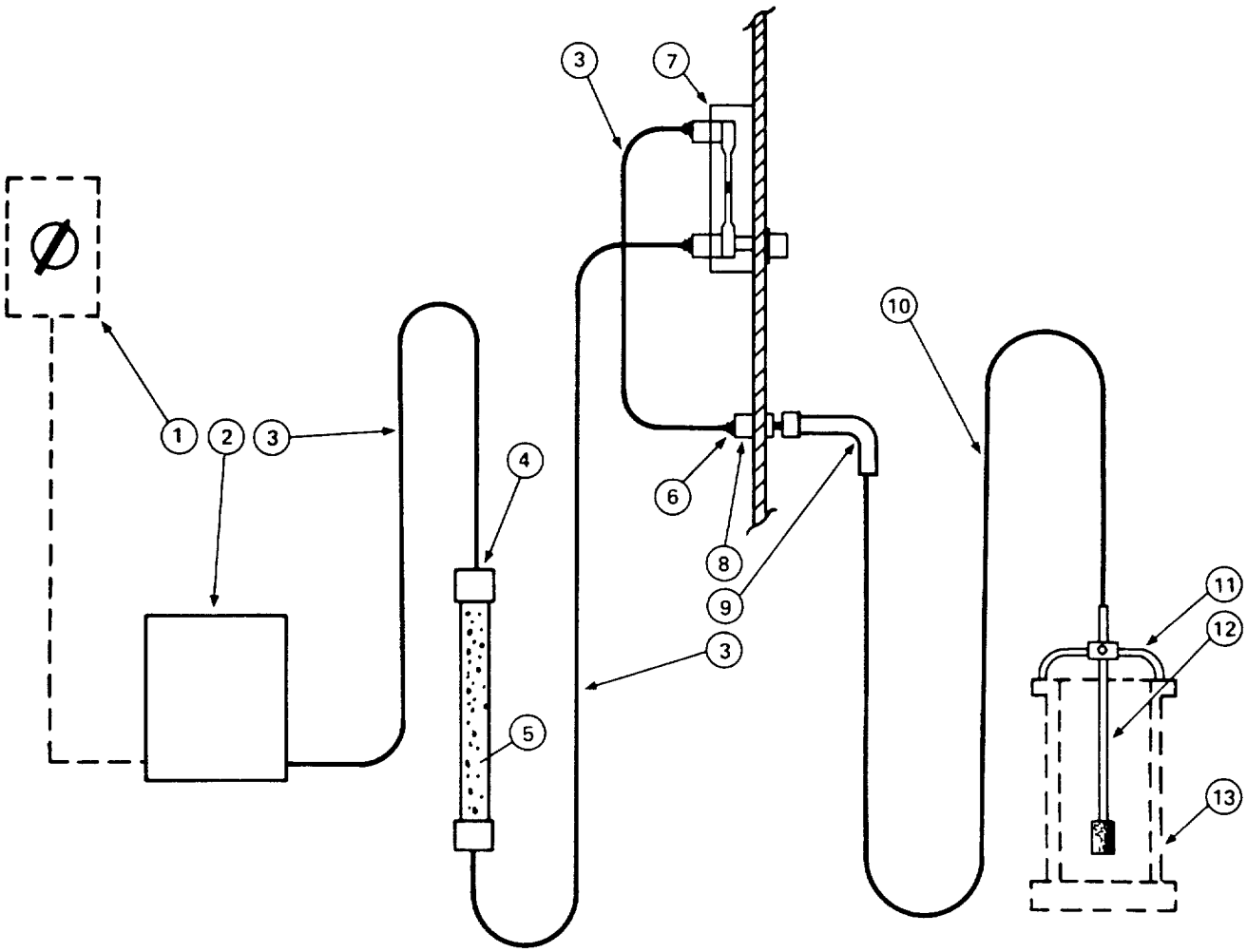
4.1.4 All major components are connected to each other by Plastic Tubing, (and)

4.1.5 The aeration cycle is started manually by a Timer Switch O which is set to the desired or specified running time. Shutoff occurs automatically at the end of the period.

4.1.6 Before starting Timer Switch O and Aeration Pump 0 be sure flowmeter O valve is in open position, otherwise excessive air pressure will develop and Plastic Tubing 0 will slip off fitting. As soon as air flow starts, turn valve to place flowmeter float into green range. This setting corresponds to approximately 1.5 liters per minute.

4.2 Maintenance

4.2.1 Every three months, inspect Air Filter and Dryer Assembly (and ascertain that indicating Silica Gel () is still blue. If pink in appearance, Silica Gel is no longer effective and should be replaced.



	P/N	DESCRIPTION		P/N	DESCRIPTION
1	88265	Timer Switch	7	57962	Flowmeter(Includes2-28094)
2	60086	Aeration Pump	8	28076	Bulkhead Fitting
3.	49292	Plastic Tubing (1 PC-6" long) (1 PC-9" long) (1 PC-15" long)	9	43754	Air Discharge Tube Assy
			10	49328	Clear Plastic Tubing
4	49274	Air Filter & Dryer Assy	11	37995	Aeration Tube Holder
5	38024	Silica Gel	12	38026	Aeration Tube
6.	28094	Fitting, 1/4T-1/8P	13	63251	Reservoir

Figure M4-1 Air Flow Schematic for Fuel Aeration

5. NITROGEN SYSTEM

5.1 Description

5.1.1 Figure M5-1 shows a schematic of the nitrogen system, including the respective part number and description of each component. Regulated nitrogen pressure at 3.45 MN, (500 psig) must be supplied to the JFTOT apparatus by the operator for the purpose of pressurizing the test fuel. The Pressure nitrogen bottle must be carefully adjusted so as to indicate 3.45 MN. ^{m2} (500 psig) on the Nitrogen Pressure Gage (on the JFTOT panel. DO NOT SET BY REGULATOR GAGE.

5.1.2 Optional components between nitrogen bottle and JFTOT apparatus are normally provided by the owner, operator. However, with the exception of the nitrogen bottle, these components can be obtained from ALCOR.

5.1.3 As the nitrogen enters the JFTOT apparatus, it flows through a Pressure Limiter (D, whose purpose is to safeguard the JFTOT from any over pressure condition caused by either a faulty pressure regulator or careless application of excess pressure. The Pressure Limiter is adjustable and is set to cut off all nitrogen flow if the inlet pressure exceeds 3.7 MN; (525 psig). It will also cut off if any sudden high flow condition is induced as, for example, when pressurizing the system too fast.

5.1.4 When the pressure limiter cuts off, it is necessary to relieve the pressure on the inlet side in order to allow reset of the limiter. To accomplish this, close Inlet Valve (22) and loosen Line Connection (18) at JFTOT Nitrogen Inlet Fitting (8). With the release of pressure, a "click" sound can be heard, indicating that Pressure Limiter has reset.

5.1.5 Pressurizing Valve (4) and Bleed Valve (4) located on the front panel are needle valves which need to be operated with great care. They control the application and release of the pressurizing nitrogen.

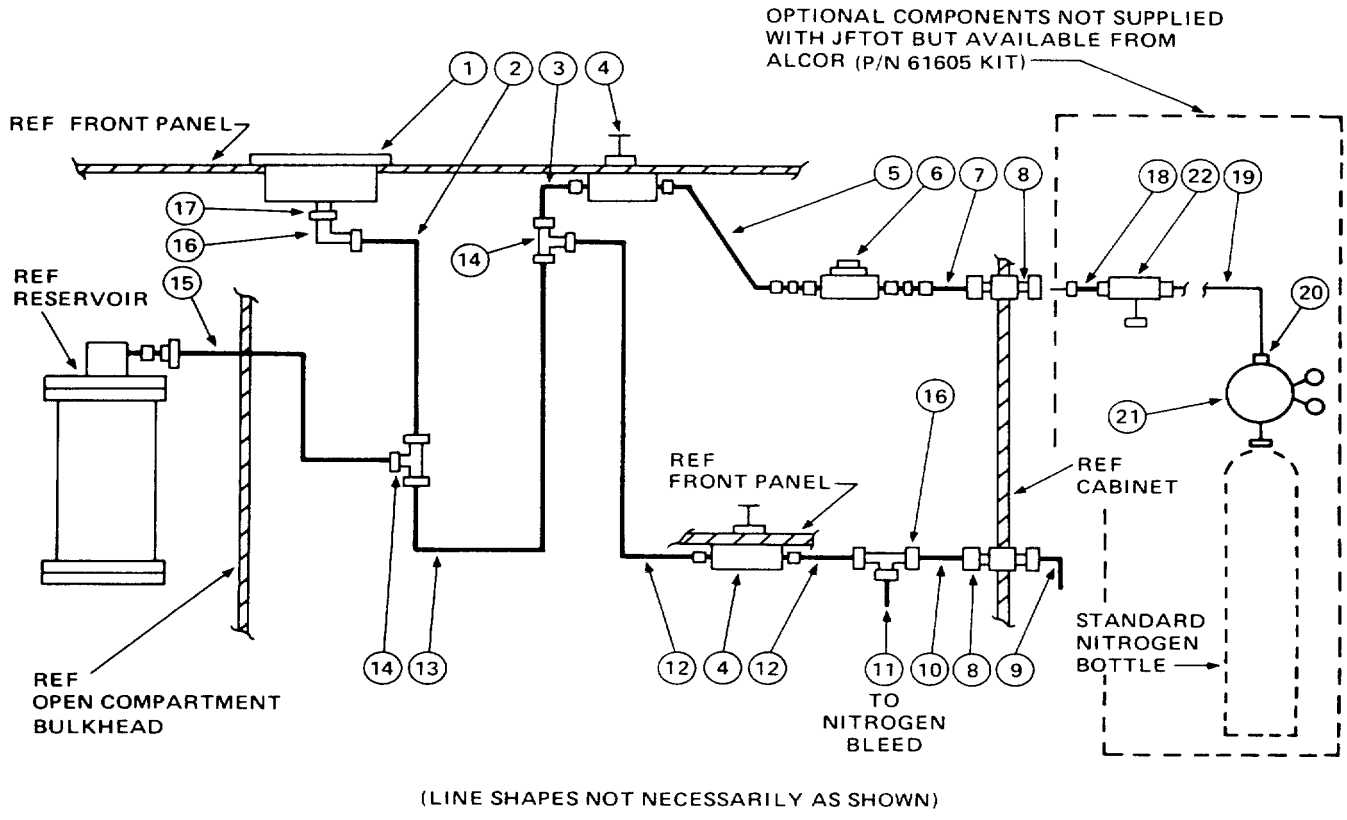
5.2 Maintenance

5.2.1 Every twelve months, check accuracy of Pressure Gauge.

5.2.2 If Pressure Limiter (needs to be adjusted, following is a step-by-step sequence for readjustment.

(1) Cap off Nitrogen Inlet Line) with Cap Seal (P/'N 28193) in test section compartment.

(2) Ascertain the cutoff point of Pressure Limiter by slowly pressurizing system until cutoff occurs. Note cutoff pressure.



(LINE SHAPES NOT NECESSARILY AS SHOWN)

	P/N	DESCRIPTION		P/N	DESCRIPTION
1.	57968	Pressure Gage, 0-4 M Pa	13	43884	Line Ass y, 1/8 ss (N)
2	43882	Line Assy, ,8a ss (N) N2 Tee to Press Gauge			Bleed Valve Tee to RSVR Tee
3.	43716	Line Assy, 1/8 ss (N)	14	28048	Tee 1/8T
4.	93057	Valve, Bleed-Pressurize	15	43883	Line, Assy. 1/8 ss (N)
5	43801	Line Assy, 1/8 Copper (N)			Tee to RSVR Press Fitting
6.	93058	Pressure Limiter (w/Fittings)	16	28174	Elbow, 1/8 T - 1/8P (S S)
7	43799	Line Assy, 1/8 Copper (N)	17	28147	Reducer Coupling '4 - 'e P
8	28027	Bulkhead Union, a' T	18	61607	Line Connection, 1/8 ss
9.	43724	Line Assy, , ss (N) (Outside Bleed)	19	61608	Line. Supply 1/8 x 8 ft (Copper)
10.	43723	Line Assy, 1/8 Copper (N)	20	28308	Fittlng, 1/4 MPT to 1/8 T
11.	43720	Line Assy, 1/8 ss	21	61611	Pressure Regulator
12	43720	Line Assy, 'a ss (N)	22	93057	Valve, Inlet

Figure M5-1 Nitrogen Schematic

(3) Bleed all nitrogen from ,JFOT system and also bleed all nitrogen from inlet side of Pressure Iimiter. This will allow the reset of the limiter

(4) Loosen lock nut of Pressure Limiter and turn adjusting screw slightly clockwise to raise cutoff point and counterclockwise to lower cutoff point.

(5') Ascertain new cutoff point (repeat of Step 2).

(6) Repeat Step :3 if cutoff point is not at :3.7 MN (525 psi) and turn adjusting screw appropriately. Repeat above procedure until the limiter will cut off repeatedly at '3.7 MN (525 psi).

(7) Set nitrogen pressure regulator at ;O() psi and check pressurizing and bleed operations of JFTO'T.

(NOTE: If pressurizing valve is opened too fast, the Pressure Limiter will cut off at a level well below its set point.

(8) Remove Cap Seal. Tester is ready for ;3.45 MN/ $m^{'2}$ (500 psi) operation

5.2.3 If Pressure Limiter acts erratically, disassembly, cleaning, and possible replacement of O-rings may be necessary. Remove Pressure Limiter from JFTOT

Referring to Figure M5 2, follow disassembly sequence.

(1) Remove lock nut and adjusting screw.

(2) Remove upper housing from body.

(3) Remove spring, button and Teflon disc from upper part of housing.

(4) Remove piston from lower part of housing.

(5) Remove ()-rings and thoroughly clean all parts.

(6) Secure new 0-rings and Teflon disc., lightly coat with ,silicone grease to assure easy sliding.

(7) Reassemble in the reverse of the above order and secure housing to body with about 27 kg-m (200 pound-inch) torque.

(8) Adjust the Pressure Limiter to 3.7 MN ^{m2} (.525 psi) - .07 MN m^2 (10 psi) in accordance with sequence outlined in paragraph 5.2.2 above.

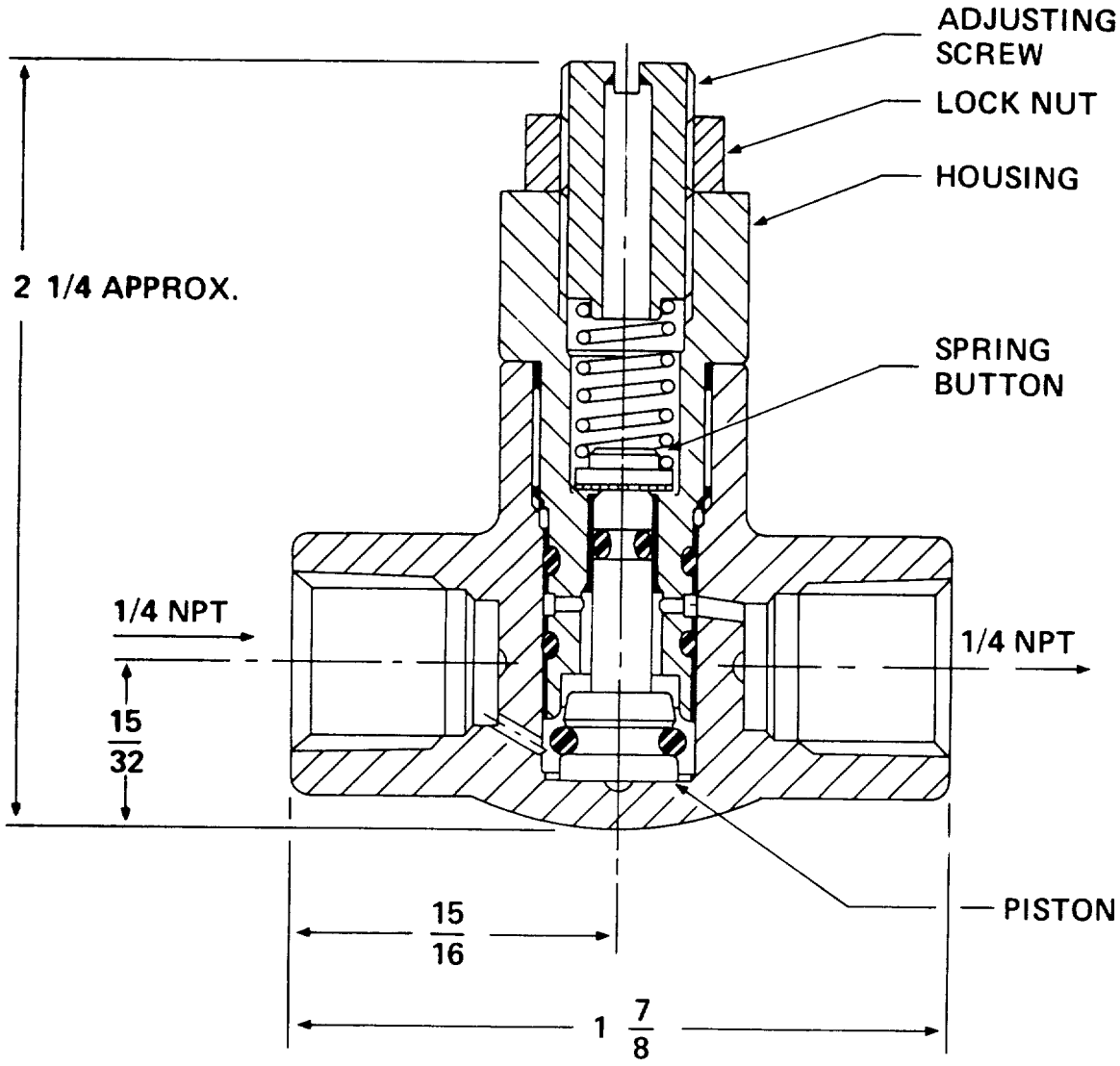


Figure M5-2 Pressure Limiter, P/N 93058

6. WATER SYSTEM (Reference Figure M6-1)

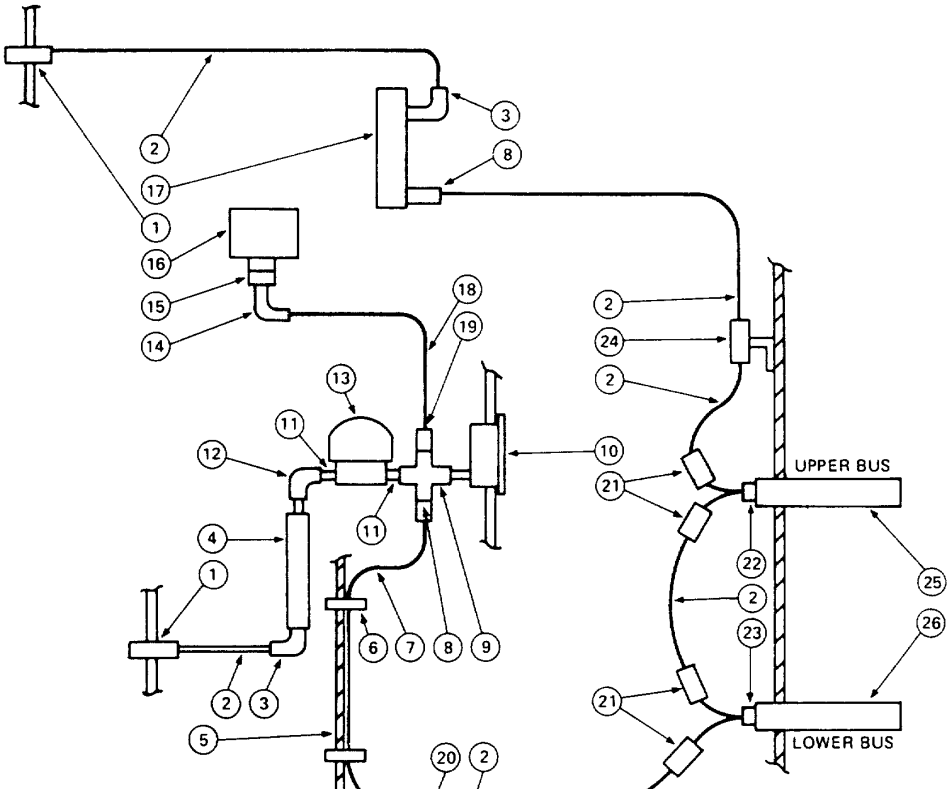
6.1 The water system is used to provide cooling to the Bus Bars e and e, Lug Connector) and to the spent hot test fuel before it enters the metering pump. Other components in the system consist of a Filter (, Cutoff Solenoid @, Pressure Switch 0, Pressure Gage 8, Flowmeter w/control valve @, plus connecting fittings and tubing. To provide electrical insulation between ground and the bus bars, Insulating Tubing () is used. Water pressure required by the system is in the range 200-700 kN/m2 (30-100 psi).

6.2 Safety Shutoff A Pressure Switch) set to trip at approximately 170 kN/m2 (25 psi) is provided to protect the water cooled Bus Bars from overheating in the event of water pressure loss.

6.3 Filtration An in-line Filter (with a sintered bronze element is provided to filter out any particles which could cause plugging of the cooling passages. If the water supply is such that frequent servicing of the filter due to plugging is required, it is recommended that a larger capacity supplemental filter be provided at the inlet of the JFTOT.

6.3.1 Servicing of the water system consists of periodic cleaning of the Filter (or when required, consistent with the quality of the water supply. To accomplish this, disconnect filter from system and remove filter element. Clean element by soaking in cleaning solution and blow out the compressed air.

6.3.2 In location where very hard water is available, it is possible to build up lime deposits in the bus bars to the point of restricting water flow. In these instances, it is necessary to treat the bus bars by pumping a solution of acetic acid or other lime dissolving solution through the cooling passages.



	P/N	DESCRIPTION		P/N	DESCRIPTION
1	28029	Bulkhead Union, '4 T	14	28168	Elbow, ' T x -. PT
2	49291	Insulating Tubing, 4	15	11936	Reducer Bushing, - 'P
		(4 PCS-16" long) & (2 PCS-4'." long)	16	80799	Water Pressure Switch
3.	28167	Elbow, '4 Tx 'a MPT	17	57985	Water Flowmeter
4	27045	Water Filter			Assembly includes 28167 28071)
5.	43740	Line Assy, 'B ss (Fuel)	18	43753	Line Assy , Copper (Water)
6.	28078	Split Connector	19	28065	Male Connector, 1/8 T x 1/8 P
7	43751	Line Assy, 1/4 Copper (Water)	20	28030	Union, 1/4T
8	28071	Male Connector. 4 T x '. MPT	21	28031	Reducer Union. 1/8 x 1/4 T
9	28150	Cross, 1/8 PT Brass	22	10775	Jet Assy, Upper Bus
10.	57984	Water Pressure Gage	23	10783	Jet, Assy, Lower Bus
11	28130	Nipple. 1/8 P Close	24	84064	Lug Connector, Water Cooled
12.	28298	Elbow, "1/'8 PT Street, Brass	25	10774	Upper Bus, Assy
13	93060	Water Cut-off Solenoid	26	10781	Lower Bus, Assy

Figure M6-1 Water Schematic

7. ELECTRICAL SYSTEM

7.1 The electrical schematic for the unit is presented in Figures M7-1. All wires are numbered and can easily be traced. Early JFTOT units (under S/ N 107) were equipped with replaceable fuses. Model 215 JFTOT units are equipped with circuit breakers which can be reset (P/N 29687, 29688, 29689) that are 3, 6 and 8 amp respectively.

7.2 Power Requirements

7.2.1 Basically all JFTOT units operate on 1 15 Volts, single phase power and require a supply circuit capable of delivering at least 1.7 k.

7.2.2 For 220 Volt operation, an external Step down Transformer is supplied.

7.2.3 JFTOT's are supplied for either 60 Hz operation or 50 Hz operation. Each unit will not operate properly if it is used with the incorrect power supply, because the pump motor and timers will be at incorrect speed due to the frequency difference.

7.2.4 All JFTOT units are supplied with a plug-in externally mounted constant voltage transformer which normally can be placed adjacent to the tester or placed under the bench. The function of this transformer is to provide a stabilized voltage to the heater tube circuit of the tester. There is no need to rewire the transformer; simply connect JFTOT to transformer with cable provided.

7.3 Circuits

7.3.1 Power Switch

7.3.2 Pump Switch

7.3.3 Heater Switch

7.3.4 Auto-Manual Switch

7.3.5 Auto Cal Switches

7.3.6 Heater Tube Control

7.3.7 AP and Alarm

7.3.8 Safety-shutoff

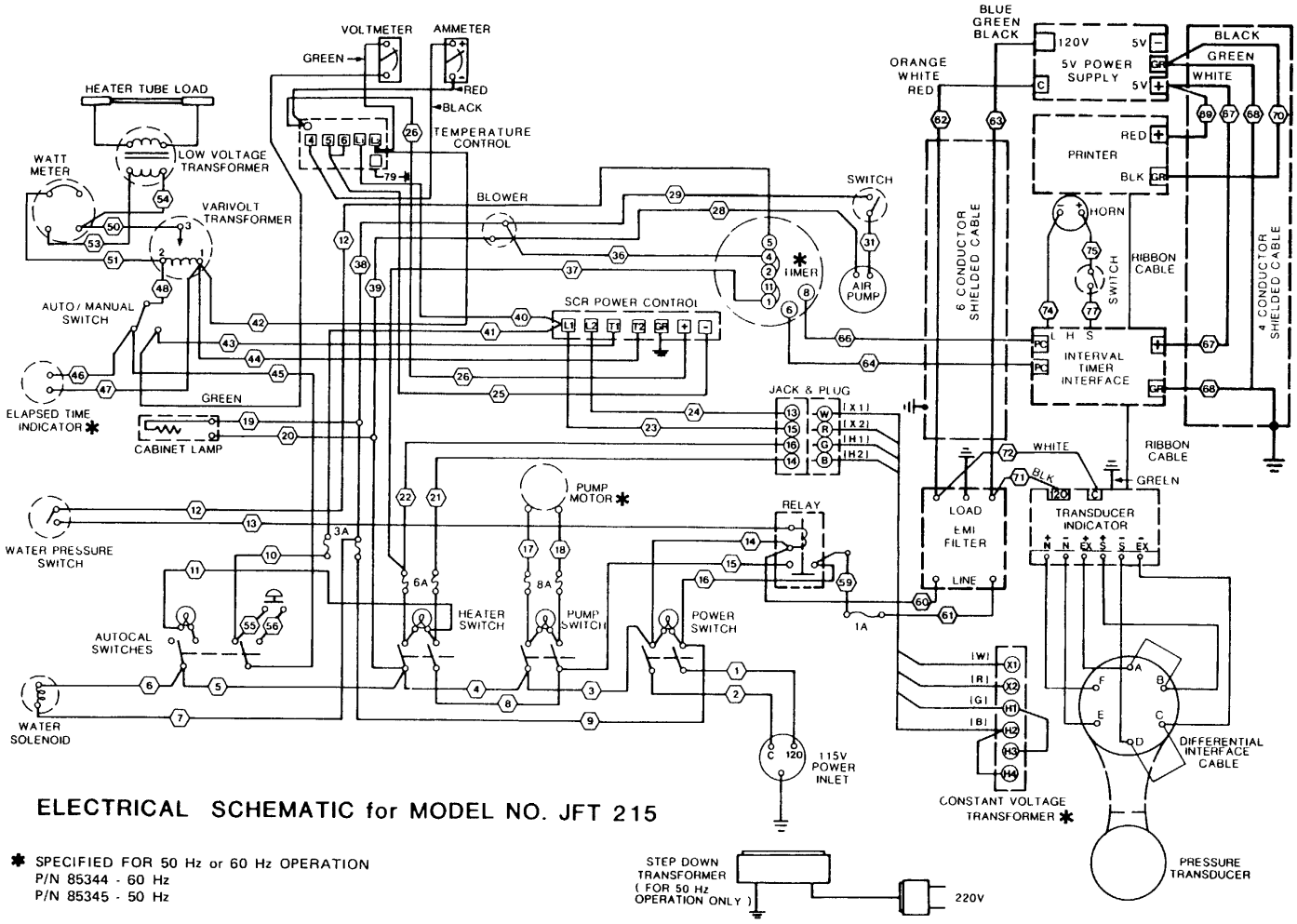


Figure M7-1 Electrical Schematic

JFTOT TROUBLESHOOTING GUIDE

	Symptom	Probable Cause	Recommended Action
1	**No electrical Power when "POWER" switch is turned ON (Red Indicator and Cabinet Lights do not come ON, Fan inoperative, and "clicking" sound of Water Solenoid cannot be heard).**	**1. External Power Supply is off.** **2. Power Cord into JFTOT not properly plugged in.** **3. Faulty Power Cord.** **4. Faulty Power Switch.**	**1. Restore external Power Supply.** **2. Be sure both ends of JFTOT Power Cord are plugged all the way.** **3. Replace Power Cord.** **4. Replace Power Switch.**
2	No power available in "AUTOCAL" Mode.	1 Constant Voltage Transformer not plugged in 2 Power Controls not set properly. 3 Fuse blown or Circuit Breaker off 4 Faulty AutoCal Switch.	1 Plug in Transformer 2 Set "Power Control" to 75—110 setting, and switch to "Manual" Mode. 3 Replace Fuse or reset Circuit Breaker. 4 Replace AutoCal Switch.
3	**Water Pressure below minimum in RED range.**	**1. Plant Water Supply Pressure too low.** **2. Water Filter in JFTOT is plugged.**	**1. Provide minimum required Water Pressure 200 kN/m² (30 psig) adequate Water Supply Line to minimize pressure drop.** **2. Remove Filter - Clean - Replace.**
4	Marginal or No Water Flow but Water Pressure is adequate and in GREEN range.	1 Flow Control Valve of Water Flowmeter closed or not properly set. 2. Water Solenoid malfunctioning and blocking flow. 3. Restriction in System such as Lime Deposit build-up in Bus Bars	1 Open and set Flow control valve to proper flow in GREEN range. 2. Replace Water Solenoid Valve. 3 Locate Restriction and clean. To dissolve Lime Deposits circulate Acetic Acid solution until full flow capability is restored.
5	**No electrical Power available when PUMP and HEATER Switches are turned ON (Red Indicator lights do not come Off).**	**1. Water pressure too low. Not closing Water Pressure Switch.** **2. Water Pressure Switch malfunctioning or defective.** **3. Timer set in OFF position.** **4. Malfunction of KAPTAG Relay Assembly.** **5. Malfunction of Power Cutoff Relay.**	**1. Provide minimum required Water Pressure 200 kN/m² (30 psig).** **2. Replace with new Switch.** **3. Place Timer at 2½ hour position.** **4. Replace Relay.** **5. Replace Relay.**
6	Heater Tube does not get any Power and therefore will not heat. HEATER Switch and Indicator Light are ON.	1 Constant Voltage Transformer not plugged in properly 2 Broken Thermocouple which causes Deviation Pointer of Temperature Controller to go to extreme right (up scale) resulting in Power Cutoff 3 Switches and Power Control in incorrect Position 4 SCR Power Supply Switches incorrectly set.	1. Check to see that unit is plugged in properly 2. Replace Thermocouple. 3. See that AutoCal Switch is in OFF Position and Power Control is turned clockwise to 75 to 110 setting and Switch in AUTOMATIC Mode. 4. Slide switch should be on "Local" Position. "Bias" Knob should be at 0 position and "Gain" Knob should be at .5 Position.
7	**Excessive high Wattage on Heater Tube.**	**1. Heater Tube not properly clamped onto Bus Bars.** **2. Bus Bar connection with Heater Tube is dirty.** **3. Loose, or corroded Connections between Secondary Cable and Bus Bars.**	**1. Tighten Screws on Bus Bar Caps.** **2. Thoroughly clean Bus Bar connection points.** **3. Clean all Connection Points thoroughly and reassemble Connections.**
8	Automatic Shutoff does not terminate Test at preset Time.	1 Momentary interruption of Electrical Power to JFTOT has reset Timer	1 Determine and eliminate power interruption. If aware that a momentary Interruption has occurred, terminate Test by Elapsed Time Clock or by resetting Timer for remaining balance of test time.
9	**Low Nitrogen Pressure (less than 3.45 MN/m² - 50 psig). If pressure cannot be raised by opening PRESSURIZE Valve.**	**1. Supply Regulator set too low.** **2. Nitrogen supply exhausted.** **3. Pressure Limiter cut off due to fast pressurization or over-pressure condition on Nitrogen Inlet.**	**1. Increase setting.** **2. Install new bottle.** **3. Cut off Nitrogen supply to JFTOT. Relieve all Pressure on both Sides of Limiter to allow reset of Limiter. Repressurize carefully not to exceed 3.45 MN/m² (500 psig).**
10	FUEL LEAKS 1. Pump 2. Heater Tube Section 3. Lines & Fittings	1 Loose Trunnion - worn out Pump Seal. 2 Seal leakage 3 Seal leakage or faulty Fitting	1 Tighten Trunnion or install new Pump. 2 Finger tighten or install new Seals. 3 Tighten or replace.
11	**No Fuel flow at Start of Test - Pump Motor Running**	**1. Air/Nitrogen in System.** **2. Pump Drive Gear disengaged.** **3. Prefilter Backup Screen covering outlet.**	**1. Allow time, approx. 1 Minute, for Air/Nitrogen to be pumped through.** **2. Pivot Pump to re-engage Gear Drive and tighten Trunnion.** **3. Replace screen, make sure outlet tube not protruding.**
12	Fuel Flow stops before completion of Test.	1. Reservoir was charged with insufficient quantity of Fuel. 2. Piston sunk to bottom of Reservoir because of leakage past damaged Lip Seal or due to improper seal installation. 3. Prefilter plugged - Reservoir probably charged with unfiltered Test Fuel	1 Repeat Test with proper amount of Fuel. 2 Repeat test complying with paragraph 7.3 of Operating Manual. 3. Repeat Test. Be sure Test Fuel is filtered through proper Filter Paper and Reservoir is cleaned as per Paragraph 7.4 of Operating Manual.
13	**Transducer indicator won't zero**	**1. Air in Transducer Cell.** **2. Incidental pressure on one side of differential.**	**1. Follow air bleed procedure.** **2. Adjust course tare on transducer indicator.**
14	Excessive Nitrogen Consumption	1. Nitrogen Leak because of loose Fitting or faulty seal.	1 Locate Leak using bubble forming Solution. Tighten Fitting or replace Seal.
15	**No Air Flow when Aeration Timer Switch is turned ON.**	**1. No electrical power available at Air Pump.** **2. Air Flow Control Valve closed.** **3. Plastic Tubing slipped off Fitting.** **4. Air Pump failure.**	**1. Turn POWER Switch ON.** **2. Open Valve and adjust flow to GREEN range.** **3. Reconnect.** **4. Replace Air Pump.**
16	Indicating Silica Gel in Filter and Dryer Assembly turns from blue to pink.	1. Capacity for the Silica Gel to absorb moisture has been expended	1. Recharge Dryer Assembly with new Silica Gel or install new Filter Assembly.

TOLL FREE 1/800-354-7233 (US) 1/800-348-3835 (TX)

Alcor inc.

WARRANTY CERTIFICATE

ALCOR Inc. warrants the listed Jet Fuel Thermal Oxidation Tester (JFTOT) manufactured by ALCOR Inc. to be free from defects in material and workmanship under normal use and service for a period of 1 year of operation except for the Metering Pump, P/N 60055 for which the warranty period is limited to 6 months of operation.

The obligation of ALCOR Inc. under this warranty is limited to the repair or replacement, at ALCOR's option, of any part, component or JFTOT which, in the opinion of ALCOR, is defective and which has been returned to ALCOR's plant, transportation prepaid. This warranty shall not apply to any JFTOT, its component parts or accessories, which have been improperly installed, adjusted, stored, handled, repaired, altered or operated contrary to current ALCOR recommendations.

Warranty will not be granted for removal and installation of parts, components or accessories or for normally required maintenance functions such as minor repair, gasket or seal replacement, inspection requirements, adjustments, etc. Replacement or repair of a JFTOT, component or accessory will not be construed to extend the initial warranty period.

This warranty is expressly in lieu of all other warranties and representations, expressed or implied and all other obligations and liabilities, either direct or consequential on the part of ALCOR Inc.

Alcor inc.

By: [signature]

Title: Shipping Supervisor

Date: May 25, 1988

JFTOT

Model Number: 55344

Serial Number: 842

— NOT TRANSFERABLE —

P/N 59155

OPERATING MANUAL

Standard Method of Test for

THERMAL OXIDATION STABILITY OF TURBINE FUELS

(JFTOT PROCEDURE)

Following the procedure of

American Society of Testing and Materials

Method D-3241

JANUARY 1985

MAIL ADDRESS: P.O. BOX 792222 · SAN ANTONIO, TEXAS 78279-2222
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INTRODUCTION TO THE JFTOT

The original Jet Fuel Thermal Oxidation Tester (JFTOT), Model 202, 203, was used from about 1973 to present. The device proved to be a reliable and effective tool for monitoring thermal stability, an important characteristic of jet fuel. In 1984 a permanent change was made in the equipment to replace the undesirable mercury manometer with an electronic transducer for measuring pressure differential, or A P, in the test. This model is the JFTOT 215.

This manual is an expansion of the basic method (published by ASTM). Herein pictures are used extensively to illustrate the steps. Typically, laboratory people unfamiliar with the JFTOT can, with the aid of this manual, operate the JFTOT and achieve a satisfactory test.

Both instruments (with manometer or transducer) operate similarly. In this manual is illustrated the transducer model, but the steps of the method are the same using either model. Only a few details regarding checking and adjustment of the pressure measuring components are unique to a specific model.

UNITS

Following the ASTM standard practice, certain units abbreviations are used, as shown:

A	amps	rnin	minutes
^{o}	degrees	rnm	millimeters
g	grams	Pa	Pascal = Newton/meter^2
h	hours	psi	pounds force/inch2
Hz	hertz	s	seconds
K	kilo = x 10^3	V	volts
L	liters	W	watts
M	mega =10^6	Δ	delta = change in
m	milli = **10^{-3}**		

Though the ASTM method is now metricated, some old JFTOTs have gages in psi and controllers in °F only.

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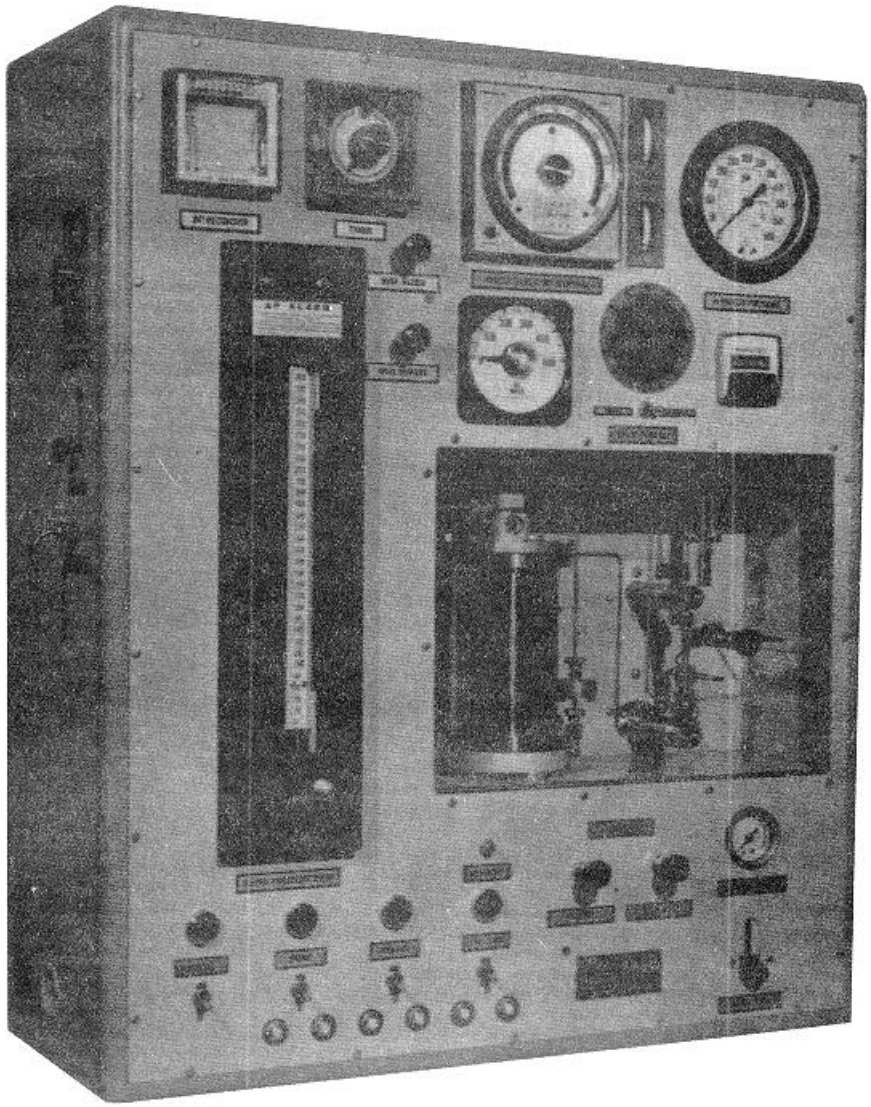


Figure 1. ALCOR Jet Fuel Thermal Oxidation Tester. Mercury Manometer Model

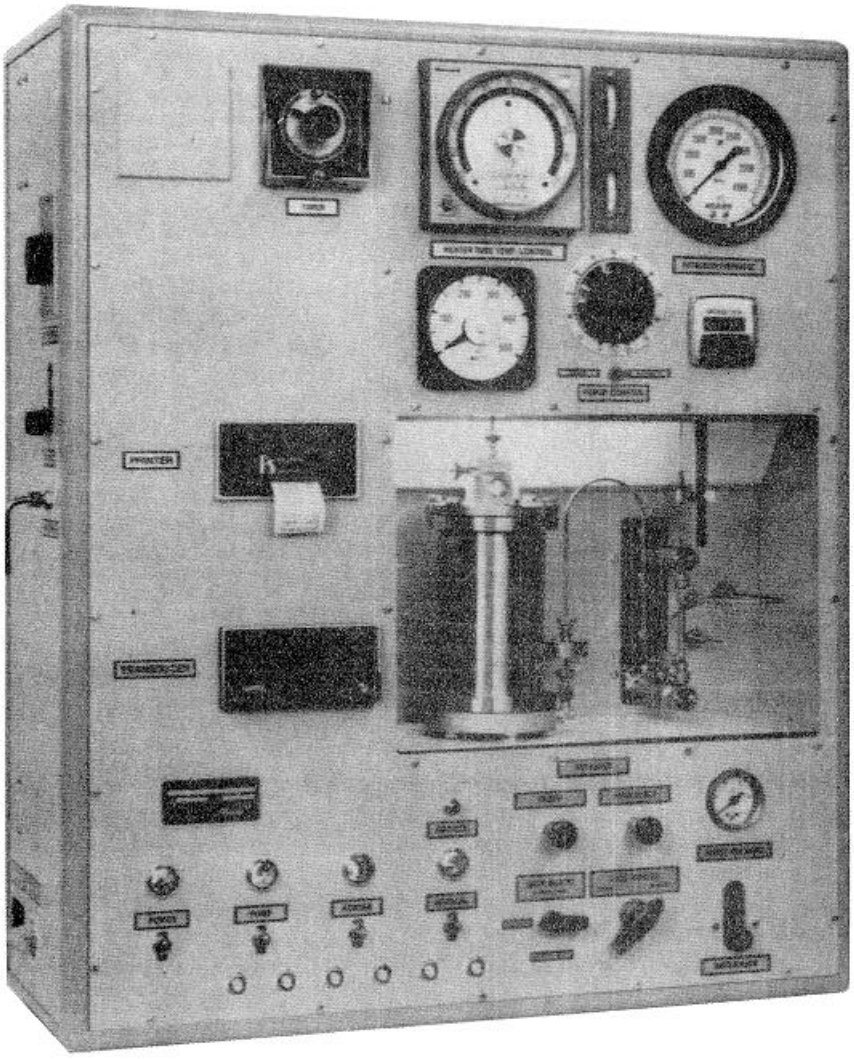


Figure 2. ALCOR Jet Fuel Thermal Oxidation Tester, Differential Pressure Transducer Model

Standard Method of Test for

THERMAL OXIDATION STABILITY OF TURBINE FUELS

(JFTOT PROCEDURE)'

Designation: D-3241

This Method has been approved by the sponsoring committee and accepted by the Society in accordance with established procedures. Suggestions for revisions should be addressed to the Society at 1916 Race Street, Philadelphia, Pennsylvania, 19103.

1. **Scope 1.1** This method of test covers the procedure for rating the tendencies of gas turbine fuels to deposit decomposition products within the fuel system.

2. Summary of Method

2.1 This method for measuring the high temperature stability of gas turbine fuels uses the Jet Fuel Thermal Oxidation Tester (JFTOT) which subjects the test fuel to conditions which can be related to those occurring in gas turbine engine fuel systems. The fuel is pumped at a fixed volumetric flow rate through a heater after which it enters a precision stainless steel filter where fuel degradation products may become trapped**.**

2.1.1 The apparatus requires 600 mL of test fuel for a 21H-h test. The essential data derived are the amount of deposits on an aluminum heater tube, and the rate of plugging of a 17 micron nominal porosity precision filter located just downstream of the heater tube.

3. Significance

3.1 The test results are indicative of fuel performance during gas turbine operation and can be used to assess the level of deposits that form when liquid fuel contacts a heated surface that is at a specified temperature.

4. Apparatus

4.1 Jet Fuel Thermal Oxidation Tester2 (JFTOT)Either of two models can be used: (Fig. 1,2) mercury manometer (MM) model **or** differential pressure transducer (DPT) model. Both are the same size, 914 mm high, 762 mm wide, and 305 mm deep and designed to sit upon a standard height chemical laboratory bench. A detailed description of the apparatus is in A1.

NO ATTEMPT SHOULD BE MADE TO OPERATE THE JFTOT WITHOUT FIRST BECOMING ACQUAINTED WITH ALL COMPONENTS AND THE FUNCTIONS OF EACH.

4.2 Heater Tube Deposit Rating Apparatus-
The amount of deposits on the heater tube are rated by either the Mark 8A Tube Deposit Rater2 or a Tuberator2 and the ASTM Color Standard3.
4.3 Materials, Supplies, and Spares These are listed in A2.

5. Standard Operating Conditions

5.1 Standard conditions of test are as follows:
5.1.1 Fuel Quantity 600 mL.
5.1.2 Fuel Pre-treatment Filtration through a single layer of general purpose, re tentative, qualitative filter paper followed by a 6-min aeration at 1.5 L/min air flow rate.
5.1.3 Fuel System Pressure 3.45 M Pa (500 psi) gage.
5.1.4 Maximum Heater Tube Temperature Preset as specified for fuel being tested.
5.1.5 Fuel Flow Rate -3.0 mL/min.
5.1.6 Test Duration 150 min.

1This method is under the Jurisdiction of ASTM Committee D-2 on Petroleum Products and Lubricants.

Current edition approved Aug. 27, 1982, Published October, 1982. Originally published as D3241 73T. Last previous edition D3241-77.

2Available from ALCOR, Inc., 10130 Jones Maltsberger Road, San Antonio, Texas 78284.

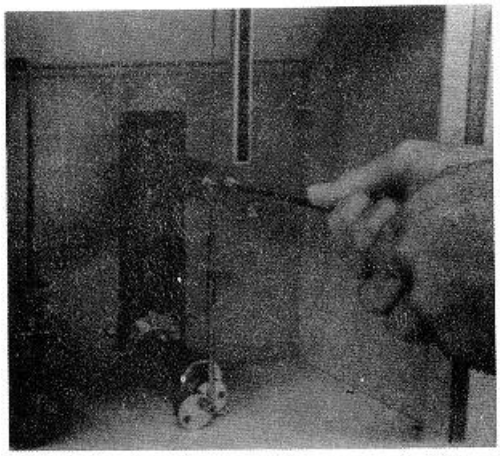
3The ASTM. Color Standard for tube deposit rating may be purchased from ASTM Headquarters, 1916 Race St., Philadelphia, PA, 19103. Request Adjunct No. 124 16600-00.

6. Preparation for Test

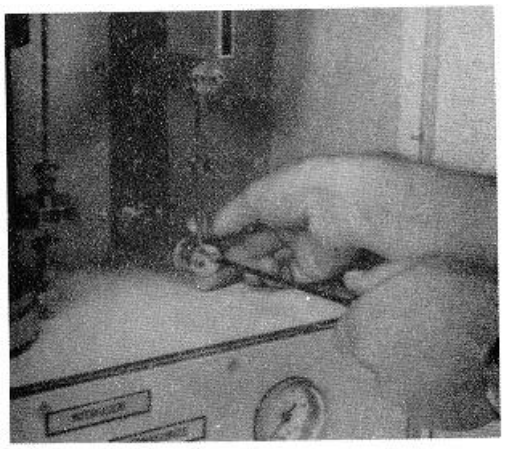
6.1 Calibration of Heater Tube Temperature Controller:

6.1.1 The AutoCal Calibrator is used for calibrating the heater tube temperature controller. This calibrator is a nickel-plated heater tube which has a small well containing pure tin. This method utilizes the freezing point of tin, 232°C, as the standard.

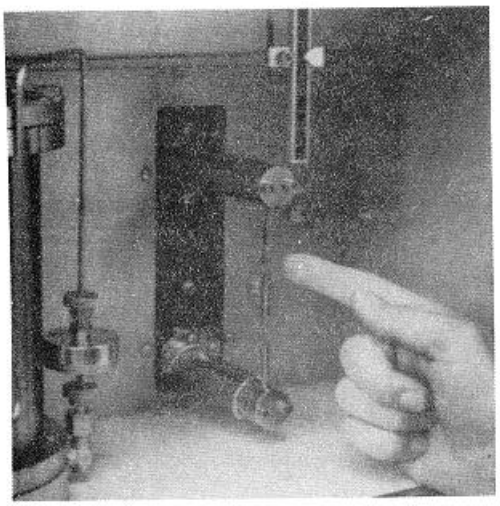
6.1.2 Install the AutoCal Calibrator by placing the hollow end of the calibrator flush with the top surface of the upper fixed bus and tighten both Allen screws.



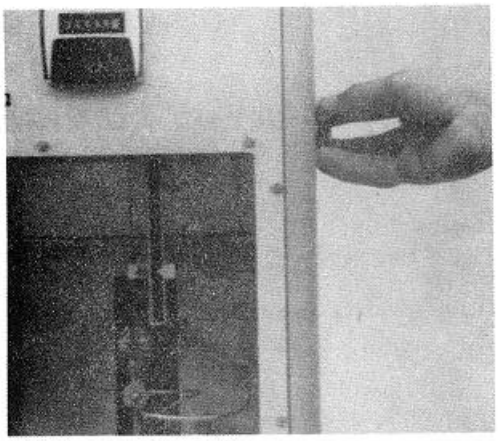
6.1.3 Secure the plugged end of the calibrator by raising the lower floating bus to the upper limit of its travel and tighten both Allen screws.



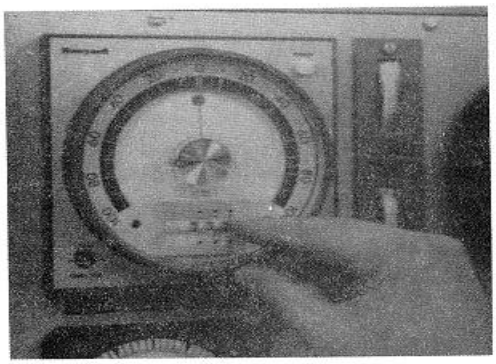
6.1.4 Lower the thermocouple through the upper section of the calibrator and coat the thermocouple tip with silicone grease to prevent sticking to tin.



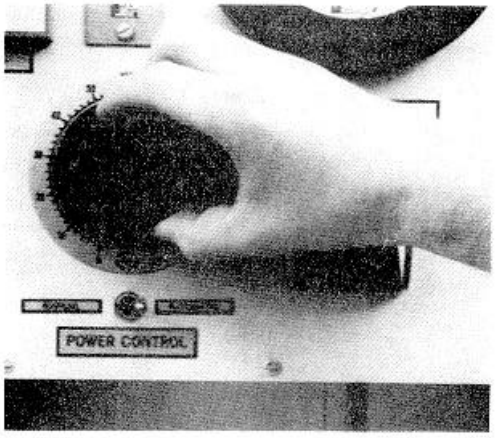
6.1.5 Lower the thermocouple into the well to press lightly against upper surface of the solid tin.



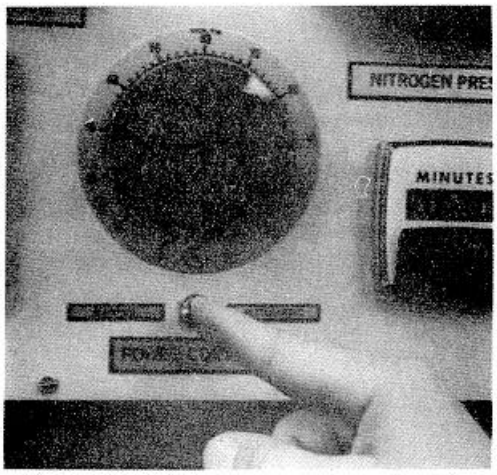
6.1.6 Set digital readout on HEATER TUBE TEMPERATURE CONTROL at 232.



6.1.7 Set POWER CONTROL at zero.

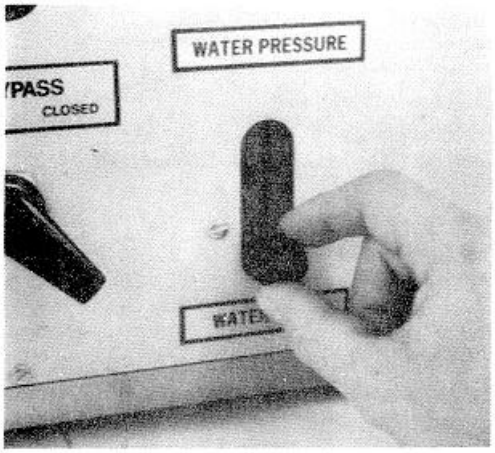


6.1.8 Switch CONTROL MODE to MANUAL position.

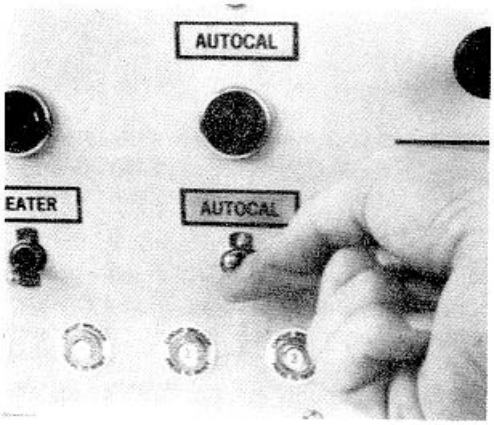


6.1.9 Switch POWER to ON.

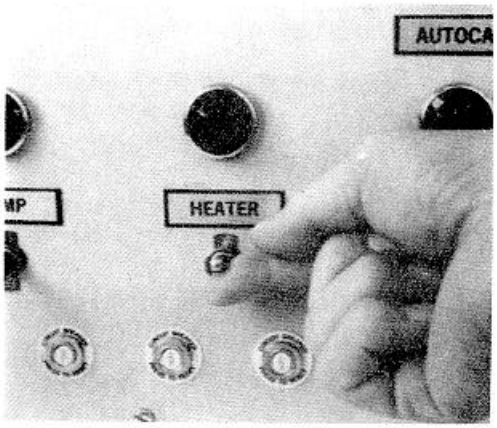
6.1.10 Check that water pressure is in green arc. Set WATER FLOW in green area (this corresponds to 38±8 L/h).



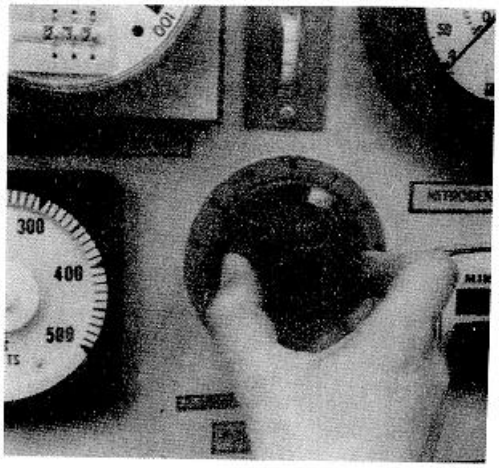
6.1.11 Switch AUTOCAL to ON.



6.1.12 Switch HEATER to ON.



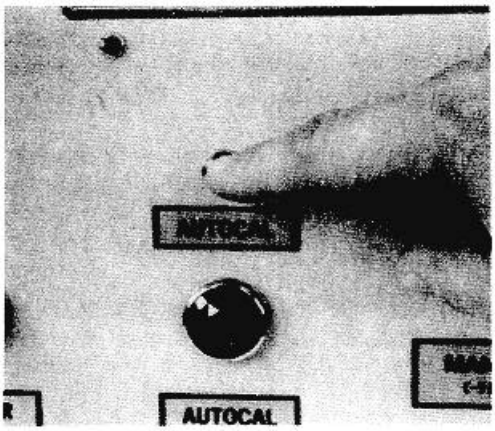
6.1.13 Set POWER CONTROL at 75 to 80 setting.



NOTE 1 - This power setting is normal; if more power is needed, this indicates some loss of power due likely to degradation of contact points in low voltage circuit (See A2.4.2).

6.1.14 Wait at least 2 min before proceeding with the calibration check to allow for temperature stabilization and warm-up of the temperature controller.

6.1.15 Depress AUTOCAL pushbutton for 3 sec. and observe the deviation meter needle of the HEATER TUBE TEMPERATURE CONTROL. Repeat at short intervals until the deviation meter needle swings to full right. This indicates that the tin is molten.



6.1.16 While the temperature deviation meter needle is deflected full right, carefully lower the thermocouple to the bottom of the well, noting the total distance of travel on the thermocouple positioning indicator and then raise it 2.5 mm. Be sure the thermocouple is centered in well.

NOTE 2 - If the travel of the thermocouple is not at least 5mm, refill the well with new tin in accordance with A5.1, then repeat procedure above, starting at 6.1.2.

6.1.17 If the temperature deviation meter needle is less than full right, depress AUTOCAL button until the needle is again full right scale deflection and then release. The deviation meter needle will move slowly from right to left, stop, and then reverse abruptly to the right and pause for about 3 to 5s. During the time the needle has paused, change the digital setting up or down to center the needle. The pause period constitutes the freezing point, the change of state from liquid to solid tin. The drop in temperature below the freeze point and abrupt reversal is due to the super-cooling characteristic of tin (see Fig. 3). If the deviation meter needle does not remain stationary for a minimum of 3s, the tin is contaminated and needs to be replaced. See A5 for replacement instructions.

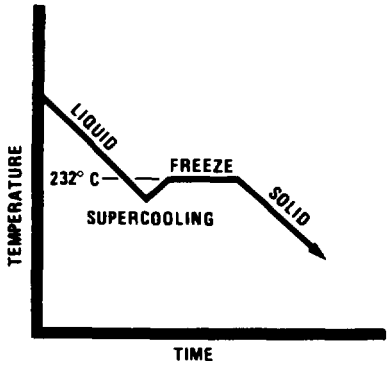
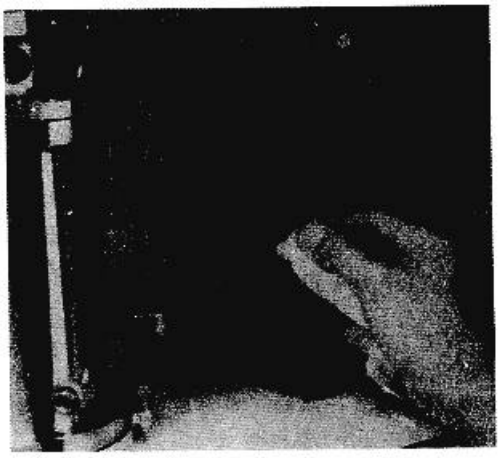


Figure 3. Freezing Characteristics of Tin

6.1.18 Repeat this procedure as necessary until the deviation meter needle is centered during pause without the need for adjustment of the controller digital setting. Observe and record on a data sheet (Fig. 4) the "indicated melting point" that is, the digital setting necessary to center the needle during pause.

6.1.19 When the "indicated melting point" has been satisfactorily determined, remelt the tin by depressing the AUTOCAL pushbutton to obtain a full right-scale deflection of the temperature deviation meter needle. Release the pushbutton and immediately raise the thermocouple tip so it is accessible. Remove all residual traces of silicone and tin by wiping the tip carefully with paper tissue. Inspect the tip closely for cleanliness.



6.1.20 Switch HEATER to OFF.

6.1.21 Switch AUTOCAL to OFF.

6.1.22 Raise the thermocouple to the extreme upper limit and remove the AutoCal calibrator.

6.2 *Checking Validity of DPT Cell:*

6.2.1 The calibration of the transducer system is internal and not normally access-

D-3241

ASTM THERMAL OXIDATION STABILITY TEST

USING

JET FUEL THERMAL OXIDATION TESTER

TEST NO. _____ FUEL DESCRIPTION _____

DATE _____ SAMPLE NO. _____

TESTING LAB _____ BATCH NO. _____

OPERATOR _____ TANK NO. _____

CONTROLLER CALIBRATION:

Indicated Melting Point _____ °C

True Melting Point 232 °C

Controller Error _____ °C

MAXIMUM HEATER TUBE TEMPERATURE:

Specified _____ °C

Controller Error _____ °C

Controller Setting _____ °C

CLOCK TIME:

Fuel Aerated _____ Heater On _____

FUEL TEMPERATURE AT AERATION _____

FILTER PRESSURE DROP DATA

Test Time, Minutes	Filter ΔP mm Hg.	Recorded ΔP mm Hg.	Test Time, Minutes
0	_____	2	_____
30	_____	10	_____
60	_____	15	_____
90	_____	25	_____
120	_____	50	_____
150	_____	75	_____
_____	250	125	_____

HEATER TUBE DEPOSIT DATA

Maximum Visual Deposit Rating, ASTM Code No. _____

Maximum Mark 8A TDR Spun Deposit Rating _____

Maximum Mark 8A TDR Spot Deposit Rating _____

REMARKS _____

Figure 4. JFTOT Data Sheet

ible to the user. The following procedure can be used to ensure that the DPT system is operational within the limits required for the test. DPT systems failing these criteria should be serviced by the vendor. A detailed discussion of the pressure measurement systems is given in A. 1.7.

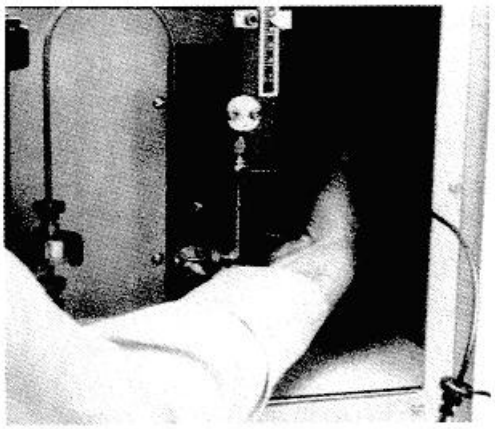
6.2.2 The DPT cell is factory calibrated to give an equivalent pressure reading to that which would result from using the mercury manometer. When a static check is made to confirm that the DPT cell is okay, the reading includes the offset tare for the flow compensation and the bias due to the basis being a mercury-kerosene manometer. The readings, therefore, are only relative to true but should be consistent for each JFTOT (see A1.7.4).

6.2.3 DPT system check. To confirm that the DPT model is reading correctly, perform the following check using the ΔP check device described in A.5.4.

6.2.3.1 Turn on system power and the transducer indicator. Allow warmup of at least 1 min.

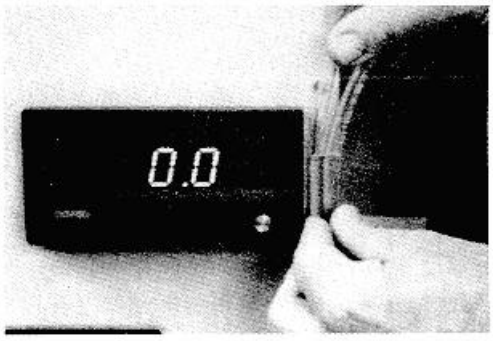
6.2.3.2 Fill the ΔP check manometer about half full of clean water. Make sure there are no air bubbles trapped by the water.

6.2.3.3 Connect and tighten snugly the manometer fitting to either bulkhead fitting on rear wall of the test section of a JFTOT 215, or either fitting of the transducer cell for a ΔP converted JFTOT 202/203.

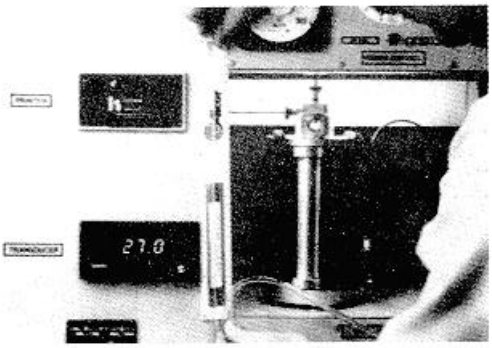


NOTE 3 - For this test it is assumed the system from bulkhead fittings to transducer is liquid full from previous test. If not, system must be filed and run to exclude air from transducer and related tubing as described in A5.3.

6.2.3.4 While holding the hose so the water columns are even, turn the zeroing knob of the transducer indicator to a convenient value (e.g. 1, 0, -1) and remember the value. Since the knob covers a very small range, 0.0 may not be possible in this static test, depending on whether the lines to the transducer are full of fuel or not.



6.2.3.5 Raise open end of plastic tubing until a difference of 343 mm (13.5 inches) is achieved between water levels in loop. After subtracting the starting value, this should yield about 27.0 mm on transducer indicator (which includes the 6% bias of the basic calibration). Value should hold steady; if it drops, there is a leak somewhere in system.



6.2.3.6 Value found by this check should fall within the range 26 to 28 mm. If this check indicates the DPT has drifted in accuracy, the transducer should be recalibrated using a millivolt source.

7. Preparation for Test

7.1 *Disassembly* - All the steps required for disassembly of the test section are given in Section 9.

7.2 *Inspection of Components:*

7.2.1 Inspect the reservoir cover O-ring for cuts, abrasion, and excessive swelling and replace as necessary.

7.2.2 Inspect all O-rings used on all line fittings, including those on nitrogen and fuel return lines, for cuts, abrasion, and excessive swelling and replace as necessary.

7.2.3 Inspect the heater tube insulators and replace if they are burred or badly scratched (aluminum) or broken (ceramic).

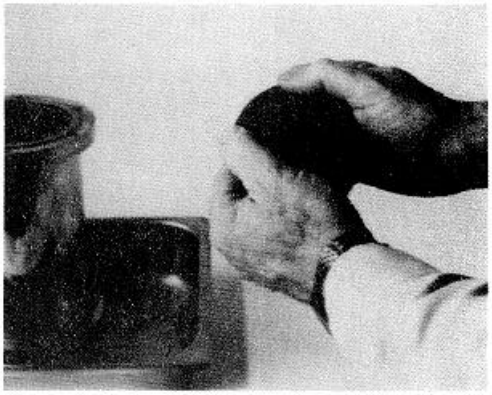
7.2.4 Inspect all stainless steel components for damage and replace as necessary.

7.3 *Inspection and Testing of Reservoir Piston Lip Seal:*

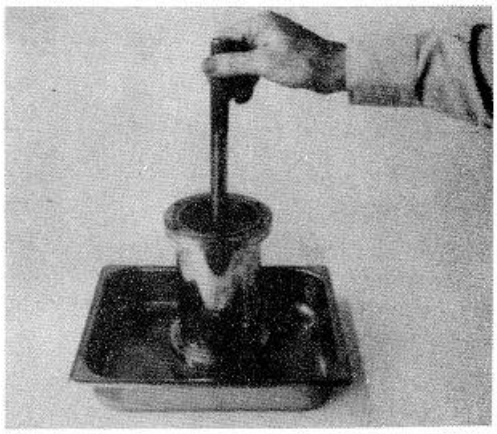
7.3.1 Inspect the lip seal for cuts, abrasion, or excessive swelling and replace as necessary.

7.3.2 When required to install a lip seal on the piston, be sure the inner lip is properly placed under retaining shoulder of piston. See Fig. A2.5 for proper lip seal assembly position.

7.3.3 With the thumbs, gently push the sealing edge of the lip seal outward from the center of the reservoir piston while slowly rotating the piston in the hands. This will minimize leaks past the seal.



7.3.4 Attach the piston puller to the piston. Wet the lip seal and reservoir wall with jet fuel and insert the piston so that the top of the lip seal is about 25 mm into the reservoir.



7.3.5 Close the outlet of the reservoir with the cap seal.

7.3.6 Pour jet fuel on top of the piston to a depth of about 6 mm.

7.3.7 Press downward on the piston puller until air leaks past the lip seal as evidenced by bubbles.

7.3.8 Release the pressure and observe whether air leakage past the lip seal stops. Change to a new lip seal if the air leakage does not stop immediately.

7.3.9 Remove the cap seal at the outlet and observe whether the piston moves downward with the piston puller in place. Change to a new lip seal if the piston does not move downward and repeat the lip seal test procedure, commencing with 7.3.2.

7.4 *Cleaning*:

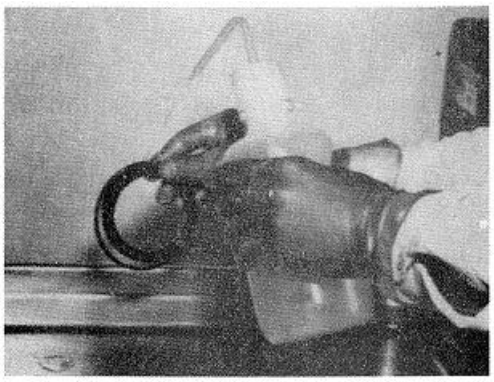
7.4.1 Put on protective gloves because of the possibility of skin irritation from solvents.

7.4.2 Position the cleaning pan to catch solvent during cleaning operations.

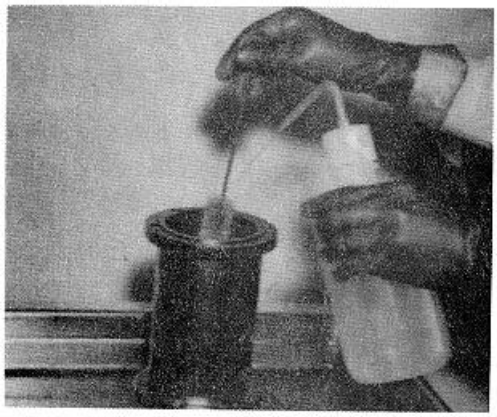
7.4.3 Place a new piece of aluminum foil about 450 mm square on the bench for placing all test section components after cleaning.

7.4.4 Using the wash bottle filled with n-heptane, flush the reservoir cover O-ring.

CAUTION - These solvents will irritate skin after a short time. Use rubber gloves, but it is recommended that gloves not be reused.



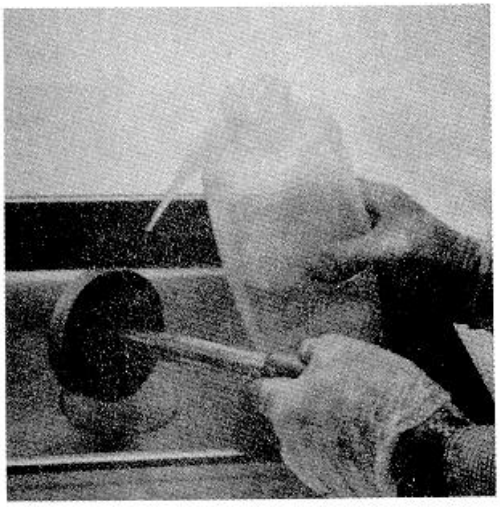
7.4.5 Flush all inside surfaces of the reservoir with solvent while scrubbing the surfaces with nylon brush.



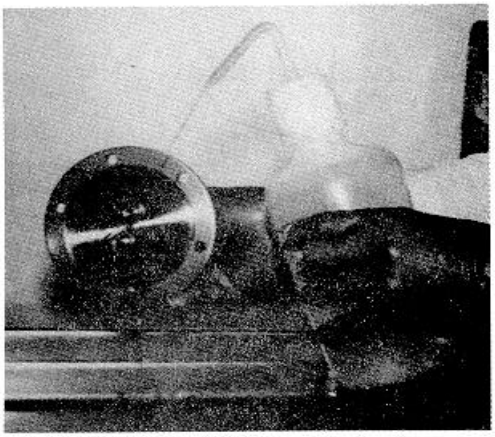
7.4.6 Flush all inside surfaces of the reservoir with solvent without brushing, and set the reservoir upside down on aluminum foil.

7.4.7 Using a squeeze bulb, blow out the reservoir fuel outlet exit fitting on the bottom of the reservoir to remove solvent.

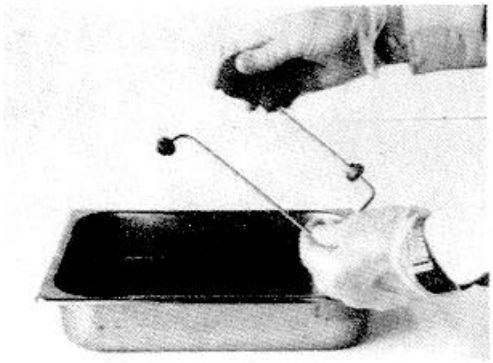
7.4.8 Handling the reservoir piston by a piston puller, repeat 7.4.4 and 7.4.5 for the reservoir piston, being careful not to brush or damage the lip seal.



7.4.9 Flush reservoir cover assembly with solvent.



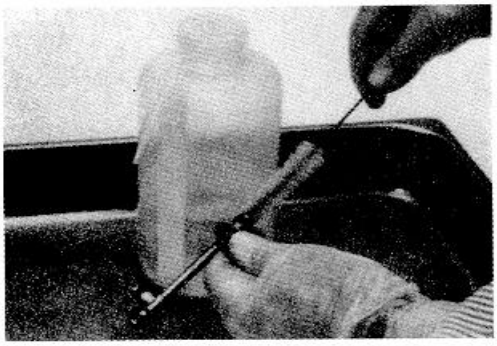
7.4.10 Flush heater tube fuel supply line and heater tube fuel outlet line with solvent and thoroughly blow dry using a squeeze bulb.



7.4.11 Flush the pre-filter components with solvent.

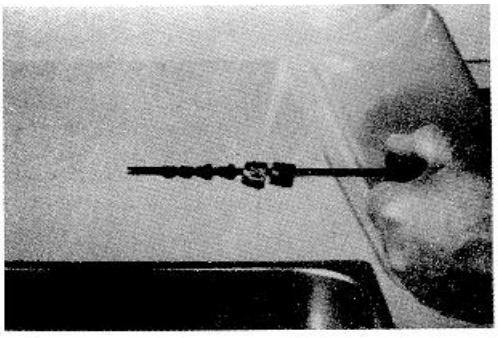
7.4.12 Using a nylon brush saturated with trisolvent, brush the inside surfaces of the heater tube housing.

NOTE 4 - This is the only component that requires cleaning with trisolvent.

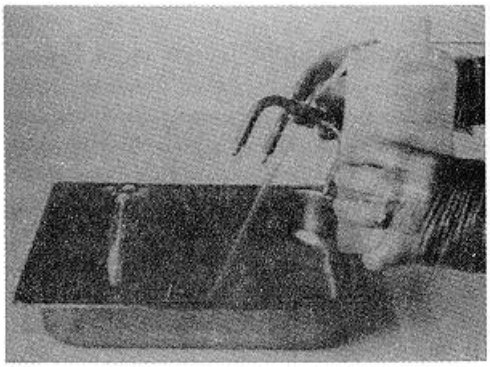


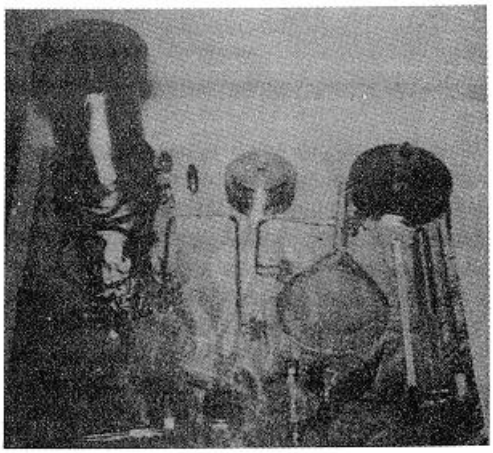
7.4.13 Flush the heater tube housing and filter bypass line with solvent and blow dry with a squeeze bulb. Visually inspect the inner surfaces of the heater tube housing for cleanliness and repeat 7.4.12 as required to remove all deposits.

7.4.14 Flush the four insulators and heater tube housing nuts with solvent.



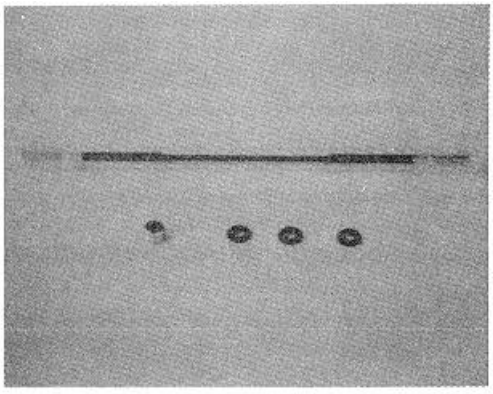
7.4.15 Flush the glass filter funnel and glass aeration tube with solvent.





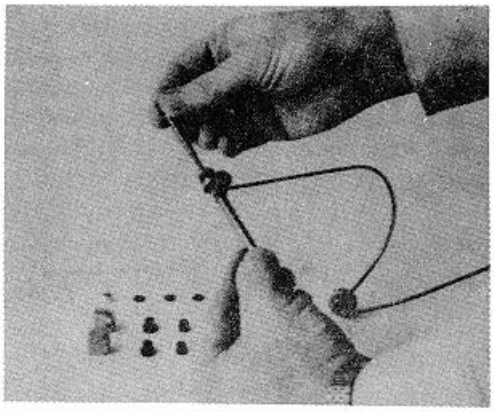
7.5 *Assembly of Heater Tube Section:*

7.5.1 New heater tube, test filter, and three new high temperature O-rings are required for each test2.



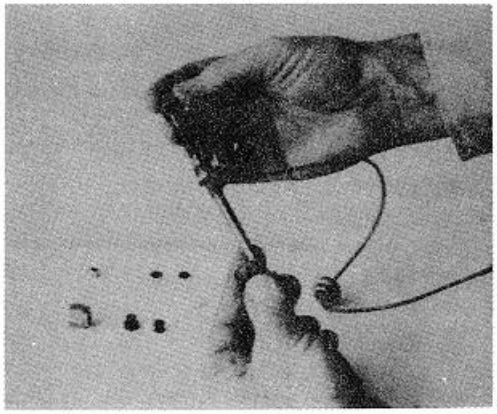
7.5.2 During assembly be sure to have CLEAN hands or wear clean, dry gloves.

7.5.3 Holding the heater tube at one end, carefully insert it into the heater tube housing. Note the the open end of the heater tube must be oriented UP to permit thermocouple insertion while the lower end is plugged to identify it. See Fig. A2.4 for proper heater tube section assembly.



IF THE CENTER TEST SECTION IS TOUCHED, REJECT THE TUBE AS THE DEPOSIT-FORMING CHARACTERISTICS ON THE TUBE WILL BE AFFECTED.

7.5.4 Onto one end of the heater tube, sequentially install a flared insulator (flared end out), high temperature O-ring, shoulder insulator (large end first), and hex nut. Lightly finger tighten nut with the heater tube approximately centered in the housing. See Fig. A2.4.



7.5.5 Repeat the above procedure for the other end of the heater tube.

7.5.6 Observe the heater tube through the fuel discharge hole of the heater tube housing. Align heater tube shoulder with the center of the fuel discharge hold (see Fig. 5). Tighten the hex nuts firmly with fingers only. DO NOT USE A WRENCH.

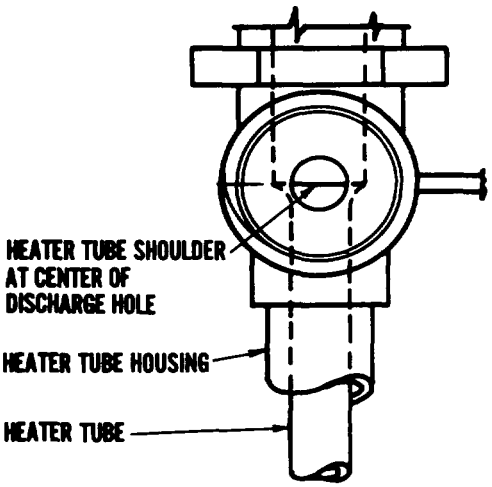
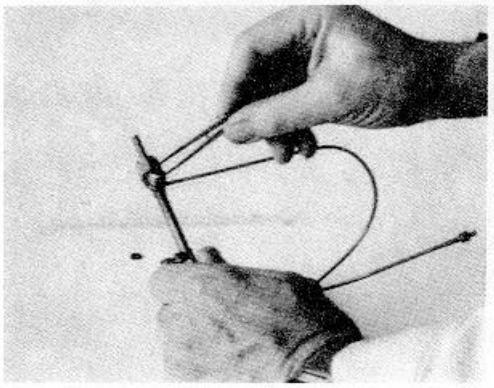
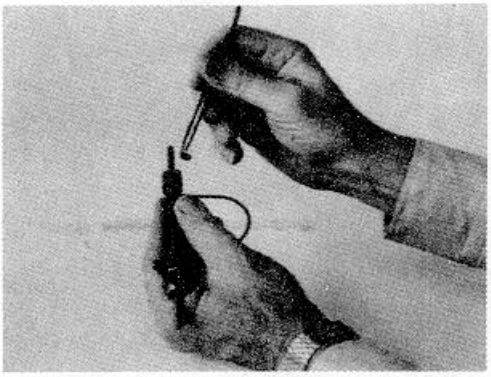


Figure 5 - Alignment of Heater Tube

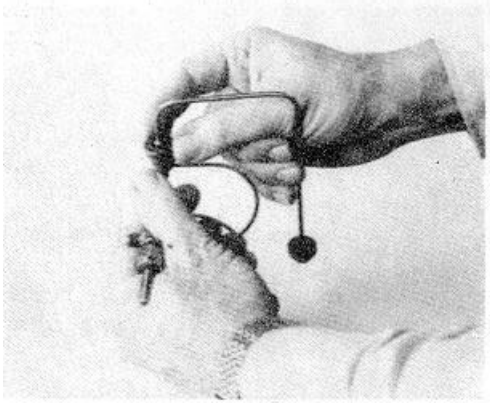
7.5.7 Using clean tweezers, install the test filter RED COLORED SIDE OUT in the outlet chamber of the heater tube housing.



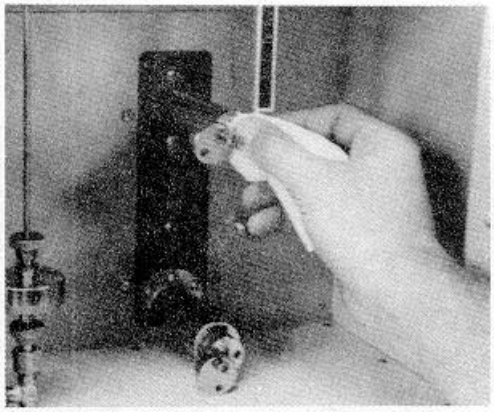
7.5.8 Place a new O-ring on top of the test filter, pushing the O-ring in until it bottoms against the filter.



7.5.9 Connect the fuel outlet line assembly to the heater tube housing outlet. Finger tighten lightly.

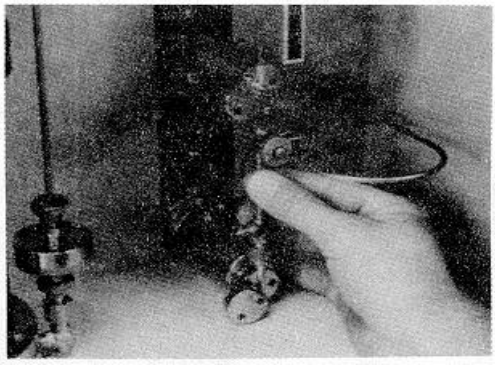


7.5.10 Using paper tissue wet with solvent, clean the contact areas of busses.



7.5.11 Raise the thermocouple to the uppermost position.

7.5.12 Place the heater tube test section between busses. Check the alignment. Connect and tighten the heater tube fuel outlet and bypass lines to the bulkhead fittings on the rear wall of the test section being sure that the O-rings on these fittings are in place.

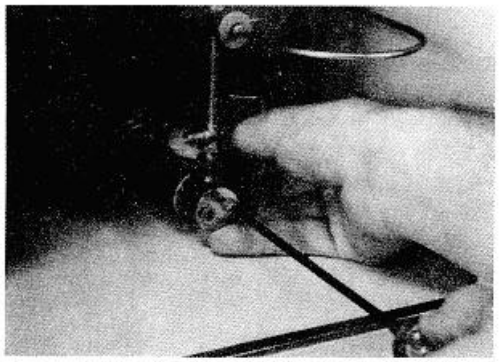


7.5.13 If the bus caps have been removed, check for proper mating. Numbers are stamped on inside faces and these must be the same and must face each other.

NOTE 5 - Normally do not remove the caps entirely from their respective bus during disassembly.

7.5.14 Tighten both Allen screws of the upper fixed bus cap after making sure that upper end of the heater tube is flush with the top surface of the upper fixed bus.

7.5.15 Raise the lower floating bus until it touches the lower insulator of the heater tube test section and tighten both Allen screws of the lower floating bus cap.



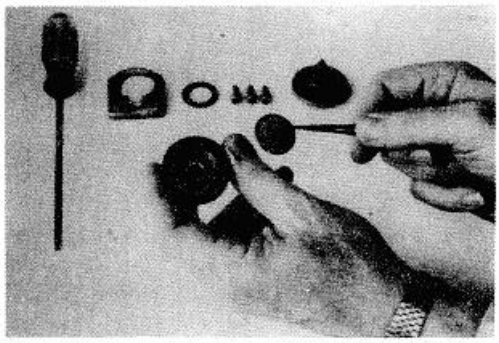
7.5.16 Check the thermocouple for proper position by raising the position indicator to the thermocouple reference line. See Fig. A2. The thermocouple tip must be flush with the top of the heater tube and the top of the upper fixed bus. If not, see A5.

7.5.17 Insert the thermocouple into the upper end of the heater tube and lower to 38.7 mm position.

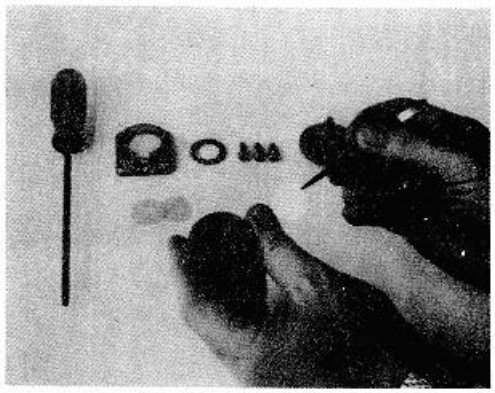
7.6 *Assembly and Installation of Pre-Filter:*

7.6.1 For each test, use a new 0.45 micron membrane filter element of 25 mm diameter.

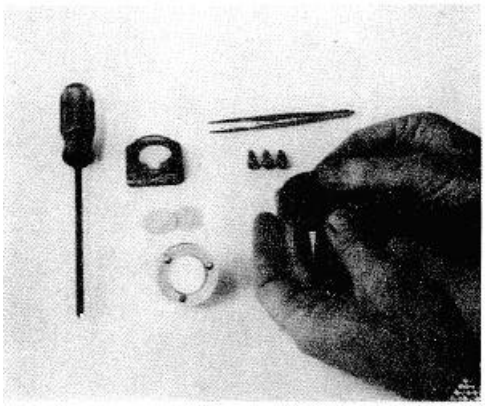
7.6.2 Using clean flat-bladed unserrated tweezers, install the filter element back-up screen in the pre-filter housing recess.



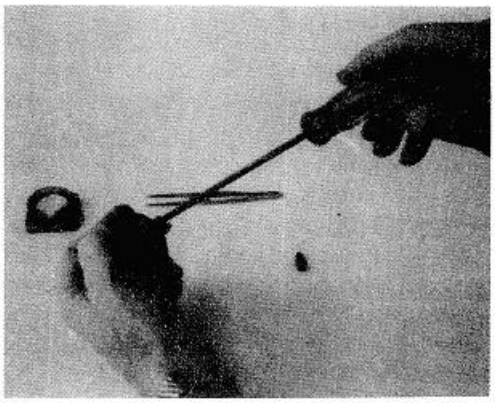
7.6.3 Using clean tweezers, place the white 0.45 micron membrane filter element on the back-up screen.



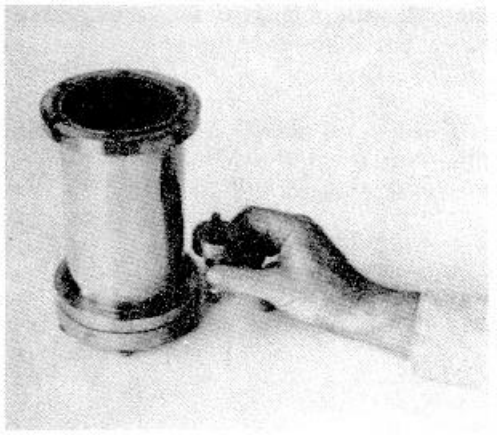
7.6.4 Install the O-ring on the other half of the pre-filter housing.



7.6.5 Assemble the two housing sections, insert the three screws and tighten.

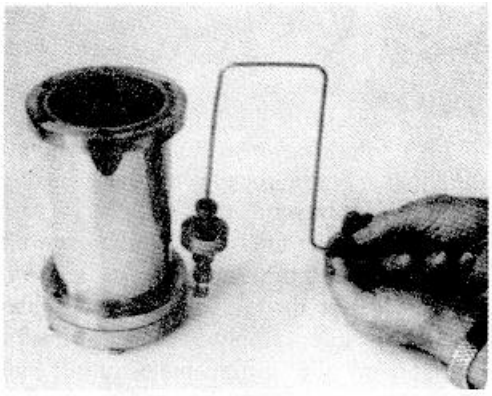


7.6.6 Connect the pre-filter assembly to the reservoir outlet and finger tighten snugly.



7.6.7 Connect the heater tube fuel supply line to pre-filter and finger tighten snugly.

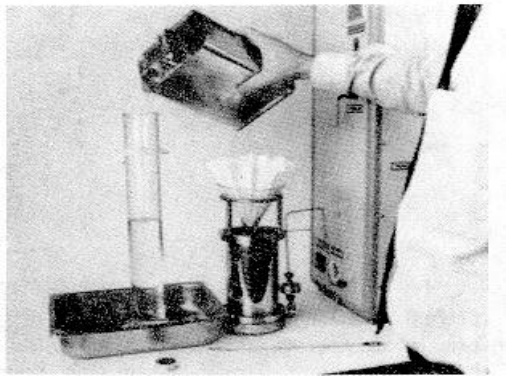
7.6.8 Install cap seal at end of heater tube fuel supply line.



7.7 *Preparation of Test Fuel:*

7.7.1 Place a general-purpose, retentive, qualitative filter paper into a glass funnel and set the funnel into funnel holder that attaches to the reservoir.

7.7.2 Measure 600 mL of fuel using a clean graduated cylinder.



NOTE 6 - Because it is necessary to have the test fuel at 15 to 32°C after filtration, it is desirable to have the test fuel within the temperature range at this time.

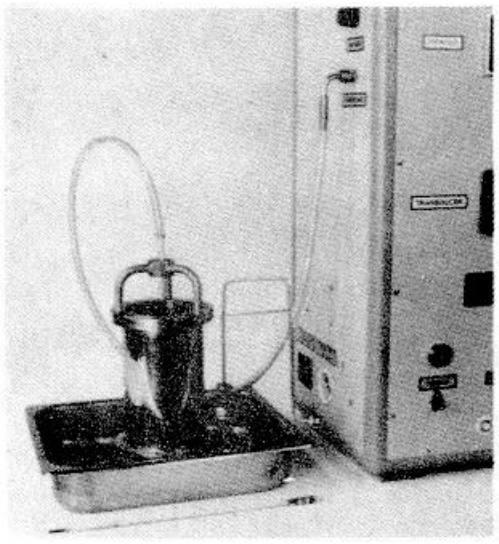
7.7.3 Pour the test fuel into the filter and allow the fuel to flow into the reservoir.

7.7.4 Remove the funnel holder.

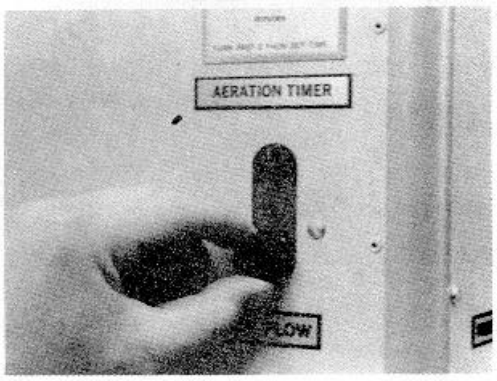
7.7.5 Insert a clean glass thermometer to measure the temperature of the test fuel. The test fuel shall be between 15 and 32° C. If the fuel temperature is outside of these limits, a suitable way to change the temperature is to set the reservoir comtaining the filtered test fuel into a hot or cold water bath as required to bring the fuel temperature within limits.

7.7.6 Insert into the reservoir the sintered glass aeration tube attached to the aeration tube holder. Position the diffuser so that it is touching the bottom of reservoir.

7.7.7 Using clean, dry flexible plastic tubing, connect the aeration tube to the METERED AIR outlet on the left side of the JFTOT.

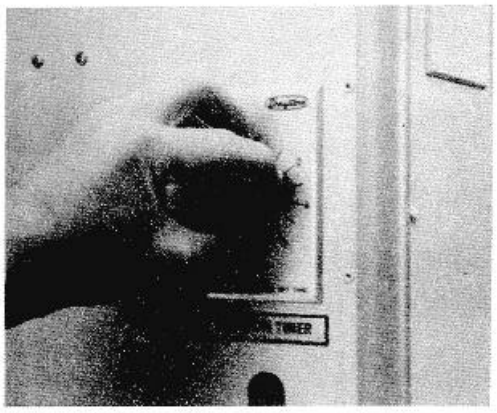


7.7.8 Open the AIR FLOW rotometer control valve approximately 1/8 of a turn to avoid possible pressure build-up.

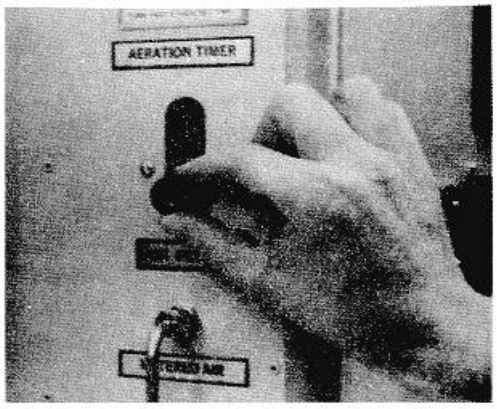


7.7.9 Switch POWER to ON.

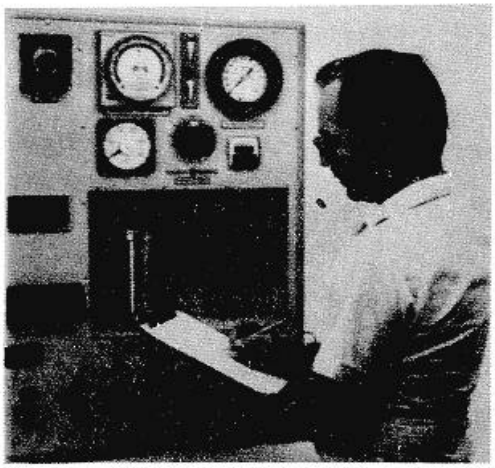
7.7.10 Turn the AERATION TIMER control to 6 min.



7.7.11 Using the AIR FLOW valve, adjust float to green range on flowmeter (this corresponds to approximately 1.5 L/min.



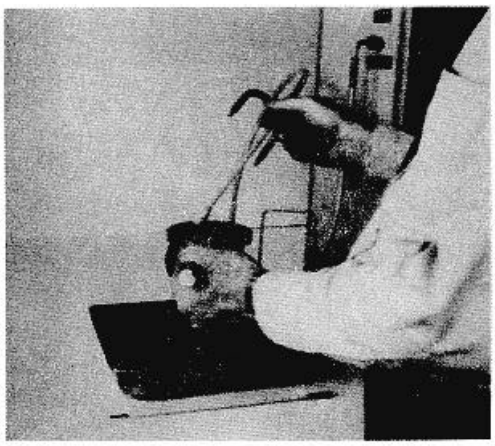
7.7.12 Record on the data sheet clock time at which aeration is complete. No more than 1 h should elapse between this time and time at which the heater switch is turned on.



7.7.13 When the AERATION TIMER has shut off the air flow, remove the aeration tube and its holder from the reservoir. Use the test fuel dripping from the aeration tube to wet piston lip seal in 7.8.1.

7.8 *Assembly of Reservoir Section:*

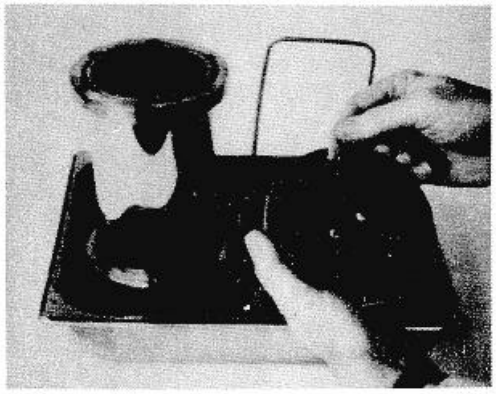
7.8.1 With the reservoir piston puller attached to the piston, wet the lip seal with filtered test fuel dripping from the aeration tube in accordance with 7.7.13



7.8.2 Insert the piston into the reservoir.

7.8.3 Push down with the piston puller, applying a gentle rocking motion, moving the piston downward until air leakage past the seal turns to fuel; that is, eliminate all air below the piston and lip seal. Loosen the cap seal at the end of the heater tube fuel supply line. Apply a slight downward pressure on the piston puller until fuel appears at the cap seal, and retighten the cap seal. Unscrew and remove the piston puller.

7.8.4 Wet the reservoir O-ring with any fuel and place the O-ring into cover groove.

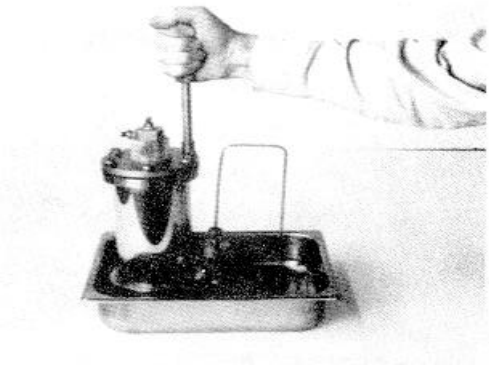


7.8.5 Place the reservoir cover on top of the fuel reservoir, taking care that the O-ring stays in the groove. Orient the cover so that the nitrogen inlet fitting on the drip flow

indicator is diametrically opposite to the pre-filter fitting.

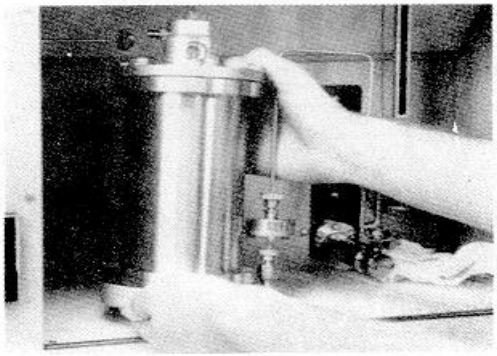
NOTE 7 - Be sure that PROTECTOR SIGHT GLASS is mounted properly over the drip flow housing.

7.8.6 Insert the capscrews into the reservoir cover holes and tighten uniformly with nut driver.

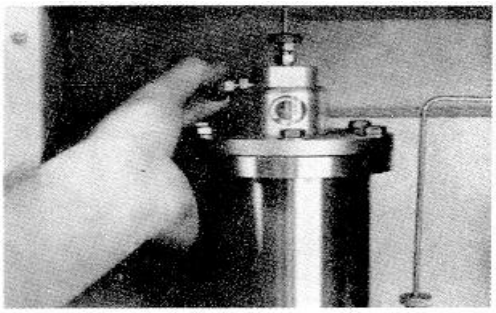


7.8.7 Flush outside of the reservoir with solvent to remove fuel.

7.8.8 Place the reservoir assembly into the cabinet so that the fore and aft bottom capscrew heads drop into positioning recesses with the pre-filter section oriented toward the heater tube section.

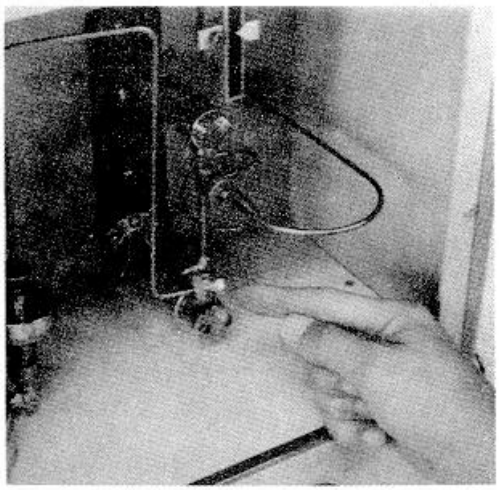


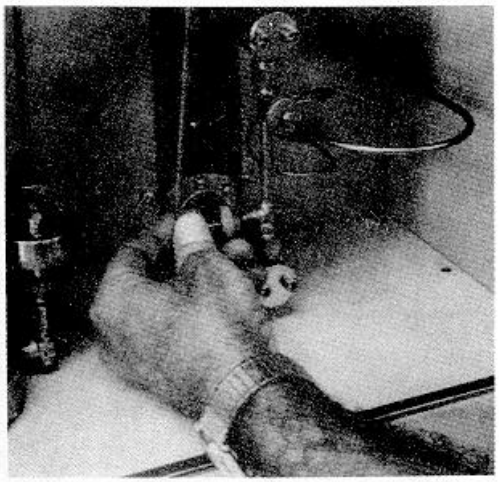
7.8.9 Connect the nitrogen inlet line to the side of the drip flow indicator and finger tighten snugly.



7.8.10 Connect the fuel return line to the top of the drip flow indicator and finger tighten snugly.

7.8.11 Remove the cap seal from the heater tube fuel supply line and immediately connect the line to the heater tube housing inlet. The time between removal of the cap seal and connection should be a minimum to reduce loss of test fuel.





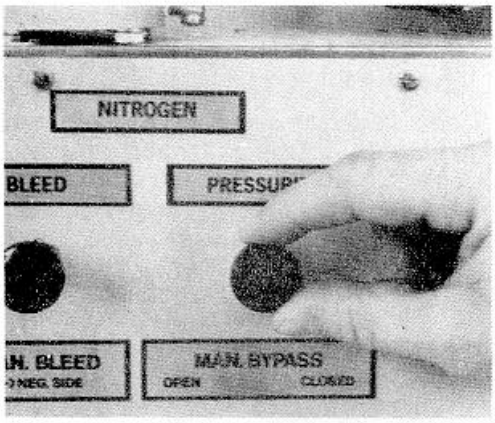
7.8.12 Recheck all eight knurled fittings to be sure they are tightened snugly. Recheck the thermocouple position, 38.7 mm position.

7.8.13 The apparatus is now ready for the test.

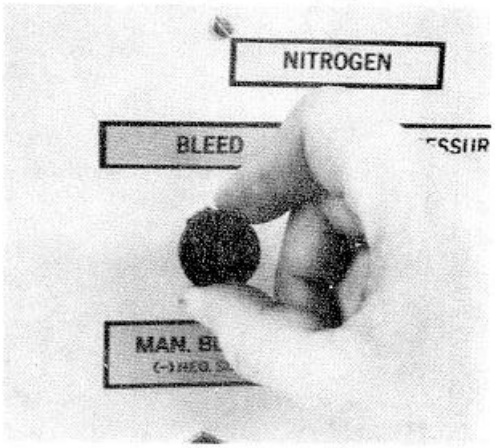
8. Test Procedure

8.1 *Fuel System Pressurization:*

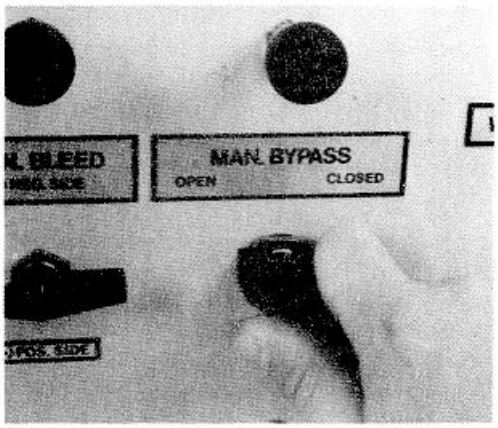
8.1.1 Check the NITROGEN PRESSURIZE valve CLOSED.



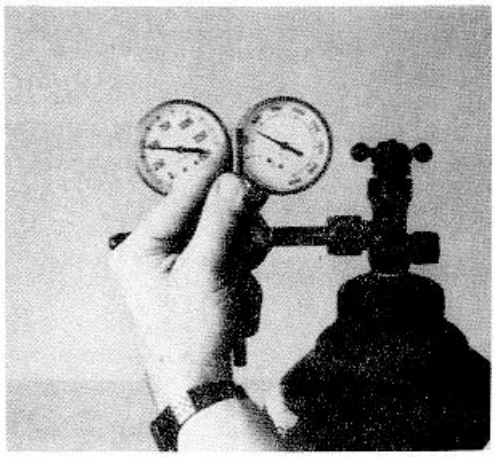
8.1.2 Check the NITROGEN BLEED valve - CLOSED.



8.1.3 Check the MAN. BYPASS valve - OPEN. The MAN. BLEED valve is normally CLOSED. To bleed manometer or transducer of air see A2.7.3 or A5.3.

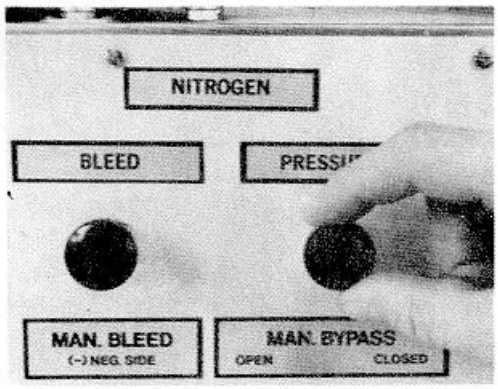


8.1.4 Check the nitrogen supply - 3.45 MPa at pressure regulator control gage.



8.1.5 Open and close NITROGEN PRESSURIZE valve to obtain a pressure of approximately 0.2 to 0.3 MPa. Immediately check for any obvious test section fitting leaks.

8.1.6 If a leak is apparent , immediately open the NITROGEN BLEED valve and take corrective action. Close the BLEED valve and resume pressurization in accordance with 8.1.5.



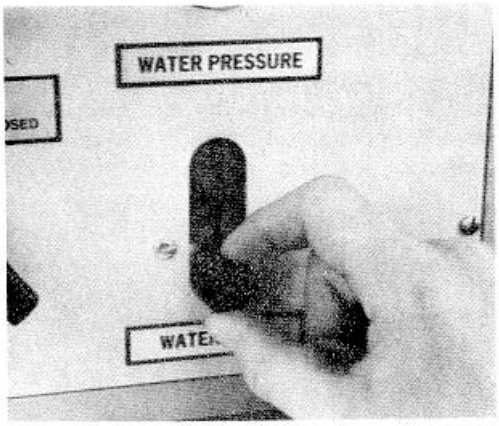
8.1.7 Slowly open the NITROGEN PRESSURIZE valve to allow for full 3.45 MPa pressurization at a rate of approximately 0.2 to 0.3 MPa/s.

8.1.8 Readjust the nitrogen pressure regulator if required. In making a reduction in pressure, it is necessary to have the BLEED valve cracked during the adjustment.

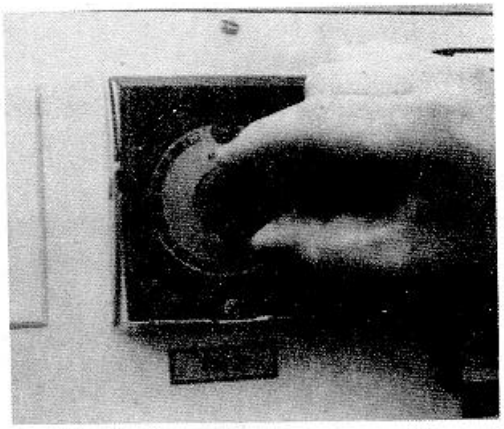
8.2 *Setting of Controls.*

8.2.1 Switch POWER to ON.

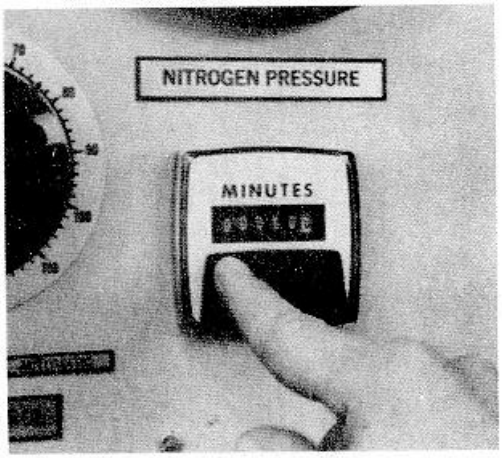
8.2.2 Adjust the WATER FLOW to center of green range (this corresponds to 38±8 L/h).



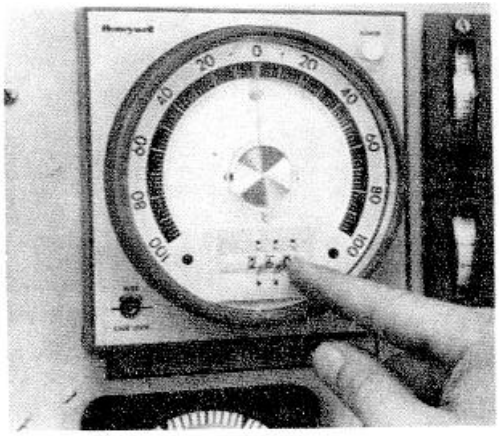
8.2.3 Set the TIMER to test time, 2 h and 30 min.



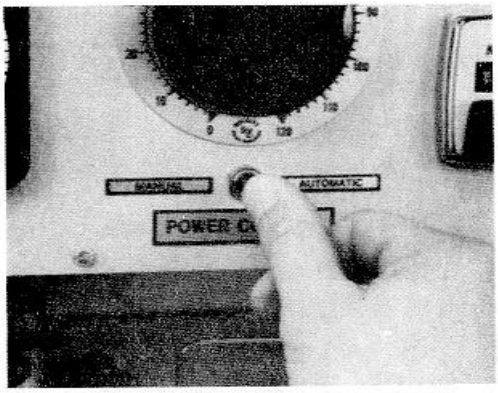
8.2.4 Set the digital elapsed time indicator to zero.



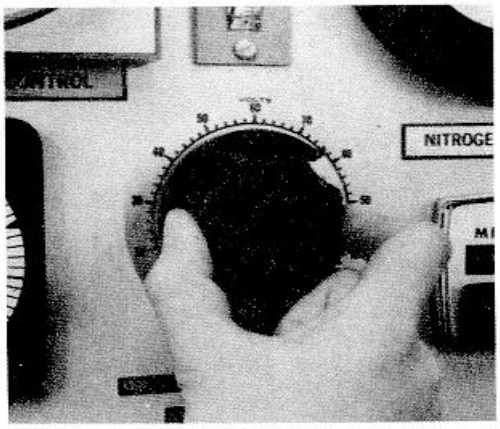
8.2.5 Set the HEATER TUBE TEMPERATURE CONTROL to the specified maximum heater tube control temperature after applying correction for any error determined in 6.1.18. If the "indicated melting point" of tin is below 232°C, subtract the error from the specified maximum heater tube temperature. Conversely, if the "indicated melting point" of tin is above 232°C, add the error to the specified maximum heater tube temperature.



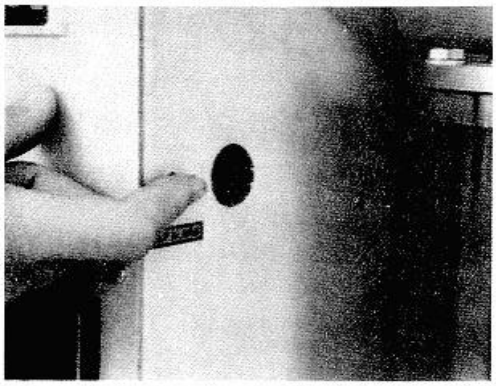
8.2.6 Turn the control mode switch to AUTOMATIC.



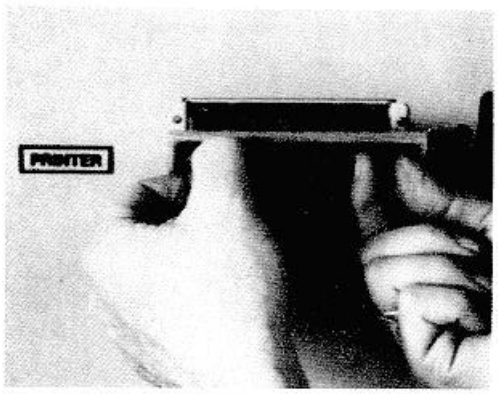
8.2.7 Set the POWER CONTROL at 75 to 80 setting (see Note 2).



8.2.8 Switch ΔP ALARM switch to ON by pressing upward.

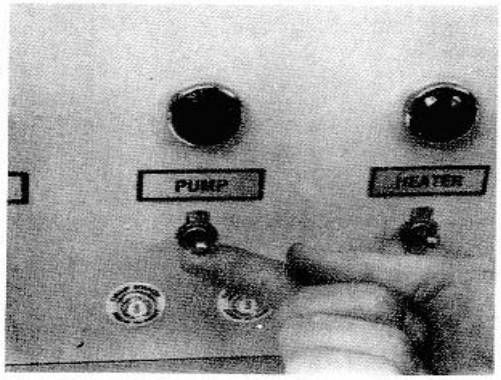


8.2.9 Note that there is sufficient paper on printer for test. If a streak of red shows, then paper is near end of roll. See separate printer instructions for opening case to add new roll. About 6 cm of paper are needed for test.



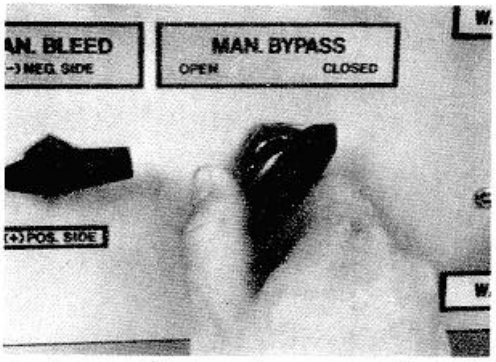
8.3 *Start-Up.*

8.3.1 Switch PUMP to ON. Observe the drip flow indicator to see that flow has started, usually after 10 to 15 s. This may take longer if system has lost residual fuel from previous test.

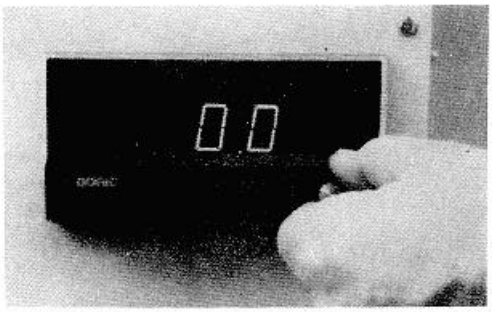


8.3.2 Switch HEATER to ON. Full power, approximately 250 W, is initially applied to the heater tube for a few seconds and then is automatically cut back to prevent temperature overshoot. The controller generally will bring the heater tube to the desired control temperature in less than 90 s.

8.3.3 When the temperature deviation meter needle centers, close the MAN. BYPASS valve.

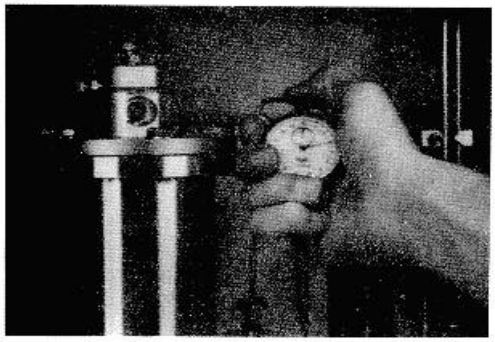


8.3.4 Adjust the transducer indicator to zero.



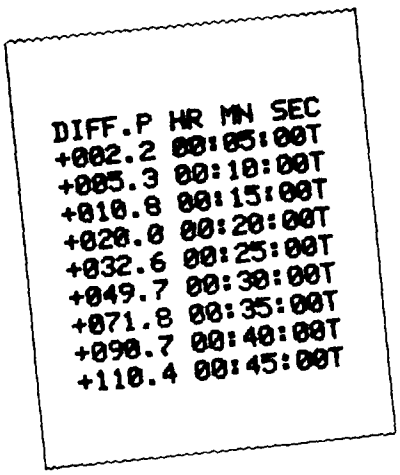
8.3.5 Record, on data sheet, the clock time the IIEATER switch was turned ON. This time must not be later than 1 h after completion of fuel aeration from 7.7.12.

8.3.6 Determine the fuel flow rate with stop watch, measuring time for 20 drops. This time should be 9.0 ± 1.0 s but will vary with viscosity and surface tension of the test fuel.



8.3.7 As indicated on the data sheet (Fig. 4), pressure drop data is to be recorded at least as often as every 30 min.

8.3.8 AP data is printed automatically on a tape. Transfer or affix this tape to the data sheet at end of the test.



8.3.9 If AP reaches 125 mm and the AP ALARM is armed as is 8.2.8, warning horn will sound. To stop hornm, switch AP ALARM OFF.

8.3.10 If AP approaches 250mm before 150 min. and it is desired to continue the test, open the MAN. BYPASS valve so that fuel flow can continue uninhibited.

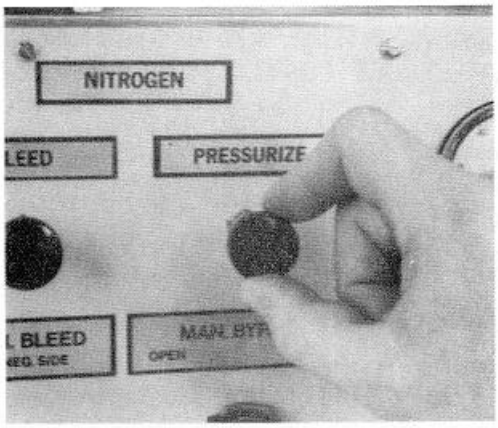
8.3.11 *Heater Tube Temperature Profile* If the heater tube temperature profile is specified, obtain in accordance with A4.

8.4 *Shutdown:*

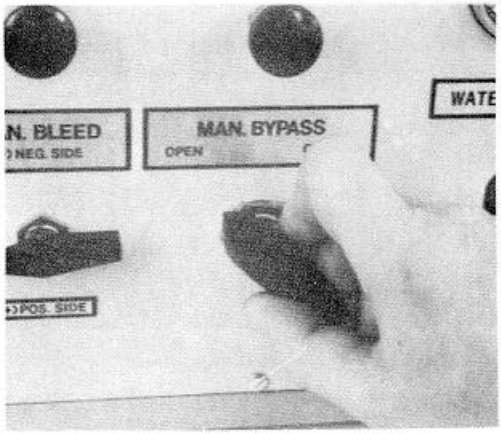
8.4.1 Switch HEATER to OFF.

8.4.2 Switch PUMP to OFF.

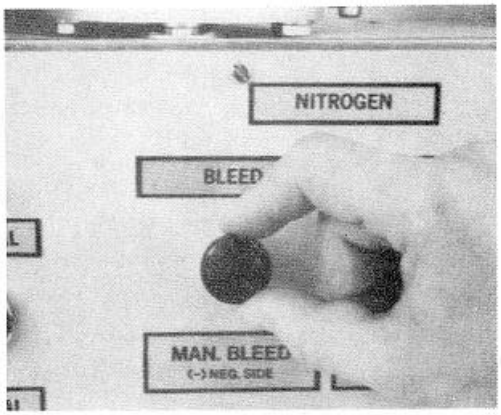
8.4.3 CLOSE the NITROGEN PRESSURIZE valve.



8.4.4 OPEN the MAN. BYPASS valve.

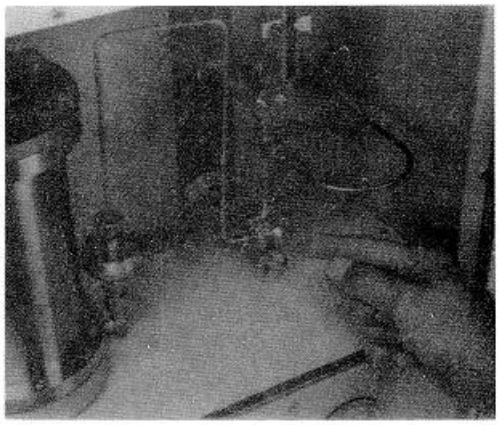


8.4.5 Slowly open the NITROGEN BLEED valve and allow the pressure to decrease to zero at an approximate rate of 0.15 MPa/s.

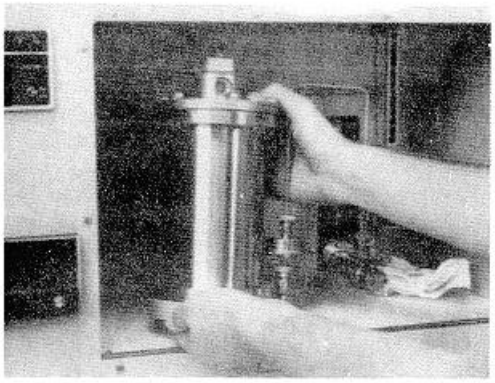


9 Disassembly

9.1 Disconnect the heater tube fuel supply line fitting from the heater tube housing and quickly install the cap seal.



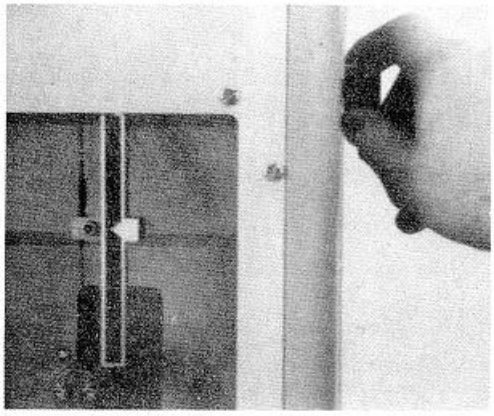
9.2 Disconnect the nitrogen and fuel return line fittings. Remove the reservoir from the test compartment. placing the reservoir in a cleaning pan.



9.3 Disconnect and remove the heater tube fuel outlet line.

9.4 Disconnect the filter bypass line.

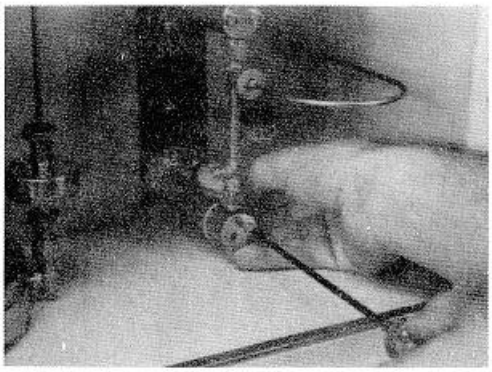
9.5 Raise the heater tube thermo couple to the top reference mark.



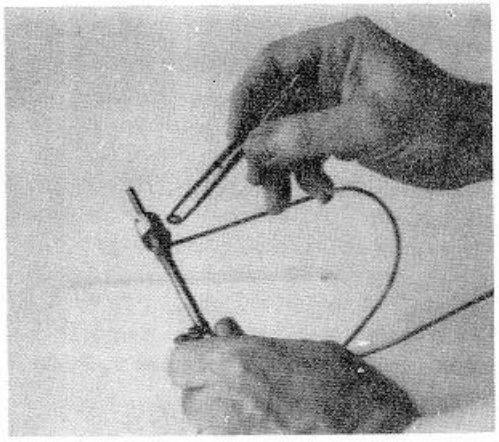
9.6 Remove tile right hand Allen cap screws from each bus.

9.7 Loosen the left hand Allen cap screws three to four turns each. but do not remove.

9.8 Rotate the bus caps and remove the heater tube test section.

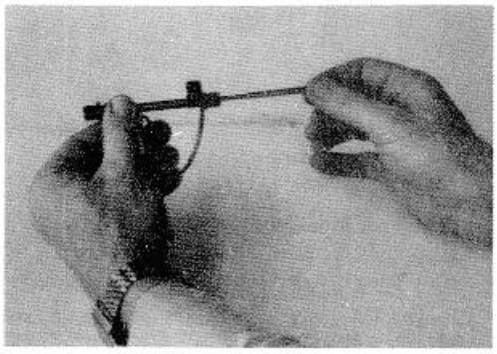


9.9 Using tweezers. remove the test filter and O-ring from the discharge chamber and discard.

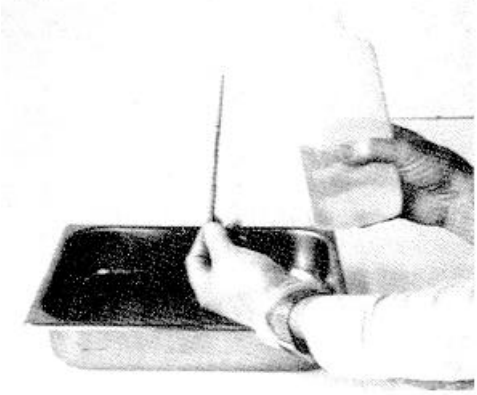


9.10 CAREFULLY remove the hex nuts and shoulder insulators.

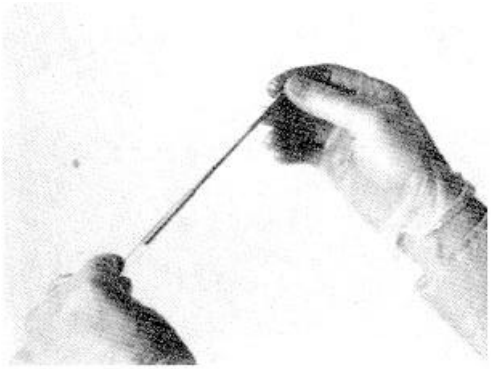
9.11 Slide the heater tube out of the housing. DO NOT TOUCH TUBE IN AREA THAT FUEL CONTACTS. Remove and discard the O-rings. Save the insulators.



9.12 Holding the heater tube so that it points upward from fingers, flush with solvent. Use rubber gloves.



9.13 After the solvent has evaporated from the heater tube, replace the heater tube in the original container and seal with a cap. MARK WITH APPROPRIATE IDENTIFICATION.



9.14 Remove the reservoir cover and empty the fuel into the waste disposal.

9.15 Using a piston puller, remove the piston from the reservoir and empty any remaining fuel into waste disposal.

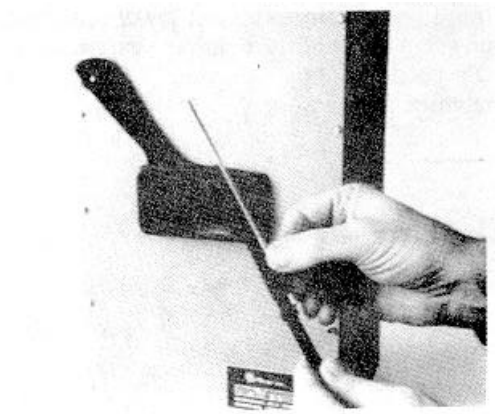
9.16 Disconnect the inlet line from the pre-filter.

9.17 Disconnect the pre-filter section from the reservoir outlet and disassemble it by removing three Allen screws. Discard the filter element.

10. Heater Tube Deposit Rating

10.1 Visual Method:

10.1.1 Snap the upper end of the heater tube into the clamp of the adapter for the heater tube.



10.1.2 Push the heater tube against the stop of the adapter for the heater tube.
10.1.3 Slide the adapter with the heater tube over the guide rod into the Tuberator equipped with a magnifying glass assembly.

10.1.4 Insert the ASTM Color Standard into the Tuberator.

10.1.5 Rotate the adapter and position the heater tube such that the side with the maximum deposit is visible.

10.1.6 Compare the maximum heater tube deposit with the ASTM Color Standard. When the maximum deposit corresponds exactly to a color standard, that number should be recorded. If the maximum heater tube deposit being rated is in the obvious transition state between any two adjacent color standards, the rating should be reported as less than the darker (that is higher number) standard.

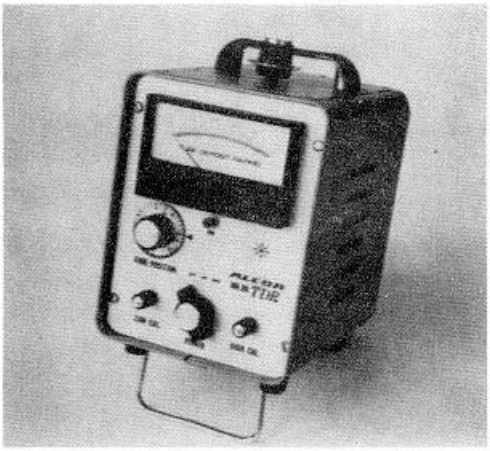
10.1.7 Return the heater tube to its original container.

10.2 ALCOR Tube Deposit Rating Methods.

10.2.1 Place the ALCOR Tube Deposit

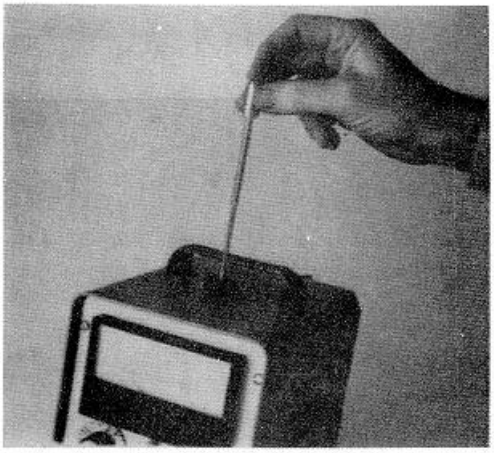
Rater (TDR) on a table or bench, extend

the front support, plug it into a suitable power point, and turn the power switch to ON position. Approximately 2 minutes are required for warmup.



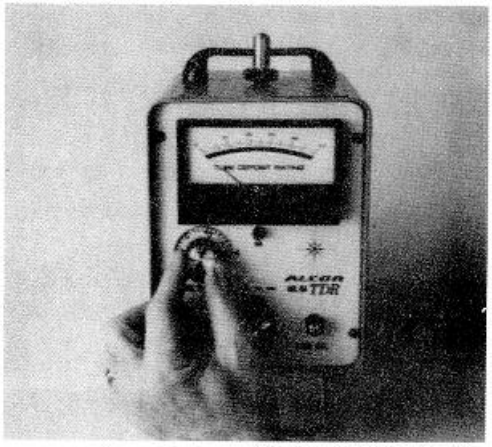
10.2.2 Remove the calibration tube from its container by pulling on the cap which is attached to the calibration tube. DO NOT touch the tube's center section; otherwise it will affect the calibration of the TDR.

10.2.3 Holding the calibration tube by its cap, insert it into the rating rack on top of the TDR. It is necessary that the tube be pushed down firmly until it bottoms.

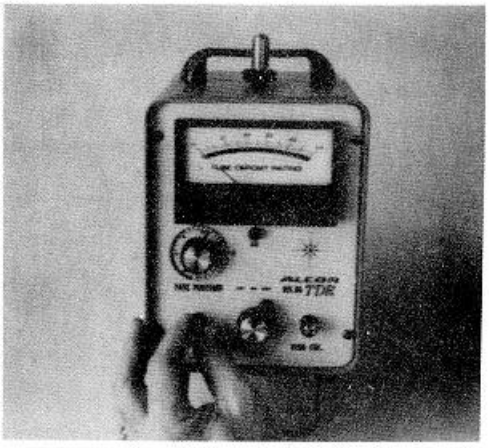


10.2.4 Turn the POWER switch to SPIN position.

10.2.5 Turn the TUBE POSITION control to set indicator at 35 position.



10.2.6 Turn the LOW-CAL control to obtain a tube deposit rating in accordance with the calibration printed on the calibration tube.



10.2.7 Turn the TUBE POSITION control to set indicator at 53 position.

10.2.8 Turn the HIGH-CAL control to obtain a tube deposit rating in accordance with the calibration pnnted on the calibration tube.

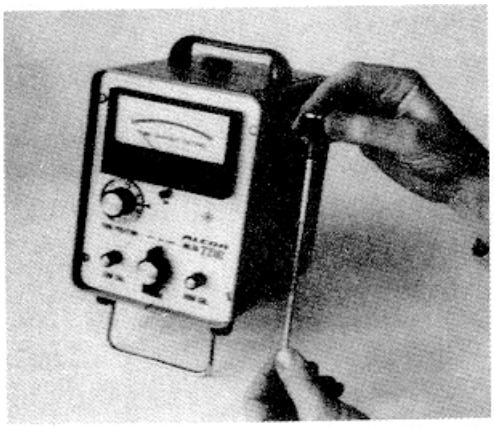
10.2.9 Turn the TUBE POSITION con-trol to obtain the maximum TDR reading in the vicinity of 22 position. If the position indicator does not read 22 for the maximum TDR reading, then the calibration tube is not fully inserted or the tube position dial needs correction. See maintenance manual for adjustment of the tube position dial.

10.2.10 Turn the POWER switch from SPIN to ON position.

10.2.11 Remove the calibration tube and insert the tube into its storage container.

10.3 *Spun and Spot Deposit Methods:*

10.3.1 Remove the JFTOT heater tube to be rated from its container by inserting



10.3.2 Holding the rotation knob, insert the heater tube into the rating rack on top of the TDR. It is necessary that the heater tube be pushed down firmly until it bottoms.

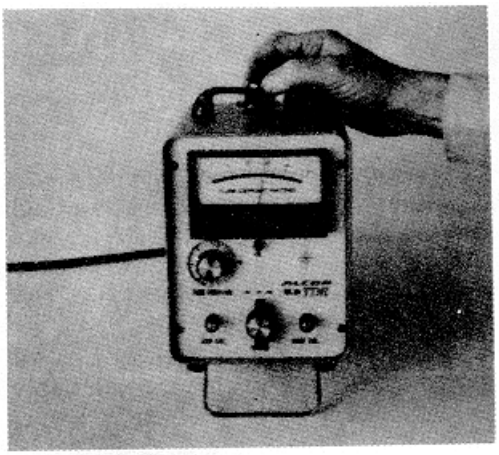
10.3.3 Turn the POWER switch to SPIN position.

10.3.4 To obtain the SPUN deposit ra-ting for any position, set the TUBE POSITION index to the desired position and read the meter.

10.3.5 To obtain the maximum SPUN deposit rating, slowly scan from a TUBE PO-SITION indicator reading of 15 to 55, stopping at the position of maximum rea-ding. Record this reading as the maximum SPUN deposit rating. Do not change the TUBE POSITION knob.

10.3.6 Turn the POWER switch to ON position.

Slowly and manually rotate the heater tube counterclockwise 360 deg, stopping when the maximum obtainable meter reading is observed. Record this meter reading as the maximum spot deposit rating.



10.3.8 Replace the test heater tube in its original container and seal with a cap.

11. Report

11.1 The report shall include the following:
11.1.1 The maximum heater tube temperature.
11.1.2 Heater tube deposit rating(s).
11.1.3 Pressure drop across the filter at the end of the test or the time required to reach a pressure differential of 250 mm Hg. For the recording model JFTOT report, the maximum recorded ΔP shall be considered the ΔP at the end of the test.
11.1.4 The tube rating and ΔP criteria are a means of deciding whether a pass or fail result has been obtained at the test temperature.
11.2 A suggested data form is shown in Fig. 4.

12. Precision

12.1 In the case of pass-fail data or results from other qualitative tests, no generally accepted method for determining precision is currently available.

APPENDIXES

JET FUEL THERMAL OXIDATION TESTER

A1. JFTOT Equipment Description

Al.1 Apparatus

A1.1. The apparatus described in this appendix shall be used for the thermal oxidation stability test of turbine fuels. The apparatus is known as the JFTOT (Jet Fuel Thermal Oxidation Tester) and consists essentially of a closed loop fuel system with a heater tube section including a test filter together with associated equipment for controlling and measuring the heater tube temperature. Two models are available: the earlier model with mercury manometer as the A P measuring means, and the current model with a differential pressure transducer to measure AP. Details of the P systems are given in Al 7 Al.1.2 Certain essential accessories and materials are not furnished These are listed in A2.6

A1.2 General Description

A1.2.1 Figures I and 2 are front *views* of the mercury manometer (IMM) and differential pressure transducer (DPT) models of JI TO 1. Figure A2.1 is a drawing of the test section compartment. Figure A2.2 is a schematic of the fuel system. Figure A2.3 is a schematic of the heater tube power and temperature control systems Figure A2.4 is an assembly draining of the heater tube section. Figure A2.5 Is an assembly drawing of the reservoir and pre-filter. Figure A2.6 is the electrical schematic of the JFTOT Model 215 with differential pressure transducer.

A1.3 Fuel System

A1.3.1 Test fuel contained in the reservoir is circulated through the test section by a constant displacement pump located downstream of the heater tube section to preclude contamination by pump wear particles. The pump is driven by a constant speed motor so as to have a displacement of 3 ml/min

Al.3.2 From the reservoir outlet, the fuel flows through a 0.45 micron membrane type filter, thence to the lower (inlet) part of the heater tube section. The heater tube is connected between two busses and is electrically insulated from the outer housing by means of a non-conductive ferrule/ O-ring seal combination. The fuel rise vertically in the annular space between the aluminum heater tube and its outer stainless steel housing. A low voltage, high-current a-c signal is passed through the heater tube so as to obtain resistance heating. Exiting the heater tube section, the fuel passes through a test filter having an element made from stainless steel cloth with a rated porosity of 17 microns. The test filter can be bypassed at any time, normally when AP reaches 250 mm Hg.

The fuel reaches the cooler by either route and proceeds through the metering pump to return to the fuel reservoir. A sight gage drip flow indicator allows visual monitoring of flow rate. Return fuel is isolated from the test fuel by a piston with a lip seal.

A1.4.1 The heater tube is heated by conduction of an electrical current of approximately 200 to 300 A at 0.3 to 0.5 V. The heater tube is clamped at each end into busses having corrosion resistant contact surfaces. The busses are cooled by internal water lines. The busses receive electrical power from a low voltage transformer having a step-down ratio to match the electrical resistance of the heater tube.

A 1.4 2 A temperature controller is employed, both as a temperature indicator (manual mode) and as a controller (automatic model) The input signal to the controller is from a thermocouple inserted through the top of the heater tube and positioned at the point of maximum temperature. This thermocouple can be positioned at any point along the heated portion of the tube for the purpose of obtaining a temperature profile. An indicator i1 provided to define the position of the thermocouple junction with 0 0 station being the heater tube's lower shoulder. AX wattmeter measures electrical power supplied to the low voltage transformer and. therefore, indicates total power consumed lb) the heater tube plus bus connector. transformer, and Iine losses. -k variable voltage transformer, labeled POWER CONTROL, having dual function. controls the maximum voltage and is the only control when in the manual mode. POWER CONTROL has a removable stop to limit the power so as to prevent melting of the heater tube in the event that the operator neglects to insert the thermocouple into the heater tube. When the desired maximum heater tube temperature control (greater than about 343 C) cannot be obtained with the POWER CONTROL against this stop. It may be removed. A constantvoltage transformer Is supplied with each tester to compensate for plant line voltage fluctuations

AI.5 Cooling System

Al 5 51 Ordinary tap water at any pressure between 200 and 700 kPa is required for bus connector cooling. The JFTOT has a flow adjustment valve and rotometer type flow indicator to set the rate at 38 ± 8 L/h. After entering the cabinet, the water flow through a filter adequate to remove any solid particles that could

5Suitable equipment is available from ALCOR, Inc, 10130 Jones Maltsberger Rd.. San Antonio, Texas 78284

A parts list for the JI-TOT may be obtained from ALCOR, Inc, San Antonio. Texas 78284.

plug the lines with time or interfere with the operation of the solenoid valve which is normally closed and opens when the power switch is turned on. A water pressure switch is in the power line to the pump motor and heater and is normally open, closing only when the water pressure rises above 140 KPa and opening (turning heater and pump off) if water pressure drops below this value. The water next flows through a heat exchanger used to cool the fuel prior to entering the pump. After this, the water passes through copper tubing internally silver soldered to the busses The water lines are electrically insulated from the bus connectors by means of polyethylene tubing.

Al.6 Fuel Pressurization System

A1.6.1 A standard nitrogen cylinder with regulator is used to pressurize the fuel system to 3.45 MPa. All system components have been tested to 6.9 MPa. For safety, an adjustable pressure limiter is provided in the nitrogen inlet line and is set at approximately 3.7 MPa. Two nitrogen control needle valves marked "PRESSURIZE" and "BLEED" are provided.
Their function is evident from the schematic, Fig. A2.2.

A1.7 Differential Pressure Measurement System

A1.7.1 Two instrument configurations are approved to measure differential pressure across the test filter as the filter fouls with products of fuel degradation. JFTOTs produced before 1984 are equipped with a mercury manometer tMMi system, and may include a strip chart event recorder option. Instruments produced after 1984 are equipped with a differential pressure transducer (DPT) and electronic printer. This modification was made to eliminate maintenance and toxicity concerns associated with the use of mercury.
Instruments using the manometer system can be retrofit with the pressure transducer conversion kit at the user's option.
A1.7.2 Differential Pressure Transducer (DPT): The transducer is connected across the test filter as per Fig. A2.2. The DPT is controlled by two valves: MAN. BYPASS and MAN. BLEED. The first allows the test fluid to bypass the filter. The second provides an easy way to bleed and eliminate air/nitrogen from the system when required. The DPT output is displayed on a digital indicator which is interfaced to a digital printer. AP readings are recorded automatically at user defined time intervals. The indicator sounds an alarm at about *125* mm Hg. The alarm is armed by an OFF/ON switch.

A1.7.3 The mercury manometer (NNMM) system is connected across the test filter as per Fig. A2.2. A manual valve labeled MAN. BYPASS permits the fuel to bypass the test filter when 250 mm Hg AP occurs before the set test duration and it is desired to continue the test to obtain heater tube deposits for the full test peiod A float type check valve in the low pressure leg of the manometer prevents mercury from "going over the top" during abnormally high differential pressure surges and consequently contaminating the fuel system. This could happen only by applying an excessively rapid rate of pressurization or failure of the automatic system to shut the rig down at 250 mm Hg AP. A manual valve labeled MAN. BLEED is provided to bleed readily and eliminate any air or nitrogen from the manometer system whenever required. For the recording MM model, automatic recording of AP versus time is obtained with a 10-channel event recorder which has a dual speed capability of 60 and 360 mm/h. Normal speed is 60 mm/h. Reed type switches at stations 2, 10, 15, 25, 50, 75, 125, and 250 mm Hg respectively are mounted adjacent to the manometer tube and are activated by a small plastic-enclosed magnet floating on top of the mercury column. As AP increases, the magnet activates each switch and the resulting signal records the event on the appropriate channel of the event recorder. A AP warning system sounds a horn when the AP reaches 125mm Hg to alert the operator of impending rig shutdown at 250 mm Hg. The AP alarm system controls are located at the top of the manometer cover and consist of an ON-OFF switch, red light to show that the system is armed, and a high frequency horn. Anytime the AP reaches 250 mm Hg, the reed switch action cuts off the power to metering pump, heater tube and timing devices with all other devices such as blower and solenoid remaining ON until the power switch is turned OFF manually Al.7.4 The manometer system by nature includes a bias due to the presence of hydrocarbon in the manometer tube. When the pressure is expressed in terms of mercury column height or converted to pressure units using the density of mercury as per the JI-TOT procedure, a result about 6'higher than true is obtained. This bias is predictable based on the density of mercury and the test fuel. The pressure transducer (DPT) Is not susceptible to this manometer error, and is factory calibrated to include the bias in the DPT system readings. This is necessary to make mercury manometer (NMMI) and DPT readings equivalentunder equivalent test conditions.

Factory calibrated DPT cells checked against an absolute standard, such as a dead weight tester or air/mercury manometer should read about 6% higher than true (e g DPT reading of 265 mm Hg with a 250 mm Htg AP applied).

Al.8 Thermocouple Calibration System A1.8.1 The AutoCal calibration system provides for a reliable check of the calibration of the entire temperature indication system by utilizing the freezing point of 99.99% pure tin (232°(') as the standard. The AutoCal consists of a special heater tube device which has at its middle section a small well containing pure tin into which the thermocouple is immersed. The test thermocouple is introduced into the tin after raising the temperature above the melting point and the cool-down temperature-time characteristic is observed by the operator who notes the temperature indication at which the temperature controller deviation meter needle paused. Any difference between this reading and 232 C is the error in the temperature measurement system and must be applied as a correction when setting maximum heater tube control temperature and when plotting heater tube temperature profile.

A1.9 Fuel Aeration System
A 1.9.1 A system is provided to air saturate

the test fuel charge in the reservoir prior to test A rotameter flow control and automatic timer-cutoff are set to flow dry, filtered air at 1.5 L/min for 6 min. The 9.0 litres thus passed through the fuel ensures at least 97% of air saturation.

Al.10 Elapsed Test Time Measurement A1.10.1 There are at least two indications of elapsed test time: a digital readout indicator (to nearest 0.1 min) and a timer-cutoff (to nearest 3 min) which can be set to cut off at the specified time up to 5.0 h. For the recording model JFTOT the automatic AP recorder provides yet a third measure of elapsed test time.

Al.11 Laboratory Installation Requirements A .11.1 The tester should be placed on a level laboratory bench, allowing 200 to 300 mm wide bench area in front of the tester. Ready access to the rear of the tester should be provided for normal maintenance and service requirements. Ensure that the vent on top of the JFTOT cabinet is not obstructed during installation or use. Adequate ventilation should be provided and proper procedures for handling solvents and hydrocarbons should be followed. The constant voltage transformer must be plugged into the left side of the tester and can be placed either adjacent to the tester or preferably under the bench. Singlephase electrical power, 115V, 60Hz, 15A or optional 230V, 50Hz, 8A with a ground outlet is required.

A1.11.2A nitrogen supply bottle with a suitable regulator capable of supplying 3.45 MPa should be placed conveniently and connected with appropriate tubing to the tester (3mm or 1/8 inch is recommended). A suitable line (6mm or 3/8 inch is recommended) needs to be connected from the WATER INLET connection to a 200 to 700 KPa water supply and from WATER DRAIN to a drain having a minimum capacity to receive 80 L/h.

A2. MATERIALS, SUPPLIES, AND SPARES

A2.1 The following items are supplied with each JFTOT

A2.1.1 Magnifying assembly for tuberator.
A2.1.2 Tuberator adapter for heater tube
A2.1.3 AutoCal heater assembly.
A2.1.4 Piston puller.
A2.1.5 Cap seal.
A2.1.6 Aeration tube.
A2.1.7 Clear plastic tubing for aerating tube.
A2.1.8 Aeration tube holder
A2.1.9 Funnel holder.
A2.1.10 Nut driver, ',2-in.
A2.1.11 Allen screw driver, 5/32-in.
A2.1.12 Power cord.
A2.1.13 Constant-voltage transformer, 60Hz or 50 Hz.
A2.1.14 Step-down transformer, 230/115 V (Note - These are supplied only with 230V-50Hz JFTOT.)
A2.1.15 Protector, sight glass.
A2.2 The following items are required to be replaced each test and therefore must be stocked in accordance with volume of testing involved.
A2.2.1 Heater tube and filter kit.
A2.2.2 Pre-filter element.
A2.2.3 General-purpose, retentive, qualitative filter paper.
A2.2.4 Data sheets.
A2.3 The following supplies are spare parts needing periodic replacement as required and should therefore be stocked in accordance with volume of testing involved:
A2.3.1 Insulator bushings (4/set).
A2.3.2 Lip seal, reservoir piston.
A2.3.3 O-ring, reservoir.
A2.3.4 O-ring, sight glass.
A2.3.5 O-ring, retention screw.
A2.3.6 O-ring, line connections.
A2.3 7 O-ring, pre-filter.
A2.3.8 Thermocouple assembly.
A2.3.9 Temperature calibration standard (tin).
A2.3.10 Metering pump.
A2.3 11 AP recorder chart paper.
A2.3 12 Aeration tube.
A2.4 The following additional items are not supplied with the JFTOT but are required for normal operation:
A2.4 1 ALCOR Tube Deposit Rater (optional).
A2.4.2 ALCOR Visual Tuberator.
A2.4.3 Nitrogen supply bottle.
A2.4.4 Pressure regulator 0 to 7 MPa.
A2.4.5 Solvent - may be technical grade of methyl pentane, n-pentane, or 2-24 trimethyl pentane, 95 mol % minimum purity.
A2.4.6 Disposable gloves.
A2.4.7 Trisolvent (equal parts of toulene, acetone, and isopropyl alcohol, 99 percent grade).
A2.4.8 Wash bottle, polyethylene.
A2.4.9 Cleaning pan, stainless steel (250 by 350 mm minimum).
A2.4.10 Brush, nylon (40 by 100 mm).
A2.4.11 Brush, nylon (15 by 75 mm).
A2.4.12 Funnel, glass.
A2.4.13 Thermometer, glass (ASTM IC, 5C or IP IC).
A2.4.14 Tweezers.
A2.4.15 Rubber squeeze bulb.
A2.4.16 Extractor for insulators.
A2.4.17 Silicone grease.
A2.4.18 Paper tissues
A2.4.19 Aluminum foil, about 450 mm wide.
A2.5 ALCOR DPT conversion kit (for pre 1984 models, optional)

A3. ,P DATA RECORDING

A3.1 Before utilizing the AP data recorder, familiarization with the instruction manual furnished with the particular equipment is suggested. An appropriate manual is furnished with each JFTOT.

A3.2 DPT models using printer: At selected interval, the AP value on the transducer indicator will be printed. Choose a print time interval that will include a 30 minute print so data for the times on the data sheet (Fig. 4) will be directly available. Suggestion: use 15 minute print interval.

A3.3 Models using event recorder: The AP events are recorded in sequence by styluses which move at right angles to the chart's direction of motion. Normal chart speed is 60 mm/h with chart subdivisions spacing every 5 min. Channel 1 records the start and the end of the test; that is, HEATER ON and OFF events. The chart drive is also actuated by the HEATER ON or OFF function. Channels 2 through 8 record 2, 10, 15, 25, 50, 75, and 125 mm Hg AP respectively. If AP reaches 250 mm Hg, automatic shutdown is actuated, which also stops recorder chart drive. After completion of test, remove that portion of the chart that is applicable to the test and with pencil or pen emphasize locations where styluses are first activated by movement to the right Interpret time after start of test that activation occurred for each AP channel and record on data sheet.

A4. HEATER TUBE TEMPERATURE PROFILE

A4.1 Data are presented in Table Al to permit establishing the heater tube temperature profile for maximum heater tube temperatures from 200 to 370 C. If it is desired to measure the heater tube temperature profile, the following procedure should be followed after the second half hour of the test or before significant AP has been obtained.

A4.2 Observe the wattmeter reading and *simultaneously* switch the controller mode to MANUAL and reduce POWER CONTROL to previously observed wattmeter reading. Fine adjust the POWER CONTROL to place temperature deviation meter needle at exact center and let stabilize. If no temperature drift is observed for 30 s, proceed to the next step.

A4.3 Set the thermocouple in sequence to following positions to obtain their respective temperatures.

mm 56 50 44 38.7 32 26 18 10 At each position, adjust the digital set point control on the temperature indicator

to center the devia

tion meter needle. Allow at least 5 s for temperature stabilization before recording the indicated temperature.

A4.4 If temperature at the 38.7 mm station has drifted more than $^{+}$ 2 C from initial value, readjust the POWER CONTROL and begin again at the 56 mm position. If drift is less than $\pm$2 C, readjust POWER CONTROL and proceed to position 32 mm.

A4.5 Return the thermocouple to the 38.7 mm position. Again if this temperature has drifted in excess of + 2 C. reset manually and repeat the above procedure.

A4.6 Simultaneously switch the temperature controller to AUTOMATIC mode and adjust the POWER CONTROL to 78-80 settings (see Note 2, main text).

A4.7 Correct recorded temperatures for error in accordance with 8.2.5.

A4.8 Continue the test.

A5. MAINTENANCE

A5.1 AutoCal Calibrator Tin Replacement

A5 1 1 The tin m the well of the AutoCal Calibrator must be replaced whenever the quantity is below minimum or when contaminated.

A5.1.2 To remove the tin, install the AutoCal Calibrator *inverted* between the upper fixed bus and the lower float mg bus.

A5 1.3 Place a paper tissue or rag under the well to catch the molten tin.

A5.1.4 Apply power to the AutoCal Calibrator in accordance with paragraph 6.2 and at the same time gently tap the well until all molten tin has dropped out

A5.1.5 Remove and install the AutoCal Calibrator in upright position and refill with new tin charge. The proper amount of tin for one filling 1L furnished m a capsule 1.6 $\pm$0.5 g)see A2 3.9 A5.2 Thermocouple Replacement and Position Adjustment A5.2.1 The thermocouple used for measuring and controlling the temperature of the JFTOT heater tube must be replaced at intervals due to insulation abrading or other damage.

A5.2.2 To remove the thermocouple, loosen the thermocouple clamp, support clamp, and thermocouple connections on back of the temperature controller A5.2.3 install a new thermocouple following the same routing as old thermocouple. Replace and tighten screws. When tightening the Allen screw of thermocouple clamp, the tip of the thermocouple must be flush with top of upper fixed bus when position indicator is set at the reference mark.

A5.2.4 Check for proper thermocouple indexing under actual test operating conditions.

A5.2.5 Operate the JFTOT at some control temperature with the new thermocouple set at the 38.7 mm position. The specific control temperature choser is not critical, but must be between 200 and 370 C.

A5.2.6 Change to manual mode for tempera

ture control following instructions in A4.2 and observe temperature at the 18 mm position in accordance with A4.3. If the observed temperature at the 18 mm position Is not within 1 C of the value in Table Al, adjustment of the thermocouple is necessary.

A5.2.7 To adjust the thermocouple, loosen the Allen screw of the thermocouple clamp.
Without moving the position index, move the thermocouple until a reading within 1 C of the Table Al value is obtained. Tighten the Allen screw snugly.

A5.2.8 Return index to the 38.7 mm position and observe temperature. If the observed temperature differs by more than 0.5 C from the value selected in
A5.2.5, readjust POWER CONTROL to obtain the selected control temperature. If a power adjustment was necessary, recheck the temperature at the 18 mm position which should be within 1 C of the Table Al value.
A5.2.9 Repeat steps A5.2.7 and A5.2.8 until alternate readings at the 3§.7 and 18 mm positions are within 0.5 and 1 C, respectively, of the table values.
A5.3Maintaining Liquid Full System A5.3.1 In order to check the transducer properly, the tubing and transducer must contain only liquid (fuel), no gas bubbles. The fuel transmits the pressure force via tubing to the transducer and in doing so establishes some net column height above the transducer. If gas pockets are present or the fuel column is lowered, this lessens the effect of the liquid column, resulting in an incorrect pressure.

A5.3.2 At the end of each test It is assumed the system is liquid full. The MAN BLEED must be kept closed and not turned. It is recommended the bulkhead connections be capped then so the transducer will remain full and can be checked if necessary at the beginning of the next run.

A5.3.3. If gas happens to be introduced mto the transducer system or liquid is lost because the MAN BLEED is opened, the system can be filled as follows:

A5.3.3.1 Prepare the system as for a test run. The essential parts are: the reservoir at least 1/3 full and all tubing in place and secure. MAN. BYPASS and MAN BLEED must be closed. It is not necessary to filter the fuel to be used, nor have in place either of the filters, the reservoir piston or thermocouple. These items are superfluous to pumping liquid around the closed system.
A5.3.3.2 Turn on POWER and PUMP but not HEATER.
A5.3.3.3 When the drops begin to show in the sight glass, most of the system is full of fuel. Next open MAN. BYPASS to make sure the bypass lines are full. Allow to run a few minutes, then close the MAN. BYPASS. Nov put about 340 Pa (50 psi) nitrogen pressure on the system. Finally vent the transducer by turning the MAN. BLEED to + and in any order. Hold each way until all gas trapped in the top of each half of the transducer is vented.

A5.3.3.4 Stop pump, open NITROGEN BLEED slowly to drop system pressure. Disassemble parts, first capping transducer inlet fittings. Leave for next test (or transducer check).

A5.4 Basic Calibration of AP Transducer The pressure transducer is calibrated by applying an accurate millivolt signal into the transducer cell and setting the output indicator appropriately.
Details of this calibration procedure are included in the maintenance manual.

A5 4 1 In order to quickly ascertain If the transducer Is likely calibrated, a simple test can be performed **A** ith a water manometer.

A5.4.2 The manometer is a length of transparent flexible tubing partially filled with water. When one end is connected to, say, the positive side of the transducer (with the negative side open) and the open end of the tubing is raised, the water column will place a predicable pressure on the transducer.

A5.4.3 The conversion is, for example.

13.5 inches H20 (true)	25.4 mm Hg (true)
13-5 ccH20	inch=(1.06)(25.4mm)acutual
ccHg	=(26.9 mm Hg actual*
	*6% bias inclued

A.5 Other Maintenance
A5.5.1 A maintenance manual is available2 that provides additional maintenance details for each the fuel, p, aeration, nitrogen, water, and electrical systems. There is also included maintenance details for the Mark 8A Tuberator.

A6. PRECAUTION ARY STATEMENTS
A6 1 In the ASIMI manual there are listed m standard format all the hazardous chemicals that are used in the method with appropriate detail included A simple list is herein included to alert the user to these materials

A6 2 JFTOL method, hazardous materials

a. Acetone
b toluene
c. isopropanol
d. heptane
e compressed N
f jet fuel
g kerosene
h. mercury (MMI)model only)

TABLE A1 JFTOT Standard Temperature Profiles

ation	Maximum Temperatures from 200 to 242°C																					
	200	202	204	206	208	210	212	214	216	218	220	222	224	226	228	230	232	234	236	238	240	242
10.0	139	140	142	143	144	145	146	147	149	150	151	152	153	155	156	157	158	159	160	162	163	164
12.0	147	148	149	150	152	153	154	156	157	158	159	161	162	163	165	166	167	168	170	171	172	173
14.0	154	155	156	158	159	160	162	163	165	166	167	169	170	171	173	174	176	177	178	180	181	182
16.0	160	162	163	165	166	167	169	170	172	173	175	176	178	179	181	182	184	185	186	188	189	191
18.0	166	168	169	171	172	174	176	177	179	180	182	183	185	186	188	189	191	192	194	196	197	199
20.0	172	174	175	177	178	180	182	183	185	186	188	190	191	193	195	196	198	199	201	203	204	206
22.0	177	179	180	182	184	186	187	189	191	192	194	196	197	199	201	202	204	206	207	209	211	213
24.0	182	184	185	187	189	191	192	194	196	198	199	201	203	205	206	208	210	212	213	215	217	219
26.0	186	188	190	191	193	195	197	199	200	202	204	206	208	210	211	213	215	217	219	220	222	224
28.0	190	192	193	195	197	199	201	203	205	206	208	210	212	214	216	218	219	221	223	225	227	229
30.0	193	195	197	199	201	202	204	206	208	210	212	214	216	218	220	221	223	225	227	229	231	233
32.0	196	198	199	201	203	205	207	209	211	213	215	217	219	221	223	225	227	229	230	232	234	236
34.0	198	200	202	204	206	208	209	211	213	215	217	219	221	223	225	227	229	231	233	235	237	239
36.0	199	201	203	205	207	209	211	213	215	217	219	221	223	225	227	229	231	233	235	237	239	241
38.0	200	202	204	206	208	210	212	214	216	218	220	222	224	226	228	230	232	234	236	238	240	242
38.7	200	202	204	206	208	210	212	214	216	218	220	222	224	226	228	230	232	234	236	238	240	242
40.0	200	202	204	206	208	210	212	214	216	218	220	222	224	226	228	230	232	234	236	238	240	242
42.0	198	200	202	204	206	208	210	212	214	216	218	220	222	224	226	228	230	232	234	236	238	240
44.0	196	198	200	202	204	206	208	210	212	214	216	218	220	222	223	225	227	229	231	233	235	237
46.0	192	194	196	198	200	202	204	206	208	209	211	213	215	217	219	221	223	225	227	229	231	233
48.0	187	189	191	192	194	196	198	200	202	204	206	208	210	211	213	215	217	219	221	223	225	227
50.0	180	182	184	186	187	189	191	193	195	197	198	200	202	204	206	208	210	211	213	215	217	219
52.0	172	174	175	177	179	181	183	184	186	188	190	192	193	195	197	199	200	202	204	206	208	209
54.0	162	164	166	167	169	171	172	174	176	178	179	181	183	185	186	188	190	191	193	195	197	198
56.0	151	153	154	156	158	159	161	162	164	166	167	169	171	172	174	176	177	179	180	182	184	185

TABLE A1 *Continued*

ation	Maximum Temperatures from 242 to 284°C																					
	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284
0.0	164	165	166	168	169	170	171	172	173	175	176	177	178	179	180	182	183	184	185	186	188	189
2.0	173	175	176	177	179	180	181	182	184	185	186	188	189	190	191	193	194	195	196	198	199	200
4.0	182	184	185	187	188	189	191	192	193	195	196	198	199	200	202	203	204	206	207	209	210	211
6.0	191	192	194	195	197	198	200	201	203	204	205	207	208	210	211	213	214	216	217	219	220	222
8.0	199	200	202	203	205	206	208	209	211	213	214	216	217	219	220	222	223	225	226	228	230	231
0.0	206	208	209	211	212	214	216	217	219	220	222	224	225	227	229	230	232	233	235	237	238	240
2.0	213	214	216	218	219	221	223	224	226	228	229	231	233	235	236	238	240	241	243	245	246	248
4.0	219	220	222	224	226	227	229	231	233	234	236	238	240	241	243	245	247	248	250	252	254	255
6.0	224	226	228	229	231	233	235	237	238	240	242	244	246	248	249	251	253	255	257	258	260	262
8.0	229	231	233	234	236	238	240	242	244	246	247	249	251	253	255	257	259	260	262	264	266	268
0.0	233	235	237	239	241	242	244	246	248	250	252	254	256	258	260	261	263	265	267	269	271	273
2.0	236	238	240	242	244	246	248	250	252	254	256	258	260	262	263	265	267	269	271	273	275	277
4.0	239	241	243	245	247	249	251	253	255	257	259	261	263	265	267	269	270	272	274	276	278	280
6.0	241	243	245	247	249	251	253	255	257	259	261	263	265	267	269	271	273	275	277	279	281	283
8.0	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284
8.7	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284
0.0	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284
2.0	240	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282
4.0	237	239	241	243	245	247	249	251	253	255	257	259	261	263	265	267	269	271	273	275	277	279
6.0	233	235	237	239	241	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274
8.0	227	229	230	232	234	236	238	240	242	244	246	248	249	251	253	255	257	259	261	263	265	267
0.0	219	221	223	224	226	228	230	232	234	236	237	239	241	243	245	247	248	250	252	254	256	258
2.0	209	211	213	215	217	218	220	222	224	226	227	229	231	233	234	236	238	240	242	243	245	247
4.0	198	200	202	203	205	207	209	210	212	214	215	217	219	221	222	224	226	227	229	231	233	234
6.0	185	187	189	190	192	194	195	197	198	200	202	203	205	207	208	210	212	213	215	216	218	220

TABLE A1 *Continued*

Station	Maximum Temperatures from 284 to 326°C																						
	284	286	288	290	292	294	296	298	300	302	304	306	308	310	312	314	316	318	320	322	324	32
10.0	189	190	191	192	193	195	196	197	198	199	200	202	203	204	205	206	208	209	210	211	212	21
12.0	200	202	203	204	205	207	208	209	211	212	213	214	216	217	218	219	221	222	223	225	220	22
14.0	211	213	214	215	217	218	219	221	222	224	225	226	228	229	230	232	233	235	236	237	239	24
16.0	222	223	224	226	227	229	230	232	233	235	236	238	239	241	242	243	245	246	248	249	251	25
18.0	231	233	234	236	237	239	240	242	243	245	247	248	250	251	253	254	256	257	259	260	262	26
20.0	240	242	243	245	246	248	250	251	253	255	256	258	259	261	263	264	266	267	269	271	272	27
22.0	248	250	251	253	255	256	258	260	262	263	265	267	268	270	272	273	275	277	278	280	282	28
24.0	255	257	259	261	262	264	266	268	269	271	273	275	276	278	280	282	283	285	287	289	290	29
26.0	262	264	266	267	269	271	273	275	277	278	280	282	284	286	287	289	291	293	295	296	298	30
28.0	268	270	272	273	275	277	279	281	283	285	286	288	290	292	294	296	298	299	301	303	305	30
30.0	273	275	277	279	280	282	284	286	288	290	292	294	296	298	300	301	303	305	307	309	311	31
32.0	277	279	281	283	285	287	289	291	293	295	296	298	300	302	304	306	308	310	312	314	316	31
34.0	280	282	284	286	288	290	292	294	296	298	300	302	304	306	308	310	312	314	316	318	320	32
36.0	283	285	287	289	291	293	295	297	299	301	303	305	307	308	310	312	314	316	318	320	322	32
38.0	284	286	288	290	292	294	296	298	300	302	304	306	308	310	312	314	316	318	320	322	324	32
38.7	284	286	288	290	292	294	296	298	300	302	304	306	308	310	312	314	316	318	320	322	324	32
40.0	284	286	288	290	292	294	296	298	300	302	304	306	308	310	312	314	316	318	320	322	324	32
42.0	282	284	286	288	290	292	294	296	298	300	302	304	306	308	310	312	314	316	318	320	322	32
44.0	279	281	283	285	287	288	290	292	294	296	298	300	302	304	306	308	310	312	314	316	318	32
46.0	274	275	277	279	281	283	285	287	289	291	293	295	297	299	301	303	305	306	308	310	312	31
48.0	267	268	270	272	274	276	278	280	282	284	286	287	289	291	293	295	297	299	301	303	305	30
50.0	258	260	261	263	265	267	269	271	273	274	276	278	280	282	284	285	287	289	291	293	295	29
52.0	247	249	251	252	254	256	258	260	261	263	265	267	268	270	272	274	276	277	279	281	283	28
54.0	234	236	238	240	241	243	245	246	248	250	252	253	255	257	258	260	262	264	265	267	269	27
56.0	220	221	223	225	226	228	230	231	233	234	236	238	239	241	243	244	246	248	249	251	252	25

TABLE A1 *Continued*

Station	Maximum Temperatures from 326 to 370°C																						
	326	328	330	332	334	336	338	340	342	344	346	348	350	352	354	356	358	360	362	364	366	368	3
10.0	213	215	216	217	218	219	220	222	223	224	225	226	228	229	230	231	232	233	235	236	237	238	2
12.0	227	228	230	231	232	234	235	236	237	239	240	241	242	244	245	246	248	249	250	251	253	254	2
14.0	240	241	243	244	246	247	248	250	251	252	254	255	257	258	259	261	262	263	265	266	268	269	2
16.0	252	254	255	257	258	260	261	262	264	265	267	268	270	271	273	274	276	277	278	280	281	283	2
18.0	263	265	267	268	270	271	273	274	276	277	279	280	282	284	285	287	288	290	291	293	294	296	2
20.0	274	276	277	279	280	282	284	285	287	289	290	292	293	295	297	298	300	301	303	305	306	308	3
22.0	284	285	287	289	290	292	294	295	297	299	300	302	304	305	307	309	311	312	314	316	317	319	3
24.0	292	294	296	298	299	301	303	305	306	308	310	312	313	315	317	319	320	322	324	326	327	329	3
26.0	300	302	304	305	307	309	311	313	315	316	318	320	322	324	325	327	329	331	333	334	336	338	3
28.0	307	309	311	313	314	316	318	320	322	324	326	327	329	331	333	335	337	339	340	342	344	346	3
30.0	313	315	317	319	320	322	324	326	328	330	332	334	336	338	340	341	343	345	347	349	351	353	3
32.0	318	320	322	324	326	327	329	331	333	335	337	339	341	343	345	347	349	351	353	355	357	359	3
34.0	322	324	326	328	330	332	333	335	337	339	341	343	345	347	349	351	353	355	357	359	361	363	3
36.0	324	326	328	330	332	334	336	338	340	342	344	346	348	350	352	354	356	358	360	362	364	366	3
38.0	326	328	330	332	334	336	338	340	342	344	346	348	350	352	354	356	358	360	362	364	366	368	3
38.7	326	328	330	332	334	336	338	340	342	344	346	348	350	352	354	356	358	360	362	364	366	368	3
40.0	326	328	330	332	334	336	338	340	342	344	346	348	350	352	354	356	358	360	362	364	366	368	3
42.0	324	326	328	330	332	334	336	338	340	342	344	346	348	350	352	354	356	358	360	362	364	366	3
44.0	320	322	324	326	328	330	332	334	336	338	340	342	344	346	348	350	352	353	355	357	359	361	3
46.0	314	316	318	320	322	324	326	328	330	332	334	336	338	339	341	343	345	347	349	351	353	355	3
48.0	306	308	310	312	314	316	318	320	322	324	325	327	329	331	333	335	337	339	341	343	344	346	3
50.0	297	298	300	302	304	306	308	310	311	313	315	317	319	321	323	324	326	328	330	332	334	335	3
52.0	285	286	288	290	292	294	295	297	299	301	303	304	306	308	310	311	313	315	317	319	320	322	3
54.0	270	272	274	276	277	279	281	282	284	286	288	289	291	293	295	296	298	300	301	303	305	307	3
56.0	254	256	257	259	261	262	264	266	267	269	270	272	274	275	277	279	280	282	284	285	287	288	2

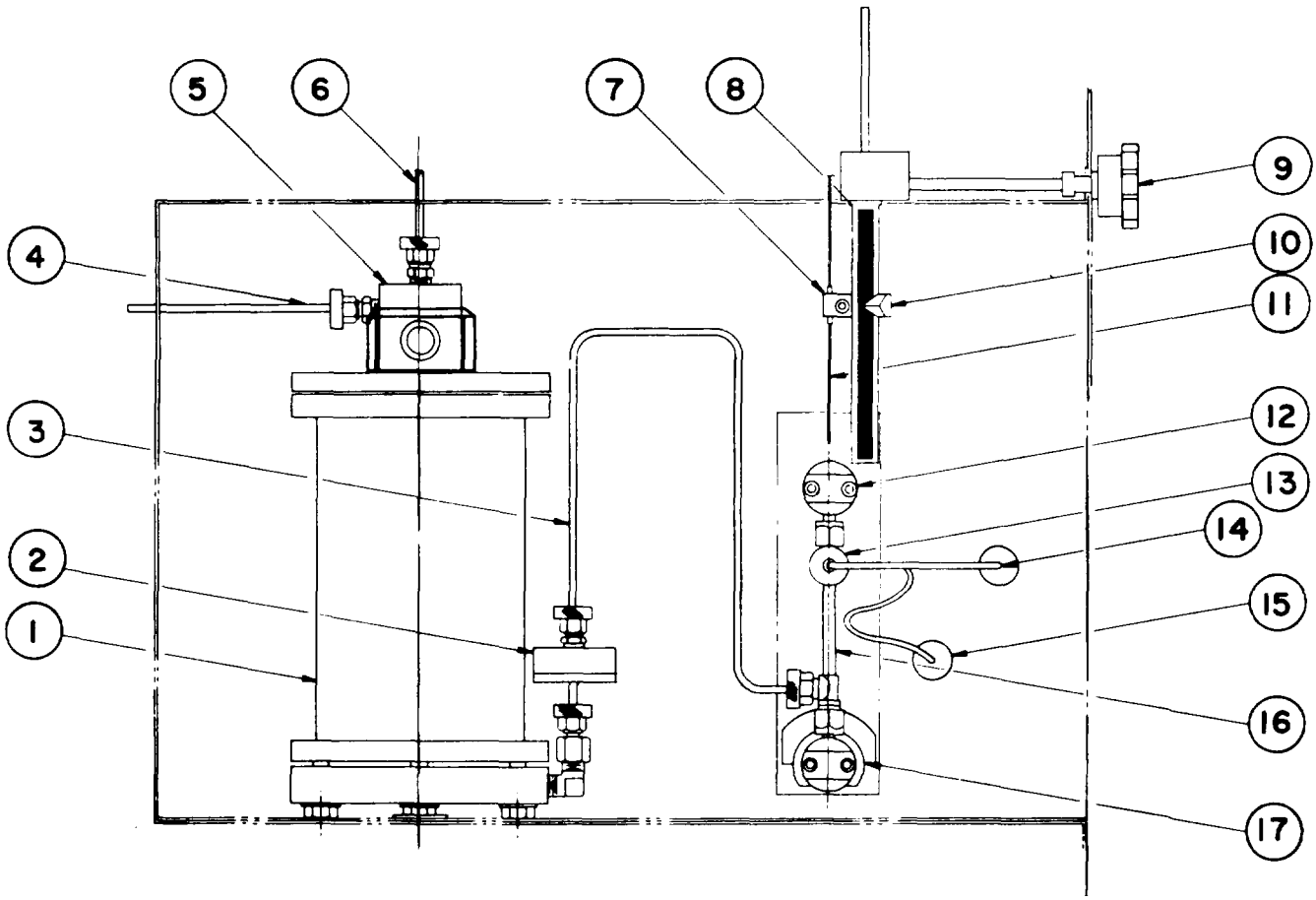


Figure A2. 1 Test Section Compartment

1. Reservoir
2. Pre-filter
3. Heater Tube Supply Line
4. N2 Inlet Line
5. Drip Flow Indicator
+6. Spent Fuel Return Line
7. Thermocouple Clamp
8. Thermocouple Reference Line
9. Thermocouple Position Control
10. Thermocouple Position Indicator
11. Thermocouple
12. Upper Fixed Bus
13. Test filter Housing
14. Heater Tube Fuel Outlet Line
15. Filter Bypass Line
16. Heater Tube Housing
17. Lower Floating Bus

Figure A2.1 Test Section Compartment

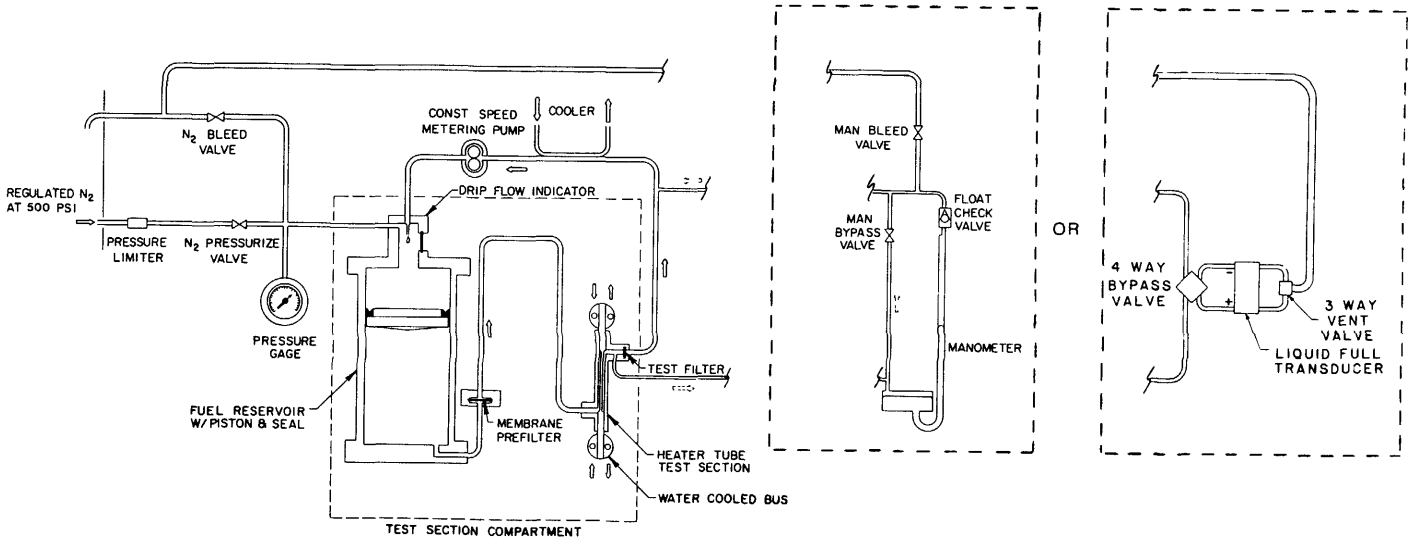


Figure A2.2. Fuel System Schematic

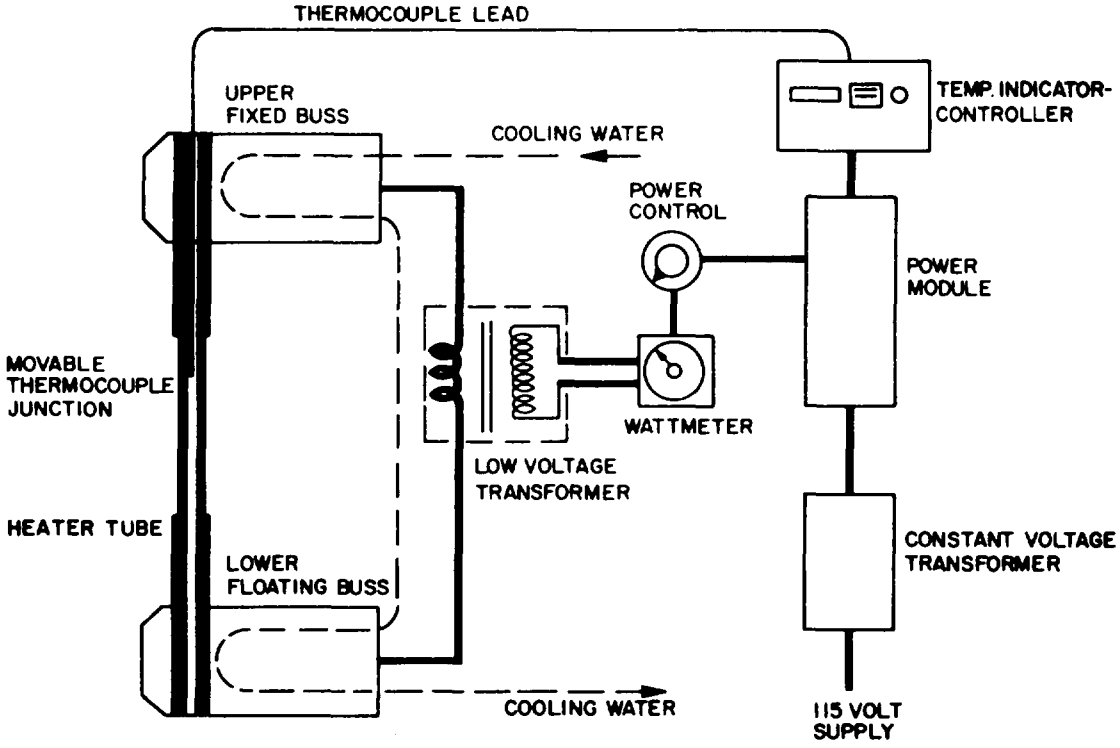


Figure A2.3 Heater Tube Power and Temperature Control Schematic

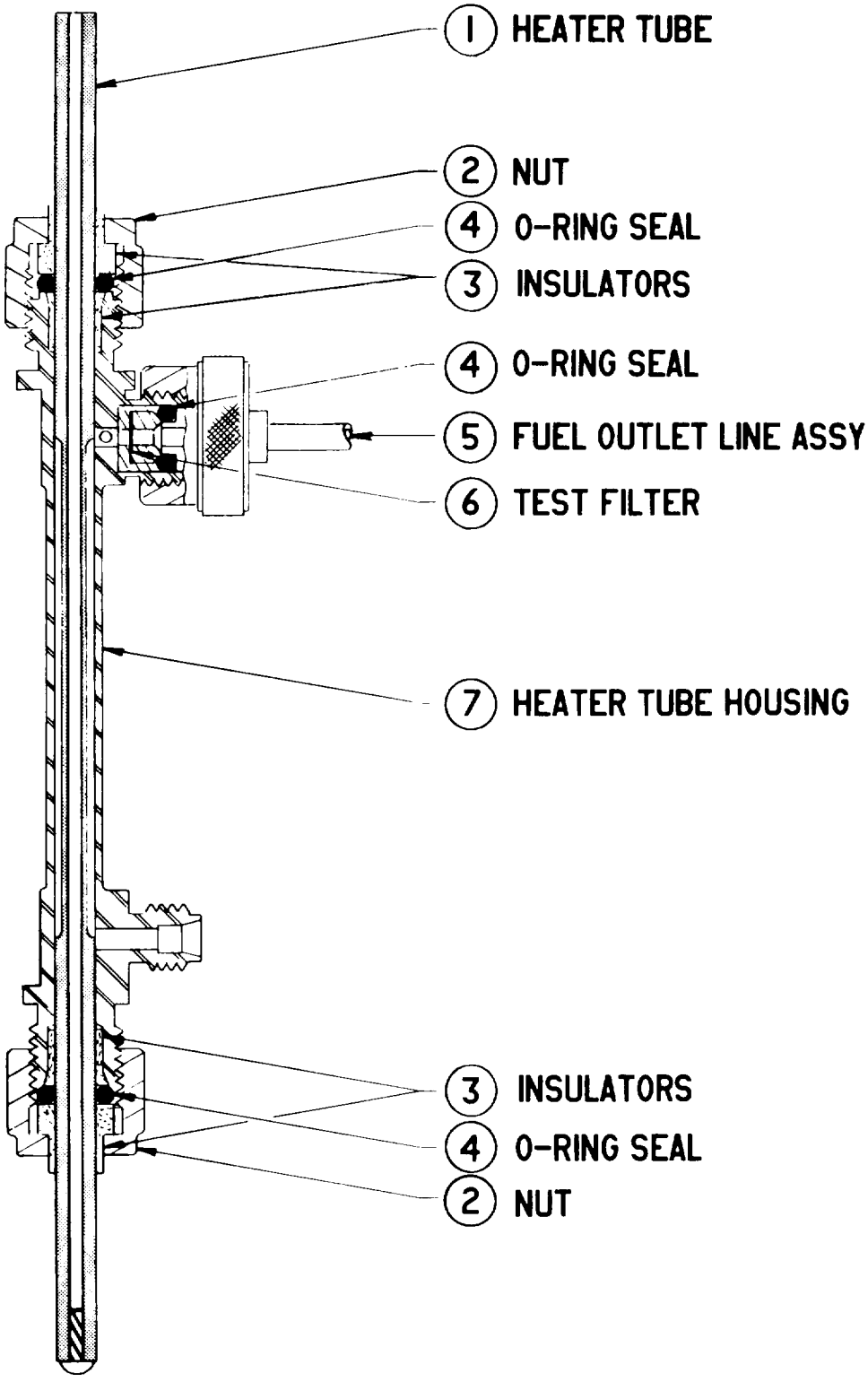
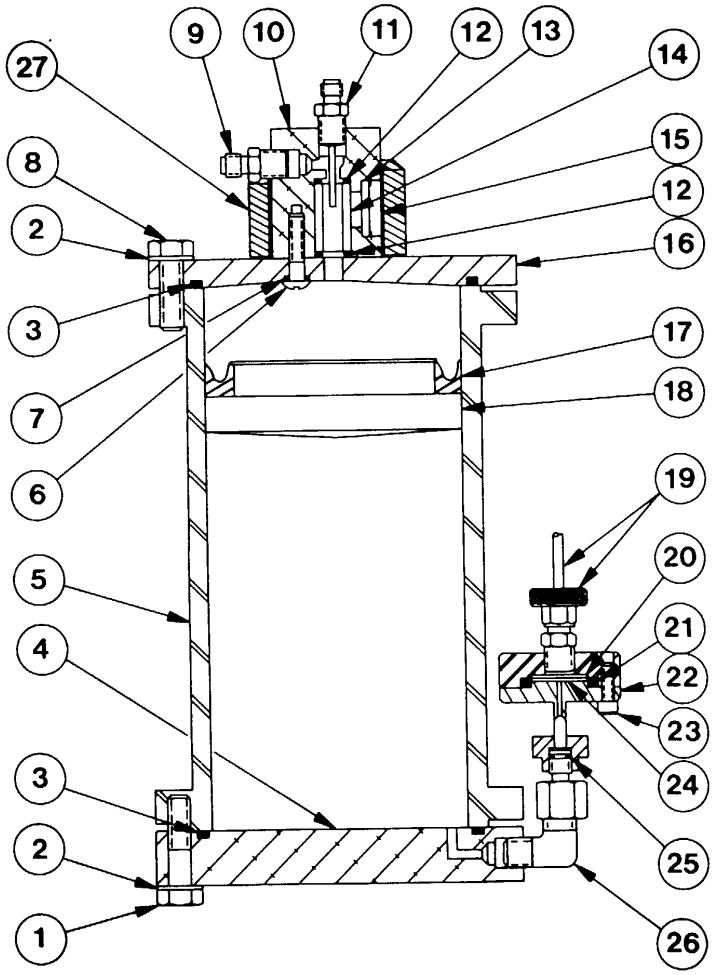


Figure A2.4 Assembly Drawing of Heater Tube Section



1. Cap Screw, Hex Head
2. Washer
3. O-Ring Seal, Reservoir
4. Base
5. Cylinder
6. Screw, Truss Head
7. O-Ring Seal, Ret. Screw
8. Cap Screw, Hex. Head
9. Nitrogen Inlet Fitting
10. Housing, Drip Flow Indicator
11. Drip Tube Fitting
12. O-Ring Seal, Sight Glass
13. Retaining Ring
14. Sight Glass
15. Window Glass
16. Cover
17. Lip Seal
18. Piston
19. Heater Tube Fuel Supply Line Assy.
20. Filter Backup Screen
21. O-Ring Seal, Pre-filter
22. Housing, Pre-filter
23. Cap Screw, Allen Head
24. Membrane Filter
25. O-Ring Seal
26. Reservoir Fuel Outlet Fitting
27. Protector, Drip Flow Indicator

Figure A2.5 Reservoir and Pre-Filter Assembly

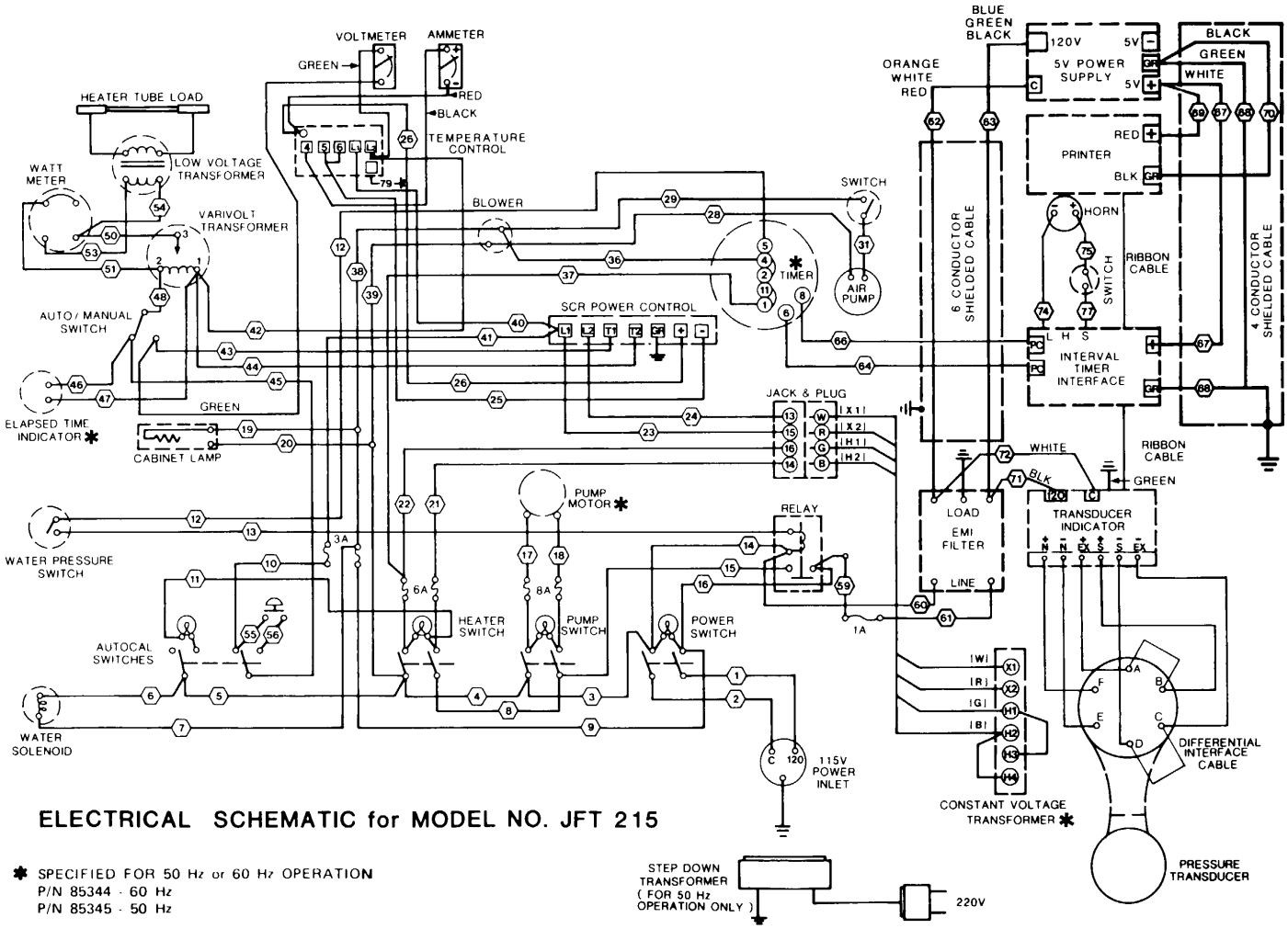


Figure A2.6 Electrical Schematic, Differential Pressure Transducer Model

APPENDIX A

REFERENCES

A-1. Scope. This appendix contains all forms, pamphlets and technical manuals referenced In both the Air mobile and Semitrailer mounted Laboratories

A-2. Forms

Recommended Changes to Publications ..... DA Form 2028
..... DA Form 2028-2
Quality Deficiency Report..... SF 368
Equipment Inspection and Maintenance Work Sheet..... DA Form 2404
Hand Receipts..... DA Form 2062

A-3. Field Manuals

Petroleum Testing Faculties:
Laboratories and Kits ..... FM 10-72
Inspecting and Testing Petroleum Products..... FM 10-70
ASTM Test Method Supplement to..... FM 10-92C1/C2

A-4. Technical Manuals

Atlas-Copco Compressor..... TM 10-4310-392-13&P
Alcor Jet Fuel Thermal Oxidation Tester Operating and Maintenance Manual..... TM 10-6635-210-13&P
Bacharach Gas Alarm and Calibration Data ..... TM 10-6665-297-13&P
Brother Portable Typewriter..... TM 10-7430-218-13&P
Chemtrix Field Ph Meter ..... TM 10-6630-237-13&P
Elkay Manufacturing 30 GPH Cooler..... TM 10-4130-240-13&P
Emcee Micro-Separometer ..... TM 10-6640-222-13&P
Foxboro Pressure Recording Gauge ..... TM 10-6685-365-13&P
Gammon Aqua Glo Water Detector..... TM 10-6640-221-13&P
Gammon Mini Monitor Fuel Sampling Kit..... TM 10-6630-230-13&P
Jelrus Burn-Out Furnace ..... TM 10-6640-231-13&P
Koehler Cleveland Open Tester ..... TM 10-6630-236-13&P
Koehler Cloud and Pour Point Chamber..... TM 10-6630-238-13&P
Koehler Copper Strip Corrosion Bomb Bath ..... TM 10-6640-220-13&P
Koehler Distillation Apparatus ..... TM 10-6630-233-13&P
Koehler Dropping Point Apparatus ..... TM 10-6635-211-13&P
Koehler Electric Pensky-Martlns Tester..... TM 10-6630-231-13&P
Koehler Foaming Characteristics Determination Apparatus..... TM 10-6640-228-13&P
Koehler Kinematic Viscosity Bath..... TM 10-6630-239-13&P
Koehler Tag Closed Cup Flash Tester..... TM 10-6630-235-13&P
Lab-Line Explosion Proof Refrigerator..... TM 10-6640-219-13&P
Lily Freezer..... TM 10-6640-234-13&P
Millipore OM 39 Filter Holder ..... TM 10-6640-225-13&P
Millipore Vacuum Pump ..... TM 10-6640-217-13&P
Ohaus Harvard Trip Balance..... TM 10-6670-278-13&P
Precision Gas-Oil Distillation Test Equipment ..... TM 10-6630-219-13&P
Precision General Purpose Water Bath..... TM 10-6640-229-13&P

Precision High Temperature Bronze Block Gum Bath ..... TM 10-6630-234-13&P
Precision General Purpose Ovens..... TM 10-6640-218-13&P
Precision Heater Instruction Manual and Parts List..... TM 10-6640-223-13&P
Precision Oxidatlon Stability Bath ..... TM 10-6640-232-13&P
Precision Pensky-Martens Flash Testers..... TM 10-6630-231-13&P
Precision Rein Vapor Pressure Bath..... TM 10-6640-226-13&P
Precision Slo-Speed Stirrer..... TM 10-6640-224-13&P
Precision Universal Centrifuge ..... TM 10-6640-230-13&P
Precision Universal Penetrometer ..... TM 10-6640-228-13&P
Sargent-Welch Vacuum Pump..... TM 10-4310-391-13&P
Sartorious Analytical Balance..... TM 10-6670-277-13&P
Scotsman Cuber ..... TM 10-6640-227-13&P
Soltec VOM-Multimeter..... TM 10-6625-3127-13&P
Teel Self-Priming Centrifugal Pump..... TM 10-6640-217-13&P
Teel Submersible Pump..... TM 10-4320-320-13&P
Texas Instrument TI-503011 Calculator..... TM 10-7420-210-13&P

A-5. Pamphlets

The Army Maintenance Management System (TAMMS) ..... DA Pam 738-750

A-6. Miscellaneous Publications

The Army Integrated Publishing and Printing Program ..... AR 25-30
Laboratory, Airmobile, Aviation Fuel ..... MIL-L-52733A(ME)
Apparatus, Instruments, Chemicals, Furniture, and Supplies for Industrial,
Clinical, College and Government Laboratories.....Fisher Scientific Laboratories Catalog
Petroleum-Petrochemical Testing Equipment..... Precision Scientific Catalog

APPENDIX B

MAINTENANCE ALLOCATION CHART

Section I. INTRODUCTION

B-1. General.

a. This section provides a general explanation of all maintenance and repair functions authorized at various maintenance categories.

b. The Maintenance Allocation Chart (MAC) In Section II designates overall authority and responsibility for the performance of maintenance functions on the identified end item or component. The application of the maintenance functions to the end item or component will be consistent with the capacities and capabilities of the designated maintenance categories.

c. Section III lists the tools and test equipment (both special tools and common tool sets) required for each maintenance function as referenced from Section II

d. Section IV contains supplemental Instructions and explanatory notes for a particular maintenance function.

B-2 Maintenance Functions. Maintenance functions will be limited to and defined as follows:

a. Inspect. To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination (e g, by sight, sound, or feel)

b. Test To verify serviceability by measuring the mechanical, pneumatic, hydraulic, or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. *Service* required periodically to keep an item in proper operating condition, i e. , to clean (includes decontaminate, when required), to preserve, to drain, to paint, or to replenish fuel, lubricants, chemical fluids, or gases.

d. Adjust. To maintain or regulate, within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to specified parameters.

e. Align. To adjust specified variable elements of an Item to bring about optimum or desired performance.

f. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test, measuring, and diagnostic equipments used In precision measurement Consists of companions of two instruments, one of which is a certified standard of knob accuracy, to detect and adjust any discrepancy in the accuracy of the Instrument being compared.

g. Remove/Install. To remove and install the same Item when required to perform service or other maintenance functions. Install may be the act of emplacing, seating, or fixing Into position a spare, repair part, or module (component or assembly) In a manner to allow the proper functioning of an equipment or system

h. Replace. To remove an unserviceable Item and install a serviceable counterpart In Its place "Replace" is authorized by the MAC and is shown as the third position code of the SMR code

i. *Repair.* The application of maintenance services, including fault location/troubleshooting, 2 removal/installation, and disassembly/assembly procedures3 and maintenance actions, 4 to identify troubles and restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

j. *Overhaul.* That maintenance effort (service/action) prescribed to restore an item to a completely serviceable/operational condition as required by maintenance standards in appropriate technical publications (i. e, DMWR). Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like-new condition.

k. *Rebuild.* Consists of those services/actions necessary for the restoration of unserviceable equipment to a like-new condition in accordance with original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours/miles, etc.) considered in classifying Army equipment/components.

B-3. Explanation Of Columns In The MAC, Section II.

a. *Column I. Group Number* Column 1 lists functional group code numbers, the purpose of which is to identify maintenance significant components, assemblies, subassemblies, and modules with the next higher assembly. End item group number shall be "00 "

b. *Column 2. Component/Assembly*. Column 2 contains the names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. *Column 3. Maintenance Function*. Column 3 lists the functions to be performed on the item listed in column 2. (For a detailed explanation of these functions, see paragraph B-2.)

d. *Column 4. Maintenance Category.* Column 4 specifies, by the listing of a work time figure in the appropriate subcolumn(s), the category of maintenance authorized to perform the function listed in column 3 This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number or complexity of the tasks within the listed maintenance function vary at different maintenance categories, appropriate work time figures will be shown for each category. The work time figure represents the average time required to restore an item (assembly, subassembly, component, module, end item, or system) to a serviceable condition under typical field operating conditions. This time includes preparation time (including any necessary disassembly/ assembly time), troubleshooting/fault location time, and quality assurance/quality control time in addition to the time required to perform the specific tasks Identified for the maintenance functions authorized in the maintenance allocation chart The symbol designations for the various maintenance categories are as follows:

1 Services - Inspect, test, service, adjust, align, calibrate, and/or replace.

2 Fault locate/troubleshoot-theprocess of investigating and detecting the cause of equipment malfunctioning, the act of isolating a fault within a system or unit under test (UUT)

3 Disassemble/assemble - encompasses the step-by-step taking apart (or breakdown) of a spare/functional group coded item to the level of its least competency identified as maintenance significant (I e. , assigned an SMR code) for the category of maintenance under consideration

4 Actions - welding, grinding, riveting, straightening, facing, remachining, and/or resurfacing

C.....Operator/Crew

O.....Unit Maintenance

F.....Direct Support Maintenance

H.....General Support Maintenance

D.....Depot Maintenance

e. Column 5. Tools and Equipment. Column 5 specifies, by code, those common tool sets (not individual tools) and special tools, TMDE, and support equipment required to perform the designated function.

f. Column 6. Remarks. This column shall, when applicable, contain a letter code, in alphabetic order, which shall be keyed to the remarks contained in section IV .

B-4 Explanation Of Columns In Tool And Test Equipment Requirements, Section III.

a. Column I. Reference Code.The tool and test equipment reference code correlates with a code used in the MAC, section II, column 5.

b. Column 2. Maintenance Category.The lowest category of maintenance authorized to use the tool or test equipment.

c. Column 3. Nomenclature Name or identification of the tool or test equipment.

d. Column 4. National Stock Number The National stock number of the tool or test equipment.

e. Column 5. Tool Number. The manufacturer's part number.

B-5. Explanation Of Columns In Remarks, Section IV.

a. Column I. Reference Code. The code recorded In column 6, Section II.

b. Column 2. Remarks. This column lists information pertinent to the maintenance function being performed as indicated In the MAC, section II.

Section II. MAINTENANCE ALLOCATION CHART

(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND TEST EQUIPMENT	(6) REMARKS
			C	O	F	H	D		
01	TESTER, JET FUEL	INSPECT REPLACE REPAIR	0 2	2 0	40			1, 2,3	A B C,D

Section III. TOOL AND TEST EQUIPMENT REQUIREMENTS

FOR

MAINTENANCE ALLOCATION CHART

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
1	F	TOOL KIT,GENERAL AUTOMOTIVE	5180-00-177-7033	(50980) SC 5180-90-CL-N26
2	F	SHOP EQUIPMENT AUTOMOTIVE MAINTENANCE AND REPAIR COMMON #1 (LESS POWER)	4910-00-754-0654	(19204) SC 4910-95 CL-A74
3	F	MULTIMETER, 0-500V	6625-00-691-2453	

Section IV. REMARKS

REFERENCE CODE	REMARKS
A	Inspect according to procedures listed in sections 7.2 and 7.3 of manual: Inspection of components and inspection and testing of reservoir piston seal.
B	Replacement limited to items such as fuses, lines and tubing.
C	Repair limited to replacement of parts such as metering pump, sight glass, filter/dryer, pressure limiter, water
D	Repairs above Direct Support should be performed by authorized manufacturer repair facility or services

APPENDIX C

COMPONENTS OF END ITEM AND BASIC ISSUE ITEMS LISTS

Section I. INTRODUCTION

C-1. Scope.

This appendix lists components of end item and basic issue items for the Jet Fuel Thermal Oxidation Tester to help you Inventory Items required for safe and efficient operation

C-2. General.

The Components of End Item and Basic Issue Items Lists are divided into the following sections:

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

b. Section 111. Basic Issue Items. These are the minimum essential Items required to place the Jet Fuel Thermal Oxidation Tester in operation, to operate It, and to perform emergency repairs. Although shipped separately packaged, BII must be with the shelter during operation and whenever it Is transferred between property accounts. The illustrations will assist you with hard-to-identify items. This manual is your authority to request/requisition replacement BII 1, based on TOE/MTOE authorization of the end item.

C-3. Explanation of Columns.

The following provides an explanation of columns found In the tabular listings

a. Column(1) Illustration Number (Illus. Number). This column indicates the number of the illustration In which the Item is shown

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

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

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

e. Column(5) - Quantity required (QTY RQR). Indicates the quantity of the Item authorized to be used with/on the equipment

Section II. COMPONENTS OF END ITEM

NOT APPLICABLE

Section III. BASIC ISSUE ITEMS

(1) ILLUS NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION, CAGEC and Part Number	Usable On Code	(4) U/M	(5) QTY
	8415-00-266-8679	GLOVES, RUBBER, SIZE 9 (81348) ZZ-G-381, TYPE 1, STYLE I		PR	1
	8415-00-266-867	GLOVES, RUBBER, SIZE 11 (81348) ZZ-G-381, TYPE 1, STYLE I		PR	1
		WASH,BOTTLE, LABORATORY		EA	1
	q	POLYETHYLENE, 500 ML (22527) NO 3-409-10 (53078) S-9486C			
	6670-00-263-0249	FORCERS CRESCENT, 4 IN (22527) 2-354		EA	1
	9150-00-965-2408	GREASE,GROUND GLASS JOINT SILICONE,HIGH VACUUM GREASE (71986)		OZ	2
	9535-00-541-2453	ALUMINUM FOIL DRY ANNEAL SURFACE, 75 FT LG (81348) QQ-A-1876,TYPE 1, GRADE A		FT	75
	7920-00-965-1709	TOWEL, PAPER SINGLE FOLD,15 IN W, 72 PER SELF DISPENSING BOX (81348) UU-T-598		BX	2

APPENDIX D

ADDITIONAL AUTHORIZATION LIST

NOT APPLICABLE

APPENDIX E

EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

Section I. INTRODUCTION

E-1. Scope. This listing is for informational purposes only and is not authonty to requisition the listed Items These items are authorized to you by CTA 50-970, Expendable/Durable Items (except medical, class V, repair parts, and heraldic items)

E-2 Explanation of Columns.

a. Column (1) Item Number This number is assigned to the entry in the listing and is referenced in the narrative Instructions to identify the material (e. g , Use cleaning compound, Item 5, appendix C)

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

C	Operator/Crew
O	Unit Maintenance
F	Direct Support Maintenance
H	General Support Maintenance

c. Column (3)National Stock Number This Is the National stock number assigned to the Item, use It to request or requisition the Item

d. Column (4) Description Indicates the Federal item name, and, If required, a description to identify the Item The last line for each Item indicates the Commercial and Government Entity Code (CAGEC) In parentheses followed by the part number

e. Column (5) Unit of Measure (U/M) Indicates the measure used In performing the actual maintenance function This measure is expressed by a two-character alphabetical abbreviation (e g. , EA, IN, PR) If the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.

Section II. EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
		C	RECORDING PAPER AND RIBBON CARTRIDGES (05647) 89226	KT
		C	DATA SHEETS (05647) 89037	EA
		C	FILTER PAPER, GENERAL PURPOSE (05647) 27050	EA
		C	HEATER TUBE AND FILTER KIT (05647) 91652	KT
		O	PREFILTER ASSEMBLY (05647) 27042	EA

By Order of the Secretary of the Army:

CARL E. VUONO
General, United States Army
Chief of Staff

Official:

THOMAS F. SIKORA
Brigadier General, United States Army
The Adjutant General

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The Metric System and Equivalents

Linear Measure

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

Weights

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

Liquid Measure

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

Square Measure

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

Cubic Measure

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

Approximate Conversion Factors

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

Temperature (Exact)

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

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