

**TECHNICAL MANUAL**

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

**EMCEE MICRO-SEPAROMETER**

**MARK V DELUXE**

**MODEL NO. 1140**

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.

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**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. If inside storage is not available, trucks, vans, conex containers and other containers may be used.

MICRO-SEPAROMETER MARK V DELUXE

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OPERATION MANUAL



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## MICRO-SEPAROMETER MARK V DELUXE OPERATION MANUAL

### 1.0 SCOPE

1.1 The Micro-Separometer Mark V Deluxe incorporates solid state design and self-contained power source. The instrument provides a quick, portable means for field and laboratory use to rate the ability of aviation turbine fuels to release entrained or emulsified water when passed through fiberglass coalescence material.

### 2.0 SIGNIFICANCE

2.1 The test provides a measure of surface active materials in aviation turbine fuels. These are known to affect the ability of filter separators to separate free water from fuel.

### 3.0 DEFINITION

3.1 To distinguish from the standard Water Separometer rating (WSIM) and Minisonic Separometer rating WSIM (MSS), the Micro-Separometer numerical rating should be reported as Micro-Separometer rating (MSEP).

### 4.0 SUMMARY OF METHOD

4.1 The fuel sample is emulsified with water in a syringe, using the emulsifier which is programmed to operate for a predetermined time period. After emulsification there is a programmed waiting period to allow time to insert the plunger, add the ALUMICEL®COALESCER and place the entire assembly on the syringe drive. The sample is expelled from the syringe at a programmed rate by the syringe drive mechanism through a standard ALUMICEL®COALESCER. When all of the fuel has been expelled from the syringe, another programmed waiting period is initiated to allow the coalesced water to settle. At the end of the settling time period, an audible signal sounds. Immediately after the audible signal stops, the meter indicates the Micro-Separometer rating which is a measure of the uncoalesced water remaining in the fuel. The results are reported on a 0-100 scale to the nearest whole number. High ratings indicate the water is easily coalesced, and the fuel is relatively free of surfactant materials. A test can be performed in approximately 5 minutes.

### 5.0 APPARATUS

5.1 The Micro-Separometer is a completely portable and self-contained unit, operating on an internal rechargeable battery. The unit may be operated at sites where no AC power

## MICRO-SEPAROMETER MARK V DELUXE OPERATION MANUAL

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supply is available. It also may be operated while connected to an AC power line. Detachable power cords are available for various voltages. The AC power source will power the unit and charge the battery. A place has been provided in the cover of the case to store a six-pack of disposable materials for running six tests.

5.2 The main features of the Micro-Separometer are shown in Figure 1 thru Figure 3. Figure 1 shows the right hand panel supporting the emulsifier and syringe drive. Figure 2 shows the control panel. Figure 3 shows the syringe drive mechanism.

5.2.1 The MAIN POWER is controlled by momentarily depressing the "ON" switch. In the battery mode a steady lamp at the ON switch location indicates the battery level is sufficient for testing. If the ON lamp flickers during fuel testing the instrument should be attached to an A.C. power source for battery charging. In the A.C. mode the lamp at the ON switch location will flash at a steady rate which indicates the A.C. source and instrument supply is ready for testing. The power is turned off by momentarily depressing the "OFF" switch. If power is inadvertently left on closing the right hand drive panel will also turn off the instrument. The battery is automatically charged and maintained when the A.C. power cord is attached to the power line. The A.C. circuit breaker located on the front panel, offers protection for the A.C. power circuit. D.C. power is protected by an internal fuse.

5.2.2 The TEST SELECT section, switches A through G are utilized to select the various test modes available. Individual test parameters are described in sections 9.0 through 15.0.

5.2.3 The "RESET" pushbutton, located on the main control panel, automatically resets the electronic program to test scan and positions the syringe drive into the packing mode.

5.2.4 The SYRINGE DRIVE section is utilized in tests F and G to manually operate the syringe mechanism. "UP" and "DOWN" switches are operational when indicated by the annunciator lamps.

5.2.5 The PROGRAM section consists of the "START" and "READ" switches. During automatic tests A through E the "START" switch is used to initiate all automatic programming. The "READ" switch is used during manual tests F and G to operate the turbidimeter.

5.2.6 The METER adjust section consists of switches labeled with up and down arrows. When the annunciator lamps are on, the switches allow adjustment of the turbidimeter.

5.2.7 The ALERT section is utilized as an annunciator. The "SYR" indicator will light when the syringe drive elapsed

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time is out of preset limits. The "C/S" indicator will light when 15 ml. of fuel sample is left for collection.

5.2.8 The TURBIDIMETER, located under the main control panel, consists of a well for placing the sample vial, a light source and a photocell.

5.3 The small parts and supplies needed to carry out the test are shown in Figure 4 and consist of the following.

5.3.1 WIRE AID A piece of wire with a loop and hook twisted on one end, used to release air when the syringe plunger is inserted. (Supplied with Instrument - Part No. 001-00-6928)

5.3.2 PIPETTE An automatic hand pipette for use with disposable plastic tip. (Supplied with Instrument Part No. 001-00-5983)

5.3.3 DRIP PAN - A pan used to receive the waste fuel. (Supplied with Instrument - Part No. 001-00-7902)

5.3.4 CONTAINER - A clean container for water. (Not included)

5.3.5 SYRINGE (barrel and plunger) - A disposable 50 ml. plastic syringe. (Part of Six-Pack)

5.3.6 SYRINGE PLUG - A plug for the syringe. (Part of Six-Pack)

5.3.7 ALUMICEL®COALESCER A pre-calibrated aluminum, throwaway coalescer cell with a tapered end to fit the syringe. (Part of Six-Pack)

5.3.8 VIALS - A glass vial pre-marked for proper turbidimeter positioning. (Part of Six-Pack)

5.4 SIX-PACK A new syringe, pipette tip, test sample vial, plug and ALUMICEL®COALESCER are used in each test. These disposable parts are available from Emcee in a kit containing all the disposables for 6 tests. This kit is designed to fit inside the Micro-Separometer. (Part No. 840.99-5944)

## 6.0 REAGENTS

6.1 WATER - Clean, surfactant-free, preferably distilled.

## 7.0 PREPARATION OF APPARATUS

7.1 If possible, locate the instrument in an area where the temperature is between 65 degrees F. and 85 degrees F.

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Test performed outside of these temperature limits may not meet ASTM repeatability/reproducibility criteria.

7.2 Remove the instrument from the protective foam case. Open the case and remove the Six-Pack box from the lid. Insert your finger into the hole in the right panel and raise the panel until completely vertical and locked in place. If power is available, check to be certain the source voltage matches the power cord label and connect the power cord.

7.3 Have ready a supply of syringes, ALUMICEL®COALESCERS, vials, plugs, pipette tips, drip pan, and a container for clean water. All but the water container are provided with the instrument and Six-Pack.

7.4 The syringe drive speeds are pre-set at the factory and are automatically checked during each test. The syringe drive time is measured and compared to an internal clock. As soon as the syringe reaches the bottom limit the "SYR. " alert indicator will illuminate if the syringe speed is out of limits. The syringe alert lamp will remain on until the end of the test to alert the operator the data may be suspect. If the syringe speed is further out of limits the audible alarm will sound 3 times and any test data should be discarded.

7.5 If the instrument is to be operated in a location where an AC outlet is not available, the instrument should be charged for approximately 16 hours before testing. The unit will function properly for approximately 25 tests before battery recharging is necessary.

### 8.0 PREPARATION OF SAMPLE

8.1 Obtain and handle the samples with the utmost care and cleanliness as required in the ASTM Procedure D-3948. Before pouring the test sample from container, wipe the container outlet thoroughly with a clean, lintless wipe. Then pour the test sample into a clean beaker or directly into the syringe.

8.2 If the sample for test is not within the test temperature limits let the container stand or preferably put sample in a clean beaker and let it come to operating temperature.

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### 9.0 JET A TEST PROCEDURE

9.1 Prepare the DELUXE MICRO-SEPAROMETER as stated in section 7.0.

9.2 Momentarily depress the "ON" switch. The annunciator lamps located on switches A through G in the TEST SELECT section will then be scanning for your selection. Depress switch "A". This will initiate the standard automatic program for Jet A fuel.

9.3 The annunciator lamp on the "START" switch will be illuminated which indicates the program can be started by momentarily depressing this switch.

9.4 Remove a plunger from a 50 ml. syringe, insert a plug in the bottom, add approximately 50 ml. of fuel to be tested, place the syringe on the emulsifier turning to lock in place. Caution should be exercised to center the emulsifier blade in the syringe (Figure 5). Press the "START" pushbutton which will automatically clean the syringe for approximately 30 seconds and also raise the syringe drive to its UP position.

9.5 Add about 15 or 20 ml. of the fuel to be tested to a clean vial and insert into the TURBIDIMETER (the hole directly above the PROGRAM and METER sections). Align the black vial mark with the white line on the front panel.

9.6 Remove the syringe from the emulsifier, empty the fuel, draining thoroughly, and add exactly 50 ml. of test fuel.

9.7 Using a fresh tip on the hand pipette, add 50 microliters of clean water to fuel sample as follows. Push in plunger, immerse tip just below the water surface, release the plunger and withdraw from the water slowly to avoid water drips adhering to the outside of the tip. Immerse the tip of the pipette just below the fuel surface in the center of the syringe, to ensure the water drops break away cleanly and fall to the bottom; push the plunger, withdraw the pipette, and then release the plunger.

9.8 Place the syringe on the emulsifier, turning to lock in place. Caution should be exercised to center the emulsifier blade in the syringe (Figure 5).

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9.9 When securely in place depress the "START" pushbutton. This will initiate the automatic program.

### AUTOMATIC PROGRAM

Pulsed Tone	4 Seconds
Meter Adjust Period #1	10 Seconds
Emulsification	30 Seconds
Wait	30 Seconds
Pulsed Tone	4 Seconds
Meter Adjust Period #2	10 Seconds
Syringe Drive Down	45 Seconds
Wait	56 Seconds
Steady Tone	4 Seconds
Meter Read	10 Seconds

9.9.1 The automatic program starts with a read meter warning followed by a 10 second full scale adjustment period. During this period adjust the display to 100 using the meter adjust up or down switches.

9.9.2 After the emulsification period, remove the syringe from the emulsifier and insert the plunger using the wire aid to help expel the air. Remove the wire aid while maintaining the plunger at the 50 ml. position. Remove the plug from the bottom, replace it with an ALUMICEL®COALESCER, and place the whole assembly onto the syringe drive mechanism. Attach ground lead between ground jack on side of syringe drive and ALUMICEL®COALESCER. Place a waste container beneath the syringe to collect the unwanted fuel.

9.9.3 At the end of the second meter adjust period the syringe will start down. Remove and empty the sample vial and prepare for sample collection. The audio alert and the C/S indicator will indicate the proper time to collect the last 15 milliliters from the syringe.

9.9.4 Place the sample vial in the turbidimeter and rotate to the marked position.

9.9.5 When the steady tone starts the meter will automatically turn on. An additional one second tone during the meter on period will indicate the proper time to read the meter. Record the reading and report as Micro-Separometer rating (MSEP rating).

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### 10.0 JET B TEST PROCEDURE

10.1 Prepare the DELUXE MICRO-SEPAROMETER as stated in section 7.0.

10.2 Momentarily depress the "ON" switch. The annunciator lamps located on switches A through G in the TEST SELECT section will then be scanning for your selection. Depress switch "B". This will initiate the standard automatic program for Jet B fuel.

10.3 The annunciator lamp on the "START" switch will be illuminated which indicates the program can be started by momentarily depressing this switch.

10.4 Remove a plunger from a 50 ml. syringe, insert a plug in the bottom, add approximately 50 ml. of fuel to be tested, place the syringe on the emulsifier turning to lock in place. Caution should be exercised to center the emulsifier blade in the syringe (Figure 5). Press the "START" pushbutton which will automatically clean the syringe for approximately 30 seconds and also raise the syringe drive to its UP position.

10.5 Add about 15 or 20 ml. of the fuel to be tested to a clean vial and insert into the TURBIDIMETER (the hole directly above the PROGRAM and METER sections). Align the black vial mark with the white line on the front panel.

10.6 Remove the syringe from the emulsifier, empty the fuel, draining thoroughly, and add exactly 50 ml. of test fuel.

10.7 Using a fresh tip on the hand pipette, add 50 microliters of clean water to fuel sample as follows. Push in plunger, immerse tip just below the water surface, release the plunger and withdraw from the water slowly to avoid water drips adhering to the outside of the tip. Immerse the tip of the pipette just below the fuel surface in the center of the syringe, to ensure the water drops break away cleanly and fall to the bottom; push the plunger, withdraw the pipette, and then release the plunger.

10.8 Place the syringe on the emulsifier, turning to lock in place. Caution should be exercised to center the emulsifier blade in the syringe (Figure 5).

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10.9 When securely in place depress the "START" pushbutton. This will initiate the automatic program.

### AUTOMATIC PROGRAM

Pulsed Tone	4 Seconds
Meter Adjust Period #1	10 Seconds
Emulsification	30 Seconds
Wait	30 Seconds
Pulsed Tone	4 Seconds
Meter Adjust Period #2	10 Seconds
Syringe Drive Down	25 Seconds
Wait	56 Seconds
Steady Tone	4 Seconds
Meter Read	10 Seconds

10.9.1 The automatic program starts with a read meter warning followed by a 10 second full scale adjustment period. During this period adjust the display to 100 using the meter adjust up or down switches.

10.9.2 After the emulsification period, remove the syringe from the emulsifier and insert the plunger with the help of the wire aid. Remove the plug from the bottom, replace it with an ALUMICEL®COALESCER, and place the whole assembly onto the syringe drive mechanism. Attach ground lead between ground jack on side of syringe drive and ALUMICEL®COALESCER. Place a waste container beneath the syringe to collect the unwanted fuel.

10.9.3 At the end of the second meter adjust period the syringe will start down. Remove and empty the sample vial and prepare for sample collection. The audio alert and the C/S indicator will indicate the proper time to collect the last 15 milliliters from the syringe.

10.9.4 Place the sample vial in the turbidimeter and rotate to the marked position.

10.9.5 When the steady tone starts the meter will automatically turn on. An additional one second tone during the meter on period will indicate the proper time to read the meter. Record the reading and report as Micro-Separometer rating (MSEP rating).

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### 11.0 CLEAR AND BRIGHT

11.1 A numeric value can be determined with the Micro-Separometer relative to sample haze. Using this procedure a fuel sample is passed through a filter to remove water and particulate contamination. This sample provides a clear and bright reference which is compared to the original sample in the turbidimeter.

11.2 Prepare the DELUXE MICRO-SEPAROMETER as stated in section 7.0.

11.3 Momentarily depress the "ON" switch. The annunciator lamps located on switches A through G in the TEST SELECT section will then be scanning for your selection. Depress switch "C". This will initiate the standard automatic program for Clear and Bright Testing. The syringe drive mechanism will automatically move to the up position after depressing switch "C".

11.4 The annunciator lamp on the "START" switch will be illuminated which indicates the program can be started by momentarily depressing this switch.

11.5 Remove a plunger from a 50 ml. syringe, insert a plug in the bottom and add approximately 50 ml. of fuel to be tested. Insert the plunger with the help of the wire aid. Remove the plug from the bottom, replace it with a special ALUMICEL® COALESCER marked CLEAR & BRIGHT. Insert the syringe assembly into the syringe drive mechanism.

11.6 Momentarily depress the "START" pushbutton this will initiate the automatic program.

#### AUTOMATIC PROGRAM

Syringe Drive Down	45 Seconds
Pulsed Tone	4 Seconds
Meter Adjust Period	10 Seconds
Wait	30 Seconds
Steady Tone	4 Seconds
Meter Read	10 Seconds

11.7 The automatic program starts by passing the test fuel through the ALUMICEL®COALESCER marked CLEAR & BRIGHT. Prepare the sample vial for fuel collection. The audio alert and the C/S indicator will indicate the proper time to collect the last 15 ml. from the syringe.

11.8 Place the vial of filtered fuel into the turbidimeter and rotate to the marked position.

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11.9 When the pulsed tone starts the meter will automatically turn on. During this period adjust the display to 100 using the meter adjust up or down switches.

11.10 Discard the fuel sample and place 15 ml. of unfiltered fuel into the sample vial. Insert sample vial into the turbidimeter and rotate to the marked position.

11.11 When the steady tone starts the meter will automatically turn on. During this period record the display as the Clear and Bright rating.

## 12.0 DIESEL TEST PROCEDURE

12.1 Prepare the DELUXE MICRO-SEPAROMETER as stated in section 7.0.

12.2 Momentarily depress the "ON" switch. The annunciator lamps located on switches A through G in the TEST SELECT section will then be scanning for your selection. Depress switch "D". This will initiate the standard automatic program for Diesel fuel.

12.3 The annunciator lamp on the "START" switch will be illuminated which indicates the program can be started by momentarily depressing this switch.

12.4 Remove a plunger from a 50 ml. syringe, insert a plug in the bottom, add approximately 50 ml. of fuel to be tested, place the syringe on the emulsifier turning to lock in place. Caution should be exercised to center the emulsifier blade in the syringe (Figure 5). Press the "START" pushbutton which will automatically clean the syringe for approximately 30 seconds and also raise the syringe drive to its UP position.

12.5 Add about 15 or 20 ml. of the fuel to be tested to a clean vial and insert into the TURBIDIMETER (the hole directly above the PROGRAM and METER sections). Align the black vial mark with the white line on the front panel.

12.6 Remove the syringe from the emulsifier, empty the fuel, draining thoroughly, and add exactly 50 ml. of test fuel.

12.7 Using a fresh tip on the hand pipette, add 50 microliters of clean water to fuel sample as follows. Push in plunger, immerse tip just below the water surface, release the plunger and withdraw from the water slowly to avoid water drips adhering to the outside of the tip. Immerse the tip of the pipette just below the fuel surface in the center of the syringe, to ensure the water drops break away cleanly and fall to the bottom; push the plunger, withdraw the pipette, and then release the plunger.

12.8 Place the syringe on the emulsifier, turning to lock in place. Caution should be exercised to center the emulsifier blade in the syringe (Figure 5).



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12.9 When securely in place depress the "START" pushbutton. This will initiate the automatic program.

### AUTOMATIC PROGRAM

Pulsed Tone	4 Seconds
Meter Adjust Period #1	10 Seconds
Emulsification	30 Seconds
Wait	30 Seconds
Pulsed Tone	4 Seconds
Meter Adjust Period #2	10 Seconds
Syringe Drive Down	45 Seconds
Wait	56 Seconds
Steady Tone	4 Seconds
Meter Read	10 Seconds

12.9.1 The automatic program starts with a read meter warning followed by a 10 second full scale adjustment period. During this period adjust the display to 100 using the meter adjust up or down switches.

12.9.2 After the emulsification period, remove the syringe from the emulsifier and insert the plunger with the help of the wire aid. Remove the plug from the bottom, replace it with an ALUMICEL®COALESCER marked DIESEL, and place the whole assembly onto the syringe drive mechanism. Attach ground lead between ground jack on side of syringe drive and ALUMICEL®COALESCER. Place a waste container beneath the syringe to collect the unwanted fuel.

12.9.3 At the end of the second meter adjust period the syringe will start down. Remove and empty the sample vial and prepare for sample collection. The audio alert and the C/S indicator will indicate the proper time to collect the last 15 milliliters from the syringe.

12.9.4 Place the sample vial in the turbidimeter and rotate to the marked position.

12.9.5 When the steady tone starts the meter will automatically turn on. An additional one second tone during the meter on period will indicate the proper time to read the meter. Record the reading and report as Micro-Separometer rating (DMSEP rating).

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### 13.0 FILTER SEPARATOR MONITOR TEST

13.1 The DELUXE MICRO-SEPAROMETER can be utilized to evaluate the condition of filter separators. A proportionate sample is passed through a side-stream sensor to compare with the main-stream filter separator. The side-stream element is then tested using the following method.

13.2 Prepare the DELUXE MICRO-SEPAROMETER as stated in section 7.0.

13.3 Momentarily depress the "ON" switch. The annunciator lamps located on switches A through G in the TEST SELECT section will then be scanning for your selection. Depress switch "E". This will initiate the standard automatic program for Filter Separator testing.

13.4 The annunciator lamp on the "START" switch will be illuminated which indicates the program can be started by momentarily depressing this switch.

13.5 Momentarily depress the "START" switch. This will automatically operate the emulsifier for a period of 30 seconds and raise the syringe drive to the up position.

13.6 After the emulsification period, remove the syringe from the emulsifier and insert the plunger with the help of the wire aid. Remove the plug from the bottom, replace it with the F/S Monitor filter.

13.7 Momentarily depress "START" pushbutton. This will initiate the automatic program.

#### AUTOMATIC PROGRAM

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Pulsed Tone	4 Seconds
Meter Adjust Period	10 Seconds
Syringe Drive Down	15 Seconds
Steady Tone	4 Seconds
Meter Read #1	10 Seconds
Wait	46 Seconds
Steady Tone	4 Seconds
Meter Read #2	10 Seconds

13.8 Upon completion of the F/S Monitor Program, the instrument will automatically reset.

## MICRO-SEPAROMETER MARK V DELUXE OPERATION MANUAL

### 14.0 CLAY MONITOR TEST PROCEDURE

14.1 The DELUXE MICRO-SEPAROMETER can be used for the Clay Monitor Test in the following manner.

14.2 Prepare the DELUXE MICRO-SEPAROMETER as stated in section 7.0.

14.3 Momentarily depress the "ON" switch. The annunciator lamps located on switches A through G in the TEST SELECT section will then be scanning for your selection. Depress switch "F" to initiate the standard automatic program for Clay Monitor testing.

14.4 The annunciator lamps in the SYRINGE section will indicate that manual control can be executed on the syringe drive mechanism. Depress the "UP" pushbutton. This will move the syringe mechanism to the upper limit. The annunciator lamp in the PROGRAM section will indicate the turbidimeter can be utilized on demand. Depressing the "READ" switch will turn on the turbidimeter and the adjust capability of the turbidimeter.

14.5 Insert sample into syringe and attach to syringe drive mechanism.

14.6 Momentarily depressing the "DOWN" pushbutton will cause the syringe drive to dispense the fuel sample in approximately 15 seconds.

## 15.0 MINISTATIC TEST PROCEDURE

15.1 The Ministatic test utilizes the syringe drive mechanism. For this test it is necessary to move 50 ml. of fuel through the syringe in 30 seconds.

15.2 Prepare the DELUXE MICRO-SEPAROMETER as stated in section 7.0.

15.3 Momentarily depress the "ON" switch. The annunciator lamps located on switches A through G in the TEST SELECT section will then be scanning for your selection. Depress switch "G". This will initiate the MINISTATIC TEST program.

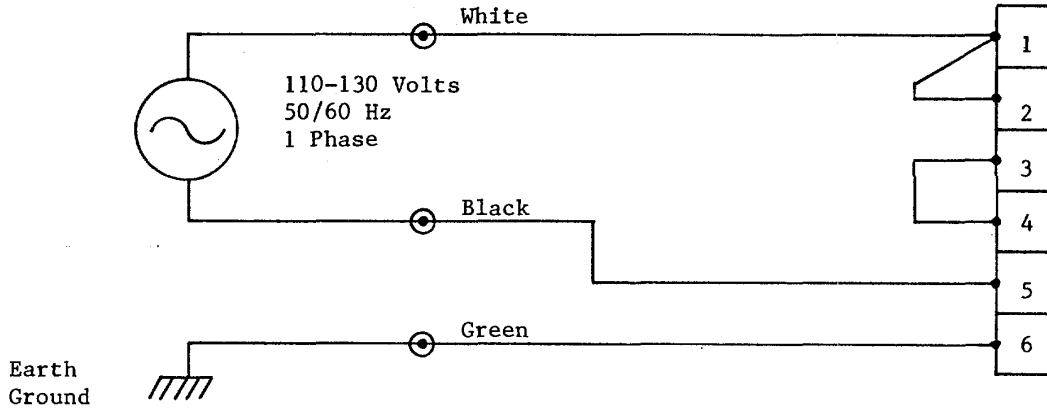
15.4 The annunciator lamps in the SYRINGE section will indicate that manual control can be executed on the syringe drive mechanism. Depress the "UP" pushbutton. This will move the syringe mechanism to the upper limit. The annunciator lamp in the PROGRAM section will indicate the turbidimeter can be utilized on demand. Depressing the "READ" switch will turn on the turbidimeter and the adjust capability of the turbidimeter.

15.5 Insert sample into syringe and attach to syringe drive mechanism.

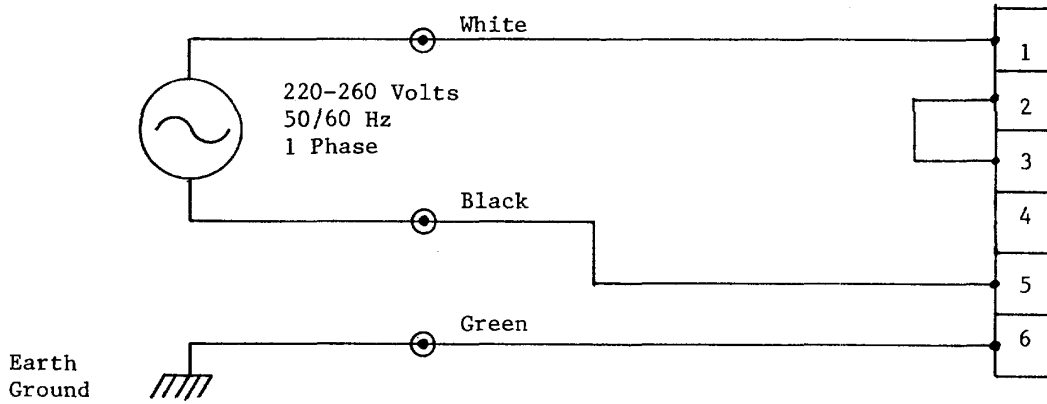
15.6 Momentarily depressing the "DOWN" pushbutton will cause the syringe drive to dispense the fuel sample in approximately 30 seconds.

16.0 POWER CORD WIRING

110 - 130 VOLT



220 - 260 Volt



## 17.0 FIELD SERVICE

The DELUXE MICRO-SEPAROMETER has been calibrated and adjusted at the factory and should require very little maintenance. This section, however, may assist in cases of minor difficulties that do not require factory service.

17.2 Syringe alert indication should a syringe alert light or light plus the audible alarm occur during testing, the following steps should be taken: Repeat the test insuring the syringe is centered in the drive mechanism and not binding. Use only a new syringe and plunger since the rubber on the plunger will swell causing increased drag. If possible, time the total syringe down time with a stopwatch. If the time is correct  $45 \pm 2$  seconds (mode A) or  $25 \pm 1$  second (mode B) and the alert is not repeated the instrument can be put back into service. If the syringe is within normal limits and the alert system is still triggered the internal clocking system would be at fault and would require factory service. If the syringe drive time is near or above the 47 second time limit it may be due to the syringe gear lubrication. The syringe drive mechanism should be removed from the support panel and cleaned using a suitable solvent (Toluene or Kerosene) and blow dry with an air pressure source. The gears and rack should then be lubricated with Molykote. After remounting the syringe drive on the support panel, cycle the syringe drive several times and repeat the test. Should the drive time still be out of limits factory service will be required.

18.0 PHOTOGRAPHS

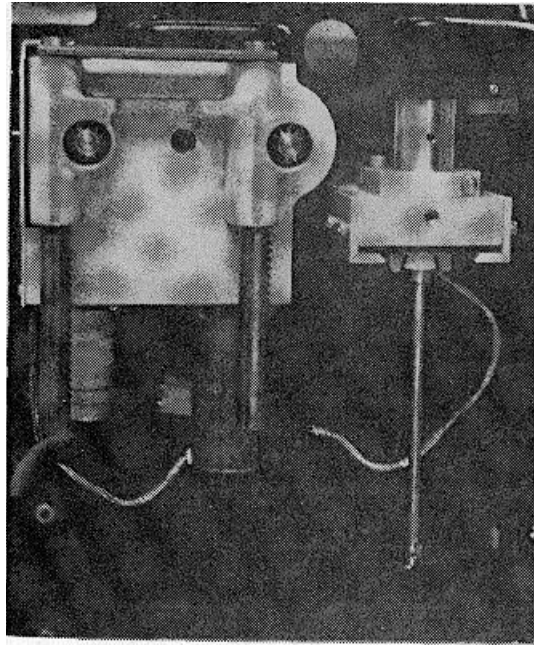


Figure 1

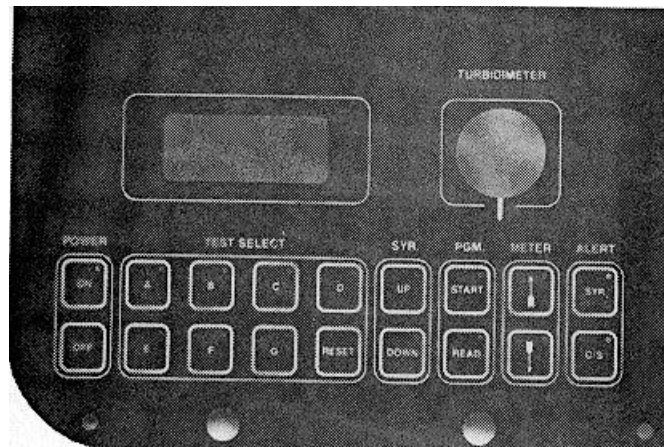
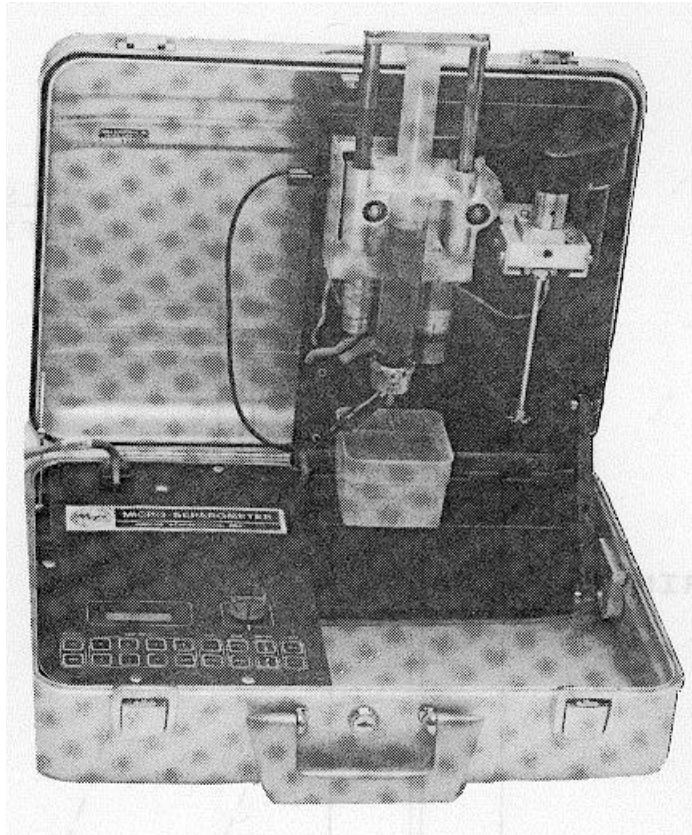
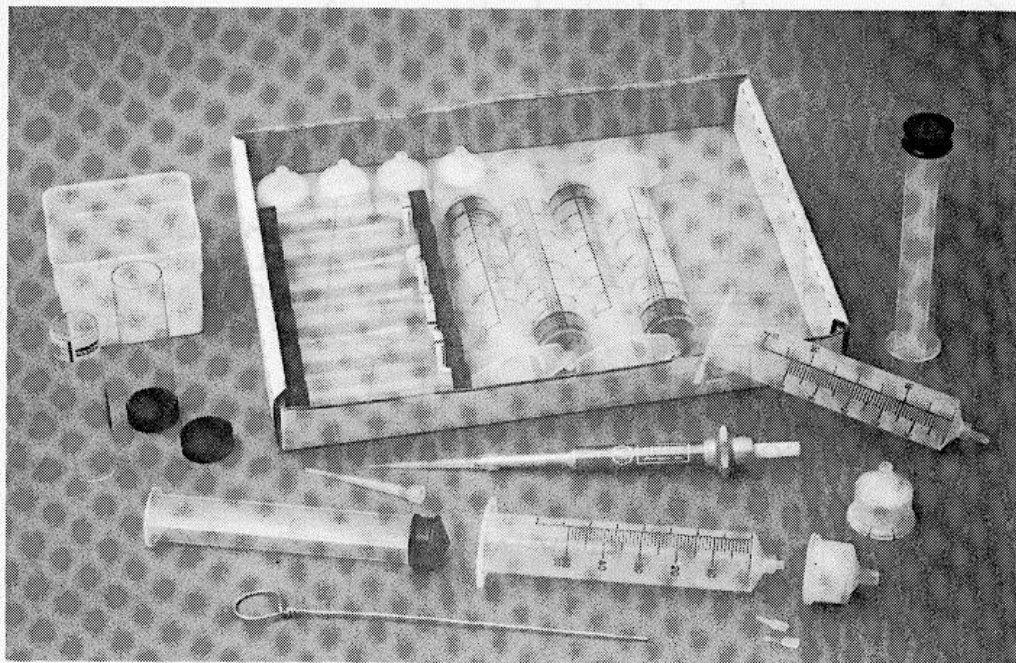


Figure 2

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REVISION DATE: FEBRUARY 12, 1987

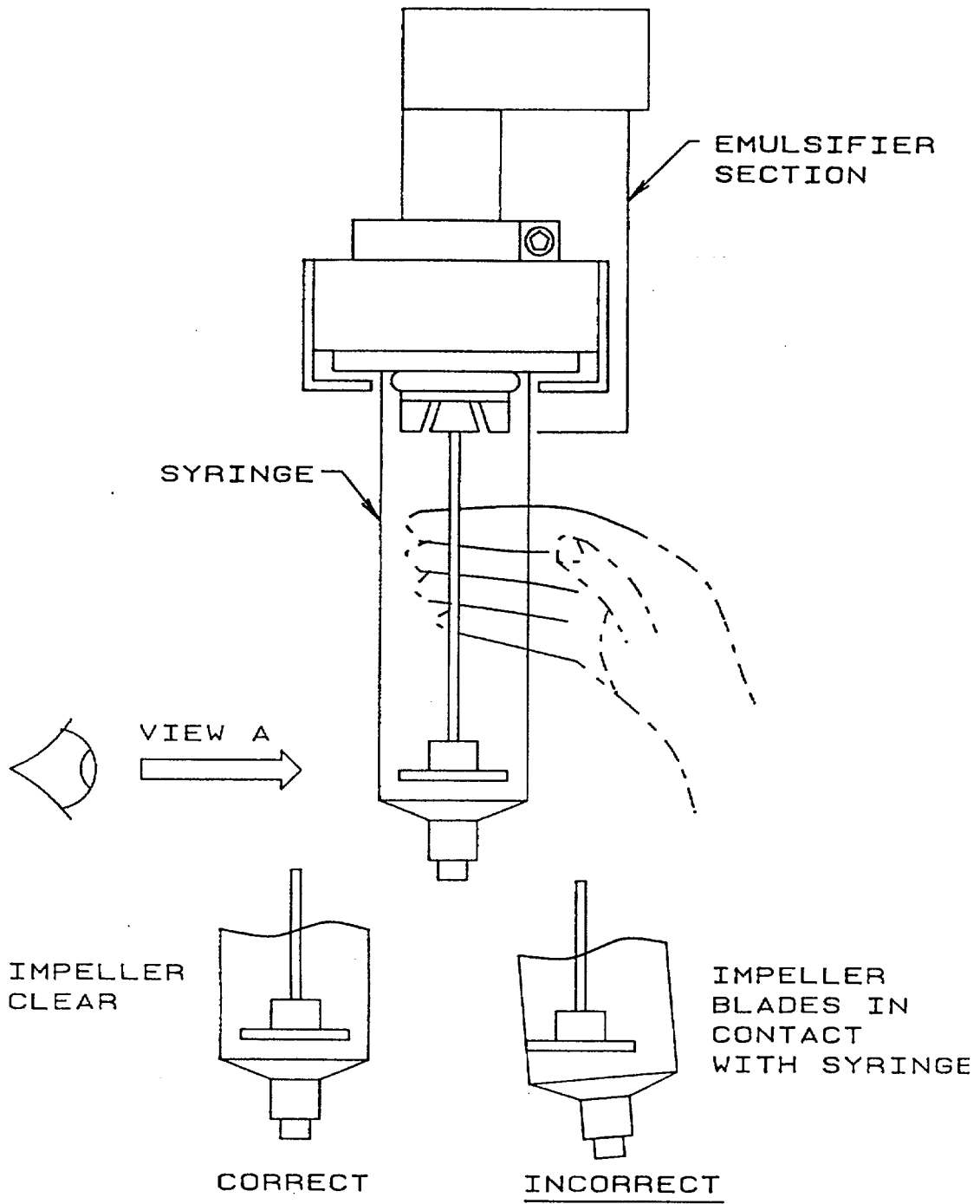


**Figure 3**



**Figure 4**





VIEW A

Figure 5

## MICRO-SEPAROMETER MARK V DELUXE OPERATION MANUAL

### 19.0 SERVICE POLICY

#### 19.1 NEW INSTRUMENT WARRANTY

Each instrument manufactured by Emcee Electronics, Inc. is warranted to be free from defects in materials and workmanship for one year from the date of shipping.

Emcee Electronics, Inc. will replace or repair (at its option) any instrument manufactured by Emcee Electronics, Inc. which has been authorized for return by Emcee Electronics, Inc. Transportation charges shall be shared by the customer and Emcee Electronics, Inc. The customer shall pay freight charges to Emcee Electronics, Inc. and Emcee Electronics, Inc. shall pay return freight. In general, the repaired instrument will be returned via the same mode of transportation the customer used to ship the unit. The liability of Emcee Electronics, Inc. shall be limited to repair or replacement and shall not include installation or any other charge or expense.

This warranty shall not apply to any unit or part which in Emcee's opinion has been installed or used improperly, or has been damaged by accident, misuse or negligence or has been altered or repaired in such a way to impair performance, nor shall it apply to pumps, batteries, belts and other similar items which have a limited life and/or degrade as a function of use, nor shall it apply to normal wear and tear.

This Warranty is in lieu of all other guarantees expressed or implied.

The obligation of Emcee Electronics, Inc. shall be limited to repair or replacement of defective equipment and shall not include consequential or other damage or expense whatsoever.

Emcee Electronics, Inc. reserves the right to make changes in design or construction in its equipment without obligation to install similar changes in equipment already sold.

## 19.2 REPAIR WARRANTY

All repairs will be warranted for 30 days. The repair warranty will be limited to the previously repaired area as determined by Emcee. The repair warranty will not apply to any instrument that has been damaged by any accident, alteration, misuse, or negligence.

### 19.3 REPAIR PROCEDURE

If your instrument exhibits a malfunction which cannot be corrected by the suggested troubleshooting procedures listed in the manual, then the following procedure should be initiated.

19.3.1 Emcee Electronics, Inc. should be contacted and the problem should be discussed with Customer Service at (813) 485-1515.

If the problem is adequately described, the malfunction may be corrected without having to return the unit to the factory. In addition to describing the problem, additional information should be available such as the serial number of the unit; date of purchase; frequency of use; the physical use environment (temperature, humidity, etc.); and other similar information which may identify the source of the problem.

19.3.2 If the instrument, in Emcee's opinion, cannot be repaired in the field, a Return Authorization Number should be requested by the user and issued by Emcee prior to returning the unit. A standard repair cost has been established for non-warranty repairs of current production instruments (out of production instruments will be repaired at standard rates provided parts are available) and will be quoted when the return authorization number is issued. The return authorization number should be shown on the return documentation and the outside of the package. The return documentation should accompany the instrument and include the serial number, description of problem, a purchase order for repair and a return address. Failure to provide this information will delay repair and subsequent return of the instrument.

The proper address for returned instruments is as follows:

Emcee Electronics, Inc.  
223 South Warfield Ave.  
Venice, FL 33595  
Return Authorization No. \_\_\_\_\_

19.3.3 The instrument, when possible, should be returned in its original shipping container (or similar packaging). This will reduce the possibility of shipping damage which could be misconstrued as customer abuse, necessitating additional charges.

## MICRO-SEPAROMETER MARK V DELUXE OPERATION MANUAL

19.3.4 If the instrument, in Emcee's opinion, is deemed to be defective due to a manufacturing defect, workmanship or materials and is returned within the warranty period, the unit will be repaired at no charge. Transportation charges will be shared by the customer and Emcee Electronics, Inc. The customer will pay the freight charges to Emcee Electronics, Inc. and Emcee Electronics, Inc. will pay return freight. Customer's will be billed for all transportation charges on non-warranty repairs.

In general, the repaired instrument (unless otherwise requested) will be returned to the customer via the same method of transportation as was received.

#### 19.4 EXTENDED WARRANTY POLICY/PROCEDURE

An Extended Warranty is available for Model 1152 Conductivity Meters and Model 1140 Micro-Separometers. The Extended Warranty may be purchased during the first nine months after the shipping date. Instruments in service beyond the nine month period must be returned to the factory for service and calibration at the standard service cost to qualify for the Extended Warranty. Extended Warranties will be renewed/issued at the discretion of Emcee Electronics, Inc.

Emcee Electronics, Inc. will replace or repair (at its option) any instrument manufactured by Emcee Electronics, Inc. which has been authorized for return by Emcee Electronics, Inc. Transportation charges shall be shared by the customer and Emcee Electronics, Inc. The customer shall pay freight charges to Emcee Electronics, Inc. and Emcee Electronics, Inc. shall pay return freight. In general, the repaired instrument will be returned via the same mode of transportation the customer used to ship the unit. The liability of Emcee Electronics, Inc. shall be limited to repair or replacement and shall not include installation or any other charge or expense. This warranty shall not apply to any unit or part which in Emcee's opinion has been installed or used improperly, or has been damaged by accident, misuse or negligence or has been altered or repaired in such a way to impair performance, nor shall it apply to pumps, batteries, belts and other similar items which have a limited life and/or degrade as a function of use, nor shall it apply to normal wear and tear.

This Warranty is in lieu of all other guarantees expressed or implied.

The obligation of Emcee Electronics, Inc. shall be limited to repair or replacement of defective equipment and shall not include consequential or other damage or expense whatsoever. Emcee Electronics, Inc. reserves the right to make changes in design or construction in its equipment without obligation to install similar changes in equipment already sold.

19.5 EQUIPMENT RENTAL POLICY/PROCEDURE Emcee Electronics, Inc. will supply Model 1140 Micro-Separometer rental instruments for use during a service period on an as-available basis. A fee is calculated from the date of shipping to the date of return plus shipping costs. All accessories and manuals shipped with the rental equipment must be returned. Manuals and/or accessories that are not returned will be billed with the rental fees and shipping charges.

Rental Equipment can be acquired by contacting Emcee Customer Service at (813) 485-1515.

## 19.6 REPLACEABLE ASSEMBLY EXCHANGE/REPAIR POLICY/PROCEDURE

Field repair of the 1140 Deluxe Micro-Separometer and the 1152 Digital Conductivity Meter are achieved by replacement of various assemblies. The assemblies are serialized and warranted under the new instrument warranty policy. Assemblies under warranty will be replaced/repared at no charge. For non-warranty assemblies, a price list is available which provides standard cost for exchange or repair of each assembly.

The assemblies shall be properly packaged and returned to

Emcee Electronics, Inc.  
223 South Warfield Ave.  
Venice, FL 33595

with the following documentation:

1. Shipping address for the return of exchange/repair unit.
2. Description of assembly malfunction.
3. Purchase Order for exchange/repair.

Emcee will forward an exchange/repair assembly and bill the exchange/repair rate and shipping cost.



#### 19.7 RETURN GOODS POLICY/PROCEDURE

Shipping damage must be reported by the customer to the carrier. The carrier will inspect the damage prior to any return to Emcee. Emcee Electronics, Inc. must be notified of a shipping discrepancy and/or a manufacturing defect of instruments, spare parts or supplies prior to their return. Contact our Accounting Department at (813) 485-1515 for a return authorization number within 30 days of invoice date to assure credit or replacement. Credit or replacement will not be issued for a returned item(s) which in Emcee's opinion is defective due to customer abuse. If Emcee determines that a discrepancy or manufacturing defect does not exist and according to Emcee's policy the item(s) can be restocked, a 20% charge will be invoked. Credit will not be issued for non-restockable items.

When, at Emcee's discretion, an advance replacement is made prior to the return of the item(s) in question, an invoice will be issued for the replacement item(s). A credit will be issued only after the questionable item(s) has been returned, and Emcee has verified the discrepancy and/or manufacturing defect.

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 Facilities:	
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-Martins 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 Oxidation Stability Bath .....	TM 10-6640-232-13&P
Precision Pensky-Martens Flash Testers.....	TM 10-6630-231-13&P
Precision Reid 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
Sartorius 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. Operations 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 comparisons 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,<sup>1</sup> including fault location/troubleshooting,<sup>2</sup> removal/installation, and disassembly/assembly procedures,<sup>3</sup> and maintenance actions,<sup>4</sup> 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 1, 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:

---

<sup>1</sup> Services - inspect, test, service, adjust, align, calibrate, and/or replace.

<sup>2</sup> Fault locate/troubleshoot- the process of investigating and detecting the cause of equipment malfunctioning; the act of isolating a fault within a system or unit under test (UUT).

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

<sup>4</sup> 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 1, 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 1, Reference Code. The code recorded in column 6, Section II.

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

**Section II. MAINTENANCE ALLOCATION CHART**

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIPMENT	(6) REMARKS
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
01	SEPAROMETER	INSPECT REPLACE REPAIR	0.2	0.5 0.5				1, 2 1, 2	A B

**Section III. TOOL AND TEST EQUIPMENT REQUIREMENTS  
FOR  
MAINTENANCE ALLOCATION CHART**

(1) TOOL/TEST EQUIP. REF CODE	(2) MAINTENANCE CATEGORY	(3) NOMENCLATURE	(4) NSN	(5) TOOL NUMBER
1	O	TOOL KIT, GENERAL AUTOMOTIVE	5180-00-177-7033	(50980)
2	O	MULTIMETER, 0-500V	6625-00-691-2453	SC 5180-90- CL-N26

**Section IV. REMARKS**

REFERENCE CODE	REMARKS
A	Replacement of circuit boards may require shipping separometer to manufacturer as there is no field fault analyzer available.
B	Repair limited to replacement of parts. Repairs above this level may require shipping instrument to manufacturer.

APPENDIX C

COMPONENTS OF END ITEM AND BASIC ISSUE ITEMS LISTS

NOT APPLICABLE



**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 authority 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		TEST KIT: SIX PACK (23299) 840. 99-5944	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*

**DISTRIBUTION:**

To be distributed in accordance with DA Form 12-21A, Operator, Unit and Direct Support Maintenance requirements for Laboratory, Petroleum, MTD

☆U.S. GOVERNMENT PRINTING OFFICE: 1990 654-126/20036

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS



THEN...JOT DOWN THE DOPE ABOUT IT ON THIS FORM. CAREFULLY TEAR IT OUT, FOLD IT AND DROP IT IN THE MAIL.

SOMETHING WRONG WITH PUBLICATION

FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS)

DATE SENT

PUBLICATION NUMBER

PUBLICATION DATE

PUBLICATION TITLE

BE EXACT PIN-POINT WHERE IT IS

PAGE NO.

PARA-GRAPH

FIGURE NO.

TABLE NO.

IN THIS SPACE, TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT.

TEAR ALONG PERFORATED LINE

PRINTED NAME, GRADE OR TITLE AND TELEPHONE NUMBER

SIGN HERE

# 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 = 3.2808.8 feet

## Square measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. in.  
 1 sq. decimeter = 100 sq. centimeters = 15.5 inches  
 1 sq. meter (centare) = 100 sq. decimeters = 10.76 feet  
 1 sq. dekameter (are) = 100 sq. meters = 1.076.4 sq. ft.  
 1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres  
 1 sq. kilometer = 100 hectometers = .386 sq. miles

## 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 dekaliter = 10 liters = 2.64 gallons  
 1 hectoliter = 10 dekaliters = 26.42 gallons  
 1 kiloliter = 10 hectoliters = 264.18 gallons  
 1 liter = 10 deciliters = 33.81 fl. ounces  
 1 centiliter = 10 milliliters = .34 fl. ounce  
 1 deciliter = 10 centiliters = 3.38 fl. ounces  
 1 metric ton = 10 quintals = 1.1 short tons

## Cubic Measure

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

## Approximate Conversion Factors

To change	To	Multiply by	To change	To	Multiply by
inches	centimeters	2.540	ounce inches	newton-meters	.0070062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
sq. inches	sq. centimeters	6.451	kilometers	miles	.621
sq. feet	sq. meters	.093	sq. centimeters	sq. inches	.155
sq. yards	sq. meters	.836	sq. meters	sq. yards	10.764
sq. miles	sq. kilometers	2.590	sq. kilometers	sq. miles	1.196
acres	sq. hectometers	.405	sq. hectometers	acres	2.471
cubic feet	cubic meters	.028	cubic meters	cubic feet	35.315
cubic yards	cubic meters	.765	milliliters	fluid ounces	.034
fluid ounces	milliliters	29.573	liters	pints	2.113
pints	liters	.472	liters	quarts	1.057
quarts	liters	.946	grams	ounces	.035
gallons	liters	3.785	kilograms	pounds	2.205
ounces	grams	28.349	metric tons	short tons	1.102
pounds	kilograms	.454	pound-feet	newton-meters	1.356
short tons	metric tons	.907			
pound inches	newton-meters	.11296			

## Temperature (Exact)

°F Fahrenheit temperature

5/9 ( after subtracting 32)

Celsius Temperature °C



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