RADeCO, INC.

"The Industry Standard in Air Sampling."

OPERATION AND MAINTENANCE MANUAL

AIR SAMPLER WITH AIR VOLUME TOTALIZER

MODEL H-810DC

17 West Pkwy
Plainfield CT 06374
(860) 564-1220
(860) 564-6631 Fax
WWW.RADeCOINC.COM

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OPERATION AND MAINTENANCE MANUAL

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MODEL H-810DC

CAUTION

CARE MUST BE TAKEN TO PREVENT THIS DEVICE FROM COMING INTO CONTACT WITH FOAM, LIQUID (INCLUDING WATER) AND OTHER FOREIGN SUBSTANCES. SUCH MATERIALS MUST BE PREVENTED FROM REACHING THE FAN SYSTEM INTAKE, MOTOR HOUSING AND ELECTRICAL COMPONENTS. FAILURE TO DO SO COULD RESULT IN AN ELECTRICAL SHOCK, WHICH MAY RESULT IN SEVERE BODILY INJURY OR EVEN DEATH IN EXTREME CASES.

SPECIAL INFORMATION

The following information is for reference only.

Model H-810DC	Used primarily with combination filter and cartridge sampling (2 to 4 CFM range).
Model H-810DC-2	Used primarily with 4” diameter filters for high volume particulate sampling (20-35 CFM).
Model H-810DC-N	Used primarily with 47mm and 2” diameter filters for particulate sampling (8 to 12 CFM).

To convert a Model H-810 DC to a Model H-810DC-2, replace the #1 barrel (Part No. 106010-1)
with a #2 barrel (Part No. 103010-2) and recalibrate according to procedure.

To convert a Model H-810DC to a Model H-810DC-N, replace the #1 barrel (Part No. 106010-1) with a #3 barrel (Part No. 106010-3) and recalibrate according to procedure.

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SPECIFICATIONS

Operational Range:	Up to 99999 cubic feet, of 99999 liters
Accuracy of Totalizer:	±5%
Readout of Totalizer:	LCD: 2 Lines, 16 Characters, backlit. Continuous display of cumulative volume + flow rate + elapsed time. Battery backed to recall sample data in the event of power loss.
Timer Circuit:	Microprocessor-controlled crystal oscillator
Operating Voltage:	7 to 30 VDC
Dimensions:	81/2" Wide, 71/2" Deep, 9" High
Weight:	8.5 pounds (4 Kg)
Air Mover:	Internally mounted; two stage turbine blower
Motor:	1 HP, self-cooled
Eye Bolt:	Top mounted, for carrying or hanging sampler. Supplied with 2" wide, 6 foot long belt.
Power:	ON/OFF switch/circuit breaker controls DC power to unit.
Keypad, 16 Key – Features:	**Start Key:** Initiate pre-programmed sample. **Stop Key:** Manually terminates sample. **Units Key:** Toggles display between liters and cubic feet units. **Set Key:** Allows user to change sample preset. **Numeric Keys:** Allows entry of numeric values in response to displayed menus. **Calibration:** Energizing unit with a special combination of keys depressed puts the unit into a menu-driven calibration mode. **Security:** Keypad function can be selectively limited to Start/Stop and Units, in order to prevent changing of sample presets.

DESCRIPTION

The RADeCO Model H-810DC is a dependable, lightweight Grab Sampler which incorporates the reliability of the Model H-809V with an Air Volume Totalizer, the new way to measure the volume of air sampled. This microprocessor based unit is designed to eliminate the use of rotometers and mechanical time meters, simplifying air sampling procedures while adding significantly higher accuracy to air sampling data.

The Air Volume Totalizer portion of the sampler is composed of an enclosed air-turbine, which rotates at speeds proportional to the air velocity of the sampled air. The turbine's rotation is sensed by a reflective sensor/breaker disc. The microprocessor converts the signal to volume and displays the flow rate, total volume and elapsed time on the LCD readout.

The Model H-810 DC may be operated in either the "Total Volume" mode or the "Total Elapsed Time" mode with the mode of operation selected during instrument calibration. The functions/parameters that are established during calibration may be locked-in using the "keypad security" feature. When keypad security is enabled, the SET function on the keypad is disabled, which prevents the operator from altering the sample presets.

The operation of the Model H-810DC is a very simple four-step procedure and the training time required is relatively short. Its operational procedure is:

1. Connect to a DC power source such as a battery.
2. Install the sample holder with the filter media.
3. Turn power switch on.
4. Press the START key.

The Model H-810DC samples the environment until the desired total volume or total elapsed time has been reached and then turns itself off. The LCD readout indicates the total volume and elapsed sample time. A STOP key is provided to stop the sampling procedure at any point during the sampling period, and the total volume of air sampled, and elapsed time up to that point are indicated.

The Model H-810DC is supplied with a 2 inch wide, 6 foot belt for carrying purposes or for hanging the instrument during sampling. The instrument is not designed to be suspended by the power cord.

METHOD OF OPERATION

Operation of the H-810DC is simplified through the use of English-language prompts on a digital display. After turning the unit ON, the display will indicate the current calibrated flow range. Pressing any key on the keypad will cause the unit to indicate the current preset volume or time. At this point a sample may be initiated by pressing the START key, or the preset may be changed by pressing the SET key. i.e.:

Calibrated Range	to	**Target Volume:**	or	**Target Run Time:**
4.0 to 6.0 CFM		**1000 ft3**		**10:00**

After pressing the SET key, the display will prompt for a new target time or volume, depending on the current mode of operation selected during the last calibration. i.e.:

Enter Target	or	**Enter Target**	or	**Enter Target**
Time: 00:00		**Volume 0 ft3**		**Volume 0 lit**

Enter a new value using the digit keys followed by ENTER, or press ENTER to cancel changing the target.

The H-810DC is equipped with KEYPAD SECURITY. With this feature enabled, the SET function on the keypad is disabled, preventing the operator from altering the preset sample time or volume. This feature also inhibits the display of the current calibrated range upon power-up.

Upon pressing the START key, the motor will turn on, and the display will indicate the "warm-up delay", if enabled. The display will then indicate the current totalized volume, the current flow rate, and the elapsed time (volume mode) or remaining time (time mode). i.e.:

ft3	**CFM**	**Time**	or	**lit**	**LPM**	**Time**
123.4	**4.5**	**12:34**		**12345**	**123**	**12:34**

If the FLOW RATE reading is blinking during sample collection, it is because the unit is running at a flow rate outside of its calibrated range. This can be corrected by recalibrating the unit.

The unit will continue to sample unit the target time or volume has been reached, or until the STOP key is pressed. Upon completion or termination of a sample, the display will indicate the final time/volume of the sample. i.e.:

Volume: 123.4 ft3
Run Time: 12:34

NOTE: In the event that power is disconnected or turned off prior to completion of a sample, the elapsed time/volume will be displayed upon power-up. The CLEAR key must be pressed to clear the last run and again display the originally set target volume.

When using the Model H-810DC with the optional tripod for breathing zone sampling applications (See Appendix C), please note the adaptor or tripod mounting block may be installed on the bottom or the front of the unit. When the adaptor is mounted on the front, the keypad display is most accessible.

The H-810DC is equipped with a battery voltage monitor circuit, which may be optionally enabled or disabled during the calibration process. If enabled, a "bar-graph" character will be displayed in the upper left corner of the display while the unit is sampling. A fully charged battery will be indicated as a seven-segment tall character, while a discharged battery will be indicated as a blank character. Intermediate levels of charge will be indicated by a variable-height character, from zero to seven vertical segments. The battery monitor can be optionally enabled to shut the unit off after five continuous seconds of operation with a discharged battery, to prevent over-discharge of the battery.

PRINCIPLE OF OPERATION

The principle of operation of the air volume totalizer is very simple and basic in nature. Theoretically, a fan mounted on a freely turning shaft will rotate at a rate proportional to the velocity of the air passing the fan. This velocity is proportional to the flow rate, assuming the pressure differential across the filter media stays constant, and the ambient air temperature/pressure stays constant. By measuring the fan RPM for a number of flow rates, a nearly linear response can be generated between the airflow rate and the fan speed.

RADeCO tested the above principle and learned that the above was true within limits. We found that for each filter media, the turbine speed was close to linear, but only over a limited flow range. The CFM versus RPM curve also varied depending on the pressure drop of different filter media. For any given filter media, we found that by using a three point calibration we could very closely track the CPF/RPM curve with linear approximations over a relatively wide flow range. The microprocessor determines all calibration constants required based on operator-entered flow rates and measured turbine RPM during the calibration process. These constants are stored in battery-backed memory, which will hold this data for at least 10 years. Recalibration is only required if or when a different type of filter media is to be used.

The Model H-810DC has been designed using the latest in technology. The unit is microprocessor-based with battery backed data memory to store operational parameters for at least 10 years. The microprocessor keeps track of turbine RPM by counting pulses from a reflective sensor/breaker disk located in the head adapter. The microprocessor tracks the battery voltage level using a voltage/frequency converter circuit, where the frequency generated is proportional to the input voltage.

INSPECTION AND MAINTENANCE OF FLOW SENSOR

1. Carefully remove front barrel (See Figure 2, Item 2) by turning counterclockwise.

2. Inspect six holes in barrel focusing plate and clean holes with isopropyl alcohol if there is any dirt present.

3. Inspect fan for wear around edges and the presence of dirt. This is a compression fitted fan, which may be readily removed from the shaft for cleaning or replacement.

4. Check space setting between front of bearing support and rear of fan. This should be 0.5 inches.

5. Verify that fan turns freely without binding and is free of wobble, which may indicate a bent fan shaft.

6. Replace barrel and cinch down tight. Again verify that the fan turns freely by blowing into the barrel. The fan should come to a stop gradually and without resistance.

7. To clean photo sensor, remove right case half (four screws). Remove photo sensor circuit board assembly (two screws). Clean photo sensor using a soft cloth or cotton swab and reassemble.

CALIBRATION

1. Install a sample holder assembly containing the filter or combination filter and cartridge normally to be used for air sampling into the front of the barrel and connect inlet to air flow calibrator (RADeCO Model C-828 with adaptor). See Figure 5.

2. Attach unit to a variable DC power supply, ad adjust its voltage just higher than the maximum battery voltage anticipated during operation (28VDC max).

3. Depress and hold the ENTER and SET keys simultaneously while turning the power switch to the ON position.

4. If Step 3 has been done correctly, after approximately five seconds the display will prompt:

   Calibrate Flow?
   1= YES, 0= NO:

   Press "1" for Yes.

5. Display will read:

   Volume Units?
   1= Ft3, 0=liters:

6. Display will read:

   Adjust Flow For High Flow Rate then **Enter high Flow Rate: 0.0 CFM**

   Adjust flow to high point of calibration range using a variable DC power supply. (Example: 3-4-5 CFM, 3 = LOW POINT, 4 = MID POINT, 5 = HIGH POINT) Enter the high flow rate using the keypad and then press "ENTER". Keep flow constant for 10 seconds.

7. Display will read:

   Adjust Flow For Mid Flow Rate then **Enter Mid Flow Rate: 0.0 CFM**

   Reduce flow to mid point of calibration range using the variable DC power supply. Enter rate using keypad and then press "ENTER". Keep flow constant for 10 seconds.

8. Display will read:

Adjust Flow For Low Flow Rate	then	**Enter Low Flow Rate: 0.0 CFM**

Reduce flow to low point of calibration range using a variable DC power supply. Enter rate using keypad and then press "ENTER". Keep flow constant for 10 seconds.

9. Display will read:

Verify Linearity
Rate: 0.0 CFM

Adjust flow to various points within the calibration range to verify calibration accuracy. Press ENTER to accept calibration or CLEAR to reject. At this point the motor will shut off.

NOTE: If display reads "BAD CALIBRATION", then inaccurate flow data has been entered, or the turbine speed sensor requires service.

10. Display will read:

CAL BAT Monitor?
1= YES, 0= NO:

The unit comes shipped from RADeCO with the battery monitor calibrated for a 12V, 24AH Yuasa gel-cell battery. If you intend to use a battery with different max/min charge voltage specifications, press 1 for YES and go ahead to step 11. Otherwise, press 0, and the display will read:

Disable Monitor?
1= YES, 0= NO:

Pressing 1 will inhibit display of the "bar-graph" on the LCD readout. Press 0 or 1 as desired, and skip ahead to step 12.

11. Display will read:

Set Vin to Max
Press Any Key

Adjust the DC power supply to 13.0 VDC, (or to the voltage of a fully charged battery to be used with this unit, plus 0.25VDC) and press any key. The unit will count for one second, then the display will read:

Set Vin to Min
Press Any Key

Adjust the DC power supply to 11.0 VDC, (or the minimum safe discharge voltage of the battery to be used with this unit, plus 0.35VDC) and press any key. The unit will count for one second.

12. Display will read:

Default Run Mode
0=Vol, 1=Time:

Select mode of operation. Select "0" for TOTAL VOLUME, select "1" for TOTAL TIME.

NOTE: During normal operation, both volume and time are displayed.

13. Display will read:

Enter Target	or	**Enter Target**	or	**Enter Target**
Time: 00:00		**Volume 0 ft3**		**Volume 0 lit**

Enter default sample time or volume using the keypad.

NOTE: This is the default target that will be displayed each time the unit is turned on. If keypad security is disabled, this number may be temporarily changed using the SET function, described above.

14. Display will read:

Warm-Up Delay In
Seconds (0-9):

Enter the time desired for the unit to come up to speed, before actual sampling totalizing period begins (typically two seconds).

15. Display will read:

Keypad Security?
0= OFF, 1= ON:

Select either "0" for OFF or "1" for ON. When keypad security is on, all keys on the keypad are disabled with the exception of the UNITS, START and STOP keys. These keys will allow the user to start the run or toggle the display readout from CFM to LPM using the UNITS key.

16. Display will read:

LO-BAT Shutdown?
0= OFF, 1= ON:

Select either "0" for OFF or "1" for ON. When this feature is ON, the unit will automatically terminate a sample if the battery voltage drops below the MIN voltage set in step 11, above, for more than five seconds. The use of this feature is recommended if you are using a gel-cell type battery to prevent battery damage due to over-discharge.

TROUBLESHOOTING:

The H-810DC has capabilities for checking the performance of the turbine sensor and the battery monitor.

To exercise the battery monitor, select NO at the CALIBRATE FLOW? prompt, then press YES at the BATT TEST MODE? prompt. The display will indicate the frequency output of the voltage/frequency converter circuit until any key is pressed. The input voltage may be varied from approximately 7 to 30 VDC, and the displayed frequency is approximately 100 times the input voltage, i.e., 12V gives roughly 1200Hz.

To exercise the turbine, select NO at the CALIBRATE FLOW? prompt, then NO at the BATT TEST MODE prompt, then YES at the RPM TEST MODE? prompt. The display will indicate the RPM rate as sensed by the reflective sensor circuit. This rate is nearly proportional to flow, and the range is affected by the filter media and the turbine barrel hole configuration.

NOTE: To change these default run parameters without recalibrating flow, follow steps 3 and 4. On step 4: CALIBRATE FLOW, enter "0" for NO. For BATT TEST MODE and RPM TEST MODE, enter "0" for NO. Display will prompt for "VOLUME UNITS". Select desired units of measure per the menu prompts, and continue through steps 12 through 16.

COMPATIBLE RADeCO SAMPLE HOLDERS AND OPTIONAL EQUIPMENT

FOR H-810DC

Model No.	Open Face
2500-23	2” Diameter Filter
2500-33	47mm Diameter Filter
	Open Face Combination
2500-19	2” Diameter Filter / RADeCO Cartridge
2500-27	2” Diameter Filter / Scott Cartridge
2500-34	47mm Diameter Filter / RADeCO Cartridge
2500-39	47mm Diameter Filter / Scott Cartridge

FOR H-810DC-2

Model No.	Open Face
2500-25A	4” Diameter Filter

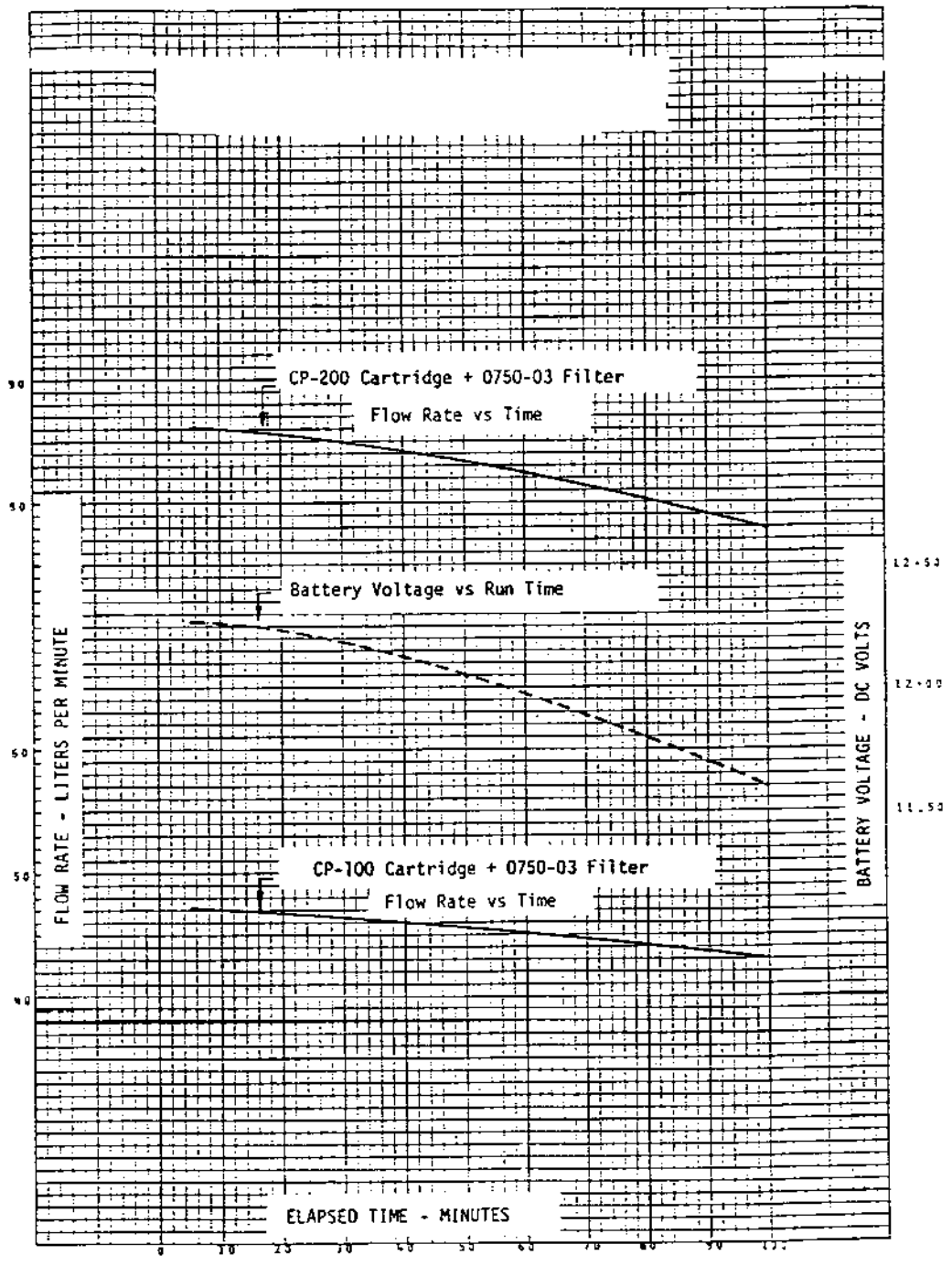
Available Filter Papers

Model No.	Diameter	Type
0750-02	47mm	HD-2064
0750-03	2”	HD-2064
0750-09P	4”	HD-2064
0750-36	47mm	LB-5211
0750-37	2”	LB-5211

Tripod

Model TRP-2 (with Adaptor) See Appendix C

TYPICAL FLOW RATE PERFOMANCE



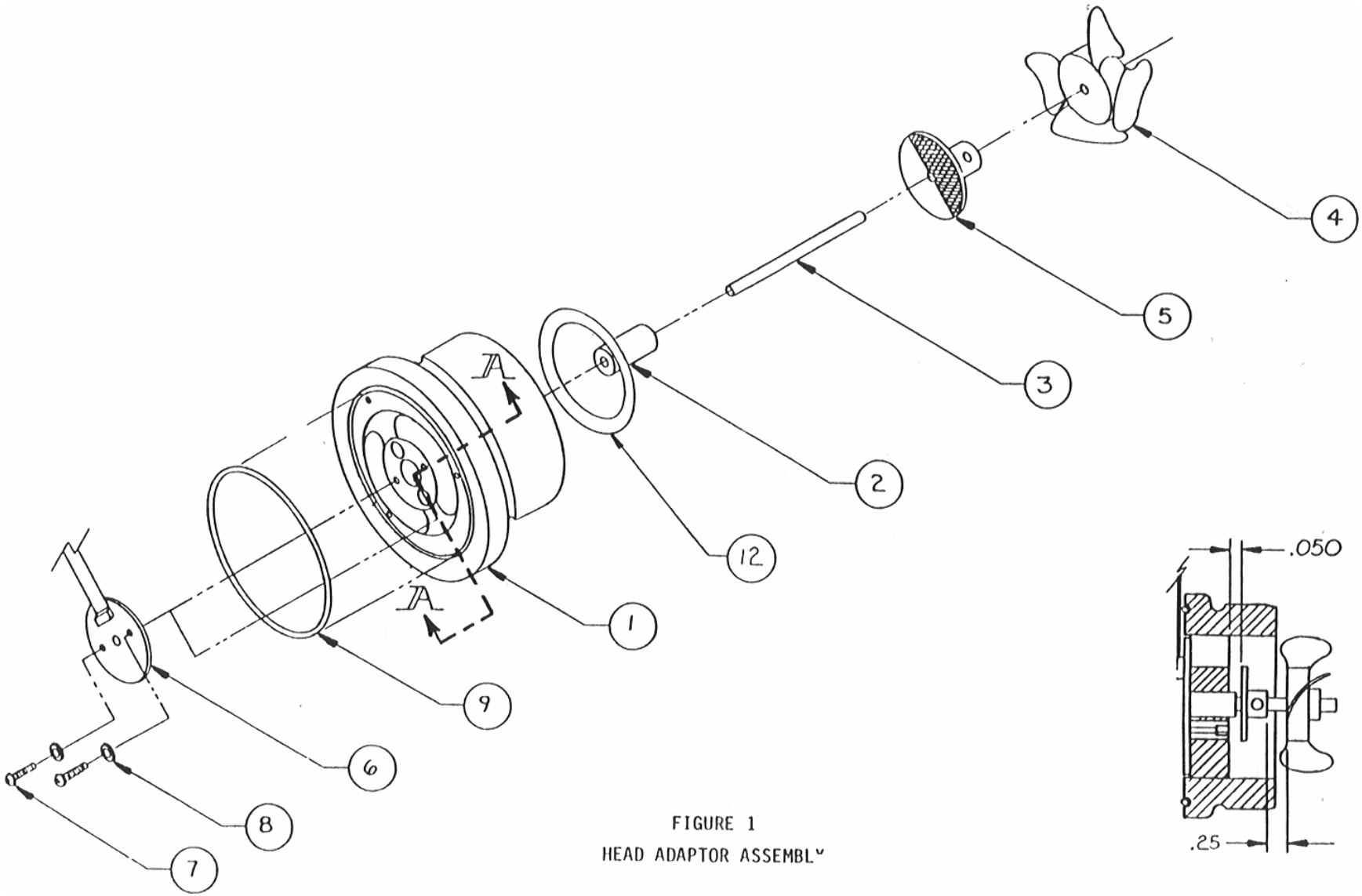


FIGURE 1
HEAD ADAPTOR ASSEMBLY

LEGEND-FIGURE 1

HEAD ADAPTOR ASSEMBLY

ITEM	PART NO.	DESCRIPTION
1	106010-1, -2, -3	Head Adaptor
2	7000-03	Cartridge Bearing
3	S2-16	Ultra Precision Shaft
4	6050-49	Fan Blade
5	106013-1	Sensor Disc
6	106004-1	Photo Sensor PCB Assembly
7	1350-22	Screw, 4-40 x .25 Pan Head
8	1550-88	Washer, Fiber, #4
9	2200-30	O-Ring
12	2201-09	O-Ring

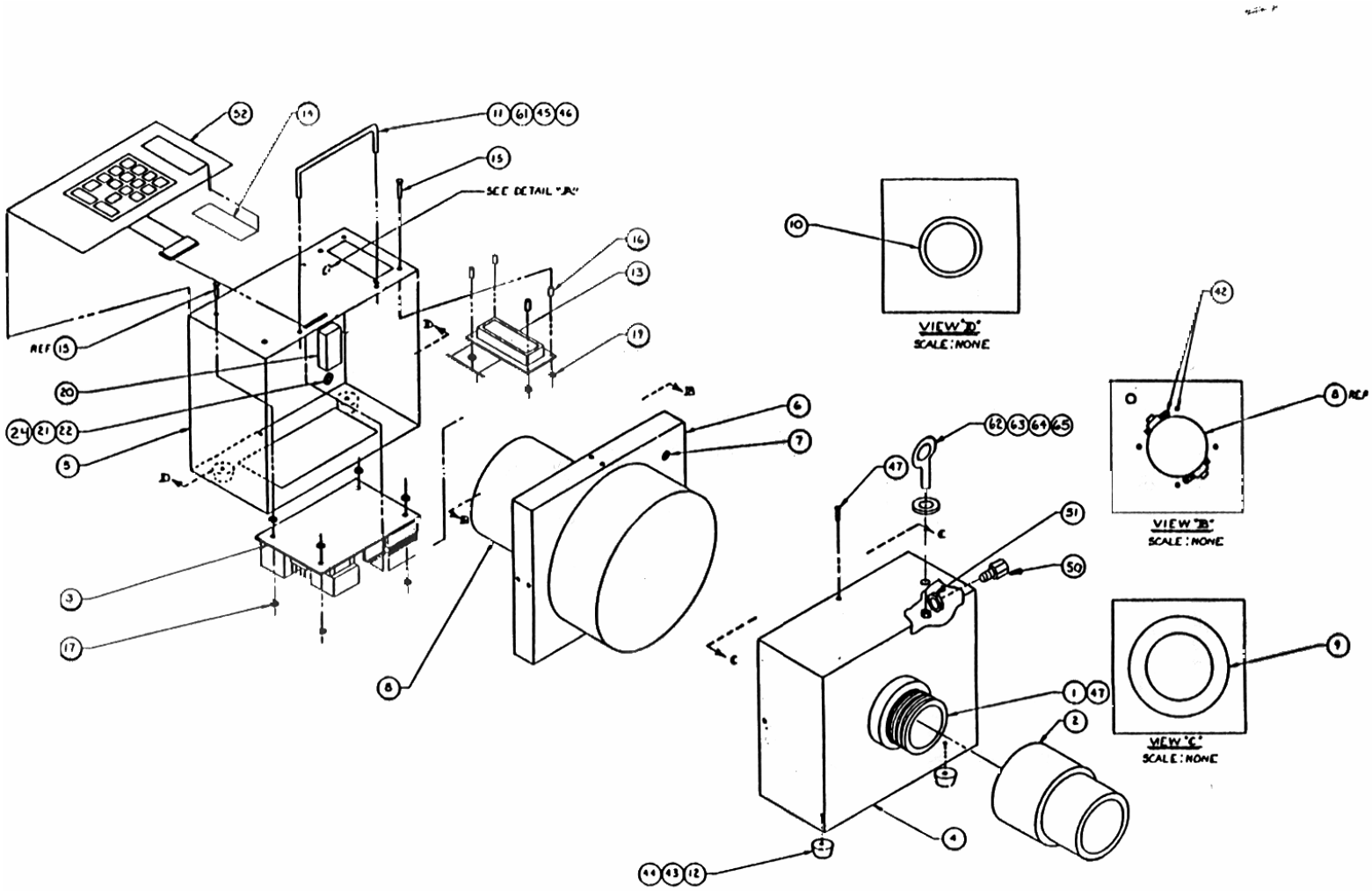
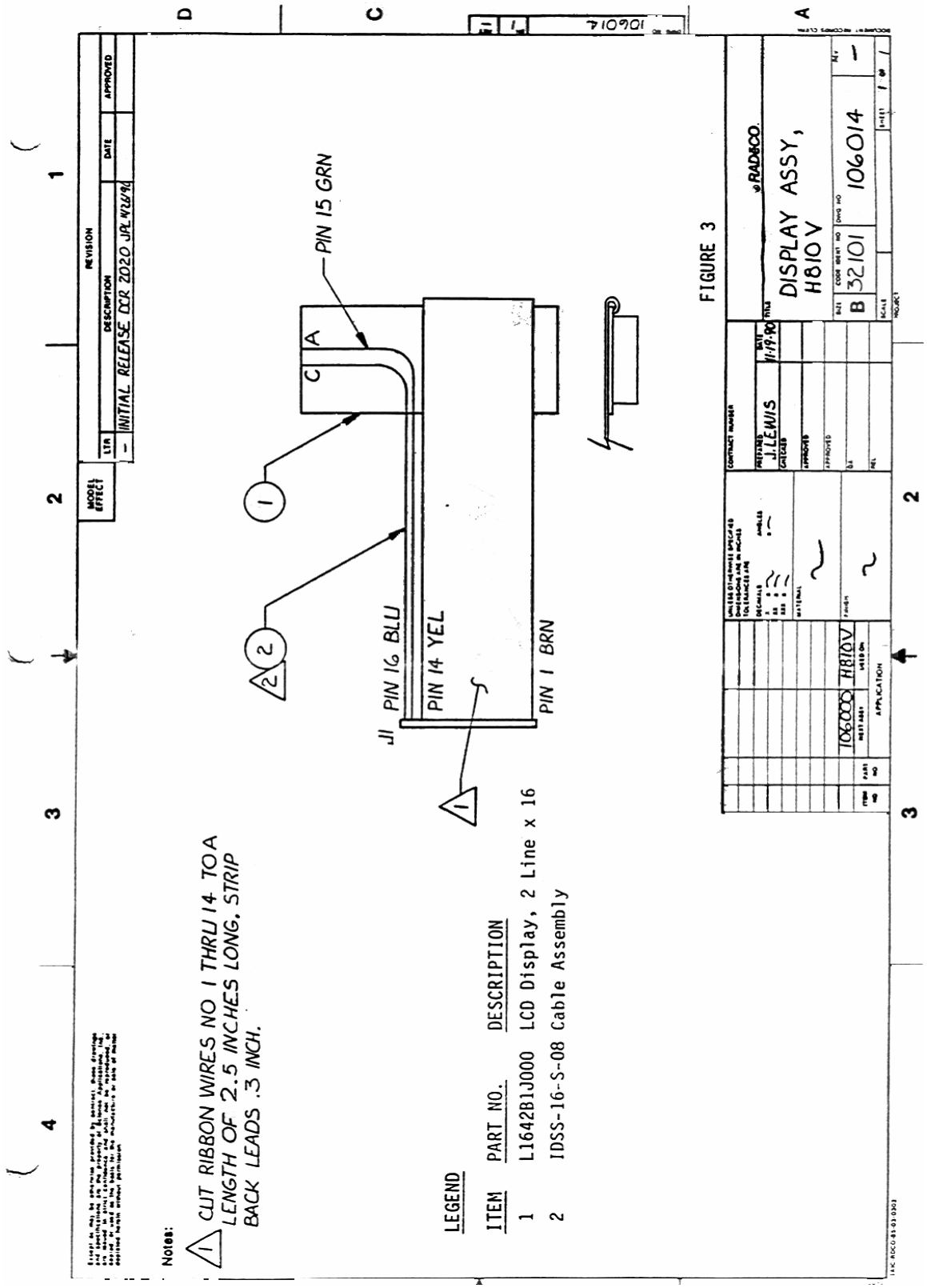


FIGURE 2
H-810DC ASSEMBLY

LEGEND-FIGURE 2
MODEL H-810DC ASSEMBLY

ITEM	PART NO.	DESCRIPTION
1	106012-1	Head Adaptor Assembly
2	106011-1	Flowmeter Barrel
3	106002-1(A)	Circuit Board Assembly
4	106006-1	Case Half, Right
5	106007-1	Case Half, Left
6	106008-1	Motor Mounting Plate
7	1/81D	Grommet
8	0100-58	Motor, Air Mover
9	6525775	Gasket, Motor Seal
10	106017-1	Motor Gasket
11	1300-21	Handle
12	1800-24	Feet (4)
13	106014-1(A)	LCD Display Assembly
14	106015-1	Display Filter
15	1350-86	Screw, #4-40 x .625 Flat Head
16	0700-72	Stand-Off, Threaded
17	1350-85	Kepnut, #4-40
19	MS21042-L04	Locknut, #4-40
20	0900-41	Circuit Breaker
21	8000-51	DC Power Cable Assembly
22	2201-40	Bushing, Strain Relief
24	8000-52	Jumper Cable Assembly, 6 foot
42	1350-72	Screw, Self-Tapping, #10
43	1350-43	Screw, #10-32 x .50, Pan Head
44	1350-87	Kepnut, #10-32
45	MS35333-73	Lock Washer, #10-32, Intl Tooth
46	NAS620C10L	Flat Washer, #10
47	MS51957-26	Screw, 6-32 x .25, Pan Head
50	0800-128	Adaptor, ½ NPT
51		Jam Nut
52	106003	Membrane Keypad Assembly
61	1350-48	Screw, Cap
62	1650-74	Eye Bolt
63	1300-18	Carrying Strap

FIGURE 3
DISPLAY ASSEMBLY



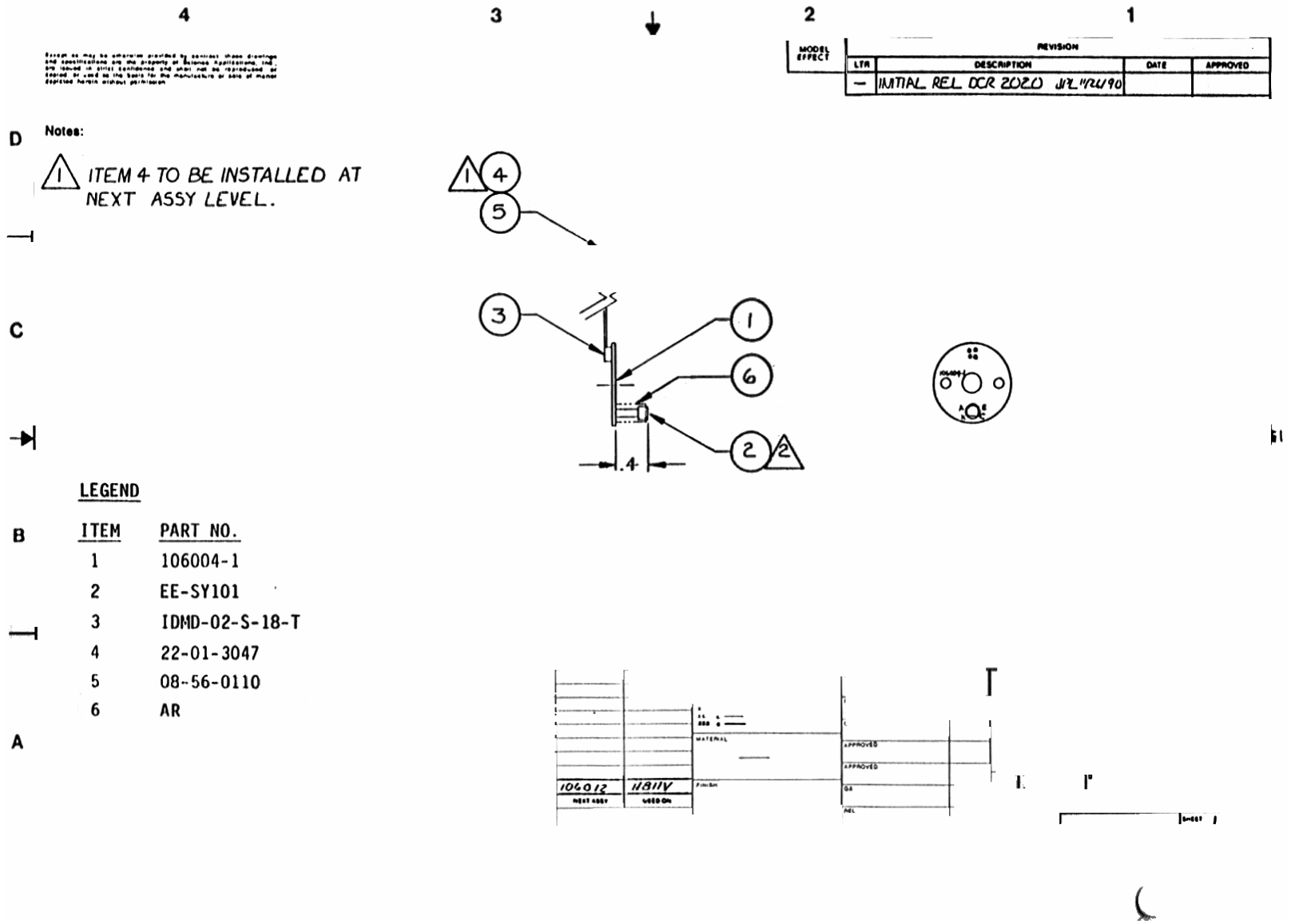
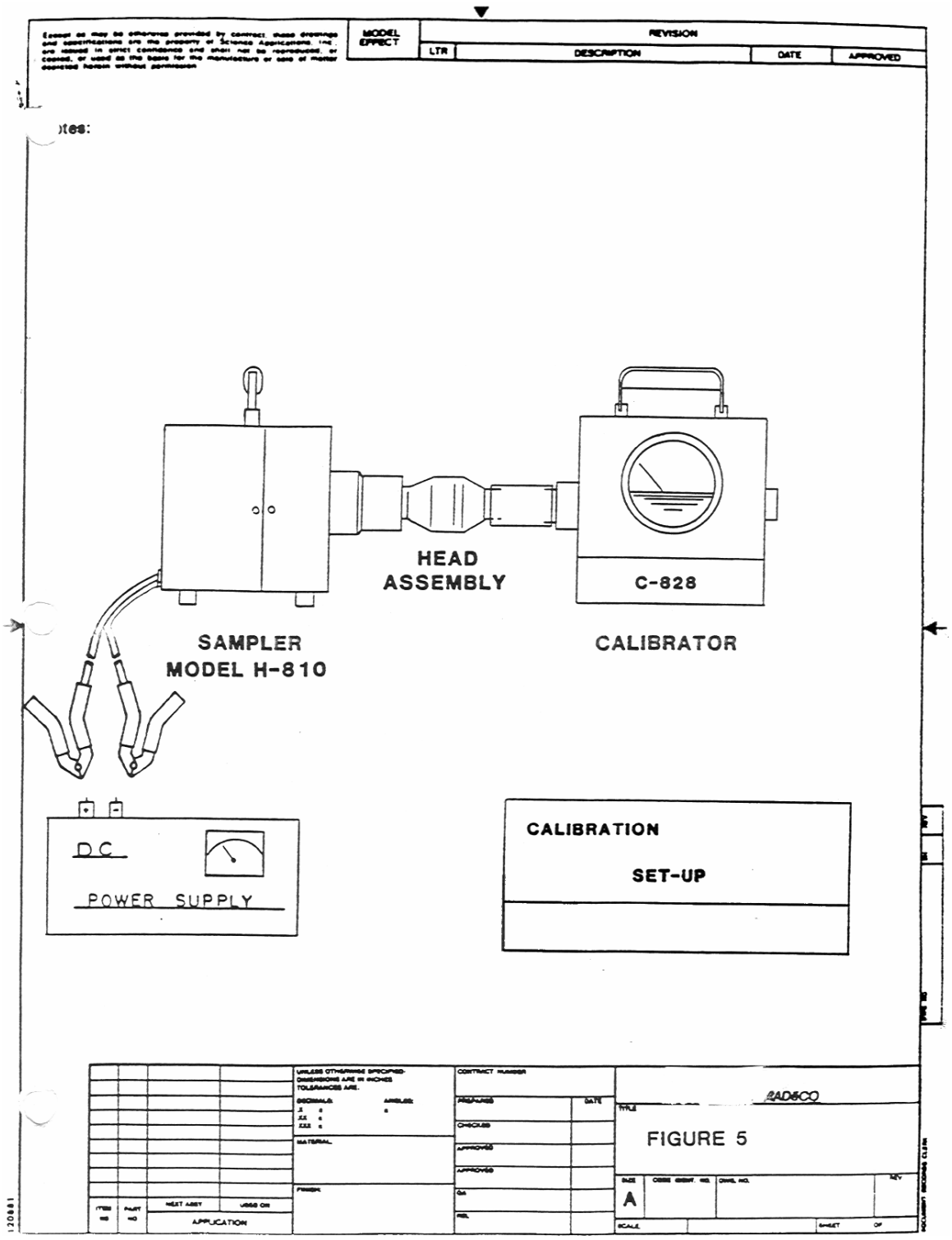


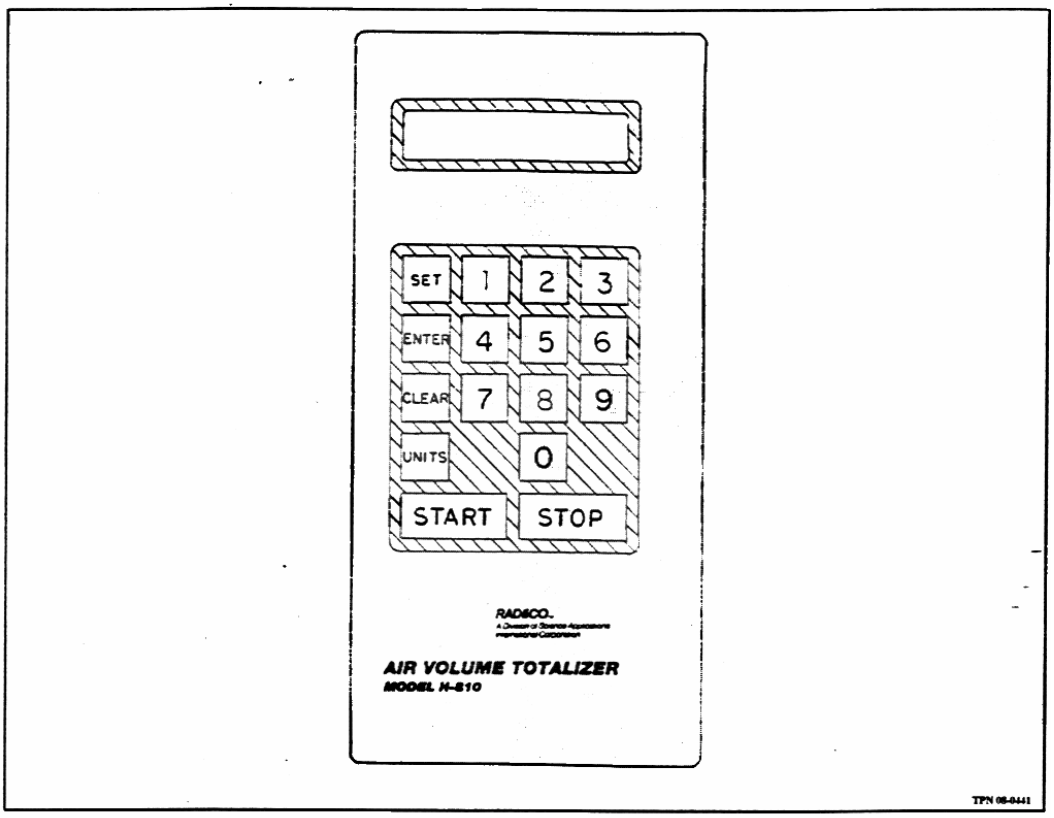
FIGURE 4
PHOTO SENSOR CIRCUIT BOARD ASSEMBLY

FIGURE 5
CALIBRATION SET-UP



APPENDIX A

KEYPAD AND DISPLAY CONFIGURATION



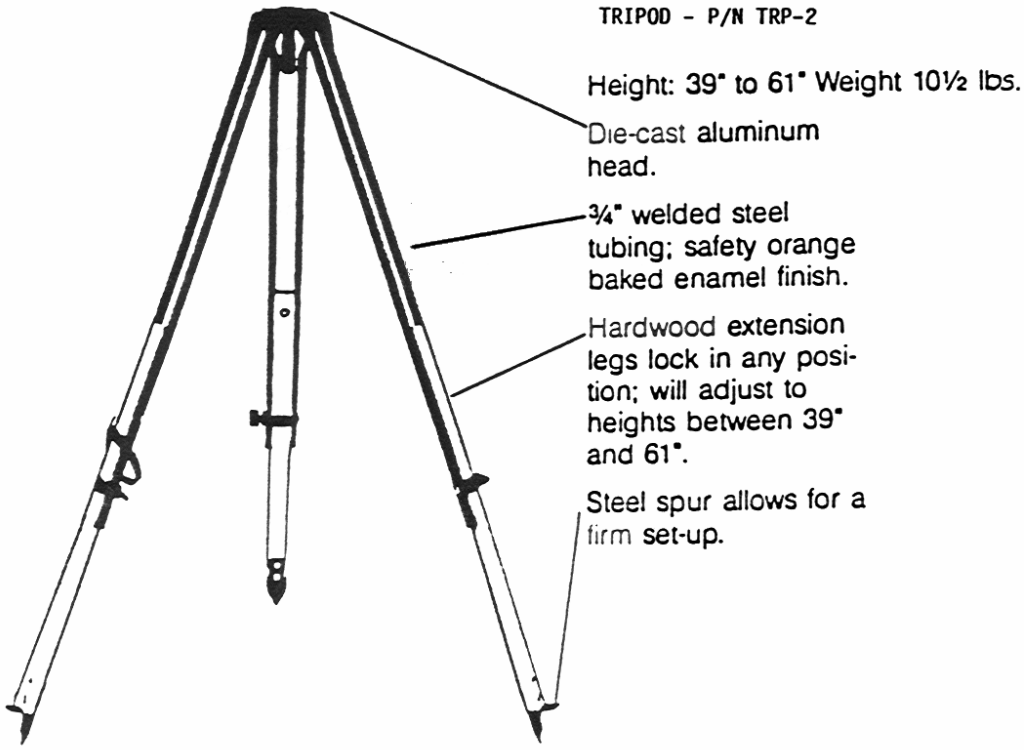
Readout of Totalizer:

LCD: 2 Lines x 16 Characters, backlit. Continuous display of cumulative volume + flow rate + elapsed time. Battery-backed to recall sample data in the event of power loss.

Keypad, 16 Key – Features:

Start Key:	Initiates pre-programmed sample
Stop Key:	Manually terminates sample
Units Key:	Toggles display between liters and cubic feet units
Set Key:	Allows user to change sample reset
Numeric Keys:	Allows entry of numeric values in response to displayed menus
Calibration:	Energizing unit with a special combination of keys puts the unit into a menu-driven calibration mode
Security:	Keypad function can be selectively limited to **Start**, **Stop**, and **Units** in order to prevent changing of sample presets

APPENDIX B
TRIPOD



APPENDIX C
MODEL H-810DC RECOMMENDED SPARE PARTS FOR ONE YEAR

QUANTITY	PART NUMBER	DESCRIPTION
2	2201-09	O-Ring
1	6050-49	Fan Blade
4	6050-04	Motor Brush Assembly
1	106002-1(A)	Circuit Board Assembly
1	0100-58	Motor, Air Mover
2	2201-12	Motor Seal Gasket
1	2201-13	Motor Gasket
4	1800-24	Rubber Feet
1	106014-1	Display Assembly
4	0700-72	Stand-Off, Threaded
1	0900-41	Circuit Breaker
1	106003	Membrane Keypad Assembly