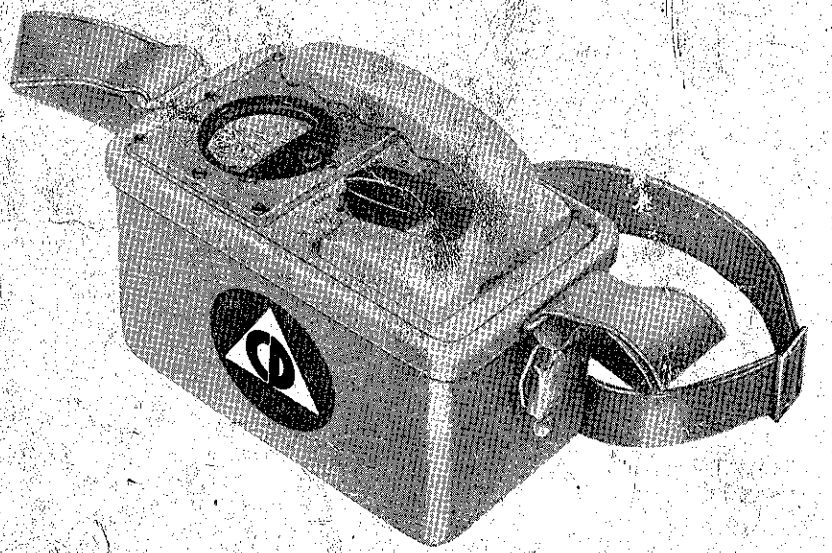
Instruction and Maintenance Manual
for
RADIOLOGICAL SURVEY METER
SID – 1

(FCDA #CD V-710)



The RAD-TEK

EL-TRONICS INCORPORATED
PHILADELPHIA 23, PENNSYLVANIA

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1.0 SPECIFICATIONS

1.1 RANGES:

Three scales, 0-0.5; 0-5; 0-50 r/hr. Capable of detecting radiation intensities from 0.02 to 50 roentgens per hour.

1.2 SPECTRAL DEPENDENCY:

Measures gamma radiation from 70 Kev. to 1.2 Mev. within the accuracy of the instrument. Useful for detecting radiation beyond these limits.

1.3 INSTRUMENT ACCURACY:

Plus or minus 20%.

1.4 WEIGHT:

3 lbs. 12 ozs.

1.5 CONTROLS:

SELECTOR SWITCH and ZERO adjustment on the exterior of the instrument. COARSE ZERO and CALIBRATION (CAL) control on the interior.

1.6 BATTERY LIFE AND COMPLEMENT:

1 each—D Type flashlight cell 1.5 volt.
5 each—#412 22.5 volt photoflash and hearing aid type.
Life over 100 hours continuous operation.

1.7 TUBE COMPLEMENT:

1 each 5886 Electrometer.

1.8 SIZE AND FINISH:

7" H x 3¾" W x 7¾" L (overall), bright yellow enamel, with black lettering.

1.9 MISCELLANEOUS:

Easy grip non-slip carrying handle and large adjustable shoulder strap.

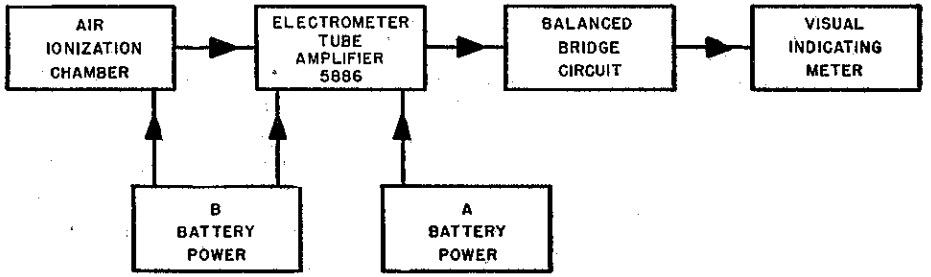

FIGURE #1 FUNCTIONAL DIAGRAM

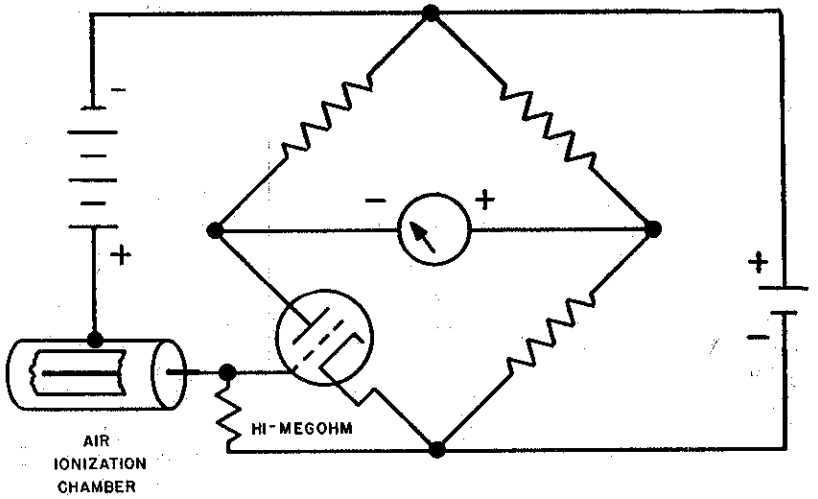

FIGURE #2 SIMPLIFIED SCHEMATIC

2.0 GENERAL DESCRIPTION

The El-Tronics "Rad-Tek" Model SID-1 (FCDA #CD V-710) is a portable survey meter for detecting and measuring gamma radiation. It is battery powered and makes use of an air ionization chamber as the radiation sensitive element. There are three ranges, 0 to 0.5, 0 to 5, and 0 to 50 roentgens per hour (r/hr). Radiation intensity is indicated directly by an electrical meter. The instrument ZERO may be checked and adjusted in the presence of high radiation background. This instrument is of rugged construction and is completely waterproof, making it particularly suitable for field application. The Rad-Tek was especially designed for use as a civil defense instrument.

3.0 THEORY OF OPERATION

3.1 FUNCTIONAL OPERATION:

The air ionization chamber is used as the radiation detecting element. (See Figure #1.) The current developed in the ionization chamber is amplified by a special tube called an "electrometer" tube amplifier. The amplifier functions as one leg of a balanced bridge circuit. An electrical indicating meter gives visual indications of the change in the balance of the bridge circuit. Meter scale indications are marked directly in units of radiation intensity. The battery power supplies provide the necessary power to operate these circuits.

3.2 CIRCUIT OPERATION:

When the ionization chamber is exposed to radiation, the air in the chamber becomes ionized. These ions are collected by electrodes, which develope an electrical current through the chamber. This current flows through an extremely high value resistor (Hi-Megohm). The voltage developed across this resistor is fed to the grid of an electrometer tube connected as one leg of a bridge circuit. (See Fig. #2.) A change in grid voltage causes a proportional unbalance in the bridge and produces a current flow in the indicating meter. The amount of unbalance is directly proportional to the intensity of radiation. Therefore, the instrument meter may be calibrated directly in roentgens per hour.

NOTE: ***It should be remembered that this instrument reads RATE of radiation only and does not indicate total exposure.***

Calibration adjustment is provided by varying a meter shunt potentiometer R12 (See Fig. #5). Ranges are changed by switching to different values of Hi-Megohm resistors. When the selector switch is placed in the ZERO position, the Hi-Megohm resistors are shorted-out and the output from the ion chamber is grounded. The electrometer tube (5886) then reads zero signal voltage. The ZERO control balances the bridge circuit

by changing the bias on the tube. Since the ionization chamber is shorted during this ZERO procedure, the instrument can be ZERO set even in high radiation fields.

4.0 INSTALLATION

4.1 INSPECTION:

The instrument should be carefully unpacked and inspected. Batteries may or may not be installed upon receipt. If batteries have been installed the instrument is ready for operation.

4.2 BATTERY INSTALLATION AND REPLACEMENT:

Remove the top cover of the instrument by unfastening the two spring-lock fasteners on either end of the case and lift the cover and chassis from the case. Perform this operation carefully because the waterproofing rubber gasket surrounding the top of the case may cause some sticking.

Remove four knurled nuts from the back of the chassis to expose the "B" battery compartment and install five 22½ volt hearing aid-type (Eveready #412 or equivalent) batteries. Match the plus and minus mark of the battery with the plus and minus mark in the battery compartment. When the hearing-aid type batteries are installed, care should be taken that the spring contacts fit tightly against the battery terminals. The spring contacts can be tightened by bending them slightly inward. Overbending may damage the contacts. Replace the cover and tighten down with the four nuts. (See Fig. #3.)

Install one size "D" flashlight battery in the bottom battery compartment. This is done by removing the rod and rubber roller. Place the battery between the contacts in the compartment. The center battery contact should face the terminal marked +. Replace the rod and the rubber roller. Be sure the knurled nut is tight.

The chassis is now ready to be returned to the case. Use care in replacing the gasket on the case. Fasten cover with the two spring-lock fasteners.

CAUTION: ***The screw driver adjustments must not be disturbed. They seriously affect the instrument calibration.***

5.0 OPERATION

5.1 GENERAL:

The Rad-Tek is designed so that it can be operated by personnel without special training. The carrying strap should be installed and adjusted to the desire of the operator, The carrying handle protects the controls from accidental movement (See Fig. #4.)

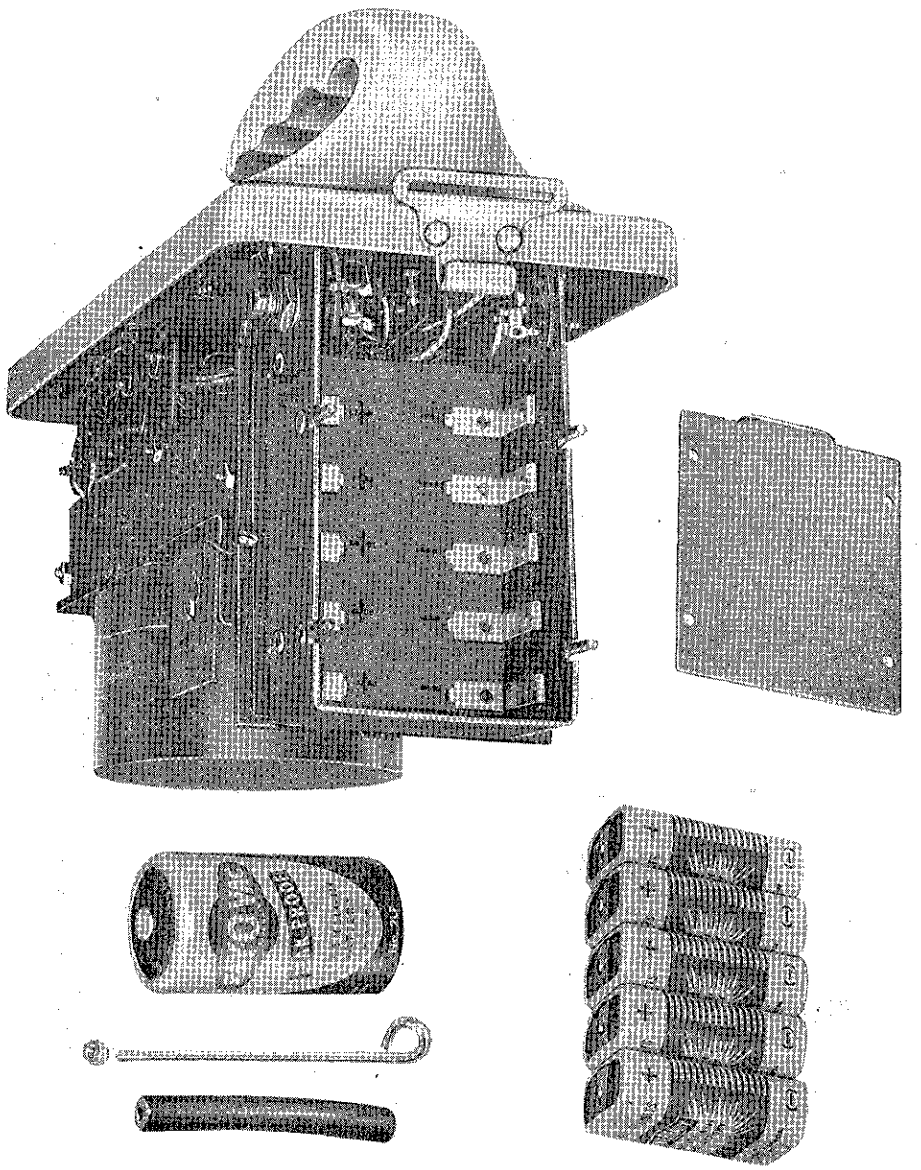

FIGURE #3. BATTERY COMPARTMENT

5.2 BATTERY CHECK:

Press the selector switch counter-clockwise to the BATTERY CHECK position. In this position the switch is spring loaded and will return to OFF unless the knob is held tightly. In the BATTERY CHECK position the indicating meter should read to the half scale mark or above. If the reading is below the half scale mark the size D flashlight battery must be replaced. (See Section 4.2.)

5.3 ZERO ADJUSTMENT:

Turn the selector switch to the ZERO position and allow the instrument to warm up for one minute. Next turn the ZERO adjust knob to the right or left until the meter pointer rests exactly on the zero mark of the scale.

5.4 RANGE AND METER SCALE READING:

The next step is to turn the selector switch clockwise to the X100 range. If insufficient deflection of the meter needle is noted proceed to the X10 range. Again if insufficient deflection of the meter needle is noted proceed to the X1 range. A meter reading when taken will be multiplied by the factor of X100, X10 or read directly on the X1 range, depending on the position of the selector switch.

EXAMPLE:	METER READING	.38
	RANGE	X100
	INTENSITY OF RADIATION	38 r/hr

Care should be given to carefully select the X100 range first and note the reading before proceeding to the next more sensitive ranges. A few moments' study of the meter scale markings and the selector switches' three ranges should enable the operator to make accurate readings without delay or difficulty.

6.0 OPERATOR'S MAINTENANCE

6.1 BATTERIES:

The extent of operator's maintenance should be limited to replacing the batteries (See Section 4.2). None of the parts on the chassis should be removed except those necessary for the replacement of the batteries. Removal of other covers may cause damage to the sensitive electrometer

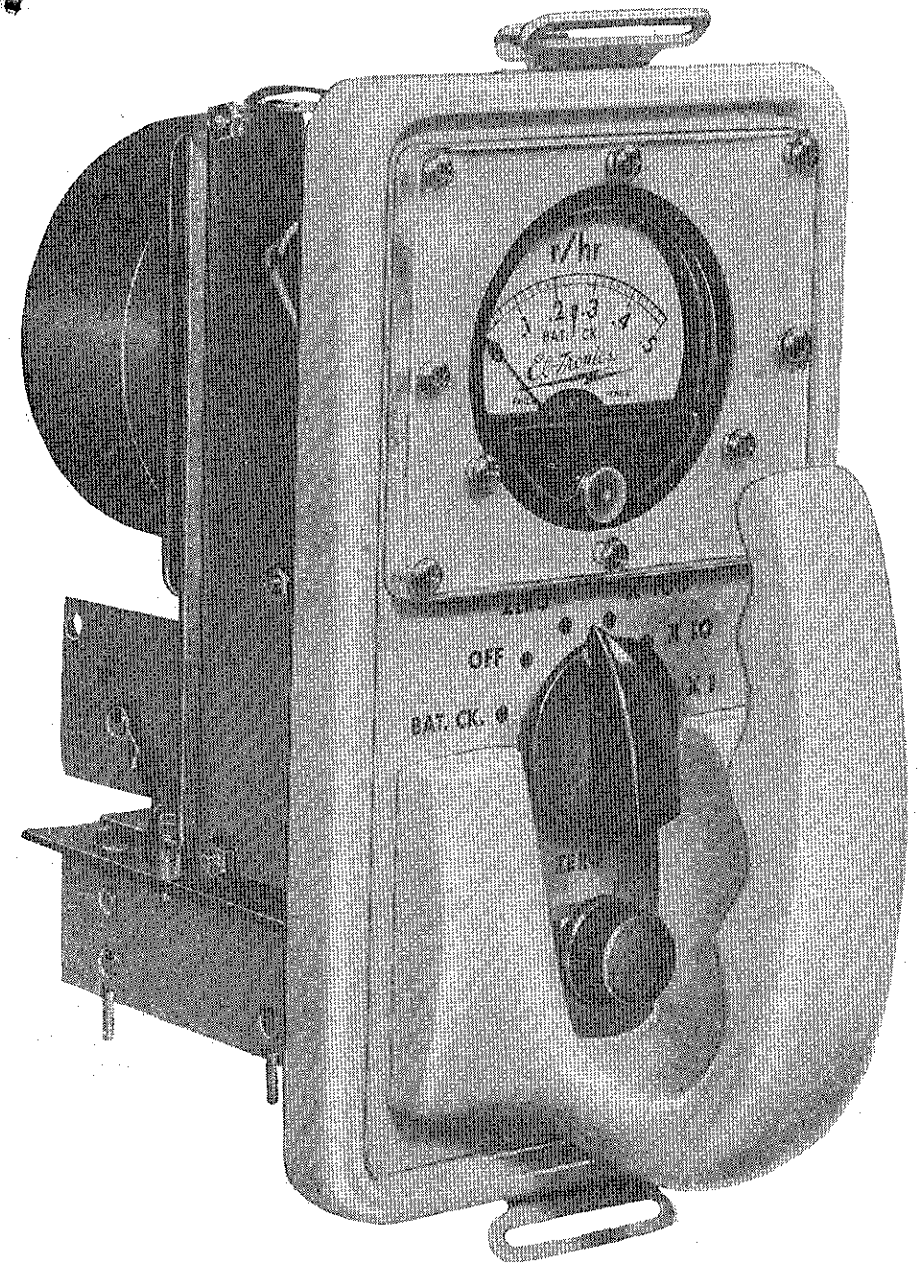

FIGURE #4. METER & CONTROLS

tube and circuit through the admission of dust and dirt. Batteries should be removed from the instrument if prolonged storage is planned. This will avoid damage by battery deterioration.

6.2 RADIOACTIVE CONTAMINATION:

In the event the instrument surface becomes contaminated with radioactive material, it should be cleaned with soap and water. Care should be taken to avoid scratching the plastic meter window.

7.0 PREVENTIVE MAINTENANCE

7.1 MONTHLY CHECK:

To insure proper operation of the Rad-Tek, the following procedure is recommended:

(a) Remove batteries, wipe contacts and battery terminals, remove any corrosion.

(b) Replace the batteries and be sure all contacts make good connection.

(c) Check in accordance with the instructions of Section 5.0.

7.2 18 MONTH MAINTENANCE:

(a) Repeat MONTHLY CHECK (Section 7.1)
(b) Have all batteries tested and replace weak ones (See Section 8.2)
(c) Check gasket seals for deterioration
(d) Check calibration (See Section 8.7)

8.0 CORRECTIVE MAINTENANCE

8.1 ZERO SET DOES NOT ADJUST PROPERLY:

Practically all difficulties with the instrument will first show up as an inability to make the instrument ZERO set and probably can be traced to batteries. Therefore batteries should be suspected first and all battery connections cleaned and checked.

8.2 TESTING THE BATTERIES:

The size D battery can be tested in the instrument. (See Section 5.2.) The 22½ volt batteries must be tested individually. They should read no less than 18 volts when measured on the 50 volt scale of a 1000 ohm per volt voltmeter. Several battery testers on the market are made especially for testing this type of battery. The testers are available from photo and radio service shops.

8.3 ADJUSTING THE COARSE ZERO (Balanced Bridge Circuit):

To test the balanced bridge circuit, set the selector switch to the ZERO position and adjust the ZERO knob to the approximate center of its rotation limits. Remove the instrument from the case and adjust the COARSE ZERO potentiometer until the meter reads exactly on zero. If the meter reads continually to the extreme left, check to see that the tube leads are secure in the tube socket. If this does not correct the trouble, a new tube should be tried.

8.4 REPLACING THE ELECTROMETER TUBE (5886):

To replace the tube it is necessary to first remove the batteries. (See Section 4.2.) Next remove the right side shield plate by taking off the three nuts. Unsolder the long lead of the tube and gently pull the short leads from the socket. Carefully note the position of the leads with respect to the socket. A red dot indicates the No. 1 lead which is the tube plate. Cut the No. 1, No. 2, No. 3 and No. 4 leads to a ⅜ inch length with a pair of wire cutters. Use the original tube as a sample. Be sure to leave No. 5 lead full length. Bend the leads as in the original tube, place in the tube socket and solder the No. 5 lead in place. Extreme care must be exercised to avoid touching the base end of the tube. Fingerprints will cause surface leakage and reduced sensitivity. Next replace the batteries and adjust the COARSE ZERO. (See Section 8.3.) Calibrate as in section 8.7.

8.5 INTERMITTENT DIFFICULTIES:

In most cases intermittents can be traced to defective batteries or battery connections. All other connections are soldered and except in cases of severe instrument damage should not fail. However, if intermittent difficulties persist, one of the component parts may be defective. The switch should be carefully checked.

8.6 TROUBLESHOOTING:

All of the components with the exception of the HI-MEGOHM resistors and the electrometer tube are similar to parts used in radio and television sets and most radio servicemen or radio amateurs can test them. A voltage test can be made by checking with the schematic diagram. Batteries should be removed before making any resistance or continuity checks. The HI-MEGOHM resistors cannot be tested with standard radio test equipment, but generally can be assumed to be functioning properly unless breakage or dirt contamination has occurred.

10.0 PARTS LIST

10.1 ELECTRICAL COMPONENTS:

Part	*Type*	*Manufacturer*	*Function*
B1	Battery 22.5 volt hearing aid and photo type	Eveready #412 National Carbon Co.	High voltage supply for vacuum tube and Ion chamber
B2	Battery 1.5 volt flashlight D cell	No. 2LP RAY-O-VAC Co.	Vacuum tube filament power supply
M1	Meter 0-20 u Amps	El-Tronics A-2333	Visual indicator
R1	Resistor Carbon 100K ±5%, ½W	Allen Bradley #EB 1041	Battery Protection for 90 volt supply
R2	Resistor Carbon 51K ±5%, ½W	Allen Bradley #EB 5135	V1 Plate Load
R3	Potentiometer 250K ±20%	Clarostat Series 47 #X-2371-2	Coarse Zero Control V1 Plate Load
R4	Resistor 600 Megohms ±2%	Victoreen HI-MEG	Chamber Load and V1 grid leak (X-100 Range)
R5	Resistor 6000 Megohms ±2%	Victoreen HI-MEG	Chamber Load and V1 grid leak (X-10 Range)
R6	Resistor 60,000 Megohms ±2%	Victoreen HI-MEG	Chamber Load and V1 grid leak (X1 Range)
R7	Resistor Carbon 12K ±10%, ½W	Allen Bradley #EB 1231	Voltage Divider (Bridge)
R8	Resistor Carbon 6.2K ±5%, ½W	Allen Bradley #EB 6225	Voltage Divider (Bridge)
R9	Resistor Carbon 20 Ω ±5%, ½W	I.R.C. BTS-20	V1 Filament Dropping
R10	Resistor Carbon 1.8K ±10%, ½W	Allen Bradley #EB 1821	Limit resistor for bias control
R11	Potentiometer 1K ±20%	Clarostat Series 47 #X-2371-3	Zero Adjustment-Bias control on V1
R12	Potentiometer 30K ±20%	Clarostat Series 47 #X-2371-1	Calibration (CAL) control
R13	Resistor Carbon 130K ±5%, ½W	Allen Bradley #EB 1345	Battery Test Voltage limiter

10.1 ELECTRICAL COMPONENTS (Continued):

Part	*Type*	*Manufacturer*	*Function*
SW1A	Switch section, special steatite	El-Tronics A-2454	Chamber load range switch section
SW1B SW1C SW1D	Switch, selector	El-Tronics A-2370	Selector Switch for power and range functions
V1	Tube 5886	Victoreen	Amplifier
	Ion Chamber Assembly	El-Tronics A-2345	Gamma Radiation detector

10.2 MECHANICAL COMPONENTS:

1 each—Cover Assembly	El-Tronics 2302
1 each—Box Assembly	El-Tronics 2303
1 each—Channel Gasket	El-Tronics 2366
1 each—Handle	El-Tronics 2304
2 each—Handle Gasket	El-Tronics 2326
1 each—Carrying Strap	El-Tronics 2335
1 each—Window	El-Tronics 2305
1 each—Window Gasket	El-Tronics 2306
10 each—Screw Seals	El-Tronics 2327
3 each—Meter Spacers	El-Tronics 2497
1 each—Shield Assembly	El-Tronics 2308
1 each—Shield Side	El-Tronics 2309-1
1 each—Shield Side	El-Tronics 2309-2
2 each—Grommets	Walsco 3342
1 each—Tube Socket	Cinch #34A11953
1 each—Socket Retainer Spring	Cinch #20K12446
1 each—"A" Battery Holder Assembly	El-Tronics 2316
1 each—"B" Battery Holder Assembly	El-Tronics 2322
1 each—"B" Battery Hold Down	El-Tronics 2325
1 each—Resistor Board Assembly	El-Tronics 2329
2 each—Lugs #8	Shakeproof #2101-08-00
1 each—Wiring Diagram	El-Tronics 2365
5 each—Knurled Nut	El-Tronics 1871-1
1 each—Knob (Selector Switch)	Rogan Bros. RB-31
1 each—Knob (ZERO)	Davis 1450

11.0 MANUFACTURERS' NAMES AND ADDRESSES

Allen Bradley, Milwaukee, Wisconsin

Cinch Mfg. Corp., 1026 S. Homan Ave., Chicago, Illinois

Clarostat Mfg. Co., Dover, New Hampshire

H. Davis Molding Co., 1428 N. Wells St., Chicago Illinois

El-Tronics, Inc., 437 N. Fifth St., Philadelphia 23, Pa.

International Resistance Co., 401 N. Broad St., Philadelphia, Pa.

National Carbon Co., 3020 Thomson Ave., Long Island City, New York

Ray-O-Vac Co., 212 E. Washington Ave., Madison 10, Wisconsin

Rogan Brothers, Irving Park & Campbell Ave., Chicago 18, Illinois

Shakeproof, Inc., 2501 N. Keeler Ave., Chicago 39, Illinois

Victoreen Instrument Co., 5806 Hough Ave., Cleveland, Ohio

Walter L. Schott Co. (Walsco), Beverly Hills, California

12.0 RECOMMENDED MAINTENANCE SPARE PARTS LIST

12.1 PARTS RECOMMENDED FOR FIVE UNITS FOR ONE YEAR BASED ON 200 HOURS OPERATION:

Qty.	*Item*	*Part Description*
35	B1	Battery 22.5 volt #412
10	B2	Battery 1.5 volt Flashlight D cell
1	V1	Tube 5886 Electrometer pentode
1	M1	Meter El-Tronics A-2333
1	SW1A	Switch section El-Tronics 2454
1	SW1B, C, D	Switch, Selector El-Tronics 2370
1	R3	Potentiometer 250K
1	R11	Potentiometer 1K
1	R12	Potentiometer 30K
1		Ion chamber assembly El-Tronics 2345
1	R4	Resistor 600 Megohms HI-MEG
1	R5	Resistor 6000 Megohms HI-MEG
1	R6	Resistor 60,000 Megohms HI-MEG
25		"O" Ring seals El-Tronics 2327
2		Window gaskets El-Tronics 2306
2		Meter windows El-Tronics 2305
4		Handle gaskets El-Tronics 2326
2		Channel gasket El-Tronics 2366
1		Carrying strap El-Tronics 2335