TECHNICAL MANUAL

Model: RSO-50 ™
Portable Survey Meter

Manual Part No. 1022900

Issue	Date
Original	7/84
Rev. A	1/85
Rev. B	3/85
Rev. C	5/86
Rev. D	3/90

HARSHAW BICRON RADIATION MEASUREMENT PRODUCTS

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Saint-Gobain/Norton Industrial Ceramics Corporation

ELECTRONIC PRODUCTS
STANDARD WARRANTY

Instruments and options manufactured by Bicron are warranted against defects in materials and workmanship for a period of two years from the date of shipment, unless otherwise agreed upon by Bicron and the customer.

Bicron's obligation with regard to such products shall be limited to repair or replacement, FOB Bicron factory or authorized repair station, at Bicron's option.

The calibration (when applicable) for each instrument is warranted to be within its specified accuracy at the time of shipment. If this initial calibration is determined to be in error, the instrument will be recalibrated at no charge, provided it is returned as described above.

The aforesaid warranty does not cover instruments, options or probes which are subject to excessive physical abuse or are used for purposes other than those intended. In no event shall Bicron be liable for consequential or special damages, transportation, installation, adjustment, work done by customer or other expenses which may arise in connection with such defective product or parts.

EXCLUSION OF LIMITED WARRANTY

THERE ARE NO WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTY OF MERCHANTIBILITY OR FITNESS, WHICH EXTEND BEYOND THE DESCRIPTION OF THE FACE HEREOF. THIS EXPRESS WARRANTY EXCLUDES COVERAGE OF AND DOES NOT PROVIDE RELIEF FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY KIND OR NATURE, INCLUDING, BUT NOT LIMITED TO LOSS OF USE, LOSS OF SALES OR INCONVENIENCE. THE EXCLUSIVE REMEDY OF THE PURCHASER IS LIMITED TO REPAIR, RECALIBRATION, OR REPLACEMENT OF THE INSTRUMENT AT BICRON'S OPTION.

This warranty specifically excludes the following items which are covered by their original manufacturers' warranties: photomultiplier tubes, GM and proportional tubes, crystal and other solid-state detectors, and batteries.

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EXCLUSION OF WARRANTY

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There are no warranties, express or implied, including without limitation any implied warranty of merchantability or fitness, which extend beyond the description of the face hereof. This express warranty excludes coverage of and does not provide relief for incidental or consequential damages of any kind or nature, including, but not limited to loss of use, loss of sales or inconvenience. The exclusive remedy of the purchaser is limited to repair, recalibration, or replacement of the instrument at Bicron's option.

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PROCEDURES and CAUTIONS

The equipment herein described is designed and manufactured in compliance with all applicable safety standards. Nevertheless, certain hazards are inherent in the use of electronic and radiometric equipment.

Adequate warnings are included in the manual and on the product itself to cover hazards that may be encountered in normal use and servicing of this equipment. No other procedures are warranted by Bicron.

It shall be the owner's or user's responsibility to see to it that the procedures and cautionary notes are heeded.

Failure on the part of the user in any way to follow the prescribed procedures shall absolve Bicron and its agents from any resulting liability.

This instrument is intended solely for the detection and measurement of ionizing radiation. It should be used only by persons who have been trained in the proper interpretation of its readings and the appropriate safety procedures to be followed in the presence of radiation.

All instructions and warnings contained in this manual or on the instrument must be read before use and must be strictly followed. Failure to follow these instructions and warnings may result in inaccurate readings and/or user hazard.

Indicated battery and other operational tests must be performed prior to each use to assure that the instrument is functioning properly.

*****CAUTION*****

FAILURE TO CONDUCT PERIODIC PERFORMANCE TESTS IN ACCORDANCE WITH ANSI N323-1978, PARAGRAPHS 4.6 AND 5.4, AND TO KEEP RECORDS THEREOF IN ACCORDANCE WITH PARAGRAPH 4.5 OF THE SAME STANDARD, COULD RESULT IN ERRONEOUS READING OF POTENTIAL DANGER. ANSI N323-1978 BECOMES, BY THIS REFERENCE, A PART OF THIS OPERATING PROCEDURE.

INSPECTION

Instruments should be examined and tested as soon as received. Claims for transportation damages, if any, should be filed at once with the delivery carrier.

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1.0 GENERAL DESCRIPTION

The Bicron RSO-50™ model is an ergonomically designed survey meter which embodies state-of-the-art electronics and a unique concept in rugged construction.

The instrument features an ion chamber detector, wide-view meter, beta, gamma and X-ray detection, 0-50 R/h, and an ion chamber collection potential test.

1.1 SPECIFICATIONS

RADIATION DETECTED: beta, gamma and X-ray
DETECTOR: Air-filled ionization chamber vented to atmosphere through silica gel desiccant
RANGE: 0-50 R/h in 4 linear ranges
ACCURACY: Within +/- 5% of full scale
ENERGY RESPONSE: +/- 20% from 12 keV to 7 MeV
WARMUP TIME: None
RESPONSE TIME: Approx. 5 sec., 0-90% of final reading
TEMPERATURE: Operational from -40°C to +60°C
HUMIDITY: <5% change in reading from 10-95% RH
RF SENSITIVITY: Unaffected by radar fields up to 20 mW/cm^2
BATTERY COMPLEMENT: One, 9-volt MN1604 or equal (the additional battery holder may be used as storage for spare or parallel-wired)
BATTERY LIFE: > 100 hours or > 200 hours with parallel option
COLLECTION POTENTIAL: 30 volts, provided by ten permanently installed energy cells (life expectancy > 5 years)
COLLECTION POTENTIAL TEST: Exclusive self-test to verify proper ion chamber collection potential
CONTROLS: Seven-position rotary switch marked off, bat., zero, 50 and 5 R/h, 500 and 50 mR/h; protected zero adjustment knob; top-mounted calibration pots under removable cover.
DISPLAY: Ruggedized, recessed, high-torque 1 mA meter with 3.35 inch (8.51 cm) scale marked 0-5, 'Bat.ok'. Meter protected by impact-resistant Lexan® polycarbonate window
GEOTROPISM: Within +/- 2% of full scale
SHOCK: 100g per lightweight machine of MIL-STD 202C, method 202B
VIBRATION: 5g in each of three mutually orthogonal axes at one or more frequencies from 10-33 Hz
CONSTRUCTION: Splash-proof, shock proof, two-piece all-metal case. Scratch-resistant laminated control panel and Bicron Kleen-Krome® trim on case top, durable black polyurethane paint used on handle and case bottom, chrome-plated steel clips for optional shoulder strap

The ion chamber desiccant system is designed to simplify desiccant maintenance.

Ion chamber volume is approx. 200 cm^3; ion chamber made of 200 mg/cm^2 phenolic

Window is 7 mg/cm^2 mylar. Positive lock sliding beta shield is 400 mg/cm^2 phenolic.
SIZE: 4.25" X 8" X 8" including handle (10.8 X 20.4 X 20.4 cm)
WEIGHT: 3.1 lbs. (1.4 kg)
OPTION: Over-the-shoulder type carrying strap

2.0 BATTERY INSTALLATION

BATTERY TYPE: 9-volt Mallory MN1604 or equivalent.
PROCEDURE:
1. Turn instrument off.
2. Open pull catches at ends of case and separate case

bottom from top.

3. Install battery in appropriate clip on bottom circuit board, (clip for spare battery is so marked), observing proper polarity.
4. Replace bottom, orienting rubber pad under battery; close catches.

PARALLEL-WIRED OPTION: Instruments with this option have both battery clips wired into the circuit. Installing a second battery thus provides approximately twice the operational hours of one battery. Only one battery is needed to power the instrument, however.

2.1 BATTERY TEST

Turn control switch to the "bat." position; a meter reading within the "bat. OK" range should be observed.
This test allows monitoring of the condition of the battery.

2.2 COLLECTION POTENTIAL TEST

The ion chamber collection potential is also checked when the control switch is in "bat.". The meter needle will oscillate in an obvious manner and not come to rest in the "bat. OK" range if the proper collection potential is not being supplied to the ion chamber, regardless of the condition of the 9V main battery.

Note: The collection potential energy cells do not normally require replacement or maintenance, due to the relatively insignificant drain imposed by the ion chamber itself. Each can be replaced by the user, however, if rendered unusable for some reason (accidental damage, etc.).

3.0 RADIATION MEASUREMENTS

To make a radiation measurement:

1. Turn the control switch to "zero" and zero the meter using the zero adjustment knob.
2. Turn the control switch to one of the four linear ranges. Due to the sensitivity of the ion chamber to transient switching noise, the meter will normally deflect momentarily when the 50 mR/h range is selected.
3. When surveying for medium to high energy gammas or X-rays, slide the positive-lock beta shield closed to protect the mylar window. Radiation incident on the front, sides and bottom of the case will be detected.
4. When surveying for betas or low energy gammas or X-rays, slide the beta shield open and orient the instrument so that radiation is incident on the exposed window. Note that the end of the shield protrudes beyond the end of the case bottom when fully opened.

*****CAUTION*****

An external source of ionizing radiation of the type the instrument was designed to measure must be used to determine proper operation of this instrument.

3.1 CALIBRATION

The instrument is normally calibrated with ^{137}Cs gamma rays. Recalibration is required after servicing and at regular intervals specified by appropriate regulatory agencies.

The unit is placed in a known radiation field in the appropriate fixed geometry. The center of the ion chamber is indicated by markings on the case bottom to aid in achieving correct orientation.

The calibration controls are located under a splash-proof cover on the top panel. Loosening the single thumbscrew and removing the cover provides access to the controls. The controls themselves are designed to be splash-proof.

A detailed calibration procedure is part of the Q.C. Acceptance Procedure found elsewhere in this manual. Note that the calibration performed provides the instrument with an accuracy well within the +/- 5% of full scale accuracy specification.

4.0 IONIZATION CHAMBER

The ion chamber used in the RSO-50 is essentially a phenolic cylinder with one end sealed with an aluminized mylar film and the other sealed against the housing for the electronic amplifier. The inside of the cylinder is conductive so that it can carry the negative potential. A collector plate is suspended within the cylinder. The chamber is air-filled and vented to the atmosphere through a silica gel desiccant.

This assembly is mounted to the main circuit board and oriented so that the chamber window is aligned with the aluminized mylar window in the case bottom. Note that the case bottom and top can go together only one way because of the alignment.

Total density of the two mylar windows is 7 mg/cm^2. These windows are designed to be easily replaced by the user in the event of accidental damage.

4.1 ELECTRONIC AMPLIFIER

This section of the ion chamber assembly amplifies the current generated in the chamber to provide a meter reading. Due to the amplifier's extreme sensitivity, it can be damaged by electrostatic discharge.

Since such damage is not covered by the warranty on the instrument, it is recommended that the ion chamber amplifier section be serviced (should it require servicing) only by a qualified technician.

4.2 CAM AND ARM ASSEMBLY

This assembly controls operating range selection by positioning the permanent magnet mounted on the arm properly around magnetic reed switches.

Set screws on the cam are user-adjustable, although the factory settings will not normally require adjustment.

4.3 ION CHAMBER DESICCANT SYSTEM

The air-filled ionization chamber is vented to the atomosphere through the amplifier section. Because of the sensitivity of the chamber, leakage currents can be easily set up by small amounts of moisture within the chamber. To keep this moisture to a minimum, the chamber vent is connected to a desiccant system.

The desiccant used is an indicating type of silica gel. At the first sign of pink coloration in the normally blue-colored crystals,

remove the crystals, dry them at 200°F for 24 hours, and return them to their container. For immediate use, replace the "used" desiccant with new or previously dried desiccant.

If the desiccant is allowed to become saturated, leakage currents may develop and the instrument may produce erratic readings. The chamber air will then have to be dried by flushing it over fresh desiccant to restore proper operation. This is accomplished by heating the instrument to around 140°F and cooling to room temperature several times after the saturated desiccant has been dried or replaced.

The design of the system is such that removal and replacement of the desiccant is a relatively simple operation. Access to the crystals is gained through a snap-off/snap-on cap. The container is held securely by its clip but can be quickly taken out and put back in. The tube can be separated from and put back on its fittings in simple fashion.

5.0 CORRECTION FACTORS

Since the operation of the ion chamber is affected by air density, correction factors may have to be applied to readings obtained when the instrument is used at temperatures and/or pressures significantly different from those at which the instrument was calibrated. In practice, these factors are significant mainly at the extremes of temperature and pressure.

The correction factors for temperature are found in Table C-2; those for pressure (altitude) are found in Table C-1.

TABLE C-1

CORRECTION FACTORS FOR ALTITUDE (PRESSURE)

OPERATING ALTITUDE \ CALIBRATION ALTITUDE	SEA LEVEL	1000'	2000'	3000'	4000'	5000'	6000'	7000'	8000'
SEA LEVEL	1.00	.96	.93	.90	.86	.83	.80	.76	.73
1000'	1.04	1.00	.96	.93	.90	.86	.83	.80	.76
2000'	1.08	1.04	1.00	.96	.93	.90	.86	.83	.80
3000'	1.12	1.08	1.04	1.00	.96	.93	.90	.86	.83
4000'	1.16	1.12	1.08	1.04	1.00	.96	.93	.90	.86
5000'	1.20	1.16	1.12	1.08	1.04	1.00	.96	.93	.90
6000'	1.25	1.20	1.16	1.12	1.08	1.04	1.00	.96	.93
7000'	1.30	1.25	1.20	1.16	1.16	1.08	1.04	1.00	.96
8000'	1.35	1.30	1.25	1.21	1.21	1.12	1.08	1.04	1.00

METER READING X CORRECTION FACTOR = CORRECTED READING

NOTE: When both temperature and altitude are different from those at which the instrument was calibrated, Corrected Reading = Meter Reading x Temperature Correction Factor x Altitude Correction Factor.

TABLE C-2

CORRECTION FACTORS FOR TEMPERATURE

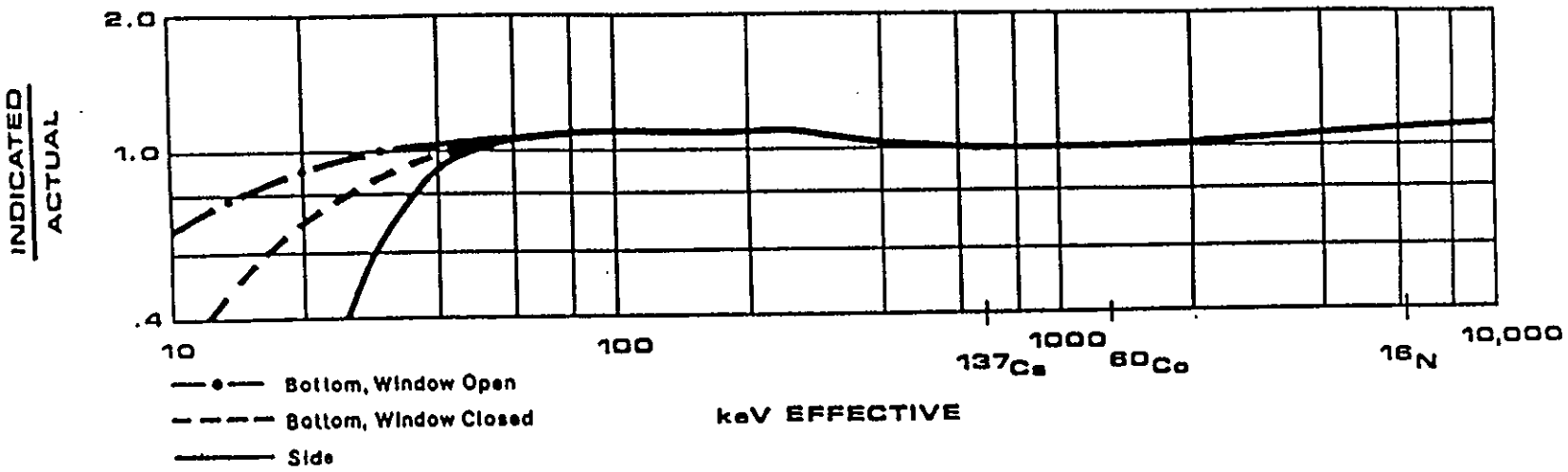
CALIBRATION TEMPERATURE

OPERATING TEMPERATURE

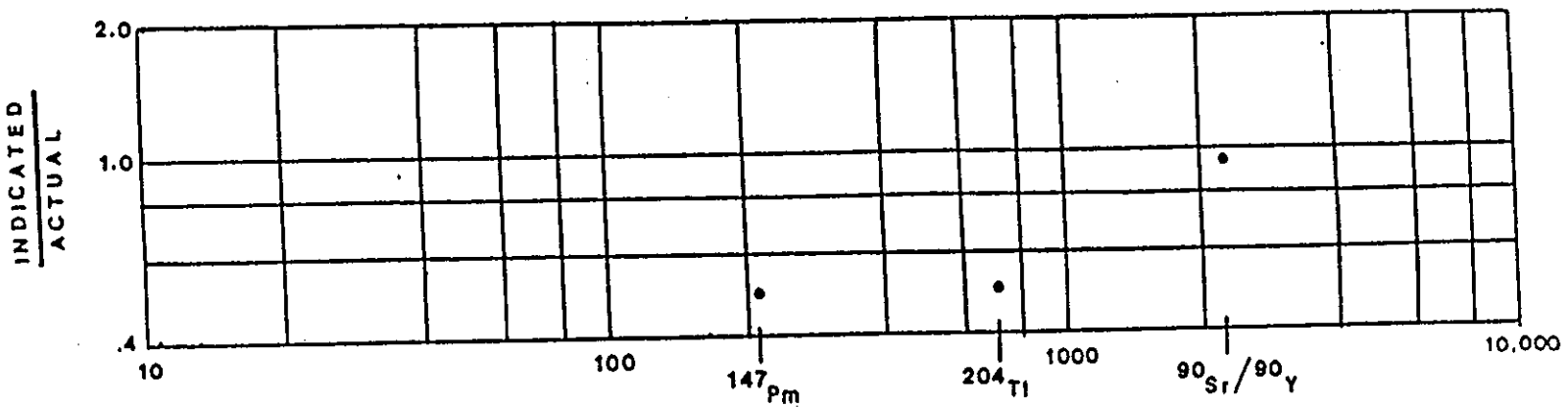
°C		-40	-34.4	-28.9	-23.3	-17.8	-12.2	-6.7	-1.1	4.4	10	15.6	21.1	26.7	32.2	37.8	43.3	48.9	54.4	60
	°F	-40	-30	-20	-10	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140
-40	-40	1.00	.98	.95	.93	.91	.89	.87	.85	.84	.83	.81	.79	.78	.76	.75	.74	.72	.71	.70
-34.4	-30	1.02	1.00	.98	.95	.93	.92	.89	.88	.86	.84	.83	.81	.79	.78	.77	.75	.74	.73	.71
-28.9	-20	1.05	1.02	1.00	.98	.96	.94	.92	.90	.88	.86	.85	.83	.81	.80	.79	.77	.76	.75	.73
-23.3	-10	1.07	1.05	1.02	1.00	.98	.96	.94	.92	.90	.88	.87	.85	.83	.82	.80	.79	.78	.76	.75
-17.8	0	1.10	1.07	1.05	1.02	1.00	.98	.96	.94	.92	.90	.88	.87	.85	.84	.82	.81	.79	.78	.77
-12.2	10	1.12	1.09	1.07	1.04	1.02	1.00	.98	.96	.94	.92	.90	.89	.87	.85	.84	.82	.81	.80	.78
- 6.7	20	1.14	1.12	1.09	1.07	1.04	1.02	1.00	.98	.96	.94	.92	.91	.89	.87	.86	.84	.83	.81	.80
- 1.1	30	1.17	1.14	1.11	1.09	1.07	1.04	1.02	1.00	.98	.96	.94	.92	.91	.89	.87	.86	.85	.83	.82
4.4	40	1.19	1.16	1.14	1.11	1.09	1.06	1.04	1.02	1.00	.98	.96	.94	.93	.91	.89	.87	.86	.85	.83
10	50	1.21	1.19	1.16	1.13	1.11	1.09	1.06	1.04	1.02	1.00	.98	.96	.94	.92	.91	.89	.88	.86	.85
15.6	60	1.24	1.21	1.18	1.16	1.13	1.11	1.08	1.06	1.04	1.02	1.00	.98	.96	.95	.93	.91	.90	.88	.87
21.1	70	1.26	1.23	1.20	1.18	1.15	1.13	1.10	1.08	1.06	1.04	1.02	1.00	.98	.96	.95	.93	.91	.90	.88
26.7	80	1.29	1.26	1.23	1.20	1.17	1.15	1.13	1.10	1.08	1.06	1.04	1.02	1.00	.98	.96	.95	.93	.92	.90
32.2	90	1.31	1.28	1.25	1.22	1.20	1.17	1.15	1.12	1.10	1.08	1.06	1.04	1.02	1.00	.98	.96	.95	.93	.92
37.8	100	1.33	1.30	1.27	1.24	1.22	1.19	1.17	1.14	1.12	1.10	1.08	1.06	1.04	1.02	1.00	.98	.97	.95	.93
43.3	110	1.36	1.33	1.30	1.27	1.24	1.21	1.19	1.16	1.14	1.12	1.10	1.08	1.06	1.04	1.02	1.00	.98	.97	.95
48.9	120	1.38	1.35	1.32	1.29	1.26	1.23	1.21	1.18	1.16	1.14	1.12	1.09	1.07	1.05	1.04	1.02	1.00	.98	.97
54.4	130	1.41	1.37	1.34	1.31	1.28	1.26	1.23	1.20	1.18	1.16	1.13	1.11	1.09	1.07	1.05	1.04	1.02	1.00	.98
60	140	1.43	1.40	1.36	1.33	1.30	1.28	1.25	1.22	1.20	1.18	1.15	1.13	1.11	1.09	1.07	1.05	1.03	1.02	1.00

METER READING X CORRECTION FACTOR = CORRECTED READING

TYPICAL PHOTON ENERGY RESPONSE



TYPICAL BETA ENERGY RESPONSE



BICRON QC ACCEPTANCE PROCEDURE NUMBER 1022930

MODEL: RSD-50™

1. Perform visual inspection of finished product.

2. Remove all 9V batteries. Connect a power source of 9.30V +/- .05V across the main battery terminals of the battery board. Perform the following tests:

   a. Turn the control switch to "off". Mechanically zero the meter via the rear zero adjustment screw on the meter barrel.

   b. Leave the control switch in "off" position and measure the voltage of each energy cell on the ion chamber mounting board. A minimum voltage of 2.7V should be observed on each cell.

      Note: The RSD-50 contains 10 energy cells.

   c. Leave the control switch in "off" and disconnect the 9-pin "D" connector from the ion chamber. Turn the control switch to the "bat." position. The meter should oscillate at a rate of about 2 to 5 hertz.

   d. Turn the control switch to "off" and reconnect the 9-pin "D" connector to the ion chamber. Turn the control switch to "bat.". The meter should indicate a "bat. ok" condition within +/- 5% of full scale on the meter.

   e. Leave the control switch in "bat." and measure the -V supply between pins 1 and 11 of the 24-pin header. The supply should be -8.0V or greater (more negative).

   f. Turn the control switch to "zero" and check to see that clockwise rotation of the zero control increases the meter reading. Zero the meter with the control.

   g. Check to see that the reed switch magnet arm is functioning properly, as follows:

      1. <u>off, bat., zero positions</u>: arm with magnet should be to the <u>right</u> side of the chamber.

      2. <u>50 R/h, 5 R/h positions</u>: arm with magnet should be to the <u>left</u> side of the chamber.

3. 500 mR/h, 50 mR/h positions: arm with magnet should be in the center of the chamber.

Adjust the set screws on the cam as required to insure proper reed switch magnet arm action.

3. Perform the following isotopic calibration:

a. Turn the control switch to "50 R/h" and position the unit so that the ion chamber is in the appropriate fixed geometry in a known 137Cs radiation field. (Note: Make sure that the entire chamber is being irradiated.)

b. Expose the unit to the proper field intensity (listed in Table T-1) required to calibrate the unit at 80% of full scale.

c. Adjust R5 (50 R/h calibration pot) until the unit reads 80% of full scale on the meter.

d. To test linearity, expose the unit to the proper field intensity required for 20% of full scale (this value also listed in Table T-1).

e. Note these readings on a Certificate of Calibration.

f. Repeat this procedure for the "5 R/h" position (using R8, the 5 R/h calibration pot), the "500 mR/h" position (using R10, the 500 mR/h calibration pot), and the "50 mR/h" position (using R13, the 50 mR/h calibration pot).

TABLE T-1

Isotopic Calibration Table for the RSO-50

Acceptable Meter Range (mR/h)	Exposure Rate (mR/h)	Reading
50 R/h (80%)	40000	38000 - 42000
50 R/h (20%)	10000	9000 - 11000
5 R/h (80%)	4000	3800 - 4200
5 R/h (20%)	1000	900 - 1100
500 mR/h (80%)	400	380 - 420
500 mR/h (20%)	100	90 - 110
50 mR/h (80%)	40	38 - 42
50 mR/h (20%)	10	9.0 - 11.0

Please note that these calibration values provide an accuracy well within the +/- 5% of full scale accuracy specification for the instrument.

4. Turn the unit off. Install a new +9V alkaline battery (MN1604 or equal) in the main battery holder. (Note: If unit is parallel-wired, battery can be installed in either holder. Only 1 battery is required for proper operation).

5. Complete, date, and sign a Certificate of Calibration.

6. Procedures for RSO-50 instruments to ensure proper operation of the magnetic circuit.

   a. Zero the instrument.

   b. Set the instrument to the most sensitive range.

   c. The magnet arm should be aligned with the head of the forward rivet which holds the magnetic shunt to the chamber mounting board (see drawing A-9700107 position "A"). If it is not, adjust the magnet arm and/or cam assembly as necesasry to obtain this positioning.

   d. With the instrument set to the most sensitive range, use a check source to obtain a reading of at least 3% of full scale.

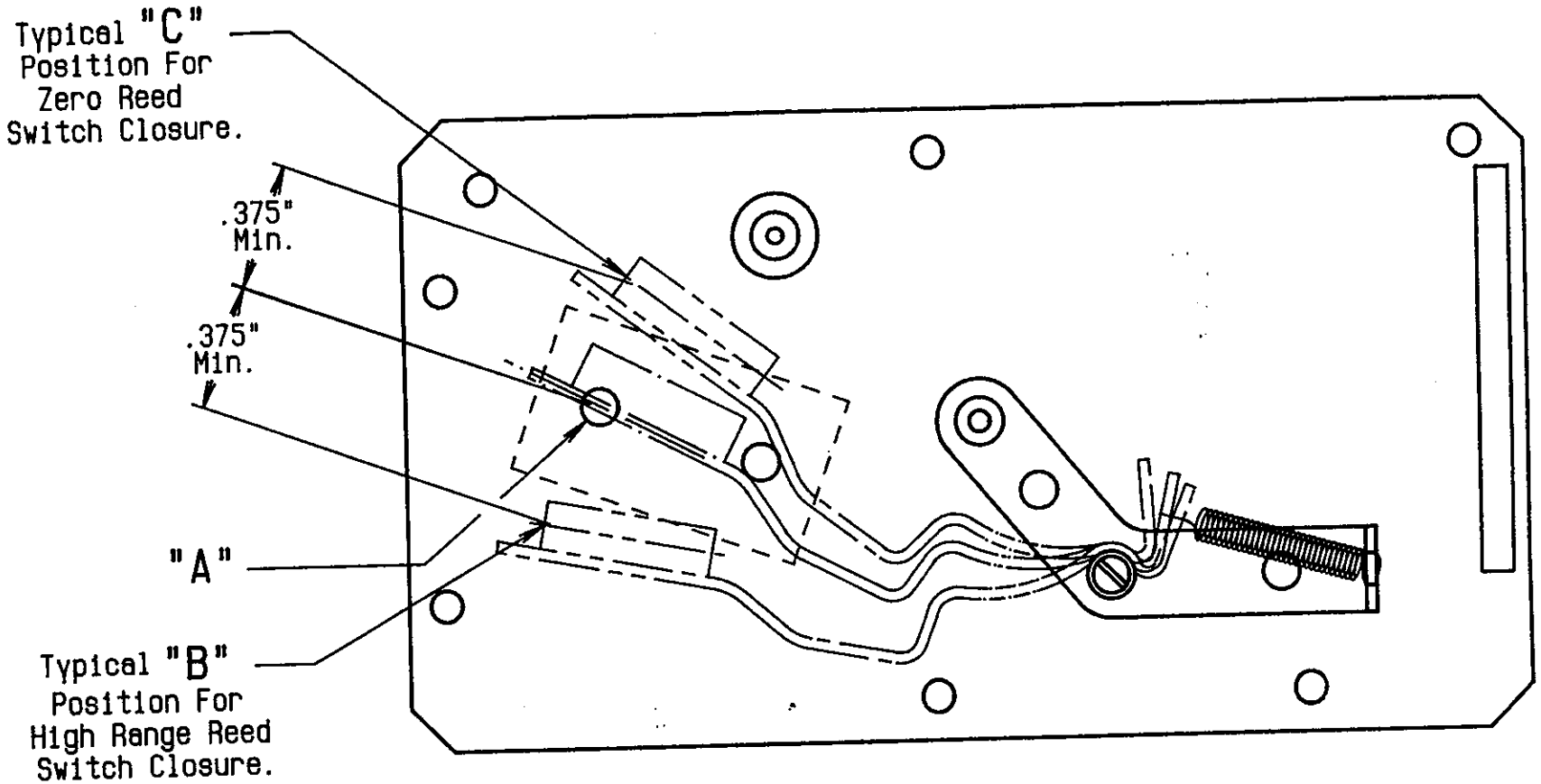
   e. Set the instrument to the "zero" position and manually move the magnet arm so that it is aligned with the forward rivet head as in step C.

   f. Move the magnet arm toward the zero reed switch until the switch closes (the reading will drop to zero). Mark the position of the front center of the magnet on the chamber mounting board, using a marking pen (see drawing A-9700107 position C).

   g. Move the magnet arm toward the high range reed switch until the switch closes (the reading will drop to zero). Mark the position of the magnet on the chamber mounting board (see drawing A-9700107 position B).

   h. The distance between the center of the front rivet head and the closure location marks must be at least .375 inches. If it is not, rework the magnetic circuit as necessary.

This test is to be performed during final test and again prior to calibrating the instrument for shipment.



REV.	DATE	DESCRIPTION	BY
A	4/18/90	Reversed Image To Correct Viewing Position	J.V.

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NEWBURY, OHIO U.S.A.

Typical Magnet Arm Position
RSO Instruments

PROD. CODE	BASIC PART NUMBER	DIMENSION	FINISH	REV.
	A 9700107			A

SPARE PARTS LIST
BICRON RSO-50

SCHEMATIC SYMBOL	DESCRIPTION			PART NO
	Switch PC Board Assembly			9420005
C5,C6	Capacitor,	33 uF,	10 V tan.	9233361
D1,D5,D7-D11	Diode,	1N4148		9600004
Q1	VMOS FET,	VN10KMA		9610003
R4,R20,R21	Resistor,	10 meg,	1/4w, 5%	8110054
R5,R8,R10,R13	Trimpot,	50k		9395032
R6,R9,R11,R14	Resistor,	33.2k,	1/4w, 1%	8533224
R7,R12	Resistor,	1 meg,	1/4w, 1%	8510044
R15	Resistor,	3.3k,	1/4w, 5%	8133014
R16	Resistor,	8.45k,	1/4w, 1%	8584514
RN1	Res. Network,	7 x 220k		8822031
SW3	Switch,	Rotary,	2-7 pos.	9560006
U2,U3	Int. Ckt.,	CD4016BEX		9650002
U5	Int. Ckt.,	ICL7660CPA		9640005
	Header,	12-pin		9780006
	Header,	24-pin		9780002
	Circuit Board			9410008
	Chamber Mtg. PC Board Assembly			1022020
BT3-BT12	Battery, 3V lithium, BR1225			9750003
C1,C2	Capacitor,	0.1 uF,	Film	9211041
C3	Capacitor,	.047 uF,	Film	9214731
C4	Capacitor,	1 uF,	35 V tan.	9231051
D2	Diode,	1N5255B		9600006
D3,D4	Diode,	1N4148		9600004
R17	Resistor,	10 meg,	1/4w, 5%	8110054
R18	Resistor,	22 meg,	1/4w, 5%	8122054
R19	Resistor,	1 meg,	1/4w, 5%	8110044
U4	Int. Ckt.,	MC14093BCPDS		9650001
	Connector,	24-pin		9780001
	Connector, 9-pin D, male			9780005
	Pivot Arm Assembly			9100055
	Bracket Assembly			9850006
	Magnet			9100060
	Spring			9470003
	Battery PC Board Assembly			9420003
	Ion Chamber Assembly			1022060
	Chamber Shell Assembly			9100051
	Angle Bracket (Small)			9850004
	Angle Bracket (Large)			9850005
	Case Top Assembly			1022140

	Handle	9710005
	Meter	9400022
	Meter Window	9400011
	Meter Support Bracket	9850002
	Case Bottom Assembly	1022050
	Slide Plate	9100036
	Mylar Window	9100058
	Beta Shield Assembly	9100039
	Miscellaneous	
BT1	Battery, 9V alkaline, MN1604	9750001
R3	Potentiometer,20k	9382031
	Knob, Function	9770003
	Knob, Round	9770004
	Zero Knob Guard	9100034
	Calibration Pot Door With Chain	9100059
	Cam Assembly	9100053
	Desiccant Holder	9100056
	Vent Tube	9100057
	Manual, Operator's	1022900
	Spare Parts List	1022910
	Schematic Circuit Diagram	1022920
	QC Acceptance Procedure	1022930

Part No. 1022910

Issue:	Date:
Original	07/10/84
Rev. A	01/04/85
Rev. B	03/14/86

Symptom	Possible Cause	Corrective Action
Low battery check	Low 9 volt battery	Replace 9 volt battery
No battery check	Q1 defective	Replace Q1
	U5 defective	Replace U5
	Meter movement defective	Replace meter
Meter needle oscillates in battery check	Collection potential batteries low	Replace collection potential batteries
Short 9V battery life	Q1 defective	Replace Q1
Short collection potential battery life (possible if chamber was serviced by non-factory personnel)	Partial short to ground in ion chamber	Disconnect D connector cable from ion chamber. Check resistance from pin 7 to pin 8 of the connector on the ion chamber - should be > 100 meg. If not, remove ion chamber shell, locate and clear short in "dagged" area of chamber mounting plate or chamber shell*.
Instrument will not zero	Negative voltage supply defective	Replace U5
	Defective operational amplifier	Replace U1*
	Reed switch SW1 not closing	Check for proper operation of magnet arm
		Check SW1*
	Open wire in chamber D connector cable	Check cable assembly continuity - repair if needed
Instrument will not calibrate properly on the 2 most sensitive ranges	Reed switch SW1 or SW2 not opening properly	Check for proper magnet arm operation
		Check SW1* and SW2*
	R1 (feedback resis.) defective	Replace R1*
	U1 defective	Replace U1*

Symptom	Possible Cause	Corrective Action
Instrument will not calibrate properly on the 2 least sensitive ranges	Reed switch SW2 not closing properly	Check for proper magnet arm operation
		Check SW2*
	R2 (feedback resis.) defective	Replace R2
Instrument will not calibrate properly on any range	Meter movement defective	Replace meter
	U2 defective	Replace U2
	U3 defective	Replace U3
	U1 defective	Replace U1
	Reed switch SW1 not opening	Replace SW1*
Excessive zero offset or noise on most sensitive range	Moisture in ion chamber	Replace desiccant in instrument and bake unit at 60°C for 24 hours
	U1 defective	Replace U1*

* Components in the high impedence section of the ion chamber are easily damaged and should be serviced only by specially trained technicians.

IMPORTANT! Instructions on Returning Items for Calibration or Repair

To help you get your equipment to us for repair or calibration and to help us do the work and return the equipment to you as quickly as we can, we ask that you fill out this form and enclose it with the items you're sending. A reminder: if your instrument uses an external GM probe and is to be calibrated in mR/h, please send the probe with the instrument.

Be sure to read the warranty statement which accompanied your equipment (it's usually in the front of the tech manual). It describes what's covered and what we can do for you under warranty and provides other useful information as well. If you have any questions or need help filling out this form, just give us a call.

To: **Bicron** 6801 Cochran Road Solon, OH 44139 Attn: Electronics Repair Dept	Phone # (216)248-7400 Fax # (216)349-6581
Date:	P.O. for the calibration or repair

Please list what you're sending to us: *(Please Mark the Appropriate Box)*

Model	Serial Number	Calibration Only	Need Cost Estimate for Calibration or Non-Warranty Repair

If your units need repair, please describe the problems you're encountering with them (use the back of this form or a separate sheet, if necessary.)

Whom should we contact about this return?	To what address should we return the units?
Name: Company: Phone # Fax #	

BICRON

AUTHORIZED REPAIR SERVICE REPRESENTATIVES
February, 1993
(Subject to change without notice)

ATLAN-TECH, INC.
1345 Hembree Road
Roswell, GA 30076
404/442-1067 Fax: 442-8445
Robert A. Sirpak

GP INSTRUMENT SERVICES, INC.
2045 Route 286
Pittsburgh, PA 15239
412/733-1900
James Christopher

HEALTH PHYSICS ASSOCIATES, INC.
3334 Commercial Avenue
Northbrook, IL 60062
708/480-1900
Theodore Fields

HEALTH PHYSICS NORTHWEST
11535 South West 67th Street
Tigard, OR 97223
503/620-6617 Fax: 684-5548
Corwin Hymes

HEALTH PHYSICS SERVICES, INC.
1350 Piccaro Drive, Suite 304
Rockville, MD 20850
301/670-1818 or 800/969-4774
Richard Brown

W. H. HENKEN INDUSTRIES, INC.
415 Lillard Road
Arlington, TX 76012
817/261-5566 Fax: 261-5555
Scott Henken

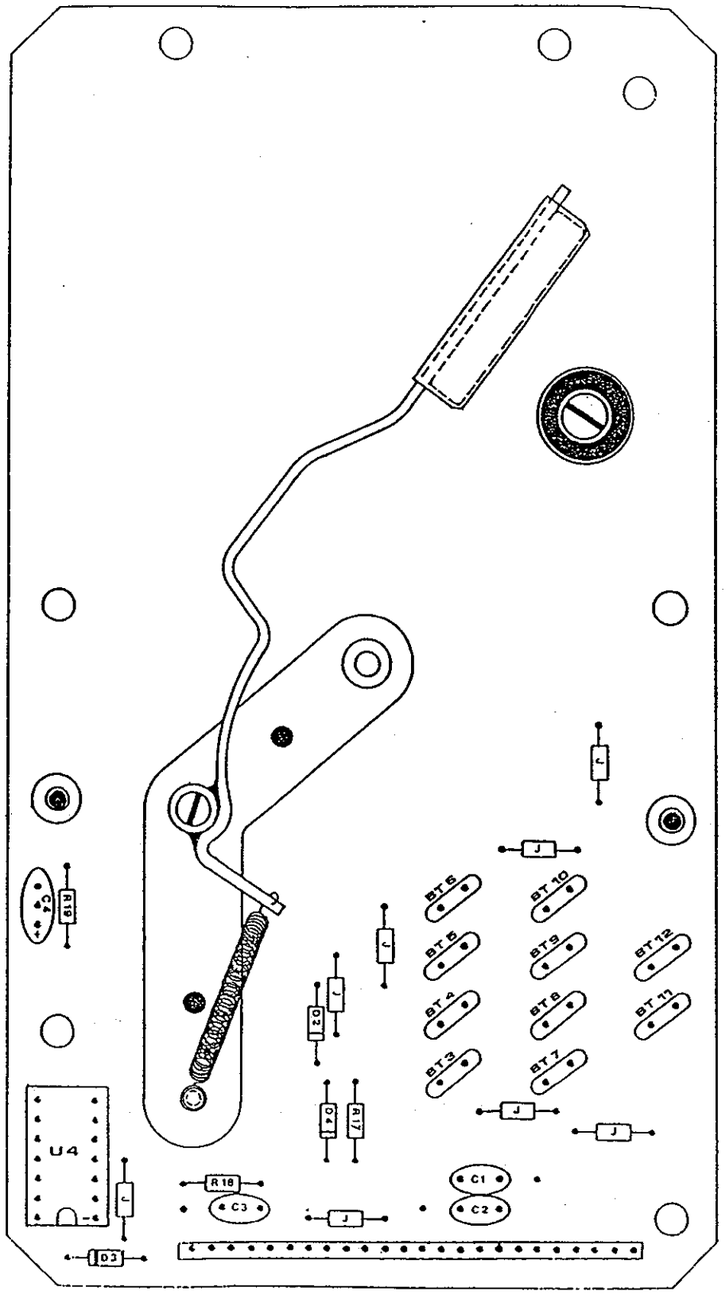
NC SYSTEMS, INC.
5785 Arapahoe - Suite D
Boulder, CO 80303
303/442-7358
Charles H. Rose

NWT ANALYTIC & CONSULTATION
1724 Holmes Street
Livermore, CA 94550-6012
510/443-7967
Don Wadsworth

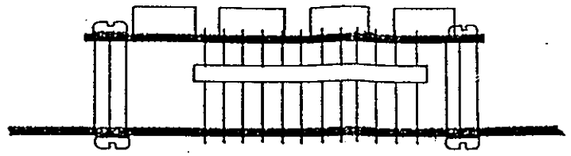
RADIATION DETECTION COMPANY
162 Wolfe Road
Sunnyvale, CA 94086
408/935-8700
Richard H. Holden

SOUTHEASTERN ATOMICS LAB
1354 N. W. 53rd Avenue
Gainesville, FL 32601
904/372-9716
Don Price

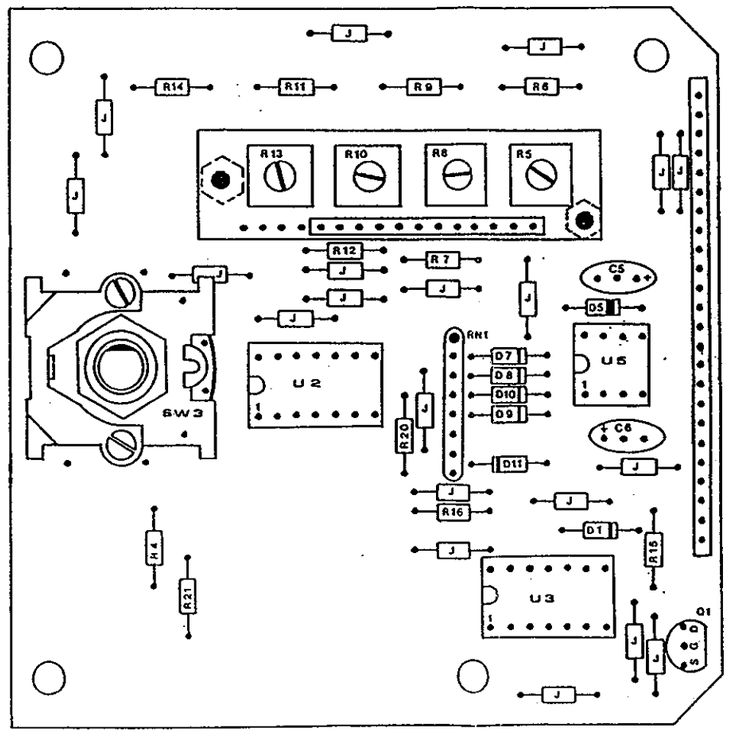
TECHNICAL SERVICES GROUP, INC.
361 Pike Blvd., Suite 220
Lawrenceville, GA 30245
404/822-9117
Alan Farriba



TOP VIEW
COMPONENT SIDE



SIDE VIEW
(SHOWING MOUNTING OF
CALIBRATION BOARD)



ION CHAMBER SECTION

R1 3 x 10^{11} SW1 REED SWITCHES

R2 3 x 10^{9} SW 2

U1-9640004

C1 .1

C2 .1

R3 20K ZERO POT

COLLECTION VOLTAGE
10 x 3V LITHIUM BATTERIES
BT3 - BT12

EXCEPT AS NOTED:
ALL RESISTORS IN OHMS
ALL CAPACITORS IN μF
ALL DIODES 1N4148
(X) TOP ENTRY CONNECTOR PIN NUMBERS
⟨X⟩ ION CHAMBER "D" CONNECTOR PIN NUMBERS
[X] 1/4 CD4016BEX
2 IC'S – 1 thru 4 = U3
5 thru 8 = U2
PIN 14 = +V PIN 7 = ///
BOTH IC'S

R4 10 M

U2A x1000 U2B x100 U2C x10 U2D x1

R5 50K CW R6 33.2K 1%
R7 1M 1% R8 50K CW R9 33.2K 1%
R10 50K CW R11 33.2K 1%
R12 1M 1% R13 50K CW R14 33.2K 1%
CAL POTS

R15 3.3K

R16 8.45K 1%

U3A U3B

D1

1mA METER

signal

D2 1N5255B

R17 10 M

D3

U4 - MC14093 BCPDS

D4

R18 22M

C3 .047

U4A U4B U4C

R19 1M C4 1.0

bat.

U3C U3A U3B

D10 D9 D8 D7

zero x1000 x100 x10 x1

MODE RANGE SWITCH

D11

SW 3 off +V

RN1
* 7 X 220K SIP

BT1 - BT2
9V BATTERY
TYPE 1604
BT2 OPTIONAL

D6 1N4001

R21 10M

POWER SUPPLY

U3D 4 off

R20 10M

VN10KMA Q1

ICL 7660 CPA U5

C6 33 C5 33

D5

+V -V

U40

REV.	DATE	DESCRIPTION	BY

TOLERANCES UNLESS OTHERWISE SPECIFIED
FRAC. ±
.X ±
.XX ±
.XXX ±
ANGLES ± °
MICRO FIN. √
DE-BURR & BREAK ALL EDGES

SCALE: NONE
DRAWN: JAR
DATE: 7-2-84
CHECKED:
DATE:
DO NOT SCALE PRINT

BICRON CORPORATION
NEWBURY, OHIO U.S.A.

SCHEMATIC CIRCUIT DIAGRAM

RSO - 50

PROD. CODE	Dwg. Code	BASIC PART NUMBER	Dimension	FINISH	REV.
	B1	022920			