

**OPERATION
AND
MAINTENANCE
MANUAL**

MODEL # TBM-IC-MARK V

ION CHAMBER MONITOR

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INSTRUCTIONS FOR USE
FOR
TBM-IC MARK V

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DRAWINGS

B 9704	Top View (lid removed) (2 Pages)
A 9981	Front Panel
A 10679	Electrometer Box Lid Labeling
Red Lion Ratemeter Manual Model #CUB5R	

This manual covers both mR and μ Sv versions of Model TBM-IC-MARK V.

TBM-IC MARK V INSTRUCTIONS FOR USE

GENERAL

The TBM-IC Mark V is a small Ion Chamber Radiation Monitor.

DOSE RATE MEASUREMENT RANGE

mR Version:

0.1 mR/h to 9999.9 mR/h

Sv Version:

1 μ Sv/h to 99,999 μ Sv/h

TOTAL DOSE MEASUREMENT RANGE

mR Version:

0.01 mR to 99,999.99 mR

Sv Version:

0.1 μ Sv to 999,999.9 μ Sv

PRINCIPLE OF OPERATION

Ionizing radiation such as X-Rays, Gamma Rays and mid to high energy Beta particles enter the Ion chamber. The air in the Ion Chamber becomes ionized. These ions flow to the anode and cathode of the Ion chamber because of the bias voltage. This very small chamber current is amplified and converted to pulses then they are counted by the **Dose-Rate Display**. The pulses are accumulated each second and are displayed on the front panel readout and **Integrated Dose** is also displayed.

BATTERY TEST

- 1) Press the battery button.
- 2) Battery is "OK" if light comes on.
- 3) Red LED comes on showing when battery supply is 4 volts or above.

COUNT PULSES LED

This LED is near the battery LED. This LED flashes green as count rate increases. This is a two (2) color LED, GREEN for normal counts, RED for "over range".

DIGITAL READOUT

On the front panel is an 8 digit LCD digital readout which can display radiation level from 0.1 mR/hr (1 μ Sv/h) to 9999 mR/hr (99990 μ Sv).

Please see above for Integrated Dose (Total Dose) function.

Display time constant: 12 seconds from 0 to 2mR/h and 2 – 3 seconds above 2 mR/h.

BATTERY REPLACEMENT

To replace the 6 "AA" batteries unscrew the 2 thumbscrews which hold the rear cover plate on to the instrument. Remove this cover plate with its attached battery holder. Unplug the old batteries. Slide the 6 new batteries into place. Be careful to use correct polarity for each cell. Reinstall battery holder and battery cover plate. You may wish to tape batteries into holder if rough handling or shipping is expected. See "trouble shooting" section regarding 7 year bias cell replacement.

WARNING:
Ion Chamber should not be opened unnecessarily. A temporary zero shift may occur and unit will read too high for up to 4 days.

CALIBRATION

Calibration of this instrument is accomplished by adjusting how much chamber current is needed to produce each pulse. The number of pulses accumulated is one count/sec for 1 mR/hr. Thus 100 counts accumulated in 1 second will read out correctly as 100 mR/hr. If one count is recorded every 10 seconds, then the display will read 0.1 mR/hr.

Verify that reading is within plus or minus 10% at 2 points on each decade.

A. If calibration adjustment is needed please follow this procedure:

1. Turn on instrument, wait 2 minutes.
2. Use front panel button to test batteries.
3. Place TBM-IC MARK V at highest available (calibrated) radiation field point – but not exceeding 9.9 R/hr and no less than 100 mR/hr.
4. Loosen the 2 thumbscrews on instrument panel and lift-up front panel. Do Not disconnect any wires or ribbon cable.
5. This exposes E-box lid (See Drawing B10679 at back of this manual).
6. Rotate recessed RANGE potentiometer counter clockwise to increase display reading or clockwise to decrease reading as needed so display shows correct radiation field value within desired error limits.
7. Place TBM-IC MARK V at 0.1 mR/hr or other low field, but not exceeding 2 mR/hr.
8. Adjust front panel 10-turn dial to achieve correct meter reading. (clockwise turn increases readings).
9. Repeat steps 6 through 8.
10. Move to location where field is low. Preferably 10-20 microR/hr.
11. Verify that display reads zero most of the time. It may occasionally read higher due to counting statistics or “shot noise” in the pre-amp.
12. Press “set” button on main instrument panel. Hold button down for 15 seconds, if display reads 2.0 * – this procedure is finished.
13. If it does not read 2.0 * continue holding the red button and slowly adjust recessed pot marked “set” (on E-box lid, just to the left of the ribbon cable) adjust this pot until 2.0 reading is achieved.
14. Recheck unit at 2 points on each decade.
15. Done

* Reading will be “20” for Sv/h instruments.

Count pulse / over range LED

A two color LED shows a green color of increasing intensity as 10 R/hr is approached. The color gradually changes to Red to indicate “over range condition above 10 R/hr.”

The TBM-IC Mark V electronics are fully temperature compensated in ambient temperature range. As in all free air Ion Chambers, thermally based air expansion results in a sensitivity change of **less than 0.5% degree C**, which meets all standard portable instrument requirements. However, even this may be eliminated by the following correction.

These instruments are calibrated in international roentgens correct to standard temperature and pressure (32 degrees F (0° C) and 29.92 inches Hg when used at 71.6 degrees F (22 degrees C) and 29.92 inches (760 mm Hg). For temperature other than 71.6 degrees F and pressures other than 29.92 inches Hg, a correction factor may be applied to the meter reading to compensate for ionization chamber air density changes.

$$\text{Correction Factor} = \frac{459.7 + T \text{ (degrees F)}}{3} \times \frac{29.92}{P \text{ (inches Hg)}}$$

Example: A radiation measurement is taken and the meter reading is 25 mR/hr. The air temperature is 90 degrees F and the barometric pressure is 29.13 Hg.

$$\frac{459.7 + 90}{3} = \frac{549.7}{531.3} = 1.035$$

$$\frac{29.92}{29.13} = 1.027$$

$$\begin{aligned} \text{Correction Factor} &= 1.035 \times 1.027 = 1.063 \\ \text{Corrected Reading} &- 25 \text{ mR/hr} \times 1.063 = 26.6 \text{ mR/hr} \end{aligned}$$

The effects of air temperature and pressure must be taken into consideration when these instruments are re-calibrated or when the calibration is checked.

UNITS EQUIVALENCE

MODE	UNITS	RADIATION FIELD					
Rate	mR/h	0.1	1	10	100	1,000	mR/h
Rate	µSv/h	1	10	100	1,000	10,000	µSv/h
Total Dose	mR/hr	0.0016	0.016	0.16	1.6	16	mR
Total Dose	µSv	0.016	0.16	1.6	16	160	µSv

Total dose accumulated when TBM-IC is exposed to this particular Sv/h field for one minute.

TROUBLE SHOOTING

When calibrating the instrument, if reading is low:

1. First check the programming (see page 6).
2. Check wiring.
3. Calibrate the TBM-IC by adjusting "Range" pot on E-Box and zero adjust dial on front panel.
4. Next check the 30 – 45 Volt bias voltage. Replace bias battery supply if the voltage is less than 15 volts. (Call TA for bias battery replacement instruction sheet.)

WINDOW OR BETA CAP REPLACEMENT

The TBM-IC MARK V has a beta cap on the front of the Ion chamber. Remove the Beta Cap to allow measurement of Alpha, low energy Betas and very low energy X-Rays. This exposes thin Mylar Alpha window 0.5 milligrams per square centimeter.

CAUTION: The Alpha Screen is Exposed and Can Be Very Easily Damaged.

- 1) To replace red beta cap, gently pull old cap off of ion chamber, and slide on new Beta cap.
Caution: Do not damage exposed mylar window. Do not cover 2 air holes when installing new beta cap. Alpha window rupture may result.

- 2) Mylar Alpha Window is integral part of ion chamber and window and chamber must be replaced as a unit.

- 3) In the event that the Mylar window becomes torn or damaged, turn instrument off.
- 4) Unscrew the chamber and remove beta cap.
- 5) Screw on a new chamber, add cap.

PRE-AMPLIFIER

The pre-amplifier is a current to voltage amplifier. This is a very high input impedance amplifier with high meg feedback resistors. The input current starts from sub-pico amp range. The input is susceptible to noise pick-up, static charge, etc. if the metal cover is removed from the internal metal E-Box. The amplified voltage drives a pulse generator which in turn feeds into the LCD counter/display module.

ZERO SET

- 1) On the left side of the TBM-IC front panel are the Zero-Set Controls.
- 2) Take the instrument to a location where background radiation field is not elevated above the normal. (nominal .015 mR/h).
- 3) Turn on TBM-IC and wait 2 minutes.
- 4) Press and hold "Set" button.
- 5) Hold button down for 20 seconds.
- 6) Display will show the number given on your calibration certificate (for example this may be the number 2.0). *
- 7) If display does not show this number, then continue to hold down "set" button, and adjust ten-turn dial a small amount until correct number is shown. Note: The physical rotation of the pot may cause a temporary over-shoot in the reading, so please observe reading for 20 seconds to be sure 2.0 ± 0.1 reading is stable. *
- 8) Rotate thumb-lock to lock ten-turn dial.
- 9) Release Zero-Set button and wait 10 seconds for Rate-display to settle.
- 10) Set completed.

* This reading will be 20 ± 1 for Sv/h units.

INTEGRATE FEATURE

- The front panel display has both Rate (Dose Rate) and Integrate (Accumulated Dose) data buffers in operation all the time. You can look at either (without disturbing the other) by pressing the left Select button (SEL).
- To reset the Integrate buffer, push right hand "RST" button. The user can disable this button if required. (See programming section of manual.) This is useful if you wish to prevent inadvertent or unauthorized reset during a long integration measurement.
- The integrate function is "free running", so please use a stop watch or wrist watch to determine how long TBM-IC has been integrating.

NOTE: TBM-ICM-V is shipped in Program Locked Mode.

PROGRAMMING:

Model TBM-ICM-V incorporates a programmable display. The program parameters are in non-volatile memory and are retained when unit is turned on or off and even if the 6 "AA" batteries are removed.

To make changes in the programming parameters: Ref. CUB5 insert at the back of this manual.

1. Loosen thumb screws and remove top panel. Move slide switch to the right to "OP" position.
2. Hold select button for 2 seconds.
3. Press RST button once to enter module #1, twice for module 2 etc.
4. Press SEL to scroll through the settings in that module.
5. If display is correct, press SEL. If not, and you wish to change that parameter, press RST instead. Then make the needed changes, and when ready, press and hold SEL to store the value.

Programming Screens

Module - Step #	Function	"As Shipped" Setting	Setting
		mR	µSv
1-1	Count Modes (cnta-Ud)	cnt ud	cnt ud
1-2	Integrate Mode Decimal Point (cnta-dP)	0.00	0.0
1-3	Integrate Mode Scale Factor (cnta-scf)	0.0278	0.0278
1-4	Counter Reset At Power Up	No	No
1-5	User Input (USEr INP)	pro-loc	pro-loc
2-1	Rate Enable (rAtE Enb)	Yes	Yes
2-2	Rate Decimal Point (rAtE dP)	0.0	0
2-3	Rate Display (rAtE dSP)	10000.0	10000
2-4	Rate Input (rAtE INP)	10000.0	10000
2-5	Min. Display Refresh Seconds (Lo-Udt)	02.0	02.0
2-6	Max Display Refresh Seconds (Hi-Udt)	12.0	12.0
3-1	Select Enable (dSPSEL)	Yes	Yes
3-2	Reset Enable ((rSt Enb)	Yes	Yes
3-3	Display Scroll (dSPS ScroL)	No	No
4.	Program Security Code	000	000
3-5	Fact Set	No	No
4-1,2---9	See CUB 5 Instructions		

1. Move slide switch back to the left to lock the program and operate the instrument.
2. Replace instrument lid.
3. Job completed.

CHANGING DOSE RATE READ-OUT UNITS

Model TBM-IC MARK V converts Ion Chamber current into pulses.

The pulse rate is factory set to equal 1.0 counts per second in radiation field of 1 mR/h (10 μ Sv/h).

CHANGING INTEGRATED DOSE READOUT UNITS

As previously mentioned, the TBM-IC MARK V E-box produces 1 count per second for each mR/h (10 μ Sv/h) of radiation field strength (dose rate). If the TBM-IC is placed in a 1 mR/h (10 μ Sv/h) field and left there for exactly one hour, the raw counts in the "total" buffer will be:

$$1.0 \text{ count/sec} \times 3600 \text{ sec/hour} = 3600 \text{ total counts.}$$

This is multiplied by "counterA scale factor (SCLFAC)" of 0.0028 to give 3600 total counts x 0.028 scalefactor=10.08.

However, the decimal point is shifted one digit to the left (because we set the total DP at 0.00) to give 1.008 which will be displayed at the end of one hour as 1.01 mR total dose.

TBM-ICM V RECOMMENDED PARTS LIST

DESCRIPTION
IN TBM

PART # _____

QUANTITY USED

Beta Cap	A9926/VC2500-16	1
Ion Chamber Shell (Includes Alpha Window)	A9705	1
Ion Chamber Base	A9706	1
Center Electrode (Graphite coated)	A9911	1
Spring for Center Electrode	SP-IC3V	1
Digital Display	53300-405	1
Battery Holder for six (6) 'AA' cells	BHGAA	1
Battery cover plate with (6"AA" Holder)	A9946	1
Thumb Screws to hold lid or Bat cover	58-28-506-24	4

CONSUMABLES

SIZE

FUNCTION	VOLTAGE PER CELL	CHEMISTRY	CAPACITY	DIA.	LENGTH
MFG. PART #	#/TBM	TYPICAL LIFE			
Main Battery Eveready EV 115	1.5 6	Carbon Zinc Up to 1000	Heavy Duty	0.55"	2"
AA Size	hrs. of life				
(Alternate) AA Size	1.5	Alkaline		0.55"	2"
Chamber Bias Renata CR 1220	3. 10-15	Lithium 7 years		0.450"	.075