8 – Model 9-4 Ionization Chamber

SAND2011-2062P

Defense Nuclear Nonproliferation

Operation and Use

Search and Secure Workshop

Ionization Chamber Topics

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- Uses
- External Controls
- Standard Features
- Specifications
- Operational Check
- Practical Exercise

Ion Chamber Appropriate Uses

- Tissue equivalent gamma and x-ray reading
  - 2 μSv h^{-1} to 500 mSv h^{-1}
- Beta + Gamma readings only with Beta slide "open"
  - (Open window – Closed Window) x 4.8 = true Beta response for a Uranium slab
- Allow 30 minutes stabilization time
  - Temperature change of ≥ 10 ºC
- Protect mylar chamber window

Ion Chamber Inappropriate Uses

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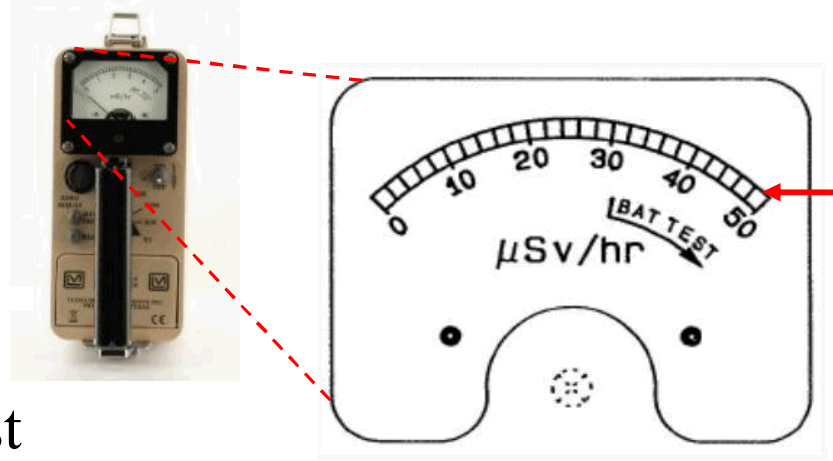
- Alpha measurements
- Beta + Gamma measurements with slide closed
- Environmental level gamma and x-ray

External Controls



0 – 50 µSv/hr Scale

Zero Adjust Knob

Light Switch

Battery Test Button

Range Selector Switch

Reset Button

Standard Features

- Simple user interface
- Temperature and pressure compensated
- Wide – view meter with backlight
- Open-air ion chamber
  - Measures gamma and X-ray dose rate
  - Detects beta radiation (slide open)
- Battery and Zero Indicators
- Single rotary switch operation

Specifications

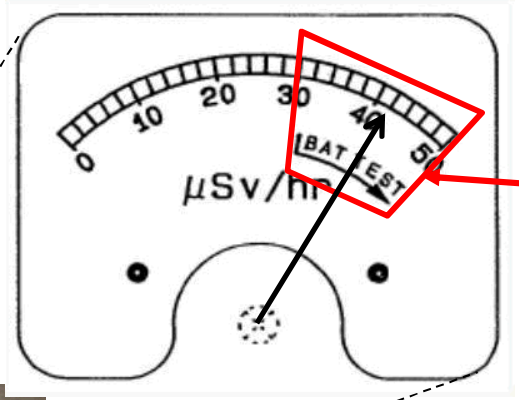
- Dose rate range 2 μSv h^{-1} to 500 mSv h^{-1}
  - ± 20% of true value
  - Energy range is 40 keV – 2 MeV (beta window open)
- Temperature range –20 ºC to 50 ºC
- Temperature and Pressure Compensation
  - ± 20% (-20 ºC to 50 ºC)
  - ± 15% (70 – 106 kPa)
  - Note: 1 kPa = 7.5 torr = 9.869 x 10^{-3} atmospheres

Specifications (cont.)

- Response time (0 – 90% scale)
  - 5 seconds (x1 and x10 scales)
  - 3 seconds (x100, x1K, and x10K scales)
  - Note: 1K = 1000
- Uses two “D” cell alkaline batteries
  - Battery life is 400 hours (use dependent)
  - Low-battery warning
- Lightweight (1.9 kg) with batteries

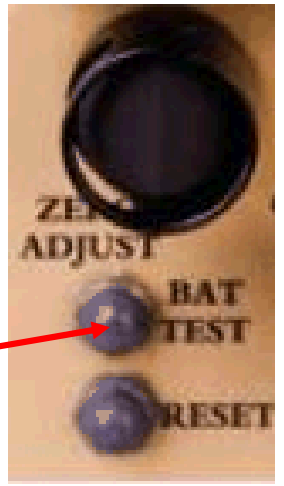
Battery Test

Unit must be "On"!



Verify Indicator is within the BAT TEST Region

Press BAT TEST Button



Replacing the Batteries

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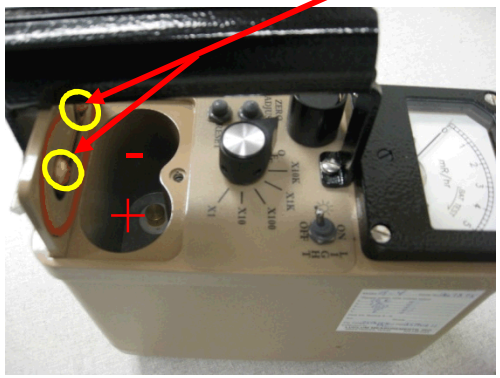
Twist compartment knob ¼ turn (counter-clockwise)

Next

Open the cover and insert batteries according to polarity (shown on the cover)



Finally

Close compartment and twist knob ¼ turn (clockwise)

Setting the Zero Position

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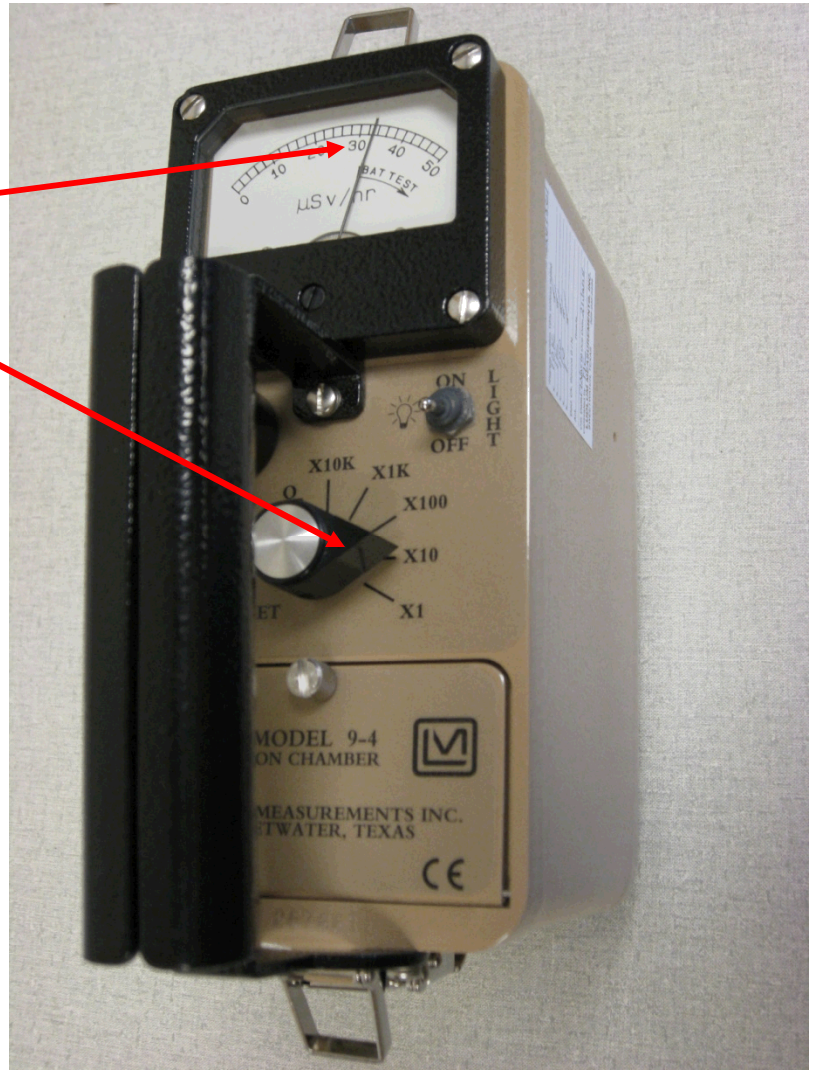
Turn unit "On"

Adjust Zero knob To get "0" indication

Interpreting the Meter Reading

Multiply the displayed dose rate x selector switch setting

For this case,
33 µSv/hr x 10 = 333 µSv/hr



Beta Slide

Opening the Beta Slide (Hold Unit in Upright Position)

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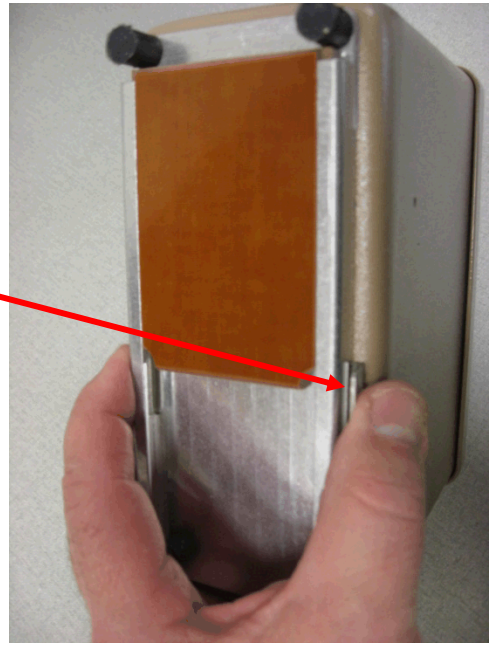
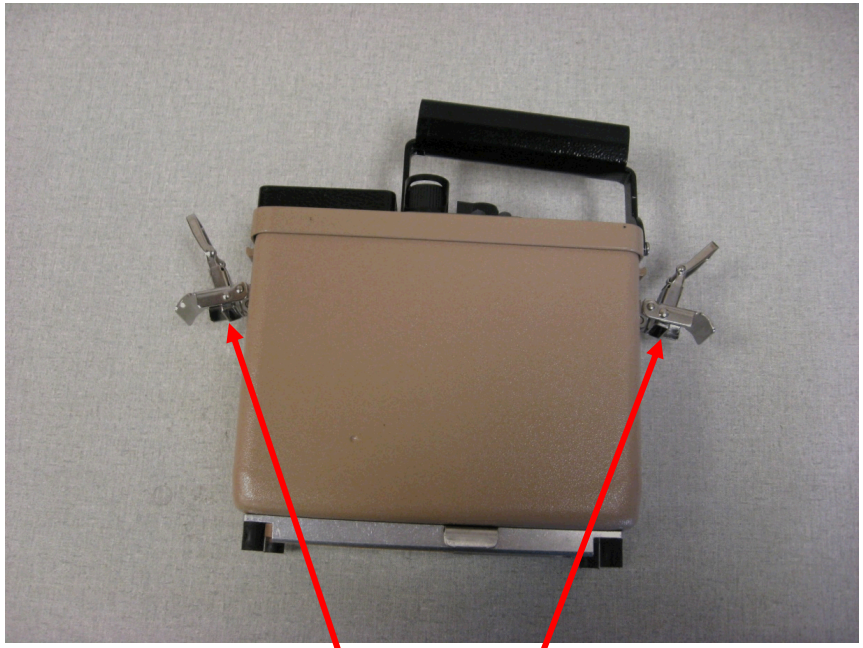
Press button



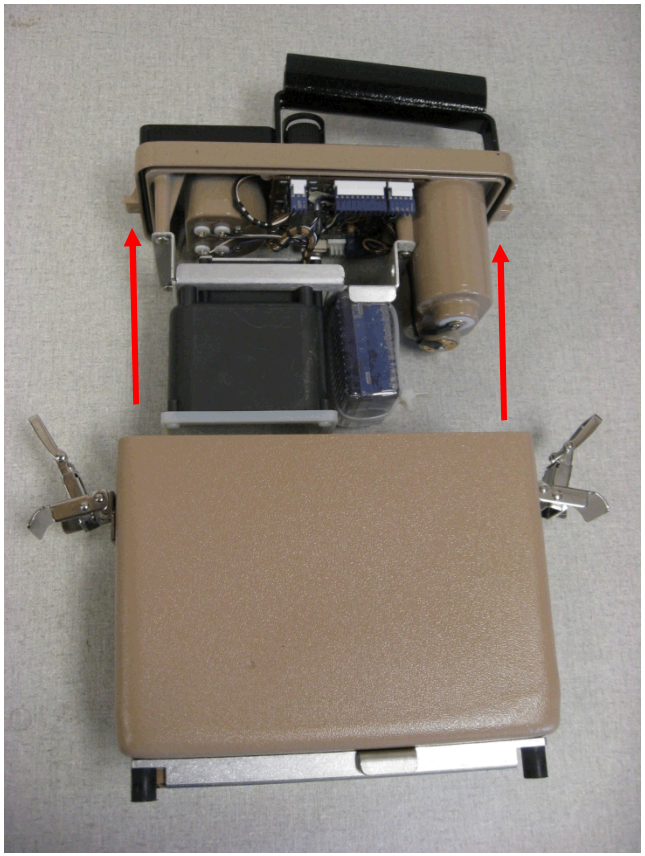
Shield should slide downward on its own.

Caution!
Do Not Puncture Mylar

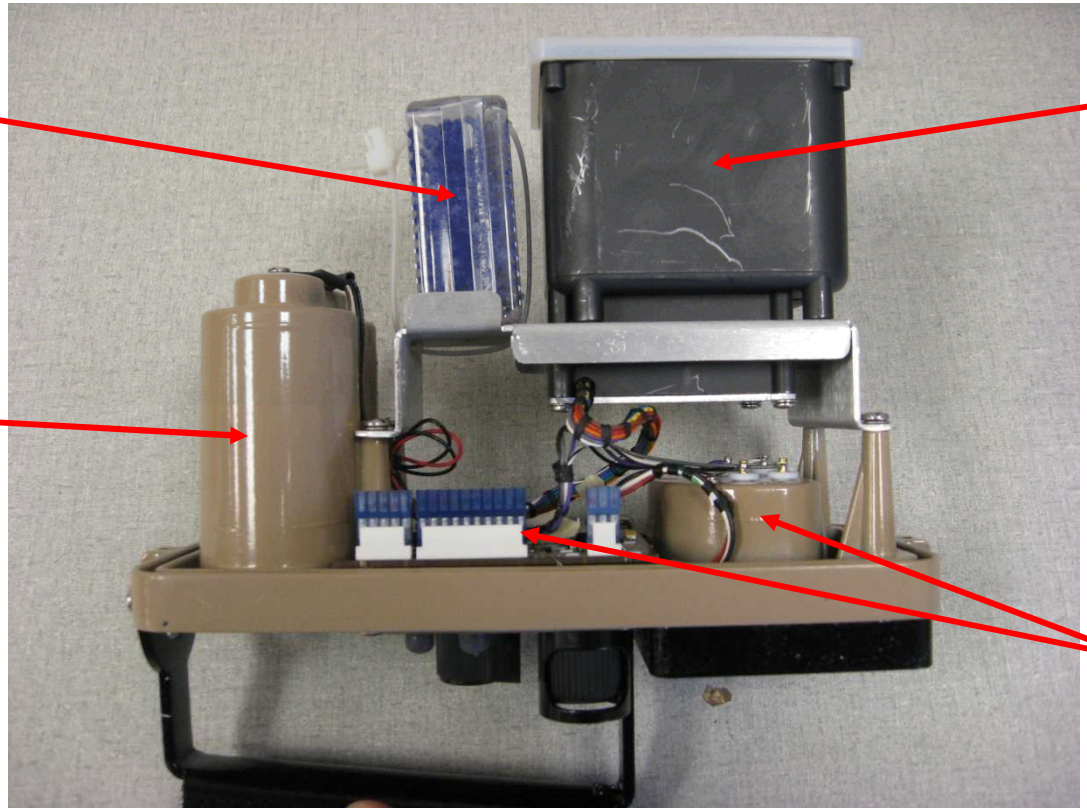
Opening the Case



Release latches



Internal Components



Summary

Appropriate Uses

- Photon measurements in the range of 2 μSv h^{-1} – 500 mSv h^{-1}
- Beta + Gamma measurements with Beta slide open

Inappropriate Uses

- Alpha measurements
- Beta + Gamma measurements with Beta slide closed
- Environmental level gamma and x-ray

Practical Exercise

- Place selector switch in any of the selector switch settings (i.e. x1, x10, … x10K).
- Press "BAT TEST" button and verify meter indication is within the "Bat TEST" range
  - Replace 2 X "D" batteries if test fails
- Adjust the zero knob until the meter indicates "0"
- Turn the selector switch fully clockwise to the "x1" position (0 – 50 μSv h^{-1} or 0.05 mSv h^{-1})

Practical Exercise (cont.)

- Conduct a background check (check response away from sources)
- Make measurements near the radioactive source
- Select the appropriate range during your measurements
- Open beta slide only for beta + gamma or low-energy photons (< 80 keV)

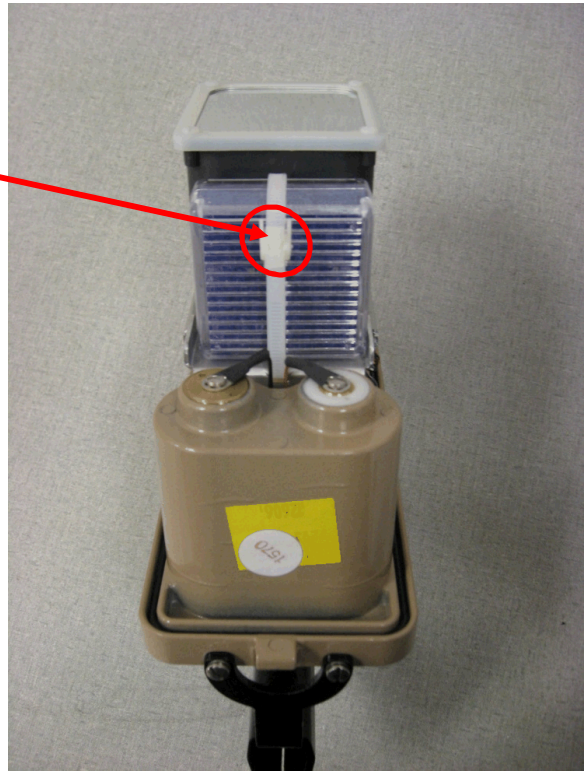
Ion Chamber Moisture Issues

Ion Chamber Moisture

- A desiccant dries the air that enters the ion chamber.
  - Blue desiccant is dry
  - Pink desiccant is mostly saturated
  - Clear/translucent desiccant is fully saturated
- Replace or regenerate desiccant
  - Every 6 – 12 months, or
  - When it becomes pink in color.
- If desiccant is allowed to become saturated:
  - The ion chamber may operate erratically due to transient currents.
  - Erratic behavior can be characterized by:
    - Negative or positive indication after zeroing meter (> 2 scale divisions)
    - Mostly affects stability of the two lowest ranges
      - 0 – 50 $\mu Sv\ h^{-1}$
      - 0 – 500 $\mu Sv\ h^{-1}$

Desiccant Regeneration

- Remove the desiccant box
  - The restraining strap may be loosened by pressing the center tab toward the strap.
- Place the entire box into an appropriate container
  - Metal dish for regular oven, or
  - Microwave-proof dish
- Heat the desiccant box:
  - 116º C (240º F) for 3 hours in an oven, or
  - Microwave on "High" setting for 20 seconds
- If water vapor is apparent:
  - Wipe off any excess water
  - Repeat the heating cycle until the box and desiccant both appear dry



Take precautions to prevent skin burns when removing a hot box from the oven!