

Portable Radiation Detection Equipment

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Introduction

Portable Radiation Detection Equipment can be used to detect, measure, and identify radiation. Thorough training, however, is essential in the proper use and selection of equipment.

Overview

Portable radiation detection equipment is used widely in the scrap industry to locate and separate unwanted radioactive scrap.

Portable detectors can have great sensitivity, but their sensitivity is highly dependant upon correct training. Too often, portable detectors are used ineffectively by inattentive or untrained people.

The Three Functions of Radiation Detectors

- Detecting or Locating
- Measuring
- Identifying

DETECTION

- The MOST important function
- Most detection instruments rely on operator watching a display
- digital display usually harder to read than meter
- Better detection instruments give the operator an audible signal when background is exceeded
- detection not enough--idiot lights make user uneasy how MUCH radiation is present

MEASUREMENT

- Measurement tells the extent of radiation
- Best display scale is microR/hr ($\mu\text{R/hr}$) or rem, cpm or cps doesn't tell you dose rate
- “True” dose rate meters will have less detection sensitivity than typical meter, typical meter overresponds at lower gamma energies

IDENTIFICATION

- After radiation is found, identification will identify the isotope involved
- typically expensive instruments, with advanced training or knowledge required
- identification typically takes minutes

Strengths and Weaknesses of Portable Detectors

■ Strengths

- distance: detector can be put next to scrap (inverse square law!)
- versatility: detector can be used anywhere
- usually low equipment cost

■ Weaknesses

- sensitivity highly dependant upon user
- labor intensive

Types of Radiation Detectors

- Choosing the correct type of radiation detector is very important. Different radiation detectors may have strengths or weaknesses in the following areas:
 - type of radiation detected
 - sensitivity
 - ruggedness
 - measurement linearity
 - spectral resolution

Geiger-Muller (GM)

- cheap and rugged detectors
- able to detect alpha, beta, and some gamma radiation
- not very sensitive to gamma radiation
- no spectral resolution; every pulse is the same height

Ion Chambers

- Extended range of measurement
- Can see beta and gamma radiation
- Good measurement device
- Pressurized types can have fair gamma sensitivity
- Generally more troublesome to use and maintain

Gas-Proportional

- good for alpha, beta, and neutron radiation
- pulse height is proportional to energy
- window of detector very fragile
- little gamma sensitivity

Solid-State

- small, compact detector
- excellent spectral resolution for isotope identification
- large size and sensitivity difficult and expensive to manufacture

Scintillator

- Excellent gamma sensitivity
- NaI (sodium iodide) crystal has good spectral resolution for isotope identification
- generally uses fragile and magnetically sensitive photomultiplier tube (PMT)
 - THE OVERALL CHOICE IN DETECTION OF GAMMA RADIATION

Components of a Typical Scintillator Detector

■ Detector

- scintillator
- photomultiplier tube
- voltage divider board

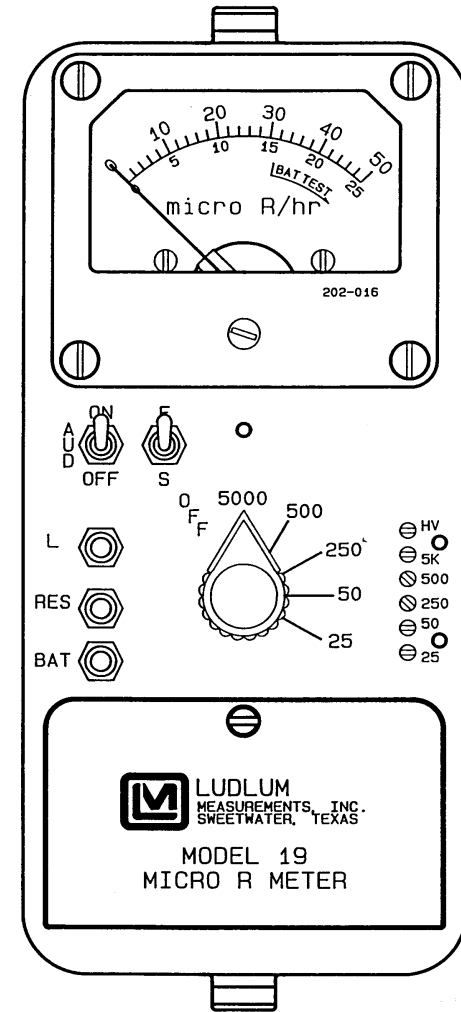
■ Electronics

- Amplifier
- High Voltage (HV) supply
- Display Driver (Meter or digital)
- microprocessor?

Inside a Typical Portable Detector



A Typical Survey Meter instrument



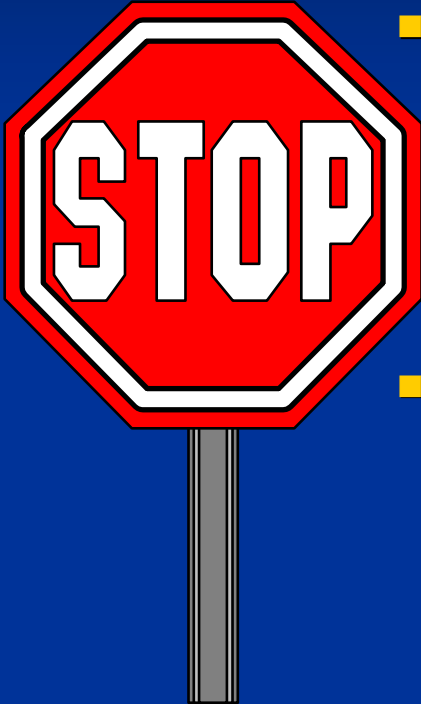
Maintenance on a Portable Detector

- cables receive lots of abuse-keep a spare cable handy
- meter can become damaged or “sticky” after a hard fall-should be able to check during battery test
- crystal (if NaI) or PMT can break-suspect anytime instrument goes “dead” or pegs the meter

How To Use a Typical Radiation Meter

- Make sure that:
 - Audio is ON
 - F/S (Fast/Slow) is on F (Fast)
- Turn instrument ON and check batteries
- If you have a radiation check source, use it to confirm correct operation
- Change range to lowest scale or correct scale to check background
- As you approach possible source, change range to higher scales as necessary
- Position bottom front of instrument as close as possible to source (check manual for most sensitive side)

When to Stop



- Be cautious measuring radiation above 1000 microR/hr (1 mR/hr). Measure, then limit your exposure by backing off.
- STOP measuring about 2000 microR/hr (2 mR/hr). Back off and call your RSO (Radiation Safety Officer) or state health department.

Summary

- most important function is Detection
- Scintillation detectors primarily used because of high gamma sensitivity
- training very important--sensitivity depends on the user
- the trend is towards smarter instruments that help the user to detect small changes in radiation level