



BWXT Y-12, L.L.C.
RADIOLOGICAL CONTROL ORGANIZATION
TECHNICAL BASIS DOCUMENT

**Y-12 National Security Complex
Radiological Control Organization
Instrument Users Guide**

March 28, 2001

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RADCON INSTRUMENT USERS GUIDE

This document contains information to assist the Radiological Control Technicians (RCT's) using instruments provided by the Y-12 National Security Complex RADCON Instrument Section. The Users Guide should be used to enhance compliance to requirements from 10 CFR 835.401: *"instruments used for monitoring should be appropriate for existing environmental conditions"*, and the DOE RADCON Manual Article 562.4: *"the effects of environmental conditions, including interfering radiation, on an instrument shall be known prior to use"*, for using instruments appropriate for environmental and interfering radiation conditions. Information in this guide has been obtained from vendor specifications, available performance test data, environmental and interfering radiation test data. The data for the environmental and interfering radiation test was generated by testing to ANSI N4217 specifications through an agreement with Oak Ridge National Laboratory (ORNL). Several instruments were not tested because of size or technical limitations. Data for the instruments not tested were obtained from vendor specifications or performance testing.

The following instruments are calibrated to RADCON instrumentation instructions that include the applicable information described in ANSI N323A. RCT's performing calibration shall be trained for each task or work directly under the supervision of the Subject Matter Expert (SME) for the specific instrument. Performance testing and operation of instruments shall be performed in a manner consistent with RADCON field operating instructions that comply with applicable ANSI N323A elements.

RCT's should use this guide to improve their knowledge of instrument performance and limitations. RCT's should know the environmental and interfering radiation conditions in their work areas. As users, only RCT's determine when, where and under what conditions surveys may be performed. Finally, RCT's should use examples given for interfering radiation as examples not inclusive of all generating devices of interfering radiation.

This document will provide information about instrument(s) with or without external detectors to perform the following types of monitoring:

- A. Contamination
- B. Dose Rate
- C. Air Sampling/Monitoring
- D. Personnel Monitoring
- E. Field or Laboratory Counting

The appendix for each instrument will also provide information for type of use for surveying and sensitivities.

The Y-12 National Security Complex utilizes instructions to provide consistent operation of calibrated equipment and training is documented through performance documentation checklists to ensure RCT knowledge.

The contamination survey instruments are calibrated for the primary concern of contamination at the Y-12 National Security Complex, which is uranium. Instruments may not be appropriate for special use or other types of contamination. If no information is given for special uses of instruments, the user shall check with the Instrumentation section.

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A. Contamination Instruments

1. Ludlum Model 12 Count Ratemeter with a Ludlum Model 43-65 Alpha Scintillator Detector

General Information

The Ludlum Model 12 is a portable, battery operated, count ratemeter. The Ludlum Model 12 has a scale of 0-500 cpm with four range multipliers; X1, X10, X100, and X1000. The Ludlum Model 43-65 is a square 50 cm² zinc sulfide scintillator detector with a 0.8 mg/cm² aluminized mylar window that detects alpha radiation. The primary use of the Ludlum Model 12 with a Ludlum Model 43-65 shall be to measure alpha surface contamination. The static detection limit is 200 dpm (100 cpm times 2) and the scanning detection limit is 1,000 dpm (250 cpm times 4) with a maximum background of 100 cpm. The correction factors are 2 for an area less than the size of the detector (~50 cm²) and 4 for an area larger than the size of the Detector.

Manufacturers Specifications

Operating temperature range should be -40°C to 50°C (-40°F to 122°F).

Limitations

The Ludlum Model 12 with a Ludlum Model 43-65 may be subject to erroneous readings and must pass a performance test if used under the following conditions:

Technical	Field Conditions
relative humidity > 95%	Hot, sticky environment such as during summer season or cold as in winter season
magnetic fields such as those produced by magnets, accelerators or generators	ex. Operating generators used for emergency power, or motors used in machine shop equipment
1 hour after being subjected to a temperature change of $\geq 10^{\circ}\text{C}$ (50°F)	from office to environment of freezing water, or cold to very hot environment

The Ludlum Model 12 with a Ludlum Model 43-65 shall not be used on the X1 range under the following conditions:

microwave fields such as those produced by microwave communications equipment	ex. Dish antenna
radio frequency fields such as those produced by RF heaters and high intensity transmitters	environment in close proximity to ceramic heaters, or radio transmitters
when the temperatures are $\leq 0^{\circ}\text{C}$ (32° F) or $\geq 40^{\circ}\text{C}$ (104° F)	environments of frozen water, or extreme heat as in a furnace room

Interfering Ionizing Radiation

The response of the Ludlum Model 12 with a Ludlum Model 43-65 was 2000 to 4000 cpm when exposed to the 1 rem/h ²⁵²Cf neutron field. The Ludlum Model 12 with a Ludlum Model 43-65 did not respond when exposed to the 11.7 rad/hr ¹³⁷Cs gamma field.

Performance Criteria

The Ludlum Model 12 with a Ludlum Model 43-65 shall be performance tested each day prior to use. The performance test shall follow ANSI N323A guidelines. The performance test will be completed with a ²³⁰Th check source. The performance test shall be performed and documented by trained RADCON personnel according to RADCON operating instruction Y75-56-FO-600INS: *Operation of Ludlum 12 Count Ratemeter w/43-65 or 43-5 Alpha Scintillator Probe.*

2. Ludlum Model 12 Count Ratemeter with a Ludlum Model 43-5 Alpha Scintillator Detector

General Information

The Ludlum Model 12 is a portable, battery operated, count ratemeter. The Ludlum Model 12 has a scale of 0-500 cpm with four range multipliers; X1, X10, X100 and X1000. The Ludlum Model 43-5 detects alpha radiation. The primary use of the Ludlum Model 12 with a Ludlum Model 43-5 shall be to measure alpha surface contamination. The static detection limit is 200 dpm (100 cpm times 2) and the scanning detection limit is 1,000 dpm (250 cpm times 4) with a maximum background of 100 cpm. The correction factors are 2 for an area less than the size of the detector (~50 cm²) and 4 for an area larger than the size of the detector.

Manufacturer Specifications

Operating temperature range should be -40°C to 50°C (-40°F to 122°F).

Limitations

The Ludlum Model 12 with a Ludlum Model 43-5 may be subject to erroneous readings and must pass a performance test if used under the following conditions:

Technical	Field Conditions
relative humidity < 40% or > 95%	Hot, sticky environment such as during summer season or cold as in winter season
magnetic fields such as those produced by magnets, accelerators or generators	ex. Operating generators used for emergency power, or motors used in machine shop equipment
1 hour after being subjected to a temperature change of $\geq 10^{\circ}\text{C}$ (50°F)	from office to environment of freezing water, or cold to very hot environment
when the temperatures are < 0°C (32° F)	environments of frozen water

The Ludlum Model 12 with a Ludlum Model 43-5 shall not be used on the X1 range under the following conditions:

radio frequency fields such as those produced by RF heaters and high intensity transmitters	environment in close proximity to ceramic heaters, or radio transmitters
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The Ludlum Model 12 with a Ludlum Model 43-5 shall not be used under the following conditions:

microwave fields such as those produced by microwave communications equipment	ex. Dish antenna
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Interfering Ionizing Radiation

The response of the Ludlum Model 12 with a Ludlum Model 43-5 was 2000 to 4000 cpm when exposed to the 1 rem/hr ²⁵²Cf neutron field. The Ludlum Model 12 with a Ludlum Model 43-5 did not respond when exposed to the 11.7 rad/hr ¹³⁷Cs gamma field.

Performance Criteria

The Ludlum Model 12 with a Ludlum Model 43-5 shall be performance tested each day prior to use. The performance test shall follow ANSI N323A guidelines. The performance test will be completed with a ²³⁰Th check source. The performance test shall be performed and documented by trained RADCON personnel according to RADCON operating instruction Y75-56-FO-600INS: *Operation of Ludlum 12 Count Ratemeter w/43-65 or 43-5 Alpha Scintillator Probe.*

3. Ludlum Model 3 Survey Meter with a Ludlum Model 44-9 Alpha-Beta-Gamma Detector

General Information

The Ludlum Model 3 is a portable, battery operated, survey meter. The Ludlum Model 3 has a scale of 0-5K cpm with four range multipliers; X0.1, X1, X10 and X100. The Ludlum Model 44-9 detects alpha-beta-gamma radiations using a pancake type halogen quenched G-M tube but has a plastic cover on the detector that creates an alpha shield. The primary use of the Ludlum Model 3 with a Ludlum Model 44-9 shall be to measure beta-gamma surface contamination. Direct survey contamination results of 100 cpm above background are approximately 3,000 dpm/100 cm² (100 cpm times correction factor of 30). Direct survey contamination results > 100 cpm above background are multiplied by the correction factor (ex. 170 cpm times 30 = 5100 dpm/100 cm²). Allow a maximum background of 300 cpm.

Manufacturer Specifications

Battery seal failure may occur at 100° F.

Limitations

The Ludlum Model 3 with a Ludlum Model 44-9 may be subject to erroneous readings and must pass a performance test if used under the following conditions:

Technical	Field Conditions
relative humidity < 40% or > 95%	hot, sticky environment such as during summer season or cold as in winter season
1 hour after being subjected to a temperature change of 10°C (50°F).	From office to environment of freezing water, or cold to very hot environment

The Ludlum Model 3 with a Ludlum Model 44-9 shall not be used on the X 0.1 scale under the following conditions:

when the temperatures are > 40°C (104°F)	Environments of extreme heat
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The Ludlum Model 3 with a Ludlum Model 44-9 shall not be used under the following conditions:

magnetic fields range such as those produced by magnets, accelerators or generators	ex. Operating generators used for emergency power, or motors used in machine shop equipment
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Performance Criteria

The Ludlum Model 3 with a Ludlum Model 44-9 shall be performance tested each day prior to use. The performance test shall follow ANSI N323A guidelines. The performance test will be completed with a ¹³⁷Cs check source. The performance test shall be performed and documented by trained RADCON personnel according to RADCON operating procedure Y75-56-FO-515INS: *Operation of Ludlum 3 Survey Meter with a 44-9 Alpha-Beta-Gamma Detector*.

4. Ludlum Model 2221 Scaler Ratemeter with a Ludlum Model 43-65 Alpha Scintillator Detector

General Information

The Ludlum Model 2221 is a portable battery operated scaler ratemeter. The Ludlum Model 2221 has a dual scale of 0-500 and 50-500K counts per minute with five range multipliers; X1, X10, X100, X1K and LOG. The Ludlum Model 43-65 is a square 50 cm² zinc sulfide scintillator detector with a 0.8 mg/cm² aluminized mylar window that detects alpha radiation. The Ludlum Model 2221 with a Ludlum Model 43-65 detector is the primary instrument used at the Y-12 National Security Complex to measure transuranic alpha surface contamination. The alpha scanning detection limit is 300 dpm/100 cm² at a distance of $\leq \frac{1}{4}$ inch and a rate of ≤ 1 inch per second. The static alpha detection limit is 125 dpm/100cm². Allow a maximum background of 3 cpm. The correction factors are 5 for a point source and 10 for a plane source.

Manufacturers Specifications

Operating temperature range should be -40°C to 50°C (-40°F to 122°F).
 Operating voltage of 500-1200 volts (set at calibration according to counts versus high voltage plateau).

Limitations

The Ludlum Model 2221 with a Ludlum Model 43-65 may be subject to erroneous readings and must pass a performance test if used under the following conditions:

Technical	Field Conditions
relative humidity > 95%	hot, sticky environment such as during summer season or cold as in winter season
1 hour after being subjected to a temperature change of 10°C (50°F).	From office to environment of freezing water, or cold to very hot environment

Performance Criteria

Perform surveys to document results from any areas of detectable contamination greater than background with portable survey instruments. The Ludlum Model 2221 with a Ludlum Model 43-65 shall be performance tested each day prior to use. The performance test shall follow ANSI N323A guidelines. The performance test will be completed with a ²³⁰Th check source. The performance test shall be performed and documented by trained RADCON personnel according to RADCON operating instruction Y75-56-FO-511INS: *Operation of the Ludlum Model 2221 with a Ludlum Model 43-65 Alpha Scintillator Probe for TRU Limit Surveys.*

5. Ludlum Model 2221 Scaler Ratemeter with a Ludlum Model 44-9 Alpha-Beta-Gamma Detector

General Information

The Ludlum Model 2221 is a portable battery operated scaler ratemeter. The Ludlum Model 2221 has a dual scale of 0-500 and 50-500K counts per minute with five range multipliers; X1, X10, X100, X1K and LOG. The Ludlum Model 44-9 using a pancake type halogen quenched G-M tube detects alpha and beta-gamma radiation. The Ludlum Model 2221 with a Ludlum Model 44-9 detector is the primary instrument used at the Y-12 National Security Complex to measure the presence of ^{14}C , ^{137}Cs , ^{99}Tc , and ^{90}SrY surface contamination. The beta scanning detection limit is 14,900 dpm/100 cm² for ^{14}C , 2,750 dpm/100 cm² for ^{137}Cs , 4,300 dpm/100 cm² for ^{99}Tc and 2,400 dpm/100 cm² for ^{90}SrY , at a distance of $\leq \frac{1}{4}$ inch and a rate of ≤ 1 inch per second. The static beta detection limit is 4,900 dpm/100 cm² for ^{14}C , 900 dpm/100 cm² for ^{137}Cs , 1,000 dpm/100 cm² for ^{99}Tc and 200 dpm/100 cm² for ^{90}SrY . The correction factors for a point source are 29 for ^{14}C , 6 for ^{137}Cs 7 for ^{99}Tc and 4 for ^{90}SrY . The correction factors for a plane source are 145 for 30 for ^{137}Cs , 35 for ^{99}Tc and 20 for ^{90}SrY . Allow a maximum background of 60 CPM for ^{137}Cs , ^{99}Tc , and ^{90}SrY and 45 CPM for ^{14}C .

Manufacturers Specifications

Operating temperature range should be -40°C to 65°C (-40°F to 150°F).
 Operating voltage of 900 volts (set at calibration).

Limitations

The Ludlum Model 2221 with a Ludlum Model 44-9 may be subject to erroneous readings and must pass a performance test if used under the following conditions. .

Technical	Field Conditions
relative humidity > 95%	hot, sticky environment such as during summer season or cold as in winter season
1 hour after being subjected to a temperature change of 10°C (50°F).	From office to environment of freezing water, or cold to very hot environment

The Ludlum Model 2221 with a Ludlum Model 44-9 shall not be used under the following conditions:

radio frequency fields such as those produced by radios, or RF generators	ex. Operating RF generators or radios.
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Performance Criteria

Perform surveys to document results from any areas of detectable contamination greater than background with portable survey instruments. The Ludlum Model 2221 with a Ludlum Model 44-9 shall be performance tested each day prior to use. The performance test shall follow ANSI N323A guidelines. The performance test will be completed with a ^{137}Cs check source. The performance test shall be performed and documented by trained RADCON personnel according to RADCON operating instruction Y75-56-FO-523INS: *Operation of a Ludlum Model 2221 with a Ludlum Model 44-9 Alpha-Beta-Gamma (GM) Probe for Technetium 99 or Strontium-Yttrium 90 Surveys.*

6. Ludlum Model 239-1F Floor Monitor

General Information

The Ludlum Model 239-1F Floor Monitor is comprised of a Ludlum Model 2221 and Ludlum Model 43-37 on a specially designed cart. The Ludlum Model 2221 is a portable battery operated scaler ratemeter. The Ludlum Model 43-37 is a large area (425 cm²) gas proportional probe that detects alpha and beta-gamma radiation. The Ludlum Model 2221 has a dual scale of 0-500 and 50-500K counts per minute with five range multipliers; X1, X10, X100, X1K and LOG. The primary use of Ludlum Model 239-1F is used as a floor monitor to determine the presence of surface radioactive contamination. The alpha scanning detection limit is <1,000 dpm/100 cm² (14 cpm alpha) and the beta scanning detection limit is <2,600 dpm/100 cm² (693 cpm beta/gamma). The calibrated efficiencies are approximately 15% for alpha and 27% for beta/gamma. Allow a maximum background of ≤ 2,000 CPM and survey at a scanning speed of 4 inches per second.

Manufacturers Specifications

Operating temperature range should be -40°C to 50°C (-40°F to 122°F).
 Operating voltage of 1000-1800 volts (set at calibration according to counts versus high voltage plateau).
 Cart mounted detector, instrument and bottle rack with a total weight of approximately 25 lbs.

Limitations

The Ludlum Model 239-1F may be subject to erroneous readings and must pass a performance test if used under the following conditions:

Technical	Field Conditions
detector must adjust to changes in relative humidity	Hot, sticky environment such as during summer season or cold as in winter season
1 hour after being subjected to a temperature change of ≥10°C (50°F) or when detector has stabilized	from office to environment of freezing water, or cold to very hot environment
quantify results in temperatures of ≥ 10° C (50° F) and ≤ 30° C (86° F)	environments of frozen water, or extreme heat as in a furnace room

The 239-1F shall not be used within the following conditions:

microwave fields such as those produced by microwave communications equipment	ex. Dish antenna
radio frequency fields such as those produced by RF heaters and high intensity transmitters	environment in close proximity to ceramic heaters, or radio transmitters

Interfering Ionizing Radiations

The response of the 239-1F was 3155 to 5032 counts per minute when exposed to the 1 mrem/hr neutron field.

Performance Criteria

Perform surveys to document results from any areas of detectable contamination greater than background with portable survey instruments. The 239-1F shall be performance tested each day prior to use. The performance test shall follow ANSI N323A guidelines. The performance test will be completed with a ²³⁰Th check source. The performance test shall be performed and documented by trained RADCON personnel according to RADCON operating instruction Y75-56-FO-503INS: *Operation of the Ludlum Model 2221 with a Ludlum Model 43-37-1 Gas Proportional Detector (Floor Monitor)*

7. Ludlum Model 2224/2224-1 Scaler Ratemeter with a Ludlum Model 43-89 100 cm² Alpha-Beta-Gamma Scintillator Detector

General Information

The Ludlum Model 2224/2224-1 is a portable battery operated dual channel (alpha-beta) scaler ratemeter. The Ludlum Model 2224/2224-1 has a scale of 0-500 counts per minute with four range multipliers; X1, X10, X100, X1000. The Ludlum Model 2224/2224-1 has a selector switch for alpha-beta, alpha only or beta only. The major difference between the Ludlum Model 2224 and the Ludlum Model 2224-1 is that the Ludlum Model 2224-1 has a user adjustable scaler count time selector switch. The Ludlum Model 2224 scaler count time must be set at calibration. The Ludlum Model 43-89 is a 100 cm² zinc sulfide coated PhoSwich scintillation detector with a 1.2 mg/cm² aluminized mylar window that detects alpha and beta-gamma radiations. The Ludlum Model 2224/2224-1 with a Ludlum Model 43-89 detector is the primary instrument used at the Y-12 National Security Complex to measure the presence of alpha and beta contaminants where a 100 cm² detector proves most efficient and costly. The alpha scanning detection limit is 100 dpm/100 cm² at a distance of $\leq \frac{1}{4}$ inch and a rate of ≤ 0.5 inch per second. The static alpha detection limit is 85 dpm/100cm². The beta scanning detection limit is 2,500 dpm/100 cm² at a distance of $\leq \frac{1}{4}$ inch and a rate of ≤ 0.5 inch per second. The static beta detection limit is 800 dpm/100cm². Allow a maximum of 3 cpm alpha and 300 cpm beta background.

Manufacturers Specifications

Operating temperature range should be -20°C to 50°C (-4°F to 122°F).
Operating voltage of 200-2000 volts (set at calibration according to counts versus high voltage plateau).

Limitations

The Ludlum Model 2224/2224-1 with a Ludlum Model 43-89 may be subject to erroneous readings and must pass a performance test if used under the following conditions.

Technical	Field Conditions
detector must adjust to changes in relative humidity	Hot, sticky environment such as during summer season or cold as in winter season
1 hour after being subjected to a temperature change of $\geq 10^{\circ}\text{C}$ (50°F) or when detector has stabilized	from office to environment of freezing water, or cold to very hot environment
quantify results in temperatures of $\geq 10^{\circ}\text{C}$ (50° F) and $\leq 30^{\circ}\text{C}$ (86° F)	environments of frozen water, or extreme heat as in a furnace room

The Ludlum Model 2224/2224-1 with a Ludlum Model 43-89 shall not be used within the following conditions:

microwave fields such as those produced by microwave communications equipment	ex. Dish antenna
radio frequency fields such as those produced by RF heaters and high intensity transmitters	environment in close proximity to ceramic heaters, or radio transmitters
magnetic fields such as those produced by large generators or magnets	areas near large generators or magnets such as 9204-3

7. **Ludlum Model 2224/2224-1 Scaler Ratemeter with a Ludlum Model 43-89 100 cm² Alpha-Beta-Gamma Scintillator Detector (cont.)**

Interfering Ionizing Radiations

The interfering ionizing radiation test was an exposure to a 7 mrem/hr ²⁵²Cf neutron field. The response of the Ludlum Model 2224/2224-1 with a Model 43-89 scintillator detector was 20 to 50 counts per minute alpha, 15000 to 18000 counts per minute alpha + beta, and 14000 to 19000 counts per minute beta when exposed to the 7 mrem/hr neutron field.

Performance Criteria

Perform surveys to document results from any areas of detectable contamination greater than background with portable survey instruments. The Ludlum Model 2224/2224-1 with a Ludlum Model 43-89 shall be performance tested each day prior to use. The performance test shall follow ANSI N323A guidelines. The performance test will be completed with a ²³⁰Th and ¹³⁷Cs check sources. The performance test shall be performed and documented by trained RADCON personnel according to RADCON operating instruction Y75-56-FO-531INS: *Operation of the Ludlum Model 2224 or 2224-1 with a Ludlum Model 43-89 Alpha/Beta Detector.*

8. Ludlum Model 2224/2224-1 Scaler Ratemeter with a Ludlum Model 43-2-2 Alpha-Beta-Gamma Scintillator Detector

General Information

The Ludlum Model 2224/2224-1 is a portable battery operated dual channel (alpha-beta) scaler ratemeter. The Ludlum Model 2224/2224-1 has a scale of 0-500 counts per minute with four range multipliers; X1, X10, X100, X1000. The Ludlum Model 2224/2224-1 has a selector switch for alpha-beta, alpha only or beta only. The major difference between the Ludlum Model 2224 and the Ludlum Model 2224-1 is that the Ludlum Model 2224-1 has a user adjustable scaler count time selector switch. The Ludlum Model 2224 scaler count time must be set at calibration. The Ludlum Model 43-2-2 is a 12 cm² zinc sulfide coated PhoSwich scintillation detector with a 0.8 mg/cm² or 1.2 mg/cm² aluminized mylar window that detects alpha and beta-gamma radiations. The Ludlum Model 2224/2224-1 with a Ludlum Model 43-2-2 detector is the primary instrument used at the Y-12 National Security Complex to measure the presence of alpha and beta contamination in drums or where a small detector may be used on an extended cable. The alpha scanning detection limit is 1000 dpm/100 cm² at a distance of $\leq \frac{1}{4}$ inch and a rate of ≤ 0.5 inch per second. The static alpha detection limit is 430 dpm/100cm². The beta scanning detection limit is 4000 dpm/100 cm² at a distance of $\leq \frac{1}{4}$ inch and a rate of ≤ 0.5 inch per second. The static beta detection limit is 1300 dpm/100cm². Allow a maximum of 3 cpm alpha and 50 cpm beta background.

Manufacturers Specifications

Operating temperature range should be -20°C to 50°C (-4°F to 122°F).
 Operating voltage of 200-2000 volts (set at calibration according to counts versus high voltage plateau).

Limitations

The Ludlum Model 2224/2224-1 with a Ludlum Model 43-2-2 may be subject to erroneous readings and must pass a performance test if used under the following conditions.

Technical	Field Conditions
relative humidity > 95%	Hot, sticky environment such as during summer season or cold as in winter season
1 hour after being subjected to a temperature change of $\geq 10^\circ\text{C}$ (50°F) or when detector has stabilized	from office to environment of freezing water, or cold to very hot environment

The Ludlum Model 2224/2224-1 with a Ludlum Model 43-2-2 should not be used within the following conditions:

microwave fields such as those produced by microwave communications equipment	ex. Dish antenna
radio frequency fields such as those produced by RF heaters and high intensity transmitters	environment in close proximity to ceramic heaters, or radio transmitters
magnetic fields such as those produced by large generators or magnets	areas near large generators or magnets such as 9204-3

8. Ludlum Model 2224/2224-1 Scaler Ratemeter with a Ludlum Model 43-2-2 Alpha-Beta-Gamma Scintillator Detector (cont.)

Interfering Ionizing Radiations

The interfering ionizing radiation test was an exposure to a 7 mrem/hr ^{252}Cf neutron field. The response of the Ludlum Model 2224/2224-1 with a Model 43-2-2 scintillator detector was 0 to 10 counts per minute alpha, 2900 to 3000 counts per minute alpha + beta, and 2800 to 2900 counts per minute beta when exposed to the 7 mrem/hr neutron field.

Performance Criteria

Perform surveys to document results from any areas of detectable contamination greater than background with portable survey instruments. The Ludlum Model 2224/2224-1 with a Ludlum Model 43-2-2 shall be performance tested each day prior to use. The performance test shall follow ANSI N323A guidelines. The performance test will be completed with a ^{230}Th and ^{137}Cs check sources. The performance test shall be performed and documented by trained RADCON personnel according to RADCON operating instruction Y75-56-FO-509INS: *Operation of the Ludlum Model 2224/2224-1 with a Ludlum Model 43-2-2 Alpha/Beta Detector.*

9. N.E. Technology Model Electra Scaler Ratemeter with a N.E. Technology Model DP6 100 cm² Alpha-Beta-Gamma Scintillator Detector

General Information

The N.E. Technology Model Electra is a portable battery operated dual channel (alpha-beta) scaler ratemeter. The N.E. Technology Model Electra has an autoranging digital readout in 1 count per minute to 1000 kilocounts per minute. The N.E. Technology Model Electra has a pushbutton for alpha-beta, alpha only or beta only. The N.E. Technology Model DP6 is 100 cm² with a 1.2 mg/cm² aluminized mylar window and detects alpha and beta-gamma radiations. The N.E. Technology Model Electra with a N.E. Technology Model DP6 detector is the primary instrument used at the Y-12 National Security Complex to measure the presence of alpha and beta contamination in inert atmospheres. The alpha scanning detection limit is 100 dpm/100 cm² at a distance of ≤ ¼ inch and a rate of ≤ 0.5 inch per second. The static alpha detection limit is <100 dpm/100cm². The beta scanning detection limit is 1000 dpm/100 cm² at a distance of ≤ ¼ inch and a rate of ≤ 0.5 inch per second. The static beta detection limit is <1000 dpm/100cm². Maximum allowable background is listed on the side of each instrument.

Manufacturers Specifications

Operating voltage of 400-1400 volts (set at calibration according to counts versus high voltage plateau).

Limitations

The N.E. Technology Model Electra with a N.E. Technology Model DP6 may be subject to erroneous readings and must pass a performance test if used under the following conditions.

Technical	Field Conditions
relative humidity > 95%	Hot, sticky environment such as during summer season or cold as in winter season
1 hour after being subjected to a temperature change of ≥10°C (50°F) or when detector has stabilized	from office to environment of freezing water, or cold to very hot environment

The N.E. Technology Model Electra with a N.E. Technology Model DP6 shall not be used within the following conditions:

microwave fields such as those produced by microwave communications equipment	ex. Dish antenna
radio frequency fields such as those produced by RF heaters and high intensity transmitters	environment in close proximity to ceramic heaters, or radio transmitters

Interfering Ionizing Radiations

The interfering ionizing radiation test was an exposure to a 11 mrem/hr ²⁵²Cf neutron field. The response of the N.E. Technology Model Electra with a N.E. Technology Model DP6A scintillator detector was 59 kcpm to 104 kcpm alpha, when operated in the beta-gamma mode, readings were off-scale high. The response of the N.E. Technology Model Electra with a N.E. Technology Model DP6 scintillator detector was 22 to 52 cpm alpha when exposed to the 1 R/hr ¹³⁷Cs gamma field.

Performance Criteria

Perform surveys to document results from any areas of detectable contamination greater than background with portable survey instruments. The N.E. Technology Model Electra with a N.E. Technology Model DP6 shall be performance tested each day prior to use. The performance test shall follow ANSI N323A guidelines. The performance test will be completed with a ²³⁰Th and ¹³⁷Cs check sources. The performance test shall be performed and documented by trained RADCON personnel according to RADCON operating instruction Y75-56-FO-524INS: *Operation of an N. E. Electra with a Dual Scintillator Alpha-Beta Detector.*

10. Ludlum Model 3 Survey meter with a Ludlum Model 44-10 Sodium Iodide (NaI) Gamma Scintillator Detector

General Information

The Ludlum Model 3 is a portable battery operated survey meter. The Ludlum Model 3 has a scale of 0-5000 counts per minute with four range multipliers; X0.1, X1, X10 and X100. The Ludlum Model 44-10 is an approximately 20 cm² NaI detector. The Ludlum Model 3 with a Ludlum Model 44-10 detector is the primary instrument used at the Y-12 National Security Complex to detect gamma contamination. The scanning detection limit is 1 μ Ci. This unit is not used to measure contamination.

Manufacturers Specifications

Battery seal failure may occur at 100° F.

Limitations

The Ludlum Model 3 with a Ludlum Model 44-10 should only be used within the ranges of the manufacturers environmental conditions. If operation of the Ludlum Model 3 with an Ludlum Model 44-10 outside the ranges of the following conditions is necessary, a performance test should be passed before use. To satisfy a performance test in an environment outside the following conditions, ensures the instrument is operating properly.

Performance Criteria

The Ludlum Model 3 with a Ludlum Model 44-10 shall be performance tested each day prior to use. The performance test shall follow ANSI N323A guidelines. The performance test will be completed with a ¹³⁷Cs check source. The performance test shall be performed and documented by trained RADCON personnel according to RADCON operating instruction Y75-56-FO-534INS; *Operation of a Ludlum Model 3 with a Ludlum Model 44-10 Sodium Iodide (NaI) Gamma Detector.*

B. Dose Rate Instruments

1. Eberline Model RO-2 Ion Chamber

General Information

The Eberline Model RO-2 is a portable battery operated air ion chamber instrument. The Eberline Model RO-2 detects beta, gamma, and x-ray radiations on four linear ranges of 0-5, 0-50, 0-500, and 0-5000 mR/h. The Eberline Model RO-2 is the primary instrument used at the Y-12 National Security Complex to measure Beta/Gamma/X-ray dose rates. The Eberline Model RO-2 is also the primary instrument used at the Y-12 National Security Complex to detect the presence of pulsed x-rays but shall not be used to quantify pulses. The lowest reliable dose rate reading is 0.1 mRem/hr. The detectable beta dose rate limit is 0.1 times the Beta Response Factor (approximately 3.5) and the detectable beta/gamma dose rate limit is times the Beta Response Factor plus 0.1 gamma. The bottom of the case has a 400 mg/cm² sliding phenolic beta shield covering the mylar window of the detector that is opened to detect beta.

Manufacturers Specifications

Operating temperature range should be -40°C to 60°C (-40°F to 140°F). Eberline also states the Model RO-2 photon energy response of nominal ±15% from 12 keV to greater than 1.3 MeV. Also, Eberline states a RO-2 fast neutron response reads approximately 10% in mR/h of a true neutron field in mrem/h. Over response to photon energies > 2 MeV may vary by 50%.

Limitations

The Eberline Model RO-2 may be subject to erroneous readings and must pass a performance test if used under the following conditions.

Technical	Field Conditions
1 hour after being subjected to a temperature change of ≥10°C (50°F) or when detector has stabilized	from office to environment of freezing water, or cold to very hot environment

Interfering Ionizing Radiation

The response of the Eberline Model RO-2 was 8% of the 1 rem/hr Pu-Be neutron field.

Performance Criteria

Eberline Model RO-2s used at the Y-12 National Security Complex are calibrated to ¹³⁷Cs by the RASCAL facility, Health Physics, Oak Ridge National Lab. Eberline Model RO-2s used at the Y-12 National Security Complex have a beta response factor determined and labeled on each instrument at the time of calibration.

Eberline Model RO-2s shall be performance tested each day prior to use. The performance test shall follow ANSI N323A guidelines. The performance test will be completed with a ⁹⁰SrY source testing each range with the beta shield open. A range has been calculated for each of four test points coinciding with the four ranges on the Eberline Model RO-2. The performance test shall be performed and documented by trained RADCON personnel according to RADCON operating instruction Y75-56-FO-506INS; *Performance Test and Operation of an Eberline Model RO-2 Ion Chamber*.

2. Eberline Model RO-20 Ion Chamber

General Information

The Eberline Model RO-20 is a portable battery operated air ion chamber instrument. The Eberline Model RO-20 detects beta, gamma, and x-ray radiations on five linear ranges of 0-5, 0-50, 0-500 mR/hr and 0-5, 0-50 R/h. The Eberline Model RO-20 is the primary instrument used at the Y-12 National Security Complex to measure Beta/Gamma/X-ray dose rates from emitters with energies of > 2 MeV. The lowest reliable dose rate reading is 0.1 mRem/hr. The detectable beta dose rate limit is 0.1 times the Beta Response Factor (approximately 3.5) and the detectable beta/gamma dose rate limit is times the Beta Response Factor plus 0.1 gamma. The bottom of the case has a 1,000 mg/cm² sliding phenolic beta shield covering the mylar window of the detector that is opened to detect beta.

Manufacturers Specifications

Operating temperature range should be -40°C to 60°C (-40°F to 140°F). Eberline states the Model RO-20 should be used with alkaline or Nicad batteries in temperatures < 0°F. Over response to photon energies > 2 MeV may vary by 30%.

Limitations

The Eberline Model RO-20 may be subject to erroneous readings and must pass a performance test if used under the following conditions.

Technical	Field Conditions
1 hour after being subjected to a temperature change of $\geq 10^{\circ}\text{C}$ (50°F) or when detector has stabilized	from office to environment of freezing water, or cold to very hot environment

Interfering Ionizing Radiation

The response of the Eberline Model RO-20 was 8% of the 1 rem/hr Pu-Be neutron field.

Performance Criteria

Eberline Model RO-20s used at the Y-12 National Security Complex are calibrated to ¹³⁷Cs by the RASCAL facility, Oak Ridge National Lab. Eberline Model RO-20s used at the Y-12 Complex have a beta response factor determined and labeled on each instrument at the time of calibration.

Eberline Model RO-20s shall be performance tested each day prior to use. The performance test shall follow ANSI N323A guidelines. The performance test will be completed with a ⁹⁰SrY source testing each range with the beta shield open. A range has been calculated for each of five test points coinciding with the five ranges on the Eberline Model RO-20. The performance test shall be performed and documented by trained RADCON personnel according to RADCON operating instruction Y75-56-FO-506INS; *Performance Test and Operation of an Eberline Model RO-2 Ion Chamber*.

3. Bicron Model Micro Rem Tissue Equivalent Survey Meter

General Information

The Bicron Model Micro Rem is a portable battery operated tissue equivalent organic scintillator instrument. The Bicron Model Micro Rem detects low gamma, and x-ray radiations on five linear ranges of 0-20, 0-200, 0-2000, 0-20,000 and 0-200,000 mrem/h. The Bicron Model Micro Rem instrument is the primary instrument used at the Y-12 National Security Complex to measure low level Gamma/X-ray dose rates. The Bicron Model Micro Rem detects low gamma, and x-ray radiations from 17 keV to 1.3 Mev.

Manufacturers Specifications

Operating temperature range should be -20°C to 50°C (-4°F to 122°F).
 Bicron states a 5% change in readings from 10 - 95% relative humidity (RH). Response times stated are < 15 seconds for X0.1 and X1, < 5 seconds for X10, and < 2 seconds for X100 and X1000 ranges.

Limitations

The Bicron Model Micro Rem may be subject to erroneous readings and must pass a performance test if used under the following conditions.

Technical	Field Conditions
relative humidity > 95%	Hot, sticky environment such as during summer season or cold as in winter season
1 hour after being subjected to a temperature change of $\geq 10^{\circ}\text{C}$ (50°F) or when detector has stabilized	from office to environment of freezing water, or cold to very hot environment

The Bicron Model Micro Rem shall not be used within the following conditions:

microwave fields such as those produced by microwave communications equipment	ex. Dish antenna
radio frequency fields such as those produced by RF heaters and high intensity transmitters	environment in close proximity to ceramic heaters, or radio transmitters

Interfering Ionizing Radiation

The response of the Bicron Model Micro Rem was 4% to 4.5% of the 1 rem/hr Pu-Be neutron field.

Performance Criteria

Bicron Model Micro Rem shall be performance tested each day prior to use. The performance test shall follow ANSI N323 guidelines. A performance test range will be calculated for the Bicron Model Micro Rem when it is returned from RASCAL using a ^{137}Cs source. The performance test shall be performed and documented by trained RADCON personnel according to RADCON operating instructions Y75-56-FO-532INS; *Performance Test and Operation of the Bicron Model Micro Rem Tissue Equivalent Survey Meter*.

4. Ludlum Model 12-4 Count Ratemeter Neutron Counter

General Information

The Ludlum Model 12-4 is a portable battery operated neutron dose rate instrument. The Ludlum Model 12-4 detects neutron radiations on a scale of 0-10 mrem/h or 0-500 counts per minute with four range multipliers; X1, X10, X100, and X1000. The 12-4 utilizes a Ludlum Model 42-31 boron trifluoride (Bf³) proportional detector surrounded by a polyethylene sphere moderator. The Ludlum Model 12-4 is the primary instrument used at the Y-12 National Security Complex to measure neutron dose rates. The Minimum Detectable Activity (MDA) of the Ludlum Model 12-4 is 0.2 mrem/hr. Ludlum Model 12-4 instruments equipped with a scalar option will have a cpm meter face and a specific MDA for that instrument.

Manufacturers Specifications

Ludlum states battery seal may fail at 100°F.

Limitations

The Ludlum Model 12-4 may be subject to erroneous readings and must pass a performance test if used under the following conditions.

Technical	Field Conditions
relative humidity > 95%	Hot, sticky environment such as during summer season or cold as in winter season
1 hour after being subjected to a temperature change of $\geq 10^{\circ}\text{C}$ (50°F) or when detector has stabilized	from office to environment of freezing water, or cold to very hot environment
when temperatures are $< 0^{\circ}\text{C}$ (32°F).	Icy, freezing environment

Performance Criteria

Ludlum Model 12-4 shall be performance tested each day prior to use. The performance test shall follow ANSI N323 guidelines. The performance test will be completed with a AmBe source testing one range. A range has been calculated for the test point coinciding with the range on the Ludlum Model 12-4. The performance test shall be performed and documented by trained RADCON personnel according to RADCON operating instruction 75-56-FO-522INS; *Operation of the Ludlum Model 12-4 Count Ratemeter Neutron Counter (Rem Ball)*.

5. Automess Model 6112B Teletector

General Information

The Automess Model 6112B is a portable battery operated telescopic dual Geiger Mueller (GM) tube instrument. The Automess Model 6112B detects beta, gamma, and x-ray radiations on five linear ranges of 2 mR/h, 50 mR/h, 2 R/h, 50 R/h, and 1000 R/h. The Automess Model 6112B is used at the Y-12 National Security Complex to detect high range gamma/x-ray dose rates. The Automess Model 6112B is used for indication purposes only.

Manufacturers Specifications

Operating temperature range should be -30° C to 50° C.

Class 1.5 vibration and shock resistant.

Response of ±15% for energy from 80 keV to 200 keV; response of ±10% for energy from .2 MeV to 2 MeV.

Limitations

The Automess Model 6112B may be subject to erroneous readings and must pass a performance test if used under the following conditions.

Technical	Field Conditions
relative humidity > 95%	Hot, sticky environment such as during summer season or cold as in winter season
1 hour after being subjected to a temperature change of $\geq 10^{\circ}\text{C}$ (50°F) or when detector has stabilized	from office to environment of freezing water, or cold to very hot environment
temperatures < 0° C (32° F)	icy, freezing environment

Interfering Ionizing Radiation

The response of the Automess Model 6112B was 50 mR/hr when exposed to the 1 Rem/hr Pu-Be neutron field.

Performance Criteria

Automess Model 6112Bs shall be performance tested each day prior to use. The performance test shall follow ANSI N323 guidelines. The performance test will be completed with a ⁶⁰Co source testing the 2R/h and 50 mR/h ranges. An acceptance range has been calculated for each test point coinciding with the ranges on the Automess Model 6112B. The performance test shall be performed and documented by trained RADCON personnel according to RADCON operating instructions Y75-56-IN-561INS; *Performance Testing an Automess Model 6112-B Teletector* and Y75-56-FO-519INS; *Operation of Automess Model 6112-B Teletector*.

6. Bicron Model Radiographer Dose Rate Meter

General Information

The Bicron Model Radiographer is a portable battery operated internal Geiger Mueller tube instrument. The Bicron Model Radiographer detects gamma, and x-ray radiations on three linear ranges of 0-10, 0-100, and 0-1,000, mR/h. The Bicron Model Radiographer is the primary instrument used at the Y-12 National Security Complex to detect and measure gamma/x-ray dose rates at assembly stations. The Bicron Model Radiographer is used for indication purposes only. The Bicron Model Radiographer is used to measure and detect photon/x-rays from 40 keV to 1.2 MeV.

Manufacturers Specifications

Operating temperature range should be -40°C to 60°C (-40°F to 140°F).

Bicron states a 5% change in readings from 10 - 95% relative humidity (RH).

Response times stated are < 5 seconds for 10 mR/h, < 2 seconds for 100 mR/h, and < 1 second for 1 R/h ranges.

Shock resistant to 100g per lightweight machine of MIL-STD 202C, method 202B.

Vibration resistant to 5g in each of three mutually orthogonal axes at one or more frequencies from 10-33Hz.

Limitations

The Bicron Model Micro Rem shall not be used within the following conditions:

radio frequency fields such as those produced by RF heaters and high intensity transmitters	environment in close proximity to ceramic heaters, or radio transmitters
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Interfering Ionizing Radiation

The response of the Bicron Model Radiographer was 60 mR/hr when exposed to the 1 rem/hr Pu-Be neutron field.

Performance Criteria

The Bicron Model Radiographer is used as an emergency instrument at the Y-12 National Security Complex assembly stations. Bicron Model Radiographers shall be performance tested each day prior to use. The performance test shall follow Y-12 Complex emergency procedures Y40-100; Management of a Nuclear Criticality Accident (11/01/2000) - Effective Date 11/01/2000, Appendix B.1.D-E.

7. Keithley Model 36100 Survey Meter

General Information

The Keithley Model 36100 Survey Meter is a portable battery operated air ion chamber instrument. The Keithley Model 36100 is the primary instrument used in the Y-12 National Security Complex by radiographers to check for the presence of a radiation field. The Keithley Model 36100 may only be used to detect photon/x-ray radiation with energies from 7.5 keV to 2 MeV.

Manufacturers Specifications

Operating temperature range should be 0°C to 50°C (32°F to 122°F).
Moisture resistance is provided by gaskets, seals, and replaceable desiccant cartridges.

Limitations

The Keithley Model 36100 may be subject to erroneous readings and must pass a performance test if used under the following conditions.

Technical	Field Conditions
relative humidity > 95%	Hot, sticky environment such as during summer season or cold as in winter season
1 hour after being subjected to a temperature change of $\geq 10^{\circ}\text{C}$ (50°F) or when detector has stabilized	from office to environment of freezing water, or cold to very hot environment

The Keithley Model 36100 shall not be used within the following conditions:

magnetic fields range such as those produced by magnets, accelerators or generators	ex. Operating generators used for emergency power, or motors used in machine shop equipment
radio frequency fields such as those produced by RF heaters and high intensity transmitters	environment in close proximity to ceramic heaters, or radio transmitters

Performance Criteria

The Keithley Model 36100 is not used to perform quantifying radiological measurements but to detect the presence of photon/x-ray radiations.

8. Xetex Model Telescan Teletector

General Information

The Xetex Model Telescan Teletector is a portable battery operated telescopic dual Geiger Mueller (GM) tube instrument. The Xetex Model Telescan Teletector detects beta, gamma, and x-ray radiations on seven linear ranges of X0.1, X1, X10, X100 mR/h; and X1, X10, X100 R/hr. The Xetex Model Telescan Teletector is used at the Y-12 National Security Complex to detect high range gamma/x-ray dose rates. The Xetex Model Telescan Teletector is used for indication purposes only.

Manufacturers Specifications

Operating temperature range should be -10°C to 50°C .
Extendable from 3.6 to 14 feet. Weighs 6.5 lbs.

Limitations

The Xetex Model Telescan may be subject to erroneous readings and must pass a performance test if used under the following conditions.

Technical	Field Conditions
1 hour after being subjected to a temperature change of $\geq 10^{\circ}\text{C}$ (50°F) or when detector has stabilized	from office to environment of freezing water, or cold to very hot environment

Performance Criteria

Xetex Model Telescan Teletectors shall be performance tested each day prior to use. The performance test shall follow ANSI N323 guidelines. The performance test will be completed with a ^{60}Co source testing the 1R/h and X10 mR/h ranges. An acceptance range has been calculated for each test point coinciding with the ranges on the Xetex Model Telescan Teletector. The performance test shall be performed and documented by trained RADCON personnel according to RADCON operating instructions Y75-56-IN-566INS; *Performance Testing of Xetex Telescan*.

9. Ludlum Model 12 Count Ratemeter with a Ludlum Model 15 Neutron Detector

General Information

The Ludlum Model 12 is a portable, battery operated, count ratemeter with an optional digital scaler. The Ludlum Model 12 has a scale of 0-500 cpm with four range multipliers; X1, X10, X100, and X1000. The Ludlum Model 15 is a boron trifluoride BF³ proportional detector with a 3" diameter cadmium lined moderator that detects neutron radiation. The Ludlum Model 12 Count Ratemeter with a Ludlum Model 15 Neutron Detector is the primary instrument used at the Y-12 National Security Complex to detect neutron radiation above 0.1 mrem/hr. The scanning detection limit is 0.1mrem/hr which is equivalent to ≥ 2 cpm. Detected levels above this limit will require a measurement with a rem equivalent neutron instrument such as the Ludlum Model 12-4.

Manufacturers Specifications

Operating temperature range should be -40°C to 50°C (-40°F to 122°F).

Limitations

The Ludlum Model 12 Count Ratemeter with a Ludlum Model 15 Neutron Detector should only be used within the ranges of the manufacturers environmental conditions. If operation of the Ludlum Model 12 Count Ratemeter with a Ludlum Model 15 Neutron Detector outside the ranges of the following conditions is necessary, a performance test should be passed before use. To satisfy a performance test in an environment outside the following conditions, ensures the instrument is operating properly.

Interfering Ionizing Radiations

There was no ratemeter response to a ¹³⁷Cs 10 R/hr gamma field. The digital readout response was 3-5 cpm for a 10 minute count.

Performance Criteria

The Ludlum Model 12 Count Ratemeter with a Ludlum Model 15 Neutron Detector shall be performance tested each day prior to use. The performance test shall follow ANSI N323A guidelines. The performance test shall be performed and documented by trained RADCON personnel according to RADCON operating instruction Y75-56-IN-537INS: *Performance Test of the Ludlum Model 12-4 Count Ratemeter Neutron Counter (Rem Ball) and the Ludlum Model 12-15 Count Ratemeter Neutron Counter* and Y75-56-FO-522INS; *Operation of the Ludlum Model 12-4 Count Ratemeter Neutron Counter (Rem Ball)*.

10. Ludlum Model 375 Digital Area Monitor with a Ludlum Model 42-30 Wall Mount Neutron Detector

General Information

The Ludlum Model 375 Digital Area Monitor with a Ludlum Model 42-30 Neutron Detector is a digital AC/DC operated area monitor. The Ludlum Model 375 Digital Area Monitor with a Ludlum Model 42-30 Neutron Detector detects neutron radiations with a display range of 0 to 9999 mR/hr. The Model 42-30 Neutron detector is a boron trifluoride BF³ proportional detector surrounded by a polyethylene sphere moderator. The Ludlum Model 375 Digital Area Monitor with a Ludlum Model 42-30 Neutron Detector is used at the Y-12 National Security Complex to measure neutron dose rates. The Ludlum Model 375 Digital Area Monitor with a Ludlum Model 42-30 Neutron Detectors primary use is in areas near a Cf neutron source.

Manufacturers Specifications

Operating temperature range should be -20° C to 50° C.
Operating voltage of 1600 to 1900 volts.

Limitations

The Ludlum Model 375 Digital Area Monitor with a Ludlum Model 42-30 Neutron Detector should only be used within the ranges of the manufacturers environmental conditions.

Interfering Ionizing Radiation

The Ludlum Model 375 Digital Area Monitor with a Ludlum Model 42-30 Neutron Detector has a gamma rejection of 10 cpm up to 10 R/hr.

Performance Criteria

Ludlum Model 375 Digital Area Monitor with a Ludlum Model 42-30 Neutron Detector used at the Y-12 National Security Complex are calibrated to ¹³⁷Cs by the RASCAL facility, Oak Ridge National Lab.

11. Eberline Model RO-7 Ion Chamber

General Information

The Eberline Model RO-7 Ion Chamber is a portable battery operated ion chamber high range gamma meter. The Eberline Model RO-7 Ion Chamber detects beta, gamma, and x-ray radiations on a digital readout up to 20,000 R/hr. The Eberline Model RO-7 Ion Chamber may be equipped with an waterproof detector housing and underwater cable, a rigid extension or a 60 ft. cable. The Eberline Model RO-7 Ion Chamber is used at the Y-12 National Security Complex to detect high range gamma/x-ray dose rates. The Eberline Model RO-7 Ion Chamber is used for special purposes only that require its specified capabilities.

Manufacturers Specifications

Operating temperature range should be -10° C to 50° C.
Extendable from to 6.5 feet. Weighs 2.7 lbs. plus cable and detector.

Limitations

The Eberline Model RO-7 Ion Chamber shall not be used within the following conditions:

radio frequency fields such as those produced by RF heaters and high intensity transmitters	environment in close proximity to ceramic heaters, or radio transmitters
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The radio frequency field test were a frequency scan of 100 MHz to 1000 MHz at 20 volts/meter and frequencies from 45-430 MHz. The response of the Eberline Model RO-7 Ion Chamber was unacceptable for the radio frequency field test.

Performance Criteria

Eberline Model RO-7 Ion Chamber shall be performance tested each day prior to use. The performance test shall follow ANSI N323 guidelines. The performance test will be completed with a ⁶⁰Co source. An acceptance range has been calculated for each test point coinciding with the ranges on Eberline Model RO-7 Ion Chamber. The performance test shall be performed and documented by trained RADCON personnel according to RADCON operating instructions Y75-56-FO-520INS; *Operation of the Eberline Model RO-7 with a Eberline Model RO-7-LD Low Range Detector, RO-7-BM Mid Range Detector, RO-7-BH High Range Detector or a RO-7-UWH Underwater Housing.*

12. MGP Model DMC 90/100 Electronic Pocket Dosimeter

General Information

The MGP Model DMC 90/100 Electronic Pocket Dosimeter is a portable battery operated ion chamber high range gamma meter. The MGP Model DMC 90/100 Electronic Pocket Dosimeter detects beta, gamma, and x-ray radiations on a digital readout up to 20,000 R/hr. The MGP Model DMC 90/100 Electronic Pocket Dosimeter is used at the Y-12 National Security Complex to detect and measure gamma/x-ray dose rates. The MGP Model DMC 90/100 Electronic Pocket Dosimeter is used as a general indicator of dose and no dose will be assigned to the user from this dosimeter.

Manufacturers Specifications

Operating temperature range should be -10° C to 50° C.

Limitations

The MGP Model DMC 90/100 Electronic Pocket Dosimeter is not reliable to detect x-rays from single pulse x-ray machines.

Performance Criteria

MGP Model DMC 90/100 Electronic Pocket Dosimeter used at the Y-12 National Security Complex are calibrated to ¹³⁷Cs by the RASCAL facility, Oak Ridge National Lab.

C. Air Sampling/Monitoring Instruments

1. F & J Specialty Products Inc. (F&J) Model HV-1S/HV-1ST/HV-1SRT High Volume Air Sampler

General Information

The F&J Model HV-1S is an AC line operated high volume vacuum pump. The F&J Model HV-1S and variants of this model is the primary instrument used at the Y-12 National Security Complex as a high volume air sampler to collect airborne contamination.

Manufacturers Specifications

F&J states maximum capacity of 94 cubic feet per minute (cfm) at 29.92 in Hg and 68°F.
F&J states an ultimate vacuum of 80 in H₂O at standard temperature and pressure.

Limitations

The F&J Model HV shall only be used in conditions stated by the manufacturer. The operating temperatures, humidity, and ambient pressures should be environmentally controlled for human occupation.

Performance Criteria

The F&J Model HV shall be used with 10.16 cm Whatman 41 filter paper. The F&J Model HV flow rate shall be documented at calibration and labeled on each pump. The F&J Model HV is a pump and does not make measurements of contamination. The operation shall be performed and documented by trained RADCON personnel according to RADCON operating instruction Y75-56-FO-514INS; *Low and High Volume Air Sampling*.

2. Science Applications International Corporation (SAIC) Model HD-29A Low Volume Air Sampler

General Information

The SAIC Model HD-29A is an AC line operated low volume vacuum pump. The SAIC Model HD-29A has an adjustable air flow rate of 0.5 to 3.0 CFM (20 to 90 lpm). The SAIC Model HD-29A is the primary instrument used at the Y-12 National Security Complex as a low volume air sampler to collect airborne contamination.

Manufacturers Specifications

SAIC states a pressure of 0 to 30 in Hg (vacuum) for reading the Delta P gauge.
SAIC states a pressure of 0 to 30 in Hg (vacuum) for reading the pump head gauge.

Limitations

The SAIC Model HD-29A shall only be used in conditions stated by the manufacturer. The operating temperatures, humidity, and ambient pressures should be environmentally controlled for human occupation.

Performance Criteria

The SAIC Model HD-29A shall be used with Whatman 41 filter paper. The SAIC Model HD-29A flow rate shall be set to 40 lpm during calibration and labeled on each pump. The SAIC Model HV is a pump and does not make measurements of contamination. The operation shall be performed and documented by trained RADCON personnel according to RADCON operating instruction Y75-56-FO-514INS; *Low and High Volume Air Sampling*.

3. Eberline Model ALPHA-6S Continuous Air Monitor (CAM)

General Information

The Eberline Model ALPHA-6S CAM is an AC line operated microprocessor-based alpha continuous air monitor. The Eberline Model ALPHA-6S CAM detects alpha radiation and uses a multi-channel analyzer to calculate activity of particular isotopes. The Eberline Model ALPHA-6S CAM is equipped with an alarm system to alert personnel in the area of air counts over the Derived Air Concentration Limit (DAC). The Eberline Model ALPHA-6S CAM is the primary instrument used at the Y-12 National Security Complex to measure levels of airborne alpha contamination. Uranium limit is 1 DAC averaged over 8 hours in laboratory conditions.

Manufacturers Specifications

Operating temperature range should be 0°C to 40°C (32°F to 104°F).

Limitations

The Eberline Model ALPHA-6S CAM will be used in the buildings at the Y-12 National Security Complex that have environmental conditions within the manufacturers operating specifications.

Radio frequencies at the Y-12 Complex may cause false alarms if portable radios are used in CAM areas.

Performance Criteria

The Eberline Model ALPHA-6S CAM shall be functionally checked each day and source checked weekly. The weekly source check will be completed with a ^{235}U check source. The performance tests shall be performed and documented by trained RADCON personnel according to RADCON operating instruction Y50-66-RC-151; *Operation of the Eberline Alpha - 6S Continuous Air Monitor*.

4. MSA Model Escort Elf Personal Air Monitor (PAM)

General Information

The MSA Model Escort Elf PAM is an battery operated microprocessor-based air monitor. The MSA Model Escort Elf PAM measures the flow rate and battery voltage. The MSA Model Escort Elf PAM is equipped with an alarm system to alert personnel of low flow or battery failure. The MSA Model Escort Elf PAM is the primary instrument used at the Y-12 National Security Complex to collect samples of airborne alpha contamination in the breathing area of the worker.

Manufacturers Specifications

Operating temperature range should be 0°C to 40°C (32°F to 104°F).

Limitations

The MSA Model Escort Elf PAM will be used in the environmental conditions of buildings at the Y-12 National Security Complex that are within the manufacturers operating specifications.

Performance Criteria

The MSA Model Escort Elf PAM shall be functionally checked each day. The operation of the PAM shall be performed and documented by trained RADCON personnel according to RADCON operating instruction Y75-56-FO-501INS; *Operation of the MSA Escort Elf Personal Air Monitor (PAM)*.

5. Overhoff Model 400SBDyC Tritium Monitor

General Information

The Overhoff Model 400SBDyC Tritium Monitor is a portable battery (or AC adapter) operated air monitor with a 10 position alarm. The Overhoff Model 400SBDyC Portable Tritium Monitor uses multiple ion chambers with a port to port air volume of 440 cm³. The response of the Overhoff Model 400SBDyC Portable Tritium Monitor is 30 seconds to reach 90% of final reading. The pump pulls 3-5 volume changes per minute. The Overhoff Model 400SBDyC Tritium Monitor is the primary instrument used at the Y-12 National Security Complex to detect and measure the airborne concentrations of tritium. Detection of quantities greater than limit set per task are then measured from an air sample.

Manufacturer Specifications

Operating temperature range of -20° C to 40° C.
 Operating humidity range of 0-98 % R.H.

Limitations

The Overhoff Model 400SBDyC may be subject to erroneous readings and must pass a performance test if used under the following conditions.

Technical	Field Conditions
relative humidity > 95%	Hot, sticky environment such as during summer season or cold as in winter season
1 hour after being subjected to a temperature change of $\geq 10^{\circ}\text{C}$ (50°F) or when detector has stabilized	from office to environment of freezing water, or cold to very hot environment
temperatures < -10° C (14°F) or > 50° C (122°F)	icy, freezing or hot dry environment

The Overhoff Model 400SBDyC shall not be used within the following conditions:

radio frequency fields such as those produced by RF heaters and high intensity transmitters	environment in close proximity to ceramic heaters, or radio transmitters
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Performance Criteria

The Overhoff Model 400SBDyC Portable Tritium Monitor shall be functionally checked and performance tested before use each day. The operation of the Overhoff Model 400SBDyC Portable Tritium Monitor shall be performed and documented by trained RADCON personnel according to RADCON operating instruction Y75-56-FO-505INS; *Operation of the Overhoff Technology Corporation Model 400SBDyC Portable Tritium Monitor*.

6. Johnston Laboratories, Inc. (JLI) Triton Model 111 Tritium Air Monitor

General Information

The JLI Triton Model 111 is an AC/DC microprocessor-based tritium air monitor. The JLI Triton Model 111 detects beta radiation and uses an ion chamber to calculate activity of tritium. The JLI Triton Model 111 is equipped with an alarm system to alert personnel in the area of elevated air counts. The JLI Triton Model 111 is used at the Y-12 National Security Complex to measure levels of airborne tritium beta contamination. Sensitive to the 0-50 $\mu\text{Ci}/\text{M}^3$ linear scale.

Manufacturers Specifications

Operating temperature range should be 0°C to 50°C (32°F to 122°F).

Operating relative humidity (RH) range should be 0 to 95% RH.

Battery operation is <6 hours of continuous use.

Limitations

Operating temperature range is 0 to 50°C.

Operating humidity range is 0 to 90% R.H.

Interfering Ionizing Radiations

The JLI Triton Model 111 is gamma compensated up to 5 mR/hr for a uniform gamma field.

Performance Criteria

The JLI Triton Model 111 will be used in the environmental conditions of buildings at the Y-12 Complex that are within the manufacturers operating specifications.

The JLI Triton Model 111 shall be performance tested each day prior to use. The performance test will be completed with a ^{137}Cs check source. The performance tests shall be performed and documented by trained RADCON personnel according to RADCON operating instruction Y75-56-FO-512INS; *Operation of the Triton Model 111 Tritium Monitor*.

7. F & J Specialty Products Inc. (F&J) Model LV-14M Low Volume Air Sampler

General Information

The F&J Model LV-14M is an AC line operated low volume carbon vane vacuum pump. The F&J Model LV-14M is an instrument used at the Y-12 National Security Complex as a low volume air sampler to collect airborne contamination on filter media.

Manufacturers Specifications

F&J states maximum capacity of 4 cubic feet per minute (cfm) at 0 in Hg pressure drop.

F&J states an ultimate vacuum of 25 in H₂O at sea level.

Weight of 29 lbs.

Limitations

The weight of this unit may create a hazard if proper lifting techniques are not used due to the total of 29 lbs on a small handle.

Performance Criteria

The F&J Model LV-14M shall be used with Millipore AW-19 or Whatman 41 filter paper. The F&J Model LV-14M flow rate shall be set to 40 lpm during calibration and labeled on each pump. The F&J Model LV-14M is a pump and does not make measurements of contamination. The operation shall be performed and documented by trained RADCON personnel according to RADCON operating instruction Y75-56-FO-514INS; *Low and High Volume Air Sampling*.

8. Science Applications International Corporation (SAIC) Model AVS-28A Low Volume Air Sampler

General Information

The SAIC Model AVS-28A is an AC line operated low volume carbon vane vacuum pump. The SAIC Model AVS-28A has an adjustable air flow rate of 0.5 to 3.5 CFM (20 to 100 lpm). The SAIC Model AVS-28A is an instrument used at the Y-12 National Security Complex as a low volume air sampler to collect airborne contamination on filter media.

Manufacturers Specifications

SAIC states operating range up to 4 CFM and 28" Hg maximum vacuum.

SAIC states a noise level of 70 db at 1 meter.

Weighs 25 lbs.

Limitations

The weight of this unit may create a hazard if proper lifting techniques are not used due to the total of 25 lbs on a small handle.

Performance Criteria

The SAIC Model AVS-28A shall be used with Millipore AW-19 or Whatman 41 filter paper. The SAIC Model AVS-28A flow rate shall be set to 40 lpm during calibration and labeled on each pump. The SAIC Model AVS-28A is a pump and does not make measurements of contamination. The operation shall be performed and documented by trained RADCON personnel according to RADCON operating instruction Y75-56-FO-514INS; *Low and High Volume Air Sampling*.

9. Science Applications International Corporation (SAIC) Model H-810 Air Volume Totalizer

General Information

The SAIC Model H-810 Air Volume Totalizer is an AC line operated low volume carbon vane vacuum pump. The SAIC Model H-810 Air Volume Totalizer has an adjustable total air flow to 99999 CFM. The SAIC Model H-810 Air Volume Totalizer is an instrument used at the Y-12 National Security Complex as a high volume air sampler to collect airborne contamination on filter media.

Manufacturers Specifications

SAIC states operating range up to 99999 CFM.
Totalizer accuracy of $\pm 5\%$.

Limitations

The SAIC Model H-810 Air Volume Totalizer shall only be used in conditions stated by the manufacturer.

Performance Criteria

The SAIC Model H-810 Air Volume Totalizer shall be used with Millipore AW-19 or Whatman 41 filter paper. The SAIC Model H-810 Air Volume Totalizer flow rate shall be set during calibration and labeled on each pump. The SAIC Model H-810 Air Volume Totalizer is a pump and does not make measurements of contamination. The operation shall be performed and documented by trained RADCON personnel according to RADCON operating instruction Y75-56-FO-514INS; *Low and High Volume Air Sampling*.

10. Science Applications International Corporation (SAIC) Model HD-66A Low Volume Air Sampler

General Information

The SAIC Model HD-66A is an AC line operated low volume carbon vane vacuum pump. The SAIC Model HD-66A has an adjustable air flow rate of 1.0 to 7.0 CFM. The SAIC Model HD-66A is an instrument used at the Y-12 National Security Complex as a low volume air sampler to collect airborne contamination on filter media.

Manufacturers Specifications

SAIC states operating range up to 7 CFM and 30" Hg maximum vacuum.

SAIC states air flow regulation of 5%.

Weighs 75 lbs.

Limitations

The SAIC Model HD-66A shall only be used in conditions stated by the manufacturer. The weight of this unit may create a hazard if proper lifting techniques are not used due to the total weight of 75 lbs.

Performance Criteria

The SAIC Model HD-66A shall be used with Millipore AW-19 or Whatman 41 filter paper. The SAIC Model HD-66A flow rate shall be set to 40 lpm during calibration and labeled on each pump. The SAIC Model HD-66A is a pump and does not make measurements of contamination. The operation shall be performed and documented by trained RADCON personnel according to RADCON operating instruction Y75-56-FO-514INS; *Low and High Volume Air Sampling*.

D. Personnel Monitoring Instruments

1. Eberline Model RM-14S Radiation Monitor with Eberline Model HP-100A Gas Proportional Detector

General Information

The Eberline Model RM-14S is AC line operated alarm ratemeter. The Eberline Model RM-14S has a scale of 0-5 counts per minute with six range multipliers; X10, X100, X1K, X10K and X1M. The Eberline Model HP-100A Gas Proportional Detector responds to alpha, beta, gamma, and x-ray radiations. The Eberline Model RM-14S with the Eberline Model HP-100A is the primary instrument used at the Y-12 National Security Complex to measure alpha-beta-gamma surface contamination on personnel after an alarm in an automated monitor. The static detection limit is 100 dpm/100 cm² alpha and 300 dpm/100 cm² beta/gamma. The scanning detection limit is 350 dpm/100 cm² alpha and 1,000 dpm/100 cm² beta/gamma. The corrections are for efficiency only because the size of the detector is 100 cm². The efficiency is specific to each instrument calibration. The Eberline Model RM-14S should be used for scanning surveys at a speed of 1-2 inches per second at a distance of $\leq \frac{1}{4}$ inch. The Eberline Model RM-14S performs background subtract.

Manufacturers Specifications

Operating temperature range should be -30°C to 60°C (-22°F to 140°F).

Limitations

The Eberline Model RM-14S with the Eberline Model HP-100A may be subject to erroneous readings and must pass a performance test if used under the following conditions.

Technical	Field Conditions
relative humidity > 95%	Hot, sticky environment such as during summer season or cold as in winter season
1 hour after being subjected to a temperature change of $\geq 10^\circ\text{C}$ (50°F) or when detector has stabilized	from office to environment of freezing water, or cold to very hot environment

The Eberline Model RM-14S with the HP-100A shall not be used within the following conditions:

radio frequency fields such as those produced by RF heaters and high intensity transmitters	environment in close proximity to ceramic heaters, or radio transmitters
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Interfering Ionizing Radiation

The interfering ionizing radiation test was an exposure to a 1 mrem/hr neutron field. The response of the Eberline Model RM-14S with the Eberline Model HP-100A was 1330 to 1480 counts per minute of the 1 mRem/hr ²⁵²Cf neutron field with the Alpha/Beta switch in the Beta position. There was no response when exposed to the 1 mrem/hr ²⁵²Cf neutron field with the Alpha/Beta switch in the Alpha position.

Performance Criteria

Eberline Model RM-14S with the Eberline Model HP-100A used at the Y-12 National Security Complex are calibrated to ²⁴¹Am and ⁹⁰SrY by the RADCON Instrumentation Section.

Eberline Model RM-14S with the Eberline Model HP-100A shall be performance tested each day prior to use. The performance test shall follow ANSI N323 guidelines. The performance test will be completed with a ²⁴¹Am and ⁹⁰SrY sources testing one range. The performance test shall be performed and documented by trained RADCON personnel according to RADCON operating instruction Y75-56-FO-518INS; *Performance Test and Operation of an Eberline Model RM-14S Radiation Monitor with an Eberline Model HP-100A Gas Proportional Detector*.

2. Ludlum Model 177-45 Alarm Ratemeter with a Ludlum Model 44-9 Alpha-Beta-Gamma Detector

General Information

The Ludlum Model 177-45 is a portable battery or line operated alarm ratemeter. The Ludlum Model 44-9 detects alpha-beta-gamma radiation. The Ludlum Model 177-45 has a scale of 0-500 counts per minute with four range multipliers; X1, X10, X100, and X1K. The Ludlum Model 177-45 with a Ludlum Model 44-9 is the primary instrument used at the Y-12 National Security Complex for self-monitoring of personnel for beta-gamma surface contamination. The Ludlum Model 44-9 has a plastic cover installed to attenuate alpha particles. The alarm set point is 5,000 dpm/100 cm².

Manufacturers Specifications

Operating temperature range should be -40°C to 50°C (-40°F to 122°F).

Limitations

The Ludlum Model 177-45 with a Ludlum Model 44-9 may be subject to erroneous readings and must pass a performance test if used under the following conditions.

Technical	Field Conditions
on the X1 range when the temperatures are $\leq 10^{\circ}\text{C}$ (50° F)	cool environment such as during spring or fall season or cold as in winter season
1 hour after being subjected to a temperature change of $\geq 10^{\circ}\text{C}$ (50°F) or when detector has stabilized	from office to environment of freezing water, or cold to very hot environment

The Ludlum Model 177-45 with a Ludlum Model 44-9 shall not be used within the following conditions:

magnetic fields range such as those produced by magnets, accelerators or generators	ex. Operating generators used for emergency power, or motors used in machine shop equipment
radio frequency fields such as those produced by RF heaters and high intensity transmitters	environment in close proximity to ceramic heaters, or radio transmitters

Interfering Ionizing Radiation

The Ludlum Model 177-45 with a Ludlum Model 44-9 response was 120,000 counts per minute when exposed to the 1 rem/hr Pu-Be neutron field.

Performance Criteria

The Ludlum Model 177-45 with a Ludlum Model 44-9 shall be performance tested each day prior to use. The performance test shall follow ANSI N323 guidelines. The performance test will be completed with a ¹³⁷Cs check source. The performance test shall be performed and documented by trained RADCON personnel according to RADCON operating instruction Y75-56-FO-502INS; *Performance Test of a Ludlum Model 177-45 Alarm Ratemeter (PMI)*.

3. Ludlum Model 177-45 Alarm Ratemeter with a Ludlum Model 43-65 Alpha Scintillator Detector

General Information

The Ludlum Model 177-45 is a portable battery or line operated alarm ratemeter. The Ludlum Model 177-45 has a scale of 0-500 counts per minute with four range multipliers; X1, X10, X100, and X1K. The Ludlum Model 43-65 is a 50 cm² zinc sulfide scintillator with a 0.8 mg mylar window that detects alpha radiation. The Ludlum Model 177-45 with a Ludlum Model 43-65 is the primary instrument used at the Y-12 National Security Complex for self-monitoring of personnel for alpha surface contamination. The alarm set point is 5,000 or 1,000 dpm/100 cm² depending on the area and nuclide of concern.

Manufacturers Specifications

Operating temperature range should be -40°C to 50°C (-40°F to 122°F).

Limitations

The Ludlum Model 177-45 Alarm Ratemeter with a Ludlum Model 43-65 may be subject to erroneous readings and must pass a performance test if used under the following conditions.

Technical	Field Conditions
on the X1 range when the temperatures are $\leq 10^{\circ}\text{C}$ (50° F)	cool environment such as during spring or fall season or cold as in winter season
1 hour after being subjected to a temperature change of $\geq 10^{\circ}\text{C}$ (50°F) or when detector has stabilized	from office to environment of freezing water, or cold to very hot environment

The Ludlum Model 177-45 Alarm Ratemeter with a Ludlum Model 43-65 shall not be used within the following conditions:

magnetic fields range such as those produced by magnets, accelerators or generators	ex. Operating generators used for emergency power, or motors used in machine shop equipment
radio frequency fields such as those produced by RF heaters and high intensity transmitters	environment in close proximity to ceramic heaters, or radio transmitters

Interfering Ionizing Radiation

The interfering ionizing neutron radiation test was an exposure to a 100 mrem/hr Pu-Be neutron field. The response of the Ludlum Model 177-45 with a Ludlum Model 43-65 was 9000 to 9300 counts per minute when exposed to the neutron field. The interfering ionizing gamma radiation test was an exposure to 1 R/hr ¹³⁷Cs gamma field. The Ludlum Model 177-45 with a Ludlum Model 43-65 did not respond when exposed to the gamma field.

Performance Criteria

The Ludlum Model 177-45 with a Ludlum Model 43-65 shall be performance tested each day prior to use. The performance test shall follow ANSI N323 guidelines. The performance test will be completed with a ²³⁵U check source. The performance test shall be performed and documented by trained RADCON personnel according to RADCON operating instruction Y75-56-FO-502INS; *Performance Test of a Ludlum Model 177-45 Alarm Ratemeter (PMI)*.

4. Eberline Model PCM-1B Personnel Contamination Monitor

General Information

The Eberline Model PCM-1B is a whole body beta/gamma surface contamination personnel monitor. The Eberline Model PCM-1B has an array of fifteen 500 cm² detectors positioned to monitor one side of a persons body per count time before the user is prompted to insert other side. Minimum Count Time is the primary mode used to operate the Eberline Model PCM-1Bs because of the modes ability to adjust the optimal count time due to background changes and the other set parameters. The Eberline Model PCM-1Bs have been equipped to monitor for alpha surface contamination on the hands, forearms and feet. The Eberline Model PCM-1Bs are installed inside buildings as the primary automated instrument used at the Y-12 National Security Complex to perform beta/gamma whole body frisking. An optional alpha frisk for hands, feet and forearm (detectors with probability of geometry for alpha particle interaction) is also performed by the Eberline Model PCM-1B. The contamination alarms are set to 5,000 dpm/100 cm² .

Manufacturers Specifications

Operating temperature should be 0⁰ to 50⁰ C (32⁰ F to 122⁰ F).

Pressure should be ambient atmosphere.

Operating humidity should be 0 to 95% (non-condensing).

Limitations

The operating temperatures at Boundary Control Stations are suitable for routine work for personnel and temperatures shall fall within the specified range. Ambient pressures should be approximately equivalent to atmospheric pressure. The Eberline Model PCM-1B is a 550 lb. fixed location monitor.

Performance Criteria

Daily performance tests of the alarm in the environment of use with sources of approximately Complex release limits should provide sufficient qualification for the intended use. The Eberline Model PCM-1B continuously diagnoses the background updates using statistical routines to provide users information about the status of the monitors ability to detect the activity specified in the instrument parameters. Diagnostic routines built into the monitor alert RADCON technicians to the presence of interfering radiations. The RADCON technician may take corrective actions for continued operation of the monitor or discontinue use of the monitor until the interfering radiations no longer present a problem. The performance test shall be performed and documented by trained RADCON personnel according to RADCON operating instruction Y75-56-IN-503INS; *Performance Test of an Eberline Model PCM-1B Personnel Contamination Monitor*.

5. Eberline Model PCM-2 Personnel Contamination Monitor

General Information

The Eberline Model PCM-2 is a whole body alpha/beta/gamma surface contamination personnel monitor. The Eberline Model PCM-2 has an array of sixteen detectors divided into thirty-four counting zones. The detectors are positioned to monitor one side (front or back) of a persons body per count time before the user is prompted to insert other side. Minimum Count Time is the primary mode used to operate the Eberline Model PCM-2s because of the modes ability to adjust to the optimal count time due to background changes and the other set parameters. The Eberline Model PCM-2s are installed inside buildings as the primary automated instrument used at the Y-12 National Security Complex to perform for alpha/beta/gamma whole body frisking. The design allows geometry for personnel to monitor surface contamination. The contamination alarms are set to 5,000 dpm/100 cm² or less depending on area and nuclide of concern.

Manufacturers Specifications

Operating temperature should be 0^o to 45^o C (32^o to 113^o F).
Pressure should be ambient atmosphere.
Operating humidity should be 0 to 95% (non-condensing).

Limitations

The operating temperatures at Boundary Control Stations are suitable for routine work for personnel and temperature/humidity shall fall within the specified range. Ambient pressures should be approximately equivalent to atmospheric pressure. The Eberline Model PCM-2 is a 660 lb. fixed location monitor.

Performance Criteria

Daily performance tests of the alarm in the environment of use with sources of approximately Complex release limits should provide sufficient qualification for the intended use. The PCM-2 continuously diagnoses the background updates using statistical routines to provide user information about the status of the monitors ability to detect the activity specified in the instrument parameters. Diagnostic routines built into the monitor alert RADCON technicians to the presence of interfering radiations. The RADCON technician may take corrective actions for continued operation of the monitor or discontinue use of the monitor until the interfering radiations no longer present a problem. The performance test shall be performed and documented by trained RADCON personnel according to RADCON operating instruction Y75-56-IN-502INS; *Performance Test of an Eberline Model PCM-2 Personnel Contamination Monitor*.

6. Ludlum Model 2200 Scaler Ratemeter with a Ludlum Model 43-65 Alpha Scintillator Detector

General Information

The Ludlum Model 2200 is a portable battery or line operated scaler ratemeter. The Ludlum Model 2200 has a scale of 0-500 counts per minute with four range multipliers; X1, X10, X100, and X1000. The Ludlum Model 43-65 is a 50 cm² zinc sulfide scintillator with a 0.8 mg mylar window that detects alpha radiation. The Ludlum Model 2200 with a Ludlum Model 43-65 is the primary instrument used at the Y-12 National Security Complex as a special hand monitor in areas prior to performing an exit survey from alpha contamination areas. The detection limit is 100 cpm is approximately 5,000 dpm per 100 cm².

Manufacturers Specifications

Operating temperature range should be -40°C to 50°C (-40°F to 122°F).

Limitations

The Ludlum Model 2200 with a Ludlum Model 43-65 should only be used within the ranges of the manufacturers environmental conditions. If operation of the Ludlum Model 2200 with an Ludlum Model 43-65 outside the ranges of the following conditions is necessary, a performance test should be passed before use. To satisfy a performance test in an environment outside the following conditions, ensures the instrument is operating properly.

Interfering Ionizing Radiation

The interfering ionizing radiation test was not performed.

Performance Criteria

The Ludlum Model 2200 with a Ludlum Model 43-65 shall be performance tested each day prior to use. The performance test shall follow ANSI N323A guidelines. The performance test shall be performed and documented by trained RADCON personnel according to RADCON PROTOCOL-99-13, Rev. 1, PROTOCOL Between Radiological Control (RADCON) and Materials and Mechanical Operations (MMO) for Handwashing and Monitoring Prior to Exiting the 9215 Material Access Area (MAA), M-Wing, 03-29-00.

E. Counters (Field and Laboratory)

1. Ludlum Model 2200 Scaler Ratemeter with a Ludlum Model 43-1 Alpha Scintillator Detector

General Information

The Ludlum Model 2200 is a portable battery or line operated scaler ratemeter. The Ludlum Model 2200 has a scale of 0-500 counts per minute with four range multipliers; X1, X10, X100, and X1000. The Ludlum Model 43-1 is a 75 cm² zinc sulfide scintillator that detects alpha radiation. The Ludlum Model 2200 with a Ludlum Model 43-1 is the primary instrument used at the Y-12 National Security Complex as a quick count air sample counter for large filters to measure airborne alpha contamination. The detection limit is 44 dpm per filter for one minute count time with background < 6 cpm. For different detection limits and longer count times, refer to Procedure Y75-56-FO-109INS, *Airborne Radioactivity Monitoring*.

Manufacturers Specifications

Operating temperature range should be -40°C to 50°C (-40°F to 122°F).

Limitations

The Ludlum Model 2200 with a Ludlum Model 43-1 may be subject to erroneous readings and must pass a performance test if used under the following conditions.

Technical	Field Conditions
1 hour after being subjected to a temperature change of $\geq 10^{\circ}\text{C}$ (50°F) or when detector has stabilized	from office to environment of freezing water, or cold to very hot environment

The Ludlum Model 2200 with a Ludlum Model 43-1 shall not be used within the following conditions:

magnetic fields range such as those produced by magnets, accelerators or generators	ex. Operating generators used for emergency power, or motors used in machine shop equipment
radio frequency fields such as those produced by RF heaters and high intensity transmitters	environment in close proximity to ceramic heaters, or radio transmitters

Interfering Ionizing Radiation

The response of the Ludlum Model 2200 with a Ludlum Model 43-1 was 120 to 180 counts per minute when exposed to the ²⁵²Cf neutron field. The interfering ionizing gamma radiation test was an exposure to 11.7 R/hr ¹³⁷Cs gamma field. The Ludlum Model 2200 with a Ludlum Model 43-1 did not respond when exposed to the gamma field.

Performance Criteria

The Ludlum Model 2200 with a Ludlum Model 43-1 shall be performance tested each day prior to use. The performance test shall follow ANSI N323 guidelines. The performance test will be completed with a ²³⁵U check source. The performance test shall be performed and documented by trained RADCON personnel according to RADCON operating instruction Y75-56-FO-516INS; *Operation of Ludlum 2200 Portable Scaler Ratemeter with a 43-1 Alpha Scintillator Probe*.

2. Ludlum Model 2929 Dual Channel Scaler with a Ludlum Model 43-10-1 Alpha-Beta Sample Counter

General Information

The Ludlum Model 2929 is an AC line operated dual channel scaler. The Ludlum Model 2929 has a simultaneous digital readout for alpha and beta-gamma. The Ludlum Model 43-10-1 detects alpha and beta-gamma radiation. The Ludlum Model 2929 with a Ludlum Model 43-10-1 is the primary instrument used at the Y-12 National Security Complex as a smear or air sample counter to measure removable or airborne alpha-beta-gamma contamination. The detection limits are calculated for and labeled on each instrument. This instrument typically has an alpha detection limit of ≤ 20 dpm. For different detection limits and longer count times, refer to Procedure Y75-56-FO-109INS, *Airborne Radioactivity Monitoring*.

Manufacturers Specifications

Ludlum states alpha cross talk in the beta channel is $\leq 10\%$ and beta cross talk in the alpha channel is $\leq 1\%$.

Limitations

The Ludlum Model 2929 with a Ludlum Model 43-10-1 may be subject to erroneous readings and must pass a performance test if used under the following conditions.

Technical	Field Conditions
1 hour after being subjected to a temperature change of $\geq 10^{\circ}\text{C}$ (50°F) or when detector has stabilized	from office to environment of freezing water, or cold to very hot environment
temperatures $\geq 0^{\circ}\text{C}$ (32°F) and $\leq 30^{\circ}\text{C}$ (86°F)	office environment

The operating temperatures, humidity, and ambient pressures should be environmentally controlled as in an office environment. Limits are placed, on each monitor, for the amount of background allowed for alpha or beta-gamma.

Performance Criteria

The Ludlum Model 2929 with a Ludlum Model 43-10-1 shall be performance tested each day prior to use. The performance test shall follow ANSI N323 guidelines. The performance test will be completed with ^{235}U and/or ^{238}U check sources. The performance test shall be performed and documented by trained RADCON personnel according to RADCON operating instruction Y75-56-FO-517INS; *Operation of Ludlum 2929 Dual Channel Scaler with a 43-10-1 Alpha and Beta-Gamma Detector*.

3. Science Applications International Corporation (SAIC) Model AP-2 Alpha Analyzer

General Information

The SAIC Model AP-2 Alpha Analyzer is a portable instrument for alpha detection and measurement. The SAIC Model AP-2 Alpha Analyzer has a multichannel analyzer with a solid state 2" detector to determine the energy(s) of alpha particles. Analyzing unknown alpha particles can now be performed outside a laboratory environment. The SAIC Model AP-2 Alpha Analyzer is the primary instrument used in the Y-12 National Security Complex to identify the nuclide of alpha contamination from smears or air samples. Limits are instrument specific and calculated at time of calibration.

Manufacturer Specifications

Operating temperature range is 0° to 50° C
 Operating humidity range is 0 to 85% non-condensing.
 Energy discrimination adjustable from 1.0 to 9.9 MeV.

Limitations

The SAIC Model AP-2 Alpha Analyzer may be subject to erroneous readings and must pass a performance test if used under the following conditions.

Technical	Field Conditions
1 hour after being subjected to a temperature change of $\geq 10^{\circ}\text{C}$ (50°F) or when detector has stabilized	from office to environment of freezing water, or cold to very hot environment

The SAIC Model AP-2 Alpha Analyzer shall not be used within the following conditions:

radio frequency fields such as those produced by RF heaters and high intensity transmitters	microwave fields such as those produced by microwave communications equipment
microwave fields such as those produced by microwave communications equipment	ex. Dish antenna

Interfering Ionizing Radiations

The interfering ionizing radiation test was an exposure to a 1 mrem/hr ^{252}Cf neutron field. The response of the SAIC Model AP-2 Alpha Analyzer was 21 to 28 counts per minute alpha. The interfering ionizing radiation test included an exposure to a 1 mrem/hr ^{137}Cs gamma field. The response of the SAIC Model AP-2 Alpha Analyzer was 133 to 221 counts per minute alpha + gamma. The interfering ionizing radiation test included an exposure to a 0.5 rad/hr $^{90}\text{Sr/Y}$ beta field. The response of the SAIC Model AP-2 Alpha Analyzer was 323 to 511 counts per minute beta.

Performance Criteria

The SAIC Model AP-2 Alpha Analyzer shall be performance tested each day prior to use. The performance test shall follow ANSI N323 guidelines. The performance test will be completed with ^{235}U or ^{238}U check sources. The performance test shall be performed and documented by trained RADCON personnel according to RADCON operating instruction Y75-56-FO-510INS; *Operation of the SAIC AP-2 Alpha Analyzer*.

4. IN/US Systems β -RAM[®] Model 2B Radioactivity HPLC Detector

General Information

The IN/US Systems β -RAM[®] Model 2B is an AC line operated instrument with a flow through detection system. The IN/US Systems β -RAM[®] Model 2B detects β emitting and soft γ emitting isotopes in continuous flow. Based upon scintillation principles, detection takes advantage of processes which generate light as radioactive decay occurs. The actual measurement is made in cells of coiled Teflon tubing positioned between two opposed photomultipliers operating in coincidence; only light pulses seen simultaneously by both detectors are analyzed and recorded. Pulses arising from one, not matched by the other, are assumed to derive from thermal phenomena and other spurious sources within the photomultiplier and are rejected. The IN/US Systems β -RAM[®] Model 2B is used at the Y-12 National Security Complex as a tritium detector. The IN/US Systems β -RAM[®] Model 2B is used for indication only.

Manufacturers Specifications

^3H is detected with 60% efficiency with a background of 4 cpm while ^{14}C is detected with >90% efficiency with a background of about 12 cpm.

Limitations

The IN/US Systems β -RAM[®] Model 2B shall only be used in environmental conditions of buildings at the Y-12 National Security Complex that are suitable for human occupation.

Performance Criteria

The IN/US Systems β -RAM[®] Model 2B shall be performance tested each day prior to use. The performance test shall follow ANSI N323 guidelines. The performance test will be completed with a ^3H check source. The performance test shall be performed and documented by trained RADCON personnel according to RADCON operating instruction Y75-56-FO-504INS; *Operation of a HPLC-2 Tritium Detector*.

5. Tennelec Model Eclipse 5XLB Low Background Proportional Counter

General Information

The Tennelec Model Eclipse 5XLB Low Background Proportional Counter is a laboratory counter that should reside in a controlled environment. The Tennelec Model Eclipse 5XLB Low Background Proportional Counter is an automated counter that may be loaded with up to 100 samples to be counted. The Tennelec Model Eclipse 5XLB Low Background Proportional Counter uses a P-10 counting gas to supply a windowed proportional detector. The Tennelec Model Eclipse 5XLB Low Background Proportional Counter is the primary instrument used in the Y-12 National Security Complex to perform measurement of alpha/beta contamination on smears or air samples. Fixed Air Samples (FAS) and Personal Air Monitor (PAM) Samples are counted on the Tennelec Model Eclipse 5XLB Low Background Proportional Counters. Limits are instrument specific and calculated at time of calibration.

Manufacturer Specifications

Operating temperature range is 0° to 50° C
Operating humidity range is 0 to 80% non-condensing.

Limitations

The Tennelec Model Eclipse 5XLB Low Background Proportional Counter should only be used within the ranges of the manufacturers environmental conditions. If operation of the Tennelec Model Eclipse 5XLB Low Background Proportional Counter outside the ranges of the following conditions is necessary, a performance test should be passed before use. To satisfy a performance test in an environment outside the following conditions, ensures the instrument is operating properly.

Performance Criteria

The Tennelec Model Eclipse 5XLB Low Background Proportional Counter shall be performance tested each day prior to use. The performance test shall follow ANSI N323 guidelines. The performance test will be completed with ⁹⁹Tc check sources. The performance test shall be performed and documented by trained RADCON personnel according to RADCON operating instruction Y75-56-IN-536INS; *Operation of a Tennelec Eclipse Low Background Proportional Counter*.