CP4-RP-1309 FRev. 7	**TITLE**: Setup for Operability Tests of Portable Field Instruments	Page 1 of 14
DOCUMENT CATEGORY:	Administrative	
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FUNCTIONAL AREA: Radiation Protection **SUBJECT MATTER AREA:** Dosimetry & Instrumentation	**SUBJECT MATTER EXPERT**: Dan Tockstein, Radiological Engineering Manager	
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REVISION/CHANGE LOG

Revision/Change Letter	Description of Changes	Pages Affected	Date of Revision/Change
FR0	Bluesheet	All	10/20/2017
FR1	Non-Intent Changes for Bluesheet Incorporation	All	12/19/2017
FR2	General revision	All	8/31/2020
FR3	Revised Step 6.1.4 and 6.1.5 to reflect minimum acceptable efficiency values for portable alpha and beta instruments. Other minor format changes throughout.	All	05/26/2021
FR4	General revision and reorganization. Added verbiage to address use of Ludlum Models 12-4, 30-7B, 3000.	All.	2/2/2022
FR5	Delete section 6.2.3	All	5/9/2023
FR6	Revise section 6.1.7 for verifying tamper indicator on Vernier adjustment knob per CAPA CA-004903.	6,17,18	02/28/2024
FR7	Revise 6.2.4 to change background count time for Ludlum 2929/3030 instruments. Remove form attached to Administrative procedure.	All	03/04/2025

TABLE OF CONTENTS

1.0 PURPOSE AND SCOPE

1.1 Purpose

The purpose of this procedure is to provide a means of assuring that a radiological instrument is operating properly and accurately, that performance criteria are established for each instrument and used for developing quantitative radiological data.

These criteria are typically source response and background levels, but may include other parameters; depending on the specific instrument type and application.

Performance criteria are established by the Paducah Gaseous Diffusion Plant (PGDP) Deactivation and Remediation (D&R) Radiological Control (RADCON) Management following the guidance in this procedure.

After the criteria are established, instrument users or other designated personnel must routinely test the instrument performance, relative to these criteria, on each day the instrument is to be used for radiological measurement purposes, following the direction in the appropriate instrumentation operating procedure.

1.2 Scope

This procedure applies to PGDP D&R individuals performing setup for operability tests of portable field instruments.

2.0 REFERENCES

2.1 Use References

- CP3-RP-1109, *Radioactive Contamination Control and Monitoring*
- CP5-RP-2016, *Radiological Protection Contamination Control and Monitoring Technical Basis Document*
- CP5-RP-2022, *Radiological Protection Instrumentation Operation Technical Basis Document*

2.2 Source References

- ANSI N42.17, *Performance Specifications for Health Physics Instrumentation*
- ANSI N323A-1997, *American National Standard Radiation Protection Instrumentation Test and Calibration, Portable Survey Instruments*
- CP2-RP-0002, *Radiological Control Manual*
- CP3-RP-1302, *Radioactive Source Control*
- CP3-RP-1401, *Radiation Protection Program Records*
- CP5-RP-2017, *Radiation Survey Technical Basis Document*

3.0 COMMITMENTS

None

4.0 RESPONSIBILITIES

4.1 Radiation Protection Manager (RPM)

4.1.1 Implements requirements of this procedure.

4.1.2 Ensures Radiological Control Technicians (RCTs) are properly qualified and trained.

4.1.3 Communicates radiological instrumentation needs to U.S. Department of Energy (DOE).

4.2 Radiation Protection Project Manager (RPPM) or Radiological Control Supervisor (RCS)

4.2.1 Requests RCTs as designated by RPPM setup instrumentation as required by projects.

4.2.2 Notifies RADCON management of instrumentation needs.

4.2.3 Reviews daily/weekly/monthly test sheets for technical accuracy at completion of each month, as appropriate.

4.2.4 Reviews and approves instrument setup sheets prior to instruments being placed into service.

4.2.5 Maintains an adequate supply of radiation detection instruments.

4.3 Radiological Engineering Manager

Identifies appropriate sources to be used in setup and use of radiological instrumentation, as needed.

4.4 RCT

4.4.1 Ensures Boundary Control Station (BCS) portable alarming instruments are set to 50 counts per minute (cpm) above background for an alpha and 100 cpm above background for beta/gamma probes and can detect the surface contamination values in Appendix B of CP3-RP-1109, *Radioactive Contamination Control and Monitoring*.

4.4.2 Performs the setup of the radiation detection instruments as required in this procedure.

4.4.3 Completes the required documentation set forth in this procedure.

4.4.4 Completes **and** maintains applicable instrument On-The-Job Training (OJTs).

5.0 GENERAL INFORMATION

5.1.1 RADCON supervision reviews daily and/or weekly test sheet for technical accuracy at completion of each month.

5.1.2 Instrument Performance Test Setup – Initial reference response setup for performance testing shall be conducted:

- After receipt and configuration (pairing) of instrument and detector at instrument laboratory.
- After receipt of instrument at a remote or satellite site, a new “Initial Reference Response Test” is required only if remote site uses different test sources.

5.1.3 Test instruments at levels typical of those anticipated in actual applications:

- A minimum of one scale should be tested.
- To avoid unnecessary personnel exposure, neutron dose rate instruments should be checked on lower scales.

5.1.4 Ensures that areas where tests are to be performed are **NOT** impacted by elevated background.

5.1.5 **If** background is elevated, **then** sources must be removed, if possible, **or** the instrument relocated to an area where background will **NOT** interfere with setup activities.

5.1.6 The instrument daily test sheet form consists of two parts:

- Part 1: contains the general instrument setup conditions and acceptable performance information.
- Part 2: contains information used by the instrument operator to record the performance test results, obtained according to the appropriate instrumentation operating procedure as described in CP5-RP-2022, *Radiological Protection Instrumentation Operation Technical Basis Document*.

5.1.7 Appropriate Radiological Instrument Initial Setup spreadsheet must be used, or other approved method, such as the RADCON instrument management database during instrument setup activities.

5.1.8 Source(s) of the appropriate radiation type, energy, and activity level must be checked for each instrument to be used during instrument setup.

5.1.9 **If** unsure as to the appropriate source(s) to be used, **then** Radiological Engineering must be consulted and the check source radionuclide and check source identification number entered in appropriate block.

5.1.10 An appropriate source holder (jig) must be used, appropriate for the instrument, as applicable (for example, Ludlum Models 2929 and 3030 will **NOT** require the use of a source jig).

5.1.11 **If** unsure as to the appropriate source holder to be used, **then** RCS must be consulted to determine appropriate source holder.

5.1.12 The maximum (average) alpha background acceptable is 5 cpm for all alpha detectors of less than 100 cm^2 (for example, Ludlum Model 43-5, or equivalent).

5.1.13 The maximum (average) alpha background is 10 cpm for large surface area detectors and dual scintillation probes (for example, Ludlum Model 43-93, or equivalent).

5.1.14 The maximum beta-gamma background acceptable for instruments equipped with Ludlum Model 44-9, or equivalent, probes is 300 cpm.

5.1.15 The maximum beta-gamma background acceptable for instrument equipped with Ludlum Model 43-93, or equivalent, probes is 400 cpm.

5.1.16 The maximum alpha background for instruments equipped with Ludlum Model 43-10-1, or equivalent, probes is 5 cpm.

5.1.17 The maximum beta-gamma background for instruments equipped with Ludlum Model 43-10-1, or equivalent, probes is 100 cpm.

5.1.18 For purposes of instrument setup, sodium iodide probes do **NOT** have a maximum background.

6.0 INSTRUCTIONS

6.1 General Instrument Setup

RCT

6.1.1 Confirm that instrument calibration is current based on affixed calibration label on instrument.

6.1.2 Confirm that the instrument calibration label matches the information shown on the instrument calibration certificate.

6.1.3 Enter the instrument serial number, probe serial number, and other operating parameter information from the instrument calibration form into the RADCON instrument management database/spreadsheet.

6.1.4 Enter the efficiency, or efficiencies for dual instruments, indicated on the instrument calibration sticker into the RADCON instrument management database/spreadsheet.

NOTE:

Minimum efficiency values stated in Step **6.1.5** and **6.1.6** do **NOT** apply to Ludlum Model 177 instruments used for personnel monitoring from radiological areas.

6.1.5 **If** the actual alpha efficiency values determined during calibration are less than 13% for a Ludlum Model 43-5 **or** less than 20% for a Ludlum Model 43-93, **then** tag instrument out of service **and** return instrument to the calibration facility for repair as soon as possible.

6.1.6 **If** the actual beta efficiency values determined during calibration are less than 20% for a Ludlum Model 44-9 **or** less than 15% for a Ludlum Model 43-93, **then** tag instrument out of service **and** return instrument to the calibration facility for repair as soon as possible.

6.1.7 Verify that the tamper indicator on the Vernier adjustment knob, if equipped, is in place and intact on a Ludlum Model 2929 or 3030E. If no tamper indicator, then confirm that the Vernier setting matches that on the calibration label and calibration certificate and install a tamper indicator on the Vernier adjustment knob.

6.1.8 Following the sequence of actions and guidance provided in the appropriate section of the instrumentation operating guide, perform the following:

A. Ensure probe and instrument serial numbers are paired correctly as indicated on calibration label or calibration certificate, test battery power, high voltage, input sensitivity (threshold), window setting (WIN switch is set to “OUT”, unless otherwise directed by RADCON management), audible signal, average flow rate, etc.

B. **If** there is a zero adjust, **then** perform this adjustment.

C. Ensure that all parameters are as indicated in Part 1 of the appropriate daily test sheet.

D. Perform battery tests on instruments.

- For Ludlum Model 2221 instruments, ensure a reading greater than 4.8 volts.
- For Ludlum Model 30-7B or 3000 series instruments, ensure the "low battery indicator" is **NOT** displayed on the instrument face.
- Ensure battery tests for analog instruments are indicated in the "battery OK", or equivalent, range of the meter face.

E. **If** there are discrepancies, **then** replace the batteries **and** re-test.

F. **If** the problem persists, **then** tag the instrument out of service **and** notify RADCON supervision, as appropriate.

6.2 Establishing Background for Instruments Equipped with Scalers

6.2.1 **When** determining a background, **then** use the slow response setting.

6.2.2 For portable contamination monitoring instrumentation equipped with a single-use detector and scaler, perform **and** record one one-minute background count.

6.2.3 Enter the results of the background counts into the appropriate block(s).

6.2.4 For dual instruments (for example, Ludlum Model 2929 or 3030), perform **and** record one thirty-minute background count.

6.2.5 Enter the results of the background count into the appropriate block(s).

6.2.6 For the Ludlum Model 2224-1, or equivalent, equipped with a Ludlum Model 43-10-1 probe, perform **and** record one five-minute background count for alpha and beta.

6.2.7 Enter the results of the background count into the appropriate block(s).

6.2.8 For Ludlum Model 2224, or equivalent, equipped with a Ludlum Model 43-93 probe, or equivalent, perform **and** record one one-minute background counts for alpha and beta.

6.2.9 Enter the results of the background counts into the appropriate block(s) of the Radiological Instrument Initial Setup spreadsheet, or equivalent.

6.3 Establishing Source Ranges for Instruments Equipped with Scalers

6.3.1 **When** establishing source ranges for instruments, **then** use the slow response setting.

6.3.2 For portable contamination monitoring instrumentation equipped with a single-use detector and scaler:

A. Perform **and** record ten one-minute source counts.

B. Enter the results of the source counts into the appropriate block(s) on the Radiological Instrument Initial Setup spreadsheet, or equivalent.

6.3.3 For portable contamination monitoring instrumentation equipped with a dual-use detector and scaler, such as the Ludlum Model 2224, or equivalent, paired with a Ludlum Model 43-93, or equivalent:

A. Perform **and** document ten one-minute source counts for each type of source (alpha and beta).

B. Enter the results of the source counts into the appropriate block(s) on the Radiological Instrument Initial Setup spreadsheet, or equivalent.

6.3.4 For dual instruments (for example, Ludlum Model 2929, 3030, or equivalent):

A. Perform **and** document ten one-minute source counts for each type of source (alpha and beta).

B. Enter the results of the source counts into the appropriate block on the Radiological Instrument Initial Setup spreadsheet, or equivalent.

6.3.5 Upon entering all information into the Radiological Instrument Initial Setup spreadsheet, or equivalent, save **and** print the completed sheet(s).

6.3.6 Ensure the appropriate daily response test sheet for the instrument to be tested is properly completed.

NOTE:

Estimated Minimum Detectable Concentrations (MDCs) are referenced in CP5-RP-2016, *Radiological Protection Contamination Control and Monitoring Technical Basis Document*.

6.3.7 Review the associated "Instrument Information Card" that is generated to ensure information is accurate.

6.3.8 Laminate the "Instrument Information Card" **and** attach it to the appropriate instrument, as applicable.

6.3.9 Ensure the instrument daily response test sheet form is placed at the proper setup location for use.

6.4 Establishing Background and Source Range for Analog Instruments:

6.4.1 **When** determining background for analog instruments, **then** use the slow response setting **and** allow the meter to stabilize for thirty to forty seconds.

6.4.2 Record the resulting background reading as indicated by the needle.

6.4.3 **When** determining background on a Ludlum Model 177 paired with a Ludlum Model 43-5 probe, or equivalent, **then** count the number of "clicks" over a period of one minute **and** record the resulting background reading.

6.4.4 Ensure the reading is within the typical range, indicated in CP5-RP-2022 or in the instrument user's manual.

6.4.5 Calculate +/- twenty percent of the average source response **and** record the range of the average plus or minus 20% as the accepted source response range (if **NOT** performed automatically in spreadsheet).

6.4.6 Enter the results of the background and source counts into the appropriate block(s) of the Radiological Instrument Initial Setup spreadsheet, or equivalent.

6.4.7 Ensure the appropriate daily response test sheet for the instrument to be tested is properly completed.

6.5 Setup of Ion Chambers

NOTE:

Ion chamber instruments are typically setup and response checked with a Sr-90 thumbwheel source, but may be setup with different sources depending upon setup location.

6.5.1 **If** setting-up ion chambers or telescoping instruments (RO-20, RSO-50, 6112B, 6150 AD2, etc.), **then** obtain the appropriate source.

6.5.2 **When** response checking, **then** ensure the instrument's window is in the open position, if applicable, **and** tested according to Step **5.1.3**.

6.5.3 **When** using a thumbwheel or slide-type source jig with different ranges of source strength, **then** ensure the source slide is opened for each range tested.

6.5.4 Enter the results of the background and source counts into the appropriate block(s) of the Radiological Instrument Initial Setup spreadsheet, or equivalent.

6.5.5 Ensure the appropriate daily response test sheet for the instrument to be tested is properly completed.

6.6 Setup of Microrem Instruments

6.6.1 Turn on the instrument **and** allow it to appropriately warm up.

6.6.2 **If** using a Microrem instrument, **then** obtain a background by turning the instrument to its lowest scale:

A. Allow the instrument to stabilize **and** record the reading indicated on the instrument face.

B. Verify the background reading is less than 9 µrem/hr.

6.6.3 **If** the background is greater than 9 µrem/hr., **then** ensure a source is **NOT** affecting the background reading **and** retest.

6.6.4 **If** a source is affecting the background reading, **then** remove the source from the area **and** retest **or** obtain a background reading in another location.

6.6.5 **If** the background is greater than 9 µrem/hr and a source is **NOT** affecting the instrument, **then** tag the instrument out of service.

NOTE:

Steps **6.6.6** through **6.6.11** apply to setup of Microrem instruments with a Sr-90 thumbwheel source. The Sr-90 source should **NOT** be exposed (slide should be closed).

6.6.6 Ensure the instrument is placed on the "x10" scale and the source placed in the "0-500m/R" position.

6.6.7 Place the instrument on the source by lining up the "+" marks on the sides and front of the instrument with the marks indicated on the source jig to ensure repeatability during the daily source check process.

6.6.8 Allow the instrument to stabilize.

6.6.9 Ensure repeatability with the initial reading **and** record the reading indicated on the instrument face on CP4-RP-1309-F04, *Dose Rate Instrument Daily Test* form.

6.6.10 Enter the results of the background and source counts into the appropriate block(s) of the Radiological Instrument Initial Setup spreadsheet, or equivalent.

6.6.11 Ensure the appropriate daily response test sheet for the instrument to be tested is properly completed.

NOTE:

Steps **6.6.12** through **6.6.15** apply to setup of Microrem instruments with a Cs-137 button source.

6.6.12 Ensure the instrument is placed on the "x1" scale (the second scale).

6.6.13 Place the instrument above the source by lining up the "+" marks on the sides and front of the instrument with the marks indicated on the source jig to ensure repeatability during the daily source check process.

6.6.14 Enter the results of the background and source counts into the appropriate block(s) of the Radiological Instrument Initial Setup spreadsheet, or equivalent.

6.6.15 Ensure the appropriate daily response test sheet for the instrument to be tested is properly completed.

6.7 Setup of Neutron Instruments

NOTE:

Neutron instruments with Neutron Rate Dosimeter (NRD or equivalent) detectors may be source checked using an Americium-241 source. Steps in Section **6.4** must be followed to setup a Ludlum Model 12-4 equipped with a NRD detector.

6.7.1 Turn on the instrument **and** allow it to appropriately warm up for approximately 10 minutes.

NOTE:

The background reading must be obtained in an area that will **NOT** interfere with the setup activities (for example, Count Lab or other low background area).

6.7.2 Perform a one minute count when determining background levels.

6.7.3 **When** establishing the source response of the NRD detector, **then** place the detector in the proper location marked on floor near the box containing the Am-241 source.

6.7.4 Perform a one minute count when establishing source response of the instrument:

A. To perform a one minute count using the Thermo ASP-2E:

1. Switch the instrument to "Scaler" to automatically commence a one minute count.

2. Obtain additional one minute counts by pressing the Star key.

B. To perform a one minute counting using the Ludlum Model 30-7B:

1. Press the MODE button two times to get to the COUNT mode **and** press the OK button to commence a one minute count.

2. Obtain additional one minute counts by pressing the OK button upon completion of the original count.

6.7.5 Record the results of these one minute background and source counts in the appropriate blocks of the daily test sheet.

6.7.6 Enter the results of the background and source counts into the appropriate block(s) of the Radiological Instrument Initial Setup spreadsheet, or equivalent.

6.7.7 Ensure the appropriate daily response test sheet for the instrument to be tested is properly completed.

6.8 Setup of Telescoping Dose Rate Instruments

NOTE:

Telescoping dose rate instruments (that is, Eberline 6112B and Automess 6150 AD2) may be setup with different sources and in different configurations, depending upon setup location.

6.8.1 Test instruments according to Step **5.1.3**.

6.8.2 **If** using a thumbwheel or slide-type source jig with different ranges of source strength, **then** ensure the source slide is opened for each range tested.

6.8.3 Notify RCS for guidance in the proper setup of these instruments.

6.8.4 Enter the results of the background and source counts into the appropriate block(s) of the Radiological Instrument Initial Setup spreadsheet, or equivalent.

6.8.5 Ensure the appropriate daily response test sheet for the instrument to be tested is properly completed.

6.9 Setup of Lapel Air Samplers

6.9.1 Obtain a copy of the calibration certificate.

6.9.2 Obtain CP4-RP-1309-F01, *Lapel Air Sampler Daily Instrument Performance Check Sheet* form.

6.9.3 Ensure the sampler is in calibration.

6.9.4 Determine the average flow rate, as determined during calibration. This is typically indicated on the calibration certificate in the "Reproducibility" section.

6.9.5 Calculate plus or minus ten percent of the average flow rate, as determined during calibration, **and** record on CP4-RP-1309-F01.

6.10 Test Sheets

6.10.1 Place the test sheet in a file binder, or other designated location, as instructed by RADCON supervision.

6.10.2 **If** the response test information is maintained by automated methods, **then** forward a copy of the Test Sheet to the appropriate data input group as identified by the RADCON supervision.

7.0 RECORDS

7.1 Records Generated

The following records may be generated by this procedure:

- CP4-RP-1309-F01, *Lapel Air Sampler Daily Instrument Performance Check Sheet*
- CP4-RP-1309-F02*, Dual Instrument Daily Test*
- CP4-RP-1309-F03, *Contamination Instrument Daily Test Sheet (Lud 3, 12, 2221, 177, or equivalent)*
- CP4-RP-1309-F04*, Dose Rate Instrument Daily Test*
- Radiological Instrument Initial Setup spreadsheet, or equivalent

Forms are to be completed according to CP3-OP-0024, *Forms Control.*

7.2 Records Disposition

The records are to be maintained according to CP3-RD-0010, *Records Management Process*.

Appendix A – Acronyms/Definitions

ACRONYMS

BCS – Boundary Control Station

BKG – Back Ground

CPM – Counts Per Minute

D&R – Deactivation and Remediation

DOE – U.S. Department of Energy

JPM – Job Performance Measure

MDC – Minimum Detectable Concentration

NRD – Neutron Rate Detector

OJT – On-The-Job Training

PGDP –Paducah Gaseous Diffusion Plant

RADCON – Radiological Control

RCS – Radiological Control Supervisor

RCT – Radiological Control Technician

RPM – Radiation Protection Manager

RPPM – Radiation Protection Project Manager

DEFINITIONS

CP2-RP-0002, *Radiological Control Manual*, should be referenced for definitions.

Appendix B - Active Surface Areas of Detectors

Following are the active surface areas of common detector probes used at the PGDP D&R location:

- Ludlum Model 44-9/44-9-18/44-40: 15.5 cm^2
- Ludlum Model 43-5: 76 cm^2
- Ludlum Model 43-93: 100 cm^2