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# Calibration and Maintenance of Radiological Survey Instruments

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**Revision 1**

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## **1.0 SCOPE**

### **1.1 Purpose**

The purpose of this procedure is to specify the general calibration and maintenance requirements for handheld and portable radiological survey instruments and equipment. Any project specific calibration and maintenance requirements should be included in the site specific Work Plans or other project specific documentation.

### **1.2 Applicability**

This procedure applies to the following types of instruments for Commercial Services (CS) field projects:

- Radiation Survey Instruments (dose rate meters),
- Contamination Survey Instruments (friskers),
- Portable and Stationary Scalar Counters,
- Personnel Monitoring Devices (TLDs and Self-Reading and Electronic Dosimeters), and
- Air Samplers.

Calibration and maintenance of survey instrumentation not covered by this procedure, but covered in instrument specific operating procedures or manuals include laboratory analytical and specialized equipment such as:

- Gamma Spectroscopy Equipment,
- Alpha or Beta Spectroscopy Equipment,
- Liquid Scintillation Counters,
- Automated Counters, and
- Portal Monitors.

## **2.0 REFERENCES**

- 2.1** ANSI N323A-1997, *American National Standard Radiation Protection Instrumentation Test and Calibration, Portable Survey Instruments*, April 1997
- 2.2** CS-AD-PR-002, *Commercial Services Project Records*
- 2.3** CS-FO-PR-001, *Performance of Radiological Surveys*
- 2.4** CS-FO-PR-004, *QA/QC of Portable Radiological Survey Instruments*
- 2.5** CS-FO-PR-005, *General Operations of Radiological Survey Instruments*
- 2.6** CS-RS-PR-006, *Unconditional Release of Tools and Equipment*
- 2.7** DOE G 441.1-7, *Portable Monitoring Instrument Calibration Guide for Use with Title 10, Code of Federal Regulations, Part 835, Occupational Radiation Protection*, June 17, 1999
- 2.8** ES-AD-PR-009, *Control of Measuring and Test Equipment*

### 3.0 GENERAL

#### 3.1 Definitions

- 3.1.1. *Calibration* – Setting the response or reading of an instrument relative to a series of conventionally true values traceable to the National Institute of Standards and Technology (NIST).
- 3.1.2. *Check Source* – A radioactive source, not necessarily traceable to NIST, which is used to confirm the continuing satisfactory operation of an instrument.
- 3.1.3. *General Maintenance* – Activities allowable on instruments without requiring recalibration. These include light cleaning, battery and cable change outs, Mylar window replacements and repair, and other similar activities that do not impact the instruments response.
- 3.1.4. *Radiological Survey Instrument* – A complete system designed to quantify one or more characteristics of ionizing radiation or radioactive material.
- 3.1.5. *Range* – All values lying between an upper and lower bound or an indicated limit.

#### 3.2 Responsibilities

**Note: Depending upon personnel qualifications and the size of the project, project personnel may be assigned multiple roles and/or responsibilities.**

##### 3.2.1. Project Manager (PM)

The Project Manager is responsible for ensuring that the proper procedures and programs are implemented on the project site as required by customer agreements and contracts. The PM is responsible for ensuring that these programs and procedures are properly incorporated into project-specific plans and procedures. The PM is responsible for ensuring that Commercial Services and/or client programs and procedures are available for use by field personnel.

##### 3.2.2. CS Radiation Safety Officer (RSO)

The CS RSO maintains and oversees the implementation of the CS Radiation Protection Program (RPP). The CS RSO shall ensure that radiation safety, radioactive materials management, and radiological operations procedures and programs are kept up to date such that they comply with current regulations and incorporate current and relevant industry practices and regulatory guidance.

##### 3.2.3. Radiation Protection Supervisor (RPS)

The RPS is responsible for implementing the CS RPP and the project specific radiological requirements at the field project location. The RPS manages and oversees the technicians performing radiation protection surveys and site monitoring and reports directly to both the PM and the CS RSO.

3.2.4. Project Health Physicist (PHP)

The PHP is responsible for assisting the CS RSO in providing health physics support to the PM and RPS. This includes technical support to ensure procedural and regulatory compliance and to ensure that the project specific Data Quality Objectives are met.

**3.3 Precautions and Limitations**

3.3.1. This procedure is for the exclusive use of EnergySolutions Commercial Services field projects.

3.3.2. An evaluation of the environmental conditions at the project site should be performed as any significant change in temperature or change in elevation may affect the performance of the field instrument(s) depending upon the calibration settings.

**3.4 Records**

3.4.1. The following records shall be maintained by the RPS or designee as applicable:

- Instrument calibration certificate(s),
- Maintenance history of the instrument(s) during the project,
- Baseline field readings and instrument response ranges, and
- Daily instrument response test results and control charts to document the instrument performance.

3.4.2. The RPS shall ensure that an instrument inventory is maintained listing all the instruments on site, their calibration date, their calibration due date and the instruments status.

3.4.3. Copies of all the instrument records shall be maintained at the field project location in accordance with Reference 2.2.

**4.0 REQUIREMENTS AND GUIDANCE**

**4.1 Calibration**

4.1.1. All Instruments used for radiological surveys shall be calibrated at least annually, when in use, and after any major instrument repair. Certain Agreement States or clients may require instrument calibration every six (6) months. Calibration frequencies other than annually shall be documented in project-specific documents.

4.1.2. As needed, the calibration due date may be extended up to 3 months upon written authorization by the CS RSO following a review of the current calibration and instrument response test records as guided by Reference 2.6 which states:

*If routine checks indicate that the response of an instrument remains stable over a long period of time, then the calibration frequency may be extended.*

- 4.1.3. Instrument calibration shall be performed using NIST traceable sources and Measurement and Test Equipment (M&TE).
- 4.1.4. All instrument calibrations shall be performed by the original equipment manufacturer, by a qualified vendor, or under the direct supervision of the RPS following approved procedures which shall include the determination and documentation of the “as found” conditions.
- 4.1.5. If using an off-site vendor for calibration, the PHP should specify the calibration requirements.
- 4.1.6. The PHP should evaluate the site specific conditions to determine if calibration adjustments are required based upon environmental factors such as extreme temperature changes or significant changes in elevation or whether on-site calibration should be performed, specifically, instrument plateau tests to set the proper high voltages for the instruments.
- 4.1.7. Any on-site calibrations shall be performed using approved calibration procedures or the instruments operating manual under the guidance and review of the PHP.
- 4.1.8. Air Samplers shall be calibrated by a qualified vendor or on site using a primary standard or a calibrated secondary standard.
- 4.1.9. The RPS shall maintain copies of calibration certificates at the project site in accordance with Reference 2.2. The RPS shall confirm that the certificate of calibration and the calibration sticker attached to the radiation survey instrument agree and are up to date.
- 4.1.10. Efficiency calibrations should simulate field conditions as closely as possible. Efficiency calibrations should be performed to the types and energies of radiation expected during field conditions. Cable length, distance from source, etc. should be as close as possible to those anticipated to be used in the field.

## **4.2 Instrument Shipment**

- 4.2.1. Ensure all the necessary instrument attachments are included (i.e., cables, detectors, recorders, audible output devices, etc.).
- 4.2.2. Prepare specific calibration or maintenance instructions, as applicable.
- 4.2.3. Survey the instrument for release in accordance with the site/project specific release criteria and References 2.3 and 2.6.
- 4.2.4. Package the instruments accordingly to prevent damage during shipment.
- 4.2.5. **Do not ship instruments with the batteries installed.** Place the batteries away from the instrument(s) such that the instrument(s) shall be protected if the batteries leak during shipment.
- 4.2.6. Include the PO or charge number, survey results, and any special calibration or maintenance instructions with the instrument.

- 4.2.7. Update the instrument log and inventory to reflect the current status of the instrument.

### **4.3 Instrument Receipt**

- 4.3.1. Unpack the instrument and check for physical damage.
- 4.3.2. Review the packing list to ensure everything was received.
- 4.3.3. The PHP or designee shall review the calibration paperwork to ensure the meter was calibrated as requested. As applicable, the high voltage settings, instrument plateau tests, reported instrument efficiencies, and other calibration settings will be evaluated. If the “as found” condition on the calibration paperwork varies by more than 20% from the true value, the RPS shall evaluate any previous measurement made with the instrument and determine if any measurements need to be repeated.
- 4.3.4. Update the instrument log and inventory, Attachment 5.1.
- 4.3.5. Perform a Baseline Field Evaluation and generate Control Charts and daily response test forms in accordance with Reference 2.3 as required.

### **4.4 Instrument Failure**

- 4.4.1. Instruments and equipment which fail the daily inspection, battery check or daily response check shall be brought to the attention of the RPS.
- 4.4.2. The RPS may have technicians attempt simple instrument maintenance in accordance with Section 4.5.
- 4.4.3. If instrument failure cannot be repaired in the field, the instrument shall be removed from service and clearly labeled “Do Not Use” or “Out of Service” until the cause of the instruments failure is corrected.
- 4.4.4. Update the instrument maintenance log and inventory, Attachments 5.1 and 5.2, as needed to reflect the current status of the instrument and any repairs that were performed.
- 4.4.5. Notify the instrument vendor and coordinate the repair and/or recalibration of the instrument.
- 4.4.6. Prepare and ship the instrument in accordance with Section 4.2

### **4.5 General Field Maintenance and Repair**

- 4.5.1. General maintenance may be performed in the field on survey instruments and equipment provided it will not affect the instrument calibration. This includes cleaning, gas and hose change-out, and cable and battery exchange. For cable replacement, the cable must be approximately the same length as used during calibration (i.e., within 12 inches).
- 4.5.2. The exchange of probes may also be permitted, as approved by the RPS. This is typically performed for GM tubes such as pancake friskers which may have popped.

- 4.5.3. Mylar windows may be replaced or patched to repair pin holes, tears, and light leaks. If the Mylar window is replaced, ensure that the new window is of the same Mylar thickness as when calibrated.
- Note: If replacing the Mylar window on a scintillation detector, it should be replaced in a dark area or in a light tight bag since the detector is very sensitive to light. It may take up to 24 hours before a scintillation detector is acceptable for re-use following window replacement.**
- Note: For gas flow proportionally detectors, care should be taken not to touch the electrode wires inside the detector as these are very fine and fragile.**
- 4.5.4. Ensure that gas flow proportional detectors are properly purged following detector window maintenance and gas bottle exchange. To ensure the detector is purged, perform a purge test to make sure the detector response has reached a steady rate.
- 4.5.4.1. Place the gas flow proportional detector such that the gas exhaust is elevated. P-10 gas is heavier than air and the detector will purge quicker by displacing the air in the detector.
- 4.5.4.2. Increase the gas flow rate to 100 to 150 cc/min.
- 4.5.4.3. Allow the detector to purge a minimum 20 minutes.
- 4.5.4.4. Perform a 1 minute source count, wait 10 minutes and perform a second count.
- 4.5.4.5. If second count is with +/- 10% of the prior count, the detector has been purged and is ready for use.
- 4.5.4.6. Reduce the gas flow rate to the operational rate in accordance with Reference 2.5, (approximately 40-60 cc/min depending upon the detector).
- 4.5.5. Instrument decontamination may also be performed as necessary. During decontamination, care should be taken not to damage the detector window.
- 4.5.6. Following field instrument repair, perform an instrument response test to ensure it falls within the range of acceptable values as established during the baseline evaluation. Notify the RPS if the instrument does not fall within the acceptable range of values. The RPS shall determine if the instrument will be taken out of service for further repair and recalibration or to have a new baseline field evaluation performed.
- 4.5.7. Complete the instrument maintenance log and document any field repairs that were performed to track the maintenance history of the instrument.
- 4.5.8. All instruments, after repairs which may affect instrument calibration, shall be removed from service and scheduled for recalibration of the instrument prior to re-use.



**5.0 ATTACHMENTS AND FORMS**

**5.1 Instrument Inventory Tracking Form (Example)**

**5.2 Instrument Field Maintenance Log (Example)**



