Eberline Model RO-3B (CP) Operation and Source Checks

Tank Farm Plant Operating Procedure

RADCON

USQ # N/A-4

CHANGE HISTORY (≤ LAST 5 REV-MODS)

<table>
<thead>
<tr>
<th>Rev-Mod</th>
<th>Release Date</th>
<th>Justification</th>
<th>Summary of Changes</th>
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<tr>
<td>C-5</td>
<td>11/09/2016</td>
<td>RadCon Request</td>
<td>Modified step 5.2.4.2 and updated Records section.</td>
</tr>
<tr>
<td>C-4</td>
<td>09/01/2016</td>
<td>PER</td>
<td>Updated Records section to current standard.</td>
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<tr>
<td>C-3</td>
<td>02/23/2016</td>
<td>RadCon Request</td>
<td>Changed note above 5.3.8 &amp; added note to Attachment 2.</td>
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<tr>
<td>C-2</td>
<td>08/04/2015</td>
<td>PCA</td>
<td>Added 4th bullet under 4.2, Add Step 5.2.4 with sub-steps. Struck Notes and changed to Special Instructions prior to Step 5.2.1. Reworded Records Section</td>
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<tr>
<td>C-1</td>
<td>09/09/2014</td>
<td>RadCon request</td>
<td>Changed from Reference to Routine.</td>
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1.0 PURPOSE AND SCOPE

1.1 Purpose

This procedure provides specific information regarding the Eberline RO-3B (CP) radiation survey instrument.

1.2 Scope

This procedure provides instruction for operation and performing operational and source checks of the Eberline RO-3B (CP) radiation survey instrument.

2.0 INFORMATION

2.1 General Information

2.1.1 Specific information regarding theory of operation, calibration, maintenance, and instrument specifications and limitations, including environmental and interfering radiation can be found in MA-562, Radiation Protection Instrument Manual (or equivalent).

3.0 PRECAUTIONS AND LIMITATIONS

3.1 Equipment Safety

3.1.1 Static discharge at any point along instrument signal path may damage the instrument’s integrated circuit.
4.0 PREREQUISITES

4.1 Special Tools, Equipment, and Supplies

The following supplies may be needed to perform this procedure:

- Ion Chamber Check Source (ICCS) or Linear Beta Source (LBS)
- Four 9-volt alkaline batteries (type NEDA 1604, no substitution permitted)
- Other tools, equipment, and supplies as identified by Shift Manager/OE/FWS.

4.2 Performance Documents

The following documents may be needed to perform this procedure:

- A-6002-895, Daily Instrument Source Check Log
- BL-6006-213, Daily Source Check
- BT-6002-880, Instrument Service Tag
5.0 PROCEDURE

5.1 Operational Check

5.1.1 CONFIRM calibration of the instrument is current.

5.1.2 CONFIRM instrument source check is current (Section 5.2).

5.1.3 INSPECT instrument for the following physical defects:

- Broken meter glass
- Loose knobs
- Punctured/damaged chamber window
- Loose detector barrel
- Loose barrel ring
- Any other observable defects that would affect operation.

NOTE - Missing beta shields can be replaced in the field.

5.1.4 IF beta shield is missing, CONTACT the calibration facility for a new beta shield.

5.1.5 TURN selector switch to “BAT 1” AND CONFIRM meter reading is above the BATT cutoff line.

5.1.6 TURN selector switch to “BAT 2” AND CONFIRM meter reading is above the BATT cutoff line.

5.1.7 TURN selector switch to “BAT 3” AND CONFIRM meter reading is above the BATT cutoff line.

5.1.8 IF any battery check indicates below the BATT cutoff line, REQUEST an Instrument Technician replace all four 9-Volt alkaline batteries (type NEDA 1604) AND

REPEAT Steps 5.1.5 through 5.1.7.
5.1 Operational Check (Cont.)

5.1.9 IF batteries were replaced, PERFORM Daily Source Check (Section 5.2) prior to use.

5.1.10 TURN selector switch to the “ZERO” position.

5.1.10.1 USING the zero knob, SET instrument to zero.

5.1.11 TURN selector switch to the “5 mR/hr” range AND OBSERVE meter needle for erratic behavior.

NOTE - The intent of Step 5.1.12 is to reveal problems associated with loose parts or component stress introduced by holding the instrument in various orientations.

5.1.12 ROTATE AND HOLD instrument from one orientation to another AND OBSERVE meter indication.

5.1.13 IF placing instrument in any orientation causes fluctuations or large changes in meter reading, TAG AND RETURN instrument to the calibration facility for servicing.

5.1.14 IF the CP fails any steps other than Steps 5.1.2, 5.1.5 through 5.1.7, TAG it with a completed Instrument Service Tag, (BT-6002-880) AND RETURN it to the calibration facility for servicing.

5.1.15 IF it is determined the Instrument Service Tag was installed in error, PERFORM the following:

5.1.15.1 CONFIRM instrument passes all required operational checks.

5.1.15.2 OBTAIN concurrence from First Line Manager to place instrument back in service.

5.1.15.3 REMOVE blue tag.

5.1.15.4 PLACE instrument back in service.
5.2 Source Check

NOTE - The CP is source checked using a linear beta source or an ion chamber check source (ICCS) assembly.

- Source checks will be performed on all four ranges of the CP.
- The initial source check is performed when the instrument is received from the calibration facility.

**Initial Source Check (Receipt Test)**

**Special Instructions**

The responses observed during an instrument’s initial source check should be evaluated to determine if:

a) Net response is within the acceptable ranges printed on a calibrated source Data Sheet

OR

b) Net response is within ±20% of the mean instrument response for that source (average of measured response for three to five instruments, A-6006 – 668).

5.2.1 REMOVE beta shield from the window AND CENTER the CP window over the source position on the check source assembly.

5.2.2 MOVE the source to the appropriate position for each range of the instrument AND ALLOW instrument’s reading to stabilize.

5.2.3 OBSERVE instrument’s response on each range.
5.2 Source Check (Cont.)

5.2.4 EVALUATE initial source response as follows:

5.2.4.1 IF response is within +/- 20% of the mean or typical instrument response for that source (3-5 instruments),

OR

IF response is within +/- 20% of source strength as determined for the source by a source calibration provider, proceed to Step 5.2.5.

5.2.4.2 IF response is not within +/- 20% of the mean or typical instrument response for that source,

OR

IF response is not within +/- 20% of source strength as determined for the source by a source calibration provider, PERFORM the following:

a. IF reading is high out-of-range, CONTACT the Instrument FPOC for evaluation for continued use.

b. IF the reading is low out-of-range or Instrument FPOC determines not acceptable for continued use, THEN:

1. TAG the instrument with a completed instrument service tag (BT-6002-880) identifying the problem(s).

2. SEGREGATE the instrument to prevent inadvertent use.

3. NOTIFY RadCon management.

5.2.5 MULTIPLY instrument’s response by 0.8 and 1.2 to determine acceptable range for that instrument.

5.2.6 RECORD acceptable ranges on the Daily Instrument Source Check Log (A-6002-895) AND

COMPLETE remainder of form.

5.2.7 IF initial response is acceptable, ATTACH a Daily Source Check label (BL-6006-213), to the CP AND

COMPLETE the label.
5.2 Source Check (Cont.)

5.2.8 IF CP fails source check, TAG with a completed Instrument Service Tag (BT-6002-880) AND

RETURN instrument to calibration facility for service.

5.2.9 IF it is determined the Instrument Service Tag was installed in error, PERFORM the following:

5.2.9.1 CONFIRM instrument passes all required operational checks.

5.2.9.2 OBTAIN concurrence from First Line Manager to place instrument back in service.

5.2.9.3 REMOVE blue tag.

5.2.9.4 PLACE instrument back in service.

Daily Source Check

5.2.10 REMOVE beta shield from window AND

CENTER the CP window over the source position on the check source assembly.

5.2.11 MOVE source to the appropriate position for each range of the instrument.

5.2.12 CONFIRM instrument's response falls within the acceptable ranges on the A-6002-895, Daily Instrument Source Check Log.

5.2.13 IF instrument response is within the acceptable ranges, COMPLETE the following:

- Daily Instrument Source Check Log (A-6002-895)
- Daily Source Check label (BL-6006-213).

5.2.14 IF instrument failed the source check, TAG it with a complete Instrument Service Tag, (BT-6002-880) AND

RETURN it to the calibration facility.
5.2 Source Check (Cont.)

5.2.15 IF it is determined the Instrument Service Tag was installed in error, PERFORM the following:

5.2.15.1 CONFIRM instrument passes all required operational checks.

5.2.15.2 OBTAIN concurrence from First Line Manager to place instrument back in service.

5.2.15.3 REMOVE blue tag.

5.2.15.4 PLACE instrument back in service.
5.3 Operating Instructions

NOTE - Readings below 0.1 mR/hr are typically considered below the minimum sensitivity of the instrument and are recorded as “< 0.1 mR/hr”.

- The minimum sensitivity of the CP should be considered when choosing the appropriate instrument to perform a survey.

- For example, the CP does not have sufficient sensitivity to perform a posting survey to establish the boundary of an RBA (100 mRem/yr).

5.3.1 PRIOR to using the RO-3B (CP) PERFORM Steps 5.1.1 through 5.1.14.

NOTE - Typical symptoms of damage due to static discharge include the following:

- A zero reading with no response to source check
- An off scale high reading with no reduction when moved away from source
- A moderate reading with the inability to zero the instrument.

5.3.2 IF damage to the CP is suspected during survey (e.g., instrument is dropped), PERFORM either of the following:

5.3.2.1 CHECK CP against a previous reading or a well-known, constant, non-zero field AND CONFIRM response is within ± 20%.

5.3.2.2 IF an established field is not available, PERFORM the Daily Source Check per Section 5.2.

NOTE - Under conditions where there is a high potential for static build-up (dry conditions), the RO-3B (CP) may be grounded frequently (approximately once every hour) and before making a measurement near (within 1 inch) a grounded object.

5.3.3 GROUND the RO-3B (CP) in order to discharge static in a controlled manner and to prevent instrument damage as follows:

5.3.3.1 TURN instrument to the “OFF” or “ZERO” position.

5.3.3.2 TOUCH metal case to any grounded metal surface.
5.3 Operating Instructions (Cont.)

NOTE - Rapid movement of the instrument can cause momentary measurement inaccuracy due to the effects of 1) inertia on the needle of the meter movement and 2) response time.

- When selecting the most sensitive range (5 mR/hr), switching noise may cause a temporary meter deflection. This can be avoided by first selecting a higher range, letting the needle settle and then switching to the 5 mR/hr range.

5.3.4 TURN the RO-3B (CP)’s selector switch to the desired range AND

MOVE the instrument slowly while observing the meter response.

5.3.5 WHEN a measurement is to be performed at a particular location, ALLOW at least one time constant (5 seconds on lowest range) for the reading to stabilize on the final value.

5.3.6 POINT instrument toward all possible sources of radiation.

5.3.7 PERFORM window open (WO) and window closed (WC) radiation measurements.
5.3 Operating Instructions (Cont.)

NOTE - Applying correction factors is required when setting personal dose rates or as directed by Technical Work Documents. If not, the minimum 3 for beta and 1 for gamma is required. Use Attachment 2 to find the correction factors.

- Correction factors for temperature are required when the ambient temperature is less than 0 °C (32 °F).

5.3.8 CALCULATE deep and shallow dose rates as follows (include neutron dose contribution, as applicable):

Deep Dose Rate = \((WC \times CF_{pen}) \times CF_{temp}\)

Shallow Dose Rate = \(\left[\left(WO-WC\right) \times CF_{non-pen} + WC \times CF_{pen}\right] \times CF_{temp}\)

Where:

- \(WC\) = the instrument response with the window closed
- \(WO\) = the instrument response with the window open
- \(CF_{non-pen}\) = non-penetrating (i.e., beta) correction factor
- \(CF_{pen}\) = penetrating (i.e., gamma) correction factor
- \(CF_{temp}\) = Temperature correction factor

5.3.8.1 IF \(WC\) indication is less than one tenth of the \(WO\) indication, CALCULATE shallow dose as follows:

Shallow Dose Rate = \((WO \times CF_{non-pen}) \times CF_{temp}\)
5.4 Geometry Correction Factors

NOTE - Small Beam Correction Factors are used when the beam is too narrow to ionize the air in the chamber uniformly (i.e., beam diameter is less than 3 inches).

- Small Beam Correction Factors are calculated as the ratio of the chamber cross sectional area to the beam cross sectional area.
- When measuring beams, the chamber axis should be parallel with the beam (beam must be coaxial with the chamber).
- Though beams are not typically observed with non-penetrating radiation, the beam correction factors are applied to both penetrating and non-penetrating beam conditions.

**Small-Beam Correction Factors**

5.4.1 **USE** the CP correction factor chart on the side of the instrument, except when \( CF_\text{non-pen} < 3 \).

5.4.1.1 **WHEN** \( CF_\text{non-pen} < 3 \), **USE** a minimum value of 3.

NOTE - Close Geometry Corrections Factors are used when the CP measurements are taken with the CP window less than 6 inches from the source.

**Close Geometry Corrections Factors**

5.4.2 **IF** the CP window is less than 1 inch from the source, **USE** the correction factors provided in MA-562 and on the side of the CP.

5.4.3 **IF** measurements are for large uniform cylindrical sources (diameter > 18”) and large flat surfaces (diameter > 18”) that have uniform surface dose rate, **USE** a correction factor of 1 (\( CF_\text{pen} = 1 \)) for penetrating radiation.

5.4.4 **IF** the CP window is \( \geq 1” \) and < 6” from the source, **USE** a \( CF_\text{non-pen} = 3 \) and \( CF_\text{pen} = 1.5 \).

NOTE - Far Field Geometry Correction Factors are used when radiation fields are measured at distances \( \geq 6” \) from the source.

**Far Field Geometry Correction Factors**

5.4.5 **IF** the CP window is \( \geq 6 \) inches from the source **USE** a \( CF_\text{non-pen} = 3 \) and \( CF_\text{pen} = 1 \).
5.5 Temperature Correction Factors

NOTE - Temperature Correction Factors are used when the CP is used in an environment where the temperature is less than 0°C (32°F). The correction factors are given below.

- Temperature Correction examples are given on Attachment 1.

5.5.1 IF Temperature is ≥ 0 but < 32 °F (≥ -17 but < 0 °C), MULTIPLY Instrument Response by 0.90.

5.5.2 IF Temperature is ≥ -20 but < 0 °F (≥ -29 but < -17 °C), MULTIPLY Instrument Response by 0.85.
### 5.6 Records

5.6.1 **PERFORM** the following for records identified within this procedure.

5.6.1.1 On the Records Submittal Checklist, **RECORD** the number of pages that were completed

**OR**

PLACE a check mark (√) in the N/A column.

5.6.1.2 **ATTACH** the completed records to the Records Submittal Checklist **AND**

**SIGN** Records Submittal Checklist indicating the package is complete.

5.6.1.3 **SUBMIT** the completed records to an approved RadCon Record Storage Area for retention.

The record custodian identified in the Company Level Records Inventory and Disposition Schedule (RIDS), is responsible for record retention in accordance with TFC-BSM-IRM_DC-C-02.

<table>
<thead>
<tr>
<th>Records Submittal Checklist</th>
<th>Number of pages completed</th>
<th>N/A (√)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Form A-6002-895, Daily Instrument Source Check Log</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| __________________________ | __________________________ | __________________________ |
| Signature                  | Print (First and Last Name) | Date                   |
| First Line Manager (or designee) |                             |                       |
1. Determine the shallow dose rate on contact with a 0.5” source. The contact window open and window closed readings are WO = 20 mR/hr and WC = 10 mR/hr, measured outdoors at a temperature of 5 °F.

From the correction factor chart on the side of the CP, the CF\text{non-pen} = 90 and CF\text{pen} = 40.

\[
\text{Shallow Dose Rate} = [(\text{WO} - \text{WC}) \times \text{CF}_{\text{non-pen}} + \text{WC} \times \text{CF}_{\text{pen}}] \times \text{CF}_{\text{temp}}
\]

\[
= [(20 - 10) \times 90 + (10 \times 40)] \times 0.90
\]

\[
= 1,170 \text{ mRem/hr}
\]

\[
= 1.2 \text{ Rem/hr}
\]

2. A large drum (36” diameter) is being prepared for shipment. The window closed reading is WC = 25 mR/hr and is uniform over all exterior surfaces of the drum. The measurement is made indoors at a temperature of 70 °F. Determine the deep dose rate on contact with the drum.

Because this is a large source (diameter > 18”), the penetrating correction factor is CF\text{pen} = 1.

\[
\text{Deep Dose Rate} = \text{WC} \times \text{CF}_{\text{pen}} \times \text{CF}_{\text{temp}}
\]

\[
= 25 \times 1 \times 1 \text{ mRem/hr}
\]

\[
= 25 \text{ mRem/hr}
\]
## Attachment 2 – CP Correction Factors to Obtain Exposure Rate at the Window

<table>
<thead>
<tr>
<th>Diameter&lt;sup&gt;(a)&lt;/sup&gt; in.</th>
<th>Disc</th>
<th>Disc and Field</th>
<th>Beam</th>
<th>Cylinder&lt;sup&gt;(b)&lt;/sup&gt;</th>
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<tbody>
<tr>
<td></td>
<td>β @ Contact</td>
<td>γ @ Contact</td>
<td>β @ ½ in.</td>
<td>γ @ ½ in.</td>
</tr>
<tr>
<td>&lt; ½</td>
<td>100</td>
<td>40</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>½</td>
<td>90</td>
<td>9</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>¼</td>
<td>54</td>
<td>30</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>1</td>
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<td>23</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>½</td>
<td>17</td>
<td>13</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>9</td>
<td>8</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>4.5</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>&gt; 3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(a) γ correction for source ≥ 18 in. = 1.0.
(b) Cylinder is on contact w/end of CP barrel; axis of cylinder is perpendicular to axis of CP chamber.
(c) Dimension is the cylinder length.
(d) For measurements at greater than 6 in., measure the distance between centerline of the instrument chamber and source.

NOTE – When determining correction factor values on the length of a cylinder that is between available lengths on the table (e.g. between the 4” and 8” choose the smaller length or 4” correction factor). When the diameter of the item is between two available values on the table (e.g. between 3” and 2” choose the smaller diameter or 2” correction factors).