

**Canadian Nuclear Safety Commission**  
**Regulatory Expectations for Calibration of Survey Meters**

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## **1. Introduction**

The CNSC regulations require radiation survey meters to be calibrated, in order to assure persons using the survey meter that the unit is functioning properly and that the readings obtained are representative of the actual conditions.

This document outlines the CNSC's expectations for applicants and licensees to meet regulatory requirements with respect to the calibration of survey meters.

Nothing in this document shall be construed to imply that the CNSC authorizes, certifies or licences persons to conduct survey meter calibrations. It is the responsibility of the licensee to ensure that any person conducting a survey meter calibration on their behalf can do so in accordance with CNSC regulatory requirements and the expectations outlined in this document.

## **2. Regulatory Basis**

The regulatory requirement to have a calibrated survey meter is specified in section 20 of the *Nuclear Substances and Radiation Devices Regulations* and in sub-section 18(2) of the *Class II Nuclear Facilities and Prescribed Equipment Regulations*:

*No person shall use, for the purpose of the Act, the regulations made under the Act or an order or a licence, a radiation survey meter that has not been calibrated within the 12 months preceding its use.*

## **3. Program Expectations for Calibration of Survey Meters**

In order to ensure that the requirements of the Regulations are met for having a survey meter that is calibrated, applicants and licensees must verify that the calibration is carried out in accordance with the following expectations.

### **3.1. Calibration Procedure Documentation**

Before calibrating any specific make and model of survey meter, the person conducting the calibration shall have available for inspection and assessment a documented calibration procedure consisting of:

- (a) a general description of the method of calibration;
- (b) an identification and proof of verification of uncertainties associated with the jig, the source, attenuators, and decay correction which are associated with the total uncertainty of the calibration;

(c) step-by-step procedures, preferably including manufacturers' manuals, to show that sufficient information about the survey meter is available to operate, to perform pre-calibration checks and to calibrate the specific survey meter.

### **3.2. Survey Meter Pre-Calibration Check**

Before calibration, each survey meter shall have a pre-calibration check that consists of:

- (a) a battery check to ensure a satisfactory voltage can be maintained throughout the calibration;
- (b) a verification of operating voltage, and
- (c) a comprehensive functional check on all ranges of the survey meter.

### **3.3. Physical and Environmental Expectations for Jigs and Survey Meters**

- (a) The beam calibrator jig must be located in the following manner:
  - (i) to minimize radiation scatter and be at least 1 m from the floor, the ceiling, and from any wall. The distance between any scattering object and the source must be at least 0.5 m,
  - (ii) in an area free of interference from sources of ionizing radiation other than the calibration source, and
  - (iii) in an area where electrostatic, electrical and magnetic fields and other non-ionizing radiation, such as radio frequency and microwave, will not affect instrument response.
- (b) The survey meter to be calibrated shall:
  - (i) be positioned on the jig to minimize bias due to geotropism, directional dependence, and non-uniformity of the source radiation beam across and through the detector volume, and
  - (ii) have any beta window or shield in the optimum position (normally closed) for best (i.e. flattest) energy response.
- (c) The uncertainty in calibration distance shall not be greater than 2% and shall be the arithmetic sum of the uncertainty of the jig distance scale, the uncertainty in physical placement and repositioning of the survey meter, the uncertainty in location of the source centre when on the jig, and the uncertainty of the centre of the sensitive volume of the survey meter detector.
- (d) The survey meter to be calibrated shall have achieved equilibrium with the temperature, pressure and humidity of the local calibration area. These environmental parameters should be noted and shall be within the approved range as specified by the manufacturer of the survey meter. It is recommended that instruments are calibrated at about 20°C (68°F) and 101.3 kPa (1 atmosphere), or at the anticipated operational parameters. It should be noted that the response of some survey meters must be corrected for temperature and pressure. Therefore, where required, such corrections must be performed.

(e) The calibration should be carried out where the level of background radiation is known and the appropriate corrections made to compensate for the contribution from this potential source of error. This is particularly important when measuring at the lowest ranges on the survey meter.

### **3.4. Expectations for Calibration Sources**

It is preferable to use the same reference isotope as the manufacture for the calibration source, especially if the manufacturer's specified energy response is to be assumed. Whatever isotope is used, the energy dependence of the dose rate response of the survey meter shall be known and shall be within 30% of the true dose rate over the energy spectrum of interest.

The calibration source activity (or exposure rate) shall be known to an uncertainty of not greater than  $\pm 10\%$ . This uncertainty shall include attenuators (used singly or in combination), if they are an integral part of the source assembly. A calibration source certificate shall be available for inspection, and as a minimum the source shall be implicitly traceable through a source supplier to a national or international standard. The calibration source activity shall be corrected for decay at a frequency to ensure its activity is within 1 % of its true value.

### **3.5. Expectations for Survey Meter Calibration**

Each survey meter shall be calibrated up to its highest range or the 10 mSv/h range, whichever is lower. The manufacturer's recommended calibration method, if any, must be followed, and the calibration shall be verified at about 20 to 25% and 75 to 80% of the measurement of each range or decade.

Measurement shall be recorded before and after any necessary (or preferred) calibration adjustments. A survey meter shall be considered to meet the criteria for being adequately calibrated when each observed measurement is within  $\pm 20\%$  of the expected dose rate.

Measurements above 10 mSv/h need not be calibrated, but each range shall be checked to ensure response and, as far as practicable, by decreasing calibration distance the appropriate increasing dose rate response shall be checked.

### **3.6. Expectations for Record Completion**

Immediately following calibration the person completing the calibration must complete a calibration certificate, and complete and affix a durable calibration sticker, bearing the date of calibration, to the survey meter. The person conducting the calibration shall return the original certificate with the survey meter to the user.

If a survey meter fails to meet the criteria for being adequately calibrated, the person conducting the calibration shall immediately notify the person who requested the calibration.

If requested to do so, a person conducting the calibration may, if they are qualified through training or other certification, repair a survey meter before returning to the user. Subsequent to any repair which exceeds the manufacturer's instructions for normal maintenance, a survey meter shall be recalibrated.

### **3.7. Documentation of Calibration**

In order to meet the requirements of Section 20 of the NSRD Regulations, licensees must make available on request to the CNSC a document for each survey meter which includes the following information:

- (a) Licensee Name and CNSC Licence Number;
- (b) Survey meter make and model, including serial number of the detector unit and the probe used in the calibration, if appropriate;
- (c) The calibration source used, including isotope and activity;
- (d) The results of the pre-calibration checks, including:
  - (i) battery condition
  - (ii) operating voltage
  - (iii) temperature, pressure and humidity, at the time of calibration;
- (e) For each range calibrated,
  - (i) the range on the survey meter that was calibrated,
  - (ii) the expected dose rate using the calibration device,
  - (iii) the observed dose rate on the survey meter, with units, including both pre- and post calibration;
  - (iv) the calculated percent variance of the observed dose rate versus expected dose rate; and,
  - (v) any notes of concerns or anomalies for that range;
- (f) Any notes of anomalies or problems associated with the calibration of the survey meter in general;
- (g) The date of the calibration of the survey meter;
- (h) The name and signature of the person who conducted the calibration; and,
- (i) Acknowledgement that the calibration was carried out in accordance with these requirements.

### **4. Maintenance of Records**

The licensee shall retain a record of each survey meter calibration as required by the NSC Act and Regulations and shall retain those records for the period specified in the licence or the Regulations, as appropriate.