



**Radiation Safety  
Institute of Canada**  
Institut de radioprotection du Canada

Radiation Safety &  
Wellness Webinars



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# Survey Meter Calibration

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Followed by Mandel Fraser from PowerYoga West

Good Science in Plain Language®



# Webinar Functionality

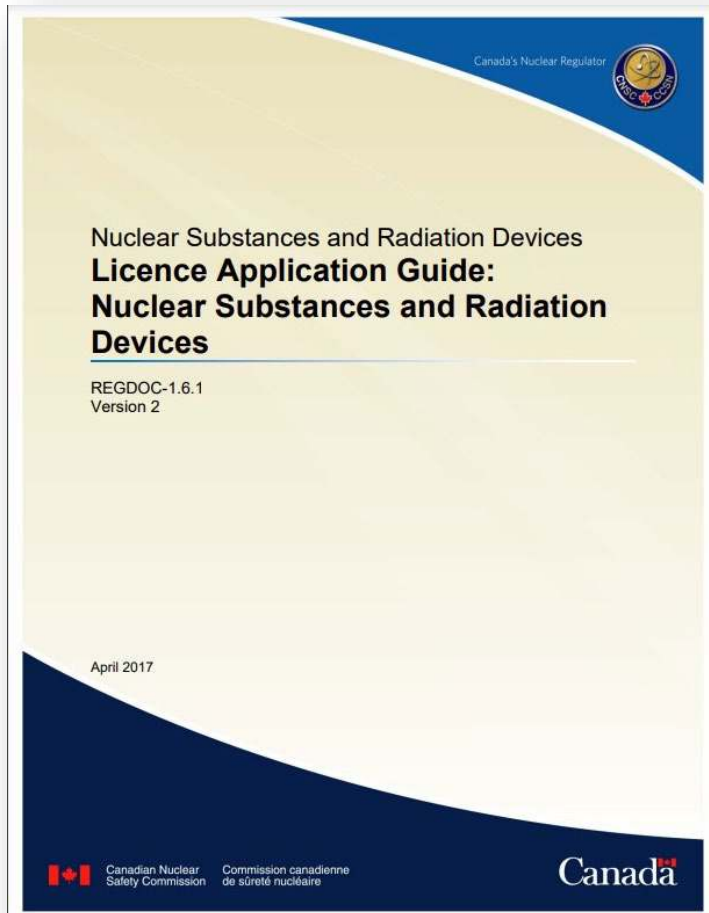


- Audio and video
  - During the presentation, from the presenters only
  - Use computer or telephone (call in)
  - Computer seems to give the best sound quality
  - Technical difficulties: 1-800-263-5803 x321
- Use the “Chat” feature to enter comments and questions
- Posted on webinar page
  - Video, answers to questions, copy of the slides
- Follow up email will be sent
  - Topics covered, time of attendance
- It may be possible to change your Zoom view if the controls are hiding the closed captioning.



- CNSC Regulatory Expectations of Calibration of Survey Meters
  - REGDOC 1.6.1
    - Appendix Z
- Tour of Calibration Laboratory
- Q&A
- Wellness





- Guidance documents
- REGDOC 1.6.1
  - Licence Application Guide: Nuclear Substances and Radiation Devices
- Appendix Z
  - Regulatory Expectations for Calibration of Survey Meters
- Nuclear substances>Class II nuclear facilities and prescribed equipment>Information for Class II licensed facilities>Regulatory Expectations for Calibration of Survey Meters





### Nuclear Substances and Radiation Devices Regulations

- Section 20



### Class II Nuclear Facilities and Prescribed Equipment Regulations

- Sub-section 18(2)

*"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."*



Applicants and licensees are responsible to verify the calibration is carried out in accordance with CNSC expectations.



- Person calibrating must have a documented calibration procedure
  - General description
  - Identification and proof of verification of uncertainties
    - Jig
    - Source
    - Attenuators
    - Decay correction
  - Step-by-step procedures to show sufficient survey meter information
    - Operate
    - Perform pre-calibration checks
    - Calibrate specific meter





- Before calibration
  - Battery check
  - Verification of operating voltage
  - Comprehensive functional check
    - All ranges



# Jig & Survey Meter Expectations

## Z.3.3 | 3.3

Consideration	Requirements
Beam calibrator jig location	<ul style="list-style-type: none"><li>• At least 1 m from floor, ceiling, wall</li><li>• At least 0.5 m from any scattering object</li><li>• Free from ionizing radiation interference</li><li>• Free from interference from electrostatic, electrical, and magnetic fields, other non-ionizing radiation</li></ul>
Position in the jig	Minimize bias due to geotropism, directional dependence, non-uniformity of the source radiation beam across and through the detector volume
Window/shield	Have any beta window or shield in the optimum position for best energy response
Distance uncertainty	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 center when on the jig, and the uncertainty of the center of the sensitive volume of the survey meter detector
Environmental conditions	<ul style="list-style-type: none"><li>• Achieved temperature, pressure, humidity equilibrium</li><li>• Recommended 20°C and 101.2 kPa</li><li>• Corrections for temperature and pressure required by a survey meter must be performed</li><li>• Level of background radiation in area should be known and appropriate corrections made to compensate.</li></ul>



- Preferable to use the same reference isotope as the manufacturer
- Energy dependence of dose rate response
  - Shall be known
  - Shall be within 30% of the true dose rate over the energy spectrum of interest
- Calibration source activity or exposure rate
  - Uncertainty  $< \pm 10\%$ 
    - Includes attenuators which are integrate parts of source assembly
  - Calibration source certificate
    - Source traceable to national or international standard
  - Source activity corrected to be accurate within 1% of current value



ENERGY.GOV, Public domain, via Wikimedia Commons



# Calibration Expectations

## Z.3.5 | 3.5



- Calibrated up to highest range or 10 mSv/h range
  - Whichever is lower
- Follow manufacturer's recommended method
  - If available
- Verified at about 20-25% and 75 – 80% of the measurement of each range or decade
- $\pm 20\%$  of expected dose rate is adequate calibration
- Above 10 mSv/h need not be calibrated, but must be checked for response
  - Increasing dose rate response



- Must immediately
  - Complete calibration certificate
  - Complete and affix durable calibration sticker
    - Date of calibration
  - Return original certificate to user
  - Fails to meet requirements:
    - Immediately notify requesting person
    - If qualified and requested to do so, repair
      - If repair goes beyond maintenance, recalibration required



# Documentation Z.3.7 | 3.7

Licensee name and CNSC licence number

Survey meter make and model, including serial number of the detector unit and the probe used in the calibration, if appropriate

The calibration source used, including isotope and activity

The results of the pre-calibration checks, including:

- Battery condition
- Operating voltage
- Temperature, pressure and humidity, at the time of calibration

For each range used in the calibration

- The range on the survey meter that was calibrated
- The expected dose rate using the calibration device
- The observed dose rate on the survey meter, with units, including both pre and post calibration
- The calculated percent variance of the observed dose rate versus expected dose rate
- Any notes of concerns or anomalies for that range

Any notes of anomalies or problems associated with the calibration of the survey meter in general

The date of the calibration of the survey meter

The name and signature of the person who conducted the calibration

Acknowledgement that the calibration was carried out in accordance with these requirements

Upon request, licensees must produce to the CNSC





- Licencee must retain records of calibration for period specified in the licence or the Regulations

### 5.1 Accelerators

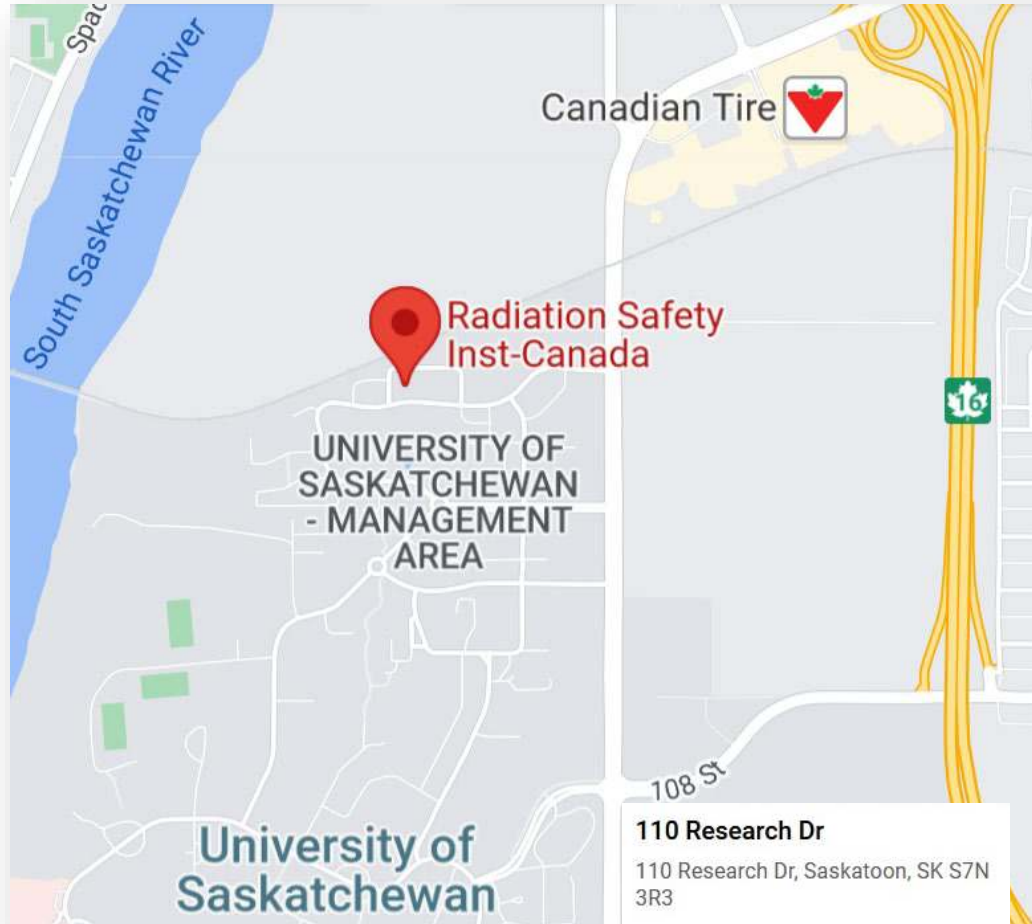
- Pulsed radiation fields
- Ion chambers preferred
- G-M not suitable, not accepted for dose-rate measurements
  - Can be used to scan for hot spots, activated components, ancillary equipment (check sources)
- Scintillators evaluated on case-by-case basis

### 5.2 Cyclotrons

- Analog displays such as magnetic deflection meters not suitable

### 5.3 Sealed Sources

- Any type may be used provided specifications confirm it is suitable for intended use
- If GM, energy compensated are preferred;
- Non-compensated GM must be calibrated for energy of interest



Map courtesy of Google Maps



- Questions posted in the chat room
- To ask a question verbally
  - use “raise hand” button
  - When asked, press spacebar or unmute to speak
- Questions we do not get to
  - Answers will be posted to our website and link to resources emailed out





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***“Good science in plain language”<sup>®</sup>***

***Thank you for listening!***

[www.radiationsafety.ca](http://www.radiationsafety.ca)

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- Nuclear Safety and Control Act: <https://laws-lois.justice.gc.ca/eng/acts/n-28.3/>
- Class II Nuclear Facilities and Prescribed Equipment Regulations: [\*Class II Nuclear Facilities and Prescribed Equipment Regulations\*](#)
- Nuclear Substances and Radiation Devices Regulations: <https://laws.justice.gc.ca/eng/regulations/sor-2000-207/>
- REGDOC-1.6.1 Version 2 - Nuclear Substances and Radiation Devices Licence Application Guide: [http://nuclearsafety.gc.ca/pubs\\_catalogue/uploads/REGDOC-1-6-1-Licence-Application-Guide-Nuclear-substances-and-Radiation-Devices-version2-eng.pdf](http://nuclearsafety.gc.ca/pubs_catalogue/uploads/REGDOC-1-6-1-Licence-Application-Guide-Nuclear-substances-and-Radiation-Devices-version2-eng.pdf)
- Regulatory Expectations for Calibration of Survey Meters: <http://nuclearsafety.gc.ca/eng/nuclear-substances/licensing-class-II-nuclear-facilities-and-prescribed-equipment/information-class-II-licensed-facilities/regulatory-expectations-calibration-survey-meters.cfm>