Department of Health and Human Services
Population Health

Radiation Protection Act 2005 – Section 17

CERTIFICATE OF COMPLIANCE:

STANDARD FOR SEALED RADIATION SOURCE -

BETA GAUGE

SECTION 1: REQUIREMENTS FOR CERTIFICATES OF COMPLIANCE FOR CLASSES OF RADIATION SOURCES

SECTION 2: PARTS OF STANDARDS AND CODES OF PRACTICE ADOPTED BY THIS STANDARD

This information can also be accessed at
http://www.dhhs.tas.gov.au/peh/radiation_protection

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Section 1 – REQUIREMENTS FOR CERTIFICATES OF COMPLIANCE FOR CLASSES OF RADIATION SOURCES

This Standard is to be used when assessing Radiation Sources, classified by Radiation Protection Act 2005 licences as "Sealed Thickness Measurement" or "Sealed Mineral Content Measurement", for the purpose of issuing a certificate of compliance.

In order for a certificate of compliance to be issued the Radiation Source must be shown to fully comply with the requirements in Section 2.

† **Where an item was demonstrated to comply at the time of manufacture or supply, ongoing compliance for that item may be stated only if it is reasonable to assume there has been no change, modification, damage or unacceptable wear and tear to that item since the time of manufacture.**

The requirements in Section 2 are taken from the following:

RPS 13	*Code of Practice for Safe Use of Fixed Radiation Gauges (2007).*
ISO 1	*ISO 9978: 1992 (E) International Standard* Radiation protection – Sealed radioactive sources – Leakage test methods.
ISO 2	*ISO 2919: 1999 (E) International Standard* Radiation protection – Sealed radioactive sources – General requirements and classification

For the most part the ***RAR*** requirements for construction of the gauge, shutter and its associated assemblies, have been based on information provided by Honeywell and Metso Automation. More general requirements regarding sources, type, toxicity etc are based on **ARPANSA *RPS 13*** *"Code of Practice for Safe Use of Fixed Radiation Gauges (2007)*".

Section 2 – PARTS OF STANDARDS AND CODES OF PRACTICE ADOPTED BY THIS STANDARD

ITEM	**Requirements**
Radioactive Sources	
Only appropriate sources †	Radioactive material used in gauges must be appropriate for the particular application, with regard to its activity, half-life, energy and type of radiations emitted. Typically only ^{85}Kr, ^{147}Pm, ^{90}Sr and ^{55}Fe will be used in this type of gauge ***RPS 13* B1.1 (a)**
Toxicity †	The radioactive source must not be a radioactive material of high committed effective dose per unit of intake activity ($Sv\ Bq^{-1}$), such as those listed below, unless: (i) it is necessary for the production of neutron radiation for the particular gauging use; or (ii) a radioactive material of low committed effective dose per unit of intake activity, that produces radiation of the required type and energy for the particular gauging application, is unavailable or is otherwise impracticable for use as the source. **Radioactive materials of high committed effective dose per unit of intake:** ^{210}Pb, ^{210}Po, ^{226}Ra, ^{228}Ra, ^{227}Ac, ^{228}Th, ^{230}Th, ^{231}Pa, ^{232}U, ^{233}U, ^{234}U, ^{237}Np, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{242}Pu, ^{241}Am, ^{243}Am, ^{242}Cm, ^{243}Cm, ^{244}Cm, ^{245}Cm, ^{246}Cm, ^{249}Cf, ^{250}Cf, ^{252}Cf ***RPS 13 B1.1 (b)***
Chemical and physical form †	The radioactive material must be in a chemical and physical form that, throughout the projected useful life of the gauge in which it is used, will minimise: (i) corrosion and build up of internal pressure; and (ii) dispersal and solubility of the radioactive material if the source capsule is ruptured. ***RPS 13* B 1.1 (c)**
Minimum activity †	The radioactive material must not have an activity that is greater than necessary to ensure that the gauge operates effectively during its projected useful life and the activity will depend on the: (i) effective radiation path length between the source and detector; and (ii) detector sensitivity and the proposed conditions of its use, where an allowance may be made for a 25% loss of detection sensitivity during the lifetime of the gauge; and (iii) shielding effects of intra-beam material; and (iv) half-life of the radioactive material used. ***RPS 13* B 1.1 (d)**

Radioactive source encapsulation †	Each radioactive source used in a gauge must be: (a) a sealed source of durable design and construction; and (b) readily identifiable by use of appropriate markings and documentation. ***RPS 13 B* 2.1** The form and working life of each source used in a gauge must be suitable for: (a) the particular application; and (b) the useful life of the gauge; and (c) environmental conditions of its use. ***RPS 13* B2.2** The outermost capsule of a radioactive source that is used in a gauge (located inside a gauge) must satisfy the American National Standard N 452.1977 (NBS Handbook 126) if the source pre dates 2000. **RAR** For radioactive sources post 2000 they must satisfy ISO (International Standard) 2919-1999(E); Note: A radioactive source that complies with the 'special form' design and test requirements of the IAEA (International Atomic Energy Agency) would satisfy the ISO test requirements. **RPS 13 *B 2.3*** **RPS 13 *B 2.3***
Gauges	
Construction requirements for a gauge	
Shielding with depleted uranium †	Radiation source containment that incorporates depleted uranium in its construction must be durably marked to: (a) warn of the presence of depleted uranium; and (b) indicate the quantity incorporated; and (c) provide information on the relevant physical (i.e. may spontaneously catch fire when finely divided) and radiological safety requirements. ***RPS 13* C1.1**
Useful beam aperture †	The useful beam aperture in the shielded container for a radioactive source must be limited to a size no larger than necessary for the effective operation of the gauge. ***RPS 13* C1.2**
Collimator requirements †	Where a collimator insert or diaphragm is required to limit the size of the useful beam, such a modification must: (a) only be fitted by the manufacturer or authorised service representative; and (b) not interfere with the effective operation of the gauge; and (c) not reduce the shielding properties or other safety features of the containment. ***RPS 13* C 1.3**
Means for terminating exposure ††	A fixed Beta gauge must be fitted with: (a) a shutter; or (b) a means of moving the source to a safe position; or (c) a means of de-energising the radiation source. ***RPS 13* C 1.4**

Exposure rates	When the source container is loaded with the source of greatest activity for which it is designed, the radiation level must not exceed 500 micro Sv/h at any point 5 cm from the external surface and 10 micro Sv/h at any point 1 metre from its surface. Determination of these radiation levels is to be made with the shutter or source control mechanism in the beam off position. **RPS 13 C2.3**
Temperature variation while gauge is in use †	The gauge must be designed to withstand variations of temperature to which it may be subjected in use, without deterioration either of containment or ease of operation of the shutter or source control mechanism that may be fitted; and with due consideration given to brittle fracture of the materials used. ***A typical environment for a beta gauge would be 20 degrees Celsius to 85 degrees Celsius.*** ***RAR***
Gauge resistant to heat †	Evidence of testing without malfunction of the gauge or loss of shielding when subjected to at least: ***85 degrees Celsius for a period of one hour*** must be provided
Lifting attachments for the gauge †	The gauge must be designed so that when any incorporated lifting attachments are used in the intended manner, they do not impose damaging stresses on the structure of the gauge or shielded enclosure. ***RPS 13* C 1.8 (b)**
Quality of welding and brazing used in constructing the gauge †	Any welded, brazed or similar joint must: (a) be in accordance with published standards (AS2205.1 to AS2205.10) ***RPS 13* C 1.9**
Resistance to impact †	Evidence of testing without malfunction of the gauge or loss of shielding when subjected to at least ***5 drop tests from 1 meter*** must be provided. ***RAR***
Resistance to compression †	Evidence of testing without malfunction of the gauge or loss of shielding when subjected to at least ***compression in three perpendicular directions with a force of 2.5 kN*** must be provided ***RAR***

Shutter	The gauge must have a shutter, and/or a means of moving the source to a safe position. ***RAR***
Indicators	The status (ON/OFF) of the shutter must be indicated by mechanical or electronic indicators. There must be a means of visually indicating if the shutter fails to close. ***RAR***
Shutter to be "fail safe"	In case of power failure or malfunction in software or hardware controls the shutter must automatically close. ***RAR***
Mechanism to be tested for reliability. †	The design of the shutter mechanism must be demonstrated to be reliable by providing evidence of testing of the gauge, without malfunction, when subjected to at least: ***a minimum of 25,000 ON/OFF cycles*** ***RAR***
Lockable Shutter	The shutter or source control mechanism must be provided with an effective lock so that it can be secured in the beam off position. ***RAR***
Exposure rates	When the gauge is loaded with the source of greatest activity for which it is designed, the radiation level (ambient dose equivalent) must not exceed 50 µSv/h at any point 5 cm from the external surface and 3 µSv/h at any point 1 metre from its surface. Determination of these radiation levels is to be made with the shutter or source control mechanism in the beam off position. ***RAR***
Means of ensuring that no part of any person can enter the while the gauge is in the 'beam on' configuration.	Any air gap between the source and detector head must be small enough to restrict such access. Typical air gaps of between 6 mm and 14 mm restrict access while the gauge is in use. ***RAR***
Damage to the gauge from vibration, acceleration and vibration resonance †	The gauge must be designed and constructed so that it can withstand the effects of all vibrations, acceleration and vibration resonance likely to arise during its use, without damage, or reduction in ease of operation of the shutter, where fitted, or source control mechanism. Evidence of testing without malfunction of the gauge or loss of shielding when subjected to at least: ***Vibrations in the frequency range 10 Hz to 500 Hz at a peak acceleration of 40 m/s² for 2 hours at critical resonance frequency in each direction*** must be provided. ***RAR***
Compatibility of materials used in constructing the gauge †	The gauge must be constructed of materials that: (a) are physically and chemically compatible with each other and, where applicable, the materials of the radioactive sources that it is designed to contain; and (b) can withstand the effects of prolonged irradiation without significant deterioration of any physical properties necessary for the safety of the gauge; and (c) are resistant to corrosion or other physical or structural damage, which may occur during the use, transport and storage of the gauge. ***RPS 13* C 1.10**

Manual and mechanical handling for the gauge †	The gauge must be provided with features to maintain safe: (a) manual handling, if it has a gross mass of 10 kilograms to 50 kilograms; or (b) mechanical handling, if it has a gross mass of greater than 50 kilograms. ***RPS 13* C 1.11**
Labels and markings required on the gauge	Each label located on a gauge must be made of a material that can withstand the long-term effects of corrosion and general exposure to the environment in which it is to be used. ***RPS 13* C 1.14**
Marked with trefoil and CAUTION or WARNING	The gauge must be durably marked with a legibly stamped or engraved label incorporating the trefoil radiation hazard symbol followed by words of the general form: "Radiation Source ". ***RPS 13* C 1.12** The symbol and markings on the label specified above must be black on a yellow background. ***RPS 13* C 1.13**
Information required on the durable label on a gauge	The durable label on the gauge must also contain the following information: (a) manufacturer name, model and serial number of the gauge and/or container; and (b) name and address of the source supplier and/or manufacturer; and (c) name of the radioactive material; and (d) model and serial number of the radioactive source; and (e) ISO class number of the radioactive source; and (f) original activity of the radioactive source and date the activity was measured; and (g) maximum radiation dose rate at one metre from the surface of the gauge (with all shutters closed) and date this measurement was made. ***RPS 13* C2.5**
Test for non fixed contamination	^{55}Fe, ^{147}Pm and ^{90}Sr sources must be wipe tested[1] and the non fixed contamination levels [1] not to exceed those specified in ISO 9978 ***RAR***
Non fixed contamination levels	Non-fixed contamination levels must not exceed those specified in ISO 9978. **RAR**
Preventative maintenance	Evidence that the gauge has been inspected at 6 monthly intervals to ensure all control mechanisms operate properly. ***RAR***

[1] **Wipe test** is based on taking with wet or dry tissue possible radioactive contamination from source surface. The tissue may be wetted with water, diluted nitric acid or another solution inactive for capsule material but actively removing radioactive contamination. If measured activity of tissue does not exceed 185 Bq (5 nCi) the source surface proves to be non-contaminated.
Electroplated sources (such as Ni63) should not be tested for leakage by wiping the foil directly. An indication of leakage can be obtained by checking the storage container for radioactivity or by checking the exhaust ports of items such as gas chromatography devices (ICRP 1977).