Department of Health and Human Services
Population Health

*Radiation Protection Act 2005 – Section 17*

# CERTIFICATE OF COMPLIANCE:

# STANDARD FOR SEALED RADIATION SOURCE-

# BULK MINERAL ANALYSER

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

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 SOURCE.

**This Standard is to be used when assessing a Radiation Source, classified by Radiation Protection Act 2005 licences as "Bulk Mineral Analyser" or "Belt Mineral Analyser" for the purpose of issuing an annual certificate of compliance.**

**Note: This standard covers analysers where there is a readily identifiable "source container" which holds the shielding material and the sealed sources, and analysers where there is no readily identifiable "source container" that performs this function. These latter types of analysers use a variety of structures to hold the sealed sources and the necessary radiation shielding.**

- **For analysers with an identifiable "source container" the requirements for the "source container" in this standard must be met.**

- **For analysers not having an easily identifiable source container it is necessary to meet the same radiation safety outcomes that a "source container" would provide by using a combination of engineered and administrative means.**

**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:**

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| ***RPS 13*** | *Code of Practice for Safe Use of Fixed Radiation Gauges (2007).* |
| ***RPS 2*** | *Code of Practice for the Safe Transport of Radioactive Material (2001)* |
| ***RAR*** | *Regulatory Authority Requirements – Department of Health and Human Services* |
| ***ISO*** | *ISO 9978: 1992 (E) International Standard* Radiation protection – Sealed radioactive sources – Leakage test methods. |

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

| **ITEM** | **Requirements** |
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| **Radioactive Sources** | |
| Only appropriate sources † | Radioactive material used in a bulk mineral analyser must be appropriate for the particular application, with regard to its activity, half-life, energy and type of radiations emitted.<br>***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:<br>(i) it is necessary for the production of neutron radiation for the particular gauging use; or<br>(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.<br>**Radioactive materials of high committed effective dose per unit of intake:**<br>$^{210}Pb$, $^{210}Po$, $^{226}Ra$, $^{228}Ra$, $^{227}Ac$, $^{228}Th$, $^{230}Th$, $^{231}Pa$, $^{232}U$, $^{233}U$, $^{234}U$, $^{237}Np$, $^{238}Pu$, $^{239}Pu$, $^{240}Pu$, $^{241}Pu$, $^{242}Pu$, $^{241}Am$, $^{243}Am$, $^{242}Cm$, $^{243}Cm$, $^{244}Cm$, $^{245}Cm$, $^{246}Cm$, $^{249}Cf$, $^{250}Cf$, $^{252}Cf$<br>***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 bulk mineral analyser in which it is used, will minimise:<br>(i) corrosion and build up of internal pressure; and<br>(ii) dispersal and solubility of the radioactive material if the source capsule is ruptured.<br>***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 bulk mineral analyser operates effectively during its projected useful life and the activity will depend on the:<br>(i) effective radiation path length between the source and detector; and<br>(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 bulk mineral analyser; and<br>(iii) shielding effects of intra-beam material; and<br>(iv) half-life of the radioactive material used.<br>***RPS 13* B 1.1 (d)** |

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| **Radioactive source encapsulation** † | Each radioactive source used in an analyser must be:<br>(a) a sealed source of durable design and construction; and<br>(b) readily identifiable by use of appropriate markings and documentation.<br>***RPS 13 B* 2.1**<br>The form and working life of each source used in an analyser must be suitable for:<br>(a) the particular application; and<br>(b) the useful life of the bulk mineral analyser; and<br>(c) environmental conditions of its use.<br>***RPS 13* B2.2**<br>The outermost capsule of a radioactive source that is used in an analyser (located inside a source container) must satisfy the American National Standard N 452.1977 (NBS Handbook 126) if the source pre dates 2000.<br>***RPS 13* B 2.4**<br>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.<br>***RAR*** |

| **Analysers having an identifiable source container** | |
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| **Construction requirements for a source container** | |
| Shielding with depleted uranium † | Radiation source containment that incorporates depleted uranium in its construction must be durably marked to:<br>(a) warn of the presence of depleted uranium; and<br>(b) indicate the quantity incorporated; and<br>(c) provide information on the relevant physical (i.e. may spontaneously catch fire when finely divided) and radiological safety requirements.<br>***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 analyzer.<br>***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:<br>(a) only be fitted by the manufacturer or authorised service representative; and<br>(b) not interfere with the effective operation of the analyser; and<br>(c) not reduce the shielding properties or other safety features of the containment.<br>***RPS 13* C 1.3** |
| Means for terminating exposure † | The analyser must be fitted with:<br>(a) a shutter; or<br>(b) a means of moving the source to a safe position; or<br>(c) a means of de-energising the radiation source.<br>***RPS 13* C 1.4** |
| Monitoring on a continuously moving line. | If the analyser is on a continuously moving line there must be a means of restricting access to the primary radiation field when the line stops moving.<br>***RAR*** |

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| Indication of beam on/off | The source container must be designed so that whenever the shutter or source control mechanism is in either the 'beam on' or 'beam off' position, the beam condition is clearly and unambiguously indicated.<br><br>**RPS 13 C1.6** |
| Protection and operation of beam on/off indicator. | The beam condition indicator must be protected against mechanical damage<br>and:<br>(a) where the indicator is mechanical, the 'beam on' and 'beam off' markings must be of a type that cannot be readily obscured by dust, precipitation, corrosion or paint; or<br>(b) where the indicator is electrical, it must:<br>(i) include separate lamps or signals to indicate the 'beam on' and 'beam off' conditions; and<br>(ii) be designed to be fail safe in the event of a lamp failure.<br><br>**RPS 13 C1.7** |
| 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 µSv/h at any point 5 cm from the external surface and 10 µSv/h at any point 1 metre from its surface. Determination of these radiation levels are to be made with the shutter or source control mechanism in the beam off position.<br>**RPS 13 C2.3** |
| Source container resistant to heat † | The analyser must be designed so that any primary shielding material, which has a melting point of less than 800 C, used in its construction:<br>(a) is entirely sealed within a durable metal vessel that has a melting point of more than 800 C; and<br>(b) maintains the required effectiveness of the primary shield if the shielding material is in a molten state.<br>**RPS 13 C2.4 (a), (b) ,(c)** |
| Temperature variation while source container is in use † | The source container 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.<br>***RPS 13* C 1.8 (a) (d)** |
| Lifting attachments for the source container † | The source container 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 source container, shielded tube housing or shielded enclosure.<br>***RPS 13* C 1.8 (b)** |
| Quality of welding and brazing used in constructing the source container † | Any welded, brazed or similar joint must be in accordance with published standards (AS2205.1 to AS2205.10)<br>***RPS 13* C 1.9** |
| Damage to the source container from vibration, acceleration and vibrational resonance † | The source container 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.<br>RPS 13 **C 1.8 (c)** |
| Compatibility of materials used in constructing the source container † | The source container must be constructed of materials that:<br>(a) are physically and chemically compatible with each other and, where applicable, the materials of the radioactive sources |

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| | that it is designed to contain; and<br>(b) can withstand the effects of prolonged irradiation without significant deterioration of any physical properties necessary for the safety of the bulk mineral analyser; and<br>(c) are resistant to corrosion or other physical or structural damage which may occur during the use, transport and storage of the bulk mineral analyser.<br>**RPS 13 C 1.10** |
| Manual and mechanical handling for the source container † | The source container must be provided with features to maintain safe:<br>(a) manual handling, if it has a gross mass of 10 kilograms to 50 kilograms; or<br>(b) mechanical handling, if it has a gross mass of greater than 50 kilograms.<br>***RPS 13* C 1.11** |
| **Shutter** | A shutter or source control mechanism must be fitted.<br>**RAR**<br><br>The shutter or source control mechanism and the associated mechanism for its operation, must be designed, constructed and, if necessary, protected by a rugged covering, so that its operation is not adversely affected by corrosive substances, dust, moisture, other contaminants, vibration or heat, to which it may be exposed during its projected useful life.<br>**RPS 13 C2.1** |
| Mechanism to withstand tests of Annex III and dust and corrosion † | The shutter or source control mechanism, if fitted to the source container, and the associated mechanism for manual or power operation must be designed and constructed or encased in a protective enclosure that they are adequate if subjected to the relevant tests in Annex III to satisfy the test requirements given there and their operation is not adversely affected by corrosion, dust, moisture, vibration or heat that may be present in the immediate environment of the analyser during its projected life.<br>**NHMRC 3.1.2** |
| Lockable Shutter † | The shutter or source control mechanism must be:<br>(a) provided with an effective lock so that it can be secured in the 'beam off' position; and<br>(b) designed so that it cannot be locked in the 'beam on' position.<br>**RPS 13 C2.2 (a),(b)** |
| Quality of locks † | Locks required for fitting to source containers must be so designed, constructed and mounted that they:<br>(a) forcible interference using common hand tools; and<br>(b) key cylinder picking.<br>**RPS 13 C1.15** |
| **Labels and markings required on the source container** | Each label located on gauge be 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.<br>**RPS 13 C 1.14** |
| Marked with trefoil and CAUTION or WARNING | The source container 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, Bulk Mineral Analyser".<br>**RPS 13 C 1.12**<br>The symbol and markings on the label specified above must be black on a yellow background.<br>**RPS 13 C 1.13** |

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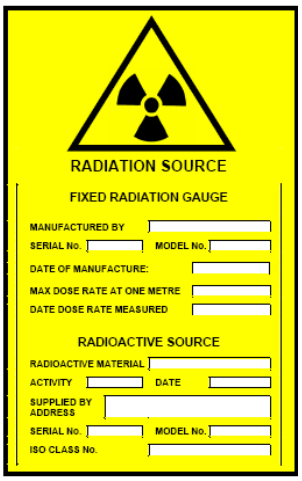
| Information required on the durable label | The durable label on the analyser must be of the form:<br>  <br>RADIATION SOURCE<br>FIXED RADIATION GAUGE<br>MANUFACTURED BY<br>SERIAL No. MODEL No.<br>DATE OF MANUFACTURE:<br>MAX DOSE RATE AT ONE METRE<br>DATE DOSE RATE MEASURED<br>RADIOACTIVE SOURCE<br>RADIOACTIVE MATERIAL<br>ACTIVITY DATE<br>SUPPLIED BY ADDRESS<br>SERIAL No. MODEL No.<br>ISO CLASS No.<br><br>and contain the following information:<br><br>(a) manufacturer name, model and serial number of the bulk mineral analyser and/or container; and<br>(b) name and address of the source supplier and/or manufacturer; and<br>(c) name of the radioactive material; and<br>(d) model and serial number of the radioactive source; and<br>(e) ISO class number of the radioactive source; and<br>(f) original activity of the radioactive source and date the activity was measured; and<br>(g) maximum radiation dose rate at one metre from the surface of the source container (with all shutters closed) and date this measurement was made.<br>***RPS 13* C2.5** |
| **Test for non fixed contamination** | |
| | The source housing is to be wipe tested[1] and non fixed contamination levels must not exceed those specified for transport in **RPS 2** |
| **Preventative maintenance** | Inspection of the source container must ensure all control mechanisms, including the shutter or source control mechanism, operate properly<br>***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.

| Analyser without an identifiable source container | |
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| Exposure rates | When the analyser is loaded with the source of greatest activity for which it is designed, the radiation level must not exceed 500 µSv/h at any point 5 cm from the external surface and 10 µSv/h at any point 1 metre from its surface. Determination of these radiation levels are to be made with the shutter or source control mechanism in the beam off position.<br>**RPS 13 C2.3** |
| Effect of Heat† | Loss of radiation shielding in the event of a fire must not lead to radiation exposure rates in potentially occupied areas exceeding 10 uSv/h from the sealed sources.<br><br>**Note: for this type of analyser a combination of administrative/engineering features employed for the installation of the analyser are an acceptable means of complying with this requirement. For example physical barriers and or signage. While this requirement does not strictly relate to the design of the analyser, compliance that these measures are in place must be demonstrated.**<br>***RAR***. |
| Temperature variation while the analyser is in use† | The analyser 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.<br>**RPS 13 C 1.8 (a) (d)** |
| Quality of welding and brazing used in constructing the analyser† | Any welded, brazed or similar joint must be in accordance with published standards (AS2205.1 to AS2205.10)<br>**RPS 13 C 1.9** |
| Damage to analyser from vibration, acceleration and vibrational resonance.† | The analyser 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.<br>**RPS 13 C 1.8 (c)** |
| Compatibility of materials used in constructing the analyser. | The analyser must be constructed of materials that:<br>(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<br>(b) can withstand the effects of prolonged irradiation without significant deterioration of any physical properties necessary for the safety of the bulk mineral analyser; and<br>(c) are resistant to corrosion or other physical or structural damage which may occur during the use, transport and storage of the bulk mineral analyser.<br>**RPS 13 C 1.10** |
| Monitoring on a continuously moving line. | If the analyser is on a continuously moving line there must be a means of restricting access to the primary radiation field when the line stops moving.<br>***RAR*** |

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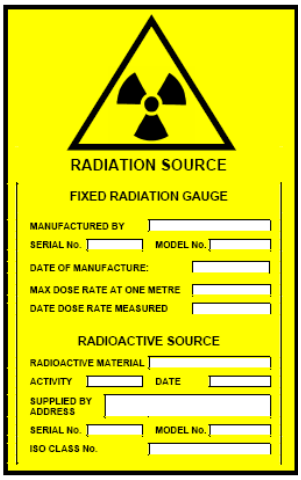
| **Labels and markings required on an analyser without an identifiable source container** | Each label located on the analyser be must be made of a material that can withstand the long-term effects of corrosion and general exposure to the environment in which it is to be used.<br>**RPS 13 C 1.14** |
| Marked with trefoil and CAUTION or WARNING | The analyser must be durably marked with a legibly stamped or engraved label incorporating the trefoil radiation hazard symbol followed by words of the general form:<br>"Radiation Source, Bulk Mineral Analyser"<br>**RPS 13 C 1.12**<br>The symbol and markings on the label specified above must be black on a yellow background.<br>**RPS 13 C 1.13** |
| Information required on the durable label | The durable label on the analyser must be of the form:<br>  <br>RADIATION SOURCE<br>FIXED RADIATION GAUGE<br>MANUFACTURED BY<br>SERIAL No. MODEL No.<br>DATE OF MANUFACTURE:<br>MAX DOSE RATE AT ONE METRE<br>DATE DOSE RATE MEASURED<br>RADIOACTIVE SOURCE<br>RADIOACTIVE MATERIAL<br>ACTIVITY DATE<br>SUPPLIED BY ADDRESS<br>SERIAL No. MODEL No.<br>ISO CLASS No.<br><br>and contain the following information:<br><br>(a) manufacturer name, model and serial number of the bulk mineral analyser and/or container; and<br>(b) name and address of the source supplier and/or manufacturer; and<br>(c) name of the radioactive material; and<br>(d) model and serial number of the radioactive source; and<br>(e) ISO class number of the radioactive source; and<br>(f) original activity of the radioactive source and date the activity was measured; and<br>(g) maximum radiation dose rate at one metre from the surface of the analyser (with all shutters closed) and date this measurement was made.<br>***RPS 13* C2.5** |

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| **Test for non fixed contamination**[2] analyser without an identifiable source container. | The sealed source is to be wipe tested for the presence of non-fixed radioactive contamination.<br><br>**Note if the sealed source has a thin window that could be damaged if wiped then the wipe test is only to be carried out by a person authorised by a licence or other authority to do such testing.**<br><br>**A wipe test taken and analysed 3 months prior to issuing a certificate of compliance is acceptable for the purpose of complying with this requirement.**<br><br>***RAR*** |
| | Non fixed contamination levels must not exceed those specified in ISO 9978.<br>***RAR*** |

## Requirements for all types of analysers

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| **Preventative maintenance** | The source container or analyser must be inspected to ensure all control mechanisms, including the shutter or source control mechanism, operate properly.<br>***RAR*** |
| **Restricted access** | The analyser must be physically secured against unauthorised access.<br>***RAR*** |

[2] **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.