

APPROVAL OF SPECIAL FORM OF RADIOACTIVE MATERIAL

(Please refer AERB/NRF-TS/SC-1 (Rev.1) Safe Transport of Radioactive Material 2016, for the respective clauses)

Special Form Radioactive Material

It is either a non-dispersible solid radioactive material or a sealed capsule containing radioactive material, conforming to the requirements specified and approved by the Competent Authority for special form radioactive material.

Classification as Special Form Radioactive Material

Radioactive material may be classified as special form radioactive material only if it meets the applicable requirements specified in clause 4.4.2 below and is approved as special form radioactive material by the Competent Authority.

Requirements for classification as Special Form Radioactive Material

Special form radioactive material shall have at least one dimension of not less than 5 mm.

Special form radioactive material shall be of such a nature or shall be so designed that if it is subjected to the tests specified it shall meet the following requirements:

- a) It would not break or shatter under the impact, percussion and bending tests specified for special form radioactive material
- b) It would not melt or disperse in the heat test specified for special form radioactive material
- c) The activity in the water from the leaching tests would not exceed 2 kBq; or alternatively, for sealed sources, the leakage rate for the volumetric leakage assessment test specified in the International Organization for Standardization document ISO 9978: Radiation Protection: Sealed Radioactive Sources - Leakage Test Methods [8], would not exceed the applicable acceptance threshold acceptable to the Regulatory Body.
- d) When a sealed capsule constitutes part of the special form radioactive material, the capsule shall be so manufactured that it can be opened only by destroying it.

Tests for Special Form Radioactive Material

- 1) Specimens that comprise or simulate special form radioactive material shall be subjected to the impact test, the percussion test, the bending test and the heat test specified. A different specimen may be used for each of the tests. Following each test, a leaching assessment or volumetric leakage test shall be performed on the specimen by a method no less sensitive than the methods specified in clause 4.4.3.7 for indispersible solid material or in clause 4.4.3.8 for encapsulated material.
- 2) **Impact test:** The specimen shall drop onto the target from a height of 9 m. The target shall be as defined as follows. It shall be a flat, horizontal surface of such a character that any increase in its resistance to displacement or deformation upon impact by the specimen would not significantly increase damage to the specimen.

- 3) **Percussion test:** The specimen shall be placed on a sheet of lead that is supported by a smooth solid surface and struck by the flat face of a mild steel bar so as to cause an impact equivalent to that resulting from a free drop of 1.4 kg through 1 m. The lower part of the bar shall be 25 mm in diameter with the edges rounded off to a radius of 3.0 ± 0.3 mm. The lead, of hardness number 3.5–4.5 on the Vickers scale and not more than 25 mm thick, shall cover an area greater than that covered by the specimen. A fresh surface of lead shall be used for each impact. The bar shall strike the specimen so as to cause maximum damage.
- 4) **Bending test:** The test shall apply only to long, slender sources with both a minimum length of 10 cm and a length to minimum width ratio of not less than 10. The specimen shall be rigidly clamped in a horizontal position so that one half of its length protrudes from the face of the clamp. The orientation of the specimen shall be such that the specimen will suffer maximum damage when its free end is struck by the flat face of a steel bar. The bar shall strike the specimen so as to cause an impact equivalent to that resulting from a free vertical drop of 1.4 kg through 1 m. The lower part of the bar shall be 25 mm in diameter with the edges rounded off to a radius of 3.0 ± 0.3 mm.
- 5) **Heat test:** The specimen shall be heated in air to a temperature of 800°C and held at that temperature for a period of 10 min and shall then be allowed to cool.
- 6) Specimens that comprise or simulate radioactive material enclosed in a sealed capsule may be excepted from
- a) The impact and the percussion tests prescribed above, provided that the specimens are alternatively subjected to the impact test prescribed in the International Organization for Standardization document ISO 2919: Sealed Radioactive Sources: Classification
 - Class 4 impact test if the mass of the special form radioactive material is less than 200 g;
 - The Class 5 impact test if the mass of the special form radioactive material is more than 200 g but less than 500 g.
 - b) The heat test prescribed above, provided the specimens are alternatively subjected to the Class 6 temperature test specified in ISO 2919
- 7) Leaching and Volumetric Leakage Assessment Methods

For specimens that comprise or simulate indispersible solid material, a leaching assessment shall be performed as follows:

- a. The specimen shall be immersed for 7 days in water at ambient temperature. The volume of water to be used in the test shall be sufficient to ensure that at the end of the 7 day test period the free volume of the unabsorbed and unreacted water remaining shall be at least 10% of the volume of the solid test sample itself. The water shall have an initial pH of 6–8 and a maximum conductivity of $1 \text{ mS}\cdot\text{m}^{-1}$ at 20°C.

- b. The water with the specimen shall then be heated to a temperature of $50 \pm 5^\circ\text{C}$ and maintained at this temperature for 4 h.
 - c. The activity of the water shall then be determined.
 - d. The specimen shall then be kept for at least 7 days in still air at not less than 30°C and with a relative humidity of not less than 90%.
 - e. The specimen shall then be immersed in water of the same specification as that in (a) and the water with the specimen heated to $50 \pm 5^\circ\text{C}$ and maintained at this temperature for 4 h.
 - f. The activity of the water shall then be determined.
- 8) For specimens that comprise or simulate radioactive material enclosed in a sealed capsule, either a leaching assessment or a volumetric leakage assessment shall be performed as follows:
- a. The leaching assessment shall consist of the following steps:
 - i. The specimen shall be immersed in water at ambient temperature. The water shall have an initial pH of 6–8 with a maximum conductivity of $1 \text{ mS}\cdot\text{m}^{-1}$ at 20°C .
 - ii. The water and the specimen shall be heated to a temperature of $50 \pm 5^\circ\text{C}$ and maintained at this temperature for 4 h.
 - iii. The activity of the water shall then be determined.
 - iv. The specimen shall then be kept for at least 7 days in still air at not less than 30°C and with a relative humidity of not less than 90%.
 - v. The process in (i), (ii) and (iii) shall be repeated.
 - b. The alternative volumetric leakage assessment shall comprise any of the tests prescribed in the International Organization for Standardization document ISO 9978: Radiation Protection: Sealed Radioactive Sources — Leakage Test Methods