

**Sealed radioactive sources — Leak test methods**

Sources radioactives scellées — Méthodes de contrôle d'étanchéité

Technical Report 4826 was drawn up by Technical Committee ISO/TC 85, *Nuclear energy*, and approved by the majority of its members. The main reason which led to the publication of this document in the form of a technical report rather than as a part of ISO 2919, *Sealed radioactive sources — Classification*, is the fact that, owing to lack of experience, it is not yet possible to specify the acceptance levels corresponding to the various leak test methods described. It is hoped that further experience of these test methods will permit the transformation of this Technical Report into an International Standard.

In 1978, this document was submitted to the ISO Council, which approved its publication as a technical report.

1 SCOPE AND FIELD OF APPLICATION

The leak test methods described in this Technical Report are primarily in support of International Standard ISO 2919, *Sealed radioactive sources — Classification*¹⁾. The methods are primarily applicable to prototype testing but may also be used for production or other testing.

Not all of the test methods are applicable or appropriate to all sealed sources, and it is necessary to select from them the most suitable test or combination of tests for the particular situation.

2 LEAK TEST METHODS**2.1 By radioactive means**

NOTE — If a sealed source is not free from surface contamination before being subjected to one of the following leak tests by radioactive means (with the exception of the test described in 2.1.2), a failure in the test may be due to this contamination. In such a case, the sealed source may be cleaned of surface contamination and, after a period of 7 d, the test can be repeated to establish whether there is a leak.

2.1.1 Wipe (smear) test

Wipe all external surfaces of the sealed source thoroughly with a swab of filter paper or other suitable material of high absorbent capacity, moistened with a liquid which will not attack the material of which the external surfaces of the sealed source are made and which, under the conditions of this test, has been demonstrated to be effective in removing any radioactive material present. Measure the activity on the swab. If this activity is less than 185 Bq (5 nCi), the sealed source is considered to be leak-free.

1) At present at stage of draft.

2.1.2 Dry wipe test

Place the sealed source in an ultrasonic cleaning bath containing a recognized cleaning agent such as inhibited trichloroethylene or an aqueous solution of EDTA (ethylene-diamine-tetra-acetic acid). Clean the sealed source for 10 min, and then allow it to dry.

NOTE — If an aqueous solution has been used for cleaning, the sealed source should be rinsed with distilled water and then acetone before drying.

Thoroughly rub all external surfaces of the sealed source with a dry swab of filter paper and measure the activity of the swab. This activity has to be less than 185 Bq (5 nCi). After a period of not less than 7 d, rub again with a swab of filter paper and measure its activity. If the activity detected on this swab is also less than 185 Bq (5 nCi), the sealed source is considered to be leak-free.

2.1.3 Immersion test

Immerse the sealed source in a liquid which will not attack the material of which the external surfaces of the sealed source are made and which, under the conditions of this test, has been demonstrated to be effective in removing the radioactive material present. Examples of such liquids include distilled water and weak solutions of detergents or chelating agents. Heat the liquid to 323 ± 5 K and hold it at this temperature for 4 h. Remove the sealed source and measure the activity in the liquid. If the detected activity is less than 185 Bq (5 nCi), the sealed source is considered to be leak-free.

2.1.4 Boiling immersion test

Immerse the sealed source in a liquid which will not attack the material of which the external surfaces of the sealed source are made and which, under the conditions of this test, has been demonstrated to be effective in removing the radioactive material present. Boil for 10 min, allow to cool, then rinse the sealed source using fresh liquid. Repeat these operations two more times (a total of three times) and then boil in the liquid used for the preceding rinsing operation. Remove the sealed source and measure the activity in all the liquid used. If the detected activity is less than 185 Bq (5 nCi), the sealed source is considered to be leak-free.

2.1.5 Gaseous emanation test (for ^{226}Ra sources)

Put the sealed source to be tested into an appropriate small, gas-tight container together with a suitable absorbent, for example activated carbon, cotton-wool or polyethylene, and leave it there for at least 3 h. Remove the sealed source and shut the container again. Measure immediately the activity of the absorbent. If the detected activity is less than 185 Bq (5 nCi) of radon per 12 h, the sealed source is considered to be leak-free. Appropriate corrections have to be made if the test period is less than 12 h.

2.1.6 Liquid scintillant emanation test (for ^{226}Ra sources)

Immerse the sealed source for 3 d at ambient temperature under reduced pressure in a solution of a phosphor in an organic liquid which will not attack the material of which the external surfaces of the sealed source are made. Store in the dark to avoid photoluminescence. Remove the sealed source and measure the activity of the liquid by liquid scintillation counting. If the detected activity corresponds to less than 185 Bq (5 nCi) of radon per 12 h, the sealed source is considered to be leak-free.

2.2 By non-radioactive means

NOTE — Before any of the following tests, thoroughly clean and dry the sealed source. Ensure that there are no gross defects which might invalidate the results of the subsequent test, for example by visual inspection or by a method less sensitive than that of the subsequent test.

2.2.1 Vacuum bubble test

NOTE — For this test to be valid, the free volume inside the sealed source should be greater than $0,1 \text{ cm}^3$.¹⁾ This test is not applicable to sealed sources with leachable or gaseous content (see table).

Using analytical reagent grade ethylene glycol, water or oil²⁾ as the leak test fluid in a suitable vacuum chamber, lower the air content of the fluid by evacuating the chamber for at least 1 min. Return the air pressure to atmospheric and submerge

1) If this test is used for sources with free volume less than $0,1 \text{ cm}^3$, the user must be able to demonstrate the validity of the test. Information from users on this point including precise details of operational procedures for the test would be welcomed by the Secretariat.

2) Suitable properties of oil are :

mass density at 293 K : $\approx 890 \text{ kg/m}^3$

kinematic viscosity at 293 K : $\approx 25 \text{ mm}^2/\text{s}$

kinematic viscosity at 323 K : $\approx 9 \text{ mm}^2/\text{s}$