

SCHEDULE 9

TEST PROCEDURES

PART IV

TESTS FOR PACKAGES

1. All specimens must be inspected before testing in order to identify and record faults or damage including the following—
 - (a) divergence from the design;
 - (b) defects in manufacture;
 - (c) corrosion or other deterioration; and
 - (d) distortion of features.
2. The containment system of the package must be clearly specified.
3. The external features of the specimen must be clearly identified so that reference may be made simply and clearly to any part of such specimen.
4. After each of the applicable tests specified in paragraphs 6 — 26 below—
 - (a) faults and damage must be identified and recorded;
 - (b) it must be determined whether the integrity of the containment system and shielding has been retained to the extent required in Schedule 8 for the package under test; and
 - (c) for packages containing fissile material, it must be determined whether the assumptions and conditions made in the assessments required by paragraphs 1 to 9 of Part XIV Schedule 8 regarding the most reactive configuration and degree of moderation of the fissile contents, of any escaped material, and for one or more packages are valid.

Target for Drop Tests

5. The target for the drop tests specified in paragraph 4 of Part II and paragraphs 10, 13(a), 15, and 24 and 26 of Part IV must 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 the damage to the specimen.

Packages Designed to contain Uranium Hexafluoride

6. Specimens that comprise or simulate packagings designed to contain 0.1 kg or more of uranium hexafluoride must be tested hydraulically at an internal pressure of at least 1.38 MPa but, when the test pressure is less than 2.76 MPa, the design must require multilateral approval. For retesting packagings, any other equivalent non-destructive testing may be applied subject to multilateral approval.

Tests for demonstrating ability to withstand normal conditions of transport

7. The tests are: the water spray test, the free drop test, the stacking test, and the penetration test. Specimens of the package must be subjected to the free drop test, the stacking test and the penetration test, preceded in each case by the water spray test. One specimen may be used for all the tests, provided that the requirements of paragraph 8 are fulfilled.

Status: This is the original version (as it was originally made).

8. The time interval between the conclusion of the water spray test and the succeeding test must be such that the water has soaked in to the maximum extent, without appreciable drying of the exterior of the specimen. In the absence of any evidence to the contrary, this interval must be taken to be two hours if the water spray is applied from four directions simultaneously. No time interval shall elapse, however, if the water spray is applied from each of the four directions consecutively.

9. Water spray test: The specimen must be subjected to a water spray test that simulates exposure to rainfall of approximately 5 cm per hour for at least one hour.

10. Free drop test: The specimen must drop on to the target so as to suffer maximum damage in respect of the safety features to be tested and—

- (a) the height of drop measured from the lowest point of the specimen to the upper surface of the target must be not less than the distance specified in Table XI of Schedule 1 for the applicable mass. The target must be as defined in paragraph 5 above;
- (b) for rectangular fibreboard or wood packages not exceeding a mass of 50 kg, a separate specimen must be subjected to a free drop on to each corner from a height of 0.3 metres;
- (c) for cylindrical fibreboard packages not exceeding a mass of 100 kg, a separate specimen must be subjected to a free drop on to each of the quarters of each rim from a height of 0.3 metres.

11. Stacking test: Unless the shape of the packaging effectively prevents stacking, the specimen must be subjected, for a period of 24 hours, to a compressive load equal to the greater of the following—

- (a) the equivalent of 5 times the mass of the actual package; and
- (b) the equivalent of 13 kPa multiplied by the vertically projected area of the package.

The load must be applied uniformly to two opposite sides of the specimen, one of which must be the base on which the package would normally rest.

12. Penetration test: The specimen must be placed on a rigid, flat, horizontal surface which will not move significantly while the test is carried out—

- (a) a bar of 3.2 cm in diameter with a hemispherical end and a mass of 6 kg must be dropped and directed to fall, with its longitudinal axis vertical, on to the centre of the weakest part of the specimen, so that, if it penetrates sufficiently far, it will hit the containment system. The bar must not be significantly deformed by the test performance;
- (b) the height of drop of the bar measured from its lower end to the intended point of impact on the upper surface of the specimen must be 1 metre.

Tests for Type A packages designed to carry liquids and gases

13. A specimen or separate specimens must be subjected to each of the following tests unless it can be demonstrated that one test is more severe for the specimen in question than the other, in which case one specimen must be subjected to the more severe test—

- (a) free drop test: The specimen must drop on to the target so as to suffer the maximum damage in respect of containment. The height of the drop measured from the lowest part of the specimen to the upper surface of the target must be 9 metres. The target must be as defined in paragraph 5 above;
- (b) penetration test: The specimen must be subjected to the test specified in paragraph 12 above except that the height of drop must be increased to 1.7 metres from the 1 metre specified in paragraph 12(b).

Tests for demonstrating ability to withstand accident conditions of transport

14. The specimen must be subjected to the cumulative effects of the tests specified in paragraphs 15 and 16, in that order. Following these tests, either this specimen or a separate specimen must be subjected to the effect(s) of the water immersion test(s) as specified in paragraph 17 and, if applicable, paragraph 18.

15. Mechanical test: The mechanical test consists of three different drop tests. Each specimen must be subjected to the applicable drops as specified in paragraph 7 of Part XI of Schedule 8 or paragraphs 5 and 8 of Part XIV of Schedule 8. The order in which the specimen is subjected to the drops must be such that, on completion of the mechanical test, the specimen must have suffered such damage as will lead to the maximum damage in the thermal test which follows—

- (a) for drop I, the specimen must drop on to the target so as to suffer the maximum damage, and the height of the drop measured from the lowest point of the specimen to the upper surface of the target must be 9 metres. The target must be as defined in paragraph 5 above;
- (b) for drop II, the specimen must drop so as to suffer the maximum damage on to a bar rigidly mounted perpendicularly on the target. The height of the drop measured from the intended point of impact of the specimen to the upper surface of the bar must be 1 metre. The bar must be of solid mild steel of circular section, (15.0 ± 0.5) cm in diameter, and 20 cm long unless a longer bar would cause greater damage, in which case a bar of sufficient length to cause maximum damage must be used. The upper end of the bar must be flat and horizontal with its edges rounded off to a radius of not more than 6 mm. The target on which the bar is mounted must be as described in paragraph 5;
- (c) for drop III, the specimen must be subjected to a dynamic crush test by positioning the specimen on the target so as to suffer maximum damage by the drop of a 500 kg mass from 9 metres on to the specimen. The mass must consist of a solid mild steel plate 1 metre \times 1 metre which must fall in a horizontal attitude. The height of the drop must be measured from the underside of the plate to the highest point of the specimen. The target on which the specimen rests must be as defined in paragraph 5.

16. Thermal test: The thermal test must consist of—

- (a) the specimen must be in thermal equilibrium under the conditions of ambient temperature of 38°C, subject to the solar insolation conditions specified in Table IX of Schedule I and subject to the design maximum rate of internal heat generation from the radioactive contents. Alternatively, any of these parameters are allowed to have different values prior to and during the test, providing due account is taken of them in the subsequent assessment of package response, followed by;
- (b) the exposure of a specimen to a thermal environment which provides a heat flux at least equal to that of a hydrocarbon fuel/air fire in sufficiently quiescent ambient conditions to give an average emissivity coefficient of at least 0.9 and an average flame temperature of at least 800°C fully engulfing the specimen for a period of 30 minutes, with a surface absorptivity coefficient of either 0.8 or that value which the package may be demonstrated to possess if exposed to the fire specified, followed by;
- (c) exposure of the specimen to an ambient temperature of 38°C, subject to the solar insolation conditions specified in Table IX of Schedule I and subject to the design maximum rate of heat generation from the radioactive contents for a sufficient period to ensure that temperatures in the specimen are everywhere decreasing and/or are approaching steady state conditions. Alternatively, any of these parameters are allowed to have different values following cessation of heating, providing due account is taken of them in the subsequent assessment of package response.

During and following the test the specimen must not be artificially cooled and any combustion of materials of the specimen must be permitted to proceed naturally.

17. Water immersion test: The specimen must be immersed under a head of water of at least 15 metres for a period of not less than eight hours in the attitude which will lead to maximum damage. For demonstration purposes, an external gauge pressure of at least 150 kPa must be considered to meet these conditions.

Enhanced water immersion test

18. The specimen must be immersed under a head of water of at least 200 metres for a period of not less than one hour. For demonstration purposes, an external gauge pressure of at least 2 MPa must be considered to meet these conditions.

Water leakage test for packages containing fissile material

19. Packages for which water in-leakage or out-leakage to the extent which results in greatest reactivity has been assumed for purposes of assessment under paragraphs 5 to 8 of Part XIV of Schedule 8 shall be excepted from the test specified in paragraph 21.

20. Before the specimen is subjected to the water leakage test specified in paragraph 21, it must be subjected to the tests in paragraph 15(b), and either paragraph 15(a) or (c), and the test specified in paragraph 16.

21. The specimen must be immersed under a head of water of at least 0.9 metres for a period of not less than eight hours and in the attitude for which maximum leakage is expected.

Tests for Type C packages

22. Specimens must be subjected to the effects of each of the following test sequences in the orders specified—

- (a) the tests specified in paragraphs 15(a), 15(c), 24 and 25; and
- (b) the test specified in paragraph 26.

23. Separate specimens are allowed to be used for each of the sequences 22 (a) and (b).

24. Puncture/tearing test: The specimen must be subjected to the damaging effects of a solid probe made of mild steel. The orientation of the probe to the surface of the specimen must be as to cause maximum damage at the conclusion of the test sequence specified in paragraph 22(a)—

- (a) The specimen, representing a package having a mass less than 250 kg, must be placed on a target and subjected to a probe having a mass of 250 kg falling from a height of 3 m above the intended impact point. For this test, the probe must be a 20 cm diameter cylindrical bar with the striking end forming a frustum of a right circular cone with the following dimensions: 30 cm height and 2.5 cm in diameter at the top. The target on which the specimen is placed must be as specified in paragraph 5.
- (b) For packages having a mass of 250 kg or more, the base of the probe must be placed on a target and the specimen dropped onto the probe. The height of the drop, measured from the point of impact with the specimen to the upper surface of the probe must be 3 m. For this test the probe must have the same properties and dimensions as specified in (a) above, except that the length and mass of the probe must be such as to incur maximum damage to the specimen. The target on which the base of the probe is placed must be as specified in paragraph 5.

25. Enhanced thermal test: The conditions for this test are as specified in paragraph 16, except that the exposure to the thermal environment must be for a period of 60 minutes.

26. Impact test: The specimen must be subjected to an impact on a target at a velocity of not less than 90 m/s, at such an orientation as to suffer maximum damage. The target must be as defined in paragraph 5.