

SECTION 10 – RADIOACTIVE MATERIAL

Transport of Radioactive Material

1 Scope and Application

1.1 Scope

Regulations establish standards of safety which ensure an acceptable level of control of the radiation, ionizing and thermal hazards to persons, property and the environment that are associated with the transport of radioactive material. These Regulations are based on the Regulations for the Safe Transport of Radioactive Material, (2009 Edition), Safety Standards Series No. TS-R-1, IAEA, Vienna (2009). Explanatory material is found in *Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material, Guide No. TS-G-1.1 (Rev. 1)*, IAEA, Vienna. The prime responsibility for safety must rest with the person or organization responsible for facilities and activities that give rise to radiation risk.

1.2 Objective

The objective of these Regulations is to establish requirements that must be satisfied to ensure safety and to protect persons, property and the environment from the effects of radiation in the transport of radioactive material. This protection is achieved by requiring:

- (a) containment of the radioactive contents;
- (b) control of external radiation levels;
- (c) prevention of criticality; and
- (d) prevention of damage by heat.

1.3 Application

Regulations apply to the transport of radioactive material by air, including transport that is incidental to the transport of the radioactive material. Transport comprises all operations and conditions associated with and involved in the movement of radioactive material; these include the design, manufacture, maintenance, and repair of packaging and the preparation, consigning, loading, carriage, in-transit storage, unloading and receipt at the destination of the radioactive material and packages. A graded approach is applied to the performance standards in these Regulations that are characterized by three different security levels:

- (a) routine conditions of transport (incident free);
- (b) normal condition of transport (minor mishaps); and
- (c) accident conditions of transport.

10.0.1.4 Exceptions

These Regulations do not apply to:

- (a) radioactive material implanted or incorporated into a person or live animal for diagnosis or treatment;
- (b) radioactive material in consumer products which have received regulatory approval, following their sale to the end user;
- (c) natural material and ores containing naturally occurring radionuclides, which are either in their natural state, or have only been processed for purposes other than for extraction of the radionuclides, and not intended to be processed for use of these radionuclides, provided the activity concentration of the material does not exceed 10 times the values specified in 10.3.2.1(b) or calculated in accordance with 10.3.2.2 to 10.3.2.5;
- (d) non-radioactive solid objects with radioactive substances present on any surfaces in quantities not in excess of the limit specified in the definition of contamination in 10.3.6.

10.0.1.5 Specific Provisions for Excepted Packages

Excepted packages which contain radioactive material in limited quantities, instruments, manufactured articles and empty packages as specified in 10.3.11.1 are subject to:

- (a) the applicable provisions specified in 10.5.8;
- (b) the requirements for excepted packages specified in 10.6.2.1.

10.0.2 Radiation Protection Programme

10.0.2.1 The transport of radioactive material must be subject to a radiation protection programme, which must consist of systematic arrangements aimed at providing adequate consideration of radiation protection measures.

10.0.2.2 Doses to persons must be below the relevant dose limits. Protection and safety must be optimized in order that the magnitude of individual doses, the number of persons exposed, and the likelihood of incurring exposure must be kept as low as reasonably achievable, economic and social factors being taken into account within the restriction that the doses to individuals be subject to dose constraints. A structured and systematic approach must be adopted and must include consideration of the interfaces between transport and other activities.

- △ **10.0.2.3** The nature and extent of the measures to be employed in the programme must be related to the magnitude and likelihood of radiation exposures. The programme must incorporate the requirements in 10.0.2.2, 10.0.2.4 to 10.0.2.7 and 9.2.1.1 and applicable

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emergency response procedures. Programme documents must be available, on request, for inspection by the relevant competent authority.

10.0.2.4 For occupational exposures arising from transport activities, where it is assessed that the effective dose is:

- (a) likely to be between 1 and 6 mSv in a year, a dose assessment programme via work place monitoring or individual monitoring must be conducted;
- (b) likely to exceed 6 mSv in a year, individual monitoring must be conducted.

When individual or work place monitoring is conducted, appropriate records must be kept.

Note:

For occupational exposures arising from transport activities, where it is assessed that the effective dose is most unlikely to exceed 1 mSv in a year, no special work patterns, detailed monitoring, dose assessment programmes or individual record keeping need be required.

10.0.2.5 In the event of accidents or incidents during the transport of radioactive material, emergency provisions, as established by relevant national and/or international organizations, must be observed to protect persons, property and the environment. Appropriate guidelines for such provisions are contained in "Planning and Preparing for Emergency Response to Transport Accidents Involving Radioactive Material," Safety Standard Series No. TS-G-1.2 (ST-3), IAEA Vienna (2002).

10.0.2.6 Emergency procedures must take into account the formation of other dangerous substances that may result from the reaction between the contents of a consignment and the environment in the event of an accident.

- △ **10.0.2.7** Personnel must be appropriately trained in the radiation hazards involved including the precautions to be observed in order to restrict their occupational exposure and the exposure of other persons who might be affected by their actions.

10.0.3 Quality Assurance

10.0.3.1 Quality assurance programmes based on international, national or other standards acceptable to the competent authority must be established and implemented for the design, manufacture, testing, documentation, use, maintenance and inspection of all Special Form radioactive material, low dispersible radioactive material and packages and for transport and in-transit storage operations to ensure compliance with the relevant provisions of these Regulations. Certification that the design specification has been fully implemented must be available to the competent authority. The manufacturer, consignor or user must be prepared to provide facilities for competent authority inspection during manufacture and use and to demonstrate to any cognizant authority that:

- (a) the manufacturing methods and materials used are in accordance with the approved design specifications; and

- (b) all packagings are periodically inspected and, as necessary, repaired and maintained in good condition so that they continue to comply with all relevant requirements and specifications, even after repeated use.

10.0.3.2 Where competent authority is required, such approval must take into account and be contingent upon the adequacy of the quality control programme.

10.0.4 Shipment Approval By Special Arrangement

STATE VARIATIONS: BEG-04, DEG-02, DKG-01

10.0.4.1 Special arrangements means those provisions, approved by the competent authority, under which consignments of radioactive material, which do not satisfy all the applicable requirements of these Regulations may be transported.

10.0.4.2 Consignments for which conformity with any provision applicable to Class 7 is impracticable must not be transported except under special arrangement. Provided the competent authority is satisfied that conformity with the Class 7 provisions of these Regulations is impractical and that the requisite standards of safety established by these Regulations have been demonstrated through alternative means the competent authority may approve special arrangement transport operations for a single or planned series of multiple consignments. The overall level of safety in transport must be at least equivalent to that which would be provided if all the applicable requirements had been met. Each consignment shipped under special arrangement requires multi-lateral approval.

10.0.5 Radioactive Materials Possessing Other Dangerous Properties

In addition to the radioactive and fissile properties, any subsidiary risk of the contents of a package, such as explosiveness, flammability, pyrophoricity, chemical toxicity and corrosiveness, must also be taken into account in the documentation, packing, labelling, marking, placarding, stowage, segregation and transport, in order to be in compliance with all relevant provisions for dangerous goods of these Regulations.

10.0.6 Non-compliance

In the event of non-compliance with any limit in these Regulations applicable to radiation level or contamination:

- (a) the shipper must be informed of the non-compliance by the operator if the non-compliance is identified during transport;
- (b) the shipper and the operator must be informed of the non-compliance by the consignee if the non-compliance is identified at receipt;
- (c) the operator, shipper or consignee, as appropriate must:
 1. take immediate steps to mitigate the consequence of the non-compliance;
 2. investigate the non-compliance and its causes, circumstances and consequences;

10.2.3 Other Limitations

The following provisions of Section 2 of these Regulations are also applicable:

- Hidden Dangerous Goods (Subsection 2.2);
- Dangerous Goods Carried by Passengers or Crew (Subsection 2.3);
- Dangerous Goods in Operator's Property (Subsection 2.5);
- Dangerous Goods in Excepted Quantities (Subsection 2.6);
- State and Operator Variations (Subsection 2.8).

Note:

Applicable State and operator variations that specifically relate to radioactive material are identified by the trefoil symbol in the left margin, however, any or all variations may be applicable.

10.3 Classification

STATE VARIATIONS: RUG-03, SAG-04, UKG-01, USG-10

10.3.1 Definition

Radioactive material means any material containing radionuclides where both the activity concentration and the total activity in the consignment exceed the values specified in 10.3.2.

Note:

For Class 7, the type of packaging may have a decisive effect on classification.

10.3.2 Determining Activity

Activity limits for packagings containing radioactive material are determined by the activity values for "Special Form" radioactive material and for material, which is "Other than Special Form". The value for Special Form is designated A₁. The value for "Other than Special Form" is designated A₂.

10.3.2.1 Listed Single Radionuclides

The following basic values for individual radionuclides are given in Table 10.3.A:

- (a) A₁ and A₂ in TBq;
- (b) activity concentration for exempt material in Bq/g; and
- (c) activity limits for exempt consignments in Bq.

10.3.2.2 Unlisted Single Radionuclides

For individual radionuclides whose identities are known, but which are not listed in Table 10.3.A, the determination of the basic radionuclide values referred to in 10.3.2.1 must have multilateral approval. Where the chemical form of each radionuclide is known, it is permissible to use the A₂ value calculated using a dose coefficient for the appropriate lung absorption type, as recommended by

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appropriate action to remedy the causes of non-compliance and to prevent a recurrence of circumstances that led to the non-compliance;

communicate to the relevant competent authority(ies) the causes of the non-compliance and corrective or preventative actions taken to be taken; and

communication of the non-compliance to the relevant competent authority(ies), must be made as soon as possible and immediately whenever an emergency exposition has developed or is developing.

applicability

provisions of Section 1 of the Regulations

- of Dangerous Goods (Subsection 1.0);
- of the Regulations (Subsection 1.1);
- of the Regulations (Subsection 1.2);
- Responsibilities (Subsection 1.3);
- Responsibilities (Subsection 1.4);
- Requirements (Subsection 1.5).

Limitations

Radioactive Material Forbidden or Exempted

Radioactive material must not be carried on a consignment unless it is exempted by the States under the provisions of these Regulations:

- (a) type B(M) packages;
- (b) packages which require external cooling by an external cooling system;
- (c) packages subject to operational controls during transport, storage, handling, and disposal; and
- (d) radioactive liquid.

Transport of Radioactive Material by Post

STATE VARIATIONS: CAG-09, FRG-07, NLG-02,

STATE VARIATIONS: AR-03, AV-07, BR-05, C8-03, D5-03, EY-07, IJ-04, KQ-03, MU-03, QR-02, TK-06, UU-01, VN-03, XK-02

International Postal Union (UPU), subject to the provisions of these Regulations, allows the carriage of radioactive material in excepted packages, provided the activity does not exceed one tenth of the relevant limit in Table 10.3.D. The provisions relating to excepted packages (Subsection 10.8) do not apply to such material.

1. the activity concentration of the material does not exceed one tenth of the relevant limit in Table 10.3.D. The provisions relating to excepted packages (Subsection 10.8) do not apply to such material.
2. the activity concentration of the material does not exceed one tenth of the relevant limit in Table 10.3.D. The provisions relating to excepted packages (Subsection 10.8) do not apply to such material.

the International Commission on Radiological Protection, if the chemical forms of each radionuclide under both normal and accident conditions of transport are taken into consideration. Alternatively, the values of A_1 and A_2 in Table 10.3.B may be used without obtaining such approval.

10.3.2.3 Determining A_1 and A_2

In the calculations of A_1 and A_2 for a radionuclide not in Table 10.3.A, a single radioactive decay chain, in which the radionuclides are present in their naturally occurring

proportions and in which no daughter nuclide has a half-life either longer than 10 days or longer than that of the parent nuclide, must be considered as a single radionuclide, and the activity to be taken into account and the A_1 or A_2 value to be applied, must be that corresponding to the parent nuclide of that chain. In the case of radioactive decay chains in which any daughter nuclide has a half-life either longer than 10 days or greater than that of the parent nuclide, the parent and such daughter nuclides must be considered as mixtures of different nuclides.

TABLE 10.3.A
 A_1 and A_2 Values for Common Radionuclides (10.3.2.1)

Radionuclide	Element (Atomic No)	A_1 (Special Form) (TBq)	A_2 (Other form) (TBq)	Activity concentration for exempt material (Bq/g)	Activity limit for an exempt consignment (Bq)
Ac-225 ^a	Actinium (89)	0.8	0.006	1×10^1	1×10^4
Ac-227 ^a		0.9	0.00009	1×10^{-1}	1×10^3
Ac-228		0.6	0.5	1×10^1	1×10^6
Ag-105	Silver (47)	2	2	1×10^2	1×10^6
Ag-108m ^a		0.7	0.7	1×10^1 ^b	1×10^6 ^b
Ag-110m ^a		0.4	0.4	1×10^1	1×10^6
Ag-111		2	0.6	1×10^3	1×10^6
Al-26	Aluminium (13)	0.1	0.1	1×10^1	1×10^5
Am-241	Americium (95)	10	0.001	1×10^0	1×10^4
Am-242m ^a		10	0.001	1×10^0 ^b	1×10^4 ^b
Am-243 ^a		5	0.001	1×10^0 ^b	1×10^3 ^b
Ar-37	Argon (18)	40	40	1×10^6	1×10^8
Ar-39		40	20	1×10^7	1×10^4
Ar-41		0.3	0.3	1×10^2	1×10^9
As-72	Arsenic (33)	0.3	0.3	1×10^1	1×10^5
As-73		40	40	1×10^3	1×10^7
As-74		1	0.9	1×10^1	1×10^6
As-76		0.3	0.3	1×10^2	1×10^5
As-77		20	0.7	1×10^3	1×10^6
At-211	Astatine (85)	20	0.5	1×10^3	1×10^7
Au-193	Gold (79)	7	2	1×10^2	1×10^7
Au-194		1	1	1×10^1	1×10^6
Au-195		10	6	1×10^2	1×10^7
Au-198		1	0.6	1×10^2	1×10^6
Au-199		10	0.6	1×10^2	1×10^6
Ba-131 ^a	Barium (56)	2	2	1×10^2	1×10^6
Ba-133		3	3	1×10^2	1×10^6
Ba-133m		20	0.6	1×10^2	1×10^6
Ba-140 ^a		0.5	0.3	1×10^1 ^b	1×10^5 ^b
Be-7	Beryllium (4)	20	20	1×10^3	1×10^7
Be-10		40	0.6	1×10^4	1×10^9

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TABLE 10.3.A
A₁ and A₂ Values for Common Radionuclides (10.3.2.1) (continued)

Radionuclide	Element (Atomic No)	A ₁ (Special Form) (TBq)	A ₂ (Other form) (TBq)	Activity concentration for exempt material (Bq/g)	Activity limit for an exempt consignment (Bq)
Bi-205	Bismuth (83)	0.7	0.7	1 × 10 ¹	1 × 10 ⁶
Bi-206		0.3	0.3	1 × 10 ¹	1 × 10 ⁵
Bi-207		0.7	0.7	1 × 10 ¹	1 × 10 ⁶
Bi-210		1	0.6	1 × 10 ³	1 × 10 ⁶
Bi-210m ^a		0.6	0.02	1 × 10 ¹	1 × 10 ⁵
Bi-212 ^a		0.7	0.6	1 × 10 ^{1 b}	1 × 10 ^{5 b}
Bk-247	Berkelium (97)	8	0.0008	1 × 10 ⁰	1 × 10 ⁴
Bk-249 ^a		40	0.3	1 × 10 ³	1 × 10 ⁶
Br-76	Bromine (35)	0.4	0.4	1 × 10 ¹	1 × 10 ⁵
Br-77		3	3	1 × 10 ²	1 × 10 ⁶
Br-82		0.4	0.4	1 × 10 ¹	1 × 10 ⁶
C-11	Carbon (6)	1	0.6	1 × 10 ¹	1 × 10 ⁶
C-14		40	3	1 × 10 ⁴	1 × 10 ⁷
Ca-41	Calcium (20)	unlimited	unlimited	1 × 10 ⁵	1 × 10 ⁷
Ca-45		40	1	1 × 10 ⁴	1 × 10 ⁷
Ca-47 ^a		3	0.3	1 × 10 ¹	1 × 10 ⁶
Cd-109	Cadmium (48)	30	2	1 × 10 ⁴	1 × 10 ⁶
Cd-113m		40	0.5	1 × 10 ³	1 × 10 ⁶
Cd-115 ^a		3	0.4	1 × 10 ²	1 × 10 ⁶
Cd-115m		0.5	0.5	1 × 10 ³	1 × 10 ⁶
Ce-139	Cerium (58)	7	2	1 × 10 ²	1 × 10 ⁶
Ce-141		20	0.6	1 × 10 ²	1 × 10 ⁷
Ce-143		0.9	0.6	1 × 10 ²	1 × 10 ⁶
Ce-144 ^a		0.2	0.2	1 × 10 ^{2 b}	1 × 10 ^{5 b}
Cf-248	Californium (98)	40	0.006	1 × 10 ¹	1 × 10 ⁴
Cf-249		3	0.0008	1 × 10 ⁰	1 × 10 ³
Cf-250		20	0.002	1 × 10 ¹	1 × 10 ⁴
Cf-251		7	0.0007	1 × 10 ⁰	1 × 10 ³
Cf-252		0.1	0.003	1 × 10 ¹	1 × 10 ⁴
Cf-253 ^a		40	0.04	1 × 10 ²	1 × 10 ⁵
Cf-254		0.001	0.001	1 × 10 ⁰	1 × 10 ³
Cl-36	Chlorine (17)	10	0.6	1 × 10 ⁴	1 × 10 ⁶
Cl-38		0.2	0.2	1 × 10 ¹	1 × 10 ⁵
Cm-240	Curium (96)	40	0.02	1 × 10 ²	1 × 10 ⁵
Cm-241		2	1	1 × 10 ²	1 × 10 ⁶
Cm-242		40	0.01	1 × 10 ²	1 × 10 ⁵
Cm-243		9	0.001	1 × 10 ⁰	1 × 10 ⁴
Cm-244		20	0.002	1 × 10 ¹	1 × 10 ⁴
Cm-245		9	0.0009	1 × 10 ⁰	1 × 10 ³
Cm-246		9	0.0009	1 × 10 ⁰	1 × 10 ³
Cm-247 ^a		3	0.001	1 × 10 ⁰	1 × 10 ⁴

TABLE 10.3.A
A₁ and A₂ Values for Common Radionuclides (10.3.2.1) (continued)

Radionuclide	Element (Atomic No)	A ₁ (Special Form) (TBq)	A ₂ (Other form) (TBq)	Activity concentration for exempt material (Bq/g)	Activity limit for an exempt consignment (Bq)
Cm-248		0.02	0.0003	1 × 10 ⁰	1 × 10 ³
Co-55	Cobalt (27)	0.5	0.5	1 × 10 ¹	1 × 10 ⁶
Co-56		0.3	0.3	1 × 10 ¹	1 × 10 ⁵
Co-57		10	10	1 × 10 ²	1 × 10 ⁶
Co-58		1	1	1 × 10 ¹	1 × 10 ⁶
Co-58m		40	40	1 × 10 ⁴	1 × 10 ⁷
Co-60		0.4	0.4	1 × 10 ¹	1 × 10 ⁵
Cr-51	Chromium (24)	30	30	1 × 10 ³	1 × 10 ⁷
Cs-129	Caesium (55)	4	4	1 × 10 ²	1 × 10 ⁵
Cs-131		30	30	1 × 10 ³	1 × 10 ⁶
Cs-132		1	1	1 × 10 ³	1 × 10 ⁶
Cs-134		0.7	0.7	1 × 10 ¹	1 × 10 ⁴
Cs-134m		40	0.6	1 × 10 ³	1 × 10 ⁵
Cs-135		40	1	1 × 10 ⁴	1 × 10 ⁷
Cs-136		0.5	0.5	1 × 10 ¹	1 × 10 ⁵
Cs-137 ^a		2	0.6	1 × 10 ¹ ^b	1 × 10 ⁴ ^b
Cu-64	Copper (29)	6	1	1 × 10 ²	1 × 10 ⁶
Cu-67		10	0.7	1 × 10 ²	1 × 10 ⁶
Dy-159	Dysprosium (66)	20	20	1 × 10 ³	1 × 10 ⁷
Dy-165		0.9	0.6	1 × 10 ³	1 × 10 ⁶
Dy-166 ^a		0.9	0.3	1 × 10 ³	1 × 10 ⁶
Er-169	Erbium (68)	40	1	1 × 10 ⁴	1 × 10 ⁷
Er-171		0.8	0.5	1 × 10 ²	1 × 10 ⁶
Eu-147	Europium (63)	2	2	1 × 10 ²	1 × 10 ⁶
Eu-148		0.5	0.5	1 × 10 ¹	1 × 10 ⁶
Eu-149		20	20	1 × 10 ²	1 × 10 ⁷
Eu-150 (short lived)		2	0.7	1 × 10 ³	1 × 10 ⁶
Eu-150 (long lived)		0.7	0.7	1 × 10 ¹	1 × 10 ⁶
Eu-152		1	1	1 × 10 ¹	1 × 10 ⁶
Eu-152m		0.8	0.8	1 × 10 ²	1 × 10 ⁶
Eu-154		0.9	0.6	1 × 10 ¹	1 × 10 ⁶
Eu-155		20	3	1 × 10 ²	1 × 10 ⁷
Eu-156		0.7	0.7	1 × 10 ¹	1 × 10 ⁶
F-18	Fluorine (9)	1	0.6	1 × 10 ¹	1 × 10 ⁶
Fe-52 ^a	Iron (26)	0.3	0.3	1 × 10 ¹	1 × 10 ⁶
Fe-55		40	40	1 × 10 ⁴	1 × 10 ⁶
Fe-59		0.9	0.9	1 × 10 ¹	1 × 10 ⁶
Fe-60 ^a		40	0.2	1 × 10 ²	1 × 10 ⁵
Ga-67	Gallium (31)	7	3	1 × 10 ²	1 × 10 ⁶
Ga-68		0.5	0.5	1 × 10 ¹	1 × 10 ⁵
Ga-72		0.4	0.4	1 × 10 ¹	1 × 10 ⁵

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TABLE 10.3.A
A₁ and A₂ Values for Common Radionuclides (10.3.2.1) (continued)

Radionuclide	Element (Atomic No)	A ₁ (Special Form) (TBq)	A ₂ (Other form) (TBq)	Activity concentration for exempt material (Bq/g)	Activity limit for an exempt consignment (Bq)
Gd-146 ^a	Gadolinium (64)	0.5	0.5	1 × 10 ¹	1 × 10 ⁶
Gd-148		20	0.002	1 × 10 ¹	1 × 10 ⁴
Gd-153		10	9	1 × 10 ²	1 × 10 ⁷
Gd-159		3	0.6	1 × 10 ³	1 × 10 ⁶
Ge-68 ^a	Germanium (32)	0.5	0.5	1 × 10 ¹	1 × 10 ⁵
Ge-71		40	40	1 × 10 ⁴	1 × 10 ⁸
Ge-77		0.3	0.3	1 × 10 ¹	1 × 10 ⁵
Hf-172 ^a	Hafnium (72)	0.6	0.6	1 × 10 ¹	1 × 10 ⁶
Hf-175		3	3	1 × 10 ²	1 × 10 ⁶
Hf-181		2	0.5	1 × 10 ¹	1 × 10 ⁶
Hf-182		unlimited	unlimited	1 × 10 ²	1 × 10 ⁶
Hg-194 ^a	Mercury (80)	1	1	1 × 10 ¹	1 × 10 ⁶
Hg-195m ^a		3	0.7	1 × 10 ²	1 × 10 ⁶
Hg-197		20	10	1 × 10 ²	1 × 10 ⁷
Hg-197m		10	0.4	1 × 10 ²	1 × 10 ⁶
Hg-203		5	1	1 × 10 ²	1 × 10 ⁵
Ho-166	Holmium (67)	0.4	0.4	1 × 10 ³	1 × 10 ⁵
Ho-166m		0.6	0.5	1 × 10 ¹	1 × 10 ⁶
I-123	Iodine (53)	6	3	1 × 10 ²	1 × 10 ⁷
I-124		1	1	1 × 10 ¹	1 × 10 ⁶
I-125		20	3	1 × 10 ³	1 × 10 ⁶
I-126		2	1	1 × 10 ²	1 × 10 ⁶
I-129		unlimited	unlimited	1 × 10 ²	1 × 10 ⁵
I-131		3	0.7	1 × 10 ²	1 × 10 ⁶
I-132		0.4	0.4	1 × 10 ¹	1 × 10 ⁵
I-133		0.7	0.6	1 × 10 ¹	1 × 10 ⁶
I-134		0.3	0.3	1 × 10 ¹	1 × 10 ⁵
I-135 ^a		0.6	0.6	1 × 10 ¹	1 × 10 ⁶
In-111	Indium (49)	3	3	1 × 10 ²	1 × 10 ⁶
In-113m		4	2	1 × 10 ²	1 × 10 ⁶
In-114m ^a		10	0.5	1 × 10 ²	1 × 10 ⁶
In-115m		7	1	1 × 10 ²	1 × 10 ⁶
Ir-189 ^a	Iridium (77)	10	10	1 × 10 ²	1 × 10 ⁷
Ir-190		0.7	0.7	1 × 10 ¹	1 × 10 ⁶
Ir-192		1 ^c	0.6	1 × 10 ¹	1 × 10 ⁴
Ir-194		0.3	0.3	1 × 10 ²	1 × 10 ⁵
K-40	Potassium (19)	0.9	0.9	1 × 10 ²	1 × 10 ⁶
K-42		0.2	0.2	1 × 10 ²	1 × 10 ⁶
K-43		0.7	0.6	1 × 10 ¹	1 × 10 ⁶
Kr-79		4	2	1 × 10 ³	1 × 10 ⁵
Kr-81		40	40	1 × 10 ⁴	1 × 10 ⁷

TABLE 10.3.A
A₁ and A₂ Values for Common Radionuclides (10.3.2.1) (continued)

Radionuclide	Element (Atomic No)	A ₁ (Special Form) (TBq)	A ₂ (Other form) (TBq)	Activity concentration for exempt material (Bq/g)	Activity limit for an exempt consignment (Bq)
Kr-85		10	10	1 × 10 ⁵	1 × 10 ⁴
Kr-85m		8	3	1 × 10 ³	1 × 10 ¹⁰
Kr-87		0.2	0.2	1 × 10 ²	1 × 10 ⁹
La-137	Lanthanum (57)	30	6	1 × 10 ³	1 × 10 ⁷
La-140		0.4	0.4	1 × 10 ¹	1 × 10 ⁵
LSA	Low Specific Activity	note 4	note 4		
Lu-172	Lutetium (71)	0.6	0.6	1 × 10 ¹	1 × 10 ⁶
Lu-173		8	8	1 × 10 ²	1 × 10 ⁷
Lu-174		9	9	1 × 10 ²	1 × 10 ⁷
Lu-174m		20	10	1 × 10 ²	1 × 10 ⁷
Lu-177		30	0.7	1 × 10 ³	1 × 10 ⁷
MFP	Mixed Fission Products	note 3	note 3		
Mg-28 ^a	Magnesium (12)	0.3	0.3	1 × 10 ¹	1 × 10 ⁵
Mn-52	Manganese (25)	0.3	0.3	1 × 10 ¹	1 × 10 ⁵
Mn-53		unlimited	unlimited	1 × 10 ⁴	1 × 10 ⁹
Mn-54		1	1	1 × 10 ¹	1 × 10 ⁶
Mn-56		0.3	0.3	1 × 10 ¹	1 × 10 ⁵
Mo-93	Molybdenum (42)	40	20	1 × 10 ³	1 × 10 ⁸
Mo-99 ^a		1	0.6	1 × 10 ²	1 × 10 ⁶
N-13	Nitrogen (7)	0.9	0.6	1 × 10 ²	1 × 10 ⁹
Na-22	Sodium (11)	0.5	0.5	1 × 10 ¹	1 × 10 ⁶
Na-24		0.2	0.2	1 × 10 ¹	1 × 10 ⁵
Nb-93m	Niobium (41)	40	30	1 × 10 ⁴	1 × 10 ⁷
Nb-94		0.7	0.7	1 × 10 ¹	1 × 10 ⁶
Nb-95		1	1	1 × 10 ¹	1 × 10 ⁶
Nb-97		0.9	0.6	1 × 10 ¹	1 × 10 ⁶
Nd-147	Neodymium (60)	6	0.6	1 × 10 ²	1 × 10 ⁶
Nd-149		0.6	0.5	1 × 10 ²	1 × 10 ⁶
Ni-59	Nickel (28)	unlimited	unlimited	1 × 10 ⁴	1 × 10 ⁸
Ni-63		40	30	1 × 10 ⁵	1 × 10 ⁸
Ni-65		0.4	0.4	1 × 10 ¹	1 × 10 ⁶
Np-235	Neptunium (93)	40	40	1 × 10 ³	1 × 10 ⁷
Np-236 (short lived)		20	2	1 × 10 ³	1 × 10 ⁷
Np-236 (long lived)		9	0.02	1 × 10 ²	1 × 10 ⁵
Np-237		20	0.002	1 × 10 ⁰ ^b	1 × 10 ³ ^b
Np-239		7	0.4	1 × 10 ²	1 × 10 ⁷
Os-185	Osmium (76)	1	1	1 × 10 ¹	1 × 10 ⁶
Os-191		10	2	1 × 10 ²	1 × 10 ⁷
Os-191m		40	30	1 × 10 ³	1 × 10 ⁷
Os-193		2	0.6	1 × 10 ²	1 × 10 ⁶
Os-194 ^a		0.3	0.3	1 × 10 ²	1 × 10 ⁵

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TABLE 10.3.A
A₁ and A₂ Values for Common Radionuclides (10.3.2.1) (continued)

Radionuclide	Element (Atomic No)	A ₁ (Special Form) (TBq)	A ₂ (Other form) (TBq)	Activity concentration for exempt material (Bq/g)	Activity limit for an exempt consignment (Bq)
P-32	Phosphorus (15)	0.5	0.5	1 × 10 ³	1 × 10 ⁵
P-33		40	1	1 × 10 ⁵	1 × 10 ⁸
Pa-230 ^a	Protactinium (91)	2	0.07	1 × 10 ¹	1 × 10 ⁶
Pa-231		4	0.0004	1 × 10 ⁰	1 × 10 ³
Pa-233		5	0.7	1 × 10 ²	1 × 10 ⁷
Pb-201	Lead (82)	1	1	1 × 10 ¹	1 × 10 ⁶
Pb-202		40	20	1 × 10 ³	1 × 10 ⁶
Pb-203		4	3	1 × 10 ²	1 × 10 ⁶
Pb-205		unlimited	unlimited	1 × 10 ⁴	1 × 10 ⁷
Pb-210 ^a		1	0.05	1 × 10 ^{1 b}	1 × 10 ^{4 b}
Pb-212 ^a		0.7	0.2	1 × 10 ^{1 b}	1 × 10 ^{5 b}
Pd-103 ^a	Palladium (46)	40	40	1 × 10 ³	1 × 10 ⁸
Pd-107		unlimited	unlimited	1 × 10 ⁵	1 × 10 ⁸
Pd-109		2	0.5	1 × 10 ³	1 × 10 ⁶
Pm-143	Promethium (61)	3	3	1 × 10 ²	1 × 10 ⁶
Pm-144		0.7	0.7	1 × 10 ¹	1 × 10 ⁶
Pm-145		30	10	1 × 10 ³	1 × 10 ⁷
Pm-147		40	2	1 × 10 ⁴	1 × 10 ⁷
Pm-148m ^a		0.8	0.7	1 × 10 ¹	1 × 10 ⁶
Pm-149		2	0.6	1 × 10 ³	1 × 10 ⁶
Pm-151		2	0.6	1 × 10 ²	1 × 10 ⁶
Po-210	Polonium (84)	40	0.02	1 × 10 ¹	1 × 10 ⁴
Pr-142	Praseodymium (59)	0.4	0.4	1 × 10 ²	1 × 10 ⁵
Pr-143		3	0.6	1 × 10 ⁴	1 × 10 ⁶
Pt-188 ^a	Platinum (78)	1	0.8	1 × 10 ¹	1 × 10 ⁶
Pt-191		4	3	1 × 10 ²	1 × 10 ⁶
Pt-193		40	40	1 × 10 ⁴	1 × 10 ⁷
Pt-193m		40	0.5	1 × 10 ³	1 × 10 ⁷
Pt-195m		10	0.5	1 × 10 ²	1 × 10 ⁶
Pt-197		20	0.6	1 × 10 ³	1 × 10 ⁶
Pt-197m		10	0.6	1 × 10 ²	1 × 10 ⁶
Pu-236	Plutonium (94)	30	0.003	1 × 10 ¹	1 × 10 ⁴
Pu-237		20	20	1 × 10 ³	1 × 10 ⁷
Pu-238		10	0.001	1 × 10 ⁰	1 × 10 ⁴
Pu-239		10	0.001	1 × 10 ⁰	1 × 10 ⁴
Pu-240		10	0.001	1 × 10 ⁰	1 × 10 ³
Pu-241 ^a		40	0.06	1 × 10 ²	1 × 10 ⁵
Pu-242		10	0.001	1 × 10 ⁰	1 × 10 ⁴
Pu-244 ^a		0.4	0.001	1 × 10 ⁰	1 × 10 ⁴
Ra-223 ^a	Radium (88)	0.4	0.007	1 × 10 ^{2 b}	1 × 10 ^{5 b}
Ra-224 ^a		0.4	0.02	1 × 10 ^{1 b}	1 × 10 ^{5 b}

TABLE 10.3.A
A₁ and A₂ Values for Common Radionuclides (10.3.2.1) (continued)

Radionuclide	Element (Atomic No)	A ₁ (Special Form) (TBq)	A ₂ (Other form) (TBq)	Activity concentration for exempt material (Bq/g)	Activity limit for an exempt consignment (Bq)
Ra-225 ^a		0.2	0.004	1 × 10 ²	1 × 10 ⁵
Ra-226 ^a		0.2	0.003	1 × 10 ¹ ^b	1 × 10 ⁴ ^b
Ra-228 ^a		0.6	0.02	1 × 10 ¹ ^b	1 × 10 ⁵ ^b
Rb-81	Rubidium (37)	2	0.8	1 × 10 ¹	1 × 10 ⁶
Rb-83 ^a		2	2	1 × 10 ²	1 × 10 ⁶
Rb-84		1	1	1 × 10 ¹	1 × 10 ⁶
Rb-86		0.5	0.5	1 × 10 ²	1 × 10 ⁵
Rb-87		unlimited	unlimited	1 × 10 ⁴	1 × 10 ⁷
Rb (natural)		unlimited	unlimited	1 × 10 ⁴	1 × 10 ⁷
Re-184	Rhenium (75)	1	1	1 × 10 ¹	1 × 10 ⁶
Re-184m		3	1	1 × 10 ²	1 × 10 ⁶
Re-186		2	0.6	1 × 10 ³	1 × 10 ⁶
Re-187		unlimited	unlimited	1 × 10 ⁶	1 × 10 ⁹
Re-188		0.4	0.4	1 × 10 ²	1 × 10 ⁵
Re-189 ^a		3	0.6	1 × 10 ²	1 × 10 ⁶
Re (natural)		unlimited	unlimited	1 × 10 ⁶	1 × 10 ⁹
Rh-99	Rhodium (45)	2	2	1 × 10 ¹	1 × 10 ⁶
Rh-101		4	3	1 × 10 ²	1 × 10 ⁷
Rh-102		0.5	0.5	1 × 10 ¹	1 × 10 ⁶
Rh-102m		2	2	1 × 10 ²	1 × 10 ⁶
Rh-103m		40	40	1 × 10 ⁴	1 × 10 ⁸
Rh-105		10	0.8	1 × 10 ²	1 × 10 ⁷
Rn-222 ^a	Radon (86)	0.3	0.004	1 × 10 ¹ ^b	1 × 10 ⁸ ^b
Ru-97	Ruthenium (44)	5	5	1 × 10 ²	1 × 10 ⁷
Ru-103 ^a		2	2	1 × 10 ²	1 × 10 ⁶
Ru-105		1	0.6	1 × 10 ¹	1 × 10 ⁶
Ru-106 ^a		0.2	0.2	1 × 10 ² ^b	1 × 10 ⁵ ^b
S-35	Sulphur (16)	40	3	1 × 10 ⁵	1 × 10 ⁸
Sb-122	Antimony (51)	0.4	0.4	1 × 10 ²	1 × 10 ⁴
Sb-124		0.6	0.6	1 × 10 ¹	1 × 10 ⁶
Sb-125		2	1	1 × 10 ²	1 × 10 ⁶
Sb-126		0.4	0.4	1 × 10 ¹	1 × 10 ⁵
Sc-44	Scandium (21)	0.5	0.5	1 × 10 ¹	1 × 10 ⁵
Sc-46		0.5	0.5	1 × 10 ¹	1 × 10 ⁶
Sc-47		10	0.7	1 × 10 ²	1 × 10 ⁶
Sc-48		0.3	0.3	1 × 10 ¹	1 × 10 ⁵
SCO	Surface Contaminated Object	note 5	note 5		
Se-75	Selenium (34)	3	3	1 × 10 ²	1 × 10 ⁶
Se-79		40	2	1 × 10 ⁴	1 × 10 ⁷
Si-31	Silicon (14)	0.6	0.6	1 × 10 ³	1 × 10 ⁶

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TABLE 10.3.A
A₁ and A₂ Values for Common Radionuclides (10.3.2.1) (continued)

Radionuclide	Element (Atomic No)	A ₁ (Special Form) (TBq)	A ₂ (Other form) (TBq)	Activity concentration for exempt material (Bq/g)	Activity limit for an exempt consignment (Bq)
Si-32		40	0.5	1 × 10 ³	1 × 10 ⁶
Sm-145	Samarium (62)	10	10	1 × 10 ²	1 × 10 ⁷
Sm-147		unlimited	unlimited	1 × 10 ¹	1 × 10 ⁴
Sm-151		40	10	1 × 10 ⁴	1 × 10 ⁸
Sm-153		9	0.6	1 × 10 ²	1 × 10 ⁶
Sn-113 ^a	Tin (50)	4	2	1 × 10 ³	1 × 10 ⁷
Sn-117m		7	0.4	1 × 10 ²	1 × 10 ⁶
Sn-119m		40	30	1 × 10 ³	1 × 10 ⁷
Sn-121m ^a		40	0.9	1 × 10 ³	1 × 10 ⁷
Sn-123		0.8	0.6	1 × 10 ³	1 × 10 ⁶
Sn-125		0.4	0.4	1 × 10 ²	1 × 10 ⁵
Sn-126 ^a		0.6	0.4	1 × 10 ¹	1 × 10 ⁵
Sr-82 ^a	Strontium (38)	0.2	0.2	1 × 10 ¹	1 × 10 ⁵
Sr-85		2	2	1 × 10 ²	1 × 10 ⁶
Sr-85m		5	5	1 × 10 ²	1 × 10 ⁷
Sr-87m		3	3	1 × 10 ²	1 × 10 ⁶
Sr-89		0.6	0.6	1 × 10 ³	1 × 10 ⁶
Sr-90 ^a		0.3	0.3	1 × 10 ² ^b	1 × 10 ⁴ ^b
Sr-91 ^a		0.3	0.3	1 × 10 ¹	1 × 10 ⁵
Sr-92 ^a		1	0.3	1 × 10 ¹	1 × 10 ⁶
T (All Forms) (see note 2)	Tritium (1)	40	40	1 × 10 ⁶	1 × 10 ⁹
Ta-178 (long lived)	Tantalum (73)	1	0.8	1 × 10 ¹	1 × 10 ⁶
Ta-179		30	30	1 × 10 ³	1 × 10 ⁷
Ta-182		0.9	0.5	1 × 10 ¹	1 × 10 ⁴
Tb-157	Terbium (65)	40	40	1 × 10 ⁴	1 × 10 ⁷
Tb-158		1	1	1 × 10 ¹	1 × 10 ⁶
Tb-160		1	0.6	1 × 10 ¹	1 × 10 ⁶
Tc-95m ^a	Technetium (43)	2	2	1 × 10 ¹	1 × 10 ⁶
Tc-96		0.4	0.4	1 × 10 ¹	1 × 10 ⁶
Tc-96m ^a		0.4	0.4	1 × 10 ³	1 × 10 ⁷
Tc-97		unlimited	unlimited	1 × 10 ³	1 × 10 ⁸
Tc-97m		40	1	1 × 10 ³	1 × 10 ⁷
Tc-98		0.8	0.7	1 × 10 ¹	1 × 10 ⁶
Tc-99		40	0.9	1 × 10 ⁴	1 × 10 ⁷
Tc-99m		10	4	1 × 10 ²	1 × 10 ⁷
Te-121	Tellurium (52)	2	2	1 × 10 ¹	1 × 10 ⁶
Te-121m		5	3	1 × 10 ²	1 × 10 ⁶
Te-123m		8	1	1 × 10 ²	1 × 10 ⁷
Te-125m		20	0.9	1 × 10 ³	1 × 10 ⁷
Te-127		20	0.7	1 × 10 ³	1 × 10 ⁶
Te-127m ^a		20	0.5	1 × 10 ³	1 × 10 ⁷

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TABLE 10.3.A
A₁ and A₂ Values for Common Radionuclides (10.3.2.1) (continued)

Radionuclide	Element (Atomic No)	A ₁ (Special Form) (TBq)	A ₂ (Other form) (TBq)	Activity concentration for exempt material (Bq/g)	Activity limit for an exempt consignment (Bq)
Te-129		0.7	0.6	1 × 10 ²	1 × 10 ⁶
Te-129m ^a		0.8	0.4	1 × 10 ³	1 × 10 ⁶
Te-131m ^a		0.7	0.5	1 × 10 ⁴	1 × 10 ⁶
Te-132 ^a		0.5	0.4	1 × 10 ²	1 × 10 ⁷
Th-227	Thorium (90)	10	0.005	1 × 10 ¹	1 × 10 ⁴
Th-228 ^a		0.5	0.001	1 × 10 ^{0 b}	1 × 10 ^{4 b}
Th-229		5	0.0005	1 × 10 ^{0 b}	1 × 10 ^{3 b}
Th-230		10	0.001	1 × 10 ⁰	1 × 10 ⁴
Th-231		40	0.02	1 × 10 ³	1 × 10 ⁷
Th-232		unlimited	unlimited	1 × 10 ¹	1 × 10 ⁴
Th-234 ^a		0.3	0.3	1 × 10 ^{3 b}	1 × 10 ^{5 b}
Th (natural)		unlimited	unlimited	1 × 10 ^{0 b}	1 × 10 ^{3 b}
Ti-44 ^a	Titanium (22)	0.5	0.4	1 × 10 ¹	1 × 10 ⁵
Tl-200	Thallium (81)	0.9	0.9	1 × 10 ¹	1 × 10 ⁶
Tl-201		10	4	1 × 10 ²	1 × 10 ⁶
Tl-202		2	2	1 × 10 ²	1 × 10 ⁶
Tl-204		10	0.7	1 × 10 ⁴	1 × 10 ⁴
Tm-167	Thulium (69)	7	0.8	1 × 10 ²	1 × 10 ⁶
Tm-170		3	0.6	1 × 10 ³	1 × 10 ⁶
Tm-171		40	40	1 × 10 ⁴	1 × 10 ⁸
U-230 (fast lung absorption) ^{a d}	Uranium (92)	40	0.1	1 × 10 ^{1 b}	1 × 10 ^{5 b}
U-230 (medium lung absorption) ^{a e}		40	0.004	1 × 10 ¹	1 × 10 ⁴
U-230 (slow lung absorption) ^{a f}		30	0.003	1 × 10 ¹	1 × 10 ⁴
U-232 (fast lung absorption) ^d		40	0.01	1 × 10 ^{0 b}	1 × 10 ^{3 b}
U-232 (medium lung absorption) ^e		40	0.007	1 × 10 ¹	1 × 10 ⁴
U-232 (slow lung absorption) ^f		10	0.001	1 × 10 ¹	1 × 10 ⁴
U-233 (fast lung absorption) ^d		40	0.09	1 × 10 ¹	1 × 10 ⁴
U-233 (medium lung absorption) ^e		40	0.02	1 × 10 ²	1 × 10 ⁵
U-233 (slow lung absorption) ^f		40	0.006	1 × 10 ¹	1 × 10 ⁵
U-234 (fast lung absorption) ^d		40	0.09	1 × 10 ¹	1 × 10 ⁴
U-234 (medium lung absorption) ^{e f}		40	0.02	1 × 10 ²	1 × 10 ⁵
U-234 (slow lung absorption) ^f		40	0.006	1 × 10 ¹	1 × 10 ⁵
U-235 (all lung absorption types) ^{a d e f}		unlimited	unlimited	1 × 10 ^{1 b}	1 × 10 ^{4 b}
U-236 (fast lung absorption) ^d		unlimited	unlimited	1 × 10 ¹	1 × 10 ⁴

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TABLE 10.3.A
A₁ and A₂ Values for Common Radionuclides (10.3.2.1) (continued)

Radionuclide	Element (Atomic No)	A ₁ (Special Form) (TBq)	A ₂ (Other form) (TBq)	Activity concentration for exempt material (Bq/g)	Activity limit for an exempt consignment (Bq)
U-236 (medium lung absorption) ^e		40	0.02	1 × 10 ²	1 × 10 ⁵
U-236 (slow lung absorption) ^f		40	0.006	1 × 10 ¹	1 × 10 ⁴
U-238 (all lung absorption types) ^{d e f}		unlimited	unlimited	1 × 10 ^{1 b}	1 × 10 ^{4 b}
U (natural)		unlimited	unlimited	1 × 10 ^{0 b}	1 × 10 ^{3 b}
U (enriched to 20% or less) ^g		unlimited	unlimited	1 × 10 ⁰	1 × 10 ³
U (depleted)		unlimited	unlimited	1 × 10 ⁰	1 × 10 ³
V-48	Vanadium (23)	0.4	0.4	1 × 10 ¹	1 × 10 ⁵
V-49		40	40	1 × 10 ⁴	1 × 10 ⁷
W-178	Tungsten (74)	9	5	1 × 10 ¹	1 × 10 ⁶
W-181		30	30	1 × 10 ³	1 × 10 ⁷
W-185		40	0.8	1 × 10 ⁴	1 × 10 ⁷
W-187		2	0.6	1 × 10 ²	1 × 10 ⁶
W-188 ^a		0.4	0.3	1 × 10 ²	1 × 10 ⁵
Xe-122 ^a	Xenon (54)	0.4	0.4	1 × 10 ²	1 × 10 ⁹
Xe-123		2	0.7	1 × 10 ²	1 × 10 ⁹
Xe-127		4	2	1 × 10 ³	1 × 10 ⁵
Xe-131m		40	40	1 × 10 ⁴	1 × 10 ⁴
Xe-133		20	10	1 × 10 ³	1 × 10 ⁴
Xe-135		3	2	1 × 10 ³	1 × 10 ¹⁰
Y-87 ^a	Yttrium (39)	1	1	1 × 10 ¹	1 × 10 ⁶
Y-88		0.4	0.4	1 × 10 ¹	1 × 10 ⁶
Y-90		0.3	0.3	1 × 10 ³	1 × 10 ⁵
Y-91		0.6	0.6	1 × 10 ³	1 × 10 ⁶
Y-91m		2	2	1 × 10 ²	1 × 10 ⁶
Y-92		0.2	0.2	1 × 10 ²	1 × 10 ⁵
Y-93		0.3	0.3	1 × 10 ²	1 × 10 ⁵
Yb-169	Ytterbium (70)	4	1	1 × 10 ²	1 × 10 ⁷
Yb-175		30	0.9	1 × 10 ³	1 × 10 ⁷
Zn-65	Zinc (30)	2	2	1 × 10 ¹	1 × 10 ⁶
Zn-69		3	0.6	1 × 10 ⁴	1 × 10 ⁶
Zn-69m		3	0.6	1 × 10 ²	1 × 10 ⁶
Zr-88	Zirconium (40)	3	3	1 × 10 ²	1 × 10 ⁶
Zr-93		unlimited	unlimited	1 × 10 ^{3 b}	1 × 10 ^{7 b}
Zr-95 ^a		2	0.8	1 × 10 ¹	1 × 10 ⁶
Zr-97 ^a		0.4	0.4	1 × 10 ^{1 b}	1 × 10 ^{5 b}

A₁ and/or A₂ values for these parent radionuclides include contributions from daughter radionuclides with half-lives less than 10 days as listed in the following:

- Mg-28 — Al-28
- Ar-42 — K-42
- Ca-47 — Sc-47

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Ti-44 — Sc-44
Fe-52 — Mn-52m
Fe-60 — Co-60m
Zn-69m — Zn-69
Ge-68 — Ga-68
Rb-83 — Kr-83m
Sr-82 — Rb-82
Sr-90 — Y-90
Sr-91 — Y-91m
Sr-92 — Y-92
Y-87 — Sr-87m
Zr-95 — Nb-95m
Zr-97 — Nb-97m, Nb-97
Mo-99 — Tc-99m
Tc-95m — Tc-95
Tc-96m — Tc-96
Ru-103 — Rh-103m
Ru-106 — Rh-106
Pd-103 — Rh-103m
Ag-108m — Ag-108
Ag-110m — Ag-110
Cd-115 — In-115m
In-114m — In-114
Sn-113 — In-113m
Sn-121m — Sn-121
Sn-126 — Sb-126m
Te-118 — Sb-118
Te-127m — Te-127
Te-129m — Te-129
Te-131m — Te-131
Te-132 — I-132
I-135 — Xe-135m
Xe-122 — I-122
Cs-137 — Ba-137
Ba-131 — Cs-131
Ba-140 — La-140
Ce-144 — Pr-144m, Pr-144
Pm-148m — Pm-148
Gd-146 — Eu-146
Dy-166 — Ho-166
Hf-172 — Lu-172
W-178 — Ta-178
W-188 — Re-188
Re-189 — Os-189m
Os-194 — Ir-194
Ir-189 — Os-189m
Pt-188 — Ir-188
Hg-194 — Au-194
Hg-195m — Hg-195
Pb-210 — Bi-210
Pb-212 — Bi-212, Tl-208, Po-212
Bi-210m — Tl-206
Bi-212 — Tl-208, Po-212
At-211 — Po-211
Rn-222 — Po-218, Pb-214, At-218, Bi-214, Po-214
Ra-223 — Rn-219, Po-215, Pb-211, Bi-211, Po-211, Tl-207
Ra-224 — Rn-220, Po-216, Pb-212, Bi-212, Tl-208, Po-212
Ra-225 — Ac-225, Fr-221, At-217, Bi-213, Tl-209, Po-213, Pb-209
Ra-226 — Rn-222, Po-218, Pb-214, At-218, Bi-214, Po-214
Ra-228 — Ac-228
Ac-225 — Fr-221, At-217, Bi-213, Tl-209, Po-213, Pb-209
Ac-227 — Fr-223
Th-228 — Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208, Po-212
Th-234 — Pa-234m, Pa-234
Pa-230 — Ac-226, Th-226, Fr-222, Ra-222, Rn-218, Po-214

U-230 — Th-226, Ra-222, Rn-218, Po-214
 U-235 — Th-231
 Pu-241 — U-237
 Pu-244 — U-240, Np-240m
 Am-242m — Am-242, Np-238
 Am-243 — Np-239
 Cm-247 — Pu-243
 Bk-249 — Am-245
 Cf-253 — Cm-249

Parent nuclides and their progeny included in secular equilibrium are listed in the following:

Sr-90 — Y-90
 Zr-93 — Nb-93m
 Zr-97 — Nb-97
 Ru-106 — Rh-106
 Ag-108m — Ag-108
 Cs-137 — Ba-137m
 Ce-144 — Pr-144
 Ba-140 — La-140
 Bi-212 — Tl-208 (0.36), Po-212 (0.64)
 Pb-210 — Bi-210, Po-210
 Pb-212 — Bi-212, Tl-208 (0.36), Po-212 (0.64)
 Rn-222 — Po-218, Pb-214, Bi-214, Po-214
 Ra-223 — Rn-219, Po-215, Pb-211, Bi-211, Tl-207
 Ra-224 — Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)
 Ra-226 — Rn-222, Po-218, Pb-214, Bi-214, Po-214, Pb-210, Bi-210, Po-210
 Ra-228 — Ac-228
 Th-228 — Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)
 Th-229 — Ra-225, Ac-225, Fr-221, At-217, Bi-213, Po-213, Pb-209
 Th-nat — Ra-228, Ac-228, Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)
 Th-234 — Pa-234m
 U-230 — Th-226, Ra-222, Rn-218, Po-214
 U-232 — Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)
 U-235 — Th-231
 U-238 — Th-234, Pa-234m
 U-nat — Th-234, Pa-234m, U-234, Th-230, Ra-226, Rn-222, Po-218, Pb-214, Bi-214, Po-214, Pb-210, Bi-210, Po-210
 Np-237 — Pa-233
 Am-242m — Am-242
 Am-243 — Np-239

- The quantity may be determined from a measurement of the rate of decay or a measurement of the radiation level at a prescribed distance from the source.
- These values apply only to compounds of uranium that take the chemical form of UF_6 , UO_2F_2 and $UO_2(NO_3)_2$ in both normal and accident conditions of transport.
- These values apply only to compounds of uranium that take the chemical form of UO_3 , UF_4 , UCl_4 and hexavalent compounds in both normal and accident conditions of transport.
- These values apply to all compounds of uranium other than those specified in (d) and (e) above.
- These values apply to unirradiated uranium only.

Notes:

1. In Table 10.3.A, and elsewhere in these Regulations, the symbols for the various radionuclides are styled thus "Ir-192". The alternative form of "192 Ir" is equally acceptable.
2. Tritium (T) is a synonym for the radionuclide Hydrogen-3.
3. For Mixed Fission Products (MFP) values for A_1 and A_2 are calculated using the formula for mixtures or Table 10.3.B.
4. For Low Specific Activity (LSA) material, please consult 10.3.5 of these Regulations.
5. For Surface Contaminated Objects (SCO), please consult 10.3.6 of these Regulations.
6. Type A packages must not contain activities greater than the following values: for Special Form radioactive material: A_1 ; or for all other radioactive materials: A_2 .

10.3.2.4 Mixtures

For mixtures of radionuclides, the determination of the basic radionuclide values referred to in 10.3.2.1 may be determined as follows:

$$X_m = \frac{1}{\sum_i \frac{f(i)}{X(i)}}$$

where:

f_i is the fraction of activity or activity concentration of radionuclide i in the mixture;

X_i is the appropriate value of A_1 or A_2 , or the activity concentration for exempt material or the activity limit for an exempt consignment as appropriate for the radionuclide i ; and

X_m is the derived value of A_1 or A_2 , or the activity concentration for exempt material or the activity limit for an exempt consignment in the case of a mixture.

10.3.2.5 A_2 Value for Mixtures — Unknown Individual Activities

10.3.2.5.1 When the identity of each radionuclide is known but the individual activities of some of the radionuclides are not known, the radionuclides may be grouped and the lowest radionuclide value, as appropriate, for the radionuclides in each group may be used in applying the formulas in 10.3.2.4 and 10.3.11.4.3. Groups may be based on the total alpha activity and the total beta/gamma activity, when these are known, in each case using the lowest radionuclide values for the alpha emitters or beta/gamma emitters, respectively.

10.3.2.5.2 For individual radionuclides or for mixtures of radionuclides for which relevant data are not available, the values shown in Table 10.3.B must be used.

TABLE 10.3.B
Basic Radionuclide Values for Unknown Radionuclides or Mixtures (10.3.2.5.2)

Radioactive contents	A_1	A_2	Activity concentration for exempt material	Activity limits for an exempt consignment
	(TBq)	(TBq)	(Bq/g)	(Bq)
Only beta or gamma emitting nuclides are known to be present	0.1	0.02	1×10^1	1×10^4
Alpha emitting nuclides but no neutron emitters are known to be present	0.2	9×10^{-5}	1×10^{-1}	1×10^3
Neutron emitting nuclides are known to be present or no relevant data available	0.001	9×10^{-5}	1×10^{-1}	1×10^3

10.3.3 Nomenclature

Radioactive materials are grouped according to their form and/or characteristics. These include:

- Special Form;
- Low Specific Activity (LSA);
- Surface Contaminated Object (SCO);
- Fissile;
- Low dispersible radioactive material;
- Other form.

A radioactive material may meet the definition of one or more of the above.

10.3.4 Special Form

10.3.4.1 Definition

Special Form radioactive material is either an indispersible solid radioactive material or a sealed capsule containing radioactive material that meets the requirements of 10.3.4.2.

10.3.4.2 Requirements

Special Form radioactive material must meet the requirements of 10.3.4.2.1 to 10.3.4.2.3.

10.3.4.2.1 If it is in a sealed capsule, that capsule must be so constructed that it can only be opened by destroying it.

10.3.4.2.2 The design for Special Form radioactive material must have at least one dimension not less than 5 mm.

10.3.4.2.3 The design for special form requires unilateral approval.

10.3.4.2.4 Special Form radioactive material must be of such a nature or so designed that if it is subjected to the tests specified in 10.3.4.3 and 10.3.4.4 it must meet the following requirements:

- (a) it would not break or shatter under the impact, percussion or bending tests 10.3.4.3.1 to 10.3.4.3.3 and 10.3.4.3.5(a), as applicable;
- (b) it would not melt or disperse in the heat test 10.3.4.3.4 or 10.3.4.3.5(b), as applicable; and
- (c) the activity in the water from the leaching tests specified in 10.3.4.4 would not exceed 2 kBq (50 nCi); or alternatively for sealed sources, the leakage rate for the volumetric leakage assessment test specified in ISO 9978:1992 "Radiation Protection — Sealed Radioactive Sources — Leak Test Methods", would not exceed the applicable acceptance threshold acceptable to the competent authority.

10.3.4.2.5 Demonstration of compliance with the standards shown in 10.3.4.2.4 must be in accordance with 10.6.3.1.1 and 10.6.3.1.2.

10.3.4.3 Tests

The tests to be performed on specimens that comprise or simulate Special Form radioactive material are: the impact test, the percussion test, the bending test, and the

heat test specified in 10.3.4.3.1 to 10.3.4.3.4 or alternative tests as authorized in 10.3.4.3.5. A different specimen may be used for each of the tests. After each of the tests specified in 10.3.4.3.1 to 10.3.4.3.5, a leaching assessment or volumetric leakage test must be performed on the specimen by a method no less sensitive than the methods given in 10.3.4.4.1 for indispersible solid material and 10.3.4.4.2 for encapsulated material.

10.3.4.3.1 Impact Test

The specimen must drop from a height of 9 m (30 ft) onto a target as specified in 10.6.3.3.

10.3.4.3.2 Percussion Test

The specimen must be placed on a sheet of lead, which 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 must be 25 mm in diameter with the edges rounded off to a radius of 3 mm \pm 0.3 mm. The lead, of hardness number 3.5 to 4.5 on the Vickers scale and not more than 25 mm thick, must cover an area greater than that covered by the specimen. A fresh surface of lead must be used for each impact. The bar must strike the specimen so as to cause maximum damage.

10.3.4.3.3 Bending Test

The test need 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 must 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 must 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 must strike the specimen so as to produce an impact equivalent to that resulting from a free vertical drop of 1.4 kg through 1 m. The flat face of the bar must be 25 mm in diameter with the edges rounded off to a radius of 3 mm \pm 0.3 mm.

10.3.4.3.4 Heat Test

The specimen must be heated in air to a temperature of 800°C (1472°F) and held at that temperature for a period of 10 minutes and then allowed to cool.

10.3.4.3.5 Alternative Tests

Specimens that comprise or simulate radioactive material enclosed in a sealed capsule may be excepted from:

- (a) the tests prescribed in 10.3.4.3.1 and 10.3.4.3.2, provided the mass of the Special Form radioactive material is:
 1. less than 200 g and they are alternatively subjected to the Class 4 impact test prescribed in ISO 2919:1999 "Radiation Protection — Sealed Radioactive Sources — General requirements and classification"; or

2. less than 500 g and they are alternatively subjected to the Class 5 impact test prescribed in ISO 2919:1999: "Radiation Protection — Sealed Radioactive Sources — General requirements and classification"; and

- (b) the test prescribed in 10.3.4.3.4, provided they are alternatively subjected to the Class 6 temperature test prescribed in ISO 2919:1999 "Radiation Protection — Sealed Radioactive Sources — General requirements and classification".

10.3.4.4 Leaching and Volumetric Leakage Assessment Methods

10.3.4.4.1 Indispersible Solid Material

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

- (a) the specimen must be immersed for 7 days in water at ambient temperature. The volume of water to be used in the test must be sufficient to ensure that at the end of the 7-day test period the free volume of the unabsorbed and unreacted water remaining must be at least 10% of the volume of the solid test sample itself. The water must have an initial pH of 6 to 8 and a maximum conductivity of 1 mS/m at 20°C;
- (b) the water with specimen must then be heated to a temperature of 50°C \pm 5°C and maintained at this temperature for 4 hours;
- (c) the activity of the water must then be determined;
- (d) the specimen must then be stored for at least 7 days in still air at not less than 30°C and relative humidity not less than 90%;
- (e) the specimen must then be immersed in water of the same specification as shown in 10.3.4.4.1(a) and the water with the specimen heated to 50°C \pm 5°C and maintained at this temperature for 4 hours;
- (f) the activity of the water must then be determined.

10.3.4.4.2 Encapsulated Material

For specimens, which comprise or simulate radioactive material enclosed in a sealed capsule, either a leaching assessment or a volumetric leakage assessment must be performed as follows:

- (a) The leaching assessment must consist of the following steps:
 1. the specimen must be immersed in water at ambient temperature. The water must have an initial pH of 6 to 8 with a maximum conductivity of 1 mS/m at 20°C;
 2. the water and specimen must be heated to a temperature of 50°C \pm 5°C and maintained at this temperature for 4 hours;
 3. the activity of the water must then be determined;
 4. the specimen must then be stored for at least 7 days in still air at a temperature at not less than 30°C and relative humidity of not less than 90%;
 5. the process in 1, 2 and 3 must be repeated;

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- (b) the alternative volumetric leakage assessment may comprise any of the tests prescribed in ISO 9978:1992 "Radiation Protection — Sealed Radioactive Sources — Leak Test Methods", which are acceptable to the competent authority.

10.3.5 Low Specific Activity (LSA) Material

10.3.5.1 Definition

Radioactive material, which by its nature has a limited specific activity, or radioactive material for which limits of estimated average specific activity apply, is termed Low Specific Activity, or LSA material. External shielding material surrounding the LSA material must not be considered in determining the estimated average specific activity. LSA material is classified in one of three groups:

- LSA-I;
- LSA-II;
- LSA-III.

10.3.5.1.1 LSA-I

LSA-I material is:

- (a) uranium and thorium ores and concentrates of such ores, and other ores containing naturally occurring radionuclides which are intended to be processed for the use of these radionuclides;
- (b) natural uranium, depleted uranium, natural thorium or their compounds or mixtures, providing they are unirradiated and in solid or liquid form;
- (c) radioactive material, for which the A_2 value is unlimited, other than fissile material not accepted according to 10.3.7.2; or
- (d) other radioactive material in which the activity is distributed throughout and the estimated average specific activity does not exceed 30 times the values for activity concentration specified in 10.3.2, excluding fissile material not accepted under 10.3.7.2.

10.3.5.1.2 LSA-II

LSA-II material is:

- (a) water with tritium concentration up to 0.8 TBq/L; or
- (b) other material in which the activity is distributed throughout and the estimated average specific activity does not exceed 10^{-4} A_2/g for solids and gases, and 10^{-5} A_2/g for liquids.

Note:

See Appendix A for definition of A_1 and A_2 .

10.3.5.1.3 LSA-III

LSA-III material is a solid (e.g. consolidated wastes, activated materials), excluding powders meeting the requirements of 10.3.5.1.3.1, in which:

- (a) the radioactive material is distributed throughout a solid or a collection of solid objects, or is essentially uniformly distributed in a solid compact binding agent (such as concrete, bitumen, ceramic, etc.);

- (b) the radioactive material is relatively insoluble, or it is intrinsically contained in a relatively insoluble matrix, so that, even under loss of packaging, the loss of radioactive material per package by leaching when placed in water for 7 days would not exceed $0.1 A_2$; and
- (c) the estimated average specific activity of the solid, excluding any shielding material, does not exceed $2 \times 10^{-3} A_2/g$.

10.3.5.1.3.1 LSA-III material must be a solid of such a nature that if the entire contents of the package were subjected to the tests specified in 10.3.5.1.3.3 the activity in the water would not exceed $0.1 A_2$.

10.3.5.1.3.2 Compliance Demonstration of compliance with the performance standards in 10.3.5.1.3.3 must be in accordance with 10.6.3.1.1 and 10.6.3.1.2.

10.3.5.1.3.3 Tests LSA-III material must be tested as follows:

Solid material representing the entire contents of the package must be immersed for 7 days in water at ambient temperature. The volume of water to be used in the test must be sufficient to ensure that at the end of the 7 day test period the free volume of the unabsorbed and unreacted water remaining will be at least 10% of the volume of the solid test sample itself. The water must have an initial pH of 6 to 8 and a maximum conductivity of 1 mS/m at 20°C. The total activity of the free volume of water must be measured following the 7-day immersion of the test sample.

10.3.6 Surface Contaminated Object (SCO)

10.3.6.1 Definition

Surface Contaminated Object (SCO) means a solid object which is not itself radioactive but which has radioactive material distributed on its surfaces. SCO is classified in one of two groups:

- SCO-I;
- SCO-II.

10.3.6.1.1 SCO-I

A solid object on which:

- (a) the non-fixed contamination on the accessible surface averaged over 300 cm² (or the surface area if less than 300 cm²) does not exceed 4 Bq/cm² (0.1 nCi/cm²) for beta and gamma emitters and low toxicity alpha emitters, or 0.4 Bq/cm² (0.01 nCi/cm²) for all other alpha emitters; and
- (b) the fixed contamination on the accessible surface averaged over 300 cm² (or the surface area if less than 300 cm²) does not exceed 40 kBq/cm² (1 µCi/cm²) for beta and gamma emitters and low toxicity alpha emitters, or 4 kBq/cm² (0.1 µCi/cm²) for all other alpha emitters; and
- (c) the non-fixed contamination plus the fixed contamination on the inaccessible surface averaged over 300 cm² (or the surface area if less than 300 cm²) does not exceed 40 kBq/cm² (1 µCi/cm²) for beta and

gamma emitters and low toxicity alpha emitters, or 4 kBq/cm² (0.1 µCi/cm²) for all other alpha emitters.

10.3.6.1.2 SCO-II

A solid object on which either the fixed or non-fixed contamination on the surface exceeds the applicable limits specified for SCO-I in 10.3.6.1.1 and on which:

- (a) the non-fixed contamination on the accessible surface averaged over 300 cm² (or the surface area if less than 300 cm²) does not exceed 400 Bq/cm² (10 nCi/cm²) for beta and gamma emitters and low toxicity alpha emitters, or 40 Bq/cm² (1 nCi/cm²) for all other alpha emitters;
- (b) the fixed contamination on the accessible surface averaged over 300 cm² (or the surface area if less than 300 cm²) does not exceed 800 kBq/cm² (20 µCi/cm²) for beta and gamma emitters and low toxicity alpha emitters, or 80 kBq/cm² (2 µCi/cm²) for all other alpha emitters; and
- (c) the non-fixed contamination plus the fixed contamination on the inaccessible surface averaged over 300 cm² (or the surface area if less than 300 cm²) does not exceed 800 kBq/cm² (20 µCi/cm²) for beta and gamma emitters and low toxicity alpha emitters, or 80 kBq/cm² (2 µCi/cm²) for all other alpha emitters.

10.3.7 Fissile Material

10.3.7.1 Definition

10.3.7.1.1 Fissile material is a material containing any of the following fissile nuclides: Uranium-233, Uranium-235, Plutonium-239 and Plutonium-241. Excluded from the definition of fissile material are:

- natural uranium or depleted uranium which is unirradiated; and
- natural uranium or depleted uranium, which has been irradiated in thermal reactors only.

10.3.7.1.2 Packages containing fissile material must be classified under the relevant entry of Table 10.4.A the description of which includes the words "fissile" or "fissile excepted". Classification as "fissile excepted" is only allowed if one of the conditions set out in 10.3.7.2.1 to 10.3.7.2.4 is met. Only one type of exception is allowed per consignment. Packages containing fissile material must be designed and used so as to comply with the requirements specified in 10.6.2.8.

10.3.7.2 Fissile Excepted

Fissile material meeting one of the requirements of 10.3.7.2.1 to 10.3.7.2.4 is excepted from the requirement to be transported in packages that comply with 10.6.2.8 and from the other requirements of these Regulations that apply to fissile material. Only one type of exception is permitted per consignment.

10.3.7.2.1 A mass limit per consignment provided that the smallest external dimension of each package is not less than 10 cm such that:

$$\frac{\text{mass of uranium - 235 (g)}}{X} + \frac{\text{mass of other fissile material (g)}}{Y} < 1$$

where X and Y are the mass limits defined in Table 10.3.C, provided that either:

- (a) each individual package contains not more than 15 g of fissile nuclides; or
- (b) the fissile material is a homogeneous hydrogenous solution or mixture where the ratio of fissile nuclides to hydrogen is less than 5% by mass; or
- (c) there are not more than 5 g of fissile nuclides in any 10 L volume of material.

Beryllium must not be present in quantities exceeding 1% of the applicable consignment mass limits provided in Table 10.3.C, except where the concentration of beryllium in the material does not exceed 1 g beryllium in any 1,000 g

Deuterium must also not be present in quantities exceeding 1% of the applicable consignment mass limits provided in Table 10.3.C, except where deuterium occurs up to natural concentration in hydrogen.

10.3.7.2.2 Uranium enriched in Uranium-235 to a maximum of 1% by weight, and with a total plutonium and Uranium-233 content not exceeding 1% of the weight of Uranium-235, provided that the fissile nuclides are distributed essentially homogeneously throughout the material. In addition, if Uranium-235 is present in metallic, oxide or carbide forms, it must not form a lattice arrangement.

10.3.7.2.3 Liquid solutions of uranyl nitrate enriched in Uranium-235 to a maximum of 2% by weight, with a total plutonium and Uranium-233 content not exceeding 0.002% of the weight of uranium, and with a minimum nitrogen to uranium atomic ratio (N/U) of 2.

10.3.7.2.4 Plutonium containing not more than 20% of fissile nuclides by weight up to a maximum of 1 kg of plutonium per consignment. Shipments under this exemption must be under exclusive use.

TABLE 10.3.C
Consignment Mass Limits for Exceptions from the Requirements for Packages Containing Fissile Material (10.3.7.2.1)

Fissile material	Fissile material mass (g) mixed with substances having an average hydrogen density ≤ water	Fissile material mass (g) mixed with substances having an average hydrogen density > water
Uranium-235 (X)	400	290
Other fissile material (Y)	250	180

10.3.8 Low Dispersible Material

10.3.8.1 Definition

Low dispersible radioactive material means either a solid radioactive material or a solid radioactive material in a sealed capsule that has limited dispersibility and is not in powder form.

10.3.8.2 Requirements

The design for low dispersible radioactive material requires multilateral approval. Low dispersible radioactive

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material must be such that the total amount of this radioactive material in a package, taking into account the provisions of 10.6.2.5.15, must meet the following requirements:

- (a) the radiation level at 3 m from the unshielded radioactive material does not exceed 10 mSv/h;
- (b) if subjected to the tests specified in 10.6.3.7.3 and 10.6.3.7.4, the airborne release in gaseous and particulate forms of up to 100 µm aerodynamic equivalent diameter would not exceed 100 A₂. A separate specimen may be used for each test; and
- (c) if subjected to the test specified in 10.3.5.1.3.3, the activity in the water would not exceed 100 A₂. In the application of this test, the damaging effects of the tests specified in (b) above, must be taken into account.

10.3.8.3 Tests

Low dispersible material must be tested as follows:

A specimen that comprises or simulates low dispersible radioactive material must be subjected to the enhanced thermal test specified in 10.6.3.7.3 and the impact test specified in 10.6.3.7.4. A different specimen may be used for each of the tests. Following each test, the specimen must be subjected to the leach test specified in 10.3.5.1.3.3. After each test it must be determined if the applicable requirements of 10.3.8.2 have been met.

10.3.8.4 Compliance

Demonstration of compliance with the performance standards in 10.3.8.2 and 10.3.8.3 must be in accordance with 10.6.3.1.1 and 10.6.3.1.2.

10.3.9 Other Form

Other form radioactive material is radioactive material that does not meet the definition of Special Form as specified in 10.3.4.1.

10.3.10 Subsidiary Risks

10.3.10.1 With the exception of UN 2908, UN 2909, UN 2910, UN 2911, UN 2977, UN 2978, radioactive material with a subsidiary risk must:

- (a) be labelled with subsidiary risk labels corresponding to each subsidiary risk exhibited by the material. Corresponding placards must be affixed to transport units in accordance with the relevant provisions of 10.7.5;
- (b) be allocated to Packing Groups I, II or III, as and if appropriate, by application of the grouping criteria in Section 3 corresponding to the nature of the predominant subsidiary risk;
- (c) be capable of meeting the appropriate packaging performance criteria for the subsidiary risk.

10.3.10.2 The description required in 10.8.3.9.2(b) must include a description of these subsidiary risks (e.g. "Subsidiary risk: 3, 6.1"), the name of the constituents which most predominantly contribute to this (these) subsidiary risk(s), and where applicable, the packing group.

10.3.10.3 Radioactive material with a subsidiary risk of Division 4.2 (Packing Group I) must be transported in Type B packages. Radioactive material with a subsidiary risk of Division 2.1 is forbidden from transport on passenger aircraft and radioactive material with a subsidiary risk of Division 2.3 is forbidden from transport on passenger or cargo aircraft except with the prior approval of the appropriate authority of the State of origin under the conditions established by that authority. A copy of the document of approval, showing the quantity limitations and the packaging requirements, must accompany the consignment.

10.3.11 Classification of Packages

STATE VARIATIONS: BEG-04, JPG-03/10

The quantity of radioactive material in a package must not exceed the relevant limits for the package type as specified below.

10.3.11.1 Classification as Excepted Packages

10.3.11.1.1 General

10.3.11.1.1.1 Packages may be classified as excepted packages if:

- (a) they contain radioactive material in limited quantities as specified in Table 10.3.D;
- (b) they contain instruments or articles in limited quantities as specified in Table 10.3.D;
- (c) they contain articles manufactured of natural uranium, depleted uranium or natural thorium; or
- (d) they are empty packages having contained radioactive material.

10.3.11.1.1.2 A package containing radioactive material may be classified as an excepted package provided that the radiation level at any point on its external surface does not exceed 5 µSv/h (0.5 mrem/h).

10.3.11.1.2 Radioactive Material in Limited Quantities

Radioactive material in forms other than as specified in 10.3.11.1.3 with an activity not exceeding the limit specified in the column headed "Materials — Package Limits" in Table 10.3.D may be classified as UN 2910, **Radioactive material, excepted package — Limited quantity of material**, provided that:

- (a) these materials are packaged in such a manner that, in conditions likely to be encountered during routine transport (incident-free conditions), there can be no leakage of radioactive material from the package; and
- (b) the packaging bears the marking "RADIOACTIVE" on an internal surface in such a manner that a warning of the presence of radioactive material is visible on opening the package.

Note:

Categorisation, hazard labels and Shipper's Declaration are NOT required.

10.3.11.1.3 Instruments and Manufactured Articles

Radioactive material which is enclosed in or is included as a component part of an instrument or other manufactured article may be classified as UN 2911, **Radioactive material, excepted package – articles** or **Radioactive material, excepted package – instruments**, only if:

- (a) the radiation level at 10 cm (4 in) from any point on the external surface of any unpacked instrument or article does not exceed 0.1 mSv/h (10 mrem/h);
- (b) the activity of an instrument or article does not exceed the relevant exception limits listed in the column headed "Instruments and Articles – Item Limits" in Table 10.3.D;
- (c) the total activity per package does not exceed the relevant exception limit listed in the column headed "Instruments and Articles – Package Limits" in Table 10.3.D;
- (d) each instrument or article is marked "RADIOACTIVE", except:
 1. radioluminescent time-pieces or devices;
 2. consumer products that either have received regulatory approval according to 10.0.1.4 (b), following their sale to the end user or do not individually exceed the activity limit for an exempt consignment in Table 10.3.A (column 6), provided such products are transported in a package that bears the marking "RADIOACTIVE" on an internal surface in such a manner that warning of the presence of radioactive material is visible on opening the package; and

- (e) the active material is completely enclosed by non-active components (a device performing the sole function of containing radioactive material must not be considered to be an instrument or manufactured article).

Note:

Categorisation, hazard labels and Shipper's Declaration are NOT required.

10.3.11.1.4 Articles Manufactured from Natural Uranium or Depleted Uranium or Natural Thorium

Articles manufactured of natural uranium, depleted uranium or natural thorium and articles in which the sole radioactive material is unirradiated natural uranium, unirradiated depleted uranium or unirradiated natural thorium may be classified as UN 2909, **Radioactive material, excepted package – articles manufactured from depleted uranium**, or **Radioactive material, excepted package – articles manufactured from natural uranium**, or **Radioactive material, excepted package – articles manufactured from natural thorium** only if the outer surface of the uranium or thorium is enclosed in an inactive sheath made of metal or some other substantial material.

Note:

Categorisation, hazard labels and Shipper's Declaration are NOT required.

10.3.11.1.5 Empty Packages

An empty packaging which had previously contained radioactive material with an activity not exceeding the limit specified in the column headed "Materials – Package Limits" in Table 10.3.D may be classified as UN 2908, **Radioactive material, excepted package empty packaging**, provided that:

- (a) it is in a well-maintained condition and securely closed;
- (b) the outer surface of any uranium or thorium in its structure is covered with an inactive sheath made of metal or some other substantial material;
- (c) the level of internal non-fixed contamination when averaged over any 300 cm² does not exceed:
 1. 400 Bq/cm² for beta and gamma emitters and low toxicity alpha emitters; and
 2. 40 Bq/cm² for all other alpha emitters.
- (d) any labels which may have been displayed on it in conformity with 10.7.4 are no longer visible.

Note:

Categorisation, hazard labels and Shipper's Declaration are NOT required.

TABLE 10.3.D
Excepted Package Activity Limits
(10.3.11.1.2 to 10.3.11.1.5)

Nature of Contents	Materials	Instruments and Articles	
	Package Limits*	Item Limits*	Package Limits*
Solids:			
Special Form	10 ⁻³ A ₁	10 ⁻² A ₁	A ₁
Other forms	10 ⁻³ A ₂	10 ⁻² A ₂	A ₂
Liquids:	10 ⁻⁴ A ₂	10 ⁻³ A ₂	10 ⁻¹ A ₂
Gases:			
Tritium	2 × 10 ⁻² A ₂	2 × 10 ⁻² A ₂	2 × 10 ⁻¹ A ₂
Special Form	10 ⁻³ A ₁	10 ⁻³ A ₁	10 ⁻² A ₁
Other forms	10 ⁻³ A ₂	10 ⁻³ A ₂	10 ⁻² A ₂

* For mixtures of radionuclides in items, see 10.3.2.4 and 10.3.2.5.

Note:

For values of A₁ and A₂ see Table 10.3.A. Where the A₁ or A₂ is unlimited, the limits for excepted packages will be satisfied by meeting the requirements of 10.5.8.1.

10.3.11.2 Classification as Low Specific Activity (LSA) Material

10.3.11.2.1 Radioactive material may only be classified as LSA material if the definition of LSA in 10.3.5.1 and the conditions of 10.3.5, 10.5.9.6 and 9.3.10.3.3 are met.

10.3.11.3 Classification as Surface Contaminate Object (SCO)

Radioactive material may only be classified as SCO if the definition of SCO in 10.3.6.1 and the conditions of 10.3.6, 10.5.9.6 and 9.3.10.3.3 are met.

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10.3.11.4 Classification of Type A Packages

10.3.11.4.1 Packages containing radioactive material may be classified as Type A packages provided the conditions set out in 10.3.11.4.2 are met.

10.3.11.4.2 Type A packages must not contain activities greater than the following:

- (a) for Special Form radioactive material: A_1 ; or
- (b) for all other radioactive materials: A_2
where A_1 and A_2 are determined in accordance with the procedures described in 10.3.2.

10.3.11.4.3 For mixtures of radionuclides whose identities and respective activities are known, the following conditions must apply to the radioactive contents of the Type A package:

$$\sum_i \frac{B(i)}{A_1(i)} + \sum_j \frac{C(j)}{A_2(j)} \leq 1$$

where:

$B(i)$ is the activity of radionuclide i as Special Form radioactive material and $A_1(i)$ is the A_1 value for radionuclide i ; and

$C(j)$ is the activity of radionuclide j as other than Special Form radioactive material and $A_2(j)$ is the A_2 value for radionuclide j .

10.3.11.5 Classification of Uranium Hexafluoride

10.3.11.5.1 Uranium hexafluoride must only be assigned to UN 2977, **Radioactive material, uranium hexafluoride, fissile** or UN 2978, **Radioactive material, uranium hexafluoride, non-fissile or fissile excepted**.

10.3.11.5.2 Packages containing uranium hexafluoride must not contain:

- (a) a mass of uranium hexafluoride different from that authorized for the package design;
- (b) a mass of uranium hexafluoride greater than a value that would lead to an ullage smaller than 5% at the maximum temperature of the package as specified for the plant systems where the package will be used; or
- (c) uranium hexafluoride other than in solid form or at an internal pressure above atmospheric pressure when presented for transport.

10.3.11.6 Classification as Type B(U), Type B(M) or Type (C) Packages

10.3.11.6.1 Packages not otherwise classified in 10.3.11.1 to 10.3.11.5 must be classified in accordance with the competent authority approval certificate for the package issued by the State of origin of design.

10.3.11.6.2 A package may only be classified as a Type B(U) package if it does not contain:

- (a) activities greater than those authorized for the package design;
- (b) radionuclides different from those authorized for the package design; or
- (c) contents in a form, or a physical or chemical state, different from those authorized for the design;

as specified in the certificate of approval.

10.3.11.6.3 A package may only be classified as a Type B(M) package if it does not contain:

- (a) activities greater than those authorized for the package design;
- (b) radionuclides different from those authorized for the package design; or
- (c) contents in a form, or a physical or chemical state, different from those authorized for the design;

as specified in the certificate of approval.

10.3.11.6.4 A package may only be classified as a Type C package if it does not contain:

- (a) activities greater than those authorized for the package design;
- (b) radionuclides different from those authorized for the package design; or
- (c) contents in a form, or a physical or chemical state, different from those authorized for the design;

as specified in the certificate of approval.

10.3.12 Special Arrangements

Radioactive material must be classified as transport under special arrangement when the intention is for it to be transported in accordance with 10.0.4.

10.4 Identification

STATE VARIATION: USG-10

OPERATOR VARIATIONS: KZ-02, LX-01

10.4.1 Proper Shipping Name

10.4.1.1 Radioactive material must be assigned to one of the proper shipping names/UN numbers specified in Table 10.4.A depending on the activity level of the radionuclides contained in a package, the fissile or non-fissile properties of these radionuclides, the type of package to be presented for transport, and the nature or form of the contents of the package, or special arrangements governing the transport operation, in accordance with the provisions laid down in 10.3.2 to 10.3.11.

TABLE 10.4.A
Assignment of Proper Shipping Name/UN Number (10.4.1.1)

UN Number	Proper Shipping Name
Excepted Package (10.3.11.1)	
UN 2908	Radioactive material, excepted package—empty packaging
UN 2909	Radioactive material, excepted package—articles manufactured from depleted uranium
UN 2909	Radioactive material, excepted package—articles manufactured from natural thorium
UN 2909	Radioactive material, excepted package—articles manufactured from natural uranium
UN 2910	Radioactive material, excepted package—limited quantity of material
UN 2911	Radioactive material, excepted package—articles
UN 2911	Radioactive material, excepted package—instruments
Low Specific Activity (LSA) Material (10.3.11.2)	
UN 2912	Radioactive material, low specific activity (LSA-I), non fissile or fissile-excepted
UN 3321	Radioactive material, low specific activity (LSA-II), non fissile or fissile-excepted
UN 3322	Radioactive material, low specific activity (LSA-III), non fissile or fissile-excepted
UN 3324	Radioactive material, low specific activity (LSA-II) fissile
UN 3325	Radioactive material, low specific activity (LSA-III) fissile
Surface Contaminated Objects (SCO) (10.3.11.3)	
UN 2913	Radioactive material, surface contaminated objects (SCO-I), non fissile or fissile excepted
UN 2913	Radioactive material, surface contaminated objects (SCO-II), non fissile or fissile excepted
UN 3326	Radioactive material, surface contaminated objects (SCO-I), fissile
UN 3326	Radioactive material, surface contaminated objects (SCO-II), fissile
Type A Package (10.3.11.4)	
UN 2915	Radioactive material, Type A package, non-special form, non fissile or fissile-excepted
UN 3327	Radioactive material, Type A package, fissile, non-special form
UN 3332	Radioactive material, Type A package, Special Form, non fissile or fissile-excepted
UN 3333	Radioactive material, Type A package, Special Form, fissile
Type B(U) Package (10.3.11.6)	
UN 2916	Radioactive material, Type B(U) package, non fissile or fissile-excepted
UN 3328	Radioactive material, Type B(U) package, fissile
Type B(M) Package (10.3.11.6)	
UN 2917	Radioactive material, Type B(M) package, non fissile or fissile-excepted
UN 3329	Radioactive material, Type B(M) package, fissile
Type C Package (10.3.11.6)	
UN 3323	Radioactive material, Type C package, non fissile or fissile-excepted
UN 3330	Radioactive material, Type C package, fissile
Special Arrangement (10.3.12)	
UN 2919	Radioactive material, transported under special arrangement, non fissile or fissile-excepted
UN 3331	Radioactive material, transported under special arrangement, fissile
Uranium Hexafluoride (10.3.11.5)	
UN 2978	Radioactive material, uranium hexafluoride, non fissile or fissile-excepted
UN 2977	Radioactive material, uranium hexafluoride, fissile

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10.4

10.5 Packing

STATE VARIATION: USG-10

10.5.1 Shipper's Responsibility

The shipper is responsible for all aspects of the packing of radioactive materials in compliance with these Regulations. See also 5.0.1.

10.5.2 Packaging Criteria

10.5.2.1 Explanatory Information on Packing of Radioactive Materials

10.5.2.1.1 Packing requirements for radioactive materials vary with the particular radionuclide (or radionuclides) involved. In all cases, the radiation is considered; if the material is not in "Special Form", then the possibility of leakage is considered; and if the material is fissile, then the possibility of criticality is considered. A further factor, relevant if the quantity, i.e. activity, of the radioactive material is very large, is that the heat generated by the radiation may be significant, in which case heat dissipation is considered.

10.5.2.1.2 As noted in 10.5.2.1.1, the radiation level depends on several factors — and the activity (quantity) of the radioactive material is only one of those factors. Equal quantities of two different radionuclides, each packed in the same type of packaging, may produce very different radiation levels both on the external surface of the package and at any specific distance. Therefore, to ensure that radiation levels comply with specified permissible limits, the specified permitted quantities vary with the particular radionuclides involved.

10.5.2.1.3 The terms A_1 and A_2 used in these packing requirements denote the maximum activity (or quantity) limits for "Special Form" and "other forms" respectively, of each radionuclide permitted in a Type A package. They also serve as the basic limits for other purposes. The values of A_1 and A_2 for many radionuclides are listed in Table 10.3.A; the values of A_1 and A_2 for other cases must be obtained by the approved procedures given in 10.3.2.2 to 10.3.2.5.

10.5.2.1.4 It may be observed from Table 10.3.A that for many radionuclides the A_2 value is less than the A_1 value, but that for all others the A_2 value is the same as the A_1 value. The A_2 value cannot be greater than the A_1 value.

10.5.2.1.5 When a radioactive material has been packed in compliance with these packing requirements the complete package in most cases, must be allotted a "Transport Index" in accordance with 10.5.14. The "Transport Index" is a number devised with the purpose of indicating the relative degree of radiation hazard of packages containing radioactive material.

10.5.2.1.6 The complete package, in most cases, must also be allotted to one of three categories as shown in Table 10.5.C and then labelled with the hazard label for that category.

10.5.3 General Requirements

10.5.3.1 Radioactive material, packagings and packages must meet the requirements of 10.6. The quantity of radioactive material in a package must not exceed the limits specified in 10.3.11. The types of packages for radioactive materials covered by these regulations are:

- (a) Excepted packages (10.5.8);
- (b) Industrial package Type 1 (Type IP-1 package) (10.5.9.3);
- (c) Industrial package Type 2 (Type IP-2 package) (10.5.9.4);
- (d) Industrial package Type 3 (Type IP-3 package) (10.5.9.5);
- (e) Type A packages (10.5.10);
- (f) Type B(U) and B(M) packages (10.5.11);
- (g) Type C Packages (10.5.12).

10.5.3.1.1 Packages containing fissile material or uranium hexafluoride are subject to additional requirements.

10.5.3.2 External Contamination: The non-fixed radioactive contamination on any external surface of any package must be kept as low as practicable and, under normal conditions of transport, must not exceed the following limits:

- (a) 4 Bq/cm² for beta and gamma emitters and low toxicity alpha emitters, and
- (b) 0.4 Bq/cm² for all other alpha emitters.

These limits are applicable when averaged over an area of 300 cm² of any part of the surface.

10.5.3.3 In the case of overpacks and freight containers, the level of non-fixed contamination on the external and internal surfaces must not exceed the limits specified in 10.5.3.2. An overpack or freight container dedicated to the transport of radioactive material under exclusive use is excepted from the requirements of this paragraph solely with regard to its internal surfaces and only for as long as it remains under that specific exclusive use.

10.5.3.4 Radioactive material meeting the criteria of other Classes or Divisions as defined in Section 3 must be allocated to Packing Group I, II or III, as appropriate, by the application of the grouping criteria provided in Section 3 corresponding to the nature of the predominant subsidiary risk. It must also be capable of meeting the appropriate packaging performance criteria for the subsidiary risk.

10.5.4 Different Radionuclides in One Package

When different individual radionuclides are packaged together in the same package, the total activity must be determined as described in 10.3.2.4 and 10.3.2.5.

10.5.5 Packed with Other Items

A package containing radioactive material, other than an excepted package must not contain any other items except such articles and documents as are necessary for the use of the radioactive material. Low Specific Activity materials (LSA) and Surface Contaminated Objects (SCO) may be packed with other items. Articles and

documents (and for LSA and SCO other items) may be included, provided that there is no interaction between them and the packaging or the radioactive contents that would reduce the safety of the package.

10.5.6 Overpacks Containing Packages of Radioactive Materials

10.5.6.1 Packages of radioactive material may be combined together in an overpack for transport, provided that each package contained therein meets the applicable requirements of these Regulations. However, packages of fissile material for which the transport index exceeds zero must not be carried in an overpack.

10.5.6.2 Only the original shipper of the packages contained within an overpack is permitted to use the method of direct measurement of radiation level to determine the transport index of a rigid overpack.

10.5.7 Requirements Before Shipment

10.5.7.1 Requirements Before First Shipment

Before the first shipment of any package, the following requirements must be fulfilled:

- (a) for each Type B(U), Type B(M) and Type C package and for each package containing fissile material, it must be ensured that the effectiveness of its shielding, containment system, and, where necessary, the heat transfer characteristics, and the effectiveness of the confinement system, are within the limits applicable to or specified for the approved design;
- (b) if the design pressure of the containment system exceeds 35 kPa (0.35 bar, 5 lb/in²) (gauge), it must be ensured that the containment system of each package conforms to the approved design requirements relating to the capability of that system to maintain its integrity under that pressure;
- (c) for each package containing fissile material where neutron poisons are specifically included as components of the package, tests must be performed to confirm the presence and distribution of those neutron poisons in order to comply with the requirements of 10.6.2.8.

10.5.7.2 Requirements Before Each Shipment

10.5.7.2.1 Before each shipment of any package, the following requirements must be fulfilled:

- (a) for any package it must be ensured that all the requirements specified in the relevant provisions of these Regulations have been satisfied;
- (b) each Type B(U) and Type B(M) and Type C package must be held until equilibrium conditions have been approached closely enough to demonstrate compliance with the requirements for temperature and pressure, unless an exemption from these requirements has received unilateral approval;

- (c) for each package requiring competent authority approval, it must be ensured that all the requirements specified in the approval certificates have been met;
- (d) for each Type B(U), Type B(M) and Type C package it must be ensured by examination and/or appropriate tests that all closures, valves and other openings of the containment system through which the radioactive contents might escape are properly closed and, where appropriate, sealed in the manner for which the demonstrations of compliance with the requirements of 10.6.2.5.8 and 10.6.2.7.4 were made;
- (e) it must be ensured that lifting attachments which do not meet the requirements of 10.6.0.3, have been removed or otherwise rendered incapable of being used to lift the package, in accordance with 10.6.0.4;
- (f) for each Special Form radioactive material, it must be ensured that all the requirements specified in the approval certificate and the relevant provisions of these Regulations have been satisfied;
- (g) for packages containing fissile material the measurement specified in 10.6.2.8.1.4(b) and the tests to demonstrate closure of each package as specified in 10.6.2.8.2 must be performed where applicable; and
- (h) for each low dispersible radioactive material, it must be ensured that all the requirements specified in the approval certificate and the relevant provisions of these Regulations have been satisfied.

10.5.7.2.2 Before making any shipment, the shipper must have in his possession a copy of any instructions for the proper closing of the package and any other preparation for shipment, together with a copy of each of the following certificates relevant to the package:

- Special Form approval certificate;
- Low dispersible radioactive material;
- Packages containing 0.1 kg or more of uranium hexafluoride;
- Type B package design approval certificate;
- Type B(M) package shipment approval certificate;
- Type C package design approval and shipment approval certificate;
- Fissile Material package design approval certificate;
- Fissile Material package shipment approval certificate;
- Special Arrangement approval certificate.

Note:

Package design approval and package shipment approval may be combined on a single certificate.

For package designs where a competent authority issued certificate is not required, the shipper must, on request, make available for inspection by the relevant authority, documentary evidence of the compliance of the package design with all the applicable requirements.

9. HANDLING

6. PACKAGING SPECIFICATIONS

10. RADIOACTIVE MATERIAL

7. MARKING AND LABELLING

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10.5

10.5.8 Excepted Packages

STATE VARIATIONS: CHG-03, JPG-03/10/23, RUG-01

OPERATOR VARIATIONS: BR-11, CA-07, DL-01, IJ-07, KE-06

Excepted Package is a packaging, used for containing radioactive material, that is designed to meet the requirements of 10.6.0 and 10.6.1.

10.5.8.1 General

Radioactive materials in limited quantities, instruments, manufactured articles and empty packagings as specified in 10.3.11.1 may be transported as excepted packages, provided that:

- (a) the radiation level at any point on the external surface of the package does not exceed 5 $\mu\text{Sv/h}$ (0.5 mrem/h);
- (b) if the excepted package contains fissile material, one of the requirements provided by 10.3.7.2 must be met, and the smallest dimension of the package must not be less than 10 cm; and
- (c) the non-fixed radioactive contamination on any external surface of the excepted package does not exceed the limits of 10.5.3.2;
- (d) if transported by air mail, the requirements of Subsection 10.2.2 are met.

10.5.8.2 Exceptions

10.5.8.2.1 Excepted packages are subject to the provisions of the Regulations relating to:

- training requirements (1.5);
- package marking (10.7.1.3.2);
- "Excepted package" label (10.7.4.4.3);
- air waybill completion (10.8.8.3);
- inspection and decontamination requirements (9.4.3);
- the reporting of dangerous goods accidents, incidents and other occurrences (9.6.1, 9.6.2);
- general packaging requirements (10.6.0 to 10.6.1); and
- any other provisions specifically retained in this Section.

10.5.8.2.2 Excepted packages are not subject to the provisions relating to:

- categorisation of packages (10.5.15.1);
- packing (9.3.10.7, 10.5.5, 10.5.6, 10.5.9.6 to 10.5.9.9, Tables 9.3.B and 10.5.B);
- packaging nomenclature, marking requirements and tests (Subsection 10.6, except for 10.6.2.1);
- marking (10.7.1 except as required in 10.7.1.3.2);
- labelling (10.7.2 except as required in 10.7.4.4.3);
- documentation (Subsection 10.8, except for 10.8.8.3); and
- other shippers and operators responsibilities (Subsection 10.10).

10.5.8.3 Other Hazards

For excepted packages of radioactive materials possessing any other dangerous characteristics, the other hazard takes precedence. Therefore, the package is subject to the Regulations relevant to the other hazard, see Special Provision A130.

10.5.9 Requirements and Controls for Transport of LSA Material and SCO

STATE VARIATION: CAG-02

OPERATOR VARIATIONS: JL-03, KZ-02, NH-06, UA-09, UX-10, VN-09

10.5.9.1 Application

Industrial Packaging may be used for Low Specific Activity (LSA) material and Surface Contaminated Objects (SCO) (see 10.3.5 and 10.3.6).

10.5.9.2 Activity Limit

The total activity in a single package of LSA material or in a single package of SCO must be so restricted that the radiation level specified in 10.5.9.6 is not exceeded, and the activity in a single package must also be so restricted that the activity limits for an aircraft specified in Table 9.3.B are not exceeded. A single package of non-combustible solid LSA-II or LSA-III material must not contain an activity greater than 3,000 A_2 .

10.5.9.3 Industrial Package Type 1

A packaging or freight container containing LSA material or Surface Contaminated Object (SCO) that is designed to meet the requirements of 10.6.2.2.1 is an Industrial Package Type 1.

10.5.9.4 Industrial Package Type 2

A packaging or freight container containing LSA material or Surface Contaminated Object (SCO) that is designed to meet the requirements of 10.6.2.2.2 is an Industrial Package Type 2. Packages or freight containers may also be used as Industrial Packages Type 2 (Type IP-2) in accordance with the requirements of 10.6.2.2.2 and 10.6.2.2.5.

10.5.9.5 Industrial Package Type 3

A packaging or freight container containing LSA material or Surface Contaminated Object (SCO) that is designed to meet the requirements of 10.6.2.2.3 is an Industrial Package Type 3. Freight containers may also be used as an Industrial Package Type 3 (Type IP-3) in accordance with the requirements of 10.6.2.2.5.

10.5.9.6 LSA and SCO Quantity Limit

The quantity of Low Specific Activity material (LSA) or Surface Contaminated Objects (SCO) in a single Industrial Package Type 1, Industrial Package Type 2, Industrial Package Type 3 must be so restricted that the external radiation level at 3 m (10 ft) from the unshielded material does not exceed 10 mSv/h (1 rem/h).

10.5.9.7 LSA and SCO — Fissile

LSA material and SCO which is, or contains, fissile material must meet the applicable requirements of 9.3.10.5 and 10.6.2.8.1.2.

10.5.9.8. LSA and SCO — Restrictions

Packages and freight containers containing LSA material or SCO must meet the requirements of 10.5.3.2 and 10.5.5. LSA material in group LSA-I and SCO in group SCO-I must not be transported unpackaged.

10.5.9.9 LSA and SCO — Integrity Limits

LSA material and SCO must be packaged in accordance with Table 10.5.A.

TABLE 10.5.A
Industrial Package Integrity Requirements
for LSA Material and SCO (10.5.9.9)

Contents	Industrial Package Type (see 10.6.2.2)	
	Exclusive Use	NOT Under Exclusive Use
LSA-I:		
Solid	Type 1	Type 1
Liquid	Type 1	Type 2
LSA-II:		
Solid	Type 2	Type 2
Liquid and gas	Type 2	Type 3
LSA-III	Type 2	Type 3
SCO-I	Type 1	Type 1
SCO-II	Type 2	Type 2

10.5.10 Type A Packages

Type A packages must not contain activities greater than A_1 (if Special Form radioactive material) or A_2 (if not in Special Form Radioactive Material). Type A packages must be designed to meet the requirements of 10.6.0, 10.6.1, 10.6.2.4.1 to 10.6.2.4.4.

10.5.11 Type B(U) and B(M) Packages

STATE VARIATIONS: BEG-04, CAG-03, DEG-02, DKG-01, FRG-04, ITG-02, JPG-08/26, NLG-03, USG-10

OPERATOR VARIATIONS: JL-03/05, KE-05, KZ-02, MH-16, NH-06, OZ-04, PX-04, TU-10, UA-09, UX-10, VN-09

10.5.11.1 Activity Limits

Type B(U) and Type B(M) must in addition not contain activities greater than the following:

- for low dispersible radioactive material, as authorized for the package design as specified in the certificate of approval;
- for Special Form radioactive material, 3,000 A_1 or 100,000 A_2 , whichever is the lower; or
- for all other radioactive material, 3,000 A_2 .

10.5.11.2 Unilateral Approval

Each Type B(U) package design requires unilateral approval, i.e. approval of the competent authority of the State of origin of design only, except that

- a Type B(U) package design for fissile material, which is also subject to 10.5.11.3 and 10.5.7.2.2, must require multilateral approval; and
- a Type B(U) package design for low dispersible radioactive material must require multilateral approval.

10.5.11.3 Multilateral Approval

Each Type B(M) package design requires multilateral approval, i.e. approval by the competent authorities of the State of origin and of each State through or into which the package is to be transported (see Note following definition of "Multilateral Approval" in Appendix A).

Note:

Type B(M) packages are forbidden on Passenger Aircraft.

10.5.12 Type C Packages

Type C packages may contain activities greater than A_1 (if Special Form radioactive material) or A_2 (if not in Special Form radioactive material). Type C packages must be designed to meet the requirements of 10.6.0, 10.6.1, 10.6.2.4.1 except for 10.6.2.4.1(b), 10.6.2.4.2, 10.6.2.5.3, 10.6.2.5.4, 10.6.2.5.6, 10.6.2.5.11 to 10.6.2.5.16, and, in addition, the requirements specified in 10.6.2.7.3 to 10.6.2.7.5.

10.5.13 Packages Containing Fissile Materials

STATE VARIATIONS: CAG-01, DEG-01/02, DKG-01, ITG-01/02, JPG-08/26, NLG-03, RUG-01/02, USG-10

OPERATOR VARIATIONS: AV-08, BR-11, C8-01, CA-11, CV-01, D0-05, GF-07, HF-01, IB-02, IC-13, IJ-03, JL-03, KZ-02, LA-15, LG-01, MH-17, MU-01, NH-06, OK-03, OU-09, QY-05, SQ-04, UA-09, VN-09

10.5.13.1 Fissile Material Activity Limit

Unless excepted by 10.3.7.2, any packages containing fissile material must not contain:

- a mass of fissile material (or mass of each fissile nuclide for mixtures when appropriate) different than that authorized for the package design;
- any radionuclide or fissile material different from those authorized for the package design; or
- contents in a form or physical or chemical state, or in a spatial arrangement, different from those authorized for the package design;

as specified in the certificate of approval where appropriate.

10.5.13.2 Design

The design for packaging for fissile material must comply in all respects with the requirements for packages containing fissile materials of 10.3.7 and 10.6.2.8.

10.5.13.3 Approval

Each package design for fissile material requires multilateral approval, i.e. approval by the competent authorities of the State of origin and of each State through or into which the package is to be transported.

10.5.14 Determination of Transport Index and Criticality Safety Index

STATE VARIATIONS: JPG-02/17, USG-10

10.5.14.1 Determination of Transport Index (TI)

Transport Index (TI) is a single number assigned to a package, overpack or freight container used to provide control over radiation exposure. It is also used to establish categories for labelling, to determine whether transport under exclusive use is required; to establish spacing requirements during storage in transit, and to define the number of packages allowed in a freight container or aboard an aircraft. The TI is determined as described in 10.5.14.1.1 and 10.5.14.1.2.

10.5.14.1.1 Transport Index — Radiation Exposure Control

The TI based on radiation exposure control for a package, overpack or freight container is the number derived using the following procedure:

- (a) determine the maximum radiation level at a distance of 1 m from the external surfaces of the package, overpack or freight container. Where the radiation level is determined in units of millisievert per hour (mSv/h), the value determined must be multiplied by 100. (Where the radiation level is determined in units of millirem per hour (mrem/h), the value determined is not changed.) For uranium and thorium ores and concentrates, the maximum radiation dose rate at any point 1 m from the external surface of the load may be taken as:

- 0.4 mSv/h (40 mrem/h) — for ores and physical concentrates of uranium and thorium;
- 0.3 mSv/h (30 mrem/h) — for chemical concentrates of thorium; or
- 0.02 mSv/h (2 mrem/h) — for chemical concentrates of uranium, other than uranium hexafluoride.

- (b) for freight containers the value determined in (a) must be multiplied by the appropriate factor from Table 10.5.B;

TABLE 10.5.B
Multiplication Factors for Freight Containers
(10.5.14.1.1(b))

Largest Cross-Sectional Area of the Freight Container	Multiplication Factor
≤1 m ²	1
>1 m ² to ≤5 m ²	2
>5 m ² to ≤20 m ²	3
>20 m ²	10

- (c) the figure obtained in (a) and (b) must be rounded up to the first decimal place (e.g. 1.13 becomes 1.2), except that a value of 0.05 or less may be considered as zero.

10.5.14.1.2 Transport Index — Consignment

The Transport Index for each overpack or freight container must be determined as either the sum of the TIs of all the packages contained, or by direct measurement of radiation level, except in the case of non-rigid overpacks for which the transport index must be determined only as the sum of the TIs of all the packages.

10.5.14.2 Determination of Criticality Safety Index (CSI)

10.5.14.2.1 The Criticality Safety Index (CSI) for packages containing fissile material must be obtained by dividing the number 50 by the smaller of the two values of N derived using the procedures specified in 10.6.2.8.3, i.e. CSI equals 50/N. The value of the Criticality Safety Index may be zero, provided that an unlimited number of packages is subcritical, i.e. N is effectively equal to infinity.

10.5.14.2.2 The Criticality Safety Index (CSI) for each overpack or freight container must be determined as the sum of the CSIs of all the packages contained. The same procedure must be followed for determining the total sum of CSIs in a consignment or aboard an aircraft.

10.5.15 Limits on Transport Index (TI), Criticality Safety Index (CSI), Radiation Levels for Packages and Overpacks

STATE VARIATIONS: JPG-02/17, USG-10

OPERATOR VARIATIONS: E8-03, LG-02, VN-09

10.5.15.1 Packages and overpacks must be assigned to Category I-White, II-Yellow or III-Yellow in accordance with Table 10.5.C and with the requirements set out below. Each category is assigned a specific label; this labelling system is outlined in 10.7.2:

- (a) for a package or overpack, both the transport index and the surface radiation level conditions must be taken into account in determining which is the appropriate category. Where the transport index satisfies the condition for one category but the surface radiation level satisfies the condition for a different category, the package must be assigned to

the higher category of the two. For this purpose, Category I-White being regarded as the lowest category;

- (b) the Transport Index must be determined following the procedures specified in 10.5.14.1.1;
- (c) if the Transport Index is greater than 10, the package or overpack must be transported under exclusive use;
- (d) if the surface radiation level is greater than 2 mSv/h (200 mrem/h), the package or overpack must be transported under exclusive use and under the provisions of 9.3.10.3;

- (e) a package transported under a special arrangement must be assigned to Category III-Yellow, except under the provisions of 10.5.15.2;
- (f) an overpack which contains packages transported under special arrangement must be assigned to Category III-Yellow, except under the provisions of 10.5.15.2.

10.5.15.2 In all cases of international transport of packages requiring competent authority design or shipment approval, for which different approval types apply in the different countries concerned by the shipment, the categorisation must be in accordance with the certificate of the country of origin of design.

TABLE 10.5.C
Category Determination for Packages, Overpacks and Freight Containers (10.5.15.1)

Categories of Packages (Other Than Excepted Packages) and Overpacks		
Transport index	Maximum Radiation Level at any Point on External Surface	Category
0*	Not more than 0.005 mSv/h (0.5 mrem/h)	I-White
More than 0 but not more than 1*	More than 0.005 mSv/h (0.5 mrem/h) but not more than 0.5 mSv/h (50 mrem/h)	II-Yellow
More than 1 but not more than 10	More than 0.5 mSv/h (50 mrem/h) but not more than 2 mSv/h (200 mrem/h)	III-Yellow
More than 10	More than 2 mSv/h (200 mrem/h) but not more than 10 mSv/h (1000 mrem/h)	III-Yellow**

* If the measured TI is not greater than 0.05, the value quoted may be zero in accordance with 10.5.14.1.1(c).

** Must be transported under exclusive use and special arrangement (see 10.5.16 and 10.5.17).

10.5.16 Special Arrangement

STATE VARIATIONS: BEG-04, DEG-02, DKG-01

If the radioactive material does not comply with any of the methods of packing provided in this subsection, the material may be permitted to be carried under special arrangement. The provisions for carrying the radioactive material under special arrangement must be approved by the competent authorities of the States concerned (note that for radioactive consignments this includes only the States of origin, transit and destination). These provisions must be adequate to ensure that the overall level of safety in transport and in-transit storage is at least equivalent to the level of safety which would be provided if all the applicable requirements of these Regulations had been met. Each consignment must have multilateral approval.

10.5.17 Exclusive Use

10.5.17.1 Except for consignments under exclusive use, the Transport Index of any individual package or overpack must not exceed 10, nor must the Criticality Safety Index of any package or overpack exceed 50.

10.5.17.2 Except for packages or overpacks transported under exclusive use under the conditions specified in 9.3.10.3.1, the maximum radiation level at any point on any external surface of a package or overpack must not exceed 2 mSv/h (200 mrem/h).

10.5.17.3 The maximum radiation level at any point on any external surface of a package or overpack under exclusive use must not exceed 10 mSv/h (1,000 mrem/h).

10.6 Packaging Specifications and Performance Testing

10.6.0 General Requirements

10.6.0.1 Package and packaging performance specifications, in terms of retention of integrity of containment and shielding, depend upon the quantity and nature of the radioactive material transported. Performance specifications applied are graded to take into account conditions of transport characterized by the following severity levels:

- (a) conditions likely to be encountered in routine transport (incident-free);
- (b) normal conditions of transport (minor mishaps); and
- (c) accident conditions of transport.

The performance specifications include design requirements and tests.

10.6.0.2 The package must be do designed in relation to its weight, volume and shape that it can be easily and safely handled and transported. In addition, the package must be do designed that it can be properly secured in the aircraft during transport.

10.6.0.3 The design must be such that any lifting attachments on the package will not fail when used in the

intended manner and that, if failure of the attachments should occur, the ability of the package to meet other requirements of these Regulations would not be impaired. The design must take account of appropriate safety factors to cover snatch lifting.

10.6.0.4 Attachments, and any other features on the outer surface of the package, which could be used to lift it, must be designed either to support its weight in accordance with the requirements of 10.6.0.3 or must be removable or otherwise rendered incapable of being used during transport.

10.6.0.5 As far as practicable, the packaging must be so designed and finished that the external surfaces are free from protruding features and can be easily decontaminated.

10.6.0.6 As far as practicable, the outer layer of the package must be so designed as to prevent the collection and the retention of water.

10.6.0.7 Any features added to the package at the time of transport, which are not part of the package, must not reduce its safety.

10.6.0.8 The package must be capable of withstanding the effects of any acceleration, vibration or vibration resonance which may arise under conditions likely to be encountered in routine transport without any deterioration in the effectiveness of the closing devices on the various receptacles or in the integrity of the package as a whole. In particular, nuts, bolts and other securing devices must be so designed as to prevent them from becoming loose or being released unintentionally, even after repeated use.

Note:

Information on vibration in commercial aircraft is given in 5.0.4.3.

10.6.0.9 The materials of the packaging and any other components or structures must be physically and chemically compatible with each other and with the radioactive contents. Account must be taken of their behaviour under irradiation.

10.6.0.10 All valves through which the radioactive contents could otherwise escape must be protected against unauthorized operation. The design of the package must take into account ambient temperatures and pressures that are likely to be encountered under normal conditions of transport. For radioactive material having other dangerous properties, the package design must take into account those properties.

10.6.1 Additional Requirements for Packages Transported by Air

10.6.1.1 The temperature of the accessible surfaces of packages must not exceed 50°C (122°F) at an ambient temperature of 38°C (100°F) with no account taken for insolation.

10.6.1.2 Packages must be so designed that, if they were exposed to ambient temperatures ranging from -40°C to +55°C (-40°F to +131°F), the integrity of containment would not be impaired.

10.6.1.3 Packages containing radioactive material must be capable of withstanding without leakage, an internal pressure that produces a pressure differential of not less than the maximum normal operating pressure plus 95 kPa.

10.6.2 Packaging Requirements

10.6.2.1 Requirements for Excepted Packages

An Excepted Package is a packaging containing radioactive material that is designed to meet the requirements specified in 10.6.0 and 10.6.1.

10.6.2.2 Requirements for Industrial Packages

10.6.2.2.1 Industrial Packages Type 1 (Type IP-1)

An Industrial Package Type 1 (Type IP-1) is a packaging or freight container containing Low Specific Activity (LSA) material or Surface Contaminated Object (SCO) that is designed to meet the requirements specified in 10.6.0 and 10.6.1. The smallest overall external dimension of the package must not be less than 10 cm.

10.6.2.2.2 Industrial Packages Type 2 (Type IP-2)

An Industrial Package Type 2 (Type IP-2) is a packaging or freight container containing Low Specific Activity (LSA) material or Surface Contaminated Object (SCO) that must meet the requirements for an Industrial Package Type 1 as specified in 10.6.2.2.1 and, in addition, if it were subjected to the tests specified in 10.6.3.4.3 and 10.6.3.4.4 it would prevent:

- (a) the loss or dispersal of the radioactive contents; and
- (b) more than a 20% increase in the maximum radiation level at any external surface of the package.

For package and freight container alternative see 10.6.2.2.4 and 10.6.2.2.5.

10.6.2.2.3 Industrial Package Type 3 (Type IP-3)

An Industrial Package Type 3 (Type IP-3) is a packaging or freight container containing Low Specific Activity (LSA) material or Surface Contaminated Object (SCO) that must meet the requirements specified in 10.6.2.4.1 and 10.6.2.4.2. For freight container alternative see 10.6.2.2.5.

10.6.2.2.4 Alternative Requirements for Industrial Packages Type 2

Packages may be used as Industrial Package Type 2 (Type IP-2) provided that:

- (a) they satisfy the requirements of Type IP-1 specified in 10.6.2.2.1;
- (b) they are designed to satisfy the requirements prescribed for Packing Group I or II in Subsections 6.1 to 6.3 of these Regulations; and

- (c) when subjected to the tests required for Packing Group I or II in Subsection 6.3 they would prevent:
- loss or dispersal of the radioactive contents; and
 - more than a 20% increase in the maximum radiation level at any external surface of the package.

10.6.2.2.5 Freight Container Alternative

Freight containers with the characteristics of a permanent enclosure may also be used as Industrial Packages Types 2 and 3, (Types IP-2 or IP-3) provided that:

- (a) the radioactive contents are restricted to solid material;
- (b) they satisfy the requirements for an Industrial Package Type 1 (Type IP-1) as specified in 10.6.2.2.1; and
- (c) they are designed to conform to the requirements prescribed in the document ISO 1496-1:1990, "Series 1 Freight Containers — Specifications and Testing — Part 1: General Cargo Containers" and subsequent amendments 1:1993, 2:1998, 3:2005, 4:2006 and 5:2006, excluding dimensions and ratings. They must be designed such that if subjected to the tests prescribed in that document and the accelerations occurring during routine conditions of transport they would prevent:
- loss or dispersal of the radioactive contents, and
 - more than 20% increase in the maximum radiation level at any external surface of the freight container.

10.6.2.3 Requirements for Packages Containing Uranium Hexafluoride

10.6.2.3.1 Packages designed to contain uranium hexafluoride must meet the requirements prescribed elsewhere in these Regulations which pertain to the radioactive and fissile properties of the material. Except as allowed in 10.6.2.3.4, uranium hexafluoride in quantities of 0.1 kg or more must also be packaged and transported in accordance with the provisions of ISO 7195:2005 "Nuclear Energy—Packaging of uranium hexafluoride (UF₆) for transport", and the requirements of 10.6.2.3.2 and 10.6.2.3.3.

10.6.2.3.2 Each package designed to contain 0.1 kg or more of uranium hexafluoride must be designed so that it would meet the following requirements:

- (a) withstand without leakage and without unacceptable stress, as specified in ISO 7195:2005, the structural test as specified in 10.6.3.8;
- (b) withstand without loss or dispersal of the uranium hexafluoride the free drop test specified in 10.6.3.4.3; and
- (c) withstand without rupture of the containment system the thermal test specified in 10.6.3.6.2.

10.6.2.3.3 Packages designed to contain 0.1 kg or more of uranium hexafluoride must not be provided with pressure relief devices.

10.6.2.3.4 Subject to the approval of the competent authority, packages designed to contain 0.1 kg or more of uranium hexafluoride may be transported if:

- (a) the packages are designed to international or national standards other than ISO 7195:2005 provided an equivalent level of safety is maintained;
- (b) the packages are designed to withstand without leakage and without unacceptable stress a test pressure less than 2.76 MPa as specified in 10.6.3.8; or
- (c) for packages designed to contain 9,000 kg or more of uranium hexafluoride, the packages do not meet the requirement of 10.6.2.3.2(c);
- (d) in all other respects the requirements specified in 10.6.2.3.1 to 10.6.2.3.3 must be satisfied.

10.6.2.4 Requirements for Type A Packages

A Type A package is a packaging containing an activity up to A₁ (if Special Form radioactive material) or up to A₂ (if not Special Form Radioactive Material). Type A packages must be designed to meet the requirements of 10.6.0, 10.6.1, 10.6.2.4.1 to 10.6.2.4.4.

10.6.2.4.1 General

10.6.2.4.1.1 The smallest overall external dimension of the package must not be less than 10 cm.

10.6.2.4.1.2 The outside of every package must incorporate a feature, such as a seal, which is not readily breakable and which, while intact, will be evidence that the package has not been opened.

10.6.2.4.1.3 Any tie-down attachments on the package must be so designed that, under both normal and accident conditions, the forces in those attachments must not impair the ability of the package to meet the requirements of these Regulations.

10.6.2.4.1.4 The design of the package must take into account temperatures ranging from -40°C to +70°C (-40°F to +158°F) for the components of the packaging. Special attention must be given to freezing temperatures for liquid contents and to the potential degradation of packaging materials within the given temperature range.

10.6.2.4.1.5 The design, fabrication and manufacturing techniques must be in accordance with national or international standards, or other requirements, acceptable to the competent authority.

10.6.2.4.1.6 A package must be designed so that if it were subjected to the tests specified in 10.6.3.4, it would prevent:

- (a) more than a 20% increase in the maximum radiation level at any external surface of the package; and
- (b) loss or dispersal of the radioactive contents.

10.6.2.4.2 Containment System

10.6.2.4.2.1 The design must include a containment system securely closed by a positive fastening device which cannot be opened unintentionally or by pressure which may develop within the package.

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10.6.2.4.2.2 Special Form radioactive material may be considered as a component of the containment system.

10.6.2.4.2.3 If the containment system forms a separate unit of the package, it must be capable of being securely closed by a positive fastening device which is independent of any other part of the packaging.

10.6.2.4.2.4 The design of any component of the containment system must take into account, where applicable, the radiolytic decomposition of liquids and other vulnerable materials and the generation of gas by chemical reaction and radiolysis.

10.6.2.4.2.5 The containment system must retain its radioactive contents under a reduction of ambient pressure to 60 kPa.

10.6.2.4.2.6 All valves, other than pressure relief valves, must be provided with an enclosure to retain any leakage from the valve.

10.6.2.4.2.7 A radiation shield which encloses a component of the package specified as a part of the containment system must be so designed as to prevent the unintentional release of that component from the shield. Where the radiation shield and such component within it form a separate unit, the radiation shield must be capable of being securely closed by a positive fastening device which is independent of any other packaging structure.

10.6.2.4.3 Additional Requirements for Type A Packages Designed to Contain Liquids

10.6.2.4.3.1 Type A packages designed to contain liquid radioactive material must be adequate to meet the conditions specified in 10.6.2.4.1.6 if the package is subjected to the tests specified in 10.6.3.5.

10.6.2.4.3.2 Type A packages designed to contain liquids must be provided with sufficient absorbent material to absorb twice the volume of the liquid contents. Such absorbent material must be suitably positioned so as to contact the liquid in the event of leakage. Alternatively the package must be provided with a containment system composed of primary inner and secondary outer containment components designed to enclose the liquid contents completely and ensure their retention within the secondary outer containment components, even if the primary inner components leak.

10.6.2.4.3.3 The design of a package intended for liquid radioactive material must make provision for ullage to accommodate variations in the temperature of the contents, dynamic effects and filling dynamics.

10.6.2.4.4 Additional Requirements for Type A Packages Designed to Contain Gases

10.6.2.4.4.1 A package designed for gases must prevent loss or dispersal of the radioactive contents if the package were subjected to the tests specified in 10.6.3.5. A Type A package designed for tritium gas or for noble gases must be excepted from this requirement.

10.6.2.5 Requirements for Type B(U) Packages

10.6.2.5.1 A Type B package is a packaging containing an activity that may be in excess of A_1 (if Special Form radioactive material) or in excess of A_2 (if not Special Form radioactive material).

10.6.2.5.2 Type B(U) packages must be designed to meet the requirements of 10.6.0, 10.6.1, 10.6.2.4.1 except for 10.6.2.4.1.6(b), 10.6.2.4.2 and in addition, to the requirements specified in 10.6.2.5.3 to 10.6.2.5.16.

10.6.2.5.3 A package must be so designed that, under the ambient conditions specified below, the heat generated within the package by the radioactive contents will not, under normal conditions of transport, as demonstrated by the tests in 10.6.3.4, adversely affect the package in such a way that it would fail to meet the applicable requirements for containment and shielding if left unattended for a period of one week. Particular attention must be paid to the effects of heat, which may:

- (a) alter the arrangement, the geometrical form or the physical state of the radioactive contents or, if the material is enclosed in a can or receptacle (for example, clad fuel elements), cause the can, receptacle or material to deform or melt;
- (b) lessen the efficiency of the packaging through differential thermal expansion or cracking or melting of the radiation shielding material; or
- (c) in combination with moisture, accelerate corrosion.

10.6.2.5.4 For the purposes of 10.6.2.5.3, the ambient temperature must be taken as 38°C and the solar insolation conditions must be assumed to be as given by Table 10.6.A.

10.6.2.5.5 A package must be so designed that, under the ambient condition specified in 10.6.2.5.4 and in the absence of insolation, the temperature of the accessible surfaces of a package must not exceed 50°C, unless the package is transported under exclusive use.

10.6.2.5.6 In meeting the requirements of 10.6.1.1, account may be taken of barriers or screens intended to give protection to persons without the need for the barriers or screens being subject to any test.

TABLE 10.6.A
Type B Package Insolation Criteria (10.6.2.5.4)

Case	Form and Location of Surface	Insolation for 12 hours per day W/m^2
1	Flat surfaces transported horizontally - downward facing	0
2	Flat surfaces transported horizontally - upward facing	800
3	Surfaces transported vertically	200*
4	Other downward facing (not horizontal) surfaces	200*
5	All other surfaces	400*

* Alternatively, a sine function may be used, adopting an absorption coefficient and neglecting the effects of possible reflection from neighbouring objects.

10.6.2.5.7 A package which includes thermal protection for the purpose of satisfying the requirements of the thermal test specified in 10.6.3.6.2 must be so designed that such protection will remain effective if the packaging is subjected to the tests specified in 10.6.3.4; 10.6.3.6.1.1 Drop Test 1 and 10.6.3.6.1.2 Drop Test 2 or 10.6.3.6.1.2 Drop Test 2 and 10.6.3.6.1.3 Drop Test 3, as appropriate. Any such protection on the exterior of the package must not be rendered ineffective by conditions commonly encountered in normal handling or transport, or in accidents, and which are not simulated in the tests referred to above, e.g. by ripping, cutting, skidding abrasion or other rough handling.

10.6.2.5.8 A package must be so designed that, if it were subjected to:

- (a) the tests specified in 10.6.3.4, it would restrict the loss of radioactive contents to not more than $10^{-6} A_2$ per hour; and
- (b) the tests specified in 10.6.3.6, 10.6.3.6.1.2 Drop Test 2, 10.6.3.6.2 and 10.6.3.6.3.1 and the tests in:
 1. 10.6.3.6.1.3 Drop Test 3 when the package has a weight less than or equal to 500 kg, an overall density not greater than $1,000 \text{ kg/m}^3$ based on the external dimensions, and radioactive contents greater than $1,000 A_2$ not as Special Form radioactive material; or
 2. 10.6.3.6.1.1 Drop Test 1 for all other packages.

it would meet the following requirements:

- retain sufficient shielding to ensure that the radiation level at 1 m from the surface of the package would not exceed 10 mSv/h with the maximum radioactive contents for which the package is designed to contain; and
- restrict the accumulated loss of radioactive contents in a period of one week to not more than $10 A_2$ for Krypton-85 and not more than A_2 for all other radionuclides.

10.6.2.5.9 Where mixtures of different radionuclides are present, the provisions of 10.3.2.4 and 10.3.2.5 must apply except that for Krypton-85 an effective A_2 value equal to 100 TBq may be used. For 10.6.2.5.8(a), the evaluation must take into account the external contamination limitations of 10.5.3.2.

10.6.2.5.10 A package for radioactive contents with activity greater than $10^5 A_2$ must be so designed that if it were subjected to the enhanced water immersion test specified in 10.6.3.6.3.2 there would be no rupture of the containment system.

10.6.2.5.11 Compliance with the permitted activity release limits must not depend either upon filters or upon a mechanical cooling system.

10.6.2.5.12 A package must not include a pressure relief system from the containment system which would allow the release of radioactive material to the environment under the conditions of the tests specified in 10.6.3.4, 10.6.3.6 and 10.6.3.6.1 to 10.6.3.6.3.

10.6.2.5.13 A package must be so designed that if it were at the maximum normal operating pressure and it were subjected to the tests specified in 10.6.3.4, 10.6.3.6 and 10.6.3.6.1 to 10.6.3.6.3, the level of strains in the

containment system would not attain values which would adversely affect the package in such a way that it would fail to meet the applicable requirements.

10.6.2.5.14 A package must not have a maximum normal operating pressure in excess of a gauge pressure of 700 kPa.

10.6.2.5.15 A package containing low dispersible radioactive material must be so designed that any features added to the low dispersible radioactive material that are not part of it, or any internal components of the packaging must not adversely affect the performance of the low dispersible radioactive material.

10.6.2.5.16 A package must be designed for an ambient temperature range from -40°C to $+38^\circ\text{C}$.

10.6.2.6 Requirements for Type B(M) Packages

10.6.2.6.1 Type B(M) packages must meet the requirements for Type B(U) packages specified in 10.6.2.5.2 except that for packages to be transported solely within a specified State or solely between specified States, conditions other than those given in 10.6.2.4.1.4, 10.6.2.5.4, 10.6.2.5.10 to 10.6.2.5.16 may be assumed with the approval of the competent authorities of those States. Notwithstanding, the requirements for Type B(U) packages specified in 10.6.2.5.10 to 10.6.2.5.16 must be met as far as practicable.

10.6.2.7 Requirements for Type C Packages

10.6.2.7.1 A Type C package is a packaging containing an activity that may be in excess of A_1 (if Special Form radioactive material) or in excess of A_2 (if not in Special Form radioactive material).

10.6.2.7.2 Type C packages must be designed to meet the requirements of 10.6.0, 10.6.1, 10.6.2.4.1 except for 10.6.2.4.1(b), 10.6.2.4.2, 10.6.2.5.3, 10.6.2.5.4, 10.6.2.5.6, 10.6.2.5.11 to 10.6.2.5.16, and, in addition, the requirements specified in 10.6.2.7.3 to 10.6.2.7.5.

10.6.2.7.3 A package must be capable of meeting the assessment criteria prescribed for tests in 10.6.2.5.8(b) and 10.6.2.5.12 after burial in an environment defined by a thermal conductivity of 0.33 W/(m.K) and a temperature of 38°C in the steady state. Initial conditions for the assessment must assume that any thermal insulation of the package remains intact, the package is at the maximum normal operating pressure and the ambient temperature is 38°C .

10.6.2.7.4 A package must be so designed that, if it were at the maximum normal operating pressure and subjected to:

- (a) the tests specified in 10.6.3.4, it would restrict the loss of radioactive contents to not more than $10^{-6} A_2$ per hour; and
- (b) the test sequences in 10.6.3.7.1, it would meet the following requirements:
 - retain sufficient shielding to ensure that the radiation level at 1 m from the surface of the package would not exceed 10 mSv/h with

containing Special Form not Special

designed to 10.6.2.4.1 addition, to 10.6.2.5.16.

that, under the heat contents as demonstrated affect the shielding if Particular which may:

form or the tests or, if the spectacle (for can), recep-

through differ- or melting of

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and that, under 4 and in the accessible C, unless the

of 10.6.1.1, s intended to need for the

10.6.2.5.4)

Insolation for 12 hours per day W/m^2
0
800
200*
200*
400*

used, adopting the effects of objects.

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the maximum radioactive contents which the package is designed to contain; and

- restrict the accumulated loss of radioactive contents in a period of 1 week to not more than 10 A₂ for Krypton-85 and not more than A₂ for all other radionuclides.

Where mixtures of different radionuclides are present, the provisions of 10.3.2.4 and 10.3.2.5 must apply except that for Krypton-85 an effective A₂(I) value equal to 10 A₂ may be used. For case (a) above, the assessment must take into account the external contamination limits of 10.5.3.2.

10.6.2.7.5 A package must be so designed that there will be no rupture of the containment system following performance of the enhanced water immersion test specified in 10.6.3.6.3.2.

10.6.2.8 Requirements for Packages Containing Fissile Materials

10.6.2.8.1 General

Except as provided in 10.3.7.2, packages containing fissile material must be designed and used so as to comply with the requirements of 10.6.2.8.1.1 to 10.6.2.8.1.6.

10.6.2.8.1.1 Packages containing fissile materials must be stored and transported in accordance with the relevant controls in 9.2.1 and 9.3.10.

10.6.2.8.1.2 Fissile material must be transported so as to:

- (a) maintain subcriticality under conditions likely to be encountered during normal conditions of transport and in accidents. In particular, the following contingencies must be considered:

1. water leaking into or out of packages;
2. the loss of efficiency of built-in neutron absorbers or moderators;
3. possible rearrangement of the radioactive contents either within the package or as a result of loss from the package;
4. reduction of spaces between packages or radioactive contents;
5. packages becoming immersed in water or buried in snow; and
6. temperature changes; and

(b) meet the requirements:

1. that the smallest overall external dimension of a package containing fissile material must not be less than 10 cm;
2. prescribed elsewhere in these Regulations which pertain to the radioactive properties of the material; and
3. specified in 10.6.2.8.1.3 to 10.6.2.8.1.6 and 10.6.2.8.2 and 10.6.2.8.3 unless excepted by 10.3.7.2.

10.6.2.8.1.3 Where the chemical or physical form, isotopic composition, mass or concentration, moderation ratio or density, or geometric configuration is not known, the assessments of 10.6.2.8.2 and 10.6.2.8.3 must be

performed assuming that each parameter that is not known has the value which gives the maximum neutron multiplication consistent with the known conditions and parameters in these assessments.

10.6.2.8.1.4 For irradiated nuclear fuel the assessments of 10.6.2.8.2 and 10.6.2.8.3 must be based on an isotopic composition demonstrated to provide:

- (a) the maximum neutron multiplication during the irradiation history; or
- (b) a conservative estimate of the neutron multiplication for the package assessments. After irradiation but prior to shipment, a measurement must be performed to confirm the conservatism of the isotopic composition.

△ **10.6.2.8.1.5** The package after being subjected to the tests specified in 10.6.3.4, must:

- (a) preserve the minimum overall outside dimensions of the package to at least 10 cm; and
- (b) prevent the entry of a 10 cm cube.

10.6.2.8.1.6 The package must be designed for an ambient temperature range of -40°C to +38°C unless the competent authority specifies otherwise in the certificate of approval for the package design.

10.6.2.8.2 Assessment of an Individual Package in Isolation

10.6.2.8.2.1 For a package in isolation, it must be assumed that water can leak into or out of all void spaces of the package, including those within the containment system. However, if the design incorporates special features to prevent such leakage of water into or out of certain void spaces, even as a result of human error, absence of leakage may be assumed in respect of those void spaces. Special features include the following:

- (a) multiple high standard water barriers, not less than two of which would remain leak-tight if the package were subject to the tests prescribed in 10.6.2.8.3.2(b); a high degree of quality control in the production and maintenance of packagings; and tests to demonstrate the closure of each package before shipment; or
- (b) for packages containing uranium hexafluoride only, with a maximum enrichment of 5 mass per cent uranium-235:

1. packages where, following the tests prescribed in 10.6.2.8.3.2(b), there is no physical contact between the valve and any other component of the packaging other than at its original point of attachment and where, in addition, following the thermal test prescribed in 10.6.3.6.2 the valves remain leaktight; and
2. a high degree of quality control in the manufacture, maintenance and repair of packagings coupled with tests to demonstrate closure of each package before each shipment.

10.6.2.8.2.2 It must be assumed that the confinement system must be closely reflected by at least 20 cm of water or such greater reflection as may additionally be provided by the surrounding material of the packaging. However, when it can be demonstrated that the

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confinement system remains within the packaging following the tests prescribed in 10.6.2.8.3.2(b), close reflection of the package by at least 20 cm of water may be assumed.

10.6.2.8.2.3 The package, must be subcritical under the conditions specified in 10.6.2.8.2.1 and 10.6.2.8.2.2 with the package conditions that result in the maximum neutron multiplication consistent with:

- (a) routine conditions of transport (incident free);
- (b) the tests specified in 10.6.2.8.3.1(b);
- (c) the tests specified in 10.6.2.8.3.2(b).

10.6.2.8.2.4 The package must be subcritical under conditions consistent with the Type C package tests specified in 10.6.3.7.1 assuming reflection by at least 20 cm of water but no water leakage. In the assessment of 10.6.2.8.2.3 allowance must not be made for special features of 10.6.2.8.2.1 unless, following the Type C package tests specified in 10.6.3.7.1 and, subsequently, the water leakage test of 10.6.3.6.4.3, leakage of water into or out of the void spaces is prevented.

10.6.2.8.3 Assessment of Packages Arrays

10.6.2.8.3.1 Under normal conditions of transport. A number "N" must be derived, such that five times "N" must be subcritical for the arrangement and package conditions that provide the maximum neutron multiplication consistent with the following:

- (a) there must not be anything between the packages, and the package arrangement must be reflected on all sides by at least 20 cm of water; and
- (b) the state of the packages must be their assessed or demonstrated condition if they had been subjected to the tests specified in 10.6.3.4.

10.6.2.8.3.2 Under accident conditions of transport. A number "N" must be derived, such that two times "N" must be subcritical for the arrangement and package conditions that provide the maximum neutron multiplication consistent with the following:

- (a) hydrogenous moderation between packages, and the package arrangement reflected on all sides by at least 20 cm of water; and
- (b) the tests specified in 10.6.3.4 followed by whichever of the following is the more limiting:
 1. the Drop Test 2 specified in 10.6.3.6.1.2 and, either Drop Test 3 specified in 10.6.3.6.1.3 for packages having a mass not greater than 500 kg and an overall density not greater than 1,000 kg/m³ based on the external dimensions, or Drop Test 1 specified in 10.6.3.6.1.1 for all other packages; followed by the Thermal Test specified in 10.6.3.6.2 and completed by the Water Leakage Test specified in 10.6.3.6.4; or
 2. the test specified in 10.6.3.6.3.1; and
- (c) where any part of the fissile material escapes from the containment system following the tests specified in 10.6.2.8.3.2(b), it must be assumed that fissile material escapes from each package in the array and all of the fissile material must be arranged in the configuration and moderation that results in the

maximum neutron multiplication with close reflection by at least 20 cm of water.

10.6.2.8.4 Approval of Package Design

Each package design for fissile material which is not excepted according to 10.3.7.2 from the requirements that apply specifically to packages containing fissile material, requires multilateral approval.

10.6.3 Package Tests Procedures

10.6.3.1 Test Procedures and Demonstration of Compliance

10.6.3.1.1 Demonstration of compliance with the performance standards required in this section may be accomplished by any of the following methods or by a combination thereof:

- (a) performance of tests with specimens representing LSA-III material, or Special Form radioactive material, or low dispersible radioactive material or with prototypes or samples of the packaging, provided that the contents of the specimen or the packaging for the tests simulate as closely as practicable the expected range of radioactive contents and the packaging to be tested is prepared as normally presented for transport;
- (b) reference to previous satisfactory demonstrations of sufficiently similar nature;
- (c) performance of tests with models of appropriate scale incorporating those features which are significant with respect to the item under investigation when engineering experience has shown the results of such tests to be suitable for design purposes. When a scale model is used, the need for adjusting certain test parameters, such as the penetrator diameter or the compressive load, must be taken into account;
- (d) calculation, or reasoned argument, when the calculation procedures and parameters are generally agreed to be reliable or conservative.

10.6.3.1.2 After the specimen, prototype or sample has been subjected to the tests, appropriate methods of assessment must be used to assure that the requirements of this subsection have been fulfilled in compliance with the performance and acceptance standards prescribed in 10.3.4.2, 10.3.5.1.3.3, 10.3.8.2, 10.5.3, 10.6.0 to 10.6.2.

10.6.3.1.3 All specimens must be examined 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.

10.6.3.1.4 The containment system of the packaging must be clearly specified. 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.

10.6.3.2 Testing the Integrity of the Containment System and Shielding and Evaluating Criticality Safety

After the applicable tests specified in 10.6.3.4 to 10.6.3.8:

- (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 10.6.0 to 10.6.2 for the packaging under test; and
- (c) for packages containing fissile material, it must be determined whether the assumptions made in 10.5.14.2.1 and 10.6.2.8 regarding the most reactive configuration and degree of moderation of the fissile contents, of any escaped material, and of one or more packages are valid.

10.6.3.3 Target for Drop Tests

The target for the drop tests specified in 10.3.4.3.1, 10.6.3.4.3, 10.6.3.5.1, 10.6.3.6.1, 10.6.3.7.2 and 10.6.3.7.4 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.

10.6.3.4 Tests for Demonstrating Ability to Withstand Normal Conditions of Transport

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 10.6.3.4.1 are fulfilled.

10.6.3.4.1 Sequencing of Tests

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 may elapse, however, if the water spray is applied from each of the four directions consecutively.

10.6.3.4.2 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.

10.6.3.4.3 Free Drop Test

The specimen must drop onto the target so as to suffer maximum damage in respect of the safety features to be tested:

- (a) the height of drop measured from the lowest point of the package to the upper surface of the target must be not less than the distance specified in Table 10.6.B for the applicable weight. The target must be as defined in 10.6.3.3;

TABLE 10.6.B
Free Drop Distance for Testing Packages to Normal Conditions of Transport (10.6.3.4.3(a))

Package Weight (kg)	Free Drop Distance (m)
<5,000	1.2
≥5,000 to <10,000	0.9
≥10,000 to <15,000	0.6
≥15,000	0.3

- (b) for rectangular fibreboard or wood packages not exceeding a mass of 50 kg (110 lb), a separate specimen must be subjected to a free drop onto each corner from a height of 0.3 m (1 ft);
- (c) for cylindrical fibreboard packages not exceeding a mass of 100 kg (220 lb), a separate specimen must be subjected to a free drop onto each of the quarters of each rim from a height of 0.3 m (1 ft).

10.6.3.4.4 Stacking Test

The specimen must be subjected, for a period of 24 hours, to a compressive load equal to the greater of the following:

- a total weight equal to five times the maximum weight of the package; or
- the equivalent of 13 kPa (0.13 bar or 2 lb/in²) 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.

10.6.3.4.5 Penetration Test

The specimen must be placed on a rigid, flat, horizontal surface which will not move significantly while the test is being carried out. A bar of 32 mm (1.25 in) diameter with a hemispherical end and a weight of 6 kg (13 lb) must be dropped and directed to fall, with its longitudinal axis vertical, onto the centre of the weakest part of the package, so that, if it penetrates sufficiently far, it will hit the containment system. The bar must not be significantly deformed by the test performance. 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 m (40 in).

10.6.3.5 Additional Tests for Type A Packages Designed for Liquids and Gases

A single package or separate packages must be subjected to each of the following tests unless it can be demonstrated that one test is more severe for the package in question than the other, in which case one package only must be subjected to the more severe test.

10.6.3.5.1 Free Drop Test

The specimen must drop onto the target so as to suffer the maximum damage in respect of containment. The height of drop measured from the lowest part of the

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package to the upper surface of the target must be 9 m (30 ft). The target must be as defined in 10.6.3.3.

10.6.3.5.2 Penetration Test

The specimen must be subjected to the test specified in 10.6.3.4.5 except that the height of drop must be increased to 1.7 m (67 in).

10.6.3.6 Tests for Demonstrating Ability to Withstand Accident Conditions in Transport

The specimen must be subjected to the cumulative effects of the tests specified in 10.6.3.6.1 and 10.6.3.6.2, 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 10.6.3.6.3.1 and, if applicable, 10.6.3.6.3.2.

10.6.3.6.1 Mechanical Test

The mechanical test consists of three different drop tests. Each specimen must be subjected to the applicable drops as specified in 10.6.2.5.8 and 10.6.2.8.3.2. The order in which the package is subjected to the drops must be such that, on completion of the mechanical test, the specimen will have suffered such damage as will lead to the maximum damage in the thermal test which follows.

10.6.3.6.1.1 Drop Test 1

The package must be dropped onto the target so as to suffer the maximum damage, and the height of the drop measured from the lowest point of the package to the upper surface of the target must be 9 m (30 ft). The target must be as defined in 10.6.3.3.

10.6.3.6.1.2 Drop Test 2

The specimen must be dropped so as to suffer the maximum damage onto a bar rigidly mounted perpendicularly on the target. The height of the drop measured from the intended point of impact of the package to the upper surface of the bar must be 1 m (40 in). The bar must be of solid mild steel of circular section 150 mm \pm 5 mm in diameter and 200 mm (8 in) 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 edge rounded off to a radius of not more than 6 mm (0.25 in). The target on which the bar is mounted must be as described in 10.6.3.3.

10.6.3.6.1.3 Drop Test 3

The package 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 weight from 9 m (30 ft) onto the specimen. The weight must consist of a solid mild steel plate 1 m \times 1 m (40 \times 40 in) and 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 package. The target on which the specimen tests must be as defined in 10.6.3.3.

10.6.3.6.2 Thermal Test

10.6.3.6.2.1 The specimen must be in thermal equilibrium under conditions of an ambient temperature of 38°C, subject to the solar insolation conditions specified in Table 10.6.A and subject to the design maximum rate of internal heat generation within the package 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.

10.6.3.6.2.2 The thermal test must then consist of:

- exposure of a specimen for a period of 30 minutes to a thermal environment which provides a heat flux at least equivalent to that of a hydrocarbon fuel/air fire in sufficiently quiescent ambient conditions to give a minimum average flame emissivity coefficient of 0.9 and an average temperature of at least 800°C, fully engulfing the specimen, with a surface absorptivity coefficient of 0.8 or that value which the package may be demonstrated to possess if exposed to the fire specified, followed by;
- exposure of the specimen to an ambient temperature of 38°C, subject to the solar insolation conditions specified in Table 10.6.A and subject to the design maximum rate of internal heat generation within the package by the radioactive contents for a sufficient period to ensure that temperatures in the specimen are everywhere decreasing and/or are approaching initial 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.

10.6.3.6.3 Water Immersion Test

10.6.3.6.3.1 General

The specimen must be immersed under a head of water of at least 15 m (50 ft) for a period of not less than 8 hours in the attitude which will lead to maximum damage. For demonstration purposes, an external pressure of at least 150 kPa [gauge] (1.5 bar [gauge] or 22 lb/in² [gauge]) is considered to meet these conditions.

10.6.3.6.3.2 Enhanced Water Immersion Test for Type B(U) and Type B(M) Packages Containing more than 10⁵ A₂ and Type C Packages

The specimen must be immersed under a head of water of at least 200 m (656 ft) for a period of not less than one hour. For demonstration purposes, an external gauge pressure of at least 2 MPa is considered to meet these conditions.

10.6.3.6.4 Water Leakage Test for Packages Containing Fissile Material

10.6.3.6.4.1 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 10.6.2.8.2 and 10.6.2.8.3 must be excepted from the test.

10.6.3.6.4.2 Before the specimen is subjected to the water leakage test specified in 10.6.3.6.4.3, it must be subjected to Drop Test 2 in 10.6.3.6.1.2, and either Drop Test 1 in 10.6.3.6.1.1 or Drop Test 3 in 10.6.3.6.1.3 as required by 10.6.2.8.3.2 and the Thermal Test specified in 10.6.3.6.2.

10.6.3.6.4.3 The specimen must be immersed under a head of water of at least 0.9 m (3 ft) for a period of not less than 8 hours and in the attitude for which maximum leakage is expected.

10.6.3.7 Tests for Type C Packages

10.6.3.7.1 Test Requirements

Specimens must be subjected to the effects of each of the following test sequences in the orders specified:

- (a) the tests specified in 10.6.3.6.1.1, 10.6.3.6.1.3, 10.6.3.7.2 and 10.6.3.7.3; and
- (b) the test specified in 10.6.3.7.4.

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

10.6.3.7.2 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 10.6.3.7.1(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 with its rounded edge rounded off to a radius of not more than 6 mm. The target on which the specimen is placed must be as specified in 10.6.3.3;
- (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 10.6.3.3.

10.6.3.7.3 Enhanced Thermal Test

The conditions for this test must be as specified in 10.6.3.6.2, except that the exposure to the thermal environment must be for a period of 60 minutes.

10.6.3.7.4 Impact Test

The specimen must be subject 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 10.6.3.3, except that the target surface may be at any orientation as long as the surface is normal to the specimen path.

10.6.3.8 Tests for Packagings Designed to Contain Uranium Hexafluoride

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.

10.6.3.9 Notification and Registration of Serial Numbers

The competent authority must be informed of the serial number of each packaging manufactured to a design approved under 10.6.2.5, 10.6.2.7 and 10.6.2.8.4. The competent authority will maintain a register of such serial numbers.

Multilateral approval may be by validation of the original certificate issued by the competent authority of the State of origin of the design or shipment.

10.6.4 Transitional Measures for Class 7

10.6.4.1 Packages Not Requiring Competent Authority Approval of Design Under the 1985 and 1985 (as amended 1990) Editions of IAEA Safety Series No. 6

10.6.4.1.1 Excepted packages, Industrial packages Type IP-1, Type IP-2 and Type IP-3 and Type A packages that did not require approval of design by the competent authority and which meet the requirements of the 1985 or 1985 (As Amended 1990) Editions of IAEA Regulations for the Safe Transport of Radioactive Material (IAEA Safety Series No. 6) may continue to be used subject to the mandatory programme of quality assurance in accordance with the requirements of 10.0.3 and the activity limits and material restrictions of 10.3.2 and 10.3.11.

Any packaging modified, unless to improve safety, or manufactured after 31 December 2003, must meet the requirements of these Regulations in full. Packages prepared for transport not later than 31 December 2003 under the 1985 or 1985 (As amended 1990) Editions of IAEA Safety Series No. 6 may continue in transport. Packages prepared for transport after this date must meet the requirements of these Regulations in full.

10.6.4.2 Packages Approved Under the 1973, 1973 (as amended), 1985 and 1985 (as amended 1990) Editions of IAEA Safety Series No. 6

10.6.4.2.1 Packagings manufactured to a package design approved by the competent authority under the provisions of the 1973 or 1973 (As Amended) Editions of IAEA Safety Series No. 6 may continue to be used, subject to: multilateral approval of package design, the mandatory programme of quality assurance in accordance with the applicable requirements of 10.0.3 the activity limits and material restrictions of 10.3.2 and 10.3.11; and for a package containing fissile material and transported by air, the requirement of 10.6.2.8.4. No new manufacture of such packaging must be permitted to commence. Changes in the design of the packaging or in the nature or quantity of the authorized radioactive contents which, as determined by the competent authority, would significantly affect safety must require that the requirements of these Regulations be met in full. A serial number according to the provision of 10.7.1.3.5 and 10.7.1.3.6 must be assigned to and marked on the outside of each packaging.

10.6.4.2.2 Packagings manufactured to a package design approved by the competent authority under the provisions of the 1985 or 1985 (As Amended 1990) Editions of IAEA Safety Series No. 6 may continue to be used subject to the multilateral approval of package designs; the mandatory programme of quality assurance in accordance with the requirements of 10.0.3; the activity limits and material restrictions of 10.3.2 and 10.3.11 and for a package containing fissile material and transported by air, the requirement of 10.6.2.8.4. Changes in the design of the packaging or in the nature or quantity of the authorized radioactive contents which, as determined by the competent authority, would significantly affect safety must require that the requirements of these Regulations be met in full. All packagings for which manufacture begins after 31 December 2006 must meet the requirements of these Regulations in full.

10.6.4.3 Special Form Radioactive Material Approved Under the 1973, 1973 (As Amended), 1985 and 1985 (As Amended 1990) Editions of IAEA Safety Series No. 6

Special Form radioactive material manufactured to a design which had received unilateral approval by the competent authority under the 1973, 1973 (As Amended), 1985 or 1985 (As Amended 1990) Editions of IAEA Safety Series No. 6 may continue to be used when in compliance with the mandatory programme of quality assurance in accordance with the applicable requirements of 10.0.3. All Special Form radioactive material manufactured after 31 December 2003 must meet the requirements of these Regulations in full.

10.7 Marking and Labelling

10.7.1 Marking

STATE VARIATIONS: ESG-01, HKG-02, MYG-06, PKG-01, SAG-03, USG-01, VCG-05, VUG-01

OPERATOR VARIATIONS: FX-11, IR-03, MS-01, NH-02, PX-01

10.7.1.0 General

The shipper is responsible for all necessary marking and labelling of each package, overpack or freight container containing radioactive material in compliance with these Regulations.

10.7.1.1 Shipper's Responsibility

10.7.1.1.1 Specific

For each package and overpack requiring marking, the shipper must:

- check that any relevant marking on the package or overpack already on the package is in the correct location and meets the quality and specification requirements of the Regulations;
- remove or obliterate any irrelevant marking already on the package or overpack;
- ensure that each outer or single packaging used for radioactive material bears the identification markings as specified in 10.7.1.3.3 to 10.7.1.3.7;
- apply any appropriate new marking in the correct location, and ensure that it is of durable quality and correct specification; and
- ensure that his responsibilities for marking are completely fulfilled when the package or overpack is presented to the operator for shipment.

10.7.1.2 Quality and Specification of Markings

10.7.1.2.1 General

All markings must be so placed on the packagings or overpacks that they are not covered or obscured by any part of or attachment to the packaging or overpack or any other label or marking. The required markings must not be located with other package markings that could substantially reduce their effectiveness.

10.7.1.2.2 Quality

All markings must be:

- durable and printed or otherwise marked on, or affixed to, the external surface of the package or overpack;
- readily visible and legible;
- able to withstand open weather exposure without a substantial reduction in effectiveness; and
- displayed on a background of contrasting colour.

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10.7.1.2.3 Language

English must be used in addition to the language which may be required by the State of origin.

10.7.1.2.4 Size

Package and overpack use markings required by 10.7.1.3 and 10.7.1.4 should be at least 12 mm high, except for packages of 30 L or 30 kg capacity or less when they should have a minimum height of 6 mm.

10.7.1.3 Required Markings**10.7.1.3.1 General**

The following markings are required on all Industrial Package Types IP-1, IP-2 and IP-3, Type A, Type B(U), Type B(M) and Type C packages containing radioactive material:

- Proper Shipping Name;
- UN Number, preceded by the letters "UN";
- full name and address of the shipper and consignee; and
- permissible gross weight if this exceeds 50 kg (110 lb);
- when carbon dioxide, solid (dry ice) is used as a refrigerant, the additional marking requirements of 7.1.5.1(e) are required.

10.7.1.3.2 Excepted Packages

Excepted Packages must be marked with:

- UN number, preceded by the letters "UN";
- full name and address of the shipper and consignee; and
- permissible gross weight, if this exceeds 50 kg (110 lb);
- when carbon dioxide, solid (dry ice) is used as a refrigerant, the additional marking requirements of 7.1.5.1(e) are required.

10.7.1.3.3 Industrial Package Identification

Each package which conforms to a Type IP-1 package, "TYPE IP-1".

Each package which conforms to a Type IP-2 package or a Type IP-3 package design must be marked with:

- "TYPE IP-2" or "TYPE IP-3" as appropriate;
- International Vehicle Registration code (VRI Code), as indicated in Appendix D.1 and D.2, of the country of origin of design; and
- name of the manufacturer, or other identification of the packaging specified by the competent authority of the country of origin of design.

10.7.1.3.4 Type A Package Identification

Each package which conforms to a Type A packaging design must be marked with:

- "TYPE A";
- International Vehicle Registration code (VRI Code), as indicated in Appendix D.1 and D.2, of the country of origin of design; and
- name of the manufacturer, or other identification of the packaging specified by the competent authority of the country of origin of design.

10.7.1.3.5 Type B Package Identification

Each package which conforms to a Type B packaging design must be marked as follows:

- "TYPE B(U)" or "TYPE B(M)" as appropriate;
- identification mark allocated to the design by the competent authority;
- serial number to uniquely identify each packaging which conforms to that design; and
- trefoil symbol, as shown in Figure 10.7.1.A, must be plainly marked by embossing, stamping or by other means, resistant to the effects of fire and water, on the outermost receptacle, which is resistant to the effects of fire and water.

10.7.1.3.6 Type C Package Identification

Each package which conforms to a Type C packaging design must be marked as follows:

- "TYPE C";
- identification mark allocated to the design by the competent authority;
- serial number to uniquely identify each packaging which conforms to that design; and
- trefoil symbol, as shown in Figure 10.7.1.A, must be plainly marked by embossing, stamping or by other means, resistant to the effects of fire and water, on the outermost receptacle, which is resistant to the effects of fire and water.

10.7.1.3.7 Fissile Package Identification

Each package containing fissile material must be marked according to the requirements of its type.

Note:

For packages containing fissile material only, the identification mark should contain the type codes "AF", "B(U)F", "B(M)F", "CF" or "IF".

10.7.1.3.8 Competent Authority Design or Shipment Approval

In all cases of international transport of packages requiring competent authority design or shipment approval, for which different approval types apply in the different countries concerned by the shipment, marking must be in accordance with the certificate of the country of origin of the design.

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10.7.1.4 Overpacks

10.7.1.4.1 Unless all markings required by 10.7.1.3 for all dangerous goods in the overpack are clearly visible, the overpack must be marked with:

- the word "Overpack";
- the required marking of 10.7.1.3;
- any special handling instructions appearing on packages inside the overpack.

Packaging specification markings must not be reproduced on the overpack. The "Overpack" marking is an indication that packages contained within comply with prescribed specifications.

10.7.1.4.2 When a consignment consists of more than one overpack, to facilitate identification, loading and notification, the operator requires each overpack to show an identification mark (which may be in any alphanumeric format) and the total quantity of radioactive material, as required by 10.7.3.4.

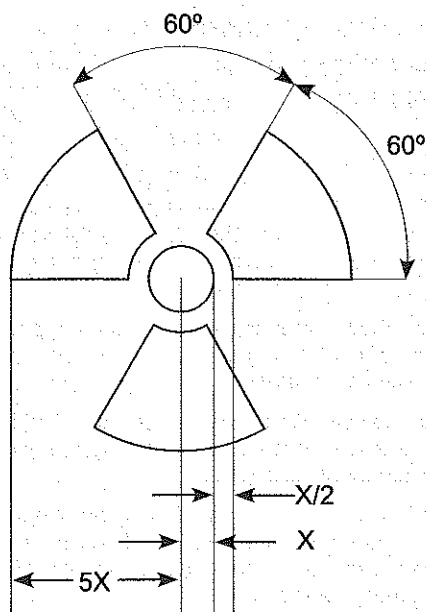
Note:

Where an overpack contains more than one UN number, the total quantity of dangerous goods should be shown by UN number.

10.7.1.5 Markings of Other Regulations

Markings required by other international or national transport regulations are permitted in addition to markings required by these Regulations provided that they cannot be confused with or conflict with any markings prescribed by these Regulations because of their colour, design or shape.

FIGURE 10.7.1.A
Trefoil Symbol (10.7.1.3.5 and 10.7.1.3.6)



Basic trefoil symbol with proportions based on a central circle of radius "X". The minimum allowable size of "X" is 4 mm.

10.7.2 Labelling

STATE VARIATIONS: PKG-02, VCG-06, VUG-05

OPERATOR VARIATIONS: IC-09, JW-01, KC-07, NH-03, PX-02, QF-01

10.7.2.1 Shipper's Specific Responsibilities

For each such package and overpack requiring labelling, the shipper must:

- remove or obliterate any irrelevant labelling already on the package or overpack;
- use only labels of durable quality and correct specification;
- inscribe on each label, in a durable manner, any required additional information;
- affix the appropriate label(s) in the correct location(s) and in a secure manner;
- ensure that the responsibilities for labelling are completely fulfilled when the package or overpack is presented to the operator for shipment; and
- when an empty packaging is transported as an excepted package under the provisions of 10.3.11.1.5, the previously displayed labels must be removed or obliterated.

10.7.2.2 Quality and Specification of Labels

10.7.2.2.1 Durability

The material of every label, the printing and any adhesive thereon, must be sufficiently durable to withstand normal transport conditions including open weather exposure without a substantial reduction in effectiveness.

10.7.2.2.2 Types of Labels

Labels are of two types:

- hazard labels (in the shape of a square set at 45°); and
- handling labels (in various rectangular shapes), which are required, either alone or in addition to hazard labels.

10.7.2.2.3 Label Specifications

All labels (hazard labels and handling labels) used on packages and overpacks containing radioactive material, must conform, in shape, colour, format, symbol and text, to the specimen designs reproduced in 10.7.7. Except as indicated, no variation in specification is permitted. Except as otherwise provided in these Regulations, the minimum dimensions of the hazard labels must be 100 × 100 mm (4 × 4 in). The dimensions for handling label shown in Figure 7.4.A to Figure 7.4.F are the minimum dimension. Hazard labels must have a line of the same colour as the symbol, 5 mm inside the edge and running parallel to it. A label may contain form identification, including the name of its maker, provided the information is printed outside of the solid line border in no larger than 10-point type. Except for the Criticality Safety Index label (CSI),

the upper half of the label is reserved for the trefoil symbol and the lower half for texts and the class number.

10.7.3 Applicability of Hazard Labels

10.7.3.1 Hazard Label

The hazard labels to be used on packages and overpacks of radioactive material are specified in the List of Dangerous Goods in Subsection 4.2. Each package of radioactive material must be labelled in accordance with the category assigned to it in Table 10.5.C. Each package of fissile material must, in addition, bear the Criticality Safety Index (CSI) label (10.7.7.4) adjacent to the radioactive hazard labels.

10.7.3.2 Subsidiary Risk Label

Packages of radioactive material, which possesses other hazardous properties meeting the criteria for one or more of the other classes, must bear the applicable subsidiary risks labels. Such subsidiary risk labelling is not required for an uncompressed gas that is non-flammable and non-toxic.

Note:

See Section 7 for information on handling labels.

10.7.3.3 Label Marking

The contents, activity and for Category II and III Yellow labels, the transport index must be marked on the label in a clear and durable manner, and for the CSI label, the Criticality Safety Index.

10.7.3.3.1 Contents

The contents must be inscribed as follows:

- (a) except for LSA-I material, the symbol of the radionuclide as listed in Table 10.3.A;
- (b) for mixtures of radionuclides, or for different individual radionuclides packed together in the same package, the most restrictive radionuclides must be listed to the extent that space on the line permits;
- (c) LSA (except LSA-I) or SCO the symbol of the radionuclide followed by "LSA-II", "LSA-III", "SCO-I" or "SCO-II" as appropriate;
- (d) for LSA-I materials, only the term "LSA-I" need be used.

10.7.3.3.2 Activity

The maximum activity of the radioactive contents must be inscribed in terms of becquerel or multiples thereof. The equivalent activity in curies or multiples thereof may be shown in parentheses following the becquerel units. In each case, the units used must be clearly indicated either in full or by use of the correct abbreviations. For fissile materials, the total mass of the fissile material (or mass of each fissile nuclide for mixtures when appropriate) in grams or kilograms may be used in place of the activity (in all cases the units used must be clearly indicated).

10.7.3.3.3 Transport Index (TI)

For Category II and Category III Yellow labels only, the Transport Index must be inscribed in the box provided. It must be rounded up to one decimal place.

10.7.3.3.4 Criticality Safety Index (CSI)

10.7.3.3.4.1 The Criticality Safety Index label, 10.7.7.4, must be inscribed with the Criticality Safety Index (CSI) as stated in the certificate of approval for special arrangement or the certificate of approval for the package design, issued by the competent authority, in the box provided.

10.7.3.3.4.2 For overpacks and freight containers, the Criticality Safety Index (CSI) on the label, must bear the information required by 10.7.3.3.4.1 totalled together for the fissile contents of the overpack or freight container.

10.7.3.3.5 Competent Authority Design or Shipment Approval

In all cases of international transport of packages requiring competent authority design or shipment approval, for which different approval types apply in the different countries concerned by the shipment, labelling must be in accordance with the certificate of the country of origin of the design.

10.7.3.4 Overpacks and Freight Containers

For overpacks and freight containers, the "Contents" and "Activity" entries on the labels must bear the information as required by 10.7.3.3.1 and 10.7.3.3.2, totalled together for the entire contents of the overpack or freight container. For overpacks and freight containers containing mixed loads of packages containing different radionuclides, such entries may read "See Shipper's Declaration".

10.7.4 Affixing Labels

STATE VARIATION: JPG-09

OPERATOR VARIATION: FX-11

10.7.4.1 General

10.7.4.1.1 All labels must be securely affixed or printed on the packaging so that they are readily visible, legible and not covered or obscured by any part of the packaging or by any other label or marking.

10.7.4.1.2 Each label must be affixed or printed on a background of contrasting colour or must have a dotted or solid line outer boundary.

10.7.4.1.3 Labels must not be folded or affixed in such a manner that parts of the same label appear on different faces of the package.

10.7.4.1.4 If the package is of such an irregular shape that a label cannot be attached or printed on a surface, it is acceptable to attach the label(s) to the package by means of strong tag(s).

10.7.4.1.5 The package must be of such a size that there is adequate space to affix all required labels.

Note:

See 9.3.7 for the replacement of labels during transport.

10.7.4.2 Label Location

10.7.4.2.1 When the package dimensions are adequate, one set of labels (10.7.4.3.1) must be located on the same surface of the package near the proper shipping name marking.

10.7.4.2.2 Labels should be affixed adjacent to the shipper's or consignee's address appearing on the package.

10.7.4.2.3 Subsidiary hazard labels, when applicable, must be affixed adjacent to the primary hazard labels.

10.7.4.2.4 When a "Cargo Aircraft Only" handling label (see Figure 7.4.B) is required, it must be affixed on the same surface of the package near the hazard label(s).

10.7.4.2.5 Unless the package dimensions are inadequate hazard labels must be affixed at an angle of 45° (diamond shaped).

10.7.4.3 Number of Labels

10.7.4.3.1 The Radioactive Material label together with any subsidiary risk label(s), the Criticality Safety Index label (if applicable) and the "Cargo Aircraft Only" label (if applicable) must be affixed to two opposite sides of the package.

10.7.4.3.2 For a freight container, the labels must be affixed to all four sides of the container.

10.7.4.3.3 For a cylindrical package, two sets of labels must be affixed opposite each other such that they are centred on opposite points of the circumference.

10.7.4.3.4 On very small packages including cylinders, where the two sets of labels would overlap, only one label is required, provided it does not overlap itself.

10.7.4.3.5 If a rigid overpack is used, two sets of labels, affixed to opposite sides of the overpack must be used.

10.7.4.3.6 If a non-rigid overpack is used, at least one set of labels must be affixed to a durable tag secured to the overpack.

10.7.4.4 Handling Labels

10.7.4.4.1 Cargo Aircraft Only Label

This label must always be used on Type B(M) packages of radioactive materials and on freight containers containing such Type B(M) packages.

10.7.4.4.2 Package Orientation Label

A package orientation "This Way Up" label (see Figure 7.4.E and Figure 7.4.F) is not necessary on a package containing radioactive material, in liquid form.

10.7.4.4.3 Radioactive Material Excepted Package Label

10.7.4.4.3.1 Excepted packages of radioactive material must be labelled with the "Radioactive Material, Excepted Package" handling label (see Figure 10.7.8.A). This label must conform in shape, colour, format and text to the specimen reproduced in Figure 10.7.8.A. The label must be affixed or printed on the package on a contrasting background. If the package is included in an overpack, this label must be clearly visible or be reproduced on the overpack.

Note:

The "Radioactive Material, Excepted Package" label is not required on a package when Special Provision A130 is applied.

10.7.4.4.3.2 If required, the wording in English may be supplemented by an accurate translation in another language. Alternatively, a second label in a different language may be affixed.

Note:

The text "The information for this package need not appear on the Notification to Captain (NOTOC)" is optional and does not have to appear on the label.

10.7.4.4.3.3 The border of the label must have red diagonal hatchings. The label may be printed in black and red on white paper or it may be printed in red only on white paper.

10.7.4.4.3.4 The label may contain identification information, including the name of its printer, provided that the information is printed outside the border and is no larger than 10 point type.

10.7.5 Placarding Large Freight Containers

Large freight containers containing radioactive material, other than excepted packages must bear four placards conforming to 10.7.7.5 in addition to the required labels. The placards must be affixed in a vertical orientation to each side wall and each end wall of the freight container. Any placards which do not relate to the contents of the freight container must be removed. As an alternative to the use of both labels and placards, enlarged radioactive material labels conforming to 10.7.7.1 to 10.7.7.3, and where appropriate 10.7.7.4, may be used providing they have the minimum dimensions shown in 10.7.7.5.

10.7.6 Labels of Other Regulations

Labels required by other international or national transport regulations are permitted in addition to labels required by these Regulations provided that they cannot be confused with or conflict with any labels prescribed by these Regulations because of their colour, design or shape.

10.7.7 Class 7 Label Specifications

10.7.7.1 Category I-White

STATE VARIATIONS: PKG-02, VCG-06, VUG-05

OPERATOR VARIATIONS: IC-09, JW-01, KC-07, PX-02, QF-01

**FIGURE 10.7.7.A
Category I-White**



Name: Radioactive
 Cargo Imp Code: RRW
 Minimum dimensions: 100 × 100 mm
 Symbol (trefoil): Black
 Background: White

10.7.7.2 Category II-Yellow

STATE VARIATIONS: PKG-02, VCG-06, VUG-05

OPERATOR VARIATIONS: IC-09, JW-01, KC-07, PX-02, QF-01

**FIGURE 10.7.7.B
Category II-Yellow**



Name: Radioactive
 Cargo Imp Code: RRY
 Minimum dimensions: 100 × 100 mm
 Symbol (trefoil): Black
 Background: Top half Yellow (Pantone Colour No. 109U) with White border, bottom half White

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10.7.7.3 Category III–Yellow

STATE VARIATIONS: PKG-02, VCG-06, VUG-05

OPERATOR VARIATIONS: IC-09, JW-01, KC-07, PX-02, QF-01

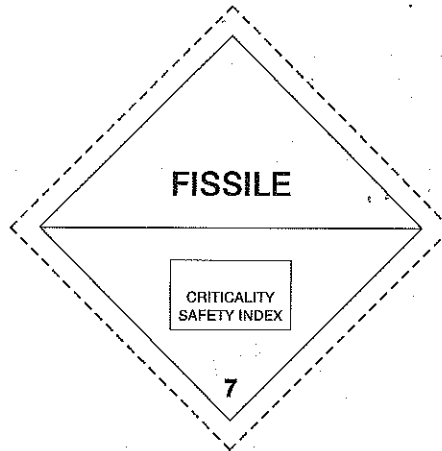
FIGURE 10.7.7.C
Category III–Yellow



Name: Radioactive
 Cargo Imp Code: RRY
 Minimum dimensions: 100 × 100 mm
 Symbol (trefoil): Black
 Background: Top half Yellow (Pantone Colour No. 109U) with White border, bottom half White

10.7.7.4 Criticality Safety Index Label

FIGURE 10.7.7.D
Criticality Safety Index Label



Minimum dimensions: 100 × 100 mm
 Text (mandatory): "FISSILE" in black on white in upper half of label

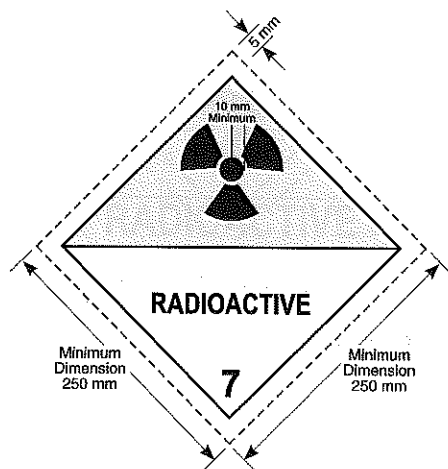
10.7.7.5 Placard for Class 7 — Radioactive Materials

STATE VARIATIONS: PKG-02, VCG-06, VUG-05

OPERATOR VARIATIONS: IC-09, JW-01, KC-07, PX-02, QF-01

This placard is to be used on large freight containers as per 10.7.5.

FIGURE 10.7.7.E
Placard for Class 7 — Radioactive Materials



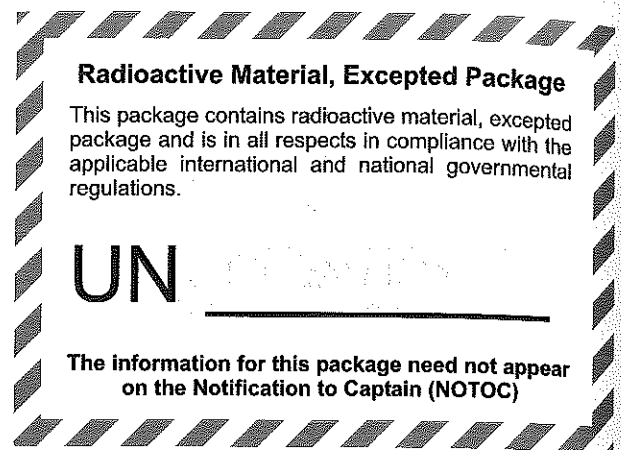
Dimensions: The dimensions shown are minimum, where larger dimensions are used, the proportions must be maintained. The figure "7" must be 25 mm or larger.

Note: The word "Radioactive" in the bottom half of the placard is optional.

10.7.8 Handling Label

10.7.8.1 Radioactive Material — Excepted Package

FIGURE 10.7.8.A
Radioactive Material — Excepted Package



Radioactive Material, Excepted Package

This package contains radioactive material, excepted package and is in all respects in compliance with the applicable international and national governmental regulations.

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The information for this package need not appear on the Notification to Captain (NOTOC)

Name: Radioactive Material — Excepted Package
Cargo IMP Code: RRE

Colour: The border of the label must have red diagonal hatchings. The label may be printed in black and red on white paper or it may be printed in red only on white paper

Minimum dimensions: 74 × 105 mm

Notes:

1. The text "The information for this package need not appear on the Notification to Captain (NOTOC)" is optional and does not have to appear on the label.
2. The "Radioactive Material, Excepted Package" label is not required on a package when Special Provision A130 is applied.

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10.8 Documentation

10.8.0 General

Except as otherwise specified in these Regulations, a "Shipper's Declaration for Dangerous Goods" form and an "Air Waybill" must be completed for each consignment of radioactive material.

Note:

All references to "Shipper's Declaration for Dangerous Goods" in this Section also include provision of the required information by use of electronic data processing (EDP) and electronic data interchange (EDI) transmission techniques.

10.8.0.1 Shipper's Responsibility

10.8.0.1.1 Provision of Information

The shipper is responsible for providing information applicable to a consignment of dangerous goods to the operator as set out in this section. The information may be provided on a prescribed declaration form, "Shipper's Declaration for Dangerous Goods" or, where an agreement exists with the operator, by EDP or EDI techniques, for each and every shipment containing radioactive material. This requirement is not applicable to "Radioactive Material, excepted packages."

For each shipment containing radioactive material, the shipper must:

- use only the correct form in the correct manner;
- ensure that the information on the form is accurate, easy to identify, legible and durable;
- ensure that the form is properly signed when the shipment is presented to the operator for shipment; and
- ensure that the shipment has been prepared in accordance with these Regulations.

10.8.0.1.2 Retention of Documentation

10.8.0.1.2.1 The shipper must retain a copy of the Shipper's Declaration for Dangerous Goods and additional information and documentation as specified in these Regulations, for a minimum period of three months.

10.8.0.1.2.2 When the documents are kept electronically or in a computer system, the shipper must be able to reproduce them in a printed form.

10.8.1 Shipper's Declaration for Dangerous Goods

10.8.1.1 Specification for Declaration Form

STATE VARIATIONS: CAG-14/20, ESG-01, HKG-02, MYG-06, PKG-01/03, USG-01/13, VUG-01

OPERATOR VARIATION: FX-12

The specifications for Shipper's Declaration for Dangerous Goods form are to be found in 8.1.1.

10.8.1.2 Language

The declaration form must be completed in the English language. The wording in English may be accompanied by an accurate translation in another language.

10.8.1.3 Information Required

The specific information to be provided in each box of the declaration form is itemized in 10.8.3. In addition to the provisions of this Section, other elements of information may be required by the appropriate national authority for certain modes of transport.

10.8.1.3.1 A declaration form containing information not relevant to the particular dangerous goods shipment, or to the dangerous goods contained in the shipment, is not acceptable. If both dangerous and non-dangerous goods are listed on the declaration form, the dangerous goods must be listed first, or be otherwise emphasized.

10.8.1.4 Number of Copies

△ OPERATOR VARIATIONS: 5X-05, AC-01, FX-14, KE-03, KZ-06, MP-03

10.8.1.4.1 Where a paper document is used, the shipper must provide two copies of the declaration form completed and signed, with a signature as specified in 10.8.1.9.1, for presentation to the operator with the shipment. One signed copy must be retained by the accepting operator. The other signed copy must be forwarded with the shipment to its destination. One of the two copies, including the signature thereon, may be a carbon copy.

Note:

Only the initial operator is required to retain (an original) copy of the Shipper's Declaration. A photocopy of the original Shipper's Declaration is acceptable to be held on file when a consignment is transhipped.

10.8.1.4.2 Where the Shipper's Declaration information is provided by EDP or EDI techniques the data must be able to be produced as a paper document without delay, with the data in the sequence required by this Section.

Note:

The purpose of this requirement is to facilitate surveillance/audit and/or incident/accident investigation by the appropriate national authority. In this case the document produced need not be the form shown in Figure 8.1.A or Figure 8.1.B.

10.8.1.5 Consolidations

OPERATOR VARIATIONS: AZ-01, BR-06, CA-01, CI-03, CZ-02, GA-02, IC-12, IR-02, JK-02, KE-01, KQ-01, KZ-05, LH-02, ME-02, MH-05, MU-02, OM-06, OU-14, PX-03, RJ-02, SK-07, SV-03, SW-03, TK-03, TY-02, UA-06, UX-03, VN-12

For the purpose of these Regulations, a consolidation or consolidated shipment is a consignment of multi-packages which has been originated by more than one person, each of whom has made an agreement for carriage by air with another person other than a scheduled air carrier.

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11. MARKING AND LABELLING

10.8.1.5.1 In the case of a consolidated shipment, a separate declaration form must be presented to the accepting operator for each component consignment containing dangerous goods.

10.8.1.5.2 The declaration forms for these component consignments must accompany the consolidated shipment. At the airport of destination of the consolidated shipment, the delivering operator will hand a copy of each declaration form to the de-consolidator (break-bulk agent).

Note:

When offering a deconsolidated shipment for further air transportation, at least two copies of the Shipper's Declaration for Dangerous Goods must be presented to the next accepting operator.

10.8.1.6 Multi-page Declarations

10.8.1.6.1 If the declaration form does not contain sufficient space in the "Nature and Quantity of Dangerous Goods" box to accommodate all the required entries and information, additional pages in the form of an extension list (which must have vertical red hatchings) may be used. In such a case, each page of its extension list must show:

- (a) a page number and the total number of pages;
- (b) the Air Waybill number.

10.8.1.6.2 Where multiple Shipper's Declaration Forms are used, the aircraft limitation and shipment type must be the same for all pages.

Note:

The extension lists are not required to have a signature.

10.8.1.7 Alterations and Amendments

The operator will not accept a declaration form that has been altered or amended unless the alteration or amendment to an entry has been signed by the shipper with the same signature used to sign the document. Alteration of the "Air Waybill Number", the "Airport of Departure" and the "Airport of Destination" are excepted from this provision.

10.8.1.7.1 An entry inserted in different handwriting or different printing or in a combination of handwriting and printing, is not considered to be an alteration or amendment and is acceptable.

10.8.1.8 Proper Shipping Name

Each radioactive material offered for transportation must be declared by its "Proper Shipping Name". The proper shipping name is considered to be that portion of the entry most accurately describing the goods in the List of Dangerous Goods (see Subsection 4.2) and is shown in bold characters. Proper shipping names may appear in the singular or plural, as appropriate. In addition, when qualifying words are used as part of the proper shipping name, their sequence on documentation or package marking is optional, however, the sequence shown in 10.4.1 is preferred.

10.8.1.9 Other Requirements

10.8.1.9.1 Signature

10.8.1.9.1.1 The declaration form must be signed and dated by the shipper. Facsimile signatures are acceptable where applicable laws and regulations recognize the legal validity of facsimile signatures. A typewritten signature is not acceptable. Persons or organisations (including consolidators, freight forwarders, and IATA Cargo Agents) employed by the shipper to act on their behalf to undertake the shipper's responsibilities in the preparation of the consignment and trained as required by Section 1.5 may sign the Shipper's Declaration for Dangerous Goods.

10.8.1.9.1.2 If the Shipper's Declaration information is presented to the operator by means of EDP or EDI transmission techniques, the signature(s) may be electronic signature(s) or may be replaced by the name(s) (in capitals) of the person authorized to sign. Where the original consignment details are provided to an operator, by EDP or EDI techniques and subsequently the consignment is transhipped to an operator that requires a paper document, the operator must ensure that the document produced is the "Shipper's Declaration for Dangerous Goods" in the format and design shown in Figure 8.1.A or Figure 8.1.B. The Shipper's Declaration must indicate "Original Received Electronically" in association with the signature and the name of the signatory must be shown in capital letters.

10.8.1.9.2 Additional Approval or Endorsement

The operator reserves the right to require the shipper to have the "Shipper's Declaration for Dangerous Goods" confirmed or endorsed by an authority nominated by the operator.

10.8.1.9.3 Goods not Classified as Dangerous Goods

The operator may require the shipper to certify that a shipment does not contain dangerous goods if the shipper states that they are not so classified. In such a case, the operator may also require the shipper to have the certification confirmed or endorsed by an authority nominated by the operator.

10.8.1.9.4 Part Shipments

Where it is necessary for a multi-piece shipment to be carried in more than one lot, on more than one aircraft, the first operator must obtain from the shipper, or provide, a copy of the "Shipper's Declaration for Dangerous Goods" for each part of the shipment to be carried on each aircraft.

10.8.2 General Instructions for Completing the Declaration Form

STATE VARIATIONS: USG-01/10/12

OPERATOR VARIATION: FX-12

10.8.2.1 The "Shipper's Declaration for Dangerous Goods" form must be completed strictly in accordance with the following instructions. Entries in the boxes for AIR WAYBILL NUMBER, AIRPORT OF DEPARTURE

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and AIRPORT OF DESTINATION may be inserted or amended either by the shipper, his agent, or by the accepting operator, but all other details must only be entered by the shipper, or persons or organizations employed by the shipper to act on their behalf to undertake the shipper's responsibilities.

10.8.2.2 The shipper may complete the "Shipper's Declaration for Dangerous Goods" either manually or mechanically (typewriter, computer, etc.).

10.8.3 Detailed Instructions for Completing the Declaration Form

STATE VARIATIONS: USG-10/12

OPERATOR VARIATIONS: AM-07, AV-09, MK-01, MX-07

10.8.3.1 Shipper

Enter the full name and address of the shipper.

Note:

The name and address of the shipper which appears on the Shipper's Declaration for Dangerous Goods form may differ from that on the Air Waybill.

10.8.3.2 Consignee

Enter the full name and address of the consignee. It is recommended that the telephone number of the consignee is included to facilitate a prompt release of the consignment at the airport of destination.

Note:

The name and address of the consignee which appears on the Shipper's Declaration for Dangerous Goods form may differ from that on the Air Waybill.

10.8.3.3 Air Waybill Number

Enter the number of the Air Waybill to which the declaration form will be attached. This may be entered or amended by the Shipper, his agent or by the operator or its handling agent. In the case of a consolidated shipment, enter the number of the House Air Waybill after the Air Waybill number separated by "/".

10.8.3.4 Page ... of ... Pages

Enter the page number and total number of pages or "Page 1 of 1 pages" if there is no extension list.

10.8.3.5 Aircraft Limitations

Delete either "Passenger and Cargo Aircraft" or "Cargo Aircraft Only" to indicate whether the shipment is packed to comply with the limitations prescribed for passenger and cargo aircraft or the limitations for cargo aircraft only.

Note:

When a radioactive material shipment is required to be transported on a cargo aircraft solely because of USG-10, that shipment may be carried on passenger aircraft outside US jurisdiction. In this case, the "Cargo Aircraft Only" label must be removed before the shipment is loaded onto a passenger aircraft outside US jurisdiction.

The following note should be added in the "Additional Handling Information" box of the Shipper's Declaration:

This shipment may be carried on passenger aircraft outside US jurisdiction.

When this statement is used, no other "Cargo Aircraft Only" articles may appear on the declaration.

10.8.3.6 Airport of Departure

Enter the full name of the airport or city of departure, which may be entered or amended by the Shipper, his agent or by the operator or its handling agent.

10.8.3.7 Airport of Destination

Enter the full name of the airport or city of destination, which may be entered or amended by the Shipper, his agent or by the operator or its handling agent.

△ 10.8.3.8 Shipment Type

Delete "Non-Radioactive" to indicate the shipment contains radioactive material.

Radioactive material must not be included on the same declaration form as other dangerous goods, except for Carbon dioxide, solid (dry ice) when used as a refrigerant or when the other dangerous goods are contained within the same article. When Carbon dioxide, solid (dry ice) is used as a refrigerant for radioactive material or other dangerous goods are contained within the same article, those items must be fully described on the same Shipper's Declaration as the radioactive materials. This does not apply to radioactive material, excepted packages, which do not require a Shipper's Declaration.

10.8.3.9 Nature and Quantity of Dangerous Goods

For a radioactive consignment, the information must be entered strictly in accordance with the following instructions. Each sequence of information must be clearly separated or identified.

Note:

Columns indicated are those in the List of Dangerous Goods.

10.8.3.9.1 First Sequence — Identification

OPERATOR VARIATIONS: 5X-02/03/04, IC-10

Step 1. UN number (from Column A) preceded by the prefix "UN".

Step 2. Proper shipping name (from Column B).

Step 3. The Class number — "7" (Column C).

Step 4. Any assigned subsidiary hazard class or division number(s) (from Column D) must be entered following the numerical hazard class or division and must be enclosed in brackets. A subsidiary risk may also have to be entered where a subsidiary hazard label is required by a Special Provision. The word "Class" or "Division" may be included preceding the primary and/or subsidiary hazard class or division numbers.

Step 5. For radioactive materials having a subsidiary risk the assigned packing group (Column F), which may be preceded by "PG" (e.g. "PG II").

The dangerous goods description specified above must be shown in sequence with no information interspersed except as provided by these Regulations. Examples of this dangerous goods description are:

- UN 2978, Radioactive material, uranium hexafluoride, 7 (8)
- UN 2978, Radioactive material, uranium hexafluoride, Class 7 (Class 8).

10.8.3.9.2 Second Sequence — Quantity and Type of Packing

Step 6.

- (a) name or symbol of each radionuclide(s) or, for mixtures of radionuclides, an appropriate general description or a list of the most restrictive radionuclides;
- (b) a description of the physical and chemical form of the material, or a notation that the material is Special Form radioactive material (not required for UN 3332 and UN 3333) or low dispersible material. A generic chemical description is acceptable for chemical form;

Step 7. Number of packages (of same type and content), their type of package and activity in becquerel or multiples thereof (units used must be clearly indicated) of the radioactive contents in each package, including packages in overpacks. (The activity in Curie or multiples thereof [units used must be clearly indicated] may be added in parentheses following the becquerel units). For fissile material, the total weight of fissile material (or the weight of each fissile nuclide for mixtures when appropriate) in grams or kilograms may be used in place of activity (in all cases the units used must be clearly identified).

For different individual radionuclides packed together in the same package, the activity of each radionuclide.

The words "All Packed in One" (description of package type) must immediately follow the relevant entries.

Step 8. When an overpack is used, the wording "Overpack Used" must be inserted on the declaration form immediately after all the relevant entries relating to the packages within the overpack. In such cases, packages within overpacks must be listed first.

For packages in an overpack or freight container, a detailed statement of the contents of each package within the overpack or freight container and, where appropriate, of each overpack or freight container must be included. If packages are to be removed from the overpack or freight container at a point of intermediate unloading, additional Shipper's Declaration for Dangerous Goods forms must be made available.

Note:

While the indication of "Overpack Used" will be added at this point in the columnar format Shipper's Declaration, for the open format Shipper's Declaration (see Figure 8.1.A) the wording "Overpack Used" will appear after all of the information associated with the dangerous

goods, including the packing instruction number and any applicable authorizations.

10.8.3.9.3 Third Sequence — Packing Instructions

Step 9. Category of the package(s), overpack or freight container, i.e. "I-White" or "II-Yellow" or "III-Yellow".

- for Category "II-Yellow" and "III-Yellow" only — Transport Index and dimensions including dimensional units of each package, overpack or freight container. The dimensions must be shown in the order length x width (or diameter for drum-shaped packages) x height, with the height as the last dimension. "L", "W" (or "D"), "H" may be shown immediately preceding each dimension. The Transport Index must be rounded up to the first decimal place;
- for Fissile Material, other than fissile excepted, the Criticality Safety Index;
- for Fissile Material only — The words "Fissile Excepted", if the material is excepted under 10.3.7.2.

10.8.3.9.4 Fourth Sequence — Authorizations

STATE VARIATIONS: BEG-04, BHG-02, CAG-01/03/04, CHG-03, DEG-01/02/03, DKG-01, DQG-01, EGG-01/02, FRG-03, GBG-06, ING-02, IRG-01, ITG-01/02, JPG-08, KGG-01, MYG-02, NLG-03, RUG-03, SAG-04, TRG-02, UKG-01

OPERATOR VARIATIONS: JU-04, KZ-02, TU-10

Step 10. (if relevant) A list of the identification marks of any of the following documents issued by a competent authority for the shipment together with a statement that such documents are attached to the declaration form:

- Special Form approval certificate;
- Low Dispersible Material certificate;
- Type B package design approval certificate;
- Type B(M) package shipment approval certificate;
- Type C package design approval and shipment approval certificate;
- Fissile Material package design approval certificate;
- Fissile Material package shipment approval certificate;
- Special Arrangement approval certificate;
- Any similar documents.

Authorizations, approvals and/or exemptions which must accompany the Shipper's Declaration and which are in a language other than English must be accompanied by an accurate translation in English.

Step 11. Where a consignment is required to be shipped under exclusive use, the statement "Exclusive Use Shipment".

Step 12. For LSA-II, LSA-III, SCO-I and SCO-II, the total activity of the consignment as a multiple of A₂. For radioactive material for which the A₂ value is unlimited, the multiple of A₂ must be zero.

A shipper may enter a package reference or identification number on the declaration form as the last item in the fourth sequence.

10.8.3.10 Completion of "Nature and Quantity of Dangerous Goods" Box

When completing the "Nature and Quantity of Dangerous Goods" box, each sequence of information must be clearly separated or identified.

- (a) for the computerized form, the sequences as detailed in 10.8.3.9 must be indicated:
 - either by using two oblique strokes as a separator between the sequences; or
 - by putting each sequence on a separate line;
- (b) for the manually completed form, the information must be entered in sequence within the columns provided;
- (c) information within a sequence must be separated by commas.

10.8.3.11 Additional Handling Information

STATE VARIATIONS: AEG-05, CAG-15/16, FRG-08, JMG-03, USG-12, VCG-07, ZAG-04

OPERATOR VARIATIONS: 8V-01, AC-02, AH-01, CZ-03, D0-09, D5-05, DL-03, EK-01, EY-01, GF-06, IJ-08, JJ-03, JK-07, JL-11, JX-02, KA-04, KQ-05, KZ-09, LC-06, LD-04, LX-05, MK-08, MP-04, MX-10, OU-10, PZ-03, QY-09, SK-06, SQ-08, TK-02, V3-02

Enter any special handling information relevant to the shipment. For radioactive materials covered by a Competent Authority Certificate, this must include:

- (a) any special stowage provisions that may be required for the safe dissipation of heat from the package, and if applicable, an indication that the package to be offered for transport has an average surface heat flux exceeding 15 W/m^2 (1.4 W/ft^2);
- (b) for type B(M) package, any statement that no supplementary operational controls are required, when appropriate;
- (c) any restrictions on the type of aircraft and any necessary routing instructions;
- (d) emergency arrangements appropriate to the shipment.

10.8.3.12 Certification Statement

OPERATOR VARIATION: LH-06

10.8.3.12.1 The declaration must contain a certification or declaration statement that ensures the consignment is acceptable for transport and has been properly prepared in accordance with the Regulations, including additional air transport requirements. Examples of these requirements are indicated in 1.3.2. The text for the certification statement is:

"I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labelled/placarded, and are in all respects in proper condition for transport according to the applicable international and national governmental regulations."

10.8.3.12.2 For air transport the following additional statement is required:

"I declare that all of the applicable air transport requirements have been met."

10.8.3.13 Name and Title of Signatory

Enter the name and title of the person signing the declaration. This information may be printed or stamped.

Note:

The title of the person or the name of the department he/she is employed with, are both acceptable.

10.8.3.14 Place and Date

Enter the place and date of signing the declaration.

Note:

The preferred format for indicating the date is YYYY-MM-DD. Other formats, such as DD/MM/YYYY, DD.MM.YYYY, DD/MMM/YYYY or written out completely, are acceptable provided they cannot be misunderstood.

10.8.3.15 Signature

See 10.8.1.9.1 for the signature requirements for the Shipper's Declaration for Dangerous Goods.

10.8.4 Specimens of Shipper's Declaration

Two specimens are shown on the following pages. The first specimen is designed for computerized completion, the second the preferred format for manual completion. Both forms may be completed either manually or mechanically.

10.8.5 Diagrammatic Instructions

The two specimen forms also show diagrammatically where to insert the information required in 10.8.3. The numbers shown correspond to the subparagraphs of 10.8.3.

10.8.6 Examples of Completed Declaration Forms

Examples of completion of the Shipper's Declaration for Dangerous Goods, or parts thereof, are shown on the pages following Figures 10.8.A and 10.8.B. The radioactive shipment examples illustrate:

Example 1 for computerized completion. It shows both methods outlined in 10.8.3.10.

Note:

This also applies when several pages are used.

Example 2 for manual completion.

Example 3 carbon dioxide, solid (dry ice) as a refrigerant.



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10.8.6.1 When a package contains two or more entries, the wording "All packed in One (description of type of package)" must immediately follow the relevant entries.

Example UN 2915, Radioactive material Type A Package, 7, Sr90 metal solid, 1.48 GBq, Am241 metal solid, 74 MBq, III-Yellow, TI 0.2, Dimensions 20 x 20 x 20 cm, All Packed in One Type A Package.

10.8.6.2 If the shipment consists of several identical packages, then, as an alternative to listing each one, a

statement immediately following the relevant entries must read:

"All Packed in One (insert description of package type) x (insert the actual number of packages)."

Example If there were 10 identical packages in the shipment, the statement would read: "All packed in One Type A package x 10".

FIGURE 10.8.A
Shipper's Declaration Completion for a Computerized Form

SHIPPER'S DECLARATION FOR DANGEROUS GOODS

Shipper 10.8.3.1		Air Waybill No. 10.8.3.3 Page of Pages 10.8.3.4 Shipper's Reference Number <i>(optional)</i>
Consignee 10.8.3.2		For optional use for Company logo name and address
Two completed and signed copies of this Declaration must be handed to the operator.		WARNING Failure to comply in all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties.
TRANSPORT DETAILS 10.8.3.5 This shipment is within the limitations prescribed for: <i>(delete non-applicable)</i>		Airport of Departure: 10.8.3.6
PASSENGER AND CARGO AIRCRAFT CARGO AIRCRAFT ONLY	Airport of Destination: 10.8.3.7	
		Shipment type: <i>(delete non-applicable)</i> <input checked="" type="checkbox"/> NON-RADIOACTIVE <input type="checkbox"/> RADIOACTIVE 10.8.3.8
NATURE AND QUANTITY OF DANGEROUS GOODS UN Number or Identification Number, Proper shipping name, Class or Division (subsidiary risk), Packing Group (if required), and all other required information.		
from 10.8.3.9, 10.8.3.10 Steps 1, 2, 3, 4, 5 // Steps 6, 7, 8 // Step 9 // Steps 10, 11, 12		
Additional Handling Information 10.8.3.11		
I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labelled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. I declare that all of the applicable air transport requirements have been met.		Name/Title of Signatory 10.8.3.13 Place and Date 10.8.3.14 Signature 10.8.3.15 <i>(see warning above)</i>

10.8.3.12

FIGURE 10.8.B
Shipper's Declaration Completion for a Manual Form

SHIPPER'S DECLARATION FOR DANGEROUS GOODS

Shipper <div style="text-align: center;">10.8.3.1</div>		Air Waybill No. 10.8.3.3 Page of Pages 10.8.3.4 Shipper's Reference Number <i>(optional)</i>				
Consignee <div style="text-align: center;">10.8.3.2</div>		For optional use for Company logo name and address				
Two completed and signed copies of this Declaration must be handed to the operator.		WARNING Failure to comply in all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties.				
TRANSPORT DETAILS 10.8.3.5 This shipment is within the limitations prescribed for: <i>(delete non-applicable)</i>		Airport of Departure: <div style="text-align: center;">10.8.3.6</div>				
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px;">PASSENGER AND CARGO AIRCRAFT</td> <td style="padding: 2px;">CARGO AIRCRAFT ONLY</td> </tr> </table>	PASSENGER AND CARGO AIRCRAFT	CARGO AIRCRAFT ONLY	Airport of Destination: 10.8.3.7			
PASSENGER AND CARGO AIRCRAFT	CARGO AIRCRAFT ONLY					
Shipment type: <i>(delete non-applicable)</i> <input type="checkbox"/> NON-RADIOACTIVE <input type="checkbox"/> RADIOACTIVE 10.8.3.8						
NATURE AND QUANTITY OF DANGEROUS GOODS						
Dangerous Goods Identification						
UN or ID No.	Proper Shipping Name	Class or Division (Subsidiary Risk)	Pack- ing Group	Quantity and type of packing	Packing Inst.	Authorization
Step 1	from 10.8.3.9 Step 2	Steps 3 and 4		Steps 6, 7, 8	Steps 10, 11, 12	
		Step 5			Step 9	
Additional Handling Information <div style="text-align: center;">10.8.3.11</div>						
I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labelled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. I declare that all of the applicable air transport requirements have been met.				Name/Title of Signatory 10.8.3.13 Place and Date 10.8.3.14 Signature 10.8.3.15 <i>(see warning above)</i>		
10.8.3.12						

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FIGURE 10.8.C
Shipper's Declaration Completion — Example 1

SHIPPER'S DECLARATION FOR DANGEROUS GOODS

Shipper Advanced Chemical Co. 345 Main Street Reigate, Surrey England		Air Waybill No. 800 1234 5686 Page 1 of 1 Pages Shipper's Reference Number 1213 / A12 <i>(optional)</i>	
Consignee ABC Co. Ltd. 1000 High Street Athens Greece		For optional use for Company logo name and address	
Two completed and signed copies of this Declaration must be handed to the operator.		WARNING Failure to comply in all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties.	
TRANSPORT DETAILS			
This shipment is within the limitations prescribed for: <i>(delete non-applicable)</i>	Airport of Departure: London Heathrow	Shipment type: <i>(delete non-applicable)</i> <input checked="" type="checkbox"/> NON-RADIOACTIVE <input type="checkbox"/> RADIOACTIVE	
<table border="1"> <tr> <td>PASSENGER AND CARGO AIRCRAFT</td> <td>CARGO AIRCRAFT ONLY</td> </tr> </table>	PASSENGER AND CARGO AIRCRAFT		CARGO AIRCRAFT ONLY
PASSENGER AND CARGO AIRCRAFT	CARGO AIRCRAFT ONLY		
NATURE AND QUANTITY OF DANGEROUS GOODS UN Number or Identification Number, proper shipping name, Class or Division (subsidiary risk), packing group (if required), and all other required information. UN 3328, Radioactive material, Type B(U) package, fissile, 7 U-235, (UO ₂), solid, 1 Type B(U) package x 3.4 GBq I-White, CSI=1 Type B package design approval certificate B/30/B(U)F Fissile material package shipment approval certificate B/30/B(U)F/T attached.			
Additional Handling Information			
I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labelled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. I declare that all of the applicable air transport requirements have been met.		Name/Title of Signatory A. Brown, Shipping Manager Place and Date Reigate, 1 Jan 2011 Signature <i>(see warning above)</i> <u>A. Brown</u>	



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FIGURE 10.8.D Shipper's Declaration Completion — Example 2

SHIPPER'S DECLARATION FOR DANGEROUS GOODS

Shipper ADVANCED CHEMICAL CO. 345 MAIN STREET REIGATE, SURREY, ENGLAND		Air Waybill No. 800 1234 5686 Page 1 of 1 Pages Shipper's Reference Number 1213 / A12 <i>(optional)</i>				
Consignee ABC Co.Ltd. 1000 HIGH STREET ATHENS, GREECE		<i>For optional use for Company logo name and address</i>				
<i>Two completed and signed copies of this Declaration must be handed to the operator.</i>		WARNING Failure to comply in all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties.				
TRANSPORT DETAILS						
This shipment is within the limitations prescribed for: <i>(delete non-applicable)</i>		Airport of Departure: LONDON				
<table border="1"> <tr> <td>PASSENGER AND CARGO AIRCRAFT</td> <td>CARGO AIRCRAFT ONLY</td> </tr> </table>		PASSENGER AND CARGO AIRCRAFT	CARGO AIRCRAFT ONLY	Airport of Destination: ATHENS		
PASSENGER AND CARGO AIRCRAFT	CARGO AIRCRAFT ONLY					
Shipment type: <i>(delete non-applicable)</i> <input checked="" type="checkbox"/> NON-RADIOACTIVE <input type="checkbox"/> RADIOACTIVE						
NATURE AND QUANTITY OF DANGEROUS GOODS						
Dangerous Goods Identification						
UN or ID No.	Proper Shipping Name	Class or Division (Subsidiary Risk)	Packing Group	Quantity and type of packing	Packing Inst.	Authorization
UN2916	RADIOACTIVE MATERIAL, TYPE B(U) PACKAGE	7		IRIDIUM - 192 SPECIAL FORM 1 TYPE B(U) PACKAGE X 1.925 TBq	III-YELLOW 113.0 DIM 30x30 x40CM	SPECIAL FORM CERTIFICATE No 9999 TYPE B(U) PACKAGE CERTIFICATE UK1735/ B(U)S ATTACHED
Additional Handling Information						
I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labelled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. I declare that all of the applicable air transport requirements have been met.					Name/Title of Signatory A. BROWN, SHIPPING MANAGER Place and Date REIGATE, 1 JAN 2011 Signature <i>(see warning above)</i> A. Brown	

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FIGURE 10.8.E
Shipper's Declaration Completion — Example 3

NATURE AND QUANTITY OF DANGEROUS GOODS						
Dangerous Goods Identification				Quantity and type of packing	Packing Inst.	Authorization
UN or ID No.	Proper Shipping Name	Class or Division (Subsidiary Risk)	Packing Group			
UN2915	RADIOACTIVE MATERIAL, TYPE A PACKAGE	7		Sr-90, METAL SOLID 1.48 GBq Am-241, METAL SOLID 74 MBq	II YELLOW TI 0.2 Dims (L)20x (W)20x (H)20 cm	
UN1845	CARBON DIOXIDE, SOLID	9	III	5 kg ALL PACKED IN ONE TYPE A PACKAGE	904	

A way to show the dimensions in the required sequence with the addition of suggested dimension qualifiers, (L)length × (W)width × (H)height.

10.8.7 Competent Authority Certificates

For radioactive materials, the shipper must have in his possession a copy of any of the following competent authority certificates relevant to the shipment, and a copy of the instructions for proper closing of packages and other preparation for shipment, before consigning any shipment under the terms of the certificate(s):

- Special Form approval certificate;
- Low dispersible radioactive material approval certificate;
- Packages containing 0.1 kg or more of uranium hexafluoride approval certificate;
- Type B package design approval certificate;
- Type B(M) package shipment approval certificate;
- Type C package design approval certificate;
- Fissile Material package design approval certificate;
- Fissile Material package shipment approval certificate;
- Special Arrangement approval certificate.

The package design and shipment approval certificates may be combined into a single certificate. The applicable competent authority certificate(s) must accompany the shipment.

10.8.7.1 Type A Packages Documentation

Documentation requirements may be summarized as follows:

- Special Form approval certificate — required only if material is Special Form;
- Fissile Material package design/shipment approval certificate (see 10.8.7.4);
- Shipper's Declaration — required in all cases.

10.8.7.2 Type B Package Documentation

Documentation requirements may be summarized as follows:

- Type B package design approval certificate required in all cases;
- Type B(M) package shipment approval certificate required for each Type B(M) package containing radioactive material with an activity greater than 3,000 A₁ or 3,000 A₂, as appropriate, or 1,000 TBq (20,000 Ci), whichever is least;
- Fissile Material package design/shipment approval certificate (see 10.8.7.4);
- Shipper's Declaration — required in all cases.

Note:

Type B(M) package design approval and package shipment approval may be combined on a single certificate.

10.8.7.3 Type C Package Documentation

Documentation requirements may be summarized as follows:

- Type C package design approval certificate required in all cases;
- Type C package shipment approval certificate for each Type C package containing radioactive material with an activity greater than 3,000 A₁ or 3,000 A₂ as appropriate or 1,000 TBq whichever is least;
- Fissile Material package design/shipment approval certificate (see 10.8.7.4);
- Shipper's Declaration — required in all cases.

Note:

Type C package design approval and package shipment approval may be combined on a single certificate.

10.8.7.4 Fissile Package Documentation

Documentation requirements may be summarized as follows:

- Fissile Material package design approval certificate is required unless the fissile material package design is excepted by 10.3.7.2;
- Fissile Material package shipment approval certificate is required for each package containing fissile materials if the sum of the Criticality Safety Indexes of the individual package exceeds 50 as provided in 9.3.10.5;
- Shipper's Declaration — required in all cases.

Note:

Fissile Material package design approval and package shipment approval may be combined on a single certificate.

10.8.7.5 Special Form Design Approval

10.8.7.5.1 The design for Special Form radioactive material must meet the definition of Special Form radioactive material given in Appendix A and requires unilateral approval, i.e. approval by the competent authority of the State of origin only.

10.8.7.5.2 The competent authority must establish a "Special Form Approval Certificate" stating that the approved design meets the definition of Special Form radioactive material given in Appendix A, and must attribute to that design an identification mark.

10.8.7.6 Competent Authority Design or Shipment Approval

In case of international transport of packages requiring competent authority design or shipment approval, for which different approval types apply in the different countries concerned, the UN number and proper shipping name required in 10.8.3.9.1 must be in accordance with the certificate of the country of origin of the design.

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10.8.8 Air V

STATE VARIATION OPERATOR VAF 1-01/02, MH-04

Note: the following information on the waybill cover or goods consignment note of an Air Waybill Handbook".

10.8.8.1 Ha

Air Waybill(s) and document(s) must include, in the "H

(a) "Dangerous Declaration" (DGD);

(b) "Cargo Air

10.8.8.2 M

An Air Waybill non-dangerous information" block of dangerous

"Dangerous Goods" or "Dangerous

Con:

Airp	
Handling Infc	
Dange	
No. of Pieces RCP	

10.8.8 Air Waybill

STATE VARIATIONS: BNG-01, DQG-04, SAG-03
 OPERATOR VARIATIONS: CA-05, GF-06, IC-10/11,
 LY-01/02, MH-04, MS-01

Note:
 The following instructions for the completion of the Air Waybill cover only the information required for dangerous goods consignments. Full instructions for the completion of an Air Waybill are to be found in the IATA "Air Waybill Handbook".

10.8.8.1 Handling Information Statement

Air Waybill(s) accompanying radioactive material consignment(s) must include the following statements, as applicable, in the "Handling Information" box:

- (a) "Dangerous goods as per attached Shipper's Declaration" or "Dangerous Goods as per attached DGD";
- (b) "Cargo Aircraft Only" or "CAO".

10.8.8.2 Mixed Shipment

An Air Waybill containing both dangerous goods and non-dangerous goods must indicate in the "Handling Information" box of the Air Waybill, the number of pieces of dangerous goods either before or after the statement "Dangerous Goods as per attached Shipper's Declaration" or "Dangerous Goods as per attached DGD".

△ 10.8.8.3 Excepted Packages

10.8.8.3.1 The provisions of 10.8.8.1 do not apply to excepted packages of radioactive material.

10.8.8.3.2 When Carbon dioxide, solid (dry ice) is used as a refrigerant for Radioactive material, 'excepted packages, no Shipper's Declaration is required and the details of the Carbon dioxide, solid (dry ice) shown in the "Nature and Quantity of Goods" box as required by 8.2.3.

10.8.8.3.3 For excepted packages of radioactive material, the UN Number(s) preceded by "UN", the proper shipping name(s) and the number of packages must be shown in the "Nature and Quantity of Goods" box of the Air Waybill. The preferred format is with the UN number shown first, followed by the proper shipping name. Where an agreement exists with the operator, the shipper may provide the information by EDP or EDI techniques.

10.8.8.3.4 A Shipper's Declaration for Dangerous Goods is required for "excepted packages" of radioactive material possessing other dangerous characteristics that are subject to the provisions of these Regulations (see Special Provision A130), unless the provisions of dangerous goods in excepted quantities under Subsection 2.6 are met.

10.8.8.4 Examples

The following examples illustrate how the information required above appears on the Air Waybill.

FIGURE 10.8.F
Consignment Containing Dangerous Goods for which a Shipper's Declaration is Required

Airport of Destination		Requested Flight/Date		Amount of Insurance		INSURANCE - If carrier offers insurance, and such insurance is requested in accordance with the conditions thereof, indicate amount to be insured in figures in box marked "Amount of Insurance".		
Handling Information								
Dangerous Goods as per attached Shipper's Declaration							SCI	
No. of Pieces RCP	Gross Weight	kg lb	Rate Class		Chargeable Weight	Rate / Charge	Total	Nature and Quantity of Goods (incl. Dimensions of Volume)
			Commodity Item No.					

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FIGURE 10.8.G
Air Waybill Example – Cargo Aircraft Only

Airport of Destination		Requested Flight/Date		Amount of Insurance		INSURANCE - If carrier offers insurance, and such insurance is requested in accordance with the conditions thereof, indicate amount to be insured in figures in box marked "Amount of Insurance".	
Handling Information							
Dangerous Goods as per attached DGD - Cargo Aircraft Only							SCI
No. of Pieces RCP	Gross Weight	kg lb	Rate Class	Chargeable Weight	Rate / Charge	Total	Nature and Quantity of Goods (incl. Dimensions of Volume)
			Commodity Item No.				

FIGURE 10.8.H
Consignment Containing Excepted Packages of Radioactive Material

Airport of Destination		Requested Flight/Date		Amount of Insurance		INSURANCE - If carrier offers insurance, and such insurance is requested in accordance with the conditions thereof, indicate amount to be insured in figures in box marked "Amount of Insurance".	
Handling Information							
							SCI
No. of Pieces RCP	Gross Weight	kg lb	Rate Class	Chargeable Weight	Rate / Charge	Total	Nature and Quantity of Goods (incl. Dimensions of Volume)
			Commodity Item No.				
							Luminous Paint - Radioactive material, excepted package - Limited Quantity of Material. UN2910, 3 packages.

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10.9 Handling

The following provisions of Section 9 of these Regulations are also applicable:

- General (Subsection 9.0);
- Acceptance (Subsection 9.1);
- Storage (Subsection 9.2);
- Loading (Subsection 9.3);
- Inspection (Subsection 9.4);
- Provision of Information (Subsection 9.5);
- Reporting (Subsection 9.6);
- Training (Subsection 9.7);
- Retention of Documents (Subsection 9.8).

10.10 Additional Shipment Preparation

10.10.1 General

Prior to offering a shipment of Radioactive Material for transport, the shipper must ensure that the shipment is in full compliance with all relevant sections of these Regulations. The package must comply with the requirements of the Competent Authority Approval Certificates as required. Competent Authority Approval Certificates must accompany the shipment where necessary. All parties, which must be notified in advance of the shipment (operator(s), competent authorities, etc.), must have been notified where required by these Regulations. Inspection of the packages, where required by these Regulations, must be performed by the shipper prior to offering the shipment for transport.

10.10.2 Design and Shipment Approvals and Notification

STATE VARIATIONS: BEG-04, BHG-02, CAG-01/03/04, CHG-03, DEG-01/02/03, DKG-01, DQG-01, EGG-01/02/04, FRG-03, GBG-06, ING-02, IRG-01, ITG-01/02, JPG-08, KGG-01, MYG-02, NLG-03, RUG-02, SAG-02/04, TRG-02, UKG-01, USG-10

OPERATOR VARIATIONS: 9S-01, AV-08, BA-06, BR-11, BZ-04, C8-01, CM-04, CV-01, CZ-07, D0-05/06, D5-02, FJ-01, FX-03, GF-07, HA-04, HF-01, HV-01, IB-02, IC-13, IJ-03, JK-04, JL-03/05, JU-04, KC-02, KE-05, KL-02, KZ-02, LA-15, LG-01, MU-01, NF-01, NH-03, OK-03, OM-08, OU-09, OZ-04, PS-01, PX-04, QY-05/06, SQ-04, SS-01, TU-10, TY-04, UA-09, UU-03, UX-11

10.10.2.0 General

In all cases of international transport of packages requiring competent authorities design or shipment approval, for which different approval types apply in the different countries concerned by the shipment, the UN number and proper shipping name required in 10.8.3.9.1 must be in accordance with the certificate of the country of origin of design.

10.10.2.1 Design Approvals

10.10.2.1.1 Special Form

The design for Special Form radioactive material requires unilateral approval, i.e. approval by the competent authority of the State of origin only.

10.10.2.1.2 Type B(U) Package

Each Type B(U) package design requires unilateral approval, i.e. approval by the competent authority of the State of origin only, except that:

- (a) a Type B(U) package design for fissile material, which is also subject to 10.6.2.8, must require multilateral approval; and
- (b) a Type B(U) package design for low dispersible radioactive material must require multilateral approval.

10.10.2.1.3 Type B(M) Package

Each Type B(M) package design requires multilateral approval, i.e. approval by the competent authorities of the State of origin and of each State through or into which the package is to be transported (see Note following definition of multilateral approval in Appendix A).

10.10.2.1.4 Type C Package

Each Type C package design requires unilateral approval, i.e. approval by the competent authorities of the State of origin only, except that:

- (a) a Type C package design for fissile material, which is also subject to 10.6.2.8, must require multilateral approval.

10.10.2.1.5 Fissile Material

Each package design for fissile material requires multilateral approval, i.e. approval by the competent authorities of the State of origin and of each State through or into which the package is to be transported.

10.10.2.1.6 Uranium Hexafluoride

The approvals of designs for packages containing 0.1 kg or more of uranium hexafluoride require that:

- (a) each design that meets the requirements of 10.6.2.3.4 must require multilateral approval;
- (b) each design that meets the requirements of 10.6.2.3.1 to 10.6.2.7.4 must require unilateral approval by the competent authority of the country of origin of the design, unless multilateral approval is otherwise required by these Regulations.

10.10.2.2 Shipment Approval

Multilateral approval is required for:

- (a) the shipment of Type B(M) packages not conforming with the requirements of 10.6.2.4.1.4;
- (b) the shipment of Type B(M) packages containing radioactive material with an activity greater than $3 \times 10^3 A_1$ or $3 \times 10^3 A_2$, as appropriate, or 1,000 TBq, whichever is the lower; and

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9. HANDLING

(c) the shipment of packages containing fissile material if the sum of the criticality safety indexes of the individual packages in a single freight container or in an aircraft exceeds 50 as provided in 9.3.10.5.

10.10.2.2.1 A competent authority may authorize transport into or through its country without shipment approval, by a specific provision in its design approval.

10.10.2.3 Notification

In addition to the requirements for the above approval certificates (see 10.5.7.2.2), there are also requirements in some circumstances to provide notification of shipment to competent authorities.

10.10.2.3.1 Before the first shipment of any package requiring competent authority approval, the shipper must ensure that copies of each applicable competent authority certificate applying to that package design have been submitted to the competent authority of the country of origin of the shipment and to the competent authority of each State through or into which the package is to be transported. The shipper is not required to await an acknowledgement from the competent authority nor is the competent authority required to make such acknowledgement of receipt of the certificate.

10.10.2.3.2 For each shipment listed below, the shipper must notify the competent authority of the country of origin of the shipment and to the competent authorities of each State through or into which the package is to be transported. This notification must be in the hands of each competent authority prior to the commencement of

the shipment, and preferably at least 7 (seven) days in advance:

- Type C packages containing radioactive material with an activity greater than 3,000 A₁ or 3,000 A₂, as appropriate, or 1,000 TBq, whichever is lower;
- Type B(U) packages containing radioactive material with an activity greater than 3,000 A₁ or 3,000 A₂, as appropriate, or 1,000 TBq, whichever is lower;
- Type B(M) packages; and
- transported under special arrangement.

10.10.2.3.3 The shipper is not required to send a separate notification if the required information has been included in the application for shipment approval.

10.10.2.3.4 The consignment notification must include:

- (a) sufficient information to enable the package to be identified, including all applicable certificate numbers and identification marks;
- (b) information on the date of shipment, the expected date of arrival and proposed routing;
- (c) the name of the radioactive material or nuclide;
- (d) a description of the physical and chemical form of the radioactive material, or whether it is Special Form radioactive material; and
- (e) the maximum activity of the radioactive contents during transport, in becquerel (Bq) with an appropriate SI prefix symbol, or multiples thereof. For fissile material, the mass of fissile material (or the mass of each fissile nuclide for mixtures when appropriate) in grams (g), or multiples thereof, may be used in place of activity.

10. PACKAGING SPECIFICATIONS

10. RADIOACTIVE MATERIAL

7. MARKING AND LABELLING

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