

## **Committee of Experts on the Transport of Dangerous Goods and on the Globally Harmonized System of Classification and Labelling of Chemicals**

**Sub-Committee of Experts on the Transport of Dangerous Goods**

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Item 4 of the provisional agenda

**Cooperation with the International Atomic Energy Agency**

### **Harmonization with the IAEA Regulations for the Safe Transport of Radioactive Material**

#### **Note by the secretariat**

1. The secretariat reproduces hereafter the text from Parts 1, 2, 4, 5, 6 and 7 of the Model Regulations as amended in accordance with the draft list of amendments in document ST/SG/AC.10/C.3/2012/100.
2. This text is a revised version of informal document INF.12 discussed at the last session and has been prepared after consultation of the IAEA secretariat. It takes account of the comments made during the session and those made by the IAEA Transport Safety Standard Committee (TRANSSC) at its twenty-fourth session (Vienna, 16-20 July 2012) and at its twenty-fifth session (Vienna, 29 October – 2 November 2012).
3. The uranium hexafluoride (UF<sub>6</sub>) issue (excepted packages) is addressed in a separate document (ST/SG/AC.10/C.3/2012/101).

## CHAPTER 1.1÷

### GENERAL PROVISIONS

#### 1.1.1 Scope and application

1.1.1.1 These Regulations prescribe detailed requirements applicable to the transport of dangerous goods. Except as otherwise provided in these Regulations, no person may offer or accept dangerous goods for transport unless those goods are properly classified, packaged, marked, labelled, placarded, described and certified on a transport document, and otherwise in a condition for transport as required by these Regulations.

1.1.1.2 These Regulations do not apply to the transport of:

- (a) Dangerous goods that are required for the propulsion of the means of transport or the operation of its specialised equipment during transport (e.g. refrigeration units) or that are required in accordance with the operating regulations (e.g. fire extinguishers); and
- (b) Dangerous goods, packaged for retail sale, that are carried by individuals for their own use.

**NOTE 1:** *Specific modal provisions for the transport of dangerous goods as well as derogations from these general requirements can be found in the modal regulations.*

**NOTE 2:** *Certain special provisions of Chapter 3.3 also indicate substances and articles which are not subject to these Regulations.*

1.1.1.3 In certain parts of these Regulations, a particular action is prescribed, but the responsibility for carrying out the action is not specifically assigned to any particular person. Such responsibility may vary according to the laws and customs of different countries and the international conventions into which these countries have entered. For the purposes of these Regulations, it is not necessary to make this assignment, but only to identify the action itself. It remains the prerogative of each government to assign this responsibility.

1.1.1.4 In the transport of dangerous goods, the safety of persons and protection of property and the environment are assured when these Regulations are complied with. Confidence in this regard is achieved through quality assurance and compliance assurance programmes.

#### 1.1.1.5 *Exceptions for dangerous goods packed in limited quantities*

Certain dangerous goods packed in limited quantities are exempted from certain requirements of these regulations subject to the conditions laid down in Chapter 3.4.

#### 1.1.1.6 *Transport of dangerous goods by post*

In accordance with the Universal Postal Union Convention, dangerous goods as defined in these Regulations, with the exception of those listed below, are not permitted in mail transported internationally. Appropriate national authorities should ensure that provisions are complied with in relation to the international transport of dangerous goods. The following dangerous goods may be acceptable in international mail subject to the provisions of the appropriate national authorities:

- (a) Infectious substances, assigned to Category B (UN 3373) only, and solid carbon dioxide (dry ice) when used as a refrigerant for UN 3373; and

- (b) Radioactive material in an excepted package conforming to the requirements of 1.5.1.5, the activity of which does not exceed one tenth of that listed in Table 2.7.2.4.1.2 ~~[- and that does not contain uranium hexafluoride] -[and that does not meet the definitions and criteria of classes, other than Class 7, or divisions, as defined in Part 2.]~~

~~[IAEA: 580 and 581]~~

~~*Note by the secretariat: It is suggested to replace this insertion by “and that not meet the definitions and criteria of classes, other than Class 7, or divisions, as defined in Part 2”.*~~

~~*Reasoning: After consultation of the secretariat of the Universal Postal Union (UPU), the secretariat comes to the conclusion that according to the UPU rules and regulations, radioactive material possessing other hazards (including, but not limited to uranium hexafluoride) is not acceptable in international mail.*~~

For international movement by post additional requirements as prescribed by the Acts of the Universal Postal Union apply.

**NOTE:** *The Acts of the Universal Postal Union do not apply to the domestic transport of dangerous goods by mail. Domestic transport of dangerous goods in the mail is subject to the provisions of the appropriate national authorities.*

#### 1.1.1.7 *Application of standards*

Where the application of a standard is required and there is any conflict between the standard and these Regulations, the Regulations take precedence.

#### 1.1.1.8 *Transport of dangerous goods used as a coolant or conditioner*

Dangerous goods, that are only asphyxiant (which dilute or replace the oxygen normally in the atmosphere), when used in cargo transport units for cooling or conditioning purposes are only subject to the provisions of section 5.5.3.

### 1.1.2 **Dangerous goods forbidden from transport**

#### 1.1.2.1 Unless provided otherwise by these Regulations, the following are forbidden from transport:

Any substance or article which, as presented for transport, is liable to explode, dangerously react, produce a flame or dangerous evolution of heat or dangerous emission of toxic, corrosive or flammable gases or vapours under normal conditions of transport.

## CHAPTER 1.2:

## DEFINITIONS AND UNITS OF MEASUREMENT

1.2.1 Definitions<sup>1</sup>

\_\_\_\_\_ [.....]

*Design*, for the transport of Class 7 material, means the description of fissile material excepted under 2.7.2.3.5 (f), special form radioactive material, low dispersible radioactive material, package or packaging which enables such an item to be fully identified. The description may include specifications, engineering drawings, reports demonstrating compliance with regulatory requirements, and other relevant documentation;

[IAEA: 220]

*Exclusive use*, for the transport of Class 7 material, means the sole use, by a single consignor, of a conveyance or of a large freight container, in respect of which all initial, intermediate and final loading and unloading and shipment are carried ~~is~~ carried out in accordance with the directions of the consignor or consignee, where so required by these Regulations;

[IAEA: 221]

*Freight container* means an article of transport equipment that is of a permanent character and accordingly strong enough to be suitable for repeated use; specially designed to facilitate the transport of goods, by one or other modes of transport, without intermediate reloading; designed to be secured and/or readily handled, having fittings for these purposes, and approved in accordance with the International Convention for Safe Containers (CSC), 1972, as amended. The term “freight container” includes neither vehicle nor packaging. However a freight container that is carried on a chassis is included. For freight containers for the transport of Class 7 material, a freight container may be used as a packaging.

In addition:

As

Small freight container means a freight container that has ~~is that which has either any overall outer dimension less than 1.5 m, or~~ an internal volume of not more than 3 m<sup>3</sup>.

~~Any other freight container is considered to be a~~ Large freight container means a freight container that has an internal volume of more than 3 m<sup>3</sup>;

[IAEA: 223]

Management system means a set of interrelated or interacting elements (system) for establishing policies and objectives and enabling the objectives to be achieved in an efficient and effective manner.

[IAEA: 228]

*Radiation level*, for the transport of Class 7 material, means the corresponding dose rate expressed in millisieverts per hour or microsieverts per hour;

[IAEA: 233]

<sup>1</sup> [Note by the secretariat: Only definitions for which amendments are proposed are reproduced hereafter. The remainder of the definitions in Chapter 1.2 remain unchanged].

## Chapters 1.3 and 1.4: Unchanged

### CHAPTER 1.5:

#### GENERAL PROVISIONS CONCERNING CLASS 7

##### 1.5.1 Scope and application

1.5.1.1 These Regulations establish standards of safety which provide an acceptable level of control of the radiation, criticality and thermal hazards to persons, property and the environment that are associated with the transport of radioactive material. These regulations are based on the [IAEA Regulations for the Safe Transport of Radioactive Material \(2009-2012 Edition\)](#), IAEA Safety Standards Series No. [TS-R-1/SSR-6](#), IAEA, Vienna (2009/2012). Explanatory material can be found in “Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material [\(2005 Edition\)](#)”, IAEA Safety Standard Series No. TS-G-1.1 (Rev. [1.2](#)), IAEA, Vienna (2008/2012). The prime responsibility for safety shall rest with the person or organization responsible for facilities and activities that give rise to radiation risk.

1.5.1.2 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 caused by heat.

These requirements are satisfied firstly by applying a graded approach to contents limits for packages and conveyances and to performance standards applied to package designs depending upon the hazard of the radioactive contents. Secondly, they are satisfied by imposing [requirements conditions](#) on the design and operation of packages and on the maintenance of packagings, including a consideration of the nature of the radioactive contents. Finally, they are satisfied by requiring administrative controls including, where appropriate, approval by competent authorities.

1.5.1.3 These Regulations apply to the transport of radioactive material by all modes on land, water or in the air, including transport which is incidental to the use 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, transport including in-transit storage, unloading and receipt at the final destination of loads of radioactive material and packages. A graded approach is applied to the performance standards in these Regulations that are characterized by three general severity levels:

- (a) Routine conditions of transport (incident free);
- (b) Normal conditions of transport (minor mishaps);
- (c) Accident conditions of transport.

1.5.1.4 These Regulations do not apply to [any of the following](#):

- (a) Radioactive material that is an integral part of the means of transport;

- (b) Radioactive material moved within an establishment which is subject to appropriate safety regulations in force in the establishment and where the movement does not involve public roads or railways;
- (c) Radioactive material implanted or incorporated into a person or live animal for diagnosis or treatment;
- ~~(d) Radioactive material in or on a person who is to be transported for medical treatment because the person has been subject to accidental or deliberate intake of radioactive material or to contamination;~~
- ~~(de)~~ Radioactive material in consumer products which have received regulatory approval, following their sale to the end user;
- ~~(ef)~~ Natural material and ores containing naturally occurring radionuclides which ~~may have~~~~are either in their natural state, or have only~~ been processed ~~for purposes other than for extraction of the radionuclides, and which are 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 Table 2.7.2.2.1 (b), or calculated in accordance with 2.7.2.2.2 (a) and 2.7.2.2.3 to 2.7.2.2.6. For natural materials and ores containing naturally occurring radionuclides that are not in secular equilibrium the calculation of the activity concentration shall be performed in accordance with 2.7.2.2.4;
- ~~(fg)~~ Non-radioactive solid objects with radioactive substances present on any surfaces in quantities not in excess of the limit set out in the definition for “contamination” in 2.7.1.2.

[IAEA: 107]

#### 1.5.1.5 *Specific provisions for the transport of excepted packages*

1.5.1.5.1 Excepted packages which may contain radioactive material in limited quantities, instruments, manufactured articles and empty packagings as specified in 2.7.2.4.1 shall be subject only to the following provisions of Parts 5 to 7:

- (a) The applicable provisions specified in 5.1.1.2, 5.1.2, 5.1.3.2, 5.1.5.2.2, 5.1.4, 5.1.5.4, 5.2.1.7, 7.1.8.3.1, and 7.1.8.5.21 to 7.1.8.5.4 and 7.1.8.6.1; and
- (b) The requirements for excepted packages specified in 6.4.4. ~~and~~
- ~~(c) If the excepted package contains fissile material, one of the fissile exceptions provided by 2.7.2.3.5 shall apply and the requirement of 6.4.7.2 shall be met.~~

[IAEA: 515]

1.5.1.5.2 Excepted packages shall be subject to the relevant provisions of all other parts of these Regulations. If the excepted package contains fissile material, one of the fissile exceptions provided by 2.7.2.3.5 shall apply and the requirement of 7.1.8.4.3 shall be met.

-[IAEA: 515]

#### 1.5.2 **Radiation protection programme**

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

1.5.2.2 Doses to persons shall be below the relevant dose limits. Protection and safety shall be optimized in order that the magnitude of individual doses, the number of persons exposed, and the likelihood of incurring exposure shall be kept

as low as reasonably achievable, economic and social factors being taken into account, within the restriction that the doses to individuals ~~be~~ are subject to dose constraints. A structured and systematic approach shall be adopted and shall include consideration of the interfaces between transport and other activities.

[IAEA: 3011]

1.5.2.3 The nature and extent of the measures to be employed in the programme shall be related to the magnitude and likelihood of radiation exposures. The programme shall incorporate the requirements in 1.5.2.2, 1.5.2.4 to 1.5.2.7 and 7.1.8.1.1. Programme documents shall be available, on request, for inspection by the relevant competent authority.

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

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

When individual monitoring or workplace monitoring is conducted, appropriate records shall be kept.

[IAEA: 3031]

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

1.5.2.5 In the event of accidents or incidents during the transport of radioactive material, emergency provisions, as established by relevant national and/or international organizations, shall 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”, IAEA Safety Standard Series No. TS-G-1.2 (ST-3), IAEA, Vienna (2002).

1.5.2.6 Emergency procedures shall 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.

1.5.2.7 Workers shall be appropriately trained in the radiation hazards involved and the precautions to be observed in order to ensure restriction of their exposure and that of other persons who might be affected by their actions.

### 1.5.3 ~~Quality assurance~~ Management system

1.5.3.1 ~~Quality assurance programmes~~ A management system based on international, national or other standards acceptable to the competent authority shall 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~~ all activities within the scope of these Regulations, as identified in 1.5.1.3, to ensure compliance with the relevant provisions of these Regulations. Certification that the design specification has been fully implemented shall be available to the competent authority. The manufacturer, consignor or user shall be prepared:

- (a) to provide facilities for ~~competent authority~~ inspection during manufacture and use; and
- (b) to demonstrate ~~to any cognizant~~ compliance with these Regulations to the competent 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.~~

Where competent authority approval is required, such approval shall take into account and be contingent upon the adequacy of the ~~quality assurance programme~~ management system.

[IAEA: 3061]

#### **1.5.4 Special arrangement**

1.5.4.1 Special arrangement shall mean those provisions, approved by the competent authority, under which consignments which do not satisfy all the requirements of these Regulations applicable to radioactive material may be transported.

1.5.4.2 Consignments for which conformity with any provision applicable to Class 7 is impracticable shall not be transported except under special arrangement. Provided the competent authority is satisfied that conformity with the Class 7 provisions of these Regulations is impracticable 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 single or a planned series of multiple consignments. The overall level of safety in transport shall be at least equivalent to that which would be provided if all the applicable requirements had been met. For international consignments of this type, multilateral approval shall be required.

#### **1.5.5 Radioactive material possessing other dangerous properties**

1.5.5.1 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, shall 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.

#### **1.5.6 Non-compliance**

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

- (a) The consignor, consignee, carrier and any organization involved during transport, who may be affected, as appropriate, shall be informed of the non-compliance:
  - (i) by the carrier if the non-compliance is identified during transport; or
  - (ii) by the consignee if the non-compliance is identified at receipt;
- (b) The carrier, consignor or consignee, as appropriate, shall:
  - (i) take immediate steps to mitigate the consequences of the non-compliance;
  - (ii) investigate the non-compliance and its causes, circumstances and consequences;
  - (iii) take appropriate action to remedy the causes and circumstances that led to the non-compliance and to prevent a recurrence of similar circumstances that led to the non-compliance; and



- (iv) communicate to the relevant competent authority(ies) on the causes of the non-compliance and on corrective or preventive actions taken or to be taken; ~~and~~
- (c) The communication of the non-compliance to the consignor and relevant competent authority(ies), respectively, shall be made as soon as practicable and it shall be immediate whenever an emergency exposure situation has developed or is developing.

[IAEA: 309]

## CHAPTER 2.7

### CLASS 7 - RADIOACTIVE MATERIAL

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

#### 2.7.1 Definitions

2.7.1.1 *Radioactive material* means any material containing radionuclides where both the activity concentration and the total activity in the consignment exceed the values specified in 2.7.2.2.1 to 2.7.2.2.6.

#### 2.7.1.2 Contamination

*Contamination* means the presence of a radioactive substance on a surface in quantities in excess of 0.4 Bq/cm<sup>2</sup> for beta and gamma emitters and low toxicity alpha emitters, or 0.04 Bq/cm<sup>2</sup> for all other alpha emitters.

*Non-fixed contamination* means contamination that can be removed from a surface during routine conditions of transport.

*Fixed contamination* means contamination other than non-fixed contamination.

#### 2.7.1.3 Definitions of specific terms

$A_1$  and  $A_2$

$A_1$  means the activity value of special form radioactive material which is listed in the Table in 2.7.2.2.1 or derived in 2.7.2.2.2 and is used to determine the activity limits for the requirements of these Regulations.

$A_2$  means the activity value of radioactive material, other than special form radioactive material, which is listed in the Table in 2.7.2.2.1 or derived in 2.7.2.2.2 and is used to determine the activity limits for the requirements of these Regulations.

*Fissile nuclides* means uranium-233, uranium-235, plutonium-239 and plutonium-241. *Fissile material* means a material containing any of the fissile nuclides. Excluded from the definition of fissile material are the following:

- (a) Natural uranium or depleted uranium which is unirradiated; ~~and~~
- (b) Natural uranium or depleted uranium which has been irradiated in thermal reactors only; ~~:-~~
- (c) Material with fissile nuclides less than a total of 0.25g;
- (d) Any combination of (a), (b) and/or (c).

These exclusions are only valid if there is no other material with fissile nuclides in the package or in the consignment if shipped unpackaged.

[IAEA: 222]

*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.

*Low specific activity (LSA) material* means radioactive material which by its nature has a limited specific activity, or radioactive material for which limits of estimated average specific activity apply. External shielding materials surrounding the LSA material shall not be considered in determining the estimated average specific activity.

*Low toxicity alpha emitters* are: natural uranium; depleted uranium; natural thorium; uranium-235 or uranium-238; thorium-232; thorium-228 and thorium-230 when contained in ores or physical and chemical concentrates; or alpha emitters with a half-life of less than 10 days.

*Special form radioactive material* means either:

- (a) An indispersible solid radioactive material; or
- (b) A sealed capsule containing radioactive material.

*Specific activity of a radionuclide* means the activity per unit mass of that nuclide. The specific activity of a material shall mean the activity per unit mass of the material in which the radionuclides are essentially uniformly distributed.

*Surface contaminated object (SCO)* means a solid object which is not itself radioactive but which has radioactive material distributed on its surfaces.

[\[IAEA: 241\]](#)

*Unirradiated thorium* means thorium containing not more than  $10^{-7}$  g of uranium-233 per gram of thorium-232.

*Unirradiated uranium* means uranium containing not more than  $2 \times 10^3$  Bq of plutonium per gram of uranium-235, not more than  $9 \times 10^6$  Bq of fission products per gram of uranium-235 and not more than  $5 \times 10^{-3}$  g of uranium-236 per gram of uranium-235.

*Uranium - natural, depleted, enriched* means the following:

*Natural uranium* means uranium (which may be chemically separated) containing the naturally occurring distribution of uranium isotopes (approximately 99.28% uranium-238, and 0.72% uranium-235 by mass).

*Depleted uranium* means uranium containing a lesser mass percentage of uranium-235 than in natural uranium.

*Enriched uranium* means uranium containing a greater mass percentage of uranium-235 than 0.72%.

In all cases, a very small mass percentage of uranium-234 is present.

## 2.7.2 Classification

### 2.7.2.1 General provisions

2.7.2.1.1 Radioactive material shall be assigned to one of the UN **numbers** specified in Table 2.7.2.1.1 ~~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~~ 2.7.2.2 ~~4.2~~ to 2.7.2.5, ~~taking into account the material characteristics determined in 2.7.2.3.~~

[\[IAEA: 401\]](#)

Table 2.7.2.1.1: Assignment of UN numbers

UN Nos.	Proper shipping name and description <sup>a</sup>
<b>Excepted packages</b> (1.5.1.5)	
UN 2908	RADIOACTIVE MATERIAL, EXCEPTED PACKAGE - EMPTY PACKAGING
UN 2909	RADIOACTIVE MATERIAL, EXCEPTED PACKAGE - ARTICLES MANUFACTURED FROM NATURAL URANIUM or DEPLETED URANIUM or NATURAL THORIUM
UN 2910	RADIOACTIVE MATERIAL, EXCEPTED PACKAGE - LIMITED QUANTITY OF MATERIAL
UN 2911	RADIOACTIVE MATERIAL, EXCEPTED PACKAGE - INSTRUMENTS or ARTICLES
<del>UN 3507</del>	<del>URANIUM HEXAFLUORIDE, RADIOACTIVE MATERIAL, EXCEPTED PACKAGE - URANIUM HEXAFLUORIDE, less than 0.1 kg per package, non-fissile or fissile-excepted<sup>b, c, d</sup></del>
<b>Low specific activity radioactive material</b> (2.7.2.3.1)	
UN 2912	RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA-I), non-fissile or fissile-excepted <sup>b</sup>
UN 3321	RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA-II), non fissile or fissile-excepted <sup>b</sup>
UN 3322	RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA-III), non fissile or fissile-excepted <sup>b</sup>
UN 3324	RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA-II), FISSILE
UN 3325	RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY <sup>b</sup> (LSA-III), FISSILE
<b>Surface contaminated objects</b> (2.7.2.3.2)	
UN 2913	RADIOACTIVE MATERIAL, SURFACE CONTAMINATED OBJECTS (SCO-I or SCO-II), non-fissile or fissile-excepted <sup>b</sup>
UN 3326	RADIOACTIVE MATERIAL, SURFACE CONTAMINATED OBJECTS (SCO-I or SCO-II), FISSILE
<b>Type A packages</b> (2.7.2.4.4)	
UN 2915	RADIOACTIVE MATERIAL, TYPE A PACKAGE, non-special form, non-fissile or fissile-excepted <sup>b</sup>
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 <sup>b</sup>
UN 3333	RADIOACTIVE MATERIAL, TYPE A PACKAGE, SPECIAL FORM, FISSILE
<b>Type B(U) packages</b> (2.7.2.4.6)	
UN 2916	RADIOACTIVE MATERIAL, TYPE B(U) PACKAGE, non-fissile or fissile-excepted <sup>b</sup>
UN 3328	RADIOACTIVE MATERIAL, TYPE B(U) PACKAGE, FISSILE
<b>Type B(M) packages</b> (2.7.2.4.6)	
UN 2917	RADIOACTIVE MATERIAL, TYPE B(M) PACKAGE, non-fissile or fissile-excepted <sup>b</sup>
UN 3329	RADIOACTIVE MATERIAL, TYPE B(M) PACKAGE, FISSILE

UN Nos.	Proper shipping name and description <sup>a</sup>
<b>Type C packages</b> (2.7.2.4.6)	
UN 3323	RADIOACTIVE MATERIAL, TYPE C PACKAGE, non fissile or fissile-excepted <sup>b</sup>
UN 3330	RADIOACTIVE MATERIAL, TYPE C PACKAGE, FISSILE
<b>Special arrangement</b> (2.7.2.5)	
UN 2919	RADIOACTIVE MATERIAL, TRANSPORTED UNDER SPECIAL ARRANGEMENT, non-fissile or fissile-excepted <sup>b</sup>
UN 3331	RADIOACTIVE MATERIAL, TRANSPORTED UNDER SPECIAL ARRANGEMENT, FISSILE
<b>Uranium hexafluoride</b> (2.7.2.4.5)	
UN 2977	RADIOACTIVE MATERIAL, URANIUM HEXAFLUORIDE, FISSILE
UN 2978	RADIOACTIVE MATERIAL, URANIUM HEXAFLUORIDE, non-fissile or fissile-excepted <sup>b</sup>
UN 3507 <sup>21</sup>	for “NOTE: see also under “Excepted packages””] URANIUM HEXAFLUORIDE, RADIOACTIVE MATERIAL, EXCEPTED PACKAGE less than 0.1 kg per package, non-fissile or fissile-excepted <sup>b, c</sup>

<sup>a</sup> The proper shipping name is found on the column “proper shipping name and description” and is restricted to that part shown in capital letters. In the cases of UN Nos. 2909, 2911, 2913 and 3326, where alternative proper shipping names are separated by the word “or” only the relevant proper shipping name shall be used.

<sup>b</sup> The term “fissile-excepted” refers only to material excepted under 2.7.2.3.5.

<sup>c</sup> For UN No. 3507, see also Special Provision 369 in Chapter 3.3.

[IAEA: Table 11]

## 2.7.2.2 Determination of activity level

2.7.2.2.1 The following basic values for individual radionuclides are given in Table 2.7.2.2.1:

- (a)  $A_1$  and  $A_2$  in TBq;
- (b) Activity concentration limits for exempt material in Bq/g; and
- (c) Activity limits for exempt consignments in Bq.

[IAEA: 402]

**Table 2.7.2.2.1: Basic radionuclides values for individual radionuclides**

Radionuclide (atomic number)	$A_1$ (TBq)	$A_2$ (TBq)	Activity concentration <u>limit</u> for exempt material (Bq/g)	Activity limit for an exempt consignment (Bq)
Actinium (89)				
Ac-225 (a)	$8 \times 10^{-1}$	$6 \times 10^{-3}$	$1 \times 10^1$	$1 \times 10^4$
Ac-227 (a)	$9 \times 10^{-1}$	$9 \times 10^{-5}$	$1 \times 10^{-1}$	$1 \times 10^3$
Ac-228	$6 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Silver (47)				

Radionuclide (atomic number)	A <sub>1</sub> (TBq)	A <sub>2</sub> (TBq)	Activity concentration <b>limit</b> for exempt material (Bq/g)	Activity limit for an exempt consignment (Bq)
Ag-105	$2 \times 10^0$	$2 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Ag-108m (a)	$7 \times 10^{-1}$	$7 \times 10^{-1}$	$1 \times 10^1$ (b)	$1 \times 10^6$ (b)
Ag-110m (a)	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Ag-111	$2 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Aluminium (13)				
Al-26	$1 \times 10^{-1}$	$1 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Americium (95)				
Am-241	$1 \times 10^1$	$1 \times 10^{-3}$	$1 \times 10^0$	$1 \times 10^4$
Am-242m (a)	$1 \times 10^1$	$1 \times 10^{-3}$	$1 \times 10^0$ (b)	$1 \times 10^4$ (b)
Am-243 (a)	$5 \times 10^0$	$1 \times 10^{-3}$	$1 \times 10^0$ (b)	$1 \times 10^3$ (b)
Argon (18)				
Ar-37	$4 \times 10^1$	$4 \times 10^1$	$1 \times 10^6$	$1 \times 10^8$
Ar-39	$4 \times 10^1$	$2 \times 10^1$	$1 \times 10^7$	$1 \times 10^4$
Ar-41	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^9$
Arsenic (33)				
As-72	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
As-73	$4 \times 10^1$	$4 \times 10^1$	$1 \times 10^3$	$1 \times 10^7$
As-74	$1 \times 10^0$	$9 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
As-76	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^5$
As-77	$2 \times 10^1$	$7 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Astatine (85)				
At-211 (a)	$2 \times 10^1$	$5 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^7$
Gold (79)				
Au-193	$7 \times 10^0$	$2 \times 10^0$	$1 \times 10^2$	$1 \times 10^7$
Au-194	$1 \times 10^0$	$1 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$
Au-195	$1 \times 10^1$	$6 \times 10^0$	$1 \times 10^2$	$1 \times 10^7$
Au-198	$1 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Au-199	$1 \times 10^1$	$6 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Barium (56)				
Ba-131 (a)	$2 \times 10^0$	$2 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Ba-133	$3 \times 10^0$	$3 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Ba-133m	$2 \times 10^1$	$6 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Ba-140 (a)	$5 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^1$ (b)	$1 \times 10^5$ (b)

Radionuclide (atomic number)	A <sub>1</sub> (TBq)	A <sub>2</sub> (TBq)	Activity concentration <b>limit</b> for exempt material (Bq/g)	Activity limit for an exempt consignment (Bq)
Beryllium (4)				
Be-7	$2 \times 10^1$	$2 \times 10^1$	$1 \times 10^3$	$1 \times 10^7$
Be-10	$4 \times 10^1$	$6 \times 10^{-1}$	$1 \times 10^4$	$1 \times 10^6$
Bismuth (83)				
Bi-205	$7 \times 10^{-1}$	$7 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Bi-206	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Bi-207	$7 \times 10^{-1}$	$7 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Bi-210	$1 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Bi-210m (a)	$6 \times 10^{-1}$	$2 \times 10^{-2}$	$1 \times 10^1$	$1 \times 10^5$
Bi-212 (a)	$7 \times 10^{-1}$	$6 \times 10^{-1}$	$1 \times 10^1$ (b)	$1 \times 10^5$ (b)
Berkelium (97)				
Bk-247	$8 \times 10^0$	$8 \times 10^{-4}$	$1 \times 10^0$	$1 \times 10^4$
Bk-249 (a)	$4 \times 10^1$	$3 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Bromine (35)				
Br-76	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Br-77	$3 \times 10^0$	$3 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Br-82	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Carbon (6)				
C-11	$1 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
C-14	$4 \times 10^1$	$3 \times 10^0$	$1 \times 10^4$	$1 \times 10^7$
Calcium (20)				
Ca-41	Unlimited	Unlimited	$1 \times 10^5$	$1 \times 10^7$
Ca-45	$4 \times 10^1$	$1 \times 10^0$	$1 \times 10^4$	$1 \times 10^7$
Ca-47 (a)	$3 \times 10^0$	$3 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Cadmium (48)				
Cd-109	$3 \times 10^1$	$2 \times 10^0$	$1 \times 10^4$	$1 \times 10^6$
Cd-113m	$4 \times 10^1$	$5 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Cd-115 (a)	$3 \times 10^0$	$4 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Cd-115m	$5 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Cerium (58)				
Ce-139	$7 \times 10^0$	$2 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Ce-141	$2 \times 10^1$	$6 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^7$
Ce-143	$9 \times 10^{-1}$	$6 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$

Radionuclide (atomic number)	A <sub>1</sub> (TBq)	A <sub>2</sub> (TBq)	Activity concentration <b>limit</b> for exempt material (Bq/g)	Activity limit for an exempt consignment (Bq)
Ce-144 (a)	$2 \times 10^{-1}$	$2 \times 10^{-1}$	$1 \times 10^2$ (b)	$1 \times 10^5$ (b)
Californium (98)				
Cf-248	$4 \times 10^1$	$6 \times 10^{-3}$	$1 \times 10^1$	$1 \times 10^4$
Cf-249	$3 \times 10^0$	$8 \times 10^{-4}$	$1 \times 10^0$	$1 \times 10^3$
Cf-250	$2 \times 10^1$	$2 \times 10^{-3}$	$1 \times 10^1$	$1 \times 10^4$
Cf-251	$7 \times 10^0$	$7 \times 10^{-4}$	$1 \times 10^0$	$1 \times 10^3$
Cf-252	$1 \times 10^{-1}$	$3 \times 10^{-3}$	$1 \times 10^1$	$1 \times 10^4$
Cf-253 (a)	$4 \times 10^1$	$4 \times 10^{-2}$	$1 \times 10^2$	$1 \times 10^5$
Cf-254	$1 \times 10^{-3}$	$1 \times 10^{-3}$	$1 \times 10^0$	$1 \times 10^3$
Chlorine (17)				
Cl-36	$1 \times 10^1$	$6 \times 10^{-1}$	$1 \times 10^4$	$1 \times 10^6$
Cl-38	$2 \times 10^{-1}$	$2 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Curium (96)				
Cm-240	$4 \times 10^1$	$2 \times 10^{-2}$	$1 \times 10^2$	$1 \times 10^5$
Cm-241	$2 \times 10^0$	$1 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Cm-242	$4 \times 10^1$	$1 \times 10^{-2}$	$1 \times 10^2$	$1 \times 10^5$
Cm-243	$9 \times 10^0$	$1 \times 10^{-3}$	$1 \times 10^0$	$1 \times 10^4$
Cm-244	$2 \times 10^1$	$2 \times 10^{-3}$	$1 \times 10^1$	$1 \times 10^4$
Cm-245	$9 \times 10^0$	$9 \times 10^{-4}$	$1 \times 10^0$	$1 \times 10^3$
Cm-246	$9 \times 10^0$	$9 \times 10^{-4}$	$1 \times 10^0$	$1 \times 10^3$
Cm-247 (a)	$3 \times 10^0$	$1 \times 10^{-3}$	$1 \times 10^0$	$1 \times 10^4$
Cm-248	$2 \times 10^{-2}$	$3 \times 10^{-4}$	$1 \times 10^0$	$1 \times 10^3$
Cobalt (27)				
Co-55	$5 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Co-56	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Co-57	$1 \times 10^1$	$1 \times 10^1$	$1 \times 10^2$	$1 \times 10^6$
Co-58	$1 \times 10^0$	$1 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$
Co-58m	$4 \times 10^1$	$4 \times 10^1$	$1 \times 10^4$	$1 \times 10^7$
Co-60	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Chromium (24)				
Cr-51	$3 \times 10^1$	$3 \times 10^1$	$1 \times 10^3$	$1 \times 10^7$
Caesium (55)				
Cs-129	$4 \times 10^0$	$4 \times 10^0$	$1 \times 10^2$	$1 \times 10^5$



Radionuclide (atomic number)	A <sub>1</sub> (TBq)	A <sub>2</sub> (TBq)	Activity concentration <u>limit</u> for exempt material (Bq/g)	Activity limit for an exempt consignment (Bq)
Cs-131	$3 \times 10^1$	$3 \times 10^1$	$1 \times 10^3$	$1 \times 10^6$
Cs-132	$1 \times 10^0$	$1 \times 10^0$	$1 \times 10^1$	$1 \times 10^5$
Cs-134	$7 \times 10^{-1}$	$7 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^4$
Cs-134m	$4 \times 10^1$	$6 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^5$
Cs-135	$4 \times 10^1$	$1 \times 10^0$	$1 \times 10^4$	$1 \times 10^7$
Cs-136	$5 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Cs-137 (a)	$2 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^1$ (b)	$1 \times 10^4$ (b)
Copper (29)				
Cu-64	$6 \times 10^0$	$1 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Cu-67	$1 \times 10^1$	$7 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Dysprosium (66)				
Dy-159	$2 \times 10^1$	$2 \times 10^1$	$1 \times 10^3$	$1 \times 10^7$
Dy-165	$9 \times 10^{-1}$	$6 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Dy-166 (a)	$9 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Erbium (68)				
Er-169	$4 \times 10^1$	$1 \times 10^0$	$1 \times 10^4$	$1 \times 10^7$
Er-171	$8 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Europium (63)				
Eu-147	$2 \times 10^0$	$2 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Eu-148	$5 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Eu-149	$2 \times 10^1$	$2 \times 10^1$	$1 \times 10^2$	$1 \times 10^7$
Eu-150(short lived)	$2 \times 10^0$	$7 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Eu-150(long lived)	$7 \times 10^{-1}$	$7 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Eu-152	$1 \times 10^0$	$1 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$
Eu-152m	$8 \times 10^{-1}$	$8 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Eu-154	$9 \times 10^{-1}$	$6 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Eu-155	$2 \times 10^1$	$3 \times 10^0$	$1 \times 10^2$	$1 \times 10^7$
Eu-156	$7 \times 10^{-1}$	$7 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Fluorine (9)				
F-18	$1 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Iron (26)				
Fe-52 (a)	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Fe-55	$4 \times 10^1$	$4 \times 10^1$	$1 \times 10^4$	$1 \times 10^6$

Radionuclide (atomic number)	A <sub>1</sub> (TBq)	A <sub>2</sub> (TBq)	Activity concentration <b>limit</b> for exempt material (Bq/g)	Activity limit for an exempt consignment (Bq)
Fe-59	$9 \times 10^{-1}$	$9 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Fe-60 (a)	$4 \times 10^1$	$2 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^5$
Gallium (31)				
Ga-67	$7 \times 10^0$	$3 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Ga-68	$5 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Ga-72	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Gadolinium (64)				
Gd-146 (a)	$5 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Gd-148	$2 \times 10^1$	$2 \times 10^{-3}$	$1 \times 10^1$	$1 \times 10^4$
Gd-153	$1 \times 10^1$	$9 \times 10^0$	$1 \times 10^2$	$1 \times 10^7$
Gd-159	$3 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Germanium (32)				
Ge-68 (a)	$5 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Ge-71	$4 \times 10^1$	$4 \times 10^1$	$1 \times 10^4$	$1 \times 10^8$
Ge-77	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Hafnium (72)				
Hf-172 (a)	$6 \times 10^{-1}$	$6 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Hf-175	$3 \times 10^0$	$3 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Hf-181	$2 \times 10^0$	$5 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Hf-182	Unlimited	Unlimited	$1 \times 10^2$	$1 \times 10^6$
Mercury (80)				
Hg-194 (a)	$1 \times 10^0$	$1 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$
Hg-195m (a)	$3 \times 10^0$	$7 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Hg-197	$2 \times 10^1$	$1 \times 10^1$	$1 \times 10^2$	$1 \times 10^7$
Hg-197m	$1 \times 10^1$	$4 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Hg-203	$5 \times 10^0$	$1 \times 10^0$	$1 \times 10^2$	$1 \times 10^5$
Holmium (67)				
Ho-166	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^5$
Ho-166m	$6 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Iodine (53)				
I-123	$6 \times 10^0$	$3 \times 10^0$	$1 \times 10^2$	$1 \times 10^7$
I-124	$1 \times 10^0$	$1 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$
I-125	$2 \times 10^1$	$3 \times 10^0$	$1 \times 10^3$	$1 \times 10^6$

Radionuclide (atomic number)	A <sub>1</sub> (TBq)	A <sub>2</sub> (TBq)	Activity concentration <b>limit</b> for exempt material (Bq/g)	Activity limit for an exempt consignment (Bq)
I-126	$2 \times 10^0$	$1 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
I-129	Unlimited	Unlimited	$1 \times 10^2$	$1 \times 10^5$
I-131	$3 \times 10^0$	$7 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
I-132	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
I-133	$7 \times 10^{-1}$	$6 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
I-134	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
I-135 (a)	$6 \times 10^{-1}$	$6 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Indium (49)				
In-111	$3 \times 10^0$	$3 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
In-113m	$4 \times 10^0$	$2 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
In-114m (a)	$1 \times 10^1$	$5 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
In-115m	$7 \times 10^0$	$1 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Iridium (77)				
Ir-189 (a)	$1 \times 10^1$	$1 \times 10^1$	$1 \times 10^2$	$1 \times 10^7$
Ir-190	$7 \times 10^{-1}$	$7 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Ir-192	$1 \times 10^0$ (c)	$6 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^4$
Ir-194	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^5$
Potassium (19)				
K-40	$9 \times 10^{-1}$	$9 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
K-42	$2 \times 10^{-1}$	$2 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
K-43	$7 \times 10^{-1}$	$6 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Krypton (36)				
Kr-79	$4 \times 10^0$	$2 \times 10^0$	$1 \times 10^3$	$1 \times 10^5$
Kr-81	$4 \times 10^1$	$4 \times 10^1$	$1 \times 10^4$	$1 \times 10^7$
Kr-85	$1 \times 10^1$	$1 \times 10^1$	$1 \times 10^5$	$1 \times 10^4$
Kr-85m	$8 \times 10^0$	$3 \times 10^0$	$1 \times 10^3$	$1 \times 10^{10}$
Kr-87	$2 \times 10^{-1}$	$2 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^9$
Lanthanum (57)				
La-137	$3 \times 10^1$	$6 \times 10^0$	$1 \times 10^3$	$1 \times 10^7$
La-140	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Lutetium (71)				
Lu-172	$6 \times 10^{-1}$	$6 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Lu-173	$8 \times 10^0$	$8 \times 10^0$	$1 \times 10^2$	$1 \times 10^7$

Radionuclide (atomic number)	A <sub>1</sub>  (TBq)	A <sub>2</sub>  (TBq)	Activity concentration <b>limit</b> for exempt material (Bq/g)	Activity limit for an exempt consignment (Bq)
Lu-174	$9 \times 10^0$	$9 \times 10^0$	$1 \times 10^2$	$1 \times 10^7$
Lu-174m	$2 \times 10^1$	$1 \times 10^1$	$1 \times 10^2$	$1 \times 10^7$
Lu-177	$3 \times 10^1$	$7 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^7$
Magnesium (12)				
Mg-28 (a)	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Manganese (25)				
Mn-52	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Mn-53	Unlimited	Unlimited	$1 \times 10^4$	$1 \times 10^9$
Mn-54	$1 \times 10^0$	$1 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$
Mn-56	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Molybdenum (42)				
Mo-93	$4 \times 10^1$	$2 \times 10^1$	$1 \times 10^3$	$1 \times 10^8$
Mo-99 (a)	$1 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Nitrogen (7)				
N-13	$9 \times 10^{-1}$	$6 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^9$
Sodium (11)				
Na-22	$5 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Na-24	$2 \times 10^{-1}$	$2 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Niobium (41)				
Nb-93m	$4 \times 10^1$	$3 \times 10^1$	$1 \times 10^4$	$1 \times 10^7$
Nb-94	$7 \times 10^{-1}$	$7 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Nb-95	$1 \times 10^0$	$1 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$
Nb-97	$9 \times 10^{-1}$	$6 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Neodymium (60)				
Nd-147	$6 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Nd-149	$6 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Nickel (28)				
Ni-59	Unlimited	Unlimited	$1 \times 10^4$	$1 \times 10^8$
Ni-63	$4 \times 10^1$	$3 \times 10^1$	$1 \times 10^5$	$1 \times 10^8$
Ni-65	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Neptunium (93)				
Np-235	$4 \times 10^1$	$4 \times 10^1$	$1 \times 10^3$	$1 \times 10^7$
Np-236(short-lived)	$2 \times 10^1$	$2 \times 10^0$	$1 \times 10^3$	$1 \times 10^7$

Radionuclide (atomic number)	A <sub>1</sub> (TBq)	A <sub>2</sub> (TBq)	Activity concentration <b>limit</b> for exempt material (Bq/g)	Activity limit for an exempt consignment (Bq)
Np-236(long-lived)	$9 \times 10^0$	$2 \times 10^{-2}$	$1 \times 10^2$	$1 \times 10^5$
Np-237	$2 \times 10^1$	$2 \times 10^{-3}$	$1 \times 10^0$ (b)	$1 \times 10^3$ (b)
Np-239	$7 \times 10^0$	$4 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^7$
Osmium (76)				
Os-185	$1 \times 10^0$	$1 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$
Os-191	$1 \times 10^1$	$2 \times 10^0$	$1 \times 10^2$	$1 \times 10^7$
Os-191m	$4 \times 10^1$	$3 \times 10^1$	$1 \times 10^3$	$1 \times 10^7$
Os-193	$2 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Os-194 (a)	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^5$
Phosphorus (15)				
P-32	$5 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^5$
P-33	$4 \times 10^1$	$1 \times 10^0$	$1 \times 10^5$	$1 \times 10^8$
Protactinium (91)				
Pa-230 (a)	$2 \times 10^0$	$7 \times 10^{-2}$	$1 \times 10^1$	$1 \times 10^6$
Pa-231	$4 \times 10^0$	$4 \times 10^{-4}$	$1 \times 10^0$	$1 \times 10^3$
Pa-233	$5 \times 10^0$	$7 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^7$
Lead (82)				
Pb-201	$1 \times 10^0$	$1 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$
Pb-202	$4 \times 10^1$	$2 \times 10^1$	$1 \times 10^3$	$1 \times 10^6$
Pb-203	$4 \times 10^0$	$3 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Pb-205	Unlimited	Unlimited	$1 \times 10^4$	$1 \times 10^7$
Pb-210 (a)	$1 \times 10^0$	$5 \times 10^{-2}$	$1 \times 10^1$ (b)	$1 \times 10^4$ (b)
Pb-212 (a)	$7 \times 10^{-1}$	$2 \times 10^{-1}$	$1 \times 10^1$ (b)	$1 \times 10^5$ (b)
Palladium (46)				
Pd-103 (a)	$4 \times 10^1$	$4 \times 10^1$	$1 \times 10^3$	$1 \times 10^8$
Pd-107	Unlimited	Unlimited	$1 \times 10^5$	$1 \times 10^8$
Pd-109	$2 \times 10^0$	$5 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Promethium (61)				
Pm-143	$3 \times 10^0$	$3 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Pm-144	$7 \times 10^{-1}$	$7 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Pm-145	$3 \times 10^1$	$1 \times 10^1$	$1 \times 10^3$	$1 \times 10^7$
Pm-147	$4 \times 10^1$	$2 \times 10^0$	$1 \times 10^4$	$1 \times 10^7$
Pm-148m (a)	$8 \times 10^{-1}$	$7 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$

Radionuclide (atomic number)	A <sub>1</sub> (TBq)	A <sub>2</sub> (TBq)	Activity concentration <b>limit</b> for exempt material (Bq/g)	Activity limit for an exempt consignment (Bq)
Pm-149	$2 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Pm-151	$2 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Polonium (84)				
Po-210	$4 \times 10^1$	$2 \times 10^{-2}$	$1 \times 10^1$	$1 \times 10^4$
Praseodymium (59)				
Pr-142	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^5$
Pr-143	$3 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^4$	$1 \times 10^6$
Platinum (78)				
Pt-188 (a)	$1 \times 10^0$	$8 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Pt-191	$4 \times 10^0$	$3 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Pt-193	$4 \times 10^1$	$4 \times 10^1$	$1 \times 10^4$	$1 \times 10^7$
Pt-193m	$4 \times 10^1$	$5 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^7$
Pt-195m	$1 \times 10^1$	$5 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Pt-197	$2 \times 10^1$	$6 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Pt-197m	$1 \times 10^1$	$6 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Plutonium (94)				
Pu-236	$3 \times 10^1$	$3 \times 10^{-3}$	$1 \times 10^1$	$1 \times 10^4$
Pu-237	$2 \times 10^1$	$2 \times 10^1$	$1 \times 10^3$	$1 \times 10^7$
Pu-238	$1 \times 10^1$	$1 \times 10^{-3}$	$1 \times 10^0$	$1 \times 10^4$
Pu-239	$1 \times 10^1$	$1 \times 10^{-3}$	$1 \times 10^0$	$1 \times 10^4$
Pu-240	$1 \times 10^1$	$1 \times 10^{-3}$	$1 \times 10^0$	$1 \times 10^3$
Pu-241 (a)	$4 \times 10^1$	$6 \times 10^{-2}$	$1 \times 10^2$	$1 \times 10^5$
Pu-242	$1 \times 10^1$	$1 \times 10^{-3}$	$1 \times 10^0$	$1 \times 10^4$
Pu-244 (a)	$4 \times 10^{-1}$	$1 \times 10^{-3}$	$1 \times 10^0$	$1 \times 10^4$
Radium (88)				
Ra-223 (a)	$4 \times 10^{-1}$	$7 \times 10^{-3}$	$1 \times 10^2$ (b)	$1 \times 10^5$ (b)
Ra-224 (a)	$4 \times 10^{-1}$	$2 \times 10^{-2}$	$1 \times 10^1$ (b)	$1 \times 10^5$ (b)
Ra-225 (a)	$2 \times 10^{-1}$	$4 \times 10^{-3}$	$1 \times 10^2$	$1 \times 10^5$
Ra-226 (a)	$2 \times 10^{-1}$	$3 \times 10^{-3}$	$1 \times 10^1$ (b)	$1 \times 10^4$ (b)
Ra-228 (a)	$6 \times 10^{-1}$	$2 \times 10^{-2}$	$1 \times 10^1$ (b)	$1 \times 10^5$ (b)
Rubidium (37)				
Rb-81	$2 \times 10^0$	$8 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Rb-83 (a)	$2 \times 10^0$	$2 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Rb-84	$1 \times 10^0$	$1 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$

Radionuclide (atomic number)	A <sub>1</sub>  (TBq)	A <sub>2</sub>  (TBq)	Activity concentration <b>limit</b> for exempt material (Bq/g)	Activity limit for an exempt consignment (Bq)
Rb-86	$5 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^5$
Rb-87	Unlimited	Unlimited	$1 \times 10^4$	$1 \times 10^7$
Rb(nat)	Unlimited	Unlimited	$1 \times 10^4$	$1 \times 10^7$
Rhenium (75)				
Re-184	$1 \times 10^0$	$1 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$
Re-184m	$3 \times 10^0$	$1 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Re-186	$2 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Re-187	Unlimited	Unlimited	$1 \times 10^6$	$1 \times 10^9$
Re-188	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^5$
Re-189 (a)	$3 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Re(nat)	Unlimited	Unlimited	$1 \times 10^6$	$1 \times 10^9$
Rhodium (45)				
Rh-99	$2 \times 10^0$	$2 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$
Rh-101	$4 \times 10^0$	$3 \times 10^0$	$1 \times 10^2$	$1 \times 10^7$
Rh-102	$5 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Rh-102m	$2 \times 10^0$	$2 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Rh-103m	$4 \times 10^1$	$4 \times 10^1$	$1 \times 10^4$	$1 \times 10^8$
Rh-105	$1 \times 10^1$	$8 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^7$
Radon (86)				
Rn-222 (a)	$3 \times 10^{-1}$	$4 \times 10^{-3}$	$1 \times 10^1$ (b)	$1 \times 10^8$ (b)
Ruthenium (44)				
Ru-97	$5 \times 10^0$	$5 \times 10^0$	$1 \times 10^2$	$1 \times 10^7$
Ru-103 (a)	$2 \times 10^0$	$2 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Ru-105	$1 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Ru-106 (a)	$2 \times 10^{-1}$	$2 \times 10^{-1}$	$1 \times 10^2$ (b)	$1 \times 10^5$ (b)
Sulphur (16)				
S-35	$4 \times 10^1$	$3 \times 10^0$	$1 \times 10^5$	$1 \times 10^8$
Antimony (51)				
Sb-122	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^4$
Sb-124	$6 \times 10^{-1}$	$6 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Sb-125	$2 \times 10^0$	$1 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Sb-126	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Scandium (21)				
Sc-44	$5 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$

Radionuclide (atomic number)	A <sub>1</sub> (TBq)	A <sub>2</sub> (TBq)	Activity concentration <b>limit</b> for exempt material (Bq/g)	Activity limit for an exempt consignment (Bq)
Sc-46	$5 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Sc-47	$1 \times 10^1$	$7 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Sc-48	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Selenium (34)				
Se-75	$3 \times 10^0$	$3 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Se-79	$4 \times 10^1$	$2 \times 10^0$	$1 \times 10^4$	$1 \times 10^7$
Silicon (14)				
Si-31	$6 \times 10^{-1}$	$6 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Si-32	$4 \times 10^1$	$5 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Samarium (62)				
Sm-145	$1 \times 10^1$	$1 \times 10^1$	$1 \times 10^2$	$1 \times 10^7$
Sm-147	Unlimited	Unlimited	$1 \times 10^1$	$1 \times 10^4$
Sm-151	$4 \times 10^1$	$1 \times 10^1$	$1 \times 10^4$	$1 \times 10^8$
Sm-153	$9 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Tin (50)				
Sn-113 (a)	$4 \times 10^0$	$2 \times 10^0$	$1 \times 10^3$	$1 \times 10^7$
Sn-117m	$7 \times 10^0$	$4 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Sn-119m	$4 \times 10^1$	$3 \times 10^1$	$1 \times 10^3$	$1 \times 10^7$
Sn-121m (a)	$4 \times 10^1$	$9 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^7$
Sn-123	$8 \times 10^{-1}$	$6 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Sn-125	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^5$
Sn-126 (a)	$6 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Strontium (38)				
Sr-82 (a)	$2 \times 10^{-1}$	$2 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Sr-85	$2 \times 10^0$	$2 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Sr-85m	$5 \times 10^0$	$5 \times 10^0$	$1 \times 10^2$	$1 \times 10^7$
Sr-87m	$3 \times 10^0$	$3 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Sr-89	$6 \times 10^{-1}$	$6 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Sr-90 (a)	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^2$ (b)	$1 \times 10^4$ (b)
Sr-91 (a)	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Sr-92 (a)	$1 \times 10^0$	$3 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Tritium (1)				
T(H-3)	$4 \times 10^1$	$4 \times 10^1$	$1 \times 10^6$	$1 \times 10^9$



Radionuclide (atomic number)	A <sub>1</sub> (TBq)	A <sub>2</sub> (TBq)	Activity concentration <b>limit</b> for exempt material (Bq/g)	Activity limit for an exempt consignment (Bq)
Tantalum (73)				
Ta-178(long-lived)	$1 \times 10^0$	$8 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Ta-179	$3 \times 10^1$	$3 \times 10^1$	$1 \times 10^3$	$1 \times 10^7$
Ta-182	$9 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^4$
Terbium (65)				
Tb-157	$4 \times 10^1$	$4 \times 10^1$	$1 \times 10^4$	$1 \times 10^7$
Tb-158	$1 \times 10^0$	$1 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$
Tb-160	$1 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Technetium (43)				
Tc-95m (a)	$2 \times 10^0$	$2 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$
Tc-96	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Tc-96m (a)	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^7$
Tc-97	Unlimited	Unlimited	$1 \times 10^3$	$1 \times 10^8$
Tc-97m	$4 \times 10^1$	$1 \times 10^0$	$1 \times 10^3$	$1 \times 10^7$
Tc-98	$8 \times 10^{-1}$	$7 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Tc-99	$4 \times 10^1$	$9 \times 10^{-1}$	$1 \times 10^4$	$1 \times 10^7$
Tc-99m	$1 \times 10^1$	$4 \times 10^0$	$1 \times 10^2$	$1 \times 10^7$
Tellurium (52)				
Te-121	$2 \times 10^0$	$2 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$
Te-121m	$5 \times 10^0$	$3 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Te-123m	$8 \times 10^0$	$1 \times 10^0$	$1 \times 10^2$	$1 \times 10^7$
Te-125m	$2 \times 10^1$	$9 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^7$
Te-127	$2 \times 10^1$	$7 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Te-127m (a)	$2 \times 10^1$	$5 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^7$
Te-129	$7 \times 10^{-1}$	$6 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Te-129m (a)	$8 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Te-131m (a)	$7 \times 10^{-1}$	$5 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Te-132 (a)	$5 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^7$
Thorium (90)				
Th-227	$1 \times 10^1$	$5 \times 10^{-3}$	$1 \times 10^1$	$1 \times 10^4$
Th-228 (a)	$5 \times 10^{-1}$	$1 \times 10^{-3}$	$1 \times 10^0$ (b)	$1 \times 10^4$ (b)
Th-229	$5 \times 10^0$	$5 \times 10^{-4}$	$1 \times 10^0$ (b)	$1 \times 10^3$ (b)
Th-230	$1 \times 10^1$	$1 \times 10^{-3}$	$1 \times 10^0$	$1 \times 10^4$

Radionuclide (atomic number)	A <sub>1</sub> (TBq)	A <sub>2</sub> (TBq)	Activity concentration <b>limit</b> for exempt material (Bq/g)	Activity limit for an exempt consignment (Bq)
Th-231	$4 \times 10^1$	$2 \times 10^{-2}$	$1 \times 10^3$	$1 \times 10^7$
Th-232	Unlimited	Unlimited	$1 \times 10^1$	$1 \times 10^4$
Th-234 (a)	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^3$ (b)	$1 \times 10^5$ (b)
Th(nat)	Unlimited	Unlimited	$1 \times 10^0$ (b)	$1 \times 10^3$ (b)
Titanium (22)				
Ti-44 (a)	$5 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
Thallium (81)				
Tl-200	$9 \times 10^{-1}$	$9 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Tl-201	$1 \times 10^1$	$4 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Tl-202	$2 \times 10^0$	$2 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Tl-204	$1 \times 10^1$	$7 \times 10^{-1}$	$1 \times 10^4$	$1 \times 10^4$
Thulium (69)				
Tm-167	$7 \times 10^0$	$8 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Tm-170	$3 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Tm-171	$4 \times 10^1$	$4 \times 10^1$	$1 \times 10^4$	$1 \times 10^8$
Uranium (92)				
U-230 (fast lung absorption)(a)(d)	$4 \times 10^1$	$1 \times 10^{-1}$	$1 \times 10^1$ (b)	$1 \times 10^5$ (b)
U-230 (medium lung absorption)(a)(e)	$4 \times 10^1$	$4 \times 10^{-3}$	$1 \times 10^1$	$1 \times 10^4$
U-230 (slow lung absorption) (a)(f)	$3 \times 10^1$	$3 \times 10^{-3}$	$1 \times 10^1$	$1 \times 10^4$
U-232 (fast lung absorption)(d)	$4 \times 10^1$	$1 \times 10^{-2}$	$1 \times 10^0$ (b)	$1 \times 10^3$ (b)
U-232 (medium lung absorption)(e)	$4 \times 10^1$	$7 \times 10^{-3}$	$1 \times 10^1$	$1 \times 10^4$
U-232 (slow lung absorption)(f)	$1 \times 10^1$	$1 \times 10^{-3}$	$1 \times 10^1$	$1 \times 10^4$
U-233 (fast lung absorption)(d)	$4 \times 10^1$	$9 \times 10^{-2}$	$1 \times 10^1$	$1 \times 10^4$
U-233 (medium lung absorption)(e)	$4 \times 10^1$	$2 \times 10^{-2}$	$1 \times 10^2$	$1 \times 10^5$
U-233 (slow lung absorption)(f)	$4 \times 10^1$	$6 \times 10^{-3}$	$1 \times 10^1$	$1 \times 10^5$
U-234 (fast lung absorption)(d)	$4 \times 10^1$	$9 \times 10^{-2}$	$1 \times 10^1$	$1 \times 10^4$
U-234 (medium lung absorption)(e)	$4 \times 10^1$	$2 \times 10^{-2}$	$1 \times 10^2$	$1 \times 10^5$
U-234 (slow lung absorption)(f)	$4 \times 10^1$	$6 \times 10^{-3}$	$1 \times 10^1$	$1 \times 10^5$

<b>Radionuclide (atomic number)</b>	<b>A<sub>1</sub> (TBq)</b>	<b>A<sub>2</sub> (TBq)</b>	<b>Activity concentration <u>limit</u> for exempt material (Bq/g)</b>	<b>Activity limit for an exempt consignment (Bq)</b>
U-235 (all lung absorption types)(a),(d),(e),(f)	Unlimited	Unlimited	$1 \times 10^1$ (b)	$1 \times 10^4$ (b)
U-236 (fast lung absorption)(d)	Unlimited	Unlimited	$1 \times 10^1$	$1 \times 10^4$
U-236 (medium lung absorption)(e)	$4 \times 10^1$	$2 \times 10^{-2}$	$1 \times 10^2$	$1 \times 10^5$
U-236 (slow lung absorption)(f)	$4 \times 10^1$	$6 \times 10^{-3}$	$1 \times 10^1$	$1 \times 10^4$
U-238 (all lung absorption types)(d),(e),(f)	Unlimited	Unlimited	$1 \times 10^1$ (b)	$1 \times 10^4$ (b)
U (nat)	Unlimited	Unlimited	$1 \times 10^0$ (b)	$1 \times 10^3$ (b)
U (enriched to 20% or less)(g)	Unlimited	Unlimited	$1 \times 10^0$	$1 \times 10^3$
U (dep)	Unlimited	Unlimited	$1 \times 10^0$	$1 \times 10^3$
Vanadium (23)				
V-48	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^5$
V-49	$4 \times 10^1$	$4 \times 10^1$	$1 \times 10^4$	$1 \times 10^7$
Tungsten (74)				
W-178 (a)	$9 \times 10^0$	$5 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$
W-181	$3 \times 10^1$	$3 \times 10^1$	$1 \times 10^3$	$1 \times 10^7$
W-185	$4 \times 10^1$	$8 \times 10^{-1}$	$1 \times 10^4$	$1 \times 10^7$
W-187	$2 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
W-188 (a)	$4 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^5$
Xenon (54)				
Xe-122 (a)	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^9$
Xe-123	$2 \times 10^0$	$7 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^9$
Xe-127	$4 \times 10^0$	$2 \times 10^0$	$1 \times 10^3$	$1 \times 10^5$
Xe-131m	$4 \times 10^1$	$4 \times 10^1$	$1 \times 10^4$	$1 \times 10^4$
Xe-133	$2 \times 10^1$	$1 \times 10^1$	$1 \times 10^3$	$1 \times 10^4$
Xe-135	$3 \times 10^0$	$2 \times 10^0$	$1 \times 10^3$	$1 \times 10^{10}$
Yttrium (39)				
Y-87 (a)	$1 \times 10^0$	$1 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$
Y-88	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Y-90	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^5$
Y-91	$6 \times 10^{-1}$	$6 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^6$
Y-91m	$2 \times 10^0$	$2 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Y-92	$2 \times 10^{-1}$	$2 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^5$

Radionuclide (atomic number)	A <sub>1</sub>  (TBq)	A <sub>2</sub>  (TBq)	Activity concentration <b>limit</b> for exempt material (Bq/g)	Activity limit for an exempt consignment (Bq)
Y-93	$3 \times 10^{-1}$	$3 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^5$
Ytterbium (70)				
Yb-169	$4 \times 10^0$	$1 \times 10^0$	$1 \times 10^2$	$1 \times 10^7$
Yb-175	$3 \times 10^1$	$9 \times 10^{-1}$	$1 \times 10^3$	$1 \times 10^7$
Zinc (30)				
Zn-65	$2 \times 10^0$	$2 \times 10^0$	$1 \times 10^1$	$1 \times 10^6$
Zn-69	$3 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^4$	$1 \times 10^6$
Zn-69m (a)	$3 \times 10^0$	$6 \times 10^{-1}$	$1 \times 10^2$	$1 \times 10^6$
Zirconium (40)				
Zr-88	$3 \times 10^0$	$3 \times 10^0$	$1 \times 10^2$	$1 \times 10^6$
Zr-93	Unlimited	Unlimited	$1 \times 10^3$ (b)	$1 \times 10^7$ (b)
Zr-95 (a)	$2 \times 10^0$	$8 \times 10^{-1}$	$1 \times 10^1$	$1 \times 10^6$
Zr-97 (a)	$4 \times 10^{-1}$	$4 \times 10^{-1}$	$1 \times 10^1$ (b)	$1 \times 10^5$ (b)

*[IAEA: Table 2]*

- (a) A<sub>1</sub> and/or A<sub>2</sub> values for these parent radionuclides include contributions from ~~daughter radionuclides~~ their progeny with half-lives less than 10 days, as listed in the following:

Mg-28	Al-28
Ar-42	K-42
Ca-47	Sc-47
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-137m
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;

- (b) 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;

- (c) 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;
- (d) These values apply only to compounds of uranium that take the chemical form of  $\text{UF}_6$ ,  $\text{UO}_2\text{F}_2$  and  $\text{UO}_2(\text{NO}_3)_2$  in both normal and accident conditions of transport;
- (e) These values apply only to compounds of uranium that take the chemical form of  $\text{UO}_3$ ,  $\text{UF}_4$ ,  $\text{UCl}_4$  and hexavalent compounds in both normal and accident conditions of transport;
- (f) These values apply to all compounds of uranium other than those specified in (d) and (e) above;

- (g) These values apply to unirradiated uranium only.

#### 2.7.2.2.2 For individual radionuclides:

- (a) -which are not listed in Table 2.7.2.2.1 the determination of the basic radionuclide values referred to in 2.7.2.2.1 shall require multilateral approval. For these radionuclides, activity concentrations limits for exempt material and activity limits for exempt consignments shall be calculated in accordance with the principles established in the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources, Safety Series No.115, IAEA, Vienna (1996). It is permissible to use an  $A_2$  value calculated using a dose coefficient for the appropriate lung absorption type as recommended by 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 radionuclide values in Table 2.7.2.2.2 may be used without obtaining competent authority approval;
- (b) In instruments or articles in which the radioactive material is enclosed or is included as a component part of the instrument or other manufactured article and which meet 2.7.2.4.1.3 (c), alternative basic radionuclide values to those in Table 2.7.2.2.1 for the activity limit for an exempt consignment are permitted and shall require multilateral approval. Such alternative activity limits for an exempt consignment shall be calculated in accordance with the principles set out in the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources, Safety Series No.115, IAEA, Vienna (1996).

[IAEA: 403]

**Table 2.7.2.2.2: Basic radionuclide values for unknown radionuclides or mixtures**

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

2.7.2.2.3 In the calculations of  $A_1$  and  $A_2$  for a radionuclide not in Table 2.7.2.2.1, 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, shall 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 shall be those 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 shall be considered as mixtures of different nuclides.

2.7.2.2.4 For mixtures of radionuclides, ~~the determination of~~ the basic radionuclide values referred to in 2.7.2.2.1 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 limit 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 limit for exempt material or the activity limit for an exempt consignment in the case of a mixture.

[IAEA: 4051]

2.7.2.2.5 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 2.7.2.2.4 and 2.7.2.4.4. Groups may be based on the total alpha activity and the total beta/gamma activity when these are known, using the lowest radionuclide values for the alpha emitters or beta/gamma emitters, respectively.

2.7.2.2.6 For individual radionuclides or for mixtures of radionuclides for which relevant data are not available, the values shown in Table 2.7.2.2.2 shall be used.

### 2.7.2.3 *Determination of other material characteristics*

#### 2.7.2.3.1 *Low specific activity (LSA) material*

##### 2.7.2.3.1.1 (Reserved)

##### 2.7.2.3.1.2 LSA material shall be in one of three groups:

##### (a) LSA-I

- (i) 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;~~
- (ii) Natural uranium, depleted uranium, natural thorium or their compounds or mixtures, that are unirradiated and in solid or liquid form;
- (iii) radioactive material for which the  $A_2$  value is unlimited, ~~excluding fissile material~~ may be included only if not excepted under 2.7.2.3.5; or
- (iv) 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 2.7.2.2.1 to 2.7.2.2.6, ~~excluding fissile material~~ may be included only if not excepted under 2.7.2.3.5;

##### (b) LSA-II

- (i) water with tritium concentration up to 0.8 TBq/l; ~~or~~
- (ii) other material in which the activity is distributed throughout and the estimated average specific activity does not exceed  $10^{-4}$  A<sub>2</sub>/g for solids and gases, and  $10^{-5}$  A<sub>2</sub>/g for liquids;



- (c) LSA-III - Solids (e.g. consolidated wastes, activated materials), excluding powders, ~~meeting that meet~~ the requirements of 2.7.2.3.1.3, in which:
- (i) 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 ~~and~~ ceramic, ~~etc.~~);
  - (ii) 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 seven days would not exceed  $0.1 A_2$ ; and
  - (iii) the estimated average specific activity of the solid, excluding any shielding material, does not exceed  $2 \times 10^{-3} A_2/g$ .

[IAEA: 4091]

2.7.2.3.1.3 LSA-III material shall be a solid of such a nature that if the entire contents of a package were subjected to the test specified in 2.7.2.3.1.4 the activity in the water would not exceed  $0.1 A_2$ .

2.7.2.3.1.4 LSA-III material shall be tested as follows:

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

2.7.2.3.1.5 Demonstration of compliance with the performance standards in 2.7.2.3.1.4 shall be in accordance with 6.4.12.1 and 6.4.12.2.

2.7.2.3.2 *Surface contaminated object (SCO)*

SCO is classified in one of two groups:

- (a) SCO-I: A solid object on which:
  - (i) the non-fixed contamination on the accessible surface averaged over  $300 \text{ cm}^2$  (or the area of the surface if less than  $300 \text{ cm}^2$ ) does not exceed  $4 \text{ Bq/cm}^2$  for beta and gamma emitters and low toxicity alpha emitters, or  $0.4 \text{ Bq/cm}^2$  for all other alpha emitters; ~~and~~
  - (ii) the fixed contamination on the accessible surface averaged over  $300 \text{ cm}^2$  (or the area of the surface if less than  $300 \text{ cm}^2$ ) does not exceed  $4 \times 10^4 \text{ Bq/cm}^2$  for beta and gamma emitters and low toxicity alpha emitters, or  $4 \times 10^3 \text{ Bq/cm}^2$  for all other alpha emitters; ~~and~~
  - (iii) the non-fixed contamination plus the fixed contamination on the inaccessible surface averaged over  $300 \text{ cm}^2$  (or the area of the surface if less than  $300 \text{ cm}^2$ ) does not exceed  $4 \times 10^4 \text{ Bq/cm}^2$  for beta and gamma emitters and low toxicity alpha emitters, or  $4 \times 10^3 \text{ Bq/cm}^2$  for all other alpha emitters;
- (b) 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 (a) above and on which:

- (i) the non-fixed contamination on the accessible surface averaged over 300 cm<sup>2</sup> (or the area of the surface if less than 300 cm<sup>2</sup>) does not exceed 400 Bq/cm<sup>2</sup> for beta and gamma emitters and low toxicity alpha emitters, or 40 Bq/cm<sup>2</sup> for all other alpha emitters; ~~and~~
- (ii) the fixed contamination on the accessible surface, averaged over 300 cm<sup>2</sup> (or the area of the surface if less than 300 cm<sup>2</sup>) does not exceed  $8 \times 10^5$  Bq/cm<sup>2</sup> for beta and gamma emitters and low toxicity alpha emitters, or  $8 \times 10^4$  Bq/cm<sup>2</sup> for all other alpha emitters; ~~and~~
- (iii) the non-fixed contamination plus the fixed contamination on the inaccessible surface averaged over 300 cm<sup>2</sup> (or the area of the surface if less than 300 cm<sup>2</sup>) does not exceed  $8 \times 10^5$  Bq/cm<sup>2</sup> for beta and gamma emitters and low toxicity alpha emitters, or  $8 \times 10^4$  Bq/cm<sup>2</sup> for all other alpha emitters.

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#### 2.7.2.3.3 *Special form radioactive material*

2.7.2.3.3.1 Special form radioactive material shall have at least one dimension not less than 5 mm. When a sealed capsule constitutes part of the special form radioactive material, the capsule shall be so manufactured that it can be opened only by destroying it. The design for special form radioactive material requires unilateral approval.

2.7.2.3.3.2 Special form radioactive material shall be of such a nature or shall be so designed that if it is subjected to the tests specified in 2.7.2.3.3.4 to 2.7.2.3.3.8, it shall meet the following requirements:

- (a) It would not break or shatter under the impact, percussion and bending tests 2.7.2.3.3.5 (a), (b), (c) and 2.7.2.3.3.6 (a) as applicable;
- (b) It would not melt or disperse in the applicable heat test 2.7.2.3.3.5 (d) or 2.7.2.3.3.6 (b) as applicable; and
- (c) The activity in the water from the leaching tests specified in 2.7.2.3.3.7 and 2.7.2.3.3.8 would not exceed 2 kBq; or alternatively for sealed sources, the leakage rate for the volumetric leakage assessment test specified in ISO 9978:1992 "Radiation Protection – Sealed Radioactive Sources – Leakage Test Methods", would not exceed the applicable acceptance threshold acceptable to the competent authority.

2.7.2.3.3.3 Demonstration of compliance with the performance standards in 2.7.2.3.3.2 shall be in accordance with 6.4.12.1 and 6.4.12.2.

2.7.2.3.3.4 Specimens that comprise or simulate special form radioactive material shall be subjected to the impact test, the percussion test, the bending test, and the heat test specified in 2.7.2.3.3.5 or alternative tests as authorized in 2.7.2.3.3.6. A different specimen may be used for each of the tests. Following each test, a leaching assessment or volumetric leakage test shall be performed on the specimen by a method no less sensitive than the methods given in 2.7.2.3.3.7 for indispersible solid material or 2.7.2.3.3.8 for encapsulated material.

2.7.2.3.3.5 The relevant test methods are:

- (a) Impact test: The specimen shall drop onto the target from a height of 9 m. The target shall be as defined in 6.4.14;
- (b) Percussion test: The specimen shall 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 shall be 25 mm in diameter with the edges rounded off to a radius of  $(3.0 \pm 0.3)$  mm. The lead, of hardness number

3.5 to 4.5 on the Vickers scale and not more than 25 mm thick, shall cover an area greater than that covered by the specimen. A fresh surface of lead shall be used for each impact. The bar shall strike the specimen so as to cause maximum damage;

- (c) Bending test: The test shall apply only to long, slender sources with both a minimum length of 10 cm and a length to minimum width ratio of not less than 10. The specimen shall be rigidly clamped in a horizontal position so that one half of its length protrudes from the face of the clamp. The orientation of the specimen shall be such that the specimen will suffer maximum damage when its free end is struck by the flat face of a steel bar. The bar shall strike the specimen so as to cause an impact equivalent to that resulting from a free vertical drop of 1.4 kg through 1 m. The lower part of the bar shall be 25 mm in diameter with the edges rounded off to a radius of  $(3.0 \pm 0.3)$  mm;
- (d) Heat test: The specimen shall be heated in air to a temperature of 800 °C and held at that temperature for a period of 10 minutes and shall then be allowed to cool.

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

- (a) The tests prescribed in 2.7.2.3.3.5 (a) and (b) provided that the specimens are alternatively subjected to the impact test prescribed in ISO 2919:1999-2012 "Radiation protection – Sealed radioactive sources – General requirements and classification" ~~the mass of the special form radioactive material:~~
  - (i) the Class 4 impact test if the mass of the special form radioactive material is 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~~
  - (ii) the Class 5 impact test if the mass of the special form radioactive material is more than 200 g but 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 2.7.2.3.3.5 (d) provided they are alternatively subjected to the Class 6 temperature test specified in ISO 2919:1999-2012 "Radiation protection – Sealed radioactive sources – General requirements and classification".

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

- (a) The specimen shall be immersed for 7 days in water at ambient temperature. The volume of water to be used in the test shall be sufficient to ensure that at the end of the 7 day test period the free volume of the unabsorbed and unreacted water remaining shall be at least 10% of the volume of the solid test sample itself. The water shall have an initial pH of 6-8 and a maximum conductivity of 1 mS/m at 20 °C;
- (b) The water with specimen shall then be heated to a temperature of  $(50 \pm 5)$  °C and maintained at this temperature for 4 hours;
- (c) The activity of the water shall then be determined;

- (d) The specimen shall then be kept for at least 7 days in still air at not less than 30 °C and relative humidity not less than 90%;
- (e) The specimen shall then be immersed in water of the same specification as in (a) above and the water with the specimen heated to  $(50 \pm 5)$  °C and maintained at this temperature for 4 hours;
- (f) The activity of the water shall then be determined.

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

- (a) The leaching assessment shall consist of the following steps:
  - (i) the specimen shall be immersed in water at ambient temperature. The water shall have an initial pH of 6-8 with a maximum conductivity of 1 mS/m at 20 °C;
  - (ii) the water and specimen shall be heated to a temperature of  $(50 \pm 5)$  °C and maintained at this temperature for 4 hours;
  - (iii) the activity of the water shall then be determined;
  - (iv) the specimen shall then be kept for at least 7 days in still air at not less than 30 °C and relative humidity of not less than 90%;
  - (v) the process in (i), (ii) and (iii) shall be repeated;
- (b) The alternative volumetric leakage assessment shall comprise any of the tests prescribed in ISO 9978:1992 “Radiation Protection – Sealed radioactive sources – Leakage test methods”, ~~which~~ provided that they are acceptable to the competent authority.

[IAEA: 711]

#### 2.7.2.3.4 *Low dispersible material*

2.7.2.3.4.1 The design for low dispersible radioactive material shall require multilateral approval. Low dispersible radioactive material shall be such that the total amount of this radioactive material in a package, taking into account the provisions of 6.4.8.14, shall 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 6.4.20.3 and 6.4.20.4, the airborne release in gaseous and particulate forms of up to 100 µm aerodynamic equivalent diameter would not exceed 100 A<sub>2</sub>. A separate specimen may be used for each test; and
- (c) If subjected to the test specified in 2.7.2.3.1.4 the activity in the water would not exceed 100 A<sub>2</sub>. In the application of this test, the damaging effects of the tests specified in (b) above shall be taken into account.

#### 2.7.2.3.4.2 Low dispersible material shall be tested as follows:

A specimen that comprises or simulates low dispersible radioactive material shall be subjected to the enhanced thermal test specified in 6.4.20.3 and the impact test specified in 6.4.20.4. A different specimen may be used for each of the tests. Following each test, the specimen shall be subjected to the leach test specified in 2.7.2.3.1.4. After each test it shall be determined if the applicable requirements of 2.7.2.3.4.1 have been met.

2.7.2.3.4.3 Demonstration of compliance with the performance standards in 2.7.2.3.4.1 and 2.7.2.3.4.2 shall be in accordance with 6.4.12.1 and 6.4.12.2.

2.7.2.3.5 *Fissile material*

Fissile material and P packages containing fissile material shall be classified under the relevant entry as “FISSILE” ~~of in accordance with Table 2.7.2.1.1; unless excepted by the description of which includes the words “FISSILE” or “fissile excepted”. Classification as “fissile excepted” is allowed only if one of the conditions provisions (a) to (d) of this paragraph below and transported subject to the requirements of 7.2.3.1.3–7.1.8.4.3. is met. Only one type of exception is allowed per consignment. All provisions apply only to material in packages that meets the requirements of 6.4.7.2 unless unpackaged material is specifically allowed in the provision.~~ (see also 6.4.7.2):

- (a) ~~— 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 2.7.2.3.5, provided that either:~~

- (i) ~~— each individual package contains not more than 15 g of fissile nuclides; for unpackaged material, this quantity limitation shall apply to the consignment being carried in or on the conveyance; or~~
- (ii) ~~— 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~~
- (iii) ~~— there are not more than 5 g of fissile nuclides in any 10 litre volume of material.~~

~~Beryllium shall not be present in quantities exceeding 1% of the applicable consignment mass limits provided in Table 2.7.2.3.5 except where the concentration of beryllium in the material does not exceed 1 gram beryllium in any 1 000 grams.~~

~~Deuterium shall also not be present in quantities exceeding 1% of the applicable consignment mass limits provided in Table 2.7.2.3.5 except where deuterium occurs up to natural concentration in hydrogen.~~

- (b) ~~Uranium enriched in uranium-235 to a maximum of 1% by mass, and with a total plutonium and uranium-233 content not exceeding 1% of the mass 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 shall not form a lattice arrangement;~~
- (e) ~~Liquid solutions of uranyl nitrate enriched in uranium-235 to a maximum of 2% by mass, with a total plutonium and uranium-233 content not exceeding 0.002% of the mass of uranium, and with a minimum nitrogen to uranium atomic ratio (N/U) of 2;~~
- (c) Uranium with a maximum uranium enrichment of 5% by mass uranium-235 provided:
- (i) There is no more than 3.5 g of uranium-235 per package;
- (ii) The total plutonium and uranium-233 content does not exceed 1% of the mass of uranium-235 per package;

(iii) Transport of the package is subject to the consignment limit provided in 7.1.8.4.3 (c).

(d) Fissile nuclides with a total mass not greater than 2.0 g per package provided the package is transported subject to the consignment limit provided in 7.1.8.4.3 (d);

(e) Fissile nuclides with a total mass not greater than 45 g either packaged or unpackaged subject to limits provided in 7.1.8.4.3 (e);

(f) A fissile material that meets the requirements of 7.1.8.4.3 (b), 2.7.2.3.6 and 5.1.5.2.1.

[IAEA: 417]

~~(d) Plutonium containing not more than 20% of fissile nuclides by mass up to a maximum of 1 kg of plutonium per consignment. Shipments under this exception shall be under exclusive use.~~

~~Table 2.7.2.3.5: Consignment mass limits for exceptions from the requirements for packages containing fissile material~~

<del>Fissile material</del>	<del>Fissile material mass (g) mixed with substances having an average hydrogen density less than or equal to water</del>	<del>Fissile material mass (g) mixed with substances having an average hydrogen density greater than water</del>
<del>Uranium-235 (X)</del>	<del>400</del>	<del>290</del>
<del>Other fissile material (Y)</del>	<del>250</del>	<del>180</del>

[IAEA: Table 4]

2.7.2.3.6 A fissile material excepted from classification as FISSILE under 2.7.2.3.5 (f) shall be subcritical without the need for accumulation control under the following conditions:

(a) The conditions of 6.4.11.1(a);

(b) The conditions consistent with the assessment provisions stated in 6.4.11.12 (b) and 6.4.11.13 (b) for packages;

(c) The conditions specified in 6.4.11.11 (a), if transported by air.

[IAEA: 606]

#### 2.7.2.4 *Classification of packages or unpacked material*

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

##### 2.7.2.4.1 *Classification as excepted package*

2.7.2.4.1.1 A packages may be classified as excepted packages if it meets one of the following conditions:

(a) They are~~It is an~~ empty ~~packagings~~ package having contained radioactive material;

(b) They~~It~~ contains instruments or articles ~~in limited quantities~~ not exceeding the activity limits as specified in Table 2.7.2.4.1.2;

- (c) ~~They~~ It contains articles manufactured of natural uranium, depleted uranium or natural thorium; or
- (d) ~~They~~ It contains radioactive material not exceeding the activity limits in limited quantities as specified in Table 2.7.2.4.1.2; or

- (e) It contains less than 0.1 kg of uranium hexafluoride not exceeding the activity limits specified in column 4 of Table 2.7.2.4.1.2.

[IAEA: 422]

2.7.2.4.1.2 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.

**Table 2.7.2.4.1.2: Activity limits for excepted packages**

Physical state of contents	Instruments or article		Materials Package limits <sup>a</sup>
	Item limits <sup>a</sup>	Package limits <sup>a</sup>	
(1)	(2)	(3)	(4)
<b>Solids</b>			
special form	$10^{-2} A_1$	$A_1$	$10^{-3} A_1$
other form	$10^{-2} A_2$	$A_2$	$10^{-3} A_2$
Liquids	$10^{-3} A_2$	$10^{-1} A_2$	$10^{-4} A_2$
<b>Gases</b>			
tritium	$2 \times 10^{-2} A_2$	$2 \times 10^{-1} A_2$	$2 \times 10^{-2} A_2$
special form	$10^{-3} A_1$	$10^{-2} A_1$	$10^{-3} A_1$
other forms	$10^{-3} A_2$	$10^{-2} A_2$	$10^{-3} A_2$

<sup>a</sup> For mixtures of radionuclides, see 2.7.2.2.4 to 2.7.2.2.6.

2.7.2.4.1.3 Radioactive material which is enclosed in or is included as a component part of an instrument or other manufactured article may be classified under UN 2911 RADIOACTIVE MATERIAL, EXCEPTED PACKAGE - INSTRUMENTS or ARTICLES only if provided that:

- (a) The radiation level at 10 cm from any point on the external surface of any unpackaged instrument or article is not greater than 0.1 mSv/h; and
- (b) Each instrument or manufactured article bears the marking "RADIOACTIVE" on its internal external surface except for the following:
- (i) radioluminescent time-pieces or devices;
- (ii) consumer products that either have received regulatory approval according to in accordance with 1.5.1.4 (de) or do not individually exceed the activity limit for an exempt consignment in Table 2.7.2.2.1 (column 5), provided such products are transported in a package that bears the marking "RADIOACTIVE" on an-its internal surface in such a manner that a warning of the presence of radioactive material is visible on opening the package; and
- (iii) Other instruments or articles too small to bear the marking "RADIOACTIVE" -do not require markings. provided that they are transported in a package that bears the marking "RADIOACTIVE" on its internal surface in such a manner that a warning of the presence of radioactive material is visible on opening the package.

- (c) The active material is completely enclosed by non-active components (a device performing the sole function of containing radioactive material shall not be considered to be an instrument or manufactured article); and
- (d) The limits specified in columns 2 and 3 of Table 2.7.2.4.1.2 are met for each individual item and each package, respectively.

[IAEA: 423]

2.7.2.4.1.4 Radioactive material in forms other than as specified in 2.7.2.4.1.3 and with an activity not exceeding the limits specified in column 4 of Table 2.7.2.4.1.2, may be classified under UN 2910 RADIOACTIVE MATERIAL, EXCEPTED PACKAGE - LIMITED QUANTITY OF MATERIAL provided that:

- (a) The package retains its radioactive contents under routine conditions of transport; and
- (b) The package bears the marking "RADIOACTIVE" on either:

(i) an internal surface in such a manner that a warning of the presence of radioactive material is visible on opening the package; or

(ii) the outside of the package, where it is impractical to mark an internal surface.

[IAEA: 424]

[2.7.2.4.1.5 Uranium hexafluoride not exceeding the limits specified in column 4 of Table 2.7.2.4.1.2 may be classified under UN 3507 RADIOACTIVE MATERIAL, EXCEPTED PACKAGE - URANIUM HEXAFLUORIDE, less than 0.1 kg per package, non-fissile or fissile-excepted] provided that:

- (a) The mass of uranium hexafluoride in the package is less than 0.1 kg;
- (b) The conditions of 2.7.2.4.5.1 and 2.7.2.4.1.4 (a) and (b) are met.]

[IAEA: 425]

2.7.2.4.1.6 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 under UN 2909 RADIOACTIVE MATERIAL, EXCEPTED PACKAGE - ARTICLES MANUFACTURED FROM NATURAL URANIUM or DEPLETED URANIUM or NATURAL THORIUM, only if provided that the outer surface of the uranium or thorium is enclosed in an inactive sheath made of metal or some other substantial material.

[IAEA: 426]

2.7.2.4.1.57 An empty packaging which had previously contained radioactive material may be classified under UN 2908 RADIOACTIVE MATERIAL, EXCEPTED PACKAGE - EMPTY PACKAGING, only if 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 cm<sup>2</sup>, does not exceed:
  - (i) 400 Bq/cm<sup>2</sup> for beta and gamma emitters and low toxicity alpha emitters; and
  - (ii) 40 Bq/cm<sup>2</sup> for all other alpha emitters; and



- (d) Any labels which may have been displayed on it in conformity with 5.2.2.1.12.1 are no longer visible.

[IAEA: 427]

#### 2.7.2.4.2 *Classification as Low specific activity (LSA) material*

Radioactive material may only be classified as LSA material if the definition of LSA in 2.7.1.3 and the conditions of 2.7.2.3.1, 4.1.9.2 and 7.1.8.2 are met.

#### 2.7.2.4.3 *Classification as Surface contaminated object (SCO)*

Radioactive material may be classified as SCO if the definition of SCO in 2.7.1.3 and the conditions of 2.7.2.3.2, 4.1.9.2 and 7.1.8.2 are met.

#### 2.7.2.4.4 *Classification as Type A package*

Packages containing radioactive material may be classified as Type A packages provided that the following conditions are met:

Type A packages shall not contain activities greater than either of the following:

- (a) For special form radioactive material -  $A_1$ ; ~~or~~
- (b) For all other radioactive material -  $A_2$ .

For mixtures of radionuclides whose identities and respective activities are known, the following condition shall apply to the radioactive contents of a 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;

$A_1(i)$  is the  $A_1$  value for radionuclide  $i$ ;

$C(j)$  is the activity of radionuclide  $j$  as other than special form radioactive material;  
~~and~~

$A_2(j)$  is the  $A_2$  value for radionuclide  $j$ .

[IAEA 428, 429, 430]

#### 2.7.2.4.5 *Classification of uranium hexafluoride*

Uranium hexafluoride shall ~~only~~ be assigned to one of the following UN Nos. only:

(a) UN ~~Nos.~~ 2977, RADIOACTIVE MATERIAL, URANIUM HEXAFLUORIDE, FISSILE;

(b), ~~or~~ UN 2978, RADIOACTIVE MATERIAL, URANIUM HEXAFLUORIDE, non-fissile or fissile-excepted;

~~[(c) UN 3507, RADIOACTIVE MATERIAL, EXCEPTED PACKAGE—URANIUM HEXAFLUORIDE, less than 0.1 kg per package, non-fissile or fissile-excepted].~~

~~[IAEA 419]~~

2.7.2.4.5.1 ~~The contents of a P~~packages containing uranium hexafluoride shall ~~not contain~~comply with the following requirements:

- (a) ~~A~~the mass of uranium hexafluoride ~~shall not be~~ different from that ~~authorized~~allowed for the package design;
- (b) ~~A~~the mass of uranium hexafluoride ~~shall not be~~ greater than a value that would lead to an ullage ~~smaller of less~~ than 5 % at the maximum temperature of the package as specified for the plant systems where the package ~~shall~~might be used; ~~or~~
- (c) ~~the~~ Uranium hexafluoride ~~shall be other than~~ in solid form ~~or at an~~and the internal pressure ~~shall not be~~ above atmospheric pressure when presented for transport.

~~[IAEA 420]~~

2.7.2.4.6 *Classification as Type B(U), Type B(M) or Type C packages*

2.7.2.4.6.1 Packages not otherwise classified in 2.7.2.4 (2.7.2.4.1 to 2.7.2.4.5) shall be classified in accordance with the competent authority ~~approval~~certificate of approval for the package issued by the country of origin of design.

~~[IAEA 431]~~

2.7.2.4.6.2 ~~The contents of a A~~package may only be classified as aType B(U), Type B (M) or Type C package shall be as specified in the certificate of approval, 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 package design;~~

~~as specified in the certificate of approval.~~

~~[IAEA 432]~~

~~2.7.2.4.6.3 A package may only be classified as a Type B(M) 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 package design;~~

~~as specified in the certificate of approval.~~

~~2.7.2.4.6.4 A package may only be classified as a Type C 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 physical or chemical state different from those authorized for the package design;~~

~~as specified in the certificate of approval.~~

~~[IAEA 432, 434]~~

#### 2.7.2.5 *Special arrangements*

Radioactive material shall be classified as transported under special arrangement when it is intended to be transported in accordance with 1.5.4.

## CHAPTER 4.1

### USE OF PACKAGINGS, INCLUDING INTERMEDIATE BULK CONTAINERS (IBCs) AND LARGE PACKAGINGS

#### Sections 4.1.1 to 4.1.8: Unchanged

#### 4.1.9 Special packing provisions for Class 7

##### 4.1.9.1 *General*

4.1.9.1.1 Radioactive material, packagings and packages shall meet the requirements of Chapter 6.4. The quantity of radioactive material in a package shall not exceed the limits specified in 2.7.2.2, 2.7.2.4.1, 2.7.2.4.4, 2.7.2.4.5, 2.7.2.4.6, SP336 of Chapter 3.3 and 4.1.9.3.

The types of packages for radioactive materials covered by these Regulations, are:

- (a) Excepted package (see 1.5.1.5);
- (b) Industrial package Type 1 (Type IP-1 package);
- (c) Industrial package Type 2 (Type IP-2 package);
- (d) Industrial package Type 3 (Type IP-3 package);
- (e) Type A package;
- (f) Type B(U) package;
- (g) Type B(M) package;
- (h) Type C package.

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

4.1.9.1.2 The non-fixed contamination on the external surfaces of any package shall be kept as low as practicable and, under routine conditions of transport, shall not exceed the following limits:

- (a) 4 Bq/cm<sup>2</sup> for beta and gamma emitters and low toxicity alpha emitters; and
- (b) 0.4 Bq/cm<sup>2</sup> for all other alpha emitters.

These limits are applicable when averaged over any area of 300 cm<sup>2</sup> of any part of the surface.

4.1.9.1.3 A package, ~~other than an excepted package,~~ shall not contain any items other than those that are necessary for the use of the radioactive material. The interaction between these items and the package under the conditions of transport applicable to the design, shall not reduce the safety of the package.

[IAEA: 504]

4.1.9.1.4 Except as provided in 7.1.8.5.5, the level of non-fixed contamination on the external and internal surfaces of overpacks, freight containers, tanks, intermediate bulk containers and conveyances shall not exceed the limits specified in 4.1.9.1.2.

4.1.9.1.5 For radioactive material having other dangerous properties the package design shall take into account those properties. Radioactive material with a subsidiary risk, packaged in packages that do not require competent authority approval, shall be transported in packagings, IBCs, tanks or bulk containers fully complying with the requirements of the relevant chapters of Part 6 as appropriate, as well as applicable requirements of chapters 4.1, 4.2 or 4.3 for that subsidiary risk.

4.1.9.1.6 Before a packaging is first used to transport radioactive material, it shall be confirmed that it has been manufactured in conformity with the design specifications to ensure compliance with the relevant provisions of these Regulations and any applicable certificate of approval.~~the first shipment of any package, †~~The following requirements shall be fulfilled, if applicable:

- (a) If the design pressure of the containment system exceeds 35 kPa (gauge), it shall be ensured that the containment system of each ~~packaging~~package conforms to the approved design requirements relating to the capability of that system to maintain its integrity under that pressure;
- (b) For each packaging intended for use as a Type B(U), Type B(M) ~~and or~~ Type C package and for each ~~packaging~~package containing fissile material, it shall be ensured that the effectiveness of its shielding and containment 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;
- (c) For each packaging intended to contain ~~packages containing~~ fissile material, it shall be ensured that the effectiveness of the criticality safety features is within the limits applicable to or specified for the design and in particular where, in order to comply with the requirements of 6.4.11.1, neutron poisons are specifically included, ~~as components of the package,~~ checks shall be performed to confirm the presence and distribution of those neutron poisons.

[IAEA: 501]

4.1.9.1.7 Before each shipment of any package, it shall be ensured that the package contains neither:

- (a) Radionuclides different from those specified for the package design; nor
- (b) Contents in a form, or physical or chemical state different from those specified for the package design.

[IAEA: 502]

4.1.9.1.78 Before each shipment of any package, it shall be ensured that all the requirements specified in the relevant provisions of these Regulations and in the applicable certificates of approval have been fulfilled. ~~†~~The following requirements shall be fulfilled, if applicable:

- ~~(a) For any package it shall be ensured that all the requirements specified in the relevant provisions of these Regulations have been satisfied;~~
- ~~(b)~~ (a) It shall be ensured that lifting attachments which do not meet the requirements of 6.4.2.2 have been removed or otherwise rendered incapable of being used for lifting the package, in accordance with 6.4.2.3;

- ~~(e) For each package requiring competent authority approval, it shall be ensured that all the requirements specified in the approval certificates have been satisfied;~~
- (db) Each Type B(U), Type B(M) and Type C package shall 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;
- (ec) For each Type B(U), Type B(M) and Type C package, it shall be ensured by inspection 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 6.4.8.8 and 6.4.10.3 were made;
- ~~(f) For each special form radioactive material, it shall be ensured that all the requirements specified in the approval certificate and the relevant provisions of these Regulations have been satisfied;~~
- (gd) For packages containing fissile material the measurement specified in 6.4.11.4-5(b) and the tests to demonstrate closure of each package as specified in 6.4.11.7-8 shall be performed where applicable;
- ~~(h) For each low dispersible radioactive material, it shall be ensured that all the requirements specified in the approval certificate and the relevant provisions of these Regulations have been satisfied.~~

[IAEA: 503]

4.1.9.1.89 The consignor shall also have a copy of any instructions with regard to the proper closing of the package and any preparation for shipment before making any shipment under the terms of the certificates.

4.1.9.1.910 Except for consignments under exclusive use, the transport index of any package or overpack shall not exceed 10, nor shall the criticality safety index of any package or overpack exceed 50.

4.1.9.1.1011 Except for packages or overpacks transported under exclusive use by rail or by road under the conditions specified in 7.2.3.1.2 (a), or under exclusive use and special arrangement by vessel or by air under the conditions specified in 7.2.3.2.1 or 7.2.3.3.3 respectively, the maximum radiation level at any point on any external surface of a package or overpack shall not exceed 2 mSv/h.

4.1.9.1.1112 The maximum radiation level at any point on any external surface of a package or overpack under exclusive use shall not exceed 10 mSv/h.

#### 4.1.9.2 Requirements and controls for transport of LSA material and SCO

4.1.9.2.1 The quantity of LSA material or SCO in a single Type IP-1 package, Type IP-2 package, Type IP-3 package, or object or collection of objects, whichever is appropriate, shall be so restricted that the external radiation level at 3 m from the unshielded material or object or collection of objects does not exceed 10 mSv/h.

4.1.9.2.2 For LSA material and SCO which ~~is~~ are or contains fissile material, ~~which is not excepted under 2.7.2.3.5,~~ the applicable requirements of ~~6.4.11.1,~~ 7.1.8.4.1 and 7.1.8.4.2 shall be met.

[IAEA: 518]

~~4.1.9.2.3 For LSA material and SCO which are or contain fissile material, the applicable requirements of 6.4.11.1 shall be met.~~

~~[IAEA: 519]~~

4.1.9.2.34 LSA material and SCO in groups LSA-I and SCO-I may be transported unpackaged under the following conditions:

- (a) All unpackaged material other than ores containing only naturally occurring radionuclides shall be transported in such a manner that under routine conditions of transport there will be no escape of the radioactive contents from the conveyance nor will there be any loss of shielding;
- (b) Each conveyance shall be under exclusive use, except when only transporting SCO-I on which the contamination on the accessible and the inaccessible surfaces is not greater than ten times the applicable level specified in 2.7.1.2; ~~and~~
- (c) For SCO-I where it is suspected that non-fixed contamination exists on inaccessible surfaces in excess of the values specified in 2.7.2.3.2 (a)(i), measures shall be taken to ensure that the radioactive material is not released into the conveyance;

~~(d) Unpackaged fissile material shall meet the requirements of 2.7.2.3.5 (e).~~

~~-[IAEA: 520]~~

4.1.9.2.45 LSA material and SCO, except as otherwise specified in 4.1.9.2.34, shall be packaged in accordance with Table 4.1.9.2.45.

**Table 4.1.9.2.45: Industrial package requirements for LSA material and SCO**

Radioactive contents	Industrial package type	
	Exclusive use	Not under exclusive use
LSA-I Solid <sup>a</sup> Liquid	Type IP-1 Type IP-1	Type IP-1 Type IP-2
LSA-II Solid Liquid and gas	Type IP-2 Type IP-2	Type IP-2 Type IP-3
LSA-III	Type IP-2	Type IP-3
SCO-I <sup>a</sup>	Type IP-1	Type IP-1
SCO-II	Type IP-2	Type IP-2

<sup>a</sup> Under the conditions specified in 4.1.9.2.34, LSA-I material and SCO-I may be transported unpackaged.

~~[IAEA: 521]~~

4.1.9.3 Packages containing fissile material

~~The contents of packages containing fissile material shall be as specified for the package design either directly in these Regulations or in the certificate of approval.~~

~~Unless not classified as fissile in accordance with 2.7.2.3.5, packages containing fissile material shall not contain:~~

~~(a) A mass of fissile material (or mass of each fissile nuclide for mixtures when appropriate) different from that authorized for the package design;~~

~~— (b) — Any radionuclide or fissile material different from those authorized for the package design; or~~

~~— (c) — 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 their certificates of approval where appropriate.~~

~~[IAEA: 418]~~



## CHAPTER 5.1

### GENERAL PROVISIONS

#### 5.1.1 Application and general provisions

5.1.1.1 This Part sets forth the provisions for dangerous goods consignments relative to authorization of consignments and advance notifications, marking, labelling, documentation (by manual, electronic data processing (EDP) or electronic data interchange (EDI) techniques) and placarding.

5.1.1.2 Except as otherwise provided in these Regulations, no person may offer dangerous goods for transport unless those goods are properly marked, labelled, placarded, described and certified on a transport document, and otherwise in a condition for transport as required by this Part.

#### 5.1.2 Use of overpacks

5.1.2.1 An overpack shall be marked with the word “OVERPACK”, with the proper shipping name and the UN number and labelled, as required for packages by Chapter 5.2, for each item of dangerous goods contained in the overpack unless markings and labels representative of all dangerous goods in the overpack are visible, except as required in 5.2.2.1.12.

5.1.2.2 Each package of dangerous goods contained in the overpack shall comply with all applicable provisions of these Regulations. The “overpack” marking is an indication of compliance with this requirement. The intended function of each package shall not be impaired by the overpack.

5.1.2.3 Each package bearing package orientation markings as prescribed in 5.2.1.7 of these Regulations and which is overpacked or placed in a large packaging shall be oriented in accordance with such markings.

#### 5.1.3 Empty packagings

5.1.3.1 Other than for Class 7, a packaging which previously contained dangerous goods shall be identified, marked, labelled and placarded as required for those dangerous goods unless steps such as cleaning, purging of vapours or refilling with a non-dangerous substance are taken to nullify any hazard.

5.1.3.2 ~~Freight containers, Packagings, including tanks, IBCs, and tanks as well as other packagings and overpacks,~~ used for the transport of radioactive material shall not be used for the storage or transport of other goods unless decontaminated below the level of 0.4 Bq/cm<sup>2</sup> for beta and gamma emitters and low toxicity alpha emitters and 0.04 Bq/cm<sup>2</sup> for all other alpha emitters.

[IAEA: 505]

#### 5.1.4 Mixed packing

When two or more dangerous goods are packed within the same outer packaging, the package shall be labelled and marked as required for each substance. Subsidiary risk labels need not be applied if the hazard is already represented by a primary risk label.

## 5.1.5 General provisions for Class 7

### 5.1.5.1 Approval of shipments and notification

#### 5.1.5.1.1 General

In addition to the approval ~~for of~~ package designs described in Chapter 6.4, multilateral shipment approval is also required in certain circumstances (5.1.5.1.2 and 5.1.5.1.3). In some circumstances it is also necessary to notify competent authorities of a shipment (5.1.5.1.4).

#### 5.1.5.1.2 Shipment approvals

Multilateral approval shall be required for:

- (a) The shipment of Type B(M) packages not conforming to the requirements of 6.4.7.5 or designed to allow controlled intermittent venting;
- (b) The shipment of Type B(M) packages containing radioactive material with an activity greater than 3 000 A<sub>1</sub> or 3 000 A<sub>2</sub>, as appropriate, or 1 000 TBq, whichever is the lower;
- (c) The shipment of packages containing fissile materials if the sum of the criticality safety indexes of the packages in a single freight container or in a single conveyance exceeds 50. Excluded from this requirement shall be shipments by seagoing vessels, if the sum of the criticality safety indexes does not exceed 50 for any hold, compartment or defined deck area and the distance of 6 m between groups of packages or overpacks as required in table 7.1.8.4.2 is met; and
- (d) Radiation protection programmes for shipments by special use vessels ~~according to~~ in accordance with 7.2.3.2.2;

except that a competent authority may authorize transport into or through its country without shipment approval, by a specific provision in its design approval (see 5.1.5.2.1).

~~NOTE: Multilateral approval may also be required prior to shipment for the determination of the basic radionuclide values or alternative activity limits for an exempt consignment of instruments or articles (see 2.7.2.2.2 (a) and (b)).~~

#### 5.1.5.1.3 Shipment approval by special arrangement

Provisions may be approved by a competent authority under which a consignment, which does not satisfy all of the applicable requirements of these Regulations may be transported under special arrangement (see 1.1.2.4).

#### 5.1.5.1.4 Notifications

Notification to competent authorities is required as follows:

- (a) Before the first shipment of any package requiring competent authority approval, the consignor shall 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 country through or into which the consignment is to be transported. The consignor 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;

(b) For each of the following types of shipments:

- (i) Type C packages containing radioactive material with an activity greater than 3 000 A<sub>1</sub> or 3 000 A<sub>2</sub>, as appropriate, or 1 000 TBq, whichever is the lower;
- (ii) Type B(U) packages containing radioactive material with an activity greater than 3 000 A<sub>1</sub> or 3 000 A<sub>2</sub>, as appropriate, or 1 000 TBq, whichever is the lower;
- (iii) Type B(M) packages;
- (iv) Shipment under special arrangement,

the consignor shall notify the competent authority of the country of origin of the shipment and the competent authority of each country through or into which the consignment is to be transported. This notification shall be in the hands of each competent authority prior to the commencement of the shipment, and preferably at least 7 days in advance;

(c) The consignor is not required to send a separate notification if the required information has been included in the application for approval of shipment ~~approval~~ (see 6.4.23.2);

[IAEA: 560]

(d) The consignment notification shall include:

- (i) sufficient information to enable the identification of the package or packages including all applicable certificate numbers and identification marks;
- (ii) information on the date of shipment, the expected date of arrival and proposed routing;
- (iii) the names of the radioactive material or nuclides;
- (iv) descriptions of the physical and chemical forms of the radioactive material, or whether it is special form radioactive material or low dispersible radioactive material; and
- (v) the maximum activity of the radioactive contents during transport expressed in units of becquerels (Bq) with an appropriate SI prefix symbol (see 1.2.2.1). For fissile material, the mass of fissile material (or of each fissile nuclide for mixtures when appropriate) in units of grams (g), or multiples thereof, may be used in place of activity.

### 5.1.5.2 *Certificates issued by Competent Authority*

5.1.5.2.1 Certificates issued by the competent authority are required for the following:

(a) Designs for

- (i) special form radioactive material;
- (ii) low dispersible radioactive material;

(iii) Fissile material excepted under 2.7.2.3.5 (f);

~~(iii)~~ (iv) packages containing 0.1 kg or more of uranium hexafluoride;

~~(iv)~~ (v) ~~all~~ packages containing fissile material unless excepted by 2.7.2.3.5, 6.4.11.2 or 6.4.11.3;

- (vi) Type B(U) packages and Type B(M) packages;
- (vii) Type C packages;
- (b) Special arrangements;
- (c) Certain shipments (see 5.1.5.1.2);
- ~~-(d) Determination of the basic radionuclide values referred to in 2.7.2.2.1 for individual radionuclides which are not listed in Table 2.7.2.2.1 (see 2.7.2.2.2 (a));~~
- ~~(ed) Alternative activity limits for an exempt consignment of instruments or articles (see 2.7.2.2.2 (b));~~
- ~~(ed) Certain shipments (see 5.1.5.1.2).~~

The certificates shall confirm that the applicable requirements are met, and for design approvals shall attribute to the design an identification mark. For certificates of approval of alternative activity limits for an exempt consignment of instruments or articles, the competent authority shall attribute to those certificates an identification mark.

The certificates of approval for the package design and the shipment ~~approval certificates~~ may be combined into a single certificate.

~~The competent authority shall attribute to the approved alternative activity limit for an exempt consignment of instruments or articles certificate an identification mark.~~

Certificates and applications for these certificates shall be in accordance with the requirements in 6.4.23.

[IAEA 802, 818]

5.1.5.2.2 The consignor shall be in possession of a copy of each applicable certificate.

5.1.5.2.3 For package designs where it is not required that a competent authority issue a certificate of approval ~~competent authority issued certificate is not required~~, the consignor shall, on request, make available for inspection by the relevant competent authority, documentary evidence of the compliance of the package design with all the applicable requirements.

[IAEA: 801]

5.1.5.3 *Determination of transport index (TI) and criticality safety index (CSI)*

5.1.5.3.1 The transport index (TI) for a package, overpack or freight container, or for unpackaged LSA-I or SCO-I, shall be the number derived in accordance with the following procedure:

- (a) Determine the maximum radiation level in units of millisieverts per hour (mSv/h) at a distance of 1 m from the external surfaces of the package, overpack, freight container, or unpackaged LSA-I and SCO-I. The value determined shall be multiplied by 100 and the resulting number is the transport index. For uranium and thorium ores and their concentrates, the maximum radiation level at any point 1 m from the external surface of the load may be taken as:
 

0.4 mSv/h	for ores and physical concentrates of uranium and thorium;
0.3 mSv/h	for chemical concentrates of thorium;
0.02 mSv/h	for chemical concentrates of uranium, other than uranium hexafluoride;

- (b) For tanks, freight containers and unpackaged LSA-I and SCO-I, the value determined in step (a) above shall be multiplied by the appropriate factor from Table 5.1.5.3.1;
- (c) The value obtained in steps (a) and (b) above shall 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.

**Table 5.1.5.3.1: Multiplication factors for tanks, freight containers and unpackaged LSA-I and SCO-I**

Size of load <sup>a</sup>	Multiplication factor
size of load $\leq 1 \text{ m}^2$	1
$1 \text{ m}^2 < \text{size of load} \leq 5 \text{ m}^2$	2
$5 \text{ m}^2 < \text{size of load} \leq 20 \text{ m}^2$	3
$20 \text{ m}^2 < \text{size of load}$	10

<sup>a</sup> Largest cross-sectional area of the load being measured.

5.1.5.3.2 The transport index for each overpack, freight container or conveyance shall 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 shall be determined only as the sum of the TIs of all the packages.

5.1.5.3.3 The criticality safety index for each overpack or freight container shall be determined as the sum of the CSIs of all the packages contained. The same procedure shall be followed for determining the total sum of the CSIs in a consignment or aboard a conveyance.

5.1.5.3.4 Packages, ~~and~~ overpacks and freight containers shall be assigned to either category I-WHITE, II-YELLOW or III-YELLOW in accordance with the conditions specified in Table 5.1.5.3.4 and with the following requirements:

- (a) For a package, ~~or~~ overpack or freight container, both the transport index and the surface radiation level conditions shall 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, ~~or~~ overpack or freight container shall be assigned to the higher category. For this purpose, category I-WHITE shall be regarded as the lowest category;
- (b) The transport index shall be determined following the procedures specified in 5.1.5.3.1 and 5.1.5.3.2;
- (c) If the surface radiation level is greater than 2 mSv/h, the package or overpack shall be transported under exclusive use and under the provisions of 7.2.3.1.3, 7.2.3.2.1, or 7.2.3.3.3, as appropriate;
- (d) A package transported under a special arrangement shall be assigned to category III-YELLOW except under the provisions of 5.1.5.3.5;
- (e) An overpack or freight container which contains packages transported under special arrangement shall be assigned to category III-YELLOW except under the provisions of 5.1.5.3.5.

[IAEA: 529]

Table 5.1.5.3.4: Categories of packages, ~~and~~ overpacks and freight containers

Conditions		
Transport index	Maximum radiation level at any point on external surface	Category
0 <sup>a</sup>	Not more than 0.005 mSv/h	I-WHITE
More than 0 but not more than 1 <sup>a</sup>	More than 0.005 mSv/h but not more than 0.5 mSv/h	II-YELLOW
More than 1 but not more than 10	More than 0.5 mSv/h but not more than 2 mSv/h	III-YELLOW
More than 10	More than 2 mSv/h but not more than 10 mSv/h	III-YELLOW <sup>b</sup>

<sup>a</sup> If the measured TI is not greater than 0.05, the value quoted may be zero in accordance with 5.1.5.3.1(c).

<sup>b</sup> Shall also be transported under exclusive use except for freight containers (see Table 7.1.8.3.3).

5.1.5.3.5 In all cases of international transport of packages requiring competent authority approval of design or shipment ~~approval~~, for which different approval types apply in the different countries concerned by the shipment, the categorization shall be in accordance with the certificate of the country of origin of design.  
[IAEA: 530]

#### 5.1.5.4 *Specific provisions for excepted packages*

5.1.5.4.1 Excepted packages shall be legibly and durably marked on the outside of the packaging with:

- (a) The UN number preceded by the letters “UN”;
- (b) An identification of either the consignor or consignee, or both; and
- (c) The permissible gross mass if this exceeds 50 kg.

5.1.5.4.2 The documentation requirements of Chapter 5.4 do not apply to excepted packages of radioactive material, except that:

(a)- The UN number preceded by the letters “UN” and the name and address of the consignor and the consignee and, if relevant, the identification mark for each competent authority certificate of approval (see 5.4.1.5.7.1 (g)) shall be shown on a transport document such as a bill of lading, air waybill or other similar document complying with the requirements of 5.4.1.2.1 to ~~5.4.1.2.3~~ 5.4.1.2.4.

(b) ~~†~~The requirements of 5.4.1.6.2 and, if relevant, those of 5.4.1.5.7.1 (g), 5.4.1.5.7.3 and 5.4.1.5.7.4 shall apply.

(c) The requirements of 5.4.2 and 5.4.4 shall apply.

5.1.5.4.3 The requirements of 5.2.1.5.8 and 5.2.2.1.12.5 shall apply if relevant.

## CHAPTER 5.2

### MARKING AND LABELLING

#### 5.2.1 Marking

5.2.1.1 Unless provided otherwise in these Regulations, the proper shipping name for the dangerous goods as determined in accordance with 3.1.2 and the corresponding UN number preceded by the letters “UN”, shall be displayed on each package. The UN number and the letters “UN” shall be at least 12 mm high, except for packagings of 30 litres or 30 kg capacity or less, when they shall be at least 6 mm in height and for packagings of 5 litres or 5 kg or less when they shall be of an appropriate size. In the case of unpackaged articles the marking shall be displayed on the article, on its cradle or on its handling, storage or launching device. For goods of Division 1.4, Compatibility Group S, the division and compatibility group letter shall also be marked unless the label for 1.4S is displayed. A typical package marking is:

Corrosive liquid, acidic, organic, n.o.s. (Caprylyl chloride) UN 3265.

**NOTE:** *The size requirements for the UN number marking shall apply as from 1 January 2014.*

5.2.1.2 All package markings required by 5.2.1.1:

- (a) Shall be readily visible and legible;
- (b) Shall be able to withstand open weather exposure without a substantial reduction in effectiveness;
- (c) Shall be displayed on a background of contrasting colour on the external surface of the package; and
- (d) Shall not be located with other package markings that could substantially reduce their effectiveness.

5.2.1.3 Salvage packagings and salvage pressure receptacles shall additionally be marked with the word “SALVAGE”.

5.2.1.4 Intermediate bulk containers of more than 450 litres capacity and large packagings shall be marked on two opposing sides.

5.2.1.5 *Special marking provisions for Class 7*

5.2.1.5.1 Each package shall be legibly and durably marked on the outside of the packaging with an identification of either the consignor or consignee, or both. Each overpack shall be legibly and durably marked on the outside of the overpack with an identification of either the consignor or consignee, or both unless these markings of all packages within the overpack are clearly visible.  
[IAEA: 531]

5.2.1.5.2 The marking of excepted packages shall be as required by 5.1.5.4.1.

5.2.1.5.3 Each package of gross mass exceeding 50 kg shall have its permissible gross mass legibly and durably marked on the outside of the packaging.

5.2.1.5.4 Each package which conforms to:

- (a) a Type IP-1 package, a Type IP-2 package or a Type IP-3 package design shall be legibly and durably marked on the outside of the packaging with “TYPE IP-1”, “TYPE IP-2” or “TYPE IP-3” as appropriate;
- (b) a Type A package design shall be legibly and durably marked on the outside of the packaging with “TYPE A”;
- (c) a Type IP-2 package, a Type IP-3 or a Type A package design shall be legibly and durably marked on the outside of the packaging with the international vehicle registration code (VRI Code) of the country of origin of design and either the name of the manufacturer or other identification of the packaging specified by the competent authority of the country of origin of design.

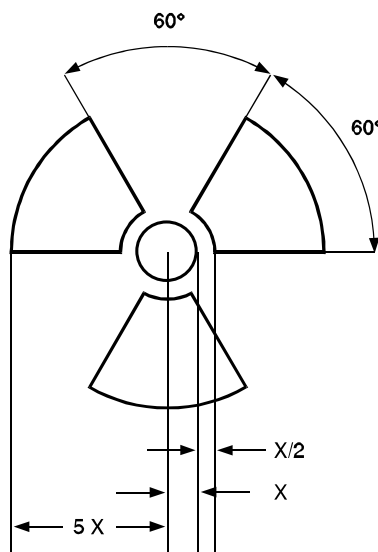
5.2.1.5.5 Each package which conforms to a design approved under one or more of paragraphs 5.1.5.2.1, 6.4.22.1 to 6.4.22.4, 6.4.23.4 to 6.4.23.7 and 6.4.24.2 ~~by the competent authority~~ shall be legibly and durably marked on the outside of the packaging with the following information:

- (a) the identification mark allocated to that design by the competent authority;
- (b) a serial number to uniquely identify each packaging which conforms to that design;
- (c) “TYPE B(U)”, “TYPE B(M)” or “TYPE C(M)”, in the case of a Type B(U), ~~or~~ Type B(M) or Type C package design, ~~with “TYPE B(U)” or “TYPE B(M)”~~; and
- ~~(d) in the case of a Type C package design, with “TYPE C”.~~

[IAEA: 535]

5.2.1.5.6 Each package which conforms to a Type B(U), Type B(M) or Type C package design shall have the outside of the outermost receptacle which is resistant to the effects of fire and water plainly marked by embossing, stamping or other means resistant to the effects of fire and water with the trefoil symbol shown in the figure below:

Figure 5.2.1  
Basic trefoil symbol with proportions based on a central circle of radius X.  
The minimum allowable size of X shall be 4 mm.





5.2.1.5.7 Where LSA-I or SCO-I material is contained in receptacles or wrapping materials and is transported under exclusive use as permitted by 4.1.9.2.34, the outer surface of these receptacles or wrapping materials may bear the marking “RADIOACTIVE LSA-I” or “RADIOACTIVE SCO-I”, as appropriate.

[IAEA: 537]

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

[IAEA: 530]

#### 5.2.1.6 *Special marking provisions for environmentally hazardous substances*

5.2.1.6.1 Packages containing environmentally hazardous substances meeting the criteria of 2.9.3 (UN Nos. 3077 and 3082) shall be durably marked with the environmentally hazardous substance mark with the exception of single packagings and combination packagings where such single packagings or inner packagings of such combination packagings have:

- a net quantity of 5 l or less for liquids; or
- a net mass of 5 kg or less for solids.

5.2.1.6.2 The environmentally hazardous substance mark shall be located adjacent to the markings required by 5.2.1.1. The requirements of 5.2.1.2 and 5.2.1.4 shall be met.

5.2.1.6.3 The environmentally hazardous substance mark shall be as shown in Figure 5.2.2. For packagings, the dimensions shall be 100 mm × 100 mm, except in the case of packages of such dimensions that they can only bear smaller marks. For cargo transport units (see 5.3.2.3.1), the minimum dimensions shall be 250 mm × 250 mm.

**Figure 5.2.2**



Symbol (fish and tree): black on white or suitable contrasting background

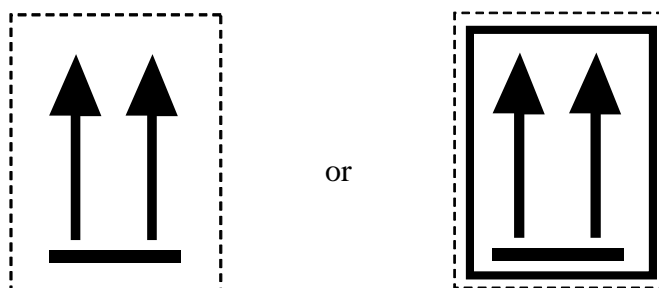
**NOTE:** *The labelling provisions of 5.2.2 apply in addition to any requirement for packages to bear the environmentally hazardous substance mark.*

#### 5.2.1.7 *Orientation arrows*

5.2.1.7.1 Except as provided in 5.2.1.7.2:

- combination packagings having inner packagings containing liquid dangerous goods;
- single packagings fitted with vents; and
- cryogenic receptacles intended for the transport of refrigerated liquefied gases,

shall be legibly marked with package orientation arrows which are similar to the illustration shown below or with those meeting the specifications of ISO 780:1997. The orientation arrows shall appear on two opposite vertical sides of the package with the arrows pointing in the correct upright direction. They shall be rectangular and of a size that is clearly visible commensurate with the size of the package. Depicting a rectangular border around the arrows is optional.



Two black or red arrows on white or suitable contrasting background. The rectangular border is optional

5.2.1.7.2 Orientation arrows are not required on:

- (a) Outer packagings containing pressure receptacles except cryogenic receptacles;
- (b) Outer packagings containing dangerous goods in inner packagings each containing not more than 120 ml, with sufficient absorbent material between the inner and outer packagings to completely absorb the liquid contents;
- (c) Outer packagings containing division 6.2 infectious substances in primary receptacles each containing not more than 50 ml;
- (d) Type IP-2, type IP-3, type A, type B(U), type B(M) or type C packages containing Class 7 radioactive material;
- (e) Outer packagings containing articles which are leak-tight in all orientations (e.g. alcohol or mercury in thermometers, aerosols, etc.); or
- (f) Outer packagings containing dangerous goods in hermetically sealed inner packagings each containing not more than 500 ml.

5.2.1.7.3 Arrows for purposes other than indicating proper package orientation shall not be displayed on a package marked in accordance with this sub-section.

#### 5.2.1.8 *Excepted quantities mark*

Packages containing excepted quantities of dangerous goods shall be marked according to 3.5.4.

## 5.2.2 Labelling

### 5.2.2.1 Labelling provisions

**NOTE:** *These provisions relate essentially to danger labels. However, additional markings or symbols indicating precautions to be taken in handling or storing a package (e.g. a symbol representing an umbrella indicating that a package shall be kept dry) may be displayed on a package if appropriate.*

5.2.2.1.1 Labels identifying primary and subsidiary risks shall conform to models Nos. 1 to 9 illustrated in 5.2.2.2.2. The “EXPLOSIVE” subsidiary risk label is model No. 1.

5.2.2.1.2 Where articles or substances are specifically listed in the Dangerous Goods List, a danger class label shall be affixed for the hazard shown in Column 3. A subsidiary risk label shall also be affixed for any risk indicated by a class or division number in the Column 4 of the Dangerous Goods List. However, special provisions indicated in Column 6 may also require a subsidiary risk label where no subsidiary risk is indicated in Column 4 or may exempt from the requirement for a subsidiary risk label where such a risk is indicated in the Dangerous Goods List.

5.2.2.1.3 Except as provided in 5.2.2.1.3.1, if a substance which meets the definition of more than one class is not specifically listed by name in the Dangerous Goods List in Chapter 3.2, the provisions in Chapter 2.0 shall be used to determine the primary risk class of the goods. In addition to the label required for that primary risk class, subsidiary risk labels shall also be applied as specified in the Dangerous Goods List.

5.2.2.1.3.1 Packages containing substances of Class 8 need not bear subsidiary risk label model No. 6.1 if the toxicity arises solely from the destructive effect on tissue. Packages containing substances of Division 4.2 need not bear subsidiary risk label model No. 4.1.

#### 5.2.2.1.4 Labels for Class 2 gases with subsidiary risk(s)

Division	Subsidiary risk(s) shown in Chapter 2.2	Primary risk label	Subsidiary risk label(s)
2.1	None	2.1	None
2.2	None	2.2	None
	5.1	2.2	5.1
2.3	None	2.3	None
	2.1	2.3	2.1
	5.1	2.3	5.1
	5.1, 8	2.3	5.1, 8
	8	2.3	8
	2.1, 8	2.3	2.1, 8

5.2.2.1.5 Three separate labels have been provided for Class 2, one for flammable gases of Division 2.1 (red), one for non-flammable, non-toxic gases of Division 2.2 (green) and one for toxic gases of Division 2.3 (white). Where the Dangerous Goods List indicates that a Class 2 gas possesses single or multiple subsidiary risks, labels shall be used in accordance with the table in 5.2.2.1.4.

5.2.2.1.6 Except as provided in 5.2.2.2.1.2, each label shall:

- (a) Be located on the same surface of the package near the proper shipping name marking, if the package dimensions are adequate;

- (b) Be so placed on the packaging that they are not covered or obscured by any part or attachment to the packaging or any other label or marking; and
- (c) When primary and subsidiary risk labels are required, be displayed next to each other.

Where a package is of such an irregular shape or small size that a label cannot be satisfactorily affixed, the label may be attached to the package by a securely affixed tag or other suitable means.

5.2.2.1.7 Intermediate bulk containers of more than 450 litres capacity and large packagings shall be labelled on two opposing sides.

5.2.2.1.8 Labels shall be affixed on a surface of contrasting colour.

5.2.2.1.9 *Special provisions for the labelling of self-reactive substances*

An “EXPLOSIVE” subsidiary risk label (Model No. 1) shall be applied for type B self-reactive substances, unless the competent authority has permitted this label to be dispensed with for a specific packaging because test data have proved that the self-reactive substance in such a packaging does not exhibit explosive behaviour.

5.2.2.1.10 *Special provisions for the labelling of organic peroxides*

The Division 5.2 label (model No. 5.2) shall be affixed to packages containing organic peroxides classified as types B, C, D, E or F. This label also implies that the product may be flammable and hence no “FLAMMABLE LIQUID”, subsidiary risk label (model No. 3) is required. In addition, the following subsidiary risk labels shall be applied:

- (a) An “EXPLOSIVE” subsidiary risk label (model No. 1) for organic peroxides type B, unless the competent authority has permitted this label to be dispensed with for a specific packaging because test data have proved that the organic peroxide in such a packaging does not exhibit explosive behaviour;
- (b) A “CORROSIVE” subsidiary risk label (model No. 8) is required when packing group I or II criteria of Class 8 are met.

5.2.2.1.11 *Special provisions for the labelling of infectious substances packages*

In addition to the primary risk label (model No. 6.2), infectious substances packages shall bear any other label required by the nature of the contents.

5.2.2.1.12 *Special provisions for the labelling of radioactive material*

5.2.2.1.12.1 Except when enlarged labels are used in accordance with 5.3.1.1.5.1, each package, overpack and freight container containing radioactive material shall bear at least two labels ~~which conforming to the applicable models Nos. 7A, 7B, and or 7C, except as allowed under the alternative provisions of 5.3.1.1.5.1 for large freight containers and tanks, as appropriate according to the appropriate category, (see 5.1.5.3.4) of that package, overpack or freight container.~~ Labels shall be affixed to two opposite sides on the outside of the package or ~~overpack or~~ on the outside of all four sides of ~~the a~~ freight container ~~or tank~~. Each overpack containing radioactive material shall bear at least two labels on opposite sides of the outside of the overpack. In addition, each package, overpack and freight container containing fissile material, other than fissile material excepted under ~~the provisions of 6.4.11.22.7.2.3.5~~ shall bear labels ~~which conforming to model No. 7E; such labels, where applicable shall be affixed adjacent to the labels conforming to the applicable model No. 7A, 7B and or 7C for radioactive material.~~ Labels shall not cover the markings specified in 5.2.1. Any labels which do not relate to the contents shall be removed or covered.

*[IAEA: 538 and 539]*

5.2.2.1.12.2 Each label conforming to the applicable models ~~numbers No. 7A, 7B, and or 7C~~ shall be completed with the following information:

- (a) Contents:
  - (i) except for LSA-I material, the name(s) of the radionuclide(s) as taken from Table 2.7.2.2.1, using the symbols prescribed therein. For mixtures of radionuclides, the most restrictive nuclides shall be listed to the extent the space on the line permits. The group of LSA or SCO shall be shown following the name(s) of the radionuclide(s). The terms “LSA-II”, “LSA-III”, “SCO-I” and “SCO-II” shall be used for this purpose;
  - (ii) for LSA-I material, the term “LSA-I” is all that is necessary; the name of the radionuclide is not necessary;
- (b) Activity: The maximum activity of the radioactive contents during transport expressed in units of becquerels (Bq) with the appropriate SI prefix symbol (see 1.2.2.1). For fissile material, the total mass of ~~fissile material (or mass of each fissile nuclide for mixtures when appropriate)~~ in units of grams (g), or multiples thereof, may be used in place of activity;
- (c) For overpacks and freight containers the “contents” and “activity” entries on the label shall bear the information required in 5.2.2.1.12.2 (a) and 5.2.2.1.12.2 (b), respectively, totalled together for the entire contents of the overpack or freight container except that on labels for overpacks or freight containers containing mixed loads of packages containing different radionuclides, such entries may read “See Transport Documents”;
- (d) Transport index: The number determined in accordance with 5.1.5.3.1 and 5.1.5.3.2 (no transport index entry is required for category I-WHITE).

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5.2.2.1.12.3 Each label conforming to the model No. 7E shall be completed with the criticality safety index (CSI) as stated in the certificate of approval applicable in the countries through or into which the consignment is transported and for special arrangement or the certificate of approval for the package design issued by the competent authority or as specified in 6.4.11.2 or 6.4.11.3.

[IAEA: 541]

5.2.2.1.12.4 For overpacks and freight containers, the label conforming to model No. 7E ~~the criticality safety index (CSI) on the label~~ shall bear the sum of the criticality safety indexes of all the packages contained therein ~~information required in 5.2.2.1.12.3 totalled together for the fissile contents of the overpack or freight container~~.

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

[IAEA: 530]

## 5.2.2.2 Provisions for labels

5.2.2.2.1 Labels shall satisfy the provisions of this section and conform, in terms of colour, symbols and general format, to the specimen labels shown in 5.2.2.2.2.

**NOTE:** Where appropriate, labels in 5.2.2.2.2 are shown with a dotted outer boundary as provided for in 5.2.2.2.1.1. This is not required when the label is applied on a background of contrasting colour.

5.2.2.2.1.1 Labels shall be in the form of a square set at an angle of 45° (diamond-shaped) with minimum dimensions of 100 mm by 100 mm, except in the case of packages of such dimensions that they can only bear smaller labels and as provided in 5.2.2.2.1.2. They shall have a line 5 mm inside the edge and running parallel with it. In the upper half of a label the line shall have the same colour as the symbol and in the lower half it shall have the same colour as the figure in the bottom corner. Labels shall be displayed on a background of contrasting colour, or shall have either a dotted or solid outer boundary line.

5.2.2.2.1.2 Cylinders for Class 2 may, on account of their shape, orientation and securing mechanisms for transport, bear labels representative of those specified in this section, which have been reduced in size, according to ISO 7225:2005, for display on the non-cylindrical part (shoulder) of such cylinders. Labels may overlap to the extent provided for by ISO 7225:2005 “Gas cylinders – Precautionary labels”, however, in all cases, the labels representing the primary hazard and the numbers appearing on any label shall remain fully visible and the symbols recognisable.

5.2.2.2.1.3 With the exception of labels for divisions 1.4, 1.5 and 1.6 of Class 1, the upper half of the label shall contain the pictorial symbol and the lower half shall contain the class or division number 1, 2, 3, 4, 5.1, 5.2, 6, 7, 8 or 9 as appropriate. The label may include such text as the UN number, or words describing the hazard class (e.g. “flammable”) in accordance with 5.2.2.2.1.5 provided that the text does not obscure or detract from the other required label elements.

5.2.2.2.1.4 In addition, except for divisions 1.4, 1.5 and 1.6, labels for Class 1 shall show in the lower half, above the class number, the division number and the compatibility group letter for the substance or article. Labels for divisions 1.4, 1.5 and 1.6 shall show in the upper half the division number, and in the lower half the class number and the compatibility group letter. For Division 1.4, Compatibility Group S, no label is generally required. However, in cases where a label is considered necessary for such goods, it shall be based on model No. 1.4.

5.2.2.2.1.5 On labels other than those for material of Class 7, the insertion of any text (other than the class or division number) in the space below the symbol shall be confined to particulars indicating the nature of the risk and precautions to be taken in handling.

5.2.2.2.1.6 The symbols, text and numbers shall be shown in black on all labels except for:

- (a) The Class 8 label, where the text (if any) and class number shall appear in white;
- (b) Labels with entirely green, red or blue backgrounds where they may be shown in white;
- (c) The Division 5.2 label, where the symbol may be shown in white; and
- (d) The Division 2.1 label displayed on cylinders and gas cartridges for liquefied petroleum gases, where they may be shown in the background colour of the receptacle if adequate contrast is provided.

5.2.2.2.1.7 All labels shall be able to withstand open weather exposure without a substantial reduction in effectiveness.

## 5.2.2.2.2 Specimen labels

**CLASS 1****Explosive substances or articles**

(No. 1)

Divisions 1.1, 1.2 and 1.3

Symbol (exploding bomb): black; Background: orange; Figure '1' in bottom corner



(No. 1.4)

Division 1.4



(No. 1.5)

Division 1.5



(No. 1.6)

Division 1.6

Background: orange; Figures: black; Numerals shall be about 30 mm in height and be about 5 mm thick (for a label measuring 100 mm x 100 mm); Figure '1' in bottom corner

\*\* Place for division - to be left blank if explosive is the subsidiary risk

\* Place for compatibility group - to be left blank if explosive is the subsidiary risk

**CLASS 2****Gases**

(No. 2.1)

Division 2.1

Flammable gases

Symbol (flame): black or white;  
(except as provided for in 5.2.2.2.1.6 (d))  
Background: red; Figure '2' in bottom corner

(No. 2.2)

Division 2.2

Non-flammable, non-toxic gases

Symbol (gas cylinder): black or white;  
Background: green; Figure '2' in bottom corner**CLASS 3****Flammable liquids**

(No. 2.3)

Division 2.3

Toxic gases

Symbol (skull and crossbones): black;  
Background: white; Figure '2' in bottom corner

(No. 3)

Symbol (flame): black or white;

Background: red; Figure '3' in bottom corner





## CLASS 4



(No. 4.1)  
Division 4.1  
Flammable solids  
Symbol (flame): black;  
Background: white with  
seven vertical red stripes;  
Figure '4' in bottom corner



(No. 4.2)  
Division 4.2  
Substances liable  
to spontaneous combustion  
Symbol (flame): black;  
Background: upper half white,  
lower half red;  
Figure '4' in bottom corner



(No. 4.3)  
Division 4.3  
Substances which, in contact  
with water, emit flammable gases  
Symbol (flame): black or white;  
Background: blue;  
Figure '4' in bottom corner



## CLASS 5



(No. 5.1)  
Division 5.1  
Oxidizing substances  
Symbol (flame over circle): black;  
Background: yellow;  
Figure '5.1' in bottom corner



(No. 5.2)  
Division 5.2  
Organic peroxides  
Symbol (flame); black or white;  
Background: upper half red; lower half yellow;  
Figure '5.2' in bottom corner



## CLASS 6



(No. 6.1)  
Division 6.1  
Toxic substances  
Symbol (skull and crossbones): black;  
Background: white; Figure '6' in bottom corner



(No. 6.2)  
Division 6.2  
Infectious substances  
The lower half of the label may bear the inscriptions: 'INFECTIOUS SUBSTANCE'  
and 'In the case of damage or leakage immediately notify Public Health Authority';  
Symbol (three crescents superimposed on a circle) and inscriptions: black;  
Background: white; Figure '6' in bottom corner



# **CLASS 7** **Radioactive material**



(No. 7A)  
Category I – White  
Symbol (trefoil): black;  
Background: white;  
Text (mandatory): black in lower half of label:  
'RADIOACTIVE'  
'CONTENTS .....'  
'ACTIVITY .....'  
One red bar shall  
follow the word 'RADIOACTIVE';  
Figure '7' in bottom corner



(No. 7B)  
Category II – Yellow  
Symbol (trefoil): black;  
Background: upper half yellow with white border, lower half white;  
Text (mandatory): black in lower half of label:  
'RADIOACTIVE'  
'CONTENTS .....'  
'ACTIVITY .....'  
In a black outlined box: 'TRANSPORT INDEX';  
Two red vertical bars shall  
follow the word  
'RADIOACTIVE';  
Figure '7' in bottom corner



(No. 7C)  
Category III – Yellow  
Symbol (trefoil): black;  
Background: upper half yellow with white border, lower half white;  
Text (mandatory): black in lower half of label:  
'RADIOACTIVE'  
'CONTENTS .....'  
'ACTIVITY .....'  
In a black outlined box: 'TRANSPORT INDEX';  
Three red vertical bars shall  
follow the word  
'RADIOACTIVE';  
Figure '7' in bottom corner



(No. 7E)  
Class 7 fissile material  
Background: white;  
Text (mandatory): black in upper half of label: 'FISSILE';  
In a black outlined box in the lower half of the label:  
'CRITICALITY SAFETY INDEX'  
Figure '7' in bottom corner

## **CLASS 8** **Corrosive substances**



(No. 8)  
Symbol (liquids, spilling from two glass vessels  
and attacking a hand and a metal): black;  
Background: upper half white;  
lower half black with white border;  
Figure '8' in bottom corner

## **CLASS 9** **Miscellaneous dangerous substances and articles, including environmentally hazardous substances**



(No. 9)  
Symbol (seven vertical stripes in upper half): black;  
Background: white;  
Figure '9' underlined in bottom corner

## CHAPTER 5.3

### PLACARDING AND MARKING OF CARGO TRANSPORT UNITS

#### 5.3.1 Placarding

##### 5.3.1.1 *Placarding provisions*

###### 5.3.1.1.1 *Deleted.*

5.3.1.1.2 Placards shall be affixed to the exterior surface of cargo transport units to provide a warning that the contents of the unit are dangerous goods and present risks. Placards shall correspond to the primary risk of the goods contained in the cargo transport unit except that:

- (a) Placards are not required on cargo transport units carrying any quantity of explosives of Division 1.4, Compatibility Group S; and
- (b) Placards indicating the highest risk only need be affixed on cargo transport units carrying substances and articles of more than one division in Class 1.

Placards shall be displayed on a background of contrasting colour, or shall have either a dotted or solid outer boundary line.

5.3.1.1.3 Placards shall also be displayed for those subsidiary risks for which a subsidiary risk label is required according to 5.2.2.1.2. However, cargo transport units containing goods of more than one class need not bear a subsidiary risk placard if the hazard represented by that placard is already indicated by a primary risk placard.

5.3.1.1.4 Cargo transport units carrying dangerous goods or the residue of dangerous goods in unpurged tanks or empty uncleaned bulk containers shall display placards clearly visible on at least two opposing sides of the units and in any case in such a position as may be seen by all those involved in the loading or unloading process. Where the cargo transport unit has a multiple compartment tank which is carrying two or more dangerous goods and/or the residues of dangerous goods, appropriate placards shall be displayed along each side at the position of the relevant compartments.

###### 5.3.1.1.5 *Special provisions for Class 7*

5.3.1.1.5.1 Large freight containers carrying packages other than excepted packages, and tanks shall bear four placards which conform to the model No.7D given in Figure 5.3.1. The placards shall be affixed in a vertical orientation to each side wall and each end wall of the large freight container or tank. Any placards which do not relate to the contents shall be removed. Instead of using both labels and placards, it is permitted as an alternative to use enlarged labels only, as shown in label model Nos. 7A, 7B and 7C, ~~and where appropriate 7E, with dimensions as required for the placard~~ except having the minimum size shown in Figure 5.3.1.

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5.3.1.1.5.2 Rail and road vehicles carrying packages, overpacks or freight containers labelled with any of the labels shown in 5.2.2.2.2 as models No. 7A, 7B, 7C ~~or~~ and 7E, or carrying consignments under exclusive use, shall display the placard shown in Figure 5.3.1 (Model No. 7D) on each of:

- (a) the two external lateral walls in the case of a rail vehicle;
- (b) the two external lateral walls and the external rear wall in the case of a road vehicle.

In the case of a vehicle without sides the placards may be affixed directly on the cargo-carrying unit provided that they are readily visible; in the case of physically large tanks or freight containers, the placards on the tanks or freight containers shall suffice. In the case of vehicles which have insufficient area to allow the fixing of larger placards, the dimensions of the placard as described in Figure 5.3.1 may be reduced to 100 mm. Any placards which do not relate to the contents shall be removed.

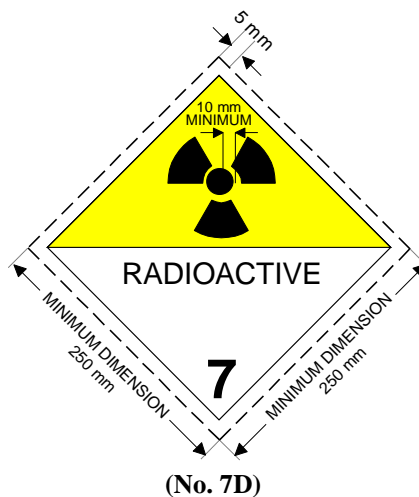
### 5.3.1.2 *Specifications for placards*

5.3.1.2.1 Except as provided in 5.3.1.2.2 for the Class 7 placard, a placard shall:

- (a) Be not less than 250 mm by 250 mm, with a line running 12.5 mm inside the edge and parallel with it. In the upper half of the label the line shall have the same colour as the symbol and in the lower half it shall have the same colour as the figure in the bottom corner;
- (b) Correspond to the label for the class of the dangerous goods in question with respect to colour and symbol; and
- (c) Display the number of the class or division (and for goods in Class 1, the compatibility group letter) of the dangerous goods in question in the manner prescribed in 5.2.2.2 for the corresponding label, in digits not less than 25 mm high.

5.3.1.2.2 For Class 7, the placard shall have minimum overall dimensions of 250 mm by 250 mm (except as permitted by 5.3.1.1.5.2) with a black line running 5 mm inside the edge and parallel with it, and shall be otherwise as shown in Figure 5.3.1 below. When different dimensions are used, the relative proportions shall be maintained. The number “7” shall not be less than 25 mm high. The background colour of the upper half of the placard shall be yellow and of the lower half white, the colour of the trefoil and the printing shall be black. The use of the word “RADIOACTIVE” in the bottom half is optional to allow the use of this placard to display the appropriate United Nations number for the consignment.

Figure 5.3.1  
Placard for radioactive material of Class 7



(No. 7D)

Symbol (trefoil): black; Background: upper half yellow with white border, lower half white; The lower half shall show the word RADIOACTIVE or alternatively, when required (see 5.3.2.1), the appropriate UN number; and the figure “7” in the bottom corner

## 5.3.2 Marking

5.3.2.1 *Display of UN numbers*

5.3.2.1.1 Except for goods of Class 1, the UN number shall be displayed as required by this section on consignments of:

- (a) Solids, liquids or gases transported in tank cargo transport units including on each component of a multicompartment tank cargo transport unit;
- (b) Solids in bulk containers;
- (c) Packaged dangerous goods of a single commodity which constitute a full load for the cargo transport unit;
- (d) Unpackaged LSA-1 or SCO-1 material of Class 7 in or on a vehicle, or in a freight container, or in a tank; and
- (e) Packaged radioactive material with a single UN number in or on a vehicle, or in a freight container, when required to be transported under exclusive use.

5.3.2.1.2 The UN number for the goods shall be displayed in black digits not less than 65 mm high, either:

- (a) Against a white background in the area below the pictorial symbol and above the class or division number and the compatibility group letter in a manner that does not obscure or detract from the other required label elements (see Figures 5.3.1 and 5.3.2); or
- (b) On an orange rectangular panel not less than 120 mm high and 300 mm wide, with a 10 mm black border, to be placed immediately adjacent to each placard (see Figure 5.3.3).

5.3.2.1.3 *Examples of display of UN numbers*

Figure 5.3.2



- \* location of class or division number
- \*\* location of UN number

Figure 5.3.3



### 5.3.2.2 *Elevated temperature substances*

Cargo transport units containing a substance that is transported or offered for transport in a liquid state at a temperature equal to or exceeding 100 °C, in a solid state at a temperature equal to or exceeding 240 °C shall bear on each side and on each end the mark shown in Figure 5.3.4. The triangular shaped mark shall have sides of at least 250 mm and shall be shown in red.

**Figure 5.3.4**  
**Mark for carriage at elevated temperature**



### 5.3.2.3 *Environmentally hazardous substance mark*

5.3.2.3.1 A cargo transport unit containing environmentally hazardous substances meeting the criteria of 2.9.3 (UN Nos. 3077 and 3082) shall be marked on at least two opposing sides of the unit and in any case in such a position as may be seen by all those involved in the loading or unloading processes, with the environmentally hazardous substance mark to be affixed in accordance with the provisions of 5.3.1.1.4 for placards.

## CHAPTER 5.4

### DOCUMENTATION

#### Introductory note

**NOTE:** *These Regulations do not preclude the use of electronic data processing (EDP) and electronic data interchange (EDI) transmission techniques as an alternative to paper documentation. All references to “dangerous goods transport document” in this Chapter also include provision of the required information by use of EDP and EDI transmission techniques.*

#### 5.4.1 Dangerous goods transport information

##### 5.4.1.1 General

5.4.1.1.1 Except as otherwise provided, the consignor who offers dangerous goods for transport shall give to the carrier the information applicable to those dangerous goods, including any additional information and documentation as specified in these Regulations. This information may be provided on a dangerous goods transport document or, with the agreement of the carrier, by EDP or EDI techniques.

5.4.1.1.2 When a paper document is used, the consignor shall give the initial carrier a copy of the dangerous goods transport document, completed and signed as required in this Chapter.

5.4.1.1.3 When the dangerous goods transport information is given to the carrier by EDP or EDI techniques, the consignor shall be able to produce the information without delay as a paper document, with the information in the sequence required by this Chapter.

##### 5.4.1.2 Form of the transport document

5.4.1.2.1 A dangerous goods transport document may be in any form, provided it contains all of the information required by these Regulations.

5.4.1.2.2 If both dangerous and non-dangerous goods are listed in one document, the dangerous goods shall be listed first, or otherwise be emphasised.

##### 5.4.1.2.3 Continuation page

A dangerous goods transport document may consist of more than one page, provided pages are consecutively numbered.

5.4.1.2.4 The information on a dangerous goods transport document shall be easy to identify, legible and durable.

#### 5.4.1.2.5 *Example of a dangerous goods transport document*

The form shown in Figure 5.4.1 at the end of this Chapter is an example of a dangerous goods transport document<sup>2</sup>.

#### 5.4.1.3 *Consignor, consignee and date*

The name and address of the consignor and the consignee of the dangerous goods shall be included on the dangerous goods transport document. The date the dangerous goods transport document or an electronic copy of it was prepared or given to the initial carrier shall be included.

#### 5.4.1.4 *Information required on the dangerous goods transport document*

##### 5.4.1.4.1 *Dangerous goods description*

The dangerous goods transport document shall contain the following information for each dangerous substance, material or article offered for transport:

- (a) The UN number preceded by the letters “UN”;
- (b) The proper shipping name, as determined according to 3.1.2, including the technical name enclosed in parenthesis, as applicable (see 3.1.2.8);
- (c) The primary hazard class or, when assigned, the division of the goods, including for Class 1, the compatibility group letter. The words “Class” or “Division” may be included preceding the primary hazard class or division numbers;
- (d) Subsidiary hazard class or division number(s) corresponding to the subsidiary risk label(s) required to be applied, when assigned, shall be entered following the primary hazard class or division and shall be enclosed in parenthesis. The words “Class” or “Division” may be included preceding the subsidiary hazard class or division numbers;
- (e) Where assigned, the packing group for the substance or article which may be preceded by “PG” (e.g. “PG II”).

<sup>1</sup> For standardized formats, see also the relevant recommendations of the UNECE United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT), in particular Recommendation No. 1 (United Nations Lay-out Key for Trade Documents) (ECE/TRADE/137, edition 81.3), UN Layout Key for Trade Documents - Guidelines for Applications (ECE/TRADE/270, edition 2002), Revised Recommendation No. 11 (Documentary Aspects of the International Transport of Dangerous Goods) (ECE/TRADE/C/CEFACT/2008/8) and Recommendation No. 22 (Lay-out Key for standard Consignment Instructions) (ECE/TRADE/168, edition 1989). Refer also to the UN/CEFACT Summary of Trade Facilitation Recommendations (ECE/TRADE/346, edition 2006) and the United Nations Trade Data Elements Directory (UNTDDED) (ECE/TRADE/362, edition 2005).

#### 5.4.1.4.2 *Sequence of the dangerous goods description*

The five elements of the dangerous goods description specified in 5.4.1.4.1 shall be shown in the order listed above (i.e. (a), (b), (c), (d), (e)) with no information interspersed, except as provided in these Regulations. Examples of a dangerous goods description are:

**UN1098 ALLYL ALCOHOL 6.1 (3) I**  
**UN1098, ALLYL ALCOHOL, Division 6.1, (Class 3), PG I**

**NOTE:** *In addition to the requirements of these Regulations, other elements of information may be required by the competent authority or for certain modes of transport (e.g. flash point for sea transport). Unless permitted or required by these Regulations, additional information shall be placed after the dangerous goods description.*

#### 5.4.1.4.3 *Information which supplements the proper shipping name in the dangerous goods description*

The proper shipping name in the dangerous goods description shall be supplemented as follows:

- (a) Technical names for “n.o.s.” and other generic descriptions: Proper shipping names that are assigned special provision 274 in Column 6 of the Dangerous Goods List shall be supplemented with their technical or chemical group names as described in 3.1.2.8;
- (b) Empty uncleaned packagings, bulk containers and tanks: Empty means of containment (including packagings, IBCs, bulk containers, portable tanks, tank-vehicles and tank-wagons) which contain the residue of dangerous goods of classes other than Class 7 shall be described as such by, for example, placing the words “**EMPTY UNCLEANED**” or “**RESIDUE LAST CONTAINED**” before or after the dangerous goods description specified in 5.4.1.4.1 (a) to (e);
- (c) Wastes: For waste dangerous goods (other than radioactive wastes) which are being transported for disposal, or for processing for disposal, the proper shipping name shall be preceded by the word “**WASTE**”, unless this is already a part of the proper shipping name;
- (d) Elevated temperature substances: If the proper shipping name of a substance which is transported or offered for transport in a liquid state at a temperature equal to or exceeding 100 °C, or in a solid state at a temperature equal to or exceeding 240 °C, does not convey the elevated temperature condition (for example, by using the term “**MOLTEN**” or “**ELEVATED TEMPERATURE**” as part of the shipping name), the word “**HOT**” shall immediately precede the proper shipping name.

#### 5.4.1.5 *Information required in addition to the dangerous goods description*

In addition to the dangerous goods description the following information shall be included after the dangerous goods description on the dangerous goods transport document.

##### 5.4.1.5.1 *Total quantity of dangerous goods*

Except for empty uncleaned packagings, the total quantity of dangerous goods covered by the description (by volume or mass as appropriate) of each item of dangerous goods bearing a different proper shipping name, UN number or packing group shall be included. For Class 1 dangerous goods, the quantity shall be the net explosive mass. For dangerous goods transported in salvage packagings, an estimate of the quantity of dangerous goods shall be given. The number and kind (e.g. drum, box, etc.) of packages shall also be indicated. UN packaging codes may only be used to supplement the description of the kind of package (e.g. one box (4G)). Abbreviations may be used to specify the unit of measurement for the total quantity.



**NOTE:** *The number, type and capacity of each inner packaging within the outer packaging of a combination packaging is not required to be indicated.*

5.4.1.5.2 *Limited quantities*

When dangerous goods are transported according to the exceptions for dangerous goods packed in limited quantities provided for in Column 7a of the Dangerous Goods List and Chapter 3.4, the words “**limited quantity**” or “**LTD QTY**” shall be included.

5.4.1.5.3 *Salvage packagings and salvage pressure receptacles*

For dangerous goods transported in salvage packagings or salvage pressure receptacles, the words “**SALVAGE PACKAGING**” or “**SALVAGE PRESSURE RECEPTACLE**” shall be included.

5.4.1.5.4 *Substances stabilized by temperature control*

If the word “STABILIZED” is part of the proper shipping name (see also 3.1.2.6), when stabilization is by means of temperature control, the control and emergency temperatures (see 7.1.5.3.1) shall be indicated in the transport document, as follows:

**“Control temperature: .... °C Emergency temperature: .... °C”**

5.4.1.5.5 *Self-reactive substances and organic peroxides*

For self-reactive substances of Division 4.1 and for organic peroxides which require temperature control during transport, the control and emergency temperatures (see 7.1.5.3.1) shall be indicated on the dangerous goods transport document, as follows:

**“Control temperature: .... °C Emergency temperature: .... °C”**

5.4.1.5.5.1 When for certain self-reactive substances of Division 4.1 and organic peroxides of Division 5.2 the competent authority has permitted the “EXPLOSIVE” subsidiary risk label (model No. 1) to be dispensed with for the specific package, a statement to this effect shall be included.

5.4.1.5.5.2 When organic peroxides and self-reactive substances are transported under conditions where approval is required (for organic peroxides, see 2.5.3.2.5, 4.1.7.2.2, 4.2.1.13.1 and 4.2.1.13.3; for self-reactive substances, see 2.4.2.3.2.4 and 4.1.7.2.2), a statement to this effect shall be included in the dangerous goods transport document. A copy of the classification approval and conditions of transport for non-listed organic peroxides and self-reactive substances shall be attached to the dangerous goods transport document.

5.4.1.5.5.3 When a sample of an organic peroxide (see 2.5.3.2.5.1) or a self-reactive substance (see 2.4.2.3.2.4(b)) is transported, a statement to this effect shall be included in the dangerous goods transport document.

5.4.1.5.6 *Infectious substances*

The full address of the consignee shall be shown on the document, together with the name of a responsible person and his telephone number.

5.4.1.5.7 *Radioactive material*

5.4.1.5.7.1 The following information shall be included for each consignment of Class 7 material, as applicable, in the order given:

- (a) The name or symbol of each radionuclide or, for mixtures of radionuclides, an appropriate general description or a list of the most restrictive nuclides;
- (b) A description of the physical and chemical form of the material, or a notation that the material is special form radioactive material or low dispersible radioactive material. A generic chemical description is acceptable for chemical form;
- (c) The maximum activity of the radioactive contents during transport expressed in units of becquerels (Bq) with an appropriate SI prefix symbol (see 1.2.2.1). For fissile material, the mass of fissile material (or mass of each fissile nuclide for mixtures when appropriate) in units of grams (g), or appropriate multiples thereof, may be used in place of activity;
- (d) The category of the package, i.e. I-WHITE, II-YELLOW, III-YELLOW;
- (e) The transport index (categories II-YELLOW and III-YELLOW only);
- (f) For consignments including fissile material: ~~other than consignments excepted under 6.4.11.2, the criticality safety index;~~
  - (i) Shipped under one exception of 2.7.2.3.5 (a) to (f), reference to that paragraph;
  - (ii) Shipped under 2.7.2.3.5 (c) to (e), the total mass of fissile nuclides;
  - (iii) Contained in a package for which one of 6.4.11.2 (a) to (c) or 6.4.11.3 is applied, reference to that paragraph;
  - (iv) The criticality safety index, where applicable.
- (g) The identification mark for each competent authority certificate of approval ~~approval certificate~~ (special form radioactive material, low dispersible radioactive material, fissile material excepted under 2.7.2.3.5 (f), special arrangement, package design, or shipment) applicable to the consignment;
- (h) For consignments of more than one package, the information contained in 5.4.1.4.1 (a) to (c) and 5.4.1.5.7.1 (a) to (g) shall be given for each package. For packages in an overpack, freight container, or conveyance, a detailed statement of the contents of each package within the overpack, freight container, or conveyance and, where appropriate, of each overpack, freight container, or conveyance shall be included. If packages are to be removed from the overpack, freight container, or conveyance at a point of intermediate unloading, appropriate transport documents shall be made available;
- (i) Where a consignment is required to be shipped under exclusive use, the statement “EXCLUSIVE USE SHIPMENT”; and
- (j) For LSA-II, LSA-III, SCO-I and SCO-II, the total activity of the consignment as a multiple of  $A_2$ . For radioactive material for which the  $A_2$  value is unlimited, the multiple of  $A_2$  shall be zero.

[IAEA: 546 (e) to (n)]

5.4.1.5.7.2 The transport document shall include a statement regarding actions, if any, that are required to be taken by the carrier. The statement shall be in the languages deemed necessary by the carrier or the authorities concerned, and shall include at least the following points:

- (a) Supplementary requirements for loading, stowage, transport, handling and unloading of the package, overpack or freight container including any special stowage provisions for the safe dissipation of heat (see 7.1.8.3.2), or a statement that no such requirements are necessary;
- (b) Restrictions on the mode of transport or conveyance and any necessary routing instructions;
- (c) Emergency arrangements appropriate to the consignment.

5.4.1.5.7.3 In all cases of international transport of packages requiring competent ~~authorities~~ **authority approval of** 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 5.4.1.4.1 shall be in accordance with the certificate of the country of origin of design.

[IAEA: 5301](#)

5.4.1.5.7.4 The applicable competent authority certificates need not necessarily accompany the consignment. The consignor shall make them available to the carrier(s) before loading and unloading.

#### 5.4.1.5.8 *Transport of solids in bulk containers*

For bulk containers other than freight containers, the following statement shall be shown on the transport document (see 6.8.4.6):

**“Bulk container BK(x) approved by the competent authority of...”**

#### 5.4.1.5.9 *Transport of IBCs or portable tanks after the date of expiry of the last periodic test or inspection*

For transport in accordance with 4.1.2.2 (b), 6.7.2.19.6 (b), 6.7.3.15.6 (b) or 6.7.4.14.6 (b), a statement to this effect shall be included in the transport document, as follows: “Transport in accordance with 4.1.2.2 (b)”, “Transport in accordance with 6.7.2.19.6 (b)”, “Transport in accordance with 6.7.3.15.6 (b)” or “Transport in accordance with 6.7.4.14.6 (b)” as appropriate.

#### 5.4.1.5.10 *Firework classification reference*

When fireworks of UN Nos. 0333, 0334, 0335, 0336 and 0337 are transported, the dangerous goods transport document shall include a classification reference(s) issued by the competent authority.

The classification reference(s) shall consist of the competent authority’s state, indicated by the distinguishing sign for motor vehicles in international traffic, the competent authority identification and a unique serial reference. Examples of such classification references are:

GB/HSE123456  
D/BAM1234  
USA EX20091234.

### 5.4.1.6 *Certification*

5.4.1.6.1 The dangerous goods transport document shall include a certification or declaration that the consignment is acceptable for transport and that the goods are properly packaged, marked and labelled, and in proper condition for transport in accordance with the applicable regulations. The text for this certification 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 applicable international and national governmental regulations.”

The certification shall be signed and dated by the consignor. Facsimile signatures are acceptable where applicable laws and regulations recognize the legal validity of facsimile signatures.

5.4.1.6.2 If the dangerous goods documentation is presented to the carrier 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.

5.4.1.6.3 When the dangerous goods transport information is given to a carrier by EDP or EDI techniques and subsequently the dangerous goods are transferred to a carrier that requires a paper dangerous goods transport document, the carrier shall ensure that the paper document indicates “Original received electronically” and the name of the signatory shall be shown in capital letters.

## **5.4.2 Container/vehicle packing certificate**

5.4.2.1 When dangerous goods are packed or loaded into any container<sup>3</sup> or vehicle which will be transported by sea, those responsible for packing of the container or vehicle shall provide a “container/vehicle packing certificate” specifying the container/vehicle identification number(s) and certifying that the operation has been carried out in accordance with the following conditions:

- (a) The container/vehicle was clean, dry and apparently fit to receive the goods;
- (b) Packages, which need to be segregated in accordance with applicable segregation requirements, have not been packed together onto or in the container/vehicle;
- (c) All packages have been externally inspected for damage, and only sound packages have been loaded;
- (d) All goods have been properly loaded and, where necessary, adequately braced with securing material to suit the mode(s) of transport for the intended journey;
- (e) Goods loaded in bulk have been evenly distributed within the container/vehicle;
- (f) For consignments including goods of Class 1 other than Division 1.4, the container/vehicle is structurally serviceable in accordance with 7.1.3.2.1;
- (g) The container/vehicle and packages are properly marked, labelled and placarded, as appropriate;
- (h) When solid carbon dioxide (CO<sub>2</sub>-dry ice) is used for cooling purposes, the container/vehicle is externally marked or labelled in a conspicuous place, such as, at the door end, with the words: “DANGEROUS CO<sub>2</sub> (DRY ICE) INSIDE. VENTILATE THOROUGHLY BEFORE ENTERING”; and
- (i) A dangerous goods transport document, as indicated in 5.4.1.1, has been received for each dangerous goods consignment loaded in the container/vehicle.

**NOTE:** *The container/vehicle packing certificate is not required for tanks.*

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<sup>2</sup> Container means an article of transport equipment that is of a permanent character and accordingly strong enough to be suitable for repeated use; specially designed to facilitate the transport of goods, by one or more modes of transport, without intermediate reloading; designed to be secured and/or readily handled, having fittings for these purposes, and approved in accordance with the International Convention for Safe Containers (CSC), 1972, as amended. The term “container” includes neither vehicle nor packaging. However, a container that is transported on a chassis is included.

5.4.2.2 The information required in the dangerous goods transport document and the container/vehicle packing certificate may be incorporated into a single document, if not, these documents shall be attached one to the other. If the information is incorporated into a single document, the document shall include a signed declaration such as “It is declared that the packing of the goods into the container/vehicle has been carried out in accordance with the applicable provisions”. This declaration shall be dated and the person signing this declaration shall be identified on the document. Facsimile signatures are acceptable where applicable laws and regulations recognize the legal validity of facsimile signatures.

5.4.2.3 If the dangerous goods documentation is presented to the carrier 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.

5.4.2.4 When the dangerous goods transport information is given to a carrier by EDP or EDI techniques and subsequently the dangerous goods are transferred to a carrier that requires a paper dangerous goods transport document, the carrier shall ensure that the paper document indicates “Original received electronically” and the name of the signatory shall be shown in capital letters.

### 5.4.3 Emergency response information

For consignments for which a dangerous goods transport document is required by these Regulations, appropriate information shall be immediately available at all times for use in emergency response to accidents and incidents involving dangerous goods in transport. The information shall be available away from the packages containing the dangerous goods and immediately accessible in the event of an accident or incident. Methods of compliance include:

- (a) Appropriate entries in the transport document; or
- (b) Provision of a separate document such as a safety data sheet; or
- (c) Provision of a separate document, such as the International Civil Aviation Organization (ICAO) “Emergency Response Guidance for Aircraft Incidents Involving Dangerous Goods” or the International Maritime Organization (IMO) “Emergency Procedures for Ships Carrying Dangerous Goods” and “Medical First Aid Guide in Accidents Involving Dangerous Goods”, for use in conjunction with the transport document.

### 5.4.4 Retention of dangerous goods transport information

5.4.4.1 The consignor shall retain a copy of the dangerous goods transport document and additional information and documentation as specified in these Regulations, for a minimum period of three months.

5.4.4.2 When the documents are kept electronically or in a computer system, the consignor shall be able to reproduce them in a printed form.

**Figure 5.4.1: Multimodal Dangerous Goods Form (next page)**



MULTIMODAL DANGEROUS GOODS FORM

Continuation Sheet

1. Shipper / Consignor / Sender	2. Transport document number			
	3. Page 1 of	Pages	4. Shipper's reference	
			5. Freight Forwarder's reference	
14. Shipping marks	* Number and kind of packages; description of goods	Gross mass (kg)	Net mass	Cube (m³)

\* FOR DANGEROUS GOODS you must specify: UN No., proper shipping name, hazard class, packing group (where assigned) and any other element of information required under applicable national and international regulations

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## CHAPTER 6.4

# **REQUIREMENTS FOR THE CONSTRUCTION, TESTING AND APPROVAL OF PACKAGES AND MATERIAL FOR CLASS 7**

**6.4.1 (Reserved)****6.4.2 General requirements**

6.4.2.1 The package shall be so designed in relation to its mass, volume and shape that it can be easily and safely transported. In addition, the package shall be so designed that it can be properly secured in or on the conveyance during transport.

6.4.2.2 The design shall 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 shall take account of appropriate safety factors to cover snatch lifting.

6.4.2.3 Attachments and any other features on the outer surface of the package which could be used to lift it shall be designed either to support its mass in accordance with the requirements of 6.4.2.2 or shall be removable or otherwise rendered incapable of being used during transport.

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

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

6.4.2.6 Any features added to the package at the time of transport which are not part of the package shall not reduce its safety.

6.4.2.7 The package shall be capable of withstanding the effects of any acceleration, vibration or vibration resonance which may arise under routine conditions of 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 shall be so designed as to prevent them from becoming loose or being released unintentionally, even after repeated use.

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

6.4.2.9 All valves through which the radioactive contents could escape shall be protected against unauthorized operation.

6.4.2.10 The design of the package shall take into account ambient temperatures and pressures that are likely to be encountered in routine conditions of transport.

6.4.2.11 A package shall be so designed that it provides sufficient shielding to ensure that, under routine conditions of transport and with the maximum radioactive contents that the package is designed to contain, the radiation level at any point on the external surface of the package would not exceed the values specified in 2.7.2.4.1.2, 4.1.9.1.10 and 4.1.9.1.11, as applicable, with account taken of 7.1.8.3.3 (b) and 7.2.3.1.2.

[IAEA: 617]



6.4.2.12 For radioactive material having other dangerous properties the package design shall take into account those properties; see 2.0.3.1, 2.0.3.2 and 4.1.9.1.5.

6.4.2.13 Manufacturers and subsequent distributors of packagings shall provide information regarding procedures to be followed and a description of the types and dimensions of closures (including required gaskets) and any other components needed to ensure that packages as presented for transport are capable of passing the applicable performance tests of this Chapter.

#### 6.4.3 Additional requirements for packages transported by air

6.4.3.1 For packages to be transported by air, the temperature of the accessible surfaces shall not exceed 50 °C at an ambient temperature of 38 °C with no account taken for insolation.

6.4.3.2 Packages to be transported by air shall be so designed that, if they were exposed to ambient temperatures ranging from -40 °C to +55 °C, the integrity of containment would not be impaired.

6.4.3.3 Packages containing radioactive material, to be transported by air, shall be capable of withstanding, without ~~loss or dispersal of radioactive contents from the containment system~~ leakage, an internal pressure which produces a pressure differential of not less than maximum normal operating pressure plus 95 kPa.

[IAEA: 621]

#### 6.4.4 Requirements for excepted packages

An excepted package shall be designed to meet the requirements specified in 6.4.2 and in addition, the requirements of 6.4.3 if carried by air.

#### 6.4.5 Requirements for industrial packages

6.4.5.1 Type IP-1, IP-2, and IP-3 packages shall meet the requirements specified in 6.4.2 and 6.4.7.2, and, if appropriate, the additional requirements for packages transported by air specified in 6.4.3.

6.4.5.2 A Type IP-2 package shall, if it were subjected to the tests specified in 6.4.15.4 and 6.4.15.5, prevent:

- (a) 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.

6.4.5.3 A Type IP-3 package shall meet all the requirements specified in 6.4.7.2 to 6.4.7.15.

#### 6.4.5.4 Alternative requirements for Type IP-2 and IP-3 packages

6.4.5.4.1 Packages may be used as Type IP-2 package provided that:

- (a) They satisfy the requirements of 6.4.5.1;
- (b) They are designed to satisfy the requirements prescribed for packing group I or II in Chapter 6.1 of these Regulations; and
- (c) When subjected to the tests required for packing group I or II in Chapter 6.1, they would prevent:
  - (i) loss or dispersal of the radioactive contents; and

- (ii) more than a 20% increase in the maximum radiation level at any external surface of the package.

6.4.5.4.2 Portable tanks may also be used as Type IP-2 or IP-3 packages, provided that:

- (a) They satisfy the requirements of 6.4.5.1;
- (b) They are designed to satisfy the requirements prescribed in Chapter 6.7 of these Regulations and are capable of withstanding a test pressure of 265 kPa; and
- (c) They are designed so that any additional shielding which is provided shall be capable of withstanding the static and dynamic stresses resulting from handling and routine conditions of transport and of preventing more than a 20% increase in the maximum radiation level at any external surface of the portable tanks.

6.4.5.4.3 Tanks, other than portable tanks, may also be used as Type IP-2 or IP-3 package for transporting LSA-I and LSA-II liquids and gases as prescribed in Table 4.1.9.2.4, provided that:

- (a) They satisfy the requirements of 6.4.5.1;
- (b) They are designed to satisfy the requirements prescribed in regional or national regulations for the transport of dangerous goods and are capable of withstanding a test pressure of 265 kPa; and
- (c) They are designed so that any additional shielding which is provided shall be capable of withstanding the static and dynamic stresses resulting from handling and routine conditions of transport and of preventing more than a 20% increase in the maximum radiation level at any external surface of the tanks.

6.4.5.4.4 Freight containers with the characteristics of a permanent enclosure may also be used as Type IP-2 or IP-3 package, provided that:

- (a) The radioactive contents are restricted to solid materials;
- (b) They satisfy the requirements of 6.4.5.1; and
- (c) They are designed to conform to 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 shall 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:
  - (i) loss or dispersal of the radioactive contents; and
  - (ii) more than a 20% increase in the maximum radiation level at any external surface of the freight containers.

6.4.5.4.5 Metal intermediate bulk containers may also be used as Type IP-2 or IP-3 package provided that:

- (a) They satisfy the requirements of 6.4.5.1; and
- (b) They are designed to satisfy the requirements prescribed in Chapter 6.5 of these Regulations for packing group I or II, and if they were subjected to the tests prescribed in that Chapter, but with the drop test conducted in the most damaging orientation, they would prevent:

- (i) loss or dispersal of the radioactive contents; and
- (ii) more than a 20% increase in the maximum radiation level at any external surface of the intermediate bulk container.

#### 6.4.6 Requirements for packages containing uranium hexafluoride

6.4.6.1 Packages designed to contain uranium hexafluoride shall meet the requirements ~~prescribed elsewhere in these Regulations which pertain to the radioactive and fissile properties of the material~~ which pertain to the radioactive and fissile properties of the material prescribed elsewhere in these Regulations. Except as allowed in 6.4.6.4, uranium hexafluoride in quantities of 0.1 kg or more shall also be packaged and transported in accordance with the provisions of ISO 7195:2005 “Nuclear Energy – Packaging of uranium hexafluoride (UF<sub>6</sub>) for transport”, and the requirements of 6.4.6.2 and 6.4.6.3.

[IAEA: 631]

6.4.6.2 Each package designed to contain 0.1 kg or more of uranium hexafluoride shall 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 6.4.21 except as allowed in 6.4.6.4;
- (b) Withstand without loss or dispersal of the uranium hexafluoride the free drop test specified in 6.4.15.4; and
- (c) Withstand without rupture of the containment system the thermal test specified in 6.4.17.3 except as allowed in 6.4.6.4.

[IAEA: 632]

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

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

- (a) ~~The packages are designed~~ to international or national standards other than ISO 7195:2005 provided an equivalent level of safety is maintained; and/or;
- (b) ~~The packages are designed~~ to withstand without leakage and without unacceptable stress a test pressure of less than 2.76 MPa as specified in 6.4.21; and/or ~~and~~
- (c) ~~For packages designed~~ to contain 9 000 kg or more of uranium hexafluoride and, the packages do not meet the requirement of 6.4.6.2 (c).

In all other respects the requirements specified in 6.4.6.1 to 6.4.6.3 shall be satisfied.

[IAEA: 634]

**6.4.7 Requirements for Type A packages**

6.4.7.1 Type A packages shall be designed to meet the general requirements of 6.4.2, the requirements of 6.4.3 if transported by air, and of 6.4.7.2 to 6.4.7.17:

6.4.7.2 The smallest overall external dimension of the package shall not be less than 10 cm.

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

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

6.4.7.5 The design of the package shall take into account temperatures ranging from -40 °C to +70 °C for the components of the packaging. Attention shall be given to freezing temperatures for liquids and to the potential degradation of packaging materials within the given temperature range.

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

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

6.4.7.8 Special form radioactive material may be considered as a component of the containment system.

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

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

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

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

6.4.7.13 A radiation shield which encloses a component of the package specified as a part of the containment system shall 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 shall be capable of being securely closed by a positive fastening device which is independent of any other packaging structure.

6.4.7.14 A package shall be so designed that if it were subjected to the tests specified in 6.4.15, it would prevent:

- (a) 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.

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

*Type A packages to contain liquids*

6.4.7.16 A Type A package designed to contain liquid radioactive material shall, in addition:

- (a) Be adequate to meet the conditions specified in 6.4.7.14 (a) above if the package is subjected to the tests specified in 6.4.16; and
- (b) Either
  - (i) be provided with sufficient absorbent material to absorb twice the volume of the liquid contents. Such absorbent material shall be suitably positioned so as to contact the liquid in the event of leakage; or
  - (ii) 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.

*Type A packages to contain gas*

6.4.7.17 A package designed for gases shall prevent loss or dispersal of the radioactive contents if the package were subjected to the tests specified in 6.4.16. A Type A package designed for tritium gas or for noble gases shall be excepted from this requirement.

#### 6.4.8 Requirements for Type B(U) packages

6.4.8.1 Type B(U) packages shall be designed to meet the requirements specified in 6.4.2, the requirements ~~of~~ specified in 6.4.3 if carried by air, and of 6.4.7.2 to 6.4.7.15, except as specified in 6.4.7.14 (a), and, in addition, the requirements specified in 6.4.8.2 to 6.4.8.15.

6.4.8.2 A package shall be so designed that, under the ambient conditions specified in 6.4.8.5 and 6.4.8.6 heat generated within the package by the radioactive contents shall not, under normal conditions of transport, as demonstrated by the tests in 6.4.15, 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 shall be paid to the effects of heat, which may cause one or more of the following:

- (a) Alter the arrangement, the geometrical form or the physical state of the radioactive contents or, if the radioactive material is enclosed in a can or receptacle (for example, clad fuel elements), cause the can, receptacle or radioactive material to deform or melt; ~~or~~
- (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.

[IAEA: 653]

6.4.8.3 A package shall be so designed that, under the ambient condition specified in 6.4.8.5 and in the absence of insulation, the temperature of the accessible surfaces of a package shall not exceed 50 °C, unless the package is transported under exclusive use.

6.4.8.4 Except as required in 6.4.3.1 for a package transported by air, the maximum temperature of any surface readily accessible during transport of a package under exclusive use shall not exceed 85 °C in the absence of insulation under

the ambient conditions specified in 6.4.8.5. 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.

6.4.8.5 The ambient temperature shall be assumed to be 38 °C.

6.4.8.6 The solar insolation conditions shall be assumed to be as specified in Table 6.4.8.6.

**Table 6.4.8.6: Insolation data**

Case	Form and location of surface	Insolation for 12 hours per day (W/m <sup>2</sup> )
1	Flat surfaces transported horizontally-downward facing	0
2	Flat surfaces transported horizontally-upward facing	800
3	Surfaces transported vertically	200 <sup>a</sup>
4	Other downward facing (not horizontal) surfaces	200 <sup>a</sup>
5	All other surfaces	400 <sup>a</sup>

<sup>a</sup> Alternatively, a sine function may be used, with an absorption coefficient adopted and the effects of possible reflection from neighbouring objects neglected.

6.4.8.7 A package which includes thermal protection for the purpose of satisfying the requirements of the thermal test specified in 6.4.17.3 shall be so designed that such protection will remain effective if the package is subjected to the tests specified in 6.4.15 and 6.4.17.2 (a) and (b) or 6.4.17.2 (b) and (c), as appropriate. Any such protection on the exterior of the package shall not be rendered ineffective by ripping, cutting, skidding, abrasion or rough handling.

6.4.8.8 A package shall be so designed that, if it were subjected to:

- (a) The tests specified in 6.4.15, it would restrict the loss of radioactive contents to not more than  $10^{-6}$  A<sub>2</sub> per hour; and
- (b) The tests specified in 6.4.17.1, 6.4.17.2 (b), 6.4.17.3, and 6.4.17.4 and either the tests in:
  - (i) 6.4.17.2 (c), when the package has a mass not greater than 500 kg, an overall density not greater than 1 000 kg/m<sup>3</sup> based on the external dimensions, and radioactive contents greater than 1 000 A<sub>2</sub> not as special form radioactive material; or
  - (ii) 6.4.17.2 (a), 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 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<sub>2</sub> for krypton-85 and not more than A<sub>2</sub> for all other radionuclides.

Where mixtures of different radionuclides are present, the provisions of 2.7.2.2.4 to 2.7.2.2.6 shall apply except that for krypton-85 an effective A<sub>2</sub>(i) value equal to 10 A<sub>2</sub> may be used. For case (a) above, the assessment shall take into account the external contamination limits of 4.1.9.1.2.

[IAEA: 659]

6.4.8.9 A package for radioactive contents with activity greater than  $10^5$  A<sub>2</sub> shall be so designed that if it were subjected to the enhanced water immersion test specified in 6.4.18, there would be no rupture of the containment system.

6.4.8.10 Compliance with the permitted activity release limits shall depend neither upon filters nor upon a mechanical cooling system.

6.4.8.11 A package shall 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 6.4.15 and 6.4.17.

6.4.8.12 A package shall be so designed that if it were at the maximum normal operating pressure and it were subjected to the tests specified in 6.4.15 and 6.4.17, 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.

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

6.4.8.14 A package containing low dispersible radioactive material shall 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 shall not adversely affect the performance of the low dispersible radioactive material.

6.4.8.15 A package shall be designed for an ambient temperature range from -40 °C to +38 °C.

#### **6.4.9 Requirements for Type B(M) packages**

6.4.9.1 Type B(M) packages shall meet the requirements for Type B(U) packages specified in 6.4.8.1, except that for packages to be transported solely within a specified country or solely between specified countries, conditions other than those given in 6.4.7.5, 6.4.8.54 to 6.4.8.6, and 6.4.8.9 to 6.4.8.15 above may be assumed with the approval of the competent authorities of these countries. Notwithstanding, the requirements for Type B(U) packages specified in 6.4.8.4 and 6.4.8.9 to 6.4.8.15 shall be met as far as practicable.

[IAEA: 667]

6.4.9.2 Intermittent venting of Type B(M) packages may be permitted during transport, provided that the operational controls for venting are acceptable to the relevant competent authorities.

#### **6.4.10 Requirements for Type C packages**

6.4.10.1 Type C packages shall be designed to meet the requirements specified in 6.4.2 and 6.4.3, and of 6.4.7.2 to 6.4.7.15, except as specified in 6.4.7.14 (a), and of the requirements specified in 6.4.8.2 to 6.4.8.6, 6.4.8.10 to 6.4.8.15, and, in addition, of 6.4.10.2 to 6.4.10.4.

6.4.10.2 A package shall be capable of meeting the assessment criteria prescribed for tests in 6.4.8.8 (b) and 6.4.8.12 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 shall 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.

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

- (a) The tests specified in 6.4.15, it would restrict the loss of radioactive contents to not more than  $10^{-6}$  A<sub>2</sub> per hour; and
- (b) The test sequences in 6.4.20.1

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-it would meet the following requirements:

- (i) 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 which the package is designed to contain; and
- (ii) restrict the accumulated loss of radioactive contents in a period of 1 week to not more than 10 A<sub>2</sub> for krypton-85 and not more than A<sub>2</sub> for all other radionuclides.

Where mixtures of different radionuclides are present, the provisions of 2.7.2.2.4 to 2.7.2.2.6 shall apply except that for krypton-85 an effective A<sub>2</sub>(i) value equal to 10 A<sub>2</sub> may be used. For case (a) above, the assessment shall take into account the external contamination limits of 4.1.9.1.2.

[IAEA: 671]

6.4.10.4 A package shall be so designed that there will be no rupture of the containment system following performance of the enhanced water immersion test specified in 6.4.18.

6.4.11 Requirements for packages containing fissile material

6.4.11.1 Fissile material shall be transported so as to;

- (a) Maintain subcriticality during routine, normal and accident conditions of transport; in particular, the following contingencies shall be considered:
  - (i) water leaking into or out of packages;
  - (ii) the loss of efficiency of built-in neutron absorbers or moderators;
  - (iii) rearrangement of the contents either within the package or as a result of loss from the package;
  - (iv) reduction of spaces within or between packages;
  - (v) packages becoming immersed in water or buried in snow; and
  - (vi) temperature changes; and
- (b) Meet the requirements:
  - (i) of 6.4.7.2 except for unpackaged material when specifically allowed by 2.7.2.3.5 (e) for packages containing fissile material;
  - (ii) prescribed elsewhere in these Regulations which pertain to the radioactive properties of the material; and
  - (iii) of 6.4.7.3 unless the material is excepted by 2.7.2.3.5; specified in 6.4.11.3 to 6.4.11.12, unless excepted by 6.4.11.2.
  - (iv) of 6.4.11.4 to 6.4.11.14, unless the material is excepted by 2.7.2.3.5, 6.4.11.2 or 6.4.11.3.

[IAEA: 673]

~~6.4.11.2 Fissile material meeting one of the provisions (a) to (d) of 2.7.2.3.5 is excepted from the requirement to be transported in packages that comply with 6.4.11.3 to 6.4.11.12 as well as the other requirements of these Regulations that apply to fissile material. Only one type of exception is allowed per consignment.~~



6.4.11.2 Packages containing fissile material that meet the provisions of subparagraph (d) and one of the provisions of (a) to (c) below are excepted from the requirements of 6.4.11.4 to 6.4.11.14.

(a) Packages containing fissile material in any form provided that:

- (i) The smallest external dimension of the package is not less than 10 cm;
- (ii) The criticality safety index of the package is calculated using the following formula:

$$CSI=50 \times 5 \times \left( \frac{\text{Mass of U-235 in package (g)}}{Z} + \frac{\text{Mass of other fissile nuclides* in package (g)}}{280} \right)$$

\* Plutonium may be of any isotopic composition provided that the amount of Pu-241 is less than that of Pu-240 in the package

where the values of Z are taken from Table 6.4.11.2.

- (iii) The CSI of any package does not exceed 10;

(b) Packages containing fissile material in any form provided that:

- (i) The smallest external dimension of the package is not less than 30 cm;
- (ii) The package, after being subjected to the tests specified in 6.4.15.1 to 6.4.15.6:

- Retains its fissile material contents.
- Preserves the minimum overall outside dimensions of the package to at least 30 cm.
- Prevents the entry of a 10 cm cube.

- (iii) The criticality safety index of the package is calculated using the following formula:

$$CSI=50 \times 2 \times \left( \frac{\text{Mass of U-235 in package (g)}}{Z} + \frac{\text{Mass of other fissile nuclides* in package (g)}}{280} \right)$$

\* Plutonium may be of any isotopic composition provided that the amount of Pu-241 is less than that of Pu-240 in the package

where the values of Z are taken from Table 6.4.11.2.

- (iv) The criticality safety index of any package does not exceed 10.

(c) Packages containing fissile material in any form provided that:

- (i) The smallest external dimension of the package is not less than 10 cm;
- (ii) The package, after being subjected to the tests specified in 6.4.15.1 to 6.4.15.6:
  - Retains its fissile material contents;
  - Preserves the minimum overall outside dimensions of the package to at least 10 cm;
  - Prevents the entry of a 10 cm cube.

- (iii) The CSI of the package is calculated using the following formula:

$$CSI=50 \times 2 \times \left( \frac{\text{Mass of U-235 in package (g)}}{450} + \frac{\text{Mass of other fissile nuclides* in package (g)}}{280} \right)$$

\* Plutonium may be of any isotopic composition provided that the amount of Pu-241 is less than that of Pu-240 in the package

(iv) The maximum mass of fissile nuclides in any package does not exceed 15 g;

(d) The total mass of beryllium, hydrogenous material enriched in deuterium, graphite and other allotropic forms of carbon in an individual package shall not be greater than the mass of fissile nuclides in the package except where their total concentration does not exceed 1 g in any 1000 g of material. Beryllium incorporated in copper alloys up to 4% in weight of the alloy does not need to be considered.

[IAEA: 674]

Table 6.4.11.2 Values of Z for calculation of criticality safety index in accordance with 6.4.11.2

<u>Enrichment<sup>a</sup></u>	<u>Z</u>
<u>Uranium enriched up to 1.5%</u>	<u>2200</u>
<u>Uranium enriched up to 5 %</u>	<u>850</u>
<u>Uranium enriched up to 10 %</u>	<u>660</u>
<u>Uranium enriched up to 20 %</u>	<u>580</u>
<u>Uranium enriched up to 100 %</u>	<u>450</u>

<sup>a</sup> If a package contains uranium with varying enrichments of U-235, then the value corresponding to the highest enrichment shall be used for Z.

6.4.11.3 Packages containing not more than 1000 g of plutonium are excepted from the application of 6.4.11.4 to 6.4.11.14 provided that:

(a) Not more than 20% of the plutonium by mass is fissile nuclides.

(b) The criticality safety index of the package is calculated using the following formula:

$$CSI = 50 \times 2 \times \frac{\text{mass of plutonium (g)}}{1000}$$

(c) If uranium is present with the plutonium, the mass of uranium shall be no more than 1% of the mass of the plutonium.

[IAEA: 675]

6.4.11.34 Where the chemical or physical form, isotopic composition, mass or concentration, moderation ratio or density, or geometric configuration is not known, the assessments of 6.4.11.7-8 to 6.4.11.42-13 shall 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.

[IAEA: 676]

6.4.11.45 For irradiated nuclear fuel the assessments of 6.4.11.7-8 to 6.4.11.42-13 shall be based on an isotopic composition demonstrated to provide either:

(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 shall be performed to confirm the conservatism of the isotopic composition.

[IAEA: 677]

6.4.11.56 The package, after being subjected to the tests specified in 6.4.15, shall:

- (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.

6.4.11.67 The package shall 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.

6.4.11.78 For a package in isolation, it shall 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 error, absence of leakage may be assumed in respect of those void spaces. Special features shall include either of the following:

- (a) Multiple high standard water barriers, not less than two of which would remain watertight if the package were subject to the tests prescribed in 6.4.11.42-13(b), a high degree of quality control in the manufacture, maintenance and repair of packagings and tests to demonstrate the closure of each package before each shipment; or
- (b) For packages containing uranium hexafluoride only, with maximum enrichment of 5 mass percent uranium-235:
  - (i) packages where, following the tests prescribed in 6.4.11.42-13(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 test prescribed in 6.4.17.3 the valves remain leaktight; and
  - (ii) 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.

[IAEA: 680]

6.4.11.89 It shall be assumed that the confinement system ~~shall be~~is 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 confinement system remains within the packaging following the tests prescribed in 6.4.11.42-13(b), close reflection of the package by at least 20 cm of water may be assumed in 6.4.11.9-10(c).

[IAEA: 681]

6.4.11.910 The package shall be subcritical under the conditions of 6.4.11.7-8 and 6.4.11.8-9 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 6.4.11.44-12(b);
- (c) The tests specified in 6.4.11.42-13(b).

[IAEA: 682]

6.4.11.4011 For packages to be transported by air:

- (a) The package shall be subcritical under conditions consistent with the Type C package tests specified in 6.4.20.1 assuming reflection by at least 20 cm of water but no water inleakage; and

- (b) In the assessment of 6.4.11.9-10 allowance shall not be made for special features of 6.4.11.7-8 unless, following the Type C package tests specified in 6.4.20.1 and, subsequently, the water in-leakage test of 6.4.19.3, leakage of water into or out of the void spaces is prevented.

[IAEA: 683]

6.4.11.4-12 A number “N” shall be derived, such that five times “N” packages shall be subcritical for the arrangement and package conditions that provide the maximum neutron multiplication consistent with the following:

- (a) There shall not be anything between the packages, and the package arrangement shall be reflected on all sides by at least 20 cm of water; and
- (b) The state of the packages shall be their assessed or demonstrated condition if they had been subjected to the tests specified in 6.4.15.

6.4.11.4-13 A number “N” shall be derived, such that two times “N” packages shall 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 6.4.15 followed by whichever of the following is the more limiting:
- (i) the tests specified in 6.4.17.2 (b) and, either 6.4.17.2 (c) for packages having a mass not greater than 500 kg and an overall density not greater than 1 000 kg/m<sup>3</sup> based on the external dimensions, or 6.4.17.2 (a) for all other packages; followed by the test specified in 6.4.17.3 and completed by the tests specified in 6.4.19.1 to 6.4.19.3; or
- (ii) the test specified in 6.4.17.4; and
- (c) Where any part of the fissile material escapes from the containment system following the tests specified in 6.4.11.4-13 (b), it shall be assumed that fissile material escapes from each package in the array and all of the fissile material shall be arranged in the configuration and moderation that results in the maximum neutron multiplication with close reflection by at least 20 cm of water.

[IAEA: 685]

6.4.11.4-14 The criticality safety index (CSI) for packages containing fissile material shall be obtained by dividing the number 50 by the smaller of the two values of N derived in 6.4.11.4-12 and 6.4.11.4-13 (i.e.  $CSI = 50/N$ ). 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 in both cases).

[IAEA: 686]

## 6.4.12 Test procedures and demonstration of compliance

6.4.12.1 Demonstration of compliance with the performance standards required in 2.7.2.3.1.3, 2.7.2.3.1.4, 2.7.2.3.3.1, 2.7.2.3.3.2, 2.7.2.3.4.1, 2.7.2.3.4.2 and 6.4.2 to 6.4.11 must be accomplished by any of the methods listed below 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, where the contents of the specimen or the packaging for the tests shall simulate as closely as

practicable the expected range of radioactive contents and the specimen or packaging to be tested shall be prepared as presented for transport;

- (b) Reference to previous satisfactory demonstrations of a 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 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 penetrator diameter or compressive load, shall be taken into account;
- (d) Calculation, or reasoned argument, when the calculation procedures and parameters are generally agreed to be reliable or conservative.

6.4.12.2 After the specimen, prototype or sample has been subjected to the tests, appropriate methods of assessment shall be used to assure that the requirements for the test procedures have been fulfilled in compliance with the performance and acceptance standards prescribed in 2.7.2.3.1.3, 2.7.2.3.1.4, 2.7.2.3.3.1, 2.7.2.3.3.2, 2.7.2.3.4.1, 2.7.2.3.4.2 and 6.4.2 to 6.4.11.

6.4.12.3 All specimens shall be inspected before testing in order to identify and record faults or damage including the following:

- (a) Divergence from the design;
- (b) Defects in manufacture;
- (c) Corrosion or other deterioration; and
- (d) Distortion of features.

The containment system of the package shall be clearly specified. The external features of the specimen shall be clearly identified so that reference may be made simply and clearly to any part of such specimen.

6.4.13 Testing the integrity of the containment system and shielding and evaluating criticality safety

After each of the applicable tests specified in 6.4.15 to 6.4.21:

- (a) Faults and damage shall be identified and recorded;
- (b) It shall be determined whether the integrity of the containment system and shielding has been retained to the extent required in 6.4.2 to 6.4.11 for the package under test; and
- (c) For packages containing fissile material, it shall be determined whether the assumptions and conditions used in the assessments required by 6.4.11.1 to 6.4.11.13-14 for one or more packages are valid.

[IAEA: 716]

#### **6.4.14 Target for drop tests**

The target for the drop tests specified in 2.7.2.3.3.5 (a), 6.4.15.4, 6.4.16 (a), 6.4.17.2 and 6.4.20.2 shall be a flat, horizontal surface of such a character that any increase in its resistance to displacement or deformation upon impact by the specimen would not significantly increase the damage to the specimen.

6.4.15 Test for demonstrating ability to withstand normal conditions of transport

6.4.15.1 The tests are: the water spray test, the free drop test, the stacking test and the penetration test. Specimens of the package shall 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 6.4.15.2 are fulfilled.

6.4.15.2 The time interval between the conclusion of the water spray test and the succeeding test shall 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 shall be taken to be two hours if the water spray is applied from four directions simultaneously. No time interval shall elapse, however, if the water spray is applied from each of the four directions consecutively.

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

6.4.15.4 Free drop test: The specimen shall 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 specimen to the upper surface of the target shall be not less than the distance specified in Table 6.4.15.4 for the applicable mass. The target shall be as defined in 6.4.14;
- (b) For rectangular fibreboard or wood packages not exceeding a mass of 50 kg, a separate specimen shall be subjected to a free drop onto each corner from a height of 0.3 m;
- (c) For cylindrical fibreboard packages not exceeding a mass of 100 kg, a separate specimen shall be subjected to a free drop onto each of the quarters of each rim from a height of 0.3 m.

**Table 6.4.15.4: Free drop distance for testing packages to normal conditions of transport**

Package Mass (kg)	Free drop distance (m)
Package mass < 5 000	1.2
5 000 ≤ Package mass < 10 000	0.9
10 000 ≤ Package mass < 15 000	0.6
15 000 ≤ Package mass	0.3

6.4.15.5 Stacking test: Unless the shape of the packaging effectively prevents stacking, the specimen shall be subjected, for a period of 24 h, to a compressive load equal to the greater of the following:

- (a) A total weight equal to 5 times the maximum weight of the package; and
- (b) The equivalent of 13 kPa multiplied by the vertically projected area of the package.

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

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

- (a) A bar of 3.2 cm in diameter with a hemispherical end and a mass of 6 kg shall be dropped and directed to fall, with its longitudinal axis vertical, onto the centre of the weakest part of the

specimen, so that, if it penetrates sufficiently far, it will hit the containment system. The bar shall not be significantly deformed by the test performance;

- (b) The height of drop of the bar measured from its lower end to the intended point of impact on the upper surface of the specimen shall be 1 m.

#### 6.4.16 Additional tests for Type A packages designed for liquids and gases

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

- (a) Free drop test: The specimen shall drop onto the target so as to suffer the maximum damage in respect of containment. The height of the drop measured from the lowest part of the specimen to the upper surface of the target shall be 9 m. The target shall be as defined in 6.4.14;
- (b) Penetration test: The specimen shall be subjected to the test specified in 6.4.15.6 except that the height of drop shall be increased to 1.7 m from the 1 m specified in 6.4.15.6 (b).

#### 6.4.17 Tests for demonstrating ability to withstand accident conditions in transport

6.4.17.1 The specimen shall be subjected to the cumulative effects of the tests specified in 6.4.17.2 and 6.4.17.3, in that order. Following these tests, either this specimen or a separate specimen shall be subjected to the effect(s) of the water immersion test(s) as specified in 6.4.17.4 and, if applicable, 6.4.18.

6.4.17.2 *Mechanical test:* The mechanical test consists of three different drop tests. Each specimen shall be subjected to the applicable drops as specified in 6.4.8.8 or 6.4.11.4213. The order in which the specimen is subjected to the drops shall be such that, on completion of the mechanical test, the specimen shall have suffered such damage as will lead to the maximum damage in the thermal test which follows.

- (a) For drop I, the specimen shall drop onto the target so as to suffer the maximum damage, and the height of the drop measured from the lowest point of the specimen to the upper surface of the target shall be 9 m. The target shall be as defined in 6.4.14;
- (b) For drop II, the specimen shall drop ~~so as to suffer the maximum damage~~ onto a bar rigidly mounted perpendicularly on the target so as to suffer the maximum damage. The height of the drop measured from the intended point of impact of the specimen to the upper surface of the bar shall be 1 m. The bar shall be of solid mild steel of circular section,  $(15.0 \pm 0.5)$  cm in diameter and 20 cm long unless a longer bar would cause greater damage, in which case a bar of sufficient length to cause maximum damage shall be used. The upper end of the bar shall be flat and horizontal with its edge rounded off to a radius of not more than 6 mm. The target on which the bar is mounted shall be as described in 6.4.14;
- (c) For drop III, the specimen shall be subjected to a dynamic crush test by positioning the specimen on the target so as to suffer maximum damage by the drop of a 500 kg mass from 9 m onto the specimen. The mass shall consist of a solid mild steel plate 1 m by 1 m and shall fall in a horizontal attitude. The lower face of the steel plate shall have its edges and corners rounded off to a radius of not more than 6 mm. The height of the drop shall be measured from the underside of the plate to the highest point of the specimen. The target on which the specimen rests shall be as defined in 6.4.14.

[IAEA: 7271]

6.4.17.3 *Thermal test:* The specimen shall be in thermal equilibrium under conditions of an ambient temperature of 38 °C, subject to the solar insolation conditions specified in Table 6.4.8.6 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.

The thermal test shall then consist of:

- (a) 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;
- (b) Exposure of the specimen to an ambient temperature of 38 °C, subject to the solar insolation conditions specified in Table 6.4.8.6 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 shall not be artificially cooled and any combustion of materials of the specimen shall be permitted to proceed naturally.

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

6.4.18 Enhanced water immersion test for Type B(U) and Type B(M) packages containing more than  $10^5$  A<sub>2</sub> and Type C packages

*Enhanced water immersion test:* The specimen shall be immersed under a head of water of at least 200 m for a period of not less than one hour. For demonstration purposes, an external gauge pressure of at least 2 MPa shall be considered to meet these conditions.

#### **6.4.19 Water leakage test for packages containing fissile material**

6.4.19.1 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 6.4.11.7-8 to 6.4.11.12-13 shall be excepted from the test.

[IAEA: 731]

6.4.19.2 Before the specimen is subjected to the water leakage test specified below, it shall be subjected to the tests in 6.4.17.2 (b), and either 6.4.17.2 (a) or (c) as required by 6.4.11.12-13, and the test specified in 6.4.17.3.

[IAEA: 732]

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

#### **6.4.20 Tests for Type C packages**

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

- (a) The tests specified in 6.4.17.2 (a), 6.4.17.2 (c), 6.4.20.2 and 6.4.20.3; and



- (b) The test specified in 6.4.20.4.

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

6.4.20.2 *Puncture/tearing test:* The specimen shall be subjected to the damaging effects of a **vertical** solid probe made of mild steel. The orientation of **the package specimen and the impact point on the package surface** ~~the probe to the surface of the specimen~~ shall be **such** as to cause maximum damage at the conclusion of the test sequence specified in 6.4.20.1 (a).

**[IAEA: 7351]**

- (a) The specimen, representing a package having a mass less than 250 kg, shall 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 shall 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 edge rounded off to a radius of not more than 6 mm. The target on which the specimen is placed shall be as specified in 6.4.14;
- (b) For packages having a mass of 250 kg or more, the base of the probe shall 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 shall be 3 m. For this test the probe shall have the same properties and dimensions as specified in (a) above, except that the length and mass of the probe shall be such as to incur maximum damage to the specimen. The target on which the base of the probe is placed shall be as specified in 6.4.14.

6.4.20.3 *Enhanced thermal test:* The conditions for this test shall be as specified in 6.4.17.3, except that the exposure to the thermal environment shall be for a period of 60 minutes.

6.4.20.4 *Impact test:* The specimen shall 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 shall be as defined in 6.4.14, except that the target surface may be at any orientation as long as the surface is normal to the specimen path.

#### **6.4.21 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 shall 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 shall require multilateral approval. For retesting packagings, any other equivalent non-destructive testing may be applied subject to multilateral approval.

#### **6.4.22 Approvals of package designs and materials**

6.4.22.1 The approval of designs for packages containing 0.1 kg or more of uranium hexafluoride requires that:

- (a) Each design that meets the requirements of 6.4.6.4 shall require multilateral approval;
- (b) Each design that meets the requirements of 6.4.6.1 to 6.4.6.3 shall require unilateral approval by the competent authority of the country of origin of the design, unless multilateral approval is otherwise required by these Regulations.

6.4.22.2 Each Type B(U) and Type C package design shall require unilateral approval, except that:

- (a) A package design for fissile material, which is also subject to 6.4.22.4, 6.4.23.7, and 5.1.5.2.1 shall require multilateral approval; and

- (b) A Type B(U) package design for low dispersible radioactive material shall require multilateral approval.

6.4.22.3 Each Type B(M) package design, including those for fissile material which are also subject to 6.4.22.4, 6.4.23.7 and 5.1.5.2.1 and those for low dispersible radioactive material, shall require multilateral approval.

6.4.22.4 Each package design for fissile material which is not excepted ~~by any of the paragraphs 2.7.2.3.5 (a) to (f), according to 6.4.11.2 and 6.4.11.3 from the requirements that apply specifically to packages containing fissile material~~ shall require multilateral approval.

[IAEA: 814]

6.4.22.5 The design for special form radioactive material shall require unilateral approval. The design for low dispersible radioactive material shall require multilateral approval (see also 6.4.23.8).

6.4.22.6 The design for a fissile material excepted from FISSILE classification in accordance with 2.7.2.3.5 (f) shall require multilateral approval.

[IAEA: 805]

6.4.22.7 Alternative activity limits for an exempt consignment of instruments or articles in accordance with 2.7.2.2(b) shall require multilateral approval.

[IAEA: 817]

6.4.23 Applications and approvals for radioactive material transport

6.4.23.1 (Reserved)

6.4.23.2 An application for ~~shipment~~ approval of shipment shall include:

- (a) The period of time, related to the shipment, for which the approval is sought;
- (b) The actual radioactive contents, the expected modes of transport, the type of conveyance, and the probable or proposed route; and
- (c) The details of how the precautions and administrative or operational controls, referred to in the certificate of approval for the package design, if applicable, ~~approval certificates~~ issued under 5.1.5.2.1 (a) (iii), (vi) or (vii), are to be put into effect.

[IAEA: 827]

6.4.23.3 An application for approval of shipments under special arrangement shall include all the information necessary to satisfy the competent authority that the overall level of safety in transport is at least equivalent to that which would be provided if all the applicable requirements of these Regulations had been met.

The application shall also include:

- (a) A statement of the respects in which, and of the reasons why, the shipment cannot be made in full accordance with the applicable requirements; and
- (b) A statement of any special precautions or special administrative or operational controls which are to be employed during transport to compensate for the failure to meet the applicable requirements.

6.4.23.4 An application for approval of Type B(U) or Type C package design shall include:

- (a) A detailed description of the proposed radioactive contents with reference to their physical and chemical states and the nature of the radiation emitted;
- (b) A detailed statement of the design, including complete engineering drawings and schedules of materials and methods of manufacture;
- (c) A statement of the tests which have been done and their results, or evidence based on calculative methods or other evidence that the design is adequate to meet the applicable requirements;
- (d) The proposed operating and maintenance instructions for the use of the packaging;
- (e) If the package is designed to have a maximum normal operating pressure in excess of 100 kPa gauge, a specification of the materials of manufacture of the containment system, the samples to be taken, and the tests to be made;
- (f) Where the proposed radioactive contents are irradiated nuclear fuel, a statement and a justification of any assumption in the safety analysis relating to the characteristics of the fuel and a description of any pre-shipment measurement as required by 6.4.11.4-5(b);
- (g) Any special stowage provisions necessary to ensure the safe dissipation of heat from the package considering the various modes of transport to be used and type of conveyance or freight container;
- (h) A reproducible illustration, not larger than 21 cm by 30 cm, showing the make-up of the package; and
- (i) A specification of the applicable management system ~~quality assurance programme~~ as required by ~~1.1.2.3.1~~ 1.5.3.1.

[IAEA: 809]

6.4.23.5 An application for approval of a Type B(M) package design shall include, in addition to the general information required ~~for package [design] approval~~ in 6.4.23.4 for Type B(U) packages:

- (a) A list of the requirements specified in 6.4.7.5, 6.4.8.5-~~54~~, to 6.4.8.6 and 6.4.8.9 to 6.4.8.15 with which the package does not conform;
- (b) Any proposed supplementary operational controls to be applied during transport not regularly provided for in these Regulations, but which are necessary to ensure the safety of the package or to compensate for the deficiencies listed in (a) above;
- (c) A statement relative to any restrictions on the mode of transport and to any special loading, carriage, unloading or handling procedures; and
- (d) A statement of ~~The~~ range of ambient conditions (temperature, solar radiation) which are expected to be encountered during transport and which have been taken into account in the design.

[IAEA: 812]

6.4.23.6 The application for approval of designs for packages containing 0.1 kg or more of uranium hexafluoride shall include all information necessary to satisfy the competent authority that the design meets the applicable requirements 6.4.6.1, and a specification of the applicable management system ~~quality assurance programme~~ as required in ~~1.1.2.3.1~~ 1.5.3.1.

[IAEA: 807]

6.4.23.7 An application for a fissile package approval shall include all information necessary to satisfy the competent authority that the design meets the applicable requirements of 6.4.11.1, and a specification of the applicable ~~management system quality assurance programme~~ as required by ~~4.1.2.3.1~~ 1.5.3.1. *[IAEA: 815]*

6.4.23.8 An application for approval of design for special form radioactive material and design for low dispersible radioactive material shall include:

- (a) A detailed description of the radioactive material or, if a capsule, the contents; particular reference shall be made to both physical and chemical states;
- (b) A detailed statement of the design of any capsule to be used;
- (c) A statement of the tests which have been done and their results, or evidence based on calculative methods to show that the radioactive material is capable of meeting the performance standards, or other evidence that the special form radioactive material or low dispersible radioactive material meets the applicable requirements of these Regulations;
- (d) A specification of the applicable ~~management system quality assurance programme~~ as required in ~~4.1.2.3.1~~ 1.5.3.1; and
- (e) Any proposed pre-shipment actions for use in the consignment of special form radioactive material or low dispersible radioactive material.

*[IAEA: 803]*

6.4.23.9 An application for approval of design for **fissile** material ~~excepted for from~~ **FISSILE** classification in accordance with Table 2.7.2.1.1, under 2.7.2.3.5 (f) shall include:

- (a) A detailed description of the material; particular reference shall be made to both physical and chemical states;
- (b) A statement of the tests that have been **carried out** and their results, or evidence based on calculation methods to show that the material is capable of meeting the requirements specified in 2.7.2.3.6;
- (c) A specification of the applicable management system as required in 1.5.3.1;
- (d) A statement of specific actions to be taken prior to shipment.

*[IAEA: 805]*

6.4.23.10 An application for approval of alternative activity limits for an exempt consignment of instruments or articles shall include:

- (a) An identification and detailed description of the instrument or article, its intended uses and the radionuclide(s) incorporated;
- (b) The maximum activity of the radionuclide(s) in the instrument or article;
- (c) Maximum external radiation levels arising from the instrument or article;
- (d) The chemical and physical forms of the radionuclide(s) contained in the instrument or article;

- (e) Details of the construction and design of the instrument or article, particularly as related to the containment and shielding of the radionuclide in routine, normal and accident conditions of transport;
- (f) The applicable management system, including the quality testing and verification procedures to be applied to radioactive sources, components and finished products to ensure that the maximum specified activity of radioactive material or the maximum radiation levels specified for the instrument or article are not exceeded, and that the instruments or articles are constructed according to the design specifications;
- (g) The maximum number of instruments or articles expected to be shipped per consignment and annually;
- (h) Dose assessments in accordance with the principles and methodologies set out in the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources, Safety Series No.115, IAEA, Vienna (1996), including individual doses to transport workers and members of the public and, if appropriate, collective doses arising from routine, normal and accident conditions of transport, based on representative transport scenarios the consignments are subject to.

[IAEA: 817]

6.4.23.911 Each ~~approval~~ certificate of approval issued by a competent authority shall be assigned an identification mark. The mark shall be of the following generalized type:

VRI/Number/Type Code

- (a) Except as provided in 6.4.23.40-12(b), VRI represents the international vehicle registration identification code of the country issuing the certificate<sup>4</sup>;
- (b) The number shall be assigned by the competent authority, and shall be unique and specific with regard to the particular design or shipment or alternative activity limit for exempt consignment. The ~~shipment approval~~ identification mark of the approval of shipment shall be clearly related to the ~~design approval~~ identification mark of the approval of design;
- (c) The following type codes shall be used in the order listed to indicate the types of certificate of approval ~~certificates~~ issued:

AF	Type A package design for fissile material
B(U)	Type B(U) package design (B(U)F if for fissile material)
B(M)	Type B(M) package design (B(M)F if for fissile material)
C	Type C package design (CF if for fissile material)
IF	Industrial package design for fissile material
S	Special form radioactive material
LD	Low dispersible radioactive material
<u>FE</u>	<u>Fissile material complying with the requirements of 2.7.2.3.6</u>
T	Shipment
X	Special arrangement
<u>AL</u>	<u>Alternative activity limits for an exempt consignment of instruments <u>or</u> articles</u>

<sup>4</sup> See Vienna Convention on Road Traffic (1968).

In the case of package designs for non-fissile or fissile excepted uranium hexafluoride, where none of the above codes apply, then the following type codes shall be used:

H(U)      Unilateral approval  
H(M)      Multilateral approval;

- (d) For ~~certificates of approval of~~ package design and special form radioactive material ~~approval certificates~~, other than those issued under transitional packaging the provisions of 6.4.24.2 to 6.4.24.45, and for low dispersible radioactive material ~~approval certificates~~, the symbols “-96” shall be added to the type code.

[IAEA: 832]

6.4.23.4012 These ~~type codes~~ identification marks shall be applied as follows:

- (a) Each certificate and each package shall bear the appropriate identification mark, comprising the symbols prescribed in 6.4.23.9-11 (a), (b), (c) and (d) above, except that, for packages, only the applicable design type codes including, if applicable, the symbols “-96”, shall appear following the second stroke, that is, the “T” or “X” shall not appear in the identification marking on the package. Where the ~~design approval~~ of design and the ~~shipment approval~~ of shipment are combined, the applicable type codes do not need to be repeated. For example:

A/132/B(M)F-96:      A Type B(M) package design approved for fissile material, requiring multilateral approval, for which the competent authority of Austria has assigned the design number 132 (to be marked on both the package and on the ~~package design approval~~ certificate of approval for the package design);

A/132/B(M)F-96T:      The ~~shipment approval~~ of shipment issued for a package bearing the identification mark elaborated above (to be marked on the certificate only);

A/137/X:      An ~~special arrangement~~ approval of special arrangement issued by the competent authority of Austria, to which the number 137 has been assigned (to be marked on the certificate only);

A/139/IF-96:      An Industrial package design for fissile material approved by the competent authority of Austria, to which package design number 139 has been assigned (to be marked on both the package and on the ~~package design approval~~ certificate of approval for the package design); and

A/145/H(U)-96:      A package design for fissile excepted uranium hexafluoride approved by the competent authority of Austria, to which package design number 145 has been assigned (to be marked on both the package and on the ~~package design approval~~ certificate of approval for the package design);

- (b) Where multilateral approval is effected by validation according to 6.4.23.4620, only the identification mark issued by the country of origin of the design or shipment shall be used. Where multilateral approval is effected by issue of certificates by successive countries, each certificate shall bear the appropriate identification mark and the package whose design was so approved shall bear all appropriate identification marks.

For example:

A/132/B(M)F-96  
CH/28/B(M)F-96

would be the identification mark of a package which was originally approved by Austria and was subsequently approved, by separate certificate, by Switzerland. Additional identification marks would be tabulated in a similar manner on the package;

- (c) The revision of a certificate shall be indicated by a parenthetical expression following the identification mark on the certificate. For example, A/132/B(M)F-96 (Rev.2) would indicate revision 2 of the Austrian ~~package design approval~~ certificate of approval for the package design; or A/132/B(M)F-96(Rev.0) would indicate the original issuance of the Austrian ~~package design approval~~ certificate of approval for the package design. For original issuances, the parenthetical entry is optional and other words such as “original issuance” may also be used in place of “Rev.0”. Certificate revision numbers may only be issued by the country issuing the original ~~approval~~ certificate of approval;
- (d) Additional symbols (as may be necessitated by national requirements) may be added in brackets to the end of the identification mark; for example, A/132/B(M)F to 96(SP503);
- (e) It is not necessary to alter the identification mark on the packaging each time that a revision to the design certificate is made. Such re-marking shall be required only in those cases where the revision to the package design certificate involves a change in the letter type codes for the package design following the second stroke.

[IAEA: 833]

6.4.23. ~~4.13~~ Each ~~approval~~ certificate of approval issued by a competent authority for special form radioactive material or low dispersible radioactive material shall include the following information:

- (a) Type of certificate;
- (b) The competent authority identification mark;
- (c) The issue date and an expiry date;
- (d) List of applicable national and international regulations, including the edition of the IAEA Regulations for the Safe Transport of Radioactive Material under which the special form radioactive material or low dispersible radioactive material is approved;
- (e) The identification of the special form radioactive material or low dispersible radioactive material;
- (f) A description of the special form radioactive material or low dispersible radioactive material;
- (g) Design specifications for the special form radioactive material or low dispersible radioactive material which may include references to drawings;
- (h) A specification of the radioactive contents which includes the activities involved and which may include the physical and chemical form;
- (i) A specification of the applicable ~~quality assurance programme~~ management system as required in ~~4.1.2.3.1~~ 1.5.3.1;

- (j) Reference to information provided by the applicant relating to specific actions to be taken prior to shipment;
- (k) If deemed appropriate by the competent authority, reference to the identity of the applicant;
- (l) Signature and identification of the certifying official.

[IAEA: 834]

6.4.23.14 Each certificate of approval issued by a competent authority for material excepted from classification as FISSILE shall include the following information:

- (a) Type of certificate;
- (b) The competent authority identification mark;
- (c) The issue date and an expiry date;
- (d) List of applicable national and international regulations, including the edition of the IAEA Regulations for the Safe Transport of Radioactive Material under which the exception is approved;
- (e) A description of the excepted material;
- (f) Limiting specifications for the excepted material;
- (g) A specification of the applicable management system as required in 1.5.3.1;
- (h) Reference to information provided by the applicant relating to specific actions to be taken prior to shipment;
- (i) If deemed appropriate by the competent authority, reference to the identity of the applicant;
- (j) Signature and identification of the certifying official;
- (k) Reference to documentation that demonstrates compliance with 2.7.2.3.6.

[IAEA: 835]

6.4.23.1215 Each ~~approval~~ certificate of approval issued by a competent authority for a special arrangement shall include the following information:

- (a) Type of certificate;
- (b) The competent authority identification mark;
- (c) The issue date and an expiry date;
- (d) Mode(s) of transport;
- (e) Any restrictions on the modes of transport, type of conveyance, freight container, and any necessary routing instructions;
- (f) List of applicable national and international regulations, including the edition of the IAEA Regulations for the Safe Transport of Radioactive Material under which the special arrangement is approved;



- (g) The following statement: “This certificate does not relieve the consignor from compliance with any requirement of the government of any country through or into which the package will be transported.”;
- (h) References to certificates for alternative radioactive contents, other competent authority validation, or additional technical data or information, as deemed appropriate by the competent authority;
- (i) Description of the packaging by a reference to the drawings or a specification of the design. If deemed appropriate by the competent authority, a reproducible illustration, not larger than 21 cm by 30 cm, showing the make-up of the package shall also be provided, accompanied by a brief description of the packaging, including materials of manufacture, gross mass, general outside dimensions and appearance;
- (j) A specification of the authorized radioactive contents, including any restrictions on the radioactive contents which might not be obvious from the nature of the packaging. This shall include the physical and chemical forms, the activities involved (including those of the various isotopes, if appropriate), ~~amounts—mass~~ in grams (for fissile material or for each fissile nuclide when appropriate), and whether special form radioactive material, ~~or~~ low dispersible radioactive material, or fissile material excepted under 2.7.2.3.5 (f) if applicable;
- (k) Additionally, for packages containing fissile material:
  - (i) a detailed description of the authorized radioactive contents;
  - (ii) the value of the criticality safety index;
  - (iii) reference to the documentation that demonstrates the criticality safety of the contents;
  - (iv) any special features, on the basis of which the absence of water from certain void spaces has been assumed in the criticality assessment;
  - (v) any allowance (based on 6.4.11.4.5(b)) for a change in neutron multiplication assumed in the criticality assessment as a result of actual irradiation experience; and
  - (vi) the ambient temperature range for which the special arrangement has been approved;
- (l) A detailed listing of any supplementary operational controls required for preparation, loading, carriage, unloading and handling of the consignment, including any special stowage provisions for the safe dissipation of heat;
- (m) If deemed appropriate by the competent authority, reasons for the special arrangement;
- (n) Description of the compensatory measures to be applied as a result of the shipment being under special arrangement;
- (o) Reference to information provided by the applicant relating to the use of the packaging or specific actions to be taken prior to the shipment;
- (p) A statement regarding the ambient conditions assumed for purposes of design if these are not in accordance with those specified in 6.4.8.5, 6.4.8.6, and 6.4.8.15, as applicable;
- (q) Any emergency arrangements deemed necessary by the competent authority;

- (r) A specification of the applicable ~~quality assurance programme~~ management system as required in ~~4.1.2.3.1~~ 1.5.3.1;
- (s) If deemed appropriate by the competent authority, reference to the identity of the applicant and to the identity of the carrier;
- (t) Signature and identification of the certifying official.

[IAEA: 836]

6.4.23. ~~1316~~ Each ~~approval~~ certificate of approval for a shipment issued by a competent authority shall include the following information:

- (a) Type of certificate;
- (b) The competent authority identification mark(s);
- (c) The issue date and an expiry date;
- (d) List of applicable national and international regulations, including the edition of the IAEA Regulations for the Safe Transport of Radioactive Material under which the shipment is approved;
- (e) Any restrictions on the modes of transport, type of conveyance, freight container, and any necessary routing instructions;
- (f) The following statement: "This certificate does not relieve the consignor from compliance with any requirement of the government of any country through or into which the package will be transported.";
- (g) A detailed listing of any supplementary operational controls required for preparation, loading, carriage, unloading and handling of the consignment, including any special stowage provisions for the safe dissipation of heat or maintenance of criticality safety;
- (h) Reference to information provided by the applicant relating to specific actions to be taken prior to the shipment;
- (i) Reference to the applicable ~~design approval~~ certificate(s) of approval of design;
- (j) A specification of the actual radioactive contents, including any restrictions on the radioactive contents which might not be obvious from the nature of the packaging. This shall include the physical and chemical forms, the total activities involved (including those of the various isotopes, if appropriate), ~~amounts~~ mass in grams (for fissile material or for each fissile nuclide when appropriate), and whether special form radioactive material, ~~or~~ low dispersible radioactive material or fissile material excepted under 2.7.2.3.5 (f), if applicable;
- (k) Any emergency arrangements deemed necessary by the competent authority;
- (l) A specification of the applicable ~~quality assurance programme~~ management system as required in ~~4.1.2.3.1~~ 1.5.3.1;
- (m) If deemed appropriate by the competent authority, reference to the identity of the applicant;
- (n) Signature and identification of the certifying official.

[IAEA: 837]

6.4.23.1417 Each ~~approval~~ certificate of approval of the design of a package issued by a competent authority shall include the following information:

- (a) Type of certificate;
- (b) The competent authority identification mark;
- (c) The issue date and an expiry date;
- (d) Any restriction on the modes of transport, if appropriate;
- (e) List of applicable national and international regulations, including the edition of the IAEA Regulations for the Safe Transport of Radioactive Material under which the design is approved;
- (f) The following statement: "This certificate does not relieve the consignor from compliance with any requirement of the government of any country through or into which the package will be transported.";
- (g) References to certificates for alternative radioactive contents, other competent authority validation, or additional technical data or information, as deemed appropriate by the competent authority;
- (h) A statement authorizing shipment where ~~shipment~~ approval of shipment is required under 5.1.5.1.2, if deemed appropriate;
- (i) Identification of the packaging;
- (j) Description of the packaging by a reference to the drawings or specification of the design. If deemed appropriate by the competent authority, a reproducible illustration, not larger than 21 cm by 30 cm, showing the make-up of the package shall also be provided, accompanied by a brief description of the packaging, including materials of manufacture, gross mass, general outside dimensions and appearance;
- (k) Specification of the design by reference to the drawings;
- (l) A specification of the authorized radioactive content, including any restrictions on the radioactive contents which might not be obvious from the nature of the packaging. This shall include the physical and chemical forms, the activities involved (including those of the various isotopes, if appropriate), ~~amounts~~ mass in grams (for fissile material the total mass of fissile nuclides or the mass for each fissile nuclide, when appropriate), and whether special form radioactive material, ~~or~~ low dispersible radioactive material or fissile material excepted under 2.7.2.3.5 (f), if applicable;
- (m) A description of the containment system;
- (n) ~~Additionally, for~~ packages ~~designs~~ containing fissile material which require multilateral approval of the package design in accordance with 6.4.22.4:
  - (i) a detailed description of the authorized radioactive contents;
  - (ii) a description of the confinement system;
  - (iii) the value of the criticality safety index;
  - (iv) reference to the documentation that demonstrates the criticality safety of the contents;

- (v) any special features, on the basis of which the absence of water from certain void spaces has been assumed in the criticality assessment;
- (vi) any allowance (based on 6.4.11.4.5 (b)) for a change in neutron multiplication assumed in the criticality assessment as a result of actual irradiation experience; and
- (vii) the ambient temperature range for which the package design has been approved;
- (o) For Type B(M) packages, a statement specifying those prescriptions of 6.4.7.5, 6.4.8.4, 6.4.8.5, 6.4.8.6 and 6.4.8.9 to 6.4.8.15 with which the package does not conform and any amplifying information which may be useful to other competent authorities;
- (p) For packages containing more than 0.1 kg of uranium hexafluoride, a statement specifying those prescriptions of 6.4.6.4 which apply if any and any amplifying information which may be useful to other competent authorities;
- (q) A detailed listing of any supplementary operational controls required for preparation, loading, carriage, unloading and handling of the consignment, including any special stowage provisions for the safe dissipation of heat;
- (r) Reference to information provided by the applicant relating to the use of the packaging or specific actions to be taken prior to shipment;
- (s) A statement regarding the ambient conditions assumed for purposes of design if these are not in accordance with those specified in 6.4.8.5, 6.4.8.6 and 6.4.8.15, as applicable;
- (t) A specification of the applicable ~~quality assurance programme~~ management system as required in ~~4.1.2.3.1~~ 1.5.3.1;
- (u) Any emergency arrangements deemed necessary by the competent authority;
- (v) If deemed appropriate by the competent authority, reference to the identity of the applicant;
- (w) Signature and identification of the certifying official.

[IAEA: 838]

6.4.23.18 Each certificate issued by a competent authority for alternative activity limits for an exempt consignment of instruments or articles according to 5.1.5.2.1 (d) shall include the following information:

- (a) Type of certificate
- (b) The competent authority identification mark.
- (c) The issue date and an expiry date.
- (d) List of applicable national and international regulations, including the edition of the IAEA Regulations for the Safe Transport of Radioactive Material under which the exemption is approved.
- (e) The identification of the instrument or article
- (f) A description of the instrument or article
- (g) Design specifications for the instrument or article

- (h) A specification of the radionuclide(s), the approved alternative activity limit(s) for the exempt consignment(s) of the instrument(s) or article(s).
- (i) Reference to documentation that demonstrates compliance with 2.7.2.2.2 (b).
- (j) If deemed appropriate by the competent authority, reference to the identity of the applicant.
- (k) Signature and identification of the certifying official.”

[IAEA: 839]

6.4.23.1519 The competent authority shall be informed of the serial number of each packaging manufactured to a design approved by them under 6.4.22.2, 6.4.22.3, 6.4.22.4, 6.4.24.2 and 6.4.24.3.

6.4.23.1620 Multilateral approval may be by validation of the original certificate issued by the competent authority of the country of origin of the design or shipment. Such validation may take the form of an endorsement on the original certificate or the issuance of a separate endorsement, annex, supplement, etc., by the competent authority of the country through or into which the shipment is made.

#### **6.4.24 Transitional measures for Class 7**

*Packages not requiring competent authority approval of design under the 1985 and 1985 (As amended 1990) editions of IAEA Safety Series No. 6*

6.4.24.1 Packages not requiring competent authority approval of design (Excepted packages, Type IP-1, Type IP-2, and Type IP-3 packages and Type A packages) shall meet these Regulations in full, except that 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):

- (a) May continue in transport provided that they were prepared for transport prior to 31 December 2003, and subject to the requirements of 6.4.24.4, if applicable;
- (b) May continue to be used provided that:
  - (i) They were not designed to contain uranium hexafluoride;
  - (ii) The applicable requirements of 1.5.3.1 of these Regulations are applied;
  - (iii) The activity limits and classification in Chapter 2.7 of these Regulations are applied;
  - (iv) The requirements and controls for transport in Parts 1, 3, 4, 5 and 7 of these Regulations are applied;
  - (v) The packaging was not manufactured or modified after 31 December 2003.

~~may continue to be used subject to the mandatory programme of quality assurance in accordance with the requirements of 1.1.2.3.1 and the activity limits and material restrictions of 2.7.2.2, 2.7.2.4.1, 2.7.2.4.4, 2.7.2.4.5, 2.7.2.4.6, SP336 of Chapter 3.3 and 4.1.9.3.~~

~~Any packaging modified, unless to improve safety, or manufactured after 31 December 2003, shall 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 shall meet the requirements of these Regulations in full.~~

[IAEA: 819]

*Packages approved under the 1973, 1973 (As amended), 1985 and 1985 (As amended 1990) editions of IAEA Safety Series No. 6*

~~6.4.24.2 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 1.1.2.3.1; the activity limits and material restrictions of 2.7.2.2, 2.7.2.4.1, 2.7.2.4.4, 2.7.2.4.5, 2.7.2.4.6, SP336 of Chapter 3.3 and 4.1.9.3; and, for a package containing fissile material and transported by air, the requirement of 6.4.11.10. No new manufacture of such packaging shall 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 shall require that the requirements of these Regulations be met in full. A serial number according to the provision of 5.2.1.5.5 shall be assigned to and marked on the outside of each packaging.~~

6.4.24.2 Packages requiring competent authority approval of the design shall meet these Regulations in full unless the following conditions are met:

- (a) The packagings were manufactured to a package design approved by the competent authority under the provisions of the 1973 or 1973 (As Amended) or the 1985 or 1985 (As Amended 1990) Editions of IAEA Safety Series No.6);
- (b) The package design is subject to multilateral approval.
- (c) The applicable requirements of 1.5.3.1 of these Regulations are applied.
- (d) The activity limits and classification in Chapter 2.7 of these Regulations are applied.
- (e) The requirements and controls for transport in in Parts 1, 3, 4, 5 and 7 of these Regulations are applied.
- (f) For a package containing fissile material and transported by air, the requirement of 6.4.11.11 is met.
- (g) For packages that meet the requirements of the 1973 or 1973 (As Amended) Editions of these Regulations:
  - (i) The packages retain sufficient shielding to ensure that the radiation level at 1 m from the surface of the package would not exceed 10 mSv/h in the accident conditions of transport defined in the 1973 Revised or 1973 Revised (As Amended) Editions of IAEA Safety Series No.6 with the maximum radioactive contents which the package is authorized to contain.
  - (ii) The packages do not utilize continuous venting.
  - (iii) A serial number in accordance with the provision of 5.2.1.5.5 is assigned to and marked on the outside of each packaging.

[IAEA: 820]

6.4.24.3 No new manufacture of packagings to a package design meeting the provisions of the 1973, 1973 (As Amended), 1985, and 1985 (As Amended 1990) Editions of IAEA Safety Series No.6 shall be permitted to commence.

[IAEA: 821]

~~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 design; the mandatory programme of quality assurance in accordance with the requirements of 1.1.2.3.1; the activity limits and material restrictions of 2.7.2.2, 2.7.2.4.1, 2.7.2.4.4, 2.7.2.4.5, 2.7.2.4.6, SP336 of Chapter 3.3 and 4.1.9.3; and, for a package containing fissile material and transported by air, the requirement of 6.4.11.10. 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 shall require that the requirements of these Regulations be met in full. All packagings for which manufacture begins after 31 December 2006 shall meet the requirements of these Regulations in full.~~

~~***[Fissile material and] Packages excepted from the requirements for fissile materials under the Regulations annexed to the 16th revised edition or the 17th revised edition of the United Nations Recommendations on the Transport of Dangerous Goods (2009 Edition of IAEA Safety Standard Series No. TS-R-1)***~~

~~6.4.24.4 ***[Fissile material and]*** Packages containing fissile material that is excepted from classification as FISSILE according to 2.7.2.3.5 (a)(i) or (iii) of the Regulations annexed to the 16th revised edition or the 17th revised edition of the United Nations Recommendations on the Transport of Dangerous Goods (paras. 417 (a) (i) or (iii) of the 2009 Edition of IAEA Regulations for the Safe Transport of Radioactive Material prepared for transport before 31 December 2014 may continue in transport and may continue to be classified as non-fissile or fissile-excepted except that the consignment limits in Table 2.7.2.3.5 of these editions shall apply to the conveyance. The consignment shall be transported under exclusive use.~~

~~*[IAEA: 822]*~~

~~***Special form radioactive material approved under the 1973, 1973 (As Amended), 1985 and 1985 (As Amended 1990) Editions of these Regulations editions of IAEA Safety Series No. 6***~~

~~6.4.24.4<sup>45</sup> 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~~**management system** in accordance with the applicable requirements of ~~1.1.2.3.1~~**1.5.3.1**. **No new manufacture of such special form radioactive material shall be permitted to commence.**~~All special form radioactive material manufactured after 31 December 2003 shall meet the requirements of these Regulations in full.~~~~

~~*[IAEA: 823]*~~

**Chapters 6.5, 6.6, 6.7 and 6.8      Unchanged**

## CHAPTER 7.1

## PROVISIONS CONCERNING TRANSPORT OPERATIONS BY ALL MODES OF TRANSPORT

Sections 7.1.1 to 7.1.8:            **Unchanged**

### 7.1.8                    **Special provisions applicable to the transport of radioactive material**

#### 7.1.8.1                *Segregation*

7.1.8.1.1            Packages, overpacks and freight containers containing radioactive material and unpackaged radioactive material shall be segregated during transport and during storage in transit:

- (a)    From workers in regularly occupied working areas by distances calculated using a dose criterion of 5 mSv in a year and conservative model parameters;
- (b)    From members of ~~the critical group of~~ the public, in areas where the public has regular access, by distances calculated using a dose criterion of 1 mSv in a year and conservative model parameters;
- (c)    From undeveloped photographic film by distances calculated using a radiation exposure criterion for undeveloped photographic film due to the transport of radioactive material for 0.1 mSv per consignment of such film; and
- (d)    From other dangerous goods in accordance with 7.1.2 and 7.1.3.2.

[IAEA: 562]

7.1.8.1.2            Category II-YELLOW or III-YELLOW packages or overpacks shall not be carried in compartments occupied by passengers, except those exclusively reserved for couriers specially authorized to accompany such packages or overpacks.

#### 7.1.8.2                *Activity limits*

The total activity in a single hold or compartment of an inland waterway craft, or in another conveyance, for carriage of LSA material or SCO in Type IP-1, Type IP-2, Type IP-3 or unpackaged, shall not exceed the limits shown in Table 7.1.8.2.

**Table 7.1.8.2:    Conveyance activity limits for LSA material and SCO  
in industrial packages or unpackaged**

[IAEA: Table 6]

Nature of material	Activity limit for conveyances other than by inland waterway <u>other than inland waterway craft</u>	Activity limit for a hold or compartment of an inland waterway craft
LSA-I	No limit	No limit
LSA-II and LSA-III non-combustible solids	No limit	100 A <sub>2</sub>
LSA-II and LSA-III combustible solids, and all liquids and gases	100 A <sub>2</sub>	10 A <sub>2</sub>
SCO	100 A <sub>2</sub>	10 A <sub>2</sub>



### 7.1.8.3 *Stowage during transport and storage in transit*

7.1.8.3.1 Consignments shall be securely stowed.

7.1.8.3.2 Provided that its average surface heat flux does not exceed  $15 \text{ W/m}^2$  and that the immediately surrounding cargo is not in sacks or bags, a package or overpack may be carried or stored among packaged general cargo without any special stowage provisions except as may be specifically required by the competent authority in an applicable [approval certificate of approval](#).  
[\[IAEA: 565\]](#)

7.1.8.3.3 Loading of freight containers and accumulation of packages, overpacks and freight containers shall be controlled as follows:

- (a) Except under the condition of exclusive use, and for consignments of LSA-I material, the total number of packages, overpacks and freight containers aboard a single conveyance shall be so limited that the total sum of the transport indexes aboard the conveyance does not exceed the values shown in Table 7.1.8.3.3;
- (b) The radiation level under routine conditions of transport shall not exceed 2 mSv/h at any point on, and 0.1 mSv/h at 2 m from, the external surface of the conveyance, except for consignments transported under exclusive use by road or rail, for which the radiation limits around the vehicle are set forth in 7.2.3.1.2 (b) and (c);
- (c) The total sum of the criticality safety indexes in a freight container and aboard a conveyance shall not exceed the values shown in Table 7.1.8.4.2.

**Table 7.1.8.3.3: TI limits for freight containers and conveyances not under exclusive use**

[\[IAEA: Table 10\]](#)

Type of freight container or conveyance	Limit on total sum of transport indexes in a freight container or aboard a conveyance
Freight container — <del>Small</del>	<del>50</del>
<del>Small freight container</del>	<del>50</del>
<del>Freight container</del> — Large <del>freight container</del>	50
Vehicle	50
Aircraft	
Passenger	50
Cargo	200
Inland waterway vessel	50
Seagoing vessel <sup>a</sup>	
(1) Hold, compartment or defined deck area:	
Packages, overpacks, small freight containers	50
Large freight containers	200
(2) Total vessel:	
Packages, overpacks, small freight containers	200
Large freight containers	no limit

<sup>a</sup> Packages or overpacks carried in or on a vehicle which are in accordance with the provisions of 7.2.3.1.3.2 may be transported by vessels provided that they are not removed from the vehicle at any time while on board the vessel.

7.1.8.3.4 Any package or overpack having either a transport index greater than 10, or any consignment having a criticality safety index greater than 50, shall be transported only under exclusive use.

7.1.8.4 *Additional requirements relating to Segregation of packages containing fissile material during transport and storage in transit of fissile material*

7.1.8.4.1 Any group of packages, overpacks, and freight containers containing fissile material stored in transit in any one storage area shall be so limited that the total sum of the criticality safety indexes in the group does not exceed 50. Each group shall be stored so as to maintain a spacing of at least 6 m from other such groups.

7.1.8.4.2 Where the total sum of the criticality safety indexes on board a conveyance or in a freight container exceeds 50, as permitted in Table 7.1.8.4.2, storage shall be such as to maintain a spacing of at least 6 m from other groups of packages, overpacks or freight containers containing fissile material or other conveyances carrying radioactive material.

**Table 7.1.8.4.2: CSI limits for freight containers and conveyances containing fissile material**

*[IAEA: Table 11]*

Type of freight container or conveyance	Limit on total sum of criticality safety indexes in a freight container or aboard a conveyance	
	Not under exclusive use	Under exclusive use
<u>Freight container</u>		
<del>Freight container</del> —Small <u>freight container</u>	50	n.a.
<del>Freight container</del> —Large <u>freight container</u>	50	100
Vehicle	50	100
Aircraft		
Passenger	50	n.a.
Cargo	50	100
Inland waterway vessel	50	100
Seagoing vessel <sup>a</sup>		
(1) Hold, compartment or defined deck area:		
Packages, overpacks, small freight containers	50	100
Large freight containers	50	100
(2) Total vessel:		
Packages, overpacks, small freight containers	200 <sup>b</sup>	200 <sup>c</sup>
Large freight containers	No limit <sup>b</sup>	No limit <sup>c</sup>

<sup>a</sup> Packages of overpacks carried in or on a vehicle which are in accordance with the provisions of 7.2.3.1.2 may be transported by vessels provided that they are not removed from the vehicle at any time while on board the vessel. In that case the entries under the heading “under exclusive use” apply.

<sup>b</sup> The consignment shall be so handled and stowed that the total sum of CSI's in any group does not exceed 50, and that each group is handled and stowed so as to maintain a spacing of ~~that the groups are separated from each other by~~ at least 6 m from other groups.

<sup>c</sup> The consignment shall be so handled and stowed that the total sum of CSI's in any group does not exceed 100, and that each group is handled and stowed so as to maintain a spacing of ~~that the groups are separated from each other by~~ at

least 6 m from other groups. For transport under exclusive use, the intervening space between groups may be occupied by other compatible cargo.

7.1.8.4.3 Fissile material meeting one of the provisions (a) to (f) of 2.7.2.3.5 shall meet the following requirements:

- (a) Only one of the provisions (a) to (f) of 2.7.2.3.5 is allowed per consignment;
- (b) Only one approved fissile material in packages classified in accordance with 2.7.2.3.5 (f) is allowed per consignment unless multiple materials are authorized in the certificate of approval;
- (c) Fissile material in packages classified in accordance with 2.7.2.3.5 (c) shall be transported in a consignment with no more than 45 g of fissile nuclides;
- (d) Fissile material in packages classified in accordance with 2.7.2.3.5 (d) shall be transported in a consignment with no more than 15 g of fissile nuclides;
- (e) Unpackaged or packaged fissile material classified in accordance with 2.7.2.3.5 (e) shall be transported under exclusive use on a conveyance with no more than 45 g of fissile nuclides.

[IAEA: 570]

#### **7.1.8.5 Damaged or leaking packages, contaminated packagings**

7.1.8.5.1 If it is evident that a package is damaged or leaking, or if it is suspected that the package may have leaked or been damaged, access to the package shall be restricted and a qualified person shall, as soon as possible, assess the extent of contamination and the resultant radiation level of the package. The scope of the assessment shall include the package, the conveyance, the adjacent loading and unloading areas, and, if necessary, all other material which has been carried in the conveyance. When necessary, additional steps for the protection of persons property and the environment, in accordance with provisions established by the relevant competent authority, shall be taken to overcome and minimize the consequences of such leakage or damage.

7.1.8.5.2 Packages damaged or leaking radioactive contents in excess of allowable limits for normal conditions of transport may be removed to an acceptable interim location under supervision, but shall not be forwarded until repaired or reconditioned and decontaminated.

7.1.8.5.3 A conveyance and equipment used regularly for the transport of radioactive material shall be periodically checked to determine the level of contamination. The frequency of such checks shall be related to the likelihood of contamination and the extent to which radioactive material is transported.

7.1.8.5.4 Except as provided in 7.1.8.5.5, any conveyance, or equipment or part thereof which has become contaminated above the limits specified in 4.1.9.1.2 in the course of the transport of radioactive material, or which shows a radiation level in excess of 5 µSv/h at the surface, shall be decontaminated as soon as possible by a qualified person and shall not be re-used unless the following conditions are fulfilled:

- (a) the non-fixed contamination does not exceed the limits specified in 4.1.9.1.2; ~~and~~
- (b) the radiation level resulting from the fixed contamination ~~on surfaces after decontamination is less than~~ shall not exceed 5 µSv/h at the surface.

[IAEA: 513]

7.1.8.5.5 A freight container, tank, intermediate bulk container or conveyance dedicated to the transport of unpackaged radioactive material under exclusive use shall be excepted from the requirements of 4.1.9.1.4 and 7.1.8.5.4 solely with regard to its internal surfaces and only for as long as it remains under that specific exclusive use.

**7.1.8.6** *Other requirements*

7.1.8.6.1 Where a consignment is undeliverable, the consignment shall be placed in a safe location and the appropriate competent authority shall be informed as soon as possible and a request made for instructions on further action.

**Sections 7.1.9 and 7.1.10** **Unchanged**

## CHAPTER 7.2

### MODAL PROVISIONS

#### 7.2.1 Application and general provisions

7.2.1.1 This Chapter requires provisions applicable to dangerous goods transport operations by individual modes of transport. These provisions are in addition to those applicable to all modes of transport as provided in Chapter 7.1.

#### 7.2.2 Special provisions applicable to the transport of portable tanks on vehicles

Portable tanks may only be transported on vehicles whose fastenings are capable, in conditions of maximum permissible loading of the portable tanks, of absorbing the forces specified in 6.7.2.2.12, 6.7.3.2.9 or 6.7.4.2.12, as appropriate.

#### 7.2.3 Special provisions applicable to the transport of radioactive material

##### 7.2.3.1 Transport by rail and by road

7.2.3.1.1 Rail and road vehicles carrying packages, overpacks or freight containers labelled with any of the labels shown in 5.2.2.2.2 as models No. 7A, 7B, 7C or 7E or carrying consignments under exclusive use, shall display the placard shown in Figure 5.3.1 (Model 7D) on each of:

- (a) The two external lateral walls in the case of a rail vehicle;
- (b) The two external lateral walls and the external rear wall in the case of a road vehicle.

In the case of a vehicle without sides the placards may be affixed directly on the cargo-carrying unit provided that they are readily visible; in the case of physically large tanks or freight containers, the placards on the tanks or freight containers shall suffice. In the case of vehicles which have insufficient area to allow the fixing of larger placards, the dimensions of the placard as described in Figure 5.3.1 may be reduced to 100 mm. Any placards which do not relate to the contents shall be removed.

7.2.3.1.2 For consignments under exclusive use, the radiation level shall not exceed:

- (a) 10 mSv/h at any point on the external surface of any package or overpack, and may only exceed 2 mSv/h provided that:
  - (i) The vehicle is equipped with an enclosure which, during routine conditions of transport, prevents the access of unauthorized persons to the interior of the enclosure, and
  - (ii) Provisions are made to secure the package or overpack so that its position within the vehicle enclosure remains fixed during routine conditions of transport, and
  - (iii) There is no loading or unloading during the shipment;
- (b) 2 mSv/h at any point on the outer surfaces of the vehicle, including the upper and lower surfaces, or, in the case of an open vehicle, at any point on the vertical planes projected from the outer edges of the vehicle, on the upper surface of the load, and on the lower external surface of the vehicle; and

- (c) 0.1 mSv/h at any point 2 m from the vertical planes represented by the outer lateral surfaces of the vehicle, or, if the load is transported in an open vehicle, at any point 2 m from the vertical planes projected from the outer edges of the vehicle.

7.2.3.1.3 In the case of road vehicles, no persons other than the driver and assistants shall be permitted in vehicles carrying packages, overpacks or freight containers bearing category II-YELLOW or III-YELLOW labels.

#### **7.2.3.2 Transport by vessels**

7.2.3.2.1 Packages or overpacks having a surface radiation level greater than 2 mSv/h, unless being carried in or on a vehicle under exclusive use in accordance with Table 7.1.8.3.3, footnote (a), shall not be transported by vessel except under special arrangement.

7.2.3.2.2 The transport of consignments by means of a special use vessel which, by virtue of its design, or by reason of its being chartered, is dedicated to the purpose of carrying radioactive material, shall be excepted from the requirements specified in 7.1.8.3.3 provided that the following conditions are met:

- (a) A radiation protection programme for the shipment shall be approved by the competent authority of the flag state of the vessel and, when requested, by the competent authority at each port of call;
- (b) Stowage arrangements shall be predetermined for the whole voyage including any consignments to be loaded at ports of call en route; and
- (c) The loading, carriage and unloading of the consignments shall be supervised by persons qualified in the transport of radioactive material.

#### **7.2.3.3 Transport by air**

7.2.3.3.1 Type B(M) packages and consignments under exclusive use shall not be transported on passenger aircraft.

7.2.3.3.2 Vented Type B(M) packages, packages which require external cooling by an ancillary cooling system, packages subject to operational controls during transport, and packages containing liquid pyrophoric materials shall not be transported by air.

7.2.3.3.3 Packages or overpacks having a surface radiation level greater than 2 mSv/h shall not be transported by air except by special arrangement.

#### **7.2.4 Security provisions for transport by road, rail and inland waterway**

**NOTE:** *These provisions are in addition to those applicable to all modes of transport as provided in Chapter 1.4.*

7.2.4.1 Each crew member of road vehicles, trains and inland waterway craft transporting dangerous goods shall carry with them means of identification, which includes their photograph, during transport.

7.2.4.2 When appropriate and already fitted, the use of transport telemetry or other tracking methods or devices shall be used to monitor the movement of high consequence dangerous goods (see Table 1.4.1 in Chapter 1.4.).

7.2.4.3 The carrier shall ensure the application to vehicles and inland waterway craft transporting high consequence dangerous goods (see Table 1.4.1 in Chapter 1.4) of devices, equipment or arrangements to prevent the theft of the vehicle or inland waterway craft or its cargo and shall ensure that these are operational and effective at all times.

7.2.4.4 Safety inspections on cargo transport units shall cover appropriate security measures.

**TABLE OF CORRESPONDENCE BETWEEN****PARAGRAPH NUMBERS****IN****THE IAEA REGULATIONS FOR THE SAFE TRANSPORT  
OF RADIOACTIVE MATERIAL****(~~2009-xxxx~~2012 EDITION) (SSR-6)****AND****THE ~~SEVENTEENTH~~EIGHTEENTH REVISED EDITION OF  
THE RECOMMENDATIONS ON THE TRANSPORT  
OF DANGEROUS GOODS****(~~INCLUDING THE~~ MODEL REGULATIONS)**

***Note:** Any revision of this Table of correspondence may be found on the UNECE Transport Division website:  
<http://www.unece.org/trans/danger/danger.htm>.*

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104	1.5.1.2
105	1.1.1.4
106	1.5.1.3
107	1.5.1.4
108	X
109	X (Chapter 1.4)
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307	Par. 17, Recommendations
308	Par. 18, Recommendations
309	1.5.6.1
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407	2.7.2.2.6
408	2.7.2.4.2
409	2.7.2.3.1.2
410	3.3.1 <del>SP337</del> <u>SP336</u>
411	4.1.9.2.1, 7.1.8.2
412	2.7.2.4.3
413	2.7.2.3.2
414	4.1.9.2.1, 7.1.8.2
415	2.7.2.3.3
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417	2.7.2.3.5, <del>6.4.11.2</del>
418	4.1.9.3
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<del>424 (c):</del>	<u>1.1.1.6 (b)</u>
<del>425 (new)</del>	<u>2.7.2.4.1.5 (new)</u>
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506 <del>507</del>	1.5.5.1
507 <del>508</del>	4.1.9.1.2
508 <del>509</del>	4.1.9.1.4
509 <del>510</del>	7.1.8.5.1
510 <del>511</del>	7.1.8.5.2
511 <del>512</del>	7.1.8.5.3
512 <del>513</del>	7.1.8.5.4
513 <del>514</del>	7.1.8.5.5
514 <del>515</del>	1.5.1.5.1, 1.5.1.5.2
515 <del>516</del>	2.7.2.4.1.2
516 <del>517</del>	4.1.9.2.1
517 <del>518</del>	4.1.9.2.2
519 (new)	4.1.9.2.3 (new)
518 <del>520</del>	4.1.9.2.34
519 <del>521</del>	4.1.9.2.45
520 <del>522</del>	7.1.8.2
521 <del>523</del>	5.1.5.3.1
522 <del>524</del>	5.1.5.3.2
523 <del>525</del>	5.1.5.3.3
524 <del>526</del>	4.1.9.1.910
525 <del>527</del>	4.1.9.1.1011
526 <del>528</del>	4.1.9.1.1112
527 <del>529</del>	5.1.5.3.4
528 <del>530</del>	5.1.5.3.5, 5.2.1.5.8, 5.2.2.1.12.5, 5.4.1.5.7.3
529 <del>531</del>	5.2.1.5.1
530 <del>532</del>	<del>[5.2.1.5.2][X]5.2.1.1, 5.2.1.2, 5.1.2.1</del>
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532 <del>534</del>	5.2.1.5.4
533 <del>535</del>	5.2.1.5.5
534 <del>536</del>	5.2.1.5.6
535 <del>537</del>	5.2.1.5.7
536 <del>538</del>	5.2.2.1.12.1
537 <del>539</del>	5.2.2.1.12.1
538 <del>540</del>	5.2.2.1.12.2

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540 <del>542</del>	5.2.2.1.12.4
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542 <del>544</del>	5.3.2.1.1, 5.3.2.1.2
543 <del>545</del>	5.1.1.2
544 <del>546</del>	5.4.1.3, 5.4.1.4.1, 5.4.1.5.7.1
545 <del>547</del>	5.4.1.6.1
546 <del>548</del>	X
547 <del>549</del>	5.4.1.6
548 <del>550</del>	5.4.1.6.2 <del>[5.4.2.3]</del>
549 <del>551</del>	5.4.2.1
550 <del>552</del>	5.4.2.2
551 <del>553</del>	[Not correct] [should be replaced by text of 5.4.2.3 and 5.4.2.4][5.4.2.3] X
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555 <del>558</del>	5.1.5.1.4 (b)
556 <del>559</del>	5.1.5.1.4 (d)
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558 <del>561</del>	4.1.9.1.89, 5.1.5.2.2
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560 <del>563</del>	7.1.8.1.2
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562 <del>565</del>	7.1.8.3.2
563 <del>566</del>	7.1.8.3.3
564 <del>567</del>	7.1.8.3.4
565 <del>568</del>	7.1.8.4.1
566 <del>569</del>	7.1.8.4.2
570 (new)	7.1.8.4.3 (new)
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568 <del>572</del>	5.3.2.1.1, 5.3.2.1.2
569 <del>573</del>	7.2.3.1.2
570 <del>574</del>	7.2.3.1.3
571 <del>575</del>	7.2.3.2.1
572 <del>576</del>	7.2.3.2.2

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574 <del>578</del>	7.2.3.3.2
575 <del>579</del>	7.2.3.3.3
576 <del>580</del>	1.1.1.6
577 <del>581</del>	1.1.1.6
578 <del>582</del>	X
579 <del>583</del>	7.1.8.6.1
584 (new)	<del>5.4.1.1.1/5.4.1.1.2</del>
585 (new)	<del>X</del>
586 (new)	<del>5.4.1.1.3</del>
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588 (new)	<del>5.4.4.2X</del>
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602	2.7.2.3.3.1
603	2.7.2.3.3.2
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605	2.7.2.3.4.1
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607 <del>608</del>	6.4.2.2
608 <del>609</del>	6.4.2.3
609 <del>610</del>	6.4.2.4
610 <del>611</del>	6.4.2.5
611 <del>612</del>	6.4.2.6
612 <del>613</del>	6.4.2.7
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614 <del>615</del>	6.4.2.9
615 <del>616</del>	6.4.2.10
617 (new)	6.4.2.11
616 <del>618</del>	6.4.2.1112
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619 <del>621</del>	6.4.3.3
620 <del>622</del>	6.4.4
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<del>628</del> <del>630</del>	6.4.5.4.5	<del>668</del> <del>670</del>	6.4.10.2	724	6.4.15.6
<del>629</del> <del>631</del>	6.4.6.1	<del>669</del> <del>671</del>	6.4.10.3	725	6.4.16
<del>630</del> <del>632</del>	6.4.6.2	<del>670</del> <del>672</del>	6.4.10.4	726	6.4.17.1
<del>631</del> <del>633</del>	6.4.6.3	<del>671</del> <del>673</del>	6.4.11.1	727	6.4.17.2
<del>632</del> <del>634</del>	6.4.6.4	<del>672</del> <del>674</del>	<del>2.7.2.3.5</del> , 6.4.11.2	728	6.4.17.3
<del>633</del> <del>635</del>	6.4.7.1	<del>673</del> <del>676</del>	<del>675 (new)</del> <del>6.4.11.3</del>	729	6.4.17.4
<del>634</del> <del>636</del>	6.4.7.2	<del>674</del> <del>677</del>	6.4.11. <del>43</del>	730	6.4.18
<del>635</del> <del>637</del>	6.4.7.3	<del>675</del> <del>378</del>	6.4.11. <del>54</del>	731	6.4.19.1
<del>636</del> <del>638</del>	6.4.7.4	<del>676</del> <del>679</del>	6.4.11. <del>65</del>	732	6.4.19.2
<del>637</del> <del>639</del>	6.4.7.5	<del>677</del> <del>680</del>	6.4.11. <del>76</del>	733	6.4.19.3
<del>638</del> <del>640</del>	6.4.7.6	<del>678</del> <del>681</del>	6.4.11. <del>87</del>	734	6.4.20.1
<del>639</del> <del>641</del>	6.4.7.7	<del>679</del> <del>682</del>	6.4.11. <del>89</del>	735	6.4.20.2
<del>640</del> <del>642</del>	6.4.7.8	<del>680</del> <del>683</del>	6.4.11. <del>109</del>	736	6.4.20.3
<del>641</del> <del>643</del>	6.4.7.9	<del>681</del> <del>684</del>	6.4.11. <del>1110</del>	737	6.4.20.4
<del>642</del> <del>644</del>	6.4.7.10	<del>682</del> <del>685</del>	6.4.11. <del>1211</del>	801	5.1.5.2.3
<del>643</del> <del>645</del>	6.4.7.11	<del>683</del> <del>686</del>	6.4.11. <del>1312</del>	802abc	5.1.5.2.1
<del>644</del> <del>646</del>	6.4.7.12	701	6.4.12.1	802d	7.2.3.2.2
<del>645</del> <del>647</del>	6.4.7.13	702	6.4.12.2	802e	2.7.2.2.2
<del>646</del> <del>648</del>	6.4.7.14	703	2.7.2.3.1.4	803	2.7.2.3.3.1, 2.7.2.3.4.1, 6.4.22.5, 6.4.23.8
<del>647</del> <del>649</del>	6.4.7.15	704	2.7.2.3.3.4	804	5.1.5.2.1
<del>648</del> <del>650</del>	6.4.7.16	705	2.7.2.3.3.5 (a)	<del>805 (new)</del> <del>6.4.22.6</del> , <del>6.4.23.9</del>	
<del>649</del> <del>651</del>	6.4.7.17	706	2.7.2.3.3.5 (b)	<del>805a</del> <del>807a</del>	6.4.22.1 (a)
<del>650</del> <del>652</del>	6.4.8.1	707	2.7.2.3.3.5 (c)	<del>805b</del> <del>807b</del>	6.4.22.1 (b)
<del>651</del> <del>653</del>	6.4.8.2	708	2.7.2.3.3.5 (d)	<del>805c</del> <del>807c</del>	6.4.23.6
<del>652</del> <del>654</del>	6.4.8.3	709	2.7.2.3.3.6	<del>805d</del> <del>807d</del>	5.1.5.2.1
<del>653</del> <del>655</del>	6.4.8.4	710	2.7.2.3.3.7	<del>806</del> <del>808</del>	6.4.22.2
<del>654</del> <del>656</del>	6.4.8.5	711	2.7.2.3.3.8	<del>807</del> <del>809</del>	6.4.23.4
<del>655</del> <del>657</del>	6.4.8.6	712	2.7.2.3.4.2	<del>808</del> <del>810</del>	5.1.5.2.1
<del>656</del> <del>658</del>	6.4.8.7	713	6.4.12.3	<del>809</del> <del>811</del>	6.4.22.3
<del>657</del> <del>659</del>	6.4.8.8	714	6.4.12.3	<del>810</del> <del>812</del>	6.4.23.5
<del>658</del> <del>660</del>	6.4.8.9	715	6.4.12.3	<del>811</del> <del>813</del>	5.1.5.2.1
<del>659</del> <del>661</del>	6.4.8.10	716	6.4.13	<del>812</del> <del>814</del>	6.4.22.4
<del>660</del> <del>662</del>	6.4.8.11	717	6.4.14	<del>813</del> <del>815</del>	6.4.23.7
<del>661</del> <del>663</del>	6.4.8.12	718	6.4.21	<del>814</del> <del>816</del>	5.1.5.2.1
<del>662</del> <del>664</del>	6.4.8.13	719	6.4.15.1	<del>817 (new)</del> <del>6.4.22.7</del> , <del>6.4.23.10</del>	
<del>663</del> <del>665</del>	6.4.8.14	720	6.4.15.2	<del>818 (new)</del> <del>5.1.5.2.1</del>	
<del>664</del> <del>666</del>	6.4.8.15	721	6.4.15.3	<del>815</del> <del>819</del>	6.4.24.1
<del>665</del> <del>667</del>	6.4.9.1	722	6.4.15.4		
<del>666</del> <del>668</del>	6.4.9.2				

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<del>822</del> <u>827</u>	6.4.23.2
<del>823</del> <u>828</u>	5.1.5.2.1
<del>824</del> <u>829</u>	1.5.4.2
<del>825</del> <u>830</u>	6.4.23.3
<del>826</del> <u>831</u>	5.1.5.2.1
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Correspondence between IAEA ~~TS-R-1~~SSR-6 table and figure numbers  
and  
table and figure numbers in the UN Model Regulations  
on the Transport of Dangerous Goods

<del>TS-R-1</del> <u>SSR-6</u> Table	UN Model Regulations
1	included in 2.7.2.1.1
2	2.7.2.2.1
3	2.7.2.2.2
<del>4</del>	<del>2.7.2.3.5</del>
<del>5</del> <u>4</u>	2.7.2.4.1.2
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<del>7</del> <u>6</u>	7.1.8.2
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<del>9</del> <u>8</u>	5.1.5.3.4
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<del>11</del> <u>10</u>	7.1.8.3.3
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14	6.4.15.4

<del>TS-R-1</del> <u>SSR-6</u> Figure	UN Model Regulations
1	Figure 5.2.1
2	5.2.2.2.2 No. 7A
3	5.2.2.2.2 No. 7B
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6	5.3.1.2.2 Figure 5.3.1 No. 7D
7	5.3.2.1.3, Figure 5.3.3