Australian Government
Civil Aviation Safety Authority

Advisory Circular

AC 92-7(0) FEBRUARY 2013

APPLICATIONS FOR COMPETENT AUTHORITY APPROVAL: RADIOACTIVE MATERIAL

1. REFERENCES

- Section 23 of the *Civil Aviation Act 1988* (the Act) – Dangerous Goods
- Part 92 of the *Civil Aviation Safety Regulations 1998* (CASR 1998) – Dangerous Goods
- International Civil Aviation Organization (ICAO) Technical Instructions for the Safe Transport of Dangerous Goods By Air DOC 9284 AN/905 (ICAO TIs)
- Supplement to the ICAO TIs DOC 9284 AN/905
- Advisory Circular (AC) 92-04(0) – Applications for Permission to Carry or Consign Dangerous Goods under Section 23 of the Civil Aviation Act 1988
- International Atomic Energy Agency (IAEA) Safety Standards – Regulations for the Safe Transport of Radioactive Material – No: TS-R-1 (IAEA TS-R-1)
- Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) – Code of Practice – Safe Transport of Radioactive Material – Radiation Protection Series No. 2 (ARPANSA RPS-2)

CONTENTS

Advisory Circulars (ACs) are intended to provide advice and guidance to illustrate a means, but not necessarily the only means, of complying with the Regulations, or to explain certain regulatory requirements by providing informative, interpretative and explanatory material.

Where an AC is referred to in a 'Note' below the regulation, the AC remains as guidance material.

ACs should always be read in conjunction with the referenced regulations.

This AC has been approved for release by the Executive Manager, Standards Division.

2. PURPOSE

2.1 The Civil Aviation Safety Authority (CASA) is the designated *Competent Authority* of Australia for the air transport of radioactive material.

Note: *This AC must be read in conjunction with the ICAO TIs, the IAEA TS-R-1, the ARPANSA RPS-2 and, where relevant, AC 92-04(0).*

2.2 This AC provides guidance and information to persons applying to CASA for an approval in relation to:

- Designs for:
  - Special form radioactive material;
  - Low dispersible radioactive material;
  - Packages containing 0.1 kg or more of uranium hexafluoride;
  - All packages containing fissile material unless excepted;
  - Type B(U) packages and Type B(M) packages; and
  - Type C packages;
- Special arrangements;
- Certain Shipments; and
- Calculation of radionuclide values that are not listed in Table 2 of TS-R-1.

3. STATUS OF THIS ADVISORY CIRCULAR

3.1 This is the first AC to be written on this subject.

4. ACRONYMS

AC	Advisory Circular
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
CASA	Civil Aviation Safety Authority
CASR	Civil Aviation Safety Regulations 1998
DGI	Dangerous Goods Inspector
IAEA	International Atomic Energy Agency
ICAO	International Civil Aviation Organization
RPS-2	ARPANSA Radiation Protection Series 2 – Safe Transport of Radioactive Material
TI	Technical Instructions for the Safe Transport of Dangerous Goods by Air
TS-R-1	IAEA Safety Standards – Regulations for the Safe Transport of Radioactive Material – Safety Requirements No. TS-R-1

5. DEFINITIONS

5.1 For the purposes of this document:

Act means the *Civil Aviation Act 1988*.

Approval means an approval issued by CASA as *Competent Authority* of Australia for the air transport of radioactive material.

Multilateral approval shall mean approval by the relevant *competent authority* of the country of origin of the *design* or *shipment*, as applicable, and also, where the *consignment* is to be transported *through or into* any other country, approval by the *competent authority* of that country.

Para means the applicable paragraph contained within the TS-R-1 referenced by its number.

Special arrangement shall mean those provisions, approved by the *competent authority*, under which *consignments* which do not satisfy all the applicable requirements of the IAEA TS-R-1 or ICAO TIs may be transported.

Technical Instructions means the ICAO TI as amended and in force from time to time.

Unilateral approval shall mean an approval of a *design* which is required to be given by the *competent authority* of the country of origin of the *design* only.

Note: *Definitions not listed above regarding the transport of radioactive material can be found in Section II of the IAEA TS-R-1.*

6. BACKGROUND

6.1 In Australia, the transport of radioactive material by air is regulated by CASA. This is done through the relevant provisions of the Act, CASR 1998 and the ICAO TI.

6.2 As the designated *Competent Authority* of Australia for the air transport of radioactive material, CASA is responsible for the issuing of certain approvals as outlined in para.802 of the IAEA TS-R-1.

6.3 ARPANSA is the competent authority for Commonwealth entities for transport of radioactive material by road and rail. The Australian Maritime Safety Authority is the competent authority for transport of radioactive material by sea.

6.4 This AC provides guidance for persons applying for an approval from CASA and outlines the information required in an application.

7. INFORMATION FOR APPLICANTS

7.1 Before applying to CASA for any approval relating to air transport, it is expected that the applicant has obtained the necessary approval from ARPANSA as air transport is only one part of the multi-modal transport chain, with road transport to and from an airport being assumed. It is therefore expected that a copy of the ARPANSA approval, or evidence of an application being made to ARPANSA, will be provided with the application submitted to CASA.

7.2 Applicants are encouraged to contact a Dangerous Goods Inspector (DGI) at CASA prior to, and during, the approval process in order to ensure a full understanding of the regulatory requirements.

7.3 Applicants should note that a considerable amount of time is required to conduct a proper assessment of an application and they should plan accordingly. As a guide, it is not unusual to take three months from the date of application to the date of issue of an approval.

8. INFORMATION REQUIRED IN AN APPLICATION

8.1 In all cases where an application is made to CASA, such application will need to conform to all of the requirements of this section of the AC. The application will require an expanded compliance statement addressing the requirements of the ICAO TIs taking into account the relevant edition of the TS-R-1 document required by the TIs valid at the time of intended transport.

8.2 The RPS-2 uses the 2005 edition of the TS-R-1 but the 2011-2012 edition of the TI requires the 2009 edition of the TS-R-1. The compliance statement should therefore address the relevant paragraphs of the 2009 edition in paragraph number order and the relevant paragraphs of the 2005 edition, or later edition as applicable, in number order. In addition, the correlating reference in the TIs may also be shown and any requirement specific to the TIs listed.

8.3 It is important to note that if the application does not include the minimum information required, additional information will be requested and CASA might not be in a position to begin the assessment of the application until such time as this information is made available. Furthermore, the documentation submitted must be updated with respect to the legal and regulatory requirements applicable at the time of making the application.

8.4 Applications should be prepared in detail having regard to the relevant Appendix of this AC that applies to the type of approval sought.

8.5 Where a compliance statement has been included in an Appendix to this AC, then a completed Compliance Statement must be submitted with the application.

8.6 In all cases, it is expected that any relevant Safety Analysis Report will be submitted with the application.

9. VALIDATION OF FOREIGN PACKAGES

9.1 CASA may give *Multilateral* approval by validation of the original certificate issued by the competent authority of the country of origin of the design or shipment.

9.2 This validation can be made by CASA issuing an approval document that is in addition to the original approval.

9.3 Often the process for the validation of foreign packages is much shorter than an initial approval as it is accepted that the design or shipment has already been subject to an assessment by the country of origin.

9.4 Details of the information required to be provided in an application for validation is found in Appendix 10.

10. SUBMITTING AN APPLICATION

10.1 An application can be submitted by mail, facsimile or email. A list of CASA offices and contact details can be found on the CASA website at: http://www.casa.gov.au.

10.2 Applications by e-mail must be made to dg@casa.gov.au. Alternative arrangements can be made by contacting a DGI on 131 757.

Executive Manager
Standards Division

February 2013

APPENDIX 1

APPROVAL OF SPECIAL FORM RADIOACTIVE MATERIAL OR LOW DISPERSIBLE RADIOACTIVE MATERIAL

The *design* for *special form radioactive material* shall require *unilateral approval*.

The *design* for *low dispersible radioactive material* shall require *multilateral approval*.

In both cases, an application for *approval* shall include a *Safety Analysis Report* containing:

(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 *quality assurance* programme as required in para. 306;

(e) Any proposed pre-*shipment* actions for use in the *consignment* of *special form radioactive material* or *low dispersible radioactive material*; and

(f) A completed *Compliance Statement.*

IAEA Safety Standards TS-R-1 2009 Edition Paragraph Number	IAEA Safety Standards TS-R-1 2005 Edition Paragraph	ICAO Technical Instructions DOC 9284 2011-2012 Edition Reference	Compliance Statement for Approval of Special Form Radioactive Material	Reference in Safety Analysis Report
201	201	2;7.1.3	Definition of - A_1	[redacted]
220	220	1;3.1.1	Definition of - design	
239	239	2;7.1.3	Definition of - Special Form Radioactive Material	
306	306	1;6.3	Quality assurance programme required	
415	n/a	2;7.2.3.3	Special Form must comply with 602-604 & 802	[redacted]
428	413	2;7.2.4.4.1.1(a)	Special Form - maximum activity A_1 in a Type A package	
502	502	4;9.1.7	Requirements before each shipment	
544	544	5;4.1.3, 5;4.1.4.1, 5;4.1.4.2 and 5;4.1.5.6	Particulars of consignment	
556		5;1.2.1.4(d)	Notification of competent authority	
602	602	2;7.2.3.3.1	At least one dimension not less than 5 mm	
603(a)	603(a)	2;7.2.3.3.2(a)	Not to break or shatter when tested	
603(b)	603(b)	2;7.2.3.3.2(b)	Not to melt or disperse heat when tested	
603(c)	603(c)	2;7.2.3.3.2(c)	Activity in water following leaching test	
604	604	2;7.2.3.3.1	Sealed capsule can only be opened by destroying it	
640	640	6;7.6.8	Special Form may be considered as part of the containment system in Type A	[redacted]
701	701	6;7.11	Demonstration of compliance	
704	704	2;7.2.3.3.4	Tests for Special Form Radioactive Material - 705 - 711	
705	705	2;7.2.3.3.5(a)	Impact test	
706	706	2;7.2.3.3.5(b)	Percussion test	
707	707	2;7.2.3.3.5(c)	Bending test	
708	708	2;7.2.3.3.5(d)	Heat test	
709	709	2;7.2.3.3.6	Testing exceptions	
710	710	2;7.2.3.3.7	Leaching assessment	

IAEA Safety Standards TS-R-1 2009 Edition Paragraph Number	IAEA Safety Standards TS-R-1 2005 Edition Paragraph	ICAO Technical Instructions DOC 9284 2011-2012 Edition Reference	Compliance Statement for Approval of Special Form Radioactive Material	Reference in Safety Analysis Report
711	711	2;7.2.3.3.8	Leaching assessment - sealed capsules	
802	802	6;7.21.5	Requirement for competent authority approval	
803	803	2;7.2.3.3.1	Unilateral approval required	
803(a)	803(a)		A detailed description of the radioactive material; or if a capsule, the contents; particular reference must be made to both physical and chemical states	
803(b)	803(b)		A detailed statement of the design of any capsule to be used	
803(c)	803(c)	6;7.11	A statement of the test 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 meets the applicable requirements	
803(d)	803(d)	6;7.23.4 & 1.6.3	A specification of the applicable quality assurance programme as required by paragraph 306	
803(e)	803(e)		Any proposed pre-shipment actions for use in the consignment of the special form radioactive material	
804	804		Competent authority approval certificate	
818	818		Transitional provisions	
827	827		Competent authority approval certificate	
828	828		Competent authority approval certificate	
830	830		Competent authority approval certificate	
831	831		Competent authority approval certificate	
832	832		Competent authority approval certificate	
833	833		Competent authority approval certificate	

APPENDIX 2

APPROVAL OF PACKAGE DESIGNS TO CONTAIN URANIUM HEXAFLUORIDE

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 para. 632 shall require *multilateral approval*.

(b) Each *design* that meets the requirements of paras 629–631 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.

The application for approval shall include a *Safety Analysis Report* containing:

(a) all information necessary to satisfy the *competent authority* that the *design* meets the requirements of para. 629, and

(b) a specification of the applicable *quality assurance* programme as required in para. 306.

APPENDIX 3

APPROVAL OF TYPE B(U) PACKAGE DESIGNS

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 paras 812-814, shall require multilateral approval; and.

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

An application for approval shall include a *Safety Analysis Report* containing:

(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 carried out 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 fuel, the applicant shall state and justify any assumption in the safety analysis relating to the characteristics of the fuel and describe any pre-*shipment* measurement required by para. 674(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 the type of *conveyance* or *freight container*;

(h) A reproducible illustration, not larger than 21 cm × 30 cm, showing the make-up of the *package*; and

(i) A specification of the applicable *quality assurance* programme as required in para. 306.

(j) A completed *Compliance Statement*

IAEA Safety Standards TS-R-1 2009 Edition Paragraph Number	IAEA Safety Standards TS-R-1 2005 Edition Paragraph	ICAO Technical Instructions DOC 9284 2011-2012 Edition Reference	Compliance Statement for Approval of a Type B(U) Package	Reference in Safety Analysis Report
110	109	2; introductory chapter 4.2	If applicable per 616:- For radioactive material having subsidiary risks, and for transport of radioactive material with other dangerous goods, the relevant transport regulations for dangerous goods shall apply in addition to these Regulations.	
201	201	2;7.1	Definition of - A_1 and A_2	[redacted]
230	230	2;7.1.3	Definition of Package	
430	n/a	2;7.2.4.6.1	Type B(U), Type B(M) and Type C packages shall be classified in accordance with the competent authority approval certificate for the package issued by the country of origin of design	
431	416	2;7.2.4.6.2	431.A Type B(U) package shall 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.	
433	417	A160	433.Type B(U) and Type B(M) packages, if transported by air, shall meet the requirements of paras 431 or 432 and shall not contain activities greater than the following: (a) For low dispersible radioactive material — as authorized for the package design as specified in the certificate of approval; (b) For special form radioactive material — $3000A_1$ or $100{,}000A_2$, whichever is the lower; or (c) For all other radioactive material — $3000A_2$.	

IAEA Safety Standards TS-R-1 2009 Edition Paragraph Number	IAEA Safety Standards TS-R-1 2005 Edition Paragraph	ICAO Technical Instructions DOC 9284 2011-2012 Edition Reference	Compliance Statement for Approval of a Type B(U) Package	Reference in Safety Analysis Report
501	501	4;9.1.6	Requirements before first shipment Before a *packaging* is first used to transport *radioactive material*, the following requirements shall be fulfilled: (a) If the *design* pressure of the *containment system* exceeds 35 kPa (gauge), it shall be ensured that the *containment system* of each *package* conforms to the approved *design* requirements relating to the capability of that system to maintain its integrity under that pressure. (b) For each *Type B(U)*, *Type B(M)* and *Type C package* and for each *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 *packages* containing *fissile material*, where, in order to comply with the requirements of para. 671, neutron poisons are specifically included as components of the *package*, checks shall be performed to confirm the presence and distribution of those neutron poisons.	
502	502	4;9.1.7	Requirements before each shipment	
506	507	1;6.6.1	If applicable per 616: - In addition to the radioactive and fissile properties, any other dangerous properties of the contents of the package, such as explosiveness, flammability, pyrophoricity, chemical toxicity and corrosiveness, shall be taken into account in the packing, labelling, marking, placarding, storage and transport in order to be in compliance with the relevant transport regulations for dangerous goods of each of the countries through or into which the materials will be transported, and, where applicable, with the regulations of the cognizant transport organizations, as well as these Regulations	
533	n/a	5;2.4.5.1c)	Each *package* which conforms to a *design* approved under paras 805-814 or 816, 817 shall be legibly and durably marked on the outside of the *packaging* with: (a) The identification mark allocated to that *design* by the *competent authority*; (b) A serial number to identify uniquely each *packaging* which conforms to that *design*; (c) In the case of a *Type B(U)* or *Type B(M) package design*, with “TYPE B(U)” or “TYPE B(M)”; and (d) In the case of a *Type C package design*, with “TYPE C”.	
534	540	5;2.4.5.1d)	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 Fig. 1.	

IAEA Safety Standards TS-R-1 2009 Edition Paragraph Number	IAEA Safety Standards TS-R-1 2005 Edition Paragraph	ICAO Technical Instructions DOC 9284 2011-2012 Edition Reference	Compliance Statement for Approval of a Type B(U) Package	Reference in Safety Analysis Report
554	558	6;7.21.2	Notification of competent authority	
555	559		Notification of competent authority - see 554 to 556	
573	577	7;2.10.3.3	Consignments under exclusive use shall not be transported on passenger aircraft.	
574	578	7;2.10.5.2	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.	
575	579	7;2.10.5.3	Packages or overpacks having a surface radiation level greater than2 mSv/h shall not be transported by air except by special arrangement.	
606	606	6;7.1.1	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.	
607	607	6;7.1.2	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.	
608	608	6;7.1.3	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 para. 607, or shall be removable or otherwise rendered incapable of being used during transport.	
609	609	6;7.1.4	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.	
610	610	6;7.1.5	As far as practicable, the outer layer of the *package* shall be so designed as to prevent the collection and the retention of water.	
611	611	6;7.1.6	Any features added to the package at the time of transport which are not part of the package shall not reduce its safety.	

IAEA Safety Standards TS-R-1 2009 Edition Paragraph Number	IAEA Safety Standards TS-R-1 2005 Edition Paragraph	ICAO Technical Instructions DOC 9284 2011-2012 Edition Reference	Compliance Statement for Approval of a Type B(U) Package	Reference in Safety Analysis Report
612	612	6;7.1.7	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.	
613	613	6;7.1.8	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.	
614	614	6;7.1.9	All valves through which the radioactive contents could escape shall be protected against unauthorized operation.	
615	615	6;7.1.10	The design of the package shall take into account ambient temperatures and pressures that are likely to be encountered in routine conditions of transport.	
616	616	6;7.1.11	For radioactive material having other dangerous properties, the package design shall take into account those properties (see paras 110 and 506).	
617	617	6;7.2.1	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.	
618	618	6;7.2.2	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.	
619	619	6;7.2.3 M	Packages containing radioactive material to be transported by air shall be capable of withstanding, without leakage, an internal pressure which produces a pressure differential of not less than maximum normal operating pressure plus 95 kPa.	
634	634	6;7.6.2	The smallest overall external dimension of the package shall not be less than 10 cm.	
635	635	6;7.6.3	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 the package has not been opened.	
636	636	6;7.6.4	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.	

IAEA Safety Standards TS-R-1 2009 Edition Paragraph Number	IAEA Safety Standards TS-R-1 2005 Edition Paragraph	ICAO Technical Instructions DOC 9284 2011-2012 Edition Reference	Compliance Statement for Approval of a Type B(U) Package	Reference in Safety Analysis Report
637	637	6;7.6.5	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.	
638	638	6;7.6.6	The design and manufacturing techniques shall be in accordance with national or international standards, or other requirements, acceptable to the competent authority.	
639	639	6;7.6.7	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.	
640	640	6;7.6.8	Special form radioactive material may be considered as a component of the containment system.	
641	641	6;7.6.9	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.	
642	642	6;7.6.10	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.	
643	643	6;7.6.11	The containment system shall retain its radioactive contents under a reduction of ambient pressure to 60 kPa.	
644	644	6;7.6.12	All valves, other than pressure relief valves, shall be provided with an enclosure to retain any leakage from the valve.	
645	645	6;7.6.13	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.	
646 (b) only	646	6;7.6.14	A package shall be so designed that if it were subjected to the tests specified in paras 719–724, it would prevent: More than a 20% increase in the maximum radiation level at any external surface of the package.	
647	647	6;7.6.15	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.	

IAEA Safety Standards TS-R-1 2009 Edition Paragraph Number	IAEA Safety Standards TS-R-1 2005 Edition Paragraph	ICAO Technical Instructions DOC 9284 2011-2012 Edition Reference	Compliance Statement for Approval of a Type B(U) Package	Reference in Safety Analysis Report
650	650	6;7.7.1	Type B(U) packages shall be designed to meet the requirements specified in paras 606–616, the requirements specified in paras 617–619 if carried by air, and in paras 634–647, except as specified in para. 646(a), and, in addition, the requirements specified in paras 651–664.	
651	651	6;7.7.2	A package shall be so designed that, under the ambient conditions specified in paras 654 and 655, heat generated within the package by the radioactive contents shall not, under normal conditions of transport, as demonstrated by the tests in paras 719–724, 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: (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; (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.	
652	652	6;7.7.3	A package shall be so designed that, under the ambient condition specified in para. 654 and in the absence of insolation, the temperature of the accessible surfaces of a package shall not exceed 50°C, unless the package is transported under exclusive use.	
653	653	6;7.7.4	Except as required in para. 617 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 insolation under the ambient conditions specified in para. 654. 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.	
654	654	6;7.7.5	The ambient temperature shall be assumed to be 38°C.	
655	655	6;7.7.6	The solar insolation conditions shall be assumed to be as specified in Table 13.	
656	656	6;7.7.7	A package which includes thermal protection for the purpose of satisfying the requirements of the thermal test specified in para. 728 shall be so designed that such protection will remain effective if the package is subjected to the tests specified in paras 719–724 and 727(a) and (b) or 727(b) and (c), as appropriate. Any such protection on the exterior of the package shall not be rendered ineffective by ripping, cutting, skidding, abrading or rough handling.	

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657	657	6;7.7.8	A package shall be so designed that if it were subjected to: (a) The tests specified in paras 719–724, it would restrict the loss of radioactive contents to not more than $10–6A_2$ per hour. (b) The tests specified in paras 726, 727(b), 728 and 729 and the tests in paras: (i) 727(c), when the package has a mass not greater than 500 kg, an overall density not greater than 1000 kg/m3 based on the external dimensions, and radioactive contents greater than $1000A_2$ not as special form radioactive material, or (ii) 727(a), for all other packages, it would meet the following requirements: —Retain sufficient shielding to ensure that the radiation level 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 $10A_2$ for krypton-85 and not more than A_2 for all other radionuclides. Where mixtures of different radionuclides are present, the provisions of paras 405–407 shall apply, except that for krypton-85 an effective A_2 (i) value equal to $10A_2$ may be used. For case (a) above, the assessment shall take into account the external contamination limits of para. 507.	
658	658	6;7.7.9	A package for radioactive contents with activity greater than 10^5A_2 shall be so designed that, if it were subjected to the enhanced water immersion test specified in para. 730, there would be no rupture of the containment system.	
659	659	6;7.7.10	Compliance with the permitted activity release limits shall depend neither upon filters nor upon a mechanical cooling system.	
660	660	6;7.7.11	*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 paras 719–724 and 726–729.*	
661	661	6;7.7.12	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 paras 719–724 and 726–729, the levels 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.	

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662	662	6;7.7.13 M	A package shall not have a maximum normal operating pressure in excess of a gauge pressure of 700 kPa.	
663	663	6;7.7.14	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.	
664	664	6;7.7.15	A package shall be designed for an ambient temperature range from -40°C to +38°C.	
717	717	6;7.13	The target for the drop test specified in paras 705, 722, 725(a), 727 and 735 shall be a flat, horizontal surface of such a character that any increase in its resistance to displacement or deformation upon impact by the specimen would not significantly increase damage to the specimen.	
719	719	6;7.14.1	Tests for Normal Conditions of Transport The tests are: the water spray test, the free drop test, the stacking test and the penetration test. Specimens of the package 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 para. 720 are fulfilled.	
720	720	6;7.14.2	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.	
721	721	6;7.14.3	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.	
722	722	6;7.14.4	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 14 for the applicable mass. The target shall be as defined in para. 717. (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.	

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723	723	6;7.14.5	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.	
724	724	6;7.14.6	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 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.	
726	726	6;7.16.1	The specimen shall be subjected to the cumulative effects of the tests specified in paras 727 and 728, 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 para. 729 and, if applicable, para. 730.	

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727	727	6;7.16.2	Mechanical test: The mechanical test consists of three different drop tests. Each specimen shall be subjected to the applicable drops as specified in para. 657 or para. 682. 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 maximum damage in the thermal test which follows: (a) For drop I, the specimen shall drop onto the target so as to suffer 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 para. 717. (b) For drop II, the specimen shall drop so as to suffer maximum damage onto a bar rigidly mounted perpendicularly on the target. The height of the drop measured from the intended point of impact of the 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 ± 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 para. 717. (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 × 1 m and shall fall in a horizontal attitude. 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 para. 717.	

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728	728	6;7.16.3	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 13 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, provided due account is taken of them in the subsequent assessment of package response. The thermal test shall then consist of (a) followed by (b). (a) Exposure of a specimen for a period of 30 min 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. (b) Exposure of the specimen to an ambient temperature of 38°C, subject to the solar insolation conditions specified in Table 13 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, provided 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.	
729	729	6;7.16.4	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 8 h 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.	
730	730	6;7.17	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 1 h. For demonstration purposes, an external gauge pressure of at least 2 MPa shall be considered to meet these conditions.	
802	802	6;7.21.2	Requirement for competent authority approval.	[redacted]
806	806	6;7.21.2	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 paras 812-814, shall require multilateral approval; and (b) A Type B(U) package design for low dispersible radioactive material shall require multilateral approval.	

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807	807		An application for approval 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 carried out 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 fuel, the applicant shall state and justify any assumption in the safety analysis relating to the characteristics of the fuel and describe any pre-shipment measurement required by para. 674(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 the type of conveyance or freight container; (h) A reproducible illustration, not larger than 21 cm × 30 cm, showing the make-up of the package; and (i) A specification of the applicable quality assurance programme as required in para. 306.	
808	808		Competent authority approval certificate and design identification mark.	
828	828		Competent authority identification marks.	
829	829		Competent authority identification marks - type code.	
833	833		Competent authority package design approval certificate.	

APPENDIX 4

APPROVAL OF TYPE C PACKAGE DESIGNS

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 paras 812-814, shall require multilateral approval; and
(b) A Type B(U) package design for low dispersible radioactive material shall require multilateral approval.

An application for approval shall include a *Safety Analysis Report* containing:

(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 carried out 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 fuel, the applicant shall state and justify any assumption in the safety analysis relating to the characteristics of the fuel and describe any pre-shipment measurement required by para. 674(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 the type of conveyance or freight container;
(h) A reproducible illustration, not larger than 21 cm × 30 cm, showing the make-up of the package; and
(i) A specification of the applicable quality assurance programme as required in para. 306; and
(j) A completed *Compliance Statement.*

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110	109	2; introductory chapter 4.2	If applicable per 616:- For radioactive material having subsidiary risks, and for transport of radioactive material with other dangerous goods, the relevant transport regulations for dangerous goods shall apply in addition to these Regulations.	
201	201	2;7.1	Definition of - A_1 and A_2.	[redacted]
230	230	2;7.1.3	Definition of Package.	
430	n/a	2;7.2.4.6.1	Type B(U), Type B(M) and Type C packages shall be classified in accordance with the competent authority approval certificate for the package issued by the country of origin of design.	
434	418	2;7.2.4.6.4	A Type C package shall 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.	
501	501	4;9.1.6	Requirements before first shipment Before a *packaging* is first used to transport *radioactive material*, the following requirements shall be fulfilled: (a) If the *design* pressure of the *containment system* exceeds 35 kPa (gauge), it shall be ensured that the *containment system* of each *package* conforms to the approved *design* requirements relating to the capability of that system to maintain its integrity under that pressure. (b) For each *Type B(U)*, *Type B(M)* and *Type C package* and for each *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 *packages* containing *fissile material*, where, in order to comply with the requirements of para. 671, neutron poisons are specifically included as components of the *package*, checks shall be performed to confirm the presence and distribution of those neutron poisons.	
502	502	4;9.1.7	Requirements before each shipment.	[redacted]

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506	507	1;6.5	If applicable per 616: - In addition to the radioactive and fissile properties, any other dangerous properties of the contents of the package, such as explosiveness, flammability, pyrophoricity, chemical toxicity and corrosiveness, shall be taken into account in the packing, labelling, marking, placarding, storage and transport in order to be in compliance with the relevant transport regulations for dangerous goods of each of the countries through or into which the materials will be transported, and, where applicable, with the regulations of the cognizant transport organizations, as well as these Regulations.	
533	n/a	5;2.4.5.1c)	Each *package* which conforms to a *design* approved under paras 805-814 or 816, 817 shall be legibly and durably marked on the outside of the *packaging* with: (a) The identification mark allocated to that *design* by the *competent authority*; (b) A serial number to identify uniquely each *packaging* which conforms to that *design*; (c) In the case of a *Type B(U)* or *Type B(M) package design*, with “TYPE B(U)” or “TYPE B(M)”; and (d) In the case of a *Type C package design*, with “TYPE C”.	
534	540	5;2.4.5.1d)	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 Fig. 1.	
554	558		Notification of competent authority.	[redacted]
555	559		Notification of competent authority - see 554 to 556.	
573	577	7;2.10.10.3 & Table 7-6	Consignments under exclusive use shall not be transported on passenger aircraft.	
574	578	7;2.10.5.2	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.	
575	579	7;2.10.5.3	Packages or overpacks having a surface radiation level greater than2 mSv/h shall not be transported by air except by special arrangement.	
606	606	6;7.1.1	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.	

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607	607	6;7.1.2	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.	
608	608	6;7.1.3	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 para. 607, or shall be removable or otherwise rendered incapable of being used during transport.	
609	609	6;7.1.4	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.	
610	610	6;7.1.5	As far as practicable, the outer layer of the *package* shall be so designed as to prevent the collection and the retention of water.	
611	611	6;7.1.6	Any features added to the package at the time of transport which are not part of the package shall not reduce its safety.	
612	612	6;7.1.7	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.	
613	613	6;7.1.8	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.	
614	614	6;7.1.9	All valves through which the radioactive contents could escape shall be protected against unauthorized operation.	
615	615	6;7.1.10	The design of the package shall take into account ambient temperatures and pressures that are likely to be encountered in routine conditions of transport.	
616	616	6;7.1.11	For radioactive material having other dangerous properties, the package design shall take into account those properties (see para's 110 and 506).	
617	617	6;7.2.1	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.	

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618	618	6;7.2.2	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.	
619	619	6;7.2.3 M	Packages containing radioactive material to be transported by air shall be capable of withstanding, without leakage, an internal pressure which produces a pressure differential of not less than maximum normal operating pressure plus 95 kPa.	
634	634	6;7.6.2	The smallest overall external dimension of the package shall not be less than 10 cm.	
635	635	6;7.6.3	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 the package has not been opened.	
636	636	6;7.6.4	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.	
637	637	6;7.6.5	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.	
638	638	6;7.6.6	The design and manufacturing techniques shall be in accordance with national or international standards, or other requirements, acceptable to the competent authority.	
639	639	6;7.6.7	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.	
640	640	6;7.6.8	Special form radioactive material may be considered as a component of the containment system.	
641	641	6;7.6.9	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.	
642	642	6;7.6.10	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.	
643	643	6;7.6.11	The containment system shall retain its radioactive contents under a reduction of ambient pressure to 60 kPa.	

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644	644	6;7.6.12	All valves, other than pressure relief valves, shall be provided with an enclosure to retain any leakage from the valve.	
645	645	6;7.6.13	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.	
646 (b) only	646	6;7.6.14	A package shall be so designed that if it were subjected to the tests specified in paras 719–724, it would prevent: More than a 20% increase in the maximum radiation level at any external surface of the package.	
647	647	6;7.6.15	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.	
651	651	6;7.7.2	A package shall be so designed that, under the ambient conditions specified in paras 654 and 655, heat generated within the package by the radioactive contents shall not, under normal conditions of transport, as demonstrated by the tests in paras 719–724, 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: (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; (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.	
652	652	6;7.7.3	A package shall be so designed that, under the ambient condition specified in para. 654 and in the absence of insolation, the temperature of the accessible surfaces of a package shall not exceed 50°C, unless the package is transported under exclusive use.	
653	653	6;7.7.4	Except as required in para. 617 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 insolation under the ambient conditions specified in para. 654. 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.	

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654	654	6;7.7.5	The ambient temperature shall be assumed to be 38°C.	
655	655	6;7.7.6	The solar insolation conditions shall be assumed to be as specified in Table 13.	
657	657	6;7.7.8	A package shall be so designed that if it were subjected to: (a) The tests specified in paras 719–724, it would restrict the loss of radioactive contents to not more than 10–6A_2 per hour. (b) The tests specified in paras 726, 727(b), 728 and 729 and the tests in paras: (i) 727(c), when the package has a mass not greater than 500 kg, an overall density not greater than 1000 kg/m3 based on the external dimensions, and radioactive contents greater than 1000A_2 not as special form radioactive material, or (ii) 727(a), for all other packages, it would meet the following requirements: —Retain sufficient shielding to ensure that the radiation level 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 10A_2 for krypton-85 and not more than A_2 for all other radionuclides. Where mixtures of different radionuclides are present, the provisions of paras 405–407 shall apply, except that for krypton-85 an effective A_2 (i) value equal to 10A_2 may be used. For case (a) above, the assessment shall take into account the external contamination limits of para. 507.	
659	659	6;7.7.10	Compliance with the permitted activity release limits shall depend neither upon filters nor upon a mechanical cooling system.	
660	660	6;7.7.11	*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 paras 719–724 and 726–729.*	
661	661	6;7.7.12	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 paras 719–724 and 726–729, the levels 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.	

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662	662	6;7.7.13 M	A package shall not have a maximum normal operating pressure in excess of a gauge pressure of 700 kPa.	
663	663	6;7.7.14	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.	
664	664	6;7.7.15	A package shall be designed for an ambient temperature range from -40°C to +38°C.	
667	667	6;7.9.1	Type C packages shall be designed to meet the requirements specified in paras 606–619 and 634–647, except as specified in para. 646(a), and the requirements specified in paras 651–655, 659–664 and 668–670.	
668	668	6;7.9.2	A package shall be capable of meeting the assessment criteria prescribed for tests in paras 657(b) and 661 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.	
669	669	6;7.9.3	A package shall be so designed that if it were at the maximum normal operating pressure and subjected to: (a) The tests specified in paras 719–724, it would restrict the loss of radioactive contents to not more than $10^{-6}A_2$ per hour. (b) The test sequences in para. 734, it would meet the following requirements: (i) Retain sufficient shielding to ensure that the radiation level 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 one week to not more than $10A_2$ for krypton-85 and not more than A_2 for all other radionuclides. Where mixtures of different radionuclides are present, the provisions of paras 405–407 shall apply, except that for krypton-85 an effective A_2 (i) value equal to $10A_2$ may be used. For case (a), the assessment shall take into account the external contamination limits of para. 507.	
670	670	6;7.9.4	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 para. 730.	

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680	680	6;7.10.10	For packages to be transported by air: (a) The package shall be subcritical under conditions consistent with the Type C package tests specified in para. 734, assuming reflection by at least 20 cm of water but no water in-leakage; and (b) In the assessment of para. 679, allowance shall not be made for special features of para. 677 unless, following the Type C package tests specified in para. 734 and, subsequently, the water in-leakage test of para. 733, leakage of water into or out of the void spaces is prevented.	
717	717	6;7.13	The target for the drop test specified in paras 705, 722, 725(a), 727 and 735 shall be a flat, horizontal surface of such a character that any increase in its resistance to displacement or deformation upon impact by the specimen would not significantly increase damage to the specimen.	
719	719	6;7.14.1	Tests for Normal Conditions of Transport The tests are: the water spray test, the free drop test, the stacking test and the penetration test. Specimens of the package 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 para. 720 are fulfilled.	
720	720	6;7.14.2	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.	
721	721	6;7.14.3	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.	

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722	722	6;7.14.4	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 14 for the applicable mass. The target shall be as defined in para. 717. (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.	
723	723	6;7.14.5	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.	
724	724	6;7.14.6	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 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.	

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727	727	6;7.16.2	Mechanical test: The mechanical test consists of three different drop tests. Each specimen shall be subjected to the applicable drops as specified in para. 657 or para. 682. 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 maximum damage in the thermal test which follows: (a) For drop I, the specimen shall drop onto the target so as to suffer 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 para. 717. (b) For drop II, the specimen shall drop so as to suffer maximum damage onto a bar rigidly mounted perpendicularly on the target. The height of the drop measured from the intended point of impact of the 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 ± 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 para. 717. (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 × 1 m and shall fall in a horizontal attitude. 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 para. 717.	

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728	728	6;7.16.3	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 13 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, provided due account is taken of them in the subsequent assessment of package response. The thermal test shall then consist of (a) followed by (b). (a) Exposure of a specimen for a period of 30 min 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. (b) Exposure of the specimen to an ambient temperature of 38°C, subject to the solar insolation conditions specified in Table 13 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, provided 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.	
730	730	6;7.17	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 1 h. For demonstration purposes, an external gauge pressure of at least 2 MPa shall be considered to meet these conditions.	
734	734	6;7.19.1	Specimens shall be subjected to the effects of each of the following test sequences in the orders specified: (a) The tests specified in paras 727(a), 727(c), 735 and 736; and (b) The test specified in para. 737. Separate specimens are allowed to be used for each of the sequences (a) and (b).	

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735	735	6;7.19.2	735. Puncture–tearing test: The specimen shall be subjected to the damaging effects of a solid probe made of mild steel. The orientation of the probe to the surface of the specimen shall be such as to cause maximum damage at the conclusion of the test sequence specified in para. 734(a): (a) The specimen, representing a package having a mass of 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 the frustum of a right circular cone with the following dimensions: 30 cm height and 2.5 cm 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 para. 717. (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), except that the length and mass of the probe shall be such as to cause maximum damage to the specimen. The target on which the base of the probe is placed shall be as specified in para. 717.	
736	736	6;7.19.3	Enhanced thermal test: The conditions for this test shall be as specified in para. 728, except that the exposure to the thermal environment shall be for a period of 60 minutes.	
737	737	6;7.19.4	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 para. 717, except that the target surface may be at any orientation as long as the surface is normal to the specimen path.	
802	802		Requirement for competent authority approval.	[redacted]
806	806	6;7.21.2	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 paras 812-814, shall require multilateral approval; and (b) A Type B(U) package design for low dispersible radioactive material shall require multilateral approval.	

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807	807		An application for approval 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 carried out 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 fuel, the applicant shall state and justify any assumption in the safety analysis relating to the characteristics of the fuel and describe any pre-shipment measurement required by para. 674(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 the type of conveyance or freight container; (h) A reproducible illustration, not larger than 21 cm × 30 cm, showing the make-up of the package; and (i) A specification of the applicable quality assurance programme as required in para. 306.	
808	808		Competent authority approval certificate and design identification mark.	
828	828		Competent authority identification marks.	
829	829		Competent authority identification marks - type code.	
833	833		Competent authority package design approval certificate.	

APPENDIX 5

APPROVAL OF TYPE B(M) PACKAGE DESIGNS

Each *Type B(M) package design*, including those for *fissile material* which are also subject to paras 812–814 and those for *low dispersible radioactive material*, shall require *multilateral approval*.

An application for approval of a Type B(M) package design shall include a *Safety Analysis Report* containing:

(a) A list of the requirements specified in paras 637, 653–655 and 658–664 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);

(c) A statement relative to any restrictions on the mode of transport and to any special loading, carriage, unloading or handling procedures; and

(e) A completed *Compliance Statement.*

Note: *This above is in addition to the information required in para. 807 for Type B(U) packages*

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110	109	2; introductory chapter 4.2	If applicable per 616:- For radioactive material having subsidiary risks, and for transport of radioactive material with other dangerous goods, the relevant transport regulations for dangerous goods shall apply in addition to these Regulations.	
201	201	2;7.1.3	Definition of - A_1 and A_2.	[redacted]
230	230	2;7.1.3	Definition of Package.	
430	n/a	2;7.2.4.6.1	Type B(U), Type B(M) and Type C packages shall be classified in accordance with the competent authority approval certificate for the package issued by the country of origin of design.	
432	416	2;7.2.4.6.3	432.A Type B(M) package shall 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.	
433	417	A160	433. Type B(U) and Type B(M) packages, if transported by air, shall meet the requirements of paras 431 or 432 and shall not contain activities greater than the following: (a) For low dispersible radioactive material — as authorized for the package design as specified in the certificate of approval; (b) For special form radioactive material — $3000A_1$ or $100{,}000A_2$, whichever is the lower; or (c) For all other radioactive material — $3000A_2$.	

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501	501	4;9.1.6	Requirements before first shipment Before a *packaging* is first used to transport *radioactive material*, the following requirements shall be fulfilled: (a) If the *design* pressure of the *containment system* exceeds 35 kPa (gauge), it shall be ensured that the *containment system* of each *package* conforms to the approved *design* requirements relating to the capability of that system to maintain its integrity under that pressure. (b) For each *Type B(U)*, *Type B(M)* and *Type C package* and for each *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 *packages* containing *fissile material*, where, in order to comply with the requirements of para. 671, neutron poisons are specifically included as components of the *package*, checks shall be performed to confirm the presence and distribution of those neutron poisons.	
502	502	4;9.1.7	Requirements before each shipment.	
506	507	1;6.5	If applicable per 616: - In addition to the radioactive and fissile properties, any other dangerous properties of the contents of the package, such as explosiveness, flammability, pyrophoricity, chemical toxicity and corrosiveness, shall be taken into account in the packing, labelling, marking, placarding, storage and transport in order to be in compliance with the relevant transport regulations for dangerous goods of each of the countries through or into which the materials will be transported, and, where applicable, with the regulations of the cognizant transport organizations, as well as these Regulations.	
533	n/a	5;2.4.5.1c)	Each *package* which conforms to a *design* approved under paras 805-814 or 816, 817 shall be legibly and durably marked on the outside of the *packaging* with: (a) The identification mark allocated to that *design* by the *competent authority*; (b) A serial number to identify uniquely each *packaging* which conforms to that *design*; (c) In the case of a *Type B(U)* or *Type B(M) package design*, with “TYPE B(U)” or “TYPE B(M)”; and (d) In the case of a *Type C package design*, with “TYPE C”.	
534	540	5;2.4.5.1d)	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 Fig. 1.	

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554	558		Notification of competent authority.	[redacted]
555	559		Notification of competent authority - see 554 to 556.	
573	577	7;2.10.3.3 & Table 7-6	Type B(M) packages and consignments under exclusive use shall not be transported on passenger aircraft.	
574	578	7;2.10.5.2	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.	
575	579	7;2.10.5.3	Packages or overpacks having a surface radiation level greater than2 mSv/h shall not be transported by air except by special arrangement.	
606	606	6;7.1.1	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.	
607	607	6;7.1.2	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.	
608	608	6;7.1.3	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 para. 607, or shall be removable or otherwise rendered incapable of being used during transport.	
609	609	6;7.1.4	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.	
610	610	6;7.1.5	As far as practicable, the outer layer of the *package* shall be so designed as to prevent the collection and the retention of water.	
611	611	6;7.1.6	Any features added to the package at the time of transport which are not part of the package shall not reduce its safety.	

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612	612	6;7.1.7	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.	
613	613	6;7.1.8	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.	
614	614	6;7.1.9	All valves through which the radioactive contents could escape shall be protected against unauthorized operation.	
615	615	6;7.1.10	The design of the package shall take into account ambient temperatures and pressures that are likely to be encountered in routine conditions of transport.	
616	616	6;7.1.11	For radioactive material having other dangerous properties, the package design shall take into account those properties (see paras 110 and 506).	
617	617	6;7.2.1	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.	
618	618	6;7.2.2	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.	
619	619	6;7.2.3 M	Packages containing radioactive material to be transported by air shall be capable of withstanding, without leakage, an internal pressure which produces a pressure differential of not less than maximum normal operating pressure plus 95 kPa.	
634	634	6;7.6.2	The smallest overall external dimension of the package shall not be less than 10 cm.	
635	635	6;7.6.3	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 the package has not been opened.	
636	636	6;7.6.4	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.	

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637	637	6;7.6.5	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.	
638	638	6;7.6.6	The design and manufacturing techniques shall be in accordance with national or international standards, or other requirements, acceptable to the competent authority.	
639	639	6;7.6.7	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.	
640	640	6;7.6.8	Special form radioactive material may be considered as a component of the containment system.	
641	641	6;7.6.9	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.	
642	642	6;7.6.10	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.	
643	643	6;7.6.11	The containment system shall retain its radioactive contents under a reduction of ambient pressure to 60 kPa.	
644	644	6;7.6.12	All valves, other than pressure relief valves, shall be provided with an enclosure to retain any leakage from the valve.	
645	645	6;7.6.13	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.	
646 (b) only	646	6;7.6.14	A package shall be so designed that if it were subjected to the tests specified in paras 719–724, it would prevent: More than a 20% increase in the maximum radiation level at any external surface of the package.	

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647	647	6;7.6.15	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.	
650	650	6;7.7.1	Type B(U) packages shall be designed to meet the requirements specified in paras 606–616, the requirements specified in paras 617–619 if carried by air, and in paras 634–647, except as specified in para. 646(a), and, in addition, the requirements specified in paras 651–664.	
651	651	6;7.7.2	A package shall be so designed that, under the ambient conditions specified in paras 654 and 655, heat generated within the package by the radioactive contents shall not, under normal conditions of transport, as demonstrated by the tests in paras 719–724, 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: (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; (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.	
652	652	6;7.7.3	A package shall be so designed that, under the ambient condition specified in para. 654 and in the absence of insolation, the temperature of the accessible surfaces of a package shall not exceed 50°C, unless the package is transported under exclusive use.	
653	653	6;7.7.4	Except as required in para. 617 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 insolation under the ambient conditions specified in para. 654. 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.	
654	654	6;7.7.5	The ambient temperature shall be assumed to be 38°C.	
655	655	6;7.7.6	The solar insolation conditions shall be assumed to be as specified in Table 13.	

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656	656	6;7.7.7	A package which includes thermal protection for the purpose of satisfying the requirements of the thermal test specified in para. 728 shall be so designed that such protection will remain effective if the package is subjected to the tests specified in paras 719–724 and 727(a) and (b) or 727(b) and (c), as appropriate. Any such protection on the exterior of the package shall not be rendered ineffective by ripping, cutting, skidding, abrading or rough handling.	
657	657	6;7.7.8	A package shall be so designed that if it were subjected to: (a) The tests specified in paras 719–724, it would restrict the loss of radioactive contents to not more than 10–6A_2 per hour. (b) The tests specified in paras 726, 727(b), 728 and 729 and the tests in paras: (i) 727(c), when the package has a mass not greater than 500 kg, an overall density not greater than 1000 kg/m3 based on the external dimensions, and radioactive contents greater than 1000A_2 not as special form radioactive material, or (ii) 727(a), for all other packages, it would meet the following requirements: —Retain sufficient shielding to ensure that the radiation level 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 10A_2 for krypton-85 and not more than A_2 for all other radionuclides. Where mixtures of different radionuclides are present, the provisions of paras 405–407 shall apply, except that for krypton-85 an effective A_2 (i) value equal to 10A_2 may be used. For case (a) above, the assessment shall take into account the external contamination limits of para. 507.	
658	658	6;7.7.9	A package for radioactive contents with activity greater than 10^5A_2 shall be so designed that, if it were subjected to the enhanced water immersion test specified in para. 730, there would be no rupture of the containment system.	
659	659	6;7.7.10	Compliance with the permitted activity release limits shall depend neither upon filters nor upon a mechanical cooling system.	
660	660	6;7.7.11	*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 paras 719–724 and 726–729.*	

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661	661	6;7.7.12	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 paras 719–724 and 726–729, the levels 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.	
662	662	6;7.7.13	A package shall not have a maximum normal operating pressure in excess of a gauge pressure of 700 kPa.	
663	663	6;7.7.14	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.	
664	664	6;7.7.15	A package shall be designed for an ambient temperature range from -40°C to +38°C.	
665	665	6;7.8	Type B(M) packages shall meet the requirements for Type B(U) packages specified in para. 650, except that for packages to be transported solely within a specified country or solely between specified countries, conditions other than those given in paras 637, 653–655 and 658–664 may be assumed with the approval of the competent authorities of these countries. Notwithstanding, the requirements for Type B(U) packages specified in paras 653 and 658–664 shall be met as far as practicable.	
666	666		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.	
717	717	6;7.13	The target for the drop test specified in paras 705, 722, 725(a), 727 and 735 shall be a flat, horizontal surface of such a character that any increase in its resistance to displacement or deformation upon impact by the specimen would not significantly increase damage to the specimen.	
719	719	6;7.14.1	Tests for Normal Conditions of Transport The tests are: the water spray test, the free drop test, the stacking test and the penetration test. Specimens of the package 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 para. 720 are fulfilled.	
720	720	6;7.14.2	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	

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			simultaneously. No time interval shall elapse, however, if the water spray is applied from each of the four directions consecutively.	
721	721	6;7.14.3	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.	
722	722	6;7.14.4	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 14 for the applicable mass. The target shall be as defined in para. 717. (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.	
723	723	6;7.14.5	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.	
724	724	6;7.14.6	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 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.	

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726	726	6;7.16.1	The specimen shall be subjected to the cumulative effects of the tests specified in paras 727 and 728, 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 para. 729 and, if applicable, para. 730.	
727	727	6;7.16.2	Mechanical test: The mechanical test consists of three different drop tests. Each specimen shall be subjected to the applicable drops as specified in para. 657 or para. 682. 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 maximum damage in the thermal test which follows: (a) For drop I, the specimen shall drop onto the target so as to suffer 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 para. 717. (b) For drop II, the specimen shall drop so as to suffer maximum damage onto a bar rigidly mounted perpendicularly on the target. The height of the drop measured from the intended point of impact of the 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 ± 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 para. 717. (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 × 1 m and shall fall in a horizontal attitude. 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 para. 717.	

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728	728	6;7.16.3	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 13 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, provided due account is taken of them in the subsequent assessment of package response. The thermal test shall then consist of (a) followed by (b). (a) Exposure of a specimen for a period of 30 min 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. (b) Exposure of the specimen to an ambient temperature of 38°C, subject to the solar insolation conditions specified in Table 13 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, provided 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.	
729	729	6;7.16.4	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 8 h 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.	
730	730	6;7.17	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 1 h. For demonstration purposes, an external gauge pressure of at least 2 MPa shall be considered to meet these conditions.	
802	802		Requirement for competent authority approval.	

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806	806		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 paras 812-814, shall require multilateral approval; and (b) A Type B(U) package design for low dispersible radioactive material shall require multilateral approval.	
807	807		An application for approval 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 carried out 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 fuel, the applicant shall state and justify any assumption in the safety analysis relating to the characteristics of the fuel and describe any pre-shipment measurement required by para. 674(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 the type of conveyance or freight container; (h) A reproducible illustration, not larger than 21 cm × 30 cm, showing the make-up of the package; and (i) A specification of the applicable quality assurance programme as required in para. 306.	
809	809		Each Type B(M) package design, including those for fissile material which are also subject to paras 812–814 and those for low dispersible radioactive material, shall require multilateral approval.	

IAEA Safety Standards TS-R-1 2009 Edition Paragraph Number	IAEA Safety Standards TS-R-1 2005 Edition Paragraph	ICAO Technical Instructions DOC 9284 2011-2012 Edition Reference	Compliance Statement for Approval of a Type B(M) Package	Reference in Safety Analysis Report
810	810		An application for approval of a Type B(M) package design shall include, in addition to the information required in para. 807 for Type B(U) packages: (a) A list of the requirements specified in paras 637, 653–655 and 658–664 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); (c) A statement relative to any restrictions on the mode of transport and to any special loading, carriage, unloading or handling procedures; and (d) 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.	
811	811		Competent authority approval certificate and design identification mark.	[redacted]
820	820		Approval of Shipments.	
828	828		Competent authority identification marks.	
829	829		Competent authority identification marks - type code.	
833	833		Competent authority package design approval certificate.	

APPENDIX 6

APPROVAL OF SPECIAL ARRANGEMENTS

Each *consignment* transported under *special arrangement* shall require *multilateral approval*.

The applicant will need to have regard to AC 92-04(0) Applications for Permission to Carry or Consign Dangerous Goods under Section 23 of the Civil Aviation Act 1988.

An application for approval of *shipments* under *special arrangement* shall include a *Safety Case* containing:

(a) 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 the IAEA TS-R-1 and ICAO TI had been met.

(b) A statement of the respects in which, and of the reasons why, the *shipment* cannot be made in full accordance with the applicable requirements;

(c) 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; and

(d) A completed CASA Form 361.

APPENDIX 7

APPROVAL OF CERTAIN SHIPMENTS

Multilateral approval shall be required for:

(a) The *shipment* of *Type B(M) packages* not conforming with the requirements of para. 637 or designed to allow controlled intermittent venting;

(b) The *shipment* of *Type B(M) packages* containing *radioactive material* with an activity greater than 3000*A1* or 3000*A2*, as appropriate, or 1000 TBq, whichever is the lower;

(c) The *shipment* of *packages* containing *fissile materials* if the sum of the *CSIs* 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 *CSIs* 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 12 is met; and

(d) *Radiation protection programmes* for *shipments* by special use *vessels* according to para. 572(a).

A *competent authority* may authorize transport into or through its country without *shipment* approval, by a specific provision in its *design* approval (see para. 827). The applicant will need to have regard to AC 92-04(0) Applications for Permission to Carry or Consign Dangerous Goods under Section 23 of the Civil Aviation Act 1988.

An application for *shipment* approval shall include a Safety Case containing:

(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;

(c) The details of how the precautions and administrative or operational controls, referred to in the *package design* approval certificates issued under paras 808, 811 and 814, are to be put into effect; and

(d) A completed CASA Form 361.

APPENDIX 8

APPROVAL OF THE CALCULATION OF RADIONUCLIDE VALUES THAT ARE NOT LISTED IN TABLE 2 OF THE IAEA TS-R-1

Competent authority approval is required for the Calculation of radionuclide values that are not listed in Table 2 of the IAEA TS-R-1 (See para. 403.)

403. For individual radionuclides which are not listed in Table 2, the determination of the basic radionuclide values referred to in para. 402 shall require *multilateral approval*.

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 3 may be used without obtaining *competent authority* approval.

An application for approval shall include a Safety Analysis Report containing:

(a) all information necessary to satisfy the *competent authority* of the radionuclide value calculated; and

(b) relevant supporting documents (as required).

Where the application cites numerical values, the number of significant figures should reflect the accuracy or precision to which the number is known. In addition, the SI units with equivalent legacy units, if appropriate, should be provided for the numerical values.

APPENDIX 9

APPROVAL OF PACKAGE DESIGNS TO CONTAIN FISSILE MATERIAL

Each *package design* for *fissile material* which is not excepted, according to para. 417, from the requirements that apply specifically to *packages* containing *fissile material* shall require *multilateral approval*.

An application for approval shall include a Safety Analysis Report containing:

(a) all information necessary to satisfy the *competent authority* that the *design* meets the requirements of para. 671, and

(b) a specification of the applicable *quality assurance* programme as required in para. 306.

APPENDIX 10

APPLICATION FOR VALIDATION OF FOREIGN PACKAGES

The application for the validation of a foreign package for air transport must be made to CASA including, the following information as a minimum:

(a) a copy of the foreign package design approval certificate or copy of the shipment approval;
(b) if the original certificate or approval is in a language other than English, an English translation of the original as well as copy of the original;
(c) detailed information about the construction of the package including drawings, shock limiters, devices for thermal insulation and packaging inserts (where applicable);
(d) a copy of the Safety Analysis Report (in English);
(e) information on the quality assurance program required in para 306 of the IAEA TS-R-1;
(f) operating instructions;
(g) confirmation or otherwise that the design or shipment complies with the version of the IAEA TS-R-1 required by the ICAO TI applicable at the time of transport;
(h) the following additional information for validation of a design approval of a Type B(M) or a Type B(M)F package:
   - a list of the requirements for Type B(U) and Type B(U)F package designs to which the package design does not conform;
   - any supplementary operational controls applicable during transport to compensate the above deficiencies;
   - any restrictions on the mode of transport;
   - any special loading, carriage, unloading and handling procedures; and
   - the range of ambient conditions (temperature, solar radiation) for the which the package is designed.

Note: *The RPS-2 uses the 2005 edition of the TS-R-1 but the 2011-2012 edition of the Technical Instructions requires compliance with the 2009 edition of the TS-R-1. The application should therefore address the relevant paragraphs of the 2009 edition of the TS-R-1.*