International Civil Aviation Organization

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WORKING PAPER

DANGEROUS GOODS PANEL (DGP)
MEETING OF THE WORKING GROUP OF THE WHOLE

Montréal, 15 to 19 April 2013

Agenda Item 2: Development of recommendations for amendments to the *Technical Instructions for the Safe Transport of Dangerous Goods by Air*(Doc 9284) for incorporation in the 2015-2016 Edition

2.6 : Part 6 — Packaging Nomenclature, Marking, Requirements and Tests

DRAFT AMENDMENTS TO THE TECHNICAL INSTRUCTIONS TO ALIGN WITH THE UN RECOMMENDATIONS — PART 6

(Presented by the Secretary)

SUMMARY

This working paper contains draft amendments to Part 6 of the Technical Instructions to reflect the decisions taken by the UN Committee of Experts on the Transport of Dangerous Goods and on the Globally Harmonized System of Classification and Labelling of Chemicals at its sixth session (Geneva, 14 December 2012).

Part 6

PACKAGING NOMENCLATURE, MARKING, REQUIREMENTS AND TESTS

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Chapter 2

MARKING OF PACKAGINGS OTHER THAN INNER PACKAGINGS

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2.1 MARKING REQUIREMENTS FOR PACKAGINGS OTHER THAN INNER PACKAGINGS

2.1.1 Each packaging intended for use according to these Instructions must bear markings which are durable, legible and placed in a location and of such a size relative to the packaging as to be readily visible. For packages with a gross mass of more than 30 kg the markings, or a duplicate thereof, must appear on the top or on a side of the packaging. Letters, numerals and symbols must be at least 12 mm high, except for packagings of 30 L or 30 kg capacity or less, when they must be at least 6 mm in height and for packagings of 5 L or 5 kg or less when they must be of an appropriate size. The markings must show:

a) the United Nations packaging symbol (un)

This symbol must not be used for any purpose other than certifying that a packaging complies with the relevant requirements in Chapters 1 to 6. For embossed metal packagings the capital letters “UN” may be applied as the symbol;

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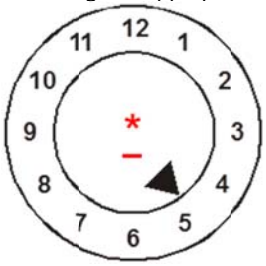
UN Model Regulations, paragraph 6.1.3.1 e), ST/SG/AC.10/40/Add.1

e) the last two digits of the year during which the packaging was manufactured. Packagings of types 1H1, 1H2, 3H1 and 3H2 must also be appropriately marked with the month of manufacture; this may be marked on the packaging in a different place from the remainder of the marking. An appropriate method is:



* The last two digits of the year of manufacture may be displayed at that place. In such a case, the two digits of the year in the type approval marking and in the inner circle of the clock must be identical.

Note.— Other methods that provide the minimum required information in a durable, visible and legible form are also acceptable.

f) the State authorizing the allocation of the mark, indicated by the distinguishing sign for motor vehicles in international traffic;

g) the name of the manufacturer or other identification of the packaging specified by the appropriate national authority.

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2.4 PACKAGING MARKINGS FOR INTERMEDIATE BULK CONTAINERS

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UN Model Regulations, paragraph 6.5.2.2.2, ST/SG/AC.10/40/Add.1

2.4.3 The maximum permitted stacking load applicable when the IBC is in use must be displayed on a symbol as ~~follows~~ shown in Figure 6-1 or Figure 6-2~~:~~. The symbol must be durable and clearly visible.

Replace the symbols with the following:

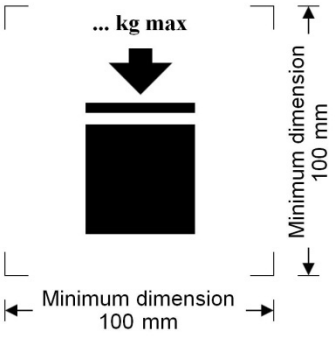

Figure 6-1. IBCs capable of being stacked

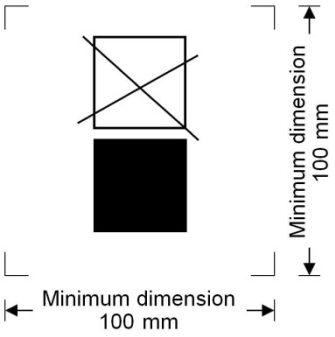

Figure 6-2. IBCs NOT capable of being stacked

The minimum dimensions must be 100 mm x 100 mm. The letters and numbers indicating the mass must be at least 12 mm high. The area within the printer's marks indicated by the dimensional arrows must be square. Where dimensions are not specified, all features must be in approximate proportion to those shown. The mass marked above the symbol must not exceed the load imposed during the design type test (see 6.5.6.6.4 of the UN Model Regulations) divided by 1.8.

Note.— The provisions of 2.4.3 must apply to all IBCs manufactured, repaired or remanufactured as from 1 January 2011. The provisions of 2.4.3 of the 2013-2014 Edition of these Instructions may continue to be applied to all IBCs manufactured, repaired or remanufactured between 1 January 2011 and 31 December 2016.

2.4.4 Example of a marking is:

(un)	13H3/Z/03 01	as in as in 2.4.2 a), b),c), and d)
	F/Meunier1713/0/1000	as in 2.4.2 e), f), g) and h)

Chapter 5

REQUIREMENTS FOR THE CONSTRUCTION AND TESTING OF CYLINDERS AND CLOSED CRYOGENIC RECEPTACLES, AEROSOL DISPENSERS AND SMALL RECEPTACLES CONTAINING GAS (GAS CARTRIDGES) AND FUEL CELL CARTRIDGES CONTAINING LIQUEFIED FLAMMABLE GAS

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5.1 GENERAL REQUIREMENTS

5.1.1 Design and construction

5.1.1.1 Cylinders and closed cryogenic receptacles and their closures must be designed, manufactured, tested and equipped in such a way as to withstand all conditions, including fatigue, to which they will be subjected during normal conditions of transport.

5.1.1.2 In recognition of scientific and technological advances, and recognizing that cylinders and closed cryogenic receptacles other than those that are marked with a UN certification marking may be used on a national or regional basis, cylinders and closed cryogenic receptacles conforming to requirements other than those specified in these Instructions may be used if approved by the appropriate national authorities in the countries of transport and use.

5.1.1.3 In no case must the minimum wall thickness be less than that specified in the design and construction technical standards.

5.1.1.4 For welded cylinders and closed cryogenic receptacles, only metals of weldable quality must be used.

UN Model Regulations, paragraph 5.1.1.5, ST/SG/AC.10/40/Add.1

5.1.1.5 The test pressure of cylinders must be in accordance with Packing Instruction 200 or, for a chemical under pressure, with Packing Instruction 218. The test pressure for closed cryogenic receptacles must be in accordance with Packing Instruction 202. The test pressure of a metal hydride storage system must be in accordance with Packing Instruction 214. The test pressure of a cylinder for an adsorbed gas must be in accordance with Packing Instruction 219.

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5.2 REQUIREMENTS FOR UN CYLINDERS AND CLOSED CRYOGENIC RECEPTACLES

UN Model Regulations, paragraph 6.2.2, ST/SG/AC.10/40/Add.1

In addition to the general requirements of 5.1, UN cylinders and closed cryogenic receptacles must comply with the requirements of this section, including the standards, as applicable. Manufacture of new UN cylinders and closed cryogenic receptacles or service equipment according to any particular standard in 5.2.1 and 5..2.3 is not permitted after the date shown in the right hand column of the tables.

Note 1.— With the agreement of the appropriate national authority, more recently published versions of the standards, if available, may be used.

Note 2.— UN cylinders and closed cryogenic receptacles and service equipment constructed according to standards applicable at the date of manufacture may continue in use subject to the periodic inspection provisions of these Instructions.

5.2.1 Design, construction and initial inspection and testing

5.2.1.1 The following standards apply for the design, construction and initial inspection and test of UN cylinders, except that inspection requirements related to the conformity assessment system and approval must be in accordance with 5.2.5:

UN Model Regulations, paragraph 6.2.2.1.1, ST/SG/AC.10/40/Add.1

References to ISO standards are reformatted into tables with three columns, the last being new information for applicable for manufacture date.

Reference	*Title*	*Applicable for manufacture*
ISO 9809-1:1999	Gas cylinders — Refillable seamless steel gas cylinders — Design, construction and testing — Part 1: Quenched and tempered steel cylinders with tensile strength less than 1 100 MPa. *Note.— The note concerning the F factor in section 7.3 of this standard must not be applied for UN cylinders.*	Until 31 December 2018
ISO 9809-1:2010	Gas cylinders — Refillable seamless steel gas cylinders — Design, construction and testing — Part 1: Quenched and tempered steel cylinders with tensile strength less than 1 100 MPa	Until further notice
ISO 9809-2:2000	Gas cylinders — Refillable seamless steel gas cylinders — Design, construction and testing — Part 2: Quenched and tempered steel cylinders with tensile strength greater than or equal to 1 100 MPa.	Until 31 December 2018
ISO 9809-2:2010	Gas cylinders — Refillable seamless steel gas cylinders — Design, construction and testing — Part 2: Quenched and tempered steel cylinders with tensile strength greater than or equal to 1 100 MPa	Until further notice
ISO 9809-3:2000	Gas cylinders — Refillable seamless steel gas cylinders — Design, construction and testing — Part 3: Normalized steel cylinders.	Until 31 December 2018
ISO 9809-3:2010	Gas cylinders — Refillable seamless steel gas cylinders — Design, construction and testing — Part 3: Normalized steel cylinders	Until further notice
ISO 7866:1999	Gas cylinders — Refillable seamless aluminium alloy gas cylinders — Design, construction and testing. *Note.— The note concerning the F factor in section 7.2 of this standard must not be applied for UN cylinders. Aluminium alloy 6351A — T6 or equivalent must not be authorized.*	Until further notice
ISO 4706:2008	Gas cylinders — Refillable welded steel cylinders — Test pressure 60 bar and below.	Until further notice
ISO 18172-1:2007	Gas cylinders — Refillable welded stainless steel cylinders — Part 1: Test pressure 6 MPa and below.	Until further notice
ISO 20703:2006	Gas cylinders — Refillable welded aluminium-alloy cylinders — Design, construction and testing.	Until further notice
ISO 11118:1999	Gas cylinders — Non-refillable metallic gas cylinders — Specification and test methods.	Until further notice
ISO 11119-1:2002	Gas cylinders of composite construction — Specification and test methods — Part 1: Hoop wrapped composite gas cylinders.	Until further notice
ISO 11119-2:2002	Gas cylinders of composite construction — Specification and test methods — Part 2: Fully wrapped fibre reinforced composite gas cylinders with load-sharing metal liners.	Until further notice
ISO 11119-3:2002	Gas cylinders of composite construction — Specification and test methods — Part 3: Fully wrapped fibre reinforced composite gas cylinders with non-load-sharing metallic or non-metallic liners.	Until further notice

Note 1.— In the above-referenced standards, composite cylinders must be designed for unlimited service life.

Note 2.— After the first 15 years of service, composite cylinders manufactured according to these standards, may be approved for extended service by the appropriate national authority which was responsible for the original approval of the cylinders and which will base its decision on the test information supplied by the manufacturer or owner or user.

5.2.1.2 Not used.

5.2.1.3 The following standards apply for the design, construction and initial inspection and test of UN acetylene cylinders except that inspection requirements related to the conformity assessment system and approval must be in accordance with 5.2.5.

Note.— The maximum of 1 000 L volume as mentioned in the ISO standard ISO 21029-1:2004 Cryogenic vessels, does not apply for refrigerated liquefied gases in closed cryogenic receptacles installed in apparatus (e.g. MRI or cooling machines).

For the cylinder shell:

UN Model Regulations, paragraph 6.2.2.1.3, ST/SG/AC.10/40/Add.1

References to ISO standards are reformatted into tables with three columns, the last being new information for applicable for manufacture date.

Reference	*Title*	*Applicable for manufacture*
ISO 9809-1:1999	Gas cylinders — Refillable seamless steel gas cylinders — Design, construction and testing — Part 1: Quenched and tempered steel cylinders with tensile strength less than 1 100 MPa. *Note.— The note concerning the F factor in section 7.3 of this standard must not be applied for UN cylinders.*	Until 31 December 2018
ISO 9809-1:2010	Gas cylinders — Refillable seamless steel gas cylinders — Design, construction and testing — Part 1: Quenched and tempered steel cylinders with tensile strength less than 1 100 MPa	Until further notice
ISO 9809-3:2000	Gas cylinders — Refillable seamless steel gas cylinders — Design, construction and testing — Part 3: Normalized steel cylinders.	Until 31 December 2018
ISO 9809-3:2010	Gas cylinders — Refillable seamless steel gas cylinders — Design, construction and testing — Part 3: Normalized steel cylinders	Until further notice

For the porous mass in the cylinder:

Reference	*Title*	*Applicable for manufacture*
ISO 3807-1:2000	Cylinders for acetylene — Basic requirements — Part 1: Cylinders without fusible plugs.	Until further notice
ISO 3807-2:2000	Cylinders for acetylene — Basic requirements — Part 2: Cylinders with fusible plugs.	Until further notice

5.2.1.4 The following standard applies for the design, construction and initial inspection and test of UN closed cryogenic receptacles, except that inspection requirements related to the conformity assessment system and approval must be in accordance with 5.2.5:

UN Model Regulations, paragraph 6.2.2.1.4, ST/SG/AC.10/40/Add.1

References to ISO standards are reformatted into tables with three columns, the last being new information for applicable for manufacture date.

Reference	*Title*	*Applicable for manufacture*
ISO 21029-1:2004	Cryogenic vessels — Transportable vacuum insulated vessels of not more than 1 000 L volume — Part 1: Design, fabrication, inspection and tests.	Until further notice

5.2.1.5 The following standards apply for the design, construction, and initial inspection and test of UN metal hydride storage systems, except that inspection requirements related to the conformity assessment system and approval must be in accordance with 5.2.5:

UN Model Regulations, paragraph 6.2.2.1.5, ST/SG/AC.10/40/Add.1

References to ISO standards are reformatted into tables with three columns, the last being new information for applicable for manufacture date.

Reference	*Title*	*Applicable for manufacture*
ISO 16111:2008	Transportable gas storage devices — Hydrogen absorbed in reversible metal hydride.	Until further notice

5.2.1.6 Not used.

UN Model Regulations, paragraph 6.2.2.1.7, ST/SG/AC.10/40/Add.1

5.2.1.7 The following standards apply for the design, construction and initial inspection and test of UN cylinders for adsorbed gases except that the inspection requirements related to the conformity assessment system and approval must be in accordance with 5.2.5.

References to ISO standards are reformatted into tables with three columns, the last being new information for applicable for manufacture date.

Reference	*Title*	*Applicable for manufacture*
ISO 11513:2011	Gas cylinders — Refillable welded steel cylinders containing materials for sub-atmospheric gas packaging (excluding acetylene) — Design, construction, testing, use and periodic inspection	Until further notice
ISO 9809-1:2010	Gas cylinders — Refillable seamless steel gas cylinders — Design, construction and testing — Part 1: Quenched and tempered steel cylinders with tensile strength less than 1 100 MPa	Until further notice

5.2.2 Materials

In addition to the material requirements specified in the cylinder and closed cryogenic receptacle design and construction standards, and any restrictions specified in the applicable Packing Instruction for the gas(es) to be transported (e.g. Packing Instruction 200, Packing Instruction 202 or Packing Instruction 214), the following standards apply to material compatibility:

UN Model Regulations, paragraph 6.2.2.2, ST/SG/AC.10/40/Add.1

Note.— The highlighted text in the third column was not provided in ST/SG/AC.10/40/Add.1 (nothing was provided).

References to ISO standards are reformatted into tables with three columns, the last being new information for applicable for manufacture date.

Reference	*Title*	*Applicable for manufacture*
ISO 11114-1:~~1997~~2012	~~Transportable g~~Gas cylinders — Compatibility of cylinder and valve materials with gas contents — Part 1: Metallic materials.	Until further notice
ISO 11114-2:2000	Transportable gas cylinders — Compatibility of cylinder and valve materials with gas contents — Part 2: Non-metallic materials.	Until further notice

~~*Note.— The limitations imposed in ISO 11114-1 on high strength steel alloys at ultimate tensile strength levels up to 1 100 MPa do not apply to* **Silane** *(UN 2203).*~~

5.2.3 Service equipment

The following standards apply to closures and their protection:

UN Model Regulations, paragraph 6.2.2.3, ST/SG/AC.10/40/Add.1

References to ISO standards are reformatted into tables with three columns, the last being new information for applicable for manufacture date.

Reference	*Title*	*Applicable for manufacture*
ISO 11117:1998	Gas cylinders — Valve protection caps and valve guards for industrial and medical gas cylinders — Design, construction and tests	Until 31 December 2014
ISO 11117:2008+ Cor 1:2009	Gas cylinders — Valve protection caps and valve guards — Design, construction and tests. ~~*Note. Construction according to ISO 11117:1998 may continue until 31 December 2014.*~~	Until further notice
ISO 10297:1999	Gas cylinders – Refillable gas cylinder valves – Specification and type testing	Until 31 December 2008
ISO 10297:2006	Gas cylinders — Refillable gas cylinder valves — Specification and type testing.	Until further notice
ISO 13340:2001	Transportable gas cylinders — Cylinder valves for non-refillable cylinders — Specification and prototype testing	Until further notice

For UN metal hydride storage systems, the requirements specified in the following standard apply to closures and their protection:

Reference	*Title*	*Applicable for manufacture*
ISO 16111:2008	Transportable gas storage devices — Hydrogen absorbed in reversible metal hydride.	Until further notice

5.2.4 Periodic inspection and test

The following standards apply to the periodic inspection and testing of UN cylinders and UN metal hydride storage systems:

UN Model Regulations, paragraph 6.2.2.4, ST/SG/AC.10/40/Add.1

References to ISO standards are reformatted into tables with three columns, the last being new information for applicable for manufacture date.

ISO 10460:2005 was moved from last row to second.

Reference	*Title*	*Applicable for manufacture*
ISO 6406:2005	Seamless steel gas cylinders — Periodic inspection and testing.	Until further notice
ISO 10460:2005	Gas cylinders – Welded carbon-steel gas cylinders – Periodic inspection and testing. *Note.— The repair of welds described in clause 12.1 of this standard must not be permitted. Repairs described in clause 12.2 require the approval of the appropriate national authority which approved the periodic inspection and test body in accordance with 5.2.6.*	Until further notice
ISO 10461:2005/A1:2006	Seamless aluminium-alloy gas cylinders — Periodic inspection and testing.	Until further notice
ISO 10462:2005	Transportable cylinders for dissolved acetylene — Periodic inspection and maintenance.	Until further notice
ISO 11513:2011	Gas cylinders — Refillable welded steel cylinders containing materials for sub-atmospheric gas packaging (excluding acetylene) — Design, construction, testing, use and periodic inspection	Until further notice
ISO 11623:2002	Transportable gas cylinders — Periodic inspection and testing of composite gas cylinders.	Until further notice
ISO 16111:2008	Transportable gas storage devices — Hydrogen absorbed in reversible metal hydride.	Until further notice

5.2.7 Marking of UN refillable cylinders and closed cryogenic receptacles

Note.— Marking requirements for UN metal hydride storage systems are given in 5.2.9.

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5.2.7.4 The following manufacturing marks must be applied:

m) Identification of the cylinder thread (e.g. 25E). (This mark is not required for closed cryogenic receptacles);

n) The manufacturer's mark registered by the appropriate national authority. When the country of manufacture is not the same as the country of approval, then the manufacturer's mark must be preceded by the character(s) identifying the country of manufacture, as indicated by the distinguishing signs of motor vehicles in international traffic. The country mark and the manufacturer's mark must be separated by a space or slash;

o) The serial number assigned by the manufacturer;

UN Model Regulations, paragraph 6.2.2.7.4, ST/SG/AC.10/40/Add.1

p) In the case of steel cylinders and closed cryogenic receptacles and composite cylinders and closed cryogenic receptacles with steel liner intended for the transport of gases with a risk of hydrogen embrittlement, the letter "H" showing compatibility of the steel (see ISO 11114-1:~~1997~~2012).

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5.2.9 Marking of UN metal hydride storage systems

5.2.9.1 UN metal hydride storage systems must be marked clearly and legibly with the marks listed in 5.2.9.2. These marks must be permanently affixed (e.g. stamped, engraved, or etched) on the metal hydride storage system. The marks must be on the shoulder, top end or neck of the metal hydride storage system or on a permanently affixed component of the metal hydride storage system. Except for the United Nations packaging symbol, the minimum size of the marks must be:

. . .

5.2.9.2 The following marks must be applied:

a) The UN packaging symbol (un)

This symbol must not be used for any purpose other than for certifying that a packaging complies with the relevant requirements in Chapters 1 to 6;

. . .

UN Model Regulations, paragraph 6.2.2.9.2 j), ST/SG/AC.10/40/Add.1

j) In the case of steel cylinders and composite cylinders with steel liner, the letter "H" showing compatibility of the steel (see 1SO 11114-1:~~1997~~2012); and

k) In the case of metal hydride storage systems having limited life, the date of expiry, denoted by the letters "FINAL" followed by the year (four digits), followed by the month (two digits) and separated by a slash (i.e. "/").

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UN Model Regulations, paragraph 6.2.4, ST/SG/AC.10/40/Add.1

5.4 REQUIREMENTS FOR AEROSOL DISPENSERS, SMALL RECEPTACLES CONTAINING GAS (GAS CARTRIDGES) AND FUEL CELL CARTRIDGES CONTAINING LIQUEFIED ~~FLAMMABLE~~ GAS

Each filled aerosol dispenser or gas cartridge or fuel cell cartridge must be subjected to a test in a hot water bath in accordance with 5.4.1 or an approved water bath alternative in accordance with 5.4.2.

UN Model Regulations, paragraph 6.2.4.1, ST/SG/AC.10/40/Add.1

~~**5.4.1 Small receptacles containing gas (gas cartridges) and fuel cell cartridges containing liquefied flammable gas**~~

~~5.4.1.1 Each receptacle or fuel cell cartridge must be subjected to a test performed in a hot water bath; the temperature of the bath and the duration of the test must be such that the internal pressure reaches that which would be reached at 55°C (50°C if the liquid phase does not exceed 95 per cent of the capacity of the receptacle or the fuel cell cartridge at 50°C). If the contents are sensitive to heat or if the receptacles or the fuel cell cartridges are made of plastics material which softens at this test temperature, the temperature of the bath must be set at between 20°C and 30°C but, in addition, one receptacle or fuel cell cartridge in 2 000 must be tested at the higher temperature.~~

~~5.4.1.2 No leakage or permanent deformation of a receptacle or fuel cell cartridge may occur, except that a plastic receptacle or fuel cell cartridge may be deformed through softening provided it does not leak.~~

UN Model Regulations, paragraph 6.2.4.2, ST/SG/AC.10/40/Add.1

~~**5.4.2 Aerosol dispensers**~~

~~5.4.2.1 Each filled aerosol dispenser must be subjected to a test performed in a hot water bath or an approved water bath alternative.~~

Heading has been reformatted:

UN Model Regulations, paragraph 6.2.4.1 (previous 6.2.4.2), ST/SG/AC.10/40/Add.1

~~5.4.2.2~~5.4.1 Hot water bath test

~~5.4.2.2.1~~5.4.1.1 The temperature of the water bath and the duration of the test must be such that the internal pressure reaches that which would be reached at 55°C (50°C if the liquid phase does not exceed 95 percent of the capacity of the aerosol dispenser, gas cartridge or fuel cell cartridge at 50°C). If the contents are sensitive to heat or if the aerosol dispensers, gas cartridges or fuel cell cartridges are made of plastics material which softens at this test temperature, the temperature of the bath must be set at between 20°C and 30°C but, in addition, one aerosol dispenser, gas cartridge or fuel cell cartridge in 2 000 must be tested at the higher temperature.

~~5.4.2.2.2~~5.4.1.2 No leakage or permanent deformation of an aerosol dispenser, receptacle or fuel cell cartridge may occur, except that a plastic aerosol dispenser, gas cartridge or fuel cell cartridge may be deformed through softening provided that it does not leak.

UN Model Regulations, paragraph 6.2.4.2 (previous 6.2.4.2.2), ST/SG/AC.10/40/Add.1

Heading has been reformatted:

~~5.4.2.3~~5.4.2 Alternative methods

~~5.4.2.3.1~~ With the approval of the appropriate national authority, alternative methods which provide an equivalent level of safety may be used provided that the requirements of ~~5.4.2.2.1, 5.4.2.2.2 and 5.4.2.3~~ 5.4.2.1 and, as appropriate, 5.4.2.2 or 5.4.2.3 are met.

UN Model Regulations, paragraph 6.2.4.2.1 (previous 6.2.4.2.2.1), ST/SG/AC.10/40/Add.1

~~5.4.2.3.2~~5.4.2.1 *Quality system*

~~5.4.2.3.2.1~~5.4.2.1.1 Aerosol dispenser, gas cartridge or fuel cell cartridge fillers and component manufacturers must have a quality system. The quality system must implement procedures to ensure that all aerosol dispensers, gas cartridges or fuel cell cartridges that leak or that are deformed are rejected and not offered for transport.

~~5.4.2.3.2.2~~5.4.2.1.1.1 The quality system must include:

a) a description of the organizational structure and responsibilities;

b) the relevant inspection and test, quality control, quality assurance, and process operation instructions that will be used;

c) quality records, such as inspection reports, test data, calibration data and certificates;

d) management reviews to ensure the effective operation of the quality system;

e) a process for control of documents and their revision;

f) a means for control of non-conforming aerosol dispensers, gas cartridges or fuel cell cartridges;

g) training programmes and qualification procedures for relevant personnel; and

h) procedures to ensure that there is no damage to the final product.

~~5.4.2.3.2.3~~5.4.2.1.1.2 An initial audit and periodic audits must be conducted to the satisfaction of the appropriate national authority. These audits must ensure the approved system is and remains adequate and efficient. Any proposed changes to the approved system must be notified to the appropriate national authority in advance.

UN Model Regulations, paragraph 6.2.4.2.2 (before previous 6.2.4.2.2.2.2), ST/SG/AC.10/40/Add.1

5.4.2.2 *Aerosol dispensers*

~~5.4.2.3.3~~5.4.2.2.1 *Pressure and leak testing of aerosol dispensers before filling*

~~Every~~ Each empty aerosol dispenser must be subjected to a pressure equal to or in excess of the maximum expected in the filled aerosol dispensers at 55°C (50°C if the liquid phase does not exceed 95 percent of the capacity of the receptacle at 50°C). This must be at least two-thirds of the design pressure of the aerosol dispenser. If any aerosol dispenser shows evidence of leakage at a rate equal to or greater than 3.3×10^{-2} mbar.l.s^{-1} at the test pressure, distortion or other defect, it must be rejected.

UN Model Regulations, paragraph 6.2.2.2.2 (previous 6.2.4.2.2.3), ST/SG/AC.10/40/Add.1

~~5.4.2.3.4~~5.4.2.2.2 *Testing of the aerosol dispensers after filling*

~~5.4.2.3.4.1~~5.4.2.2.2.1 Prior to filling, the filler must ensure that the crimping equipment is set appropriately and the specified propellant is used.

~~5.4.2.3.4.2~~5.4.2.2.2.2 Each filled aerosol dispenser must be weighed and leak tested. The leak detection equipment must be sufficiently sensitive to detect at least a leak rate of 2.0×10^{-3} mbar.l.s^{-1} at 20°C.

~~5.4.2.3.4.3~~5.4.2.2.2.3 Any filled aerosol dispenser which shows evidence of leakage, deformation or excessive mass must be rejected.

UN Model Regulations, paragraph 6.2.4.2.3, ST/SG/AC.10/40/Add.1

5.4.2.3 *Gas cartridges and fuel cell cartridges*

5.4.2.3.1 *Pressure testing of gas cartridges and fuel cell cartridges*

5.4.2.3.1.1 Each gas cartridge or fuel cell cartridge must be subjected to a test pressure equal to or in excess of the maximum expected in the filled receptacle at 55°C (50°C if the liquid phase does not exceed 95 per cent of the capacity of

the receptacle at 50°C). This test pressure must be that specified for the gas cartridge or fuel cell cartridge and must not be less than two thirds the design pressure of the gas cartridge or fuel cell cartridge. If any gas cartridge or fuel cell cartridge shows evidence of leakage at a rate equal to or greater than 3.3×10^{-2} mbar.l.s^{-1} at the test pressure or distortion or any other defect, it must be rejected.

5.4.2.3.2 *Leak testing gas cartridges and fuel cell cartridges*

5.4.2.3.2.1 Prior to filling and sealing, the filler must ensure that the closures (if any) and the associated sealing equipment are closed appropriately and the specified gas is used.

5.4.2.3.2.2 Each filled gas cartridge or fuel cell cartridge must be checked for the correct weight of gas and must be leak tested. The leak detection equipment must be sufficiently sensitive to detect at least a leak rate of 2.0×10^{-3} mbar.l.s^{-1} at 20°C.

5.4.2.3.2.3 Any gas cartridge or fuel cell cartridge that has gas weights not in conformity with the declared weight limits or shows evidence of leakage or deformation, must be rejected.

5.4.3 With the approval of the appropriate national authority, aerosols and receptacles, small, are not subject to 5.4.1 and 5.4.2 if they are required to be sterile, but may be adversely affected by water bath testing, provided:

a) they contain a non-flammable gas and either:

   i) contain other substances that are constituent parts of pharmaceutical products for medical, veterinary or similar purposes; or

   ii) contain other substances used in the production process for pharmaceutical products; or

   iii) are used in medical, veterinary or similar applications;

b) an equivalent level of safety is achieved by the manufacturer's use of alternative methods for leak detection and pressure resistance, such as helium detection and water bathing using a statistical sample of at least 1 in 2 000 from each production batch; and

c) for pharmaceutical products according to a) i) and iii) above, they are manufactured under the authority of a national health administration. If required by the appropriate national authority, the principles of Good Manufacturing Practice (GMP) established by the World Health Organization (WHO)[1] must be followed.

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[1]. WHO Publication: Quality assurance of pharmaceuticals. A compendium of guidelines and related materials. Volume 2: Good manufacturing practices and inspection.

Chapter 7

REQUIREMENTS FOR THE CONSTRUCTION, TESTING AND APPROVAL OF PACKAGES AND MATERIAL OF ~~CLASS 7~~ RADIOACTIVE MATERIAL

Parts of this Chapter are affected by State Variations CA 1, CA 3, CA 4, DE 2, IR 4, JP 8, JP 26, US 10; see Table A-1

7.1 GENERAL REQUIREMENTS

7.1.1 The package must be so designed in relation to its mass, volume and shape that it can be easily and safely transported. In addition, the package ~~shall~~ must be so designed that it can be properly secured in the aircraft during transport.

7.1.2 The design must be such that any lifting attachments on the package will not fail when used in the intended manner and that, if failure of the attachments should occur, the ability of the package to meet other requirements of these Instructions would not be impaired. The design must take account of appropriate safety factors to cover snatch lifting.

7.1.3 Attachments and any other features on the outer surface of the package which could be used to lift it must be designed either to support its mass in accordance with the requirements of 7.1.2 or must be removable or otherwise rendered incapable of being used during transport.

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

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

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

7.1.7 The package must 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 must be designed so as to prevent them from becoming loose or being released unintentionally, even after repeated use.

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

7.1.9 All valves through which the radioactive contents could escape must be protected against unauthorized operation.

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

UN Model Regulations, paragraph 6.4.2.11, ST/SG/AC.10/40/Add.1

7.1.11 A package must be so designed that it provides sufficient shielding to ensure that, under routine conditions of transport and with the maximum radioactive contents that the package is designed to contain, the radiation level at any point on the external surface of the package would not exceed the values specified in 2;7.2.4.1.1.2, 4;9.1.10 and 4;9.1.11, as applicable, with account taken of 7;2.10.3.3 c) and [7.2.3.1.2 of the UN Model Regulations].

~~7.1.11~~7.1.12 For radioactive material having other dangerous properties, the package design must take into account those properties (see Part 2, Introductory Chapter, 3.1, 3.2 and 4;9.1.5).

7.2 ADDITIONAL REQUIREMENTS FOR PACKAGES TRANSPORTED BY AIR

7.2.1 The temperature of the accessible surfaces must not exceed 50°C at an ambient temperature of 38°C with no account taken of insolation.

7.2.2 Packages must be designed so that, if they were exposed to ambient temperatures ranging from –40°C to +55°C, the integrity of the containment would not be impaired.

UN Model Regulations, paragraph 6.4.3.3, ST/SG/AC.10/40/Add.1

7.2.3 Packages containing radioactive material must be capable of withstanding, without ~~leakage~~ loss or dispersal of radioactive contents from the containment system, an internal pressure that produces a pressure differential of not less than maximum normal operating pressure plus 95 kPa.

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UN Model Regulations, paragraph 6.4.6.1, ST/SG/AC.10/40/Add.1

7.5 REQUIREMENTS FOR PACKAGES CONTAINING URANIUM HEXAFLUORIDE

7.5.1 Packages designed to contain uranium hexafluoride must meet the requirements ~~prescribed elsewhere in these Instructions~~ which pertain to the radioactive and fissile properties of the material prescribed elsewhere in these Instructions. Except as allowed in 7.5.4, uranium hexafluoride in quantities of 0.1 kg or more must also be packaged and transported in accordance with the provisions of ISO 7195:2005: "Nuclear Energy — Packaging of uranium hexafluoride (UF_6) for transport", and the requirements of 7.5.2 and 7.5.3. The package must also meet the requirements prescribed elsewhere in these Instructions, which pertain to the radioactive and fissile properties of the material.

UN Model Regulations, paragraph 6.4.6.2, ST/SG/AC.10/40/Add.1

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

a) withstand, without leakage and without unacceptable stress, as specified in ISO 7195:2005, the structural test as specified in 7.20 except as allowed in 7.5.4;

b) withstand, without loss or dispersal of the uranium hexafluoride, the free drop test specified in 7.14.4; and

c) withstand, without rupture of the containment system, the thermal test specified in 7.16.3 except as allowed in 7.5.4.

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

UN Model Regulations, paragraph 6.4.6.4, ST/SG/AC.10/40/Add.1

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

a) ~~the packages are designed~~ to international or national standards other than ISO 7195:2005 provided an equivalent level of safety is maintained; and/or

b) ~~the packages are designed~~ to withstand, without leakage and without unacceptable stress, a test pressure of less than 2.76 MPa, as specified in 7.20; and/or

c) ~~for packages designed~~ to contain 9 000 kg or more of uranium ~~hexafluoride, the packages~~ hexafluoride and the packages do not meet the requirement of 7.5.2 c).

In all other respects, the requirements specified in 7.5.1 to 7.5.3 must be satisfied.

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7.7 REQUIREMENTS FOR TYPE B(U) PACKAGES

7.7.1 Type B(U) packages must be designed to meet the requirements specified in 7.1, 7.2 and 7.6.2 to 7.6.15, except 7.6.14 a), and, in addition, to the requirements specified in 7.7.2 to 7.7.15.

UN Model Regulations, paragraph 6.4.8.2, ST/SG/AC.10/40/Add.1

7.7.2 A package must be designed so that, under the ambient conditions specified in 7.7.5 and 7.7.6, heat generated within the package by the radioactive contents ~~shall~~ must not, under normal conditions of transport, as demonstrated by the tests in 7.14, 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~~ must be paid to the effects of heat, which may cause one or more of the following:

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

b) lessen the efficiency of the packaging through differential thermal expansion or cracking or melting of the radiation shielding material; ~~or~~

c) in combination with moisture, accelerate corrosion.

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UN Model Regulations, paragraph 6.4.8.8, ST/SG/AC.10/40/Add.1

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

a) the tests specified in 7.14, it would restrict the loss of radioactive contents to not more than 10^{-6} A_2 per hour; and

b) the tests specified in 7.16.1, 7.16.2 b), 7.16.3 and 7.16.4 and either the test~~s~~ in:

i) 7.16.2 c), when the package has a mass not greater than 500 kg, an overall density not greater than 1 000 kg/m^3 based on the external dimensions, and radioactive contents greater than 1 000 A_2 not as special form radioactive material; or

ii) 7.16.2 a), for all other packages,

it would meet the following requirements:

— retain sufficient shielding to ensure that the radiation level at 1 m from the surface of the package would not exceed 10 mSv/h with the maximum radioactive contents which the package is designed to contain; and

— restrict the accumulated loss of radioactive contents in a period of one week to not more than 10 A_2 for krypton-85 and not more than A_2 for all other radionuclides.

Where mixtures of different radionuclides are present, the provisions of 2;7.2.2.4 to 2;7.2.2.6 must apply except that for krypton-85, an effective A2(i) value equal to 10 A2 may be used. For case a) above, the assessment must take into account the external contamination limits of 4;9.1.2.

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UN Model Regulations, paragraph 6.4.9.1, ST/SG/AC.10/40/Add.1

7.8 REQUIREMENTS FOR TYPE B(M) PACKAGES

Type B(M) packages must meet the requirements for Type B(U) packages specified in 7.7.1, except that for packages to be transported solely within a specified country or solely between specified countries, conditions other than those given in 7.6.5, ~~7.7.5~~7.7.4~~,~~ to 7.7.6 and 7.7.9 to 7.7.15 may be assumed with the approval of the competent authorities of these countries. Notwithstanding, the requirements for Type B(U) packages specified in 7.7.4 and 7.7.9 to 7.7.15 must be met as far as practicable.

7.9 REQUIREMENTS FOR TYPE C PACKAGES

7.9.1 Type C packages must be designed to meet the requirements specified in 7.1, 7.2 and 7.6.2 to 7.6.15, except as specified in 7.6.14 a), and the requirements specified in 7.7.2 to 7.7.6, 7.7.10 to 7.7.15 and 7.9.2 to 7.9.4.

7.9.2 A package must be capable of meeting the assessment criteria prescribed for tests in 7.7.8 b) and 7.7.12 after burial in an environment defined by a thermal conductivity of 0.33 W/(m.K) and a temperature of 38°C in the steady state. Initial conditions for the assessment must assume that any thermal insulation of the package remains intact, the package is at the maximum normal operating pressure and the ambient temperature is 38°C.

UN Model Regulations, paragraph 6.4.10.3, ST/SG/AC.10/40/Add.1

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

a) the tests specified in 7.14, it would restrict the loss of radioactive contents to not more than 10^{-6} A_2 per hour; and

b) the test sequences in 7.19.1,

it would meet the following requirements:

~~i)~~ retain sufficient shielding to ensure that the radiation level at 1 m from the surface of the package would not exceed 10 mSv/h with the maximum radioactive contents which the package is designed to contain; and

~~ii)~~ restrict the accumulated loss of radioactive contents in a period of one week to not more than 10 A_2 for krypton-85 and not more than A_2 for all other radionuclides.

Where mixtures of different radionuclides are present, the provisions of 2;7.2.2.4 to 2;7.2.2.6 must apply, except that for krypton-85 an effective A_2(i) value equal to 10 A_2 may be used. For case a) above, the assessment must take into account the external contamination limits of 4;9.1.2.

7.9.4 A package must be so designed that there will be no rupture of the containment system following performance of the enhanced water immersion test specified in 7.17.

7.10 REQUIREMENTS FOR PACKAGES CONTAINING FISSILE MATERIAL

UN Model Regulations, paragraph 6.4.11.1, ST/SG/AC.10/40/Add.1

7.10.1 Fissile material must be transported so as to:

a) maintain subcriticality during routine normal and accident conditions of transport; in particular, the following contingencies must be considered:

i) water leaking into or out of packages;

ii) the loss of efficiency of built-in neutron absorbers or moderators;

iii) rearrangement of the contents either within the package or as a result of loss from the package;

iv) reduction of spaces within or between packages;

v) packages becoming immersed in water or buried in snow; and

vi) temperature changes; and

b) meet the requirements:

i) of 7.6.2 ~~for packages containing fissile material~~ except for unpackaged material when specifically allowed by 2;7.2.3.5.1 e);

ii) prescribed elsewhere in these Instructions and which pertain to the radioactive properties of the material; ~~and~~

iii) ~~specified in 7.10.3 to 7.10.12~~ of 7.6.3, unless the material is excepted by ~~7.10.2~~ 2;7.2.3.5; and

iv) of 7.10.4 to 7.10.14, unless the material is excepted by 2;7.2.3.5, 7.10.2 or 7.10.3.

UN Model Regulations, paragraph 6.4.11.2, ST/SG/AC.10/40/Add.1

7.10.2 Packages containing ~~F~~fissile material that meet~~ing one of~~ the provisions ~~in~~ of subparagraph d) and one of the provisions of a) to c) below ~~a) to d) of 2;7.2.3.5 is~~ are excepted from the requirements of 7.10.4 to 7.10.14 ~~to be transported in packages that comply with 7.10.3 to 7.10.12, as well as the other requirements of these Instructions that apply to fissile material. Only one type of exception is allowed per consignment~~.

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

i) the smallest external dimension of the package is not less than 10 cm;

ii) the criticality safety index of the package is calculated using the following formula:

$$CSI=50x5x\left(\frac{\text{Mass of U-235 in package(g)}}{Z}\right)+\left(\frac{\text{Mass of other fissile nuclides}^{*}\text{ in package (g)}}{280}\right)$$

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

where the values of Z are taken from Table 6-6.

iii) the CSI of any package does not exceed 10;

b) packages containing fissile material in any form provided that:

i) the smallest external dimension of the package is not less than 30 cm;

ii) the package, after being subjected to the tests specified in 7.14.1 to 7.14.6;

— retains its fissile material contents;

— preserves the minimum overall outside dimensions of the package to at least 30 cm;

— prevents the entry of a 10 cm cube.

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

$$CSI=50x2x\left(\frac{\text{Mass of U-235 in package(g)}}{Z}\right)+\left(\frac{\text{Mass of other fissile nuclides}^{*}\text{ in package (g)}}{280}\right)$$

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

where the values of Z are taken from Table 6-6.

(iv) the criticality safety index of any package does not exceed 10;

c) packages containing fissile material in any form provided that:

i) the smallest external dimension of the package is not less than 10 cm;

ii) the package, after being subjected to the tests specified in 7.14.1 to 7.14.6;

— retains its fissile material contents;

— preserves the minimum overall outside dimensions of the package to at least 10 cm;

— prevents the entry of a 10 cm cube.

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

$$CSI=50x2x\left(\frac{\text{Mass of U-235 in package(g)}}{450}\right)+\left(\frac{\text{Mass of other fissile nuclides}^{*}\text{ in package (g)}}{280}\right)$$

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

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

d) the total mass of beryllium, hydrogenous material enriched in deuterium, graphite and other allotropic forms of carbon in an individual package must not be greater than the mass of fissile nuclides in the package except where their total concentration does not exceed 1 g in any 1 000 g of material. Beryllium incorporated in copper alloys up to 4 per cent in weight of the alloy does not need to be considered.

UN Model Regulations, paragraph Table 6.4.11.2, ST/SG/AC.10/40/Add.1

Table 6-6. Values of Z for calculation of criticality safety index in accordance with 7.10.2

Enrichement[a]	*Z*
Uranium enriched up to 1.5%	2200
Uranium enriched up to 5%	850
Uranium enriched up to 10%	660
Uranium enriched up to 20%	580
Uranium enriched up to 100%	450

[a] If a package contains uranium with varying enrichments of U-235, then the value corresponding to the highest enrichment must be used for Z.

UN Model Regulations, paragraph 6.4.11.3, ST/SG/AC.10/40/Add.1

7.10.3 Packages containing not more than 1 000 g of plutonium are excepted from the application of 7.10.4 to 7.4.14 provided that:

a) not more than 20 per cent of the plutonium by mass is fissile nuclides;

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

$$CSI=50x2x\left(\frac{Mass\ \text{of plutonium (g)}}{1000}\right)$$

c) if uranium is present with the plutonium, the mass of uranium must be no more than 1 per cent of the mass of the plutonium.

UN Model Regulations, paragraphs 6.4.11.4 to 6.4.11.14, ST/SG/AC.10/40/Add.1

~~7.10.3~~7.10.4 Where the chemical or physical form, isotopic composition, mass or concentration, moderation ratio or density, or geometric configuration is not known, the assessments of ~~7.10.7~~7.10.8 to ~~7.10.12~~7.10.13 must be performed assuming that each parameter that is not known has the value which gives the maximum neutron multiplication consistent with the known conditions and parameters in these assessments.

~~7.10.4~~7.10.5 For irradiated nuclear fuel the assessments of ~~7.10.7~~7.10.8 to ~~7.10.12~~7.10.13 must be based on an isotopic composition demonstrated to provide:

a) the maximum neutron multiplication during the irradiation history; or

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

~~7.10.5~~7.10.6 The package, after being subjected to the tests specified in 7.14, must:

a) preserve the minimum overall outside dimensions of the package to at least 10 cm; and

b) prevent the entry of a 10-cm cube.

~~7.10.6~~7.10.7 The package must be designed for an ambient temperature range of –40°C to +38°C unless the competent authority specifies otherwise in the certificate of approval for the package design.

~~7.10.7~~7.10.8 For a package in isolation, it must be assumed that water can leak into or out of all void spaces of the package, including those within the containment system. However, if the design incorporates special features to prevent such leakage of water into or out of certain void spaces, even as a result of error, absence of leakage may be assumed in respect of those void spaces. Special features must include either of the following:

a) multiple high standard water barriers not less than two of which would remain watertight if the package were subject to the tests prescribed in 7.10.~~12~~13 b), a high degree of quality control in the manufacture, maintenance and repair of packagings and tests to demonstrate the closure of each package before each shipment; or

b) for packages containing uranium hexafluoride only, with maximum enrichment of 5 mass per cent uranium-235:

i) packages where, following the tests prescribed in 7.10.~~12~~13 b), there is no physical contact between the valve and any other component of the packaging other than at its original point of attachment and where, in addition, following the test prescribed in 7.16.3, the valves remain leaktight; and

ii) a high degree of quality control in the manufacture, maintenance and repair of packagings coupled with tests to demonstrate closure of each package before each shipment.

~~7.10.8~~7.10.9 It must be assumed that the confinement system ~~must be~~ is closely reflected by at least 20 cm of water or such greater reflection as may additionally be provided by the surrounding material of the packaging. However, when it can be demonstrated that the confinement system remains within the packaging following the tests prescribed in 7.10.~~12~~.13 b), close reflection of the package by at least 20 cm of water may be assumed in 7.10.~~9~~.10 c).

~~7.10.9~~7.10.10 The package must be subcritical under the conditions of 7.10.~~7~~.8 and 7.10.~~8~~.9, with the package conditions that result in the maximum neutron multiplication consistent with:

a) routine conditions of transport (incident free);

b) the tests specified in 7.10.~~11~~.12 b);

c) the tests specified in 7.10.~~12~~.13 b).

~~7.10.10~~7.10.11:

a) The package must be subcritical under conditions consistent with the Type C package tests specified in 7.19.1 assuming reflection by at least 20 cm of water but no water-in leakage.

b) In the assessment of 7.10.~~9~~.10, allowance must not be made for special features of 7.10.~~7~~8 unless, following the Type C package tests specified in 7.19.1 and, subsequently, the water-in leakage test of 7.18.3, leakage of water into or out of the void spaces is prevented.

~~7.10.11~~7.10.12 A number “N” must be derived, such that five times “N” must be subcritical for the arrangement and package conditions that provide the maximum neutron multiplication consistent with the following:

a) There must not be anything between the packages, and the package arrangement must be reflected on all sides by at least 20 cm of water; and

b) The state of the packages must be their assessed or demonstrated condition if they had been subjected to the tests specified in 7.14.

~~7.10.12~~7.10.13 A number “N” must be derived, such that two times “N” must be subcritical for the arrangement and package conditions that provide the maximum neutron multiplication consistent with the following:

a) hydrogenous moderation between packages, and the package arrangement reflected on all sides by at least 20 cm of water; and

b) the tests specified in 7.14 followed by whichever of the following is the more limiting:

i) the tests specified in 7.16.2 b) and, either 7.16.2 c) for packages having a mass not greater than 500 kg and an overall density not greater than 1 000 kg/m^3 based on the external dimensions, or 7.16.2 a) for all other packages; followed by the test specified in 7.16.3 and completed by the tests specified in 7.18.1 to 7.18.3; or

ii) the test specified in 7.16.4; and

c) where any part of the fissile material escapes from the containment system following the tests specified in 7.10.~~12~~13 b), it must be assumed that fissile material escapes from each package in the array and all of the fissile material must be arranged in the configuration and moderation that results in the maximum neutron multiplication with close reflection by at least 20 cm of water.

~~7.10.13~~7.10.14 The criticality safety index (CSI) for packages containing fissile material must be obtained by dividing the number 50 by the smaller of the two values of N derived in 7.10.~~11~~.12 and 7.10.~~12~~.13 (i.e. CSI = 50/N). The value of the CSI may be zero, provided that an unlimited number of packages is subcritical (i.e. N is effectively equal to infinity in both cases).

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7.12 TESTING THE INTEGRITY OF THE CONTAINMENT SYSTEM AND SHIELDING AND EVALUATING CRITICALITY SAFETY

After each of the applicable tests specified in 7.14 to 7.20:

a) faults and damages must be identified and recorded;

b) it must be determined whether the integrity of the containment system and shielding has been retained to the extent required in 7.1 to 7.10 for the package under test; and

UN Model Regulations, paragraph 6.4.13 c), ST/SG/AC.10/40/Add.1

c) it must be determined, for packages containing fissile material, whether the assumptions and conditions used in the assessments required by 7.10.1 to 7.10.~~13~~.14 for one or more packages are valid.

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7.14 TESTS FOR DEMONSTRATING ABILITY TO WITHSTAND NORMAL CONDITIONS OF TRANSPORT

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

a) The height of the drop measured from the lowest point of the specimen to the upper surface of the target must be not less than the distance specified in Table 6-6 for the applicable mass. The target must be as defined in 7.13;

b) For rectangular fibreboard or wood packages not exceeding a mass of 50 kg, a separate specimen must 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 must be subjected to a free drop onto each of the quarters of each rim from a height of 0.3 m.

Table ~~6-6~~ 6-7. Free drop distance for testing packages to normal conditions of transport

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

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

UN Model Regulations, paragraph 6.4.15.5, ST/SG/AC.10/40/Add.1

a) the equivalent of five times a total weight equal to five 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 must be applied uniformly to two opposite sides of the specimen, one of which must be the base on which the package would typically rest.

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

a) A bar of 3.2 cm in diameter with a hemispherical end and a mass of 6 kg must be dropped and directed to fall, with its longitudinal axis vertical, 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 must not be significantly deformed by the test performance;

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

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7.16 TESTS FOR DEMONSTRATING THE ABILITY TO WITHSTAND ACCIDENT CONDITIONS IN TRANSPORT

7.16.1 The specimen must be subjected to the cumulative effects of the tests specified in 7.16.2 and 7.16.3, in that order. Following these tests, either this specimen or a separate specimen must be subjected to the effect(s) of the water immersion test(s) as specified in 7.16.4 and, if applicable, 7.17.

UN Model Regulations, paragraph 6.4.17.2, ST/SG/AC.10/40/Add.1

7.16.2 Mechanical test: the mechanical test consists of three different drop tests. Each specimen must be subjected to the applicable drops as specified in 7.7.8 or 7.10~~.12~~.13. The order in which the specimen is subjected to the drops must be such that, on completion of the mechanical test, the specimen must have suffered such damage as will lead to the maximum damage in the thermal test which follows:

a) For drop I, the specimen must drop onto the target so as to suffer the maximum damage, and the height of the drop measured from the lowest point of the specimen to the upper surface of the target must be 9 m. The target must be as defined in 7.13;

b) For drop II, the specimen must drop~~, so as to suffer the maximum damage,~~ onto a bar rigidly mounted perpendicularly on the target so as to suffer the maximum damage. The height of the drop measured from the intended point of impact of the specimen to the upper surface of the bar must be 1 m. The bar must be of solid mild steel of circular section, (15.0 ± 0.5 cm) in diameter and 20 cm long unless a longer bar would cause greater damage, in which case a bar of sufficient length to cause maximum damage must be used. The upper end of the bar ~~shall~~ must 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~~ must be as described in 7.13;

c) For drop III, the specimen must be subjected to a dynamic crush test by positioning the specimen on the target so as to suffer maximum damage by the drop of a 500 kg mass from 9 m onto the specimen. The mass must consist of a solid mild steel plate 1 m by 1 m and must fall in a horizontal attitude. The lower face of the steel plate must have its edges and corners rounded off to a radius of not more than 6 mm. The height of the drop must be measured from the underside of the plate to the highest point of the specimen. The target on which the specimen rests must be as defined in 7.13.

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UN Model Regulations, paragraph 6.4.19, ST/SG/AC.10/40/Add.1

7.18 WATER LEAKAGE TEST FOR PACKAGES CONTAINING FISSILE MATERIAL

7.18.1 Packages for which water-in leakage or out-leakage to the extent which results in the greatest reactivity has been assumed, for purposes of assessment under 7.10~~.7~~.8 to 7.10~~.12~~.13, must be excepted from the test.

7.18.2 Before the specimen is subjected to the water leakage test specified below, it must be subjected to the tests in 7.16.2 b) and either 7.16.2 a) or c) as required by 7.10~~.12~~.13 and the test specified in 7.16.3.

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

7.19 TESTS FOR TYPE C PACKAGES

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

a) the tests specified in 7.16.2 a), 7.16.2 c), 7.19.2 and 7.19.3; and

b) the test specified in 7.19.4.

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

UN Model Regulations, paragraph 6.4.20.2, ST/SG/AC.10/40/Add.1

7.19.2 Puncture/tearing test: the specimen must be subjected to the damaging effects of a vertical solid probe made of mild steel. The orientation of ~~the probe to the surface of the specimen must be positioned so~~ the package specimen and the impact point on the package surface must be such as to cause maximum damage at the conclusion of the test sequence specified in 7.19.1 a).

a) The specimen, representing a package having a mass less than 250 kg, must be placed on a target and subjected to a probe having a mass of 250 kg and falling from a height of 3 m above the intended impact point. For this test, the probe must be a 20 cm in diameter cylindrical bar with the striking end forming a frustum of a right circular cone with the following dimensions: 30 cm in height and 2.5 cm in diameter at the top with its edge rounded off to a radius of not more than 6 mm. The target on which the specimen is placed must be as specified in 7.13;

b) For packages having a mass of 250 kg or more, the base of the probe must be placed on a target and the specimen dropped onto the probe. The height of the drop, measured from the point of impact with the specimen to the upper surface of the probe must be 3 m. For this test, the probe must have the same properties and dimensions as specified in a) above, except that the length and mass of the probe must be such as to incur maximum damage to the specimen. The target on which the base of the probe is placed must be as specified in 7.13.

7.19.3 Enhanced thermal test: the conditions for this test must be as specified in 7.16.3, except that the exposure to the thermal environment must be for a period of 60 minutes.

7.19.4 Impact test: the specimen must be subject to an impact on a target at a velocity of not less than 90 m/s, at such an orientation as to suffer maximum damage. The target must be as defined in 7.13, except that the target surface may be at any orientation as long as the surface is normal to the specimen path.

7.20 TESTS FOR PACKAGINGS DESIGNED TO CONTAIN URANIUM HEXAFLUORIDE

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

7.21 APPROVALS OF PACKAGE DESIGNS AND MATERIALS

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

a) each design that meets the requirements of 7.5.4 requires multilateral approval;

b) each design that meets the requirements of 7.5.1 to 7.5.3 must require unilateral approval by the competent authority of the State of Origin of the design, unless multilateral approval is otherwise required by these Instructions.

7.21.2 Each Type B(U) and Type C package design requires unilateral approval, except that:

a) a package design for fissile material, which is also subject to 5;1.2.2.1 and 7.21.4 must require multilateral approval; and

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

7.21.3 Each Type B(M) package design, including those for fissile material which are also subject to 5;1.2.2.1 and 7.21.4 and those for low dispersible radioactive material, must require multilateral approval.

UN Model Regulations, paragraph 6.4.22.4, ST/SG/AC.10/40/Add.1

7.21.4 Each package design for fissile material ~~that~~ which is not excepted~~, according to 7.10.2, from the requirements which apply specifically to packages containing fissile material must require multilateral approval~~ by any of the paragraphs 2;7.2.3.5.1 a) to f), 7.10.2 and 7.10.3 must require multilateral approval.

7.21.5 The design for special form radioactive material must require unilateral approval. The design for low dispersible radioactive material must require multilateral approval (see also 6.4.23.8 of the UN Recommendations).

UN Model Regulations, paragraph 6.4.22.6 and 6.4.22.7, ST/SG/AC.10/40/Add.1

7.21.6 The design for a fissile material excepted from FISSILE classification in accordance with 2;7.2.3.5.1 f) must require multilateral approval.

7.21.7 Alternative activity limits for an exempt consignment of instruments or articles in accordance with 2;7.2.2.2 b) must require multilateral approval.

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7.23 TRANSITIONAL MEASURES FOR CLASS 7

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

UN Model Regulations, paragraph 6.4.24.1, ST/SG/AC.10/40/Add.1

7.23.1.1 ~~Excepted packages, Industrial packages Type IP-1, Type IP-2 and Type IP-3 and Type A packages that did not require approval of design by the competent authority and which meet the requirements of the 1985 or 1985 (As Amended 1990) editions of the IAEA *Regulations for the Safe Transport of Radioactive Material* (IAEA Safety Series No. 6) may continue to be used subject to the mandatory programme of quality assurance in accordance with the requirements of 1;6.3 and the activity limits and material restrictions of 2;7.2.4.~~ Packages not requiring competent authority approval of design (excepted packages, Type IP-1, Type IP-2, Type IP-3 and Type A packages) must meet these Instructions in full, except that packages that meet the requirements of the 1985 or 1985 (As Amended 1990) Editions of IAEA Regulations for the Safe Transport of Radioactive Material (IAEA Safety Series No.6):

a) may continue in transport provided that they were prepared for transport prior to 31 December 2003, and subject to the requirements of 7.23.4, if applicable;

b) may continue to be used provided that:

i) they were not designed to contain uranium hexafluoride;

ii) the applicable requirements of 1;6.3 of these Instructions are applied;

iii) the activity limits and classification in Part 2;7 of these Instructions are applied;

iv) the requirements and controls for transport in Parts 1, 3, 4, 5 and 7 of these Instructions are applied;

v) the packaging was not manufactured or modified after 31 December 2003.

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

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

UN Model Regulations, paragraph 6.4.24.2, ST/SG/AC.10/40/Add.1

7.23.2.1 ~~Packagings manufactured to a package design approved by the competent authority under the provisions of the 1973 or 1973 (As Amended) editions of IAEA Safety Series No. 6 may continue to be used subject to: multilateral approval of package design; the mandatory programme of quality assurance in accordance with the applicable requirements of 1;6.3; the activity limits and material restrictions of 2;7.2.4; and, for a package containing fissile material and transported by air, the requirements of 7.10.10. No new manufacture of such packaging must be permitted to commence. Changes in the design of the packaging or in the nature or quantity of the authorized radioactive contents which, as determined by the competent authority, would significantly affect safety, must meet the requirements of these Instructions in full. A serial number according to the provision of 5;2.4.5.1 c) must be assigned to and marked on the outside of each packaging.~~ Packages requiring competent authority approval of the design must meet these Instructions in full unless the following conditions are met:

a) the packagings were manufactured to a package design approved by the competent authority under the provisions of the 1973 or 1973 (As Amended) or the 1985 or 1985 (As Amended 1990) Editions of IAEA Safety Series No.6);

b) the package design is subject to multilateral approval;

c) the applicable requirements of 1;6.3 of these Instructions are applied;

d) the activity limits and classification in Part 2;7 of these Instructions are applied;

e) the requirements and controls for transport in in Parts 1, 3, 4, 5 and 7 of these Instructions are applied;

f) for a package containing fissile material and transported by air, the requirement of 7.10.11 is met;

g) for packages that meet the requirements of the 1973 or 1973 (As Amended) Editions of these Instructions:

i) the packages retain sufficient shielding to ensure that the radiation level at 1 m from the surface of the package would not exceed 10 mSv/h in the accident conditions of transport defined in the 1973 Revised or 1973 Revised (As Amended) Editions of IAEA Safety Series No. 6 with the maximum radioactive contents which the package is authorized to contain;

ii) the packages do not utilize continuous venting;

iii) a serial number in accordance with the provision of 5;2.4.5.1 c) is assigned to and marked on the outside of each packaging.

UN Model Regulations, paragraph 6.4.24.3, ST/SG/AC.10/40/Add.1

7.23.2.2 ~~Packagings manufactured to a package design approved by the competent authority under the provisions of the 1985 or 1985 (As Amended 1990) editions of IAEA Safety Series No. 6 may continue to be used subject to the multilateral approval of package design; the mandatory programme of quality assurance in accordance with the requirements of 1;6.3; the activity limits and material restrictions of 2;7.2.4; and, for a package containing fissile material and transported by air, the requirements of 7.10.10. Changes in the design of the packaging or in the nature or quantity of the authorized radioactive contents which, as determined by the competent authority, would significantly affect safety must meet the requirements of these Instructions in full. All packagings for which manufacture begins after 31 December 2006 must meet the requirements of these Instructions in full.~~ No new manufacture of packagings to a package design meeting the provisions of the 1973, 1973 (As Amended), 1985, and 1985 (As Amended 1990) Editions of IAEA Safety Series No.6 must be permitted to commence.

UN Model Regulations, paragraph 6.4.24.4, ST/SG/AC.10/40/Add.1

7.23.4 Packages excepted from the requirements for fissile materials under the 2011-2012 or 2013-2014 Edition of these Instructions (2009 Edition of IAEA Safety Standard Series No.TS-R-1)

Packages containing fissile material that is excepted from classification as FISSILE according to 2;7.2.3.5.1 a) i) or iii) of the 2011-2012 or 2013-2014 Edition of these Instructions (paras. 417 (a) (i) or (iii) of the 2009 Edition of IAEA Regulations for the Safe Transport of Radioactive Material) prepared for transport before 31 December 2014 may continue in transport and may continue to be classified as non-fissile or fissile-excepted except that the consignment limits in Table 2-14 of these editions must apply to the conveyance. The consignment must be transported under exclusive use.

UN Model Regulations, paragraph 6.4.24.5, ST/SG/AC.10/40/Add.1

7.23.~~4~~5 Special form radioactive material approved under the 1973, 1973 (As Amended), 1985 and 1985 (As Amended 1990) editions of IAEA Safety Series No. 6

Special form radioactive material manufactured to a design which had received unilateral approval by the competent authority under the 1973, 1973 (As Amended), 1985 or 1985 (As Amended 1990) editions of IAEA Safety Series No. 6 may continue to be used when in compliance with the mandatory ~~programme of quality assurance~~ management system in accordance with the applicable requirements of 1;6.3. ~~All special form radioactive material manufactured after 31 December 2003 must meet the requirements of these Instructions in full.~~No new manufacture of such special form radioactive material must be permitted to commence

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