

**Part 4**

**PACKING INSTRUCTIONS**

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## INTRODUCTORY NOTES

### ≠ *Note 1.— Packing groups*

For packing purposes, dangerous goods other than those of Classes 1, 2 and 7, Divisions 5.2 and 6.2 and self-reactive substances of Division 4.1 are assigned to three packing groups in accordance with the degree of danger they present:

- Packing Group I — Substances presenting high danger
- Packing Group II — Substances presenting medium danger
- Packing Group III — Substances presenting low danger

Some substances in Class 9 and liquids in Division 5.1 have been assigned to packing groups by experience rather than through application of technical criteria. The packing group to which a substance is assigned is listed in Table 3-1. The criteria for the packing groups are given in Part 2, Chapters 3, 4, 5, 6 and 8.

### *Note 2.— Temperature variations*

For the information of users of these Instructions, the extremes of temperature which may be encountered in international transportation are in the order of  $-40^{\circ}\text{C}$  and  $55^{\circ}\text{C}$ . Since receptacles or packagings may be filled at low temperatures and then exposed in transit in tropical areas, the increase in temperature may tend to cause discharge of liquid contents or bursting of the receptacles or packagings during transit, unless a suitable ullage (outage) has been provided and the receptacles or packagings meet the pressure requirement specified in 1.1.6 of this Part.

### *Note 3.— Pressure variations*

Due to altitude, the ambient pressure experienced by a package in flight will be lower than standard atmospheric pressure at sea level. Since receptacles or packagings will generally be filled at a standard atmospheric pressure of approximately 100 kPa, this lower ambient pressure will result in a pressure differential between the contents of the receptacle or package and the cargo compartment. For pressurized cargo compartments, the pressure differential may be approximately 25 kPa, while for non-pressurized or partially pressurized cargo compartments, the pressure differential may be as much as 75 kPa. This pressure differential will tend to cause discharge of liquid contents or bursting of the receptacles or packagings during flight unless each receptacle or packaging and its closures meet the packaging test requirements.

### *Note 4.— Vibrations*

Vibrations in commercial aircraft to which packagings may be exposed range from 5 mm amplitude at 7 Hz (corresponding to 1 g acceleration), to 0.05 mm amplitude at 200 Hz (corresponding to 8 g acceleration).

### *Note 5.— Nomenclature*

A nomenclature of some packaging terms used in the Instructions is given in 1;3.1. Explanations of the codes used in this Part to designate types of inner and outer packagings may be found in Tables 6-2 and 6-3.

### *Note 6.— Portable tanks*

With the approval of the appropriate authority of the State of Origin and the State of the Operator, certain dangerous goods may also be carried on cargo aircraft in portable tanks in accordance with the provisions of Part S-4, Chapter 12 of the Supplement.

### ≠ *Note 7.— Carriage of oxygen and air with aquatic animals*

With the approval of the appropriate authority of the State of Origin, of Destination and of the Operator, for the purpose of providing life support to aquatic animals during transport, cylinders containing Oxygen compressed (UN 1072) or Air, compressed (UN 1002) may be carried to oxygenate the water in accordance with the provisions of Table S-3-1 and Special Provision A202 (which appear in the Supplement).

### *Note 8.— Packagings for explosives, self-reactive substances and organic peroxides*

Unless specific provision to the contrary is made in these Instructions, the packagings used for goods of Class 1, self-reactive substances of Division 4.1 and organic peroxides of Division 5.2 should comply with the provisions for the medium danger (Packing Group II) category.

*Note 9.— Additional requirements for the air mode*

The transport of dangerous goods by air is subject to requirements additional to those of other modes of transport (e.g. quantity limitations, requirements for absorbent material, pressure differential requirements, appropriate closure procedures, specific packing instruction requirements).

*Note 10.— Carriage of flames*

With the approval of the appropriate authority of the State of Origin, or transit (where applicable), of Destination and of the Operator, lamps fuelled by UN 1223 — **Kerosene** or UN 3295 — **Hydrocarbons, liquid, n.o.s.**, carried by a passenger to transport a symbolic flame (e.g. Olympic flame, Peace flame) may be carried in accordance with the provisions of Special Provision A224 (which appears in the Supplement to this document).

≠ *Note 11.— Open external carriage*

When dangerous goods are prepared for open external carriage (e.g. suspended from a helicopter or in open external carrying devices), consideration should be given to the type of packaging used and protection of those packagings where necessary from the effects of airflow and weather (e.g. by damage from rain or snow).

## Chapter 1

### GENERAL PACKING REQUIREMENTS

*Parts of this Chapter are affected by State Variations IT 7, JP 20, JP 24;  
see Table A-1*

#### 1.1 GENERAL REQUIREMENTS APPLICABLE TO ALL CLASSES EXCEPT CLASS 7

1.1.1 Dangerous goods must be packed in good quality packagings, which must be strong enough to withstand the shocks and loadings normally encountered during transport, including removal from a pallet, unit load device or overpack for subsequent manual or mechanical handling. Packagings must be constructed and closed so as to prevent any loss of contents when prepared for transport, which may be caused under normal conditions of transport, by vibration, or by changes in temperature, humidity or pressure (resulting from altitude, for example). Packagings (including inner packagings and receptacles) must be closed in accordance with the information provided by the manufacturer. No dangerous residue must adhere to the outside of packages during transport. These provisions apply, as appropriate, to new, reused, reconditioned or re-manufactured packagings.

*Note.— The nature of transport dictates that many packages are likely to be moved between different modes of transport with the attendant increase in handling, e.g. from vehicles into warehouses and then onto aircraft. Additionally, packages consigned on a pallet may be removed from that pallet to assist handling and loading which may be carried out manually. To avoid damage and leakage from packages during transport, shippers should take this into account in selecting an appropriate packaging or in making the decision about the suitability of an already packaged item. In this respect, it is recommended that single steel or aluminium packagings (1A1, 1A2, 1B1, 1B2, 3A1, 3A2, 3B1, 3B2), when transported in narrow-bodied aircraft and not otherwise protected by, for example, placement in a unit load device, be provided additional protection against the abrasive effects experienced in loading the aircraft through overpacking, palletization or other means of protecting the bottom head and chime. Also, small single packagings, with a capacity of 2 L or less, should be overpacked to facilitate handling and to permit adequate securing of the dangerous goods aboard the aircraft.*

1.1.2 New, remanufactured, reused or reconditioned packagings which are listed in Tables 6-2 and 6-3, must meet the applicable requirements of Part 6 of these Instructions. Such packagings must be manufactured and tested under a quality assurance programme which satisfies the appropriate national authority, in order to ensure that such packagings meet those applicable requirements. Where packagings are required to be tested in accordance with 6;4, their subsequent use must be as specified in the applicable test report and conform in all respects with the design type which was tested, including the method of packing and size and type of any inner packagings, except as provided for in 1.1.10.1 and 6;4.1.7. Before being filled and handed over for transport, every packaging must be inspected to ensure that it is free from corrosion, contamination or other damage. Any packaging which shows signs of reduced strength as compared with the approved design type must no longer be used or must be so reconditioned that it is able to withstand the design type tests.

*Note.— ISO 16106:2006 Packaging — Transport packages for dangerous goods — Dangerous goods packagings, intermediate bulk containers (IBCs) and large packagings — Guidelines for the application of ISO 9001 provides acceptable guidance on procedures which may be followed.*

#### 1.1.3 Compatibility requirements

1.1.3.1 Parts of packagings which are in direct contact with dangerous goods:

- a) must not be affected or significantly weakened by those dangerous goods;
- b) must not cause a dangerous effect, e.g. catalyzing a reaction or reacting with the dangerous goods; and
- c) must not allow permeation of the dangerous goods that could constitute a danger under normal conditions of transport.

Where necessary, they must be provided with a suitable inner coating or treatment.

1.1.3.2 Shippers must also ensure that any absorbent materials and the materials of intermediate packagings for liquids do not react dangerously with the liquid.

1.1.3.3 Materials, such as some plastics, which can be significantly softened or rendered brittle or permeable by the temperatures likely to be experienced during transport or because of the chemical action of the contents or the use of a refrigerant, must not be used. Even though certain packagings are specified in individual packing instructions, it is, nevertheless, the responsibility of the shipper to ensure that such packagings are, in every way, compatible with the articles or substances to be contained within such packagings. This particularly applies to corrosivity, permeability, softening, premature aging and embrittlement.

Particular attention should be paid to the following:

- a) the effect of fluorine on glass;
- b) the effects of corrosion on metals such as steel and aluminium; and
- c) consideration of the interaction (such as swelling, permeation, chemical degradation and environmental stress cracking) of substances with polymer materials such as polyethylene and polypropylene.

1.1.3.4 Shippers must ensure that all appropriate measures have been taken to ensure that the packagings used are compatible with the dangerous goods to be transported. Evidence of such measures or assessments must be made available to the competent authority upon request.

1.1.4 The body and the closure of any packaging must be so constructed as to be able to adequately resist the effects of temperature and vibration occurring in normal conditions of transport. The closure device must be so designed that it:

- a) is unlikely that it can be incorrectly or incompletely closed, and must be such that it may be checked easily to determine that it is completely closed; and
- b) remains securely closed during transport.

≠ 1.1.4.1 In addition, for inner packagings containing liquids, closures must be held securely, tightly and effectively in place by secondary means. Examples of such methods include: adhesive tape, friction sleeves, welding or soldering, positive locking wires, locking rings, induction heat seals and child-resistant closures. When secondary means of closure cannot be applied, the inner packaging must be securely closed and placed in a leakproof liner and then placed in an outer packaging.

1.1.5 When filling packagings for liquids sufficient ullage (outage) must be left to ensure that neither leakage nor permanent distortion of the packaging will occur as a result of an expansion of the liquid caused by temperatures likely to prevail during transport. Liquids must not completely fill a packaging at a temperature of 55°C.

1.1.6 Packagings for which retention of liquid is a basic function must be capable of withstanding without leakage an internal pressure which produces a pressure differential of not less than 95 kPa (not less than 75 kPa for liquids in Packing Group III of Class 3 or Division 6.1), or a pressure related to the vapour pressure of the liquid to be conveyed, whichever is the greater. The pressure related to the vapour pressure must be determined as either:

- a) the total gauge pressure measured in the packaging (i.e. the vapour pressure of the filling substance and the partial pressure of the air or other inert gases, less 100 kPa) at 55°C, multiplied by a safety factor of 1.5; this total gauge pressure should be determined on the basis of a degree of filling in accordance with 1.1.5 and a filling temperature of 15°C; or
- b) 1.75 times the vapour pressure at 50°C less 100 kPa, but with a minimum of 95 kPa.

This is expressed as:

$$P = (V_{p50} \times 1.75) - 100 \text{ kPa with a minimum of 95 kPa}$$

where

P = Pressure requirement in kPa (gauge)

$V_{p50}$  = Vapour pressure at 50°C; or

- c) 1.5 times the vapour pressure at 55°C less 100 kPa, but with a minimum of 95 kPa.

This is expressed as:

$$P = (V_{p55} \times 1.5) - 100 \text{ kPa with a minimum of 95 kPa}$$

where

P = Pressure requirement in kPa (gauge)

$V_{p55}$  = Vapour pressure at 55°C.

*Note.— The capability of a packaging to withstand an internal pressure without leakage that produces the specified pressure differential should be determined by testing samples of inner packagings of combination packagings and single packagings. Pressure differential is the difference between the pressure exerted on the inside of the packaging and the pressure on the outside. The appropriate test method should be selected based on packaging type. Acceptable test methods include any method that produces the required pressure differential between the inside and outside of a single packaging or an inner packaging of a combination packaging. The test may be conducted using internal hydraulic or pneumatic pressure (gauge) or external vacuum test methods. Internal hydraulic or pneumatic pressure can be applied in most cases as the required pressure differential can be achieved under most circumstances. An external vacuum test is not acceptable if the specified*

pressure differential is not achieved and maintained. The external vacuum test is a generally acceptable method for rigid packagings but is not normally acceptable for:

- flexible packagings;
- packagings filled and closed under an absolute atmospheric pressure lower than 95 kPa or for liquids in Packing Group III of Class 3 or Division 6.1 with an absolute pressure of 75 kPa;
- packagings intended for the transport of high vapour pressure liquids (i.e. vapour pressure greater than 111 kPa at 50°C or 130 kPa at 55°C and accordingly greater than 100 kPa at 50°C or 117 kPa at 55°C for liquids in Packing Group III of Class 3 or Division 6.1.

1.1.7 Notwithstanding the foregoing, dangerous goods may be contained in an inner packaging which does not itself meet the pressure requirement provided that the inner packaging is packed within a supplementary packaging which does meet the pressure requirement and all the other requirements of this Chapter and the applicable packing instruction.

1.1.8 Dangerous goods must not be packed together in the same outer packaging with dangerous or other goods if they react dangerously with each other and cause:

- a) combustion and/or evolution of considerable heat;
- b) evolution of flammable, toxic or asphyxiant gases;
- c) the formation of corrosive substances; or
- d) the formation of unstable substances.

1.1.9 Subject to 1.1.8 an outer packaging may contain more than one item of dangerous goods provided that:

- a) the inner packaging used for each item of dangerous goods and the quantity contained therein complies with the relevant part of the packing instruction applicable to that item;
- b) the outer packagings used are permitted by all the packing instructions applicable to each item of dangerous goods;
- c) the package as prepared for shipment meets the specification performance tests for the most restrictive packing group of a substance or article contained in the package;
- d) the dangerous goods do not require segregation according to Table 7-1, unless otherwise provided for in these Instructions; and
- e) the quantities of different dangerous goods contained in one outer packaging must be such that "Q" does not exceed the value of 1, where "Q" is calculated using the formula:

$$Q = \frac{n_1}{M_1} + \frac{n_2}{M_2} + \frac{n_3}{M_3} + \dots$$

where  $n_1$ ,  $n_2$ , etc. are the net quantities of the different dangerous goods and  $M_1$ ,  $M_2$ , etc. are the maximum net quantities for these different dangerous goods according to Table 3-1 for passenger or cargo aircraft as applicable. However, the following dangerous goods do not need to be taken into account in the calculation of the "Q" value:

- 1) carbon dioxide, solid (dry ice), UN 1845;
- 2) those where columns 11 and 13 of Table 3-1 indicate "No limit";
- 3) those with the same UN number, packing group, and physical state (i.e. solid or liquid), providing they are the only dangerous goods in the package and the total net quantity does not exceed the maximum net quantity according to Table 3-1.

An outer packaging containing Division 6.2 (Infectious Substances) may contain material for refrigeration, or freezing or packaging material such as absorbent material.

*Note.— For packages containing radioactive material, see 9.1.3.*

1.1.10 Inner packagings must be so packed, secured or cushioned in an outer packaging in such a way that, under normal conditions of transport, they cannot break, be punctured or leak their contents into the outer packaging. Inner packagings containing liquids must be packaged with their closures upward and placed within outer packagings consistent with the orientation markings prescribed in 5.3.2.12 b) of these Instructions. Inner packagings that are liable to break or be punctured easily, such as those made of glass, porcelain or stoneware or of certain plastic material, must be secured in outer packagings with suitable cushioning material. Any leakage of the contents must not substantially impair the protective properties of the cushioning material or of the outer packaging.

1.1.10.1 Where an outer packaging of a combination packaging has been successfully tested with different types of inner packagings, a variety of such different inner packagings may also be assembled in this outer packaging or large packaging. In addition, provided an equivalent level of performance is maintained, the following variations in inner packagings are allowed without further testing of the package:

- a) inner packagings of equivalent or smaller size may be used provided:
  - 1) the inner packagings are of similar design to the tested inner packagings (e.g. shape — round, rectangular);
  - 2) the material of construction of the inner packagings (glass, plastics, metal, etc.) offers resistance to impact and stacking forces equal to or greater than that of the originally tested inner packaging;
  - 3) the inner packagings have the same or smaller openings and the closure is of similar design (screw cap, friction lid, etc.);
  - 4) sufficient additional cushioning material is used to take up void spaces and to prevent significant movement of the inner packagings; and
  - 5) inner packagings are oriented within the outer packaging in the same manner as in the tested package; and
- b) a lesser number of the tested inner packagings, or of the alternative types of inner packagings identified in a) above, may be used provided sufficient cushioning is added to fill the void space(s) and to prevent significant movement of the inner packagings.

1.1.11 The nature and the thickness of the outer packaging must be such that friction during transport does not generate any heat likely to alter dangerously the chemical stability of the contents.

1.1.12 Venting of packagings to reduce internal pressure, which may develop by the evolution of gas from the contents, not permitted for air transport, except as otherwise specified in these Instructions.

≠ 1.1.13 Except as provided in 1.1.13.1, combination packagings having inner packagings containing liquid dangerous goods must be packed so that the closures on the inner packagings are upward and the upright position of the package must be indicated on it by the "Package orientation" label described in 5;3.2.12 b). The words "This side up" or "This end up" may also be displayed on the top cover of the package.

+ 1.1.13.1 Orientation arrows are not required on outer packagings containing:

- a) dangerous goods in inner packagings each containing not more than 120 mL with sufficient absorbent material between the inner and outer packagings to completely absorb the liquid contents;
- b) Division 6.2 infectious substances in primary receptacles each containing not more than 50 mL; or
- c) dangerous goods in gas tight inner packagings such as tubes, bags or vials which are opened by breaking or puncturing. Each inner packaging must not contain more than 500 mL.

1.1.14 Except as provided in 5;3.5.1.1 a), a package must be of such size that there is adequate space to affix all necessary labels and markings.

1.1.15 An empty packaging that has contained a dangerous substance must be treated in the same manner as is required by these Instructions for a package filled with that substance unless adequate measures have been taken to nullify any hazard.

*Note.— Purging and thorough flushing of the packaging with a neutralizing agent is an acceptable method of nullifying the hazard.*

1.1.16 Packagings tested as prescribed in 6;4.5 and marked with the hydraulic test pressure prescribed in 6;2.1.1 d) 1) must be filled only with a liquid having a vapour pressure:

- a) such that the total gauge pressure in the packaging (i.e. the vapour pressure of the filling substance plus the partial pressure of air or other inert gases, less 100 kPa) at 55°C, determined on the basis of a maximum degree of filling in accordance with 1.1.5 and a filling temperature of 15°C, will not exceed two-thirds of the marked test pressure; or
- b) at 50°C less than four-sevenths of the sum of the marked test pressure plus 100 kPa; or
- c) at 55°C less than two-thirds of the sum of the marked test pressure plus 100 kPa (see Table 4-1).

However, where the packaging is selected on the basis of 1.1.16 a) the hydraulic test pressure marked in accordance with 6;2.1.1 d) 1) must be not less than 100 kPa (not less than 80 kPa for liquids in Packing Group III of Class 3 or Division 6.1).

1.1.17 Packagings used for solids which may become liquid at temperatures encountered during air transport must also be capable of containing that substance in the liquid state.

Note.— Packagings for solids (both inner and single) which may be permitted by the applicable packing instruction should not be used if they are unsuitable for containing liquids (e.g. paper or plastic bags as inner packagings, unlined fibre drums as single packagings, should not be used).

**Table 4-1. Examples of required marked test pressures calculated as in 1.1.16 c)**

UN No.	Name	Class	Packing Group	$V_{p55}$ (kPa)	$V_{p55} \times 1.5$ (kPa)	$(V_{p55} \times 1.5)$ minus 100 (kPa)	Required minimum test pressure (gauge) under 6;4.5.3 c) (kPa)	Minimum test pressure (gauge) to be marked on the packaging (kPa)
2056	Tetrahydrofuran	3	II	70	105	5	100	100
2247	n-Decane	3	III	1.4	2.1	-97.9	100	100
1593	Dichloromethane	6.1	III	164	246	146	146	150
1155	Diethyl ether	3	I	199	299	199	199	250

Note 1.— For pure liquids the vapour pressure at 55°C ( $V_{p55}$ ) can often be obtained from scientific tables.

Note 2.— The maximum vapour pressures in 1.1.16 b) and c) refer to the basis of the formula while the minimum hydraulic test pressure in the last sentence of 1.1.16 refers to the aircraft altitude.

Note 3.— This table refers to the use of 1.1.16 c) only, which means that the marked test pressure must exceed 1.5 times the vapour pressure at 55°C less 100 kPa. When, for example, the test pressure for n-Decane is determined according to 6;4.5.3 a) the minimum marked test pressure of 80 kPa applies.

Note 4.— For Diethyl ether the required minimum test pressure under 6;4.5.4 is 250 kPa.

1.1.18 Every packaging intended to contain liquids must successfully undergo a suitable leakproofness test and be capable of meeting the appropriate test level indicated in 6;4.4.2:

- a) before it is first used for transport;
- b) after remanufacturing or reconditioning, before it is reused for transport.

For this test, packagings need not have their own closures fixed.

The inner receptacle of composite packagings may be tested without the outer packaging provided the test results are not affected. This test is not necessary for inner packagings of combination packagings.

1.1.19 The closures of packagings containing wetted or diluted substances must be such that the percentage of liquid (water, solvent or phlegmatizer) does not fall below the prescribed limits during transport.

1.1.20 For plastic drums and jerricans, rigid plastic IBCs and composite IBCs with plastic inner receptacles, unless otherwise approved by the appropriate national authority, the period of use permitted for the transport of dangerous goods must not more than five years from the date of manufacture of the receptacles, except where a shorter period of use is prescribed because of the nature of the substance to be transported.

+ 1.1.21 Where ice is used as a coolant it must not affect the integrity of the packaging.

## 1.2 PACKING GROUP

Unless otherwise provided for, the specification packagings (i.e. those listed in Table 6-2) detailed in the packing instructions must meet the performance test requirements of the relevant packing group shown in column 8 of Table 3-1 for the particular substance or article.

## 1.3 TRANSITIONAL PACKAGING ARRANGEMENTS FOR RADIOACTIVE MATERIAL

For the arrangements for the use of packagings for radioactive material manufactured under earlier requirements, see 6;7.23.

#### 1.4 SALVAGE PACKAGINGS

1.4.1 Damaged, defective, leaking or non-conforming packages, or dangerous goods that have spilled or leaked may be transported in salvage packagings (see 1;3.1.1) meeting the requirements of 1.4.2 and 6;4.8. These salvage packagings may be used provided that appropriate measures are taken to prevent excessive movement of the damaged or leaking packages within the salvage packaging and that when the salvage packaging contains liquids, sufficient absorbent material is added to eliminate the presence of free liquid. Prior approval from the appropriate national authority must be obtained to ship salvage packagings.

1.4.2 Salvage packagings must be single packagings of a material resistant to any chemical or other action of the leaking or spilled dangerous goods. Not more than one damaged, defective or leaking package of dangerous goods may be packed in any one of such single packagings.

1.4.3 Damaged, defective or leaking packages of dangerous goods of Classes 1, 2 and 7 and Division 6.2 (other than Clinical waste and Medical waste falling under UN 3291) must not be transported in salvage packagings.

1.4.4 Damaged, defective or leaking packages of self-reactive substances of Division 4.1 or substances of Division 5.2 must not be transported in metal salvage packagings meeting Packing Group I requirements.

## Chapter 2

### GENERAL

2.1 Each of the succeeding Chapters of this Part is devoted to the specific packing instructions applicable to an individual class of dangerous goods. In some cases the Chapters start with general requirements which apply to all goods in that class.

2.2 The Dangerous Goods List (Table 3-1) shows for each article or substance, in columns 10 and 12, the number of the packing instruction that must be used.

2.3 Each instruction shows, where applicable, the acceptable single and combination packagings. For combination packagings, tables show the acceptable outer packagings and associated inner packagings with the maximum net quantity permitted in each inner packaging. Where provisions for particular articles or substances apply, a table shows the inner packagings with associated quantity limitations, the permitted quantity per package and, where applicable, an indication if single packagings are permitted. Where appropriate, additional packing requirements are also indicated at the end of a packing instruction. These additional packing requirements may impose a higher standard of packaging than would normally apply to the packing group, or may require specific packaging considerations.

2.4 Unless otherwise specified, each packaging must conform to the applicable requirements of Part 6. Generally packing instructions do not provide guidance on compatibility and the user must not select a packaging without checking that the substance is compatible with the packaging material selected (e.g. most fluorides are unsuitable for glass receptacles). Where glass receptacles are permitted in the packing instructions porcelain, earthenware and stoneware packagings are also allowed.

2.5 The following packagings must not be used when the substances being transported are liable to become liquid during transport:

Drums:	1D and 1G
Boxes:	4C1, 4C2, 4D, 4F, 4G and 4H1
Bags:	5L1, 5L2, 5L3, 5H1, 5H2, 5H3, 5H4, 5M1 and 5M2
Composite packagings:	6HC, 6HD2, 6HG1, 6HG2, 6HD1, 6PC, 6PD1, 6PD2, 6PG1, 6PG2 and 6PH1.

2.6 Where the packing instructions in this Part authorize the use of a particular type of outer packaging (e.g. 4G, 1A2), packagings bearing the same packaging identification code followed by the letters "V", "U" or "W" marked in accordance with the requirements of 6;4.1.7 h) (e.g. 4GV, 4GU or 4GW; 1A2V, 1A2U or 1A2W) may also be used under the same conditions and limitations applicable to the use of that type of packaging according to the relevant packing instruction. For example, a combination packaging marked with the packaging code "4GV" may be used whenever a combination packaging marked "4G" is authorized, provided the requirements in the relevant packing instruction regarding types of inner packagings and quantity limitations are respected.

2.7 Cylinders may be used for liquids and solids when indicated in a packing instruction. The cylinder must meet the standards set out below.

2.7.1 Unless otherwise indicated in these Instructions, cylinders conforming to:

- a) the applicable requirements of 6;5; or
- b) the national or international standards on the design, construction, testing, manufacturing and inspection, as applied by the country in which the cylinders are manufactured, provided that the provisions of 2.7 and 6;5.3.3 are met.

2.7.2 Every design type of cylinder must be approved by the competent authority of the country of manufacture or as indicated in 6;5.

2.7.3 Unless otherwise indicated, cylinders having a minimum test pressure of 0.6 MPa must be used.

2.7.4 Unless otherwise indicated, cylinders may be provided with an emergency pressure relief device designed to avoid bursting in case of overfill or fire accidents.

Cylinder valves must be designed and constructed in such a way that they are inherently able to withstand damage without release of the contents or must be protected from damage which could cause inadvertent release of the contents of the cylinder, by one of the methods as given in 4.1.1.9 a) to e).

2.7.5 The level of filling must not exceed 95 per cent of the capacity of the cylinder at 50°C. Sufficient ullage (outage) must be left to ensure that the cylinder will not be liquid full at a temperature of 55°C.

2.7.6 Unless otherwise indicated cylinders must be subjected to a periodic inspection and test every 5 years. The periodic inspection must include an external examination, an internal examination or alternative method as approved by the competent authority, a pressure test or equivalent effective non-destructive testing with the agreement of the competent authority including an inspection of all accessories (e.g. tightness of valves, emergency relief valves of fusible elements). Cylinders must not be filled after they become due for periodic inspection and test but may be transported after the expiry of the time limit. Cylinder repairs must meet the requirements of 4.1.1.11.

2.7.7 Prior to filling, the filler must perform an inspection of the cylinder and ensure that the cylinder is authorized for the substances to be transported and that the provisions of these Instructions have been met. Shut-off valves must be closed after filling and remain closed during transport. The shipper must verify that the closures and equipment are not leaking.

2.7.8 Refillable cylinders must not be filled with a substance different from that previously contained unless the necessary operations for change of service have been performed.

2.7.9 Marking of cylinders for liquids and solids according to 2.7 (not conforming to the requirements of 6;5) must be in accordance with the requirements of the competent authority of the country of manufacturing.

2.8 The appropriate authority of the State of Origin may approve the use of a packaging alternative to those provided in a particular packing instruction indicated in Table 3-1 for listed dangerous goods provided:

- a) the alternative packaging complies with the general requirements of 4;1;
- b) when the particular packaging instruction indicated in Table 3-1 specifies packagings which are listed in Tables 6-2 and 6-3, the alternative packaging must meet the applicable requirements of Part 6;
- c) for the type of alternative packaging, the expressions "Not used in these Instructions" or "Specialized use only" do not appear in Table 6-2 under the "Paragraph" column heading;
- d) the appropriate authority of the State of Origin determines that the alternative packaging achieves at least the same level of safety as if the substance were packed in accordance with a method specified in the particular packing instruction indicated in Table 3-1;
- e) the maximum net quantity of dangerous goods in the packaging does not exceed the quantity specified in the appropriate column of Table 3-1; and
- f) a copy of the document of approval accompanies each consignment.

## 2.9 UNPACKAGED ARTICLES OTHER THAN CLASS 1 ARTICLES

The appropriate authority of the State of Origin and the State of the Operator may approve the transport of large and robust articles which cannot be packaged in accordance with the requirements of 6;1 to 6;4, where they have to be transported empty, uncleaned and unpackaged, providing they comply with the requirements in Part S-4, Chapter 3 of the Supplement.