UNITED
NATIONS

ST

Secretariat

Distr.
GENERAL

ST/SG/AC.10/C.3/32/Add.1
29 July 1999

Original: ENGLISH

COMMITTEE OF EXPERTS ON THE TRANSPORT OF DANGEROUS GOODS

Sub-Committee of Experts on the Transport of Dangerous Goods

REPORT OF THE SUB-COMMITTEE OF EXPERTS ON ITS SIXTEENTH SESSION

(Geneva, 5-14 July 1999)

Addendum 1

Annex 1

Report of the Working Group on Gas Receptacles and Multiple Elements Gas Containers (MEGCs)

General

1. The Working Group on Gas Receptacles and MEGC's met from 5 July to 8 July 1999 under the chairmanship of Mr. H. Puype (EIGA). Representatives of Canada, France, Germany, the United Kingdom, the United States of America, ISO, CGA, HMAC, ECMA, AEGPL and EIGA participated in the meeting.

2. The objective of the working group was to have a first reading of document ST/SG/AC.10/C.3/1999/24 taking into account informal document INF.11 providing comments from the United States of America, ISO submission ST/SG/AC.10/C.3/1999/50 and the submission from Canada, ST/SG/AC.10/C.3/1999/35. The outcome of the discussions is reflected in the annexed proposals 1 to 7.

Proposal 1: Inclusion of additional Definitions in Part 1

3. The Working Group agreed on the inclusion of the proposed definitions with minor editorial changes. The expert from the United States of America indicated that they preferred not to use the term “drum” to describe welded cylinders with a capacity greater than 150 litres. The term “gas drum” was put between brackets. EIGA indicated that a joint proposal with CEFIC had been introduced for the next Joint Meeting of ADR/RID in order to set the limit at 3000 litres instead of 1000 litres.

4. The Working Group felt it was necessary to include a definition for test pressure.

Proposal 2: Definitions and General provisions in Part 2

5. The chairman of the ISO Technical Committee TC58 confirmed that in the review of ISO standard 10286 on terminology the new cut-off temperatures as proposed by EIGA would be incorporated. The working group adopted the definitions. These new definitions affect 4 gases, namely 1982 tetrafluoromethane, compressed, 2451 nitrogen trifluoride, compressed, 1859 silicon tetrafluoride, compressed and 1008 boron trifluoride, compressed, where the proper shipping names will lose the qualification “compressed”.

6. The group proposes to introduce a definition of “highly toxic gases” to replace the phrase “gases with an LC_{50} lower than or equal to 200 ppm”.

Proposal 3: Special packing provisions for dangerous goods of class 2 in chapter 4.1

7. The expert from the United States of America wants to review the provisions of ISO 11621 on the change of gas service for pressure receptacles to ensure that there is no conflict with procedures used in North America.

8. It was agreed that the requirements of the drop test for valve protection of ISO 11117:1998 were at least as stringent as the requirements proposed by the United States of America in INF.11. Hence the reference to ISO was confirmed and the brackets lifted.

9. The Working Group agreed that additional data should be tabled to assess the need for pressure relief devices. Risk assessments, taking into account the nature and the use of the gas, the transport conditions as well as emergency response, will be circulated amongst the members before the December meeting where a decision should be made.

10. The Working Group confirmed that pressure relief devices should not be fitted on pressure receptacles containing highly toxic gases.

11. The Working Group decided to change the range of automatic opening of pressure-relief devices from 90-110% to 100–120% of the test pressure. It was noted that this change may affect the acoustic emission test and might need further investigation. An additional provision on fusible plugs was added.

12. The Working Group agreed that a uniform temperature of 65°C should be retained as a maximum temperature to be considered for compressed, high and low pressure liquefied gases.

13. The formulae in P200 were put between brackets to allow CGA, EIGA and the experts from Germany to validate them.

14. The expert from the United States of America noted discrepancies in some values of filling ratios and will circulate the comparative tables. He will liaise with BAM and EIGA experts to validate the values to be retained.

15. At the request of the expert from the United States of America new provisions have been added between brackets for the receptacles containing highly toxic gases to safeguard against mechanical impact.

16. The Working Group agreed to add special requirements in packing instruction P200 to cover the risk of hydrogen embrittlement for the gases identified in ISO 11114-1 on the compatibility of gases with cylinders.

17. The expert from the United States of America proposed to raise the periodic inspection for gases of division 2.3 with a subsidiary corrosive risk from 3 to 5 years taking into account their positive experience. Experts from the United States of America and European countries will provide data to support the proposed extended period. The expert from the United States of America proposed to make a review of the periodicities as proposed in the document and the current periodicities in the United States of America and to circulate it before the next meeting. It was noted that no periodicity is actually specified when gas receptacles are used to contain liquids from other classes.

18. For special provision “k” of P200, the extension to 10 years for the use of aluminium alloys has been made conditional to the passing of a stress corrosion test as described in ISO 7866.

19. Some members asked to put special requirement “m” relating to the extension of the interval periods for LPG receptacles between brackets until further discussion with the industry concerned.

20. The whole of P203 was put between brackets. The expert from the United States of America will verify its conformity with the ICAO Technical Instructions.

Proposal 4: Requirements for the construction and testing of pressure receptacle for gases

21. It was agreed that the general requirements for design and construction are necessary as a regulatory framework to cover all pressure receptacles. The provisions need further investigation taking into account e.g. ISO TR 13763 Safety and Performance criteria for seamless gas cylinders (copies distributed at the meeting). The expert from the United States of America offered to circulate additional requirements before 15 September 1999 in advance of the next ISO October meeting (20-24 September) dealing with the same subject.

22. The Working Group agreed that standards other than ISO presenting the same or a higher level of safety could be incorporated in the reference list upon review by the experts of the Working Group. However the intent is not to include every standard in existence to-day.

23. The UN mark can only be applied if the appropriate standards in the reference list are used for the design, construction and testing of the pressure receptacles. The UN mark will allow free international multi-modal transport.

24. The provisions related to the service equipment of cryogenic receptacles was put between brackets. EIGA will provide the expert from the United States of America with the relevant CEN standard.

25. There was no consensus as to the exclusive use of Ultra Sonic Testing for the periodic inspection of high strength steel receptacles.

26. The Working Group agreed to include the requirement for an additional marking to indicate hydrogen embrittlement compatibility.

27. The Working Group agreed to move requirement “g” of 6.2.1.6.3 on the marking of the product name of non-refillable receptacles to Part 5.

28. Canada will circulate the ISO CD 14600 on international Quality Assurance systems for gas cylinders to the members of the group.

29. Based on the ISO document, the expert from United States of America and EIGA will prepare proposals for the provisions on the accreditation of authorised bodies.

Proposal 5: proposed text for Part 5

30. The Working Group agreed that the cylindrical part of very small cylinder could also be used for labelling.

Proposal 6: proposed text for MEGC’s in Part 4

31. The Working Group agreed to remove the redundant paragraphs put between brackets.

32. The expert from the United States of America expressed concern about the provisions for the transport of toxic gases in bundles in accordance with 4.2.4.9.4 but is ready to reconsider its position after examination of the proposed standards for bundles. EIGA will provide copies of the CEN standards in preparation.

Proposal 7: Requirements for the design, construction, inspection and testing of multiple-element gas containers (MEGCs) intended for the transport of non-refrigerated gases

33. Several definitions have been deleted because they have been transferred into Part 1.

34. The provisions of paragraph 6.7.5.2.12 bear no relevance to MEGC's and have been deleted.

35. The provisions for service equipment were reviewed, brackets lifted, sentences deleted. The Working Group put 6.7.5.3.4 between brackets for further investigation on how to comply with the requirements in the case of MEGC's. No agreement was yet reached on the number of isolation valves to be installed for the transport of flammable gases. The expert from the United States of America agreed to consider the EIGA arguments on the hierarchy of safety hazards and related control measures. The modified provisions proposing a lower limit of 3000 litre remain between brackets.

36. A distinction on the marking of pressure-relief devices was made between on one hand the spring loaded pressure-relief devices and on the other hand the frangible disk; the latter not offering enough space to accommodate extensive marking.

37. The Working Group agreed to remove the superfluous examples in the requirements for the protection of the MEGC's and make a close link to ISO 1496 in the definition of the MEGC. The expert from the United States of America will check the suitability of the ISO standard before 15 September 1999.

38. The expert from the United States of America noted that in the ISO 1496-3 currently under review impact test were being considered and will propose to refer to them in the next meeting rendering the reference to the various railways methods redundant.

39. The Working Group agreed that the elements and the related pressure equipment are to be inspected at the periodic intervals and according to the prescriptions defined for the elements. MEGC's shall undergo visual examination at not more than 5 years intervals.

* * * * *

Proposal 1

Proposed texts : **1.2.1 Definitions**

The following definitions should be added at the appropriate places.

Bundles of cylinders are assemblies of cylinders held firmly together and which are interconnected by a manifold and transported as a unit. The total water capacity shall not exceed 3000 litres;

Cylinders are transportable pressure receptacles of a capacity not exceeding 150 litres;

Cryogenic receptacles are transportable thermally insulated receptacles closed or not for refrigerated liquefied gases of a capacity of not more than 1000 litres;

Multiple-element gas containers (MEGC's) are multimodal assemblies of cylinders, tubes and bundles of cylinders which may be interconnected by a manifold and which are assembled within a framework with overall dimensions in accordance with ISO 668 and corner fitting in accordance with ISO 1161.They are used for the transport of gases of Class 2. The multiple-element gas container includes service equipment and structural equipment necessary for the transport of gases;

[Gas drums] are welded transportable pressure receptacles of a capacity exceeding 150 litres and of not more than [1000] litres, (e.g. cylindrical receptacles equipped with rolling hoops, receptacles on skids and receptacles in frames);

Tubes are seamless transportable pressure receptacles of a capacity exceeding 150 litres and of not more than 3000 litres;

Pressure receptacles are cylinders, tubes, pressure drums, closed cryogenic receptacles and bundles of cylinders";

Filling ratio means the mass of liquefied gas in kg. per litre water capacity(see ISO definition);

Settled pressure is the pressure of a gas at a uniform temperature;

Working pressure is the settled pressure of a compressed gas at the reference temperature of 15 °C in a full receptacle;

Test pressure is the required pressure applied during a pressure test;

Proposal 2

2.2.1 Definitions and general provisions

Paragraph 2.2.1.2 shall be replaced with the following text:

2.2.1.2 The transport condition of a gas is described according to its physical state as :

(a) ***Compressed gas*** **-** a gas which when packaged under pressure for transport is entirely gaseous at -50 °C. This category includes all gases with a critical temperature below -50 °C

(b) ***Liquefied gas*** - a gas which when packaged under pressure for transport is partially liquid at temperatures above -50 °C. A distinction is made between:

High pressure liquefied gas - gases with a critical temperature between -50 °C and +65 °C

Low pressure liquefied gas - gases with a critical temperature above +65 °C

(c) ***Refrigerated liquefied gas*** - a gas which when packaged for transport is made partially liquid because of its low temperature

(d) ***Gas in solution*** - a gas which when packaged under pressure for transport is dissolved in a solvent

Note: The existing text has been adopted for cut-offs in critical temperature to harmonise with ADR/RID and ISO standard 10286 on terminology which is actually under review.

Add a second note at the end of 2.2.2.1 (c) :

Note: Gases with a LC_{50} lower than or equal to 200 ppm are referenced as "highly toxic gases".

Proposal 3

4.1.6 Special packing provisions for dangerous goods of Class 2

4.1.6.1 *General requirements*

4.1.6.1.1 Pressure receptacles, including their closures, shall be selected to contain a gas or a mixture of gases according to the requirements of section 6.2.1.2 "Materials of pressure receptacles" and the requirements of the specific packing instructions of section 4.1.4.2. This section also applies to pressure receptacles which are elements of MEGCs.

4.1.6.1.2 Refillable pressure receptacles shall not be filled with a gas or gas mixture different from that previously contained unless the necessary operations of emptying, purging and evacuation have been performed. [The provisions of ISO 11621:1997 shall be considered.]

4.1.6.1.3 Pressure receptacles with the exception of open cryogenic receptacles, including their closures, shall conform to the design, construction, inspection and testing requirements detailed in section 6.2. When outer packagings are prescribed, the pressure receptacles shall be firmly secured therein. Unless otherwise specified in the detailed packing instructions, one or more inner packagings may be enclosed in an outer packaging.

4.1.6.1.4 Valves shall be protected from damage which could cause release of the contents of the pressure receptacle, if the pressure receptacle falls during storage, transport or handling, by one of the following methods:

(a) Valves are placed inside the neck of the pressure receptacle and protected by a screw-threaded plug;

(b) Valves are protected by caps. Caps shall possess vent-holes of sufficient cross-sectional area to evacuate the gas if leakage occurs at the valves;

(c) Valves are protected by shrouds or guards;

(d) Valves are designed and constructed in such a way that they are inherently able to withstand damage without leakage of product;

(e) Valves are placed inside a protective frame;

(f) Pressure receptacles are carried in protective boxes or frames.

For pressure receptacles with valves as described in (b), (c) and (d), the requirements of ISO 11117:1998 shall be considered.

4.1.6.1.5 Pressure receptacles, containing pyrophoric gases and very toxic gases shall have their valve openings fitted with gas-tight plugs or cap nuts which shall be made of a material compatible with the contents of the pressure receptacle.

4.1.6.1.6 Pressure receptacles may be transported after the expiry of the time-limit set for the periodic inspection prescribed for the purpose of undergoing the inspection. Pressure receptacles shall not be charged or filled after they become due for periodic inspection.

4.1.6.1.7 Refillable pressure receptacles shall be periodically inspected according to the provisions of P 200 and P 203.

4.1.6.1.8 The following requirements of the general conditions of packing are considered to have been complied with if the following standards, as relevant are applied:

Applicable sections	Reference	Title of document
4.1.6.1.2	ISO 11621: 1997	Gas cylinders: Procedures for change of gas service.
4.1.6.1.5	ISO 11117:1998	Valve protection caps and valve guards for industrial and medical gas cylinders- design, construction and tests

4.1.4.1 Insert the following packing instructions

P200	**Packing Instruction**	**P200**

This packing instruction applies to Class 2 compressed and liquefied gases. The general packing requirements of 4.1.6.1 shall be met. The following types of pressure receptacles are authorized:

Cylinder, tubes, pressure drums and bundles of cylinders.

200(a) Pressure receptacles shall be closed and leakproof as to prevent escape of the gases. Pressure receptacles containing very toxic gases as specified in the table shall not be equipped with any pressure-relief device. [Other pressure receptacles shall be fitted with a pressure-relief device where specified by the competent authority.] The bursting component of the pressure-relief device shall open automatically at a pressure between 100 and 120% of the test pressure. Where fusible components are used, an appropriate temperature range for functioning shall be specified by the competent authority (see CGA pamphlet S.1.1 and ISO 3807-2 for acetylene cylinders).

200(b) The following tables:
- identify the types of pressure receptacles authorised for a gas;
- identify the test pressure, the filling ratio and the maximum water capacity for the various gases, as well as restrictions concerning very toxic gases;
- refer to additional requirements that are specific to a gas.

200(c) For compressed gases, the working pressure shall be not more than two thirds of the test pressure of the pressure receptacles. In no case shall the internal pressure at 65°C exceed the test pressure.

200(d) For high pressure liquefied gases, the filling ratio shall be such that the internal pressure at 65 °C does not exceed the test pressure of the pressure receptacles.

200(e) For high pressure liquefied gases and gas mixtures with insufficient thermodynamical and physical data, the maximum filling ratio (FR) shall be determined as follows:

[Formula]

where FR = maximum filling ratio (in $kg.l^{-1}$)
d_g = gas density (at 15 °C, 1 bar)(in $g.l^{-1}$)
P_h = minimum test pressure (in bar)

[Formula]

If the density of the gas is unknown, the maximum filling ratio shall be determined as follows:

[Formula]

where FR = maximum filling ratio (in $kg.l^{-1}$)
P_h = minimum test pressure (in bar)
MM = molecular mass (in $g.mol^{-1}$)
R = $8{,}31451 \cdot 10^{-2}$ $bar.l.mol^{-1}.K^{-1}$ (gas constant)

For gas mixtures the average molecular mass is to be taken, taking into account the volumetric concentrations of the various components;

P200	Packing Instruction (cont'd)	P200

200(f) For low pressure liquefied gases, the maximum mass of contents per litre of capacity (filling factor) equals 0.95 times the density of the liquid phase at 50 °C; in addition, the vapour phase shall not disappear below 60 °C. The test pressure will be at least equal to the vapour pressure of the liquid at 65 °C, minus 100 kPa (1 bar).

200(g) For pure low pressure liquefied gases with insufficient thermodynamical or physical data the maximum filling ratio shall be determined as follows:

[Formula]

where FR = maximum filling ratio in $kg.l^{-1}$
BP = boiling point (in Kelvin)
d_l = density of the liquid at boiling point (in $g.l^{-1}$)

200(h) For acetylene, dissolved, UN 1001, once equilibrium has been achieved at 15 °C, the working pressure shall not exceed the value prescribed by the competent authority for the porous mass. The quantity of solvent and the quantity of acetylene shall likewise correspond to the figures specified in the approval.

200(i) Refillable pressure receptacles shall be subjected to periodic inspections in accordance with the provisions of section 6.2.

200(j) If special requirements for certain substances do not appear in the table below, periodic inspections shall be carried out:

(a) Every [5] years in the case of receptacles intended for the carriage of gases of division 2.3 with a subsidiary corrosive risk;

(b) Every 5 years in the case of receptacles intended for the carriage of gases of division 2.3 other than those included in (a);

(c) Every 10 years in the case of receptacles intended for the carriage of gases of division 2.1 and of division 2.2.

200(k) Keys for the column " receptacles"

(1) Cylinders;
(2) Tubes;
(3) Pressure drums;
(4) MEGC;
(5) Bundles of cylinders.

200(l) Keys for the column "Special requirements":

a: Aluminium alloys shall not be in contact with the gas (see also ISO 11114-1).

b: Valves made of copper shall not be used (see also ISO 11114-1).

c: Metal parts in contact with the contents shall not contain more than 70% copper (see also ISO 11114-1).

d: A pressure receptacle shall not contain more than 5 kg of the gas.

e: The valve outlets shall be fitted with plugs or cap-nuts ensuring gas-tightness.

P200	Packing Instruction (cont'd)	P200

g: The use of test pressures and filling ratio combinations other than those indicated are permitted provided that the developed pressure at 65°C does not exceed the test pressure of the receptacle (re. 200(d)).

h: If a non-monolithic material is used as a porous mass, the interval between inspections shall be maximum of 5 years.

i: The maximum filling ratio shall be in accordance with the figures specified in the approval.

j: The test pressure and filling ratio shall be calculated in accordance with the requirements of 200(d) and 200 (e).

k: The interval between tests may be extended to 10 years when the pressure receptacles are made of aluminium alloys.

l: Each cylinder within a bundle shall be fitted with an individual valve that shall be closed during transport.

[m: The interval between inspections for steel cylinders may be extended to 15 years:

(a) with the agreement of the competent authority (authorities) of the country (countries) where the periodic inspection and the transport take place; and

(b) in accordance with the requirements of a technical code or a standard recognised by the competent authority, or standard ISO/DIS 10464 "Liquefied petroleum gas (LPG) cylinders - Periodic inspection and testing".]

n: a pressure receptacle with a test pressure greater than or equal to 200 bar shall be used unless the receptacle is shipped in a secondary packaging or calculation shows an equivalent resistance to mechanical impact.

o: compatibility with the material should be checked when steel receptacles with a tensile strength above 950 Mpa are to be used (sese ISO 11114-1).

z: In the case of pressure receptacles for the transport of gases under a N.O.S. position, the following requirements shall be complied with as applicable:

(1) The materials of which the pressure receptacles and their accessories are made shall be compatible with the contents and shall not form harmful or dangerous compounds therewith.

(2) The test pressure and filling ratio shall be calculated in accordance with the requirements of paragraphs 200 (c), 200 (d) and 200 (e).

(4) Very toxic gases and gas mixtures shall not be transported in tubes and pressure drums.

(5) The valves of pressure receptacles for toxic gases and gas mixtures with a LC_{50} less than 200 ppm or for pyrophoric gases or flammable mixtures of gases containing more than 1% of pyrophoric compounds shall be fitted with gas tight plugs or cap-nuts. When these pressure receptacles are manifolded in a bundle, each of the pressure receptacles shall be fitted with an individual valve that shall be closed during transport.

(6) The necessary steps shall be taken to prevent dangerous reactions (i.e. polymerisation, decomposition) during transport. If necessary, stabilisation or addition of an inhibitor is required.

Note: The table will be rearranged in UN number order pending comments on content and layout to be provided by the participants.

Identi-fication No	Name of the substance or article	Receptacles	TEST			FILLING	Special Requir-ements
			PRESSURE		PERIOD (years) */	MAX. FILL. ratio kg/l or MPa or Vol %	
			X working pressure	MPa			
1002	AIR, COMPRESSED	(1),(2),(3),(4),(5)	1.5		10	2/3 T.P.	
1006	ARGON, COMPRESSED	(1),(2),(3),(4),(5)	1.5		10	2/3 T.P.	
1046	HELIUM, COMPRESSED	(1),(2),(3),(4),(5)	1.5		10	2/3 T.P.	
1056	KRYPTON, COMPRESSED	(1),(2),(3),(4),(5)	1.5		10	2/3 T.P.	
1065	NEON, COMPRESSED	(1),(2),(3),(4),(5)	1.5		10	2/3 T.P.	
1066	NITROGEN, COMPRESSED	(1),(2),(3),(4),(5)	1.5		10	2/3 T.P.	
1979	RARE GASES MIXTURE, COMPRESSED	(1),(2),(3),(4),(5)	1.5		10	2/3 T.P.	
1980	RARE GASES AND OXYGEN MIXTURE, COMPRESSED	(1),(2),(3),(4),(5)	1.5		10	2/3 T.P.	
1981	RARE GASES AND NITROGEN MIXTURE, COMPRESSED	(1),(2),(3),(4),(5)	1.5		10	2/3 T.P.	
1982	TETRAFLUOROMETHANE, COMPRESSED (REFRIGERANT GAS R 14, COMPRESSED)	(1),(2),(3),(4),(5)		20	10	0.62	g
		(1),(2),(3),(4),(5)		30		0.94	g
2036	XENON, COMPRESSED	(1),(2),(3),(4),(5)		13	10	1.24	g
2193	HEXAFLUOROETHANE, COMPRESSED (REFRIGERANT GAS R 116, COMPRESSED)	(1),(2),(3),(4),(5)		20	10	1.10	g
1956	COMPRESSED GAS, N.O.S.	(1),(2),(3),(4),(5)	1.5		10	2/3 T.P.	z
1014	CARBON DIOXIDE AND OXYGEN MIXTURE, COMPRESSED	(1),(2),(3),(4),(5)	1.5		10	2/3 T.P.	
1072	OXYGEN, COMPRESSED	(1),(2),(3),(4),(5)	1.5		10	2/3 T.P.	
2451	NITROGEN TRIFLUORIDE	(1),(2),(3),(4),(5)		20	10	0.5	g
		(1),(2),(3),(4),(5)		30		0.75	g
3156	COMPRESSED GAS, OXIDIZING, N.O.S.	(1),(2),(3),(4),(5)	1.5		10	2/3 T.P.	z
1049	HYDROGEN, COMPRESSED	(1),(2),(3),(4),(5)	1.5		10	2/3 T.P.	
1957	DEUTERIUM, COMPRESSED	(1),(2),(3),(4),(5)	1.5		10	2/3 T.P.	
1962	ETHYLENE, COMPRESSED	(1),(2),(3),(4),(5)		22.5	10	0.34	g
		(1),(2),(3),(4),(5)		30.0	10	0.37	g
1971 1971	METHANE, COMPRESSED or NATURAL GAS, COMPRESSED with high methane content	(1),(2),(3),(4),(5)	1.5		10	2/3 T.P.	

Identification No	Name of the substance or article	Receptacles	TEST			FILLING	Special Requirements
			PRESSURE		PERIOD (years) */	MAX. FILL. ratio kg/l or MPa or Vol %	
			X working pressure	MPa			
2034	HYDROGEN AND METHANE MIXTURE, COMPRESSED	(1),(2),(3),(4),(5)	1.5		10	2/3 T.P.	
2203	SILANE, COMPRESSED **/	(1),(2),(3),(4),(5)		22.5	10	0.32	e,g,l
		(1),(2),(3),(4),(5)		25.0	10	0.41	e,g,l
1964	HYDROCARBON GAS MIXTURE, COMPRESSED,N.O.S	(1),(2),(3),(4),(5)	1.5		10	2/3 T.P.	z
1954	COMPRESSED GAS, FLAMMABLE, N.O.S	(1),(2),(3),(4),(5)	1.5		10	2/3 T.P.	z
1612	HEXAETHYL TETRAPHOSPHATE AND COMPRESSED GAS MIXTURE	(1),(2),(3),(4),(5)	1.5		5	2/3 T.P.	z
1955	COMPRESSED GAS, TOXIC, N.O.S.	(1),(2),(3),(4),(5)	1.5		5	2/3 T.P.	z
1016	CARBON MONOXIDE, COMPRESSED	(1),(2),(3),(4),(5)	1.5		5	2/3 T.P.	k
1023	COAL GAS, COMPRESSED	(1),(2),(3),(4),(5)	1.5		5	2/3 T.P.	
1071	OIL GAS, COMPRESSED	(1),(2),(3),(4),(5)	1.5		5	2/3 T.P.	
1911	DIBORANE, COMPRESSED	(1),(5)		25.0	5	0.072	e,f,l
2600	CARBON MONOXIDE AND HYDROGEN MIXTURE, COMPRESSED	(1),(2),(3),(4),(5)	1.5		5	2/3 T.P.	k
1953	COMPRESSED GAS, TOXIC, FLAMMABLE, N.O.S.	(1),(2),(3),(4),(5)	1.5		5	2/3 T.P.	z
1008	BORON TRIFLUORIDE, COMPRESSED	(1),(2),(3),(4),(5)		22.5	3	0.715	g
		(1),(2),(3),(4),(5)		30.0		0.86	g
1859	SILICON TETRAFLUORIDE, COMPRESSED	(1),(2),(3),(4),(5)		20	3	0.74	g
		(1),(2),(3),(4),(5)		30		1.1	g
2198	PHOSPHORUS PENTAFLUORIDE, COMPRESSED	(1),(5)		20	3	0.9	e,g,l
		(1),(5)		30		1.34	e,g,l
2417	CARBONYL FLUORIDE, COMPRESSED	(1),(2),(3),(4),(5)		20	3	0.47	g
		(1),(2),(3),(4),(5)		30		0.7	g
3304	COMPRESSED GAS, TOXIC, CORROSIVE, N.O.S.	(1),(2),(3),(4),(5)	1.5		3	2/3 T.P.	z
3303	COMPRESSED GAS, TOXIC, OXIDIZING, N.O.S.	(1),(2),(3),(4),(5)	1.5		5	2/3 T.P.	z
3305	COMPRESSED GAS, TOXIC, FLAMMABLE, CORROSIVE, N.O.S.	(1),(2),(3),(4),(5)	1.5		3	2/3 T.P.	z

Identi-fication No	Name of the substance or article	Receptacles	TEST			FILLING	Special Requir-ements
			PRESSURE		PERIOD (years) */	MAX. FILL. ratio kg/l or MPa or Vol %	
			X working pressure	MPa			
1045	FLUORINE, COMPRESSED	(1),(5)		20.0	5	2.8 MPa	a,d,e,l
1660	NITRIC OXIDE, COMPRESSED	(1),(5)	1.5		3	2/3 T.P.	e,l
2190	OXYGEN DIFLUORIDE	(1),(5)		20.0	3	2.8 MPa	a,d,e,l
3306	COMPRESSED GAS, TOXIC, OXIDIZING, CORROSIVE, N.O.S.	(1),(2),(3),(4),(5)	1.5		3	2/3 T.P.	z
1009	BROMOTRIFLUOROMETHANE (REFRIGERANT GAS R 13B1)	(1),(2),(3),(4),(5)		4.2	10	1.13	g
		(1),(2),(3),(4),(5)		12.0	10	1.44	g
		(1),(2),(3),(4),(5)		25.0	10	1.60	g
1013	CARBON DIOXIDE	(1),(2),(3),(4),(5)		19.0	10	0.66	g
		(1),(2),(3),(4),(5)		25.0	10	0.75	g
1015	CARBON DIOXIDE AND NITROUS OXIDE MIXTURE	(1),(3),(5)		25.0	10	0.75	g
1018	CHLORODIFLUOROMETHANE (REFRIGERANT GAS R 22)	(1),(2),(3),(4),(5)		2.9	10	1.03	
1020	CHLOROPENTAFLUOROETHANE (REFRIGERANT GAS R 115)	(1),(2),(3),(4),(5)		2.5	10	1.08	
1021	1-CHLORO-1,2,2,2-TETRAFLUORO ETHANE (REFRIGERANT GAS R 124)	(1),(2),(3),(4),(5)		1.2	10	1.2	
1022	CHLOROTRIFLUOROMETHANE (REFRIGERANT GAS R 13)	(1),(2),(3),(4),(5)		10.0	10	0.83	g
		(1),(2),(3),(4),(5)		12.0	10	0.90	g
		(1),(2),(3),(4),(5)		19.0	10	1.04	g
		(1),(2),(3),(4),(5)		25.0	10	1.10	g
1028	DICHLORODIFLUOROMETHANE (REFRIGERANT GAS R 12)	(1),(2),(3),(4),(5)		1.8	10	1.15	
1029	DICHLOROFLUOROMETHANE (REFRIGERANT GAS R 21)	(1),(2),(3),(4),(5)		1.0	10	1.23	
1058	LIQUEFIED GASES, non-flammable, charged with nitrogen, carbon dioxide or air	(1),(2),(3),(4),(5)	1.5		10		j
1080	SULPHUR HEXAFLUORIDE	(1),(2),(3),(4),(5)		7.0	10	1.04	g
		(1),(2),(3),(4),(5)		14.0	10	1.33	g
		(1),(2),(3),(4),(5)		16.0	10	1.37	g
1858	HEXAFLUOROPROPYLENE (REFRIGERANT GAS R 1216)	(1),(2),(3),(4),(5)		2.2	10	1.11	
1952	CARBON DIOXIDE AND ETHYLENE OXIDE MIXTURE	(1),(2),(3),(4),(5)		19	10	0.66	

Identi-fication No	Name of the substance or article	Receptacles	TEST			FILLING	Special Requir-ements
			PRESSURE		PERIOD (years) */	MAX. FILL. ratio kg/l or MPa or Vol %	
			X working pressure	MPa			
	with not more than 9% ethylene oxide	(1),(2),(3),(4),(5)		25	10	0.75	
1958	DICHLOROTETRAFLUOROETHANE (REFRIGERANT GAS R 114)	(1),(2),(3),(4),(5)		1.0	10	1.30	
1973	CHLORODIFLUOROMETHANE AND CHLOROPENTAFLUOROETHANE MIXTURE with fixed boiling point, with approximately 49% chlorodifluoromethane (REFRIGERANT GAS R 502)	(1),(2),(3),(4),(5)		3.1	10	1.05	
1974	CHLORODIFLUOROBROMO-METHANE (REFRIGERANT GAS R 12B1)	(1),(2),(3),(4),(5)		1.0	10	1.61	
1976	OCTAFLUOROCYCLOBUTANE (REFRIGERANT GAS RC 318)	(1),(2),(3),(4),(5)		1.1	10	1.34	
1983	1-CHLORO-2,2,2-TRIFLUOROETHANE (REFRIGERANT GAS R 133a)	(1),(2),(3),(4),(5)		1.0	10	1.18	
1984	TRIFLUOROMETHANE (REFRIGERANT GAS R 23)	(1),(2),(3),(4),(5)		19.0	10	0.87	g
		(1),(2),(3),(4),(5)		25.0	10	0.95	g
2422	OCTAFLUOROBUT-2-ENE (REFRIGERANT GAS R 1318)	(1),(2),(3),(4),(5)		1.2	10	1.34	
2424	OCTAFLUOROPROPANE (REFRIGERANT GAS R 218)	(1),(2),(3),(4),(5)		2.5	10	1.09	
2599	CHLOROTRIFLUOROMETHANE AND TRIFLUOROMETHANE, AZEOTROPIC MIXTURE with approximately 60% chlorotrifluoromethane (REFRIGERANT GAS R 503)	(1),(2),(3),(4),(5)		4.2 10.0 10.0	10 10 10	0.20 0.66 0.66	
2602	DICHLORODIFLUOROMETHANE AND 1,1-DIFLUOROETHANE , AZEOTROPIC MIXTURE with approximately 74% dichlorodifluoromethane (REFRIGERANT GAS R 500)	(1),(2),(3),(4),(5)		2.2	10	1.01	
3070	ETHYLENE OXIDE AND DICHLORODIFLUOROMETHANE MIXTURE with not more than 12,5% ethylene oxyde	(1),(2),(3),(4),(5)		1.8	10	1.09	
3159	1,1,1,2-TETRAFLUOROETHANE (REFRIGERANT GAS R 134a)	(1),(2),(3),(4),(5)		2.2	10	1.04	
3220	PENTAFLUOROETHANE (REFRIGERANT GAS R 125)	(1),(2),(3),(4),(5)		3.4 3.6	10 10	0.95 0.72	g g
3296	HEPTAFLUOROPROPANE (REFRIGERANT GAS R 227)	(1),(2),(3),(4),(5)		1.5	10	1.2	

Identi-fication No	Name of the substance or article	Receptacles	TEST			FILLING	Special Requir-ements
			PRESSURE		PERIOD (years) */	MAX. FILL. ratio kg/l or MPa or Vol %	
			X working pressure	MPa			
3297	ETHYLENE OXIDE AND CHLOROTETRAFLUOROETHANE MIXTURE, with not more than 8,8% ethylene oxide	(1),(2),(3),(4),(5)		1.0	10	1.16	
3298	ETHYLENE OXIDE AND PENTAFLUOROETHANE MIXTURE, with not more than 7,9% ethylene oxide	(1),(2),(3),(4),(5)		2.6	10	1.02	
3299	ETHYLENE OXIDE AND TETRAFLUOROETHANE MIXTURE, with not more than 5,6% ethylene oxide	(1),(2),(3),(4),(5)		1.7	10	1.03	
3337	REFRIGERANT GAS R 404A	(1),(2),(3),(4),(5)		3.6	10	0.82	
3338	REFRIGERANT GAS R 407A	(1),(2),(3),(4),(5)		3.6	10	0.94	
3339	REFRIGERANT GAS R 407B	(1),(2),(3),(4),(5)		3.8	10	0.93	
3340	REFRIGERANT GAS R 407C	(1),(2),(3),(4),(5)		3.5	10	0.95	
1078	REFRIGERANT GASES, N.O.S.	(1),(2),(3),(4),(5)			10		z
	MIXTURE F1	(1),(2),(3),(4),(5)		1.2	10	1.23	
	MIXTURE F2	(1),(2),(3),(4),(5)		1.8	10	1.15	
	MIXTURE F3	(1),(2),(3),(4),(5)		2.9	10	1.03	
1968	INSECTICIDE GAS, N.O.S.	(1),(2),(3),(4),(5)			10		z
3163	LIQUEFIED GAS, N.O.S.	(1),(2),(3),(4),(5)			10		z
1070	NITROUS OXIDE	(1),(2),(3),(4),(5)		18.0	10	0.68	g
		(1),(2),(3),(4),(5)		22.5	10	0.74	g
		(1),(2),(3),(4),(5)		25.0	10	0.75	g
3157	LIQUEFIED GAS, OXIDIZING, N.O.S.	(1),(2),(3),(4),(5)			10		z
1010	1.2-BUTADIENE, INHIBITED or	(1),(2),(3),(4),(5)		1.0	10	0.59	f
1010	1.3-BUTADIENE, INHIBITED or	(1),(2),(3),(4),(5)		1.0	10	0.55	f
1010	MIXTURES OF 1,3-BUTADIENE AND HYDROCARBONS, INHIBITED	(1),(2),(3),(4),(5)			10	0.5	f,j
1011	BUTANE	(1),(2),(3),(4),(5)		1.0	10	0.51	
1012	BUTYLENES MIXTURE or	(1),(2),(3),(4),(5)			10	0.5	j
1012	1-BUTYLENE or	(1),(2),(3),(4),(5)		1.0	10	0.53	
1012	CIS-2-BUTENE or	(1),(2),(3),(4),(5)		1.0	10	0.55	
1012	TRANS-2-BUTYLENE	(1),(2),(3),(4),(5)		1.0	10	0.54	
1027	CYCLOPROPANE	(1),(2),(3),(4),(5)		2.0	10	0.53	

Identi-fication No	Name of the substance or article	Receptacles	TEST			FILLING	Special Requir-ements
			PRESSURE		PERIOD (years) */	MAX. FILL. ratio kg/l or MPa or Vol %	
			X working pressure	MPa			
1030	1,1-DIFLUOROETHANE (REFRIGERANT GAS R 152a)	(1),(2),(3),(4),(5)		1.8	10	0.79	
1032	DIMETHYLAMINE, ANHYDROUS	(1),(2),(3),(4),(5)		1.0	10	0.59	b
1033	DIMETHYL ETHER	(1),(2),(3),(4),(5)		1.8	10	0.58	
1035	ETHANE	(1),(2),(3),(4),(5)		9.5	10	0.25	g
		(1),(2),(3),(4),(5)		12	10	0.29	g
		(1),(2),(3),(4),(5)		30.0	10	0.39	g
1036	ETHYLAMINE	(1),(2),(3),(4),(5)		1.0	10	0.61	b
1037	ETHYL CHLORIDE	(1),(2),(3),(4),(5)		1.0	10	0.80	a
1039	ETHYL METHYL ETHER	(1),(2),(3),(4),(5)		1	10	0.64	
1041	ETHYLENE OXIDE AND CARBON DIOXIDE MIXTURE, with more than 9% ethylene oxide but not more than 87%	(1),(2),(3),(4),(5)		19 25	10 10	0.66 0.75	g g
1055	ISOBUTYLENE	(1),(2),(3),(4),(5)		1.0	10	0.52	
1060	METHYLACETYLENE AND PROPADIENE MIXTURE, STABILIZED	(1),(2),(3),(4),(5)			10		c,f,j
	Propadiene with 1% to 4% methylacetylene	(1),(2),(3),(4),(5)		2.2	10	0.50	c,f
	MIXTURE P1	(1),(2),(3),(4),(5)		3.0	10	0.49	c,f
	MIXTURE P2	(1),(2),(3),(4),(5)		2.4	10	0.47	c,f
1061	METHYLAMINE, ANHYDROUS	(1),(2),(3),(4),(5)		1.3	10	0.58	b
1063	METHYL CHLORIDE (REFRIGERANT GAS R 40)	(1),(2),(3),(4),(5)		1.7	10	0.81	a
1077	PROPYLENE	(1),(2),(3),(4),(5)		3.0	10	0.43	
1081	TETRAFLUOROETHYLENE, INHIBITED	(1),(2),(3),(4),(5)		20.0	10	0.5 MPa	f
1083	TRIMETHYLAMINE, ANHYDROUS	(1),(2),(3),(4),(5)		1.0	10	0.56	b
1085	VINYL BROMIDE, INHIBITED	(1),(2),(3),(4),(5)		1.0	10	1.37	a,f
1086	VINYL CHLORIDE, INHIBITED	(1),(2),(3),(4),(5)		1.2	10	0.81	a,f
1087	VINYL METHYL ETHER, INHIBITED	(1),(2),(3),(4),(5)		1.0	10	0.67	f
1860	VINYL FLUORIDE, INHIBITED	(1),(2),(3),(4),(5)		25.0	10	0.64	a,f,g
1912	METHYLCHLORIDE AND METHYLENE CHLORIDE MIXTURE	(1),(2),(3),(4),(5)		1.7	10	0.81	a

Identi-fication No	Name of the substance or article	Receptacles	TEST			FILLING	Special Requir-ements
			PRESSURE		PERIOD (years) */	MAX. FILL. ratio kg/l or MPa or Vol %	
			X working pressure	MPa			
1959	1,1-DIFLUOROETHYLENE (REFRIGERANT GAS R 1132a)	(1),(2),(3),(4),(5)		25	10	0.77	g
1969	ISOBUTANE	(1),(2),(3),(4),(5)		1.0	10	0.49	
1978	PROPANE	(1),(2),(3),(4),(5)		2.5	10	0.42	
2035	1,1,1-TRIFLUOROETHANE (REFRIGERANT GAS R 143a)	(1),(2),(3),(4),(5)		3.5	10	0.75	
2044	2,2-DIMETHYLPROPANE	(1),(2),(3),(4),(5)		1.0	10	0.53	
2200	PROPADIENE, INHIBITED	(1),(2),(3),(4),(5)		2.2	10	0.50	f
2419	BROMOTRIFLUOROETHYLENE	(1),(2),(3),(4),(5)		1.0	10	1.19	
2452	ETHYLACETYLENE, INHIBITED	(1),(2),(3),(4),(5)		1.0	10	0.57	c,f
2453	ETHYL FLUORIDE (REFRIGERANT GAS R 161)	(1),(2),(3),(4),(5)		3.0	10	0.57	
2454	METHYL FLUORIDE (REFRIGERANT GAS R 41)	(1),(2),(3),(4),(5)		30.0	10	0.36	
2517	1-CHLORO-1,1-DIFLUOROETHANE (REFRIGERANT GAS R 142b)	(1),(2),(3),(4),(5)		1.0	10	0.99	
2601	CYCLOBUTANE	(1),(2),(3),(4),(5)		1.0	10	0.63	
3153	PERFLUORO(METHYL VINYL ETHER)	(1),(2),(3),(4),(5)		2.0	10	0.75	
3154	PERFLUORO(ETHYL VINYL ETHER)	(1),(2),(3),(4),(5)		1.0	10	0.98	
3252	DIFLUOROMETHANE (REFRIGERANT GAS R 32)	(1),(2),(3),(4),(5)		4.8	10	0.78	
1965	HYDROCARBON GAS MIXTURE, LIQUEFIED N.O.S.	(1),(2),(3),(4),(5)			10	**/	m, z
	MIXTURE A	(1),(2),(3),(4),(5)		1.0	10	0.50	
	MIXTURE A01	(1),(2),(3),(4),(5)		1.5	10	0.49	
	MIXTURE A02	(1),(2),(3),(4),(5)		1.5	10	0.48	
	MIXTURE A0	(1),(2),(3),(4),(5)		1.5	10	0.47	
	MIXTURE A1	(1),(2),(3),(4),(5)		2.0	10	0.46	
	MIXTURE B1	(1),(2),(3),(4),(5)		2.5	10	0.45	
	MIXTURE B2	(1),(2),(3),(4),(5)		2.5	10	0.44	
	MIXTURE B	(1),(2),(3),(4),(5)		2.5	10	0.43	
	MIXTURE C	(1),(2),(3),(4),(5)		3.0	10	0.42	
3354	INSECTICIDE GAS, FLAMMABLE, N.O.S	(1),(2),(3),(4),(5)			10		z
3161	LIQUEFIED GAS, FLAMMABLE, N.O.S.	(1),(2),(3),(4),(5)			10		z

Identification No	Name of the substance or article	Receptacles	TEST			FILLING	Special Requirements
			PRESSURE		PERIOD (years) */	MAX. FILL. ratio kg/l or MPa or Vol %	
			X working pressure	MPa			
1062	METHYL BROMIDE	(1),(2),(3),(4),(5)		1.0	5	1.51	a
1581	CHLOROPICRIN AND METHYL BROMIDE MIXTURE	(1),(2),(3),(4),(5)		1.0	5	1.51	a
1582	CHLOROPICRIN AND METHYL CHLORIDE MIXTURE	(1),(2),(3),(4),(5)		1.7	5	0.81	a
2191	SULPHURYL FLUORIDE	(1),(2),(3),(4),(5)		5.0	5	1.10	k
1967	INSECTICIDE GAS, TOXIC, N.O.S.	(1),(2),(3),(4),(5)			5		z
3162	LIQUEFIED GAS, TOXIC, N.O.S.	(1),(2),(3),(4),(5)			5		z
1026	CYANOGEN	(1),(2),(3),(4),(5)		10.0	5	0.70	k
1040	ETHYLENE OXIDE, or ETHYLENE OXIDE WITH NITROGEN up to a total pressure of 1MPa (10 bar) at 50 °C	(1),(2),(3),(4),(5)		1.5	5	0.78	f
1053	HYDROGEN SULPHIDE	(1),(2),(3),(4),(5)		5.5	5	0.67	k
1064	METHYL MERCAPTAN	(1),(2),(3),(4),(5)		1.0	5	0.78	k
1082	TRIFLUOROCHLOROETHYLENE, INHIBITED	(1),(2),(3),(4),(5)		1.9	5	1.13	f,k
2188	ARSINE	(1),(5)		4.2	5	1.10	e,l
2192	GERMANE ***/	(1),(5)		25.0	5	1.02	e,g,l
2199	PHOSPHINE ***/	(1),(5)		25.0	5	0.51	e,g,l
		(1),(5)		25.0	5	0.51	e,g,l
2202	HYDROGEN SELENIDE, ANHYDROUS	(1),(5)		3.1	5	1.60	e,l
2204	CARBONYL SULPHIDE	(1),(2),(3),(4),(5)		2.6	5	0.84	k
2676	STIBINE	(1),(5)		2.0	5	1.2	e,l
3300	ETHYLENE OXIDE AND CARBON DIOXIDE MIXTURE with more than 87% ethylene oxide	(1),(2),(3),(4),(5)		2.8	5	0.73	f
3355	INSECTICIDE GAS, TOXIC, FLAMMABLE N.O.S.	(1),(2),(3),(4),(5)			5		z
3160	LIQUEFIED GAS, TOXIC, FLAMMABLE N.O.S.	(1),(2),(3),(4),(5)			5		z
1005	AMMONIA, ANHYDROUS	(1),(2),(3),(4),(5)		3.3	5	0.53	b
1017	CHLORINE	(1),(2),(3),(4),(5)		2.2	5	1.25	a
1048	HYDROGEN BROMIDE, ANHYDROUS	(1),(2),(3),(4),(5)		6.0	3	1.54	a
1050	HYDROGEN CHLORIDE, ANHYDROUS	(1),(2),(3),(4),(5)		10.0	3	0.30	a,g
		(1),(2),(3),(4),(5)		12.0	3	0.56	a,g
		(1),(2),(3),(4),(5)		15.0	3	0.67	a,g
		(1),(2),(3),(4),(5)		20.0	3	0.74	a,g
1069	NITROSYL CHLORIDE	(1),(5)		1.3	3	1.10	e,l
1076	PHOSGENE	(1),(3),(5)		2.0	3	1.23	e,l
1079	SULPHUR DIOXIDE	(1),(2),(3),(4),(5)		1.4	3	1.23	

Identi-fication No	Name of the substance or article	Receptacles	TEST			FILLING	Special Requir-ements
			PRESSURE		PERIOD (years) */	MAX. FILL. ratio kg/l or MPa or Vol %	
			X working pressure	MPa			
1589	CYANOGEN CHLORIDE, INHIBITED	(1),(5)		2.0	3	1.03	e,f,l
1741	BORON TRICHLORIDE	(1),(2),(3),(4),(5)		1.0	3	1.19	
2194	SELENIUM HEXAFLUORIDE	(1),(5)		3.6	3	1.46	e,g,l
2195	TELLURIUM HEXAFLUORIDE	(1),(5)		2.0	3	1.0	e,l
2196	TUNGSTEN HEXAFLUORIDE	(1),(5)		1.0	3	2.70	a,e,l
2197	HYDROGEN IODIDE, ANHYDROUS	(1),(2),(3),(4),(5)		2.3	3	2.25	a
2418	SULPHUR TETRAFLUORIDE	(1),(5)		3	3	0.91	e,l
2420	HEXAFLUOROACETONE	(1),(2),(3),(4),(5)		2.2	3	1.08	
3057	TRIFLUOROACETYL CHLORIDE	(1),(2),(3),(4),(5)		1.7	3	1.17	
3308	LIQUEFIED GAS, TOXIC, CORROSIVE N.O.S.	(1),(2),(3),(4),(5)			3		z
3083	PERCHLORYL FLUORIDE	(1),(2),(3),(4),(5)		3.3	5	1.21	e,k,l
3307	LIQUEFIED GAS, TOXIC, OXIDIZING N.O.S.	(1),(2),(3),(4),(5)			5		z
2189	DICHLOROSILANE	(1),(2),(3),(4),(5)		1	3	0.90	
2534	METHYLCHLOROSILANE	(1),(2),(3),(4),(5)			3		j
3309	LIQUEFIED GAS, TOXIC, FLAMMABLE, CORROSIVE N.O.S.	(1),(2),(3),(4),(5)			3		z
1067	DINITROGEN TETROXIDE (NITROGEN DIOXIDE)	(1),(3),(5)		1.0	3	1.30	e,l
1749	CHLORINE TRIFLUORIDE	(1),(2),(3),(4),(5)		3.0	3	1.40	a
1975	NITRIC OXIDE AND DINITROGEN TETROXIDE MIXTURE (NITRIC OXIDE AND NITROGEN DIOXIDE MIXTURE)	(1),(3),(5)			3		e,j,l
2548	CHLORINE PENTAFLUORIDE	(1),(5)		1.3	3	1.49	a,e,l
2901	BROMINE CHLORIDE	(1),(2),(3),(4),(5)		1.0	3	1.5	a
3310	LIQUEFIED GAS, TOXIC, OXIDIZING, CORROSIVE N.O.S.	(1),(2),(3),(4),(5)			3		z
2073	AMMONIA SOLUTION, relative density less than 0.88 at 15 °C						
	with more than 35% and not more than 40% ammonia	(1),(2),(3),(4),(5)		1.0	5	0.80	
	with more than 40% and not more than 50% ammonia	(1),(2),(3),(4),(5)		1.2	5	0.77	
1001	ACETYLENE , DISSOLVED	(1),(5)		6.0	10		c,h,i
3318	AMMONIA SOLUTION, relative density less than 0.880 at 15 °C in water, with more than 50% ammonia	(1),(2),(3),(5)			5		j

P 201	Packing Instruction	P201

Type of packages

Gas samples of class 2

The general packing requirements of 4.1.4.1 when applicable shall be met.

201(a) Gas samples shall be at a pressure corresponding to ambient atmospheric pressure at the time the containment system is closed and this shall not exceed 105 kPa absolute.

201(b) The gases shall be contained in hermetically sealed glass or metal inner packagings with a maximum net quantity per package of 5 litres for flammable gases and 1 litre for toxic gases.

201(c) The outer packagings shall meet the packing group III performance level.

P 202	**Packing Instruction**	**P202**

Type of packages

Air bag inflators, modules and seat pretensioners

see text as proposed in ST/SG/AC.10/C.3/1998/19)

P 203	**Packing Instruction**	**P203**

Type of receptacles

Cryogenic receptacles, closed

The general packing requirements of 4.1.4.1 shall be met.

Particular instructions for closed cryogenic receptacles:

203(a) For non-flammable, non- toxic refrigerated liquefied gases the degree of filling, at the filling temperature and at a pressure of 0.1 MPa (1 bar) shall not exceed 98% of the capacity.

203(b) For flammable refrigerated liquefied gases the degree of filling shall remain below the level at which, if the contents were raised to the temperature at which the vapour pressure equalled the opening pressure of the relief valve, the volume would reach 95% of the capacity at that temperature.

203(c) In the case of receptacles intended for the carriage of oxidising gases , the substances used to ensure the leakproofness of the joints or for the maintenance of the closures shall be compatible with the contents.

203(d) Receptacles shall be subjected to periodic inspections in accordance with the provisions of 6.2.1.5.

203(e) Periodic inspections shall be carried out every 10 years.

By derogation from this paragraph, the periodic inspection of receptacles which make use of composite materials (composite receptacles) shall be carried out at intervals determined by the competent authority which has approved the technical code for the design and construction.

Particular instructions for open cryogenic receptacles:

203(f) The receptacles shall be so insulated that they cannot become coated with dew or hoar-frost.

203(g) Open cryogenic receptacles are not allowed for refrigerated liquefied gases of 3°F, carbon dioxide, refrigerated liquid (2187) and its mixtures.

203(h) The receptacles shall be equipped with devices which prevent the liquid from splashing out.

203(i) Glass receptacles shall be protected by iron-wire baskets and placed in metal cases. The metal cases for the glass receptacles and the other receptacles shall be fitted with means of handling. Receptacles in glass are not allowed for [...] [?]

203(j) The openings of the receptacles shall be fitted with devices allowing gases to escape, preventing any splashing out of the liquid, and so fixed that they cannot fall out.

203(k) In the case of refrigerated liquid oxygen (1073) of 3O and mixtures thereof, the devices referred to above and the absorbent insulating material surrounding the glass receptacles shall be made of incombustible materials.]

Proposal 4

6.2 Requirements for the construction and testing of pressure receptacles for gases including pressure receptacles which are elements of MEGCs.

6.2.1 General requirements

[6.2.1.1 Design and construction

6.2.1.1.1 Pressure receptacles and their closures shall be designed, manufactured, tested and equipped in such a way as to withstand all conditions to which they will be subjected during their normal use and during normal transport conditions.

6.2.1.1.2 For metallic cylinders, tubes, pressure drums, bundles of cylinders, the construction shall be such that a minimum burst ratio (burst pressure divided by test pressure) is

1.60 for refillable pressure receptacles
2.00 for non-refillable pressure receptacles

6.2.1.1.3 Pressure receptacles and their closures shall be made of suitable materials which shall be resistant to brittle fracture and to stress corrosion cracking between -20 °C and +50 °C.

6.2.1.1.4 For welded pressure receptacles only materials of faultless weldability whose adequate impact strength at an ambient temperature of -20 °C can be guaranteed, particularly in the weld seams and the zones adjacent thereto, shall be used. Welds shall be skilfully made and shall afford the fullest safety. Any additional thickness to allow for corrosion shall not be taken into consideration in calculating the thickness of the walls.

6.2.1.1.5 Pressure receptacles for acetylene, dissolved, UN 1001 shall be filled entirely with a porous material, uniformly distributed, of a type approved by the competent authority and which:

(a) does not attack the pressure receptacles or form harmful or dangerous compounds either with the acetylene or with the solvent;

(b) is capable of preventing the spread of decomposition of the acetylene in the mass

The solvent shall not attack the pressure receptacles.

6.2.1.1.6 For composite cylinders, tubes, pressure drums and bundles of cylinders which make use of composite materials i.e. comprising a liner hoop wrapped or fully wrapped with reinforcement material, the construction shall be such that a minimum burst ratio (burst pressure divided by test pressure) is

1.67 for hoop wrapped pressure receptacles
2.00 for fully wrapped pressure receptacles

6.2.1.1.7 The following requirements apply to the construction of closed cryogenic pressure receptacles for refrigerated liquefied gases:

- All the mechanical and technological characteristics of the metal used shall be established for each pressure receptacle at the initial inspection; with regard to the

impact strength and the bending coefficient.

- The pressure receptacles shall be thermally insulated. The thermal insulation shall be protected against impact by means of continuous sheathing. If the space between the pressure receptacle and the sheathing is airless (vacuum-insulation), the protective sheathing shall be designed to withstand without deformation an external pressure of at least 100 kPa (1 bar). If the sheathing is so closed as to be gas-tight (e.g. in the case of vacuum-insulation), a device shall be provided to prevent any dangerous pressure from developing in the insulating layer in the event of inadequate gas-tightness of the pressure receptacle or its fittings. The device shall prevent moisture from penetrating into the insulation.

6.2.1.1.8 The test pressure of receptacles is provided in P200 for cylinders, tubes, pressure drums and bundle of cylinders. The test pressure for cryogenic receptacles, closed, is not less than 1.3 times the maximum allowable working pressure (MAWP) increased by 1 bar for vacuum insulated receptacles.]

6.2.1.2 Materials of pressure receptacles

6.2.1.2.1 The materials of which the pressure receptacles and their closures are made and all substances that might come into contact shall be compatible with the contents and shall not form harmful or dangerous compounds therewith. Additionally, they shall resist brittle fracture at the lowest working temperature of the receptacle and its fittings.

6.2.1.3 Service equipment

6.2.1.3.1 Valves, piping and fittings equipment shall have at least the same test pressure as the receptacles.

6.2.1.3.2 Service equipment shall be so arranged as to be protected against the risk of being wrenched off or damaged during handling and transport. Manifold piping leading to shut-off valves shall be sufficiently flexible to protect the valves and the piping from shearing. The filling and discharge and any protective caps shall be capable of being secured against unintended opening. Valves shall be protected as specified in section 4.1.4.1.4.

6.2.1.3.3 Pressure receptacles which are not capable of being carried manually or rolled, shall be fitted with devices (skids, rings, straps,) ensuring that they can be safely handled by mechanical means and so arranged as not to impair the strength of, nor cause undue stresses in, the wall of the receptacle.

[6.2.1.3.4 Cryogenic receptacles, closed, shall be fitted with one or more pressure-relief devices to protect the vessel against excess pressure. Excess pressure means a pressure in excess of 110% of the MAWP due to normal heat leak or in excess of the test pressure due to the loss of vacuum for vacuum insulated receptacles or due to the failure in the open position of a pressure build up system. The valves shall be so constructed as to work perfectly even at their lowest working

temperature. Their reliability of functioning at that temperature shall be established and checked by testing each valve or a sample of valves of the same type of construction. The vents and safety valves of receptacles shall be so designed as to prevent the liquid from splashing out.]

6.2.1.3.5 Receptacles whose filling is measured by volume shall be provided by a level indicator.

6.2.1.4 Initial inspection and tests

6.2.1.4.1 New pressure receptacles shall be subjected to testing and inspection after manufacture in accordance with the following:

On an adequate sample of pressure receptacles:

(a) Testing of the mechanical characteristics of the material of construction ;

(b) Verification of the minimum wall thickness;

(c) Checking the homogeneity of the material for each manufacturing batch, and inspection of the external and internal condition of the pressure receptacles;

For all pressure receptacles:

(d) A hydraulic pressure test. Pressure receptacles shall withstand the test pressure without undergoing permanent deformation or exhibiting cracks.

NOTE: *With the agreement of the testing and certifying body authorised by the competent authority, the hydraulic pressure test may be replaced by a test using a gas, where such an operation does not entail any danger.*

(e) An inspection of the markings on the pressure receptacles, see sub-section 6.2.1.6;

(f) In addition, pressure receptacles intended for the transport of acetylene, dissolved, UN 1001 shall have an inspection of the nature of the porous material and the quantity of solvent.

6.2.1.4.2 Aluminium alloy shall be checked for intercrystalline corrosion.

6.2.1.5 Periodic inspection

6.2.1.5.1 Refillable pressure receptacles, with the exception of open cryogenic receptacles, shall be subjected to periodic inspections under the supervision of a body authorised by the competent authority, in accordance with the following :

(a) Check of the external conditions of the pressure receptacle and verification of the equipment and the external markings;

(b) Check of the internal conditions of the pressure receptacle (e.g. by weighing, internal inspection, checks of wall thickness);

(c) The hydraulic pressure test and, if necessary, verification of the characteristics of the material by suitable tests;

***NOTE 1**: With the agreement of the testing and certifying body authorised by the competent authority, the hydraulic pressure test may be replaced by a test using a gas, where such an operation does not entail any danger*

***NOTE 2**: With the agreement of the testing and certifying body authorised by the competent authority, the hydraulic pressure test of cylinders and tubes may be replaced by an equivalent method based on acoustic emission or based on ultrasound.*

6.2.1.5.2 For pressure receptacles intended for the transport of acetylene, dissolved, UN 1001 only the external condition (corrosion, deformation), and the condition of the porous mass (loosening, settlement) shall be examined.

6.2.1.5.3 By derogation from paragraph 6.2.1.5.1(c) closed cryogenic pressure receptacles shall be subjected to external inspection and to a leakproofness test. The leakproofness test shall be carried out with the gas contained in the receptacle or with an inert gas. Checking shall be performed by means of a pressure gauge or by vacuum measurement. The thermal insulation need not be removed.

6.2.1.6 Marking of receptacles

6.2.1.6.1 Refillable pressure receptacles shall be marked clearly, legibly and permanently, as follows:

(a) The name or the mark of the manufacturer;

(b) The receptacles specification (the type specification or the standard used for the design);

(c) The serial number of the receptacle provided by the manufacturer;

(d) The mass of the receptacle***;***

(e) The test pressure;

(f) The date (month and year) of the initial inspection

(g) The identification mark of the authorised body who carried out the tests and inspections;

(h) In the case of acetylene, dissolved UN 1001: the permitted filling pressure (see section 4.1.4.5) and the total of the mass of: the empty receptacle, the fittings and accessories, the porous material and the solvent;

(i) The water capacity in litres;

(j) The working pressure in the case of compressed gases;

(k) The letter “H” showing compatibility with gases with a risk of hydrogen embritlement.

These marks shall be permanently affixed, (e.g. stamped, engraved, or etched) on the pressure receptacle. The markings shall be on the shoulder, top head or neck of the pressure receptacle or on a permanently affixed component of the pressure receptacle (e.g welded collar). Other markings are allowed provided they are made in low stress areas other than the side wall and are not of a size and depth that will create harmful stress concentrations. Such marks shall not conflict with required markings.

6.2.1.6.2 In addition to the markings specified in section 6.2.1.6.1, each refillable pressure receptacle shall be marked indicating the date (month and year) of the last periodic inspection and the registered mark of the test body authorized by the competent authority of the country of use.

6.2.1.6.3 Non-refillable pressure receptacles shall be marked clearly, legibly, and durably, as follows:

(a) The name or the mark of the manufacturer;

(b) The pressure receptacles specification (the type specification or the standard used for the design);

(c) The serial or batch number of the pressure receptacle provided by the manufacturer;

(d) The test pressure;

(e) The date (month and year) of manufacturing;

(f) The identification stamp of the authorised body who carried out the tests and inspections;

(g) The words "DO NOT REFILL"; this marking shall be a minimum of 6 mm in height.

These marks shall be permanently stencilled, stamped, engraved or etched on the pressure receptacle. Except when stencilled the markings shall be on the shoulder, top head or neck of the pressure receptacle or on a permanently affixed component of the pressure receptacle (e.g welded collar). Other markings are allowed provided they are made in low stress areas other than the side

wall and are not of a size and depth that will create harmful stress concentrations. Such marks shall not conflict with required markings.

6.2.1.6.4 Pressure receptacles designed, manufactured and tested according the appropriate standards out of the reference list of 6.2.2 may in addition bear the UN mark. When affixed, the UN mark shall be followed by the country authorising the mark.

6.2.2 Pressure receptacles designed, constructed and tested according to standards

The following requirements of section 6.2.1 are considered to have been complied with if the following standards, as relevant are applied:

Reference	Title of document	Applicable sections
for materials		
EN ISO 11114-1:1997	Compatibility of cylinder and valve materials with gas contents- Part 1: Metallic materials	6.2.1.2
prEN ISO/DIS 11114-2	Compatibility of cylinder and valve materials with gas contents- Part 2: Non-metallic materials	6.2.1.2

Reference	Title of document	Applicable sections
for cylinders		
ISO/DIS 9809-1	Transportable seamless steel gas cylinders - Design, construction and testing - Part 1: Quenched and tempered steel cylinders with tensile strength less than 1100 MPa	
ISO/DIS 9809-2	Transportable seamless steel gas cylinders - Design, construction and testing - Part 2: Quenched and tempered steel cylinders with tensile strength greater than or equal to 1100 MPa	
ISO/DIS 9809-3	Transportable seamless steel gas cylinders - Design, construction and testing - Part 3: Normalized steel cylinders	
ISO/DIS 7866	Refillable transportable seamless aluminium alloy for world-wide usage - Design, manufacture and acceptance	
ISO/CD 11119-1	Gas cylinders of composite material - Specifications and test methods - Part 1: Hoop wrapped, metallic	
ISO/CD 11119-1	Gas cylinders of composite material - Specifications and test methods - Part 2: Fully wrapped, metallic	
ISO/CD 11119-1	Gas cylinders of composite material - Specifications and test methods - Part 3: Fully wrapped, non metallic	
ISO/DIS 3807-1	Dissolved acetylene cylinders - Basic requirements - Part 1 Cylinders without fusible plugs	
ISO/DIS 3807-2	Dissolved acetylene cylinders - Basic requirements - Part 2 Cylinders with fusible plugs	
ISO/DIS 11118	Non-refillable gas cylinders - Specifications and test methods	
for tubes		
prEN ISO/DIS 11120	Gas cylinders - Refillable seamless steel gas cylinders, capacity between 150l and 3000l - Design and testing	

for closures and their protection		
ISO/AWI 14245	Specification and testing for liquefied petroleum gas (LPG) valves self closing	
ISO/AWI 15995	Specifications and testing for manually operated liquefied petroleum gas valves	
ISO/FDIS 11117	Gas cylinders - Valve protection caps and valve guards for industrial and medical gas cylinders- design, construction and tests	6.2.1.1
ISO/DIS 10297.2	Gas cylinder valves - Specification and type testing. All gases except LPG	6.2.1.1.
for markings		
ISO/CD 13769	Gas cylinders - Stamp marking	6.2.1.6.1 or 6.2.1.6.2
for periodic inspection		
ISO 6406: 1992	Periodic inspection and testing of seamless steel gas cylinders	
ISO 10460:1993	Welded carbon steel gas cylinders - Periodic inspection and testing	
ISO 10461:1993	Seamless aluminium - alloy gas cylinders - Periodic inspection and testing	
ISO 10462:1993	Cylinders for dissolved acetylene - Periodic inspection and testing	
ISO 10464:1993	Liquefied petroleum gas cylinders - Periodic inspection and testing	
prEN ISO/DIS 11623	Composite gas cylinders - Periodic inspection and testing	

6.2.3 Requirements for pressure receptacles not designed, constructed and tested according to standards

Pressure receptacles not designed, constructed and tested according to standards listed in the table of 6.2.2 shall be designed, constructed and tested in accordance with the provisions of a technical code recognised by the competent authority and . The requirements of 6.2.1 however shall be met.

[6.2.4 Approval of pressure receptacles

6.2.4.1 The conformity of pressure receptacles, having a test pressure capacity product of more than 300 MPa.litre (3000 bar.litre) with the provisions of Class 2, shall be assessed by one of the following methods:

(a) Single pressure receptacles shall be examined, tested and approved by a testing and certifying body approved by the competent authority of the country of origin, on the basis of the technical documentation and declaration of the manufacturer on compliance with the relevant provisions of this Class.
The technical documentation shall include full specifications on design and construction, and full documentation on the manufacturing and testing; or

(b) The construction of the pressure receptacles shall be tested and approved by a testing and certifying body approved by the competent authority of the country of origin 6/ on the basis of the technical documentation with regard to their

compliance with the relevant provisions of this Class.
Pressure receptacles shall furthermore be designed, manufactured and tested according to a comprehensive quality assurance programme for design, manufacture, final inspection and testing. The quality assurance programme shall guarantee the conformity of the pressure receptacles with the relevant provisions of this Class and shall be approved and supervised by a testing and certifying body approved by the competent authority of the country of origin; or

(c) The design type of the pressure receptacles shall be approved by a testing and certifying body approved by the competent authority of the country of origin. Any pressure receptacle of this design shall be manufactured and tested according to a quality assurance programme for production, final inspection and testing, which shall be approved and supervised by a testing and certifying body approved by the competent authority of the country of origin; or

(d) The design type of the pressure receptacles shall be approved by a testing and certifying body approved by the competent authority of the country of origin. Any pressure receptacle of this design shall be tested under the supervision of a testing and certifying body approved by the competent authority of the country of origin on the basis of a declaration of the manufacturer on compliance with the approved design and the relevant provisions of this Class.

6.2.4.2 The conformity of pressure receptacles having a test pressure capacity product of more than 100 MPa.litre (100 bar.litre) and not more than 300 MPa.litre (3000 bar.litre) with the provisions of Class 2 shall be assessed by one of the methods described in (1) or by one of the following methods:

(a) The pressure receptacles shall be designed, manufactured and tested according to a comprehensive quality assurance programme for their design, manufacture, final inspection and testing, approved and supervised by a testing and certifying body approved by the competent authority of the country of origin; or

(b) The design type of the pressure receptacle shall be approved by a testing and certifying body approved by the competent authority of the country of origin. The compliance of any pressure receptacle with the approved design shall be declared in writing by the manufacturer on the basis of his quality assurance programme for final inspection and testing of pressure receptacles, approved and supervised by a testing and certifying body approved by the competent authority of the country of origin; or

(c) The design type of the pressure receptacle shall be approved by a testing and certifying body approved by the competent authority of the country of origin. The compliance of any pressure receptacle with the approved design shall be declared in writing by the manufacturer and all pressure receptacles of this type shall be tested under the supervision of a testing and certifying body approved by the

competent authority of the country of origin.

6.2.4.3 The conformity of pressure receptacles, having a test pressure capacity product of not more than 100 MPa.litre (100 bar.litre) with the provisions of Class 2 shall be assessed by one of the methods described in 6.2.4.1 or 6.2.4.2 or by one of the following methods:

(a) The compliance of any pressure receptacle with a design, fully specified in technical documentation, shall be declared in writing by the manufacturer and pressure receptacles of this design shall be tested under the supervision of a testing and certifying body approved by the competent authority of the country of origin; or

(b) The design type of the pressure receptacles shall be approved by a testing and certifying body approved by the competent authority of the country of origin. The compliance of all pressure receptacles with the approved design shall be declared in writing by the manufacturer and all pressure receptacles of this type shall be tested individually.

6.2.4.4 The requirements of paragraphs 6.2.4.1 to 6.2.4.3 as regards the quality assurance systems shall be deemed to be complied with, if they conform to the relevant standard of the ISO 9000 series or to ISO/CD 14600 Transportable gas cylinders - International quality assurance system.

6.2.4.5 Requirements for manufacturers

The manufacturer shall be technically able and shall possess all suitable means required for the satisfactory manufacture of pressure receptacles; this relates in particular to qualified personnel

(a) to supervise the entire manufacturing process;

(b) to carry out joining of materials;

(c) to carry out the relevant tests.

The proficiency test of a manufacturer shall in all instances be carried out by a testing and certifying body approved by the competent authority of the country of origin. The particular certification process the manufacturer intends to apply shall be taken into consideration.

6.2.4.6 Requirements for testing and certifying bodies

Testing and certifying bodies shall be independent from manufacturing enterprises and technologically competent to the degree required.]

Proposal 5

Proposed text for Part 5

5.2.2.2.1.2 Gas cylinders for Class 2 may, on account of their shape, orientation and securing mechanisms for transport, bear labels representative of those specified in this section, which have been reduced in size **according to ISO 7225**, for display on the non-cylindrical part (shoulder) of such cylinders.

For cylinders with an outside diameter lower or equal to 75mm, the cylindrical part may also be used.

Proposal 6

Proposed texts for MEGC's in Part 4

The existing 4.2.4 should be renumbered as 4.2.5 and replaced by the following text.

4.2.4 General provisions for the use of multiple-element gas containers (MEGCs)

4.2.4.1 This section provides general requirements applicable to the use of multiple-element gas containers (MEGCs) for the transport of non-refrigerated gases.

4.2.4.2 MEGCs shall conform to the design, construction, inspection and testing requirements detailed in 6.7.7.5. The elements of MEGC's shall be periodically inspected according to the provisions set out in P200 in 4.1.4.1 and in 6.2.

4.2.4.3 During transport, MEGCs shall be adequately protected against damage to the elements and service equipment resulting from lateral and longitudinal impact and overturning. If the elements and service equipment are so constructed as to withstand impact or overturning they need not be protected in this way. Examples of such protection are given in **6.6.5.11.5**.

4.2.4.4 Toxic gases and gas mixtures classified under N.O.S. entries of Division 2.3 with an LC_{50} < 200 ppm] shall not be authorised for transport in MEGCs.

4.2.4.5 Empty MEGCs not cleaned and not gas-free shall comply with the same requirements as MEGCs filled with the previous gas.

4.2.4.6 Empty MEGC's, uncleaned may be moved after the expiration of the period for undergoing the test.

4.2.4.9 ***Filling***

4.2.4.9.1 Prior to filling the shipper shall ensure that the MEGC is authorized for the gas to be transported.

4.2.4.9.2 Elements of MEGC's shall be filled according to the filling ratios determined in packing instruction P200 in 4.1.4.1

4.2.4.9.3 MECG's shall not be filled above their maximum permissible gross mass prescribed under section 6.7.5.13.

4.2.4.9.4 Toxic gases of division 2.3 shall only be transported in multiple-element gas containers where each element is equipped with an isolation valve. The isolation valves shall be closed after filling and remain closed during transport.

4.2.4.9.5 The opening(s) for filling shall be closed by caps or plugs. The leakproofness of the closures and equipment shall be verified by the consigner after filling.

4.2.4.10 MEGCs shall not be offered for transport:

(a) when leaking;

(b) when damaged to such an extent that the integrity of the elements, the lifting or securing arrangements may be affected; and

(c) unless the service equipment has been examined and found to be in good working order.

Proposal 7

Proposed texts for MEGC's in Part 6

6.7.5 Requirements for the design, construction, inspection and testing of multiple-element gas containers (MEGCs) intended for the transport of non-refrigerated gases

6.7.5.1 Definitions

For the purposes of this section:

*Element*s are restricted to cylinders, tubes or bundle of cylinders

Manifold means an assembly of piping and valves connecting the filling/discharge openings of the elements;

Service equipment means measuring instruments and filling, discharge, venting and safety devices;

Structural equipment means the reinforcing, fastening, protective and stabilizing members external to the elements;

bar:

or

be:

gas;

bar;]

Design pressure means the pressure to be used in calculations required by a recognized pressure vessel code or standard. The design pressure shall be not less than the test pressure:

Test pressure means the maximum gauge pressure of the elements during the pressure test;

Leakproofness test means a test using gas subjecting the elements and its service equipment to an effective internal pressure of not less than 20% of the test pressure;

Maximum permissible gross mass (MPGM) means the sum of the tare mass of the multiple-element gas container and the heaviest load authorized for transport;

Design reference temperature means the temperature determined for the purpose of calculating the MAWP for liquefied gases. This value is fixed at 65 °C.

6.7.5.2 ***General design and construction requirements***

6.7.5.2.1 The multiple-element gas container shall be capable of being loaded and discharged without the removal of its structural equipment. It shall possess stabilizing members external to the elements, and shall be capable of being lifted also when full. It shall be designed primarily to be loaded onto a transport vehicle or ship and shall be equipped with skids, mountings or accessories to facilitate mechanical handling.

6.7.5.2.2 MEGC's shall be designed, manufactured, tested and equipped in such a way as to withstand all conditions to wich they will subjected during their normal use and during normal transport conditions. The design shall take into account the effects of dynamic loading and fatigue.

6.7.5.2.3 Elements of a MEGC shall be made of seamless steel and be constructed according to section 6.2.

6.7.5.2.4 MEGCs, fittings and pipework shall be constructed of materials which are:

(a) substantially immune to attack by the gas(es) intended to be transported(see e.g. ISO 11114).; or

(b) properly passivated or neutralized by chemical reaction.

6.7.5.2.5 Contact between dissimilar metals which could result in damage by galvanic action shall be avoided.

6.7.5.2.6 The materials of the MEGC, including any devices, gaskets, and accessories, shall not adversely affect the gases intended for transport in the MEGC.

6.7.5.2.7 MEGCs shall be designed and constructed with supports to provide a secure base during transport and with suitable lifting and tie-down attachments.

6.7.5.2.8 MEGCs shall be designed to withstand, without loss of contents, at least the internal pressure due to the contents, and the static, dynamic and thermal loads during normal conditions of handling and transport. The design shall demonstrate that the effects of fatigue, caused by repeated application of these loads through the expected life of the multiple-element gas container, have been taken into account.

6.7.5.2.9 MEGCs and their fastenings shall, under the maximum permissible load, be capable of absorbing the following separately applied static forces:

(a) in the direction of travel: twice the MPGM multiplied by the acceleration due to gravity (g) */;

(b) horizontally at right angles to the direction of travel: the MPGM (when the direction of travel is not clearly determined, the forces shall be equal to twice the MPGM) multiplied by the acceleration due to gravity (g) */;

(c) vertically upwards: the MPGM multiplied by the acceleration due to gravity (g)*/; and

(d) vertically downwards: twice the MPGM (total loading including the effect of gravity) multiplied by the acceleration due to gravity (g) */.

6.7.5.2.10 Under the stresses defined above, the stress at the most severely stressed point of the elements shall not exceed the values given in the relevant standards of section 6.2.2 or if or, if the elements are not designed, constructed and tested according to those standards, in section 6.2.3.

6.7.5.2.11 Under each of the forces in 6.7.5.2.9, the safety factor for the framework and fastenings to be observed shall be as follows:

(a) for steels having a clearly defined yield point, a safety factor of 1.5 in relation to the guaranteed yield strength; or

(b) for steels with no clearly defined yield point, a safety factor of 1.5 in relation to the guaranteed 0.2% proof strength and, for austenitic steels, the 1% proof strength.

6.7.5.2.12 MEGC intended for the transport of flammable gases shall be capable of being electrically earthed.

6.7.5.2.13 The elements shall be secured in a manner that prevents undesired movement in relation to the structure and the concentration of local stresses.

6.7.5.3 *Service equipment*

6.7.5.3.1 Service equipment shall be so arranged as to be protected against the risk of being wrenched off or damaged during handling and transport. When the connection between the frame and the elements allows relative movement between the sub-assemblies, the equipment shall be so fastened as to permit such movement without risk of damage to working parts. The manifolds, the discharge fittings (pipe sockets, shut-off devices), the stop-valves shall be protected against the danger of being wrenched off by external forces . Manifold piping leading to shut-off valves shall be suffciently flexible to protect the valves and the piping from shearing. The filling and discharge devices (including flanges or threaded plugs) and any protective caps shall be capable of being secured against unintended opening.

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*/ *For calculation purposes* $g = 9{,}81\ m/s^2$.

6.7.5.3.2 Each element intended for the transport of toxic gases division 2.3 shall be fitted with a valve. The manifold for liquefied toxic gases division 2.3 shall be so designed that the elements can be filled separately and be kept isolated by a valve capable of being sealed.
[The assembly of elements intended for the transport of flammable gases of division 2.1 shall be fitted with an isolation valve when the combined volume exceeds [3000] litres]

6.7.5.3.3 For filling and discharge openings of the MEGC two valves in series shall be placed in an accessible position on each discharge and filling pipe.. One of the valves may be a non-return valve. The filling and discharge devices may be fitted to a manifold. For sections of piping which can be closed at both ends and where liquid product can be trapped a pressure-relief valve shall be provided to prevent excessive pressure build-up.

6.7.5.3.4 [For filling and discharge openings of MEGC intended for the transport of flammable and/or toxic liquefied gases the stop-valve shall be a quick closing safety device which closes automatically in the event of unintended movement of the MEGC during filling or discharge or fire engulfment. Except for MEGCs having a capacity of not more than 1 000 litres, it shall be possible to operate this device by remote control.]]

6.7.5.3.5 External fittings shall be grouped together at the ends so far as reasonably practicable.

6.7.5.3.6 Each valve on a multiple-element gas container shall be clearly marked to indicate its function.

6.7.5.3.7 Each stop-valve or other means of closure shall be designed and constructed to a burst pressure equal to or greater than the burst pressure of the elements. All stop-valves with screwed spindles shall close by a clockwise motion of the handwheel. For other stop-valves the position (open or closed) and direction of closure shall be clearly indicated. All stop-valves shall be designed and positioned to prevent unintentional opening.

6.7.5.3.8 Piping shall be designed, constructed and installed so as to avoid the risk of damage due to expansion and contraction, mechanical shock and vibration.

6.7.5.3.9 Joints in copper tubing shall be brazed or have an equally strong metal union. The melting point of brazing materials shall be no lower than 525 °C.

6.6.5.3.10 The rated pressure of the service equipment and of the manifold shall be not less than two thirds of the test pressure of the elements.

6.6.5.3.11 Ductile metals shall be used in the construction of valves or accessories.

6.7.5.4 Pressure-relief devices

6.7.5.4.1 MEGCs used for the transport of of non-flammable, non-toxic, high pressure liquefied gases may be provided with one or more pressure-relief devices. Every element or group of elements of a multiple-element gas container that can be isolated shall then be fitted with one or

more pressure relief-devices. The pressure-relief devices shall open automatically at a pressure between 100 and 120 percent of the test pressure. The pressure-relief devices shall be of a type that will resist dynamic forces including liquid surge (see for example CGA S-1.1-1994).

6.7.5.4.2 Pressure-relief devices, when fitted, shall be designed to prevent the entry of foreign matter, the leakage of gas and the development of any dangerous excess pressure.

6.7.5.4.3 MEGCs used for the transport of certain non-refrigerated gases identified in instructions T50 in 4.2.5.2.8 {shall/may} have a pressure-relief device approved by the competent authority. Unless a multiple-element gas container in dedicated service is fitted with an approved relief device constructed of materials compatible with the load, such device (shall) comprise a frangible disc preceding a spring-loaded device. The space between the frangible disc and the device may be provided with a pressure gauge or a suitable tell-tale indicator. This arrangement permits the detection of disc rupture, pinholing or leakage which could cause a malfunction of the pressure-relief device. The frangible discs shall rupture at a nominal pressure 10% above the start-to-discharge pressure of the spring-loaded relief device.

6.7.5.4.4 In the case of multi-purpose MEGCs used for the transport of low-pressure liquefiedgases, the pressure-relief devices shall open at a pressure indicated in 6.7.3.7.1 for the gas having the highest maximum allowable pressure of the gases allowed to be transported in the MEGC.

6.7.5.5 Capacity of relief devices

6.7.5.5.1 The combined delivery capacity of the relief devices when fitted shall be sufficient that, in the event of total fire engulfment, the pressure (including accumulation) inside the elements intended for the transport of gases does not exceed 120% of the set pressure of the relief device. Spring-loaded relief devices may be used to achieve the full relief capacity prescribed in the case of low pressure liquefied gases. In the case of multi-purpose elements, the combined delivery capacity of the pressure-relief devices shall be taken for the gas which requires the highest delivery capacity of the gases allowed to be transported in MEGCs.

6.7.5.5.2 To determine the total required capacity of the relief devices installed on the elements for the transport of low pressure liquefied gases, the thermodynamic properties of the gas have to be considered (see for example CGA S-1.2-1995).

6.7.5.5.3 To determine the total required capacity of the relief devices installed on the elements for the transport of high pressure liquefied gases, the thermodynamic properties of the gas have to be considered (see for example CGA S-1.1-1994).

6.7.5.6 Marking of pressure-relief devices

6.7.5.6.1 Spring loaded pressure-relief devices [shall be plainly and permanently marked with the following:

(a) the pressure (in bar or kPa) at which it is set to discharge;

(b) the allowable tolerance at the discharge pressure;

(c) the rated flow capacity of the device in standard cubic metres of air per second (m^3/s);

When practicable, the following information shall also be shown:

(d) the manufacturer's name and relevant catalogue number.

6.7.5.6.2 The rated flow capacity marked on the frangible disk shall be determined according to CGA S-1.1-1994.

6.7.5.6.3 The rated flow capacity marked on the pressure-relief devices for low pressure liquefied gases shall be determined according to ISO 4126-1:1996.

6.7.5.7 Connections to pressure-relief devices

6.7.5.7.1 Connections to pressure-relief devices shall be of sufficient size to enable the required discharge to pass unrestricted to the safety device. No stop-valve shall be installed between the element and the pressure-relief devices except when duplicate devices are provided for maintenance or other reasons and the stop-valves serving the devices actually in use are locked open or the stop-valves are interlocked so that at least one of the duplicate devices is always operable and capable of meeting the requirements of 6.6.5.6. There shall be no obstruction in an opening leading to a vent or pressure-relief device which might restrict or cut-off the flow from the element to that device. Vents from the pressure-relief devices, when used, shall deliver the relieved vapour or liquid to the atmosphere in conditions of minimum back-pressure on the relieving device.

6.7.5.8 Siting of pressure-relief devices

6.7.5.8.1 All pressure-relief devices shall under under maximum filling conditions be situated in the vapour space of the elements for the transport of liquefied gases.
The devices when fitted shall be so arranged as to ensure that the escaping vapour is discharged upwards and unrestrictedly. For flammable and oxidising gases, the escaping gas shall be directed away from the element in such a manner that it cannot impinge upon the other elements. Protective devices which deflect the flow of gas are permissible provided the required relief-device capacity is not reduced.

6.7.5.8.2 Arrangements shall be made to prevent access to the pressure-relief devices by unauthorized persons and to protect the devices from damage caused by the MEGC overturning.

6.7.5.9 Gauging devices

6.7.5.9.1 When a MEGC is intended to be filled by mass/weight it shall be equipped with one or more gauging devices. Level-gauges made of glass or other fragile material shall not be used.

6.7.5.10 MEGC supports, frameworks, lifting and tie-down attachments

6.7.5.10.1 MEGCs shall be designed and fabricated with a support structure to provide a secure base during transport. The forces specified in 6.7.5.2.8 and the safety factor specified in 6.7.5.2.9 shall be considered in this aspect of the design. Skids, frameworks, cradles or other similar structures are acceptable.

6.7.5.10.2 The combined stresses caused by element mountings (e.g. cradles, frameworks, etc.) and MEGC lifting and tie-down attachments shall not cause excessive stress in any element. Permanent lifting and tie-down attachments shall be fitted to all MEGCs. In no case shall mountings or attachments be welded onto the elements.

6.7.5.10.3 In the design of supports and frameworks the effects of environmental corrosion shall be taken into account.

6.7.5.10.4 When MEGCs are not protected during transport, according to 4.2.4.3, the elements and service equipment shall be protected against damage resulting from lateral or longitudinal impact or overturning. External fittings shall be protected so as to preclude the release of the elements contents upon impact or overturning of the MEGC on its fittings. Particular attention shall be paid to the protection of the manifold. [Examples of protection include:

(a) protection against lateral impact which may consist of longitudinal bars;

(b) protection against overturning which may consist of reinforcement rings or bars fixed across the frame;

(c) protection against rear impact which may consist of a bumper or frame;

(d) protection of the elements and service equipment against damage from impact or overturning by use of an ISO frame in accordance with [ISO 1496-3:1995](to be checked by MT).]

6.7.5.11 Design approval

6.7.5.11.1 The competent authority or its authorized body shall issue a design approval certificate for any new design of a MEGC. This certificate shall attest that the MEGC has been surveyed by that authority, is suitable for its intended purpose and meets the requirements of this Chapter and when appropriate the provisions for gases provided in instructions *P200 in 4.1.4 and , T50 and T60* in 4.2.5.2.8. When a series of MEGCs are manufactured without change in the design, the certificate shall be valid for the entire series. The certificate shall refer to the prototype test report,

the materials of construction of the manifold, the standards to which the elements are made and an approval number. The approval number shall consist of the distinguishing sign or mark of the State in whose territory the approval was granted, i.e. the distinguishing sign for use in international traffic, as prescribed by the Convention on Road Traffic, Vienna 1968, and a registration number. Any alternative arrangements according to 6.6.1.2 shall be indicated on the certificate. A design approval may serve for the approval of smaller MEGCs made of materials of the same kind and thickness, by the same fabrication techniques and with identical supports, equivalent closures and other appurtenances.

6.7.5.11.2 The prototype test report for the design approval shall include at least the following:

(a) the results of the applicable framework test specified in [ISO 1496-3:1995];

(b) the results of the initial inspection and test in 6.6.5.13.3;

(c) the results of the impact test in 6.6.5.12.1, when applicable [(see ISO 1496-3)]; and

(d) certification documents verifying that cylinders and tubes comply with the applicable standards.

6.7.5.12 Inspection and testing

6.7.5.12.1 For MEGCs meeting the definition of container in the CSC, a prototype representing each design shall be subjected to an impact test. The prototype MEGC shall be shown to be capable of absorbing the forces resulting from an impact not less than 4 times (4 g) the MPGM of the fully loaded portable tank at a duration typical of the mechanical shocks experienced in rail transport{by either calculation or impact test}. The following is a listing of standards describing methods acceptable for performing the impact test:

Association of American Railroads,
Manual of Standards and Recommended Practices,
Specifications for Acceptability of Tank Containers (AAR.600), 1992

Canadian Standards Association (CSA),
Highway Tanks and Portable Tanks for the Transportation of Dangerous Goods (B620-1987)

Deutsche Bahn AG
Zentralbereich Technik, Minden
Portable tanks, longitudinal dynamic impact test

Société Nationale des Chemins de Fer Français
C.N.E.S.T. 002-1966.
Tank containers, longitudinal external stresses and dynamic impact tests

Spoornet, South Africa
Engineering Development Centre (EDC)
Testing of ISO Tank Containers
Method EDC/TES/023/000/1991-06

6.6.5.12.2 The elements and items of equipment of each MEGC shall be inspected and tested before being put into service for the first time (initial inspection and test). Thereafter MEGC shall be inspected at no more than five-year intervals An exceptional inspection and test shall be performed regardless of the last periodic inspection and test when necessary according to 6.6.5.13.7.

6.6.5.12.3 The initial inspection and test of a MEGC shall include a check of the design characteristics, an external examination of the MEGC and its fittings with due regard to the gases to be transported, and a pressure test referring to the test pressures according to 6.6.5.3.1. The pressure test may be performed as a hydraulic test or by using another liquid or gas with the agreement of the competent authority or its authorized body. Before the MEGC is placed into service, a leakproofness test and a test of the satisfactory operation of all service equipment shall also be performed. When the elements and their fittings have been pressure-tested separately, they shall be subjected together after assembly to a leakproofness test.

6.7.5.12.4 The 5 year periodic inspection shall include an and]external examination of the structure, the elements and the service equipment. The elements and the piping shall be tested as required in P200 and described in 6.2.1.5. When the elements and equipment have been pressure-tested separately, they shall be subjected together after assembly to a leakproofness test.

6.7.5.12.5 A MEGC shall not be filled and offered for transport after the date of expiry of the last periodic inspection and test as required by 6.7.5.13.2. However a MEGC filled prior to the date of expiry of the last periodic inspection and test may be transported for a period not to exceed three months beyond the date of expiry of the last periodic test or inspection. In addition, a MEGC may be transported after the date of expiry of the last periodic test and inspection:

(a) after emptying but before cleaning, for purposes of performing the next required test or inspection prior to refilling; or

(b) unless otherwise approved by the competent authority, for a period not to exceed six months beyond the date of expiry of the last periodic test or inspection, in order to allow the return of dangerous goods for proper disposal or recycling. Reference to this exemption shall be mentioned in the transport document.

The exceptional inspection and test is necessary when the MEGC shows evidence of damaged or corroded areas, or leakage, or other conditions that indicate a deficiency that could affect the integrity of the MEGC. The extent of the exceptional inspection and test shall depend on the amount of damage or deterioration of the MEGC. It shall include at least the inspection required under 6.7.5.12.6

6.7.5.12.6 The examinations shall ensure that:

(a) [the elements are inspected for pitting, corrosion, or abrasions, dents, distortions], defects in welds or any other conditions, including leakage, that might render the MEGC unsafe for transport;

(b) the piping, valves, and gaskets are inspected for corroded areas, defects, and other conditions, including leakage, that might render the MEGC unsafe for filling, discharge or transport;

(c) missing or loose bolts or nuts on any flanged connection or blank flange are replaced or tightened;

(d) all emergency devices and valves are free from corrosion, distortion and any damage or defect that could prevent their normal operation. Remote closure devices and self-closing stop-valves shall be operated to demonstrate proper operation;

(e) required markings on the MEGC are legible and in accordance with the applicable requirements; and

(f) the framework, the supports and the arrangements for lifting the portable tank are in satisfactory condition.

6.7.5.12.9 The inspections and tests in 6.7.5.13.1, 6.7.5.13.3, 6.7.5.13.4, 6.7.5.13.5 and 6.7.5.12.7 shall be performed or witnessed by a body authorized by the competent authority. When the pressure test is a part of the inspection and test, the test pressure shall be the one indicated on the data plate of the MEGC. While under pressure, the MEGC shall be inspected for any leaks in the elements, piping or equipment.

6.7.7.12.10 When evidence of any unsafe condition is discovered, the MEGC shall not be returned to service until it has been corrected and the applicable tests and verifications are passed.

6.7.5.13 Marking

6.6.5.13.1 Every MEGC shall be fitted with a corrosion resistant metal plate permanently attached to the MEGC in a conspicuous place readily accessible for inspection.The elements shall be marked with at least the information required by the pressure vessel code. As a minimum at least the following information shall be marked on the plate by stamping or by any other similar method.

[Country of manufacture

U	Approval For Alternative "AA"	Approval Arrangements
N	Country	Number

Manufacturer's name or mark

Manufacturer's serial number

Authorized body for the design approval

Owner's registration number

Year of manufacture

Test pressure _____bar/kPa gauge */

Maximum settled pressure at 15 °C_____bar/kPa gauge

Design temperature range_____ °C to_____°C

Design reference temperature_____ °C

Number of elements_____

Total water capacity at 20° _C _____litres

Initial pressure test date and witness identification

Elements materials and material standard references

Date and type of most recent periodic tests

Month_____ Year_____ Test pressure_____bar/kPa gauge */

Stamp of expert who performed or witnessed the most recent test]

***NOTE**: No metal plate may be fixed to the elements.*

[6.6.5.13.2 The following information shall be marked on a metal plate firmly secured to the MEGC:

Name of the operator

Name of gas(es) permitted for transport

Maximum permissible load mass_____kg

Maximum permissible load mass per element (liquefied gas only)_____kg

Maximum permissible gross mass (MPGM)_____kg

Unladen (tare) mass_____kg

***NOTE**: For the identification of the gases being transported, see also Part 5.]"*

*/ *The unit used shall be marked.*