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**COMMITTEE OF EXPERTS ON THE TRANSPORT
OF DANGEROUS GOODS**

(Twenty-first session,
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**WORK OF THE SUB-COMMITTEE OF EXPERTS
ON THE TRANSPORT OF DANGEROUS GOODS**

Development of provisions for the transport of gases

**Annex to the Report of the Working Group on Gas Receptacles and
Multiple-Element Gas Containers (MEGCs)**

1. Reference is made to the report of the Working Group on Gas Receptacles and Multiple-Element Gas Containers (MEGCs) (see ST/SG/AC.10/C.3/36, annex 1).
2. This Annex is submitted for approval by the Committee of Experts for inclusion in the 12th Revision of the UN Model Regulations.
3. In September 2000 EIGA submitted a paper identified as ST/SG/AC.10/2000/22 which represented a consolidation of the work of the Working Group up to that time. Following the meeting held from 4th to 7th December, the Working Group presents its agreed and finalised text on the following pages. The texts proposed by the Working Group are reproduced as a revised version of ST/SG/AC.10/2000/22; new text is shown underlined and the deleted text is shown by being struck through.

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Proposal 1

Proposed texts: 1.2.1 Definitions

The following definitions should be added at the appropriate places.

Alternative arrangement means an approval granted by the competent authority for a portable tank or MEGC that has been designed, constructed or tested to technical requirements or testing methods other than those specified in these Model Regulations (see, for instance, 6.7.5.11.1);

Bundles of cylinders are assemblies of cylinders that are fastened together and which are interconnected by a manifold and transported as a unit. The total water capacity shall not exceed 3000 litres except that bundles intended for the transport of gases of Division 2.3 shall be limited to 1000 litres water capacity;

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

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

Multiple-element gas containers (MEGCs) are multimodal assemblies of cylinders, tubes and bundles of cylinders which are interconnected by a manifold and which are assembled within a framework. The MEGC includes service equipment and structural equipment necessary for the transport of gases;

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

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

Pressure receptacles is a collective term that includes cylinders, tubes, pressure drums, closed cryogenic receptacles and bundles of cylinders;

Filling ratio is the ratio of the mass of ~~liquefied~~ gas to the mass of water at 15°C that would fill a pressure receptacle fitted ready for use;

Settled pressure is the pressure of the contents of a pressure receptacle in thermal and diffusive equilibrium;

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

Test pressure is the required pressure applied during a pressure test for qualification or requalification ~~of a~~ pressure receptacle;

Critical temperature is the temperature above which the substance cannot exist in the liquid state;

Inspection body is an independent inspection and testing body (or bodies) approved by the competent authority;

Proposal 2

2.2.1 Definitions and general provisions

Paragraphs 2.2.1.2 and 2.2.1.3 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 less than or equal to -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*** – a gas with a critical temperature between -50 °C and +65 °C,
 - Low pressure liquefied gas*** – a gas 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; or
- (d) ***Dissolved gas*** – a gas which when packaged under pressure for transport is dissolved in a liquid phase solvent.

2.2.1.3 The class comprises compressed gases; liquefied gases; dissolved gases; refrigerated liquefied gases; mixtures of one or more gases with one or more vapours of substances of other classes; articles charged with a gas; ~~tellurium hexafluoride~~; aerosols.

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 This section provides general requirements applicable to the use of pressure receptacles for the transport of Class 2 gases and other dangerous goods that are required to be transported in pressure receptacles (e.g. Hydrogen cyanide, stabilized, UN 1051). ~~Compressed gases shall be transported in good quality pressure receptacles which shall be strong enough to withstand the shocks and loadings normally encountered during transport, including trans shipment between transport units and/or warehouses as well as any removal from a pallet or overpack for subsequent manual or mechanical handling. Pressure receptacles shall be closed and leakproof as to prevent the escape of the gases contained.~~ Pressure receptacles shall be constructed and closed so as to prevent any loss of contents ~~when prepared for transport~~ which might be caused under normal conditions of transport, including by vibration, or by changes in temperature, humidity or pressure (resulting from change in altitude, for example). ~~No dangerous residue shall adhere to the outside of the pressure receptacle during transport.~~

4.1.6.1.2 Parts of pressure receptacles which are in direct contact with dangerous goods shall not be affected or ~~significantly~~ weakened by those dangerous goods and shall not cause a dangerous effect (e.g. catalysing a reaction or reacting with the dangerous goods). The provisions of ISO 11114-1:1997 and ISO 11114-2:2000 shall be met as applicable. Pressure receptacles for acetylene, dissolved, UN 1001 and acetylene, solvent free, UN 3374 shall be filled with a porous material, uniformly distributed, of a type that conforms to the requirements and testing specified by the competent authority and which:

- (a) is compatible with the pressure receptacle and does not form harmful or dangerous compounds either with the acetylene or with the solvent in the case of UN 1001; and
- (b) is capable of preventing the spread of decomposition of the acetylene in the mass.

In the case of UN 1001, the solvent shall be compatible with the pressure receptacles

4.1.6.1.3 Pressure receptacles, including their closures, shall be selected to contain a gas or a mixture of gases according to the requirements of 6.2.1.2 ("Materials") and the requirements of the specific packing instructions of section 4.1.4.1. This section also applies to pressure receptacles which are elements of MEGCs.

4.1.6.1.4 Refillable pressure receptacles shall not be filled with a gas or gas mixture different from that previously contained unless the necessary operations for change of gas service have been performed in accordance with ISO 11621:1997. In addition, a pressure receptacle that previously contained a Class 8 corrosive substance or a substance of another class with a corrosive subsidiary risk shall not be authorized for the transport of a Class 2 substance unless the necessary inspection and testing as specified in 6.2.1.5 have been performed.

~~4.1.6.1.5~~ Prior to filling, the filler ~~and shipper~~ shall perform an inspection of the pressure receptacle and ensure that the pressure receptacle is authorized for the gas to be transported and that the provisions of these Model Regulations have been met. Valves shall be closed after filling and remain closed during transport. The leakproofness of shipper shall verify that the closures and equipment are not leaking ~~shall be verified by the shipper after filling.~~

4.1.6.1.6 Pressure receptacles shall be filled according to the working pressures, filling ratios and provisions specified in the appropriate packing instruction for the specific gas substance being filled. Reactive gases and gas mixtures shall be filled to a pressure such that if complete decomposition of the gas occurs, the working pressure of the pressure receptacle shall not be exceeded. Bundles of cylinders ~~pressure receptacles~~ shall not be filled in excess of the lowest working pressure of any given cylinder ~~pressure receptacle~~ in the bundle.

4.1.6.1.7 Pressure 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.

4.1.6.1.8 Valves shall be protected from damage which could cause inadvertent release of the contents of the pressure receptacle, by one of the following methods:

- (a) Valves are placed inside the neck of the pressure receptacle and protected by a threaded plug or cap;
- (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; ~~or~~
- (e) Pressure receptacles are transported in ~~protective boxes~~ or frames, (e.g. bundles); or
- (f) Pressure receptacles are transported in an outer packaging. The packaging as prepared for transport shall be capable of meeting the drop tests specified in 6.1.5.3 at the PG I performance level.

For pressure receptacles with valves as described in (b) and (c), the requirements of ISO 11117:1998 shall be met; for unprotected valves as described in (d), the requirements of annex ~~A~~B of ISO 10297:1999 shall be met.

4.1.6.1.9 Non-refillable pressure receptacles shall:

- (a) be transported in an outer packaging, such as a box or crate;
- (b) be of a water capacity less than or equal to 1.25 litres when filled with flammable or toxic gas;
- (c) not be used for toxic gases with an LC_{50} less than or equal to 200 ml/m^3 ;
- ~~(d) not be subject to periodic inspection requirements; and~~
- ~~(de)~~ not be repaired after being put into service.

4.1.6.1.10 Refillable pressure receptacles shall be periodically inspected according to the provisions of P200 or P203 as applicable. Pressure receptacles shall not be charged or filled after they become due for periodic inspection but may be transported after the expiry of the time limit.

4.1.6.1.11 Repairs are only permitted as indicated in the periodic inspection standards specified in 6.2.2.4, consistent with the applicable design and construction standards. Pressure receptacles shall not be subjected to repairs of any of the following;

- (a) weld cracks or other weld defects;
- (b) cracks in walls;
- (c) leaks or defects in the material of the wall, head or bottom.

4.1.6.1.12 Pressure receptacles shall not be offered for filling:

- (a) when damaged to such an extent that the integrity of the pressure receptacle or its service equipment may be affected;
- (b) unless the pressure receptacle and its service equipment has been examined and found to be in good working order; and
- (c) unless the required certification, retest, and filling markings are legible.

4.1.6.1.13 Charged pressure receptacles shall not be offered for transport;

- (a) when leaking;
- (b) when damaged to such an extent that the integrity of the pressure receptacle or its service equipment may be affected;
- (c) unless the pressure receptacle and its service equipment has been examined and found to be in good working order; and
- (d) unless the required certification, retest, and filling markings are legible.

4.1.4.1 Insert the following packing instructions

P200	PACKING INSTRUCTION	P200
<p>This packing instruction applies to Class 2 compressed gases, liquefied gases, and dissolved gases <u>and substances of other Classes assigned the P200 packing instruction.</u></p>		
<p>For pressure receptacles, the general packing requirements of 4.1.6.1 shall be met. In addition, for MEGCs, the general requirements of 4.2.4 shall be met.</p> <p>Cylinders, tubes, pressure drums, bundles of cylinders constructed as specified in 6.2 and MEGCs constructed as specified in 6.7.5 are authorised for the transport of a specific gases <u>substances</u> when specified in the table. For some gases <u>substances</u> the special packing provisions may prohibit a particular type of cylinder, tube, pressure drum or bundle of cylinders.</p> <p>(1) Pressure receptacles containing toxic gases <u>substances</u> with an LC₅₀ less than or equal to 200 ml/m³ (ppm) as specified in the table shall not be equipped with any pressure relief device. Pressure relief devices shall be fitted on pressure receptacles used for the transport of UN 1013 carbon dioxide and UN 1070 nitrous oxide. Other pressure receptacles shall be fitted with a pressure relief device as <u>if</u> specified by the competent authority of the country of use. The type of pressure relief device, the set to discharge pressure and relief capacity of pressure relief devices, if required, shall be specified by the competent authority.</p> <p>(2) The following <u>three tables cover compressed gases, liquefied and dissolved gases and substances not in Class 2 respectively. They provide:</u></p> <ol style="list-style-type: none"> 1. the UN number, proper shipping name, and classification of the gas <u>substance</u>; 2. the LC₅₀ for toxic gases <u>substances</u>; 3. the types of pressure receptacles authorised for the gas <u>substance</u>; 4. the maximum test period for periodic inspection of the pressure receptacles; 5. the minimum test pressure of the pressure receptacles; 6. the maximum working pressure of the pressure receptacles for compressed gases (where no value is given, the working pressure shall not exceed two thirds of the test pressure) or the maximum filling ratio(s) dependent on the test pressure(s) for liquefied and dissolved gases; 7. special packing provisions that are specific to a gas <u>substance</u>. <p>(3) The degree of filling is subject to the following requirements. <u>In no case shall pressure receptacles be filled to a filling limit in excess of that permitted in these requirements.</u></p> <ol style="list-style-type: none"> 1. For compressed gases, the working pressure shall be not more than two thirds of the test pressure of the pressure receptacles. <u>Restrictions to this upper limit on working pressure are imposed by special packing provision 'o'.</u> In no case shall the internal pressure at 65 °C exceed the test pressure. 2. For high pressure liquefied gases, the filling ratio shall be such that the internal <u>settled</u> pressure at 65 °C does not exceed the test pressure of the pressure receptacles. <u>The use of test pressures and filling ratios other than those in the tables is permitted provided that the above criterion is met, except where special packing provision 'o' applies.</u> 3. For high pressure liquefied gases for which data is not provided in the table, the maximum filling ratio (FR) shall be determined as follows: 		

P200	PACKING INSTRUCTION (cont'd)	P200
	$FR = 8.5 \times 10^{-4} \times d_g \times P_h$	
where	FR = maximum filling ratio d_g = gas density (at 15 °C, 1 bar)(in g/l) P_h = minimum test pressure (in bar)	
	If the density of the gas is unknown, the maximum filling ratio shall be determined as follows:	
	$FR = \frac{P_h \times MM \times 10^{-3}}{R \times 338}$	
where	FR = maximum filling ratio P_h = minimum test pressure (in bar) MM = molecular mass (in g/mol) R = 8.31451×10^{-2} bar.l/mol.K (gas constant)	
	For gas mixtures, the average molecular mass is to be taken, taking into account the volumetric concentrations of the various components.	
3.	For low pressure liquefied gases, the maximum mass of contents per litre of water capacity (filling factor) shall equal 0.95 times the density of the liquid phase at 50 °C; in addition, the liquid phase shall not fill the pressure receptacle at any temperature up to 60 °C. The test pressure of the pressure receptacle shall be at least equal to the vapour pressure (absolute) of the liquid at 65 °C, minus 100 kPa (1 bar).	
	For low pressure liquefied gases for which filling data is not provided in the table, the maximum filling ratio shall be determined as follows:	
	$FR = (0.0032 \times BP - 0.24) \times d_l$	
where	FR = maximum filling ratio BP = boiling point (in Kelvin) d_l = density of the liquid at boiling point (in kg/l)	
4.	For acetylene, dissolved, UN 1001, and acetylene, solvent free, UN 3374, see (4), special packing provision p.	
(4)	Keys for the column "Special packing provisions":	
	<u>Material Compatibility (for gases see ISO 11114-1:1997 and ISO 11114-2:2000)</u>	
a:	Aluminium alloy pressure receptacles are not authorised.	
b:	Copper valves shall not be used.	
c:	Metal parts in contact with the contents shall not contain more than 65% copper.	
d:	Only <u>When steel pressure receptacles are used, only those</u> bearing the 'H' mark shall be used <u>shall be authorized.</u>	

P200

PACKING INSTRUCTION (cont'd)

P200

Requirements for toxic gases substances with an LC₅₀ less than or equal to 200 ml/m³ (ppm)

k: Valve outlets shall be fitted with gas tight plugs or caps.

Each cylinder within a bundle shall be fitted with an individual valve that shall be closed during transport. After filling, the manifold shall be evacuated, purged and plugged.

The pressure receptacle(s) shall:

- (i) have a test pressure greater than or equal to 200 bar and a minimum wall thickness of 3.5 mm for aluminium alloy or 2 mm for steel; or
- (ii) have an outer packaging meeting the PG I performance level.

Pressure receptacles shall not be fitted with a pressure relief device.

Cylinders and individual cylinders in a bundle shall be limited to a maximum water capacity of 85 litres.

Each valve shall have a taper threaded connection directly to the pressure receptacle and be capable of withstanding the test pressure of the pressure receptacle.

Each valve shall either be of the packless type with non-perforated diaphragm, or be of a type which prevents leakage through or past the packing.

Each pressure receptacle shall be tested for leakage after filling.

Gas specific limitations provisions

l: UN 1040 ethylene oxide may also be packed in hermetically sealed glass or metal inner packagings suitably cushioned in fibreboard, wooden or metal boxes meeting the packing group I performance level. The maximum quantity permitted in any glass inner packaging is 30 g, and the maximum quantity permitted in any metal inner packaging is 200 g. After filling, each inner packaging shall be determined to be leak-tight by placing the inner packaging in a hot water bath at a temperature, and for a period of time, sufficient to ensure that an internal pressure equal to the vapour pressure of ethylene oxide at 55 °C is achieved. The total quantity in any outer packaging shall not exceed 2.5 kg.

m: Pressure receptacles shall be filled to a working pressure not exceeding 5 bars.

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

o: The use of test pressures and filling ratio combinations other than those indicated are permitted provided that the settled pressure at 65 °C does not exceed the test pressure of the pressure receptacle. In no case shall the working pressure or filling ratio shown in the table be exceeded.

P200	PACKING INSTRUCTION (cont'd)	P200
p:	<p>For acetylene, dissolved, UN 1001, and acetylene, solvent free, UN 3374: cylinders shall be filled with a homogeneous monolithic porous mass; the working pressure and the quantity of acetylene shall not exceed the values prescribed in the approval or in ISO 3807-1:2000 or ISO 3807-2:2000, as applicable.</p> <p>For acetylene, dissolved, UN 1001: cylinders shall contain a quantity of acetone or suitable solvent as specified in the approval (see ISO 3807-1:2000 or ISO 3807-2:2000, as applicable); cylinders fitted with pressure relief devices or manifolded together shall be transported vertically.</p> <p>The test pressure of 52 bar applies only to cylinders conforming to ISO 3807-2:2000.</p>	
q:	<p>The valves of pressure receptacles for pyrophoric gases or flammable mixtures of gases containing more than 1% of pyrophoric compounds shall be fitted with gas-tight plugs or caps. 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, and the manifold outlet valve shall be fitted with a gas-tight plug or cap.</p>	
s:	<p>Aluminium alloy pressure receptacles shall be:</p> <ul style="list-style-type: none"> - Equipped only with brass or stainless steel valves; and - Cleaned in accordance with ISO 11621:1997 and not contaminated with oil. 	
<u>Periodic Inspection</u>		
u:	<p>The interval between periodic tests may be extended to 10 years for aluminium alloy pressure receptacles when the alloy of the pressure receptacle has been subjected to stress corrosion testing as specified in ISO 7866:1999.</p>	
v:	<p>The interval between periodic inspections for steel cylinders may be extended to 15 years if approved by the competent authority of the country of use.</p>	
<u>Requirements for N.O.S. Descriptions</u>		
z:	<p>The construction materials of the pressure receptacles and their accessories shall be compatible with the contents and shall not react to form harmful or dangerous compounds therewith.</p> <p>The test pressure and filling ratio shall be calculated in accordance with the relevant requirements of (3).</p> <p>Toxic gases <u>substances</u> with an LC₅₀ less than or equal to 200 ml/m³ shall not be transported in tubes, pressure drums <u>or MEGCs</u> and shall meet the requirements of special packing provision k.</p> <p>For pressure receptacles containing pyrophoric gases or flammable mixtures of gases containing more than 1% pyrophoric compounds, the requirements of special packing provision q shall be met.</p> <p>The necessary steps shall be taken to prevent dangerous reactions (i.e. polymerisation or decomposition) during transport. If necessary, stabilisation or addition of an inhibitor shall be required.</p> <p>Mixtures containing diborane, UN 1911, shall be filled to a pressure such that, if complete decomposition of the diborane occurs, <u>two thirds of the test</u> working pressure of the pressure receptacle shall not be exceeded.</p>	

Table of COMPRESSED GASES

¹ Where the entries are blank, the working pressure shall not exceed two thirds of the test pressure.

UN No.	Proper Shipping Name	Class or Division	Subsidiary Risk	LC ₅₀ ml/m ³	Cylinders	Tubes	Pressure drums	Bundles of cylinders	MEGCs	Test Period, years	Test Pressure, bar ¹	Working Pressure, bar ¹	Special Packing Provisions
1002	AIR, COMPRESSED	2.2			Y	Y	Y	Y	Y	10			
1006	ARGON, COMPRESSED	2.2			Y	Y	Y	Y	Y	10			
1014	CARBON DIOXIDE AND OXYGEN MIXTURE, COMPRESSED	2.2	5.1		Y	Y	Y	Y	Y	10			
1016	CARBON MONOXIDE, COMPRESSED	2.3	2.1	3760	Y	Y	Y	Y	Y	5			u
1023	COAL GAS, COMPRESSED	2.3	2.1		Y	Y	Y	Y	Y	5			
1045	FLUORINE, COMPRESSED	2.3	5.1,8	185	Y			Y		5	200	30	a, k, n, o
1046	HELIUM, COMPRESSED	2.2			Y	Y	Y	Y	Y	10			
1049	HYDROGEN, COMPRESSED	2.1			Y	Y	Y	Y	Y	10			d
1056	KRYPTON, COMPRESSED	2.2			Y	Y	Y	Y	Y	10			
1065	NEON, COMPRESSED	2.2			Y	Y	Y	Y	Y	10			
1066	NITROGEN, COMPRESSED	2.2			Y	Y	Y	Y	Y	10			
1071	OIL GAS, COMPRESSED	2.3	2.1		Y	Y	Y	Y	Y	5			
1072	OXYGEN, COMPRESSED	2.2	5.1		Y	Y	Y	Y	Y	10			s
1612	HEXAETHYL TETRAPHOSPHATE AND COMPRESSED GAS MIXTURE	2.3			Y	Y	Y	Y	Y	5			z
1660	NITRIC OXIDE, COMPRESSED	2.3	5.1,8	115	Y			Y		5	200	50	k, o
1953	COMPRESSED GAS, TOXIC, FLAMMABLE, N.O.S.	2.3	2.1		Y	Y	Y	Y	Y	5			z
1954	COMPRESSED GAS, FLAMMABLE, N.O.S	2.1			Y	Y	Y	Y	Y	10			z
1955	COMPRESSED GAS, TOXIC, N.O.S.	2.3			Y	Y	Y	Y	Y	5			z
1956	COMPRESSED GAS, N.O.S.	2.2			Y	Y	Y	Y	Y	10			z
1957	DEUTERIUM, COMPRESSED	2.1			Y	Y	Y	Y	Y	10			d
1964	HYDROCARBON GAS MIXTURE, COMPRESSED, N.O.S	2.1			Y	Y	Y	Y	Y	10			z
1971	METHANE, COMPRESSED or NATURAL GAS, COMPRESSED with high methane content	2.1			Y	Y	Y	Y	Y	10			
1979	RARE GASES MIXTURE, COMPRESSED	2.2			Y	Y	Y	Y	Y	10			
1980	RARE GASES AND OXYGEN MIXTURE, COMPRESSED	2.2			Y	Y	Y	Y	Y	10			
1981	RARE GASES AND NITROGEN MIXTURE, COMPRESSED	2.2			Y	Y	Y	Y	Y	10			
2034	HYDROGEN AND METHANE MIXTURE, COMPRESSED	2.1			Y	Y	Y	Y	Y	10			d
2190	OXYGEN DIFLUORIDE, COMPRESSED	2.3	5.1,8	2.6	Y			Y		5	200	30	a, k, n, o

Table of COMPRESSED GASES

¹ Where the entries are blank, the working pressure shall not exceed two thirds of the test pressure.

UN No.	Proper Shipping Name	Class or Division	Subsidiary Risk	LC ₅₀ ml/m ³	Cylinders	Tubes	Pressure drums	Bundles of cylinders	MEGCs	Test Period, years	Test Pressure, bar ¹	Working Pressure, bar ¹	Special Packing Provisions
2600	CARBON MONOXIDE AND HYDROGEN MIXTURE, COMPRESSED	2.3	2.1		Y	Y	Y	Y	Y	5			d, u
3156	COMPRESSED GAS, OXIDIZING, N.O.S.	2.2	5.1		Y	Y	Y	Y	Y	10			z
3303	COMPRESSED GAS, TOXIC, OXIDIZING, N.O.S.	2.3	5.1		Y	Y	Y	Y	Y	5			z
3304	COMPRESSED GAS, TOXIC, CORROSIVE, N.O.S.	2.3	8		Y	Y	Y	Y	Y	5			z
3305	COMPRESSED GAS, TOXIC, FLAMMABLE, CORROSIVE, N.O.S.	2.3	2.1,8		Y	Y	Y	Y	Y	5			z
3306	COMPRESSED GAS, TOXIC, OXIDIZING, CORROSIVE, N.O.S.	2.3	5.1,8		Y	Y	Y	Y	Y	5			z

Table of LIQUEFIED GASES AND DISSOLVED GASES

*This LC₅₀ value is under review

UN No.	Proper Shipping Name	Class or Division	Subsidiary Risk	LC ₅₀ ml/m ³	Cylinders	Pressure drums	Bundles of cylinders	Tubes	MEGCs	Test Period, years	Test Pressure, bar	Filling Ratio	Special Packing Provisions
1001	ACETYLENE, DISSOLVED	2.1			Y		Y			10	60 52		c, p
1005	AMMONIA, ANHYDROUS	2.3	8	4000	Y	Y	Y	Y	Y	5	33	0.53	b
1008	BORON TRIFLUORIDE	2.3	8	387*	Y	Y	Y	Y	Y	5	225 300	0.715 0.86	
1009	BROMOTRIFLUOROMETHANE (REFRIGERANT GAS R 13B1)	2.2			Y	Y	Y	Y	Y	10	42 120 250	1.13 1.44 1.60	
1010	BUTADIENES, STABILIZED (1,2-butadiene), or	2.1			Y	Y	Y	Y	Y	10	10	0.59	
1010	BUTADIENES, STABILIZED (1,3-butadiene), or	2.1			Y	Y	Y	Y	Y	10	10	0.55	
1010	BUTADIENES, STABILIZED (mixtures of 1,3-butadiene and hydrocarbons)	2.1			Y	Y	Y	Y	Y	10	10	0.50	z
1011	BUTANE	2.1			Y	Y	Y	Y	Y	10	10	0.51	v
1012	BUTYLENE (butylenes mixture) or	2.1			Y	Y	Y	Y	Y	10	10	0.50	z
1012	BUTYLENE (1-butylene) or	2.1			Y	Y	Y	Y	Y	10	10	0.53	
1012	BUTYLENE (cis-2-butylene) or	2.1			Y	Y	Y	Y	Y	10	10	0.55	
1012	BUTYLENE (trans-2 butylene)	2.1			Y	Y	Y	Y	Y	10	10	0.54	
1013	CARBON DIOXIDE	2.2			Y	Y	Y	Y	Y	10	190 250	0.66 0.75	
1015	CARBON DIOXIDE AND NITROUS OXIDE MIXTURE	2.2			Y	Y	Y	Y	Y	10	250	0.75	
1017	CHLORINE	2.3	8	293	Y	Y	Y	Y	Y	5	22	1.25	a
1018	CHLORODIFLUOROMETHANE (REFRIGERANT GAS R 22)	2.2			Y	Y	Y	Y	Y	10	29	1.03	
1020	CHLOROPENTAFLUOROETHANE (REFRIGERANT GAS R 115)	2.2			Y	Y	Y	Y	Y	10	25	1.08	
1021	1-CHLORO-1,2,2,2-TETRAFLUOROETHANE (REFRIGERANT GAS R 124)	2.2			Y	Y	Y	Y	Y	10	12	1.20	
1022	CHLOROTRIFLUOROMETHANE (REFRIGERANT GAS R 13)	2.2			Y	Y	Y	Y	Y	10	100 120 190 250	0.83 0.90 1.04 1.10	
1026	CYANOGEN	2.3	2.1	350	Y	Y	Y	Y	Y	5	100	0.70	u
1027	CYCLOPROPANE	2.1			Y	Y	Y	Y	Y	10	20	0.53	
1028	DICHLORODIFLUOROMETHANE (REFRIGERANT GAS R 12)	2.2			Y	Y	Y	Y	Y	10	18	1.15	
1029	DICHLOROFLUOROMETHANE (REFRIGERANT GAS R 21)	2.2			Y	Y	Y	Y	Y	10	10	1.23	

Table of LIQUEFIED GASES AND DISSOLVED GASES

*This LC₅₀ value is under review

UN No.	Proper Shipping Name	Class or Division	Subsidiary Risk	LC ₅₀ ml/m ³	Cylinders	Pressure drums	Bundles of cylinders	Tubes	ME/Cs	Test Period, years	Test Pressure, bar	Filling Ratio	Special Packing Provisions
1030	1,1-DIFLUOROETHANE (REFRIGERANT GAS R 152a)	2.1			Y	Y	Y	Y	Y	10	18	0.79	
1032	DIMETHYLAMINE, ANHYDROUS	2.1			Y	Y	Y	Y	Y	10	10	0.59	b
1033	DIMETHYL ETHER	2.1			Y	Y	Y	Y	Y	10	18	0.58	
1035	ETHANE	2.1			Y	Y	Y	Y	Y	10	95 120 300	0.25 0.29 0.39	
1036	ETHYLAMINE	2.1			Y	Y	Y	Y	Y	10	10	0.61	b
1037	ETHYL CHLORIDE	2.1			Y	Y	Y	Y	Y	10	10	0.80	a
1039	ETHYL METHYL ETHER	2.1			Y	Y	Y	Y	Y	10	10	0.64	
1040	ETHYLENE OXIDE, or ETHYLENE OXIDE WITH NITROGEN up to a total pressure of 1MPa (10 bar) at 50 °C	2.3	2.1	2900 *	Y	Y	Y	Y	Y	5	15	0.78	l
1041	ETHYLENE OXIDE AND CARBON DIOXIDE MIXTURE with more than 9% ethylene oxide but not more than 87%	2.1			Y	Y	Y	Y	Y	10	190 250	0.66 0.75	
1043	FERTILIZER AMMONIATING SOLUTION with free ammonia	2.2			Y	Y	Y			5			b, z
1048	HYDROGEN BROMIDE, ANHYDROUS	2.3	8	2860	Y	Y	Y	Y	Y	5	60	1.54	a, d
1050	HYDROGEN CHLORIDE, ANHYDROUS	2.3	8	2810 *	Y	Y	Y	Y	Y	5	100 120 150 200	0.30 0.56 0.67 0.74	a, d a, d a, d a, d
1053	HYDROGEN SULPHIDE	2.3	2.1	712	Y	Y	Y	Y	Y	5	55	0.67	d, u
1055	ISOBUTYLENE	2.1			Y	Y	Y	Y	Y	10	10	0.52	
1058	LIQUEFIED GASES, non- flammable, charged with nitrogen, carbon dioxide or air	2.2			Y	Y	Y	Y	Y	10	Test pressure = 1.5 x working pressure		
1060	METHYLACETYLENE AND PROPADIENE MIXTURE, STABILIZED or	2.1			Y	Y	Y	Y	Y	10			c, z
1060	METHYLACETYLENE AND PROPADIENE MIXTURE, STABILIZED (Propadiene with 1% to 4% methylacetylene)	2.1			Y	Y	Y	Y	Y	10	22	0.52	c
1061	METHYLAMINE, ANHYDROUS	2.1			Y	Y	Y	Y	Y	10	13	0.58	b
1062	METHYL BROMIDE	2.3		850	Y	Y	Y	Y	Y	5	10	1.51	a
1063	METHYL CHLORIDE (REFRIGERANT GAS R 40)	2.1			Y	Y	Y	Y	Y	10	17	0.81	a
1064	METHYL MERCAPTAN	2.3	2.1	1350	Y	Y	Y	Y	Y	5	10	0.78	d, u

Table of LIQUEFIED GASES AND DISSOLVED GASES

*This LC₅₀ value is under review

UN No.	Proper Shipping Name	Class or Division	Subsidiary Risk	LC ₅₀ ml/m ³	Cylinders	Pressure drums	Bundles of cylinders	Tubes	MEGCs	Test Period, years	Test Pressure, bar	Filling Ratio	Special Packing Provisions
1067	DINITROGEN TETROXIDE (NITROGEN DIOXIDE)	2.3	5.1,8	115	Y		Y			5	10	1.30	k
1069	NITROSYL CHLORIDE	2.3	8	35	Y		Y			5	13	1.10	k
1070	NITROUS OXIDE	2.2	5.1		Y	Y	Y	Y	Y	10	180 225 250	0.68 0.74 0.75	
1075	PETROLEUM GASES, LIQUEFIED	2.1			Y	Y	Y	Y	Y	10			v, z
1076	PHOSGENE	2.3	8	5	Y	Y	Y			5	20	1.23	k
1077	PROPYLENE	2.1			Y	Y	Y	Y	Y	10	30	0.43	
1078	REFRIGERANT GAS, N.O.S.	2.2			Y	Y	Y	Y	Y	10			z
1079	SULPHUR DIOXIDE	2.3	8	2520	Y	Y	Y	Y	Y	5	14	1.23	
1080	SULPHUR HEXAFLUORIDE	2.2			Y	Y	Y	Y	Y	10	70 140 160	1.04 1.33 1.37	
1081	TETRAFLUOROETHYLENE, STABILIZED	2.1			Y	Y	Y	Y	Y	10	200		m, o
1082	TRIFLUOROCHLOROETHYLENE, STABILIZED	2.3	2.1	2000	Y	Y	Y	Y	Y	5	19	1.13	u
1083	TRIMETHYLAMINE, ANHYDROUS	2.1			Y	Y	Y	Y	Y	10	10	0.56	b
1085	VINYL BROMIDE, STABILIZED	2.1			Y	Y	Y	Y	Y	10	10	1.37	a
1086	VINYL CHLORIDE, STABILIZED	2.1			Y	Y	Y	Y	Y	10	12	0.81	a
1087	VINYL METHYL ETHER, STABILIZED	2.1			Y	Y	Y	Y	Y	10	10	0.67	
1581	CHLOROPICRIN AND METHYL BROMIDE MIXTURE	2.3		850	Y	Y	Y	Y	Y	5	10	1.51	a
1582	CHLOROPICRIN AND METHYL CHLORIDE MIXTURE	2.3		*	Y	Y	Y	Y	Y	5	17	0.81	a
1589	CYANOGEN CHLORIDE, STABILIZED	2.3	8	80	Y		Y			5	20	1.03	k
1741	BORON TRICHLORIDE	2.3	8	2541	Y	Y	Y	Y	Y	5	10	1.19	
1749	CHLORINE TRIFLUORIDE	2.3	5.1,8	299	Y	Y	Y	Y	Y	5	30	1.40	a
1858	HEXAFLUOROPROPYLENE (REFRIGERANT GAS R 1216)	2.2			Y	Y	Y	Y	Y	10	22	1.11	
1859	SILICON TETRAFLUORIDE	2.3	8	450	Y	Y	Y	Y	Y	5	200 300	0.74 1.10	
1860	VINYL FLUORIDE, STABILIZED	2.1			Y	Y	Y	Y	Y	10	250	0.64	a
1911	DIBORANE	2.3	2.1	80	Y		Y			5	250	0.07	d, k, o
1912	METHYLCHLORIDE AND METHYLENE CHLORIDE MIXTURE	2.1			Y	Y	Y	Y	Y	10	17	0.81	a

Table of LIQUEFIED GASES AND DISSOLVED GASES

*This LC₅₀ value is under review

UN No.	Proper Shipping Name	Class or Division	Subsidiary Risk	LC ₅₀ ml/m ³	Cylinders	Pressure drums	Bundles of cylinders	Tubes	MEG/Cs	Test Period, years	Test Pressure, bar	Filling Ratio	Special Packing Provisions
1952	ETHYLENE OXIDE AND CARBON DIOXIDE MIXTURE with not more than 9% ethylene oxide	2.2			Y	Y	Y	Y	Y	10	190 250	0.66 0.75	
1958	1,2-DICHLORO-1,1,2,2-TETRAFLUOROETHANE (REFRIGERANT GAS R 114)	2.2			Y	Y	Y	Y	Y	10	10	1.30	
1959	1,1-DIFLUOROETHYLENE (REFRIGERANT GAS R 1132a)	2.1			Y	Y	Y	Y	Y	10	250	0.77	
1962	ETHYLENE	2.1			Y	Y	Y	Y	Y	10	225 300	0.34 0.37	
1965	HYDROCARBON GAS MIXTURE, LIQUEFIED, N.O.S.	2.1			Y	Y	Y	Y	Y	10			v, z
1967	INSECTICIDE GAS, TOXIC, N.O.S.	2.3			Y	Y	Y	Y	Y	5			z
1968	INSECTICIDE GAS, N.O.S.	2.2			Y	Y	Y	Y	Y	10			z
1969	ISOBUTANE	2.1			Y	Y	Y	Y	Y	10	10	0.49	v
1973	CHLORODIFLUOROMETHANE AND CHLOROPENTAFLUOROETHANE MIXTURE with fixed boiling point, with approximately 49% chlorodifluoromethane (REFRIGERANT GAS R 502)	2.2			Y	Y	Y	Y	Y	10	31	1.05	
1974	CHLORODIFLUOROBROMOMETHANE (REFRIGERANT GAS R 12B1)	2.2			Y	Y	Y	Y	Y	10	10	1.61	
1975	NITRIC OXIDE AND DINITROGEN TETROXIDE MIXTURE (NITRIC OXIDE AND NITROGEN DIOXIDE MIXTURE)	2.3	5.1,8	115	Y	Y	Y			5			k, z
1976	OCTAFLUOROCYCLOBUTANE (REFRIGERANT GAS RC 318)	2.2			Y	Y	Y	Y	Y	10	11	1.34	
1978	PROPANE	2.1			Y	Y	Y	Y	Y	10	25	0.42	v
1982	TETRAFLUOROMETHANE (REFRIGERANT GAS R 14)	2.2			Y	Y	Y	Y	Y	10	200 300	0.62 0.94	
1983	1-CHLORO-2,2,2-TRIFLUOROETHANE (REFRIGERANT GAS R 133a)	2.2			Y	Y	Y	Y	Y	10	10	1.18	
1984	TRIFLUOROMETHANE (REFRIGERANT GAS R 23)	2.2			Y	Y	Y	Y	Y	10	190 250	0.87 0.95	
2035	1,1,1-TRIFLUOROETHANE (REFRIGERANT GAS R 143a)	2.1			Y	Y	Y	Y	Y	10	35	0.75	
2036	XENON	2.2			Y	Y	Y	Y	Y	10	130	1.24	
2044	2,2-DIMETHYLPROPANE	2.1			Y	Y	Y	Y	Y	10	10	0.53	

Table of LIQUEFIED GASES AND DISSOLVED GASES

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UN No.	Proper Shipping Name	Class or Division	Subsidiary Risk	LC ₅₀ ml/m ³	Cylinders	Pressure drums	Bundles of cylinders	Tubes	MEGCs	Test Period, years	Test Pressure, bar	Filling Ratio	Special Packing Provisions
2073	AMMONIA SOLUTION, relative density less than 0.880 at 15 °C in water, With more than 35% but not more than 40% ammonia With more than 40% but not more than 50% ammonia	2.2				Y	Y	Y	Y	5	10	0.80	b
						Y	Y	Y	Y	5	12	0.77	b
2188	ARSINE	2.3	2.1	20	Y		Y			5	42	1.10	d, k
2189	DICHLOROSILANE	2.3	2.1,8	314	Y	Y	Y	Y	Y	5	10	0.90	
2191	SULPHURYL FLUORIDE	2.3		3020	Y	Y	Y	Y	Y	5	50	1.10	u
2192	GERMANE	2.3	2.1	620*	Y	Y	Y	Y	Y	5	250	1.02	d
2193	HEXAFLUOROETHANE (REFRIGERANT GAS R 116)	2.2			Y	Y	Y	Y	Y	10	200	1.10	
2194	SELENIUM HEXAFLUORIDE	2.3	8	50	Y		Y			5	36	1.46	k
2195	TELLURIUM HEXAFLUORIDE	2.3	8	25	Y		Y			5	20	1.00	k
2196	TUNGSTEN HEXAFLUORIDE	2.3	8	160*	Y		Y			5	10	2.70	a, k
2197	HYDROGEN IODIDE, ANHYDROUS	2.3	8	2860	Y	Y	Y	Y	Y	5	23	2.25	a, d
2198	PHOSPHORUS PENTAFLUORIDE	2.3	8	190*	Y		Y			5	200	0.90	k
											300	1.34	k
2199	PHOSPHINE	2.3	2.1	20	Y		Y			5	225	0.30	d, k
											250	0.45	d, k
2200	PROPADIENE, STABILIZED	2.1			Y	Y	Y	Y	Y	10	22	0.50	
2202	HYDROGEN SELENIDE, ANHYDROUS	2.3	2.1	2	Y		Y			5	31	1.60	k
2203	SILANE	2.1			Y	Y	Y	Y	Y	10	225	0.32	d, q
											250	0.36	d, q
2204	CARBONYL SULPHIDE	2.3	2.1	1700	Y	Y	Y	Y	Y	5	26	0.84	u
2417	CARBONYL FLUORIDE	2.3	8	360	Y	Y	Y	Y	Y	5	200	0.47	
											300	0.70	
2418	SULPHUR TETRAFLUORIDE	2.3	8	40	Y		Y			5	30	0.91	k
2419	BROMOTRIFLUOROETHYLENE	2.1			Y	Y	Y	Y	Y	10	10	1.19	
2420	HEXAFLUOROACETONE	2.3	8	470	Y	Y	Y	Y	Y	5	22	1.08	
2421	NITROGEN TRIOXIDE	2.3	5.1,8	57*	Y		Y			5			k
2422	OCTAFLUOROBUT-2-ENE (REFRIGERANT GAS R 1318)	2.2			Y	Y	Y	Y	Y	10	12	1.34	
2424	OCTAFLUOROPROPANE (REFRIGERANT GAS R 218)	2.2			Y	Y	Y	Y	Y	10	25	1.09	
2451	NITROGEN TRIFLUORIDE	2.2	5.1		Y	Y	Y	Y	Y	10	200	0.50	
											300	0.75	
2452	ETHYLACETYLENE, STABILIZED	2.1			Y	Y	Y	Y	Y	10	10	0.57	c

Table of LIQUEFIED GASES AND DISSOLVED GASES

*This LC₅₀ value is under review

UN No.	Proper Shipping Name	Class or Division	Subsidiary Risk	LC ₅₀ ml/m ³	Cylinders	Pressure drums	Bundles of cylinders	Tubes	MEG/Cs	Test Period, years	Test Pressure, bar	Filling Ratio	Special Packing Provisions
2453	ETHYL FLUORIDE (REFRIGERANT GAS R 161)	2.1			Y	Y	Y	Y	Y	10	30	0.57	
2454	METHYL FLUORIDE (REFRIGERANT GAS R 41)	2.1			Y	Y	Y	Y	Y	10	300	0.36	
2455	METHYL NITRITE	2.2											
2517	1-CHLORO-1,1-DIFLUOROETHANE (REFRIGERANT GAS R 142b)	2.1			Y	Y	Y	Y	Y	10	10	0.99	
2534	METHYLCHLOROSILANE	2.3	2.1,8	600	Y	Y	Y	Y	Y	5			z
2548	CHLORINE PENTAFLUORIDE	2.3	5.1,8	122	Y		Y			5	13	1.49	a, k
2599	CHLOROTRIFLUOROMETHANE AND TRIFLUOROMETHANE AZEOTROPIC MIXTURE with approximately 60% chlorotrifluoromethane (REFRIGERANT GAS R 503)	2.2			Y	Y	Y	Y	Y	10	31 42 100	0.11 0.20 0.66	
2601	CYCLOBUTANE	2.1			Y	Y	Y	Y	Y	10	10	0.63	
2602	DICHLORODIFLUOROMETHANE AND DIFLUOROETHANE AZEOTROPIC MIXTURE with approximately 74% dichlorodifluoromethane (REFRIGERANT GAS R 500)	2.2			Y	Y	Y	Y	Y	10	22	1.01	
2676	STIBINE	2.3	2.1	20	Y		Y			5	20	1.20	k
2901	BROMINE CHLORIDE	2.3	5.1,8	290	Y	Y	Y	Y	Y	5	10	1.50	a
3057	TRIFLUOROACETYL CHLORIDE	2.3	8	10*	Y	Y	Y			5	17	1.17	k
3070	ETHYLENE OXIDE AND DICHLORODIFLUOROMETHANE MIXTURE with not more than 12,5% ethylene oxide	2.2			Y	Y	Y	Y	Y	10	18	1.09	
3083	PERCHLORYL FLUORIDE	2.3	5.1	770	Y	Y	Y	Y	Y	5	33	1.21	k, u
3153	PERFLUORO(METHYL VINYL ETHER)	2.1			Y	Y	Y	Y	Y	10	20	0.75	
3154	PERFLUORO(ETHYL VINYL ETHER)	2.1			Y	Y	Y	Y	Y	10	10	0.98	
3157	LIQUEFIED GAS, OXIDIZING, N.O.S.	2.2	5.1		Y	Y	Y	Y	Y	10			z
3159	1,1,1,2-TETRAFLUOROETHANE (REFRIGERANT GAS R 134a)	2.2			Y	Y	Y	Y	Y	10	22	1.04	
3160	LIQUEFIED GAS, TOXIC, FLAMMABLE, N.O.S.	2.3	2.1		Y	Y	Y	Y	Y	5			z
3161	LIQUEFIED GAS, FLAMMABLE, N.O.S.	2.1			Y	Y	Y	Y	Y	10			z
3162	LIQUEFIED GAS, TOXIC, N.O.S.	2.3			Y	Y	Y	Y	Y	5			z

Table of LIQUEFIED GASES AND DISSOLVED GASES

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UN No.	Proper Shipping Name	Class or Division	Subsidiary Risk	LC ₅₀ ml/m ³	Cylinders	Pressure drums	Bundles of cylinders	Tubes	MEGCs	Test Period, years	Test Pressure, bar	Filling Ratio	Special Packing Provisions
3163	LIQUEFIED GAS, N.O.S.	2.2			Y	Y	Y	Y	Y	10			z
3220	PENTAFLUOROETHANE (REFRIGERANT GAS R 125)	2.2			Y	Y	Y	Y	Y	10	49 36	0.95 0.72	
3252	DIFLUOROMETHANE (REFRIGERANT GAS R 32)	2.1			Y	Y	Y	Y	Y	10	48	0.78	
3296	HEPTAFLUOROPROPANE (REFRIGERANT GAS R 227)	2.2			Y	Y	Y	Y	Y	10	15	1.20	
3297	ETHYLENE OXIDE AND CHLOROTETRAFLUOROETHANE MIXTURE with not more than 8.8% ethylene oxide	2.2			Y	Y	Y	Y	Y	10	10	1.16	
3298	ETHYLENE OXIDE AND PENTAFLUOROETHANE MIXTURE with not more than 7.9% ethylene oxide	2.2			Y	Y	Y	Y	Y	10	26	1.02	
3299	ETHYLENE OXIDE AND TETRAFLUOROETHANE MIXTURE with not more than 5.6% ethylene oxide	2.2			Y	Y	Y	Y	Y	10	17	1.03	
3300	ETHYLENE OXIDE AND CARBON DIOXIDE MIXTURE with more than 87% ethylene oxide	2.3	2.1	More than 2900	Y	Y	Y	Y	Y	5	28	0.73	
3307	LIQUEFIED GAS, TOXIC, OXIDIZING, N.O.S.	2.3	5.1		Y	Y	Y	Y	Y	5			z
3308	LIQUEFIED GAS, TOXIC, CORROSIVE, N.O.S.	2.3	8		Y	Y	Y	Y	Y	5			z
3309	LIQUEFIED GAS, TOXIC, FLAMMABLE, CORROSIVE, N.O.S.	2.3	2.1,8		Y	Y	Y	Y	Y	5			z
3310	LIQUEFIED GAS, TOXIC, OXIDIZING, CORROSIVE, N.O.S.	2.3	5.1,8		Y	Y	Y	Y	Y	5			z
3318	AMMONIA SOLUTION, relative density less than 0.880 at 15 °C in water, with more than 50% ammonia	2.3	8		Y	Y	Y	Y		5			b
3337	REFRIGERANT GAS R 404A	2.2			Y	Y	Y	Y	Y	10	36	0.82	
3338	REFRIGERANT GAS R 407A	2.2			Y	Y	Y	Y	Y	10	36	0.94	
3339	REFRIGERANT GAS R 407B	2.2			Y	Y	Y	Y	Y	10	38	0.93	
3340	REFRIGERANT GAS R 407C	2.2			Y	Y	Y	Y	Y	10	35	0.95	
3354	INSECTICIDE GAS, FLAMMABLE, N.O.S.	2.1			Y	Y	Y	Y	Y	10			z
3355	INSECTICIDE GAS, TOXIC, FLAMMABLE, N.O.S.	2.3	2.1		Y	Y	Y	Y	Y	5			z
3374	ACETYLENE, SOLVENT FREE	2.1			Y		Y			5	60 52		c, p

Table of SUBSTANCES NOT IN CLASS 2

*This LC₅₀ value is under review

** A minimum ullage of 8% by volume is required

UN No.	Proper Shipping Name	Class or Division	Subsidiary Risk	LC ₅₀ ml/m ³	Cylinders	Pressure drums	Bundles of cylinders	Tubes	MEG/Cs	Test Period, years	Test Pressure, bar	Filling Ratio	Special Packing Provisions
1051	HYDROGEN CYANIDE, STABILIZED containing less than 3% water	6.1	3	140	Y		Y			5	100	0.55	k
1052	HYDROGEN FLUORIDE, ANHYDROUS	8	6.1	966*	Y	Y	Y			5	10	0.84	
1745	BROMINE PENTAFLUORIDE	5.1	6.1,8	25*	Y		Y			5	10	**	k
1746	BROMINE TRIFLUORIDE	5.1	6.1,8	180	Y		Y			5	10	**	k
2495	IODINE PENTAFLUORIDE	5.1	6.1,8	120	Y		Y			5	10	**	k
2983	ETHYLENE OXIDE AND PROPYLENE OXIDE MIXTURE, not more than 30% ethylene oxide	3	6.1		Y	Y	Y			5	10		z

P203	PACKING INSTRUCTION	P203
[reserved for cryogenic receptacles]		

Proposal 4

The existing provisions on the leakproofness test for aerosols under 6.2.2 should be renumbered.

6.2 Requirements for the construction and testing of pressure receptacles

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 normal conditions of transport.

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

6.2.1.1.3 ~~Pressure receptacles and their closures shall be made of materials consistent with those specified in the design and construction technical standards and the applicable packing instruction for the gas(es) intended for transport in the pressure receptacle. The materials shall be resistant to brittle fracture and to stress corrosion cracking as indicated in the design and construction technical standards. Any additional thickness used for the purpose of providing a corrosion allowance shall not be taken into consideration in calculating the thickness of the walls. In no case shall the minimum wall thickness be less than that specified in the design and construction technical standards.~~

6.2.1.1.4 For welded pressure receptacles, only metals of weldable quality shall be used.

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

- (a) The mechanical properties of the metal used shall be established for each pressure receptacle at the initial inspection, including the impact strength and the bending coefficient;
- (b) 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 evacuated of air (vacuum-insulation), the protective sheathing shall be designed to withstand without permanent 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.

6.2.1.1.6 The test pressure of cylinders, tubes, pressure drums and bundles of cylinders shall be in accordance with P200. The test pressure for closed cryogenic receptacles shall be in accordance with P203.

6.2.1.1.7 Pressure receptacles assembled in bundles shall be structurally supported and held together as a unit. Pressure receptacles shall be secured in a manner that prevents movement in relation to the

structural assembly and movement that would result in the concentration of harmful local stresses. Manifolds shall be designed such that they are protected from impact. For Division 2.3 liquefied gases, means shall be provided to ensure that each pressure receptacle can be separately charged and that no interchange of pressure receptacle contents can occur during transport.

6.2.1.2 Materials

6.2.1.2.1 Construction materials of pressure receptacles and their closures which are in direct contact with dangerous goods shall not be affected or ~~significantly~~ weakened by the dangerous goods intended and shall not cause a dangerous effect e.g. catalysing a reaction or reacting with the dangerous goods.

6.2.1.2.2 ~~Under all service conditions, the construction material shall resist brittle fracture at the lowest working temperature of the receptacle and its fittings.~~ Pressure receptacles and their closures shall be made of materials consistent with those specified in the design and construction technical standards and the applicable packing instruction for the gas(es) substances intended for transport in the pressure receptacle. The materials shall be resistant to brittle fracture and to stress corrosion cracking as indicated in the design and construction technical standards. (Editorial note for translators: this text previously appeared in 6.2.1.1.3.)

~~6.2.1.2.3 Aluminium alloys shall meet the intercrystalline and stress corrosion tests specified in ISO 7866 :1999.~~

6.2.1.3 Service equipment

6.2.1.3.1 Except for pressure relief devices, valves, piping, fittings and other equipment subjected to pressure, shall be designed and constructed to withstand at least 1.5 times the test pressure of the pressure receptacles.

6.2.1.3.2 Service equipment shall be configured or designed to prevent damage that could result in the release of the pressure receptacle contents during normal conditions of handling and transport. Manifold piping leading to shut-off valves shall be sufficiently flexible to protect the valves and the piping from shearing or releasing the pressure receptacle contents. The filling and discharge valves and any protective caps shall be capable of being secured against unintended opening. Valves shall be protected as specified in section 4.1.6.1.8.

6.2.1.3.3 Pressure receptacles which are not capable of being handled 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 pressure receptacle.

6.2.1.3.4 Individual pressure receptacles shall be equipped with approved pressure relief devices as required in P200(1) or as specified by the country of use. When fitted, pressure relief devices on manifolded horizontal pressure receptacles filled with flammable gas shall be arranged to discharge freely to the open air in such a manner as to prevent any impingement of escaping gas upon the pressure receptacles under normal conditions of transport.

[6.2.1.3.5 Reserved for Cryogenic receptacles]

6.2.1.3.6 Pressure receptacles whose filling is measured by volume shall be provided with a level indicator.

6.2.1.4 Initial inspection and test

6.2.1.4.1 New pressure receptacles shall be subjected to testing and inspection during and after manufacture in accordance with the applicable design standards including 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) Verification of the homogeneity of the material for each manufacturing batch, and inspection of the external and internal conditions of the pressure receptacles;
- (d) Inspection of the neck threads;
- (e) Verification of the conformance with the design standard;

For all pressure receptacles:

- (f) A hydraulic pressure test. Pressure receptacles shall withstand the test pressure without expansion greater than that allowed in the design specification;

NOTE : With the agreement of the inspection body, the hydraulic pressure test may be replaced by a test using a gas, where such an operation does not entail any danger.

- (g) Inspection and assessment of manufacturing defects and either repairing them or rendering the pressure receptacles unserviceable.
- (h) An inspection of the markings on the pressure receptacles;
- (i) In addition, pressure receptacles intended for the transport of acetylene, dissolved, UN 1001, and acetylene, solvent free, UN 3374 shall be inspected to ensure proper installation and condition of the porous material and the quantity of solvent.

6.2.1.5 Periodic inspection and test

6.2.1.5.1 Refillable pressure receptacles, other than cryogenic receptacles, shall be subjected to periodic inspections and tests under the supervision of an inspection body, 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) Checking of the neck threads;
- (d) A hydraulic pressure test and, if necessary, verification of the characteristics of the material by suitable tests.

NOTE 1: With the agreement of the inspection body, 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 inspection body and/or~~ the competent authority, the hydraulic pressure test of cylinders and tubes may be replaced by an equivalent method based on acoustic emission or ultrasound.

6.2.1.5.2 For pressure receptacles intended for the transport of acetylene, dissolved, UN 1001, and acetylene, solvent free, UN 3374, only the external condition (corrosion, deformation) and the condition of the porous mass (loosening, settlement) ~~needs~~ shall be required to be examined.

6.2.1.5.3 Closed cryogenic pressure receptacles shall be inspected to verify external conditions, condition and operation of pressure relief devices and the legibility and adequacy of the markings. The thermal insulation need not be removed.

~~6.2.1.5.4 Non-refillable pressure receptacles shall not be subject to periodic inspection requirements.~~

6.2.1.6 ***Approval of pressure receptacles***

6.2.1.6.1 The conformity of pressure receptacles shall be assessed at time of manufacture as required by the competent authority. Pressure receptacles shall be inspected, tested and approved by an inspection body. The technical documentation shall include full specifications on design and construction, and full documentation on the manufacturing and testing.

6.2.1.6.2 Quality assurance systems shall conform to the requirements of the competent authority.

6.2.1.7 ***Requirements for manufacturers***

6.2.1.7.1 The manufacturer shall be technically able and shall possess all resources 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; and
- (c) to carry out the relevant tests.

6.2.1.7.2 The proficiency test of a manufacturer shall in all instances be carried out by an inspection body approved by the competent authority of the country of approval.

6.2.1.8 ***Requirements for inspection bodies***

6.2.1.8.1 Inspection bodies shall be independent from manufacturing enterprises and competent to perform the tests, inspections and approvals required.

6.2.2 Requirements for UN certified pressure receptacles

In addition to the general requirements of section 6.2.1, UN certified pressure receptacles shall comply with the requirements of this section, including the standards, as applicable.

Note: With the agreement of the competent authority, more recently published versions of the standards, if available, may be used.

6.2.2.1 Design, construction and initial inspection and test

6.2.2.1.1 The following standards apply for the design, construction, and initial inspection and test of UN certified cylinders:

ISO 9809-1:1999	Gas cylinders – Refillable seamless steel gas cylinders - Design, construction and testing - Part 1: Quenched and tempered steel cylinders with tensile strength less than 1100 MPa <i>Note: The note concerning the F factor in section 7.3 of this standard shall not be applied for UN certified cylinders.</i>
ISO 9809-2:2000	Gas cylinders – Refillable seamless steel gas cylinders - Design, construction and testing - Part 2: Quenched and tempered steel cylinders with tensile strength greater than or equal to 1100 MPa
ISO 9809-3:2000	Gas cylinders – Refillable seamless steel gas cylinders - Design, construction and testing - Part 3: Normalized steel cylinders
ISO 7866:1999	Gas cylinders – Refillable seamless aluminium alloy gas cylinders – Design, construction and testing <i>Note: The note concerning the F factor in section 7.2 of this standard shall not be applied for UN certified cylinders. Aluminium alloy 6351A – T6 or equivalent is <u>shall not be</u> authorized.</i>
ISO 3807 1:2000	Cylinders for acetylene – Basic requirements – Part 1: Cylinders without fusible plugs
ISO 3807 2:2000	Cylinders for acetylene – Basic requirements – Part 2: Cylinders with fusible plugs
ISO 11118:1999	<u>Gas cylinders</u> – Non-refillable metallic gas cylinders - Specification and test methods

6.2.2.1.2 The following standards apply for the design, construction, and initial inspection and test of UN certified tubes:

ISO 11120:1999	Gas cylinders – Refillable seamless steel tubes of water capacity between 150l and 3000l – Design, construction and testing <i>Note: The note concerning the F factor in section 7.1 of this standard shall not be applied for UN certified tubes</i>
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6.2.2.1.3 The following standards apply for the design, construction and initial inspection and test of UN certified acetylene cylinders:

For the cylinder shell:

<u>ISO 9809-1:1999</u>	<u>Gas cylinders – Refillable seamless steel gas cylinders - Design, construction and testing – Part 1: Quenched and tempered steel cylinders with tensile strength less than 1100 MPa</u> <i><u>Note: The note concerning the F factor in section 7.3 of this standard shall not be applied for UN certified cylinders.</u></i>
<u>ISO 9809-3:2000</u>	<u>Gas cylinders – Refillable seamless steel gas cylinders - Design, construction and testing – Part 3: Normalized steel cylinders</u>
<u>ISO 7866:1999</u>	<u>Gas cylinders – Refillable seamless aluminium alloy gas cylinders – Design, construction and testing</u> <i><u>Note: The note concerning the F factor in section 7.2 of this standard shall not be applied for UN certified cylinders.</u></i> <i><u>Aluminium alloy 6351A – T6 or equivalent is shall not be authorized.</u></i>
<u>ISO 11118:1999</u>	<u>Gas cylinders – Non-refillable metallic gas cylinders - Specification and test methods</u>

For the porous mass in the cylinder:

<u>ISO 3807-1:2000</u>	<u>Cylinders for acetylene – Basic requirements - Part 1: Cylinders without fusible plugs</u>
<u>ISO 3807-2:2000</u>	<u>Cylinders for acetylene – Basic requirements - Part 2: Cylinders with fusible plugs</u>

6.2.2.2 Materials

In addition to the material requirements specified in the pressure receptacle design and construction standards, and any restrictions specified in the applicable packing instruction for the gas(es) to be transported (e.g. P200), the following standards apply to material compatibility:

<u>ISO 11114-1:1997</u>	<u>Transportable gas cylinders – Compatibility of cylinder and valve materials with gas contents – Part 1: Metallic materials</u>
<u>ISO 11114-2:2000</u>	<u>Transportable gas cylinders – Compatibility of cylinder and valve materials with gas contents – Part 2: Non-metallic materials</u>

6.2.2.3 Service equipment

The following standards apply to closures and their protection:

<u>ISO 11117:1998</u>	<u>Gas cylinders - Valve protection caps and valve guards for industrial and medical gas cylinders- Design, construction and tests</u>
<u>ISO 10297:1999</u>	<u>Gas cylinders –Refillable gas cylinder valves - Specification and type testing.</u>

6.2.2.4 Periodic inspection and test

The following standards apply to the periodic inspection and testing of UN certified cylinders:

ISO 6046:1992	Periodic inspection and testing of seamless steel gas cylinders
ISO 10461:1993	Seamless aluminium - alloy gas cylinders - Periodic inspection and testing
ISO 10462:1994 1993	Cylinders for dissolved acetylene – Periodic inspection and maintenance

6.2.2.5 ~~Quality conformance~~ Conformity assessment system and for approval of pressure receptacles and requirements for manufacturers and inspection bodies

Note: This section describes an international quality conformance system that ensures and documents compliance to relevant pressure receptacle design and manufacturing standards and the requirements in these model regulations. The text is generally adopted from ISO/TR 14600:2000.

6.2.2.5.1 Definitions

For the purposes of this section:

~~Quality conformance~~ Conformity assessment system means a system for ~~overall approval by the competent authority approval of a manufacturer~~, by ~~inclusive of~~ pressure receptacle design type approval, approval of manufacturer's quality system, ~~approval of manufacturers~~, and approval of inspection bodies;

~~Accreditation body~~ means a body ~~approved by the competent authority having authority for the approval of inspection bodies~~;

Note: This may be the competent authority or a different entity.

~~Quality system~~ means the organisational structure, procedures, processes, and resources needed to implement quality management;

Verify means confirm by examination or provision of objective evidence that specified requirements have been fulfilled;

Design type means a pressure receptacle design as specified by a particular pressure receptacle standard, e.g. ISO 7866, ISO 9809-1, ISO 9809-2, etc.

6.2.2.5.2 General requirements

~~6.2.2.5.2.1~~ Framework ~~Competent Authority~~

~~6.2.2.5.2.1~~ The competent authority that approves the pressure receptacle shall approve the conformity assessment system for the purpose of ensuring that pressure receptacles conform to the requirements of these model regulations. In instances where the competent authority that approves a pressure receptacle is not the competent authority in the country of manufacture, the marks of the approval country and the country of manufacture shall be indicated in the pressure receptacle marking (see 6.2.2.6 and 6.2.2.7). ~~in the country of manufacture shall be responsible for ensuring the implementation of this quality conformance system in accordance with national law.~~

Note: The country of approval (authorising the UN marking) may be different from the country of manufacture, if for example, this quality conformance system is not in place in the country of manufacture.

~~6.2.2.5.2.1.2~~—The competent authority of a the country of ~~pressure receptacle manufacture~~ approval shall supply, upon request, evidence demonstrating compliance to this ~~quality conformance~~ conformity assessment system to its counterpart in a country of use.

~~6.2.2.5.2.1.3~~—It is ~~the objective that the competent authority in the country of use shall accept for filling, transport, use, and refilling, pressure receptacles which have been certificated in accordance with the requirements of this quality conformance system, provided the relevant design standard has been ratified by that country.~~

~~6.2.2.5.2.1.4~~—Where the competent authority in a country of use believes, on reasonable grounds, that the applicable pressure receptacle standard or the quality conformance system has not been complied with or that certain pressure receptacles present a danger to public safety, it shall take appropriate steps to ensure an acceptable level of safety. The competent authority shall define what actions are required to enable the pressure receptacles to be acceptable. The affected pressure receptacles may be detained, condemned, re-exported, re-examined, or subject to such other actions as the competent authority stipulates.

~~6.2.2.5.2.1.2~~ The competent authority ~~shall retain its authority, but~~ may delegate its functions in this ~~quality conformance~~ conformity assessment system in whole or in part ~~to a qualified entity of its choice.~~

~~6.2.2.5.2.1.3~~ The competent authority, ~~or its delegated entity,~~ shall ensure that a current list of approved inspection bodies and their identity marks and approved manufacturers and their identity marks is available.

- ~~(a) be knowledgeable of relevant pressure receptacle standards;~~
- ~~(b) have a staff sufficient in number, technical competence, and skill to adequately carry out its supervisory and administrative responsibilities;~~
- ~~(c) when operating its own inspection and testing activities, ensure that these activities conform with the stipulations given for inspection bodies and testing laboratories in 6.2.2.5.2.2 (inspection body) and 6.2.2.5.2.4 (testing laboratory);~~
- ~~(d) not require additional tests and results thereof in excess of those specified in the relevant standard, unless there is evidence of undue risk to public;~~
- ~~(e) approve inspection bodies and make available a current list of approved inspection bodies and their identity mark;~~

~~*Note: This activity may be undertaken by an accreditation body, as authorised by the competent authority. ISO/IEC TR 17010:1998 may be used for guidance.*~~

- ~~(f) ensure confidentiality of the commercial and proprietary activities of the inspection bodies and manufacturers;~~
- ~~(g) provide a system for identification of the manufacturer for each pressure receptacle; and~~
- ~~(h) be free from any influence which could prevent it from operating in an impartial manner.~~

~~6.2.2.5.2.2~~ Inspection body

~~6.2.2.5.2.2.14~~ The inspection body shall be approved by the competent authority ~~or the accreditation body, if applicable~~, as an inspector of pressure receptacles and

~~The inspection body may be an integral part of the competent authority or a separate body, domestic or foreign.~~

~~An inspection body shall apply for approval to the competent authority or the accreditation body, if applicable, of the country of manufacture. Such application shall include detailed and complete information on the inspection body's organisation, staffing, documented quality system, technical competence, inspection methods and procedures, records and reports, confidentiality and security, related to inspection of pressure receptacles and a manufacturer's quality system.~~

~~*Note: The competent authority of the country of manufacture may accept an approval of an inspection body by another competent authority.*~~

~~The inspection body may use the manufacturer's testing laboratory or the manufacturer's selected testing laboratory.~~

~~The inspection body may delegate certain functions in accordance with 6.2.2.5.4.15.~~

~~6.2.2.5.2.2.26~~ The general requirements for an inspection body shall be as follows:

- (a) have a staff with an organisational structure, capable, trained, competent, and skilled, to satisfactorily perform its technical functions;
- (b) have access to suitable and adequate facilities and equipment;
- (c) operate in an impartial manner and be free from any influence which could prevent it from doing so;
- (d) ensure confidentiality of the commercial and proprietary activities of the manufacturer and other bodies;
- (e) maintain clear demarcation between actual inspection body functions and unrelated functions;
- (f) operate a documented quality system;
- (g) ensure that the tests and inspections specified in the relevant pressure receptacle standard and these model regulations are performed; and
- (h) maintain an effective and appropriate report and record system in accordance with 6.2.2.5.56 (records).
- ~~(i) to require a written and accepted order before providing its services to a client; and~~
- ~~(j) to provide the competent authority with their registered identity mark.~~

~~Note: ISO/IEC 17020:1998 or ISO Guide 65:1996 may be used for guidance.~~

6.2.2.5.2.5 The ~~services of an~~ inspection body shall perform ~~be required by manufacturers in~~ design type approval, pressure receptacle production testing and inspection, and certification to verify conformity with the relevant pressure receptacle standard (see 6.2.2.5.34 (approval process) and 6.2.2.5.45 (production inspection and certification)).

~~6.2.2.5.2.3~~ — **Manufacturer**

~~6.2.2.5.2.3.16~~ The manufacturer shall

- (a) operate a documented quality system in accordance with 6.2.2.5.3.4;
- (b) apply for design type approvals in accordance with 6.2.2.5.3 4 (approval process);
- (c) select an inspection body from the list of approved inspection bodies maintained by the competent authority in the country of approval; and
- (d) maintain records in accordance with 6.2.2.5.56 (records).

~~6.2.2.5.2.3.2~~ — The manufacturer shall ~~apply for design type approvals in accordance with 6.2.2.5.3~~ (approval process).

~~6.2.2.5.2.3.3~~ — The manufacturer shall ~~select an inspection body from the list of approved inspection bodies maintained by the competent authority.~~

~~6.2.2.5.2.3.4~~ — The manufacturer may use his own testing laboratory or select a testing laboratory, subject to approval by the inspection body.

~~6.2.2.5.2.3.5~~ — The manufacturer shall ~~maintain records in accordance with 6.2.2.5.5~~ (records).

~~6.2.2.5.2.4~~ — **Testing Laboratory**

~~6.2.2.5.2.4.17~~ The testing laboratory, ~~or the function it performs,~~ may be an integral part of the manufacturer, the competent authority, the inspection body, or a separate body, domestic or foreign. ~~The services of a testing laboratory other than the one chosen by the manufacturer shall be required in cases where the testing capabilities are deemed by the inspection body to be insufficient.~~

~~6.2.2.5.2.4.2~~ — The general requirements for a testing laboratory shall have ~~be~~ as follows:

- (a) ~~to have a~~ staff with an organisational structure, sufficient in number, competence, and skill ~~to perform the tests; and~~
- (b) ~~to have~~ suitable and adequate facilities and equipment ~~to satisfactorily perform its technical functions;~~
to perform the tests required by the manufacturing standard to the satisfaction of the inspection body.
- (c) ~~to generate an appropriate report and record and transmit copy to the inspection body and the manufacturer;~~
- (d) ~~to ensure that accurate measuring and testing equipment is used in the laboratory through initial and periodic calibration to the required level;~~

- ~~_____ (e) to ensure that the environment in which the tests are undertaken does not invalidate the test results or adversely affect the required accuracy of measurement; and~~
- ~~_____ (f) to require a written and accepted order before providing its services to a client.~~

~~*Note: ISO/IEC 17025:1999 may be used for guidance.*~~

6.2.2.5.3.4.3 Manufacturer's quality system

6.2.2.5.3.4.1 ~~The quality system documentation~~ The quality system shall contain all the elements, requirements, and provisions adopted by the manufacturer. It shall be documented in a systematic and orderly manner in the form of written policies, procedures and instructions.

The contents shall in particular include adequate descriptions of:

- (a) the organisational structure, responsibilities, and power of the management with regard to design and product quality;
- (b) the design control and design verification techniques, processes, and systematic actions that will be used when designing the pressure receptacles;
- (c) the relevant pressure receptacle manufacturing, quality control, quality assurance, and process operation instructions that will be used;
- (d) quality records, such as inspection reports, test data, and calibration data;
- (e) management reviews to ensure the effective operation of the quality system arising from the audits in accordance with 6.2.2.5.3.4.2 (audit of the quality system);
- (f) the process describing how customer requirements are met;
- (g) the process for control of documents and their revision;
- (h) the means for control of non-conforming pressure receptacles, purchased components, in-process and final materials; and
- (i) training programmes for relevant personnel.

6.2.2.5.3.4.2 Audit of the quality system

The quality system shall be initially assessed to determine whether it meets ~~satisfies, to the satisfaction of the competent authority,~~ the requirements referred to in 6.2.2.5.3.4.1 ~~(quality system documentation)~~ to the satisfaction of the competent authority.

~~The purpose of the audit shall be to ensure that the manufacturer duly fulfils the obligations resulting from the approved quality system.~~

~~For audit purposes, the manufacturer shall provide unrestricted access to the locations of design, manufacture, service, inspection, testing, and storage, and shall provide all necessary information and documentation.~~

The manufacturer shall be notified of the results of the audit. The notification shall contain the conclusions of the audit and any corrective actions required.

Periodic audits shall be carried out, to the satisfaction of the competent authority, to ensure that the manufacturer maintains and applies the quality system. Reports of the periodic audits shall be provided to the manufacturer.

6.2.2.5.3.4.3. *Maintenance of the quality system*

The manufacturer shall ~~undertake to fulfil the obligations resulting from the quality system as approved and to maintain the quality system as approved~~ in order that it remains adequate and efficient.

The manufacturer shall notify the competent authority that approved the quality system, of any intended changes. The proposed changes shall be evaluated in order to determine whether the amended quality system will still satisfy the requirements ~~referred to in 6.2.2.5.3.4.1 1 (quality system documentation), or whether a reassessment is required, to the satisfaction of the competent authority.~~

Note: Certified quality systems, such as the ISO 9000 series, may be accepted by the competent authority when assessing the quality system according to 6.2.2.5.3.4 (manufacturer's quality system). ISO Guide 61:1996 and ISO Guide 62:1996 may be used for guidance.

6.2.2.5.43 *Approval process*

~~6.2.2.5.3.1~~ Layout of the approval process

~~The approval process for the manufacture of pressure receptacles shall consist of the following steps:~~

- ~~_____ (a) application for initial design type approval (6.2.2.5.3.2);~~
- ~~_____ (b) application for subsequent design type approval (6.2.2.5.3.3), if it follows an initial design type approval;~~
- ~~_____ (c) quality system procedures (6.2.2.5.3.4);~~
- ~~_____ (d) design type approval procedures (6.2.2.5.3.5).~~

~~6.2.2.5.3.2~~ Application for Initial design type approval

~~6.2.2.5.3.2.14.1~~ The initial design type approval shall consist of approval of the manufacturer's quality system and approval of the pressure receptacle design to be produced. An application for an initial design type approval shall encompass the requirements of 6.2.2.5.3.2.2 ~~to 6.2.2.5.4.6 (application for initial design type approval), 6.2.2.5.3 (manufacturer's quality system), and 6.2.2.5.3.5.9 (procedure for design type approval).~~

~~6.2.2.5.3.2.24.2A~~ A manufacturer desiring to produce pressure receptacles in accordance with a pressure receptacle standard and these model regulations shall apply for, obtain, and retain a Design Type Approval Certificate issued by the competent authority in the country of ~~manufacture~~ approval for at least one pressure receptacle design type in accordance with the procedure given in 6.2.2.5.3.2.34.2. This written approval shall, on request, be submitted to the competent authority of the country of use.

6.2.2.5.3.2.3.4.3 ~~An~~ The application shall be made for each manufacturing facility ~~by the manufacturer to the competent authority of the country of manufacture~~ and shall include:

- (a) the name and registered address of the manufacturer and in addition, if the application is submitted by an authorised representative, its name and address;
- (b) the address of the manufacturing facility (if different from the above);
- (c) the name and title of the person(s) responsible for the quality system;
- (d) the designation of the pressure receptacle and the relevant pressure receptacle standard;

~~Note: The criteria for determining the design type are provided in the applicable pressure receptacle standard.~~

- (e) ~~a written declaration that the same application has not been submitted and denied by any other competent authority~~ details of any refusal of approval of a similar application by any other competent authority;
- (f) ~~the technical documentation required for design type approval according to 6.2.2.5.3.2.4;~~
- (f) the ~~name~~ identity of the inspection body for design type approval;
- (g) documentation on the manufacturing facility as specified under 6.2.2.5.3.4.1 ~~(quality system documentation)~~ and
- (h) the technical documentation required for design type approval ~~6.2.2.5.3.3 2.4~~ ~~The technical documentation for design type approval~~ which shall enable verification of the conformity of the pressure receptacles with the requirements of the relevant pressure receptacle design standard. It shall cover the design and method of manufacture and shall contain, as far as is relevant for assessment, at least the following:
 - (i) pressure receptacle design standard, design and manufacturing drawings, showing components and subassemblies, if any;
 - (ii) descriptions and explanations necessary for the understanding of the drawings and intended use of the pressure receptacles;
 - (iii) a list of the standards necessary to fully define the manufacturing process;
 - (iv) design calculations and material specifications; and
 - (v) design type approval test reports, describing the results of examinations and tests carried out in accordance with 6.2.2.5.3.5.1 4.9.

6.2.2.5.3.2.5.4.4 An initial audit in accordance with 6.2.2.5.3.4.2 2(audit of the quality system) shall be performed to the satisfaction of the competent authority.

~~6.2.2.5.3.2.6~~ 4.5 If the manufacturer is denied approval, the competent authority shall provide written detailed reasons for such denial.

~~6.2.2.5.3.2.7~~ 4.6 Following approval, changes to the information submitted under ~~6.2.2.5.3.2.2~~ 4.2 relating to the initial approval shall be provided to the competent authority.

~~6.2.2.5.3.3~~ Application for *Subsequent design type approvals*

~~6.2.2.5.3.3.1~~ 4.7 An application for a subsequent design type approval shall encompass the requirements of ~~6.2.2.5.3.3.4.8 (application for subsequent design type approvals)~~ and ~~6.2.2.5.3.5~~ 4.9 (procedure for design type approval), provided a manufacturer is in the possession of an initial design type approval. In such a case, the manufacturer's quality system according to ~~6.2.2.5.3.4~~ (manufacturer's quality system) shall have been approved during the initial design type approval and shall be applicable for the new design.

~~6.2.2.5.3.3.2~~ 4.8 The application shall include:

- (a) the name and address of the manufacturer and in addition, if the application is submitted by an authorised representative, its name and address;
- (b) ~~a written declaration that the same application has not been submitted and denied by any other competent authority~~ details of any refusal of approval of a similar application by any other competent authority;
- (c) evidence that initial design type approval has been granted; and
- (d) the technical documentation, as described in ~~6.2.2.5.3.2.4~~ 4.3(h).

~~6.2.2.5.3.5~~ Procedure for design type approval

~~6.2.2.5.3.5.14.9~~ ~~Inspection body~~ The inspection body shall:

- (a) examine the technical documentation to verify that:
 - (i) the design is in accordance with the relevant provisions of the standard, and
 - (ii) the prototype lot has been manufactured in conformity with the technical documentation and is representative of the design;
- (b) verify that the production inspections have been carried out as required in accordance with ~~6.2.2.5.4.5~~ (production inspection and ~~inspection~~ certification);
- (c) ~~randomly~~ select pressure receptacles from a prototype production lot and supervise the tests of these pressure receptacles as required for design type approval;
- (d) perform or have performed the examinations and tests specified in the pressure receptacle standard to determine that:
 - (i) the standard has been applied and fulfilled, and

- (ii) the procedures adopted by the manufacturer meet the requirements of the standard; and
- (e) ensure that the various type approval examinations and tests are correctly and competently carried out.

~~6.2.2.5.3.5.2 Recommendations~~ After prototype testing has been carried out with satisfactory results and all applicable requirements of 6.2.2.5.4 have been satisfied, ~~the inspection body shall recommend to the competent authority that the manufacturer be issued a Design Type Approval Certificate shall be issued and shall include~~ The recommendation shall contain the name and address of the manufacturer, results and conclusions of the examination, and the necessary data for identification of the design type.

~~After these examinations and tests have been performed with acceptable results, the competent authority shall issue a written approval to the manufacturer with a Design Type Approval Certificate for each design type that is approved, including the authorisation to affix the pressure receptacle certification marking to each pressure receptacle manufactured and approved. A list of the relevant parts of the technical documentation shall be annexed to the Design Type Approval Certificate.~~

If the manufacturer is denied a design type certification, the competent authority shall provide written detailed reasons for such denial.

~~*Note: In the case where the competent authority has delegated its authority to the inspection body, the Design Type Approval Certificate may be issued directly to the manufacturer, with a copy to the competent authority.*~~

6.2.2.5.3.5.3.4.10 Modifications to approved design types

The manufacturer shall inform the issuing competent authority of modifications to the approved design type as specified in the pressure receptacle standard. A subsequent design type approval shall be requested where such modifications constitute a new design according to the relevant pressure receptacle standard. This additional approval shall be given in the form of an amendment to the original Design Type Approval Certificate.

6.2.2.5.4.11 Upon ~~the request of the manufacturer~~, the competent authority shall communicate to any other competent authority, information concerning design type approval, modifications of approvals, and withdrawn approvals.

6.2.2.5.4.5 Production inspection and certification

~~6.2.2.5.4.1 General requirements~~ An inspection body, or its delegate, shall carry out the inspection and certification of each pressure receptacle. The inspection body selected by the manufacturer for inspection and testing during production may be different from the inspection body used for the design type approval testing.

Where it can be demonstrated to the satisfaction of the inspection body that the manufacturer has trained and competent inspectors, independent of the manufacturing operations, inspection may be performed by those inspectors. In such a case, the manufacturer shall maintain training records of the inspectors.

The inspection body shall verify that the inspections by the manufacturer, and tests performed on those pressure receptacles, fully conform to the standard and the requirements of these model regulations. Should

non-conformance in conjunction with this inspection and testing be determined, the permission to have inspection performed by the manufacturer's inspectors may be withdrawn.

The manufacturer shall, after approval by the inspection body, make a declaration of conformity with the certified design type. The application of the pressure receptacle certification marking shall be considered a declaration that the pressure receptacle complies with the applicable pressure receptacle standards and the requirements of this ~~quality conformance~~ conformity assessment system and these model regulations. The inspection body shall affix or delegate the manufacturer to affix the pressure receptacle certification marking and the registered mark of the inspection body to each approved pressure receptacle.

Note: Misuse of the prescribed marks is subject to sanctions by the competent authority.

~~6.2.2.5.4.2~~ Production inspection — Details

~~The inspection body shall ensure that the requirements of the applicable pressure receptacle standards and these model regulations are complied with.~~ A certificate of compliance, signed by the inspection body and the manufacturer, shall be issued before the pressure receptacles are ~~filled~~ dispatched.

6.2.2.5.56 *Records*

Design type approval and certificate of compliance records shall be retained by the manufacturer and the inspection body for not less than 20 years.

6.2.2.6 *Marking of UN certified refillable pressure receptacles*

UN certified refillable pressure receptacles shall be marked clearly and legibly with certification and gas or pressure receptacle specific marks. These marks shall be permanently affixed (e.g. stamped, engraved, or etched) on the pressure receptacle. The marks shall be on the shoulder, top end or neck of the pressure receptacle or on a permanently affixed component of the pressure receptacle (e.g. welded collar). Except for the “UN” mark, the minimum size of the marks shall be 5mm for pressure receptacles with a diameter greater than or equal to 140 mm and 2.5 mm for pressure receptacles with a diameter less than 140 mm. The minimum size of the “UN” mark shall be 10mm for pressure receptacles with a diameter greater than or equal to 140 mm and 5mm for pressure receptacles with a diameter less than 140 mm.

6.2.2.6.1 The following certification marks shall be applied ~~consist of~~:

- (a) The UN packaging symbol



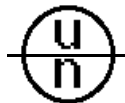
This symbol shall only be marked on pressure receptacles which conform to the requirements of these model regulations for UN certified pressure receptacles.

~~In addition, the following markings shall appear as close as practicable to the UN packaging symbol and in the sequence as listed below from (a) to (g):~~

- (b) The technical standard (e.g. ISO 9809-1) used for design, manufacture and testing;

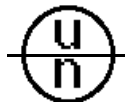
- (c) ~~The two alphabetic character(s) identifying the country of approval authorizing the UN marking as indicated by the distinguishing signs of motor vehicles in international traffic specified in the alpha 2 code of ISO 3166 1:1997;;~~
- (d) The identity mark or stamp of the inspection body that is registered with the competent authority of the country authorizing;
- (e) The date of the initial inspection, the year (four digits) followed by the month (two digits) separated by a slash (i.e. “/”).

~~An example is shown below of a certification marking for which the country of manufacture (Germany) is the same as the country authorising the mark:~~



~~ISO 9809 1/[PH300BAR]/2000 07/DE/IB/MF/123123~~

~~A second example shows a certification marking for a pressure receptacle manufactured in the United States of America and authorised by Italy:~~



~~ISO 9809 1/[PH300BAR]/2000 07/IT/IB/USMF/456456~~

6.2.2.6.2 The following ~~essential operational~~ marks shall be applied ~~as applicable according to the characteristics of the gas or the pressure receptacle:~~

- (f) The test pressure in bar, preceded by the letters “PH” and followed by the letters “BAR”;
- (g) The empty mass of the pressure receptacle including all permanently attached integral parts (e.g. neck ring, foot ring, etc.) in kilograms, followed by the letters “KG”. This mass shall not include the mass of valve, valve cap or valve guard, any coating, or porous mass for acetylene. The empty mass shall be expressed to three significant figures rounded up to the last digit. For cylinders of less than 1 kg, the weight shall be expressed to two significant figures rounded up to the last digit;
- (h) ~~In the case of pressure receptacles with a water capacity greater than 1 litre,~~ The minimum guaranteed wall thickness of the pressure receptacle in millimetres followed by the letters “MM”. This mark is not required for pressure receptacles with a water capacity less than or equal to 1 litre or for composite cylinders;
- (i) In the case of pressure receptacles intended for the transport of compressed gases, acetylene, dissolved, UN 1001, and acetylene, solvent free, UN 3374, the working pressure in bar, preceded by the letters “PW” followed by the letters “BAR”;
- (j) In the case of liquefied gases, the water capacity in litres expressed to three significant digits rounded down to the last digit, followed by the letter “L”. If the value of the

minimum or nominal water capacity is an integer, the digits after the decimal point may be neglected;

- (k) In the case of acetylene, dissolved, UN 1001, the total of the mass of the empty receptacle, the fittings and accessories not removed during filling, the porous material, the solvent and the saturation gas expressed to two significant figures rounded down to the last digit followed by the letters “KG”;
- (l) In the case of acetylene, solvent free, UN 3374, the total of the mass of the empty receptacle, the fittings and accessories not removed during filling and the porous material expressed to two significant figures rounded down to the last digit followed by the letters “KG”;

~~In the case of pressure receptacles made of aluminium alloy, the aluminium alloy preceded by the letters “AA”;~~

~~The mark for non-destructive testing if used according to the periodic test requirements in 6.2.1.5 (e.g. UT, MT, PT, see EN 1089-1 : 1996).~~

~~Note: Full definitions of the above markings are given in EN 1089-1 : 1996.~~


6.2.2.6.3 The following manufacturing marks shall be applied

- (m) Identification of the cylinder thread (e.g. 25E)
- (n) The manufacturer's mark ~~specified~~ registered by the competent authority. When the country of manufacture is not the same as the country ~~authorizing the mark of approval~~, then the manufacturer's mark shall be preceded by the ~~two~~ character(s) identifying the country of manufacture as indicated by the distinguishing signs of motor vehicles in international traffic, specified in the alpha 2 code of ISO 3166-1:1997 ~~The country mark and the manufacturer's mark shall be separated by a space or slash;~~
- (o) The serial number assigned by the manufacturer.
- (p) In the case of steel pressure receptacles and composite pressure receptacles with steel liner intended for the transport of gases with a risk of hydrogen embrittlement, the letter “H” showing compatibility of the steel (see ISO 11114-1 :1997);

6.2.2.6.4 The above marks shall be placed in three groups as shown in the example below.

- Manufacturing marks shall be the top grouping and shall appear consecutively in the sequence given in 6.2.2.6.3.
- The middle grouping shall include the test pressure (f) which shall be immediately preceded by the working pressure (i) when the latter is required.
- Certification marks shall be the bottom grouping and shall appear in the sequence given in 6.2.2.6.1.



(m) 25E	(n) D MF	(o) 765432	(p) H	
(i) PW200PH300BAR	(f) 	(g) 62.1KG	(j) 50L	(h) 5.8MM
(a) 	(b) ISO 9809-1	(c) F	(d) IB	(e) 2000/12

6.2.2.6.5 Other marks are allowed in areas other than the side wall, 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 marks.

6.2.2.6.6 In addition to the preceding marks, each refillable pressure receptacle shall be marked indicating the date (year and month) of the last periodic inspection and the registered mark of the inspection body authorized by the competent authority of the country of use.

6.2.2.7 *Marking of non-refillable pressure receptacles*

UN certified non-refillable pressure receptacles shall be marked clearly and legibly with certification and gas or pressure receptacle specific marks. These marks shall be permanently affixed (e.g. stencilled, stamped, engraved, or etched) on the pressure receptacle. Except when stencilled, the marks shall be on the shoulder, top end or neck of the pressure receptacle or on a permanently affixed component of the pressure receptacle (e.g. welded collar). Except for the “UN” mark and the “DO NOT REFILL” mark, the minimum size of the marks shall be 5mm for pressure receptacles with a diameter greater than or equal to 140 mm and 2.5mm for pressure receptacles with a diameter less than 140 mm. The minimum size of the “UN” mark shall be 10mm for pressure receptacles with a diameter greater than or equal to 140 mm and 5mm for pressure receptacles with a diameter less than 140 mm. The minimum size of the “DO NOT REFILL” mark shall be 5mm.

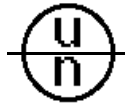
6.2.2.7.1 The marks listed in 6.2.2.6.1 to 6.2.2.6.3 shall be applied with the exception of (g), (h), and (m). The serial number (o) may be replaced by the batch number. In addition, the words “DO NOT REFILL” in letters of at least 5 mm in height are required.

6.2.2.7.2 The requirements of 6.2.2.6.4 shall apply.

Note: Non-refillable pressure receptacles may, on account of their size, substitute this marking by a label (see 5.2.2.2.1.2).

~~6.2.2.7.1 The certification markings consist of:~~

~~The UN packaging symbol~~

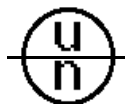


~~This symbol shall only be marked on pressure receptacles which conform to the requirements of these model regulations for UN certified pressure receptacles.~~

~~In addition, the following markings shall appear as close as practicable to the UN packaging symbol and in the sequence as listed below from (a) to (g):~~

- ~~———— (a) The technical standard (e.g. ISO 11118) used for design, manufacture and testing;~~
- ~~———— (b) [The test pressure in bar, preceded by the letters ‘PH’ and followed by the letters ‘BAR’; *in brackets pending a decision on the place this should appear*]~~
- ~~———— (c) The date of the initial inspection, the year (four digits) followed by the month (two digits);~~
- ~~———— (d) The two alphabetic characters identifying the country authorising the UN marking as specified in the alpha 2 code of ISO 3166 1:1997;~~
- ~~———— (e) The identity mark or stamp of the inspection body that is registered with the competent authority of the country authorizing the marking;~~
- ~~———— (f) The manufacturer’s mark specified by the competent authority. When the country of manufacture is not the same as the country authorising the mark, then the manufacturer’s mark shall be preceded by the two characters identifying the country of manufacture as specified in the alpha 2 code of ISO 3166 1:1997;~~
- ~~———— (g) The serial or batch number assigned by the manufacturer.~~

~~An example of a certification marking is shown below:~~



~~ISO 11118/[PH40BAR]/2000-07/US/IB/MF/789789~~

~~6.2.2.7.2 The following essential markings shall be applied as applicable according to the characteristics of the gas or the pressure receptacle:~~

- ~~(a) The words “DO NOT REFILL” in letters of at least 6 mm in height;~~
- ~~(b) In the case of pressure receptacles intended for the transport of compressed gases, the working pressure in bar and followed by the letters “BAR”;~~
- ~~(c) In the case of pressure receptacles intended for the transport of liquefied gases, the water capacity in litres to three significant digits, followed by the letter “L”;~~

~~*Note: Full definitions of the above markings are given in EN 1089 1:1996.*~~

6.2.2.7.3 Other marks 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 marks.

6.2.3 Requirements for non-UN certified pressure receptacles

6.2.3.1 Pressure receptacles not designed, constructed, inspected, tested and approved according to the requirements of section 6.2.2 shall be designed, constructed, inspected, tested and approved in accordance with the provisions of a technical code recognised by the competent authority and the general requirements of section 6.2.1.

6.2.3.2 Pressure receptacles designed, constructed, inspected, tested and approved under the provisions of this section shall not be marked with the UN packaging symbol.

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

- 1.50 for refillable pressure receptacles,
- 2.00 for non-refillable pressure receptacles.

6.2.3.4 Marking shall be in accordance with the requirements of the competent authority of the country of use.

Proposal 5

Proposed text for Part 5

5.2.2.2.1.2 Cylinders for Class 2 may, on account of their shape, orientation and securing mechanisms for transport, bear labels representative of those specified in this section, which have been reduced in size according to ISO 7225:1994, for display on the non-cylindrical part (shoulder) of such cylinders.

Proposal 6

Proposed texts for MEGCs 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 6.7.5. The elements of MEGCs shall be periodically inspected according to the provisions set out in P200 and in 6.2.1.5.

4.2.4.3 During transport, MEGCs shall be 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 6.7.5.10.4.

4.2.4.4 The periodic testing and inspection requirements for MEGCs are specified in 6.7.5.12. MEGCs or their elements shall not be charged or filled after they become due for periodic inspection but may be transported after the expiry of the time limit.

4.2.4.5 *Filling*

4.2.4.5.1 Prior to filling, the MEGC shall be inspected to ensure that it is authorized for the gas to be transported and that the applicable provisions of these Model Regulations have been met.

4.2.4.5.2 Elements of MEGCs shall be filled according to the working pressures, filling ratios and filling provisions specified in packing instruction P200 for the specific gas being filled into each element. In no case shall a MEGC or group of elements be filled as a unit in excess of the lowest working pressure of any given element.

4.2.4.5.3 MEGCs shall not be filled above their maximum permissible gross mass.

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

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

4.2.4.5.6 MEGCs shall not be offered for filling:

- (a) when damaged to such an extent that the integrity of the pressure receptacle s or its structural or service equipment may be affected;
- (b) unless the pressure receptacle s and its structural and service equipment has been examined and found to be in good working order; and

- (c) unless the required certification, retest, and filling markings are legible.

4.2.4.6 Charged MEGCs shall not be offered for transport;

- (a) when leaking;
- (b) when damaged to such an extent that the integrity of the pressure receptacle or its structural or service equipment may be affected;
- (c) unless the pressure receptacles and its structural and service equipment has been examined and found to be in good working order; and
- (d) unless the required certification, retest, and filling markings are legible.

4.2.4.7 Empty MEGCs that have not been cleaned and purged shall comply with the same requirements as MEGCs filled with the previous substance.

Proposal 7

Proposed texts for MEGCs 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:

Elements are restricted to cylinders, tubes or bundles of cylinders;

Manifold means an assembly of piping and valves connecting the filling and/or 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;

Leakproofness test means a test using gas subjecting the elements and the service equipment of the MEGC 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 MEGC and the heaviest load authorized for transport.

6.7.5.2 General design and construction

6.7.5.2.1 The MEGC shall be capable of being loaded and discharged without the removal of its structural equipment. It shall possess stabilizing members external to the elements to provide structural integrity for handling and transport. MEGCs shall be designed and constructed with supports to provide a secure base during transport and with lifting and tie-down attachments which are adequate for lifting the MEGC including when loaded to its maximum permissible gross mass. The MEGC shall be designed to be loaded onto a transport unit or ship and shall be equipped with skids, mountings or accessories to facilitate mechanical handling.

6.7.5.2.2 MEGCs shall be designed, manufactured and equipped in such a way as to withstand all conditions to which they will be subjected during normal conditions of handling and transport. 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 and tested according to section 6.2. All of the elements in a MEGC shall be of the same design type.

6.7.5.2.4 Elements of MEGCs, fittings and pipework shall be ~~constructed of materials:~~

- (a) compatible with the ~~gas(es)-substances~~ intended to be transported (for gases see ISO 11114-1:1997 and ISO 11114 -2:2000); 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 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.

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

- (a) in the direction of travel: twice the MPGM multiplied by the acceleration due to gravity (g)¹;
- (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)¹;
- (c) vertically upwards: the MPGM multiplied by the acceleration due to gravity (g)¹; and
- (d) vertically downwards: twice the MPGM (total loading including the effect of gravity) multiplied by the acceleration due to gravity (g)¹.

6.7.5.2.9 Under the forces defined above, the stress at the most severely stressed point of the elements shall not exceed the values given in either the relevant standards of 6.2.2.1 or, if the elements are not designed, constructed and tested according to those standards, in the technical code or standard recognised or approved by the competent authority of the country of use (see 6.2.3.1).

6.7.5.2.10 Under each of the forces in 6.7.5.2.8, 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.

6.7.5.2.11 MEGCs intended for the transport of flammable gases shall be capable of being electrically earthed.

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

¹ For calculation purposes, $g = 9.81 \text{ m/s}^2$

6.7.5.3 *Service equipment*

6.7.5.3.1 Service equipment shall be configured or designed to prevent damage that could result in the release of the pressure receptacle contents during normal conditions of 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 damage to working parts. The manifolds, the discharge fittings (pipe sockets, shut-off devices), and the stop-valves shall be protected from being wrenched off by external forces. Manifold piping leading to shut-off valves shall be sufficiently flexible to protect the valves and the piping from shearing, or releasing the pressure receptacle contents. The filling and discharge devices (including flanges or threaded plugs) and any protective caps shall be capable of being secured against unintended opening.

6.7.5.3.2 Each element intended for the transport of gases of Division 2.3 shall be fitted with a valve. The manifold for liquefied gases of 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. For the transport of gases of Division 2.1, the elements shall be isolated by a valve into assemblies of not more than 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 a liquid product can be trapped, a pressure-relief valve shall be provided to prevent excessive pressure build-up. The main isolation valves on an MEGC shall be clearly marked to indicate their directions of closure. Each stop-valve or other means of closure shall be designed and constructed to withstand a pressure equal to or greater than 1.5 times the test pressure of the MEGC. 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. Ductile metals shall be used in the construction of valves or accessories.

6.7.5.3.4 Piping shall be designed, constructed and installed so as to avoid damage due to expansion and contraction, mechanical shock and vibration. Joints in tubing shall be brazed or have an equally strong metal union. The melting point of brazing materials shall be no lower than 525 °C. 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.

6.7.5.4 *Pressure-relief devices*

6.7.5.4.1 One or more pressure relief devices shall be fitted on MEGCs used for the transport of UN 1013 carbon dioxide and UN 1070 nitrous oxide. Other MEGCs shall be fitted with pressure relief devices as specified by the competent authority for the country use.

6.7.5.4.2 When pressure relief devices are fitted, every element or group of elements of an MEGC that can be isolated shall then be fitted with one or more pressure relief devices. Pressure relief devices shall be of a type that will resist dynamic forces including liquid surge and 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 instruction T50 in 4.2.5.2.6 (*editorial note: this reference is numbered 4.2.4.2.6 in Rev.11 of the Model Regulations, but will change when this proposal is adopted*) may have a pressure-relief device as required by the competent authority of the country of use. Unless an MEGC in dedicated service is fitted with an approved pressure relief device constructed of materials compatible with the load, such a device shall comprise a frangible

disc preceding a spring-loaded device. The space between the frangible disc and the spring-loaded device may be equipped with a pressure gauge or a suitable telltale indicator. This arrangement permits the detection of disc rupture, pinholing or leakage which could cause a malfunction of the pressure relief device. The frangible disc shall rupture at a nominal pressure 10% above the start-to-discharge pressure of the spring-loaded device.

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

6.7.5.5 *Capacity of pressure relief devices*

6.7.5.5.1 The combined delivery capacity of the pressure relief devices when fitted shall be sufficient that, in the event of total fire engulfment, the pressure (including accumulation) inside the elements does not exceed 120% of the set pressure of the pressure relief device. The formula provided in CGA S-1.2-1995 shall be used to determine the minimum total flow capacity for the system of pressure relief devices. CGA S-1.1-1994 may be used to determine the relief capacity of individual elements. Spring-loaded pressure 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 MEGCs, 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 the MEGC.

6.7.5.5.2 To determine the total required capacity of the pressure relief devices installed on the elements for the transport of liquefied gases, the thermodynamic properties of the gas shall be considered (see, for example, CGA S-1.2-1995 for low pressure liquefied gases and CGA S-1.1-1994 for high pressure liquefied gases).

6.7.5.6 *Marking of pressure-relief devices*

6.7.5.6.1 Spring loaded pressure relief devices shall be clearly 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 (m³/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 frangible discs shall be determined according to CGA S-1.1-1994.

6.7.5.6.3 The rated flow capacity marked on spring loaded pressure relief devices for low pressure liquefied gases shall be determined according to ISO 4126-1:1991.

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 pressure relief 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 6.7.5.5. There shall be no obstruction in an opening leading to or leaving from a vent or pressure-relief device which might restrict or cut-off the flow from the element to that device. The opening through all piping and fittings shall have at least the same flow area as the inlet of the pressure relief device to which it is connected. The nominal size of the discharge piping shall be at least as large as that of the pressure relief device outlet. Vents from the pressure-relief devices, when used, shall deliver the relieved vapour or liquid to the atmosphere in conditions of minimum backpressure on the relieving device.

6.7.5.8 *Siting of pressure-relief devices*

6.7.5.8.1 All pressure relief devices shall, under maximum filling conditions, be in communication with 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 as to prevent any impingement of escaping gas or liquid upon the MEGC, its elements or personnel. 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. Heat resistant protective devices which deflect the flow of gas are permissible provided the required pressure 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, 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 6.7.5.2.10 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 the relevant provisions of ISO 1496-3:1995.

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, the applicable provisions for gases of Chapter 4 and of packing instruction P200. 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 country granting the approval, i.e. the distinguishing sign for use in international traffic, as prescribed by the Convention on Road Traffic, Vienna 1968, the characters identifying the country of approval as specified in the alpha-2 code of ISO 3166-1:1997, and a registration number. Any alternative arrangements according to 6.2.1.1.2 or 6.7.1.2 shall be indicated on the certificate. A design approval may serve for the approval of smaller MEGCs made of materials of the same type 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 specified in 6.7.5.12.3;
- (c) the results of the impact test specified in 6.7.5.12.1; and
- (d) certification documents verifying that the 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 MEGC at a duration typical of the mechanical shocks experienced in rail transport. 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
Transportable 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

6.7.5.12.2 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, MEGCs shall be inspected at no more than five-year intervals (5 year periodic inspection). An exceptional inspection and test shall be performed, regardless of the last periodic inspection and test, when necessary according to 6.7.5.12.5.

6.7.5.12.3 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 performed at the test pressures according to P200. The pressure test of the manifold 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 testing for 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 external examination of the structure, the elements and the service equipment in accordance with 6.7.5.12.6. The elements and the piping shall be tested at the periodicity specified in P200 and in accordance with the provisions 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 An exceptional inspection and test is necessary when the MEGC shows evidence of damaged or corroded areas, 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 examinations required under 6.7.5.12.6.

6.7.5.12.6 The examinations shall ensure that:

- (a) the elements are inspected externally for pitting, corrosion, 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 MEGC are in satisfactory condition.

6.7.5.12.7 The inspections and tests in 6.7.5.12.1, 6.7.5.12.3, 6.7.5.12.4 and 6.7.5.12.5 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.

6.7.5.12.8 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

6.7.5.13.1 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 in accordance with 6.2. At least the following information shall be marked on the plate by stamping or by any other similar method:

Country of manufacture

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

Manufacturer's name or mark

Manufacturer's serial number

Authorized body for the design approval

Year of manufacture

Test pressure: _____ bar gauge

Design temperature range _____ °C to _____ °C

Number of elements _____

Total water capacity _____ litres

Initial pressure test date and identification of the authorised body

Date and type of most recent periodic tests

Year _____ Month _____

Stamp of the authorised body who performed or witnessed the most recent test

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

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

Name of the operator

Maximum permissible load mass _____ kg

Working pressure at 15°C: _____ bar gauge

Maximum permissible gross mass (MPGM) _____ kg

Unladen (tare) mass _____ kg

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