UNITED NATIONS

ST

Secretariat

Distr.
GENERAL

ST/SG/AC.10/C.3/2000/51
19 April 2000

ORIGINAL : ENGLISH

COMMITTEE OF EXPERTS ON THE TRANSPORT OF DANGEROUS GOODS

Sub-Committee of Experts on the Transport of Dangerous Goods
(Eighteenth session, 3-14 July 2000, agenda item 2 (a))

DEVELOPMENT OF PROVISIONS FOR THE TRANSPORT OF GASES

Gas cylinders and other gas receptacles

Transmitted by the expert from the United States of America

1. Comments relative to the development of provisions for the transport of gases are provided in the Annex of this document. These comments are submitted for consideration by the working group on the transport of gases.

Annex

Comments on ST/SG/AC.10/C.3/34/Add.1 from the expert from the United States of America

Proposal 1

1.2.1 Definitions

In the definition for pressure drums the figure of "1000 litres" is in square brackets. After consideration of this capacity limit the US can agree to a 3000 litre maximum capacity. However until an ISO standard for pressure drums is finalized and published the US can not support requirements for internationally accepted UN marked pressure drums.

In the definition for "compressed gas" it would be useful to add "(also referred to as *permanent gas*)." ISO 11622 and other ISO documents refer to permanent gases. The terms are synonymous.

It is proposed that the definition for settled pressure be amended as follows:

Settled pressure means the pressure of the contents of a pressure receptacle at 15 ^{o}C in thermal and diffusive equilibrium.

The definition of authorized body was added during the previous meeting. There are a number of terms applicable to quality conformance which need to be included in the requirements for pressure receptacles. These terms are defined in ISO Document N 524; Gas cylinders - International Quality Conformance System - Basic rules. In addition, other pertinent terms including: Quality conformance system, Accreditation body, Inspection body, Quality system, and design type should be considered consistent with the ISO document. The definition for design type in the ISO document needs to be more specific, however. Since these terms as defined in the ISO document are applicable to cylinders, it would be preferable to include them in Chapter 6.2.

Several additional definitions are proposed as follows:

Critical temperature means the temperature above which the substance can not exist in the liquid state.

Dissolved gas means a gas which is dissolved under pressure in a liquid phase solvent.

Filling factor for liquefied gases means the mass of a gas, in kg, which can be filled into a 1 liter water capacity pressure receptacle at a specified reference temperature. The filling factor of each liquefied compressed gas must be calculated to meet all requirements of Part 4 of these Model Regulations

Proposal 2

The United States supports the definitions in proposal 2.

Proposal 3

In paragraph 4.1.6.1.4 the words “if the pressure receptacle falls during storage, transport or handling” should be deleted. Valves are not solely protected to prevent damage resulting from the pressure receptacle falling. Deleting these words will cover all scenarios.

The following comments apply to paragraph 4.1.6.1.4:

Paragraph (e) - It is not clear how the frame in (e) is different from the shrouds and guards in (c). If the shrouds and guards are required to be tested then the frames should also be tested.

In subparagraph (f) the word “carried” should be changed to “transported”. This should be a global amendment to the document. Subparagraph (f) should also be amended to delete the words “or frames”. Frames are covered in paragraph (e).

It is proposed that an additional sentence be added to 4.1.6.1.5 as follows:

Pressure receptacles used for toxic gases with an LC_{50} <200 ppm shall not be manifolded or interconnected.

In 4.1.6.1.5 it is also proposed to add the following:

The following requirements apply to plugs and valves used for toxic gases with an LC_{50} <200 ppm:

(1) Each plug or valve shall have a taper-threaded connection directly to the pressure receptacle and be capable of withstanding the test pressure of the pressure receptacle;

(2) Each valve shall be of the packless type with non-perforated diaphragm, except that for corrosive materials, a valve may be of the packed type provided the assembly is made gas-tight by means of a seal cap with gasketed joint attached to the valve body or the pressure receptacle to prevent loss of material through or past the packing;

(3) Each valve outlet shall be sealed by a threaded cap or threaded solid plug; and

(4) Valves, plugs, outlet caps, luting and gaskets shall be compatible with each other and with the gas contained in the pressure receptacle.

In 4.1.6.1.7 the following sentence should be added: “Non-refillable cylinders are not subject to periodic inspection requirements.” In the first sentence the words “except for cryogenic cylinders where the requirements of P203 apply” should replace the words “and P203".

It is proposed that paragraph 4.1.6.1.8 (d) be amended as follows:

(d) Unless the required certification, retest and filling markings are legible. Retest markings and original markings which are becoming illegible may be reproduced and permanently secured to the pressure receptacle by stamping on a metal plate if they are verified by the owner of the pressure receptacle.

(e) This paragraph is confusing and does not make sense! The working group should reconsider this paragraph.

In 4.1.6 it is proposed that additional general requirements be included as follows:

The internal pressure within a pressure receptacle at 55 ^{o}C shall not exceed the marked working pressure. In no case shall the pressure of a gas within a pressure receptacle exceed the marked test pressure, at the maximum anticipated temperature during transport.

The suitability of the pressure receptacle, valve and fittings shall be verified prior to transport, at the maximum anticipated temperature during transport.

A pressure receptacle which has a limited service life may not be used or filled if the specified service life has expired. For composite cylinders the service life shall be 15 years from the marked manufacturing date.

Class 2 gases which may cause hydrogen embrittlement in pressure receptacles may not be transported in pressure receptacles unless they have an “H” marking stamped on the cylinder as specified in 6.2.1.11.

Pressure receptacles shall not be transported with leaking safety relief devices. Safety relief devices shall be tested for leaks before the filled pressure receptacle is transported from the filling plant. It is forbidden to repair leaking fuse plug devices, where leak is through the fusible metal or between the fusible metal and the opening in the plug body, (except by removal of the device and replacement of the fusible metal.) Pressure relief devices, if used, must be in the vapor space of pressure receptacles containing liquids.

Ownership of a pressure receptacle. A pressure receptacle filled with dangerous goods shall not be transported unless it was filled by the owner of the pressure receptacle or with the owner's consent. Pressure receptacles containing acetylene gas shall not be transported unless they were charged by or with the consent of the owner, and by a person, firm, or company having possession of complete information as to the nature of the porous filling, the kind and quantity of solvent in the cylinders, and the meaning of such markings on the cylinders.

The working group should consider requiring all non-refillable cylinders to be transported in outer packaging (overpacked).

Requirements for bundles

ST/SG/AC.10/C.3/34/Add.1 is incomplete in the sense that it provides absolutely no requirements applicable to the use of bundles. The working group should consider whether requirements for the use of bundles should be included.

Repair

The working group should consider including text generally referring to repairs. For instance stating that repairs are not authorized unless approved by the competent authority or designated approval body. Stating that the repair and the inspection of the work performed must be made in accordance with the requirements of the pressure receptacle design specification. The text should indicate the types of repairs that may not be made under any circumstances. For instance non-refillable cylinders may not be repaired. Repair of weld defects which have any cracking is not permitted. Cracks in pressure receptacle walls may not be repaired. Pressure receptacle walls, heads or bottoms of pressure receptacles with injurious defects or leaks in base metal shall not be repaired.

The working group should consider what requirements are necessary for liquids or solids which are transported in pressure receptacles. The working group should review paragraph 4.1.3.6 and make necessary amendments. Particularly the terms “gas cylinders” and “receptacles” need to be revised. It is also necessary to indicate that if pressure receptacles are used for the transport of liquids or solids the applicable requirements for pressure receptacles shall be met.

P200

The second sentence “The following types of pressure receptacles are authorized: Cylinder, tubes, pressure drums and bundles of cylinders” in P200 needs to be amended. This sentence is misleading. It needs to state that “Cylinder, tubes, pressure drums, bundles of cylinders and MEGCs are authorized when specified in column 3 of the P200 Table.”

In 200(a) the US proposes that pressure relief devices be required for all 2.2 gases required to be fitted with pressure relief devices in accordance with CGA S-1.1 Pressure Relief Device Standards-Part 1. We see no safety benefit in not fitting non-toxic, non-flammable gases with pressure relief devices. Although in general toxic and flammable gases are required to be transported in pressure receptacles with pressure relief devices according to US regulations we will defer any proposals on these gases until the risk analysis agreed to be developed by CGA and EIGA is presented to the working group. In the interim, we are satisfied with the wording “Other pressure receptacles shall be fitted with a pressure-relief device where specified by the competent authority.” However for 2.2 gases we propose:

Pressure receptacles used for the transport of Division 2.2 gases shall be equipped with one or more pressure relief devices sized and selected as to type, location, and quantity and tested in accordance with CGA Pamphlet S-1.1 (compliance with paragraph 9.1.1.1 of CGA Pamphlet S-1.1 is not required). The pressure relief device system shall be capable of preventing rupture of

the normally charged pressure receptacle when subjected to a fire test conducted in accordance with CGA Pamphlet C-14.

In addition we propose that the following be added in 200 (a) after the words "and UN 1070 nitrous oxide":

In 200(e) and in (g) the words “with insufficient thermodynamic and physical data” should be changed to “for which data is not provided in the table”.

In 200(h) the words “by the competent authority” should be deleted.

In 200(j) there is still a reference to the 3 year periodicity for corrosive gases. This should be changed to 5 years. It is proposed that (j) be revised to remove reference to a 3 year periodicity for corrosive gases.

In 200(l) special provisions the following comments are provided:

Special provision *a*:

Special provision *a* addresses aluminium material restrictions and is not considered sufficient from a safety perspective. Certain substances should not be authorized in aluminium pressure receptacles. The working group should consider prohibiting the use of aluminium pressure receptacles for certain gases and should consider the following:

Aluminum pressure receptacle restrictions:

The US regulations, 49 CFR has limitations for aluminum pressure receptacles. The working group should consider whether the following restrictions should be added in P200:

Aluminium pressure receptacles are authorized only for liquefied gases and the following compressed gases: air, argon, carbon monoxide, diborane, ethylene, helium, mercury free hydrogen, krypton, methane, nitrogen, neon, oxygen and xenon. Flammable gases transported in aluminium pressure receptacles are not authorized for transport by sea and in passenger aircraft.

When used in oxygen service, aluminum pressure receptacles shall be in compliance with the following conditions:

(i) Pressure receptacle shall be equipped only with brass or stainless steel valve;

(ii) Pressure receptacle shall have only straight threads in the opening;

(iii) Each pressure receptacle shall be cleaned in compliance with the requirements of ISO 11621:1997 and shall be be tested for oil contamination.

Special provision *b* includes a copper compatibility restriction and applies to a number of amines (UN 1030, 1036, 1061 and 1083) and anhydrous ammonia (UN 1005). We question whether these are the only gases which react with copper and whether the general compatibility requirements are sufficient. ***The working group should check the design standard (ISO 7866) to see if it covers compatibility or restrictions on the use of copper***

Special provision c also includes a copper compatibility provision. It applies to UN 1001, Acetylene, dissolved, UN 1060, Propadiene with 1% to 4% methylacetylene which is a mixture only identified in the ADR (The US does not support breaking out the separate entries in the P200 Table) and UN 2452, Ethylacetylene, stabilized. The US does not agree that this special provision is necessary. ***The working group should check the design standards (ISO 3807-1 and 3807-2) to see if they cover compatibility or restrictions on the use of copper in which case this special provision may be unnecessary.***

Special provision *d* imposes a 5 kg limit per pressure receptacle to: UN 1045 Fluorine, compressed and UN 2190 Oxygen diflouride compressed. In US Regulations fluorine is limited to 2.7 kg (6 pounds) per cylinder (49 CFR 173.302) and may not be charged to more than 2758 kPa at 21 ^{0}C. The US regulation does not limit the quantity of oxygen difluoride in a cylinder. The US could support limiting fluorine to 3 kgs per pressure receptacle. The following is proposed:

For UN 1045, Fluorine compressed and UN 2190 Oxygen diflouride, compressed the settled pressure shall not exceed 30 bar and 1/3 of the marked test pressure. Each pressure receptacle shall not contain more than 3 kg of gas.
The above limitation has been checked and confirmed with current US regulation and industry practice and rational for the limitation is the reactivity of the gases at high vapor pressure and their toxicities.

Special provision *e* The requirements for plugs and valves for toxic gases with an LC_{50} <200 ppm and pyrophoric gases are covered in 4.1.6.1.5. This is redundant. If necessary a simple cross reference could be sufficient. Although this special provision was intended to apply for all toxic gases with an LC_{50} <200 ppm a check reveled that it is not (see list of toxic gases with an LC_{50} <200 ppm provided below under Table comments).

Special provision *f* The US does not agree that this special provision is necessary. The word "stabilized" in the name should trigger the user to the fact that inhibition or stabilization is necessary. Only three entries have f and do not have stabilized in their proper shipping name (UN 1911, 1040 and 3300). This issue is also covered by a general requirement in 1.1.3.1 of the Model Regulations. It is recommended that special provision *f* be deleted.

Special provision g this special provisions allows the use of alternate test pressures and filling ratios. There is no rationale for assigning g to some compressed gases and not to others. The US favors using a criteria for filling.

Special provision *h* this is already covered by PP23

Special provision *i* applies to acetylene and is vague. What approval is applicable? We would prefer a more specific requirement. The US proposes additional requirements for acetylene as follows:

The following requirements for acetylene should be included in P200:

The specific gravity of acetone solvent in acetylene cylinders shall be 0.796 or over at 15° C.

The amount of solvent added in the refilling operation shall not cause the tare weight of the cylinder to exceed its marked tare weight. The tare weight includes the weight of the cylinder shell, porous filling, valve, safety relief devices and solvent, but without the removable cap.

Manifolding is authorized for pressure receptacles of acetylene, provided that each pressure receptacle is individually equipped with approved safety relief devices and each pressure receptacle is equipped with an individual shutoff valve, or valves, which shall be tightly closed while in transport. Manifold branch lines to these individual shutoff valves shall be sufficiently flexible to prevent injury to the valves which otherwise might result from the use of rigid branch lines. Manifolded pressure receptacles shall be transported in a vertical position. For checking of tare weights or for replacement of solvent, the pressure receptacle shall be removed from the manifold. This requirement is not intended to prohibit the charging of the acetylene cylinders while manifolded.

Prefill requirements. Before each filling of an acetylene cylinder, the person filling the cylinder shall visually inspect the outside of the cylinder in accordance with the prefill requirements contained in CGA Pamphlet C-13, Section 3.

Special provision *j* This special provision applies to: UN 1058, Liquefied gases, non-flammable, charged with nitrogen, carbon dioxide,or air, UN 1010 Mixtures of 1,3-butadiene and hydrocarbons, stabilized, UN 1012, Butylenes mixture, UN 1060, Methylacetylene and propadiene mixture, stabilized, UN 2534, Methylchlorosilane, UN 1975, Nitric oxide and dinitrogen tetroxide mixture (nitric oxide and nitrogen dioxide mixture), UN 3318, Ammonia solution, relative density less than 0.880 at 15 °C in water, with more than 50%, ammonia. Firstly 200(d) applies for all liquified gases so it is not necessary to reference it. This special provision would not be necessary if criteria were adopted for test pressure and filling. It appears that j is not applied consistently to all gases where data is not provided for test pressure and filling. For instance, UN 3157 Liquefied gas, oxidizing, n.o.s. or UN 3163 Liquefied gas, n.o.s., etc. For liquefied gases in which filling density is not available in US regulations we simply indicate "Not liquid full at 55 ^{0}C." in the filling tables.

Special provision *k* The corrosion test in Appendix A of ISO 7866 is not an optional test. Every pressure receptacle made under ISO 7866 should be subjected to this test. Are we saying the test interval for cylinders made under ISO 7866 may be extended to 10 years? The working group should consider this carefully!

Special provision *l* would not be required if it is agreed that bundles (see proposal under Table comments below) are not allowed for toxic gases with an LC_{50} <200 ppm.

Special provision *m* The US can support a 15 year test periodicity for LPG cylinders if the conditions which are submitted by Germany are found to be acceptable.

Special provision *n* This special provision was intended to apply for toxic gases with an LC_{50} <200 ppm. However, in the working group report it is only applied to UN 2190 Oxygen difluoride, compressed. It should be applied to all the toxic gases with an LC_{50} <200 ppm (see list provided below under Table comments). The US favors an impact test for each design type to ensure its resistance to impact. For pressure receptacles that have a test pressure less than 200 bar the US supports requiring that the rigid packaging overpack be subjected to a PG I performance test to verify that the pressure receptacle and fittings including valves as packaged for transport are able to withstand a 1.8 metre drop test. The words "or calculation shows an equivalent resistance to mechanical shock" is too vague. This wording should be deleted. The working group should consolidate requirements for highly toxic gases under a single special provision if possible.

Special provision *o* - It is proposed that pressure receptacl*es* with tensile strength above 950 Mpa shall not be used for hydrogen or hydrogen bearing gases such as Hydrogen fluoride and other substances that have a primary or subsidiary hazard of Class 8, where the addition of water may make the material corrosive. Special provision *o* should be amended and applied to all gases where hydrogen embrittlement may be a concern. This would preclude the use of cylinders which do not have an "H" marking as prescribed in 6.2.1.11. The reason for prohibiting hydrogen in high strength cylinders is that hydrogen embrittlement will result and cause the cylinder failure. *Until TC58, WG 7 finishes their work, pressure receptacles with a tensile strength greater than 950 Mpa should not be authorized.*

Special provision *z* The following comments apply to special provision z:

It is proposed that paragraph z(3) be amended to prohibit non-refillable cylinders and bundles and to add the words "Pressure receptacles used for toxic gases with an LC_{50} <200 ppm shall be limited to a maximum volume of 75 litres."

In paragraph z(4) we have proposed to prohibit the manifolding of pressure receptacles containing gases with an LC_{50} <200 ppm. Depending on the outcome of the proposal this paragraph will need to be amended. Paragraph z(4) refers to caps and plugs but this is covered in 4.1.6.1.5. Perhaps a simple cross reference would be sufficient.

Paragraph z(5) is general in nature. This requirement should apply to all gases transported in cylinders. This issue is also covered by a general requirement in 1.1.3.1. The working group should consider moving this to 4.1.6 or deleting it entirely (see US comments on special provision f).

Additional special provisions for toxic gases:

The following requirements should be applied to all toxic gases with an LC_{50} <200 ppm. These could be added to special provision *n*:

Pressure receptacles used for toxic gases with an LC_{50} <200 ppm shall be limited to a maximum volume of 75 litres.

Each pressure receptacle used to transport toxic gases with an LC_{50} <200 ppm shall be tested for leakage at a temperature of 65°C prior to being transported. The valve of the pressure receptacle shall not be loosened after this test.

Based on a survey of the industry we were informed that companies such as Matheson, Air Products and Praxair are using high sensitive tapes, acoustic emission and other modern technology for testing toxic gas pressure receptacles prior to offering them for transport.

For Diborane, compressed, UN 1911 the working group should consider a new special provision as follows:

The maximum filling density for Diborane shall not exceed 7 percent. For Diborane and Diborane mixtures compressed the settled pressure shall not exceed 1/3 of the marked test pressure. Diborane mixed with compatible compressed gases shall not have a pressure exceeding the service pressure of the pressure receptacle if complete decomposition of the diborane occurs. Pressure receptacle valves shall be protected either by metal caps or by over packing the pressure receptacle in strong wooden boxes.

It is proposed to include a new special provision for Nitrogen trifluoride as follows:

For UN 2451 Nitrogen trifluoride, compressed the settled pressure shall not exceed 140 bar and 1/3 of the pressure receptacle's marked test pressure.

-It is proposed that a new special provision be adopted for the transport of toxic gases with an LC_{50} <1000 ppm (The US can provide a list of these gases with associated LC_{50} values) as follows:

xx{*p*}. Non-reusable cylinders shall be prohibited for the transport of toxic gases with an LC_{50} <1000 ppm Each pressure receptacle used for toxic gases with an LC_{50} <1000 ppm shall meet the valve damage protection performance requirements specified in ISO 11117 or for unprotected valves the requirements of the annex of ISO 10297.

Special provision for Carbon monoxide

For UN 1016, Carbon monoxide compressed the settled pressure shall not exceed 140 bar and 1/3 of the pressure receptacle's marked test pressure, except that if the gas is dry and sulfur free, the settled pressure may not exceed l/2 of the pressure receptacle's marked test pressure.

Special provision for flammable gases

It is proposed that a new special provision be added for flammable gases in non-refillable cylinders as follows: "Non-refillable cylinders when used for the transport of flammable gases may not have an internal volume exceeding 1 litre."

Special provision for hydrogen bearing gases

It is proposed that pressure receptacles with tensile strength above 950 Mpa shall not be requalified (periodic testing) by hydrostatic testing and that only an ultrasonic examination is permitted. Substances that have a primary or subsidiary hazard of Class 8, hydrogen sulfide or other hydrogen or sulfide bearing compounds, carbon dioxide, carbon monoxide, atmospheric gases with a dew point above -50°C and any substance where the addition of water may make the substance corrosive to the pressure receptacle shall not be hydrostatically tested during the [initial or] periodic test. Alternatively, an ultrasonic examination or other non-destructive test as specified by the competent authority shall be conducted.

The reason for prohibiting the hydro test is that the presence of moisture in a pressure receptacle used for gases such as hydrogen fluoride causes rapid corrosion of the pressure receptacle wall. Since removal of moisture after hydrostatic testing is extremely difficult ultrasonic examination should be required.

P200 Table Comments:

There is no explanation of the columns in the P200 table. This is not user friendly. The US proposes that two tables be developed one for permanent gases and one for liquefied gases. The values for test pressure, if they are retained, should be given in bar not MPa. There is no explanation for */ in the test period column. Filling indicates kg/l or % volume this supports the proposal to have two tables.

A number of entries are listed with the word "inhibited" in the proper shipping name. The word "inhibited" was changed to "stabilized" in the 11th edition of the UN Model Regulation.

The list of gases in the table should be arranged in either UN number or alphabetical order. It would be useful to include the Class/Division and subsidiary risks of each gas in the table.

There are a number of substances (not only gases are assigned to P200) that are assigned P200 in the UN Dangerous Goods List that are not listed in the P200 table. These include: UN 1043 Fertilizer Ammoniating solution, UN 1051 Hydrogen cyanide stabilized, UN 1052 Hydrogen fluoride, anhydrous, UN 1072 Oxygen compressed, UN 1075 Petroleum gas liquefied, UN 1614 Hydrogen cyanide stabilized (this is a toxic gas with an LC_{50} <200 ppm), UN 1745 Bromine pentafluoride, UN 1746 Bromine trifluoride, UN 2421 Nitrogen Trioxide, UN 2455 Methyl Nitrite, UN 2495 Iodine pentafluoride, UN 2983 Ethylene oxide and propylene oxide mixture, n.o.s. These need to be addressed by the working group.

There are two entries for UN 2203, Silane, compressed and no explanation of **/. There is also no explanation of the asterisks for UN 1965, 2192 or 2199. There are two or more entries for UN 1008, Boron Trifluoride, compressed, UN 1009, Bromotrifluoromethane (Refrigerant gas R13B1), UN 1010 Butadienes, stabilized, UN 1012 Butylene mixture, UN 1013, Carbon Dioxide, UN 1022 Chlorotrifluoromethane (Refrigerant gas R13), UN 1035 Ethane, UN 1050 Hydrogen chloride, anhydrousUN 1080, Sulphur hexafluoride, UN 1859, Silicon Tetrafluoride, compressed, UN 1952, Carbon dioxide and ethylene oxide mixture, UN 1962, Ethylene, compressed, UN 1982

Tetrafluoromethane, compressed (Refrigerant gas R14, compressed), and no explanation for which entry applies and under what conditions.

Filling Limits

The US is considering the proposed filling limit requirements but has not completed a detailed review of each value in the table. The US is working with CGA to validate each value. The working group should consider whether the filling limit table values could be removed. The US prefers to incorporate performance requirements as opposed to specific values for gases in the P200 table. If agreed industry could publish the values in a safety pamphlet or technical standard. The following is proposed:

200 (c) The gauge pressure in a pressure receptacle containing a compressed gas at 65 ^{0}C shall not exceed:

For gases with an $LC_{50} \leq$ 200 ppm the marked test pressure multiplied by 0.85;
For gases with an LC_{50} > 200 ppm and $\leq$1000 ppm >200 the marked test pressure multiplied by 0.90;
For gases with an LC_{50} > 1000 ppm and $\leq$5000 ppm the marked test pressure multiplied by 0.95;
For all other compressed gases the marked test pressure at 65 ^{0}C.

200 (d) The filling density of a pressure receptacle containing high pressure liquefied gas at 65 ^{0}C shall not exceed the following values:
For gases with an $LC_{50} \leq$ 200 ppm the calculated maximum filling density multiplied by 0.85;
For gases with an LC_{50} > 200 ppm and $\leq$1000 ppm >200 the calculated maximum filling density multiplied by 0.90;
For gases with an LC_{50} > 1000 ppm and $\leq$5000 ppm the calculated maximum filling density multiplied by 0.95;
For all other high pressure liquefied gases the filling ratio shall be such that the internal pressure at 65 °C does not exceed the test pressure of the pressure receptacles.

200(f) For low pressure liquefied gases, the filling ratio shall be such that the internal pressure at 55 °C does not exceed the test pressure of the pressure receptacle. In no case shall the pressure receptacle be liquid full at 50 °C. Except for toxic gases with an $LC_{50} \leq$ 1000 ppm, low pressure liquefied gases shall not be filled to more than 95% of the total pressure receptacle water capacity at a reference temperature of 50 °C. Low pressure liquefied toxic gases with an $LC_{50} \leq$ 200 shall not be filled to more than 85% of the total pressure receptacle water capacity at a reference temperature of 65 °C and low pressure liquefied toxic gases with an $LC_{50} \leq$ 1000 shall not be filled to more than 90% of the total pressure receptacle water capacity at a reference temperature of 65 °C.

Comments on toxic gases:

It is proposed that bundles not be allowed for toxic gases with an LC_{50} <200 ppm. We do not believe that toxic gases with an LC_{50} <200 ppm should be permitted to be manifolded or interconnected. On this basis bundles should not be allowed for (i.e. delete (5) in the P200 Table) the following toxic gases the US can provide LC_{50} values if needed):

UN 1045 Fluorine, compressed
UN 1067 Dinitrogen Tetroxide (Nitrogen Dioxide)
UN 1076 Phosgene
UN 1589 Cyanogen chloride, inhibited
UN 1660 Nitric Oxide
UN 1911 Diborane
UN 1975 Nitric oxide and dinitrogen tetroxide mixture
UN 2188 Arsine
UN 2189 Dichlorosilane
UN 2190 Oxygen difluoride compressed
UN 2194 Selenium hexafluoride
UN 2195 Tellurium hexafluoride
UN 2199 Phosphine
UN 2202 Hydrogen selenide, anhydrous
UN 2418 Sulphur tetrafluoride
UN 2421 Nitrogen trioxide
UN 2548 Chlorine Pentafluoride
UN 2676 Stibine

As a general rule pressure drums and tubes should not be allowed for toxic gases with an LC_{50} <200 ppm Pressure drums (3) should not be allowed for :

UN 1067 Dinitrogen Tetroxide (Nitrogen Dioxide)
UN 1076, Phosgene
UN 1975 Nitric oxide and dinitrogen tetroxide mixture
UN 2189 Dichlorosilane - in addition (2) Tubes and (4) MEGCs should not be allowed.

P201
ST/SG/AC.10/C.3/34/Add.1 includes P201 but this is already included in the UN Model Regulation in a format that is more appropriate. Since there are only a few entries assigned to P201 the specific UN numbers (i.e UN 3167, 3168 and 3169) should be indicated in the packing instruction.

P202
This can be removed since it is adequately addressed in the Model Regulation (see page 316, 11th ed.)

P203

The US is reserving the majority of its comments on the basis that CGA agreed to prepare revised text. The US will comment on the CGA proposal. However, it is requested that the working group consider the following for carbon dioxide, refrigerated liquid or nitrous oxide, refrigerated liquid in P203:

For carbon dioxide, refrigerated liquid or nitrous oxide, refrigerated liquid each pressure receptacle shall be protected with at least one pressure relief device and at least one frangible disc. The relieving
capacity of the pressure relief device system shall be equal to or greater than that calculated by the applicable formula in paragraph 5.9 of CGA Pamphlet S-1.1. The temperature and pressure of the gas at the time the shipment is offered f or transportation may not exceed -18 ^{0}C and 20 bar for carbon dioxide and -15.6 ^{0}C and 20 bar for nitrous oxide. Maximum time in transit may not exceed 120 hours.

(2) The following pressure relief device settings, design service temperatures and filling densities apply:

Pressure relief device setting maximum start-to discharge Gauge pressure in bar	**Maximum permitted filling density (percent by weight)**	
	Carbon dioxide, refrigerated liquid	**Nitrous oxide, refrigerated liquid**
7.2 bar	108	104
11.7 bar	105	101
16 bar	104	99
20 bar	102	97
25 bar	100	95
31 bar	98	83
37 bar	92	87
43 bar	86	80
Design service temperature	-196 °C	-196 °C

In addition, consequential amendments need to be made to the Dangerous Goods List because the refrigerated liquids are not currently assigned to P203 in the Dangerous Goods List. Entries which should be assigned to P203 include:

UN 1003 Air Refrigerated liquid,
UN 1038 Ethylene Refrigerated liquid,
UN 1073 Oxygen Refrigerated liquid,
UN 1913 Neon, Refrigerated liquid,
UN 1951 Argon Refrigerated liquid,
UN 1961 Ethane Refrigerated liquid,
UN 1963 Helium Refrigerated liquid,
UN 1966 Hydrogen Refrigerated liquid,
UN 1970 Krypton Refrigerated liquid,
UN 1972 Methane Refrigerated liquid or Natural gas, Refrigerated liquid,
UN 1977 Nitrogen Refrigerated liquid,

UN 2186 Hydrogen chloride refrigerated liquid,
UN 2187 Carbon dioxide refrigerated liquid,
UN 2201 Nitrous oxide refrigerated liquid,
UN 2591 Xenon refrigerated liquid,
UN 3136 Trifluoromethane refrigerated liquid,
UN 3138 Ethylene, acetylene and propylene mixture refrigerated liquid,
UN 3158 Gas refrigerated liquid, n.o.s.,
UN 3311 Gas refrigerated liquid, oxidizing, n.o.s.,
UN 3312 Gas refrigerated liquid, flammable, n.o.s.

Chapter 6.2

This document is incomplete in the sense that it provides absolutely no requirements applicable to manifolded pressure receptacles which are transported in bundles. The working group needs to develop requirements applicable to the manifold construction.

Pressure receptacles assembled in bundles shall be supported and held together as a unit by structurally adequate means. Safety relief devices, if used on manifolded horizontal pressure receptacles filled with flammable compressed gas shall be arranged to discharge upward and unobstructed to the open air in such a manner as to prevent any impingement of escaping gas upon the pressure receptacles. Manifold branch lines shall be sufficiently flexible to prevent damage to shut-off valves and to prevent damage during handling and transport which otherwise might result from the use of rigid branch lines. Each pressure receptacle shall be separately charged and means shall be provided to insure that no interchange of pressure receptacle contents can occur during transportation. For acetylene and acetylene gas mixtures all bundled pressure receptacles shall be transported in a vertical position.

In 6.2 1.3 it is proposed that “Pressure receptacle valves and fittings be rated at or above the pressure receptacle's burst pressure. The suitability of the pressure receptacle, valve and fitting materials shall be checked, at the maximum anticipated temperature during transport.”

In 6.2.1.6.2 the reference to aluminium alloy “6351A” should be “6351-T6 or equivalent”

Composite cylinders
Also in 6.2.1.6.2 the references to ISO 11119-1, -2 and -3 should be deleted unless conditions for their use are provided. It was not agreed to adopt these composite cylinder standards. At the previous working group meeting, the US indicated safety concerns regarding ISO 11119 including 1) Cylinder life exceeding 15 years; 2) Low safety factor (urst pressure/test pressure) and 3)Fiber strength less then currently required in the DOT FRP and CFFC specifications. There still remains contentious technical safety issues that are yet to be resolved by ISO and the UN SCOE should not undertake efforts to adopt these standards until the technical issues have been satisfactorily resolved. These have yet to be considered and discussed in detail by the working group. For these and other reasons identified at the previous meeting, the US can not support adoption of composite cylinder requirements in the UN Model Regulations. We could support these standards if the exceptions identified at the previous meeting (see INF.17) are incorporated directly in the text as has been done for seamless cylinders.

Acetylene and non-refillable cylinders
We also have not agreed to ISO 3807 or 11118 but will attempt to formulate a position on these standards prior to the working group meeting.

Cryogenic pressure receptacles
We support the adoption of the TC 4L specification for cryogenic cylinders but would prefer to wait until ISO Technical Committee TC 220 completes its work to develop an internationally acceptable ISO standard for cryogenic cylinders. US representatives have established a TAG and plan to participate in the development of the ISO standard.

Requirements for pressure receptacles not designed, constructed and tested according to standards
It is proposed that 6.2.1.7.2 and 6.2.1.7.3 be deleted. Paragraph 6.2.1.7.1 is sufficient except that the words "these pressure receptacles shall not bare a "UN" mark" should be added. The title of this section is misleading because these cylinders are designed to standards they just are not the standards recognized in the Model Regulations.

Approval of pressure receptacles
The US will provide comments on quality conformance and approval in a separate document.

Initial inspection
In 6.2.1.9 it is necessary to state that the initial inspection and test shall be as specified in the applicable design and construction technical code.

In 6.2.1.9.1(d) the words "permanent deformation" should be reconsidered. During a hydrostatic test, some permanent expansion can occur. Each specification defines the percentage of permanent expansion which is allowed for initial testing and US regulation allow for a 10% maximum expansion. Perhaps it would be better to indicate "...without undergoing permanent expansion greater than that allowed in the design specification or exhibiting cracks."

6.2.1.11 **Markings** - The comments we provided at the previous meeting and decisions taken are not adequately captured in the report of the working group. In our view, it is absolutely essential to specify the content and format of the UN pressure receptacle certification mark. This mark must be consistent for all pressure receptacles designed, manufactured, tested and approved according to the UN Model Regulation in order for them to be accepted internationally. We believe the UN marking should be consistent with the format and content specified for packagings (see 6.1.3). We propose the following certification markings for UN pressure receptacles:

Proposed Pressure receptacle Certification Markings

(a) The letters "UN". This shall only be marked on pressure receptacles which conform to the requirements of these Model Regulations for UN certified and approved pressure receptacles;

(b) indication of the technical standard (e.g. ISO 9809-1:1999) authorized for use in 6.2.1.6.2 to which the pressure receptacle is designed, constructed, tested and approved;

(c) test pressure in bar followed by the letters "BAR";

(d) year (two figures) and month (two figures)) of the initial inspection and tests (e.g 03-00);

(e) state authorizing the mark indicated by the distinguishing sign for motor vehicles in international traffic;

(f) the registered mark of the manufacturer* (the manufacturer's mark shall be registered with the competent authority);

(g) serial number for the pressure receptacle assigned by the manufacturer or user preceded by the letters "SN". In the case of a pressure receptacle not greater than 1 litre capacity, the manufacturing batch number may replace the manufacturing serial number;

(h) the identifying mark or stamp of the authorized independent inspection body who carried out the tests and inspections* (The independent inspection body's mark shall be registered with the competent authority of the state authorizing the mark);

* *The US* believes *that it would be desirable to clearly specify the alpha-numeric content of the manufacturer's and the independent inspection body's marks. This would be useful since numerous competent authorities will be registering and issuing marks. ISO 13769 does not provide sufficient guidance on the content of the manufacturer's mark (i.e. it shows it as a two digit mark) or the inspection body's mark. The US believes that an international marking scheme should be developed. The working group should develop marks that can account for all the manufacturers and inspection bodies worldwide. Competent authorities would be required to issue marks consistent with the international system and established format. Since each manufacturing facility will need a specific mark regardless of whether it is the same company, the mark should also have a country/facility location designation). These marks could be compiled in an international database that all competent authorities, inspection bodies and other parties could easily access.*

(i) empty weight of the pressure receptacle in kilograms including all integral parts (for example neck ring, foot ring, etc.) followed by the letters "kg". This weight shall not include the mass of the valve, valve cap or valve guard, any coating, or porous mass for acetylene. The empty weight shall be expressed in three significant figures rounded down to the last digit, for acetylene cylinders, to at least one digit after the decimal point. (e.g. 0.99 kg, 1.06 kg, 10.70 kg or 107 kg).

(j) minimum guaranteed wall thickness of the pressure receptacle in millimetres followed by "mm" (not required for composite pressure receptacles and pressure receptacles with a water capacity less than 1 litre).

(k) if an aluminium pressure receptacle, the aluminium alloy preceded by “AA” shall be indicated.

Other essential markings which are required but not in the certification marking (*These would be required on the pressure receptacle but not as part of the certification marking)*:

(a) working pressure in bar preceded by “WP” and followed by the letters “BAR” for permanent gases and acetylene (not required for liquefied gases);

(b) the tare of the pressure receptacle in kilograms preceded by the letters “TARE” and followed by the letters “KG” shall be indicated on pressure receptacles used for the transport of liquefied gases and dissolved gases and for compressed gases which are filled by weight (for acetylene cylinders, the tare shall include the mass of the porous material, the solvent, and saturation gas). The tare weight is the sum of the empty weight, the mass of the valve including dip tube where fitted*, any fixed valve guard and the mass of all other parts which are permanently attached (for example by clamping or fastening to the pressure receptacle when offered for filling); *ISO 13769 requires an empty weight and tare weight -we are not totally convinced both are necessary but the working group should consider this.*

* If a pressure receptacle valve is replaced, a pressure receptacle valve of the same weight shall be used or the tare weight of the cylinder shall be adjusted to compensate for the valve weight differential.

(c) the minimum guaranteed water capacity in litres followed by the letter “L”; *the water capacity may vary from one pressure receptacle to another in a given design type. The water capacity needs to be the minimum per design type.*

(d) stamp for non-destructive testing (e.g. UT, MT, PT, etc.), if applicable, see ISO 13769;

(e) the letter “H” shall be stamped if the pressure receptacle is authorized for the transport of gases with a risk of hydrogen embrittlement;

(f) the year (last two figures) and month (two figures) of the retest and inspection and the mark of the authorized independent inspection body that witnessed the test and inspection;

In 6.2.1.11.5 we agree with the concept of the UN mark, however we believe that it is important to provide an example of the UN mark and of a typical marking on a UN certified pressure receptacle (see for example 6.1.3).

Examples of markings for UN certified and approved pressure receptacles:
UN/ISO 9809-1/200 BAR/03-00/NL/ACME-NL*/SN1234-56/
IIA-worldtest*/50KG/2mm/AA6061-T6

**The US believes that it would be desirable to clearly specify the alpha-numeric content of the manufacturer's and the independent inspection body's marks.*

Non-refillable cylinder marks - Since these marks are not required to be stamped the UN mark in a circle could be used. An earlier EIGA proposal proposed this mark for non-refillable cylinders (see para. 6.2.1.6.3 of ST/SG/AC.10/C.3/1999/24).
