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**COMMITTEE OF EXPERTS ON THE TRANSPORT OF  
DANGEROUS GOODS AND ON THE GLOBALLY  
HARMONIZED SYSTEM OF CLASSIFICATION  
AND LABELLING OF CHEMICALS**

Sub-Committee of Experts on the  
Transport of Dangerous Goods

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**MISCELLANEOUS PROPOSALS OF AMENDMENTS TO THE MODEL REGULATIONS  
ON THE TRANSPORT OF DANGEROUS GOODS**

Model Regulations on the Transport of Dangerous Goods

Proposals concerning requirements for open cryogenic receptacles

Transmitted by the expert from the United Kingdom

**I. BACKGROUND**

**A. Introduction**

1. Open cryogenic receptacles are used in international transport for carrying biological products such as semen and vaccines or other specialised equipment or product which must be maintained at low temperatures. These open vessels usually have wide necks to allow the insertion and withdrawal of the products and the products themselves are kept cold by immersion in liquid nitrogen.
2. A second type of open cryogenic receptacle is used for transporting refrigerated liquefied gases such as the air gases (nitrogen, argon and oxygen) and helium, but their use is usually restricted to carriage over short distances, such as distributing small quantities of refrigerated liquefied gases to

laboratories and clinics. Examples of these two types are shown in the following pictures:



**Open cryogenic receptacles used for carrying specimens and articles immersed in a refrigerated liquefied gas**



**Open cryogenic receptacle used for carrying refrigerated liquefied gases**

3. The high ratio of surface area to volume of these receptacles means that vacuum insulation is needed to maintain an adequately low heat flow into the contents. The conventional construction consists of an inner vessel constructed from aluminium with an epoxy glass fibre neck or stainless steel with a stainless steel neck. The outer jacket is made of stainless steel, aluminium or carbon steel. The neck of the vessel connects the inner vessel and outer jacket so it is necessary for it to have a low thermal conductance. This means that either it has a thin wall if of metal or if made of a non-metallic material will need to be bonded with an adhesive to the metal parts. The neck is therefore the part most vulnerable to damage due to mechanical shock. Neck damage will break the vacuum and lead to the formation of ice on the outer surface of the receptacle.
4. Double-walled vacuum insulated receptacles made of glass also come within the definition of open cryogenic receptacles. The International Civil Aviation Organization Technical Instructions for the Safe Transport of Dangerous Goods by Air (ICAO TIs) do not permit such a construction, but the Regulations for the International Carriage of Dangerous Goods by Rail (RID) and the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) include them provided they are protected and supported inside a metal case. Glass receptacles are usually of up to 5 litres capacity.
5. Open cryogenic receptacles maintain their low temperature by evaporation of the refrigerated liquefied gas. This results in a continuous evolution of a small quantity of the gas. For this reason only nitrogen, argon, krypton and xenon

are permitted for air transport. RID/ADR allows all but one of the division 2.2 refrigerated liquefied gases, but does not permit flammable gases.

## B. The need for action at UN level

6. To date the only specific requirements on open cryogenic receptacles in the international transport of dangerous goods regulations are in the ICAO TIs and in RID/ADR. The International Maritime Dangerous Goods (IMDG) Code follows the UN Model Regulations in requiring in P203 that "...open cryogenic receptacles shall conform to the construction, testing and filling requirements approved by the competent authority." The United States Code of Federal Regulations CFR49 exempts open cryogenic receptacles.
7. The international traffic in goods such as semen and vaccines can be expected to increase over the coming years and so it is desirable to harmonise the modes especially between air and road/rail where most of the carriage occurs. Another incentive for harmonisation is that carriage of small quantities of refrigerated liquefied gases can take place across national borders to supply clinics and laboratories. Significant traffic by sea is not foreseen, given the relatively short time that these receptacles can function before refilling with refrigerated liquefied gas. Nevertheless, it is desirable that the sea mode harmonises with other modes to facilitate short sea ferry crossings.

## C. Summary of regulations in the RID/ADR and ICAO TIs

Parameter	ICAO Technical Instructions	RID/ADR
Materials of construction	Metal	Material must not be affected or weakened by the dangerous goods nor cause a dangerous effect
Insulation	Vacuum	Specified only by performance:- exterior is not coated with hoar frost
Accessories fitted to opening(s)	Fill and discharge openings must be protected against entry of foreign materials which might increase internal pressure. vessels shall not have safety relief valves, check valves, frangible discs or similar devices in vent lines	...devices which allow gases to escape, preventing any splashing out of liquid, so fixed that they cannot fall out
Refrigerated liquefied gases permitted	Nitrogen, argon, krypton and xenon	All gases of Division 2.2 except UN 2187 carbon dioxide, refrigerated liquid
Maximum volume	50 litres	1000 litres
Shape of the receptacle	Secure base, will remain stable and not topple during transport	Receptacles shall be fitted with means of handling
Special conditions		(1) Glass receptacles shall be double wall vacuum insulated and surrounded by an absorbent insulating material; they shall be protected by iron-wire

Parameter	ICAO Technical Instructions	RID/ADR
		baskets and placed in metal cases. (2) In the case of UN 1073 oxygen, refrigerated liquid, accessories and the absorbent insulating material surrounding glass receptacles shall be made of incombustible materials.
Special provisions	A152: Insulated packagings containing refrigerated liquid nitrogen fully absorbed in a porous material and intended for transport, at low temperature, of non-dangerous products are not subject to these Instructions provided the design of the insulated packaging would not allow the build-up of pressure within the container and would not permit the release of any refrigerated liquid nitrogen irrespective of the orientation of the insulated packaging.	593. This gas, (i.e. all non-oxidising gases of division 2.2) intended for cooling of e.g. medical or biological specimens if contained in double wall glass receptacles which comply with the requirements (1) above are not subject to the requirements of RID/ADR

## II. PROPOSALS FOR REGULATIONS

### A. Introduction

8. Open cryogenic receptacles are effectively self-checking. The only thing that can go wrong with the receptacle itself is that the vacuum breaks down, in which case the fault becomes immediately apparent by the rapid build-up of ice on the exterior. The other essential features of the receptacle can be verified by the filler or consignor. The existing regulations recognize this and have no system of packaging approval such as is required in Part 6 of the Model Regulations. The expert from the United Kingdom proposes that the UN Model Regulations should also not require competent authority or third party approval of open cryogenic receptacles.
9. The simplicity of use and the low risks appear to be supported by the absence of detailed regulations, absence of standards and the fact that only one industry guidance document has been identified (the British Compressed Gases Association's Code of Practice 30). The BCGA document was mainly focussed on the risks of filling and use in confined spaces, and covered transport by simply indicating the need for ventilation in transport plus the transport labelling and documentation requirements.
10. So far as is practicable the proposed regulations should set safety objectives to allow for technological innovation. Specifications such as iron wire baskets should be avoided.
11. Other receptacles for Class 2 goods are inherently robust in order to withstand the internal pressure. They are therefore not subject to drop testing (except for the valves and valve protection). Open cryogenic receptacles are not inherently robust in the same way and it would appear logical to subject them

to type testing according to the drop test in 6.1.5.3 at the PG III level. However, neither ICAO nor the RID/ADR Joint Meeting have found this necessary and there are doubts whether the neck of metal receptacles would survive such treatment. Further discussion including input from the manufacturers is needed before adding this test.

12. The risks in transport are:
- (a) The slow release of gas due to vaporization leading to the build-up of gas in confined spaces;
  - (b) Loss of contents due to falling over of the receptacle or overturning of the transport unit causing a spill; and
  - (c) Dropping of the receptacle causing loss of vacuum or damage.
13. The proposals below are intended to be the subject of debate and to establish a consensus for the eventual text. Consultation with industry and other stakeholders has not been very wide at this stage so comments and corrections, particularly from manufacturers and users, are welcome.

## B. Outline of proposed regulations

Parameter	Proposal for regulations	Comments
Definition 1.2.1	“Open cryogenic receptacle” means a transportable thermally insulated receptacle for refrigerated liquified gases of a water capacity of not more than 50 litres and having a neck connecting the inner vessel to the outer jacket allowing venting of the refrigerated liquified gas	
Dangerous Goods List Chapter 3.2	Add a Special Provision (SP) against the main gases covered	
Construction Chapter 6.2	Shall be constructed so as to prevent any loss of contents when prepared for transport	From 4.1.1.1 not quite the same as resistance to damage below but could perhaps be combined
Materials of construction Chapter 6.2	Construction materials of the open cryogenic receptacle which are in direct contact with the dangerous goods shall not be affected or weakened by the dangerous goods intended and shall not cause a dangerous effect. The suitability of the mechanical properties of the materials shall be established at the service temperature. Open cryogenic receptacles intended for oxidizing gases shall not include materials which may react with the gas or refrigerated liquefied gas in a dangerous manner.	Based on UN 6.2.1.1.8 and 6.2.1.2.1.

Parameter	Proposal for regulations	Comments
Insulation Chapter 6.2	The receptacle shall have double wall construction with the space between the inner and outer wall being vacuum insulated.	It seems necessary to specify vacuum insulation on these high surface area to volume vessels to minimise the rate of evaporation of the contents
Resistance to damage Chapter 6.2	Open cryogenic receptacles and their closures shall be designed, calculated, manufactured, tested and equipped in such a way as to withstand all conditions, including fatigue, to which they will be subjected during their normal use and during normal conditions of transport.	Based on UN 6.2.1.1.1
Accessories fitted to opening(s) Chapter 6.2	openings shall be protected by devices which protect against entry of foreign materials, allow gases to escape and are so fixed that they cannot fall out.	The RID/ADR requirement that these devices prevent liquid from splashing out has been omitted since it is hard to specify and create standard conditions which would initiate liquid splashing out. The requirement to exclude ingress of foreign materials seems sufficient.
Refrigerated liquefied gases permitted Chapter 3.3	all gases of Division 2.2 except UN 2187 carbon dioxide, refrigerated liquid	A more restricted list may be given in some of the modal regulations
Maximum volume Chapter 6.2	50 litres	Controlling the size of the receptacle also controls the risks from spillage. Suggestions for other volumes would be welcome.
Shape of the receptacle Chapter 6.2	The receptacle shall have a secure base, will remain in an upright position during transport or shall be fitted with devices such as gyroscopic controls to ensure that the receptacle remains upright.  Receptacles shall be fitted with suitable lifting and securing arrangements	based on ICAO TI Packing instruction 202  Based on UN 6.2.1.1.8.4 for closed cryogenic receptacles
Marking of open cryogenic receptacles Chapter 6.2	The manufacturer's name and address. Model number Serial or batch number The gases for which the receptacle is intended. The maximum mass of each gas. The net mass of the receptacle.	

Parameter	Proposal for regulations	Comments
Special provisions Chapter 3.3	<i>Applicable to UN 1977 Nitrogen, refrigerated liquid;-</i> Insulated packagings containing refrigerated liquid nitrogen fully absorbed in a porous material and intended for transport, at low temperature, of non-dangerous products are not subject to these regulations provided the design of the insulated packaging does not allow the build-up of pressure within the container and does not permit the release of any refrigerated liquid nitrogen irrespective of the orientation of the insulated packaging.	This useful special provision in the ICAO TIs should be carried forward into all modes. It is hoped that its inclusion would encourage the wider adoption of this relatively risk free technology.  The exemption in RID/ADR 593 has not been repeated since, on the one hand it is very specific about the nature of the receptacle, but on the other, the meaning of e.g. biological and medical specimens is rather vague.
Marking 5.2.1	UN number and Proper Shipping Names.	5.2.1
Labelling 5.2.2.2 and 5.2.1.7	Label 2.2 (and 5.1 when oxidizing); orientation arrows specified in 5.1.2.7.1	ICAO TIs require a cryogenic liquid label.

**NOTE:** Some of these provisions might be combined to produce a new Packing Instruction P20X

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