BRITISH STANDARD

BS EN
13530-1:2002

Cryogenic vessels — Large transportable vacuum insulated vessels —

Part 1: Fundamental requirements

The European Standard EN 13530-1:2002 has the status of a British Standard

ICS 23.020.40

National foreword

This British Standard is the official English language version of EN 13530-1:2002.

The UK participation in its preparation was entrusted to Technical Committee PVE/18, Cryogenic vessels, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

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This British Standard, having been prepared under the direction of the Engineering Sector Policy and Strategy Committee, was published under the authority of the Standards Policy and Strategy Committee on 24 May 2002

Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 14, an inside back cover and a back cover.

The BSI copyright date displayed in this document indicates when the document was last issued.

Amendments issued since publication

Amd. No.	Date	Comments

ISBN 0 580 39774 2

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 13530-1

May 2002

ICS 23.020.40

English version

Cryogenic vessels - Large transportable vacuum insulated vessels - Part 1: Fundamental requirements

Récipients cryogéniques - Grands récipients transportables isolés sous vide - Partie 1: Exigences fondamentales

Kryo-Behälter - Große ortsbewegliche, vakuum-isolierte Behälter - Teil 1: Grundanforderungen

This European Standard was approved by CEN on 3 January 2002.

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Ref. No. EN 13530-1:2002 E

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Foreword

This document EN 13530-1:2002 has been prepared by Technical Committee CEN/TC 268, "Cryogenic vessels", the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2002, and conflicting national standards shall be withdrawn at the latest by November 2002.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

In this standard the annex A is informative.

EN 13530 consists of the following parts under the general title, *Cryogenic vessels – Large transportable vacuum insulated vessels*:

– *Part 1: Fundamental requirements.*

– *Part 2: Design, fabrication, inspection and testing.*

– *Part 3: Operational requirements.*

This European Standard has been submitted for reference into the RID and/or in the technical annexes of the ADR. Therefore in this context the standards listed in the normative references and covering basic requirements of the RID/ADR not addressed within the present standard are normative only when the standards themselves are referred to in the RID and/or in the technical annexes of the ADR.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard specifies the fundamental requirements for large transportable vacuum insulated cryogenic vessels designed to operate above atmospheric pressure. Appropriate parts can be used as a guidance for vessels designed to operate to the atmosphere.

This European Standard applies to fixed tanks (of tank-vehicles and tank-wagons), demountable tanks, tanks of battery-vehicles and tank-containers (TC) for refrigerated liquefied gases in the sense of the regulations of the transport of dangerous goods. This standard applies to large transportable vacuum insulated cryogenic vessels for fluids as specified in 3.1 and is not applicable to such vessels designed for toxic fluids.

2 Normative references

This European Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 1252-1, *Cryogenic vessels - Materials - Part 1: Toughness requirements for temperatures below – 80 °C.*

EN 1252-2, *Cryogenic vessels - Materials - Part 2: Toughness requirements for temperatures between – 80 °C and – 20 °C.*

EN 1626, *Cryogenic vessels - Valves for cryogenic service.*

EN 1797, *Cryogenic vessels - Gas/material compatibility.*

EN 10204, *Metallic products; Types of inspection documents.*

EN 12300, *Cryogenic vessels - Cleanliness for cryogenic service.*

prEN 13648-1, *Cryogenic vessels - Safety devices for protection against excessive pressure - Part 1: Safety valves for cryogenic service.*

prEN 13530-2, *Cryogenic vessels - Large transportable vacuum insulated vessels - Part 2: Design, fabrication, inspection and testing.*

EN 13530-3, *Cryogenic vessels - Large transportable vacuum insulated vessels - Part 3: Operational requirements.*

3 Terms and definitions

For the purposes of this European Standard, the following terms and definitions apply.

3.1
cryogenic fluid (refrigerated liquefied gas)
gas which is partially liquid because of its low temperature[1)]. In the context of all parts of this standard the (refrigerated but) non-toxic gases and mixtures of them given in Table 1 are referred to as cryogenic fluids

1) This includes totally evaporated liquids and supercritical fluids.

Table 1 — Refrigerated but non toxic gases

classification code	Identification number, name and description[a]	
3 °A	Asphyxiant gases	
	1913	Neon, refrigerated liquid
	1951	Argon, refrigerated liquid
	1963	Helium, refrigerated liquid
	1970	Krypton, refrigerated liquid
	1977	Nitrogen, refrigerated liquid
	2187	Carbon dioxide, refrigerated liquid
	2591	Xenon, refrigerated liquid
	3136	Trifluoromethane refrigerated liquid
	3158	Gas, refrigerated liquid, N.O.S.[b]
3 °O	Oxidizing gases	
	1003	Air, refrigerated liquid
	1073	Oxygen, refrigerated liquid
	2201	Nitrous oxide, refrigerated liquid, oxidizing
	3311	Gas, refrigerated liquid, oxidizing, N.O.S[b]
3 °F	Flammable gases	
	1038	Ethylene, refrigerated liquid
	1961	Ethane, refrigerated liquid
	1966	Hydrogen, refrigerated liquid
	1972	Methane, refrigerated liquid or Natural gas, refrigerated liquid, with high methane content
	3138	Ethylene, acetylene and propylene mixture, refrigerated liquid, containing at least 71,5 % ethylene with not more than 22,5 % acetylene and not more than 6 % propylene
	3312	Gas, refrigerated liquid, flammable, N.O.S[b]

[a] Classification codes, identification number, name and description according to ADR.

[b] N.O.S. = not otherwise specified.

3.2
large transportable cryogenic vessels (tank)
thermally insulated vessel of more than 1 000 l intended for the transport of one or more cryogenic fluids, consisting of an inner vessel, an outer jacket, all of the valves and service equipment together with the structural equipment. This large transportable cryogenic vessel representing a complete assembly ready for putting into service

3.3
thermal insulation
vacuum interspace between the inner vessel and the outer jacket. The space can or can not be filled with material to reduce the heat transfer between the inner vessel and the outer jacket

3.4
inner vessel
vessel intended to contain the cryogenic fluid

3.5
outer jacket
gas-tight enclosure which contains the inner vessel and enables the vacuum to be established

3.6
normal operation
intended operation of the vessel at a pressure not greater than the maximum allowable working pressure including the handling loads defined in 3.7

3.7
handling loads
loads exerted on the transportable cryogenic vessel in all expected situations of transport including loading, unloading, moving lifting equipment

3.8
documentation
technical documents delivered by the manufacturer to the owner consisting of:

— all certificates establishing the conformity with this standard (e.g. material, pressure test, cleanliness, safety devices);

— a short description of the vessel (including characteristic data etc.);

— a list of fluids and their net mass for which the cryogenic vessel is designed;

— an operating manual (for the user) which consists of:

  — a short description of the vessel (including characteristic data etc.);

  — a statement that the vessel is in conformity with this standard;

  — the instructions for normal operation

3.9
piping system
all pipes which can come in contact with cryogenic fluids including their valves, fittings, pressure relief devices as well as their supports

3.10
equipment
devices which have a safety related function with respect to pressure containment and/or control (e. g. protective or limiting devices, regulating and monitoring devices, valves, indicators)

3.11
manufacturer of the large transportable cryogenic vessel
company who carries out the final assembly, including the final acceptance test, of the large transportable cryogenic vessel

3.12
volume of the inner vessel
volume of the shell, excluding nozzles, pipes etc. determined at minimum design temperature and atmospheric pressure

3.13
tare mass
mass of the empty large transportable cryogenic vessel

3.14
net mass
maximum allowable mass of the cryogenic fluid which may be filled. The maximum allowable mass is equal or less of the mass of the cryogenic fluid at filling temperature and pressure when filled to 98 % of the volume of the inner vessel in the case of gases of 3 °A or 3 °O or when filled to 95 % in the case of gases of 3 °F

3.15
gross mass
sum of tare mass plus net mass

3.16
pressure
pressure relative to atmospheric pressure, i.e. gauge pressure. As a consequence, vacuum is designated by a negative value

3.17
maximum allowable pressure (p_S)
maximum operating pressure at normal operating conditions normally measured at the top of inner vessel, specified for safety reasons

4 General requirements

The large transportable cryogenic vessel shall safely withstand the mechanical and thermal loads and the chemical effects encountered during pressure test and normal operation. These requirements are deemed to be satisfied if clause 5 to 9 are fulfilled. The vessel shall be marked in accordance with clause 10, tested in accordance with clause 11 and clause 12 and operated in accordance with EN 13530-3.

5 Mechanical loads

5.1 General

The large transportable cryogenic vessel shall resist the mechanical loads mentioned in clause 4 without such deformation which could affect safety and which could lead to leakage. This requirement can be validated by:

— the calculation;

— the calculation and pressure strengthening method (see prEN 13530-2);

— the calculation and experimental method.

The mechanical loads to be considered are given in 5.2 and 5.3.

5.2 Load during the pressure test

The load exerted during the pressure test shall be:

$$p_T \geq 1{,}3\ (p_s + 1)$$

where

p_T is the test pressure (in bar);

p_s is the maximum allowable pressure (in bar);

+ 1 is the allowance for external vacuum (in bar).

5.3 Other mechanical loads during normal operation

5.3.1 The following loads shall be considered to act in combination where relevant:

— a pressure equal to the maximum allowable working pressure in the inner vessel and pipework;

— the pressure exerted by the liquid column when filled to capacity;

— loads produced by the thermal movement of the inner vessel, outer jacket and interspace piping;

— loads imposed in lifting and handling fixtures (at the vessel);

— full vacuum in the outer jacket;

— a pressure in the outer jacket equal to the set pressure of the relief device protecting the outer jacket;

— load due to dynamic effects, when the vessel is filled to capacity, giving consideration to:

  — the inner vessel support system including attachments to the inner vessel and outer jacket;

  — the interspace and external piping;

  — the outer jacket supports and where applicable the supporting frame.

The following dynamic loads during normal operation shall be considered for the fastenings and the support system of the inner vessel:

— equal to twice the mass of the inner vessel when filled to the capacity shown on the data plate exerted by the inner vessel in the direction of travel and vertically downwards;

— equal to the mass of the inner vessel when filled to the capacity shown on the data plate exerted by the inner vessel at right angle to the direction of travel and vertically upwards; for tank-containers: equal to twice the mass if the direction of travel is not clearly determined.

5.3.2 The following dynamic loads during normal operation shall be considered for the fastenings and the support system of the outer jacket on the vehicle, wagon respective frame of a TC:

— equal to twice the sum of the masses of the inner vessel, the outer jacket, the piping etc. and when filled to the capacity shown on the data plate exerted by the shells etc. in the direction of travel and vertically downwards;

— equal to the sum of the masses of the inner vessel, the outer jacket, the piping etc. when filled to the capacity shown on the data plate exerted by the shells etc. at right angle to the direction of travel and vertically upwards; for tank-containers: equal to twice the mass if the direction of travel is not clearly determined.

6 Chemical effects

Due to the cryogenic fluids, their temperatures and the materials of construction used, the possibility of chemical action on the inner surfaces in contact with the cryogenic fluids can be neglected.

Due to the fact that the inner vessel is inside an evacuated outer jacket, neither external corrosion of the inner vessel, nor corrosion on the inner surfaces of the outer jacket will occur. Therefore inspection openings are not required in the inner vessel or the outer jacket.

Corrosion allowance is also not required on surfaces in contact with the operating fluid or exposed to the vacuum interspace between the inner vessel and the outer jacket.

7 Thermal loads

The following thermal conditions shall be taken into account:

7.1 For the inner vessel and its associated equipment the full range of temperature expected.

7.2 For the outer jacket and equipment thereof (other than equipment covered by 7.1):

— a minimum working temperature of - 20 °C;

— a maximum working temperature of 50 °C.

8 Materials

For the materials used to manufacture the transportable cryogenic vessels, the requirements of 8.1 and 8.2 apply.

8.1 Selection of materials

8.1.1 Materials which are or might be in contact with cryogenic fluids shall be in accordance with EN 1797.

8.1.2 Materials used at low temperatures shall follow the requirements of the relevant EN 1252-1, EN 1252-2; for non-metallic materials low temperature suitability shall be validated by an experimental method, taking into account operating temperatures.

8.2 Inspection certificates

8.2.1 The material according EN 1252-1 and EN 1252-2 has to be declared by an inspection certificate 3.1B in accordance with EN 10204.

8.2.2 The material manufactured to a recognised International Standard shall meet the testing requirements of EN 1252-1 or EN 1252-2 and has to be declared by an inspection certificate 3.1B in accordance with EN 10204.

8.2.3 The first delivery of material which is not manufactured to a recognised standard has to be guaranteed by an inspection certificate 3.1A in accordance with EN 10204 confirming that the material fulfils 8.1. The following deliveries from the same source shall be accepted with an inspection certificate 3.1B in accordance with EN 10204.

8.3 The outer jacket and the equipment not subjected to low temperature shall be manufactured from material suitable for the intended service.

9 Design, fabrication, inspection and testing

9.1 Large transportable cryogenic vessels shall be designed, fabricated, inspected and tested in accordance with prEN 13530-2.

9.2 Large transportable cryogenic vessels shall be equipped with valves, pressure relief devices etc. configured and installed in such a way that the vessel can be operated safely. The number of openings in the inner vessel for these equipments shall be as smallest as possible.

The inner vessel, the outer jacket and any section of pipework containing cryogenic fluid which can be isolated, shall be protected against overpressurisation. The inner vessel shall be protected by two independent safety devices which permit such an outflow that the test pressure is not reached in the event of loss of the vacuum.

Relief devices shall be in accordance with prEN 13648-1.

Valves shall be in accordance with EN 1626.

9.3 The large transportable cryogenic vessel shall be clean for the intended service in accordance with EN 12300.

9.4 The manufacturer shall retain the documents referred to in 3.8 for a period required by regulation (e.g. product liability). In addition the manufacturer shall retain all supporting and background documentation (including that from his subcontractors if any) which establishes that the vessel conforms to this standard.

10 Marking and labelling

The large transportable cryogenic vessel shall bear the markings and labellings required by the applicable Road/Rail/Sea/Air Regulation. Examples of tank plates (of the complete tank and of the inner vessel) for fixed tanks of road tankers (tank-vehicles), demountable tanks, tank-containers and tank swap bodies are given for information in annex A.

11 Final acceptance test

The first date and stamp of the expert (marks 4, 16, see A.1) after the final acceptance test on the large transportable cryogenic vessel confirms that the marking and labelling and that the vessel itself meets the requirements of this standard. These marks also confirm that the large transportable cryogenic vessel is ready for putting into service provided that the requirements of EN 13530-3 are met.

12 Periodic inspection

The large transportable cryogenic vessel has to be inspected periodically in accordance with the relevant Road/Rail/Sea/Air Regulations. By affixing the mark of the inspector and the date on the data plate, the inspector confirms the successfully completed periodic inspection.

The periodic inspection shall be done in accordance with EN 13530-3.

Annex A
(informative)

Tank plates

A.1 Example 1 Tank plate (of the complete tank) for fixed tanks of road tankers (tank-vehicles), demountable tanks, tank-containers and tank swap bodies

A.1.1 General

Every tank is be fitted with a corrosion resistant metal plate permanently attached to the tank readily accessible for inspection. The following particulars at least are marked on the plate by stamping or by any other similar method. These particulars can be engraved directly on the walls of the shell itself, if the walls are so reinforced that the strength of the shell is not impaired.

Table A.1 — Tank plate for the complete tank

1	**Manufacturer**				
2	**Approval number**		2 a	**Conformity mark**	
3	**Manufacturer's serial number**		4	**Year of manufacture**	
5	**Tank Code**		6	**Test pressure**	**bar**
7	**Capacity of the tank**	**l**	8	**Design temperature**	**°C**
9	**Material and materials standards of**	**inner vessel:**			
		outer jacket:			
10	**Insulation**	**vacuum insulated** or **thermally insulated by vacuum**			
11	**Maximum allowable working pressure**				**bar**
12	**The proper shipping name of the gas(es), for whose transport the portable tank is approved**				

13	**minimum filling temperature for each gas**	**°C**	**°C**	°C	
14	**maximum permissible load mass for each gas**	**kg**	**kg**	kg	
15	**date (month and year) of initial test and most recent periodic test**				
16	**stamp of the expert who carried out the tests**				

The following particulars are inscribed on the tank-vehicle itself or on a plate: (These particulars are not required in the case of a vehicle carrying demountable tanks.)

17	**name of owner or operator**	
18	**maximum permissible mass**	**kg**
19	**unladen mass**	**kg**

The text in **bold letters** can be supplemented in an other language. The arrangement of the particulars is optional.

A.1.2 Explanation of the marking of the tank plate (complete tank)

The markings of Table A.1 are explained in Table A.2.

Table A.2 — Explanation of the marking of the tank plate (compete tank)

No.	Content/explanation
1	Manufacturer's name or mark of the complete tank
2	Approval number given by the competent authority or body designated by this authority
2a	Conformity mark (π) according to annex VII of the Directive 1999/36/EC accompanied by the identification number of the notified or approved body
3	Serial or production number issued by the manufacturer
4	Year of manufacture
5	Tank code according to the certificate
6	Test pressure (gauge) of the shell in MPa or bar
7	Water capacity in litres
8	Design temperature in °C
9	Materials of the shell (and of the ends if different) of the inner vessel and reference to materials standards, if available and materials of the shell (and of the ends if different) of the outer jacket and reference to materials standards, if available.
10	Type of insulation of the tank in words, e.g. "thermally insulated" or "thermally insulated by vacuum", if applicable, in an official language of the country of registration and also, if that language is not English, French or German, in English, French or German, unless any agreements concluded between the countries concerned in the transport operation provide otherwise.
	"*continued*"

Table A.2 *(concluded)*

No.	Content/explanation
11	Maximum (allowable) working pressure (gauge) in bar or MPa
12	The name(s) in full of the gas(es), and, in addition for gases classified under an n.o.s. entry, the technical name of the gases, for whose transport the tank is approved, if applicable
13	Minimum filling temperature for each gas
14	Maximum allowable (net) mass of each gas according to mark 12 in kg
15	Month and year of the initial inspection and of each subsequent periodic inspection
16	stamp of the inspector (notified or approved body) who carried out the inspection(s) of mark 14 accompanied by the identification number of the notified or approved body
17	Name of owner or operator
18	Maximum permissible mass (gross mass of the road tanker (tank-vehicle), demountable tank, tank-container and tank swap body)
19	Unladen mass (tare mass of the road tanker (tank-vehicle), demountable tank, tank-container and tank swap body)

A.2 Example 2 Tank plate for the inner vessel of fixed tanks of road tankers (tank-vehicles), demountable tanks, tank-containers and tank swap bodies

A.2.1 General

Every inner vessel is fitted with a corrosion resistant metal plate permanently attached to the shell readily accessible for inspection.

The following particulars at least are marked on the plate by stamping or by any other similar method. These particulars can be engraved directly on the walls of the shell itself, if the walls are so reinforced that the strength of the shell is not impaired.

A.2.2 Tank plate for the inner vessel

The tank plate of the inner vessel can be identical to the tank plate of the fixed tank (see A.1) considering the explanations of Table A.3.

Table A.3 — Explantion of the marking of the tank plate for the inner vessel

No.	Content/explanation
1	Manufacturer's name or mark of the inner vessel
2	Kind of allocating to the approval number of Table A.2
3	Serial or production number issued by the manufacturer
4	Year of manufacture
5	To be dropped
6	Test pressure (gauge) of the inner vessel in MPa or bar
7	Water capacity in litres
8	Design temperature in °C
9	Materials of the shell (and of the ends if different) of the inner vessel and reference to materials standards, if available
10	To be dropped
11	Maximum (allowable) working pressure (gauge) in bar or MPa
	"*continued*"

Table A.3 (*concluded*)

No.	Content/explanation
12	To be dropped
13	
14	
15	Month and year of the initial inspection
16	Stamp of the inspector who carried out the inspection of mark 14
17	To be dropped
18	
19	

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