



BS 3951 : Part 2 : Section 2.3 : 1983
ISO 1496/3-1981

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British Standard

Freight containers

Part 2. Specification and testing of series 1
freight containers

Section 2.3 Tank containers for liquids and gases

[ISO title : Series 1 freight containers — Specification and testing —
Part 3 : Tank containers for liquids and gases]

Conteneurs pour le transport de marchandises
Partie 2. Spécifications et essais des conteneurs de la série 1
Section 2.3 Conteneurs-citernes pour les liquides et les gaz

Frachtcontainer
Teil 2. Prüfung von Frachtcontainern der Reihe 1
Abschnitt 2.3 Tankcontainer für Flüssigkeiten und Gase

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National foreword

This Section of this Part of this British Standard is one of a series relating to freight containers and has been prepared under the direction of the Packaging and Freight Containers Standards Committee.

This Section is identical with ISO 1496/3-1981 'Series 1 freight containers — Specification and testing — Part 3 : Tank containers for liquids and gases' prepared by Technical Committee 104, Freight containers, of the International Organization for Standardization (ISO).

Terminology and conventions. The text of the international standard has been approved as suitable for publication as a British Standard without deviation. Some terminology and certain conventions are not identical with those used in British Standards; attention is drawn especially to the following.

The comma has been used as a decimal marker. In British Standards it is current practice to use a full point on the baseline as the decimal marker.

Wherever the words 'International Standard' appear, referring to this standard, they should be read as 'British Standard'.

Cross-references

International standards	Corresponding British Standards
ISO 668-1979	BS 3951 Freight containers Part 1. General Section 1.1 : 1979 Specification for series 1 freight containers: Classification, external dimensions and ratings (Identical)
ISO 1161-1980	BS 3951 Freight containers Part 1. General Section 1.2 : 1977 Specification for corner fittings for series 1 freight containers (Identical)
ISO 6346-1981	BS 3951 Freight containers Part 1. General Section 1.6 : 1983 Specification for coding, identification and marking (Identical)

Other British Standards giving information on freight containers are BS 5073 'Guide to stowage of goods in freight containers' and BS 5237 'Specification for lifting twistlocks'.

NOTE. The following typographical errors should be noted:

- (a) on page 9 in the footnote '7.57g' should read '7.5tf';
- (b) on page 9 in the footnote '157g' should read '15tf';
- (c) on pages 16, 17 and 18 in footnote 2 'à' should read 'to'.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

British Standard

Freight containers

Part 2. Specification and testing of series 1 freight containers

Section 2.3 Tank containers for liquids and gases

0 Introduction

Grouping of container types for specification purposes

Part 1

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NOTE — Container groupings for Parts 1 and 2, and 4 to 7 will be set forth in detail in the relevant documents.

1 Scope and field of application

1.1 This International Standard sets out the basic requirements for the specification and testing of ISO Series 1 tank containers suitable for the carriage of gases and liquids, including solid substances which may be loaded or unloaded as liquids either for gravity or pressure discharge, for international exchange and for conveyance by road, rail and sea including interchange between these forms of transport.

1.2 Except where otherwise stated, the requirements of this International Standard are "minima". Tank containers to be used for the carriage of dangerous goods are subject to additional national and international requirements as applied by competent authorities.

1.3 Pending the publication of an International Standard for pressurized, tank-type dry-bulk containers, the requirements of this International Standard may be considered suitable as a guide for the design and testing of these, or dual purpose, tank containers. In such cases, special attention shall be given to fluidizing, filling and discharging fittings and any hazardous properties of the cargo.

1.4 The tank container types covered by this International Standard are as follows :

1) At present under study.

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ISO type code			Minimum test pressure bar gauge ¹⁾	Corresponding maximum allowable working pressure bar gauge	Code basis, comments
Liquids		Gases			
Non-dangerous	Dangerous				
70 ²⁾			0,45	—	Atmospheric pressure, commercial practice
71			1,5	1,0	Pressure discharge
72			2,65	1,75	
	73		1,5	1,0	IMCO 2 (min.), ECOSOC
	74		2,65	1,75	IMCO 2 (max.), IMCO 1 (min.)
	75		4,0	2,65	ADR/RID, ECOSOC
	76		6,0	4,0	ECOSOC
		77	10,5	7,0	IMCO 5 (min.), ECOSOC
		78	22,0	14,7	ADR/RID,
		79 ³⁾			

1) Pressures used in this International Standard are expressed in gauge units except where indicated otherwise and in the case of the vapour pressures of substances which are expressed in absolute units. 1 bar = 10^5 Pa = 10^5 N/m² = 14,5 lbf/in² = 1,02 kgf/cm².

2) The number 70 may, in addition, be used to designate tank containers for which the type code relevant to the test pressure is not used.

3) To be developed as required for gases to which more stringent design requirements are applicable than in the case of type 78 units.

NOTE — The ISO type code designation does not imply the approval of any competent authority for the transport of specific goods or products the tank container may carry. The type code is dependent only on the test pressure (see 6.11).

The test pressure given is the minimum value of the respective class. Any tank container with a test pressure in the range between a given minimum pressure and the next higher minimum pressure belongs to the lower class.

The values which are in bold type are those which formed the basis for the selection of the pressure steps in this table.

2 References

ISO 668, *Series 1 freight containers — Classification, external dimensions and ratings.*

ISO 1161, *Series 1 freight containers — Corner fittings — Specification.*

ISO 6346, *Freight containers — Coding, identification and marking.*

3 Definitions

For the purposes of this International Standard, the following definitions apply :

3.1 tank container : A freight container which includes two basic elements, the tank or tanks and the framework, and complies with the requirements of this International Standard.

3.2 framework : The tank mountings, end structure and all load-bearing elements not present for the purposes of containing cargo, which transmit static and dynamic forces arising out of the lifting, handling, securement and transporting of the tank container as a whole.

3.3 tank or tanks : The vessel or vessels and associated piping and fittings which are designed to contain the cargo carried.

3.4 compartment : Any fluid-tight section of the tank formed by the shell, ends or bulk heads.

NOTE — Baffles, surge plates or other perforated plates do not form tank compartments within the meaning of this definition.

3.5 gas : A fluid substance having a vapour pressure greater than 3 bar (absolute) at 50 °C or as otherwise defined by the competent authority.

3.6 liquid : A fluid substance having a vapour pressure not greater than 3 bar (absolute) at 50 °C.

3.7 competent authority : The authority or authorities designated as such in each country and in each specific case by the governments concerned.

3.8 dangerous goods : Those substances classified as dangerous by the United Nations Committee of experts on the transport of dangerous goods or by the competent authority as defined in 3.7.

3.9 maximum allowable working pressure : That pressure assigned for design by either a competent authority or other responsible person to a particular tank, above which that tank is not intended to be operated.

3.10 test pressure : The gauge pressure at which the tank is tested (see note to 6.11.2)

3.11 total capacity : That volume of water which will completely fill the tank at 20 °C.

3.12 ullage : That portion of the "total capacity" of the tank not occupied by its cargo, expressed as a percentage of that total capacity.

4 Dimensions and ratings

4.1 External dimensions

The overall external dimensions and tolerances of tank containers covered in this International Standard are those established in ISO 668, except that tank containers may be of reduced height, in which case they shall be designated 1AX, 1BX, 1CX, 1DX. No part of the tank container and its associated fittings or equipment shall project beyond these specified overall external dimensions.

4.2 Ratings

The values of the rating R , being the maximum gross mass of the tank container, are those given in ISO 668.

NOTES

1 The maximum operating payload, P , is deduced from the rating R by subtracting the tare mass T , including fittings and associated equipment carried with the tank container.

2 Due consideration should be paid to the variation of specific gravity of the cargoes which may be carried and to their appropriate ullages so that the rating R is not exceeded.

3 The tank container rating, R , and its tare mass, T are, by definition, in units of mass. Where test requirements are based on the gravitational forces derived from these values, those forces are indicated thus :

Rg and Tg

the units of which are newtons or multiples thereof. The word "load" when used to describe a quantity to which units may be ascribed, implies mass. The word "loading" implies force.

5 Design requirements

5.1 General

5.1.1 All tank containers shall be capable of fulfilling the following requirements for the framework, the design and construction of the tank and any optional provisions. The ability of the tank container to withstand the specified design loadings shall be established by calculation.

5.1.2 The strength requirements for tank containers are given in diagrammatic form in annex A (these requirements are applicable to all tank containers except where otherwise stated). They apply to tank containers as complete units.

5.1.3 The tank container shall be capable of withstanding the loads and loadings detailed in clause 6.

5.1.4 Each tank container shall be designed to withstand the effects of inertia of the tank contents resulting from transport motions. For design purposes these effects may be taken to be equivalent to loadings of $2 Rg$ longitudinally, $1 Rg$ laterally and $2 Rg$ vertically. These loadings may be considered individually, to be evenly distributed and to act through the geometric centre of the tank. Vertical loadings are total loadings including dynamic effects. It should be noted that the above loadings do not give rise to an increase in the pressure in the vapour space. For design purposes, an equivalent pressure loading may be used.

5.1.5 Each tank container shall be capable of withstanding the static head produced by up-ending the tank container while loaded to its rating R . Due regard shall be given to the liquid of highest density that is to be carried and to any compartmentation of the tank.

5.1.6 As the effects of loads encountered under any dynamic operating condition should only approach, but not exceed, the effects of the corresponding test loads, it is implicit that the capabilities of tank containers indicated in annex A and demonstrated by the tests described in clause 6 shall not be exceeded in any mode of operation.

5.1.7 Any closure in a tank container which, if unsecured, could lead to a dangerous situation shall be provided with an adequate securing system having, so far as may be practicable, external indication of the positive securing of that closure in the appropriate operating position.

5.1.8 Fork lift pockets shall not be provided in tank containers.

NOTE — Fork lift transport of tank containers is considered dangerous because of stability problems with loaded or partly-loaded tanks, and the danger of impact damage from the forks of fork lift trucks.

5.1.9 The tank container materials shall be suitable for, or adequately protected from, the cargo and the environment in which the tank container may be operated.

Due regard should be given to the problems of low ambient temperature, corrosive atmospheres, the possibility of uncontrolled cargo release in fire, etc.

5.2 Framework

5.2.1 Corner fittings

All Series 1 tank containers shall be equipped with top and bottom corner fittings. The requirements and positioning of the corner fittings are given in ISO 1161. The upper faces of the top corner fittings shall protrude above the top of all other components of the tank container by a minimum of 6 mm¹⁾ (see 5.2.2.5).

1) 6 mm = 1/4 in

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5.2.2 Base structure

5.2.2.1 All tank containers shall be capable of being supported by their bottom corner fittings only.

5.2.2.2 Tank containers other than 1D and 1DX shall also be capable of being supported on load-transferring areas in their base structures only.

5.2.2.2.1 Consequently, these tank containers shall have end transverse members and sufficient intermediate load-transferring areas (or a flat underside) of sufficient strength to permit vertical load transfer to or from the longitudinal members of a carrying vehicle, which are assumed to lie within the two 250 mm¹⁾ wide zones defined by the dotted lines of figure 22 of annex B.

5.2.2.2.2 The lower faces of the load-transferring areas, including those of the end transverse members, shall lie in a plane located :

$$12,5 \begin{matrix} + 5 \\ - 1,5 \end{matrix} \text{ mm}^{1)}$$

above the base plane of the bottom faces of the lower corner fittings of the tank container.

5.2.2.2.3 The transfer of load between the underside of any bottom side rails, which may be fitted, and carrying vehicles is not envisaged.

The transfer of load between any side rails which may be fitted and handling equipment should only occur when provisions have been made in accordance with 5.3.1.

5.2.2.2.4 Load transfer area requirements are given in annex B.

5.2.2.3 For tank containers 1D and 1DX, the level of the underside of the base structure is not specified, except in so far as it is implied in 5.2.2.4 and 5.2.2.5.

5.2.2.4 When the tank container is loaded to its rating *R* no part of the tank or its associated shell fittings shall project downwards below the plane of 25 mm¹⁾ above the base plane (bottom faces of the bottom corner fittings).

5.2.2.5 For tank containers under dynamic conditions, or the static equivalent thereof, with the tank container loaded in such a way that the combined mass of the tank container and test load is equal to 1,8 *R*, no part of the base of the tank container

shall deflect more than 6 mm¹⁾ below the base plane (bottom faces of the bottom corner fittings).

5.2.3 End structure

For tank containers other than 1D and 1DX, the sideways deflection of the top of the tank container with respect to the bottom of the tank container at the time it is under full transverse rigidity test conditions (see 6.7) shall not cause the sum of the changes in length of the two diagonals to exceed 60 mm.¹⁾

5.2.4 Side structure

For tank containers other than 1D and 1DX, the longitudinal deflection of the top of the tank container with respect to the bottom of the tank container at the time it is under full longitudinal rigidity test conditions (see 6.8) shall not exceed 25 mm.¹⁾

5.3 Requirements — Optional features**5.3.1 Provisions for handling at the base by means of grapple arms or similar devices**

Provision for handling tank containers by means of grapple arms or similar devices may be provided as optional features.

The dimensional requirements for such provisions are specified in annex C.

5.3.2 Gooseneck tunnels

Gooseneck tunnels may be provided as optional features in tank containers 1AA, 1A and 1AX. The dimensional requirements are specified in annex D and, in addition, all other parts of the base structure shall be as specified in 5.2.2.

5.3.3 Walkways and ladders**5.3.3.1 Walkways**

Where provided, walkways shall be designed to withstand a load of 300 kg¹⁾ uniformly distributed over an area of 600 mm × 300 mm.¹⁾

5.3.3.2 Ladders

Where provided, ladders shall be designed to withstand a load of 200 kg¹⁾ on any rung.

1) 6 mm = 1/4 in
 $12,5 \begin{matrix} + 5 \\ - 1,5 \end{matrix} \text{ mm} = 1/2 \begin{matrix} + 3/8 \\ - 1/16 \end{matrix} \text{ in}$
 25 mm = 1 in
 60 mm = 2 3/8 in
 250 mm = 10 in
 200 kg = 440 lb
 300 kg = 660 lb
 300 mm = 12 in
 600 mm = 24 in

5.4 Tank

5.4.1 Design and construction

5.4.1.1 Each tank or compartment thereof shall be designed and constructed to good technical practice.

5.4.1.2 Each tank or tanks shall be firmly secured to structural elements of the tank framework. The tank or tanks shall be capable of being filled and emptied without removal from the framework.

5.4.1.3 Tanks or tank compartments without vacuum relief devices shall be designed to withstand an external pressure of at least 0,4 bar above the internal pressure.

Tanks equipped with vacuum relief valves shall be designed to withstand an external over-pressure of 0,21 bar or greater.

5.4.2 Corrosion allowance

In addition to the requirements of 5.1.9, an allowance for corrosion shall be taken into consideration where necessary.

5.4.3 Tank openings

5.4.3.1 All tank openings except those fitted with pressure relief devices shall be provided with adequate closures to prevent accidental escape of the contents.

5.4.3.2 Tank nozzles and outlet fittings shall be substantially made and attached to the tank in such a manner as to minimize the risks of breakage. Protective covers or housings shall be employed wherever necessary to comply with this requirement (see 4.1 and 5.2.2).

5.4.3.3 Any tank opening located below the normal liquid level of the contents and fitted with a valve capable of being operated manually shall be provided with an additional means of closure on the outlet side of the valve. Such additional means of closure may be a fluid-tight cap, bolted blank flange, or other suitable protection against accidental escape of the contents.

All valves, whether fitted internally or externally, shall be located as close to the tank shell as practicable.

5.4.3.4 Stop valves with screwed spindles shall be closed by clockwise motion of the handwheel.

5.4.3.5 All tank connections, such as nozzles, outlet fittings and stop valves, shall be clearly marked to indicate their appropriate functions.

5.4.4 Pressure and vacuum relief devices

5.4.4.1 Each tank or compartment thereof intended to carry non-dangerous cargo shall be fitted with a pressure relief device set to be fully open at a pressure not greater than the tank's test pressure, to prevent excessive internal over-pressure. Such devices shall be connected to the vapour space of the tank and located as near to the top of the tank and as near to the tank's (or tank compartment's) mid-length as practicable.

In those cases where the tank container will be utilized for both dangerous and non-dangerous cargo, the relief devices shall be set in accordance with 5.4.4.3.

5.4.4.2 Pressure relief devices, installed as required in 5.4.4.1, should have a minimum relief capacity of 0,05 m³/s¹⁾ of standard air (1 bar absolute, 15 °C). This may be considered as providing over-pressure protection under non-emergency conditions, but should not be considered as adequate to protect a tank container, or a compartment thereof, from excessive over-pressure under full fire exposure conditions.

5.4.4.3 Tanks, or a compartment thereof, intended for the carriage of dangerous goods shall be provided with pressure relief devices meeting the relevant regulations to the satisfaction of the competent authority.

5.4.4.4 Each pressure relief device shall be plainly and permanently marked with the pressure at which it is set to operate.

5.4.4.5 A tank container, or a compartment thereof, with external design pressure of less than 0,4 bar shall be equipped with a vacuum relief device set to relieve at 0,79 bar absolute, except that a lower absolute setting may be utilized provided that the external design pressure is not exceeded. The vacuum relief device shall have a minimum through area of 284 mm² ¹⁾ and shall conform to the requirements of the competent authority. The use of combination pressure-vacuum relief devices is allowed.

NOTE — The above requirements are intended to protect against collapse of the tank, or compartment thereof, during conditions of normal, ambient temperature variations. They will not necessarily prevent collapse if a tank, or a compartment thereof is, for example, closed tightly immediately after steam cleaning or discharged without opening the man-hole covers.

5.4.5 Inspection and maintenance openings

Tank containers shall be provided with man-holes or other openings to allow for complete internal inspection, unless exempted by the competent authority.

The size of man-holes shall be a minimum of 450 mm¹⁾ diameter and shall be determined by the need for men and

1) 0,05 m³/s = 106 ft³/min
284 mm² = 0,44 in²
450 mm = 17,75 in

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machines to enter the tank to inspect, maintain, or repair its interior, taking into account the requirements of the governing competent authority.

5.4.6 Gauging devices

Gauging devices which may be in direct communication with the contents of the tank shall not be made of easily destructible material.

5.4.7 Sealing (customs requirements)

Adequate provision shall be made for the sealing of the tank in accordance with international customs agreements.

5.5 Optional features for the tank

5.5.1 Insulation

When insulation is provided, the design and construction shall be such that the insulation will in no way impinge on the specified requirements nor interfere with the proper function of the tank fittings.

Due regard shall be given to the requirements of 5.1.9.

5.5.2 Heating and refrigeration

When heating or refrigeration is provided, due consideration shall be given to the safety of the tank and its contents. Suitable safeguards shall be provided to avoid the development of excessive temperature and stresses.

6 Testing

6.1 General

Unless otherwise stated, tank containers complying with the design and construction requirements specified in clause 5 shall, in addition, be capable of withstanding the tests specified in 6.2 to 6.10 inclusive. The pressure test (test No.10) shall be applied to every tank container and shall, where practicable, be carried out last if other tests are to be performed.

NOTES

1 Tank containers intended for the carriage of dangerous goods shall, in addition, comply with the test requirements of the relevant regulations to the satisfaction of the competent authority.

2 Dynamic tests are not included pending possible development of a satisfactory and reproducible test specification.

3 As indicated in note 3 to 4.2, the tank container rating R and its tare mass T are, by definition, in units of mass. Where test requirements are based on the gravitational forces derived from these values, those forces are indicated thus :

Rg and Tg

the units of which are newtons or multiples thereof.

The word "load" when used to describe a quantity to which units may be ascribed, implies mass. The word "loading" implies force.

6.1.1 The tank container under test, unless otherwise stated, shall be loaded with a suitable fluid to achieve the test load or loading specified.

If the test load or loading cannot readily be met by the above method, or if such a method is undesirable, the tank container shall be loaded with a suitable fluid and supplementary load or loading applied. The total load or loading thus applied shall be such as to simulate uniform loading. Variations within 20 % by comparison with the calculated bending moment diagrams of the uniformly loaded tank container will be considered acceptable.

NOTE — Other alternative test load or loadings (for example, for longitudinal and lateral internal restraint tests) may be used, provided that they achieve the specified test loading.

6.1.2 The test load and loadings specified in all of the following requirements are minimum requirements.

6.1.3 The dimensional requirements to which reference is made in the requirements clause after each test are those specified in :

- a) the dimensional and design requirement clauses of this International Standard;
- b) ISO 668;
- c) ISO 1161.

6.2 Test No. 1 — Stacking

6.2.1 General

This test shall be carried out to prove the ability of a tank container to support five other fully-loaded containers of the same length and rating under the acceleration conditions encountered in ship cell structures, taking into account relative eccentricities between containers due to clearances.

6.2.2 Procedure

The tank container, in tare condition T , shall be placed on four level pads, one under each bottom corner fitting. The pads shall be centralized under the fittings and be substantially of the same plan dimensions as the fittings.

The tank container shall be subjected to a vertical force of $2,25 Rg$ on each of the four top corner fittings simultaneously, or $4,5 Rg$ on each pair of end fittings. The forces shall be applied through a test fixture equipped with corner fittings as specified in ISO 1161 or equivalent fittings which have imprints of the same geometry (i.e. with the same external dimensions, chamfered aperture and rounded edges) as the bottom face of the bottom corner fitting specified in ISO 1161. If equivalent fittings are used, they must be designed to produce the same effect on the container under test loads as when corner fittings are used.

In all cases, the forces shall be applied in such a manner that rotation of the planes through which the forces are applied and on which the container is supported, is minimized.