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Transportable gas cylinders – Conditions for filling gases into receptacles – Single component gases

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English version

Transportable gas cylinders - Conditions for filling gases into receptacles - Single component gases

Bouteilles à gaz transportables - Conditions de remplissage
des récipients - Gaz à composant unique

Orstbewegliche Gasflaschen - Bedingungen für das Füllen
von Gasen in Gefäße - Einzelne Gase

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Foreword

This document (EN 13096:2003) has been prepared by Technical Committee CEN/TC 23 “Transportable gas cylinders”, the secretariat of which is held by BSI.

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of an identical text or by endorsement, at the latest by June 2004, and conflicting national standards shall be withdrawn at the latest by June 2004.

This European Standard has been submitted for reference into the RID and/or 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 the technical annexes of the ADR.

Annex A is informative.

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, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

EN 13096:2003 (E)

Introduction

It is recognised that higher filling degrees than those specified in this standard have been safely used for many years in certain northern European countries, where ambient temperatures are consistently lower than more southern parts of Europe. In these cases, gas receptacles have been filled, transported and used exclusively within the country concerned in accordance with local National Standards.

1 Scope

This European Standard specifies the general requirements (such as charging pressure, filling factor etc.) for filling single gas receptacles, manifolded gas cylinders (bundles) tubes and drums with single component gases.

This standard excludes the specific requirements for filling acetylene cylinders, cryogenic gases are also excluded.

For the requirements for filling with gas mixtures EN 13099 should be consulted.

This standard is primarily for industrial gases other than LPG but may also be applied for LPG. However for dedicated LPG cylinders, EN 1439, *Transportable refillable welded steel cylinders for liquefied petroleum gas (LPG) – Procedure for checking before, during and after filling* prepared by CEN/TC 286 – *Liquefied petroleum gas equipment and accessories*, should be consulted.

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 ISO 11114-1, *Transportable gas cylinders — Compatibility of cylinder and valve materials with gas contents — Part 1: Metallic materials (ISO 11114-1:1997)*.

3 Terms and definitions

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

3.1

gas

substance, which:

- a) at 50 °C has a vapour pressure greater than 300 kPa (3 bar); or
- b) is completely gaseous at 20 °C at the standard pressure of 101,3 kPa

NOTE Hydrogen fluoride and hydrogen cyanide are listed in Table 3 together with other liquids which may be filled into gas receptacles.

3.2

single component gas

substance as defined in 3.1 which is technically pure in the gas receptacle. A single component gas dissolved under pressure falls within this category

NOTE A single component gas may contain other components deriving from its production process or added to preserve the stability of the product provided that the level of these components does not change its classification or its conditions of carriage, such as filling ratio, filling pressure or test pressure.

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3.3 gas receptacles

3.3.1 cylinders

transportable pressure receptacles of a capacity not exceeding 150 litres

3.3.2 tubes

seamless transportable pressure receptacles of a capacity exceeding 150 litres and of not more than 3 000 litres

3.3.3 pressure drums

welded transportable pressure receptacles of a capacity exceeding 150 litres and of not more than 1 000 litres, (e.g. cylindrical receptacles equipped with rolling hoops, receptacles on skids and receptacles equipped in frames)

3.3.4 bundles of cylinders (also known as frames)

transportable assemblies of cylinders which are interconnected by a manifold and held firmly together

3.4 compressed gases

gases having a critical temperature less than or equal to - 50 °C

3.5 liquefied gases

3.5.1 liquefied gases

gases having a critical temperature above - 50 °C

3.5.2 high pressure liquefied gas

gas which has a critical temperature above - 50 °C and equal to or below + 65 °C

3.5.3 low pressure liquefied gas

gas which has a critical temperature above + 65 °C

3.6 dissolved gas

gas which is dissolved under pressure in a liquid (solvent). The liquid (solvent) may be supported in a porous mass.

3.7 critical temperature

temperature above which the substance cannot exist in the liquid state

3.8 filling degree (filling ratio)

mass of gas in kg which can be filled into 1 litre of cylinder water capacity. Normally applied to liquefied gases only

NOTE The water capacity stamped on the cylinder may apply to the minimum designed water capacity without internal fittings, in which case, the net water capacity should be ascertained.

3.9

filling degree reference temperature(s)

temperature at which the liquid density is to be evaluated for calculating the filling degree (see 4.3 and 4.4.)

3.10

developed pressure

pressure achieved by the contents of a gas cylinder filled according to the standard when raised to the reference temperature for developed pressure

NOTE All pressures are given in bar gauge¹⁾ unless otherwise stated.

3.11

developed pressure reference temperature

that chosen to represent the expected maximum temperature in normal service

NOTE All pressures are given in bar gauge unless otherwise stated.

3.12

settled pressure (P_{15})

pressure of the content of the cylinder at + 15 °C

NOTE All pressures are given in bar gauge unless otherwise stated.

3.13

test pressure (P_t)

pressure at which the receptacle is hydraulically or pneumatically tested

NOTE 1 The test pressure should not be exceeded under any foreseeable normal conditions (for example during filling).

NOTE 2 All pressures are given in bar¹⁾ gauge unless otherwise stated.

3.14

pressure relief device

device which is fitted to the cylinder or cylinder valve and designed to relieve gas pressure in the event of abnormal conditions resulting in the development of excessive pressure inside the receptacle

3.15

compatibility

term relating to the interaction of gas and receptacles/cylinder equipment (parts in contact with gas) under the conditions of use. Hence the term 'compatible' implies a satisfactory gas/cylinder/cylinder equipment combination.

3.16

tare weight

sum of the masses of the receptacles and other fittings not removed during the receptacle filling operation, such as valve, dip tube and any permanently or semi permanently fixed valve protection device

4 Principles and requirements for filling gas receptacles

4.1 General requirements (all gases and gas receptacles)

The gas to be filled shall be compatible with the receptacles, the cylinder valve and any other fittings that may be in contact with the gas (see EN ISO 11114-1).

1) 1 bar = 10^5 Pa = 0,1 MPa

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The receptacles when presented for filling shall be within the specified period for periodic inspection and test.

The receptacles and cylinder valve shall be in a serviceable condition.

The receptacles shall be equipped with a suitable valve with the appropriate valve outlet.

The receptacles shall be correctly identified for the intended gas.

Filling degrees specified in this standard are maximum values and hence the filling mass charged into the receptacle shall take account of the accuracy of the filling procedure and weighing equipment. The tare weight of the receptacle shall be identified.

4.2 For compressed gases

The maximum settled pressure shall be the lower of the following values:

- a) two thirds of the test pressure; or
- b) the pressure, which, when the receptacle content is raised to the reference temperature at 65 °C produces a developed pressure that does not exceed the receptacle test pressure.

4.3 For low pressure liquefied gases

The maximum permissible mass of contents per litre capacity (filling factor) equals 0,95 times the density of the liquid phase at 50 °C; in addition, the vapour phase shall not disappear below 60 °C. The test pressure shall be at least equal to the vapour pressure of the liquid at 65 °C, minus 100 kPa (1 bar).

For pure gases with sufficient data the maximum filling degree (*FD*) shall be determined as follows:

$$FD \leq (0,0032 \times BP - 0,24) \times d_l$$

where:

FD = max. permissible filling degree (in kg/l)

BP = boiling point (in Kelvin)

d_l = density of the liquid at boiling point (in kg/l)

Data for low pressure liquefied gases are given in Table 1.

4.4 For high pressure liquefied gases

The maximum permissible mass of contents per litre capacity shall be such that the degree of filling shall be such that the internal pressure at 65 °C does not exceed the test pressure of the receptacles.

For gases and gas mixtures with insufficient data, the maximum permissible filling degree (*FD*) shall be determined as follows:

$$FD \leq 8,5 \times 10^{-4} \times d_g \times P_h$$

where

FD = max. permissible filling degree (in kg/l)

d_g = gas density (at 15 °C, 1 bar) (in kg/m³)

P_h = minimum test pressure (in bar)

If the density of the gas is unknown, the maximum permissible filling degree shall be determined as follows:

$$FD \leq \frac{P_h \times MM \times 10^{-3}}{R \times 338}$$

where

FD = max. permissible filling degree (in kg/l)

P_h = minimum test pressure (in bar)

MM = molar mass (in g/mol)

$R = 8,31451 \cdot 10^2 \text{ bar} \cdot \text{l} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}$ (gas constant)

Data for high pressure liquefied gases are given in Table 1. Receptacles of other test pressures may be used provided the filling degrees are adjusted accordingly.

4.5 For dissolved gases

If receptacles are filled with gases dissolved under pressure, the test pressure shall correspond to that pressure resulting from a reference temperature of 65 °C and prescribed concentration of the gas in the solvent. For acetylene the minimum test pressure shall amount to 60 bar.

4.6 In cases where the reference temperatures are to be deliberately exceeded

4.6.1 The maximum anticipated temperature shall be established. The suitability of the receptacles and valve materials shall be checked for operation at the maximum anticipated temperature. In such cases the filling degrees for high pressure and low pressure liquefied gases shall be appropriately calculated and shall be lower than those given in this standard.

4.6.2 For compressed gases, a filling pressure shall be chosen to ensure the developed pressure at the maximum anticipated temperature does not exceed the cylinder test pressure.

4.6.3 For liquefied gases, where the critical temperature is equal to or greater than the maximum anticipated temperature, the cylinder test pressure shall exceed the vapour pressure of the gas at the maximum anticipated temperature. A filling factor shall be chosen to ensure the receptacle is not hydraulically full at the maximum anticipated temperature.

4.6.4 For liquefied gases, where the critical temperature is less than the maximum anticipated temperature, a filling factor shall be chosen to ensure the cylinder test pressure is not exceeded at the maximum anticipated temperature.

4.7 For gases not listed in Tables of this standard

4.7.1 Data shall be sought or determined experimentally as follows:

- gas group: i.e. compressed, low pressure liquefiable, high pressure liquefiable or dissolved gas;
- for compressed gases: the relationship of developed pressure at the reference temperature and the charging pressure at 15 °C;
- for low pressure liquefied gases: the vapour pressure at 65 °C and liquid density at the filling degree reference temperature;