SLOVENSKI STANDARD
SIST EN 14140:2015

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Nadomešča:
SIST EN 14140:2004+A1:2007

Oprema in pribor za utekočinjeni naftni plin (UNP) - Premične, ponovno polnljive varjene jeklenke iz jekla za UNP - Alternativni način konstruiranja in izdelava

LPG equipment and accessories - Transportable refillable welded steel cylinders for LPG - Alternative design and construction

Flüssiggas-Geräte und Ausrüstungsteile - Ortsbewegliche, wiederbefüllbare, geschweißte Flaschen aus Stahl für Flüssiggas (LPG) - Alternative Gestaltung und Konstruktion

Equipements pour GPL et leurs accessoires - Bouteilles en acier soudé transportables et rechargeables pour gaz de pétrole liquéfié (GPL) - Autres solutions en matière de conception et construction

Ta slovenski standard je istoveten z: **EN 14140:2014**

ICS:

23.020.30	Tlačne posode, plinske jeklenke	Pressure vessels, gas cylinders

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EUROPEAN STANDARD

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EN 14140

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English Version

LPG equipment and accessories - Transportable refillable welded steel cylinders for LPG - Alternative design and construction

Équipements pour GPL et leurs accessoires - Bouteilles en acier soudé transportables et rechargeables pour gaz de pétrole liquéfié (GPL) - Autres solutions en matière de conception et construction

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This European Standard was approved by CEN on 9 August 2014.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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COMITÉ EUROPÉEN DE NORMALISATION
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Foreword

This document (EN 14140:2014) has been prepared by Technical Committee CEN/TC 286 "Liquefied petroleum gas equipment and accessories", the secretariat of which is held by NSAI.

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of an identical text or by endorsement, at the latest by June 2015 and conflicting national standards shall be withdrawn at the latest by June 2015.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 14140:2003+A1:2006.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

This European Standard has been submitted for reference into:

- the RID [11]; and
- the technical annexes of the ADR [12].

NOTE These regulations take precedence over any clause of this European Standard. It is emphasised that RID/ADR/ADN are being revised regularly at intervals of two years which may lead to temporary non-compliances with the clauses of this European Standard.

The major changes to this revision include:

- restructure of standard;
- the addition of requirements for hot air balloon cylinders;
- an update on the terminology;
- the addition of requirements for over-moulded cylinders;
- the addition of the environmental checklist, Annex D.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

This European Standard calls for the use of substances and procedures that may be injurious to health and/or the environment if adequate precautions are not taken. It refers only to technical suitability: it does not absolve the user from their legal obligations at any stage.

It has been assumed in the drafting of this European Standard that the execution of its provisions is entrusted to appropriately qualified and experienced people.

This European Standard permits the use of new and higher strength steels and has the potential for cylinders to have a wall thickness thinner than the minimum wall thickness related to diameter, when compared with cylinders in accordance with EN 1442. These changes in technology are justified by requiring a series of performance tests, including impact testing, to demonstrate the adequacy of the calculated pressure thickness for service and transport considerations

Reference should also be made to EN 1439 and EN 1440, which requires the cylinder manufacturer to perform additional tests to determine the rejection limits for in-service damage and to include these limits in the documentation for the cylinder.

Protection of the environment is a key political issue in Europe and elsewhere around the world. Protection of the environment in this document is understood in a very broad sense. The phrase is used, for example, in relation to the total life-cycle aspects of a product on the environment, including expenditure of energy, and during all phases of its existence, from mining of raw materials, to fabrication, packaging, distribution, use, scrapping, recycling of materials, etc. Annex D comprises an environmental checklist which highlights the clauses of this European Standard that address environmental aspects.

It is recommended that manufacturers develop an environmental management policy. For guidance see EN ISO 14000 series, [6], [7] and [8]].

Provisions need to be restricted to a general guidance. Limit values are specified in national laws.

All pressures are gauged unless otherwise stated.

NOTE This European Standard requires measurement of material properties, dimensions and pressures. All such measurements are subject to a degree of uncertainty due to tolerances in measuring equipment etc. It may be beneficial to refer to the leaflet “measurement uncertainty leaflet" SP INFO 2000 27 [14].

1 Scope

This European Standard specifies the minimum requirements for the design, construction and testing during manufacture of transportable refillable welded steel Liquefied Petroleum Gas (LPG) cylinders, of water capacity from 0,5 l up to and including 150 l, exposed to temperatures of -20 °C to +65 °C. It allows alternative design and construction methods to those required in EN 1442, including coated cylinders, over-moulded cylinders and cylinders for hot air balloons.

This European Standard applies only to pressure receptacles with a circular cross-section.

This European Standard does not include the equipping of the cylinders with valves and other service equipment.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1439, *LPG equipment and accessories - Procedure for checking LPG cylinders before, during and after filling*

EN 10028-7, *Flat products made of steels for pressure purposes - Part 7: Stainless steels*

EN 10120, *Steel sheet and strip for welded gas cylinders*

EN 10204:2004, *Metallic products - Types of inspection documents*

EN 10272, *Stainless steel bars for pressure purposes*

EN 14717, *Welding and allied processes - Environmental check list*

EN 14894, *LPG equipment and accessories - Cylinder and drum marking*

EN ISO 643, *Steels - Micrographic determination of the apparent grain size (ISO 643)*

EN ISO 2409:2013, *Paints and varnishes - Cross-cut test (ISO 2409:2013)*

EN ISO 2812-2, *Paints and varnishes - Determination of resistance to liquids - Part 2: Water immersion method (ISO 2812-2)*

EN ISO 3231:1997, *Paints and varnishes - Determination of resistance to humid atmospheres containing sulfur dioxide (ISO 3231:1993)*

EN ISO 4136, *Destructive tests on welds in metallic materials - Transverse tensile test (ISO 4136)*

EN ISO 4624, *Paints and varnishes - Pull-off test for adhesion (ISO 4624)*

EN ISO 5173, *Destructive tests on welds in metallic materials - Bend tests (ISO 5173)*

EN ISO 6520-1, *Welding and allied processes - Classification of geometric imperfections in metallic materials - Part 1: Fusion welding (ISO 6520-1)*

EN ISO 6892-1, *Metallic materials - Tensile testing - Part 1: Method of test at room temperature (ISO 6892-1)*

EN ISO 9227, *Corrosion tests in artificial atmospheres - Salt spray tests (ISO 9227)*

EN ISO 9606-1, *Qualification testing of welders - Fusion welding - Part 1: Steels (ISO 9606-1)*

EN ISO 9712:2012, *Non-destructive testing - Qualification and certification of NDT personnel (ISO 9712:2012)*

EN ISO 11117:2008, *Gas cylinders - Valve protection caps and valve guards - Design, construction and tests (ISO 11117:2008)*

EN ISO 11997-2, *Paints and varnishes - Determination of resistance to cyclic corrosion conditions - Part 2: Wet (salt fog)/dry/humidity/UV light (ISO 11997-2)*

EN ISO 14732, *Welding personnel - Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials (ISO 14732)*

EN ISO 15609-1, *Specification and qualification of welding procedures for metallic materials - Welding procedure specification - Part 1: Arc welding (ISO 15609-1)*

EN ISO 15613, *Specification and qualification of welding procedures for metallic materials - Qualification based on pre-production welding test (ISO 15613)*

EN ISO 15614-1, *Specification and qualification of welding procedures for metallic materials - Welding procedure test - Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys (ISO 15614-1)*

EN ISO 17636-1:2013, *Non-destructive testing of welds - Radiographic testing - Part 1: X- and gamma-ray techniques with film (ISO 17636-1:2013)*

EN ISO 17636-2:2013, *Non-destructive testing of welds - Radiographic testing - Part 2: X- and gamma-ray techniques with digital detectors (ISO 17636-2:2013)*

EN ISO 17637, *Non-destructive testing of welds - Visual testing of fusion-welded joints (ISO 17637)*

EN ISO 17639, *Destructive tests on welds in metallic materials - Macroscopic and microscopic examination of welds (ISO 17639)*

EN ISO 19232-1, *Non-destructive testing - Image quality of radiographs - Part 1: Determination of the image quality value using wire-type image quality indicators (ISO 19232-1)*

EN ISO 19232-2, *Non-destructive testing - Image quality of radiographs - Part 2: Determination of the image quality value using step/hole-type image quality indicators (ISO 19232-2)*

3 Terms, definitions and symbols

3.1 Terms and definitions

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

3.1.1
liquefied petroleum gas
LPG
low pressure liquefied gas composed of one or more light hydrocarbons which are assigned to UN 1011, UN 1075, UN 1965, UN 1969 or UN 1978 only and which consists mainly of propane, propene, butane, butane isomers, butene with traces of other hydrocarbon gases

3.1.2
cylinder
transportable, pressure receptacle with a water capacity not exceeding150 l

3.1.3
over-moulded cylinder
a cylinder intended for the carriage of LPG of a water capacity not exceeding 13 l made of a coated steel inner pressure receptacle with an over-moulded protective case made from cellular plastic which is non removable and bonded to the outer surface of the inner receptacle wall

3.1.4
manufacturer
manufacturer of the cylinder, unless otherwise specified

3.1.5
yield strength
upper yield strength R_{eh} or, for steels that do not exhibit a definite yield, the 0,2 % proof strength R_p0,2

3.1.6
heat treatment
solution heat treatment, quenching and artificial or natural ageing that ensures the strength values required

3.1.7
normalised
condition resulting from heat treatment to a uniform temperature above the upper critical point (Ac3) of the steel and then cooled under controlled conditions

3.1.8
stress relieved
condition resulting from heat treatment in which a finished cylinder is heated to a uniform temperature below the lower critical point (Ac1) of the steel and cooled in a still atmosphere, the object of which is to reduce the residual stresses without altering the metallurgical structure of the steel

3.1.9
production batch
group of pressure parts or finished pressure vessels, made consecutively by the same manufacturer using the same manufacturing techniques to the same design, nominal size and material specifications on the same production machinery and subject to the same heat treatment conditions

Note 1 to entry: In this context, 'consecutively' need not imply continuous production.

3.1.10
over-moulded casing
layer of over-moulded material which gives mechanical protection which, either cannot be removed without destroying it or is only removable with special tools or is bonded to the cylinder wall

Note 1 to entry: This definition can be applied to cylinders with over-moulded layers or with separate casings.

3.1.11
protective coating
layer of paint or other material applied to the pressure receptacle to provide resistance to external corrosion

3.1.12
hot air balloon cylinder
stainless steel cylinder, fitted with a removable structural foam protective cover, which has been approved for aviation purposes (Commission Regulation (EU) No 748/2012, Annex Part 21)

3.1.13
cold-forming
forming at temperatures not less than 25 °C below the maximum permissible temperature for stress relieving, in accordance with the applicable material specifications

3.1.14
production batch (over-moulded cylinders)
12 months production of cylinders from a single over-moulding company, using inner cylinders manufactured by one manufacturer

3.2 Symbols

a	Calculated minimum thickness of the cylindrical shell, in millimetres.
A	Percentage elongation after fracture.
b	Calculated minimum thickness of the end of the cylinder, in millimetres.
C	Shape factor for ends (see Table 1 and Figure 2).
D	Outside diameter of the cylinder as given in the design drawing (see Figure 1), in millimetres.
D_p	Outside diameter of a bend tests former (see Figure 8), in millimetres.
e	Actual thickness of the material used, in millimetres.
F	Energy, in Joules, used in the cylinder body impact tests.
h	Height, in millimetres, of the cylindrical part of the end (see Figure 1).
H	Outside height, in millimetres, of the domed part of the end (see Figure 1).
J	Stress reduction factor.
l	Length of the cylinder, in millimetres.
L_O	Original gauge length of the test piece, in accordance with EN ISO 6892-1, in millimetres.
M	Maximum operating mass of the cylinder, in kg.
n	Ratio of diameter of bend test former to the thickness of the test piece, (see Table 5).
P_c	Calculation pressure (1 bar = 10^5 Pa = 10^5 N/m^2), used to calculate the minimum required thickness of the cylindrical shell and ends, in bar.
P_b	Maximum pressure attained during the burst test, in bar.
P_h	Actual test pressure applied to the cylinder by the manufacturer, in bar.
P_{hmin}	Minimum permissible test pressure, in bar.
r	Inside knuckle radius of the end, in millimetres.
R	Inside dishing radius of the end, in millimetres.
R_g	Guaranteed tensile strength guaranteed by the cylinder manufacturer for the finished cylinder, in N/mm^2.
R_o	Minimum value of yield strength guaranteed by the cylinder manufacturer for the finished cylinder, in N/mm^2.
R_m	Actual value of tensile strength determined by the tensile test specified in 7.4, in N/mm^2.

4 Materials

4.1 Steels for the pressure receptacle shall not be affected or weakened by the intended contents (LPG) and shall not cause a dangerous effect e.g. catalysing a reaction or reacting with the dangerous goods. The steel shall be resistant to brittle fracture and to stress corrosion cracking.

NOTE See EN ISO 11114-1.

4.2 Materials for shells and end pressings shall be:

a) carbon steel in accordance with EN 10120 or other appropriate standard providing they comply with the tests results described in this European Standard, or

b) stainless steel in accordance with EN 10028-7.

4.3 All parts welded to the cylinder shall be made of material compatible with the cylinder material. For hot air balloon cylinders the valve and fitting bosses shall be stainless steel in accordance with EN 10272.

4.4 Materials used for the coating, protection and over-moulding of cylinders shall conform to the material specifications, which shall be available to the manufacturer and for the type approval.

4.5 The welding consumables shall be such that they are capable of giving consistent welds. The strength characteristics of the welds in the finished cylinder shall fulfil all requirements for the design and calculation of the cylinder.

4.6 The cylinder manufacturer shall obtain certificates showing the chemical analysis and details of the mechanical properties of the steel supplied for the construction of the pressure retaining parts. The certificates shall be in accordance with EN 10204:2004, certificate Type 3.1 for shells and ends and Type 2.2 for the valves and fittings boss or bosses.

4.7 The manufacturer shall maintain a system of identification for the materials used in the fabrication in order that all materials for pressure parts in the completed cylinder can be traced to their origin.

4.8 The manufacturer shall endeavour to acquire materials and components from suppliers who have a declared environmental policy, see EN ISO 14021 [6], EN ISO 14024 [7] and EN ISO 14025 [8].

4.9 The design of cylinders and over-moulded or protective casings shall minimize the waste of materials.

4.10 The manufacturer should endeavour to minimise wastage of material by selecting appropriately sized materials related to the finished parts required for manufacture.

4.11 Over-moulded or protective casings manufactured from recyclable plastic materials shall display the appropriate recycling symbol.

4.12 All processes should be designed to minimise VOC emissions.

5 Design

5.1 General requirements

5.1.1 The calculation of the wall thickness of the pressure parts shall be based on the yield strength of the material.

5.1.2 For calculation purposes, the value of the yield strength R_o is limited to a maximum of 0,85 R_g.

5.1.3 The calculation pressure (P_c) shall be:

a) for cylinders restricted to LPG with a test pressure not exceeding 16 bar absolute (UN1011, UN 1965 Mixtures A, A01, A02 and A0 and UN 1969):

$P_c = P_{hmin}$ = 15 bar.

b) for all other LPG cylinders:

$P_c = P_{hmin}$ = 30 bar.

NOTE See RID/ADR 4.1.4.1 P200 Table 2 for LPG test pressures.

5.1.4 A fully dimensioned drawing including the specification of the material shall be produced.

5.1.5 The design of the cylinder should take into account the following:

- ease of manual handling;
- ease of connection for filling and use;
- safe stacking (when designed to be stacked);
- minimising the use of materials; and
- minimising the environmental impact of in service, maintenance and end of life disposal.

5.2 Calculation of cylindrical shell wall thickness

The wall thickness, *a*, of the cylindrical shell shall be not less than:

$$a = \frac{P_c \times D}{\frac{20 \times R_o \times J}{4/3} + P_c}$$

For cylinders with a longitudinal weld: $J = 0{,}9$

For cylinders without a longitudinal weld: $J = 1{,}0$

5.3 Design of torispherical and semi-ellipsoidal ends concave to pressure

5.3.1 The shape of ends shall be such that the following conditions are fulfilled:

- for torispherical ends $R < D$; $r > 0{,}1\ D$; $h > 4b$ (see Figure 1);
- for semi-ellipsoidal ends $H > 0{,}192\ D$; $h > 4b$ (see Figure 1).

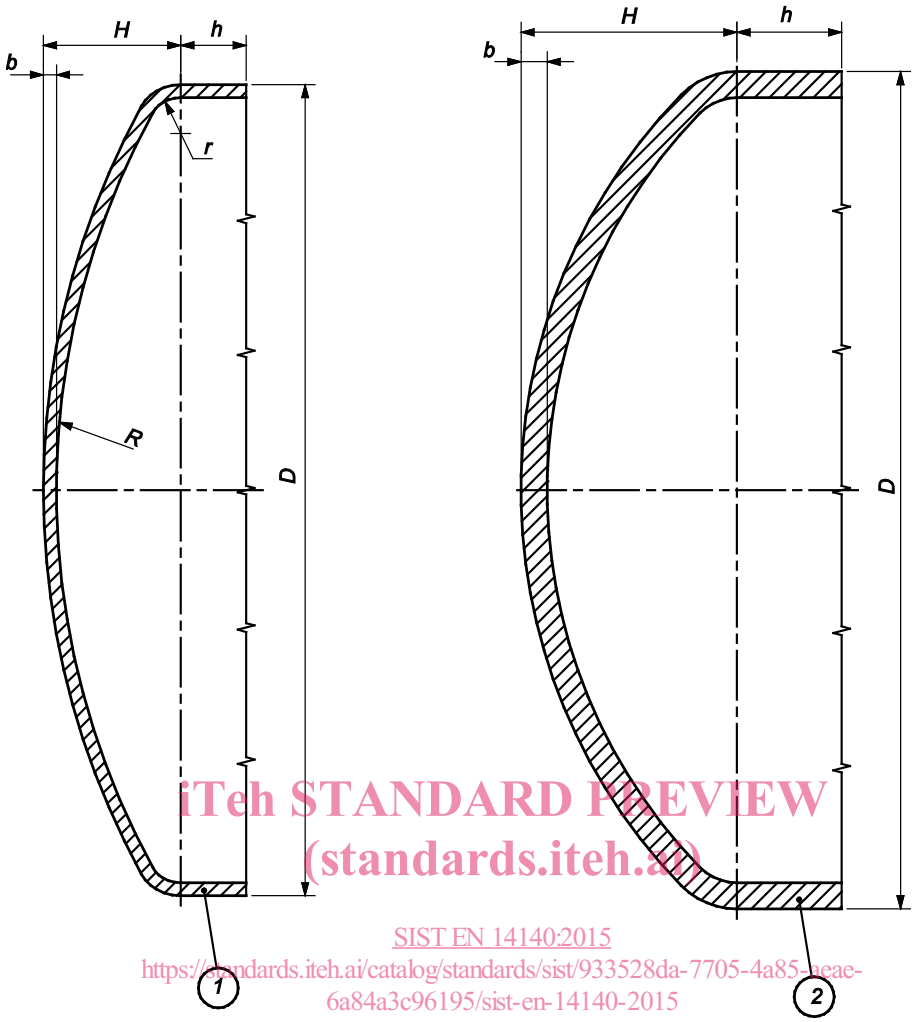
5.3.2 The wall thickness, *b*, shall be not less than:

$$b = \frac{P_c \times D \times C}{(15 \times R_o) + P_c}$$

In this formula, *C* is a shape factor, the value of which depends on the ratio H/D.

For H/D values between 0,2 and 0,25 the value of C shall be obtained from Figure 2.

For H/D values between 0,25 and 0,5 the value of C shall be obtained from Table 1 or Figure 3.



Key

1 torispherical end

2 semi-ellipsoidal end

NOTE For torispherical ends the height *H* can be calculated using:

$$H = (R + b) - \sqrt{[(R + b) - \frac{D}{2}] \times [(R + b) + \frac{D}{2} - 2(r + b)]}$$

Figure 1 — Illustration of cylinder ends concave to pressure

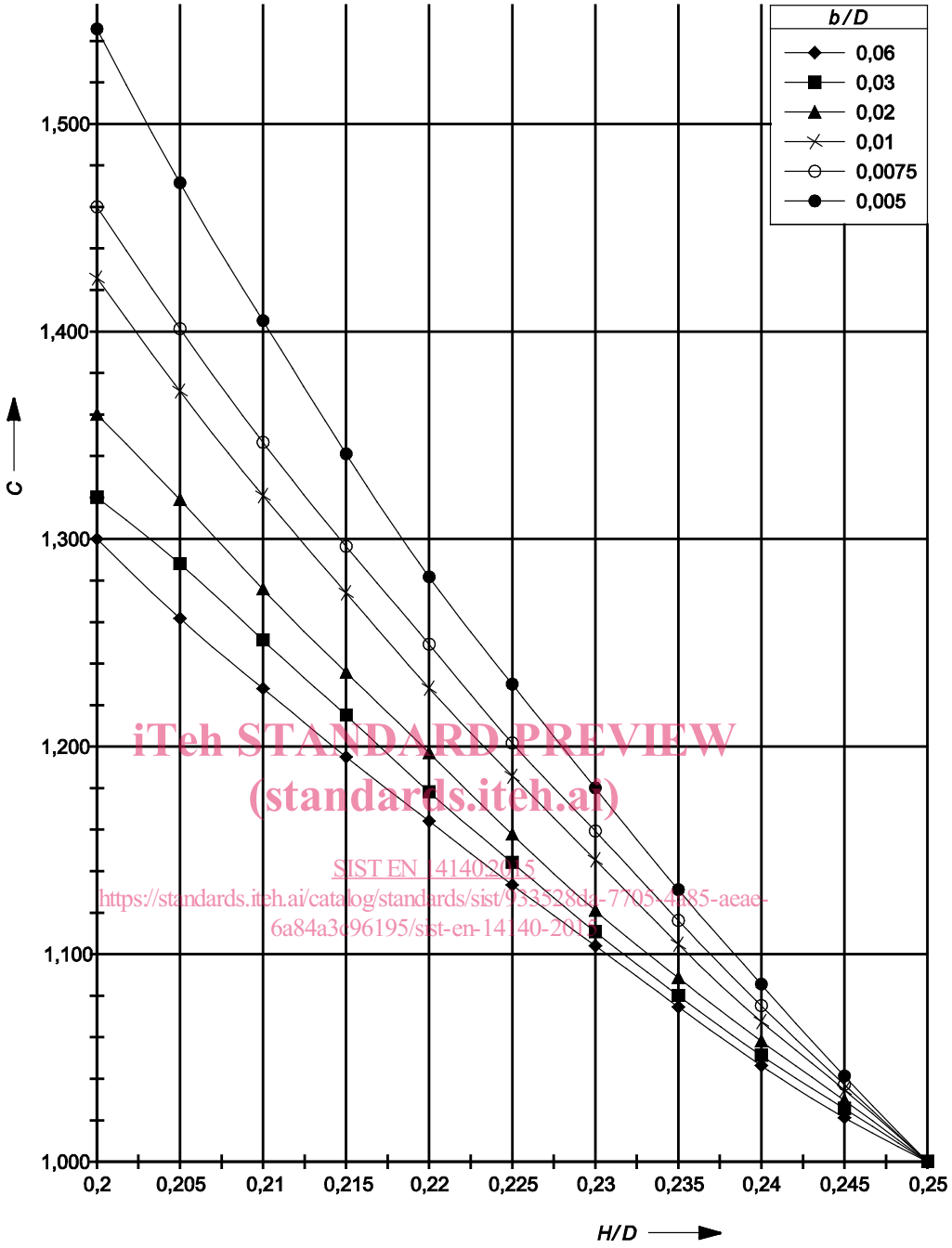


Figure 2 — Values of shape factor *C* for *H/D* between 0,2 and 0,25