SLOVENSKI STANDARD
SIST EN 14140:2004

01-junij-2004

Premiļne, ponovno polnljive varjene jeklenke iz jekla za utekoļ injeni naftni plin (UNP) ï Alternativni naļin konstruiranja in izdelave

Transportable refillable welded steel cylinders for Liquefied Petroleum Gas (LPG) - Alternative design and construction

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

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

Ta slovenski standard je istoveten z: **EN 14140:2003**

ICS:

23.020.30	Tlaļne posode, plinske jeklenke	Pressure vessels, gas cylinders

SIST EN 14140:2004 **en**

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English version

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This European Standard was approved by CEN on 10 July 2003.

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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 Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This document EN 14140:2003 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of an identical text or by endorsement, at the latest by February 2004, and conflicting national standards shall be withdrawn at the latest by February 2004.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports the objectives of the framework Directives on Transport of Dangerous Goods.

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

Therefore 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.

Annex A is normative.

This document includes a Bibliography.

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.

Introduction

This European Standard calls for the use of substances and procedures that may be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety 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 standard permits the use of new and higher strength steels and has the potential for cylinders to be thinner than the minimum thickness related to diameter, 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.

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 ambient temperatures. It allows alternative design and construction methods to those required in EN 1442.

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

All pressures are gauge unless otherwise stated.

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).

Euronorm 103–71, *Micrographic determination of the ferritic or austenitic grain size of steels.*

EN 287–1, *Approval testing of welders - Fusion welding – Part 1: Steels.*

EN 288–2, *Specification and approval of welding procedures for metallic materials — Part 2: Welding procedure specification for arc welding.*

EN 288–3,*Specification and approval of welding procedures for metallic materials – Part 3: Welding procedure tests for the arc welding of steels.*

EN 462–1, *Non-destructive testing - Image quality of radiographs – Part 1: Image quality indicators (wire type) - Determination of image quality value.*

EN 462–2, *Non-destructive testing - Image quality of radiographs – Part 2: Image quality indicators (step/hole type) - Determination of image quality value.*

EN 473:2000, *Non-destructive testing - Qualification and certification of NDT personnel - General principles.*

EN 895, *Destructive tests on welds in metallic materials – Transverse tensile test.*

EN 910, *Destructive tests on welds in metallic materials – Bend tests.*

EN 962, *Transportable gas cylinders – Valve protection caps and valve guards for industrial and medical gas cylinders – Design, construction and tests.*

EN 970, *Non-destructive examination of fusion welds - Visual examination.*

EN 1321, *Destructive tests on welds in metallic materials - Macroscopic and microscopic examination of welds.*

EN 1418, *Welding personnel - Approval testing of welding operators for fusion welding and resistance weld setters for fully mechanized and automatic welding of metallic materials.*

EN 1435:1997, *Non-destructive examination of welds - Radiographic examination of welded joints.*

EN 1439, *Transportable refillable welded steel cylinders for liquefied petroleum gas (LPG) - Procedure for checking before, during and after filling.*

EN 10002–1, *Metallic materials - Tensile testing - Part 1: Method of test at ambient temperature.*

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 10204:1991, *Metallic products - Types of inspection documents.*

EN ISO 2409: 1994, *Paints and varnishes - Cross-cut test (ISO 2409:1992).*

EN ISO 2812-2, *Paints and varnishes - Determination of resistance to liquids - Part 2: Water immersion method (ISO 2812-2:1993).*

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

EN ISO 6520–1, *Welding and allied processes - Classification of geometric imperfections in metallic materials - Fusion welding (ISO 6520-1:1998).*

EN ISO 7253, *Paints and varnishes - Determination of resistance to neutral salt spray (fog) (ISO 7253:1996)*

ISO 4624, *Paints and varnishes. Pull-off test for adhesion.*

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

3 Terms, definitions and symbols

3.1 Terms and definitions

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

3.1.1
yield stress
upper yield strength R_{eh} for carbon steels or
0,2% proof stress (non-proportional elongation), $R_{p0,2}$, for steels that do not exhibit a defined yield, and
1% proof stress for stainless steels, $R_{p1,0}$

3.1.2
normalised
condition resulting from heat treatment in which a finished cylinder is heated to a uniform temperature above the upper critical point (Ac_3) of the steel and then cooled under controlled conditions

3.1.3
stress relieved
condition resulting from heat treatment in which a finished cylinder is heated to a uniform temperature below the lower critical point (Ac_1) 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

3.2 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.

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 10002-1, in millimetres.

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_t Actual test pressure applied to the cylinder by the manufacturer, in bar.

P_{tmin} 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 newtons per square millimetre.

R_o Minimum value of yield stress guaranteed by the cylinder manufacturer for the finished cylinder, in newtons per square millimetre.

R_m Actual value of tensile strength determined by the tensile test specified in 7.4, in newtons per square millimetre.

4 Materials

4.1 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 standard, or

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

4.2 All parts welded to the cylinder shall be made of material compatible with the cylinder material.

4.3 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.

4.4 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 10204:1991, certificate Type 3.1.B.

4.5 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.

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 stress of the material.

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

5.1.3 The calculation pressure (P_c) shall be:

— for cylinders restricted to LPG with a vapour pressure not exceeding 16 bar absolute at 70 °C:

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

— for all other LPG cylinders:

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

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

5.2 Calculation of cylindrical shell thickness

The wall thickness (a) of the cylindrical shell shall be not less than:

$$a = \frac{P_c \times D}{(15 \times R_o \times J) + P_c}$$

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

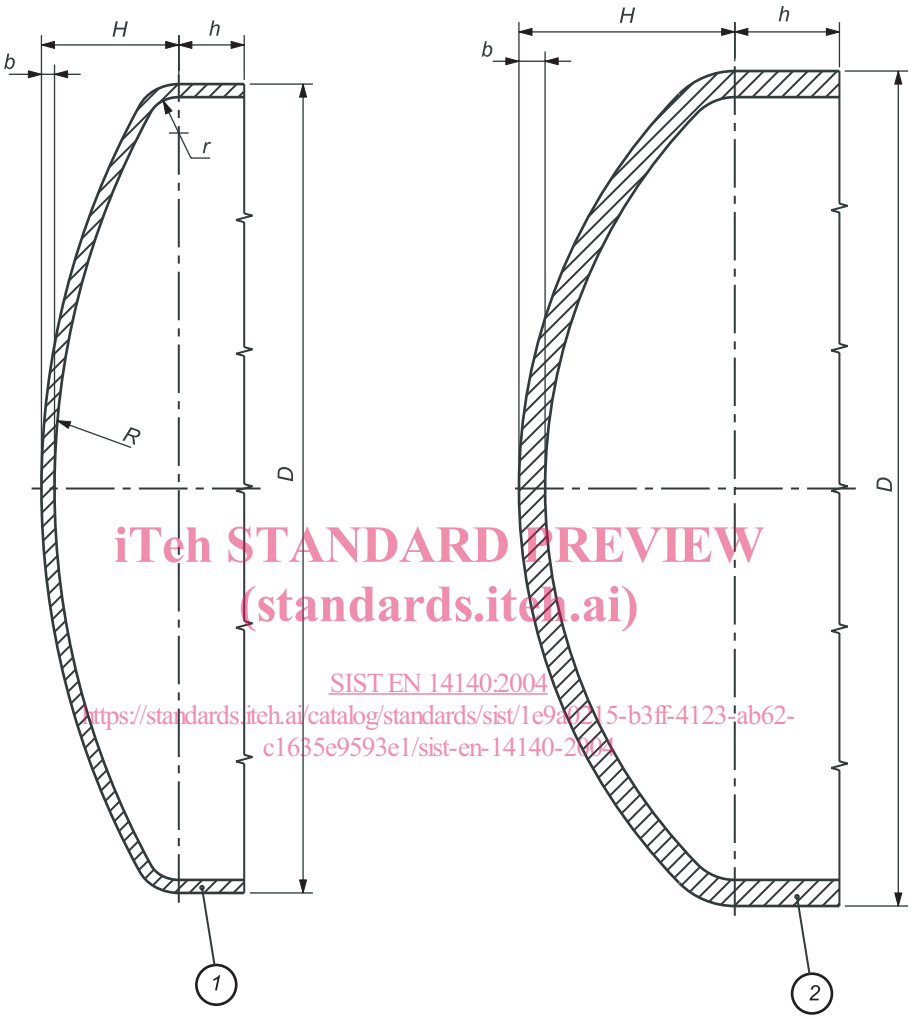
For cylinders without a longitudinal weld: J = 1,0

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 $R \leq D$; $r \geq 0{,}1\ D$; $h \geq 4b$ (see Figure 1),

— for semi-ellipsoidal ends $H \geq 0{,}192\ D$; $h \geq 4b$ (see Figure 1),



Key

1 Torispherical end
2 Semi-ellipsoidal end

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

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

Figure 1 — Illustration of cylinder ends concave to pressure

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*.

The value of *C* shall be obtained from Figure 2 and Table 1 or Figure 3.

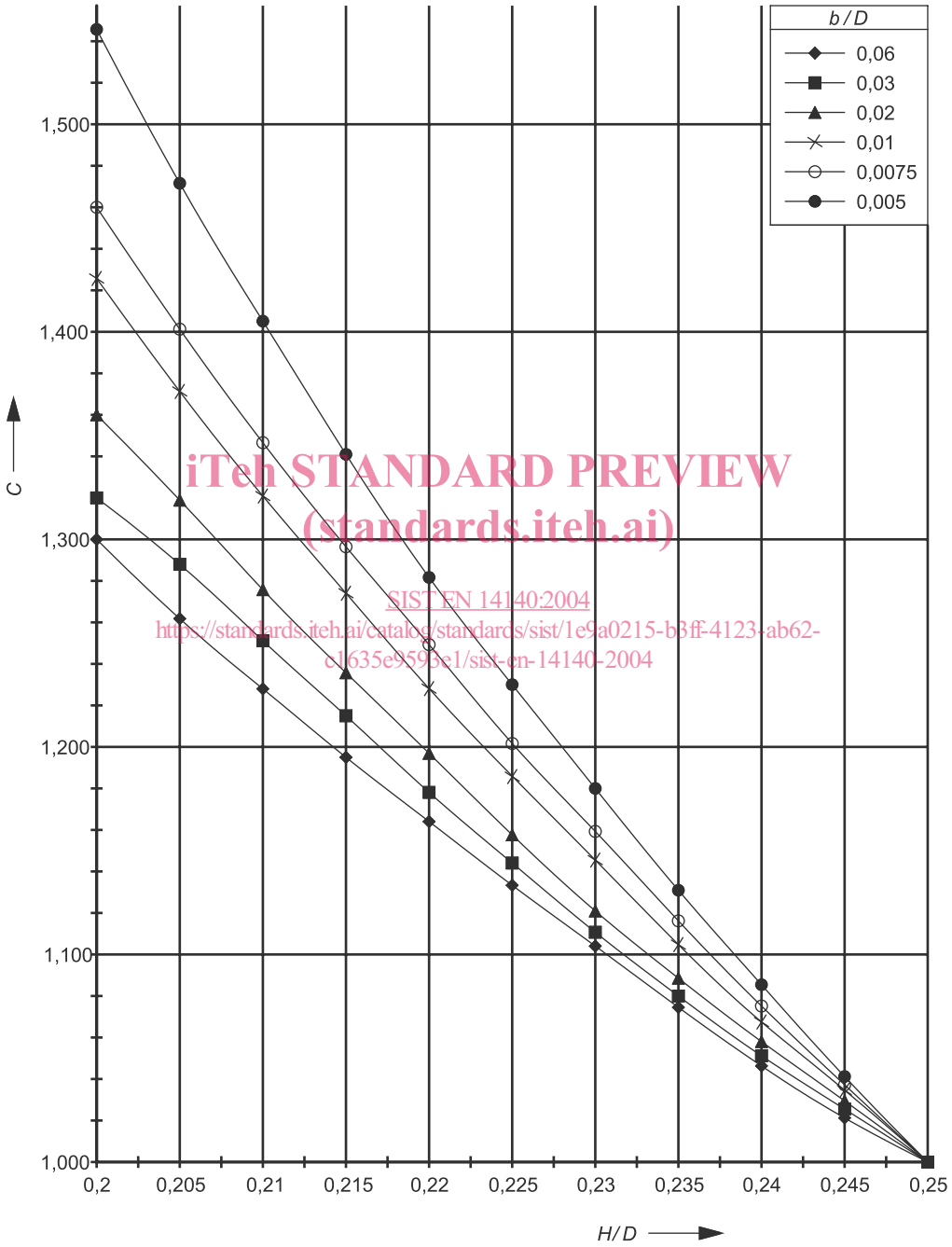


Figure 2 — Values of shape factor *C* for *H/D* between 0,2 and 0,25

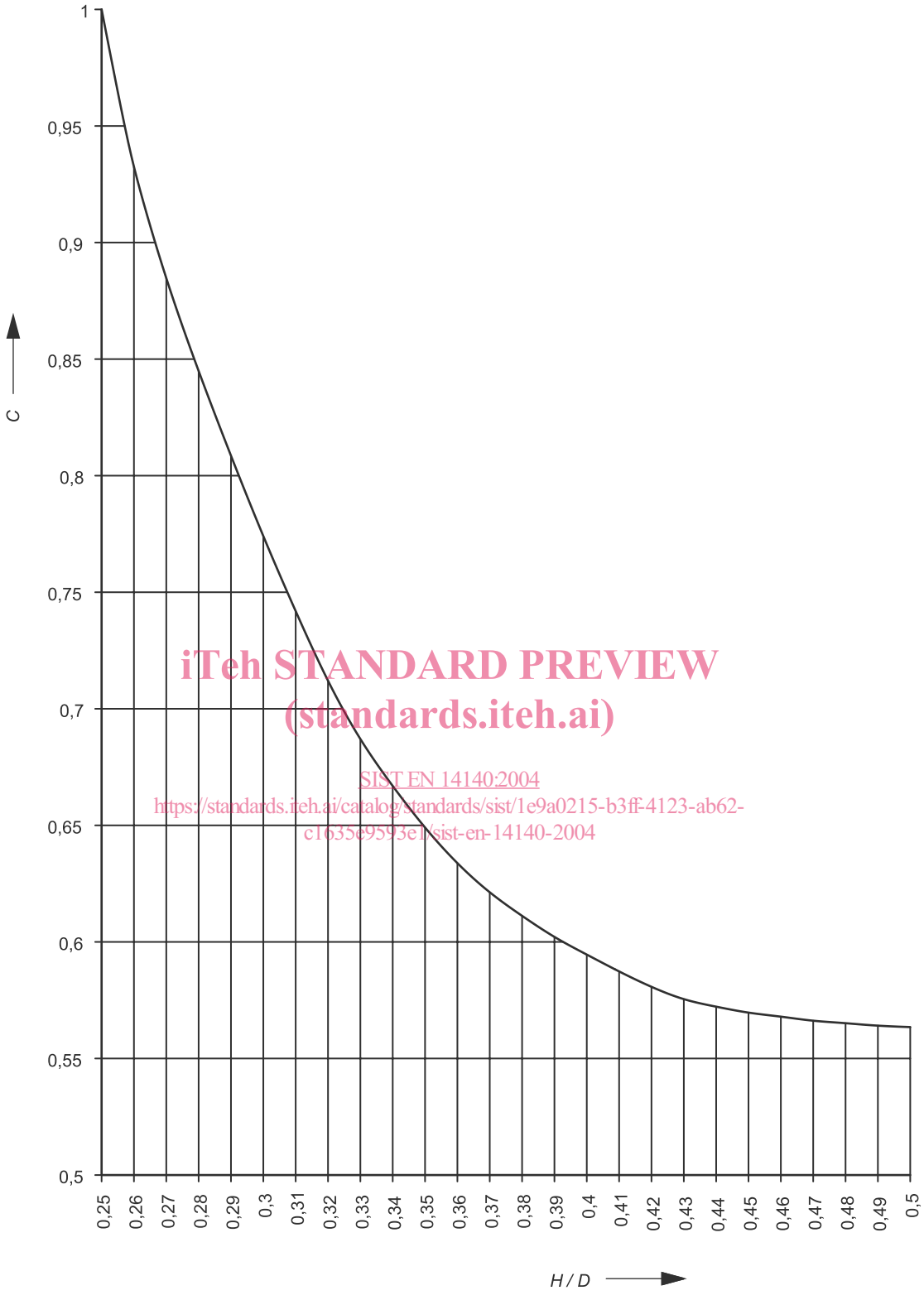


Figure 3 — Values of shape factor *C* for *H/D* between 0,25 and 0,5