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Pressure equipment - Part 4: Establishment of technical delivery conditions for metallic materials

Druckgeräte - Teil 4: Erstellung von technischen Lieferbedingungen für metallische Werkstoffe

Equipements sous pression - Partie 4: Etablissement des conditions techniques de livraison des matériaux métalliques

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Pressure equipment - Part 4: Establishment of technical delivery conditions for metallic materials

Equipements sous pression - Partie 4: Etablissement des conditions techniques de livraison des matériaux métalliques

Druckgeräte - Teil 4: Erstellung von technischen Lieferbedingungen für metallische Werkstoffe

This European Standard was approved by CEN on 8 November 2014.

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COMITÉ EUROPÉEN DE NORMALISATION
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Foreword

This document (EN 764-4:2014) has been prepared by Technical Committee CEN/TC 54 “Unfired pressure vessels”, 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of an identical text or by endorsement, at the latest by June 2015 and conflicting national standards shall be withdrawn at the latest by June 2015.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 764-4:2002.

This document 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.

For relationship with EU Directive 97/23/EC (PED), see informative Annex ZA, which is an integral part of this document.

Regarding the most significant technical changes that have been implemented in this new edition of EN 764-4, see Annex G.

EN 764, *Pressure equipment*, consists of the following parts:

— *Part 1: Terminology - Pressure, temperature, volume, nominal size*;

— *Part 2: Quantities, symbols and units*;

— *Part 3: Definition of parties involved*;

— *Part 4: Establishment of technical delivery conditions for metallic materials* (the present document);

— *Part 5: Inspection documentation of metallic materials and compliance with the material specification*;

— *Part 6: Structure and content of operating instructions* [Technical Report CEN/TR 764-6];

— *Part 7: Safety systems for unfired pressure equipment;*

— *Part 8: Proof test* [Technical Specification prCEN/TS 764-8, currently under development].

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.

1 Scope

This European Standard specifies the requirements, under the regime of the EU Directive 97/23/EC on Pressure Equipment (PED), for the establishment of the technical delivery conditions in the form of:

— harmonized European Standards for material;

— European Approval for Materials (EAM);

— Particular Material Appraisal (PMA)

for metallic materials for pressure equipment in all product forms. Welding consumables are not covered by this standard.

This European Standard was developed predominantly on the basis of steel, nickel and nickel-based materials. However, application to other materials is not restricted but should consider specific aspects relevant to the material concerned.

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 764-1:2004, *Pressure equipment - Part 1: Terminology - Pressure, temperature, volume, nominal size*

EN 764-2:2012, *Pressure equipment - Part 2: Quantities, symbols and units*

EN 10028 (all parts), *Flat products made of steels for pressure purposes*

EN 10164, *Steel products with improved deformation properties perpendicular to the surface of the product - Technical delivery conditions*

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

EN 10213, *Steel castings for pressure purposes*

EN 10216 (all parts), *Seamless steel tubes for pressure purposes - Technical delivery conditions*

EN 10217 (all parts), *Welded steel tubes for pressure purposes - Technical delivery conditions*

EN 10222 (all parts), *Steel forgings for pressure purposes*

EN 10272, *Stainless steel bars for pressure purposes*

EN 10273, *Hot rolled weldable steel bars for pressure purposes with specified elevated temperature properties*

EN 10314, *Method for the derivation of minimum values of proof strength of steel at elevated temperatures*

EN ISO 148-1, *Metallic materials - Charpy pendulum impact test - Part 1: Test method (ISO 148-1)*

EN ISO 204, *Metallic materials - Uniaxial creep testing in tension - Method of test (ISO 204)*

EN ISO 6892-1:2009, *Metallic materials - Tensile testing - Part 1: Method of test at room temperature (ISO 6892-1)*

EN ISO 10052, *Acoustics - Field measurements of airborne and impact sound insulation and of service equipment sound - Survey method (ISO 10052)*

EN ISO 15607, *Specification and qualification of welding procedures for metallic materials - General rules (ISO 15607)*

CR ISO 15608:2000, *Welding - Guidelines for a metallic material grouping system (ISO/TR 15608:2000)*

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)*

3 Terms and definitions, symbols and abbreviations

3.1 Terms and definitions

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

3.1.1
European Approval for Materials
EAM
technical document defining the characteristics of materials intended for repeated use in the manufacture of pressure equipment which are not covered by any harmonized standard

Note 1 to entry: See Article 11 of the EU Directive 97/23/EC on Pressure Equipment (PED) and see also the PED Guideline 7/26.

3.2 Symbols and abbreviations

For the purposes of this standard, the symbols and abbreviations of EN 764-1:2004, EN 764-2:2012 and the following in Table 1 and Table 2 apply.

Table 1 — Symbols and units

Symbols	Characteristic	Units
b	width	mm
e	thickness	mm
h	max. permissible reinforcement of weld	mm
T	temperature	°C
T_D	design temperature	°C
A	elongation after fracture	%
C	constant	—
D	diameter	mm
E	modulus of elasticity	MPa
G	shear modulus	MPa
HV	Vickers hardness	—
KV_2	Charpy V-notch impact energy	J
L_o	original gauge length	mm
P	pressure	bar
P_{LM}	parameter according to Larson-Miller	—
R_e	yield strength	MPa
R_{eH}	upper yield strength	MPa
R_{eL}	lower yield strength	MPa
R_m	tensile strength	MPa
$R_{cm/t/T}$	creep rupture strength for t hours at T °C	MPa
$R_{m/T}$	tensile strength at temperature T	MPa
$R_{p0,2/T}$	0,2 % proof strength at temperature T	MPa
$R_{p0,2}$	0,2 % proof strength	MPa
$R_{p1,0}$	1,0 % proof strength	MPa
$R_{p1,0/T}$	1,0 % proof strength at temperature T	MPa
S_o	original cross sectional area	mm^2
t	time	h
α	linear expansion coefficient	K^{-1}
ε	strain	%
V	Poisson's ratio	—

Table 2 — Abbreviations

Abbreviation	Description
EAM	European Approval for Materials
EC	European Commission
PED	Pressure Equipment Directive
PMA	Particular Material Appraisal
OJEU	Official Journal of the European Union

4 Types of technical delivery conditions

4.1 Harmonized European Standards for material for pressure equipment

Harmonized European material standards under the regime of the PED define the technical requirements for materials frequently used in pressure equipment in Europe. It is within the remit of the responsible technical committee for materials to check at each occasion of the revision work whether related material grades covered by an EAM are used to an extent that justifies the incorporation of the grade into the relevant harmonized European material Standard.

4.2 European Approvals for Materials for pressure equipment (EAMs)

A European approval for materials means a technical document defining the characteristics of materials intended for repeated use in the manufacture of pressure equipment, the type of which is not covered by any harmonized European material standard. According to Guiding Principles for the contents of EAM drafts, agreed by the Member States of the European Union and the European Commission, it shall i.a. describe material properties in a concise, complete and correct manner.

The ways and means undertaken to achieve an EAM and a data sheet containing at least the applicable elements is given in Annex A.

An EAM shall not be issued for:

a) a grade of material listed in a current or former national material standard that has a specification covered by a harmonized European material standard;

b) a grade of material which is previously included in a European national material standard but which is not included in the harmonized European material standard which has replaced the European national material standard (ref. PED Guideline 7/26).

NOTE 1 Reference of available EAMs is published in the Official Journal of the European Union (OJEU).

NOTE 2 Actual EAMs are also published at the following website of the European Commission: http://ec.europa.eu/enterprise/sectors/pressure-and-gas/documents/ped/materials/index_en.htm.

4.3 Particular Material Appraisals for pressure equipment (PMAs)

Particular material appraisals apply for individual cases as for example:

a) a material grade or a product form or a thickness not covered by a harmonized European material standard, harmonized under the scope of the PED, or by an EAM;

b) a product specified in a harmonized European material standard for pressure purposes or in an EAM is intended in an exceptional case for service conditions outside its specified range of application.

For pressure equipment classified in category III and IV according to the PED, the PMA/PMAs, which irrespective of category (I to IV) always shall be drawn up by the equipment manufacturer, shall be appraised and confirmed by the Notified Body in charge of the conformity assessment for the actual piece of pressure equipment.

Where relevant to the pressure equipment under consideration the requirements given in Annex B to Annex E together with EN 13445-2:2014, 4.1 and 4.2, may be used as guidance. An example for PMA is given in Annex F.

5 Content of technical delivery conditions for materials for pressure equipment

5.1 General

Technical delivery conditions for materials for pressure equipment shall describe the material with its specific properties and shall at least contain clauses for scope, normative references, requirements, testing and inspection and marking and restriction on application where necessary with a distinction between mandatory and optional requirements.

EAMs and PMAs shall take account of material processing. If appropriate, information on the allocation of the material to the relevant material group in CR ISO 15608 shall be provided with the technical material specification. PMAs shall always specify in detail the range of application.

5.2 Requirements

5.2.1 Manufacture

The method of manufacture of the material shall be specified. Details need only be specified to an extent as is necessary to ensure the specified quality.

5.2.2 Treatment condition

The following conditions shall be specified:

— type of heat treatment condition;

— surface condition of the material at the time of delivery, where necessary.

5.2.3 Chemical composition

The chemical composition limits shall be specified. Where the composition of the product may be different from the composition of the cast, limit deviations from the cast analysis shall be specified.

The specification of the chemical composition shall include the following general statement:

Elements, which can influence the essential material characteristics, not specified for the specific material shall not intentionally be added. All reasonable precautions shall be taken to prevent the addition of elements from scrap or other materials used in the manufacture, but residual elements may be present, provided the specified mechanical properties are met and the applicability is not impaired.

5.2.4 Mechanical and technological properties

The technical material specification shall specify properties in the direction and location of test pieces which shall be representative of the material characteristics.

Where the form and thickness of the products permit the verification testing of transverse test pieces, the property characteristics shall be given for the transverse (radial for pipes) direction.

In those cases, where the properties in the longitudinal direction are lower, this shall be taken into account.

The following properties shall be specified for the individual steel grades:

a) Tensile properties at room temperature:

1) Yield or proof strength:

For austenitic steels minimum proof strength values for 1,0 % non proportional extension ($R_{p1,0/min}$ and, where appropriate, $R_{p0,2/min}$ values additionally) shall be specified;

For all other materials the minimum value for the upper yield strength or, for cases where no yield phenomenon occurs, the minimum proof strength for 0,2 % non proportional extension shall be specified;

2) Tensile strength:

For the tensile strength, a minimum value shall be specified. A maximum value shall be specified additionally where no maximum yield or proof strength value is specified;

3) Elongation after fracture:

The minimum percentage elongation after fracture for the proportional gauge length $A = 5,65\sqrt{S_o}$ shall be specified;

b) Charpy V-notch impact properties:

The impact properties of the material shall be specified with regard to the Essential Safety Requirements to avoid brittle fracture; A minimum level of Charpy energy shall be specified even if the product form and size does not allow to extract Charpy specimen;

c) Elevated temperature tensile properties:

The following tensile properties shall be specified for temperatures in accordance with Table 3:

1) for austenitic steels intended for an application at a temperature ≥ 50 °C and in accordance with Table 3 the minimum 1,0 % proof strength at elevated temperatures. It is also proposed to specify the minimum elevated temperature tensile strength;

2) for all other steels intended for an application at a temperature in accordance with Table 3, but not higher than the maximum design temperature rounded up to 50 K, the minimum 0,2 % proof strength at elevated temperatures.

The specified minimum proof strength values at elevated temperatures should be derived in accordance with EN 10314 on the basis of data determined in accordance with EN ISO 6892-1 and EN ISO 6892-2;

Table 3 — Elevated temperatures for steels

Steel group	Temperature		
in accordance with CR ISO 15608:2000	**from** °C	**to a maximum of** °C	**preferably in steps of** K
Clause 2, 7.1, 7.2, Clause 3 1.1 to 1.3	100	400	50
Clause 4, 5.1, 5.2	100	500	50
5.3, 5.4, Clause 6	100	600	50
Clause 8	50	600	50
Clause 10	50	250 [a]	50

[a] 250 °C if welded, 280 °C unwelded.

d) Creep properties:

If a material shall be used at elevated temperatures, where creep rupture is likely to occur, the creep rupture strength shall be evaluated. For creep testing steps of 10 °C are recommended;

e) Technological properties:

Where necessary, requirements for formability, e.g. specified on the basis of flattening or ring expanding tests or on the basis of tests for the deformation properties perpendicular to the surface of the product (see EN 10164) or requirements for other technological properties, important for the processing or use of the material, shall be specified.

NOTE Direction of axis of test specimen: see EN ISO 3785 [16].

5.2.5 Other material properties

Where necessary, the requirements for properties other than those covered under 5.2.2 to 5.2.4, shall also be specified together with their methods of verification.

NOTE Other material properties could be weldability, corrosion resistance, fatigue, etc.

5.2.6 Freedom from surface and internal defects

The requirements for non-destructive testing and visual inspection shall be specified.

5.2.7 Dimensions, shape, mass and related tolerances

Dimensions, shape and mass and related tolerances shall be specified where necessary, preferably by reference to an appropriate dimensional standard.

5.3 Testing and inspection

Depending on product form and type of material, the location and preparation of samples and test pieces and frequency of testing shall as a minimum be based on the analogous European Standard (EN), e.g.: EN 10028 (all parts) for flat products, EN 10216 (all parts) and EN 10217 (all parts) for tubes, EN 10213 for castings, and EN 10222 (all parts) for forgings, EN 10272 and EN 10273 for bars.