BS EN 12952-2:2011

BSI Standards Publication

Water-tube boilers and auxiliary installations

Part 2: Materials for pressure parts of boilers and accessories

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National foreword

This British Standard is the UK implementation of EN 12952-2:2011. It supersedes BS EN 12952-2:2001 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PVE/2, Water Tube And Shell Boilers.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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This European Standard was approved by CEN on 25 June 2011.

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Foreword

This document (EN 12952-2:2011) has been prepared by Technical Committee CEN/TC 269 “Shell and water-tube boilers”, the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by February 2012, and conflicting national standards shall be withdrawn at the latest by February 2012.

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 12952-2:2001.

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(s).

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

Annex D provides details of significant technical changes between this European Standard and the previous edition.

The European Standard series EN 12952 concerning water-tube boilers and auxiliary installations consists of the following parts:

— *Part 1: General;*

— *Part 2: Materials for pressure parts of boilers and accessories;*

— *Part 3: Design and calculation for pressure parts;*

— *Part 4: In-service boiler life expectancy calculations*

— *Part 5: Workmanship and construction of pressure parts of the boiler;*

— *Part 6: Inspection during construction, documentation and marking of pressure parts of the boiler;*

— *Part 7: Requirements for equipment for the boiler;*

— *Part 8: Requirements for firing systems for liquid and gaseous fuels for the boiler;*

— *Part 9: Requirements for firing systems for pulverized solid fuels for the boiler;*

— *Part 10: Requirements for safeguards against excessive pressure;*

— *Part 11: Requirements for limiting devices of the boiler and accessories;*

— *Part 12: Requirements for boiler feedwater and boiler water quality;*

— *Part 13: Requirements for flue gas cleaning systems;*

— *Part 14: Requirements for flue gas DENOX-systems using liquefied pressurized ammonia and ammonia water solution;*

— *Part 15: Acceptance tests;*

— *Part 16: Requirements for grate and fluidized-bed firing systems for solid fuels for the boiler;*

— *CR 12952 Part 17: Guideline for the involvement of an inspection body independent of the manufacturer.*

NOTE 1 A Part 18 on operating instructions is currently in preparation.

Although these parts may be obtained separately, it should be recognized that the parts are inter-dependent. As such, the design and manufacture of water-tube boilers requires the application of more than one part in order for the requirements of the European Standard to be satisfactorily fulfilled.

NOTE 2 Part 4 and Part 15 are not applicable during the design, construction and installation stages.

NOTE 3 A "Boiler Helpdesk" has been established in CEN/TC 269 which may be contacted for any questions regarding the application of European Standards series EN 12952 and EN 12953, see the following website: http://www.boiler-helpdesk.din.de

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, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard specifies the requirements for the product forms for use in pressure parts of water-tube boilers and for parts welded on to pressure parts:

— plates;

— wrought seamless tubes;

— electrically welded tubes;

— submerged, plasma and TIG arc-welded tubes;

— forgings;

— castings;

— rolled bars;

— welding consumables;

— fasteners;

— seamless composite tubes.

2 Normative references

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

EN 757:1997, *Welding consumables — Covered electrodes for manual metal arc welding of high strength steels — Classification*

EN 760:1996, *Welding consumables — Fluxes for submerged arc welding — Classification*

EN 764-4:2002, *Pressure equipment — Part 4: Establishment of technical delivery conditions for metallic materials*

EN 764-5:2002, *Pressure equipment — Part 5: Compliance and inspection documentation of materials*

EN 1092-1:2007, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 1: Steel flanges*

EN 1503-1:2000, *Valves — Materials for bodies, bonnets and covers — Part 1: Steels specified in European Standards*

EN 1503-2:2000, *Valves — Materials for bodies, bonnets and covers — Part 2: Steels other than those specified in European Standards*

EN 1600:1997, *Welding consumables — Covered electrodes for manual metal arc welding of stainless and heat resisting steels — Classification*

EN 1759-1:2004, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, class designated — Part 1: Steel flanges, NPS ½ to 24*

EN 10021, *General technical delivery conditions for steel products*

EN 10028-2:2009, *Flat products made of steels for pressure purposes — Part 2: Non-alloy and alloy steels with specified elevated temperature properties*

EN 10028-3:2009, *Flat products made of steels for pressure purposes — Part 3: Weldable fine grain steels, normalized*

EN 10028-7:2007, *Flat products made of steels for pressure purposes — Part 7: Stainless steels*

EN 10160:1999, *Ultrasonic testing of steel flat product of thickness equal or greater than 6 mm (reflection method)*

EN 10164:2004, *Steel products with improved deformation properties perpendicular to the surface of the product — Technical delivery conditions*

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

EN 10213:2007, *Steel castings for pressure purposes*

EN 10216-2, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 2: Non-alloy and alloy steel tubes with specified elevated temperature properties*

EN 10216-3:2002, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 3: Alloy fine grain steel tubes*

EN 10216-5:2004, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 5: Stainless steel tubes*

EN 10217-2:2002, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 2: Electric welded non-alloy and alloy steel tubes with specified elevated temperature properties*

EN 10217-3:2002, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 3: Alloy fine grain steel tubes*

EN 10217-5, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 5: Submerged arc welded non-alloy and alloy steel tubes with specified elevated temperature properties*

EN 10217-7:2005, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 7: Stainless steel tubes*

EN 10222-2:1999, *Steel forgings for pressure purposes — Part 2: Ferritic and martensitic steels with specified elevated temperature properties*

EN 10222-3:1998, *Steel forgings for pressure purposes — Part 3: Nickel steels with specified low temperature properties*

EN 10222-4:1998, *Steel forgings for pressure purposes — Part 4: Weldable fine grain steels with high proof strength*

EN 10222-5:1999, *Steel forgings for pressure purposes — Part 5: Martensitic, austenitic and austenitic-ferritic stainless steels*

EN 10228-1:1999, *Non-destructive testing of steel forgings — Part 1: Magnetic particle inspection*

EN 10228-2:1998, *Non-destructive testing of steel forgings — Part 2: Penetrant testing*

EN 10228-3:1998, *Non-destructive testing of steel forgings — Part 3: Ultrasonic testing of ferritic or martensitic steel forgings*

EN 10253-2:2007, *Butt-welding pipe fittings — Part 2: Non alloy and ferritic alloy steels with specific inspection requirements*

EN 10253-4, *Butt-welding pipe fittings — Part 4: Wrought austenitic and austenitic-ferritic (duplex) stainless steels with specific inspection requirements*

EN 10254:1999, *Steel closed die forgings — General technical delivery conditions*

EN 10269:1999, *Steels and nickel alloys for fasteners with specified elevated and/or low temperature properties*

EN 10273:2007, *Hot rolled weldable steel bars for pressure purposes with specified elevated temperature properties*

EN 10308:2001, *Non destructive testing — Ultrasonic testing of steel bars*

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

EN 12074:2000, *Welding consumables — Quality requirements for manufacture, supply and distribution of consumables for welding and allied processes*

EN 12536:2000, *Welding consumables — Rods for gas welding of non alloy and creep-resisting steels — Classification*

EN 12952-3:2011, *Water-tube boilers and auxiliary installations — Part 3: Design and calculation for pressure parts*

EN 12952-5:2011, *Water-tube boilers and auxiliary installations — Part 5: Workmanship and construction of pressure parts of the boiler*

EN 12952-6:2011, *Water-tube boilers and auxiliary installations — Part 6: Inspection during construction, documentation and marking of pressure parts of the boiler*

EN 12952-7:2002, *Water-tube boilers and auxiliary installations — Part 7: Requirements for equipment for the boiler*

EN 12952-12:2003, *Water-tube boilers and auxiliary installations — Part 12: Requirements for boiler feedwater and boiler water quality*

EN 13479:2004, *Welding consumables — General product standard for filler metals and fluxes for fusion welding of metallic materials*

EN ISO 148-1, *Metallic materials — Charpy pendulum impact test — Part 1: Test method (ISO 148-1:2009)*

EN ISO 544:2011, *Welding consumables — Technical delivery conditions for filler materials and fluxes — Type of product, dimensions, tolerances and markings (ISO 544:2011)*

EN ISO 636:2008, *Welding consumables — Rods, wires and deposits for tungsten inert gas welding of non-alloy and fine-grain steels — Classification (ISO 636:2004)*

EN ISO 2560:2009, *Welding consumables — Covered electrodes for manual metal arc welding of non-alloy and fine grain steels — Classification (ISO 2560:2009)*

EN ISO 2566-1, *Steel — Conversion of elongation values — Part 1: Carbon and low alloy steels (ISO 2566-1:1984)*

EN ISO 2566-2, *Steel — Conversion of elongation values — Part 2: Austenitic steels (ISO 2566-2:1984)*

EN ISO 3580:2011, *Welding consumables — Covered electrodes for manual metal arc welding of creep-resisting steels — Classification (ISO 3580:2010)*

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

EN ISO 6892-2, *Metallic materials — Tensile testing — Part 2: Method of test at elevated temperature (ISO 6892-2:2011)*

EN ISO 8495, *Metallic materials — Tube — Ring-expanding test (ISO 8495:1998)*

EN ISO 10893-10, *Non-destructive testing of steel tubes — Part 10: Automatic full peripheral ultrasonic testing of seamless and welded (except submerged arc-welded) steel tubes for the detection of longitudinal and/or transverse imperfections (ISO 10893-10:2011)*

EN ISO 14171:2010, *Welding consumables — Solid wire electrodes, tubular cored electrodes and electrode/flux combinations for submerged arc welding of non alloy and fine grain steels — Classification (ISO 14171:2010)*

prEN ISO 14174:2010, *Welding consumables — Fluxes for submerged arc welding and electroslag welding — Classification (ISO/DIS 14174:2010)*

EN ISO 14341:2011, *Welding consumables — Wire electrodes and weld deposits for gas shielded metal arc welding of non alloy and fine grain steels — Classification (ISO 14341:2010)*

EN ISO 14343:2009, *Welding consumables — Wire electrodes, strip electrodes, wires and rods for arc welding of stainless and heat resisting steels — Classification (ISO 14343:2009)*

EN ISO 14344:2010, *Welding consumables — Procurement of filler materials and fluxes (ISO 14344:2010)*

EN ISO 16834:2007, *Welding consumables — Wire electrodes, wires, rods and deposits for gas-shielded arc welding of high strength steels — Classification (ISO 16834:2006)*

EN ISO 17632:2008, *Welding consumables — Tubular cored electrodes for gas shielded and non-gas shielded metal arc welding of non-alloy and fine grain steels — Classification (ISO 17632:2004)*

EN ISO 17633:2010, *Welding consumables — Tubular cored electrodes and rods for gas shielded and non-gas shielded metal arc welding of stainless and heat-resisting steels — Classification (ISO 17633:2010)*

EN ISO 17634:2006, *Welding consumables — Tubular cored electrodes for gas shielded metal arc welding of creep-resisting steels — Classification (ISO 17634:2004)*

EN ISO 18276:2006, *Welding consumables — Tubular cored electrodes for gas-shielded and non-gas-shielded metal arc welding of high-strength steels — Classification (ISO 18276:2005)*

EN ISO 21952:2007, *Welding consumables — Wire electrodes, wires, rods and deposits for gas-shielded arc welding of creep-resisting steels — Classification (ISO 21952:2007)*

EN ISO 24598:2007, *Welding consumables — Solid wire electrodes, tubular cored electrodes and electrode/flux combinations for submerged arc welding of creep-resisting steels — Classification (ISO 24598:2007)*

EN ISO 26304:2009, *Welding consumables — Solid wire electrodes, tubular cored electrodes and electrode-flux combinations for submerged arc welding of high strength steels — Classification (ISO 26304:2008, including Cor 1:2009)*

ISO 3581:2003, *Welding consumables — Covered electrodes for manual metal arc welding of stainless and heat-resisting steels — Classification*

ISO 6303, *Pressure vessel steels not included in ISO 2604, Parts 1 to 6 — Derivation of long-time stress rupture properties*

ISO 18275:2011, *Welding consumables — Covered electrodes for manual metal arc welding of high-strength steels — Classification*

CEN ISO/TR 15608:2005, *Welding — Guidelines for a metallic materials grouping system (ISO/TR 15608:2005)*

3 General requirements

3.1 Selection of materials with regard to service conditions

The manufacturer of the water-tube boilers shall select the material (including welding consumables) for the manufacture of the boilers so that, when the delivered material (including welding consumables) complies with the requirements specified in the material order and when the design rules in EN 12952-3:2011 and the rules for the fabrication, inspection and testing of the boilers in EN 12952-5:2011 and EN 12952-6:2011 are observed, the boilers can be operated without hazard under the service conditions (pressures, temperatures, environments, etc.) for the life time provided in the order for the boiler.

The materials specified in Clause 4 which satisfy the elongation and impact energy requirements of 4.2.5.3 and 4.2.5.4 respectively shall not be considered prone to brittle fracture during manufacture and subsequent operation in accordance with the provisions of this European Standard. It is also considered that for operation within the parameters specified in EN 12952-3:2011 using feedwater and boiler water as specified in EN 12952-12:2003 the selected materials will not be significantly affected by ageing or chemical attack.

3.2 Selection of materials with regard to fabrication

The selection of the materials of construction for pressure parts of water-tube boilers and to parts welded on pressure parts shall take into account the suitability of the material with regard to fabrication, e.g. cold and hot forming, weldability, expanding, and heat treatment.

NOTE The rules for forming or post weld heat treatment are included in EN 12952-5:2011.

3.3 Material specification

3.3.1 General

The selection and order of materials for pressure parts shall be based on one of the following material specifications for pressure equipment in the form of:

a) harmonized European material Standards;

b) European approval of material (EAM);

c) particular material appraisals.

3.3.2 European Standards

Materials in accordance with harmonized European Standards shall be selected for types, treatment conditions and dimensions of products frequently used in Europe.

NOTE Materials in accordance with European Standards are given in Annex A.

3.3.3 European approvals for materials

European approvals for materials are intended for repeated use. They are established in accordance with EN 764-4:2002 and apply to materials or treatment conditions and product forms or dimensions not covered in a European material Standard for pressure equipment. Additionally to the requirements of EN 764-4:2002 the requirements of this European Standard shall be met.

NOTE Reference of available European approvals for materials is published in the Official Journal of the European Union.

3.3.4 Particular material appraisals

Particular material appraisals apply for individual cases as for example:

a) a material or a product form or a thickness not covered by a European material Standard or EAM intended for use in a particular pressure equipment;

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

Where relevant to the pressure equipment under consideration the requirements given in EN 764-4:2002 should be considered. Additionally to the requirements of EN 764-4:2002 the requirements of this European Standard shall be met.

3.4 Consideration of special materials properties

When materials are chosen with properties other than those specified in the material specification, or which may influence the lifetime or the safe service behaviour of the water-tube boiler, they shall be taken into account when selecting the material and its dimensions.

NOTE Examples are the scaling or ageing behaviour of the material.

3.5 Contents of material specification

The different types of specifications for materials for water-tube boilers include the clauses given in Table 3.5-1 as a minimum.

Table 3.5-1 — Content of specifications for materials for pressure parts

<table>
<tr><th rowspan="2">Clauses</th><th rowspan="2">EN standards</th><th colspan="2">European material data sheets</th><th rowspan="2">Particular material appraisals</th></tr>
<tr><th>Unrestricted [a]</th><th>restricted</th></tr>
<tr><td>Scope</td><td>X</td><td colspan="3" rowspan="8">see EN 764-4</td></tr>
<tr><td>References</td><td>X</td></tr>
<tr><td>Definitions</td><td>(X)</td></tr>
<tr><td>Requirements</td><td>X</td></tr>
<tr><td>Inspection</td><td>X</td></tr>
<tr><td>Marking</td><td>X</td></tr>
<tr><td>Guidelines for processing the material etc. (welding, heat treatment, forming, flame-cutting)</td><td>Z</td></tr>
<tr><td>Restrictions on application</td><td>Z</td></tr>
<tr><td colspan="5">X = in all cases
(X) = if necessary
Z = the relevant guidelines for fabrication and the restrictions on application are, where necessary, given in EN 12952-5</td></tr>
<tr><td colspan="5">[a] If applicable by reference to a European Standard for pressure purposes.</td></tr>
</table>

3.6 Compliance and inspection documentation of materials

Manufacturers and stockists of materials for pressure parts including welding consumables shall follow the requirements in accordance with EN 764-5. They shall provide sufficient evidence of their capability to deliver materials with consistent quality in accordance with the specifications and EN 764-5.

4 Material for pressure parts

4.1 Materials covered by harmonized European product Standards for pressure purposes

4.1.1 Flat products, forgings, castings, tubes, fittings, flanges and valve bodies

The material shall be ordered and delivered in accordance with Annex A and the relevant European Standards EN 10028-2:2009, EN 10028-3:2009, EN 10028-7:2007, EN 10213:2007, EN 10216-2:2002+A2:2007, EN 10216-3:2002, EN 10216-5:2004, EN 10217-2:2002, EN 10217-3:2002, EN 10217-7:2005, EN 10222-2:1999, EN 10222-5:1999, EN 10253-2:2007, EN 10254:1999 and EN 10273:2007. The additional requirements given in this clause shall be taken into account. Harmonized supporting standards are EN 1092-1:2007, EN 1503-1:2000, EN 1503-2:2000, EN 1759-1:2004.

In case EN 12952-3:2011 requires Z35 quality in 10.3.1 for flat ends machined from a plate, this should be determined in accordance with EN 10164:2004.

4.1.2 Cast iron

Spheroidal graphite cast iron shall not be used in the construction of pressure parts, except for valves and fittings as indicated in EN 12952-7:2002, within the design limits specified in EN 12952-3:2011. The use of other types of cast iron is not permitted.

4.1.3 Studs, bolts and nuts

Requirements for studs, bolts and nuts shall be in accordance with EN 10269:1999.

4.1.4 Welding consumables

The welding consumables (electrodes, filler wires, filler rods, fluxes, fusible inserts) shall be selected so that the mechanical properties of the weld metal are compatible with the relevant requirements of the base materials.

The welding consumables are classified or specified, respectively, in accordance with the following standards: EN 757:1997, EN 760:1996, EN 1600:1997, EN 12074:2000, EN 12536:2000, EN 13479:2004, EN ISO 544:2011, EN ISO 636:2008, EN ISO 2560:2009, EN ISO 3580:2011, EN ISO 14171:2010, prEN ISO 14174:2010, EN ISO 14341:2008, EN ISO 14343:2009, EN ISO 14344:2010, EN ISO 16834:2007, EN ISO 17632:2008, EN ISO 17633:2006, EN ISO 17634:2006, EN ISO 18276:2006, EN ISO 21952:2007, EN ISO 24598:2007, EN ISO 26304:2009, ISO 3581:2003, ISO 18275:2011.

Technical delivery conditions for welding consumables and additives used for welding of pressure parts and their structural attachments shall comply with EN 12074:2000 or EN ISO 544:2011.

NOTE Equivalent national/international provisions are admissible, provided they meet the same criteria concerning the requirements for the manufacturing, delivery, distribution, test procedures and evaluation of welding consumables and additives regarding the requirements for the quality management system.

4.1.5 Requirements for plates used for heads

Plates which are to be used in the manufacture of heads shall represent the quality class Z35 in accordance with EN 10164:2004 (see EN 12952-3:2011, 10.3.1).

4.1.6 Requirements for non-destructive examination

The non-destructive examination (NDE) requirement for materials in the various product forms shall be as given below.

a) plates:

Ultrasonic testing (UT) in accordance with EN 10160:1999, class S1.

b) tubes – seamless:

Seamless tubes shall be tested in accordance with EN 10216 (Series) test category 2 (TC2). For unalloyed seamless tubes with design temperatures below 450 °C and design pressures below 42 bar, it is permitted to perform test category 1 (TC1) in accordance with EN 10216-2:2002+A2:2007.

1) longitudinal imperfections:
   UT in accordance with EN ISO 10893-10:2011
   acceptance level: U2 sub-category B for cold finished and machined tubes
   U2 sub-category C for all other conditions.

2) transverse imperfections:
   UT in accordance with EN ISO 10893-10:2011
   acceptance level: U2 sub-category C for all headers with outside diameters > 142 mm.

3) tube ends:
   UT in accordance with EN ISO 10893-10:2011, Annex B;
   acceptance level: U2 sub-category B or C as for longitudinal imperfections.

NOTE This is only mandatory for fixed length tubes. When the tubes are in close end to end contact, it can be accepted that 100 % (full length) ultrasonic examination has taken place, and therefore no additional tube end examination is required.

c) tubes – welded:

Welded tubes of test category 2 (TC2) in accordance with EN 10217-2:2002. For unalloyed welded steel tubes with design temperatures below 450 °C and design pressures below 42 bar, it is permitted to perform test category 1 (TC1) in accordance with EN 10217-2:2002. However, the longitudinal weld shall be subject to ultrasonic testing.

1) longitudinal imperfections:
   UT in accordance with EN ISO 10893-10:2011
   acceptance level: U2 sub-category C.

2) transverse imperfections:
   UT in accordance with EN ISO 10893-10:2011
   acceptance level: U2 sub-category C for all headers with outside diameter > 142 mm.

3) tube ends:
   UT in accordance with EN ISO 10893-10:2011, Annex B
   acceptance level: U2 sub-category C as for longitudinal imperfections.

NOTE This is only mandatory for fixed length tubes. When the tubes are in close end to end contact, it can be assumed that 100 % (full length) ultrasonic testing has taken place, and therefore no additional tube end examination is required. The requirements Annex I, 3.1.2 and 3.1.3 of Pressure Equipment Directive 97/23/EC should be taken into account.

d) Forgings and rolled bars:

For pressure part of boilers, rolled bars in accordance with EN 10273:2007 as well as forgings shall be examined according to EN 10222-2:1999, EN 10222-3:1998, EN 10222-4:1998 and EN 10222-5:1999 in

accordance with EN 10228-1:1999 up to EN 10228-3:1998. The volumetric testing in accordance with EN 10228-3:1998 shall be carried out in quality class 3 as 100 % examination with straight-beam probe scanning and angle-beam probe scanning.

Steel die forgings for pressure parts of boilers shall be delivered as specified in EN 10254:1999. A volumetric testing as a complete examination in quality class 3 of the forged or rolled stock for die forgings has to be performed according to EN 10308:2001.

e) Steel castings:

Steel castings shall be delivered and tested in accordance with EN 10213:2007.

f) Butt-welding pipe fittings:

Butt-welding pipe fittings shall be tested in accordance with EN 10253-2:2007.

4.1.7 Inspection documents

The type of inspection document to be applied shall be as specified in EN 10204:2004.

NOTE Additional tests may be specified to cover additional or deviating requirements.

4.1.8 Marking

Marking shall be carried out in accordance with the requirements of EN 12952-5:2011, 6.3. For methods of marking see European Standards for materials.

4.2 Material covered by European approvals of materials for pressure equipment – technical requirements

4.2.1 General

The material shall be covered by a European approval of material (EAM) established in EN 764-4. This data sheet shall meet the requirements in accordance with Table 3.5-1.

The non-destructive examination (NDE) requirement for materials in the various product forms according to 4.1.6 shall be specified as well for materials according to EN as for materials covered by European approvals as for materials with particular material appraisal.

NOTE The term "cast", when related to chemical composition, is used in the same way as in all European base materials standards and refers to the material in its molten condition.

4.2.2 Manufacture

If the properties specified can be reliably achieved only when special methods of manufacture are applied (e.g. vacuum melting, treatment of the cast with nitrogen binding elements, or, in the case of welded tubes, defined welding methods are applied), these methods shall be considered.

Rimming steels and semi-killed steels shall not be used.

4.2.3 Heat treatment condition

The heat treatment condition of the material at the time of delivery shall be specified.

NOTE Plates to be hot formed may be supplied in any suitable condition, e.g. as rolled, hot finished, normalized and tempered.

Carbon and carbon manganese steel plates (Steel group 1, 2) to be cold formed shall be supplied in the normalized condition.

Low alloy steel plates (Steel group 4, 5) to be cold formed shall be supplied in the normalized and tempered condition except that, where metallurgically suitable and where post-welded heat treatment will suffice as the tempering treatment, plates supplied in the normalized condition shall be permitted.

Electrically welded tubes shall be supplied in the normalized condition.

4.2.4 Chemical composition

The chemical composition for the cast analysis and for the product analysis shall be specified. For steels intended for welding or forming, the values specified should not exceed the values given in Table 4.2-1. Steels for which the values are higher than those given in Table 4.2-1 may be used subject to appropriate welding approvals with appropriate heat treatment.

Table 4.2-1 — General requirements for the chemical composition of steels for welding and forming

Steel	Maximum content according to analysis					
	% C		% P		% S	
	cast	product	cast	product	cast	product
Ferritic steels	0,23	0,25	0,035	0,040	0,020	0,025
Austenitic steels	0,10	0,11	0,035	0,040	0,015	0,018

Elements not specified in the EAM shall not be added intentionally, except for finishing the cast. 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 mechanical properties and applicability are not adversely affected.

4.2.5 Mechanical and technological properties

4.2.5.1 General

The following property values shall be specified for each type of material, so that they reflect the specific properties of the individual steel grade.

4.2.5.2 Tensile properties at room temperature

The tests shall be carried out in accordance with EN ISO 6892-1.

a) Yield or proof strength values

For all ferritic steels, the minimum value for the upper yield strength $R_{eH,\,min}$ or, for cases where no yield phenomenon occurs, the minimum proof strength for 0,2 % non-proportional extension $R_{p0,2,\,min}$ shall be specified.

For austenitic steels, the minimum proof strength values for 1 % non-proportional extension $R_{p1,0,\,min}$ and, where appropriate, additionally $R_{p0,2,\,min}$ values shall be specified.

b) Tensile strength

For the tensile strength, a minimum value $R_{m,\,min}$ and, unless no maximum yield or proof strength value is specified, a maximum value $R_{m,\,max}$ shall be specified.

The specified minimum tensile strength shall be not less than 320 MPa. The specified maximum tensile strength should not exceed the specified minimum tensile strength by more than

1) 120 MPa for carbon and carbon manganese steels;

2) 150 MPa for alloy steels, except austenitic steels;

3) 200 MPa for austenitic steels.

4.2.5.3 Elongation after fracture

The minimum percentage elongation after fracture A_{min} shall be specified for longitudinal and transverse direction if possible. The gauge length shall be as recommended for the relevant product form and thickness in EN ISO 6892-1. Transverse test specimens shall be taken where the form and thickness of the products permit.

Steels shall have a specified minimum elongation after fracture measured on a gauge length $L_0 = 5{,}65\sqrt{S_0}$ (S_0 = original cross sectional area within the gauge length) that is:

≥ 14 % for the transverse direction, or in those rare cases where it is the more critical direction, the longitudinal direction

and

≥ 16 % for the longitudinal direction, or where this is the less critical direction, the transverse direction. However, lower elongation values than specified in 4.2 (e.g. fasteners or castings) may also be applied, provided that appropriate measures are proposed, discussed and agreed to compensate for these lower values.

NOTE Examples for compensation:
– application of higher safety factors in design;
– performance of appropriate burst tests to demonstrate ductile material behaviour.

For gauge lengths other than $L_0 = 5{,}65\sqrt{S_0}$ the minimum value for elongation after fracture shall be determined by conversion of the above specified values of 14 % and 16 % using the conversion tables given

— in EN ISO 2566-1 for carbon and low alloy steels;

— in EN ISO 2566-2 for austenitic steels.

4.2.5.4 Charpy V – notch impact energy

The tests shall be carried out with Charpy V-notch specimens in accordance with EN ISO 148-1. Transverse specimens shall be used, if possible.

The specified average impact energy value obtained from a set of three specimens at a temperature not greater than 20 °C but not higher than the lowest scheduled operating temperature shall be

— ≥ 27 J for transverse specimens, or

— ≥ 35 J for longitudinal specimens.

Only one individual value may be lower than the specified average value, but it shall not be less than 70 % of the average value. The sequential test method in accordance with EN 10021 shall be applied.

4.2.5.5 Elevated temperature proof strength

The test shall be carried out in accordance with EN ISO 6892-2. For materials intended for the application at temperatures above 50 °C,

— the minimum 0,2 % non-proportional proof strength values $R_{p0,2,\ min}$, or

— the minimum 1 % non-proportional proof strength values $R_{p1,0,\ min}$ as defined in 4.2.5.2 a)

shall be specified, preferably for the following series of temperatures:

100 °C, 150 °C, 200 °C etc. up to the highest temperature for which proof strength values are used for the design.

The minimum values specified for room temperature may be used for temperatures equal to or less than 50 °C.

For other than austenitic and austenitic-ferritic stainless steels, the specified value of R_{eH} ($R_{p0,2}$) at room temperature (RT) may be used for temperatures less than or equal to 50 °C. Interpolation between 50 °C and 100 °C shall be performed with the values of RT and 100 °C and using 20 °C as the starting point for interpolation. Above 100 °C linear interpolation shall be performed between the tabulated values given in the relevant material standard.

The specified minimum elevated temperature proof strength values shall be derived in accordance with EN 10314.

4.2.5.6 Creep rupture strength

For materials intended for the application at temperatures in the creep range, the average stress rupture values shall be specified in accordance with ISO 6303, taking into account the requirements of Annex B.

When only stress rupture values with extended time or stress extrapolation or such values derived from an insufficient number of test results (see ISO 6303) are available, account of this shall be taken either by increasing the safety factor or by shortened intervals between repeated inspections.

The material supplier shall provide the boiler manufacturer with a written statement declaring that the product supplied complies with the specified properties and that the manufacturing processes have remained equivalent to those for the steel from which the test results were obtained.

4.2.5.7 Technological properties

Where necessary, requirements for formability shall be specified e.g. on the basis of flattening or drift 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.

4.2.5.8 Other properties

Where necessary, the requirements for properties other than those covered under 4.2.5.2 to 4.2.5.7 shall be specified, e.g. requirements referring to the corrosion resistance of the material and the relevant verification procedure.

4.2.5.9 Surface condition and internal soundness

The products shall be free from surface and internal imperfections which might impair their usability.

The requirements for non-destructive examination shall be the same as for the same type of products of a comparable material listed in Annex A and as given in 4.1.6.

4.2.5.10 Dimensions and tolerance on dimensions, shape and weight

Dimensions and tolerances on dimensions, shape and weight shall, where possible, be specified by reference to the appropriate dimensional standard.

4.2.5.11 Testing and inspection

For assessing the conformity of the delivered material with the requirements, the technical delivery conditions shall specify the following:

a) the types of inspection documents (see Clause 6);

b) the properties to be verified (e.g. cast analysis, tensile properties);

c) the conditions applicable for specific inspection and testing (acceptance testing), namely:

   1) the composition and maximum size of the test unit (e.g. the maximum weight or number of products of the same cast, heat treatment batch) and

      i) the numbers of sample products per test unit and;

      ii) the number of samples per sample product;

      to be taken and tested;

   2) the location and direction of the test pieces in the product;

   3) where necessary, the additional conditions for sampling and conditions for the preparation of the samples and test pieces;

   4) the European Standards in which the test methods are described;

   5) the test repetitions to be carried out in accordance with EN 10021.

4.2.5.12 Marking

The technical delivery conditions shall specify, for the individual product forms, appropriate conditions for marking and shall comply with 4.1.8.

4.2.5.13 Supplementary requirements

The water-tube boiler manufacturer shall specify any additional tests considered appropriate.

NOTE Where appropriate, the EAM should cover guidelines for processing the material and/or restrictions for the application (see Table 3.5-1).

4.3 Materials with particular material appraisals

Particular material appraisals shall be applied for materials used in special cases not covered in 3.3.2 and 3.3.3 and not intended for frequent use. The materials shall be specified in a material specification and shall be approved by an responsible authority in accordance with 3.3.4.

Where appropriate, the particular material appraisals shall, cover guidelines for processing the material. The individual application for which the material is intended shall be clearly specified in the scope of the respective material specification.

The non-destructive examination (NDE) requirement for materials in the various product forms according to 4.1.6 shall be specified as well for materials according to EN as for materials covered by European approvals as for materials with particular material appraisal.

5 Materials for non-pressure parts

Materials for supporting lugs, fins, baffles and similar non-pressure parts welded to water-tube boiler components shall be supplied to material specifications covering at least requirements for the chemical composition and the tensile properties. Impact properties shall be specified when required by in-service conditions. These materials shall be compatible with the material to which they are attached.

6 Inspection documentation

Inspections and tests shall be certified in accordance with EN 764-5:2002:

— with 2.2 test report in accordance with EN 10204:2004 for attachment materials;

— with 3.1 inspection certificate in accordance with EN 10204:2004 in the case of materials included in European Standards ordered at manufacturers having a certified QM system, unless the purchaser orders an inspection certificate of the type 3.2, which is the requirement for the direct inspection route in accordance with EN 764-5:2002. The certificates shall contain information concerning the certification of the material manufacturer's quality system, the proof of applicability of the quality system to the inspected material, the name of the competent body carrying out the quality system assessment, the certificate number and expiry date;

— with the type of inspection document specified in the EAM in the case of new materials; with 3.2 inspection certificate in accordance with EN 10204:2004 in case of materials included in European Standards ordered at manufacturers without a certified QM system;

— with test report 2.2 in accordance with EN 10204:2004 of welding consumables at least chemical composition.

Annex A
(normative)

Materials covered by European material Standards

A.1 Pressure parts

Pressure parts of water-tube boilers covered by this European Standard shall be constructed from steel products in accordance with Table A.1. Steel products shall be of the types listed in the European Standards, see Clause 2, manufactured in accordance with these standards, and which comply in all respects with the minimum requirements of this European Standard.

A.2 Fittings

Non-alloy and alloy steel butt-welding fittings shall be in accordance with EN 10253-2. Stainless steel butt-welding fittings shall be in accordance with EN 10253-4 for application in the non creep range.

A.3 Flanges

Material grades for steel flanges in accordance with EN 1092-1 and EN 1759-1 shall be as listed in Table A.1.

A.4 Valves

Metal valves for use in flanged tubing systems shall be in accordance with EN 1503-1 or EN 1503-2.

Table A.1 — Steels provided for elevated temperature use (assorted according to EN standards for product forms)

Serial No.	Product form	EN standard	Material description	Grade	Material No.	Heat treatment [d]	Thickness [a] mm		Material group to CEN ISO/TR 15608:2005
							min.	max.	
1	plate and strip	EN 10028-2	Elevated temperature properties	P235GH	1.0345	N	0	150	1.1
2	plate and strip	EN 10028-2	Elevated temperature properties	P265GH	1.0425	N	0	150	1.1
3	plate and strip	EN 10028-2	Elevated temperature properties	P295GH	1.0481	N	0	150	1.2
4	plate and strip	EN 10028-2	Elevated temperature properties	P355GH	1.0473	N	0	150	1.2
5	plate and strip	EN 10028-2	Elevated temperature properties	16Mo3	1.5415	N	0	150	1.1
6	plate and strip	EN 10028-2	Elevated temperature properties	18MnMo4-5	1.5414	NT	0	150	1.2
7	plate and strip	EN 10028-2	Elevated temperature properties	20MnMoNi4-5	1.6311	QT	0	250	4.1
8	plate and strip	EN 10028-2	Elevated temperature properties	15NiCuMoNb5-6-4	1.6368	NT	0	100	4.2
9						NT, QT	100	150	
10						QT	150	200	
11	plate and strip	EN 10028-2	Elevated temperature properties	13CrMo4-5	1.7335	NT	0	100	5.1
12						NT, QT	100	150	
13						QT	150	250	
14	plate and strip	EN 10028-2	Elevated temperature properties	12CrMo9-10	1.7375	NT, QT	0	250	5.2

Table A.1 *(continued)*

Serial No.	Product form	EN standard	Material description	Grade	Material No.	Heat treatment [d]	Thickness [a] mm		Material group to CEN ISO/TR 15608:2005
							min.	max.	
15	plate and strip	EN 10028-2	Elevated temperature properties	10CrMo9-10	1.7380	NT	0	60	5.2
16						NT, QT	60	100	
17						QT	100	250	
18	plate and strip	EN 10028-2	Elevated temperature properties	X10CrMoVNb9-1	1.4903	NT	0	150	6.4
19						QT	150	250	
20	plate and strip	EN 10028-3	Fine grain steel	P275NH	1.0487	N	0	150	1.1
21	plate and strip	EN 10028-3	Fine grain steel	P355NH	1.0565	N	0	150	1.2
22	plate and strip	EN 10028-3	Fine grain steel	P460NH	1.8935	N	0	150	1.3
23	plate and strip	EN 10028-7	austenitic, elevated temperature properties	X6CrNiTiB18-10	1.4941	AT	0	75	8.1
24	plate and strip	EN 10028-7	austenitic, elevated temperature properties	X6CrNi18-10	1.4948	AT	0	75	8.1
25	plate and strip	EN 10028-7	austenitic, elevated temperature properties	X6CrNi23-13	1.4950	AT	0	75	8.2
26	plate and strip	EN 10028-7	austenitic, elevated temperature properties	X6CrNi25-20	1.4951	AT	0	75	8.2
27	plate and strip	EN 10028-7	austenitic, elevated temperature properties	X5NiCrAlTi31-20	1.4958	AT	0	75	8.2
28	plate and strip	EN 10028-7	austenitic, elevated temperature properties	X5NiCrAlTi31-20 (+RA)	1.4958 (+RA)	AT+RA	0	75	8.2

Table A.1 *(continued)*

Serial No.	Product form	EN standard	Material description	Grade	Material No.	Heat treatment [d]	Thickness [a] mm		Material group to CEN ISO/TR 15608:2005
							min.	max.	
29	plate and strip	EN 10028-7	austenitic, elevated temperature properties	X8NiCrAlTi32-21	1.4959	AT	0	75	8.2
30	plate and strip	EN 10028-7	austenitic, elevated temperature properties	X3CrNiMoBN17-13-3	1.4910	AT	0	75	8.1
31	plate and strip	EN 10028-7	austenitic, elevated temperature properties	X8CrNiNb16-13	1.4961	AT	0	75	8.2
32	tube, seamless	EN 10216-2	elevated temperature properties	P195GH	1.0348	N	0	16	1.1
33	tube, seamless	EN 10216-2	elevated temperature properties	P235GH	1.0345	N	0	60	1.1
34	tube, seamless	EN 10216-2	elevated temperature properties	P265GH	1.0425	N	0	60	1.1
35	tube, seamless	EN 10216-2	elevated temperature properties	16Mo3	1.5415	N	0	60	1.1
36	tube, seamless	EN 10216-2	elevated temperature properties	14MoV6-3	1.7715	NT [a]	0	60	6.1
37	tube, seamless	EN 10216-2	elevated temperature properties	10CrMo5-5	1.7338	NT [b]	0	60	5.1
38	tube, seamless	EN 10216-2	elevated temperature properties	13CrMo4-5	1.7335	NT [b]	0	60	5.1
39	tube, seamless	EN 10216-2	elevated temperature properties	8MoB5-4	1.5450	N [b]	0	16	1.3
40	tube, seamless	EN 10216-2	elevated temperature properties	10CrMo9-10	1.7380	NT [b]	0	60	5.2

Table A.1 *(continued)*

Serial No.	Product form	EN standard	Material description	Grade	Material No.	Heat treatment [d]	Thickness [a] mm		Material group to CEN ISO/TR 15608:2005
							min.	max.	
41	tube, seamless	EN 10216-2	elevated temperature properties	7CrWVMoNb9-6	1.8201	NT [b]	0	60	6.2
42	tube, seamless	EN 10216-2	elevated temperature properties	7CrMoVTiB10-10	1.7378	NT [c]	0	60	6.2
43	tube, seamless	EN 10216-2	elevated temperature properties	11CrMo9-10	1.7383	QT	0	60	5.2
44	tube, seamless	EN 10216-2	elevated temperature properties	15NiCuMoNb5-6-4	1.6368	NT [b]	0	80	4.2
45	tube, seamless	EN 10216-2	elevated temperature properties	X10CrMoVNb9-1	1.4903	NT [b]	0	120	6.4
46	tube, seamless	EN 10216-2	elevated temperature properties	X10CrWMoVNb9-2	1.4901	NT [b]	0	120	6.4
47	tube, seamless	EN 10216-2	elevated temperature properties	X11CrMoWVNb9-1-1	1.4905	NT [b]	0	120	6.4
48	tube, seamless	EN 10216-2	elevated temperature properties	X20CrMoV11-1	1.4922	NT [b]	0	80	6.4
49	tube, seamless	EN 10216-3	fine grain normalised	P355NH	1.0565	N	0	100	1.2
50	tube, seamless	EN 10216-3	fine grain normalised	P460NH	1.8935	N	0	100	1.3
51	tube, seamless	EN 10216-5	austenitic, elevated temperature properties	X7CrNiTiB18-10	1.4941	AT	0	60	8.1
52	tube, seamless	EN 10216-5	austenitic, elevated temperature properties	X5NiCrAlTi31-20	1.4958	AT	0	60	8.2
53	tube, seamless	EN 10216-5	austenitic, elevated temperature properties	X8NiCrAlTi32-21	1.4959	AT	0	60	8.2

Table A.1 *(continued)*

Serial No.	Product form	EN standard	Material description	Grade	Material No.	Heat treatment [d]	Thickness [a] mm		Material group to CEN ISO/TR 15608:2005
							min.	max.	
54	tube, seamless	EN 10216-5	austenitic, elevated temperature properties	X3CrNiMoBN17-13-3	1.4910	AT	0	60	8.1
55	tube, seamless	EN 10216-5	austenitic, elevated temperature properties	X8CrNiNb16-13	1.4961	AT	0	60	8.1
56	tube, seamless	EN 10216-5	austenitic, elevated temperature properties	X8CrNiMoVNb16-13	1.4988	AT	0	60	8.1
57	tube, seamless	EN 10216-5	austenitic, elevated temperature properties	X8CrNiMoNb16-16	1.4981	AT	0	60	8.1
58	tube, seamless	EN 10216-5	austenitic, elevated temperature properties	X10CrNiMoMnNbVB15-10-1	1.4982	AT	0	60	8.1
59	tube, welded	EN 10217-2	elevated temperature properties	P195GH	1.0348	N	0	16	1.1
60	tube, welded	EN 10217-2	elevated temperature properties	P235GH	1.0345	N	0	16	1.1
61	tube, welded	EN 10217-2	elevated temperature properties	P265GH	1.0425	N	0	16	1.1
62	tube, welded	EN 10217-2	elevated temperature properties	16Mo3	1.5415	N	0	16	1.1
63	tube, welded	EN 10217-3	fine grain steel, HFW	P355 NH	1.0565	N	0	16	1.2
64			fine grain steel, SAW				0	40	1.2
65	tube, welded	EN 10217-3	fine grain steel, HFW	P460NH	1.8935	N	0	16	1.3
66			fine grain steel, SAW				0	40	1.3

Table A.1 *(continued)*

Serial No.	Product form	EN standard	Material description	Grade	Material No.	Heat treatment [d]	Thickness [a] mm		Material group to CEN ISO/TR 15608:2005
							min.	max.	
67	tube, welded	EN 10217-5	SAW, elevated temperature properties	P235GH	1.0345	N	0	40	1.1
68	tube, welded	EN 10217-5	SAW, elevated temperature properties	P265GH	1.0425	N	0	40	1.1
69	tube, welded	EN 10217-5	SAW, elevated temperature properties	16Mo3	1.5415	N	0	40	1.1
70	forging	EN 10222-2	elevated temperature properties	P245GH	1.0352	A	0	35	1.1
71						N, NT, QT	35	160	
72	forging	EN 10222-2	elevated temperature properties	P280GH	1.0426	N	0	35	1.2
73						NT, QT	35	160	
74	forging	EN 10222-2	elevated temperature properties	P305GH	1.0436	N	0	35	1.2
75						NT	35	160	
76						QT	0	70	
77	forging	EN 10222-2	elevated temperature properties	16Mo3	1.5415	N	0	35	1.1
78						QT	35	500	
79	forging	EN 10222-2	elevated temperature properties	13CrMo4-5	1.7335	NT	0	70	5.1
80						QT	70	500	

Table A.1 *(continued)*

Serial No.	Product form	EN standard	Material description	Grade	Material No.	Heat treatment [d]	Thickness [a] mm		Material group to CEN ISO/TR 15608:2005
							min.	max.	
81	forging	EN 10222-2	elevated temperature properties	15MnMoV4-5	1.5402	NT, QT	0	250	1.2
82	forging	EN 10222-2	elevated temperature properties	18MnMoNi5-5	1.6308	QT	0	200	4.1
83	forging	EN 10222-2	elevated temperature properties	14MoV6-3	1.7715	NT, QT	0	500	6.1
84	forging	EN 10222-2	elevated temperature properties	15MnCrMoNiV5-3	1.6920	NT, QT	0	100	4.1
85	forging	EN 10222-2	elevated temperature properties	11CrMo9-10	1.7383	NT	0	200	5.2
86						NT, QT	200	500	
87	forging	EN 10222-2	elevated temperature properties	X10CrMoVNb9-1	1.4903	NT	0	130	6.4
88	forging	EN 10222-2	elevated temperature properties	X20CrMoV11-1	1.4922	QT	0	330	6.4
89	forging	EN 10222-4	fine grain steel, high proof strength	P285NH	1.0477	N	0	100	1.2
90	forging	EN 10222-4	fine grain steel, high proof strength	P285QH	1.0478	QT	100	400	1.2
91	forging	EN 10222-4	fine grain steel, high proof strength	P355NH	1.0565	N	0	100	1.2
92	forging	EN 10222-4	fine grain steel, high proof strength	P355QH1	1.0571	QT	100	400	1.2
93	forging	EN 10222-4	fine grain steel, high proof strength	P420NH	1.8932	N	0	100	1.3
94	forging	EN 10222-4	fine grain steel, high proof strength	P420QH	1.8936	QT	100	400	1.3

Table A.1 *(continued)*

Serial No.	Product form	EN standard	Material description	Grade	Material No.	Heat treatment [d]	Thickness [a] mm		Material group to CEN ISO/TR 15608:2005
							min.	max.	
95	forging	EN 10222-5	austenitic, elevated temperature properties	X6CrNiTiB18-10	1.4941	AT	0	450	8.1
96	forging	EN 10222-5	austenitic, elevated temperature properties	X7CrNiNb18-10	1.4912	AT	0	450	8.1
97	forging	EN 10222-5	austenitic, elevated temperature properties	X3CrNiMoBN17-13-3	1.4910	AT	0	75	8.1
98	fittings	EN 10253-2	elevated temperature properties	P235GH	1.0345	N	0	60	1.1
99	fittings	EN 10253-2	elevated temperature properties	P265GH	1.0425	N	0	60	1.1
100	fittings	EN 10253-2	elevated temperature properties	16Mo3	1.5415	N	0	60	1.1
101	fittings	EN 10253-2	elevated temperature properties	13CrMo4-5	1.7335	NT [b]	0	60	5.1
102	fittings	EN 10253-2	elevated temperature properties	10CrMo9-10	1.7380	NT [b]	0	60	5.2
103	fittings	EN 10253-2	elevated temperature properties	X10CrMoVNb9-1	1.4903	NT [b]	0	60	6.4
104	fittings	EN 10253-2	elevated temperature properties	P355N	1.0562	N	0	100	1.2
105	fittings	EN 10253-2	elevated temperature properties	P355NH	1.0565	N	0	100	1.2

Table A.1 *(continued)*

Serial No.	Product form	EN standard	Material description	Grade	Material No.	Heat treatment [d]	Thickness [a] mm		Material group to CEN ISO/TR 15608:2005
							min.	max.	
106	fasteners	EN 10269	elevated temperature properties	20Mn5	1.1133	N	0	150	1.4
107	fasteners	EN 10269	elevated temperature properties	25CrMo4	1.7218	QT	0	150	5.1
108	fasteners	EN 10269	elevated temperature properties	21CrMoV5-7	1.7709	QT	0	160	6.2
109	fasteners	EN 10269	elevated temperature properties	20CrMoVTiB4-10	1.7729	QT	0	160	6.1
110	fasteners	EN 10269	martensitic, elevated temperature properties	X22CrMoV12-1	1.4923	QT	0	160	6.4
111	fasteners	EN 10269	austenitic, elevated temperature properties	X6CrNi18-10	1.4948	AT	0	160	8.1
112	fasteners	EN 10269	austenitic, elevated temperature properties	X10CrNiMoMnNbVB15-10-1	1.4982	AT+WW	0	100	8.1
113	fasteners	EN 10269	austenitic, elevated temperature properties	X3CrNiMoBN17-13-3	1.4910	AT	0	160	8.1
114	fasteners	EN 10269	austenitic, elevated temperature properties	X6CrNiMoB17-12-2	1.4919	AT	0	160	8.1
115	fasteners	EN 10269	austenitic, elevated temperature properties	X6CrNiTiB18-10	1.4941	AT	0	160	8.1
116	fasteners	EN 10269	austenitic, elevated temperature properties	X6NiCrTiMoVB25-15-2	1.4980	AT+P	0	160	8.2
117	fasteners	EN 10269	austenitic, elevated temperature properties	X7CrNiMoBNb16-16	1.4986	WW+P	0	100	8.1
118	fasteners	EN 10269	austenitic, elevated temperature properties	NiCr15Fe7TiAl	2.4669	AT+P	0	25	43

Table A.1 *(continued)*

Serial No.	Product form	EN standard	Material description	Grade	Material No.	Heat treatment [d]	Thickness [a] mm		Material group to CEN ISO/TR 15608:2005
							min.	max.	
119	bar	EN 10273	elevated temperature properties	P235GH	1.0345	N	0	150	1.1
120	bar	EN 10273	elevated temperature properties	P250GH	1.0460	N	0	150	1.1
121	bar	EN 10273	elevated temperature properties	P265GH	1.0425	N	0	150	1.1
122	bar	EN 10273	elevated temperature properties	P275NH	1.0487	N	0	150	1.1
123	bar	EN 10273	elevated temperature properties	P295GH	1.0481	N	0	150	1.2
124	bar	EN 10273	elevated temperature properties	P355GH	1.0473	N	0	150	1.2
125	bar	EN 10273	elevated temperature properties	P355NH	1.0565	N	0	150	1.2
126	bar	EN 10273	elevated temperature properties	P355QH	1.8867	QT	0	150	1.2
127	bar	EN 10273	elevated temperature properties	16Mo3	1.5415	N	0	220	1.1
128	bar	EN 10273	elevated temperature properties	13CrMo4-5	1.7335	NT	0	60	5.1
129						NT, QA, QL	60	100	
130						QL	100	150	
131	bar	EN 10273	elevated temperature properties	10CrMo9-10	1.7380	NT, QA, QL	0	60	5.2
132						QL	60	100	

[a] Relevant thickness for forgings: t_R

[b] It can be necessary according to the manufacturer, that these bars shall be quenched and tempered over 25 mm or T/D > 0,15; if so, „+QT“ shall be added.

[c] It can be necessary according to the manufacturer, that these bars shall be quenched and tempered over 16 mm or T/D > 0,15; if so, „+QT“ shall be added.

[d] Heat treatment:

A = annealed
N = normalised
P = precipitation hardened
T = tempered
AT = solution annealed
NT = normalised and tempered
QA = quenched and annealed
QL = liquid quenched
QT = quenched and tempered
RA = recrystallizing annealed condition
WW = warm worked

Annex B
(normative)

Establishment of creep rupture strength values for new materials

The establishment of creep rupture strength values for new materials shall be done in two steps as described in Table B.1.

Table B.1 — Establishment of creep rupture strength values

	Available Test Data	**Procedure for evaluation**	**Further tests**
First step for preliminary data in data sheets (EAS)	Creep tests (3 samples each) for 3 casts at min. 2 test temperatures (Δt = 50 °C – 100 °C) for more than 10 000 h (rupture). where embrittlement may occur, for each cast and temperature 1 notched sample for more than 10 000 h (rupture).	For scatter bands not greater than ± 10 % extrapolation factor < 3 for time. Max. application temperature ≤ max. test temperature. For scatter bands greater than ± 10 % no extrapolated values in data sheets. In this case the calculation values shall be defined in each case.	From each manufacturer creep tests for (min. 5 samples) min. 1 cast with min. 2 test temperatures for more than 30 000 h (rupture). Where necessary for each test temperature min. 2 notched samples for more than 30 000 h (rupture).
Second step for final data in data sheets (EAM)	Creep tests (min., 5 samples each) for min. 6 casts at test temperatures with $\Delta t \leq 50$ °C up to 35 % max. intended operating time. where necessary for notched creep tests (min. 2 samples) at min. 2 temperatures in embrittlement range up to more than 30 000 h (rupture).	For scatter bands not greater than ± 20 % extrapolation factor < 3 for time. Max. application temperature ≤ 25 °C above max. test temperature.	New manufacturers of such materials shall test samples at least at one test temperature for more than 30 000 h (rupture). In the case of extension of the application range of the data sheet creep tests (min. 5 samples each) for one cast at min. 2 test temperatures more than 30 000 h (rupture).

Annex C
(normative)

Special requirements for composite tubes

C.1 General

This annex gives the special requirements applicable to the properties of composite tubes used for pressure parts in boilers with severe corrosion conditions.

C.2 Special requirements for composite tubing

C.2.1 Composite tubing

Composite tube consists of ferritic pressure retaining inner core and corrosion resistant outer cladding metallurgically bonded to each other.

C.2.2 General

Material manufactured in accordance with this annex shall conform to the applicable requirements of the current edition of the documents listed in 3.3 unless otherwise provided herein.

The composite tube shall be seamless tube manufactured by the hot extrusion process or hot extrusion followed by cold working. A billet with the two component materials shall be co-extruded at high temperature and high pressure in order to obtain a complete metallurgical bond.

All tube shall be furnished in the heat-treated condition. The heat treatment shall be performed at the temperature suitable for the two components to obtain optimum mechanical and corrosion properties.

The finished tubes shall be straight, see C.2.5.2 and free from injurious imperfections.

C.2.3 Chemical composition

The chemical composition shall be in accordance with 3.3.

C.2.4 Mechanical and technological properties

C.2.4.1 Tensile test of ferritic pressure retaining inner core

The tensile test shall be performed on a number of tubes in accordance with C.2.9 (random lengths). The mechanical properties shall conform to the values given in the specification selected in accordance with 3.3.

C.2.4.2 Ring expanding test (composite tube)

One ring expanding test shall be carried out on a specimen from each end of each tube (random lengths). The ring shall be expanded to a minimum of 30 % of inside diameter or to rupture, if this should occur earlier. The sample shall be free from imperfections as determined by visual inspection. The test shall be performed in accordance with EN ISO 8495.

C.2.5 Tolerances

C.2.5.1 Permissible variations in OD and wall thickness

Outside diameter: ± 0,5 %, but with a minimum ± 0,30 mm
Total wall thickness: outside diameter < 50,8 mm + 22 % – 0
outside diameter ≥ 50,8 mm + 15 % – 0

Thickness of stainless steel component: ± 0,40 mm

The thickness of the stainless steel component shall be checked by eddy current testing over the whole length of each tube.

Other tolerances may also be used upon agreement.

C.2.5.2 Permissible variations in straightness

Out of straightness max. 1,5 mm/1 000 mm.

C.2.6 Surface finish

The tubes shall be pickled free from scale.

C.2.7 Ultrasonic testing

C.2.7.1 Ultrasonic testing of the metallurgical bond in composite tubes

C.2.7.1.1 Extent of testing

The test procedure shall provide complete testing of the entire volume.

C.2.7.1.2 Reference standard

The reference standard shall be prepared from a length of tube of the same nominal dimensions, material, surface finish and nominal heat treatment as the tubes to be tested.

A flat bottom hole 5 mm in diameter shall be introduced radially from the bore surface of the tube. The bottom of the hole shall be positioned at the interface of the two materials. The flat bottom hole together with a chosen combination of probe beam width or diameter, scan pitch and speed shall produce unambiguously at least one signal at the ultrasonic testing apparatus corresponding to instantaneous detection of the bottom area of the flat bottom hole. This shall be the reference signal. The equipment shall be adjusted to produce a clearly identifiable reference signal pattern from the flat bottom hole. The amplitude of the reference signal from the flat bottom hole shall be used to set the visual standard on the cathode ray screen or the threshold in the electronic monitoring equipment.

C.2.7.1.3 Acceptance criteria

Any tube that does not produce a signal greater than the signal from the reference standard should be deemed to have passed the test. Tubes with imperfections which produce a signal greater than that from the reference standard shall be rejected.

On rejected tubes, the part with defective bonding shall be cropped off and the remaining part (parts) considered accepted.

C.2.7.2 Ultrasonic testing of composite tubes concerning longitudinal and transverse imperfections

C.2.7.2.1 Method of testing

Immersion testing will be used. The scanning will be conducted using shear waves (approximately 45° refraction of the sound beam). For the longitudinal scanning the beams will be directed in two opposite circumferential directions and for the transversal scanning the beams will be directed in two opposite axial directions.

C.2.7.2.2 Reference standard

The reference standard shall be prepared from a length of tube of the same nominal dimensions, material, surface finish and nominal heat treatment as the tubes to be tested. On the outside and inside surface, artificial notches shall be machined along the same line and with the dimensions and profile given in the Table C.1. The dimensions and the profile shall be checked by the plastic replica technique.

Table C.1 — Artificial notches

Type	Location	Nominal depth mm	Length mm	Profile
Longitudinal	Inside	5 % of the total nominal wall thickness, but minimum 0,20 mm Tolerance: ± 10 %	25	U-shape
Longitudinal	Outside			
Transverse	Inside			
Transverse	Outside			

C.2.7.2.3 Calibration

For calibration purposes the reference standard shall be passed through the scanning head at the same rate and in the same directions as the tube to be tested.

C.2.8 Thickness check of stainless steel component

C.2.8.1 General

The measuring shall be carried out with an eddy current instrument intended for measuring the thickness of non-metallic or non-magnetic layers on a ferromagnetic material.

C.2.8.2 Calibration

For the calibration two composite-tube pieces shall be used, one with a thickness of the stainless steel component as near the minimum tolerance limit and the other as near to the maximum tolerance limit as possible.

C.2.8.3 Acceptance criteria

Any tube that does not produce a signal outside the specified austenitic layer tolerances should be deemed to have passed the test.

Tubes with the austenitic layer outside the tolerances shall be rejected.

On rejected tubes, the part outside the tolerances shall be cropped off and the remaining part (parts) considered accepted.

C.2.9 Summary of tests and examinations

The tests and examinations shall be in accordance with Table C.2.

Table C.2 — Extent of tests and examinations

Test	Extent
Cast analysis	1 per heat
Tensile test at room temperature (carbon steel component only)	2 per lot of 2 to 15 tubes 3 per lot of 16 to 50 tubes 4 per lot of 51 to 100 tubes 6 per lot of ≥ 101 tubes (random lengths)
Ring expanding test	Each tube, both ends (random lengths)
Ultrasonic test [a]	Each tube (random lengths)
Thickness control of stainless steel	Each tube (random lengths)
Dimensional check	Each tube, both ends
Visual inspection	Each tube, inside and outside

[a] Ultrasonic test according to C.2.7.2 is replacing leak tightness test (hydrostatic test or electromagnetic test) as required according to EN 10216-2:2002+A2:2007.

C.3 Marking

C.3.1 General

Tubes shall be longitudinally marked with black ink along their entire length and marked in accordance with 4.1.8.

C.3.2 Additional marking requirements

The following additional marking shall be made:

— steel grade or material grade or material number of both components;

— the cast number of both components;

— outside diameter and wall thickness.

Annex D
(informative)

Significant technical changes between this European Standard and the previous edition

Clause/Paragraph/Table/Figure	Change
General	Numbering system of tables and drawings has changed.
General	— Alignment of materials to valid standards. — Further material grades (including austenitic steels) incorporated.
2 / Normative references	References updated.
4.1.4 / Welding consumables	— Referenced standards for classification of consumables updated. — Requirements modified.
4.1.6 d) / Requirement for non-destructive examination – forgings and rolled bars	Requirements enlarged to rolled bars.
4.1.6 f) / Requirement for non-destructive examination – butt-welding pipe fittings	Requirements for butt-welding pipe fittings added.
Table 4.2-1 / General requirements for the chemical composition of steels for welding and forming	Max. S-content specified on lower level.
4.2.5.5 / Elevated temperature proof strength	Interpolation procedure for proof strength values clarified.
6 / Inspection documentation	Information concerning certification of manufacturers quality system required.
Table A.1 / Steels provided for elevated temperature use	Material group classification according to CEN ISO/TR 15608:2005 was added.
Annex C / Special requirements for composite tubes	Title revised.
NOTE The technical changes referred include the significant technical changes from the EN revised but is not an exhaustive list of all modifications from the previous version.	

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of Directive 97/23/EC

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the New Approach Directive 97/23/EC.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the Clauses of this standard given in Table ZA.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations.

Table ZA.1 — Correspondence between this European Standard and Directive 97/23/EC

Clauses of this European Standard	Content	Essential Safety Requirements (ESRs) of Directive 97/23/EC, Annex I
3.1, 3.3	Appropriate material properties	4.1, a
3.1, 3.2	Suitable for the processing procedures	4.1, d
4.1	Technical documentation – EN materials	4.2b, 1st indent
6	Certification – Supplier compliance with specification	4.3, 1st paragraph
6	Certification – Supplier specific product control	4.3, 2nd paragraph
6	Certification – Supplier quality assurance	4.3, 3rd paragraph

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

Bibliography

EN ISO/IEC 17021, *Conformity assessment — Requirements for bodies providing audit and certification of management systems (ISO/IEC 17021:2006)*

EN ISO 9001, *Quality management systems — Requirements (ISO 9001:2008)*

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