

Specification for unfired fusion welded pressure vessels

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ICS 23.020.30

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ISBN 978 0 580 70032 3

The following BSI references relate to the work on this standard:
Committee reference PVE/1

Publication history

First published as BS 5500 March 1976
Second edition January 1982
Third edition January 1985
Fourth edition January 1988
Fifth edition January 1991
Sixth edition January 1994
Seventh edition January 1997
First published as PD 5500 January 2000
Second edition January 2003
Third edition January 2006
Fourth edition January 2009

Amendments issued since publication

Date	Text affected
September 2009	See p xix.
September 2010	See p xix.

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Foreword

This Published Document has been prepared by Technical Committee PVE/1, Pressure vessels, to supersede PD 5500:2006 on 31 January 2009. It provides a specification for the design, manufacture, inspection and testing of pressure vessels manufactured from carbon, ferritic alloy and austenitic steels, nickel and aluminium.

The form and content of the original issue of PD 5500 was derived, without technical amendment, from the 1997 edition of BS 5500, *Specification for unfired fusion welded pressure vessels*, and all amendments issued thereto, up to and including No. 6 (September 1999). At the time PD 5500 differed from BS 5500 only insofar as it did not retain the latter's status as a national standard. This specification is thus, founded on the experience derived from the application of BS 5500 and the first edition of PD 5500, providing an integrated set of rules which have been shown to provide vessels of suitable integrity for a wide range of duties and risk environments.

BS 5500:1997 was withdrawn because its status as a national standard was incompatible with BSI's obligations to CEN consequent to the development of the European Standard EN 13445, *Unfired pressure vessels*. That European Standard was first published in May 2002.  A new edition of EN 13445 was published in July 2009. 

The process of development of EN 13445 by CEN and its reference in the Official Journal of the European Communities creates, for equipment which conforms to that standard, a presumption of conformity with the essential safety requirements of the EU's pressure equipment directive, 97/23/EC (see article 5 of that directive). This Published Document does not provide that presumption of conformity. However, this Published Document can be used, for vessels within the scope of directives, subject to:

- adherence of the directive's conformity assessment requirements;
- the manufacturer satisfying himself that this PD covers all the technical requirements of the Directive relevant to the vessel in question.

This use may be to cover the full range of applicable vessel requirements or to cover an issue not, at the time, appropriately supported in EN 13445.

The normative form of wording is used in this Published Document, even though this does not have the status of a national standard, in order to ensure clarity in the definition of its requirements and recommendations.

Reference is made in the text to a number of standards which have been withdrawn. Such standards are identified in the list of references (see page V). Consideration is currently being given as to whether replacement standards are available or are being developed, for example, in the European programme, and to the implications for PD 5500 of such replacement standards. When a decision is made about any replacements standards, these will be identified by the issue of an amendment.

The British Standards Institution will be pleased to receive constructive proposals based on experience or research that may lead to improvements in this Published Document. PVE/1 intends to keep the content and technical status of this specification under review along with the need to publish appropriate supplements covering other types of pressure vessels. If there is sufficient demand from industry, this Published Document will be extended to cover other non-ferrous materials.

The requirements for materials not listed in Section 2. Materials, are given in supplements to the main text, which are to be read in conjunction with the main text so as to provide comprehensive requirements for pressure vessels produced in the relevant material. Annexes to the main text are provided which can be either normative (i.e. requirements) or informative (i.e. recommendations). These annexes can include additional requirements to the main text or informative guidance or recommendations, or can provide worked examples. Enquiry cases are published primarily to give guidance and clarification of possible ambiguities

in the main text and will be incorporated into the main text or into an annex at an appropriate stage. Some Enquiry cases are published to provide new information and are identified as “preliminary rules”.

It should be noted that the effective date of amendments to this Published Document will be later than the publication date to allow users time to amend their own working procedures and documentation. See the introduction to the summary of pages table.

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Figure G.2.5-1 was originally published as Figure 2 on page 21 of WRC Bulletin 90 September 1963.

Figure G.2.5-2 was originally published as Figure 3 on page 21 of WRC Bulletin 90 September 1963.

Figure G.2.5-3 was originally published as Figure 7 on page 24 of WRC Bulletin 90 September 1963.

Figure G.2.5-4 was originally published as Figure 8 on page 24 of WRC Bulletin 90 September 1963.

Figure G.2.5-5 was originally published as Figure 9 on page 25 of WRC Bulletin 90 September 1963.

Figure G.2.5-6 was originally published as Figure 10 on page 25 of WRC Bulletin 90 September 1963.

Figure G.2.5-7 was originally published as Figure 11 on page 26 of WRC Bulletin 90 September 1963.

Figure G.2.5-8 was originally published as Figure 12 on page 26 of WRC Bulletin 90 September 1963.

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This document may be referred to by the UK Health and Safety Executive (HSE) when giving guidance.

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

Compliance with a Published Document does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to xviii, pages 1/1 to 5/30, pages A/1 to Z/8, pages A1/1 to Ni/6, pages I to XII, an inside back cover and a back cover.

Summary of pages

This specification is kept up to date by the issue, from time to time, of replacement pages.

Tags (**A₁**) (**A₁**) (**C₁**) (**C₁**) on replacement pages will indicate that changes of technical reference significance have been made at that point. The tags applied for any particular amendment or corrigendum carry the same designation number, commencing with 1 for the first amendment, then 2 for the second amendment, and 1 for the first corrigendum, then 2 for the second corrigendum, and so on. Minor editorial changes are not tagged.

The following table identifies for each page of the specification whether or not an amendment or corrigendum has been made to that page and the designation number of the amendment or corrigendum made. Each amended page becomes part of the authorized version at the effective date given for each amendment or corrigendum on the inside front cover.

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Section 1. General

1.1 Scope

1.1.1 This Published Document specifies requirements for the design, construction, inspection, testing and verification of compliance of new unfired fusion welded pressure vessels. The materials of construction are specified in Section 2. The term “pressure vessel” as used in this specification includes branches up to the point of connection to the connecting piping by bolting, screwing or welding, and supports, brackets or other attachments directly welded to the pressure containing shell. The term “unfired” excludes vessels that are subject to direct generated heat or flame impingement from a fired process. It does not exclude vessels subject to electrical heating or heated process streams.

NOTE Whilst this specification is limited to the construction of new vessels, with the agreement of the relevant parties it can be used to guide the maintenance or any modification of existing vessels. Where these existing vessels were designed and constructed using an earlier edition of PD 5500, with the agreement of the relevant parties, that earlier edition can be used to guide the maintenance or any modification.

1.1.2 In addition to the definitive requirements this specification also requires the items detailed in **1.5** to be documented. For compliance with this specification, both the definitive requirements and the documented items have to be satisfied.

1.1.3 This specification applies only to pressure vessels manufactured under the survey of a competent engineering Inspecting Authority or Organization. The competent engineering Inspection Authority or Organization shall either be:

- a) a notified body appointed by a member state of the European Union for the Pressure Equipment Directive 97/23/EC for the range of activities covered by this specification; or

NOTE Within the UK the United Kingdom Accreditation Service (UKAS) acts on behalf of the regulating authority in accrediting inspection bodies.

- b) accredited to BS EN 45004, to Type A independence criteria, for inspection in the subject matter of this specification; or

- c) accredited by an organization authorized by the local Regulatory Authority in countries outside the EU and in circumstances where the Pressure Equipment Directive 97/23/EC does not apply.

The intent of this requirement is regarded as satisfied where inspection is carried out by competent personnel of a separate engineering inspection department maintained by the purchaser of the vessel (in which case Type B independence criteria shall be met). An inspection department maintained by the manufacturer does not satisfy this requirement except:

- a) that specific responsibilities may be delegated at the discretion of the Inspecting Authority or Organization; or

- b) in the case of vessels for the manufacturer’s own use and not for resale.

This specification applies only to vessels made by manufacturer’s who can satisfy the Inspecting Authority or Organization that they are competent and suitably equipped to fulfil the appropriate requirements of this specification.

The requirements for testing and inspecting serially manufactured pressure vessels are given in Annex V. In all other respects the appropriate requirements in the specification apply.

Glass lined steel vessels require special design considerations subject to the limits imposed by the method of construction which should have the agreement of the Inspecting Authority.

1.1.4 This specification does not cover the following.

- a) Storage tanks designed for the storage of liquids at near atmospheric pressures, i.e. where the pressure additional to that due to the hydrostatic head does not exceed 140 mbar¹⁾ above or 6 mbar below atmospheric pressure.
- b) Low pressure, above ground storage tanks which have a single vertical axis of revolution designed for the storage of liquids at a pressure not exceeding 1 bar¹⁾.
- c) Vessels in which the stresses calculated in accordance with the Equations given in Section 3 are less than 10 % of the design stress permitted by Section 3.
- d) Multilayered, autofrettaged, prestressed vessels or other special designs of vessels which may be appropriate for very high pressures.
- e) Transport vessels, i.e. vessels used for transport of contents under pressure.
- f) Vessels for specific applications which are covered by standards listed in the *BSI Catalogue*.

NOTE 1 PD 5500 may be used for the design and manufacture of liquid and bulk powder road tankers, provided consideration is given to the following:

- chapter 6.8.2 of ADR (European Agreement concerning International Carriage of Dangerous Goods by Road); in particular relating to static and dynamic stresses in motion, protection of the shell and supports and fittings, minimum thickness and the provision of anti-surge plates;
- chapter 9.7.5.1 of ADR relating to stability.

BS 3441 gives guidance on the design and construction of tanks for the transport of milk and liquid milk products.

Road tankers used to transport non-hazardous substances in the UK and which operate at a pressure above 0.5 bar g are subject to the Pressure Systems Safety Regulations, 2000 (SI 128).

NOTE 2 See Note 1 of 3.2.2 regarding the applicability of PD 5500 Section 3 to thick walled vessels.

NOTE 3 The titles of the publications referred to in this specification are listed at the end of the document.

1.1.5 This specification does not address the nature or consequences of a fire in the vicinity of a pressure vessel. Any consideration of the effect of a fire hazard in the design of a pressure vessel would have to be under the direction of the plant owner or his responsible agent such as the plant architect/engineer, with analysis of the consequences of a fire adjacent to a pressure vessel being undertaken in accordance with a comprehensive specification of the fire conditions, impingement parameters, analytical methods and assessment criteria.

1.1.6 This specification addresses materials in various ways.

- a) The main text gives requirements for steels.
- b) Certain other materials are covered by supplements which identify either where the main text is applicable or where specific requirements of the supplement apply.

1.1.7 When another standard or specification calls for the provisions of PD 5500 to be applied, the responsibility for defining the manner in which the provisions are applied and their appropriateness for the intended duty, is defined in that other document.

1.1.8 Guidance on the application of PD 5500 to pressure vessels that fall within the scope of the European Pressure Equipment Directive is given in Annex Z.

¹⁾ 1 mbar = 10² N/m² = 100 Pa.
1 bar = 10⁵ N/m² = 0.1 N/mm² = 100 kPa.

1.2 Interpretation

If any ambiguity be found or doubt arise as to the meaning or effect of any part of this specification or as to whether anything ought to be done or omitted to be done in order that this specification should be complied with in full, the question shall be referred to the Pressure Vessels Technical Committee (PVE/1) of the British Standards Institution, whose interpretation of the requirements of this specification upon the matter at issue shall be given free of charge and shall be final and conclusive. Parties adopting this specification for the purposes of any contract shall be deemed to adopt this provision unless they expressly exclude it or else import an arbitration provision in terms extending to interpretation of this specification. However, this provision is limited to questions of interpretation and does not confer upon the committee any power, duty or authority to adjudicate upon the contractual rights or duties of any person under a contract except in so far as they may necessarily be affected by the interpretation arrived at by the committee.

Findings or rulings of the committee upon all enquiries, including matters of interpretation, which are of sufficient importance that both enquiries and replies be made public as soon as possible will be published in an enquiry reply form for inclusion in the PD 5500 ring binder as Enquiry Cases. Their availability will be notified in *BSI News*.

After taking into account any public comment thereon, Enquiry Cases may be incorporated, as appropriate, into this specification as amendments which will form part of the next convenient annual updating.

1.3 Definitions

For the purposes of this specification the following definitions apply.

1.3.1

purchaser

the organization or individual who buys the finished pressure vessel for its own use or as an agent for the owner

1.3.2

manufacturer

the organization that designs, constructs and tests the pressure vessel in accordance with the purchaser's order. The design function may be carried out by the purchaser or his agent, independently from the organization that constructs and tests the vessel (see 1.4.2)

1.3.3

Inspecting Authority

the body or organization that verifies that the vessel has been designed, constructed and tested in accordance with this specification

1.3.4

Regulating Authority

the authority in the country of installation that is legally charged with the enforcement of the requirements of the law and regulations of that country relating to pressure vessels

1.4 Responsibilities

NOTE Reference should be made to Annex Z when this specification is being used to satisfy the EU's pressure equipment directive, 97/23/EC, or any national implementation thereof.

1.4.1 Responsibilities of the purchaser

The purchaser shall be responsible for furnishing the manufacturer and the Inspecting Authority with the information required by 1.5.1.

The purchaser shall detail in a purchase specification any requirements additional to those of this specification. Table 1.4-1 summarizes where this specification identifies additional purchase specification options.

Where the Inspecting Authority is nominated by the purchaser, the purchaser shall be responsible for ensuring that any information which the manufacturer is required to supply, as specified in this specification, is made available to the Inspecting Authority.

Where necessary, it shall be the responsibility of the purchaser to ensure that the Inspecting Authority is acceptable to the Regulating Authority.

Where the purchaser elects to perform the design function for the vessel, the purchaser shall be responsible for maintaining a complete design dossier for the vessel (see 1.5.1) and for ensuring that all the information contained in it, or agreed modifications to it, comply with this specification; the purchaser shall also be responsible for the accuracy of all design calculations for the vessel.

1.4.2 Responsibilities of the manufacturer

The manufacturer shall be responsible for the completeness and accuracy of all design calculations and for compliance with all applicable requirements of this specification for the whole vessel. The manufacturer shall, as required at various points in this specification, obtain the agreement of the purchaser and/or Inspecting Authority for aspects of vessel design, material choice, manufacture and testing (summarized in Table 1.4-2). These agreements shall be documented for inclusion in the vessel records [see 1.5.2.2e)].

If during fabrication unexpected deviations from the requirements of this specification arise, that the manufacturer can justify will not impair the intended functionality or integrity of the vessel, the manufacturer may submit a justification to the purchaser and Inspecting Authority for their approval. Such approved deviations shall be documented for inclusion in the vessel records [see 1.5.2.2e)] and require the application of suffix XX to Form X (see 1.4.4 and Note 1 to Form X).

Where the Inspecting Authority is not nominated by the purchaser, the manufacturer shall appoint an Inspecting Authority. The manufacturer shall be responsible for ensuring that the Inspecting Authority is provided with any information the manufacturer is required to supply, as specified in this specification.

The organization which discharges the manufacturer's responsibilities for construction and testing shall assume overall responsibility for compliance with this specification during all related activities including part manufacture and subsequent fabrication to completion at works and/or site. It shall satisfy the Inspecting Authority, as necessary, under the general provisions of 1.1 that it is competent to ensure by appropriate control or surveillance of such activities, whether carried out by itself or by subcontractors, that all the relevant requirements of this specification are met.

Examinations carried out by the Inspecting Authority do not absolve the manufacturer from his responsibility for compliance with the applicable requirements of this specification.

Where the purchaser elects to perform the design function for the vessel, the manufacturer shall be responsible for ensuring that all the design information he requires to construct and test the vessel is provided by the purchaser and for ensuring that all construction and testing is carried out in compliance with this specification. The manufacturer shall also be responsible for the accuracy of any information he provides to enable the purchaser to fulfil the design function.

Table 1.4-1 — Purchase specification options

Clause	Item
1.4.1	Table 1.4-1, identification of purchase specification options
1.4.3b)	Responsibility of IIA regarding purchase specification
1.5.1b)	Information supplied by purchaser regarding purchase specification
2.1.1.2	Any special material limits
2.1.2.1	Use of castings for pressure parts
2.2.4	Requirements for material groups 5 and 6, and sub-group 9.2
3.1.5, Note	Zero negative thickness tolerance
3.2.2	Service life and design margin for fatigue vessels
3.2.4	Design lifetime for time dependent stresses
3.3.1	Identification of the risk of stress corrosion cracking
3.3.2	Required corrosion allowance
3.3.3	Surface finish for coated vessels
3.4.1	Choice of construction category
3.4.2.1	Reduced design stress for operational reasons
3.4.2.1a)	Any special material tests
3.8.1, Note 5	Special requirements for leak tight flanges
3.9.4.1	Tubesheet design for as-new condition
3.9.4.3.4	Tubesheet design for simultaneous shellside and tubeside pressures
3.13.2, Note 2	Additional relief capacity for the event of fire
4.2.1.2	Supplementary NDT in addition to visual inspection
4.2.6	Supplementary structural tolerances
4.3.1c)	Production control test plates
4.4.3.1d)	PWHT
4.5.2	Special finish
Table 5.1-1	Material examination etc.
5.4.1	Requirements for production control test plates for non 9 % Ni
5.6.2	NDT or parent plates
5.6.6.6	Specific method of marking
5.8.2.6	Use of differential pressure in testing of multi-compartment vessels
5.8.8.1	Gas leak test before hydraulic or pneumatic tests
C.1.2.3	Design conditions for cyclic operation in creep range
D.7.2.2	Heat treatment of production test plates with the vessel
D.7.2.2a)	Use of previous results of production test plates
D.7.2.2b)	Requirements for production weld test plates
D.7.2.2	Additional tests on test plates
N.1.1	Use of Annex N for non-UK applications
N.1.3	Definition of information for purchase specification
N.2.2	Extent information to be provided by manufacturer
N.2.3	Requirement for manufacturer to recommend periodic examination
Annex S	Optional documentation
T.5.1	Optional tube-end joint tests
V.7	Records for serially produced vessels
Al.5.4.1	Need for production control test plates
Al.5.5.3	Transverse tensile tests for welder approval
Al.5.6.6.6	Specific marking for NDT
Cu.3.4.1	Choice of construction category
Cu.5.4.1	Production control test pieces for C106 alloy

Table 1.4-2 — Items for manufacturer, purchaser and/or Inspecting Authority agreement

Clause	Item
2.1.2.1c)	Use of non BS, BS EN or European approved materials
2.3.1.1a)	Procedure for determination of design strength
2.1.2.2.1	Choice of equivalent material group
2.2.1	Consideration of materials for low temperature testing
2.2.4	Requirements for material in groups 5 and 6, and sub-group 9.2
2.1.2.2.2.1	Use of steels with C content > 0.25 %
2.1.2.2.2.7, Note 2	Use of rolling process to achieve normalized properties
Table 2.1-3, Note 5	Additional procedure for correction of minor defects in category 3 components
3.2.2b)	Alternative design methods
3.2.2b)4)	Alternative design by comparison with similar vessels
3.2.3	Design vacuum with break valve
3.3.3	Cladding thickness included in calculation in thickness
3.4.2.1b)2)	Alloy design stresses with PWHT not to Table 4.4-1
3.8.1.4	Bolt design stresses higher than Table 3.8-1
3.8.1.5	Use of plate material for hubbed flanges
3.9.2.1, Note	Ligament efficiency of non-standard tube end fixing
4.1.1	Commencement of manufacture before drawing approval
4.1.1	Modification of approved drawings
4.1.6	Additional NDT after rectification of departure from tolerance
4.2.1.1	Dressing of cut edges of ferritic steels
4.2.1.2	Major defect notification and rectification
4.2.2.2	NDT method on butt welded plates prior to forming
4.2.2.4.1	Ferritic steel: forming procedure involving plate heating; possible supporting data
4.2.2.4.2	Austenitic steel: forming procedure involving plate heating
4.2.2.5	Sectional flanging for dished ends
4.2.3.1a)	Assembly tolerance of longitudinal joints $e > 200$ mm
4.2.3.1b)	Assembly tolerance of circumferential joints $e > 200$ mm
4.2.4.2.3	Circularity tolerance at nozzle
4.3.2.2	Weld metal properties for 9 % Ni
4.3.2.4	Austenitic stainless steel consumables for 9 % Ni below -101 °C
4.3.6.2	Permanent backing strips for inaccessible second side
4.3.6.2	Backing strips for tubes
4.4.3.1a)	PWHT ferritic steel thicker than Table 4.4-1
4.4.3.1	Welding of lightly loaded parts after heat treatment
4.4.3.5	PWHT for austenitic stainless steel
4.4.4.4b)	Requirements for local heat treatment of branches
4.4.5.1	PWHT for materials other than sub-groups 1.1, 1.2 or 1.3
Table 4.4-1	Thickness limits for PWHT of 3½ Ni
Table 4.4-1, Note 3	PWHT of 9 % Ni
5.2.5	Criteria for all weld test
5.3.3	Retake whole or part of welder approval test
5.4.1	Number and details of production control test plates for non-9 % Ni
5.4.2	Number and details of production control test plates for 9 % Ni
5.6.2	Acceptance standards for flaws in parent plates and NDT of repairs

Table 1.4-2 — Items for manufacturer, purchaser and/or Inspecting Authority agreement *(continued)*

Clause	Item
5.6.4.1.2	Method of examination for surface flaws in type A welds
5.6.4.3	Additional testing for visual examination of category 3 components
5.6.5.1	Choice of NDT method
5.6.5.2	Alternative NDT methods to assess depth surface defects
5.6.6.1	Alternative radiographic techniques
5.7.2.2	Deviation from acceptance criteria of Table 5.7-1, Table 5.7-2 and Table 5.7-3
5.7.2	Assessment of defects to Annex U
5.7.3	Repair of welds
5.8.2.2	Pressure test procedure
5.8.2.4	Elevation of test temperature to avoid brittle fracture
5.8.2.5	Pressure test procedure for large vessels
5.8.4.1	Consultation for pneumatic testing
5.8.5.5	Testing vacuum vessels with anti-vacuum valves
5.8.6.1	Proof test procedure
5.8.6.2	Strain indicating coating for proof test
5.9.1	Quality specification for castings
5.9.2	Examination and heat treatment of weld repair of cast components
C.3.4.3.1	Raising the weld class for cyclic loading
C.3.4.6.4	Stress factor for machined weld toes
D.1	Alternative to Annex D requirements
D.7.1, Note	Alternative toughness requirements using Annex U
D.7.2.2	Waiving of impact testing of production weld test plates
D.7.2.3, Note	Position of impact test specimen
H.3.2	PWHT of different material grades with differences in temperature >10 °C
H.5.3	Time at PWHT
Annex J	Fitting of additional pressure relief valve(s)
K.1.4.1.2	Extrapolation of upper temperature stress values
K.1.4.2, Note 1d)	Design strengths at higher temperatures
K.1.4.2, Note 17	Design strengths for slit rimming tubes
Q.1.3	Selection of test specimen
Q.2.3.2	Maximum strength of all-weld tensiles
Q.2.6	Micro-examination of production control test plates
T.4.3a)	Alternative leak test method for tube-end joints
T.5.3	Tracer gas test of tube-end joints
T.5.4	Radiography for back-face tube to tubesheet welds
T.5.5	Testing production control test pieces
T.5.5	Frequency of production control test pieces for tube-end joints
U.1	Fracture mechanics approach
V.4.4	Reduction in extent of weld examination for serially produced vessels
Al, Table Al.2.3-1, Note 1	Tube produced by the porthole/bridge method
Al.4.2.2.1	Use of local heating and hammering for forming
Al.4.2.2.4.2	Softening for cold worked aluminium
Al.4.3.6.2	Use of backing rings in circumferential butt joints in tubing
Al.4.3.7.7	Alternative to two layers of weld metal at branches etc.

Table 1.4-2 — Items for manufacturer, purchaser and/or Inspecting Authority agreement *(continued)*

Clause	Item
Al.4.4.3.1	Details of any post weld heat treatment
Al.5.4.1	Number and detail of production control test plates
Al.5.4.4	Selection of test specimen
Al.5.5.5	Optional micro examination of production, welder and production control tests
Al.5.6.2	Acceptance standards and techniques for defects in parent materials
Al.5.6.4.1.2	Need for surface flaw examination of full penetration butt welds
Al.5.6.5.2	Alternative method for surface flaw detection
Al.5.7.3.2	Alternative acceptance levels for assessment defects
Al.5.7.4	Repair of welds
Ni.4.4.1	Heat treatment procedure for PWHT
Cu.4.2.2.3	Heat treatment after cold forming
Cu.Cu.4.3.2	Non-matching filler rod metals
Cu.4.3.6	Temporary/consumable backing strips for circumferential tube welds
Cu.4.4.1	Preheat requirements for each type of weld
Cu.Cu.5.4.1	Details of production control testing of C106 sheet
Cu.5.4.2	Details of production control testing of non-C106 alloys
Cu.5.5.4	Macro- and micro-examination of test specimen
Cu.5.6.2	Acceptance standards for defects in parent material
Cu.5.6.6.1	Alternative to radiographic techniques
Enquiry cases	Application of any specific enquiry cases

1.4.3 Responsibilities of the Inspecting Authority

The Inspecting Authority shall be responsible for verifying:

- a) that all parts of the vessel have been designed in accordance with the requirements of this specification as are applicable for the conditions specified by the purchaser according to 1.5.1;
- b) that the vessel has been constructed and tested in accordance with this specification and any additional requirements in respect of purchaser options covered in the purchase specification (see 1.4.1).

1.4.4 Certificate of Conformance

On completion of the vessel the manufacturer shall issue Form X to certify that the vessel has been designed, constructed and tested in every respect in accordance with this specification and with any additional requirements in respect of purchaser's options covered by this specification. Form X shall be countersigned by the Inspecting Authority as required.

Where some of the activities covered by this specification are performed under the surveillance of a second Inspecting Authority, each Inspecting Authority shall attach a statement to Form X, countersigned as required thereon, confirming which part of the total works has been carried out under its surveillance.

The countersigned Certificate and its attachments (if any) shall be furnished to the purchaser with a copy of the Regulating Authority if required.

Where the purchaser or his appointed design consultant/contractor elects to perform the design function for the vessel, the purchaser or his appointed design consultant/contractor shall complete the section of Form X which certifies that the design of the vessel complies with this specification.

If a vessel is subject to deviations from the requirements of this specification the vessel serial number on Form X shall have the suffix XX added (see 1.4.2).

NOTE Form X may be reproduced as hard copy or by electronic means provided that such reproductions are fair copies of the original. All copies should state "Reproduced from PD 5500" with a reference to the current issue.

Form X Certificate of Conformance*Vessel description*

Type

Approx. overall dimensions

Approved drawing number(s)

.....

.....

.....

.....

Manufacture

Year of manufacture Relevant PD 5500 edition including Amd. No(s).

Purchaser Purchaser's serial no.

Name of manufacturer

Manufacturer's serial number (see Note 1)

Name of Design Organization (if not above manufacturer)

Name of Inspecting Authority

Design

Design conditions of principal components (see Note 2 and Note 3)	Design pressure bar	Design temp. °C	Construction category	Corrosion allowance mm
.....				
.....				
.....				
.....				
.....				

Other factors affecting design (e.g. weight, nature of contents, environment)
(see Note 3 and Note 4)

.....

.....

.....

.....

.....

Post-weld heat treatment

Component	Temperature °C	Holding time h
.....		
.....		
.....		
.....		
.....		
.....		
.....		

Pressure test

Location (see Note 5)	Test pressure bar	Test medium and temperature	Date
.....			
.....			
.....			
.....			

Form X (continued)**Certificate of Conformance (design)**

We hereby certify that the design of this vessel conforms to PD 5500.

Date:

For manufacturer (see Note 6):

Position:

Name of company:

We hereby confirm that we have checked the design of the above vessel and that this conforms to PD 5500.

Date:

For Inspecting Authority:

Position:

Name of company:

Certificate of Conformance (construction and testing)

We hereby certify that this vessel has been constructed and tested in conformance with PD 5500.

Date:

For manufacturer:

Position:

Name of company:

We hereby confirm that the construction and testing of the above vessel has been carried out under our surveillance and that to the best of our knowledge and belief all aspects of this work conforms to PD 5500.

Date:

For Inspecting Authority:

Position:

Name of company:

To this certificate shall be attached, where appropriate, the records of any items that caused an XX designation along with the records of the decisions arrived at on any items from Table 1.4-2 that were subject to agreement.

NOTE 1 The suffix "XX" is to be added to the serial number of each vessel for which any deviations or concessions have been authorized (see 1.4.2 and 1.4.4).

NOTE 2 The design conditions associated with the operational duties specified by the purchaser should be given.

If a purchaser wishes to change the operational duty of a vessel, revised design conditions, consistent with the vessel scantlings, will be established separately, as appropriate.

NOTE 3 Where the design covers operation below 0 °C the various combinations of temperature, pressure and calculated membrane stresses considered in determining the minimum design temperature (see 3.2.5 and Annex D) should be stated.

NOTE 4 Where appropriate, cross reference to drawings or specifications will suffice.

NOTE 5 Where a vessel is tested in a different orientation to that in which it will normally operate, this should be stated.

NOTE 6 This part of the Certificate is to be signed by the purchaser in cases where the purchaser elects to perform the design function (see 1.4.4).

1.5 Information and requirements to be agreed and to be documented

1.5.1 Information to be supplied by the purchaser

The following information shall be supplied by the purchaser and shall be fully documented.

- a) The normal working conditions of the required vessel, together with details of any transient cyclic and/or adverse conditions in which the vessel is required to operate and any special requirements for in-service inspection.
- b) Any requirements relating to the various options covered by the purchase specification (see 1.4.1).
- c) Any special statutory or other regulations with which the finished vessel is required to comply.
- d) The name of the Inspecting Authority to be commissioned by the purchaser.
- e) The name of the Regulating Authority (if any).
- f) The requirement to obtain copies for record purposes of any documents other than those listed in 1.5.2.2a) to 1.5.2.2g). (To facilitate the identification of such documents, a check list of optional documents is given in Annex S.)

Where the purchaser elects to perform the design function for the vessel, the purchaser shall supply any additional design information required by the manufacturer in accordance with 1.4.2. The design dossier maintained by the purchaser in accordance with 1.4.1 shall cover all the information (whether supplied by the purchaser or by the manufacturer) which the manufacturer would otherwise be required by 4.1.1 to submit before commencing manufacture.

The fulfilment of specified requirements and the availability of documentation/records identified shall both be satisfied before a claim of conformance with the specification can be made and verified.

1.5.2 Information to be supplied by the manufacturer

The information in 1.5.2.1 and 1.5.2.2 shall be supplied by the manufacturer and shall be fully documented.

The fulfilment of specified requirements and the availability of documentation/records identified shall both be satisfied before a claim of conformance with the specification can be made and verified.

1.5.2.1 *Before commencement of manufacture*

The manufacturer shall submit the information specified in 4.1.1 for approval before commencement of manufacture. In submitting this information, the manufacturer shall identify, in an appropriate manner, any features of the proposed design and/or in the proposed manufacturing, inspection or test procedures which by the terms of this specification require to be approved by the purchaser.

NOTE Table 1.4-2 lists such features. The features should be identified in an appropriate document such as purchase order, approved drawing or an approved working procedure (e.g. weld preparation procedure, heat treatment procedure, welding procedure etc.).

1.5.2.2 *On completion of construction*

The manufacturer shall supply to the purchaser for record purposes a copy of the following documentation, as finally approved, for each vessel or batch of vessels.

- a) A fully dimensioned drawing of the vessel, as built, together with any relevant supporting information as specified in 4.1.1 and which is not covered by items b) to g) as follows.
- b) A list of materials (including welding consumables) used in the construction of the vessel with details of any special heat treatments carried out by the material supplier.

NOTE 1 For materials specified to a British Standard the date of the standard is to be given. Where other materials are used [see 2.1.2.1b)] the full specification is to be supplied.

- c) Factors effecting the equipment operation or design life – safe operating limits and design basis (which may be on the drawings).

- d) Factors effecting the design life i.e.
- 1) Creep — design hours of operation at specified temperature.
 - 2) Fatigue — design number of cycles at specified stress levels.
 - 3) Corrosion — design corrosion allowance.
 - 4) Residual hazards not prevented by design or protective measures that might arise from foreseeable misuse.
 - 5) Information about replaceable parts (liners, wear plates etc.).
- e) The welding procedures used during vessel manufacture (see **5.2.2**).
- f) The procedures used for radiography, ultrasonic inspection and/or crack detection of welds (see **5.6.6.1**, **5.6.6.2**, **5.6.6.3** and **5.6.6.4**).
- g) Records detailing all deviations from this specification and the decision made on all matters subject to agreement (see **1.4.2**).
- h) A Certificate of Conformance (Form X) for each vessel (see **1.4.4**).
- i) A facsimile of the vessel nameplate (see **5.8.9**).
- j) Details of any statutory required marking (e.g. CE marking).
- k) Operating instructions for mounting, putting into service its use and maintenance (as far as is relevant).

NOTE 2 The duration for which a manufacturer will retain all records produced during the manufacture of a vessel is influenced by a number of factors which are outside the scope of this specification.

1.6 Thicknesses

Thicknesses are referred to in several ways in this specification in accordance with the following definitions.

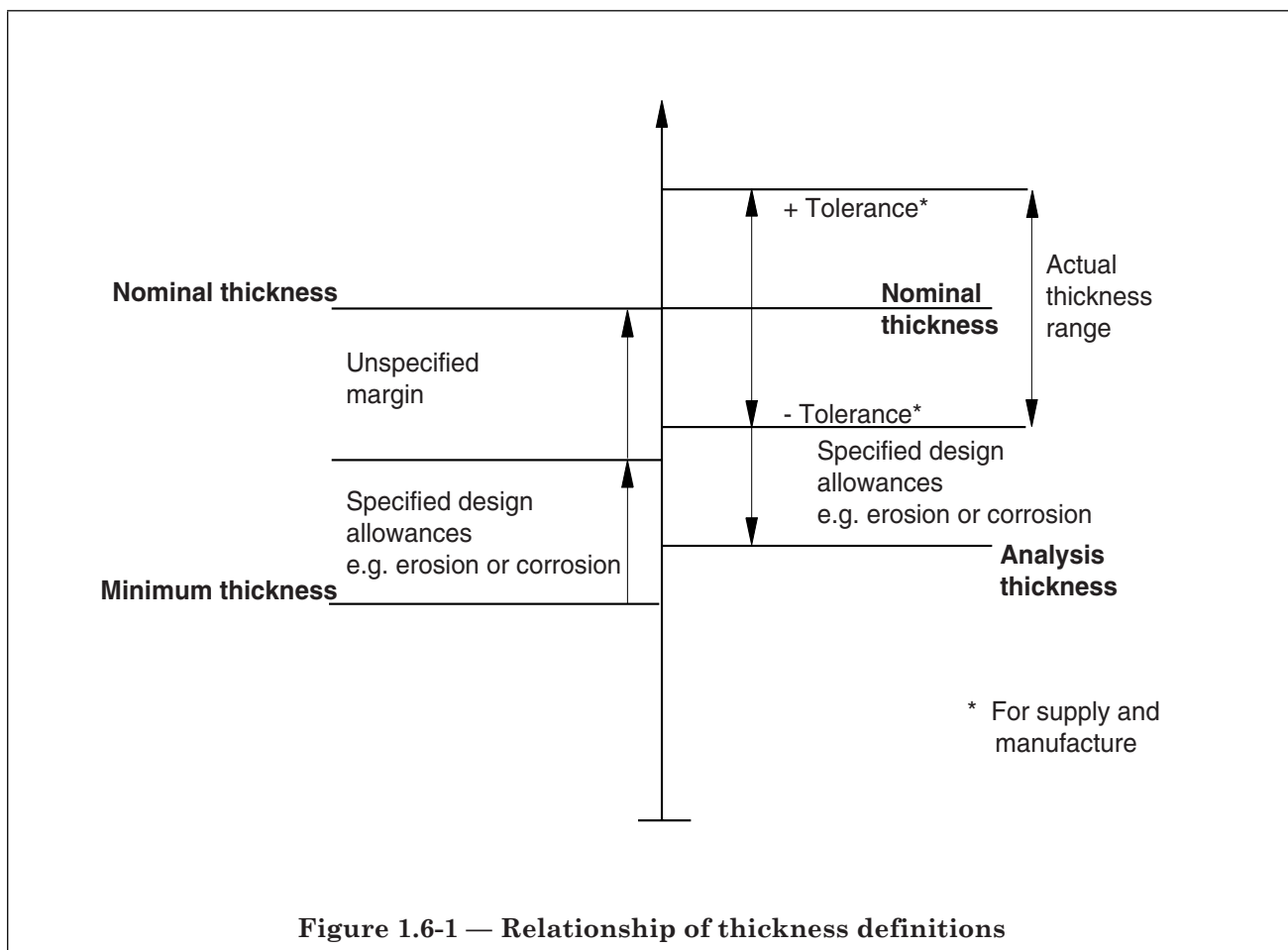
- a) Minimum thickness; the thickness calculated in Section 3 and some design annexes, to satisfy the relevant design requirement.
- b) Nominal thickness; the thickness as specified on the construction drawing which includes all allowances and tolerances.
- c) Analysis thickness; the thickness used in design calculations and assessments, which equals the nominal thickness less corrosion allowances and less any other allowances and tolerances.

The nominal thickness, less any negative tolerance permitted by the specification to which the material is ordered, shall not be less than the minimum thickness plus any allowances specified for corrosion, erosion etc.

The relationships between the defined thicknesses are shown in Figure 1.6-1. This figure indicates:

- a) on the left hand side, that the thickness calculated from the rules is increased by the amount of the specified allowances (for effects such as corrosion) and possibly by an unspecified margin (in consideration, for example, of materials availability);
- b) on the right hand side, that the nominal thickness should be reduced by any negative supply (i.e. negative plate thickness) tolerance and any manufacturing (i.e. dishing) allowances as well as by the specified design allowances, to arrive at the analysis thickness.

NOTE Following the replacement of BS 1501 by BS EN 10028, it should be noted that plate conforming to this latter specification is normally supplied in accordance with BS EN 10029 class B which permits a negative tolerance of 0.3 mm for all nominal thicknesses. However, the purchaser may specify a zero negative tolerance.



Section 2. Materials

2.1 Selection of materials

2.1.1 General

2.1.1.1 The selection of the materials of construction for pressure containing parts and their integral attachments shall take into account the suitability of the material with regard to fabrication¹⁾ and to the conditions under which they will eventually operate.

2.1.1.2 Any special limits for the materials of construction, e.g. composition, heat treatment and non-destructive testing (NDT), which are different to those given in this specification shall be specified in the purchase specification.

2.1.1.3 For the ease of reference throughout this specification, materials, with the exception of the following:

- clad material;
- duplex austenitic-ferritic stainless steel;

are identified by a group number which has been derived from PD CR ISO 15608:2000. This grouping is summarized in Table 2.1-1.

2.1.2 Materials for pressure parts

2.1.2.1 General

All the materials used in the manufacture of pressure parts shall:

- a) conform to BS EN steels given in Table 2.1-2; or
- b) conform to BS steels given in Table K.1-2 to Table K.1-12; or
- c) be agreed between purchaser, Inspecting Authority and manufacturer, be documented [see **1.5.2.2b**] and shall conform to **2.1.2.2**; or
- d) be the subject of a “European approval for material” in accordance with the EU directive 97/23/EC; or
- e) be detailed in supplements, annexes or enquiry cases to this specification.

Welding material shall conform to Section 4 and Section 5.

The option to be able to use castings for pressure parts shall be specified in the purchase specification. An appropriate “quality specification” for such castings shall be agreed between the manufacturer and material supplier at the time of enquiry, specifying the standards of inspection to be applied and of acceptance for defects. As a minimum, all accessible fillets and changes of section, etc., shall be subject to magnetic particle or penetrant inspection.

Materials for bolts and nuts shall conform to the specifications listed in Table 3.8-1 or Table 3.8-1. Requirements for bolting materials for low temperature application are referred to in **2.2.2**.

NOTE For equipment that is subject to the Pressure Equipment Directive PED 97/23/EC, requirements for the selection of bolting are given in BS EN 1515-4. 

2.1.2.2 Materials covered by 2.1.2.1c)

2.1.2.2.1 General

The material shall be covered by a written specification at least as comprehensive as the nearest equivalent British Standard listed in Table 2.1-2. The written specification shall as a minimum specify the manufacturing process, compositional limits for all constituents, deoxidation practice, heat treatment and appropriate mechanical properties for acceptance and other purposes.

An equivalent grouping for the material (see **2.1.1.3**) shall be chosen and agreed between manufacturer, inspection authority and purchaser. This grouping shall be used to assist in the selection of manufacturing and inspection requirements of Section 4 and Section 5.

¹⁾ See BS EN 1011 for general guidance on the susceptibility of materials to lamellar tearing during fabrication.

Table 2.1-1 — Material grouping

Sub-group	Type of steel
Group 1	
—	Steels with a specified minimum yield strength $R_{eH} \leq 460 \text{ N/mm}^2$ ^a and with analysis in %: $C \leq 0.25$ $Si \leq 0.60$ $Mn \leq 1.70$ $Mo \leq 0.70$ ^b $S \leq 0.045$ $P \leq 0.045$ $Cu \leq 0.40$ ^b $Ni \leq 0.5$ ^b $Cr \leq 0.3$ (0.4 for castings) ^b $Nb \leq 0.05$ $V \leq 0.12$ ^b $Ti \leq 0.05$
1.1	Steels with a specified minimum yield strength $R_{eH} \leq 275 \text{ N/mm}^2$
1.2	Steels with a specified minimum yield strength $275 \text{ N/mm}^2 < R_{eH} \leq 360 \text{ N/mm}^2$
1.3	Normalized fine grain steels with a specified minimum yield strength $R_{eH} > 360 \text{ N/mm}^2$
1.4	Steels with improved atmospheric corrosion resistance whose analysis may exceed the requirements for the single elements as indicated in Group 1
Group 2	
—	Thermomechanically treated fine grain steels and cast steels with a specified minimum yield strength $R_{eH} > 360 \text{ N/mm}^2$
2.1	Thermomechanically treated fine grain steels and cast steels with a specified minimum yield strength $360 \text{ N/mm}^2 < R_{eH} \leq 460 \text{ N/mm}^2$
2.2	Thermomechanically treated fine grain steels and cast steels with a specified minimum yield strength $R_{eH} > 460 \text{ N/mm}^2$
Group 3	
—	Quenched and tempered steels and precipitation hardened steels, except stainless steels, with a specified minimum yield strength $R_{eH} > 360 \text{ N/mm}^2$
3.1	Quenched and tempered steels with a specified minimum yield strength $360 \text{ N/mm}^2 < R_{eH} \leq 690 \text{ N/mm}^2$
3.2	Quenched and tempered steels with a specified minimum yield strength $R_{eH} > 690 \text{ N/mm}^2$
3.3	Precipitation hardened steels except stainless steels
Group 4	
—	Low vanadium alloyed Cr-Mo-(Ni) steels with $Mo \leq 0.7 \%$ and $V \leq 0.1 \%$
4.1	Steels with $Cr \leq 0.3 \%$ and $Ni \leq 0.7 \%$
4.2	Steels with $Cr \leq 0.7 \%$ and $Ni \leq 1.5 \%$
Group 5	
—	Cr-Mo steels free of vanadium with $C \leq 0.35 \%$ ^c
5.1	Steels with $0.75 \% \leq Cr \leq 1.5 \%$ and $Mo \leq 0.7 \%$
5.2	Steels with $1.5 \% < Cr \leq 3.5 \%$ and $0.7 \% < Mo \leq 1.2 \%$
5.3	Steels with $3.5 \% < Cr \leq 7.0 \%$ and $0.4 \% < Mo \leq 0.7 \%$
5.4	Steels with $7.0 \% < Cr \leq 10.0 \%$ and $0.7 \% < Mo \leq 1.2 \%$
^a In accordance with the specification of the steel product standards, R_{eH} may be replaced by $R_{p0.2}$ or $R_{t0.5}$. ^b A higher value is accepted provided that $Cr + Mo + Ni + Cu + V \leq 0.75 \%$. ^c "Free of vanadium" means not deliberately added to the material.	

Table 2.1-1 — Material grouping (*continued*)

Sub-group	Type of steel
Group 6	
—	High vanadium alloyed Cr-Mo-(Ni) steels
6.1	Steels with $0.3 \% \leq \text{Cr} \leq 0.75 \%$, $\text{Mo} \leq 0.7 \%$ and $\text{V} \leq 0.35 \%$
6.2	Steels with $0.75 \% < \text{Cr} \leq 3.5 \%$, $0.7 \% < \text{Mo} \leq 1.2 \%$ and $\text{V} \leq 0.35 \%$
6.3	Steels with $3.5 \% < \text{Cr} \leq 7.0 \%$, $\text{Mo} \leq 0.7 \%$ and $0.45 \% \leq \text{V} \leq 0.55 \%$
6.4	Steels with $7.0 \% < \text{Cr} \leq 12.5 \%$, $0.7 \% < \text{Mo} \leq 1.2 \%$ and $\text{V} \leq 0.35 \%$
Group 7	
—	Ferritic, martensitic or precipitation hardened stainless steels with $\text{C} \leq 0.35 \%$ and $10.5 \% \leq \text{Cr} \leq 30 \%$
7.1	Ferritic stainless steels
7.2	Martensitic stainless steels
7.3	Precipitation hardened stainless steels
Group 8	
—	Austenitic stainless steels
8.1	Austenitic stainless steels with $\text{Cr} \leq 19 \%$
8.2	Austenitic stainless steels with $\text{Cr} > 19 \%$
8.3	Manganese austenitic stainless steels with $4.0 \% < \text{Mn} \leq 12.0 \%$
Group 9	
—	Nickel alloy steels with $\text{Ni} \leq 10.0 \%$
9.1	Nickel alloy steels with $\text{Ni} \leq 3.0 \%$
9.2	Nickel alloy steels with $3.0 \% < \text{Ni} \leq 8.0 \%$
9.3	Nickel alloy steels with $8.0 \% < \text{Ni} \leq 10.0 \%$
Group 10	
—	Austenitic ferritic stainless steels (duplex)
10.1	Austenitic ferritic stainless steels with $\text{Cr} \leq 24.0 \%$
10.2	Austenitic ferritic stainless steels with $\text{Cr} > 24.0 \%$
Group 11	
—	Steels covered by group 1 ^d except $0.25 \% < \text{C} \leq 0.5 \%$
11.1	Steels as indicated under 11 with $0.25 \% < \text{C} \leq 0.35 \%$
11.2	Steels as indicated under 11 with $0.35 \% < \text{C} \leq 0.5 \%$
^d A higher value is accepted provided that $\text{Cr} + \text{Mo} + \text{Ni} + \text{Cu} + \text{V} \leq 1 \%$.	

Table 2.1-2 — List of materials covered by BS EN material standards

1 No.	2 Product form	3 EN standard	4 Material description	5 Grade	6 Material number	7 Heat treatment ^a	8 Thickness mm		9 Material group to PD CR ISO 15608:2000	10 Notes
							min.	max.		
1	Plate and strip	BS EN 10028-2	Elevated temperature properties	P235GH	1.0345	N	0	150	1.1	a)
2	Plate and strip	BS EN 10028-2	Elevated temperature properties	P265GH	1.0425	N	0	150	1.1	a)
3	Plate and strip	BS EN 10028-2	Elevated temperature properties	P295GH	1.0481	N	0	150	1.2	a)
4	Plate and strip	BS EN 10028-2	Elevated temperature properties	P355GH	1.0473	N	0	150	1.2	a)
5	Plate and strip	BS EN 10028-2	Elevated temperature properties	16Mo3	1.5415	N	0	150	1.1	a) f)
6	Plate and strip	BS EN 10028-2	Elevated temperature properties	13CrMo4-5	1.7335	NT	0	60	5.1	a)
7	Plate and strip	BS EN 10028-2	Elevated temperature properties	13CrMo4-5	1.7335	NT QT	60	100	5.1	a)
8	Plate and strip	BS EN 10028-2	Elevated temperature properties	13CrMo4-5	1.7335	QT	100	150	5.1	a)
9	Plate and strip	BS EN 10028-2	Elevated temperature properties	10CrMo9-10	1.7380	NT	0	60	5.2	a)
10	Plate and strip	BS EN 10028-2	Elevated temperature properties	10CrMo9-10	1.7380	NT QT	60	100	5.2	a)
11	Plate and strip	BS EN 10028-2	Elevated temperature properties	10CrMo9-10	1.7380	QT	100	150	5.2	a)
12	Plate and strip	BS EN 10028-2	Elevated temperature properties	11CrMo9-10	1.7383	NT QT	0	60	5.2	a)
13	Plate and strip	BS EN 10028-2	Elevated temperature properties	11CrMo9-10	1.7383	QT	60	100	5.2	a)
14	Plate and strip	BS EN 10028-3	Fine grain steel normalized	P275N	1.0486	N	0	150	1.1	a)
15	Plate and strip	BS EN 10028-3	Fine grain steel normalized	P275NH	1.0487	N	0	150	1.1	a)
16	Plate and strip	BS EN 10028-3	Fine grain steel normalized	P275NL1	1.0488	N	0	150	1.1	a)
17	Plate and strip	BS EN 10028-3	Fine grain steel normalized	P275NL2	1.1104	N	0	150	1.1	a)
18	Plate and strip	BS EN 10028-3	Fine grain steel normalized	P355N	1.0562	N	0	150	1.2	a)
19	Plate and strip	BS EN 10028-3	Fine grain steel normalized	P355NH	1.0565	N	0	150	1.2	a)
20	Plate and strip	BS EN 10028-3	Fine grain steel normalized	P355NL1	1.0566	N	0	150	1.2	a)
21	Plate and strip	BS EN 10028-3	Fine grain steel normalized	P355NL2	1.1106	N	0	150	1.2	a)
22	Plate and strip	BS EN 10028-4	Low temperature properties	11MnNi5-3	1.6212	N NT	0	50	9.1	a)
23	Plate and strip	BS EN 10028-4	Low temperature properties	13MnNi6-3	1.6217	N NT	0	50	9.1	a)
24	Plate and strip	BS EN 10028-4	Low temperature properties	15NiMn6	1.6228	N NT QT	0	50	9.1	a)
25	Plate and strip	BS EN 10028-4	Low temperature properties	12Ni14	1.5637	N NT QT	0	50	9.2	a)
26	Plate and strip	BS EN 10028-4	Low temperature properties	12Ni19	1.5680	N NT QT	0	50	9.2	a)
27	Plate and strip	BS EN 10028-4	Low temperature properties	X8Ni9	1.5662	N NT QT	0	50	9.3	a)
28	Plate and strip	BS EN 10028-4	Low temperature properties	X7Ni9	1.5663	QT	0	50	9.3	a)
29	Plate and strip	BS EN 10028-6	Fine grain steel, quenched/tempered	P355Q	1.8866	QT	0	150	1.2	a)
30	Plate and strip	BS EN 10028-6	Fine grain steel, quenched/tempered	P355QH	1.8867	QT	0	150	1.2	a)
31	Plate and strip	BS EN 10028-6	Fine grain steel, quenched/tempered	P355QL1	1.8868	QT	0	150	1.2	a)

Table 2.1-2 — List of materials covered by BS EN material standards (continued)

1 No.	2 Product form	3 EN standard	4 Material description	5 Grade	6 Material number	7 Heat treatment ^a	8 Thickness mm		9 Material group to PD CR ISO 15608:2000	10 Notes
							min.	max.		
32	Plate and strip	BS EN 10028-6	Fine grain steel, quenched/tempered	P355QL2	1.8869	QT	0	150	1.2	a)
33	Plate and strip	BS EN 10028-7	Stainless steel, austenitic	X2CrNiN18-7	1.4318	AT	0	75	8.1	a)
34	Plate and strip	BS EN 10028-7	Stainless steel, austenitic	X2CrNi18-9	1.4307	AT	0	75	8.1	a)
35	Plate and strip	BS EN 10028-7	Stainless steel, austenitic	X2CrNi19-11	1.4306	AT	0	75	8.1	a)
36	Plate and strip	BS EN 10028-7	Stainless steel, austenitic	X2CrNiN18-10	1.4311	AT	0	75	8.1	a)
37	Plate and strip	BS EN 10028-7	Stainless steel, austenitic	X5CrNi18-10	1.4301	AT	0	75	8.1	a)
38	Plate and strip	BS EN 10028-7	Stainless steel, austenitic	X5CrNiN19-9	1.4315	AT	0	75	8.1	a)
39	Plate and strip	BS EN 10028-7	Stainless steel, austenitic	X6CrNi18-10	1.4948	AT	0	75	8.1	a)
40	Plate and strip	BS EN 10028-7	Stainless steel, austenitic	X6CrNi23-13	1.4950	AT	0	75	8.2	a)
41	Plate and strip	BS EN 10028-7	Stainless steel, austenitic	X6CrNi25-20	1.4951	AT	0	75	8.2	a)
42	Plate and strip	BS EN 10028-7	Stainless steel, austenitic	X6CrNiTi18-10	1.4541	AT	0	75	8.1	a)
43	Plate and strip	BS EN 10028-7	Stainless steel, austenitic	X6CrNiTiB18-10	1.4941	AT	0	75	8.1	a)
44	Plate and strip	BS EN 10028-7	Stainless steel, austenitic	X2CrNiMo17-12-2	1.4404	AT	0	75	8.1	a)
45	Plate and strip	BS EN 10028-7	Stainless steel, austenitic	X2CrNiMoN17-11-2	1.4406	AT	0	75	8.1	a)
46	Plate and strip	BS EN 10028-7	Stainless steel, austenitic	X5CrNiMo17-12-2	1.4401	AT	0	75	8.1	a)
47	Plate and strip	BS EN 10028-7	Stainless steel, austenitic	X6CrNiMoTi17-12-2	1.4571	AT	0	75	8.1	a)
48	Plate and strip	BS EN 10028-7	Stainless steel, austenitic	X2CrNiMo17-12-3	1.4432	AT	0	75	8.1	a)
49	Plate and strip	BS EN 10028-7	Stainless steel, austenitic	X2CrNiMo18-14-3	1.4435	AT	0	75	8.1	a)
50	Plate and strip	BS EN 10028-7	Stainless steel, austenitic	X2CrNiMoN17-13-5	1.4439	AT	0	75	8.1	a)
51	Plate and strip	BS EN 10028-7	Stainless steel, austenitic	X1NiCrMoCu25-20-5	1.4539	AT	0	75	8.2	a)
52	Plate and strip	BS EN 10028-7	Stainless steel, austenitic	X5NiCrAlTi31-20	1.4958	AT	0	75	8.2	a)
53	Plate and strip	BS EN 10028-7	Stainless steel, austenitic	X5NiCrAlTi31-20 + RA	1.4958 + RA	RA	0	75	8.2	a)
54	Plate and strip	BS EN 10028-7	Stainless steel, austenitic	X8NiCrAlTi32-21	1.4959	AT	0	75	8.2	a)
55	Plate and strip	BS EN 10028-7	Stainless steel, austenitic	X3CrNiMoBN17-13-3	1.4910	AT	0	75	8.1	a)
56	Plate and strip	BS EN 10028-7	Stainless steel, austenitic, special	X1CrNi25-21	1.4335	AT	0	75	8.2	a)
57	Plate and strip	BS EN 10028-7	Stainless steel, austenitic, special	X6CrNiNb18-10	1.4550	AT	0	75	8.1	a)
58	Plate and strip	BS EN 10028-7	Stainless steel, austenitic, special	X8CrNiNb16-13	1.4961	AT	0	75	8.1	a)
59	Plate and strip	BS EN 10028-7	Stainless steel, austenitic, special	X1CrNiMoN25-22-2	1.4466	AT	0	75	8.2	a)
60	Plate and strip	BS EN 10028-7	Stainless steel, austenitic, special	X6CrNiMoNb17-12-2	1.4580	AT	0	75	8.1	a)
61	Plate and strip	BS EN 10028-7	Stainless steel, austenitic, special	X2CrNiMoN17-13-3	1.4429	AT	0	75	8.1	a)
62	Plate and strip	BS EN 10028-7	Stainless steel, austenitic, special	X3CrNiMoN17-13-3	1.4436	AT	0	75	8.1	a)

Table 2.1-2 — List of materials covered by BS EN material standards (continued)

1 No.	2 Product form	3 EN standard	4 Material description	5 Grade	6 Material number	7 Heat treatment ^a	8 Thickness mm		9 Material group to PD CR ISO 15608:2000	10 Notes
							min.	max.		
63	Plate and strip	BS EN 10028-7	Stainless steel, austenitic, special	X2CrNiMoN18-12-4	1.4434	AT	0	75	8.1	a)
64	Plate and strip	BS EN 10028-7	Stainless steel, austenitic, special	X2CrNiMo18-15-4	1.4438	AT	0	75	8.1	a)
65	Plate and strip	BS EN 10028-7	Stainless steel, austenitic, special	X1NiCrMoCu31-27-4	1.4563	AT	0	75	8.2	a)
66	Plate and strip	BS EN 10028-7	Stainless steel, austenitic, special	X1CrNiMoCuN25-25-5	1.4537	AT	0	75	8.2	a)
67	Plate and strip	BS EN 10028-7	Stainless steel, austenitic, special	X1CrNiMoCuN20-18-7	1.4547	AT	0	75	8.2	a)
68	Plate and strip	BS EN 10028-7	Stainless steel, austenitic, special	X1NiCrMoCuN25-20-7	1.4529	AT	0	75	8.2	a)
69	Bar	BS EN 10272	Stainless steel, austenitic	X2CrNi18-9	1.4307	AT	0	250	8.1	a)
70	Bar	BS EN 10272	Stainless steel, austenitic	X2CrNi19-11	1.4306	AT	0	250	8.1	a)
71	Bar	BS EN 10272	Stainless steel, austenitic	X2CrNi18-10	1.4311	AT	0	250	8.1	a)
72	Bar	BS EN 10272	Stainless steel, austenitic	X5CrNi18-10	1.4301	AT	0	250	8.1	a)
73	Bar	BS EN 10272	Stainless steel, austenitic	X6CrNiTi18-10	1.4541	AT	0	250	8.1	a)
74	Bar	BS EN 10272	Stainless steel, austenitic	X2CrNiMo17-12-2	1.4404	AT	0	250	8.1	a)
75	Bar	BS EN 10272	Stainless steel, austenitic	X2CrNiMoN17-11-2	1.4406	AT	0	250	8.1	a)
76	Bar	BS EN 10272	Stainless steel, austenitic	X5CrNiMo17-12-2	1.4401	AT	0	250	8.1	a)
77	Bar	BS EN 10272	Stainless steel, austenitic	X6CrNiMoTi17-12-2	1.4571	AT	0	250	8.1	a)
78	Bar	BS EN 10272	Stainless steel, austenitic	X2CrNiMo17-12-3	1.4432	AT	0	250	8.1	a)
79	Bar	BS EN 10272	Stainless steel, austenitic	X2CrNiMo18-14-3	1.4435	AT	0	250	8.1	a)
80	Bar	BS EN 10272	Stainless steel, austenitic	X2CrNiMo17-13-5	1.4439	AT	0	250	8.1	a)
81	Bar	BS EN 10272	Stainless steel, austenitic	X1NiCrMoCu25-20-5	1.4539	AT	0	250	8.2	a)
82	Bar	BS EN 10272	Stainless steel, austenitic	X6CrNiNb18-10	1.4550	AT	0	250	8.1	a)
83	Bar	BS EN 10272	Stainless steel, austenitic	X6CrNiMoNb17-12-2	1.4580	AT	0	250	8.1	a)
84	Bar	BS EN 10272	Stainless steel, austenitic	X2CrNiMoN17-13-3	1.4429	AT	0	250	8.1	a)
85	Bar	BS EN 10272	Stainless steel, austenitic	X3CrNiMo17-13-3	1.4436	AT	0	250	8.1	a)
86	Bar	BS EN 10272	Stainless steel, austenitic	X1NiCrMoCu31-27-4	1.4563	AT	0	250	8.2	a)
87	Bar	BS EN 10272	Stainless steel, austenitic	X1CrNiMoCuN20-18-7	1.4547	AT	0	250	8.2	a)
88	Bar	BS EN 10272	Stainless steel, austenitic	X1NiCrMoCuN25-20-7	1.4529	AT	0	250	8.2	a)
89	Bar	BS EN 10273	Elevated temperature properties	P235GH	1.0345	N	0	150	1.1	a)
90	Bar	BS EN 10273	Elevated temperature properties	P250GH	1.0460	N	0	150	1.1	a)
91	Bar	BS EN 10273	Elevated temperature properties	P265GH	1.0425	N	0	150	1.1	a)
92	Bar	BS EN 10273	Elevated temperature properties	P295GH	1.0481	N	0	150	1.2	a)
93	Bar	BS EN 10273	Elevated temperature properties	P355GH	1.0473	N	0	150	1.2	a)

Table 2.1-2 — List of materials covered by BS EN material standards (continued)

1 No.	2 Product form	3 EN standard	4 Material description	5 Grade	6 Material number	7 Heat treatment ^a	8 Thickness mm		9 Material group to PD CR ISO 15608:2000	10 Notes
							min.	max.		
94	Bar	BS EN 10273	Elevated temperature properties	P275NH	1.0487	N	0	150	1.1	a)
95	Bar	BS EN 10273	Elevated temperature properties	P355NH	1.0565	N	0	150	1.2	a)
96	Bar	BS EN 10273	Elevated temperature properties	P355QH	1.8867	QT	0	150	1.2	a)
97	Bar	BS EN 10273	Elevated temperature properties	16Mo3	1.5415	N	0	150	1.1	a) f)
98	Bar	BS EN 10273	Elevated temperature properties	13CrMo4-5	1.7335	NT QT	60	100	5.1	a)
99	Bar	BS EN 10273	Elevated temperature properties	13CrMo4-5	1.7335	QT	100	150	5.1	a)
100	Bar	BS EN 10273	Elevated temperature properties	10CrMo9-10	1.7380	NT	0	60	5.2	a)
101	Bar	BS EN 10273	Elevated temperature properties	10CrMo9-10	1.7380	NT QT	60	150	5.2	a)
102	Bar	BS EN 10273	Elevated temperature properties	11CrMo9-10	1.7383	NT QT	0	60	5.2	a)
103	Bar	BS EN 10273	Elevated temperature properties	11CrMo9-10	1.7383	QT	60	100	5.2	a)
104	Seamless tube	BS EN 10216-1	Room temperature properties	P195TR2	1.0255	N	0	60	1.1	a)
105	Seamless tube	BS EN 10216-1	Room temperature properties	P235TR2	1.0258	N	0	60	1.1	a)
106	Seamless tube	BS EN 10216-1	Room temperature properties	P265TR2	1.0259	N	0	60	1.1	a)
107	Seamless tube	BS EN 10216-2	Elevated temperature properties	P195GH	1.0348	N	0	16	1.1	a)
108	Seamless tube	BS EN 10216-2	Elevated temperature properties	P235GH	1.0345	N	0	60	1.1	a)
109	Seamless tube	BS EN 10216-2	Elevated temperature properties	P265GH	1.0425	N	0	60	1.1	a)
110	Seamless tube	BS EN 10216-2	Elevated temperature properties	20MnNb6	1.0471	N	0	60	1.2	a)
111	Seamless tube	BS EN 10216-2	Elevated temperature properties	16Mo3	1.5415	N	0	60	1.2	a) f)
112	Seamless tube	BS EN 10216-2	Elevated temperature properties	8MoB5-4	1.5450	N	0	16	1.3	a)
113	Seamless tube	BS EN 10216-2	Elevated temperature properties	14MoV6-3	1.7715	NT QT c)	0	60	6.1	a)
114	Seamless tube	BS EN 10216-2	Elevated temperature properties	10CrMo5-5	1.7338	NT QT c)	0	60	5.1	a)
115	Seamless tube	BS EN 10216-2	Elevated temperature properties	13CrMo4-5	1.7335	NT QT c)	0	60	5.1	a)
116	Seamless tube	BS EN 10216-2	Elevated temperature properties	10CrMo9-10	1.7380	NT QT c)	0	60	5.2	a)
117	Seamless tube	BS EN 10216-2	Elevated temperature properties	11CrMo9-10	1.7383	QT	0	60	5.2	a)
118	Seamless tube	BS EN 10216-2	Elevated temperature properties	25CrMo4	1.7218	QT	0	60	5.1	a) b)
119	Seamless tube	BS EN 10216-2	Elevated temperature properties	20CrMoV13-5-5	1.7779	QT	0	60	6.3	a)
20	Seamless tube	BS EN 10216-2	Elevated temperature properties	15NiCuMoNb5-6-4	1.6368	NT QT c)	0	80	4.2	a)
21	Seamless tube	BS EN 10216-2	Elevated temperature properties	X11CrMo5 + I	1.7362 + I	I	0	100	5.3	a)
22	Seamless tube	BS EN 10216-2	Elevated temperature properties	X11CrMo5 + NT1	1.7362 + NT1	NT	0	100	5.3	a)
23	Seamless tube	BS EN 10216-2	Elevated temperature properties	X11CrMo5 + NT2	1.7362 + NT2	NT QT c)	0	100	5.3	a)
24	Seamless tube	BS EN 10216-2	Elevated temperature properties	X11CrMo9-1 + I	1.7386 + I	I	0	60	5.4	a)

Table 2.1-2 — List of materials covered by BS EN material standards (continued)

1 No.	2 Product form	3 EN standard	4 Material description	5 Grade	6 Material number	7 Heat treatment ^a	8 Thickness mm		9 Material group to PD CR ISO 15603:2000	10 Notes
							min.	max.		
125	Seamless tube	BS EN 10216-2	Elevated temperature properties	X11CrMo9-1 + NT	1.7386 + NT	NT QT c)	0	60	5.4	a)
126	Seamless tube	BS EN 10216-2	Elevated temperature properties	X10CrMoVNb9-1	1.4903	NT QT c)	0	100	6.4	a)
127	Seamless tube	BS EN 10216-2	Elevated temperature properties	X20CrMoV11-1	1.4922	NT QT c)	0	100	6.4	a)
128	Seamless tube	BS EN 10216-3	Fine grain steel	P275NL1	1.0488	N	0	100	1.1	a)
129	Seamless tube	BS EN 10216-3	Fine grain steel	P275NL2	1.1104	N	0	100	1.1	a)
130	Seamless tube	BS EN 10216-3	Fine grain steel	P355N	1.0562	N	0	100	1.2	a)
131	Seamless tube	BS EN 10216-3	Fine grain steel	P355NH	1.0565	N	0	100	1.2	a)
132	Seamless tube	BS EN 10216-3	Fine grain steel	P355NL1	1.0566	N	0	100	1.2	a)
133	Seamless tube	BS EN 10216-3	Fine grain steel	P355NL2	1.1106	N	0	100	1.2	a)
134	Seamless tube	BS EN 10216-3	Fine grain steel	P460NH	1.8935	N c)	0	100	1.3	a)
135	Seamless tube	BS EN 10216-3	Fine grain steel	P460NL2	1.8918	N c)	0	100	1.1	a)
136	Seamless tube	BS EN 10216-4	Low temperature properties	P215NL	1.0451	N	0	10	1.1	a)
137	Seamless tube	BS EN 10216-4	Low temperature properties	P255QL	1.0452	QT	0	40	1.1	a) f)
138	Seamless tube	BS EN 10216-4	Low temperature properties	P265NL	1.0453	N	0	25	1.1	a)
139	Seamless tube	BS EN 10216-4	Low temperature properties	26CrMo4-2	1.7219	QT	0	40	5.1	a) b)
140	Seamless tube	BS EN 10216-4	Low temperature properties	11MnNi5-3	1.6212	N NT c)	0	40	9.1	a)
141	Seamless tube	BS EN 10216-4	Low temperature properties	13MnNi6-3	1.6217	N NT c)	0	40	9.1	a)
142	Seamless tube	BS EN 10216-4	Low temperature properties	12Ni14	1.5637	NT	0	40	9.2	a)
143	Seamless tube	BS EN 10216-4	Low temperature properties	12Ni14 + QT	1.5637	QT	0	40	9.2	a)
144	Seamless tube	BS EN 10216-4	Low temperature properties	X12Ni5	1.5680	N	0	40	9.2	a)
145	Seamless tube	BS EN 10216-4	Low temperature properties	X12Ni5 + QT	1.5680	QT	0	40	9.2	a)
146	Seamless tube	BS EN 10216-4	Low temperature properties	X10Ni9	1.5682	N NT	0	40	9.3	a)
147	Seamless tube	BS EN 10216-4	Low temperature properties	X10Ni9 + QT	1.5682	QT	0	40	9.3	a)
148	Seamless tube	BS EN 10216-5	Stainless steel, austenitic	X2CrNi18-9	1.4307	AT	0	60	8.1	a)
149	Seamless tube	BS EN 10216-5	Stainless steel, austenitic	X2CrNi19-11	1.4306	AT	0	60	8.1	a)
150	Seamless tube	BS EN 10216-5	Stainless steel, austenitic	X2CrNiN18-10	1.4311	AT	0	60	8.1	a)
151	Seamless tube	BS EN 10216-5	Stainless steel, austenitic	X5CrNi18-10	1.4301	AT	0	60	8.1	a)
152	Seamless tube	BS EN 10216-5	Stainless steel, austenitic	X6CrNiTi18-10	1.4541	AT	0	60	8.1	a)
153	Seamless tube	BS EN 10216-5	Stainless steel, austenitic	X6CrNiNb18-10	1.4550	AT	0	60	8.1	a)
154	Seamless tube	BS EN 10216-5	Stainless steel, austenitic	X2CrNiMo18-14-3	1.4435	AT	0	60	8.1	a)
155	Seamless tube	BS EN 10216-5	Stainless steel, austenitic	X2CrNiMo17-12-2	1.4404	AT	0	60	8.1	a)

Table 2.1-2 — List of materials covered by BS EN material standards (continued)

1 No.	2 Product form	3 EN standard	4 Material description	5 Grade	6 Material number	7 Heat treatment ^a	8 Thickness mm		9 Material group to PD CR ISO 15608:2000	10 Notes
							min.	max.		
156	Seamless tube	BS EN 10216-5	Stainless steel, austenitic	X5CrNiMo17-12-2	1.4401	AT	0	60	8.1	a)
157	Seamless tube	BS EN 10216-5	Stainless steel, austenitic	X1CrNiMoN25-22-2	1.4466	AT	0	60	8.2	a)
158	Seamless tube	BS EN 10216-5	Stainless steel, austenitic	X6CrNiMoTi17-12-2	1.4571	AT	0	60	8.1	a)
159	Seamless tube	BS EN 10216-5	Stainless steel, austenitic	X6CrNiMoNb17-12-2	1.4580	AT	0	60	8.1	a)
160	Seamless tube	BS EN 10216-5	Stainless steel, austenitic	X2CrNiMoN17-13-3	1.4429	AT	0	60	8.1	a)
161	Seamless tube	BS EN 10216-5	Stainless steel, austenitic	X3CrNiMo17-13-3	1.4436	AT	0	60	8.1	a)
162	Seamless tube	BS EN 10216-5	Stainless steel, austenitic	X1CrNi25-21	1.4335	AT	0	60	8.2	a)
163	Seamless tube	BS EN 10216-5	Stainless steel, austenitic	X2CrNiMoN17-13-5	1.4439	AT	0	60	8.1	a)
164	Seamless tube	BS EN 10216-5	Stainless steel, austenitic	X1NiCrMoCu31-27-4	1.4563	AT	0	60	8.2	a)
165	Seamless tube	BS EN 10216-5	Stainless steel, austenitic	X1NiCrMoCu25-20-5	1.4539	AT	0	60	8.2	a)
166	Seamless tube	BS EN 10216-5	Stainless steel, austenitic	X1CrNiMoCuN20-18-7	1.4547	AT	0	60	8.2	a)
167	Seamless tube	BS EN 10216-5	Stainless steel, austenitic	X1NiCrMoCuN25-20-7	1.4529	AT	0	60	8.2	a)
168	Seamless tube	BS EN 10216-5	Stainless steel, austenitic	X2NiCrAlTi32-20	1.4558	AT	0	60	8.2	a)
169	Seamless tube	BS EN 10216-5	Stainless steel, austenitic	X6CrNi18-10	1.4948	AT	0	60	8.1	a)
170	Seamless tube	BS EN 10216-5	Stainless steel, austenitic	X7CrNiTi18-10	—	AT	0	60	8.1	a)
171	Seamless tube	BS EN 10216-5	Stainless steel, austenitic	X7CrNiNb18-10	—	AT	0	60	8.1	a)
172	Seamless tube	BS EN 10216-5	Stainless steel, austenitic	X7CrNiTiB18-10	1.4941	AT	0	60	8.1	a)
173	Seamless tube	BS EN 10216-5	Stainless steel, austenitic	X6CrNiMo17-13-2	—	AT	0	60	8.1	a)
174	Seamless tube	BS EN 10216-5	Stainless steel, austenitic	X5NiCrAlTi31-20	1.4958	AT	0	60	8.2	a)
175	Seamless tube	BS EN 10216-5	Stainless steel, austenitic	X8NiCrAlTi32-21	1.4959	AT	0	60	8.2	a)
176	Seamless tube	BS EN 10216-5	Stainless steel, austenitic	X3CrNiMoNb17-13-3	1.4910	AT	0	60	8.1	a)
177	Seamless tube	BS EN 10216-5	Stainless steel, austenitic	X8CrNiNb16-13	1.4961	AT	0	60	8.1	a)
178	Seamless tube	BS EN 10216-5	Stainless steel, austenitic	X8CrNiMoVNb16-13	1.4988	AT	0	60	8.1	a)
179	Seamless tube	BS EN 10216-5	Stainless steel, austenitic	X8CrNiMoNb16-16	1.4981	AT	0	60	8.1	a)
180	Seamless tube	BS EN 10216-5	Stainless steel, austenitic	X10CrNiMoMnNbVB15-10-1	1.4982	AT	0	60	8.1	a)
181	Welded tube	BS EN 10217-1	Room temperature properties	P195TR2	1.0108	N	0	40	1.1	a)
182	Welded tube	BS EN 10217-1	Room temperature properties	P235TR2	1.0255	N	0	40	1.1	a)
183	Welded tube	BS EN 10217-1	Room temperature properties	P265TR2	1.0259	N	0	40	1.1	a)
184	Welded tube	BS EN 10217-2	Elevated temperature properties	P195GH	—	N	0	16	1.1	a)
185	Welded tube	BS EN 10217-2	Elevated temperature properties	P235GH	—	N	0	16	1.1	a)
186	Welded tube	BS EN 10217-2	Elevated temperature properties	P265GH	—	N	0	16	1.1	a)

Table 2.1-2 — List of materials covered by BS EN material standards (continued)

1 No.	2 Product form	3 EN standard	4 Material description	5 Grade	6 Material number	7 Heat treatment ^a	8 Thickness mm		9 Material group to PD CR ISO 15608:2000	10 Notes
							min.	max.		
187	Welded tube	BS EN 10217-2	Elevated temperature properties	16Mo3	1.5415	N	0	16	1.2	a) f)
188	Welded tube	BS EN 10217-3	Fine grain steel	P275NL1	1.0488	N	0	40	1.1	a)
189	Welded tube	BS EN 10217-3	Fine grain steel	P275NL2	1.1104	N	0	40	1.1	a)
190	Welded tube	BS EN 10217-3	Fine grain steel	P355N	1.0562	N	0	40	1.2	a)
191	Welded tube	BS EN 10217-3	Fine grain steel	P355NH	1.0565	N	0	40	1.2	a)
192	Welded tube	BS EN 10217-3	Fine grain steel	P355NL1	1.0566	N	0	40	1.2	a)
193	Welded tube	BS EN 10217-3	Fine grain steel	P355NL2	1.1106	N	0	40	1.2	a)
194	Welded tube	BS EN 10217-4	Low temperature properties	P215NL	1.0451	N	0	16	1.1	a)
195	Welded tube	BS EN 10217-4	Low temperature properties	P265NL	1.0453	N	0	16	1.1	a)
196	Welded tube	BS EN 10217-5	Sub. Arc, elevated temperature props.	P235GH	1.0345	N	0	40	1.1	a)
197	Welded tube	BS EN 10217-5	Sub. Arc, elevated temperature props.	P265GH	1.0425	N	0	40	1.1	a)
198	Welded tube	BS EN 10217-5	Sub. Arc, elevated temperature props.	16Mo3	1.5415	N	0	40	1.1	a) f)
199	Welded tube	BS EN 10217-6	Sub. Arc, low temperature props.	P215NL	1.0451	N	0	25	1.1	a)
200	Welded tube	BS EN 10217-6	Sub. Arc, low temperature props.	P265NL	1.0453	N	0	25	1.1	a)
201	Welded tube	BS EN 10217-7	Stainless steel, austenitic	X2CrNi18-9	1.4307	AT	0	60	8.1	a)
202	Welded tube	BS EN 10217-7	Stainless steel, austenitic	X2CrNi19-11	1.4306	AT	0	60	8.1	a)
203	Welded tube	BS EN 10217-7	Stainless steel, austenitic	X2CrNiN18-10	1.4311	AT	0	60	8.1	a)
204	Welded tube	BS EN 10217-7	Stainless steel, austenitic	X5CrNi18-10	1.4301	AT	0	60	8.1	a)
205	Welded tube	BS EN 10217-7	Stainless steel, austenitic	X6CrNiTi18-10	1.4541	AT	0	60	8.1	a)
206	Welded tube	BS EN 10217-7	Stainless steel, austenitic	X6CrNiNb18-10	1.4550	AT	0	60	8.1	a)
207	Welded tube	BS EN 10217-7	Stainless steel, austenitic	X2CrNiMo17-12-2	1.4404	AT	0	60	8.1	a)
208	Welded tube	BS EN 10217-7	Stainless steel, austenitic	X5CrNiMo17-12-2	1.4401	AT	0	60	8.1	a)
209	Welded tube	BS EN 10217-7	Stainless steel, austenitic	X6CrNiMoTi17-12-2	1.4571	AT	0	60	8.1	a)
210	Welded tube	BS EN 10217-7	Stainless steel, austenitic	X2CrNiMo17-12-3	1.4432	AT	0	60	8.1	a)
211	Welded tube	BS EN 10217-7	Stainless steel, austenitic	X2CrNiMoN17-13-3	1.4429	AT	0	60	8.1	a)
212	Welded tube	BS EN 10217-7	Stainless steel, austenitic	X3CrNiMo17-13-3	1.4436	AT	0	60	8.1	a)
213	Welded tube	BS EN 10217-7	Stainless steel, austenitic	X2CrNiMo18-14-3	1.4435	AT	0	60	8.1	a)
214	Welded tube	BS EN 10217-7	Stainless steel, austenitic	X2CrNiMoN17-13-5	1.4439	AT	0	30	8.1	a)
215	Welded tube	BS EN 10217-7	Stainless steel, austenitic	X2CrNiMo18-15-4	1.4438	AT	0	60	8.1	a)
216	Welded tube	BS EN 10217-7	Stainless steel, austenitic	X1NiCrMoCu31-27-7	1.4563	AT	0	60	8.2	a)
217	Welded tube	BS EN 10217-7	Stainless steel, austenitic	X1NiCrMoCu25-20-5	1.4539	AT	0	60	8.2	a)

Table 2.1-2 — List of materials covered by BS EN material standards (continued)

1 No.	2 Product form	3 EN standard	4 Material description	5 Grade	6 Material number	7 Heat treatment ^a	8 Thickness mm		9 Material group to PD CR ISO 15608:2000	10 Notes
							min.	max.		
218	Welded tube	BS EN 10217-7	Stainless steel, austenitic	X1CrNiMoCu320-18-7	1.4547	AT	0	60		
219	Welded tube	BS EN 10217-7	Stainless steel, austenitic	X1NiCrMoCuN25-20-7	1.4529	AT	0	60	8.2	a)
220	Forging	BS EN 10222-2	Elevated temperature properties	P245GH	1.0352	A	0	35	1.1	a)
221	Forging	BS EN 10222-2	Elevated temperature properties	P245GH	1.0352	N NT QT	35	160	1.1	a)
222	Forging	BS EN 10222-2	Elevated temperature properties	P280GH	1.0426	N	0	35	1.2	a)
223	Forging	BS EN 10222-2	Elevated temperature properties	P280GH	1.0426	NT QT	35	160	1.2	a)
224	Forging	BS EN 10222-2	Elevated temperature properties	P305GH	1.0436	N	0	35	1.2	a)
225	Forging	BS EN 10222-2	Elevated temperature properties	P305GH	1.0436	NT	35	160	1.2	a)
226	Forging	BS EN 10222-2	Elevated temperature properties	P305GH	1.0436	QT	0	70	1.2	a) f)
227	Forging	BS EN 10222-2	Elevated temperature properties	16Mo3	1.5415	N	0	35	1.2	a) f)
228	Forging	BS EN 10222-2	Elevated temperature properties	16Mo3	1.5415	QT	35	500	1.2	a) f)
229	Forging	BS EN 10222-2	Elevated temperature properties	13CrMo4-5	1.7335	NT	0	70	5.1	a)
230	Forging	BS EN 10222-2	Elevated temperature properties	13CrMo4-5	1.7335	NT QT	70	500	5.1	a)
231	Forging	BS EN 10222-2	Elevated temperature properties	15MnMoV4-5	1.5402	NT QT	0	250	1.2	a)
232	Forging	BS EN 10222-2	Elevated temperature properties	18MnMoNi5-5	1.6308	QT	0	200	4.1	a)
233	Forging	BS EN 10222-2	Elevated temperature properties	14MoV6-3	1.7715	NT QT	0	500	6.1	a)
234	Forging	BS EN 10222-2	Elevated temperature properties	15MnCrMoNiV5-3	1.6920	NT QT	0	100	4.1	a)
235	Forging	BS EN 10222-2	Elevated temperature properties	11CrMo9-10	1.7383	NT	0	200	5.2	a)
236	Forging	BS EN 10222-2	Elevated temperature properties	11CrMo9-10	1.7383	NT QT	200	500	5.2	a)
237	Forging	BS EN 10222-2	Elevated temperature properties	X16CrMo5-1	1.7366	A	0	300	5.3	a)
238	Forging	BS EN 10222-2	Elevated temperature properties	X16CrMo5-1	1.7366	NT	0	300	5.3	a)
239	Forging	BS EN 10222-2	Elevated temperature properties	X10CrMoVNb9-1	1.4903	NT	0	130	6.4	a)
240	Forging	BS EN 10222-2	Elevated temperature properties	X20CrMoV11-1	1.4922	QT	0	330	6.4	a)
241	Forging	BS EN 10222-3	Low temperature properties	13MnNi6-3	1.6217	NT	0	70	9.1	a)
242	Forging	BS EN 10222-3	Low temperature properties	15NiMn6	1.6228	N	0	35	9.1	a)
243	Forging	BS EN 10222-3	Low temperature properties	15NiMn6	1.6228	NT QT	35	50	9.1	a)
244	Forging	BS EN 10222-3	Low temperature properties	12Ni14	1.5637	N	0	35	9.2	a)
245	Forging	BS EN 10222-3	Low temperature properties	12Ni14	1.5637	NT	35	50	9.2	a)
246	Forging	BS EN 10222-3	Low temperature properties	12Ni14	1.5637	QT	50	70	9.2	a)
247	Forging	BS EN 10222-3	Low temperature properties	X12Ni5	1.5680	N	0	35	9.2	a)
248	Forging	BS EN 10222-3	Low temperature properties	X12Ni5	1.5680	NT QT	35	50	9.2	a)

Table 2.1-2 — List of materials covered by BS EN material standards (continued)

1 No.	2 Product form	3 EN standard	4 Material description	5 Grade	6 Material number	7 Heat treatment ^a	8 Thickness mm		9 Material group to PD CR ISO 15608:2000	10 Notes
							min.	max.		
249	Forging	BS EN 10222-3	Low temperature properties	X8Ni9	1.5662	N NT	0	50	9.3	a)
250	Forging	BS EN 10222-3	Low temperature properties	X8Ni9	1.5662	QT	50	70	9.3	a)
251	Forging	BS EN 10222-4	Fine grain steel, high proof strength	P285NH	1.0477	N	0	70	1.2	a)
252	Forging	BS EN 10222-4	Fine grain steel, high proof strength	P285QH	1.0478	QT	70	400	1.2	a) f)
253	Forging	BS EN 10222-4	Fine grain steel, high proof strength	P355NH	1.0565	N	0	70	1.2	a)
254	Forging	BS EN 10222-4	Fine grain steel, high proof strength	P355QH1	1.0571	QT	70	400	1.2	a) f)
255	Forging	BS EN 10222-4	Fine grain steel, high proof strength	P420NH	1.8932	N	0	70	1.3	a)
256	Forging	BS EN 10222-5	Stainless steel, austenitic	X2CrNi18-9	1.4307	AT	0	250	8.1	a)
257	Forging	BS EN 10222-5	Stainless steel, austenitic	X2CrNi18-10	1.4311	AT	0	250	8.1	a)
258	Forging	BS EN 10222-5	Stainless steel, austenitic	X5CrNi18-10	1.4301	AT	0	250	8.1	a)
259	Forging	BS EN 10222-5	Stainless steel, austenitic	X6CrNi18-10	1.4541	AT	0	450	8.1	a)
260	Forging	BS EN 10222-5	Stainless steel, austenitic	X6CrNiNb18-10	1.4550	AT	0	450	8.1	a)
261	Forging	BS EN 10222-5	Stainless steel, austenitic	X6CrNi18-10	1.4948	AT	0	250	8.1	a)
262	Forging	BS EN 10222-5	Stainless steel, austenitic	X6CrNiTiB18-10	1.4941	AT	0	450	8.1	a)
263	Forging	BS EN 10222-5	Stainless steel, austenitic	X7CrNiNb18-10	1.4912	AT	0	450	8.1	a)
264	Forging	BS EN 10222-5	Stainless steel, austenitic	X2CrNiMo17-12-2	1.4404	AT	0	250	8.1	a)
265	Forging	BS EN 10222-5	Stainless steel, austenitic	X2CrNiMoN17-11-2	1.4406	AT	0	160	8.1	a)
266	Forging	BS EN 10222-5	Stainless steel, austenitic	X5CrNiMo17-12-2	1.4401	AT	0	250	8.1	a)
267	Forging	BS EN 10222-5	Stainless steel, austenitic	X6CrNiMoTi17-12-2	1.4571	AT	0	450	8.1	a)
268	Forging	BS EN 10222-5	Stainless steel, austenitic	X2CrNiMo17-12-3	1.4432	AT	0	250	8.1	a)
269	Forging	BS EN 10222-5	Stainless steel, austenitic	X2CrNiMoN17-13-3	1.4429	AT	0	160	8.1	a)
270	Forging	BS EN 10222-5	Stainless steel, austenitic	X3CrNiMo17-13-3	1.4436	AT	0	250	8.1	a)
271	Forging	BS EN 10222-5	Stainless steel, austenitic	X2CrNiMo18-14-3	1.4435	AT	0	75	8.1	a)
272	Forging	BS EN 10222-5	Stainless steel, austenitic	X3CrNiMoN17-13-3	1.4910	AT	0	75	8.1	a)
273	Forging	BS EN 10222-5	Stainless steel, austenitic	X2CrNiCu19-10	1.4650	AT	0	450	8.1	a)
274	Forging	BS EN 10222-5	Stainless steel, austenitic	X3CrNiMo18-12-3	1.4449	AT	0	450	8.1	a)
275	Casting	BS EN 10213 A1	Elevated temperature properties	GP240GR	1.0621	N	0	100	1.1	a)
276	Casting	BS EN 10213 A1	Elevated temperature properties	GP240GH	1.0619	N QT	0	100	1.1	a) f)
277	Casting	BS EN 10213 A1	Elevated temperature properties	GP280GH	1.0625	N QT	0	100	1.2	a) f)
278	Casting	BS EN 10213 A1	Elevated temperature properties	G20Mo5	1.5419	QT	0	100	3.1	a)
279	Casting	BS EN 10213 A1	Elevated temperature properties	G17CrMo5-5	1.7357	QT	0	100	5.1	a)

Table 2.1-2 — List of materials covered by BS EN material standards (continued)

1 No.	2 Product form	3 EN standard	4 Material description	5 Grade	6 Material number	7 Heat treatment ^a	8 Thickness mm		9 Material group to PD CR ISO 15608:2000	10 Notes
							min.	max.		
280	Casting	BS EN 10213	Elevated temperature properties	G17CrMo9-10	1.7379	QT	0	150	5.2	a)
281	Casting	BS EN 10213	Elevated temperature properties	G12MoCrV5-2	1.7720	QT	0	100	6.1	a)
282	Casting	BS EN 10213	Elevated temperature properties	G17CrMoV5-10	1.7706	QT	0	150	6.2	a)
283	Casting	BS EN 10213	Elevated temperature properties	GX15CrMo5	1.7365	QT	0	150	5.3	a)
284	Casting	BS EN 10213	Elevated temperature properties	GX23CrMoV12-1	1.4931	QT	0	150	6.4	a)
285	Casting	BS EN 10213	Low temperature properties	G17Mn5	1.1131	QT	0	50	1.1	a)
286	Casting	BS EN 10213	Low temperature properties	G20Mn5	1.6220	N	0	30	1.2	a)
287	Casting	BS EN 10213	Low temperature properties	G20Mn5	1.6220	QT	0	100	1.2	a) f)
288	Casting	BS EN 10213	Low temperature properties	G18Mo5	1.5422	QT	0	100	1.2	a) f)
289	Casting	BS EN 10213	Low temperature properties	G9Ni10	1.5636	QT	0	35	9.1	a)
290	Casting	BS EN 10213	Low temperature properties	G17NiCrMo13-6	1.6781	QT	0	200	9.2	a)
291	Casting	BS EN 10213	Low temperature properties	G9Ni14	1.5638	QT	0	35	9.2	a)
292	Casting	BS EN 10213	Stainless steel, austenitic	GX2CrNi19-11	1.4309	AT	0	150	8.1	a)
293	Casting	BS EN 10213	Stainless steel, austenitic	GX5CrNi19-10	1.4308	AT	0	150	8.1	a)
294	Casting	BS EN 10213	Stainless steel, austenitic	GX5CrNiNb19-11	1.4552	AT	0	150	8.1	a)
295	Casting	BS EN 10213	Stainless steel, austenitic	GX2CrNiMo19-11-2	1.4409	AT	0	150	8.1	a)
296	Casting	BS EN 10213	Stainless steel, austenitic	GX5CrNiMo19-11-2	1.4408	AT	0	150	8.1	a)
297	Casting	BS EN 10213	Stainless steel, austenitic	GX5CrNiMoNb19-11-2	1.4581	AT	0	150	8.1	a)
298	Casting	BS EN 10213	Stainless steel, austenitic	GX2NiCrMo28-20-2	1.4458	AT	0	150	8.2	a)

a) Materials are considered to meet the requirements of the PED and BS EN 13445-2.

b) Because of the carbon content special precautions are necessary when the material is welded.

c) See BS EN 10216 for details of heat treatment.

d) *Not used.*e) *Not used.*

f) Additional requirements for forming and welding shall be considered on a case by case basis.

g) *Not used.*^a Heat treatment conditions:

A annealed;

C cold worked;

AT solution annealed;

I isothermally annealed;

N normalized;

NT normalized and tempered;

QT quenched and tempered;

RA recrystallized annealed.

2.1.2.2.2 Carbon, carbon manganese and alloy steels

2.1.2.2.2.1 The maximum allowable phosphorus and sulfur content shall not exceed 0.05 % each in the ladle analysis. For ferritic steels intended for welding, the upper limit of the carbon range (in the ladle analysis) shall not exceed 0.25 %. If the manufacturer proposes to weld materials with a carbon content exceeding 0.25 %, this proposal and the welding procedure shall be approved by the purchaser and Inspection Authority.

2.1.2.2.2.2 The deoxidation practice shall be appropriate to the type of steel ordered, particularly where it influences the level of elevated or low temperature properties. It is permitted to use semi-killed steel in accordance with this specification for plates and seamless and welded tubes in carbon and carbon manganese steels with an upper limit of the specified tensile strength range of 640 N/mm² and with a thickness not exceeding 100 mm. Rimmed steel shall only be used for welded tubes in carbon and carbon manganese steel types with an upper limit of the specified tensile strength range of 490 N/mm² under service temperature conditions between 0 °C and 380 °C.

2.1.2.2.2.3 Mechanical properties at room temperature shall be specified for acceptance tests in accordance with BS EN 10002-1²⁾ covering R_m , R_e (see 2.3) and minimum elongation at fracture.

The specified minimum percentage elongation at fracture referred to a gauge length of $5.65\sqrt{S_0}$ ³⁾ shall be appropriate to the type of steel with a lower limit of 16 % for plates, 15 % for castings and 14 % for tubes and forgings, unless the use of the steel is subject to special agreement (see 2.1.1.2).

The rate of testing and methods of acceptance testing shall generally be consistent with appropriate British Standards for similar product forms.

2.1.2.2.2.4 For materials that will be used above 50 °C, yield point or proof stress properties shall be specified by the manufacturer for acceptance tests in accordance with BS EN 10002-5²⁾.

2.1.2.2.2.5 Stress rupture properties shall be specified for materials that will be used in the creep range. These shall be determined in accordance with the procedure laid down in ISO 6303²⁾. The manufacturer of the vessel shall be assured that the product supplied is capable of conforming to the specified properties by a statement that the manufacturing processes have remained equivalent to those for the steel for which the test results were obtained.

2.1.2.2.2.6 Charpy V-notch impact test properties at appropriate temperatures shall, where necessary, conform to 2.2.3, 2.2.4 and 2.2.5.

2.1.2.2.2.7 Materials shall be supplied in a heat treated condition appropriate to the nearest equivalent British Standard.

NOTE 1 Plates for hot forming may be supplied in any suitable condition as agreed between the manufacturer and the material supplier.

NOTE 2 Any proposal by the manufacturer to use the rolling process to achieve normalized properties of non-BS materials, should be agreed with the purchaser and Inspecting Authority. The properties of the normalized rolled plates should be demonstrated to be similar to the nearest equivalent BS normalized material.

2.1.2.2.2.8 Carbon and carbon manganese steel plates for cold forming shall be supplied in the normalized condition except when their thickness is less than 25 mm, when it is permissible to supply plates as-rolled if guaranteed elevated temperature properties are not required.

Low alloy steel plates for cold forming shall normally be supplied in the normalized and tempered condition. Where the plate is metallurgically suitable and where post-weld heat treatment will suffice as the tempering treatment, plates supplied in the normalized condition shall be permitted.

2.1.2.2.2.9 It is permissible to use electric resistance welded or induction welded tubes in the as-welded condition provided the specified upper limit of tensile strength does not exceed 540 N/mm² and they are not intended for service below a temperature of 0 °C.

²⁾ Acceptance of properties obtained by other recognized test methods (e.g. other national standards) shall be subject to agreement between the purchaser, manufacturer and Inspection Authority.

³⁾ S_0 is the original cross-sectional area of the gauge length of the tensile test specimen.