

	<p style="text-align: center;">Steel forgings for pressure purposes Part 1: General requirements for open die forgings (includes Amendment A1 : 2002) English version of DIN EN 10222-1 : 1998 + A1 : 2002</p>	DIN EN 10222-1
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ICS 77.140.30; 77.140.85

Supersedes
September 1998 edition.

Schmiedestücke aus Stahl für Druckbehälter – Teil 1: Allgemeine Anforderungen an Freiformschmiedestücke (enthält Änderung A1 : 2002)

European Standard EN 10222-1 : 1998 + Amendment A1 : 2002 has the status of a DIN Standard.

A comma is used as the decimal marker.

National foreword

This standard has been prepared by ECISS/TC 28 'Steel forgings' (Secretariat: United Kingdom).

The responsible German body involved in its preparation was the *Normenausschuss Eisen und Stahl* (Steel and Iron Standards Committee), Technical Committee *Schmiedestücke*.

DIN V 17006-100 is the standard corresponding to CEN Report CR 10260 referred to in clause 2 of the EN.

Amendments

This standard differs from the September 1998 edition in that Annex ZA has been included.

Previous editions

DIN 1611: 1935-12; DIN 1612: 1943x-03; DIN 1620: 1958-03; DIN 1621: 1924-09; DIN 1622: 1933-12;
DIN 17100: 1957-10, 1966-09, 1980-01; DIN 17103: 1989-10; DIN 17243: 1987-01; DIN 17280: 1985-07;
DIN 17440: 1967-01, 1972-12, 1985-07, 1996-09; DIN EN 10222-1: 1998-09.

National Annex NA

Standard referred to

(and not included in **Normative references**)

DIN V 17006-100 Designation systems for steel – Additional symbols for steel names

EN comprises 20 pages.

English version

Steel forgings for pressure purposes

Part 1: General requirements for open die forgings
(includes Amendment A1 : 2002)

Pièces forgées en acier pour appareils à pression – Partie 1: Prescriptions générales concernant les pièces obtenues par forgeage libre (amendement A1 : 2002 inclus)

Schmiedestücke aus Stahl für Druckbehälter – Teil 1: Allgemeine Anforderungen an Freiformschmiedestücke (enthält Änderung A1 : 2002)

This European Standard was approved by CEN on 1997-10-26 and Amendment A1 on 2002-03-14.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Management Centre or to any CEN member.

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

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

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Foreword to EN 10222-1 : 1998

This European Standard has been prepared by Technical Committee ECISS/TC 28 'Steel forgings', the Secretariat of which is held by BSI.

The titles of the other Parts of this European Standard are:

Part 2: Ferritic and martensitic steels with specified elevated temperature properties

Part 3: Nickel steels with specified low temperature properties

Part 4: Weldable fine grain steels with high proof strength

Part 5: Martensitic, austenitic and austenitic-ferritic stainless steels

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, and conflicting national standards withdrawn, by July 1998 at the latest.

In accordance with the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard:

Austria, Belgium, the Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom.

Foreword to EN 10222-1 : 1998/A1 : 2002

This amendment to EN 10222-1 : 1998 has been prepared by Technical Committee ECISS/TC 28 'Steel forgings', the Secretariat of which is held by BSI.

This amendment has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of the relevant EU Directive.

For relationship with this directive, see Annex ZA.

This amendment shall be given the status of a national standard, either by publication of an identical text or by endorsement, and conflicting national standards withdrawn, by October 2002 at the latest.

In accordance with the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard:

Austria, Belgium, the Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom.

1 Scope

This Part of this European Standard specifies the general technical delivery conditions for open die steel forgings, ring rolled products and forged bars for pressure purposes.

General information on technical delivery conditions is given in EN 10021.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

- EN 287-1 Approval testing of welders. Fusion welding. Part 1 : Steels
- EN 288 Specification and qualification of welding procedure for fusion welding
Part 1: General rules
Part 2: Welding procedure specification for arc welding of metallic materials
Part 3: Welding procedure tests for arc welding of steels
- EN 10 002-1 Metallic materials - Tensile testing - Method of test (at ambient temperature)
- EN 10 002-5 Metallic materials - Tensile test - Method of test at elevated temperatures
- EN 10 020 Definition and classification of grades of steel
- EN 10 021 General technical delivery requirements for iron and steel products
- EN 10 027 Designation system for steel
Part 1 : Steel names, principal symbols
Part 2 : Steel numbers
- EN 10 045-1 Metallic materials - Charpy impact test - Test method
- EN 10 052 Vocabulary of heat treatment terms for ferrous products
- EN 10 079 Definition of steel products
- EN 10 204 Metallic products - Inspection documents

- prEN 10228 Non-destructive testing of steel forgings.
Part 1. Magnetic particle inspection.
Part 2. Penetrant testing.
Part 3. Ultrasonic testing of ferritic or martensitic steel forgings.
Part 4. Ultrasonic testing of austenitic and austenitic-ferritic stainless steel forgings.
- EURONORM 168 Iron and Steel products - Inspection documents - Contents
- ENV 22605-1 Steel products for pressure purposes - Derivation and verification of elevated temperature properties -
Part 1: Yield or proof stress of carbon and low alloy steel products
- ENV 22605-2 Steel products for pressure purposes - Derivation and verification of elevated temperature properties -
Part 2: Proof stress of austenitic steel products
- EN ISO 377 Steel and steel products - Location of samples and test pieces for mechanical testing.
- prEN ISO 3651 Determination of resistance to intergranular corrosion stainless steels
Part 2: Ferritic, austenitic and ferritic-austenitic (duplex) stainless steels -
Corrosion test in media containing sulfuric acid
- CR10260 ECISS Information Circular 10. Designation systems for steel :
Additional symbols for steel names
- CR 10261 ECISS Information Circular 11 - Iron and steel - Review of available methods of chemical analysis

3 Definitions

3.1 General

For the purposes of this Part of this European Standard the following definitions apply in addition to the definitions in EN 10 020, EN 10 021, EN 10 052, EN 10 079 and EN ISO 377.

3.2 batch: Forgings of similar dimensions from the same cast, made by the same forging procedure and from the same heat treatment charge.

4 Classification and designation

4.1 Classification

The steels in this European Standard are classified as follows:

Part 2: Non-alloy quality steels 1.0352, 1.0426 and 1.0436 -

Alloy special steels - remaining steels.

Part 3: Alloy special steels

Part 4: Non alloy quality steels - 1.0477, 1.0478, 1.0565 and 1.0571 - Alloy special steels - 1.8932 and 1.8936.

Part 5: Alloy special steels.

4.2 Designation

The steels in Parts 2 to 5 of this European Standard are designated in accordance with the requirements of EN 10 027: Parts 1 and 2 and CR 10260.

5 Information to be supplied by the purchaser

5.1 Mandatory information

The purchaser shall select the steel type, the shape and dimensions of the forging taking the intended use into account.

The purchaser shall provide in the purchase order all the information necessary for describing the forging and its characteristics and details concerning delivery including the following :

- I. the quantity of forgings required;
- II. the forging dimensions, or the drawing number(s) containing the dimensions, tolerances and surface finish, to which the forgings shall conform;
- III. the steel designation of the material of which the forgings are made (see clause 4);
- IV. whether the purchaser needs to be informed of the forging procedure (see 7.2);
- V. whether production and testing of the forgings is to be witnessed by the purchaser's representative, and if so, the particular stages in production and testing at which the purchaser's representative may require to be present (see clause 15);
- VI. any required options (see 5.2 and annex A);
- VII. whether additional sample material is required for welding tests, the dimensions and location of such test pieces being agreed with the manufacturer;
- VIII. the type of inspection document in accordance with EN 10 204.

5.2 Options

A number of options are available and these are detailed in annex A. Where any of the options given are specified at the time of the order, the forgings shall conform to the requirements of any such option, in addition to the mandatory requirements of this Part of this European Standard.

If the purchaser does not specify any options at the time of enquiry and order, the manufacturer shall supply in accordance with the basic specification.

6 Manufacture of the steel

6.1 Steelmaking process

The steel shall be produced by an electric process or one of the basic oxygen processes (see option A.1).

6.2 Deoxidation

The steel shall be fully killed.

7 Manufacture of the product

7.1 Hot working

The choice of hot working process shall be at the discretion of the manufacturer (see option A.2).

7.2 Forging reduction

The forging shall receive a sufficient forging reduction to completely consolidate the forging and remove the cast structure (see A.3).

7.3 Heat treatment

The forgings shall be heat treated as specified in the relevant Part of EN 10222, unless otherwise agreed at the time of enquiry and order.

7.4 Weldability

The steels in this European Standard are generally regarded as being weldable. Welding shall be carried out in accordance with EN 287 and EN 288.

8 Surface condition and soundness

8.1 General

The forgings shall be sound and free from defects that preclude their intended use (see also A.4, A.5, A.6 and A.7).

8.2 Removal of surface defects

8.2.1 *Conformity to 8.1*

Before the forgings are despatched or presented for acceptance, surface defects shall be removed in order to conform to 8.1.

8.2.2 *Chipping and/or grinding*

Surface defects shall be removed by chipping and/or grinding providing the residual thickness meets the minimum tolerance and that the resulting depression does not undercut the rest of the surface. If the thickness is to be reduced to below the minimum tolerance, repair shall only be carried out following agreement with the purchaser.

8.2.3 *Chipping and/or grinding and resurfacing by welding*

If resurfacing by welding is agreed by the purchaser, prior to the repair being carried out, larger surface defects shall be removed by chipping and/or grinding followed by resurfacing by welding and levelling the weld. Any welding operations carried out shall be in accordance with EN 287-1 and EN 288-1, EN 288-2 and EN 288-3.

8.3 Dimensions, shape, tolerances and nominal mass

The dimensions and shape of the product shall conform to the tolerances stated in the order.

Any calculation of the nominal mass of the product shall be based on the following density values :

- non alloy quality and alloy special steels in Parts 2, 3 and 4 7,85 kg/dm³
- martensitic stainless steels 7,7 kg/dm³

– austenitic stainless CrNi steels	7,9 kg/dm ³
– austenitic stainless CrNi Mo steels	8,0 kg/dm ³
– austenitic ferritic stainless steels	7,8 kg/dm ³
– X8Ni9	7,89 kg/dm ³

8.4 Compatibility with non-destructive testing

The agreed requirements for surface finish shall be compatible with the requirements for non-destructive testing.

9 Chemical composition

9.1 Cast analysis

The chemical composition of the steel, determined by cast analysis, shall conform to the requirements specified in the relevant Part of EN 10222.

Elements not listed in the composition tables in the other Parts of EN 10222 shall not be intentionally added without the agreement of the purchaser except for finishing the cast (see options A.8 and A.9).

9.2 Product analysis (optional requirement)

The results of a product analysis on samples taken and prepared in accordance with clause 12 shall not deviate from the specified limits for the cast analysis by more than the values given in the table of permissible deviations of product analysis in the relevant Parts of EN 10222 (see A.10 to A.12).

NOTE 1: Further restriction to composition may be imposed by the purchaser by the use of the carbon equivalent values (see A.13).

NOTE 2: Greater tolerances to composition may be agreed for large forgings at the time of enquiry and order.

10 Mechanical properties at room temperature and low temperatures

The mechanical properties obtained from the test pieces, selected, prepared and tested in accordance with the requirements of clauses 12 and 13 shall comply with the values specified in the relevant Part of EN 10222. For impact tests see also A.16.

If a simulated post-weld heat treatment of test samples is required this option shall be requested by the purchaser at the time of enquiry and order (see A.14).

The mean value for the Charpy impact strength obtained in 3 tests at the temperature specified in the relevant Part of EN 10222 shall be not lower than the value specified in the relevant Part of EN 10222 for the appropriate limiting equivalent thickness (see annex B) of the relevant steel. Not more than one individual value shall be below the specified value and no individual value shall be lower than 70 % of the specified value.

NOTE: Details of the assessment of impact tests based on the sequential method are given in 8.3 of EN 10 021.

11 Mechanical properties at elevated temperature

11.1 The mechanical properties obtained from the test pieces, selected, prepared and tested in accordance with the requirements of clauses 12 and 13 shall comply with the values specified in the relevant Part of this European Standard.

11.2 For forgings whose designation has an "H" suffix (EN 10 222 : Part 2) either of the following shall apply :

- I. The manufacturer shall satisfy the purchaser in accordance with the procedure given in ENV 22605: Parts 1 and 2 that the product consistently meets the elevated temperature values specified for the relevant steel or.
- II. if insufficient data are available to satisfy ENV 22605: Parts 1 and 2, one test shall be made on each cast of steel used for the manufacture of the forgings, the test sample being taken in accordance with clause 12. The temperature of test shall be chosen by the purchaser from those quoted in EN 10 222: Part 2. The proof strength values obtained shall comply with requirements specified for the relevant steel in EN 10 222: Part 2. If forgings of more than one thickness are to be supplied from one cast, then the test shall be made on the thickest forging.

NOTE: Additional elevated temperature tests may be required by the purchaser. (see A.15).

11.3 The average stress rupture values are given for information in the relevant tables of Part 2 and Part 5 of EN 10222.

12 Sampling and preparation of test pieces

12.1 General

The minimum number of samples shall be in accordance with 12.2 according to the mass and/or size of the forging.

For the provision of samples, forgings up to the unit mass given in table 1 may be batched to the maximum batch masses given in table 1. Forgings greater than those unit masses shall be sampled individually.

12.2 Samples

12.2.1 General

Samples shall be provided by one of the following methods :

- I. for small forgings (up to 1000 kg) if specifically agreed with the purchaser, as separately forged samples forged from the bars, billets or ingots from which the forgings have been made. The samples shall receive nominally the same hot working reduction and have nominally the same equivalent diameter as the ruling section of the forgings they represent, as defined in annex B;
- II. for prolongations of the forgings having a diameter or section approximately equal to the ruling section of the forging at the time of heat treatment (see annex B). Integral samples shall not be parted from the forging until all heat treatment is completed except as in 12.2.6.
- III. from additional forgings.

12.2.2 Separate samples or additional forgings

Separate samples or additional forgings shall be heat treated with the batch they represent.

Table 1: Unit mass and batch mass limit

	Austenitic and non-alloyed steel forgings ($R_m \leq 510 \text{ N/mm}^2$)	Other steel forgings
	kg	kg
Maximum mass of final individual product	1000	500
Maximum batch mass	6000	3000

12.2.3 Forgings up to and including 1000 kg mass (≤ 5 m in length)

For forgings up to and including 1000 kg mass, samples shall be provided according to 12.2.1 a), b) or c).

12.2.4 Forgings from 1000 kg up to and including 4000 kg (≤ 5 m in length)

For forgings from 1000 kg up to and including 4000 kg, samples shall be provided according to method 12.2.1 b) or c). A sample shall be taken from one end of each forging.

12.2.5 Forgings over 4000 kg or greater than 5 m in length (any mass)

For forgings over 4000 kg and/or greater than 5 m in length, samples shall be provided according to method 12.2.1 b) or c). A sample shall be taken from each end of each forging in two diametrically opposite areas.

For forgings whose diameter exceeds the length of the axis, such as discs or rings, test samples shall be provided by increasing the outside diameter, length or thickness of the forgings or by reducing the inside diameter of the forgings, as applicable.

12.2.6 Forgings for closed hollow vessels

In the case of forgings for closed hollow vessels, the samples shall be cut off before closing (i.e. either by hot working or welding on ends) and shall be subjected to the same heat treatment as the vessels themselves. In the case of open hollow vessels a sample shall be cut off after completion of the heat treatment. The number of samples taken from these forgings shall conform to the relevant requirements of 12.2.3, 12.2.4 and 12.2.5.

12.3 Preparation of test pieces

All samples shall be taken at a distance of $t/4$ below the heat treated surface, (with a minimum of 20 mm and a maximum of 80 mm) and $t/2$ from the end (where t is the equivalent thickness (t_{eq}) or the thickness of the ruling section (t_R) of the forging at the time of heat treatment, see annex B).

For integral samples, the end of the forging shall be projected by means of a thermal buffer, the height of which shall be at least equal to $t/2$ (maximum 90 mm). This thermal buffer, the width of which shall at least equal t , shall be welded to the part before heat treatment.

The direction of test pieces shall be :

- transverse to the grain flow, for hollow cylindrical forgings and forged bars ≥ 160 mm in diameter;
- parallel to the grain flow for forged bars < 160 mm in diameter;

- transverse to the grain flow for other products, grain flow to be determined by etching or consideration of the forging procedure.

If requested by the purchaser at the time of enquiry and order, additional tests shall be carried out in different directions and positions.

From each sample the following test pieces shall be prepared :

- I. one room temperature tensile test piece which shall be of type and dimensions complying with the requirements of EN 10 002: Part 1;
- II. three impact test pieces as specified in EN 10 045: Part 1. The axis of the notch shall be perpendicular to the nearest surface of the forging;
- III. if an elevated temperature tensile test is required (see clause 11), the test piece shall be cut from a position on the sample adjacent to one of the room temperature tensile test pieces, and prepared in accordance with the requirements of EN 10002-5.

13 Mechanical test methods

13.1 Tensile tests at room temperature

Tensile tests at room temperature shall be carried out in accordance with the requirements of EN 10 002-1. The yield strength to be determined shall be the upper yield strength (R_{eH}) or if this is not pronounced, the 0,2 % proof strength ($R_{p0.2}$).

13.2 Tensile tests at elevated temperatures

See option A.15.

13.3 Impact tests

Impact tests shall be carried out, at the specified temperature, in accordance with EN 10 045 (see A.16).

13.4 Intergranular corrosion test

See A.17.

14 Retests

14.1 General

Retest procedures shall be carried out in accordance with 8.3.4.3 of EN 10 021.

14.2 Re-heat treatment

The manufacturer shall have the right to repeat the heat treatment of any material, including material already found not to fulfil the test requirements, and resubmit it for testing. No forging shall be fully re-heat treated more than twice.

15 Inspection

Inspection shall be carried out in accordance with the procedures given in EN 10 021.

An inspection document to EN 10 204 covering specific inspection shall be supplied to the purchaser. An inspection certificate type 3.1B shall be provided unless another is requested at the time of enquiry and order such as 3.1A, 3.1C or 3.2. The content of the inspection certificate shall conform to Euronorm 168 and shall contain the following information :

- I. the number of the relevant Parts of this European Standard and the steel designation (name or number).
- II. the identification number of each forging;
- III. the steelmaking process;
- IV. the cast analysis in respect of all specified elements;
- V. the residual element content, if required;
- VI. the details of the heat treatment given to the forgings;
- VII. the room temperature mechanical properties determined;
- VIII. if elevated temperature tests have been made, the test temperature used and the results obtained.
- IX. for forgings whose complete designation contains the suffix "H", either;
 - A. a statement that the material conforms to the verification requirements of ENV 22605-1 and ENV 22605-2 (see 11 a)); or
 - B. if insufficient data were available to meet the requirements of ENV 22605-1 and ENV 22605-2, the test temperature of the elevated temperature test and the proof strength values obtained (see 11 b));
- X. the temperature at which the impact tests were made and the results obtained;

- XI. details and results of any agreed additional tests;
- XII. whether any repairs have been performed (see 8.2). The location of such repairs shall be marked clearly on the drawings and/or the forgings.

16 Marking

16.1 Unless otherwise agreed, each forging, or batch of forgings, as appropriate, shall be legibly marked to show :

- I. the manufacturer's name or trade mark;
- II. the identification reference numbers of other identification marks by which the forgings can be related to the manufacturer's certificate;
- III. the mark of the inspection representative, if required (see clause 15).

NOTE. Marking EN 10 222 on or in relation to a product is a claim by the manufacturer that the product has been manufactured in accordance with the requirements of this European Standard. The accuracy of such a claim is therefore the manufacturer's sole responsibility.

16.2 The mark shall be placed in the area indicated on the forging drawing, or at the discretion of the supplier, if not shown on the forging drawing.

16.3 If stamping is not permissible the mark shall be made with paint (see A.18).

16.4 For small forgings that are boxed, the information required by 16.1 may be marked on the box, or on a tag securely attached to the box, in which the forgings are shipped.

Annex A (normative)

Options

A.1 Steelmaking process

Any specific requirements for the steelmaking process or information required by the purchaser concerning the manufacturing process, shall be indicated at the time of the enquiry and order.

A.2 Hot working

The hot working process and, if so agreed, the degree of hot working, shall be in compliance with any special agreements made at the time of the enquiry and order.

A.3 Forging reduction

The purchaser may request to be informed of the forging procedure, and the calculated forging reduction.

A.4 Hydraulic testing

When hydraulic testing is required by the purchaser, every forging shall be tested, unless otherwise agreed between the purchaser and the manufacturer. Details of the test procedure, including the test temperature and pressure shall be agreed between the purchaser and manufacturer. In no case shall the nominal stress produced by the hydraulic test exceed 90 % of the specified minimum room temperature yield strength of the steel or where the steel does not exhibit a pronounced yield point, 90% of the 0,2% proof strength (see 13.1). The test pressure shall be maintained for a time to be agreed between the purchaser and manufacturer.

A.5 Ultrasonic inspection

Ultrasonic inspection shall be carried out in accordance with prEN 10228: Part 3 or Part 4. The acceptance criteria shall be agreed at the time of enquiry and order. The quantity of forgings tested shall be a statistically controlled sample or 100 % as agreed between purchaser and supplier.

A.6 Magnetic particle inspection

Magnetic particle inspection shall be carried out in accordance with prEN 10228: Part 1. The acceptance criteria shall be agreed at the time of enquiry and order. The quantity of forgings tested shall be a statistically controlled sample or 100 % as agreed between purchaser and supplier.

A.7 Penetrant inspection

Penetrant inspection shall be carried out in accordance with prEN 10228: Part 2. The acceptance criteria shall be agreed at the time of the enquiry and order. The quantity of forgings tested shall be a statistically controlled sample or 100 % as agreed between purchaser and supplier.

A.8 Declaration of residual elements

The residual elements specified in the order shall be declared on the manufacturers certificate at the request of the purchaser.

A.9 Limits on residual incidental elements

The limits on residual incidental elements other than those specified, shall be agreed between purchaser and manufacturer.

A.10 Product analysis

The number of samples for product analysis shall be stated by the purchaser. The samples shall be taken either from the test pieces used for the verification of the mechanical properties or from drillings from the same location (see also A.11 and A.12).

A.11 Product analysis from a different location

The location, if different from that in A.10, shall be agreed between purchaser and manufacturer, as shall also the permissible deviations in analyses, taking into account the heterogeneity of the product, (see also A.12).

A.12 Product analysis dispute

In the case of dispute, product analyses shall be carried out in accordance with the methods in the relevant European Standards listed in CR10261.

A.13 Maximum carbon equivalent values for weldability

As agreed between the manufacturer and purchaser, forgings shall be supplied with a specific maximum carbon equivalent value. These maximum values which are based upon cast analysis, shall be as given in Part 2 of this European Standard. The carbon equivalent value (CEV) shall be calculated using the following formula :

$$CEV = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15} \%$$

A.14 Simulated post-weld heat treatment of samples

If the purchaser intends to incorporate the forging or fabrication in a welded vessel or structure and applies a post-weld heat treatment, samples that have received heat treatment in accordance with 7.3 shall also be subjected to a heat treatment that simulates the post-weld heat treatment to be applied to the welded vessel or structure by the purchaser. The post-weld heat treatment and the mechanical properties to be obtained after testing these samples in accordance with clause 13 shall be agreed between the purchaser and the manufacturer.

NOTE 1: If any additional or unforeseen post-weld heat treatment is applied by the purchaser, the heat treatment temperature should not exceed the temperature of the final heat treatment, i.e. either tempering or post-weld heat treatment applied to the samples.

NOTE 2: If required, the purchaser may be supplied with additional test samples cut from the forging after heat treatment in accordance with 7.3 with a view to subjecting these samples to additional heat treatment and subsequent mechanical testing for information purposes.

NOTE 3: The samples for simulation of post-weld heat treatment exclude test materials supplied for welding tests and should receive the heat treatments referred to in 7.3.

A.15 Elevated temperature properties and verification

Should additional elevated temperature testing be required (see 11.2) this shall be carried out in accordance with EN 10 002-5. The number, position and temperatures of tests shall be agreed between the purchaser and the manufacturer.

A.16 Impact tests

The purchaser shall state whether impact testing is required at below room temperature (see clause 13) or on samples subjected to a stress-relieving post-weld heat treatment. In the latter case values required shall be agreed between purchaser and supplier. The Charpy V-notch impact tests shall be carried out in accordance with the requirements of EN 10 045-1. For austenitic stainless steels the purchaser may request Charpy V-notch impact tests to be carried out in accordance with EN 10 045-1. The required levels shall be specified at the time of enquiry and order.

A.17 Intergranular corrosion test

An intergranular corrosion test shall be carried out as specified in prEN ISO 3651-2 (unless otherwise specified in the order). One test shall be made on each cast and heat treatment batch on the forging having the largest equivalent diameter in the batch.

A.18 Marking by use of paint

Where stamping is not permissible, marking shall be by use of a permanent paint, neutral with regard to the steel to which it is applied. Any restriction regarding the composition shall be specified by the purchaser at the time of enquiry and order.

NOTE: In the choice of paints legal requirements of CEC or national countries should be taken into account.

Annex B (informative)

Ruling section and equivalent thickness

B.1 General

This annex covers definitions for the term "Ruling section" and "equivalent thickness" (t_{eq}) and describes methods for the determination of t_{eq} .

B.2 Definitions

B.2.1 Ruling section

That section for which the mechanical properties are specified.

B.2.2 Equivalent thickness (t_{eq})

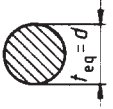
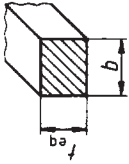
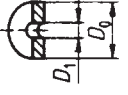
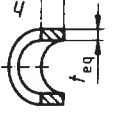
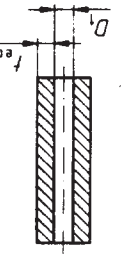
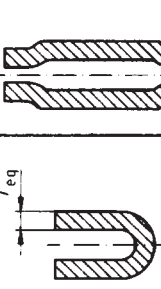
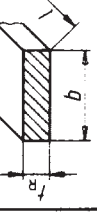
That thickness of a section of a shape X for which the same properties as for the thickness t_R of the ruling section can be expected when the same heat treatment, sampling and testing conditions are applied.

B.3 Determination of the equivalent thickness

B.3.1 Thicknesses equivalent to the thicknesses given in the tables for the mechanical properties in the relevant Parts of this European Standard shall, unless otherwise agreed at the time of the enquiry and order, be read off from table B.1 (see B.3.2).

B.3.2 If for the shape of the section of the ordered product no equivalent thicknesses are given in table B.1, the thickness range of table 1 in the relevant Parts of this European Standard which is applicable for the relevant section, shall be agreed at the time of the enquiry and order.

Table B.1: Equivalent thickness for sections of shapes different from the ruling sections¹⁾

Equivalent thickness t_{eq} , in mm, for															
Bars with round cross section		Bars with rectangular cross section		Discs	Rings	Cylindrical hollow section both ends open			Cylindrical hollow section both ends closed	Other sections	Thickness t_R of ruling section ¹⁾				
	$t_{eq} \approx 1,5t_R$		$1 \leq \frac{b}{t_{eq}} < 2$ $t_{eq} \approx 1,2t_R$		$D_o - D_i \geq 2t_{eq}$ $D_i \leq 200 \text{ mm}$ $t_{eq} \approx t_R$		$h > t_{eq}$ $D_i > 200 \text{ mm}$ $t_{eq} \approx t_R$		$D_i > 200 \text{ mm}$ $t_{eq} \approx t_R$	$D_i \geq 80 \leq 200 \text{ mm}$ $t_{eq} \approx 0,85$	$D_i < 80 \text{ mm}$ $t_{eq} \approx 0,75t_R$		$t_{eq} \approx 0,6t_R$		$\frac{b}{t_R} \geq 2 \frac{l}{t_R} \geq 4$ 
25	20	16	16	16	16	16	16	16	15	12	10	16	16	16	$\frac{b}{t_R} \geq 2 \frac{l}{t_R} \geq 4$
50	40	35	35	35	35	35	35	35	30	25	20	35	35	35	
75	60	50	50	50	50	50	50	50	40	35	30	50	50	50	
100	80	70	70	70	70	70	70	70	55	50	40	70	70	70	
150	120	100	100	100	100	100	100	100	85	75	60	100	100	100	
200	160	130	130	130	130	130	130	130	115	100	80	130	130	130	
250	200	160	160	160	160	160	160	160	140	125	100	160	160	160	
300	250	200	200	200	200	200	200	200	170	150	120	200	200	200	
375	300	250	250	250	250	250	250	250	210	180	150	250	250	250	
500	400	330	330	330	330	330	330	330	280	250	200	330	330	330	
600	480	400	400	400	400	400	400	400	340	300	240	400	400	400	
750	600	500	500	500	500	500	500	500	425	375	300	500	500	500	

¹⁾ Indicated are the thickness values given in the tables for the mechanical properties in EN 10222 : Parts 2 to 5 for the ruling section, i.e. regular cross section with a width to thickness ratio of ≥ 2 and a length to thickness ratio of ≥ 4 .

Annex ZA **(informative)**

Clauses of this European Standard addressing essential requirements or other provisions of EU Directives

This European Standard has been prepared under a mandate given to CEN by the European Commission and supports essential requirements of EU Directive 97/23/EC.

Warning: Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this European Standard.

The clauses of this European Standard are likely to support the essential requirements of section 4 of annex 1, "Essential safety requirements" of the Pressure Equipment Directive 97/23/EC.

Compliance with this European Standard provides one means of conforming with the specific essential requirements of the Directive concerned.