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**Jekleni izkovki za tlačne posode - 2. del: Feritna in martenzitna jekla s specificiranimi lastnostmi pri povišanih temperaturah**

Steel forgings for pressure purposes - Part 2: Ferritic and martensitic steels with specified elevated temperatures properties

Schmiedestücke aus Stahl für Druckbehälter - Teil 2: Ferritische und martensitische Stähle mit festgelegten Eigenschaften bei erhöhten Temperaturen

Pièces forgées en acier pour appareils à pression - Partie 2 : Aciers ferritiques et martensitiques avec propriétés spécifiées à température élevée

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**Ta slovenski standard je istoveten z: EN 10222-2:2017+A1:2021**

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**ICS:**

77.140.30	Jekla za uporabo pod tlakom	Steels for pressure purposes
77.140.85	Železni in jekleni kovani izdelki	Iron and steel forgings

**SIST EN 10222-2:2017+A1:2021****en,fr,de**

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EUROPEAN STANDARD  
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**EN 10222-2:2017+A1**

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English Version

## Steel forgings for pressure purposes - Part 2: Ferritic and martensitic steels with specified elevated temperatures properties

Pièces forgées en acier pour appareils à pression -  
Partie 2 : Aciers ferritiques et martensitiques avec  
propriétés spécifiées à température élevée

Schmiedestücke aus Stahl für Druckbehälter - Teil 2:  
Ferritische und martensitische Stähle mit festgelegten  
Eigenschaften bei erhöhten Temperaturen

This European Standard was approved by CEN on 25 December 2016 and includes Amendment 1 approved by CEN on 2 May 2021.

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

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

**CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels**

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## European foreword

This document (EN 10222-2:2017+A1:2021) has been prepared by Technical Committee ECISS/TC 459/SC 11 “Steel castings and forgings”, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2021, and conflicting national standards shall be withdrawn at the latest by December 2021.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN not be held responsible for identifying any or all such patent rights.

This document supersedes A1 EN 10222-2:2017 A1.

This document includes Amendment 1 approved by CEN on 11 April 2021.

The start and finish of text introduced or altered by amendment is indicated in the text by tags A1 A1.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive 2014/68/EU.

For relationship with EU Directive 2014/68/EU, see informative Annex ZA, which is an integral part of this document.

EN 10222 consists of the following parts under the general title “Steel forgings for pressure purposes”:

- *Part 1: General requirements for open die forgings*
- *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.*

A1 *deleted sentence* A1.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

**EN 10222-2:2017+A1:2021 (E)****1 Scope**

This part of this European Standard specifies the technical delivery conditions for forgings for pressure purposes, made of ferritic and martensitic steels with specified elevated temperature properties. Chemical composition and mechanical properties are specified.

**NOTE** Once this standard is published in the EU Official Journal (OJEU) under Directive 2014/68/EU, presumption of conformity to the Essential Safety Requirements (ESRs) of Directive 2014/68/EU is limited to technical data of materials in this standard and does not presume adequacy of the material to a specific item of equipment. Consequently, the assessment of the technical data stated in this material standard against the design requirements of this specific item of equipment to verify that the ESRs of Directive 2014/68/EU are satisfied, needs to be done. The series EN 10222-1 to EN 10222-5 is structured so that the data related to different materials is in the part allocated for that material. The presumption of conformity to the Essential Safety Requirements of Directive 2014/68/EU depends on both the text in part 1 and the data in part 2, 3, 4 or 5.

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

**2 Normative references**

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

EN 10222-1:2017, *Steel forgings for pressure purposes — Part 1: General requirements*

**3 Terms and definitions**

For the purpose of this document, the terms and definitions given in EN 10222-1:2017 apply.

**4 Classification and designation****4.1 Classification**

In accordance with EN 10020, the grades P235GH, P245GH, P250GH, P265GH, P280GH, P295GH and P305GH are non-alloy quality steels. All others are alloy special steels.

**4.2 Designation**

See EN 10222-1:2017.

**5 Information to be supplied by the purchaser****5.1 Mandatory informations**

See EN 10222-1:2017

## 5.2 Options

A number of options are specified in this European Standard and listed below. Additionally the relevant options of EN 10222-1:2017 apply. If the purchaser does not give any information to implement any of these options at the time of enquiry and order, the products shall be supplied in accordance with the basic specification (see also EN 10222-1:2017).

- 1) test temperature for the tensile test at elevated temperature, if applicable (see 6.4);
- 2) normalized forming instead normalizing (see Table 1, footnote c);
- 3) carbon equivalent for non-alloy steels (see Table 2);
- 4) increased minimum chromium content (see Table 2, footnote b);
- 5) minimum impact energy values (see Table 4, footnote d);
- 6) test to evaluate the resistance to hydrogen induced cracking (see 6.7);
- 7) different test temperature for the impact energy and appropriate values (see Table 4, footnote e);
- 8) higher sulphur content for alloy steels (see Table 2, footnote e).

## 6 Requirements

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### 6.1 Steelmaking process and manufacture of the product

Shall be in accordance with EN 10222-1:2017  
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### 6.2 Delivery condition

The products shall be delivered in the heat treatment condition specified of Table 1.

### 6.3 Chemical composition and chemical composition properties

#### 6.3.1 Cast analysis

The chemical composition (cast analysis), determined in accordance with EN 10222-1:2017 shall conform the requirements of Table 2.

#### 6.3.2 Product analysis

The product analysis shall not deviate from the specified cast analysis (see 6.3.1) by more than the values specified in Table 3.

### 6.4 Mechanical properties

When heat treated in accordance with Table 1, the mechanical properties at room temperature determined in accordance with EN 10222-1:2017, shall conform to the requirements of Table 4.

Elevated temperature proof strength ( $R_{p0,2}$ ) properties shall conform to the requirements of Table 5.

If verification of specified proof strength at elevated temperature is requested (see option in EN 10222-1:2017), the testing temperature should be agreed at the time of enquiry and order. Otherwise, the test shall be carried out at 300 °C.

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Reference data for 1 % (plastic) creep strain and creep rupture are given in Annex A.

**6.5 Surface condition**

See EN 10222-1:2017.

**6.6 Internal soundness**

See EN 10222-1:2017.

**6.7 Resistance to hydrogen induced cracking**

Non-alloy and low alloy steels may be susceptible to cracking when exposed to corrosive H<sub>2</sub>S containing environments, usually referred to as „sour service“.

A test to evaluate the resistance to hydrogen induced cracking in accordance with EN 10229 may be agreed at the time of enquiry and order.

**7 Inspection**

See EN 10222-1:2017.

**8 Sampling**

See EN 10222-1:2017.

**9 Test methods**

See EN 10222-1:2017.

**10 Retests**

See EN 10222-1:2017.

**11 Marking**

See EN 10222-1:2017.

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Table 1 — Heat treatment

Steel designation		Heat treatment				
Name	Number	Symbol <sup>b</sup>	Austenizing or solution annealing		Tempering	
			Temperature °C	Cooling in <sup>a</sup>	Temperature °C	Cooling in <sup>a</sup>
P235GH	1.0345	+N <sup>c</sup>	890 to 950	a	-	-
P245GH	1.0352	+A	890 to 930	f	600 to 640	a, f
		+N <sup>c</sup>		a		
		+NT or +QT		a, o, p, w		
P250GH	1.0460	+N <sup>c</sup>	890 to 950	a	-	-
P265GH	1.0425	+N <sup>c</sup>	890 to 950	a	-	-
P280GH	1.0426	+N <sup>c</sup>	880 to 920	a	600 to 640	a, f
		+NT or +QT		a, o, p, w		
P295GH	1.0481	+N <sup>c</sup>	890 to 950	a	600 to 640	a, f
		+NT or +QT		a, o, p, w		
P305GH	1.0436	+N <sup>c</sup>	880 to 920	a	620 to 660	a, f
		+NT or +QT		a, o, p, w		
16Mo3	1.5415	+N	890 to 950	a	-	-
		+QT	890 to 960	o, p, w	620 to 700	a, f
13CrMo4-5	1.7335	+NT	890 to 950	a	630 to 740	a, f
		+NT or +QT		a, o, p, w		
15MnMoV4-5	1.5402	+NT or +QT	875 to 925	a, w	600 to 675	a, f
18MnMoNi5-5	1.6308	+QT	850 to 925	w	625 to 675	a, f
14MoV6-3	1.7715	+NT or +QT	950 to 990	a, o, p	670 to 720	a, f
15MnCrMoNiV5-3	1.6920	+NT or +QT	900 to 950	a, w	625 to 675	a, f
11CrMo9-10	1.7383	+NT	900 to 980	a, o, p	670 to 770	a, f
		+NT or +QT		a, o, p, w		
X16CrMo5-1	1.7366	+A	850 to 880	f	-	-

Steel designation		Heat treatment				
Name	Number	Symbol <sup>b</sup>	Austenizing or solution annealing		Tempering	
			Temperature °C	Cooling in <sup>a</sup>	Temperature °C	Cooling in <sup>a</sup>
				+NT or +QT	925 to 975	a, o, p
X10CrMoVNb9-1	1.4903	+NT	1040 to 1090	a, o, p	730 to 780	a,
X20CrMoV11-1	1.4922	+QT	1020 to 1070	a, o, p	730 to 780	a, f

<sup>a</sup> a = air; f = furnace; o = oil; p = polymer; w = water.

<sup>b</sup> A = annealed; N = normalized; QT = quenched and tempered; NT = normalized and tempered.

<sup>c</sup> If agreed at time of enquiry and order normalizing "N" may be replaced by normalizing forming

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Table 2 — Chemical composition

Steel designation		Chemical composition (cast analysis) % <sup>a</sup>															
Name	Number	C	Si max.	Mn	P max.	S max.	Al total	N	Cr	Cu	Mo	Nb	Ni	Ti max.	V	Others	Carbon equivalent value max. %
P235GH <sup>c</sup>	1.0345	≤ 0,16	0,35	0,40 to 1,20	0,025	0,010	≥ 0,020	≤ 0,012	≤ 0,30	≤ 0,30	≤ 0,08	≤ 0,01f	≤ 0,30	0,03	≤ 0,02	Cr+Cu+Mo+Ni ≤ 0,70	-
P245GH <sup>c</sup>	1.0352	0,08 to 0,20	0,40	0,50 to 1,30	0,025	0,015	≥ 0,020	≤ 0,012	≤ 0,30	≤ 0,30	≤ 0,08	≤ 0,01	≤ 0,30	-	≤ 0,02	Cr+Cu+Mo+Ni ≤ 0,70	0,41
P250GH <sup>c</sup> d	1.0460	0,18 to 0,23	0,40	0,30 to 0,90	0,025	0,015	≥ 0,020	≤ 0,012	≤ 0,30	≤ 0,30	≤ 0,08	≤ 0,01f	≤ 0,30	0,03	≤ 0,02	Cr+Cu+Mo+Ni ≤ 0,70	0,43
P265GH <sup>c</sup>	1.0425	≤ 0,20	0,40	0,60 to 1,40	0,025	0,010	≥ 0,020	≤ 0,012	≤ 0,30	≤ 0,30	≤ 0,08	≤ 0,01f	≤ 0,30	0,03	≤ 0,02	Cr+Cu+Mo+Ni ≤ 0,70	0,43
P280GH <sup>c</sup>	1.0426	0,08 to 0,20	0,40	0,90 to 1,50	0,025	0,015	≥ 0,020	≤ 0,012	≤ 0,30	≤ 0,30	≤ 0,08	≤ 0,01	≤ 0,30	-	≤ 0,02	Cr+Cu+Mo+Ni ≤ 0,70	0,45
P295GH <sup>c</sup>	1.0481	0,08 to 0,20	0,40	0,70 to 1,50	0,025	0,010	≥ 0,020	≤ 0,012	≤ 0,30	≤ 0,30	≤ 0,08	≤ 0,01f	≤ 0,30	0,03	≤ 0,02	Cr+Cu+Mo+Ni ≤ 0,70	0,45
P305GH <sup>c</sup>	1.0436	0,15 to 0,20	0,40	0,90 to 1,60	0,025	0,015	≥ 0,020	≤ 0,012	≤ 0,30	≤ 0,30	≤ 0,08	≤ 0,01	≤ 0,30	-	≤ 0,02	Cr+Cu+Mo+Ni ≤ 0,70	0,47
16Mo3 <sup>e</sup>	1.5415	0,12 to 0,20	0,35	0,40 to 0,90	0,025	0,010	-	≤ 0,012	≤ 0,30	≤ 0,30	0,25 to 0,35	-	≤ 0,30	-	-	-	-
13CrMo4-5 <sup>e</sup>	1.7335	0,08 to 0,18	0,35	0,40 to 1,00	0,025	0,010	-	≤ 0,012	0,70 <sup>b</sup> to 1,15	≤ 0,30	0,40 to 0,60	-	≤ 0,30	-	-	-	-