



SLOVENSKI STANDARD SIST EN 10222-2:2000

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gdYWZVfUb]a]`Uglbcgla]df]'dcj]yUb]`hYa dYfUi fU

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

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

Pieces forgées en acier pour appareils a pression - Partie 2: Aciers ferritiques et martensitiques avec caractéristiques spécifiées a température élevée

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Ta slovenski standard je istoveten z: EN 10222-2:1999

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 |

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ICS 77.140.30; 77.140.85

English version

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This European Standard was approved by CEN on 5 September 1999.

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 Central Secretariat or to any CEN member.

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 Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

| Contents | Page |
|--|-------------|
| Foreword | 3 |
| 1 Scope | 4 |
| 2 Normative references | 4 |
| 3 Chemical composition | 4 |
| 3.1 Cast analysis | 4 |
| 3.2 Product analysis | 4 |
| 4 Heat treatment and mechanical properties | 5 |
| Annex A (informative) | 11 |
| Annex ZA (informative) A–deviations | 19 |
| Annex ZB (informative) Clauses of this European Standard addressing essential requirements or other provisions of EU Directives. | 20 |

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Foreword

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

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by Juni 2000, and conflicting national standards shall be withdrawn at the latest by Juni 2000.

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

For relationship with EU Directive(s), see informative Annex ZB, which is an integral part of this standard.

Attention is drawn to annex ZA which is an A-deviation requested by Sweden.

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

Part 1: General requirements for open die forgings

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

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

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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.

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 10021 | General technical delivery requirements for iron and steel products. |
| EN 10222-1:1998 | Steel forgings for pressure purposes - Part 1: General requirements for open die forgings. |

3 Chemical composition

3.1 Cast analysis

The chemical composition (cast analysis), determined in accordance with EN 10222-1 shall conform to the requirements of table 1 (see 9.1 of EN 10222-1:1998).

3.2 Product analysis

The product analysis shall not deviate from the specified cast analysis (see table 1) by more than the values specified in table 2 (see 9.2 of EN 10222-1:1998).

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4 Heat treatment and mechanical properties

When heat treated in accordance with table 1, the mechanical properties determined in accordance with EN 10222-1, shall conform to the requirements of table 1.

Elevated temperature proof strength ($R_{p0,2}$) properties shall conform to the requirements of table 3.

The testing temperature for impact properties and elevated temperature properties shall be agreed at the time of enquiry and order.

Reference data for stress rupture properties and 1% creep limit properties are given in annex A for information.

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Table 1: Chemical composition, mechanical properties and heat treatment

| Steel designation | | Chemical composition (cast analysis) % ¹⁾ | | | | | | | | | | Mechanical properties at room temperature | | | | | | Heat treatment | | | | Carbon equivalent value |
|-------------------|--------|--|---------|------|--------|--------|----------------------------|--------------|--------|--|---|---|---|-------------------------------------|----------------------|--|---------------|--------------------------|---------------|--------------------------------|------|-------------------------|
| Name | Number | C | Si max. | Mn | P max. | S max. | Cr | Mo | Others | Thickness of the ruling section t_R ²⁾ mm | Yield strength R_{eH} ³⁾ N/mm ² min | Tensile strength R_m N/mm ² | Elongation after fracture A ⁴⁾ min % | Notch impact KV ⁴⁾ min J | Symbol ⁵⁾ | Austenitizing or solution annealing Temperature °C | Cooling in °C | Tempering Temperature °C | Cooling in °C | Carbon equivalent value max. % | | |
| P245GH | 1.0352 | 0,08 | 0,40 | 0,50 | 0,025 | 0,015 | - | - | - | $t_R \leq 35$ | 245 | 410 to 530 | 25 | 32 ⁷⁾ | A | 890 to 930 | f | - | - | - | - | |
| | | to 0,20 | | 1,30 | | | | | | 220 | 410 to 530 | 25 | 32 ⁷⁾ | N | 890 to 930 | a | - | - | - | - | - | 0,41 |
| P280GH | 1.0426 | 0,08 | 0,40 | 0,90 | 0,025 | 0,015 | - | - | - | $t_R \leq 35$ | 280 | 460 to 580 | 23 | 48 ⁷⁾ | N | 880 to 920 | a | - | - | - | - | |
| | | to 0,20 | | 1,50 | | | | | | 255 | 460 to 580 | 23 | 48 ⁷⁾ | NT or QT | 880 to 920 | a, o, w | 600 to 640 | a, f | - | - | 0,45 | |
| P305GH | 1.0436 | 0,15 | 0,40 | 0,90 | 0,025 | 0,015 | - | - | - | $t_R \leq 35$ | 305 | 490 to 610 | 22 | 48 ⁷⁾ | N | 880 to 920 | a | - | - | - | - | |
| | | to 0,20 | | 1,60 | | | | | | 280 | 490 to 610 | 22 | 48 ⁷⁾ | NT | 880 to 920 | a, o, w | 620 to 660 | a, f | - | - | 0,47 | |
| 16Mo3 | 1.5415 | 0,12 | 0,35 | 0,40 | 0,025 | 0,015 | - | 0,25 to 0,35 | - | $t_R \leq 35$ | 295 | 440 to 570 | 23 | 50 ⁷⁾ | N | 890 to 950 | a | - | - | - | - | |
| | | to 0,20 | | 0,90 | | | | | | 285 | 440 to 570 | 23 | 50 ⁷⁾ | QT | 890 to 960 | o, w | 620 to 700 | a, f | - | - | - | |
| 13CrMo4.5 | 1.7335 | 0,08 | 0,35 | 0,40 | 0,025 | 0,015 | 0,70 to 1,15 ⁸⁾ | 0,40 to 0,60 | - | $t_R \leq 250$ | 265 | 440 to 570 | 23 | 50 ⁷⁾ | QT | 890 to 960 | o, w | 620 to 700 | 630 to 740 | 630 to 740 | a, f | - |
| | | to 0,18 | | 1,00 | | | | | | 250 | 420 to 550 | 20 | 44 ⁷⁾ | NT | 890 to 950 | a | 630 to 740 | a, f | - | - | - | |
| | | | | | | | | | | $250 < t_R \leq 500$ | 240 | 420 to 570 | 20 | 44 ⁷⁾ | NT or QT | 890 to 950 | a, o, w | 630 to 740 | 630 to 740 | a, f | - | |

¹⁾ Elements not listed in this table shall not be intentionally added to the steel without the approval of the purchaser except for finishing the cast. All appropriate measures shall be taken to prevent the addition from scrap or other materials used in steelmaking of these elements which may adversely affect the mechanical properties and usability. The following elements shall not exceed the limits stated: chromium 0,30 % max., copper 0,30 % max., niobium 0,01 % max., vanadium 0,02 % max. The total of chromium + copper + molybdenum shall not exceed 0,50 %.

²⁾ The thickness ranges given in this column apply for the as heat treated thickness of forgings with the ruling section. This is characterized by rectangular shape, a width to thickness ratio of ≥ 2 and a length to thickness ratio of ≥ 4 . For forgings with other sections the equivalent thickness shall be determined according to EN 10222-1, annex B or be agreed at the time of enquiry and order.

³⁾ Until the yield point criteria are harmonized in the various national codes, determination of R_{eH} may be replaced by determination of $R_{p0.2}$. In this case, $R_{p0.2}$ values are 10 N/mm² lower for R_{eH} values up to 355 N/mm² and 15 N/mm² lower for R_{eH} values greater than 355 N/mm².

⁴⁾ l – longitudinal t – transverse
 a – air f – furnace o – oil w – water
 N – normalized QT – quenched and tempered NT – normalized and tempered

⁵⁾ Optional at 0 °C. The minimum requirements of the Standard shall be met.

⁶⁾ If resistance to pressurized hydrogen is of importance, a min Cr of 0,80 % may be agreed at the time of enquiry and order.

Table 1: Chemical composition, mechanical properties and heat treatment (continued)

| Steel designation | | Chemical composition (cast analysis) (% ¹⁾) | | | | | | | | | | Mechanical properties at room temperature | | | | | | Heat treatment | | | | Carbon equivalent value max. % |
|-------------------|--------|---|---------|--------------|--------|--------|--------------|--------------|--|--|---|---|---|--|----------------------|--|-----------------|--------------------------|--------------|---|--|--------------------------------|
| Name | Number | C | Si max. | Mn | P max. | S max. | Cr | Mo | Others | Thickness of the ruling section r_k ²⁾ mm | Yield strength R_{eH} ³⁾ N/mm ² min | Tensile strength R_m N/mm ² | Elongation after fracture A % ⁴⁾ min | Notch impact KV ⁵⁾ min J | Symbol ⁶⁾ | Austenitizing or solution annealing Temperature °C | Cooling in °C | Tempering Temperature °C | Cooling in | | | |
| 15MnMoV4-5 | 1.5402 | 0,18 max. | 0,40 | 0,90 to 1,40 | 0,025 | 0,015 | — | 0,40 to 0,60 | V 0,04 to 0,08 | $r_k \leq 35$ $35 < r_k \leq 70$ $70 < r_k \leq 250$ | 345 345 325 | 510 to 650 | 23 22 21 | 40 ⁷⁾ 40 ⁷⁾ 40 ⁷⁾ | NT or QT | 875 to 925 | a, w | 600 to 675 | a, f | — | | |
| 18MnMoNi5-5 | 1.6308 | 0,20 max. | 0,40 | 1,15 to 1,55 | 0,025 | 0,015 | — | 0,45 to 0,55 | Ni 0,50 to 0,80 V 0,03 max. | $r_k \leq 200$ | 400 | 550 to 670 | 20 | 56 ⁷⁾ | QT | 850 to 925 | w | 625 to 675 | a, f | — | | |
| 14MoV6-3 | 1.7715 | 0,10 to 0,18 | 0,40 | 0,40 to 0,70 | 0,025 | 0,015 | 0,30 to 0,60 | 0,50 to 0,70 | V 0,22 to 0,28 Sn $\leq 0,025$ Al 0,020 max. | $r_k \leq 500$ | 300 | 460 to 610 | 20 | 27 | NT or QT | 950 to 990 | a, o | 670 to 720 | a, f | — | | |
| 15MnCrMoNiV5-3 | 1.6920 | 0,17 max. | 0,40 | 1,00 to 1,50 | 0,025 | 0,015 | 0,50 to 1,00 | 0,20 to 0,35 | Ni 0,30 to 0,70 V 0,05 to 0,10 | $r_k \leq 100$ | 370 | 560 to 710 | 17 | 40 | NT or QT | 900 to 950 | a, w | 625 to 675 | a, f | — | | |
| 11CrMo9-10 | 1.7383 | 0,08 to 0,15 | 0,50 | 0,40 to 0,80 | 0,025 | 0,015 | 2,00 to 2,50 | 0,90 to 1,10 | — | $r_k \leq 200$ $200 < r_k \leq 500$ | 310 265 | 520 to 670 450 to 600 | 20 23 | 40 ⁷⁾ 60 50 | NT or QT | 900 to 980 900 to 980 | a, o a, o, w | 670 to 770 670 to 770 | a, f a, f | — | | |

¹⁾ Elements not listed in this table shall not be intentionally added to the steel without the approval of the purchaser except for finishing the cast. All appropriate measures shall be taken to prevent the addition from scrap or other materials used in steelmaking of these elements which may adversely affect the mechanical properties and usability. The following elements shall not exceed the limits stated: chromium 0,30 % max., copper 0,30 % max., molybdenum 0,08 % max., nickel 0,30 % max., niobium 0,01 % max., vanadium 0,02 % max. The total of chromium + copper + molybdenum shall not exceed 0,30 %.

²⁾ The thickness ranges given in this column apply for the as heat treated thickness of forgings with the ruling section. This is characterized by rectangular shape, a width to thickness ratio of ≥ 2 and a length to thickness ratio of ≥ 4 . For forgings with other sections the equivalent thickness shall be determined according to EN 10222-1, annex B or be agreed at the time of enquiry and order.

³⁾ Until the yield point criteria are harmonized in the various national codes, determination of R_{eH} may be replaced by determination of $R_{p0,2}$. In this case, $R_{p0,2}$ values are 10 N/mm² lower for R_{eH} values up to 355 N/mm² and 15 N/mm² lower for R_{eH} values greater than 355 N/mm².

⁴⁾ l – longitudinal
t – transverse

⁵⁾ A – annealed
N – normalized
NT – quenched and tempered

⁶⁾ a – air
f – furnace
o – oil
w – water

⁷⁾ Optional at 0 °C. The minimum requirements of the Standard shall be met.

⁸⁾ If resistance to pressurized hydrogen is of importance, a min Cr of 0,80 % may be agreed at the time of enquiry and order.

Table 1: Chemical composition, mechanical properties and heat treatment (concluded)

| Steel designation | | Chemical composition (cast analysis) % ¹⁾ | | | | | | | Mechanical properties at room temperature | | | | | Heat treatment | | | | Carbon equivalent value max. % | | |
|-------------------|--------|--|---------|--------------|--------|--------|----------------|--------------|--|--|---|--|---|-----------------------------|----------------------|--|---------------|--------------------------------|--------------------------|---------------|
| Name | Number | C | Si max. | Mn | P max. | S max. | Cr | Mo | Others | Thickness of the ruling section t_k ²⁾ mm | Yield strength R_{eH} ³⁾ N/mm ² min | Tensile strength R_m N/mm ² | Elongation after fracture A ⁴⁾ min % | Notch impact KV min J tr.t. | Symbol ⁵⁾ | Austenitizing or solution annealing Temperature °C | Cooling in °C | | Tempering Temperature °C | Cooling in °C |
| X16CrMo5-1 | 1.7366 | 0,18 max. | 0,40 | 0,30 to 0,80 | 0,025 | 0,015 | 4,00 to 6,00 | 0,45 to 0,65 | - | $t_k \leq 300$ | 205 420 | 410 to 510 640 to 780 | 18 16 | 40 40 | A NT | 850 to 880 925 to 975 | f a, o | - 690 to 750 | - a, f | - |
| X10CrMoVNb9-1 | 1.4903 | 0,08 to 0,12 | 0,50 | 0,30 to 0,60 | 0,025 | 0,015 | 8,00 to 9,50 | 0,85 to 1,05 | Ni 0,40 max. Nb 0,06 to 0,10 V 0,18 to 0,25 N 0,030 to 0,070 Al 0,040 max. | $t_k \leq 130$ | 450 | 630 to 730 | 19 | 40 ⁷⁾ | NT | 1040 to 1090 | a, o | 730 to 780 | a, f | - |
| X20CrMoV11-1 | 1.4922 | 0,17 to 0,23 | 0,40 | 0,30 to 1,00 | 0,025 | 0,015 | 10,00 to 12,50 | 0,80 to 1,20 | Ni 0,30 to 0,80 V 0,20 to 0,35 | $t_k \leq 100$ $100 < t_k \leq 250$ $250 < t_k \leq 330$ | 500 500 500 | 700 to 850 700 to 850 700 to 850 | 16 16 16 | 39 31 27 | QT | 1020 to 1070 | a, o | 730 to 780 | a, f | - |

¹⁾ Elements not listed in this table shall not be intentionally added to the steel without the approval of the purchaser except for finishing the cast. All appropriate measures shall be taken to prevent the addition from scrap or other materials used in steelmaking of these elements which may adversely affect the mechanical properties and usability. The following elements shall not exceed the limits stated: chromium 0,30 % max., copper 0,30 % max., nickel 0,30 % max., niobium 0,01 % max., vanadium 0,02 % max. The total of chromium + copper + molybdenum shall not exceed 0,50 %.

²⁾ The thickness ranges given in this column apply for the as heat treated thickness of forgings with the ruling section. This is characterized by rectangular shape, a width to thickness ratio of ≥ 2 and a length to thickness ratio of ≥ 4 . For forgings with other sections the equivalent thickness shall be determined according to EN 10222-1, annex B or be agreed at the time of enquiry and order.

³⁾ Until the yield point criteria are harmonized in the various national codes, determination of R_{eH} may be replaced by determination of $R_{p0.2}$. In this case, $R_{p0.2}$ values are 10 N/mm² lower for R_{eH} values up to 355 N/mm² and 15 N/mm² lower for R_{eH} values greater than 355 N/mm².

⁴⁾ l – longitudinal
t – tangential
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⁵⁾ A – annealed
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⁶⁾ a – air
f – furnace
o – oil
w – water

⁷⁾ Optional at 0 °C. The minimum requirements of the Standard shall be met.

⁸⁾ If resistance to pressurized hydrogen is of importance, a min Cr of 0,80 % may be agreed at the time of enquiry and order.

Table 2: Permissible deviations of the product analysis from specified values of the cast analysis

| Element | Specified value in the cast analysis according to table 1 % | Permissible deviations ¹⁾ of the product analysis % |
|---------|--|---|
| C | ≤ 0,23 | ± 0,02 |
| Si | ≤ 0,50 | + 0,05 |
| Mn | ≤ 1,00 > 1,00 ≤ 160 | ± 0,05 ±0,10 |
| P | ≤ 0,025 | + 0,005 |
| S | ≤ 0,015 | + 0,003 |
| Al | ≤ 0,040 | + 0,005 |
| Cr | ≤ 1,00 > 1,00 ≤ 10,0 > 10,0 ≤ 12,5 | ± 0,05 ± 0,10 ± 0,15 |
| Mo | ≤ 0,35 > 0,35 ≤ 1,20 | ± 0,03 ± 0,04 |
| N | ≤ 0,07 | ± 0,01 |
| Nb | ≤ 0,10 | ± 0,005 |
| Ni | ≤ 0,80 | + 0,05 |
| Sn | ≤ 0,025 | + 0,005 |
| V | ≤ 0,35 | ± 0,03 |
| Cu | ≤ 0,30 | + 0,05 |

¹⁾ If several product analyses are carried out for one cast and if, in this case, values for an individual element are established which fall outside the permitted range for the chemical composition, then it is only permissible that the values either exceed the maximum permitted value or fall short of the minimum permitted value. It is not acceptable for both to apply for one cast.

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