

# Steel forgings for pressure purposes —

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

压力用途用钢制锻件

第 5 部分：马氏体、奥氏体和奥氏体 - 铁  
素体不锈钢

The European Standard EN 10222-5:1999 has the status of a  
British Standard

ICS 77.140.30; 77.140.85

# National foreword

This British Standard is the official English language version of EN 10222-5:1999. Together with BS EN 10222-1, -2, -3 and -4, it supersedes BS 1503:1989 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee ISE/73, Steel for pressure purposes, to Subcommittee ISE/73/3, Steel forgings for pressure purposes, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

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

## Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled “International Standards Correspondence Index”, or by using the “Find” facility of the BSI Standards Electronic Catalogue.

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## Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 17 and a back cover.

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English version

## Steel forgings for pressure purposes - Part 5: Martensitic, austenitic and austenitic-ferritic stainless steels

Pièces forgées en acier pour appareils à pression -  
Partie 5: Aciers inoxydables, martensitiques, austénitiques  
et austéno-ferritiques

Schmiedestücke aus Stahl für Druckbehälter - Teil 5:  
Martensitische, austenitische, und austenitisch-ferritische  
nichtrostende Stähle

This European Standard was approved by CEN on 3 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.



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

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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 June 2000, and conflicting national standards shall be withdrawn at the latest by June 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 the 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.

Attention is drawn to a non-conflicting national addition requested by Germany. This addition only appears as a national annex to the German edition of this European Standard.

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

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

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.

## **1 Scope**

This part of this European Standard specifies the technical delivery conditions for forgings for pressure purposes made of stainless steels, including creep resisting steels. 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 table 1.

### **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 to EN 10222-1:1998).

## **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.

Verification of the impact properties of martensitic and austenitic-ferritic stainless steels shall be mandatory and for austenitic stainless steels shall be by agreement.

Elevated temperature 0,2 % proof strength ( $R_{p0,2}$ ) values shall conform to table 3.

Elevated temperature 1,0 % proof strength ( $R_{p1,0}$ ) values shall conform to table 4.

Elevated temperature tensile strength ( $R_m$ ) values shall conform to the requirements of table 5.

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 are given in annex A for information.

Table 1: Chemical composition, mechanical properties and heat treatment

| Steel designation                                                                                                                                                                                                                                                                                                                                                      |        |                 | Chemical composition % (cast analysis) <sup>1)</sup> |            |           |                     |                      |                 |                  |                 |                                                       |                                                                             | Mechanical properties at room temperature                                         |                                                                                   |                                                                  |                                              |                                                                                             |     |                      |                                              |                                            |                                     | Heat treatment |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-----------------|------------------------------------------------------|------------|-----------|---------------------|----------------------|-----------------|------------------|-----------------|-------------------------------------------------------|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------|----------------------------------------------|---------------------------------------------------------------------------------------------|-----|----------------------|----------------------------------------------|--------------------------------------------|-------------------------------------|----------------|--|
| Name                                                                                                                                                                                                                                                                                                                                                                   | Number | C               | Si<br>max.                                           | Mn<br>max. | P<br>max. | S<br>max.           | Cr                   | Mo              | Ni               | N               | Others <sup>8)</sup>                                  | Thickness of<br>the ruling<br>section<br><i>t<sub>R</sub></i><br>mm<br>max. | 0,2%<br>proof<br>strength<br><i>R<sub>p0,2</sub></i><br>min.<br>N/mm <sup>2</sup> | 1,0%<br>proof<br>strength<br><i>R<sub>p1,0</sub></i><br>min.<br>N/mm <sup>2</sup> | Tensile<br>strength<br><i>R<sub>m</sub></i><br>N/mm <sup>2</sup> | Elongation <sup>3)</sup><br><i>A</i><br>tr,t | Impact energy (ISO-V)<br><i>KV</i> > 10 mm thick<br>J min.<br>at 20 °C<br>(l)   (tr)   (tr) |     | Symbol <sup>4)</sup> | Conditions of<br>reference heat<br>treatment | Cooling<br>temp.<br>in <sup>5)</sup><br>°C |                                     |                |  |
| Martensitic steel<br>X3 CrNiMo 13-4                                                                                                                                                                                                                                                                                                                                    | 1.4313 | ≤ 0,05          | 0,70                                                 | 1,50       | 0,040     | 0,015               | 12,00<br>to<br>14,00 | 0,30 to<br>0,70 | 3,50 to<br>4,50  | 0,020<br>min    | -                                                     | 350                                                                         | 550                                                                               | -                                                                                 | 750 to<br>900                                                    | 17                                           | 16                                                                                          | 100 | 80                   | -                                            | QT+T                                       | a,o <sup>7)</sup><br>950 to<br>1050 |                |  |
|                                                                                                                                                                                                                                                                                                                                                                        |        |                 |                                                      |            |           |                     |                      |                 |                  |                 |                                                       | 250                                                                         | 650                                                                               | -                                                                                 | 780 to<br>930                                                    | 17                                           | 15                                                                                          | 90  | 70                   | -                                            | QT                                         | a,o <sup>8)</sup><br>950 to<br>1050 |                |  |
| Austenitic steels<br>X2 CrNi 18-9                                                                                                                                                                                                                                                                                                                                      | 1.4307 | ≤ 0,030         | 1,00                                                 | 2,00       | 0,045     | 0,015 <sup>2)</sup> | 17,50<br>to<br>19,50 | -               | 8,00 to<br>10,00 | 0,11<br>max     | -                                                     | 250                                                                         | 200                                                                               | 230                                                                               | 500 to<br>700                                                    | 45                                           | 35                                                                                          | 100 | 60                   | 60                                           | AT                                         | w,a<br>1025 to<br>1100              |                |  |
|                                                                                                                                                                                                                                                                                                                                                                        | 1.4311 | ≤ 0,030         | 1,00                                                 | 2,00       | 0,045     | 0,015 <sup>2)</sup> | 17,00<br>to<br>19,50 | -               | 8,50 to<br>11,50 | 0,12 to<br>0,22 | -                                                     | 250                                                                         | 270                                                                               | 305                                                                               | 550 to<br>750                                                    | 45                                           | 35                                                                                          | 100 | 60                   | 60                                           | AT                                         | w,a<br>1000 to<br>1100              |                |  |
|                                                                                                                                                                                                                                                                                                                                                                        | 1.4301 | ≤ 0,07          | 1,00                                                 | 2,00       | 0,045     | 0,015 <sup>2)</sup> | 17,00<br>to<br>19,50 | -               | 8,00 to<br>10,50 | 0,11<br>max     | -                                                     | 250                                                                         | 200                                                                               | 230                                                                               | 500 to<br>700                                                    | 45                                           | 35                                                                                          | 100 | 60                   | 60                                           | AT                                         | w,a<br>1000 to<br>1100              |                |  |
|                                                                                                                                                                                                                                                                                                                                                                        | 1.4541 | ≤ 0,08          | 1,00                                                 | 2,00       | 0,045     | 0,015 <sup>2)</sup> | 17,00<br>to<br>19,00 | -               | 9,00 to<br>12,00 | -               | Ti<br>5x %C<br>to 0,70                                | 450                                                                         | 200                                                                               | 235                                                                               | 510 to<br>710                                                    | 40                                           | 30                                                                                          | 100 | 60                   | 60                                           | AT                                         | w,a<br>1020 to<br>1120              |                |  |
|                                                                                                                                                                                                                                                                                                                                                                        | 1.4550 | ≤ 0,08          | 1,00                                                 | 2,00       | 0,045     | 0,015 <sup>2)</sup> | 17,00<br>to<br>19,00 | -               | 9,00 to<br>12,00 | -               | Nb<br>10x %C<br>to 1,00                               | 450                                                                         | 205                                                                               | 240                                                                               | 510 to<br>710                                                    | 40                                           | 30                                                                                          | 100 | 60                   | 40                                           | AT                                         | w,a<br>1020 to<br>1120              |                |  |
|                                                                                                                                                                                                                                                                                                                                                                        | 1.4948 | 0,04 to<br>0,08 | 1,00                                                 | 2,00       | 0,035     | 0,015 <sup>2)</sup> | 17,00<br>to<br>19,00 | -               | 8,00 to<br>11,00 | 0,11<br>max     | -                                                     | 250                                                                         | 195                                                                               | 230                                                                               | 490 to<br>690                                                    | 45                                           | 35                                                                                          | 100 | 60                   | -                                            | AT                                         | w,a<br>1050 to<br>1120              |                |  |
|                                                                                                                                                                                                                                                                                                                                                                        | 1.4941 | 0,04 to<br>0,08 | 1,00                                                 | 2,00       | 0,035     | 0,015 <sup>2)</sup> | 17,00<br>to<br>19,00 | -               | 9,00 to<br>12,00 | -               | Ti<br>5x %C<br>to 0,80<br>B<br>0,0015<br>to<br>0,0050 | 450                                                                         | 175                                                                               | 210                                                                               | 490 to<br>690                                                    | 40                                           | 30                                                                                          | 100 | 60                   | -                                            | AT                                         | w,a<br>1070 to<br>1140              |                |  |
|                                                                                                                                                                                                                                                                                                                                                                        |        |                 |                                                      |            |           |                     |                      |                 |                  |                 |                                                       |                                                                             |                                                                                   |                                                                                   |                                                                  |                                              |                                                                                             |     |                      |                                              |                                            |                                     |                |  |
| 1) Elements not listed in this table may not be intentionally added to the steel without the agreement of the purchaser except for finishing the cast. All appropriate precautions are to be taken to avoid the addition of such elements from scrap and other materials used in production which would impair mechanical properties and the suitability of the steel. |        |                 |                                                      |            |           |                     |                      |                 |                  |                 |                                                       |                                                                             |                                                                                   |                                                                                   |                                                                  |                                              |                                                                                             |     |                      |                                              |                                            |                                     |                |  |
| 2) For products to be machined a controlled sulfur content of 0,015 % to 0,030 % is recommended and permitted by agreement.                                                                                                                                                                                                                                            |        |                 |                                                      |            |           |                     |                      |                 |                  |                 |                                                       |                                                                             |                                                                                   |                                                                                   |                                                                  |                                              |                                                                                             |     |                      |                                              |                                            |                                     |                |  |
| 3) l = longitudinal; t = tangential; tr = transverse.                                                                                                                                                                                                                                                                                                                  |        |                 |                                                      |            |           |                     |                      |                 |                  |                 |                                                       |                                                                             |                                                                                   |                                                                                   |                                                                  |                                              |                                                                                             |     |                      |                                              |                                            |                                     |                |  |
| 4) AT = solution treated; QT = quenched and tempered; T = tempered.                                                                                                                                                                                                                                                                                                    |        |                 |                                                      |            |           |                     |                      |                 |                  |                 |                                                       |                                                                             |                                                                                   |                                                                                   |                                                                  |                                              |                                                                                             |     |                      |                                              |                                            |                                     |                |  |
| 5) a = air; o = oil; w = water.                                                                                                                                                                                                                                                                                                                                        |        |                 |                                                      |            |           |                     |                      |                 |                  |                 |                                                       |                                                                             |                                                                                   |                                                                                   |                                                                  |                                              |                                                                                             |     |                      |                                              |                                            |                                     |                |  |
| 6) Patented grade.                                                                                                                                                                                                                                                                                                                                                     |        |                 |                                                      |            |           |                     |                      |                 |                  |                 |                                                       |                                                                             |                                                                                   |                                                                                   |                                                                  |                                              |                                                                                             |     |                      |                                              |                                            |                                     |                |  |
| 7) Double temper at 600 °C to 620 °C.                                                                                                                                                                                                                                                                                                                                  |        |                 |                                                      |            |           |                     |                      |                 |                  |                 |                                                       |                                                                             |                                                                                   |                                                                                   |                                                                  |                                              |                                                                                             |     |                      |                                              |                                            |                                     |                |  |
| 8) Temper at 570 °C to 600 °C.                                                                                                                                                                                                                                                                                                                                         |        |                 |                                                      |            |           |                     |                      |                 |                  |                 |                                                       |                                                                             |                                                                                   |                                                                                   |                                                                  |                                              |                                                                                             |     |                      |                                              |                                            |                                     |                |  |

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

| Steel designation   |        | Chemical composition % (cast analysis) <sup>1)</sup> |         |        |        |                     |                |              |                |              |                      | Mechanical properties at room temperature |                                          |                                          |                                  |                          |                       |      | Heat treatment |                      |                   |                          |
|---------------------|--------|------------------------------------------------------|---------|--------|--------|---------------------|----------------|--------------|----------------|--------------|----------------------|-------------------------------------------|------------------------------------------|------------------------------------------|----------------------------------|--------------------------|-----------------------|------|----------------|----------------------|-------------------|--------------------------|
| Name                | Number | C                                                    | Si max. | Mn max | P max. | S max.              | Cr             | Mo           | Ni             | N            | Others <sub>8)</sub> | Thickness of the ruling section           | 0,2% proof strength                      | 1,0% proof strength                      | Tensile strength                 | Elongation <sup>3)</sup> | Impact energy (ISO-V) |      |                | Symbol <sup>4)</sup> | Solution temp. °C | Cooling in <sup>5)</sup> |
|                     |        |                                                      |         |        |        |                     |                |              |                |              |                      | t <sub>R</sub> mm max.                    | R <sub>p0.2</sub> min. N/mm <sup>2</sup> | R <sub>p1.0</sub> min. N/mm <sup>2</sup> | R <sub>m</sub> N/mm <sup>2</sup> | A l                      | (l)                   | (tr) | (tr)           |                      |                   |                          |
| X7 CrNiNb 18-10     | 1.4912 | 0,04 to 0,10                                         | 1,00    | 2,00   | 0,045  | 0,015 <sup>2)</sup> | 17,00 to 19,00 | -            | 9,00 to 12,00  | -            | Nb 10x%C to 1,20     | 450                                       | 205                                      | 240                                      | 510 to 710                       | 40                       | 30                    | 60   | 40             | AT                   | 1070 to 1125      | w,a                      |
| X2 CrNiMo 17-12-2   | 1.4404 | ≤0,030                                               | 1,00    | 2,00   | 0,045  | 0,015 <sup>2)</sup> | 16,50 to 18,50 | 2,00 to 2,50 | 10,00 to 13,00 | 0,11 max     | -                    | 250                                       | 190                                      | 225                                      | 490 to 690                       | 45                       | 35                    | 60   | 60             | AT                   | 1020 to 1120      | w,a                      |
| X2 CrNiMoN 17-11-2  | 1.4406 | ≤0,030                                               | 1,00    | 2,00   | 0,045  | 0,015 <sup>2)</sup> | 16,50 to 18,50 | 2,00 to 2,50 | 10,00 to 12,00 | 0,12 to 0,22 | -                    | 160                                       | 280                                      | 315                                      | 580 to 780                       | 45                       | 35                    | 60   | 60             | AT                   | 1020 to 1120      | w,a                      |
| X5 CrNiMo 17-12-2   | 1.4401 | ≤0,07                                                | 1,00    | 2,00   | 0,045  | 0,015 <sup>2)</sup> | 16,50 to 18,50 | 2,00 to 2,50 | 10,00 to 13,00 | 0,11 max     | -                    | 250                                       | 205                                      | 240                                      | 510 to 710                       | 45                       | 35                    | 60   | 60             | AT                   | 1020 to 1120      | w,a                      |
| X6 CrNiMoTi 17-12-2 | 1.4571 | ≤0,08                                                | 1,00    | 2,00   | 0,045  | 0,015 <sup>2)</sup> | 16,50 to 18,50 | 2,00 to 2,50 | 10,50 to 13,50 | -            | Ti 5x%C to 0,70      | 450                                       | 210                                      | 245                                      | 510 to 710                       | 45                       | 35                    | 60   | 60             | AT                   | 1020 to 1120      | w,a                      |
| X2 CrNiMo 17-12-3   | 1.4432 | ≤0,030                                               | 1,00    | 2,00   | 0,045  | 0,015 <sup>2)</sup> | 16,50 to 18,50 | 2,50 to 3,00 | 10,50 to 13,00 | 0,11 max     | -                    | 250                                       | 190                                      | 225                                      | 490 to 690                       | 45                       | 35                    | 60   | 60             | AT                   | 1020 to 1120      | w,a                      |
| X2 CrNiMoN 17-13-3  | 1.4429 | ≤0,030                                               | 1,00    | 2,00   | 0,045  | 0,015 <sup>2)</sup> | 16,50 to 18,50 | 2,50 to 3,00 | 11,00 to 14,00 | 0,12 to 0,22 | -                    | 160                                       | 280                                      | 315                                      | 580 to 780                       | 45                       | 35                    | 60   | 60             | AT                   | 1020 to 1120      | w,a                      |
| X3 CrNiMo 17-13-3   | 1.4436 | ≤0,05                                                | 1,00    | 2,00   | 0,045  | 0,015 <sup>2)</sup> | 16,50 to 18,50 | 2,50 to 3,00 | 10,50 to 13,00 | 0,11 max     | -                    | 250                                       | 205                                      | 240                                      | 510 to 710                       | 45                       | 35                    | 60   | 60             | AT                   | 1020 to 1120      | w,a                      |
| X2 CrNiMo 18-14-3   | 1.4435 | ≤0,030                                               | 1,00    | 2,00   | 0,045  | 0,015 <sup>2)</sup> | 17,00 to 19,00 | 2,50 to 3,00 | 12,50 to 15,00 | 0,11 max     | -                    | 75                                        | 200                                      | 235                                      | 520 to 670                       | -                        | 45                    | 60   | 60             | AT                   | 1020 to 1120      | w,a                      |
| X3 CrNiMoN 17-13-3  | 1.4910 | ≤0,04                                                | 0,75    | 2,00   | 0,035  | 0,015               | 16,00 to 18,00 | 2,00 to 3,00 | 12,00 to 14,00 | 0,10 to 0,18 | B 0,0015 to 0,0050   | 75                                        | 260                                      | 300                                      | 550 to 750                       | -                        | 40                    | 60   | -              | AT                   | 1020 to 1100      | w,a                      |

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

| Steel designation               |        | Chemical composition % (cast analysis) <sup>1)</sup> |         |         |        |        |                |              |                |              |                      | Mechanical properties at room temperature                              |                                                                              |                                                                              |                                                                   |                                                    |                                                                    |          | Heat treatment       |                                        |                   |                          |     |
|---------------------------------|--------|------------------------------------------------------|---------|---------|--------|--------|----------------|--------------|----------------|--------------|----------------------|------------------------------------------------------------------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------|-------------------------------------------------------------------|----------------------------------------------------|--------------------------------------------------------------------|----------|----------------------|----------------------------------------|-------------------|--------------------------|-----|
| Name                            | Number | C                                                    | Si max. | Mn max. | P max. | S max. | Cr             | Mo           | Ni             | N            | Others <sup>8)</sup> | Thickness of the ruling section<br><br><i>t<sub>R</sub></i><br>mm max. | 0,2% proof strength<br><br><i>R<sub>p0,2</sub></i><br>min. N/mm <sup>2</sup> | 1,0% proof strength<br><br><i>R<sub>p1,0</sub></i><br>min. N/mm <sup>2</sup> | Tensile strength<br><br><i>R<sub>m</sub></i><br>N/mm <sup>2</sup> | Elongation <sup>3)</sup><br><br><i>A</i><br>l tr,t | Impact energy (ISO-V)<br><br><i>KV</i> > 10 mm thick<br><br>J min. |          | Symbol <sup>4)</sup> | Conditions of reference heat treatment |                   |                          |     |
|                                 |        |                                                      |         |         |        |        |                |              |                |              |                      |                                                                        |                                                                              |                                                                              |                                                                   |                                                    |                                                                    | at 20 °C | (tr)                 | at - 196 °C                            | Solution temp. °C | Cooling in <sup>5)</sup> |     |
| X2 CrNiCu 19-10                 | 1.4650 | ≤0,030                                               | 1,00    | 2,00    | 0,045  | 0,015  | 18,50 to 20,00 | -            | 9,00 to 10,00  | 0,08 max     | Cu 1,0 max           | 450                                                                    | 210                                                                          | 245                                                                          | 520 to 720                                                        | 45                                                 | 40                                                                 | 100      | 60                   | 60                                     | AT                | 1050 to 1125             | w,a |
| X3 CrNiMo 18-12-3               | 1.4449 | ≤0,035                                               | 1,00    | 2,00    | 0,045  | 0,015  | 17,00 to 18,20 | 2,25 to 2,75 | 11,50 to 12,50 | 0,08 max     | Cu 1,0 max           | 450                                                                    | 220                                                                          | 255                                                                          | 520 to 720                                                        | 45                                                 | 40                                                                 | 100      | 60                   | 60                                     | AT                | 1050 to 1125             | w,a |
| Austenitic-ferritic steels      |        |                                                      |         |         |        |        |                |              |                |              |                      |                                                                        |                                                                              |                                                                              |                                                                   |                                                    |                                                                    |          |                      |                                        |                   |                          |     |
| X2 CrNiMoN 22-5-3               | 1.4462 | ≤0,030                                               | 1,00    | 2,00    | 0,035  | 0,015  | 21,00 to 23,00 | 2,50 to 3,50 | 4,50 to 6,50   | 0,10 to 0,22 | -                    | 350                                                                    | 450                                                                          | -                                                                            | 680 to 880                                                        | 30                                                 | 25                                                                 | 200      | 100                  | -                                      | AT                | 1020 to 1100             | -   |
| X2 CrNiMoN 25-7-4 <sup>6)</sup> | 1.4410 | ≤0,030                                               | 1,00    | 2,00    | 0,035  | 0,015  | 24,00 to 26,00 | 3,00 to 4,50 | 6,00 to 8,00   | 0,20 to 0,35 | -                    | 160                                                                    | 500                                                                          | -                                                                            | 800 to 1000                                                       | 30                                                 | 25                                                                 | 200      | 100                  | -                                      | AT                | 1040 to 1120             | w,a |

<sup>1)</sup> Elements not listed in this table may not be intentionally added to the steel without the agreement of the purchaser except for finishing the cast. All appropriate precautions are to be taken to avoid the addition of such elements from scrap and other materials used in production which would impair mechanical properties and the suitability of the steel.

<sup>2)</sup> For products to be machined a controlled sulfur content of 0,015 % to 0,030 % is recommended and permitted by agreement.

<sup>3)</sup> l = longitudinal; t = tangential; tr = transverse.

<sup>4)</sup> AT = solution treated; QT = quenched and tempered; T = tempered.

<sup>5)</sup> a = air; o = oil; w = water.

<sup>6)</sup> Patented grade.

<sup>7)</sup> Double temper at 600 °C to 620 °C.

<sup>8)</sup> Temper at 570 °C to 600 °C.

**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<br>% | Permissible deviations <sup>1)</sup> of the product analysis<br>% |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|-------------------------------------------------------------------|
| C                                                                                                                                                                                                                                                                                                                                                                                                           | $\leq 0,030$                                                   | + 0,005                                                           |
|                                                                                                                                                                                                                                                                                                                                                                                                             | > 0,030 $\leq 0,10$                                            | $\pm 0,01$                                                        |
| Si                                                                                                                                                                                                                                                                                                                                                                                                          | $\leq 1,00$                                                    | + 0,05                                                            |
| Mn                                                                                                                                                                                                                                                                                                                                                                                                          | $\leq 2,00$                                                    | + 0,04                                                            |
| P                                                                                                                                                                                                                                                                                                                                                                                                           | $\leq 0,045$                                                   | + 0,005                                                           |
| S                                                                                                                                                                                                                                                                                                                                                                                                           | $\leq 0,15$                                                    | + 0,003                                                           |
|                                                                                                                                                                                                                                                                                                                                                                                                             | > 0,015 $\leq 0,030$                                           | + 0,005                                                           |
| N                                                                                                                                                                                                                                                                                                                                                                                                           | $\leq 0,35$                                                    | $\pm 0,01$                                                        |
| Cr                                                                                                                                                                                                                                                                                                                                                                                                          | < 15,00                                                        | $\pm 0,15$                                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                             | $\geq 15,00$ < 20,00                                           | $\pm 0,20$                                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                             | $\geq 20,00$ $\leq 26,00$                                      | $\pm 0,25$                                                        |
| Mo                                                                                                                                                                                                                                                                                                                                                                                                          | $\leq 0,70$                                                    | $\pm 0,03$                                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                             | > 0,70 < 2,50                                                  | $\pm 0,05$                                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                             | $\geq 2,50$ $\leq 4,50$                                        | $\pm 0,10$                                                        |
| Ni                                                                                                                                                                                                                                                                                                                                                                                                          | > 3,50 < 5,00                                                  | $\pm 0,07$                                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                             | $\geq 5,00$ < 10,0                                             | $\pm 0,10$                                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                             | $\geq 10,0$ $\leq 15,0$                                        | $\pm 0,15$                                                        |
| Nb                                                                                                                                                                                                                                                                                                                                                                                                          | $\leq 1,20$                                                    | $\pm 0,05$                                                        |
| Ti                                                                                                                                                                                                                                                                                                                                                                                                          | $\leq 0,80$                                                    | $\pm 0,05$                                                        |
| Cu                                                                                                                                                                                                                                                                                                                                                                                                          | $\leq 1,00$                                                    | $\pm 0,07$                                                        |
| B                                                                                                                                                                                                                                                                                                                                                                                                           | $\leq 0,0050$                                                  | $\pm 0,0005$                                                      |
| <sup>1)</sup> 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. |                                                                |                                                                   |

**Table 3: Minimum 0,2 % proof strength ( $R_{p0,2}$ ) at elevated temperatures**

| Steel designation          |        | $R_{p0,2}$ min. in N/mm <sup>2</sup> at a temperature of: |        |        |        |        |        |        |        |        |
|----------------------------|--------|-----------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|
| Name                       | Number | 100 °C                                                    | 150 °C | 200 °C | 250 °C | 300 °C | 350 °C | 400 °C | 500 °C | 600 °C |
| Martensitic steel          |        |                                                           |        |        |        |        |        |        |        |        |
| X3 CrNiMo 13-4             | 1.4313 | 590                                                       | 575    | 560    | 545    | 530    | 515    | -      | -      | -      |
| Austenitic steels          |        |                                                           |        |        |        |        |        |        |        |        |
| X2 CrNi 18-9               | 1.4307 | 147                                                       | 132    | 118    | 108    | 100    | 94     | 89     | 81     | -      |
| X2 CrNiN 18-10             | 1.4311 | 205                                                       | 175    | 157    | 145    | 136    | 130    | 125    | 119    | -      |
| X5 CrNi 18-10              | 1.4301 | 157                                                       | 142    | 127    | 118    | 110    | 104    | 98     | 92     | -      |
| X6 CrNiTi 18-10            | 1.4541 | 176                                                       | 167    | 157    | 147    | 136    | 130    | 125    | 119    | -      |
| X6 CrNiNb 18-10            | 1.4550 | 177                                                       | 167    | 157    | 147    | 136    | 130    | 125    | 119    | -      |
| X6 CrNi 18-10              | 1.4948 | 157                                                       | 142    | 127    | 117    | 108    | 103    | 98     | 88     | 78     |
| X6 CrNiTiB 18-10           | 1.4941 | 162                                                       | 152    | 142    | 137    | 132    | 127    | 123    | 113    | 103    |
| X7 CrNiNb 18-10            | 1.4912 | 171                                                       | 162    | 153    | 147    | 139    | 133    | 129    | 124    | 121    |
| X2 CrNiMo 17-12-2          | 1.4404 | 166                                                       | 152    | 137    | 127    | 118    | 113    | 108    | 100    | -      |
| X2 CrNiMoN 17-11-2         | 1.4406 | 211                                                       | 185    | 167    | 155    | 145    | 140    | 135    | 128    | -      |
| X5 CrNiMo 17-12-2          | 1.4401 | 177                                                       | 162    | 147    | 137    | 127    | 120    | 115    | 110    | -      |
| X6 CrNiMoTi 17-12-2        | 1.4571 | 185                                                       | 177    | 167    | 157    | 145    | 140    | 135    | 129    | -      |
| X2 CrNiMo 17-12-3          | 1.4432 | 166                                                       | 152    | 137    | 127    | 118    | 113    | 108    | 100    | -      |
| X2 CrNiMoN 17-13-3         | 1.4429 | 211                                                       | 185    | 167    | 155    | 145    | 140    | 135    | 129    | -      |
| X3 CrNiMo 17-13-3          | 1.4436 | 177                                                       | 162    | 147    | 137    | 127    | 120    | 115    | 110    | -      |
| X2 CrNiMo 18-14-3          | 1.4435 | 165                                                       | 150    | 137    | 127    | 119    | 113    | 108    | 100    | -      |
| X3 CrNiMoN 17-13-3         | 1.4910 | 205                                                       | 187    | 170    | 159    | 148    | 141    | 134    | 127    | 121    |
| X2 CrNiCu 19-10            | 1.4650 | 155                                                       | 140    | 127    | 118    | 110    | 104    | 98     | 92     | -      |
| X3 CrNiMo 18-12-3          | 1.4449 | 175                                                       | 158    | 145    | 135    | 127    | 120    | 115    | 110    | 100    |
| Austenitic-ferritic steels |        |                                                           |        |        |        |        |        |        |        |        |
| X2 CrNiMo 22-5-3           | 1.4462 | 360                                                       | 335    | 315    | 300    | -      | -      | -      | -      | -      |
| X2 CrNiMoN 25-7-4          | 1.4410 | 450                                                       | 420    | 400    | 380    | -      | -      | -      | -      | -      |

**Table 4: Minimum 1,0 % proof strength ( $R_{p1,0}$ ) for austenitic steels at elevated temperatures**

| Steel designation   |        | $R_{p1,0}$ min. in N/mm <sup>2</sup> at a temperature of: |        |        |        |        |        |        |        |        |
|---------------------|--------|-----------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|
| Name                | Number | 100 °C                                                    | 150 °C | 200 °C | 250 °C | 300 °C | 350 °C | 400 °C | 500 °C | 600 °C |
| X2 CrNi 18-9        | 1.4307 | 181                                                       | 162    | 147    | 137    | 127    | 121    | 116    | 109    | -      |
| X2 CrNiN 18-10      | 1.4311 | 240                                                       | 210    | 187    | 175    | 167    | 161    | 156    | 149    | -      |
| X5 CrNi 18-10       | 1.4301 | 191                                                       | 172    | 157    | 145    | 135    | 129    | 125    | 120    | -      |
| X6 CrNiTi 18-10     | 1.4541 | 208                                                       | 196    | 186    | 177    | 167    | 161    | 156    | 149    | -      |
| X6 CrNiNb 18-10     | 1.4550 | 211                                                       | 196    | 186    | 177    | 167    | 161    | 156    | 149    | -      |
| X6 CrNi 18-10       | 1.4948 | 191                                                       | 172    | 157    | 147    | 137    | 132    | 127    | 118    | 108    |
| X6 CrNiTiB 18-10    | 1.4941 | 201                                                       | 191    | 181    | 176    | 172    | 167    | 162    | 152    | 142    |
| X7 CrNiNb 18-10     | 1.4912 | 204                                                       | 192    | 182    | 172    | 166    | 162    | 159    | 155    | 151    |
| X2 CrNiMo 17-12-2   | 1.4404 | 199                                                       | 181    | 167    | 157    | 145    | 139    | 135    | 128    | -      |
| X2 CrNiMoN 17-11-2  | 1.4406 | 246                                                       | 218    | 198    | 183    | 175    | 169    | 164    | 158    | -      |
| X5 CrNiMo 17-12-2   | 1.4401 | 211                                                       | 191    | 177    | 167    | 156    | 150    | 144    | 139    | -      |
| X6 CrNiMoTi 17-12-2 | 1.4571 | 218                                                       | 206    | 196    | 186    | 175    | 169    | 164    | 158    | -      |
| X2 CrNiMo 17-12-3   | 1.4432 | 199                                                       | 181    | 167    | 157    | 145    | 139    | 135    | 128    | -      |
| X2 CrNiMoN 17-13-3  | 1.4429 | 246                                                       | 218    | 198    | 183    | 175    | 169    | 164    | 158    | -      |
| X3 CrNiMo 17-13-3   | 1.4436 | 211                                                       | 191    | 177    | 167    | 156    | 150    | 144    | 139    | -      |
| X2 CrNiMo 18-14-3   | 1.4435 | 200                                                       | 180    | 165    | 153    | 145    | 139    | 135    | 128    | -      |
| X3 CrNiMoN 17-13-3  | 1.4910 | 240                                                       | 220    | 200    | 189    | 178    | 171    | 164    | 157    | 151    |
| X2 CrNiCu 19-10     | 1.4650 | 190                                                       | 170    | 155    | 145    | 135    | 129    | 125    | 120    | -      |
| X3 CrNiMo 18-12-3   | 1.4449 | 210                                                       | 190    | 175    | 165    | 155    | 150    | 144    | 139    | 129    |

**Table 5: Minimum tensile strength ( $R_m$ ) at elevated temperature**

| Steel designation          |        | $R_m$ min. in N/mm <sup>2</sup> at a temperature of: |        |        |        |        |        |        |        |        |
|----------------------------|--------|------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|
| Name                       | Number | 100 °C                                               | 150 °C | 200 °C | 250 °C | 300 °C | 350 °C | 400 °C | 500 °C | 600 °C |
| Martensitic steels         |        |                                                      |        |        |        |        |        |        |        |        |
| X3 CrNiMo 13-4             | 1.4313 | 710                                                  | 695    | 680    | 665    | 650    | 635    | -      | -      | -      |
| Austenitic steels          |        |                                                      |        |        |        |        |        |        |        |        |
| X2 CrNi 18-9               | 1.4307 | 410                                                  | 380    | 360    | 350    | 340    | 340    | -      | -      | -      |
| X2 CrNiN 18-10             | 1.4311 | 490                                                  | 460    | 430    | 420    | 410    | 410    | -      | -      | -      |
| X5 CrNi 18-10              | 1.4301 | 450                                                  | 420    | 400    | 390    | 380    | 380    | 380    | 360    | -      |
| X6 CrNiTi 18-10            | 1.4541 | 440                                                  | 410    | 390    | 385    | 375    | 375    | 375    | 360    | -      |
| X6 CrNiNb 18-10            | 1.4550 | 435                                                  | 400    | 370    | 350    | 340    | 335    | 330    | 310    | -      |
| X6 CrNi 18-10              | 1.4948 | 440                                                  | 410    | 390    | 385    | 375    | 375    | 375    | 360    | 300    |
| X6 CrNiTiB 18-10           | 1.4941 | 410                                                  | 390    | 370    | 360    | 350    | 345    | 340    | 330    | 300    |
| X7 CrNiNb 18-10            | 1.4912 | 410                                                  | 390    | 370    | 360    | 350    | 345    | 340    | 330    | 300    |
| X2 CrNiMo 17-12-2          | 1.4404 | 430                                                  | 410    | 390    | 385    | 380    | 380    | 380    | 360    | -      |
| X2 CrNiMoN 17-11-2         | 1.4406 | 520                                                  | 490    | 460    | 450    | 440    | 435    | -      | -      | -      |
| X5 CrNiMo 17-12-2          | 1.4401 | 430                                                  | 410    | 390    | 385    | 380    | 380    | -      | -      | -      |
| X6 CrNiMoTi 17-12-2        | 1.4571 | 440                                                  | 410    | 390    | 385    | 375    | 375    | 375    | 360    | -      |
| X2 CrNiMo 17-12-3          | 1.4432 | 430                                                  | 410    | 390    | 385    | 380    | 380    | 380    | 360    | -      |
| X2 CrNiMoN 17-13-3         | 1.4429 | 520                                                  | 490    | 460    | 450    | 440    | 435    | 435    | 430    | -      |
| X3 CrNiMo 17-13-3          | 1.4436 | 460                                                  | 440    | 420    | 415    | 410    | 410    | 410    | 390    | -      |
| X2 CrNiMo 18-14-3          | 1.4435 | 420                                                  | 400    | 380    | 375    | 370    | 370    | -      | -      | -      |
| X3 CrNiMoN 17-13-3         | 1.4910 | 495                                                  | 472    | 450    | 440    | 430    | 425    | 420    | 400    | 365    |
| X2 CrNiCu 19-10            | 1.4650 | 450                                                  | 420    | 400    | 390    | 380    | 380    | 380    | 360    | -      |
| X3 CrNiMo 18-12-3          | 1.4449 | 460                                                  | 440    | 420    | 514    | 410    | 410    | 410    | 390    | 350    |
| Austenitic-ferritic steels |        |                                                      |        |        |        |        |        |        |        |        |
| X2 CrNiMo 22-5-3           | 1.4462 | 590                                                  | 570    | 550    | 540    | -      | -      | -      | -      | -      |
| X2 CrNiMoN 25-7-4          | 1.4410 | 680                                                  | 660    | 640    | 630    | -      | -      | -      | -      | -      |

**Annex A (informative)**  
**Reference data for stress rupture properties**  
**Table A.1: Stress rupture properties**

| Steel designation                 |                      | Rupture<br>time<br>h | Estimated average stress in N/mm <sup>2</sup> for rupture at a temperature of: |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |    |
|-----------------------------------|----------------------|----------------------|--------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----|
|                                   |                      |                      | 540 °C                                                                         | 550 °C | 560 °C | 570 °C | 580 °C | 590 °C | 600 °C | 610 °C | 620 °C | 630 °C | 640 °C | 650 °C | 660 °C | 670 °C | 680 °C | 690 °C | 700 °C |    |
| Name                              | Number               | h                    | -                                                                              | 156    | 138    | 124    | 113    | 72     | 65     | 59     | 54     | 49     | 45     | 40     | 36     | 32     | 28     | 25     | 21     | 18 |
|                                   |                      |                      | -                                                                              | 92     | 85     | 78     | 72     | 65     | 59     | 54     | 49     | 45     | 40     | 36     | 32     | 28     | 25     | 21     | 18     |    |
| X2 CrNi 18-9 <sup>2)</sup>        | 1.4307 <sup>3)</sup> | 100 000              | -                                                                              | 156    | 138    | 124    | 113    | 104    | 97     | 90     | 83     | 76     | 70     | 64     | 59     | 54     | 49     | 43     | 38     |    |
|                                   |                      | 100 000              | -                                                                              | 92     | 85     | 78     | 72     | 65     | 59     | 54     | 49     | 45     | 40     | 36     | 32     | 28     | 25     | 21     | 18     |    |
| X6 CrNi 18-10                     | 1.4948 <sup>4)</sup> | 10 000               | -                                                                              | 191    | 177    | 165    | 154    | 143    | 132    | 122    | 113    | 104    | 95     | 87     | 80     | 73     | 67     | 61     | 55     |    |
|                                   |                      | 100 000              | -                                                                              | 140    | 128    | 117    | 107    | 98     | 89     | 81     | 73     | 65     | 58     | 52     | 47     | 42     | 37     | 32     | 28     |    |
| X6 CrNiNb 18-10 <sup>1)</sup>     | 1.4550 <sup>5)</sup> | 200 000              | -                                                                              | 125    | 114    | 104    | 95     | 86     | 78     | 70     | 62     | 55     | 49     | 43     | 38     | 34     | 30     | 26     | 22     |    |
|                                   |                      | 10 000               | 258                                                                            | 236    | 218    | 202    | 187    | 174    | 162    | 151    | 140    | 131    | 121    | 113    | 104    | 96     | 88     | 80     | 71     |    |
| X7 CrNiNb 18-10                   | 1.4912 <sup>5)</sup> | 100 000              | 174*                                                                           | 161*   | 148*   | 137*   | 127*   | 117*   | 107*   | 98*    | 89*    | 80*    | 71*    | 58*    | -      | -      | -      | -      | -      |    |
|                                   |                      | 200 000              | 154*                                                                           | 142*   | 131*   | 120*   | 110*   | 101*   | 92*    | 82*    | 72*    | 61*    | -      | -      | -      | -      | -      | -      | -      |    |
| X6 CrNiTi 18-10 <sup>1)</sup>     | 1.4541 <sup>5)</sup> | 10 000               | 253                                                                            | 237    | 221    | 206    | 192    | 178    | 166    | 154    | 142    | 132    | 122    | 112    | 104    | 96     | 88     | 81     | 74     |    |
|                                   |                      | 100 000              | 186*                                                                           | 172*   | 159*   | 147*   | 135*   | 125*   | 115*   | 106*   | 97*    | 89*    | 81*    | 74*    | 67*    | 61*    | 54*    | -      | -      |    |
| X6 CrNiTiB 18-10                  | 1.4941 <sup>4)</sup> | 200 000              | 169*                                                                           | 156*   | 144*   | 132*   | 122*   | 112*   | 102*   | 94*    | 86*    | 78*    | 71*    | 64*    | 59*    | (51)*  | -      | -      | -      |    |
|                                   |                      | 10 000               | 222                                                                            | 206    | 192    | 178    | 165    | 152    | 140    | 129    | 118    | 108    | 98     | 88     | 79     | 71     | 63     | 56     | 49     |    |
| X6 CrNiTiB 18-10                  | 1.4941 <sup>4)</sup> | 100 000              | 142*                                                                           | 129*   | 118*   | 107*   | 96*    | 86*    | 77*    | 68*    | 60*    | 53*    | 46*    | 40*    | 35*    | 31*    | (27)*  | -      | -      |    |
|                                   |                      | 200 000              | 136*                                                                           | 123*   | 112*   | 101*   | 91*    | 81*    | 72*    | 63*    | 55*    | 48*    | 42*    | 36*    | 32*    | (28)*  | -      | -      | -      |    |
| X6 CrNiTiB 18-10                  | 1.4941 <sup>4)</sup> | 10 000               | -                                                                              | 223    | 210    | 196    | 182    | 170    | 156    | 142    | 130    | 119    | 108    | 98     | 89     | 80     | 73     | 66     | 60     |    |
|                                   |                      | 100 000              | -                                                                              | 170    | 154    | 140    | 127    | 114    | 102    | 92     | 84     | 76     | 68     | 62     | 56     | 50     | 44     | 39     | 35     |    |
| X6 CrNiMoTi 17-12-2 <sup>1)</sup> | 1.4571 <sup>3)</sup> | 200 000              | -                                                                              | 150    | 135    | 122    | 110    | 100    | 91     | 82     | 74     | 67     | 60     | 54     | 49     | 43     | 39     | 33     | 29     |    |
|                                   |                      | 10 000               | 247                                                                            | 233    | 220    | 206    | 193    | 180    | 167    | 155    | 142    | 130    | 119    | 108    | 97     | 87     | 78     | 70     | 63     |    |
| X6 CrNiMoTi 17-12-2 <sup>1)</sup> | 1.4571 <sup>3)</sup> | 100 000              | 194                                                                            | 181    | 167    | 154    | 141    | 128    | 116    | 105    | 94     | 84     | 75     | 67     | 60     | 54     | 49     | 44     | -      |    |
|                                   |                      | 200 000              | 178*                                                                           | 164*   | 151*   | 138*   | 125    | 113    | 102    | 91     | 81     | 72*    | 65*    | 58*    | 52*    | 47*    | (43)*  | -      | -      |    |
| X2 CrNiMoN 17-11-2                | 1.4406 <sup>3)</sup> | 10 000               | -                                                                              | 300    | 284    | 267    | 250    | 236    | 221    | 205    | 189    | 173    | 157    | 143    | 128    | 115    | 102    | 90     | 78     |    |
|                                   |                      | 100 000              | -                                                                              | 234*   | 217*   | 199*   | 182*   | 166*   | 151*   | 135*   | 119*   | 105*   | 92*    | 80*    | 71*    | 62*    | 55*    | 48*    | 42*    |    |
| X2CrNiMoN 17-13-3                 | 1.4429 <sup>3)</sup> | 200 000              | -                                                                              | 213*   | 195*   | 179*   | 162*   | 145*   | 130*   | 114*   | 100*   | 87*    | 76*    | 66*    | 58*    | 51*    | 45*    | 40*    | 35*    |    |
|                                   |                      | 100 000              | -                                                                              | 151*   | 135*   | 122*   | 110*   | 100*   | 91*    | 82*    | 74*    | 67*    | 60*    | 54*    | 49*    | 43*    | 39*    | 33*    | 29*    |    |

\* Extended time extrapolation.

( ) Extended stress extrapolation.

<sup>1)</sup> Values apply only for a minimum carbon content of 0,04 %.

<sup>2)</sup> Values apply only for a minimum nitrogen content of 0,06 %.

<sup>3)</sup> These data are based on recommendations of the European Creep Collaborative Committee, ECC, WG 3.3.

<sup>4)</sup> These data are taken from DIN 17460.

<sup>5)</sup> These data are taken from BS PD 6525-1.

Table A.1: Stress rupture properties (continued)

| Steel designation                                                                                                  |                      | Rupture time<br>h | Estimated average stress in N/mm <sup>2</sup> for rupture at a temperature of: |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |  |
|--------------------------------------------------------------------------------------------------------------------|----------------------|-------------------|--------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--|
| Name                                                                                                               | Number               |                   | 540 °C                                                                         | 550 °C | 560 °C | 570 °C | 580 °C | 590 °C | 600 °C | 610 °C | 620 °C | 630 °C | 640 °C | 650 °C | 660 °C | 670 °C | 680 °C | 690 °C | 700 °C |  |
| X5 CrNiMo 17-12-2 <sup>1)</sup>                                                                                    | 1.4401 <sup>3)</sup> | 10 000            | 265                                                                            | 247    | 230    | 213    | 189    | 183    | 168    | 155    | 142    | 130    | 119    | 109    | 99     | 90     | 82     | 75     | 68     |  |
|                                                                                                                    |                      | 100 000           | 205                                                                            | 188    | 172    | 158    | 144    | 130    | 118    | 107    | 96     | 87     | 78     | 70     | 63     | 56     | 50     | 45     | 40     |  |
|                                                                                                                    |                      | 200 000           | 188                                                                            | 172    | 157    | 142    | 129    | 117    | 105    | 94     | 85     | 76     | 68     | 61     | 54     | 48     | 43     | 38     | 34     |  |
| X3 CrNiMo 17-13-3 <sup>1)2)</sup>                                                                                  | 1.4436 <sup>3)</sup> | 10 000            | -                                                                              | 290    | 272    | 254    | 237    | 220    | 205    | 190    | 174    | 162    | 148    | 135    | 122    | 112    | 102    | 93     | 84     |  |
|                                                                                                                    |                      | 100 000           | -                                                                              | 220    | 202    | 186    | 170    | 155    | 141    | 127    | 114    | 102    | 92     | 83     | 75     | 68     | 61     | 56     | 52     |  |
| X3 CrNiMoN 17-13-3                                                                                                 | 1.4910 <sup>4)</sup> | 200 000           | -                                                                              | (200)  | (184)  | (166)  | (151)  | (137)  | (122)  | (113)  | (100)  | (91)   | (81)   | (73)   | (65)   | (58)   | (52)   | (46)   | (42)   |  |
| * Extended time extrapolation.                                                                                     |                      |                   |                                                                                |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |  |
| ( ) Extended stress extrapolation.                                                                                 |                      |                   |                                                                                |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |  |
| <sup>1)</sup> Values apply only for a minimum carbon content of 0,04 %.                                            |                      |                   |                                                                                |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |  |
| <sup>2)</sup> Values apply only for a minimum nitrogen content of 0,06 %.                                          |                      |                   |                                                                                |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |  |
| <sup>3)</sup> These data are based on recommendations of the European Creep Collaborative Committee, ECCC, WG 3.3. |                      |                   |                                                                                |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |  |
| <sup>4)</sup> These data are taken from DIN 17460.                                                                 |                      |                   |                                                                                |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |  |

Table A.1: Stress rupture properties (concluded)

| Steel designation  |                      | Rupture time | Estimated average stress in N/mm <sup>2</sup> for rupture at a temperature of: |        |        |        |        |        |  |  |  |  |
|--------------------|----------------------|--------------|--------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--|--|--|--|
| Name               | Number               | h            | 710 °C                                                                         | 720 °C | 730 °C | 740 °C | 750 °C | 800 °C |  |  |  |  |
| X3 CrNiMoN 17-13-3 | 1.4910 <sup>4)</sup> | 10 000       | 78                                                                             | 71     | 65     | 58     | 52     | 33     |  |  |  |  |
|                    |                      | 100 000      | 48                                                                             | 45     | 41     | 37     | 34     | 20     |  |  |  |  |
|                    |                      | 200 000      | (39)                                                                           | (36)   | (34)   | (31)   | (28)   | (17)   |  |  |  |  |

<sup>4)</sup>These data are taken from DIN 17460

NOTE 1: The values given in table A.1 are mean values of the scatter band considered until now.

NOTE 2: The strength values given for the elevated temperatures listed in table A.1 do not mean that the steels can be used in continuous duty up to these temperatures. The governing factor is the total stressing during operation. Where relevant, the oxidation conditions should also be taken into account.

## Annex ZA

### A-deviations

**A-deviation:** National deviation due to regulations, the alteration of which is for the time being outside the competence of the CEN/CENELEC member

This European Standard falls under Directive 97/23/EEC (Pressure equipment)

NOTE: (from CEN/CENELEC IR Part 2,3.1.9): Where standards fall under EC Directives, it is the view of the Commission of the European Communities (OJ No C 59, 1982-03-09) that the effect of the decision of the Court of Justice in case 815/79 Cremonini/Vrankovich (European Court Reports 1980, p. 3583) is that compliance with A-deviations is not longer mandatory and that the free movement of products complying with such a standard should not be restricted except under the safeguard procedure provided for in the relevant Directive.

A-deviations in an EFTA country are valid instead of the relevant provisions of the European Standard in that country until they have been removed.

| Clause         | Deviation                                                                                                                                                                                                                                                                                                                     |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                | Sweden (Ordinance AFS 1994: 39 Chapter 3, Section 1)                                                                                                                                                                                                                                                                          |
| <b>General</b> | Only the following grades are regarded as adequately validated and documented according to Swedish regulations:<br><br>Martensitic steels: none;<br><br>Austenitic steels: 1,4307, 1,4311, 1,4541, 1,4550, 1,4941, 1,4912, 1,4404, 1,4406, 1,4571, 1,4432, 1,4429, 1,4436, 1,4435;<br><br>Austenitic-ferritic steels: 1,4462. |

## **Annex ZB**

### **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.

## **Bibliography**

- DIN 17460:1992 High temperature austenitic steel plate and sheet, cold and hot rolled strip, bars and forgings; technical delivery conditions
- BS PD 6525-1:1990 Elevated temperature properties for steels for pressure purposes. Stress rupture properties

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