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July 1985

Stainless steels

Technical delivery conditions for plate and sheet, hot rolled strip, wire rod, drawn wire, steel bars, forgings and semi-finished products

DIN 17 440

Nichtrostende Stähle; technische Lieferbedingungen für Blech, Warmband, Walzdraht, gezogenen Draht, Stabstahl, Schmiedestücke und Halbzeug

This standard, together with DIN 17 441, DIN 17 455, DIN 17 456, DIN 17 457 and DIN 17 458 (July 1985 editions) supersedes DIN 17 440, December 1972 edition.

In keeping with current practice in standards published by the International Organization for Standardization (ISO), a comma has been used throughout as the decimal marker.

See Explanatory notes for connection with International Standards ISO 683/13 – 1974, ISO 2604/1 – 1975 and ISO 2604/4 – 1975 published by the International Organization for Standardization (ISO), and also for connection with EURONORMS 88 – 1971 and 141 – 1979 published by the European Coal and Steel Community (ECSC).

The clauses marked with a single dot ● give specifications which are to be agreed upon at the time of ordering.

The subclauses marked with two dots ●● give specifications which are optional and may be agreed upon at the time of ordering.

Contents

1 Field of application

1.1 This standard applies to hot rolled strip, cold or hot rolled plate as rolled, wire rod, drawn wire, steel bars, forgings and semi-finished products made from stainless steels with a wide range of applications.

Stainless steel cold rolled strip, slit strip and sheet and plate cut therefrom, with a wide range of applications, are specified in DIN 17 441, whilst stainless steel tubes and pipes are specified in DIN 17 455 to DIN 17 458.

Note. The term "plate as rolled" which is not featured amongst the terms used in EURONORM 79 refers to plate produced from rolled plate, as opposed to plate cut from strip.

1.2 In addition to the requirements specified in the present standard, the general technical delivery conditions for steel and steel products as given in DIN 17 010 shall apply to the products covered by this standard including forgings, unless otherwise specified in this standard.

1.3 This standard is not applicable to the components manufactured by subsequent processing of the semi-finished products listed in subclause 1.1, which exhibit quality characteristics deviating from those specified here, as a result of manufacturing processes.

2 Concepts

2.1 Stainless steels

Steels which are particularly resistant to chemically aggressive agents are considered to be stainless steels; they generally have a chromium content of not less than 12 % by mass and a carbon content not exceeding 1,2 % by mass.

2.2 Types of heat treatment

The terminology used in DIN 17 014 Part 1 shall apply for the types of heat treatment.

2.3 Product forms

The definitions given in EURONORM 79 shall apply for the product forms.

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3 ● Dimensions and permissible dimensional deviations

The dimensions and the permissible dimensional deviations shall be agreed at the time of ordering, preferably on the basis of the dimensional standards indicated in Appendix A.

4 Calculation of mass and permissible deviations in mass

4.1 The density values listed in table B.1 shall be adopted for the calculation of the theoretical mass of the products.

4.2 ●● The permissible deviations in mass may be agreed at the time of ordering, in so far as they are not specified in the dimensional standards listed in Appendix A.

5 Designation and ordering

5.1 The standard designation for a steel complying with this standard shall be composed of the following particulars, as illustrated in the examples below:

- the term "steel";
- the number of this standard;
- the symbol or material number of the steel grade concerned (see table 1) [1];
- the symbol for the type of condition (see table 8);
- if applicable, the heat treatment condition (see tables 3 and 4);
- if applicable, the degree of strain hardening (see table 7).

Example 1:

Steel DIN 17440 – X 5 CrNi 18 10 c2
or
Steel DIN 17440 – X 5 CrNi 18 10 II a
or
Steel DIN 17440 – 1.4301 c2
or
Steel DIN 17440 – 1.4301 II a

Example 2:

Steel DIN 17440 – X 5 CrNi 18 10 f K800
or
Steel DIN 17440 – X 5 CrNi 18 10 III a K800
or
Steel DIN 17440 – 1.4301 f K800
or
Steel DIN 17440 – 1.4301 IIIa K800

5.2 The specifications given in the relevant dimensional standard shall apply for the standard designation of the product concerned.

5.3 The order shall provide any information necessary for a clear description of the required products, including their condition and testing. Should in certain cases the designations as in subclauses 5.1 and 5.2 not be adequate for this purpose, for example in the case of agreements as provided for in the clauses marked with ● and ●●, the necessary information shall be added to these designations.

6 Requirements

6.1 Manufacturing process

6.1.1 The steelmaking process for the products complying with this standard shall be left to the manufacturer's discretion unless a particular steelmaking process has been agreed at the time of ordering.

●● If agreed, the purchaser shall be informed on the steelmaking process used.

[1] *DIN-Normenheft* (DIN Standardization booklet) No. 3 provides information on how the symbols and material numbers for steels are formed.

6.1.2 ●● The shaping process of the products shall be left to manufacturer's discretion unless otherwise agreed at the time of ordering.

6.2 As delivered condition

The normal treatment conditions and types of condition are listed in tables 3 to 5 and 8 (see also table B.2).

6.3 Chemical composition

6.3.1 Cast analysis

The chemical composition of the steels as determined in the cast analysis shall correspond to table 1. Minor deviations from these values shall be permitted by agreement with the purchaser or his representative, on condition that the mechanical properties, the weldability and the corrosion resistance of the steel comply with the requirements specified in this standard.

6.3.2 Product analysis

When testing the chemical composition of the finished product, the deviations shown in table 2 from the values given in table 1 are permitted.

6.4 Corrosion resistance

The data given in tables 3 and 5 shall apply for the resistance of the ferritic and austenitic steels to intercrystalline corrosion when tested as described in DIN 50914.

Note. The behaviour of stainless steels in respect of corrosion cannot be characterized unambiguously by laboratory tests. It is advisable therefore to refer to experience gained in the use of these steels for confirmation of likely behaviour. The DECHEMA tables of materials, amongst others, provide information on the behaviour of these steels under given corrosion conditions.

6.5 Mechanical properties

6.5.1 Tables 3 to 5 shall apply for the mechanical properties of the steels at ambient temperature in the heat treated condition. These tables are however not applicable to products of types of condition a1 and a2 specified in table 8.

●● In cases where the products are supplied in the types of condition a1 or a2, the mechanical properties listed in tables 3, 4 or 5 shall be capable of being achieved with suitable treatment. At the time of ordering, the verification of the mechanical properties on reference test pieces and the heat treatment of these reference test pieces may be agreed.

Table 7 shall apply for the mechanical properties of strain hardened bars and wires at ambient temperature.

6.5.2 Table 10 shall apply for the mechanical properties of finally heat treated wire with diameters less than 2 mm.

6.5.3 Table 6 shall apply for the elevated temperature 0,2% and 1% proof stresses.

6.6 Surface finish

Table 8 gives information on the surface finish.

6.7 Susceptibility to brittle fracture and low temperature toughness

The austenitic steels specified in this standard are unsusceptible to brittle fracture. In addition, the austenitic steels listed in table 11 are tough at low temperatures and may therefore also be used at low temperatures. For the verification of low temperature toughness, the test of impact energy at ambient temperature will suffice.

Note. The steels listed in table 11 are specified in *AD-Merkblatt* (AD Data sheet) W 10. Apart from the above steels, other austenitic steels can also be considered for use at low temperatures.

7 Testing

7.1 ●● Tests to be carried out and documents on materials testing

At the time of ordering, the issue of one of the documents on materials testing specified in DIN 50049 may be agreed for each consignment.

7.1.1 If it has been agreed in the purchase order that a test report (DIN 50049 – 2.2) shall be issued, said document shall include the following particulars:

a) the confirmation that the products comply with the purchase order specifications;

b) the results of the cast analysis in respect of all the elements listed in table 1 for the steel grade concerned.

7.1.2 If it has been agreed in the purchase order that a manufacturer's test certificate [2] (DIN 50049 – 2.3) shall be issued, said document shall include the following particulars:

a) the details given in subclause 7.1.1;

b) the results of the tests carried out in accordance with subclauses 7.2.2 to 7.2.9;

c) the marking of the products as described in clause 8.

7.1.3 If it has been agreed in the purchase order that either an inspection certificate (DIN 50049 – 3.1 A or DIN 50049 – 3.1 B or DIN 50049 – 3.1 C) or an inspection report (DIN 50049 – 3.2 A or DIN 50049 – 3.2 C) shall be issued, said document shall include the following particulars:

a) the results of the tests carried out in accordance with subclauses 7.2.2 to 7.2.9;

b) the marking of the products as described in clause 8.

In addition, the results of the cast analysis shall be notified in a test report; alternatively, these results may be included in the higher type of document in each case.

In the case of third-party acceptance inspection, the purchaser shall inform the manufacturer on the inspector.

7.2 Scope of test programme

7.2.1 The specifications contained in subclauses 7.2.2 to 7.2.9 shall apply for all products.

7.2.2 ●● A check analysis of the chemical composition on the finished product may be agreed at the time of ordering; the scope of test programme shall also be agreed in this respect.

7.2.3 The particulars specified in table 9 shall apply for the composition of the test units and to the number of samples to be taken for the tensile test at ambient temperature, depending on the product form and also to the number of test pieces to be tested.

7.2.4 ●● At the time of ordering, a verification of the impact energy values specified in tables 4 and 5 may be agreed; if no arrangements in respect of the scope of test programme are made in this connection, the specifications of table 9 shall apply, except that in accordance with DIN 17010 a set of three impact test pieces shall be tested in lieu of a single test piece.

7.2.5 ●● At the time of ordering, a verification of the elevated temperature 0,2% and 1% proof stress values specified in table 6 may be agreed; in this connection, the test temperature and the scope of test programme shall also be agreed.

7.2.6 ●● At the time of ordering, a test of the resistance to intercrystalline corrosion may be agreed; in this connection, the scope of test programme shall also be agreed.

7.2.7 The dimensions of all products shall be checked.

7.2.8 The surface finish of all products shall be examined.

7.2.9 All products shall be subjected to a materials identity test by the manufacturer.

7.3 Sampling and sample preparation

7.3.1 As regards the product analysis, the specifications given in *Stahl-Eisen-Prüfblatt* (Iron and steel test sheet) 1805 shall be complied with.

7.3.2 For the tensile test and for the impact test, the test pieces in the as delivered condition shall be taken as described in subclauses 7.3.2.1 to 7.3.2.3.

●● Subject to agreement, the test pieces may also be taken before straightening.

7.3.2.1 ●● In the case of plate, sheet and strip, the test pieces shall be taken as shown in figure 1, unless otherwise agreed, in such a way that the test pieces are situated at mid-distance between the longitudinal edges and the centreline.

7.3.2.2 In the case of steel bars not exceeding 160 mm diameter or an edge length not exceeding this value, and in the case of wire, the test pieces shall be taken as illustrated in figure 2. In the case of wire, the testing of impact test pieces may be dispensed with.

7.3.2.3 In the case of steel bars with diameters or edge lengths exceeding 160 mm and in the case of forgings, the indications shown in figure 3 shall apply.

7.4 Procedure

7.4.1 The chemical composition shall be checked in accordance with the methods [3] specified by the Chemists' Committee of the *Verein Deutscher Eisenhüttenleute* (Society of German Ferrous Metallurgy Engineers).

7.4.2 The tensile test shall be carried out as follows.

7.4.2.1 In the case of sheet and strip with a nominal thickness of less than 3 mm, the test shall be carried out as described in DIN 50114 on test pieces with a gauge length of 80 mm and a width of 20 mm (large ISO flat test piece).

7.4.2.2 In the case of wire of less than 6 mm diameter, the test shall be carried out as described in DIN 51210 Part 1 and Part 2.

7.4.2.3 In all other cases, the test shall be carried out as described in DIN 50145, on short proportional test pieces specified in DIN 50125.

7.4.3 The impact test shall be carried out as described in DIN 50115 on ISO V-notch test pieces and shall be evaluated in accordance with DIN 17010 (refer to footnote 4 of table 4).

7.4.4 The Vickers hardness test shall be carried out as described in DIN 50133 and the Brinell hardness test as described in DIN 50351.

7.4.5 The verification of resistance to intercrystalline corrosion shall be carried out as specified in DIN 50914.

●● If required, agreements may be made in respect of the details of testing.

7.4.6 The dimensions of the products and the dimensional deviations shall be checked in accordance with the specifications given in the dimensional standards concerned, if available.

7.4.7 The surface finish shall be examined visually under appropriate lighting conditions by an inspector having normal vision.

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[2] Not applicable to forgings.

[3] *Handbuch für das Eisenhüttenlaboratorium* (Handbook for the ferrous metallurgy laboratory); see "Standards and other documents referred to" clause.

7.5 Retests

DIN 17010 shall apply for retests.

8 Marking

8.1 Extent of marking

8.1.1 ●● Unless otherwise agreed at the time of ordering, the products shall be marked with the manufacturer's trade mark and the steel grade, and also with the cast number, if desired. Flat products may be marked in addition with the symbol for the type of condition, with the thickness and if required, with the coil number.

8.1.2 In the case of acceptance inspections, the products shall be marked in addition with the cast number, the number of the test batch or of the coil, and with the inspector's mark. Only the samples from which the test pieces were taken shall be marked with the test piece number, unless the test batch number is used in lieu of the test piece number.

8.2 Method of marking

As a general rule, the products shall be marked as follows:

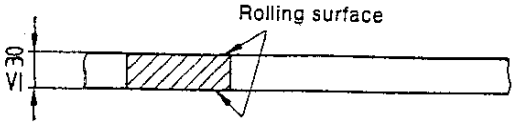
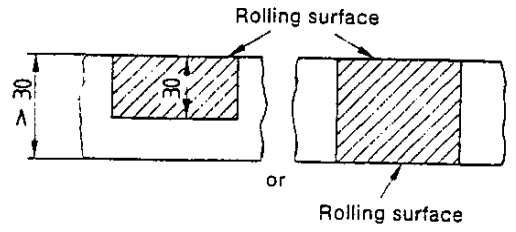
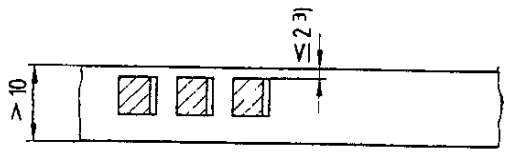
- flat products by coloured stamp at right angles to the direction of rolling; in the case of strip and plate or sheet cut from strip, roll stamping in the longitudinal direction is also permitted;
- bars and forgings by coloured stamp or punch marking;
- wire and bars less than 35 mm thick by means of a tag attached to the coil or bundle.

●● Other types of marking may be agreed at the time of ordering.

9 Complaints

9.1 Under current law, a complaint may only be raised against defective products if the defects impair their processing and use to a more than negligible extent. This shall apply unless otherwise agreed at the time of ordering.

9.2 It is normal and practical for the purchaser to give the supplier the opportunity to judge whether the complaints are justified, if possible by submitting the products objected to or samples of the products supplied.

Type of test piece	Product thickness, in mm	Position of longitudinal axis of test piece for a rolled width of		Distance of the test pieces (shown hatched) from rolling surface, in mm
		< 300 mm	≧ 300 mm	
Tensile test piece [1]	≦ 30	Longitudinal	Transverse	
	> 30			
Impact test piece [2]	> 10	Transverse	Transverse	

[1] In the case of a product thickness less than 3 mm, the test piece shall be taken as specified in DIN 50114, and in the case of other products, as specified in DIN 50125. In cases of doubt and in arbitration cases, the initial gauge length shall be $L_0 = 5{,}65\sqrt{S_0}$ for test pieces taken from products with a thickness of 3 mm and over.

●● In the case of product thicknesses over 30 mm, a round test piece may be used subject to agreement; the round test piece shall be taken at a distance from the external surface equal to one quarter of the product thickness.

[2] The longitudinal axis of the notch shall be orientated at right angles to the rolling surface of the product in all cases.

[3] In the case of product thicknesses over 30 mm, the impact test pieces shall be taken at a distance from the external surface equal to one quarter of the product thickness.

Figure 1. Location of test pieces to be taken from plate, sheet or strip

Dimensions in mm

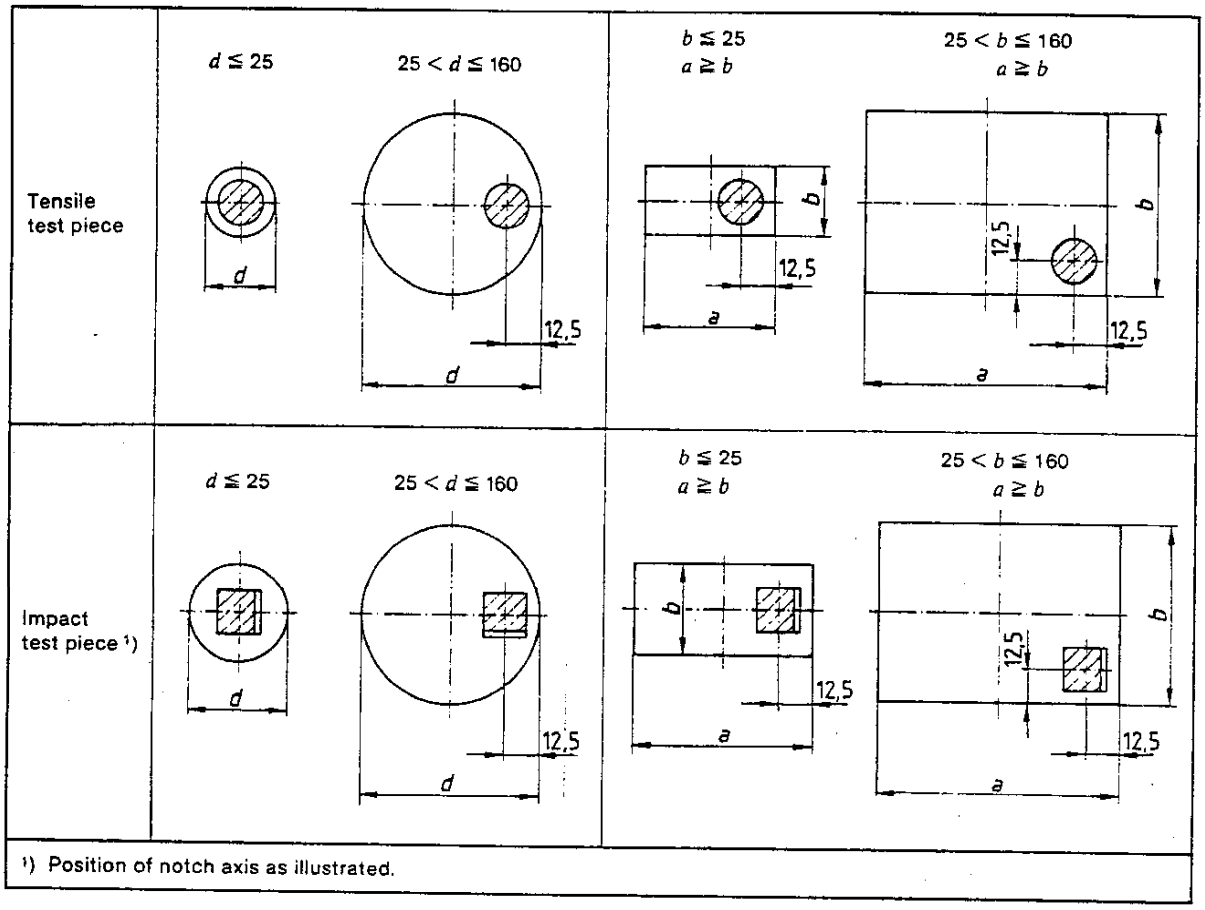


Figure 2. Location of test pieces to be taken from steel bars and wire, including hexagons and similar cross sections

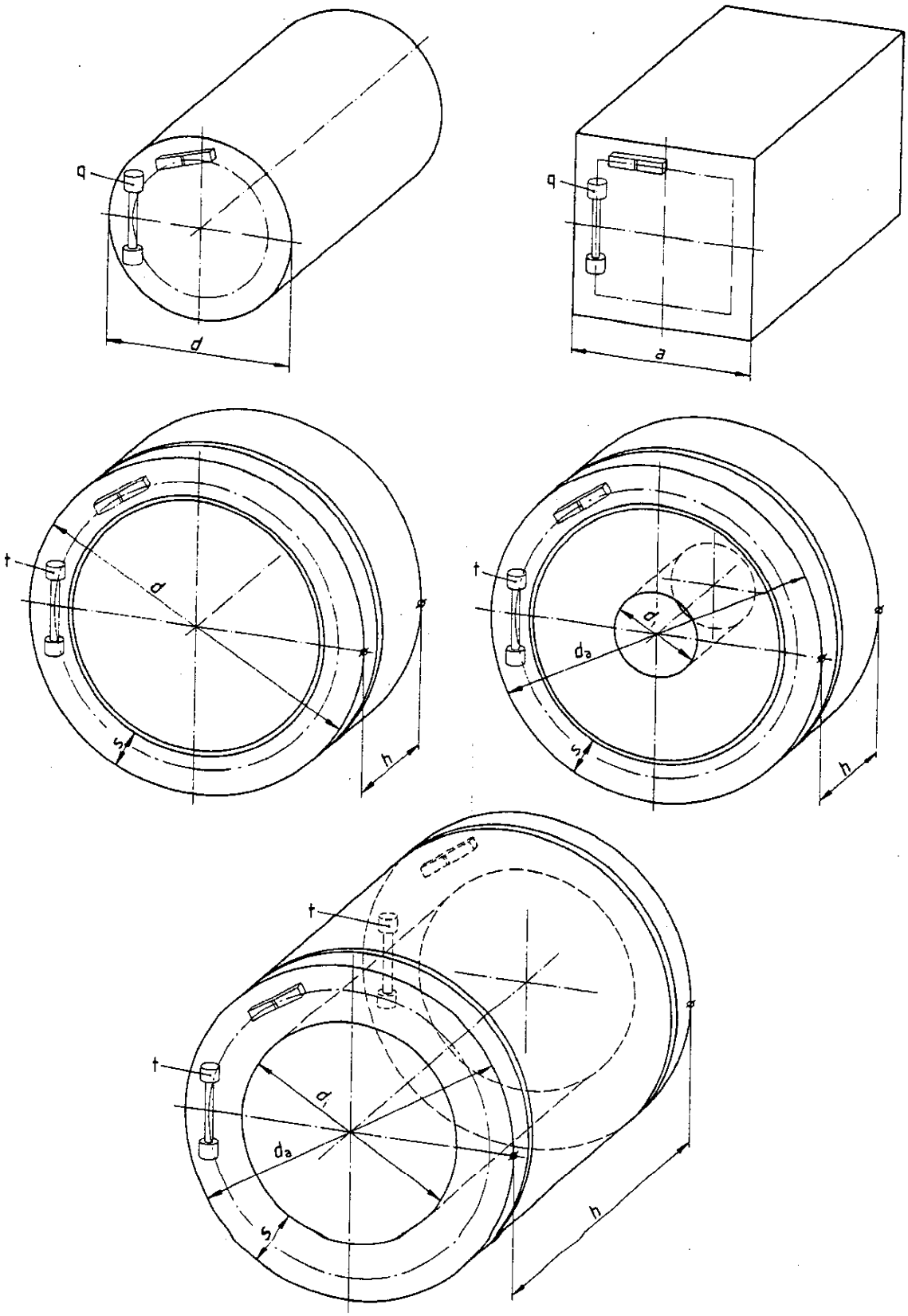


Figure 3. Dimensions and locations of test pieces to be considered in the case of bars with a diameter or thickness of 160 mm and over, and in the case of simple forgings

Figure 3. (continued)

Product form	Location and direction of test piece axis	Dimension to be considered
Steel bars, round or rectangular	$d/6$, but not more than 50 mm. q = transverse test piece	Diameter or smallest edge length.
Disc [1], with $0{,}1 \cdot d \leqq h \leqq d$. Perforated disc, with $0{,}1 \cdot d_a \leqq h \leqq d_a$ and $d_i \leqq 0{,}4 \cdot d_a$.	$h/6$ and $d_a/6$, but not more than 50 mm, taken from a parted-off ring. t = tangential test piece	h
Ring, with $h \leqq d_a$ and $d_i > 0{,}4 \cdot d_a$.	$h/6$ and $s/6$, but not more than 50 mm, taken from a parted-off ring or from a (perforated) disc parted-off from the end face. t = tangential test piece	The smaller of the two dimensions, either h or s.
Bush, with $h > d_a$ and $d_i > 0{,}4 \cdot d_a$.		s

[1]) Discs machined from steel bars shall be regarded as steel bars in respect of their dimension to be considered.

Table 1. **Steel grades and chemical composition determined in the cast analysis [1]**

Steel grade		Chemical composition (% by mass)				
Symbol [2]	Material number	C	Cr	Mo	Ni	Others [3]
Ferritic and martensitic steels						
X 6 Cr 13	1.4000	≦ 0,08	12,0 to 14,0	–	–	–
X 6 CrAl 13	1.4002	≦ 0,08	12,0 to 14,0	–	–	Al: 0,10 to 0,30
X 10 Cr 13	1.4006	0,08 to 0,12	12,0 to 14,0	–	–	–
X 15 Cr 13	1.4024	0,12 to 0,17	12,0 to 14,0	–	–	–
X 20 Cr 13	1.4021	0,17 to 0,25	12,0 to 14,0	–	–	–
X 30 Cr 13	1.4028	0,28 to 0,35	12,0 to 14,0	–	–	–
X 38 Cr 13	1.4031	0,35 to 0,42	12,5 to 14,5	–	–	–
X 46 Cr 13	1.4034	0,42 to 0,50	12,5 to 14,5	–	–	–
X 45 CrMoV 15	1.4116	0,42 to 0,50	13,8 to 15,0	0,45 to 0,60	–	V: 0,10 to 0,15
X 6 Cr 17	1.4016	≦ 0,08	15,5 to 17,5	–	–	–
X 6 CrTi 17	1.4510	≦ 0,08	16,0 to 18,0	–	–	Ti: 7 x % C, up to 1,20
X 4 CrMoS 18	1.4105	≦ 0,06	16,5 to 18,5	0,2 to 0,6	–	P ≦ 0,060; S: 0,15 to 0,35; Mn ≦ 1,5
X 12 CrMoS 17	1.4104	0,10 to 0,17	15,5 to 17,5	0,2 to 0,6	–	P ≦ 0,060; S: 0,15 to 0,35; Mn ≦ 1,5
X 20 CrNi 17 2	1.4057	0,14 to 0,23	15,5 to 17,5	–	1,5 to 2,5	–
Austenitic steels						
X 5 CrNi 18 10	1.4301	≦ 0,07	17,0 to 19,0	–	8,5 to 10,5	–
X 5 CrNi 18 12	1.4303	≦ 0,07	17,0 to 19,0	–	11,0 to 13,0	–
X 10 CrNiS 18 9	1.4305	≦ 0,12	17,0 to 19,0	–	8,0 to 10,0	P ≦ 0,060; S: 0,15 to 0,35
X 2 CrNi 19 11	1.4306	≦ 0,030	18,0 to 20,0	–	10,0 to 12,5	–
X 2 CrNiN 18 10	1.4311	≦ 0,030	17,0 to 19,0	–	8,5 to 11,5	N: 0,12 to 0,22
X 6 CrNiTi 18 10	1.4541	≦ 0,08	17,0 to 19,0	–	9,0 to 12,0	Ti: 5 x % C, up to 0,80
X 6 CrNiNb 18 10	1.4550	≦ 0,08	17,0 to 19,0	–	9,0 to 12,0	Nb: 10 x % C, up to 1,00 [4]
X 5 CrNiMo 17 12 2	1.4401	≦ 0,07	16,5 to 18,5	2,0 to 2,5	10,5 to 13,5	–
X 2 CrNiMo 17 13 2	1.4404	≦ 0,030	16,5 to 18,5	2,0 to 2,5	11,0 to 14,0	–
X 2 CrNiMoN 17 12 2	1.4406	≦ 0,030	16,5 to 18,5	2,0 to 2,5	10,5 to 13,5	N: 0,12 to 0,22
X 6 CrNiMoTi 17 12 2	1.4571	≦ 0,08	16,5 to 18,5	2,0 to 2,5	10,5 to 13,5	Ti: 5 x % C, up to 0,80
X 6 CrNiMoNb 17 12 2	1.4580	≦ 0,08	16,5 to 18,5	2,0 to 2,5	10,5 to 13,5	Nb: 10 x % C, up to 1,00 [4]
X 2 CrNiMoN 17 13 3	1.4429	≦ 0,030	16,5 to 18,5	2,5 to 3,0	11,5 to 14,5	N: 0,14 to 0,22; S ≦ 0,025
X 2 CrNiMo 18 14 3	1.4435	≦ 0,030	17,0 to 18,5	2,5 to 3,0	12,5 to 15,0	S ≦ 0,025
X 5 CrNiMo 17 13 3	1.4436	≦ 0,07	16,5 to 18,5	2,5 to 3,0	11,0 to 14,0	S ≦ 0,025
X 2 CrNiMo 18 16 4	1.4438	≦ 0,030	17,5 to 19,5	3,0 to 4,0	14,0 to 17,0	S ≦ 0,025
X 2 CrNiMoN 17 13 5	1.4439	≦ 0,030	16,5 to 18,5	4,0 to 5,0	12,5 to 14,5	Ni: 0,12 to 0,22; S ≦ 0,025

[1] Elements not quoted in this table in respect of the individual steel grades shall not be added deliberately to the steel without the purchaser's consent, except for the purpose of finishing the melt. Such elements shall in no way impair the usability or processability of the steel, e.g. its weldability, nor shall they affect the properties specified in this standard.

[2] The symbols given in the December 1972 edition of DIN 17 440 may continue to be used during the period of validity of this standard (see comparison table in the Explanatory notes).

[3] Unless otherwise specified, P ≦ 0,045 %, S ≦ 0,030 %, Si ≦ 1,0 % and for ferritic and martensitic steels, Mn ≦ 1,0 %, whilst for austenitic steels, Mn ≦ 2,0 %.

[4] Tantalum determined together with niobium and expressed in the form of niobium content.

Table 2. **Amounts by which the chemical composition in the product analysis may deviate from the limit values specified for the cast analysis**

Element	Limit values for the cast analysis as specified in table 1 % by mass	Permissible deviations [1] % by mass
Carbon (C)	≦ 0,030 > 0,030 < 0,20 ≧ 0,20 ≦ 0,50	+ 0,005 ± 0,01 ± 0,02
Silicon (Si)	≦ 1,0	+ 0,05
Manganese (Mn)	≦ 1,0 > 1,0 ≦ 2,0	+ 0,03 + 0,04
Phosphorus (P)	≦ 0,045 > 0,045 ≦ 0,060	+ 0,005 + 0,010
Sulfur (S)	≦ 0,030 ≧ 0,15 ≦ 0,35	+ 0,005 ± 0,020
Nitrogen (N)	≦ 0,22	± 0,01
Aluminium (Al)	≦ 0,30	± 0,05
Chromium (Cr)	≧ 12,0 < 15,0 ≧ 15,0 ≦ 20,0	± 0,15 ± 0,20
Molybdenum (Mo)	≦ 0,60 > 0,60 < 1,75 ≧ 1,75 ≦ 5,0	± 0,03 ± 0,05 ± 0,10
Nickel (Ni)	> 1,0 < 5,0 ≧ 5,0 < 10,0 ≧ 10,0 ≦ 17,0	± 0,07 ± 0,10 ± 0,15
Niobium (Nb)	≦ 1,00	± 0,05
Titanium (Ti)	≦ 1,20	± 0,05
Vanadium (V)	≦ 0,15	± 0,03

[1] If several product analyses are carried out for a single cast and if these elements show contents for a single element outside the range specified for the cast analysis, this content shall either exceed the permissible maximum content or be below the permissible minimum content, but not both at the same time for one cast.

Table 3. **Mechanical properties of ferritic steels at ambient temperature and resistance to intercrystalline corrosion**

Steel grade		Heat treatment condition [1]	Maximum HB or HV hardness [2]	Minimum yield stress or 0,2% proof stress, in N/mm²	Tensile strength, in N/mm²	Minimum elongation after fracture, in %				Resistance to intercrystalline corrosion when tested as described in DIN 50914	
			Flat products not exceeding 12 mm in thickness	Flat products not exceeding 12 mm in thickness	Flat products not exceeding 12 mm in thickness	Flat products			Steel bars		
					Wire from 2 to 20 mm in diameter or thickness	less than 3 mm in thickness	from 3 to 12 mm in thickness		not exceeding 25 mm in diameter or thickness		
			Steel bars not exceeding 25 mm in diameter or thickness	Steel bars not exceeding 25 mm in diameter or thickness	Steel bars not exceeding 25 mm in diameter or thickness	($A_{80\,mm}$)	(A_5)		(A_5)		
Symbol	Material number					Longitudinal Transverse	Longitudinal	Transverse	Longitudinal	In the as delivered condition	In the welded condition
X 6 Cr 13	1.4000	Annealed	185	250	400 to 600	15	20	15	20	No	No
		Quenched and tempered	–	400	550 to 700	–	–	13	18	No	No
X 6 CrAl 13	1.4002	Annealed	185	250	400 to 600	15	20	15	20	No	No
		Quenched and tempered	–	400	550 to 700	–	–	13	18	No	No
X 6 Cr 17	1.4016	Annealed	185	270	450 to 600	18	20	18	20	Yes	No
X 6 CrTi 17	1.4510	Annealed	185	270	450 to 600	18	20	18	20	Yes	Yes
X 4 CrMoS 18	1.4105	Annealed	200	270	450 to 650	–	–	–	20	No	–

[1] See table B.2 for guideline values on heat treatment.
[2] Guideline values; a recomputation of the tensile strength from the hardness gives inaccurate values.

Table 4. **Mechanical properties of martensitic steels at ambient temperature**

Steel grade		Heat treatment condition [1]	Maximum HB or HV hardness [2]	Minimum yield stress or 0,2 % proof stress, in N/mm²	Tensile strength, in N/mm²	Minimum elongation after fracture, in %						Minimum average value of impact energy, in J [4] (Evaluation in accordance with DIN 17 010)						
						Flat products			Steel bars and forgings				Steel bars and forgings						
			Flat products not exceeding 25 mm in thickness, semi-finished products, steel bars and forgings	Flat products not exceeding 25 mm in thickness, steel bars and forgings	Flat products not exceeding 25 mm in thickness Wire from 2 to 20 mm in diameter or thickness, steel bars and forgings	less than 3 mm in thickness (A_{80mm})	from 3 to 25 mm in thickness (A_5)		Dimension to be considered (figure 3)	(A_5)			Dimension to be considered (figure 3)	ISO V-notch test pieces			DVM test pieces		
Symbol	Material number					Longitudinal Transverse	Longitudinal	Transverse	mm	Longitudinal	Transverse	Tangential [3]	mm	Longitudinal	Transverse	Tangential [3]	Longitudinal	Transverse	Tangential [3]
X 10 Cr 13	1.4006	Annealed	200	250	450 to 650	15	20	15	≦ 25	20	–	–	≦ 25	–	–	–	–	–	–
		Quenched and tempered	–	420	600 to 800	–	16	12	≦ 60	18	–	15	≦ 60	–	–	–	–	–	
									> 60 ≦ 160	15	–	13	> 60 ≦ 160	–	–	–	–	–	–
X 15 Cr 13	1.4024	Annealed	225	–	≦ 720	–	–	–	≦ 100	–	–	–	≦ 100	–	–	–	–	–	–
		Quenched and tempered	–	450	650 to 800	–	15	11	≦ 60	14	–	12	≦ 60	30	–	20	40	–	30
									> 60 ≦ 160	14	–	12	> 60 ≦ 160	25	–	–	35	–	25
X 20 Cr 13	1.4021	Annealed	230	–	≦ 740	–	–	–	≦ 100	–	–	–	≦ 100	–	–	–	–	–	–
		Quenched and tempered	–	450	650 to 800	–	15	11	≦ 60	14	–	12	≦ 60	30	–	20	40	–	30
									> 60 ≦ 160	14	–	12	> 60 ≦ 160	25	–	–	35	–	25
									> 160 ≦ 400	–	10	12	> 160 ≦ 400	–	–	–	–	20	25
		Quenched and tempered	–	550	750 to 950	–	13	10	≦ 60	14	–	10	≦ 60	–	–	–	30	–	20
									> 60 ≦ 160	12	–	10	> 60 ≦ 160	–	–	–	30	–	–
									> 160 ≦ 400	–	8	10	> 160 ≦ 400	–	–	–	–	–	–
X 30 Cr 13	1.4028	Annealed Quenched and tempered	245	–	≦ 780	–	–	–	≦ 100	–	–	–	≦ 100	–	–	–	–	–	–
			–	600	800 to 1000	–	–	–	≦ 100	11	–	–	≦ 100	–	–	–	–	–	–
X 38 Cr 13	1.4031	Annealed	250	–	≦ 800	–	–	–	≦ 100	–	–	–	≦ 100	–	–	–	–	–	–
X 46 Cr 13	1.4034	Annealed	250	–	≦ 800	–	–	–	≦ 100	–	–	–	≦ 100	–	–	–	–	–	–
X 45 CrMoV 15	1.4116	Annealed	280	–	≦ 900	–	–	–	≦ 100	–	–	–	≦ 100	–	–	–	–	–	–
X 12 CrMoS 17	1.4104	Annealed Quenched and tempered	230	–	540 to 740	–	–	–	≦ 100	16	–	–	≦ 100	–	–	–	–	–	–
			–	450	640 to 840	–	–	–	≦ 100	11	–	–	≦ 100	–	–	–	–	–	–
X 20 CrNi 17 2	1.4057	Annealed	295	–	≦ 950	–	–	–	≦ 100	–	–	–	≦ 100	–	–	–	–	–	–
		Quenched and tempered	–	550	750 to 950	–	14	10	≦ 60	14	–	10	≦ 60	20	–	–	30	–	–
									> 60 ≦ 160	12	–	10	> 60 ≦ 160	20	–	–	25	–	–
									> 160 ≦ 400	–	5	10	> 160 ≦ 400	–	–	–	–	–	–

[1] See table B.2 for guideline values on heat treatment.

[2] Guideline values; a recomputation of the tensile strength from the hardness value gives inaccurate values. In the case of bars and forgings in the annealed condition, the determination of hardness will however suffice as a general rule.

[3] Applies only to forgings (see figure 3).

[4] Subject to agreement, the impact test shall be carried out on ISO V-notch test pieces. If the minimum values of impact energy required in this respect are not attained, or if no ISO V-notch values are specified for the relevant dimensional ranges and test piece locations, proof of an adequate impact energy shall be provided by testing DVM test pieces.

Table 5. **Mechanical properties of austenitic steels in the quenched condition at ambient temperature (see table B.2) and resistance to intercrystalline corrosion**

Steel grade		Minimum 0,2 % proof stress, in N/mm²	Minimum 1 % proof stress, in N/mm²	Tensile strength, in N/mm²	Minimum elongation after fracture, in %						Minimum average value of impact energy (ISO V-notch test piece), in J (Evaluation in accordance with DIN 17 010)					Resistance to intercrystalline corrosion when tested as described in DIN 50 914	
		Flat products not exceeding 75 mm in thickness [1], steel bars and forgings		Flat products not exceeding 75 mm in thickness [1], wire from 2 to 20 mm in diameter or thickness, steel bars and forgings	Flat products			Steel bars and forgings			Steel bars and forgings				Flat products not exceeding 75 mm in thickness		
					less than 3 mm in thickness ($A_{80\,mm}$)	from 3 to 75 mm in thickness [1] (A_5)		Dimension to be considered (figure 3)	(A_5)			Dimension to be considered (figure 3)						
Symbol	Material number				Longi-tudinal	Trans-verse	Longitudinal Transverse	mm	Longi-tudinal	Trans-verse [2]	Tangen-tial [3]	mm	Longi-tudinal	Trans-verse [2]	Tangen-tial [3]	Trans-verse	In the as delivered condition	In the welded condition
X 5 CrNi 18 10	1.4301	195	230	500 to 700 [4]	35	40	40	≦ 160 > 160 ≦ 250	45 [4] –	– 35	40 40	≦ 160 > 160 ≦ 250	85 –	55 [5] 55	70 65	55	Yes [6]	Yes [7]
X 5 CrNi 18 12	1.4303	185	220	490 to 690	35	40	40	≦ 160	45	–	–	≦ 160	85	55 [5]	–	55	Yes [6]	Yes [7]
X 10 CrNiS 18 9	1.4305	195	230	500 to 700	–	–	35	≦ 160	35	–	–	≦ 160	–	–	–	–	No	No
X 2 CrNi 19 11	1.4306	180	215	460 to 680	37	42	40	≦ 160 > 160 ≦ 250	45 –	– 35	40 40	≦ 160 > 160 ≦ 250	85 –	55 [5] 55	70 65	55	Yes	Yes
X 2 CrNiN 18 10	1.4311	270	305	550 to 760	35	40	35	≦ 160 > 160 ≦ 250	40 –	– 30	35 35	≦ 160 > 160 ≦ 250	85 –	55 [5] 55 (50)	65 60	55	Yes	Yes
X 6 CrNiTi 18 10	1.4541	200 [8]	235 [8]	500 to 730 [4]	35	42	35	≦ 160 > 160 ≦ 450	40 [4] –	– 30 (26)	35 35	≦ 160 > 160 ≦ 450	85 –	55 [5] 55 (45)	60 55	55	Yes	Yes
X 6 CrNiNb 18 10	1.4550	205	240	510 to 740	35	42	30	≦ 160 > 160 ≦ 450	40 –	– 30 (26)	35 35	≦ 160 > 160 ≦ 450	85 –	55 [5] 55 (45)	60 55	55	Yes	Yes
X 5 CrNiMo 17 12 2	1.4401	205	240	510 to 710 [4]	35	40	40	≦ 160 > 160 ≦ 250	40 [4] –	– 30	35 35	≦ 160 > 160 ≦ 250	85 –	55 [5] 55 (50)	65 60	55	Yes [6]	Yes [7]
X 2 CrNiMo 17 13 2	1.4404	190	225	490 to 690	35	40	40	≦ 160 > 160 ≦ 250	40 –	– 30	35 35	≦ 160 > 160 ≦ 250	85 –	55 [5] 55 (50)	65 60	55	Yes	Yes
X 2 CrNiMoN 17 12 2	1.4406	280	315	580 to 800	35	40	35	≦ 160	40	–	35	≦ 160	85	55 [5]	65	55	Yes	Yes
X 6 CrNiMoTi 17 12 2	1.4571	210 [8]	245 [8]	500 to 730 [4]	35	40	35	≦ 160 > 160 ≦ 450	35 [4] –	– 30 (26)	30 30	≦ 160 > 160 ≦ 450	85 –	55 [5] 55 (45)	60 55	55	Yes	Yes
X 6 CrNiMoNb 17 12 2	1.4580	215	250	510 to 740	–	–	30	≦ 160 > 160 ≦ 250	35 –	– 30 (26)	30 30	≦ 160 > 160 ≦ 250	85 –	55 [5] 55 (45)	60 55	55	Yes	Yes
X 2 CrNiMoN 17 13 3	1.4429	295	330	580 to 800	35	40	35	≦ 160 > 160 ≦ 400	40 –	– 30	35 35	≦ 160 > 160 ≦ 400	85 –	55 [5] 55 (50)	65 60	55	Yes	Yes
X 2 CrNiMo 18 14 3	1.4435	190	225	490 to 690	35	40	40	≦ 160 > 160 ≦ 250	35 –	– 30	30 30	≦ 160 > 160 ≦ 250	85 –	55 [5] 55 (50)	65 60	55	Yes	Yes
X 5 CrNiMo 17 13 3	1.4436	205	240	510 to 710	35	40	40	≦ 160	40	–	35	≦ 160	85	55 [5]	65	55	Yes [6]	Yes [7]
X 2 CrNiMo 18 16 4	1.4438	195	230	490 to 690	35	40	35	≦ 160	35	–	30	≦ 160	85	55 [5]	60	55	Yes	Yes
X 2 CrNiMoN 17 13 5	1.4439	285	315	580 to 800	35	40	35	≦ 160	35	–	30	≦ 160	85	55 [5]	60	55	Yes	Yes

For [1] to [8], see page 14.

Table 6. **Minimum values of elevated temperature 0,2 % and 1 % proof stress for flat products, steel bars and forgings for the dimensional ranges listed in tables 3 to 5**

Steel grade		Heat treatment condition [1]	0,2 % proof stress											1 % proof stress										Limit temperature [2]
			at a temperature, in °C, of											at a temperature, in °C, of										
Symbol	Material number		50	100	150	200	250	300	350	400	450	500	550	50	100	150	200	250	300	350	400	450	500	550	
			N/mm² min.											N/mm² min.										°C
Ferritic and martensitic steels																								
X 6 Cr 13	1.4000	Annealed	240	235	230	225	225	220	210	195	–	–	–											
X 6 CrAl 13	1.4002	Annealed																						
X 10 Cr 13	1.4006	Annealed																						
X 10 Cr 13	1.4006	Quenched and tempered	430	420	410	400	382	365	335	305	–	–	–											
X 15 Cr 13	1.4024		430	420	410	400	382	365	335	305	–	–	–											
X 20 Cr 13	1.4021		430	420	410	400	382	365	335	305	–	–	–											
X 20 CrNi 17 2	1.4057		515	495	475	460	450	430	390	345	–	–	–											
Austenitic steels																								
X 5 CrNi 18 10	1.4301	Quenched	177	157	142	127	118	110	104	98	95	92	90	211	191	172	157	145	135	129	125	122	120	120	300
X 5 CrNi 18 12	1.4303		175	155	142	127	118	110	104	98	95	92	90	208	188	172	157	145	135	129	125	122	120	120	300
X 2 CrNi 19 11	1.4306		162	147	132	118	108	100	94	89	85	81	80	201	181	162	147	137	127	121	116	112	109	108	350
X 2 CrNiN 18 10	1.4311		245	205	175	157	145	136	130	125	121	119	118	280	240	210	187	175	167	161	156	152	149	147	400
X 6 CrNiTi 18 10 [3]	1.4541 [3]		190	176	167	157	147	136	130	125	121	119	118	222	208	195	185	175	167	161	156	152	149	147	400
X 6 CrNiNb 18 10	1.4550		191	177	167	157	147	136	130	125	121	119	118	226	211	196	186	177	167	161	156	152	149	147	400
X 5 CrNiMo 17 12 2	1.4401	Quenched	196	177	162	147	137	127	120	115	112	110	108	230	211	191	177	167	156	150	144	141	139	137	300
X 2 CrNiMo 17 13 2	1.4404		182	166	152	137	127	118	113	108	103	100	98	217	199	181	167	157	145	139	135	130	128	127	400
X 2 CrNiMoN 17 12 2	1.4406		250	211	185	167	155	145	140	135	131	129	127	284	246	218	198	183	175	169	164	160	158	157	400
X 6 CrNiMoTi 17 12 2 [3]	1.4571 [3]		202	185	177	167	157	145	140	135	131	129	127	234	218	206	196	186	175	169	164	160	158	157	400
X 6 CrNiMoNb 17 12 2	1.4580		206	186	177	167	157	145	140	135	131	129	127	240	221	206	196	186	175	169	164	160	158	157	400
X 2 CrNiMoN 17 13 3	1.4429	Quenched	265	225	197	178	165	155	150	145	140	138	136	300	260	227	208	195	185	180	175	170	168	166	400
X 2 CrNiMo 18 14 3	1.4435		182	166	152	137	127	118	113	108	103	100	98	217	199	181	167	157	145	139	135	130	128	127	400
X 5 CrNiMo 17 13 3	1.4436		196	177	162	147	137	127	120	115	112	110	108	230	211	191	177	167	156	150	144	141	139	137	300
X 2 CrNiMo 18 16 4	1.4438		186	172	157	147	137	127	120	115	112	110	108	221	206	186	177	167	156	148	144	140	138	136	350
X 2 CrNiMoN 17 13 5	1.4439		260	225	200	185	175	165	155	150	–	–	–	290	255	230	210	200	190	180	175	–	–	–	400

[1] See table B.2.

[2] When used up to the temperatures listed in the table, and for service times up to 100 000 hours, no intercrystalline corrosion will occur when tested as described in DIN 50 914.

[3] In the case of bars and forgings with dimensions to be considered not less than 160 mm (see figure 3), the proof stress values may be up to 10 N/mm² lower than the values given here.

Table 7. **Data [1] relating to the mechanical properties of strain hardened stainless steel bars and wire**

Strain hardening class	Minimum 0,2 % proof stress, in N/mm²	Minimum tensile strength, in N/mm²	Minimum elongation after fracture (A_5), in %	Diameters which can be supplied, in mm	Steel grades under consideration (material numbers)
Ferritic and martensitic steels					
K 550	400	550 to 750	15	≦ 12	1.4016, 1.4104
K 800	650	800 to 1000	10	≦ 3,0	1.4016
Austenitic steels					
K 700	350	700 to 850	20	≦ 12	1.4301, 1.4305, 1.4401, 1.4541, 1.4571
K 800	500	800 to 1000	12	≦ 9	1.4301, 1.4305, 1.4401, 1.4541, 1.4571
K 1000	750	1000 to 1200	–	≦ 4	1.4301, 1.4401, 1.4541, 1.4571
K 1200	950	1200 to 1400	–	≦ 3	1.4301, 1.4401, 1.4541, 1.4571

[1] The tensile strength shall be complied with. The 0,2 % proof stress and elongation after fracture values represent guideline values only.

Footnotes relating to table 5, page 12:

[1] Up to 100 mm thickness for steel grades 1.4301, 1.4306, 1.4404, 1.4406, 1.4541, 1.4571 and 1.4435.
[2] The values given in brackets shall apply for the test piece locations deviating from those specified in subclause 7.3.2.3.
[3] Applies only for forgings (see figure 3).
[4] In the case of quenched and cold follow-up drawn bars and rods in the diameter range from 4 to 20 mm, an upper tensile strength limit of 850 N/mm² and an elongation after fracture of not less than 20 % are permitted by way of departure from the values specified in this table.
[5] This value shall only apply for bars with a diameter exceeding 100 mm.
[6] Applies only for thicknesses not exceeding 6 mm or diameters not exceeding 40 mm.
[7] ●● The dimensional limits in respect of resistance to intercrystalline corrosion may vary, depending on the actual chemical composition and on the welding conditions, and they shall be agreed at the time of ordering.
[8] A 5 N/mm² higher minimum value shall apply for flat products with thicknesses not exceeding 30 mm.

Table 8. **Type of condition and surface finish of the products**

Symbol [1]	Type of condition	Surface finish	Product form: Flat products	Wire	Steel bars	Forgings	Semi-finished products	Notes
a1	Hot worked, not heat treated, not descaled	Covered with rolling skin and exhibiting conditioned patches in some cases	×	×	×	–	×	Suitable only for products which are destined for subsequent hot processing (see subclause B.2.7)
a2	Hot worked, not heat treated, ground overall	Metallic (ground smoothness of semi-finished product)	–	–	–	–	×	
b or Ic	Hot worked, heat treated [2], not descaled	Covered with rolling skin	×	×	×	×	× [3]	Suitable only for components which will be descaled all over or machined after production (see subclause B.2.7)
c1 or II a	Hot worked, heat treated [2], mechanically descaled [4]	Metallically clean	×	×	×	×	–	●● The type of mechanical descaling, such as grinding, blasting or peeling, depends on the product form and is left to manufacturer's discretion unless otherwise agreed.
c2 or II a	Hot worked, heat treated [2], pickled		×	×	×	×	–	
e	Hot worked, heat treated [2], prepared by machining	Metallic bright	–	×	×	×	–	
f or IIIa	Heat treated, mechanically or chemically descaled, and finally cold worked	Smooth and bright, much smoother than for condition c2 or IIa	×	×	×	–	–	Cold working without subsequent heat treatment modifies the properties depending on the degree of working (see table 7).
h or IIIb	Mechanically or chemically descaled, cold worked, heat treated [2], pickled	Smoother than for condition c2 or IIa	×	×	×	–	–	
m or IIId	Mechanically or chemically descaled, cold worked, bright annealed [5] or bright annealed [5] and lightly cold rerolled or redrawn	Glossy and smoother than for condition h or IIIb	×	×	–	–	–	Especially suitable for grinding and polishing.
n or IIIc	Mechanically or chemically descaled, cold worked, heat treated [2], pickled, bright drawn (polished-drawn)	Matt and smoother than for condition h or IIIb	–	×	×	–	–	Products complying with this condition are somewhat harder than those of condition h or IIIb, m or IIId; they are especially suitable for grinding, brushing or polishing.
o or IV	Ground	●● The nature, degree and extent of grinding or polishing shall be agreed at the time of ordering.	×	–	×	–	–	Conditions b or Ic, c1 or IIa, f or IIIa, n or IIIc, m or IIId are generally used as starting condition.
p or V	Polished		×	×	×	–	–	
q	Brushed	Matt silk	×	–	–	–	–	The best starting condition is condition n or IIIc.

See page 16 for footnotes [1] to [5].

Table 9. **Test unit and scope of test programme in respect of the tensile test at ambient temperature**

Test unit	Scope of test programme per test unit				
	Hot rolled strip, plate and sheet cut therefrom	Plate and sheet (as rolled)	●● Wire rod, steel bars and forgings for general purposes	●● Steel bars and forgings for special applications, e.g. for plants subject to regular inspection	Strain-hardened steel bars and wire, also finally heat treated wire of less than 2 mm diameter
Melt, dimension [1], heat treatment batch	One test piece each from the beginning and the end of each hot rolled coil [2]	a) Plate and sheet not exceeding 20 mm in thickness: testing by batches, with a maximum of 20 rolled plates. b) Plate exceeding 20 mm in thickness: individual testing. One test piece shall be tested per batch, or per rolled plate in the case of thicknesses exceeding 20 mm.	Wire rod, steel bars and forgings may be grouped into one batch not exceeding 5000 kg in each case. One test piece per batch shall be tested.	a) One test piece per batch if the dimensions to be considered do not exceed 250 mm. Each batch shall not exceed 500 kg. If one consignment comprises more than four identical batches, only four batches shall be tested. b) If the dimensions to be considered exceed 250 mm, individual tests shall be carried out a follows: – in the case of masses per unit not exceeding 2500 kg, one test piece per individual piece; – in the case of masses per unit exceeding 2500 kg, one test piece each from the beginning and the end of the individual piece, and in the case of forgings with diameters exceeding 1000 mm, the test pieces shall be offset 180° in relation to each other.	Subject to agreement.

[1] Deviations of 20% from the largest dimension to be considered in each case may be grouped together.
[2] In the case of consignments for plants subject to regular inspection and for nuclear engineering plants, proof of uniformity shall be submitted.

Footnotes relating to table 8, page 15:

[1] The new symbols in alphabetical order have not yet become generally established. In addition, work is still proceeding on an international system of symbols, so that the usefulness of conversion to the letters featured in the table is now debatable. Consequently, both kinds of symbols have again been listed in the present table, as in the previous December 1972 edition of DIN 17440.
[2] In this context, "heat treated" is understood to mean the conventional heat treatment condition specified in tables 3 to 5.
[3] In the case of martensitic steels, it is permitted to supply semi-finished products in the annealed condition. The mechanical properties specified in table 4 for this condition are however not applicable in this case.
[4] ●● Subject to agreement at the time of ordering, flat products in particular may be supplied pickled for a short time in this surface condition.
[5] In this context, "bright annealed" is understood to mean the conventional heat treatment condition specified in tables 3 to 5.

Table 10. **Mechanical properties of finally heat treated wire less than 2 mm in diameter**

Steel grade		Diameter mm	Tensile strength N/mm^2 max.
Symbol	Material number		
Austenitic steels			
X 5 CrNi 18 10	**1.4301**	> 0,1 to ≦ 0,5	900
X 5 CrNi 18 12	**1.4303**	> 0,5 to ≦ 1,0	850
X 6 CrNiTi 18 10	**1.4541**	> 1,0 to ≦ 2,0	800
X 5 CrNiMo 17 12 2	**1.4401**		
X 6 CrNiMoTi 17 12 2	**1.4571**		
Ferritic steels			
X 6 Cr 13	**1.4000**	> 0,1 to < 2,0	650
X 6 Cr 17	**1.4016**		
X 6 CrTi 17	**1.4510**		

Table 11. **Austenitic stainless steels for use at low temperatures** [1]

Steel grade	
Symbol	Material number
X 5 CrNi 18 10	1.4301
X 5 CrNi 18 12	1.4303
X 2 CrNi 19 11	1.4306
X 6 CrNiTi 18 10	1.4541
X 6 CrNiNb 18 10	1.4550
X 5 CrNiMo 17 12 2	1.4401
X 2 CrNiMo 17 13 2	1.4404
X 6 CrNiMoTi 17 12 2	1.4571
X 6 CrNiMoNb 17 12 2	1.4580
X 2 CrNiN 18 10	1.4311
X 2 CrNiMoN 17 12 2	1.4406
X 2 CrNiMoN 17 13 3	1.4429

[1] Flat products, bars and forgings for the dimensional ranges listed in table 5. The lowest application temperatures, graded according to the loading case, are listed in *AD-Merkblatt* (AD Instruction sheet) W 10.

Appendix A

Dimensional standards applicable to the stainless steel products specified in the present standard

DIN	174	Bright flat steel; dimensions, permissible deviations, masses
DIN	175	Polished round steel; dimensions, permissible deviations according to ISO tolerance zone h9
DIN	176	Bright drawn hexagonal steel; dimensions, permissible deviations, masses
DIN	177	Cold drawn steel wire; dimensions, permissible deviations, masses
DIN	178	Bright square steel; dimensions, permissible deviations, masses
DIN	668	Bright round steel; dimensions, permissible deviations according to ISO tolerance zone h11
DIN	669	Bright steel shafts; dimensions, permissible deviations according to ISO tolerance zone h9
DIN	670	Bright round steel; dimensions, permissible deviations according to ISO tolerance zone h8
DIN	671	Bright round steel; dimensions, permissible deviations according to ISO tolerance zone h9
DIN	1013 Part 1	Steel bars; hot rolled round steel for general purposes; dimensions, permissible dimensional deviations and deviations of form
DIN	1013 Part 2	Steel bars; hot rolled round steel for special purposes; dimensions, permissible dimensional deviations and deviations of form
DIN	1014 Part 1	Steel bars; hot rolled squares for general purposes; dimensions, permissible dimensional deviations and deviations of form
DIN	1014 Part 2	Steel bars; hot rolled squares for special purposes; dimensions, permissible dimensional deviations and deviations of form
DIN	1015	Steel bars; hot rolled hexagon steel; dimensions, masses, permissible deviations
DIN	1016	Steel flat products; hot rolled strip, hot rolled sheet under 3 mm thick; dimensions, permissible dimensional deviations, deviations of form and in mass
DIN	1017 Part 1	Steel bars; hot rolled flat steel for general purposes; dimensions, masses, permissible deviations
DIN	1017 Part 2	Steel bars; hot rolled flat steel for special purposes (in bar drawing mills, bolt and screw factories etc.); dimensions, masses, permissible deviations
DIN	1543	Steel flat products; hot rolled plate 3 to 150 mm thick; permissible dimensional deviations, deviations of form and in mass
DIN	6880	Bright key steel; dimensions, permissible deviations, masses
DIN	7526	Steel forgings; tolerances and permissible variations for drop forgings
DIN	7527 Part 1	Steel forgings; machining allowances and permissible deviations for hand forged discs
DIN	7527 Part 2	Steel forgings; machining allowances and permissible deviations for hand forged pierced discs
DIN	7527 Part 3	Steel forgings; machining allowances and permissible deviations for seamless hand forged rings
DIN	7527 Part 4	Steel forgings; machining allowances and permissible deviations for seamless hand forged bushes
DIN	7527 Part 5	Steel forgings; machining allowances and permissible deviations for hand forged, rolled and welded rings
DIN	7527 Part 6	Steel forgings; machining allowances and permissible deviations for hand forged bars
DIN 59 110		Steel wire rod; dimensions, permissible deviations, masses
DIN 59 413		Cold rolled steel sections; permissible dimensional deviations, deviations of form and mass

Appendix B

Additional information

B.1 Physical properties

Guideline data on physical properties are listed in table B.1.

B.2 Guideline data on heat treatment and on subsequent processing

B.2.1 Agreement with the manufacturer is recommended in respect of the subsequent processing of the steels.

B.2.2 Guideline data on heat treatment are listed in table B.2.

B.2.3 As a general rule, the steels are suitable for cold working (e.g. drawing, stretching, spinning, bending). Stainless steel grades which are particularly suitable for cold upsetting are specified in DIN 1654 Part 5. It shall be borne in mind that the susceptibility to corrosion, mechanical and physical properties are affected by cold working.

B.2.4 The filler metals suitable for arc welding are listed in table B.3. Welding without filler metals, e.g. flash butt welding is permitted. Welding is not customary in the case of free-cutting steels X 12 CrMoS 17 (1.4104), X 4 CrMoS 18 (1.4105) and X 10 CrNiS 18 9 (1.4305). In cases of doubt, it is recommended to consult the supplier of the steel grade concerned in respect of the most suitable welding process and of which filler metal to use.

B.2.5 Thermal cutting shall be carried out under suitable working conditions, e.g. with the use of powder, shielding gas or plasma. Surface zones which are adversely affected by thermal cutting shall be dressed off.

B.2.6 Soft soldering is possible on all steel grades. Brazing is not possible in the case of the hardenable martensitic steels. Austenitic steels shall be soldered with special solders (silver solders) with a low melting point.

B.2.7 Because the resistance of stainless steels to corrosion is only reliably ensured if the surface is metallically clean, it is essential to remove any layers of scale and annealing colours which may have formed during hot working, heat treatment or welding, before use. Finished steel components containing approximately 13 % Cr demand the very best surface finish quality (precision ground or polished) in order to achieve the highest degree of resistance to corrosion.

Table B.1. **Guideline data on physical properties**

Steel grade		Density	Modulus of elasticity at						Thermal expansion between 20 °C and					Thermal conductivity at 20 °C	Specific heat capacity at 20 °C	Electrical resistance at 20 °C	Magnetizability
Symbol	Material number	kg/dm³	20 °C	100 °C	200 °C	300 °C	400 °C	500 °C	100 °C	200 °C	300 °C	400 °C	500 °C	W/(m · K)	J/(kg · K)	Ω · mm²/m	
			kN/mm²						$10^{-6} \cdot K^{-1}$								
Ferritic and martensitic steels																	
X 6 Cr 13 X 6 CrAl 13 X 10 Cr 13 X 15 Cr 13 X 20 Cr 13	1.4000 1.4002 1.4006 1.4024 1.4021	7,7	216	213	207	200	192		10,5	11,0	11,5	12,0	12,0	30	460	0,60	Existing.
X 30 Cr 13 X 38 Cr 13	1.4028 1.4031		220	218	212	205	197									0,65	
X 46 Cr 13 X 45 CrMoV 15	1.4034 1.4116										11,0	11,5					
X 6 Cr 17 X 6 CrTi 17	1.4016 1.4510	7,7	220	218	212	205	197		10,0	10,0	10,5	10,5	11,0	25	460	0,60	Existing.
X 4 CrMoS 18 X 12 CrMoS 17	1.4105 1.4104		216	213	207	200	192			10,5						0,70	
X 20 CrNi 17 2	1.4057										11,0	11,0					
Austenitic steels																	
X 5 CrNi 18 10 X 5 CrNi 18 12 X 10 CrNiS 18 9 X 2 CrNi 19 11 X 2 CrNiN 18 10 X 6 CrNiTi 18 10 X 6 CrNiNb 18 10	1.4301 1.4303 1.4305 1.4306 1.4311 1.4541 1.4550	7,9	200	194	186	179	172	165	16,0	17,0	17,0	18,0	18,0	15	500	0,73	Non-existent [1].
X 5 CrNiMo 17 12 2 X 2 CrNiMo 17 13 2 X 2 CrNiMoN 17 12 2	1.4401 1.4404 1.4406	7,98							16,5	17,5	17,5	18,5	18,5			0,75	
X 6 CrNiMoTi 17 12 2	1.4571										18,5		19,0				
X 6 CrNiMoNb 17 12 2	1.4580										18,0						
X 2 CrNiMoN 17 13 3 X 2 CrNiMo 18 14 3 X 5 CrNiMo 17 13 3	1.4429 1.4435 1.4436	7,98									17,5		18,5				
X 2 CrNiMo 18 16 4	1.4438	8,00									18,0		19,0	14		0,85	
X 2 CrNiMoN 17 13 5	1.4439	8,02									17,5		18,5				

[1]) Austenitic steels may be slightly magnetizable in the quenched condition in certain cases. Their magnetizability may increase with an increasing degree of cold working.

Table B.2. **Guideline data on hot working during subsequent processing, and on heat treatment**

Steel grade		Hot working		Annealing		Hardening or quenching		Tempering
Symbol	Material number	Temperature °C	Type of cooling	Temperature [1] °C	Type of cooling	Temperature [1] °C	Type of cooling	Temperature °C
Ferritic steels								
X 6 Cr 13 X 6 CrAl 13	1.4000 1.4002	1100 to 800	Air	750 to 800	Furnace, air	950 to 1000	Oil, air [2]	650 to 750
X 6 Cr 17 X 6 CrTi 17 X 4 CrMoS 18	1.4016 1.4510 1.4105			750 to 850	Air, water			
Martensitic steels								
X 10 Cr 13 X 15 Cr 13	1.4006 1.4024	1100 to 800	Air	750 to 800	Furnace, air	950 to 1000	Oil, air [2]	680 to 780
X 20 Cr 13	1.4021		Slow cooling	730 to 780		980 to 1030		650 to 750; 600 to 700
X 30 Cr 13	1.4028							640 to 740
X 38 Cr 13 X 46 Cr 13 X 45 CrMoV 15	1.4031 1.4034 1.4116							100 to 200
X 12 CrMoS 17	1.4104		Air	750 to 850				550 to 650
X 20 CrNi 17 2	1.4057		Slow cooling	650 to 750 [3]				620 to 720 [4]
Austenitic steels [5]								
X 5 CrNi 18 10 X 5 CrNi 18 12 X 10 CrNiS 18 9 X 2 CrNi 19 11 X 2 CrNiN 18 10	1.4301 1.4303 1.4305 1.4306 1.4311	1150 to 750	Air			1000 to 1080	Water, air [2]	
X 6 CrNiTi 18 10 X 6 CrNiNb 18 10 X 5 CrNiMo 17 12 2 X 2 CrNiMo 17 13 2 X 2 CrNiMoN 17 12 2 X 6 CrNiMoTi 17 12 2 X 6 CrNiMoNb 17 12 2	1.4541 1.4550 1.4401 1.4404 1.4406 1.4571 1.4580					1020 to 1100		
X 2 CrNiMoN 17 13 3	1.4429					1040 to 1120		
X 2 CrNiMo 18 14 3 X 5 CrNiMo 17 13 3	1.4435 1.4436					1020 to 1100		
X 2 CrNiMo 18 16 4 X 2 CrNiMoN 17 13 5	1.4438 1.4439					1040 to 1120		

[1] In the case of continuous annealing of strip, the upper temperature limits may be exceeded.
[2] Cooling shall be reasonably rapid.
[3] In certain cases, after previous transformation in the martensitic stage.
[4] In the case of a higher nickel content, a two-stage tempering with intermediate cooling down to ambient temperature is recommended.
[5] In the case of a heat treatment forming part of the further processing, the lower values of the range specified for solution annealing shall be aimed at. If the temperature during hot working did not drop below 850 °C, or if the product was cold worked, the solution annealing temperature may, during a repeated solution annealing, be up to 20 K below the lower limit of solution annealing temperature given.

Table B.3. **Guideline data on filler metals for arc welding of the steels concerned, and on the heat treatment after welding (see subclause B.2.4)**

Steel grade		Suitable filler metals [1]			Heat treatment after welding
Symbol	Material number	Symbol for the weld metal of covered electrodes	Filler rods, wire electrodes, filler wires		
			Symbols	Material number	
Ferritic and martensitic steels [2]					
X 6 Cr 13	1.4000	199, 199 Nb, 13 [3]	X 5 CrNi 199, X 5 CrNiNb 199, X 8 Cr 14 [3]	1.4302, 1.4551, 1.4009 [3]	Annealing
X 6 CrAl 13	1.4002	199, 199 Nb, 13 [3]	X 5 CrNi 199, X 5 CrNiNb 199, X 8 Cr 14 [3]	1.4302, 1.4551, 1.4009 [3]	Tempering
X 10 Cr 13	1.4006	199, 199 Nb, 13 [3]	X 5 CrNi 199, X 5 CrNiNb 199, X 8 Cr 14 [3]	1.4302, 1.4551, 1.4009 [3]	
X 15 Cr 13	1.4024	199, 199 Nb, 13 [3]	X 5 CrNi 199, X 5 CrNiNb 199, X 8 Cr 14 [3]	1.4302, 1.4551, 1.4009 [3]	
X 20 Cr 13	1.4021	199, 199 Nb, 13 [3]	X 5 CrNi 199, X 5 CrNiNb 199, X 8 Cr 14 [3]	1.4302, 1.4551, 1.4009 [3]	
X 30 Cr 13	1.4028	S-NiCr 19 Nb, S-NiCr 16 FeMn	S-NiCr 20 Nb	2.4806	
X 38 Cr 13	1.4031				
X 46 Cr 13	1.4034				
X 45 CrMoV 15	1.4116				
X 6 Cr 17 [4]	1.4016	(199), (199 Nb), 17 [3]	(X 5 CrNi 199), (X 5 CrNiNb 199), X 8 CrTi 18 [3]	(1.4302), (1.4551), 1.4502 [3]	Not necessary as a general rule; in the case of relatively large cross sections, annealing at 600 to 800 °C.
X 6 CrTi 17 [4]	1.4510	(199), (199 Nb), (17) [3]	(X 5 CrNi 199), (X 5 CrNiNb 199), (X 8 CrTi 18) [3]	(1.4302), (1.4551), (1.4502) [3]	
X 20 CrNi 17 2	1.4057	S-NiCr 19 Nb, S-NiCr 16 FeMn	S-NiCr 20 Nb	2.4806	Tempering at 650 to 700 °C
Austenitic steels					
X 5 CrNi 18 10	1.4301	199, 199 L, 199 Nb	X 5 CrNi 199, X 2 CrNi 199, X 5 CrNiNb 199	1.4302, 1.4316, 1.4551	Generally not necessary.
X 5 CrNi 18 12	1.4303	199, 199 L, 199 Nb	X 5 CrNi 199, X 2 CrNi 199, X 5 CrNiNb 199	1.4302, 1.4316, 1.4551	
X 2 CrNi 19 11	1.4306	199 L, (199 Nb)	X 2 CrNi 199, (X 5 CrNiNb 199)	1.4316, (1.4551)	
X 2 CrNiN 18 10	1.4311	199 L, (20 16 3 Mn L)	X 2 CrNi 199, (X 2 CrNiMnMoN 20 16)	1.4316, (1.4455)	
X 6 CrNiTi 18 10	1.4541	199 Nb, 199 L	X 5 CrNiNb 199, X 2 CrNi 199	1.4551, 1.4316	
X 6 CrNiNb 18 10	1.4550	199 Nb, 199 L	X 5 CrNiNb 199, X 2 CrNi 199	1.4551, 1.4316	
X 5 CrNiMo 17 12 2	1.4401	19 12 3, 19 12 3 L, 19 12 3 Nb	X 5 CrNiMo 19 11, X 2 CrNiMo 19 12, X 5 CrNiMoNb 19 12	1.4403, 1.4430, 1.4576	Generally not necessary.
X 2 CrNiMo 17 13 2	1.4404	19 12 3 L, (19 12 3 Nb)	X 2 CrNiMo 19 12, (X 5 CrNiMoNb 19 12)	1.4430, (1.4576)	
X 2 CrNiMoN 17 12 2	1.4406	19 12 3 L, 20 16 3 Mn L	X 2 CrNiMo 19 12, X 2 CrNiMnMoN 20 16	1.4430, 1.4455	
X 6 CrNiMoTi 17 12 2	1.4571	19 12 3 Nb, 19 12 3 L	X 5 CrNiMoNb 19 12, X 2 CrNiMo 19 12	1.4576, 1.4430	
X 6 CrNiMoNb 17 12 2	1.4580	19 12 3 Nb, 19 12 3 L	X 5 CrNiMoNb 19 12, X 2 CrNiMo 19 12	1.4576, 1.4430	
X 2 CrNiMoN 17 13 3	1.4429	19 12 3 L, 20 16 3 Mn L	X 2 CrNiMo 19 12, X 2 CrNiMnMoN 20 16	1.4430, 1.4455	Generally not necessary.
X 2 CrNiMo 18 14 3	1.4435	19 12 3 L, (19 12 3 Nb)	X 2 CrNiMo 19 12, (X 5 CrNiMoNb 19 12)	1.4430, (1.4576)	
X 5 CrNiMo 17 13 3	1.4436	19 12 3, 19 12 3 L, 19 12 3 Nb	X 5 CrNiMo 19 11, X 2 CrNiMo 19 12, X 5 CrNiMoNb 19 12	1.4403, 1.4430, 1.4576	
X 2 CrNiMo 18 16 4	1.4438	18 16 5	X 2 CrNiMo 18 16 5	1.4440	
X 2 CrNiMoN 17 13 5	1.4439	18 16 5	X 2 CrNiMo 18 16 5	1.4440	

[1] See DIN 8556 Part 1 and DIN 1736 Part 1 for further details on filler metals. Filler metals given in brackets mean that the filler metal in question only has minor significance.
[2] Only weldable if certain specific measures are observed; if the carbon content exceeds 0,25 %, weldability is only given to a limited extent.
[3] Final runs with homogeneous filler metals.
[4] Steels with 17 % Cr are predominantly suited for welding by processes which generate only a moderate amount of heat input, such as spot welding or seam welding, welding with filler metals representing an exception in the case of these steels.

Standards and other documents referred to

DIN 1654 Part 5 Steels for cold heading and cold extruding; technical delivery conditions for stainless steels
DIN 1736 Part 1 Welding filler metals for nickel and nickel alloys; composition, use and technical delivery conditions
DIN 8556 Part 1 Filler metals for welding stainless and heat resisting steels; designation, technical delivery conditions
DIN 17010 General technical delivery conditions for steel and steel products
DIN 17014 Part 1 Heat treatment of ferrous materials; technical concepts
DIN 17441 Stainless steels; technical delivery conditions for cold rolled strip and slit strip and for plate and sheet cut therefrom
DIN 17455 General purpose welded circular stainless steel tubes; technical delivery conditions
DIN 17456 General purpose seamless circular stainless steel tubes; technical delivery conditions
DIN 17457 Welded circular austenitic stainless steel tubes subject to special requirements; technical delivery condition
DIN 17458 Seamless circular austenitic stainless steel tubes subject to special requirements; technical delivery conditions
DIN 50049 Documents on materials testing
DIN 50114 Testing of metals; tensile test on sheet or strip less than 3 mm thick, not using an extensometer
DIN 50115 Testing of metallic materials; impact test
DIN 50125 Testing of metallic materials; tensile test pieces; guidelines for their preparation
DIN 50133 Testing of metallic materials; Vickers hardness test, range HV 0,2 to HV 100
DIN 50145 Testing of metallic materials; tensile test
DIN 50351 Testing of metallic materials; Brinell hardness test
DIN 50914 Testing of stainless steels for resistance to intercrystalline corrosion; copper sulfate-sulfuric acid method; Strauss test
DIN 51210 Part 1 Testing of metallic materials; tensile test on wires without extensometer measurement
DIN 51210 Part 2 Testing of metallic materials; tensile test on wires with extensometer measurement
EURONORM 79 Definition and classification of steel products by shape and dimensions
Stahl-Eisen-Prüfblatt 1805[4]) *Probenahme und Probenvorbereitung für die Stückanalyse bei Stählen* (Sampling and sample preparation for the product analysis of steels)
Handbuch für das Eisenhüttenlaboratorium[4]) (Handbook for the ferrous metallurgy laboratory);
volume 2: *Die Untersuchung der metallischen Werkstoffe* (Investigation of metallic materials); Düsseldorf 1966;
volume 2a (supplement): Düsseldorf 1982;
volume 5 (supplement):
A 4.1 — *Aufstellung empfohlener Schiedsverfahren* (List of recommended arbitration procedures);
B — *Probenahmeverfahren* (Sampling methods);
C — *Analysenverfahren* (Methods of analysis);
most recent edition in each case.
DIN-Normenheft 3 *Kurznamen und Werkstoffnummern der Eisenwerkstoffe in DIN-Normen und Stahl-Eisen-Werkstoffblättern* (Symbols and material numbers for ferrous materials in DIN Standards and Iron and steel material sheets)
AD-Merkblatt W 10[5]) *Werkstoffe für tiefe Temperaturen; Eisenwerkstoffe* (Materials for low temperature applications; ferrous materials)
DECHEMA-Werkstofftabelle[6]) (DECHEMA Table of materials)
Refer also to the dimensional standards listed in Appendix A.

Other relevant standards and documents

DIN 17145 Round wire rod for welding filler metals; technical delivery conditions
DIN 17224 Stainless steel wire and strip for springs; technical delivery conditions
DIN 17445 Stainless steel castings; technical delivery conditions
Stahl-Eisen-Werkstoffblatt 390[4]) *Nichtmagnetisierbare Stähle* (Non-magnetizable steels)
Stahl-Eisen-Werkstoffblatt 400[4]) *Nichtrostende Walz- und Schmiedestähle* (Stainless rolled and forged steels)
Stahl-Eisen-Werkstoffblatt 410[4]) *Nichtrostender Stahlguß* (Stainless cast steel)
Stahl-Eisen-Werkstoffblatt 470[4]) *Hitzebeständige Walz- und Schmiedestähle* (Heat-resistant rolled and forged steels)
AD-Merkblatt W 2 *Austenitische Stähle* (Austenitic steels)

Previous editions

DIN 17440: 01.67, 12.72

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[4]) Obtainable from *Verlag Stahleisen mbH*, Postfach 82 29, D-4000 Düsseldorf 1.
[5]) Obtainable from *Beuth Verlag GmbH*, Burggrafenstraße 4–10, D-1000 Berlin 30.
[6]) Obtainable from *Deutsche Gesellschaft für chemische Apparatewesen e.V.*, Theodor-Heuss-Allee 25, D-6000 Frankfurt 97.

Amendments

The following amendments have been made in comparison with the December 1972 edition:

a) Seamless and welded pipes and cold rolled strip have been excluded from the field of application.

b) Semi-finished products have now been included in the field of application. Details on sampling and requirements regarding the mechanical properties have been adopted in the standard for larger forgings.

c) X 30 Cr 13 (1.4028), X 38 Cr 13 (1.4031), X 4 CrMoS 18 (1.4105) and X 2 CrNiMoN 17 13 5 (1.4439) steels have been adopted. X 8 CrNb 17 (1.4511) and X 6 CrMo 17 (1.4113) steels have been dropped, because they are supplied only in the form of cold rolled strip; they are now referred to as X 6 CrNb 17 steel and X 6 CrMo 17 1 steel respectively in DIN 17 441.

d) Some symbols have been altered in line with the specifications regarding the chemical composition.

e) The dimensional ranges to which the mechanical requirements are assigned have been extended.

f) Data relating to the mechanical properties of finally heat treated wire with diameters less than 2 mm have been adopted.

g) Austenitic stainless steels which are particularly suitable for use at low temperatures have been specified in tabular form.

h) The ISO V-notch test piece has been introduced for the impact test.

i) The specifications relating to the marking of the products have been formulated in a more precise manner.

j) The specifications relating to the chemical composition of the following steel grades have been altered: 1.4021, 1.4034, 1.4016, 1.4116, 1.4510, 1.4104, 1.4057, 1.4305, 1.4301, 1.4303, 1.4306, 1.4541, 1.4550, 1.4406, 1.4571, 1.4580, 1.4429, 1.4435, 1.4436 and 1.4438.

k) The specifications relating to the mechanical properties at ambient temperature and at elevated temperatures have been revised.

l) K 800, K 1000 and K 1200 have been adopted as the most widely used strain hardening stages for strain hardened bars, and K 65 has been deleted.

m) The data relating to the test units and scope of the test programme for the tensile test at ambient temperature have been revised in line with *AD-Merkblatt* W 2.

n) The guideline data relating to hot forming and to heat treatment have been revised.

o) The guideline data relating to suitable filler metals for arc welding have been revised, and the symbols for the weld metal of covered electrodes have been adopted, as have also the particulars relating to heat treatment after welding.

p) In the case of flat products, the tensile test shall be carried out on transverse test pieces for rolling widths from 300 mm.

Explanatory notes

a) In response to a request from the tube manufacturers, stainless steel tubes and pipes are now excluded from DIN 17 440 and specified in four new standards (DIN 17 455 to DIN 17 458), distinctions being made in respect of manufacturing method (seamless and welded) and of the stringency of requirements (general requirements and special requirements). This request was founded on the following arguments:
   - not all the steel grades specified in the present standard are used for tubes and pipes;
   - there is a whole category of specifications which apply solely to tubes and pipes (e.g. in respect of testing and inspection);
   - by segregating tubes and pipes, the quantity of footnotes in the present standard can be greatly reduced, and data processing is thereby greatly simplified;
   - the revision of the present standard will be simplified by this arrangement.

b) During the discussions relating to the present standard, it was also decided to exclude cold rolled strip and plate, sheet and bars (strips) cut therefrom from DIN 17 440, in addition to the stainless steel seamless and welded tubes and pipes, and to specify the properties of the above products in a separate standard, viz. DIN 17 441. The main reason for the exclusion of cold rolled strip from DIN 17 440 resides in the fact that the mechanical properties of this product form are in part widely different from the mechanical properties of other product forms.

c) In the past few years, necessary information and documentation has been gathered, rendering it possible to specify data on values determined in the tensile test and impact test on forgings, which are to be complied with. The evaluation of the assembled data indicated that specifications which differ from those for the other product forms are only required in respect of the elongation after fracture and impact energy. The special requirements relating to test pieces to be taken from forgings have been illustrated in sketches.

d) At the instigation of the steel manufacturers, an adaptation of the symbols to the altered specifications for the chemical composition was already undertaken at the time of the draft version of the present standard; the retention of these new symbols was unanimously confirmed when reviewing the comments received. However, in order to give plenty of time to all parties concerned to revise their existing documents, and taking due note of the fact that international efforts are being made at present to develop a system of symbols, it was also decided that the symbols given in the December 1972 edition of DIN 17 440 could still continue to be used during the period of validity of the present standard.

Material number	Symbol specified in DIN 17 440 (December 1972 edition)	New symbol
1.4000	X 7 Cr 13	X 6 Cr 13
1.4002	X 7 CrAl 13	X 6 CrAl 13
1.4016	X 8 Cr 17	X 6 Cr 17
1.4034	X 40 Cr 13	X 46 Cr 13
1.4057	X 22 CrNi 17	X 20 CrNi 17 2
1.4301	X 5 CrNi 189	X 5 CrNi 18 10
1.4303	X 5 CrNi 19 11	X 5 CrNi 18 12
1.4305	X 12 CrNiS 188	X 10 CrNiS 189
1.4306	X 2 CrNi 189	X 2 CrNi 19 11
1.4401	X 5 CrNiMo 18 10	X 5 CrNiMo 17 122
1.4404	X 2 CrNiMo 18 10	X 2 CrNiMo 17 132
1.4406	X 2 CrNiMoN 18 12	X 2 CrNiMoN 17 122
1.4429	X 2 CrNiMoN 18 13	X 2 CrNiMoN 17 133
1.4435	X 2 CrNiMo 18 12	X 2 CrNiMo 18 143
1.4436	X 5 CrNiMo 18 12	X 5 CrNiMo 17 133
1.4438	X 2 CrNiMo 18 16	X 2 CrNiMo 18 164
1.4510	X 8 CrTi 17	X 6 CrTi 17
1.4541	X 10 CrNiTi 189	X 6 CrNiTi 18 10
1.4550	X 10 CrNiNb 189	X 6 CrNiNb 18 10
1.4571	X 10 CrNiMoTi 18 10	X 6 CrNiMoTi 17 122
1.4580	X 10 CrNiMoNb 18 10	X 6 CrNiMoNb 17 122

It should also be mentioned that the former symbols are still specified in several other DIN Standards at the time of publication of the present standard, e.g. in DIN 1654 Part 5, DIN 17 224, DIN 17 442; when these standards are revised, the symbols contained in them will be amended accordingly. The tabular comparison on page 23 gives a list of the symbols included in this standard which have been amended in comparison with the December 1972 edition of DIN 17 440, together with their unchanged material numbers.

All the participants were agreed that the symbols should correctly designate the chemical composition of the steel grades concerned; thus for example, percentages by mass of carbon not exceeding 0,07 % shall have this fact expressed in the symbol by the figure 5, and the average percentage by mass of molybdenum shall also be featured in the symbol. The users stated however that, after conclusion of the discussions on an international system of symbols, it would be highly probable that further alterations to these symbols would have to be carried out at the national level and, consequently, that it would be a waste of time to carry out any unnecessary alterations of symbols on existing drawings, parts lists etc. at the present time. There was also a general consensus that an alteration of symbols would have far less serious consequences in the case of stainless steels than in the case of general purpose structural steels specified in DIN 17 100, because stainless steels are usually designated by their material number and not by their symbol.

e) Because stainless steel grades with low temperature toughness have in past practice always been ordered on the basis of their material numbers as featured in DIN 17 440, and not on the basis of the material numbers listed in *Stahl-Eisen-Werkstoffblatt* 680 for these steels (i.e. 1.69xx), the stainless steel grades listed in *Stahl-Eisen-Werkstoffblatt* 680-70 have now been dropped from DIN 17 280 on the occasion of the incorporation of the above *Stahl-Eisen-Werkstoffblatt* into DIN 17 280. In lieu thereof, the present standard features a list of those austenitic stainless steels which are particularly suitable for use at low temperatures.

f) The DVM test piece formerly used for the impact test has basically been superseded by the ISO V-notch test piece which is more commonly used internationally. The previously specified minimum values of 85 J (for longitudinal test pieces) and 55 J (for transverse test pieces) for DVM test pieces of austenitic steels have been adopted unaltered for the ISO V-notch test pieces. The demand for material-specific minimum values for the martensitic steels made it necessary to retain the DVM test piece side by side with the ISO V-notch test piece for this group of steels for the time being, and to specify values for both types of test piece, in view of the relatively small amount of experience at present available in respect of ISO V-notch test pieces. However, the impact test shall normally be carried out on ISO V-notch test pieces even in the case of martensitic steels.

g) Alterations in the specifications relating to the mechanical properties at ambient temperature have also been made in consideration of international agreements, which, however, do not include detailed data in respect of forgings.

h) The following details relating to the minimum values of elevated temperature proof stress given in this standard should be borne in mind.

- As regards steel grades 1.4000 and 1.4002, the previous values have been retained unaltered. The same values have now also been specified for steel grade 1.4006 in the annealed condition, which represents a decrease in value in comparison with the former values.
- In the case of steel grade 1.4057, the previous minimum values have been multiplied by the factor $\frac{550}{600}$, in line with a reduction of the minimum value of 0,2 % proof stress at ambient temperature from 600 to 550 N/mm^2.
- Because it was deemed necessary to retain the previously specified minimum value of 295 N/mm^2 for the 0,2 % proof stress at ambient temperature of steel grade 1.4429, in place of the internationally agreed value of 280 N/mm^2 (in conjunction with a minimum percentage by mass of nitrogen of 0,14 % specified in the present standard, in place of 0,12 %), the elevated temperature proof stress values for this steel grade have also been left unaltered.
- The elevated temperature proof stress values for all the remaining steel grades are in agreement with the previous values listed in the December 1972 edition of DIN 17 440, with minor deviations, with the exception however of certain corrections in the 50 to 150 °C temperature range, caused by changed minimum values at ambient temperature. In these cases, the values are in agreement with those intended for incorporation in the revised edition of EURONORM 88 (at present at the stage of "green" draft, document No. CECA/AG 23/EU 88 N 65).
- It was however agreed not to adopt the minimum values based on the ISO method, intended for inclusion in the revised edition of ISO 2604; these minimum values are in many cases considerably lower than those used up to now for calculation purposes, and this is in contradiction with past experience in Germany.

i) Based on the observation that the minimum proof stress values are sometimes below those listed in the standard for austenitic steels, after subsequent processing and after renewed solution annealing treatment complying with the standard (steel grades 1.4541, 1.4571, 1.4306 and 1.4404 have been cited in this context in particular), footnote 5 has been added to table B.2. According to this footnote, it is permitted to reduce the lower temperature limit specified in the table for solution annealing by 20 K. The steel manufacturers considered this reduction acceptable from the corrosion point of view.

Because the steel processing industry feared that the proof stress values entered in the test certificates might in some cases be altered as a result of straightening, i.e. might be higher than after the heat treatment, the possibility of taking the test pieces before straightening has been provided for in subclause 7.3.2.

j) Contrary to the intention expressed on publication of the December 1972 edition of DIN 17 440, no standard dealing with symbols for the surface finish of steel products of all kinds has either been prepared or even planned. Practical experience has shown that the symbols listed in alphabetical sequence are used almost as frequently as the symbols designated as "former symbols" in the December 1972 edition, and as a consequence the present edition of this standard gives both types of symbol side by side and equally valid.

It is worth mentioning that it is intended to adopt this table 8, without the symbols, practically unamended in the new versions of EURONORM 88 (at present in the form of document CECA/AG 23/EU 88 N 65) and of ISO 683/13 (at present in the form of document ISO/TC 17/SC 4 N 979), according to the most recent stage of discussions on the subject.

k) In the case of products supplied in the untreated condition because of subsequent processing, but in respect of which compliance with the strength requirements in the heat treated condition is to be verified, it has been specified that the values given in tables 3, 4 or 5 may be verified on reference test pieces.

The present standard is related with the following international documents:

ISO 683/13 – 1974 Heat-treated steels, alloy steels and free-cutting steels. Part 13: Wrought stainless steels

ISO 2604/1 – 1975 Steel products for pressure purposes; quality requirements. Part 1: Forgings

ISO 2604/4 – 1975 Steel products for pressure purposes; quality requirements. Part 4: Plates

EURONORM 88 – 71 Stainless steels; quality specifications

EURONORM 141 – 79 Austenitic stainless steel plate and strip for application at low temperature; technical conditions of delivery

The present standard deals with all types of products with the exception of tubes, pipes and cold rolled strip, and is applicable both to general purpose applications and to the field of pressure vessels, whilst the international standards listed above are applicable either only to the general purpose field or to the pressure vessel field, and in the case of the ISO Standards in the pressure vessel field, the application of the standard is further limited to one single product type only, but it does however cover other steel groups in addition to stainless steels.

ISO 683/13 – 74, ISO 2604/4 – 75 and EURONORM 88 – 71 are at present in process of being revised, and a clear picture has already emerged in respect of the selection of grades and chemical composition. A comparison of the steel grades specified in the present standard with those specified in the international standards is given in the following table, which is based on the latest information available on the proposed revised standards, and not on the published versions which are in fact out of date.

Comparison of stainless steels as specified in national documents with the stainless steels specified in ISO/DR 683/13, ISO 2604/1–75, ISO/DR 2604/4 (at present in the form of document TC 17/SC 10 N 492), **EURONORM 88 and EURONORM 141–79**

National documents			ISO/DR 683/13		ISO 2604/1–75		ISO/DR 2604/4		EURONORM 88		EURONORM 141–79	
Source [1]	Symbol	Material number	Steel type	[2]	Steel type	[2]	Symbol	[2]	Symbol	[2]	Symbol	[2]
DIN 17 441	X 6 CrTi 12	1.4512	1 Ti	●	–		–		X 5 CrTi 12	●	–	
DIN 17 440	X 6 Cr 13	1.4000	1	●	–		–		X 6 Cr 13	●	–	
DIN 17 440	X 6 CrAl 13	1.4002	2	●	–		–		X 6 CrAl 13	●	–	
DIN 17 440	X 10 Cr 13	1.4006	3	○	–		–		X 10 Cr 13	●	–	
DIN 17 440	X 15 Cr 13	1.4024	3	○	–		–		X 15 Cr 13	●	–	
	–	–	7		–		–		X 12 CrS 13		–	
DIN 17 440	X 20 Cr 13	1.4021	4	○	–		–		X 20 Cr 13	○	–	
DIN 17 440	X 30 Cr 13	1.4028	5	○	–		–		X 30 Cr 13	●	–	
DIN 17 440	X 38 Cr 13	1.4031	–		–		–		X 40 Cr 13	●	–	
DIN 17 440	X 46 Cr 13	1.4034	–		–		–		X 45 Cr 13	●	–	
DIN 17 440	X 45 CrMoV 15	1.4116	–		–		–		–		–	
DIN 17 440	X 6 Cr 17	1.4016	8	○	–		–		X 8 Cr 17	○	–	
	–	–	8a		–		–		X 10 CrS 17		–	
DIN 17 440	X 6 CrTi 17	1.4510	8b	○	–		–		X 8 CrTi 17	○	–	
DIN 17 441	X 6 CrNb 17	1.4511	–		–		–		–		–	
DIN 17 441	X 6 CrMo 17 1	1.4113	9c	●	–		–		X 8 CrMo 17	●	–	
DIN 17 440	X 12 CrMoS 17	1.4104	9a	○	–		–		X 14 CrS 17	●	–	
DIN 17 440	X 4 CrMoS 18	1.4105	–		–		–		–		–	
DIN 17 440	X 20 CrNi 17 2	1.4057	9b	●	–		–		X 21 CrNi 17	●	–	
DIN 17 440	X 5 CrNi 18 10	1.4301	11	○	F 47	○	X 5 CrNi 18 9	○	X 6 CrNi 18 10	○	–	
	–	–	–		F 48		X 7 CrNi 18 9		–		–	
DIN 17 440	X 5 CrNi 18 10	1.4301	–		F 49	○	X 5 CrNi 18 10	○	–		X 6 CrNi 18 10 KT	●
DIN 17 440	X 5 CrNi 18 12	1.4303	13	●	–		–		X 8 CrNi 18 12	●	–	
DIN 17 440	X 10 CrNiS 18 9	1.4305	17	●	–		–		X 10 CrNiS 18 9	●	–	
	–	–	17a		–		–		–		–	
DIN 17 440	X 2 CrNi 19 11	1.4306	10	○	F 46	○	X 2 CrNi 18 10	○	X 3 CrNi 18 10	○	X 3 CrNi 18 10 KT	○
DIN 17 440	X 2 CrNiN 18 10	1.4311	10 N	×	–		X 2 CrNiN 18 10	×	X 3 CrNiN 18 10	×	X 3 CrNiN 18 10 KT	×
DIN 17 440	X 6 CrNiTi 18 10	1.4541	15	×	F 53	●	X 6 CrNiTi 18 10	×	X 6 CrNiTi 18 10	×	–	
	–	–	–		F 54		–		–		–	
DIN 17 440	X 6 CrNiTi 18 10	1.4541	–		F 55	●	X 6 CrNiTi 18 11	●	–		X 6 CrNiTi 18 10 KT	×
DIN 17 440	X 6 CrNiNb 18 10	1.4550	16	×	F 50	●	X 6 CrNiNb 18 10	×	X 6 CrNiNb 18 10	×	–	
	–	–	–		F 51		–		–		–	
DIN 17 440	X 6 CrNiNb 18 10	1.4550	–		F 52	●	X 6 CrNiNb 18 11	●	–		–	
	–	–	12		–		–		X 10 CrNi 18 9		–	
SEW 400	X 12 CrNi 17 7	1.4310	14	○	–		–		X 12 CrNi 17 7	○	–	
	–	–	–		F 56		X 7 CrNiNb 16 12		–		–	
	–	–	–		–		X 5 CrNiN 18 9		–		–	
	–	–	–		–		–		–		X 5 CrNiN 18 9 KT	

For [1] and [2], see page 27.

(Continued)

National documents			ISO/DR 683/13		ISO 2604/1-75		ISO/DR 2604/4		EURONORM 88		EURONORM 141-79	
Source [1]	Symbol	Material number	Steel type	[2]	Steel type	[2]	Symbol	[2]	Symbol	[2]	Symbol	[2]
DIN 17 440	X5 CrNiMo 17 12 2	1.4401	20	×	F 62	O	X5 CrNiMo 17 12	×	X6 CrNiMo 17 12 2	×	–	
	–	–	–		F 64		X7 CrNiMo 17 12		–		–	
DIN 17 440	X2 CrNiMo 17 13 2	1.4404	19	×	F 59	O	X2 CrNiMo 17 12	×	X3 CrNiMo 17 12 2	×	–	
DIN 17 440	X2 CrNiMoN 17 12 2	1.4406	19 N	×	–		X2 CrNiMoN 17 12	×	X3 CrNiMoN 17 12 2	×	–	
DIN 17 440	X6 CrNiMoTi 17 12 2	1.4571	21	●	F 66	O	X6 CrNiMoTi 17 12	●	X6 CrNiMoTi 17 12 2	×	–	
DIN 17 440	X6 CrNiMoNb 17 12 2	1.4580	23	●	–		X6 CrNiMoNb 17 12	●	X6 CrNiMoNb 17 12 2	×	–	
	–	–	–		–		X5 CrNiMoN 17 12		–		–	
DIN 17 440	X2 CrNiMoN 17 13 3	1.4429	19a N	●	–		X2 CrNiMoN 17 13	●	X3 CrNiMoN 17 13 3	●	–	
DIN 17 440	X2 CrNiMo 18 14 3	1.4435	19a	O	F 59	O	X2 CrNiMo 17 13	O	X3 CrNiMo 17 13 3	O	–	
DIN 17 440	X5 CrNiMo 17 13 3	1.4436	20a	●	F 62	O	X5 CrNiMo 17 13	●	X6 CrNiMo 17 13 3	●	–	
	–	–	–		F 64		–		–		–	
DIN 17 440	X2 CrNiMo 18 16 4	1.4438	24	●	–		X3 CrNiMo 18 16 4	●	X3 CrNiMo 18 16 4	●	–	
DIN 17 440	X2 CrNiMoN 17 13 5	1.4439	–		–		–		X3 CrNiMoN 17 13 5	●	–	
	–	–	A-2		–		–		–		–	
	–	–	A-3		–		–		–		–	
	–	–	–		–		X8 NiCrAlTi 32 21		–		–	
	–	–	–		–		X5 CrNiMoN 17 13		–		–	
	–	–	–		–		X6 CrNiMoTi 17 13		–		–	
	–	–	–		–		X7 CrNiMoNb 16 16		–		–	
	–	–	–		–		–		–		X3 CrMnNiN 18 8 7 KT	

[1] DIN 17 440 = specified in this standard.
DIN 17 441 = specified in DIN 17 441.
SEW 400 = specified in *Stahl-Eisen-Werkstoffblatt* 400-73.

[2] This column indicates the degree of agreement with regard to the chemical composition of the steels specified in national documents and those specified in international standards. The symbols have the following meaning: × complete agreement, ● slight differences, O significant differences.

International Patent Classification

C 22 C 38/00