UDC 669.14.018.298.23-4:620.1

April 1987

Nitriding steels

Technical delivery conditions

DIN 17 211

Nitrierstähle; technische Lieferbedingungen

Supersedes
August 1970 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 Standard ISO 683/10 – 1987 published by the International Organization for Standardization (ISO) and with EURONORM 85-70 published by the European Coal and Steel Community (ECSC).

The clauses and subclauses marked • give specifications which are to be agreed upon at the time of ordering. The subclauses marked •• give specifications which are optional and may be agreed upon at the time of ordering.

1 Field of application

1.1 This standard applies to

semi-finished products, e.g. blooms, slabs, billets,

hot rolled wire,

hot rolled, hot forged or bright steel bars (round, square, hexagonal, octagonal and flat steel bars),

hot rolled wide flats,

hot or cold rolled plate, sheet and strip, and

hammer forgings and drop forgings made from the nitriding steels listed in table 2.

The heat treatment conditions in which the various product forms concerned can be supplied are shown in table 1, and the possible surface finishes are given in subclause 7.2.2.

Note 1. DIN Standards covering steels which are to meet the same requirements regarding chemical composition as given in table 2, but are supplied in other product forms or other treatment conditions or are intended for particular applications, and also DIN Standards covering similar steels are listed in the 'Other relevant standards and documents' clause.

Note 2. Hammer forged semi-finished products, for example blooms, slabs, billets and hammer forged steel bars are referred to in this standard as 'semi-finished products' and 'steel bars', and not as 'hammer forgings and drop forgings'.

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

2 Concepts

2.1 Nitriding steels

Nitriding steels as defined in this standard are heat-treatable steels which, owing to the nitride forming elements they contain, are particularly suitable for nitriding or nitrogen case-hardening resulting in a high surface hardness. In this respect, nitriding or nitrogen case-hardening shall be understood to be annealing in nitrogen or in a nitrogen and carbon providing environment to obtain a nitrogen-enriched or nitrogen and carbon-enriched surface zone for increasing surface hardness, wear resistance, fatigue strength and/or resistance to rusting.

2.2 Product

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

2.3 Types of heat treatment

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

3 • Dimensions, dimensional deviations and form tolerances

The nominal sizes, dimensional deviations and form tolerances for the products shall be agreed at the time of ordering, reference being made, if possible, to the appropriate dimensional standards (see appendix B).

4 Mass

The mass of the steels covered in this standard has been calculated taking the density as 7,85 kg/dm^3.

5 Designation

5.1 The standard designation for steel complying with this standard, shall give in the following order:

- the name of product (steel);
- the number of this standard;
- the symbol or material number identifying the steel grade (see table 2)[1];
- where applicable, the code letter identifying the treatment condition (see subclause 7.2.1).

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

Continued on pages 2 to 15

Example 1:

Steel DIN 17 211 – 34 CrAlNi 7

or

Steel DIN 17 211 – 1.8550

Example 2:

Steel DIN 17 211 – 34 CrAlNi 7 V

or

Steel DIN 17 211 – 1.8550 V

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

6 Classification into grades

6.1 Steel grades

6.1.1 The steel grades specified in this standard are alloy high-grade steels (see EURONORM 20) with lower maximum contents of phosphorus.

6.1.2 • The steel grade is to be selected by the purchaser.

7 Requirements

7.1 Manufacturing process

The steelmaking process, the casting process and the process of shaping the product shall be at the manufacturer's discretion.

•• In special cases, however, an agreement on this may be made at the time of ordering.

7.2 Heat treatment condition and surface finish of material on delivery

7.2.1 • Heat treatment condition

See table 1 for the permitted heat treatment conditions.

7.2.2 •• Surface finish

If agreed at the time of ordering, the products shall be provided with one of the following surface finishes:

- hot formed and pickled;
- hot formed and abrasive blasted;
- hot formed and rough-machined;
- other surface finishes (details to be agreed).

7.3 Chemical composition, mechanical properties and maximum hardness

Table 1 summarizes the usual combinations of heat treatment conditions of the material on delivery, product forms and requirements regarding chemical composition, mechanical properties and maximum hardness.

•• Unless otherwise agreed, the requirements given in column 8 of table 1 shall apply for the relevant heat treatment condition of the material on delivery and for the particular product form.

7.3.1 Table 2 shall apply for the chemical composition determined by the ladle analysis.

7.3.2 The specifications given in table 3 (see also footnote 3 to table 5) shall apply for the limit deviations of the values applicable to the product analysis from the results of the ladle analysis (see table 2).

7.3.3 The maximum values of Brinell hardness given in table 4 shall apply for the softened condition.

7.3.4 The values given in table 4 for the mechanical properties shall apply to test pieces in the 'quenched and tempered' heat treatment condition, which have been taken and prepared in accordance with figure 1 and table 5 (see also footnote 2 to table 1).

7.4 Technological properties

7.4.1 •• Machinability

In cases where the 'softened' (G) condition characterized by the hardness values given in table 4 are not adequate for providing satisfactory machinability under the proposed machining conditions, special heat treatments and/or a minimum sulfur content shall be agreed.

7.4.2 Shearability

Under suitable conditions, all steel grades specified in this standard are shearable in the 'softened' treatment condition.

7.5 •• Structure

A ferritic content in the core is inevitable in the case of larger products. A maximum value of ferritic content in the core of quenched and tempered products may be agreed at the time of ordering.

7.6 •• Internal soundness

Requirements regarding the internal soundness of steel products, based, for example, on non-destructive testing, may be agreed at the time of ordering.

7.7 Surface quality

7.7.1 General

The products shall have a smooth surface appropriate to the forming process used. For the requirements regarding the surface quality of sheet and wide flats, the specifications given in EURONORM 163 shall apply.

7.7.2 •• Permissible depth of cracks and skin decarburization

It may be agreed at the time of ordering that a specified depth of crack and/or depth of skin decarburization shall not be exceeded.

Specification of the permissible crack depth, in the case of steel bars and rods of circular cross section shall be in accordance with *Stahl-Eisen-Lieferbedingungen* (Iron and steel delivery conditions) 055 (at present at the stage of draft).

7.7.3 •• Suitability for bright drawing

Suitability for bright drawing may be agreed at the time of ordering in the case of steel bars and rods.

7.8 Separation of products by casts

Within one consignment, the products shall be separated by casts.

8 Testing

8.1 General

The manufacturer shall inspect the quality of his production in such a manner as he considers appropriate and on his own responsibility, with such measures as he

considers suitable, in the light of the requirements specified in clause 7.

●● The issue of a document as specified in DIN 50 049 covering tests on materials carried out at the manufacturer's works or by independent inspectors, may be agreed at the time of ordering.

8.2 ●● Materials testing certificates issued by the manufacturer

8.2.1 If a test report (DIN 50 049 – 2.2) is to be issued in accordance with agreements made at the time of ordering, this report shall specify the results of the ladle analysis for all the elements listed in table 2 for the relevant steel grade.

8.2.2 ● If a manufacturer's test certificate (DIN 50 049 – 2.3) is to be issued, the required tests shall be agreed. The document shall give the following details:

a) the results of the ladle analysis for all the elements listed in table 2 for the relevant steel grade;

b) the results of the agreed tests.

8.3 ●● Materials testing certificates issued by independent inspectors

Materials testing certificates, e.g. inspection certificate 3.1 A, 3.1 B or 3.1 C or inspection report 3.2 A or 3.2 C, as specified in DIN 50 049, shall be issued on the basis of acceptance inspection.

● The required tests or the tests required to comply with official regulations and the appropriate codes of practice shall be agreed.

●● If the acceptance inspection is not to be carried out by the works expert, the body carrying out the acceptance inspection or the expert concerned shall be designated by the purchaser.

The certificate shall give the following details:

a) the information referred to in subclause 8.2.2, items a and b;

b) the mark identifying the inspector.

8.4 Scope of test programme, sampling, preparation of samples and test procedure

8.4.1 Chemical composition, mechanical properties and maximum hardness

Where the chemical composition, mechanical properties and maximum hardness are to be tested, the test conditions specified in table 5 shall apply.

8.4.2 ●● Soundness

In cases where testing of the products for their soundness (e.g. by ultrasonics) has been agreed, but the testing procedure has not been specified, the scope of test programme, test conditions and test criteria shall be at the manufacturer's discretion.

8.4.3 ●● Surface defects

Unless otherwise agreed at the time of ordering, the method of testing products for surface defects, the scope of test programme and the test criteria shall be at the manufacturer's discretion.

8.4.4 ●● Skin decarburization

Normally, for determining the depth of skin decarburization, a sufficient number of polished sections with adequately defined edges shall be prepared from products in the as delivered condition, in accordance with DIN 50 192, and etched and examined microscopically. The scope of test programme, unless otherwise agreed at the time of ordering, shall be at the manufacturer's discretion.

Note. The depth of decarburization for the purposes of this standard is understood to be the depth of the zone with no carbon plus $^2/_3$ of the depth of the zone with a reduced carbon content.

8.4.5 ●● Visual examination and dimensional inspection

Unless otherwise agreed at the time of ordering, the procedure for visual examination and dimensional inspection shall be at the manufacturer's discretion.

8.4.6 Retests

The specifications given in DIN 17 010 shall apply.

9 Marking

9.1 The manufacturer shall mark the products or the bundles or packets, as far as possible in compliance with DIN 1599, so that it is possible to identify the cast, the grade of steel and the origin of the consignment.

9.2 If the consignments are to be accompanied by documents covering acceptance inspection, the marking shall additionally include the test piece number and the inspector's mark.

9.3 ●● Any further requirements with regard to the marking of the products may be agreed at the time of ordering.

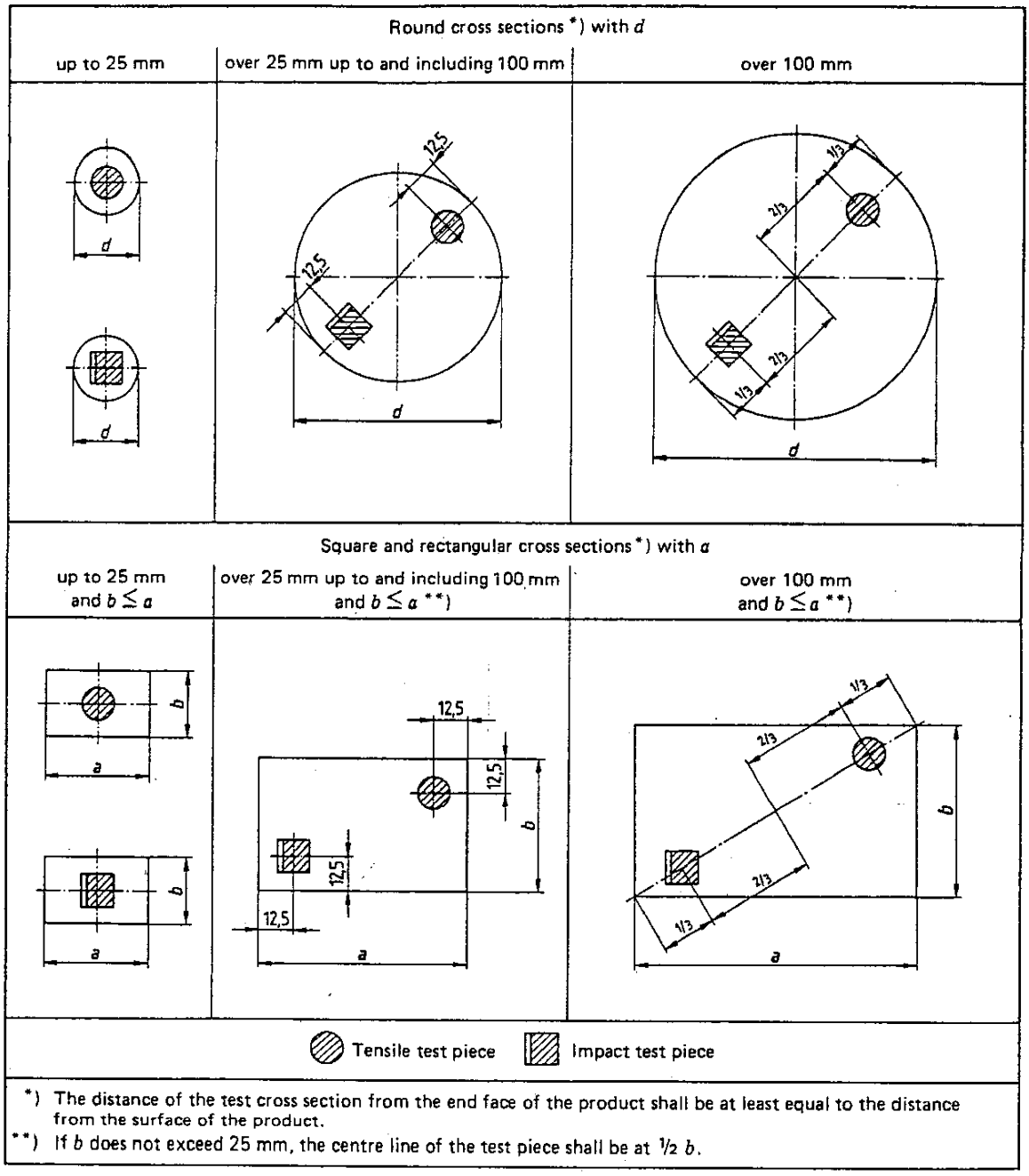
10 Heat treatment

Guideline values for the temperatures during heat treatment are given in table 6.

11 Complaints

11.1 Under current law, warranty claims 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.

11.2 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 product objected to or samples of the products supplied.



*) The distance of the test cross section from the end face of the product shall be at least equal to the distance from the surface of the product.

**) If b does not exceed 25 mm, the centre line of the test piece shall be at $\frac{1}{2}\ b$.

Figure 1. Location of tensile and impact test pieces for round, square and rectangular cross sections

Table 1. **Heat treatment conditions and product forms in which steels are supplied and associated requirements as specified in tables 2 to 4**

No.	1	2	3	4	5	6	7	8	
1	Heat treatment condition of material on delivery	Symbol	Product form					The following requirements given in tables 2 to 4 shall apply:	
			Semi-finished products	Bars	Rod	Flats	Hammer forgings and drop forgings	8.1	8.2
2	Untreated[1])	U	×	×	–	×	×	Chemical composition as in tables 2 and 3.	[2])
3	Softened	G	×	×	×	×	×		Maximum hardness[2]) as in table 4.
4	Quenched and tempered	V	–	×	–	–	×		Mechanical properties as in table 4.
5	●● If a treatment condition other than those in lines 2 to 4 is required, this shall be specified in uncoded form in the order. This requires the product form and the relevant requirements to be agreed at the time of ordering.								

[1]) This condition is not usual for products to be subjected to subsequent machining or shearing.
[2]) If the products are supplied in the 'untreated' or 'softened' condition, the mechanical properties specified in table 4 shall be achievable for the ruling section after proper heat treatment.

Table 2. **Chemical composition of nitriding steels (ladle analysis)**

Steel grade		Chemical composition, in % by mass[1])									
Symbol	Material number	C	Si max.	Mn	P max.	S max.	Al	Cr	Mo	Ni	V
31 CrMo 12	1.8515	0,28 to 0,35	0,40	0,40 to 0,70	0,025	0,030	–	2,80 to 3,30	0,30 to 0,50	≤ 0,30	–
31 CrMoV9	1.8519	0,26 to 0,34	0,40	0,40 to 0,70	0,025	0,030	–	2,30 to 2,70	0,15 to 0,25	–	0,10 to 0,20
15 CrMoV5 9	1.8521	0,13 to 0,18	0,40	0,80 to 1,10	0,025	0,030	–	1,20 to 1,50	0,80 to 1,10	–	0,20 to 0,30
34 CrAlMo5	1.8507	0,30 to 0,37	0,40	0,50 to 0,80	0,025	0,030	0,80 to 1,20	1,00 to 1,30	0,15 to 0,25	–	–
34 CrAlNi7	1.8550	0,30 to 0,37	0,40	0,40 to 0,70	0,025	0,030	0,80 to 1,20	1,50 to 1,80	0,15 to 0,25	0,85 to 1,15	–

[1]) Elements not listed in this table shall not be deliberately added to the steel except for finishing the heat, without the purchaser's approval. In case of doubt, the limits given in EURONORM 20 shall apply.

Table 3. **Amounts by which the chemical composition in the product analysis may deviate from the limiting values specified for the ladle analysis in table 2** (applies for diameters not exceeding 160 mm)

Element	Maximum permissible content in the ladle analysis % by mass	Limit deviations in the product analysis from the limiting values specified for the ladle analysis[1]) % by mass
C	≤ 0,37	0,02
Si	≤ 0,40	0,03
Mn	≤ 1,00 > 1,00 ≤ 1,10	0,04 0,05
P	≤ 0,025	0,005
S	≤ 0,030	0,005
Al	≥ 0,80 ≤ 1,20	0,10
Cr	≤ 2,00 > 2,00 ≤ 3,30	0,05 0,10
Mo	≤ 0,30 > 0,30 ≤ 1,10	0,03 0,04
Ni	≤ 1,15	0,05
V	≤ 0,20 > 0,20 ≤ 0,30	0,02 0,03

[1]) If several product analyses are to be carried out, the deviations shown by an element within one cast shall lie either only above the upper limit or below the lower limit of the range specified for the ladle analysis.

Table 4. **Mechanical properties of steels in the softened condition and in the quenched and tempered condition**

Steel grade		Softened (G) Maximum hardness, in HB	Quenched and tempered (V)						
Symbol	Material number		Diameter, in mm	Minimum yield strength (0,2 % proof stress), in N/mm²	Tensile strength, in N/mm²	Minimum elongation after fracture ($L_0 = 5\,d_0$), in %	Minimum impact value, in J: DVM test pieces	Minimum impact value, in J: ISO V-notch test pieces	Guideline values relating to surface hardness after nitriding or nitrogen case-hardening (HV 1) [1]
31 CrMo 12	1.8515	248	≤ 100 > 100 ≤ 250	800 700	1000 to 1200 900 to 1100	11 12	40 50	35 45	800
31 CrMoV 9	1.8519	248	≤ 100 > 100 ≤ 250	800 700	1000 to 1200 900 to 1100	11 12	40 50	35 45	800
15 CrMoV 59	1.8521	248	≤ 100 > 100 ≤ 250	750 700	900 to 1100 850 to 1050	10 12	35 40	30 35	800
34 CrAlMo5	1.8507	248	≤ 70	600	800 to 1000	14	40	35	950
34 CrAlNi 7	1.8550	248	≤ 100 > 100 ≤ 250	650 600	850 to 1050 800 to 1000	12 13	35 40	30 35	950

[1]) See Explanatory notes.

Table 5. **Test conditions for verifying compliance with the requirements [1]**

1	2		3	4	5	6	7
No.	Property	See tables	Test unit [2]	Number of test pieces per test unit	Number of tests per test piece	Sampling and preparation of samples	Test method to be used
1	Chemical Composition	2 and 3	S	The manufacturer shall inform the purchaser of the results of the ladle analysis. See footnote 3 as to whether a product analysis is to be carried out.			
2	Hardness in G condition	4	S+W	1	1	In cases of dispute, the hardness shall be determined as close as possible to the product surface, at a distance of one diameter or length of (smaller) side from one end, and in the case of squares and flats, also at a distance of 0,25 times the product thickness or width from a longitudinal edge. ●● If the above specifications cannot be complied with, appropriate agreements shall be made at the time of ordering (for example in the case of hammer forgings or drop forgings). Preparation of samples as described in DIN 50 351.	As described in DIN 50 351.
3	Mechanical properties to be determined on quenched and tempered products in the as delivered sizes	4	S+A+W	1	1 tensile test and 3 impact tests	The test pieces for the tensile test and for the impact test shall be taken as follows: a) in the case of steel bars (including reference test bars of corresponding shape) and rod, as shown in figure 1; b) ● in the case of hammer forgings and drop forgings (including reference test bars of corresponding shape), the test pieces shall be taken from a location on the forging to be agreed at the time of ordering, in such a manner that their longitudinal axis is parallel to the direction of principal grain flow. The tensile test pieces shall be prepared as described in DIN 50 125 and DIN 50 145, and the impact test pieces as described in DIN 50 115.	The tensile test shall be carried out as described in DIN 50 145, using the short proportional bar specified in DIN 50 125. If there is no pronounced yield strength, the 0,2 % proof stress shall be determined. ●● The impact test shall be carried out on ISO V-notch test pieces as described in DIN 50 115 unless otherwise agreed. The impact test on DVM test pieces as described in DIN 50 115 may be agreed at the time of ordering. The impact value shall be determined as the average value for three tests on test pieces lying side by side in the same sample and at the same distance from the surface or, if this is impossible or not desirable, immediately behind each other. Only one of three individual values may be below the specified minimum value, provided it is not less than 70 % of that value. If, because the product thicknesses are small, the impact values can only be tested on test pieces with a width of less than 10 mm, but at least 5 mm, the minimum values specified in table 4 shall be reduced in proportion to the test piece cross section.

1) Verification is only necessary for the product forms for which the individual requirement specified in table 1, column 8, applies and the method of test has been agreed.

2) S = cast, A = dimensions, W = heat treatment batch.

3) ●● If subsequent checking of the chemical composition has been agreed at the time of ordering, one product analysis shall be carried out per cast, unless otherwise specified. The specifications given in *Stahl-Eisen-Prüfblatt* (Iron and steel test sheet) 1805 shall apply for sampling and preparation of samples. The composition may be determined by chemical or spectrochemical methods of analysis. For the analytical procedure, the specifications given in *Handbuch für das Eisenhüttenlaboratorium* (Handbook for the ferrous metallurgy laboratory) shall apply. In cases of dispute, the method to be applied shall be agreed.

Table 6. **Guideline values for heat treatment temperatures**

Steel grade		Softening	Quenching and tempering			Gas nitriding[1] or plasma nitriding	Nitrogen case-hardening[2] in	
			Quenching		Tempering		gas or molten salts	powder or plasma
Symbol	Material number	°C	°C	in	°C	°C	°C	°C
31 CrMo 12	1.8515	650 to 700	870 to 910	oil	570 to 700	500 to 520	570 to 580	max. 580
31 CrMoV 9	1.8519	680 to 720	840 to 880	oil or water	570 to 680	500 to 520	570 to 580	max. 580
15 CrMoV 5 9	1.8521	680 to 740	940 to 980	oil or water	600 to 700	500 to 520	570 to 580	max. 580
34 CrAlMo 5	1.8507	650 to 700	900 to 940	oil or water	570 to 650	500 to 520	570 to 580	max. 580
34 CrAlNi 7	1.8550	650 to 700	850 to 890	oil	570 to 660	500 to 520	570 to 580	max. 580

[1] The duration of nitriding depends on the required depth of nitration.
[2] See Explanatory notes.

Appendix A

Equivalent diameter for the mechanical properties

A.1 Concept

The ruling section of a product is the cross section to which the values specified for the mechanical properties refer. Irrespective of the actual shape and dimensions of the product, the size of the ruling section is always expressed as a diameter ('equivalent diameter'). This diameter is that of an 'equivalent round steel bar', meaning a round bar which, at the position in the cross section specified for taking the test pieces for mechanical testing, on cooling from the austenitizing temperature, has a cooling rate equivalent to that of the ruling section of the product concerned at the location specified for sampling.

A.2 Determining the equivalent diameter

A.2.1 In the case of round steel, the equivalent diameter is equal to the nominal diameter of the product.

A.2.2 In the case of hexagonal and octagonal steel, the equivalent diameter is equal to the nominal distance between two opposite parallel sides.

A.2.3 In the case of square steel and flat steel, the equivalent diameter shall be determined as shown in the example in figure A.1.

In the case of forgings, the equivalent diameter shall be determined as described in figure A.2.

A.2.4 • For all other product forms, the equivalent diameter shall be agreed.

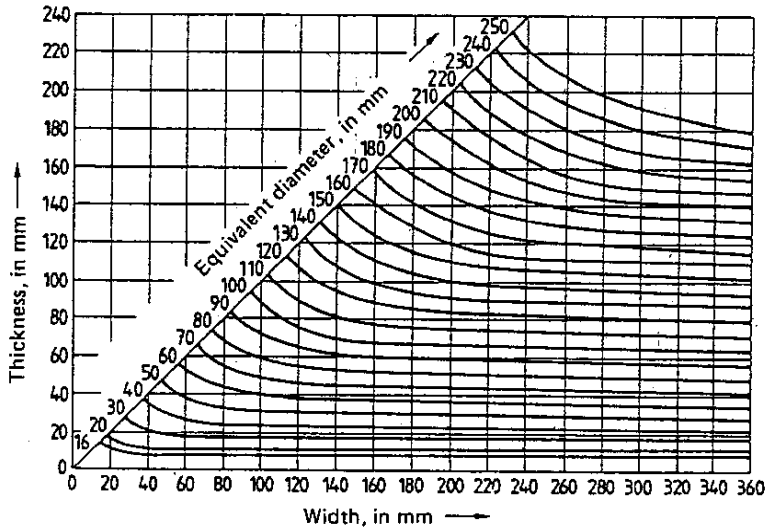
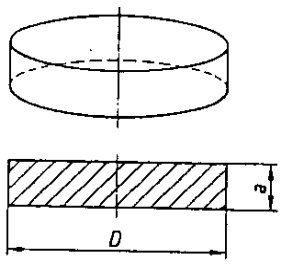


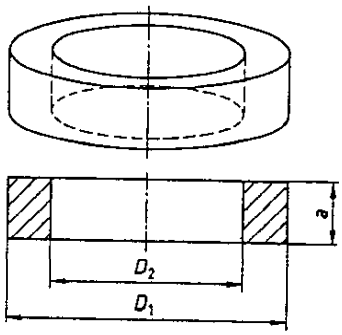
Figure A.1. Determination of equivalent diameter for square and rectangular steel bars on the basis of the values specified for round steel bars in the quenched and tempered condition

Example: for a flat steel of 40 mm X 60 mm in size, the equivalent diameter is 50 mm.

The following shall apply for determining the equivalent diameter (d):

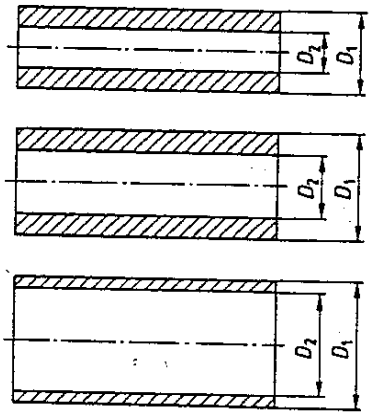


a) in the case of compact solid parts (for example, circular discs without holes) and in the case of similar pieces with holes (with an inside diameter of the hole of up to 200 mm),
1,5 times the smallest side length, i.e.
$d = a \times 1{,}5$;



b) in the case of rings (with an inside diameter of more than 200 mm),
1,5 times the thickness,
if $\frac{D_1 - D_2}{2} < a$,
or $d = a \times 1{,}5$,
if $\frac{D_1 - D_2}{2} > a$;

c) in the case of open cylindrical hollow parts



twice the wall thickness, if the inside diameter is less than 80 mm:

$$d = \frac{D_1 - D_2}{2} \times 2;$$

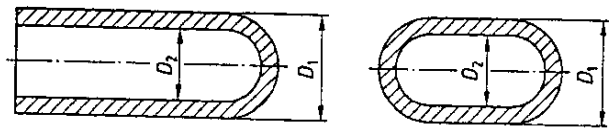
1,75 times the wall thickness if the inside diameter is between 80 and 200 mm:

$$d = \frac{D_1 - D_2}{2} \times 1{,}75;$$

1,5 times the wall thickness if the inside diameter is greater than 200 mm:

$$d = \frac{D_1 - D_2}{2} \times 1{,}5;$$

d) in the case of cylindrical hollow parts closed at one end or at both ends



2,5 times the wall thickness if the inside diameter does not exceed 800 mm:

$$d = \frac{D_1 - D_2}{2} \times 2{,}5,$$

but d shall not exceed D_1;
the multiplication factor shall be agreed if the inside diameter exceeds 800 mm.

e) in the case of non-cylindrical symmetrical hollow parts, the equivalent diameter shall be determined as appropriate on the basis of item c or d above.

Figure A.2. Equivalent diameters in the case of forgings

Appendix B

Dimensional standards relating to products covered by this standard

Hot rolled wire

DIN 59 110	Steel wire rod; dimensions, permissible deviations, mass
DIN 59 115	Steel wire rod for bolts, nuts and rivets; dimensions, permissible deviations, mass

Hot rolled and forged bars

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 hexagons; dimensions, permissible deviations, mass
DIN 1017 Part 1	Steel bars; hot rolled flats for general purposes; dimensions, permissible deviations, mass
DIN 1017 Part 2	Steel bars; hot rolled flats for special applications (in bar drawing shops, screw works, etc.); dimensions, permissible deviations, mass
DIN 7527 Part 6	Steel forgings; machining allowances and permissible deviations for hammer forged bars
DIN 59 130	Steel bars; hot rolled round steel for bolts and rivets; dimensions, permissible dimensional deviations and deviations of form

Bright bars

DIN 174	Bright flat steel; dimensions, permissible deviations, mass
DIN 176	Bright hexagon steel; dimensions, permissible deviations, mass
DIN 178	Bright square steel; dimensions, permissible deviations, mass
DIN 668	Bright round steel; dimensions, permissible deviations according to ISO tolerance zone h11
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 59 360	Ground and polished bright round steel; dimensions, permissible deviations according to ISO tolerance zone h7
DIN 59 361	Ground and polished bright round steel; dimensions, permissible deviations according to ISO tolerance zone h6

Cold rolled flat products

DIN 1544	Steel flat products; cold rolled steel strip; dimensions, permissible dimensional deviations and deviations of form

Hot rolled plate, sheet, strip and hot rolled wide flats

DIN 1016	Steel flat products; hot rolled strip, hot rolled sheet under 3 mm thickness; dimensions, permissible dimensional deviations, deviations of form and in mass
DIN 1543	Steel flat products; hot rolled plate 3 to 150 mm thick; permissible dimensional deviations, deviations of form and in mass
DIN 59 200	Steel flat products; hot rolled wide flats; dimensions, permissible dimensional deviations, deviations of form and in mass

Forgings

DIN 7526	Steel forgings; tolerances and permissible deviations for drop forgings
Supplement to	
DIN 7526	Steel forgings; tolerances and permissible deviations for drop forgings; examples of application
DIN 7527 Part 1	Steel forgings; machining allowances and permissible deviations for hammer forged discs
DIN 7527 Part 2	Steel forgings; machining allowances and permissible deviations for hammer forged pierced discs
DIN 7527 Part 3	Steel forgings; machining allowances and permissible deviations for seamless hammer forged rings
DIN 7527 Part 4	Steel forgings; machining allowances and permissible deviations for seamless hammer forged bushes
DIN 7527 Part 5	Steel forgings; machining allowances and permissible deviations for hammer forged, rolled and welded rings
DIN 7527 Part 6	Steel forgings; machining allowances and permissible deviations for hammer forged bars

Standards and other documents referred to

DIN 1599 Identification markings for steel

DIN 17 010 General technical delivery conditions for steel and steel products

DIN 17 014 Part 1 Heat treatment of ferrous materials; terminology

DIN 50 049 Materials testing certificates

DIN 50 115 Testing of metallic materials; impact test

DIN 50 125 Testing of metallic materials; tensile test pieces

DIN 50 145 Testing of metallic materials; tensile test

DIN 50 192 Determination of decarburization depth

DIN 50 351 Testing of metallic materials; Brinell hardness test

EURONORM 20 Definitions and classification of steel grades

EURONORM 79 Terminology and classification of steel products by shape and size

EURONORM 163 Delivery conditions for surface quality of hot rolled sheet, plate and wide flats

Stahl-Eisen-Lieferbedingungen 055 *)
(at present at the stage of draft) *Warmgewalzter Stabstahl und Walzdraht mit rundem Querschnitt und nicht profilierter Oberfläche; Oberflächengüteklassen; technische Lieferbedingungen* (Hot rolled steel bars and wir rod of circular cross section and non-profiled surface; surface quality classes; technical delivery conditions)

Stahl-Eisen-Prüfblatt 1805 *)
Probenahme und Probenvorbereitung für die Stückanalyse bei Stählen (Sampling and preparation of samples for product analysis of steels)

Handbuch für das Eisenhüttenlaboratorium *)
volume 2: *Die Untersuchung der metallischen Werkstoffe*
(Investigation of metallic materials), Düsseldorf 1966;
volume 5 (supplement):
A4.4 – *Aufstellung empfohlener Schiedsverfahren*
(List of recommended arbitration procedures);
B – *Probenahmeverfahren* (Sampling methods);
C – *Analyseverfahren* (Methods of analysis);
latest 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 dealt with in DIN Standards and Iron and steel materials sheets)

See appendix B for other standards referred to.

Other relevant standards and documents

DIN 17 200 Steels for quenching and tempering; technical delivery conditions

DIN 17 210 Case hardening steels; technical delivery conditions

Stahl-Eisen-Werkstoffblatt (Iron and steel material sheet) 550 *) *Stähle für größere Schmiedestücke* (Steels for larger forgings)

Previous edition

DIN 17 211: 08.70.

*) Obtainable from: *Verlag Stahleisen mbH*, Postfach 82 29, D-4000 Düsseldorf 1.

Amendments

The following amendments have been made to the August 1970 edition.

a) Seamless tubes are no longer covered (see Explanatory notes). Semi-finished products have been included.

b) The treatment conditions are now only denoted by code letters, because the corresponding appended numbers are not generally used outside the aircraft industry.

c) The following steel grades are no longer specified: 39 CrMoV 13 9 (material number 1.8523), 41 CrAlMo 7 (material number 1.8509) and 34 CrAlS 5 (material number 1.8506) (see Explanatory notes).

d) The following steel grades have been adopted for the first time: 31 CrMoV 9 (material number 1.8519) and 15 CrMoV 5 9 (material number 1.8521) (see Explanatory notes).

e) The proportions by mass of silicon, phosphorus and sulfur have been limited at 0,40 %, 0,025 % and 0,030 % maximum, respectively.

f) The previous system of requirement classes has been dropped (see Explanatory notes).

g) The specifications for mechanical properties have been revised (see Explanatory notes).

h) In the case of round, square or rectangular steel bars with a diameter or thickness of more than 25 mm up to 100 mm, the tensile and impact test pieces shall be taken in such a manner that their axis is 12,5 mm below the product surface.

i) The figure illustrating the determination of the equivalent diameter for square or rectangular steel bars on the basis of the values specified for round steel bars in the quenched and tempered condition has been replaced by a new one.

j) The equivalent diameter for the mechanical properties has been defined in appendix A.

Explanatory notes

The form of the standard has been harmonized as far as possible with the revised edition of DIN 17 200.

Particular mention should be made of the following.

The tube manufacturers requested that seamless tubes made from nitriding steels should be covered in a separate standard. The reasons for this request were

- that, for example, not all steels specified in this standard are to be used for tube making, whilst some nitriding steels used for tubes are not covered by this standard;
- that there are a number of specifications specific to tubes (e.g. test methods);
- that in this way the number of footnotes could be reduced and hence the layout of the standard made more suitable for data processing purposes;
- that revision of the standard would be facilitated.

Steel grades 34 CrAlS 5 (material number 1.8506), 41 CrAlMo 7 (material number 1.8509) and 39 CrMoV 13 9 (material number 1.8523) have been dropped because they are now virtually no longer in demand.

Steel grade 31 CrMoV 9 (material number 1.8519) has been included although DIN 17 200 already covers steel grade 30 CrMoV 9 (material number 1.7707) which is of similar chemical composition, the major difference between both grades being that steel grade 31 CrMoV 9, allowing for the nitriding temperatures, is to be tempered at a higher temperature and thus exhibits lower strength values after quenching and tempering than steel grade 30 CrMoV 9 as specified in DIN 17 200.

Steel grade 15 CrMoV 9 (material number 1.8521) was previously identified by symbol 14 CrMoV 6 9 and material number 1.7735, its inclusion in the present standard being the only reason for classifying this steel into material class 85.

Since the system of forms of supply for characterizing the desired requirements, as specified in the August 1970 edition of this standard, was hardly ever used in practice, it has been replaced, after lengthy and detailed discussions in the responsible technical committee, by a system of combinations of heat treatment conditions of the material on delivery, product forms and requirements given in table 1. Thus it has now been clearly specified which requirements have to be complied with for which heat treatment condition if no relevant information is given in the order.

In comparison with the August 1970 edition, the yield strength and tensile strength values given in table 4 for the quenched and tempered condition have been converted to N/mm^2 and rounded to numbers divisible by 50. Besides that, the coarser diameter grading for steel grade 31 CrMo 12 (material number 1.8515) required several yield strength and tensile strength values to be reduced, whereas the introduction of a diameter limit of 100 mm led to the corresponding values for steel grade 34 CrAlNi 7 (material number 1.8550) being increased.

With a view to the relatively high temperatures during nitrogen case-hardening, a loss in strength (see table 4) is, however, to be expected.

By general request, impact values have been specified for both DVM and ISO V-notch test pieces.

In general, during in-process testing of the nitriding hardness (see table 4) the surface hardness is measured, taking account of the influence of the surface condition. For more accurate measurements, the procedure shall be as described in DIN 50 190 Part 3.

There is some connection between this standard and ISO 683/10 – 1987, Heat treatable steels, alloy steels and free-cutting steels. Part 10: Wrought nitriding steels, and to EURONORM 85-70, Nitriding steels; quality specifications. The table below gives a survey of the steel grades covered by this standard and the international documentation for nitriding steels.

Nitriding steels specified in					
DIN 17 211		EURONORM 85-70		ISO 683/10 – 1987	
Symbol	Material number	Symbol	[1]	Symbol	[1]
31 CrMo 12	**1.8515**	31 CrMo 12	●	31 CrMo 12	●
31 CrMoV 9	**1.8519**	–		–	
15 CrMoV 5 9	**1.8521**	–		–	
34 CrAlMo 5	**1.8507**	34 CrAlMo 5	○	33 CrAlMo 5 4	○
–	–	39 CrMoV 13		–	
–	–	41 CrAlMo 7		41 CrAlMo 7 4	
34 CrAlNi 7	**1.8550**	–		–	

[1] This column indicates the degree of correspondance with regard to the chemical composition, between the steels specified in this standard and those specified in international documentation, the symbols having the following meanings:
● slight differences;
○ significant differences.

International Patent Classification

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G 01 N 33/20