UDC 669.14-418-122.2 : 620.1 June 1987

Steel flat products

Cold reduced mild unalloyed steel strip in widths not exceeding 650 mm

Technical delivery conditions

DIN 1624

Flacherzeugnisse aus Stahl; kaltgewalztes Band in Walzbreiten bis 650 mm aus weichen unlegierten Stählen; technische Lieferbedingungen

Supersedes July 1977 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 6932 – 1986 published by the International Organization for Standardization (ISO) and EURONORM 139 – 1981 published by the European Coal and Steel Community (ESCS).

Contents

1 Field of application

1.1 This standard applies to cold reduced flat products (strip and lengths cut from it), without coating, in widths not exceeding 650 mm and thicknesses up to 6 mm, made from mild unalloyed steels as specified in table 1. The steels are suitable for forming and surface refinement, but not for quench hardening or for quenching and tempering. They may be case hardened, but only the steels specified in DIN 17 210 may be assumed to be suitable for this purpose, and these are not covered in the present standard.

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

1.3 This standard does not apply to

- hot rolled mild unalloyed steel sheet and strip (see DIN 1614 Parts 1 and 2);
- cold reduced mild unalloyed sheet and strip for cold forming (see DIN 1623 Part 1);
- cold reduced sheet and strip made from general purpose structural steels (see DIN 1623 Part 2);
- cold reduced mild unalloyed steel sheet and strip for vitreous enamelling (see DIN 1623 Part 3);
- blackplate (see DIN 1616);
- cold reduced sheet and strip with a minimum yield strength for cold forming (see *Stahl-Eisen-Werkstoffblatt* (Iron and steel material sheet) 093 – 1975);
- magnetic sheet and strip (see DIN 46 400 Parts 1 to 4).

2 Concepts

2.1 Flat products are products of an almost rectangular cross section with a width much greater than the thickness.

2.2 Strip is a flat product which is wound to form a coil immediately after the final rolling pass or after having passed the continuous pickling furnace or furnace installations connected to the roll[1]. In the rolled condition, strip has slightly curved edges but can also be supplied with trimmed edges or made by slitting a wider strip.

For the purposes of this standard, 'strip' includes cut lengths less than 600 mm in width, which have been produced by cutting strip to length.

[1] In the case of small widths, strip as covered in this standard may be supplied transverse wound to form a coil.

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2.3 Flat products that have undergone a reduction in cross section of at least 25% by cold rolling without preheating are to be regarded as cold reduced.

Note. In the case of flat products covered in this standard, material with a reduction of less than 25% is included in this category.

3 Dimensions and limit deviations

DIN 1544 shall apply for dimensions and limit deviations.

4 Mass

The mass of steels as specified in this standard may be calculated taking the density as 7,85 kg/dm^3.

5 Classification into grades

5.1 This standard covers the steel grades listed in table 1.

5.2 The steel grade is to be selected by the purchaser, but it is recommended that the supplier be consulted as to which steel grade and which surface finish are suitable for the intended purpose and specific application.

6 Designation and ordering

6.1 The standard designation of a steel complying with this standard shall include the following:

- the name of product (steel);
- the number of this standard;
- the symbol or material number identifying the steel grade (see table 1);
- the symbol identifying the treatment condition (see table 1);
- the symbol identifying the surface appearance (see table 2);
- where required, the letter symbol identifying the surface finish, where this is to be matt, rough or mirror finish (see subclause 7.7.2);
- where required, the symbol denoting the type of coating to be applied (see subclauses 7.9.3 to 7.9.6);
- where required, the symbol denoting whether the products are to be supplied oiled or degreased (see subclauses 9.2.2 and 9.2.3).

Examples:

a) An St 2 steel (material number 1.0330), in the temper rolled condition, with a tensile strength between 290 and 450 N/mm^2 (K 32), scratch-free and pit-free surface, bright (RPG), and with normal, smooth surface finish, shall be designated:

Steel DIN 1624 – St 2 K 32 RPG

or

Steel DIN 1624 – 1.0330 K 32 RPG

b) An St 4 steel (material number 1.0338), skin passed, with a tensile strength between 270 and 370 N/mm^2 (LG), with a scratch-free and pit-free surface (RP), matt surface finish (m), intended for electroplating (UG), degreased (FE), shall be designated:

Steel DIN 1624 – St 4 LG RPm UG FE

or

Steel DIN 1624 – 1.0338 LG RPm UG FE

6.2 The specifications of the dimensional standard shall apply for the standard designation of the products.

6.3 The order shall provide all information necessary for a clear description of the products required, including condition and methods of test. If the designations as specified in subclauses 6.1 and 6.2 are not adequate for this purpose, they shall be supplemented by the information required, written out in full. Furthermore, the order shall specify if the products are to be suitable for making a particular part (see subclause 7.4.2).

7 Requirements

7.1 Steelmaking process

The steelmaking process is at the manufacturer's discretion; on request, the purchaser shall, however, be informed of the type of process used.

7.2 Type of deoxidation

7.2.1 The type of deoxidation of steel grade St 2 is at the manufacturer's discretion.

7.2.2 Steel grade St 3 may be supplied in the rimming (U) or fully killed (RR) condition, which type of deoxidation required being stated in the designation.

7.2.3 Steel grade St 4 shall be supplied in the fully killed (RR) condition.

7.3 Chemical composition

7.3.1 The values applicable for the ladle analysis and product analysis are given in table 1.

7.3.2 Any verification of the values determined in the product analysis in the course of acceptance inspection shall be particularly agreed at the time of ordering.

7.4 Choice of properties

7.4.1 The products are generally to be supplied on the basis of their mechanical properties as specified in subclause 7.5.

7.4.2 In special cases, it may be agreed that the products are to be suitable for making a particular part. If so, the number of rejects during processing, attributable to the material, shall not exceed a specific proportion, which is to be agreed. A period of six months for steel grades St 4 and St 3, and of six weeks for steel grades USt 3 and St 2, after the products have been made available for delivery, shall apply in this respect.

7.5 Mechanical and technological properties

7.5.1 Unless otherwise agreed (see subclause 7.4.2), the values of yield strength, tensile strength and elongation after fracture as specified in table 1 and the minimum cupping values as shown in figure 1 shall apply for a period of six months for grades St 4 and RRSt 3 and 8 days for grades USt 3 and St 2.

7.5.2 The tensile test values shall apply to longitudinal test pieces.

If there is no pronounced yield strength, the specified yield strength values shall apply to the 0,2% proof strength, $R_{p0,2}$, otherwise to the lower yield strength, R_{eL}.

Table 1. **Classification into grades, chemical composition, and mechanical properties (applicable for longitudinal test pieces at an ambient temperature between 15 and 35 °C as specified in DIN 50 014)**

Steel grade		Type of deoxidation[1]	Chemical composition[2] Maximum percentage by mass		Mechanical properties[3] for surface appearance BK[4]						Cupping[5]
					Treatment condition		Yield strength ($R_{p0,2}$ or R_{eL})	Tensile strength	Minimum elongation after fracture, in %, for a thickness of		
Symbol	Material number		C	N	Symbol	Condition	N/mm²	N/mm²	< 3 mm[6]	≥ 3 mm[7]	mm
St 2	1.0330	Optional	0,10 (0,12)	0,007[9] (0,008)	K	Not specified.					–
					G	Annealed	–	270 to 390	28	32	See figure 1.
					LG	Skin passed	max. 280[8]	270 to 410	28	32	
					K 32	Temper rolled.	200 to 380	290 to 430	18	24	–
					K 40		min. 310	390 to 540	4	12	–
					K 50		min. 420	490 to 640	–	–	–
					K 60		min. 520	590 to 740	–	–	–
					K 70		min. 630	min. 690	–	–	–
USt 3	1.0333	U	0,08 (0,10)	0,007[9] (0,008)	G	Annealed	–	270 to 370	32	35	See figure 1.
					LG	Skin passed	max. 250[8]	270 to 370	32	35	
					K 32	Temper rolled.	210 to 355	290 to 390	22	26	–
					K 40		min. 330	390 to 490	5	13	–
					K 50		min. 440	490 to 590	–	–	–
					K 60		min. 540	590 to 690	–	–	–
RRSt 3	1.0347	RR	0,10 (0,11)	[10]	G	Annealed	–	270 to 370	34	37	See figure 1.
					LG	Skin passed	max. 240[8]	270 to 370	34	37	
					K 32	Temper rolled.	210 to 355	290 to 390	22	26	–
					K 40		min. 330	390 to 490	5	13	–
					K 50		min. 440	490 to 590	–	–	–
					K 60		min. 540	590 to 690	–	–	–
St 4	1.0338	RR	0,08 (0,09)	[10]	G	Annealed	–	270 to 350	38	40	See figure 1.
					LG	Skin passed	max. 210[8][11]	270 to 350	38	40	
					K 32	Temper rolled.	220 to 325	290 to 390	24	28	–
					K 40		min. 350	390 to 490	6	14	–
					K 50		min. 460	490 to 590	–	–	–
					K 60		min. 560	590 to 690	–	–	–

[1] See subclause 7.2.
[2] Applies to the ladle analysis, the bracketed values applying to the product analysis. Other elements, except for manganese and aluminium, shall not be added to the melt without the purchaser's approval.
[3] See subclauses 7.5.1 and 7.5.2.
[4] In the case of surface appearances RP and RPG, the specified maximum permitted yield strength and tensile strength values are increased by 20 N/mm², and the minimum elongation after fracture values are reduced by 2 %.
[5] See subclauses 7.5.3 and 8.5.4.
[6] Applies to test pieces with a gauge length, L_0, equal to 80 mm and a width, b, equal to 20 mm as specified in DIN 50 114. The specified minimum elongation after fracture values are reduced by 2 % in the case of thicknesses between 0,5 and 0,7 mm and by 4 % in the case of thicknesses smaller than 0,5 mm.
[7] Applies to proportional test pieces with a gauge length, L_0, equal to $5{,}65 \cdot \sqrt{\text{original cross section}}$ as specified in DIN 50 125.
[8] In the case of thicknesses not exceeding 0,7 mm, values higher by 20 N/mm² are permitted.
[9] Content of free nitrogen.
[10] To permit the required fixing of the nitrogen, the steel shall not contain less than 0,02 % of metallic aluminium. The use of other elements for fixing the nitrogen shall be agreed with the purchaser.
[11] For thicknesses equal to or exceeding 1,5 mm, a yield strength not exceeding 225 N/mm² is permitted.

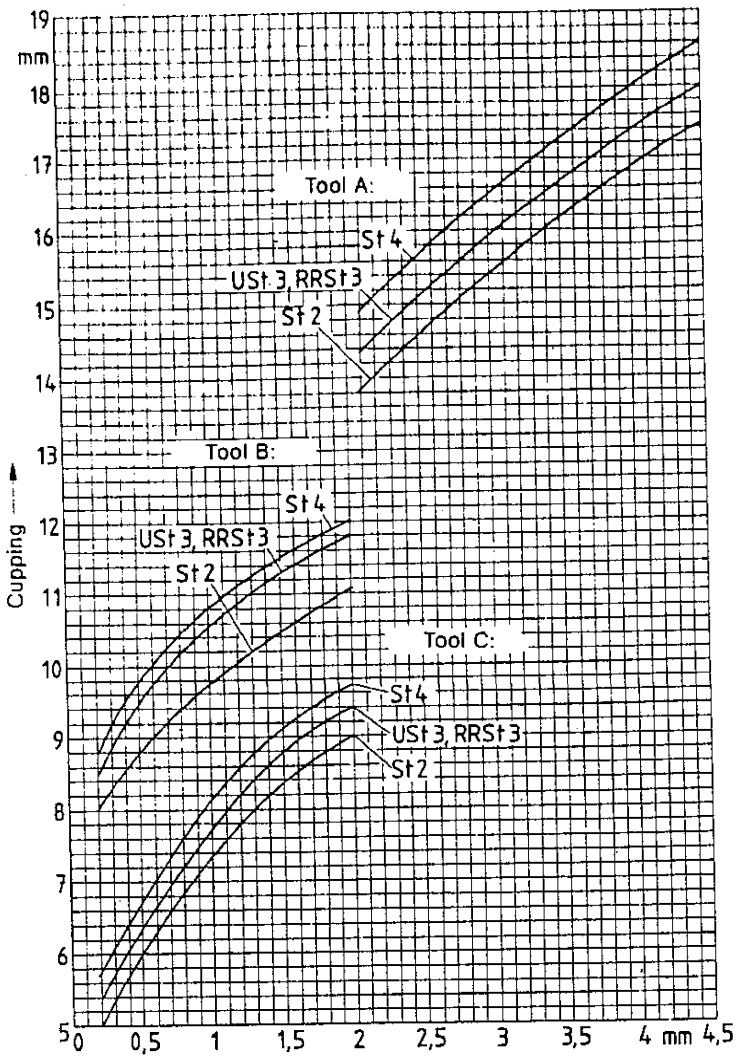

Figure 1. Minimum cupping values for treatment conditions G and LG (see subclauses 7.5.3 and 8.5.4)

7.5.3 When testing as described in subclause 8.5.4, cupping shall in no case be lower than the minimum values shown in figure 1. In the case of products with mirror finish (with average peak-to-valley height, R_a, not exceeding 0,3 µm), these minimum values shall be lower by 0,3 mm.

7.6 Weldability

7.6.1 The steels specified are suitable for welding provided that conventional welding processes are used.

7.6.1 In the case of treatment conditions K 32 to K 70, it should be noted that the higher temperatures during welding may affect the mechanical properties (i.e. the minimum yield strength and tensile strength values specified in table 1).

7.7 Surface condition

7.7.1 Surface appearance

7.7.1.1 Cold rolled flat products as covered in this standard may be supplied with the surface appearances specified in table 2, other types of surface appearance being the subject of particular agreement. The surface appearance of flat products manufactured to treatment condition G, shall always be subject to particular agreement. The required surface appearance shall be given in the designation (see subclause 6.1).

7.7.1.2 The characteristics specified in table 2 shall apply to the inspected surface, which is normally the outside surface of coils and the top surface of cut lengths. The uninspected surface shall at least meet the requirements specified for surface appearance BK. The characteristics shall not apply to the first inner and outer laps of the coil or to lengths cut from them.

If both sides are to be supplied with surface appearance RP or RPG, this shall be the subject of particular agreement.

7.7.2 Surface finish

7.7.2.1 Unless otherwise agreed at the time of ordering, flat products complying with this standard shall be supplied with a smooth surface finish (which is not denoted by a symbol).

7.7.2.2 Subject to agreement, the products may be supplied with a matt or rough surface finish, and in the case of thicknesses not exceeding 3 mm, also with a mirror finish. For these types of surface finish, symbols m (matt), r (rough) or b (mirror finish) shall be given in the designation (see subclause 6.1).

Table 2. **Characteristics of surface appearance and associated symbols**

Surface appearance	Symbol	Characteristics[1]
Bright	BK	Bright, clean surface. Pitting, small scores and minor scratches are permitted.
Scratch-free and pit-free	RP[2]	As for BK, pitting, scores and scratches, however, being permitted provided that the uniform smooth appearance is not substantially impaired when viewed with the naked eye.
Scratch-free and pit-free, bright	RPG[2]	As for RP, but with a bright surface.

1) See subclause 7.7.1.2.
2) Normally, only flat products up to 2 mm thick are supplied with surface appearance RP, and flat products up to 1 mm thick, with surface appearance RPG. For products of greater thickness, these types of surface appearance shall be the subject of particular agreement. Both types are not suitable for treatment condition G (annealed).

7.7.2.3 The different types of surface finish are characterized by the following guideline values of average peak-to-valley height, R_a:

mirror finish: R_a not exceeding 0,3 µm;

smooth: R_a not exceeding 0,6 µm;

matt: R_a between 0,6 and 1,8 µm;

rough: R_a not less than 1,5 µm.

7.8 Stretcher strain marks

In the case of steel grades St 2 and USt 3, the tendency to kink and to develop stretcher strain marks during forming can be eliminated for a time by skin passing (treatment conditions LG and K 32); with temper rolling (treatment conditions K 40 to K 70), there is no such tendency. The period of freedom from stretcher strain marks can be assumed to be four weeks for steel grades St 2 and USt 3 in treatment conditions LG and K 32, and six months for steel grades RRSt 3 and St 4 in the temper rolled treatment conditions, from the agreed date when the products have been made available for delivery.

7.9 Suitability for the application of coatings

7.9.1 The application of coatings requires the processor to prepare the surface appropriately.

7.9.2 All steel grades and surfaces specified are suitable for varnish coating.

7.9.3 All steel grades specified are suitable for the application of a metallic coating using, for example, zinc, tin or lead, by hot dipping or thermal spraying (denoted by US; cf. subclause 7.9.6).

7.9.4 All steel grades with surface appearances RP and RPG are suitable for electroplating (denoted by UG; cf. subclause 7.9.6).

7.9.5 All steel grades are suitable for enamelling with the aid of a primer (denoted by UE; cf. subclause 7.9.6).

7.9.6 If surface coating as specified in subclauses 7.9.3 to 7.9.5 is required, the respective symbol shall be given in the designation (see subclause 6.1).

7.9.7 In the case of metallic coatings as specified in subclause 7.9.3 or of enamelling as specified in subclause 7.9.5, it should be noted that, in particular for treatment conditions K 32 to K 70, recovery or recrystallization resulting from higher temperatures is liable to affect the mechanical properties of flat products.

8 Testing

8.1 Tests to be carried out and materials testing certificates

8.1.1 The purchaser may stipulate, for all steel grades specified in this standard, that one of the certificates on materials testing complying with DIN 50 049 be furnished.

8.1.2 If it is agreed that a certificate be furnished which, in accordance with DIN 50 049, requires that tests be carried out on the consignment itself, then the specifications given in subclauses 8.2 to 8.6 shall apply.

8.2 Test units

8.2.1 The usual test unit shall be 20 t or parts thereof, for flat products of the same steel grade and nominal thickness.

8.2.2 Subject to particular agreement at the time of ordering, the acceptance unit may be 10 t or parts thereof, for flat products of the same steel grade and nominal thickness.

8.3 Number of tests

One tensile test and, in the case of treatment conditions G and LG, one cupping test shall be carried out for each test unit as specified in subclause 8.2.

8.4 Sampling

8.4.1 Test pieces shall be taken parallel to the direction of rolling and shall not have undergone any surface treatment on either side. In the case of strip, the test pieces shall be taken from the beginning or end of the coil (cf. subclause 7.7.1.2). In the case of cut lengths, the test pieces for sampling purposes and the position of the test piece on the product are to be selected by the person authorized for acceptance inspection.

8.4.2 A deformation of test pieces during cutting shall be avoided as far as possible. If shears or flame cutters are used, provisions shall be made for an adequate allowance, the additional material then being removed by machining.

8.5 Tests to be carried out

8.5.1 The chemical composition shall be determined by using methods specified by the Chemists' Committee of the *Verein Deutscher Eisenhüttenleute* (Society of German Ferrous Metallurgy Engineers).

8.5.2 All tests for determining the mechanical properties shall be carried out at ambient temperature.

8.5.3 The tensile test shall be carried out as described in DIN 50 145 using a test piece of gauge length, L_0, equal to 80 mm and width, b, equal to 20 mm as specified in DIN 50 114 in the case of products less than 3 mm thick, or using a proportional test piece of gauge length, L_0, equal to $5{,}65 \times \sqrt{\text{original cross section}}$ as specified in DIN 50 125 in the case of products not less than 3 mm thick. The results

of tensile testing shall be related to the actual size of the test piece (i.e. not to the nominal size).

8.5.4 The cupping test shall be carried out as described in DIN 50102 in the case of flat products 0,2 to 2 mm thick and 55 to less than 90 mm wide (tool C as shown in figure 1),
DIN 50101 Part 1 in the case of flat products 0,2 to 2 mm thick and not less than 90 mm wide (tool B as shown in figure 1),
DIN 50101 Part 2 in the case of flat products over 2 up to 4,5 mm thick and not less than 90 mm wide (tool A as shown in figure 1).

8.5.5 The surface roughness test shall be carried out as described in EURONORM 49.

8.6 Retests

DIN 17010 shall apply to retests.

9 Condition on delivery

9.1 Marking

Marking of the products in accordance with the details given in DIN 1599 may be agreed at the time of ordering.

9.2 Oiling

9.2.1 Flat products in treatment conditions LG, K and K32 to K70 are usually covered with rolling oil during the finishing process, which, however, does not provide adequate protection against corrosion.

9.2.2 If the products are to be supplied oiled, this shall be specified in the designation (using symbol FM; cf. subclause 6.1). Both surfaces shall then be provided with a uniform protective oil film to prevent oxidation of the products for a period of three months provided that the products are packed, transported, handled and stored under normal conditions. This oil film shall be removable by aqueous alkaline solvents. Any additional requirements shall be the subject of particular agreement.

9.2.3 If the products are to be supplied with a degreased surface requiring a special phase of operation, this shall also be specified in the designation (symbol FE, see also subclause 6.1).

9.2.4 If the products are to be supplied in the as rolled or unoiled condition, there is an increased risk of scratching, scoring and rust formation during transport.

9.3 Packaging

The type of packaging shall be the subject of particular agreement.

10 Complaints

DIN 17010 shall apply to complaints and their mode of settlement.

Standards and other documents referred to

DIN 1544	Steel flat products; cold rolled steel strip; dimensions, permissible dimensional deviations and deviations of form
DIN 1599	Identification marking for steel
DIN 1614 Part 1	Steel flat products; hot rolled sheet and strip; technical delivery conditions; mild unalloyed steels for cold reducing
DIN 1614 Part 2	Steel flat products; hot rolled sheet and strip; technical delivery conditions; mild unalloyed steels for immediate cold forming
DIN 1616	Tinplate and blackplate sheet; dimensions and permissible deviations
DIN 1623 Part 1	Steel flat products; cold reduced sheet and strip; technical delivery conditions; mild unalloyed steels for cold forming
DIN 1623 Part 2	Steel flat products; cold reduced sheet and strip; technical delivery conditions; general purpose structural steels
DIN 1623 Part 3	Steel flat products; cold reduced sheet and strip; technical delivery conditions; mild unalloyed steels for vitreous enamelling
DIN 17010	General technical delivery conditions for steel and steel products
DIN 17210	Case hardening steels; technical delivery conditions
DIN 46400 Part 1	Steel flat products with special magnetic properties; cold rolled, non-oriented, finally annealed magnetic steel sheet and strip; technical delivery conditions
DIN 46400 Part 2	Steel flat products with special magnetic properties; cold rolled, non-oriented, not finally annealed unalloyed magnetic steel sheet and strip; technical delivery conditions
DIN 46400 Part 3	Steel flat products with special magnetic properties; oriented magnetic steel sheet and strip; technical delivery conditions
DIN 46400 Part 4	Steel flat products with special magnetic properties; cold rolled, non-oriented, not finally annealed magnetic alloy steel sheet and strip; technical delivery conditions
DIN 50014	Climates and their technical application; standard atmospheres
DIN 50049	Materials testing certificates
DIN 50101 Part 1	Testing of metallic materials; cupping test (Erichsen method) on sheet and strip with a width not less than 90 mm and a thickness from 0,2 to 2 mm

DIN 50 101 Part 2 Testing of metallic materials; cupping test (Erichsen method) on sheet and strip with a width not less than 90 mm and a thickness of over 2 up to 3 mm

DIN 50 102 Testing of metallic materials; cupping test (Erichsen method) on narrow strip with a width from 30 mm up to but not including 90 mm

DIN 50 114 Testing of metallic materials; tensile test on sheet and strip with a thickness less than 3 mm, without using an extensometer

DIN 50 125 Testing of metallic materials; tensile test pieces

DIN 50 145 Testing of metallic materials; tensile test

EURONORM 49[3]) Surface roughness measurements carried out on cold rolled, non-coated steel flat products

Stahl-Eisen-Werkstoffblatt 093-74[4]) *Kaltgewalztes Feinblech und Band mit gewährleisteter Mindeststreckgrenze zum Kaltumformen; Gütevorschriften* (Cold rolled sheet and strip with guaranteed minimum yield strength for cold forming; quality specifications)

Handbuch für das Eisenhüttenlaboratorium[4]) (Handbook for the ferrous metallurgy laboratory)

Volume 2 A: *Die Untersuchung der metallischen Stoffe* (Investigation of metallic materials)

Volume 3 A: *Probenahme* (Sampling)

Volume 5: *Normen, Begriffe, Definitionen und ausgewählte Kapitel der Röntgenfluoreszenzspektrometrie und der Statistik* (Standards, terminology and selective treatment of X-ray fluorescent spectrometry and statistics)

Previous editions

DIN 1624: 08.54, 07.77.

Amendments

The following amendments have been made to the July 1977 edition.

a) The type of deoxidation for steel grade St 2 is now optional.

b) Steel grade RRSt 3 has been included for the first time.

c) More detailed specifications with regard to the yield strength in the various treatment conditions have been included.

Explanatory notes

The differences between the present standard and the July 1977 edition are listed in the "Amendments" clause. The specifications regarding classification into grades and type of deoxidation have now been brought into line with the requirements to be met by cold reduced mild unalloyed steel wide strip and sheet covered in DIN 1623 Part 1. The corresponding values of yield strength, tensile strength and elongation after fracture for products in the skin passed condition (LG) are thus now identical with those for the equivalent grades given in DIN 1623 Part 1. Supplementary specifications have been given with regard to the minimum yield strength for products in the temper rolled conditions (K 32 to K 70) (see table 1), the cupping values and details in respect of surface appearance have been left as they were.

Subsequent to the publication of the July 1977 edition of DIN 1624 the regional standard EURONORM 139 – 1981 and the International Standard ISO 6932 – 1986 were published.

The specifications of EURONORM 139 are largely in agreement with those given in the July 1977 edition of the present standard. The same applies to the ISO Standard, which, however, specifies another series of steel grades characterized exclusively by Rockwell or Vickers hardness values, without giving any cupping values.

International Patent Classification

G 01 B
G 01 N 33/20

[3]) Obtainable from: *Beuth Verlag GmbH*, D-1000 Berlin 30.

[4]) Issued by: *Verein Deutscher Eisenhüttenleute*; obtainable from *Verlag Stahleisen mbH*, Postfach 82 29, D-4000 Düsseldorf 1.