

Bright steel products — Technical delivery conditions —

Part 4: Case-hardening steels

The European Standard EN 10277-4:1999 has the status of a
British Standard

ICS 77.140.60

National foreword

This British Standard is the English language version of EN 10277-4:1999. This part of BS EN 10277 together with BS EN 10278 and BS EN 10277 parts 1, 2, 3 and 5 supersedes BS 970-3:1991 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee ISE/31, Wrought steels, which has the responsibility to:

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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 7 and a back cover.

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English version

Bright steel products — Technical delivery conditions — Part 4: Case-hardening steels

Produits en acier transformés à froid — Conditions
techniques de livraison — Partie 4: Aciers pour
cémentation

Blankstahlerzeugnisse — Technische
Lieferbedingungen — Teil 4: Einsatzstähle

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

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

Foreword

This European Standard has been prepared by Technical Committee ECISS/TC 23, Steels for heat treatment, alloy steels and free-cutting steels — Qualities and dimensions, the Secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by January 2000, and conflicting national standards shall be withdrawn at the latest by January 2000.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association. This European Standard is considered to be a supporting standard to those applications and product standards which in themselves support an essential safety requirement of a New Approach Directive and which make reference to this European Standard.

This European Standard EN 10277, Bright steel products — Technical delivery conditions, is subdivided as follows:

- *Part 1: General;*
- *Part 2: Steels for general engineering purposes;*
- *Part 3: Free-cutting steels;*
- *Part 4: Case-hardening steels;*
- *Part 5: Steels for quenching and tempering.*

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

Contents

	Page
Foreword	2
1 Scope	3
2 Normative references	3
3 Definitions	3
4 Classification and designation	3
4.1 Classification	3
4.2 Designation	3
5 Information to be supplied by the purchaser	3
6 Manufacturing process	3
7 Requirements	3
7.1 Chemical composition	3
7.2 Mechanical properties	3
7.3 Hardenability	3
7.4 Grain size	3
7.5 Non-metallic inclusions	3
7.6 Supplementary or special requirements	3
8 Inspection and testing	3
9 Marking	3

1 Scope

1.1 This part of EN 10277 applies to bright steel bars in the drawn, turned or ground condition, in straight lengths of case-hardening steels.

1.2 This EN 10277-4 is complemented by EN 10277-1.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 10084:1998, *Case-hardening steels — Technical delivery conditions*.

EN 10277-1, *Bright steel products — Technical delivery conditions — Part 1: General*.

EURONORM 103¹⁾, *Microscopic determination of the ferritic or austenitic grain size of steels*.

3 Definitions

For the purpose of this standard, the following definition applies in addition to the definitions in EN 10277-1.

3.1

case-hardening steels

steels with a relatively low carbon content, which are intended for carburizing or carbonitriding and subsequent hardening. Such steels, after treatment, are characterized by a high hardness surface layer and a tough core

4 Classification and designation

4.1 Classification

Steel grades C10R, C15R and C16R are non-alloy special steels. All other steel grades covered by this European Standard are alloy special steels.

4.2 Designation

See EN 10277-1.

5 Information to be supplied by the purchaser

See EN 10277-1.

6 Manufacturing process

See EN 10277-1.

7 Requirements

7.1 Chemical composition

7.1.1 Cast analysis

The chemical composition of the steel according to the cast analysis shall be as specified in Table 1.

7.1.2 Product analysis

The permissible deviations from the chemical composition as specified in Table 1 for cast analysis and the product analysis of the steel shall be as specified in Table 2.

7.2 Mechanical properties

The mechanical properties of the steels shall be as specified in Table 3 and Table 4.

7.3 Hardenability

Where steels are ordered with hardenability requirements, the requirements of EN 10084 shall apply.

7.4 Grain size

Unless otherwise agreed, the steel when tested in accordance with one of the methods described in EURONORM 103 shall show an austenitic grain size of 5 to 8. The grain structure shall be considered satisfactory if 70 % of the area is within the specified size limits.

For verification see EN 10277-1, **B.2**.

7.5 Non-metallic inclusions

The steels shall have a degree of cleanness corresponding to the special steel quality.

For details of requirements and verification see **A.1** and annex D of EN 10084:1998.

7.6 Supplementary or special requirements

See annex B of EN 10277-1.

8 Inspection and testing

See EN 10277-1.

9 Marking

See EN 10277-1.

¹⁾ It may be agreed at the time of ordering, until this EURONORM has been adopted as a European Standard, that either this EURONORM or a corresponding national standard should be applied.

Table 1 — Steel grades and chemical composition (cast analysis)

Designation		Steel grade according to	Chemical composition, % by mass ^{1),2),3)}										
Steel name	Steel number		C	Si max.	Mn	P max.	S	Cr	Mo	Ni	B		
C10R	1.1207	EN 10084:1998	0,07 to 0,13	0,40	0,30 to 0,60	0,035	0,020 to 0,040						
C15R	1.1140	EN 10084:1998	0,12 to 0,18	0,40	0,30 to 0,60	0,035	0,020 to 0,040						
C16R	1.1208	EN 10084:1998	0,12 to 0,18	0,40	0,60 to 0,90	0,035	0,020 to 0,040						
16MnCrS5	1.7139	EN 10084:1998	0,14 to 0,19	0,40	1,00 to 1,30	0,035	0,020 to 0,040	0,80 to 1,10					
16MnCrB5	1.7160	EN 10084:1998	0,14 to 0,19	0,40	1,00 to 1,30	0,035	≤0,035	0,80 to 1,10			0,0008 to 0,0050 ⁴⁾		
20MnCrS5	1.7149	EN 10084:1998	0,17 to 0,22	0,40	1,10 to 1,40	0,035	0,020 to 0,040	1,00 to 1,30					
16NiCrS4	1.5715	EN 10084:1998	0,13 to 0,19	0,40	0,70 to 1,00	0,035	0,020 to 0,040	0,60 to 1,00		0,80 to 1,10			
15NiCr13	1.5752	EN 10084:1998	0,14 to 0,20	0,40	0,40 to 0,70	0,035	≤0,035	0,60 to 0,90		3,00 to 3,50			
20NiCrMoS2-2	1.6526	EN 10084:1998	0,17 to 0,23	0,40	0,65 to 0,95	0,035	0,020 to 0,040	0,35 to 0,70	0,15 to 0,25	0,40 to 0,70			
17NiCrMoS6-4	1.6569	EN 10084:1998	0,14 to 0,20	0,40	0,60 to 0,90	0,035	0,020 to 0,040	0,80 to 1,10	0,15 to 0,25	1,20 to 1,50			

1) Elements not quoted in this table shall not be intentionally added to the steel without the agreement of the purchaser, other than for the purpose of finishing the heat. All reasonable precautions shall be taken to prevent the addition from scrap or other material used in manufacture, of such elements which affect the hardenability, mechanical properties and applicability.

2) Where requirements are made on hardenability (see EN 10084), slight deviations from the limits for the cast analysis are permitted, except for phosphorus and sulfur; these deviations shall, however, not exceed in the case of carbon $\pm 0,01\%$ and in all other cases the values acc. to Table 2.

3) Steels with improved machinability as a result of the addition of lead (e.g. 0,15% Pb to 0,35% Pb) or higher sulfur contents, depending on the manufacturing process up to around 0,100% S (including controlled sulfide and oxide formation, e.g. calcium treatment), may be supplied on request. In this case, the upper limit of the manganese content may be increased by 0,15%.

4) Boron is in this case added not for increase of hardenability but to improve the toughness of the case hardened zone.

Table 2 — Permissible deviations between the product analysis and the limiting values given in Table 1 for the cast analysis

Element	Permissible maximum content in the cast analysis % by mass	Permissible deviation ¹⁾ % by mass
C	≤0,23	±0,02
Si	≤0,40	+0,03
Mn	≤1,00	±0,04
	>1,00 ≤1,40	±0,05
P	≤0,035	+0,005
S	≤0,040	+0,005 ²⁾
Cr	≤1,30	±0,05
Mo	≤0,25	±0,03
Ni	≤2,00	±0,05
	>2,00 ≤3,50	±0,07
B	≤0,005 0	±0,000 5

¹⁾ ± means that in one cast the deviation may occur over the upper value or under the lower value of the specified range in Table 1, but not both at the same time.

²⁾ For steels with a specified sulfur range (0,020 % to 0,040 % according to cast analysis), the permissible deviation is ±0,005 %.

Table 3 — Mechanical properties of non-alloy steels

Steel name	Designation	Thickness ¹⁾ mm	Mechanical properties ¹⁾						
			As rolled + turned (+SH)		Cold drawn (+C)			+A ³⁾ + turned (+A +SH)	
			Hardness HB	R_m N/mm ²	$R_{p0,2}$ ²⁾ N/mm ²	R_m ²⁾ N/mm ² min.	A_5 % min.	Hardness HB max.	Hardness ⁴⁾ HB max.
C10R	1.1207	≥5 ≤10	—	—	350	460 to 760	8	—	225
		>10 ≤16	—	—	300	430 to 730	9	—	216
		>16 ≤40	92 to 163	310 to 550	250	400 to 700	10	131	207
		>40 ≤63	92 to 163	310 to 550	200	350 to 640	12	131	190
		>63 ≤100	92 to 163	310 to 550	180	320 to 580	12	131	172
C15R	1.1140	≥5 ≤10	—	—	380	500 to 800	7	—	238
		>10 ≤16	—	—	340	480 to 780	8	—	231
		>16 ≤40	98 to 178	330 to 600	280	430 to 730	9	143	216
		>40 ≤63	98 to 178	330 to 600	240	380 to 670	11	143	198
		>63 ≤100	98 to 178	330 to 600	215	340 to 600	12	143	178
C16R	1.1208	≥5 ≤10	—	—	400	520 to 820	7	—	242
		>10 ≤16	—	—	360	500 to 800	8	—	238
		>16 ≤40	105 to 184	350 to 620	300	450 to 750	9	156	222
		>40 ≤63	105 to 184	350 to 620	260	400 to 690	11	156	204
		>63 ≤100	105 to 184	350 to 620	235	360 to 620	12	156	184

1) For thicknesses <5 mm the mechanical properties may be agreed at the time of enquiry and order.

2) For flats the proof strength ($R_{p0,2}$) may deviate by -10 % and the tensile strength (R_m) by ±10 %.

3) +A = annealed to maximum hardness requirement.

4) The hardness values for flats may deviate by ±10 %.

Table 4 — Mechanical properties of alloy steels

Designation		Thickness ¹⁾ mm	Mechanical properties ¹⁾			
Steel name	Steel number		+A ²⁾ + turned (+A +SH) Hardness HB max.	+A ²⁾ + cold drawn (+A +C) Hardness ⁴⁾ HB max.	+FP ³⁾ + turned (+FP +SH) Hardness HB	+FP ³⁾ + cold drawn (+FP +C) Hardness ⁴⁾ HB
16MnCrS5	1.7139	≥5 ≤10	—	260	—	—
		>10 ≤16	—	250	—	—
		>16 ≤40	207	245	140 to 187	140 to 240
		>40 ≤63	207	240	140 to 187	140 to 235
		>63 ≤100	207	240	140 to 187	140 to 235
16MnCrB5	1.7160	≥5 ≤10	—	260	—	—
		>10 ≤16	—	250	—	—
		>16 ≤40	207	245	140 to 187	140 to 240
		>40 ≤63	207	240	140 to 187	140 to 235
		>63 ≤100	207	240	140 to 187	140 to 235
20MnCrS5	1.7149	≥5 ≤10	—	270	—	—
		>10 ≤16	—	260	—	—
		>16 ≤40	217	255	152 to 201	152 to 250
		>40 ≤63	217	250	152 to 201	152 to 245
		>63 ≤100	217	250	152 to 201	152 to 245
16NiCrS4	1.5715	≥5 ≤10	—	270	—	—
		>10 ≤16	—	260	—	—
		>16 ≤40	217	255	156 to 207	156 to 245
		>40 ≤63	217	255	156 to 207	156 to 240
		>63 ≤100	217	255	156 to 207	156 to 240
15NiCr13	1.5752	≥5 ≤10	—			—
		>10 ≤16	—			—
		>16 ≤40	255		166 to 217	
		>40 ≤63	255		166 to 217	
		>63 ≤100	255		166 to 217	
20NiCrMoS2-2	1.6526	≥5 ≤10	—	270	—	—
		>10 ≤16	—	260	—	—
		>16 ≤40	212	255	149 to 194	149 to 240
		>40 ≤63	212	255	149 to 194	149 to 235
		>63 ≤100	212	255	149 to 194	149 to 235
17NiCrMoS6-4	1.6569	≥5 ≤10	—	275	—	—
		>10 ≤16	—	265	—	—
		>16 ≤40	229	260	149 to 201	149 to 250
		>40 ≤63	229	255	149 to 201	149 to 245
		>63 ≤100	229	255	149 to 201	149 to 245

¹⁾ For thicknesses <5 mm the mechanical properties may be agreed at the time of enquiry and order.

²⁾ +A = annealed to maximum hardness requirement.

³⁾ +FP = treated to ferrite-pearlite structure and hardness range.

⁴⁾ The hardness values for flats may deviate by ±10 %.

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