BRITISH STANDARD

BS EN
10277-3:2008

Bright steel products — Technical delivery conditions —

Part 3: Free-cutting steels

ICS 77.140.10; 77.140.60

BSI
British Standards

National foreword

This British Standard is the UK implementation of EN 10277-3:2008. It supersedes BS EN 10277-3:1999 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee ISE/31, Wrought steels.

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

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Management Centre: rue de Stassart, 36 B-1050 Brussels

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Foreword

This document (EN 10277-3:2008) 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of an identical text or by endorsement, at the latest by September 2008, and conflicting national standards shall be withdrawn at the latest by September 2008.

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This document supersedes EN 10277-3:1999.

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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.

During the preparation of the first edition of this European Standard there were not enough statistical data available concerning mechanical properties of bright bar products. Since then it has been recognized that the proof strength values in the cold drawn condition were too high. In addition, cyclic stresses that occur during straightening can reduce the proof strength (Bauschinger's effect), which was not taken into account when drafting the first edition of this standard. In this second edition the proof strength values of non-alloy and alloy grades in condition +QT+C in parts 3 and 5 have been adjusted downwards compared to the first edition.

Furthermore for this part the tensile strength values of 36SMn(PB)14 and 38SMn(Pb)28 in condition +C and for 35S(Pb)20 in condition +QT+C were amended in the table for mechanical properties for steels for quenching and tempering.

1 Scope

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

This EN 10277-3 is complemented by EN 10277-1.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 10087, *Free-cutting steels - Technical delivery conditions for semi-finished products, hot-rolled bars and rods*

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

3 Terms and definitions

For the purposes of this European Standard the terms and definitions given in EN 10277-1 apply.

4 Classification and designation

4.1 Classification

All steels specified in this European Standard are classified as non-alloy quality 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 shall be as specified in:

— Table 3 for steels not intended for heat treatment,

— Table 4 for case-hardening steels,

— Table 5 for steels for quenching and tempering.

7.3 Options

See Annex B of EN 10277-1.

8 Inspection and testing

See EN 10277-1.

9 Marking

See EN 10277-1.

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

Designation		Steel grade according to	Chemical composition (% by mass) [a]					
Steel name	Steel number		C	Si max.	Mn	P max.	S	Pb
Steels not intended for heat treatment								
11SMn30	1.0715	EN 10087	≤ 0,14	0,05[b]	0,90 to 1,30	0,11	0,27 to 0,33	-
11SMnPb30	1.0718	EN 10087	≤ 0,14	0,05	0,90 to 1,30	0,11	0,27 to 0,33	0,20 to 0,35
11SMn37	1.0736	EN 10087	≤ 0,14	0,05[b]	1,00 to 1,50	0,11	0,34 to 0,40	-
11SMnPb37	1.0737	EN 10087	≤ 0,14	0,05	1,00 to 1,50	0,11	0,34 to 0,40	0,20 to 0,35
Case hardening steels								
10S20	1.0721	EN 10087	0,07 to 0,13	0,40	0,70 to 1,10	0,06	0,15 to 0,25	-
10SPb20	1.0722	EN 10087	0,07 to 0,13	0,40	0,70 to 1,10	0,06	0,15 to 0,25	0,20 to 0,35
15SMn13	1.0725	EN 10087	0,12 to 0,18	0,40	0,90 to 1,30	0,06	0,08 to 0,18	-
Steels for quenching and tempering								
35S20	1.0726	EN 10087	0,32 to 0,39	0,40	0,70 to 1,10	0,06	0,15 to 0,25	-
35SPb20	1.0756	EN 10087	0,32 to 0,39	0,40	0,70 to 1,10	0,06	0,15 to 0,25	0,15 to 0,35
36SMn14	1.0764	EN 10087	0,32 to 0,39	0,40	1,30 to 1,70	0,06	0,10 to 0,18	-
36SMnPb14	1.0765	EN 10087	0,32 to 0,39	0,40	1,30 to 1,70	0,06	0,10 to 0,18	0,15 to 0,35
38SMn28	1.0760	EN 10087	0,35 to 0,40	0,40	1,20 to 1,50	0,06	0,24 to 0,33	-
38SMnPb28	1.0761	EN 10087	0,35 to 0,40	0,40	1,20 to 1,50	0,06	0,24 to 0,33	0,15 to 0,35
44SMn28	1.0762	EN 10087	0,40 to 0,48	0,40	1,30 to 1,70	0,06	0,24 to 0,33	-
44SMnPb28	1.0763	EN 10087	0,40 to 0,48	0,40	1,30 to 1,70	0,06	0,24 to 0,33	0,15 to 0,35
46S20	1.0727	EN 10087	0,42 to 0,50	0,40	0,70 to 1,10	0,06	0,15 to 0,25	-
46SPb20	1.0757	EN 10087	0,42 to 0,50	0,40	0,70 to 1,10	0,06	0,15 to 0,25	0,15 to 0,35

[a] 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. However, elements such as Te, Bi etc., may be added by the manufacturer for improving the machinability, if this has been agreed at the time of enquiry and order.

[b] If, by metallurgical techniques, the formation of special oxides is guaranteed, a Si-content of 0,10 to 0,40 % can be agreed.

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

Element	Specified maximum content in the cast analysis % by mass		Permissible deviations[a] % by mass
C		≤ 0,30	± 0,02
	> 0,30	≤ 0,50	± 0,03
Si		≤ 0,05	+ 0,01
	> 0,05	≤ 0,40	+ 0,03
Mn		≤ 1,00	± 0,04
	> 1,00	≤ 1,70	± 0,06
P		≤ 0,06	+ 0,008
	> 0,06	≤ 0,11	+ 0,02
S		≤ 0,33	± 0,03
	> 0,33	≤ 0,40	± 0,04
Pb		≤ 0,35	+ 0,03 - 0,02

[a] ± 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.

Table 3 — Mechanical properties of free-cutting steels not intended for heat treatment

Designation		Thickness[a]	Mechanical properties[a]				
			As rolled and turned (+SH)		Cold drawn (+C)		
Steel name	Steel number	mm	Hardness[b] HBW	R_m MPa	$R_{p\,0,2}$[c] MPa min.	R_m[c] MPa	A % min.
11SMn30	1.0715	≥ 5 ≤ 10	-	-	440	510 to 810	6
11SMnPb30	1.0718	> 10 ≤ 16	-	-	410	490 to 760	7
11SMn37	1.0736	> 16 ≤ 40	112 to 169	380 to 570	375	460 to 710	8
11SMnPb37	1.0737	> 40 ≤ 63	112 to 169	370 to 570	305	400 to 650	9
		> 63 ≤ 100	107 to 154	360 to 520	245	360 to 630	9

[a] For thicknesses < 5 mm the mechanical properties may be agreed at the time of enquiry and order.

[b] Only for information.

[c] For flats and special sections the yield strength ($R_{p0,2}$) may deviate by -10 % and the tensile strength (R_m) by ± 10 %.

Table 4 — Mechanical properties of free-cutting steels for case hardening

Designation		Thickness[a]	Mechanical properties[a]				
			As rolled and turned (+SH)		Cold drawn (+C)		
Steel name	Steel number	mm	Hardness[b] HBW	R_m MPa	$R_{p\,0,2}$[c] MPa min.	R_m[c] MPa	A % min.
10S20	1.0721	≥ 5 ≤ 10	-	-	410	520 to 780	7
10SPb20	1.0722	> 10 ≤ 16	-	-	390	490 to 740	8
		> 16 ≤ 40	107 to 156	360 to 530	360	460 to 720	9
		> 40 ≤ 63	107 to 156	360 to 530	295	410 to 660	10
		> 63 ≤ 100	105 to 146	350 to 490	235	380 to 630	11
15SMn13	1.0725	≥ 5 ≤ 10	-	-	450	560 to 840	6
		> 10 ≤ 16	-	-	430	500 to 800	7
		> 16 ≤ 40	128 to 178	430 to 600	390	470 to 770	8
		> 40 ≤ 63	128 to 172	430 to 580	350	460 to 680	9
		> 63 ≤ 100	125 to 160	420 to 540	265	440 to 650	10

[a] For thicknesses < 5 mm the mechanical properties may be agreed at the time of enquiry and order.

[b] Only for information.

[c] For flats and special sections the yield strength ($R_{p0,2}$) may deviate by -10 % and the tensile strength (R_m) by ±10 %.

Table 5 — Mechanical properties of free-cutting steels for quenching and tempering

Designation		Thickness[a,b]	Mechanical properties[b]											
			As rolled + turned (+SH)		Cold drawn (+C)			Cold drawn + quenched and tempered (+C + QT)[c, g]			Quenched and tempered + cold drawn (+QT + C)[g]		
Steel name	Steel number		Hardness[d]	R_m	$R_{p\,0,2}$[e]	R_m[e]	A	$R_{p\,0,2}$	R_m	A	$R_{p\,0,2}$	R_m	A
		mm	HBW	MPa	MPa min.	MPa	% min.	MPa min.	MPa	% min	MPa min.	MPa	% min.
35S20	1.0726	≥ 5 ≤ 10	-	-	480	640 to 880	6	-	-	-	490	700 to 900	9
35SPb20	1.0756	> 10 ≤ 16	-	-	400	590 to 830	7	-	-	-	490	700 to 900	11
		> 16 ≤ 40	154 to 201	520 to 680	360	560 to 800	8	380	600 to 750	16	455	650 to 850	12
		> 40 ≤ 63	154 to 198	520 to 670	340	530 to 760	9	320	550 to 700	17	400	570 to 770	13
		> 63 ≤ 100	149 to 193	500 to 650	300	510 to 680	9	320	550 to 700	17	385	550 to 750	14
36SMn14	1.0764	≥ 5 ≤ 10	-	-	500	660 to 960	6	-	-	-	525	750 to 1 000	6
36SMnPb14	1.0765	> 10 ≤ 16	-	-	440	620 to 920	6	-	-	-	520	740 to 990	6
		> 16 ≤ 40	166 to 222	560 to 750	390	600 to 900	7	420	670 to 820	15	505	720 to 970	8
		> 40 ≤ 63	166 to 219	560 to 740	360	580 to 840	8	400	640 to 790	16	475	680 to 930	9
		> 63 ≤ 100	163 to 219	550 to 740	340	560 to 820	9	360	570 to 720	17	405	580 to 840	9
38SMn28	1.0760	≥ 5 ≤ 10	-	-	550	700 to 960	6	-	-	-	595	850 to 1 000	9
38SMnPb28	1.0761	> 10 ≤ 16	-	-	500	660 to 930	6	-	-	-	545	775 to 925	10
		> 16 ≤ 40	166 to 216	560 to 730	420	610 to 900	7	420	700 to 850	15	490	700 to 900	12
		> 40 ≤ 63	166 to 216	560 to 730	400	600 to 840	7	400	700 to 850	16	490	700 to 900	13
		> 63 ≤ 100	163 to 207	550 to 700	350	580 to 820	8	380	630 to 800	16	440	625 to 850	14
44SMn28	1.0762	≥ 5 ≤ 10	-	-	600	760 to 1 030[f]	5[f]	-	-	-	595	850 to 1 000	9
44SMnPb28	1.0763	> 10 ≤ 16	-	-	530	710 to 980[f]	5[f]	-	-	-	595	850 to 1 000	9
		> 16 ≤ 40	187 to 242	630 to 820	460	660 to 900[f]	6[f]	420	700 to 850	16	490	700 to 900	11
		> 40 ≤ 63	184 to 235	620 to 790	430	650 to 870	7	410	700 to 850	16	490	700 to 900	12
		> 63 ≤ 100	181 to 231	610 to 780	390	630 to 840	7	400	700 to 850	16	490	700 to 900	12
46S20	1.0727	≥ 5 ≤ 10	-	-	570	740 to 980	5	-	-	-	595	850 to 1 000	8
46SPb20	1.0757	> 10 ≤ 16	-	-	470	690 to 930	6	-	-	-	560	800 to 950	9
		> 16 ≤ 40	175 to 225	590 to 760	400	640 to 880	7	430	650 to 800	13	490	700 to 850	10
		> 40 ≤ 63	172 to 216	580 to 730	380	610 to 850	8	370	630 to 780	14	490	700 to 850	11
		> 63 ≤ 100	166 to 211	560 to 710	340	580 to 820	8	370	630 to 780	14	455	650 to 850	11

a For non-round products in the quenched and tempered condition, see EN 10277-1, Figure A.1.

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

c These values are also valid for the 'quenched and tempered + turned' condition.

d Only for information.

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

f By means of heavy drafting these steels may be supplied with a minimum tensile strength (R_m) of 920 MPa and a minimum elongation (A) of 4 %.

g In EN 10087, the term 'direct hardening' was used. This term must be changed to 'quenching and tempering' during the next revision of that standard.

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