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Steel rod, bars and wire for cold heading and cold extrusion

Part 3: Technical delivery conditions for case hardening steels

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Steel rod, bars and wire for cold heading and cold extrusion - Part 3: Technical delivery conditions for case hardening steels

Barres, fil machine et fil en acier pour transformation à froid à froid et extrusion à froid - Partie 3: Conditions techniques de livraison des aciers de cémentation

Walzdraht, Stäbe und Draht aus Kaltstauch- und Kaltfließpressstählen - Teil 3: Technische Lieferbedingungen für Einsatzstähle

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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Contents

Page

European foreword

This document (EN 10263-3:2017) has been prepared by Technical Committee ECISS/TC 106 "Wire rod and wires", the secretariat of which is held by AFNOR.

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of an identical text or by endorsement, at the latest by May 2018, and conflicting national standards shall be withdrawn at the latest by May 2018.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 10263-3:2001.

This European Standard EN 10263 is subdivided as follows:

— *Part 1: General technical delivery conditions*

— *Part 2: Technical delivery conditions for steels not intended for heat treatment after cold working*

— *Part 3: Technical delivery conditions for case hardening steels*

— *Part 4: Technical delivery conditions for steels for quenching and tempering*

— *Part 5: Technical delivery conditions for stainless steels*

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

1.1 This part of EN 10263 is applicable to round rod, round bars and wire with a diameter up to and including 100 mm, of non-alloy and alloy steel, intended for cold heading and cold extrusion and case hardening.

1.2 EN 10263-1:2017 is indispensable for this part of EN 10263.

2 Normative references

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

EN 10020, *Definition and classification of grades of steel*

EN 10263-1:2017, *Steel rod, bars and wire for cold heading and cold extrusion — Part 1: General technical delivery conditions*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 10263-1:2017 and the following apply.

3.1
case-hardening steels
structural steels with a relatively low carbon content, which are carburized or carbonitrided on their surface and subsequently hardened

Note 1 to entry: These steels, after hardening, have a high degree of hardness in the surface zone and good resistance to wear, while the core material is characterized principally by extreme toughness.

Note 2 to entry: Further possibilities for heat treatment of case-hardening steels are, for example, nitrocarburizing and nitriding.

4 Classification and Designation

4.1 Classification

All steels covered by this part of EN 10263 are special steels according to EN 10020.

Steel grades from C10E2C to C20E2C as quoted in Table 3 are non-alloy steels and all others are alloy steels according to EN 10020.

4.2 Designation

See EN 10263-1:2017.

5 Production process

5.1 Steelmaking process

See EN 10263-1:2017.

5.2 Deoxidation

All steels quoted in Table 3 shall be deoxidised.

6 Requirements

6.1 Delivery conditions

The delivery conditions in which the products covered by this part of EN 10263 are normally supplied, the product forms and the applicable requirements are given in Tables 1 and 2.

6.2 Chemical composition

6.2.1 Cast analysis

The chemical composition shall be in accordance with the values specified in Table 3 for the cast analysis.

6.2.2 Product analysis

In cases where a product analysis is requested, the admissible deviations from the values specified for the cast analysis are indicated in Table 4.

6.3 Mechanical properties

The mechanical properties of the products, to be determined by the tensile test or hardness test, shall be in accordance with Tables 5, 6 and 7 but by consideration of the prescriptions given in Table 1 and of the delivery conditions given in Table 2.

6.4 Hardenability

6.4.1 In the case of products ordered with standard requirements regarding hardenability, that is, when the steel names or numbers as quoted in Table 3 are supplemented by the symbols "+H", the hardness values obtained in the end quench test (Jominy test) (see Table 1 of EN 10263-1:2017) shall be in compliance with the values given in Table 8.

6.4.2 In the case of products ordered with restricted requirements regarding the scatter bands of the hardness values obtained by the Jominy test, that is when the steel name or number as quoted in Table 3 is supplemented by the symbol "+HH" or "+HL", the above hardness values shall be in compliance with the values given in Table 9.

NOTE 1 The symbol "+HH" denotes that the upper limit of the scatter band coincides with the upper limit for the corresponding steel "+H".

NOTE 2 The symbol "+HL" denotes that the lower limit of the scatter band coincides with the lower limit for the corresponding steel "+H".

NOTE 3 See EN 10263-1:2017, 7.7.4 and 10.2

6.4.3 The austenizing temperatures for the Jominy test are given in Tables 8 and 9.

6.5 Surface quality

For any particular surface requirement to be agreed at the time of ordering see EN 10263-1:2017, 7.10.

6.6 Supplementary or special requirements

Other requirements that can be agreed at the time of enquiry and order are described in Annex A of EN 10263-1:2017.

Table 1 — Combination of heat-treatment condition at delivery, product forms and applicable requirements

Heat-treatment condition at delivery	Symbol	Products form			Applicable requirements in cases where the steel concerned has been ordered with reference to the steel names indicated in					
		rod	bar	wire	Tables 3, 5 or 6 or 7		Tables 3,5 or 6 or 7,8 or 9			Table 3,5,6,7,8 or 9
untreated	None or +U	X	X	X	Chemical composition as specified in Tables 3 and 4	Mechanical properties as specified in Table 5 or 6 or 7	Chemical composition as specified in Tables 3 and 4	Mechanical properties as specified in Table 5 or 6 or 7	Values for hardenability according to Tables 8 or 9	Supplementary or special requirements as specified in Annex A of EN 10263-1:2017 [a]
spheroidized	+AC	X	X	X						
Treated to ferrite-pearlite structure and hardness range	+FP	–	X	–						
Others	Other delivery conditions may be agreed at the time of ordering									

Key
X = applicable
– = not applicable

a If agreed at the time of the enquiry and order.

Table 2 — Surface condition at delivery

Surface condition at delivery		Symbol	bar	rod	wire
Unless otherwise agreed	as rolled	none or +AR	x	x	–
Particular surface conditions supplied by agreement	cold drawn	+C	x	–	x
	skin passed	+LC	x	–	x
	peeled	+PE	x	x	x

Table 3 — Steel grades and chemical composition. Heat analysis % (by mass)

Steel grades		C	Si max. [a]	Mn	P max.	S	Cr	Mo	Ni	B	Cu max
Steel name	Steel number										
C10E2C	1.1122	0.08 to 0,12	0,30	0,30 to 0,60	0,025	0,025 max.					0,25
C15E2C	1.1132	0,13 to 0,17	0,30	0,30 to 0,60	0,025	0,025 max.					0,25
C17E2C	1.1147	0,15 to 0,19	0,30	0,60 to 0,90	0,025	0,025 max.					0,25
C20E2C	1.1152	0,18 to 0,22	0,30	0,30 to 0,60	0,025	0,025 max.					0,25
15B2	1.5501	0,13 to 0,16	0,30	0,60 to 0,80	0,025	0,025 max.				0,0008 to 0,005	0,25
18B2	1.5503	0,16 to 0,20	0,30	0,60 to 0,80	0,025	0,025 max.				0,0008 to 0,005	0,25
18MnB4	1.5521	0,16 to 0,20	0,30	0,90 to 1,20	0,025	0,025 max.				0,0008 to 0,005	0,25
22MnB4	1.5522	0,20 to 0,24	0,30	0,90 to 1,20	0,025	0,025 max.				0,0008 to 0,005	0,25
17Cr3	1.7016	0,14 to 0,20	0,30	0,60 to 0,90	0,025	0,025 max.	0,70 to 1,00				0,25
17CrS3	1.7014	0,14 to 0,20	0,30	0,60 to 0,90	0,025	0,020 to 0,040	0,70 to 1,00				0,25

Steel grades		C	Si max. [a]	Mn	P max.	S	Cr	Mo	Ni	B	Cu max
Steel name	Steel number										
16MnCr5	1.7131	0,14 to 0,19	0,30	1,00 to 1,30	0,025	0,025 max.	0,80 to 1,10			0,0008 to 0,005	0,25
16MnCrS5	1.7139	0,14 to 0,19	0,30	1,00 to 1,30	0,025	0,020 to 0,040	0,80 to 1,10				0,25
16MnCrB5	1.7160	0,14 to 0,19	0,30	1,00 to 1,30	0,025	0,025 max.	0,80 to 1,10				0,25
20MnCrS5	1.7149	0,17 to 0,22	0,30	1,10 to 1,40	0,025	0,020 to 0,040	1,00 to 1,30				0,25
12CrMo4	1.7201	0,10 to 0,15	0,30	0,60 to 0,90	0,025	0,025 max.	0,90 to 1,20	0,15 to 0,25			0,25
18CrMo4	1.7243	0,15 to 0,21	0,30	0,60 to 0,90	0,025	0,025 max.	0,90 to 1,20	0,15 to 0,25			0,25
18CrMoS4	1.7244	0,15 to 0,21	0,30	0,60 to 0,90	0,025	0,020 to 0,040	0,90 to 1,20	0,15 to 0,25			0,25
20MoCr4	1.7321	0,17 to 0,23	0,30	0,70 to 1,00	0,025	0,025 max.	0,30 to 0,60	0,40 to 0,50			0,25
20MoCrS4	1.7323	0,17 to 0,23	0,30	0,70 to 1,00	0,025	0,020 to 0,040	0,30 to 0,60	0,40 to 0,50			0,25
10NiCr5-4	1.5805	0,07 to 0,12	0,30	0,60 to 0,90	0,025	0,025 max.	0,90 to 1,20		1,20 to 1,50		0,25
12NiCr3-2	1.5701	0,09 to 0,15	0,30	0,30 to 0,60	0,025	0,025 max.	0,40 to 0,70		0,50 to 0,80		0,25
17CrNi6-6	1.5918	0,14 to 0,20	0,30	0,50 to 0,90	0,025	0,025 max.	1,40 to 1,70		1,40 to 1,70		0,25
20NiCrMo2-2	1.6523	0,17 to 0,23	0,30	0,65 to 0,95	0,025	0,025 max.	0,35 to 0,70	0,15 to 0,25	0,40 to 0,70		0,25
20NiCrMoS2-2	1.6526	0,17 to 0,23	0,30	0,65 to 0,95	0,025	0,020 to 0,040	0,35 to 0,70	0,15 to 0,25	0,40 to 0,70		0,25
20NiCrMoS6-4	1.6571	0,16 to 0,23	0,30	0,50 to 0,90	0,025	0,020 to 0,040	0,60 to 0,90	0,25 to 0,35	1,40 to 1,70		0,25

a A lower silicon content or a specific silicon range may be agreed at the time of ordering.

NOTE 1 Elements not quoted in this table should not be intentionally added to the steel without the agreement of the purchaser, except those intended for finishing the heat. All reasonable precautions shall be taken in order to prevent the addition of such elements from scrap or other materials used in the production process, which may affect the hardenability, mechanical properties and applicability.

NOTE 2 In the case of steels with hardenability requirements (see Tables 8 and 9) minor deviation from the specified limits are permitted (with the exception of sulphur and phosphorus), provided that they do not exceed 0,01 % for carbon and the values indicated in Table 4 for the other elements.

NOTE 3 To improve the performance of cold heading, it is possible to add Aluminium Al: 0,020 % to 0,050 %.

Table 4 — Permissible deviations between product analysis and the limiting values specified in Table 3 for the heat analysis

Elements	Limiting values of the cast (heat) analysis % by mass	Permissible deviation for the product analysis % by mass [a]
C	≤ 0,24	±0,02
Si	≤ 0,30	±0,03
Mn	≤ 1,00	±0,04
	> 1,00 ≤ 1,40	±0,06
P	≤ 0,025	+ 0,005
S	≤ 0,040	+ 0,005 [b]
Cr	≤ 1,70	±0,05
Mo	≤ 0,30	±0,03
	> 0,30 ≤ 0,50	±0,04
Ni	≤ 1,00	±0,03
	> 1,00 ≤ 1,70	±0,05
B	≤ 0,0050	±0,0003
Cu	≤ 0,25	+ 0,03

[a] ± means that in one heat the deviation of the product analysis for a given element may occur over the upper value or under the lower value of the specified range in Table 3, but not both at the same time.

[b] for steels with a specified sulphur range (0,020 % to 0,040 % according to cast analysis) the permissible deviation is ± 0,005 %.

Table 5 — Mechanical properties of non-alloyed steel grades

Steel grade		Diameter		Delivery condition											
				+U or +PE		+AC or +AC+PE		+U+C		+U+C+AC		+U+C+AC+LC		+AC+C	
				Mechanical properties											
Steel name	Steel number	above	up to	R_m max.	Z [a] min	R_m max.	Z min	R_m max.	Z min	R_m max.	Z min	R_m max.	Z min	R_m max.	Z min
		mm	mm	MPa	%	MPa	%	MPa	%	MPa	%	MPa	%	MPa	%
C10E2C	1.1122	2	5	-	-	-	-	-	-	390	67	430	65	-	-
		5	10	450	58	400	65	540	56	380	67	420	65	490	62
		10	40	450	58	400	65	530	56	380	67	420	65	480	62
		40	100	450	58	400	65	-	-	-	-	-	-	-	-
C15E2C	1.1132	2	5	-	-	-	-	-	-	420	67	460	65	-	-
		5	10	480	58	430	65	570	56	410	67	450	65	520	62
		10	40	480	58	430	65	560	56	410	67	450	65	510	62
		40	100	480	58	430	65	-	-	-	-	-	-	-	-
C17E2C	1.1147	2	5	-	-	-	-	-	-	440	67	480	65	-	-
		5	10	530	58	450	65	630	56	430	67	470	65	550	62
		10	40	530	58	450	65	620	56	430	67	470	65	540	62
		40	100	530	58	450	65	-	-	-	-	-	-	-	-
C20E2C	1.1152	2	5	-	-	-	-	-	-	460	67	500	65	-	-
		5	10	530	58	470	65	640	56	450	67	490	65	580	62
		10	40	530	58	470	65	630	56	450	67	490	65	570	62
		40	100	530	58	470	65	-	-	-	-	-	-	-	-

[a] The values are given only for information.

Table 6 — Mechanical properties of boron-alloyed steel grades

Steel grade		Diameter		Delivery condition											
				+U		+AC or +AC+PE		+U+C		+U+C+AC		+U+C+AC+LC		+AC+C	
				Mechanical properties											
Steel name	Steel number	above	up to	R_m max.	Z [a] min	R_m max.	Z min	R_m max.	Z min	R_m max.	Z min	R_m max.	Z min	R_m max.	Z min
		mm	mm	MPa	%	MPa	%	MPa	%	MPa	%	MPa	%	MPa	%
15B2	1.5501	2	5	-	-	-	-	-	-	440	67	480	65	-	-
		5	10	500	58	450	65	590	56	430	67	470	65	540	62
		10	40	500	58	450	65	580	56	430	67	470	65	530	62
18B2	1.5503	2	5	-	-	-	-	-	-	450	67	490	65	-	-
		5	10	520	58	460	64	610	56	440	67	480	65	550	62
		10	40	520	58	460	64	600	56	440	67	480	65	540	62
18MnB4	1.5521	2	5	-	-	-	-	-	-	500	64	540	62	-	-
		5	10	580	55	500	64	680	53	480	64	520	62	600	59
		10	40	580	55	500	64	670	53	480	64	520	62	590	59
22MnB4	1.5522	2	5	-	-	-	-	-	-	520	64	560	62	-	-
		5	10	600	55	520	62	720	53	500	64	540	62	630	59
		10	40	600	55	520	62	710	53	500	64	540	62	620	59

[a] The values are given only for information.

Table 7 — Mechanical properties of alloyed steel grades

Steel grade		Diameter		Delivery condition									
				+AC		+FP		+U+C+AC		+U+C+AC+LC		+AC+C	
				Mechanical properties									
Steel name	Steel number	above	up to	R_m max.	Z min	HB		R_m max.	Z min	R_m max.	Z min	R_m max.	Z min
		mm	mm	MPa	%	min	max	MPa	%	MPa	%	MPa	%
17Cr3 17CrS3	1.7016 1.7014	2	5	-	-	-	-	520	62	560	60	-	-
		5	10	520	60	140	187	500	62	540	60	630	57
		10	40	520	60	140	187	500	62	540	60	620	57
16MnCr5 16MnCrS5 16MnCrB5	1.7131 1.7139 1.7160	2	5	-	-	-	-	550	64	590	62	-	-
		5	10	550	62	140	187	530	64	570	62	660	59
		10	40	550	62	140	187	530	64	570	62	650	59
20MnCrS5	1.7149	2	5	-	-	-	-	570	62	610	60	-	-
		5	10	570	60	152	201	550	62	590	60	680	57
		10	40	570	60	152	201	550	62	590	60	670	57
12CrMo4	1.7201	2	5	-	-	-	-	500	-	-	-	-	-
		5	10	500	62	135	185	480	64	520	62	-	-
		10	40	500	62	135	185	480	64	520	62		
18CrMo4 18CrMoS4	1.7243 1.7244	2	5	-	-	-	-	550	62	590	60	-	-
		5	10	550	60	140	187	530	62	570	60	660	57
		10	40	550	60	140	187	530	62	570	60	650	57
20MoCr4 20MoCrS4	1.7321 1.7323	2	5	-	-	-	-	560	62	600	60	-	-
		5	10	560	60	140	187	540	62	580	60	670	57
		10	40	560	60	140	187	540	62	580	60	660	57

Steel grade		Diameter		Delivery condition									
				+AC		+FP		+U+C+AC		+U+C+AC+LC		+AC+C	
				Mechanical properties									
Steel name	Steel number	above	up to	R_m max.	Z min	HB		R_m max.	Z min	R_m max.	Z min	R_m max.	Z min
		mm	mm	MPa	%	min	max	MPa	%	MPa	%	MPa	%
10NiCr5-4	1.5805	2	5	-	-	-	-	520	64	560	62	-	-
		5	10	520	62	137	187	500	64	540	62	640	59
		10	40	520	62	137	187	500	64	540	62	630	59
12NiCr3-2	1.5701	2	5	-	-	-	-	500	64	540	62	-	-
		5	10	500	62	130	180	480	64	520	62	620	59
		10	40	500	62	130	180	480	64	520	62	610	59
17CrNi6-6	1.5918	2	5	-	-	-	-	600	62	640	60	-	-
		5	10	600	60	156	207	580	62	620	60	720	57
		10	40	600	60	156	207	580	62	620	60	710	57
20NiCrMo2-2 20NiCrMoS2-2	1.6523 1.6526	2	5	-	-	-	-	590	62	630	60	-	-
		5	10	590	60	149	194	570	62	610	60	720	57
		10	40	590	60	149	194	570	62	610	60	710	57
20NiCrMoS6-4	1.6571	2	5	-	-	-	-	610	60	650	58	-	-
		5	10	610	58	149	201	590	60	630	58	730	55
		10	25	610	58	149	201	590	60	630	58	720	55

Table 8 — Hardness limits for steel grades with standard hardenability (+H grades - see 6.4.1)

Steel grades		Symbol	Austenizing temperature	Limits of range	Hardness HRC at a distance from quenched end of test piece (in mm) of												
Steel name	Steel number		°C ± 5 °C		1,5	3	5	7	9	11	13	15	20	25	30	35	40
18MnB4	1.5521	+H	890	max.	46	45	44	41	39	35	32	28	21	-	-	-	-
				min.	40	38	37	30	21	-	-	-	-	-	-	-	-
22MnB4	1.5522	+H	880	max.	49	48	47	45	42	39	35	32	24	20	-	-	-
				min.	43	41	40	32	23	-	-	-	-	-	-	-	
17Cr3	1.7016	+H	880	max.	47	44	40	33	29	27	25	24	23	21	-	-	-
17CrS3	1.7014			min.	39	35	25	20	-	-	-	-	-	-	-	-	-
16MnCr5	1.7131	+H	870	max.	47	46	44	41	39	37	35	33	31	30	29	28	27
16MnCrS5	1.7139			min.	39	36	31	28	24	21	-	-	-	-	-	-	-
16MnCrB5	1.7160	+H	870	max.	47	46	44	41	39	37	35	33	31	30	29	28	27
				min.	39	36	31	28	24	21	-	–	-	-	-	-	-
20MnCrS5	1.7149	+H	870	max	49	49	48	46	43	42	41	39	37	35	34	33	32
				min.	41	39	36	33	30	28	26	25	23	21	-	-	-
12CrMo4	1.7201	+H	870	max	44	43	41	38	34	30	28	27	23	21	-	-	-
				min.	36	34	30	26	22	-	-	-	-	-	-	–	-
18CrMo4	1.7243	+H	880	max	47	46	45	42	39	37	35	34	31	29	28	27	26
18CrMoS4	1.7244			min.	39	37	34	30	27	24	22	21	-	-	-	-	-
20MoCr4	1.7321	+H	910	max	49	47	44	41	38	35	33	31	28	26	25	24	24
20MoCrS4	1.7323			min.	41	37	31	27	24	22	-	-	-	-	-	-	-
10NiCr5	1.5805	+H	880	max	41	39	37	34	32	30	-	-	-	-	-	-	-
				min.	32	27	24	22	-	-	-	-	-	-	-	-	-

Steel grades		Symbol	Austenizing temperature	Limits of range	Hardness HRC at a distance from quenched end of test piece (in mm) of												
Steel name	Steel number		°C ± 5 °C		1,5	3	5	7	9	11	13	15	20	25	30	35	40
12NiCr3–2	1.5701	+H	870	max	43	40	35	26	21	-	-	-	-	-	-	-	-
				min.	37	32	25	-	-	-	-	-	-	-	-	-	-
17CrNi6–6	1.5918	+H	870	max	47	47	46	45	43	42	41	39	37	35	34	34	33
				min.	39	38	36	35	32	30	28	26	24	22	21	20	20
20NiCrMo2–2	1.6523	+H	920	max	49	48	45	42	36	33	31	30	27	25	24	24	23
20NiCrMoS2–2	1.6526			min.	41	37	31	25	22	20	-	-	-	-	-	-	-
20NiCrMoS6–4	1.6571	+H	880	max	49	49	48	48	47	47	46	44	41	39	38	37	36
				min.	41	40	39	36	33	30	28	26	23	21	-	-	-

Table 9 — Hardness limits for steel grades with restricted hardenability scatter bands (+HH and +HL grades - see 6.4.2)

Steel grades		Symbol	Austenizing temperature	Limits of range	Hardness HRC at a distance from quenched end of test piece (in mm) of												
Steel name	Steel number		°C ± 5 °C		1,5	3	5	7	9	11	13	15	20	25	30	35	40
17Cr 3 17CrS3	1.7016 1.7014	+HH	880	max.	47	44	40	33	29	27	25	24	23	21	-	-	-
				min.	42	38	30	24	20	-	-	-	-	-	-	-	-
17Cr3 17CrS3	1.7016 1.7014	+HL		max.	44	41	35	29	25	23	21	20	-	-	-	-	-
				min.	39	35	25	20									
16MnCr5 16MnCrS5	1.7131 1.7139	+HH	870	max.	47	46	44	41	39	37	35	33	31	30	29	28	27
				min.	42	39	35	32	29	26	24	22	20	-	-	-	-
16MnCr5 16MnCrS5	1.7131 1.7139	+HL		max.	44	43	40	37	34	32	30	28	26	25	24	23	22
				min.	39	36	31	28	24	21							

Steel grades		Symbol	Austenizing temperature	Limits of range	Hardness HRC at a distance from quenched end of test piece (in mm) of												
Steel name	Steel number		°C ± 5 °C		1,5	3	5	7	9	11	13	15	20	25	30	35	40
16MnCrB5	1.7160	+HH	870	max.	47	46	44	41	39	37	35	33	31	30	29	28	27
				min.	42	39	35	32	29	26	24	22	20	-	-	-	-
		+HL		max.	44	43	40	37	34	32	30	28	26	25	24	23	22
				min.	39	36	31	28	24	21	-	–	-	-	-	-	-
20MnCrS5	1.7149	+HH	870	max.	49	49	48	46	43	42	41	39	37	35	34	33	32
				min.	44	42	40	37	34	33	31	30	28	26	25	24	23
		+HL		max.	46	46	44	42	39	37	36	34	32	30	29	28	27
				min.	41	39	36	33	30	28	26	25	23	21	-	-	-
12CrMo4	1.7201	+HH	870	max.	44	43	41	38	34	30	28	27	23	21	-	-	-
				min.	39	37	34	30	26	21	-	-	-	-	-	-	-
		+HL		max.	41	40	37	34	30	26	23	20	-	-	-	-	-
				min.	36	34	30	26	22	-	-	-	-	-	-	-	-
18CrMo4 18CrMoS4	1.7243 1.7244	+HH	880	max.	47	46	45	42	39	37	35	34	31	29	28	27	26
				min.	42	40	38	34	31	28	26	25	22	20	-	-	-
18CrMo4 18CrMoS4	1.7243 1.7244	+HL		max.	44	43	41	38	35	33	31	30	27	25	24	23	22
				min.	39	37	34	30	27	24	22	21	-	-	-	-	-
20MoCr4 20MoCrS4	1.7321 1.7323	+HH	910	max.	49	47	44	41	38	35	33	31	28	26	25	24	24
				min.	44	40	35	32	29	26	24	22	-	-	-	-	-
20MoCr4 20MoCrS4	1.7321 1.7323	+HL		max.	46	44	40	36	33	31	29	27	24	22	21	20	20
				min.	41	37	31	27	24	22	-	-	-	-	-	-	-
10NiCr5–4	1.5805	+HH	880	max.	41	39	37	34	32	30	-	-	-	-	-	-	-
				min.	33	29	26	24	21	20	-	-	-	-	-	-	-
10NiCr5–4	1.5805	+HL		max.	38	35	32	30	27	25	-	-	-	-	-	-	-
				min.	32	27	24	22	-	-	-	-	-	-	-	-	-

Steel grades		Symbol	Austenizing temperature	Limits of range	Hardness HRC at a distance from quenched end of test piece (in mm) of												
Steel name	Steel number		°C ± 5 °C		1,5	3	5	7	9	11	13	15	20	25	30	35	40
17CrNi6-6	1.5918	+HH	870	max	47	47	46	45	43	42	41	39	37	35	34	34	33
				min	42	41	39	38	36	34	32	30	28	26	25	25	24
		+HL		max	44	44	43	42	39	38	37	35	33	31	30	29	29
				min	39	38	36	35	32	30	28	26	24	22	21	20	20
20NiCrMo2-2 20NiCrMoS2-2	1.6523 1.6526	+HH	920	max	49	48	45	42	36	33	31	30	27	25	24	24	23
				min	44	41	36	31	27	24	22	21	-	-	-	-	-
20NiCrMo2-2 20NiCrMoS2-2	1.6523 1.6526	+HL		max	46	44	40	36	31	29	27	26	23	21	20	20	-
				min	41	37	31	25	22	20	-	-	-	-	-	-	-
20NiCrMoS6-4	1.6571	+HH	880	max	49	49	48	48	47	47	46	44	41	39	38	37	36
				min	44	43	42	40	38	36	34	32	29	27	26	25	24
		+HL		max	46	46	45	44	42	41	40	38	35	33	32	31	30
				min	41	40	39	36	33	30	28	26	23	21	-	-	-

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