

Foreword

The standard has revised GB/T 3077-1988 "The Technical Conditions of Alloy Structure Steel".

There have been some changes in this national's standard over its previous edition in the following technical aspects:

- Change the name of the standard to "Alloy Structure Steel";
- After consultation between the two sides of supply and demand, the bar stock of which the diameter is more than 250mm can also be provided;
- Add a chapter of "Order Content";
- Add the unified digital code for steel grades;
- Cancel steel grades 30Mn2MoW, 20Mn2B, 20SiMnVB, 20Cr3MoWVA, 20CrV and add steel grade 18CrMnNiMoA which was developed by China;
- Add the maximum content limit for Mo;
- Delete the clauses 3.1.1.3, 3.1.1.5, 3.5.2.1 and 3.5.2.2 of GB/T 3077-1988;
- Adjust appropriately the heat treatment process of Table 3 and the heat treatment parameters of individual steel grades.

The standard will replace GB/T 3077-1988 from the date of the implementation of this standard.

The standard was proposed by the State Bureau of Metallurgical Industry.

The standard is under the jurisdiction of the National Technical Committee of Standardization Steel.

The standard was mainly drafted by the following organizations: Daye Special Steel Co., Ltd., the Standards Research Institute of Ministry of Metallurgical, and Baoshan Iron & Steel Co., Ltd. Special Steel Branch.

The standard was mainly drafted by: Mr. Fang Jun, Mr. Liu Wende, Ms. Luan Yan, Mr. Han Guoliang and Mr. Chen Changxi.

The standards was first released in May 1982 release and first emended in February 1988.

National Standard of PRC

Alloy Structure Steels

GB/T 3077-1999

Replace GB/T 3077-1988

1. Scope

The standard covers the following issues of hot rolled and forging alloy steel: the dimension, shape, weight, tolerance, engineering specification, test method, inspection rules, packaging, marking, and quality certificates.

The standard applies to alloy structural steel bar 250mm maximum diameter or thickness. After consultation between the two sides of supply and demand, bar stock of diameter greater than 250 mm can also be provided

The chemical compositions of steel grades specified in the standard also apply to steel ingot, billet and its productions.

2. Normative reference

The following standards contain provisions, which through reference in this text constitute provisions of this standard. At time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

GB/T 222-1984	Method of sampling steel for determination of chemical composition and permissible variations for product analysis
GB/T 224-1984	Determination of depth of decarburization of steel
GB/T 225-1988	Methods of Harden ability Test for Steel End Quench Method
GB/T 226-1991	Etch test for macrostructure and defect of steels
GB/T 228-1987	Methods of tensile tests for metal
GB/T 229-1994	Metallic materials—Charpy notch impact test
GB/T231-1984	Metallic materials—Brinell Hardness test
GB/T233-1982	Metallic materials—Forging test
GB/T702-1986	Hot-rolled round and square steel bars—Dimension, shape, weight and tolerance
GB/T 908-1987	Forged round and square steels dimension, shape, weight and tolerance
GB/T1979-1980	Diagram of a low magnification texture blemish grading of structural steel
GB/T2101-1989	General requirements of acceptance, packaging, marking, and certification for section steel
GB/T2975-1998	Steel and steel products--Location and preparation of test pieces for mechanical testing
GB/T4336-1984	Method for photoelectric emission spectroscopic analysis of carbon steel, medium and low alloy steel
GB/T6397-1986	Test pieces for tensile test for metallic materials

GB/T7736-1987	Ultrasonic inspecting method for macro-structure and imperfection of steel
GB/T10561-1989	Microscopic valuation method for the non-metallic inclusions in steel
GB/T13299-1991	Steel—Determination of microstructure
GB/T15711-1995	Steel products--Method for etch test of tower sample
GB/T17505-1998	Steel and steel products General technical delivery requirements
GB/T17616-1998	Unified numbering system for designations of iron, steel and alloy
YB/T5148-1993	Metal-methods for estimating the average grain size

Normative reference of chemolysis methods of iron and steel please see Annex A. (Normative Annex)

3. Order Content

Order or contract according to this standard should including following content:

- a) Standard Number;
- b) Product Name;
- c) Steel grade or unified digital code;
- d) Control of residual elements (For requirements, refer 6.1.1.2);
- e) The weight or quantity of delivery;
- f) Size and Shape;
- g) Processing methods;
- h) Delivery condition;
- i) Delivery with heat treatment condition (For requirements, refer 6.4);
- j) Hot heading (For requirements, refer 6.7);
- k) Decarburization (For requirements, refer 6.8);
- l) Non-metallic impurities (For requirements, refer 6.9);
- m) Special requirements (For requirements, refer 6.10).

4. Classification and code

4.1 By different metallurgical quality, steel divided into the following three categories:

- a) Fine steel;
- b) High-grade fine steel (code “A” added following steel grade);
- c) Extra fine steel (code “E” added following steel grade).

4.2 By different using and processing purpose, steel divided into the following two categories. The

applied processing method should be specified in the contract. If it is not specified, cutting used steel is default.

- a) Pressure process used steel (code: UP)
 - 1) Hot pressure process used steel (code: UHP)
 - 2) Upset forging steel (code: UF)
 - 3) Cold drawn steel (code: UCD)
- b) Cutting used steel (code: UC)

5. Size, Shape, Weight and Tolerance

5.1 The size, shape weight and tolerance of hot-rolled bar and square steel should be consistent with the relevant regulation of GB/T 702, and the particular requirements should be specified in the contract.

5.2 The size, shape weight and tolerance of forged bar and square steel should be consistent with the relevant regulation of GB/T 908, and the particular requirements should be specified in the contract.

5.3 The size, shape weight and tolerance of profiled bar should be comply with the appropriate standards or terms of the agreement reached between supplier and buyer, and the particular requirements should be specified in the contract.

6. Technical specification

6.1 Steel grade and chemical composition

6.1.1 Steel grade, unified digital code and chemical composition (melting analysis) should be consistent with the specification of Table 1.

6.1.1.1 The sulfur, phosphorus and residual content of copper, chromium, nickel, molybdenum of steel should be consistent with the specification of Table 2.

6.1.1.2 The residual content of tungsten, vanadium, and titanium content should be analyzed, and the results should be recorded in the quality certificate. According to the buyer's request, the restrictions of residual tungsten, vanadium, titanium content can be set up.

6.1.1.3 The maximum copper content of hot pressure process used steel is 0.2%.

6.1.2 The permissible deviation of chemical composition of steels (or billets) should comply with GB/T 222.

Table 1

Steel Group	Item	Unified digital code	Steel grade	Chemical Composition %												
				C	Si	Mn	Cr	Mo	Ni	W	B	Al	Ti	V		
Mn	1	A00202	20Mn2	0.17~0.24	0.17~0.37	1.40~1.80										
	2	A00302	30Mn2	0.27~0.34	0.17~0.37	1.40~1.80										
	3	A00352	35Mn2	0.32~0.39	0.17~0.37	1.40~1.80										
	4	A00402	40Mn2	0.37~0.44	0.17~0.37	1.40~1.80										
	5	A00452	45Mn2	0.42~0.49	0.17~0.37	1.40~1.80										
	6	A00502	50Mn2	0.47~0.55	0.17~0.37	1.40~1.80										
MnV	7	A01202	20MnV	0.17~0.24	0.17~0.37	1.30~1.60										0.07~0.12
SiMn	8	A10272	27SiMn	0.24~0.32	1.10~1.40	1.10~1.40										
	9	A10352	35SiMn	0.32~0.40	1.10~1.40	1.10~1.40										
	10	A10422	42SiMn	0.39~0.45	1.10~1.40	1.10~1.40										
SiMnMoV	11	A14202	20SiMn2MoV	0.17~0.23	0.90~1.20	2.20~2.60		0.30~0.40								0.05~0.12
	12	A14262	25SiMn2MoV	0.22~0.28	0.90~1.20	2.20~2.60		0.30~0.40								0.05~0.12
	13	A14372	37SiMn2MoV	0.33~0.39	0.60~0.90	1.60~1.90		0.40~0.50								0.05~0.12
B	14	A70402	40B	0.37~0.44	0.17~0.37	0.60~0.90						0.0005~0.0035				
	15	A70452	45B	0.42~0.49	0.17~0.37	0.60~0.90						0.0005~0.0035				
	16	A70502	50B	0.47~0.55	0.17~0.37	0.60~0.90						0.0005~0.0035				
MnB	17	A71402	40MnB	0.37~0.44	0.17~0.37	1.10~1.40						0.0005~0.0035				
	18	A71452	45MnB	0.42~0.49	0.17~0.37	1.10~1.40						0.0005~0.0035				
MnMoB	19	A72202	20MnMoB	0.16~0.22	0.17~0.37	0.90~1.20		0.20~0.30				0.0005~0.0035				
MnVB	20	A73152	15MnVB	0.12~0.18	0.17~0.37	1.20~1.60						0.0005~0.0035				0.07~0.12
	21	A73202	20MnVB	0.17~0.23	0.17~0.37	1.20~1.60						0.0005~0.0035				0.07~0.12
	22	A73402	40MnVB	0.37~0.44	0.17~0.37	1.10~1.40						0.0005~0.0035				0.05~0.10
MnTiB	23	A74202	20MnTiB	0.17~0.24	0.17~0.37	1.30~1.60						0.0005~0.0035		0.04~0.10		
	24	A74252	25MnTiBRE	0.22~0.28	0.20~0.45	1.30~1.60						0.0005~0.0035		0.04~0.10		

Table 1(continued)

Steel Group	Item	Unified digital code	Steel grade	Chemical Composition %										
				C	Si	Mn	Cr	Mo	Ni	W	B	Al	Ti	V
Cr	25	A20152	15Cr	0.12~0.18	0.17~0.37	0.40~0.70	0.70~1.00							
	26	A20153	15CrA	0.12~0.17	0.17~0.37	0.40~0.70	0.70~1.00							
	27	A20202	20Cr	0.18~0.24	0.17~0.37	0.50~0.80	0.70~1.00							
	28	A20302	30Cr	0.27~0.34	0.17~0.37	0.50~0.80	0.80~1.10							
	29	A20352	35Cr	0.32~0.39	0.17~0.37	0.50~0.80	0.80~1.10							
	30	A20402	40Cr	0.37~0.44	0.17~0.37	0.50~0.80	0.80~1.10							
	31	A20452	45Cr	0.42~0.49	0.17~0.37	0.50~0.80	0.80~1.10							
	32	A20502	50Cr	0.47~0.54	1.10~1.40	0.50~0.80	0.80~1.10							
CrSi	33	A21382	38CrSi	0.35~0.43	1.00~1.30	0.30~0.60	1.30~1.60							
CrMo	34	A30122	12CrMo	0.08~0.15	0.17~0.37	0.40~0.70	0.40~0.70	0.40~0.55						
	35	A30152	15CrMo	0.12~0.18	0.17~0.37	0.40~0.70	0.80~1.10	0.40~0.55						
	36	A30202	20CrMo	0.17~0.24	0.17~0.37	0.40~0.70	0.80~1.10	0.15~0.25						
	37	A30302	30CrMo	0.26~0.34	0.17~0.37	0.40~0.70	0.80~1.10	0.15~0.25						
	38	A30303	30CrMoA	0.26~0.33	0.17~0.37	0.40~0.70	0.80~1.10	0.15~0.25						
	39	A30352	35CrMo	0.32~0.40	0.17~0.37	0.40~0.70	0.80~1.10	0.15~0.25						
	40	A30422	42CrMo	0.38~0.45	0.17~0.37	0.50~0.80	0.90~1.20	0.15~0.25						
	CrMoV	41	A31122	12CrMoV	0.08~0.15	0.17~0.37	0.40~0.70	0.30~0.60	0.25~0.35					
42		A31352	35CrMoV	0.30~0.38	0.17~0.37	0.40~0.70	1.00~1.30	0.20~0.30						0.10~0.20
43		A31132	12Cr1MoV	0.08~0.15	0.17~0.37	0.40~0.70	0.90~1.20	0.25~0.35						0.15~0.30
44		A31253	25Cr2MoVA	0.22~0.28	0.17~0.37	0.40~0.70	1.50~1.80	0.25~0.35						0.15~0.30
45		A31263	25Cr2Mo1VA	0.22~0.29	0.17~0.37	0.50~0.80	2.10~2.50	0.90~1.10						0.30~0.50
CrMoAl	46	A33382	38CrMoAl	0.35~0.42	0.20~0.45	0.30~0.60	1.35~1.65	0.15~0.25				0.70~1.10		
CrV	47	A23402	40CrV	0.37~0.44	0.17~0.37	0.50~0.80	0.80~1.10							0.10~0.20
	48	A23503	50CrVA	0.47~0.54	0.17~0.37	0.50~0.80	0.80~1.10							0.10~0.20

Table 1(continued)

Steel Group	Item	Unified digital code	Steel grade	Chemical Composition %										
				C	Si	Mn	Cr	Mo	Ni	W	B	Al	Ti	V
CrMn	49	A22152	15CrMn	0.12~0.18	0.17~0.37	1.10~1.40	0.40~0.70							
	50	A22202	20CrMn	0.17~0.23	0.17~0.37	0.90~1.20	0.90~1.20							
	51	A22402	40CrMn	0.37~0.45	0.17~0.37	0.90~1.20	0.90~1.20							
CrMnSi	52	A24202	20CrMnSi	0.17~0.23	0.90~1.20	0.80~1.10	0.80~1.10							
	53	A24252	25CrMnSi	0.22~0.28	0.90~1.20	0.80~1.10	0.80~1.10							
	54	A24302	30CrMnSi	0.27~0.34	0.90~1.20	0.80~1.10	0.80~1.10							
	55	A24303	30CrMnSiA	0.28~0.34	0.90~1.20	0.80~1.10	0.80~1.10							
CrMnMo	56	A24353	35CrMnSiA	0.32~0.39	1.10~1.40	0.80~1.10	1.10~1.40							
	57	A34202	20CrMnMo	0.17~0.23	0.17~0.37	0.90~1.20	1.10~1.40	0.20~0.30						
CrMnMo	58	A34402	40CrMnMo	0.37~0.45	0.17~0.37	0.90~1.20	0.90~1.20	0.20~0.30						
	59	A26202	20CrMnTi	0.17~0.23	0.17~0.37	0.80~1.10	1.00~1.30						0.04~0.10	
CrMnTi	60	A26302	30CrMnTi	0.24~0.32	0.17~0.37	0.80~1.10	1.00~1.30						0.04~0.10	
	61	A40202	20CrNi	0.17~0.23	0.17~0.37	0.40~0.70	0.45~0.75		1.00~1.40					
CrNi	62	A40402	40CrNi	0.37~0.44	0.17~0.37	0.50~0.80	0.45~0.75		1.00~1.40					
	63	A40452	45CrNi	0.42~0.49	0.17~0.37	0.50~0.80	0.45~0.75		1.00~1.40					
	64	A40502	50CrNi	0.47~0.54	0.17~0.37	0.50~0.80	0.45~0.75		1.00~1.40					
	65	A41122	12CrNi2	0.10~0.17	0.17~0.37	0.30~0.60	0.60~0.90		1.50~1.90					
	66	A42122	12CrNi3	0.10~0.17	0.17~0.37	0.30~0.60	0.60~0.90		2.75~3.15					
	67	A42202	20CrNi3	0.17~0.24	0.17~0.37	0.30~0.60	0.60~0.90		2.75~3.15					
	68	A42302	30CrNi3	0.27~0.33	0.17~0.37	0.30~0.60	0.60~0.90		2.75~3.15					
	69	A42372	37CrNi3	0.34~0.41	0.17~0.37	0.30~0.60	1.20~1.60		3.00~3.50					
	70	A43122	12Cr2Ni4	0.10~0.16	0.17~0.37	0.30~0.60	1.25~1.65		3.25~3.65					
	71	A43202	20Cr2Ni4	0.17~0.23	0.17~0.37	0.30~0.60	1.25~1.65		3.25~3.65					
CrNiMo	72	A50202	20CrNiMo	0.17~0.23	0.17~0.37	0.60~0.95	0.40~0.70	0.20~0.30	0.35~0.75					
	73	A50403	40CrNiMoA	0.37~0.44	0.17~0.37	0.50~0.80	0.60~0.90	0.15~0.25	1.25~1.65					

Table 1(finished)

Steel Group	Item	Unified digital code	Steel grade	Chemical Composition %										
				C	Si	Mn	Cr	Mo	Ni	W	B	Al	Ti	V
CrMnNiMo	74	A50183	18CrNiMnMoA	0.15~0.21	0.17~0.37	1.10~1.40	1.00~1.30	0.20~0.30	1.00~1.30					
CrNiMoV	75	A51453	45CrNiMoVA	0.42~0.49	0.17~0.37	0.50~0.80	0.80~1.10	0.20~0.30	1.30~1.80					0.10~0.20
CrNiW	76	A52183	18Cr2Ni4WA	0.13~0.19	0.17~0.37	0.30~0.60	1.35~1.65		4.00~4.50	0.80~1.20				
	77	A52253	25Cr2Ni4WA	0.21~0.28	0.17~0.37	0.30~0.60	1.35~1.65		4.00~4.50	0.80~1.20				

Notes:

1. The steel grades with code "A" in the standard can only be ordered as high-grade fine steel and other as fine steel.
2. According to their requirement, the buyer can order, by adding code "A" or "E" following the steel grades (remove code "A" first for the steel grades with it), the steel grades in Table 1 as high-grade fine steel (for the steel grades without code "A") or extra fine steel (for all steel grades). The buyer can place a special order if they have more requirements against chemical compositions of steel grades in table.
3. The unified digital codes are added according to the regulation of GB/T 17616. The trailing number of fine steel is "2", high-grade fine steel (with code "A") is "3", and extra fine steel (with code "E") is "6".
4. Rare earth element can be added as 0.05% calculated volume, and the analysis results of finished products for reference.

Table 2

Steel Categories	P	S	Cu	Cr	Ni	Mo
	Maximum %					
Fine Steel	0.035	0.035	0.30	0.30	0.30	0.15
High-grade Fine Steel	0.025	0.025	0.25	0.30	0.30	0.10
Extra Fine Steel	0.025	0.015	0.25	0.30	0.30	0.10

6.2 Smelting method

The smelting method is optional for metallurgical refinery unless it has been specified in the contract.

6.3 Delivery condition

The delivery condition of steels is usually hot-rolled or hot heading. According to buyer's requirements (written in the contract), steels can also be delivered as heat treatment condition (anneal, normalizing, or high tempering).

Pressure process used bar steel, according to the agreement reached between supplier and buyer, can be delivered as turning, peeling or other finishing condition.

6.4 Mechanical properties

6.4.1 Determine the longitudinal mechanical properties and hardness of anneal or high tempering of steel, by the test specimen with heat treatment, and the determination results should be accordance with Table 3.

6.4.2 The mechanical properties specified in Table 3 apply to steels of 80mm maximum section size. For steels from 80 to 100mm in size, the elongation, reduction of area and impact absorbing energy are permissible to reduce 1% (absolute value), 5% (absolute value), and 5% (absolute value) respectively; for size from 100 to 150mm, the elongation, reduction of area and impact absorbing energy are permissible to reduce 2% (absolute value), 10% (absolute value) and 10% (absolute value) respectively; for size from 150 to 250mm, the elongation, reduction of area and impact absorbing energy are permissible to reduce 3% (absolute value), 15 (absolute value) and 15% (absolute value) respectively.

6.4.3 It is permissible to forge (or roll) the steels test specimen, of which the size more than 80mm, to make its section size as 70~80mm. The determination result should comply with Table 3.

6.4.4 If the steels are deliver as quenching or tempering condition by the buyer request; the test specimen for mechanical properties should be free of heat treatment. The mechanical properties should be specified on the agreement reached between supplier and buyer.

6.5 Macrostructure

6.5.1 The acid etch macroscopic cross-section of steel specimens should be free of visible cavity, air bubble, crackle, inclusion, skull patch, shatter crack, and intergranular crack.

6.5.2 The acid etch macrostructure grade should be comply with the Table 4.

6.5.2.1 The surface spot segregation and edge spot segregation of 38CrMoAl or 38CrMoAlA should not be more than grade 2.5 and 1.5 respectively.

6.5.2.2 The cutting used steel is allowed to have subsurface inclusion, subsurface bubble etc. defects which not more than the depth of surface defects permissible.

6.5.2.3 If the supplier can guarantee the macrostructure test of steels is qualified, ultrasonic or other nondestructive inspection method can be used to replace acid etch.

Table 3

Steel Group	Item	Steel Grade	Test Specimen Size (mm)	Heat Treatment					Mechanical Properties					Max. Brinell Hardness on anneal or high tempering condition
				Quenching			Temper		Tensile Strength (MPa)	Yield Strength (MPa)	Elong. (%)	Red. of area (%)	Impact absorbing Energy (J)	
				Heating-up Temperature (°C)		Quenching compound	Heating-up Temperature (°C)	Coolant						
				First Quenching	Second Quenching				Minimum					
Mn	1	20Mn2	15	850	-	Water, Oil	200	Water, Air	785	590	10	40	47	187
				880	-	Water, Oil	440	Water, Air						
	2	30Mn2	25	840	-	Water	500	Water	785	635	12	45	63	207
	3	35Mn2	25	840	-	Water	500	Water	835	685	12	45	55	207
	4	40Mn2	25	840	-	Water, Oil	540	Water	885	735	12	45	55	217
	5	45Mn2	25	840	-	Oil	550	Water, Oil	885	735	10	45	47	217
6	50Mn2	25	820	-	Oil	550	Water, Oil	930	785	9	40	39	229	
MnV	7	20MnV	15	880	-	Water, Oil	200	Water, Air	785	590	10	40	55	187
SiMn	8	27SiMn	25	920	-	Water	450	Water, Oil	980	835	12	40	39	217
	9	35SiMn	25	900	-	Water	570	Water, Oil	885	735	15	45	47	229
	10	42SiMn	25	880	-	Water	590	Water	885	735	15	40	47	229
SiMnMoV	11	20SiMn2 MoV	Sample	900	-	Oil	200	Water, Air	1380	-	10	45	55	269
	12	25SiMn2 MoV	Sample	900	-	Oil	200	Water, Air	1470	-	10	40	47	269
	13	37SiMn2 MoV	25	870	-	Water, Oil	650	Water, Air	980	835	12	50	63	269
B	14	40B	25	840	-	Water	550	Water	785	635	12	45	55	207
	15	45B	25	840	-	Water	550	Water	835	685	12	45	47	217
	16	50B	20	840	-	Oil	600	Air	785	540	10	45	39	207

Table 3 (Continued)

Steel Group	Item	Steel Grade	Test Specimen Size (mm)	Heat Treatment					Mechanical Properties					Max. Brinell Hardness on anneal or high tempering condition
				Quenching			Temper		Tensile Strength (MPa)	Yield Strength (MPa)	Elong. (%)	Red. of area (%)	Impact absorbing Energy (J)	
				Heating-up Temperature (°C)		Quenching compound	Heating-up Temperature (°C)	Coolant						
				First Quenching	Second Quenching				Minimum					
MnB	17	40MnB	25	850	-	Oil	500	Water, Oil	980	785	10	45	47	207
	18	45MnB	25	840	-	Oil	500	Water, Oil	1030	835	9	40	39	217
MnMoB	19	20MnMoB	15	880	-	Oil	200	Oil, Air	1080	885	10	50	55	207
MnVB	20	15MnVB	15	860	-	Oil	200	Water, Air	885	635	10	45	55	207
	21	20MnVB	15	860	-	Oil	200	Water, Air	1080	885	10	45	55	207
	22	40MnVB	25	850	-	Oil	520	Water, Oil	980	785	10	45	47	207
MnTiB	23	20MnTiB	15	860	-	Oil	200	Water, Air	1130	930	10	45	55	187
	24	25MnTiBRE	Sample	860	-	Oil	200	Water, Air	1380	-	10	40	47	229
Cr	25	15Cr	15	880	780~820	Water, Oil	200	Water, Air	735	490	11	45	55	179
	26	15CrA	15	880	770~820	Water, Oil	180	Oil, Air	685	490	12	45	55	179
	27	20Cr	15	880	780~820	Water, Oil	200	Water, Air	835	540	10	40	47	179
	28	30Cr	25	860	-	Oil	500	Water, Oil	885	685	11	45	47	187
	29	35Cr	25	860	-	Oil	500	Water, Oil	930	735	11	45	47	207
	30	40Cr	25	850	-	Oil	520	Water, Oil	980	785	9	45	47	207

Table 3 (Continued)

Steel Group	Item	Steel Grade	Test Specimen Size (mm)	Heat Treatment					Mechanical Properties					Max. Brinell Hardness on anneal or high tempering condition
				Quenching			Temper		Tensile Strength (MPa)	Yield Strength (MPa)	Elong. (%)	Red. of area (%)	Impact absorbing Energy (J)	
				Heating-up Temperature (°C)		Quenching compound	Heating-up Temperature (°C)	Coolant						
				First Quenching	Second Quenching				Minimum					
Cr	31	45Cr	25	840	-	Oil	520	Water, Oil	1030	835	9	40	39	217
	32	50Cr	25	830	-	Oil	520	Water, Oil	1080	930	9	40	39	229
CrSi	33	38CrSi	25	900	-	Oil	600	Water, Oil	980	835	12	50	55	255
CrMo	34	12CrMo	30	900	-	Air	650	Air	410	265	24	60	110	179
	35	15CrMo	30	900	-	Air	650	Air	440	295	22	60	94	179
	36	20CrMo	15	880	-	Water, Oil	500	Water, Oil	885	685	12	50	78	197
	37	30CrMo	25	880	-	Water, Oil	540	Water, Oil	930	785	12	50	63	229
	38	30CrMoA	15	880	-	Oil	540	Water, Oil	930	735	12	50	71	229
	39	35CrMo	25	850	-	Oil	550	Water, Oil	980	835	12	45	63	229
	40	42CrMo	25	850	-	Oil	560	Water, Oil	1080	930	12	45	63	217
CrMoV	41	12CrMoV	30	970	-	Air	750	Air	440	225	22	50	78	241
	42	35CrMoV	25	900	-	Oil	630	Water, Oil	1080	930	10	50	71	241
	43	12Cr1MoV	30	970	-	Air	750	Air	490	245	22	50	71	179
	44	25Cr2MoVA	25	900	-	Oil	640	Air	930	785	14	55	63	241
	45	25Cr2Mo1VA	25	1040	-	Air	700	Air	735	590	16	50	47	241
CrMo Al	46	38CrMoAl	30	940	-	Water, Oil	640	Water, Oil	980	835	14	50	71	229
CrV	47	40CrV	25	880	-	Oil	650	Water, Oil	885	735	10	50	71	241

Table 3 (Continued)

Steel Group	Item	Steel Grade	Test Specimen Size (mm)	Heat Treatment					Mechanical Properties					Max. Brinell Hardness on anneal or high tempering condition
				Quenching			Temper		Tensile Strength (MPa)	Yield Strength (MPa)	Elong. (%)	Red. of area (%)	Impact absorbing Energy (J)	
				Heating-up Temperature (°C)		Quenching compound	Heating-up Temperature (°C)	Coolant						
				First Quenching	Second Quenching				Minimum					
CrV	48	50CrVA	25	860	-	Oil	500	Water, Oil	1280	1130	10	40	-	255
CrMn	49	15CrMn	15	880	-	Oil	200	Water, Air	785	590	12	50	47	179
	50	20CrMn	15	850	-	Oil	200	Water, Air	930	735	10	45	47	187
	51	40CrMn	25	840	-	Oil	550	Water, Oil	980	835	9	45	47	229
CrMn Si	52	20CrMnSi	25	880	-	Oil	480	Water, Oil	785	635	12	45	55	207
CrMnSi	53	25CrMnSi	25	880	-	Oil	480	Water, Oil	1080	885	10	40	39	217
	54	30CrMnSi	25	880	-	Oil	520	Water, Oil	1080	885	10	45	39	229
	55	30CrMnSiA	25	880	-	Oil	540	Water, Oil	1080	835	10	45	39	229
	56	35CrMnSiA	Sample	Heating up to 880°C, isothermal quench at 280~310°C										
			Sample	950	890	Oil	230	Air, Oil						
CrMn Mo	57	20CrMnMo	15	850	-	Oil	200	Water, Air	1180	885	10	45	55	217
	58	40CrMnMo	25	850	-	Oil	600	Water, Oil	980	785	10	45	63	217
CrMn Ti	59	20CrMnTi	15	880	870	Oil	200	Water, Air	1080	850	10	45	55	217
	60	30CrMnTi	Sample	880	850	Oil	200	Water, Air	1470	-	9	40	47	229
CrNi	61	20CrNi	25	850	-	Water, Oil	460	Water, Oil	785	590	10	50	63	197
	62	40CrNi	25	820	-	Oil	500	Water, Oil	980	785	10	45	55	241

Table 3 (Continued)

Steel Group	Item	Steel Grade	Test Specimen Size (mm)	Heat Treatment					Mechanical Properties					Max. Brinell Hardness on anneal or high tempering condition
				Quenching			Temper		Tensile Strength (MPa)	Yield Strength (MPa)	Elong. (%)	Red. of area (%)	Impact absorbing Energy (J)	
				Heating-up Temperature (°C)		Quenching compound	Heating-up Temperature (°C)	Coolant						
				First Quenching	Second Quenching				Minimum					
CrNi	63	45CrNi	25	820	-	Oil	530	Water, Oil	980	785	10	45	55	255
	64	50CrNi	25	820	-	Oil	500	Water, Oil	1080	835	8	40	39	255
	65	12CrNi2	15	860	780	Water, Oil	200	Water, Air	785	590	12	50	63	207
	66	12CrNi3	15	860	780	Oil	200	Water, Air	930	685	11	50	71	217
	67	20CrNi3	25	830	-	Water, Oil	480	Water, Oil	930	735	11	55	78	241
	68	30CrNi3	25	820	-	Oil	500	Water, Oil	980	785	9	45	63	241
	69	37CrNi3	25	820	-	Oil	500	Water, Oil	1130	980	10	50	47	269
	70	12Cr2Ni4	15	860	780	Oil	200	Water, Air	1080	835	10	50	71	269
	71	20Cr2Ni4	15	880	780	Oil	200	Water, Air	1180	1080	10	45	63	269
CrNi Mo	72	20CrNiMo	15	850	-	Oil	200	Air	980	785	9	40	47	197
	73	40CrNiMoA	25	850	-	Oil	600	Water, Oil	980	835	12	55	78	269
CrMn NiMo	74	18CrMnNi MoA	15	830	-	Oil	200	Air	1180	885	10	45	71	269
CrNi MoV	75	45CrNiMoVA	Sample	860	-	Oil	460	Oil	1470	1330	7	35	31	269
Cr2Ni 4W	76	18Cr2Ni4WA	15	950	850	Air	200	Water, Air	1180	835	10	45	78	269
	77	25Cr2Ni4WA	25	850	-	Oil	550	Water, Oil	1080	930	11	45	71	269

Table 3 (Finished)

Steel Group	Item	Steel Grade	Test Specimen Size (mm)	Heat Treatment				Mechanical Properties					Max. Brinell Hardness on anneal or high tempering condition	
				Quenching			Temper		Tensile Strength (MPa)	Yield Strength (MPa)	Elong. (%)	Red. of area (%)		Impact absorbing Energy (J)
				Heating-up Temperature (°C)		Quenching compound	Heating-up Temperature (°C)	Coolant						
				First Quenching	Second Quenching				Minimum					
<p>Notes:</p> <ol style="list-style-type: none"> The allowable adjusting range of heat treatment temperature specified in table: quenching $\pm 15^{\circ}\text{C}$, low tempering $\pm 20^{\circ}\text{C}$, and high tempering $\pm 50^{\circ}\text{C}$. Boron Steel can be normalizing before quenching, and the normalizing temperature should be lower than quenching. For Chromium-manganese-titanium steel, normalizing can be used to replace first quenching. In tensile test, if unable to determine the yield strength, the alternative is to determine residual tensile stress $\delta_{r0.2}$. 														

Table 4

Steel Categories	Pattern Segregation	Center Porosity	Surface Porosity	Surface spot segregation	Edge spot segregation
	Maximum grade permissible				
Fine Steel	3	3	3	1	1
High-grade Fine Steel	2	2	2	Impermissible	
Extra Fine Steel	1	1	1		

6.6 Surface Texture

6.6.1 The surfaces of pressure process used steel should be free of crackle, spilly place, folding and inclusion. These defects must be cleaned away if they exist, and the remove depth, calculated by the actual size of steels, should be complying with Table 5. The minimum width of removed material should be five times of depth, and the maximum depth removed on a same section should not be more than one. Calculated by the actual size, the maximum individual fine nick, impression and pitting should be half the tolerance of basic size, and the maximum depth of small crackle permissible is 0.2.

Table 5

mm

Steel Size Diameter or Thickness	Remove Depth permissible	
	Fine Steel & High-grade Fine Steel	Extra Fine Steel
<80	Half tolerance of steel size	
>=80~140	Tolerance of steel size	Half tolerance of steel size
>=140~200	5% of steel size	3% of steel size
>200	6% of steel size	

6.6.2 Calculated by normal size, the surface local defects of cutting used steels, which not more than specifications of Table 6 are permissible.

Table 6

mm

Steel Size Diameter or Thickness	Remove Depth permissible	
	Fine Steel & High-grade Fine Steel	Extra Fine Steel
<100	The negative deviation of steel size	
>=100	Tolerance of steel size	The negative deviation of steel size

6.7 Hot heading

According to buyer's requirements (written in the contract), the hot heading used steel should be applied forging test. The height of specimen after test should be one-third of original. The specimen after test should be free of breach and slit. For the steel is larger than 80mm in size, the forging test can be ruled out if the supplier can guarantee it's qualified.

6.8 Decarburization

According to buyer's requirements (written in the contract), the determination of decarburization should be applied to steels of which the carbon content is more than 0.3%. The maximum total depth of decarburization (the ferrite banding added transition layer) of each edge, inspecting by microstructure method, should be 1.5% of the diameter or thickness of steels.

6.9 Non-metallic impurities

The non-metallic impurities can be inspected according to buyer's requirements, and the qualified-level

should be specified in the agreement reached by the supplier and buyer.

6.10 Special requirements

As the buyer required and the supplier agreed, written in the contract, the steels with following special requirements can be provided:

- a) The chemical composition range of steel grade specified in Table 1 can be narrow or broaden;
- b) The sulfur content should be controlled between 0.015%~0.040%;
- c) Hardenability requirement can be set up; Jominy hardenability should be tested per GB/T 225; according to agreement, the hardenability can be forecasted by computer and the detail method used to replace Jominy end quench test should be bargained between supplier and buyer;
- d) The grain refining steel of which grain size is not small than 5 grade can be offered;
- e) Tower sample test can be required;
- f) Microstructure test can be required;
- g) V-notch Charpy impact test can be required;
- h) Others.

7. Test method

Test method for each batch of steel per Table 7.

Table 7

Item	Inspection Item	Sampling quantity	Sampling position	Determination method
1	Chemical composition	1	GB/T 222	GB/T 223, GB/T 4336
2	Tensile test	2	Different bar steel, GB/T 2975	GB/T 228, GB/T 6397
3	Impact test	2	Different Bar Steel	GB/T229
4	Hardness	3	Different Bar Steel	GB/T 231
5	Macrostructure	2	Different Steel Billet or bar steel	GB/T 226, GB/T 1979
6	Hot upsetting forging	2	Different Bar Steel	GB/T 233
7	Decarburization	3	Different Bar Steel	GB/T 2249 (Metallographical method)
8	Non-metallic impurities	2	Different Bar Steel	GB/T 10561
9	End quench hardenability	1	Any one	GB/T 225
10	Grain size	1	Any one	YB/T 5148
11	Microstructure	2	Different bar steel	GB/T 13299
12	Tower sample test	2	Different bar steel	GB/T 15711
13	Ultrasonic inspection	Each one	A whole bar steel	GB/T 7736
14	Surface	Each one	A whole bar steel	Vision
15	Size	Each one	A whole bar steel	Calipers, micrometer

8. Inspection regulation

8.1 Inspection and acceptance

8.1.1 The quality and technical supervision department of supplier is responsible for the delivery inspection and acceptance of steels.

8.1.2 The supplier must guarantee the delivery steels are complying with the specification of this standard or contract. If it's necessary, the buyer has the right to inspect any item specified in the standard or contract and decide to accept or not.

8.2 Batch up rules

Steels should be inspected and accepted by batch. Batch steel should have the same grade, same furnace number, same processing method, same size, same delivery condition and same heat. The steel smelted by electroslag remelting process, with the condition that the process is stable and each requirement of this standard can be met, can be batched up and deliver by mother consumable electrode furnace number.

8.3 Sampling quantity and position

The sampling quantity and position of each batch should comply with Table 7. The sampling quantity of slag steel: 2 pieces for macrostructure, 3 pieces for hardness, each one for size and surface, 1 piece for the other items. When the slag steel is batched up by mother furnace number, the sampling quantity comply with Table 7 and 1 piece of each electroslag furnace number for item chemical composition.

8.4 Reinspection and determination rules

8.4.1 The reinspection and determination of steel comply with GB/T 17505.

8.4.2 For determination of item mechanical properties, macrostructure and non-metallic impurities of steels or billet with the same furnace number, as long as the supplier can guarantee the products are qualified, the billet is allowable to replace steels and the small size to replace large one.

9. Packaging, marking and quality certification

The packaging, marking and quality certification of steels should comply with GB/T 2101.

Annex A

(Normative Annex)

Normative reference for chemolysis method

GB/T 223.3-1988	Methods for chemical analysis of iron, steel and alloy	The diantipyrylmethane phosphomolybdate gravimetric method for the determination of phosphorus content
GB/T 223.4-1988		The volumetric method for determination of manganese content by ammonium nitrate oxidation
GB/T 223.5-1997		The reduced molybdosilicate spectrophotometric method for the determination of acid-soluble silicon content
GB/T 223.8-1991		The sodium fluoride separation-EDTA titration method for the determination of aluminum content
GB/T 223.9-1989		The chrome azurol S photometric method for the determination of aluminum content
GB/T 223.11-1991		The ammonium persulfate oxidation volumetric method for the determination of chromium content
GB/T 223.12-1991		The sodium carbonate separation-diphenyl carbazide photometric method for the determination of chromium content
GB/T 223.13-1989		The ammonium ferrous sulfate titration method for the determination of vanadium content
GB/T 223.14-1989		The N-benzoyl-N-phenylhydroxylamine extraction photometric method for the determination of vanadium content
GB/T 223.16-1991		The chromotropic acid photometric method for the determination of titanium content
GB/T 223.17-1989		The diantipyrylmethane photometric method for the determination of titanium content
GB/T 223.18-1994		The sodium thiosulfate separation iodimetric method for the determination of copper content
GB/T 223.19-1989		The neocuproine-chloroform extraction photometric method for the determination of copper content
GB/T 223.23-1994		The dimethylglyoxime spectrophotometric method for the determination of nickel content
GB/T 223.24-1994		The extraction separation -The dimethylglyoxime spectrophotometric method for the determination of nickel content
GB/T 223.25-1994		The dimethylglyoxime gravimetric method for the determination of nickel content
GB/T 223.26-1989		The thiocyanate direct photometric method for the determination of molybdenum.
GB/T 223.43-1994		The flame atomic absorption spectrophotometric method for the determination of nickel content
GB/T 223.49-1994		Extraction separation-chlorophosphonazo mA spectrophotometric method for the determination of the total rare earth content
GB/T 223.54-1987		The flame atomic absorption spectrophotometric method for the determination of nickel content
GB/T 223.58-1987	The sodium arsenite-sodium nitrite titrimetric method for the determination of manganese content	
GB/T 223.59-1987	The reduced molybdoantimonyl phosphoric acid photometric method for the determination of phosphorus content	
GB/T 223.60-1997	The perchloric acid dehydration gravimetric method for the determination of silicon content	

GB/T 223.61-1988	Methods for chemical analysis of iron, steel and alloy	The ammonium phosphomolybdate volumetric method for the determination of phosphorus content
GB/T 223.62-1988		The butyl acetate extraction photometric method for the determination of phosphorus content
GB/T 223.63-1988		The sodium (potassium) periodate photometric method for the determination of manganese content
GB/T 223.64-1988		The flame atomic absorption spectrometric method for the determination of manganese content
GB/T 223.66-1989		The thiocyanate-chlorpromazine hydrochloride-chloroform extraction photometric method for the determination of tungsten content
GB/T 223.67-1989		The reducing distillation-methylene blue photometric method for the determination of sulfur content
GB/T 223.68-1997		The potassium iodate titration method after combustion in the pipe furnace for the determination of sulfur content
GB/T 223.69-1997		The gas- volumetric method after combustion in the pipe furnace for the determination of carbon content
GB/T 223.71-1997		The gravimetric method after combustion in the pipe furnace for the determination of carbon content
GB/T 223.72-1991		The alumina chromatographic separation-barium sulfate gravimetric method for the determination of sulphur content
GB/T 223.75-1991		The methanol distillation-curcumin photometric method for the determination of boron content
GB/T 223.76-1991		The flame atomic absorption spectrometric method for the determination of vanadium content

电话: 13337883086
 传真: 0519-82076060
 QQ: 732233696
 邮箱: steeltube@foxmail.com
 网站: www.steel-tube.com



↑
访问我们的官方网站了解更多内容

← 扫描二维码关注