BAOSTEEL

Blooming Products

初 轧 产 品

www.baosteel.com

宝山钢铁股份有限公司
BAOSHAN IRON & STEEL CO., LTD.

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Corporation Profile

宝山钢铁股份有限公司（以下简称宝钢）是我国已建成的规模最大的现代化钢铁联合企业。整个工程共分三期，一期工程于1985年9月建成投产，二期工程于1991年6月投入正式生产，三期工程于2000年底全部建成。现宝钢已达到年产钢2240万吨的规模，产品主要包括热轧板卷、冷轧板卷、宽厚板、无缝钢管、焊管、钢坯、线材等。

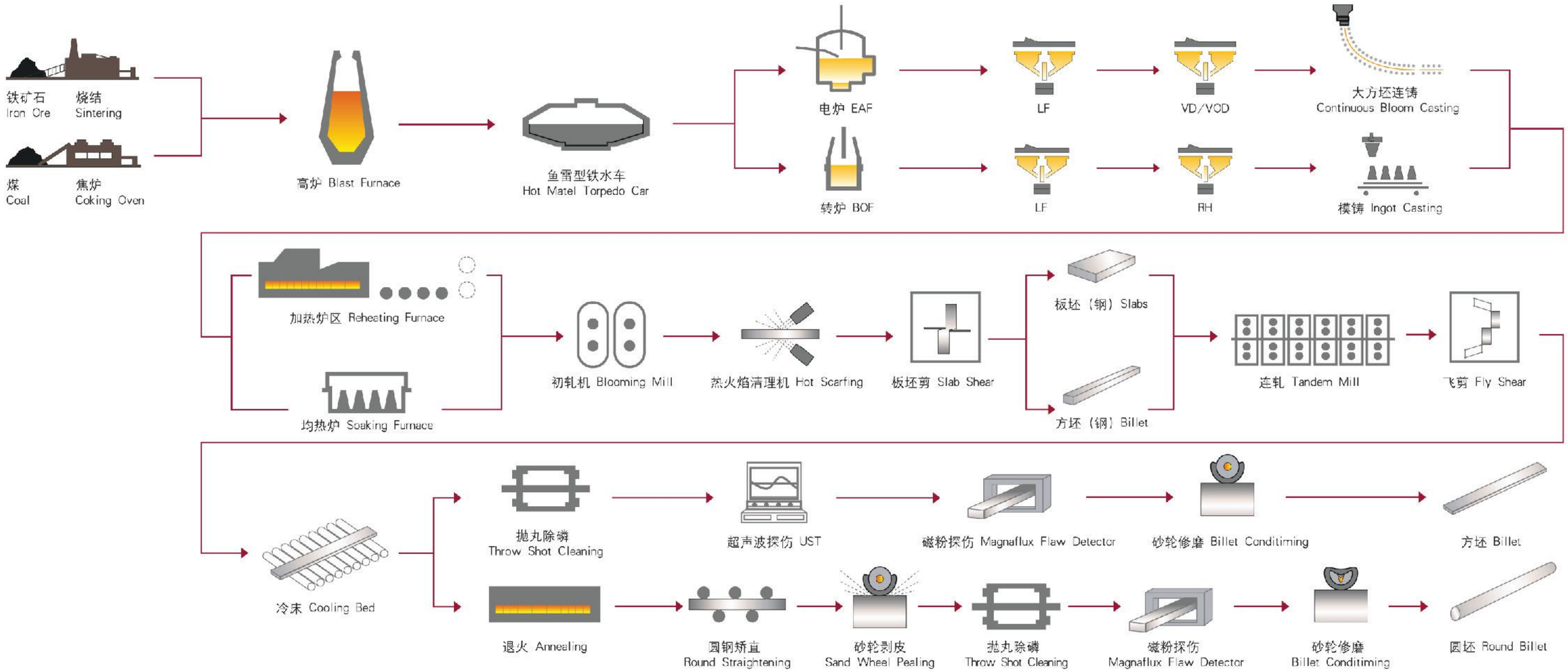
宝钢不仅具有世界一流水平的设备，而且具有技术、人才、资金、管理方面的优势。宝钢不断完善一贯质量管理，努力提高产品质量，于1995年通过英国标准协会（BSI）的ISO9001质量体系认证，并于1999年通过该机构的QS9000认证，成为国内第一家通过QS9000认证的冶金企业。宝钢还坚持可持续发展战略，致力于推进清洁生产，1998年通过国家环保总局的ISO14000环境管理体系认证。

Baoshan Iron & Steel Co., Ltd. (Baosteel) is the largest modern iron and steel enterprise in China. Its construction has experienced three phases projects: Phase I was completed and put into operation in Sep. 1985; Phase II started the production in Jun. 1991 and Phase III got completely built up by the end of 2000. Now, it has reached the capacity of 22.4 million of steel. Its main products cover: hot rolled sheet, cold rolled sheet, wide plate, seamless steel tube, welded tube, billet and bloom and wire rod as well.

Baosteel is well-known not only for its worldwide top class equipment, but also for its advantage in technology, talent, fund and management. It has kept perfecting its through-going quality control, striving to improve its product quality. In 1995, it passed the certification of ISO9001 conducted by BSI and in 1999, it got the certification of QS9000 of the same mechanism, thus becoming the first domestic steel-maker with certificate of QS9000. Yet, Baosteel persistently applies the strategy of sustainable development, devotes itself to the clean production. In 1998, it passed the certification of ISO 14000 environment management system of the State Environment Protection Bureau.

2. 生产工艺流程

Production Process Flow Chart



3．初轧产品介绍

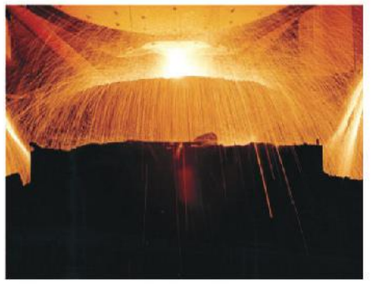
Introduction to Blooming Products

宝钢钢铁产品主要来自于进口原料冶炼的优质铁水。先进的铁水预处理手段及300吨转炉炼钢单元和150吨电炉炼钢单元的RH真空脱气、CAS吹氩、LF钢包精炼、VD/VOD真空处理及DS扒渣、转炉脱P等先进的炉外精炼设备和技术保证了钢水成分稳定，钢质纯净，S、P、N等有害元素和夹杂物含量低。

2008年投产的150吨电炉和精炼设备以及四机四流320×425mm连铸大方坯，具有热兑铁水、无渣出钢、真空脱气、全程保护浇铸、结晶器液面控制、结晶器电磁搅拌、多点矫直、动态轻压下等技术，可获得成分均匀、残余元素和气体含量低、钢质纯净、内部和表面质量良好的铸坯。

Baosteel's iron and steel products are mainly made from high-quality hot metal melted by imported raw materials. Advanced hot metal pre-treatment means and sophisticated secondary refining equipment including RH vacuum degassing in steelmaking, KIP powder injection, KST power injection, CAS argon blowing, LF refining, VD/VOD treatment and de-slagging have been used in the 300 ton converter and 150 ton electrical furnace steel making unit to ensure a stable composition of liquid steel, clean quality of steel and low content of harmful elements such as S,P and N.

150t EAF&refining unit and 320×425mm four-strand bloom caster, which were gone into production in 2008, have many technical such as hot metal charging, slag-less steel tapping, vacuum degassing, overall-protection casting, mold level control, mold electro-magnetic stirring, multi-spot unbending, dynamic soft reduction. By using these technical high inner and surface quality continuous casting billets can be produced with uniform composition, low contents of residual elements and gas.



产品特点：
Product Characteristics

化学成分均匀性
Chemical Composition Uniformity

组织（碳化物）均匀性
Structure (Carbide) Uniformity

低倍组织
Macrostructure

表面质量
Surface Quality

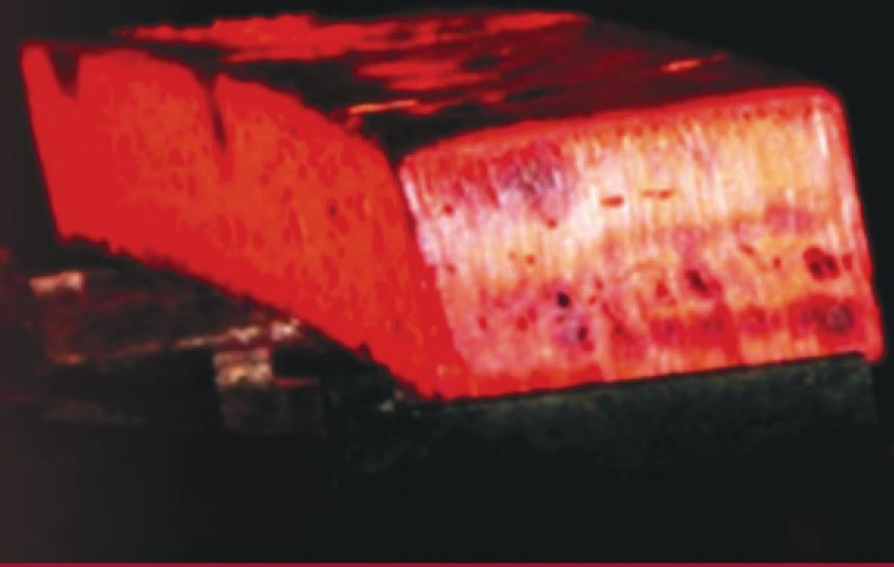
宝钢初轧产品具有以下特点：
Key Equipment and Features of Blooming Plant are:

- 均热跨有6组均热炉，一座加热炉，钢锭、钢坯采用计算机自动烧钢，加热质量均匀，烧损小。
  Soaking bay has 6 soaking furnaces, a furnace, heat treatment for bloom and billet is controlled by computer. Heating quality is even and reheating loss is low.

- 在线火焰清理机可根据需要对钢坯进行四面清理，单面清理深度达0.5~3mm。
  On-line scarfing machine can clean four sides of slab with cleaning depth on single surface up to 0.5-3mm.

- 方坯及管坯精整区分别配有二条抛丸/剥皮——超声波探伤——磁粉探伤——砂轮修磨机械清理线，可检测并修磨0.3mm以上的缺陷，以确保较高的圆方坯表面质量。
  In billet and tube billet finihing zone, there are two mechanical cleaning lines of shot-blasting/Pealing--UST--magnetic powder flaw detection--sand wheel grinding, which can detect and grind defects above 0.3mm to guarantee high surface quality of round and square billet.

初轧产品
BLOOMING PRODUCTS



4.1. 轧制板坯
Slab

4.1.1 用途及牌号 Application and Grade

用途 Application	代表牌号 Typical grade
一般结构钢 Normal structural steel	SS400、SS490、St37、St44 等
焊接结构钢 Welding structural steel	SM490A、SM490B、SM50B-1、SM502B 等
机械结构钢 Mechanical structural steel	S20C、S35C 等
锻件用钢 Forging steel	16Mn、42CrMo、F91
模具钢 Mould and die steel	BM48C、B30PH、P20、718

4.1.2 规格尺寸及偏差 Specifications and Dimension

单位：Unit: mm

公称厚度 Nominal thickness	公称宽度 Nominal width
120	650-1600
150-210	900-1600
220-250	750-1600
400	900-1150
500	1300-1600

注 Note：*经双方协议，可供应上表规定以外的板坯。
*The billet beyond the specifications in the above table can also be supplied through mutual agreement.

4.1.3 规格尺寸及偏差 Dimensional Tolerance

单位：Unit: mm

项目 Item	尺寸 Size	允许偏差 Tolerance
厚度 Thickness	< 150 ≥ 150	±3 ±5
宽度 width	650-1600	+15/-10

4.3. 轧制圆管坯
Round Billet for Seamless Tube

4.3.1 用途及牌号 Application and Grade

用途 Application	牌号 Grade
结构管用 For structural tube	KSKM8-KSKM50 等 St35-St55 等 CK45、10、20、27MnSi、SA106-B 等
锅炉管用 For boiler tube	ST35.8、ST45.8 12CrMoVG、15CrMoG、20G 等
油井管用 For oil well tube	37Mn5、42MnMo7 等

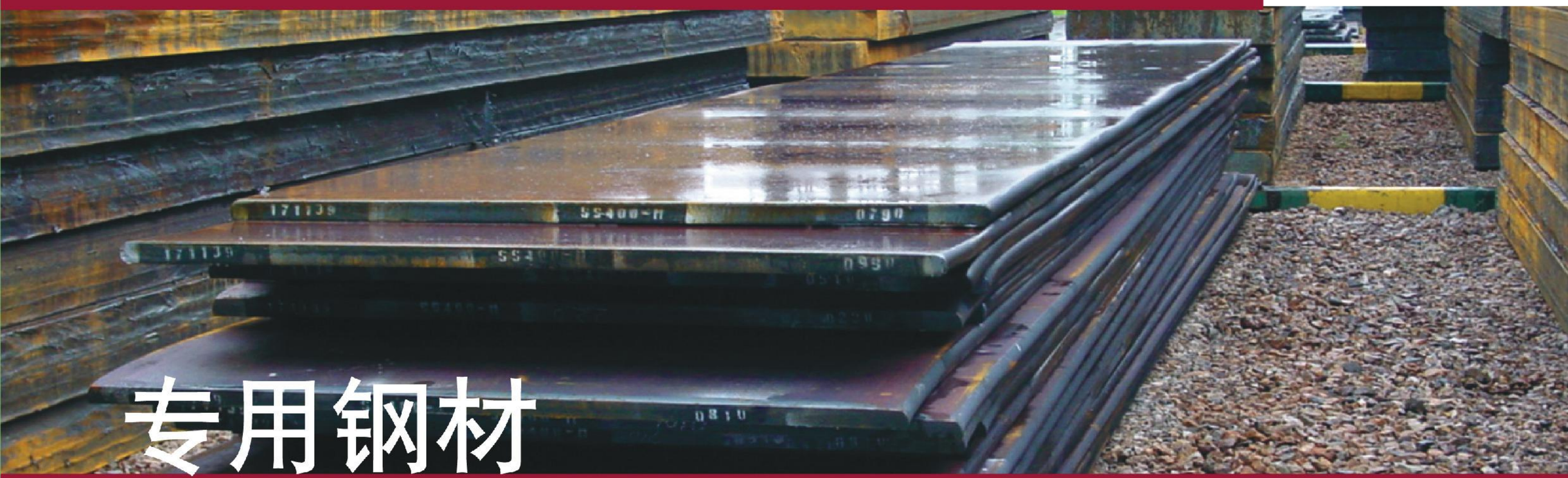
4.3.2 （圆钢）圆管坯直径及允许偏差 Diameter and Tolerance

单位：Unit: mm

直径 Diameter	直径允许偏差 Tolerance of diameter
75	±1.0
80、90、95、100、110	±1.1
115、120、130、140、150	±1.4
160、175、180、185、190	±2.0
200、210、230	±2.5

注：（1）经双方协议，可供应上表规定以外的圆管坯。

Note:(1) The billet beyond the specifications in the above table can also be supplied through mutual agreement.



专用钢材

STEEL FOR SPECIAL APPLICATION

5.2. 无缝气瓶用钢坯

Bloom for Gas Cylinder

5.2.1 尺寸及允许偏差 Dimensional Tolerance

单位：Unit: mm

边长 Side length	200	205	210	225	230	250	260	280	300	320
边长允许偏差 Tolerance of side length	+4.5 -4.5	+5.0 -4.0	+6.0 -4.0	+5.0 -5.0		+6.0 -5.0	±5.0		±5.0	
对角线长度差 Length difference of diagonal	≤6.0	≤6.0	≤6.5	≤8.0		≤8	≤10		≤14	
圆角半径 Round radius	30	30	30	35		35	40		40	

注：（1）圆角半径仅供孔型设计用。

Note：(1) Round radius is for pass design only.

（2）经双方协议，可供应上表规定以外的钢坯。

(2) The billet beyond the specifications in the above table can also be supplied through mutual agreement.

5.2.2 牌号及成分 Grade and Chemical Composition

牌号 Grade	化学成分 Chemical composition: %							
	C	Si	Mn	P	S	P+S	其他 Other	残余元素 Residual elements
37Mn	0.34-0.40	0.17-0.37	1.40-1.75	≤0.030	≤0.030	/	Cr≤0.30	Ni≤0.20 Cu≤0.20
34CrMo4	0.30-0.37	0.17-0.37	0.60-0.90	≤0.020	≤0.020	≤0.030	Mo:0.15-0.3; Cr:0.90-1.20	
34Mn2V	0.30-0.37	0.17-0.37	1.40-1.80	≤0.025	≤0.025	/	V:0.07-0.12; Cr≤0.30	
30CrMo	0.26-0.34	0.17-0.37	0.40-0.70	≤0.020	≤0.020	≤0.030	Mo:0.15-0.25; Cr:0.80-1.10	

5.2.3 力学性能 Mechanical Property

牌号 Grade	试样状态 Test condition	下屈服强度 ReL Lower yield strength ReL MPa	抗拉强度 Rm Tensile strength Rm MPa	断后伸长率 A Elongation A %	断面收缩率 Z Area reduction Z %	冲击功 AKU,J Impact energy AKU,J
		不小于 ≥				
37Mn	调质 Quenching and Tempering	≥640	≥760	≥16	/	50
34CrMo4	调质 Quenching and Tempering	835	980	12	45	63
34Mn2V	正火 Normalization	510	745	16	45	55
30CrMo	调质 Quenching and Tempering	785	930	12	50	63

5.2. 无缝气瓶用钢坯
Bloom for Gas Cylinder

5.2.4 低倍组织 Marostructure

一般疏松 General porosity	中心疏松 Genter porosity	锭型偏析 Pattern segregation
≤2级 (Rate)	≤1.5级 (Rate)	≤2.5级 (Rate)

5.2.5 非金属夹杂物 Non-metallic Inclusions

非金属夹杂物应按GB10561中的JK评级图，使用A法进行检验，其级别应符合下表的规定。

Non-metallic inclusions shall be inspected in accordance with the JK ranking chart in Standard of GB10561 by method A. Its rate shall be inconformity with the stipulations of the following table.

A类 Category A	B类 Category B	C类 Category C
≤2.5级 (Rate)	≤2.5级 (Rate)	≤2.5级 (Rate)

5.3. 模具钢
Mould and Die Steel

5.3.1 塑料模具钢系列产品 Plastic Mould Steel

宝钢自主创新的B-系列非调质预硬型塑料模具钢，具有均匀分布的硬度和组织、良好的切削加工性能、抛光性能和焊补性能，具备不需热处理、制造周期短、加工成本低的特点，满足从模架到型腔（包括镜面型腔）不同层次的技术性能需求。

B-Series plastic mould steel has the characteristics of uniformed hardness and structure, good machinability, polishability and weldability. The pre-hardened steel can eliminate the process of heat treatment for the user so that the manufacturing cycle is shortened and cast reduced. The characteristics meet the requirement of diffrernt level technical properties from mould base to mould cavity.

5.3.2 牌号及化学成分 Grade and Chemical Composition

牌号 Grade	化学成分 Chemical composition:%									
	C	Si	Mn	P	S	Cr	Ni	Cu	V	Mo
B20	0.29-0.37	0.40-0.60	1.35-1.55	≤0.030	≤0.020	0.30-0.50			0.07-0.15	
B20H	0.29-0.38	0.25-0.70	0.90-1.70	≤0.020	≤0.015	0.90-1.60				0.08-0.50
B30PH (B30M)	0.05-0.20	0.10-0.50	1.00-2.00	≤0.020	≤0.015	1.00-2.00	0.10-0.50		0.04-0.20	0.10-0.50
B30H	0.05-0.20	0.10-0.50	1.00-2.00	≤0.020	≤0.010	1.00-2.00	0.50-1.50	0.05-1.50	0.04-0.20	0.10-0.50
B40	0.05-0.20	0.10-0.50	1.00-2.00	≤0.020	≤0.010	1.00-2.00	2.00-3.50	0.50-1.50	0.04-0.20	0.10-0.50
P20	0.28-0.40	0.20-0.80	0.60-1.00	≤0.030	≤0.030	1.40-2.00				0.30-0.55
718	0.28-0.40	0.20-0.80	1.00-1.50	≤0.030	≤0.030	1.40-2.00	0.80-1.20			0.30-0.55
40Cr	0.37-0.44	0.17-0.37	0.50-0.80	≤0.020	≤0.015	0.80-1.10				
BM35C	0.32-0.38	0.15-0.35	0.60-0.90	≤0.030	≤0.035	≤0.20	Ni+Cr ≤0.35	≤0.30		
BM45C	0.42-0.48	0.15-0.35	0.60-0.90	≤0.030	≤0.035	≤0.20				
BM48C	0.41-0.50	0.15-0.35	0.60-0.90	≤0.030	≤0.035	≤0.20				
BM50C	0.47-0.53	0.15-0.35	0.60-0.90	≤0.030	≤0.035	≤0.20				
BPD25	0.30-0.40	0.15-0.60	0.90-1.60	≤0.025	≤0.020	0.90-1.50	0.10-0.40	0.20-0.80		
2Cr13	0.16-0.25	≤1.00	≤1.00	≤0.035	≤0.030	12.00-14.00	≤0.06			
4Cr13	0.36-0.45	≤0.6	≤0.8	≤0.035	≤0.030	12.00-14.00	≤0.06			
1.2311	0.35-0.45	0.2-0.4	1.3-1.6	≤0.030	≤0.030	1.8-2.1				0.15-0.25

5.3. 模具钢
Mould and Die Steel

5.3.3 非调质预硬型塑料模具钢交货硬度及用途
Hardness and Application of Pre-Hardened Steel

牌号 Grade	硬度 Hardness, HRC	厚度 Thickness, mm	用途 Application	对比钢 Comparison steel
B20	20-25	≤200	模架 Mouldbase	S50C-S55C
B20H	24-29	≤200	高档次模架 High-grade mouldbase	调质 S50C-S55C Quenched and tempered S50C-S55C
B30PH(B30M)	28-33	≤400	模具型腔 Mould cavity	调质 P20/DIN1.2311
B30H	33-38	≤200	良好抛光性型腔 Mould with good polishability	调质 718/DIN1.2738
B40	38-43	≤200	镜面抛光型腔 Mould with mirror surface finish	调质 718/DIN1.2711/NAK80
1.2311	28-36	≤200	/	/

5.3.4 热作模具钢 Hot-Working Die Steel

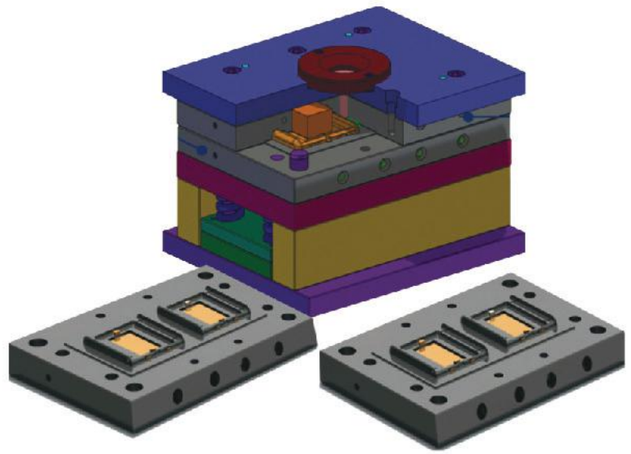
可以按照用户需要，生产常用热作模具钢，如H13,5CrNiMo, 5CrMnMo和5CrNiMoV等，并以退火态交货。

The conventional hot-working die steel, such as H13, 5CrNiMo, 5CrMnMo and 5CrNiMoV, et. Can be produced and delievered under annealed condition on the needs of customer.

5.3.5 产品规格 Specification and Dimension

模具钢以板坯、矩形坯和圆坯等形式供货。其中板坯厚度50—500mm，宽度650—1600mm，长度4—10m，矩形坯100—350×400—700mm，圆坯直径75—300mm。

The mould and die steels are supplied in slab, bloom and round and round bar. The thickness for slab is 50-550mm while the width is 650-1600mm, the length is 4-10m. The dimension is 100-350×400-700mm for blom, while the diameter for the mould bar is 75-300mm



5.3. 模具钢
Mould and Die Steel

5.3.6 使用技术
Service Technological

(1) B20微合金化非调质塑料模具钢
B20 Slightly Alloyed Pre Hardened Plastic Mould Steel

切削加工性能
Machining

用普通高速钢刀具铣削B20，其刀具磨损同铣削S45C-S55C相似，而切屑性能更好。
Using normal high speed steel cutting tools for machining, tool life is the same as S45C-S55C.

焊接性能
Welding

由于碳含量比S45C-S50C低，B20钢的焊接裂纹敏感性小，焊接热影响区的硬度和周围基体差距比焊接S45C-S50C小。
Having lower Carbon than S45C-S50C, material's tendency to crack after welding is lower, and resulting hardness changes to surrounding region as a result of welding is also lower.

耐腐蚀性能
Corrosion Resistant

由于添加合金元素铬，其耐腐蚀性能比S45C-S50C好。
With the added Cr, this material has superior corrosion resistant properties compared to S45C-S50C.

使用技术
Machining and Treatment Instructions

钢种 Type	铣削加工高速钢 Milling (high speed steel tools)	焊接 Welding	改锻 Forging
B20	粗铣：切削速度15-30m/min，切削深度3-4mm Rough milling: Cutting speed 15-30m/min, Depth of cut 3-4mm	J507焊条，预热300-400℃ J507 Welding rod, Pre-heat 300-400℃	按照40Cr工艺，锻后空冷至300℃后缓冷。 Accoring to 40Cr proocess, cool by air to 300℃ after forging, and then slowly cool to room temperature
	精铣：切削速度35-50m/min，切削深度1-2mm Fine milling: Cutting speed 35-50m/min, Depth of cut 1-2mm	焊后300-400℃回火2-4小时 After welding 300-400℃ temper 2-4hr	不用热处理，仍然保持交货硬度。 No need for heat treatment, and keep the hardness for deliveries

(2) B30PH塑料模具钢
B30PH Plastic Mould Steel

坯料改锻后热处理
Heat Treatment Instructions after Re-forging of Billets

材料经改锻后，单件空冷（禁止堆冷）至室温，450℃±20℃回火，保持预硬硬度HRC28-32。
After re-forging, individually air-cooled 450℃ ±20℃ tempered to maintain, Retain it's prehardened hardness HRC28-32.

使用技术
Machining and Treatment Instructions

铣削加工 Milling		焊接 Welding	氮化 Nitriding
高速钢刀具 Using high speed steel tools	硬质合金刀具 Using alloyed tools		
粗铣：切削速度12-18m/min，切削深度3-4mm Rough milling: Cutting speed 12-18m/min, Depth of cut 3-4mm	粗铣：切削速度70-90m/min，切削深度3-4mm Rough milling: Cutting speed 70-90m/min, Depth of cut 3-4mm	J107Cr焊条，预热300-400℃焊后300-400℃回火2-4小时 J107Cr Welding rod, Pre-heat 300-400℃ after welding 300-400℃ temper 2-4hr	575℃软氮化2小时，表面硬度达HB650以上 575℃ soft nitriding for 2 hours, surface hardness >HB650 can be achieved
精铣：切削速度90-110m/min，切削深度1-2mm Fine milling: Cutting speed 90-110m/min, Depth of cut 1-2mm	精铣：切削速度20-35m/min，切削深度1-2mm Fine milling: Cutting speed 20-35m/min, Depth of cut 1-2mm		

5.3. 模具钢
Mould and Die Steel

(3) B30H非调质预硬态塑料模具钢
B30H Pre Hardened Plastic Mould Steel

特点
Characteristics

在B30非调质预硬态塑料模具钢基础上进行了改进，组织和硬度沿大模块截面分布比P20+Ni(2738/718)钢更均匀，切削加工性能和焊接性能更好，添加合金元素钼、铜、镍，使材质具有极佳的抛光性能、耐腐蚀性能和表面氮化性能。本材料最大特点是无需热处理。HRC33-37在锻造后其组织和硬度基本不变，比B30更好。

An improved version based on the B30 series of the pre-hardened plastic mould steel. Compared to P20+Ni(2738/718), it has better crystal and hardness distribution, better machining and weldability, and as a result of added alloying composition, better corrosion resistant properties. The most important characteristic of this material is that it does not require further heat treatment. As it retains its characteristics and hardness of HRC33-37 even after reforging, it is better than the original B30.

坯料改锻工艺
Forging

加热温度1250℃，保温2-4小时，按P20锻造工艺执行，锻造后冷却至300℃后缓冷至室温，于520-560℃回火4-6小时，回火后出炉空冷。终锻温度850℃。

Using P20 treatment method, after forging air cooled to 300℃, and cool slowly to room temperature. Reheat520-560℃ and temper 4-6hrs.Final forging temperature 850℃.

使用技术
Machining and Treatment Instructions

钢种 Type	铣削加工 Milling 硬质合金刀具 Using alloyed tools	焊接 Welding	氮化 Nitriding	改锻 Forging
B30H	粗铣：切削速度60-80m/min，切削深度3-4mm Rough milling: Cutting speed 60-80m/min, Depth of cut 3-4mm 精铣：切削速度80-100m/min，切削深度1-2mm Fine milling: Cutting speed 80-100m/min, Depth of cut 1-2mm	J107Cr焊条，预热400-500℃，焊后500-550℃回火2-4小时 J107Cr Welding rod, Pre-heat 400-500℃ after welding 500-550℃ temper 2-4hr	575℃软氮化2小时，表面硬度达HB650以上 575℃ soft nitriding for 2 hours, surface hardness >HB650 can be achieved	按照P20工艺，锻后空冷至300℃后缓冷至室温。再加热至520-560℃回火 Using P20 process,cooled air to 300℃ after forging,and then slowly cooled to room temperature.tempered at 520-560℃.

B30H与2738钢性能对比

钢	B30H	2738
纤维组织	贝氏体	回火索氏体
硬度	HRC33-37	HRC30-35
沿截面硬度分布差	3	5
切削加工性能	良好	一般
抛光性能	良好	良好
电火花加工后变质层	少	多
焊接性	良好	不好
回火稳定性	稳定	不太好
切削加工刀具磨损	较小	较大

Comparison of the B30H and 2738 steels

Steel	B30H	2738
Fibrous structure	Bainite	Temperad sorbite
Hardness	HRC33-37	HRC30-35
Hardness along the section distrbution difference	3	5
Cutting and processing property	Excellent	Normal
Polishing property	Excellent	Excellent
Metamorphic layer after electric spark forming	Little	Thick
Welding property	Excellent	Bad
Temper resistance	Stable	Little bad
Cutter wear	Light	Severe

5.4. 齿轮用钢

Round Billet for Gear

5.4.1 牌号及化学成分 Grade and Chemical Composition

牌号 Grade	化学成分 Chemical composition:%									
	C	Si	Mn	P	S	Cr	Ti	Mo	Cu	Ni
B20CrMnTi B20CrMnTiH	0.17-0.23	0.17-0.37	0.80-1.10	≤0.035	≤0.035	1.00-1.30	0.04-0.10	/	≤0.20	≤0.30
B20CrMnMoH	0.17-0.23	0.17-0.37	0.85-1.20	≤0.035	≤0.035	1.05-1.40	/	0.20-0.30	≤0.20	≤0.30

5.4.2 力学性能 Mechanical Property

公称直径 Nominal diameter (mm)	力学性能 Mechanical property				
	下屈服强度 Lower yield strength ReL MPa	抗拉强度 Tensile strength Rm MPa	伸长率 A Elongation A %	断面收缩率 Z Area reduction Z %	冲击功 Impact energy AKU J
130	≥ 835	≥ 1080	≥ 8	≥ 35	≥ 50
153	≥ 835	≥ 1080	≥ 7	≥ 30	≥ 47

注：屈服点不明显时，可取0.2%规定残余伸长应力σr0.2

Note: In case that the yield point is not obvious, 0.2% can be taken as the stress of permanent elongation σr0.2

试样尺寸 Dimension of test specimen (mm)	热处理制度 Heat treatment technology				
	淬火 Quenching			回火 Tempering	
	温度 Temperature ℃		冷却剂 Coolant	温度 Temperature ℃	冷却剂 Coolant
	第一次淬火 First quenching	第二次淬火 Secondary quenching			
15	880	870	油 Oil	200	水、空气 water, air

注：热处理温度允许调整范围为：淬火温度±15℃，回火温度±30℃

Note: Allowable adjusting range of heat treatment temperature: Quenching temperature ±15℃, Tempering temperature ±30℃

5.4.3 末端淬透性 End Hardenability

B20CrMnTiH圆钢按保证淬透性交货。用经900－920℃正火处理的毛坯制成的25mm标准试样采用端淬温度为880±5℃进行端淬以测定其淬透性。淬透性订货方法按GB5216中第3.5条的"B"法订货。

The round billet of B20CrMnTiH will be delivered on guaranteed hardenability. The 25mm standard test piece, which is made of normalized blank at 900-920℃, will be end-quenched at the end quenching temperature of 880±5℃ to measure its hardenability. The method of hardenability ordering shall follow the Method B in Article 3.5 of the Standard GB 5216.

$$J\frac{30\text{-}42HRC}{9} + J\frac{\geqslant 22HRC}{15}$$

B20CrMnMoH圆钢按保证淬透性交货。用经860－880℃正火处理的毛坯制成的25mm标准试样采用端淬温度为880±5℃进行端淬以测定其淬透性。淬透性订货方法按GB5216中第3.5条的"B"法订货。

The round billet of B20CrMnMoH will be delivered on guaranteed hardenability. The 25mm standard test piece, which is made of normalized blank at 860-880℃, will be end-quenched at the end quenching temperature of 880±5℃ to measure its hardenability. The method of hardenability ordering shall follow the Method B in Article 3.5 of the Standard GB 5216.

$$J\frac{37\text{-}48HRC}{9} + J\frac{\geqslant 31HRC}{15}$$

5.4.4 低倍组织 Macrostructure

圆钢横向酸浸低倍组织试片上，不得有肉眼可见的缩孔、白点、分层、裂纹、气泡、翻皮和夹杂。

In the acid etched transversely sectioned round steel, there shall be no macroscopic shrinkage cavity, white flake, lamination, crake, abscess, skull patch and inclusion.

一般疏松 General porosity	中心疏松 Genter porosity	偏析 Segregation
≤2级 (Rate)	≤1.5级 (Rate)	≤2.5级 (Rate)

5.4.5 非金属夹杂物 Non-metallic Inclusions

圆钢应按GB 10561中的JK评级图，使用A法检验非金属夹杂物，A类及B类夹杂物级别均应不大于3级，二类夹杂物级别之和应不大于5.5级。

Round steel shall be inspected for its non-metallic inclusions in accordance with the JK ranking chart in Standard of GB 10561 by Method A. The inclusion ranking of both Category A and B shall not be greater than Rate 3 and the sum of the rates of inclusions in the two categories shall not be greater than Rate 5.5.

5.7. 石油钻具／钻杆接头用钢

Steel for Drill Rod-Joint

5.7.1 牌号及化学成分 Grade and Chemical Composition

牌号 Grade	化学成分 Chemical composition:%							
	C	Si	Mn	P	S	Mo	Cr	其它
37CrMnMo4H1	0.35-0.40	0.15-0.35	0.85-1.00	≤0.020	≤0.010	0.25-0.35	0.90-1.20	/
36CrNiMo4	0.35-0.40	0.20-0.35	0.55-0.80	≤0.035	≤0.030	0.17-0.30	1.00-1.15	Ni:1.00-1.15
AISI 4130	0.28-0.34	0.15-0.35	0.50-0.80	≤0.020	≤0.020	0.15-0.25	0.80-1.10	/
AISI 4145	0.42-0.49	0.15-0.30	0.65-1.10	≤0.020	≤0.010	0.15-0.25	0.75-1.20	Cu≤0.25

5.7.2 规格及允许偏差 Specification and Dimensional Tolerance

单位：Unit: mm

直径 Diameter	允许偏差 Tolerance
75-175	±2.0
180、185、190、195、200、230	±2.5

5.7.3 低倍组织 Macrostructure

一般疏松 General porosity	偏析 Segregation
≤1.5级 (Rate)	≤1.5级 (Rate)

5.7.4 高倍组织 Microstucture

A、B、C、D类非金属夹杂物 Category A、B、C、D non-metallic inclusion
≤2.0级 (Rate)

5.8. 系泊链钢

Steel for Offshore Mooring Chain

5.8.1 牌号及化学成分 Grade and Chemical Composition

牌号 Grade	C	Si	Mn	P	S	Cu	Ni	Cr	Mo	Al
R3	0.27 0.35	0.17 0.37	1.20 1.90	≤0.025	≤0.020	≤0.35	≤0.40	≤0.25	/	0.020 0.060
R3S	0.18 0.28	0.10 0.60	0.55 1.90	≤0.025	≤0.025	≤0.30	≤0.50	0.50 2.00	0.15 0.50	0.020 0.060
R4	0.16 0.26	0.15 0.60	1.00 1.90	≤0.025	≤0.025	≤0.40	0.20 1.50	0.50 2.00	0.20 0.80	0.020 0.050
R5	0.16 0.27	0.15 0.50	0.40 1.45	≤0.015	≤0.005	≤0.50	≤1.20	1.25 2.50	0.20 0.60	0.010 0.060

5.8.2 力学性能 Mechanical Property

牌号 Grade	屈服强度 $R_{p0.2}$ yield strength Rp0.2 MPa	抗拉强度 R_m yield strength ReL MPa	断后伸长率 A Elongation A %	断面收缩率 Z Area reduction Z %	屈强比 yield to tensile ratio $R_{p0.2}/R_m$	冲击功 Akv Impact energy A_{KU} J			氢脆 Hydrogen embrittlement Z_1/Z_2
						温度 Temperature	平均 Average	单值 Single	
R3	≥410	≥690	≥17	≥50	≤0.92	0℃	≥60	≥45	≥0.85
						-20℃	≥40	≥30	
R3S	≥490	≥770	≥15	≥50	≤0.92	0℃	≥65	≥49	≥0.85
						-20℃	≥45	≥34	
R4	≥580	≥860	≥12	≥50	≤0.92	-20℃	≥50	≥38	≥0.85
R5	≥760	≥1000	≥12	≥50	≤0.92	-20℃	≥58	≥44	≥0.85

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