



BAOSTEEL

创享改变生活

Hot-rolled Wheel Steels

热轧车轮钢

www.baosteel.com

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



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前言

PREFACE

宝钢在建厂之初就开始热轧车轮钢的产品开发与生产，经过三十多年的努力，形成了从 B330CL 到 B650CL 的全强度系列车轮钢，并且还开发出了从 580MPa-980MPa 不同强度的双相钢和 FB 高扩孔钢系列产品。宝钢全系列车轮钢采用宝钢先进的工艺进行生产，产品性能稳定，具有优异的焊接和冷成形性能。

宝钢车轮钢产品可广泛应用于各种乘用车车轮、商用车车轮等。

The development and production of wheel steels began in the very early beginning of Baosteel. By the efforts of last over thirty years, Baosteel has set up a wheel steel series from B330CL to B650CL, dual phase steels and FB steels with a strength from 590MPa to 980MPa. Baosteel wheel steels apply the advanced steelmaking and hot-rolling processes, have stable mechanical properties, excellent weldability and formability.

Baosteel wheel steels are widely used in the manufacture of wheels for passenger and commercial vehicles.

产品特点

PRODUCT CHARACTERISTICS

01

车轮钢可分为普碳型、高强低合金型和先进高强型三种，其中普碳型以 C、Mn 固溶强化为主，强度低、焊接性能和成形性能好；高强低合金型以 Nb、Ti 强化为主，具有高强度、良好的焊接性能、良好的耐疲劳性能；先进高强型则是以相变强化为主，如具有低屈强比的铁素体 + 马氏体双相钢和具有高扩孔率的铁素体 + 贝氏体钢，具有高强度、良好的焊接性能、较低的屈强比、优异的冷成形性能、很好的耐疲劳性能。

Wheel steels consist of plain steel type, the high strength low alloy (HSLA) type and advanced high strength (AHS) type. The plain steels are strengthened by solid solution strengthening and have low strength, excellent weldability and formability. HSLA steels are strengthened by Nb and Ti with high strength, good weldability, excellent cold formability. AHS steels are mainly strengthened by phase transformation such as DP steels with low yield ratio and FB steels with high hole expansion ratio with High strength, good weldability, low yield ratio, excellent cold formability, high fatigue resistance.



制造工艺及交货状态

PROCESS AND DELIVERY CONDITION

02

生产工艺流程

车轮系列钢种采用氧气转炉冶炼镇静钢，经过炉外精炼后进行连续浇铸，连铸坯送热轧厂再加热并采用控轧控冷工艺轧制成卷。

交货状态

车轮钢系列钢种以热轧钢卷状态交货。

Manufacture process

The wheel steels are killed in oxygen converter. After secondary refining and continuous casting, the slabs are reheated and rolled into coil in TMCP rolling process.

Delivery condition

The wheel steels may be delivered in hot-rolled coils.



牌号及可供规格范围

PRODUCT RANGE OF DIMENSIONS

03

产品类型 Steel Type	厚度 Thickness (mm)	宽度 Width (mm)
普碳钢 Plain Steel	1.6-14.0	800-1400
高强低合金 HSLA	1.6-14.0	800-1400
双相钢 DP Steel	1.6-6.0	800-1400
高扩孔钢 FB Steel		

化学成分 (wt%)

COMPOSITION WT%

产品类型 Steel type	产品 Steel Grade	C	Si	Mn	P	S	Alt
普碳 Plain Steel	B330CL	≤0.10	≤0.30	≤0.80			
	B380CL	≤0.12	≤0.30	≤1.50			
	B420CL	≤0.12	≤0.30	≤1.50			
	B450CL	≤0.10	≤0.30	≤1.50			
高强低合金 HSLA	B500CL	≤0.12	≤0.30	≤1.60	≤0.025	≤0.020	≥0.01
	B530CL	≤0.12	≤0.30	≤1.60			
	B550CL	≤0.12	≤0.30	≤2.00			
	B600CL	≤0.15	≤0.30	≤2.00			
	B650CL	≤0.15	≤0.50	≤2.00			
双相钢 DP Steel	BR330/580DP	≤0.23	≤2.00	≤3.30			
	BR380/650DP	≤0.23	≤2.00	≤3.30	≤0.09	≤0.015	≥0.015
	BR400/700DP	≤0.23	≤2.00	≤3.30			
	BR450/780DP	≤0.23	≤2.00	≤3.30			
高扩孔钢 FB Steel	BR300/450HE	≤0.18	≤1.20	≤2.00	≤0.05	≤0.010	≥0.015
	BR440/590HE	≤0.06	≤1.00	≤2.00	≤0.03	≤0.010	≥0.02
	BR600/780HE	≤0.18	≤1.20	≤2.00	≤0.05	≤0.010	≥0.015

力学性能

MECHANICAL PROPERTIES

05

产品类型 Steel Type	产品 Steel Grade	屈服强度 Y.S. Rp0.2,MPa	抗拉强度 T.S. Rm, MPa	延伸率 EL %	扩孔率 λ %
普碳 Plain Steel	B330CL	≥225	330-430	≥33	
	B380CL	≥235	380-480	≥28	
	B420CL	≥290	420-520	≥28	
	B450CL	350-470	450-570	≥28	
高强低合金 HSLA	B500CL	400-530	500-620	≥26	
	B530CL	430-560	530-650	≥24	
	B550CL	450-580	550-680	≥24	
	B600CL	500-630	600-750	≥22	
	B650CL	550-680	650-800	≥20	
双相钢 DP Steel	BR330/580DP	330-470	580-700	≥19	
	BR380/650DP	380-550	≥650	≥16	
	BR400/700DP	400-550	≥700	≥15	
	BR450/780DP	450-610	780-900	≥14	
高扩孔钢 FB Steel	BR300/450HE	300-400	450-600	≥24	≥80
	BR440/580HE	440-600	590-700	≥15	≥75
	BR600/780HE	600-760	780-900	≥12	≥50

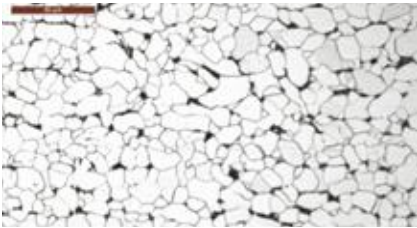
a. 屈服现象不明显时，采用 Rp0.2，否则采用 ReL

a. If the yield point is not pronounced, the values of Rp0.2 apply. Otherwise, the values of ReL apply.

微观组织

MICROSTRUCTURES

06

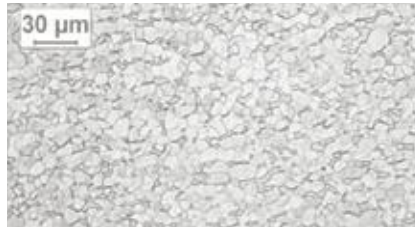


高强低合金车轮钢

铁素体 + 珠光体

HSLA Wheel Steel

F+P

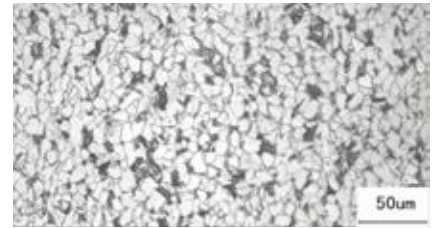


双相钢

铁素体 + 马氏体

Dual Phase Steel

F+M



高扩孔钢

铁素体 + 贝氏体

FB Steel

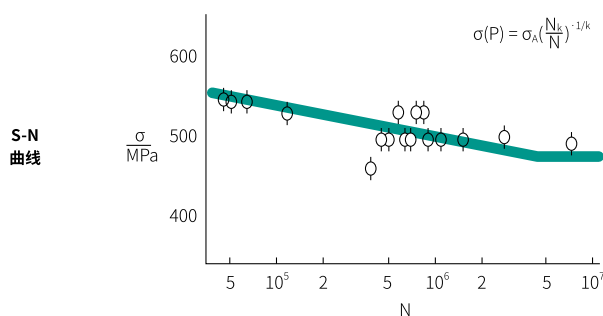
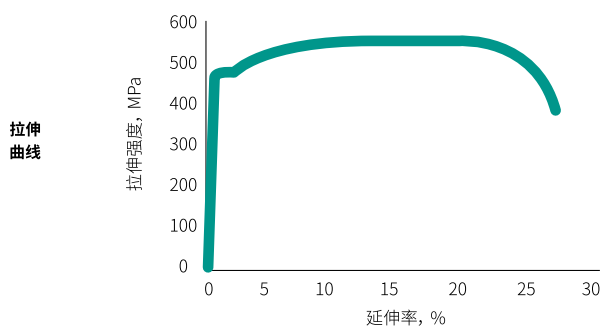
F+B

常用性能曲线

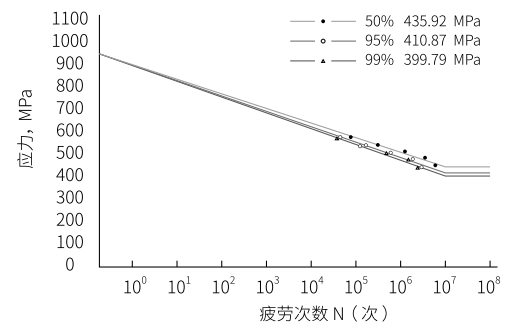
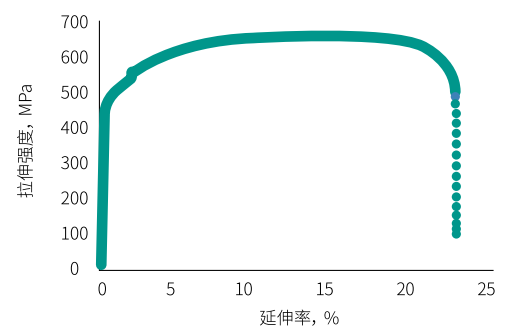
BASIC CHARACTERISTIC CURVE

07

B550CL



BR330/580DP



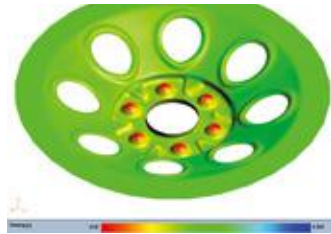
成形工艺

FORMING PROCEDURE

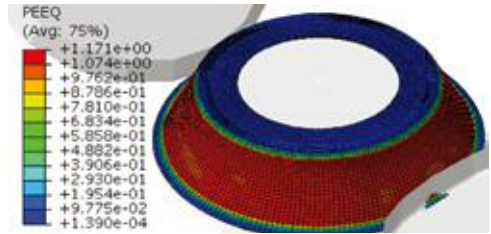
08

宝钢车轮钢具有良好的成形性能,能满足车轮成形过程中的冲压、旋压、滚形等各制造工艺要求。宝钢拥有完备的成形、性能分析软件,并有伺服压机、强力旋压机、疲劳试验机 etc 等装备,能为用户提供材料性能分析、选材优化、成形 CAE 分析、使用性能 CAE 分析等支撑工作,协同宝钢用户完成新产品、新工艺开发及样件试制工作。

Baosteel's wheel steel has good formability and can meet various manufacturing process requirements such as stamping, spinning and rolling. Baosteel has complete forming and performance analysis software, and has servo press machine, power spinning machine, fatigue testing machine and so on. We can provide our users with material performance analysis, material selection optimization, forming CAE analysis, wheel performance CAE analysis and other technical support work, and cooperate with users to complete new products, new process development and sample trial production.



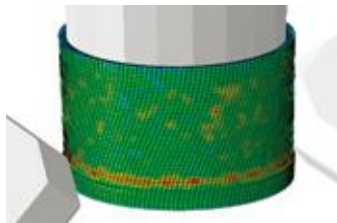
轮辐冲压成形分析
Disc Stamping FEA



轮辐旋压成形分析
Disc Spinning FEA



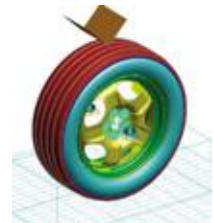
宝钢强力旋压机
Baosteel's Power Spinning Machine



轻量化轮辋旋压分析
Light-weight Rim Flowforming FEA



车轮疲劳分析
Wheel Fatigue FEA



车轮冲击性能分析
Wheel Impact FEA

焊接工艺

WELDING PROCEDURE

09

轮辋钢焊接通常选用对接焊，简称对焊。对焊分为电阻对焊和闪光对焊。

电阻对焊可以根据焊接过程压力是否改变、电流方向和频率等进一步分类。

闪光对焊可以根据是否预热、电流方向、电流模式等进一步分类。

电阻对焊接头光滑、毛刺小、焊接过程相对简单，一般焊接截面相对较小的材料。与电阻对焊相比，闪光对焊可以在较小的功率下对大截面的材料进行焊接，对装夹精度要求低，但容易产生夹杂、焊接飞溅、烟气较大、环境污染重。选择焊接方法时应根据材料厚度、截面积、钢种、附属设备承载能力等进行匹配。

宝钢在轮辋对焊方面有丰富的经验，对接头质量的检测有完备的手段和设备。

Butt welding is the main welding method for joining rims, which includes resistance butt welding and flash butt welding.

The resistance butt welding could be classified by welding pressure, direction of current, frequency of current and so on.

The flash butt welding could be classified by preheating or no, direction of current, mode of current and so on.

Compared with flash butt welding, the process of resistance butt welding is usually implemented for the rim with smaller cross section, but its process is more simple and the surface of joint is more smooth with smaller burrs. On the contrary, the flash butt welding can achieve the joint with larger cross section under a smaller power. Meanwhile, the requirement of clamping accuracy for flash butt welding is lower. However, the welding spatter, slag inclusion, smoke of welding and environmental pollution is more serious for flash butt welding.

For the butt welding of the rim, Baosteel Co., Ltd has a lot of experience. We have perfect detecting methods and equipment to detect the quality of the joint (as shown in Fig.1).

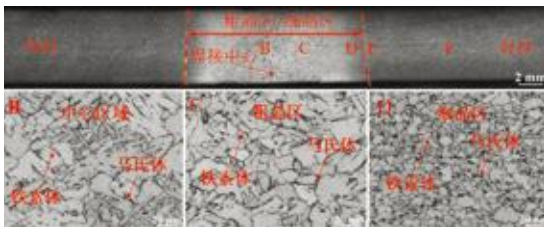
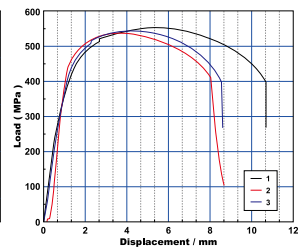
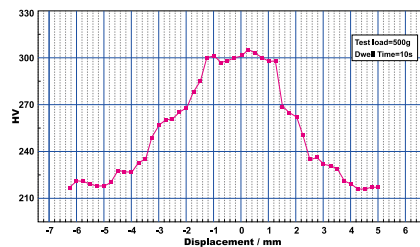


图1 接头质量检测手段



应用案例 APPLICATIONS

10

全表面车轮
Full Surface Wheel



轮辐 (Disc) : BR330/580DP
轮辋 (Rim) : B550CL

大通风孔车轮
HVA Wheel



轮辐 (Disc) : BR380/650DP
轮辋 (Rim) : B550CL



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