

Hot-rolled Protection Steel

热轧装甲防护钢

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前言

宝钢依靠自身装备水平和技术力量，在国内率先研制成功BP系列高性能装甲防护钢，厚度范围为2-12mm。该产品采用热轧卷板作为基板进行热处理，抗枪弹性能优越，抗破坏性冲击能力强，性能均匀稳定，板形和表面质量好。

本系列产品适用于运钞车、装甲运兵车、押解车辆、贵宾车辆、防盗门、银行柜台防护板、保险柜、盾牌、钢盔等。

Preface

Baosteel protection(BP) steels with 2 to 12mm in thickness were first developed at Baosteel in China by employing Baosteel's own equipments and Technologies. The steels were heat treated with hot rolled plates to gain excellent ballistic performance, uniform property, good shape and surface quality.

The steels can be used for applications where high ballistic performance is required, such as armored cars, armored personnel carriers, escort vehicles, VIP cars, security doors, bank counter shield, strongbox, shields, helmet ,et al.

制造工艺及交货状态

Manufacture process and delivery conditions

生产工艺流程：BP系列防护钢采用氧气转炉冶炼镇静钢，经过二次精炼后进行连续铸造，连铸坯送热轧厂再加热并采用控轧控冷工艺轧制成卷，经强力矫直切板后进行热处理，性能质量检测合格后准发交货。

交货状态：BP系列热轧防护钢可采用控轧、淬火、淬火加回火等状态交货。

加工配送服务：根据用户需求，钢板可采用抛丸、涂漆表面预处理方式交货。可提供钢板下料、折弯、构件加工等延伸服务。

Manufacture process: The steel is made in oxygen converter, fully killed, secondary refined and casted into slabs. The slabs are reheated and rolled into coil in TMCP rolling process. After powerful leveling, cutting, heat treatment, and inspection, the BP plates are delivered in sheets.

Delivery condition: TMCP, quenched, quenched and tempered etc.

Processing and distribution service: According to customers' requirements, steel plate can be delivered with pretreatment such as blasting, painting etc. Additional services e.g., blanking, bending and machining are also provided.

牌号及可供规格范围

Steel grades and specification

牌号含义

BP500 B: 宝钢, P: Protection, 装甲防护钢, 500: 布氏硬度级别

BP系列热轧防护钢可供规格如下表所示，超出规格范围可与宝钢热轧防护钢产销研小组联系（附后）。

Specification

BP500 B: Baosteel, P: Protection, 500: Brinell hardness value

Specification of BP steels is tabulated in the following. If customer requirement is out of the specification range, please contact technical customer service for further assistance.

牌号 Steel grade	布氏硬度典型 HB Hardness, HB typical value	可供厚度 Thickness mm	可供宽度 Width mm	可供长度 Length mm
BP300 (B900FD)	300	2-12	850-1800	2000-12000
BP370	370	2-12	850-1800	2000-12000
BP440	440	2-12	850-1800	2000-12000
BP500	500	2-12	950-1800	2000-12000
BP600	600	2-12	950-1800	2000-12000

交货技术条件 – 化学成分, wt%

Chemical composition, wt%

牌号 Steel grade	C ≤	Si ≤	Mn ≤	P ≤	S ≤	Alt ≥	Cr ≤	Ni ≤	B ≤	CEV典型值 CEV Typical value
BP300 (B900FD)	0.22	0.5	2.0	0.020	0.015	0.015	0.5	0.5	0.005	0.60
BP370	0.32	0.5	1.5	0.020	0.015	0.015	1.0	0.5	0.005	0.52
BP440	0.35	1.0	1.85	0.020	0.015	0.015	1.0	0.5	0.005	0.55
BP500	0.50	0.5	1.70	0.020	0.015	0.015	1.2	0.8	0.005	0.62
BP600	0.50	1.0	1.85	0.020	0.015	0.015	1.2	0.8	0.005	0.67

碳当量CEV=C+Mn/6+Cr/5+Mo/5+V/5+Cu/15+Ni/15

备注：可添加适量的Nb、V、Ti (Nb+V+Ti≤0.22%)

CEV=C+Mn/6+Cr/5+Mo/5+V/5+Cu/15+Ni/15

Note: Nb, V and Ti may be added if necessary (Nb+V+Ti≤0.22%)



交货技术条件 – 力学性能

Mechanical properties

牌号 Steel grade	厚度 Thickness	拉伸实验 Tensile test			90度冷弯 90° bending	冲击实验 Impact energy
		屈服强度 Yield strength ReH,MPa	抗拉强度 Tensile strength Rm,MPa	伸长率A5,% Elongation A5,%	弯心直径 Bending diameter	-20°C KV2,J
BP300 (B900FD)	2-12	≥700	≥900	≥10	d=3a	≥20
BP370	2-12	≥900	≥1050	≥10	-	≥20
BP440	2-12	≥1100	≥1250	≥8	-	≥20
BP500	2-12	≥1250	≥1450	≥8	-	≥20
BP600	2-12	≥1450	≥1750	≥6	-	≥20

注：1. 拉伸试验采用横向试样，即试样长轴的方向垂直于轧制方向；冲击试验采用纵向试样；
2. 冷弯试验采用横向试样，d = 弯心直径，a = 钢板厚度

Note: 1. Transversal specimen is adopted in the tensile test and longitudinal specimen in the impact test;
2. Transversal specimen is used in the bending test. d=bending diameter, a=plate thickness

钢板尺寸、外形、重量及允许偏差

Dimension, shape, weight and tolerance

钢板尺寸、外形、重量及允许偏差满足《GB/T 709-2006热轧钢板和钢带的尺寸、外形、质量及允许偏差》的要求。

BP系列防护钢采用特殊热处理工艺制造，板形质量优异，整板不平度可以达到≤3mm/m。

用户如对尺寸公差、不平度等有附加要求，供需双方协商确认，并在合同中注明。

Dimension, shape, weight and tolerance satisfy GB/T 709-2006 Dimension, shape, weight and tolerances for hot rolled steel plates and sheets

BP steels are manufactured by special heat treatment process with superior shape and flatness within ≤3mm/m.

Additional requirements concerning the dimension tolerance, roughness etc. should be confirmed by supplier and be customer, and be specified in the contract.

枪击标准及防护级别

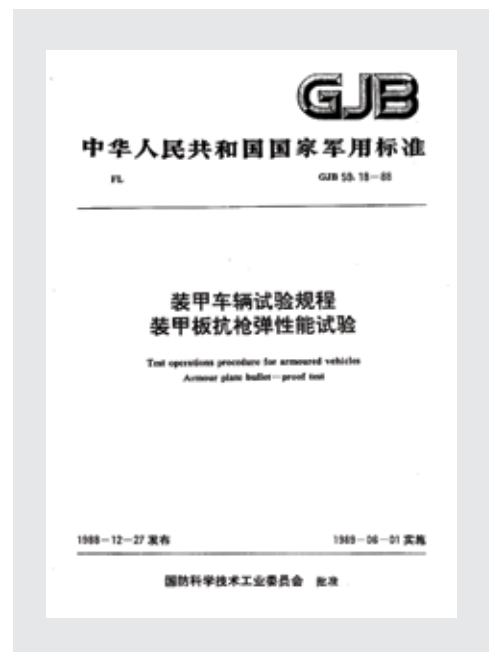
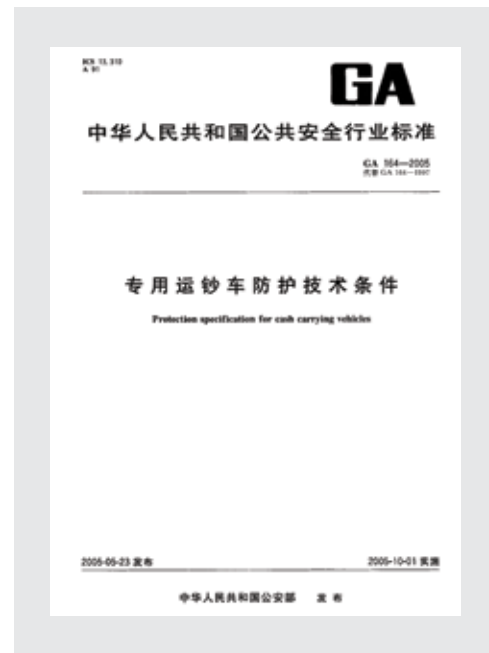
Ballistic standards and protection grades

BP系列防护钢抗枪弹性能优越，抗破坏性冲击能力强。

参照的主要标准有：GA 164-2005、GJB 1694A-2000和GJB 59.18-1988。

BP steels have excellent ballistic performance and good impact properties.

Standards: GA 164-2005, GJB 1694A-2000 and GJB 59.18-1988.



BP系列防护钢通过的防护级别多，厚度范围覆盖广，用户可根据设计要求选择合适的防护钢产品。
BP系列防护钢的枪击防护认证主要有：

A variety of BP steels, which cover a large range of thickness, have passed different ballistic standards. Approved ballistic certification reports of BP steels are listed below. Customers can select appropriate steels according to their design.



牌号 Steel grade	厚度 Typical thickness mm	技术条件 Technical conditions	枪械 Gun	子弹 Projectile	弹速范围 Striking velocity, m/s	法线角度 Normal angle	射击距离 Shooting distance, m	备注 Note
BP300 B900FD	2.85	GA 164-2005	79式微冲 79-type Mini submachine gun	51B式7.62mm手枪弹 51B-type 7.62mm handgun	490-515	0	5/10/15	A/B级
BP440	5	GJB 1496A-2000	53式7.62mm测速工作枪 53-type 7.62 mm velocimetry working gun	53式7.62mm普通钢芯弹 53-type 7.62mm steel core bullet	828	0	160	
	6		53式7.62mm测速工作枪 53-type 7.62 mm velocimetry working gun	53式7.62mm普通钢芯弹 53-type 7.62mm steel core bullet			120	
	8 10 12	GJB 1496A-2000	53式7.62mm测速工作枪 53-type 7.62 mm velocimetry working gun	53式7.62mm WO-109C型穿甲燃烧弹 53-type 7.62mm WO-109C piercing incendiary	808	35 27 23	100	
BP500	2.3 2.5	GA 164A-2005	79式7.62mm轻型冲锋枪 79-type 7.62mm light submachine gun	51B式7.62mm手枪弹 51B-type 7.62mm handgun bullet	490-515	0	5/10/15	A/B级
	4.0 4.2		56式7.62mm冲锋枪 56-type 7.62mm submachine gun	56式7.62mm手枪弹 56-type 7.62mm handgun bullet	710-735	0	10/15/30	C级
	4.8 5.0	GJB 59.18-1988	53式7.62mm测速工作枪 53-type 7.62 mm velocimetry working gun	53式7.62mm普通钢芯弹 53-type 7.62mm steel core bullet	820-835	0	10/15/30	
	10 12	GJB 1496A-2000	53式7.62mm测速工作枪 53-type 7.62 mm velocimetry working gun	53式7.62mm WO-109C型穿甲燃烧弹 53-type 7.62mm WO-109C piercing incendiary	800-815	23	100	
	4.0 4.5	GJB 59.18-1988	53式7.62mm测速工作枪 53-type 7.62 mm velocimetry working gun	53式7.62mm普通钢芯弹 53-type 7.62mm steel core bullet	820-835	0	10/15/30	
BP600	10 12	GJB 1496A-2000	53式7.62mm测速工作枪 53-type 7.62 mm velocimetry working gun	53式7.62mm WO-109C型穿甲燃烧弹 53-type 7.62mm WO-109C piercing incendiary	800-815	23	100	

注：可根据需求提供相应防护级别的枪击验证报告。

Note: Ballistic certification report is available if needed.

钻铣加工

Drilling

BP系列防护钢硬度高，机加工难度相对较大。钻孔加工一般应采用高速钢或陶瓷硬质合金钢钻头。为保证批量钻孔作业时的高效和精确，推荐使用高速合金钢（HSS-E）或含钴高速合金钢（HSS-Co）钻头。

铣削加工时应确保夹紧工件，建议采用宽矩铣刀，平面铣刀的材质可选用硬质合金涂层、陶瓷合金等，端面铣刀可选用硬质合金、含钴高速合金钢等，尽量避免采用组合铣头，平面铣的切削宽度应为铣头直径的75% - 80%。

Either high speed steel or cemented carbide drills can be used for drilling. To ensure the efficiency and accuracy, micro-alloyed(HSS-E) or cobalt-alloyed(HSS-Co) drill is recommended.

Work piece should be clamped tightly while milling and wide-space milling cutter is recommended. Carbide coating, ceramic alloy etc. can be used as the material for flat cutter, and hard alloy, cobalt-alloyed high speed steel etc. for end cutter, combined milling head is not suggested. Cutting width of flat milling is 75-80% of the diameter of milling head.

折弯加工

Bending

当用户需要对BP系列防护钢进行冷成形时，工作时须注意钢板的回弹等的影响，钢板强度越高，其回弹越大。钢板的最小折弯直径不能小于供货技术条件中双方商定的冷弯直径。BP500折弯时，最小折弯半径不应小于板厚的8倍；BP440折弯时，最小折弯半径不应小于板厚的5倍。

折弯加工时，不能采用冷切割的方式下料。

When cold forming is needed for BP steels, close attention need to be paid to the springback. High strength usually means large springback. It should be noted that the minimum bending diameter can not be smaller than that confirmed in the delivery conditions. The minimum bending diameter for BP500 has to be 8 times larger than the plate thickness; the corresponding bending diameter for BP440 has to be 5 times larger than the plate thickness.

Mechanical cutting is not recommended for bending parts.

切割

Cutting

BP系列防护钢适用于水射流切割、激光切割和等离子切割。如果设备剪切能力满足，也可以采用机械剪切来进行加工。推荐使用水射流切割，此种切割方式能够保证切割边缘的防弹性能。

BP steels are suitable for waterjet, laser and plasma cutting. Provided that the cutting blades hard enough and the equipment stiffness high enough, mechanical cutting could be an optional. However, waterjet is highly recommended, as the ballistic properties of the cut edge can be guaranteed.

热加工

Hot working

不建议对BP系列防护钢板进行热加工。如果需要钢板进行相应的热处理，请与宝钢产销研小组联系。

Heat treatment is not recommended. If a tempering process is needed, please contact the technical customer service for further assistance.

焊接

Welding

BP系列防护钢可采用常用的焊接方法进行焊接。选择焊接材料时，推荐使用奥氏体焊接材料或低强度的铁素体焊接材料。如果焊接接头强度是重要的性能要求时，也可以采用强度较高的铁素体焊接材料。

BP steels can be welded with conventional welding methods. Austenitic or low strength ferritic welding consumables are recommended. High strength ferritic welding consumables can also be used if the strength of welding joint is important.



结语

Our vision

宝钢一贯秉持“要善于学习，更要善于创新”的创业精神，在BP系列防护钢的开发征程上勇于开拓进取，产品不断升级换代，技术不断突破创新，我们愿以更好的产品和服务全心全意致力于国内外制造业的进步发展。

Following the creed, "Good at learning and better at innovation", Baosteel is pioneering in BP steel development, product upgrading, and technology breakthrough. With better products and better service, Baosteel will contribute its best to the development of both the domestic and overseas manufacture industry.

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