

宝钢取向电工钢

BAOSTEEL GO ELECTRICAL STEEL

Early Vendor Involvement

先期介入

EVI



创享生活 璀璨城市
LIVELY INNOVATION, BRIGHTER CITIES

宝钢EVI理念 | Baosteel EVI Concept

成为用户真诚可靠的材料供应商及其解决方案的合作者，
实现可持续、共赢发展。

To be customer's sincere and reliable partner in providing
electrical steels and their solutions to achieve win-win
collaboration.

宝钢EVI文化 | Baosteel EVI Culture

用户思维——源于用户、服务用户、成就用户

Customer Thinking——From customer, Serve customer, Achieve customer

协同思维——同一目标、网式工作、众口同声

Synergy Thinking——Same target, Net-working, One word

进取思维——精于专业、诚于奉献、超越期待

Enterprising Thinking——Professional, Sincere dedication, Beyond expectation

宝钢取向电工钢EVI | Baosteel EVI for GO Electrical Steel

宝钢为变压器厂提供从选材设计到产品制造的技术支持：

- 铁芯设计选材支持，以设计控制成本和性能；
- 铁芯用材和结构持续优化，实现技术降本；
- 铁芯加工制造支持，实现材料与装备最佳匹配；
- 新产品、新技术的推荐应用，提升变压器产品的竞争力。

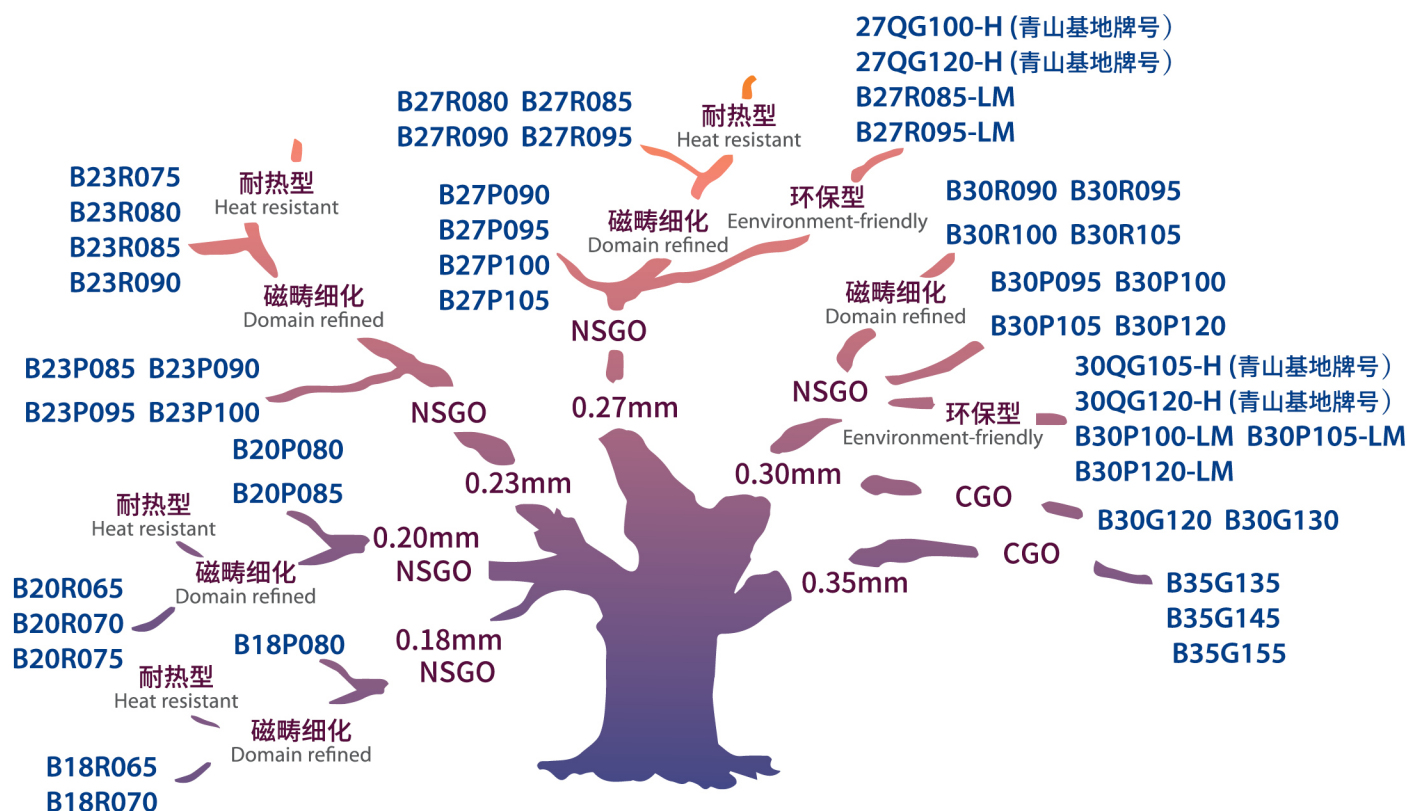
Baosteel could offer a variety of specialized services and technical support from material selection in design of transformer cores to transformer manufacturing, including:

- Material selecting in core design for property/cost control.
- Optimization of steel and structure in terms of cost and performance purposes.
- Technical support for core manufacturing to ensure the best performance.
- Recommendation of new products and technologies to enhance the competitiveness of transformer products.

完善的取向电工钢产品体系和发展方向 | Perfect Product System of GO Electrical Steel

- 经验：40年研发、生产及应用技术研究
- 品种：普通型、高磁感型、磁畴细化高磁感型、低噪声特性、环保涂层取向电工钢产品，全系列全品种
- 等级：最高牌号铁损低于0.65W/Kg
- 能力：国内首家成功开发低温工艺并具备100%高等级取向电工钢制造能力的企业

- Experience: Devoted in grain-oriented electrical steel 40 years ago, with a complete capability of R&D, manufacturing and application.
- Products: A great variety of products, including conventional, high permeability, domain refined, low magnetostriction and chromate-free coating grain-oriented electrical steel.
- Grade: The most advanced grade with iron loss P17/50 lower than 0.65W/kg.
- Ability: The ever first steel company in China who developed low-temperature reheating technology with the ability of manufacturing 100% high grade grain-oriented electrical steel.



注：该产品树主要以宝山基地取向电工钢牌号描述；
 牌号后缀有“-LM”或“-LN”代表低噪声系列产品；
 牌号后缀有“-H”代表无铬环保涂层系列产品。

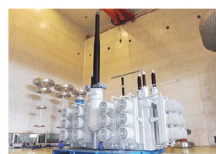
Note: Baoshan base GO electrical steel grades for illustration.
 Grades suffixed with “-LM” or “-LN” stand for low magnetostriction products.
 Grades suffixed with “-H” stand for chromate-free coating products.



500kV交流变压器
500kV AC transformer



750kV交流变压器
750kV AC transformer



1000kV交流变压器
1000kV AC transformer



±800kV直流变压器
±800kV DC transformer



一级能效配电变压器
Energy efficiency I
distribution transformer

取向电工钢全面技术解决方案 |
Comprehensive Technical Solutions for GO Electrical Steel

完善的变压器用材数据库支持 Complete Material Database Support for Transformer Use

不断更新和完善的变压器用材性能数据库, 为用户提供从机械性能、基础电磁性能及特殊工况性能等一系列全套的数据支持。根据用户的多样化需求, 可提供性能指标与原始曲线数据等各种形式数据。

Continuously updating and improving properties database of Baosteel products for transformer use, supporting customers with a range of full set of data from mechanical properties and basic magnetic properties to the properties under special working conditions. According to the diverse requirements, Baosteel can provide customers with performance data, the original curves, and other forms of data.

变压器用材性能数据库
Transformer material database

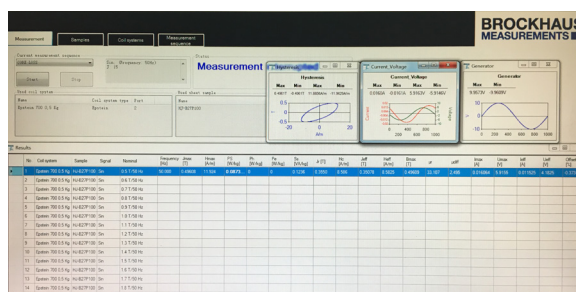
基础电磁性能 Basic magnetic properties	典型机械性能 Mechanical properties
铁损曲线 Core loss curves	抗拉强度 Tensile strength
交流激磁功率曲线 A.C. Exciting power curves	弯曲次数 Number of bends
交流激磁曲线 A.C. Exciting curves	屈服强度 Yield strength
直流磁化曲线和直流磁导率曲线 D.C.Magnetization curves/D.C. Permeability curves	延伸率 Elongation
高频铁损曲线 Core loss at high frequency	硬度 Hardness

完备的性能测试支持 Property Test Support

1) 磁性测试平台 Magnetic Property Test Platform

完备的材料性能测试平台,可为用户提供各种尺寸的材料在任一频率、场强下的磁性数据,以及B-P、B-H、H- μ 等各种电磁性能曲线的测量,最大程度地挖掘材料特性。

With complete material property test platform, Baosteel could provide customers with magnetic property data at any frequency and magnetic flux density of all size of the material, and the measurement of B-P, B-H and H- μ and other forms of magnetic property curves, to fully make use of the material properties at the greatest extent.



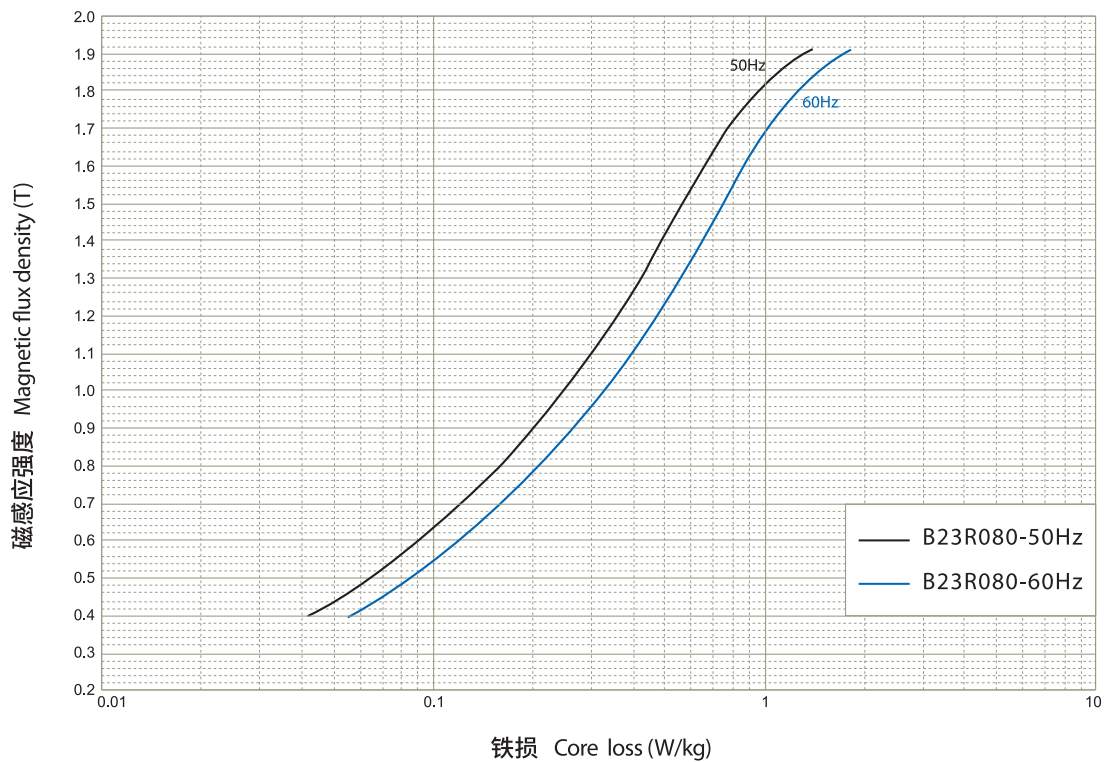
2) 基础性能数据 Typical Magnetic Properties

取向电工钢主要牌号的典型性能
Typical magnetic properties of major grain-oriented electrical steel grades

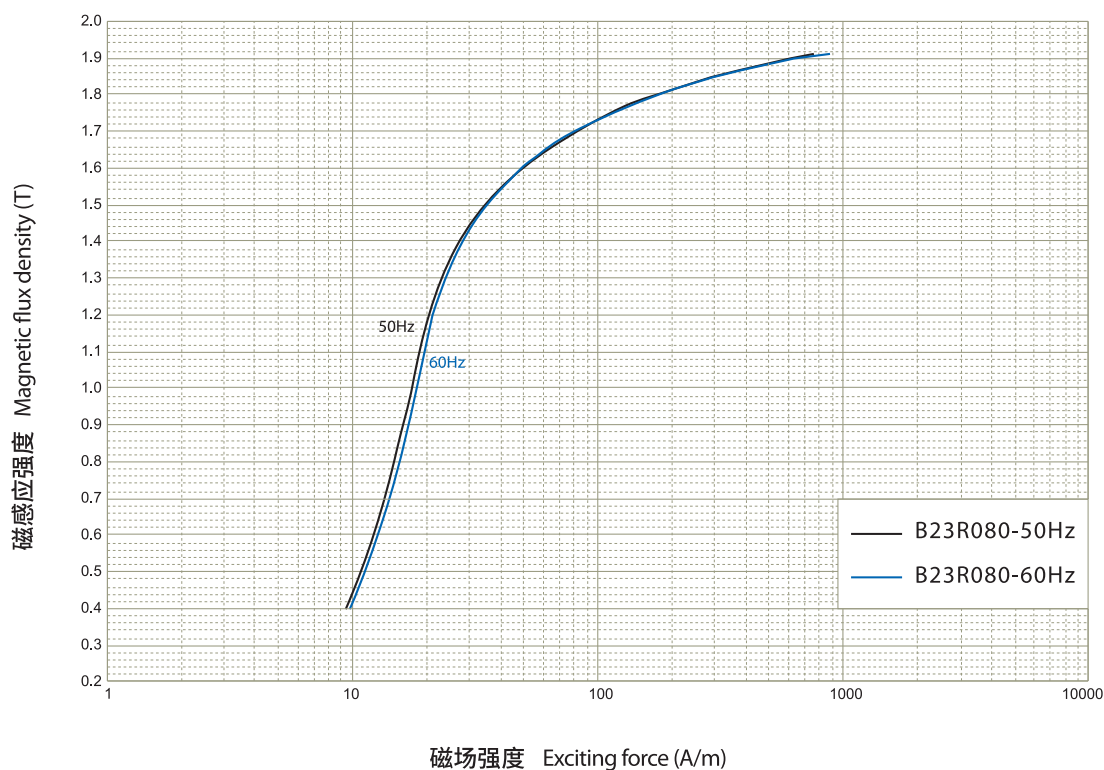
类型 Type	牌号 Grade	比总损耗 Specific total loss (W/kg)		磁极化强度 Magnetic polarization (T)	激磁功率 Exciting power (VA/kg)
		P _{1.5/50}	P _{1.7/50}	J ₈₀₀	S _{51.7/50}
普通型 Conventional Grades	B23G110	0.71	0.99	1.89	1.85
	B27G120	0.76	1.04	1.89	1.90
	B30G120	0.79	1.08	1.89	1.90
	B35G135	0.90	1.18	1.89	1.71
高磁极化 强度型 High Permeability Grades	B18P080	0.58	0.79	1.89	1.48
	B20P080	0.59	0.79	1.89	1.34
	B23P085	0.62	0.83	1.92	1.20
	B27P095	0.68	0.92	1.91	1.34
	B27P100	0.69	0.94	1.91	1.42
	B30P105	0.74	0.99	1.91	1.41
	B30P120	0.76	1.02	1.91	1.52
磁畴细化型 Domain Refined High Permeability Grades	B18R065	0.48	0.64	1.91	1.91
	B20R070	0.51	0.68	1.91	1.96
	B23R075	0.56	0.74	1.92	1.65
	B23R080	0.57	0.77	1.91	1.86
	B23R085	0.59	0.80	1.91	2.10
	B27R085	0.62	0.82	1.91	1.82
	B27R090	0.64	0.86	1.90	2.05
	B30R090	0.68	0.88	1.92	1.67
	B30R100	0.71	0.94	1.91	1.93

3) 电磁性能曲线 Typical Magnetic Curves

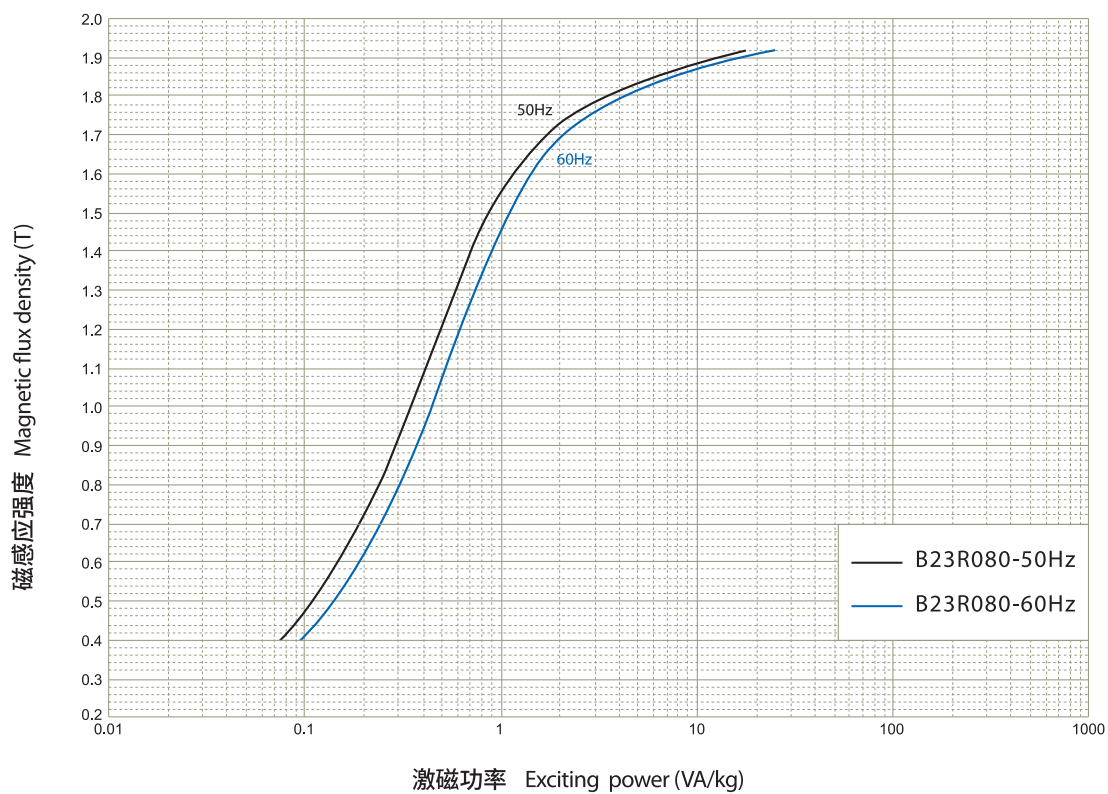
■ 铁损曲线 Iron Loss Curves



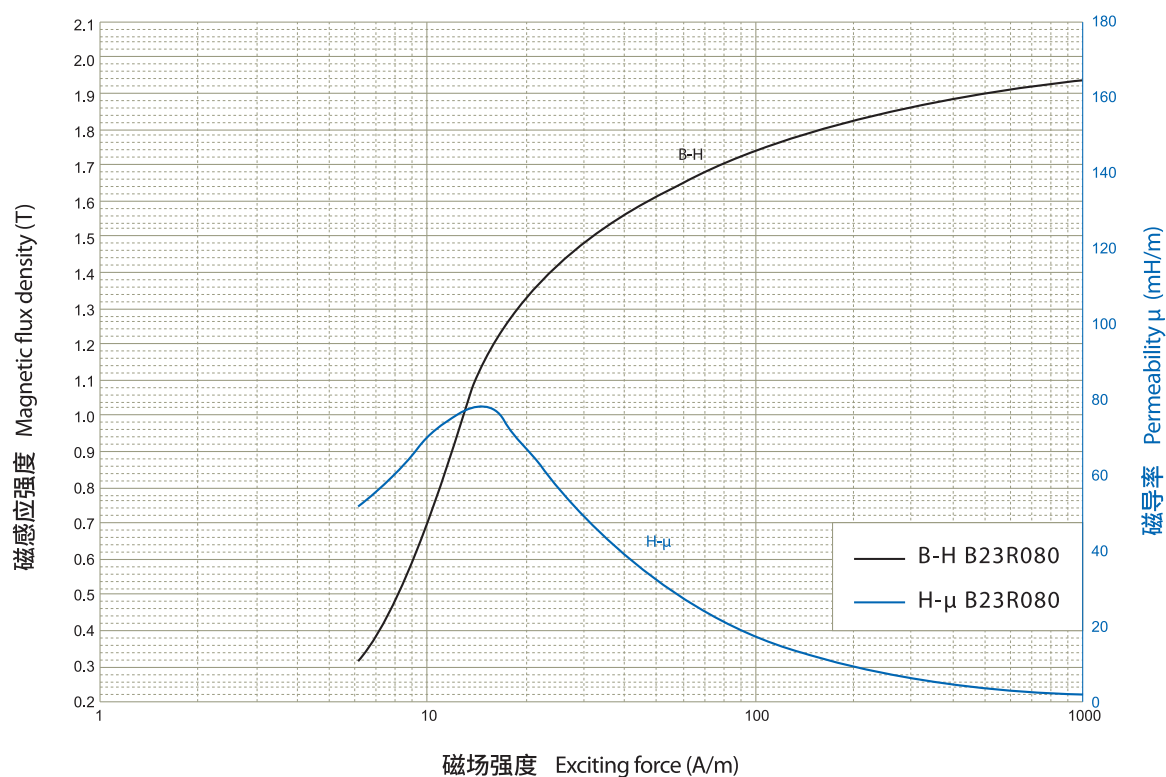
交流激磁曲线 AC Magnetic Curves



激磁功率曲线 Exciting Power Curves

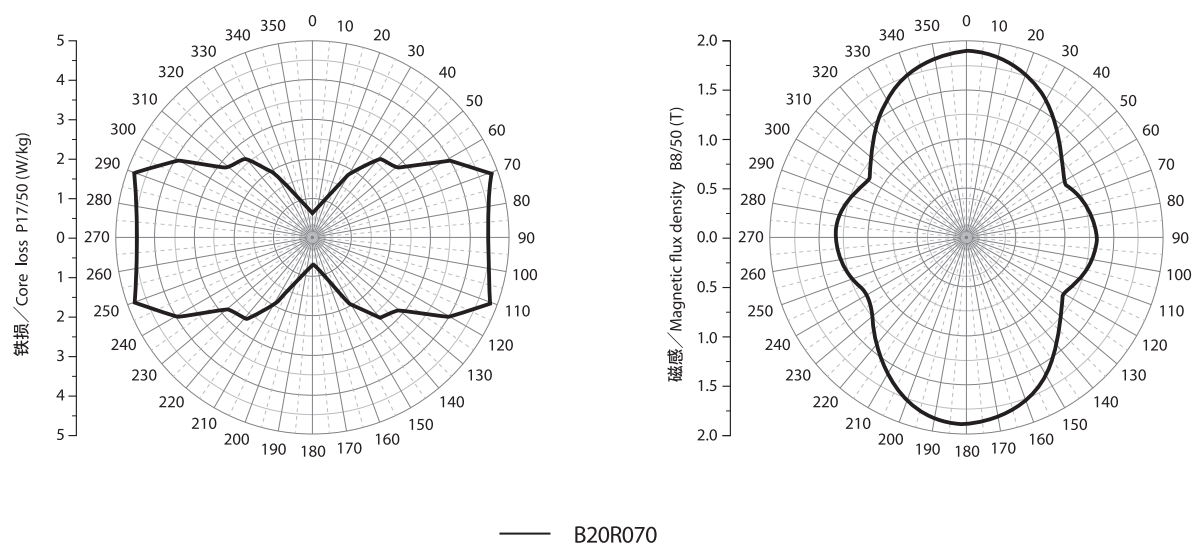


■ 直流磁化及磁导率曲线 DC Magnetic Curves

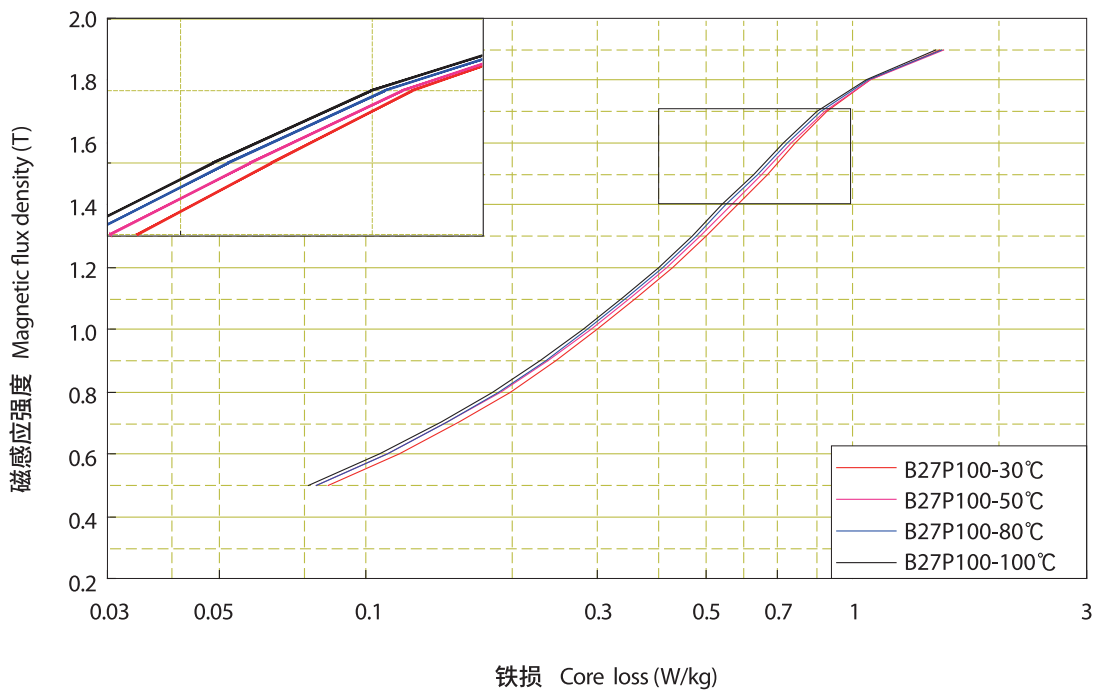


4) 特殊条件下的磁性曲线 Magnetic Curves Under Special Conditions

■ 不同方向下的磁性 Magnetic properties along various directions



不同工作温度条件下的铁损曲线 Iron loss curves at various working temperatures



使用技术支持 Application Support

1) 选材推荐 Material Selection

综合考量材料性能、价格等因素，为变压器铁芯设计进行选材支持。根据铁芯设计、加工工艺预测性能，对比不同材料的使用效果，以实现性价比最优。

Considering overall the factors such as material properties and prices, Baosteel could supply technical support for material selection for the design of transformer cores. By effective comparison between different materials through predicting core properties according to the design and process, the optimal cost can be achieved.

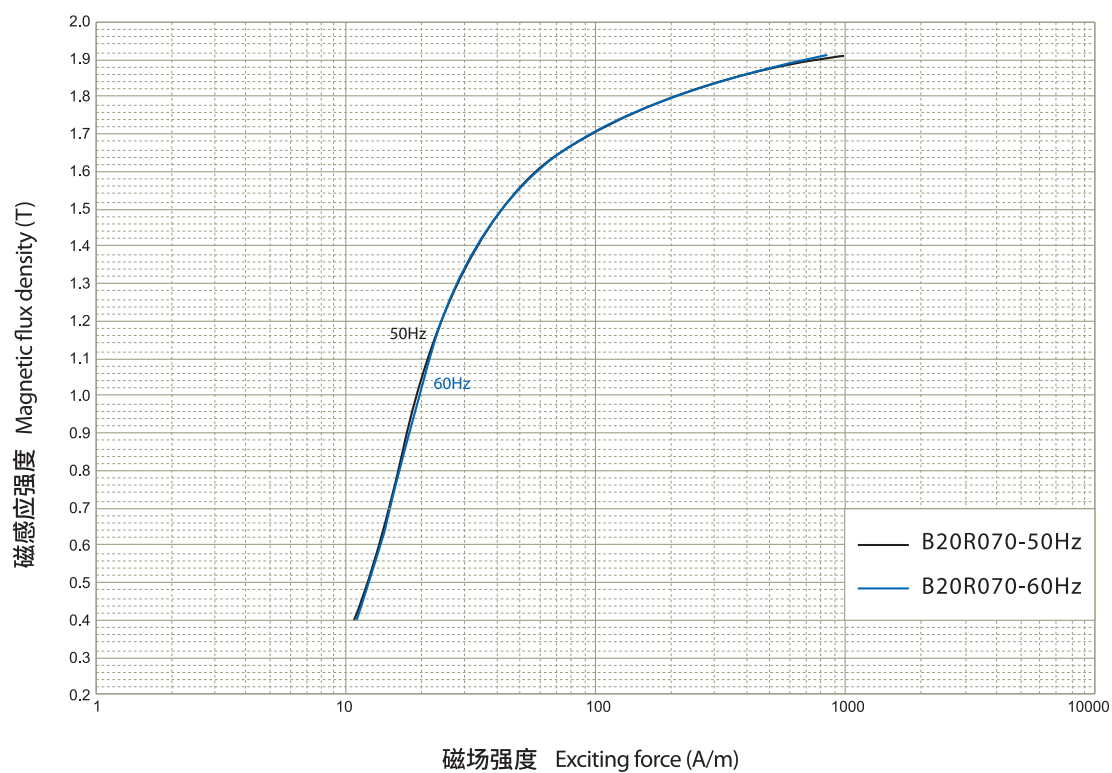
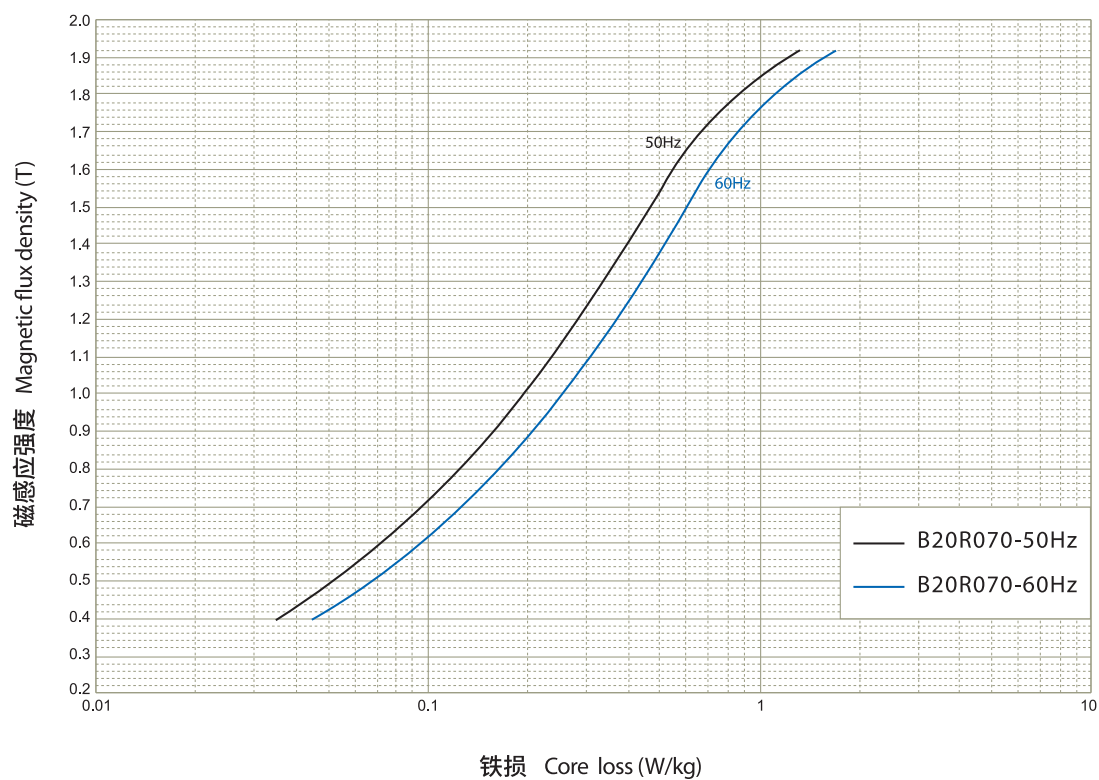
1.1) 高能效配电领域 High Efficiency Distribution Transformers

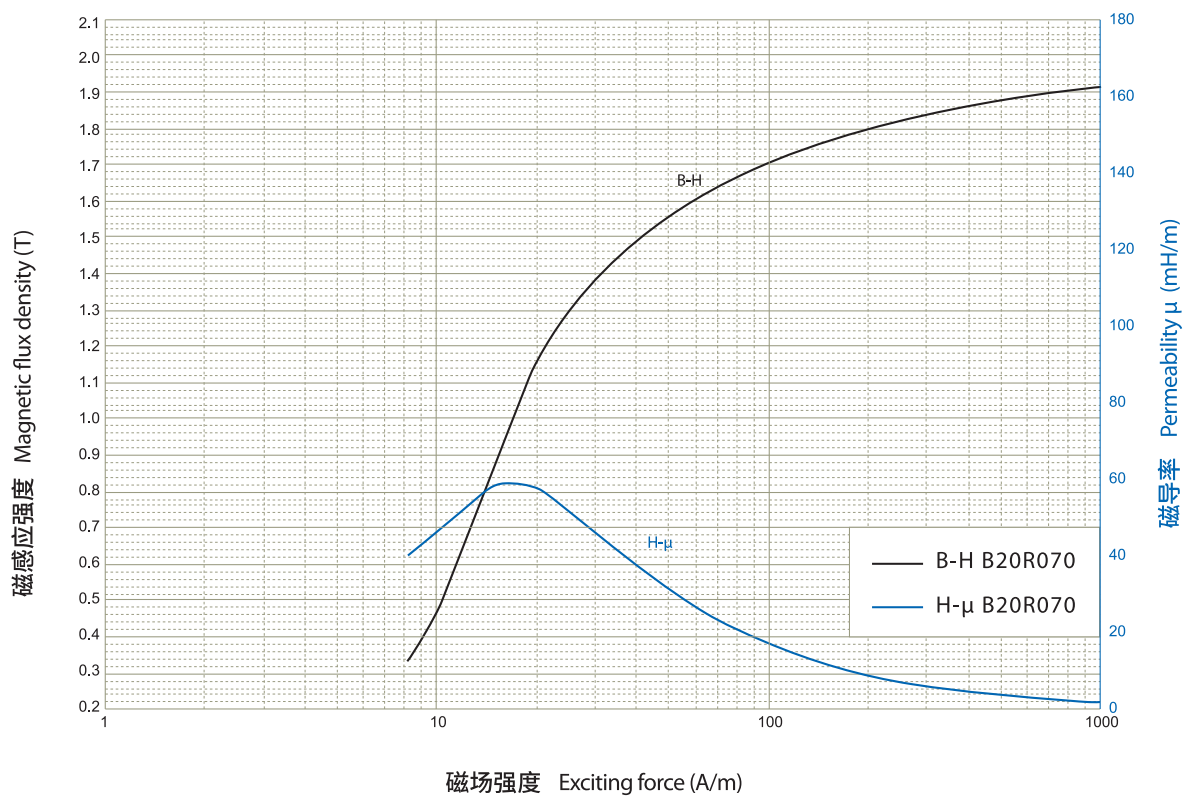
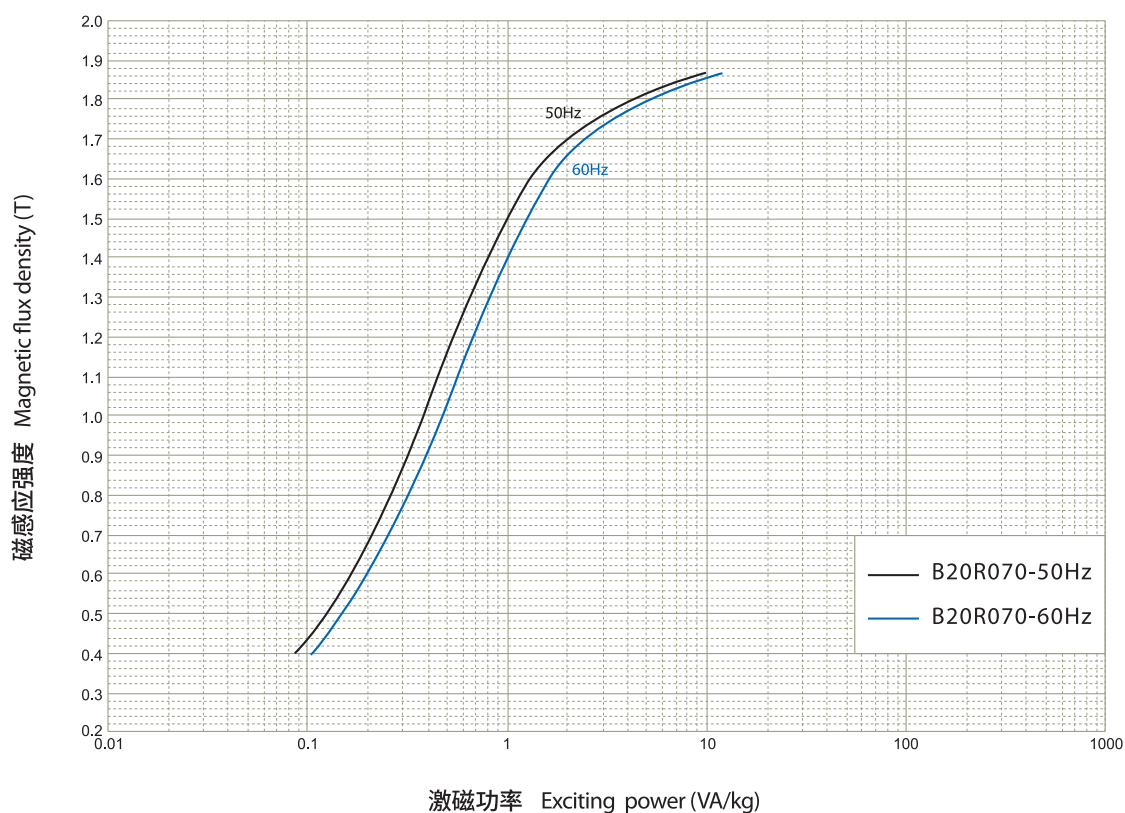
高能效配电变压器用取向电工钢牌号表
Grain-oriented electrical steel grades applied to high efficiency distribution transformers

配电变压器能效等级 Energy efficiency grades of distribution transformers	主要应用电工钢牌号 Grain-oriented electrical steel grades applied
I级能效 Energy efficiency I	B18R065 B20R065 B23R075
II级能效 Energy efficiency II	B20R070 B23R075 B23R080 B23R085

■ B20R070 : 典型值 $P_{17/50}=0.68\text{W/kg}$, $B_8=1.91\text{T}$ 。

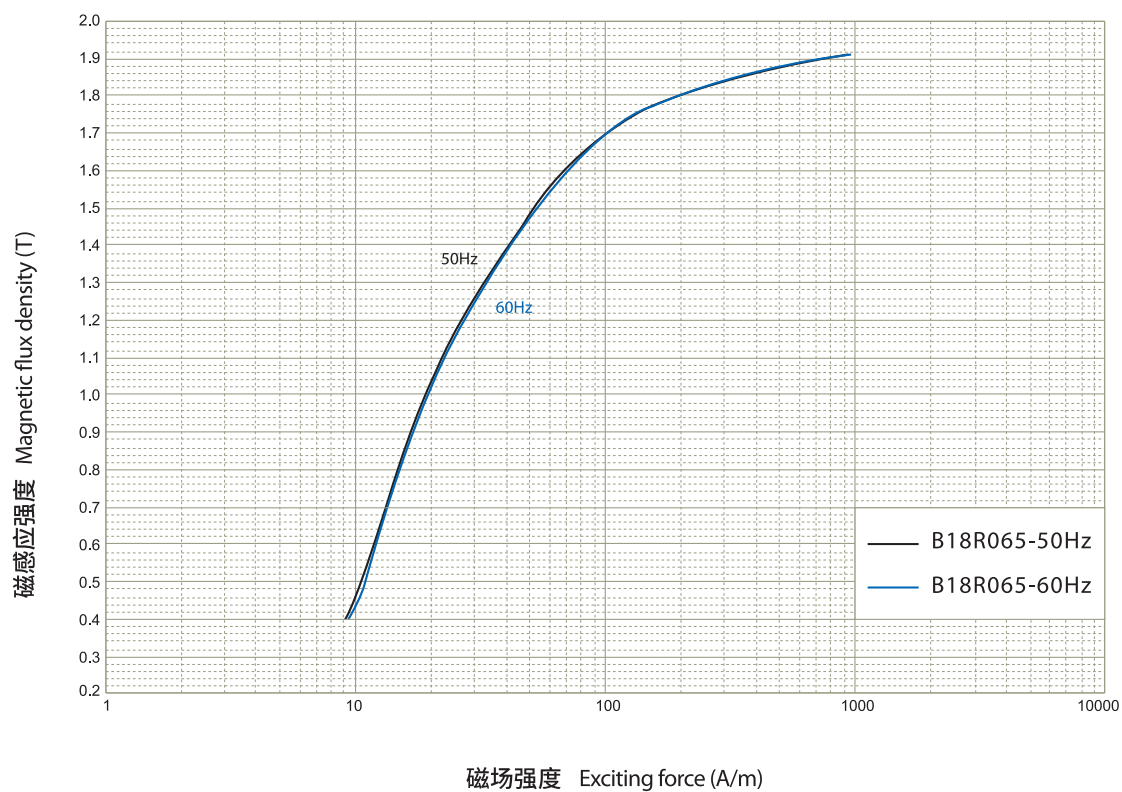
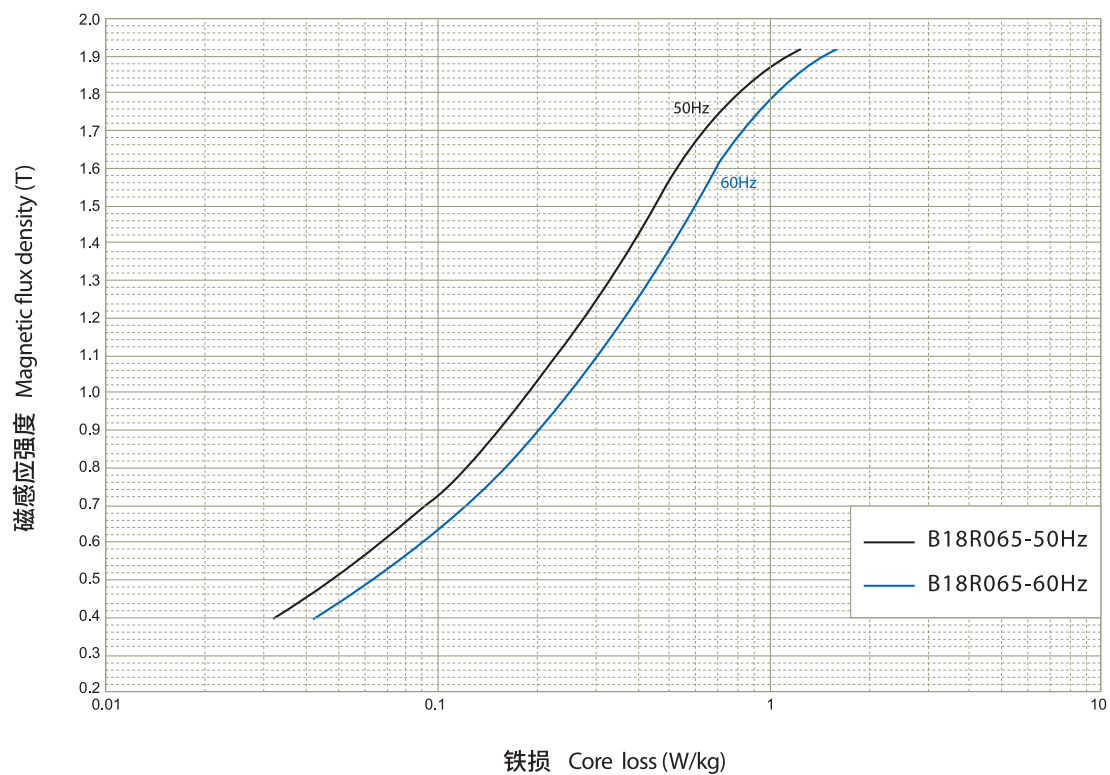
B20R070 : typical values $P_{17/50}=0.68\text{W/kg}$, $B_8=1.91\text{T}$

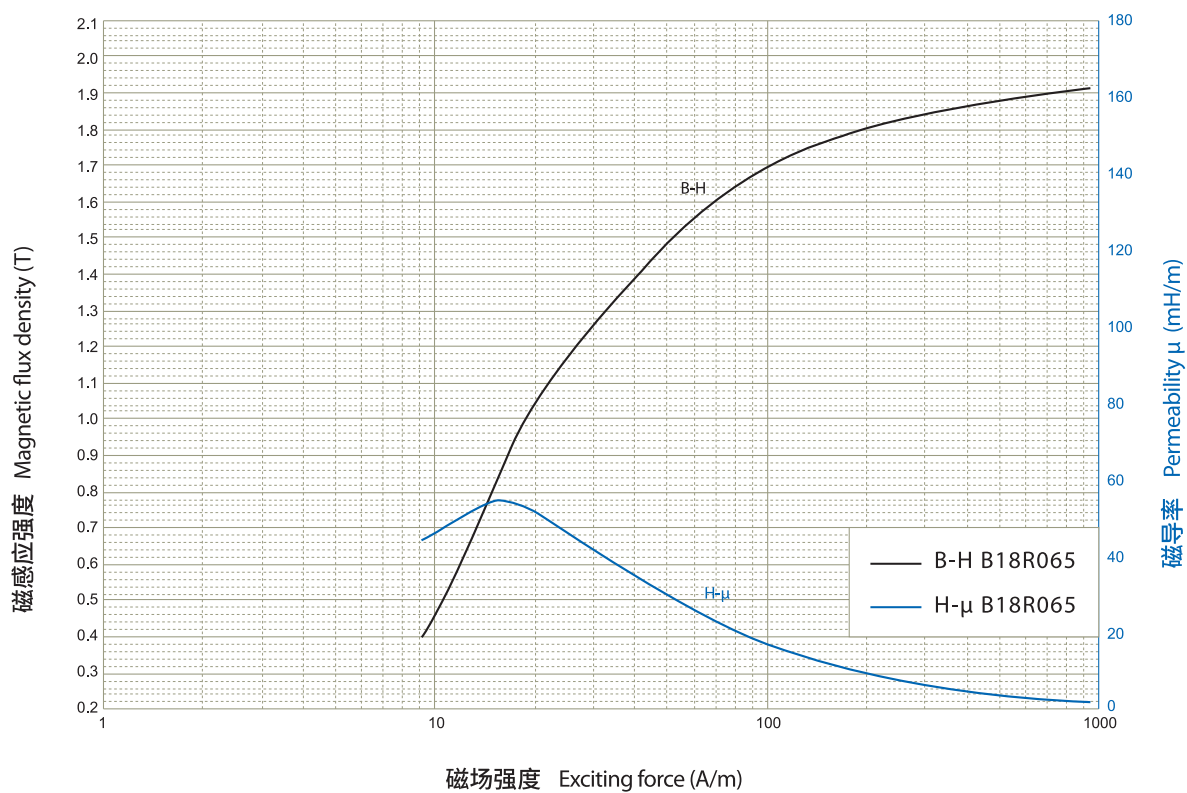
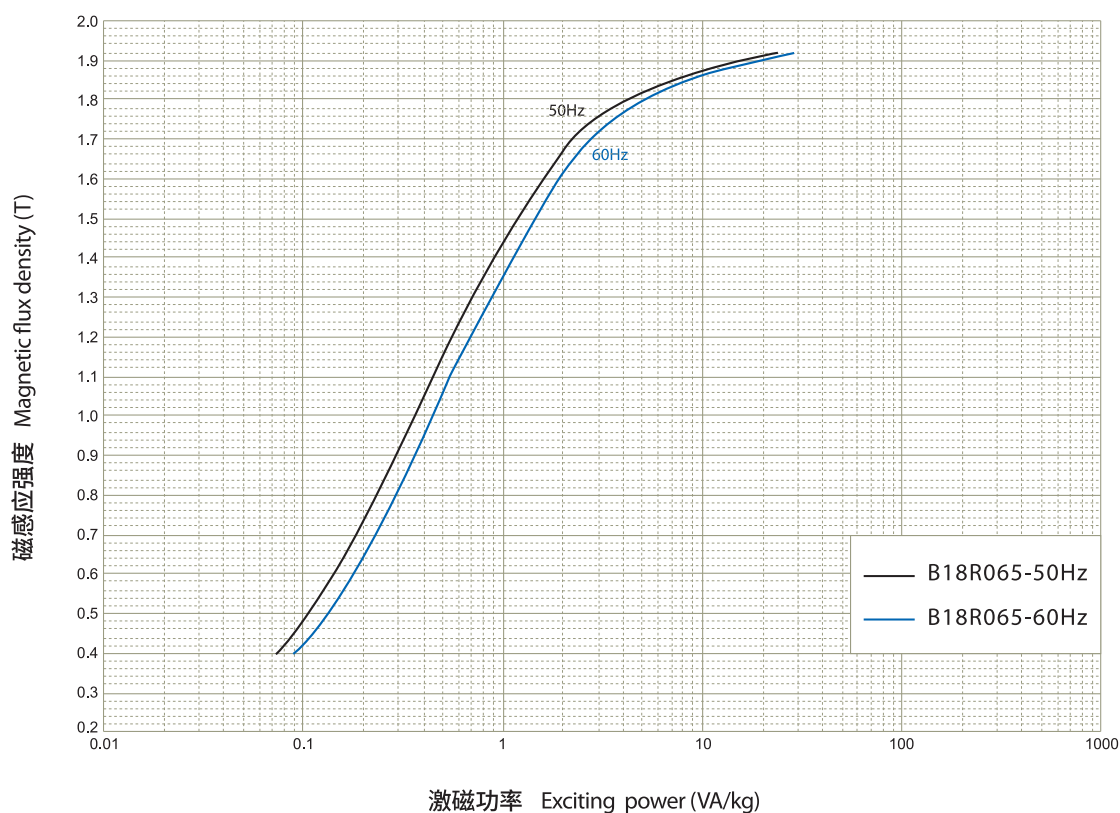




■ B18R065:典型值 $P_{17/50}=0.64\text{W/kg}$, $B_8=1.91\text{T}$ 。

B18R065: typical values $P_{17/50}=0.64\text{W/kg}$, $B_8=1.91\text{T}$



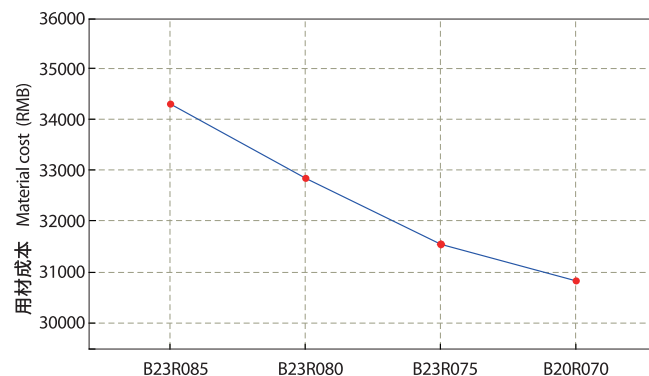
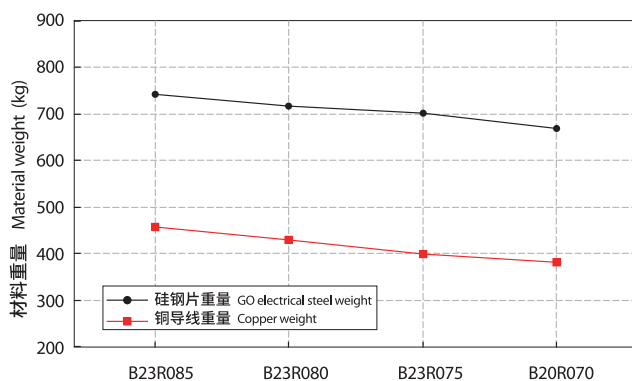
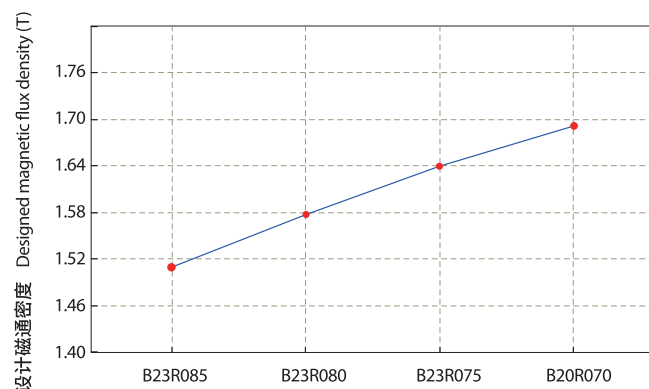
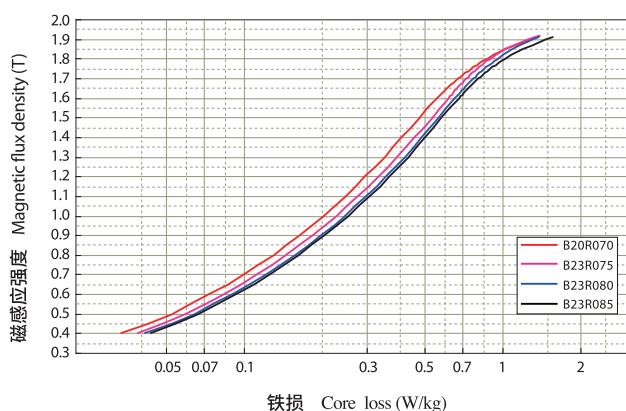


■ 案例——配电变压器性价比优化分析

Case —— Cost-performance ratio analysis for the distribution transformer

采用高性能取向电工钢产品生产变压器的动力之一在于更高的性价比。下面以能效II级叠铁心S-M-630/10-NXII油浸式配电变压器为例,采用宝钢四种牌号进行性价比分析。

High cost-performance ratio is one motivation to use high-performance grain-oriented electrical steel. For an energy efficiency II laminated core applied to the S-M-630/10-NXII oil immersed distribution transformer as an example, cost-performance ratio analysis between four Baosteel grades has been carried out.



从变压器优化设计可以看出,随牌号提高,主材成本降低,每提升一个牌号,性价比可提高3%~4%。

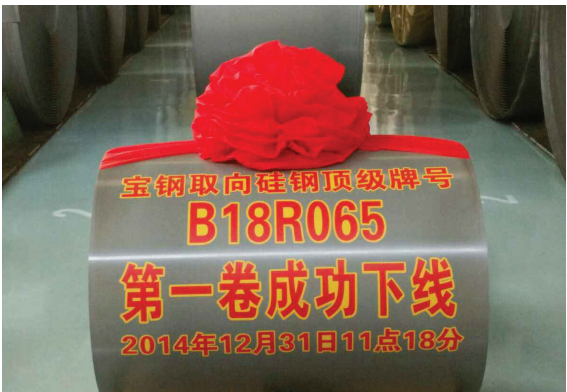
The steel consumption will be reduced with the steel grade rising. With one rise in steel grade, the cost-performance ratio will rise up 3~4%.

采用高等级取向电工钢B18R065、B20R070已成功制造生产出S-M-315/10-NX1型变压器，变压器的空载损耗、负载损耗均达到一级能效变压器的要求。

High-grade grain-oriented electrical steel B18R065、B20R070 has been successful applied to manufacture the transformer S-M-315/10-NX1. No-load loss and load loss meet the requirements of energy efficiency grade I transformer.

采用B18R065、B20R070试制的一级能效变压器性能
Properties of energy efficiency gradel transformers made of B18R065 or B20R070

S-M-315/10-NX1 测试项目 Test items	标准要求值 Standard value	实测值 Measured value
空载损耗, kW No-load loss, kW	340	298、301 (B18R065) 329、332 (B20R070)
负载损耗, kW Load loss, kW	3065	2946、2931 (B18R065) 2945、2877 (B20R070)
空载电流, % No-load current , %	--	0.21、0.21 (B18R065) 0.19、0.21 (B20R070)



1.2) 大型电力变领域 Large Power Transformers

特高压交直流变压器主要应用牌号表
Grain-oriented electrical steel grades applied to large power transformers

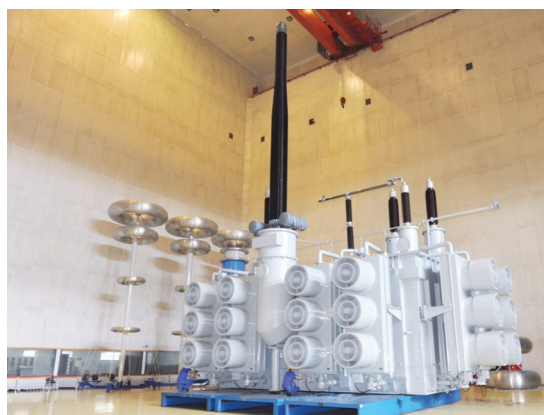
主要应用电工钢牌号 Grain-oriented electrical steel grades applied	P17/50(W/kg)	B8 (T)
B23R080	≤0.80	≥1.90
B27R085	≤0.85	≥1.90
B27R090	≤0.88	≥1.90
B27R095	≤0.90	≥1.90
B27P100	≤0.93	≥1.91

■ 案例——特高压交流输电工程项目双百万变压器应用

Case——Dual million transformers used in the ultra high voltage AC transmission project

宝钢高等级取向电工钢B27R090成功用于生产国家电网皖电东送特高压交流输电工程项目双百万变压器ODF-PS-1000000/1000, 变压器的空载损耗、空载电流、噪音达到要求。

Baosteel high-grade grain-oriented electrical steel B27R090 was successful applied to manufacture the dual million transformer ODFPS-1000000/1000 for the ultra high voltage AC transmission project. All the transformer properties including no-load loss, no-load current and noise meet the design requirements.



采用B27R090试制的双百万变压器性能
Properties of the dual million transformer made of B27R090

测试项目 Test items	合同要求值 Guaranteed value	实测值 Measured value
空载损耗, kW No-load loss, kW	185, +15%	179.9
空载电流, % No-load current, %	0.1	0.07
噪音, dB(A) Noise, dB(A)	75	72

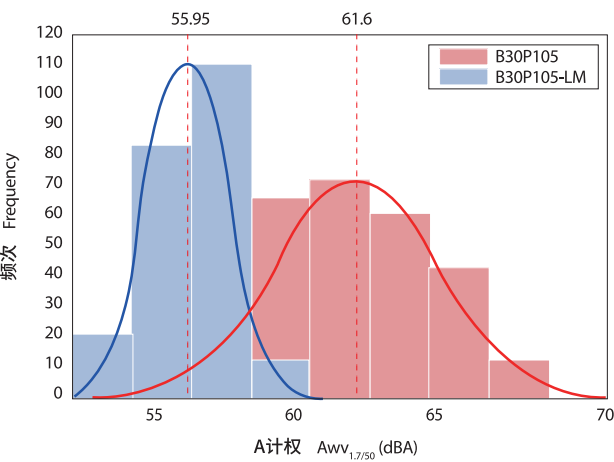
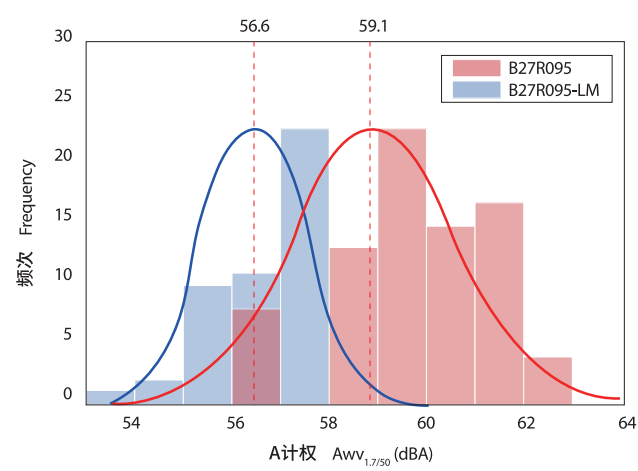
1.3) 特殊需求—低噪音变压器 Special Demand—Low Noise Transformers

随着国民经济的发展，人口密集化，变电站负荷加重，对城市变压器的噪声要求变得越来越高。

With the development of national economy, population in cities, substation load is increasing. Requirements for low noise transformers are higher.

低噪音变压器主要应用牌号表
Grain-oriented electrical steel grades applied to low noise transformers

牌号名称 Grades	磁性指标 Magnetic properties	典型值 Typical value	保证值 Guaranteed value
B27R095-LM	$Awv_{1.7/50}, \text{ dB(A)}$	57	≤ 58
	$P_{1.7/50}, \text{ W/kg}$	0.90	≤ 0.94
	$J_{800}, \text{ T}$	1.91	≥ 1.90
B30P105-LM	$Awv_{1.7/50}, \text{ dB(A)}$	57	≤ 60
	$P_{1.7/50}, \text{ W/kg}$	1.01	≤ 1.03
	$J_{800}, \text{ T}$	1.91	≥ 1.90
B30P120-LM	$Awv_{1.7/50}, \text{ dB(A)}$	57	≤ 60
	$P_{1.7/50}, \text{ W/kg}$	1.04	≤ 1.06
	$J_{800}, \text{ T}$	1.91	≥ 1.90



注: $Awv_{1.7/50}$ 表示频率为50Hz、磁感为1.7T时的磁致伸缩速度水平 (A计权)
Note: $Awv_{1.7/50}$ is the A-weighted magnetostriction velocity level at the frequency of 50Hz and the magnetic flux density of 1.7T

应用案例 Cases

宝钢低噪声特性材料经多家用户试用，变压器的噪音较标准要求降低2-3dB(A)，材料获得广泛认可。

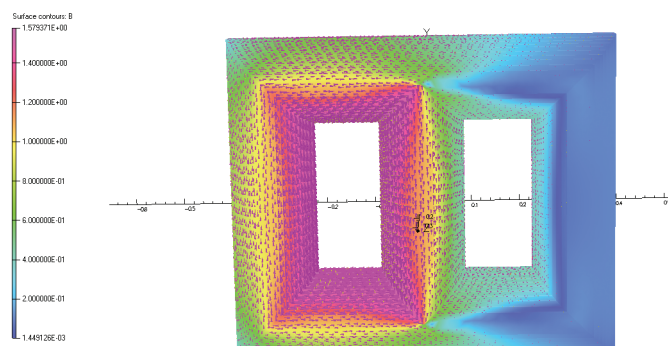
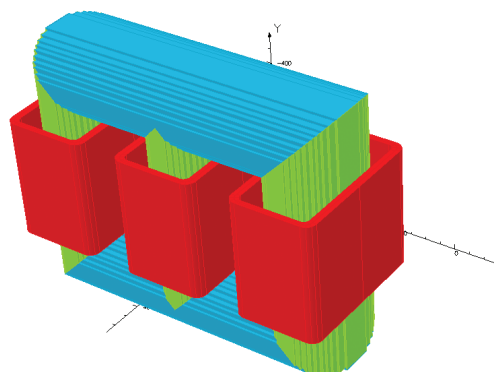
With transformer noise 2-3dB(A) lower than the requirement, Baosteel low magnetostriction GO electrical steel has been widely accepted by customers.

采用低噪声材料试制的变压器性能
Properties of transformers made of low magnetostriction grain-oriented electrical steel

电力产品名称 Power Products	噪音要求 Noise Requiremen	常规材料 Normal material B30P105	低噪音材料 Low Magnetostriction material B30P105-LM
SSZ11-240000/220型变压器 SSZ11-240000/220 transformer	≤63 dB(A)	--	60 dB(A)
SB11-M-500/10型变压器 SB11-M-500/10 transformer	≤47 dB(A)	44.3 dB(A)	42 dB(A)
SFSZ-180000/220型变压器 SFSZ-180000/220 transformer	≤63 dB(A)	60 dB(A)	58 dB(A)
SZ-50000/110型变压器 SZ-50000/110 transformer	≤60 dB(A)	58 dB(A)	56 dB(A)
SCB11-1000/10型变压器 SCB11-1000/10 transformer	≤50 dB(A)	47.5 dB(A)	44 dB(A)
BKS-75000/238型电抗器 BKS-75000/238 reactor	≤75 dB(A)	74 dB(A)	72 dB(A)

2) 仿真能力 Simulation Analysis

- 具备提供变压器空载特性分析的能力
- 具备仿真磁场分布的能力
- 具备仿真直流偏磁特性的能力
- 具备仿真谐波特性的能力
- Ability to provide no-load characteristic analysis
- Ability to simulate magnetic field distribution
- Ability to simulate DC magnetic bias characteristics
- Ability to simulate harmonic characteristics

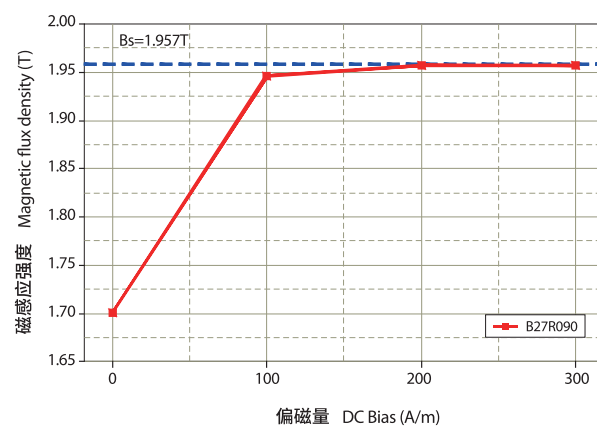
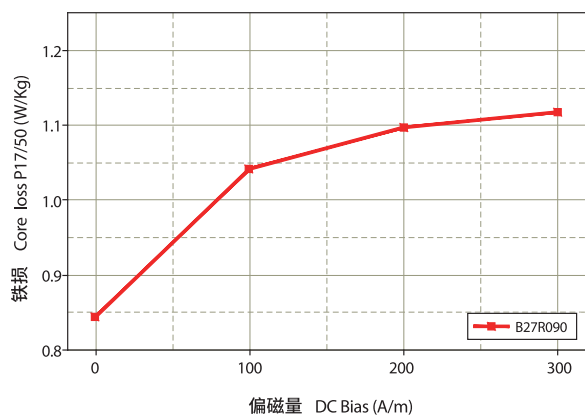


3) 材料剪切技术支持 Technical Support in Material Slitting and Cross Cutting

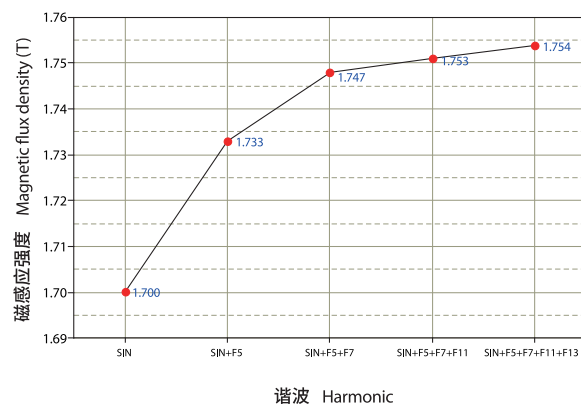
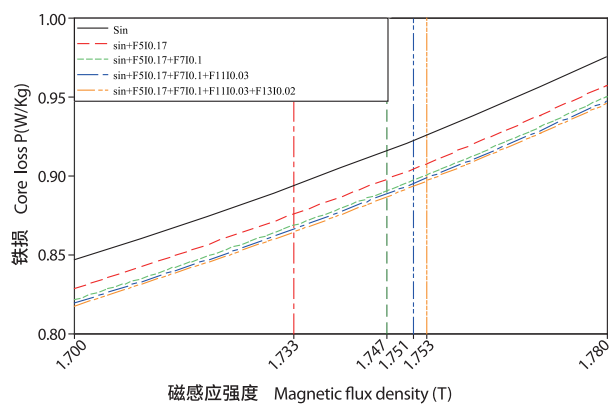


4) 特殊工况技术支持 Technical Support in Special Operating Condition

4.1) 直流偏磁 DC Magnetic Bias



4.2) 高次谐波 High Order Harmonic



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