宝钢汽车板
BAOSTEEL AUTOMOTIVE SHEETS
Early Vendor Involvement
先期介入

创享改变生活
CREATION BEYOND VISION
宝钢EVI理念  |  Baosteel EVI Concept

成为用户真诚可靠的汽车板及其解决方案的合作伙伴，实现可持续、共赢发展。

To be customers’ sincere and reliable partner in providing automotive steel 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

宝钢汽车板EVI  |  Baosteel EVI for Automotive Sheets

宝钢为汽车厂提供从设计到量产全过程的技术支持：

- 汽车设计选材支持、零部件同步开发、焊接与涂装技术支持，达到设计控制成本和质量；
- 汽车用材和结构持续优化，实现技术降本；
- 模具设计与验收技术支持，获得模具与钢材的最佳匹配；
- 新材料、新技术的推荐应用，提升汽车产品竞争力。

Baosteel could offer a variety of specialized services and technical support from concept design stage of auto body and components to launching the products and quality control, including:

- Material selecting in auto design and modification, Simultaneous Engineering in components development, Welding and Painting technical support, and quality/cost control in production.
- Optimization of steel application for auto structures in terms of cost and performance purposes.
- Tooling design and pre- and post-production evaluation to ensure the best steel performance.
- Recommendation of new materials and technologies to promote the competitiveness of automotive products.

宝钢EVI合作模式  |  Cooperation Models of Baosteel EVI

宝钢在长期与汽车用户的EVI活动中，形成了三种合作模式：

- 自车身EVI：开展自车身整车合作，结合新车型在车身轻量化、性能（弯曲刚度、扭转刚度、NVH）、碰撞安全、材料利用率、成本等方面的提升要求，宝钢全面介入并参与整车设计开发的各个阶段，通过双方组建项目合作团队及驻点式、远程支持的工作模式，利用在材料和技术方面的优势提供全面支持，确保新车型的设计要求满足开发目标；

- 零部件EVI：开展车身零部件合作，针对新车型的关键总成件、复杂成形件，新车型设计阶段介入，宝钢利用在材料和技术上优势，参与选材、结构优化、工艺设计和安全性能分析，确保零部件在设计、功能及成本方面满足设计要求；

- 模具EVI：开展模具设计合作，针对宝钢份额的零件，在模具开发阶段介入，提供免费的模具验收和失效分析，并提供相关完改建议，确保批量生产的稳定性，一次做对，效率最高，成本最低。
In longterm of EVI cooperation with automotive customers, Baosteel has established Three types of cooperation models:

- BIW EVI: Establish the cooperation team. Baosteel fully involved and participated in the vehicle design process (bending stiffness, twisting stiffness, NVH, crash performance, etc.). Auto sheet material selection and other aspects to ensure the lightweight vehicle or cost/material utilization will be conducted.
- PARTS EVI: Aimed at critical assembly parts and complex shaped parts, Baosteel uses its materials and technology advantages to participate in material selection, structural design, process design and safety analysis to ensure the requirements of safety and cost.
- DIE EVI: Provide free stamping die inspection and failure analysis to ensure the stability of mass production with the highest efficiency and lowest cost.

**Perfect Product System of Automotive Sheets**

- **Experience**: Over 30 years in the automobile industry, 20 years in high-strength steels, and 15 years in the development of high-strength steels for production and application, over 20 years of experience in HSS and over 15 years in AHSS.
- **Product**: The only domestic steel company with a great variety of products, including hot rolled and pickled sheets, cold rolled sheets, hot dip galvanized sheets, galvanized sheets, electro-galvanized sheets.
- **Grade**: Max CR 1700MPa, Gi & GA 1200MPa, EG 780MPa.
- **Ability**: The first foreign steel company to commercialize all three generations of AHSS products.
宝钢汽车板全面技术解决方案  |  Comprehensive Technical Solutions for Automotive Steel

不断更新和完善的汽车用材性能数据库，为用户提供从基础性能、使用性能到服役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、材料数据包和仿真用材料数据卡等各种形式数据。Continuously updating and improving properties database of Baosteel automotive materials, support customers with a range of full set of data from basic properties to performance of application and service. According to the diverse requirement of customers, Baosteel can provide performance indicators with the original curve data, material data packets, CAE material cards, and other forms of data.
基础性能数据  Basic Properties Data

<table>
<thead>
<tr>
<th>钢号</th>
<th>厚度 (mm)</th>
<th>屈服强度 (MPa)</th>
<th>抗拉强度 (MPa)</th>
<th>延伸率 (%)</th>
<th>n</th>
<th>r_p</th>
<th>r_0.2</th>
<th>r_m</th>
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<tr>
<td>HC340/590DP</td>
<td>1.2</td>
<td>365</td>
<td>641</td>
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<td>1051</td>
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<td>0.71</td>
<td>0.91</td>
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<td>HC820/1180DP</td>
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<td>866</td>
<td>1192</td>
<td>8</td>
<td>-</td>
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</tbody>
</table>

应力应变曲线  Strain Stress Curve

成形极限曲线  Forming Limit Curve

[图表]
High Strain Rate Data

Hole Expansion Ratio

Weld Lobe

Micro-Hardness of Joint

Fatigue Data

CAE Material Card

Embedded in AutoForm R8, or visit iBaosteel website and mini app for WeChat.
1. Full Process CAE Analysis

- OP10 Drawing
- OP20 TR
- OP30 FL+RST
- OP40 CPI+CRST
- Formability
- Thinning

2. Stamping Defect Prediction, Stamping Quality Analysis of the Panel, offering Optimization Suggestions

- Formability
- Impact line & Slip line
- Oil stone simulation
3. 零件分块优化，材料利用率提升，降低生产成本
Part Optimization to Increase the Utilization, and Decrease the Cost

原重8.3kg，利用率48.1%
Before: Weight: 8.3kg, Utilization: 48.1%

现重6.72kg，利用率58%
After: Weight: 6.72kg, Utilization: 58%

先进成形技术 Advanced Forming Technology

1. 液压成形 Hydroforming

- 液压成形用原板开发及原板性能评估标准
  - Hydroforming material development and tube assessment standard
- 协同用户开展液压成形零件设计及优化
  - Technical support of part design and optimization
- 工艺规划及可成形性评估
  - Process design and formability analysis
- 模具设计开发及样件提供
  - Die design and prototype parts supply

案例 Case

后副车架零件协同设计及样件开发 Rear Subframe SAPH440, 2.5mm

原冲压设计 → 空间轴线及截面设计 → 协同初始设计 → 协同细化设计
Original stamping design → Spacial axis and cross section design → Concept model co-design → Refinement model co-design
实施效果：实现后副车架减重13%，成本相当且性能达标，首次实现48天液压成形副车架快速高质交样

Results: Weight reduce 13%, Cost comparable and performance improving, realizing 48 days prototype development

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<tr>
<th>冲压焊接</th>
<th>管件液压成形</th>
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<tr>
<td>零件数量</td>
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<tr>
<td>总体重量</td>
<td>12.2kg</td>
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<tr>
<td>材料利用率</td>
<td>60%-70%</td>
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<tr>
<td>深筛工况最大应力</td>
<td>286MPa</td>
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<tr>
<td></td>
<td>2+1</td>
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<tr>
<td>材料</td>
<td>DP980, 1.8mm</td>
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<tr>
<td>高压成形</td>
<td>10.54(13.6%)</td>
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<tr>
<td>材料利用率</td>
<td>90%(20%)</td>
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<tr>
<td>压力成形</td>
<td>223MPa(22%)</td>
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</tbody>
</table>

其他案例及应用

扭力梁 Torsion Beam
BR1500HS, 3.5mm

后副车架横梁 Rear Subframe Cross Beam
QStE340TM, 2.7mm

后副车架纵向 Rear Subframe Stringer Beam
QStE340TM, 2.5mm

A柱 A Pillar
DP980, 1.8mm

前副车架 Front Subframe
S315MC, 2.5mm
2. 热冲压成形  Hot Stamping

- 具备为传统热冲压提供全面的一揽子技术解决方案的能力
- 具备提供绿色热冲压(低成本、低能耗、快速的)一揽子技术解决方案的能力
- 具备提供复合热冲压的全面技术解决方案能力
- 具备提供VRB板热冲压的全面技术解决方案能力

- Ability to provide comprehensive package of technical solutions for traditional hot stamping
- Ability to provide package of technical solutions for green hot stamping (low cost, low energy consumption and rapid cycle time)
- Ability to provide comprehensive technical solutions for patch hot stamping
- Ability to provide comprehensive technical solutions for VRB hot stamping

传统热冲压技术  Traditional Hot Stamping

从零件协同设计、样模样件开发到正式工装开发、工艺设计优化，全过程实现本土化，最大程度降低开发成本。

从协作设计到原型验证，再到生产工具开发，优化工艺设计，整个过程实现本地化，最大程度降低开发成本。

绿色热冲压技术  Green Hot Stamping

新型低温加热钢板、高耐磨高导热模具钢材料、模具、工艺适应性优化和轻量化夹持器、热冲压零件冷切边能耗、成本降低，生产节拍提高。在实际热冲压8柱开发案例中，零件保压时间可以控制在6秒之内，生产节拍和模具寿命达到行业领先水平。

Green means new low temperature steel, high wear resistance high conductivity steel for tooling, optimization design for tooling and process, lightweight gripper and edge cutting. Actually in B pillar development, the hold time is controlled within 6 seconds and the production cycle and the life of the tooling are to achieve the industry leading level.
先进热冲压技术-补丁板热冲压
Advanced Hot Stamping: Patch Hot Stamping

补丁板零件设计优化
Design and optimization of part

补丁板模具设计优化
Design and optimization of toolings

补丁板热冲压工艺设计优化
Design and optimization of process

先进热冲压技术-VRB板热冲压
Advanced Hot Stamping: Hot Stamping with VRB Panel

VRB热冲压零件设计优化
Design and optimization of part

VRB热冲压工艺设计优化
Design and optimization of process

VRB热冲压模具开发
Prototype development

3. 辊压成形  Roll Forming

超高强钢辊压成形技术支撑与解决方案
- 先超高强钢材料辊压成形特性评估与推荐
- 零件设计与优化支持
- 辊压工艺及样品同步开发

UHSS roll forming
- AHSS characteristic evaluation and recommendation for roll formed parts
- Technical support of profile design and optimization
- Synchronized development of roll forming process and prototype

案例  Case

结构优化
Structure optimization

零件数模及截面
3D Model and section
BAOSTEEL AUTOMOTIVE SHEETS Early Vendor Involvement

产品使用性能 CAE 分析及仿真
CAE for product performance

冲压工艺设计及模花图
Roll forming fower

Deformation simulation

其他案例及应用 Other Application Case

日字形保险杠 B Shape Bumper
HC820/1180DP 1.4mm
4. Hot Roll-bending

- Magnetic-Thermo-dynamic coupling simulation for HRB process
- Prediction and improvement of defects
- Design of induction heating and forming tools
- Technical support for prototype trial production
- Performance test under real working condition

Case

B字型热辊弯前防撞梁 HRB Bumper (B Section)

1. 经典B型截面设计, 提高抗弯性能
Classic B section design to improve bending performance

2. 变曲率设计, 满足新法规下造型要求
Variable curvature design to meet the requirements of new regulations

B字型热辊弯前防撞梁
B Section HRB Bumper B1500HS 1.5mm

- 特殊感应强化工艺, 截面强度>1500MPa
- 良好的抗弯曲截面特性
- 变曲率弯, 满足SORB新碰撞工况保险杠造型曲率要求
- Strength over 1500MPa due to special heating method
- Good bending resistance characteristics
- Variable bending radius to meet styling requirements under SORB crash test
**Case**

日字型热锻弯前防撞梁 HR8 Bumper (日Section)

日字型热锻弯前防撞梁 日Section Bumper
B1500HS 1.4mm

- 特殊感应强化工艺，截面强度>1500MPa
- 良好的抗扭转抗弯曲截面特性
- 弯曲成形质量好，无表面起皱
- Strength over 1500MPa due to special heating method
- Good bending and torsion prop.
- No wrinkling after bending

**Analysis and design**

电磁感应加热温度场分析
Thermo analysis for induction heating

异型管弯管过程分析
Bending process analysis for special shaped tubes

感应线圈设计
Design of induction heating device
5. 辊冲成形  Roll-stamping

- 高强钢辊冲成形特性评估与推荐
- 高强钢辊冲零件协同设计
- 辊冲零件工艺开发及仿真分析
- 辊冲模具设计与优化
- 辊冲样件试制

案例  Case

变截面零件辊冲成形FEA仿真分析
Roll-Stamping FEA of Variable cross-section parts

超长大梁整体辊冲成形仿真分析
Roll-stamping FEA of whole super long longitudinal beam

超长大梁整体辊冲成形模具开发
Die design of roll-stamping whole super long longitudinal beam

辊冲成形样件试制
Roll-Stamping UHSS samples
6. 旋压成形  Spin Forming

- 材料旋压特性评估
- 工艺开发、可制造性分析
- Evaluation on material spinning formability
- Process design and formability FEA

案例  Case

传统截面钢轮轮辋
Traditional steel wheel rim section

轻量化不等厚轮辋截面
Light-weight steel wheel rim section

车轮应力及疲劳FEA分析
Stress and fatigue FEA simulation of steel wheel

轮辋强度分布
Stress distribution of rim

旋压  Spinning  

cutout  Flaring  
1" roll-forming  2" roll-forming  3" roll-forming

轮辋旋压模具开发
Rim spinning die development

全新滚型模具型面设计
New roll-forming die design

轮辋坯料旋压后
Rim bandage after spinning

轻量化旋压轮辋样品
Light-weight steel wheel sample

性能实测评估
Performance evaluation with real test
7. VRB技术  Variable-Thickness Rolled Blank

在VRB技术领域，宝钢在车身零件开发全流程提供概念设计、工艺设计、模具技术及现场技术支撑服务，协助客户解决VRB技术应用过程中的各种问题。

In the field of VRB technology, Baosteel could provide various technical support including concept design, process design, tooling design, and on-site service.

CAE分析  CAE analysis

CAE分析  CAE analysis

材料技术  Materials technology

模具技术  Tooling technology

成形跟踪  Quality track

质量评价  Quality evaluation

整车结构分析  Body Structure Analysis

车身结构优化、整车性能评估能力  Body structure optimization and vehicle performance evaluation

设计/优化  Design/Optimization

- 敏感度分析  Sensitivity analysis
- 接头性能分析  Joint analysis
- 厚度灵敏度优化  Gauge optimization
- 梁骨架快速建模  Frame structure modeling
- 截面优化设计  Section optimization
- 拓扑优化  Topology optimization
- 传力路径分析  Load path analysis
- 结构设计数据库  Structure database

评估/验证  Evaluation/Verification

- 刚度工况分析  Stiffness analysis
- 强度工况分析  Strength analysis
- C-NCAP法规分析  C-NCAP regulations analysis
- C-IASI法规分析  C-IASI regulations analysis
- IIHS法规分析  IIHS regulations analysis
- 开闭件总成分析  Closure analysis
- 座椅总成分析  Seat analysis
- 电池包总成分析  Battery pack analysis
### Case

**Sensitivity**
- More
- Less
- No result

**Thickness Change**
- Up-Gauge
- No Change
- Down-Gauge

基于车身用材数据库的厚度灵敏度分析，完成对某一车型轻量化10kg。
**10kg light-weight in BIW through material gauge sensitivity optimization based on AutoSteel Database**

在关键工况性能验证的同时，完成电池包框架总成轻量化10.3kg。
**10.3kg light-weight in Battery Pack with performance in key load cases validated**

### Different Solutions for Typical Component

<table>
<thead>
<tr>
<th>方案 Design Plan</th>
<th>纵梁内板材料/厚度</th>
<th>纵梁外板材料/厚度</th>
<th>纵梁后板材料/厚度</th>
<th>纵梁后板加强板材料/厚度</th>
<th>减重 Weight Reduction</th>
<th>成本 Cost</th>
<th>正面碰撞性能 Front Impact</th>
<th>评价 Design Evaluation</th>
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<tr>
<td>原设计 Original design</td>
<td>HC340L, 1.8mm</td>
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<td>HC340/590DP, 2.3mm</td>
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<td>HC340/590DP, 1.6mm</td>
<td>1180DP, 1.8mm</td>
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<td>TWB(a)</td>
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<td>HC340/590DP, 1.6mm + HC420/780DP, 2.3mm</td>
<td>HC420/780DP, 2.3mm</td>
<td>HC420/780DP, 2.3mm</td>
<td>-9.6%</td>
<td>-18.26%</td>
<td>Lowest cost</td>
<td>★★★★★</td>
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<td>TWB(b)</td>
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<td>VR8</td>
<td>HC420L, 1.6mm</td>
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<td>-8.6%</td>
<td>-0.13%</td>
<td></td>
<td>★★★★☆</td>
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</table>
典型小总成不同解决方案  Different Solutions for Typical Component

成本 Cost

整车性能 Vehicle performance

白车身性能 BIW performance

重量 Weight

可制造性 Formability

提高材料利用率解决方案  The Solution of Improving Material Utilization Rate

倍尺镜像法  Method of Double Length and Image

针对小规格激光拼焊零件，采用倍尺镜像排样法，从激光焊接加工到后续落料，开辟了此类零件高效率、低成本的工艺路径。

解决拼焊可制造性，提升材料利用率24.39%，并可提高落料效率30%。

In the small size of TWB parts, using the layout method of double-length and image, from the laser welding processing to the blanking, opening up the process of high efficiency and low cost.

To solve the laser welding manufacturing, improve the material utilization rate of 24.39% and can improve the efficiency of blanking 30%.
现场技术支持  On-site Technical Support

在汽车板冲压成形领域，综合运用材料技术、全流程冲压仿真技术、模具及工艺技术，开展大量现场技术支持工作，协助客户解决汽车板零件成形中的质量问题。

冲压成形问题解决方案  Solution of Stamping or Forming Problem

冲压工艺因素  Stamping Process Factors

材料因素  Material Factors
- 厚度  Thickness
- 减薄率  Reduction rate
- 熔合度  Melt degree
- 表面质量  Surface quality
- 油脂消耗量  Oil consumption
- 镀层  Coating

模具因素  Tools Factors
- 模具材料  Tool material
- 模具表面光洁度  Surface finish
- 模具磨损情况  Tool wear
- 模具冷却  Cooling

成形工艺  Forming Process

成形质量  Forming Quality

互动因素  Interactive Factors
- 材料温度  Material temperature
- 模具温度  Tool temperature
- 模具湿度  Tool humidity
- 光源条件  Lighting conditions
- 消除热处理  Heat treatment
**Joining Technology**

In the field of automotive sheet jointing, based on the understanding of jointability, Baosteel has ability to support customers for jointing solution, including joint schedule design and optimization, joint performance improvement, joint defect control and prevention.

<table>
<thead>
<tr>
<th>Control Before</th>
<th>After Control</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>连接成本高</strong></td>
<td><strong>连接成本低</strong></td>
</tr>
<tr>
<td>High cost of joining</td>
<td>Low cost of joining</td>
</tr>
<tr>
<td><strong>能耗大</strong></td>
<td><strong>能耗小</strong></td>
</tr>
<tr>
<td>High energy consumption</td>
<td>Low energy consumption</td>
</tr>
<tr>
<td><strong>焊点强度波动大</strong></td>
<td><strong>焊点强度波动小</strong></td>
</tr>
<tr>
<td>High fluctuation of joint strength</td>
<td>Low fluctuation of joint strength</td>
</tr>
<tr>
<td><strong>电极寿命低</strong></td>
<td><strong>电极寿命提高</strong></td>
</tr>
<tr>
<td>Low electrode endurance</td>
<td>High electrode endurance</td>
</tr>
<tr>
<td><strong>易产生接头缺陷</strong></td>
<td><strong>接头缺陷少</strong></td>
</tr>
<tr>
<td>More defects</td>
<td>Less defects</td>
</tr>
<tr>
<td><strong>工作环境恶劣</strong></td>
<td><strong>工作环境友好</strong></td>
</tr>
<tr>
<td>Poor working environment</td>
<td>Good working environment</td>
</tr>
<tr>
<td><strong>影响涂层质量</strong></td>
<td><strong>不影响涂层质量</strong></td>
</tr>
<tr>
<td>Influence coating quality</td>
<td>Without coating quality influence</td>
</tr>
</tbody>
</table>

**Case**

焊接工艺对焊接质量的影响  
*Influence of welding schedule on welding quality*

装配与操作对焊接质量的影响  
*Influence of fit-up & operation on welding quality*
涂装技术  Painting Technology

在涂装技术领域，聚焦涂装外观优化、整车防腐优化及新材料应用的技术研究，可为用户提供涂装性能最优的钢铁产品及其应用过程的系统解决方案。

涂装外观优化 —— 全面优化车身外覆盖件选材及全涂装外观质量控制

整车防腐优化 —— 车身用钢涂装防腐选材优化及车身防腐解决方案

新材料应用 —— 新型车身用钢及非钢材料涂装使用技术解决方案

In the field of automobile coating technology, we are focusing on the technology of painting appearance optimization, vehicle anti-corrosion optimization and new material application. We can provide the best painting performance steel materials and system solution for painting application of steel materials.

Painting appearance —— Selection and optimization of outer covering parts of the body and full coating appearance quality control for 2C1B process

Vehicle anticorrosion —— Optimize steel material for car body anticorrosion and provide corrosion protection solution

New materials —— Technical solution for the application new type material for car body

零件实际变形模拟  Simulation of actual deformation of parts
涂装前处理实验室模拟  Simulation of painting pretreatment
涂装电泳实验室模拟 Simulation of painting electrophoresis
外观轮廓检测  Profile test (Ra, Pc, W, LW, SW)

实验室轮廓传递快速模拟平台  Fast simulation platform for profile transfer

涂装工艺类型  Painting Process Type

涂装外观质量优化  Painting Appearance Optimization
(刷涂 LW/SW)

实验室涂装技术工艺特征模拟  Laboratory process characteristic simulation

实验室涂装技术优化效果验证  Laboratory verification

轧制控制技术  Rolling control technology

轧辊表面技术  Roller texturing technology

轮廓传送衰减理论研究  Profile transfer attenuation theory
| Domestic Marketing System |  |
|---------------------------|  |
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