

HRB / STUDY GUIDE

BEARING MANUFACTURING & ENGINEERING

Complete Eight-Lesson Study Book

- 01 Company and products
- 02 Material science and manufacturing
- 03 Quality assurance and R&D
- 04 B2B quotations and website integration



Based on the supplied HRB learning documents and eight lessons

Educational edition | October 2026

Company-reported claims are labeled and may require verification

About this book

This eight-lesson book consolidates the HRB Bearing Group study series into a practical learning reference for understanding bearing engineering, manufacturing, quality, research and development, and international B2B sales. It is also intended to support a future technical product catalog and website.

Source distinction. “HRB reports,” “the company document states,” and “company-supplied” refer to materials supplied for this project. General engineering explanations provide learning context and are not claims that every HRB product or facility follows an identical procedure. Proposed website features are recommendations, not confirmed HRB systems.

Not a product specification. Product selection, machining settings, load ratings, chemical limits, precision requirements, and operating limits require the applicable current manufacturer datasheet, engineering approval, and relevant standards. Some supplied figures conflict or lack effective dates.

Primary material used

- Completed website information requirements (DOCX): company profile, process table, sample product specifications, R&D;, inquiry-to-delivery stages, and FAQ.
- English corporate presentation (PPTX): Jianlong affiliation, HRB background, technology highlights, digital manufacturing, and quality targets.
- Product / workflow workbook (XLSX): bearing families, series, production workflow, and media/material requirements.
- Eight prior lessons: educational explanations, definitions, examples, and knowledge checks consolidated here.

How to use the book

Read the lessons sequentially on your first pass. Then use the product tables, glossary, and process checklists as reference material when building the website. Each chapter includes a short knowledge check; the answers are collected in the back matter.

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Learning pathway

Lesson	Primary learning outcome
1. Company overview	Understand HRB, its history, affiliation, industries and claims.
2. Fundamentals	Read bearing components, load directions, dimensions and ratings.
3. Product families	Recognize ten bearing categories and major series.
4. Materials	Understand steel grades and incoming material testing.
5. Manufacturing	Follow forging to shipping and core process parameters.
6. Quality	Understand precision, vibration, life testing and QMS.
7. R&D	Understand design simulation, technical innovation and digital factory systems.
8. B2B sales	Follow inquiry-to-delivery, quotation terms and website workflow.

Company Introduction & Business Overview

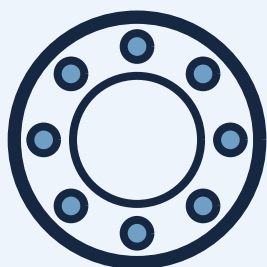
Understand the identity of Harbin Bearing Group, its historic role in Chinese bearing manufacturing, its affiliation with Jianlong, and the difference between engineering product categories and industrial applications.

1.1 Core company facts

Item	Company-supplied information
Company	Harbin Bearing Group Co., Ltd. (HRB; 哈尔滨轴承集团)
Established	1950
Main activity	Bearing research, development and manufacturing
Jianlong relationship	Presentation reports restructuring and acquisition in August 2020
Production lines	54, per completed requirements document
Reported annual capacity	33 million bearing sets per year
Reported R&D personnel	58 (date not specified)

The corporate presentation describes HRB as one of China's three historic major bearing production bases, with products serving industrial machinery, motor, machine-tool, rail, automotive, metallurgy, mining, and selected specialized applications. That is the company's stated positioning, not independent certification of current production volume or capabilities.

1.2 What is a bearing?



ROLLING BEARING

Outer ring and inner ring

Balls / rollers carry the load

Cage maintains rolling-element spacing

Raceways are precision contact surfaces

A rolling bearing supports relative motion between mechanical components, commonly a rotating shaft and stationary housing. Load passes between inner and outer rings through balls or rollers. The cage spaces and guides the rolling elements. Raceways are the controlled contact surfaces; seals, shields and lubricant arrangements depend on design.

1.3 Milestones and corporate identity

Period	Milestone
1950	Company founded.
Early development	Identified in its presentation with the First Five-Year Plan and development of domestic bearing production.
Subsequent decades	Expanded capability across precision, motor, rail, metallurgical and specialized bearing applications.
August 2020	Jianlong Group restructuring/acquisition reported by corporate presentation.
Recent direction	Development of higher-end bearings, simulation, intelligent lines and digital traceability.

1.4 HRB and Jianlong Group are not the same reporting entity

Jianlong is described as a large industrial group centered on steel and resources. HRB is its bearing-manufacturing business. Group-level revenue, assets, crude-steel output and employment figures in the presentation must not be relabeled as HRB standalone operating figures.

1.5 Product families versus market applications

The product workbook classifies bearings by engineering construction, such as deep groove ball, angular contact ball, tapered roller and spherical roller bearings. The presentation also classifies them by application, such as machine-tool, motor, rail transit, automotive, metallurgical and specialized bearings. One product can belong to both dimensions. This distinction is foundational for website navigation and technical filtering.

1.6 Manufacturing claims and publication caution

The completed requirements document gives 54 production lines and 33 million sets of annual capacity. Its component capacities sum to approximately 32.9 million sets, plausibly reflecting rounding. The corporate presentation gives more than 8,000 product specifications and a broad dimension range; another document provides a narrower range. Confirm the measurement scope, time period and site coverage before publishing metrics.

Knowledge check

1. Which is HRB's main business?

- A) Steel mining
- B) Bearing engineering and manufacturing
- C) Household retail

2. What occurred in August 2020 according to the presentation?

- A) HRB was founded

B) Jianlong restructured/acquired HRB

C) HRB stopped production

3. Is a motor bearing an engineering construction type?

A) No, it is an application class

B) Yes, identical to tapered roller

C) Yes, a precision class

4. Does annual capacity equal actual annual sales?

A) Always

B) Never measured separately

C) No, they are different metrics

Answers and explanations appear in the answer key at the end of the book.

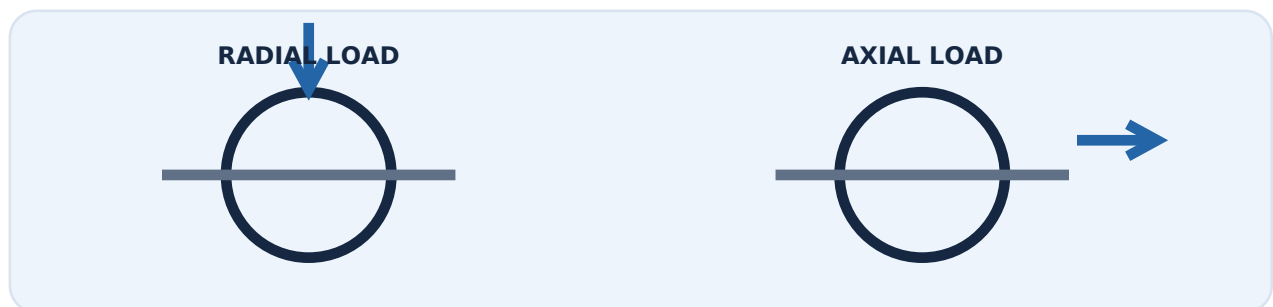
Bearing Fundamentals & Technical Language

Master bearing construction, radial and axial loading, dimensions, model-number examples, precision, dynamic and static load ratings, seals, clearance and speed.

2.1 Basic components and their functions

Component	Engineering purpose
Inner ring	Typically mounts on a shaft.
Outer ring	Typically seats in a housing.
Rolling elements	Transfer loads through rolling contact (balls or rollers).
Cage	Separates and guides rolling elements.
Raceway	Precisely formed rolling contact track.
Seal / shield	Helps protect lubricant and the bearing interior, if included.
Lubricant	Helps manage friction, wear and heat.

2.2 Radial load and axial (thrust) load



Radial loads act perpendicular to the axis of rotation. Axial loads act along the axis. Applications frequently create combined loading. Load direction is one of the first considerations in bearing selection; different bearing constructions handle these loads differently.

2.3 Ball bearings and roller bearings

Balls have nominal point-contact geometry while many roller designs have nominal line-contact geometry. Compared at similar envelope size, roller bearings often offer higher load capacity, whereas many ball-bearing designs provide lower friction and high speed capability. The actual comparison depends on geometry, lubrication, mounting and the bearing type.

2.4 Dimensions: d × D × B

For many radial bearings, d is bore/inner diameter, D is outer diameter, and B is width. The company sample motor-bearing model 6312-2RS is listed as 60 × 130 × 31 mm and GCr15. These dimensions describe the basic fit envelope, not all the tolerances and operating requirements needed for interchangeability.

2.5 Reading model numbers

In common deep-groove ball-bearing numbering conventions, 63 describes a dimensional series, the bore code 12 corresponds to a 60 mm bore (for standard bore codes 04 and higher, multiply by five), and 2RS commonly refers to seals on both sides. Exact HRB suffix definitions must be checked against its current designation system.

2.6 Basic dynamic and static load ratings

Concept	Definition and use
Dynamic load rating C / Cr	Reference rating used in standardized rolling-fatigue life calculations while rotating.
Static load rating C0 / C0r	Reference to a criterion of permanent deformation at rolling contacts under static/slow loading.
kN	Kilonewton, a unit of force (1 kN = 1000 N).
Example	Company table lists 6312-2RS Cr = 81.7 kN and C0r = 51.8 kN.

Neither load rating is a simple “maximum safe working load.” Bearing selection also needs actual radial and axial load cases, duty cycle, safety criteria, lubrication, life expectations, speed and temperature.

2.7 Precision, clearance, seals and lubrication

Term	What to remember
P0/P6/P5/P4/P2	Common progression toward tighter dimensional and running tolerances, subject to type/standard.
C3 clearance	An internal clearance category, NOT a precision class.
Runout	Variation observed during rotation relative to a defined datum.
Sealed bearing	Provides a type of contaminant protection and lubricant retention, not guaranteed waterproofing.
Limiting speed	Recommended speed boundary under stated bearing and operating assumptions.

STUDY NOTE

Higher precision does not automatically establish longer bearing life or a higher load rating. A bearing with the correct dimensions may still be unsuitable because of its clearance, seals, lubricant, load capability or fit.

Knowledge check

1. Which direction is axial?

- A) Along the shaft axis
- B) Perpendicular to the shaft
- C) Any random force

2. For standard deep-groove bore codes, what does code 12 indicate?

- A) 12 mm
- B) 60 mm
- C) 120 mm

3. What does C3 commonly indicate?

- A) Precision grade
- B) Internal clearance class
- C) Steel composition

4. What is dynamic load rating used for?

- A) Packaging quality
- B) Fatigue-life rating calculations
- C) Unit price calculation

Answers and explanations appear in the answer key at the end of the book.

Ten Bearing Families & Their Applications

Study each family in HRB's engineering catalog: its construction, principal loading, listed series, applications, strengths and limitations.

3.1 The ten families at a glance

Bearing family	Main purpose
Deep groove ball	General-purpose low-friction radial operation with some axial loading.
Self-aligning ball	Radial loads with accommodation of angular misalignment.
Angular contact ball	Combined loading, precision and preloaded arrangements.
Thrust angular contact ball	Precision axial support, especially machine tools and ball screws.
Thrust ball	Dedicated axial load support.
Cylindrical roller	High radial load and rigidity.
Tapered roller	High combined radial and axial loads.
Spherical roller	Heavy loads and angular misalignment.
Thrust spherical roller	Heavy axial loads with some radial capability and alignment compensation.
Thrust cylindrical roller	High axial loads and rigidity without self-alignment.

3.2 Deep groove ball bearing

HRB-listed series: 6000, 6200, 6300, 6400, 16000, 61800, 61900, 62200, 62300; double-row 4200/4300.

Construction: Single- and double-row; options with seals, shields or snap-ring grooves.

Typical applications: Motors, pumps, fans, alternators, home appliances and general machinery.

Selection note: Low friction and broad standardization; not a first choice for strong misalignment or unusually high thrust.

3.3 Self-aligning ball bearing

HRB-listed series: 1200, 1300, 2200, 2300.

Construction: Cylindrical or tapered bore with spherical outer-ring raceway; some angular misalignment permitted.

Typical applications: Textiles, woodworking, paper production, multi-supported shafts.

Selection note: Primarily radial; lower load capacity than many equivalent spherical roller bearings.

3.4 Angular contact ball bearing

HRB-listed series: 7000, 7200, 7300, 7400, 718, 719, 3200, 3300.

Construction: Single-row, double-row and matched mounting DB, DF, DT; company lists 15°, 25°, 40° contact-angle options.

Typical applications: Precision spindles, motors, reducers, pumps and centrifuges.

Selection note: Good combined-load support and preload options; arrangement/orientation determine axial loading.

3.5 Thrust angular contact ball bearing

HRB-listed series: 7602, 7603, 2344, 2347, 2349.

Construction: Axial-stiffness-focused designs, including single- and double-direction configurations; large contact angles.

Typical applications: Ball-screw supports, high-precision spindles and rotary tables.

Selection note: Requires suitable preload, mounting and careful application matching.

3.6 Thrust ball bearing

HRB-listed series: 51000 (511-514), 52000 (522-524), 53000 (532-534).

Construction: Single- or double-direction thrust structures; spherical-seat options.

Typical applications: Crane hooks, jacks, vertical pumps and spindles.

Selection note: Designed for axial, not radial loads; speed depends on type and conditions.

3.7 Cylindrical roller bearing

HRB-listed series: NU, NJ, NUP, N, NF, NN, NNU; four-row FC, FCD, FCDP.

Construction: Single-, double- and four-row designs; flange layouts govern axial positioning.

Typical applications: Gearboxes, motors, large fans, machine-tool spindles and rolling mills.

Selection note: High radial capacity; N and NU commonly allow axial displacement, while NJ/NUP have distinct locating roles.

3.8 Tapered roller bearing

HRB-listed series: 329, 320, 330, 331, 302, 322, 332, 303, 313, 323; double-row 350000; four-row 380000.

Construction: Conical rollers and races; paired arrangements often handle axial loads in both directions.

Typical applications: Wheel hubs, reducers, construction and agricultural machinery, rolling mills.

Selection note: Strong combined-load capability; requires appropriate mounting and clearance/preload control.

3.9 Spherical roller bearing

HRB-listed series: 213, 222, 223, 230, 231, 232, 239, 240, 241.

Construction: Usually two rows of barrel-shaped rollers and a spherical outer raceway; straight and tapered bores.

Typical applications: Mining, crushers, vibrating screens, paper machinery, heavy fans and mills.

Selection note: High load and misalignment capability; requires correct minimum load and lubrication conditions.

3.10 Thrust spherical roller bearing

HRB-listed series: 292, 293, 294.

Construction: Asymmetric roller contact geometry and self-alignment for thrust applications.

Typical applications: Vertical pumps, turbines, marine shafts and drilling machinery.

Selection note: High axial load with some radial capacity, subject to design and bearing-life conditions.

3.11 Thrust cylindrical roller bearing

HRB-listed series: 811, 812.

Construction: Thrust-oriented cylindrical rollers, with single- or double-direction arrangements.

Typical applications: Rolling-mill screwdow, heavy reducers, drilling and vertical equipment.

Selection note: High axial capacity and rigidity; cannot generally sustain radial loads or angular misalignment.

3.12 How to organize the technical catalog

The recommended taxonomy is engineering family → subcategory → series → model. Maintain a separate industry/application classification (motor, railway, machine tool, automotive, metallurgy, etc.) so buyers can discover the same product by construction or use case.

STUDY NOTE

Listed series represent categories in the supplied HRB documentation, not evidence that every suffix and variation is currently manufactured or stocked. A current model-level database is required for an accurate public catalog.

Knowledge check

1. Which family is known for heavy radial loads and self-alignment?

- A) Spherical roller
- B) Thrust ball
- C) Deep groove

2. Which group includes 811 and 812?

- A) Tapered roller
- B) Thrust cylindrical roller
- C) Self-aligning ball

3. What do DB/DF/DT commonly describe?

- A) Material grade
- B) Angular-contact mounting configurations
- C) Shipping methods

4. Is a railway bearing an engineering type?

- A) No, it is an application grouping
- B) Yes, identical to cylindrical roller
- C) A precision code

Answers and explanations appear in the answer key at the end of the book.

Bearing Raw Materials & Incoming Testing

Understand high-carbon chromium bearing steel, special materials, chemical analysis, metallography, ultrasonic flaw detection, tensile tests and batch traceability.

4.1 Why material quality matters

Bearing rolling contacts cycle through extremely high localized stress. Steel chemistry, cleanliness, heat-treatment response, microstructure and defects affect fatigue performance, wear and dimensional stability. Material acceptance is thus a key quality gate before forging or machining.

4.2 Material groups reported in the documents

Material	Documented use or caution
High-carbon chromium bearing steel	Primary material class in manufacturing process; GCr15 and GCr15A listed in sample products.
Carburizing bearing steel	Named as an available category in HRB FAQ; exact grades not supplied.
High-temperature / alloy steels	Corporate presentation mentions these for high-end product applications.
Stainless steel	Listed for a magnetic-suspension protective bearing sample.
Hybrid ceramic configurations	Mentioned among machine-tool product series; construction requires model confirmation.

4.3 GCr15 and elements in bearing steel

GCr15 is a Chinese high-carbon chromium bearing steel commonly compared with AISI 52100/100Cr6 at a broad family level. The name reflects a bearing-steel designation and nominal chromium content around 1.5%. Such comparisons are not automatic certification of full standard equivalence.

Element	Functional significance
Fe (iron)	Primary metallic matrix.
C (carbon)	Contributes to hardening and wear resistance.
Cr (chromium)	Contributes to hardenability and carbide-related properties.

Element	Functional significance
Mn / Si	Influence steelmaking and processing response.
S / P	Controlled impurities; levels and morphology affect quality.

The company refers to GB/T 18254 for high-carbon chromium bearing steel, but its uploaded documents do not give the standard edition or full chemical thresholds. “GCr15A” appears in the railway-bearing sample without a separate technical definition.

4.4 Incoming quality-control flow

The manufacturing table describes certificate verification, batch sampling, chemical and physical analysis, metallography, ultrasonic inspection and visual inspection. It does not specify that every bar receives every test.

Instrument	What it evaluates
Direct-reading spectrometer	Elemental chemical composition, typically using emission spectroscopy.
Metallographic analyzer	Microstructure, non-metallic inclusions and carbide characteristics.
Ultrasonic flaw detector	Certain subsurface discontinuities by reflected sound waves.
Tensile testing machine	Stress-strain behavior of prepared material specimens; frequency not specified.

4.5 Inclusions, carbides and microstructure

Non-metallic inclusions are particles such as oxides and sulfides. Depending on their size, shape and location, they can initiate localized fatigue damage. Carbides are hard carbon-containing phases; their morphology and distribution influence hardness, machinability, wear and fatigue behavior. Metallography can evaluate these features in prepared specimens.

4.6 Ultrasonic testing and limits

In ultrasonic testing, a probe sends high-frequency sound into material and an instrument analyzes returning echoes. It may detect internal cracks or other reflecting discontinuities, depending on geometry, equipment and procedure. A successful examination does not establish absolute absence of all defects.

4.7 Traceability

An effective material traceability system connects supplier certificate and heat/lot identifiers to incoming tests, subsequent production batches and finished products. HRB describes batch traceability as an objective; the detailed data model and acceptance workflow are not included in the files.

STUDY NOTE

For website publication, request exact approved steel grades, source material certificates, edition of GB/T 18254, inspection frequencies and acceptance criteria, equipment photographs and sanitized laboratory reports.

Knowledge check

1. What does a spectrometer measure?

- A) Chemical composition
- B) Shipment weight
- C) Rotational noise

2. What can metallography reveal?

- A) Material inclusions and carbides
- B) Website traffic
- C) Currency exchange

3. Is ultrasonic testing destructive?

- A) Always
- B) Normally non-destructive
- C) Only for finished websites

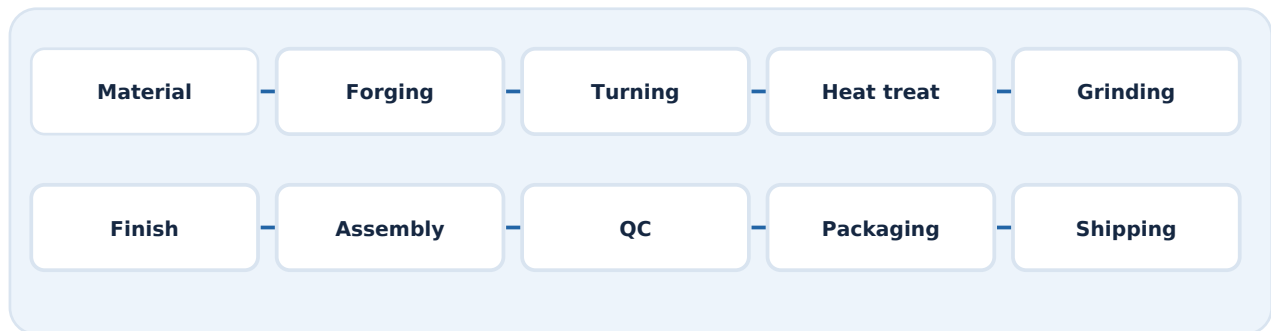
4. Does HRB prove every bar gets a tensile test?

- A) Yes
- B) No
- C) Only for motor bearings

Answers and explanations appear in the answer key at the end of the book.

Manufacturing: From Forging to Shipping

Follow HRB's ten-stage manufacturing framework, understand major equipment, selected reported parameter values and quality checks at every process.



The HRB process document provides a broad route from material receiving to shipping. Detailed steps can differ by bearing family, grade, size or component. The figures below are company-reported process parameters, not universal settings for every bearing.

5.1 Stage 1: Raw material selection and inspection

Incoming material is selected, matched with certificates, sampled and examined using spectrometric, metallographic, ultrasonic and visual methods. This establishes a documented starting point for suitable chemistry, material cleanliness and traceability.

5.2 Stage 2: Forging and spheroidizing annealing

Steel stock is cut, induction heated and formed by press and ring rolling into bearing ring blanks. HRB reports initial forging at $1080 \pm 20^\circ\text{C}$ and spheroidizing annealing at $785 \pm 10^\circ\text{C}$. The latter encourages a machinable carbide morphology in suitable steels. Inspection includes dimensions, surface cracking, Brinell hardness and metallographic sampling.

5.3 Stage 3: CNC rough and finish turning

CNC lathes machine ring diameters, end faces, chamfers and seal grooves, leaving allowance for subsequent heat treatment and precision grinding. The process table states $R_a \leq 6.3 \mu\text{m}$ and 0.25–0.4 mm per side in heat-treatment allowance. These values belong to the described turning stage.

5.4 Stage 4: Quenching, tempering and stability

Controlled heating and cooling develop a hardened steel microstructure. The HRB table reports quenching $830\text{--}850^\circ\text{C}$, low-temperature tempering $160\text{--}180^\circ\text{C}$, and a hardness range HRC 60–64 for the described process. Controls include retained austenite, decarburization, deformation and cracking; selected applications may receive cold treatment.

5.5 Stage 5: Precision grinding

Hardened ring faces, diameters and raceways are ground using dedicated equipment. Grinding corrects geometry following heat treatment, controlling dimensions, roundness and waviness. The table reports raceway roundness $\leq 0.3 \mu\text{m}$ for stated P4/P5 bearings and emphasizes avoiding grinding burn.

5.6 Stage 6: Raceway superfinishing

Fine abrasive processing reduces microscopic machining marks, roughness and waviness on bearing raceways. HRB reports raceway Ra 0.01–0.04 μm after its described superfinishing process. This supports favorable rolling contact and lower vibration but does not establish one universal tolerance for all products.

5.7 Stage 7: Assembly

Components are cleaned and matched by clearance, then rolling elements, cages, lubricant and seals are assembled as applicable. HRB reports automated assembly and inspection of cleanliness, radial clearance, cage riveting, grease filling and rotational freedom. Different bearing types require different cage and assembly approaches.

5.8 Stage 8: Finished-product inspection

The HRB table lists dimensional accuracy, radial runout, vibration (including ZVE), noise, cleanliness, appearance and traceability. It names special-purpose measuring instruments, vibration meters, runout detectors, cleanliness testing and life-testing machinery. Life/reliability testing is described by sampling for certain products, not universally on every unit.

5.9 Stage 9: Packaging

Cleaned products receive appropriate anti-corrosion protection and protective packaging. The stated process includes vacuum/moisture-resistant packaging, laser marking, quantity and batch labeling, and verification of packaging integrity.

5.10 Stage 10: Warehouse and shipping

Products are stored, picked against customer orders, and rechecked for model, batch, quantity and packaging. Shipping protection and identification help preserve quality and traceability through dispatch.

5.11 Compact process-control reference

Stage	Reported technical control
Forging	1080 ± 20°C initial forming; 785 ± 10°C spheroidizing annealing.
Turning	Ra ≤ 6.3 µm; heat-treatment allowance 0.25–0.4 mm/side.
Heat treatment	830–850°C quenching; 160–180°C tempering; HRC 60–64.
Grinding	Raceway roundness ≤ 0.3 µm for described P4/P5 products.
Superfinishing	Reported raceway Ra 0.01–0.04 µm.
Assembly / inspection	Clearance matching, cleanliness, vibration and dimensional checks.

STUDY NOTE

The specific manufacturing traveler for sample model 6312-2RS was not supplied. The ten-stage general route can illustrate its possible production flow but should not be presented as a verified model-specific manufacturing record.

Knowledge check

1. Which stage shapes ring blanks?

- A) Forging
- B) Final inspection
- C) Shipping

2. Which stage develops material hardness?

- A) Packaging
- B) Heat treatment
- C) Customer inquiry

3. What is the major goal of grinding?

- A) Create precision geometry
- B) Arrange payment
- C) Make company logos

4. Does the document say every bearing receives an endurance life test?

- A) Yes
- B) No
- C) Only with buyer permission

Answers and explanations appear in the answer key at the end of the book.

Quality Control, Precision & Reliability

Understand HRB's stated inspections, bearing precision and geometry tests, vibration analysis, life-rating principles, certificates, PPM targets and traceability.

6.1 QA versus QC

Quality assurance builds preventive processes, procedures and accountability. Quality control evaluates a product or process against requirements. HRB lists raw-material, process, dimensional, heat-treatment, surface, assembly, final and packaging controls plus traceability.

6.2 Mechanical and dimensional tests

Test	Purpose
Rockwell hardness (HRC)	Checks resistance to indentation in hardened material.
Brinell hardness	Assesses hardness in applications such as annealed/forged material.
Dimension / roundness	Checks bore, outer diameter, width and geometric form.
Runout measurement	Evaluates variation during rotation relative to reference axes.
Surface roughness (Ra)	Evaluates fine-scale contact-surface texture.
Clearance testing	Determines permitted relative movement between unmounted bearing rings.

Roundness is a shape error; runout includes the rotational relationship to specified datum features. A nearly circular component may still show significant runout when its axis is incorrectly located. Precision grades such as P0, P5, P4 and P2 govern selected tolerances; they are not direct service-life rankings.

6.3 Noise, vibration and cleanliness

Vibration and noise can be influenced by raceway waviness, defects, cage dynamics, lubricant behavior, contamination and test mounting conditions. HRB describes ZVE-related vibration checks, but complete calibration, units and model-by-model thresholds are not included. Cleanliness testing may measure extracted particle mass and particle-size distribution.

6.4 Bearing life and the L10 concept

A commonly taught basic rating-life relation is $L_{10} = (C/P)^p$, with L_{10} in millions of revolutions, C the basic dynamic rating, P an equivalent dynamic load, and p usually 3 for balls or 10/3 for rollers. L_{10} represents the rating life associated with 90% reliability in its relevant reference population and assumptions. This is general engineering theory, not an HRB-specific acceptance equation.

6.5 Reported HRB inspection arrangements

The process narrative claims 100% finished-product inspection. Its detailed table also identifies extended life and reliability checks through sampling for selected precision or military bearings. Every-unit inspection does not imply 100% endurance testing. For website claims, clarify the exact tests performed on all pieces versus samples.

6.6 Certifications and management systems

The company FAQ names ISO 9001, ISO 14001 and OHSAS 18001. ISO 9001 addresses quality management, ISO 14001 environmental management, and OHSAS 18001 is a legacy occupational-safety standard superseded by ISO 45001. Current valid certificates, editions, issuing bodies, covered sites and expiration dates must be verified.

6.7 Digital quality and PPM targets

HRB's presentation describes rapid production-data uploads, batch traceability, a QMS framework and "Ha Xiao Zhou" AI-based tracking/alerts. It sets company quality-failure targets below 50 PPM in 2026 and below 8 PPM in 2030. These are targets, not documented achieved results. The exact metric denominator and whether it represents internal/outgoing/customer defects are unspecified.

6.8 How to build a credible Quality page

Present actual laboratory facilities, inspection stages, test methods, current certifications, sample reports approved for sharing, and documented digital traceability. Do not publish numerical "zero defect," "100% tested," or life-improvement claims without scope and evidence.

Knowledge check

1. What does HRC measure?

- A) Hardness
- B) Shipping price
- C) Precision grade

2. How does runout differ from roundness?

- A) It concerns rotational variation to a reference
- B) They are identical by definition
- C) Runout means bearing weight

3. What does ISO 9001 address?

- A) A particular bearing load rating
- B) Quality management systems

C) Steel chromium percentage

4. Is “less than 8 PPM by 2030” reported as achieved?

A) No, it is a target

B) Yes, verified achieved

C) Not related to quality

Answers and explanations appear in the answer key at the end of the book.

Research, Development & Intelligent Manufacturing

Explore HRB's reported R&D; center, bearing-design optimization, numerical simulations, precision technology, automated systems, warehouse robotics and quality data.

7.1 R&D in a bearing company

R&D; develops materials, contact geometries, cage configurations, heat-treatment methods and performance analysis. The requirements document reports 58 R&D; personnel and describes a center with capabilities in material/process research, bearing failure analysis and testing. The presentation also describes a national-level enterprise technology center; current scope needs independent documentation.

7.2 Forging flow-line control

HRB reports using ring rolling to optimize material-flow orientation near the raceway, aiming to improve fatigue resistance. It claims a 15–20% bearing-life improvement versus steel-pipe-cut rings under comparison tests, but the source files lack the test conditions and statistics. Treat it as a manufacturer-reported result.

7.3 Advanced bearing materials

The presentation identifies premium bearing steel, high-temperature steel, and aerospace-standard steel or alloy materials for selected products. Material selection is coupled to temperature, contact stress, wear, corrosion, vibration, fatigue and manufacturing response; no one material is best for every bearing application.

7.4 Natural-frequency and vibration simulation

Every dynamic mechanical system has characteristic vibration modes. An excitation frequency near a natural frequency may increase vibration under suitable conditions. HRB describes adjusting rolling-element count, contact geometry, cage structure and materials to manage noise and frequency behavior. Specific algorithms and software are not supplied.

7.5 Low-noise design

HRB reports tighter cage-guidance relationships, precision matching, and vibration analysis using parameters including peak value and kurtosis. Peak value describes extreme signal magnitude; kurtosis is a statistical distribution measure sometimes used in signal diagnostics. Neither alone identifies a defect.

7.6 Mirror superfinishing and precision margin

HRB highlights mirror superfinishing for reducing machining marks and supporting retention of low vibration/noise characteristics. "High Reserve Precision" is used in the presentation to describe controlling some manufacturing characteristics more tightly than nominal requirements. It should not be generalized into a guarantee that every bearing has a higher precision class.

7.7 Thermal rotational speed and tapered roller designs

High-speed bearings generate heat from friction and lubricant interactions. The presentation describes software-based thermal-speed analysis and optimizing roller contact, quantity and geometry to manage temperature and speed. Its tapered-roller discussion emphasizes rib contact, lubricant-film behavior, low noise and running-in characteristics.

7.8 Numerical simulation services

Analysis	Purpose
Rating life	Estimate behavior under defined loads and assumptions.
Clearance / preload	Understand installed internal behavior and stiffness.
Stiffness and impact	Evaluate deformation and response to loading.
Accuracy	Evaluate geometric and functional accuracy concerns.
Lubrication interval	Explore lubricant durability / maintenance implications.
Visualization	Communicate calculation outputs to engineers and customers.

CAD is computer-aided design; CAE is computer-aided engineering; FEA is one type of numerical analysis. HRB describes simulation but does not identify its exact software stack. Mathematical analysis can reduce prototypes but does not automatically eliminate the need for validation.

7.9 Robotics, warehouse automation and digital manufacturing

Presentation claim	How to interpret
6 CTUs, one RCS scheduling platform	Specific reported warehouse robotics arrangement; exact acronym expansion/model not supplied.
300 m² stores 235,200 items	Reported warehouse configuration, not full-factory inventory.
12 online units, 5 s/piece	Cycle-time claim for a specified automated system.
±0.02 mm gripping accuracy	Robotic gripping figure, not a finished-bearing tolerance.
Motor Branch interconnection completed	Presentation says this was complete at the time of drafting.
Railway and forging automatic lines under construction	Not stated to be completed.

7.10 Digital QMS, traceability and patents

The presentation describes monitoring, batch traceability, and the Ha Xiao Zhou AI alert system. The requirements file lists patent records and R&D; capabilities. Before publication, verify patent ownership/legal status, exact automation deployment and screenshots or photographs approved for disclosure.

Knowledge check

1. Which is an R&D simulation topic listed by HRB?
 - A) Preload and stiffness
 - B) Social-media reach
 - C) Website colors
2. What does the ± 0.02 mm figure refer to?
 - A) All bearing product tolerances
 - B) Robotic gripping accuracy claim
 - C) Shaft diameter limit
3. Are all described digital factory projects complete?
 - A) Yes
 - B) No
 - C) They do not involve production
4. What is batch traceability for?
 - A) Connecting quality and production records
 - B) Replacing engineers
 - C) Counting website visits

Answers and explanations appear in the answer key at the end of the book.

International B2B Sales, RFQ & Website Integration

Understand HRB's documented inquiry-to-delivery workflow, sales and engineering responsibilities, standard-versus-custom terms, and how to build an effective product catalog and quotation system.



8.1 B2B industrial procurement

Industrial bearing customers may be machine builders, distributors, technical maintenance teams and procurement departments. Unlike a consumer checkout, a B2B sale may require model confirmation, operating-condition review, quotation, technical agreement, sample validation and negotiated shipment/payment terms.

8.2 The 15-stage HRB workflow

Stage	Documented process / output
1. Inquiry	Customer Development Dept.; approximately 0.5 working day; requirement confirmation.
2. Technical review	Product Research Institute + Customer Development; about 1 working day.
3. Product selection	Model, clearance, cage, seal suitability; about 1 working day.
4. Quotation	Customer Development; about 1 working day; official quotation.
5. Technical discussion	Risk/tolerances/terms; about 1–3 working days.
6. Sample / prototype	If required; process and manufacturing teams; about 7–15 working days.
7. Sample approval	Inspection/report; company process allotment about 2 working days.
8. Purchase order	Commercial terms and order confirmation; about 2 working days.
9. Production	Usually within 60 working days for regular standard production.
10. Final QC	Final checks and inspection report; about 1–2 working days.
11. Packaging	Anti-rust, labels, packing list; about 0.5 working day.
12. Warehousing	Quantity/location verification; about 0.5 working day.
13. Shipping	Delivery note / waybill; about 1 working day.
14. Delivery	Arrival and packaging check; depends on transportation cycle.
15. After-sales	Immediate response, feedback within 24h stated in workflow.

Stages and times are company-reported estimates. Technical discussions, samples and validation are conditional; elapsed time from inquiry to delivery cannot safely be calculated by simply adding the listed durations.

8.3 Standard, custom, OEM and ODM

The FAQ says there is no strict minimum order quantity for standard catalog bearings; nonstandard/custom quantities are negotiated. HRB prioritizes its own brand, reports capability for ODM design/manufacturing, and evaluates OEM engagements on a project basis. Standard and custom samples may be offered, with prototype pricing and delivery conditions reviewed individually.

8.4 Standard and special lead times

The FAQ states normal regular-standard production lead time of 60 working days, while in-stock product may ship immediately. The presentation separately mentions 48-hour spot delivery and 35–90-day scheduled delivery. These may apply to different circumstances and are not directly reconciled; never display a universal promise without company approval.

8.5 What is an RFQ?

A Request for Quotation (RFQ) is a structured request by a prospective buyer for an offer identifying product, commercial and delivery conditions. An inquiry is not yet a purchase order. Engineering review may be required before a responsible quotation can be issued.

8.6 Recommended quotation information

Customer data	Technical and commercial data
Name; company; country; contact email/telephone	Category, model number, quantity and target delivery.
Customer website / role (optional)	Bore, OD, width; desired material and precision, where known.
Preferred contact method	Load, speed, temperature, environment and expected lifetime, where needed.
Business/delivery country	Requested drawing, attachments, certificates, packaging and commercial terms.

8.7 Conditional form design

Use two paths: standard model RFQ (known bearing model, quantity, destination, contacts) and technical/custom RFQ (operating conditions, drawing upload, technical review and project requirements). Conditional logic minimizes unnecessary fields for experienced buyers yet captures required information for engineers.

8.8 Website technology architecture

WordPress manages pages; WooCommerce stores products/categories/models; Elementor Pro can define reusable archive and single-product templates; custom fields manage detailed bearing data; an RFQ integration captures inquiry details; and a secure CRM or inquiry tracker supports assignment and follow-up. This is a recommended website architecture, not evidence that HRB currently uses these systems.

8.9 Status, security and approval

Useful internal statuses include new inquiry, engineering review, quotation issued, awaiting acceptance, order confirmed, production, final QC, shipped and closed. Protect uploaded technical drawings, route inquiries to authorized teams, limit internal cost data visibility, provide spam protection and follow applicable data privacy requirements.

8.10 International commerce basics

International quotations may use Incoterms such as EXW, FOB, CIF, DAP and DDP, each defining different delivery-related obligations and risk transitions. Actual available Incoterms, payment conditions, currencies, taxes and warranty terms must be confirmed with HRB. The FAQ reports exports to multiple regions but does not provide a comprehensive approved country list.

8.11 Worked example: model 6312-2RS

The sample technical file identifies model 6312-2RS as a deep groove motor bearing, 60 × 130 × 31 mm, material GCr15, with sample load ratings Cr 81.7 kN and C0r 51.8 kN. A hypothetical customer asks for 500 sets. The website attaches the selected model to the RFQ; the company confirms availability, suitability, quote, terms and schedule. The sample order quantity is illustrative, not actual sales data.

Knowledge check

1. What does RFQ stand for?

- A) Request for Quotation
- B) Raw Forging Quality
- C) Retail Factory Queue

2. Who reviews technical needs in the HRB workflow?

- A) Product Research Institute + Customer Development
- B) Only shipping
- C) Only customer

3. Does the FAQ say there is a strict MOQ for standard catalog products?

- A) No
- B) Yes, always 10,000
- C) No sample models exist

4. Should an RFQ become an order automatically?

- A) Yes
- B) No, review and commercial agreement come first
- C) Only for P4

Answers and explanations appear in the answer key at the end of the book.

Quick Reference Glossary

Term	Meaning
Axial load	Force parallel to the bearing axis.
Bearing cage	Element that separates/guides balls or rollers.
Bearing clearance	Relative ring movement available under specified unmounted conditions.
Carburizing	Surface carbon enrichment applied to suitable steels followed by heat treatment.
CNC	Computer Numerical Control.
Contact angle	Geometric direction of force transmission in a rolling contact.
Dynamic load rating	Standardized rating used in fatigue-life calculations.
FEA	Finite Element Analysis.
Forging	Shaping material by compressive deformation.
GCr15	High-carbon chromium bearing steel designation.
HRC	Rockwell C hardness scale.
IPQC	In-process quality control (general industry label).
L10 life	Basic bearing rating-life concept associated with 90% reliability.
Metallography	Examination of material microstructure.
MOQ	Minimum Order Quantity.
OEM / ODM	Original Equipment Manufacturer / Original Design Manufacturer.
PPM	Parts or events per million, depending on metric definition.
Preload	Controlled initial internal loading in a bearing arrangement.
QMS	Quality Management System.
Ra	Arithmetic average surface roughness.
Radial load	Force perpendicular to the bearing axis.

Term	Meaning
RFQ	Request for Quotation.
Runout	Measured variation during rotation relative to a datum.
Spheroidizing annealing	Heat treatment to develop spheroidal carbides in applicable steels.
Superfinishing	Fine abrasive process to refine contact surfaces.
UT	Ultrasonic testing (non-destructive inspection).

Knowledge Check Answer Key

Lesson 1

1. Which is HRB's main business? — Bearing engineering and manufacturing
2. What occurred in August 2020 according to the presentation? — Jianlong restructured/acquired HRB
3. Is a motor bearing an engineering construction type? — No, it is an application class
4. Does annual capacity equal actual annual sales? — No, they are different metrics

Lesson 2

1. Which direction is axial? — Along the shaft axis
2. For standard deep-groove bore codes, what does code 12 indicate? — 60 mm
3. What does C3 commonly indicate? — Internal clearance class
4. What is dynamic load rating used for? — Fatigue-life rating calculations

Lesson 3

1. Which family is known for heavy radial loads and self-alignment? — Spherical roller
2. Which group includes 811 and 812? — Thrust cylindrical roller
3. What do DB/DF/DT commonly describe? — Angular-contact mounting configurations
4. Is a railway bearing an engineering type? — No, it is an application grouping

Lesson 4

1. What does a spectrometer measure? — Chemical composition
2. What can metallography reveal? — Material inclusions and carbides
3. Is ultrasonic testing destructive? — Normally non-destructive
4. Does HRB prove every bar gets a tensile test? — No

Lesson 5

1. Which stage shapes ring blanks? — Forging
2. Which stage develops material hardness? — Heat treatment
3. What is the major goal of grinding? — Create precision geometry
4. Does the document say every bearing receives an endurance life test? — No

Lesson 6

1. What does HRC measure? — Hardness
2. How does runout differ from roundness? — It concerns rotational variation to a reference
3. What does ISO 9001 address? — Quality management systems

4. Is “less than 8 PPM by 2030” reported as achieved? — No, it is a target

Lesson 7

1. Which is an R&D simulation topic listed by HRB? — Preload and stiffness

2. What does the ± 0.02 mm figure refer to? — Robotic gripping accuracy claim

3. Are all described digital factory projects complete? — No

4. What is batch traceability for? — Connecting quality and production records

Lesson 8

1. What does RFQ stand for? — Request for Quotation

2. Who reviews technical needs in the HRB workflow? — Product Research Institute + Customer Development

3. Does the FAQ say there is a strict MOQ for standard catalog products? — No

4. Should an RFQ become an order automatically? — No, review and commercial agreement come first

Source & Verification Notes

The learning content was consolidated from the eight lessons and user-supplied materials listed below. This volume is educational and should not be published unchanged as formal manufacturer technical documentation.

Source	Material used
Completed HRB website information requirements (DOCX)	Company details, process parameters, sample models, quality controls, R&D overview, 15-stage RFQ-to-delivery workflow, FAQ.
HRB English company introduction (PPTX)	Corporate profile, Jianlong relationship, key technologies, digital factory initiatives, quality targets, selected capacity claims.
Bearing product/workflow workbook (XLSX)	Bearing taxonomy, series and production/media source material.
Lessons 1-8 in this study series	General engineering explanations, educational examples, quizzes and suggested website system architecture.

Claims that require verification before publication

- The number and scope of production sites, floor-area figures, product-size ranges, and current annual capacity.
- Actual available steel grades, current material standards/editions, and material-test acceptance limits.
- Applicability of reported forging, heat-treatment, grinding and superfinishing parameters by bearing model.
- Current ISO certificate details; replacement/status of the legacy OHSAS 18001 reference.
- Exact meaning and achievement of the 2026 and 2030 PPM quality targets.
- Methodology for the presentation's forging and low-noise performance comparisons.
- Current deployment and technical definitions of CTU, RCS, AGV and Ha Xiao Zhou systems.
- Individual model availability, current datasheets, model suffix meanings, export terms, payment terms and lead times.
- Patent ownership, active status, and permission to publish partner/customer names, images or logos.

Suggested study-to-website workflow

1. Confirm current manufacturer source documents. 2. Establish a verified technical product master table. 3. Build category and application taxonomies. 4. Gather authorized product/factory photographs and technical drawings. 5. Create reusable product templates and a secure RFQ process. 6. Review engineering, legal, certification and marketing claims before publication.

End of the Eight-Lesson HRB Bearing Study Book.