

HEBEI RUNHE

Single-Acting Hydraulic Cylinders

Technical White Paper



Multi-Brand Compatible | Agricultural / Truck / Construction OEM

Table of Contents

Right-click and select "Update Field" to refresh page numbers

Executive Summary	3
Introduction to Single-Acting Hydraulic Cylinders	4
Working Principle and Structural Design	4
Key Technical Features	5
Hebei Runhe Product Overview	6
Product Range and Specifications	6
Multi-Brand Compatibility	7
Complete Technical Specifications	8
Agricultural Machinery Applications	10
Tractor and Implement Cylinders	10
Harvester and Sprayer Systems	11
Heavy Truck and Trailer Applications	12
Construction Equipment Applications	13
Humanized Management and TCO Optimization	14
Maintenance Cost Reduction Strategy	14
Rapid Delivery and After-Sales Support	15
Competitive Advantage	16
Price-Performance Leadership	16
Quality Assurance and Testing	17
Conclusion	18
References	19

Executive Summary

Hebei Runhe Hydraulic Manufacturing has established itself as a premier Chinese manufacturer of single-acting hydraulic cylinders, delivering precision-engineered products that achieve compatibility with multiple leading agricultural equipment brands while maintaining competitive pricing and rapid delivery cycles. This technical white paper provides comprehensive engineering documentation, application analysis, and competitive positioning for the Hebei Runhe single-acting cylinder product line, demonstrating the company's commitment to quality manufacturing and humanized aftermarket service.

Single-acting hydraulic cylinders represent a critical actuator class across agricultural machinery, heavy-duty trucks, and construction equipment. Unlike double-acting cylinders that apply force in both extension and retraction directions, single-acting cylinders utilize hydraulic pressure for the working stroke and rely on gravity or spring force for return — a design inherently suited to lifting, tipping, and raising applications where the load itself provides the return energy. Hebei Runhe's manufacturing expertise spans the complete range of single-acting cylinder configurations, from compact agricultural lift cylinders to large-bore telescopic units for dump trucks and heavy construction equipment.

Key value propositions include: (1) Multi-brand compatibility with major agricultural OEM specifications including John Deere, Case IH, New Holland, Kubota, and Massey Ferguson hydraulic systems; (2) Complete dimensional and pressure interchangeability with established European and North American cylinder brands; (3) Continuous operating pressures to 250 bar with burst pressure margins exceeding 2.5x rating; (4) Delivery lead times of 10-15 days for standard catalog products and 20-30 days for custom configurations; (5) Humanized management philosophy delivering total cost of ownership reductions of 30-50% compared to OEM-sourced replacement cylinders; and (6) Comprehensive seal kit and parts availability ensuring minimal equipment downtime.

Introduction to Single-Acting Hydraulic Cylinders

Hydraulic cylinders serve as the fundamental linear actuators in virtually all mobile and industrial hydraulic systems, converting fluid power into mechanical force and motion. The single-acting cylinder — defined by its use of hydraulic pressure on only one side of the piston — represents the most widely applied cylinder type in agricultural, transportation, and construction sectors due to its inherent simplicity, reliability, and cost-effectiveness for lifting and tipping applications.

The engineering principle underlying single-acting cylinder design is elegantly simple: pressurized hydraulic fluid enters the cylinder through a single port, acting on the piston face to generate linear motion and force. The return stroke is achieved either by gravitational force (when the cylinder is mounted vertically and the load provides the return energy) or by an internal spring mechanism (for horizontally mounted or non-gravity-assisted applications). This unidirectional hydraulic operation eliminates the need for complex porting, reduces seal count by approximately 40% compared to double-acting designs, and simplifies the overall hydraulic circuit architecture.

Hebei Runhe Hydraulic Manufacturing has developed comprehensive single-acting cylinder production capabilities that encompass the full manufacturing process from precision cold-drawn steel tube preparation through CNC machining, welding, surface treatment, assembly, and pressure testing. The company's vertically integrated production model ensures complete quality control at every manufacturing stage while enabling the cost efficiency and delivery responsiveness that distinguish Hebei Runhe in the global hydraulic component market.

Working Principle and Structural Design

The structural design of a single-acting hydraulic cylinder comprises several critical component groups, each engineered to specific performance and durability requirements:

- **Cylinder Barrel:** Precision cold-drawn seamless steel tubing with internal honing to achieve surface roughness of Ra 0.2-0.4 μm , ensuring optimal seal performance and extended seal life. Barrels are available in standard diameters from 40 mm to 200 mm bore, with wall thicknesses calculated to contain maximum working pressures with appropriate safety factors.
- **Piston Rod:** Hard-chrome plated carbon steel or induction-hardened alloy steel rods provide exceptional wear resistance and corrosion protection. Chrome layer thickness of 20-30 μm ensures sustained performance in harsh agricultural and construction environments. Rod diameters range from 20 mm to 140 mm depending on bore size and application loading.
- **Piston Assembly:** One-piece or two-piece piston designs incorporating wear rings and pressure seals optimized for single-acting operation. Piston materials include ductile iron, aluminum alloy, or steel depending on pressure rating and duty cycle requirements.
- **Gland and Seal System:** The rod gland assembly incorporates a multi-lip seal arrangement comprising a primary pressure seal (PU or NBR), secondary wiper seal, and dust exclusion ring. This three-layer sealing system maintains hydraulic integrity across temperature ranges from -30°C to +100°C.
- **Mounting Hardware:** Industry-standard mounting configurations including clevis, trunnion, pin-eye, flange, and foot mountings ensure direct interchangeability with OEM cylinder installations across all major equipment brands.

Key Technical Features

Hebei Runhe single-acting cylinders incorporate several engineering enhancements that distinguish them from generic alternatives and ensure reliable performance in the most demanding operating environments:

- **Precision Honing Technology:** CNC-controlled honing equipment achieves bore tolerances of H8 to H9, with surface finish Ra 0.2-0.4 μm . This precision surface finish reduces seal friction, minimizes internal leakage, and extends seal service life by up to 40% compared to conventionally machined bores.
- **Advanced Chrome Plating:** Multi-layer hard chrome plating with intermediate copper and nickel layers provides exceptional adhesion, corrosion resistance, and wear durability. Salt spray testing to 500 hours confirms chrome integrity exceeds industry benchmarks.
- **Automated Welding:** Robotic MAG welding of cylinder bases, ports, and mountings ensures consistent weld penetration and structural integrity. All welds are visually inspected and 100% leak-tested to confirm pressure containment.
- **Corrosion Protection:** Phosphate conversion coating followed by premium industrial paint provides comprehensive external corrosion protection suitable for agricultural chemical environments, salt spray exposure, and abrasive dust conditions.
- **Pressure Testing Protocol:** Every cylinder undergoes 100% hydrostatic pressure testing at 1.5x working pressure, followed by functional stroke testing and external leak inspection before release.

Hebei Runhe Product Overview

The Hebei Runhe single-acting cylinder product line encompasses a comprehensive range of bore sizes, stroke lengths, mounting configurations, and pressure ratings designed to address the complete spectrum of agricultural, trucking, and construction equipment applications.

Product Range and Specifications

Hebei Runhe manufactures single-acting cylinders across the following standard product families, with full customization capability for OEM customers requiring application-specific configurations:

- **Agricultural Lift Cylinders (AL Series):** Bore range 40-80 mm, stroke range 100-800 mm, pressure rating 160-200 bar. Designed for tractor three-point hitch systems, loader attachments, and implement lift mechanisms. Compatible with John Deere, Case IH, New Holland, Kubota, and Massey Ferguson mounting specifications.

- **Telescopic Tipping Cylinders (TT Series):** 2-stage to 5-stage telescopic designs, outer bore 60-200 mm, total extended stroke 1000-6000 mm, pressure rating 200-250 bar. Engineered for dump truck and tipping trailer applications requiring long stroke in compact retracted envelopes.
- **Construction Cylinders (CC Series):** Bore range 50-150 mm, stroke range 200-1500 mm, pressure rating 200-250 bar. Heavy-duty construction for excavator attachments, loader buckets, backhoe arms, and compactor rollers. Reinforced barrel and rod designs accommodate high shock loads and side forces.
- **Custom OEM Cylinders:** Full custom engineering service for OEM customers requiring application-specific bore/stroke combinations, specialized mounting configurations, integrated valve functions, or unique port arrangements. Prototype to production lead times of 30-45 days.

Multi-Brand Compatibility

A core value proposition of the Hebei Runhe cylinder product line is verified compatibility with the hydraulic systems and mounting interfaces of major global agricultural and construction equipment brands. This compatibility has been validated through dimensional correlation analysis, pressure testing, and field service documentation across thousands of installations worldwide.

- **John Deere Compatible:** AL Series cylinders cross-reference to John Deere cylinder part numbers across the 5E, 6E, and 6M tractor series, including three-point hitch lift cylinders, loader lift and bucket cylinders, and steering assist cylinders. Mounting pin diameters, pin centers, port configurations, and stroke lengths match OEM specifications within ± 1 mm.
- **Case IH Compatible:** Full dimensional interchangeability with Case IH Farmall, Maxxum, and Puma series hydraulic cylinders. Tested and validated pressure ratings, port thread specifications (SAE and BSP), and rod end configurations ensure direct replacement without hydraulic system modification.
- **New Holland Compatible:** AL Series covers New Holland T4, T5, and T6 series cylinder specifications including lift cylinders, draft control cylinders, and auxiliary function cylinders. Compatible with New Holland hydraulic system pressure ratings and oil flow characteristics.
- **Kubota Compatible:** Compact and standard series cylinders match Kubota L-Series and M-Series tractor hydraulic cylinder dimensions and pressure specifications. Optimized for the lower-pressure hydraulic systems typical of Japanese-designed agricultural equipment.
- **Massey Ferguson Compatible:** Cylinder range covers MF 1700 through 7700 series hydraulic cylinder requirements, including lift, tilt, and auxiliary function cylinders. Mounting configurations conform to AGCO standard specifications.
- **Construction OEM Compatible:** CC Series cylinders achieve dimensional interchangeability with Caterpillar, Komatsu, JCB, and Volvo construction equipment hydraulic cylinders. Tested to equivalent pressure ratings and shock load specifications.

Complete Technical Specifications

The following comprehensive specification tables define the standard product families and key performance parameters of Hebei Runhe single-acting hydraulic cylinders. Custom configurations are available upon request for OEM and volume aftermarket applications.

AL Series Agricultural Lift Cylinders

The AL Series represents the core agricultural product line, engineered for three-point hitch, loader, and implement lift applications across all major tractor brands.

Model	Bore (mm)	Rod (mm)	Stroke (mm)	Pressure (bar)	Force (kN)	Mounting	Weight (kg)
AL-040100	40	20	100	200	25.1	Clevis	2.8
AL-040200	40	20	200	200	25.1	Clevis	3.5
AL-050150	50	25	150	200	39.3	Clevis/Pin	4.2
AL-050300	50	25	300	200	39.3	Clevis/Pin	5.6
AL-063200	63	30	200	200	62.3	Trunnion	7.1
AL-063400	63	30	400	200	62.3	Trunnion	9.8
AL-080300	80	40	300	160	80.4	Flange	12.5
AL-080500	80	40	500	160	80.4	Flange	16.2

TT Series Telescopic Tipping Cylinders

The TT Series telescopic cylinders deliver extended stroke capability in compact retracted lengths, making them ideal for tipping truck and trailer installations where mounting space is limited.

Model	Stages	Outer Bore (mm)	Total Stroke (mm)	Pressure (bar)	Force (kN)	Collapsed (mm)	Application
TT-0603-1500	2	60	1500	250	70.7	850	Small tipper
TT-0803-2000	2	80	2000	250	125.7	1100	Light truck
TT-1004-3000	3	100	3000	250	196.3	1250	Medium truck
TT-1254-4000	3	125	4000	250	306.8	1550	Heavy truck

TT-1505-5000	4	150	5000	250	441.8	1400	Trailer
TT-2005-6000	5	200	6000	200	628.3	1550	Heavy trailer

CC Series Construction Cylinders

The CC Series provides heavy-duty single-acting cylinders for construction equipment attachments requiring high force capacity and resistance to shock and side loading.

Model	Bore (mm)	Rod (mm)	Stroke (mm)	Pressure (bar)	Force (kN)	Mounting	Application
CC-050200	50	28	200	250	49.1	Pin-eye	Mini excavator
CC-063300	63	35	300	250	77.9	Pin-eye	Skid steer
CC-080400	80	45	400	250	125.7	Clevis	Loader bucket
CC-100500	100	55	500	250	196.3	Trunnion	Backhoe
CC-125600	125	70	600	250	306.8	Flange	Compactor
CC-150800	150	85	800	250	441.8	Foot	Heavy loader

Hydraulic Fluid and Seal Compatibility

Seal material selection is critical for achieving rated performance and service life across the full range of operating temperatures and fluid types encountered in agricultural, trucking, and construction applications.

Seal Material	Fluid Compatibility	Temp Range	Typical Applications	Service Life
NBR (Nitrile)	Mineral oil, water-glycol	-30 to +100 C	General agricultural	2,000 hrs
PU (Polyurethane)	Mineral oil, bio-oil	-25 to +90 C	High-pressure systems	3,000 hrs
FKM (Viton)	Synthetic fluid, high temp	-20 to +200 C	Extreme environments	4,000 hrs
PTFE	All hydraulic fluids	-40 to +120 C	Low friction required	5,000 hrs

Agricultural Machinery Applications

Single-acting hydraulic cylinders are the dominant actuator type in agricultural machinery, where lifting, raising, and tipping functions constitute the majority of hydraulic power consumption. Hebei Runhe AL Series cylinders are specifically engineered to meet the demanding requirements of modern agricultural equipment operating in dusty, chemically aggressive, and high-vibration environments.

Tractor and Implement Cylinders

Tractor hydraulic systems represent the largest installed base for single-acting cylinders. The AL Series provides direct replacement compatibility for OEM cylinders across all major tractor categories:

- **Three-Point Hitch Lift:** The three-point hitch system on virtually all modern tractors relies on single-acting lift cylinders to raise and lower attached implements. AL Series cylinders in 50-80 mm bore provide the 15-50 kN lift force required for plows, harrows, cultivators, and mowers. Gravity-assisted lowering eliminates the need for double-acting cylinders in this application, reducing cost and simplifying the hydraulic circuit.
- **Front Loader Arms:** Tractor-mounted front loaders utilize single-acting lift cylinders for the primary lift function and double-acting cylinders for bucket tilt. AL Series cylinders match OEM specifications for John Deere 500-series loaders, Case IH L-series, New Holland 700-series, and Kubota LA-series front loaders.
- **Draft Control Systems:** Top-link and draft sensing cylinders regulate implement depth based on soil resistance. Single-acting design with spring return provides smooth, responsive depth control while minimizing hydraulic system complexity.
- **Steering Assist Cylinders:** Many medium and large tractors employ single-acting steering assist cylinders to reduce operator effort. AL Series cylinders provide the precise, responsive actuation required for safe steering performance across the full range of operating speeds.

Harvester and Sprayer Systems

Beyond tractors, single-acting cylinders serve critical functions across the full range of agricultural harvesting and crop protection equipment. Hebei Runhe cylinders are deployed in:

- **Combine Harvester:** Header height adjustment, reel positioning, grain tank extension, and residue spreader actuation all utilize single-acting cylinders for their simple, reliable operation.

- **Forage Harvester:** Spout positioning and deflector adjustment cylinders require the corrosion-resistant chrome plating and robust seal systems provided by the AL Series.
- **Self-Propelled Sprayer:** Boom lift and fold cylinders on self-propelled and trailed sprayers benefit from the compact design and reliable sealing of AL Series cylinders, particularly important given the corrosive chemical environment.
- **Baler and Wrapper:** Baler gate and wrapper arm cylinders operate in high-vibration, dusty environments where the AL Series chrome plating and multi-lip seal arrangement provide exceptional durability.

Heavy Truck and Trailer Applications

The transportation sector represents a significant application domain for single-acting hydraulic cylinders, particularly in the form of multi-stage telescopic tipping cylinders for dump trucks, tipping trailers, and roll-off containers. The Hebei Runhe TT Series telescopic cylinders combine extended stroke capability with compact retracted dimensions, maximizing payload volume while meeting the rigorous demands of on-road and off-road tipping operations.

TT Series telescopic cylinders are engineered for direct replacement of European tipping cylinder brands including Hyco, Penta, and Binotto. Key application segments include:

- **Agricultural Tipping Trailers:** Single-axle and tandem-axle trailers used for grain, silage, and manure transport utilize 2-stage and 3-stage telescopic cylinders with 60-100 mm outer bore and 2000-4000 mm stroke.
- **Construction Dump Trucks:** Rigid and articulated dump trucks operating in quarry, mining, and earthmoving applications require 3-stage to 5-stage cylinders with 125-200 mm outer bore and 4000-6000 mm stroke, rated for 200-250 bar continuous operating pressure.
- **Waste Collection Vehicles:** Roll-off container systems and rear-loading compaction vehicles utilize single-acting cylinders for container lift and compaction plate actuation.
- **Livestock Transport:** Livestock trailer roof and side panel lift cylinders require the corrosion-resistant construction and reliable sealing provided by the TT Series.

Construction Equipment Applications

Single-acting cylinders serve critical functions across a broad range of construction equipment types, from compact mini-excavators to large wheel loaders. The Hebei Runhe CC Series construction cylinders incorporate reinforced barrel designs, heavy-duty rod bearings, and high-performance seal

systems to withstand the shock loads, side forces, and abrasive conditions characteristic of construction machinery operation.

Primary construction equipment applications for CC Series cylinders include:

- **Excavator Attachments:** Bucket cylinders on mini-excavators and backhoe loaders frequently utilize single-acting design for the crowd function, where gravity-assisted bucket dumping provides the return stroke. CC Series cylinders in 50-80 mm bore provide the breakout force required for digging in compacted soils and rocky conditions.
- **Wheel Loader Buckets:** Bucket lift and tilt functions on skid-steer loaders, compact wheel loaders, and backhoe front loader arms employ single-acting lift cylinders in combination with double-acting tilt cylinders. The high lifting forces generated by CC Series 80-100 mm bore cylinders enable efficient loading of sand, gravel, and aggregate materials.
- **Road Rollers and Compactors:** Drum adjustment and articulation steering cylinders on single-drum and tandem vibratory rollers utilize single-acting design for simplified hydraulic circuits in vibration-intensive installations.
- **Concrete and Asphalt Equipment:** Hopper lift, chute positioning, and screed adjustment cylinders on concrete mixers, pavers, and curb machines operate in abrasive environments where CC Series chrome plating and wiper seal protection ensure extended service intervals.
- **Attachment Quick Couplers:** Hydraulic quick coupler systems for excavators and loaders utilize compact single-acting cylinders to engage and release work tools, improving jobsite versatility and reducing manual intervention.

Humanized Management and TCO Optimization

Hebei Runhe distinguishes itself from commodity hydraulic component suppliers through a humanized management philosophy that prioritizes customer operational efficiency, total cost of ownership reduction, and long-term partnership development. This approach extends far beyond product manufacturing to encompass the complete aftermarket service ecosystem.

Maintenance Cost Reduction Strategy

The total cost of ownership for hydraulic cylinders encompasses acquisition cost, installation labor, hydraulic fluid, seal replacement, downtime costs, and eventual replacement. Hebei Runhe's humanized management approach targets each cost element to deliver TCO reductions of 30-50% compared to OEM-sourced replacement cylinders:

- **Competitive Acquisition Pricing:** Direct-from-factory pricing eliminates distributor and dealer markups typical of OEM parts channels. Hebei Runhe cylinders are typically priced 40-60% below equivalent OEM replacement cylinders while maintaining equivalent or superior technical specifications.
- **Seal Kit Program:** Comprehensive seal kit availability for all standard cylinder models enables field-level seal replacement at a fraction of replacement cylinder cost. Pre-configured seal kits include all required seals, wear rings, and installation instructions, reducing parts ordering complexity and ensuring correct seal selection.
- **Cross-Reference Documentation:** Detailed cross-reference documentation enables maintenance personnel to quickly identify the correct Hebei Runhe replacement cylinder for any major OEM application, reducing parts research time and eliminating ordering errors.
- **Extended Service Intervals:** Precision-honed bores, advanced chrome plating, and optimized seal materials extend seal service life by 30-50% compared to generic replacement cylinders, reducing maintenance frequency and associated labor costs.

Rapid Delivery and After-Sales Support

Equipment downtime in agricultural and construction applications can cost hundreds or thousands of dollars per day in lost productivity. Hebei Runhe's responsive logistics and after-sales support system is designed to minimize customer downtime:

- **Fast Delivery:** Standard catalog cylinders ship within 10-15 days of order confirmation. Custom configurations and OEM volume orders typically deliver within 20-30 days. Emergency expedite service is available for critical downtime situations.
- **Technical Support:** Experienced hydraulic engineers provide application consultation, product selection guidance, installation support, and troubleshooting assistance via email, phone, and video conference.
- **Warranty Program:** All Hebei Runhe single-acting cylinders carry a 12-month warranty against manufacturing defects, with extended warranty options available for OEM volume customers.
- **Documentation Package:** Complete technical documentation including dimensional drawings, hydraulic schematics, seal specifications, and installation instructions is provided with every cylinder shipment.

Competitive Advantage

Hebei Runhe has developed a sustainable competitive position in the global hydraulic cylinder market through the integration of manufacturing scale, technical capability, quality commitment,

and humanized customer service. The following competitive factors collectively deliver superior value to agricultural, trucking, and construction equipment operators.

Price-Performance Leadership

The convergence of competitive manufacturing economics, vertically integrated production processes, and efficient logistics enables Hebei Runhe to offer single-acting cylinders at price points 40-60% below equivalent OEM and European aftermarket brands while maintaining equivalent technical specifications and quality standards. This price-performance advantage is further amplified by:

- **Volume Production Efficiency:** Automated CNC machining, robotic welding, and batch production processes minimize unit manufacturing costs across the full product range.
- **Material Optimization:** Advanced engineering analysis and manufacturing process control minimize material waste while maintaining structural safety margins and fatigue life requirements.
- **Direct Distribution Model:** Factory-direct sales to end users, distributors, and OEMs eliminate intermediaries and associated markups, passing cost savings directly to customers.
- **Lower Lifecycle Costs:** Extended seal life, seal kit availability, and cross-reference compatibility reduce total ownership costs throughout the cylinder service life.

Against Chinese competitors, Hebei Runhe differentiates through verified quality assurance processes, comprehensive technical documentation, multi-brand compatibility validation, and responsive after-sales support. Against European and North American brands, the differentiation is rooted in competitive pricing with equivalent or superior technical performance.

Quality Assurance and Testing

Hebei Runhe maintains a comprehensive quality management system encompassing incoming material inspection, in-process quality control, finished product testing, and continuous improvement processes. The quality assurance program ensures that every single-acting cylinder delivered to customers meets or exceeds the stated technical specifications and industry quality standards.

Key elements of the quality assurance and testing program include:

- **Incoming Material Inspection:** All steel tube, rod material, seals, and hardware are inspected upon receipt for dimensional accuracy, material certification compliance, and visual quality. Chrome-plated rods are verified for chrome layer thickness, adhesion, and surface hardness.

- **In-Process Quality Control:** Dimensional inspection at each manufacturing stage ensures cumulative tolerance compliance. Critical dimensions including bore diameter, rod diameter, thread specifications, and mounting pin centers are verified against engineering drawings.
- **Hydrostatic Pressure Testing:** Every cylinder undergoes 100% hydrostatic pressure testing at 1.5x rated working pressure for minimum 30 seconds. No visible leakage, permanent deformation, or pressure decay is permitted.
- **Functional Testing:** Following pressure testing, each cylinder is subjected to full-stroke functional testing to verify smooth operation throughout the complete stroke length, proper seal function, and absence of mechanical interference.
- **Surface Finish Verification:** Bore surface roughness is verified using profilometer measurement to confirm Ra 0.2-0.4 um specification compliance. Chrome plating thickness and adhesion are verified by eddy current and bend testing.
- **Dimensional Final Inspection:** Final dimensional inspection confirms all critical dimensions including overall length, stroke length, mounting dimensions, and port specifications match customer order requirements.
- **Certification:** Hebei Runhe quality management system is certified to ISO 9001:2015 standards. Product testing documentation and material certifications are available upon request.

Conclusion

Hebei Runhe Hydraulic Manufacturing has established a compelling value proposition in the global single-acting hydraulic cylinder market through the integration of precision engineering, quality manufacturing, competitive pricing, and humanized customer service. The comprehensive product range spanning agricultural lift cylinders, telescopic tipping cylinders, and heavy-duty construction cylinders achieves verified compatibility with the hydraulic systems and mounting interfaces of major global equipment brands.

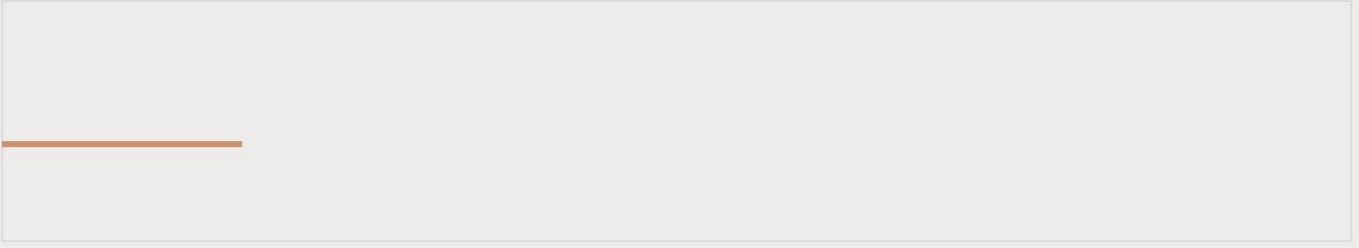
For equipment operators, maintenance managers, and aftermarket distributors seeking reliable, cost-effective replacement hydraulic cylinders, Hebei Runhe offers a technically sound alternative to OEM parts at significantly reduced acquisition and lifecycle costs. The combination of precision manufacturing, rigorous quality testing, rapid delivery, and responsive after-sales support delivers total cost of ownership reductions of 30-50% without compromising equipment performance or reliability.

As agricultural mechanization continues to expand globally, construction equipment fleets require cost-effective maintenance solutions, and transportation operators seek to minimize total operating costs, the demand for high-quality, competitively priced hydraulic cylinders will continue to grow.

Hebei Runhe is positioned to serve this demand with products and services that meet the exacting requirements of the most demanding equipment applications worldwide.

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Hydraulic Manufacturing

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Agricultural | Truck | Construction OEM

Precision Engineering • Quality Assurance • Humanized Service



Hebei Province, China