CONTENTS

I. Brief Introduction of CRCHI
   i. General..............................................................................................................1
   ii. Branches..........................................................................................................3
   iii. Qualified Certificates....................................................................................9

II. Products
   i. Tunnel Boring Machine....................................................................................10
      A. Earth Pressure Balance Shield (EPB).........................................................11
      B. Slurry Pressure Balance Shield (SPB).........................................................15
      C. Hard Rock Shield.........................................................................................19
      D. Special Functional TBM............................................................................23
   ii. Shotcrete & Diaphragm Wall.................................................................26
   iii. Turnout...........................................................................................................28
   iv. Fastener & Clip & Brake-shoe.................................................................33
   v. Railway Electrification Products............................................................37
   vi. New Developed Products............................................................................39

III. Product’s Presentation in Jobsites

IV. Technical & Service Backup
I. China Railway Construction Heavy Industry Co., Ltd

i. General

China Railway Construction Heavy Industry Co., Ltd. (hereinafter referred as CRCHI) is affiliated to the China Railway Construction Corporation. The CRCHI is a professional group which integrates research, design and manufacture of high-end tunnel/underground equipment railway equipment and special equipment. The CRCHI group, with its headquarter located in National Economical & Technical Development Zone, Changsha, Hunan, surrounding with convenient transportation and industrial environment to promote the further development for enterprise, consist of TBM Business Department, Special Equipment Business Department, Track Equipment Business Department, Overseas Business Department, Manufacture & Supply Center, Technical Center, Electric Material Company and Longchang Railway Material Co., Ltd. CRCHI develops as one with the link of capital on operation and management, possessing of strategy, brand, culture and management system. It manufactured and operate mainly on varies of TBM, Mining Equipment, Construction Machinery, Turnout, Fastener&Clip&Brake-shoe, Railway Electric Materials etc. Through the innovation of the system, management and technology, CRCHI develops as a trans-regional group, which based on two operating business of undergrounding engineering equipment and track products, assist of other complementary business.

The CRCHI has taken his industrial advantages as well as his engineering experiences and technologies, together with original innovation and primitive innovation to master on the knowledge of world-led and independent intellectual property technologies. More than 300 items of leading level underground engineering equipment and track system facilities has been sequentially researched and developed in domestic market by CRCHI. To be honored, CRCHI undertakes and participates National “863” Program,
National Technology Support Project and a numerous of regional major technological project. Meanwhile, CRCHI has been approved by National Level Enterprise Technical Center and established a innovational stage of state-level technical center, research center and post-doctoral-collaboration center for underground engineering equipment, ensured our research level keeping pace with the front of Science & Technology.

The self-developed TBM, with completely independent intellectual property rights has been widely used on Metro Line, Railway, Coal Mine Exploit, Sewage projects in Changsha, Beijing, Xi'an, Wuhan, Guangzhou, Suzhou, Nanjing etc., it stays the top in domestic market share; the self-developed equipment with Mine Tunneling Method has been used in domestic highway tunnel construction jobsites; the self-researched and developed Coal Mine Tilt-shaft TBM, Deep-shaft Full-face TBM have pioneered the engineering of coal mine field, the developing of Tunnel Pre-tunneling Equipment and Jaggy Diaphragm Wall has filled the blank of these product’s categories. Furtherly, CRCHI has possess of 174 patens, and taken part in the establishment of States' Standard of TBM.

Over the years, CRCHI Group has been award of “First Set Sample Flat of National Major Technology Equipment”, “States’ Standard Draft Unit of Engineering Machinery and TBM”, “Industrial Base of National “863” Program’s Achievements”, “The Excellent Corporation of Cultural Establishment”, “The most 10 Potential Enterprise in Hunan Province”, therefore, it has rapidly created one of the most influential self-developed innovation brand over the industry of underground engineering and track system in China.
Branches

CRCHI Headquarter

CRCHI Headquarter is one of key investment project of CRCC industry area. TBM business department under the CRCHI is mainly responsible for the research and manufacture of Earth Pressure Balance Shield, Slurry Pressure Balance Shield and Hard Rock TBM as well as other full face tunnel boring equipment. Special equipment business department is mainly responsible for the research and manufacture of mechanics-electronics-hydraulics construction equipment for concrete mixing plant, Shotcrete, CRW (Chain cutting & Re-mixing Diaphragm Wall) and bolting machine. With the long-term construction experience, construction technology, technical team, brand effect and domestic market advantage, CRCHI strives to create the special tunnel construction equipment and research base which integrates the produce, learn and research. Research starts with introduction and develops based on self-innovation, we keep in step with the advanced technology and devote to build a tunnel equipment industry center with multi functions of R&D, manufacture, assembly, test, recover of idle equipment, storage, overhaul, supply of spare parts, rental service, training, technical consultant and after-sale service.
CRCHI Technology Centre

Technology Center has been working on the research of underground engineering equipment and track equipment since it is established. The center is identified by the National Enterprise Technical Centre; it has the laboratory and testing center with full equipped instrument.

The center has TBM research institute, mechanics research institute, track equipment research institute, hydraulic technique institute, electrical technique institute, process technique institute, construction technique institute, Beijing research institute and Lanzhou research institute. The Centre has 410 employees including more than 300 medium and senior employees with 32 masters and 9 doctors. The center also is Hunan underground tunneling equipment research Centre, post-doctoral study Centre and provincial underwater tunnel engineering lab; it creates six-in-one technology innovation system which construction technique, basic research, product development, process development, applied research and engineering test.
CRCHI Turnout Company

CRCHI Turnout Company is a turnout professional manufacturer which was established on Dec. 16, 2006 under the background of acceleration of Chinese Railway. The products cover high speed turnout, conventional turnout, speed-up turnout, high manganese steel frog and alloyed frog, these products are widely used in all types of railway line, station, urban mass transit and metro system. Turnout company is a CRCC identified professional manufacturer, the company is located at idyllic Shifeng mountain in Zhuzhou, Hunan, it has the area of 240000 ㎡. The company has a design annual production capacity of 50000 groups including 1000 groups of high speed turnouts per year, 4000 groups of speed-up turnouts and conventional turnouts per year, 10000 pieces of high manganese steel frogs and alloyed steel frogs per year.

The company has already supplied quality turnouts for multiple key railway projects like Zhengzhou-Xi’an passenger dedicated line and so on.
CRCHI Longchang Railway Material Company was established in 1967, it was selected as “Railway Material Development and Research Centre” in 2001. In 2008, the company was identified as national high-tech enterprise. The company is one of largest railway Fastener system supplier which has 600 employees, mainly produces Clip I,II,III railway fastener; Clip IV,V,WJ-7,WJ-8 high speed fastener; All types of urban light rail and metro railway Fastener system; High(low) friction and heavy load brake-shoe for locomotive and vehicle.

The company has provincial enterprise technology Centre with strong technical force, advanced technique, superior equipment and complete testing method. It is the only domestic enterprise which has “high and low temperature electric-hydraulic servo fatigue testing machine” and fatigue testing equipment for turnout sleeper assembly. All types of speed-up turnout anchor bolt for high speed turnout and low speed turnout(Type II bolt and type III bolt are the only manufacturer in the industry which passed the “overall fatigue test” ).According to the requirement of GB/T 19001-2008, the company has changed management system documents to improve the enterprise management level and quality environment.
CRCHI Electric Material Company is located in Zhuzhou, Hunan. It has the area of 270000 m² including 30000 m² area of factory. The annual handling capacity is approximately 400000 tons, storage area is about 100000 m², railway special line is 1300 meters. The best solution for research, design, manufacture, trade and logistics can be given by the company. Multiple rewards like “Hunan New High-Tech Enterprise”, “Five-Star Freight Yard” and “Creditable Company” have been awarded. The following certifications have been issued by the authority: quality management system ISO9001:2000, environment management system ISO14001:2004, occupation health safety management system GB/T28001-2001, OHSAS18001:1999 standard. The main products of the company are catenary mast, and steel structure as well as the business of warehouse logistics and rental service of war material. The annual production capacity of catenary steel mast is 30000 tons. The annual production capacity of catenary concrete mast is 40000 pieces. The company has multiple production qualifications like φ400 140kN.m and φ350 160kN.m ring type concrete mast (flange type, shallow burial type, direct burial type).
iii. Qualified Certificates
II. Products

More than 300 items of leading level underground engineering equipment and track system facilities has been sequentially researched and developed in domestic market by CRCHI. Our Company is operating with 4 categories products, consist of the TBM as the competitive products, which is possess of self-developed proprietary intellectual property, and the Equipment of Mine Tunneling Method, Pilling Machinery, Special Functional Mining Equipment as subsidiary.

i. Tunnel Boring Machine

Tunnel Boring Machine is a set of efficient tunnel construction system, with themulti-function of mucking, guidance, support and dust ventilation. At present, shielding construction has been wildly adopted in the industry of tunnel establishment of Road, Metro Line and Water Conservancy Project.

Nationally, CRCHI TBM ranks ahead in the science &technology of mechanic tunnel industry, contemporarily, we are gradually developing our business worldwide, working hard to internationalize and optimize our products. Whatever EPB or Hard Rock Shields, as well as micro tunnel machine or large diameter TBM, we are an extremely reliable supplier. We devote our research not only to the mechanical tunneling, but also to client’s demand of new products’ innovation.
A. Earth Pressure Balance Shield (EPB)

The Self-designed EPB of CRCHI is one of State’s Major Technical Equipment with intellectual property rights, are particularly used for binding grounds with a high content of clay, loam or silt which have a low permeability of water. The special feature of Earth Pressure Balance Shields is that they use a rotating cutting wheel equipped with tools to press onto the tunnel face and excavates the material. The soil enters the excavation chamber through openings; a screw conveyor constantly transports the excavated material from the base of the excavation chamber onto a belt conveyor. The interaction between the screw conveyor’s throughput and the TBM’s advance rate ensure that the support pressure of the soil paste can be controlled precisely. This kind of Shield has equipped with plenty of elements which involved in the technology of Mechanical Engineering, Hydraulic Drive & Control, Automatic Control, Information Transfer, Guidance Monitor, Geotechnical Engineering, present as high-efficiently, securely, and rapidly as it’s been used in tunnel infrastructure construction of national defense, traffic system, coal mine, hydropower and municipal engineering.

Theoretically, the excavation diameter of CRCHI EPB ranks from 2m to 16m, nevertheless, our design of each shield has been provided on the basis of individual requirements and geological conditions.
Earth Pressure Balance Shield (EPB)

a. Technical characteristics of EPB

◆ **Powerful Performance:** It combines the function of excavation, support, slagging and conveyor transport when continuously advancing forward.

◆ **High Quality:** In an exquisite construction of tunnel, it can contemporarily accomplish the excavation of tunnel face, muck transport, segment lining and Grouting.

◆ **High Efficient:** In view of coincidence with the contract period and project requirements, our designs prefer to the way of decreasing man power & labor intensity, small amount of overcut, and reducing loss of materials.

◆ **Safely:** Our sustained improvements only for underground working environments, minimizing the risk of heave or settlement at the surface.

◆ **Automatically & Digitally:** The system of our tunnel boring machine adopts PC control, sensor detecting, laser guidance, advanced technology of communication and data collection, and also can be optional equipped with probe drilling system, which is competent to automatically receiving and transferring construction information.
### b. Technical Data of EPB (ZTE)4350/6250/9300

<table>
<thead>
<tr>
<th>Category</th>
<th>Earth Pressure Balance Shield (EPB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter of shield</td>
<td>4350mm 6250mm 9300mm</td>
</tr>
<tr>
<td>Length of the shield</td>
<td>6m 8m 12m</td>
</tr>
<tr>
<td>Length of the equipment</td>
<td>77m (Approximate) 80m (Approximate) 130m (Approximate)</td>
</tr>
<tr>
<td>Tail skin seal</td>
<td>3 Tail brush 3 Tail brush 4 Tail brush</td>
</tr>
<tr>
<td>Pressure bearing capacity of tail skin seal</td>
<td>3 bar 3 bar 4bar</td>
</tr>
<tr>
<td>Torque of cutter head</td>
<td>1600 KNM 6000 KNM 15000 KNM</td>
</tr>
<tr>
<td>Type of man lock</td>
<td>2+2 (per) 3+2 (per) 3+4 (per)</td>
</tr>
<tr>
<td>Transport capacity of screw conveyor</td>
<td>340m³/h 380m³/h 600 m³/h</td>
</tr>
<tr>
<td>Transport capacity of belt conveyor</td>
<td>380m³/h 450m³/h 785 m³/h</td>
</tr>
<tr>
<td>Service time of shield</td>
<td>&gt;10km &gt;10km &gt;10km</td>
</tr>
<tr>
<td>Operating power</td>
<td>850kW (Approximate) 1700kW (Approximate) 3900kW (Approximate)</td>
</tr>
<tr>
<td>Approximate gross weight of equipment (Shield &amp; Backup system)</td>
<td>350t 450t 1200t</td>
</tr>
<tr>
<td>Minimum radius of horizontal curve</td>
<td>200m 200m 300m</td>
</tr>
<tr>
<td>Minimum radius of vertical curve</td>
<td>1000m 1000m 1000m</td>
</tr>
<tr>
<td>Gradeability (Slope)</td>
<td>35‰ 50‰ 50‰</td>
</tr>
<tr>
<td>Remark</td>
<td>The theoretical excavation diameter of CRCHI EPB ranks from 2m to 16m, nevertheless, our design of each shield has been provided on the basis of individual requirements and geological conditions.</td>
</tr>
</tbody>
</table>
B. Slurry Pressure Balance Shield

The Self-designed SPB of CRCHI, with intellectual property rights, which is mainly against the geologies with aquifer and extremely required with prevention of settlement at the surface, particularly as crossing river, channel, sea tunnel.

The feature of Slurry Pressure Balance Shields is that they depend on the interaction between the pipe line’s throughput and the TBM’s advance rate to ensure that the support pressure of the slurry can be controlled precisely. A rotating cutting wheel equipped with tools to press onto the tunnel face and excavates the materials to constantly transport through outlet pipe into the separate slurry system; afterwards, the treated slurry will be inlet through the pipe back into the tunnel face. This kind of Shield has equipped with plenty of elements which involved in the technology of Mechanical Engineering, Hydraulic Drive & Control, Automatic Control, Information Transfer, Guidance Monitor, Geotechnical Engineering, present as high-efficiently, securely, and rapidly as it’s been used in tunnel infrastructure construction of national defense, traffic system, coal mine, hydropower and municipal engineering.

Theoretically, the excavation diameter of CRCHI SPB ranks from 2m to 16m, nevertheless, our design of each shield has been provided on the basis of individual requirements and geological conditions.
a. Technical characteristics of SPB

◆ **Powerful Performance:** It combines the function of excavation, support, slagging and conveyor transport when continuously advancing forward.

◆ **High Quality:** In an adoption of slurry balance system, for an exquisite construction of tunnel, to control the harassment and settlement at the surface, it can contemporarily accomplish the excavation of tunnel face, muck transport, segment lining and Grouting.

◆ **High Efficient:** In view of coincidence with the contract period and project requirements, our designs prefer to the way of decreasing man power & labor intensity, small amount of overcut, and reducing loss of materials;

◆ **Safely:** Our sustained innovation is to improve the underground working environments and minimize the risk of heave or settlement at the surface;

◆ **Environmental Protection:** For the purpose of the protection of environment, our SPB has been designed as considering comfortable working condition and the decreasing pollution;

◆ **Automatically & Digitally:** The system of our tunnel boring machine adopts PC control, sensor detecting, laser guidance, advanced technology of communication and data collection, and also can be optional equipped with probe drilling system, which is competent to automatically receiving and transferring construction information.
b. Technical Data of SPB (ZTS) 6450

<table>
<thead>
<tr>
<th>Category</th>
<th>Slurry Pressure Balance Shield (SPB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter of shield</td>
<td>6450mm</td>
</tr>
<tr>
<td>Length of shield</td>
<td>8.45m</td>
</tr>
<tr>
<td>Length of the equipment</td>
<td>90m (Approximate)</td>
</tr>
<tr>
<td>Tail skin seal</td>
<td>4 Tail Brush</td>
</tr>
<tr>
<td>Pressure bearing capacity of tail skin seal</td>
<td>5bar</td>
</tr>
<tr>
<td>Torque range of cutter head</td>
<td>5367kNm @330bar</td>
</tr>
<tr>
<td>Drive style of cutter head</td>
<td>Hydraulic drive</td>
</tr>
<tr>
<td>Type of man lock</td>
<td>3+2 (No.)</td>
</tr>
<tr>
<td>Max. thrust power</td>
<td>42575kN@350bar</td>
</tr>
<tr>
<td>Crusher</td>
<td>Hydraulic Jaw Crusher</td>
</tr>
<tr>
<td></td>
<td>(Max. diameter: 500mm)</td>
</tr>
<tr>
<td>Slurry circulatory system</td>
<td>Pipeline diameter: DN300mm</td>
</tr>
<tr>
<td></td>
<td>Power of P2.1 outlet pump: 400kW</td>
</tr>
<tr>
<td></td>
<td>Power of P0.1 booster pump: 90kW</td>
</tr>
<tr>
<td>Extension type of slurry piping</td>
<td>Tube</td>
</tr>
<tr>
<td>Service life of equipment</td>
<td>&gt;10km</td>
</tr>
<tr>
<td>Operating power</td>
<td>1960Kw (Approximate)</td>
</tr>
<tr>
<td>Weight of front shield (Approximate)</td>
<td>110t (With equipment)</td>
</tr>
<tr>
<td>Weight of mid shield (Approximate)</td>
<td>90t (With equipment)</td>
</tr>
<tr>
<td>Weight of tail skin (Approximate)</td>
<td>35t (With equipment)</td>
</tr>
<tr>
<td>Gross weight of equipment (Shield &amp; Backup system)</td>
<td>450t</td>
</tr>
<tr>
<td>Minimum radius of horizontal curve</td>
<td>200m</td>
</tr>
<tr>
<td>The minimum vertical curve radius</td>
<td>1000m</td>
</tr>
<tr>
<td>Gradeability (Slope)</td>
<td>35‰</td>
</tr>
<tr>
<td>Remark</td>
<td>The theoretical excavation diameter of CRCHI EPB ranks from 2m to 16m, nevertheless, our design of each shield has been provided on the basis of individual requirements and geological conditions.</td>
</tr>
</tbody>
</table>
C. Hard Rock Shield

Full-face Hard Rock Shield of CRCHI, an advanced new developing machine, has been researched on the technologies of large diameter TBM in the project of “863” National Program, its advancing depends on a rotating cutting wheel equipped with tools to excavate the tunnel face and crush the inner rocks to cast a entire excavated face, what is mainly work for tunnel construction with the solid layer contents of gravels, marbles, granites etc. It's an efficient giant machine with the multi-function of drilling, detecting, tunneling, mucking transport, anchor support, and dust ventilation. Compared to the method of explosion, the Hard Rock Shield acts more efficient, optimized, safely and low pollution and it's wildly been used in tunnel infrastructure construction of national defense, traffic system, coal mine, hydropower and municipal engineering.

Theoretically, the excavation diameter of CRCHI Hard Rock Shield ranks from 3m to 15m, nevertheless, our design of each shield has been provided on the basis of individual requirements and geological conditions, providing of Open Type, Single Shield and Double Shield.
Open Type TBM
a. Technical characteristics of Hard Rock TBM

◆ **Powerful Performance:** With the multi-function of excavation, anchor support, it can efficient accomplish continuous slagging with the belt conveyor and advancing forward.

◆ **High Efficient:** The excavation with the tool of heavy disc cutter press on the tunnel face, our TBM has saved man power & labor intensity, minimized volume of overcut, and reduced the loss of materials when on its operation;

◆ **Safely:** With the effective dust ventilation system, our TBM has improved the underground working environments and minimize the risk of heave or settlement at the surface;

◆ The main drive relies on the reliable PLC coordinate with the BUS control system, the on-site data and situation can be monitored on the system screen.

◆ **Automatically & Digitally:** The system of our tunnel boring machine adopts PC control, sensor detecting, laser guidance, advanced technology of communication and data collection, and also can be optional equipped with probe drilling system, which is competent to automatically receiving and transferring construction information.

◆ **Long Service Life:** Adopting the reliable imported bearing machine, and heavy load gearing system.
### b. Technical Data of Open Type Hard Rock TBM (ZTT) 8030

<table>
<thead>
<tr>
<th>Category</th>
<th>Hard Rock TBM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Category</strong></td>
<td></td>
</tr>
<tr>
<td>Service Life</td>
<td>&gt;20km</td>
</tr>
<tr>
<td>Operating power</td>
<td>4500kW</td>
</tr>
<tr>
<td>Advance capacity</td>
<td>500m / per month</td>
</tr>
<tr>
<td>Gross weight of equipment</td>
<td>1000t</td>
</tr>
<tr>
<td>Dimension of equipment</td>
<td>180000×8030×8030 mm</td>
</tr>
<tr>
<td>Max. thrust power</td>
<td>21000kN</td>
</tr>
<tr>
<td>Diameter of cutter head</td>
<td>Φ8030mm</td>
</tr>
<tr>
<td>Pressure bearing capacity of tail skin seal</td>
<td>17”cutter:250KN / 19”cutter:300KN</td>
</tr>
<tr>
<td>Space of cutter</td>
<td>75mm</td>
</tr>
<tr>
<td>Specification and quantity of cutter</td>
<td>Central cutter: 6 / Front disc:50 / Edge cutter: 3</td>
</tr>
<tr>
<td>Fix type of cutter head</td>
<td>Central support</td>
</tr>
<tr>
<td>Rotating speed of cutter head</td>
<td>0-7.4rpm</td>
</tr>
<tr>
<td>Break-out torque of cutter head</td>
<td>6280 k-Nm</td>
</tr>
<tr>
<td>Torque output of cutter head</td>
<td>5083 k-Nm</td>
</tr>
<tr>
<td>Drive mode of main bearing</td>
<td>Three row pillar roller</td>
</tr>
<tr>
<td>Lubricating mode of main bearing</td>
<td>Grease lubrication</td>
</tr>
<tr>
<td>Service life of main bearing</td>
<td>&gt;15000h</td>
</tr>
<tr>
<td>Drive mode of equipment</td>
<td>Frequency motor drive</td>
</tr>
<tr>
<td>Motor power of main drive</td>
<td>Motor power: 280kW/ Numbers: 12</td>
</tr>
<tr>
<td>Injection system</td>
<td>Hydraulic Shotcrete</td>
</tr>
<tr>
<td>Dust ventilation</td>
<td>Volume: 600m³/min, Cleanliness: 2000/1.0mg/m³</td>
</tr>
<tr>
<td>Belt conveyor system</td>
<td>Continuous Slagging</td>
</tr>
<tr>
<td>Capacity of belt conveyor</td>
<td>780m³/h</td>
</tr>
<tr>
<td>Minimum curve radius of backup system</td>
<td>500m</td>
</tr>
<tr>
<td><strong>Remark</strong></td>
<td>The theoretical excavation diameter of CRCHI Hard Rock TBM ranks from 2m to 16m, nevertheless, our design of each shield has been provided on the basis of individual requirements and geological conditions.</td>
</tr>
</tbody>
</table>
D. Special Functional TBM

Dual Mode Inclined Shaft TBM is Full-face tunnel boring machine possessing of both EPB and Single shield, together with slagging of screw conveyor and continues belt conveyor, special for the geologies and construction demand of coal mine. It's a new type TBM with high-performance which has been researched by CRCHI under the support plan of “Key Technology of Long Construction for Coal Mine”, particularly for the geological feature of Inclined Shaft tunnel construction. Compared to the old method of explosion, freezing tunneling and expansion digging, the Inclined Shaft TBM will be more efficient, optimized and safely, and it has advantages of less pollution, shorter period during the construction, what starts a new age of coal mine exploit and completes the categories of TB.

Theoretically, the excavation diameter of CRCHI Dual Mode Inclined Shaft TBM ranks from 2m to 15m, nevertheless, our design of each shield has been provided on the basis of individual requirements and geological conditions, providing of Inclined Shaft TBM and Rock Lane TBM.
a. Technical characteristics of Special Functional TBM

◆ **Powerful Performance:** It combines the function of excavation, support, slagging and conveyor transport when continuously advancing forward.

◆ **High Efficient:** The excavation with the tool of heavy disc cutter press on the tunnel face, our TBM has saved man power & labor intensity, minimized volume of overcut, and reduced the loss of materials when on its operation;

◆ **Safely:** With the effective dust ventilation system, our TBM has improved the underground working environments and minimize the risk of heave or settlement at the surface;

◆ The main drive relies on the reliable PLC coordinate with the BUS control system, the on-site data and situation can be monitored on the system screen.

◆ **Automatically & Digitally:** The system of our tunnel boring machine adopts PC control, sensor detecting, laser guidance, advanced technology of communication and data collection, and also can be optional equipped with probe drilling system, which is competent to automatically receiving and transferring construction information.

◆ **Long Service Life:** Adopting the reliable imported bearing machine, and heavy load gearing system.
### b. Technical Data of Dual Mode Inclined Shaft TBM

<table>
<thead>
<tr>
<th>Category</th>
<th>Dual Mode Inclined Shaft TBM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service Life</td>
<td>&gt;20km</td>
</tr>
<tr>
<td>Operating power</td>
<td>4500kW</td>
</tr>
<tr>
<td>Advance capacity</td>
<td>500m / per month</td>
</tr>
<tr>
<td>Gross weight of equipment</td>
<td>1000t</td>
</tr>
<tr>
<td>Dimension of equipment</td>
<td>180000×8030×8030 mm</td>
</tr>
<tr>
<td>Max. thrust power</td>
<td>21000kN</td>
</tr>
<tr>
<td>Diameter of cutter head</td>
<td>Φ8030mm</td>
</tr>
<tr>
<td>Pressure bearing capacity of tail skin seal</td>
<td>17” cutter: 250KN</td>
</tr>
<tr>
<td></td>
<td>19” cutter: 300KN</td>
</tr>
<tr>
<td>Space of cutter</td>
<td>75mm</td>
</tr>
<tr>
<td>Specification and quantity of cutter</td>
<td>Central cutter: 6 / Front disc: 50 / Edge cutter: 3</td>
</tr>
<tr>
<td>Fix type of cutter head</td>
<td>Central support</td>
</tr>
<tr>
<td>Rotating speed of cutter head</td>
<td>0-7.4rpm</td>
</tr>
<tr>
<td>Break-out torque of cutter head</td>
<td>6280 kNm</td>
</tr>
<tr>
<td>Torque output of cutter head</td>
<td>5083 kNm</td>
</tr>
<tr>
<td>Drive mode of main bearing</td>
<td>Three row pillar roller</td>
</tr>
<tr>
<td>Lubricating mode of main bearing</td>
<td>Grease lubrication</td>
</tr>
<tr>
<td>Service life of main bearing</td>
<td>&gt;15000h</td>
</tr>
<tr>
<td>Drive mode of equipment</td>
<td>Frequency motor drive</td>
</tr>
<tr>
<td>Motor power of main drive</td>
<td>Motor power: 280kW / Numbers: 12</td>
</tr>
<tr>
<td>Injection system</td>
<td>Hydraulic Shotcrete</td>
</tr>
<tr>
<td>Dust ventilation</td>
<td>Volume: 600m³/min, Cleanliness: 2000/1.0mg/m³</td>
</tr>
<tr>
<td>Belt conveyor system</td>
<td>Continuous Slagging</td>
</tr>
<tr>
<td>Capacity of belt conveyor</td>
<td>780m³/h</td>
</tr>
<tr>
<td>Minimum curve radius of backup system</td>
<td>500m</td>
</tr>
<tr>
<td>Remark</td>
<td>The theoretical excavation diameter of CRCHI Hard Rock TBM ranks from 2m to 15m, nevertheless, our design of each shield has been provided on the basis of individual requirements and geological conditions.</td>
</tr>
</tbody>
</table>
E. Workshop & Facilities

The workshop of CHCHI occupies more than 80 thousand square meters, supply with bunch of giant process facilities, such as 12.5m’s Vertical Milling Machine, φ260mm Ground Boring and Milling Machine, 16m’s Heat Treatment Plant, 110/160x4000 Digital Three Roller Bending Machine, which can fabricate the TBM with max diameter of 15m. It has the producing capacity of 40 units TBM with diameter more than 6m, 150 units of concrete plant, 100 units of non-standard equipment per year. Those provide a great environment and infrastructure for products’ research & manufacture, and the operation system.
Add: No.88 Dongqi Road, National Economic & Technical Development Zone, Changsha, China.
Zip Code: 410100                          Tel: +86 731 84071707 Fax: +86 731 84071767.

18m Digital Ground Milling Processing Center

12.5m Digital Vertical Milling Machine

8m Digital Fixed Beam Gantry Milling and Boring Machine

1.6m Digital Horizontal Lathe

10m Digital Fixed Beam Gantry Milling and Boring Machine

Z30125 Drilling Machine

1.6m Digital Horizontal Lathe

4m Digital Double Column Milling Lathe

EZW11S Three Roller Bending Machine
ii. Shotcrete & Diaphragm Wall

A. Shotcrete

Shotcrete is using of the compressor to pump the concrete mixing ingredients over the tube, which sticking on the tunnel face to formulate a supporting layer. In recent years, with its advantages of simplified and unique technique, economical cost, rapidly engineering, the Shotcrete has been wild used in the infrastructure construction of building, road & railway tunnel, coal mine shaft, hillside consolidation.

As for the market demand of construction in high-speed, road tunnel, CRCHI self-designed Shotcrete takes the advantage of less dust, less rebound, and well-distributed. Its intelligent design, stable performance and long service life really comfort to the infrastructure construction of building, road & railway tunnel, coal mine shaft, hillside consolidation.
B. Diaphragm Wall

CRCHI Diaphragm Wall, with independent intellectual property rights, which is designed for the underground continuous stirring, forming of concrete wall. The forming capacity of dimension around 9m x 8m x 10m could be accomplished by the Diaphragm Wall, which is composed of mechanic engineering, hydraulic drive, automatic technology, and digital transferring. It can build a seamless connect wall with width of 50 to 850 mm underground in range of 0-60m, especially for the construction of geologies of seacoast and aquifer, even in the infrastructure of buildings, beneath tunnel, vertical shaft, garbage landfill, metro cross shaft, obstacle wall, anti-penetrating wall, harbor and reservoir embankment.

LSJ60Diaphragm Wall in Jobsite

This equipment takes the advantages of good performance of ballast water & construct wall, high-strength, well-distributed, low gravity and reliability. The researching of Diaphragm Wall create a new category to fill the blank of domestic market, end over the complete import of these machine.
### iii. Turnout

Turnout is a significant part of rail track system when a train or locomotive need transferred from an orbit to another. It has the special feature of tremendous quantity, complex structure, short service life, limitation of train speed, low traffic safety, high investment. The basic structure of line connecting (Single turnout & Duplex turnout), cross connecting (Straight cross & Diamond cross) and cross combines (Slip switches & Crossover turnout).

![Solid Manganese Steel Frog Crossover Turnout of 60kg/m](image)

### A. Main Products

The Turnout Company under the CRCHI, mainly fabricates the Single turnout, Symmetrical turnout, Three direction turnout, Crossover turnout, Combination turnout, Fixed frog, Movable frog, Telescope adjustment of steel rail and spare parts of switch rail, stock rail, guard rail, solid manganese steel frog, alloy frog, plate and joins. Those has been wildly used in the projects of high-way, heavy load railway, railway station, and urban mass transit. Until year 2013, we’ve provide track products more than 40 railway lines construction of National Key Projects in Railways, at the same time, we devote our effort on overseas’ market development, and accomplished export in the countries of USA, Saudi Arabia, Sierra Leone and Nigeria etc.
Single Turnout  Movable turnout of “200km-18”

Turnout of “350km-42”  Alloy Frog

Solid Manganese Steel  Frog for North America
B. Workshop & Facilities

The machining equipment of Turnout Company of CRCHI was imported from Europe, the processing in steel rail of forging & press, sawing & drilling, and welding has achieved lead level in domestic market. The rail sawing & drilling lines introduced from Austria can finish the sawing and drilling in one work pass, improved the accuracy of machining, and the 5000T Forging & Heating Plant for heal of switch rail which imported from Denmark computerize the procedures of Uploading, Heating, Forging, and unloading. Contemporarily, this process of “Three times forging in one heating” reaches the international level and the technology of heel pro-long forge & press which has filled the market blank. The steel rails welding and welding of steel rail in Solid Manganese Steel Frog supposed to be furnished by GAAS-100 Steel Rail Sparkle Welder.
iv. Fastener&Clip&Brake-shoe

Clip is an elastic element; with the screw bolt and pad compose of Fastener. The Fastener is quiet important in the highway construction, and the Clip play a crucial role in it. The Longchang Material Company of CRCHI mainly operates in the Fastener products of Type I、II、III、C、D, and Type IV、V、WJ for highway, Type VII for heavy load railway, normal & high-strength fastener and track form holdings. Also, we furnish the fabrication shoe break with optional of high friction, low friction & heavy loading, and steel back of vehicle accessories, mechanical& electrical products, and business of external processing, sales & export. With more than 10 years advancing operational experiences of rail track products, our integrate ability of researching, fabrication, assembly, conveyance, quality, and reliable service has ahead of domestic market. Bunch of our products has already been exported and renowned in USA, Australia, Germany, Italy, Belgium, Croatia, Spain, Iran, Brazil, and Korea worldwide.

A. Main Products

a. Fastener& Clip

The manufacture of Type IV、V Fastener by Longchang CRCHI, with the requirement of 《Active Technology of Type IV/V Clip》【No. 2007(Year), Technology base】, researching on the assembly design of 60kg/M steel rail, which could achieve the demand of Non-shoulder blockBallast Track with Pre-stressed Concrete. It can operate the Passenger Line with the max speed of 350km/h in loading of 170KN, and the Passenger Line with 250km/h in loading of 230KN, as well as the Cargo Line.
The manufacture of Type WJ-7 Fastener by Longchang CRCHI, with the requirement of 《Active Technology of Type WJ-7 Clip》【No. 2007(Year), Technology base】，researching on the assembly design of 60kg/M steel rail, which could achieve the demand of Non-shoulder block Ballast-less Track with Pre-stressed Concrete. It can operate the Passenger Line with the max speed of 350km/h in loading of 170KN, and the Passenger Line with 250km/h in loading of 230KN, as well as the Cargo Line.

Type WJ-8 Fastener, with the requirement of 《Active Technology of Type WJ-8 Clip》【No. 2007(Year), Technology base】，researching on the assembly design of 60kg/M steel rail, which could achieve the demand of Non-shoulder block Ballast-less Track with Pre-stressed Concrete. It can operate the Passenger Line with the max speed of 350km/h in loading of 170KN, and the Passenger Line with 250km/h in loading of 230KN, as well as the Cargo Line.

The Type DT/DJK/DTIV belongs to the elastic individual categories, those special for the steel rail of 50kg/m, and has been wildly in the use of Urban Mass Transit, LRT projects in Beijing, Guangzhou, Shenzhen, Wuhan, Changsha etc.
b. Brake-shoe

The facilities in production line of brake-shoe came over from USA, which is a unique production line has entire supporting both in manufacture and testing. For instance, the equipment “1:1 Friction and Weariness Automatic Detector” of brake-shoe is advancing in Asian area; it could stimulate an environment in climate of moist, raining, torridity, windy to test in performance of friction & wear, temperature tolerance and sparkling inspection for brake-shoe.

AAR Composite brake-shoe

US ND5 locomotive brake-shoe

Engineering vehicle brake-shoe
B. Workshop & Facilities

The company has 11 production line of Clip (4 automatic line), 5 production line of Rail Bolt (1 automatic line), and production line of brake-shoe. The annual production capacity is 15 million set of Clip, 15 million set of Rail Bolt, 800,000 pies of Brake-shoe, with the institution in technology, testing and inspection.
v. Railway Electrification Products

CRCHI Electric Material Company mainly produces: Concrete column, steel column and other spare parts; Steel structure product and model; Rental service for war material and storage logistics. The company has multiple years of production experiences of catenary mast, there products have been identified by the CRCC.

A. Main Products

- H-shaped Steel Column
- Lattice Steel Column
- Pre-stressed Catenary Concrete Mast
- Annular Pre-stressed Concrete Mast
B. Workshop & Facilities

Customer first and honesty work is the top priority of the company. The company takes skilled technique and genuine attitude to fulfill the requirement of customer as our service aim. Through system innovation, management innovation and technology innovation, the company will contribute to the development of China high speed railway.

Fabrication-Inspection-Delivery

Logistics Park
vi. New Developed Products

Through original innovation, integrated innovation, collaborative innovation and continuous innovation, CRCHI has achieved multiple world leading core technologies, self-made pre-tunneling tunnel fills the blank in the industry, independent researched concrete mixing plant has gained good credit from the customers.

A. Bolter Miner

Bolter Miner is an excavating and anchoring integrated equipment, it can slice, load, transport and anchor synchronously, and widely used in global mining industry.

![ZJM4200 Shield Type Bolter Miner](image)

Self-researched ZJM4200 shield type Bolter Miner has multiple functions which highly integrates moving system, slicing system, loading system and anchoring system. The whole process can divide into tunneling system and anchoring system, and it also can operate synchronously.
B. Pre-tunneling equipment

The technique of Pre-tunneling is different from the typical tunnel excavation method. The process of the typical method is excavate first and lining support after which cause the low safety factor and slow excavation speed; The method of pre-tunneling equipment is lining support first and excavate after, its theory is to cut an arc-shaped narrow groove with chain-shape mechanical cutter (Normal thickness ranks 10-110 cm).

Pre-tunneling Equipment

Self-researched pre-tunneling equipment which has 25 meters long, 7.5 meters wide, 7.2 meters height and 200 tons weight integrates technologies of tunnel pre-supporting, hydraulic transmission and control, automatic control information transmission and guidance detect, it can be used wide range on the Railway, Highway, Urban underground traffic and Water diversion projects. It takes advantages of settlement control, shock insulation, high efficiency, economic and convenience, which boost the tunnel construction become more efficient, economic, safely and rapidly.
Ⅲ. Product’s Presentation in Jobsites

i. Tunnel Boring Machine

A. Earth Pressure Balance Shield (EPB)

Beijing Metro Line: The EPB, DZ001 mode which was used in the 11th tender of Beijing Metro Line 6 from Wuzi University to Beiguan station contracted by CRCC 18th bureau, has achieved 645.6 meters within one month and maximum daily advancing reached 31.2 meters. It broke the previous record of 508.8 meters and created a new record.
Changsha Metro Line: The TBM which used in Changsha metro line 1 contracted by CRCC 25th bureau on October 21, 2014, was an Earth Pressure Balance TBM with 6250mm diameter. Total length of two tunneling blocks was 4868.8 meters including from Provincial government station, by way of Youyi road station and to Central South University station. Tunnel length in right block is 2435.2 meters and is 2433.6 meters left side. The maximum daily advancing speed is up to 10 meters.
B. Slurry Pressure Balance Shield (SPB)

**Lanzhou Metro Line:** The TBM which used in the project of Lanzhou Metro Line 1 contracted by CRCC 21st bureau on 3 June, 2013, was a Slurry Pressure Balance TBM with diameter of 6450mm. The tunneling block’s length on right is 575 meters and is 652 meters left side.
Shenyang Metro Line: The “Xingjian Hao” TBM which used in the 7th tender of Shenyang Metro Line 9 contracted by CRCC 12th bureau on March 20, 2014, was a Slurry Pressure Balance TBM with diameter of 6250mm. The total length of tunnel is 2240 meters, in which 600 meter pass through Hun River. The maximum daily advancing speed is more than 9 meter and average advancing speed is 300 meters per month.
C. Coal Mine Inclined Shaft TBM

The World’s first unit of Inclined Shaft TBM, with length of 238 meters and weight over 1200 ton, was produced by CRCHI and used in mining area, Taigemiao, Shenhua New Street. Its excavation diameter reached $\Phi 7.62$ m, it is a complete inclined shaft equipment which combines the function of slope excavation, lining, slagging, transport, ventilation, and drainage.
The advancing speed of CRCHI’s Coal Mine Inclined Shaft TBM, in project of LaobawanFupingtong coal mine, Manasi, Xinjiang, reached 600 meters per month. The total length of tunnel is 5845 meters (3,845 rings).
D. Hard Rock TBM

**Jilin Water Diversion Project:** The Hard Rock TBM which used for Key Project of National Water Diversion in Jilin province contracted by CRCC 18th bureau on December 27, 2014, was the first set of large diameter full-face Hard Rock tunnel machine (Open Type TBM) in domestic. Its excavation diameter reaches Φ7.93 m and advancing speed of 600 meter per month. The service life achieved over 30 kilometers.
ii. Shotcrete & Diaphragm Wall

A. Shotcrete

HPS3016S Shotcrete self-designed & developed by CRCHI displays a great capability in the construction of TJ14 project, whose good performance has been highly praised by clients.
HPS3016S Shotcrete integrates the functions of walking, pumping and jetting, at the same time, it has the characteristics of better maneuverability, highly automation, wide jetting range, stable performance, easy operation, safely & reliability, high productivity, low rebound and high construction quality.
B. Diaphragm Wall

The LSJ60 Diaphragm Wall has been independently researched and developed by CRCHI. The concrete wall that constructed by this equipment can reach to 60 meters in depth, and the constructing speed can reach over 10 meters per day. The equipment had been highly praised by the proprietor and construction side when constructing in the Tianjin Luneng project of Diaphragm Wall for the commercial & residential buildings.
C. Concrete Mix Plant

The Concrete Mix Plant that used for the Nigeria project of China-Africa construction are manufactured by CRCHI.
iii. Turnout

The jobsite of Shanghai-Kunming High-speed Railway’s for assembly.

*Nigeria Akka Railway Project*: it is contracted and built by China Civil Engineering Construction Co., Ltd., the type of turnout in the picture is No.12 simple turnout of 60 kg/m steel rail.

Factory Inspection
Service in jobsite

Commissioning
iv. Fastener&Clip& Brake-shoe

In the year of 2013, the AAR composite brake-shoe that fabricated by Longchang Railway Material Company had qualified with AARM-1003 which verified by the North America railway association.
Our products had been widely used in the major railway projects, such as Ha'erbin-Dalian, Shanghai-Kunming, Xiamen-Shenzhen, Liuzhou-Nanning, and Chengdu-Chongqing etc.
v. Railway Electrification Products

We have rich experience in the manufacturing of pillars for the electrified railway catenaries. Our product series had acquired the certifications of China Railways Production Certification Center (CRCC). The products had been widely used in the railways, such as Wuhan-Guangzhou high speed railway, Zhengzhou-Xi’an highway, Fuzhou-Xiamen railway, Xiamen-Shenzhen railway, Beijing-Guangzhou railway, Luoyang-Zhangjiajie railway, Wuhan-Hefei railway and so on.
Our company undertakes the responsibilities in storage, transportation, maintenance and management of engineering war materials for the national railway project. It contains the Type 64 military railway beam, Type 65 military railway bridge pier, Type 83 light military railway bridge pier, Type 55# steel-beam etc.
vi. New Developed Products

Pre-tunneling Equipment, which weighs 200T, has been developed by CRCHI with dimension of 25m x 7.5m x 7.2m (L x W x H). It integrates multi-function and top-class technology of tunnel pre-shoring, hydraulic drive & control technology, automatic control technology, information technology, direct with supervising and controlling technology, geotechnical engineering and so on. It can be widely used in the construction of railway, highway, city underground traffic, diversion works and the similar tunnel construction. It takes advantages of settlement control, shock insulation, high efficiency, economic and convenience, which boost the tunnel construction become more efficient, economic, safely and rapidly.
IV、Technical & Service Backup

i. Consulting

At CRCC, we do our utmost to solve any queries or demand of technology, using scope, advantages and features of our products as required; we are expecting for your factory visiting kindly with appointment.

A. We can provide technology of model selection, construction design, assembly & disassembly, repairs, station tunneling, U-turn, as well as the needed technical documents.

B. Based on the drawings and technical parameters of TBM (used machine), we offer program of replacement design for your job.

C. For turnout products, on the basis of drawings and technical parameters, we offer design method for your job.

D. In special equipment line, we can offer a program of products selection & construction design complied with your jobsite condition.

E. A brief introduction of our manufacture ability and jobsite cases can be presented for your requirement.

F. During the entire operation of the equipment, we are tracing and providing technical assistance along with your projects.

ii. Inspection& Certificates

Once the contract has been signed and executed, in which the technical requirements, necessary procedures of design, fabrication, testing and files supply will be completely operated on schedule. And the products as well as the parts will be categorized in package and safely delivered.

A. We are open to any advice and inspection visiting from your company during the period of products manufacture and technical innovation. As required, the reasonable and proper suggestion can be taken after two-party researching and confirmation to benefit the quality.

B. In delivery, we can provide full set of documents varied of business, quality, technology, and certificates as follow:

   a. Packing list and Spare parts list of machine;
b. Technical standard of manufacture;
c. Qualification certificate of products;
d. Testing reports of qualification;
e. Installation Specification & Operating Manual & Spare Parts Catalog;
f. Required Certificates of Export Country.

iii. After Sale Service

A. Jobsite Inspection, Installation, Commissioning & Testing

In condition of new machine arrival as well as the incurable problem during the service period, our technical expert team will provide jobsite inspection, installation, commissioning and testing, along with instruction service of operation, maintenance, and fault solution.

a. Installation & commissioning of TBM: When the new product arrives on the jobsite, it's necessary for both of us to guarantee the equipment is unwounded in performance and package. We are working with you in research of assembly plan, technical requirements in details, and delivering related information of products' features, assembly method, technical assistance, along with monitoring the process of settlement, lifting and spot control. Finally, it's necessary for us to verify each process in assembly, and make a record for technical conclusion.

b. Launching shaft of TBM: we are in charge of the training for your technicians in the system working theory, maintenance, and operation of our products. Additionally, we will work with you by suggestion and instruction of launching condition’s confirmation, spot inspection, procedures arrangement and technical operation.

c. Testing advance of TBM: our technical expert team will operate along with your technicians during the testing advance, demonstrating operation skill and methods of maintenance, and monitoring as well. Simultaneously, we can offer our experienced suggestion of construction organization, techniques, auxiliary techniques, risk prevention, and advancing parameters varies of
references for decision.

d. Turnout products: under the purchasing order of more than 50 sets turnout products, we could offer a technical expert team for jobsite installation, inspection, and testing. Within less of 50 sets, a factory instruction of installation and inspection can be provide as required.

e. Special Equipment: As for those machines, a jobsite inspection, installation, and commissioning service will be supplied, along with 1-2 weeks instruction training of operation, maintenance, repair, and fault solution.

B. Maintenance & Repair Service

Upon request, we provide maintenance service and comprehensive spare parts in the projects to resolve any problems and queries in quality and operation.

a. Feed-back service requirements and provide solution;

b. Flexible specialists for all jobsites requirements;

c. Regular inspection and record for equipment.

d. Instruction of maintenance and technical assistance for clients.

e. Remote data acquisition to trace and monitor the equipment for ensuring it in good condition.

iv. Parts Supply

A. We provide comprehensive spare parts and instructive service of installation for our equipment in the projects.

a. Upon to our experiences of similar projects and frequency of worn parts, a 1-2 year recommended spare parts list can be offered for replacement.

b. Replacement of warranty spare parts for all equipment.

c. As for TBM and Turnout products, with the supply of drawing and specifications, we could design and fabricate components in standard.

d. For flexible and rapid delivery of spare parts, a need-based parts stock is supposed to be built in your side with our instruction and technical assistance.
B. Partners of CRCHI
v. Training Service

In the period of manufacture or use of the machine you ordered, as to acquire the features and operation of the products in detail, we offer a factory training or jobsite training for option, including:

A. Pre-delivery Inspection
B. Instruction of installation
C. Operating Skill
D. Regular Maintenance

On request, it is supposed to make a choice of the training class and method under your available schedule by setting an appointment with us, even for extra training items.