

CHANGSHA TALENT DOUBLE-LAYER
WEAR-RESISTANT PIPELINE

TECHNOLOGY INTRODUCTION



CHANGSHA TALENT
MACHINERY EQUIPMENT CO., LTD.

Address: Talent Road, Gaoxin District, Ningxiang City,
Changsha City, Hunan Province, China

Postal code: 410604
<https://tfjxsb.1688.com>



► Quality Commitment for Changsha Talent's Pipelines

1. For regular areas and regular concrete (C25, C30, C35), a quality warranty is provided for 60,000 or 80,000 cubic meters. If more than five straight pipelines fail within the committed volume, another set of straight pipelines will be provided by warranty. If more than five elbows fail, another set of elbows (excluding the end section) will be provided by warranty;

2. If the quantity of straight pipelines or elbows that fail within the committed volume is less than or equal to 5, a replacement will be provided based on the actual failure situation according to warranty policy;

3. All replacement pipes will be produced with the same quality. After receiving the warranty claim, the products will be shipped within two days.

► Specialized equipment for pipeline replacement and quick service

In order to quickly solve the production of non-standard pipes, our company has designed and manufactured a batch of welding and cutting integrated specialized machines. The equipment is small in size, versatile in function, and easy to use, which can quickly solve the unexpected failure of concrete delivery pipelines.

preferential policy

1. The welding and cutting integrated specialized machine has a standard retail price of 20,000 yuan per unit. If a customer purchases 30 sets of pump pipes, one unit of the equipment will be provided for free.

2. Our company arranges dedicated persons to be responsible for on-site installation, commissioning, and training work.



A PATENT CERTIFICATE

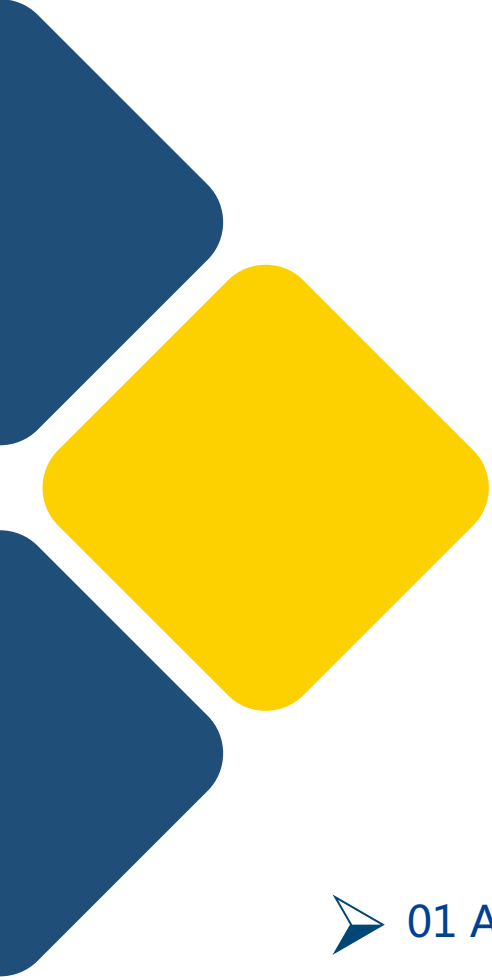




C COMPANY PROFILE ↘

Changsha Talent machinery Equipment Co., Ltd. is an R&D and manufacturing enterprise for core components of engineering machinery. It focuses on the research, manufacturing, sales, and services of the basic application disciplines of ferrous material. It has become a national high-tech enterprise, a "Small Giant" enterprise in Hunan Province, and a pilot demonstration enterprise of intelligent manufacturing in Changsha. The company has 63 independent intellectual property rights, including 9 Class I national invention patents, 2 Japanese invention patents, 2 US invention patents, and 2 EU invention patents; its patented products serve Zoomlion Heavy Industry Science and Technology Co., Ltd., Sany Heavy Industry Co., Ltd., and Xuzhou Construction Machinery Group, and are exported to international markets such as the United States, Germany, and Southeast Asia.





CONTENTS

BUSINESS DIRECTORY

- 01 An Overview of the Technology
- 02 Technology and Process Characteristics
- 03 Core Advantages
- 04 Quality Assurance
- 05 Warranty, specialized equipment for pipeline replacement, and rapid service



► Four Ways

◆ Four ways to improve the service life (wear resistance) of concrete delivery pipelines:

- A. Increase the thickness of the wear-resistant layer – limited by the lightweight Q value of the pump truck ($Q \text{ value} = \text{actual pumping volume} / \text{thickness of the pipeline}$).
- B. Use more wear-resistant materials – this requires a balance between the cost of the materials and the process.
- C. Improve the wear resistance of the easily worn parts – make up for the shortcomings.
- D. The outer layer provides protection – the outer tube has high strength and toughness.

Due to the limitation of the pump truck's boom load, there are certain requirements for the thickness of the wear-resistant layer. Although using more wear-resistant materials can improve the service life of the straight pipeline, it cannot balance the source of materials, feasibility of the process, and economic indicators. Therefore, local reinforcement and the use of materials with different wear resistance properties have ingeniously solved the above-mentioned contradictions.

◆ Design concept of Changsha Talent's double-layer wear-resistant pipeline : material selection accordingly, precise reinforcement, and composite strengthening.

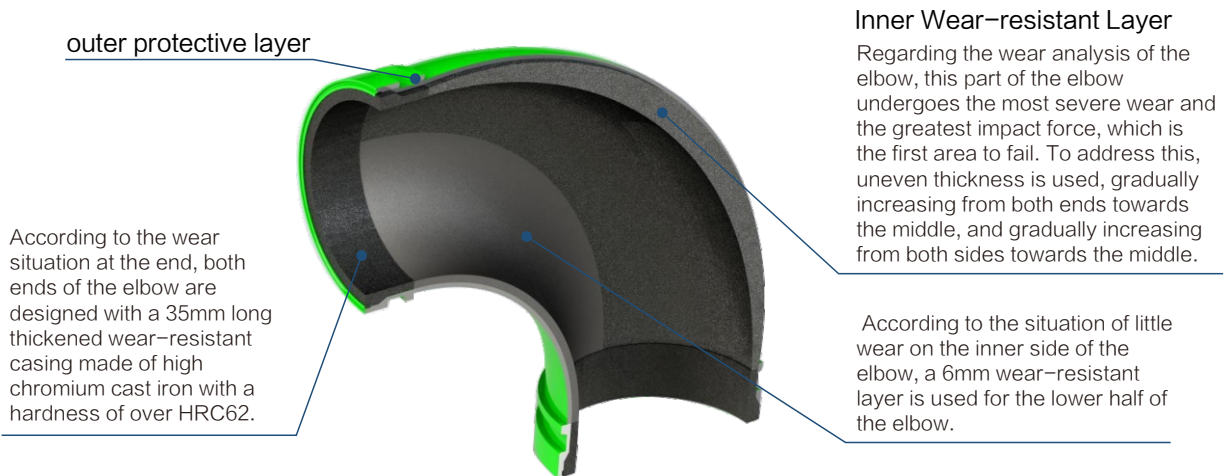
Material Selection	Precision Enhancement	Composite Strengthening
▲ According to the product function, the outer layer is pressure-resistant and the inner layer is wear-resistant; ▲ According to the wear law of the inner layer of the product, the wear of the end is greater than the wear of the pipeline body, and the wear of the outer arc is greater than the wear of the inner arc; ▲ The design is a combination of two different materials inside and outside, and different materials for the wear-resistant layer.	▲ Determine the wear and tear of the damaged area of the pipeline; ▲ Determine the wear ratio between the vulnerable area of the pipeline and other areas; ▲ Determine the wear area and range of the damaged area of the pipeline reinforcement.	▲ Composite positioning of inner and outer layers can reduce steps and increase the thickness of effective wear-resistant layer; ▲ The upper and lower halves of the curved surface are processed, with precise positioning and small gaps; ▲ The outer surface of the wear-resistant sleeve of the port is glued and compounded; ▲ Composite materials are used between the inner and outer layers, and the composite is tight.



► Dual-layer wear-resistant elbow

◆ Brief description of the structure of Changsha Talent elbow

Inner and outer layers, upper and lower halves



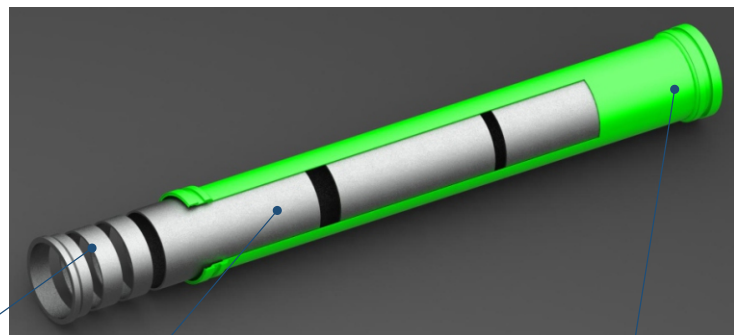
► Dual-layer wear-resistant straight pipeline

◆ Brief description of the structure of Changsha Talent straight pipeline.

Two layers, heterogeneous segmentation of the inner layer and outer layer.

High chromium cast iron wear-resistant casing (3 or multiple casings at the mouth end, symmetrical at both ends), the outer surface of the wear-resistant casing is coated with a composite bowl joint;

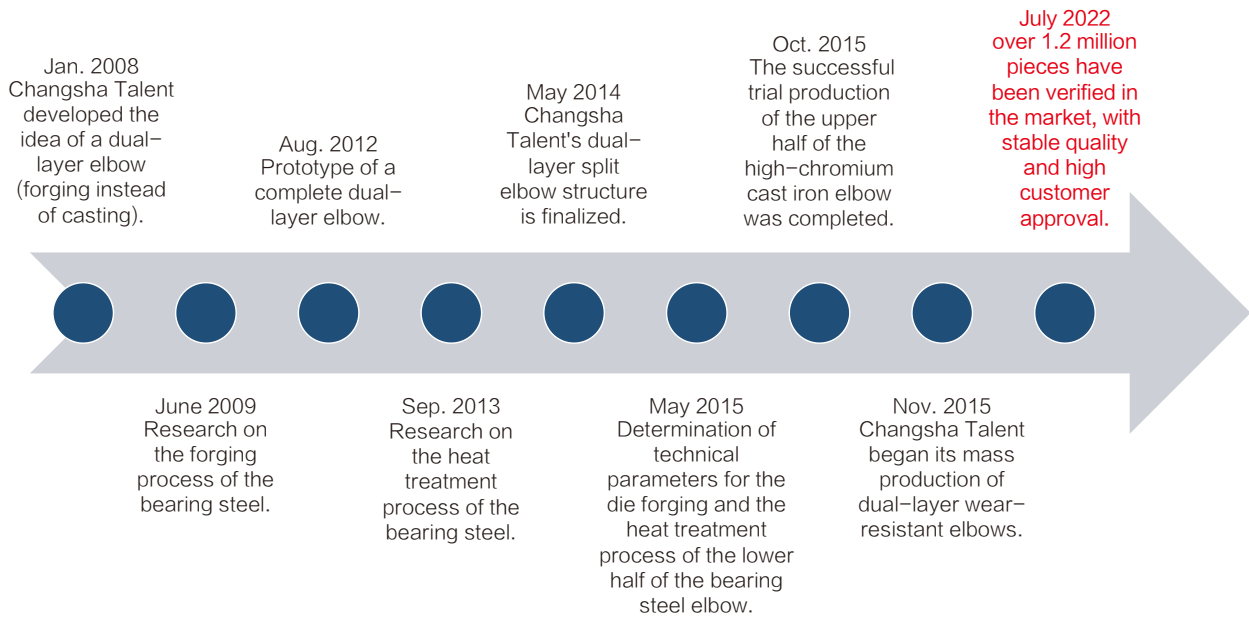
Bearing steel GCr15 material is used as the inner tube, with a hardness of HRC63-65;



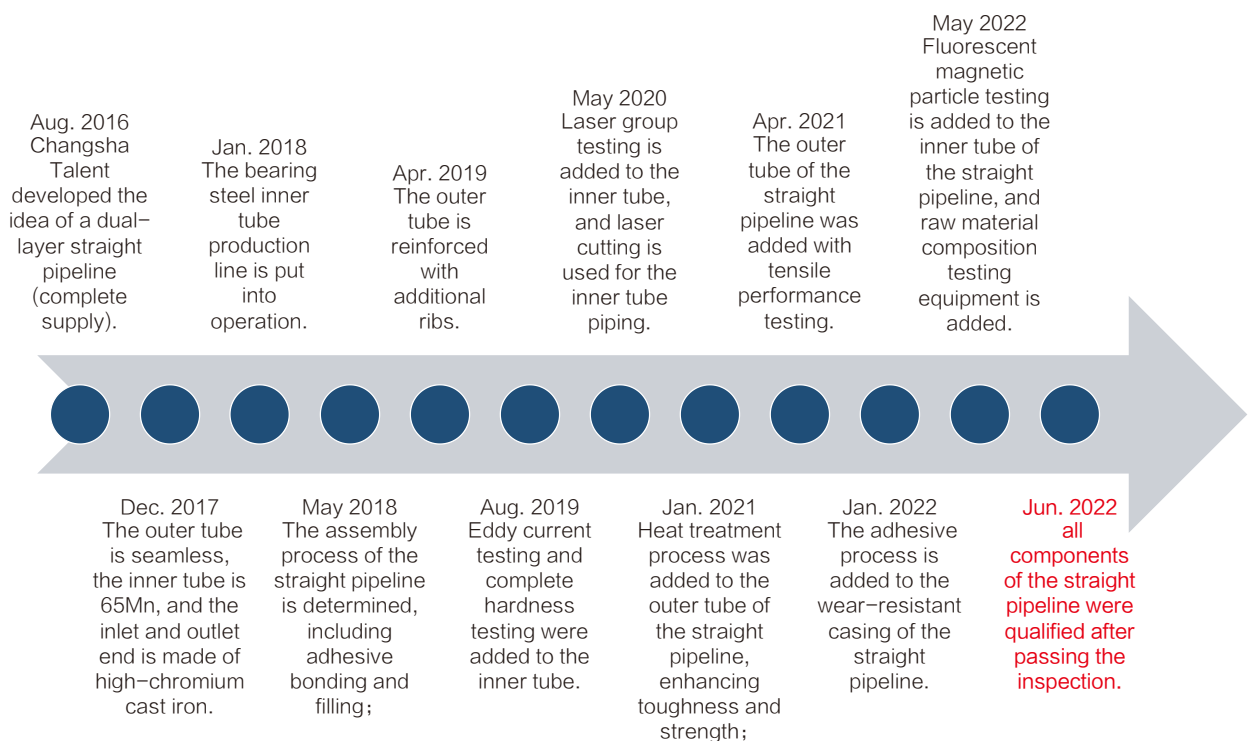
The outer tube is made of Q345B seamless pipe, with high strength and toughness after special treatment. The inner wall of the outer tube is reinforced with six reinforcing ribs and positioned for composite assembly.



History of the elbows



History of the straight pipeline

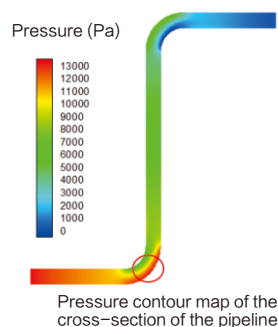




Changsha Talent elbow

1.The wear law of elbows

The function of elbows is to change the flow direction of the concrete, so the impact and wear force on the outer arc surface of the elbow is the greatest, especially at the end of the elbow, which is subjected to the greatest impact force and fails the fastest.



2.Technological innovation of elbows.

Structural innovation: dual-layer, split structure, gradual thickening from both ends and sides towards the middle to address wear on the outer arc surface.

Material matching: high-carbon and high-toughness high chromium cast iron is used for the easily worn outer arc, while cost-effective bearing steel is used for the inner arc.

Process innovation: multiple processes are used, such as casting for the outer arc and die forging for the inner ball, and combination welding.

3.Technical characteristics of elbows

Precise reinforcement of vulnerable areas

- ▲ Improved wear resistance of materials in vulnerable areas.
- ▲ Different thickness design of wear-resistant layer in vulnerable areas.

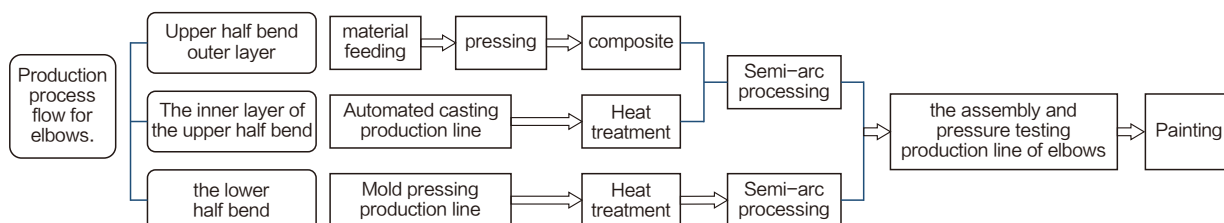
Wear-resistant material matching

- ▲ Developed a high-carbon, high-chromium, high-toughness cast iron through collaboration with peers and universities, with excellent wear resistance, impact resistance, high toughness, and strength.
- ▲ Cost-effective bearing steel material is used for the wear-resistant layer of the inner arc, which is formed by die forging.

Multiple process combinations

- ▲ Multiple process combinations achieve mass production of parts with reduced costs.
- ▲ Casting is used for the inner liner of the outer arc, and molding is used for the outer layer; Double-layer integral die forging and integral quenching are used for the inner arc. The precision of the inner and outer arcs is guaranteed by special machine tools, and automatic welding machines are used for welding.

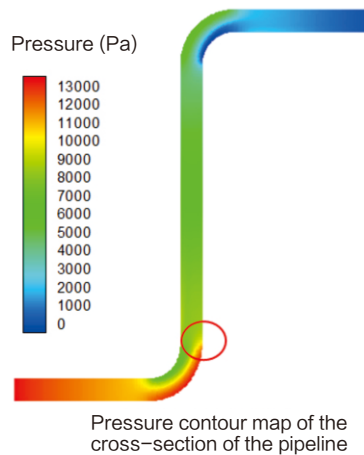
4、 Process of elbows.





► Changsha Talent straight pipeline

1. Wear law of straight pipelines.



According to research and analysis, the wear of the straight pipeline of concrete pump trucks is mainly manifested in the large wear at the end, especially at the flange welding position, which results in large wear and quick failure.

2. Technological innovation of straight pipelines

Structural innovation	Material matching	Process optimization
▲ Special structural design with two layers, with the inner layer heterogeneously segmented to precisely reinforce vulnerable areas. ▲ Strengthening at the end and segmented assembly of the pipe body.	▲ The inner layer material is divided into end material and pipe body material. Depending on the different wear, a combination of high-chromium cast iron and bearing steel is used. ▲ The outer layer is made of Q345B seamless pipe, which has high strength and strong pressure-bearing capacity after heat treatment.	▲ Integral quenching is used, with good penetrability and stable quality. ▲ Pipe-making technology for the inner tube solves the welding technology for bearing steel, which is unique in the industry. ▲ Adhesive bonding and filling are used to resist impact and solve the problem of knocking. ▲ All components are fully inspected and qualified before assembly.



3. Technical characteristics of straight pipelines.

Precise reinforcement of vulnerable areas

- ▲ By adjusting the structure, the wear-resistant material at the end is changed to improve its wear resistance performance. At the same time, it can withstand high-temperature welding without affecting its wear resistance;
- ▲ The length of the strengthening area is determined according to the degree of wear in the wear area.

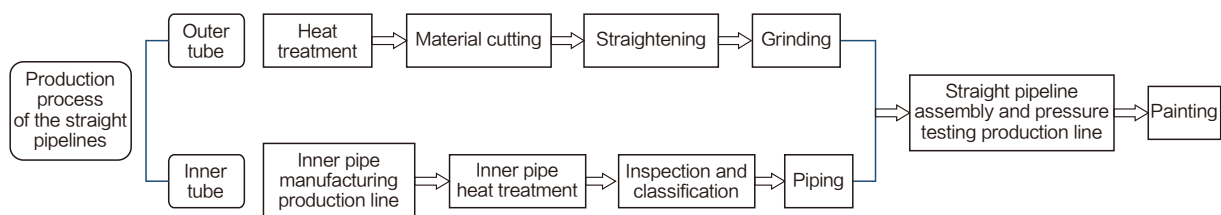
Self-developed core processes

- ▲ Solve major technical problems in welding and forming processes for bearing steel;
- ▲ Optimize the heat treatment process for the inner and outer tubes, achieving high hardness for the inner tube and high strength and toughness for the outer tube;
- ▲ Composite assembly, with special adhesive bonding used for the joint and wear-resistant sleeve of the pipeline.

Real-time detection of key parameters

- ▲ The entire heat treatment process is automated with intelligent control, ensuring stable and reliable quality;
- ▲ The multi-stage structure enables full inspection of the inner tube hardness, cracks, roundness, etc;
- ▲ The finished product is hydrotested at a pressure of 17MPa according to industry standards, with no leakage.

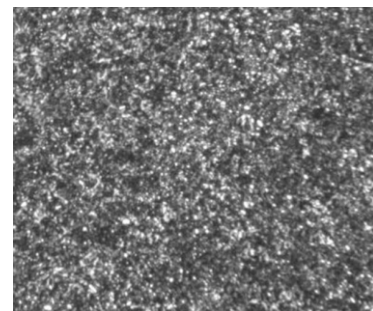
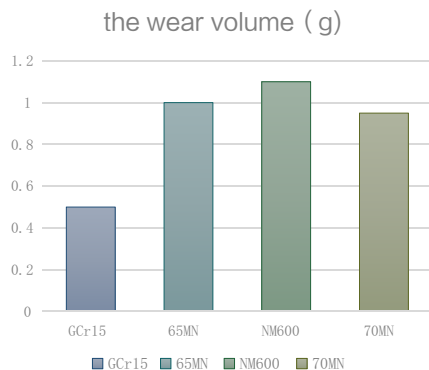
4. Process technology for straight pipelines





► Excellent material performance

1. The wear-resistant material of the inner tube is superior to that of industry competitors.



The inner tube is made of GCr15 bearing steel, which contains 0.95–1.05 carbon and 1.5–1.65 chromium. Its wear resistance is more than 50% higher than that of the two-layer straight pipelines made of 65Mn commonly used in the industry. After heat treatment, the inner tube has evenly distributed carbides with a hardness of HRC63–65, which results in high strength and hardness.

GCr15 inner tube material

Total thickness (mm)	Outer layer pipeline thickness (mm)	Inner layer pipeline thickness (mm)	Calculated pumped volume (10,000 cubic meters)	Actual pumped volume (10,000 cubic meters)	Q value
4.5	1.8	2.7	9	6.5	1.44
5.3	1.8	3.5	12	8.5	1.6

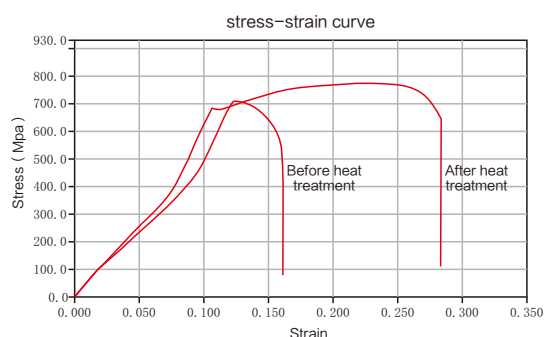
65Mn inner tube material

Total thickness (mm)	Outer layer pipeline thickness (mm)	Inner layer pipeline thickness (mm)	Calculated pumped volume (10,000 cubic meters)	Actual pumped volume (10,000 cubic meters)	Q value
4.5	1.8	2.7	6	4	0.9
5.3	1.8	3.5	8	5.5	1.0

The Q value of the inner tube made of GCr15 material is significantly higher than that of the inner tube made of 65Mn material. Using a Q value of 5.3 for a total thickness as a reference, the coefficient of the inner tube made of 65Mn material is 1.0, while the coefficient of the inner tube made of GCr15 material can reach about 1.6, and the lightweight coefficient of the straight pipeline is 60%. GCr15 material is more suitable for lightweight design of pump trucks than ordinary 65Mn material. Therefore, the inner wear-resistant layer of Changsha Talent pipelines is made of GCr15 material.

2. The outer tube has high strength and toughness.

The outer layer pipeline is made of high-quality Q355B structural steel that has been strengthened through cold drawing, which meets the requirements for the pipeline to withstand pumping pressure and structural support strength for concrete transportation.



Lot number	20210301		Test date	2021-3-1	
Material	Q345B		Dimensions (mm)	1.8*12	
Condition	Before heat treatment	After heat treatment	Condition	Before heat treatment	After heat treatment
Maximum force / Elongation / Agt(%)	12.18	22.19	Maximum deformation (Mm)	7.714	14.214
Maximum force (kN)	15521.31	16689.4	Tensile strength (Mpa)	719	773
Yield strength (kN)	6922.5	15428.54	Yield strength (kN)	321	714

The strength of the metal material was tested by a material tensile test, and the tensile strength was found to be between 670-780 MPa; The minimum value was taken as the calculation the tensile strength value for the cold-drawn and strengthened Q345B material: $\sigma_b = 670$ MPa. Taking a safety factor of 1.5, the working pressure $P_{\pm}$ of the outer tube was calculated using the following formula for pipeline pressure calculation:

$$P_{\pm} = (2 * \text{wall thickness} * \text{tensile strength } \sigma_b) / \text{inner diameter} / \text{safety factor}$$

$$= 2 * 1.8 * 670 / 130 / 1.5$$

$$= 12.37 \text{ MPa}$$

The working pressure $P_{\pm}$ of the straight pipeline at a safety factor of 1.5 is greater than the working pressure of a 63-meter pump truck. The ultimate breaking pressure P_j can be calculated as follows:

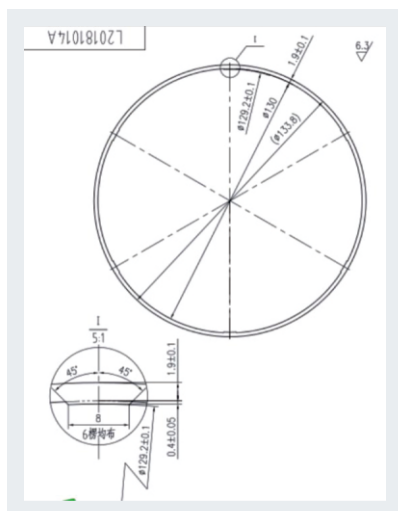
$$P_j = (2 * \text{wall thickness} * \text{tensile strength}) / \text{inner diameter}$$

$$= 2 * 1.8 * 670 / 130$$

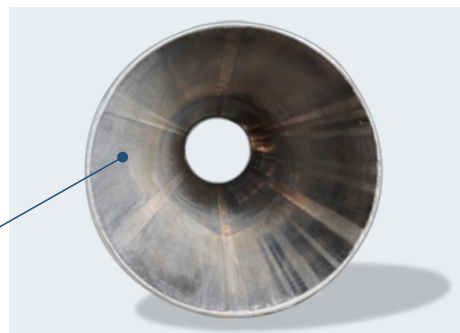
$$= 18.56 \text{ MPa}$$

This value is greater than the current pipeline technology's requirement of 17 MPa.

After undergoing a special process, the elongation of the outer tube reaches 22.19%, the tensile strength is 773MPa, and the yield strength is 714MPa; The residual stress of the outer tube is effectively eliminated, ensuring its high strength and toughness.



Reinforcing rib



The inner wall of the outer tube is equipped with 6 reinforcing ribs for positioning, ensuring that the ellipticity of the inner tube after grouping is controlled within 0.3mm to ensure the coherence of the inner tube and the effective thickness of the wear-resistant layer.



► Self-developed core processes and specialized production

◆ CNC automatic quenching and tempering equipment



Through multiple practical experiences, Changsha Talent has determined the optimal heat treatment process for GCr15NM-TF material:

the material is heated to $860 \pm 10^{\circ}\text{C}$ in the furnace, held for 180 seconds, and then oil quenched (fully immersed in oil for 30 seconds at a temperature of $50\text{--}60^{\circ}\text{C}$), followed by a 180°C low-temperature tempering. The material hardness reaches HRC62–65 as qualified, and the martensite structure is ranked at level 1–2 in the quenching and tempering martensite structure evaluation method. The martensite structure accounts for 98%, and the austenite structure accounts for 2%.



High chromium cast iron adopts the cold core casting process and robot polishing. The outer tube is formed by multiple cold drawing of seamless pipes to achieve high strength.



Through the study of the properties of GCr15 bearing steel material, a set of forming and welding process technical parameters has been developed, which solves the problem of welding and forming bearing steel materials that has been a challenge worldwide.



A set of assembly processes for straight pipelines has been developed based on the special structure of the straight pipeline. This ensures high production efficiency, excellent assembly quality, good composite bonding between the inner and outer layers, and high straightness.





Automated welding for straight pipelines and elbows ensures good welding quality. Besides, there is 100% pressure test at 17MPa for 3 minutes, ensuring that there is no leakage.

► Solve pain points for the industry

pain point 1

▲ Changsha Talent' s pipelines are not prone to bursting or delamination, reducing the risk of blockage, and are stable and safe in quality.

pain point 2

▲ Changsha Talent' s pipelines enjoy a wider range of material choices, allowing for flexible selection of materials with superior wear resistance (such as GCr15) without increasing costs, greatly improving their service life.

pain point 3

▲ Changsha Talent' s pipelines have replaced the previously low-efficiency induction quenching with mass production of overall quenching, resulting in more controllable quality and higher efficiency.

pain point 4

▲ Changsha Talent' s pipelines are filled and composite wrapped inside and outside, ensuring a tight fit and able to withstand certain impact forces.

pain point 5

▲ Full crack inspection for the inner tube solves the problem in the industry of inability to batch test cracks after quenching.

pain point 6

▲ Full hardness inspection for the inner tube solves the problem in the industry of destructive testing and sampling hardness inspection only.

pain point 7

▲ Changsha Talent' s pipelines can be installed at once without turning or turning back, making it convenient and fast.

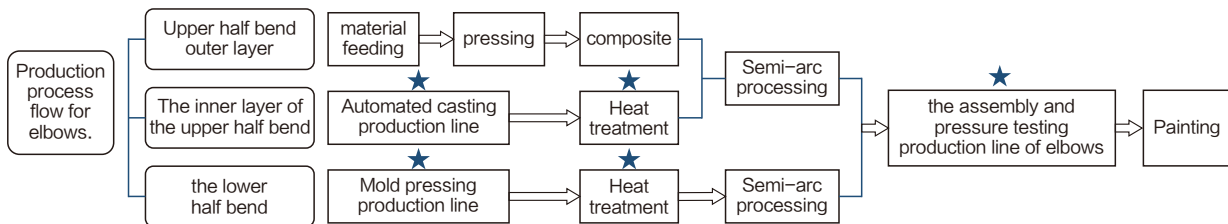
▶ Passed T V Rheinland ISO9001 quality certification in July 2021.



The company has passed certification for standardized production safety and obtained certification from T V Rheinland ISO9001 quality management system, OHSMS (Occupational Health and Safety Management Systems) , and EMS (environmental management system).

1. Key control points of product quality

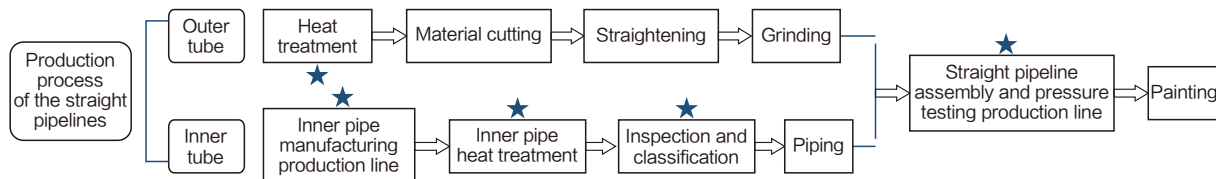
1.1.The process technology for elbows



Key control points for quality of elbows					
No.	Key control point	Key control parameters	No.	Key control point	Key control parameters
1	Half-bend casting of high-chromium cast iron	Casting quality and deformation	4	Heat treatment of GCr15 lower bend	Hardness and microstructure
2	Heat treatment of high-chromium cast iron	Hardness and microstructure	5	Elbow assembly and riveting/welding	Dimension and welding quality
3	Die forging of GCr15 lower bend	Size and deformation.			



1.2. The process technology for the straight pipeline



Key control point of straight pipelines

No.	Key control point	Key control parameters	No.	Key control point	Key control parameters
1	Heat treatment of outer tube	Strength, toughness, elongation	4	Detection classification	Hardness, cracks, roundness
2	Inner tube manufacturing	Welding, forming	5	Assembly pressure test	pressure, welding, steps
3	Inner tube heat treatment	Hardness, microstructure			

2. Quality control of raw materials – inspection items

序号	分类	名称/工序	规格	控制点	质量要求	检测工具/方法	关键控制点	检验频次	责任人
1	来料检验	外管	133. 6*1. 8	内径尺寸	129. 4-129. 6/129. 7-129. 9	千分尺	★	抽检10-30%	周攀/欧阳江南
2	来料检验			弯曲度	<2mm/m	钢板尺/目测		抽检10-30%	周攀/欧阳江南
3	来料检验			厚度	1. 8-1. 9	游标卡尺		抽检10-30%	周攀/欧阳江南
4	来料检验			椭圆度	<1. 5mm	游标卡尺		抽检10-30%	周攀/欧阳江南
5	来料检验			材质	Q345B	磨火花	★	抽检10-30%	周攀/欧阳江南
6	来料检验			材质	Q345B/Mn含量1. 0-1. 6	成分化验	★	全检	周攀/欧阳江南
7	来料检验			材质	无缝钢管	金相仪	★	每批1次	周攀/欧阳江南
8	来料检验			材质	碳含量	碳硫仪	★	每批1次	周攀/欧阳江南
9	来料检验			外观	无穿孔、锈蚀、凹陷、变形等	目测		抽检10-30%	周攀/欧阳江南
10	来料检验			强度、韧性	$\sigma_b \geq 650\text{MPa}$, $\sigma_s \geq 550\text{MPa}$, $A_{gt} \geq 16\%$	拉伸试验机	★	每批1次	周攀/欧阳江南
11	来料检验	140*3	140*3	内径尺寸	134mm	游标卡尺		抽检5-10%	周攀/欧阳江南
12	来料检验			厚度	3mm	游标卡尺		抽检5-10%	周攀/欧阳江南
13	来料检验			材质	Q345B/Mn含量1. 0-1. 6	成分化验	★	全检	周攀/欧阳江南
14	来料检验			外观	无锈蚀、凹陷、弯曲、变形等	目测		抽检10%	周攀/欧阳江南
15	来料检验			外观	无锈蚀、缺肉、变形等	目测		每批1次	周攀/欧阳江南
16	来料检验			厚度	3. 7/4. 0/5. 0	游标卡尺	★	每批1次	周攀/欧阳江南
17	来料检验	钢带	3. 7/4. 0/5. 0	宽度	285/225	卷尺		每批1次	周攀/欧阳江南
18	来料检验			成分	Gr15	厂家提供	★	必要时抽检	周攀/欧阳江南
19	来料检验			组织	脱碳层<0. 2mm、金相组织2-4级	金相仪	★	必要时抽检	周攀/欧阳江南
20	来料检验			厚度	5mm、7mm、9mm	游标卡尺	★	抽检5%	周攀/欧阳江南
21	来料检验			槽深	62mm	深度尺	★	抽检5%	周攀/欧阳江南
22	来料检验			宽度	124±1mm	游标卡尺	★	抽检5%	周攀/欧阳江南
23	来料检验	铸铁	275/190/180等	外观	无裂纹、孔洞、疏松、冷隔、缺肉、端面平整等	目测	★	抽检10%	周攀/欧阳江南
24	来料检验			成分	cr26	厂家提供	★	必要时抽检	周攀/欧阳江南
25	来料检验			弧度对角线等	专用检具	专用检具	★	抽检5%	周攀/欧阳江南
26	来料检验			凸顶厚度	11/14/18	游标卡尺	★	每批1次	周攀/欧阳江南
27	来料检验			硬度	HRC61-64/试样抽检硬度>HRC61	洛氏硬度计	★	每批1次	周攀/欧阳江南
28	来料检验			直径	128. 4-129. 2	游标卡尺		抽检3-5%	周全喜
29	来料检验			壁厚	3. 5/3. 0、4. 0	游标卡尺	★	抽检3-5%	周全喜
30	来料检验	直套	35/40/法兰套	重量	328g、720g	电子秤		抽检3-5%	周全喜
31	来料检验			外观	无裂纹、孔洞、疏松、冷隔、缺肉等	目测	★	抽检3-5%	周全喜
32	来料检验			成分	9#材料、cr26	厂家提供	★	必要时抽检	周全喜
33	来料检验			尺寸	t3	游标卡尺		抽检10%	周攀/欧阳江南
34	来料检验	钢板	t3	外观	无锈蚀、变形	目测		抽检10%	周攀/欧阳江南
35	来料检验			成分	Q345B	厂家提供		必要时抽检	周攀/欧阳江南
36	来料检验			尺寸	依图纸	游标卡尺	★	抽检5%	周全喜
37	来料检验	法兰	直管/弯管	外观	无锈蚀、变形、缺失	目测		抽检5%	周全喜
38	来料检验			成分	Q345B	厂家提供		必要时抽检	周全喜

There are professional personnel responsible for 6 categories of raw materials, 38 testing indicators, clear testing tools, testing methods, testing frequency, and criticality. Every point of raw materials entering the factory is implemented to ensure the quality control of incoming materials.

3. Quality control of raw materials

◆ High-chromium cast iron composition testing



◆ Bearing steel strip composition testing

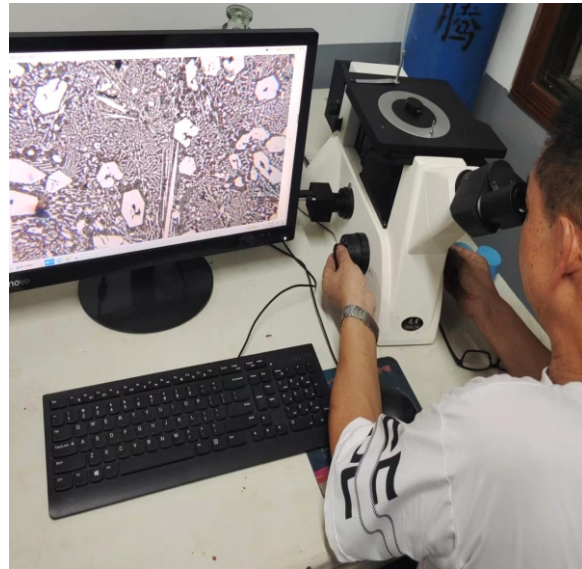




◆ Hardness testing and microstructure testing



▲ Hardness testing of cast iron after quenching



▲ Structure checking of cast iron after quenching

◆ Dimensional inspection, weight inspection, and casting quality inspection



▲ Cast iron size inspection



▲ Cast iron weight inspection



▲ Cast iron casting quality inspection

◆ Quality inspection of the outer tube

产品质量证明书
Jiangsu Yuhua Steel Tube Manufacturing Co., Ltd.
Inspection Certificate No. YTC200

合同号	产品名称	规格	数量	交货日期	检验日期
72271735-020	无缝钢管	1219.1	1219.1	2022.9	2022.9
炉号	批号	重量	长度	直径	壁厚
22100001	22100001	13	12025	1219.1	12.7
22100002	22100002	2	36	760	12.7

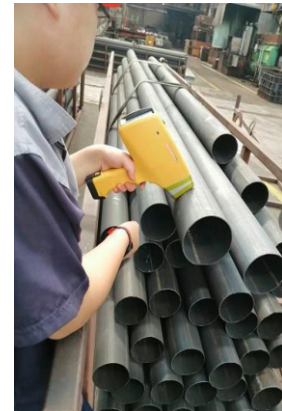
化学成分 (Chemical Composition): C: 0.18, Si: 0.35, Mn: 0.30, P: 0.012, S: 0.005, Nb: 0.010, Ti: 0.010, V: 0.010, N: 0.005, O: 0.005, H: 0.005, Al: 0.005

力学性能 (Mechanical Properties): 屈服强度 (Yield Strength): 355, 抗拉强度 (Tensile Strength): 510, 伸长率 (Elongation): 18.5, 断面收缩率 (Reduction of Area): 40.0

▲ Quality and technical agreement of the outer tube and material certificate.



▲ Tensile machinery performance testing of the outer tube



▲ Spectral composition testing of the outer tube



▲ outer tube dimension

外管进厂检验记录表 TFJY20220419						
供应商		日期		2022年 8月 20日		
检验员		周攀	本批数量	162件	10.03吨	抽检数量 10%
技术要求		1、筋内径: 129.4~129.6mm 129.7~129.9mm 2、壁厚、筋高: 抽取3根, 每根检测圆周均分的3点, 取平均值; 弯曲度和长度抽检3件 3、表面质量抽检10%; 冷拉伸抽检1件; 焊缝判断抽检1件; 材质成分磨火花10%或抽检1件。				
序号	检测项目及要求	结果	备注			结论
1	★抽检数的平均筋内径	129.58	与要求中线129.50的偏差: 0.08			符合要求
2	★椭圆度大于1.5mm的占	0.00%	最大椭圆度值: 1.13			符合要求
3	★弯曲度≤2mm/m	16	20	15	13	16.00
4	★管壁厚1.9±0.10	1.98	2.03	1.94	1.98	1.98
5	筋高度0.25±0.05	0.22	2.26	2.18	2.15	2.20
6	长度8.99~9.03m	8.88	8.75	9.19	8.687	8.88
7	★表面质量	无	1、无裂纹、穿孔及焊接痕迹; 2、无坑洼、凹陷、拉伤、烧伤、折叠、结疤、缺肉和严重波纹; 3、拉头已切除, 端面与轴线垂直, 切口毛刺应清除。			符合要求

▲ Record form for incoming inspection of the outer tube

► Quality and technical agreements

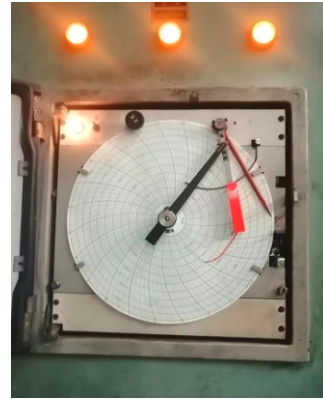
质量协议 甲方: 长沙天德机械有限公司 乙方: 湖南天德机械有限公司 为了明确产品质量, 甲乙双方经友好协商, 达成如下协议: 一、技术要求: 1. 乙方提供的产品应符合甲方提供的技术协议要求。 2. 乙方提供的产品应符合国家相关标准。 3. 乙方提供的产品应符合甲方提供的技术协议要求。 4. 乙方提供的产品应符合甲方提供的技术协议要求。 5. 乙方提供的产品应符合甲方提供的技术协议要求。	质量协议 甲方: 长沙天德机械有限公司 乙方: 湖南天德机械有限公司 为了明确产品质量, 甲乙双方经友好协商, 达成如下协议: 一、技术要求: 1. 乙方提供的产品应符合甲方提供的技术协议要求。 2. 乙方提供的产品应符合国家相关标准。 3. 乙方提供的产品应符合甲方提供的技术协议要求。 4. 乙方提供的产品应符合甲方提供的技术协议要求。 5. 乙方提供的产品应符合甲方提供的技术协议要求。	质量协议 甲方: 长沙天德机械有限公司 乙方: 湖南天德机械有限公司 为了明确产品质量, 甲乙双方经友好协商, 达成如下协议: 一、技术要求: 1. 乙方提供的产品应符合甲方提供的技术协议要求。 2. 乙方提供的产品应符合国家相关标准。 3. 乙方提供的产品应符合甲方提供的技术协议要求。 4. 乙方提供的产品应符合甲方提供的技术协议要求。 5. 乙方提供的产品应符合甲方提供的技术协议要求。	质量协议 甲方: 长沙天德机械有限公司 乙方: 湖南天德机械有限公司 为了明确产品质量, 甲乙双方经友好协商, 达成如下协议: 一、技术要求: 1. 乙方提供的产品应符合甲方提供的技术协议要求。 2. 乙方提供的产品应符合国家相关标准。 3. 乙方提供的产品应符合甲方提供的技术协议要求。 4. 乙方提供的产品应符合甲方提供的技术协议要求。 5. 乙方提供的产品应符合甲方提供的技术协议要求。
--	--	--	--

There are quality and technical agreements signed with suppliers on the quality and standards of key components.



4. Production process control – key process records

◆ Record of heat treatment quenching process parameters



▲ Heat treatment process operation process instructions

▲ Heat treatment process curve

► Key process inspection



▲ Inspection of verticality of the inner tube



▲ Quenching of the inner tube – temperature in the quenching furnace is $860 \pm 10^{\circ}\text{C}$, oil temperature is $45\text{--}70^{\circ}\text{C}$, and the time is 210 seconds.

Hardness inspection of the inner tube – the hardness of the inner tube after heat treatment is HRC61–64, and it is 100% fully inspected and qualified. Changsha Talent is the only one in the industry that can fully inspect the hardness without destructive testing, ensuring that the key indicator of product wear resistance is qualified.





The inner tube is detected using precision fluorescent magnetic particle testing technology, which has high accuracy. It can ensure scientific and accurate detection of the inner tube, effectively eliminating defects such as cracks, thus ensuring the quality of the inner tube in an all-round way.



The inner tube is inspected based on the outer diameter size, and then grouped for assembly to reduce the steps caused by the roundness of the inner tube in the pipeline.