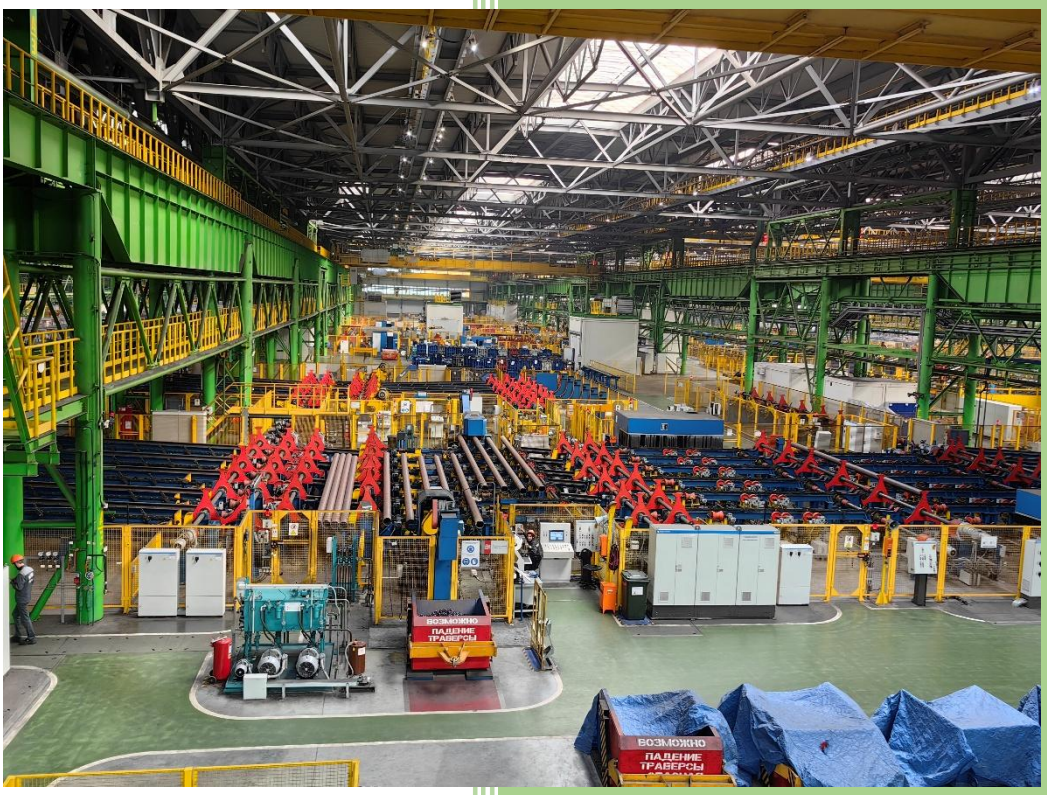
2025

# Octg Pipe Casing Line Solution

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2025-11-6

# Casing Pipe Technical Solutions

## 一、Project Detailed Requirements

### 1.1 Project Description:

This finishing line solution is intended to produce a complete set of equipment for Ø102–Ø426 mm casing finishing lines. The equipment will comply with the relevant standards and performance requirements for casing processing in the oil and gas industry.

The equipment will process casing blanks manufactured in accordance with GOST 632-80, GOST 31446-2017, API 5B, API 5CT, and API 5CRA, and will ensure that threaded connections meet the requirements of GOST 632-80, GOST 33758-2021, GOST 34057-2017, GOST 31446-2017, as well as the following "Premium" and special thread types:VAM Top, JFE, OG1M, OTTM, LC, STC, OTTG, GF, PF, FMC, TTL-01, CS, BATRESS.

Production capacity requirement: The annual output will not be less than 100,000 tons of casing products, and the equipment will meet the operating parameters specified in the table below.

| Item | Nominal Dia ，mm | Thickness ， mm | Nominal Conneting Dia，mm | Pipe Length ， m | Operating Time (CIE=100%)， Hours /Year |
|---|---|---|---|---|---|
| Casing Pipe | 102-426 | 5,0-16,7 | 114-451 | 4,88-14,63 | 5650 |

### 1.2 Steel Grades and Thread Types

The equipment will support the following casing steel grades and couplings:

- **Compliant with GOST 632-80:** D, K, E, L, M, R, T
- **Compliant with GOST 31446-2017 / API 5CT:** H40, K55, J55, K72, N80Q, N80-1, R95, M65, L80, P110, Q135

**Thread Standards:**
API 5B, API 5CT, GOST 632-80, GOST 33758-2016, GOST 34057-2017, GOST 31446-2017

# 二、Technical Solution for the pipe threading production line

## 2.1 Casing Production Line Solution Plan

Based on the equipment requirements and processing technology for the Ø102–Ø426 mm pipe diameter range, and to ensure the annual production capacity, we plan to divide the production line into two separate lines:

7-inch production line: covering the diameter range of 2 3/8"–7", dedicated to finishing operations for small and medium-size casing.
16-inch production line: covering the diameter range of 7"–16 3/4", designed for finishing operations of large-size casing.

This line division aims to optimize process flow, balance equipment load, and ensure overall production efficiency and stable product quality, meeting the requirement of an annual output of no less than 100,000 tons of casing products.

## 2.2 Production Processing Procedure Description

**2.2.1** The loose bundles are fed, the pipe enters the Box end swaging
**2.2.2** After the pipes are discharged from the box end Swaging, the box end threading begins. After the box-end thread cleaning, the pipe enters the box -end thread inspection process.
**2.2.3** The pipes that pass the thread inspection are sent to the subsequent processing, while those that fail the inspection are transferred to the subsequent flow and sent to the box-end rework saw unit by the conveyor roller for cutting heads. After the cutting is completed, the pipes are longitudinally transferred again and re-entered into the production line for processing.

**2.2.4** After the box end threading operation, the tubes are subjected to box end magnetic particle inspection, box end tube sandblasting and shot blasting, robot casing material feeding, and casing pre-tightening and tightening.

**2.2.5** After the magnetic particle inspection, the pipes that pass the inspection enter the subsequent process. The pipes that fail the inspection are transferred to the box end rework saw unit by the conveyor roller and cut off. After that, they return to the production line to continue the tubes' box end swaging, threading, inspection, and sandblasting processing.

**2.2.6** After the pipes are drafted at the box end, they are subjected to water pressure test and a long drafting test, and the tubes are threaded at the pin end and the pin end thread inspection and magnetic particle inspection, pin end sandblasting and shot blasting.

**2.2.7** The pipes that fail the thread inspection and magnetic particle inspection at the pin end follow the flow transfer process like that at the mother end.

**2.2.8** After the subsequent process, the tubes enter the automatic inner protector lubrication and robot tightening, automatic outer protective cap lubrication and robot tightening, length measurement, weighing, marking, spraying and painting color rings, UV spraying and curing, bundling, and storage.

## 2.3 Pipe Threading Line Main Equipment List

### 2.3.1 Casing Production Line 2 3/8"–7"

| Casing Production Line 2 3/8"–7" Main Equipment List | | | |
|---|---|---|---|
| No | Items | Unit | Qty |
| 1 | Bundle Feeding and Separation Device | Set | 1 |
| 2 | Roller Conveyor | Set | 1 |
| 3 | Steel Pipe Ultrasonic Inspection Main Unit(full) | Set | 1 |
| 4 | Pipe Ultrasonic Inspection Unit Auxiliary Device | Set | 1 |
| 5 | Transfer and Rejection Rack for Defect Pipes | Set | 1 |
| 6 | Transfer Roller Conveyor for Defect Pipe | Set | 2 |
| 7 | DSMT-7 Pipe Threading Machine (box end ) | Set | 1 |
| 8 | DSMT-7 Pipe Threading Machine Auxiliary Device (box end) | Set | 1 |
| 9 | Manual Thread Checking Bench (box end) | Set | 2 |
| 10 | Thread Cleaning Device (box End) | Set | 1 |
| 11 | Rotary Thread Grinding Unite (box End) | Set | 1 |
| 12 | Auxiliary Thread Inspection Device | Set | 1 |
| 13 | MPI(Magnetic Particle Inspection Unit) （box End ） | Set | 1 |
| 14 | MPI Auxiliary Unite （box End ） | Set | 1 |
| 15 | Robot System for Triangle Marking and T-Band Spraying （box End ） | Set | 1 |
| 16 | Auxiliary Device for Triangle Marking and T-Band Spraying （box End ） | Set | 1 |
| 17 | Coupling Starter | Set | 1 |
| 18 | Coupling Make-Up machine | Set | 1 |
| 19 | Auxiliary Coupling Starter and Make up machine | Set | 1 |
| 20 | Coupling Starter Robotic Loading System (optional ) | Set | 1 |
| 21 | End Cutting Saw + JIB Crane + Collecting Bins | Set | 1 |
| 22 | Transfer System for Saw-Cut and Repaired Steel Pipes （box End | Set | 1 |
| 23 | Conveyor Roller for Saw-Cut and Repaired Steel Pipes （box End | Set | 1 |
| 24 | Single-Pipe Hydrostatic Testing Machine | Set | 1 |
| 25 | Full Length Long Drifter | Set | 1 |

| | | | |
|---|---|---|---|
| 26 | Long Drifter Auxiliary Unit | Set | 1 |
| 27 | Single-Pipe Hydrostatic Testing Machine | Set | 1 |
| 28 | Transfer Roller Conveyor for Defect Pipe | Set | 1 |
| 29 | Roller Conveyor | Set | 1 |
| | | | |
| 30 | DSMT-7 Pipe Threading Machine (Pin end ) | Set | 1 |
| 31 | DSMT-7 Pipe Threading Machine Auxiliary Device(Pin end ) | Set | 1 |
| 32 | Manual Thread Checking Bench (Pin end) | Set | 2 |
| 33 | Thread Cleaning Device (Pin End) | Set | 1 |
| 34 | Rotary Thread Grinding Unite (Pin End) | Set | 1 |
| 35 | Auxiliary Thread Inspection Device(Pin End0 | Set | 1 |
| 36 | MPI(Magnetic Particle Inspection Unit) （Pin End ） | Set | 1 |
| 37 | MPI Auxiliary Unite （Pin End ） | Set | 1 |
| 38 | Robot System for Triangle Marking and T-Band Spraying （Pin End ） | Set | 1 |
| 39 | Auxiliary Device for Triangle Marking and T-Band Spraying （Pin End ） | Set | 1 |
| 40 | End Cutting Saw + JIB Crane + Collecting Bins | Set | 1 |
| 41 | Transfer System for Saw-Cut and Repaired Steel Pipes （box End | Set | 1 |
| 42 | Conveyor Roller for Saw-Cut and Repaired Steel Pipes （box End | Set | 1 |
| 43 | Box End Threads Grease Applicator | Set | 1 |
| 44 | Box End Protector Applicator ( robotic System Can be Choice ) | Set | 1 |
| 45 | Pin End Threads Grease Applicator | Set | 1 |
| 46 | Pin End Protector Applicator ( robotic System Can be Choice ) | Set | 1 |
| 47 | End Process Table | Set | 1 |
| 48 | WMS System | Set | 1 |
| 49 | UV Coating Roller Conveyor | Set | 1 |
| 50 | UV Coating Machine | Set | 1 |
| 51 | Curing Setion Unit | Set | 1 |
| 52 | Bundling Unit | Set | 1 |
| 53 | Exit Conveyor Roller | Set | 1 |
| 54 | Exit Bundling and Collection Rack | Set | 1 |
| | | | |
| 55 | Pipe Number Recognition and Single-Pipe Tracking System | Set | 1 |
| 56 | Central Hydraulic Power Unit and Hydraulic Line System | Set | 1 |
| 57 | Electrical Control System | Set | 1 |

### 2.3.2 Casing Production Line 7"-16 3/4”

| Casing Production Line 7"-16 3/4” Main Equipment List | | | |
|---|---|---|---|
| No | Items | Unit | Qty |
| 1 | Bundle Feeding and Separation Device | Set | 1 |
| 2 | Roller Conveyor | Set | 1 |
| 3 | Steel Pipe Ultrasonic Inspection Main Unit(full) | Set | 1 |

| | | | |
|---|---|---|---|
| 4 | Pipe Ultrasonic Inspection Unit Auxiliary Device | Set | 1 |
| 5 | Transfer and Rejection Rack for Defect Pipes | Set | 1 |
| 6 | Transfer Roller Conveyor for Defect Pipe | Set | 2 |
| 7 | DSMT-16 Pipe Threading Machine (box end ) | Set | 1 |
| 8 | DSMT-16 Pipe Threading Machine Auxiliary Device (box end) | Set | 1 |
| 9 | Manual Thread Checking Bench (box end) | Set | 2 |
| 10 | Thread Cleaning Device (box End) | Set | 1 |
| 11 | Rotary Thread Grinding Unite (box End) | Set | 1 |
| 12 | Auxiliary Thread Inspection Device | Set | 1 |
| 13 | MPI(Magnetic Particle Inspection Unit) （box End ） | Set | 1 |
| 14 | MPI Auxiliary Unite （box End ） | Set | 1 |
| 15 | Robot System for Triangle Marking and T-Band Spraying （box End ） | Set | 1 |
| 16 | Auxiliary Device for Triangle Marking and T-Band Spraying （box End ） | Set | 1 |
| 17 | Coupling Starter | Set | 1 |
| 18 | Coupling Make-Up machine | Set | 1 |
| 19 | Auxiliary Coupling Starter and Make up machine | Set | 1 |
| 20 | Coupling Starter Robotic Loading System (optional ) | Set | 1 |
| 21 | End Cutting Saw + JIB Crane + Collecting Bins | Set | 1 |
| 22 | Transfer System for Saw-Cut and Repaired Steel Pipes （box End | Set | 1 |
| 23 | Conveyor Roller for Saw-Cut and Repaired Steel Pipes （box End | Set | 1 |
| 24 | Single-Pipe Hydrostatic Testing Machine | Set | 1 |
| 25 | Full Length Long Drifter | Set | 1 |
| 26 | Long Drifter Auxiliary Unit | Set | 1 |
| 27 | Single-Pipe Hydrostatic Testing Machine | Set | 1 |
| 28 | Transfer Roller Conveyor for Defect Pipe | Set | 1 |
| 29 | Roller Conveyor | Set | 1 |
| | | | |
| 30 | DSMT-16 Pipe Threading Machine (Pin end ) | Set | 1 |
| 31 | DSMT-16 Pipe Threading Machine Auxiliary Device(Pin end ) | Set | 1 |
| 32 | Manual Thread Checking Bench (Pin end) | Set | 2 |
| 33 | Thread Cleaning Device (Pin End) | Set | 1 |
| 34 | Rotary Thread Grinding Unite (Pin End) | Set | 1 |
| 35 | Auxiliary Thread Inspection Device(Pin End0 | Set | 1 |
| 36 | MPI(Magnetic Particle Inspection Unit) （Pin End ） | Set | 1 |
| 37 | MPI Auxiliary Unite （Pin End ） | Set | 1 |
| 38 | Robot System for Triangle Marking and T-Band Spraying （Pin End ） | Set | 1 |
| 39 | Auxiliary Device for Triangle Marking and T-Band Spraying （Pin End ） | Set | 1 |
| 40 | End Cutting Saw + JIB Crane + Collecting Bins | Set | 1 |
| 41 | Transfer System for Saw-Cut and Repaired Steel Pipes （box End | Set | 1 |
| 42 | Conveyor Roller for Saw-Cut and Repaired Steel Pipes （box End | Set | 1 |
| 43 | Box End Threads Grease Applicator | Set | 1 |

| | | | |
|---|---|---|---|
| 44 | Box End Protector Applicator ( robotic System Can be Choice ) | Set | 1 |
| 45 | Pin End Threads Grease Applicator | Set | 1 |
| 46 | Pin End Protector Applicator ( robotic System Can be Choice ) | Set | 1 |
| 47 | End Process Table | Set | 1 |
| 48 | WMS System | Set | 1 |
| 49 | UV Coating Roller Conveyor | Set | 1 |
| 50 | UV Coating Machine | Set | 1 |
| 51 | Curing Setion Unit | Set | 1 |
| 52 | Bundling Unit | Set | 1 |
| 53 | Exit Conveyor Roller | Set | 1 |
| 54 | Exit Bundling and Collection Rack | Set | 1 |
| | | | |
| 55 | Pipe Number Recognition and Single-Pipe Tracking System | Set | 1 |
| 56 | Central Hydraulic Power Unit and Hydraulic Line System | Set | 1 |
| 57 | Electrical Control System | Set | 1 |

# 三、The Main Equipment Introduction for The Casing Line

## 3.1 Pipe Swaging Machine (optional )

### 3.1.1 Pipe Swaging Machine Introduction

The two ends of the steel pipe can be swaged before threading. The centering device of the pipe ensures that the pipe is in the center position of the shrinking die, and the hydraulic cylinder pushes several italics to drive the shrinking die to shrink the pipe end. The displacement sensor is used to track and measure the shrink size of the pipe

end. The shrink size of the pipe end is controlled by a PLC touchscreen. When the preset shrink size is reached, the control system automatically resets. The precision of the reduction dimension can be adjusted by compensating through the dialog box on the touch screen.

The pipe end swaging (shrinking) machine is composed of shrinking mechanism, flaring mechanism, pressurizing cylinder, forming mold, hydraulic system, electrical control system, etc. The functions of shrinking and expanding are realized on the same host, and the supporting roller is split type

### 3.1.2 The Pipe Swaging Machine Main Specification

**3.1.2.1** Swaging principle: The deformation at the maximum deformation is not greater than the maximum allowable deformation, the actual maximum deformation.

**3.1.2.2** Swaging Angle: rely on the closing mold control pipe end closing Angle, closing Angle ≤9°;

**3.1.2.3** Swaging length: The maximum closing length max should be confirmed according to the maximum allowable deformation a% and Swaging Angle ¢, Lmax=OD*a%/ (2tg¢). Minimum length Lmin according to the actual design needs, to meet the processing requirements of male end thread processing.

**3.1.2.4** Pipe end processing length: Max 90mm.

**3.1.2.5** Visual inspection quality inspection: The first three steel pipes after J shift and furnace number change are tested one by one for the length of the closure, the inner diameter of the tube end after the closure, and the quality of the internal and external surface of the closure area should be free of scratches, cracks and other defects.

### 3.2 Pipe Threading Machine


This product is a high-end CNC Pipe threading machine independently developed by our company based on market demand. It is primarily used in the metallurgical steel pipe industry for the three-direction multi-tool processing of the pipe-end threads of oil casing pipe materials. It features high automation, high processing precision, and high production efficiency. The threading machine adopts pipe rotating and fix tool cutting technology. The pipe threading process involves rotating the pipe (steel pipe workpiece) while the cutting tool feeds in a straight line, mechanically cutting the pipe ends, including cylindrical pipe OD turning, pipe end facing flat end face, pipe end inside and outside beveling inverse inner/outer edges, threads deburring and grinding

threading, deburring the starting threads, and processing sealing faces and shoulders. It is capable of processing API 5CT & 5B oil pipe threads as well as various special threads. According to customer requirements, the machine can be equipped with FANUC, Siemens, or other CNC control systems.

### 3.2.1 Main Features of the pipe Threading Machine

**3.2.1** Novel design concept: It draws on the design concept of the world's best similar products, and has characteristics of high precision and efficiency.

**3.2.2** High rigidity: Integrated 45º inclined bed, large diameter spindle and high rigidity and high-capacity tapered roller bearing configuration.

**3.2.3** High precision: The main shaft unit adopts imported tapered roller bearings with high precision, high rigidity and high capacity, and the main feed unit adopts INA feed bearing +Shuto high precision screw + super audio hardening guide rail + slide plate injection molding process.

The basic casting adopts the whole, box-shaped, dense reinforcement plate structure to ensure the overall rigidity of the machine tool and other design methods to effectively improve the product static geometric accuracy, positioning accuracy, transmission accuracy, motion accuracy, processing accuracy, accuracy retention and other accuracy (high-speed precision cutting accuracy) indicators are all better than the same type of domestic machine tools, and close to the same type of foreign imported machine tools.

**3.2.4** High efficiency and high dynamic: By improving the rigidity, strength, wear resistance, shock absorption (resistance), accuracy and precision retention of the design concept of the machine tool, the use of "multi-tooth comb" process for all kinds of external pipe threads of the workpiece for efficient and strong processing, effectively meet the high efficiency (low speed and high torque and high metal removal rate), high speed, high dynamic characteristics, high reliability and other characteristics of the demand

**3.2.5** Structural features: front and rear double hydraulic chuck, five axis double route, three tool holder.

**3.2.6** Transmission mode: Main transmission adopts spindle servo motor + synchronous belt + gear transmission mode; One channel feed transmission adopts high precision servo motor + ball screw pair + steel insert guide pair + drag plate The transmission mode of slide resin -coated process, the two-route l feed transmission adopts high-precision servo motor + ball screw pair + rolling guide rail pair transmission mode.

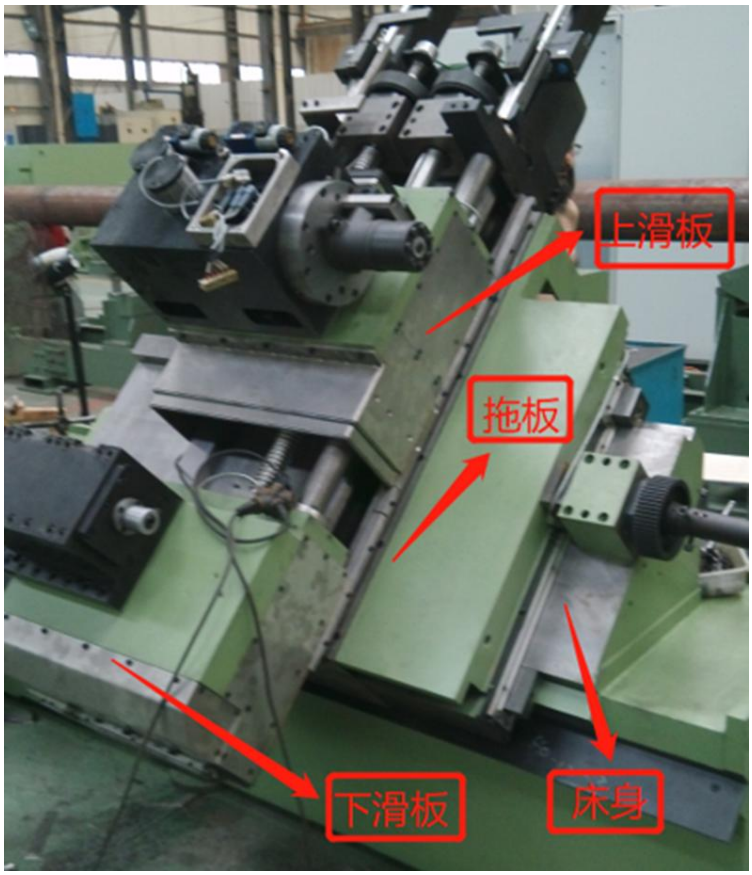
**3.2.7** High reliability, easy maintenance: spindle, screw bearings and hydraulic, lubrication, lighting, cooling system, transmission belt, electrical components, ball screw, etc. are selected from famous brand products at home and abroad.

**3.2.8** Strong control function and pleasant man-machine interface: the control system uses Siemens 840D or Japan FANUC numerical control system, and the software design and interface design are humanized and friendly.

### 3.3 Main Components Introduction for the Threading Machine

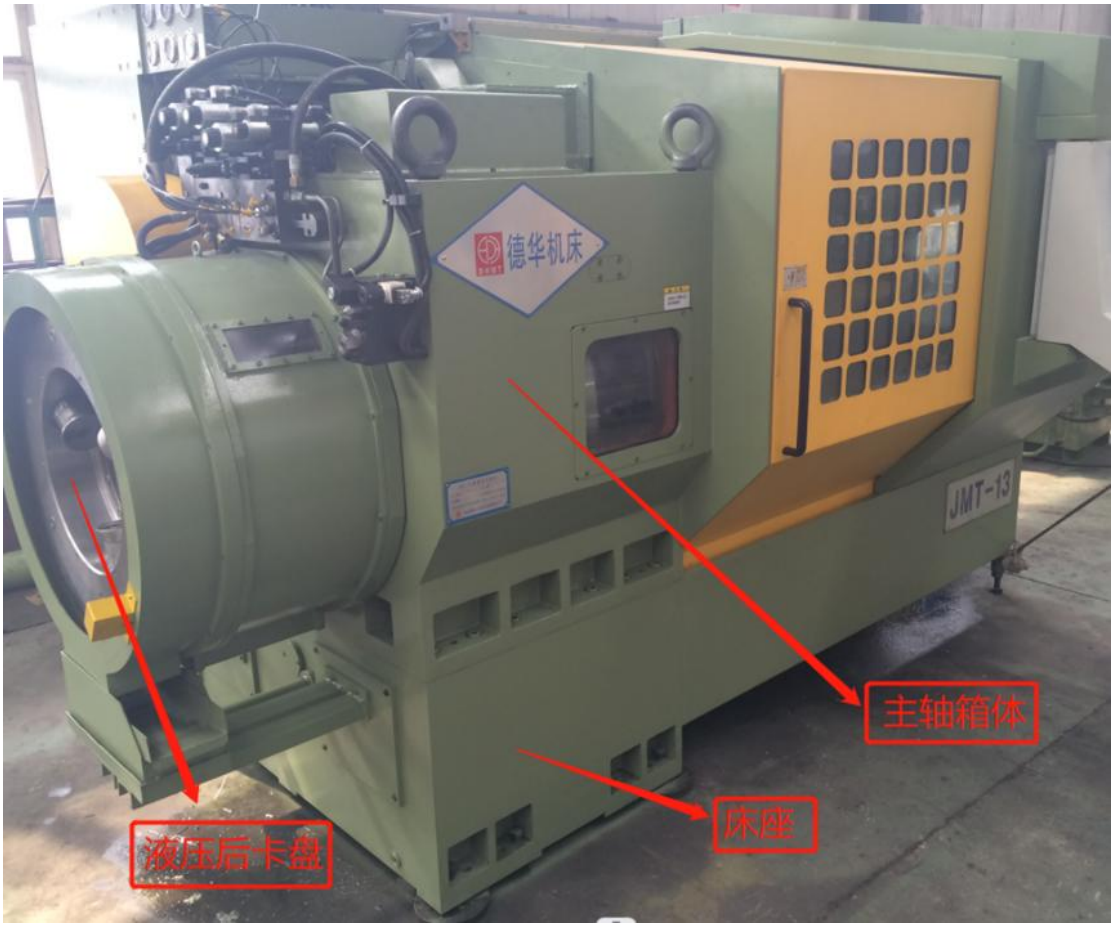
The large structural parts of the machine are made of resin sand molding and high-strength stress-free cast iron, which makes full use of the vibration-damping property of the castings and makes the accuracy of the machine tool best maintained. In the design process, the computer finite element analysis is used, and the frame type internal reinforcement plate is adopted, which has good vibration resistance, bending resistance, and torsional rigidity。

### 3.3.1 Machine Base Frame




**3.3.1.1** The bed adopts a 45° inclination Angle, high-performance cast iron casting, and annealing twice to eliminate internal stress treatment, the bed's internal reinforcement plate adopts the world's recognized bending, torsion and one of the best frame closed structures so that cutting rigidity, accuracy, and accuracy retention have been greatly improved. The guide rail of the bed is made of steel insert guide rail, which is quenched and ground by super audio quenching, the depth of the quenched layer is not less than 2.5mm, and the hardness is up to 70° Shore; The bed is made of integral, box-shaped, dense reinforcement plate casting structure, and the main shaft lubrication box is cast as one with the bed, ensuring that the machine has very high overall rigidity, and there will be no oil leakage in use

**3.3.1.2** The bed is tilted at an angle of 45°, made of high-performance cast iron, and cast using two annealing processes to eliminate internal stress. The internal ribs of the bed are designed using the closed frame structure, which is one of the best known for its resistance to bending and twisting, which greatly improves the cutting rigidity, accuracy, and accuracy retention. The bed guide ways are made of embedded steel tracks, which are quenched and tempered by ultrasonic frequency and ground to a depth of not less than 2.5mm.




The hardness is 70HRC. The sliding friction surface of the table is made by injection molding, which has the characteristics of small friction resistance during movement, good rigidity and shock absorption, and long service life, especially suitable for the needs of high-power cutting operations.

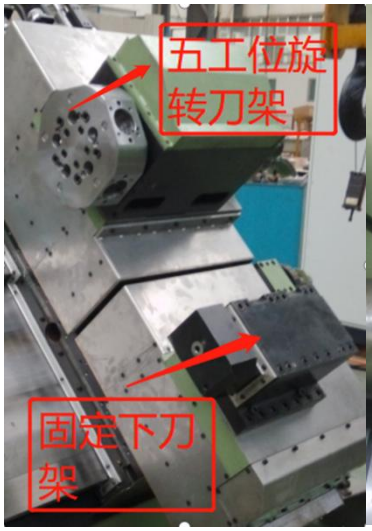
**3.3.3** The slide guideways are made of hardened and ground steel, with a hardness of more than 60HRC. The sliding surface of the sliding plate is resin-coated, which makes the dynamic and static friction resistance of the guideway system much better than the conventional method of applying a lubricant film, and the contact stiffness between the guideway system and the sliding plate is close to the stiffness of steel-on-steel contact. The maintenance cost is low, and the service life is long. Both the upper and lower sliding plates are equipped with hydraulic balancing cylinders to balance the weight of the sliding plate and the tool carrier.

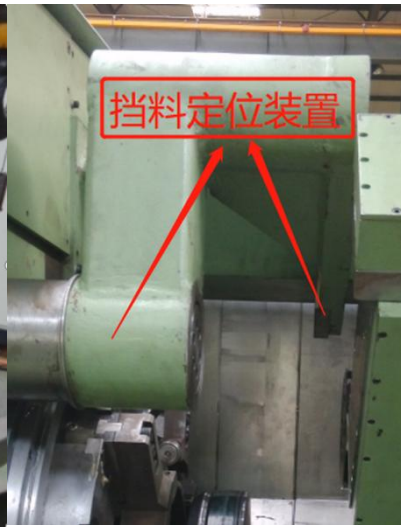
### 3.3.2 X/Y/Z Axis Feeding System （First Route ）

The X/Y/Z -axis feed screw support adopts suspension structure. Bearings imported ZARN heavy duty series needle roller thrust cylindrical roller bearings, grease lubrication, with very high accuracy, stiffness and load capacity. The speed reduction drive between the ball screw and the feed motor is made by the synchronous belt, so that the feed shaft can get more thrust than the directly connected form. Its motion position is fed back to the CNC by a high-precision absolute encoder installed directly at the end of the ball screw, which realizes closed-loop control and further improves the accuracy of the machine

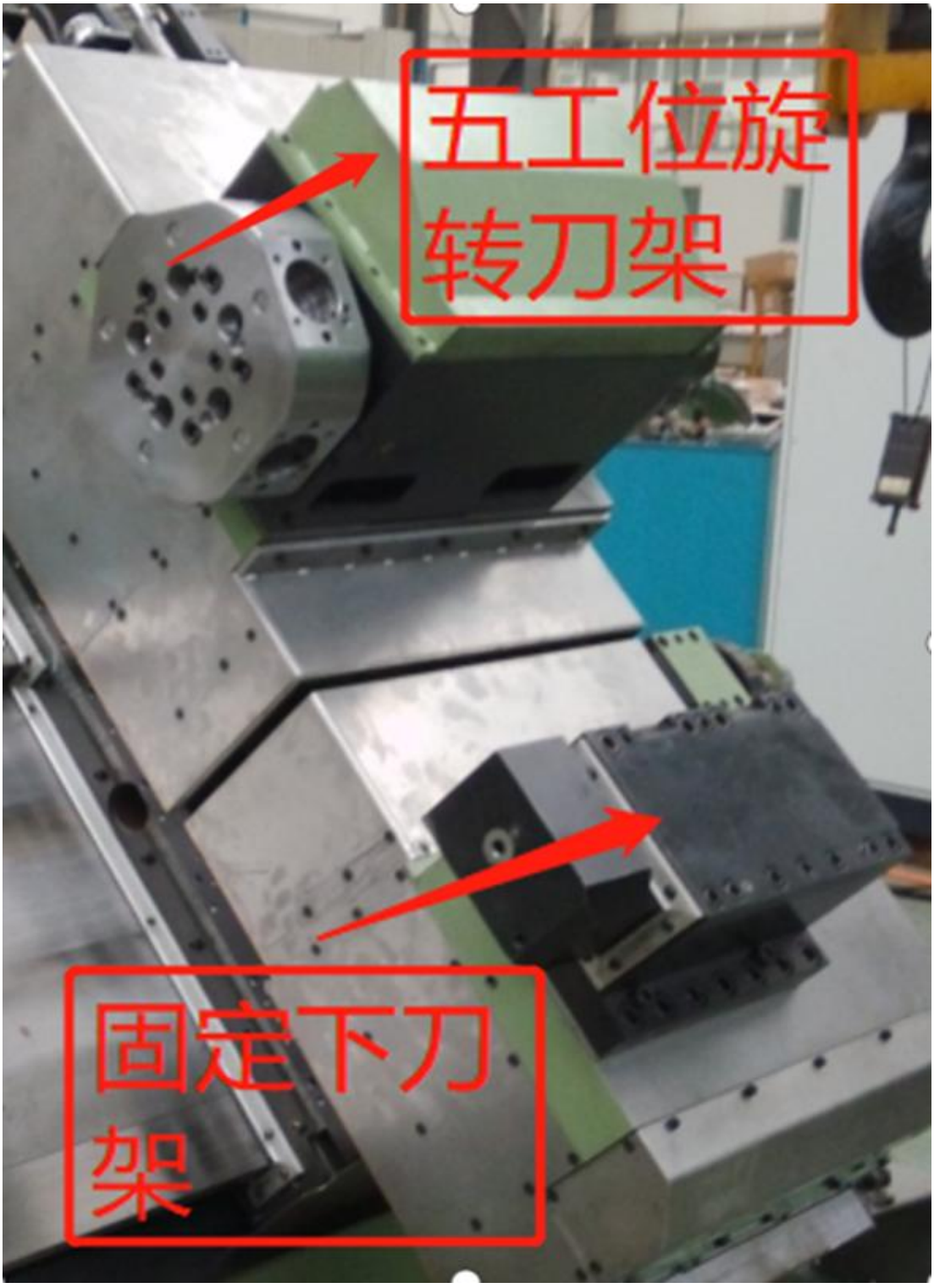

### 3.3.3 Clamping Chuck System

Steel pipe clamping adopts a double hydraulic chuck structure. Before clamping, the steel pipe is first **centered by the hydraulic motor configured on the front chuck through three centering jaws driven by multiple screws through the gear**, and then the front and rear hydraulic chucks clamp the steel pipe. The structure can realize the function of double clamping of the tube material and ensure the stability of the tube material when rotating。



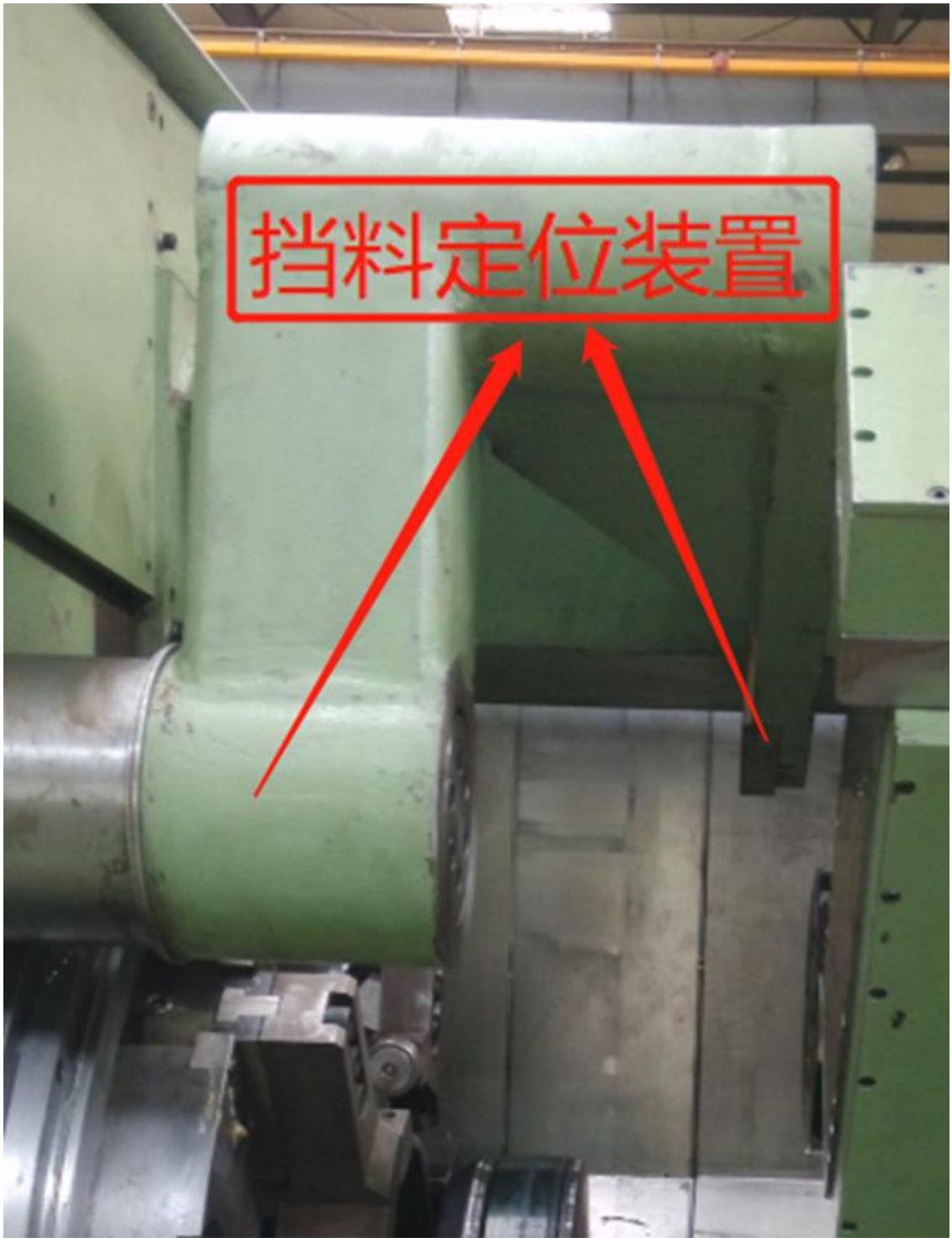



### 3.3.4 Servo Turret System



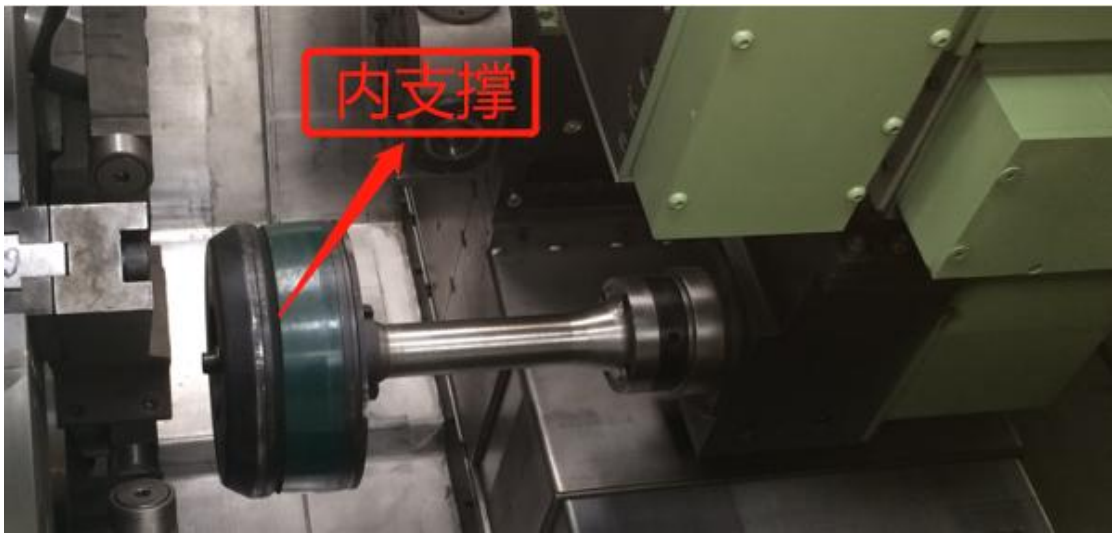

The upper turret adopts a five-station heavy Servo drive cutter head, fast and smooth rotation, high positioning accuracy, and large locking force. The lower tool holder is fixed. Capto C6 tool holder is available for both upper and lower tool holders

### 3.3.5 Pipe Stopper Device




The stopper is mounted on the front side of the headstock and is used to locate and stop the steel pipe. Its main function is to ensure the accurate positioning of the steel pipe in the machine tool host. At the same time, when the steel pipe enters the machine tool, if there is a failure, it can effectively protect the machine tool, absorb the impact energy of the steel pipe, and slow down and stop the steel pipe

### 3.3.6 Conformator System




The conformator is composed of a rotating mandrel and a hydraulic cylinder, through which the expansion and contraction of the confomator stabilizer are realized. Various sizes of stabilizers can be installed, depending on the inner diameter of the steel pipe. The stabilizer material is polyimide, which, when compressed, can be tightly combined with the inside of the steel pipe and rotate with the steel pipe. Its main function is: to ensure the stability of the processing process and reduce the risk of vibration and noise; At the same time, the tube end is completely blocked to avoid the emulsion flowing from the processing area to the other end of the steel pipe.

### 3.3.7 Auxiliary Equipment:

The pipe material loading and unloading platform is composed of a pipe material pre-alignment device, pipe material conveying roller table, rotary roller device, walking beam steel transfer device, conveyor roller and rotary roller specification adjustment

device, servo feeding device, etc. The main function is to meet the processing support of pipe material and material transfer (pipe material feeding and exiting)

### 3.3.8 Flow System For the Threading Machine

#### 3.3.8.1 Lubrication System:

The feed shaft unit lubrication system uses a centralized lubrication method to lubricate each lubrication point (such as the guideway injection molding surface, inclined iron, ball screw pair, etc.). It is an open total loss system, and the lubricating oil will be mixed into the emulsion and lost. The oil supply cycle and the amount of oil supplied at each lubrication point can be adjusted by electrical system control to achieve the best lubrication effect. The flow detection device is configured and connected to the PLC to inform the operator whether the lubrication system is functioning properly.

The lubrication system of the spindle unit extracts the lubricating oil in the bed oil tank of the motor oil pump group to forcibly lubricate the bearing, gear and other lubricating points in the spindle box and play a cooling role, which is a pressure injection lubrication cycle. Filters and electronic flow switches are configured to monitor the lubrication flow at relevant critical lubrication points and inform the operator whether the lubrication system is functioning properly.

The auxiliary platform automatic lubrication system uses Perma or SKF (using electrochemical reaction principle) brand automatic lubrication system to achieve effective lubrication of each lubrication point.

Lubrication systems are equipped with liquid-level alarm devices.

### 3.3.8.2 Emulsion Cooling System

The high pressure and large flow emulsion cooling system is configured to ensure the strong and effective cooling of the cutting tool blade during processing and facilitate the removal of iron filings to ensure the quality of turning. Equipped with a chip extractor, the chip extractor is also equipped with a return pump for filtering the emulsion into the chip extractor tank back to the cooling tank. Configure a liquid level detection device.

### 3.3.8.3 Hydraulic System

The hydraulic pump station device is completely independent and can be installed according to the requirements of the end user, the device is mainly responsible for controlling all hydraulic actions of the machine tool host and the loading platform. The hydraulic valve stand installed at the headstock contains all solenoid valves, pressure reducing valves and other hydraulic actuators to control the clamping and centering of the hydraulic chuck claws, the stopper and the balance of the feed slide and the tool holder. Equipped with liquid level detection, pressure detection, oil temperature detection devices

## 3.3.9 Machine Tool Safety and Protection Device

**3.3.9.1** The X, Y, Z axis transmission system of the machine tool is equipped with a number of safety protection devices such as electrical limit, soft limit and mechanical limit to keep the machine tool working in a safe and reliable state and ensure the absolute safety of the normal work of the operator.

**3.3.9.2** The bed and the guide rail of the drag plate are protected by the fully closed telescopic shield of stainless-steel plate, which can effectively protect the guide rail and screw and prevent the erosion of iron filings and emulsion.

**3.3.9.3** The machine is equipped with a fully enclosed sheet metal external protection, beautiful appearance, and can effectively prevent iron filings, oil, and emulsion splash

**3.3.9.4** The machine protective door is equipped with door interlock switch and power box opening protection.

**3.3.9.5** Safety protection meets the requirements of the European "CE" safety mark.

### 3.3.10 Threading Machine Specifications

| No | Item | Unit | Specification | |
|---|---|---|---|---|
| | | | DSMT-7 | DSMT-16 3/4” |
| **1** | Max Cutting Pipe Dia | inch | 2 3/8”-7’ | 7 ”- 16 3/4 ” |
| **2** | Max Cutting pipe Length | mm | 12000 | 12000 |
| **Spindle Performance** | | | | |
| **1** | Spindle Through Hole | mm | 165 | 470 |
| 2 | Spindle Speed | Rpm | 150-1000 | 500 |
| 3 | Spindle Motor Power | Kw | 160 | 95 |
| 4 | Height of spindle center | mm | 1200 | 1290 |
| **Feeding Axis System** | | | | |
| 1 | X1/Y1/Z1 Travel | mm | 110/110/550 | 400/600 |
| 2 | X2/Z2 Travel | mm | 140/700 | / |
| 3 | X1/Y1/Z1 Fast Moving Speed | m/min | 15/15/15 | 15 |
| 4 | X2/Z2 Fast Moving Speed | m/min | 20/20/20 | / |
| **Turret System** | | | | |
| 1 | Turret Positions | | 5 | 5 |
| 2 | Turret Drive Pattern | | Hydraulic /servo | Hydraulic /servo |
| | | **Clamping Chucks** | | |
| 1 | Hydraulic Chucks | | Double | Double |
| | | **Hydraulic System** | | |
| 1 | Hydraulic Pump Power | Kw | 5.5 | 5.5 |

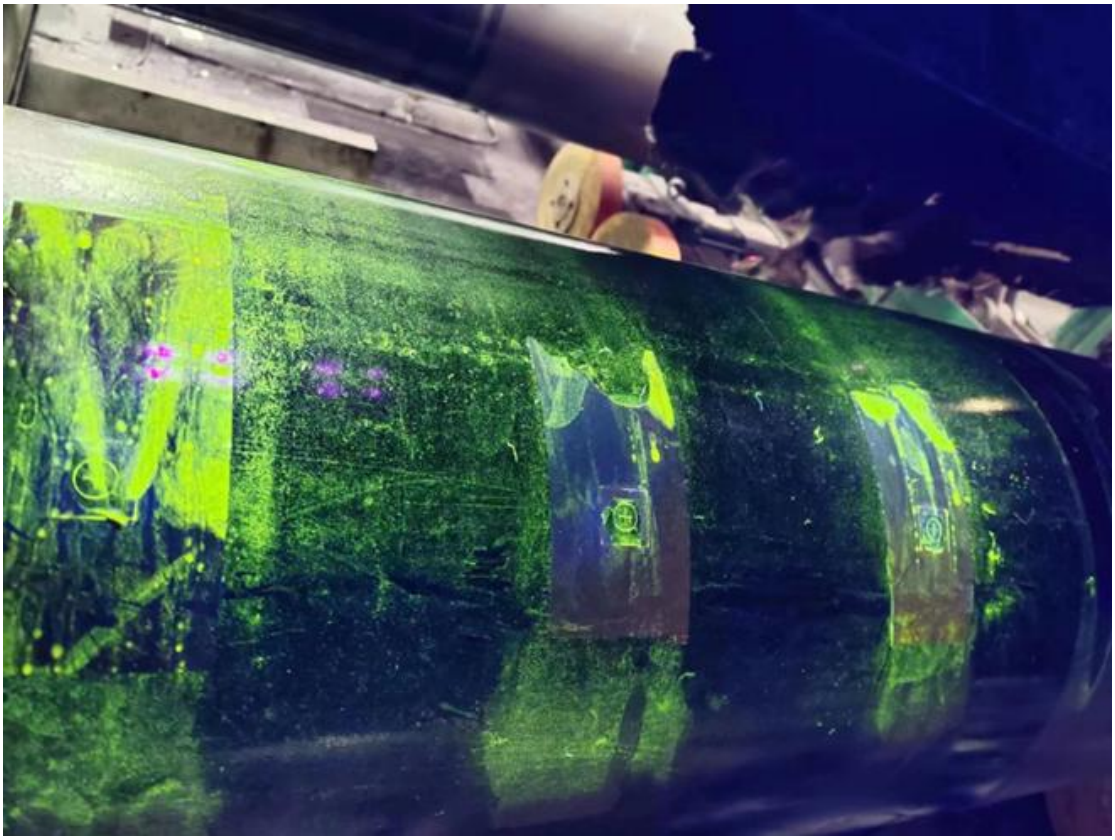
| | | | | |
|---|---|---|---|---|
| 2 | Hydraulic Pump Flow | L/Min | 40 | 40 |
| 3 | Oil Tank Capa City | L | 200 | 200 |
| 4 | Accumulator capacity | L | 20L @ 35 Bar | 20L @ 35 Bar |
| **Spindle Cooling System** | | | | |
| 1 | Oil Pump motor Power | hp | 3 | 3 |
| 2 | Oil Pump Flow | L/min | 60 | 60 |
| 3 | Working Pressure | Bar | 3-5 | 3-5 |
| 4 | Oil Tank Capacity | L | 160 | 160 |
| **Centering Lubrication System** | | | | |
| 1 | Oil Pump motor Power | Kw | 20 | 20 |
| 2 | Oil Pump Flow | L/min | 0.15 | 0.15 |
| 3 | Working Pressure | Bar | 20 | 20 |
| 4 | Oil Tank Capacity | L | 4 | 4 |
| **Emulsion Cooling System** | | | | |
| 1 | Oil Pump motor Power | Kw | 4 | 4 |
| 2 | Oil Pump Flow | L/ Min | 100 | 100 |
| 3 | Working Pressure | Bar | 20 | 20 |
| 4 | Oil Tank Capacity | L | 1200 | 1200 |
| | | **Processing Accuracy Performance** | | |
| 1 | Position Accuracy (X1/Y1/Z1) | Mm | 0.006/0.006/0.008 | 0.006/0.006/0.008 |
| 2 | Repeat Position Accuracy | Mm | 0.006/0.006/0.008 | 0.006/0.006/0.008 |
| 3 | Backsplash (X1/Y1/Z1) | mm | 0.02 | 0.02 |
| 4 | Workpiece circular run-out error | Mm | 0.01/200mm | 0.01/200mm |
| 5 | Roughness | Um | Ral1.6 Less | Ral1.6 Less |
| | | Control System | | |
| 1 | Control System | | Sinumerik One/Simens | Sinumerik One/Simens |

### 3.3.11 Threading Machine Auxiliary Equipment

### 3.4 Outside Threads Cleaning Device

The compressed air is uniformly sprayed to the surface of the steel pipe thread in a ring to blow off the emulsion and iron filings on the internal and external surfaces of the thread.

### 3.5 Magnetic Particle Inspector (MPI) System



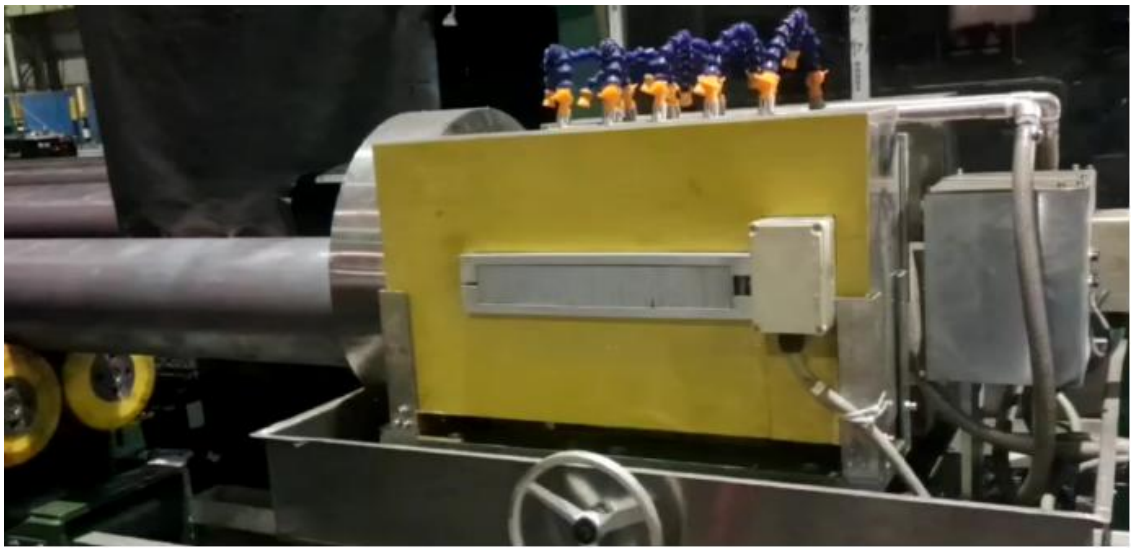
The magnetic particle detection of the tube end is used to detect the defects in all directions of the threading surface of the tube end by the principle that the magnetic field line causes local distortion after the threading surface of the tube end is magnetized, and then absorbs the magnetic powder applied to the surface of the workpiece and forms visual magnetic marks under the appropriate light.

#### 3.5.1 MPI Process Description

The application of non-contact special AC fluorescent magnetic particle flaw detection method of steel pipe end and the process flow of spray magnetization, observation and demagnetization can meet the requirements of wet magnetic online detection of steel pipe end.

After the steel pipe is aligned, it enters the magnetization position at one end → the rotary roller rises → the steel pipe rotates → the magnetization mechanism enters → automatic spray and magnetization → the magnetization mechanism falls back → the rotary roller drops → the steel pipe enters the observation position → Steel pipe rotation/manual observation → steel pipe discharge

### 3.5.2 The MPI Composition



Each set of equipment is composed of flaw detection main engine, dark room, demagnetization device, electrical control system, magnetic suspension spray/recovery system, pneumatic system, lubrication system, etc. Each set of equipment is used for inspecting the male or female end of one end of the steel pipe.

### 3.6 Sandblasting Machine

The pipe end sandblasting machine is used to sandblast the thread of the steel pipe after threading: remove the tiny burrs and dirt on the surface of the thread, eliminate the internal stress of the workpiece, and improve the anti-fatigue performance of the workpiece; Passivating the surface of the thread (with a certain roughness) to facilitate the attachment and storage of the thread grease; Increase the surface hardness of thread. They are arranged after the pin-end threading and the box end threading

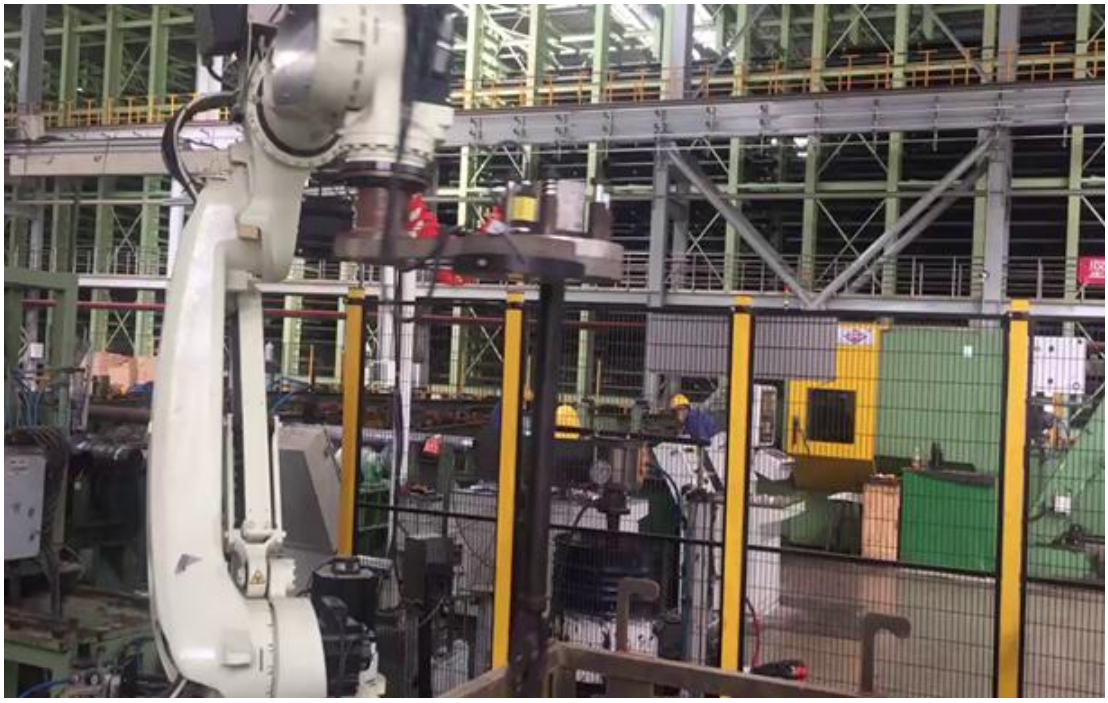
### 3.6.1 The Sandblast Machine Composition

Each set of equipment is mainly composed of a sand blasting room, spray gun group, cyclone separation dust collector and sandblasting machine walking mechanism, dust removal device

### 3.6.2 The Sandblasting Process Description

Step mechanism single feed → lift conveying roller (sandblasting station) A conveyor roller feed to a fixed position A lifting roller drop (steel pipe is placed on the rotary roller)→ Sandblasting machine moves forward → rotary roller rotation (steel pipe rotation circle beating is not more than 2.5mm, The forward and backward movement is not more than 5mm)→ the sandblasting mechanism moves forward to complete the reciprocating sandblasting → the sandblasting mechanism moves back to the original position → the main body of the sandblasting machine moves back to the original position → the lifting roller table rises → the conveying roller table returns the material → the stepper mechanism runs to complete the sandblasting cycle

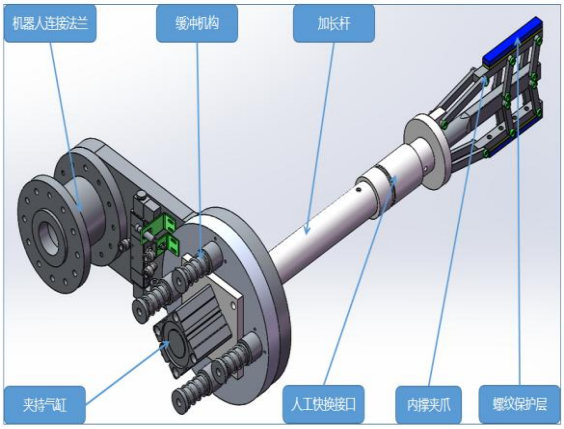
## 3.7 Robotic Coupling Starter System



After the steel pipe sandblasting, the coupling robotic starter system is installed to load the coupling pre-screw device. The coupling pre-screw loading robot system can automatically recognize the coupling visually, calculate, grab, and unload the basket automatically, and automatically load the coupling onto the loading station of the coupling pre-screw equipment

### 3.7.1 Robotic Coupling Starter System Composition

The coupling starter feeding robot system is mainly composed of a six-axis industrial robot, a robot base, a 3D vision system, a coupling material frame rotation device (coupling material basket positioning and position detection device), a robot clamp, a clamp storage table, a robot control cabinet, a safety guardrail, a lubrication system, a pneumatic system, and an electrical control system.




### 3.7.2 Robotic System Process Description

First of all, by identifying the camera, determine the coupling that can be carried, and then the robot automatically takes the coupling and loading for process, and the whole process does not require human intervention. The information on the coupling is obtained directly from the upper series machine system by the code on the coupling frame through the tracking system. At the same time, the tracking system will match the steel pipe and the coupling one by one, and complete the record of qualified products and unqualified products in the system to achieve accurate material flow process management。

## 3.8 Coupling Pre-screw and Make-Up Machine

**Coupling pre-screwing**: The steel pipe behind the pin end thread is automatically oiled and then the coupling pre-screwing is carried out.

**Coupling bucking on:** The coupling bucking on equipment is used to screw and tighten the coupling of the pin end threads and the coupling pre-screwed steel pipe, and meet the maximum screwing torque and J-value requirements.

### 3.8.1 Equipment Composition

The coupling pre-screwing machine includes the coupling loading bench, automatic grease coating, floating clamp, base, etc. The floating clamp is driven by a hydraulic motor, floating centering, clamping clamp, and automatic prescrewing, hydraulic motor is controlled by proportional valve, and the speed is continuously adjustable.

The coupling bucking-on machine includes a master clamp, back clamp, common base, etc. The master clamp is hydraulically driven closed-mouth clamp head, that clamping the collar, does not move

with the wire buckle, and can rotate forward and backward, and two gear transmission. The main clamp is equipped with a speed sensor to measure the number of turns, so as to collect the speed and the number of turns signal, and calculate the J-value with it.

### 3.8.2 Pre-Screwing and Make-Up Process Description

The process flow of pre-screwing and bucking is: feed → align → pre-screwing → Wait → bucking → discharge.

### 3.8.3 Pre-Screwing and Make-Up Machine Specifications

#### 3.8.3.1 Coupling pre-screwing :

| No | Item | Value |
|---|---|---|
| 1 | Spindle Speed | 0 ~ 60rpm adjustable; |
| 2 | Max Pre-screw Torque | 600 N·m. |

#### 3.8.3.2 Coupling Bucking-On Machine:

| No | Item | Value |
|---|---|---|
| 1 | Bucking Speed (Low) | 0.3 ~ 7r /min |
| 2 | Bucking Speed (High) | 1.6～15 r/min |
| 3 | Bucking Toque (Low) | Max 80 kN·m |
| 4 | Bucking Toque (High) | Max 30 KN.m |
| 5 | Teeth Mark | Traceless screwing |
| 6 | Clamping Open Dia | 410 mm |
| 7 | Torque Control Accuracy | ±2% (according to the maximum range |
| 8 | J-Value Measurement Accuracy | ± 0.5 mm |

### 3.9 Hydrostatic Stand

The hydrostatic pressure test is carried out on the steel pipe after coupling using oil-water balance control. The hydraulic press uses a radial large gap sealing ring to seal the outer surface of the two ends of the steel pipe and uses emulsion to test the steel pipe through the internal pressure

### 3.9.1 Hydrostatic Test Process Description

Take the steel pipe from the front bench to the alignment washing station → alignment, length measurement → rotary washing → the steel pipe into the station to be tested → the pressure test inlet and outlet pipe mechanism moves once. Move the steel pipe to the pressure test position → fixture clamping, alignment → Water injection head and exhaust head forward to the steel pipe seal position → radial pre-seal → Water injection and exhaust → close the exhaust valve and water injection valve → Boost to the set value → Pressure retention at the set time, test, display, store and record the pressure value and pressure curve → step unloading → Water injection head and exhaust head back → Fixture opening → pressure test inlet and outlet pipe mechanism At the same time, take the steel pipe to be tested into the pressure test station → empty water (air purging) → (entering the draft station) → transfer the roller table after the pressure is expected (unqualified steel pipe into the waste basket and alarm) → qualified steel pipe into the next process.

### 3.9.2 Hydrotest Equipment Composition

The hydro test machine includes a set of pipe alignment measuring device, a set of pipe pressure test device, a set of pipe empty water devices and auxiliary machinery, a water circulation system, a hydraulic system, a lubrication system, a pneumatic system an electrical control system, and other corresponding supporting facilities.

### 3.9.3 Hydrotest Equipment Specifications

| No | Item | Value |
|---|---|---|
| 1 | Test Pressure | 80 Mpa |
| 2 | Seal Type | Radial Large Gap Seal |
| 4 | Pressure Test Blind Area | ≤80mm |
| 5 | Test pressure: accuracy | ≤±0.2%; |
| 6 | Pressure fluctuation | 0.5MPa (5S) |
| 7 | Overpressure limit before holding | 200psi |
| 8 | Pressure holding mode | booster compensation& static pressure holding |
| 9 | Pressure Holding Time | 5~ 15 seconds adjustable; |
| 10 | Tooling replacement time | less than 15min |

## 3.10 Long Drifter Equipment

## Equipment composition and function description:

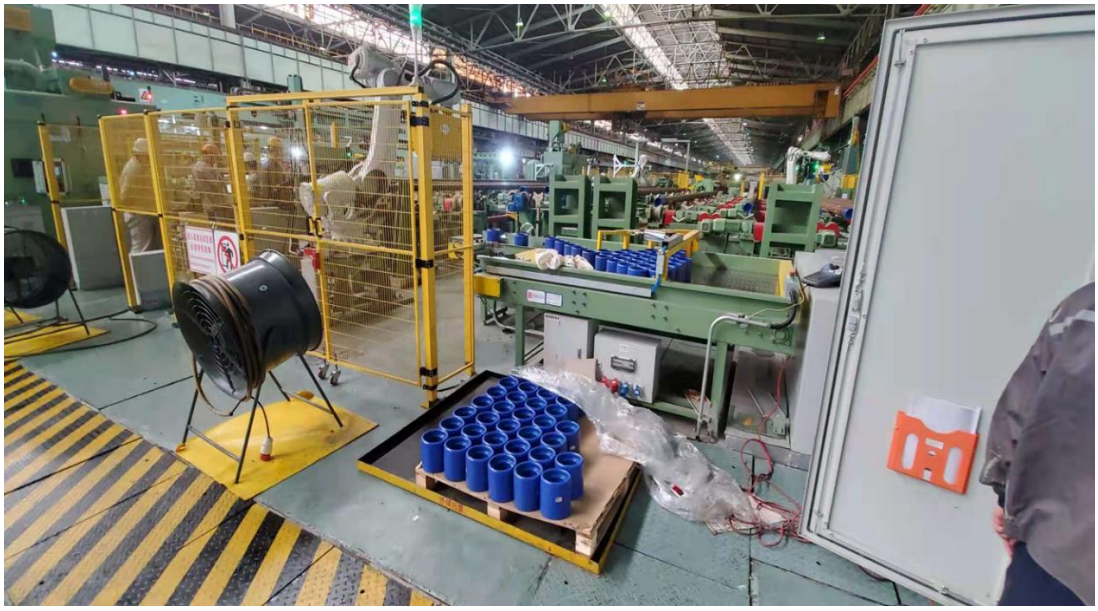
Pneumatic pattern draft, installed after the hydraulic press. The compressed air is the power source, and the full-length draft inspection of one steel pipe is carried out each time, which is composed of the drafter (composed of the support, the pressing device, the launching device, the receiving device, the conveyor device, the lifting device and the electric control system, etc.), the inlet and outlet mechanism, and the waste collection device


## Equipment Process Description And Main Technical Parameters

Hydraulic press discharge → pipe draft → Qualified steel pipe and into the next process.

Type: pneumatic type, 1 steel pipe at a time, full length draft inspection of each steel pipe; Rod standard: Gauge length and drafter comply with API 5CT standard

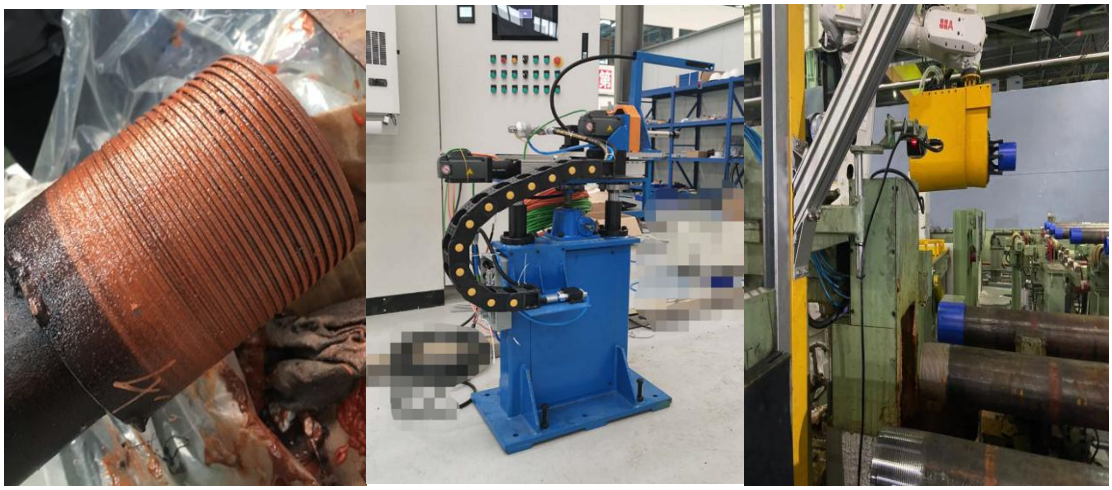
## 3.11 Robotic Protector Applicator System



The operator only needs to put the protector on the tray, and the large-size protector can also be sent to the designated position by a customized pallet conveyor. The robotic protector applicator device automatically captures the protector to complete the screwing process after it completes the oiling process.

The oiling system adopts servo automatic quantitative oil feeding mode, which can accurately oil the internal and external thread oiling device according to the set value. The outer coating is equipped with an automatic identification camera to alarm the leaky steel pipe.

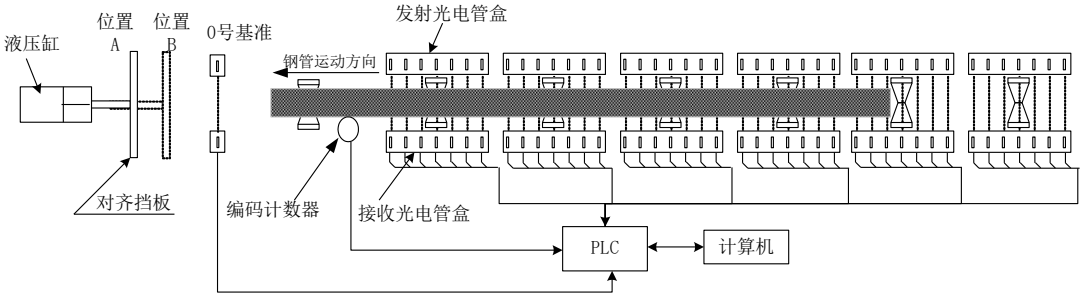
### 3.12 Automatic Oiling Device



### 3.13 Measuring Section Equipment

Length measuring, weighing, spraying mark, color ring device is used to measure the length and weight of the steel pipe, and the measurement results are marked on the surface of the steel pipe according to the requirements, and the color ring spraying of the steel pipe, the surface of the collar and the color ring spraying. The equipment includes a weighing device, a length measuring device, a spray marking device, a coloring ring device, a coupling painting device and a stepping walking beam device.

### 3.13.1 Length Measurement Device




**3.13.1.1** Hydraulic cylinder drive, through the pinion and rack drive pulse encoder to count, compared with the friction wheel length measurement method is more accurate;

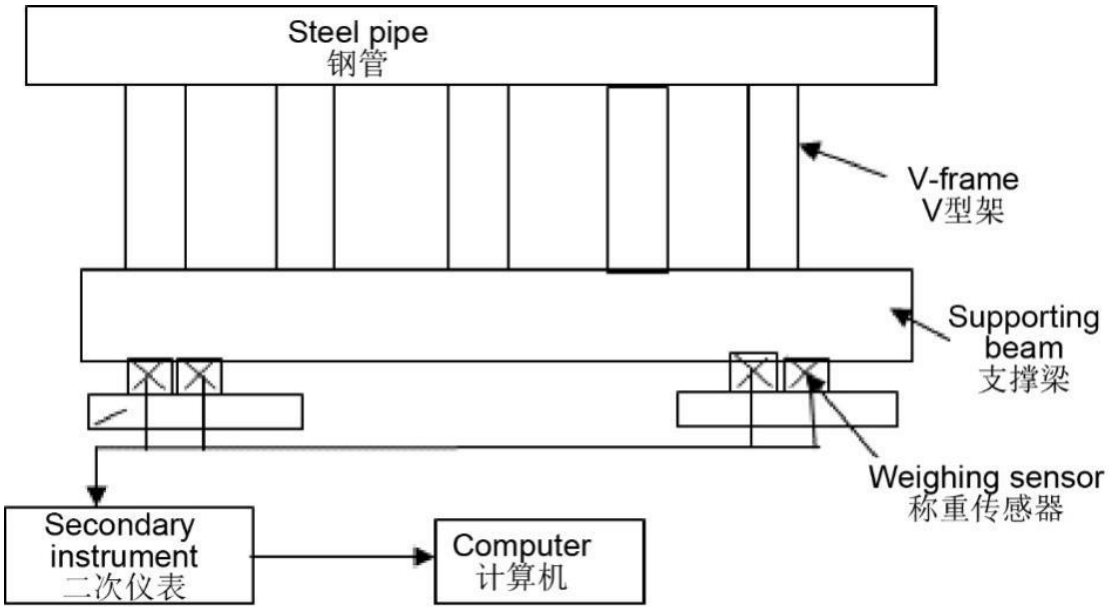
**3.13.2** Adopting Siemens high-speed counting module and PLC interrupt method to measure length, reliable work, high precision;

**3.13.3** SICK photoelectric switch, reaction time is 0.7ms, photoelectric switch installed in dust-proof box, safe and reliable;

**3.13.4** The installation box of the photoelectric sensor is isolated from the source, which can not only protect the photoelectric sensor, but also avoid the vibration during the movement of the steel moving machine to cause interference to the photoelectric sensor, but also conducive to the installation and wiring of the site.

### 3.14 Weighting Device

The weighing system is mainly composed of a weighing beam, weighing base, weighing sensor (weighing module), and V-shaped bench or roller.




### 3.14.1 Weighting Device Process Description

When the steel pipe moves to the alignment weighing station, it is detected by the "weighing station with pipe" sensor, the lifting roller rises, and after a period of delay, the steel pipe is stabilized on the V-shaped roller, and the weighing command is issued.

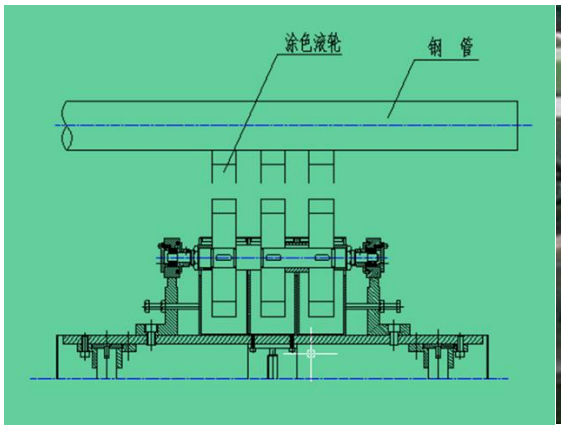
After a certain delay, the analog signal of the weighing sensor is filtered, amplified, AD conversion, digital processing, etc., and the weight value is finally obtained and displayed by the display instrument. Through RS232 transmission, the weight value of the steel pipe is read and saved by the computer from weighing secondary instruments, providing storage, printing and other functions.

When the weighing work is completed, the lifting roller is lowered, and the steel pipe is moved from the weighing system to the next station by the stepping pipe conveyor for another cycle, thus completing the weighing cycle

### 3.14.2 Color Ring Spraying Machine

Device function description: The mechanism adopts mechanical contact transmission, that is, the rotation of the steel pipe drives the paint brush wheel to rotate, so as to mark the color ring on the steel pipe. On the premise of ensuring that the paint roller has enough paint, in order to prevent the paint layer on the steel pipe from being too thick and affecting the subsequent drying speed, the paint roller and the steel pipe are disengaged and rotation for one circle, and then the paint is dried.

The contact and discontact actions of the steel pipe painting mechanism with the steel pipe are controlled by a cylinder with a stroke of 50mm (the first height adjustment). In order to make this set of mechanism can meet the requirements of different diameter steel pipe painting rings, in the cylinder control mechanism with a stroke of 50mm lifting, but also with the height of the painting ring mechanism of the fine-tuning device (second height adjustment), so as to ensure that the paint roller can not fully contact with the steel pipe because of the difference in the diameter of the steel pipe. After the adjustment of the second height regulator, it can still be fully contacted, so as to meet the needs of different batches and different pipe diameters of steel pipe coloring rings.




### 3.14.3 Pneumatic Stamp Marking Device

**Equipment composition and function description:**

The device is composed of a marking machine bracket, a marking machine head, a controller, etc. The pneumatic marking machine prints out the set characters along the program set on the outer surface of the steel pipe.

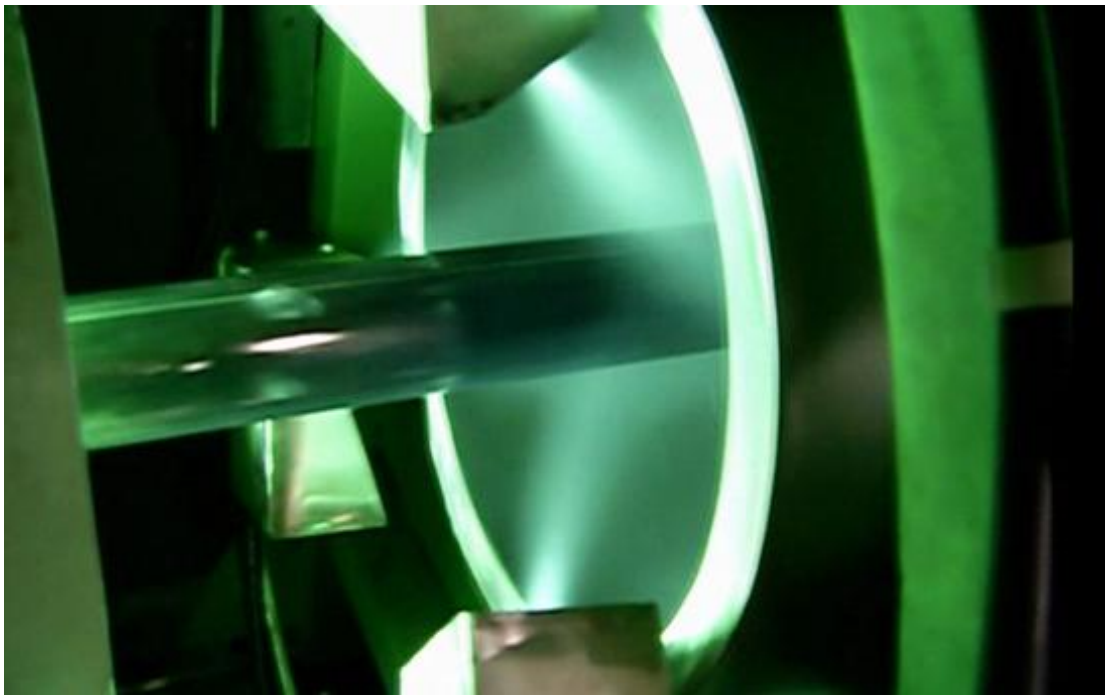
**Process description:**

When the computer controls the printing needle to move according to the character or figure stroke track, the printing needle has a high frequency impact on the surface of the steel pipe, thus forming a character or figure composed of a dense dot matrix. The printing needle can automatically follow the

surface shape of the steel pipe and move, and there is no requirement for the surface smoothness of the steel pipe. Use the computer keyboard to enter the characters or graphics you need to print and start the printing process

## 3.15 Coating and Painting System

UV coating is UV light curing coating, the equipment can automatically spray the coating evenly on the surface of the steel pipe, and form a protective film under the irradiation of the ultraviolet lamp (light) to achieve the purpose of rust prevention of the steel pipe.



### 3.15.1 Coating and Painting System Composition

UV coating equipment is mainly composed of conveying roller, rust removal device, dust removal device, painting system, paint recycling device, curing device, exhaust device, control system and other parts.

### 3.15.2 Coating Process Description

The steel pipe enters the UV painting machine through the roller in turn, the sensor obtains the signal of the steel pipe entering and sends the signal to the painting control system. The diaphragm pump transmits the paint to the coating machine, paints the steel pipe, the scraper controls the film thickness, the sensor obtains the signal of the steel pipe leaving, and sends it to the control system at the same time, the shading plate is closed, and the painting of a single steel pipe is completed. Wait for the next steel pipe to arrive

## 3.16 Pipe Transfer System

The intelligent pipe transport equipment is composed of the gantry manipulator device and the conveying roller table. The truss manipulator realizes the transverse movement of the steel pipe and the conveying roller table realizes the longitudinal movement of the steel pipe 。


### 3.16.1 Gantry Manipulators for Intelligent Pipe Handling Devices

- ✧ Lifting load: 2000KG;
- ✧ Lifting speed: 0 ~ 12m/min;
- ✧ Lifting positioning accuracy: ±1mm;
- ✧ Transverse speed: 0 ~ 30m/min;
- ✧ Transverse positioning accuracy: ±1mm;
- ✧ Manipulator to prevent carbon pollution, scratch: external polyurethane;
- ✧ Lifting, transverse control mode: servo control.
- ✧ Driving mode: servo motor + planetary reducer + rack and pinion pair;
- ✧ Taking form: V-hook;
- ✧ Span: to meet the requirements of 14.6 meters of pipe length;
- ✧ Lifting device drive mode: servo motor with brake + planetary reducer + rack and pinion pair;
- ✧ Number of hooks: 5 or 6 sets;
- ✧ Lifting stroke: 500mm。

## 3.17 The Key Advantage of the Production Line

**3.17.1** Robot application: simple, repetitive and high-intensity labor such as pre-screwing the coupling, inner and external protector screwing, etc. are all replaced by robots, which reduces the labor intensity of employees and eliminates the occurrence of industrial accidents, reduces the cost of employment, and truly realizes automation, unmanned and intelligent.

In the future, according to the process needs, when the conditions are mature, robot application scenarios such as J-value detection robot, triangle marking and color spraying robot, iron debris cleaning robot after sawing tube, protective ring laser

marking and label hanging robot can be added.

**3.17.2** Closed loop management of unqualified materials: By adopting the structure form of truss manipulator + conveyor roller, the steel pipe transportation in the online cutting head and repair area of the production line design is changed from the traditional stepping transportation to the truss-straddling transportation. The steel pipe transportation in the line cutting and repair area is tracked by pipe number one by one, and the short material is automatically judged after cutting the head, and the steel pipe is hoisted by the truss manipulator to the scrap bench. The repair pipe is hoisted by the truss to the conveyor roller and then transferred to the material side of the wire turning machine by the conveyor roller. Greatly improve transportation efficiency, to achieve automation, unmanned, intelligent.