2025

CNC Pipe Beveling Machine

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CNC Pipe Beveling Machines |DSDL-273

High-Efficiency, Energy-Saving Solution for Steel Pipe End Machining

一、Production Introduction: High Performance Pipe Beveling Machine

The DSDL Series CNC Horizontal Beveling Machine is an advanced, self-developed solution designed based on extensive research into domestic and international steel pipe processing markets.

It is tailored for high-efficiency end-face machining of steel pipes, especially suitable for oil casings, welded pipes, high-pressure boiler tubes, pipeline pipes, and plain-end pipes.

The machine adopts a fixed-pipe and rotating-tool cutting method, offering significant advantages in energy efficiency, machining stability, and automation.

1.1 The equipment consists of two main parts:

- **Main Machine System**: Includes the base bed, spindle box, length positioning device, ball screw feed system, floating tool system, clamping system, pneumatic system, hydraulic system, and lubrication system.

- **Auxiliary System**: Comprises a step beam pipe transfer machine, pre-alignment roller table, lifting conveyor rollers, and pipe size adjustment devices.

1.2 Core Functions

- Beveling of pipe ends
- Pipe End Facing
- Inner and outer chamfering
- Automatic feeding, positioning, clamping, machining, releasing, and finished product conveying.
- Supports automatic processing of steel pipes ranging from 6 to 12.5 meters in length.

1.3 Technical Innovations

- **Innovative Machining Concept**: Rotating tool disks with stationary pipe design significantly reduce energy consumption and noise.
- **Multi-Tool Simultaneous Cutting**: Supports 2–5 tools working simultaneously (for beveling, end-face, inner and outer chamfering), improving cutting efficiency.
- **Floating Profiling Guide Wheel**: Enables adaptive chamfering for varying pipe diameters and wall thickness.

- **Feed Damping System:** Effectively absorbs cutting vibrations, ensuring smooth feed and stable performance during thick-wall pipe machining.
- **Dual Chuck System**: Equipped with both rigid and floating chucks for automatic centering and deformation prevention.

1.4 Performance Advantages

- **High Efficiency**: Multi-tool simultaneous cutting significantly reduces cycle time.
- **High Rigidity & Precision**: Integrated bed design with large-diameter spindle and high-load tapered roller bearings ensures long-term accuracy.
- **High Reliability**: Simplified structure with heat-treated and precision-ground components for long service life and easy maintenance
- **Advanced Control System**: Siemens S7-1500 PLC with user-friendly interface supports automatic, semi-automatic, and manual operation modes.
- **Integrated Mechatronics**: Combines mechanical, electrical, hydraulic, and pneumatic systems for fully automated pipe end processing.

1.5 Key Component Configuration

- Bearings for Spindle and Ball Screws: Imported high-precision tapered roller bearings.
- Hydraulic, Lubrication, and Cooling Systems: Equipped with well-known domestic and international brands.
- Electrical Components, Ball Screws, and Linear Guides: Industrial-grade, high-quality components to ensure long-term stability and reliability.

二、Pipe Beveling Line Composition

The beveling production line is composed of two main machines and one set of auxiliary equipment.

No	Item	Qty	Remarks
1	Stepper Beam Pipe Transfer Machine	1 Set	Auxiliary
2	Adjustable Lifting Conveyor Roller Table	2 Set	Auxiliary
3	Conveyor Roller Table	2 Set	Auxiliary
4	Beveling Machine	2 Set	
5	Clamping System	2 Set	
6	Hydraulic System	1 Set	

7	Lubrication System	1 Set	
8	Chips Conveyor	2 Set	
9	Control System	1 Set	

三、Pipe Beveling Process Flow Description

3.1 Loading Stage

- **Stepping Beam Transfer**: Transfers the steel pipe from the loading area to the conveyor rollers at the chamfering station.
- **Positioning and Conveying**: The conveyor rollers transport the pipe to the predefined starting position of the chamfering machine.

3.2 Positioning and Clamping

- **Rigid Chuck Clamping**: The front-end rigid chuck clamps the pipe firmly to prevent axial displacement during machining.
- **Floating Chuck Clamping**: The rear-end floating chuck engages to assist the rigid chuck, allowing limited axial movement to absorb machining stress.

3.3 Chamfering Operation

- **Tool Head Feed-In**: The chamfering cutter head advances axially to perform end-face chamfering on the pipe.
- **Chamfering Completion**: Once the specified chamfer depth is reached, the cutter head stops feeding.
- **Tool Retraction and Return**: The cutter head retracts and returns to its home position, ready for the next cycle.

3.4 Release and Unloading

- **Chuck Release**: The rigid and floating chucks release the pipe sequentially.
- **Conveyor Discharge**: The conveyor rollers move the finished pipe out of the chamfering machine to the unloading buffer zone.

3.5 Discharge and Cycle Continuation

- **Stepping Beam Transfer**: Transfers the finished pipe from the buffer zone to the unloading station or the next processing stage.

- **Next Pipe Processing**: The system automatically detects and initiates processing of the next pipe, enabling continuous operation.

3.6 Notification

- **Safety Monitoring**: Sensors can be installed at key points to monitor pipe position, clamping status, and tool head location, ensuring safe operation.
- **Parameter Configuration**: Chamfering angle, depth, and feed rate can be configured and automatically adjusted via the CNC system.
- **Fault Handling**: In the event of improper clamping or tool malfunction, the system will trigger an alarm and halt the operation.

四、Equipment Specification

No	Item	Unit	Specification
1	Process Pipe Dia	Mm	114 -273
2	Max Pipe Wall Thickness	Mm	50
3	Max Pipe Length	Mm	12500
4	Spindle Speed	Rpm	60-380
5	Z-Axis Travel	Mm	400
6	Main Motor Power	Mm	110
7	Standard		API5L、GB/T 9711.2-1999 etc.
8	Perpendicularity of End Face to Pipe Axis	mm	0.15/100
9	End Face Surface Roughness	Um	Ra6.3

五、The Main Description Of The Mechanical Components

5.1 Machine Bed

The main machine base and bed of this equipment are constructed using an integrated welded steel plate structure. The design is optimized through Computer-Aided Engineering (CAE) and

Finite Element Analysis (FEA) to ensure rational structural layout and uniform stress distribution. A framework-style internal rib configuration is employed to significantly enhance the machine's resistance to vibration, bending, and torsion, thereby ensuring high rigidity and stability under heavy-duty and high-precision machining conditions.

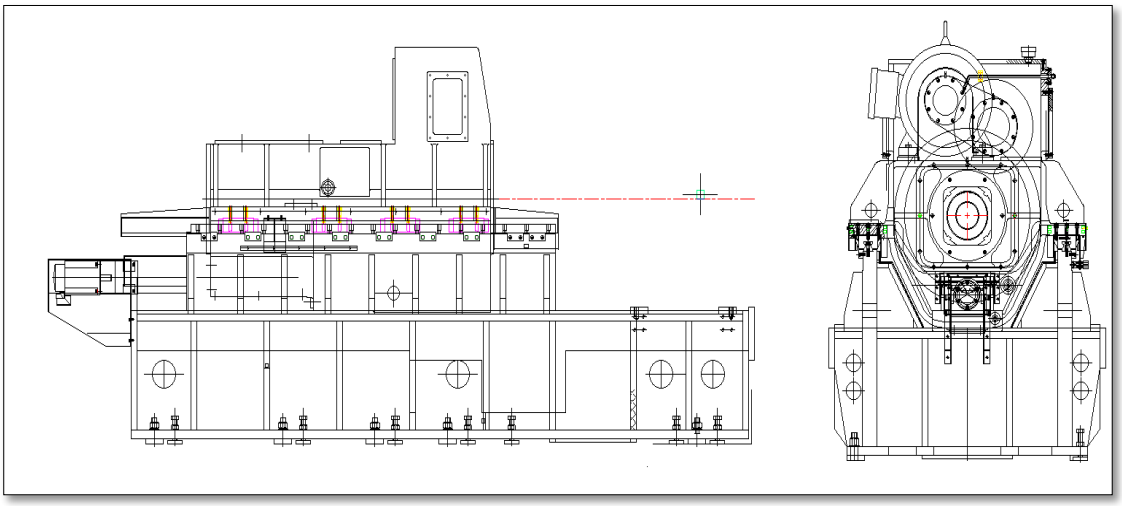
All steel plates undergo rigorous pre-welding treatment—including rust removal and stress relief—prior to fabrication. The welding process follows mature procedures for large structural components, ensuring high quality and structural integrity. Post-welding, the entire assembly is subjected to comprehensive stress-relief treatment, such as annealing or vibration aging, to effectively eliminate residual welding stress and prevent deformation during subsequent machining.

Final machining is performed using high-precision CNC machining centers, ensuring that all mounting reference surfaces and guideway surfaces meet strict geometric accuracy and alignment requirements. This provides a robust and stable foundation for the entire machine tool system.

5.2 Spindle Box

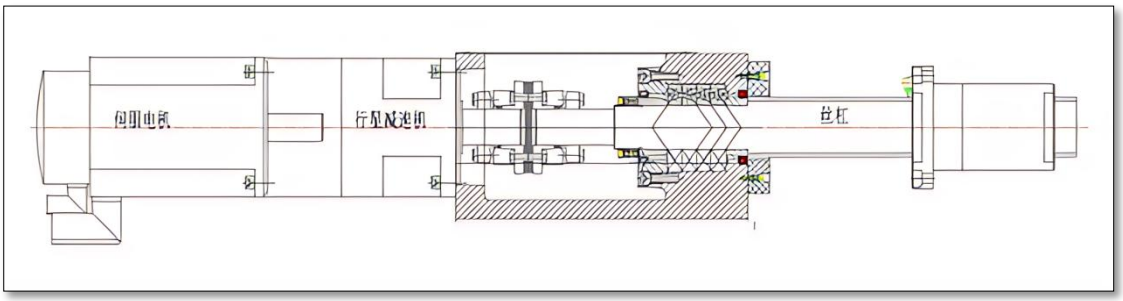
The spindle box adopts an integrated, box-type structure with densely arranged ribbed plates to ensure high structural rigidity and vibration resistance. The spindle is manufactured from high-grade alloy steel, subjected to heat treatment, and finished with precision grinding on all critical

surfaces to ensure dimensional accuracy and surface quality. It features a large through-hole design, facilitating the machining of long shaft-type workpieces. The bearing system utilizes imported high-precision tapered roller bearings, offering excellent load-bearing capacity and positioning accuracy. Lubrication and cooling are achieved through a hydraulic oil system, effectively controlling temperature rise and enhancing operational stability. The entire spindle assembly is characterized by high rigidity, low thermal deformation, and superior rotational accuracy, making it well-suited for high-efficiency, high-precision machining applications.



5.2 Servo Feeding System

The feed mechanism adopts servo-driven feed control. The servo motor offers excellent stability, high repeatability in positioning accuracy, and adjustable feed rates to accommodate various machining requirements. The ball screw support bearings for the servo feed system are equipped with imported angular contact bearings, utilizing grease lubrication. This configuration ensures exceptional precision, rigidity, and load-bearing capacity, contributing to the overall performance and reliability of the feed system.



5.3 Clamping System

5.3.1 Rigid Chuck System:

The rigid chuck is hydraulically actuated to achieve automatic clamping and precise centering of steel pipes. It features a hydraulic cylinder and a synchronized linkage mechanism to ensure simultaneous movement of the clamping jaws. The clamping force is directly controlled by the hydraulic system. Interchangeable jaws are available to accommodate various pipe diameters. During the clamping process, the hydraulic cylinder drives a slider mechanism that moves the left and right rocker arms in unison, ensuring synchronized motion. These rocker arms are connected to the left and right slides, which in turn drive the rigid jaws to securely clamp the pipe. Once clamped, a locking cylinder secures the slides in position, ensuring high stability and positional accuracy during cutting operations.

5.3.2 Floating Chuck System:

The floating chuck serves as an auxiliary clamping mechanism, also driven by hydraulic cylinders, to prevent deformation of the steel pipe during machining. It provides flexible support and enhances overall clamping reliability. The dual-chuck configuration significantly improves rigidity and machining stability, making it especially suitable for long or thin-walled pipe processing where precision and support are critical.

5.4 Cutter Head Protection System

The machine is equipped with a rotating cutter head enclosed by a dedicated protective cover. This protective housing ensures operational safety by preventing accidental contact with rotating components and effectively contains coolant splashes during machining. The design enhances both workplace safety and cleanliness, contributing to a more efficient and secure production environment.

5.5 Material Handling and Positioning System:

The system includes a step beam pipe transfer machine, pre-alignment device, conveying roller tables, and a pipe size adjustment mechanism. Its primary function is to provide stable support during pipe processing and to facilitate both lateral and longitudinal transfer of steel pipes. This integrated setup ensures efficient material flow, precise positioning, and seamless transition between various stages of the production process, thereby enhancing overall productivity and automation.

5.6 Lubrication System

The machine adopts a centralized lubrication system for the rigid chuck, floating chuck, and servo feed mechanism. Lubrication points such as linear guideways, ball screw assemblies, and sliders are serviced through an open-loop, total-loss lubrication system. Lubricating oil is

consumed during operation and mixes with the coolant emulsion. The lubrication cycle and oil delivery volume to each lubrication point can be precisely controlled via the electrical control system to ensure optimal lubrication performance. A flow monitoring device is integrated and connected to the PLC, enabling real-time status feedback to the operator regarding system operation.

The spindle unit features a forced circulation lubrication system. A motor-driven oil pump draws lubricants from the bed-mounted oil tank and delivers it under pressure to critical components such as spindle bearings and gears. This pressure-spray system also provides a cooling effect. The system includes filtration units and electronic flow switches to monitor flow rates at key lubrication points, with alerts to notify the operator of any abnormalities.

The auxiliary machine frame utilizes a manual lubrication system to ensure effective lubrication of its respective points.
All lubrication systems are equipped with oil level alarm devices to prevent dry running and ensure system reliability.

5.7 Hydraulic System

The hydraulic power unit is a fully independent module, with installation location customizable according to end-user requirements. It is responsible for all hydraulic operations of both the main and auxiliary machines. The hydraulic valve manifold integrates all solenoid valves, pressure-reducing valves, and other hydraulic actuators, providing centralized control of all hydraulic functions. This design ensures efficient, reliable, and maintainable hydraulic performance throughout the machine.

5.8 Electrical Control System

The equipment is equipped with a **SIEMENS-based control system**, enabling automatic, semi-automatic, and manual operation modes to support fully automated pipe processing. The operator panel features mode selection switches for manual/semi-automatic/automatic control, along with real-time status indicators for machine operation.

A **touchscreen interface** is integrated into the control panel, allowing operators to input key processing parameters such as pipe diameter, pipe length, cutting speed, and feed rate. The system also includes functionality for tracking the number of processed pipes.

The human-machine interface (HMI) is designed for intuitive interaction via the touchscreen, offering a user-friendly experience that simplifies programming, debugging, and maintenance tasks.

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