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Steel Coil Robotic De-Bander Solution

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Steel Coil Automatic Robotic De-Bander System

1 The Introduction of the Robotic De-bander System

The **Robotic De-Banding System** represents a new standard in steel coil unstrapping through intelligent automation. Designed to transform traditional, labor-intensive operations, the **DSCK-GS27 Intelligent Steel Coil Automatic Strapping Removal System** seamlessly integrates a **six-axis industrial robot** with a **dedicated, high-reliability unstrapping mechanism**, delivering fully automated, precise, and safe removal of steel coil strapping.

By eliminating manual unstrapping, the DSCK-GS27 significantly enhances on-site operational efficiency while reducing reliance on labor and minimizing human exposure to high-risk working conditions. Its robotic precision ensures consistent, repeatable performance, effectively addressing long-standing safety hazards associated with manual cutting and strap rebound.

Engineered for demanding industrial environments, the system provides a reliable and intelligent solution for steel mills, processing and service centers, and modern smart production lines. With its high level of automation and robust design, the DSCK-GS27 enables manufacturers to move confidently toward safer operations, higher productivity, and the next stage of intelligent manufacturing.

1.1 The Key Advantage of the Robotic De-bander System

Significant Higher Efficiency: Fully automated continuous operation greatly outperforms manual unstrapping, boosting overall production throughput

Enhanced Safety: Operators are kept away from high-tension steel straps, effectively preventing injuries caused by cutting or strap rebound

High Reliability and Consistency: Robotic precision ensures stable, repeatable performance with consistent unstrapping quality

Cost Reduction and Long-Term Value: Reduced labor requirements and lower accident risks deliver substantial long-term cost savings

1.2 Intelligent Recognition & Fully Automated Process

The DSCK-GS27 features advanced sensing and intelligent control capabilities, enabling automatic execution of the entire unstrapping workflow, including:

- ✧ Automatic recognition of **steel coil diameter**
- ✧ Precise detection of **steel coil width**
- ✧ Intelligent identification of **strapping head position**
- ✧ Automatic **cutting of strapping bands**
- ✧ Automatic **collection and recovery of steel straps**
- ✧ Automatic **cutting and handling of plastic straps**

The system operates without manual intervention, forming a closed-loop, fully automated unstrapping process from identification to removal and recovery.

1.3 Designed for Smart Production Lines

Engineered to handle complex industrial environments, the DSCK-GS27 supports steel coils of various specifications and strapping types. It can be seamlessly integrated into existing production lines or newly built intelligent logistics systems, helping enterprises move toward reduced manpower, unmanned operation, and smart manufacturing.

2 Specification of the Robotic De-Bander System

No	Item	Specification	Remarks
1	Steel Coil Dia Range	800mm-2100mm	
2	Steel Coil Width Range	800mm-1650mm	
3	De-Bander Pattern	circumferential Direction	
4	Strap Materials	Steel, PET, Others	
5	End-Lap Detection	5 o'clock or 7 o'clock Re- position	
6	Barcode Reading	Collet Transfer info to control system	
7	Control System	Siemens S7-1500	
8	Cabinet Protection Grade	Not Less Than IP54	

More detailed Requirements can be tailed

3 Process Flow and Cycle Time Sequence

3.1 Process Flow

3.1.1 When the steel coil arrives at the de-banding station, the line control system (L1) sends the signals "Steel Coil Locked" and "Start De-Banding Operation" to the PLC of the automatic de-banding system.

3.1.2 The system reads the steel coil label information (with unified label type and fixed label position) and compares the label data with the system database to verify consistency.

3.1.3 The de-banding operation is initiated. The strap-head detection device determines whether the strap head is located within the designated area.

- If the strap head is correctly positioned, the process proceeds to the next step.
- If not, the coil transfer car rotates the steel coil to adjust its position until the strap head is aligned within the designated area.

3.1.4 The robot, equipped with a dedicated gripper, moves to a position directly above the steel coil. Sensors integrated in the gripper detect the outer diameter of the coil, as well as the number, positions, and buckle locations of the strapping bands.

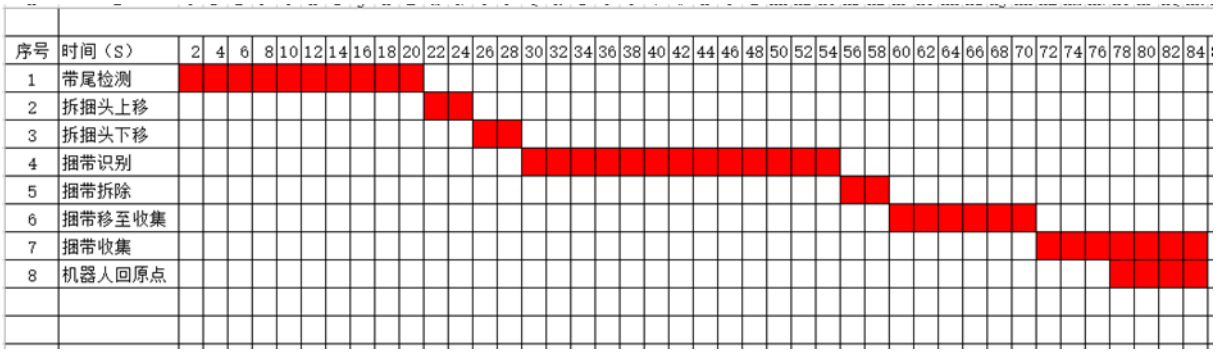
3.1.5 The robot removes the strapping bands one by one. Each cut band is clamped and transferred to the collection device.

3.1.6 After all strapping bands have been removed, the robot returns to the standby position and sends the interlock signal "All Operations Completed" to the L1 system. The transfer car is then unlocked, completing the full de-banding operation for one steel coil.

3.1.7 The system automatically identifies the material type of the strapping band.

- **Steel straps** are automatically conveyed to the recoiling mechanism after cutting and wound into coils.
- **Plastic straps** are cut to a fixed length and discharged into the waste collection bin.

3.2 Cycle Time Sequence



Series 1 End Lab Detection ,2. De-bander Head Up moved ,3. De-bander-Head Down moved ,4. Band Recognition, 5. Band Remove ,6 Removed bank move to Collecting Bin ,7 Band Collection , 8 Back To Origin Point

4 Equipment Technical Description

4.1 Equipment Composition

No	Item	Qty	Unit	Remarks
1	Robot Arms	1	Unit	
2.	Robot Arm Auxiliary	1	Unit	
3	Strap Cutting Device	1	Unit	
4	Steel Strapping Collection Device	1	Unit	
5	Steel Scrap Coil Storage Bin	1	Unit	
6	Plastic Strapping Collection Device	1	Set	
7	Hydraulic System	1	Set	
8	Lubrication System	1	Set	
9	Pneumatic System	1	Set	
10	Safety Protection System	1	Set	
11	Steel Coil Edge & Strap Detection Mechanism	1	Set	
12	Control System	1	Set	

4.2 Equipment Description

4.2.1 Robot Arm

Due to the wide variation in steel coil specifications (outer diameter φ900–2100 mm, width 700–1250 mm), the unstrapping system requires a robotic arm with a large working envelope. The proposed solution adopts the **ABB IRB 6700-170/3.1 industrial robot**, which provides a maximum working radius of **3.1 m**, a rated payload of **170 kg**, and a repeatability of **±0.1 mm**, fully meeting the operational requirements.

The robot is equipped with **two USB ports** to facilitate data storage and supports **network connectivity** for system integration and communication.

The robotic system supports **manual and automatic mode switching**, enabling flexible operation and maintenance.

The robot control system features **automatic fault detection**, **alarm indication**, and **fault history storage and query functions**, ensuring high reliability and ease of troubleshooting.

Robot payload calculation:

- Unstrapping end-effector weight: **90 kg**
- Robot rated payload: **170 kg**

- Actual payload utilization:

$$\frac{100}{170} \times 100\% \approx 60\%$$

The payload utilization is well within the allowable range, ensuring stable and safe long-term operation of the robot.

4.2.2 Robot Linear Track System

4.2.2.1 Equipment Configuration

Based on the actual site layout, either a linear track (floor-mounted rail) or a fixed pedestal can be selected. In this solution, **two coil entry positions** are arranged, and the robot is required to move between these two entry points to perform unstrapped operations. Therefore, a **robot linear track system** is adopted, enabling the robot to travel between the two workstations.

The robot linear track system mainly consists of a **track base frame**, **robot mounting plate**, **servo motor**, **linear guide rails**, **gear**, and **rack**, among other components.

4.2.2.2 Functional Description

The robot linear track system provides a **stable, reliable, and high-precision motion platform** for dual-station robot operation. The robot is mounted on the mounting plate, which travels along the linear track.

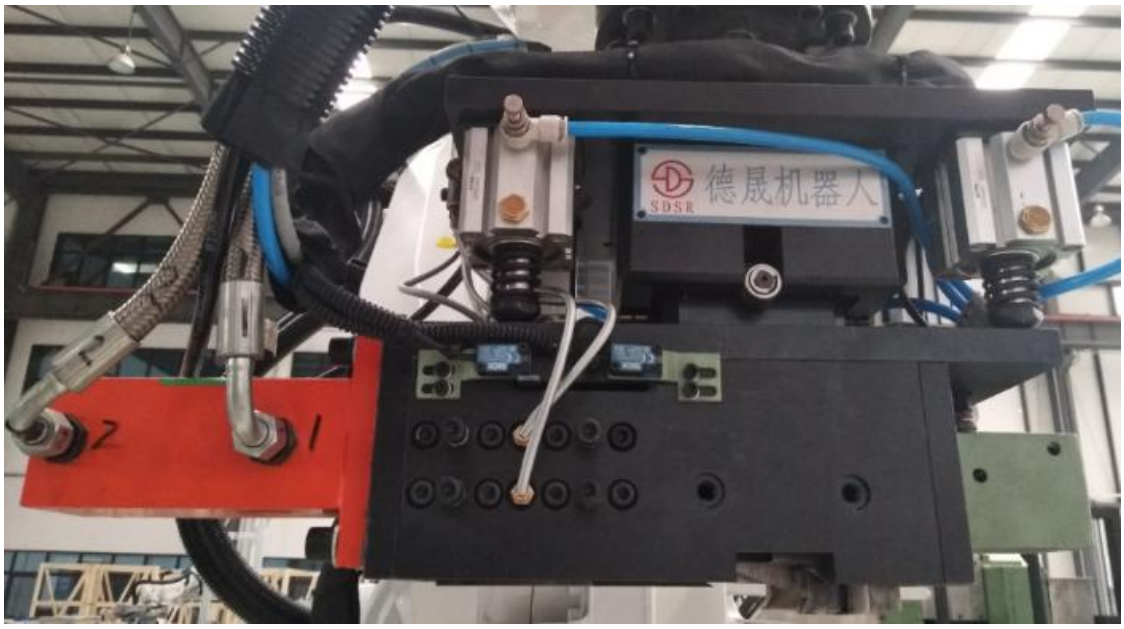
The **servo motor** supplies the driving force for robot movement. The servo motor is connected to a **reduction gearbox**, with a **gear** installed on the output shaft. A corresponding **rack** is fixed to the track base frame. Through the gear-and-rack transmission mechanism, the system ensures **accurate positioning, smooth motion, and repeatable travel accuracy** of the robot along the track.

4.2.3 Steel Coil and Steel Strapping Positioning System

The steel coil and steel strapping positioning system is responsible for detecting the position of the strapping band head**,** determining the orientation of the band head**,** identifying the number of strapping bands**, and** accurately locating each strapping band**. The obtained position data is transmitted to the robot to guide precise unstrapping operations.**

The system utilizes auxiliary technologies such as laser distance measurement **and related sensing methods to fulfill the functional requirements of steel coil and steel strapping positioning. This ensures** accurate recognition, reliable positioning, and stable information feedback**, providing a dependable basis for automated robotic unstrapping**

4.2.4 Strapping Cutting Device



4.2.4.1 Equipment Composition

The clamping and strapping cutting device consists of an unstrapping frame, lifting blade, blade holder, blade hydraulic cylinder, connection flange, balancing pneumatic cylinder, strapping detection mechanism, positioning mechanism, and static cutting blade, among other components.

4.2.4.2 Functional Description

The clamping and strapping cutting device is mounted on the **robot Axis 6 flange**. It is equipped with a set of **lifting blades and cutting blades**. When carried by the robot, the device can detect the **steel coil band head** and the **position of the strapping bands**.

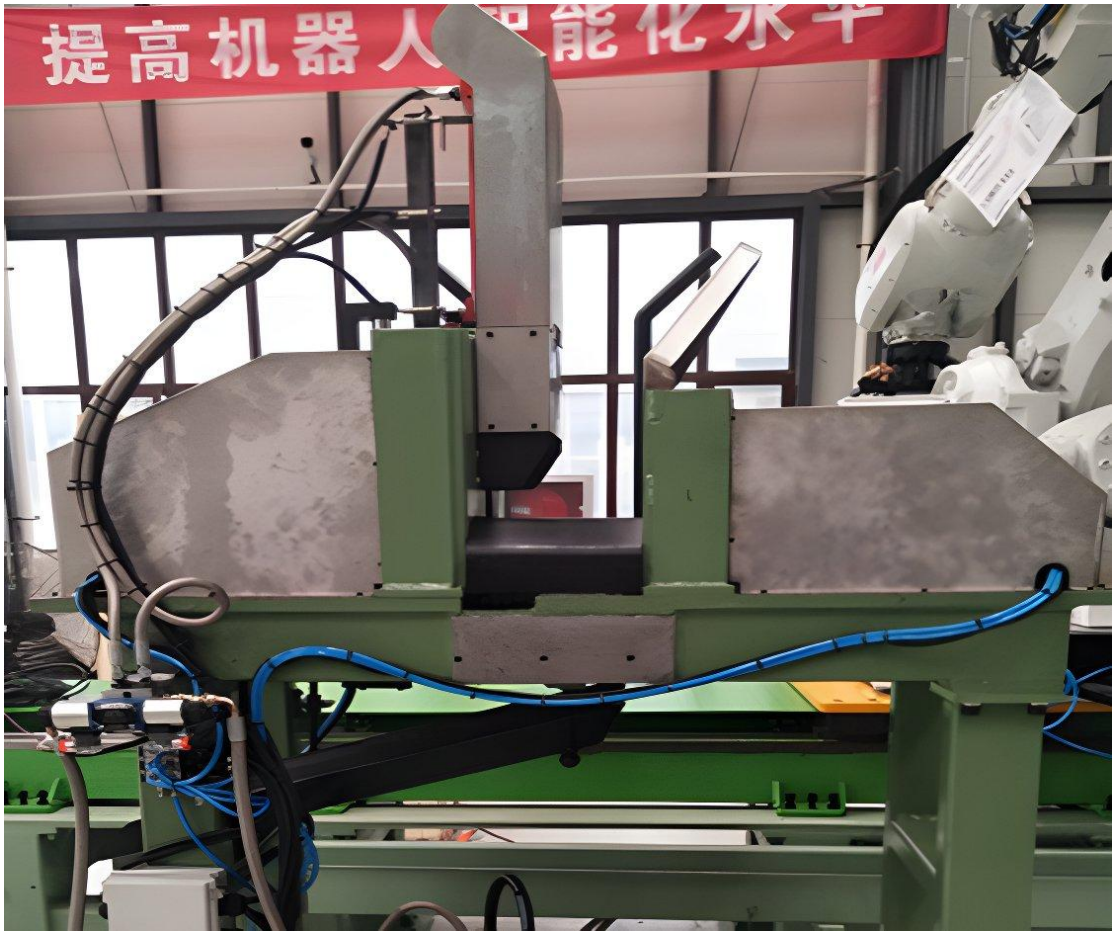
During operation, the device presses against the steel coil. The lifting blade raises and clamps the strapping band, while the cutting blade simultaneously cuts the band. After cutting, the robot holds the strapping band and transfers it to the **strapping collection device** for disposal.

The service life of the unstrapping cutting tools is **not less than 25,000 cutting cycles**, ensuring reliable performance without issues such as **incomplete cutting, edge chipping, material tearing, deformation, or damage to the steel coil**.

Remarks:

The cutting edges can be **resharpened multiple times**. Blade chipping caused by improper operation is excluded from this guarantee.

4.2.5 Steel Strapping Collection Device



The steel strapping collection device consists of a strapping positioning mechanism, strapping winding mechanism, strapping clamping mechanism, strapping compacting mechanism, and strapping collection positioning mechanism, among other components.

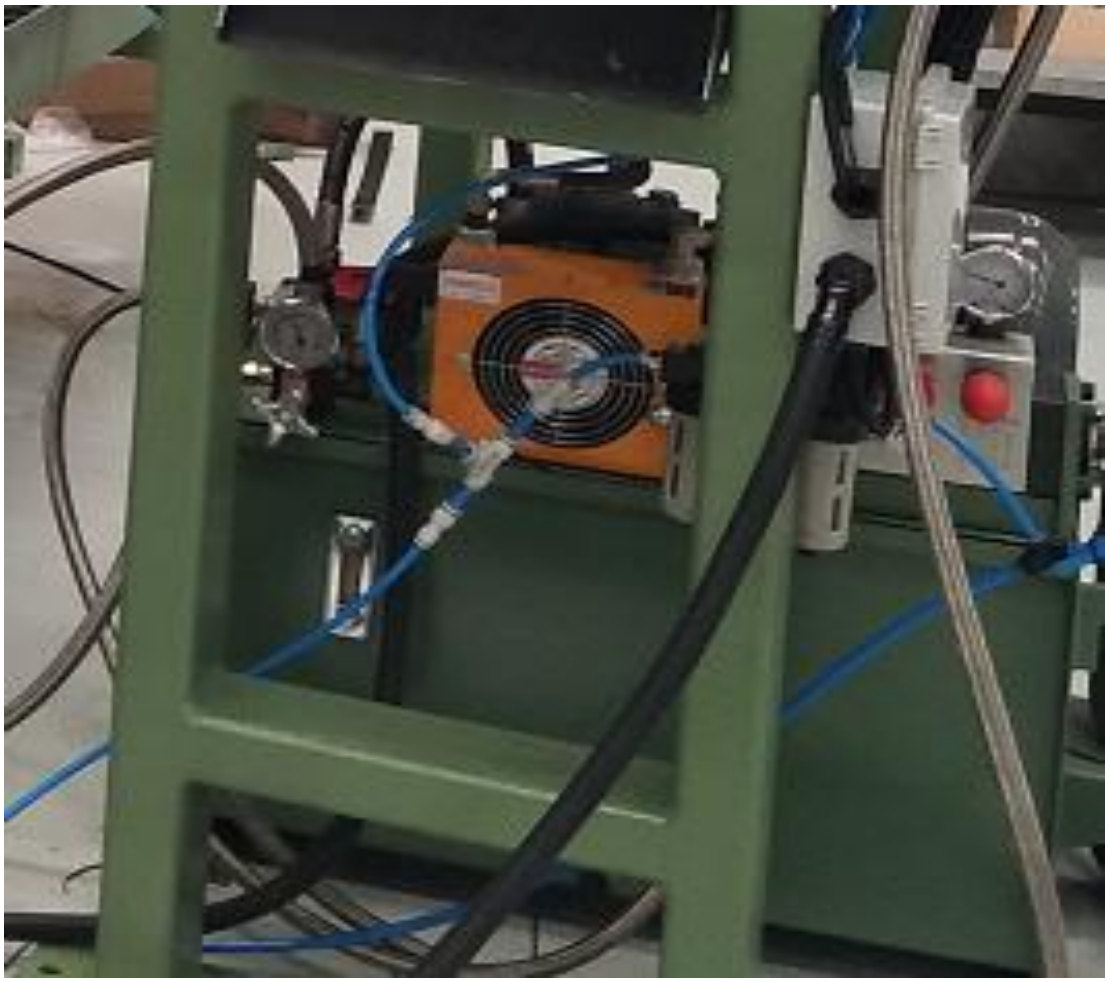
The system is designed to cooperate with the robotic unstrapping process to ensure orderly collection, secure handling, and compact storage of removed steel strapping bands.

4.2.6 PET Strapping Collection Device

The plastic strapping collection device adopts a **step-by-step conveying and fixed-length cutting mechanism** to process plastic strapping bands. The plastic straps are **cut into segments of defined length**, ensuring orderly handling and meeting the requirements for safe and efficient collection.

The system is designed to operate reliably in coordination with the robotic unstrapping process, providing **stable conveying, accurate cutting, and convenient collection** of plastic strapping materials.

4.2.7 Hydraulic System



The hydraulic system provides the necessary power for **strapping clamping**, **strapping cutting**, and **operation of the strapping collection devices**.

The system operating pressure is **10 MPa**, ensuring stable and reliable performance for all hydraulic actuators.

An **integrated hydraulic power unit** is adopted. The hydraulic valve manifolds are **distributed and installed on the oil tank and the robot base**, allowing for compact layout, efficient control, and convenient maintenance.

Key hydraulic components such as **hydraulic pumps and valves** are selected from **high-quality domestic and international brands**, while other auxiliary components are sourced from **reliable domestic manufacturers**, ensuring overall system reliability, performance stability, and cost effectiveness.

Power Voltage	Oil Tank Capacity	System Pressure	Flow Rate
380V	100L	10MPa	20L/min

4.2.8 Safety Protection System

The safety protection system is designed to ensure personnel safety during robot operation. A safety fence with a height of 2.0 meters is installed around the robot working area. The fence consists of protective mesh panels, support posts, double-leaf access doors, and safety door interlocks. (Specific dimensions shall be mutually agreed upon by both parties.)

To prevent any risk to personnel during robot operation, the robot working area is fully enclosed by the safety fence, effectively isolating it from surrounding areas. Control buttons are installed at the fence access doors to facilitate operator interaction. The available functions include Emergency Stop, Pause, Run, Reset, and Cycle Start.

Safety Door Interlocks and Alarm Light

Safety door interlock switches and an alarm indicator light are installed on the fence doors. When a fence door is opened, the detection sensor immediately sends a signal to the control system, causing the robot to stop operation instantly and trigger an alarm notification, thereby ensuring a high level of operational safety.

4.2.9 Lubrication System

The lubrication system is designed to ensure reliable lubrication of reciprocating and moving components, such as the clamping and strapping cutting device, thereby guaranteeing smooth operation and extending the service life of mechanical parts.

An automatic centralized lubrication system is adopted to provide effective and consistent lubrication to key moving components. The system features low lubricant consumption, which significantly reduces maintenance workload and overall operating costs. Lubricant is discharged accurately to each lubrication point, preventing over-lubrication, avoiding contamination, and minimizing environmental impact.

The lubrication process is controlled by a PLC. The PLC drives the motor to actuate the plunger in a reciprocating motion, delivering lubricant forward and precisely supplying it to the designated lubrication points. Components not covered by the centralized lubrication system are lubricated manually using grease to ensure comprehensive lubrication of the entire system.

4.2.10 Pneumatic System

The pneumatic system of this equipment adopts AIRTAC series pneumatic components. The incoming external air supply is filtered and pressure-regulated to provide clean and stable compressed air for the system. The pneumatic system mainly supplies power for specific actions of the strapping collection device, ensuring smooth, reliability, and efficient operation.

By effectively conditioning the air source, the system improves the reliability and service life of pneumatic components while ensuring stable performance of all related mechanisms.

No	Item	Specification	Remarks
1	Air Source Pressure	0.5-0.6MPa	
2	Purify Grade	3.3.1	
3	Air source flow Rate	1.5 m^3/H	

4.2.11 Electrical Control System

The fully automatic unstrapping system adopts a **Siemens S7-1500 series PLC** as the main controller. The PLC is equipped with **PROFINET field bus communication (Ethernet interface)**, providing strong anti-interference capability and high system reliability. The electrical control system includes a **local operator station**, **servo drives**, and a **robot control cabinet**, forming a complete and integrated control architecture.

The PLC system of the unstrapping equipment is connected to the **cold rolling line entry controller (L1)** through **hardwired I/O** for safety interlocking and floor roller control. During automatic unstrapping operation, when detecting the strapping band head, the PLC controls the entry rollers to rotate forward or reverse via the L1 system. At the same time, the unstrapping system connects to the main line **L1 network via TCP/IP**, establishing a communication link to obtain production coil information, which is used for verification of steel coil outer dimensions.

The robot control cabinet contains the robot control unit. The robot teach pendant is an integral part of the robot control cabinet and is connected to the controller via cable. Interfaces for **centralized control, remote operation and maintenance, equipment status monitoring**, and related communications and hardwired signals are reserved, with a **20% capacity allowance** based on the current number of I/O points.

The robot is connected to the L1 system through **hardwired I/O** for control and safety signals, communicates with the L1 system via **PROFINET** for data exchange, and communicates with the **Level 2 (L2) PLC** via Ethernet to obtain information such as **coil identification numbers**. Party A shall assist Party B in completing system communication integration, while all required hardware shall be supplied by Party B.

The electrical control system incorporates **multi-level operation authority management**, including general operators, advanced operators, and maintenance personnel. Each authority level is permitted to operate only the corresponding functions or modify specific parameters, thereby enhancing overall system safety. The system provides **Automatic**, **Semi-automatic**, and **Manual** operation modes.

In **Automatic mode**, the unstrapping system operates in linkage with the production line and automatically starts operation upon receiving an unstrapping command from the line.

In **Semi-automatic mode**, the operator manually inputs commands via the human-machine interface to initiate the corresponding operations.

In **Manual mode**, the system provides functions such as **Emergency Stop**, **one-key return to home position**, and **individual equipment locking**, facilitating commissioning, maintenance, and troubleshooting.

5 Installation and Operating Environment Requirements

✧ The complete system shall be installed **inside an enclosed industrial workshop**. No part of the equipment is permitted to be installed outdoors or exposed to open-air conditions.

✧ The workshop shall be equipped with a **stable power supply and compressed air source**, provide **good ventilation**, and maintain an ambient temperature range of **5°C to 40°C**.

✧ The surrounding environment, production conditions, and adjacent equipment shall **not interfere with or adversely affect the normal operation** of the system.

✧ The robot installation area shall be prepared with either **a 30 mm thick embedded steel plate** or a **concrete foundation with a thickness greater than 500 mm**. The installation surface shall be **flat and level**.

✧ **Power supply**: AC 380 V ±5%, 50 Hz.

✧ **Compressed air supply**: Clean compressed air at **0.5–0.7 MPa**.

✧ The air supply inlet pipe diameter shall be **Φ12 mm**, with a flow rate of **not less than 1.5 m³/h**.

✧ The **total workshop height** shall be **greater than 4 meters**.

6 Connection of Energy Media

The on-site power supply shall be connected to the terminal blocks installed in the junction box or distribution panel **of the equipment.**

All on-site connection points for hydraulic, pneumatic, and coolant systems **provided by Party B are equipped with** matching pairs of flanges and pipe fittings**, including** bolts and sealing gaskets**. The pipelines provided by Party A can be connected to these paired flanges and fittings by welding.**

For all fluid media, Party B shall provide shut-off valves and paired flanges or pipe fittings **(including bolts and sealing gaskets) at the** TOP points **of the on-site piping. The TOP point is defined as a location** within 1 meter outside the main body of the equipment**. All fluid piping installed on the equipment body itself shall be supplied and pre-installed by Party B prior to delivery.**

7 On-Site Video Case Study

https://youtu.be/QXsNaGk80Xg?si=8uXE_nnfn7LqAo7l

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