
	CABLE SHARK ASSEMBLY OPERATING PROCEDURE						
	WC:	219	APPROVAL INITIALS:				
	REV:	2	LEAN	AS	SAFE		ND
	DATE:	5/6/24	PROD	CB	ENGR		DF
SPECIAL SAFETY INSTRUCTIONS:							
➤ Maintain a safety distance of at least 1.5 meter from the robotic arm during operation.							
➤ Preventative Maintenance must be done before starting production							
➤ PPE (Personal Protective Equipment) Required: Safety Glasses, Cut Resistant Gloves, Earplugs/Muffs, Steel-Toed Boots/Shoes							
➤ Keep hands away from moving machinery.							

Objectives

This SOP aims to guide the assembly of the Cable Shark product using a human-robot collaborative framework enhanced by Large Language Models (LLMs) for efficient and safe operations.

Introduction

This procedure outlines the steps for assembling the Cable Shark product using a collaborative approach between human operators and robotic systems. The framework utilizes LLMs to facilitate natural language communication for task management.

About the Cable Shark Device

The Cable Shark is an innovative device designed for securing and managing cables in industrial and commercial settings. It provides a robust solution for organizing cables, preventing entanglement, and reducing wear and tear. The device enhances safety and efficiency by keeping cable systems orderly and accessible.

Component Specifications / Dimensions

1. Housing

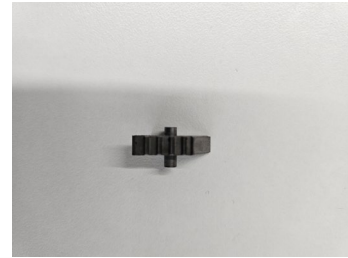
- Dimensions
 - Length: 100 mm
 - Width: 50 mm
 - Height: 40 mm
 - Wall Thickness: 5 mm
- Features: Two screw holes (diameter: 4 mm) on each side



for securing the housing. Internal grooves for accommodating the wedge and spring.

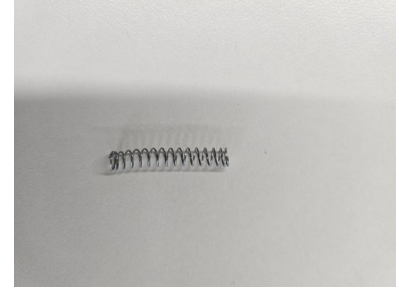
2. Wedge

- Dimensions
 - Length: 25 mm
 - Width: 5 mm
 - Height: 10 mm
- Features: Teeth facing inward with a pitch of 2 mm. One side tapered to fit securely into the housing.



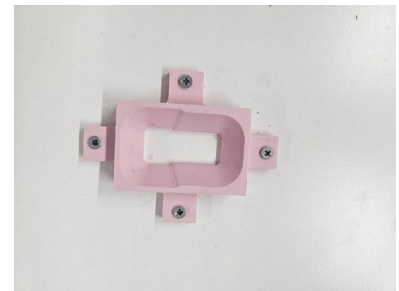
3. Spring

- Dimensions
 - Outer Diameter: 20 mm
 - Inner Diameter: 18 mm
 - Free Length: 30 mm
 - Wire Diameter: 1 mm
- Features: Compression spring providing necessary tension to secure the wedge within the housing.



4. Assembly Holder

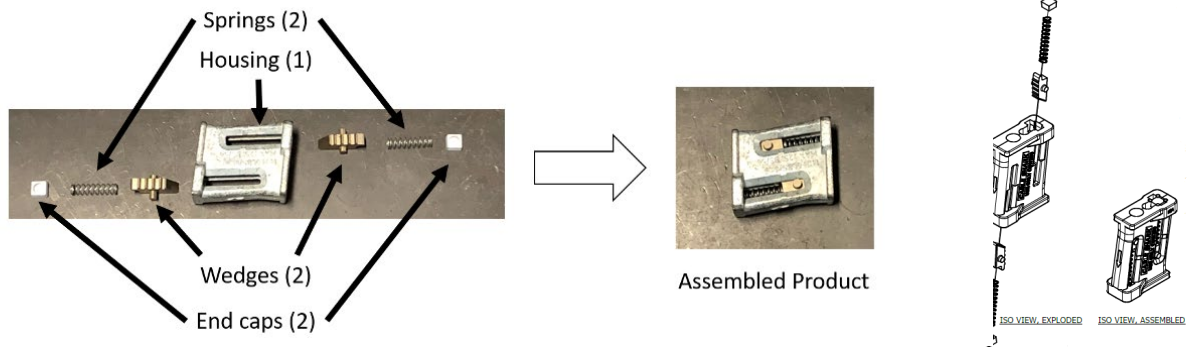
- Dimensions
 - Length: 150 mm
 - Width: 80 mm
 - Height: 50 mm
 - Groove Width: 50 mm
 - Groove Depth: 20 mm
- Features: Grooves and notches to hold the housing, wedge, and spring in place during assembly. Non-slip base to prevent movement during assembly.



xArm6 Specifications from UFactory

- **Reach:** 700 mm
- **Payload:** 5 kg
- **Degrees of Freedom:** 6 DOF
- **Repeatability:** ± 0.1 mm
- **Maximum Speed:** 1000 mm/s
- **Control Interface:** Ethernet, USB
- **Safety Features:**
 - Collision detection.
 - Emergency stop buttons.
 - Compliance with ISO 10218-1 safety standards for industrial robots.

Component Assembly Instructions



Sequence: Housing -> Wedge -> Spring

1. **Housing:** Place the housing on the assembly holder. Ensure that the internal grooves are oriented upwards to provide the correct alignment for subsequent components. The assembly holder should stabilize the housing and prevent any movement during the assembly process.
2. **Wedge:** Carefully insert the wedge into the housing. The teeth of the wedge should face inward, aligning with the internal grooves of the housing. Ensure that the tapered side of the wedge fits snugly into the grooves, providing a secure fit. This positioning ensures that the wedge locks into place and prevents any rotational movement.
3. **Spring:** Position the spring into the housing, placing it directly after the wedge. Ensure that the spring sits well within the housing and compresses slightly. This compression helps to secure the spring in place and provides the necessary tension for the assembly. Check that the spring is aligned properly and does not shift during the process.
4. **Assembly Holder:** Use the assembly holder to stabilize each component during the assembly process, ensuring precise placement and secure fitting.

Error Notification and Resolution

- The robotic system is equipped with sensors and an LLM module to monitor and manage the assembly process. If the robot encounters any errors, such as misaligned parts or missing components, it will immediately notify the human operator.
- Notifications will be delivered in clear, natural language messages generated by the LLM module, ensuring that human operators can quickly understand and address the issue. For example, if a spring is missing, the robot might say, "Spring component missing. Please place the spring in the housing."
- After the human operator resolves the error, they can instruct the robot to resume the assembly process from where it was interrupted. This ensures a continuous and efficient workflow, minimizing downtime and maintaining high productivity.

Example Commands for Human Operators

- To start assembly: "Start the assembly."
- To address a missing component error: "A component is missing. Please place the springs correctly."
- To resume after error resolution: "I've fixed the error. Resume assembly."

Safety

- During the assembly process, it is crucial for human operators to maintain a safe distance from the robot to prevent any accidents or injuries. The assembly area should be clearly marked, and operators should stay outside this zone when the robot is in operation.
- In case of any immediate danger, the emergency stop button should be pressed to halt all robotic operations instantly. The light in the e-stop button will turn off when released, and operations can only resume after the issue is resolved and the button is reset.
- **Operational Safety:**
 - Stay outside the robotic arm's range during operation.
 - Do not reach into the assembly area when the robot is active.
- **Emergency Procedures:**
 - Press the emergency stop button to halt operations immediately if necessary.
 - The robot can only resume after resetting the emergency stop and addressing the issue.
- **Equipment Maintenance:**

- Regularly inspect the xArm6 and assembly tools.
- Report any wear, damage, or malfunctions immediately.

- **Training:**

- Only trained personnel should operate or interact with the robotic system.
- Stay updated on safety protocols and operational procedures.

General Knowledge About Assembly Process

- **Preparation:**
 - Verify all components are available and free from defects.
 - Ensure the workspace is clean and organized.
- **Organization:**
 - Arrange tools and parts for easy accessibility.
 - Follow the assembly sequence strictly.
- **Quality Control:**
 - Inspect each assembled unit for proper fit and function.
 - Document any anomalies or defects found during assembly.
- **Communication:**
 - Use clear and concise language when interacting with the robotic system.
 - Report any issues immediately to the supervisory team.
- **Safety:**
 - Always wear the required PPE.
 - Be aware of your surroundings and the movements of the robotic arm.
 - Do not bypass any safety mechanisms.

Notes

- Ensure all team members are familiar with the xArm6 operation manual.
- Keep this SOP accessible in the workspace for reference.
- Regularly review and update the SOP as needed to incorporate improvements or changes in the assembly process.