Automated Assembly Cell

Project Team:
Jenna Doyle
Jacob Ruemenapp
Chris Simaz
Pedro Takayanagui
Nathan VanHouten

Faculty Advisors:
Dr. Chrisopher Pung
Dr. Wendy Reffeor
Dr. Blake Ashby

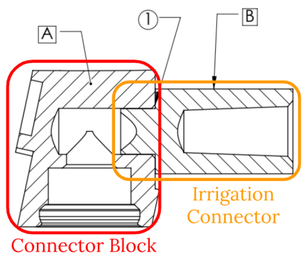
Sponsor:
Autocam Medical

Sponsor Contacts:
Chris Kolean
Dan Torralva

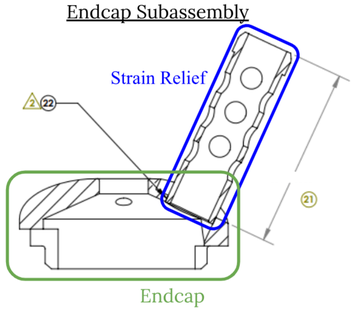
Background

Autocam Medical is contracted to manufacture a surgical handpiece used in cataract removal surgery. The handpiece is composed of many subassemblies with two of interest for this project, the endcap assembly and the sensor housing assembly. Each subassembly is made of two components: the endcap and strain relief or the connector block and irrigation connector. Each set of mated pairs is designed with an interference fit and must be pressed together for assembly prior to being welded. The current assembly solution involves an operator manually pressing together the components of the subassemblies using an arbor press. Therefore, the goal of this project was to build an automated assembly cell to perform the part handling and press-fit assembly operations of 5 sets of mated pairs with minimal operator input.

Sensor Housing Subassembly



Endcap Subassembly

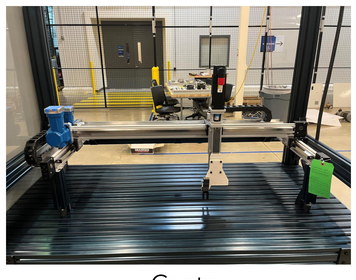


Key Specifications

- Maximum Budget: $100,000
- Minimum Part Preload Capacity: 100 assemblies
- Cycle Time Per Assembly: 60 seconds or less
- Changeover Time: 5 minutes or less
- Must meet specified strain relief assembly lengths for each part family after the pressing operation
- CPK value of 1.33 or better for each part family

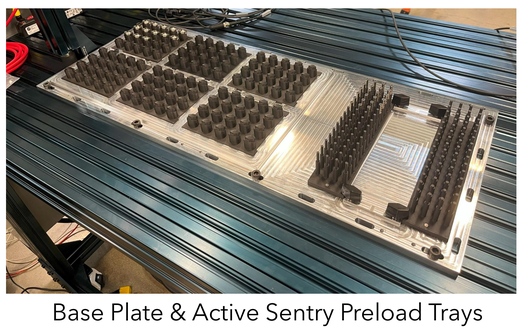
Mechanical Design

The main components of the mechanical design include a table, gantry system, grippers with custom jaws, electric press, custom press fixturing, and custom pallets. The cart was sourced from Vention and is primarily constructed from 80-20 aluminum. The cart is on casters to be movable and has an interlock door for safety. The gantry system allows for travel in the X, Y, and Z directions with a positional accuracy of ± 0.001 in. Parallel grippers with positional feedback were sourced from Schunk. A servo-electric press with a max press force of 2000 N was chosen for this cell. A large portion of the mechanical design focused on custom fixturing and tooling. The preload trays and gripper attachments were 3D printed out of carbon fiber nylon. The rest of the custom components including the base plate, press mounting plates, press fixtures, and press pin were machined out of stainless steel.



Gantry

Press



Base Plate & Active Sentry Preload Trays

Controls Design

The control system consists of a Compact GuardLogix5380 Allen Bradley Programmable Logic Controller (PLC). Two digital I/O modules of 16 bits each interface the PLC with the remaining electronic components of the system such as the gantry servos, power supply, and press. This controller allows the use of integrated redundant safety over ethernet for all components as well as the electro-mechanical safety switches (EMSS).

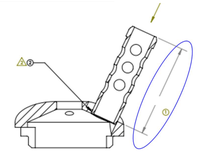
Control Panel

HMI Display Screen

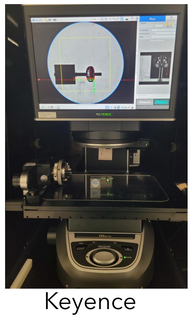
A 12-inch HMI display was used to allow operators to control and monitor the operations of the assembly cell. Operators can switch between part family programs, input the number of mated parts, and receive machine error information on the HMI.

Testing

Final testing of this automated assembly will include a capability study on the length of the strain relief left outside of the endcap after the press operation. This measurement will be taken on a Keyence Vision System. A capability study will be run on two different part families, each containing 30 assemblies. Minitab software will be used to assess the overall capability of the machine. Testing will also be completed to validate that cycle time and changeover time specifications were met.



AS Capability Study Feature



Keyence