

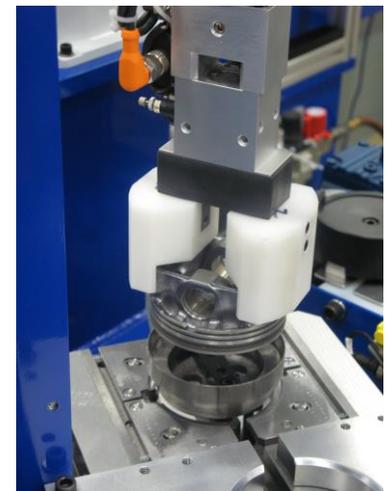


Assembly & Inspection Machine Specifications

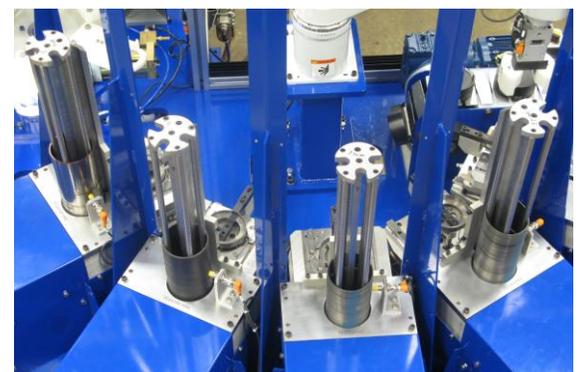
- **Assembly:** Five rings inserted and positioned onto piston head grooves.
- **Robot:** Epson SCARA.
- **Production Rate:** 500 parts per hour.
- **Dimensions:** 105" W x 132"L x 80"H
- **Utilities:** Electrical, 240 VAC, 3PH, Control voltage 24VDC, Compressed Air ¼ NPT, 80 psi.
- **Control:** Allen Bradley, CompactLogix PLC with Ethernet.
- **Safety Features:** Polycarbonate barrier guard around entire robot cell, assembly, and inspection area with electronic interlocked access doors.

Sequence:

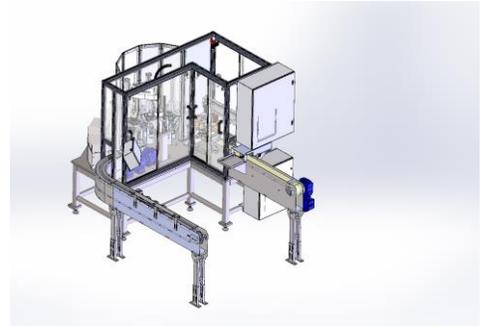
1. The operator places unassembled pistons in the product fixtures on the infeed conveyor and orients the pistons against the side rail.
2. The infeed conveyor indexes the pistons to the robot pick station.
3. Once a piston is detected and in position, the assembly robot will index to the robot pick station.
4. The robot grips and lifts the piston from the product fixture at the pick station and indexes to the first ring insertion station.
5. Prior to the robot moving the piston to the first ring insertion station, the shuttle feeder transfers an expander ring from the ring magazine to a loading position below the spreader mandrel.
6. The spreader mandrel is designed to hold the piston at the correct ring groove height to place the expander ring in the center of the piston groove.
7. The robot places the piston in the spreader mandrel and pushes the piston and mandrel down through the expander ring and tooling pocket.
8. The expander ring opens and slides along the side wall of the spreader mandrel until it reaches the top edge of the mandrel wall and snaps into the center of the piston groove.
9. The robot lifts the piston with the expander ring out of the spreader mandrel and indexes to the second ring insertion station.
10. The robot moves the piston through stations 2, 3, 4, and 5 in a similar fashion until all five rings are positioned in the piston grooves.



Scara Robot places piston into third ring insertion station.



Piston Ring Magazines hold up to 1,000 pieces per station.



Machine Sequence (continued):

11. The robot lifts the completed piston with the expander ring, both "side rail" rings, the "2nd" ring and the "top" ring out of the spreader mandrel and moves it to the rotary inspection table.
12. At the first inspection station, a camera mounted to a horizontal shuttle looks for the correct piston number stamping and the presence of the "top" ring stamping.
13. Once the stampings are verified, the camera extends to the second position and looks for the presence of the "2nd" ring stamping.
14. Once the "2nd" ring stamping is verified, the rotary table indexes to the second inspection station.
15. A fixed camera at the second inspection station looks for the presence of the expander ring and both "side rail" rings and verifies that the rings are fully seated into the piston groove.
16. Once the expander ring and "side rail" rings are verified, the rotary table indexes to the unloading station.
17. At the unloading station, a pick and place unit removes the completed piston from the rotary table fixture and transfers the piston to the discharge conveyor.
18. The completed piston is conveyed to the packing area and an operator places the piston in a shipping carton.
19. If the completed piston fails the inspection, a reject station located on the discharge conveyor will push the piston into a holding area.



Pick and place unit removes the completed piston from rotary table fixture and transfers it to the discharge conveyor

The Vision System



The system has two vision camera stations. The first camera station utilizes a Cognex In-Sight 7200 Camera with PatMax, which includes a 16mm adjustable focus lens with a white LED light. The first station looks for the identification marks on the piston and top and second compression rings to ensure the correct piston is loaded/assembled and the compression rings are oriented/positioned correctly.

In order to "see" all the identification marks, the camera has to be repositioned at the first station and perform two inspections. The camera is mounted on a pneumatic slide and moves from trailing (near side) to leading side (far side) of the piston.

The camera at the second station looks for the correct orientation of the expander ring along with the top and bottom side rail rings. This camera insures that all three rings are present and fully seated within the groove.