

DAC / Fanuc Robotic Screw Insertion Work Cell

Project Overview:

This machine is designed for any customer that requires a compact SMEMA-type screw insertion cell to install screws into a product. This specification may be modified to meet the customer's requirement by integrating Design & Assembly Concepts' DAC Robotic SMEMA Cell with an automated screwdriver and the customer's other specifications. It would consist of the following systems.

- DAC's Robotic Assembly Cell consists of:
 - Conveyor to transport product through the cell.
 - Product specific tooling with a lift and locate device to present the product to the screw insertion tooling.
 - Programmable 5-axis Fanuc Robotic positioning system to locate automated screw insertion tooling.
 - PC control with Customer Control System (CCS) interface, barcode scanner, and SMEMA interface controls.
- Screw insertion tooling with screw feeding and insertion monitoring controls mounted on the Fanuc Robot J5 axis.
- CCD Camera to read bar code and perform basic inspection mounted on robot J5 axis.

Project Details:

Specifications – General System

- The DAC Robotic SMEMA Cell is an in-line SMEMA type automated system.
- Product size envelope to be 12" across the conveyor and 18" along the conveyor.
- Facility Requirements
 - Power: 220 VAC, 15A service.
 - Air: 90 psig, 5 scfm
 - Overall Dimensions (TBD)
 - Weight (TBD)

Specification – Operation

- System is in stand-by, waiting to receive a product from the upstream system. SMEMA “Machine Ready To Receive” signal to upstream system is high.
- When the system receives a SMEMA “Product Available” signal from the upstream system, the conveyor starts.
- The pop-up stops advance to catch a product on the conveyor.
- A product conveys into the system and runs into the pop-up stops, making the part present sensor. The SMEMA “Machine Ready To Receive” is sent low.
- The robot moves the camera to the barcode position and the camera is triggered, and scans the barcode on the product.
- The system communicates to CCS, passing the barcode information.
- CCS communicates back to the system.
 - If CCS rejects this product, the system raises a fault condition at the HMI and stack-light.
 - If CCS accepts this assembly, the system reads product/model information to select an operating recipe for screw insertion.
 - If no recipe is resident for this product, a fault condition is displayed at the HMI and stack-light.
- The system advances the lift and locate tooling to lift the product off the conveyor and adequately support it during screw insertion operations.
- A screw is fed to the insertion tooling.
- The robot positions the insertion tooling to the first location.
- The system signals the screw insertion controller to insert the first screw. The bit advances and inserts the screw. Applicable parameters are monitored during insertion and reported back to the main controller.
- The robot advances to the remaining screw insertion locations and inserts screws.
- The robot positions the camera to inspect areas of the product programmed for inspection.
- If all screws are inserted in accordance with monitored parameters, and the visual inspection passes, the system communicates to CCS a passing assembly report.
 - If a screw is not properly inserted at some point in the sequence, the process is stopped and a report is communicated to CCS. A fault message is displayed at the HMI and the stack-light. The operator then removes the product from the system and clears the fault.
- A passing product is then queued and waiting for the downstream system. SMEMA “Product Available” signal to the downstream system is high.
- When a SMEMA “Machine Ready To Receive” signal is received from the downstream system, the conveyor starts, conveying the product out of the cell.
- When the product clears an exit sensor, the system’s SMEMA “Machine Ready To Receive” signal is made high and its “Product Available” signal is made low.

Specification – Controls

- Pentium based computer with MS Windows host controller
- Monitor / Keyboard / Mouse
- Software / Control Application
 - DAC developed LabView control application
 - Vision inspection of key features
 - HMI Layout, controls, and variables will be done in accordance to Customer specification if provided.
- Firewire camera w/lighting for barcode reading and visual inspection.
- Disconnect Switch.
- Digital I/O system (32 in / 32 out min)
- Fanuc Robotics robot controller
- Pneumatic control valves
- Pneumatic Service Pressure Switch
- Atlas Copco screwdriver controller or equivalent It will be set up as typically deployed in accordance with direction from the Customer and with respect to each application.
- SMEMA Conveyor By-pass switch
- Cell R/Y/G/Alarm stack-light.

Specification – Software

- SMEMA conveyor control and hand shaking with upstream and downstream systems.
- Barcode scanner communications.
- Customer Control Systems (CCS) communications.
- 5-Axis Robot controlled Screwdriver positioning and motion control.
- Screwdriver controller interface
 - Start / Stop
 - Fault Messaging
 - Recipe control and selection
- HMI and messaging interface.

- Screwdriver controller (as typically deployed by Customer)
 - Speed control
 - Torque monitoring
 - Rotation monitoring
 - QC reporting and feedback to supervisory controller.

Specification – Mechanical

- Welded steel frame, blue powder coat finish.
- Steel bottom side panels with white powder cost finish.

- Machine casters with integrated leveling mounts.
- Machine integrated PC controller and control panel
- Machine integrated 3-axis DAC drive box
- Machine integrated screwdriver controller.
- 5-Axis Fanuc Robot, 200 iC, 700mm reach, 5kg payload
- SMEMA conveyor with capability to support modules (1M long)
- Integrated pneumatic pop-up stops
- Pneumatic device lift and locate
- Camera Barcode scanner
- Guarding with interlocked doors on each side and polycarbonate panels
- Screwdriver tool with nosepiece tooling and Atlas Copco spindle motor.
- Screw feeder

Specification – Deliverables

DAC will deliver the following items:

- System and tooling
- Top Level Layout drawings
- Pneumatic Diagram
- Electrical Schematics
- Parts List with recommended spare parts

Customer will deliver the following items

- Sample Products and screws as required for feeder development and system testing.
- CAD models and drawings for the current configuration of the product to be processed.
- Required documentation
 - Product specifications and drawings
 - Screw specifications
 - Detailed CCS protocol specifications and support as required to successfully develop the software.
 - Assembly and screw insertion specifications
 - Atlas Copco controller or equivalent setup and programming specifications and parameters.

Acceptance Criteria

- The system will be demonstrated and accepted at DAC.
- Customer will supply components as required to successfully complete the demonstration.

- The system will operate as specified here unless agreed upon otherwise between DAC and Customer; changes in specifications will be documented in writing.
- The system will
 - Reliably handle products in the conveyor, pop-up stop, and lift and locate devices with 95% reliability.
 - Reliably position the screwdriver tooling with respect to the products with 98% reliability.
 - Reliably feed and drive a screw into the product to required specifications or identify if the screw has not been inserted correctly.
 - Reliably communicate to the plant CCS system upon deployment on-site.
 - Reliably interface with adjacent systems on the conveyor line via SMEMA communications.
- It is assumed supplied products are within specifications as supplied by the Customer upon award of this project.