



INVITATION FOR BIDS
OFFICE OF PROCUREMENT & CONTRACTS

1. INSTRUCTIONS FOR BIDDERS

- a. Sealed bids will be received in the Office of Procurement & Contracts, Mississippi State University, for the purchase of the items listed herein.
- b. All bids must be received in the Office of Procurement & Contracts on or before the bid opening time and date listed herein. Delivery of bids must be during normal working hours, 8:00 a.m. to 5:00 p.m. CST, except on weekends and holidays when no delivery is possible.
- c. Bidders shall submit their bids either electronically or in a sealed envelope. To submit electronically, follow the instructions below. Bids CANNOT be emailed.
 - i. Sealed bids should include the bid number on the face of the envelope as well as the bidders' name and address. Bids should be sent to: 245 Barr Avenue, 610 McArthur Hall, Mississippi State, MS 39762.
 - ii. At this time we only accept non-ITS bids electronically. For electronic submission of bids, go to: portal.magic.ms.gov and use the RFX number on the next page as your reference number.
- d. All questions regarding this bid should be directed to the Office of Procurement & Contracts at 662-325-2550.

2. TERMS AND CONDITIONS

- a. All bids should be bid "FOB Destination"
- b. Bidders must comply with all rules, regulations, and statutes relating to purchasing in the State of Mississippi, in addition to the requirements on this form. General Bid Terms and Conditions can be found here:
https://www.procurement.msstate.edu/procurement/bids/Bid_General_Terms_May_2019_V2.pdf
- c. Any contract resulting from this Invitation for Bid shall be in substantial compliance with Mississippi State University's Standard Contract Addendum:
<https://www.procurement.msstate.edu/contracts/standardaddendum.pdf>

Bid Number/RFX Number: 22-151/RFX#3160005604

Opening Date: January 11, 2023 @2:00 p.m.

Description: Fixture Assembly and Training Cell

Vendor Name: _____

Vendor Address: _____

Telephone Number: _____

Days the Offer is Firm: _____

Authorized Signature: _____

Name: _____

Title: _____

Item	Quantity	Description	Unit Price	Total Price
1	1	Automated Flexible Assembly System – as per attached specifications		
2	1	Portable Automated Training Cell – as per attached specifications		
		TOTAL		

Automated Flexible Assembly Cell with Linear Transfer For 8 Stations– Industry 4.0

Initial Release
03 November 2022

Mississippi State University
Center for Advanced Vehicular Systems – Extension (CAVS-E)
153 Mississippi Parkway
Canton, MS 39046

Table of Contents

1.0 Scope	3
2.0 Facility	3
3.0 Equipment Requirements	3
4.0 Contractor Requirements.....	10
5.0 Deliverables.....	11
6.0 Schedule	11

1.0 Scope

The Center for Advanced Vehicular Systems – Extension (CAVS-E) at Mississippi State University is expanding its capability to support high quality experiential-based training in a scaled-down Industry 4.0 (i4.0) factory environment. As part of this effort, CAVS-E is requesting bids for an automated flexible assembly cell with linear transfer for 8 stations. The system will provide professional training by simulating a real industrial assembly process. The system will consist of a flexible assembly line that will assemble the different components to create an assembled mechanism (e.g., turning mechanism). The device will consist of aluminium base or body, bearing, shaft, lid, and screws. All the components used in the system will be industrial. To provide the system with greater flexibility, the various stations adapt to a wide variety of assemblies, introducing variations in the materials, colors and part sizes and i4.0 Technologies. The combination of all these possibilities means that a total of twenty-four different assemblies can be obtained enabling the use of production management strategies, which make the most of the cell's flexibility. The delivered system should be fully assembled, wired, and programmed.

Minimum requirements for the equipment and installation are summarized in this document and are not intended to limit the configuration capabilities or services offered by potential suppliers.

2.0 Facility

This equipment would be housed in the quality lab of the CAVS-E location in Canton, MS.

3.0 Equipment Requirements

The following section describes the general requirements for the size, tolerance, and capabilities of the system.

The information listed here should be regarded as minimum performance requirements; .

In general, the training system shall include:

System Requirements

- 1 copy of the Full Version of PLC Control Software.
- PLC Software for Human Machine Interface (HMI). The system will include SCADA Software
- The completed system must fit inside 32 ft by 4ft

Body Supply Station with Linear Transfer and PLC Controller

The function of the station should be to feed the base which acts as the support to a turning mechanism and move it to the pallet with RFID tag located in the transfer system. The station process should start as soon as a pallet stops in front of the station.

This station should include an Augmented Reality application to access the machine's technical datasheets.

The station will comprise the following modules:

- **Base feeder:**

This station must store an inventory of bases (min. 12 bases). It then can confirm the presence of inventory via sensors and deploy to the next station as needed via automated process.

- **Quality Confirmation module**

This station receives the base from the base feeder station and confirms the base is oriented in the proper position. If the base is correct it is transferred to the next station via automated process. If the base is incorrect, it is then automatically rejected.

- **Insertion of the base in the pallet:**

After Quality Verification a handling device should move the base to a pallet with RFID tag.

Bearing Selection and Supply Station with PLC Controller

The function of this station is to store an inventory of bases, verify bearing height and place bearings in the assembly. The station process starts as soon as a pallet with a base inside stops in front of the station.

The station will comprise the following modules:

- **Bearing feeding module:**

This station must store an inventory of bearings (min. 38 bearings). It confirms the presence of inventory via sensors and verifies when a bearing pulled from its inventory. If inventory is not present it will stop the process and alert the operator via visual cues.

- **Height measuring module:**

The purpose of this station is to receive bearings from the bearing feeder and verify the bearing is the correct height for the assembly. If the bearing is not correct it is the rejected and a new bearing is called for.

- **Bearing insertion module:**

The purpose of this module is to pick a verified bearing from the Height Measuring module and place it in the assembly.

Hydraulic Press Station with Linear Transfer and PLC Controller

The function of the station will be to press a bearing inside a support base. The station process starts as soon as a pallet with RFID tag, with the base and bearing inside, stops in front of the station.

The station will comprise the following modules:

- **Insertion/extraction of the product in process:**

This module removes the assembly consisting of a base and a bearing from the RFID pallet and places it on the press feeder. It completes this process in reverse after the pressing operation and the feeder returns to its original position.

- **Feeding the press:**

This module loads and unloads the assembly to the press.

- **Pressing the bearing:**

Once the base containing the bearing is underneath the pressing cylinder, a protection screen actuated descends and the cylinder press will lower with an adjustable force. Once the bearing is pressed, the product in process is transported to the unloading point.

- **Methacrylate enclosure with magnetic safety switch:**

This station will have a methacrylate enclosure that completely covers the work area. This enclosure will have a door to access the work field with a magnetic safety switch fitted.

Shaft Selection and Supply Station with Linear Transfer and PLC Controller

The function of the station will be to assemble a shaft inside a bearing. This is completed with multiple modules listed below. The station process starts as soon as a pallet with RFID tag stops in front of the station.

The part to be assembled will be a shaft. There will be two shaft material options.

The station will comprise the following modules:

- **Dividing plate:**

This is a turntable to process the shafts through the various modules and then finally transferred into the assembly.

- **Feeding the shafts:**

This station must store an inventory of shafts (min. 37 shafts). It confirms the presence of inventory via sensors and verifies when a shaft is pulled from its inventory. If a shaft is present, it will transfer it to the next module when needed. If inventory is not present it will stop the process and alert the operator via visual cues.

- **Measuring the shaft height:**

This module confirms that the shaft is in the proper position by measuring its height.

- **Positioning the shaft in the correct position:**

If the previous module detects that the shaft is positioned incorrectly, a handling device must correct it. The handling device will position the shaft correctly.

- **Detection of the shaft material:**

Two measurements will be taken to determine the shaft material using inductive and capacitive detectors.

- **Removal of incorrect shaft:**

It will consist of a handling device that, when it receives the command, will remove the shaft from the plate.

- **Insertion of the shaft in the assembly**

This module picks a shaft from the dividing plate and places it into the process.

- **Methacrylate enclosure with magnetic safety switch:**

This station will have a methacrylate enclosure that completely covers the work area. This enclosure will have a door to access the work field with a magnetic safety switch fitted.

- **Security camera:**

The station will have a security camera installed in the upper corner of the methacrylate enclosure. This security camera will detect any movement in the restricted security area and send the corresponding signal to the controller should any movement be detected.

Cover Selection and Supply Station with Linear Transfer and PLC Controller

The function of the station will be to feed a lid and move it to the pallet in the transfer system. The station process starts as soon as a pallet with RFID tag stops in front of the station.

The part to be assembled will be a lid. There will be twelve options for cap attachment. Six, in terms of the material: metal, made of anodized aluminum, blue plastic, made of blue nylon and white plastic, made of white nylon. Each cap also comes in two different heights, regardless of the material it is made from.

The station will comprise the following modules:

- **Dividing plate:**

This is a turntable to process the shafts through the various modules and then finally transferred into the assembly.

- **Feeding the lid**

This station must store an inventory of lids (min. 19 lids). It confirms the presence of inventory via sensors and verifies when a lid is pulled from its inventory. If a lid is present, it will transfer it to the next module when needed. If inventory is not present it will stop the process and alert the operator via visual cues.

- **Loading station:**

The module loads a lid on the dividing plate by a handling device.

- **Material detection stations:**

Three measurements will be taken to determine the lid material using inductive, capacitive and color detectors. This module will have the following components and characteristics:

- Sensors:
 - Inductive detector.
 - Capacitive detector.
 - Colour detector.

- **Lid measuring station:**

The purpose of this module is to verify the lid is the correct height for the assembly.

- **Removal of the incorrect lid module:**

This module will remove the lid if the previous module determines it to be incorrect.

- **Lid insertion module:**

This module inserts a verified lid into the assembly via an automated process.

- **Methacrylate enclosure with magnetic safety switch:**

The station will have a methacrylate enclosure that will protect the entire station surface. This methacrylate enclosure will have a pair of security curtains installed at the front of the station. This security curtain will detect when any foreign object crosses the entrance of the methacrylate screen into the restricted security area.

Screws Supply Station with Linear Transfer and PLC Controller

The function of the station will be to feed four screws and position them in the holes on the base that will support a turning mechanism on the pallet in the transfer system. The station process starts as soon as a pallet with RFID tag stops in front of the station.

- **Screw feeding module:**

This station must store an inventory of screws (min. 38 screws). It confirms the presence of inventory via sensors and verifies when a screw is pulled from its inventory. If a screw is present, it will transfer it to the next module when needed. If inventory is not present it will stop the process and alert the operator via visual cues.

- **Transfer module:**

This will transfer screws from screw feeder via automated process.

- **Screw insertion handling device:**

This module will insert screws from the transfer module into the assembly via automated process.

Robotized Screwing Station with Modular Transfer and PLC Controller

The function of this station will be to screw and assemble and disassemble the turning mechanism components. The station process starts as soon as a pallet with RFID tag, with a turning mechanism inside, stops in front of the station. This station should utilize a collaborative robot.

- **Shaft and lid warehouses:**

The station will have two shaft and lid warehouses to store 3 shafts and 3 lids each. They will be made from anodised aluminium.

- **Robot tools:**

This module will utilize a collaborative robot outfitted with a dual-purpose end effector consisted of a gripper and electric screwdriver.

- **Robot arm and controllers:**

It will be formed by an anthropomorphic robot arm, 6 DOF, controller unit and programming console. This module will include the following components and characteristics:

- Robot: minimum 6 shafts.
- Robot controller.
- Programming console.
- The characteristics of the robot model are as follows:
- Collaborative operation: 15 advanced and adjustable safety functions. TÜV NORD certified safety device. Tested in accordance with standards: EN ISO 13849: 2008 PL d
- Payload: 3 Kg.
- Range: 500 mm
- Imprint: 128 mm in diameter.
- Degrees of freedom: 6. Radius of action (x5) 360° and (x1) Infinite

- The offline programming and simulation software will be available to download from the website for free.

Storage Station with Linear Transfer and PLC – Controller

The function of this station is to automatically store the finished product. The station process starts as soon as a pallet with RFID tag, with an assembly inside, stops in front of the station. Once the pallet is free again, it can be used in a new cycle.

The assembly to be stored will be a turning mechanism formed by an anodised aluminium block with an opening at the top and an opening in the bottom that can house a bearing, shaft, lid and four screws inside.

- **Vertical shaft / Positioning shaft:**

This module will check the quality of the assembly via a vision system and store assemblies. Capable of moving assemblies in three directions (x,y,z).

- **Methacrylate enclosure with magnetic safety switch:**

This station will have a methacrylate enclosure that completely covers the work area. This enclosure will have a door to access the work field with a magnetic safety switch fitted.

Overall Specification applied to all stations where applicable

- **Smart IO-link devices:**

- The system will include a block of electro valves and a color sensor to detect the color of the caps. Both devices will use IO Link communication protocol.
- This smart IO-Link protocol will enable remote access and the parameterization of the sensor and the block of electro valves. It will also provide access to special operating parameters (for example, the number of cycles a pneumatic valve in the block has performed).

The System will include different IO-link devices with smart features:

- Valve blocks with IO-link: counter for number of valve cycles for preventive maintenance actions, detection of power supply failure, short-circuit detection, abnormal interior temperature, internal fault detection.
- Smart light and sound device with IO-link: Emission of 7 LED color's, emission of 8 sounds, remote monitoring.

- **Pneumatic consumption monitoring and leak detection system:**

This station will include a pneumatic consumption monitoring system and a leak detection system. This module will consist of the following components and features:

- Flow meter to monitor air consumption with a built-in electro valve to guide the air inlet.
- Two non-return flow regulators with silencers to simulate air leaks.

- **HMI:**

The station will have a Human Machine Interface (HMI) with a SCADA application of the system. It will also allow the leak detection system to be activated and the air consumption displayed.

- **Breakdown generation system:**

The station has the possibility of generating up to 16 breakdowns or malfunctions. For this purpose, a box will be assembled on the side of the station structure, inside which there will be 16 switches to activate the same number of breakdowns. When a switch is activated, a breakdown will occur in one of the station components. To access these switches, the box lid must be opened, which can be locked.

- **Electrical control panel:**

This control panel will house all the electrical control modules/cards.

- All the pneumatic tubing and electrical cables must be properly identified and labelled at both ends.
- Mounted and secured
- Accessible electrical connection terminal box with power input and coded I/O.
- Safety Relay
- It will include an Ethernet switch with 5 ports.
- It will include 120VAC/24VDC power supply.
- 1 control PLC Controller wired and programmed to operate the module.
- IO Link Master.
- Industrial communication via standard ProfNet for communication with the other module

- **Leak detection system:**

This station will include a leak detection system. This module will consist of the following components and features:

- Two non-return flow regulators with silencers to simulate air leaks.

4.0 Contractor Requirements

The contractor shall deliver the system as defined in Section 3.0 and will assemble the system on site.

5.0 Deliverables

This section summarizes the products and/or services that are expected to be provided by any prospective company submitting a bid for this purchase. Please itemize quotes included in any bid submissions where possible. Deliverables for this purchase shall include:

- Body Supply Station
- Bearing ID and Supply Station
- Hydraulic Press Station
- Shaft ID and Supply Station
- Cover ID and Supply Station
- Screw Supply and Insertion Station
- Robot Screw Driving and Part Change Station
- Servo Controlled Warehousing Station

6.0 Schedule

System to be furnished 90 days ARO. Please include estimated lead time and schedule for fabrication, delivery, installation, and training after receipt of PO.

Assembly – Disassembly Mini PLC Training Cell

Initial Release
11 November 2022

Mississippi State University
Center for Advanced Vehicular Systems – Extension (CAVS-E)
153 Mississippi Parkway
Canton, MS 39046

Record of Change

REVISION	CHANGE	DATE	PAGE
None	Initial Release	11/03/22	

Table of Contents

1.0 Scope	4
2.0 Facility	4
3.0 Equipment Requirements	4
4.0 Contractor Requirements.....	6
5.0 Deliverables.....	6
6.0 Schedule	6

1.0 Scope

The Center for Advanced Vehicular Systems – Extension (CAVS-E) at Mississippi State University is expanding its capability to support high quality experiential-based training in a scaled-down Industry 4.0 (i4.0) factory environment. As part of this effort, CAVS-E is requesting bids for a portable assembly-disassembly mini PLC training cell.

Minimum requirements for the equipment and installation are summarized in this document and are not intended to limit the configuration capabilities or services offered by potential suppliers.

2.0 Facility

This equipment would be housed in the quality lab of the CAVS-E location in Canton, MS.

3.0 Equipment Requirements

The following section describes the general requirements for the size, tolerance, and capabilities of the system.

The information listed here should be regarded as minimum performance requirements.

In general, the training cell shall include:

Overall System Specifications

- Maximum Measurements: 48 in x 30 envelop with Control Keypad: Start and stop buttons, manual/auto switch and power on/off switch
- HMI Screen for system monitoring and trouble shooting.

Base Feeder Station Specifications

- **Base feeder module**

This station must store an inventory of bases (min. 5 bases). It then can confirm the presence of inventory via sensors and deploy to the next station as needed via automated process. If inventory is not present it will stop the process and alert the operator via visual cues.

- **Quality Confirmation module**

This station receives the base from the base feeder station and confirms the base is oriented in the proper position. If the base is correct it is transferred to the next station via automated process. If the base is incorrect, it is then automatically rejected.

Bearing assembly station layout:

- **Bearing assembly module**

This module confirms a bearing is present in bearing staging location. If present, it will pick a bearing from a staging location and place it in the base via automated process. If bearing is not present, it will stop the process and alert operator via visual cues.

Shaft insertion station layout:

- **Shaft insertion module**

This module first checks for presence of a shaft in the shaft staging area. If shaft is present, it then picks and places shafts in assembly. If shaft is not present, it will stop the process and alert operator via visual cues.

Lid positioning station layout:

- **Lid positioning module**

This module checks for the presence of a lid in the lid staging area. If a lid is present, it then picks the lid from the staging area and places it in the assembly. If lid is not present, it will stop the process and alert operator via visual cues.

Breakdown generation station:

- The system should be equipped with a breakdown generation system which generates up to 16 non-destructive anomalies that will be activated by switches. This system should be inside a locked box.

Electrical control panel:

- Accessible terminal box with power supply connections and coded I/O.
- Power supply: 120 VAC/24V DC (60W).
 - Wired and programmed control PLC for automatic/manual operation. This PLC should have at least 24 digital inputs including push buttons, and 15 digital outputs implemented, i.e., connected to the hardware.

Supervisory Control and Data Acquisition System

- The system should come with a SCADA application to supervise the process carried out. This will be open and will allow other projects to be changed or implemented (alarm manager, report editor, graphics, etc...).
- The SCADA structure should be via screens.
- The SCADA screen will comprise:
 - Keypad: including the “start”, “stop” and “auto/manual” buttons.
 - Display of alarms and historical charts.
 - Station synoptic screen includes the different station modules that allow the process carried out and each of the movements in real time to be monitored remotely.
- Capable to control multiple variables (min. 50) and a minimum of two hours continuous run time.

Assembly kit of support legs

- Manufactured in extruded aluminium profile.
- Height adjustable

Air requirements

If compressed air is required for unit:

- Silent air compressor with up to 100psi
- Include air regulation and filtration as required

4.0 Contractor Requirements

The contractor shall deliver the system as defined in Section 3.0 and will assemble the system on site.

5.0 Deliverables

This section summarizes the products and/or services that are expected to be provided by any prospective company submitting a bid for this purchase. Please itemize quotes included in any bid submissions where possible. Deliverables for this purchase shall include:

- Assembly/Disassembly Minicell with A/B PLC
- SCADA / Supervisory Control and Data Acquisition
- Legs Kit

6.0 Schedule

System to be furnished 30 days ARO. Please include estimated lead time and schedule for fabrication, delivery, installation, and training after receipt of PO.