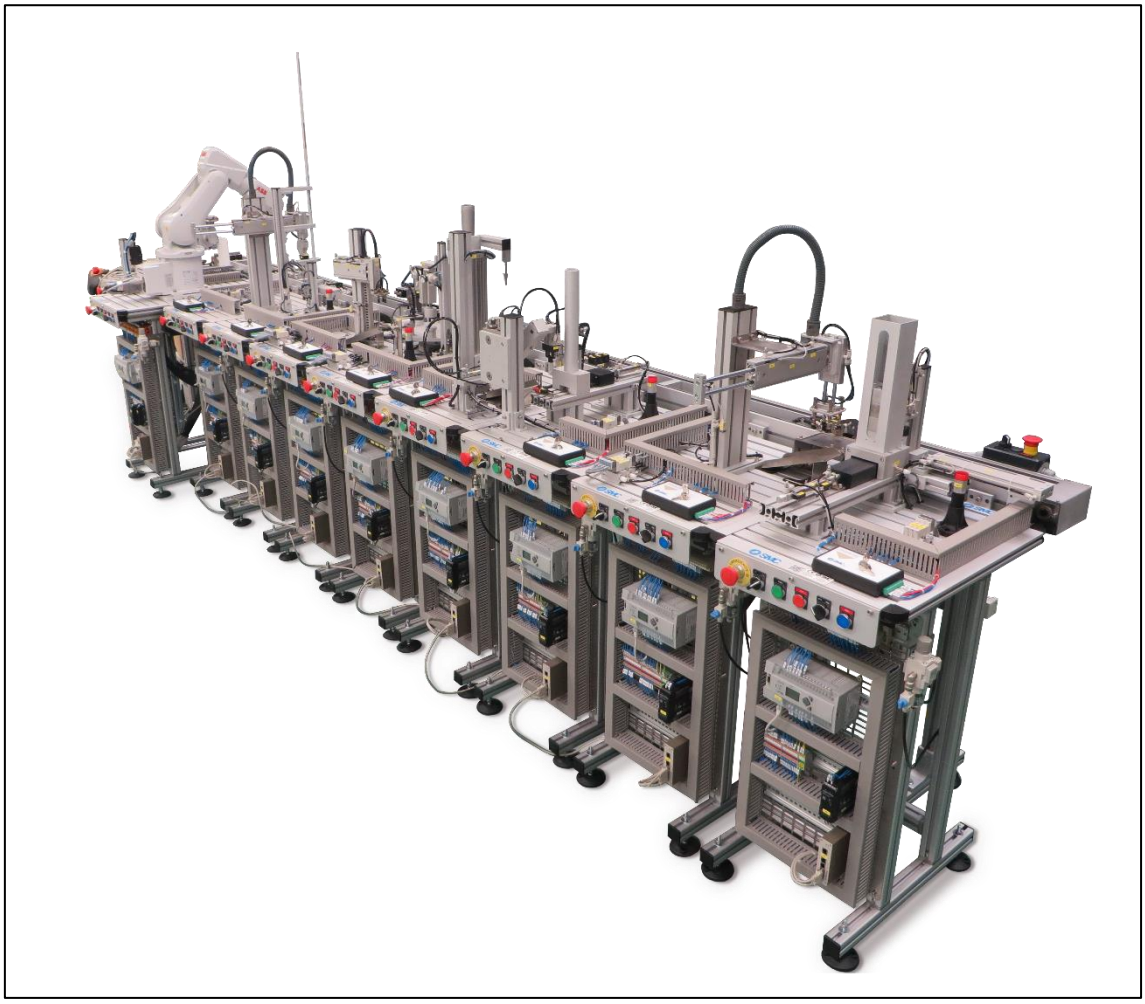
FAS-200: AUTOMATED FLEXIBLE ASSEMBLY CELL

The system provides professional training by simulating a real industrial assembly process. The system consists of a Flexible Automated Assembly Cell that assembles the different components that make up a turning mechanism.



The device consists of:

- Aluminium base or body.
- Bearing
- Shaft
- Lid
- Screws

All of the components used in the system are industrial.

To provide the system with greater flexibility, the various stations adapt to a wide variety of assemblies, introducing variations in the materials, colours and part sizes. 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 rotating system is formed by the following components:
- Body
- Bearing
- Shaft
- Cover
- Screws

TRANSPORT SYSTEM:

- SAI4230 - Linear transfer for 4 stations – Quantity: 4.

The pallet transport system is formed by an aluminium structure that connects up to four process stations. It includes a 24VDC motor, mechanical stoppers and binary code reading devices for the pallets. It also allows to configure different lay-outs and to extend the system in the future.

Each transfer module includes at least two different stop positions with the following components and characteristics:

- Actuators:
    - 1 compact double acting cylinders, Ø32, 25mm stroke. Controlled by single 5/2 solenoid valves.
- Sensors:
    - 3 inductive detectors.
    - 1 microswitch.
- Digital inputs and digital outputs in each stop position: 4 DI and 1 DO. All those inputs and outputs are controlled by the PLC implemented in each process station.

- Size: 1800x315 mm. Height: 940 mm.

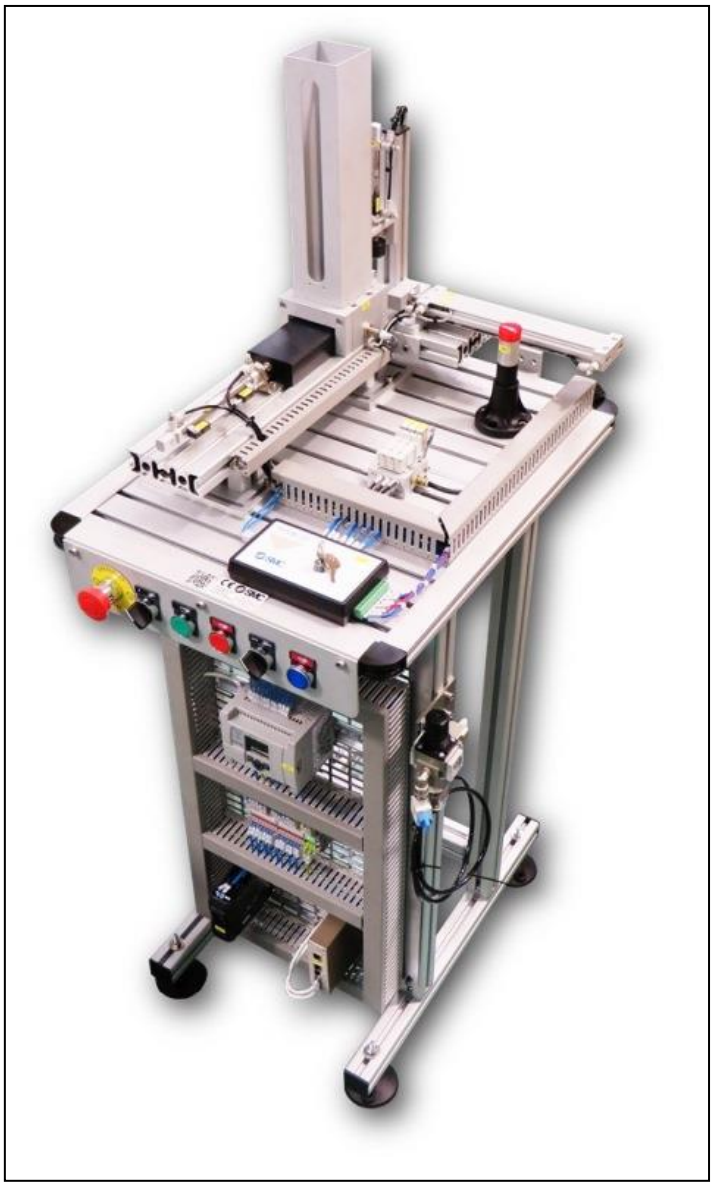
The following stations are used to assemble the turning mechanism components, each of them carrying out one part of the overall assembly process.

- Base feeding/verification.
- Base rejection/transfer.
- Bearing feeding/transfer.
- Bearing measuring/transfer.
- Hydraulic press.
- Transfer to the hydraulic press.
- Shaft classification.
- Shaft rejection/transfer.
- Lid classification.
- Lid rejection/transfer.
- Screw dispensing.
- Screw insertion.
- Robotised screwing.
- Transfer and visual inspection.
- Rejection after visual inspection.
- Storage.
- Pallet transfer station.

PROCESS STATIONS AND OPTIONALS:

SAI4201 - FAS-201: BASE FEEDING/VERIFICATION STATION WITH SIEMENS PLC – QUANTITY: 1.

The function of the station is to feed the base which acts as the support to a turning mechanism, and move it to the next station.



The part to be assembled is a 65x65x32mm anodised aluminium block with an opening at the top, 32mm diameter, and another opening at the bottom, 28mm diameter, which is used to detect whether the position is the right one or not.

The station is formed by a 450x600x900 mm height-adjustable aluminium structure, on which the components used to perform the process are mounted, which includes a block of control solenoid valves in the case of pneumatic components and a no material indication lamp.

The electrical panel is on the front, from which the station is controlled.

It also includes the control keypad, with the following buttons and indicator lights: start, stop and reset buttons, continuous/single cycle selector, disconnecting switch, endorsed emergency stop button and error warning light.

On one side of the station there is an air treatment unit comprising a 5µm filter with a pressure controller, pressure gauge, manual 3/2 stop valve.

The station comprises the following modules:

- Base feeder:

A gravity feeder stores the bases. A pneumatic cylinder with a pusher adapted to the size of the base extracts one of these. This module has the following components and characteristics:

- Storage capacity: 10 bases
- Actuators:
    - Double acting pusher cylinder, Ø16 and 100mm stroke, with speed controllers and initial and final position switches. Controlled by a single 5/2 solenoid valve.
- Sensors:
    - Auto switches, reed type.
    - Inductive detector to detect a shortage of material in the warehouse.

- Position verification:

The base includes housing to add the rest of the components, which face a particular direction. A cylinder with a cylindrical part at the tip moves towards the top of the base to verify that the base is facing the right way. This module has the following components and characteristics:

- Actuators:

    - Double acting cylinder, Ø12 and 50mm stroke, with speed controllers and final position switch. Controlled by a single 5/2 solenoid valve.

- Sensors:

    - Auto switch, reed type.

- Displacement to the transfer point:

A cylinder with a pusher at the tip is used to position the base at the point from which it is transferred to the next station. The cylinder is rectangular to avoid rotating the pusher. This module has the following components and characteristics:

- Actuators:

    - Rectangular pusher cylinder, Ø25 and 200mm stroke, with speed controllers and final position switch. Controlled by a single 5/2 solenoid valve.

- Sensors:

    - Auto switch, reed type.

- Breakdown generation system:

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

- Electrical control panel:

All of the pneumatic cables and tubing are properly identified and labelled at both ends.

- Mounted on a 375x700mm mesh
- Accessible electrical connection terminal box with power input and coded I/O.
- It includes 110-240VAC/24VDC power supply.

- 1 control PLC Siemens S7-1200 wired and programmed to operate the module with 9 digital inputs and 5 digital outputs connected to the hardware.
- Industrial communication via standard Ethernet for communication with the other modules.

SAI4202 - FAS-202: BASE REJECTION/TRANSFER STATION WITH SIEMENS PLC – QUANTITY: 1.

The function of the station is to move the base to the pallet located in the transfer system.

The part to be assembled is a 65x65x32mm anodised aluminium block with an opening at the top, 32mm diameter, and another opening at the bottom, 28mm diameter, which is used to detect whether the position is the right one or not.

The station is formed by a 450x600x900mm height-adjustable aluminium structure, on which the components used to perform the process are mounted, which include a block of control solenoid valves in the case of pneumatic components.

The electrical panel is on the front, from which the station is controlled.

It also includes the control keypad, with the following buttons and indicator lights: start, stop and reset with warning lamp buttons, continuous/single cycle selector, disconnecting switch and endorsed emergency stop button.

On one side of the station there is an air treatment unit comprising a 5µm filter with a pressure controller, pressure gauge, manual 3/2 stop valve.

The station comprises the following modules:

- Incorrect part rejection module:

If the base position is not the correct one, a single acting cylinder drives the base onto a stainless steel ramp, in order to leave the path unobstructed for the other parts. This module has the following components and characteristics:

- Actuators:

- Single-acting ejecting cylinder, Ø10, 15mm stroke, with speed controller. Controlled by a single 3/2 solenoid valve.

- Insertion of the base in the pallet:

A handling device with two axis moves the base to the pallet. Each axis contains a cylinder with parallel rods.

The terminal element is a vacuum holding platform with four vacuum pads to solve possible height misalignments. This module has the following components and characteristics:

- Actuators:

    - Horizontal axis: - Parallel-rod cylinder, Ø20 and 150 mm stroke, with speed controllers and initial and final position switches. Controlled by a double 5/2 solenoid valve.

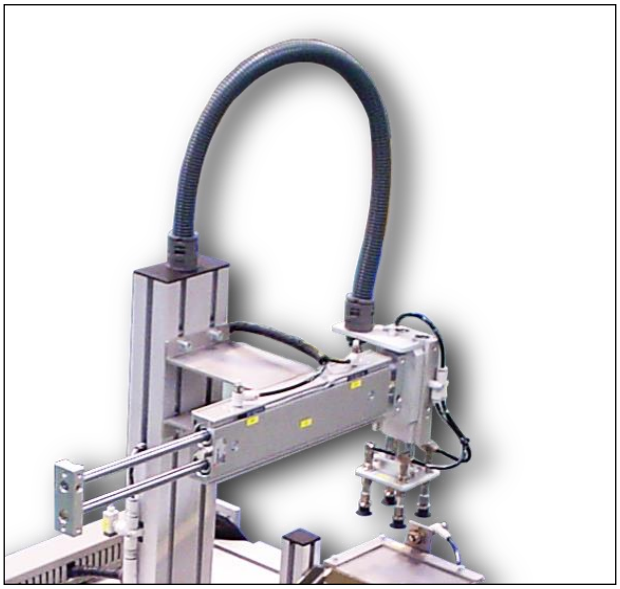
    - Vertical axis: - Parallel-rod cylinder, Ø15 and 50 mm stroke, with speed controllers and initial and final position switches. Controlled by a double 5/2 solenoid valve.

    - Holding plate: 4 buffer vacuum pads, Ø16, with vacuum ejector. controlled by a single 3/2 solenoid valve.

- Sensors:

    - Auto switches, reed type.

    - PNP output vacuum pressure switch.



- Breakdown generation system:

The station has the possibility of generating up to 16 breakdowns or malfunctions. For this purpose a box is assembled on the side of the station structure, inside which there are 16 switches to activate the same number of breakdowns. When a switch is activated a breakdown occurs in one of the

station components. To access these switches, the box lid has to be opened, which can be locked.

- Electrical control panel:

All of the pneumatic cables and tubing are properly identified and labelled at both ends.

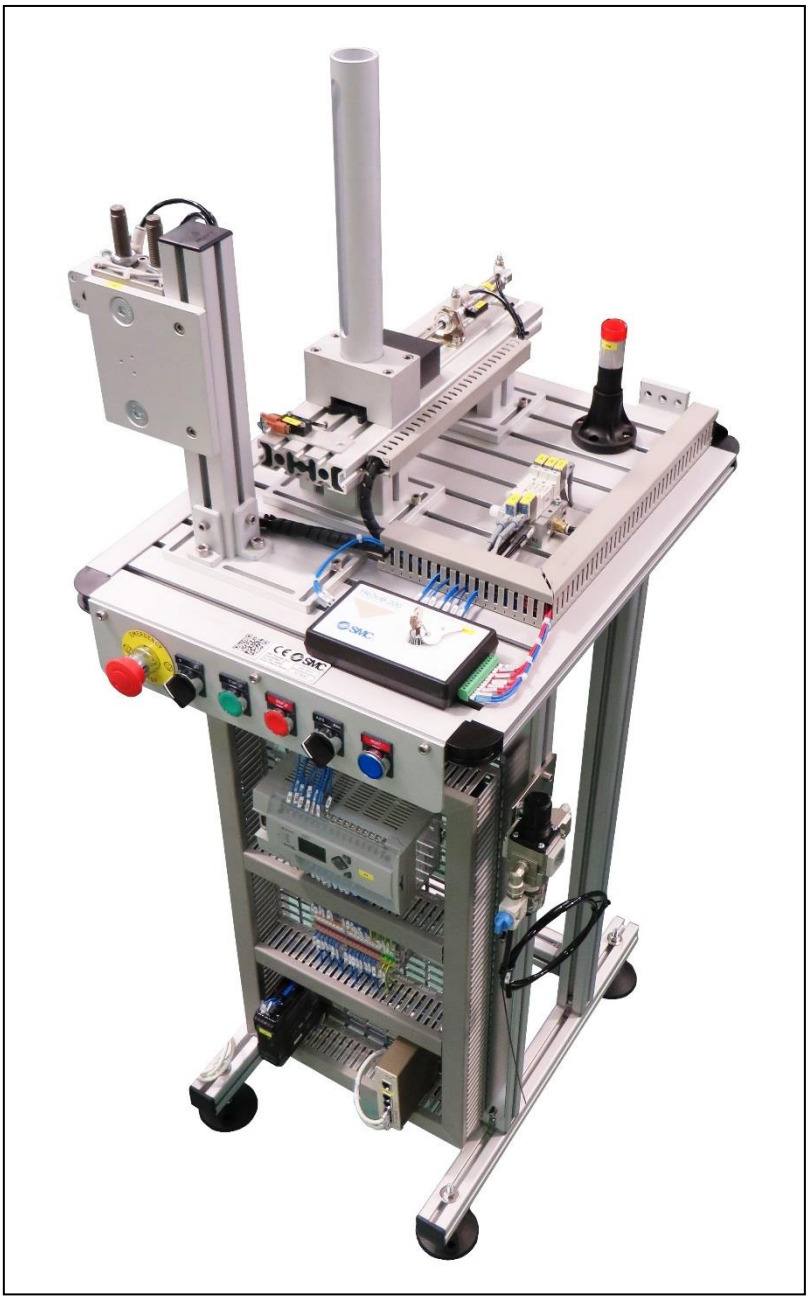
- Mounted on a 375x700mm mesh
- Accessible electrical connection terminal box with power input and coded I/O.

- It includes 110-240VAC/24VDC power supply unit.

- 1 control PLC Siemens S7-1200 wired and programmed to operate the module with 9 digital inputs and 7 digital outputs connected to the hardware.
- Industrial communication via standard Ethernet for communication with the other modules.

SAI4203 - FAS-203: BEARING FEEDING/TRANSFER STATION WITH SIEMENS PLC – QUANTITY: 1.

The function of this station is to feed a bearing and move it to the next station.



The part to be assembled is a metal ball bearing.

The station is formed by a 450x600x900mm height-adjustable aluminium structure on which the components used to perform the process are mounted, which include a block of control solenoid valves in the case of pneumatic components and a no material indication lamp.

The electrical panel is on the front, from which the station is controlled.

It also includes the control keypad, with the following buttons and indicator lights: start, stop and reset (with lamp) buttons, continuous/single cycle selector, disconnecting switch, endorsed emergency stop button.

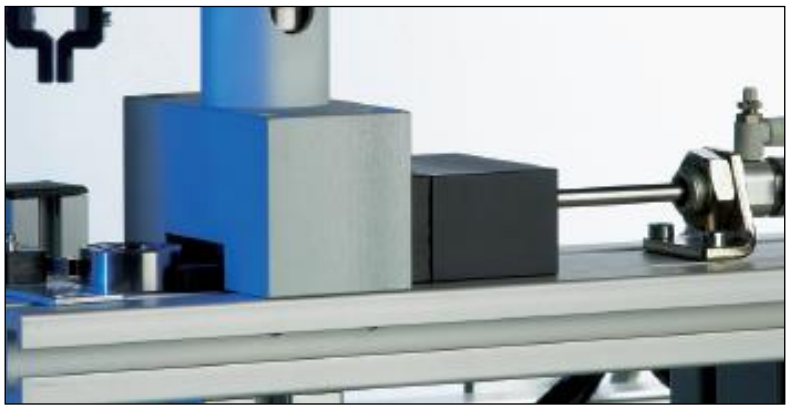
On one side of the station there is an air treatment unit comprising a 5µm filter with a pressure controller, pressure gauge, manual 3/2 stop valve.

The station comprises the following modules:

- Bearing feeding module:

The bearings are in a gravity feeder formed by a storage column and a pusher cylinder at the bottom, which extract the bearing to start the process. A presence sensor with a microswitch verifies whether a bearing has been extracted. This module has the following components and characteristics:

- Storage capacity: 38 bearings
- Actuators:
    - Double acting pusher cylinder, Ø16 and 100mm stroke, with speed controllers and final position switch. Controlled by a single 5/2 solenoid valve.
- Sensors:
    - Auto switch, reed type.
    - Presence sensor: microswitch.



- Transfer of the bearings:

It is formed by a handling device which consists of a rack and pinion rotary actuator that moves 180º. The actuator has an arm with a parallel-opening type gripper in order to hold the bearing on the inside to transfer it. Inside the arm there is a device formed by a cogged belt and two pinions. This module has the following components and characteristics:

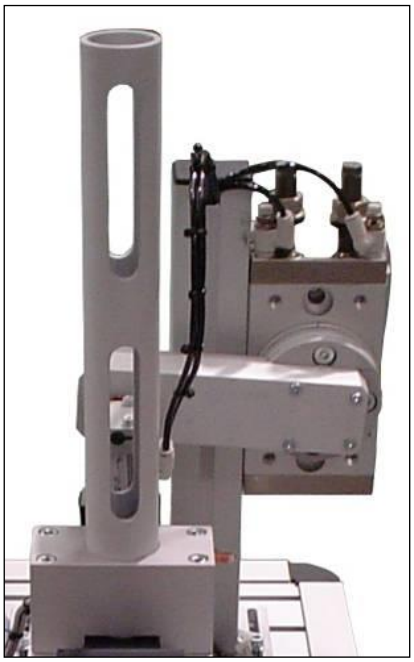
- Actuators:

    - Rotary actuator: double rack and pinion, Ø25, µmax 180º with speed controllers and 0º, 90º, and 180º position switch. Controlled by a closed-centre 5/3 solenoid valve.

    - Fixing arm: Air grippers with two parallel-opening jaws controlled by a solenoid 5/2 valve.

- Sensors:

    - Auto switches, reed type.



- Breakdown generation system:

The station has the possibility of generating up to 16 breakdowns or malfunctions. For this purpose a box is assembled on the side of the station structure, inside which there are 16 switches to activate the same number of

breakdowns. When a switch is activated a breakdown occurs in one of the station components. To access these switches, the box lid has to be opened, which can be locked.

- Electrical control panel:

All of the pneumatic cables and tubing are properly identified and labelled at both ends.

- Mounted on a 375x700mm mesh
- Accessible electrical connection terminal box with power input and coded I/O.

- It includes 110-240VAC/24VDC power supply unit.

- 1 control PLC Siemens S7-1200 wired and programmed to operate the module with 9 digital inputs and 7 digital outputs connected to the hardware.
- Industrial communication via standard Ethernet for communication with the other modules.

SAI4204 - FAS-204: BEARING MEASURING/TRANSFER STATION WITH SIEMENS PLC – QUANTITY: 1.

The function of this station is to measure and place the bearing inside the housing designed for that purpose in the base.

The part to be assembled is a metal ball bearing.

The station is formed by a 450x600x900mm height-adjustable aluminium structure, on which the components used to perform the process are mounted, which include a block of control solenoid valves in the case of pneumatic components.

The electrical panel is on the front, from which the station is controlled.

It also includes the control keypad, with the following buttons and indicator lights: start, stop and reset (with lamp) buttons, continuous/single cycle selector, disconnecting switch and endorsed emergency stop button.

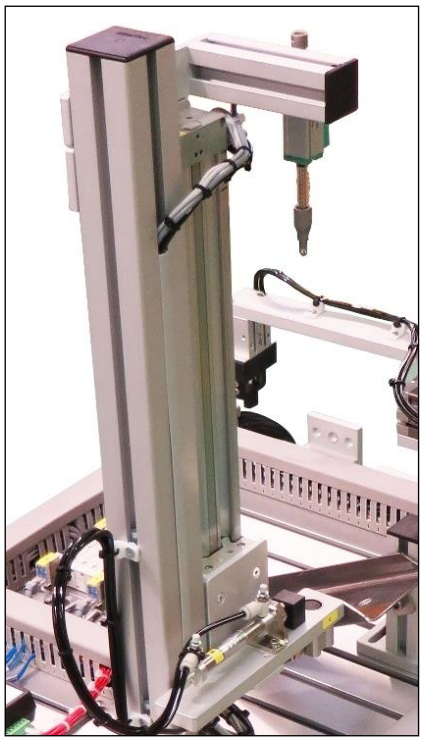
On one side of the station there is an air treatment unit comprising a 5µm filter with a pressure controller, pressure gauge, manual 3/2 stop valve.

The station comprises the following modules:

- Height measuring module:

It is formed by a platform that includes a location pin driven by a pneumatic cylinder. This platform is lifted using a pneumatic rodless cylinder and the bearing makes contact with a straight plunger which measures the height. The straight plunger is comprised of a linear potentiometer. After the measurement has been taken the platform returns to its original position. If the bearing does not have the desired height, an ejecting cylinder pushes it up to the stainless steel evacuation ramp. This module has the following components and characteristics:

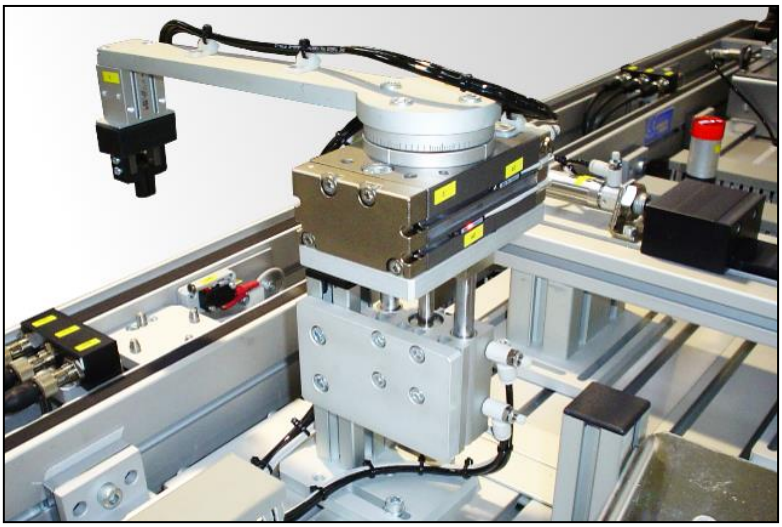
- Actuators:
    - Single acting compact cylinder, Ø12, 5mm stroke. Controlled by a 3/2 solenoid valve.
    - Vertical axis: - Rodless cylinder, Ø16 and 250mm stroke, with speed controllers and initial and final position switches. Controlled by a double 5/2 solenoid valve.
    - Module for removal of incorrect part: - Double acting cylinder, Ø10, 40mm stroke, with speed controller. Controlled by a single 5/2 solenoid valve.
- Sensors:
    - Auto switches, reed type.
    - Linear potentiometer.



- Bearing insertion module:

It is formed by a linear unit and a rotary actuator. This unit has an arm with a two-jaw gripper. Once the bearing has been picked up, the arm lifts and turns 180º, to insert the bearing in its position. This module has the following components and characteristics:

- Actuators:
    - Rotary actuator, Ø20, movement 0 -180º, with speed controllers and an initial and end of stroke position switch. Controlled by a single 5/2 solenoid valve.
    - Arm elevator: parallel rod cylinder Ø16, 30mm stroke with speed controllers and an initial and end of stroke position switch. Controlled by a single 5/2 solenoid valve.
    - Fixing arm: Pneumatic grippers with two parallel-opening jaws. Controlled by a single 5/2 solenoid valve.
- Sensors:
    - Auto switches, reed type.

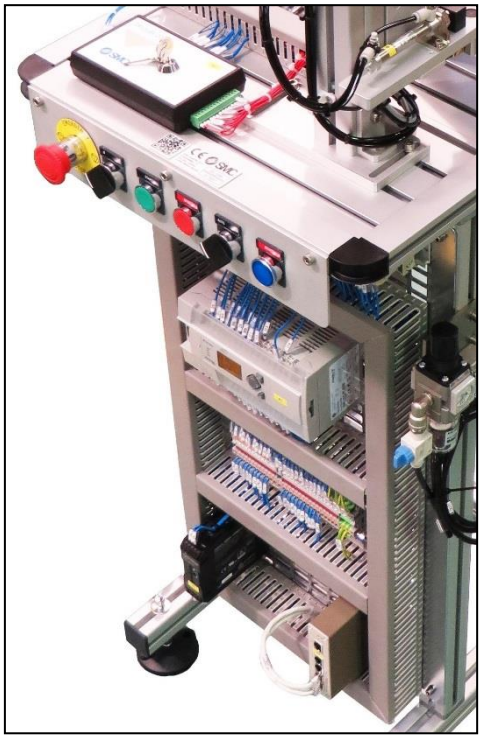


- Breakdown generation system:

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

- Electrical control panel:

All of the pneumatic cables and tubing are properly identified and labelled at both ends.



- Mounted on a 375x700mm mesh
- Accessible electrical connection terminal box with power input and coded I/O.
- It includes 110-240VAC/24VDC power supply unit.

- 1 control PLC Siemens S7-1200 wired and programmed to operate the module with 10 digital inputs, 1 analogue input and 9 digital outputs connected to the hardware.
- Industrial communication via standard Ethernet for communication with the other modules.

SAI4207 - FAS-207: SHAFT CLASSIFICATION STATION WITH SIEMENS PLC – QUANTITY: 1.

The function of the station is to feed and check the shaft.

The part to be assembled is a shaft, 14.6mm diameter and 41mm height. There are two shaft options: metal shaft, anodised aluminium shaft and plastic shaft, made from black nylon.

The station is formed by a 450x600x900mm height-adjustable aluminium structure on which the components used to perform the process are mounted, which include a block of control solenoid valves in the case of pneumatic components and a no material indication lamp.

The electrical panel is on the front, from which the station is controlled.

It also includes the control keypad, with the following buttons and indicator lights: start, stop and reset (with lamp) buttons, continuous/single cycle selector and disconnecting switch and endorsed emergency stop button.

On one side of the station there is an air treatment unit comprising a 5µm filter with a pressure controller, pressure gauge, manual 3/2 stop valve.

The station comprises the following modules:

- Dividing plate:

Made from anodised aluminium, this module is used as an alternative rotary drive system, such that with each rotary movement it advances 45 degrees. This is achieved by a pneumatic pusher cylinder with oscillating drive. It also has another two limiter cylinders operating alternately, one of them moving which holds the plate while it turns, and the other fixed, which locks it once the turning movement has stopped so that the plate is held firmly in place, and the pusher cylinder can return to its initial position to wait for a new cycle. This module has the following components and characteristics:

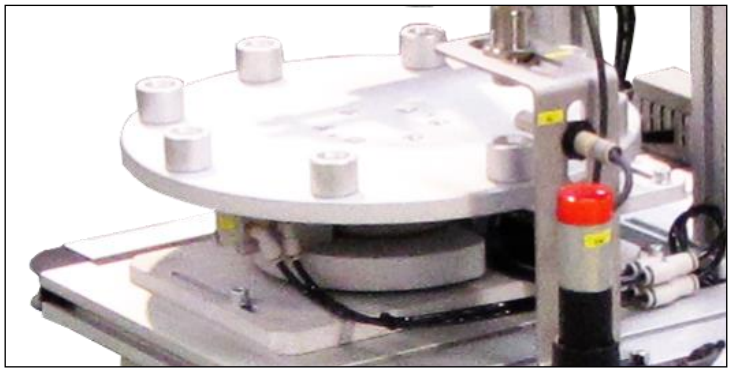
- Actuators:

    - Compact double acting pusher cylinder, Ø25 and 40mm stroke, with speed controllers and initial position switch. Controlled by a single 5/2 solenoid valve.

- Limits: 2 compact cylinders, Ø16, 10mm stroke. Controlled by a single 5/2 solenoid valve.

- Sensors:

  - Auto switch, reed type.



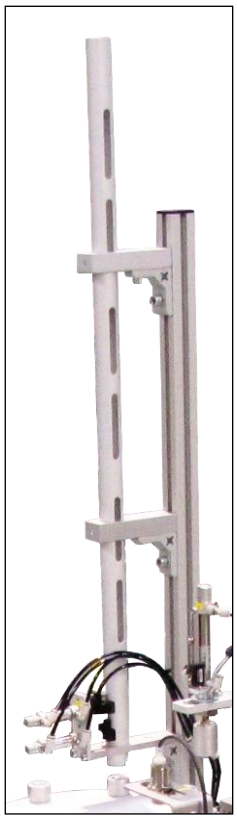
- Feeding the shafts:

The shafts are stored in a gravity feeder. A stepper feeding system, consisting of two pneumatic cylinders, places them on the first of the plate stations. This module has the following components and characteristics:

- Storage capacity: Minimum 17 shafts.

- Actuators:

  2 double acting cylinders, Ø10, 10mm stroke. Controlled by a single 5/2 solenoid valve.



- Measuring the shaft height.:

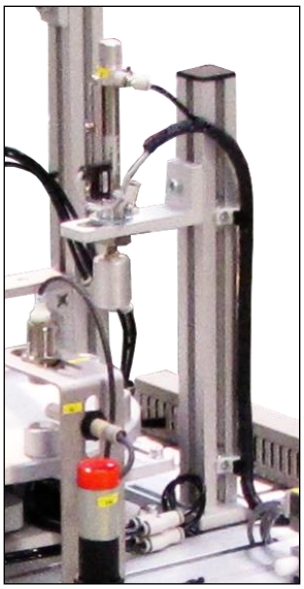
The shaft is not symmetrical and is positioned over the assembly in a specific position. A pneumatic cylinder is used to check whether it hits the shaft when it moves forward or whether it reaches the end of its stroke. This module has the following components and characteristics:

- Actuators:

    - Double acting cylinder, Ø12 and 50mm stroke, with speed controllers and end position switch. Controlled by a single 5/2 solenoid valve.

- Sensors:

    - Auto switch, reed type.



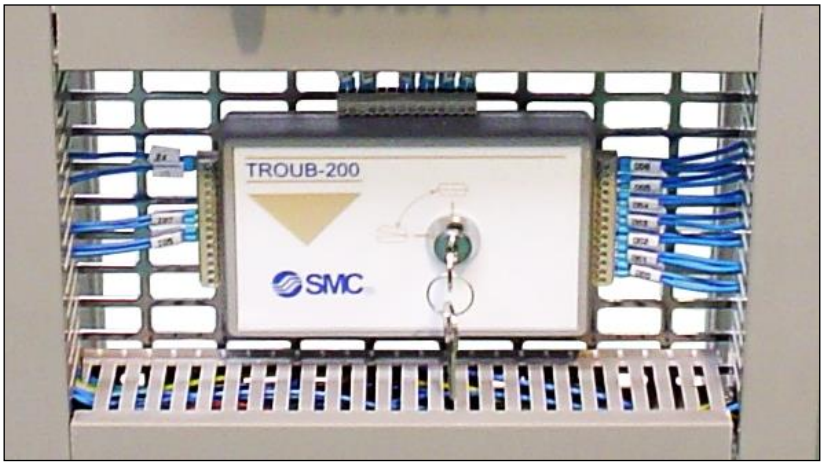
- Detection of the shaft material:

Two measurements are taken to determine the shaft material using inductive and capacitive detectors. This module has the following components and characteristics:

- Sensors:
    - PNP inductive detector.
    - PNP capacitive detector.

- Breakdown generation system:

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



- Electrical control panel:

All of the pneumatic cables and tubing are properly identified and labelled at both ends.

- Mounted on a 375x700mm mesh
- Accessible electrical connection terminal box with power input and coded I/O.
- It includes 110-240VAC/24VDC power supply unit.

- 1 control PLC Siemens S7-1200 wired and programmed to operate the module with 8 digital inputs and 6 digital outputs connected to the hardware.
- Industrial communication via standard Ethernet for communication with the other modules.

SAI4208 - FAS-208: SHAFT REJECTION/TRANSFER STATION WITH SIEMENS PLC – QUANTITY: 1.

The function of the station is to reject the incorrect shafts and to assembly the correct one in the turning mechanism.

The part to be assembled is a shaft, 14.6mm diameter and 41mm height. There are two shaft insertion options: metal shaft, anodised aluminium shaft and plastic shaft, made from black nylon.

The station is formed by a 450x600x900mm height-adjustable aluminium structure, on which the components used to perform the process are mounted, which include two blocks of control solenoid valves in the case of pneumatic components.

The electrical panel is on the front, from which the station is controlled.

It also includes the control keypad, with the following buttons and indicator lights: start, stop and reset (with lamp) buttons, continuous/single cycle selector and disconnecting switch and endorsed emergency stop button.

On one side of the station there is an air treatment unit comprising a 5µm filter with a pressure controller, pressure gauge, manual 3/2 stop valve.

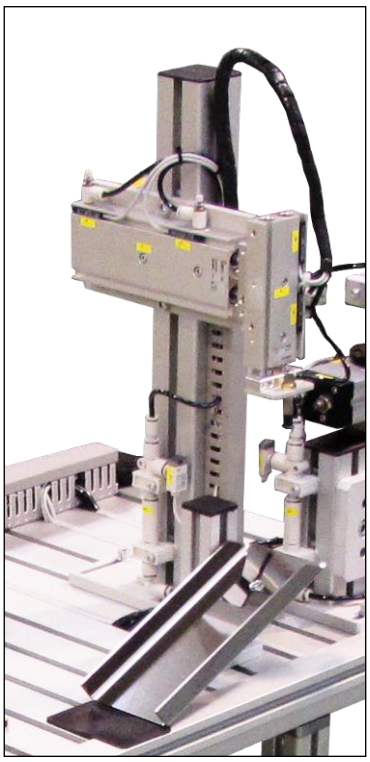
The station comprises the following modules:

- Removal of incorrect shaft:

It consists of a handling device that, when it receives the command, removes the shaft from the plate. It consists of two pneumatic shafts that have a vacuum pad as the terminal element. Each one contains a pneumatic cylinder with parallel rods. This module has the following components and characteristics:

- Actuators:
    - Horizontal axis: Double acting parallel-rod cylinder, Ø15 and 100mm stroke, with speed controllers and initial and end position switches and controlled by a double 5/2 solenoid valve.
    - Vertical axis: Double acting parallel-rod cylinder, Ø10 and 50mm stroke, with speed controllers and initial and end position switches. Controlled by a single 5/2 solenoid valve.
    - Fixing arm: Ø8 vacuum pad, with vacuum ejector. Controlled by a single 3/2 solenoid valve.
- Sensors:
    - Auto switches, reed type.

- PNP output vacuum switch.



- Insertion of the shaft in the assembly

It is formed by a rotolinear handling device to collect the shaft using vacuum technology, move it to the unloading point and position it in the assembly. This module has the following components and characteristics:

- Actuators:

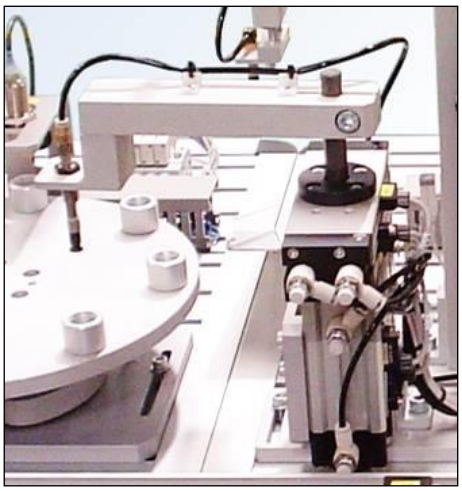
    - Compact linear and rotary drive cylinder, Ø32, 25mm stroke, with speed controllers and initial and end of stroke position switches during linear movement and 0º and 180º during rotary movement. Controlled by two single 5/2 solenoid valves.

    - Fixing arm: Ø10 vacuum pad, with vacuum ejector. Controlled by a single 3/2 solenoid valve.

- Sensors:

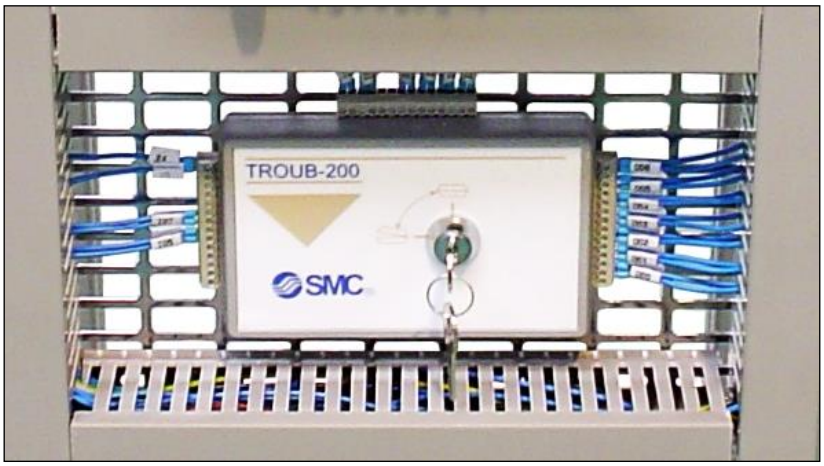
    - Auto switches, reed type.

    - PNP output vacuum switch.



- Breakdown generation system:

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



- Electrical control panel:

All of the pneumatic cables and tubing are properly identified and labelled at both ends.

- Mounted on a 375x700mm mesh
- Accessible electrical connection terminal box with power input and coded I/O.
- It includes 110-240VAC/24VDC power supply unit.

- 1 control PLC Siemens S7-1200 wired and programmed to operate the module with 14 digital inputs and 10 digital outputs connected to the hardware.
- Industrial communication via standard Ethernet for communication with the other modules.

SAI4209 - FAS-209: LID CLASSIFICATION STATION WITH SIEMENS PLC – QUANTITY: 1.

The function of the station is to feed and to check the lid.

The part to be assembled is a lid. There are six lid options depending on the material: metal, anodised aluminium, black plastic, black nylon and white plastic or white nylon. Each lid has two different heights, regardless of the material.

The station is formed by a 450x600x900mm height-adjustable aluminium structure on which the components used to perform the process are mounted, which include a block of control solenoid valves in the case of pneumatic components and a no material indication lamp.

The electrical panel is on the front, from which the station is controlled.

It also includes the control keypad, with the following buttons and indicator lights: start, stop and reset (with lamp) buttons, continuous/single cycle selector and disconnecting switch and endorsed emergency stop button.

On one side of the station there is an air treatment unit comprising a 5µm filter with a pressure controller, pressure gauge, manual 3/2 stop valve.

The station comprises the following modules:

- Dividing plate:

Made from anodised aluminium, this module is used as an alternative rotary drive system, such that with each rotary movement it advances 45 degrees. This is achieved by a pneumatic pusher cylinder with oscillating drive. It also has another two limiter cylinders operating alternately, one of them moving which holds the plate while it turns, and the other fixed, which locks it once the turning movement has stopped so that the plate is held firmly in place, and the pusher cylinder can return to its initial position to wait for a new cycle. This module has the following components and characteristics:

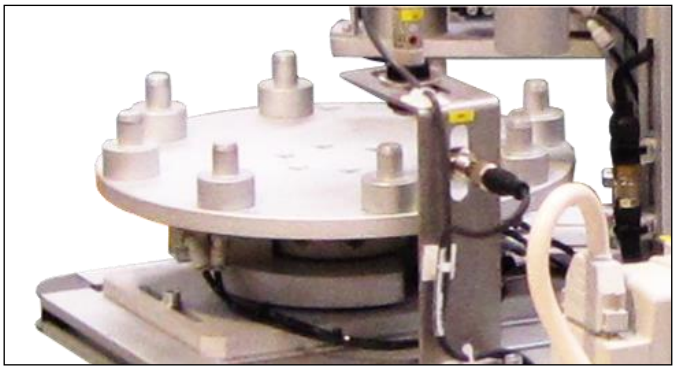
- Actuators:

    - Compact double acting pusher cylinder, Ø25 and 40mm stroke, with speed controllers and initial position switch. Controlled by a single 5/2 solenoid valve.

- Limits: 2 compact cylinders, Ø16, 10mm stroke. Controlled by a single 5/2 solenoid valve.

- Sensors:

    - Auto switch, reed type.



- Feeding the lid

The lids are stored in a gravity feeder including two pneumatic grippers with two parallel-opening jaws. This module has the following components and characteristics:

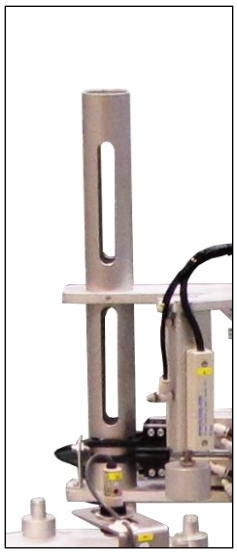
- Storage capacity: minimum 19 lids.

- Actuators:

    - 2 gripper with two parallel-opening jaws. Controlled by 5/2 solenoid valve.

- Sensors:

    - Presence sensor: fibre optic photocell.



- Material and colour detection:

Two measurements are taken to determine the lid material and colour using inductive, and photoelectrical detectors. This module has the following components and characteristics:

- Sensors:
    - Inductive detector.
    - Photoelectric detector.

- Lid measuring station:

The lid height is measured using a pneumatic cylinder that moves a plunger with regulated pressure until it touches the lid. This cylinder includes a digital transducer that sends a linear encoder with pulse output, depending on the cylinder's stroke. This module has the following components and characteristics:

- Actuators:

    - Double acting cylinder with stroke reading, Ø20 and 50mm stroke, with speed controllers. Controlled by a single 5/2 solenoid valve.

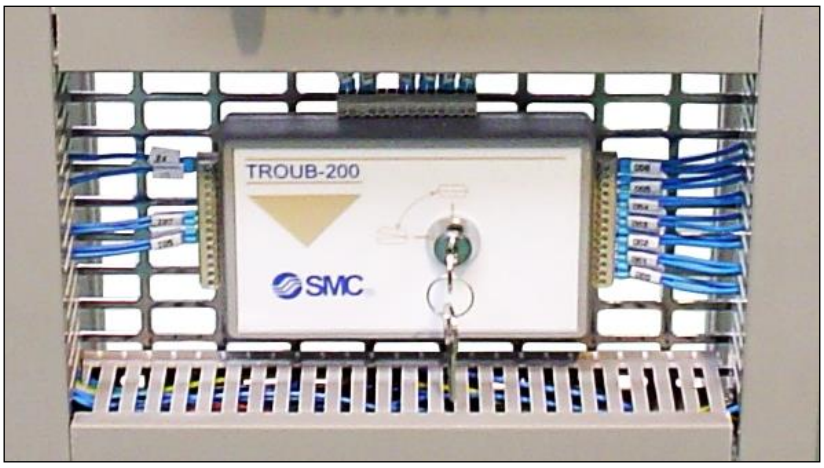
- Sensors:

    - Linear encoder built into the cylinder.

-Pressure regulator.

- Breakdown generation system:

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



- Electrical control panel:

All of the pneumatic cables and tubing are properly identified and labelled at both ends.

- Mounted on a 375x700mm mesh
- Accessible electrical connection terminal box with power input and coded I/O.
- It includes 110-240VAC/24VDC power supply unit.

- 1 control PLC Siemens S7-1200 wired and programmed to operate the module with 10 digital inputs and 7 digital outputs connected to the hardware.
- Industrial communication via standard Ethernet for communication with the other modules.

SAI4210 - FAS-210: LID REJECTION/TRANSFER STATION WITH SIEMENS PLC – QUANTITY: 1.

The function of the station is to reject the incorrect lids and to assembly the correct ones.

The part to be assembled is a lid. There are six lid insertion options depending on the material: metal, anodised aluminium, black plastic, black nylon and white

plastic or white nylon. Each lid has two different heights, regardless of the material.

The station is formed by a 450x600x900mm height-adjustable aluminium structure, on which the components used to perform the process are mounted, which include a block of control solenoid valves in the case of pneumatic components.

The electrical panel is on the front, from which the station is controlled.

It also includes the control keypad, with the following buttons and indicator lights: start, stop and reset (with lamp) buttons, continuous/single cycle selector and disconnecting switch and endorsed emergency stop button.

On one side of the station there is an air treatment unit comprising a 5µm filter with a pressure controller, pressure gauge, manual 3/2 stop valve.

The station comprises the following modules:

Removal of the incorrect lid module:

It consists of a handling device that, when it receives the command, removes the lid from the plate. It consists of two pneumatic shafts that have three vacuum pads as the terminal elements. Each one contains a pneumatic cylinder with parallel rods. This module has the following components and characteristics:

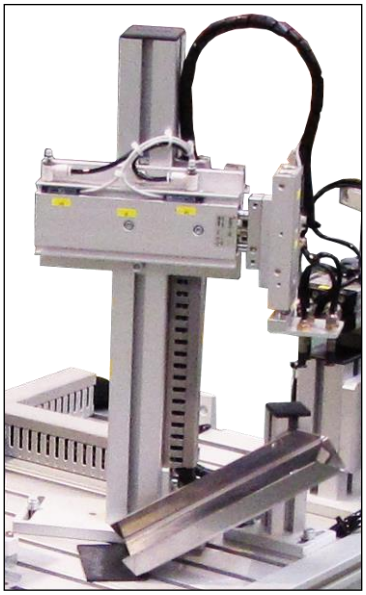
- Actuators:
    - Horizontal axis: Double acting parallel-rod cylinder, Ø15 and 100mm stroke, with speed controllers and initial and end position switches. Controlled by a double 5/2 solenoid valve.
    - Vertical axis: Double acting parallel-rod cylinder, Ø10 and 50mm stroke, with speed controllers and start position switch. Controlled by a single 5/2 solenoid valve.

- Fixing arm: 3 Ø8 vacuum pads, with vacuum ejector. Controlled by a single 3/2 solenoid valve.

- Sensors:

    - Auto switches, reed type.

    - PNP output vacuum switch.



- Lid insertion module:

The lid is inserted in the assembly by a handling device formed by a rotolinear unit with a gripper with two parallel-opening jaws. This module has the following components and characteristics:

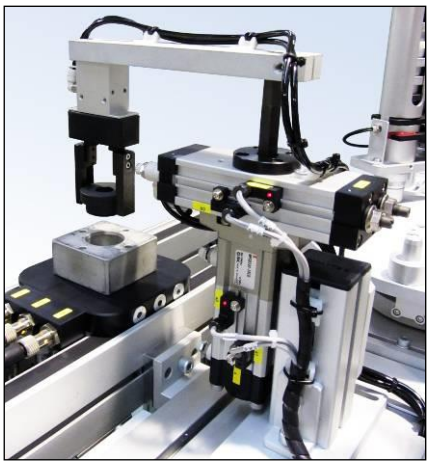
- Actuators:

    - Compact linear and rotary drive cylinder, Ø32, 25mm stroke, with speed controllers and initial and end of stroke position switches during linear movement and 0º and 180º during rotary movement. Controlled by two single 5/2 solenoid valves.

    - Fixing arm: Pneumatic grippers with two parallel-opening jaws. Controlled by a single 5/2 solenoid valve.

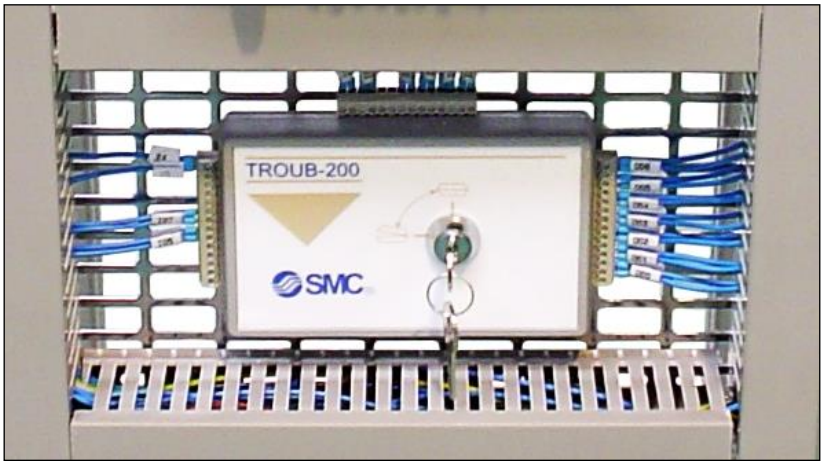
- Sensors:

    - Auto switches, reed type.



- Breakdown generation system:

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



- Electrical control panel:

All of the pneumatic cables and tubing are properly identified and labelled at both ends.

- Mounted on a 375x700mm mesh
- Accessible electrical connection terminal box with power input and coded I/O.
- It includes 110-240VAC/24VDC power supply.

- 1 control PLC Siemens S7-1200 wired and programmed to operate the module with 12 digital inputs and 10 digital outputs connected to the hardware.
- Industrial communication via standard Ethernet for communication with the other modules.

SAI4211 - FAS-211: SCREW DISPENSING STATION WITH WITH SIEMENS PLC – QUANTITY: 1.

The function of the station is to feed and to transfer to the next station M6X16 DIN912 screws.

The station is formed by a 450x600x900mm height-adjustable aluminium structure on which the components used to perform the process are mounted,

which include a block of control solenoid valves in the case of pneumatic components and a no material indication lamp.

The electrical panel is on the front, from which the station is controlled.

It also includes the control keypad, with the following buttons and indicator lights: start, stop and reset (with lamp) buttons, continuous/single cycle selector and disconnecting switch and endorsed emergency stop button.

On one side of the station there is an air treatment unit comprising a 5µm filter with a pressure controller, pressure gauge, manual 3/2 stop valve.

The station comprises the following modules:

- Screw feeding module:

The screws to be inserted are stored in a vertical gravity feeder. There is a pneumatic stepper feeder system, based on two double acting cylinders located opposite each other. This module has the following components and characteristics:

- Storage capacity: minimum 38 screws.
- Actuators:

2 double acting cylinders, Ø10, 10mm stroke. Controlled by a single 5/2 solenoid valve.

- Transfer module:

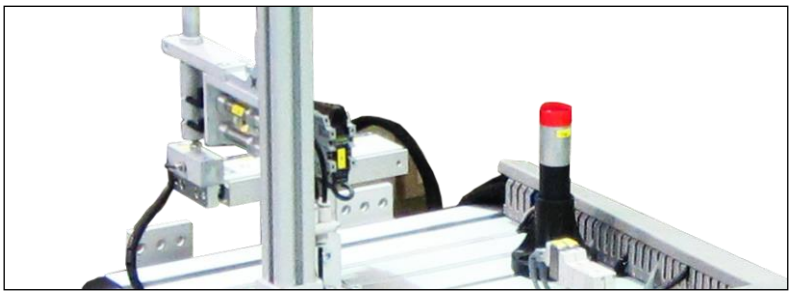
Once the screws have been fed, they are placed on a housing, on a parallel rod pneumatic cylinder. This housing includes a fibre optic barrier detector to detect the screw. This cylinder transfers the screws from the feeding point to a collection point. This module has the following components and characteristics:

- Actuators:

Double acting parallel-rod cylinder, Ø15 and 100mm stroke, with speed controllers and initial and end position switches. Controlled by a double 5/2 solenoid valve.

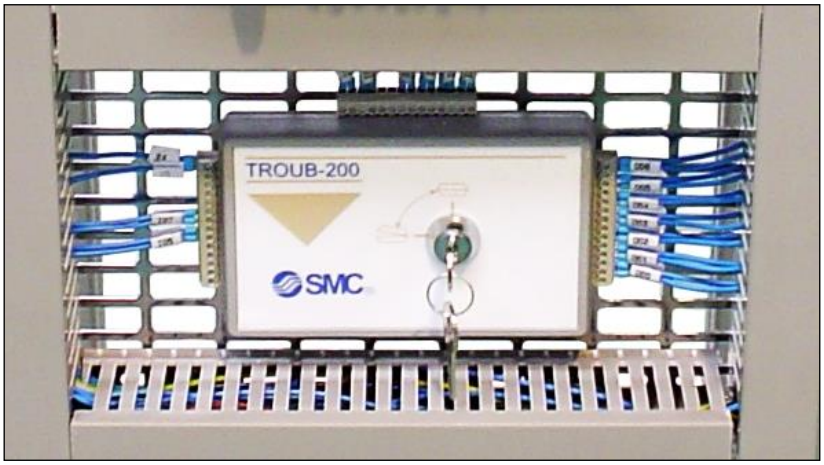
- Sensors:

- Auto switches, reed type.
- Fibre optic photocell.



- Breakdown generation system:

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



- Electrical control panel:

All of the pneumatic cables and tubing are properly identified and labelled at both ends.

- Mounted on a 375x700mm mesh
- Accessible electrical connection terminal box with power input and coded I/O.
- It includes 110-240VAC/24VDC power supply unit.

- 1 control PLC Siemens S7-1200 wired and programmed to operate the module with 7 digital inputs and 5 digital outputs connected to the hardware.
- Industrial communication via standard Ethernet for communication with the other modules.

SAI4212 - FAS-212: SCREW INSERTION STATION WITH SIEMENS PLC – QUANTITY: 1.

The function of the station is to insert four M6X16 DIN912 screws in the holes on the base that supports a turning mechanism.

The station is formed by a 450x600x900mm height-adjustable aluminium structure, on which the components used to perform the process are mounted, which include a block of control solenoid valves in the case of pneumatic components.

The electrical panel is on the front, from which the station is controlled.

It also includes the control keypad, with the following buttons and indicator lights: start, stop and reset (with lamp) buttons, continuous/single cycle selector and disconnecting switch and endorsed emergency stop button.

On one side of the station there is an air treatment unit comprising a 5µm filter with a pressure controller, pressure gauge, manual 3/2 stop valve.

The station comprises the following modules:

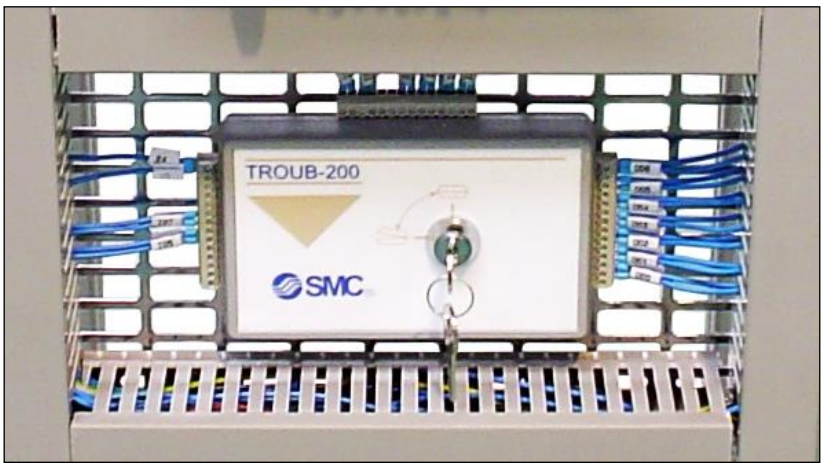
- Screw insertion handling device:

The screws are loaded on the base held on the pallet using a handling device that is formed by two pneumatic cylinders with parallel rods, relating to the horizontal and vertical shafts. It includes a pneumatic gripper with two parallel-opening jaws as the terminal element. This module has the following components and characteristics:

- Actuators:
    - Horizontal axis: Double acting parallel-rod cylinder, Ø25 and 200mm stroke, with speed controllers and initial and end position switches. Controlled by a double 5/2 solenoid valve.
    - Vertical axis: Double acting parallel-rod cylinder, Ø15 and 50mm stroke, with speed controllers and initial and end position switches. Controlled by a single 5/2 solenoid valve.
    - Holding system: Pneumatic grippers with two parallel-opening jaws and open and closed position switches. Controlled by a single 5/2 solenoid valve.
- Sensors:
    - Auto switches, reed type.
    - Solid state type switches.

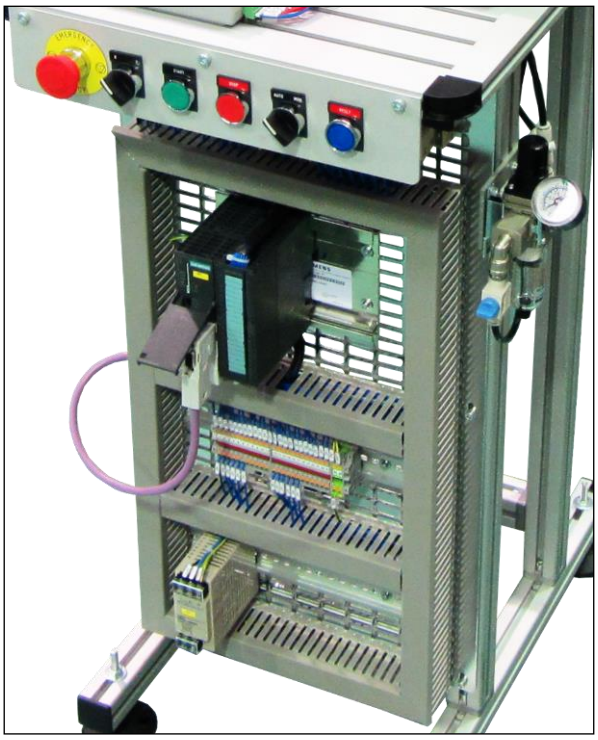
- Breakdown generation system:

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



- Electrical control panel:

All of the pneumatic cables and tubing are properly identified and labelled at both ends.

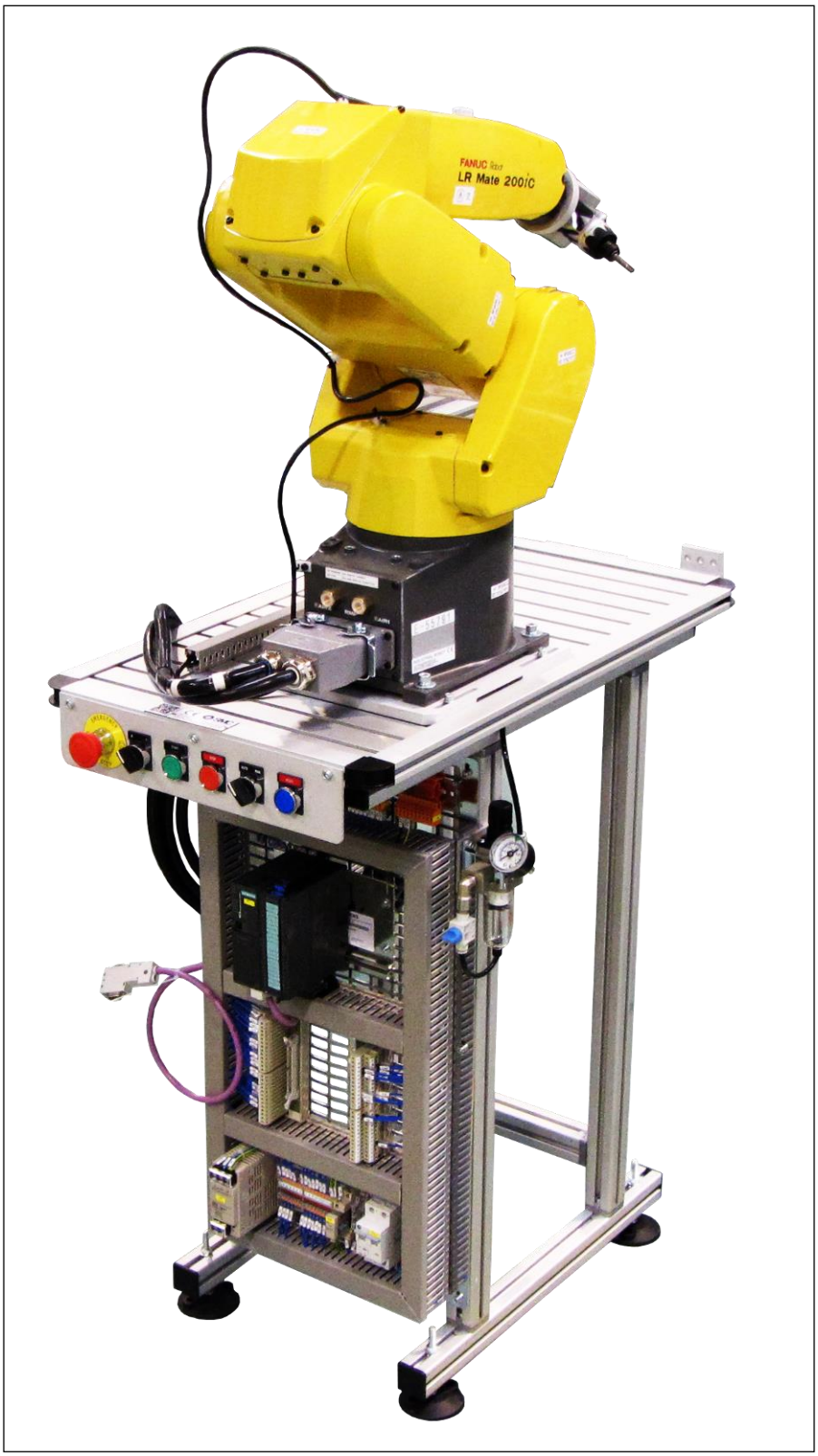


- Mounted on a 375x700mm mesh
- Accessible electrical connection terminal box with power input and coded I/O.
- It includes 110-240VAC/24VDC power supply unit.

- 1 control PLC Siemens S7-1200 wired and programmed to operate the module with 10 digital inputs and 6 digital outputs connected to the hardware.
- Industrial communication via standard Ethernet for communication with the other modules.

SAI4213 - FAS-213: ROBOTISED SCREWING STATION WITH SIEMENS PLC – QUANTITY: 1.

The function of this station is to screw the turning mechanism components.



The station is formed by a 450x760x900mm height-adjustable aluminium structure, on which the components that carry out the process are mounted.

The electrical panel is on the front, from which the station is controlled.

It also includes the control keypad, with the following buttons and indicator lights: start, stop and reset (with lamp) buttons, continuous/single cycle selector and disconnecting switch, endorsed emergency stop button and error warning light.

On one side of the station there is an air treatment unit comprising a 5µm filter with a pressure controller, pressure gauge, manual 3/2 stop valve.

The station comprises the following modules:

- Robot tool:

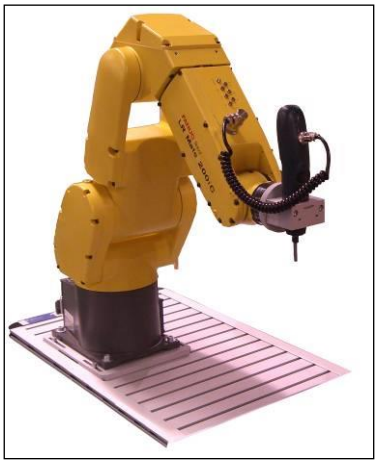
The station includes a tool that is formed by an electric screwdriver. This tool includes the necessary coupling to be assembled in the robot arm. This module has the following components and characteristics:

- Electric screwdriver.

- Robot arm and controllers:

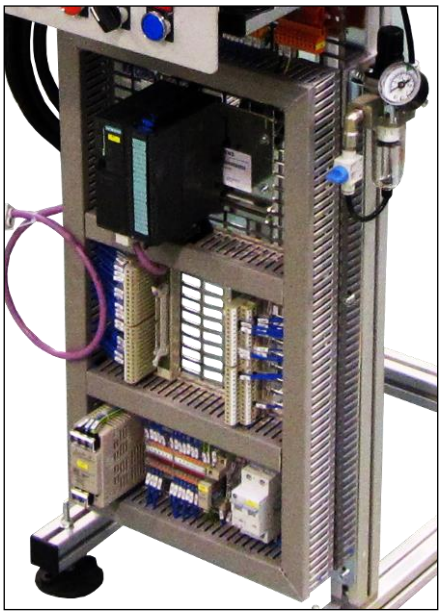
It is formed by an anthropomorphic robot arm, 6 DOF, controller unit and programming console. This module includes the following components and characteristics:

- Robot: 6 shafts.
- Robot controller.
- Programming console.



- Electrical control panel:

All of the pneumatic cables and tubing are properly identified and labelled at both ends.



- Mounted on a 375x700mm mesh
- Accessible electrical connection terminal box with power input and coded I/O.
- It includes 110-240VAC/24 VDC and 110-240VAC/5VDC power supply units.

- 1 control PLC Siemens S7-1200 wired and programmed to operate the module with 7 digital inputs and 7 digital outputs connected to the hardware.
- Industrial communication via standard Ethernet for communication with the other modules.

SAI4214 - FAS-214: TRANSFER AND VISUAL INSPECTION STATION WITH SIEMENS PLC – QUANTITY: 1.

The function of this station is to check the turning mechanism (quality control) via artificial vision.

The system inspects bearing height, shaft material, lid height and material and the tightening torque of the four screws forming the assembly.

The station is formed by a 450x600x900mm height-adjustable aluminium structure, on which the components used to perform the process are mounted, which include a block of control solenoid valves in the case of pneumatic components.

The electrical panel is on the front, from which the station is controlled.

It also includes the control keypad, with the following buttons and indicator lights: start, stop and reset (with lamp) buttons, continuous/single cycle selector and disconnecting switch and endorsed emergency stop button.

On one side of the station there is an air treatment unit comprising a 5µm filter with a pressure controller, pressure gauge, manual 3/2 stop valve.

The station comprises the following modules:

- Insertion/extraction handling device:

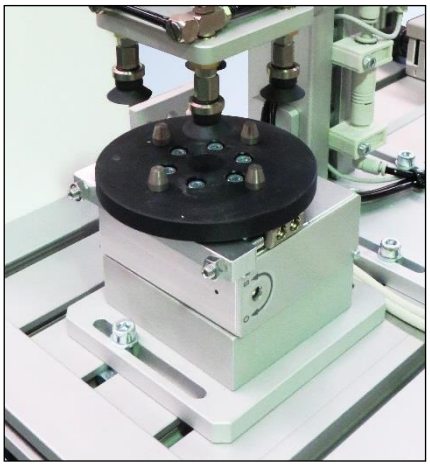
It consists of a pneumatic rotary actuator, which travels at 180º and which incorporates an arm with four vacuum pads at the end. This module has the following components and characteristics:

- Actuators:
    - Double rack and pinion rotary actuator Ø50, µmax: 190º, with speed controllers and 0º, 90º and 180º position switches. Controlled by a closed centre 5/3 solenoid valve.
    - Fixing arm: 4 vacuum pads, Ø16, with vacuum ejector. Controlled by a double 3/2 solenoid valve.
- Sensors:
    - Auto switches, reed type.
    - PNP output vacuum pressure switch.

- Revolving table:

It includes an electric rotary table with controller. This module has the following components and characteristics:

- Actuators:
    - Electric rotary table: rotation angle: 90º.
    - PNP controller.



- Artificial vision system:

It includes an artificial vision camera with the necessary lens and controller. This module has the following components and characteristics:

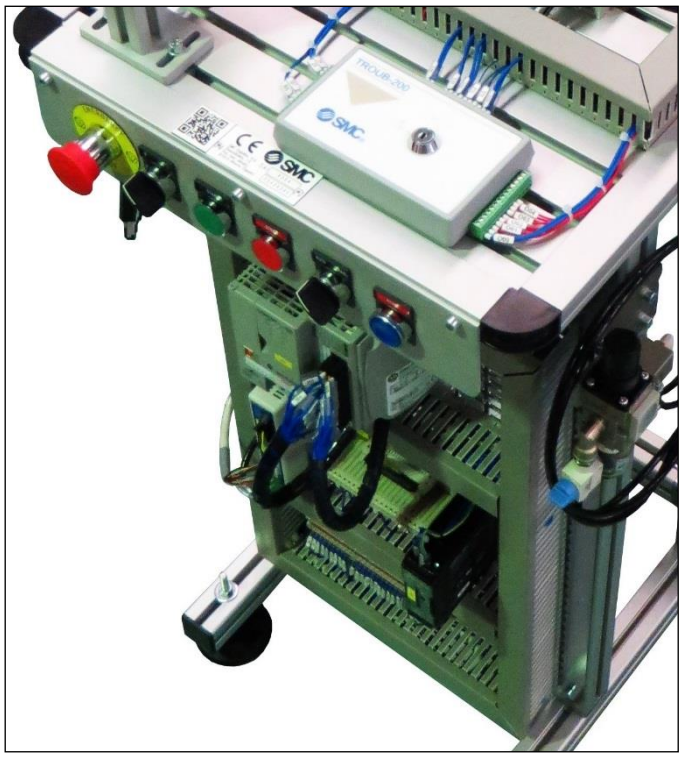
- Artificial vision camera with integrated processing unit.
- Software and cable for configuration and programming.

- Breakdown generation system:

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

- Electrical control panel:

All of the pneumatic cables and tubing are properly identified and labelled at both ends.



- Mounted on a 375x700mm mesh
- Accessible electrical connection terminal box with power input and coded I/O.
- It includes 110-240VAC/24 VDC and 110-240VAC/5VDC power supply units.
- Artificial vision system controller.
- 1 control PLC Siemens S7-1200 wired and programmed to operate the module with 13 digital inputs and 13 digital outputs connected to the hardware.
- Industrial communication via standard Ethernet for communication with the other modules.

SAI4215 - FAS-215: REJECTION STATION AFTER VISUAL INSPECTION WITH SIEMENS PLC – QUANTITY: 1.

The function of this station is to reject the turning mechanism if the result of the quality control is not satisfactory.

The station is formed by a 450x600x900mm height-adjustable aluminium structure, on which the components used to perform the process are mounted, which include a block of control solenoid valves in the case of pneumatic components.

The electrical panel is on the front, from which the station is controlled.

It also includes the control keypad, with the following buttons and indicator lights: start, stop and reset (with lamp) buttons, continuous/single cycle selector and disconnecting switch and endorsed emergency stop button.

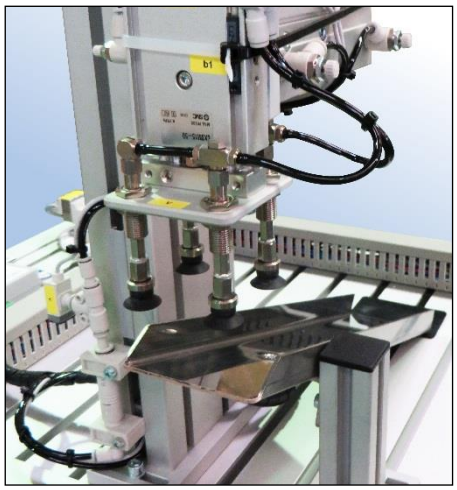
On one side of the station there is an air treatment unit comprising a 5µm filter with a pressure controller, pressure gauge, manual 3/2 stop valve.

The station comprises the following modules:

- Module for the evacuation of faulty assemblies:

If the result of the inspection is not satisfactory, the assembly is taken from the revolving table to an evacuation ramp in the station. A two-shaft handling device performs this process. Each axis is formed by a parallel-rod cylinder. The holding system is based on four vacuum pads at the end. This module has the following components and characteristics:

- Actuators:
    - Horizontal axis: parallel-rod cylinder, Ø20, 100mm stroke with speed controllers and an initial and final position switch. Controlled by a double 5/2 solenoid valve.
    - Vertical axis: parallel-rod cylinder, Ø15, 50mm stroke with speed controllers and an initial and final position switch. Controlled by a single 5/2 solenoid valve.
    - Fixing arm: 4 vacuum pads, Ø16, with vacuum ejector. Controlled by a double 3/2 solenoid valve.
- Sensors:
    - Auto switches, reed type.
    - PNP output vacuum pressure switch.



- Breakdown generation system:

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

- Electrical control panel:

All of the pneumatic cables and tubing are properly identified and labelled at both ends.

- Mounted on a 375x700mm mesh
- Accessible electrical connection terminal box with power input and coded I/O.
- It includes 110-240VAC/24 power supply unit.

- 1 control PLC Siemens S7-1200 wired and programmed to operate the module with 9 digital inputs and 6 digital outputs connected to the hardware.
- Industrial communication via standard Ethernet for communication with the other modules.

SAI4216 - FAS-216: STORAGE STATION WITH SIEMENS PLC – QUANTITY: 1.

The function of this station is to automatically store the finished product.

The assembly to be stored is a turning mechanism formed by a 65x65x32mm anodised aluminium block with an opening at the top, 32mm diameter, and an opening in the bottom, 28mm diameter.

The station is formed by a 450x600x900mm height-adjustable aluminium structure, on which the components used to perform the process are mounted, which include a block of control solenoid valves in the case of pneumatic components.

The electrical panel is on the front, from which the station is controlled.

It also includes the control keypad, with the following buttons and indicator lights: start, stop and reset (with lamp) buttons, continuous/single cycle selector and disconnecting switch and endorsed emergency stop button.

On one side of the station there is an air treatment unit comprising a 5µm filter with a pressure controller, pressure gauge and manual 3/2 stop valve.

The station comprises the following modules:

- Vertical axis:

The vertical axis is formed by a parallel rod pneumatic cylinder to which a platform is attached with four vacuum pads to hold the part. This module has the following components and characteristics:

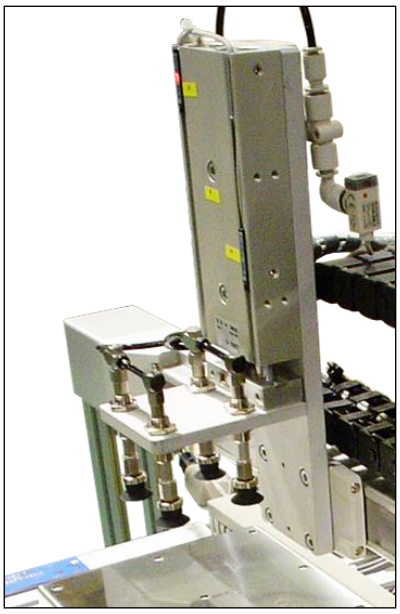
- Actuators:

Double acting parallel-rod cylinder, Ø20 and 75mm stroke, with speed controllers and initial and end position switches. Controlled by a single 5/2 solenoid valve.

- Holding system: 4 Ø16 vacuum pads, with vacuum ejector. Controlled by a single 3/2 solenoid valve.

- Sensors:

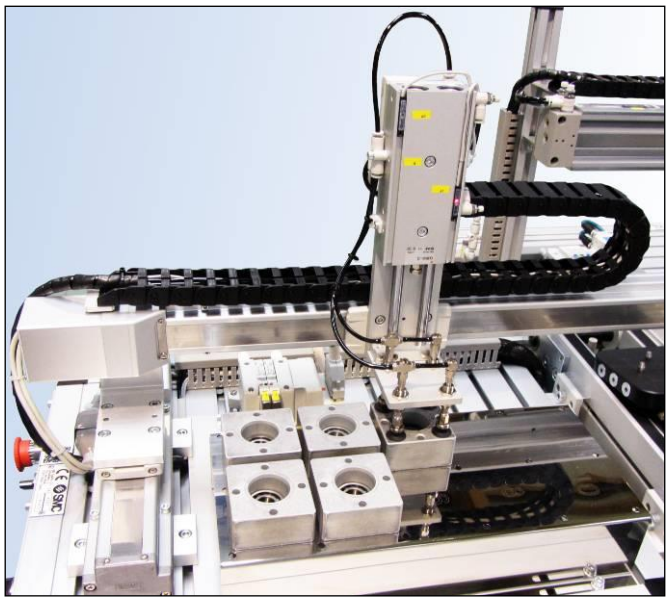
- Auto switches, reed type.
- PNP output digital vacuum pressure switch.



- Positioning axis:

The system to position the assembly at the different points on the desktop surface is formed by two linear axis: one of them electric and the other one pneumatic. This module has the following components and characteristics:

- Actuators:
    - 1 linear servodriven actuator.
    - 1 double acting air slide table: Ø20 and 75mm stroke, with speed controllers and initial and end position switches. Controlled by a double 5/2 solenoid valve.
- Sensors:
    - Auto switches, reed type.



- Electrical control panel:

All of the pneumatic cables and tubing are properly identified and labelled at both ends.

- Mounted on a 375x700mm mesh

- Accessible electrical connection terminal box with power input and coded I/O.
- It includes 110-240VAC/24VDC power supply unit.
- It includes 1 servodriver to control the motors built into the linear actuator.
- It includes programming software and cable for the servodriver.

- 1 control PLC Siemens S7-1200 wired and programmed to operate the module with 13 digital inputs and 12 digital outputs connected to the hardware.
- Industrial communication via standard Ethernet for communication with the other modules.

SAI4220 - FAS-220: PALLET TRANSFER STATION WITH SIEMENS PLC – QUANTITY: 1.

The function of this station is to move the pallet between two transfer modules that are located in parallel way.

The part to be moved is a black nylon pallet that supports a turning mechanism.

The station is formed by a 900x410x900mm height-adjustable aluminium structure, on which the components used to perform the process are mounted, which include a block of control solenoid valves in the case of pneumatic components.

The electrical panel is on the front, from which the station is controlled.

It also includes the control keypad, with the following buttons and indicator lights: start, stop and reset (with lamp) buttons, continuous/single cycle selector and disconnecting switch and endorsed emergency stop button.

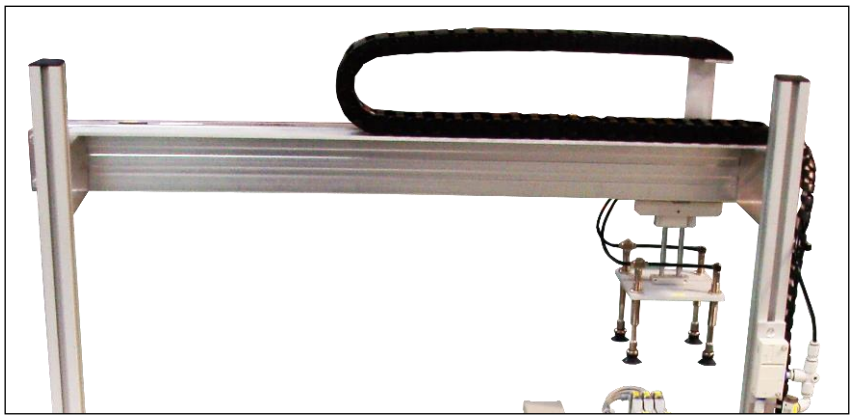
On one side of the station there is an air treatment unit comprising a 5µm filter with a pressure controller, pressure gauge and manual 3/2 stop valve.

The station comprises the following modules:

- Pallet transfer module:

A two-axis handling device performs this process. One of the axis is formed by a rod-less cylinder and the other one by a parallel-rod pneumatic cylinder. The holding system is based on four vacuum pads at the end. This module has the following components and characteristics:

- Actuators:
    - Horizontal axis: rod-less cylinder, Ø25, 600mm stroke with speed controllers and an initial and final position switch. Controlled by a double 5/2 solenoid valve.
    - Vertical axis: parallel-rod cylinder, Ø10, 50mm stroke with speed controllers and an initial and final position switch. Controlled by a double 5/2 solenoid valve.
    - Fixing arm: 4 vacuum pads, Ø16, with vacuum ejector. Controlled by a single 3/2 solenoid valve.
- Sensors:
    - Auto switches, reed type.
    - PNP output vacuum pressure switch.



- Breakdown generation system:

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

- Electrical control panel:

All of the pneumatic cables and tubing are properly identified and labelled at both ends.

- Mounted on a 375x700mm mesh
- Accessible electrical connection terminal box with power input and coded I/O.
- It includes 110-240VAC/24 power supply unit.

- 1 control PLC Siemens S7-1200 wired and programmed to operate the module with 9 digital inputs and 6 digital outputs connected to the hardware.
- Industrial communication via standard Ethernet for communication with the other modules.

SAI7243 - PLC programming software – Quantity: 15

- It includes 1 programming software licence for Siemens S7-1200 PLC.

SAI7242 - Ethernet cable – Quantity: 15

- It includes 1 standard Ethernet cable with (2x) RJ-45 connectors.

SAI2538 - 3D SIMULATION APPLICATIONS FOR AUTOSIM FAS-200 .– QUANTITY: 1.

It allows the user to simulate, control and supervise the real automated process from a virtual environment.

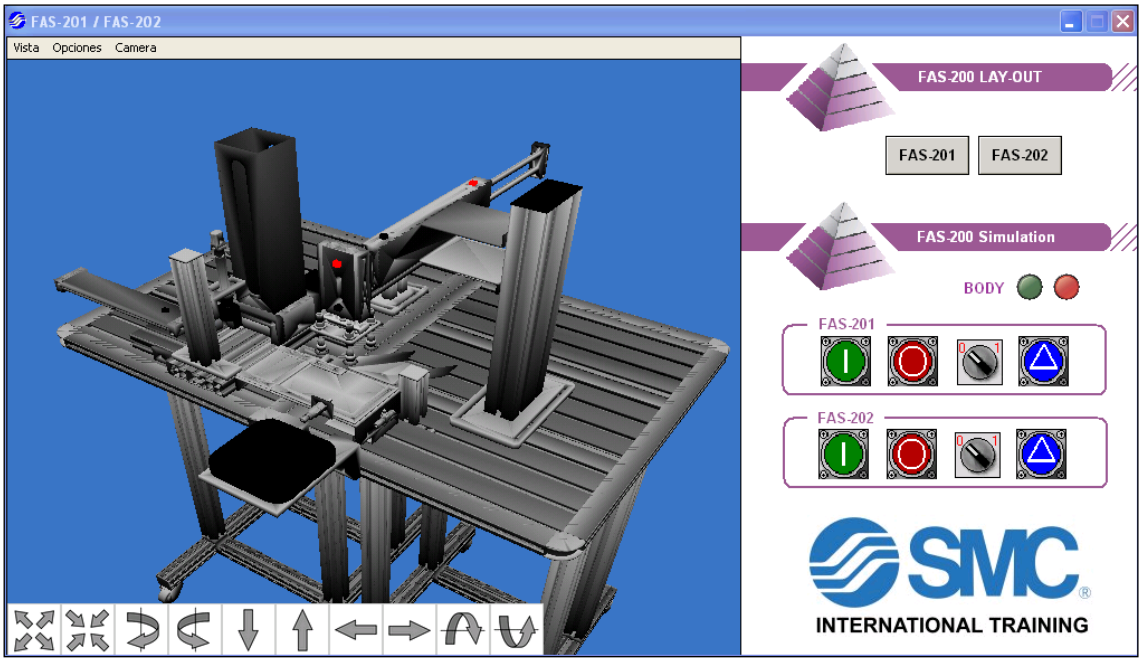
It is comprised of software applications which include 3D models of the real process.

Each application includes the following features:

- Compatibility with simulation software in automation applications.
- Independent window with 3D model.
- Independent window with keypad and control commands.
- Access to the programming editor of a built-in virtual PLC responsible for controlling the movements of the 3D model.
- Access to the symbols table in the virtual PLC.
- Access to the libraries and to the simulation panel for components in pneumatics, electro-pneumatics, hydraulics, electro-hydraulics and electrics.

The simulator includes the following applications:

- Automated flexible assembly cell comprised of:
    - Supply / verification – rejection base transfer.
    - Supply / transfer – measurement / bearing transfer.
    - Transfer and hydraulic pressing.
    - Classification – rejection / axis transfer.
    - Classification of caps - rejection / transfer.
    - Screw dispenser and insertion unit.
    - Transfer and visual inspection - rejection.
    - Storage.
    - Pallet transfer.



The package includes 16 licences for its use along with simulation software for automation applications autoSIM-200.

SAI2088 - Silent compressor – Quantity: 7

- Two-phase power supply: 230VAC.

- Flow rate: 50l/min.
- Maximum pressure: 0,8 MPa.
- Low noise level: 40 dbB.
- Reboiler: 9l.
- Weight (aprox): 21Kg.

EQUIPMENT HANDLING EDUCATION (Automation-II level)

- training for work on the offered stations.
- complete documentation for the work and exercises.
- training for handling the delivered equipment at the address of the Client for a total duration of 40 hours or five days