C120-143 WAFER METALIZATION TOOL

PROCESS SEQUENCE 1033, PALLADIUM ACTIVATOR

MEMS PROCESSING

ADVANCED PACKAGING

PHOTOVOLTAIC

> **Nickel**
> **Cobalt**
> **Gold**
> **Palladium**
> **Tin**
> **Copper**
> **Cleaning**
> **Etching**

ISO 9001:2000 Registered

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Stapleton Technologies provides several aqueous metalization tools for wafer processing. These range in size and complexity depending on the needs of the Fab. Production and tool quality requirements determine the complexity and material cost which directly effect the cost to deliver these systems.

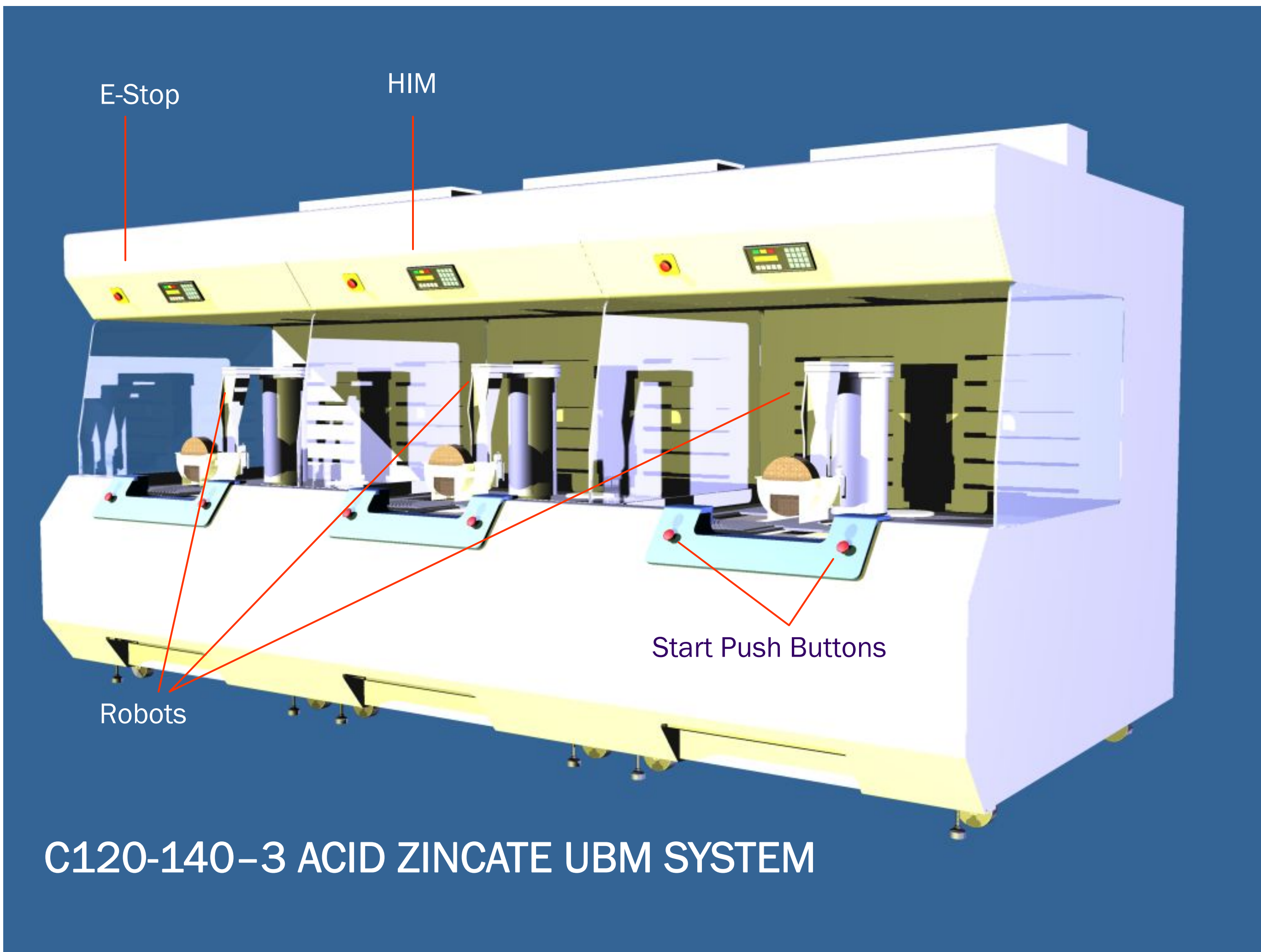
This brief document describes the C120 Tool. The 140 configuration is used with acid zincate activation with a minimum of three modules. These can be arranged in any orientation in the Fab.

The primary purpose in providing these tools to our valued customers is to insure consistent, reliable support of the wafer metalization processes we supply. The options and features we recommend are important in achieving this goal and producing the highest quality at the lowest cost.

Basic Operations

The C120 Wafer Metalization Tool is a PC controlled wafer metalization system that controls and monitors the Metalization Process. The tool is capable of being expanded with additional modules to produce any desired production goals. The basic three module system, cleaning, activation and nickel metalization and gold metalization and final rinse, is capable of delivering up to 100 wafers per hour. By adding additional modules for nickel and gold the system can produce several hundred wafers per hour using the same control hardware.

The tool has three elements, Operator Work Stations, Galileo Server, and Modules. The tool is initially switched from OFF or STANDBY to OPERATE. Once all the parameters have been reached the Tool is released for production. To process wafers, the operator loads the wafers into the wafer boat and at the same time the workstation automatically captures the boat number being loaded using an imbedded RFID tag in the boat. The operator then places the boat on the first module where the RFID reader identifies the boat. After the operator locks the boat onto the robot arm, the operator presses the two start buttons on the front of the station. The operator indicator light switches from amber to green. From this point forward the wafers are cleaned in a Megasonic cleaner, spray rinsed and quick dump rinsed and then treated with Nitric acid and spray rinsed and quick dump rinsed. When the module has completed the process the wafers are returned to the Load and Unload position and operator light switches from green to red. Once the wafers are removed the RFID reader clears and the module switches back to amber. A skip time is used in the software to delay the start of the next lot of wafers to prevent a conflict in the processing.



Basic Operations Cont,

This procedures is repeated on the next module where a second robot introduces the wafer to the acid zincate followed by the spray and quick dump rinse. After this the robot transfers the wafers to the nickel metalization cell and then after deposition to the spray and quick dump rinse. The operator then places the wafers in the last module and the third robot continues the processing. When the wafers are finished and the operator removes the wafer from the last module the lot of wafers are completed and the rack released for the next use.

Unique Features

The C120 Tool incorporates several important features that improve the operations and reduce the cost of ownership.

These are:

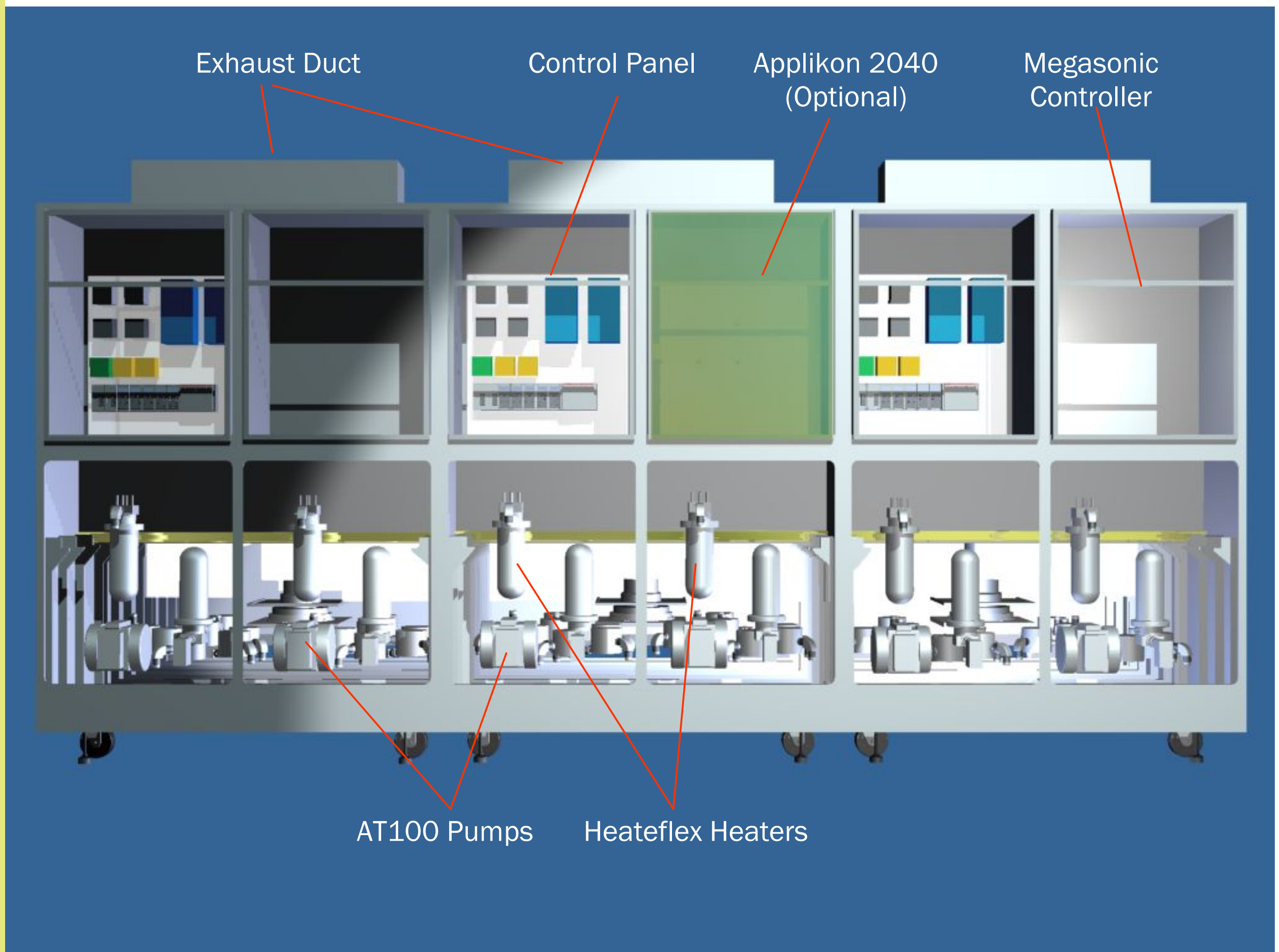
- Lot Tracking:: This feature captures the process parameters at the time each lot of wafers is introduced and removed from a process. This information is stored for analysis and reporting. This includes the temperature, pH chemical composition on processes using a titrator and the serial number of the lot of chemicals. The yield for each batch of chemicals is also captured and totalized so the quality can be monitored. This information can be used to determine the frequency of chemical maintenance.
- Automatic Passivation: This is a feature that permits the operator to automatically strip the nickel cell and passivate it with Nitric acid. This is a procedure that is required every 10 to 15 days to prevent nickel from building up in the nickel process cell. This features reduces the operator exposure to nitric acid and when multiple nickel cells are used is provides for continuous operations 24/7.
- Reverse Cell Flow: This is a simple but important feature that reverses the solution flow in the working cell while in the STANDBY mode. This eliminates solid particles trapped in the working cell due to the overflow requirement.

Standard Features

- PFA Molded Entegris Process Cells
- PTFE & PFA Piping and Wetted Assemblies
- HeateFlex In-Line Electric Heater w/ SCR ctrl.
- AT100 White Knight Pneumatic Pump 35 lpm
- PFA and PTFE Pneumatic Valves,
- PID Temp Control, Analog Flow Meters
- Radial 2 Axis Pneumatic Servo Robot
- Lip and Rear Exhaust
- Drip Containment
- Deck Top Manual Spray
- Isolated Secondary Containment for each Cell
- Nitrogen Level detection and Purge of filters
- FM4910, E-Stop and Recovery
- Megasonic Transducer on Cleaner Station
- Lot Control including RFID boats,
- Material Management System,
- Automatic Chemical Transfer into and out of cells.

Tool Options

- Applikon 2040 Titrator for Ni, Hypo and pH,
- Applikon 2040 Titrator for Au, Sulfite and pH,
- Chemical Replenishment Pumps for Nickel
- Additional Modules for higher production



Specifics

The C120 Semi-Automatic Wafer Metalization Tools combine a number of important quality and production features into a single system. This section describes some of the unique features.

- Automatic Passivation—Nickel processes incorporate an alternate material transfer system that drains and working solution and passivates the station with nitric acid cleaning it and removing nickel chips and then drains and rinses the station, This permits the maintenance to be accomplished while production is taking place at other stations.
- Automatic Reverse Circulation—While the Tool is in Stand-by mode the flow in the process cell is reversed periodically to remove particles collecting in the bottom of the overflow section. This improves the performance and reduces the number of maintenance procedures.
- Materials of Construction—Tool utilizes stainless steel frame and FM4910 poly-pro for fire protection. All wetted parts are PFA, PVDF or PTFE.
- Coded Drums—All materials are provided with coded bungs that match transfer pump heads to prevent accidental mixing of chemicals. Operators are protected from exposure to chemicals and processes are delivered ready to use.
- Standard Features— Automatic Dump Rinses with conductivity controllers, Automatic Fill, leak detection, pneumatic controls, high flow rate on metalization processes. The tool also incorporates ventilation monitoring, FM4910 construction, E-Stop on robots and electric power, APC for minimum of 8 hours, pneumatic backup for 30 seconds and Human Interface on each module including text messages and warning lights.
- Applikon 2040 Titrator (Option) provides a chemical analysis every 10 to 30 minutes so that the processes can be controlled with minimal operator involvement. This provides current process conditions of pH, Nickel and Hypo to insure the wafer deposit thickness remains constant.
- Material Management is used to integrate the Stapleton Supply Chain Management program into the tool operations. This performs critical documentation and tracking functions providing a complete history of the material from manufacture at Stapleton to final disposition by the client.
- SQL Server technology provides information to the tool and operators to effect all the operations. Two computer are used to maintain the tool, one for control and the other for data.

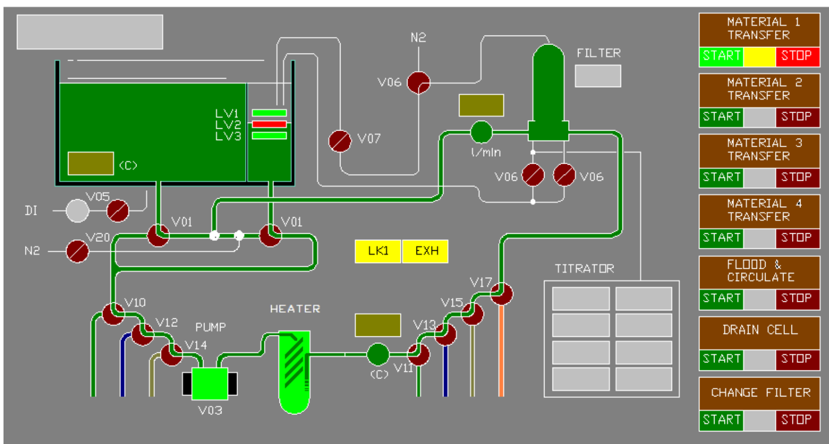
Work Station

OPERATOR CONTROLS

The tool uses a Work Station for operator input as well each module incorporates a HIM unit to display information and status. The process recipes and production information are stored on a RAID Server. This Information is delivered to the real time process control computer that communicates with each module and establishes the tool configuration. The Process Management area provides real time trending of any condition being monitored. Additional secure connections can be made to the server to provide .xml reports and diagnostics.

The Maintenance section provides for detailed description of the filling, operating and cleaning of the cells. Filter Changes provide for nitrogen purge and draining of filter chambers and recording of the service time. Materials are provided in a "Ready to Use" or as concentrates. The Material Management Option provides for the management of the materials from the point of approval at Stapleton to the final disposition at the client. This is very important in managing the supply chain especially when operating globally.

After the tool is configured for the lot all operations are controlled by the software with the only operator action being the loading of the wafer boat onto the robots and the pressing of the two start buttons



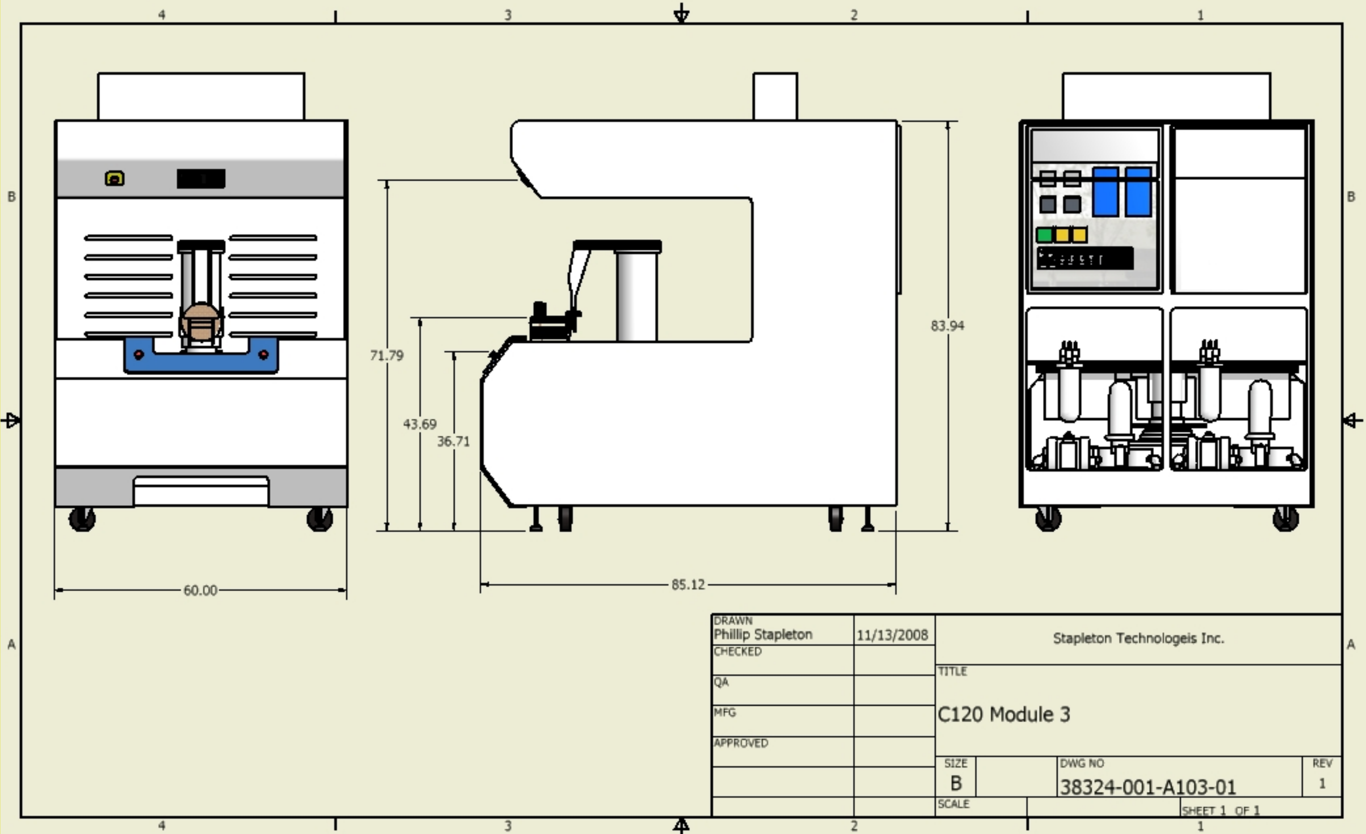
Detailed Display screens like this one provide the operator with a complete picture of the tool operations. Using standard Windows menus, the operator can quickly navigate between the different programs to control all aspects of the wafer processing.

The software incorporates programs that automate the valve settings to change filters, drain and rinse process cells and fill and drain the quick dump rinse.

Station Layout for C120-143-3

Module-Station	Process	Description	Vol	Features	C
M1-A	MICRO 209U	CMOS Wafer Cleaner w/ Megasonics	20L	0.1 Filter, 20 l/min Single Chemical Transfer	40
M1-B	Quick Dump Rinse	Rinse	20L	RFID Reader, Conductivity detect, Spray/Flood Rinse cycle	22
M1-C	MICRO 210U	CMOS Organic Acid Cleaner	20L	0.1 Filter, 20 l/min Single Chemical Transfer	22
M2-A	MICRO 214U	CMOS Palladium Activation	20L	0.1 Filter, 20 l/min Single Chemical Transfer	26
M2-B	Quick Dump Rinse	Rinse	20L	RFID Reader, Conductivity detect, Spray/Flood Rinse cycle	22
M2-C	MICRO 282U	CMOS Autocatalytic Nickel	56L	0.1 Filter, 25 l/min Dual Chemical Transfer [optional Applikon 2040 Titrator]	87
M3-A	MICRO 291U	CMOS Autocatalytic Gold	56L	0.1 Filter, 25 l/min Dual Chemical Transfer	87
M3-B	Quick Dump Rinse	Rinse	20L	RFID Reader, Conductivity detect, Spray/Flood Rinse cycle	22
M3-C	Hot Deionized Rinse	Hot Di Rinse with 2% IPA	20L	0.1 Filter, 30 l/min IPA Feed Pump	85

Physical Specification



Physical	Width Single Module 60” 1524mm Width Double Modules 120” 3050mm Width Three Modules 180” 4575mm Width Four Modules 240” 6100mm	Depth 85.125” 2162 mm Height 84” 2133 mm Weight 1250 lbs 570 Kg / Mod	Ref 1a, Ref 1b,
Water Use	C120-140 Process of a single lot of wafers 22.5 Liters/cycle approx. 270 liters per lot.	Waste Water Management Hazardous Material Management	Ref 2a Ref 2b Ref 2c
Pneumatic Use	C120-140 Module maximum usage at 60psi. 2 X 6 SCFM @ 35 lpm 36 SCFM with all pumps at max flow	Typical usage 18 SCFM with variable pressure controls on pumps. 0-35 lmp process flow control	Ref 3a Ref 3b
Electrical Use	3 Modules 36 KW approx use 10 KW 4 Modules 48 KW approx use 12 KW	APC2.5KW Battery Backup of 24V Control Power, PLCs, and Computers	Ref 4a
Electronics	Half Rack, 19” Enclosure PC1 SQL Server, RAID Controller, VPN connection PC2 Real Time Operating System, E-Stop	Operator Work Station, 19” Monitor	Ref 5a Ref 5b Ref 5c

Wafer Metalization Processes and Equipment

C120-140-3 Tool Description Features:

- Three Module Programmable Robotic Under Bump Metalization (UBM) System for 200mm wafers and smaller,
    - ♦ Module 1, 2 Axis Robot with RFID Reader, Operator Interface, HIM and E-Stop, Quick Dump Rinse with Spray and Conductivity Detect for rinse water control, Photohelic Differential Pressure Detector, CDA Pressure Sensor on controls, CDA Pressure Sensor on Pump, Nitrogen Pressure, Water Pressure, Leak Detection, accumulator tank and E-Stop pneumatic ctrl, Megasonic Transducer and Power Controller
        - — Station A, Molded Entegris Process Cell, 20L, reversing valves, AT100 pneumatic pump, Heateflex 4KW heater, safety interlock, leak detection, liquid level sensors, automatic Di water fill, filter, automatic vent, pneumatic drain, solution transfer, flare piping, PTFE piping, flow sensor, temperature sensor,
        - — Station B, Automatic Dump Rinse, 20L, spray rinse, flood rinse, conductivity detector,
        - — Station C, Molded Entegris Process Cell, 20L, reversing valves, AT100 pneumatic pump, Heateflex 4KW heater, safety interlock, leak detection, liquid level sensors, automatic Di water fill, filter, automatic vent, pneumatic drain, solution transfer, flare piping, PTFE piping, flow sensor, temperature sensor,
    - ♦ Module 2, 2 Axis Robot with RFID Reader, Operator Interface, HIM and E-Stop, Quick Dump Rinse with Spray and Conductivity Detect for rinse water control, Photohelic Differential Pressure Detector, CDA Pressure Sensor on controls, CDA Pressure Sensor on Pump, Nitrogen Pressure, Water Pressure, Leak Detection,
        - — Station A, Molded Entegris Process Cell, 20L, reversing valves, AT100 pneumatic pump, Heateflex 4KW heater, safety interlock, leak detection, liquid level sensors, automatic Di water fill, filter, automatic vent, pneumatic drain, solution transfer, flare piping, PTFE piping, flow sensor, temperature sensor,
        - — Station B, Automatic Dump Rinse, 20L, spray rinse, flood rinse, conductivity detector,
        - — Station C, Molded Entegris Process Cell, 40L, reversing valves, AT100 pneumatic pump, Heateflex 6KW heater, safety interlock, leak detection, liquid level sensors, automatic Di water fill, filter, automatic vent, pneumatic drain, solution transfer, flare piping, PTFE piping, flow sensor, temperature sensor, (Optional Applikon 2040 Titrator)
    - ♦ Module 3, 2 Axis Robot with RFID Reader, Operator Interface, HIM and E-Stop, Quick Dump Rinse with Spray and Conductivity Detect for rinse water control, Photohelic Differential Pressure Detector, CDA Pressure Sensor on controls, CDA Pressure Sensor on Pump, Nitrogen Pressure, Water Pressure, Leak Detection,
        - — Station A, Molded Entegris Process Cell, 40L, reversing valves, AT100 pneumatic pump, Heateflex 6KW heater, safety interlock, leak detection, liquid level sensors, automatic Di water fill, filter, automatic vent, pneumatic drain, solution transfer, flare piping, PTFE piping, flow sensor, temperature sensor,
        - — Station B, Automatic Dump Rinse, 20L, spray rinse, flood rinse, conductivity detector,
        - — Station C, Molded Entegris Process Cell, 20L, reversing valves, AT100 pneumatic pump, Heateflex 6KW heater, safety interlock, leak detection, liquid level sensors, automatic Di water fill, filter, automatic vent, pneumatic drain, solution transfer, flare piping, PTFE piping, flow sensor, temperature sensor, IPA auxiliary pneumatic pump
    - — Process Control Module, & Work Station, SQL Server, Real Time PC, 17” Flat Screen CRT, APC 5KW, E-Stop Control, 24 V Controller Supply, 19” Half Rack, RFID Reader,

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