YES-1224P Manual
Chemical Vapor Deposition System – With Plasma

- Installation
- Operation
- Software
- Maintenance

610-10632-01, Revision 0
900-10580-01
900-10580-02
**SCOPE:** This manual explains in detail how to use the YES-1224P(E). We hope you find it clear, concise, and capable of answering any questions you may have regarding this system. If we can assist you further, please feel free to contact us at (925) 373-8353. Our Field Service Department will be happy to help you.

**WARNING!!!**
The YES-1224P(E) systems are designed to work with a wide variety of silanes and process gases. However, due to the number of usable chemicals YES cannot guarantee final results of silanes or any other chemical and does not take responsibility for any harm either to the system or persons for use of other chemicals within the system. The operator must be aware of the potential dangers in mixing chemicals and choose a compatible solvent when cleaning the flask/chemical delivery system. Injury and/or death may be caused by not understanding associated compatibility, heat, and vapor pressure issues while using this equipment.

**CAUTION!!!**
The use of fluorinated compounds will infuse fluorine into inner chamber component surfaces, and is virtually impossible to remove. Substrates that are sensitive to fluorine cannot be processed once these compounds have been introduced. Contact YES for specifics on the use of unusual gases.
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YES-1224P(E) chemical vapor deposition (CVD) system with plasma cleaning is designed to provide complete parameter control over surface modification processes.

YES-1224P gives process engineers control over:

- Amount of liquid
- Speed of liquid injection
- Vaporization chamber temperature
- Vapor line temperature
- Process vacuum chamber temperature
- Process starting pressure
- Exposure time
- Surface Preparation
- Plasma process gas pressure
- Plasma power
- Plasma process time

Typical applications include:

- Surface modification to prevent or promote adhesion
- Photoresist adhesion for semiconductor wafers
- Silane/substrate adhesion for microarrays (DNA, gene, protein, antibody, tissue)
- MEMS coating to reduce stiction
- BioMEMS and biosensor coating to reduce "drift" in device performance
- Promote biocompatibility between natural and synthetic materials
- Copper capping
- Anti-corrosive coating
- Low-k treatment to improve hydrophobicity
- Plasma damaged low-k dielectric repair
- Decrease R/C time factor by treating and sealing low-k
Benefits include:

- Chemical deposition uniformity
- Contact angle control within +/- 3 degrees
- Moisture resistant surface modification
- More time available between process steps
- Hexamethyldisilazane (HMDS)/wafer bonds will last for weeks with no change to surface adhesion
- Promotes silane/substrate bonds
- Angstrom-level thickness control
- Increased MEMS and bioMEMS reliability
- Reduced chemical usage over wet chemical modification
- Plasma cleaning ensures all runs start from the same point in the process
Introduction

Features of the YES-1224P(E) system include:
1. PLC Control of output with input monitoring
2. 24 Volt DC instrumentation
3. Process abort, complete, and running lights on light tower
4. Audible alarm
5. Electro polished 316 stainless steel chamber
6. Internal chamber welds
7. Redundant Over-temperature monitoring
8. Preheated N\textsubscript{2}, process, and plasma gases
9. 0.5 Micron filter for N\textsubscript{2} and process gases
10. Four sets of removable, configurable electrodes/process trays of stainless steel construction
11. Chemical Delivery Cabinet with:
   - Two Stainless steel heated flash vapor flasks
   - Quick release flask connections (VCR)
   - Dual independent flash vapor flask Partlow 1160 Plus temperature control
   - Larger diameter vapor line tubes to reduce expansion cooling
   - Dual independent vapor line Partlow 1160 Plus temperature control
   - Micro-pump infuse valves for accurate volume delivery
   - Nitrogen blanketed source chemical withdraw system to inhibit “wetting” of source chemicals
   - Room temperature chemical storage of supplier chemical bottles for ease of change
   - Infusion volume tracking for source bottle level status.
   - Secondary containment system spill tray to meet safety requirements
   - Three plasma gas flow adjustment valves
Introduction

13. Emergency Machine Off buttons front and rear of main machine (EMO)
14. Four-zone, Partlow 1160 Plus temperature controlled chamber heating
15. Partlow 1160 Plus temperature controlled heated vacuum plumbing to eliminate condensation
16. 5” monochrome touch screen display operator interface
17. Dual heated capacitive manometer chamber pressure sensors with visual indication on touch screen for condensation prevention and precise pressure control, regardless of vapor composition
18. Pressurized control console for NEC compliance
19. RS-485 communications for constant temperature monitoring and remote set point operations
20. Analog communications for precise pressure, temperature and plasma output monitoring
21. Vapor detection pressure comparison to ensure chemical is evacuated before opening the door
22. Vapor trap LN$_2$ temperature feedback for refill prompt and chemical drain capability
23. Chemical volume tracking for notification of bottle exchange and trap drain operations
24. Optional automatic LN$_2$ refill system for operator free cold trap liquid nitrogen level control
25. Dual heated vacuum lines for CVD and plasma process separation
26. 100-1000 Watt RF power supply, 550VAC nominal output. Input power integrated through EMO circuit
Figure 1 YES-1224P Components
Introduction

YES-1224P chemical vapor deposition (CVD) systems provide total environmental control over the deposition process and accommodates a variety of functionally diverse silanes, for a variety of processes, on a variety of surfaces.

YES-1224P gives process engineers control over:

- Amount of liquid
- Speed of liquid injection
- Vaporization chamber temperature
- Vapor line temperature
- Process vacuum chamber temperature
- Process starting pressure
- Exposure time
- Surface preparation (using the plasma option)

1. **CVD/Surface Modification**

   Complete dehydration followed by CVD coating provides a superior silane/substrate bond that is stable after exposure to atmospheric moisture, extending the time available between process steps. Chemical usage for a vapor deposition process is typically less than 1% of the amount needed for wet application processes, significantly reducing waste and chemical costs.

   The CVD process begins with vacuum chamber cycle purges to dehydrate the product. The chamber is evacuated to low pressure and refilled with pure nitrogen several times to completely remove water vapor. Nitrogen is preheated, which helps heat the product.

   Once cycle purges are finished, the YES-1224P system pumps the chemical directly from the source bottle to the heated vaporization chamber – without exposing the chemical to moisture and the environment.

   YES-1224P accommodates two chemical source bottles as well as wide variations of vapor pressures among different silanes. Processes are easily programmed using the touch screen operator interface.

2. **Plasma Cleaning**

   YES-1224P provides a plasma cleaning option to the YES-1224 chemical vapor deposition (CVD) system. Plasma cleaning prior to silane deposition improves repeatability. Plasma cleaning the process chamber before each run ensures all runs start from the same point. Additionally, plasma prepares the substrate for deposition.

<table>
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<th>Process Overview</th>
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**CVD**

<table>
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YES-1224P(E) comes standard with four process gas connections; a chamber vent gas, usually nitrogen, and process gas 1 through 3, usually oxygen, argon, or other gas. Optional mass flow controllers are available as options. One additional process gas may be added, with or without a mass flow controller, as an option. YES-1224P(E) has separate vacuum lines for plasma processing and chemical vapor deposition.

For recipes that do not require constant pressure, gas flows may also be set to a constant value. Standard upstream process pressure control is achieved by adjusting the corresponding plasma gas needle valve. The chamber pressure can adjusted to the desired level required for plasma striking.

For recipes that do require constant pressure, automatic upstream process pressure control is an optional feature of the YES-1224P(E). The flow of process gas into the chamber may be automatically varied, via MFC, to maintain a constant pressure through the strip or descum process.

Once a substrate is in the chamber, pressure is reduced by a vacuum pump to a base pressure value. During plasma processing, process gas, usually oxygen, flows continuously through the chamber. If additional process gases with mass flow controllers are installed, the process gases may be mixed in mass flow ratios specified by recipe parameters.

YES-1224P(E) uses a 40 kHz RF power generator.

Plasma is generated between the hot electrode plate and the lower, grounded electrode plate. Free electrons created in the plasma field are drawn to ground by the lower plate. Only active ions continue “downstream” to clean components on the work trays. Electrode sets of stainless steel allow for an even distribution of the reactants giving uniform, consistent processing to each and every device. All components are safely cleaned without changing their electrical properties.
If the optional auto refill system is purchased, a supply tank or facilities connection must be located within six feet of the tool. YES recommends a 180 liter liquid nitrogen tank or jacketed transfer line from fab facilities holding tank with an output pressure of 22 psig. Facilities connection must be 1/2” AN type male connector to accept 1/2” AN type female connector on supplied 6 ft transfer line.

YES offers a choice Fomblin® oil sealed for use with the YES-1224P(E) or an oil-free (dry) scroll pump for use with plasma.

Process data collection may be added to the YES-1224P(E). Additional software is Microsoft® Office, Industrial SQL®, and Active® factory. Process data can be trended and retrieved by operator-entered lot identification number. The data collected for each process run can be sampled at 1-second intervals and includes:

- Date and Time
- Chamber pressure - Mini-Convectron® reading
- Chamber pressure set point
- Hot plate temperature
- Hot plate temperature controller set point
- Process gas flow rates (MFC option)
- RF power set point
- RF power level
- Process gas and vacuum valve states

Same as above with an additional Ethernet port to allow data to be collected and stored over a host network. The analysis software, Wonderware® Active Factory, has five seat licenses to allow remote data access over a network.
Introduction

The specifications of the YES-1224P(E) are as follows:

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<th>Specifications</th>
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<td><strong>Process Exposed Parts</strong></td>
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Chamber 316 SS electro polished with interior dimensions of 16" (406 mm) W x 18" (457 mm) D x 16" (406 mm) H

- **Tubing**: 316 SS and PFA
- **Swagelok® Fittings**: 316 SS
- **Gaskets and Seals**: Kel-F Nupro® and Vespol®, SST VCR gaskets
- **Door Plate**: 316L Stainless Steel
- **Door Seal**: Aflas® (Kalrez® or Simriz® available)
- **Micro-pump Fittings**: PEEK
- **Tray Guides**: CERAMIC

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<th>Additional Parts</th>
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- **14 - 200 Watt Chamber Heaters**
- **2 - 80 Watt Flash Vapor Chamber Heaters**
- **5 - 100 Watt Vacuum Valve and Vapor Line Assembly heaters**
- **24 Volts DC User Accessible Instrumentation**

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<th>Wafer Capacity</th>
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- **Wafer Capacity**: 8 cassettes of 6" (150 mm) wafers, 5" (125 mm) wafers or 4" (100 mm) wafers, or 2 cassettes of 8" (200 mm), 12" (300 mm) wafers
- **Wafer Throughput**: Capacity is dependent upon the process being undertaken.

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<th>Slide Throughput</th>
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- **Slide Throughput**: 600 slides per hour for CVD

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<th>Overall Dimensions</th>
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- **Overall Dimensions**: 46" (1168.5 mm) W x 42.75" (1086 mm) D x 44.38" (1127 mm) H (not including light tower, cold trap nor RF supply)

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<th>Cold Trap Capacities</th>
</tr>
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</table>

- **6-Inch Cold Trap Capacities**: LN2: 1.6 Liters, Condensate: 1.6 Liters
System Power

Domestic: 208 VAC, 60 Hz, 30 amps, 1 phase, 4835 watts
European: 230 VAC, 50 Hz, 30 amps, 1 phase, 5400 watts

Optional Auto LN2 Refill System Power

Controller: 200-240 VAC +/-10%, 50-60 Hz, 4.2 amps maximum, 1 phase, 850 Watts maximum

Energy Consumption

Power consumption based on standard process: 170°C @ 1000 Watts
Load time is 30 seconds.

Idle 420 Watts
Peak 2100 Watts
Average 1210 Watts
Vent gas should be at least 99.999% pure nitrogen. Nitrogen consumption based on standard process; 170°C @ 1000 Watts. Load time is 30 seconds. Peak value is based on the addition of three purge cycles, to the standard process, to eliminate toxic gases.

<table>
<thead>
<tr>
<th>Idle</th>
<th>Peak</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 SCF</td>
<td>1.00 SCF</td>
<td>.44 SCF</td>
</tr>
</tbody>
</table>

Reactant gas should be at least 99.999% pure. Reactant gas consumption based on standard process: 170°C @ 1000 Watts.

Load time is 30 seconds.

Values provided below are based on using an Edwards® XDS35i vacuum pump:

<table>
<thead>
<tr>
<th>Idle</th>
<th>Peak</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 SCF</td>
<td>4.2 x 10^{-3} SCF</td>
<td>4.2 x 10^{-3} SCF</td>
</tr>
</tbody>
</table>
NOTE: Inspect all crates and components of the YES-1224P(E) for damage as they are unpacked. If there is any visible shipping damage, please notify YES Customer Service at 1 (888) YES-3637.

A standard YES-1224P(E) system will arrive in two pieces: the unit itself and one box of accessories. However, if you purchased optional pumps from YES, there will be a third (and possibly fourth) piece. If you purchased the optional auto LN2 refill system from YES, there will be a fifth piece.

Take inventory of the system and its accessories to confirm that all the parts are available before proceeding:
- YES-1224P System
- YES-1224P (E) Operator Manual (including electrical and piping schematic and facilities documents)
- Partlow 1160+ Controller Manual
- Hydrocarbon Wet Vapor Pump (Optional)
  - 8” PVC Vacuum Flex Line with Reinforcing Stainless Steel Winding
  - SST Elbow
  - LN2 Trap
  - Clamps and Accessories
  - Pump Manual
- Dry Plasma Pump (Optional)
  - 8” PVC Vacuum Flex Line with Reinforcing Stainless Steel Winding
  - SST Bellows Line
  - KF-40 Tee
  - Clamps and Accessories
  - Pump Manual
- Auto LN2 Refill System (Optional)
  - Refill System Manual

NOTE: There is a choice of a dry pump or a Fomblinizer pump for the plasma side.
Installation

Getting Ready
Location Requirements

The ideal location will have access to electrical power connections, gas lines, and scrubbed exhaust ventilation ducts for the vacuum pump and reactor cooling to allow easy system installation.

Operation of the YES-1224P(E) demands maintenance access to the rear, left, and front of the system: frequent charging and cleaning of the LN$_2$ trap assembly requires rear access, Source chemical changes and cleaning procedures require left or front side tool access, and substrate loading and chamber cleaning operations require front access.

The vacuum line path from the pump to the tool should be as short and straight as possible. Performance specifications and recommendations for the vacuum pump are based on the 2.54 cm (1 in) ID, 2.44 m (8 foot) long, flexible vacuum hose that YES supplies with the vacuum pump option. For best performance, a customer-supplied vacuum line should have conductance equivalent to the standard hose.

Figure 2 Recommended Clearances (Door Open, Top View)
**Installation**

Final Light Tower installation is carried out from the front.

The Light Tower is already connected, but the actual light tower body needs to be screwed onto the exposed male thread located on the right front of the console lid.

**Vacuum Pump Requirements**

YES does NOT supply the vacuum pump or vacuum hose unless a vacuum system was purchased from YES as an option (in which case, the hose would be included).

In general, for the YES-1224P system, either a Fomblin® pump (oil) or BOC Edward® dry scroll pump is used when carrying out the plasma operation.

For the CVD operation an additional hydrocarbon pump is required.

Pump requirements:

- A vacuum source with a minimum of 15 scfm with an ultimate pump down of $1 \times 10^{-3}$ Torr (vacuum pump is NOT included unless purchased as an option from YES)
- An 8 ft. vacuum hose (not included unless a vacuum source option was purchased from YES)

**NOTE:** If vapor vacuum pump is NOT purchased through YES, we recommend a condensation trap be purchased to eliminate pump contamination. Chemicals entering the pump may cause failures due to elastomer incompatibilities and polymerization onto exposed surfaces. Furthermore, a flexible line will be required for the vacuum pump connection.

**WARNING!!!** If the plasma dry pump option is not purchased through YES, a dry pump or fully fomblinized pump must be used if there is the slightest chance that oxygen is used as a reactant. YES also offers Alcatel 16 and 19 CFM Fomblin® pump options. A larger pump will be required when high flow capacity is required.
The optional **Fomblin® oil-sealed** vacuum pump offered with the YES-1224P is an **Alcatel® model 2021C2** two-stage vacuum pump.

Power requirements are:

- **100-120VAC, 50/60 Hz, 1 phase, 550 Watts, 5A@110V**
- **200-230 VAC, 50/60 Hz, 1 phase, 4 amps, 550 Watts, 2.6@215V**

Power connection is an appliance cord.

Pump weight is 27.9 kg (61.6 lbs).

The optional vapor vacuum pump assembly includes an 8 ft. long, 1.5" ID **PVC vacuum flex line**, LN$_2$ trap, fittings, and refill thermocouple probe.

Install the Vacuum Pump by placing it in a position that makes it easy to check for correct oil level and topping up of the oil when needed.

Remove the clamp and “O” ring from the pump end of the 8ft PVC vacuum hose. Molded into the pump’s intake connector frame is an arrow that points at the connector. Place the “O” ring on this fitting, line the vacuum hose fitting up with it, then clamp the two together.

Secure the **blue oil de-mister** unit to the output connector of the pump. The output connector has an arrow molded into the frame that points away from it. An “O” ring and clamp lock the de-mister in place. Be sure that the butterfly nuts on the clamps are firmly tightened.

Secure the other end of the 8ft vacuum line to the aluminum flange at the rear of the system. A clamp and “O” ring are provided at this end of the vacuum line for this connection.

Visually confirm that Fomblin® pump oil level is correct (refer to **Alcatel® pump manual provided with the YES-1224P if option was ordered**). If needed, top-up oil, but do not overfill or the second stage of the pump can be blocked. Second stage failure will result in low vacuum and a system abort.
Figure 3 Optional Oil-Sealed Pump Dimensions in Millimeters
Installation

The optional oil-free (dry) scroll vacuum pump offered with the YES-1224P is a BOC Edwards® model XDS35i dry scroll vacuum pump.

Power requirements are:

- 100-120VAC, 50/60 Hz, 1 phase, 980 Watts, 8.5A@115V
- 200-230VAC, 50/60 Hz, 1 phase, 1080 Watts, 5.4A@215V

Power connection is an appliance cord with plug.

Pump weight is 47.6 kg (105 lbs).

To install the dry scroll pump, plug into an independent power source.

The optional plasma vacuum pump assembly includes an 8 ft. long, 1.5" ID PVC vacuum flex line, and interconnecting fittings, bellows, and adapters.

Installation is almost identical to “Oil Sealed Plasma Vapor Vacuum Pump Installation” mentioned previously.

Figure 4 Optional Dry Scroll Pump Dimensions in Millimeters
This section describes all of the facility requirements to properly set-up and connect the YES-1224P(E).

Five (5) single-phase receptacles are required: One for the YES-1224P(E) main system and one for each optional vacuum pump. Power for the Auto Refill and the RF Generator is also required. The power requirements for the standard YES-1224P(E) are below.

Figure 5 YES-1224P Facilities Drawing
Installation

<table>
<thead>
<tr>
<th>Main System Power</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>YES-1224P</th>
<th>YES-1224P(E)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>208-250 VAC</td>
</tr>
<tr>
<td>Frequency</td>
<td>50-60 Hz</td>
</tr>
<tr>
<td>Phases</td>
<td>1</td>
</tr>
<tr>
<td>Current</td>
<td>30 Amps</td>
</tr>
<tr>
<td>Power</td>
<td>5400 Watts</td>
</tr>
</tbody>
</table>

The YES-1224P(E) side assembly houses the chemical delivery system and piping to supply ammonia and chemical vapor from the flask to the oven vacuum chamber.

<table>
<thead>
<tr>
<th>Piping</th>
</tr>
</thead>
</table>

The vapor line on a YES-1224P(E) is a 1/2 inch 316 stainless steel tube that passes directly from the side assembly to the vacuum chamber sidewall.

The vapor line is heated and insulated. A temperature controller mounted on the front panel of the control console controls its temperature. Flow through the vapor line is controlled by a pneumatic shut off valve, which is mounted to the flask line.

<table>
<thead>
<tr>
<th>Vapor Line</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Chemical Flask</th>
</tr>
</thead>
</table>

The chemical flask is of an all 316 stainless steel construction with a 15.5mL capacity. All connections are located on the flask top to facilitate removal and servicing of the flask body.

Connections to each flask include a 1/8” infusion tube connection and a 1/2” vapor line connection. All tube connections are VCR type to facilitate quick removal during maintenance cycles.

The flask has an independently controlled heater sock. It also has three type J thermocouples clamped to the flask body.
**Installation**

**Infusion Lines**

Independent 1/8” PFA lines on each chemical flask top deliver chemicals from the micro-pump infusion valves. Each infusion valve connects to individual source bottles using 1/8” PFA tubing for ease of replacement and visual confirmation of fluid flow.

**Bottle Chemical Interface**

The chemical interface consists of single 6-inch needle with a Luer® connection. The long needle is connected to a PFA tube, via a barbed Luer® fitting, and terminates at the inlet of the solenoid driven micro-pump. The PFA tubing continues to the vapor chamber cap and is connected by 1/8 inch swage fitting.

**Bottle Head Purge Interface**

The head purge interface consists of single 1-inch needle with a Luer® connection. The short needle is connected to a PFA line, via a barbed Luer® fitting, and terminates at the source bottle cap purge solenoid located on the regulated four-position purge manifold. This system has an independent 1/4-inch Swagelok® low-pressure nitrogen connection on the rear of the side assembly cabinet.

**Vent/Seal Purge Nitrogen**

15-30 psig of dry, filtered nitrogen is required for purging/venting the vacuum chamber.
Installation

15-30 psig of dry, filtered nitrogen is required for **purging the source chemical bottle head area.**

**Bottle Head Purge Nitrogen**

The **process nitrogen** connection is a 1/4-inch Swagelok® fitting on the rear of the side assembly cabinet. The rest of the line is 1/4 inch 316 stainless steel tubing. The nitrogen passes through a 0.5 micron filter and a pneumatic shut-off valve before entering the chamber compartment.

In the chamber compartment, the nitrogen line divides into two equal lines that pass through heaters attached to the rear of the vacuum chamber. Each nitrogen branch then divides again to pass into the chamber through four evenly spaced ports on the rear of the chamber. Each port has a 100 micron sintered stainless steel filter element in the chamber wall to diffuse the flow.

**Process Nitrogen**

**Vapor Vacuum**

The chamber vacuum line is a 1/2 inch diameter 316 stainless steel tube leading from the rear of the chamber to a pneumatic vacuum valve mounted at the middle rear panel of the oven.

The vapor vacuum line is heated and insulated to prevent condensation of vapor during process. Vapor Vacuum line heater power is provided via the vacuum line controller located on the control console. See the maintenance section of this manual for service instructions.

See Facilities for locations.

**Plasma Vacuum**

**Pneumatics**

The high-pressure nitrogen pneumatic supply connection for the YES-1224P(E) oven is a stainless steel 1/4 Swagelok® fitting on the rear of the oven. Pneumatic gas flows in through a fourteen-position distribution manifold to 24VDC solenoid valves that control the supply of pneumatic pressure to each of the pneumatic process valves.

**Pneumatic Nitrogen/CDA**

80-100 psig of dry, filtered nitrogen/CDA is required to operate the pneumatic valves.
Installation

Anhydrous Ammonia
(Process Gas)

The ammonia connection is a recessed 1/4-inch Swagelok® fitting on the rear of the side assembly cabinet. The rest of the line is 1/4 inch 316 stainless steel tubing. The ammonia passes through a 0.5 micron filter, a pneumatic shut-off valve, and tees into the nitrogen line, just after the nitrogen pneumatic shut-off valve.

Regulate the anhydrous ammonia, or other process gas, at 5-10 psig.

Plasma Gases

The YES-1224P(E) has three gas port connections on the right side of the unit. You may use process gases of your choice. Set plasma gas pressures to 15-30 psig.

Pump Exhaust

Connect each of the vacuum pump exhausts to the scrubbed house exhaust. The pump exhaust consists of air, N₂ and the silane or other reaction by-products. Since the system only utilizes metered amounts of chemical and an LN₂ trap to capture by-products, there should be minimal chemical in the exhaust.

Side Assembly Exhaust

The system requires a house exhaust connection for incidental plumbing vapor leak evacuation. The unit is fitted with a 3" (75 mm) OD transition coupling at the rear, right center of the unit. Connect the transition coupling with a 3" ducting to a house exhaust with a differential pressure of 0.20 inches of water suction at 20 scfm.

Door Seal Purge

The seal purge system is a tee connection off the bottle purge nitrogen line, down stream of the 0.5 micron filter. All lines are ¼ inch diameter stainless steel tubing. The line continues through a pneumatically actuated bellows valve, through a fine metering valve, and into a fitting between the inner and outer chamber door seals. The gas flows between the seals and exits through a 1/3 psig relief valve located on right rear of the chamber flange.
Installation

The vapor detection system consists of a hot wire pressure sensor connected to the chamber rear via an isolation valve. The line is ¼ inch diameter stainless steel.

Vapor Detection

Optional LN₂ Auto Refill System Supply

If the optional auto refill system is purchased, a supply tank or facilities connection must be located within six feet of the tool. YES recommends a 180 liter liquid nitrogen tank or jacketed transfer line from fab facilities holding tank with an output pressure of 22 psig. Facilities connection must be 1/2” AN type male connector to accept 1/2” AN type female connector on supplied 6 ft transfer line.

The YES-1224P(E) optional refill system enables the user to manage the condensate trap LN₂ level without intervention. There are many different applications for this option (see manufactures manual CD-R for detailed information). The system can be set for inches, mm, or percentage of active sensor length. YES presets all the parameters of the controller and displayed units are in percentage of active length (7 inches).

Figure 6 Auto Refill Controller
The preset parameter settings for the unit are:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Setting</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>HI</td>
<td>90%</td>
<td>Alarm High Setting Set point</td>
</tr>
<tr>
<td>B</td>
<td>40%</td>
<td>Fill Start Set point</td>
</tr>
<tr>
<td>A</td>
<td>85%</td>
<td>Fill Stop Set point</td>
</tr>
<tr>
<td>LO</td>
<td>20%</td>
<td>Alarm Low Setting Set point</td>
</tr>
<tr>
<td>Pre-Cool Time</td>
<td>0.2 min</td>
<td>Output 2 Activation Time</td>
</tr>
<tr>
<td>Timeout</td>
<td>10 min</td>
<td>Max. Fill Cycle Duration</td>
</tr>
</tbody>
</table>
Installation

Once the auto fill controller is turned on, the following program sequence initiates:

“Output 2” is activated for a predetermined time set by the “Pre-Cool” parameter, after which “output 2” is de-energized. This is used for pre-cooling the transfer line, venting non-liquid nitrogen gas, and reducing the evaporation of existing liquid in the condensate trap.

“Output 1” is activated until capacitance sensor reaches setpoint “A”, at which point “output 1” is de-energized. If level overshoots setpoint A, and reaches setpoint “HI”, refill controller deactivates solenoids and alarms until level drops below “HI” parameter.

The controller monitors the level until it reaches setpoint “B”. The refill system will now reset and restart the pre-cool mode step (reactivates “output 2”). If for any reason the level drops below the “low” parameter, the controller will alarm until the level increases above the “low” parameter setting. The solenoids are not deenergized in this condition.

If “output 1” is energized for a period longer than the “Timeout” parameter, the controller will alarm. This feature is an alarm for liquid nitrogen source depletion.
Installation

AC electrical power enters the YES-1224P(E) via a power cord attached to the rear of the oven control console. The power flows through a main disconnect circuit breaker mounted on the rear panel.

From the circuit breaker, AC power goes to a 24VDC power supply that supplies the EMO loop, through an EMO relay, all of the actuators and controllers that operate the YES-1224P(E). Two additional supplies, -15VDC and +15 VDC, power the circuitry and heating elements on the pressure manometers.

AC power also flows through a redundant multi-zone over temperature monitoring device relay to the SCR power controllers that modulate heater power to control oven temperature. The heater power relay is turned on by the system controller and may be turned off either by the system controller or by the over temperature monitor. The over temperature monitor uses redundant thermocouples and is factory set to a value of 251°C.

Activation of one of the two EMO buttons, of the control console interlock switch, or of the chassis pressurization switch will shut off power to the heaters and to all control components except the EMO circuit.

Touch Screen Interface

The touch screen operator interface uses an RS-232 serial communications line to exchange information with the system controller. The touchscreen also has an RS-232 connection accessible at the control console rear panel for downloading application programs. CTC proprietary software is required for editing and downloading application programs. Process control software is available from YES as an option.
Installation

The system controller that operates the YES-1224P(E) is a CTC 5000 series state logic controller with digital inputs and outputs to control the system, and analog inputs are used to read a signal from each heated manometer, for pressure tracking, temperature monitoring, and vapor detection gauge voltage for HCM comparison (confirmation of chemical vapor evacuation).

RS-485 communications exchange data with the seven temperature controllers for temperature tracking/remote set point operations, RS-232 communications exchange data from the touchscreen interface panel to the PLC, and a TCP/IP Ethernet port is located on the rear of the control console for program upload/download and process monitoring operations.

CTC proprietary software is required for monitoring controller function and for editing and downloading application programs. Process control software is available from YES as an option.

Input/Output List

<table>
<thead>
<tr>
<th>Digital Outputs</th>
<th>Digital Inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Process Gas Valve</td>
<td>1 Over temperature Alarm - Watlow</td>
</tr>
<tr>
<td>2 Vacuum Valve 1</td>
<td>2 Over temperature Cal 3200</td>
</tr>
<tr>
<td>3 Vent Valve</td>
<td>3 RF Set point Confirmation</td>
</tr>
<tr>
<td>4 Pump 1 Infuse Valve</td>
<td>4 Chamber 0-1000 Torr HCM Temp</td>
</tr>
<tr>
<td>5 Pump 2 Infuse Valve</td>
<td>5 Chamber 0-100 Torr HCM Temp</td>
</tr>
<tr>
<td>6 Vapor Valve 1</td>
<td>6 Not Used</td>
</tr>
<tr>
<td>7 Not Used</td>
<td>7 Prime Pump 1</td>
</tr>
<tr>
<td>8 Audible Alarm</td>
<td>8 Prime Pump 2</td>
</tr>
<tr>
<td>9 Light Tower Green Light</td>
<td></td>
</tr>
<tr>
<td>10 Light Tower Yellow Light</td>
<td></td>
</tr>
<tr>
<td>11 Light Tower Red Light</td>
<td></td>
</tr>
<tr>
<td>12 Plasma/Aux Vacuum Valve</td>
<td></td>
</tr>
<tr>
<td>13 Vapor Valve 2</td>
<td></td>
</tr>
<tr>
<td>14 Remote RF Power</td>
<td></td>
</tr>
<tr>
<td>15 Vapor Detection Valve</td>
<td></td>
</tr>
<tr>
<td>16 Over temperature Module Reset</td>
<td></td>
</tr>
<tr>
<td>17 Unused</td>
<td></td>
</tr>
<tr>
<td>18 Unused</td>
<td></td>
</tr>
<tr>
<td>19 Source Cap 1 Purge Solenoid</td>
<td></td>
</tr>
<tr>
<td>20 Source Cap 2 Purge Solenoid</td>
<td></td>
</tr>
<tr>
<td>21 Gas 1</td>
<td></td>
</tr>
<tr>
<td>22 Gas 2</td>
<td></td>
</tr>
<tr>
<td>23 Gas 3</td>
<td></td>
</tr>
<tr>
<td>24 Door Seal Purge Valve</td>
<td></td>
</tr>
</tbody>
</table>
**Installation**

**Analog Inputs**
1. Chamber 0-1000 Torr Pressure
2. Chamber 0-100 Torr Pressure
3. RF Power Level
4. RF Supply Diagnostic
5. Cold Trap Temperature
6. Internal Chamber Monitor Temperature
7. MFC/Gas 1 Flow
8. MFC/Gas 2 Flow
10. MFC/Gas 3 Flow
11. Not Used
12. Not Used

**Analog Outputs**
1. MFC/Gas 2 Set point
2. MFC/Gas 3 Set point
3. RF Power Set point
4. MFC/Gas 1 Set point

**Communication**
Comm 1 Touch Screen RS-232 Communications
Comm 2 Heater Controllers RS-485 Communication
TCP/IP Program Download/System Monitor Port
The vacuum chamber heaters are divided into a chamber door control zone, a front chamber perimeter control zone, a middle chamber perimeter control zone, and a rear chamber wall control zone.

There are six additional temperature zones; 2x vapor flask heat controls, 2x vapor line heat controls, and the 2x vacuum valve heat controls. Each zone has a panel mounted temperature controller. Each temperature controller uses a type J thermocouple to sense chamber temperature and issues a 5VDC pulse width modulated signal to an SCR power control. The SCR modulates AC power to the appropriate heater zone.

Each temperature controller has a factory adjusted shut-off limit set point that can be used to shut off the signal to the SCR, and therefore the heater power, if the chamber reaches a temperature that is unacceptable to the process.

All heat zones are protected with a global multizone over temperature monitor. The monitor senses temperature inputs through independent type J thermocouples and issues a 24VDC signal through a global relay contact when the temperature is within safe limits.

The two heated capacitive manometers (HCM) have independent self-regulated heating elements, which are powered by the +15VDC and –15VDC power supplies (30VDC potential).

Instructions for adjusting temperature set points are in the Setup section of this manual.

One 0-1000 Torr and one 0-100 Torr heated capacitance manometers (HCM) are used to sense the vacuum chamber pressure and a 0-100 Torr HCM is used to sense the flash vapor chamber pressure. Each HCM transmits a 0-10VDC analog signal to the controller analog card. The pressure is displayed on various touch screen interface panels.

Instructions for setting the pressure variables are in the Setup section of this manual.

The YES-1224P(E) implements a redundant over temp monitor to ensure oven controller components do not fail in a run away condition. Each zone contains a redundant J-type thermocouple, which are wired to the thermocouple input bank of the controller. All heater power wires are connected in series through the overtime monitor normally open alarm relay. If any zone exceeds 250°C, the monitor will shut off heater power and send a signal to the PLC of over temp condition.
Setup, Adjustment, and Test

Getting Started

Place the unit on a bench or table under laminar flow in a location best suited to your process operations and device requirements.

The following tools are required to prepare the unit for installation:

Wrenches: 1/2, 9/16, 5/8, 3/8, 7/8
Flat head screwdriver

Getting Started

Connect the pneumatic nitrogen/CDA with a 1/4" OD line to the Swagelok® bulkhead fitting located at the back of the unit. Hold the bulkhead fitting firmly in place with a wrench while tightening the line to prevent it from twisting and creating a leak. Set regulator pressure to 80-100 PSIG.

Connect the vent/seal purge nitrogen with a 1/4" OD stainless steel or Teflon® line. Use two wrenches when tightening the line. Regulate the static pressure to approximately 20 psig. (The pressure should be adjusted later so the unit backfills from a 10 Torr vacuum level to atmospheric pressure in about 3:10 minutes).

Connect the bottle purge nitrogen with a 1/4" OD stainless steel or Teflon® line. Use two wrenches when tightening the line. Regulate the static pressure to approximately 18 psig. (Confirm the inner two-stage bottle purge regulator is set to 0.4 to 1 psig. See facilities document for detailed pictorial).

Connect the appropriate plasma gases with a 1/4" OD stainless steel or Teflon® line. Use two wrenches when tightening the line. Regulate the static pressure to approximately 18 psig.

Plasma Gases

The vapor vacuum accessories (see facilities drawing for optional configurations):

1. Connect the stainless elbow to the KF25 vapor vacuum connection flange on the rear of the oven. Secure the elbow using the flange clamp and center ring. Confirm screen mesh centering ring is installed.
2. Connect the KF-25 to KF-40 reducer to the long segment end of the elbow. Secure the trap using the flange clamp and center ring.
3. Connect the input side of the LN$_2$ trap to the KF-40 side of the reducer. Secure the trap using the flange clamp and center ring.
4. Place Supplied trap stand under the LN$_2$ trap
5. Connect one end of the vapor vacuum line to the outlet side of the LN$_2$ trap. Secure the line using the flange clamp and center ring.
Setup, Adjustment, and Test

6. Connect the other end of the vapor vacuum line to the hydrocarbon vacuum pump. Secure the line using the flange clamp and center ring.
7. Connect the K-type thermocouple plug, from the LN$_2$ trap, into the jack labeled “T/C LN2” on the rear of the control console. Insert thermocouple rod into the vent hole on the LN$_2$ trap.
8. Fill the LN$_2$ trap with liquid nitrogen. Do not start the pump motor until this step is complete.

Assemble the **plasma vacuum accessories** (see facilities drawing for optional configurations):

1. Connect the KF-40 stainless elbow to the KF40 plasma vacuum connection flange on the rear of the oven (bottom of vacuum box). Secure the elbow using the flange clamp and center ring.
2. Connect the KF-40 tee to the KF-40 stainless elbow. Secure the tee using the flange clamp and center ring.
3. Connect the KF-40 bellows line to the second plasma vacuum flange (side of vacuum box). Secure the line using the flange clamp and center ring.
4. Connect the other end of the KF-40 bellows line to the KF-40 tee. Secure the line using the flange clamp and center ring.
5. Connect one end of the plasma vacuum line to the remaining KF-40 tee connection. Secure the line using the flange clamp and center ring.
6. Connect the other end of the plasma vacuum line to the Fomblin® oil or dry scroll vacuum pump. Secure the line using the flange clamp and center ring.

Connect a scrubbed house exhaust to the ventilation collar. There should be a 2-15/16” OD tube located at the back of the unit.

Connect the system's AC cord to the specified power.

Connect the pump outlets to the scrubbed house exhaust.
Setup, Adjustment, and Test

Remove the side cover and attach the anhydrous ammonia (or other process gas) with a 1/4" OD line to the stainless steel Swagelok® fitting through the back of the Side Assembly. Hold the bulkhead fitting firmly in place with a wrench while tightening the line to prevent it from twisting and creating a leak or damaging the recessed fitting bracket (see facilities for exploded view of bulkhead connections).

Regulate the ammonia pressure to 5-10 psig (15-30 psig for other process gas).

Confirm the source chemical purge regulator is set to 0.4-1 psig (The power will have to be turned on to complete this step. (See facilities drawing for location).

Replace the side cover on the unit.

Connect the plasma RF supply power cord to the rear of the control console. Twist to lock the connector.

Connect the plasma RF supply communications cable to the rear of the control console. Install 4-40 screws to secure the DB-15 connector.
**Setup, Adjustment, and Test**

Connect the plasma RF power output cable from the rear of the tool to the plasma RF supply. Twist the BN connector outer fastener until secure.

Press the “Power On” button on the front panel and hold until the “Enclosure Pressure OK” indicator light illuminates.

**NOTE:** Do not place any obstacle within 6 inches of pressurization fan inlet zone. The positive fan pressurization interlock may not latch if obstructed.

Plug in the pump. Turn on the pump power switches. Refer to pump instruction manuals for proper voltage setting configuration and ventilation specifications.

**WARNING!!!** Do not connect vapor hydrocarbon pump to either plasma pump KF-40 connection on rear of tool. Exposing this pump to plasma may cause an explosion and may cause serious injury or death.

Plug in the pump. Turn on the pump power switches. Refer to pump instruction manuals for proper voltage setting configuration and ventilation specifications.

**CAUTION:** Do not connect plasma Fomblin® or dry pump to the vapor pump KF-25 connection on rear of tool. Exposing these pumps to vapor may cause an immediate pump seizure.

Blow out the interior of the chamber using an ionizing nitrogen blowgun.

Verify that vent/seal purge nitrogen supply pressure is regulated to 15-30 PSIG.

Verify that bottle head purge nitrogen supply pressure is regulated to 15-20 PSIG.
Setup, Adjustment, and Test

Adjust Ammonia Pressure (Process Gas)

Verify that the ammonia supply pressure is set to **5-10 PSIG** (15-30 psig for other process gases).

CAUTION: Before handling any chemical or gas, please carefully read the label and all information pertaining to that substance.

At room temperature and atmospheric pressure, ammonia is a colorless, alkaline gas that has a pungent odor and readily dissolves in water. It is shipped as a liquefied gas under its own vapor pressure of 114 psig (7.9 Bar g) at 70°F (21°C).

Ammonia is considered to be an irritant. Concentrations in the range between 50 to 100 ppm are not considered harmful but can be a nuisance. In case of accidental contact, immediately flush the affected area with water for 15 minutes to ensure all traces of the ammonia have been completely rinsed away, contact a physician and the poison control center in your area for information concerning medical treatment.

WARNING!!! Make sure the pressure in the chamber does not reach atmospheric pressure during the NH₃ filling step. The door ONLY provides a vacuum seal. If the chamber reaches atmospheric pressure, NH₃ will flow freely into the area.

Set Plasma Gas Pressures (Gas 1-3)

Verify that the plasma gas supply pressures are set to 15-30 PSIG.

CAUTION: Before handling any gas, please carefully read the label and all information pertaining to that substance.

Vapor Detection

If the system loses power during a run, when it is powered back up, the chamber must be purged. This is a result of the vapor detection interlock, which sets a flag in the PLC when the process gas or vapor valve is activated. This feature is intended to protect the user from opening the door when vapor is present in the chamber, and releasing fumes into the surrounding area.
Setup, Adjustment, and Test

The chamber leak check procedure can be used to verify chamber cleanliness and vacuum integrity. The procedure measures chamber base pressure and leak back rate. For the best results, base pressure and leak rate testing should be done after the oven has been at vacuum for several hours to allow volatile contaminants like water to vaporize and be removed from the chamber.

With the oven controller in reset mode and operator’s panel active, push the “Press to Select Recipe” button, enter “0” on the numeric keypad, and push “enter” then “done”. Press the “Press to Start” button. The program will open the vacuum valve until the “Press to Reset” button is pushed.

Wait for the pressure to stabilize with the vacuum valve open. Base pressure should be under 10 mtorr. If pressure is too high, allow the chamber to remain at vacuum for a few hours to evaporate volatile contaminants. It may be necessary to clean the chamber to remove process residues.

When a satisfactory base pressure has been reached, press the “Press to Reset” button to close the vacuum valve. Wait 1 or 2 minutes to allow chamber gas flows to stabilize, then measure the increase in pressure over a one minute period. Pressure rise rate should be less than 250 mT per minute. If pressure rise rate is too high, allow the chamber to remain at vacuum for a few hours to evaporate volatile contaminants and repeat the test. It may be necessary to clean the chamber to remove process residues.

If a leak is suspected, further path isolation can be verified by manually closing the vapor valve after resetting system:

With the oven controller in reset mode and Operator’s panel active; push the “Goto Alarm Panel”, press the “Enter Access Code” button, enter 1966 on the numeric keypad, and push “enter”. When the maintenance panel is activated; Press the “Goto Factory Setup Panel” button, press the “Goto Vacuum Panel”, and press the “Press to Open Vapor Valve” button to de-illuminate the switch.

Observation of the rate of rise of both the flask and the chamber pressures to help pinpoint the leak region. Press the “Exit button to return to the operator panel screen.

When the test is complete: With the oven controller in reset mode and operator’s panel active, push the recipe select button, enter “15” on the numeric keypad, push “enter” then “done”. Press the “START” button. The system will purge the chamber/flask and return the system pressure to atmospheric levels.
Heater control for the YES-1224P chamber is divided into seven areas.

Four chamber zones:

- **DOOR**: Heaters on front of the chamber door
- **FRONT**: Heaters around front section of chamber
- **MIDDLE**: Heaters around middle section of chamber
- **REAR**: Heaters on rear chamber wall

Two Vapor flask zones

Two Vapor Line zones

Three Vacuum line zones

The four chamber temperature controllers were pre-calibrated during testing to display the correct product temperatures at 200°C.

The maximum set point for any controller is 200°C.
Setup, Adjustment, and Test

Temperature Controller
Set Points

Press the circular arrow button located on the far right lower side of the controller until SP is displayed on the display window (press once). Press and hold the up or down arrow until the desired temperature is displayed. Press circular arrow button again to activate set point. Allow four hours for complete warm-up of system if the machine is started from a room temperature condition.

Figure 7 Partlow 1160 plus Controller
To access the liquid nitrogen trap temperature/volume alarm trip point:

1. On the touch screen, from the operator screen, press the "Goto Alarm Panel" button to go to the Alarm screen.
2. Press the "Enter Access Code" button, Enter "1966" on the numeric keypad, and press the "Enter" button to activate the Maintenance panel screen.
3. Press the "Goto Factory Setup Panel."
4. Enter the desired cold trap temperature trip point in °C (To disable the trip point alarm enter 30000. The minimum temperature entry is -50°C or a –50 numerical entry).
5. The volume alarm trip point should be preset. This value is dependant on the size of the LN\textsubscript{2} trap.

Set the pressure variables on the touch screen operator interface panel. One 0-1000 and one 0-100 torr capacitance manometers (HCM) are used to sense the vacuum chamber pressure. Each HCM transmits a 0-10VDC analog signal to individual analog card terminals and the resultant values are displayed on various touch screen panels.

The five pressure variables have different functions for each of the three types of process, vapor prime, image reversal, silylation, and chemical vapor deposition. Recipe 1-6 and recipe 10 are user defined for your particular application See the process descriptions in The Operation Section, for details. Recommended values for the five pressure variables for each process are as follows (in torr):

<table>
<thead>
<tr>
<th>Process</th>
<th>PH*</th>
<th>PL*</th>
<th>BASE</th>
<th>PRO*</th>
<th>AB*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vapor prime</td>
<td>600</td>
<td>10</td>
<td>1</td>
<td>N/A</td>
<td>20</td>
</tr>
<tr>
<td>Image Reversal</td>
<td>600</td>
<td>100</td>
<td>100</td>
<td>500</td>
<td>600</td>
</tr>
<tr>
<td>Silylation</td>
<td>600</td>
<td>10</td>
<td>1</td>
<td>100</td>
<td>500</td>
</tr>
<tr>
<td>CVD</td>
<td>600</td>
<td>10</td>
<td>0.5-1</td>
<td>1-30</td>
<td>500</td>
</tr>
<tr>
<td>Plasma</td>
<td>600</td>
<td>10</td>
<td>0.25</td>
<td>0.40</td>
<td>500</td>
</tr>
</tbody>
</table>

* PH = Purge High  
PL = Purge Low  
PRO = Process  
AB = Abort
Setup, Adjustment, and Test

To access the pressure variables screens:

1. On the touch screen, from the operator screen, press the "Goto Alarm Panel" button to go to the alarm screen.
2. Press the “Enter Access Code” button, Enter “1966” on the numeric keypad, and press the “Enter” button. To activate the maintenance panel screen.
3. Press the “Goto Recipe Set Up Panel” button, Press the “Goto Recipe Set Up Panel 2” button.
4. Press the “Press to Select Recipe Number” button and then press the “Press to Load Recipe” button to load selected recipe parameters to the PLC.
5. Set each pressure variable by pressing the appropriate display box and entering the desired value. Press the “Go Back” button to return to the recipe setup panel 1 screen and finish pressure variables.
6. Return to recipe setup panel 2 and press the “Press to Save Recipe” button. Parameters will revert to old saved configuration if not saved before exiting.

| Process Variables |

Set the process variables on the touch screen operator interface panel.

Process variables are:

- Number of pre-process dehydration cycle purge loops
- Number of post-process evacuation cycle purge loops
- Process duration
- Warm up delay
- Plasma power
- Plasma Duration

1. On the touch screen, from the operator screen, press the "Go To Alarm Panel" button to go to the Alarm panel display.
2. Press the “Enter Access Code” button, Enter “1966” on the numeric keypad, and press the “Enter” button. To activate the Maintenance panel screen.
3. Press the “Goto Recipe Set Up Panel” button; press the “Goto Recipe Set Up Panel 2” button.
4. Press the “Press to Select Recipe Number” button and then press the “Press to Load Recipe” button to load selected recipe parameters to the PLC.
5. Set each process variable value by pressing the appropriate display box and entering the desired value. Press “Enter” and then “Done.”
6. Return to recipe setup panel 2 and press the “Press to Save Recipe” button. Parameters will revert to old saved configuration if not saved before exiting.
Setup, Adjustment, and Test

Recommended process variable values for each of the process is as follows:

CVD Process Variables:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dehydration Cycle Purges:</td>
<td>3</td>
</tr>
<tr>
<td>Warm up delay:</td>
<td>10*</td>
</tr>
<tr>
<td>Evacuation Cycle Purges:</td>
<td>3</td>
</tr>
<tr>
<td>Process duration:</td>
<td>300-2700 seconds</td>
</tr>
</tbody>
</table>

*Large loads may require longer warm up delay times. Check internal thermocouple temperature and determine warm up time for delay time setting on repeated loads. 45 minutes for warm up delay is not uncommon.
Set the infusion variables on the touch screen operator interface panel.

Infusion variables are:

- Max number of pulses
- Injector pulse time open
- Injector pulse time closed

1. On the touch screen, from the operator screen, press the “Go To Alarm Panel” button to go to the Alarm panel display.
2. Press the “Enter Access Code” button, Enter “1966” on the numeric keypad, and press the “Enter” button. To activate the Maintenance panel screen.
4. Press the “Press to Select Recipe Number” button and then press the “Press to Load Recipe” button to load selected recipe parameters to the PLC. Press the “Go Back” button to return to recipe setup panel 1 screen.
5. Set each infusion variable value by pressing the appropriate display box and entering the desired value. Press “Enter” and then “Done”.
6. Press the “Goto Recipe select Panel 2” button and press the “Press to Save Recipe” button to store the new parameters to the PLC. Parameters will revert to old saved configuration if not saved before exiting.
The bottle interface may be set up for bottles in the range of 25 – 500ml.

1. Attach the barbed Luer® adapter fitting on the line from the micro-pump to the male Luer fitting on the long needle.
2. Attach the Luer adapter fitting on the line from the regulated purge manifold to the male Luer fitting on the short needle.
3. Insert the long needle through the septum seal, until needle tip touches the bottle bottom.
4. Insert the short needle through the septum.
5. Support needles so incidental retraction does not occur.

Figure 8 Septum Interface Setup
The YES-1224P(E) chemical delivery system is located in the side assembly, behind the small side and front access panel. The chemical storage tray is capable of holding 2 factory supplied chemical bottles of 25-50 ml capacity. Your system can be set to accept larger bottles (acceptable bottles are of compatible septum pierce type). Contact YES for custom size applications.

**WARNING!!!** Incompatibilities between previously sourced chemicals and fresh source chemicals of a different composition may produce undesirable and/or dangerous effects based on stoichiometric reactions.

It is therefore recommended that a cleaning solvent (such as toluene, alcohol, etc.) compatible with previously sourced chemical be run through the system and vaporized completely before attaching and priming fresh source materials.

Solvent flush cleaning routines may not be effective for crossover contamination caused by previously sourced chemicals of a different composition.

1. Insert a full *bottle 1* into the *source 1* bottle tray section
2. Pull back on the *source 1* bottle clamp to compress the four springs, until the bottle fits into the three point hold down (bottle may need to be rotated to fit as some are out of round).
3. Push bottle down so it’s flush to base tray.
4. Confirm needles are properly engaged into septum interface.
Setup, Adjustment, and Test

Regulate Bottle Head Purge Pressure

Confirm the source bottle head purge regulator is set to 0.5-1 psig (see the facilities section of this manual for an exploded view of side assembly):

1. From the operator panel press the “Go To Alarm Panel” button to switch to the alarm panel display.
2. For nitrogen conservation purposes, a positive bottle volume value initiates the bottle head purge and allows flow through the small needle. Confirm that there is a positive value stored in the “Enter source bottle Volume in ml” display. If value is zero; Press the “Enter source bottle Volume in ml” button, temporarily enter a positive value on the numerical entry panel, press “Enter” and then “Done”.
3. Adjust source bottle head purge regulator to above mentioned pressure.
4. Re-enter “0” into the “Enter source bottle Volume in ml” display. The nitrogen head purge valve will shut off until prime sequence is complete.

Recipe Management

A recipe needs to be defined in order to prime the desired pump system, run product, and clean the system. From the operators panel, press the “Press to View Recipe Define Panel” to view the recipe types and associated recipe number. Press the “Exit” button to return to the Operator’s Panel.
The pump lines will need to be evacuated of gases and replaced with the liquid chemical in order to achieve a repeatable process. YES should have set up your system for your chemical. If not, refer to the Setting Infusion Volumes/Pulse Variables section of this manual.

1. On the touch screen, from the operator screen, press the “Goto Alarm Panel” button to go to the Alarm screen.
2. Press the “Enter Access Code” button, Enter “1966” on the numeric keypad, and press the “Enter” button. To activate the Maintenance panel screen.
3. Press the “Goto Recipe Set Up Panel” button. Press the “Goto Recipe Setup Panel 2” button. Press the “Press to Select Recipe” button, enter 7 on the numeric entry pad, press ”Enter” and then “Done”. Press the “Press to Load Recipe” button to load recipe 7 from the PLC.
4. All fields should be setup for this recipe except for the source 1-2 bottle volumes. If succeeding bottle replacement volumes are to remain the same, these fields will never have to be changed.
5. Press the desired “Enter Standard Source Level in ml” button. Enter new source bottle volume on the numeric keypad, push “Enter” then “Done”.
6. Press the “Exit” button to return to the Operator’s panel display.

The prime routine can be activated from the buttons located on the left side of the control console or from the prime recipe panel on the touch screen.
Setup, Adjustment, and Test

### Preprogrammed Prime Lines Field Values

The following list contains the preprogrammed prime lines field values in case they are inadvertently changed:

- **Process time**: 60 sec
- **Evacuation purges**: 3
- **Purge pressure high**: 500
- **Base pressure**: 1
- **Purge pressure low**: 10 Torr
- **Evacuation time**: 300 sec
- **Abort pressure**: 600 Torr
- **Dehydration Purges**: 0

### Infusion Volume /Pulse Variables

If YES has NOT calibrated your system for a particular chemical (chemical volume per pulse and pulse time open/closed variables), the remaining fields will need to be identified to determine what values result in the 2 ml of chemical injection required to fill the lines. The remaining variables and their functions:

- **Max number of pulses**
  This is the maximum desired number of pulses required for the process. Correlates to a desired infusion volume.

- **Injector pulse time open**
  Used to tune the volume per pulse rate into a whole number correlation. Unit is 1/100 seconds.

- **Injector pulse time closed**
  Used to allow extra time between open pulses for slower vaporizing chemicals. Unit is 1/100 seconds.

- **Volume per pulse**
  The volume infused per each open pulse of the micro-pump. Once calibrated, the value stored in this field should never change unless a different chemical is used. Unit is μL.
The YES-1224 is a vapor pressure oriented process. Volumetric delivery is important, but the observations of vapor pressure curves of chemicals is the predominate limiter to a successful process. Infusing chemicals into the process chamber is limited to the maximum expansion pressure of a chemical at a particular temperature and the rate in which the chemical can vaporize. Further increases in volume or infusion rates over the physical limitations will not generate a beneficial result, as the chemical can no longer expand or vaporize into the process chamber. This will only result in condensation in the vapor chamber. Many chemicals are sensitive to prolonged boiling in the liquid phase and decay rapidly into solids that may be difficult to remove.

However, volumetric tracking is important to scientists when data is collected to understand the fundamentals of any laboratory test series. It is also important to the tracking system of the YES-1224 to control vapor trap drain, and chemical bottle refill/exchange routines.

The micro-pump factory delivery volume is 20μL/pulse, based on distilled water and zero pressure differentials. Volume/pulse values will be different on the YES-1224P(E) as chemical viscosity and pressure head forces on the system will affect the manufacturers factory delivery specifications.

Tests can to be done in order to calibrate the pulse to volume ratio. Selecting a pulse range, running a process, and comparing the remaining source volume to determine the infusion volume is a simple method. Special attention needs to be paid as not to exceed the maximum vapor pressure of a chemical at a particular temperature to prevent vapor condensation in the chamber.

To Set-up the infusion volume/pulse variables:

1. Consult YES for guidelines on maximum vapor pressure, maximum volume, and vaporization rate for your particular chemical. We may have data to eliminate the need for infusion variables set-up.
2. Confirm line prime routine has been completed.
3. From the Alarm Panel, Press the “Enter Access Code” button, Enter “1966” on the numeric keypad, and press the “Enter” button. To activate the Maintenance panel screen.
4. From the Maintenance Panel, push to “Goto Recipe Set Up Panel” button.

The screen will change to the last saved recipe setup panel.

1. Press the “Goto Recipe Set Up Panel 2” button. Press the “Press to Select Recipe” button, enter the recipe that requires changes on the numerical entry pad, press “Enter” and then “Done.”
2. Press the “Press to Load Recipe” button to load the recipe onto the touch screen. Press the “Go Back” button to access the pulse times. Make sure to document which recipe you will be calibrating volume with, as you will need to come back and readjust parameters.
3. Push the desired injector “Injector Pulse Time Open” button, and enter the value “8” on the keypad. Press “Enter” and then “Done” when data entry is complete.
4. Press the desired injector “Enter Max Number of Pulses” button, and enter the value “10” on the keypad. Press “Enter” and then “Done” when data entry is complete.
5. Press the desired “Injector Pulse Time Closed” button, and enter the value “8” on the keypad. Press “Enter” and then “Done” when data entry is complete.
6. Press the “Enter Process Pressure” button and enter the value “300” on the keypad. Press “Enter” and then “Done” when data entry is complete. This allows full expansion to 300 Torr, although the max number of pulses is set to 10 from 3b. A typical expansion pressure would be about 10 Torr, or 1 torr/pulse.
7. Press the “Goto Recipe Set up Panel 2” button and then press the “Press to Save Recipe” to save the changes.

After parameters are set, press the “Go Back” button twice to return to the maintenance panel. Press the “exit” button to return to the Operators panel.

1. Press the “Press to Select Recipe” button. Enter the value for the desired calibration recipe on the keypad. Press “Enter” and then “Done” when data entry is complete.
2. Press the “Reset” and then the “Press to Start” button to activate the recipe.
3. Observe the drop in volume after the run is complete.

The simplest volumetric tracking device would be a graduated cylinder with septum cork installed. Once the recipe is run, the level drop in the cylinder will give the volume displacement for 10 pulses. Be sure to dictate your results, as once verified, these pulse values will be used for all recipes. The pulse per volume is to be entered into the recipes once the volume per pulse value is determined.

It may be desirable to tune the volume per pulse rate into a whole number. Altering the “Injector Pulse Time Open” variable will help adjust the volume per pulse rate. The longer the open pulse time, the more chemical will infuse per pulse.

**NOTE:** The longer the injector is closed, the more chemical is infused.

After the calibration is complete, replace the calibration bottle with the standard volume source bottle and rerun the line prime routine. This will reset the volume counter for bottle level tracking.
WARNING!!!  The process used for HMDS in our systems also works well using other silanes. However, YES cannot guarantee results of other silanes or any other chemical and does not take responsibility for any harm either to the system or persons for use of other chemicals within the system. The operator must be aware of the potential dangers in mixing chemicals and choose a compatible solvent when cleaning the flask/chemical delivery system.

| Vapor Cure Procedure |

NOTE: Since excessive amounts of liquid may be introduced during this procedure, condensation/wetting of chemicals may leave residue in chamber and vapor flask. When vapor curve procedure is complete, it is recommended that vapor flask be disassembled and flask/chamber thoroughly cleaned before processing product.

An important aspect of the CVD or Silylation process is qualifying the vapor curve of a chemical. Most MSDS data sheets do not include this information, but analysis of the vapor curve will determine the maximum allowable process pressure expansion for a given temperature and volume of chemical. Further allowable increase in process volume will result in condensation of chemical onto the product, and uniformity performance will be adversely affected. Last, it is important not to heat chemical well past their degradation temperature. Doing so will cause deposition of reactants in the flask and will decrease maintenance cycle intervals.

Since this procedure is sensitive in nature, please contact YES for guidelines on qualifying your particular chemical.

| Liquid N₂ |
| Trap/Thermocouple |
| Installation |
Setup, Adjustment, and Test

All the necessary hardware should be supplied if a liquid nitrogen trap is purchased from YES. Attach the trap as indicated in figure below (see facilities section of this manual for trap configuration options). Confirm trap support is in place before tool operation as damage to vacuum plumbing may occur if trap is unsupported.

Align all vacuum components with clamps loose and tighten. Confirm trap valves are closed before operation. The manual fill tube is the smaller OD tube. Attach a funnel to the fill tube for manual fill operation. Insert the liquid nitrogen monitor thermocouple into the vent tube and connect the plug into the thermocouple female connector located on the rear of the control console.

![Figure 9 LN2 Trap Installation](image-url)
The optional auto refill system will need final assembly.

The auto refill system should arrive in two parts; the pre-assembled plumbing components with solenoid power cords, and the interconnecting cables, oscillator, and control unit.

The liquid nitrogen supply tank or house supply facilities connection must be closer than six feet from auto refill flow-thru sensor LN$_2$ connection as jacketed transfer line is 6 feet in length (bends in line will shorten actual liquid nitrogen supply tank or house supply facilities connection distance). Longer transfer lines are available upon request, although the pre-cool time variable and nitrogen consumption will increase.

**Figure 10 Auto Refill Plumbing Components**
To complete the assembly:

1. Insert the flow-thru sensor through the center vent tube as far as it will go. Orientate the pre-assembled unit so the pre-cool vent tube points away from the tool back panel. Tighten the nylon flow-thru sensor 3/8 male NPT fitting. **NOTE: Do not over tighten fitting.**

2. Connect the pre-cool solenoid power cord to 2 on the controller rear panel.

3. Connect the trap fill solenoid power cord to 1 on the controller rear panel.

4. Connect one side of the sensor cable to the flow-thru sensor, and the other side to channel C on the controller rear panel. Make sure the arrow on the oscillator points toward the sensor.

5. Connect the line power cord to proper facilities (see introduction section and/or facilities drawing at the end of this manual for details).

6. Connect LN2 supply to ½” female AN-type connector (see facility section and/or facilities drawing at the end of this manual for details. Turn on LN₂ source.

7. Turn on the controller power switch (see operation section for detailed information on program variables and sequences).
Press the circular arrow button located on the far right lower side of the controller until SP is displayed on the display window (press once). Press and hold the UP or DOWN arrow until the desired temperature is displayed. Press circular arrow button again to activate set point. Follow the same steps to set up the remaining temperature controllers.

**NOTE:** Allow four hours for complete warm-up of system if the machine is started from a room temperature condition.

### Tool Adjustment

#### Adjust Temp Controller Set Point

### Set Pressure Variables

Pressure variables are the dehydration high and low, base, process, and abort pressures.

1. On the Operator’s Panel touch screen, press the "GOTO ALARM PANEL" button to switch to the Alarm Panel screen.

2. Press the “ENTER ACCESS CODE” button. This will activate a numeric keypad display. Enter “1966” on the entry pad, press “Enter,” then “Done.” This will activate the Maintenance Panel.

3. Press the “GOTO RECIPE SET UP PANEL” button, and Press the “GOTO RECIPE SET UP PANEL 2” button.

4. Press the “PRESS TO SELECT RECIPE NUMBER” button. Enter recipe to be modified on numerical entry pad, press “Enter”, and then “Done”. Press the “PRESS TO VIEW RECIPE” button. This retrieves all recipe information for that particular recipe.

5. Set each pressure and process variable values by pressing the appropriate display boxes and entering the desired value on the numeric keypad.

6. Use the “GO BACK” button on Recipe Setup Panel 2 and the “GOTO RECIPE SETUP PANEL 2” button on Panel 1 to get the access to the desired pressure variable buttons.

7. When finished with data entry, press the “GO TO RECIPE SET UP PANEL 2” button and then press the “PRESS TO VIEW RECIPE” button. Modify the recipe as necessary.

8. Press the “PRESS TO SAVE RECIPE” button. This will save the current recipe parameters to the PLC.

Press the “GO BACK” button to return to the Recipe Setup Panel 1 and press “EXIT” to return to the Operator’s Panel.
Set Process Variables

Process variables are the number of pre-process cycle purge loops, the number of post-process evacuation exit cycle purge loops/durations, the process duration, volume per pulse ratio, and pulse time open closed durations. Screen navigation and variable data entry are performed in the same manner described above.
Process Description

In general, a 1224P process is divided into two parts. First is a plasma cleaning of the substrate. Second is the chemical vapor deposition of the silane or other substance. The process description is broken into sections describing each portion of a typical process.

Plasma Process Outline

1. Ensure process shelves are in the proper order (see description of shelf configuration)
2. Start the YES-1224P system.
3. Allow system to stabilize at the desired process temperature.
4. Load product while oven is hot.
5. Enter the plasma process recipe #.
6. Press Start.
7. The system is evacuated to base pressure (250-400mT).
8. Once the system reaches base pressure, the process gas is turned on and allowed to reach flow equilibrium (2 minutes).
9. The RF generator is turned on and plasma is established. Plasma is run for the duration and power set in the recipe.
10. At the end of the plasma process, the system will backfill with nitrogen.
11. If the recipe is set up to link with a chemical vapor deposition recipe, the second recipe will start.

Chemical Vapor Deposition Outline

1. The recipe starts with a pre-heat delay to warm the product to the chamber temperature.
2. The system is purged of oxygen and moisture through a series of evacuations and nitrogen back fills.
3. After the dehydration purges are complete, the chamber is evacuated to a pressure below the vapor pressure of the process silane.
4. The specified volume of silane is delivered to the micro-pump while the vapor valve is open. The silane is vaporized and the vapor passes from the flask into the chamber.
5. The product is exposed to the silane vapor for the specified process duration.
6. The main vacuum valve is opened at the end of the process duration.
7. Vapor flows out to the LN2 trap and condenses to prevent pump contamination.
8. After the vapor is evacuated, the chamber is cycle purged to remove residual silane vapor.
9. After the cycle purges, the system pumps down to 2 T and checks to ensure all silane vapors have been removed from the chamber.
10. The chamber is vented to atmospheric pressure with nitrogen so that the door can be opened.
Chemicals can be run from temperature up to 200°C depending on the vapor pressure of your chemical. If process temperature is too low, condensation may occur in the system resulting in poor coating qualities.

**Temperature Controller Set Points:**

**Tri-ethoxy silanes (APTES, OTES, etc)**
- Chamber Front, Middle, Rear Door: 150°C
- Flask Line Temperature: 145°C
- Flask Temperature: 140°C

**Tri-chloro silanes (FTDS, etc)**
- Chamber Front, Middle, Rear Door: 100°C
- Flask Line Temperature: 95°C
- Flask Temperature: 90°C

**Pressure Variables:**
- Purge high: 500T
- Purge low: 10T
- Base: 0.5-1.0T
- Abort: 500T

**Process Variable:**
- Number of purge cycles: 3
- Warm up delay: (with no plasma) 10-30 minutes
- Number of evacuation purges: 3
- Process Duration: 300-3600 seconds (600 typical)

**Process Sequence**

The following is a typical sequence description:

1. Delay cycle start a number of minutes set by the "Enter Warm Up Delay in Minutes" variable.
2. Cycle purge chamber a number of times set by the "Enter # of Dehydrate Purges" process variable.
3. Evacuate chamber to “Purge Pressure Low in Torr” variable.
4. Alarm if “Purge Low Pressure” variable is not reached within timer setting.
5. Fill chamber with nitrogen “Purge Pressure High in Torr” variable.
6. Alarm if “Purge High Pressure” is not reached within timer setting.
7. Evacuate chamber to “Base Pressure” variable.
8. Alarm if “Base Pressure” not reached within timer setting.
9. Inject quantity of chemical specified by “Enter Source 1 Injector Volume in ml” and “Enter Process Pressure” variables while vapor valve is open.
10. Leave vapor valve open for duration set by "Enter Process Pressure" process variable.
11. Alarm if pressure does not reach “Enter Abort Pressure in Torr” within timer setting.
13. Evacuate chamber to “Enter Purge Pressure Low” variable using main vacuum valve.
14. Alarm if “Dehydration Low Pressure” not reached within timer setting.
15. Cycle purge chamber a number of times set by the "Enter # of Evacuation Purges" process variable.
16. Fill chamber with nitrogen to “Enter Purge Pressure High in Torr” variable.
17. Alarm if “Purge High Pressure” is not reached within timer setting.
18. Evacuate chamber “Enter Purge Pressure Low in Torr” variable.
19. Alarm if “Purge Low Pressure” variable is not reached within timer setting.
20. Pump chamber down to 2 Torr.
21. Alarm if 2 Torr is not reached within timer setting.
22. Check Vapor detection gauge/HCM voltage comparison set by “Enter Vapor Detection Value” variable.
23. Once confirmed safe, backfill chamber to atmospheric pressure.
Establishing a Baseline

The baseline is determined by testing at base pressure without infusing chemical, typically when the system is new and chemical has never been infused. Evaluation of the substrate surface characteristics by surface tension energy or molecular examinations will determine the baseline. Modifications of the baseline will later be made after infusing chemical, cleaning, and then retesting. Contact YES for assistance on baseline parameters for your particular chemical.

Running a Process

With Fresh Chemical Installed

1. If unit is set up and has been idle for the required warm up period, skip to step 7.
2. Verify that the YES-1224P(E) facilities have been connected and that the machine has been set up in accordance with the facilities installation and setup sections of this manual.
3. Turn on the YES-1224P(E). It may be necessary to release EMO buttons that might be engaged.
4. Wait for the system controller to finish booting up. The Operator’s Panel status display will say "Reset State" when the machine is ready to run.
5. Wait approximately 2 hours for the heated manometer temperature to reach partial set point (4-hour heat up time total).
6. After 2 hours, verify that all 10 temperature controllers are set to the correct set points for the intended process. Recommended set points are listed in the process description section of this chapter (2 hour total heat up time to 200°C).
7. Verify that the LN\textsubscript{2} trap is filled with liquid nitrogen (The small tube is the fill location). Replace thermocouple rod into vent tube if removed.
8. Verify that the vacuum pumps are on.
9. Verify source bottle setups have been completed (fresh source bottles only).
10. Verify that intended recipe fields are entered.
11. Verify that pressure variables are set to the correct values for the intended process. Recommended set points are listed in the process description section of this chapter.
12. Verify that the process variables are set to the correct values for the intended process. Recommended values are listed in the process description section of this chapter.
13. Verify that the infusion pulse variables are set to the correct values for the intended process.
14. Place product in the appropriate carriers into the chamber of the system and close the door.
15. Select desired recipe number from the Operator’s Panel.
16. Ensure that enough time is entered in the “Warm Up Delay” for product/carriers to reach steady state temperature. Confirm internal thermocouple reading is at set point value if necessary.
17. Press the START button on the Operator’s Panel to initiate the program sequence.
18. When the system successfully completes a program, the yellow COMPLETE light on the light tower will flash. Press the RESET button on the Touch Screen and unload the product.

19. To run additional product, see next section.

**Running Additional Processes**

1. Verify that the LN\textsubscript{2} trap is filled with liquid nitrogen (The small tube is the fill location). Replace thermocouple rod into vent tube if removed.
2. Select desired recipe number from the Operator’s Panel. No action is required if running continuous processes.
3. Ensure that enough time is entered in the “Warm Up Delay” for product/carriers to reach steady state temperature. Confirm internal thermocouple reading is at set point value if necessary.
4. Press the START button on the Operator’s Panel to initiate the program sequence.
5. When the system successfully completes a program, the yellow COMPLETE light on the light tower will flash. Press the RESET button on the Touch Screen and unload the product.

**Running Cleaning Recipe 8 & 9**

It is recommended that the cleaning recipe be run if the tool will be idle for a substantial period. Use an appropriate, compatible solvent. Keep in mind that the infusion variables must be set to infuse the volume necessary to clean the system. Consult YES for help on infusion variable setting for your particular solvent.

The cleaning parameters are shared; Bottle 1 (Recipe 8) and Bottle 2 (Recipe 9). When Recipe 8 is selected on the Operator’s Panel, only Source 1 will deliver. When Recipe 9 is selected, only Source 2 will deliver.

1. If unit is set up and has been idle for the required warm up period, skip to step seven.
2. Verify that the YES-1224P(E) facilities have been connected and that the machine has been set up in accordance with the facilities installation and setup sections of this manual.
3. Turn on the YES-1224P(E). It may be necessary to release EMO buttons that might be engaged.
4. Wait for the system controller to finish booting up. The Operator’s Panel status display will say "Reset State" when the machine is ready to run.
5. Wait approximately 2 hours for the heated manometer temperature to reach partial set point (Manometers require 4-hour heat up time total).
6. After 2 hours, verify that all six temperature controllers are set to the correct set points for the intended process. Recommended set points are listed in the process description section of this chapter (2 hour total heat up time to 200°C).
7. Verify that the LN\textsubscript{2} trap is filled with liquid nitrogen (The small tube is the fill location). Replace thermocouple rod into vent tube if removed.
8. Verify that the vacuum pump is on.
9. The solvent bottle volume will have to be entered into the unit. Determining how much chemical volume/recipe parameters are needed for proper cleaning is based on factory testing and/or a baseline comparison. See the establishing a baseline section of this manual for further details.

10. On the touch screen, from the operator screen, press the "Go To Alarm Panel" button. Enter “1966” on the numerical entry pad, press “Enter”, and then “Done” to switch to the Maintenance Panel.

11. Press the “Goto Recipe Setup Panel” button. Press the “Goto Recipe Setup Panel 2” button. Press the “Press to Select Recipe Number” button. Enter “8” or “9” on numerical entry pad, press “Enter”, and then “Done”. Press the “Press to Load Recipe” button. This retrieves all recipe information for the cleaning recipe. Recipes 8 and 9 have the same recipe screen, and therefore share the same parameters.

12. Press the “Enter Source Bottle Volume in ml” button. Enter a volume greater than the required solvent volume needed for a proper cleaning on the numeric keypad. Press “Enter” and then “Done”. Confirm that the solvent bottle contains this same or greater entered volume. Press the “Exit” button to return to the Operator’s Panel display.

13. Insert the cleaning septum bottle into the source bottle tray. See the equipment setup section of this manual for septum pierce bottle interface setup instructions.

14. Press the “Press to Select Recipe Number” button. Enter “8” or “9” on the numerical entry panel. Press “Enter” and then “Done”. Confirm “8” or “9” is displayed in the recipe select window. Press “Reset” and then “Start”. The system will run the process based on the variables preset into recipe 8 & 9 (Selecting recipe 8 will clean bottle 1 source lines only, and selecting recipe 9 will clean bottle 2 source lines only).

15. When complete, the system will display the message “Process complete failed to reach process pressure set point”.

16. Press the “Reset” button.

17. On the touch screen, from the operator screen, press the "Go To Alarm Panel" button to switch to the alarm panel screen.

18. Press the “Enter Source Bottle Volume in ml” button. Enter “0” on the numeric keypad. Press “Enter” and then “Done.” This will shut off the bottle head purge valve and limit solvent evaporation.

Leave the solvent bottle in the tray and do not remove needles until it is desired to reinstall chemical and continue process.
There are two methods to prime the lines after completing a cleaning routine:

Prime lines directly after cleaning:
It may be of concern that the standard prime lines recipe, preceded by the cleaning recipe may cause back contamination, dilution, and or degradation to source chemical. As the solvent is pushed through the lines by the solute, a mixing in transition zone may occur. Testing through YES has shown that the infusion velocity is high enough to overcome the mixing/back-streaming effect on the chemicals we have tested, though it is not clear if this is factual with other chemicals.

Purge lines directly after cleaning:
Purging the lines with nitrogen and evacuating lines of solvent prior to the prime step will minimize the mixing/back-streaming effect, if it is truly an issue. Exchanging the solvent bottle with an empty septum pierce bottle and rerunning the cleaning recipe routine will allow the lines to be purged before initiating the prime lines routine.

To remove residual condensed liquid:

1. Press the "Press to Select Recipe Number” button from the Operator’s Panel
2. Enter “15” on the numerical entry keypad, press “Enter,” then “Done”.
3. Press “Start” from the Operator’s panel.
4. When the process is complete, push the “Reset” button on the touch screen.

This evacuation recipe differs from the purge or evacuation loop in that the system pumps down to a base pressure and remains open for a predetermined time. The YES-1224P(E) will check for vaporization by pressure rate of rise tracking, and repeat base pump down until no rate of rise is detected.
Operator Interface

This section describes the principles and theories involved in the operation of the YES-1224P(E).

Main Power Disconnect

The main power disconnect switch for the YES-1224P(E) is located on the right rear of the oven control console. The main disconnect switch removes all electrical power from the tool.

Emergency Off Buttons

Emergency power off buttons are located on the front and rear of the control console. The EMO buttons turn off all components on the tool. Both EMO buttons must be disengaged in order to turn on the machine.

Console Cover Interlock

The control console has an interlock switch for its cover. If the cover is removed during operation, the YES-1224P(E) will shut off. The switch can be manually bypassed for maintenance. The cover must be on or the switch must be bypassed in order to turn on the machine.

Console Pressure Interlock

The control console has a pressure interlock system. If the pressure differential between the internal console and the surrounding air falls below 0.25 IWC, the YES-1224P(E) will shut off. The pressure switch can be manually bypassed for maintenance using a toggle switch located on the pressure switch body. The pressure requirements must be satisfied or the switch must be bypassed in order to turn on the machine. Return the toggle switch to run mode before installing the console cover, as the machine will not stay powered up if toggle switch is not returned to the run mode.
Operator Interface

YES-1224P is operated primarily via a 5 inch monochrome touch screen operator interface on the front panel of the system (see below). The touch screen has several screens, and there are five types of buttons or displays used in the operator interface for the YES-1224P. A flowchart of the operator interface is presented below. The operation of each screen follows:

A touch screen push button is an area of the screen that displays text and that will send a value to the system controller when the operator touches it.

A message display button is an area of the screen that displays different text messages depending on the value of a number that is sent to the touch screen by the system controller. (Touching a message display button has no effect).

A numeric display button is an area of the screen that displays the value of a number that is sent to the touch screen by the system controller. (Touching a numeric display button has no effect).

A numeric entry button is an area of the screen that displays the value of a number sent to the touch screen by the system controller. Touching a numeric entry button causes the touch screen to display a numeric keypad. When the numeric keypad appears, press the number pads to enter the desired value. Press the “Enter” button to input the new value, then press the “Done” button to exit from the numeric keypad. The value of the displayed number is changed in the system controller memory.

A go to button is an area of the screen that displays the route to an undisplayed screen. Touching a go to button will cause the display to change to the indicated screen.
Figure 12: System Status Panel Architecture

Operator Interface

System Status Panel (booting software)

Main Operator's Panel

- Select Recipe
- View Recipe Define
- Enter Batch
- Start
- Reset
- Go To Alarm Panel

- Enter Source Bottle 1 Volume
- Enter Source Bottle 2 Volume
- Enter Access Code (password)
- Enter to Clear Cold Trap

Recipe Set Up Panel

- CVD Process
- Plasma Process
- Prime Injectors
- Cleaning Recipe
- Image Rev.

Factory Set Up (password)

Go Back (back one panel)

Exit (back to Main Panel)

Process

Warm Up

# Evac

Purge

Base

Process

Abort

Press

Press

Press

Press

# Evac

Vol/Pulse

Evac

Purge Pressure

Press

Purge Pressure

Press

Base Evac

Abort

Vol/Pulse

Dehydration Purges

Purge Pressure

Purge Pressure

Purge Pressure

Press
NOTE: Factory Set Up Panel is set by the manufacturer and should not be altered unless directed by a YES field service representative. Call 1 925-373-8353 (worldwide) or 1 888-YES-3637 (U.S. toll free).
Operator Interface

**Figure 14 Operator Setup Panel (Main Screen)**

This push button is used to start the selected recipe and begin your process.

Pressing this button will take you to the Recipe Define Panel. This panel shows the action that corresponds to the selected recipe number.

Pressing this button will activate the numeric entry pad. Enter the desired batch number, press enter, and then done. The touch screen will revert back to the Operator’s Panel.

Starts program sequence selected by the recipe number setting if the system controller is in the reset state (shown on the status display). Has no effect if a program is running.
**Operator Interface**

The message display shows machine system status.

A numeric display. Displays the current process chamber space temperature in °C

A numeric display. Displays the current process chamber pressure in Torr.

When the reset button is pressed, the machine stops all activity and goes back into idle mode. The reset button is pressed to (1) acknowledge alarms, (2) reset system if process is aborted (in this case, machine will ring until you press reset), or (3) simply to reset the machine at the end of a process run. It can also be used to interrupt any process.

An informational display showing chamber pressure.

Changes screen display to the Alarm Panel (see below for Alarm Panel detail).

| Reset State |
| Internal Chamber Temperature |
| Process Chamber Pressure in Torr |
| Press to Reset Button |
| Chamber Pressure in Torr Button |
| GoTo Alarm Panel |
Figure 15 Operator Panel 2

A numeric entry button. Pressing this button will activate the numeric entry pad. Enter the desired recipe number, press enter, and then done. The touch screen will revert back to the Operator’s Panel.

Press this button to activate the Recipe Define Panel. This panel defines the action that corresponds to the selected recipe number.

A numeric entry button to enter batch number. Pressing this button will activate the numeric entry pad. Enter the desired batch number, press enter, and then done. The touch screen will revert back to the Operator’s Panel.

Displays current system status.

Displays the current process chamber space temperature in °C.
**Operator Interface**

When the reset button is pressed, the machine goes back into idle mode. The reset button is pressed to (1) acknowledge alarms, (2) reset system if process is aborted (in this case, machine will ring until you press reset), or (3) simply to reset the machine at the end of a process run.

A numeric display button showing chamber pressure in torr.

Press to change screen display to Alarm Panel.
**Operator Interface**

**Plasma Process Operator Panel**

**Figure 16 Plasma Process Operator Panel**

Pressing this button will activate the numeric entry pad. Enter the desired recipe number, press enter, and then done. The touch screen will revert back to the Operator’s Panel.

Pressing this button will activate the numeric entry pad. Enter the desired batch number, press enter, and then done. The touch screen will revert back to the Operator’s Panel.

Displays system status.
Operator Interface

Displays the current process chamber space temperature in °C.

A push button. Stops execution of a program sequence and returns to the system controller to the reset state. Turns off alarm state and returns system controller to the reset state. Turns all outputs off. Has no effect if the system controller is already in the reset state.

Displays current process chamber pressure in Torr.

| Internal Chamber Temp |
| Press to Reset |
| Process Chamber Pressure in Torr |
Operator Interface

Figure 17 Recipe Define Panel

Displays process and recipe numbers:

Recipe 0  For leak check procedures.
Recipe 1-6 User defined CVD process recipes.
Recipe 7  Primes system when new chemical source bottles are installed.
Recipe 8  For solvent cleaning of bottle 1 lines, may be other than IPA (must be compatible with silane).
Recipe 9  For solvent cleaning of bottle 2 lines, may be other than IPA (must be compatible with silane).
Recipe 10 User defined Image Reversal process recipe.
Recipe 11-14 User defined Plasma Process recipes.
Recipe 15 For evacuation if process is interrupted (reset, power failure, etc). User will be cued when to use this recipe.
Recipe 16 For venting if process is interrupted (reset, power failure, etc). User will be cued when to use this recipe.

Displays the current temperature status of the LN2 trap in °C.

This button takes you to the main Operator’s Panel.
The message display screen provides useful information to troubleshoot the possible causes for an aborted process before calling YES. If the problem continues, note symptoms and call YES field service at +1-925-373-8353 (worldwide) or 1-888-YES-3637 (U.S. toll free).

The alarm window supplies the operator a list of current and historic alarms. Each entry has a brief description of the alarm as well as the trigger time-date; acknowledge time-date, and the clear time-date. To acknowledge an alarm simply touch the Alarm Window. An alarm window menu will appear at the bottom of the panel. Press the “Mode” button and then use the “Up” or “Down” button to position the pointer over the alarm to be acknowledged. Press the “ACK” button and the current time-date will appear in the acknowledge column. To delete the alarm from the Alarm Window simply press the “Del” button. To exit the Alarm Window, press the “Done” button.

A numeric entry and display button. Enter the volume of the newly inserted source bottle 1. Volume is automatically set when Source #1 Prime button is pushed on the left side of the 1224P.

A numeric entry and display button. Enter the volume of the newly inserted source bottle 2. Volume is automatically set when Source #2 Prime button is pushed on the left side of the 1224P.

**NOTE:** Data entry into source bottle volume fields on this panel are overwritten by data input in the “Enter Standard Source level in ml” from Prime Injectors Panel 2 (when prime recipe is initiated in Recipe 7).
Operator Interface

A numeric entry button. Enter 0 to clear the counter after drain operation is complete. The amount of chemical in the cold trap is calculated based on the volume dispensed and assuming 100% trapped. Actual volume may be less, depending on the solvent content of chemicals used.

Enter 0 to Clear Cold Trap Volume Counter

A numeric display button. Indicates the previous runs process pressure in Torr. Used to confirm repeatability of consecutive processes.

Last Run Process Pressure

A numeric entry button. The access code prevents unauthorized access to the maintenance, system setup, and output screens. After proper code entry, goes to Maintenance Panel.

Enter Access Code

This button takes you to the main Operator’s Panel.

Exit Button
Figure 19 Maintenance Panel

A go to button. Changes the display back to the Recipe Setup Panel 1.

A go to button. Changes the display to the Factory Setup Panel.

A go to button. Changes the screen display back to the Alarm Panel.

This button takes you to the main operator’s panel.
Operator Interface

Recipe Setup Panel

Figure 20 Recipe Setup Panel

Changes the display to the CVD Process Recipe Setup Panel.

Changes the display to the Plasma Process Recipe Setup Panel.

Changes the display to the Prime Injectors Setup Panel.

Changes the display to the Prime Injectors Setup Panel.

Changes the display to the Image Reversal Setup Panel.

Changes screen display to the Maintenance Panel.

Takes you to the main Operator’s Panel.
Operator Interface

Figure 21 CVD Recipe Setup Panel (Recipes 1-6)

Recipes 1-6 can be used to setup and preprogram chemical vapor deposition (CVD) process recipes.

A numeric entry button. Enter the desired volume for Source 1 in mls. Input range 0-50ml.

A numeric entry button. Enter the desired volume for Source 2 in mls. Input range 0-50ml.

Enter the desired time delay for Source 2 in seconds. Input range 0-99999. Only to be used if both Source 1 and Source 2 are used during the same recipe.

A numeric entry button. Enter desired total process time in seconds. Timer is initiated when chemical injection begins. Input range 0-99999
Operator Interface

Injectors 1 Pulse Time Open
in 1/100 Seconds

Injectors 2 Pulse Time Open
in 1/100 Seconds

Enter Warm Up Time
Delay in Minutes

GoTo Recipe Setup Panel
2

Enter desired open time duration for each pulse of Injector 1 in 1/100 seconds. Input range 0-99. Times shorter than 5 may result in pump malfunction.

Enter desired open time duration for each pulse of Injector 2 in 1/100 seconds. Input range 0-99. Times shorter than 5 may result in pump malfunction.

Press to enter the desired silylation warm up delay in minutes. Input range 0-9999

A go to button. Changes screen to the Recipe Set Up Panel 2.

Enter desired closed time duration for each pulse of Injector 1 in 1/100 second. This is to adjust for slow vaporizing chemicals, without over-injecting, when process pressure is the predominant process variable. Input range 0-99. Times shorter than 5 may result in pump malfunction.

Enter desired closed time duration for each pulse of Injector 1 in 1/100 second. This is to adjust for slow vaporizing chemicals, without over-injecting, when process pressure is the predominant process variable. Input range 0-99. Times shorter than 5 may result in pump malfunction.

This button takes you to the Main Operator’s Panel.
Operator Interface

**CVD Recipe Setup Panel 2**

![CVD Recipe Panel 2](image)

**Figure 22 CVD Recipe Panel 2**

- **Enter # of Dehydrate Purges**
  
  Used to set the preferred number of chamber/vapor flask purge cycles. Used to eliminate water from chamber/vapor chamber prior to vapor deposition. This differs from the evacuation purge in that: A dehydration purge has high and low pressure limits, while an evacuation purge pumps down to a base pressure and remains open for a desired time. Input range 0-999.

- **Enter Base Pressure in Torr**
  
  Used to set the process base pressure in Torr. This is the pressure achieved before infusion begins. Input range 0.05-1.0T. Base pressure settings below 0.5T may result in excessive pump down delays and process abort.

- **Enter Abort Pressure in Torr**
  
  Used to set the desired upper fluid expansion abort pressure in Torr. Input range 10-700

- **Press to Select Recipe Number**
  
  Used to set, alter, load, or save the desired recipe.

- **Enter Purge Pressure Hi in Torr**
  
  Used to set the purge cycle high pressure in Torr. Input range 100-500.

- **Enter Evac Time in Seconds**
  
  Used to set the time in seconds in which the vacuum valve constantly stays open to eliminate residual chemical from chamber/vapor chamber. Input range 0-999.
Operator Interface

Used to calibrate chemical volume to pulse ratio. Enter to set the volume per pulse calibration factor for the chemical. Factors such as, chemical viscosity, N₂ pressure and micropump cycle time will affect this input value. It is usually set to 0.1

Pushing this button displays previously defined recipe parameters.

Used to set the purge cycle low pressure in Torr. Input range 0.5-100.

Used to set the number of desired evacuation purge cycles. Eliminates residual chemical from chamber/vapor chamber. Input range 2-999.

This button takes you to the CVD Recipe Setup Screen 1.

Overwrites information pertaining to the selected recipe number as mentioned above. Pushing this button stores current recipe parameters into the controller.
Recipe 7 is used to prime system prior to installing new chemical bottles.

Used to set desired volume for injector pump 1 in mls. 
Input range 0-50ml

Used to set desired volume for injector pump 2 in mls. 
Input range 0-50ml

Used to enter desired total process time in seconds. Timer is initiated when chemical injection begins. Input range 0-99999.

Enter desired open time duration for each pulse of Injector 1 in 1/100 seconds. Input range 0-99.

Enter desired open time duration for each pulse of Injector 2 in 1/100 seconds. Input range 0-99.
Operator Interface

Changes the screen to the secondary recipe 7 set up panel.

Enter desired closed time duration for each pulse of Injector 1 in 1/100 second. This is to adjust for slow vaporizing chemicals, without over-injecting, when process pressure is the predominant process variable. Input range 0-99.

Enter desired closed time duration for each pulse of Injector 2 in 1/100 seconds. This is to adjust for slow vaporizing chemicals, without over-injecting, when process pressure is the predominant process variable. Input range 0-99.

Takes you to the Recipe Setup Panel.

Takes you to the Main Operator’s Panel.

GoTo Recipe Parameter Panel 2

Injector 1 Pulse Time Closed in 1/100 Seconds

Injector 2 Pulse Time Closed in 1/100 Seconds

Go Back Button

Exit Button
Enter Standard Source 1 Level in ml

Enter the volume of the full bottle you are going to insert into the source 1 tray. Input range 0-500ml. This volume will be used when Source 1 Prime button is pressed.

Enter Standard Source 2 Level in ml

Enter the volume of the full bottle you are going to insert into the source 2 tray. Input range 0-500ml. This volume will be used when Source 2 Prime button is pressed.

Enter # of Evacuation Purges

Enter to set the number of desired evacuation purge cycles. Used to eliminate residual chemical from chamber/vapor chamber. Input range 2-999. Usually 3 times is sufficient.

Enter Purge Pressure Hi in Torr

Enter to set the purge cycle high pressure in Torr. Input range 100-600. Normally set at 500.

Enter Base Pressure in Torr

Enter to set the process base pressure in Torr. This is the pressure achieved before infusion begins. Input range 0.1-1. Normally set at 1.
**Operator Interface**

Enter to set the volume per pulse calibration factor for the chemical. 1 equates to 0.02 ml using distilled water. Other chemicals will differ depending on density, viscosity, and pressure head differential. Input range 0-1.0. Normally set at 0.1

This button returns you to the previous Recipe 7 setup panel.

Enter to set the purge cycle low pressure in Torr. Input range 0.5-100 Torr. Normally set to 10.

Enter to set the time in seconds in which the vacuum valve constantly stays open to eliminate residual chemical from chamber/vapor chamber. Input range 0-999. Normally set to 180.

Used to set the desired upper fluid expansion abort pressure in Torr. Input range 5-700. Normally set to 100.

This button takes you to the Main Operator’s Panel.
Operator Interface

Cleaning Recipe Panel (Recipe 8 & 9)

Recipes 8 & 9 are used for solvent cleaning of source bottle lines. Cleaning parameters are shared for pump 1 and 2.

Source Bottle 1 = Recipe 8
Source Bottle 2 = Recipe 9

NOTE: when Recipe 8 is selected on the Operator’s Panel, only Source 1 will deliver. When Recipe 9 is selected, only Source 2 will deliver.

Enter desired volume for injector pump 1 in mls. Input range 0-50ml.

Enter desired volume for injector pump 2 in mls. Input range 0-50ml.

Enter desired total process time in seconds. Timer is initiated when chemical injection begins. Input range 0-99999.

Enter desired open time duration for each pulse of Injector 1 in 1/100 seconds. Input range 0-99.

Enter desired open time duration for each pulse of Injector 2 in 1/100 seconds. Input range 0-99.

Used to enter the desired silylation warm up delay in minutes. Input range 0-99999.

Enter Source 1 Injector Volume in ml
Enter Source 2 Injector Volume in ml
Process Time in Seconds
Injector 1 Pulse Time Open in 1/100 Seconds
Injector 2 Pulse Time Open in 1/100 Seconds
Enter Warm Up Delay

Figure 25 Cleaning Recipe Panel (Recipe 8 & 9)
Operator Interface

Changes the screen to the secondary recipe setup panel.

Enter desired closed time duration for each pulse of Injector 1 in 1/100 seconds. This is to adjust for slow vaporizing chemicals, without over-injecting, when process pressure is the predominant process variable. Input range 0-99.

Enter desired closed time duration for each pulse of Injector 2 in 1/100 seconds. This is to adjust for slow vaporizing chemicals, without over-injecting, when process pressure is the predominant process variable. Input range 0-99.

This button takes you to the Recipe Setup Panel.

This button takes you to the Main Operator’s Panel.

GoTo Recipe Parameter Panel 2

Injector 1 Pulse Time Closed

Injector 2 Pulse Time Closed

Go Back Button

Exit Button
Operator Interface

Figure 26 Cleaning Recipe Panel 2

Used to set the preferred number of chamber/vapor flask purge cycles. Used to eliminate water from chamber/vapor chamber. This differs from the evacuation purge in that: A *dehydration purge* has high and low pressure limits, and an *evacuation purge* pumps down to a base pressure and remains open for a desired time. Input range 0-999.

Used to set the process base pressure in Torr. This is the pressure achieved before infusion begins. Input range 0.1-10. Normally set at 1.0.

Press to set the desired upper fluid expansion abort pressure in Torr. Input range 5-700. Normally set at 100.

Used to set the purge cycle high pressure in Torr. Input range 100-600.

Enter to set the number of desired evacuation purge cycles. Used to eliminate residual chemical from chamber/vapor chamber. Input range 2-999.
Enter Volume Per Pulse in ml

This button is used to calibrate chemical volume to pulse ratio. Enter to set the volume per pulse calibration factor for the chemical. 1 equates to 0.02 ml using distilled water. Other chemicals will differ depending on density, viscosity, and pressure head differential. Input range 0-1.0. Normally set at 0.1.

Enter Purge Pressure Low in Torr

Used to set the purge cycle low pressure in Torr. Input range 0.5-100.

Enter Evac Time in Seconds

Used to set the time in seconds in which the vacuum valve constantly stays open to eliminate residual chemical from chamber/vapor chamber. Input range 0-999

Go Back Button

This button returns the screen to the previous Cleaning Recipe panel.

Exit Button

This button returns to the main Operator’s Panel.
**Operator Interface**

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**Image Reversal Panel**
*(Recipe 10)*

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**Figure 27 Image Reversal Panel (Recipe 10)**

Used to set the dwell time, in seconds, desired after the process gas is delivered into chamber. See the process descriptions for details of how the process duration variable is used for each process. Input range 0-99999

Press to enter the desired image reversal or gas treatment warm up delay in minutes. Input range 0-9999.

Used to set the preferred number of chamber purge cycles. Used to eliminate residual gases and water vapor from chamber before a chemical processing step is introduced. Input range 0-999.

Used to set the number of desired evacuation purge cycles. Used to remove unused process chemicals after the chemical processing step is complete. Both purge and evacuation cycles use the same purge high and low pressure set points. Input range 2-999.
**Operator Interface**

- **Enter Purge Pressure Hi in Torr**
  Used to set the purge cycle high pressure in Torr. Input range 100-600.

- **Enter Purge Pressure Low in Torr**
  Used to set the purge cycle low pressure in Torr. Input range 0.5-100.

- **Enter Base Pressure in Torr**
  Used to set the desired process base pressure in Torr. This is the initiated pressure directly after the infusion step. Input range 0.5-100.

- **Enter Process Pressure in Torr**
  Used to enter the desired upper process gas expansion pressure in Torr. Input range 1-600.

- **Enter Abort Pressure in Torr**
  Used to enter the desired upper gas expansion abort pressure in Torr. Input range 5-700.

- **Go Back Button**
  This button takes you to the Recipe Setup panel.
**Operator Interface**

**Panel 1 (Recipes 11-14)**

**Figure 28 Plasma Recipe Setup Panel 1**

Pressing this button will activate the numeric entry pad. Enter the desired flow rate for Gas #1, press enter, and then done. For MFC equipped systems, enter flow rate 0-100. For needle valve systems, enter 1 or 0.

Enter desired total process time in seconds. Timer is initiated when chemical injection begins.

Pressing this button will activate the numeric entry pad. Enter the desired flow rate for Gas #2, press enter, and then done. For MFC equipped systems, enter flow rate 0-100. For needle valve systems, enter 1 or 0.

Pressing this button will activate the numeric entry pad. Enter the desired flow rate for Gas #3, press enter, and then done. For MFC equipped systems, enter flow rate 0-100. For needle valve systems, enter 1 or 0.

Enter Recipe # to process upon completion of current recipe.

Returns to the Operator’s Panel.

Changes the screen to the Plasma Recipe Setup Panel 2.
Figure 29 Plasma Recipe Setup Panel 2

Press this button to activate the numeric entry pad. Enter the desired base pressure in torr, press enter, and then done. The touch screen will revert back to the Plasma Recipe Setup Panel 2. Input range 0.05 – 0.5 Torr.

Press this button to activate the numeric entry pad. Enter the desired post process evacuation purges, press enter, and then done. The touch screen will revert back to the Plasma Recipe Setup Panel 2. Input range 0-9.

Press this button to activate the numeric entry pad. Enter the number for this recipe, press enter, and then done. The touch screen will revert back to the Plasma Recipe Setup Panel 2.

Press this button to activate the numeric entry pad. Enter the process pressure hi trip point in Torr, press enter, and then done. The touchscreen will revert back to the Plasma Recipe Setup Panel 2. Input range 0.200 – 20.00.

Press this button to activate the numeric entry pad. Enter the RF calibration value in watts, press enter, and then done. The touch screen will revert back to the Plasma Recipe Setup Panel 2.
**Operator Interface**

Push this button to display previously defined recipe parameters.

Pressing this button will activate the numeric entry pad. Enter the process pressure low trip point in mTorr, press enter, and then done. The touch screen will revert back to the Plasma Recipe Setup Panel 2. Input range 0.05 – 0.5.

Press this button to return to the Plasma Recipe Setup Panel #1.

Overwrites information pertaining to the selected recipe number as mentioned above. Pushing this button stores current recipe parameters into the controller.
A numeric entry button. Enter the system controller memory register number that will be displayed and may be changed in the "Enter Register Data" button.

A numeric entry button. Enter a numeric value that is to be permanently entered into the system controller memory register location displayed in the "Enter Register Number" button. Register values may need to be edited to change the settings of program sequence timers or other program settings.

**Caution!** It is possible to affect program performance by changing certain register data.

A numeric entry button. Enter the maximum LN\textsubscript{2} trap volume capacity in ml. Input range 0-500ml

Toggles activation status of the communications loop.

Changes the display to the Setup panel screen.
Operator Interface

Changes the display to the Vacuum panel screen.

Enter the desired LN2 trap upper temperature limit in °C. Used for refill operation indication.

Changes the display to the Output panel 1.

Changes the display to the Plasma panel screen.

Takes you back to the Maintenance Panel.

This button takes you back to the main operator’s panel.

| Go To Vacuum Panel |
| Cold Trap Temp Alarm |
| Trip Point in C |
| Go To Output Panel |
| Go To Plasma Panel |
| Go Back Button |
| Exit Button |
Operator Interface

Time-Date Set Up Panel

Figure 31 Time-Date Set Up Panel

Numeric entry buttons used to set date and time on the system.

This button can be used to set the b/w color contrast for the screen. However, YES recommends using the contrast shortcut, which can be accessed from any screen. By simultaneously pressing the upper right and upper left corners of any screen, a color bar will display. Push the color bar to alter the screen contrast.

Press Here  ➔ Press Here

This button takes you to the previous panel (service access).

This button takes you to the main operator’s panel.

Set System Buttons

Set System Contrast Button

Go Back Button

Exit Button
Figure 32 Leak Check Panel

Used to enter acceptable voltage differential between the Heated Manometer and vapor detection gauge. Consult YES before changing this value.

A push button used to turn pressure valve on/off. Displays current status.

A push button used to turn plasma vacuum valve on/off. Displays current status.

A push button used to turn the CVD vacuum valve on/off. Displays current status.

Displays the current process chamber pressure in Torr from the Granville Phillips® pressure gauge.

Turns the vapor valve 1 on or off and displays current status.

Turns the vapor valve 2 on or off and displays current status.

Turns the N₂ valve on or off and displays current status.

Displays current chamber pressure in Torr from the GDG gauge.
Operator Interface

This button takes you back to the Factory Setup Panel.

This button takes you back to the main Operator’s Panel.
**Operator Interface**

**Output Panel 1**

From FACTORY SETUP PANEL

GoTo OUTPUT PANEL

---

**Figure 33 Output Panel 1**

This button turns the vacuum valve on/off and displays current status for silane vapor pump.

This push button turns vapor valve 1 on/off and displays current status (chamber to flask 1).

This push button turns gas 1 on/off and displays current status.

This push button turns the door seal purge on/off and displays current status.

This push button turns the plasma vacuum on/off and displays current status.

This push button turns vapor valve 2 on/off and displays current status (chamber to flask 2).

This push button turns gas 2 on/off and displays current status.

Pressing this button takes you to the micro pump output panel.
Operator Interface

This button turns the vacuum valve on/off and displays current status.

This push button turns vapor valve 1 on/off and displays current status.

This push button turns gas 1 on/off and displays current status.

This push button turns the door seal purge on/off and displays current status.

This push button turns the plasma vacuum on/off and displays current status.

This push button turns vapor valve 2 on/off and displays current status.

This push button turns gas 2 on/off and displays current status.

Pressing this button takes you to the micro pump output panel.

This push button turns N2 on/off to vent the chamber and displays current status.

This push button turns process gas on/off and displays current status.

This push button turns gas 3 on/off and displays current status.

Turns the audible alarm on/off and displays current status.

This push button turns the light tower YELLOW light on/off and displays current status.

This push button turns the light tower RED light on/off and displays current status.

This push button turns the light tower GREEN light on/off and displays current status.

Displays current process pressure in Torr.
Operator Interface

This button takes you to the Factory Setup panel.

This button takes you to the main Operator’s Panel.

| Go Back Button |
| Exit Button |
Figure 34 Output Panel 2

This push button turns pump 1 infuse actuator on or off and displays current status (for troubleshooting only).

This push button turns pump 2 infuse actuator on/off and displays current status (for troubleshooting only).

This push button turns the CVD vacuum valve on/off and displays current status.

This push button turns process N2 valve on/off and displays current status.

This push button turns the vapor valve 1 on or off and displays current status (chamber to Flask 1).

This push button turns the vapor valve 2 on or off and displays current status (chamber to Flask 2).

Displays current process chamber pressure in Torr.

This button takes you to the previous Maintenance panel.

This button takes you to the main Operator’s panel.
**Operator Interface**

**Plasma Process Outputs Panel**

![Figure 35 Plasma Process Outputs](image)

### Plasma Process Outputs

- **Plasma Vac On/Off**
  - A push button that turns the plasma vacuum valve on/off. Displays current valve status.

- **Gas 1 On/Off**
  - A push button that turns the gas 1 valve on/off. Displays current valve status.

- **Gas 2 On/Off**
  - A push button that turns the gas 2 valve on/off. Displays current valve status.

- **Gas 3 On/Off**
  - A push button that turns the gas 3 valve on/off. Displays current valve status.

- **N2 On/Off**
  - A push button that turns the N2 gas valve on/off. Displays current valve status.

- **Plasma Pressure Valve On/Off**
  - A push button that turns the plasma pressure valve on/off. Displays current valve status.

- **RF Power On/Off**
  - This button turns RF Power on/off and displays current power status.
**Operator Interface**

Press to enter RF power setting. Enter a value between 0-1000 in the numerical entry display. Press "Enter" and then "Done." This is used to manually set the RF power supply voltage and compare to "RF Analog Diagnostic Display" for troubleshooting purposes. Entry units are 0-4000 mV, which corresponds to 0-1000 Watts. (Divide mV by 4 to arrive at a watt value)

**NOTE:** RF power operation at improper pressures may reduce power supply lifetime.

Displays the current process chamber pressure in Torr.

**NOTE:** Plasma pressure valve must be turned on.

Returns to the Factory Setup screen.

Takes you back to the main Operator’s Panel.
Operator Interface

Figure 36 Over Temp Panel

Displays system status.

Used to reset the heaters lockout alarm on the over temp module.

Used for silence audible alarm – does not clear alarm condition. Has no effect if the system controller is not in an alarm state.

This push button stops execution of a program sequence and returns to the system controller to the reset state. Turns off alarm state and returns system controller to the reset state. Turns all outputs off. Has no effect if the system controller is already in the reset state.
Press this button to activate the prime micro pump #1 recipe screen. Pressing this touch screen has the same effect as pressing Source #1 Prime button on the left side of the 1224P Unit.

Press this button to activate the prime micro pump #2 recipe screen. Pressing this touch screen has the same effect as pressing Source #2 Prime button on the left side of the 1224P Unit.

Press this button to stop execution of a program sequence and return the system controller to the reset state. Turns off alarm state and returns system controller to the reset state. Turns all outputs off. Has no effect if the system controller is already in the reset state.
Figure 38 Plasma Gas Piping - No MFC Option

Figure 39 Plasma Gas Piping - MCF options
Figure 40 Piping Schematic
Instrumentation

Chamber Heating & Pressure Instrumentation

Vacuum Piping & Heating Instrumentation

Figure 41 Chamber Heating & Pressure Instrumentation

Figure 42 Vacuum Piping & Heating Instrumentation
Figure 43 Chemical Flask 1 Piping

Figure 44 Chemical Flask 2 Piping
Sheet numbers in the above power distribution diagram refer to the electrical schematic for the YES-1224P.

Figure 45 Electrical Power Distribution
Instrumentation

The YES-1224P tool has two separate pressure gauge types on the chamber. One is used for chamber vapor detection pressure comparison and the others are for chamber process pressure measurement.

Chamber Vapor Detection Pressure Gauge

The chamber vapor detection pressure is measured by a Convectron® pressure gauge with a measurement range of 1000 Torr to 0.1 mTorr.

Because the Convectron® gauge is sensitive to gas composition, pressure readings will differ from the pressure measurement from the HCM type.

Chamber Process Pressure Gauges

Process pressure is measured by one 0-10 and one 0-1000 Torr heated capacitance manometer (HCM). The HCM pressure reading is not sensitive to gas composition and the values are displayed on the user interface panel.

Each heating zone has redundant thermal protection to prevent an overtemperature run away if the primary controller fails. Also, all zones are monitored via 485 communications.

Chamber Temperature Controllers

Chamber temperature is controlled via a four zone controller array. The zones are; door, chamber from perimeter, chamber middle perimeter, and chamber rear. Each zone is controlled by a partlow 1160 controller located on the front of the control console.

Each zone has a bolt on type j thermocouple. Thermocouple output voltage is input to the zone temperature controller. Temperature controller output changes the amount of power supplied to the chamber zone heaters.

Vapor Line Temperature Controllers

Vapor line temperature is controller by partlow 1160 controller located on the front of the control console. The vapor line has a type j thermocouple fastened to a thermocouple clamp ring. Thermocouple output voltage is input to the zone temperature controller. Temperature controller output changes the amount of power supplied to the vapor line.

Vapor Flask Temperature Controllers

Vapor flask temperature is controller by partlow 1160 controller located on the front of the control console. The vapor flask has a type j thermocouple fastened to a thermocouple clamp ring. Thermocouple output voltage is input to the zone temperature controller. Temperature controller output changes the amount of power supplied to the vapor flask.
Vacuum line temperature is controlled by a Partlow 1160 controller located on the front of the control console. The vacuum line has a type J thermocouple fastened to a thermocouple clamp ring. Thermocouple output voltage is input to the zone temperature controller. Temperature controller output changes the amount of power supplied to the vacuum line.

### PLC Controller I/O List

<table>
<thead>
<tr>
<th>I/O#</th>
<th>Description</th>
<th>Location – Card 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Over temperature – Alarm-Watlow</td>
<td>TB3-2</td>
</tr>
<tr>
<td>2</td>
<td>Over temperature – Cal3200</td>
<td>TB4-2</td>
</tr>
<tr>
<td>3</td>
<td>RF Set point Confirmation</td>
<td>TB3-3</td>
</tr>
<tr>
<td>4</td>
<td>1000 Torr HCM Over temp</td>
<td>TB4-3</td>
</tr>
<tr>
<td>5</td>
<td>100 Torr HCM Over temp</td>
<td>TB3-4</td>
</tr>
<tr>
<td>6</td>
<td>Not Used</td>
<td>TB4-4</td>
</tr>
<tr>
<td>7</td>
<td>Prime Button 1</td>
<td>TB3-5</td>
</tr>
<tr>
<td>8</td>
<td>Prime Button 2</td>
<td>TB4-5</td>
</tr>
</tbody>
</table>
**Table 2 PLC Controller Digital Outputs**

<table>
<thead>
<tr>
<th>I/O#</th>
<th>Description</th>
<th>Location - Card 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Process Gas Valve</td>
<td>TB5-2</td>
</tr>
<tr>
<td>2</td>
<td>Vacuum Valve 1</td>
<td>TB6-2</td>
</tr>
<tr>
<td>3</td>
<td>Vent Valve</td>
<td>TB5-3</td>
</tr>
<tr>
<td>4</td>
<td>Pump 1 Infuse Valve</td>
<td>TB6-3</td>
</tr>
<tr>
<td>5</td>
<td>Pump 2 Infuse Valve</td>
<td>TB5-4</td>
</tr>
<tr>
<td>6</td>
<td>Vapor Valve 1</td>
<td>TB6-4</td>
</tr>
<tr>
<td>7</td>
<td>Not Used</td>
<td>TB5-5</td>
</tr>
<tr>
<td>8</td>
<td>Audible Alarm</td>
<td>TB6-5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>I/O#</th>
<th>Description</th>
<th>Location - Card 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Green Light</td>
<td>TB7-2</td>
</tr>
<tr>
<td>10</td>
<td>Yellow Light</td>
<td>TB8-2</td>
</tr>
<tr>
<td>11</td>
<td>Red Light</td>
<td>TB7-3</td>
</tr>
<tr>
<td>12</td>
<td>Vacuum Valve 2</td>
<td>TB8-3</td>
</tr>
<tr>
<td>13</td>
<td>Vapor Valve 2</td>
<td>TB7-4</td>
</tr>
<tr>
<td>14</td>
<td>Remote RF Power</td>
<td>TB8-4</td>
</tr>
<tr>
<td>15</td>
<td>Vapor Detect Valve</td>
<td>TB7-5</td>
</tr>
<tr>
<td>16</td>
<td>Over temperature Module Reset</td>
<td>TB8-5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>I/O#</th>
<th>Description</th>
<th>Location - Card 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>Not Used</td>
<td>TB9-2</td>
</tr>
<tr>
<td>18</td>
<td>Not Used</td>
<td>TB10-2</td>
</tr>
<tr>
<td>19</td>
<td>Source 1 Purge Solenoid</td>
<td>TB9-3</td>
</tr>
<tr>
<td>20</td>
<td>Source 2 Purge Solenoid</td>
<td>TB10-3</td>
</tr>
<tr>
<td>21</td>
<td>Plasma Gas 1</td>
<td>TB9-4</td>
</tr>
<tr>
<td>22</td>
<td>Plasma Gas 2</td>
<td>TB10-4</td>
</tr>
<tr>
<td>23</td>
<td>Plasma Gas 3</td>
<td>TB9-5</td>
</tr>
<tr>
<td>24</td>
<td>Door Seal Purge</td>
<td>TB10-5</td>
</tr>
</tbody>
</table>
## Instrumentation

### Table 3 PLC Controller Analog Inputs

<table>
<thead>
<tr>
<th>I/O#</th>
<th>Description</th>
<th>Location – Card 5</th>
<th>Config</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1000 Torr HCM Input</td>
<td>TB11-2(+) TB12-2(-)</td>
<td>0-10VDC</td>
</tr>
<tr>
<td>2</td>
<td>100 Torr HCM Input</td>
<td>TB11-3(+) TB12-3(-)</td>
<td>0-10VDC</td>
</tr>
<tr>
<td>3</td>
<td>RF Power Level</td>
<td>TB11-4(+) TB12-4(-)</td>
<td>0-10VDC</td>
</tr>
<tr>
<td>4</td>
<td>RF Supply Diagnostics</td>
<td>TB11-5(+) TB12-5(-)</td>
<td>0-10VDC</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>I/O#</th>
<th>Description</th>
<th>Location – Card 6</th>
<th>Config</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Cold Trap TC</td>
<td>TB13-2(+) TB14-2(-)</td>
<td>100 mVDC</td>
</tr>
<tr>
<td>6</td>
<td>Chamber Monitor TC</td>
<td>TB13-3(+) TB14-3(-)</td>
<td>100 mVDC</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>I/O#</th>
<th>Description</th>
<th>Location – Card 7</th>
<th>Config</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Not Used</td>
<td>TB17-2(+) TB18-2(-)</td>
<td>0-10VDC</td>
</tr>
<tr>
<td>8</td>
<td>MFC/Gas 1 Flow</td>
<td>TB17-3(+) TB18-3(-)</td>
<td>0-10VDC</td>
</tr>
<tr>
<td>9</td>
<td>MFC/Gas 1 Flow</td>
<td>TB17-3(+) TB18-3(-)</td>
<td>0-10VDC</td>
</tr>
<tr>
<td>10</td>
<td>MFC/Gas 1 Flow</td>
<td>TB17-3(+) TB18-3(-)</td>
<td>0-10VDC</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>I/O#</th>
<th>Description</th>
<th>Location – Card 8</th>
<th>Config</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Not Used</td>
<td>TB19-2(+) TB20-2(-)</td>
<td>0-10VDC</td>
</tr>
<tr>
<td>12</td>
<td>Not Used</td>
<td>TB20-3(+) TB20-3(-)</td>
<td>0-10VDC</td>
</tr>
</tbody>
</table>
Table 4 PLC Controller Analog Outputs

<table>
<thead>
<tr>
<th>I/O#</th>
<th>Description</th>
<th>Location – Card 6</th>
<th>Config</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MFC/Gas 2 Set Point</td>
<td>TB13-4(+) TB14-4(c)</td>
<td>0-10 VDC</td>
</tr>
<tr>
<td>2</td>
<td>MFC/Gas 3 Set Point</td>
<td>TB13-5(+) TB14-5(c)</td>
<td>0-10VDC</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>I/O#</th>
<th>Description</th>
<th>Location – Card 8</th>
<th>Config</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>RF Power Set Point</td>
<td>TB19-4(+) TB20-4(c)</td>
<td>0-10VDC</td>
</tr>
<tr>
<td>4</td>
<td>MFC/Gas 1 Set Point</td>
<td>TB19-5(+) TB20-5(c)</td>
<td>0-10VDC</td>
</tr>
</tbody>
</table>

Table 5 PLC Controller Serial Communications

<table>
<thead>
<tr>
<th>Description</th>
<th>COM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Touch screen</td>
<td>COM1</td>
</tr>
<tr>
<td>485 Loop – Heater Controller, Pressure</td>
<td>COM2</td>
</tr>
<tr>
<td>Monitor/Upload</td>
<td>TCP/IP</td>
</tr>
</tbody>
</table>
Instrumentation

An EMO (emergency shut off) button is located on the front deck of the tool. Pressing the EMO shuts off all power. To restore power, the EMO must be pulled out and a Power On button pressed.

The EMO circuit disables power from all electrical components downstream of the circuit. The 24VDC power supply is always active. When the EMO button is reset and the power on button is pressed, power flows through two relay coils. The DC contact coil uses one contact for the downstream 24VDC power and one for the power on button latch, and the AC contact coil uses both contacts: one for each hot leg of the 208/230 VAC power downstream of the 24VDC power supply AC input.

Power On button is located on the front panel (green button). The circuit breaker switch labeled “power disconnect” is on the rear panel.

The Power On button on the front of the system will light up green when the YES1224P is on.

The light tower is located on the top of the YES-1224P. Two status indicator lights, red and green are available to indicate tool status.

Steady Green: Process Running
Flashing Green: Process Done
Red: Process Abort
No Light: Not Running a Process

The audible alarm is located on the rear of the tool. Use of the audible alarm is configurable by the operator.

Intermittent alarm: Process Done
Steady Alarm: Process Abort
NOTE: Read this manual carefully before installing, using or servicing the YES-1224P system. If there are any doubts about the safe use of this equipment, contact the YES Customer Service Department at (888) YES-3637.

Warning! Never use combustible liquids or vapors with the system. Never use combustible solvent to clean any part of the YES-1224P system.

Safety Signal Word Definitions

Caution – Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices (ANSI Z535.4).

Warning – Indicates a potentially hazardous situation, which, if not avoided, could result in death or serious injury (ANSI Z535.4).

Danger – Indicates an imminently hazardous situation, which, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations (ANSI Z535.4).
Safety

Unavoidable hazards

Type 3 Electrical Hazards

Type 3: Maintenance in areas exposed to live circuits less than 30V RMS or 240VA with accidental contact possible.

Control enclosure entrance with power on may be required for electrical malfunction troubleshooting.

The control enclosure contains circuits with potentials up to 220VAC and 24VDC. All electrical contacts and terminals in the control enclosure are shielded from inadvertent contact.

Type 4 Electrical Hazards

Type 4: Maintenance in areas exposed to live circuits greater than 30V RMS, 240VA, or RF with accidental contact possible.

The following recommended set up and maintenance procedures require entrance into the control enclosure while the power is on. Control enclosure entrance with power on may also be required for electrical malfunction troubleshooting.

The control enclosure contains circuits with potentials up to 220VAC and 24VDC. All electrical contacts and terminals in the control enclosure are shielded from inadvertent contact.

Verify supply voltages and frequencies (set up only)

System power up (set up only)

Type 5 Electrical Hazards

Type 5: Maintenance requiring physical entrance into energized equipment.

There are no Type 5 electrical hazards on the YES-1224P. The YES-1224P is too small for physical entrance.
Hexamethyldisilazane (HMDS) Usage and Precautions
ID No. 999-97-3

HMDS is a colorless, clear liquid with an ammonia-like odor detectable at low concentration. It is a stable compound under normal conditions. HMDS reacts slowly with water, but vigorously with alcohol, and mineral acids giving off ammonia.

Avoid skin and eye contact when handling HMDS. It is a corrosive and can cause burns to the skin and eyes as well as irritation to the upper respiratory system. Goggles, faceshield, gloves, and an apron should be worn by all personnel handling HMDS.

NOTE: HMDS at room temperature has pressure of ~15 Torr. Heated HMDS at 85°C for silylation has a pressure of ~100 Torr. Atmospheric pressure is 760 Torr. The YES systems provide a vacuum seal only and cannot be pressurized above 760 Torr. Above 760 Torr gases such as N₂ would vent out the front door seal. Concerns of pressurizing the chamber are therefore unwarranted.

The most important physical properties of HMDS:

<table>
<thead>
<tr>
<th>Physical Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical formula</td>
<td>(CH₃)₃Si₂NH</td>
</tr>
<tr>
<td>Molecular weight</td>
<td>161.4</td>
</tr>
<tr>
<td>Boiling point</td>
<td>126°C/258.8°F</td>
</tr>
<tr>
<td>Flash point (closed cup)</td>
<td>12.77°C/55°F</td>
</tr>
<tr>
<td>Vapor pressure</td>
<td>~20 mm Hg</td>
</tr>
<tr>
<td>Percent volatile by volume</td>
<td>100%</td>
</tr>
</tbody>
</table>

The following provides physiological effects of various concentrations of HMDS in the air:

<table>
<thead>
<tr>
<th>HMDS (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Least detectable odor</td>
</tr>
<tr>
<td>Maximum concentration for prolonged exposure</td>
</tr>
<tr>
<td>Maximum concentration for short exposure</td>
</tr>
<tr>
<td>Least amount causing immediate eye irritation</td>
</tr>
<tr>
<td>Least amount causing cough</td>
</tr>
</tbody>
</table>

NOTE: Values are based on HMDS concentrations converted to ammonia when entering the system.
Safety

There are several methods of detecting HMDS leaks. Among the materials used for leak detection of HMDS are:

**Ammonia test paper**
Moistened phenolphthalein or litmus test paper will change color when exposed to ammonia.

**Ammonia Drager tube**
When the fumes are detected, the color changes from yellow to blue.

**Dilute hydrochloric acid**
When the fumes from the dilute hydrochloric acid come in contact with the ammonia vapor, it will produce a dense white fog.

Handling & Storage

The following are general rules which should be observed when handling and storing HMDS.

1. Store in a cool, dry area. Store under nitrogen blanket to increase shelf life.
2. Avoid breathing vapors.
3. Avoid skin contact.
4. Avoid contact with a flame.
5. In case of accidental spillage evacuate the area.
6. Soak up the spill with an absorbent material and place it in a disposal container.
7. In case of accidental contact with the skin or eyes, flush the area of contact for 15 minutes and consult a physician.
8. HMDS can build up a static charge. All equipment should be grounded during the transfer operation.

Ammonia Gas Usage and Precautions

Anhydrous ammonia gas, ID No. 1005

Anhydrous ammonia is classified by the Interstate Commerce Commission as a non-flammable gas. Anhydrous ammonia is a very stable compound under normal conditions. It reacts with water to form ammonium hydroxide, commonly known as aqua ammonia. **Ammonia will not corrode iron, steel or aluminum but reacts rapidly with copper, zinc, and their alloys.** The combination of ammonia and mercury could represent a possible explosion.

Ammonia gas is not harmful at low concentrations. The pungent odor of the gas gives adequate warning of its presence in the air and does represent a possible panic hazard. Goggles should be worn by all personnel handling anhydrous ammonia.
Safety

The most important physical properties of anhydrous ammonia, shipped in liquid form under 125 pounds of pressure are:

<table>
<thead>
<tr>
<th>Physical Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molecular symbol</td>
</tr>
<tr>
<td>Molecular weight</td>
</tr>
<tr>
<td>Boiling point</td>
</tr>
<tr>
<td>Freezing point</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>The following provides physiological effects of various concentrations of ammonia in the air:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ammonia (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Least detectable odor</td>
</tr>
<tr>
<td>Maximum concentration for prolonged exposure</td>
</tr>
<tr>
<td>Maximum concentration for short exposure</td>
</tr>
<tr>
<td>Least amount causing immediate eye irritation</td>
</tr>
<tr>
<td>Least amount causing cough</td>
</tr>
<tr>
<td>Dangerous for even short exposure</td>
</tr>
<tr>
<td>Rapidly fatal for short exposure</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ammonia Leak Detection</th>
</tr>
</thead>
<tbody>
<tr>
<td>There are several methods of detecting anhydrous ammonia leaks. Some common materials used for leak detection include:</td>
</tr>
</tbody>
</table>

- **Ammonia test paper**
  Moistened phenolphthalein or litmus test paper will change color when exposed to ammonia.

- **Dilute hydrochloric acid**
  When the fumes from the dilute hydrochloric acid come in contact with the ammonia vapor, it will produce a dense white fog.

- **Sulfur tapers**
  A dense white cloud is produced when the sulfur taper burns and reacts with the ammonia to form sulfur dioxide.
Safety

The following are general rules which should be observed when handling and storing ammonia:

27. Ammonia cylinders should be stored in a cool, dry, well ventilated and, preferably, fire resistant area.
28. When moving the ammonia cylinders do not drop, roll, slide or cause the cylinders to violently strike each other.
29. If the cylinders are to be stored outside, protect them from extreme weather conditions and keep them off the ground to prevent the cylinders from rusting.
30. It is not a safe practice to handle the cylinders by hooking them on the valve's protective cap. These caps should only be removed when the cylinder is securely in place against a wall, a bench, or in a cylinder stand and ready to be used.
31. Check the valve packing nut to ensure that it is tight.
32. Under no circumstances should any part of the cylinder reach a temperature of over 120°F.
33. The cylinder should not come in contact with a flame.
34. Before using, read all labeled information and data sheets associated with the use of anhydrous ammonia.

Determining Empty Cylinders

The best way to make sure ammonia cylinders are empty is to weigh them but it is also very inconvenient. Because of the inconvenience associated with weighing the cylinders, a pressure gauge is usually used to determine when a cylinder is empty. If the pressure gauge reads under 25 lbs, the cylinder is considered empty.

Returning Empty Cylinders

When returning empty cylinders, use the following procedure:

1. Close the valve before shipping the cylinder.
2. Mark or label the cylinder "Empty".
3. Replace protective cap over fitting.
4. Store the empty cylinder away from the full cylinders.
Figure 46 EMO Circuit

The YES-1224P emergency power off (EMO) circuit schematic is shown above. The EMO circuit is 24VDC with an EMO button on the front of the tool.

The circuit is electrically latched on when the control power disconnect switch is on and the Power On button is pushed. The electrical latch is disrupted and the EMO circuit goes off when the EMO button is pushed. The EMO button must be pulled to release and allow the EMO circuit to be turned back on. Power is not restored to YES-1224P until a Power On button is pushed on the front panel.
Safety

EMO Circuit Operation

The YES1224P EMO circuit functions by removing power from all power control contactors, relays, and line voltage accessory circuits when the EMO button is pushed.

Emergency power off buttons are located on the front and rear of the control console. Both EMO buttons must be disengaged in order to turn on the machine. When an EMO button is pushed, the EMO circuit goes off and removes power from all power control contactors and relays and all line voltage accessory circuits.

Some power conditioning components still have power supplied when the EMO circuit is off. They are as follows:

- 24VDC power supply

All power is removed from the tool if the power disconnect switches are turned off.

Power Outage Recovery

Power is not restored to YES-1224P until the Power On button is pushed on the front panel.
Safety

| Safety Interlocks

To disconnect:

Press the EMO button, turn off main disconnect circuit breaker, and remove power plug from main facility electrical receptacle. Affix clamshell over plug to ensure lockout.

To reconnect:

Remove clamshell from system plug, insert power plug into main facility electrical receptacle, and release EMO button. Press the power on button to restart tool.

| Electrical

| Pneumatic/Reactant Gases

To disconnect:

Turn off facility gas supplies to tool. Vent gases before disconnecting any pneumatic/reactant gas components from the tool. Remove gas connections from rear of tool to ensure lockout.

To reconnect:

Connect gas connections to rear of tool. Confirm pneumatic/reactant gas components are properly connected to tool. Turn on facility gas supplies to tool.
Safety

Material Disposal

Wet pumps used on plasma tools require the use of Fomblin® Y-LVAC 25/6 as a lubricant. Thermal decomposition of this lubricant will generate fluoride, which is a corrosive. Wear protective clothing when handling. Follow state, local, and federal regulations on disposal, recycling, storage, and transport of this material.

Warning!
Wash hands after handling Fomblin® lubricants. Avoid Fomblin contact with alkali metals and halogenated compounds.

Electrical Disconnect

The main power disconnect switch for the YES-1224P is located on the left side of the control console. The main disconnect switch removes all electrical power from the tool, including the pump power.

Warning!
Before servicing, engage the EMO button, turn off the main disconnect and remove plug from facilities. There is no visual device to indicate when the power has been removed from the system, other than the position of the main disconnect switch.
Safety

Indicators are placed on the tool with the above safety ground symbol, to designate which fasteners ensure proper and safe grounding of cabinet panels.

**Warning!**
Do not operate tool if indicated fasteners are missing or not fully engaged.
Safety

| RF Power Supply |

The RF power generator emits non-ionizing radiation, in the form of induced current and contact current emissions, below the safe acceptable level. Frequency is 40 kHz.

RF power generator removal will require two-person lift. Supply and drawer combined weight is 40 lbs.

| Chamber Temperature |

Temperature increases in the chamber during the plasma generating portion of the recipe. The tool implements a maximum allowable temperature limit set point, primarily to protect susceptible substrates and control uniformity. Furthermore there is hot plate temperature monitor message display box on the operator panel of the touch screen interface.

**Caution!**

Ensure hot plate temperature monitor message display box indicates safe handling temperate (51°C) before removing substrates from chamber. The use of protective gloves is recommended at elevated temperatures.
Temperatures will increase on the outer vacuum pump housing surfaces with continued operation.

**Caution!**
Ensure vacuum pump housing temperature is at a safe handling temperature (51°C) before touching. Use of protective gloves is recommended at elevated temperatures.

**EMO Circuit**

The EMO circuit disables power from all electrical components downstream of the circuit. The 24VDC power supply is always active. When the EMO button is reset and the power on button is pressed, power flows through two relay coils; the DC contact coil uses one contact for the downstream 24VDC power and one for the power on button latch, and the AC contact coil uses both contacts; one for each hot leg of the 208/230 VAC power downstream of the 24VDC power supply AC input.
Maintenance

This section describes techniques required for proper care and maintenance of the YES-1224P. Refer to the Troubleshooting Section for assistance in addressing specific process/equipment malfunctions.

Flask/Chamber Leak
Check & Evacuation

The chamber leak check procedure can be used to verify chamber cleanliness and vacuum integrity. The procedure measures chamber base pressure and leak back rate.

For the best results, base pressure and leak rate testing should be done after the oven has been at vacuum for several hours to allow volatile contaminants like water to vaporize and be removed from the chamber.

With the oven controller in reset mode and operator’s panel active:

1. Push the “Press to Select Recipe” button
2. Enter “0” on the numeric keypad
3. Push “enter”
4. Push “done”
5. Press the “Press to Start” button.
6. Program will open the vacuum valve until the “Press to Reset” button is pushed.

Wait for the pressure to stabilize with the vacuum valve open. Base pressure should be under 10 mTorr. If pressure is too high, allow the chamber to remain at vacuum for a few hours to evaporate volatile contaminants. It may be necessary to clean the chamber to remove process residues.

When a satisfactory base pressure has been reached, press the “Press to Reset” button to close the vacuum valve.

Wait 1 or 2 minutes to allow chamber gas flows to stabilize, and then measure the increase in pressure over a one-minute period. Pressure rise rate should be less than 10 mTorr per minute. If pressure rise rate is too high, allow the chamber to remain at vacuum for a few hours to evaporate volatile contaminants and repeat the test. It may be necessary to clean the chamber to remove process residues.

If a leak is suspected, further path isolation can be verified by manually closing the vapor valve after resetting system.
Maintenance

With the oven controller in reset mode and Operator’s panel active:

1. Push the “Goto Alarm Panel” button
2. Press the “Enter Access Code” button
3. Enter “1966” on the numeric keypad
4. Push “Enter”
5. Push “Done”
6. When the maintenance panel is activated, press the “Goto Factory Set Up Panel” button
7. Press the “Goto Vacuum Panel”
8. Press the “Press to Open Vapor Valve” button to darken the switch

Observe the rate of rise of both the flask and the chamber pressures to help pinpoint the leak region, then press the “Exit” button to return to the operator panel screen.

When the test is complete, with the oven controller in reset mode and operator’s panel active:

1. Push the “Recipe Select” button
2. Enter 10 on the numeric keypad
3. Push “Enter”
4. Press “Done”
5. Press the START button

The system will purge the chamber/flask and return the system pressure to atmospheric levels.

Door Seal Replacement

In the event of a door seal failure, the inner door seal will have to be replaced. It is recommended that both seals be replaced regardless of the outer seal condition. Failure to change the outer seal may result in improper functioning of the seal failure alarm. Use only brass, wood, or plastic removal tools to remove old o-ring.

Caution!

DO NOT use hard metal tools to remove o-rings. Damage to seal surfaces will result in loss of vacuum integrity.

Replace the seal, ensuring that there is even tension throughout the seal upon installation. Non-uniform tension will result in localized “thinning” of the o-ring cross section and create a leak point.
Clean the chamber walls and door plate with isopropyl alcohol. Use a squeeze bottle and wash it down. Use a clean room cloth to wipe all walls, shelves, and lower floor.

If polymerized chemicals are deposited on the chamber walls, try toluene or compatible solvent. It is our experience that this deposition is virtually impossible to remove without disassembly and CO$_2$ beadblast or other conditioning procedures.

With machine in reset status:

1. Verify all temperature controllers set to 200°C.
2. Allow 2 hours for controlled elements to reach steady state condition (HCM pressure sensors require 4 hours to heat. Heating elements activate when system is powered up and remain on regardless of temperature controller settings. Adjust steady state heat condition around initial power up time).
3. Run Recipe 10 to eliminate/check for residual chemical.
4. When complete, light tower complete light will flash.

Under usual circumstances, the flask on the YES-1224P(E) should not have to be disassembled and cleaned. Complete vaporization and cleaning solution procedures should be adequate in eliminating all residual chemicals from the vapor flask, valves, syringes, and supporting plumbing if degradation temperatures are not exceeded.

In the unlikely event of polymerization contamination, flask may need be disassembled and cleaned with CO$_2$ bead blast or other conditioning procedures. Furthermore, all infusion/withdraw tubing, and valves will need to be replaced (see parts list for replacement tubing, valve, and VCR gasket assemblies).

Vapor curve determination procedure may require flask disassembly/cleaning as the process could entail condensation of liquids in the flask.
Removal/replacement of the source bottle(s) is not difficult.

1. Open access door on the front of the system (see figure below).
2. Pull both needles out of bottle to be replaced. *NOTE: do not disconnect needles from tubing.*
3. Pull spring-loaded clamp back to release bottle.
4. Retract spring-loaded clamp and place new Source Bottle on shelf. Release clamp to secure bottle.
5. Use needles to penetrate seal in bottle cap. *NOTE: be sure the longer needle is close to the bottom of the bottle. Be sure the shorter needle is above the fluid surface. (See figure, below).*
6. Re-facilitate power to the tool as necessary.

![Source Bottle Access Door](image)

**Figure 47 Source Bottle Access Door**
The reactant and vent gas valves are normally closed, electrical solenoid valves. The solenoid valves are turned on or off by outputs from the PLC. 24VDC is supplied to the solenoid valve. The PLC output connects the low side of the solenoid coil to the 24VDC return.

Cycle the valve using the output control screen to see if it makes a clicking noise. If it does, the coil is good. If it does not, check for the presence of 24VDC across the solenoid terminals with the output ON. Replace the coil if there is voltage drop but the valve does not actuate.

Make sure the actuator gas pressure is at least 80 psig (minimum).

If the solenoid is operating properly and you suspect that the valve is not opening or closing properly, remove the valve body. Examine the Kel-F seat for abrasions or particles that could inhibit proper sealing. If all else fails, replace the entire sealing assembly. It is highly unlikely that the valve body needs replacement.
Vapor/Vacuum Valve Repair

The vapor and vacuum valves are normally closed, pneumatic valves actuated by pilot solenoid valves. The solenoid valves are turned on or off by outputs from the PLC. 24VDC is supplied to the solenoid valve. The PLC output connects the low side of the solenoid coil to the 24VDC return.

Cycle the valve using the output control screen to see if it makes a clicking noise. If it does, the coil is good. If it does not, check for the presence of 24VDC across the solenoid terminals with the output on. Replace the coil if there is voltage drop but the valve does not actuate.

Make sure the actuator gas pressure is at least 80 psig (minimum).

If the solenoid is operating properly and you suspect that the valve is not opening or closing properly, remove the valve body. Examine the polyimide or CR6100 valve stem for abrasions or particles that could inhibit proper sealing. Clean buildup off exposed surfaces with appropriate solvents. Be sure not to use scraping tool that would mar, pit or scratch sealing surfaces.

If all else fails, replace the stem tip and bonnet seal. It is likely that the entire valve body need replacement if build up is such that it cannot be removed or seal surfaces become damaged due to improper cleaning procedures.

Vapor Detection Valve Repair

The vapor detection valve is normally a closed, pneumatic valve actuated by a pilot solenoid valve. The solenoid valves are turned on or off by outputs from the PLC. 24VDC is supplied to the solenoid valve. The PLC output connects the low side of the solenoid coil to the 24VDC return.

Cycle the valve using the output control screen to see if it makes a clicking noise. If it does, the coil is good. If it does not, check for the presence of 24VDC across the solenoid terminals with the output on. Replace the coil if there is voltage drop but the valve does not actuate.

Make sure the actuator gas pressure is at least 80 psig (minimum).

If the solenoid is operating properly and you suspect that the valve is not opening or closing properly, remove the valve body. Examine the polyamide or CR6100 valve seat for abrasions or particles that could inhibit proper sealing. Clean chemical buildup off exposed surfaces with appropriate solvents. Be sure not to use scraping tool that would mar, pit or scratch sealing surfaces. If all else fails, replace the entire bonnet assembly, as seal tip is pressed into bonnet face. It is likely that the entire valve body need replacement if build up is such that it cannot be removed or seal surfaces become damaged due to improper cleaning procedures.
Maintenance

The Infusion valves are normally closed pulse solenoid valves. The solenoid valves are turned on or off by outputs from the PLC. 24VDC is supplied to the solenoid valve. The PLC output connects the low side of the solenoid coil to the 24VDC return.

Check for the presence of 24VDC across the solenoid terminals with the output on. Replace the coil if there is voltage drop but the valve does not actuate.

This valve is not serviceable and will need to be replaced upon plugging or solenoid failure.

Be sure to contact YES on proper hand-tight peek fitting installation procedures.

Infusion Valve Service

The YES-1224P vapor collection trap can be drained by two methods. Method 1 should only be used if continuing to use the same chemical and trap LN$_2$ full level sustained. Method 1 entails the use of the drain/relief valve system to which the supplied trap is modified.

Method 2 should be used if unit is to remain idle for any significant amount of time while LN$_2$ supply is exhausted, or if changing to different chemical where compatibility issues are present. Method 2 may entail the removal of the collection trap while the trap is full of residual chemical.

The operator will be cued by the PLC when vapor trap temperature rises, indicating LN$_2$ depletion.

Trap Drain Procedure

Method 1:

1. Make sure the system is in the reset state.
2. Confirm vacuum pump power is off.
3. Operator should wear protective equipment for safe LN$_2$ and chemical protection. Consult MSDS for particular safety devices required for the handling of your chemical.
4. Use back wrench while loosening upper purge valve on vapor trap.
5. Place drain container under plug valve exit and rotate plug valve pin is orientated inline valve tubing.
6. Close drain, by rotating plug valve pin until orientated perpendicular to valve tubing, when residual chemical release rate slows.
7. Use back wrench while tightening upper purge valve on vapor trap.
8. Refill trap with LN$_2$ using small inlet tube.
9. Restart vacuum pump and check for leaks on trap purge/plug valve fittings.
Method 2:

1. Make sure the system is in the reset state.
2. Confirm vacuum pump power is off.
3. Confirm trap ln2 level is *completely* exhausted. This is indicated by the absence of exhaust gases emitting from vapor trap vent tube.
4. Remove thermocouple from the vapor trap vent tube (larger diameter tube).
5. Steps 4-7 of method 1 may be used to drain most of residual chemical from trap.
6. Remove centering ring clamp connection from the downstream side of the trap. Be sure to use protective gear while performing vapor trap maintenance. Consult MSDS for particular safety devices required for the handling of your chemical.
7. Support the trap while removing the centering ring clamp connection from the upstream side of the trap.
8. Transfer trap assembly to a proper-vented disposal site while holding trap in the upright position.
9. Pour contents into chemical disposal container directly out of kf-40 connection until most of the chemical is drained.
10. Remove top trap band and separate inner ln2 bowl from outer chemical reservoir.
11. Clean chemical exposed surfaces with the appropriate solvent.
12. Inspect o-ring for nicks, cracks, hardening, and degradation. Replace with new o-ring if necessary.
13. Replace inner/outer bowl band strap and tighten
14. Reinstall trap on tool: Inspect centering ring o-rings, Replace if necessary. Replace and tighten center ring clamps.
15. Reinstall thermocouple to the vapor trap vent tube (larger diameter tube).
16. Refill trap with LN2 using small inlet tube.
17. Restart vacuum pump and check for leaks on trap purge/plug valve fittings and vapor trap o-ring.
Maintenance

Preventative Maintenance

This section describes how to properly care for and maintain the YES-1224P. Refer to the Troubleshooting Section for assistance in isolating specific equipment malfunctions.

Daily Preventative Maintenance

1. Check the door gasket for any signs of chipping, excessive wear or contamination. Change gasket when severely worn. Use only brass or plastic removal tools to remove old o-ring.

   **Caution!**
   
   DO NOT use hard metal tools to remove o-rings. Damage to seal surfaces will result in loss of vacuum integrity.

2. Check the chemical source bottle level indicators on the touch screen interface to ensure there is sufficient chemical to run product.

3. Check the temperature controller set points (4 process chamber, flask, flask line, and vacuum line).

4. Check pressure variables.

5. Confirm the process variable values are properly set for recipes (# of purge loops, # of evacuation loops, process duration, heat up delay).

6. Check infusion variables.

7. Verify scrubbed house exhaust is operating.

8. Check the vent nitrogen, nitrogen/CDA pressures (15-30 psig and 80-100 psig respectively) and levels to ensure adequate supply.

9. Check the ammonia supply pressure in the tank (approx. 114 psig vapor pressure). Pressure gauge on the flow control unit should read 5-10 psig.

10. Refill LN₂ trap with liquid nitrogen. Fill using smaller diameter tube extruding from trap lid. One fill of 1.6 liters will last approximately 6 hours for the 6-inch diameter trap, depending on generated heat load.
11. Clean out any particles that may have accumulated in the chamber, with a jet of nitrogen. If necessary, clean the system chamber with a lint-free cloth immersed in isopropyl alcohol.

Cold trap maintenance can be handled in two ways:

24 hr production:
Operator must continuously refill of the LN$_2$ trap when cued to do so (6-inch trap LN$_2$ capacity is 1.6 Liters). Auto-fill systems are available to eliminate operator intervention. PLC will cue operator when trap is to be drained. Trap should be disassembled and cleaned at this point.

**WARNING!**
Operator MUST change the touch screen panel to the maintenance panel display and disconnect the pump if system will be unattended for any length of time. After the exhaustion of trap LN$_2$ supply trap reservoir chemicals and residual vapor flask chemicals will continually vaporize through pump when LN$_2$ supply is gone, and damage to the pump may occur.
**Maintenance**

<table>
<thead>
<tr>
<th>Weekly Preventive Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Perform the Leak Check Program test to check vacuum integrity (Recipe #0) and compare to previous leak rate. Generally, a leak rate below 50mTorr/min is acceptable.</td>
</tr>
<tr>
<td>2. Check the level of the Fomblin® oil in the vacuum pump and top off if necessary (dry pumps do not require this service).</td>
</tr>
<tr>
<td>3. Observe infusion lines during delivery. Check for the presence of air bubbles, which would indicate an air leak. Possible leak points are the needle/Luer® interface, and the finger tight micro-pump fittings.</td>
</tr>
</tbody>
</table>

**NOTE:** Do not over tighten finger tight peek micro-pump fittings.

<table>
<thead>
<tr>
<th>Monthly Preventive Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Clean the chamber walls and doorplate with isopropyl alcohol. Use a squeeze bottle and wash it down. Use a clean room cloth to wipe all wall, shelf, and rail surfaces.</td>
</tr>
<tr>
<td>2. If a Fomblin® oil vacuum pump is used, inspect fluid pump levels.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bi-Annual Preventive Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The vapor chamber assembly will have to be disassembled, cleaned, and reinstalled depending on the chemicals used, chemical usage, chemical wetting activity, and/or processing chemicals over the degradation temperature. Furthermore, withdraw lines may need replacement as chemicals that are sensitive to wetting may polymerize in withdraw lines if proper cleaning/chemical change operation procedures are not followed.</td>
</tr>
<tr>
<td>2. If a Fomblin® oil pump is purchased through YES, it is recommended Fomblin oil be changed every six months or 1500 hours of use, whichever occurs first. Recycle old Fomblin oil. Standard Fomblin Alcatel® 2021 C2 16 cfm pump reservoir capacity is 1.5 Kg.</td>
</tr>
</tbody>
</table>

**NOTE:** Refer to your particular vacuum pump operator’s manual for procedures and maintenance schedule recommendations.
Troubleshooting

This section is intended to assist you in troubleshooting any issues you may have with your YES-1224P. If you are not able to correct an issue, please call Yield Engineering Systems’ field service for support at 1-888-YES-3637 (U.S. toll free) or +1 925 373-8353 (worldwide).

Process Problems

Incomplete Image Reversal

The most common problem that occurs with Image Reversal is an incomplete or unstable reversal. This condition can occur for the following reasons:

- Insufficient warm up time
- Insufficient or excessive process times or temperatures
- Failure to meet process needs
- Improper programming or execution of programming
- Equipment malfunctions due to:
  - Absence of anhydrous ammonia
  - Poor or no vacuum
  - Serious leaks

Silylation/CVD

Condensation

The most common problem that occurs with silylation is condensation. This condition may occur for the following reasons:

- Insufficient warm up time
- Exceeding infusion volumes that result in process pressures equal or greater than the maximum vapor pressure of a chemical at a given temperature
- Temperatures are too low
- Improper programming or execution of programming
- Equipment malfunctions due to:
  - Poor or no vacuum
  - Serious leaks

Incomplete Cleaning

This can be as simple as the need for a slightly longer process time, a higher power setting, or plasma gas pressure adjustment.

If a slow degradation in strip rate is noticed, check the leak rate with vacuum test procedure (Leak Check Recipe #0) to ensure no ambient air is entering the system during process.
**Troubleshooting**

Some surfaces will oxidize when exposed to either oxygen or air. Silver epoxy (and silver), for example, will turn black if the product is allowed to oxidize. This can occur either during an oxygen or air plasma, or after the process if air is used as a backfill gas while the samples are still warm from the process cycle.

If blackening occurs, even when nitrogen is used to backfill the chamber, first check the vacuum integrity of your system by doing a Leak Check (Recipe #0). If no leak is apparent, then the probable cause of the blackening is surface oxidation when the sample is exposed to atmosphere after the process. This can be prevented by extending evacuation purge cycles to allow cooling of the product before opening the door. The internal thermocouple may be used to determine the number of evacuation cycles needed for acceptable thermal oxidation reduction.

The chamber interior can turn a white/yellow color if the chamber is too hot when exposed to atmosphere. This coloration is Aluminum Trioxide, which is a simple ceramic and the effect is purely cosmetic. Follow the suggestions for oxidation problems to prevent this buildup.

In certain rare cases, material with a coloring agent that can be electrostatically charged when plasma cleaned. This electrostatically charged material may cling to the chamber walls. It may be cleaned off with isopropyl alcohol.

Check the oil level in the pump (Fomblin® pump only). If the pump oil level is correct, the cause may be that the main vacuum valve is not fully opening.

Check that the source of pneumatic nitrogen/air input to the system is in the range 80-100 psig.

This can be caused by:

Incorrect plasma gas pressure settings. Check the plasma gas bottle pressure is set to around 10psi. Check the needle valves at the rear of the system.

Too low a power setting (plasma can not be sustained below 100 Watts). Incorrect load matching between the power supply and the chamber.

If you have altered the load by adding or subtracting electrodes, it may be necessary to alter the matching transformer settings.

Finally, double check the flow rate settings if your system has MFCs or the needle valve settings (at the rear of the system) if you have a non-MFC system. The critical parameter is to maintain the chamber pressure in the 300-700 mTorr range.
Troubleshooting

Alarm List

| ATM to TP1 Abort |
| TP1 to TP2 Abort |
| TP2 to TP1 Abort |
| Base Pres Wait Abort |
| Over Temp Abort |
| Exit Loop Abort |
| Process Pressure Abort |
| Process Pressure Wait Abort |
| Invalid Recipe Number |

The watchdog timer has expired while waiting for the chamber pressure to reach the “Purge High” variable during initial evacuation of the chamber.

The watchdog timer has expired while waiting for the chamber pressure to reach the “Purge Low” variable while pumping down from the “Purge High” variable. The alarm can occur during initial pump down or during cycle purges.

The watchdog timer has expired while waiting for the chamber pressure to reach the “Purge High” variable while venting from the “Purge Low” variable. The alarm can occur during initial chamber vent or during cycle purges.

The watchdog timer has expired while waiting for the chamber pressure to reach the “Base Pressure” variable while pumping down from the “Purge Low” variable. The alarm can occur immediately after the pre-process cycle purges are complete.

The PLC has confirmed temperature is too high and heaters are shut down.

Chamber pressure has exceeded the “Abort Pressure” variable during any process.

Chamber pressure has exceeded the “Abort Pressure” variable during any process.

In the image reversal or silylation processes, the watchdog timer has expired while waiting for the chamber pressure to rise to the “Process Pressure” variable after the process gas valve has been opened.

An invalid recipe selection was entered.
Troubleshooting

Vapor Detection Alarm

Each time the YES-1224P(E) is turned on, the chamber must be evacuated in the event of a power failure during process. This safety measure ensures that no residual vapor escapes into the surrounding air. In the alarm state, no other process will run and the vapor detection alarm must be cleared before continuing.

To clear the vapor detection alarm:

1. Press the "Press to Select Recipe Number" button from the Operator’s Panel
2. Enter “15” on the numerical entry keypad, press “Enter”, then “Done”.
3. Press start from the Operator’s panel.
4. When the process is complete, push the reset button on the touch screen.

The vapor detection alarm will clear and the machine will be ready for use.
Troubleshooting

This section addresses the simplest and most general problems first, then helps you to isolate specific equipment malfunctions which may be the cause of the problem.

Problem #1: Vacuum chamber does not pump down or pumps down slowly.

- Verify that the voltage selector switch on the pump is in the correct position.
- Verify that the AC voltage supplied to the pump is within the limits specified on the pump nameplate.
- Verify auxiliary receptacle circuit breaker is in the on position if pump is powered through auxiliary receptacle
- Verify that the pneumatic nitrogen/CDA supply pressure is at least 80 psig. The vacuum and gas valves may not open if pneumatic pressure is too low.
- Verify internal pump seals are undamaged.
- Verify interconnecting vacuum line seals are not damaged/graded
- Verify that the chamber door is sealed by sliding a piece of paper around the seal with the door closed.
- Verify that the door seals are clean, undamaged, and properly seated on the chamber.
- Check chamber for leaks with leak test (Recipe #0).
- Check for leaks in the vacuum line.
- Check pneumatic signal to vacuum valve.
- Check electrical signal to the pneumatic solenoid valve that actuates the vacuum valve.
Troubleshooting

Problem #2: Chamber fills slowly or not at all.

- Verify that the pneumatic nitrogen/CDA supply pressure is at least 80 psig. The vacuum and gas valves may not open if pneumatic pressure is too low.
- Verify that the process nitrogen supply pressure are at least 15 psig.
- Check for clogged gas (0.5 micron) filter by removing the filter element and running a test process sequence. Replace the filter element if necessary. Filters are located directly downstream of the facilities bulkhead connectors within the side assembly housing.
- Check pneumatic signal to nitrogen vent valve.
- Check electrical signal to the pneumatic solenoid valve that actuates the nitrogen valve.

Process Vapor Pressure
Does Not Rise

Problem #3: Process vapor pressure does not rise to required level.

- Check the level of chemical in source bottle(s).
- Check the age of the HMDS/chemical. The shelf life of an unopened bottle of HMDS, stored under perfect environmental conditions, (humidity between 36-40% and temperature of 70°C +/- 2°C) is not to exceed six months. Once a bottle has been opened, it should be used within 30 days or properly disposed of. Chemical under the presence of nitrogen blanket will last much longer.
- Ensure that the required vapor pressure can be achieved with chemical, at current temperature settings.
- Check for plugged infuse lines/valves by confirming fluid flow when syringe pumps are active. Polymerized chemical will plug the lines/valves and require replacement or cleaning.
- Verify that the flask, vapor line, chamber, and vacuum line are heating properly. Incorrect temperature settings will also create a condensation spot and hinder complete vaporization.
Troubleshooting

- Verify that the pneumatic nitrogen/CDA supply pressure is at least 80 psig. The vacuum and gas valves may not open if pneumatic pressure is too low.
- Check pneumatic signal to process gas valve.
- Check electrical signal to the pneumatic solenoid valve that actuates the process gas valve.

**Problem #4:** During image reversal process, ammonia pressure increases slowly.

- Check the ammonia supply pressure.
- Replace ammonia filter elements.

**During Image Reversal, \( NH_3 \) Rises Slowly**

**Problem #5:** Program sequence does not operate correctly.

- Check the process pressure set points to ensure that they are correct.
- Check the temperature set points to ensure they are correct.
- Check the process variable settings (# dehydration loops, # of evacuation loops, process duration) to ensure that they are correct.

**Program Sequence Not Operating Properly**

**Problem #6:** Flask, vapor line, vacuum line, or chamber does not heat.

- Check over temperature alarm screen for overheat errors.
- Verify that the thermocouple temperature sensors are installed correctly.
- Check temperature controller settings.

**Flask, Vapor/Vacuum Line or Chamber Does Not Heat**
Troubleshooting

- Verify that the SSR heater power controllers are receiving the signal from the temperature controller. There are no visual indicators on Crydom® models. Measure the voltage across the output terminals 1 & 3 on the Partlow 1160 plus temperature controllers and/or across the input terminals on the Crydom relay. Active state voltage is 4VDC.

- Verify that AC voltage is correct on the output terminal of the SSR.

- Verify thermocouple connectors are correctly connected to control console panel jacks (look behind upper rear cabinet access panel).

- Turn off the power, disconnect the heater and measure its resistance. Each 200W heater element (chamber and door heaters) should measure approximately 260Ω. Each 350W heater element (vapor flask heaters) should measure approximately 150Ω. Each vapor/vacuum line heater element should measure approximately 540Ω.

Flask, Vapor/Vacuum Line, Chamber Temp Too High

**Problem #7:** Flask, vapor line, vacuum line, or chamber temperature is too high.

- If high temperature is due to temporary overshoot on startup check the PID settings on the temperature controller.

- Check temperature controller set point value.

- Check for erroneous offset values entered into controller.

- Check voltage on output terminal of SSR power controller. Output voltage should be 0 when input voltage is 0. Replace SSR if it is not.
Troubleshooting

Problem #8: Plasma does not fire or fires intermittently

- Check that there is a “1” entered into the MFC flow variable if no MFC options were purchased. A “0” entry disables each gas.
- Check reactant gas levels and confirm pressure is at least 15 psig.
- Check plasma power supply power on switch is in the on position.
- Check plasma power supply is not set in the local operation mode, is set in the remote operation mode.
- Check plasma power supply tap setting for proper load match.
- Check that operating pressure is in the 300-700 mTorr range (may require gas flow adjustment). Plasma will not fire if pressure is too high.
- Check that door is in the closed and locked position.
## Appendix

### Parts List

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>702-10672-01</td>
<td>Door Seal Inner</td>
</tr>
<tr>
<td>702-10673-01</td>
<td>Door Seal Outer</td>
</tr>
<tr>
<td>700-5755-03</td>
<td>Door Sealing Plate</td>
</tr>
<tr>
<td>01-780-190-4234</td>
<td>Door Draw Latch</td>
</tr>
<tr>
<td>710-10722-01</td>
<td>Active Shelf</td>
</tr>
<tr>
<td>710-10723-01</td>
<td>Floating Shelf</td>
</tr>
<tr>
<td>710-10724-01</td>
<td>Grounding Shelf</td>
</tr>
<tr>
<td>790-5589-01</td>
<td>Touch Screen</td>
</tr>
<tr>
<td>440-8477-01</td>
<td>20amp, 277 Volts AC 10KAIC Circuit Breaker</td>
</tr>
<tr>
<td>380-2425-01</td>
<td>Amber Pressure OK Lamp</td>
</tr>
<tr>
<td>750-5781-01</td>
<td>Control Console</td>
</tr>
<tr>
<td>790-10730-01</td>
<td>Gauge, Heated Capacitance Manometer 0-100 Torr</td>
</tr>
<tr>
<td>510-5846-01</td>
<td>Controller Partlow® 1160 Plus</td>
</tr>
<tr>
<td>480-4611-01</td>
<td>Type-J Thermocouple 120”</td>
</tr>
<tr>
<td>480-6231-02</td>
<td>Type-J Thermocouple 120” Vapor/Vacuum Line Heater</td>
</tr>
<tr>
<td>750-5243-01</td>
<td>Type-K LN₂ ¼” Trap Thermocouple 72”</td>
</tr>
<tr>
<td>750-4753-03</td>
<td>Vapor/Vacuum Line Heater, 85W, 120” Leads</td>
</tr>
<tr>
<td>790-5433-11</td>
<td>PLC CTC 5200</td>
</tr>
<tr>
<td>790-10680-01</td>
<td>PLC CTC 5201 Expansion Controller</td>
</tr>
<tr>
<td>01-420-020-1370</td>
<td>3-30 Volts DC Solid-State Relay (SSR)</td>
</tr>
<tr>
<td>560-5966-01</td>
<td>Over temperature Monitor, 8 J-Type T/C Input</td>
</tr>
<tr>
<td>750-7177-01</td>
<td>24 Volt DC Humphrey® Actuator Valve</td>
</tr>
<tr>
<td>520-6173-01</td>
<td>Power Supply 15VDC, 10 Amps, 150 W</td>
</tr>
</tbody>
</table>
Appendix

520-6173-02  Power Supply 24VDC, 6.5 Amps, 150 W
01-480-040-3169  Fuse Holder
440-6232-01  Fuse 7 Amp AGC
440-5590-01  Fuse 6 Amp MDL
710-10619-01  Stainless Steel Vapor Flask
750-10676-01  Sock Heater, 220VAC, 100 Watts
780-5812-02  Encapsulated Viton® Flask O-ring
420-8301-01  Relay DPDT 24VDC
750-1919-01  Chamber Heater Strip 230VAC, 200 Watts
220-8269-01  Diode 1N4004
700-5773-02  Door Insulation Flexboard
780-1483-01  Foot, Swivel
01-400-140-3446  Switch, Interlock
780-4747-01  Valve, Pneumatic Vacuum/Vapor
750-4756-01  Fan, 140 CFM, 24 VDC
01-780-60-1166  Filter, .5 Micron
780-6266-01  1-in. Septum Needle
780-6266-06  6-in. Septum Needle
820-4637-14  Micro-pump Delivery Line Replacement Kit
750-5245-01  Micro-pump
01-780-260-6152  Retainer Gasket ½ VCR Replacement Kit
750-4769-01  Audible Alarm
820-5248-01  Complete Micro-pump Delivery Replacement
790-8584-01  Temperature Controller
## Conversion Chart

### Pressure

<table>
<thead>
<tr>
<th>Torr</th>
<th>mBar</th>
<th>&quot;Hg</th>
<th>psig</th>
<th>( \text{psig} = \text{Kg/cm}^2 )</th>
<th>Kg/cm(^2) = psi</th>
<th>(^{\circ})C</th>
<th>(^{\circ})F</th>
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<tbody>
<tr>
<td>0.25</td>
<td>0.33</td>
<td>0.00</td>
<td>0.00</td>
<td>1 = 0.7</td>
<td>1 = 14.2</td>
<td>0.0</td>
<td>32.0</td>
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<tr>
<td>0.50</td>
<td>0.67</td>
<td>0.02</td>
<td>0.01</td>
<td>2 = 14</td>
<td>2 = 28.4</td>
<td>10.0</td>
<td>50.0</td>
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<tr>
<td>0.75</td>
<td>1.00</td>
<td>0.04</td>
<td>0.02</td>
<td>3 = 21</td>
<td>3 = 42.7</td>
<td>20.0</td>
<td>68.0</td>
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<tr>
<td>1.00</td>
<td>1.33</td>
<td>0.06</td>
<td>0.03</td>
<td>4 = 35</td>
<td>4 = 56.9</td>
<td>24.0</td>
<td>75.2</td>
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<tr>
<td>2.00</td>
<td>2.67</td>
<td>0.08</td>
<td>0.04</td>
<td>5 = 71.1</td>
<td></td>
<td>26.0</td>
<td>78.8</td>
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<tr>
<td>2.50</td>
<td>3.33</td>
<td>0.10</td>
<td>0.05</td>
<td>10 = 70</td>
<td>6 = 83.3</td>
<td>28.0</td>
<td>82.4</td>
</tr>
<tr>
<td>5.00</td>
<td>6.66</td>
<td>0.20</td>
<td>0.10</td>
<td>15 = 106</td>
<td>7 = 99.6</td>
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<tr>
<td>7.50</td>
<td>10.00</td>
<td>0.30</td>
<td>0.15</td>
<td>20 = 141</td>
<td>8 = 113.8</td>
<td>100.0</td>
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<tr>
<td>10.00</td>
<td>13.33</td>
<td>0.39</td>
<td>0.19</td>
<td>25 = 1.76</td>
<td>9 = 128.0</td>
<td>120.0</td>
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<tr>
<td>25.40</td>
<td>33.85</td>
<td>1.00</td>
<td>0.48</td>
<td>30 = 2.11</td>
<td>10 = 142.2</td>
<td>125.0</td>
<td>257.0</td>
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<tr>
<td>50.00</td>
<td>66.64</td>
<td>1.97</td>
<td>0.97</td>
<td>35 = 2.46</td>
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<td>146.0</td>
<td>294.8</td>
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<tr>
<td>51.70</td>
<td>69.91</td>
<td>2.04</td>
<td>1.00</td>
<td>40 = 2.81</td>
<td></td>
<td>148.0</td>
<td>298.4</td>
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<tr>
<td>75.00</td>
<td>99.97</td>
<td>2.95</td>
<td>1.45</td>
<td>45 = 3.16</td>
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<td>302.0</td>
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<tr>
<td>100.00</td>
<td>133.00</td>
<td>3.94</td>
<td>1.90</td>
<td>50 = 3.52</td>
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<td>152.0</td>
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<tr>
<td>254.00</td>
<td>359.00</td>
<td>10.00</td>
<td>4.90</td>
<td>55 = 3.87</td>
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<td>154.0</td>
<td>309.2</td>
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<tr>
<td>508.00</td>
<td>777.00</td>
<td>20.00</td>
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<td>60 = 4.22</td>
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<tr>
<td>517.00</td>
<td>689.00</td>
<td>20.36</td>
<td>10.00</td>
<td>65 = 4.57</td>
<td></td>
<td>160.0</td>
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<tr>
<td>760.00</td>
<td>1013.00</td>
<td>29.92</td>
<td>14.70</td>
<td>70 = 4.92</td>
<td></td>
<td>200.0</td>
<td>392.0</td>
</tr>
</tbody>
</table>

Figure 49 Conversion Chart