EDC 650 SERIES SPIN PROCESSOR

OPERATION MANUAL

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QUICK START INSTALLATION INSTRUCTIONS

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SECTION 1 – HEALTH, SAFETY AND ENVIRONMENTAL

INTRODUCTION

This chapter covers safety information pertaining to the spin processor system. The spin processor uses high voltage electrical power, mechanical motion, and varying temperatures in the processing of semiconductors. Safety precautions MUST be followed when servicing or maintaining the spin processor system.

Service and maintenance personnel should be trained in:

- Electrical safety
- Hazardous Chemical Handling
- Mechanical Motion

NOTE: Only Laurell trained and certified personnel should service or maintain the spin processor system.

Some maintenance tasks may require more than one person to perform. The presence of potentially hazardous chemicals may require two or more workers to safely complete the tasks. Whenever possible, turn off and lockout gases, chemical delivery valves, and electrical power before service or maintenance are performed.

Possible hazards associated with the spin processor system are:

- Electrical shock
- Inhalation, exposure, and skin contact with solvent chemicals
- Fire
- Mechanical hazards

Safety procedures associated with the spin processor are noted within this section and throughout this volume. The OEM components for your system also contain specific safety instructions, which are provided in their respective documentation.

Each spin processor is configured to use specific chemical materials in its standard process, as well as facility gases and fluids for certain maintenance tasks. These chemical materials may be hazardous, flammable and/or toxic and require careful handling. Safe handling procedures for these chemical materials are discussed in this manual.

Laurell Technologies Corporation is not liable for damages resulting from improper installation or misuse of their spin processor system. Every operator and service person must read and thoroughly understand the operation and maintenance manuals, as well as any additional information, provided by Laurell with respect to this product.

1.1 LAURELL TECHNOLOGIES ENVIRONMENTAL, HEALTH AND SAFETY POLICY

Laurell Technologies maintains an EHS (Environmental, Health and Safety) policy and will periodically notify its customers of new issues, which may affect the way in which its equipment is being used. All technical information regarding each customer and process use is entered into the company wide database. Hard copy and electronic backups are maintained as part of the company's vital information and recovery policy. This information is reviewed and updated daily.

1.2 HAZARD WARNINGS

Potential safety hazards associated with the spin processor system are clearly labeled on the equipment and in this manual using the preferred hazard-warning trilogy of alert words, pictograms, and avoidance techniques. This hazard-warning system is in accordance with ANSI Standard Z535 and OSHA 29 CFR 1910.144-147. The labels will be contained within a box border and will apply to the text immediately following the warning. (See Figure # 1-2A)

Hazard Alert Labels are subdivided into three areas:

- The Level of Hazard Intensity
- Hazard Pictograms
- Hazard Avoidance Text

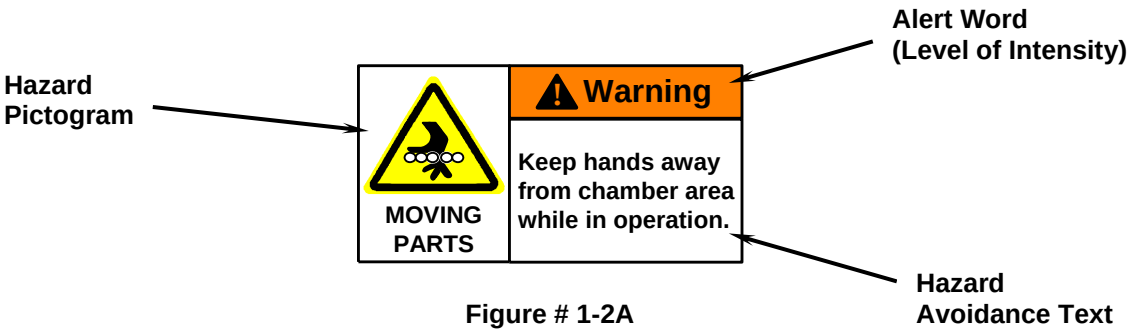


Figure # 1-2A
HAZARD ALERT LABEL

The spin processor manual uses this system of hazard warnings before each service or maintenance procedure that may involve hazards to personnel. When working on OEM sub-systems please refer to the manufacturer's documentation for specific hazard warnings. READ and UNDERSTAND precautions and hazard warnings BEFORE performing any service or maintenance task.

1.2.1 LEVEL OF HAZARD INTENSITY

Alert words are used to communicate the level of hazard intensity. The hazard alerts provided in the manual utilize some or all of the following key words:

"CAUTION" - (Depicted by black lettering on a yellow background) this indicates potential hazard or unsafe practices or operations that could cause damage to the tool or product. Proper precautions should be taken. (See Figure # 1-2B)

Figure # 1-2B
CAUTION ALERT

"WARNING" - (Depicted by black lettering on an orange background) this indicates that an immediate hazard exists and special precautions are necessary. Loss of life or limb may occur if WARNING labels are not heeded. (See Figure # 1-2C)

Figure # 1-2C
WARNING ALERT

"DANGER" - (Depicted by black lettering on a red background) this indicates that an immediate hazard exists, which, if not avoided, will result in serious injury or death. (Typically not used on Laurell spin processor) (See Figure # 1-2D)

Figure # 1-2D
DANGER ALERT

NOTE: All Danger, Warning, and Cautionary notices must be carefully read, thoroughly understood and strictly observed. The users of this product assume the responsibility of implementing all Governmental, Federal, State, and Local safety regulations applicable to the use of this product.

1.2.2 HAZARD PICTOGRAMS

Hazard Pictograms (pictorial hazard alert symbols/icons) are used to visually convey the nature, avoidance technique, and possible consequences of a given hazard, if the instructions are not followed. Pictograms help assure that non-English speaking persons are alerted to potential hazards and how the hazard may be avoided.

Laurell Technologies Corporation has adopted a series of pictograms used to identify various hazards, which may be present in the spin processor. These icons appear in the manual and on the equipment wherever exposure to hazards is possible. Several may be used in each manual; however, not all pictograms are applicable to each system. Figure # 1-2E depicts some or all of the pictograms used on Laurell spin processors. Service and maintenance personnel should become familiar with all of the pictograms shown so that the hazard represented by each will be recognized on sight.

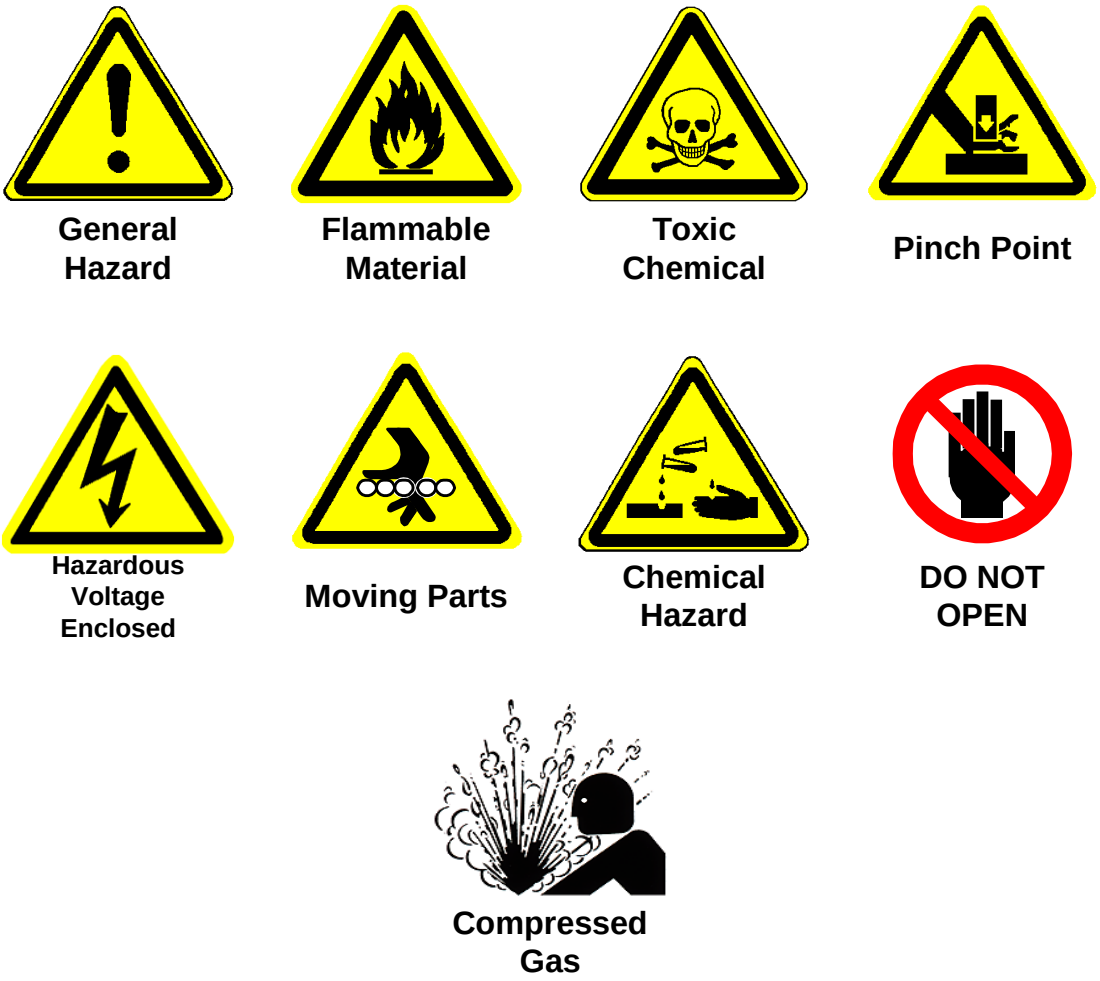


Figure # 1-2E
HAZARD PICTOGRAMS

1.2.3 HAZARD AVOIDANCE TEXT

Text is also used to convey methods of avoiding certain hazards and the consequences that will occur if proper precautions are not taken. (See Figure # 1-2F)

Figure # 1-2F
AVOIDANCE TEXT

1.3 EMERGENCY SHUTDOWN

By design, if the spin processor is NOT equipped with its own EMO (Emergency Machine Off) circuit, it is then powered by a system with EMO capability. If your safety department or policies allow: simply having the incoming power plug far enough away from the spin processor, properly labeled and fully accessible this may be sufficient.

The EMO button area should be located within easy reach of the spin processor operator. In the event of an emergency, pressing the EMO button will remove all power to the spin processor. The internal pilot valves that operate the external chemical valves will be in the “off” condition and the motor used for spinning the wafer will be powered off, placing the system in a safe “stand-by” condition.

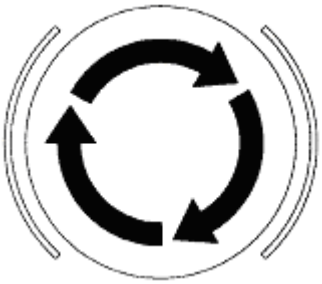
After the EMO circuit has been reset and power has been restored, the spin processor will automatically reset. The spin processor will revert to the normal “power up” condition. All chemical valves will be in the “off” condition, the motor will revert to a “stopped” condition, and any process that was being performed when the EMO occurred will have been terminated. Any wafer that was being processed during this shutdown may incur some damage and should be treated as such.

By following the normal steps, described in Section 3.6, for initiating the spin processor, a new process may be started.

1.3.1 EMO (EMERGENCY MACHINE OFF) PROCEDURE

1. Locate the nearest EMO button.

2. Press the EMO button to immediately interrupt system power.



EMO

Figure # 1-3
EMO (Emergency Machine Off) PROCEDURE

1.4 PROTECTIVE APPAREL

Always wear personal protective equipment when handling any potentially hazardous chemicals. Use and maintenance of the spin processor may require using protective gloves, an apron, and chemical goggles and/or face shield, depending on the operation. Be sure to select protective apparel that is appropriate for the chemicals being used. Refer to your company's safety policies and procedures for the personal protective equipment required.

1.5 POTENTIAL EXPOSURE HAZARDS

The following section will cover potential exposure hazards, which may occur while operating the spin processor system.

NOTE: This section should be READ and UNDERSTOOD before using the spin processor.

1.5.1 ELECTRICAL HAZARDS

WARNING

240/115 Volts AC is used throughout the system. Do not attempt to troubleshoot or make repairs unless you are familiar with the electrical circuitry in the spin processor. (Refer to Section 2 for spin processor power requirements and main circuit breaker information.)

Caution: an extreme electrical hazard will exist if this system is immersed in liquid. The system must not be located where it could be accidentally knocked into any open liquid bath. An earthquake-proof base can be supplied for any system.

Electrical components are located internally, and electrical power is distributed throughout the spin processor system. Access can only be gained by removal of the bottom panel, which is secured by screws. Only trained, qualified technicians should be permitted to work on an uncovered machine. Use all precautions and safety measures characteristically taken with AC and DC circuitry.

The spin processor should be locked and tagged out according to the procedure outlined below before any maintenance or service is performed.

Maintenance tasks are categorized by “TYPE TASK” as described below. The spin processor has no tasks that are above Type 2. The maintenance manual identifies tasks that may have electrical energy present using the following conventions:

- Type 1 - Equipment is fully de-energized (electrically "cold"). Lockout and tag-out procedures should be used.
- Type 2 - Equipment is energized. Live circuits are covered or insulated. Work is performed at a remote location to preclude accidental shock.
- Type 3 - Equipment is energized. Live circuits are exposed and accidental contact is possible. Potential exposures are less than 30 volts, 42.2 volts peak, 240 volt-amps, and 20 Joules.
- Type 4 - Equipment is energized. Live circuits are exposed and accidental contact is possible. Voltage potentials are greater than 30 volts RMS, 42.2 volts peak, 240 volt-amps, and 20 Joules, or radio frequency (rf) is present
- Type 5 - Equipment is energized and measurements and adjustment require physical entry into the equipment, or equipment configuration will not allow the use of clamp-on probes.

NOTE: Unless otherwise noted, all maintenance should be performed with the spin processor system power OFF. There are NO maintenance tasks that require servicing of the spin processor while it is energized.

1.5.2 STATIC ELECTRICITY: BONDING AND GROUNDING

WARNING

Friction caused by liquids moving can cause a static electricity buildup. If this charge is not properly dissipated, then fires or explosions may occur. Be sure to follow appropriate bonding and grounding practices when supplying flammable and combustible liquids to the spin processor.

1.5.2.1 BONDING

Bonding is creating a metal-to-metal connection between the dispensing and receiving containers to keep them both at the same electrical potential.

1.5.2.2 GROUNDING

Grounding is creating a metal-to-metal connection between the dispensing container and a known grounded object to allow static electricity to dissipate into the ground.

For more information on Bonding and Grounding see NFPA 77, Static Electricity.

1.5.3 MOVING PARTS HAZARDS

WARNING

Use care when opening or closing lids. Lids are heavy, and if dropped accidentally may crush or injure fingers.

WARNING

The chuck on the spin motor can spin in excess of 10,000 rpm. Keep hands and other body parts away from process chamber area. (Refer to Section 3.7 for information on changing chucks.)

1.5.4 AUDIO NOISE HAZARDS

Audible sound pressure readings were taken 3 feet (0.9 m) from the system during normal operation. The background decibel level during standby was measured to be 48 dB(A). The sound pressure readings during normal operations were measured to be 51 dB(A). Readings of less than 80 dB(A) are considered non-hazardous.

1.5.5 CHEMICAL HAZARDS AND COMPATIBILITY

The following section outlines some general guidelines for using chemicals. Refer to Section 2 for more chemical information.

CAUTION

Each spin processor is configured to use specific chemicals for its standard process and includes facility gases and fluids, and maintenance chemicals.

WARNING

The use of incompatible materials in the spin processor is not allowed. If incompatible materials mix in the process chamber or in the waste streams, a hazardous and/or toxic chemical reaction may occur. It is vitally important not to mix or use incompatible materials (i.e., acids with bases, corrosives with organics, acids with organics, etc.). **Before any new chemical is used in the spin processor, the compatibility of the material with other chemicals in the system and the structural materials used in making the spin processor should be investigated.** (Refer to Section 1.6.2 for more information on incompatible chemicals.)

WARNING

Residual chemicals may be left in the process chamber after processing has occurred. These potentially toxic or corrosive residues may pose inhalation or dermal hazards. Be sure to adequately rinse the process chamber before opening, wear appropriate personal protective equipment and ensure that the spin processor is located in a properly ventilated area that is also protected from splash hazards. (Refer to Section 2 for facility requirements.)

1.5.6 SOLVENTS

The following section outlines some general guidelines for using solvents.

WARNING

Most solvents are extremely flammable. Keep all flammable liquids away from ignition sources such as open flames or arcing electrical equipment. Keep all chemicals in a well-ventilated area, preferably in a cabinet designed for such storage.

WARNING

Flammable liquids should be stored and transported in approved safety cans only. When transferring flammable liquids from one container to another, be sure the pouring and receiving containers are bonded to each other and to a ground to prevent static electrical sparks. (Refer to Section 2 for secondary containment information.)

WARNING

Never store more than a one-day supply of flammable liquid in the using area, unless it is stored in a cabinet approved for flammable liquid storage.

WARNING

Depending on your location of use, other local fire or building code (e.g. UFC, UBC, NFPA, etc.) requirements may apply in the proper storage, dispensing, and use of flammable materials. Please consult with your local jurisdiction having authority for specific requirements. (Refer to Section 1.6.4 for local restrictions.)

WARNING

Before using solvents, read and understand the safety instructions, provided by the supplier, on the container labels and MSDS (Material Safety Data Sheets). (Refer to Section 1.6.1 for more information on Material Safety Data Sheets.)

1.5.7 ISOPROPYL ALCOHOL

WARNING

Isopropyl alcohol is a colorless liquid with an odor resembling alcohol. It causes irritation of the eyes, skin, and respiratory tract. It is extremely flammable and should be stored separately. Wear eye protection (safety glasses or a full-face shield), gloves, and an apron as recommended by your company's safety department or the manufacturer. If isopropyl alcohol gets on your skin, rinse with water for 15 minutes, refer to the manufacturers MSDS for first aid instructions and contact your company's safety department. Use isopropyl alcohol under a fume hood or in a well-ventilated area.

Inhalation: Inhalation of vapors irritates the respiratory tract. Exposure to high concentrations has a narcotic effect, producing symptoms of dizziness, drowsiness, headache, staggering, unconsciousness, and possibly death.
Ingestion: Can cause drowsiness, unconsciousness, and death. Gastrointestinal pain, cramps, nausea, vomiting, and diarrhea may also result. The single lethal dose for a human adult = about 250 ml (8 ounces).
Skin Contact: May cause irritation with redness and pain. May be absorbed through the skin with possible systemic effects.
Eye Contact: Vapors cause eye irritation. Splashes cause severe irritation, possible corneal burns, and eye damage.
Chronic Exposure: Chronic exposure may cause skin irritation.
Aggravation of Pre-existing Conditions: Persons with pre-existing skin disorders or impaired liver, kidney, or pulmonary function may be more susceptible to the effects of this agent.

1.5.8 HYDROGEN PEROXIDE

DANGER

Hydrogen Peroxide is a strong oxidizer; contact with other material may cause fire and/or corrosive reaction. It may cause burns to skin, eyes, and respiratory tract. Harmful if swallowed.

DANGER

Before using, read and understand the safety instructions provided by the supplier on the container labels and Material Safety Data Sheets.

Inhalation: Vapors are corrosive and irritating to respiratory tract. In severe cases, exposures may result in pulmonary edema and death.
Ingestion: Corrosive and irritating to the mouth, throat, and abdomen. Large does may cause symptoms of abdominal pain, vomiting, and diarrhea as well as blistering or tissue destruction.
Skin Contact: Corrosive. Symptoms of redness, pain and severe burn can occur.

Eye Contact: Vapors are very corrosive and irritating to the eyes. Symptoms include pain, redness and blurred vision. Splashes can cause permanent tissue destruction.
Chronic Exposure: No information found.
Aggravation of Pre-existing Conditions: Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to effects of the substance.

1.5.9 SULFURIC ACID

DANGER

Sulfuric Acid is a poisonous and corrosive liquid. It will cause severe burns to all body tissue. It may be fatal if swallowed or contacted with skin. Harmful if inhaled. Affects teeth. Water reactive. Cancer Hazard. Strong inorganic acid mists containing sulfuric acid can cause cancer.

DANGER

Before using, read and understand the safety instructions provided by the supplier on the container labels and Material Safety Data Sheets.

Inhalation: Produces damaging effects on the mucous membranes and upper respiratory tract. Symptoms may include irritation of the nose and throat and labored breathing. May cause lung edema, a medical emergency.
Ingestion: Corrosive. Swallowing can cause severe burns of the mouth, throat, and stomach, leading to death. Can cause sore throat, vomiting, and diarrhea. Circulatory collapse with clammy skin, weak and rapid pulse, shallow respiration, and scanty urine may follow ingestion or skin contact. Circulatory shock is often the immediate cause of death.
Skin Contact: Symptoms of redness, pain, and severe burn can occur.
Eye Contact: Contact can cause blurred vision, redness, pain, and severe tissue burns. Can cause blindness.
Chronic Exposure: Long-term exposure to mist or vapors may cause damage to teeth. Chronic exposure to mists containing sulfuric acid is a cancer hazard.
Aggravation of Pre-existing Conditions: Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance.

1.5.10 HAZARDOUS WASTE

CAUTION

Normal operation and maintenance of the system creates hazardous wastes that require special handling and disposal. Disposal of these wastes must follow all codes, laws, and your company's **safety and health** requirements.




1.5.11 CHEMICAL DISPOSAL

WARNING

Never mix empty acid, flammable liquid, or oxidizer containers in the same waste cans. Chemicals must be handled in accordance with local, state and federal regulations and within the guidelines established by your company. **NEVER** dispose of chemically contaminated wipes or clothes in regular trash. Contact your companies Safety or Environmental Department for instructions on how to handle and dispose of chemically contaminated trash.


1.5.12 ADDITIONAL SAFETY PRECAUTIONS

Full compliance with the following safety practices and those appearing earlier in this chapter is expected.

1. Never work alone on live electrical circuits. You must be within sight or calling distance of another employee who has the following qualifications:
   - Knows how to remove power from the equipment
   - Knows how to apply artificial respiration
   - Is acquainted with emergency procedures, first aid locations, and the location and use of fire extinguishers
2. Turn off, lockout, and tag all hazardous energy sources (e.g., gas, pneumatic, mechanical, gravitational, and electrical) before performing any maintenance.
3. Do not wear rings, wristwatches, or other jewelry on your hands or arms while working on live electrical circuits.
4. Wear eye protection while working on live electrical circuitry where a flash might occur. Do not wear contact lenses.
5. Replace all safety shields after completing setup, troubleshooting, and maintenance procedures.
6. Immediately report any unsafe conditions to the shift supervisor.
7. Comply with all applicable regulations governing the disposal of hazardous materials. Dispose of waste materials in a manner that will prevent air or water pollution and will not expose humans, animals, or vegetation to hazards.
8. Do not permit smoking or food in the work area.

9. Secure electrical cords and cables where they cannot be tripped over or otherwise accidentally pulled from their connectors.
10. Be sure that all personnel know the location of the main circuit breaker in case of an electrical emergency.
11. Locate fire extinguishers near the equipment. The extinguishers must be approved for electrical or chemical fires in accordance with OSHA and local, state, and federal codes.
12. Operating personnel must not remove covers or panels. Only qualified maintenance personnel may make component replacements and internal adjustments only.
13. Do not replace components with the power cable connected. Under certain conditions dangerous voltages may exist, even when the power cable is removed. To avoid injuries, always disconnect power; lock out the circuit breaker and discharge circuits before performing a task.
14. Do not attempt internal service or adjustment unless a person capable of rendering first aid is present. Be sure to follow your company's safety procedures.
15. Because of the danger of introducing additional hazards, do not install substitute parts or make any unauthorized modification to the system.
16. Contact Laurell Field Service for service and repair to ensure that safety features are maintained.
17. Maintain adequate safety precautions when handling toxic chemicals. Avoid breathing dust or spray mist. Use chemicals only with adequate ventilation and keep containers closed when they are not in use. Store chemicals in a locked cabinet where they cannot be removed accidentally.

1.6 ENVIRONMENTAL

1.6.1 MATERIALS SAFETY DATA SHEETS

Before introducing any new chemical, consult the factory specifications. The chemical manufacturer or supplier provides MSDS (Material Safety Data Sheets) for each chemical. The MSDS gives vital chemical safety information on the hazardous components, the chemical's physical properties, spill and leak procedures, waste disposal information, and personal protective equipment required to handle the chemicals involved. Follow the information on the MSDS when handling, refilling chemical containers or cleaning up spilled or leaked materials. Before using solvents, read and understand the safety instructions provided by the supplier on the container labels and MSDS.

NOTE: Laurell Technologies Corporation recommends that copies of the MSDS be kept with this manual and be made available to your employees. There are several web sites dedicated to providing chemical information. For reference, Laurell has listed the following:

- **http://www.hazard.com/msds/**
- **http://webbook.nist.gov/chemistry/**

1.6.2 MIXING INCOMPATIBLE CHEMICALS

It is important not to mix incompatible materials in the process chamber and/or waste stream of the spin processor (i.e., mixing acids with bases, corrosives with organics, or acids with organics...). Mixing incompatible materials can result in unwanted chemical reactions in either the chamber, exhaust or drain line. Only compatible materials are recommended for use within the spin processor system. Before any new chemical is used, compatibility of the material with other chemicals in the system and the materials used to construct the spin processor should be investigated. Some of this information may be obtained from the MSDS or the chemical supplier.

NOTE: Use of incompatible materials in the spin processor is strictly forbidden and should not be done under any circumstances.

1.6.3 RECOMMENDED ABATEMENT TECHNOLOGY

The vapor by-products expected in the effluent of the spin processor system should be handled and disposed of in accordance with any and all safety and legal abatement procedures. The recommended abatement technologies for efficient removal of hazardous process by-products are solvent destruction or solvent recovery. Several methods exist that are capable of removing the process by-products from the effluent stream. Some are reportedly more effective than others in terms of efficiency. The oldest abatement technology is to exhaust this effluent into the house *solvent* system, which is normally present in a wafer manufacturing facility.

The trend of the industry is to abate the process by-products at the *point-of-use* (POU), which localizes containment of the process effluent allowing ease of handling. Various POU technologies, as described below, are available for controlling these process by-products.

- *Thermal-oxidizers* convert the effluent gases into other compounds using either flame combustion or a heated catalytic process. The flame combustion requires fuel (usually hydrogen or natural gas) to maintain the flame.
- POU *dry scrubbers* are chemical-absorbent materials that capture the effluent onto absorbent granules. The benefits of dry scrubbers include cost effectiveness, non-hazardous cartridge disposal, and, if available, recycling or recovery of the solvent as a liquid.

More information on abatement technologies may be obtained from Semiconductor Safety Association (a trade group) at (703) 790-1745.

1.6.4 LOCAL RESTRICTIONS (EXAMPLE)

The use of IPA (Isopropyl Alcohol) creates environmental concern. Certain local jurisdictions have limitations on, and/or require permits for, the use of organic cleaning solvents. For example, the San Francisco Bay Area Air Quality Management District (BAAQMD) Regulation 2.1.118 limits the amount of volatile organic wipe cleaning solvents that may be used without obtaining a specific permit to 20 gallons per year per source area. Regular wipe down of the spin processor components could exceed this regulation's exemption limits alone or most likely when combined with similar operations at an end-user's facility.

1.6.5 EQUIPMENT DISPOSAL

It is well known fact that electrical and electronic products can pollute the environment by releasing toxic compounds from component decomposition after equipment disposal (in a landfill for instance). The aim of the European RoHS directive is to reduce the potential release of toxic substances from electronic products into the environment. All of Laurell's products sent to the EU community conform completely to the RoHS directive. The intent of the European WEEE (Waste Electrical and Electronic Equipment) directive is to force the recycling of electrical and electronic products as opposed to disposal as normal refuse. Controlled recycling of products after the end of their useful life will thereby avoid all negative impact on the environment.

We also feel that this is a very important consideration for all of our customers, no matter where the end user is located. We at Laurell Technologies support all efforts to safety dispose of all contaminated products and to minimize any and all potential environmental pollutants.

As required by the WEEE Directive of the European Union and the corresponding national laws, Laurell Technologies Corporation offers all end users in the EC and around the world the option to return, post paid, “end of life” spin processors without incurring any disposal charges.

If you wish to return a Laurell Technologies spin processor for waste recovery, please contact our home office at: support@laurell.com or call (215)699-7278.

If you do not return an “end of life” spin processor to Laurell Technologies, you must use a disposal company specializing in electronic waste recovery. Do not dispose of the spin processor as normal public refuse.

SECTION 2 - INSTALLATION

2.1 FACILITY REQUIREMENTS

2.1.1 FACILITIES

The spin processor should be installed on a vibration free surface in a clean, temperature and humidity-controlled environment to provide the best conditions for repeatable processing results.

- Seal Purge – CDA or N_2 60 - 70psig (4.13 – 4.82 bar). The CDA or N_2 must be moisture free. If moisture is present use an air dryer type filter. For particulate control it is recommended that a point of use filter, 1 micron, or less, be installed after the regulator and before the processor. The seal purge tubing **MUST NOT BE "T"** to supply another output from the same regulator.
- N_2 (if applicable) for injector(s) and for dome purge **MUST BE SUPPLIED FROM DEDICATED REGULATORS.** It is recommended that a point of use filter, 1 micron or less, be installed after the regulator and before the processor. It is also recommended that a check valve be installed after the regulator.
- Vacuum - 20 – 28" Hg with a flow volume of 1.67 - 4.5 SCFM @ 0" Hg. Other conversions see below.

20" Hg - 28" Hg or,	**1.67 - 4.5scfm or,**
0.68bar - 0.95bar or,	0.045m³/m - 0.127m³/m or,
68kpa - 9 5kpa or,	45Lpm - 127Lpm
508torr - 711torr	

- DI water (if applicable) - It is recommended that a point of use filter, 1 micron or less, be installed before the processor. It is also recommended that a check valve be installed before the filter.
- Chemical feed (if applicable) - It is recommended that a point of use filter, 1 micron or less, be installed in all the chemical feed lines between the source tank(s) and the processor. Individual regulators should be used when pressurizing more than one pressure vessel. It is also recommended that a check valve be installed after the regulator.
- Exhaust refer to section 2.1.9 below
- Drain – Open to atmosphere – NOT restricted by a vapor trap (see Figure 2-6) Refer to piping configuration drawing for installation guidance.

2.1.2 POWER REQUIREMENTS

- Power – 95 to 240VAC, 47/63HZ, 3 amps, 300 watts. A 15-foot (~200cm) power cord with a 3-pronged plug is supplied with an appropriate country plug adapter if necessary. All of our present designs have universal voltage input capability.

2.1.3 MAIN CIRCUIT BREAKER

- Power – 95 to 240VAC, 47/63HZ, 3 amps, 300 watts. A 15-foot (~200cm) power cord with a 3-pronged plug is supplied with an appropriate country plug adapter if necessary. All of our present designs have universal voltage input capability.

SEMI S2 is a Semiconductor Equipment and Materials International (SEMI) standard. S2 is the "Safety guidelines for all manufacturing equipment" standard. Circuit breakers are rated as to their ability to withstand the destructive energy of short-circuit currents. If a fault current exceeds that capability, the protective device may potentially rupture. The rating defining the capacity of a circuit breaker to maintain its integrity when reacting to fault currents is its interrupting rating, or AIC – Ampere Interruption Current. The interrupt rating of most branch-circuit, molded case, circuit breakers typically used in residential service entrance panels is 10,000A.

2.1.4 DIMENSIONS

- See Appendix for Basic System Dimensions.
- Additional space will be required for pressure vessels and pneumatic fluid/N_2 control valves.

2.1.5 AMBIENT TEMPERATURE

- The Spin processor is designed to run in an ambient temperature of between 68 - 75° F (20 -24° C).

2.1.6 SPIN PROCESSOR CHAMBER PRESSURE

- The chamber should be maintained at an operational negative pressure of ≥ 0.5 inches (12.7 mm) of H_2O while the system is in operation. This can be controlled by exhaust volume and purge gas. Idle exhaust flow should be set to 1.5" – 2.5" WC.

2.1.7 DISPENSE LIQUIDS

- See section 2.5.3 Automatic Chemical Spray

2.1.8 CHEMICAL TANKS (SSV-1 and TEV-1)

Capacity	5 Liters or 1.3 Gallon
Normal Operating Pressure	<60psig, (<4.1 bar)
Tank Rating	165psig, (11.38 bar) @ 100° F
Pressure Relief	60psig, (4.10 bar) @ 72° F
Dimensions	Height 10.75" x Diameter 9.75"
Grounding	8-32 UNC Binder Head Screw w/8-32 External Tooth Lock Washer Required
Allowable Pressure 150psig	(Teflon® [3] Tubing & Fittings)
Allowable Pressure 60psig	(Pneumatic Fluid Control Valves)
Pressurization & Depressurization	An automatic 3-way valve is provided for pressurization & depressurization (to vent) the vessel. Make sure vent tubing goes to an exhausted area.

[3] Teflon® is a registered trademark of DuPont (http://www.dupont.com)

2.1.9 EXHAUST REQUIREMENTS

- The spin processor is intended for use in an exhausted bench area. The end user is responsible for providing exhaust for the bench area.

	Volumetric Flow rate (CFM)*	Static Pressure (in H_2O)*	Duct Material	Type of Exhaust
Solvent Storage Cabinet	Solvent Storage Cabinet not supplied by Laurell			
Chamber Drain Port	50 ($1.4m^3$min.)	.5 to 2.5	PP	Chemical / Solvent

Note: These measurements were taken at the exhaust monitor port provided.

2.1.10 VACUUM PUMP (OPTION)

- LTC provided oil-less vacuum pump:
  - 25 – 28” (635 – 711mm) Hg with a flow volume of 4.5 scfm (0.11cm/m) @ 0”Hg
  - Power - 100 – 115 or 220 – 230 VAC - 50 / 60 Hz.
  - It is recommended to install the pump in an open and well-ventilated area. Normal operating temperature after 1 hour of use is 75 ± 5°C (165 ± 9°F). Pump is designed for continuous use. The factory thermal protection interlock is sensed on the motor windings and set for 135 ± 5°C (275 ± 9°F). The thermal reset temperature is 61 ± 9°C (142 ± 16°F). **Caution:** Pump will be hot after continuous use. Allow time for cooling before handling pump.
- Pneumatic Vacuum Generator (IVPVG)
  - Air pressure driven, variable, vacuum generator
  - N_2 or CDA ≤60psig (4.1 bar) required. We recommend a dedicated pressure regulator.
  - For more information go to http://www.laurell.com/accessories/iv-pvg.php

2.1.11 SECONDARY CONTAINMENT AND SPILL PREVENTION FEATURES

- When installed at the end-user site, secondary containment is recommended. It should provide for the spin processor and the pressurized tank(s). All secondary containment should incorporate appropriate gas detection, liquid sensors, and alarms. If incompatible materials are used in the spin processor, (not recommended by Laurell) containment should be designed to ensure that the materials could not be combined. Automatic shutoff capability should be considered for bulk distribution systems. The secondary containment provided should be able to contain 110% of the volume of the largest single container or all vessels combined.

2.2 INSTALLATION

SEE FRONT OF MANUAL FOR “QUICK START INSTALLATION INSTRUCTIONS”.
The first step in the installation is to unpack the spin processor. Identify each component on the packing list and verify that it was not damaged during shipping. Any

loss or damage must be reported to the factory within 30 days from shipment.

Identify each component on the packing list and verify that it was not damaged during shipping. Certain "Kits", such as tank kits and valve kits, will be shipped with lengths of tubing and unassembled parts. You should refer to the specific "Kit" assembly drawing for details of parts and assembly. This drawing should not be used as a detailed assembly drawing. Refer to section 2.1 "Facility Requirements" for required electrical power, vacuum, drain, exhaust, and N_2. Since each spin processor is configured to meet the needs of the end-user, requirements will vary for each application. It is suggested to install a point-of-use filter (at least 1 micron) a pressure regulator and a check valve (5psig breaking pressure) on the N_2 supply because it purges the process chamber directly.

2.2.1 SYSTEM CONNECTIONS

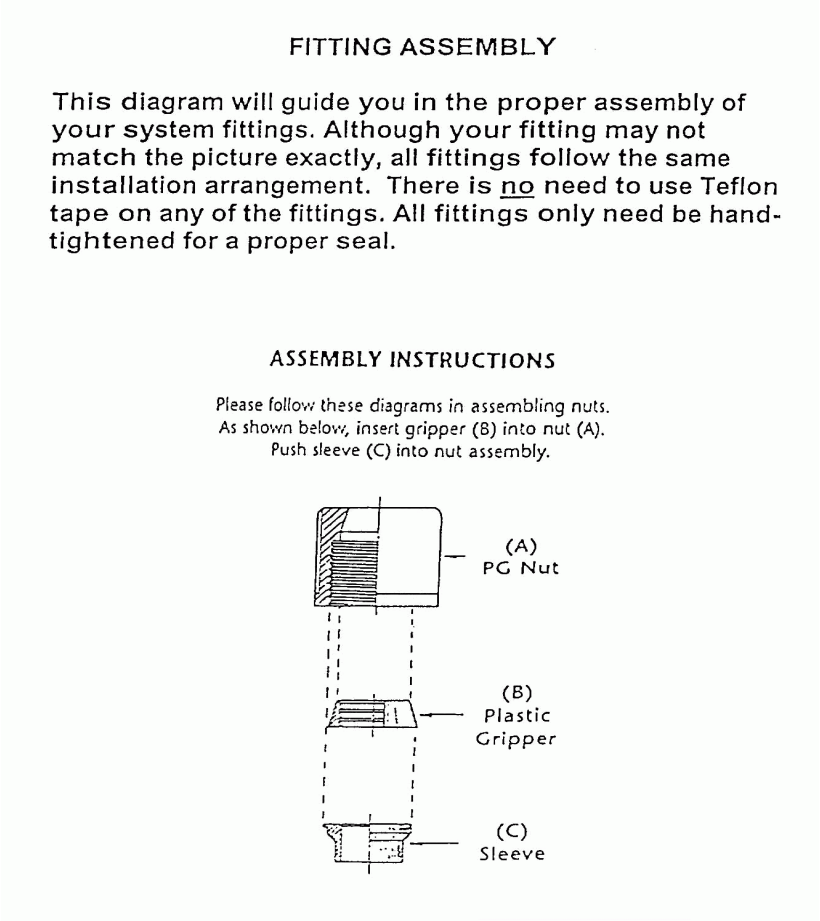
- Follow the outline in section 2 "Facilities" to prepare for installation. Use dedicated regulators and filters where appropriate.
- See section 5, Appendix, for all installation drawings.
- ***See "Quick Start Instructions" in front of manual for step-by-step installation instructions.***
- Install the processor on a stable, level and vibration free surface.
- Install the down-flow exhaust onto the drain port and connect the drain line and exhaust tubing to the down-flow exhaust. Five feet of 1" Teflon ® drain tubing and 10' of 2.5" polypropylene exhaust tubing is provided. ***See Quick Start Instructions.***
- Connect the ¼" O.D. polypropylene tubing from a 60 – 70psig N2 regulator to the SEAL PURGE push-to-connect fitting in rear of processor. If Nitrogen is not present or is <60psig (4.1 bar) the processor **WILL NOT OPERATE**. ***See Quick Start Instructions.*** See section 3.2.3 for more seal purge information.
- Connect vacuum source, using the provided 10' of 3/8" (9.52mm) O.D. x ¼" (6.35mm) I.D. tubing, to the 3/8" fitting on the vacuum control valve (right rear side of spin processor). (Applicable only if vacuum-type chuck is used.) **Note: vacuum supply tubing should be ¼" I.D. or larger to provide sufficient volume quickly.** ***See Quick Start Instructions.***
- Connect the ¼" PFA chemical feed tubing to the EDC's valve manifold or VOD valves. Refer to user's drawing for specific information in the appendix section. A ¼" (6.35mm) flaring tool is provided to prepare the tube-ends for connection. Be sure to install the flare-nut **BEFORE** flaring tube. Always be sure to cut squarely the end of the tubing using a tube cutter or razor blade. ***See Quick Start Instructions.***
- Connect the ¼" O.D. PFA tubing (provided) from the regulator to the Dome N2 valve. Its' purpose is to supply make-up gas to balance the negative exhaust flow and for dome clearing.
- Connect power cord to an appropriate AC source.
- Chamber exhaust - see section 2.2.3 below

"Installation Safety - Caution"

WARNING

Caution: an extreme electrical hazard will exist if this system is immersed in liquid. The system must not be located where it could be accidentally knocked into any open liquid bath. An earthquake-proof base can be supplied for any system.

2.2.1.1 COMPRESSION FITTING ASSEMBLY



FITTING ASSEMBLY

This diagram will guide you in the proper assembly of your system fittings. Although your fitting may not match the picture exactly, all fittings follow the same installation arrangement. There is no need to use Teflon tape on any of the fittings. All fittings only need be hand-tightened for a proper seal.

ASSEMBLY INSTRUCTIONS

Please follow these diagrams in assembling nuts.
As shown below, insert gripper (B) into nut (A).
Push sleeve (C) into nut assembly.

2.2.2 DIMENSIONAL DRAWINGS

Dimensional drawings of all of our systems can be found at
http://www.laurell.com/spin-coater/models.php

.2.3 DRAIN AND EXHAUST CONNECTIONS

Figure 2-2 is a rear view of the EDC series. The down-flow exhaust (see figure 2-3) is placed onto the drain / exhaust port. An exhaust source of approximately 1.5” to 2.5” H_2O column (W.C.), as measured with a differential pressure gauge with the lid closed is usually sufficient for processing. A differential pressure gauge in included in all EDC models. See section 2.3.2 Differential Pressure

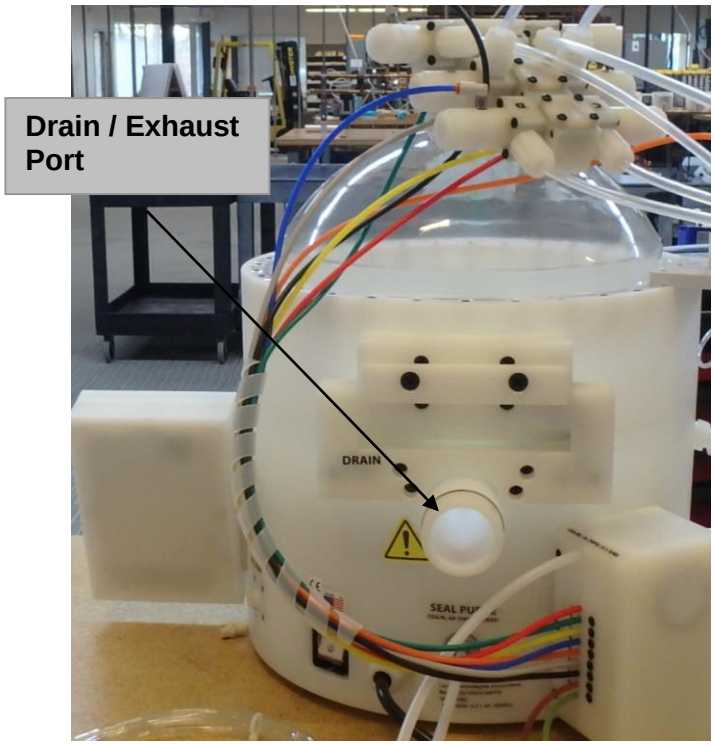


Figure 2-2
Rear View

2.2.4 ADJUSTABLE DOWN-FLOW DRAIN / EXHAUST

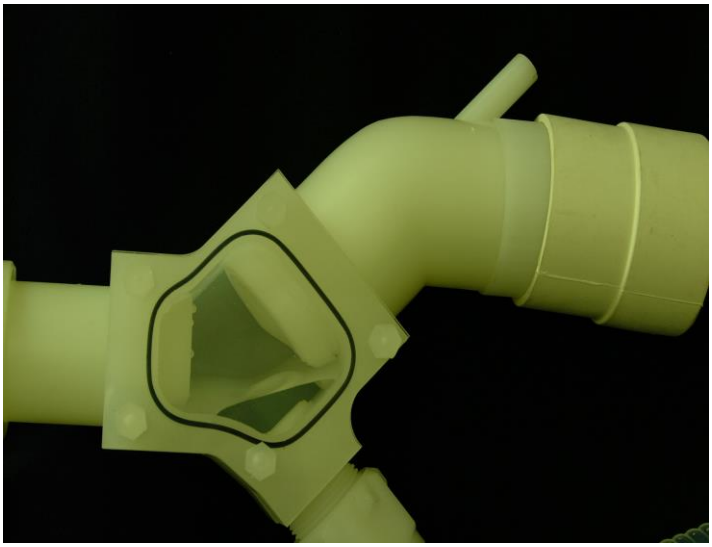


Figure 2-3
Drain and Exhaust Separator

Install down-flow drain/exhaust assembly (figure 2-4) onto the spin processor's drain port.

Tighten the locking set screw. Do not over-tighten this retaining screw, or a leak from the distortion of the thin drain port tube will undoubtedly occur.

Set idle static pressure to ~1.0” W.C. With the dome diffuser on and set to its recommended pressure the adjustment screw can be used to fine tune the exhaust flow. It is recommended to always have at minimum 0.5” W.C. of static pressure.

The adjustable down-flow exhaust and drain feature allows for efficient fluid/air separation as well as fine-tuning of the exhaust flow within the process chamber.

Note: fluid shown for illustration only – should not be allowed to accumulate as is shown here.

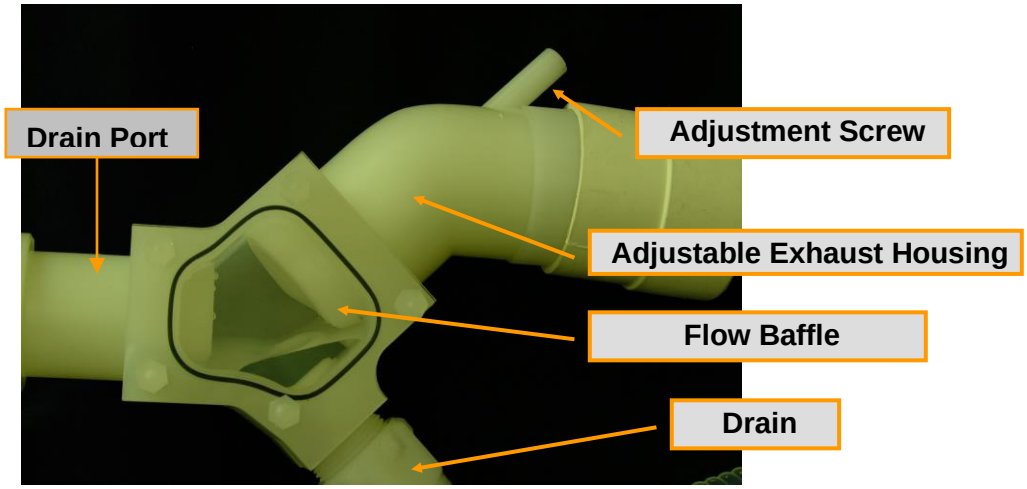


Figure 2-4
Down-flow Drain and Exhaust

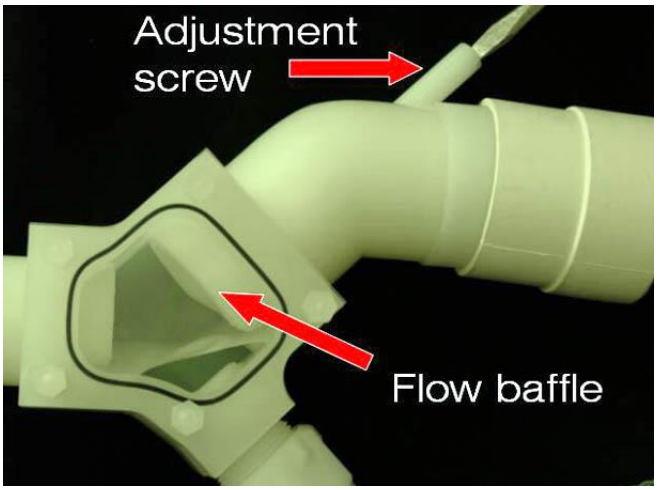


Figure 2-5
Adjustment of In-line Exhaust Control Valve

Turning the valve inward (clockwise) opens it, allowing more flow, while the opposite decreases then closes the port, which may be necessary for certain applications.

NOTE: Care should be taken not allow liquids to be pulled upward into the exhaust duct. The fluid build-up shown is for illustration only; it should not be allowed to accumulate as is shown in figure 2-5

The drawing below (figure 2-6) illustrates the recommended drain configuration

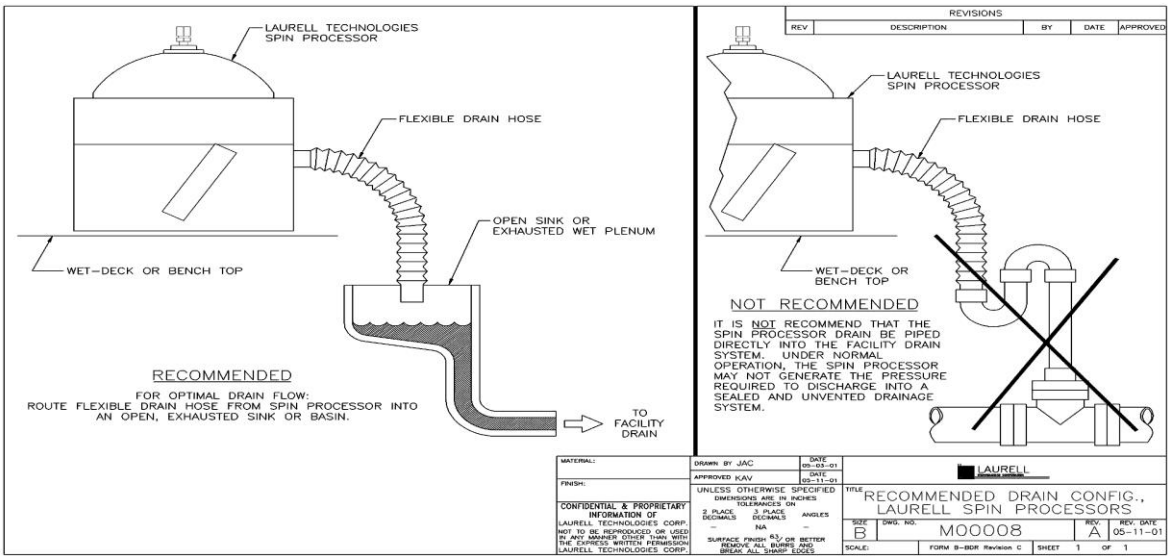


Figure 2-6
Recommended Drain Configuration

2.2.5 INDECK CONNECTIONS

Indeck installations require cabling the remote-control box assembly to the spin processor. Two cables and one vacuum sensor hose are required, which can be detached at the rear of the remote-control box (see photo below, figure 2-7A, for plumbing and electrical hook-up). **NOTE: Sufficient space should be provided within a bench or glovebox to remove the interface cable and connector in case of future servicing.**

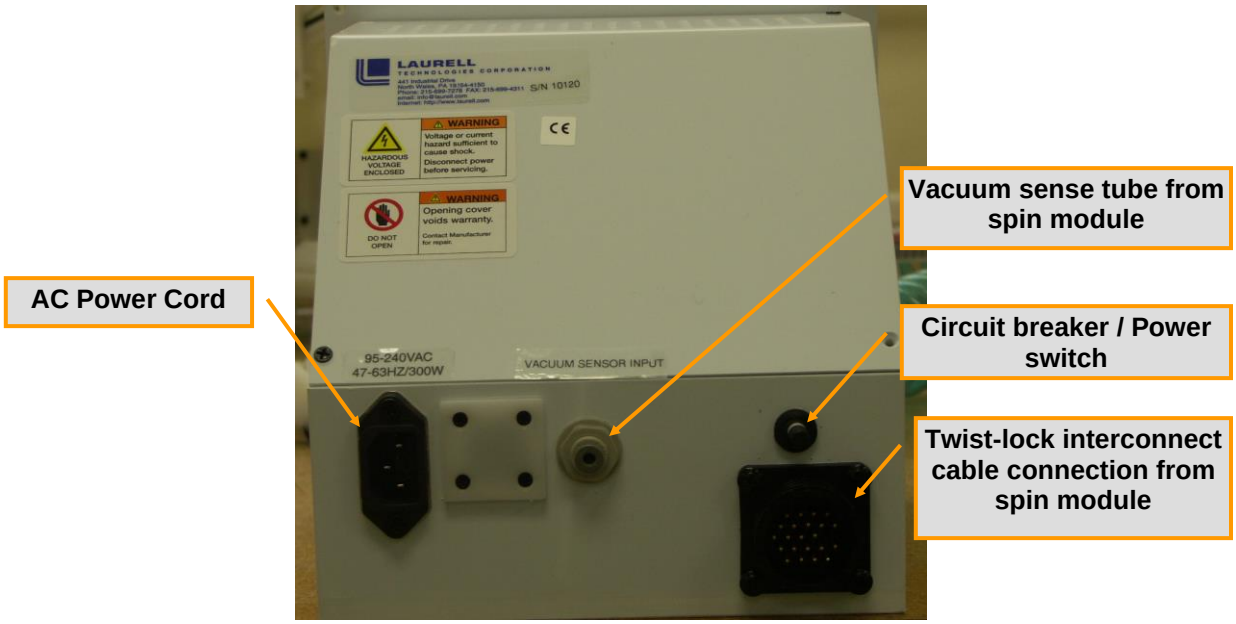


Figure 2-7A
Indeck Controller – Rear View

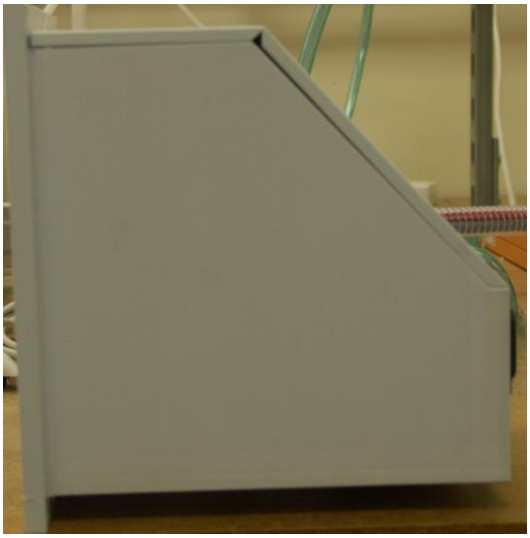


Figure 2-7B
Indeck Controller – Side View

The spin processor vacuum connection and controller interface cables are located on the bottom of the spin processor housing (see photo below, figure 2-7C, for plumbing and electrical hook-up)

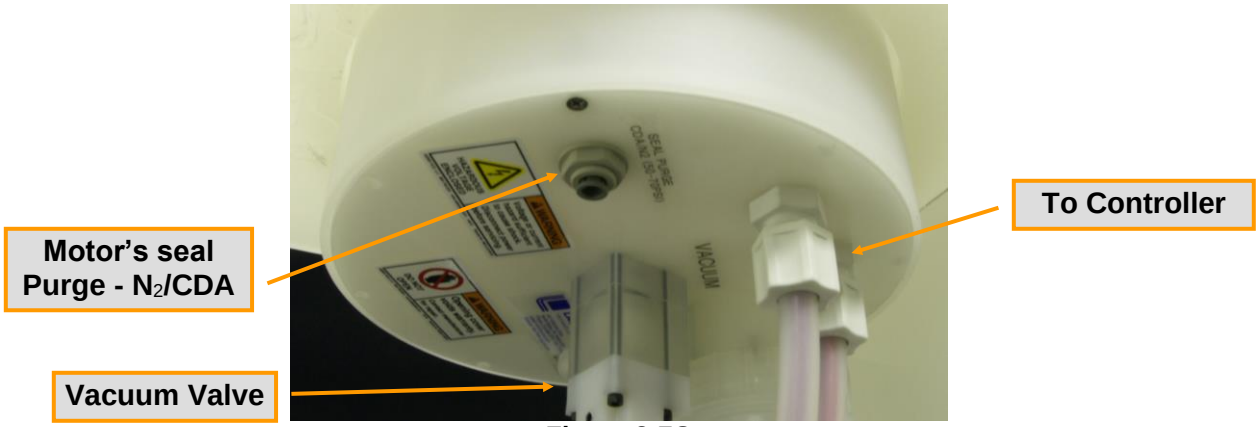


Figure 2-7C
Drain and Exhaust Locations

2.3 NITROGEN PROCESS PURGE

The Nitrogen process purge can be used during processing in few different ways. It can be used during a wet aqueous step to clear the dome for viewing. At the end of the wet processing steps, it is used for clearing the dome. The addition of DI water the dome purge can be used for dome and bowl wash. A diffuser plate adjustment (figure 2-8 & 2-10) is used to provide a balanced gas flow to the spin processor chamber.

PROCESS NOTE: The goal is to have the least flow possible which will still force the droplets down-ward to help clear the lid. It is used for a very effective bowl-wash (DI water or solvent).

Figure 2-8
Front View - Diffuser Plate

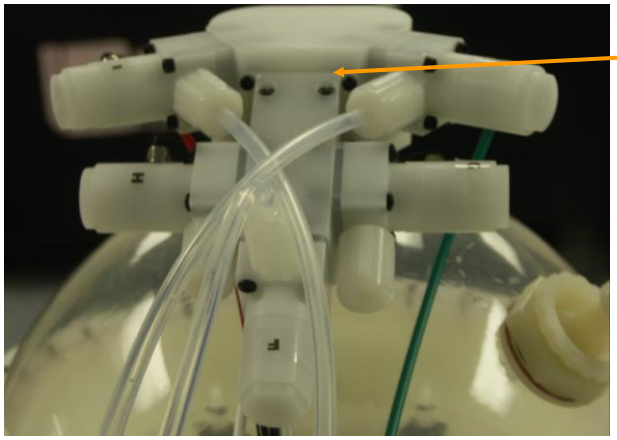
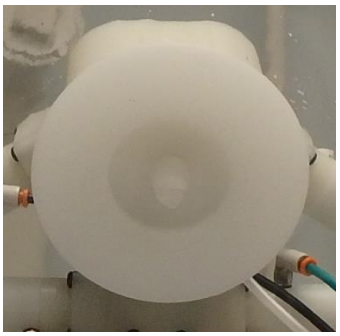


Figure 2-9
Rear View

2.3.1 NITROGEN PURGE ADJUSTMENT

Adjustments can be made to the diffuser plate by turning the plate clockwise or counter-clockwise (figure 2-10). Turning the plate inward (clockwise) restricts the flow, while the opposite increases the flow. It is best to use the minimum diffuser opening to achieve N2/DI distribution.

Figure 2-10
Diffuser Plate



Diffuser Plate Covered by Baffle

The baffle screws onto the spray nozzle stem. Do Not over tighten, screw until it lightly touches the diffuser plate.

REMEMBER: The goal is to have the least flow possible which still forces the droplets down-ward in order to clear the view.

When the combination of purge pressure and flow are set at the proper rate, chemical will flow downward toward the process chamber's collection gutter, then rearward into the lower bowl drain (see figure 2-11).

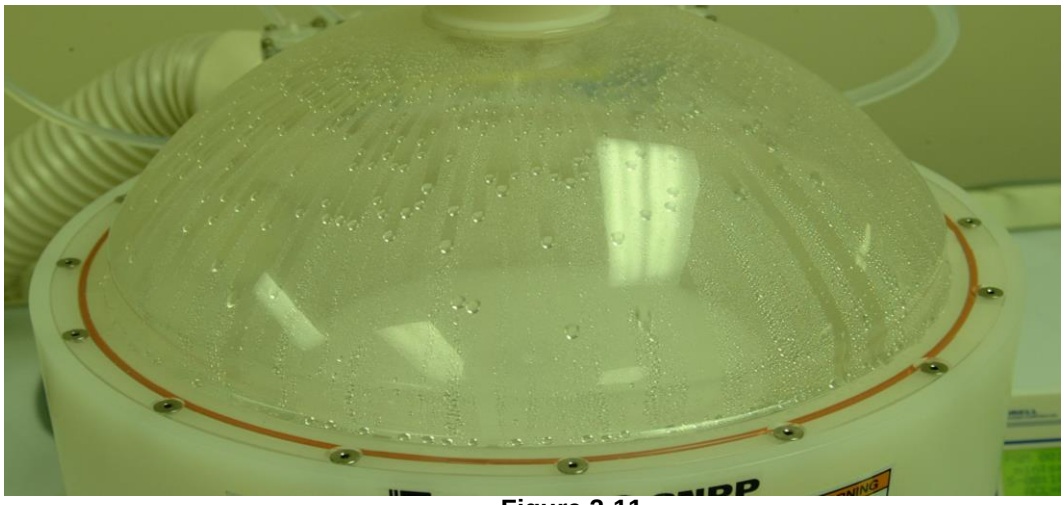


Figure 2-11
Proper Downward Flow

NOTE: If you are experiencing chemical escaping through the area between the lid and the bowl, the exhaust is not set at a proper level. This is an over-pressurization condition. (See Section 2.3.2)

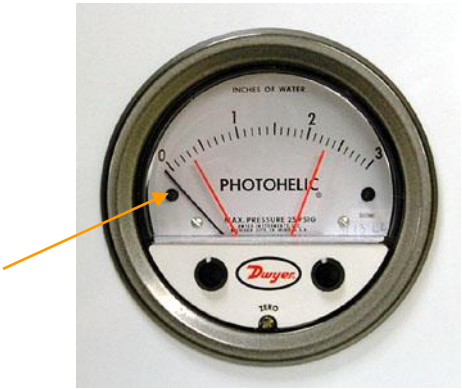


Figure 2-12
VOLUME READING TOO LOW

Figure 2-13
VOLUME READING CORRECT

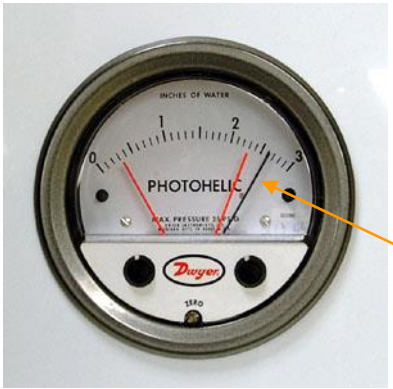


Figure 2-14
VOLUME READING TOO HIGH

2.3.2 DIFFERENTIAL PRESSURE

2.3.2.1 SETTING UP N2 PROCESS PURGE AND DIFFUSER AND ESTABLISHING A BALANCE FLOW OF PURGE GAS AND EXHAUST

1. Use DI water to exercise and set up the processor.
2. Fill pressure vessel(s) with DI water and set it to the stated pressure on the plumbing drawing located in the appendix section.
3. Place substrate on to chuck. (Turn on vacuum if required)
4. With the down flow exhaust adapter installed, connect the 5/32” (3.97mm) tubing to the hose barb on the down flow exhaust housing and insert the opposite end of the tubing into the push-to-connect fitting, installed on the low-pressure port on the rear of the differential pressure gauge.
5. **If using the digital differential pressure gauge connect the low-pressure input of the gauge to the 5/32” (3.97mm) tubing on the down flow housing.**
6. **The input air to the high-pressure side of either the digital or analog pressure gauge must always come from the same environment as the spin processor. For example, the high side input air should not come from a return air chase when the processor is in a clean room.**
7. Connect the 2.5” exhaust tubing from the down flow exhaust adapter to the exhaust main. With exhaust flow present and the lid closed the pressure gauge will show a static pressure reading. If not, check connection and ensure adequate exhaust flow. If the exhaust is excessive >3.0” reduce flow to <3.0”.
8. With the processor connected to exhaust, set exhaust flow to 1.5 - 2.5” W.C. on the differential pressure gauge.
9. Press the “Edit mode” key on the controller.
10. Set rpm value to 500rpm and press “Start”.
11. Adjust the N2 dome regulator to the stated pressure on the plumbing drawing located in the appendix section.
12. Go to the “Valv” line and activate the N2 dome. N2 should be flowing through the diffuser. You may hear a hissing sound.
13. On the controller move the cursor to activate an injector to dispense liquid onto the rotating substrate. DI water will begin to mist the dome.
14. Ideally, the dome’s N2 will begin to push the mist downward.
15. If adjustment is needed see section 2.3.1 for adjustment information.
16. Check the differential pressure gauge; pressure should be ≥ 0.5”. If not, adjust the exhaust adjustment screw on the down flow exhaust adapter to achieve at least 0.5”. (See figs. 2-12, 13, 14). This is the recommended minimum value; set flow for your specific process.
17. Test dynamically with dome DI and other valves.
18. Proper setup will always show a static pressure reading ≥ 0.5” during the entire process run.
19. **Care should be taken not to over-pressurize the chamber. Insufficient exhaust coupled with a high N2 dome pressure will cause over pressurization and leakage may occur between the lower housing and**

the upper lid. Motor damage will occur by forcing fluids and vapors into the motor housing. During processing the static pressure must never fall to <0.5" WC.

20. **A differential pressure gauge must always be installed at the drain port to accurately monitor chamber pressure. See figure 2-15A**

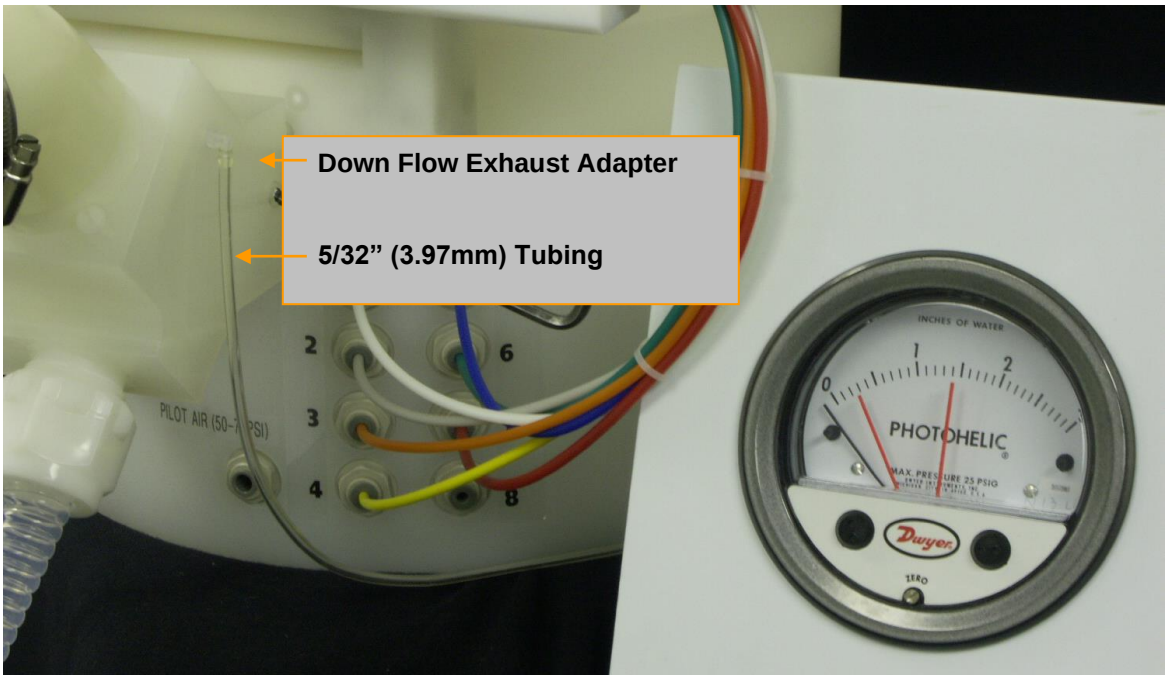


Figure 2-15
Differential Pressure Gauge Connected to Downflow Exhaust by 5/32" (3.97mm) Tubing

PROCESS TIP*: If, during operation, the process chamber pressure goes below 0.5, or above 3.0, a gross flow adjustment must be made to the exhaust source using a baffle or blast gate to limit flow volume. The adjustments of the down flow exhaust are intended for tuning, not mass flow control*

2.4 BACKPACK AND PILOT AIR VALVES

A "backpack" contains many of the systems components such as valves, circuit boards, pumps, sensors and pilot air outputs. See figure 2-16. Backpacks are configured to the user's configuration. They can be configured as a stand-alone box as in fig. 2-16 or it can be directly attached to the processor as in figure 2-17.

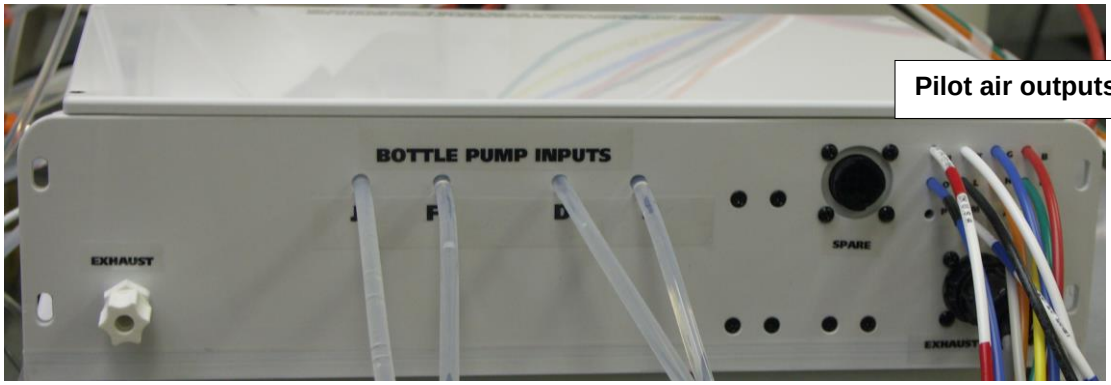


Figure 2-16
Backpack

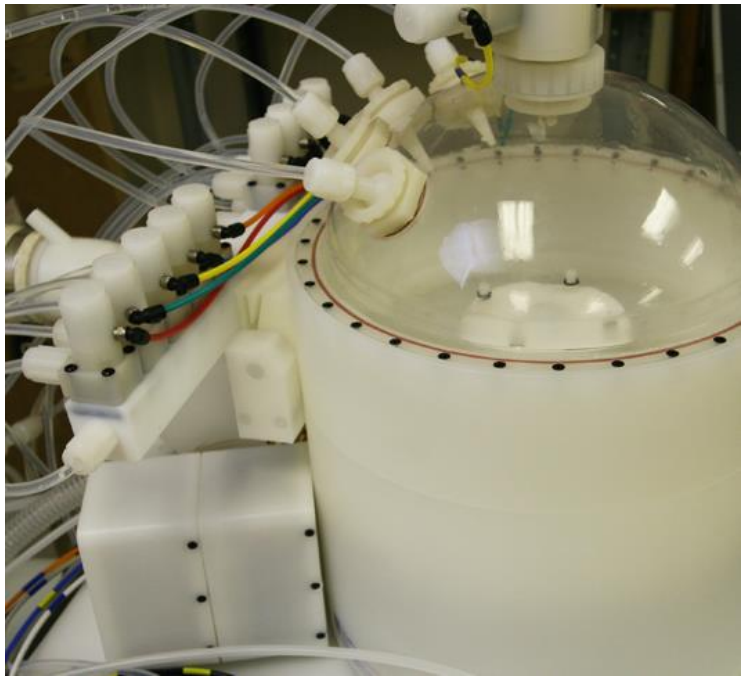


Figure 2-17
Double Backpack

Stand-alone backpacks are connected to the processor with an interconnect cable.

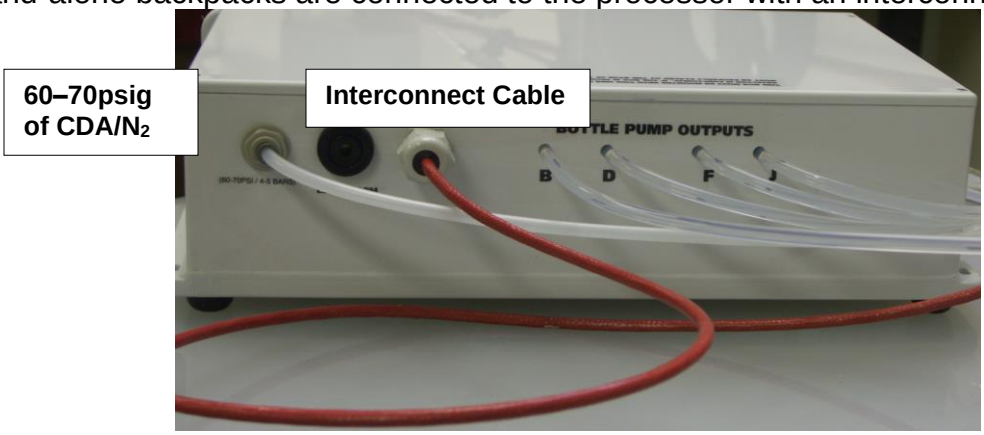


Figure 2-18

The colored 5/32” pneumatic tubing in figure 2-16 connects the pilot air outputs to the dispensing valves located on the manifold and/or the VOD (see figure 2-19). Each pilot air output corresponds to the valve letter in the controller software and controls the specific dispensing valve on the manifold.

For example, each pilot output has an associated manifold/VOD valve and is displayed on the “Valv” line of the 650 controller as a letter A, B …H. See figure 2-19.

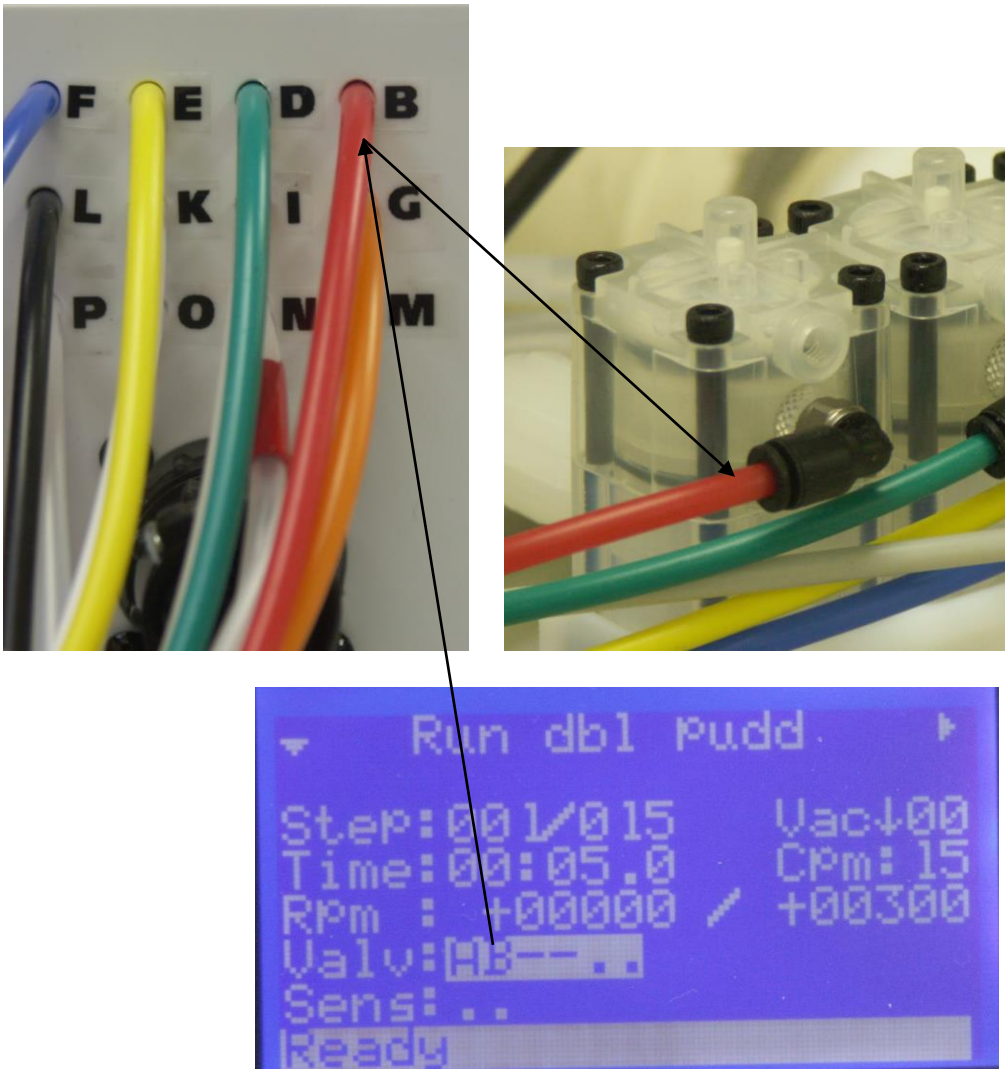


Figure 2-19
Pilot Air Output Plumbing and Valve Display

The backpack must be supplied with 60–70psig of CDA or N_2.

NOTE: Do not change output orientation of pre-run tubes to mixing manifold. Certain pilot valves are configured at the factory as mutually exclusive. This excludes more than one in the set from being activated at the same time. This also delays the turn on

of the pilot valves in the set by one second to ensure there is no overlap activation of pilot valves in the set of mutually exclusive valves.

2.4.1 VOD AND DISPENSE MANIFOLD

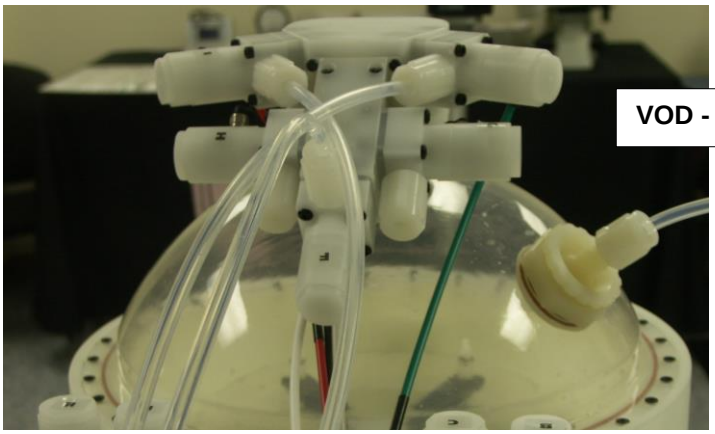


Figure 2-20
VOD and Valves - Rear View

2.4.2 OPERATION OF DISPENSING VALVES

See section 3.5 for programming.

2.5 CHEMICAL TANK INSTALLATION

In the appendix section of the manual, please review the plumbing drawing for the system

In order to ensure proper pressure at the spray nozzle or injector's dispense point, the chemical tanks should be located on the same plane or below and as close as possible to the spin processor. Provisions should be made for secondary containment of the chemicals, and proper venting and exhausting. **All tanks must be grounded and bonded together to avoid the potential of a static discharge.**

NOTE: THIS IS A GENERIC DIAGRAM; CONSULT THE INSTALLATION DRAWING FOR YOUR SPECIFIC PRODUCT

2.5.1 PRESSURE VESSELS

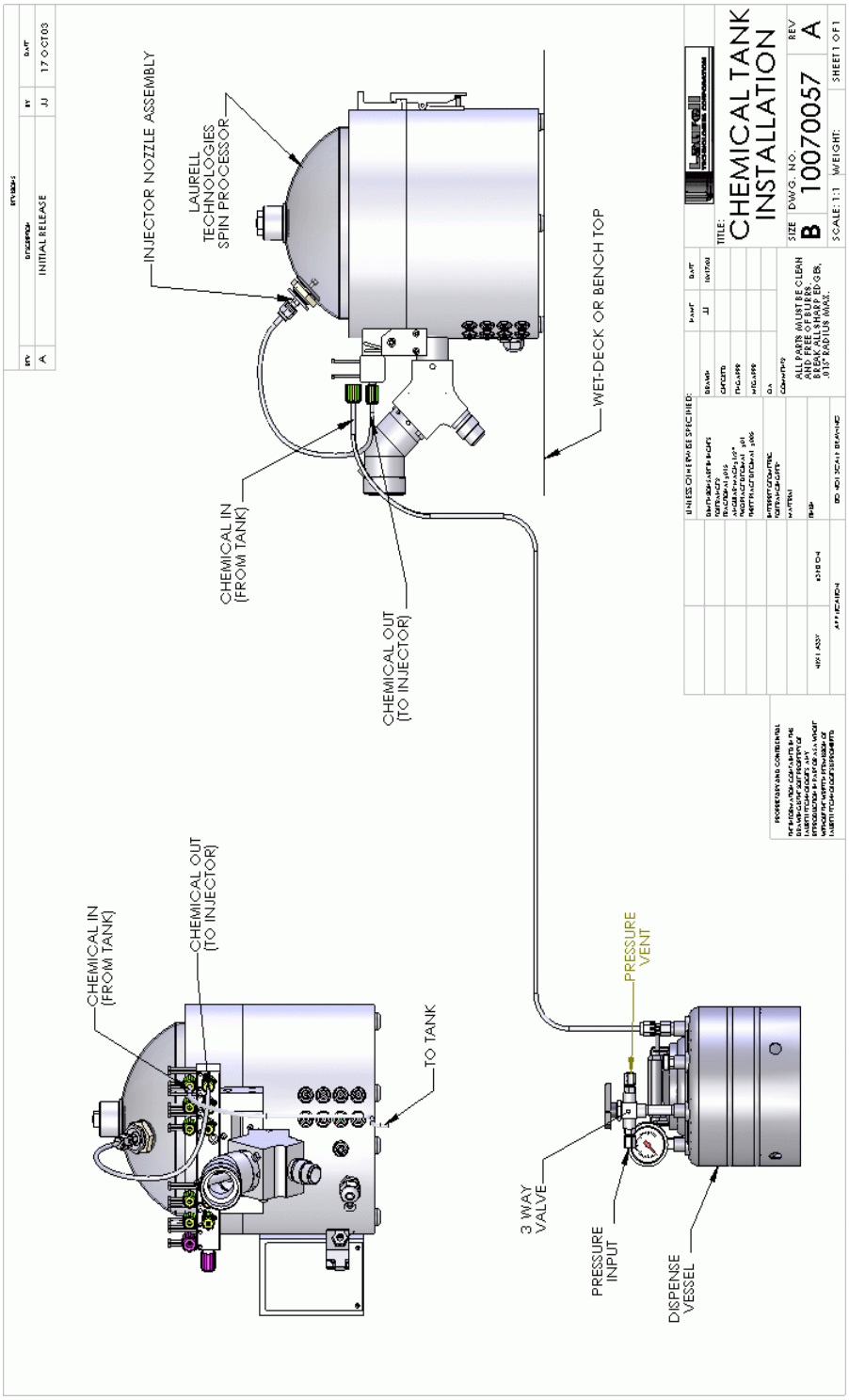


Figure 2-21
Chemical Tank Installation

All tubing and fittings should first be checked before use with N_2 or clean air without chemicals. Tubing and fittings are rated at 150psig (10.2bar).

Figure 2-22
SSV-2

Figure 2-23
TEV-1

Figure 2-22 is our 2 gallon Stainless Steel pressure Vessel (SSV) and figure 2-23 is our 1 gallon Teflon Encapsulated Vessel (TEV).

1. **Chemical Feed Line -** This line will carry the chemical from the vessel to the spin processor's valve. This tubing is made of PFA Teflon®.
2. **N_2 Supply Line -** This line carries the nitrogen to pressurize the vessel. Recommended operating pressure range is <60psig (<4.1 bar).
3. **Pressure Relief Valve -** The pressure relief valve (rated to 60psig) prevents unsafe pressures from building up in your vessel (rated to 165psig).
4. **Pressure Gauge -** The pressure gauge indicates the pressure contained within the vessel.

Please Note:

It is extremely important to recognize the fact that CDA/N2, can and most probably will, diffuse into any chemical when the chemical is under pressure for a prolong period of time. The gas diffusion rate will be different for different materials given all possible pressure settings and all possible time periods. If gas is diffused into a chemical, chemical outgassing will manifest itself as bubbles on the output side of a control valve. This can lead to possible chemical drips, droplet formation and possible lost of suckback control. Chemical outgassing may cause confusion because it looks like a leaky valve. Once gas diffusion takes place it will take a long period of time (many hours) for the gas to diffuse out of the chemical (pressure vessel must be vented to atmosphere).

It is highly recommended that consideration be given to pressurizing a vessel only at the beginning of an operation and to depressurize when the operation is complete. An alternative is to pressurize a vessel and hold it there for a period of time that does not exceed the gas diffusion initiation point.

2.5.1.1 INSTALLING AND REPLACING THE LID

- TEV-1: The sealing o-ring on the lid of the vessel is a Teflon® encapsulated silicon o-ring. The o-ring is firm, but pliable. Use care not to damage the Teflon® exterior of the o-ring. The Teflon® o-ring mating with the Teflon® coating on the pressure vessel makes replacing the lid challenging at first, but it will seal easily once the procedure is learned. When replacing the lid on the vessel face the handles away from each other (as in figure 2-24) and align the arrows on the lid and the vessel so that they point directly at each other. The lid should not be centered within the opening, but should be approximately 1/16" toward the rear (handle side) of the vessel. Push the handle down to seal the vessel, the cam action of the handle with force the lid up and forward. The objective is to minimize the forward movement of the lid while locking the handle. This process is necessary for a proper seal.

- SSV-1: Same procedure as above. O-ring made of different material.

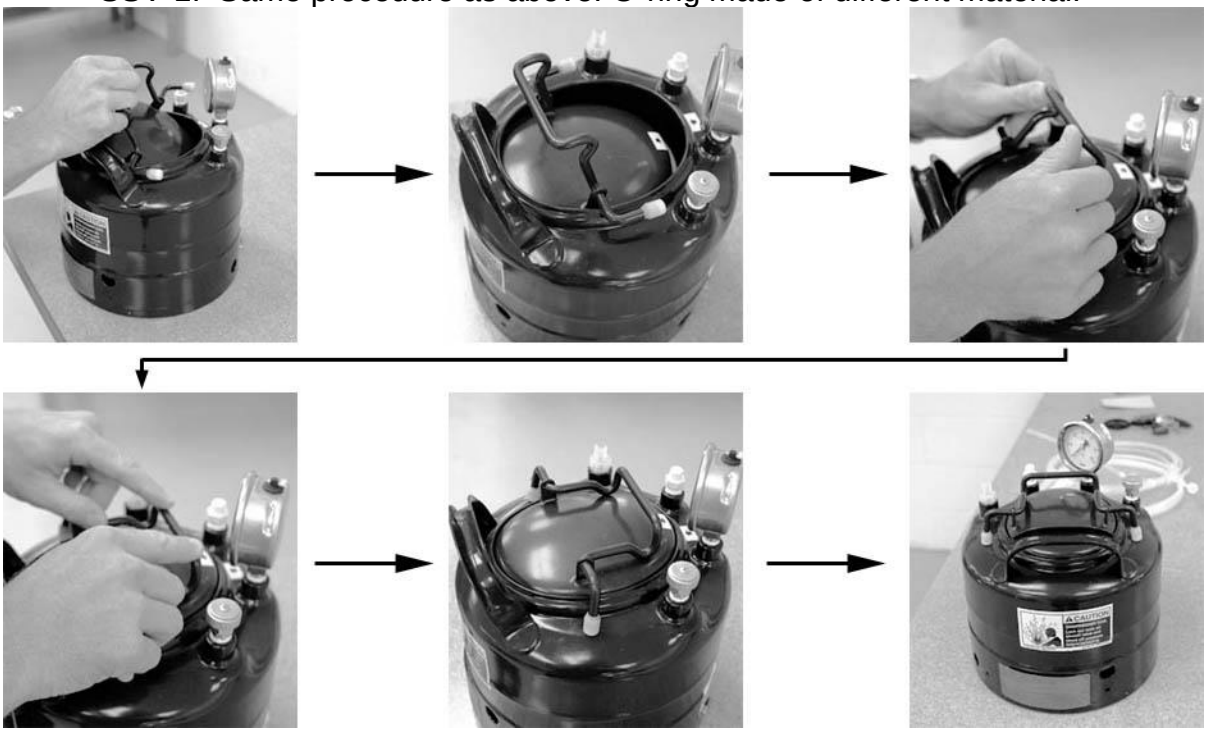


Figure 2-24
Lid Installation on a TEV-1

2.5.1.2 GROUNDING THE VESSEL

A grounding terminal has been provided on the side of the vessel (see figure 2-25). **It is strongly recommended that the vessel be grounded to avoid the potential of a static discharge.**

Figure 2-25
Vessel Ground Connection

2.5.2 DUAL CONTAINMENT PRESSURE VESSEL (OPTIONAL)

- The Dual Containment Vessel holds a 1-gallon bottle. It eliminates the need and hazard of pouring chemical directly into the vessel. An empty bottle can be easily replaced with a full bottle after depressurization.

- DCV-1C accommodates a 1-gallon vessel with a maximum bottle height of 13.5" (342.9 mm).

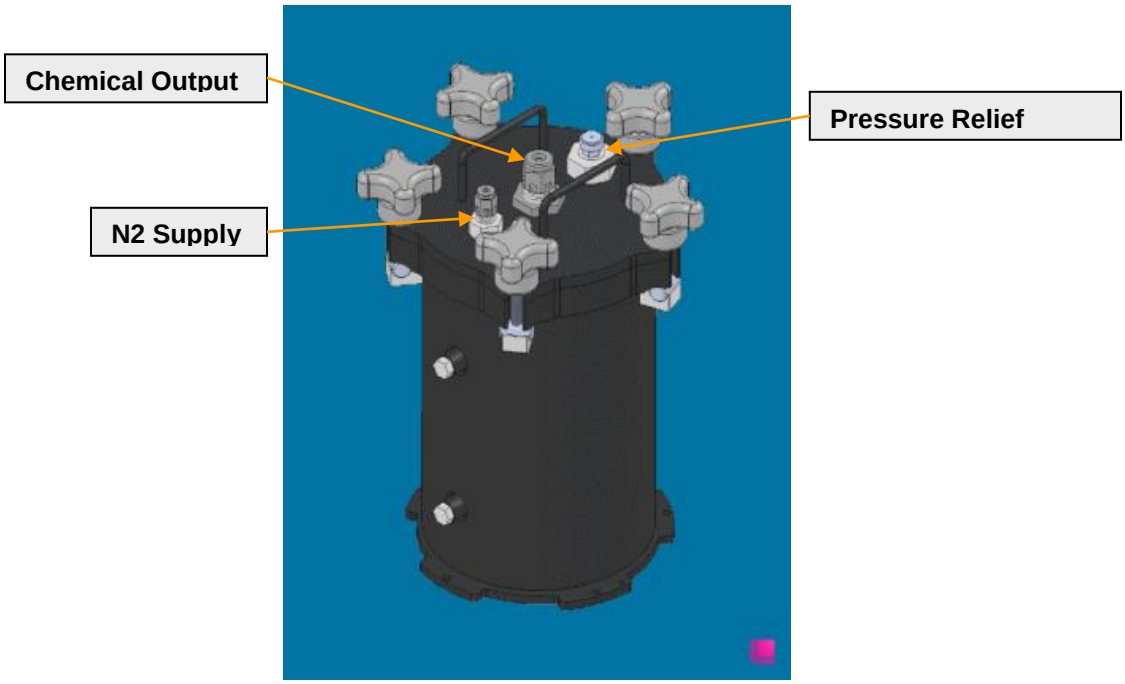


Figure 2-27
(DCV-1C)

Please review figure 2-27 to familiarize yourself with the features of our Teflon® Encapsulated Dual Containment Vessel (DCV).

1. **Lid –** The top of the Dual Containment Vessel.

2. **Lower Section –** The main body of the Dual Containment Vessel.

3. **Chemical Dispense Connection -** Required for dispensing chemical from the vessel. The tubing is PFA Teflon®.

4. **N_2 Supply Connection -** Required for pressurizing the vessel with nitrogen or air. Recommended operating pressure range is <60psig (<4.1 bar).

5. **Tightening Knob –** Five (5) knobs are required to seal the lid to the lower section.

6. **Grounding Lug -** Required to ground the vessel in case of static buildup.

7. **Pressure Relief Valve –** Relieves pressure ≥ 60psig.

8. **Pressure Testing Results -** See Figure 2-28

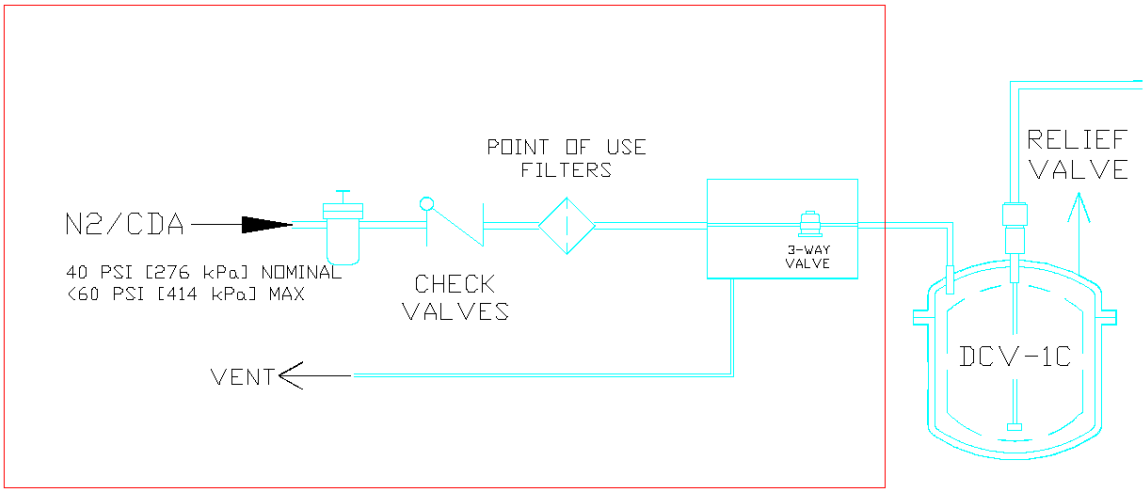


Figure 2-26
(DCV-1) Installation

Third Party Testing:

A Subsidiary of THE MMR GROUP, INC.

Massachusetts Materials Research, Inc.

P.O. BOX 810 • 1500 CENTURY DRIVE • WEST BOYLSTON, MA 01583 • TEL. 508-835-6262 • FAX 508-835-9025

Laurell Technologies Corporation
441 Industrial Drive
North Wales, PA 19454-4150

DATE: 2 November 2002
P.O. NO.: 023739
MMR NO.: F10-29
MMR ID #: 1-2
PAGE #: 1

SAMPLE IDENTIFICATION: Pressure test of dual containment pressure vessel model number 10040341 with polymer fittings and again with steel fittings

MMR has completed the pressure testing of the delivered dual containment pressure vessel.

The results are as follows:

Test No.	Max Pressure (psi)	Testing Conditions	Results
1	325	Polymer fittings/original O-ring	O-ring blow out
2	335	Steel fittings/original O-ring	O-ring blow out
3	N/A	Steel fittings/different O-ring	Leaked before test began
4	350	Steel fittings/original O-ring/epoxied lid	O-ring blow out

Please call me if you have any questions.

MASSACHUSETTS MATERIALS RESEARCH, INC.
Clayton D. Brown
Mechanical Test Engineer

Chemical analysis performed by Inductively Coupled Plasma/Optical Emission Spectrometer. Carbon, sulfur, nitrogen, hydrogen, and oxygen performed by Leco Combustion. Mechanical and metallurgical testing performed per MMR Procedures. The results reported above apply only to the test sample(s) provided. We believe the above test to be reliable and correct. Inaccuracies or errors, if they occur, will be corrected free of charge. In no event shall Massachusetts Materials Research, Inc. by liable for any special, consequential or other damages. This report shall not be reproduced, except in full, without written approval of MMR.

Figure 2-28

2.5.2.1 INSTALLING AND REPLACING THE LID – DCV-1C

Depressurize the vessel before removing the lid. Remove lid by loosening all 5 screw knobs and pulling the knobs back away from lid. Lift lid and withdraw the pickup tube from the empty bottle. **NOTE: Be careful not to allow the pickup tube to splash chemical as it is withdrawn from the bottle.** Insert a filled chemical bottle and insert the chemical pickup tube down into the bottle. Place the lid onto the o-ring located in lower section lid flange. Make sure that the lid and lower section cutouts are aligned. Lift the tightening knobs from their rest position into each cutout located in the lid. Begin tightening the knobs in an alternating fashion by going to the knob located at the OPPOSITE side of the lid successively. Make sure all knobs are tightened, by hand, before pressurizing the vessel.

2.5.2.2 GROUNDING THE VESSEL

A grounding terminal has been provided on the side of the vessel (see figure 2-29). **It is strongly recommended that the vessel be grounded to avoid the potential of a static discharge.**

Figure 2-29
VESSEL SHOWING GROUND

2.5.3 AUTOMATIC PRESSURIZATION – 3 WAY VALVE

Most pressure vessels are interfaced to an automatic 3-way valve. For safety and process reasons, systems are designed with an automatic pressurization and depressurization capability. A vessel is always held is a depressurized state. The process program determines when to pressurize the vessel and for how long and when to depressurize. At the end of a process program the vessel will always depressurize. The 3-way valve requires supply pressure; will pressurize the vessel based on valve activation within the process program; and depressurizes to the “vent” output. Below is a picture of a 3-way valve, see figure 2-30. Refer to the “Quick Start Installation Instruction” and the plumbing drawing in the appendix section for installation information.

NOTE: It is recommended to allow for, and to program, at least 30 seconds for the vessel to pressurize.

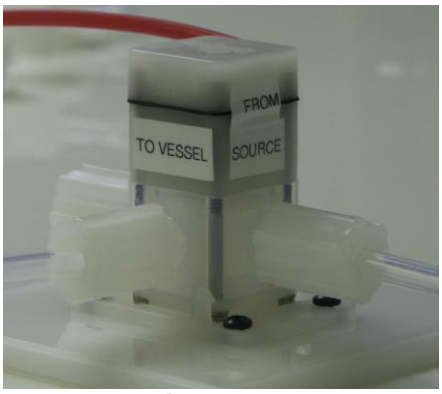


Figure 2-30
3-WAY VALVE

2.5.4 AUTOMATIC CHEMICAL SPRAY

The specific spray nozzle orifice size will dictate the flow capacity at a given nozzle pressure (see table 1 below). It should be noted that there is a pressure difference between the tank gauge reading and the actual pressure at the spray nozzle. The viscosity of the chemical being sprayed, the length and ID of the tubing being used, and the flow rate of the chemical all influence this pressure drop. In order to minimize a pressure drop the length of tubing from the pressure tank to the spray nozzle should be kept to a minimum. Table 1 gives the capacities, based on water, of a typical spray nozzle at different nozzle pressures. An increase or decrease in flow cannot be detected by eye, so the flow rate should be checked periodically. This can be done by collecting spray in a container and comparing the results to those of a new nozzle.

Another factor affecting the performance of the nozzle is the condition and length of the tubing that feeds the nozzle. Any kinking or blockage of the tubing will affect the pressure and/or flow rate at the nozzle.
The normal tubing supplied with the spin processor system is 10 feet of ¼" OD standard wall PFA Teflon® tubing. The 10 feet of tubing is intended to accommodate the entire fluid delivery line (from pressure vessel to valve). Pressure drop should be taken into consideration with installations requiring greater lengths of tubing. Other types of spray and stream nozzles are available. Contact sales@laurell.com for more information.

NOTE: Fan spray nozzles have a very small orifice to create the fan spray. If the fan is not well developed or looks distorted, it is possible that the nozzle is clogged. Remove the nozzle and look at it under high magnification. If clogged blow high pressure air into the front side of the nozzle to dislodge the blockage. Do not use a probe to remove the blockage because it may damage the orifice.

FLOW DATA

PSIG	10 PSIG	20 PSIG	30 PSIG	40 PSIG
Bar	.69	1.38	2.07	2.76
kPa	69	138	207	276
Spray Angle	21°	41°	49°	51°
Capacity *GPM*	0.068	0.095	0.118	0.133
Capacity *l / min.*	0.258	0.360	0.447	0.504

Table 1

SECTION 3 - OPERATION PROCEDURES – 650 CONTROLLER

GENERAL

The 650 controller operates with three types of spin motors. The standard performance motor is designated 650M and the high-performance motor (HPD-2) is designated 650H. The newest motor 650L is a cross between the other 2 motors. The 650L and H motors have bidirectional rotation and agitation capability. This difference is more fully explained later in this section (see section 3.4.3.1 Acel – Standard Drive)

All operational controls are interfaced through the spin processor's membrane switch keypad and the LCD (Liquid Crystal Display). There are 4 operation modes available to the user. They are; "Select Process", "Run", "Edit" and "Info". The capabilities of the 650 controller are greatly enhanced with the Spin 3000 software. Certain set points and configurations can only be assigned through Spin 3000. Figure 3-1 is an example of the "Run Mode" screen. Relevant information specific to the operation mode selected is displayed. (See Section 3.3 – "Keypad" for illustrations.)

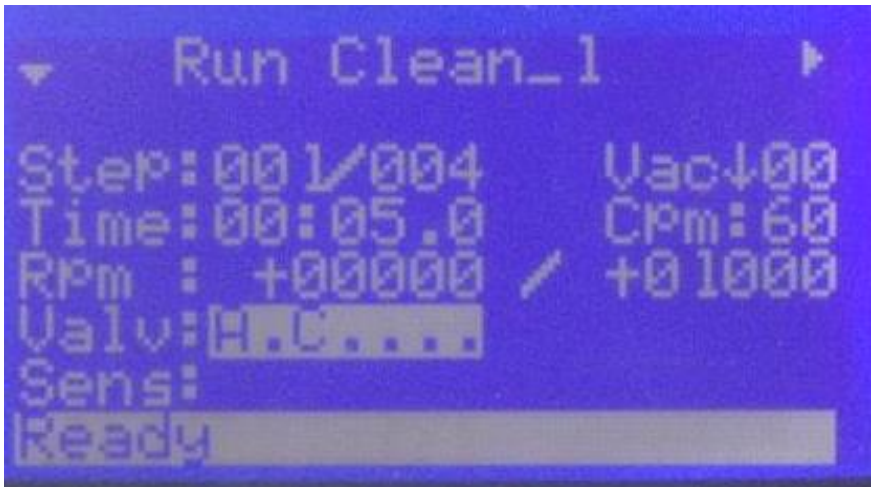


Figure 3-1
RUN MODE DISPLAY

Lists of process programs are available in the "Select Process" mode. Up to twenty (20) process programs, containing up to fifty-one (51) steps each can be permanently stored in non-volatile memory in the 650 controller. Many more programs can be stored in Spin 3000. When an operation mode key is pressed, such as "Select Process" or "Run", all active keys LEDs' become illuminated. When the "Run" operation is selected the operation mode/program name, step-of-steps, vacuum status, set point time, agitation rate, actual wafer rpm, set point rpm and spin rotation direction, valve, sensor and type status and processor's status for each step of a program are displayed. In the "Edit Mode" each program step includes: operation mode/program name, step-of-steps, vacuum status, set point time, agitation rate, set point rpm and spin rotation direction, acceleration rate (acceleration / deceleration rate is shown in edit mode only) and valve, sensor and type status. The "Info" key when pressed provides information on "Statistics", "Configuration" and "About" the spin processor.

A vacuum interlock assures that vacuum is activated before any program requiring vacuum can run. Vacuum will not disengage until the wafer comes to a complete stop. Units are equipped with a vacuum sensor to additionally ensure that sufficient vacuum is provided to hold down the substrate during processing. A safety lid interlock inhibits opening the lid while a process is running. Additionally, if the lid interlock is overcome, motor rotation and valve actuation is turned off if an open lid condition is detected. A design feature is included to avoid the accidental re-running of a process on the same wafer. In order to run a program twice on the same substrate, the lid must be opened or the program must be changed. If you desire to run the same substrate more than once simply press the edit key then the run key will allow another program cycle to be enabled without opening the processor. Vacuum to a substrate will automatically shut down after 10 minutes of non-use or when the lid is opened.

3.1 POWER

All units are equipped with a single pole over current circuit breaker with manual reset. This breaker is located on the body of the spin processor housing near the AC cord entry location (Indeck systems have the breaker switch on the remote controller's rear panel). Seeing the white band of the "reset" button is indicative that the power has been interrupted. During normal operation, the circuit breaker should never trip. If the circuit breaker does trip, a visual and mechanical inspection of the unit should be performed before resetting the circuit breaker. This circuit breaker also serves as an "ON/OFF" switch for the unit. Pressing the "reset" button will toggle power on and off to the unit.

3.2 INTERLOCKS

3.2.1 LID INTERLOCK

A lid interlock is provided to disable the spin processor's motor and dispense operation when the lid is in the open position. If the lid is opened while running, the program will be safely interrupted, the pilot air valves will be disabled and the chuck will stop slowly. "LID OPEN" notes this condition in a message displayed on the last line of the run screen on the LCD display. (See Figure 3-2) The program can be continued from the point at which it stopped by closing the lid and pressing the **START** key.

Figure 3-2
"LID OPEN" ERROR MESSAGE

3.2.2 VACUUM INTERLOCK

Two conditions must be met to allow operation of systems equipped with a vacuum hold down type chuck. **The first condition that must be present is a vacuum source with vacuum ≥15" Hg.** A factory preset sensor, set in Spin 3000, will not allow the system to operate with vacuum <15" Hg. This interlock ensures that adequate vacuum is applied to the substrate. Inadequate vacuum will cause an unsafe condition and may cause a substrate to spin off the chuck and cause breakage. A "***Need Vacuum***" message (measured in inches of Hg) is an indication that this requirement has not been met. (See figure 3-3) Without the required amount of vacuum, a process cannot be started. If the vacuum falls below the required level while a process is running, the program will be halted at that point and a "***Low Vacuum***" error message will appear on the LCD display[1]. Once vacuum has been re-established it is necessary to press the **START** key on the keypad to re-start the program from where it stopped. The vacuum set point is user defined in Spin 3000.

Figure 3-3
"NEED VACUUM" ERROR MESSAGE

The second required condition, which MUST be present for the air operated vacuum valve to function, is sufficient seal purge pressure. Since the vacuum valve is pneumatic it must have enough N_2 to operate. See section 3.2.3. If there is insufficient N_2 pressure the controller will display "***Need CDA***" and **"*Need Vacuum*"** indicating no N_2 or vacuum. See Figure 3-4 for an illustration of this condition. If there is < 60psig of N_2 the vacuum screen may show that there is vacuum ≥ 15"Hg but the lack of N_2 will display "***Need CDA***".

[1] See Section 4.1 - Errors

Figure 3-4
"NEED CDA" ERROR MESSAGE

WITHOUT THE PROPER N_2 PRESSURE THE SYSTEM WILL NOT OPERATE.

Press the VACUUM button on the keypad to turn on/off the vacuum valve. Once actuated, and a program is running, the vacuum valve cannot be turned off until the motor is stopped @ 0 RPM for 1 second. This safety feature ensures that vacuum cannot be inadvertently turned off until the chuck comes to a complete stop.

3.2.3 SEAL PURGE INTERLOCK

All of our systems require at least 60 - 70psig (4.13 – 4.83 bar) of CDA or N_2 to pressurize the labyrinth motor seal. **If Nitrogen is < 60psig (4.13 bar) the processor WILL NOT OPERATE**. The seal's purpose is to separate the process chamber from the motor and electronics in order to insure long service-free operation. The gas consumption is very low (≈3.0 cubic feet per hour). **We recommend a constant CDA/N_2 supply even when the processor is not in use.** An interlock pressure sensor monitors nitrogen pressure. This interlock will report a "***Need CDA***" error if the pressure should drop below the 60psig requirement during operation. The interlock will not allow a new process to begin until the minimum pressure of 60psig is met. If the purge falls below the required level while a program is running, the program will be halted at that point, and a "***Need CDA***" will appear on the LCD display[2], figure 3-4. Once purge pressure has been re-established, it is necessary to press the **START** key on the keypad to re-start the program.

3.3.4 EXHAUST FLOW INTERLOCK

For optimum performance and to prevent possible motor damage it is very important to monitor exhaust flow. The EDC model comes with a digital differential pressure gauge to monitor exhaust flow. The exhaust controller's lower and upper exhaust flow set points have been preset at the factory. The lower set point is 0.5" of H_2O and the upper set point has been set to 5.0" of H_2O. See section 2.3.2 to properly balance the dome purge and exhaust flow.

Figure 3-14 shows an example of a "low exhaust" error message.

[2] See Section 4 - Errors

3.3 - KEYPAD

All operator actions are initiated through the membrane switch keypad, figure 3-5.

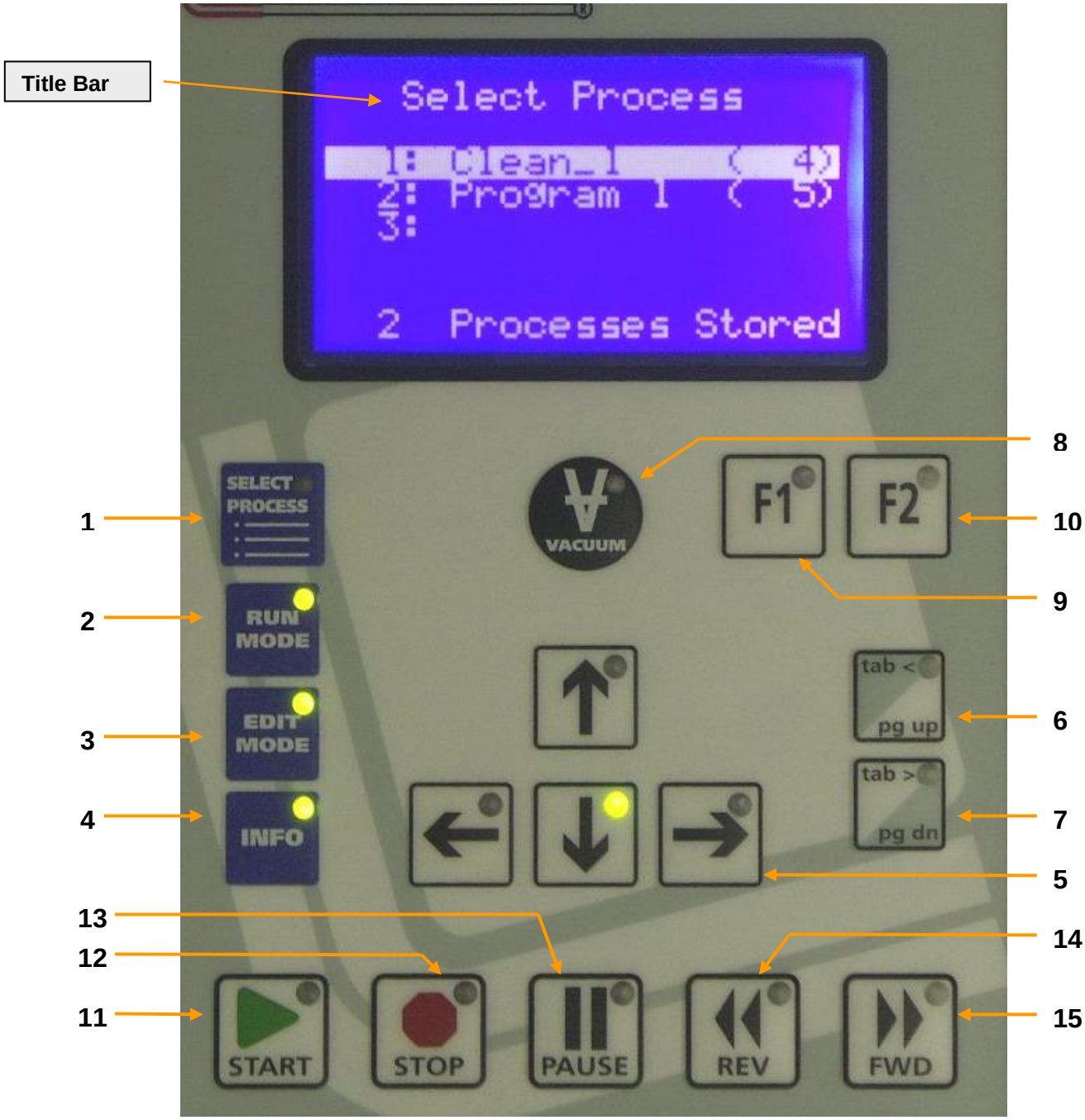


Figure 3-5
KEYPAD

NEVER flood or spray solvent such as acetone or any other type of cleaner directly onto the keypad surface. *Doing so may cause keypad failure.*
Always wet a wipe or cloth with the solvent and gently wipe the keypad surface.

3.3.1 OPERATIONAL KEYS

1 – SELECT PROCESS MODE – press this key to list all process programs stored within the 650 controller. This key is active when the green LED is illuminated. When the "select process" mode is selected a number of keys become active as indicated by illuminated green LEDs. These illuminated keys can be used to navigate the keyboard and display. Using the select process mode key the user can select the "Run Mode" (**2**), Edit Mode" (**3**) or "Info Mode" (**4**). The "Up arrow (↑)" and "Down arrow (↓)"keys (**5**) can be used to move from line-to-line.

Each line displays the ten-character program name followed by how many steps the program has, in parentheses. See figure 3-6

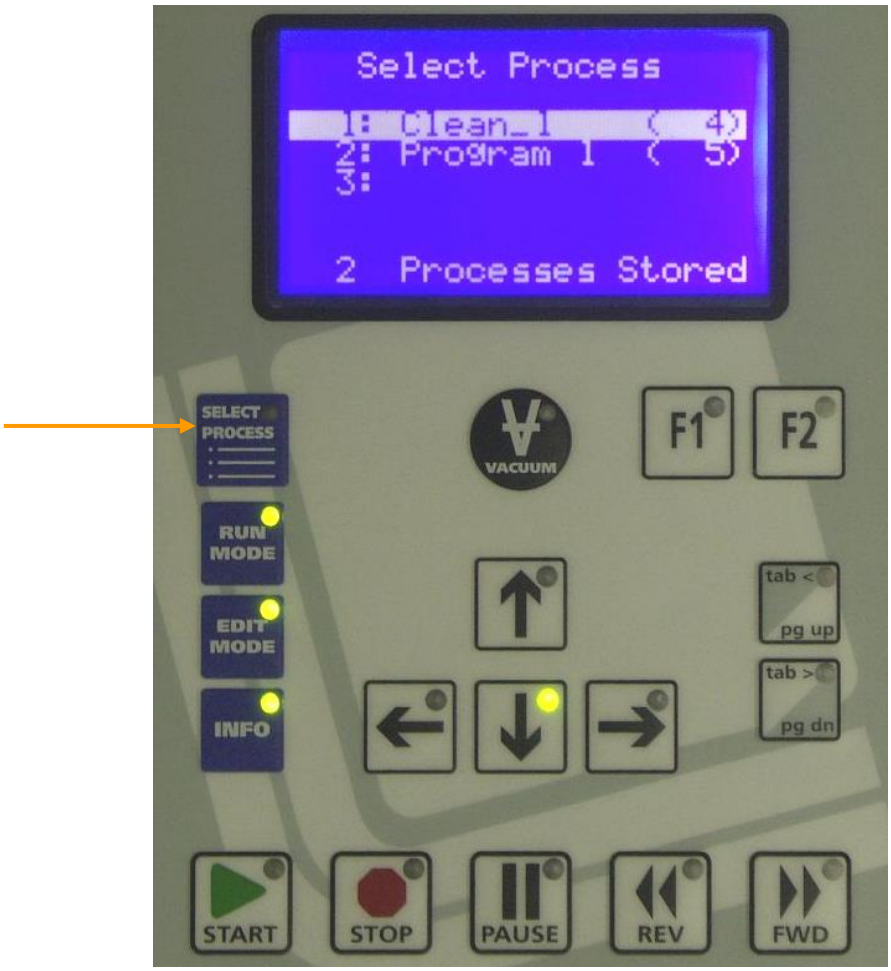


Figure 3-6
SELECT PROCESS SCREEN

Twenty (20), 51 step programs can be stored in the 650 controller. Many more can be stored in Spin 3000. The last line of the display shows the total number of resident programs within the 650 controller.

2 – RUN MODE – press this key to enter a selected program from the "Select Process" screen into the "run mode". This key is active when the green LED is illuminated. The start key (**11**) is active; pressing this key will begin processing. Figure 3-7 shows the "Run Mode" screen. When the "run mode" is selected a number of keys become active as indicated by illuminated green LEDs. From the "Run Mode" the user can enter the "Select Process Mode", Edit Mode" or "Info Mode". The "Up Arrow (↑)" and "Down Arrow (↓)" keys can be used to move between "Valv", "Sens" and "Type" line. The F1 key (**9**) becomes active when the "Valv" or "Sens" line is highlighted. The F1 key will send the user to the valve or sensor submenu. Vacuum (**8**) can be turned on or off.

Displayed fields are the operation mode/program name, step-of-steps, vacuum status, set point time, agitation rate, actual wafer RPM, set point RPM and spin rotation direction, valve, sensor and type status for each step of a program. The last line of the display will show the processor status and error messages.

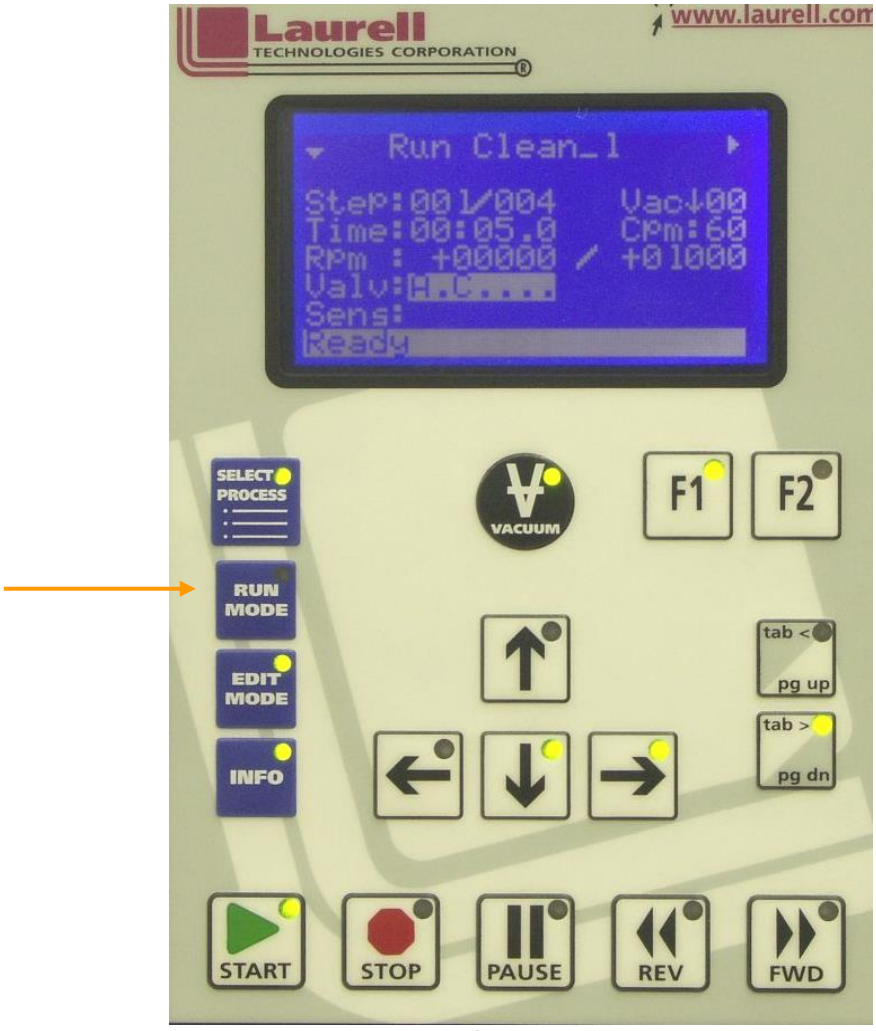


Figure 3-7
RUN MODE SCREEN

3 – EDIT MODE – press this key to create a new program or to select an existing program for modification. This key is active when the green LED is illuminated. Figure 3-8 shows the "Edit" mode screen. From the "Edit Mode" the user can enter the "Select Process Mode", Run Mode" or "Info Mode". The "Up Arrow (↑)" and "Down Arrow (↓)" keys can be used to move from line-to-line. The "Tab <" (**6**) or "Tab >" (**7**) keys can be used to switch the highlighted field into an "*editable*" field. The "FWD" (**15**) or "REV" (**14**) keys are used to move from step-to step with in a program. Vacuum can be turned on or off.

Figure 3-8
EDIT MODE SCREEN

Editable fields are: the step number, number of steps, step duration, spin speed, acceleration, motor direction, vacuum requirement, agitation rate, valves' state, and sensors' state. Each field is highlighted when it is selected. Figure 3.8 shows the first field, step number, highlighted. Use the "Up Arrow (↑)" and "Down Arrow (↓)" navigational keys to move from line to line. The "Tab<" and the "Tab>" key when pressed enables the highlighted field to be *editable*. When a "Tab<" or "Tab>" key is pressed the highlighted field will blink, this is an indicator that the field is now changeable. When a "Tab<" or "Tab>" key is pressed the blinking cursor will move from field to field within a program. The "Up Arrow (↑)" and "Down Arrow (↓)" keys will change the value or state of an *editable* field. The ←(Left) & →(Right) keys are used to move within fields with many digits such as speed. When the valve or

sensor field is highlighted the F1 key becomes active to allow access to their respective submenus.

4 – INFO – press this key to view "Statistical", "Configuration" and "About" information. This key is active when the green LED is illuminated. Highlight the desired field and press the F1 key to enter each submenu. Figure 3-9 shows the "Info Mode" menu screen. From the info mode the user can enter the "Select Process Mode", Run Mode" or "Edit Mode". The "Up Arrow (↑)" and "Down Arrow (↓)" keys can be used to move from line-to-line. The F1 key when pressed shows the information associated with each line.

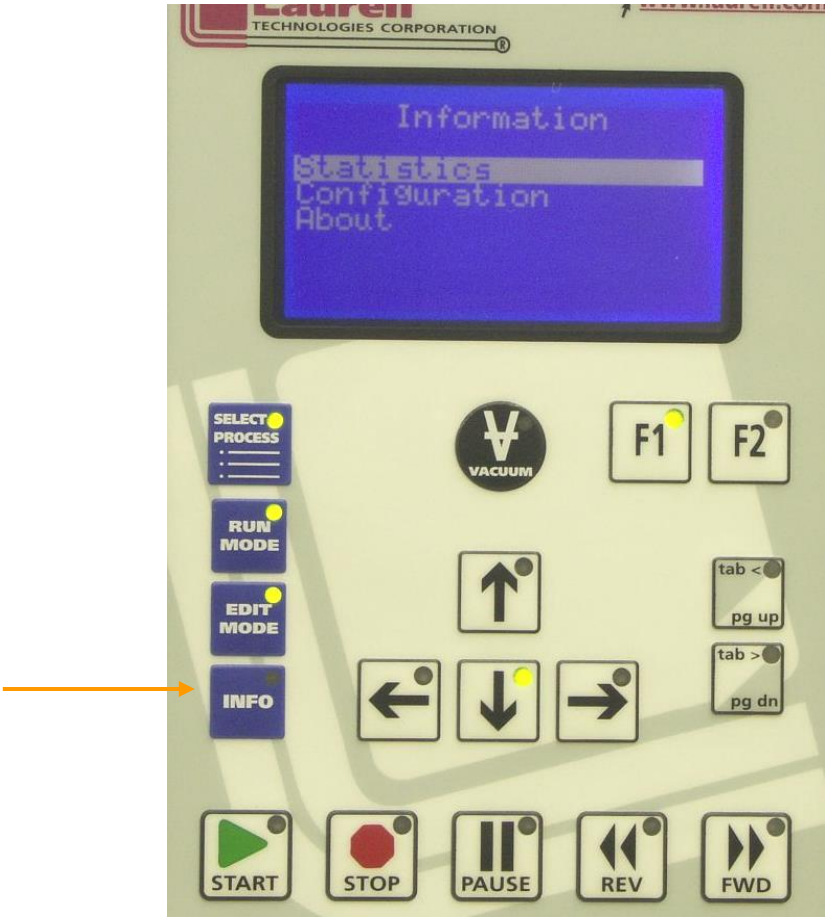


Figure 3-9
INFO MODE SCREEN

These menus are for informational purposes only. All system configurations are done through Spin 3000.

5 – NAVIGATION KEYS - ←(Left) & →(Right) and ↑(Up) & ↓(Down) – these directional keys have multiple functions within each menu. The "Up Arrow (↑)" and "Down Arrow (↓)" keys can be used to scroll up or down a list of items such as the program list in the "Select Process" menu. They can be used in the "Run" or "Edit" mode to move from line to line within a menu. The ↑(Up) & ↓(Down) keys are used

to change values when editing a field within a program. The ←(Left) & →(Right) keys are used to scroll left or right when there is addition information off to the left or right of the display. They are used in the edit mode to move within a field. These keys are active when the green LED is illuminated.

6 – TAB< / PG UP – this is a dual function key. The "Tab<" key is used to move from field to field in the "Edit Mode". When pressed this key changes a highlighted field to an *editable* blinking field. The "Pg Up" key is used to scroll up a list of items when there are 4 lines or more of information. This key is active when the green LED is illuminated.

7 – TAB> / PG DN – this is a dual function key. The "Tab>" key is used to move from field to field in the "Edit Mode". When pressed this key changes a highlighted field to an *editable* blinking field. The "Pg Dn" key is used to scroll down a list of items when there are 4 lines or more of information. This key is active when the green LED is illuminated

8 - VACUUM - this key toggles the vacuum valve on and off. This key is interlocked such that the vacuum cannot be turned off while a program is running or the chuck is in motion. The value is displayed in inches of Hg when the vacuum valve is turned on. The normal requirement to operate safely is ≥15" of Hg. This requirement can be modified in Spin 3000. The vacuum requirement of "vacuum required" or "vacuum not required" is programmable within a program. This key is active when the green LED is illuminated.

9 - F1 - this key is used to enter a submenu when available. Submenus can be accessed in the "Run" and "Edit Mode" when the valve or sensor line is highlighted. This key is active when the green LED is illuminated.

10 – F2 - this key is used to exit the submenu. When in a submenu pressing the F2 key will exit the user back to the "Run", "Edit" or "Info" mode. This key is active when the green LED is illuminated.

11 - START - this key is used to initiate a programmed sequence. While a program is running the mode display will indicate "***RUNNING"***. "***DONE"*** indicate that a program has run and will persist until the lid is opened or another program selection is made. This key is disabled until the vacuum, seal purge, exhaust and lid interlocks are satisfied. This key is active when the green LED is illuminated.

12 - STOP – this key will **"**Stop" the current program from completing the process program. When running a program in "run" or "edit" mode, the stop key will, when pressed, stop the process from completing the step, the motor will stop spinning and any active valves will close. The step and time is retained and if start is pressed again, the processing will resume where the process stopped. This key is active when the green LED is illuminated.

13 - PAUSE – this key will “Pause” the current program from completing the process program. When running a program in the run mode, the “pause” key will, when pressed, pause the process program time from proceeding. The motor will continue to spin and any active valve will remain on but the remaining time is ignored. The step and time is retained and if “pause” is pressed again, the processing will resume. This key is active when the green LED is illuminated.

14 - REV – Reverse back to the previous step in a program. This key is active in the “edit mode” to help while programming. Each time the key is pressed the user will go back to the previous step within a program. This function allows the wrapping of the first step to the last within a program. This function can be enabled to operate in the “run mode” by modifying the configuration in Spin 3000. This function in the “run mode” is disabled at the factory. This key is active when the green LED is illuminated.

15 - FWD – Advance forward to the next step in a program. This key is active in the “edit mode” to help while programming. Each time the key is pressed the user will go to the next step within a program. This function allows the wrapping of the last step to the first within a program. This function can be enabled to operate in the “run mode” by modifying the configuration in Spin 3000. This function in the run mode is disabled at the factory. This key is active when the green LED is illuminated.

3.4 - THE LCD DISPLAY

3.4.1 “SELECT PROCESS” SCREENS

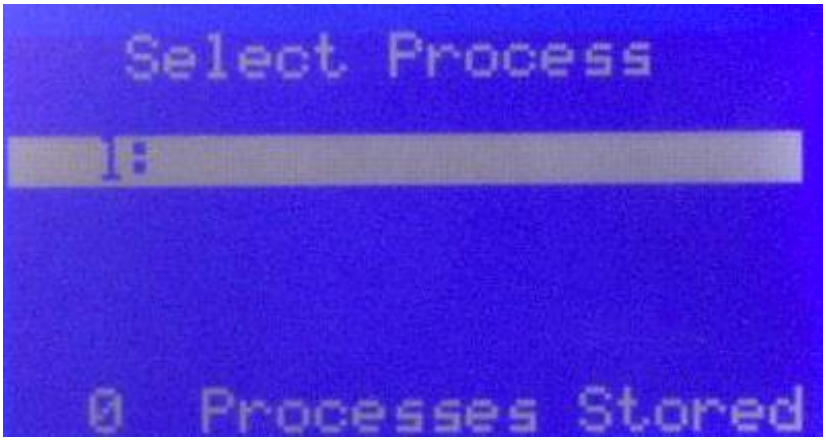


Figure 3-10A
SELECT PROCEES SCREEN

The “Select Process” screen is the default screen when the system is powered up. Figure 3-10A shows the “Select Process” screen when there are no resident programs stored in the 650 controller. Pressing the “Edit Mode” key when an empty line is highlighted, see figure 3-10B creates programs. Each line displays a ten-character program name followed by the number of program steps, in parentheses.

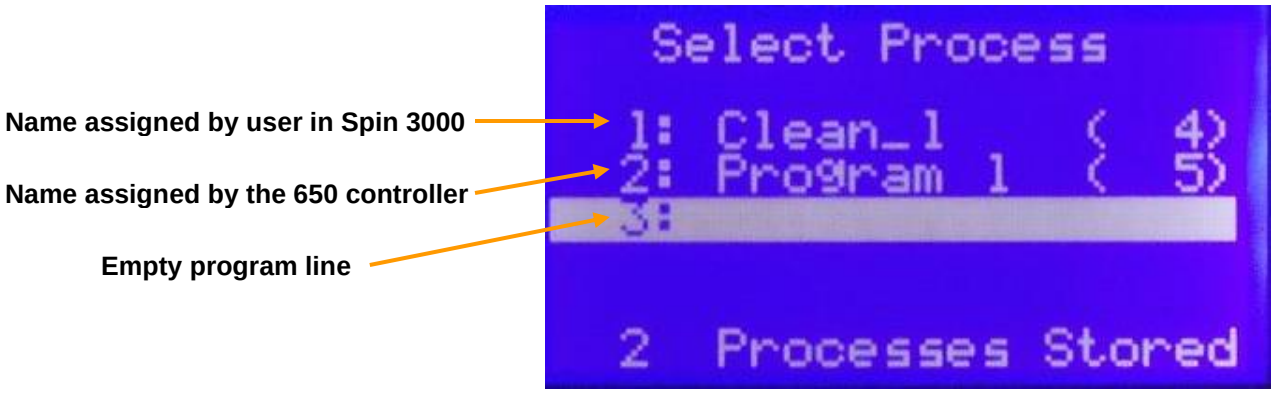


Figure 3-10B

The user selects the desired program by using the "Up Arrow (↑)" and "Down Arrow (↓)" keys to scroll through the list one line at a time. The "Page Up" and "Page Down" keys will scroll through the program list four lines at a time. The highlighted line is the currently selected program.
To creating a program in the 650 controller, highlight the last empty line, see line 3 of figure 3-10B, and press the "Edit Mode" key. Automatically a program name is assigned such as "Program 1" or "Program 2". Line 2 of figure 3-10B is an example of a program name assign in the 650 controller. When creating programs using the Spin 3000 software any 10 character name can be assigned. Line 1 of figure 3-10B is an example of a named program created in Spin 3000.

To edit a program, use the "Up Arrow (↑)" or "Down Arrow (↓)" keys to select a program and then press the "Edit Mode" key.

The "Start" key is active in this mode. By pressing the start key the selected program will enter the run mode automatically and begin processing immediately.

Similarly, pressing the "Run Mode" key enables the user to enter the run mode screen for this program.

The last line of the display shows the total number of resident programs within the 650 controller.

3.4.2 "RUN MODE" SCREENS

Press the "Run Mode" key to enter a selected program into the "run mode". Figure 3-11 shows the "Run" screen.

Displayed fields are the operation mode/program name, step-of-steps, vacuum status, set point time, agitation rate, actual wafer spin rotation direction and substrate rpm, set point wafer spin rotation direction and substrate rpm and spin rotation direction, valve, sensor and type status and processor status/error messages for each step of a program.

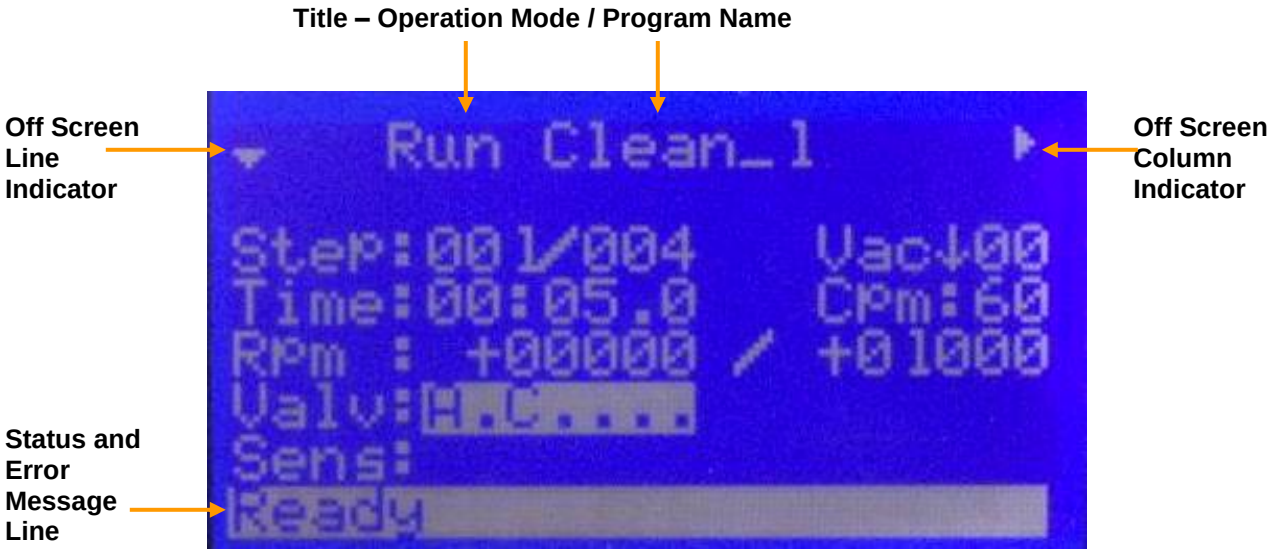


Figure 3-11

The off-screen line indicator, see figure 3-11, appear at the upper left-most side of the display and uses up or down arrows, or both, to indicate additional menu lines either above or below the portion of the menu currently being viewed.
The off-screen column indicator appears at the upper right-most side of the display and uses left or right arrows, or both, to indicate additional menu text columns either to-the-left or to-the-right of the portion of the menu currently being viewed. A user scrolls off-screen portions of a menu into view by using the navigation keys.

3.4.2.1 "RUN MODE" – DISPLAYED FIELDS – see figure 3-11

- **Title** – Operation Mode / Program Name – shows the operation mode that the user is in and the program name

- **Step** – Step-of-steps; the 1st field is the current step and the 2nd field is the total number of steps in the program. While running a program the "FWD" or "REV" keys, if enabled in Spin 3000, can move from step-to-step, by pressing the FWD or REV keys. This feature can be enabled or disabled in Spin 3000. If disabled, this function will not be available in the run mode.

- **Vac** - The ↑ shows that the vacuum key was pressed and the ↓ shows that the vacuum key was not pressed. If a program requires vacuum, set in the edit mode, the process will not run until vacuum is present and in the correct amount. The amount of vacuum present is displayed next to the arrow. The factory set point is 15" of Hg.

- **Temp** – Use the "Right Arrow (⟶)" key to scroll to the "Temp" field. This field shows the actual motor temperature. The factory set point is 55°C. The 650M or 23 models do not have temperature readout.

- **Loop -** Use the "Right Arrow (⟶)" key to scroll to the "Loop" fields. The 1st field shows actual number of loops completed and the 2nd field shows number of loops programmed. The next line "**GoTo**" shows the program line of where to loop back to.

- **Time** - Following the "Time" label are the step duration fields which are in the form of mm:ss.t where mm is minutes, ss is seconds, and t is tenths of seconds. A step must have at least one second duration. The minimum time possible is 1 second. When running, the time will count down to 00:00.00 before moving to the next step.

- **Cpm (650H/650L motor only)** - Following the "Cpm" (cycles per minute) label is a field indicating the agitation rate for the step. Selections are 0, 15, 30, and 60 cpm. When selected, the step duration and speed/acceleration can be set but must be achievable. The spin processor's controller cannot determine the inertial load so it will permit unachievable speed and acceleration rates to be entered...no control fault will occur (just not attain the requested rates). The factory can provide guidelines if requested on all Laurell manufactured chucks with defined substrate load.

- **Rpm** - Following the "Rpm" label is the desired target speed in revolutions per minute. The left field shows the actual rpm while the right field shows the set point value. Negative speeds may be entered which causes the motor to rotate in the opposite direction **(650H/650L only)**.

- **Valv** - Following the "Valv" label is a field indicating desired valve positions. From left-to-right the valves are labeled "A, B, C…" up to 16 possible valves. If a valve is enabled a letter appears. A dot "**.**" indicates the valve is off. A dash "**-**" indicates the valve is off and is mutually exclusive (MXL) with some subset of valves (also indicated by "**-**" if off). Valves that are mutually exclusive to each other cannot be turned on simultaneously. Only one valve of a MXL group can be on at any one time. If another valve in that group is activated, the other valve will automatically turn off. This is a safety feature to prevent incompatible chemicals from dispensing at the same time. The MXL feature can only be assign in Spin 3000. This field has a sub-menu where the valve names are displayed and whether or not they are mutually exclusive. Press the F1 key to enter the valve sub-menu, see figure 3-11B. Use the navigation or the "pg up" or "pg dn" keys to scroll through the list of valves. If valves are designated as MXL, the submenu will show "MXL" beside the associated valves, see figure 3-11B. Press the F2 key to exit a submenu. In the run mode the user is able to scroll down to the "Valv", "Sens" or "Type" line. Figure 3.11A shows the highlighted valves or "Valv" line. When the "Valv" or "Sens" line is highlighted the F1 key is activated. Figure 3-11A shows that there are 7 valves, "A" and "C" are enabled, "B" and "D" are MXL and not enabled, valves "E", "F" and "G" are off in step 1 of Clean_1 program.

There are no sensors. Figure 3-11B & C are an example of a submenu of valves.

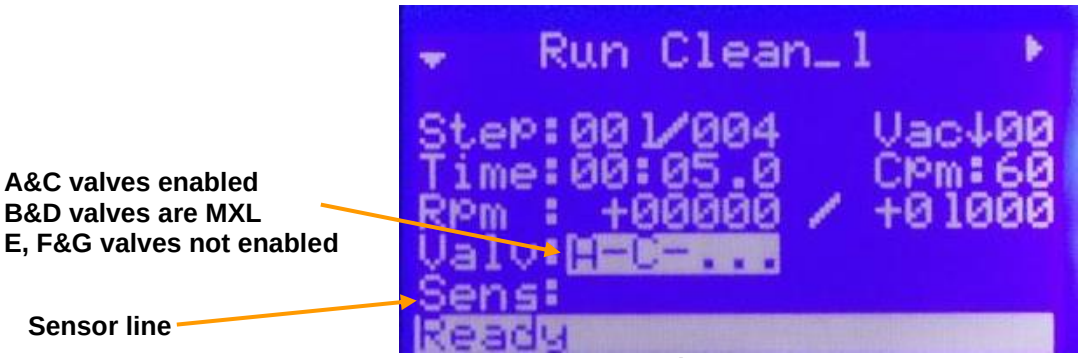


Figure 3-11A

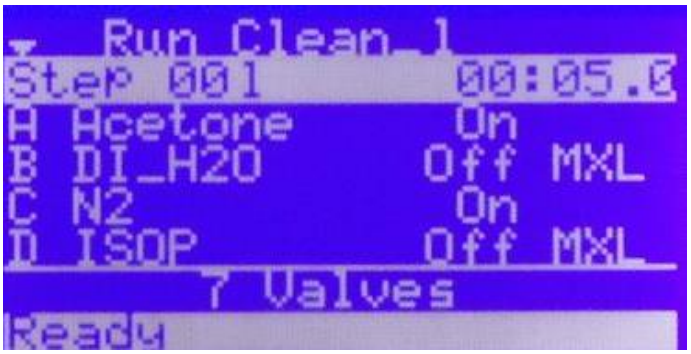


Figure 3-11B

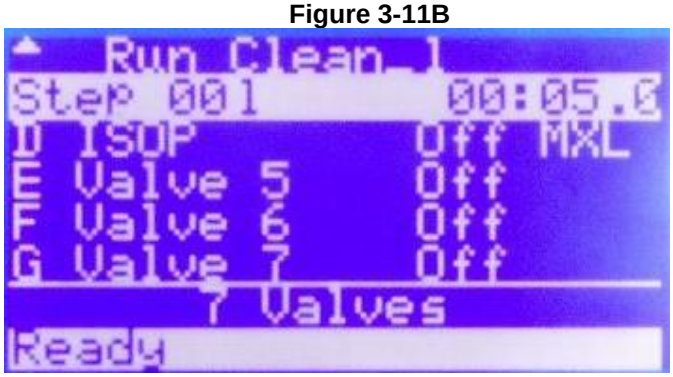


Figure 3-11C

Sens - Following the "Sens" label is a field indicating enabled sensors. From left-to-right the sensors are labeled "A, B, C…" up to 16 possible sensors. If enabled, a letter appears. A dot "**.**" indicates the sensor is inactive. This field has a sub-menu where the sensor names are displayed and what will happen if they are triggered. Pressing the "F1" key enters the sub-menu. Use the navigation or the "pg up" or "pg dn" keys to scroll through the list of sensors. For example, there are 4 possible sensors with "A" and "B" active for step 1, see figure 3-12. The sensor F1 submenu is figure 3-12A. Through Spin 3000 the first 3 valves were assigned names. "Chem Low" (chemical low) name to sensor "A", "Waste High" to sensor "B", "MOhm" (resistively) to sensor "C" and sensor "D" was not given a name.

Figure 3-12

Figure 3-12A

Figure 3-12B

The sensor “ON” state can be modified according to the input device design. Spin 3000 can be configured according to the triggering device which can be “normally on” or normally off”. See figure 3-12A, sensors A, B and C are set to off and sensor D is set to on. The resultant action associated with each sensor is shown in figure 3-12B. Sensor A will provide a “Warn” or warning message if sensor A is triggered ON. Sensor B will “Abort” the processor and provide an abort message if sensor B is triggered ON. Sensors C will “Next” or go to the next step in the program if sensor C is triggered ON. Sensor D will “Start” the processor if sensor D is triggered OFF. Press the F2 key to exit a submenu.

- **Type** – Following the “Type” label is a field indicating sensor action. This line is directly linked to the “Sens” line. Different sensor actions can be

assigned to the operation of a sensor. For example, a sensor may be assigned to “abort the process” if a certain condition is sensed. The “Type” field will show, in abbreviated form, the action assign to the sensor. The sensor action can only be assigned in Spin 3000. Below is the list of possible sensor actions and its’ abbreviation.

- “Abort” = A
- “Next Step” = N
- “Start” = S
- “Warning” = W

Figure 3-12C

The Type field in figure 3-12C has the characters “WANS”. The “W” indicates that a “Warning” command is associated with sensor A. The “A” indicates that an “Abort” command is associated with sensor B. The “N” indicates that a “Next Line” command is associated with sensor C. The “S” indicates that a “Start” command is associated with sensor D.

- **Message Line** – The bottom field of the display will always show the status of the processor, such as “***READY***”, “***RUNNING***” or “***STOPPING***”. If the processor senses an error condition, that error message will be displayed in this field. The display in figure 3-12D tells the user the system, is “***READY***” to run. Status and error messages are displayed only in the “Run Mode”.

3.4.2.2 “RUN MODE” – OPERATION

As can be seen in figure 3-12D, the message line shows the processor is “***READY***” and the “Start” key is active. Pressing the “Start key” will initiate the running of program “Clean_1”.

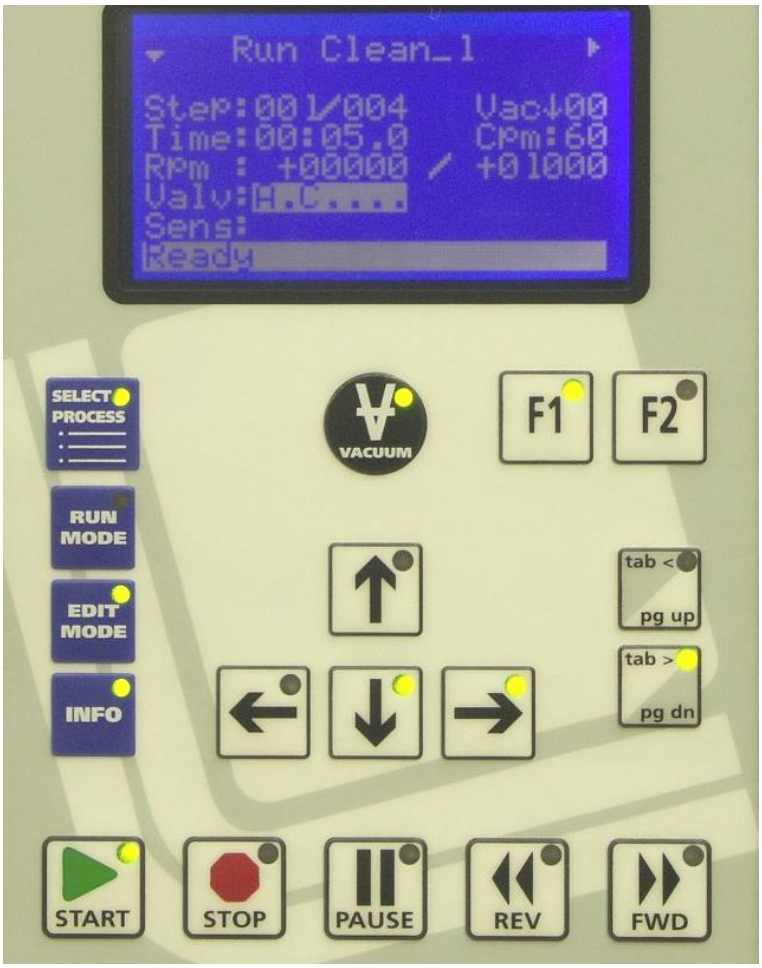


Figure 3-12D

Figure 3-13 shows the processor running program “Clean_1”. The status line tells the user the system is “***RUNNING***”. Pressing the active “Stop” or “Pause” key will stop or pause processing. Pressing the “Stop” key will cause the processor to stop. The “Start” key becomes active and by pressing the “Start” key again the processor will begin processing from the stop point. If “Stop” is pressed and the user leaves the “Run Mode” the program will revert back to the beginning of the program. Pressing the “Pause” key will cause the processor to pause at this point. The substrate will continue to spin and valves will continue to operate but the remaining time will be ignored. Pressing the “Start” key will resume processing at this point. The “Up Arrow (↑)” and “Down Arrow (↓)” keys are active in the “run mode”. Highlighting the valve or sensor line enables the F1 key to become active. Pressing the “Right Arrow (→)” key scrolls the display to the right. The motor temperature display is located off the screen to the right. While running the “Select Process”, “Edit” and “Info” keys are disabled (not active).

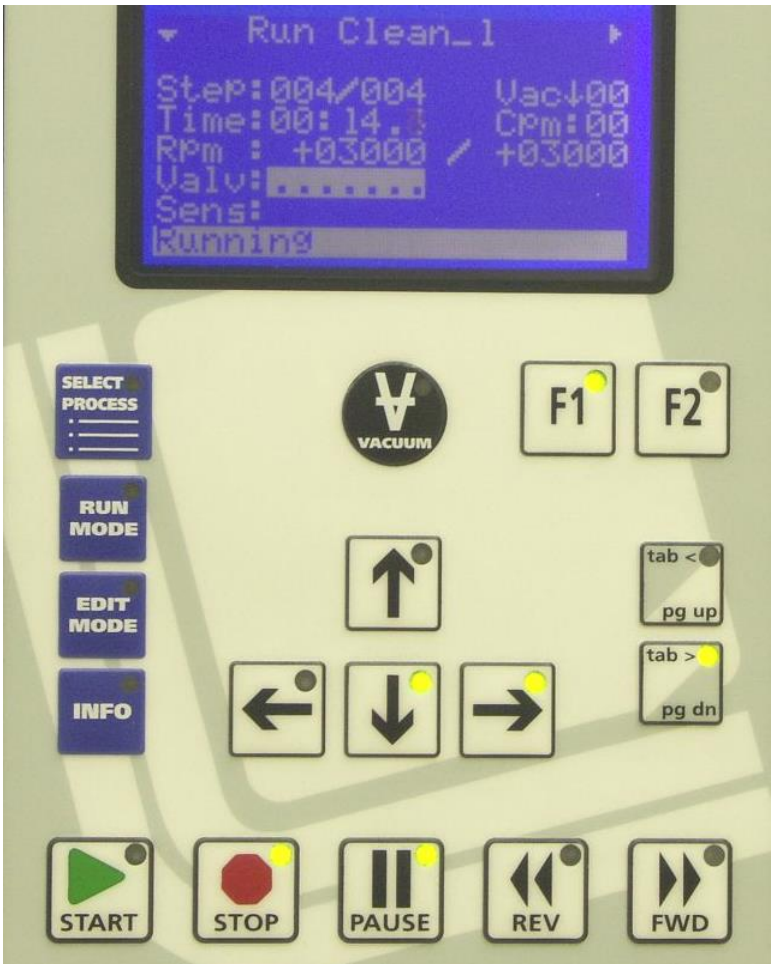


Figure 3-13

Any system fault or error message will be displayed on the last field of the LCD panel. Figure 3-14 shows an example of a “low exhaust” error message.

Figure 3-14

3.4.3 "EDIT MODE" SCREENS

Press the "Edit Mode" key to enter a selected program into the "edit mode". Figure 3-15 shows the Edit screen.
Displayed fields are the operation mode/program name, step-of-steps, vacuum status, time, agitation rate, spin rotation direction and wafer rpm, acceleration rate, valve, and sensor status and off screen the sensor type line.

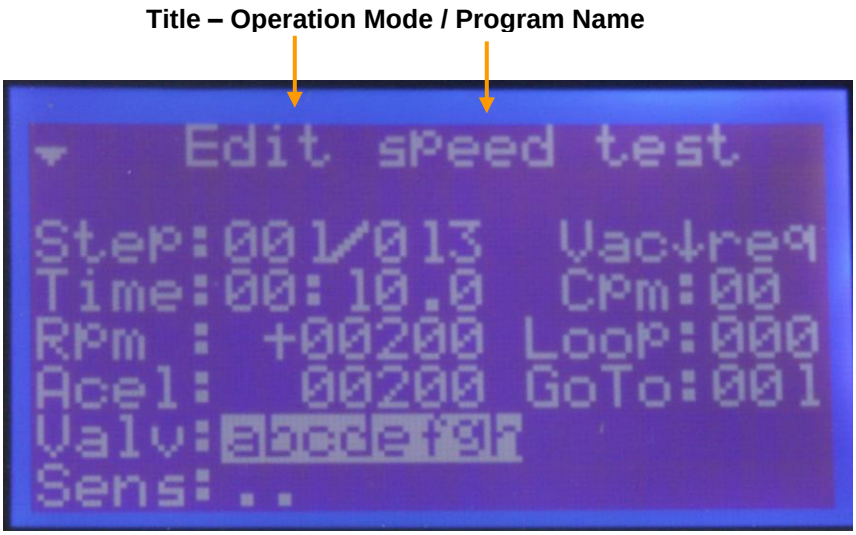


Figure 3-15

3.4.3.1 EDIT MODE – DISPLAYED FIELDS – see figure 3-15

- **Title** – Operation Mode / Program Name – shows the operational mode that the user is in and the program name

- **Step** – shows steps-of-steps; the 1st field is the current step and the 2nd field is the total number of steps in the program. When editing a program the "FWD" or "REV" keys, can move from step-to-step, by pressing the "FWD" or "REV" keys. This feature in the "edit mode" is always enabled.

- **Vac** – this field sets the vacuum requirement i.e. if vacuum is required or not required for a program. If vacuum is required the field will show "**req**"; if vacuum is not required the field will show "**non**". This setting is a global setting for the entire program. The ↑ shows that the vacuum key was pressed and the ↓ shows that the vacuum key was not pressed. If a program requires vacuum the process will not run until vacuum is present and in the correct amount. The amount of vacuum present is displayed next to the arrow. The factory set point is 15" of Hg.

- **Time** - Following the "Time" label are the step duration fields which are in the form of mm:ss.t where mm is minutes, ss is seconds, and t is tenths of seconds. A step must have at least one second duration. The

minimum time possible is 1 second. When running the time will count down to 00:00.00 before moving to the next step.

- **Cpm (650H/650L motor only)** - Following the “Cpm” (cycles per minute) label is a field indicating the agitation rate for the step. Selections are 0, 15, 30, and 60 cpm. When selected, the step duration and speed/acceleration can be set but must be achievable. The spin processor’s controller cannot determine the inertial load so will it permit unachievable speed and acceleration rates to be entered...no control fault will occur (just not attain the requested rates). The factory can provide guidelines if requested on all Laurell manufactured chucks with defined substrate load.

- **Loop –** Enter the number of loops to be performed. The “**GoTo”** line specifies where in the program to loop back to, to begin another loop cycle.

- **Rpm** - Following the “Rpm” label is the desired target speed in revolutions per minute. The field shows the set point value. (HPD2 only - Negative speeds may be entered which causes the motor to rotate in the opposite direction).

- **Acel – (HPD2 Motor Only)** Following the “Acel” label is the motor acceleration rate in rpm/second. The maximum acceleration rate is 30,000 rpm/s. This rate is also used as a deceleration rate. To slow down quickly enter a large value, conversely to slow down slowly enter a small value. **CAUTION: When using a mechanical chuck always use low acceleration rates to prevent the possibility of throwing a substrate from the chuck!**

- **Acel – (650L/650M)** - Following the “Acel” label is the motor acceleration rate in rpm/second. For the standard motor drive the maximum acceleration rate is very dependent on the mass of the chuck and substrate. A proper acceleration value will prevent spin speed overshoot when spinning a substrate.

  Calculate the acceleration rate value by taking the spin speed difference between steps and using that difference for the acceleration rate for the current step. For example:

Step	Time	RPM	Acel
1	5.0	500	500
2	5.0	1500	1000

  The speed difference between step 1 and 2 is 1000rpm. Use this difference as the acceleration rate in step 2. Continue this calculation throughout the program. This calculation is a guide for finding the proper maximum acceleration rate.

- **Valv** - Following the “Valv” label is a field indicating desired valve condition. A lower case letter, “a” for example, indicates the valve is off. From left-to-right the valves are labeled “a, b, c…” up to 16 possible valves. If a valve is enabled an upper-case letter, “A” for example, appears. This field has a sub-menu where the valve names are displayed and whether or not they are mutually exclusive. A dash “**-**” indicates the valve is off and is mutually exclusive (MXL) with some subset of the valves (also indicated by “**-**” if off). Valves that are mutually exclusive to each other means that only one valve of a MXL group can be turned on. If another valve in that group is activated, the previous valve will automatically turn off. This is a safety feature to prevent incompatible chemicals from dispensing at the same time. The MXL feature can only be assign in Spin 3000. Pressing the “F1” key enters the valve sub-menu. Use the navigation or the “pg up” or “pg dn” keys to scroll through the list of valves and sensors. If valves are designated as MXL, the submenu will show “MXL” beside the associated valves. Press the F2 key to exit a submenu. **(Note: in the Run mode only upper-case letters or dot “.” will appear.)**

- **Sens** - Following the “Sens” label is a field indicating enabled sensors. A dot “**.**” Indicates the sensor is inactive. From left-to-right the sensors are labeled “A, B, C…” up to 16 possible Sensors. If enabled, a letter appears. This field has a sub-menu where the sensor names are displayed and what will happen if they are triggered. Pressing the “F1” key enters the sub-menu. Use the navigation or the “pg up” or “pg dn” keys to scroll through the list of valves and sensors. Press the F2 key to exit a submenu.

- **Type** – Following the “Type” label is a field indicating sensors action. This line is directly linked to the “Sens” line. Different sensor actions states can be assigned to the operation of a sensor. For example, a sensor may be assigned to “abort the process” if a certain condition is sensed. The “Type” field will show, in abbreviated form, the action assign to the sensor. The assigning of sensor action can only be assigned in Spin 3000. Below is the list of possible sensor actions and its’ abbreviation.

    - “Abort” = A
    - “Next Step” = N
    - “Start” = S
    - “Warning” = W

3.4.3.2 “EDIT MODE” – OPERATION

As can be seen in figure 3-16, the 650 controller is in the “Edit Mode”. The title shows “Edit” as the operation mode. The “Start” key is active. Pressing the “Start” key will initiate running of program “speed test”. A program will run in the “edit mode” but the time is ignored. The processor will run indefinitely until the “stop” key is pressed. To move from step-to-step within a program while running, press the “FWD” or the “REV” key. All fields are changeable while running.

Figure 3-16

Each field is highlighted when it is selected. Figure 3-16 shows the “Valv” field highlighted. Use the “Up Arrow (↑)” and “Down Arrow (↓)” navigational keys to move from line to line. The “Tab<” and the “Tab>” key when pressed enables the highlighted field to be editable. When a “Tab<” or “Tab>” key is pressed the highlighted field will blink, this is an indicator that the field is now changeable. When a “Tab<” or “Tab>” key is pressed the blinking cursor will move from field to field within a program. The “Up Arrow (↑)” and “Down Arrow (↓)” keys will change the value or state of an *editable* field. The ←(Left) & →(Right) keys are used to move within a field with many digits such as speed and acceleration. When the valve or sensor field is highlighted the F1 key is becomes active to allow access to their respective submenus.

Figure 3-17 shows the “Valv” field highlighted. Valve A and B of step 1 are activated within the program. There are 8 possible valves. All the other valves are off in step 1 as indicated by “lower case” letters.

When the F1 key is pressed the user will enter the valve submenu. See figure 3-18.

Figure 3-17

Figure 3-18 shows 4 of the 7 possible valves. The last 3 valves are on the next page as indicated by the “off screen line indicator” in the upper left-hand corner of the display. Valve A, “Acetone” is set to “ON”.

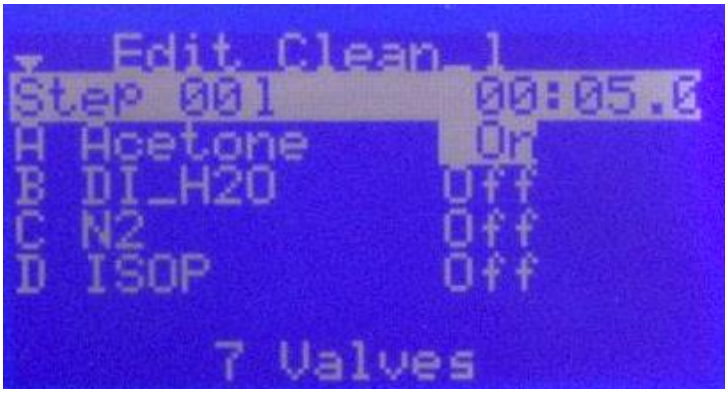


Figure 3-18

Figure 3-19 shows the last 3 valves. The first field below the title shows the step number. A specific name for a valve can be assign in Spin 3000, such as “Acetone”. The default name is “valve 1”, “valve 2” etc…

Figure 3-19

3.4.4 "INFO MODE" SCREENS

Press the "Info Mode" key to access information on the spin processors' "Statistics", "Configuration" and "About". Figure 3-20 shows the "Info Mode" screen.

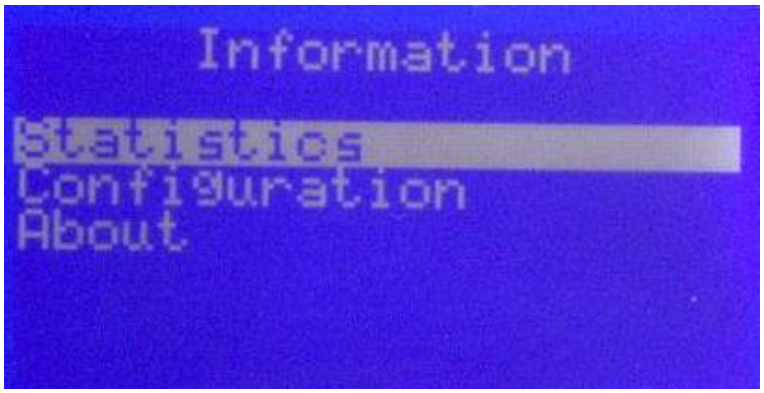


Figure 3-.20

Figure 3-21A shows the 1st screen of the Statistic page and figure 3-21B shows the 2nd page.

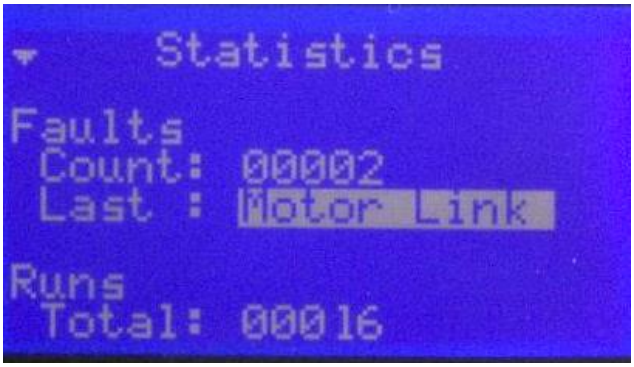


Figure 3-21A

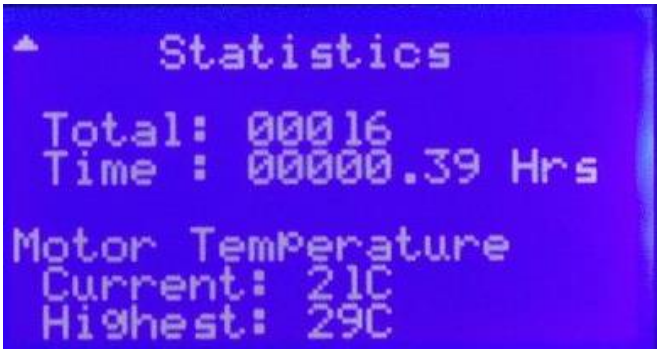


Figure 3-21B

3.4.4.1 "INFO MODE" - STATISTICS - DISPLAYED FIELDS – see figures 3-21A & 3-21B

- **Faults / Counts** - The "count" line shows the total number of faults or errors which occurred in the spin process.

- **Faults / Last** - This is an active field. Press the F1 key to access the complete list of faults or errors that have occurred. The listed error messages are organize from newest to oldest and are date and time stamped. The list will hold 255 lines of error messages. Once the list is full the oldest error message will be over written.

- **Runs / Total** – This field shows the spin processor total number of runs.

- **Runs / Time** – This field shows the total usage time of the spin processor.

- **Motor Temperature / Current** – This field shows the current motor temperature in real time.

- **Motor Temperature / Highest** - This field shows the highest motor temperature the motor ever attained.

3.4.4.2 "INFO MODE" - CONFIGURATION - DISPLAYED FIELDS – see figures 3-22A-3-22E

- The configurations pages below reflect the set up parameters as assigned in Spin 3000.
- Some of these parameters are factory settings, which cannot be changed. There are other parameters, which are user defined.
- These pages are for information only. These parameters cannot be modified using the 650 controller

Figure 3-22A

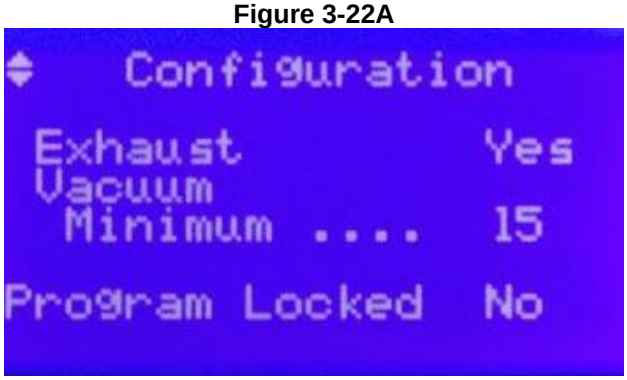


Figure 3-.22B

Figure 3-.22C

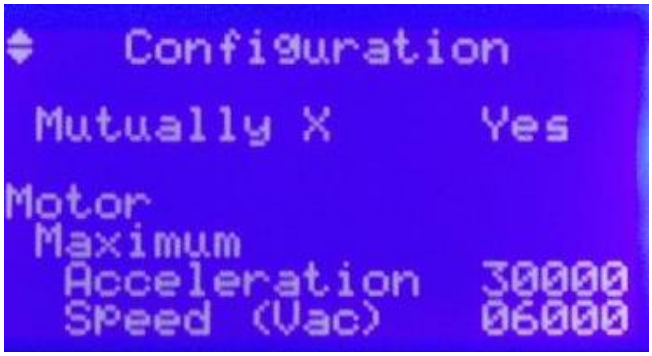


Figure 3-22D

Figure 3-22E

- **Programs / Maximum** – This field shows the maximum number of programs (20) allowed in the 650 controller. This can be modified by the user.

- **Programs / Maximum Steps** – This field shows the maximum number of steps (51) allowed in a program. The number of steps is calculated on the number of programs.

- **Requires / Clean Dry Air** – “YES” in this field enables the requirement of having N2 or CDA pressure present to actuate pilot air valves, pneumatic vacuum valve and to provide seal purge flow. Less than 60psig will cause a “need CDA” error. This is a factory setting.

- **Requires / Exhaust** – “YES” in this field enables the interface between the exhaust differential pressure gauge and the 650 controller. Any exhaust level above or below the set points enter into the exhaust controller will cause an “exhaust” error. This is a factory setting.

- **Requires / Vacuum – Minimum** – “15” in this field shows the minimum amount of vacuum required before a vacuum chuck operation can be started. A vacuum level < 15” of Hg will cause a “vacuum” error. User defined.

- **Program Locked** – “NO” in this field enables all users to create, in Spin 3000 and the 650, programs and enter programs into the 650 controller. “YES” in this field prevents all programming in Spin 3000 and the 650 controller. Downloads from Spin 3000 are prevented. User defined.

- **Purge** – This function is designed to run a “purge” program at a scheduled interval. “NO” in this field disables the use of a purge program. “YES” in the field enables a purge program to run. When “YES” the purge command operates in conjunction with the “delay and “program” parameters. User defined.

- **Purge / Delay (Min)** – When purge is set to “YES” enter a time, in minutes, in this field to set the time interval for the purge program. At this interval the specified program will run. User defined.

- **Purge / Program** – Enter the program number of the purge program. This program will run at the time interval set in “delay”. User defined.

- **Valve / Delay (1 sec)** – “Yes” is this field sets a 1 second delay between the closing of a valve and the opening of the next valve. This is a factory setting.

- **Mutually X-MXL** – This field when set to “YES” indicates that there are designated valves defined in Spin 3000 that are mutually exclusive to each other. Only 1 valve at a time will be allowed to dispense from this group. This is a factory setting.

- **Motor / Maximum / Acceleration** – This field indicates the maximum acceleration speed that the motor can achieve. The factory has limited the maximum acceleration value that can be entered. The user can modify this value.
  Caution: It is recommended not to use extremely high acceleration rates with mechanical chucks.

- **Motor / Maximum / Speed (Vac)** - This field indicates the maximum speed that the motor can achieve when vacuum is required. This is a factory setting.

- **Motor / Maximum / Speed (Non)** - This field indicates the maximum speed that the motor can achieve when vacuum is not required. This is a factory setting.

- **Temperature** – This field shows the maximum temperature the motor can reach before a fault condition is detected. This is a factory setting.
  The 650M model does not have temperature readout.

- **Brushless** – This field shows the type of motor installed in the spin processor. This is a factory setting.

- **Tune Motor** – This field is used when the brushless motor needs tuning/calibration. This is an active field. Only factory trained personnel perform tuning/calibration.

3.4.4.3 "INFO MODE" - ABOUT - DISPLAYED FIELDS – see figures 3-23A

- To access the entire screen, use the Right arrow ⟶ key to scroll to the right.
- **Model** – This field shows the spin processor model.
- **S/N** – This field shows the spin processor serial number.
- **Firmware** – This field shows the firmware revision number; scroll to the right for the its' full description.
- **Controller** - This field shows the revision level of motor controller card.

Figure 3-23A

3.5 – PROGRAMMING THE 650 CONTROLLER

1. Turn on the spin processor. The 650 will initialize and default to the "Select Process" screen.
2. If editing an existing program, highlight the desired program. If creating a new program highlight the empty line. Press the "Edit Mode" key. If this is a new program a program name will be assigned. The program name will appear on the title line.
3. Use the navigation keys to move from line-to-line or the "Tab<" or "Tab>" key to move to field-to-field. The "Tab" key enables the field to be editable. Make changes to the field by using the ↑(UP) or ↓(DOWN) arrow keys.

4. Add or delete steps by highlighting the “steps” field with the “Tab” key and increase or decrease the number.
5. Move from step-to-step by using the “FWD” or “REV” key.
6. To change valve condition, highlight the valve field, press the F1 key and edit the submenu using the “Tab” keys and the ↑(UP) or ↓(DOWN) arrow keys. Exit the submenu by pressing the F2 key. Valve configuration is done at the factory at time of order.
7. To change sensor action highlight the sensor field, press the F1 key and edit the submenu using the “Tab” keys and the. ↑(UP) or ↓(DOWN) arrow keys. . Exit the submenu by pressing the F2 key. Sensor configuration is done at the factory at time of order.
8. When finished press the “Run Mode” key.

- **Example of an etch program.** This is for example only; the user must find the best parameters for their process.

PROGRAMMING EXAMPLE

Program: Etch_1 **Valve Identification**

A BHF	E
B DI	F
C N2	G Dome N2
D	H Dome DI

Step	Time 99	59.9	Speed 0-6,000	Valves X=ON								Accel	Comment
	Min	Sec											
1		5	300	A	B	C	D	E	F	G	H	300	This step is to get the chuck rotating at step 2 spin speed.
2		30	300	A **X**	B	C	D	E	F	G	H	300	Spin speed same as step 1. Dispense BHF enough time to etch substrate. A Dispense pressure 10psig
3		30	300	A	B **X**	C	D	E	F	G **X**	H **X**	300	Purge BHF line. #2 Rinse wafer. Dome N2 on. G Dome DI on. H
4	1	00	3000	A	B	C **X**	D	E	F	G **X**	H	3000	Blow out BHF line. #3 Blow / spin dry wafer. Dome N2 on. G
5				1	2	3	4	5	6	7	8		

3.6 - RUNNING THE 650 CONTROLLER

1. Select the program to be run using the “Select Process” key. Press the “Run Mode” key. The program name will appear on the Title line
2. Open the lid; place and align a substrate on the chuck. Press the “Vacuum” key to activate the vacuum valve if vacuum is required. Sufficient vacuum to hold the substrate is required to start the motor. If using a non-vacuum chuck the vacuum requirement can be disabled in the edit mode.
3. Close lid.
4. Press “Start” key to start a program. The program will not start until the vacuum hold down requirement is met (vacuum chucks only), the seal purge requirement is satisfied, exhaust flow is correct and the lid is closed. The program will stop automatically if the lid is opened, the N_2 motor seal purge is not satisfied (>60psig), exhaust drops or increases beyond the set point or the vacuum requirement for hold down is not maintained. The remaining process time will be maintained.
5. “Done” will be displayed when the process is completed and the lid has not yet been opened for wafer removal. Restarting the same sequence on the same wafer is not allowed until the lid is opened or the “Edit “key is pressed then the “Run” key.

3.7 - REMOVING/CHANGING CHUCKS

3.7.1 “PRESS-ON” OR “SCREW DOWN” TYPE CHUCK

Laurell Technologies also uses a press-on or screw down chuck with our standard drive motors. These two styles of chucks are interchangeable – the press-on is a chuck which presses onto the motor shaft adapter and the screw down chuck screws onto the motor shaft adapter. See photos below to identify which chuck design you have.

1. **Press-on Chuck:** To remove the chuck, gently lift up on the edges; lift one side then the other. To install a chuck (see figure 3-24), align the 2 locating pins on the motor shaft adapter with the corresponding holes in the chuck; place the bottom of the chuck over the motor shaft adapter and press down. Be sure to firmly push the chuck into place.

Figure 3-24
INSTALLING PRESS-ON CHUCK

2. **Screw Down Chuck:** The first step in removing the screw down chuck is to remove the screw cover insert (see figure 3-25a). Once the insert is removed, you will notice 2 screw heads (fig. 3-25b). Use a 9/64" Allen wrench to remove both screws and gently pull the chuck upward until it is free of the motor shaft adapter (fig. 3-25c). Replacing the chuck is done by aligning the 2 locating pins on the motor shaft adapter with the corresponding holes in the chuck. Place the 2 screws into the chuck and firmly tighten the screws. **Do not force the chuck into position, or hit with anything to seat it (STOP immediately and contact the factory for advice).**

NOTE: Laurell Technologies Corporation does not warranty any damage to the equipment caused by incorrectly installing a chuck or substrate.

Figure 3-25a

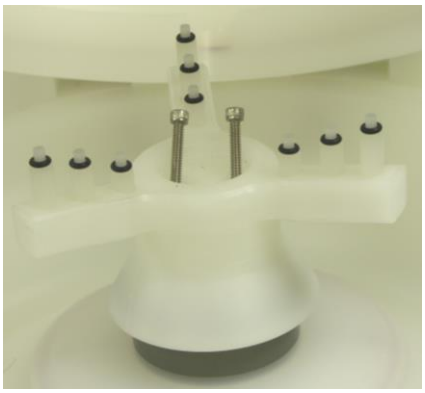


Figure 3-25b

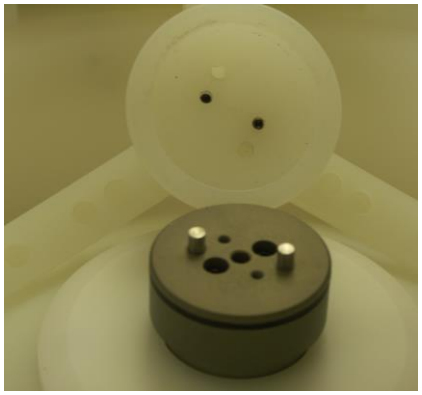


Figure 3-25c
Removing and Installing Screw Down Chuck

3.7.3 HIGH PERFORMANCE DRIVE (HPD2) MOTOR - PRESS-ON OR SCREW DOWN CHUCK

Laurell Technologies uses a press-on or screw down substrate chuck with our 300 mm processor models and with all High-Performance Drive (HPD2) motors. These two styles of chucks are interchangeable – the press-on is a chuck which presses onto the motor shaft adapter and the screw down screws onto the motor shaft adapter. See figures 3-24 & 3-25

3.8 – HIGH PERFORMANCE DRIVE MOTOR (HPD2)

The HPD2 brushless motor is standard on our 15 series models and is optional with our other spin processors. All models equipped with a HPD2 motor have an additional lid interlock which prevents the opening of the lid while the tool is in operation. All HPD2 motors have an insert or screw down type chuck (see section 3.7.1).

3.8.1 PROGRAMMING THE HPD2

See section 3.4.3 Edit mode for information on how to edit.

- **ACCELERATION:** The HPD2 is capable of extremely fast acceleration rates up to 30,000 rpm/second. (Acceleration rates are greatly influenced by chuck load so individual cases may vary.) Acceleration is programmable from 2 to 30,000 rpm/sec.

CAUTION: When using a mechanical chuck always use low acceleration rates, 500rpm/sec is the recommended maximum, to prevent the possibility of throwing a substrate from the chuck!

- **SPIN SPEED:** The HPD2 spin speed is programmable with both positive and negative numbers. Positive numbers >+00001 will cause the motor to rotate counter clockwise and negative values <-00001 will cause clockwise rotation. Negative values can be entered by highlighting the + or – symbol in the edit mode and pressing the up or down arrow key. See figure 3-26

Figure 3-26
EXAMPLE OF NEGATIVE SPIN SPEED VALUE

➢ **PROCESSING TIP:** An agitation type program is possible when using both positive and negative spin speeds. The below example is meant to show how agitation programming is possible. Use the Cpm field to enter an agitation rate (15, 30 or 60 cpm) or the user can build their own program and rate.

EXAMPLE OF AN AGITATION PROGRAMMING

Step	Time 99 59.9		Speed 0-6,000	Valves X=ON								Accel	Comment
	Min	Sec											
1		00.5	100	1	2	3	4	5	6	7	8	1000	
2		00.5	-100	1	2	3	4	5	6	7	8	1000	
3		00.5	100	1	2	3	4	5	6	7	8	1000	
4		00.5	-100	1	2	3	4	5	6	7	8	1000	
5		00.5	100	1	2	3	4	5	6	7	8	1000	
6		00.5	-100	1	2	3	4	5	6	7	8	1000	
7		00.5	100	1	2	3	4	5	6	7	8	1000	
8		00.5	-100	1	2	3	4	5	6	7	8	1000	
9		00.5	100	1	2	3	4	5	6	7	8	1000	
10		00.5	-100	1	2	3	4	5	6	7	8	1000	

3.9 – FIRMWARE VERSION

The firmware version can be determined by pressing the “INFO” key then scroll down to the “About” field then press the “F1” key. Scroll to the right to see the full field.

3.10 – WAFER SIZE vs. SPIN SPEED

Vacuum Chucks

Maximum spin speed is dependent on substrate size, shape and weight in conjunction with chuck diameter (vacuum holding area) and weight. All substrates regardless of size or shape must be centered on the vacuum chuck. Off-centered substrates will cause vibration at high spin speeds and may cause a loss of vacuum.

Examples:

- A small fragment may be able to spin up to 12krpm if the proper sized fragment adapter is used.
- A 100mm – 150mm wafer should be limited to ~6krpm if a small chuck is used. The same size wafers may be spun faster if the chuck is the same diameter as the wafer.
- 200 – 300mm wafer depending on chuck size should be limited to 2.5 – 3.5krpm (if smaller than wafer).

Non-Vacuum Chucks

- We recommend all non-vacuum chucks be limited to a maximum spin speed of 3krpm.

3.11 HOMING

Both 650H and 650L motors have a “homing” feature. At the end of a run the motor will rotate slowly back to its original starting position.

SECTION 4 - MAINTENANCE

There is very little maintenance required with our processors. Daily cleaning of the process bowl and lid is recommended. Regularly scheduled cleaning is a good practice and it prevents the excessive buildup of material over time. Use an appropriate solvent or cleaner and wear all required personal protective equipment. It is recommended to leave the N_2 or CDA supply on so that the seal purge is constantly present and to leave the lid in the up position to allow drying of residual moisture. Any questions regarding the maintenance of your spin processor can be addressed to support@laurell.com

- **NEVER flood or spray solvent such as acetone directly onto the keypad surface. *Doing so may cause keypad failure*. Always wet a wipe with the solvent and gently wipe the keypad surface.**

- **If the processor is equipped with a vacuum chuck, it is important not to allow chemicals to enter into the vacuum path.**

NOTE!
***The vacuum path is not designed for any pressure*. Air pressure or any liquid forced or drawn into the vacuum chuck will very likely damage the vacuum sensor, seals, motor and electronics. This type of damage is not covered by our warranty**

- **CLEANING** - Clean, rinse, then dry your spin processor after each use, taking care to prevent any chemicals from entering the vacuum path. A good practice is to cover the chuck during bowl cleaning. This can be done with a wafer held in place with vacuum or use a cover such as Petri dish – fluids must not be permitted to flow under the substrate. If the chuck face shows signs of chemical residue, remove and clean immediately. Cleaning the o-ring surface will improve the seal. Examine and adjust your process to prevent such occurrences. See section 4.1.3 Vacuum Chuck Wet Test.

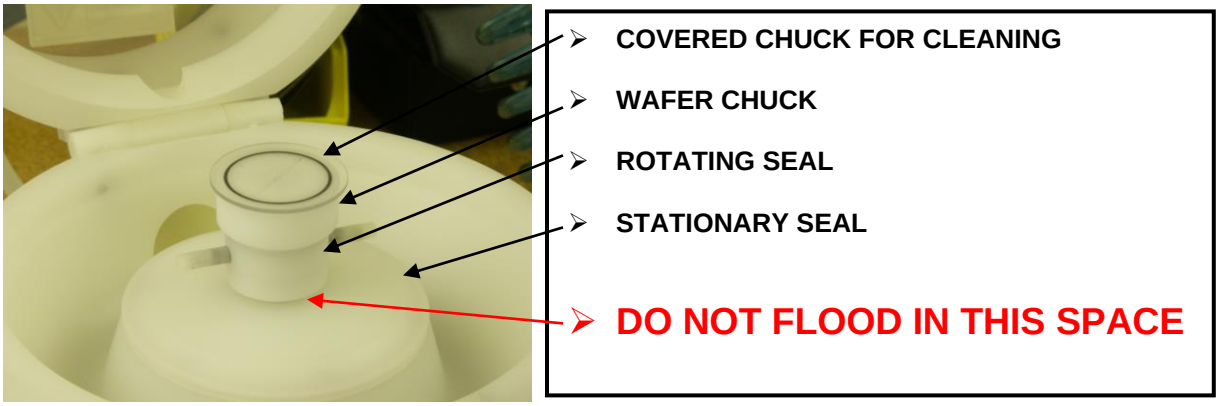


Figure 4-1

- **ALSO DO NOT FLOOD THE SPACE BETWEEN THE STATIONARY SEAL AND THE ROTATING SEAL. THIS CAN CAUSE LEAKEAGE INTO THE LOWER HOUSING CAUSING MOTOR OR ELECTRONICS DAMAGE**. See Fig. 4-1. Do not fill up and overflow the process bowl or spray excessive amount of chemistry into this space.

4.1 ERROR MESSAGES

The detection of abnormal operating conditions will cause the spin processor to shut down while in the process of running a program.

Depending on the spin processor's configuration these conditions are:

- Inability of spin processor motor to maintain the programmed speed parameters.
- Detection of vacuum loss to the wafer in systems equipped with a vacuum sensor, exhaust or N2 or CDA loss.

If these conditions occur, the display will indicate an error message in the "Run Mode" area of the display. The specific error codes are listed below.

CODE	DESCRIPTION	USER ACTION
Ready	Processor is ready to run	Press Start key
Running	Processor is running	Press Stop key to abort
Paused	Processor is in the paused state	Press the start key to resume running
Done	Processor completed a program	Open lid, remove substrate
Lid Open	Lid is open	Close lid to begin processing
Need Vacuum	Insufficient vacuum to begin processing	Increase vacuum supply to the processor / shut down processor
Need CDA	Purge Air pressure below setpoint. Will not start new process. Will shut down spin processor	Check "Seal Purge" hookup and pressure (SEC 3.2.3)
Abort	Processor aborted run	Check sensor action

Unit Hot	Motor temperature exceeded set point	Shut down spin processor
Low Vacuum	Vacuum below required minimum detected	Check vacuum source
Lost CDA	Purge Air pressure below setpoint. Will not start new process. Will shut down spin processor	Check “Seal Purge” hookup and pressure (SEC 3.2.3)
Sensor Warning	Sensor action detected	Check sensor action
Aborted by Sensor	Sensor action detected	Check sensor action
Waiting for Sensor	Sensor action detected	Check sensor action
Motor Fault	Motor controller stopped	Open lid / Press edit key to clear Shut down spin processor
Motor Link	No communication to motor controller	Open lid / Press edit key to clear Shut down spin processor
Motor High	High voltage detected by motor controller	Open lid / Press edit key to clear Shut down spin processor
Motor Low	Low voltage detected by motor controller	Open lid / Press edit key to clear Shut down spin processor
Motor Short	Motor detected a short condition	Open lid / Press edit key to clear Shut down spin processor
Control Hot	Motor controller stopped	Open lid / Press edit key to clear Shut down spin processor
Motor Fault	Motor controller stopped	Open lid / Press edit key to clear Shut down spin processor
Exhaust Low	Exhaust flow below lower set point	Check exhaust source Shut down spin processor
Exhaust Hi	Exhaust flow above upper set point	Check exhaust source Shut down spin processor
Low Speed	Failed to achieve target spin speed	Check for drag on chuck
Need Lower Exhaust	Exhaust flow too high	Check exhaust source Lower exhaust flow
Exhaust	Exhaust flow below lower set point	Check exhaust source

Low		Shut down spin processor
Need Exhaust	Exhaust flow too low	Check exhaust source Increase exhaust flow
Running Purge	Purge program running	Wait for purge program to stop before running next program.
Ready Purge	Purge program ready to run	Purge program is ready to run
Done Purge	Purge program completed	Purge program completed run
Abort Purge	Purge program aborted	Purge program aborted during run
Hot Purge	Motor hot while running purge program	Allow motor to cool before running next process
Vac Purge	Vacuum lost during purge program	Check vacuum source
CDA Purge	N2/CDA lost during purge program	Check N2/CDA source
Paused Purge	Purge program paused during run	Resume running by pressing the Start key
Local Port	Communication failure	Cycle power off and on. Try again if 1st is not successful

Certain errors will cause the motor to shut down. The timer will stop. Pressing the “Edit” key clears errors and pressing the “Start” key will restart the program.

If an error condition occurs, check the following:

- Record the time, conditions, program number, program step, and error code
- Determine if error is due to vacuum loss or motor speed. Correct any obvious problems
- If condition persists, contact Support at support@laurell.com or 215-699-7278 for assistance
- Vacuum source
- Seal Purge source pressure ≥60psig required
- Lock out power supply and turn chuck by hand making note of any excessive drag

Note: Mechanical intervention during rotation is not permitted with this equipment design and damage caused is not covered by our warranty.

4.1.1 VACUUM LOSS (ON UNITS EQUIPPED WITH VACUUM SENSOR ONLY)

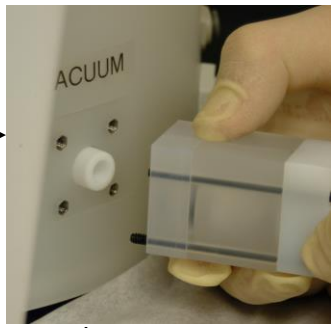
- Vacuum readings >20” Hg typically indicate sufficient vacuum hold is present. <15” Hg vacuum (factory setpoint) is normally considered insufficient to operate safely.

4.1.2 REMOVING, CLEANING AND INSTALLING THE VACUUM VALVE

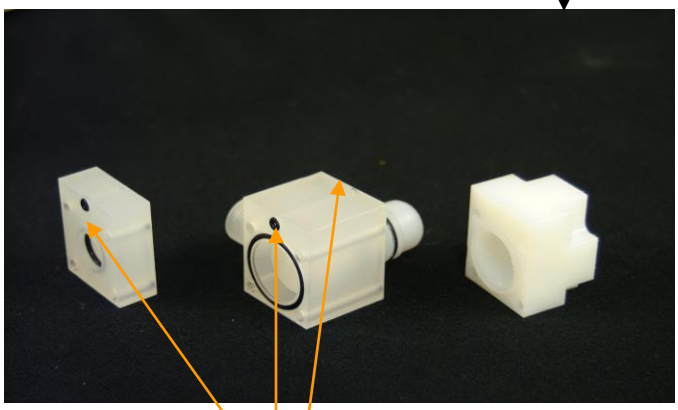
- The vacuum valve is an air operated pneumatic valve with an internal piston. Chemicals such as photoresist or polyimide, which enter into the vacuum path, can harden and prevent piston movement. The piston will fail to operate. The following procedure can be performed to clean the vacuum valve.

- **<u>NOTE: FOLLOW THIS PROCEDURE CLOSELY AND BE CAREFULL NOT TO LOSE THE 3 SMALL O-RINGS!</u>**

1 - Carefully remove the 4 socket head screws.

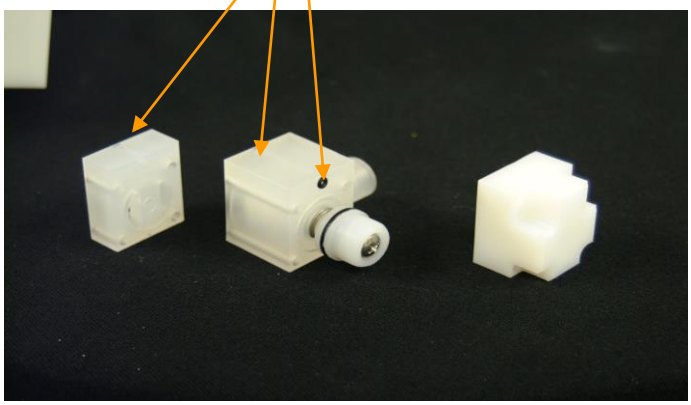


2 - Lift the 3 piece assembly away from the spinner using great care not to lose the small face o-ring.

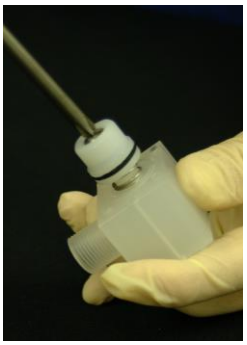


3 - The main assembly consists of 3 pieces and 3 small o-rings

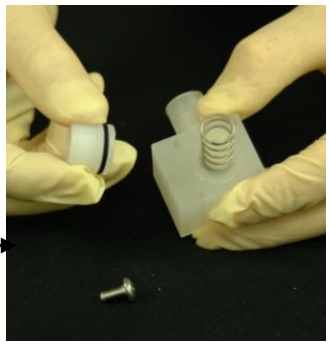
Small o-rings



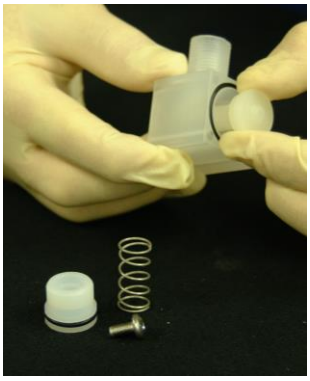
Backside view of the 3 piece assembly



4 - If you decide to disassemble the valve, first remove the bell screw.

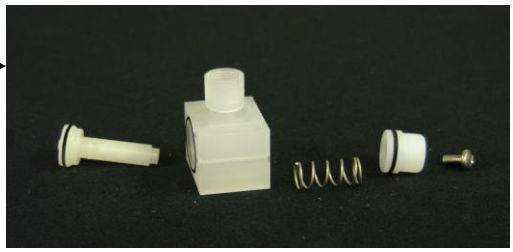


5 - After removing the screw lift off the bell and the actuation spring.

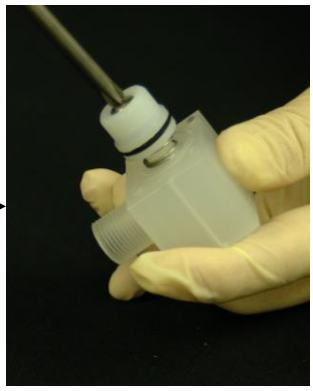


Keep track of all parts while cleaning, so as not to lose any for reassembly.

6 - Remove the piston by carefully sliding it out of the center assembly.



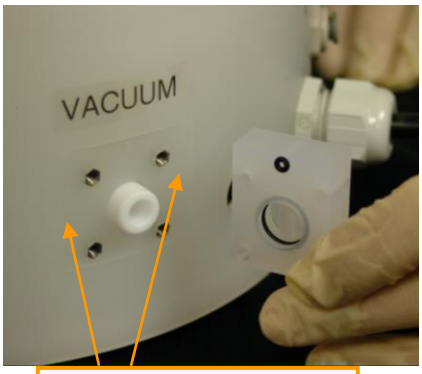
With the valve apart, hand clean with an appropriate solvent.



7 - Reassemble the center valve assembly in the same order that the valve was disassembled. If any o-rings or parts appear degraded, contact the factory.

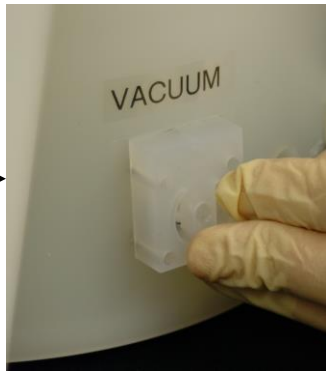
Do not soak the piston in acetone. Always hand clean the piston. All other parts can be soaked in the appropriate solvent compatible with the user's chemistry.

Never scrape the parts when cleaning! This will degrade the tolerances needed for proper operation.

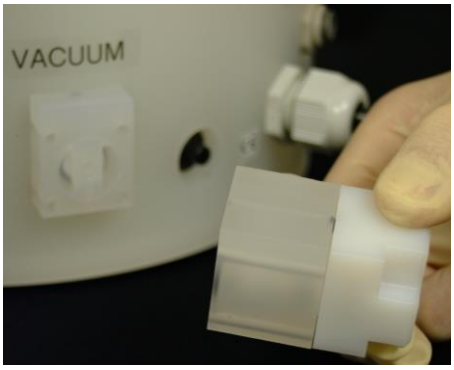


Vacuum Face Groove

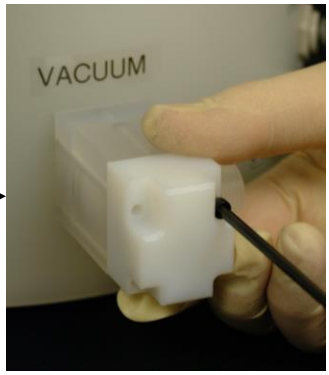
8 - Take the first section and carefully snap into vacuum face groove, making sure that the o ring stays fully seated.



9 - Hold first section into groove and attach the two other sections.



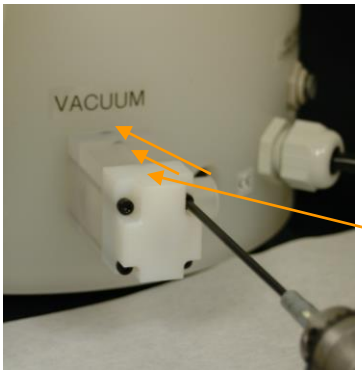
10 - Press the two remaining sections onto the first section, also making sure that the o-rings are firmly in place.



11 - With the entire assembly in tact, insert the first screw.

12 - Insert each screw loosely. **DO NOT** totally tighten until all four screws have been inserted.

13 - Tighten screws firmly, but do not over tighten. When tightening the screws, work in a criss-cross pattern.



14 - Make sure screws are secure, but not over tightened.

Also check to see if all o-rings are in place.

4.1.3 VACUUM CHUCK WET TEST

- To prevent chemicals from entering into the vacuum path, the chuck and o-ring surface must be clean and defect free. A chuck wet test can be performed to check the integrity of the o-ring seal. See figure 4-2. Using a clear substrate, place the wafer on the chuck and press the vacuum key. Using a bottle of DI water spray water around the periphery of the substrate where it meets the chuck while manually rotating the chuck. Check to see if there is any leakage across the o-ring.

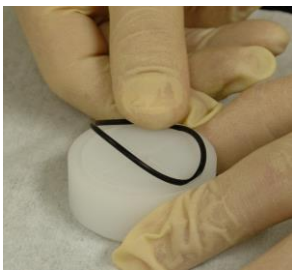
- If there is no leakage, the chuck is ok to use.

- If leakage occurs, inspect the chuck and o-ring for defects. If the chuck is damaged it is recommended that it is replaced with a new Laurell chuck. If the chuck is defect free, wipe the chuck and o-ring surface with acetone or an appropriate cleaner. The cleaning solution or solvent must be compatible with the o-ring material. Repeat wet test. If wiping down the chuck and o-ring fails to prevent leakage remove and clean the o-ring. See section 4.1.4.

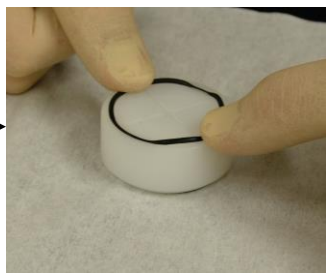
Figure 4-2
Wet Testing 1.75" and 200mm Chuck

4.1.4 CLEANING AND REPLACING THE CHUCK O-RING

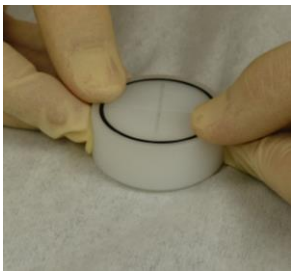
To remove the o-ring from the chuck, insert a thin blunt instrument or o-ring puller into the o-ring groove and pull upward. Be careful not to damage the o-ring or the chuck. Inspect the o-ring carefully. If the o-ring is cut, nicked or scratched it must be replaced. Contact Laurell for part number (see section 4.1.4.2 for o-ring info.) and ordering information. If the o-ring is in good condition, wipe it with a cleaner and insert it back into the o-ring groove. Use the following procedure to insert the o-ring.



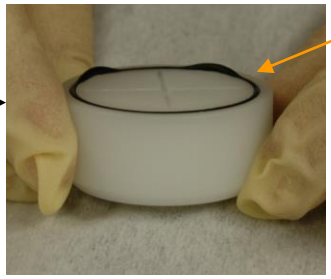
1 - Carefully press the o-ring into the chuck face groove. Do so by pressing in a small section at a time.



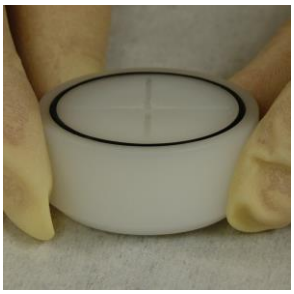
2 - After the small sections have been pressed in, carefully press around the chuck until the o-ring is fully seated.



3 - The o-ring should lay flat in the groove.



4 - There should not be any areas that do not lay flat. If this occurs, continue to press around the chuck until they are gone.



5 - Make a final check to be sure that the o-ring is entirely seated. Perform a chuck wet test to ensure o-ring sealing integrity.

4.1.4.1 O-RING COMPOSITION, USES & RECOGNITION

We have determined that O-rings are the best way to insure a tight seal between the chuck face and a non-porous substrate. The O-ring provides a gripping as well as a sealing interface to our vacuum chuck and is normally provided in two standard materials, Viton and EPDM.

The type O-ring which is installed on your chuck has been determined by the chemicals which were specified when the spin processor was quoted. EPDM O-rings are most commonly used for solvents while Viton is the choice where acids or Toluene are present. You should determine before using the equipment what chemical you will be using as well as the type O-ring which is installed. A supply of both type of o-rings is shipped with each system in properly labeled clear re-closable bags.

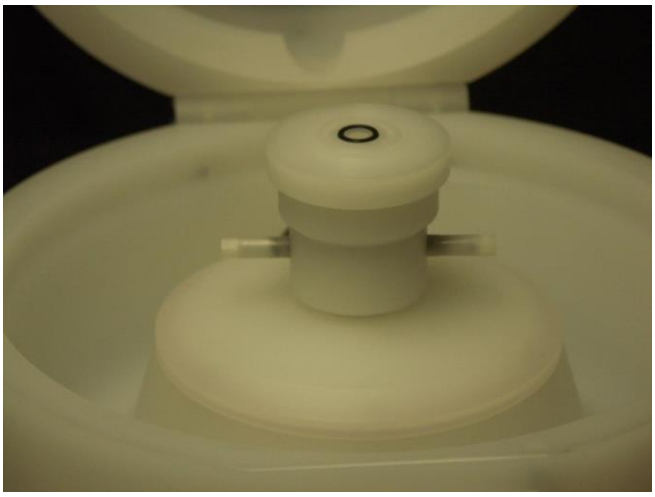
If O-rings become intermixed, an EPDM O-ring can usually be identified by the dull finish as opposed to the relatively smooth texture of the Viton material (some Viton O-rings are brown in color).

The vacuum chuck's O-ring seal should NEVER deflect (> 0.002" / 50 microns) or break a SEMI standard Silicon wafer. If you experience substrate deflection or breakage this is not a design issue but this is not normal so you **MUST STOP** immediately and contact our support department for application assistance. If you have thin or fragile material, we have developed successful approaches to eliminate or minimize deflection and breakage.

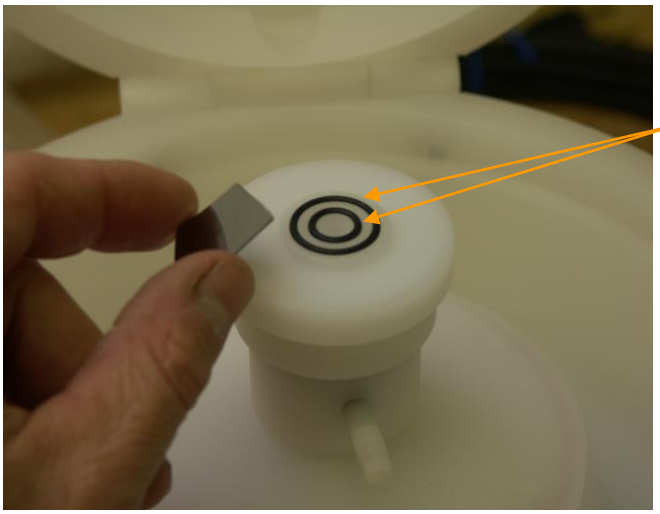
When using the fragment adapter, it is recommended that only one size O-ring should be used at a time. The simultaneous use of O-rings can add more grip and support to the substrate but if not, absolutely identical thickness can cause a vacuum leak or even cause the material to break. When both O-rings are used, an improper seal may develop allowing chemical to enter the vacuum path (a

leading cause of machine failure). **Important:** The substrate must always fully cover the face of the O-ring being used.

Note: If you notice a black residue on the O-ring or marking of the holding surface either the O-ring is dirty or the material is being damaged by the process chemistry. **STOP** immediately especially if fluid passes the sealing surface after being under vacuum.



- **The fragment adapter must be installed with a single o-ring for fragments.**
- **The inside o-ring is for fragments ≥ 11mm x 11mm.**
- **The outside o-ring is for fragments ≥ 20mm x 20mm.**
- **Only 1 size o-ring should be installed in the adapter at any one time.**



- **Improper installation of two simultaneous o-rings on the fragment adapter.**

4.1.4.2 O-RING PART LIST FOR FULL/EDC – xxNPP/TFM

LTC P/N	O-Ring Location	Qty	AS568B #	Material	Durometer	Compatibility
6200 2335	1.75” NPP/TFM LP Vacuum Chuck Face	1	028	EPDM	50	Solvents
6200 2336	1.75”NPP/TFM LP Vacuum Chuck Face	1	028	Viton	50	Acids & Toluene
6200 2363	100mm NPP/TFM LP Vacuum Chuck Face	1	042	EPDM	50	Solvents
6200 2364	100mm NPP/TFM LP Vacuum Chuck Face	1	042	Viton	50	Acids & Toluene
6200 2295	125mm NPP/TFM LP Vacuum Chuck Face	1	045	EPDM	50	Solvents
6200 2296	125mm NPP/TFM LP Vacuum Chuck Face	1	045	Viton	50	Acids & Toluene
6200 2297	150mm NPP/TFM LP Vacuum Chuck Face	1	159	EPDM	50	Solvents
6200 2298	150mm NPP/TFM LP Vacuum Chuck Face	1	159	Viton	50	Acids & Toluene
6200 2299	200mm NPP/TFM LP Vacuum Chuck Face	1	167	EPDM	50	Solvents
6200 2300	200mm NPP/TFM LP Vacuum Chuck Face	1	167	Viton	50	Acids & Toluene
6200 0251	NPP/TFM LP Vacuum Chuck Base – All Std. Chucks	1	024	EPDM	50	Solvents
6200 0046	NPP/TFM LP Vacuum Chuck Base – All Std. Chucks	1	024	Viton	50	Acids & Toluene
6200 2235	1.75” NPP/TFM Micro Fragment Adapter	1	001.5	EPDM	70	Solvents
6200 2236	1.75” NPP/TFM Micro Fragment Adapter	1	001.5	Viton	70	Acids & Toluene
6200 0274	1.75” NPP/TFM Mid Size Fragment Adapter	1	005	EPDM	70	Solvents
6200 0273	1.75” NPP/TFM Mid Size Fragment Adapter	1	005	Viton	70	Acids & Toluene
6200 0098	1.75” NPP/TFM Fragment Adapter - Small	1	011	EPDM	70	Solvents
6200 0099	1.75” NPP/TFM Fragment Adapter - Large	1	016	EPDM	70	Solvents
6200 0100	1.75” NPP/TFM Fragment Adapter - Small	1	011	Viton	70	Acids & Toluene
6200 0101	1.75” NPP/TFM Fragment Adapter - Large	1	016	Viton	70	Acids & Toluene
6200 2240	Pneumatic Vacuum Valve	3	003	EPDM	70	Solvents
6200 2134	Pneumatic Vacuum Valve	1	012	EPDM	70	Solvents
6200 0257	Pneumatic Vacuum Valve	1	014	EPDM	70	Solvents
6200 0099	Pneumatic Vacuum Valve	1	016	EPDM	70	Solvents
6200 0277	Pneumatic Vacuum Valve	1	020	EPDM	70	Solvents

6200 2397	Drain	1	031	EPDM	70	Solvents
6200 2121	Drain	1	031	Viton	70	Acids & Toluene
6200 0301	Down Flow Drain Adapter	1	034	EPDM	70	Solvents
6200 0302	Down Flow Drain Adapter	1	034	Viton	70	Acids & Toluene
6200 2232	Down Flow Drain Adapter – Side Window	1	039	EPDM	70	Solvents
6200 2231	Down Flow Drain Adapter - Side Window	1	039	Viton	70	Acids & Toluene
6200 0044	Stationary Seal	1	155	Teflon Encapsulated Silicone		Acids / Solvents
6200 0265	Motor Shaft – Standard Motor	1	017	Teflon Encapsulated Silicone		Acids / Solvents
6200 0265	Motor / Vacuum Coupling – Standard and HPD2	2	110	EPDM	70	Solvents
6200 0049	Upper Housing Lid – 6NPP/TFM	1	170	Teflon Encapsulated Silicone		Acids / Solvents
6200 0053	Upper Housing Lid – 8NPP/TFM	1	CALL	Teflon Encapsulated Silicone		Acids / Solvents
6200 0557	Upper Housing Lid – 23NPP/TFM	1	CALL	Teflon Encapsulated Silicone		Acids / Solvents
6200 2270	Upper Housing Lid – 15NPP/TFM	1	CALL	Teflon Encapsulated Silicone		Acids / Solvents
6200 2117	HPD2 Motor Adapter	1	032	EPDM	70	Solvents
6200 2118	HPD2 Motor Adapter	1	032	Viton	70	Acids & Toluene
6200 2217	Triple Labyrinth Seal	1	029	EPDM	70	Solvents
6200 2216	Triple Labyrinth Seal	1	029	Viton	70	Acids & Toluene
6200 0098	Manifold - Output Injector	1	011	EPDM	70	Solvents
6200 0100	Manifold - Output Injector	1	011	Viton	70	Acids & Toluene
6200 0355	Dome Injector Assembly	1	030	Teflon Encapsulated Silicone		Acids / Solvents
6200 0257	Locking Nut – Dome Diffuser	1	014	EPDM	70	Solvents
6200 2335	HPD2 - 1.75” NPP/TFM LP Vacuum Chuck Face	1	028	EPDM	50	Solvents
6200 2336	HPD2 - 1.75” NPP/TFM LP Vacuum Chuck Face	1	028	Viton	50	Acids & Toluene
6200 2363	HPD2 - 100mm NPP/TFM LP Vacuum Chuck Face	1	042	EPDM	50	Solvents
6200 2364	HPD2 - 100mm NPP/TFM LP Vacuum Chuck Face	1	042	Viton	50	Acids & Toluene
6200 2295	HPD2 - 125mm NPP/TFM LP Vacuum Chuck Face	1	045	EPDM	50	Solvents
6200 2296	HPD2 - 125mm NPP/TFM LP Vacuum Chuck Face	1	045	Viton	50	Acids & Toluene
6200 2297	HPD2 - 150mm NPP/TFM LP Vacuum Chuck Face	1	159	EPDM	50	Solvents
6200 2298	HPD2 - 150mm NPP/TFM	1	159	Viton	50	Acids & Toluene

	LP Vacuum Chuck Face					
6200 2299	HPD2 - 200mm NPP/TFM LP Vacuum Chuck Face	1	167	EPDM	50	Solvents
6200 2300	HPD2 - 200mm NPP/TFM LP Vacuum Chuck Face	1	167	Viton	50	Acids & Toluene

Note: to find out actual physical dimensions of any size o-ring, use the As568B#.as a reference. Many web site selling o-rings may list this information. One such site is O-rings West **http://www.oringswest.com**

4.1.5 MOTOR OPERATION

- Manually turn chuck and check for free movement and no binding. The motor should never be overloaded or held from turning.
- If RPM display shows zeroes when the chuck is actually spinning, this would indicate failure of the RPM sensor and a motor fault error will appear.

4.1.6 CALIBRATION MODE

Calibration is used to adjust rotation performance by allowing fine-tuning of the motor controller for large changes in chuck and substrate mass, as well as motor efficiency corrections in time. This is performed at the factory and is normally not required again.

NOTE: Contact the factory for detailed instruction

4.2 REPLACEMENT PARTS

Please visit our web site, http://2k10.laurell.com/support/replacement-parts.php for replacement parts and repair kit information.

4.3 WARRANTY

Warranty 1-year parts & labor - unit must be returned postpaid to factory. No other warranties express or implied. Manufacturer makes no application claims. Failures due to misuse or abuse, disassembly, modification or for any other reason out of the control of the manufacturer voids all warranties. No returns permitted without authorization from the factory. Note: The Vacuum Pump option is separately warranted by the manufacturer for 1 year. All proposals are subject to final company approval before order acceptance.

SECTION 5 – APPENDIX

5.1 DRAWINGS

Dimensional drawings of all of our systems can be found at

http://www.laurell.com/spin-coater/models.php