INSTALLATION, OPERATIONS, AND MAINTENANCE MANUAL FOR NUVAC MODEL

MRP-201 ELC

GALISO PART NUMBER 200-51-3026

GALISO® INCORPORATED
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1.0 INTRODUCTION

Galiso Incorporated/Nuvac Innovations would like to thank you for your investment and participation in this exciting new technology. Hot Gas Recirculation and Hot Gas Sweep, HGRS, is a new solution to an old problem and is the state of the art in chamber vacuum acquisition and contamination removal. The patented and patent pending HGRS systems utilize a viscous flow approach to eliminating both moisture and particulate chamber contaminants rather than the less efficient, more costly high vacuum molecular flow technology. A simplified schematic of the HGRS process is shown in figure 1-1, below.

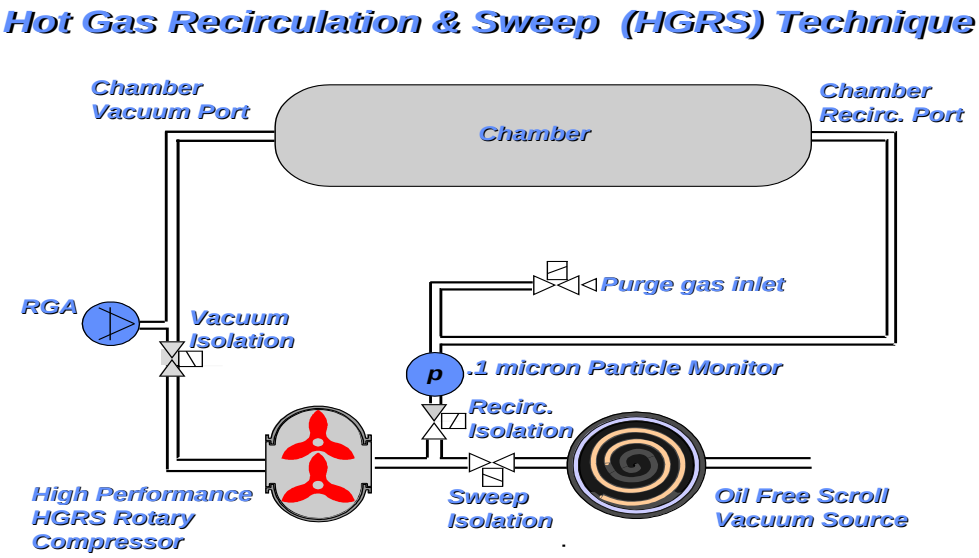

Figure 1 - 1 HGRS Process Schematic

The MRP-201 ELC incorporates all of the necessary HGRS process components into a single equipment module. It is designed to be a portable tool connected to your chamber only when necessary for scheduled service. The process equipment, blowers, valves and gauges are all controlled by a micro-controller which stores the process control program. In addition, the Galiso/Nuvac proprietary System Control And Monitoring Software provides the user with an extremely flexible, custom configured, fully automated monitoring and control system.

1.1 Scope of Manual

This manual covers the installation, operation and maintenance of the MRP-201 ELC module. Instructions for using the Process Control Recipe Editor(PCRE), Visual Control System(VCS), and Data Acquisition System(DAS) programs are contained in separate Galiso/Nuvac manuals.

1.0 INTRODUCTION, continued

Figure 1-2, below, represents a complete system installation that is ready to run an HGRS process.

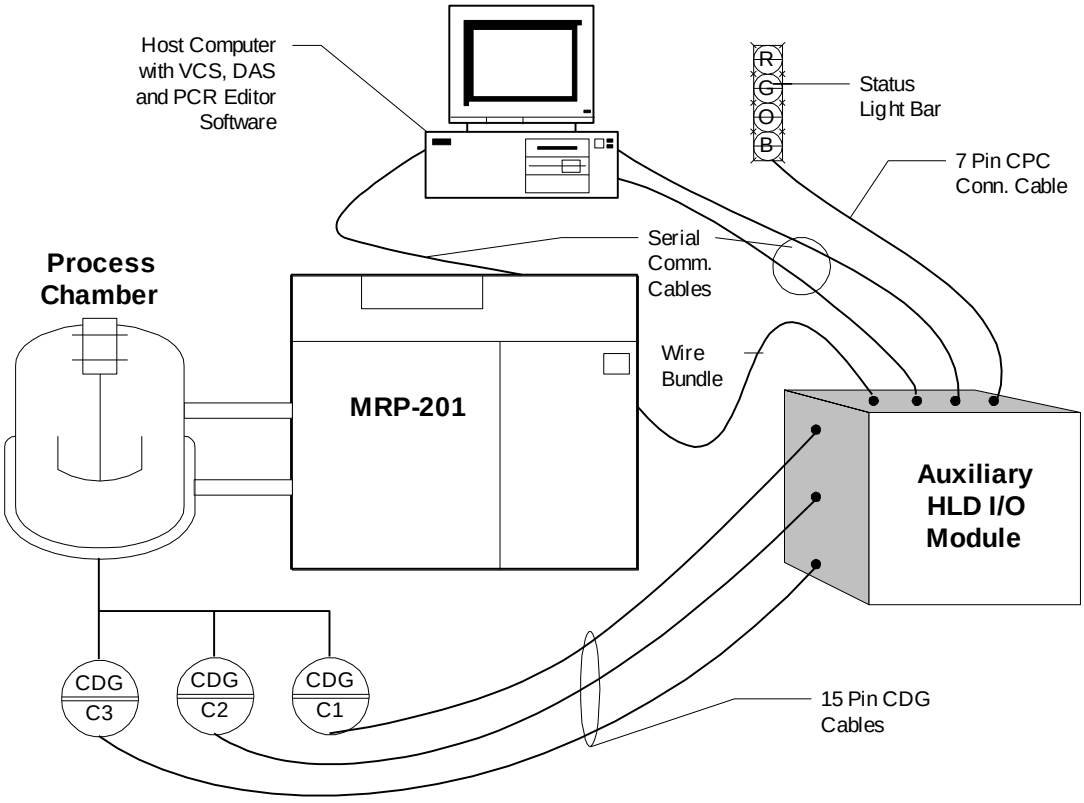

Figure 1 - 2 HGRS System

Galiso Incorporated and Nuvac Innovations thanks you for selecting the MRP-201 ELC product. If there is any way we can be of assistance in the use or care of this equipment, please contact us at (800) 854-3789 or (970) 249-0233. We would like to solicit your comments and suggestions to help us further refine and improve our products.

2.0 PRODUCT SPECIFICATIONS

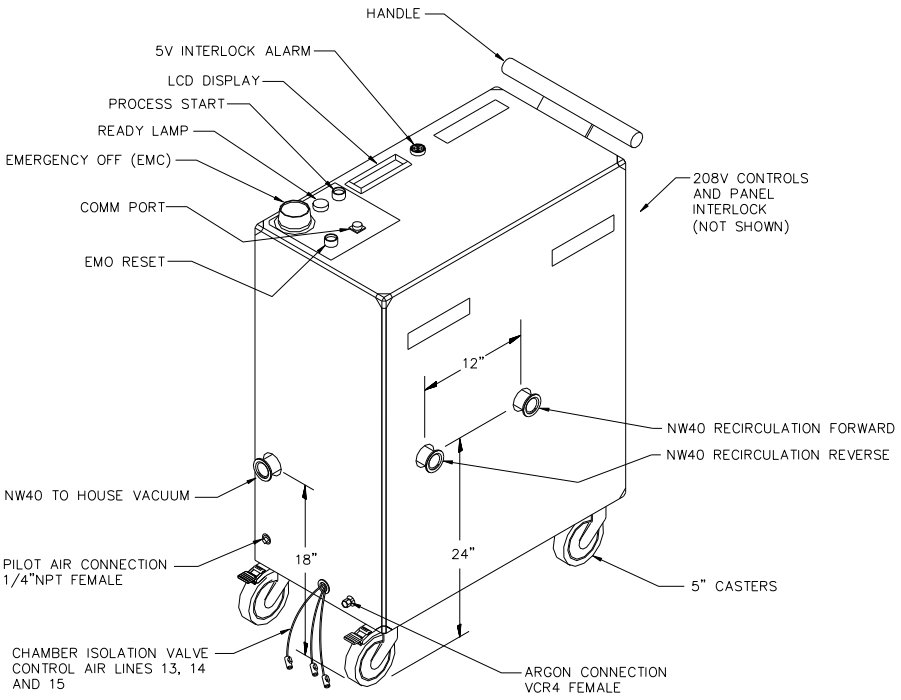

Figure 2 - 1 MRP-201; P/N 200-51-3026

Outside Dimensions: Approx. 43"H x 16"W x 30"L (109.2cm. x 40.6cm x 76.2cm)

Electrical Requirements: 208/230V 3-phase, 21.7A @ 60 Hz, 27.1A @ 50Hz, Max. Branch Circuit: 40 Amps

Argon Requirements: 20 CFM @ 20 psi (1.38 Barr) (1.46 Kg/Sq.cm)

Air Requirements: 1.0 CFM Control Air @ 80 psi (5.52 Barr) (5.62 Kg/Sq.cm)

Vacuum Requirements: 18 CFM @ Atm., 100 mTorr base pressure,

Pumping Speed: 100 CFM (47.2 Liters/sec.) at atmosphere (Recirc Mode)

Equipment Options: See page 2-2

2.0 PRODUCT SPECIFICATIONS, continued

2.1 Equipment Options

Several equipment options are available to increase the functionality of the MRP unit. Available options include:

2.1.1 Helium Leak Detector Option

The Helium Leak Detector option provides Helium leak detection capability integral to the MRP unit when the VCS software is used. As such, the MRP unit can be used as a stand alone leak checker as well as a chamber qualification tool. The performance specifications for the HLD option are:

- Sensitivity — $2x10^{-10}$ atm cc/sec He
- Response Time — 0.5 sec. He
- Power Req'd — 3 Amps @ 115 VAC
- Operating Temp. — Turbo Pump - 130 °F (max.)
Electronics - 167 °F (max.)
- Operating Press. — Less than 5 Torr (HLD-Lo)
Lessthan 500 mTorr (HLD-Hi)

See HLD addendum for additional information on the leak detector option.

2.1.2 Particle Monitoring Option

This MRP option provides particle monitoring capability when the VCS software is used. General particle monitoring performance specifications are:

- Sensitivity — 0.2 μm (minimum detectable size)
- Count rate — 1,000 particles per second (max.)
- Power Req'd — 0.2 Amps @ 120 VAC
- Operating Press. — $\geq 10^{-8}$ Torr
- Operating Temp. — Controller - 0 to 50 °C
Sensor - Up to 200 °C

See the particle monitoring addendum for additional information on this option.

3.0 Hazards, Precautions and Dangers

Nuvac Innovations has designed the MRP-201 ELC to minimize the need to conduct calibrations, testing or maintenance on equipment that may be energized and to minimize work that must be performed on components near exposed energized circuits. However, there will be instances when work must performed while electrical equipment is energized. In this manual, the five SEMI-S2 conditions are used to identify the type of electrically energized condition(s) which may exist:

- **Type 1**- Equipment is fully de-energized (electrically cold).
- **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 RMS, +2.2 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, +2.2 volts peak, 240 volt-amps, 20 Joules, or radio frequency (rf) is present.
- **Type 5** - Equipment is energized. Measurements and adjustment require physical entry into the equipment, or equipment configuration will not allow the use of clamp on probes.

Instances where maintenance, calibration or other work relates to one of the above Types will be noted in the appropriate section of this manual.

3.1 Warning labels

In general, any potential hazards, precautions and dangers associated with the MRP-201 ELC module are clearly identified with warning labels. The following pages provide the location, a description and illustration of each of the labels used.

3.1.1 Voltage Danger Label

The locations marked designate areas within the MRP-201 ELC that are powered with 208/230 volts of electricity. Power **MUST** be **OFF** and disconnected from the primary power source when ever possible before servicing. Caution should be used at all times while the unit is on or connected to a power source. Failure to observe proper safety precautions could result in severe injury or death.

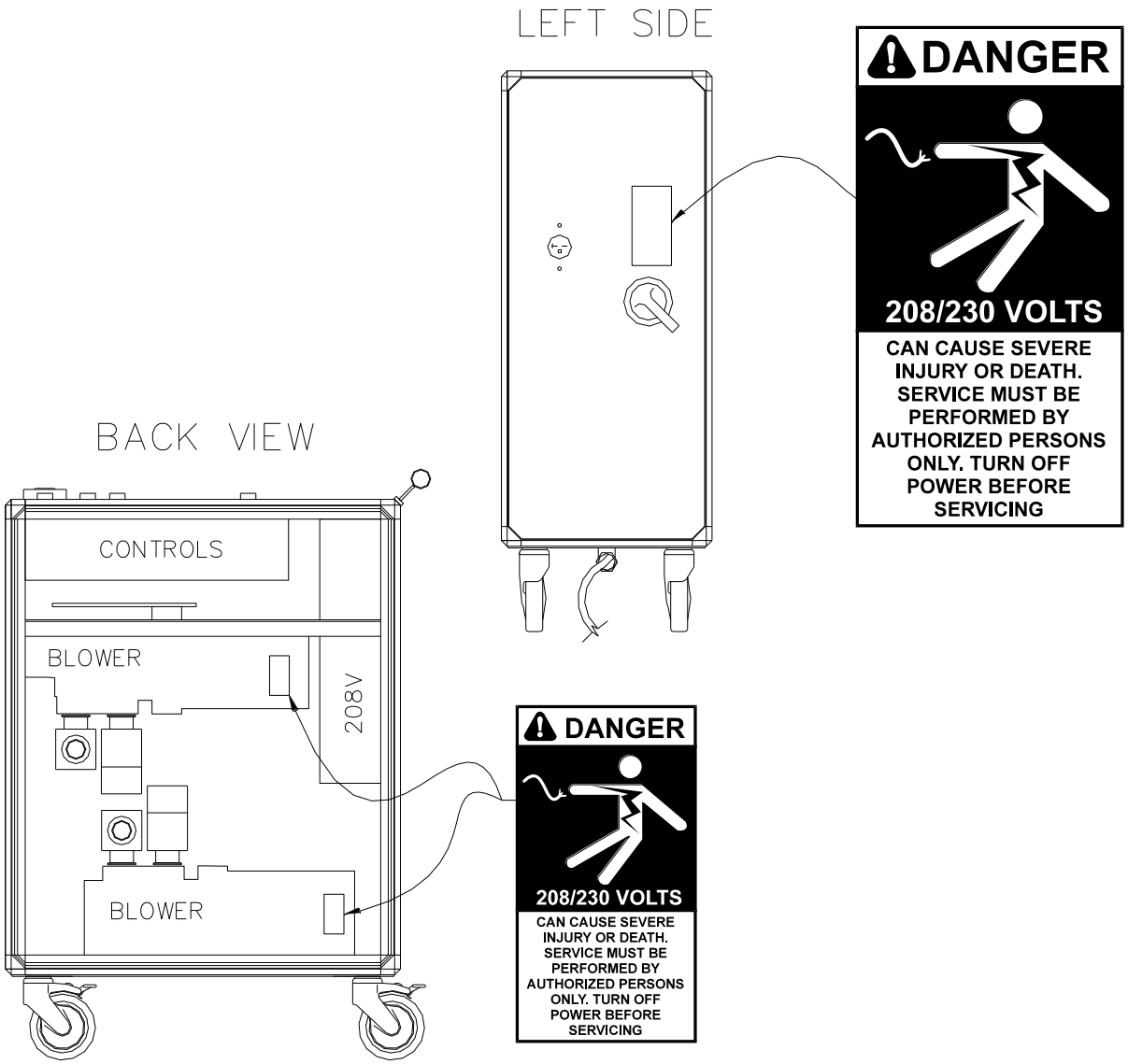

Figure 3 - 1 Voltage Danger Label(s)

3.1.2 Flammable, Volatile, Toxic or Corrosive Danger Label

The use of toxic, flammable, or corrosive gases with the MRP-201 ELC or the use of this equipment under flammable, volatile, corrosive or toxic conditions is an extreme danger to individuals and could cause severe injury or death. The MRP 201 ELC should not be connected to any chamber that uses the gas types mentioned above. Use of the above gas types, or use of the machine in the above conditions, will seriously damage the equipment.

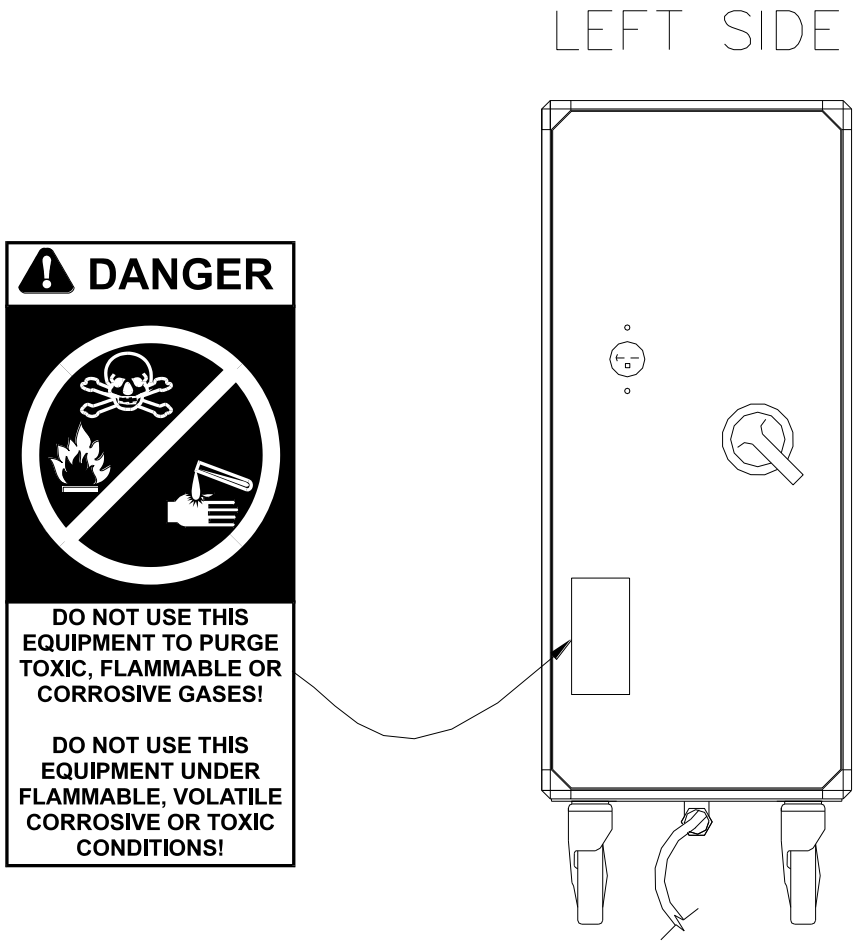

Figure 3 - 2 Flammable, Volatile, Toxic or Corrosive Danger Label

3.1.3 Do Not Operate Before Reading Manual Warning Label

Read the entire Installation, Operation, and Maintenance Manual before attempting to install or operate the NUVAC INNOVATIONS MRP-201 ELC. NUVAC INNOVATIONS is not responsible for damage or injury caused by unsafe use, improper maintenance, or improper application of this unit. Use of this equipment by individuals unfamiliar with the information provided in the manual could cause serious injury and/or damage to the equipment.

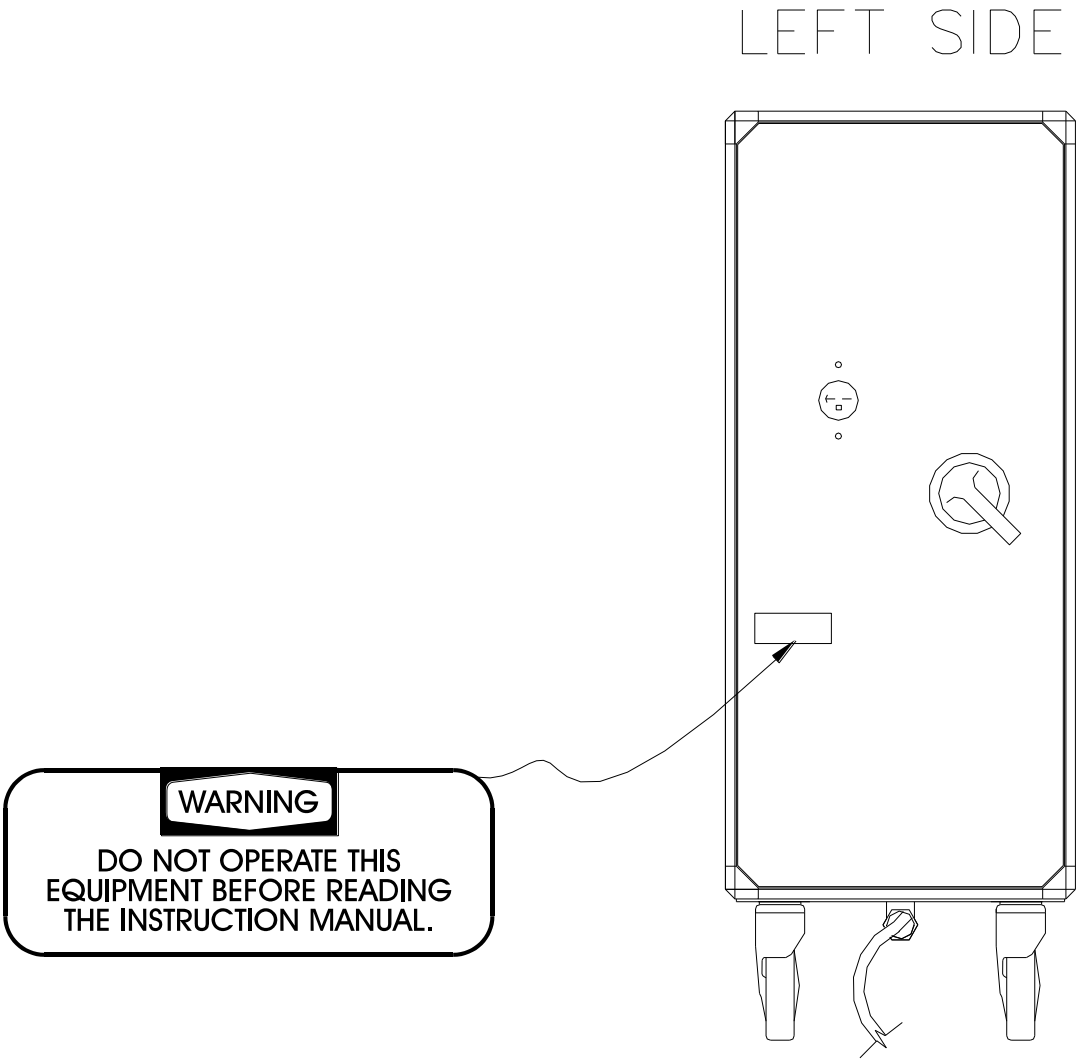

Figure 3 - 3 Do Not Operate Before Reading Manual Warning Label

3.1.4 Fuse Warning

Fuses must be replaced ONLY with the same type and rated fuse. Failure to comply with this warning could cause serious damage to the equipment and possible injury.

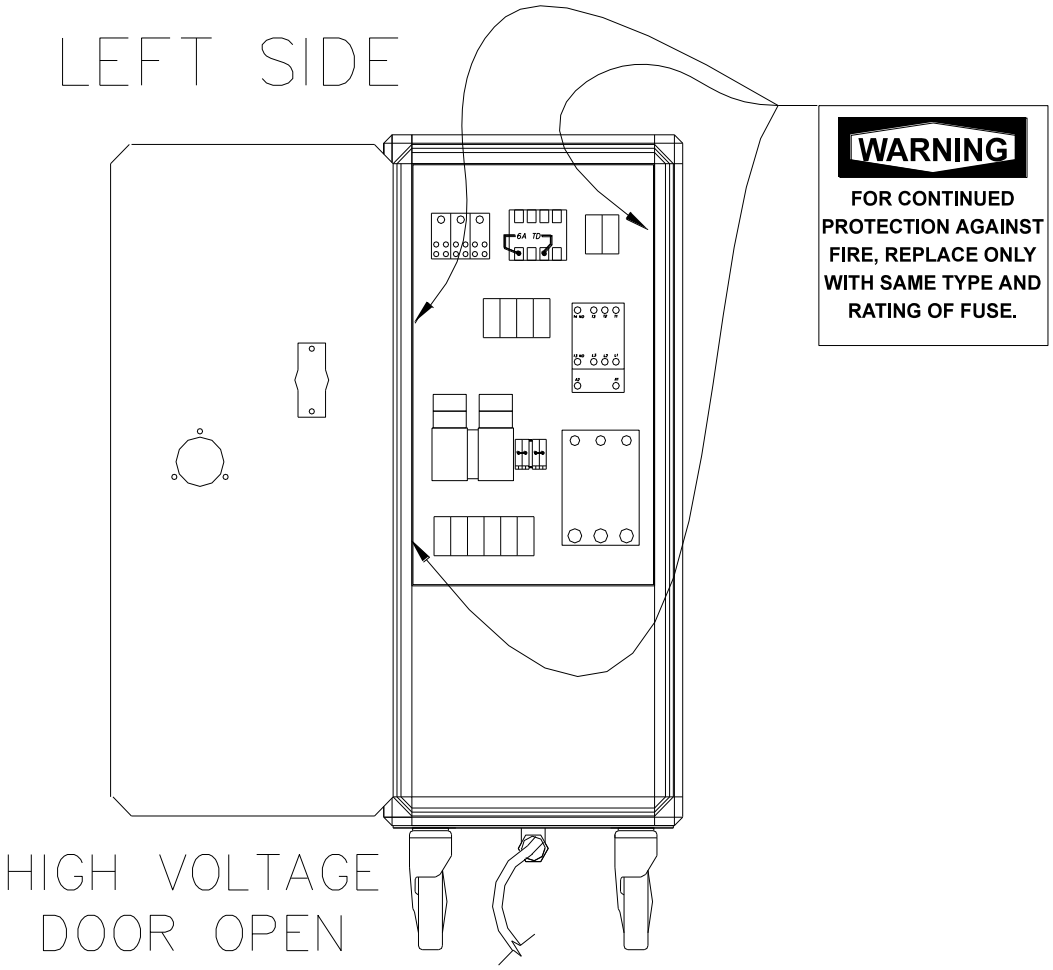

Figure 3 - 4 Fuse Warning Label

3.1.5 Possibly Hot Caution Label

Various surfaces may reach temperatures in excess of 60° C while the MRP-201 ELC is in operation. Most of the potentially hot surfaces are internal to the MRP-201 ELC module Only the Recirculation Manifolds will be exposed during normal operation. Contact with these surfaces while the unit is running could cause injury. Allow the system to cool before touching.

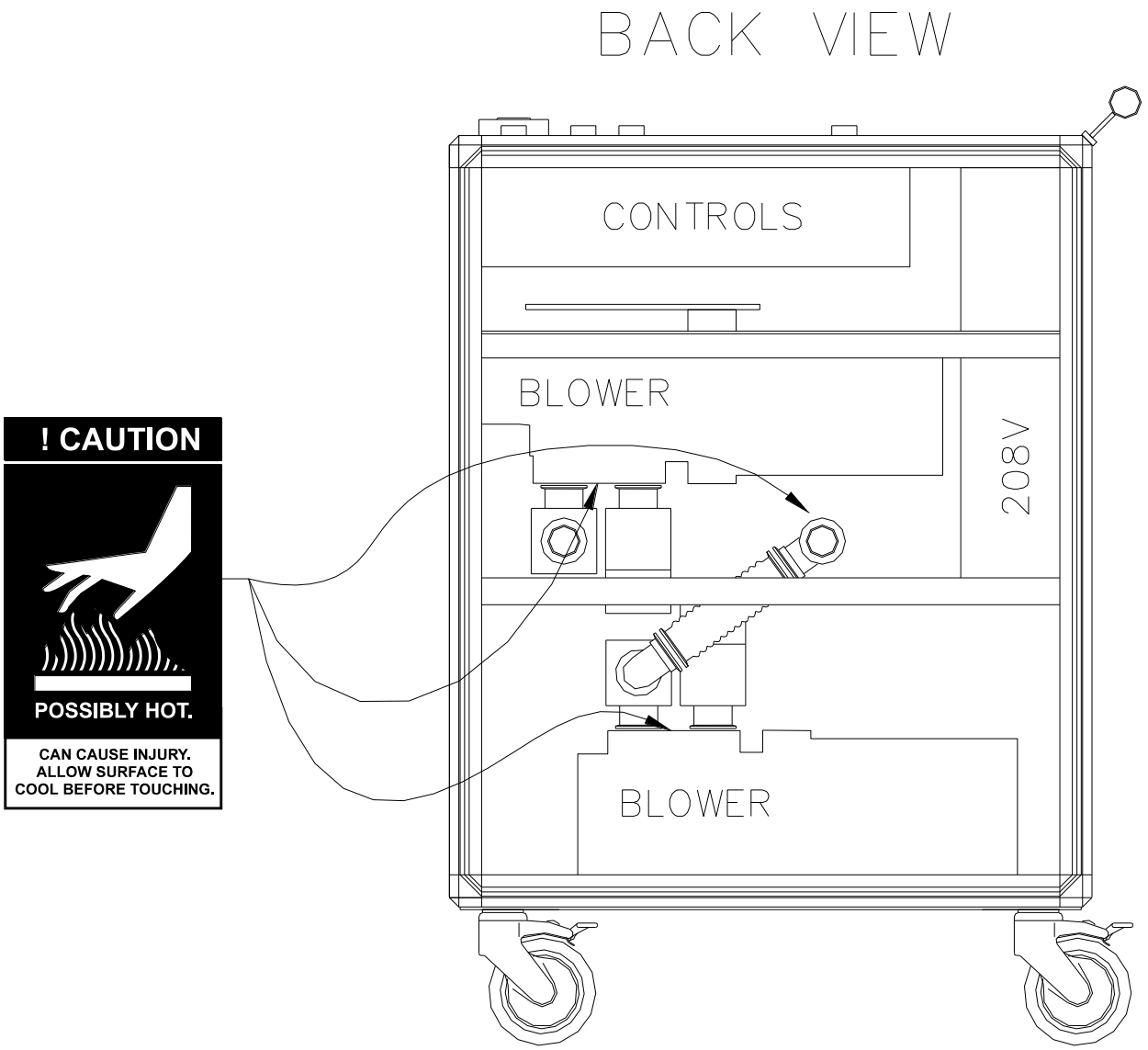

Figure 3 - 5 Possibly Hot Label

3.1.6 Heavy Caution Label

Units designated with these labels weigh in excess of 35 pounds. If either of the Blower/Motor units need to be removed for servicing or replacement, a mechanical lifting device must be used. Manual lifting of these units could result in injury.

Blower / Motor Unit

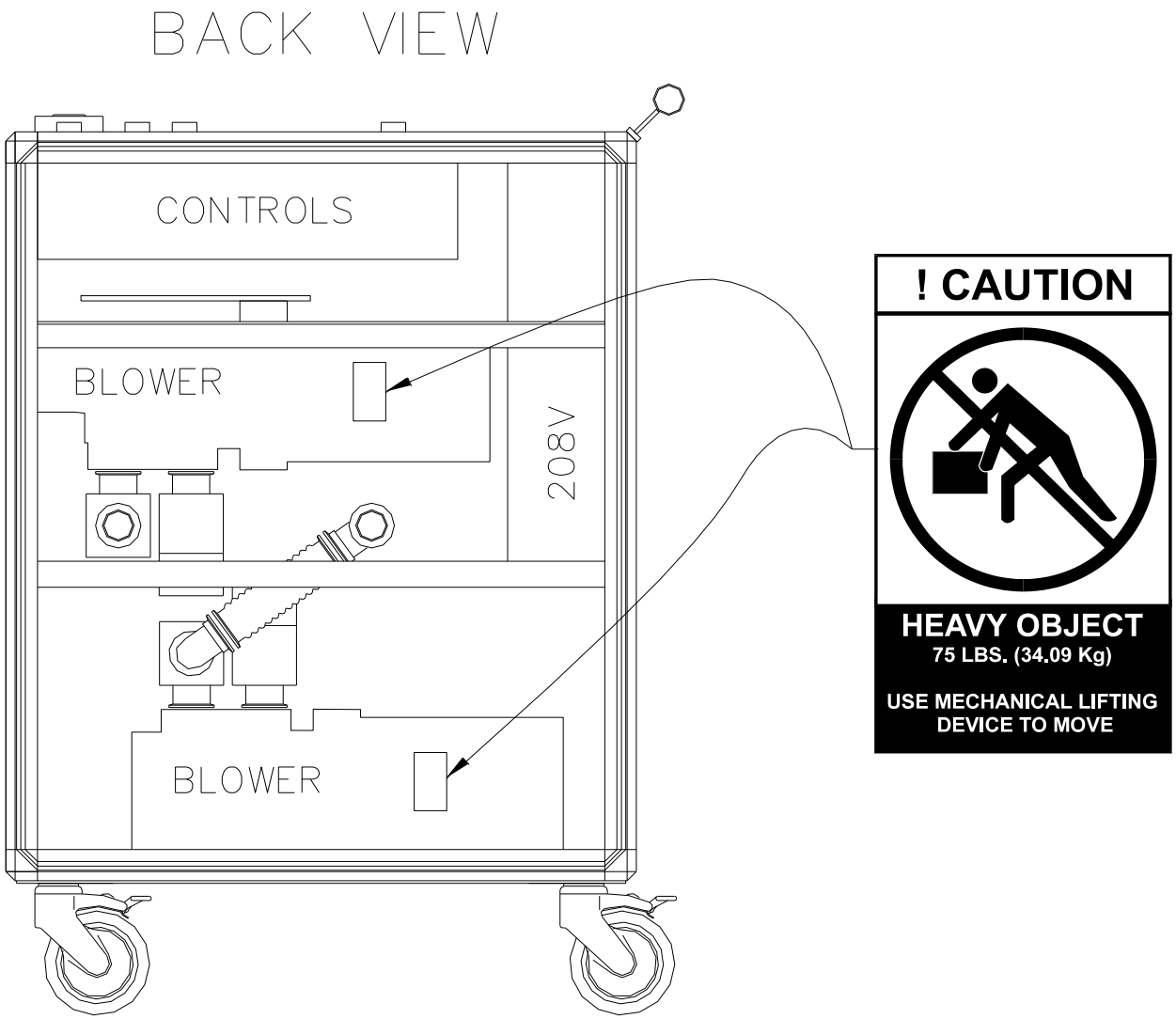

Figure 3 - 6 Heavy Caution Label

3.1.7 Ground Symbol Label

Figure 3-7 shows the location of the main grounding terminal on the MRP-201 ELC.

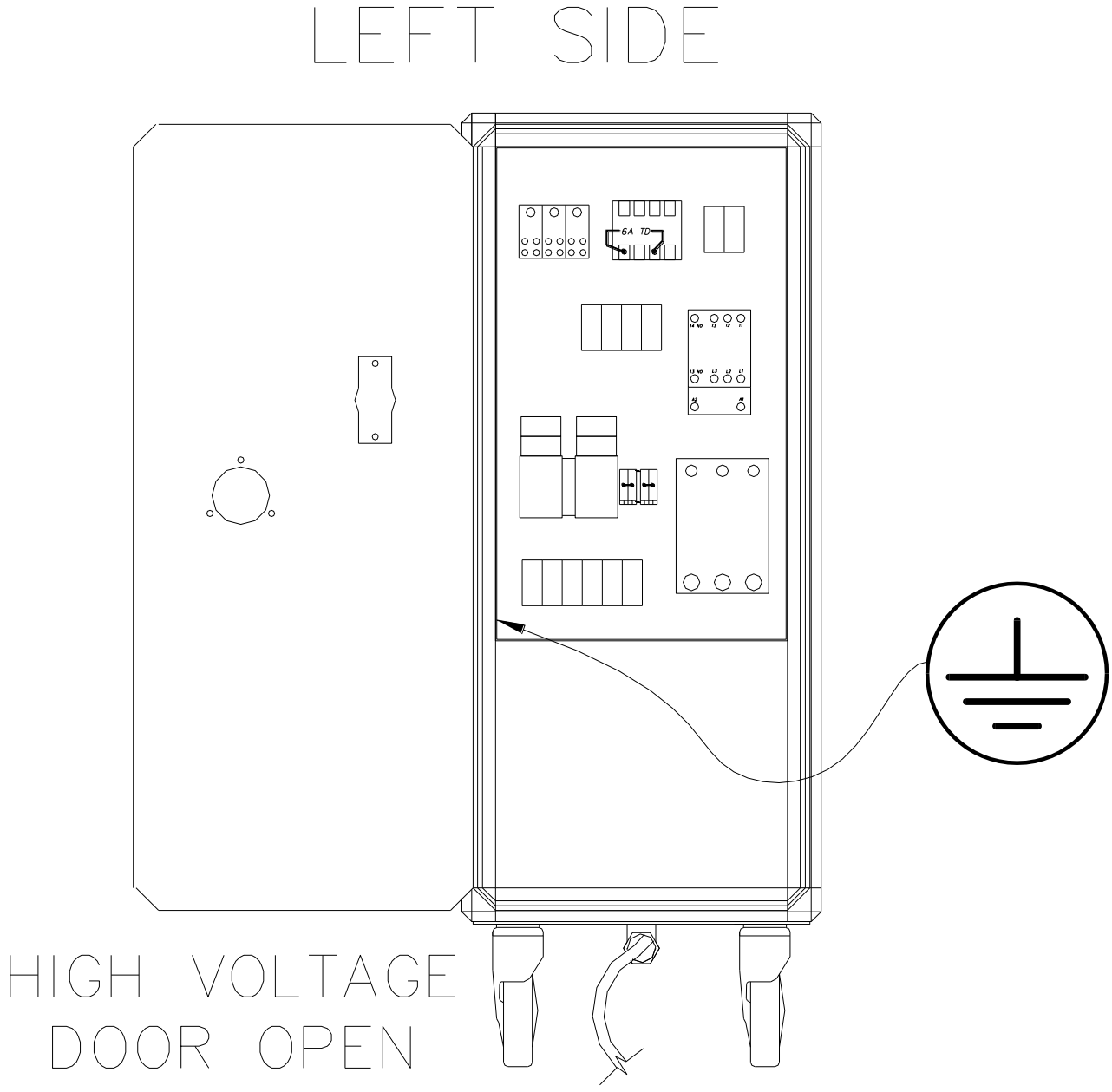

Figure 3 - 7 Ground Symbol Label

3.1.8 Serial Number Plate

The Serial Number Plate provides information pertaining to the MRP-201 ELC. Model Number, Serial Number, Voltage, Amperage, Phase, AIC and Wiring Diagram Part Number are provided. Nuvac Innovations product warranty will be voided if this plate is removed or defaced.

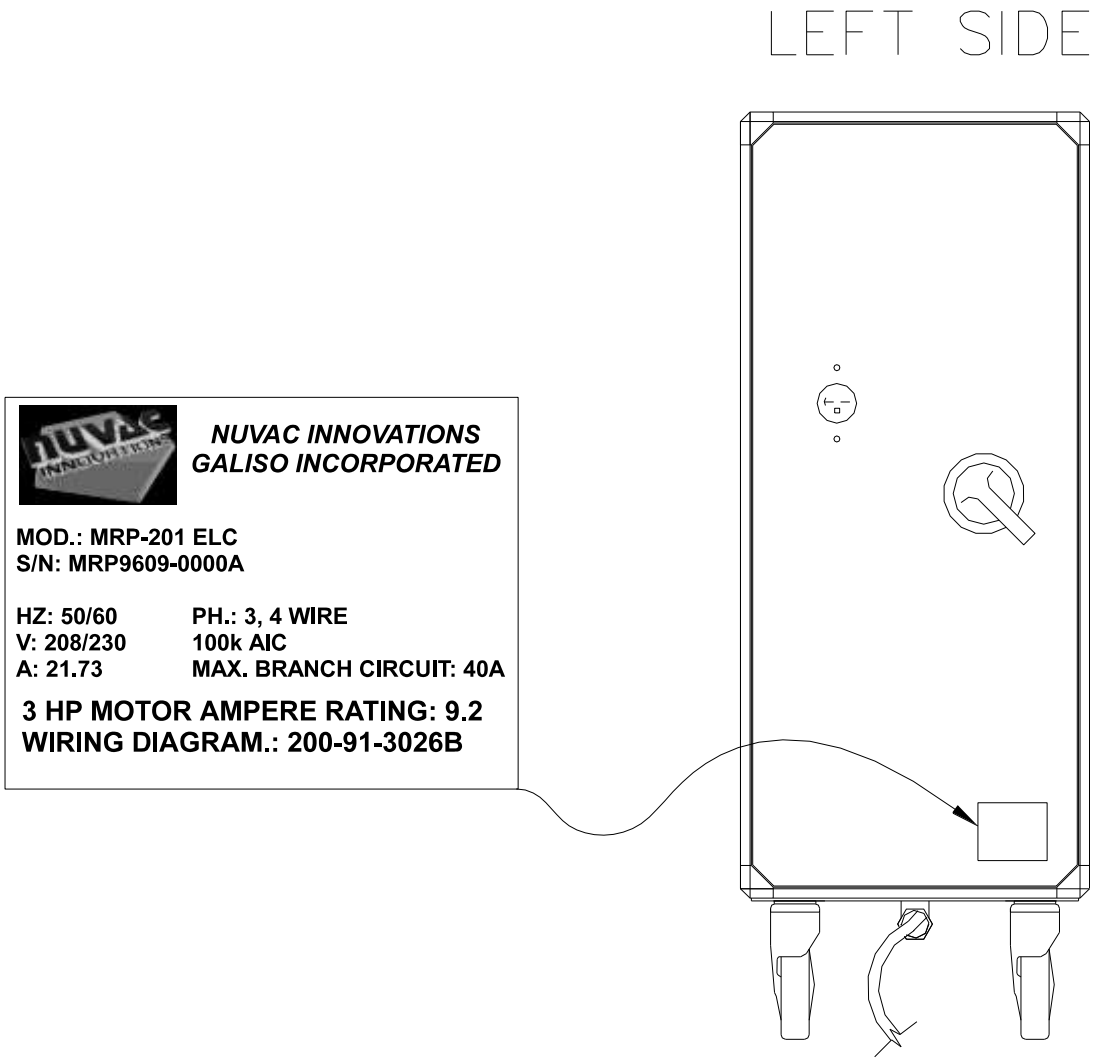

Figure 3 - 8 Serial Number Plate

3.1.9 Information and Service Label

This label provides information to the operator on where to order parts and where to contact a Nuvac Innovations' Customer Service Representative. The Model Number and Serial Number must be provided when calling with service questions or when ordering parts.

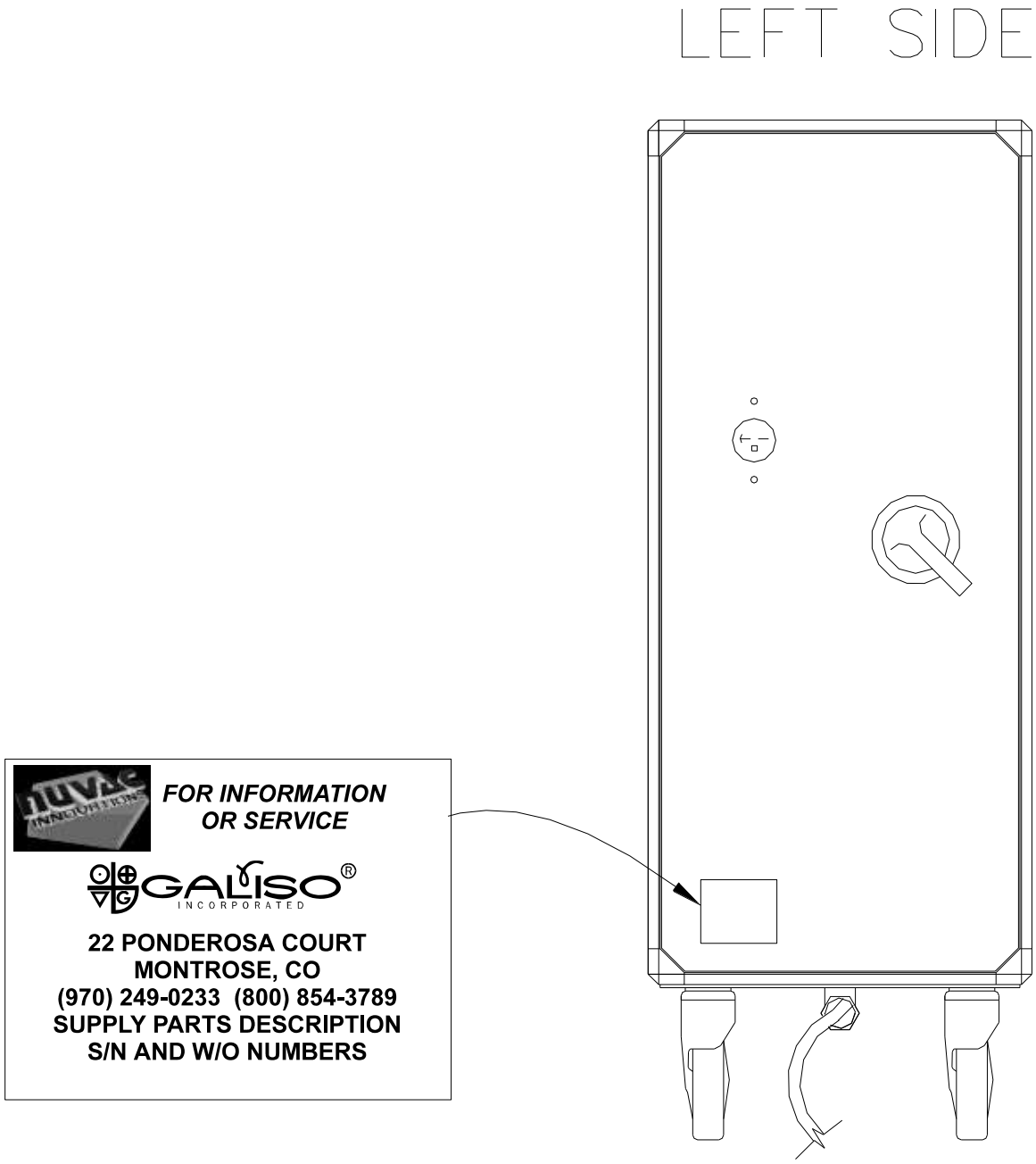

Figure 3 - 9 Information and Service Label

3.1.10 EMO LABEL

The EMERGENCY OFF (EMO) label is incorporated into the Machine Nameplate Label, located on the top of the MRP-201 ELC. This label identifies the EMO Button which, when pressed, will shut down the unit.

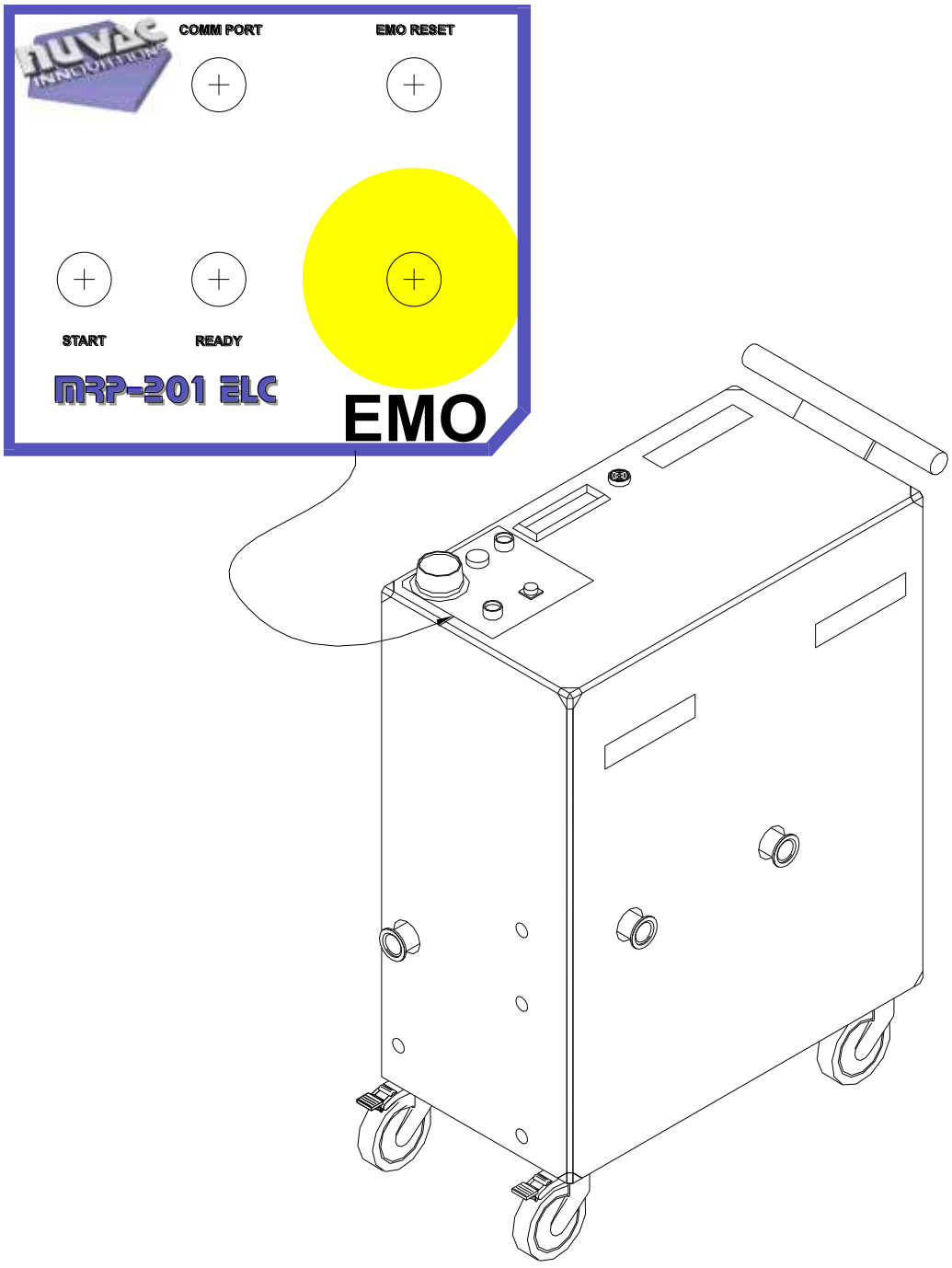

Figure 3 - 10 Emergency Off (EMO) Switch Label

3.2 Storage and Seismic (Earthquake) Readiness Precautions:

The MRP-201 ELC comes equipped with lockable wheels and a binder strap for storage of the unit when not in use. To properly secure the unit, position it against a wall that will allow it to be firmly secured. Please refer to figure 3-11. The strap should be about 28 inches above the floor when securing the unit.

- Place the straps' two "J" hooks into the securing handles or some other adequate piece of hardware, available in your facility. Use the ratchet to take up all the slack in the strap. Actuate the ratchet so that firm pressure is applied to the unit and the unit becomes immobile.
- After the unit is immobile, lock all 4 wheels by stepping on the wheel locks until they click down onto the wheels. This is done by stepping on the lower tab of the wheel lock. It will firmly snap down into place. To unlock the wheels, pull up on the lower wheel lock tab with the toe of your shoe or step down and forward on the top wheel lock tab. The wheel lock will snap firmly back into an unlocked position.

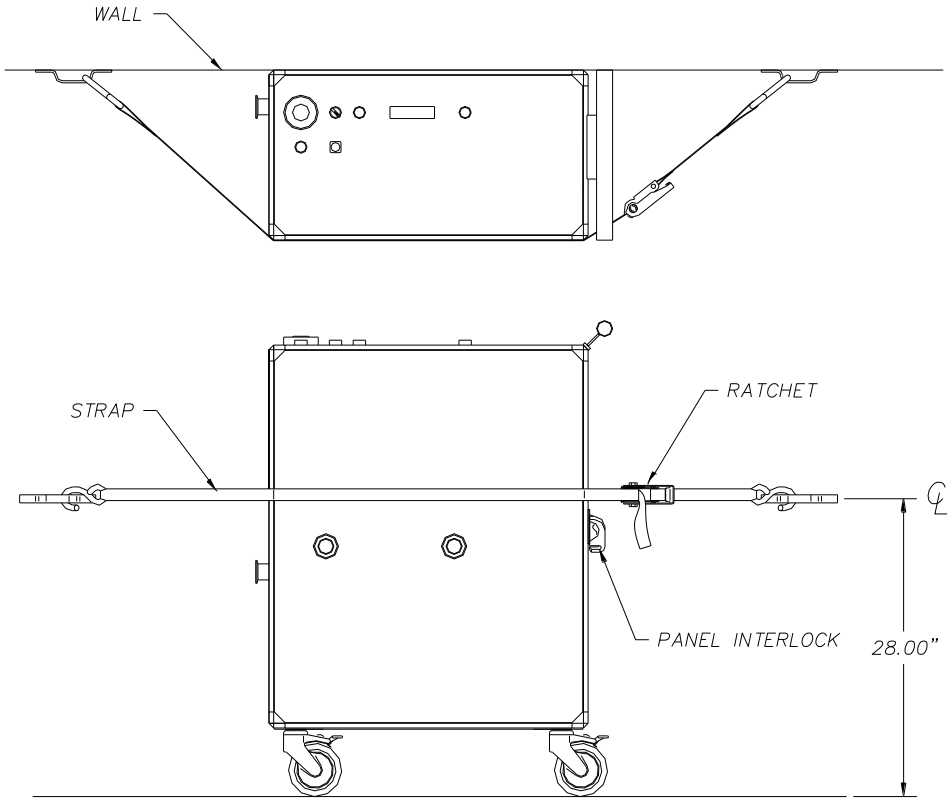

Figure 3 - 11 Seismic Storage Strap Installation

4.0 Safety

Read all instructions before attempting to install or operate the MRP-201 ELC. NUVAC INNOVATIONS and GALISO INCORPORATED are not responsible for damage or injury caused by unsafe use, improper maintenance or misapplication of this equipment. If there is any question as to the proper safety precautions to be taken when installing or operating this unit please contact your local NUVAC INNOVATIONS representative or Galiso Incorporated for guidance at:

Galiso Incorporated
P.O. Box 1468
Montrose, CO 81402
(970) 249-0233 FAX: (970) 249-0607

Any customer allowing use of the MRP-201 ELC in its field of work must distribute this manual to all users. It is the purchasers responsibility to ensure all MRP-201 ELC users are properly trained and have read, understand and follow the instructions, safety warnings, labels, etc. described in the manual

4.1 Safety Warnings

WARNING

4.1.1 Operating Environment

A. **Operation of the MRP-201 ELC in the presence of flammable gases, fumes, high concentrations of oxygen or other types of explosive environments is a critical safety hazard and must be avoided at all times**.

B. **The MRP-201 ELC is not compatible with corrosive, flammable, volatile or toxic materials or gases. Only use a recommended solvent to clean the unit's parts.**

4.1.2 Adjustment or troubleshooting must be done only by qualified personnel. Whenever possible, disconnect all power before servicing the unit.

4.2 EMO Operation

The Emergency off circuit (EMO) is a low voltage circuit that controls the power to all of the electrical parts of the MRP-201 ELC module. The EMO switch (and the EMO reset switch) are located on the top panel of the machine (see figure 4-1). Depressing the EMO switch will automatically disconnect all high voltage AC power within the module. The only remaining energized circuits will be the EMO power supply (a step down transformer) and the EMO switches which are 24VAC devices.

4.2 EMO Operation (continued)

After the EMO switch is actuated, all of the main cabinet enclosure will be in a SEMI-S2 Type 1 condition with the exception of the low voltage controls enclosure which will be in a SEMI-S2 Type 3 condition. Section 4.0, Installation, contains additional information regarding the operation and configuration of the EMO switch(es).

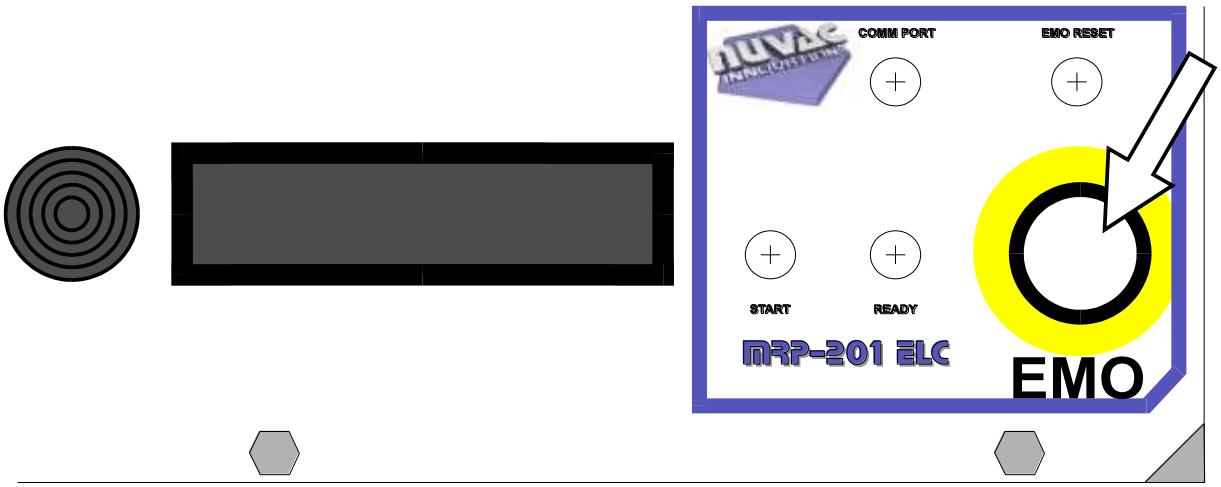

Figure 4 - 1 EMO Switch

4.2.1 EMO Switch Use

The EMO switch is intended for use under any condition which could potentially cause damage to equipment and/or personnel injury. Typical indications where EMO switch use would be warranted include:

A. Unusual or loud noises emanating from the MRP-201 ELC module.

B. Smoke and/or unusual odor emanating from the MRP-201 ELC module.

C. Excess vibration within the unit.

D. Any environmental condition within the customers facility that could adversely affect safe operation of the MRP-201 ELC module, such as fire , earthquake, etc.

4.3 System Over-Pressure Protection

The MRP-201 ELC has been designed to ensure that over-pressurization of the system recirculation manifolds and associated piping, due to excess Argon inlet pressure, is virtually impossible. The type of vacuum valves used, spring return Varian block valves, have all been tested by Galiso Inc. and are oriented to allow excess pressure to vent to vacuum.

4.4 Electrical Lock Out

The MRP-201 ELC was designed with lockout capability. The main power switch handle (ref. Figure 5-2) is equipped with a lever that, when pushed into the handle, prevents the handle from turning to the ON position. This lever can be locked in the OFF position with any standard padlock, which will prevent energizing any circuits within the module.

It is recommended that whenever major service is needed, or the unit is not expected to be used for an extended period, the MRP-201 ELC module should be locked and tagged in the **OFF** state. See the Section 7.0, Maintenance, for specific situations when the module should be locked out.

NOTE:

Policies and procedures for when the MRP-201 ELC module should be locked out and tagged out are the responsibility of the customer/user.

4.5 Safety Interlocks

4.5.1 Blower Temperature Switches

There are two blowers within the MRP-201 ELC module, each blower is protected by an over temperature switch (Thermodisk). These over temperature switches are wired in series to terminate operation of both blower motors should either motor experience excessive temperatures. The Thermodisk sensors are attached to the outside of the blower case(s) at the front of each blower, measuring the outside surface temperature of each blower (see figure 4-2).Additional information regarding temperature switch operation is included in Section 6.0, Operations.

4.5 Safety Interlocks, continued

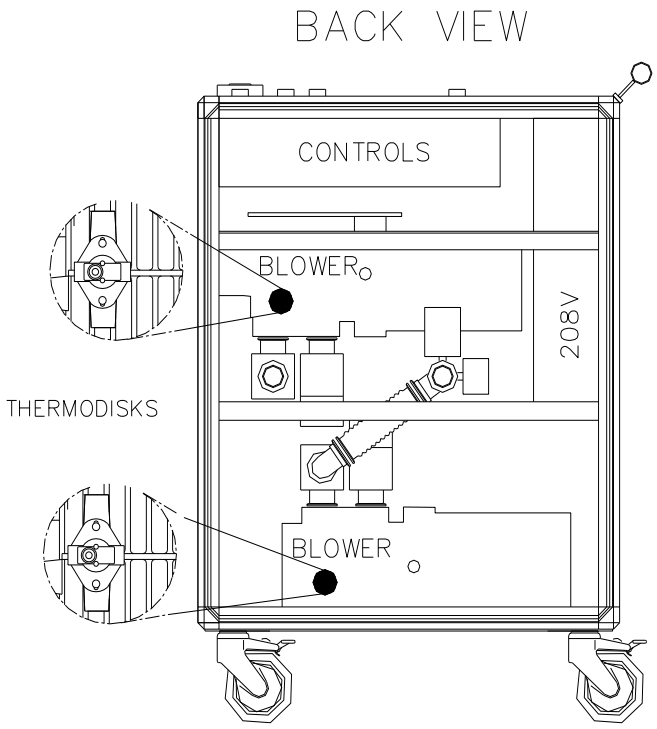

Figure 4 - 2 Thermodisk Locations

5.0 Installation Instructions

Read all instructions before attempting to install or operate this equipment.

WARNING

GALISO, INC. IS NOT RESPONSIBLE FOR DAMAGE OR INJURY CAUSED BY UNSAFE OR IMPROPER INSTALLATION, OPERATION AND/OR MAINTENANCE OF THE MRP-201 ELC.

Please contact your Galiso/Nuvac representative, when in doubt as to the proper safety precautions to be taken when installing or operating this machine.

5.1 Receiving and Placement

Immediately upon receipt of the MRP-201 ELC, inspect the unit for any damage which might have occurred during shipping. Check the Serial Number Plate to see that the Model Number, Serial Number and voltage are as ordered. The serial number plate is located on the lower right-hand corner of the High Voltage panel (ref. Figure 3-1).

The MRP-201 ELC must be located in a clean, well lit and well ventilated area. The area should be free of excessive dust, toxic, flammable or corrosive gases and moisture. Clearances should allow for safe and effective inspection and maintenance of the unit. Refer to Section 2.0, Specifications, for the physical dimensions for the MRP-201 ELC.

5.2 Utilities

The following utilities and services are required for installation and operation of the MRP-201 ELC module.

5.2.1 Electrical:

The electrical power requirement for the MRP-201 ELC is 208/230 Volt, 3 phase, 21.7 Amps @ 60 Hz, 26.1 Amps @ 50 Hz. The MRP-201 ELC is protected by an internal 40 Amp, 100 kA.I.C. at 240 volts circuit breaker.

NOTE: The MRP-201 ELC should be connected to a Branch Circuit, with a maximum over current breaker of **NO HIGHER THAN 40 AMPS**.

5.2.2 Argon Supply

A 50 - 80 psi Argon gas supply with an adjustable regulator set at 20 psi (1.38 Barr) is required for proper operation of the system. The system uses approximately 20 CFM (maximum) during certain modes of operation. At a minimum, purity specifications for the Argon should be < 50 ppb. moisture, and zero particulate > .5 micron. The drier and cleaner the Argon supply is, the more effective the unit will be at removing moisture and particulates from the chamber it is processing. Galiso recommends Argon from a cryogenic source, delivered through a stainless steel supply system, connected to the unit with a 1/4" Male VCR connector.

5.2.3 Compressed Air and Vacuum Exhaust

A. Oil free compressed air must be supplied at 80 psig min. (551.73 Barr) (5.63 Kg/Sq.cm) < 1 CFM for valve actuation.

B. A vacuum source capable of maintaining 100 mTorr (or less) capable of accepting 18 CFM at atmosphere is required.

5.3 Recirculation Process Piping

Using 1-1/2" stainless tubing and/or bellows, and the necessary KF-40/NW-40 fittings, Install recirculation lines and chamber isolation valves between the MRP and the process chamber. Galiso/Nuvac recommends installation of the following valves for chamber isolation:

Make: Varian Vacuum Valves (or equal)

Type: Air actuated, spring return, or dual air actuated gate valves

End Connections: KF-40 (MRP-201 ELC side)

Locate or place the chamber ports to maximize internal surface area exposure to the recirculating gas (Argon) flow. Those surfaces that are exposed to the process gas stream will be most efficiently decontaminated by the "Recirc" and "Sweep" processes of the HGRS system. Several examples of effective and ineffective recirculation port placements are shown below in figure 5-1

5.3 Recirculation Process Piping

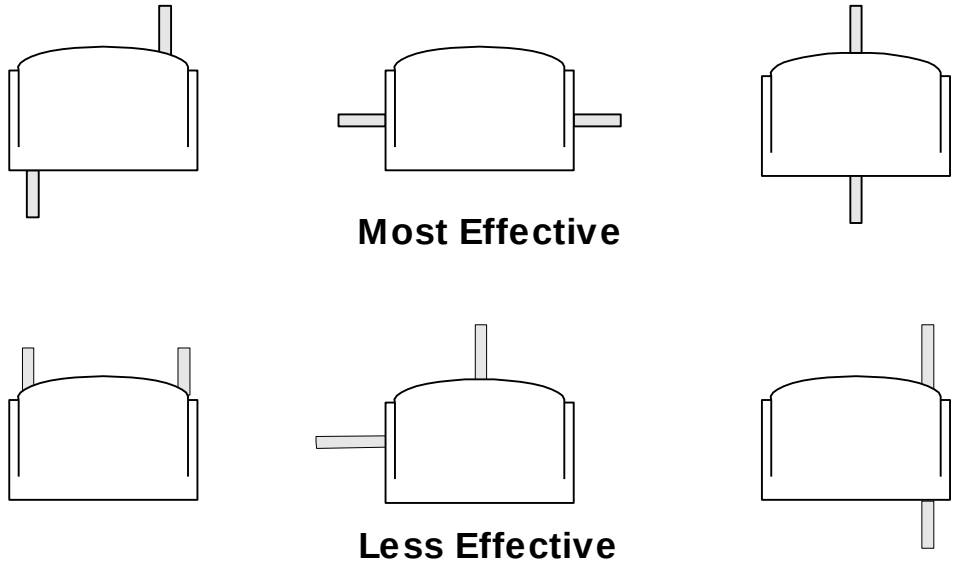

Figure 5 - 1 Recirc. Port Placement

To enable the MRP-201 ELC to most efficiently transfer heat to the process chamber, it must be located as close as possible to the chamber. The process gas, being compressed at the Nuvac blower will be the hottest at the outlet of the MRP-201 ELC.

5.4 Leak Integrity Checking

Prior to connecting the MRP-201 ELC it is very important to verify chamber leak integrity. With the installation of the process chamber recirculation valves per Section 5.3 above, the potential for introducing leaks into the chamber is significantly increased. If a leak has been introduced into the chamber, difficulties in achieving the necessary vacuum and measuring the rate of rise could later be incorrectly blamed on residual moisture. The following steps are recommended to verify chamber leak integrity:

A. Connect a helium leak checker to one side of the process piping, keeping the other chamber port valve closed.

B. Check for leaks in the process piping. Repeat this process on the other leg of the chamber process piping.

C. To check the chamber for leakage, open both process valves and blank off one end of the process piping, keeping the leak checker connected to the other end. Check for leaks in the chamber.

5.5 Three Phase Power Connections

Verify that the main power switch is in the **OFF** position. Connect the 208 Volt 3 phase power to the MRP-201 ELC.

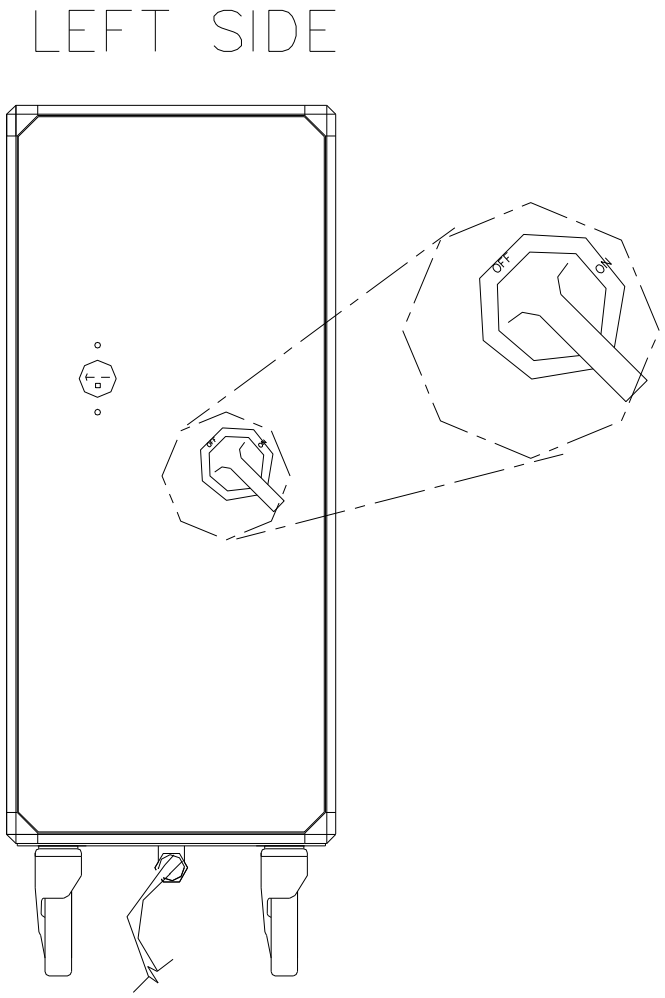

Figure 5 - 2 Main Power Switch

If the module is being hard wired for a permanent installation or the supplied plug needs to be replaced to mate with a previously installed receptacle, it is imperative that the three phases be properly connected to ensure that the motors will rotate in the correct direction. The x, y, and z phases correspond to the red, white, and black wires respectively. Use of a phase tester is recommended to ensure proper wiring of the phases.

5.6 Argon Gas Connections

Connect the Argon gas supply to the MRP-201 ELC Argon gas inlet. Be sure to use an appropriate VCR gasket and tighten accordingly, see Section 7.0, Maintenance, to obtain additional gaskets when necessary. Figure 5-3 shows the Argon connection location on the MRP-201.

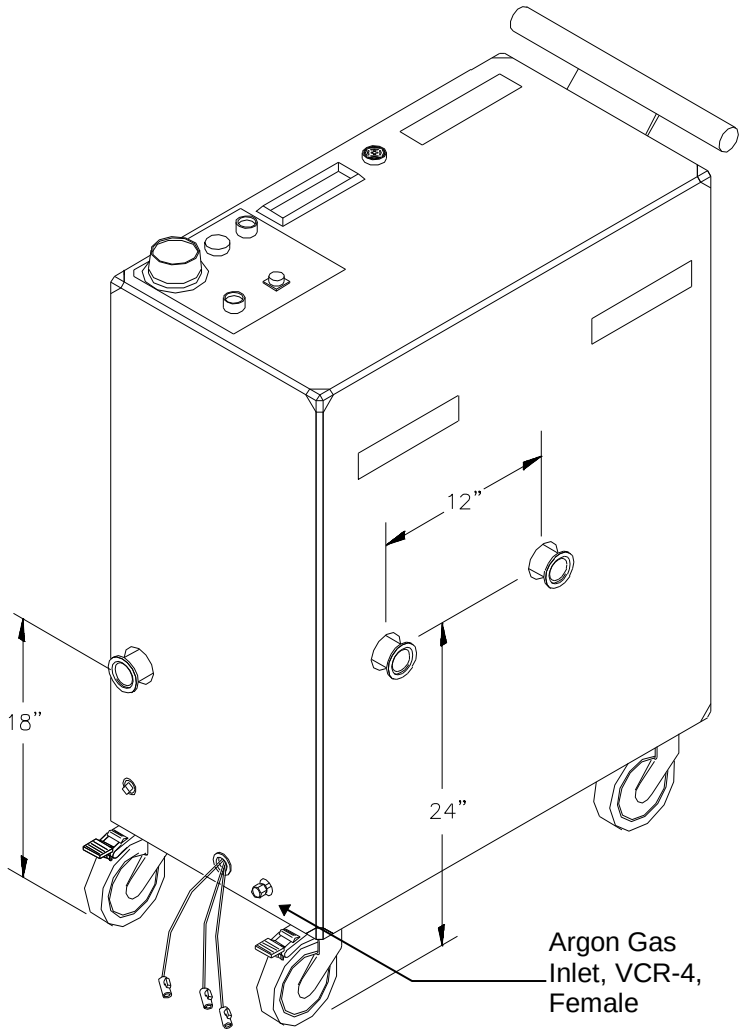

Figure 5 - 3 Argon Gas Connection

5.7 Pneumatic Control Air Supply Connection

Connect a clean, oil-free shop air supply to the pneumatic inlet of the system (1/4" NPT) located at the lower left corner of the module as shown in figure 5-4.

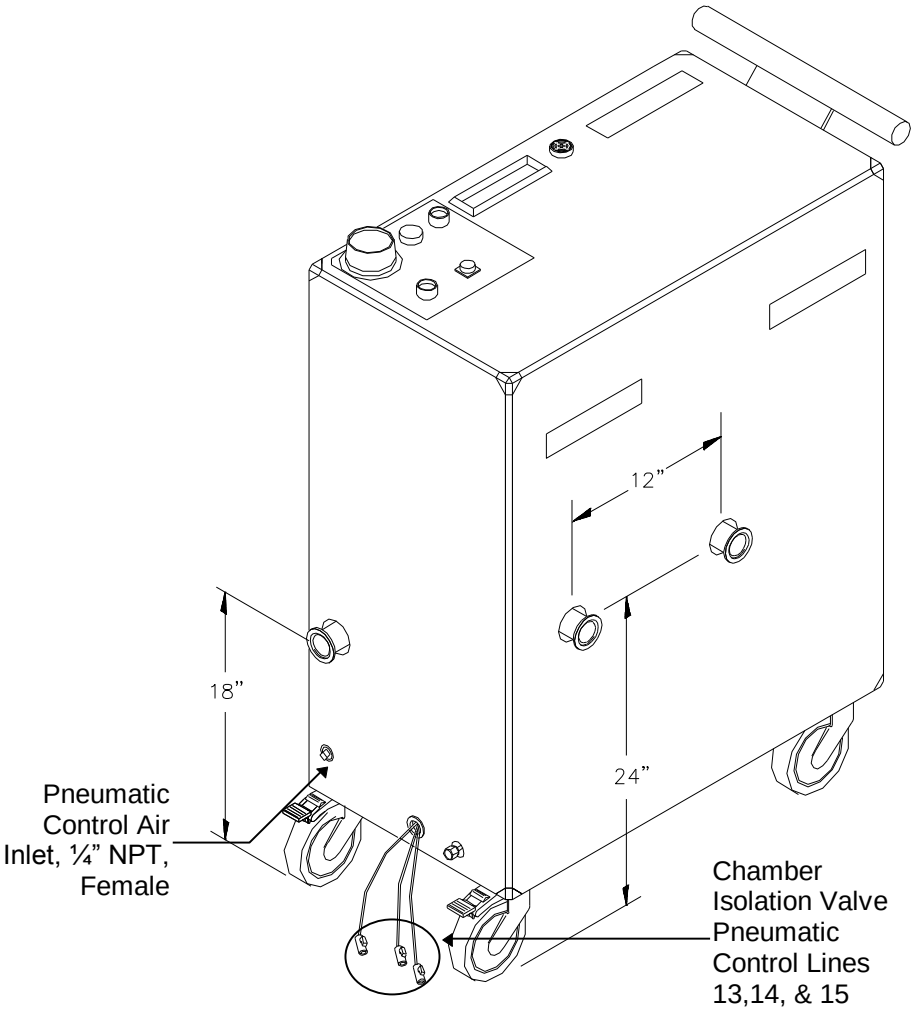

Figure 5 - 4 Air Supply Connection

5.8 Pneumatic Control Connections

Three external pneumatic control lines are provided with the standard MRP module. These lines are equipped with mini-ball valves and exit from the bottom of the MRP unit, see figure 5-4. These lines are 5/32" poly, and are numbered 13,14, and 15. Line # 13 is for normally closed chamber isolation valves (i.e. provides air pressure when a valve open signal is sent from the controller). Line #14 is for normally open chamber isolation valves (i.e. provides air pressure when a valve close signal is sent from the controller). Line #15 is continuous supply. Figure 5-5 shows the control air supply connections required for automatic HGRS operations. Note that additional pneumatic control capabilities can be configured using the MRP valve stack (figure 5-5) pneumatic connections.

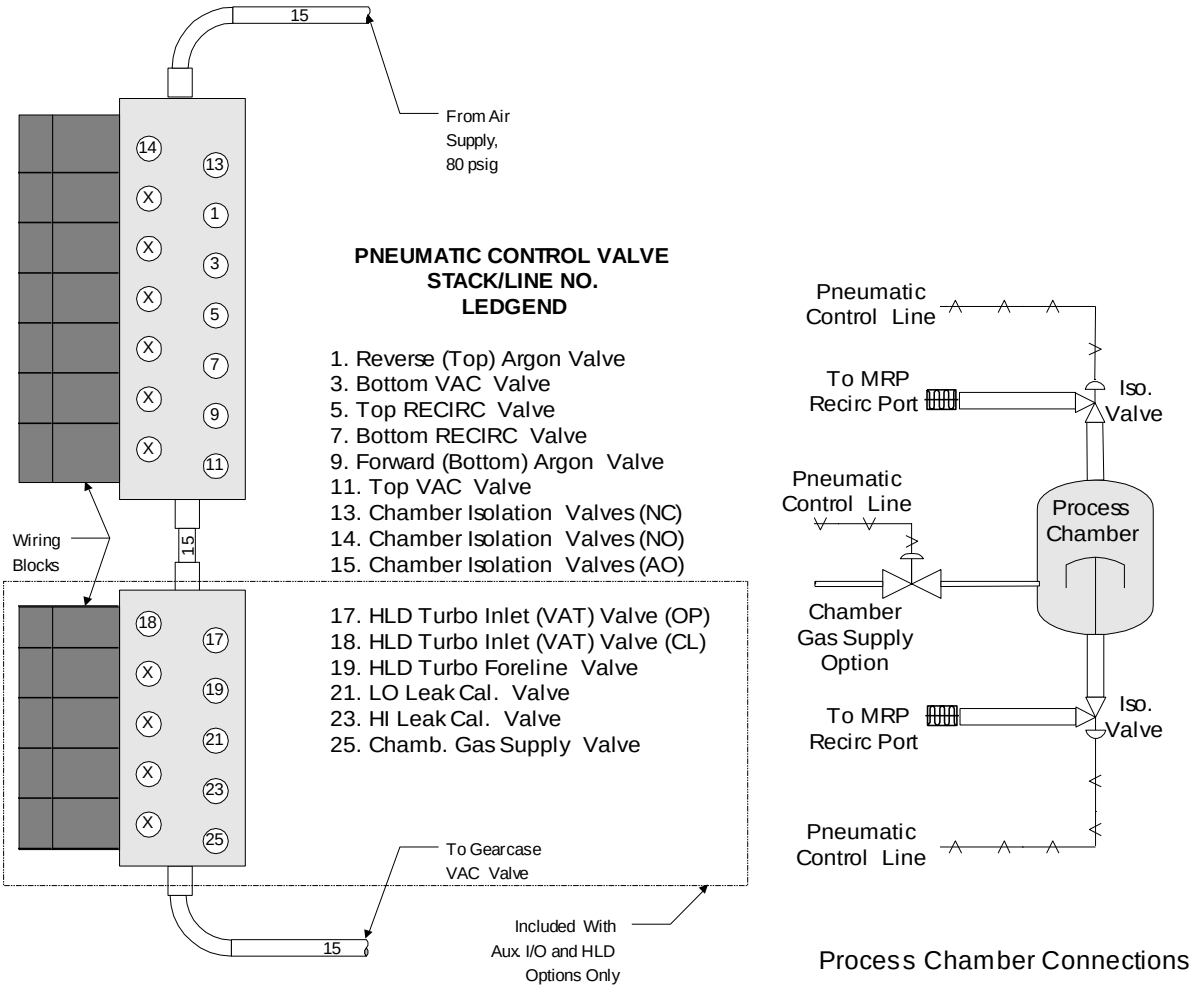

Figure 5 - 5 Pneumatic Controls

5.9 Vacuum Connections

Connect the rough vacuum to the MRP-201 ELC vacuum port as shown in figure 5-6, below.

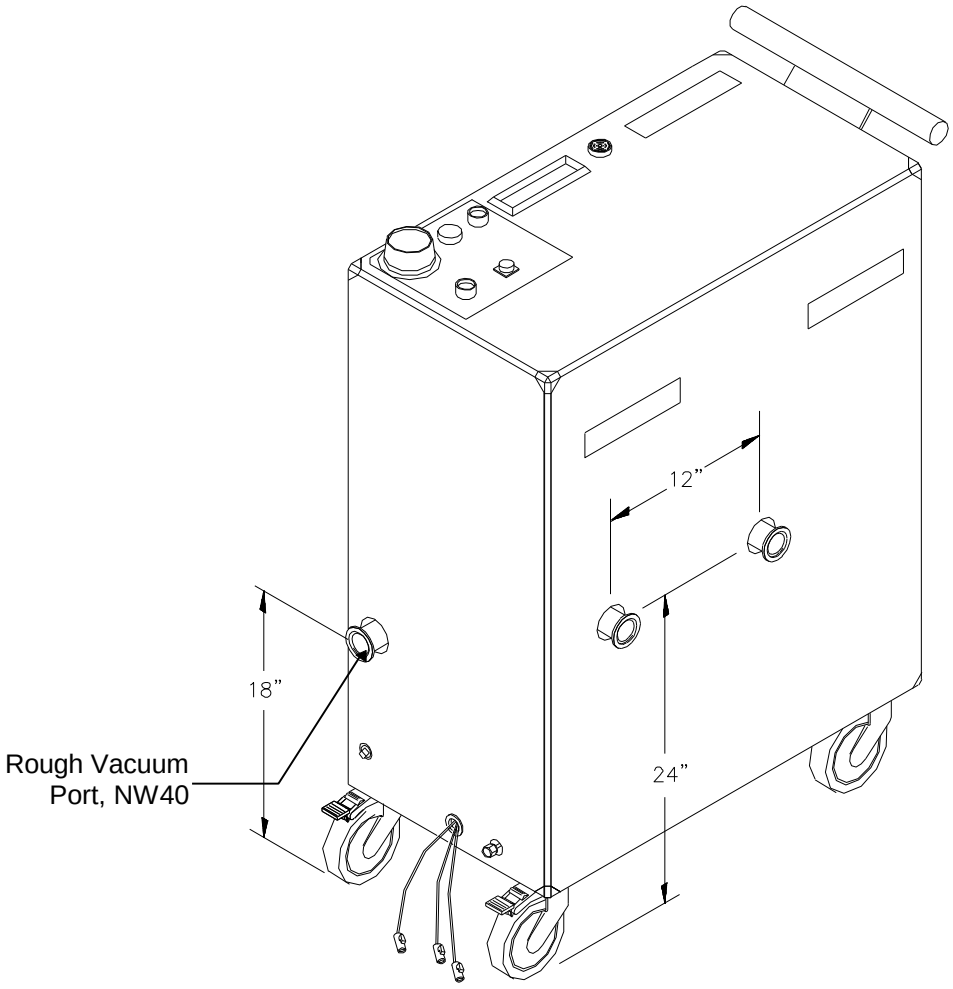

Figure 5 - 6 Rough Vacuum Connection

5.10 Connection Checklist

Upon completion of installation steps 5.1 through 5.9 all electrical and mechanical connections will be complete, with the exception of the final chamber process connections. Use the checklist below to verify completion of all required connections.

5.10.1 Process chamber ports and valves installed,(ref. 5.3)._____

5.10.2 Leak Integrity check complete,(ref. 5.4) _____

5.10.3 Three Phase power connected,(ref. 5.5) _____

5.10.4 Argon gas connected,(ref. 5.6) _____

5.10.5 Air supply connected,(ref. 5.7) _____

5.10.6 Pneumatic control connections complete,(ref. 5.8) _____

5.10.7 Rough vacuum connected,(ref. 5.9)_____

5.11 Applying Power to the MRP-201 ELC

Apply power to the module by first switching the main power switch to the **ON** position (see figure 5-2), and then pressing the **EMO RESET** button (see figure 4-1). The MRP display on top of the machine should now be displaying a message and the ready lamp will be illuminated. **Note that the MRP unit should be turned on whenever possible to ensure that the vacuum gauges are adequately warmed-up.**

When power is initially applied to the machine by turning on the main disconnect, the EMO circuit defaults to a tripped state. The EMO reset button, reference Section 3-11, must be pressed to activate the circuit, and the rest of the machine. Therefore, turning on the machine is always a two step process, first applying power and then resetting the EMO.

5.12 Vacuum Gauge Calibration

CAUTION !
THIS IS A SEMI-S2 TYPE 3 ELECTRICAL TASK!

5.12.1 Start up the MRP-201 ELC and let the 1000 Torr gauge warm-up for at least 15 minutes before adjusting the trimpots. The 0.1 and 1.0 Torr gauges are specially heated gauges, requiring as long as 4 hours to warm-up for an accurate calibration.

5.12 Vacuum Gauge Calibration (continued)

5.12.2 After the necessary warm-up time has passed, connect the vacuum source to the Forward port (see figure 5-9) on the MRP-201 ELC. The vacuum source must be 1 decade lower than the minimum reading for the vacuum gauge being calibrated (10 mTorr for the 1000 Torr, and 1E-5 Torr for the 1 Torr gauge). The reverse port (see figure 5-9) may be left disconnected because the SVAC F mode provides the proper valve line-up for gauge calibration.

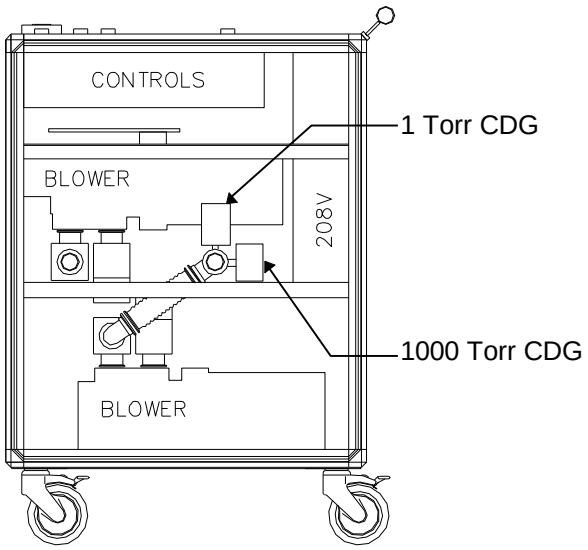

Figure 5 - 7 Vacuum Gauge Locations

5.12.3 Wait 15 minutes after the appropriate vacuum (10 mTorr or 1E-5 Torr) has been reached, and then measure the voltage output of the gauge on the I/O board in the low voltage box. The 1000 Torr gauge voltage can be measured between pins 5 and 6, and the 1 Torr gauge between pins 9 and 10.

5.12.4 Continuously reading the voltage, adjust the corresponding zero potentiometer, (found on the side or top of each gauge head) until the value is just slightly greater than zero to .004 volts.

5.13 Pre-operational Testing

The objectives of this pre-operational test are:

- Verification of proper motor rotation direction (phase wiring)
- Verification of instrument and component operability
- Verification of process control recipe functionality

5.13.1 Prerequisites

All connections completed in accordance with these instructions, except the final chamber process connection. To perform this testing, the recirculation ports must be capped off using NW 40 blanks. The power to the unit must be turned on and, whenever possible, the unit must be allowed to warm up for 4 - 6 hours before initiating testing.

5.13.2 Test Steps

Access and download the following process control recipe:

1.VAC:FVAL=4-0.05-SL-NONE

2.SVAC-F:KPRESS=5-0-SH-OR,FVAL=4-0.0001-DO-NONE

3.SVAC-R:KPRESS=5-0-SH-OR,FVAL=2-0-DO-NONE

4.OFF:TIME=NONE-1-SH-NONE

Verify that the MRP displays the “Press Start to Continue” message.

Step 1

Initiate the process control recipe by pressing the start button (see figure 5-8). Verify that the MRP executes the first step in the process control recipe. The display on the top panel of the MRP should indicate the word VAC.

A description of the operating modes is given in Section 6.3 of this manual. In the VAC mode, the rough vacuum system will be evacuating the MRP module. Verify that the pressure reading on the MRP display or the VCS process monitoring window is consistent with the rough vacuum system base pressure capabilities.

5.13 Pre-operational Testing, continued

Step 2

When the pressure reading (from the 1 Torr CDG) reaches the 0.05 Torr setpoint, the MRP should automatically switch to the SVAC-F mode.

Step 3

Switch the MRP to the next process control recipe step by pushing the start button. This will initiate the SVAC-R mode. If the blowers are operating in the correct direction, the pressure reading from the 1 Torr CDG will immediately decrease and begin to approach the blower base pressure value. The SVAC base pressure is one to two decade(s) below the typical rough vacuum base pressure. If the blowers are not rotating in the correct direction, the pressure will increase to a value above the rough vacuum base pressure. If the pressure reading shows any increase, the blowers are not operating in the correct direction and the MRP must be shut down to correct the phase wiring before re-initiating pre-operational testing. It is preferable to re-wire the facilities side of the electrical connection since all MRP units are factory wired in the same manner.

Step 4

While the MRP is operating in the SVAC-R mode, push the EMO (emergency off) button. This action should completely shut down the MRP unit. If it does not, turn off the main power switch and contact your Nuvac representative for further instructions. Once the unit has been shut down using the EMO switch, the operator must press the EMO reset button to restart the unit. With the unit restarted, the operator must press the start button to re-initiate the process control recipe.

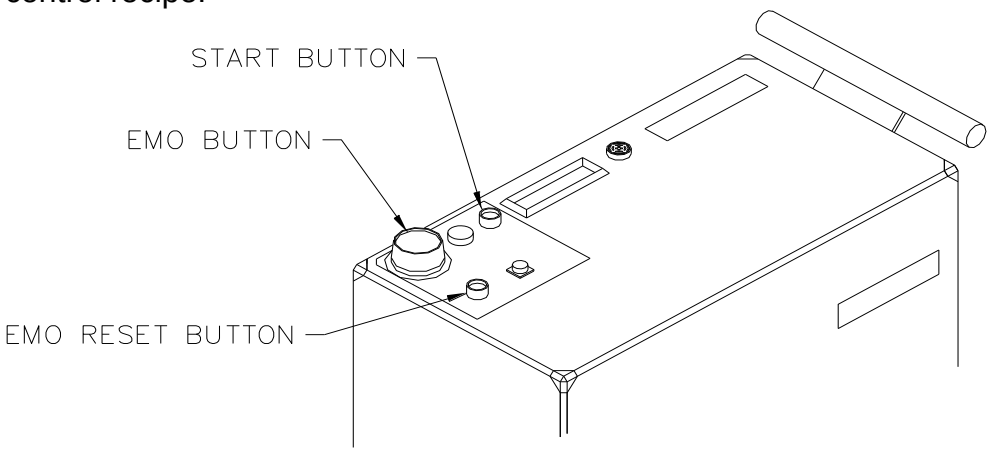

Figure 5 - 8 MRP Manual Controls

5.14 Process Chamber Connection to the MRP-201 ELC

WARNING

Do Not Use The MRP-201 ELC On Any Process Chambers Containing Toxic, Volatile, Flammable, Or Corrosive Gases

Use Of This Equipment Under Any Of The Conditions Listed Above Will Seriously Damage The Equipment And Can Cause Severe Injury Or Death To Individuals

The final connections required are from the MRP-201 ELC module to the process chamber piping and valves installed under Section 5.3.

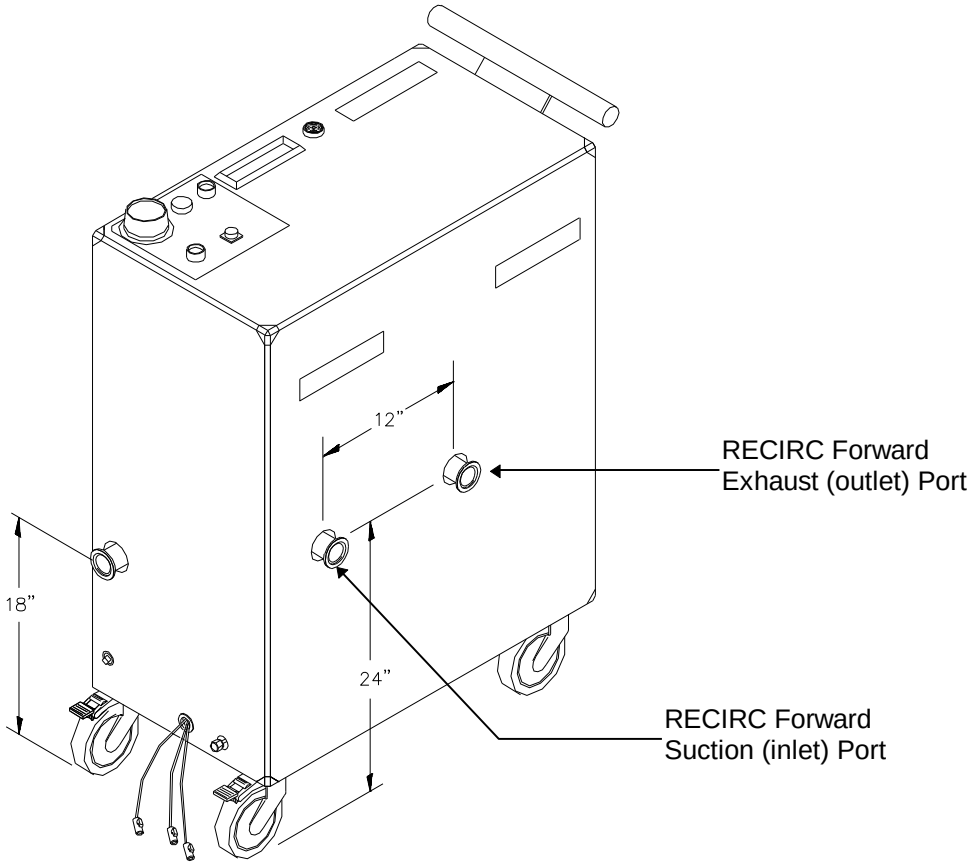

Figure 5 - 9 Process Piping Connections

5.15 Installing the Micro-controller Software

The MRP micro-controller software is pre-loaded at the factory. The following instructions are provided should a new version upgrade or re-installation be required.

In order to download the Microdac controller software a host computer with the RS-232 communication link to the MRP unit will be required.

Create a subdirectory on the hard drive of the host computer named "\mdac". Copy all of the files included on the MRP controller code diskette to the "\mdac" subdirectory. Below is a list the of the files you should find.

- hgrs_m.exe
- hgrs_m.map
- mdl.exe
- shortcut to mdl.exe
- gh-talk.exe
- gh-talk.prm
- gh-talk.hlp
- setspeed.mcr

Double click on the short cut file to start the download utility. When the 'Starting Up User Program' line appears, the download will be complete. Note that the mdl.exe will create an Hgrs_m.hex file.

If the controller has also been replaced, run the gh-talk program. A menu will be displayed with four choices. Select "continue with program". Enter through the comm port warning and type in an address of "00" when asked for it. If the program is able to comunicate with the MRP, an "A" should be returned in response to the ">00FA6" command. Press the F6 key to go to open the macro command window and select the "get macro file" selection. A window will display a list of macros, one of which should be called "setspeed". Press the enter key to select the "setspeed" macro and then using the escape key get back to the program window. Press the "Alt-F6" keys to run the macro. In order for this macro to take affect, the power must be cycled on the MRP. Using the escape key exit from the gh-talk program.

6.0 MRP-201 ELC Operations

WARNING !

THE MRP-201 ELC SHOULD NOT BE CONNECTED TO ANY CHAMBER THAT USES FLAMMABLE, VOLATILE, CORROSIVE OR TOXIC GASES. THIS IS AN EXTREME DANGER TO INDIVIDUALS AND COULD CAUSE SEVERE INJURY OR DEATH

The MRP-201 ELC combines a programmable micro-controller with the Galiso/Nuvac proprietary System Control And Monitoring Software to provide automatic control over all system operations. This combination allows the user to easily create, modify and monitor custom processes to be performed by the MRP-201 ELC. Figure 6-1 depicts the four software programs comprising the System Control And Monitoring Software, and their relationship to each other.

HGRS System Control And Monitoring Software Configuration Diagram

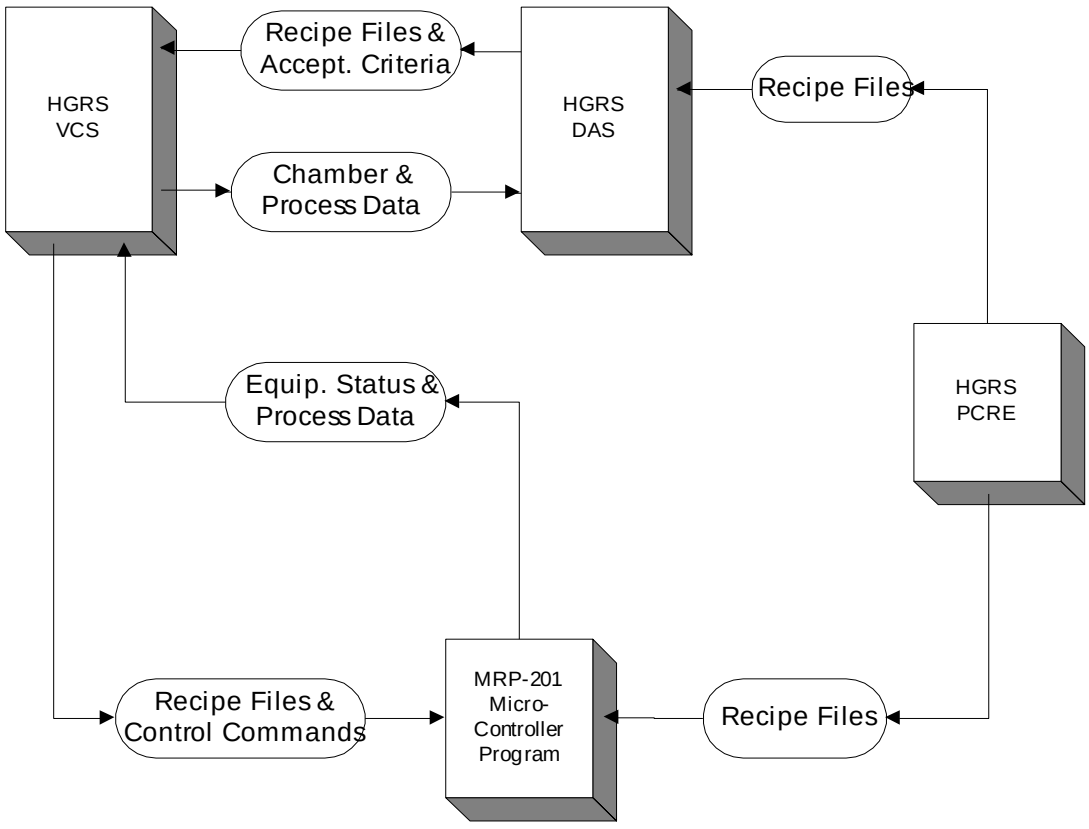

Figure 6 - 1

6.0 **Operations**, continued

Instructions for using the System Control and Monitoring Software programs are the subject of separate manuals. A brief explanation of the four programs depicted in figure 6-1 is as follows:

- HGRS VCS; This is the Visual Control System which provides primary control over the MRP-201 for chamber processing.

- HGRS DAS; This is the Data Acquisition System which is an Access database used for defining acceptance criteria and reporting chamber processing results.

- HGRS PCRE; This is the Process Control Recipe Editor which is used to develop process control recipes for execution by the MRP-201.

- The MRP-201 micro-controller program interprets and executes VCS commands and process control recipes for chamber processing.

The Operations section of this manual includes:

- Description of Components, Section 6.1
- Data Inputs and Outputs, Section 6.2
- System Operating Modes, Section 6.3
- System Operating Logic, Section 6.4
- Sequence of Operations, Section 6.5

6.1 Description of Components

The process flow diagram shown below in figure 6-2, shows the MRP's piping, valves, equipment and instrumentation.

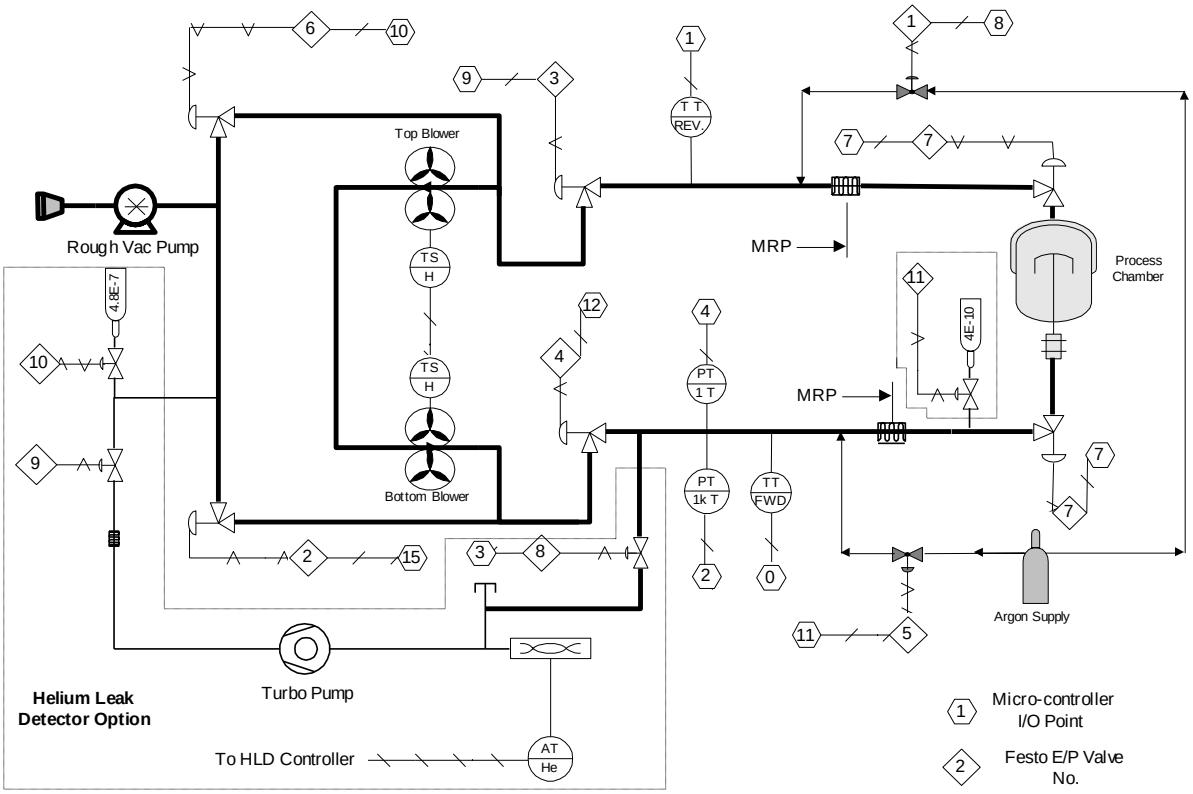

Figure 6 - 2 MRP-201 ELC Process Flow Diagram

Blowers:

The MRP-201 ELC contains two blowers which are the primary active components in the system. Using the two blowers in series, the MRP-201 ELC can sweep fresh gas though the system at high velocities, recirculate gas in a closed loop (thereby increasing internal temperatures), or act as a first stage in a vacuum system reducing the base pressure by more than a decade.

There is a top blower, mounted top plate facing down, and a bottom blower, top plate facing up. These blowers can operate in either direction, defined for our purpose as forward and reverse. In the forward direction the top blower draws gas through the top recirc valve and exhausts it to the bottom blower. The bottom blower draws gas from the top blower and exhausts it towards the bottom recirc valve. In the reverse direction the top blower takes gas from the bottom blower and exhausts it towards the top recirc valve. The bottom blower draws gas through the bottom recirc valve and exhausts it to the top blower. The blowers are used in the SWEEP, SVAC, and RECIRC operating modes.

6.1 Description of Components, continued

Temperature inputs Forward/Reverse:

The temperature inputs are J type thermocouples located in the gas stream between the top or bottom blower and the process chamber. Each probe is placed in the recirculation manifolding of the MRP-201 ELC through an 1/8 inch compression quick disconnect, inserted so the tip of the probe is in the middle of the gas stream. These thermocouples are used to monitor the temperature of the process gas either going to the chamber or returning from the chamber. These system inputs are referred to as “Analog ITCJ” inputs and are used as control inputs for establishing operating mode sequences.

Vacuum Gauges 1 Torr/1000 Torr:

The vacuum gauges used are capacitance diaphragm gauges (CDGs), located on a T in the gas stream between the bottom blower and the process chamber. Similar to the temperature inputs, these gauges are connected to the system through 1/2” compression quick disconnects. There is a 1000 Torr CDG used for measuring atmospheric pressures down to 0.1 Torr, and a 1 Torr CDG used for measuring vacuum pressures down to 1E-4 Torr. Both gauges are used to provide control inputs and are referred to as “Analog IV10” inputs.

Recirc Valves Top/Bottom:

There are two recirculation valves on each system located on the top plate of each blower. The recirculation valves are the valves between the blower and the manifold connecting the MRP-201 ELC to the chamber. Actuating the recirculation valves independently, allows one or both of the blowers to be excluded from certain system operating modes.

Argon valves Top/Bottom:

There are two 1/4 “ argon inlet valves to the system, one on each section of manifold between the recirculation valves and the process chamber. The valves are used to introduce clean dry argon into the system for the FILL, SWEEP and/or CFP operating modes.

Vac Valves Top/Bottom:

There are two vacuum valves in the system, one on the top plate of each blower. The vacuum valves are located between the blower and the vacuum manifold, connecting the MRP-201 ELC to the house vacuum source. Actuating independently, the vacuum valves allow one or both of the manifolds to be evacuated.

6.1 Description of Components, continued

Chamber Isolation Valve Control:

The MRP-201 ELC is configured to control chamber isolation valves (usually located directly on the chamber). There are normally open and normally closed pneumatic control lines (see Section 5.8) that can be connected to user supplied chamber isolation valves to fully automate the process. If the chamber isolation valves are manually actuated, or not included in the system, the control lines must be capped off.

Blower Over Temp Switches:

The MRP-201 ELC is supplied with two manually re-setable snap disk thermostats attached to the side of each blower. These thermodisks are wired in series and set to open at 200 degrees F. When the temperature of either blower case exceeds 200° F, the thermodisk opens, interrupting the 24V DC power to both of the blowers forward and reverse contactors.. When the temperature drops below 200° F, the operator may manually reset the thermodisk by pressing the reset button on the disk. This reset can only be done by removing the MRP enclosure panel and pressing in the button on the disk. Because there is a 24 V DC exposed on both thermodisks this is a SEMI-S2 type 3 action and appropriate caution should be used. Be certain to replace any panels removed, before restarting the machine. After the reset has been pressed in, the process will automatically restart where it left off.

Blower Motor Thermal Overload Relays:

Each blower motor is equipped with a thermal overload protection relay. These relays are designed to trip the blower motors should the motor time vs current function specified be exceeded. The relays are sensor relays which interrupt the 24 VAC motor contactors rather than interrupting the motor main power supply. The motors are rated for a full load current of 8.0 amps, and the overload protection relays are set to 7.0 amps.

Control Air Pressure Switch:

The system is equipped with a control air pressure switch which also interrupts the 24 VAC motor contactor(s) on loss of air pressure. The purpose of this switch is to disable the blower motors to eliminate the potential for dead-heading the blowers on loss of air (valve control) event. The control air pressure switch is set to trip the blower motors when the control air pressure drops below 70 psi. The pressure switch will automatically reset when the air pressure rises above 80 psi.

6.1 Description of Components, continued

Control Panel Components:

Control panel components include the buzzer, start button, ready light, MRP display, EMO switch, EMO reset switch, and communications port. The control panel is designed to be remotely mounted and connected to the MRP micro-controller via a 37 pin connector cable as shown on the attached wiring diagram(s). A description of each of the control panel components is provided below.

Buzzer:

The buzzer on the control panel is used to give the operator an audio signal during an alarm condition or whenever an operator input is needed. During any one of these conditions, the buzzer will beep about once a second until the operator clears the error condition and presses the start key. Specifics of the error conditions are displayed on the MRP screen.

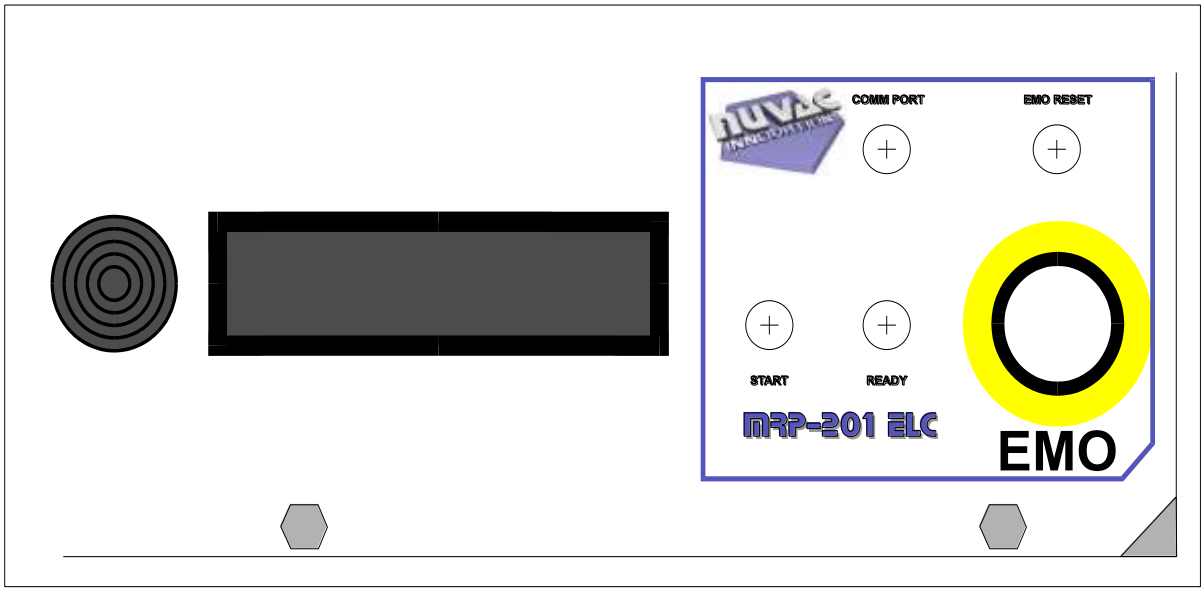

Figure 6 - 3 Control Panel Components

Start Button:

The start button for the MRP-201 ELC is the green momentary button on the control panel. It is connected directly to an input to the control system and almost all operator input takes place via this button.

6.1 Description of Components (continued)

Ready Light:

The ready light is wired in series with the thermodisk switches, control air pressure switch and thermal overload relays. When the power is on and the system is operating normally (not tripped) the light will be on. When the power is off or a system trip condition exists, the light will be off.

MRP Display:

The MRP display is a 2 line by 20 character display used to inform the operator of the current operating mode and any error conditions that may exist. Upon start-up, the MRP will display the model number of the machine and the version of the micro-controller code installed. Following this initial message the screen scrolls the text “Press Start...” across the bottom of the display. See figure 6-4 below.

After pressing the start key and the machine’s process has been initiated, the current operating mode will be displayed along with the end condition and, if applicable, the target value. Before running this system, be certain to read all operating mode and end condition descriptions to help decipher the abbreviated MRP messages.

In addition to displaying the current operating mode and end condition, the display also alerts the operator of any abnormal or faulted operating conditions. For details regarding the interlock messages, refer to the interlock descriptions in Section 6.4.

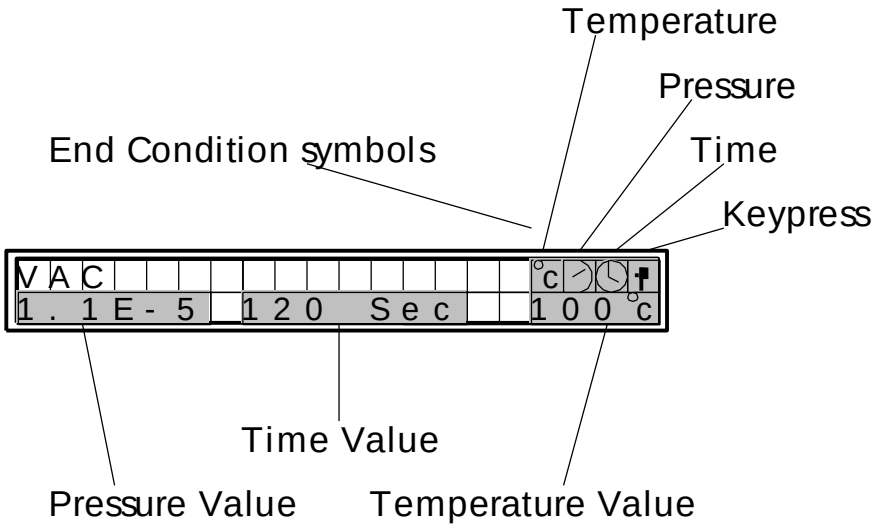

Figure 6 - 4 MRP Display

6.1 Description of Components (continued)

EMO Button:

The EMO button is the large, red momentary switch in the lower right-hand corner of the control panel. When the EMO switch is depressed, all automatic process control programming is overridden and the power to the whole control enclosure is interrupted. This causes the micro-controller to shut off, and all of the valves revert to their normally closed state. At this time, all instrumentation will shut off.

EMO Reset Button:

The EMO Reset button is the blue momentary button just above the EMO button. If the MRP-201 ELC is off, pressing this button will turn the module. The power to the controller, instrumentation and E/P valve stack will be restored. The controller, when it first receives power, runs through a self test. The MRP will display a series of initialization messages and then wait for an operator's input. The existing process control recipe will not automatically start when the EMO reset button is pressed, and the operator will have to press the start button to re-initiate a process control recipe.

Communications Port:

The communications port is an 8 position, square flange receptacle (CPC). To this port, you can connect a special communications cable allowing the MRP-201 ELC to be remotely controlled. This port is also used to download new process control recipes and micro-controller software.

Electro/Pneumatic Control Valves:

The E/P valve stack receives control signals from the on-board micro-controller and outputs air signals to open or close the appropriate process valves in accordance with micro-controller programming instructions and process control recipes. Figure 5-5 shows an illustration of the E/P valve stack. Note that the micro-controller program closes each valve momentarily during each operating mode or state transition.

Optional Helium Leak Detector Equipment:

MRP units are available with optional helium leak detection capabilities. The equipment components and functionality of the leak detection system are described in a separate Galiso/Nuvac manual, number 21-11-1125.

6.2 Data Inputs and Outputs(I/O)

The MRP-201 ELC has a 16 position I/O board through which the primary control inputs and outputs are connected. A map of the I/O used for all process control recipes is provided in Table 6-1.

Table 6 - 1

Micro-controller I/O Channels

I/O Channel	E/P Valve No.	MRP-201 Component	Indication
0		Fwd. Temp. Trans.	Degrees C
1		Rev. Temp. Trans.	Degrees C
2		Hi Range Pressure CDG	0.1-1000 Torr
3 (Note 1)			
4		Low Range Pressure CDG	0.0001-1 Torr
5		Start Switch	On/Off
6 (Note 1)			
7	7	Chamber Iso. Valves	Open/Closed
8	1	Top Argon Valve	Open/Closed
9	3	Top Recirc Valve	Open/Closed
10	6	Top Vacuum Valve	Open /closed
11	5	Bottom Argon Valve	Open/Closed
12	4	Bottom Recirc. Valve	Open/Closed
13		Blower Motor Forward	On/Off
14		Blower Motor Reverse	On/Off
15	2	Bottom Vacuum Valve	Open/Closed

Note 1: Channels 3 and 6 are used for the Helium Leak Detector Option, see HLD Addendum No. 21-11-1125.

Table 6-1 also shows the process system valves and their corresponding Electro/Pneumatic (E/P) control air signal valve number. The E/P valve stack (see figure 5-5) receives signals from the on-board micro-controller and outputs air signals to open or close the appropriate process valves in accordance with micro-controller programming instructions and process control recipes. Note that the micro-controller program closes each valve momentarily during each operating mode or state transition.

6.2.1 Auxiliary I/O Option

Auxiliary I/O capability for MRP control of external devices is available as optional equipment. See manual addendum number 21-11-1132 for additional information regarding auxiliary I/O capability.

6.3 System Operating Modes

The MRP-201 ELC is designed to support a variety of operating modes. The operating modes shown below were developed to maximize the module's capability to:

- One, eliminate contaminants from a process chamber, and
- Two, evacuate a process chamber

The operating modes for the standard MRP-201 are identified in the left hand column of Table 6-2. The active system components (blowers and valves) are shown across the top row of the table. Table 6-2 shows the position of each active component for each standard MRP-201 operating mode.

Table 6 -2 Summary of Active Component Positions by Operating Mode

Operating Mode (note 1)	Blowers	Bottom Recirc valve	Bottom Ar valve	Bottom Vac valve	Top Vac valve	Top Recirc valve	Top Ar valve	Chamber isolation valves
VAC	Off	C	C	O	O	O	C	O
SVAC F	FWD	C	C	O	C	O	C	O
SVAC R	REV	O	C	C	O	C	C	O
SWEEP F	FWD	O	O	O	C	O	C	O
SWEEP R	REV	O	C	C	O	O	O	O
FILL	Off	O	O	C	C	O	O	O
CFP F	Off	C	O	O	C	O	C	O
CFP R	Off	O	C	C	O	C	O	O
RECIRC F	FWD	O	C	C	C	O	C	O
RECIRC R	REV	O	C	C	C	O	C	O
ROR	Off	C	C	C	C	C	C	O
FILL- MRP	Off	O	O	C	C	O	O	C
OFF	Off	C	C	C	C	C	C	C
WAIT	Off	C	C	C	C	C	C	O

REV= Reverse FWD=Forward O=Open C=Closed

There are a number of additional operating modes associated with standard available options. These additional operating modes are described in the addenda for the applicable equipment option.

6.3.1 System Operating Modes- **VAC:**

As shown in Table 6-2 the VAC mode is defined as having both VAC valves open, the top RECIRC valve open, the bottom RECIRC valve closed and the chamber isolation valves open. The purpose of this mode is to evacuate the chamber to the level of vacuum supplied by the house roughing vacuum pump. The blowers are not running during this mode. Figure 6-5 shows a schematic of the VAC mode. Note that the top and bottom Argon valves and the blowers are darkened, indicating they are closed or off.

With the bottom RECIRC valve closed, the VAC mode allows the operator to verify that a chamber recirculation flow path is open. This is because of the location of the pressure monitoring instrumentation. When the VAC mode is entered, the CDGs should read the rough vacuum base pressure very quickly. If they do not indicate pressure readings consistent with the rough vacuum base pressure, then either the rough vacuum system is malfunctioning or the chamber flow path is obstructed.

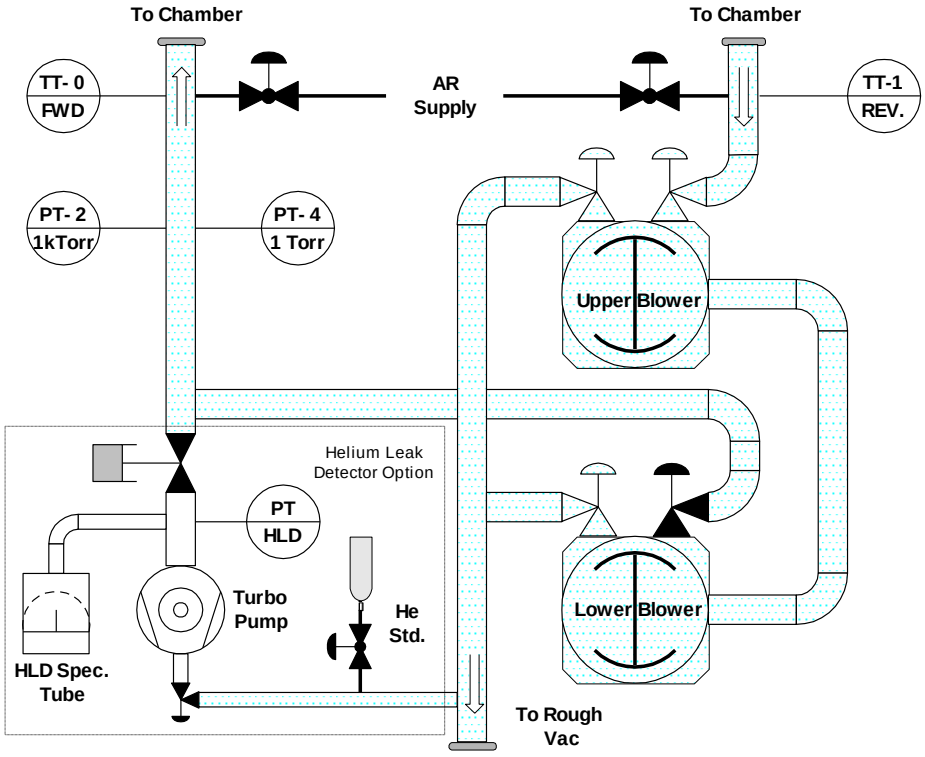

Figure 6 - 5 VAC

During the VAC mode, the word “VAC” will be displayed on the top line of the MRP display. Depending on the end condition, the current pressure, being monitored by the CDG’s, may or may not be displayed. See Section 6.4 for an explanation of the MRP messages displayed.

6.3.2 System Operating Modes - **SVAC F:**

SVAC F is defined as having the bottom VAC valve open, the top RECIRC valve open, the chamber isolation valves open, and the blowers turning in a forward direction. This will pull a vacuum on the manifold connected to the top blower. If the chamber isolation valves are not open, or if the lower manifold is not connected to the chamber being evacuated, the vacuum instrumentation will not be able to monitor the changing vacuum during this state.

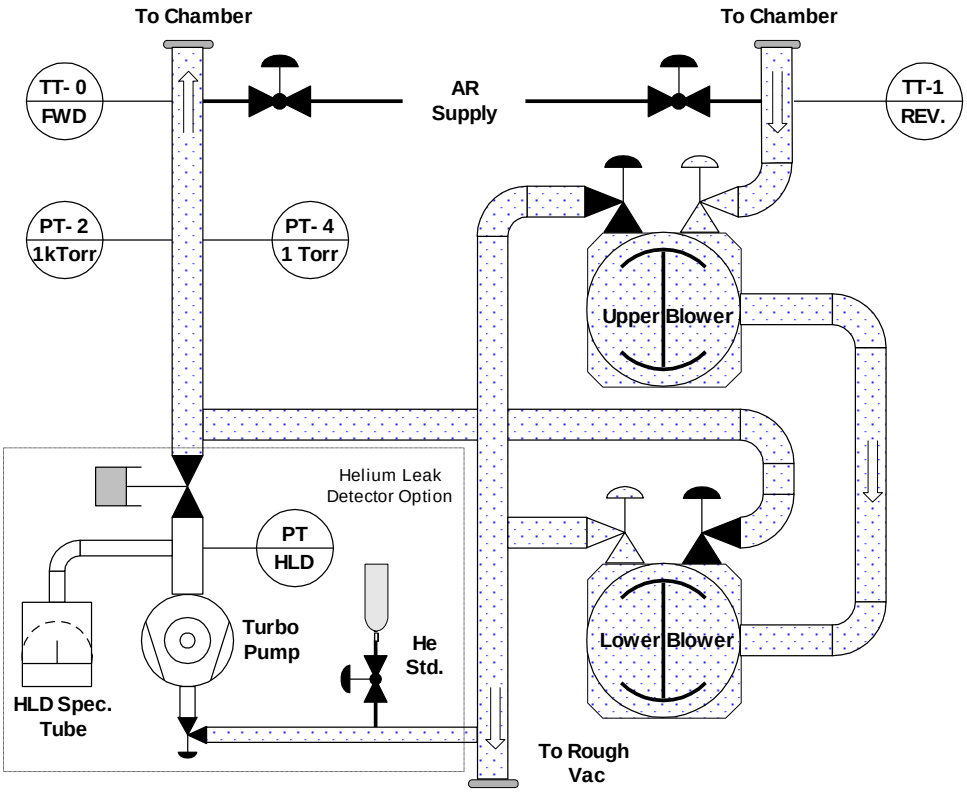

Figure 6 - 6 SVAC F

The purpose of this mode is to evacuate the chamber to a lower vacuum level than can be reached with the rough pump alone. The two blowers add a first stage to the rough pump and can add more than a decade of vacuum to the system. If the blowers overheat during this state there is a hard wired system trip (see the definition for the “Blower over temp switches” above) that will automatically shut both blowers down.

During the SVAC F mode, the word “SVAC F” will be displayed on the top line of the MRP display. Depending on the end condition, the current pressure, being monitored by the CDG’s, may or may not be displayed. See Section 6.4 for an explanation of the MRP display.

6.3.3 System Operating Modes - **SVAC R:**

SVAC R is similar to the SVAC F except the lower blower manifold is put under vacuum. The state is defined as having the top VAC valve open, the bottom RECIRC valve open, the chamber isolation valves open, and the blowers turning in a reverse direction. Putting the MRP in this mode will pull a vacuum on the manifold connected to the bottom blower. Because the vacuum instrumentation is on the lower blower manifold it will always read correctly in this state.

The purpose of this mode is the same as for SVAC F, to evacuate the chamber to a lower vacuum level than can be reached with the rough pump alone.

When this state is active, the word “SVAC R” will be displayed on the top line of the MRP display. Depending on the end condition, the current pressure, may or may not be displayed. See Section 6.4 for an explanation of the MRP message.

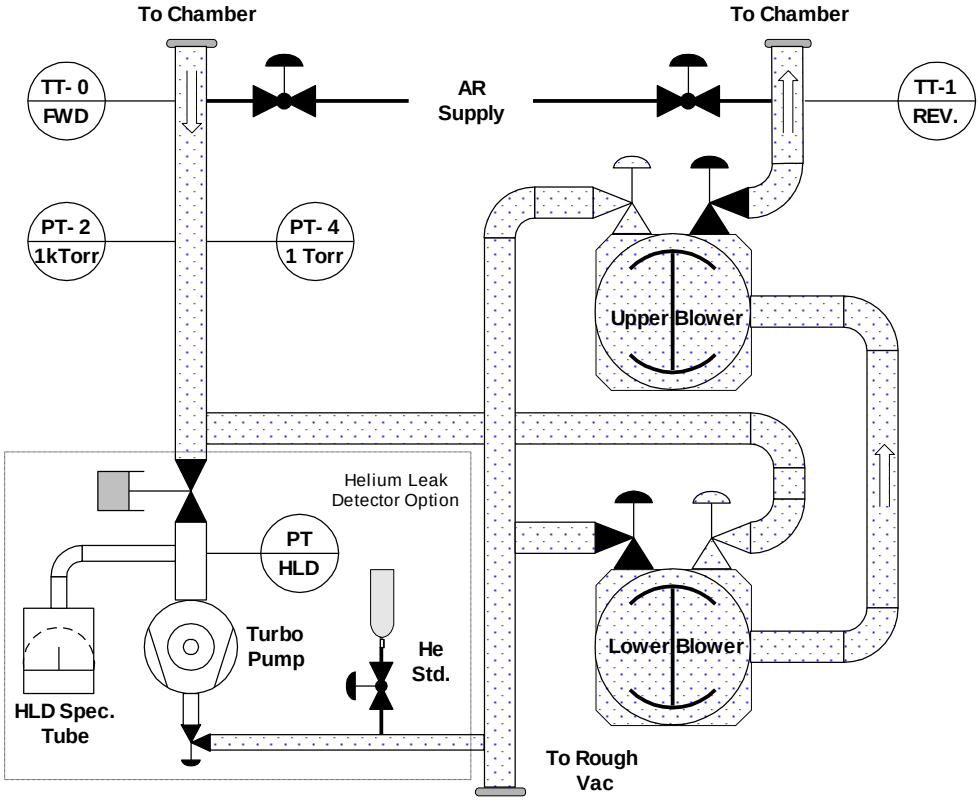

Figure 6 - 7 SVAC R

6.3.4 System Operating Modes **- SWEEP F:**

In SWEEP F, the system will automatically have the bottom VAC valve open, both RECIRC valves open, the top argon valve open, the chamber isolation valves open and the blowers turning in a forward direction. This will cause fresh gas to be introduced into the system, recirculated through the chamber via the blowers and then have some of it disposed to vacuum. Because fresh gas is being introduced, and the system is open to vacuum, the pressure the system is being swept with, is determined by the argon inlet pressure and flow rate, and the pumping speed of the rough vacuum system.

The purpose of this mode is to create a high velocity gas stream through the chamber to sweep particulates and moisture from the chamber surfaces. The orientation of the bottom VAC and RECIRC valves is designed to create an easier path for heavier particles and moisture to be exhausted, thereby returning primarily clean dry gas to the chamber.

During this mode**,** the word “SWEEP F” will be displayed on the top line of the MRP display. Depending on the end conditions defined in the recipe, other information may also be displayed. See Section 6.4 for an explanation the MRP message.

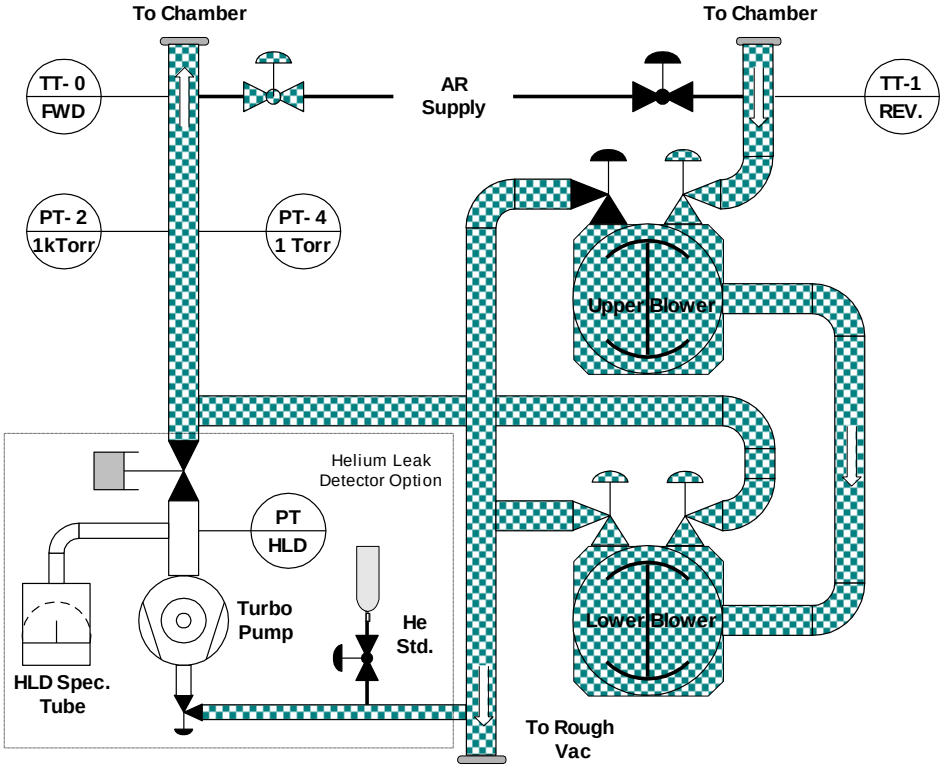

Figure 6 - 8 SWEEP F

6.3.5 System Operating Modes - **SWEEP R:**

SWEEP R is similar to the SWEEP F state, except the gas stream flows in the opposite direction. The top VAC valve is open, both RECIRC valves are open, the bottom argon valve is open, the chamber isolation valves are open, and the blowers are turning in a reverse direction. This will cause fresh gas to be introduced into the system, recirculate through the chamber via the blowers and then have some of it disposed to vacuum.

The purpose of this mode is the same as that for SWEEP F; to create a high velocity gas stream through the chamber to sweep particulates, and moisture from the chambers surface. The orientation of the top VAC and RECIRC valves is similar to that of the bottom VAC and RECIRC valves. It creates an easier path for heavier particles and moisture to be exhausted, thereby returning primarily clean dry gas to the chamber.

During this mode, the word “SWEEP R” will be displayed on the top line of the MRP display. Depending on the end conditions defined in the process control recipe, other information may also be displayed on the MRP display. See Section 6.4 for an explanation the MRP message.

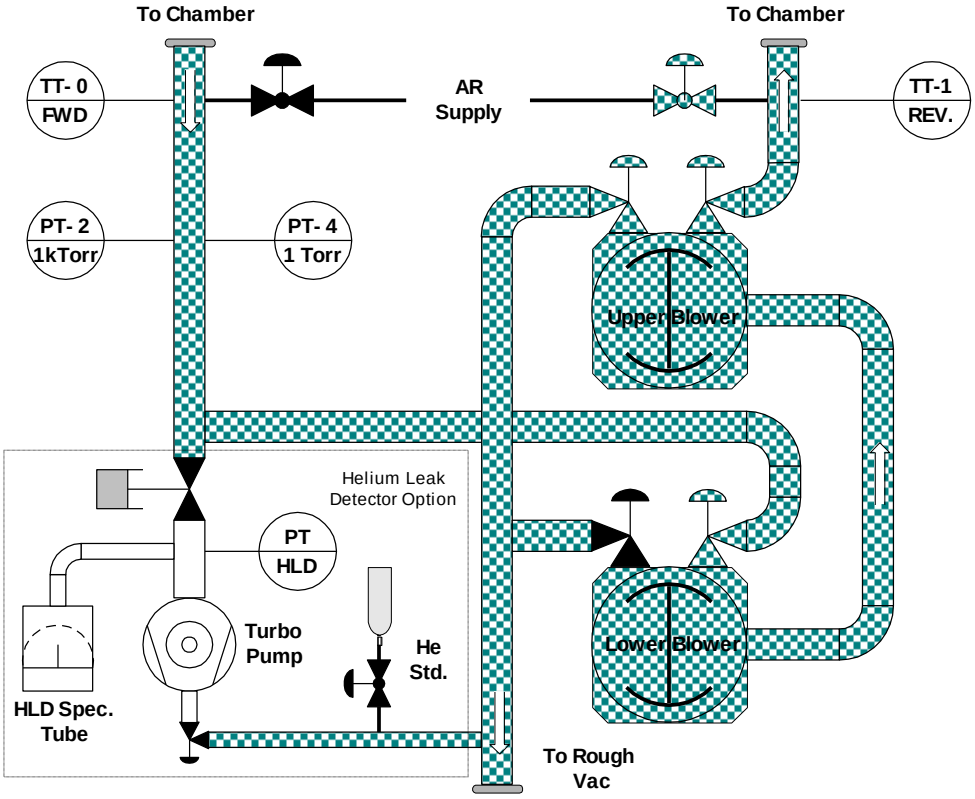

Figure 6 - 9 SWEEP R

6.3.6 System Operating Modes - **FILL and FILL-MRP:**

FILL requires top argon valve open, both RECIRC valves open, and the chamber isolation valves open. FILL-MRP is the same as fill except that the chamber isolation valves are closed. This will result in fresh gas being introduced into the system. If the pressure in the system exceeds 10 psig, the springs on the vacuum valves will allow the gas to escape through the blowers to the rough vacuum port.

The purpose of this mode is to fill the chamber and manifold with fresh dry gas prior to a recirculation state or heating the chamber using the internal bake out lamps. The purpose of the FILL-MRP mode is to fill the MRP unit with fresh dry gas after completing a process to put the MRP into a 'lay-up' condition

As mentioned above, the maximum pressure of the system will be less than 10 psig due to the orientation of the springs on the Varian block valves. The speed of the filling step will be determined by the pressure and flow of the incoming gas, as well as the chamber size. Thus, if a low chamber pressure is desired, it may be necessary to regulate the flow of gas to the MRP.

During this mode, the word "FILL" (or "FILL-MRP") will be displayed on the top line of the MRP display. Depending on the end conditions defined in the recipe, other information may also be displayed on the MRP display.

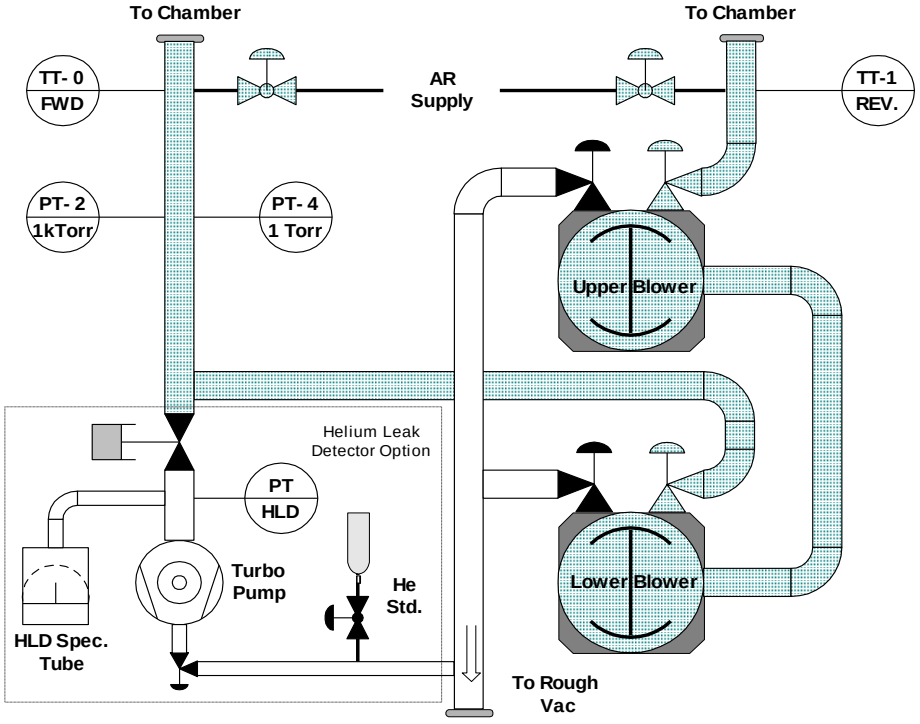

Figure 6 - 10 FILL and FILL-MRP

6.3.7 System Operating Modes **- CFP F:**

In the CFP F (Continuous Flow Purge) mode, the bottom argon valve, the bottom VAC valve, the top RECIRC valve and the chamber isolation valves will be open. This will result in fresh gas being introduced into a system that is being kept under vacuum. The blowers are not running in this mode but are still included in the gas path.

This mode is similar to the SWEEP modes except that the gas has a longer dwell time in the chamber. If the chamber bake out lamp or other chamber heaters are very good, CFP may be preferable to SWEEP. CFP may also be preferable if there are components in the chamber that can not withstand a high velocity flow of gas. As for the SWEEP states, the pressure maintained in the system during this state will be determined by the pressure and flow of the incoming gas and the pumping speed of the vacuum system.

While in this mode, the word “CFP F” will be shown on the top line of the MRP display. Depending on the end conditions defined in the process control recipes, other information may also be shown on the MRP display. See Section 6.4 for an explanation of the MRP message.

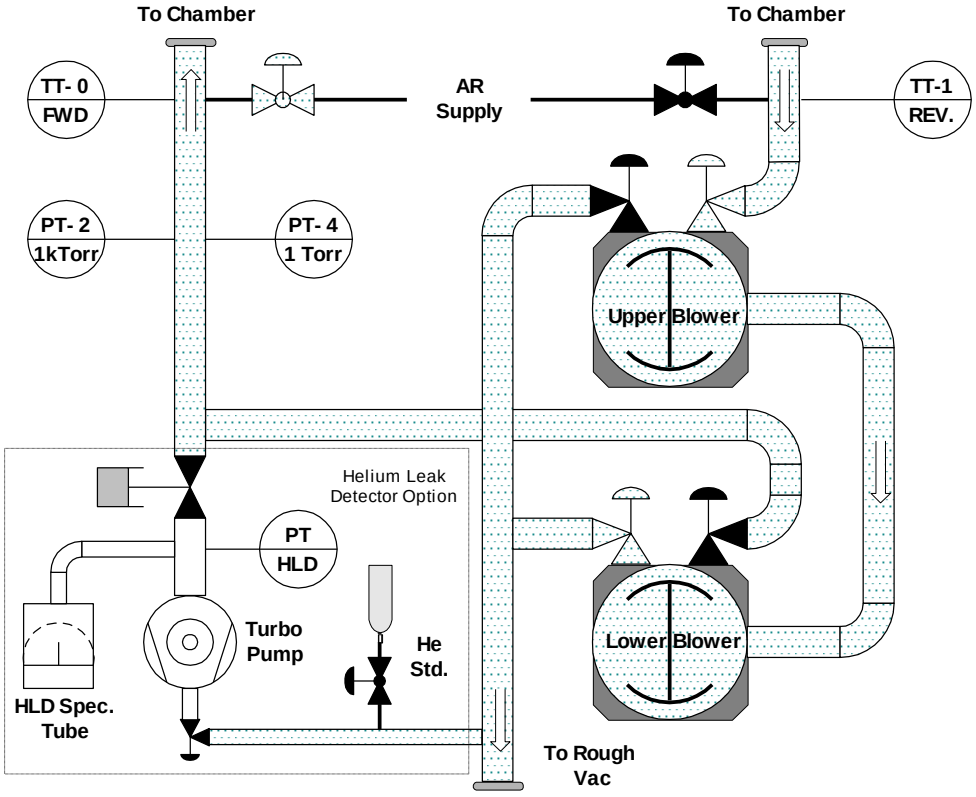

Figure 6 - 11 CFP F

6.3.8 System Operating Modes - **CFP R**

CFP R is similar to CFP F except, the direction of gas flow has been reversed. The top argon valve, the top VAC valve, the bottom RECIRC valve, and the chamber isolation valves are open for this state. This will result in fresh gas being introduced into a system that is being kept under vacuum. The blowers are not running in this mode.

This mode is similar to the SWEEP states except that the gas has a longer dwell time in the chamber. When the chamber bake out lamp or other chamber heaters are very efficient, CFP may be preferable to SWEEP. CFP may also be preferable if there are components in the chamber that can not withstand a high velocity gas flow. As with the SWEEP modes, the pressure maintained in the system during this mode will be determined by the pressure and flow of the incoming gas and the pumping speed of the vacuum system.

During this mode, the word “CFP R” will be displayed on the top line of the MRP display. Depending on the end conditions defined in the process control recipe, other information may also be shown on the MRP display. See Section 6.4 for an explanation of the MRP message.

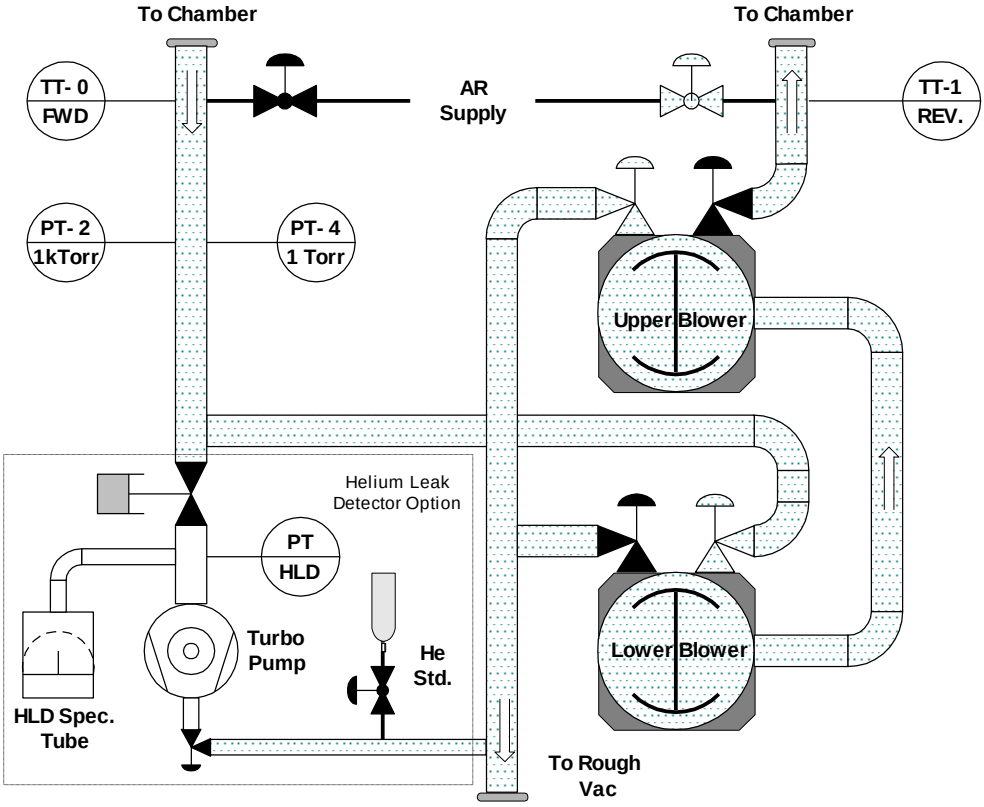

Figure 6 - 12 CFP R

6.3.9 System Operating Modes - **RECIRC F:**

In the RECIRC F both RECIRC valves will be open and the blowers will run in the forward direction. This state is a closed loop state recirculating the same gas through the chamber at high velocities. Due to the restrictions in the blowers, chamber, and connecting manifolding, the gas is compressed at the outlet of the second blower.

This mode was designed to take advantage of the heat developed by compressing the gas over and over again in a closed loop. As it heats up, the clean dry gas can absorb more moisture than the same amount of cold gas. In this fashion we can charge the system with dry gas, recirculate the gas to absorb moisture, and then expel it using a VAC or SWEEP mode.

During this mode, the word “RECIRC F” will be displayed on the top line of the MRP display. Depending on the end conditions defined in the process control recipe, other information may also be shown on the MRP display. See Section 6.4 for an explanation of the MRP message.

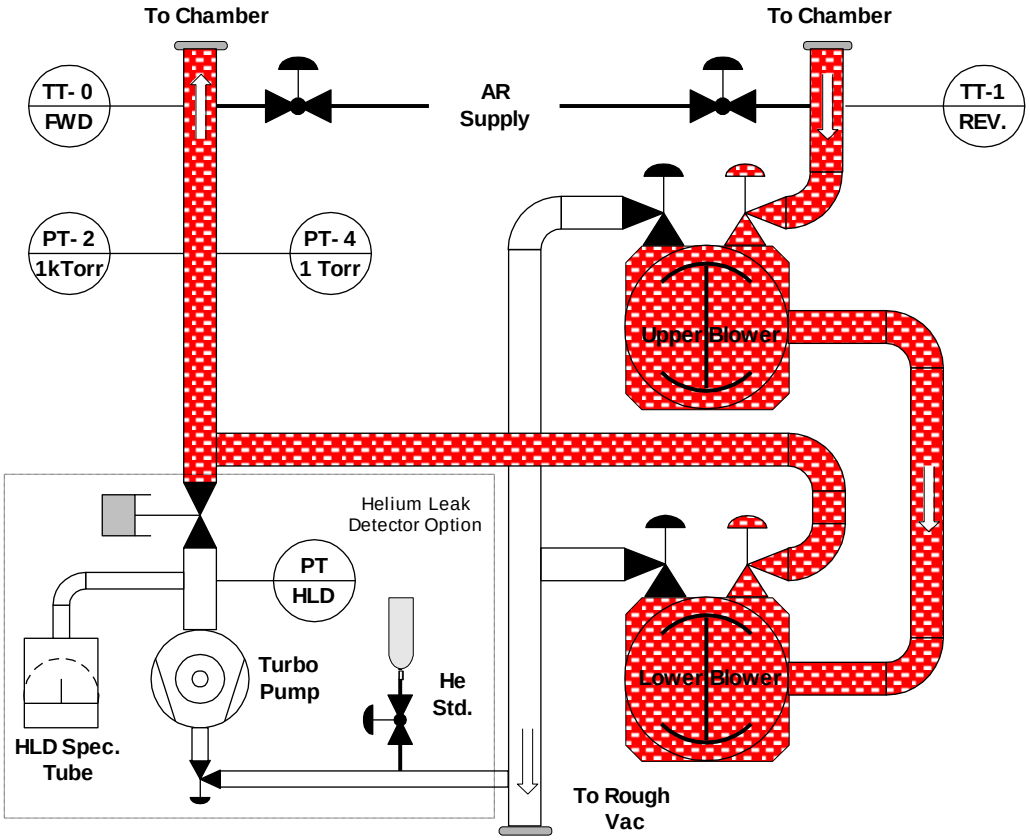

Figure 6 - 13 RECIRC F

6.3.10 System Operating Modes **- RECIRC R:**

RECIRC R is the same as RECIRC F, except the gas will flow in the opposite direction. RECIRC R is defined as having both RECIRC valves open and the blowers turning in the reverse direction. This mode is a closed loop state recirculating the same gas through the chamber at high velocities. Due to the restrictions in the blowers, chamber, and connecting manifolding, the gas is compressed at the outlet of the blower.

This mode was designed to take advantage of the heat generated by compressing the gas over and over again in a closed loop. As it heats up, the clean dry gas can absorb more moisture than the same amount of cold gas. In this fashion we can charge the system with dry gas, recirculate the gas to absorb moisture, and then expel it using a VAC or SWEEP mode.

During this mode, the word “RECIRC R” will be displayed on the top line of the MRP display. Depending on the end conditions defined in the recipe, other information may also be displayed on the MRP display. See Section 6.4 for an explanation of the MRP message.

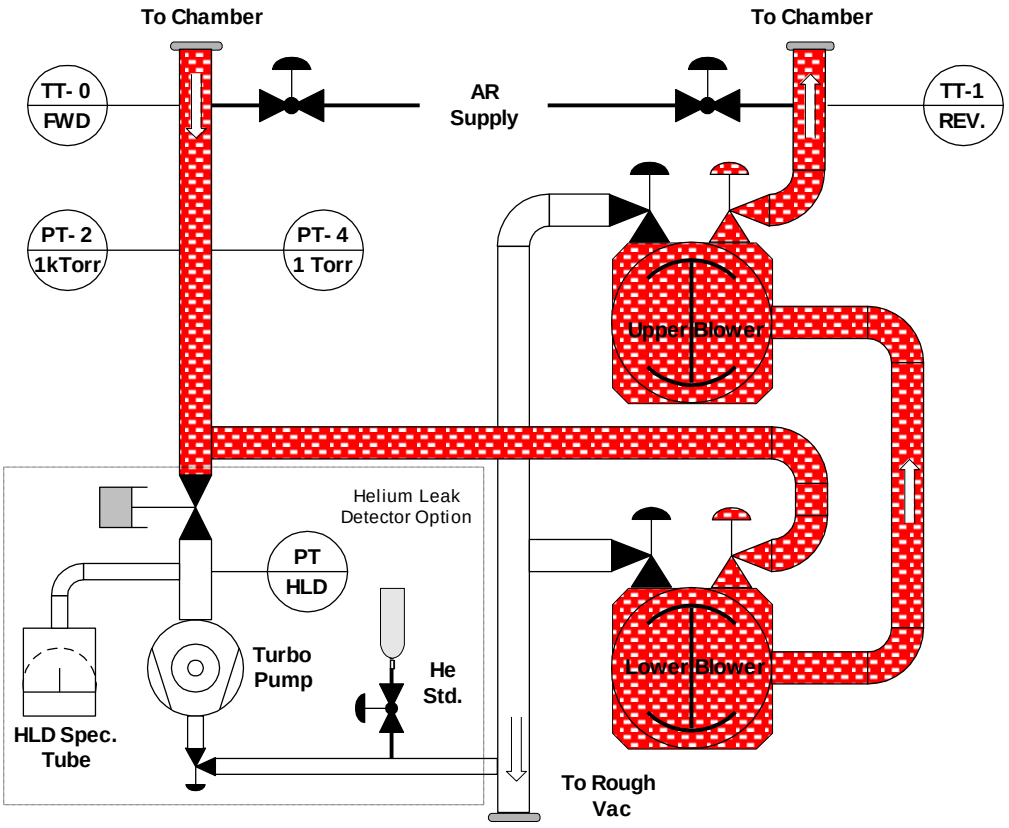

Figure 6 - 14 RECIRC R

6.3.11 System Operating Modes - **ROR and RORI:**

As shown in Table 6-2 and figure 6-11,the VAC, RECIRC and Argon supply valves will be closed in both the ROR and RORI modes. In the RORI mode the chamber isolation valves are also closed. The purpose of these modes is to measure the rise in pressure over time. The ROR mode uses the MRP's vacuum gauges, while the RORI mode is designed to use external gauges to measure the pressure rate of rise in the chamber only. The blowers are not running in this mode.

When this mode is active, the word "ROR" (or "RORI") will be displayed on the top line of the MRP display. The end condition defined for ROR is time. The time value will be displayed as a count down timer until the it gets to a value of zero. If the key press is also defined as an end condition, the time value will count up starting at the end value, until the start key is pressed. If no keypress end condition is defined, the ROR mode will be completed when the time value goes to zero. In addition to the time value being displayed, the current pressure value will be displayed.

At the end of the time value the average rate of rise will calculated and shown on the MRP display right after the word ROR (or RORI) on the first line. This display will only be momentary unless a keypress end condition is defined.

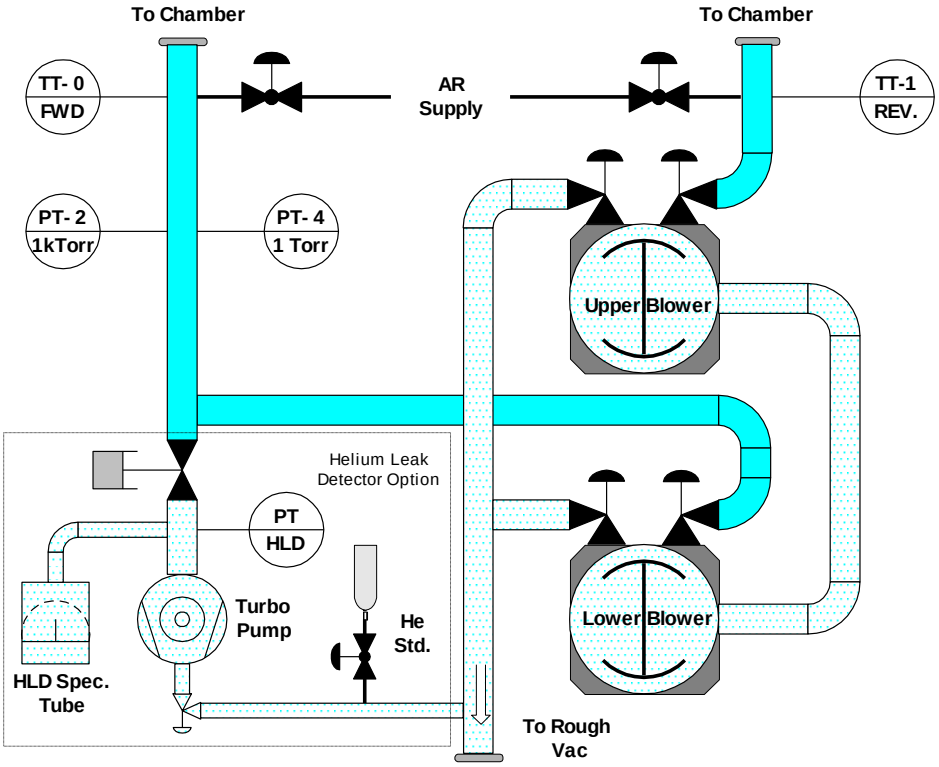

Figure 6 - 15 ROR and RORI

6.3.12 System Operating Modes - **OFF and WAIT:**

In the OFF and WAIT modes, the argon supply, RECIRC, and VAC valves to be closed. In the OFF mode, the chamber isolation valves are closed, while in the WAIT mode the chamber isolation valves are open.

The OFF mode is used as the last step in a process control recipe to place the MRP in a shut down condition. The WAIT mode is used to stabilize the MRP and process chamber immediately prior to performing a ROR test. The normal end condition for both modes is time.

During this mode, the word “OFF” (or “WAIT”) will be displayed on the top line of the MRP display. Depending on the end conditions defined in the recipe, other information may also be displayed on the MRP display. See Section 6.4 for an explanation of the MRP message.

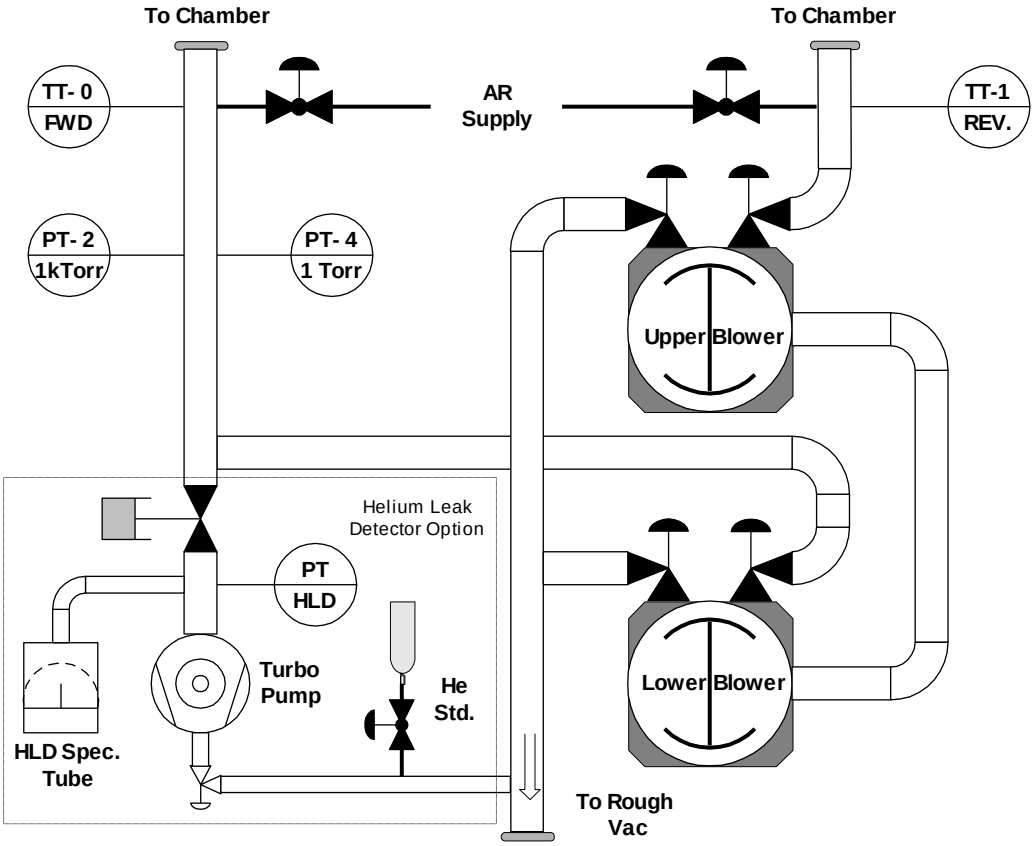

Figure 6 - 16 OFF and WAIT

6.4 System Operating Logic

The logic used by the process control recipes to switch between operating modes is defined in terms of END CONDITIONS. End conditions are defined as an input to the micro-controller that will cause an operating mode or state transition. When a defined end condition is met for a particular operating mode or state, the process control recipe(s) will initiate the next programmed operating mode or state. If an interlock end condition is met, the program will not transition to the next operating mode or state in the process control recipe, but will shut down the unit, display a special message, and wait for an operator input. A description of the various end conditions provided for process control recipe steps is provided below. Note that the Process Control Recipe Editor (PCREditor) Software Users Manual provides a complete explanation of how to use end conditions within recipe steps.

Time:

If time is the end condition for a particular operating mode or state, the program will keep track of the time that the mode or state begins. Once the time value specified has been reached, the process control recipe will then transition to the next operating mode. The current time, or the time remaining (dependent upon the program), will be shown on the MRP display. Time as an interlock may be used on FILL and VAC modes to confirm that the gas supply or vacuum system is indeed operational.

The system also includes the capability to specify a Variable Time Length Interlock (VTLI) for final value end conditions. The VTLI is used to place the MRP in an OFF state if the specified Final Value end condition is not achieved in the expected/specified time period. The VTLI must be added to a process control recipe step with a final value end condition using the PCR Editor software.

Digital Input:

The digital input end condition defined for the MRP program is the ‘Keypress’ or Start button on the MRP. When a Keypress end condition is defined (in a process control recipe) for a recipe step, the system will not transition to the next operating mode or state until the start button is pushed. For Example if the SWEEP-F step contains only a Keypress end condition, the top line of the MRP display would read “SWEEP F” and on the bottom line “Press Start.” As previously indicated, the SWEEP-F mode would remain active until an operator pressed the Start button.

6.4 System Operating Logic (continued)

Analog IV10:

The CDG vacuum gauge pressure readings are analog IV10 inputs to the MRP-201 micro-controller. When used as Final Value End Condition(s) for a recipe step, the MRP-201 ELC will transition to the next operating mode or state after the vacuum gauge being monitored has reached the specified final value. Figure 6-17 shows an example of a typical MRP message during a recipe step with a final value end condition.

There are three interlock end conditions defined for the MRP via the PCREditor software. These interlock conditions use pressure readings from the CDG's and are designed to prevent the blowers (and blower motors) from over heating in a dead-head condition. An interlock condition will automatically shut down the blowers and place all system valves in a safe position. The MRP will display a message identifying the interlock condition causing the system trip. The MRP will not restart until the interlock condition is cleared. See the PCREditor Software Users Manual for additional details regarding interlock end conditions.

In the case of a blower high temperature trip occurring, the MRP-201 ELC front panel must be opened, the thermodisk must be reset, and then, the operator may press the start button to continue. The MRP-201 ELC will not restart until the Thermodisks are reset.

Analog ITCJ:

The forward and reverse temperature inputs are the two analog ITCJ inputs to the MRP's micro-controller. When used as final value end conditions, the MRP will transition to the next operating mode after the temperature input being read has reached its specified value. This type of input also can not be used to define an interlock type of end condition. Figure 6-17 shows an example of a typical MRP message during a recipe step with a final value end condition.

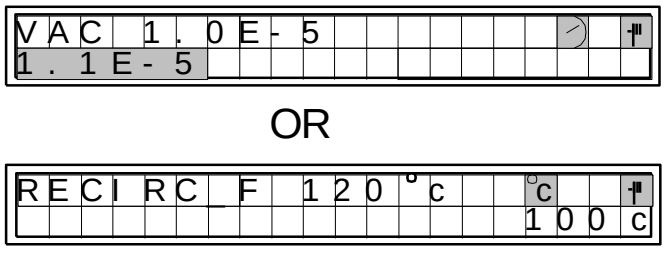

Figure 6 - 17 MRP Analog Display

6.5 Sequence of Operations

As previously mentioned, the MRP-201 is capable of being programmed to automatically cycle through any number and sequence of operating modes (up to 255 steps). For the purpose of this discussion, an example of a simplified operating cycle will be used. The flow chart shown in figure 6-18 depicts the process control recipe described below.

VAC
The first operating mode after initial start-up of the module should always be VAC. This will preliminarily evacuate the process chamber for either a specified period of time, or until a specified vacuum pressure is reached. When either of the specified conditions is met, the process control recipe will automatically switch the MRP-201 to the next operating mode.

FILL
After the initial VAC run, the system will enter the FILL mode to fill the chamber with high purity Argon gas. The module will inject Argon gas, usually until a specified chamber pressure (e.g.1,000 Torr) is reached and then automatically switch to the next mode, usually RECIRC.

RECIRC
During the sweep mode, either forward or reverse, the Argon gas is heated and recirculated through the chamber to entrain as many contaminants as possible. The RECIRC mode will typically run until a specified temperature is reached and then automatically switch to the SWEEP mode.

SWEEP
In the sweep mode, the MRP-201 pumps fresh Argon gas at high velocity through the process chamber. This operation will entrain the remaining moisture and /or other contaminants in the gas stream. The SWEEP mode typically runs for a specified period of time. At the end of the specified time period, the process control recipe will automatically switch the MRP-201 to the next mode. The system can also be programmed to continue the SWEEP until the operator provides input via pressing the Start button (Keypress).

CFP
Upon completion of the SWEEP mode the system will typically switch to a Continuous Flow Purge (CFP) operating mode. This mode is used to remove contaminants left from the SWEEP mode and introduce fresh high purity Argon into the system. The CFP mode will usually run for a specified time period before automatically switching to the next step in the process control recipe, usually SVAC.

6.5 Sequence of Operations, continued

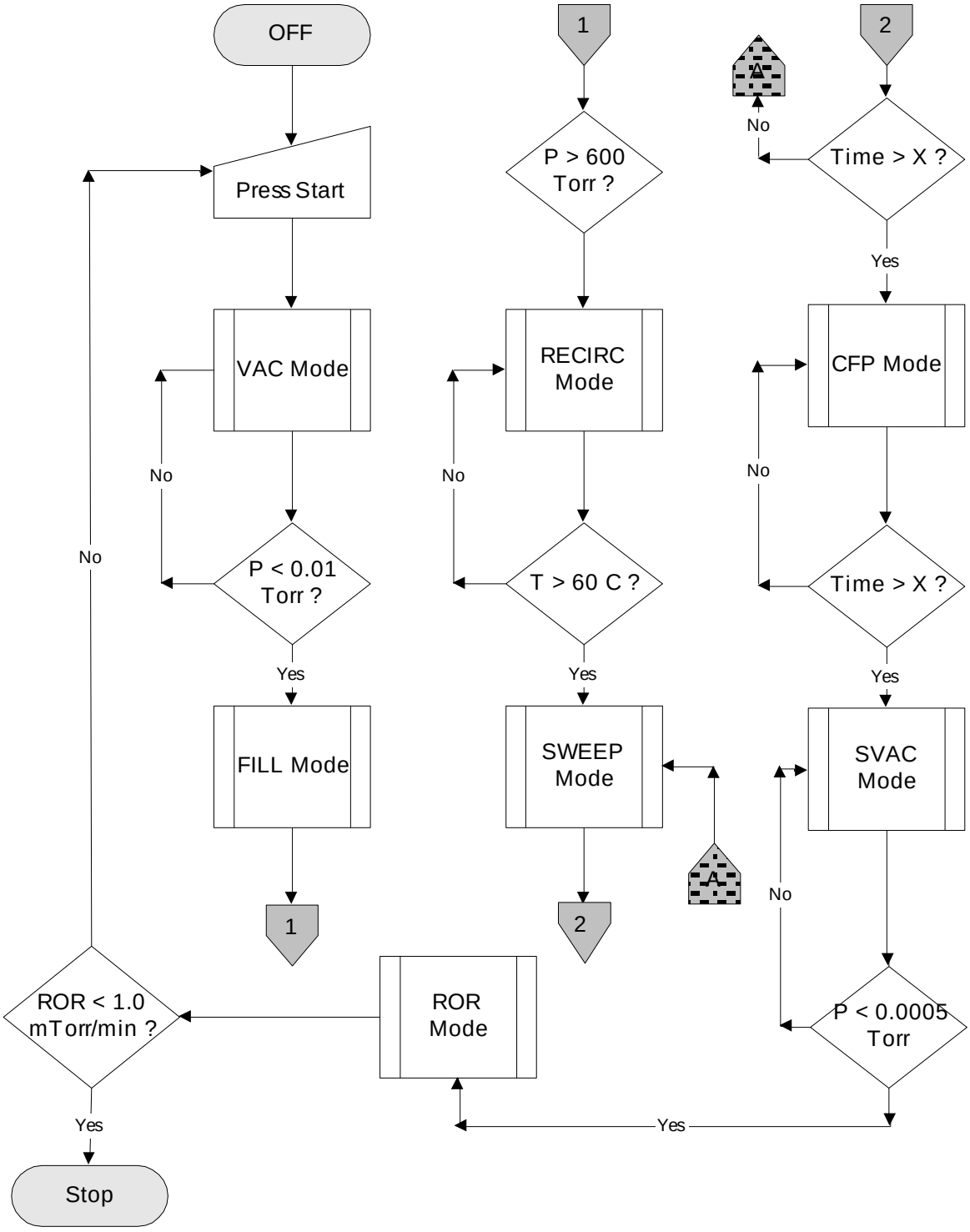

Figure 6 - 18 Process Control Recipe Flow Chart

6.5 Sequence of Operations, continued

SVAC

The SVAC mode evacuates the chamber to an extremely low vacuum pressure (<0.0005 Torr). The system will typically remain in the SVAC mode until the vacuum pressure is reached or the operator provides Keypress input. Upon completion of the final chamber evacuation, the system will be ready to perform a Rate of Rise calculation.

ROR

During the Rate of Rise (ROR) calculation, the MRP-201 is essentially shut down in a WAIT mode while monitoring the chamber pressure. The system evaluates the pressure data to determine if the rate of pressure rise per unit time is acceptable in accordance with pre-established criteria. If the pressure rise per unit time is too great, then either there is a leak in the chamber system or, there is still a significant amount of contaminants remaining in the chamber. If the rate of pressure rise is unacceptable, the process control recipe described above ,or some variation above is repeated until a satisfactory result is achieved.

The operational sequence described above is an example of how the MRP-201 performs chamber decontamination and evacuation. The number, type and sequence of operating modes, and the type of switching logic used may be custom configured to perform a wide variety of chamber processing activities. The actual process control recipe programming performed should be based on operator experience and specific facility/chamber requirements.

If the MRP is being monitored by the Visual Control System (VCS) software, and a communications failure occurs, the MRP will continue the current process. However, if the operator sends a Reset command via the VCS software, the MRP will abort the current recipe, and automatically reset itself to the OFF or ready state. See the VCS Users Manual for a detailed explanation of MRP computer control features and functions.

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7.0 Maintenance

The following maintenance instructions may or may not require power to the equipment. For example, calibration of the CDG's requires the power to be on, and is a Semi-S2 Type 3 Electrical Task . **NEVER** attempt any task that requires the power on without first checking to be **CERTAIN** that this can be performed safely.

7.1 General Maintenance

There are a variety of maintenance programs available to support any size installed base of Nuvac Innovations equipment. Contact your Galiso/Nuvac representative to determine which program is best suited to your needs. Several items that require attention periodically include:

A. Vacuum Gauge Calibration

The CDG vacuum gauges need to be calibrated periodically to ensure they are reading accurately. Perform gauge calibration in accordance with the instructions provided in Section 5.11.

B. Check Lubricant Level

The blower lubricant level should be checked approximately every 500 hours. Figure 7-1 shows the sight glass locations on the blower. If the level is significantly below midway up the sight glass contact your Galiso/Nuvac representative for instructions. Note that the blower must be warmed up, but not running to check the lubricant level.

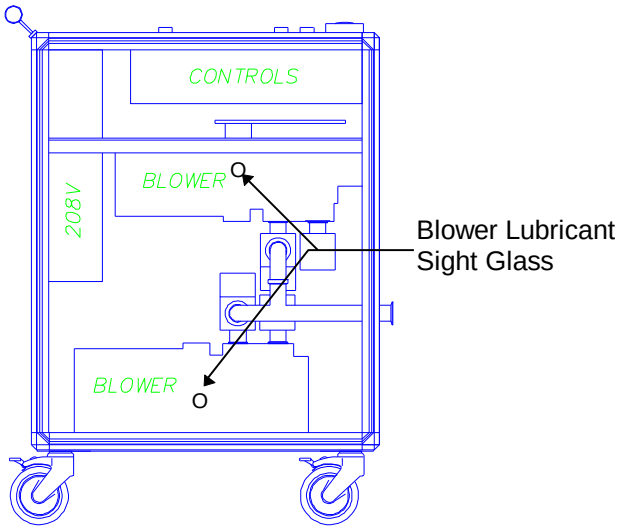

Figure 7 - 1 Blower Lubricant Sight Glass Locations

7.2 Troubleshooting

There are several performance indications that may require additional inspection and/or component replacement. See table 7-1 for spare/replacement parts list.

Indicator	Recommended Action
1. Blower not running	Check Thermodisks and reset and/or replace as necessary. Check 15 amp fuses in high voltage enclosure, replace as necessary. Check Thermal Overload switch, reset button in high voltage enclosure.
2. Fan(s) not running	Check 6 amp fuses in high voltage enclosure, replace as necessary.
3. Can’t maintain base vacuum	Check rough vacuum system for malfunction. Check connecting piping for leaks, repair as necessary, contact your Galiso/Nuvac representative for additional instructions.
4. Machine won’t restart	Check 1 amp fuse in high voltage enclosure and replace as necessary.

7.3 Recommended Spare Parts List

Table 7-2 shows the spare parts recommended for the MRP-201 ELC.

TABLE 7 - 1 Recommended Spare Parts List

Galiso Part No.	Description Of Item	Quantity Per Unit
200-4f-4007	Blower Assembly - Upper	Note 1
200-4f-4000	Blower Assembly - Lower	Note 1
88-11-0004	Fuse, 6 Amp, Buss	3
88-11-0018	Fuse, Time Delay, Class CC, 15 Amp	8
88-11-0069	Fuse, Fast Acting, Class CC 1 Amp	2
77-38-1100	VCR-4 Gaskets	8
54-99-0035	Nuvac Lubricant	1.000
89-11-0508	J Type Thermocouple Probe	1
87-11-0131	Temp. Switch, Man. Reset, 200F	1
37-11-8221	Pressure Transducer, 1K Torr, CDG	1
37-11-8227	Pressure Transducer, 0.1 Torr, CDG	1
86-11-6015	VFD Display Module	1
46-11-0012	6” Axial Fan, 240 CFM, 230 V	1
89-11-7054	Timer, Motor Coil 1.5-30s	1
89-11-3036	Control Relay, 24VDC Interface	1
89-11-3038	18A 220v 50/60 Hz Contactor, Rev.	1
89-11-3041	40A,24V,50/60Hz AC Coil Contactor	1
85-11-0528	Status Bulb	1
81-11-3002	Angle Block Valves	2
200-41-6483	Serial Comm. Cable	1
86-11-9425	MicroDac Controller	Note 1

Note 1: These field replacement units may replaced as necessary at the factory during a regularly scheduled overhaul.

7.4 Return of Equipment

The following instructions are provided if it has been determined that the unit must be returned to the factory for maintenance or replacement.

7.4 Return of Equipment, continued

A. Collect the following information:

- Galiso/Nuvac Part number: _____
- Equipment Serial Number:_____
- Equipment Description: _____
- Reason For Return: _____

B. Complete the CERA97 Service Exposure Report, attached, for transmittal to Galiso, Inc. The CERA97 form may be transmitted by Fax to the attention of:

- Nuvac Customer Service; Fax no. (970) 249-0607

C. Contact your Galiso/Nuvac representative at (970) 249-0233 and request a Return Authorization number. You will be required to supply the information gathered above in order to obtain a Return Authorization number.

D. Your Galiso/Nuvac representative will provide a Return Authorization number as well as shipping instructions. Always include the Return Authorization number on the outside of the shipping container.