




## ***VersaPrep/VersaLock*** **Operator's Guide**

Part No. 723437 Rev. 6

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# ULVAC-PHI Safety Notices

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ULVAC-PHI's products are designed and manufactured in compliance with accepted worldwide practices and standards to provide protection against electrical and mechanical hazards for the operator and the area surrounding the product. All ULVAC-PHI's products are designed and intended for professional use only, by skilled **"operators"** for their intended purpose and according to all of the instructions, safety notices, and warnings provide by ULVAC-PHI.


Those instructions, notices, and warnings assume that an "operator" will not employ any tool when using ULVAC-PHI products. They further assume that all operators clearly understand that use of ULVAC-PHI products in any manner not specified by ULVAC-PHI may impair the protection provided by the products and expose them to hazards.

A **"technician"** is a qualified servicing individual who:

- Has received training to work with voltages above 50 V,
- Has read and understood the ULVAC-PHI technician's manual for the equipment,
- Observes and understands all safety notices on ULVAC-PHI equipment.

The safety symbols that ULVAC-PHI uses are defined on the following page.\* To reduce or eliminate hazards, technicians and operators of this equipment must fully understand these symbols.

ULVAC-PHI's products are installed with international-style or **ANSI**<sup>†</sup>-style safety notices, according to site requirements. International notices are symbols within triangles (alerts) or circles (mandatory actions). ULVAC-PHI's ANSI-style safety notices contain:

- One of three signal words (in all capitals) preceded by the general caution symbol ();
- One of ULVAC-PHI's safety symbols along with a brief description of the hazard and the risk or injury that could occur;
- Short message that observes ANSI's Hazard Alert Trilogy Rule by identifying the hazard, the possible result of ignoring the notice, and how to avoid the hazard.

The three signal words are defined as follows:

- **DANGER**—imminently hazardous situation that, if not avoided, will result in death or serious injury;
- **WARNING**—potentially hazardous situation that, if not

avoided, could result in death or serious injury;

- **CAUTION**—potentially hazardous situation or unsafe practice that, if not avoided, may result in minor or moderate injury or damage to equipment.

**SEMI**<sup>‡</sup> standards require identification of type 3, 4, and 5 electrical maintenance tasks in equipment manuals:

- **Type 3** electrical maintenance tasks involve energized equipment, exposed live circuits, and possible accidental contact; potential exposures are less than 30 V RMS, 42.2 V peak, 240 V-A, and 20 J.
- **Type 4** is the same but potential exposures are greater than 30 V RMS, 42.2 V peak, 240 V-A, and 20 J or radio frequency is present.
- **Type 5** tasks involve energized equipment and measurements and adjustment require physical entry into the equipment, or equipment configuration will not allow the use of clamp-on probes.

Only experienced, trained technicians should attempt to perform type 3, 4, or 5 electrical maintenance tasks.

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\* Many of ULVAC-PHI's safety symbols are provided and copyrighted by Clarion Safety Systems LLC, Milford, PA.

† American National Standards Institute, 1430 Broadway, New York, NY 10018.

‡ Semiconductor Equipment and Materials International, 805 E. Middlefield Rd., Mountain View, CA 94043-4080.



Voltages may be present that could cause death or personal injury.



Visible or invisible radiation may be present that could cause personal injury.



A potentially dangerous magnetic field may be present.



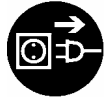
Caution (General risk). Refer to the manual(s) before proceeding.



Hot surfaces may be present that could cause personal injury.



An environment with depleted oxygen may be present that could cause death or personal injury. Open at least 2 doors and wait 2 minutes before entering the enclosure.



Pulling the plug from its power source before servicing is mandatory.



Turning off the power switch before servicing is mandatory.



Wearing protective gloves is mandatory.



A pinching point is present that could cause personal injury.



Refer to the manual(s) before proceeding.



Wearing eye protection is mandatory.



A risk of explosion or implosion may be present that could cause personal injury.



Contents are under pressure.



Wearing foot protection is mandatory.



A harmful or irritant material may be present that could cause personal injury.



This is the location of the protective grounding conductor terminal.



Lifting with assistance or equipment could cause personal injury.



Extremely low temperatures may be present that could cause personal injury.



This is the location of the fuse.



An overhead door is present that could cause personal injury. Do not work under door without auxiliary door supports installed.



A risk of fire may be present that could cause personal injury.



This is the location of an earth (ground) terminal.

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# LIMITED WARRANTY

## Basic Warranty

Except as otherwise provided herein, the Seller warrants to Buyer that the equipment sold hereunder, is new equipment and is, at the time of shipment to Buyer from Seller, free from defects in material and workmanship. As Buyer's sole exclusive remedy under this warranty Seller agrees either to repair or replace, at Seller's sole option and free of part charge to Buyer, any part or parts of such equipment which, under proper and normal conditions of use prove to be defective within twelve (12) months from the date of receipt by the Buyer. Warranty period for equipment requiring installation by Seller will commence on completion of standard installation services. If, customer delays installation beyond forty-five (45) days after delivery, the warranty period will commence to run forty-five (45) days after delivery. Seller reserves the right, at its own discretion, to perform preventative maintenance services including but not limited to realignment, readjustment, recleaning, or recalibration during said warranty period.

## Exclusions and Limitations

It is recognized that some parts by their nature (expendable items), may not function one year; therefore, excluded from the foregoing warranty are filaments, anodes, cathodes, multipliers, retard grids, special ceramics, ionizers, along with other such parts mentioned in the applicable operating manual.

The foregoing warranty excludes certain major items or accessories specifically indicated on applicable price lists or quotations, as to which Seller passes to the Buyer whatever warranty is provided to Seller by the manufacturer or the specific warranty indicated by the price list or quotation.

This warranty does not cover loss, damage, or defects resulting from transportation to the Buyer's facility, improper or inadequate maintenance by Buyer, buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the equipment or improper site preparation and maintenance.

## **Product Services**

All claims must be brought to attention of Seller within thirty (30) days of the failure to perform.

Seller at his option may require the product to be returned to the factory, transportation prepaid for repair.

## **Refund of Purchase Price**

In lieu of the foregoing, Seller may at anytime elect, in its sole discretion, to discharge its warranty by accepting the return of such equipment and refunding any portion of the purchase price paid by Buyer.

## **Software and Firmware Products**

The sole exclusive warranty applicable to software and firmware products provided by Seller for use with a processor will be as follows: Seller warrants that such software and firmware will conform to Seller's program manuals current at the time of shipment to Buyer when properly installed on that processor. Seller does not warranty that the operation of the processor software or firmware will be uninterrupted or error-free.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. SELLER EXPRESSLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

## **Exemption of Liability on Reactor Vessel**

The product is designed to realize customers various needs. For this purpose, ULVAC-PHI does not constrict customers and not only opens every necessary information for safety but also supplies every necessary consumable parts to the customers unless all rights are preserved. The customer is responsible in use and disposal of chemical gas especially it shall meet laws, local regulations and the customer's private regulations. ULVAC-PHI shall be exemption of liability in anything caused from natures of the chemical gas used such as explosion of explosive gas, burning of flammable gas, corrosion of corrosive gas, poisoning of toxic gas and other trouble due to gas.

# Section 1: Introduction

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This manual is divided into five sections. Section 1 contains brief descriptions and specifications of the additional pumping system, and Section 2 describes installation. Section 3 describes the operation. The theory of the operation is described in Section 4. Service procedures are provided in Section 5.

## Description

### **Purpose of this product**

The “VersaLock/VersaPrep” is a unique sample preparation subsystem for VersaProbe II system, which provides sample cooling/heating, chemical gas reaction and sample storage capability as standard options. Also the customized preparation subsystems that the customer prepared in advance could be added to the “VersaLock/VersaPrep” chambers. Some spare flanges that are for those requirements are provided.

### **VersaPrep with pumping system**

VersaPrep/VersaLock is the optional preparation chamber that extends capabilities of VersaProbe II. VersaPrep is designed to be attached to the extension port of VersaProbe II, and VersaLock is designed to be attached to the intro port of VersaProbe II. Second VersaLock can also be attached to Extension port. Basically, they consist of chamber, gate valve, manifold, Turbo molecular pump (TMP), Rotary pump for rough line and the controller. (Figure 1-1) The chamber has several ports in order to be equipped several components, depend on the situations. The gate valve isolates the system from Prep chamber. The manifold is equipped Cold Cathode gauge and Pirani gauge. TMP is products of Pfeiffer Vacuum, HiPACE series turbo molecular pump is used. Rotary pump is GLD series manufactured by ULVAC. VersaPrep also has ion pump version which is feasible to light gas load. All vacuum pumps are for UHV and not designed for chemical gas pumping. Three interlocks are prepared, the first is vacuum interlock from C.C. gauge, the second is TMP frequency, and the third is another vacuum interlock from Pirani gauge.

## 1: Introduction

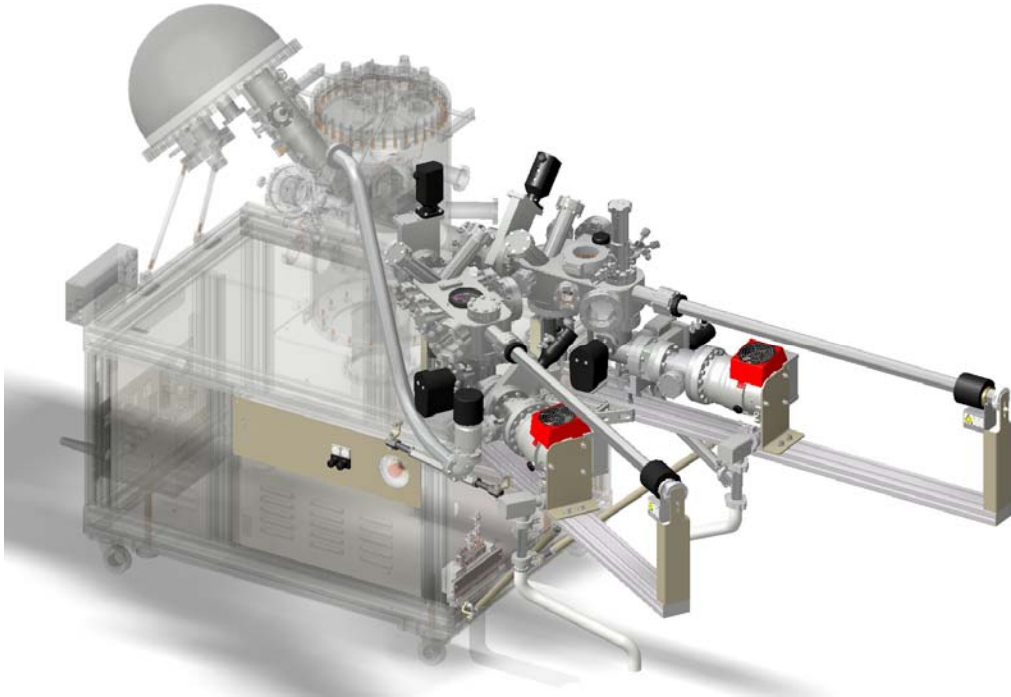


Figure 1-1. Whole View of VersaPrep with pumping system

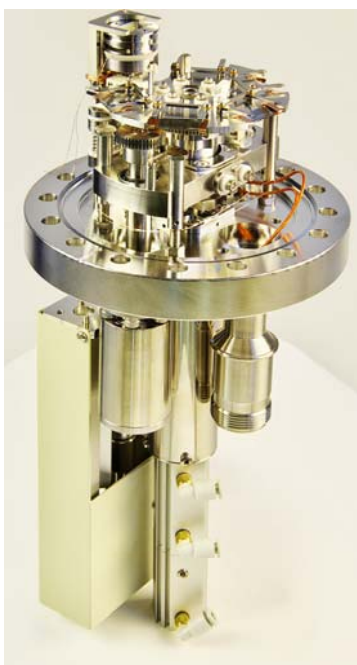
### **Sample Platens Parking Carousel**

This is the option in order to park sample platens in VersaPrep. Up to five platens park on a carousel. The carousel has a rotary drive, platen can be selected by rotating the carousel. When transferring platens, carousel height is set to a position corresponding to the operations by actuator. The actuator can be move by compressed air.

### **Hot Cold Module**

This is the option in order to cool and heat a sample in VersaPrep or VersaLock. A special sample platen enables the sample temperature control from -150 degree C to 200C or from room temperature to 800 degree C. When transferring platens, carousel height is set to a position corresponding to the operations by pneumatic actuator.

## **1: Introduction**



*Figure 1-2. Sample parking with Hot Cold Module.*

## **1: Introduction**

### **Reactor Vessel**

This option enables the customers to heat sample under some active gas atmosphere in VersaPrep or VersaLock. By using special sample platen, the sample is heated up to 800 degree C in static mode and 500 degree C in dynamic mode. In the static mode, the reaction gas stays inside the reactor vessel. The dynamic mode is the unique mode. It is aimed to handle flow of some active reaction gas.

Any customer shall understand the operating principal and the limitations of reactor vessel for safety operation.



*Figure 1-3. Reactor Vessel.*

## Specifications

Table 1-1 lists mechanical and performance specifications of each component belongs to VersaPrep chamber / VersaLock chamber. Table 1-2 lists electrical specifications of each component belongs to VersaPrep chamber / VersaLock chamber. Table 1-3 lists mechanical specifications of Rotary Pump (GLD-136C). Table 1-4 lists electrical specifications of Rotary Pump (GLD-136C). Table 1-5 lists electrical specifications of controller (Model 20-240). Table 1-6 lists environmental specifications of VersaPrep/VersaLock.

Table 1-1. Mechanical and Performance Specifications of each Component (VersaPrep chamber / VersaLock chamber)

<b>Chamber</b>	Port		
	Size(L x W x H)	453 x 340 x 230 (mm) (600 x 430 x 490 mm with flanges and valves)	
	Weight	16 kg (37 kg with flanges and valves)	
<b>Turbo Molecular Pump</b>	Model	HiPace 300	
	Pumping speed	300 l/s (Nitrogen)	
	Max. Frequency	1000 Hz	
	Cooling Method	Air	
	Weight	8.7 (kg)	
<b>Rotary Pump</b>	Model	GLD – 136C	
	Pumping speed	135 L / min @ 50Hz / 162 L / min @60Hz	
	Size(L x W x H)	170 x 487.5 x 249.5 (mm)	
	Weight	27 (kg)	
<b>Cold Cathode Gauge</b>	Model	903 Series	
	Mount	ICF 070	
	Measurement Range	$3 \times 10^{-10}$ Torr to $5 \times 10^{-3}$ Torr	
<b>Pirani Gauge</b>	Model	275	
	Mount	1/4 VCR	
	Measurement Range	Atmosphere to $1 \times 10^{-2}$ Pa	
<b>Carousel</b>		VersaPrep	VersaLock
	Available Paten Size	1 inch type only	1" or 2"
	Number of Platens	5	1"X5, 1"X2+2"X1, 2" X2
	Mount	ICF 152	
<b>H/C stage</b>	Maximum Heating Temperature	RT to 800C at heating position	
	Minimum cooling Temperature	-150C to 200C at cooling position	
	Rapid cooling	RT to -100 C within 15min after pre-cooling	
<b>Reactor Vessel</b>	Maximum Pressure	0.2MPa Inert gas and room temperature	
	Maximum Heating Temperature	800 °C Static mode	
	Maximum Reaction Temperature	500 °C Dynamic mode	

## 1: Introduction

Table 1-2. Electrical Specifications of each Component (VersaPrep chamber / VersaLock chamber)

<b>Whole System</b>	Protective Class	Class I (Safety ground required)
	Voltage	REFER TO Table 1-3.
	Frequency	REFER TO Table 1-3.
	Apparent Power	REFER TO Table 1-3.
	Overvoltage Category	REFER TO Table 1-3.
<b>V110 Position sensor</b>	Voltage	28Vdc maximum
	Current	20mA maximum
	Connector	HSG(UL E29179) 3pin Plug
<b>Convectron Gauge module</b>	Voltage	REFER TO OEM MANUAL
	Current	REFER TO OEM MANUAL
	Connector	REFER TO OEM MANUAL
<b>Cold Cathode Gauge</b>	Voltage	REFER TO OEM MANUAL
	Current	REFER TO OEM MANUAL
	Connector	REFER TO OEM MANUAL
<b>HiPace300/TC400 (RS485)</b>	Voltage	REFER TO OEM MANUAL
	Current	REFER TO OEM MANUAL
	Connector	REFER TO OEM MANUAL
<b>HiPace300/TC400 (DC in)</b>	Voltage	REFER TO OEM MANUAL
	Current	REFER TO OEM MANUAL
	Connector	REFER TO OEM MANUAL
<b>Manifold of Solenoid</b>	Voltage	REFER TO OEM MANUAL
	Current	REFER TO OEM MANUAL
	Connector	REFER TO OEM MANUAL
<b>Transfer Rod Position sensor</b>	Voltage	24Vdc $\pm$ 20%
	Current	500mA maximum
	Connector	BNC female
<b>Parking Module Sensor &amp; Power</b>	Heater Voltage	80Vdc maximum (Limited to 18V on default settings.)
	Heater Current	9.5A maximum (Depends on limited voltage and heater resistance)
	Connector	MIL 10PIN Plug
<b>Hot/Cold Module TC</b>	Voltage	100mV maximum
	Current	No current (Thermo couple output)
	Connector	MIL 4PIN Plug
<b>Parking Stage Position upper sensor 721396(SMC:D-M9NV)</b>	Voltage	24Vdc $\pm$ 20% (PIN 1)
	Rated Current	10mA maximum
	Load Current	40mA maximum
	Connector	Mini Universal MATE-N-LOK 2 pins Plug PIN 1: Parking Stage stays on upper position PIN 2: Parking Stage stays on upper position (Return)



## 1: Introduction

Table 1-2. *Electrical Specifications of each Component (VersaPrep chamber / VersaLock chamber)  
(continued)*

<b>Parking Stage Position lower sensor 721396(SMC:D- M9NV)</b>	Voltage	24Vdc $\pm$ 20% (PIN 1)
	Rated Current	10mA maximum
	Load Current	40mA maximum
	Connector	Mini Universal MATE-N-LOK 2 pins Plug PIN 1: Parking Stage stays on lower position PIN 2: Parking Stage stays on lower position (Return)
<b>Hot/Cold Stage Position upper sensor 721396(SMC:D- M9NV)</b>	Voltage	24Vdc $\pm$ 20% (PIN 1)
	Rated Current	10mA maximum
	Load Current	40mA maximum
	Connector	Mini Universal MATE-N-LOK 2 pins Plug PIN 1: H/C Stage stays on upper position PIN 2: H/C Stage stays on upper position (Return)
<b>Hot/Cold Stage Position upper sensor 721396(SMC:D- M9NV)</b>	Voltage	24Vdc $\pm$ 20% (PIN 1)
	Rated Current	10mA maximum
	Load Current	40mA maximum
	Connector	Mini Universal MATE-N-LOK 2 pins Plug PIN 1: H/C Stage stays on lower position PIN 2: H/C Stage stays on lower position (Return)
<b>Reactor Vessel Sensor &amp; Power</b>	Heater Voltage	80Vdc maximum
	Heater Current	9.5A maximum
	Connector	MIL 3PIN Plug

Table 1-3. *Mechanical Specifications. (GLD-136C)*

Pumping Speed	135 L / min @ 50Hz / 162 L / min @60Hz
Size(L x W x H)	170 x 487.5 x 249.5 (mm)
Weight	27 kg

Table 1-4. *Electrical Specifications. (GLD-136C)*

<b>Input Power</b>	Voltage	200–240 Vac
	Frequency	50 / 60 Hz
	Current	3.5A @50Hz, 2.9A@60Hz
	Overvoltage Category	Category II
	Connector	IEC320-C14

## 1: Introduction

Table 1-5. Electrical Specifications. (Model 20-240)

<b>Electrical Safety</b>	Protective Class	Class I (Safety ground required)
<b>Input Power (J1 PWR IN)</b>	Voltage	200–230 Vac (Fluctuations up to $\pm 10\%$ )
	Frequency	50 / 60 Hz
	Current	15A (3450 VA) maximum
	Overvoltage Category	Category II
	Connector	IEC320-C14
<b>Pneumatic Solenoid Control Output (J3 SOLENOID OUT)</b>	Voltage	24Vdc $\pm 20\%$ (PIN 13)
	Current	0.1A maximum per solenoid
	Solenoid Control	PIN1: SOLENOID#1      PIN14: SOLENOID #2 PIN2: SOLENOID#3      PIN15: SOLENOID #4 PIN3: SOLENOID#5      PIN16: SOLENOID #6 PIN4: SOLENOID#7A      PIN17: SOLENOID #7B PIN5: SOLENOID#8A      PIN18: SOLENOID #8B PIN6: SOLENOID#9A      PIN19: SOLENOID #9B PIN7: SOLENOID#10A      PIN20: SOLENOID #10B
	Connector	D-SUB 25 pin Socket
<b>Rotary Pump Power Output (J4 RP OUT)</b>	Voltage	200–230 Vac (Fluctuations up to $\pm 10\%$ )
	Current	5A maximum
	Connector	HAN 3A-F (HARTING Technology Group) PIN 1: Line    PIN 2: Neutral PIN 3: N/C    PIN G: Ground
<b>Turbo Molecular Pump Power Output (J12 TMP3 PWR)</b>	Voltage	24 Vdc $\pm 20\%$
	Current	10A maximum
	Connector	VG96234A-10SL-3S PIN A: 24 Vdc    PIN B: 24 Vdc Return    PIN C: Ground
<b>Heater Output (J15 HTR1 J16 HTR2 J17 HTR3 J18 HTR4)</b>	Voltage	0 to 80 Vdc
	Current	0 to 9.5A
	Load regulation	0.01V maximum, 0.003A maximum
	Noise	$\leq 80$ mV peak to peak $\leq 29$ mA peak to peak
<b>G4 HV Control Output (J10 G4 HV CTRL)</b>	Output Type	Relay Output (125 Vdc, 10A maximum)
<b>Touchscreen Power Output (J23 AUX PWR)</b>	Voltage	24 Vdc $\pm 20\%$
	Current	1 A maximum
	Connector	Mini Universal MATE-N-LOK 2 pins Socket
<b>RS485 Comm (J13 TMP3 COMM J14 PC COMM )</b>	Communication Standard	RS485 Half Duplex
	I/O	PIN1: TX    PIN4: RX    PIN3 Ground    PIN 2,5: N/C
	Connector	M12 Socket
<b>Thermocouple Input (J19 TC1 J20 TC2 J21 TC3 J22 TC4)</b>	Thermocouple Type	Type E: (TC1, TC3 and TC4) Type T: (TC2)
	Temperature Range	TC1, TC3 and TC4: 0 to +1000 °C / 1 °C step TC2: -200 to +400 °C / 0.1 °C step
	Accuracy	$\pm 1.5^\circ\text{C} \pm 1$ step
	Connector	Sub Miniature Thermocouple Socket

## 1: Introduction

Table 1-5. Electrical Specifications (20-240) (continued).

<b>H/C Stage Position Input (J5 HC UP/DON)</b>	Input Signal Type	Dry (no voltage) contact or NPN open collector (OPEN:OFF/CLOSE:ON)
	Connector	Mini Universal MATE-N-LOK 4 pins Socket PIN 1: H/C Stage stays on upper position PIN 2: H/C Stage stays on upper position (Return) PIN 3: H/C Stage stays on lower position PIN 4: H/C Stage stays on lower position (Return)
<b>Parking Stage Position Input (J6 PK UP/DON)</b>	Input Signal Type	Dry (no voltage) contact or NPN open collector( OPEN:OFF/CLOSE:ON)
	Connector	Mini Universal MATE-N-LOK 4 pins Socket PIN 1: Parking Stage stays on upper position PIN 2: Parking Stage stays on upper position (Return) PIN 3: Parking Stage stays on lower position PIN 4: Parking Stage stays on lower position (Return)
<b>Parking Stage Rotation Home Position Input (J7 PK POS)</b>	Input Signal Type	Dry (no voltage) contact or NPN open collector(OPEN:OFF/CLOSE:ON)
	Connector	Mini Universal MATE-N-LOK 2 pins Socket PIN 1: Parking Stage stays on Rotation Home Position PIN 2: Parking Stage stays on Rotation Home Position (Return)
<b>V9 Close /Open Status Input (J8 V9 POS C/O)</b>	Input Signal Type	Dry (no voltage) contact or NPN open collector (OPEN:OFF/CLOSE:ON)
	Connector	Mini Universal MATE-N-LOK 4 pins Socket PIN 1: V9 Close Status PIN 2: V9 Close Status (Return) PIN 3: V9 Open Status PIN 4: V9 Open Status (Return)
<b>V10 Close /Open Status Input (J9 V10 POS C/O)</b>	Input Signal Type	Dry (no voltage) contact or NPN open collector (OPEN:OFF/CLOSE:ON)
	Connector	Mini Universal MATE-N-LOK 4 pins Socket PIN 1: V10 Close Status PIN 2: V10 Close Status (Return) PIN 3: V10 Open Status PIN 4: V10 Open Status (Return)
<b>V10 Control Signal Input (J10 G4 HV CTRL)</b>	Input Signal Type	Dry (no voltage) contact or NPN open collector (OPEN:OFF/CLOSE:ON)
	Connector	BNC Socket Center: V10 Control Chassis: V10 Control (Return)
<b>Convectron Gauge Setpoint Input (J24 SETPT IN)</b>	Input Signal Type	Dry (no voltage) contact or NPN open collector (OPEN:OFF/CLOSE:ON)
	Connector	BNC Socket Center: Convectron Gauge Setpoint Input Chassis: Convectron Gauge Setpoint Input (Return)

## 1: Introduction

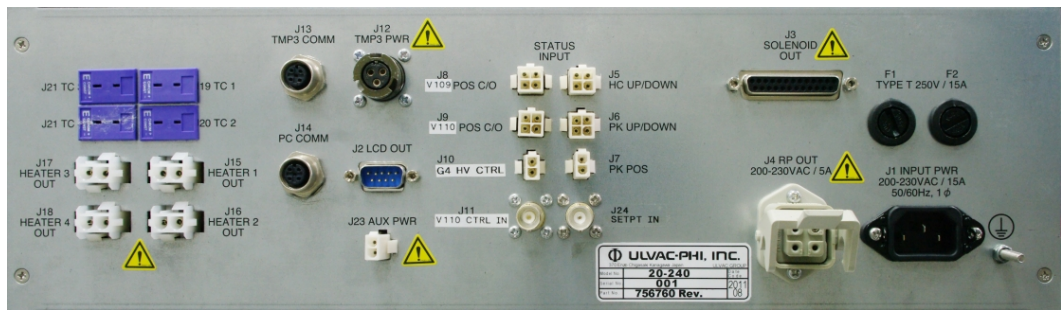


Figure 1-4. 20-240 Rear Panel

Table 1-6. Environmental Specifications (VersaPrep/VersaLock)

	Parameter	Specification
<b>Whole system</b>	Ambient operating temperature	15° to 25°C
	Temperature deviation	+/-2°C /1day
	Relative Humidity	Less than 70%
	Location	Indoor use
	Rated pollution degree	2 (Office level)
	Altitude	Up to 1500 m
	Cooling	Forced air
	Mains supply voltage fluctuations	Up to ± 10%
	Magnetic Field	The static magnetic field must be less than 1x10 <sup>-4</sup> T (1.0 G); time varying component less than 3x10 <sup>-7</sup> T (3.0 mG) (RMS)
<b>H/C stage</b>	Compressed Dry Air	0.55 MPa minimum. The connection is via a 1/4" Swagelok® adapter.
	Dry Nitrogen	18 kPa maximum. The connection is via a 1/4" One-touch fitting.
<b>H/C stage</b>	Liquid Nitrogen Inlet	1/4" Metal Tube
	Nitrogen Gas Exhaust	1/4" Metal Tube
<b>Reactor Vessel</b>	Cooling Water	10L/min Tapped water quality lower than 30°C
	Water Connections	Two 1/4" Swagelok
	Gas Connections	Four 1/4" F VCR

## Manufacturer information

**Manufacturer:**  
 ULVAC-PHI, Inc.  
 370 Enzo, Chigasaki, Kanagawa,  
 253-8522 JAPAN

# Section 2:

## Installation

---

This section describes the installation procedures for VersaPrep/VersaLock Chamber and their options.

### Inspection for Damage

*NOTE: It is the customer's responsibility to inspect and report shipping damage to the carrier, typically within 30 days. Before installing ULVAC-PHI equipment and/or software CD, inspect it for obvious damage that may have occurred during shipment.*

### Installation Procedure

Refer to "Technician's VersaPrep/VersaLock Installation, Calibration & Maintenance Manual" (ULVAC-PHI P/N 718962).



***WARNING: This is a Type 4 task. The equipment is energized. Live circuits are exposed and accidental contact is possible. Voltage potentials are greater than 30V RMS, 42.2V peak, 240V-A, and 20 J are exposed to accidental contact. Do not perform this procedure unless you are an experienced, trained technician.***

## **2: Installation**

# Section 3: Operation

---

This section describes how to operate VersaPrep/VersaLock.

## Before Starting Operation

The operations are controlled by SmartSoft-VersaProbe, Watcher, and Model 20-240/245 controller. Details in Model 20-240/245 are explained in Hardware manual for Model 20-240 and Model 20-245.

### SmartSoft-VersaProbe Operation

To transfer sample platen between main system and VersaPrep, SmartSoft-VersaProbe is used. Figure 3-1 shows **Chamber Viewer** on SmartSoft-VersaProbe.

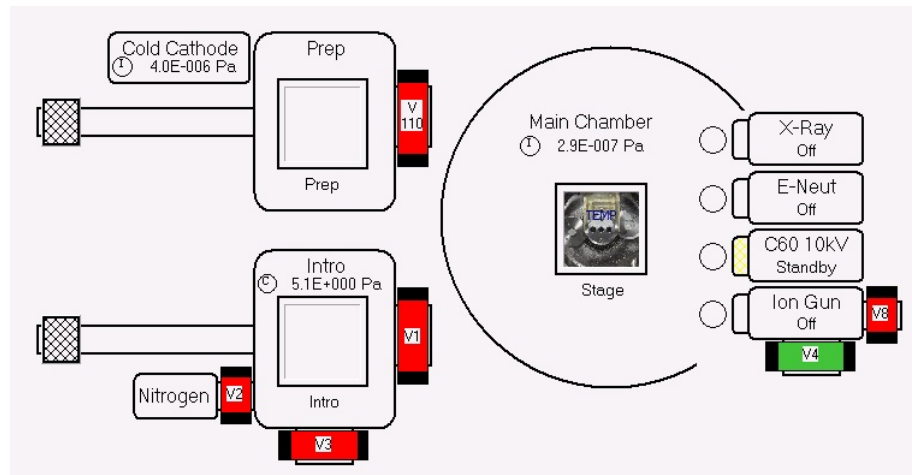


Figure 3-1. Chamber Viewer on SmartSoft-VersaProbe

### Prep Status Indication

Yellow Border indicates that this station is in a transfer process.

### Pressure Readings


VersaPrep Chamber pressure reading is indicated the corresponding **Cold Cathode Gauge** pressure.

### 3: Operation

#### Vacuum Valve State Indication

Valve status is indicated in the corresponding border color. Red indicates **Closed**. Green indicates **Open**.

#### Vacuum Task (V110 Open)

On SmartSoft-VersaProbe, click “System” Tab and “Vacuum” Tab, “Watcher Task” is shown like Figure 3-2. Select “V110 Open” and press  to execute. V110 is the gate valve between main chamber and VersaPrep. When V110 is open, sample platen can be inserted / extracted. V110 is automatically closed when transfer rod is retracted from main chamber.

*Note: Interlocks prevent V110 from opening when the **Transfer Rod** of **VersaPrep** is not fully retracted, the pressure of either the **Main Chamber** or the **VersaPrep** chamber is over  $1.0 \times 10^{-3}$  Pa. As a result, the software automatically aborts this task.*

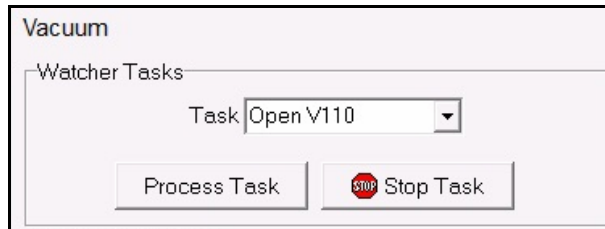


Figure 3-2. Vacuum Tab

#### Watcher Operation

Vacuum control for main chamber is operated by Watcher software. Some tasks for VersaPrep/VersaLock are controlled by Watcher software also.

#### VersaPrep Cold Cathode Gauge

This indicates the vacuum pressure in the VersaPrep. To use the gauge, select the Tab (A on Figure 3-2) on Watcher.

#### Probe Status of VersaPrep

This indicates the position of **Transfer Probe** of VersaPrep.

#### V110 VersaPrep Gate

V110 valve interlocks can be override. (Use only for Service Engineer)



### 3: Operation

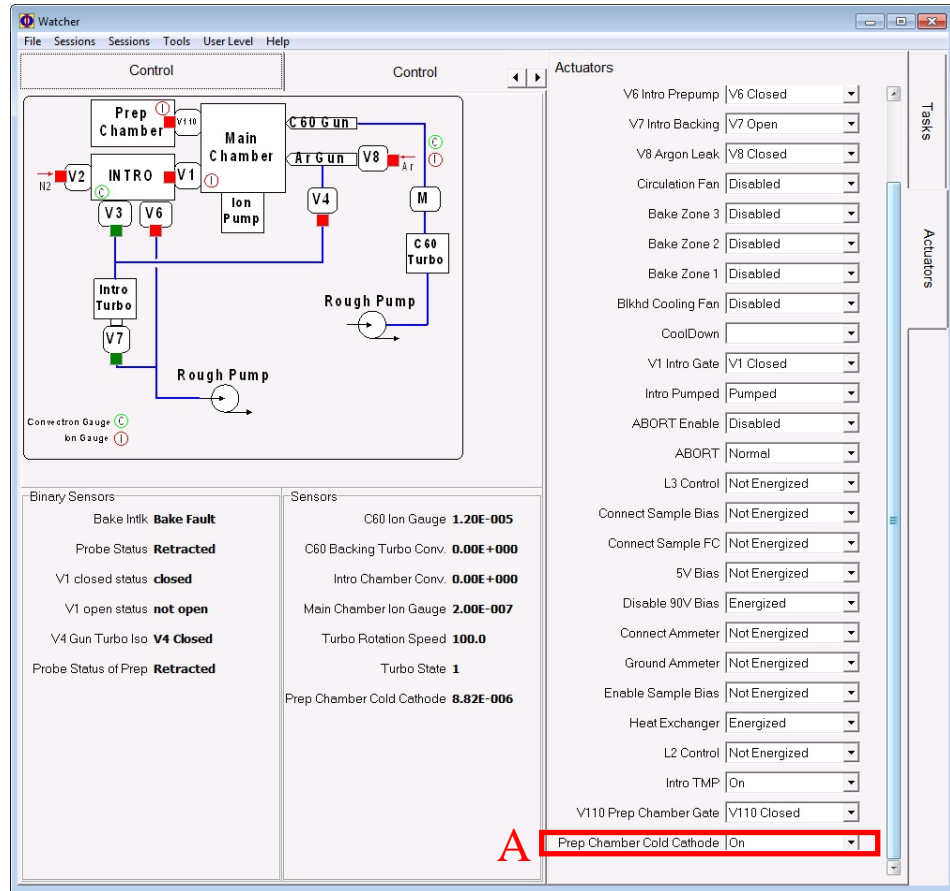


Figure 3-3. Display of "Watcher"

### Vacuum Control and Stage Control from Model 20-240/245

Display of **Vacuum Control** from Model 20-240/245 is shown in Figure 3-4. Display of **Stage Control** from Model 20-240 and Model 20-245 are in Figure 3-5 and in Figure 3-6. On Model 20-240, part "A" in Figure 3-5 is for Heating / Cooling Stage, part "B" is for Carousel. On Model 20-245, only part "B" is shown on the touch screen. Detail explanations of each function should be referred to "Hardware Manual for Model 20-240 and 20-245".

### 3: Operation

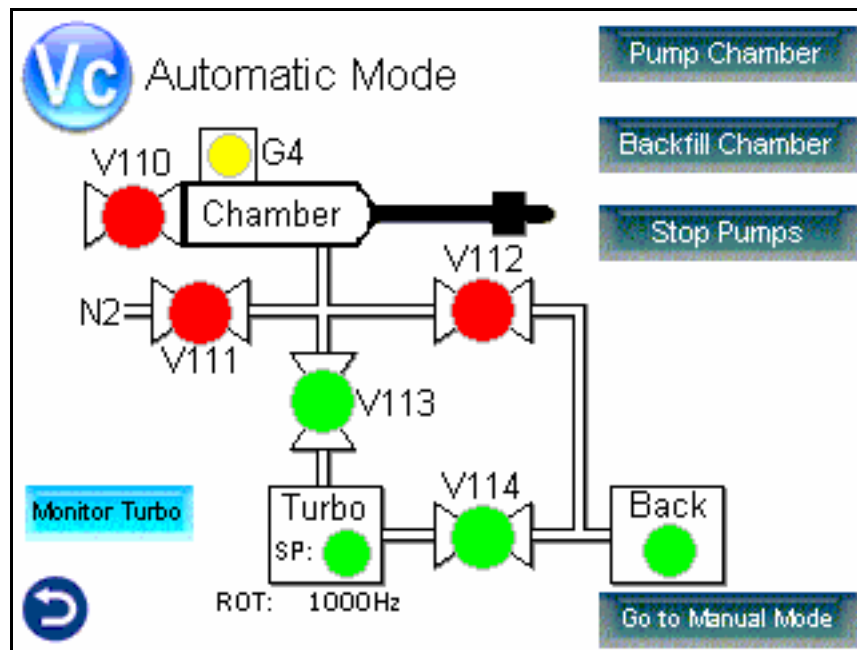


Figure 3-4. Display of "Vacuum Control" on Model 20-240/245

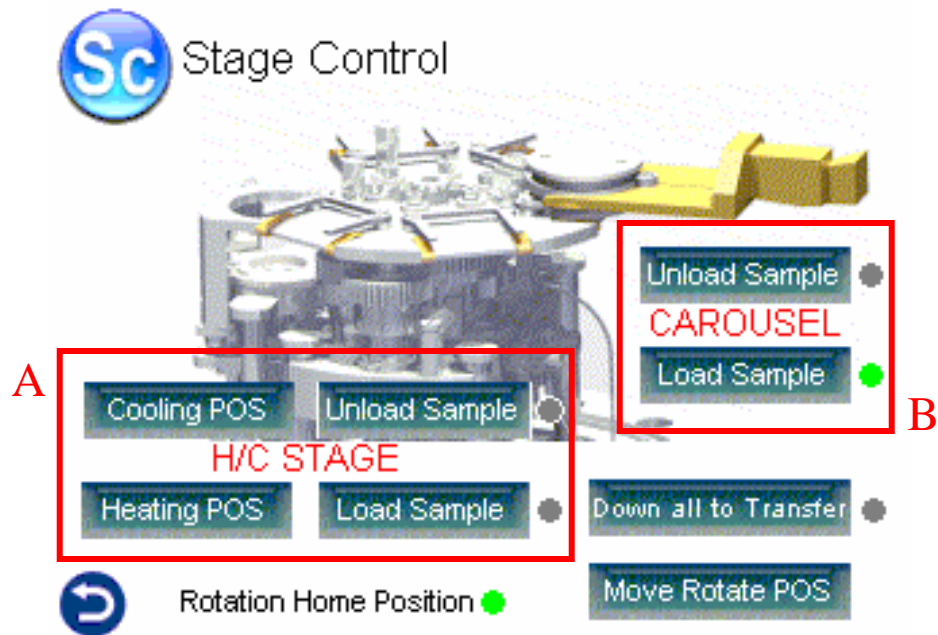


Figure 3-5. Display of "Stage Control" on Model 20-240

### 3: Operation

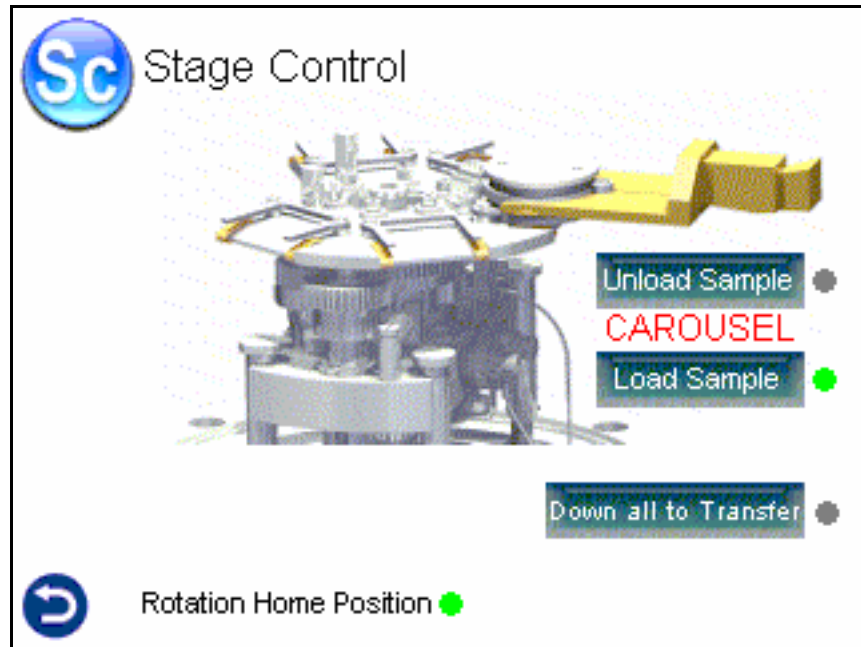


Figure 3-6. Display of "Stage Control" on Model 20-245



**WARNING: ROTARY PUMP SWITCH MUST BE ALWAYS TURNED ON.**

#### **Start/Stop Turbo Molecular Pump**

To start/stop Turbo Molecular pump, press the button (A on Figure 3-7) on the touchscreen. (Detail should be referred to Hardware Manual for Model 20-240/245.)

#### **Start/Stop Backing Pump**

To start/stop Backing pump, press the button (B on Figure 3-7) on the touchscreen. (Detail should be referred to Hardware Manual for Model 20-240/245.)

### 3: Operation



**WARNING: CHECK ALL VALVES STATUS CAREFULLY (ESPECIALLY, V110 AND V114) WHEN START / STOP PUMP.**

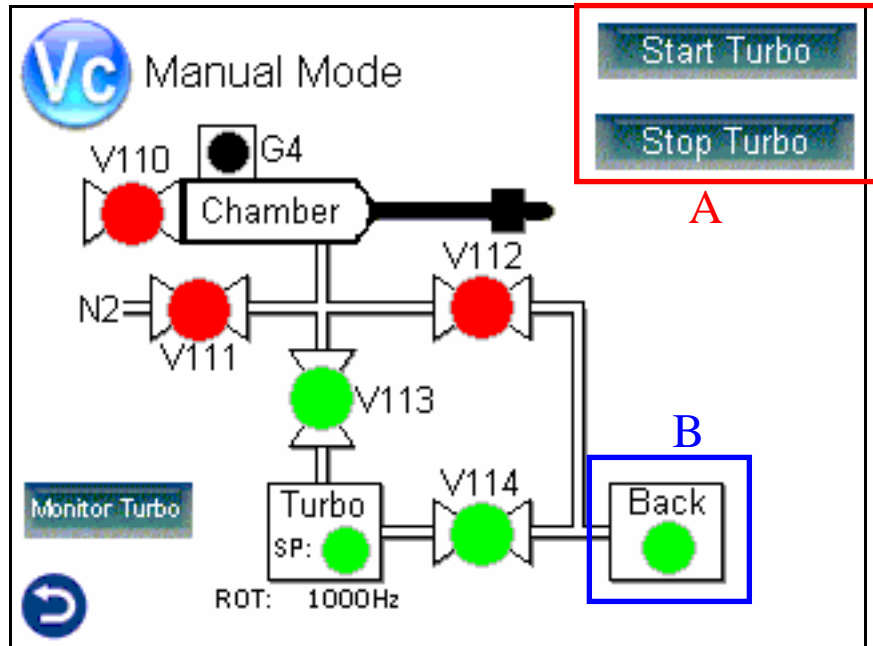


Figure 3-7. Touchscreen Display of Model 20-240/245

### Reactor Vessel



#### **SAFETY GUIDE;**

**REACTOR VESSEL IS PROVIDED EXCLUDING GAS FACILITIES. IT IS THE CUSTOMER'S RESPONSIBILITIES TO PREPARE ANY NECESSARY SAFETY FACILITIES, REACTION GAS SUPPLY, SHIELD GAS SUPPLY COOLING WATER AND WASTE GAS DISPOSAL FACILITIES. THE CUSTOMER'S SHOULD UNDERSTAND EVERY POTENTIAL HAZARD AND SHOULD PREPARE FOR THEM.**

*Note: Though the reactor vessel is used under high pressure it is also connected vacuum system. The customer is suggested pay attention to not only pressure but also vacuum tightness, leak rate, of high pressure piping joint or valves.*

*Note: The use of the reactor vessel is opened to the customer. Please refer theory of operation and other related sections to construct customer's own system and own safe operation procedures.*

## Operation



Operation consists of nine sections;

- “Backfill/Pump VersaPrep Chamber”
- “Introduction/Extraction sample platen to/from VersaPrep/VersaLock Chamber”
- “Introduction/Extraction sample platen to/from Carousel”
- “Introduction/Extraction to/from sample platen main system”
- “Introduction/Extraction sample platen to/from Reactor Vessel”
- “Reaction in Reactor Vessel”
- “Introduction/Extraction sample platen to/from Heating/Cooling Stage”
- “Cooling sample platen on Heating/Cooling Stage”
- “Heating sample platen on Heating Stage”



### Backfill/Pump VersaPrep

This procedure is described how to backfill, and pump VersaPrep.

#### Backfill VersaPrep Chamber

1. Go to **Automatic Mode** by pressing button .
2. Make sure that V110 is closed and Dry Nitrogen is supplied.
3. Press button .
4. Wait until the value of Pirani gauge is over 9.2 e+4 Pa.

#### Pump VersaPrep Chamber

1. Go to **Automatic Mode** by pressing button .
2. Press button .
3. Wait until window shown in Figure 3-8 appears, then press “OK”.

### 3: Operation



Figure 3-8. Displayed Window after Pumping VersaPrep Chamber

#### **Introduction/Extraction Sample Platen to/from VersaPrep/VersaLock Chamber**

This procedure is described how to introduce sample platen to VersaPrep/VersaLock chamber, and extract the platen from the chamber.



***WARNING: SAMPLE HEIGHT ALLOWANCE ON CAROUSEL IS LIMITED. WHEN INTRODUCING SAMPLE TO VERSAPREP/VERSALOCK, MAKE SURE SAMPLE THICKNESS IS LESS THAN 4.0MM.***



***WARNING: ON VERSAPREP/VERSALOCK WITH HEATING/COOLING STAGE, SAMPLE PLATEN SHOULD BE EXTRACT FROM VERSAPRE/VERSALOCK, AFTER CONFIRMING THE TEMPERATURE IS BETWEEN 0 AND 100C.***

#### **Introduction Sample Platen to VersaPrep/VersaLock Chamber**

1. Make sure that inside VersaPrep/VersaLock chamber is atmosphere pressure.
2. Open the lid on top of the VersaPrep/VersaLock chamber.
3. Set sample platen on fork of transfer rod.
4. Close the lid.
5. Pump VersaPrep/VersaLock chamber.

*NOTE: Pump down time may depend on the customer's sample or environment.*

### 3: Operation

#### Extract Sample Platen from VersaPrep/VersaLock Chamber

1. Make sure that sample platen is on the fork of transfer rod.
2. Backfill VersaPrep/VersaLock.
3. Open the lid.
4. Extract sample platen from VersaPrep/VersaLock chamber.


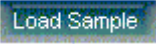
#### Introduction/Extraction Sample Platen to/from Carousel

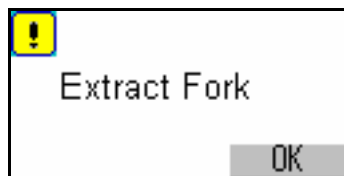
This procedure is described how to introduce the sample platen to carousel in VersaPrep/VersaLock, and extract the platen from the carousel.



***WARNING: SAMPLE HEIGHT ALLOWANCE ON CAROUSEL IS LIMITED. WHEN INTRODUCING SAMPLE TO VERSAPREP/VERSALOCK, MAKE SURE SAMPLE THICKNESS IS LESS THAN 4.0MM.***

#### Introduction of Sample Platen to Carousel

1. Introduce sample platen to VersaPrep/VersaLock.
2. Go to **Stage Control** (Figure 3-5) on Model 20-240/245 by pressing button .
3. Press button  on **Stage Control**.
4. Wait the window shown in Figure 3-9, then extract transfer rod and press “OK”.
5. Make sure that carousel position is lifted up.
6. Wait window shown in Figure 3-10, then insert sample platen to the carousel with care and press “OK” with keeping the fork.



### 3: Operation

Figure 3-9. Displayed Window before Extracting Fork

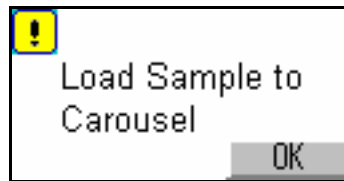
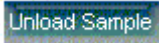


Figure 3-10. Displayed Window after Extracting Fork

7. Wait window shown in Figure 3-9 again, then extract the fork and press “OK”.

#### Extraction of Sample Platen from Carousel

1. Go to **Stage Control** on Model 20-240/245.
2. Press button  on **Stage Control**.
3. Wait window shown in Figure 3-9, then extract transfer rod and press “OK” .
4. Make sure that carousel position is lifted up.
5. Wait window shown in Figure 3-11, then insert transfer rod fork to carousel with care and press “OK” with keeping the fork.

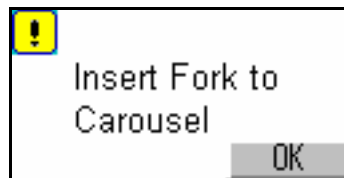
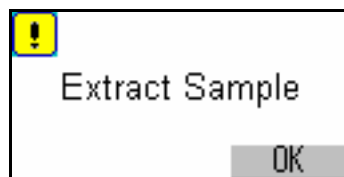


Figure 3-11. Displayed Window before Inserting Fork

6. Wait window shown in Figure 3-12, then extract sample platen and press “OK.”





### 3: Operation

Figure 3-12. Displayed Window after Inserting Fork

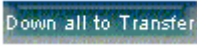
#### Introduction/Extraction Sample Platen to/from Main System

This procedure is described how to introduce sample platen to main system from VersaPrep, and extract the platen from main system to VersaPrep. For this operation, it is necessary to use SmartSoft-VersaProbe.



**WARNING: SAMPLE HEIGHT ALLOWANCE ON CAROUSEL IS LIMITED. WHEN INTRODUCING SAMPLE TO VERSAPREP/VERSALOCK, MAKE SURE SAMPLE THICKNESS IS LESS THAN 4.0MM.**

#### Introduction Sample Platen to Main system

1. Make sure that sample platen is set on fork of transfer rod in VersaPrep, and VersaPrep chamber is pumped well.
2. Go to **Stage Control** on Model 20-240/245.
3. Press button  on **Stage Control**.
4. Window like Figure 3-9 would be displayed, and press “OK” after extracting transfer rod.
5. Make sure that carousel and Heating/Cooling Stage position are the lowest.
6. On SmartSoft-VersaProbe, move to **System** main tab. Right-Click at **VersaPrep** position on the **Chamber Viewer**.(Figure 3-13)

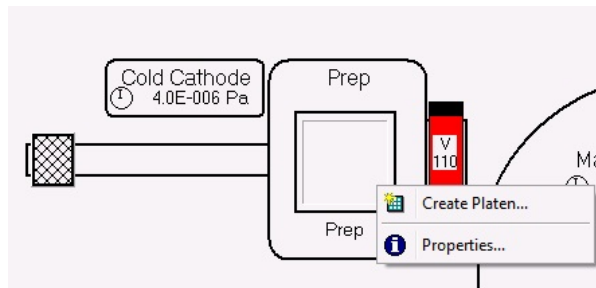



Figure 3-13. Prep Position on Chamber Viewer

7. Select  **Create Platen** button, and edit a **Platen Name** in **Create Platen** dialog. If require loading a platen which is set on the optional carousel in VersaPrep, select the Platen name. (Figure 3-14)

### 3: Operation

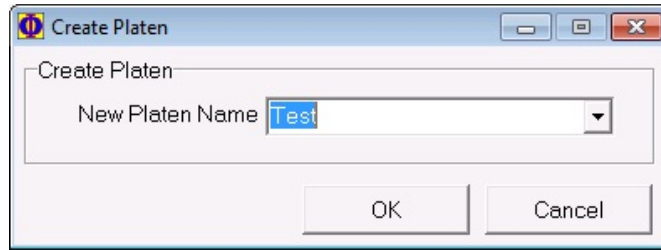


Figure 3-14. Window for Create Platen

*Note: Can not show multi-platens at a time on SmartSoft Chamber viewer. Thus when a platen is set on the **Intro**, creating new platen at **VersaPrep** will delete the platen at the **Intro** from SmartSoft UI. When transfer the platen from Intro, must re-load the platen on the **Intro**.*

8. Drag the platen on the **VersaPrep** to the **Stage**. The **Stage** moves to the transfer position, and open **V110** valve.

*Note: If the **VersaPrep** pressure is over  $1.0 \times E-3$  Pa, the software restricts to open **V110** valve.*

9. After the following Task Information -1 appears (Figure 3-15), transfer the **Transfer Rod of VersaPrep** to transfer position.

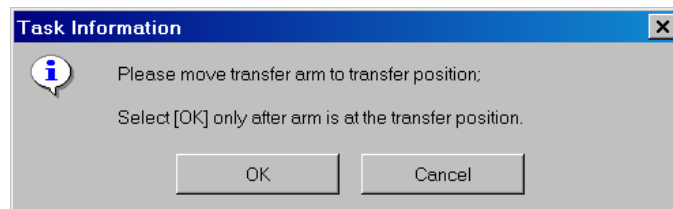


Figure 3-15. Task Information -1

*Note: If the optional **Carousel** in **VersaPrep** is installed, check the parking position.*

10. Click “OK” button to move the stage Z. After the following Task Information -2 appears (Figure 3-16), retract the **VersaPrep Transfer Arm**.

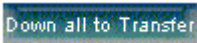


Figure 3-16. Task Information -2

### 3: Operation

11. Automatically close **V110** valve, and click “OK” button that the stage moves to the **Center** position.

#### **Extract Sample Platen to Main system**

1. Make sure that no sample platen is set on fork of transfer rod in VersaPrep, and VersaPrep chamber is pumped well.
2. Go to **Stage Control** on Model 20-240/245.
3. Press button  on **Stage Control**.
4. Window like Figure 3-8 would be displayed, and press “OK” after extracting transfer rod.
5. Make sure that carousel and Heating/Cooling Stage position are the lowest.
6. Drag the platen on the **Stage** to the **Prep** on **Chamber Viewer**. The **Stage** moves to the transfer position, and open **V110** valve. After Task Information-1 (Figure 3-15) appears, transfer the **VersaPrep Transfer Rod** to transfer position.

*Note: If the optional **Carousel** in **VersaPrep/VersaLock** is installed, check the parking position.*

7. Click “OK” button to move the stage Z. After the following Task Information -2 (Figure 3-16) appears, retract the **Prep Transfer Arm**.
8. Automatically close **V110** valve.

#### **Introduction/Extraction Sample Platen to/from Reactor Vessel**

This procedure is described how to introduce sample platen to the reactor vessel in VersaPrep/VersaLock, and extract the platen from the reactor vessel.



**WARNING:** *Recommended sample size is smaller than 10mm square. Its thickness is thinner the better, from the viewpoint of analysis and reaction. If the sample penetrates the red colored area or its height exceed 3mm, quartz cell or sapphire plate shall break to cause irremediable trouble. The quartz cell and sapphire plate nearly contacts. Therefore single powder particle may damage the sealing and any contaminants or dust may cause leak of the reaction gas. Both side of the sealing is made of excellent insulator, care must*

### 3: Operation

*be take to remove electrostatic adsorbate. (The sample platen for the reactor vessel is shown in Figure 3-17.)*

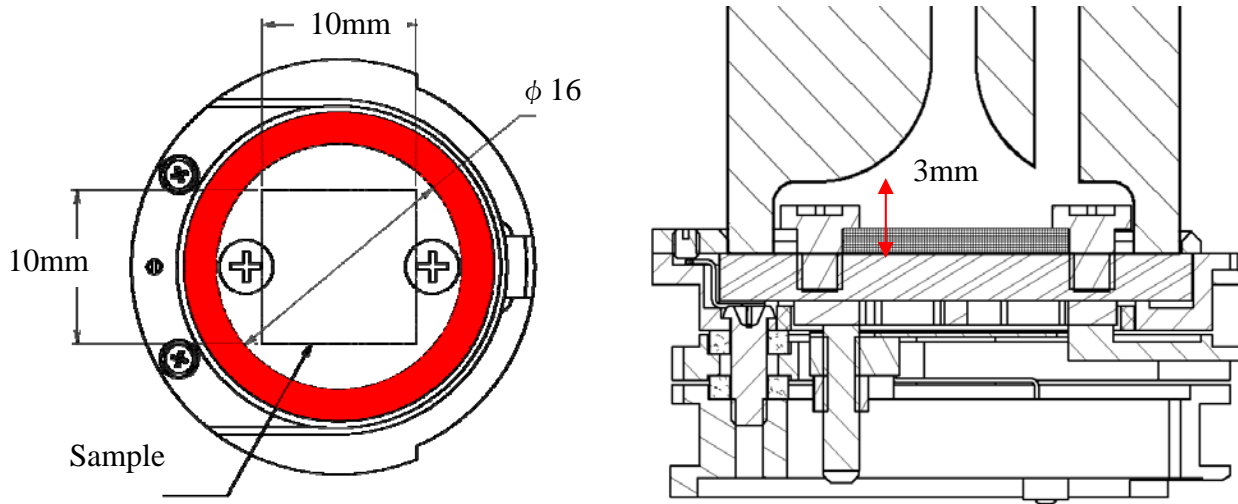


Figure 3-17. The sample platen and sample.

#### **Introduction of Sample Platen to Reactor Vessel**

1. Test the safety of reaction and shield gas lines. (Customer's facilities)
2. Make sure that V110 gate valve is closed.
3. Pick the sample platen with intro folk.
4. Fully extract the intro rod.
5. Pump down the reactor vessel. (Customer's facilities)
6. Slowly open the reactor vessel by rotating the knob clock wise.
7. Fully open the reactor vessel.
8. Slowly push in the intro rod to approach the sample platen to reactor vessel.
9. Adjust the height of the reactor vessel by rotating the knob so that the slot of the gas reaction call and base of the sample platen aligned.
10. Slowly push in the sample platen in to the reactor vessel.
11. Rotate the knob counter clock wise so that the sample platen is lifted and high enough to extract folk.

### **3: Operation**

12. Slowly extract the sample folk
13. Close the reactor vessel by rotating the knob fully counter clock wise.

#### **Extraction of Sample Platen from Reactor Vessel**

1. Make sure that V110 gate valve is closed
2. Check the sample temperature. At least it should be below 100C.
3. Pump down the reactor vessel. (Customer's facilities)
4. Slowly open the reactor vessel by rotating the knob clock wise.
5. Fully open the reactor vessel.
6. Slowly push in the intro rod to approach the folk.
7. Adjust the height of the reactor vessel by rotating the knob so that the slot of the sample platen and intro folk are aligned.
8. Rotate the knob counter clock wise so that the sample platen is fitted into intro folk.
9. Slowly extract the sample folk
10. Close the reactor vessel by rotating the knob fully counter clock wise.



**Caution: The pumps of VersaPrep/VersaLock are not designed for reaction gas pumping.**

#### **Reaction in Reactor Vessel**

This procedure is described how to operate reactor vessel in VersaPrep/VersaLock.

### 3: Operation



**WARNING: NEVER HEAT THE REACTOR VESSEL WITH ALL VALVE CLOSED**

#### **Heating under vacuum or inert gas ambient**

1. Load the sample platen and close the reactor vessel.
2. Supply cooling water to the reactor vessel.
3. Start heating with Hardware manual for Model 20-240.
4. Keep water cooling whichever longer, 30minutes after heating or temperature read out reaches 100C.

#### **Reaction in Reactor Vessel**

1. Load the sample platen and close the reactor vessel
2. Supply the shield gas and monitor the pressure of the VersaPrep/VersaLock so that there is no leak of shield gas to the chamber.
3. Supply the reaction gas. The supply pressure of the reaction gas should never be higher than that of shield gas.
4. Supply cooling water to the reactor vessel.
5. Start heating with Hardware manual for Model 20-240.
6. Keep water cooling whichever longer, 30minutes after heating or temperature read out reaches 100C.
7. Stop the reaction gas supply at desired temperature. Note that the reaction gas is substituted by the shield gas.
8. Flow the shield gas till the reaction gas is purged out.

### 3: Operation

#### Introduction/Extraction Sample Platen to/from Heating/Cooling Stage in VersaPrep/VersaLock

This procedure is described how to introduce sample platen to Heating/Cooling stage in VersaPrep/VersaLock, and extract the platen from the stage.


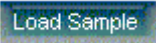


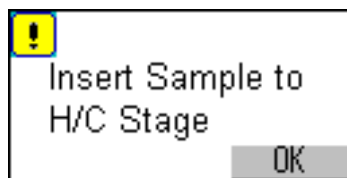
**WARNING: SAMPLE HEIGHT ALLOWANCE ON HEATING/COOLING STAGE IS LIMITED. WHEN INTRODUCING SAMPLE TO VERSAPREP/VERSALOCK, MAKE SURE SAMPLE THICKNESS IS LESS THAN 4.0MM.**



**WARNING: ON VERSAPREP/VERSALOCK WITH HEATING/COOLING STAGE, SAMPLE PLATEN SHOULD BE EXTRACT FROM VERSAPRE/VERSALOCK, AFTER CONFIRMING THE TEMPERATURE IS 0 TO 100C.**

#### Introduction Sample Platen to Heating/Cooling Stage

1. Introduce sample platen to VersaPrep/VersaLock.
2. Go to **Stage Control** (Figure 3-5) on Model 20-240 by pressing button .
3. Press button  at Heating/Cooling Stage part on **Stage Control**.
4. Wait window shown in Figure 3-9, then extract transfer rod and press “OK”.
5. Make sure that carousel position is lifted up.
6. Wait window shown in Figure 3-18, then insert sample platen to carousel with care and press “OK” with keeping the fork.



### 3: Operation

Figure 3-18. Displayed Window after Extracting Fork

7. Wait window shown in Figure 3-9 again, then extract the fork and press “OK”.

#### Extraction Sample Platen from Heating/Cooling Stage

1. Go to **Stage Control** on Model 20-240.
2. Press button **Unload Sample** at Heating/Cooling Stage part on **Stage Control**.
3. Wait window shown in Figure 3-9, then extract transfer rod and press “OK.”
4. Make sure that carousel position is the lowest.
5. Wait window shown in Figure 3-19, then insert the transfer rod fork to carousel with care and press “OK” with keeping the fork.

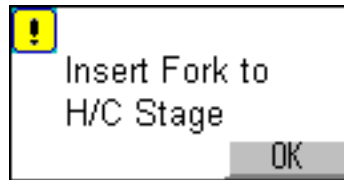


Figure 3-19. Displayed Window before Inserting Fork

6. Wait window shown in Figure 3-12, then extract sample platen and press “OK.”

#### Cooling Sample Platen on Heating/Cooling Stage

This procedure is described how to cool sample platen on Heating/Cooling stage in VersaPrep/VersaLock.




### 3: Operation



**WARNING: SAMPLE HEIGHT ALLOWANCE ON HEATING/COOLING STAGE IS LIMITED. WHEN INTRODUCING SAMPLE TO VERSAPREP/VERSALOCK, MAKE SURE SAMPLE THICKNESS IS LESS THAN 4.0MM.**

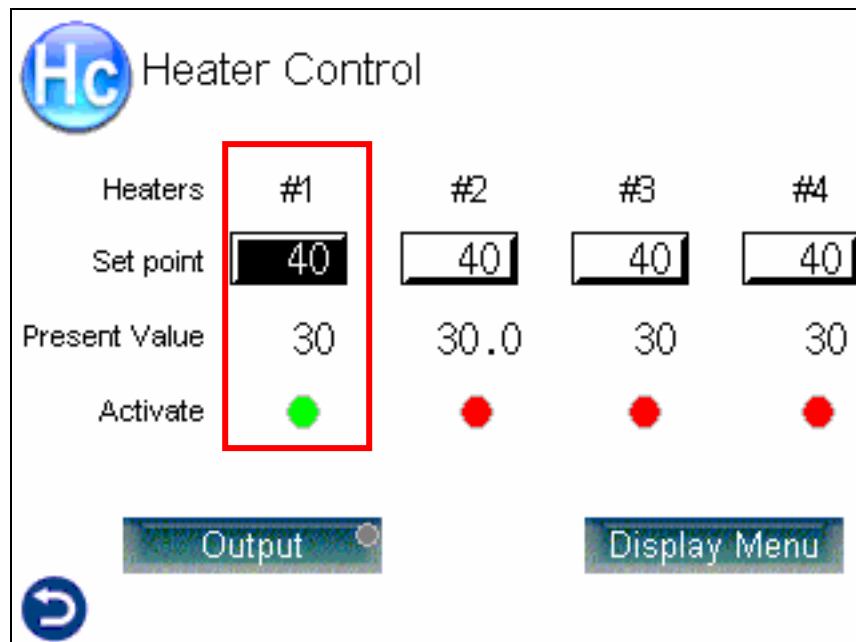


**WARNING: BE CAREFUL NOT TO TOUCH COLD AREA, DURING COOLING SAMPLE PLATEN BY LIQUID NITROGEN.**

1. Introduce sample platen to Heating/Cooling stage.
2. Press button  at Heating/Cooling Stage part on **Stage Control**.

*Note: After introducing sample platen to Heating/Cooling Stage, the platen position is cooling position already.*

3. Flow liquid Nitrogen.
4. Sample temperature is monitored at **Present Value** of #1 on **Heater Control**, as shown Figure 3-20.



### 3: Operation


Figure 3-20. Displayed Window of Heater Control

#### Heating Sample Platen on Heating/Cooling Stage

This procedure is described how to heat sample platen on Heating/Cooling stage in VersaPrep/VersaLock.



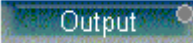
***WARNING: SAMPLE HEIGHT ALLOWANCE ON HEATING/COOLING STAGE IS LIMITED. WHEN INTRODUCING SAMPLE TO VERSAPREP/VERSALOCK, MAKE SURE SAMPLE THICKNESS IS LESS THAN 4.0MM.***

1. Introduce sample platen to Heating/Cooling stage.
2. Press button  at Heating/Cooling Stage part on **Stage Control**.


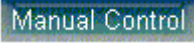
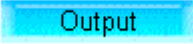
*Note: After introducing sample platen to Heating/Cooling Stage, the platen position is cooling position. Unload position is same height as heating position.*

3. Go to **Heater Control**.
4. Platen temperature during heating is monitored at #2.

#### Heating Sample Platen by Changing Set Point Value

1. Change **Set point** value to target temperature.
2. Press button  on **Heater Control**.

#### Heating Sample Platen by Changing Current (Manual Control)

1. Go to **Display Menu** (Figure 3-21) by pressing .
2. Go to Manual Control (Figure 3-22) by pressing .
3. Set **Output Current** to target value.
4. Press button  on **Manual Control**.

3: Operation



**WARNING: IN MANUAL OPERATION, OUTPUT CURRENT HAD BETTER BE INCREASED, STEP BY STEP FOR SAFETY.**

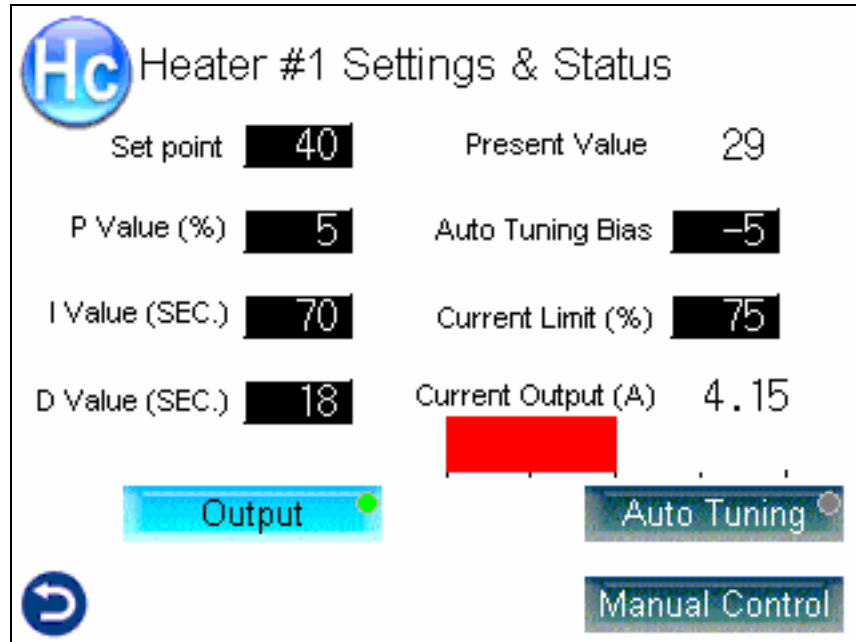


Figure 3-21. Display Menu

### 3: Operation

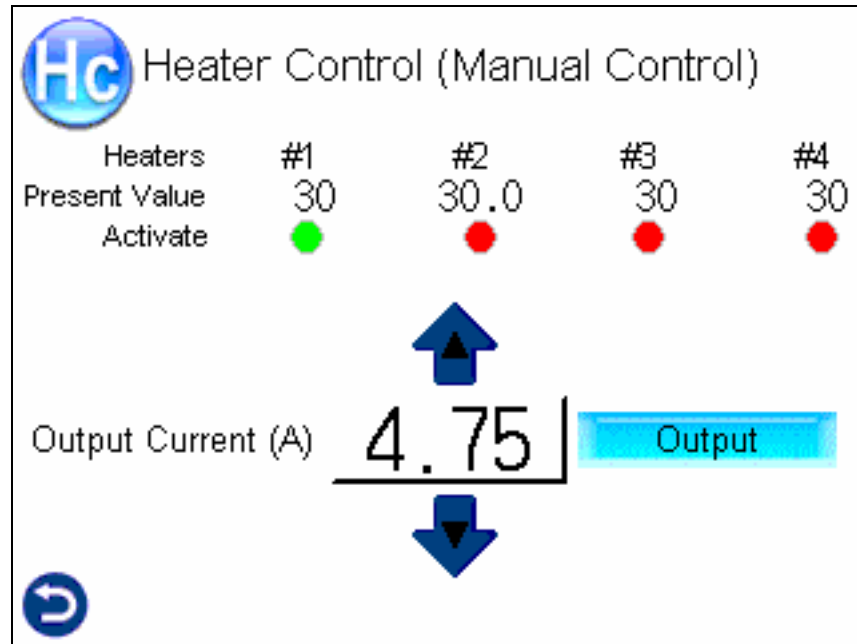


Figure 3-22. Manual Control

# Section 4:

## Theory of Operation

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This section describes the theory of operation on VersaPrep/VersaLock Chamber and their options.

### VersaPrep/VersaLock

Fig. 4-1 shows ports arrangement of VersaLock. VersaLock has eleven ports and four of them in red are open to the customer. One pair of the ports is in specular orientation that enable customer to IPES or some reflectory measurement. Side ports of ICF70 and ICF-117 are designed to attach another chamber.

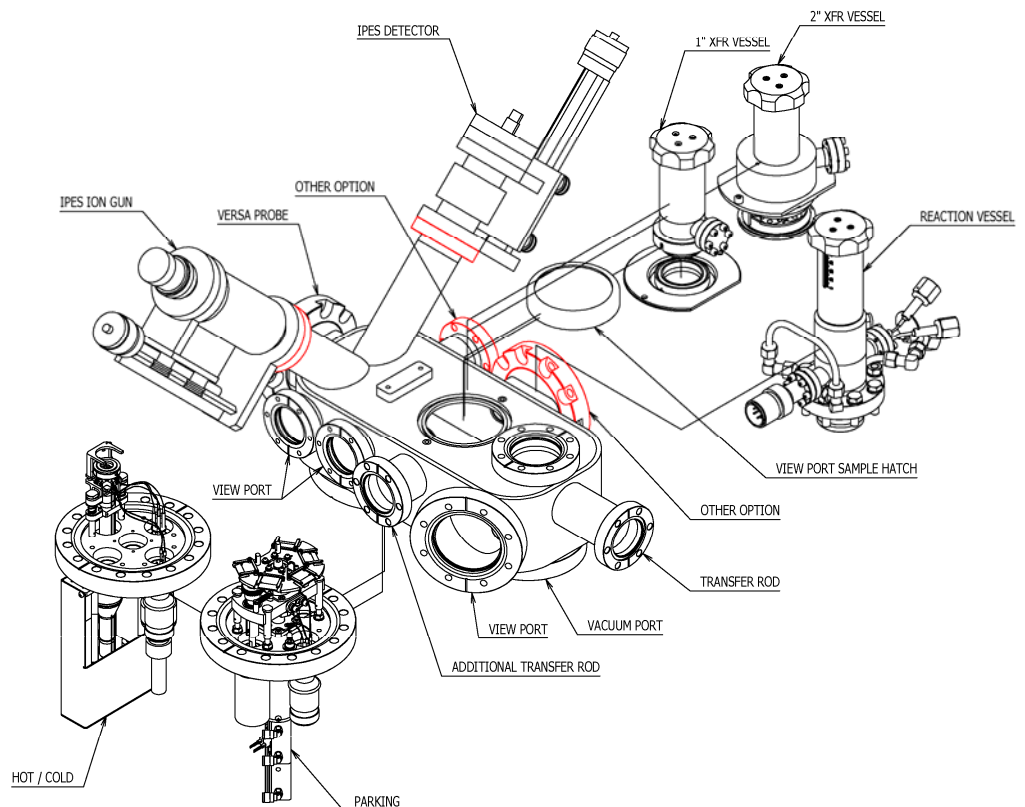


Figure 4-1. Ports expansion diagram of VersaLock

Fig. 4-2 shows ports arrangement on the VersaPrep. VersaPrep has twelve ports and five of them in red are open to the customer. One pair of the ports is in specular

#### 4: Theory of Operation

orientation. Side ports of two ICF70 and ICF-117 are designed to attach another chamber.

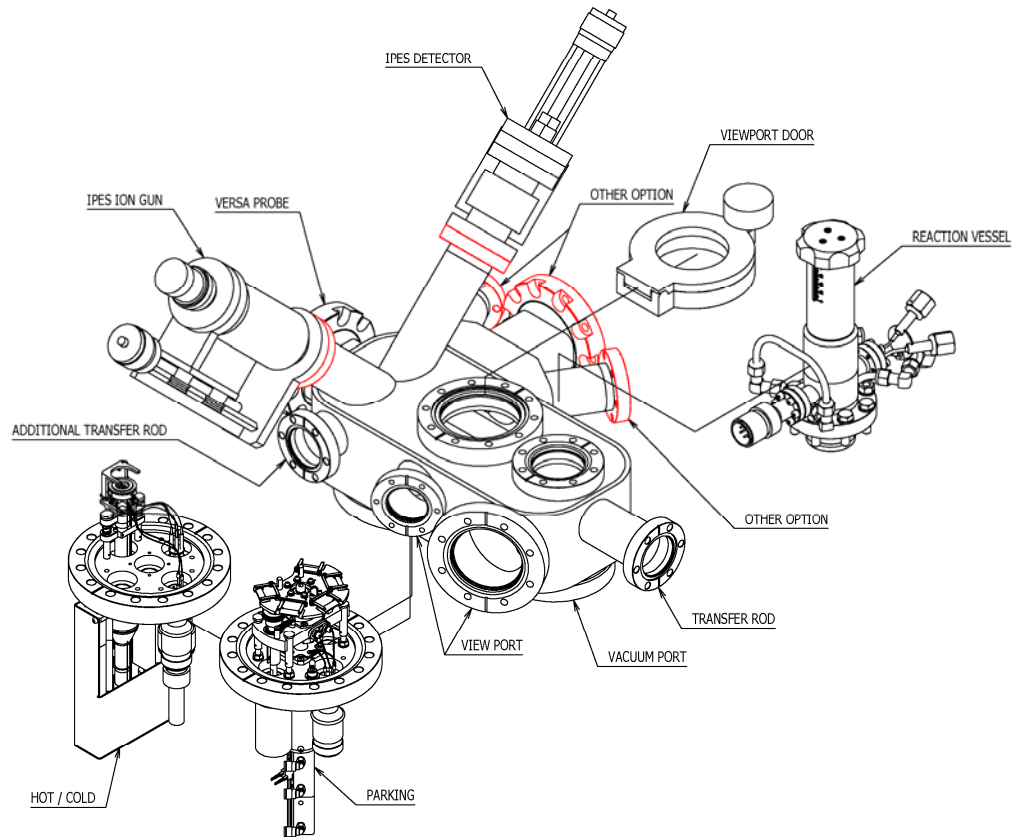


Figure 4-2. Ports expansion diagram of VersaPrep

VersaPrep and VersaLock are combined with VersaProbe II. Though basically they can work independently, their operation needs some kind of cooperation with SmartSoft software that controls VersaProbe II. The V110, pneumatic gate valve is located between VersaPrep chamber and VersaProbe II. This gate valve is interlocked by cold cathode vacuum gauge of VersaPrep/VersaLock chamber and Sample introduction rod that need to be fully extracted. Other stand alone operation and related interlock are controlled by model 20-240 / 20-245. Details shall be found in relevant manuals.

### Sample Carousel

Changing a height of the sample carousel is also important operation element. The height of the intro rod is fixed and changing the carousel height is changing height of the sample platen. The sample platen has different cross sections. Fig. 4-3 illustrates the sample platen height and its relevant cross section. When it is in its highest position, intro folk are free to move because of the cutouts of the

#### 4: Theory of Operation

sample platen. In its middle position, the platen fits to the folk to move together. Finally in it's the lowest position, the folk move beyond the sample platen to the VersaProbe II. In the side of the VersaPrep/VersaLock chamber, viewing ports to watch the sample platen are available.

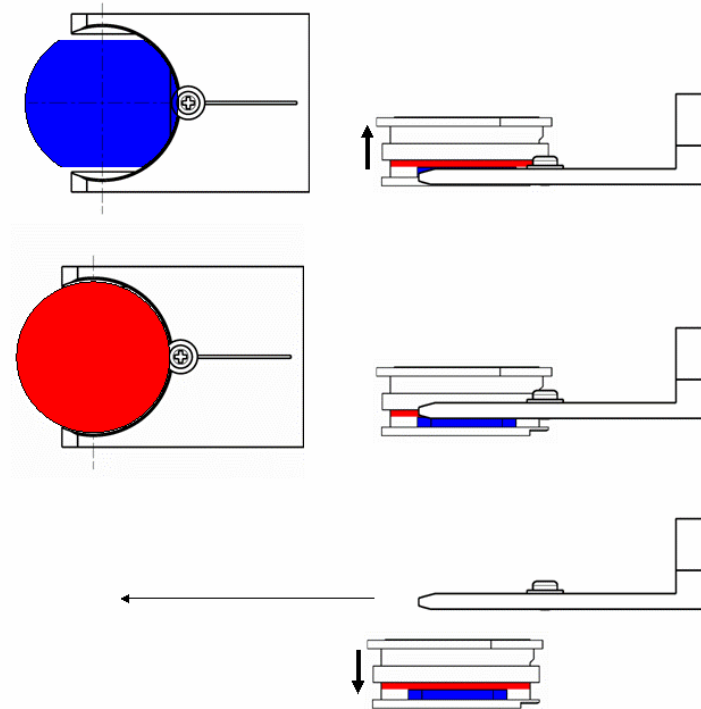


Figure 4-3. Relative height of sample platen and intro rod folk

### Hot/Cold Module

Hot/Cold sample platen is used to heat or to cool the sample. It has an integrated heater and made of good thermal conducting materials. There are two positions so called heating position and cooling position. At the heating position, the sample platen is isolated from cold finger. At the cooling position, the sample platen is pressed to the cold finger that is cooled by liquid nitrogen. If customer needs rapid cooling, cool the cold finger in advance to take advantage of its heat capacity.

### Reactor Vessel

#### **Gas shield**

The basic idea of the reactor vessel is dual sealing. The reaction gas is encapsulated by shielding gas and the shield gas is sealed by an elastomer O-ring. The inner seal is made of different high temperature resistant inorganic materials and their sealing surfaces are precisely polished. When the reactor

#### 4: Theory of Operation

vessel is closed, the inner seal is spring loaded to keep constant sealing pressure. The two surfaces are made of different materials and have different surface roughness to prevent them from mutual adhering. Consequently the inner seal is not gas tight. Surroundings shield gas is pressurized to push back the reaction gas that would diffuse out from the inner seal. There is a constant shield gas flow through the inner seal to the reactor vessel. The outer seal is conventional elastomer O-ring to keep the pressure of the shield gas.

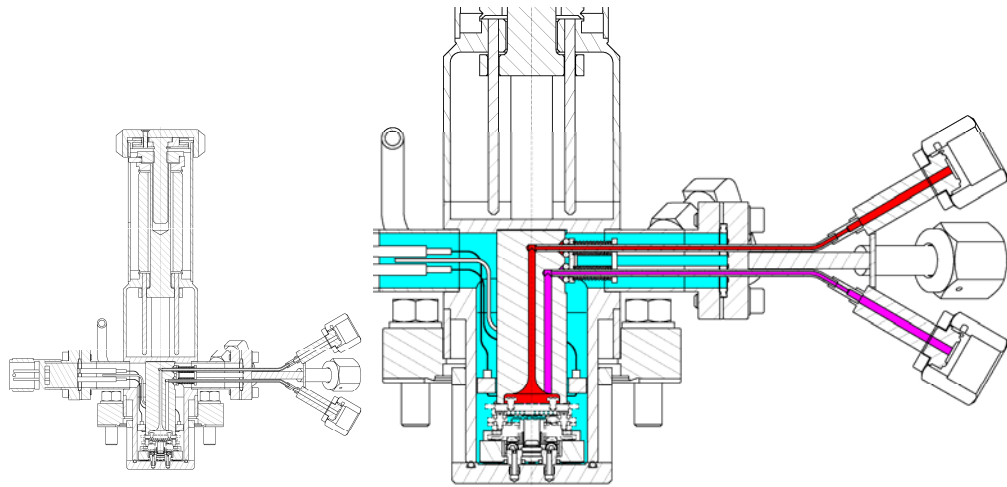


Figure 4-4. Cross section of the reactor vessel. Whole body (left panel) and close up of the gas holding area (right panel)

The cross section of the reactor vessel is shown in Figure 4-4. The left panel is over view and its bottom part is enlarged and shown in right panel. There, colors are used illustrate various gas. The reaction gas is represented by red, the shield gas is blue and mixture of the reaction gas and shield gas is purple. The reactor vessel is designed to eliminate dead volume and aimed for fluent gas flow so that inflow of shield gas is carried out immediately.



#### 4: Theory of Operation

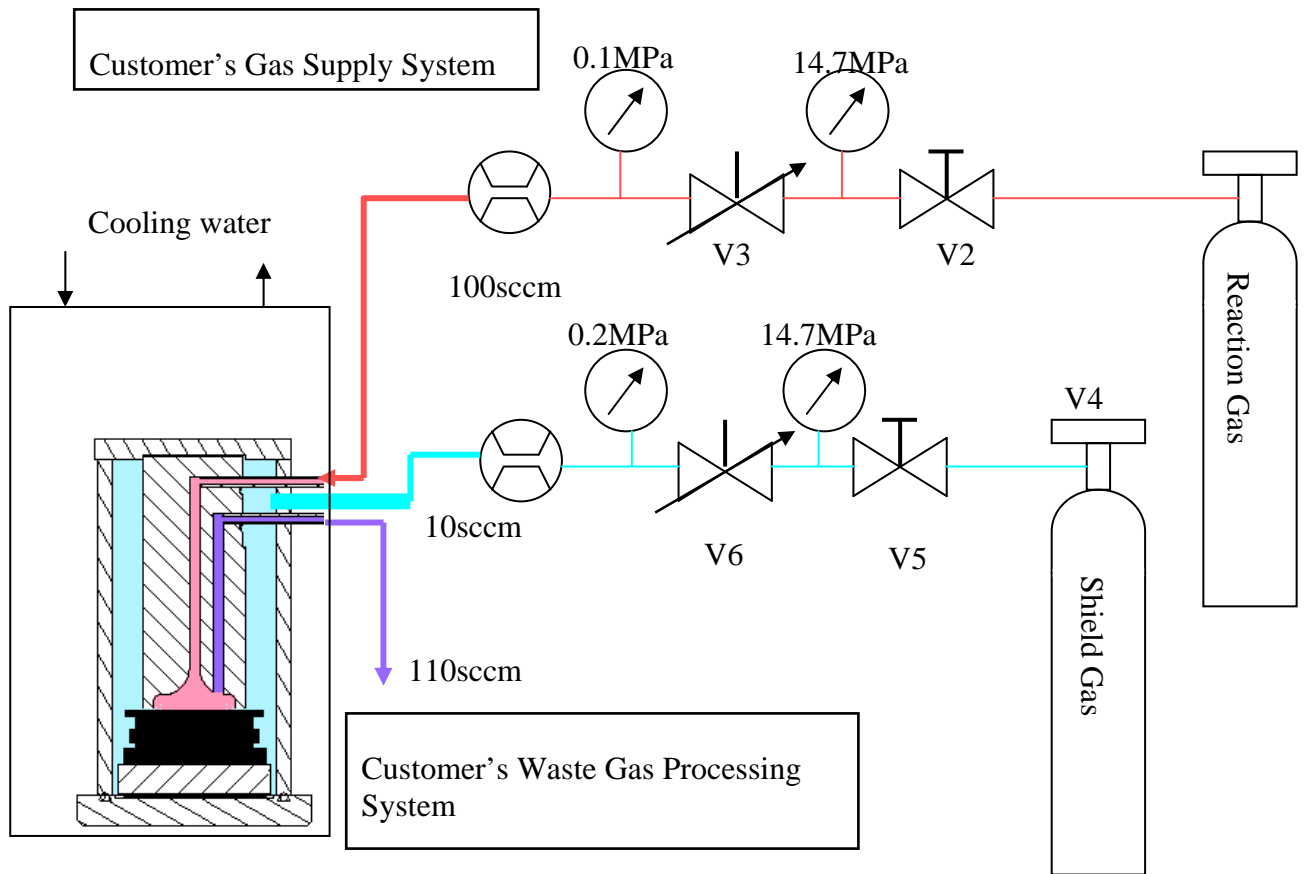


Figure 4-5. Example of gasses supply diagram

#### **Operation of the Reactor Vessel**

An example of gasses supply diagram is shown in Figure 4-5. The pressure and flow rate shown in the figure are just an example for explanation and are not real values. The flow rate of the shield gas is controlled by mass flow controller and its supply pressure is set high enough to keep up any change in reaction gas flow. As far as adequate supply pressure is kept, the flow rate of the shield gas kept constant even the pressure of reaction gas changes with in an allowance of mass flow controller. Again, as the shield gas flow is used to seal off the reaction gas, it shall be kept constant when the customer changes reaction gas flow rate or the sample temperature and when any chemical reaction took place to change the pressure inside the quartz cell.

Compared with traditional quart seal tube, the reactor vessel in dynamic mode has continuous reaction gas flow. The customer may change reaction gas or its concentration at any desirable time. As the gas supply system is open to the customer, the customer can design any necessary gas system. Some more details are explained in the following paragraphs.

#### 4: Theory of Operation

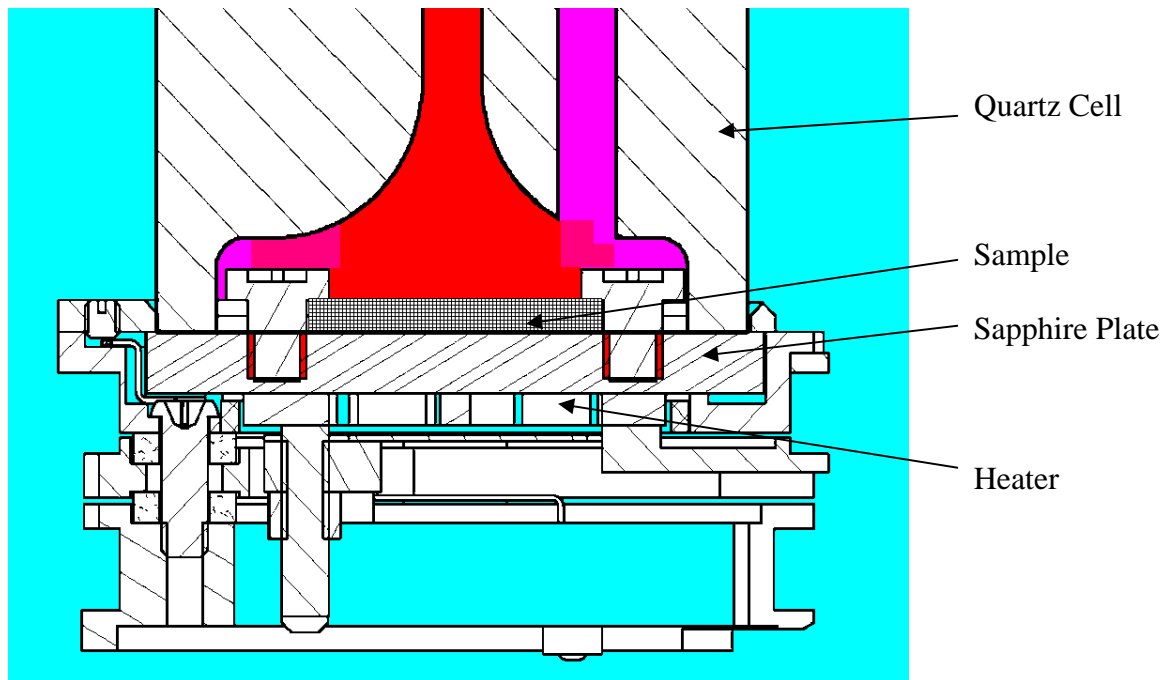


Figure 4-6. Detailed cross section of reactor vessel and sample platen

#### **Reaction Gas**

Detailed cross section is shown in Figure 4-6. The reactor vessel is made of quartz and it is substantially thermally isolated from chamber cooling water to reach high temperature. It is not designed to cool the reacting gas. Therefore it is forbidden to use any gas that potentially takes endothermic chain reaction such as self-decomposition, polymerization and any other reaction so called explosion. Once such elementary step starts, nothing could stop all reactants to be exhausted.

The heater is isolated from the reaction gas as far as reactor vessel is closed and enough shield gas is supplied. Before opening the reactor vessel, the reaction gas inside the quartz cell shall be purged otherwise it may blow out to cause trouble. It is also mentioned here that the heater is mounted to the sample platen and its power connections open when the reactor vessel is open. Before opening the reactor vessel, turn off the heater power or it may arc. If the customer is planning to use hydrogen the operator shall be known the nature of the hydrogen, easy to leak, very low energy for ignition and the operator shall be trained to handle.

The reactor vessel is designed to handle some chemical gas and consists of corrosion resistant materials. However the customer planning to use a reaction gas that attacks gas contacting materials, quartz, sapphire, SUS316 and Kalrez, should estimate corrosion speed and plan maintenance cycle. Every part that contact reaction gas is supplied as consumable part and details are found in chapter 4. Insufficient shield gas flow causes reaction gas leaking that result in corrosion of the exterior of the reactor vessel where pressurized shield gas held

#### **4: Theory of Operation**

and will burst unpredictable future. The customer may set alarm for shield gas flow shortage, interlock to reaction gas flow or emergence reaction gas purge facilities as the occasion demands. These kinds of preparations shall be valid for toxic gas.

The heater used to heat sample and its electrical connections are immersed in the shield gas. The shield gas should be inert and should not flammable. Though a heat loss by convection of shield gas is not negligible, the thermal conductivity of the shield gas is also important. Argon gas is one candidate. If the customer could recycle Krypton or Xenon, they are less thermal conductive and much more preferable in the senses of the heat loss.

There are two access ports for shield gas. The basic concept of the reactor vessel is single exhaust port. For normal use, one of the shield gas port may be plugged or closed by a valve. The port may be used to purge the reaction gas because of the leakage of the reaction gas or used to bleed shield gas to find out leakage.

#### ***Reaction Gas Injection and Purge***

Although followings might be obvious from previous description, let us be allowed to repeat them for the safety. In general, a sample platen may be stored on the carouse that is kept in vacuum. To load the sample to the reactor vessel, it needs to be pumped out. For this purpose, both the reaction gas line and shield gas line have adequate valves for isolation and have some vacuum pumps. When the reaction gas is so reactive that no applicable vacuum pumps were found, the customer may be purge the reaction gas line then vacuum it. Regarding operating theory of gas shield, after the sample platen is loaded, the reactor vessel should be closed first then a shield gas shall follow, finally the reaction gas will be injected. There are no other sequences. When the reaction is finished and sample to be taken out, a reaction gas need to be purged. Customer might design the gas supply system that use shield gas to purge the reaction gas.

#### ***Open or Close Reactor Vessel***

Though the reactor vessel is designed to hold certain pressure of shield gas, it is not designed to open or close with pressure difference. When the VersrLock or VersaPrep is evacuated, the shield gas is preferred to be pumped out before it is open. If pumping the shield gas after purging reaction gas is difficult, the VersrLock or VersaPrep chamber may be vent to be filled with atmospheric pressure of nitrogen. There is a pressure range between vacuum and atmospheric pressure where electrical discharge happens easily. The heater power shall always be off unless it is necessary.

#### **4: Theory of Operation**

# Section 5:

## Service

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### Setup Procedure

NOTE: It is the customer's responsibility to inspect and report shipping damage to the carrier, typically within 30 days. Before installing ULVAC-PHI equipment and/or software CD, inspect it for obvious damage that may have occurred during shipment.

Refer to "Technician's VersaPrep/VersaLock Installation, Calibration & Maintenance Manual" (ULVAC-PHI P/N 718962).



**WARNING:** *This is a Type 4 task. The equipment is energized. Live circuits are exposed and accidental contact is possible. Voltage potentials are greater than 30V RMS, 42.2V peak, 240V-A, and 20 J are exposed to accidental contact. Do not perform this procedure unless you are an experienced, trained technician.*

### Calibration Procedure

The VersaPrep/VersaLock has been calibrated at the factory and installation, and does not require routine calibration and maintenance. Any unit where to have trouble shall be returned to ULVAC-PHI Customer Service for repair.



**WARNING:** *This is a Type 4 task. The equipment is energized. Live circuits are exposed and accidental contact is possible. Voltage potentials are greater than 30V RMS, 42.2V peak, 240V-A, and 20 J are exposed to accidental contact. Do not perform this procedure unless you are an experienced, trained technician.*

## Cleaning Instructions

Normal maintenance does not require cleaning.

*FOR COMPONENTS WITH FRONT/OUTSIDE PANELS*

A cloth slightly moistened with water may be used on the outside only, if desired.



**CAUTION:** *Do not clean attached labels, otherwise they might be removed.*

## Replacement of fuses

*Refer to each component manuals.*



**WARNING:** *This is a Type 4 task. The equipment is energized. Live circuits are exposed and accidental contact is possible. Voltage potentials are greater than 30V RMS, 42.2V peak, 240V-A, and 20 J are exposed to accidental contact. Do not perform this procedure unless you are an experienced, trained technician.*

## Removal of the Component for Servicing

Removal for servicing is to be performed by qualified technicians or ULVAC-PHI Customer Service personnel only. Contact to ULVAC-PHI Customer Service or local distributors for assistance.



**WARNING:** *This is also a Type 4 task. Do not perform this procedure unless you are an experienced, trained technician.*

## Consumable parts

Table 5-1 Consumable parts list.

Part number	Description	Notes
C72038	GASKET-CU, 1.33 FLG,CLEAN	
C72037	GASKET-CU, 2.75 FLG,CLEAN	
A73015	GASKET-CU, 3.38 FLG,CLEAN	
C74053	GASKET-CU, 4.50 FLG,CLEAN	
C72036	GASKET-CU, 6.00 FLG,CLEAN	
723323	SCR-CAP, M8X 25,SKT,SST,SMALL HEAD	Using Quick Intro hatch
723342	O-RING,AS568-004, kalrez, 1.78W,1.78ID	Reactor Vessel
723434	O-RING,AS568-027,KALREZ,1.78W, 33.05ID	Reactor Vessel
723198	ROUND BAR-QUARTZ,20 DIA	Reactor Vessel
723199	WLDMT-FLG 1.33,PIPE $\Phi$ 2,1/8	Reactor Vessel
723406	SAPPHIRE PLATE,SPC	Sample platen
723460	SCR-PAN,M2X2.5,PHIL, SMALLHEAD,ALUMINA	Sample platen
723155	SiC HEATER-14.4DIA, 1THICK	Sample platen

### Specific accessories with specific characteristics for safety



**WARNING:** Use *ULVAC-PHI* genuine accessories. Otherwise it could cause death, personal injury and/or damage to equipment.

## 5: Service

Table 5-2 Specific accessories list.

Part number	Description	Notes
723342	O-RING,AS568-004, kalrez, 1.78W,1.78ID	Reactor Vessel
723434	O-RING,AS568-027,KALREZ,1.78W, 33.05ID	Reactor Vessel
723198	ROUND BAR-QUARTZ,20 DIA	Reactor Vessel
723199	WLDMT-FLG 1.33,PIPE $\Phi$ 2,1/8	Reactor Vessel
723406	SAPPHIRE PLATE,SPC	Sample platen
723460	SCR-PAN,M2X2.5,PHIL, SMALLHEAD,ALUMINA	Sample platen
723155	SiC HEATER-14.4DIA, 1THICK	Sample platen
757082	ASSY-CA,PWR,NEMA 6-15P-IEC320- C15,3M,ROHS	AC Power Cable
757019	ASSY-CA,PWR,HAN3A(P)-IEC320 C15,10M	Power Cable for GLD- 136C Rotary Pump
757085	ASSY-CA,MNLMINI2P- 2/MNLMINI2S,0.1M,ROHS	DC Power Output branch cable
757014	ASSY-CA,F2M-2FERRULE,PWR,10M	DC Power cable for touchscreen device
757051	ASSY-CA,10MSF-BNCF-MNL2P- MNLMINI2P,ROHS	Heater Power Output Cable for Hot/Cold Stage
757052	ASSY-CA,6MSF-MNL2P-TC(SM)M(E)- LUG,ROHS	Heater Power Output Cable for Reactor Vessel
723169	ASSY-CA TURBO PWR HIPACE,10M	DC Power cable for HiPACE Turbo Molecular Pump
757086	ASSY-CA,D9F-MNL-MINI2P-BNC,8M,ROHS	DC Power and setpoint cable for Pirani Gauge



## Contacts

If VersaPrep fails to perform specified functions, either seek the services of qualified personnel or contact ULVAC-PHI or Physical Electronics USA Customer Service as follows:

**By mail:**

ULVAC-PHI, INC.  
370 Enzo, Chigasaki, Kanagawa,  
253-8522, JAPAN

Physical Electronics USA, Inc.  
PHI Customer Service  
18725 Lake Drive East  
Chanhassen, MN 55317-9384 USA

**By e-mail:**

service@phi.com

**By telephone or fax:**

Region	Telephone	Fax
U.S.	+1-800-922-4744	+1-612-828-6325
Outside U.S.	+1-612-828-5831	+1-612-828-6325
Japan	+81-46-785-6523	+81-46-785-9406
Europe	+49-89-96275-0	+49-89-96275-50



***WARNING: ULVAC-PHI's products are designed and manufactured to provide protection against electrical and mechanical hazards for the operator and the area surrounding the product. The procedures provided in Sections 2 of this manual and in other ULVAC-PHI product manuals must be followed to ensure that these protections are not impaired in any way.***

## **5: Service**