

Glovebox &

Gas Purification System

VG1200/750TS

User's Manual

Introduction

Thank you for choosing Vigor's glovebox. Please read this manual carefully before you install and use this equipment. This manual will guide you to install and operate this equipment correctly.

If you have any question on this manual or have any problems about using this equipment, please contact our service staff at 1-716-200-1200.

Please do not make copies of this manual to a third party without obtaining a written permit from Vigor.

This manual is only for operators of this glovebox and Vigor's service staff.

Thank you again for selecting our glovebox and we hope you will enjoy using our equipment and

Chapter 1 Preparation

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1. 1 Location Preparation

1.1.1 Room

- Room Temperature: Minimum +15 °C (50 °F), Maximum +30 °C (86 °F)
- Humidity: 20% to 70%
- Good Ventilation

1.1.2 Floor

- Flat
- Strong enough to support the weight of the equipment

1.2 Gas Supply

Working Gas

Purpose	Required for operating the equipment Used to create an inert atmosphere inside the box. Used to operating the pneumatic valves
Type of the Gas	Nitrogen, Argon, or Helium
Purity	≤ 5 ppm H_2O ; ≤ 5 ppm O_2
Quantity	To support a uninterrupted gas supply
Cylinder Regulators	Cylinder Regulator for Type K cylinders with 3000 psi, regulating to at least 70 psi.
Connections	Compression Fittings (Provided by the manufacturer)

Regeneration Gas

Purposes	Used to regenerate the adsorbents in Type T purifier when the purifier is saturated with the impurity gases.
Type of Gas	Depending on the type of the working gas used for the glovebox system: a) When nitrogen is used as the working gas, please use nitrogen/hydrogen mixture (95%N_2, 5%H_2) b) When argon is used as the working gas, please use nitrogen/hydrogen mixture (95%Ar, 5%H_2) c) When helium is used as the working gas, please use helium/hydrogen mixture (95%He, 5%H_2)
Purity	≤ 5 ppm H_2O ; ≤ 5 ppm O_2



Quantity	Each regeneration requires half to one full cylinder (Type K)
Regulator	Cylinder Regulators for Type K cylinders with 3000 psi, regulating to 30 psi.
Connections	Compression Fittings

1.3 Power Supply

This equipment use single-phase 110V, 60 Hz electric power. The power rating depends on the model of the product. Please see the product information plate for the current required by the equipment.

Chapter 2 Installation

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2.1 Equipment Placement

Four casters are installed on the stand of the equipment. The equipment can be easily moved and position in the room. After the positioning the glovebox at the desirable location, please use a wrench to adjust the levelers at the four legs of the stand so that the casters are off the ground and the glovebox is leveled.

2.2 Connecting the Box with the Purifier (Only for the System with Stand-alone Purifier)

2.2.1 Connecting the circulation main pipe (OD 1¼")

2.2.2 Connecting the stainless tubing (3/8")

2.3 Connecting Gases

2.3.1 Connecting the Working Gas

Attach a gas regulator to a cylinder containing working gas, which can high purity nitrogen or argon. Using a piece of nylon tubing (OD, 8 mm, maximum pressure 120 psi) or copper tubing to connect the gas regulator to the working gas port on the glovebox. Adjust the regulator to deliver the working gas at 4 to 5 bar (65 to 75 psi).

- ✧ Warning: Setting the pressure too high will damage the equipment but the glovebox will not work properly if the pressure is too low.

2.3.2 Connecting the Regeneration Gas

Attach a gas regulator to cylinder containing the regeneration gas. Using a piece of 3/8" plastic tubing (maximum pressure 120 psi) or copper tubing to connect the gas regulator to the working gas port on the glovebox. Adjust the regulator to deliver the regeneration gas at 1 bar (15 psi).

- ✧ Warning: Too high pressure may damage the equipment

2.3.3 Vent

During the regeneration of the purifier, the regeneration gas flows through the heated purifier to the vent port. Because the purifier adsorbs some chemicals and the regeneration gas contains hydrogen, the gas coming out of the purifier may contain chemicals as well as un-reacted hydrogen. Therefore, it should be vented to outdoor or to a fume hood.

- ✧ Precaution: The exhausted gas from the regeneration may contain un-reacted hydrogen and harmful chemicals. It could have unpleasant odors and pollute the lab and may harm the equipment operators. It is recommended to vent the exhorted gas directly to outdoor or to a fume hood.

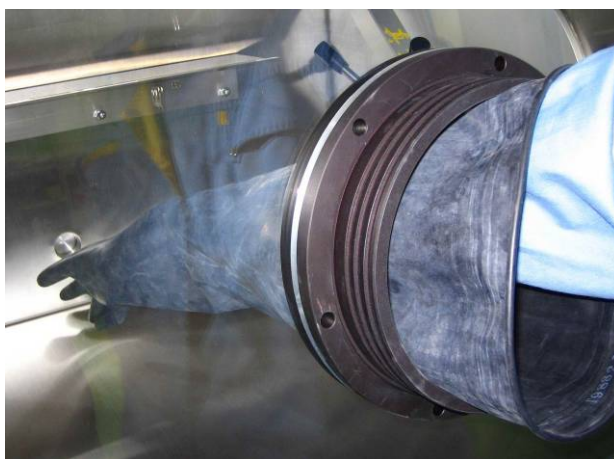
- ◆ **Warning:** If harmful materials are used in the glovebox, all the exhausted gas from the glovebox system, including the regeneration, purging, and vacuum pump, should be vented directly to outdoor or a functioning fume hood.

2.3.4 Vacuum Pump Exhausted Gas

Vent the exhausted gas from the vacuum pump to outdoor or a functioning fume hood.

2.4 Install Gloves

- 1) Insert your hand and arm into the glove to be installed and slide glove into the box through the glove port. Rotate the glove so that the thumb is pointed up.



- 2) Slide your hand out and turn the cuff inside out and over the gloveport. Rotate the cuff of the glove to further adjust the thumb's position if needed.



- 3) There are three grooves on the glove port. Adjust the glove cuff so that the rim of the glove is position in the first groove from the window. Place two O-rings over the gloves and on the other two grooves.



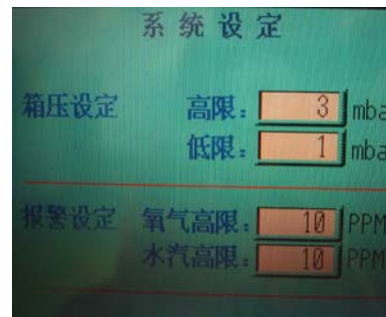
- 4) Repeat steps above to install all other gloves.

2.5 Install Power Strip inside the Glovebox

There are four spare KF40 Flange fittings, which could be used for feedthroughs for electric power, electric signals, gas, liquid, and vacuum. A power strip with a Flange fitting is provided.

The following is a installation procedure.

- 1) If the box is still an air box, skip this step. To avoid introducing air into the box, adjust the pressure inside the box to at least 5 mbar by setting the lower limit of the box pressure to 5mbar.



- 2) Remove a blanking Flange on a feedthrough you choose to use for the power supply.



- 3) Feed the plug that will be used to attach the power strip through the KF40 O-ring.

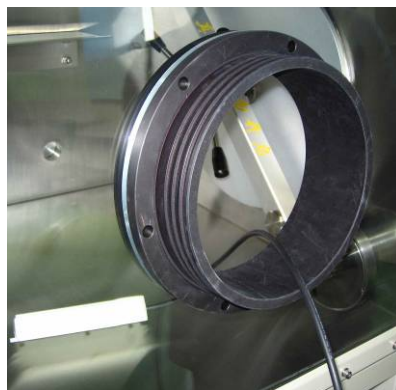


- 4) Slide the power cable into the box until the Flange on the

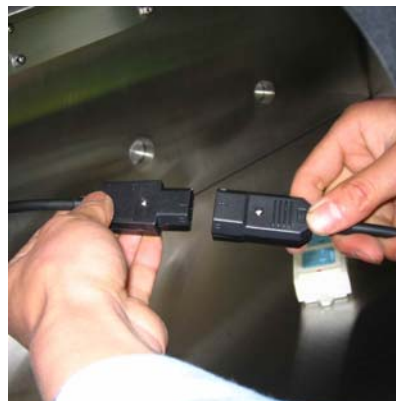


cable reach the KF40 Oring on the flange on the box. Use a KF40 clamp to attach two Flanges and tighten it.

- 5) Place the power strip into the box through a glove port or antechamber.



- 6) Connect the power plug on the power strip to the plug on the flange.



2.6 Install Oxygen and Moisture Analyzers

Fuel cell oxygen sensor is very sensitive to air. To avoid prolong exposure to high oxygen level in air, the sensor is sealed under nitrogen until it is ready to install to a glovebox with low oxygen concentration. Therefore, oxygen sensor is installed only when the oxygen level inside the box is lower than 100 ppm.

2.6.1 Moisture Analyzer (Please see the user's manual of moisture analyzer)

2.6.2 Oxygen Analyzer (Please see the User's Manual of Oxygen Analyzer)

Chapter 3 Working Principles

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3.1 Introduction

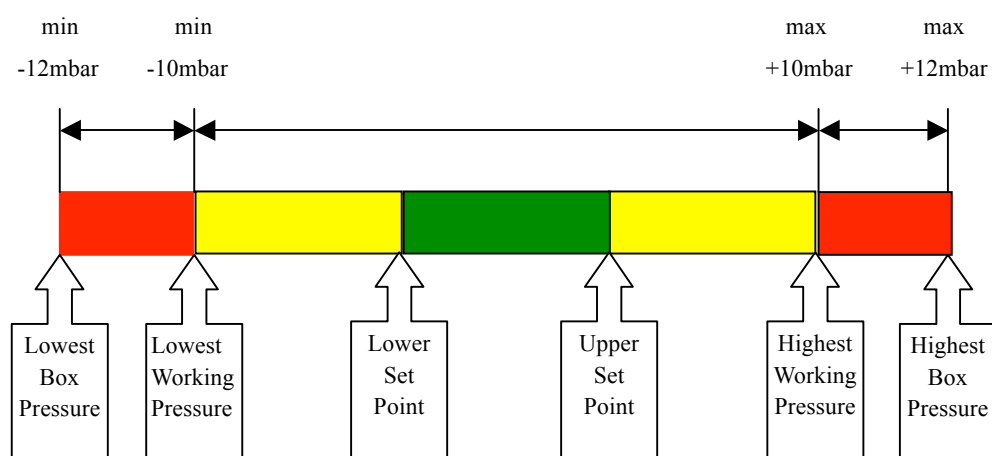
The glovebox system is an enclosed system. Air leaks into the glovebox system through seals and gloves. During the use, oxygen and moisture are introduced into the glovebox when materials are taken into the box and cylinder gas is introduced into the box to maintain the pressure. To maintain the oxygen and moisture level less than 1 ppm, a gas purifier is attached to the box. The purifier withdraws the contaminated gas from the glovebox and flow through the purifier to remove oxygen and moisture impurity. The purified gas is then sent back to the box. This purification circulation is used to maintain the impurity level in the box at desirable level.

The system has three functions, purging, circulation, and regeneration. They are described here in details but the operating procedure will in described in later chapters.

3.2 Pressure Control

The pressure inside the box is a relative pressure, comparing to the surrounding atmospheric pressure. A possible pressure indicates the pressure inside the box is greater than the outside atmospheric pressure while a negative pressure show a lower pressure inside the box. The unit of the pressure used here is mbar or one thousandth of a bar.

The pressure of the box is controlled by the PLC. The user sets the upper and lower limits of the pressure on the touch screen interface, and the PLC will regulate the pressure to within the set limits. The pressure can be set to either positive or negative.



The working pressure in the box can be controlled to a pressure ranging from -10 mbar to +10 mbar. To The range of the working pressure can be set so the control system will automatically maintain the working pressure within the set range. Users set the upper and lower limits of the range of the working pressure.

Highest Box Pressure: The highest pressure allowed in the box is 12 mbar. When the box pressure is higher than 12, the safety valve on the glovebox is actuated to vent the excess pressure to avoid damage to the equipment.

Lowest Box Pressure: The lowest pressure of the glovebox in the box is -12 mbar. When the box pressure is lower than -12 mbar, the glovebox will be shut down.

Upper Set Point: The box pressure is regulated lower than the Upper Set Point. When the box pressure is higher than the set point, the valve connecting the box and the vacuum system is opened and the gas inside the box is evacuated to lower the box pressure lower than the set point.

Lower Set Point: The box pressure is regulated higher than the Lower Set Point. When the box pressure is lower than the set point, the valve connecting the box and the gas supply system is opened and the gas from the supply system is added into the box to raise the box pressure over the lower set point.

Highest Working Pressure: The highest pressure can be set as +10 mbar.

Lowest Working Pressure: The lowest working pressure is -10 mbar.

3.3 Purge

Impurities inside the glovebox are removed by gas purification system. However, the purifier has limited capacities. When the concentrations of the impurities are too high, it is not recommended to use the purifier remove them. Instead, a process called purging is used to quickly remove large amount of impurities from the box. The purging process quickly passes large amount of high purity nitrogen through the box to flush the impurity out of the box. Purge can be done either manually or automatically.

When a new box is installed, the initial atmosphere is air and required to be purged before turning on the gas circulation system.

When air is admitted into the box due to inappropriate operations, the oxygen may rise to over 100 ppm. One should immediately stop the purification system and purge the box to below 50 ppm before turning the purification system back on.

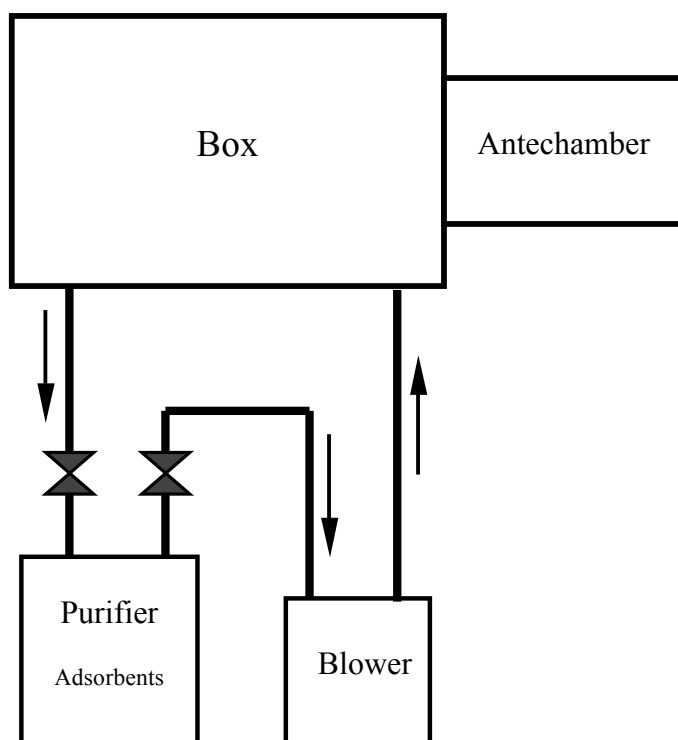
When gloves or seals are damaged, air may leak into the box and raise impurity level to > 100 ppm. The purification system should be immediately turned off and perform the purge until oxygen level decrease to below 100 ppm.

Some organic solvents may damage adsorbents. When large amount of solvents is expected to be released into the box during an experiment, it is recommended to turn off gas purifier to avoid admitting organic solvents into the purification column. After completing the experiment, purge the box for 5 minutes before turning on the purification system.

Situation	Atmosphere inside Box	Amount of N2 Required
New Box	air	One cylinder
Window taken off for repairs	air	One cylinder
Air accidentally admitted into glovebox	O ₂ > 100 ppm	Purge until O ₂ < 100 ppm
Leak through damaged gloves, seals, fittings	O ₂ > 100 ppm	Purge until O ₂ < 100 ppm
	Large amount of solvents	Purge 5 to 10 mintues
Large amount of solvents spilled or released	Large amount of solvents	Purge 5 to 10 mintues

3.4 Gas Purification System

The glovebox system is not a leak free system. Air continuously leaks into the box through rubber gloves, flange fittings, compression fittings, and the interface of window/box, gloveport/window, glove/gloveport. To maintain the atmosphere inside the box continuously below 1 ppm, a gas purification system is attached to the box, as shown in the diagram below.



The gas purification system typically contains a purifier column for removing impurities and a blower to assist the gas circulation. The gas containing impurities is withdrawn into the gas purification system and pass through the purifier column to remove impurities. The purified gas is discharged back into the box. The continuous circulation will remove maintain the impurity level inside the box below desirable system.

Because the ultralow leak rate of Vigor gloveboxes, the gas purification does not need to run continuously. The auto-circulation feature enable oxygen and moisture sensors to control the circulation system. Typically, the gas purification system works at only 10% of time and rests during 90% of the time.

3.5 Purifier Regeneration

The purifier column has limited capacities (60 L of O₂ and 2 kg of H₂O). When oxygen or moisture level can't be maintained below the desirable value, the purifier needs to be regenerated to recover the adsorption capacity. The regeneration of the purifier need regeneration gas (containing 5% reducing gas H₂). The regeneration is done automatically according to the programs preloaded to the Programmable Logic Controller (PLC) on the system, and the whole process will take 24 hours.

◆ Warning: Do not interrupt the regeneration program after it starts. In case of

interruption of the regeneration process, please do not restart the system. Waiting overnight before starting the regeneration. Contact Vigor service engineer for help.

3.6 Antechamber

Vigor glovebox box comes with a large antechamber (ID 370 mm) and a mini antechamber (optional, ID 100 mm or 150 mm). The antechambers are used to transfer materials into/out glovebox without introducing air into the box.

To transfer materials into the box, first open the outer door of the antechamber (refill the antechamber if it is under vacuum). Place the materials in the slide tray inside the antechamber and then close the outer door. Evacuate the air inside the antechamber for 20 to 30 minutes and refill the antechamber halfway so that the vacuum gauge on the antechamber is around -0.5 bar. Repeat the evacuation/refill process two more times to minimize the amount of the impurities be taken into the box. Fully refill the antechamber and open the inner door and transfer materials into the box. Close the inner door and evacuate the antechamber.

To transfer the materials out of the box, first evacuate the antechamber and fully refill the antechamber. Open the inner door and transfer materials into the antechamber. Close the inner door and open the outer door to transfer materials out of the antechamber. Close the outer door and evacuate the antechamber.

◆ **Warning:** Do not try to open the antechamber doors while the antechamber is under vacuum. Forcefully open the door will damage the equipment.

✧ **Caution:** Do not open the outer and inner door simultaneously. Make sure there is no air in the antechamber before opening the inner door.

Chapter 4 System Startup

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4.1 Introduction

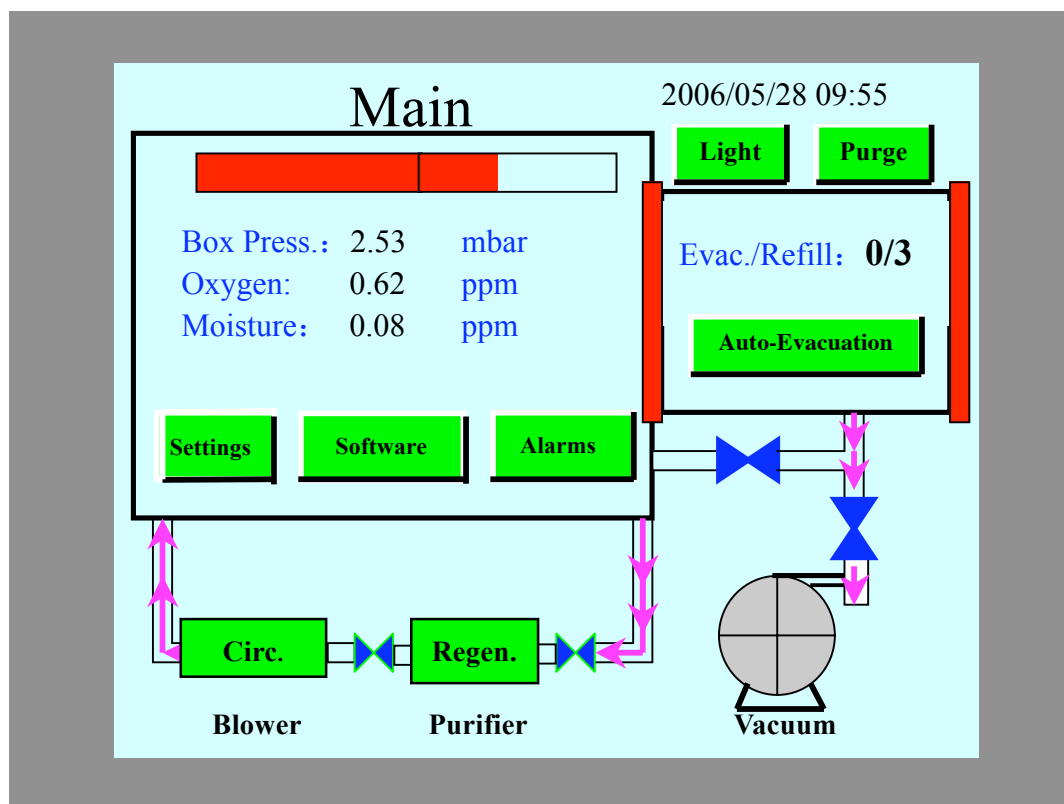
The glovebox system is operated through the touch screen. All functions can be realized by touching the buttons on the touch screen.

4.2 System Startup

The switch for the main electric power supply to the glovebox is located on side of the electric control box. The power is off when the switch is at '0' position and on when it is at '1' position.

4.3 Touch Screen Main Page

After powering up, the system will perform self diagnosis. The touch screen main page will appear in 30 seconds.

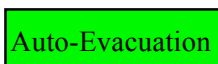


4.4 Function Buttons

There are 11 function buttons on Main page. All the function buttons will be explained in this section.



When the system encounters problems, this button will flash. Press the button to enter the Alarm page to get the information.



Touch this function button to enter the Auto-evacuation page to set the auto-evacuation parameters and start auto-evacuation of large antechamber. See Section 5.5 for details.



Touch this function button to enter the Circulation page to control the purifier circulation. See Section 5.2 for more details.



Touch this function key to turn on the box light. Touch again to turn the light off.



Touch this function key to enter the Purging page to set purging time and perform purge of the box. This function is disabled while the gas circulation is in progress. See Section 5.1 for details.



Touch this function button to enter the Purifier Regeneration page. See Section 5.3 for more details. Note: The purifier regeneration process will start while the circulation is in process. See Section 5.3 for details.



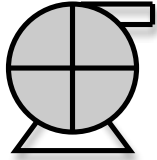
Touch this function key to enter the System Settings page where the system parameters are entered. The system parameters enter here include the box pressure limits and alarm-setting-off limits of impurities. See Section 5.4 for details.



Touch this function button to enter the Software page where the chemistry related calculations are performed. See Section 5.6 for details.



This function icon represents a valve. It is solid blue when it is close. Touch the button will turn on the valve. When the valve is open, the button change to 



This icon represents the vacuum pump on the glovebox system. Touch the icon will turn on the vacuum pump and touch it again to turn it off. When the pump is on, the cross inside the circle turns. It stops while the vacuum pump is off.



This icon display the box pressure and the range is +5 to -5 mbar.

Chapter 5 Operation Instructions

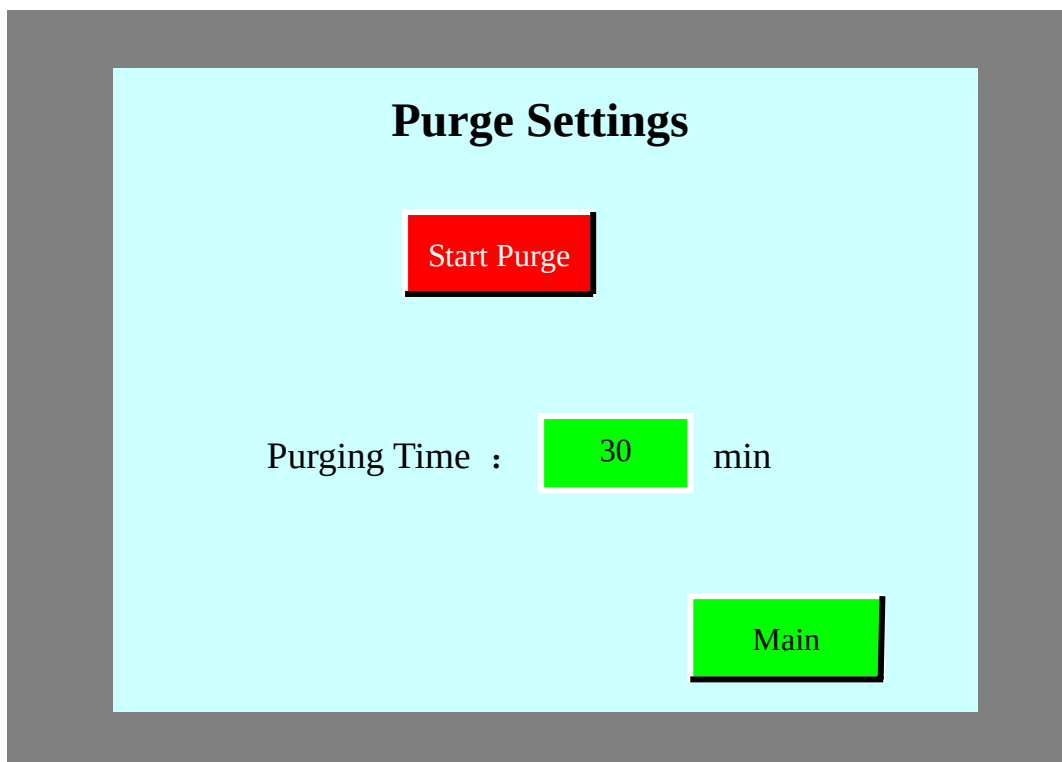
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5.1 Purge

When large amount of impurities are introduced into glovebox, it is recommended that one immediately turn off the gas circulation system and purge the impurities out of the box. Doing so can avoid introducing the impurities into the gas purification column and consume the purification capacity.

To activate the purge function, the circulation system needs to be turned off. See Section 5.2 for the details about how to turn off circulation.

On the Main page of the touch screen press  and the following screen will appear.



 To start purge

 To stop purge

 To return to Main page

After the purge function is activated, the system will introduce working gas into the box to increase the box pressure before opening the box vent valve. The system will continue introducing the working gas to purge the impurities out of the box for the amount of time set by the operator. The purge action can be terminated at any time.

The following is the purging procedure:

- 1) Set the purging time in minutes. Press the data field area and a keyboard will appear. Enter the a desirable value as the purging time.
- 2) Press to  activate the purging function. After activating the purging function, the button will become 
- 3) The program will automatically stop after the purging time expires. The button will become 
- 4) The purging program can be stopped at any time. Press  to stop purging and the button will become 

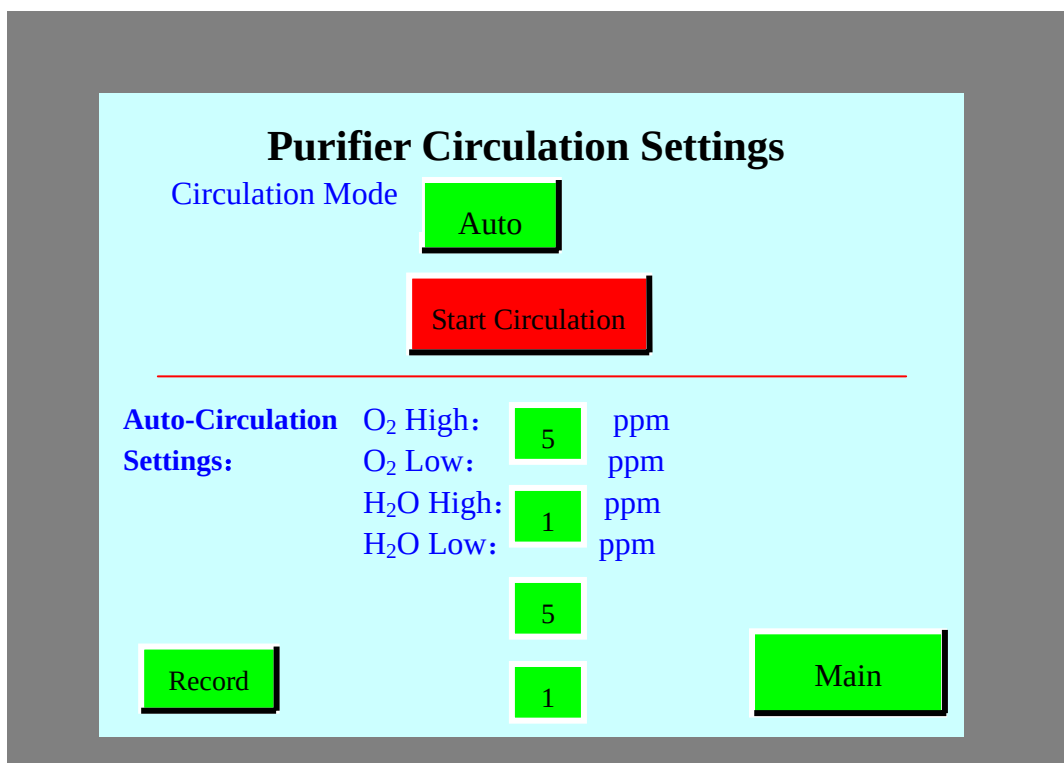
5.2 Circulation

Before starting circulation, please make sure:

- The box is not being purged
- The purifier is not being regenerated

Don't start circulation if the box is being purged or the purifier is being regenerated.

On the main page, press **Circ.** the following screen will appear.



Auto Circulation mode, Auto. At this mode, the blower and the circulation will be automatically controlled by the Auto-Circulation settings. After pressing it, this button will turn the button into **Manual**

Manual Circulation mode, Manual

Start Circulation Start the blower and activate circulation system. After pressing it, the button will turn change to **Stop Circulation**

Record Pressing this button to get to the circulation record page, which shows the circulation data, including total circulation time, circulation time after last regeneration, and the total regeneration number.

There are two circulation modes, namely Auto and Manual. The circulation mode is set by pressing the circulation mode button, which will change between **Auto** and **Manual**

5.2.1 Manual Circulation

Set the circulation mode to **Manual** and press **Start Circulation** the button will become **Stop Circulation**

To stop the circulation at the manual mode, press **Stop Circulation**

5.2.2 Auto-Circulation

The circulation can also be set to Auto mode. Under the Auto mode, the circulation blower will start if the oxygen or moisture level is higher the O2 high or H2O high. The blower will not stop until the oxygen and moisture are lower than O2 low and H2O low. Operators can set O2 High, O2 Low, H2O High, and H2O Low by pressing the value field.

Following is the procedure to set up the O2 High value.

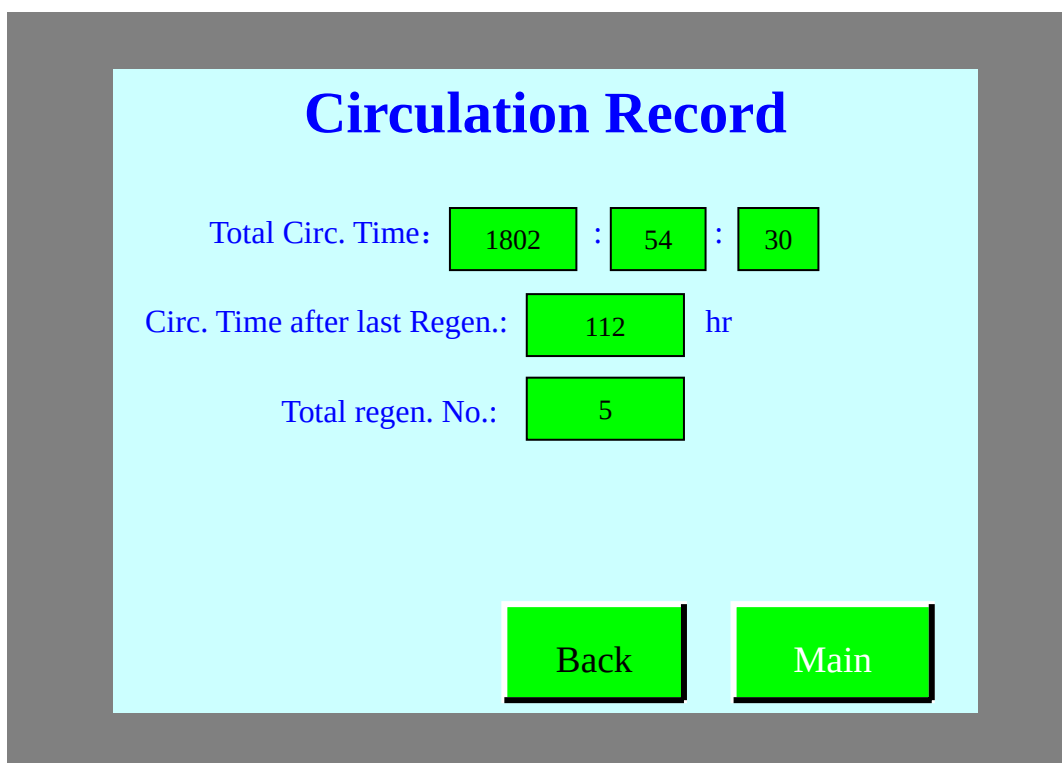
- 1) After pressing the field, a key pad will appear on the touch screen

Cancel		◀	▶
7	8	9	DE
4	5	6	-
1	2	3	E N T
0	.	CL	

- 2) Input the desirable O2 High value, which can have one digit after the decimal point.
 - 3) Press ENT key on the keypad.
 - 4) Repeat step 1) to 3) to set up O2 Low, H2O High, and H2O Low.
- ✧ Note: When the system powers on, the circulation mode will be automatically set to Auto Mode and the impurity levels inside the box will be maintained below the set value.

Press **Main** to return to the main page.

Press **Record** to enter the Circulation Record page.



The screenshot shows the 'Circulation Record' page with a light blue background. At the top, the title 'Circulation Record' is displayed in blue. Below the title, there are three rows of data, each with a label in blue and a value in a green box. The first row shows 'Total Circ. Time:' followed by three green boxes containing '1802', '54', and '30' separated by colons. The second row shows 'Circ. Time after last Regen.:' followed by a green box containing '112' and the text 'hr'. The third row shows 'Total regen. No.:' followed by a green box containing '5'. At the bottom of the page, there are two green buttons labeled 'Back' and 'Main'.

Label	Value
Total Circ. Time:	1802 : 54 : 30
Circ. Time after last Regen.:	112 hr
Total regen. No.:	5

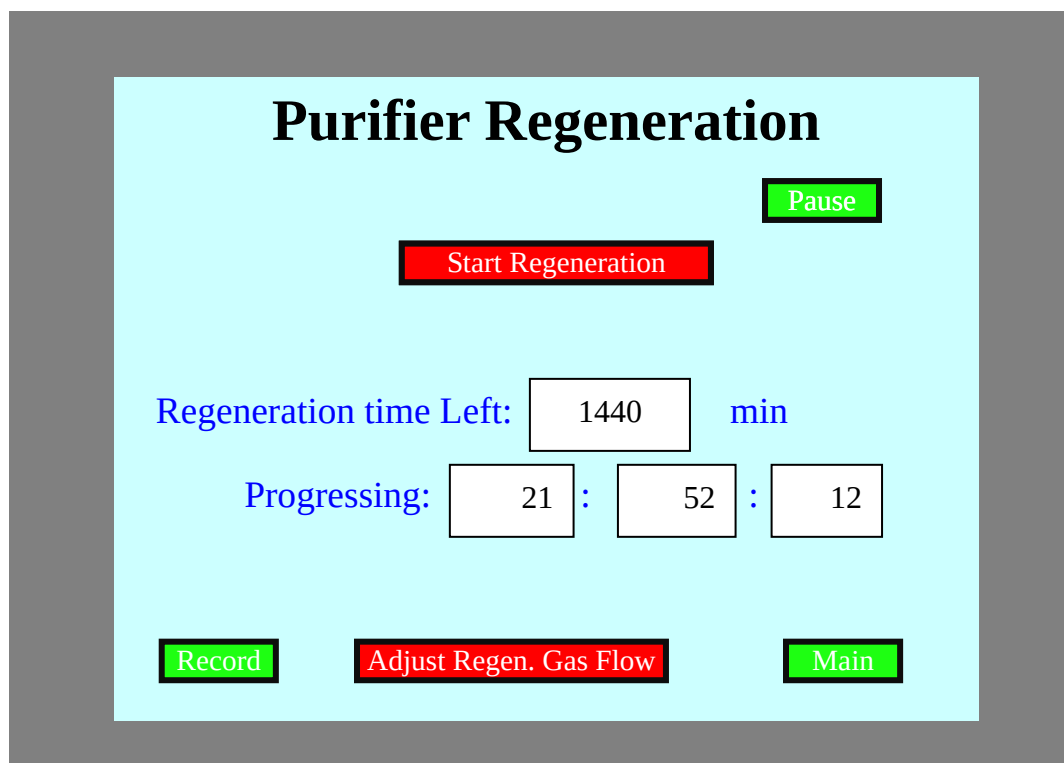
Back Main

The Circulation Record page displays the total circulation time, circulation time after last regeneration, and the total number of regeneration. These data show the status of the purifier and are useful for maintenance and repair of the equipment.

5.3 Purifier Regeneration

Stop the circulation before activate the regeneration process.

On the main page, press **Regen.** to enter the Purifier Regeneration page.



Adjust Regen. Gas Flow To start adjusting regeneration gas flow

Adjust Regen. Gas Flow To stop adjusting regeneration gas flow

Start Regeneration To start regeneration

Stop Regeneration To stop regeneration

Pause To pause the regeneration process

Continue To continue the regeneration program

5.3.1 Regeneration gas

The adsorption of oxygen by the purifier is an irreversible chemical adsorption process. Therefore, the regeneration of the purifier requires a reducing gas. A gas mixture containing about 5% of hydrogen, balanced by the working gas, is recommended. If your working gas is argon, use a gas mixture containing 5% of hydrogen and 95% of argon. If your working gas is nitrogen, use a hydrogen/nitrogen (5%/95%) mixture.

At least half cylinder of gas is required for the regeneration. Install a regulator on the gas cylinder, the pressure inside the cylinder should be greater than 1100 psi or 70 bar. Set the output pressure to 15 psi or 1 bar.

5.3.2 Adjust Regeneration Gas Flow

Before starting regeneration of the purifier, please stop the circulation (see the Section 5.2)

During the regeneration, the purifier is first heated and evacuated for 3 hours and then the regeneration gas is passed through the purifier for 3 hours. Please set the following rate so that when the regeneration gas will be introduced to the purifier at the right flow rate. Occasional attention is recommended during the reduction of the purifier. Check the flow rate and vent from time to time and make sure the gas is enough to last three hours based on the consumption rate.

The following is the procedure to adjust the regeneration gas flow.

- a) Turn on the cylinder valve and make sure the cylinder pressure is greater than 1100 psi or 70 bar.
- b) Set the cylinder regulator pressure to 15 psig or 1 bar.
- c) On Main page of the touch screen press **Circ.** to enter the Circulation page to stop the gas circulation (see Section 5.2 for details)
- d) On Main page, press **Regen.** to go to the Purifier Regeneration page
- e) Press **Adjust Regen. Gas Flow** on the Purifier Regeneration page
- f) Wait until the gas flow out of the regeneration vent and adjust the flow rate to 4th line on the flow meter.
- g) Press **Adjust Regen. Gas Flow** again to finish the gas flow adjustment.

5.3.3 Start Regeneration

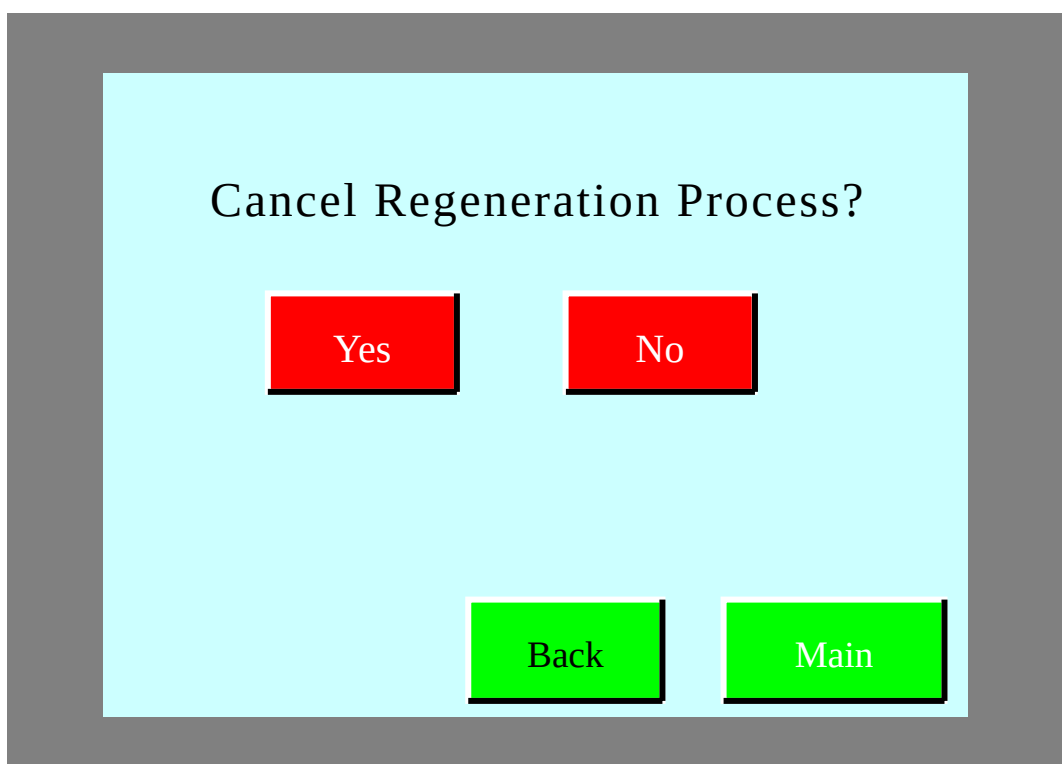
After finish adjusting the regeneration gas flow, press to start regeneration. The preloaded programs on the PLC will automatically perform various actions, including heating the purifier, evacuating the purifier, passing regeneration gas, and cooling the purifier. The regeneration will take 24 hours to finish.

During the regeneration, **Regen.** button will keep flashing until the regeneration program

ends.

During the regeneration, the program can be paused. To pause the regeneration program, press **Pause**. The program can be resume by pressing **Continue**.

During the regeneration, the program can be canceled. To cancel the regeneration program, press **Stop Regeneration**. After pressing this button, a new window will appear and the user will be prompted to choose to stop or continue the regeneration program.



Yes To Stop the regeneration

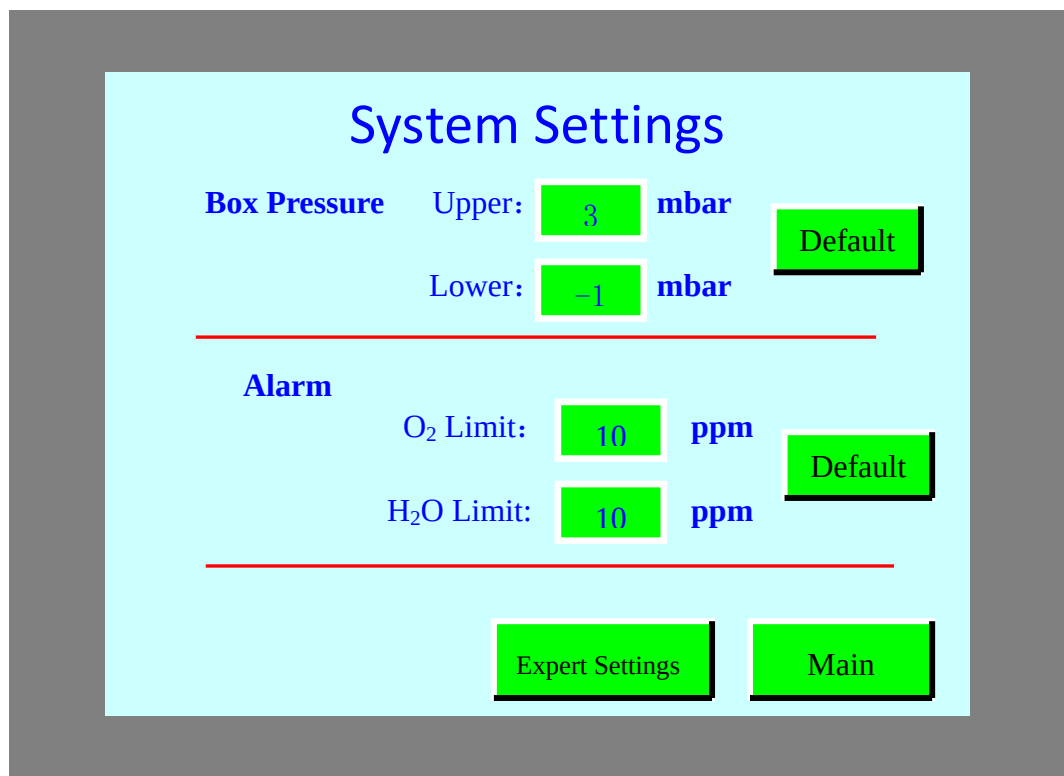
No To continue the regeneration

Pause To return to the Purifier Regeneration page

To go to **Pause** the Main page

5.4 System Settings

There are many parameters can be set for the system. However, some parameters are for the users to set while others are for the service technicians. On the Mian page, users can enter the System Settings page by pressing **Settings**



System Settings

Box Pressure Upper: mbar **Default**

 Lower: mbar

Alarm

 O₂ Limit: ppm **Default**

 H₂O Limit: ppm

Expert Settings **Main**

Default Load the default value into the field next to the button

Expert Settings To enter the Expert Settings page. The expert settings include system settings such as regeneration parameters and are for service technicians only.

Main To return to the Main page.

5.4.1 Set Box Pressure

The box working pressure can be control by the PLC. Users can define the working pressure range and the system will adjust the pressure within the set range at all time. To set the upper and lower limit of the working pressure, press **Settings** to get to the System Settings page. Touch the field for the Upper and a keypad will appear. Enter a desirable value and press the ENTER key. Do the same to the field for the lower limit of the box pressure.

Note: The minimum rage of the working pressure should be set to 2 mbar. It is **Alarm** recommend to set the upper limit to 3 mbar and the lower limit to 0 or 1. Vigor gloveboxes with patented seal technologies have very low leak rate even at negative box pressure. To ease sweating, set the pressure the negative so that gloves will wrap your hands and arms, giving better ventilation.

5.4.2 Set Impurity Alarm Level

Users can also set the oxygen and moisture alarm levels. To set the alarm level, touch the field for the alarm limits, and a keypad will appear. Enter a desirable value, and pressure ENTER key on the keypad.

When either impurity level exceeds the set value, the alarm will be triggered to inform users. On the Main page, **Settings** button will start flashing.

5.5 Antechamber Operations

Antechamber is used to transfer materials into or out of the glovebox. When transferring materials into the glovebox, one need to perform a procedure to minimized the amount of the moisture and oxygen brought into the glovebox. This procedure can be performed manually or automatically.

On the Main page of the touch screen, there are two valves  connecting to the large antechamber. The valve connecting the antechamber to a vacuum pump is used to evacuate the antechamber to remove air inside the antechamber space and on the surface of the materails. The other connecting the antechamber to the box is used to refill the antechamber, equalizing the pressure inside the antechamber with the atmospheric pressure so that the door on the antechamber can be opened.

Valve	Status
	Close
	Open

The status of the valve is changed between Close and Open by touching the valve on the touch screen.

Before opening the outside antechamber door, make sure:

- The antechamber's inside door is closed
- The refill valve is closed (in solid blue)
- The antechamber is not under vacuum and the needle on the vacuum gauge should be at 0 position.

Always keep the antechamber under vacuum when not in use.

5.5.1 Transferring Materials into Antechamber

The following is a standard procedure to bring materials into the glovebox from air.

- 1) Completely refill the antechamber and then close refill valve.

Before opening antechamber door, make sure:

- Needle on the vacuum gauge is at 0
- Inner antechamber door is closed
- Refill valve is closed (solid blue on the touch screen)



- 2) Turn the handle on the antechamber door counterclockwise to open the door



- 3) Raise the bar on the door



- 4) The air spring will raise the door above the opening of the antechamber



- 5) Pull out the sliding tray



- 6) Place the materials on the sliding tray. For easy access from inside the box, place materials as far inside the antechamber as possible.



- 7) Push the sliding tray back into the antechamber.



- 8) Pull the bar on the door down until it reaches the rest post.



- 9) Use fingers to turn the door handle clockwise to push the door touch the O-ring on the antechamber and then turn another quarter of a turn.



5.5.2 Manual Evacuation/Refil

After the materials are placed into the antechamber, the antechamber is filled with air. The gas impurities (oxygen and moisture) exist in two forms, namely the gaseous form in the antechamber space and adsorbed form on the surface and pores of the materials to be taken into the glovebox. It is easier to remove the gaseous impurities than the adsorbed impurities.

To remove the air in the antechamber and on the materials, a standard evacuation/refill procedure is used. After the outside is closed, the air in the antechamber can be evacuated by a vacuum pump. For non-porous materials, the residual pressure in antechamber can be pump down to 10^{-5} bar in 10 minutes. To minimize the amount of impurities taken into the box, it is recommended to evacuate the antechamber for 20 to 30 minutes each time. For porous materials, the evacuation time should be much longer. It could be several hours to several days. It is recommended to heat the materials in the oven to remove majority of the moisture and move hot materials into the antechamber right before the evacuation.

The following is the evacuation/refill procedure:

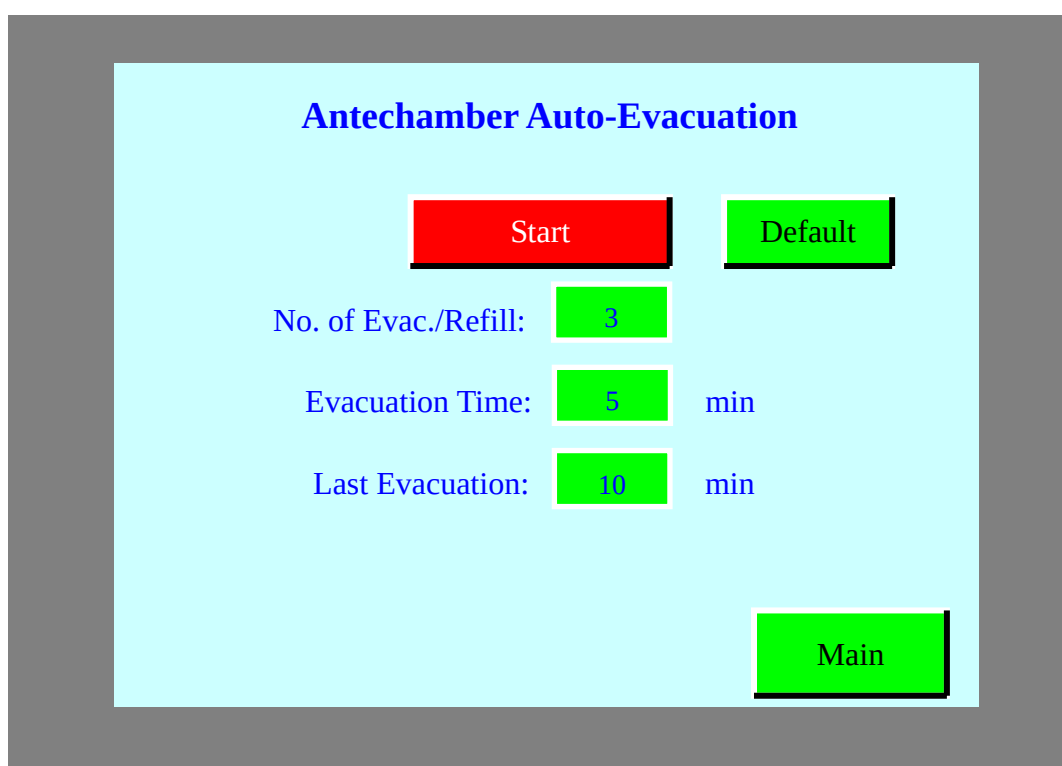
- 1) Close the antechamber outside door
- 2) On the Main page of the touch screen, press icon representing the evacuation valve, which connects the antechamber to the vacuum pump. When the valve is turned on, the icon will change from solid blue into yellow filled and an animated gas flow from antechamber to the vacuum pump indicates the evacuation is in progress.
- 3) After evacuated for 20 to 30 minutes, press the icon representing the refill valve, which connects the antechamber to the box to refill the antechamber. After the icon is pressed, the refill valve is turned on while the evacuation valve is automatically closed because the program only allow one of the two to be open at any time. An animated gas flow from the box to the antechamber indicating the refill is in progress. Refill the antechamber until the vacuum gauge is about -0.5 and press evacuation valve to stop refill and start evacuation.
- 4) Repeat evacuation/refill two more times.
- 5) Last refill allow the pressures inside the antechamber and the box totally equalized, indicating by the needle on the gauge reach 0.
- 6) Close the refill valve to cut of connection between the antechamber and the box to avoid accidentally admitting air into the box when the antechamber outside door is opened.



5.5.3 Auto-Evacuation/Refill

Transferring materials into the box through the large antechamber is a time consuming process and requires operator's attention. Even the user remembers to refill the antechamber every 20 to 30 minutes, the whole process usually required more than 90 minutes. It is difficult to perform the refill on time, resulting much longer time may be needed to finish the process. To increase the efficiency and save user's time, an auto-evacuation/refill function have been added to the system.

On Main page of the touch screen, press **Auto-Evacuation** to enter the Antechamber Auto-Evacuation page.



Start To start auto-evacuation process

Stop To stop auto-evacuation process

Default To set the default values as the parameters

Main To return to Main page

No. of Evac./Refill: This value field host a positive whole number, the number of the evacuation/refill cycles to be performed by the program. The default number is 3.

Evacuation Time: The duration of each evacuation (excluding last evacuation) to be performed.

The default value is 30 mintues.

Last Evacuation: The duration of last evacuation. The default value is 30 mintues.

The following is the auto-evacuation procedure:

- 1) Enter the number of evacuation/refill cycles. The number of cycles is usually set to 3.
- 2) Enter the time in minutes for each evacuation
- 3) Enter the time in minutes for last evacuation
- 4) Press  to start the auto-evacuation program
- 5) The auto-evacuation program will perform the action based on the parameters entered by the operator.
- 6) The program can be stop anytime by pressing on  Antechamber Auto-Evacuation page

5.5.4 Transferring Materials into Box

After the evacuation/refill procedure is completed, the materials are ready to be transferred from the antechamber into the box, following the procedure below:

- 1) Turn on the refill valve by press icon on Main screen. Wait until the vacuum gauge on antechamber reach 0.
- 2) Close the refill valve. **IMPORTANT:** Do not forget to close the refill valve.
- 3) Open the inner door of the antechamber
- 4) Pull out the sliding tray and remove the materials from the sliding tray and place them in the box.
- 5) Put anything to be removed from the box into the sliding tray
- 6) Push the sliding tray back into the antechamber
- 7) Close the antechamber door
- 8) Open the outside door to remove anything to be brought out of box. **IMPORTANT:** Make sure that refill valve is close. When the refill valve and outside door are both open, the box is connected to the air, and air may be admitted into the box.
- 9) Evacuate the antechamber by pressing the evacuation valve on Main page. **Note:** It is a good practice to keep antechamber under vacuum when not in use.

5.5.5 Mini Antechamber Operation

Mini antechamber is used to transfer small volume of materials. Because the volume of the mini antechamber is much smaller than the large antechamber, it takes much less time to evacuate it. In addition, it takes much less inert gas during the process.

Take the same precautions as transferring materials through the large antechamber. Before opening the outside door on the mini antechamber, make sure

- a) The antechamber's inside door is closed
- b) The three-way valve is at Close position
- c) The antechamber is not under vacuum and the needle on the vacuum gauge should be at 0 position.



- 1) Turn the handle on the outside door counterclockwise until the door is loose.



- 2) Turn the door counterclockwise



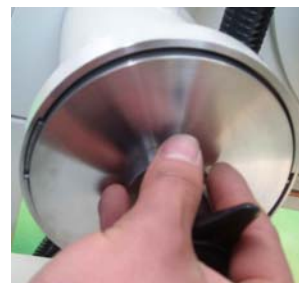
- 3) Remove the door from the antechamber.



- 4) Put materials to be transferred into the box in the removable tray
slide back the tray into the mini antechamber



- 5) Put up the outside antechamber door



- 6) Turn the door clockwise into the slot



- 7) Turn the door handle clockwise to tighten the door.



- 8) Turn the three-way valve beneath Mini Antechamber to Evacuation position to evacuate air out of the antechamber. The needle on the vacuum gauge move to -1.0 direction. Evacuate 5 minutes for no-porous materials, overnight for porous materials such as paper. If possible heat porous materials in the oven for several hours before transferring into Mini antechamber.



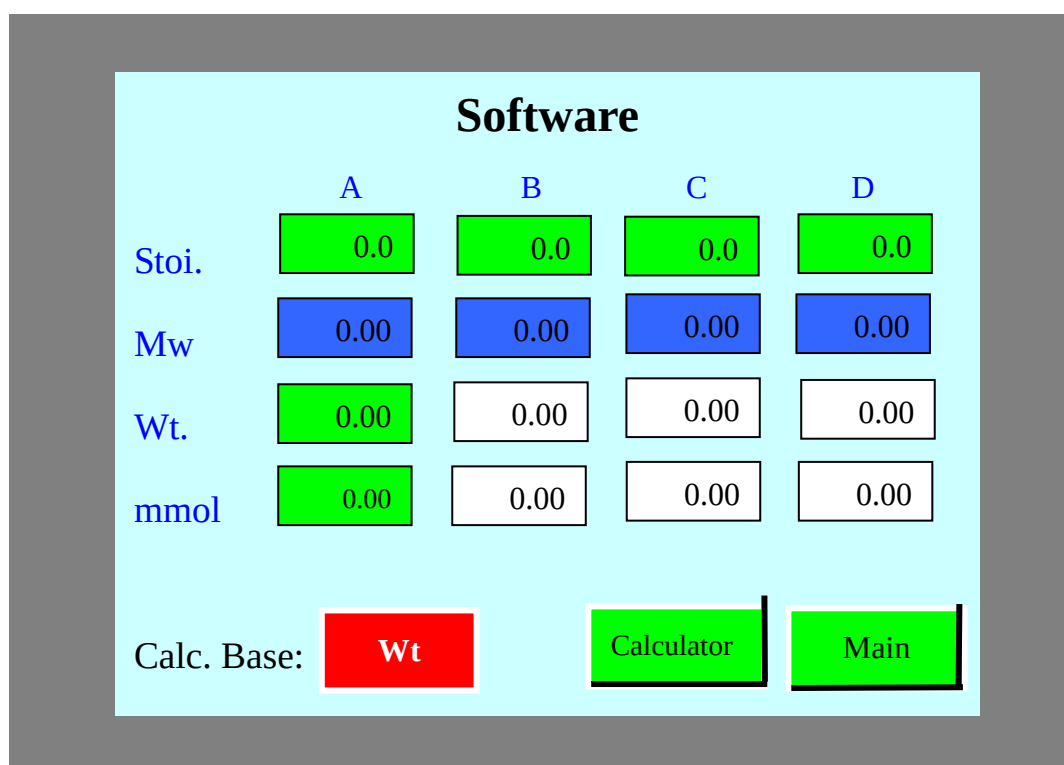
- 9) Refill Mini Antechamber by turning the three-way valve to Refill position
10) Repeat Step 8 and 9 two more times.
11) Completely refill Mini Antechamber so that the needle on the vacuum gauge at 0 position
12) Turn the three-way valve to Close position
13) Use left hand to open Mini Antechamber inner door.
14) Pull the tray out of the antechamber and remove materials from the tray and place them in the box.
15) If there are any materials to be transferred out of box through Mini Antechamber, place them into the tray
16) Put the tray back into the antechamber
17) Close the antechamber door
18) Open the outside antechamber door. **IMPORTANT:** Make sure the three-way valve is at Close position.
19) Take out the tray and remove the materials from the tray
20) Close the antechamber door
21) Evacuate the antechamber. **Note:** Always keep the antechamber under vacuum when not in use.

5.6 Chemical Software

The system comes with chemical software as an optional feature. The software package contains programs to calculate molecular weight from chemical formula, amounts of chemicals needed for a given chemical reaction, theoretical yields, the reaction yield. It also contains a simple calculator. The software package enables users to do the calculations on the touch screen.

5.6.1 Chemical Software Page

Press **Software** to enter Software page.



	A	B	C	D
Stoi.	0.0	0.0	0.0	0.0
Mw	0.00	0.00	0.00	0.00
Wt.	0.00	0.00	0.00	0.00
mmol	0.00	0.00	0.00	0.00

Calc. Base: **Wt** **Calculator** **Main**

Wt Calculation base. At this mode, the calculations will be done based on weight. Users enter a value of the weight required for compound A in the field at the first column and third row, the weight required for all other chemicals will be calculated. When **Wt** is pressed, it become **mmol**

mmol Calculation base. At this mode, the calculations will be done based on milimoles. Users enter a number of milimoles in the field at the first column and fourth row, the

weight required for all other chemicals will be calculated. When is pressed, it **Wt** become

mmol

Fields for entering values such as stoicheometry, weight, or number of milimoles.

Touch the field and the user will be prompted to enter a value.

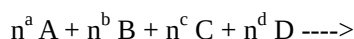
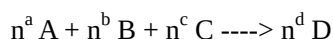
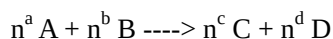
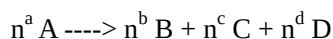
Fields for calculating molecular weight. Touch the field and the user will be brought to Molecular Weight Calculation page.

Displays calculation results

Calculator Calculator to perform arithmetic calculation

Main To return to Main page

A, B, C, and D represent compounds involved in the chemical reaction. Those four compounds can be reactants or products. The reaction can be one of the following:



‘**Stoi**’ stands for Stoichiometry. The coefficients in the balanced chemical reactions above (n^a , n^b , n^c , and n^d) should be enter in the corresponding field in the row.

‘**MW**’ stands for Molecular Weight. Touching the field in the row will take the user to the Molecular Weight Calculation page. More details about how to calculate molecular weight will be presented later in this section.

‘**Wt.**’ stands for Weight, the amount needed for the chemical reaction. When the calculation base is set to **Wt** weight for compound A is entered at the first field in the row (in green), the weight of compound of B, C, and D are automatically calculated and shown in the corresponding fields (in white).

'mmol' stands for milimoles, the number of the milimoles needed for the chemical reaction.

When the calculation base is set to **mmol** the number for compound A is entered at the first field in the row (in green), the weight of all compounds (A, B, C, and D) are automatically calculated and shown in the fields.

5.6.2 Molecular Weight Calculation

On the Chemical Software page, press the blue field on 'MW' line below compound A, B, C, and D to enter Molecular Weight Calculation page. Users are prompted to enter the formula for the corresponding compound. The program will calculate the molecular weight and return the value to the field.

There are three buttons on the page:

Clear

To zero all the field on this page

Compute

To calculate the molecular weight based on the formula entered

Back

To return to the Software page and enter the molecular weight to the field.

On this page there are 12 frequently used elements (C, H, N, O, F, Cl, Br, I, Li, Na, K, Ca) and 4 groups (X1, X2, X3, X4). The elements form 3 columns and the groups is located on the 4th column.

The field next to an element is for the number of the atom present in the formula while the field next to a group is for weight of the group. The group can be an organic functional groups such as -C4H9, elements such Fe, or part of a molecule such as FeCl and Cu(NO3)2.

Compound Cu(NH2CH2CH2NH2)3(NO3)2 or C6H28N8O6Cu is used here as an example to show how to calculate the molecular weight. There is more than one way to do the calculation. One can use formula to perform the calculation

- 1) Press **Clear** to zero all fields next to the elements and groups
- 2) Enter 6 to the field next to element C
- 3) Enter 28 to the field next to element H
- 4) Enter 8 to the field next to element N
- 5) Enter 6 to the field next to element O
- 6) Enter 63.55 to the field next to X1
- 7) Press **Compute** to calculate the molecular weight

- 8) Press **Back** register the molecular weight for the compound and return to Software page.

The formula can also be calculated using fragments of the molecule.

- 1) Press **Clear** to zero all fields next to the elements and groups
- 2) Enter 6 to the field next to element C
- 3) Enter 28 to the field next to element H
- 4) Enter 6 to the field next to element N
- 5) Enter 187.6 to the field next to X1 (weight for $\text{Cu}(\text{NO}_3)_2$ is 187.6)
- 6) Press to **Compute** calculate the molecular weight
- 7) Press **Back** register the molecular weight for the compound and return to Software page.

Note:

- 1) Remember to zero all the field by pressing **Clear** before entering formula **Compute**
- 2) After finishing entering formula, remember to press to calculate the molecular weight
- 3) If the molecular weight for the compound is known, just enter the weight to X1 and do not need to enter the formula

5.6.3 Calculating Chemical Reaction Input

On Main page of the touch screen, press to enter Software page where the chemical reaction input can be calculated.

The following is the procedure to calculate the input for a reaction to be performed.

- 1) Enter the ratio of moles of the compounds in the chemical reaction (stoichiometry) below the compound A, B, C, and D on the row leading by 'Stoi'.
- 2) Calculate molecular weight for all compounds by pressing the blue fields. See Section 6.5.2 for more details.
- 3) Set the calculation base, which can be **Wt** or **mmol**
- 4) Enter the weight of mmol for Compound A
 - a. Enter the weight for Compound A at the designated field when the calculation base is set to **Wt**
 - b. Enter the mmol for Compound A at the designated field when the calculation base is set to **mmol**
- 5) The input or theoretical yield for all other compounds are calculated.

Note: If a solution with known molar concentration to be used, use the calculated input in milimoles to calculate the volume required for the reaction.

Chapter 6 Maintenance and Troubleshooting

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6.1 Introduction

The glovebox system is designed to run without too much maintenance. However, some simple maintenance is required. The system software can also detect problems and show the information to help operator to fix the problems. This chapter will also provide information about troubleshooting of the system.

6.2 Maintenance

The system requires some simple maintenance. See the following table for details.

Item	Actions	Frequency
Working Gas	Check working gas cylinder to make there is enough gas to perform the task. Stock one cylinder to avoid interruption of use of the glovebox	Daily
Glove	Check to make sure the gloves are in good condition and there is no holes on them. Set the box pressure to > 5 mbar and wait for a couple of minutes for pressure to stabilize. If the pressure continue to drop at rate greater than 0.02 mbar/minute, the box may leaks and probably through the gloves.	Daily
Solvent Adsorber	When the solvent adsorber is saturated, organic vapor will start to accumulate inside the box. If strong odors come out of the antechamber, it is time to change the adsorbents in the solvent adsorber.	Daily
Pump Oil Level	Check the pump oil color and level. New pump oil is almost clear liquid. When it turns brown, the oil should be changed. If the oil level is approaching the minimum level, add additional oil into the pump.	Monthly
Filter	Check the filters at the inlet and outlet of the purification system. If a visible dust accumulation on the filter, please change the filter to avoid damaging the blower.	Quartly
Change Pump Oil	Change oil after regeneration or once a year, whichever come first.	Anually



Antechamber O-Rings	Check antechamber O-rings annually. If there are any signs of deterioration of material of the O-ring, replace it.	Annually
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6.3 Purge Problems

Problems	Possible Causes	Solutions
Press Start Purging but the function did not start	1. Gas circulation is in progress 2. Run out of working gas	1. Turn off the gas circulation, seeing Section 5.2 for details. 2. Change a new gas cylinder.
Press Start Purging but pressure inside the box surged	Purge vent valve did not open	1. Did the valve get electric signal? Yes ---- Replace the valve No -----Go to next step 2. Check whether the relay switch for the valve working properly? Yes ---- Contact Vigor Service Department No ---- Replace the replay switch
Press Start Purging the box pressure decreased rapidly and oxygen concentration jump	1. No working gas 2. Working gas is not opened 3. Delivery pressure for working pressure is too low 4. Air leaks on the tubing connecting working gas source and the equipment.	1. Replace the gas cylinder 2. Turn on the working gas 3. Set the pressure to 2 bar 4. Check the tubing connections for leak. 5. Check whether valve get electric signal? Yes ---- Replace valves No ---- Go to next step 6. Check whether the relay switch for the valve works properly? Yes ---- Contact Vigor Service Department No ---- Replace valves

6.4 Circulation Problems

Problems	Possible Causes	Solutions
Press Start Circulation but the circulation did not start and the system displays warning message “Blower abnormal”	1. Current Overload 2. Overheat	1. Turn on the switch for the blower in the switchbox and press Start Circulation again. Observe whether the switch break again? Yes. ---- Go to next step No. ---- Problem fixed 2. Check whether the circulation path is blocked? Yes. ---- Clean the circulation path No. ---- Go to next step 3. After replacing the switch does the switch breaks again? Yes. ---- Contact Vigor Service Dept. No. ---- Go to next step
Press but the circulation did not start and the warning message display “FCHZ1 no feedback” or “FCHZ2 no feedback”	1. The pressure of the working gas is too low 2. Solenoid valve malfunction 3. Circulation valve malfunction	1. Set working gas pressure to 4-5 bar (70-80 psi) and press Does system show the same warning message? Yes. ---- Go to next step No. ---- Problem fixed 2. Check whether the relay switches and solenoid valves work properly Yes. ---- Go to next step No. ---- Replace defect parts 3. Replace the circulation valves. Does system show the same warning message? Yes. ---- Contact Vigor Service Dept. No. ---- Problems fixed

6.5 Vacuum Problems

Problems	Possible Causes	Solutions
Vacuum pump cannot start	1. Current overload 2. Overheat	1. Check the pump oil. If the oil is dirty (brown color or opaque), change the oil. If the oil level is too low, add more oil. Can the pump start? Yes ---- Problem fixed. No. ----Go to next step 2. Replace the breaker in for the vacuum pump. Can the pump start? Yes ---- Problem fixed No ---- Contact Vigor Service Dept.
Pump Oil loss	1. Gas blast is open 2. Leak in the vacuum system	1. Check to make sure the gas blast on the vacuum pump is close. If it is open, close it. Add more oil to raise the oil level close to the maximum line and check the oil level again one month later No significant loss ---- Problem fixed Significant loss ---- Go to next step 2. Check the vacuum line leakage. Insert the vacuum pump vent line into water for 10 minutes. Without actuating the antechamber and box evacuation valve, are there still gas continuously comes out of the vent line? Yes ---- Go to next step No ---- No leak in the vacuum line 3. Set the box working pressure range to -5 to -10 mbar. After the box pressure reading stabilizes, is the pressure

		continues decreasing at rate greater than 0.05mbar/min? Yes ---- Contact Vigor Service Dept. No ---- No real from the box to the vacuum system. Go to next step 4. Tighten all the connections on the vacuum line. Is there still gas coming out of the vent line? Yes ---- Contact Vigor Service Dept. No ---- Problem fixed
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6.6 Problems with Oxygen Level inside the Box

Problems	Possible Causes	Solutions
Oxygen Level Slowly Increases	The adsorption capacity is near depleted	1. Regenerate the purifier. After regeneration, is the oxygen level returned to < 1 ppm? Yes ---- Problem fixed No ---- Contact Vigor Service Dept. Adsorbents may need replaced.
Oxygen Level Surges when Antechamber door is open	Leak at the antechamber	1. Check the O-ring on the antechamber. Are there any cracks on the O-rings? Yes ---- Replace defect O-rings No ---- Take out O-rings and grease them and reinstall them. 2. If the problem is not fixed, contact Vigor Service Dept.
Frequent Regeneration Required	1. Air leaks into the system 2. Damaged Adsorbent	1. Check the leak of the box. Set the pressure range to -5 to +10 mbar and turn off the circulation system and waiting for 5 minutes for the system to stabilize before recording the oxygen level change with time for 2 hours. If the leak rate is greater than 5 ppm/hr, there are leaks on the system. 2. If leak rate is less than 5 ppm/hr, the adsorbent needs replaced.

6.7 Error Messages

When **Alarm** is flashing, the system is encountering some error and the messages are displayed on the Alarm page. Press **Alarm** to enter the Alarm page.

Error Message	Cause	Solutions
"Vacuum Overloaded"	1. The current allowed set too low 2. Oil level too low 3. Oil too dirty	1. Adjust the current dial on the switch labeled 2 to higher amp 2. Add more oil if oil is clear 3. Change oil
"Blower Overloaded"	1. Filter blocked 2. The current allowed set too low	1. Inspect the filter and change them if dirty 2. Adjust the current dial on switch 1 to a higher amp
"FCHZ1 no feedback" or "FCHZ2 no feedback"	1. Working gas pressure is too low. 2. The faulty feedback switch on the valve on the purifier	1. Set the working gas pressure to 75 psi 2. Fix the feedback switch on the valve
"O2 exceeds the set valve"	Oxygen concentration in the box exceeds the set value	Inspect the box and take correcting actions to bring the oxygen concentration within the allowable range.
"H2O exceeds the set valve"	Moisture concentration in the box exceeds the set value	Inspect the box and take correcting actions to bring the moisture concentration within the allowable range.

Freezer Operation Instruction

1. Specifications

- 1.1 Extenal Dimensions: 550mm (H) x 400mm (W) x300mm (D)
- 1.2 Internal Dimensions: 450mm(H) x 300mm (W) x 220mm (D)
- 1.3 Operation Environment: -5 to 55 °C or (23 to 131 °F); < 90%RH
- 1.4 Power Supply: AC 110 ±10%, single phase, 50/60Hz
- 1.5 Power consumption: 300W
- 1.6 Freezer Temperature Range: -40°C~70°C, Error ±1°C
- 1.7 Input/Output
 - 1.7.1 Temperature Sensor: NTC, 1.5 m (L) x 2
 - 1.7.2 Compressors Output Contacts Capacity: 16(5)A/120VAC
 - 1.7.3 Fan Contact Capacity: 8(3)A/120VAC
 - 1.7.4 Alarm Output: Internal buzzer

2. Operating Instructions

2.1 Setting Mode: Press and hold  for 3 seconds to enter setting mode and “tS” is displayed. Press  or  to select a different parameter to adjust. See the parameter table for the abbreviations for all the parameters.

2.1.1 To set “tS” to -35 °C, follow the procedure below:

2.1.1.1 When “tS” is displayed, press to  show saved value (-18 °C as the factory preset valve)

2.1.1.2 Press or  to  adjust the value to a desired one (for example, -35 °C)

2.1.1.3 Press  or wait 15 second to save the change.

2.1.1.4 Press or  to  select “OU” and then press  or simply waiting for 15 seconds to exit the setting mode.

2.1.2 Set all other parameters according to the procedure described above

2.1.3 Set “tS” under normal mode according to the following procedure:

2.1.3.1 Press and hold for  3 second, -18 °C is shown (Factory preset valve)

2.1.3.2 Procedure to adjust the value is same as in 2.1.1.2

2.1.3.3 Press  or wait for 5 seconds to save setting and exit the setting mode.

2.2 Lock Setting

2.2.1 Press and hold  +  for 3 seconds and the setting function is locked and “LC” is displayed. When setting function is lock, all parameter can’t be adjusted.

2.2.2 Press and hold  +  again for 3 seconds, the setting function is unlocked and “UL” is displayed. When setting function is lock the parameters can be set.

2.2.3 The setting lock is not affected by disruption of power supply. The locking status will be retrieved from the memory after restoring power.

2.3 Reload the factory-preset values

Press  and  at the same time and then supply the power, “rS” is displayed and the system automatically loads the factory values and reboots in 5 seconds.

2.4 Turn off/on alarm

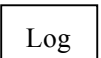
When the buzzer sounds, press  to temporarily turn off buzzer. If the problems are not fixed, press  again to restore the buzzer.

2.5 Stored Freezer Temperatures

2.5.1 When the freezer temperature is equal or less than the set temperature for the first time, the system actuates this function.

2.5.2 Store the highest and lowest temperatures that the freezer has reached

2.5.3 Under normal state (except E1, E2, EE), press  to show the highest temperature stored in the memory.

2.5.4 When the highest temperature stored in the memory is shown, press  again to show the lowest registered temperature

2.5.5 Without pressing any button within 5 seconds, the system return to display the freezer temperature

2.5.6 Press and hold

Log

 for 3 seconds, the current freezer temperature will be registered as the highest and lowest stored temperatures.

2.5.7 The stored temperatures will not be erased because of power outage. The data will be retrieved from memory when power is restored.

3. Functions

3.1 Temperature Calibration (Ot): When thermocouple ages, adjust this parameter to correct the temperature.

3.2 Temperature Alarm: When the freezer temperature is higher than AU or lower than AL, the alarm goes off

3.3 Temperature Setting Protection: To avoid the set temperature tS out of the capability of the compressor, set HS and LS to limit the temperature range for tS.

3.4 Board Temperature Protection (At): When the board temperature $\geq 95\text{ }^{\circ}\text{C}$, the controller turns off the compressor switch and display flashing “tA” and set off alarm. The “tA” alarm will not be clear until the temperature reaches 75 or below.

3.5 Compress Operation

3.5.1 When the freezer temperature reaches the set temperature (tS), compressor stop working.

When the freezer temperature rises to the set temperature (tS) plus the set temperature difference (td), the compressor is restarted.

3.5.2 Compressor Delay Start: The delay time can be set by adjusting the parameter AC.

When the system requires turning on the compressor, it starts the countdown and the compressor will not start until the countdown reach the delay time. The start of compressor is delayed by one minute every time when the freezer is turned on.

3.6 Power Outage Protection: When power outage occurs during use, the system will reloaded the parameters and continues operations after the power is restored.

3.7 Light Signals

3.7.1 Comp.: Compressor Light

3.7.1.1 Steady On: When the compress is working

3.7.1.2 Flashing: When the compressor is in delay countdown mode

3.7.1.3 Off: When the compress is off or the parameters are being adjusted

3.7.2 Defr.: Defrosting Signal Light (Omitted)

3.7.3 Fan: Fan Signal Light:

3.7.3.1 Steady on: When Fan is working

3.7.3.1 Of: When the parameters are being set.

4. Troubleshooting

4.1 Alarm Codes

4.1.1 “UA” indicates the freezer temperature $\geq AU$. UA and the freezer temperature are displayed alternatively.

4.1.2 “LA” indicates the freezer temperature $\leq AL$. LA and the freezer temperature are displayed alternatively.

4.1.3 “tA” indicates the board temperature $\geq 95^{\circ}\text{C}$. tA is displayed.

4.2 Troubleshooting Codes

The compressor works according to Cr/CS parameters. When both Cr and CS are set to 0, the compressor will keep running.

4.2.1 “EE” indicates memory abnormal. If powering off and then on could not fix the problem, send it to the manufacturer for repair.

4.2.2 “E1” indicates a faulty thermocouple. Check the temperature and replace thermocouple.

4.2.3 “E2” indicates a faulty board temperature sensor (send the manufacturer for repair).

5. Parameter Table

Code	Functions	Value Ranges		Factory Valve	Unit	Note
		Upper	Lower			
tS	Set freezer temperature	LS	HS	-18	°C	Compressor stop working at the temperature
td	Temperature Difference	0.5	10	4	°C	Compressor start working at tS+td
AU	Upper alarm temperature	AL+1	70	45	°C	Set off alarm when the freezer temperature is equal to or higher than this value. (Alarm is set off once the freezer temperature reaches this value once)
AL	Lower alarm temperature	-40	AU-1	-40	°C	Set of alarm when the freezer temperature is equal to or less than this value. (Alarm is set off once the freezer temperature reaches this value once)
HS	Upper set temperature	tS	60	25	°C	The highest allowable temperature to be set
LS	Lower set temperature	-40	tS	-30	°C	The lowest allowable temperature to be set
Ad	Alarm delay time	0	60	15	min	Buzzer delay time when the system set off alarm
AC	Compressor delay time	0	30	1	min	The compressor is delay by the set amount of time when the conditions to start the compressor is met
Cr	Working time	0	60	15	min	Under EE and E1, the compressor working time (When Cr = 0, the compress stop working)
CS	Resting time	0	60	15	min	Under EE and E1, the compressor resting time (When CS = 0, the compress keeping working)
Ot	Temperature adjustment	-12	12	0	°C	Freezer temperature correction
Ft	Fan stop running temperature	0	70	15	°C	Fan Stops working at this temperature
FC	Fan operation options	0	1	1		0: Working with the compressor 1: Continuous operation
dL	Defrost temperature lock	0	1	0		0: Display the current temperature 1: Lock the freezer temperature when defrosting
OU	End setting	-	-	-		Exit the setting mode