Operating Manual

EasyLab

INERTGAS TECHNOLOGY

Operation instructions For EasyLab

Chapter1

Operating Manual Glove Box Systems

1. General Information

1.1 General Information

This technical documentation is not liable to any obligations on the part of the manufacturer. The manufacturer M. Braun Inertgas-Systeme Shanghai Co.,Ltd reserves the right for technical and optical modifications as well as functional modifications on the systems or system's components described therein. Any duplication of this documentation, even in form of excerpts, is only permitted after having obtained the manufacturer's information and concession.

Title:..... MBRAUN Glove Box Systems

Standard operating Manual

Edition: .....

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see type plate for details

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1.2 Entries Referring to the System

We guarantee the equipment as stated in the order/contract.

This documentation is part of the system:

Designation / Type: .....

Serial number (s): .....

Person(s) in charge .....

of the system:

Space left for notes on system settings, instructions for maintenance etc.

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1.3 Scope of Delivery

The scope of delivery is defined by the acknowledgement of the order or as part of the contract. A typical standard glove box system would consist of:

Glove box with antechamber

Gas purification system with analyzers (option)

microprocessor control with operation panel

Foot switch for pressure regulation

Maintenance training (option)

Operating manual

Available accessories: see Chapter 10 Accessories & Customer Specific Components

1.4 Liability

The manufacturer will not take any liability of object, personal or secondary damage caused by improper use or ignoring of safety instructions as well as caused by the owner’s manual due to missing updates after the system or its software have been modified, nor will the manufacturer take any liability of damages due to loss of data. In addition, the terms of business that are part of the order/contract will apply.
Our products are continuously modified and improved due to innovation, legal requirements and standards. Consequently, the information given in this documentation may not accurately reflect every detail of the system actually delivered. Please contact the manufacturer in cases of uncertainty.
Products mentioned in this manual are eventually trademarks and are used for identification purposes only.

1.5 Warranty

We guarantee the equipment as stated in the order/contract.

This warranty will expire in case of:

Interference into or modification and relocation of the system without prior consent of the manufacturer;

Improper use of the system;

Insufficient maintenance of the system; Inappropriate operation of the system;
Negligence of correct supply requirements;

Application of third-part components to the system without prior consent of the manufacturer;

Alteration of program or configuration write-ups without manufacturer's consent. (Out of the parameter limits).
! NOTE!

This applies to a single unit and multi-unit system types.

1.6 Modifications

WARNING

Danger of injury and damage!

► Changes and/or modifications of any kind to MBRAUN systems should be made by MBRAUN technicians only.
Exceptions can be made with prior written confirmation from MBRAUN

► Any unauthorised change or modification to the system will cause the warranty to expire.

1.7 Transport

Preparations for transporting an MBRAUN system should be carried out by an MBRAUN technician only. The transport of the system or any part of a multi-unit system should be performed by a forwarding agency offering specialized transportation services.

WARNING

Danger of injury and damage!

The system is extremely heavy and awkward, if not handled properly tipping or overturning may occur.

► Use caution when transporting a system and ensure all parts are securely fastened prior to relocation.

► The system must be handled carefully, and must not be exposed to shock. (Adhesive shock watch label on packaging)

► The transport may only be performed with vehicles equipped with air suspension.

Prior to installation and operation of the system, the Operating Instructions must be read and observed. Contact the MBRAUN Service Department with any questions.

1.8 Storage

The system can be stored safely under the following conditions:

ROOM	**Room temperature between +10°C and +40°C** **with a relative humidity ≤80%, no condensation**
Glove Box	Free of liquids or substances (e.g. process chemicals, etc.) system Protected from dust and contamination

After moving the system from storage conditions to final site location allow sufficient time for the system to adapt to the new environment.

1.9 Conventions Used in this Manual

Representation:

Instructions begin with the symbol ► prerequesits begin with the symbol >

!	Note! Marking of notices or additional information!

1.10 Service Address

M. Braun InertGas Systems (Shanghai) Co., LTD

Adress: Ground floor of Building #1
No. 145 Jintang Road
Tangzhen, Pudong, Shanghai, 201201
P.R.China

Tel: +86 (0)21 50320257

Fax: +86 (0)21 50320229

E-Mail: service@mbraunchina.com

Internet: www.mbraunchina.com

Chapter 2

2.1 Safety Warnings

2.1.1 Safety Warnings on the System

The following symbols refer to **MBRAUN** components and parts. However, components and parts of sub-suppliers may show other symbols, not expressly mentioned or referred to in this manual. The following caution and command symbols may be seen on the system:

	**Warning** **Indicates the possibility of minor injury, the possibility of damage to the system or its accessories and of possible problems related to the quality of the inserted materials or processes.**
	**Warning of hazardous electrical voltage** **Indicates the possibility electrical hazards such as shock, involuntary muscle reaction, muscle paralysis, burnt tissues and organs, or death.** **► Be careful, Risk of serious injury!**
	**Pressurized gas hazard** **Indicates the possibility of injury, the possibility of damage to the system or its accessories due to gas supplies or hoses carrying pressurized media.**
	**Risk of burns due to hot surfaces!** **► Do not touch the hot surface!**

The owner of the system is responsible to place adequate danger signals and labels in suitable places. This applies in particular to signals and labels concerning process chemicals used.

WARNING

Risk of injury and damage!

The safety warnings on the system must always be clearly kept visible and readable.

2.2.2 Safety Warnings in the Manual

The safety warnings in the manual are marked according to European standards (98/37/EG, DIN EN ISO 12100-1, DIN EN 62079) as well as the ANSI (Z 535.6) standard.

Marking of safety warnings adhering to European standards:

	**Hazard!** **Indicates the possibility of very serious injury or fatality, and the possibility of considerable damage to property.**
	**Warning!** **Indicates the possibility of minor injury, the possibility of damage to the system or its accessories and of possible problems related to the quality of the inserted materials or processes.**
	**Electrical hazard!** **Warning of hazardous electrical voltage.**
	**Mechanical hazard!** **Risk of squeezing, shearing and cutting, catching and winding, stretching of extremities.**
	**Explosion hazard!** **Risk of damage or injury when handling flammable or explosive gases.**
	**► Wear safety mask!**
	**► Wear safety goggles!**
	**► Wear protective gloves!**

Marking of safety warnings adhering to the ANSI standard:

WARNING

Indicates an imminently hazardous situation that, if not avoided, will result in death, serious injury or serious damage to the system, other equipment or surrounding environment.

WARNING

Indicates a potentially hazardous situation that, if not avoided, could result in death, serious injury or serious damage to the system, other equipment or surrounding environment.

CAUTION

Indicates a potentially hazardous situation that, if not avoided, may result in minor or moderate injury or damage to the system, other equipment or surrounding environment.

The safety warnings in this manual generally utilize a combined marking.

An example:

WARNING

Risk of squeezing, shearing and cutting!

Freely moving parts may cause injury.
► Keep hands and arms out of the hazard area.

2.2 Safety Concept

Under normal operation condition the box may be operated between –15 mbar and +15 mbar (corresponding to – 1500 Pa to + 1500 Pa).

In the unlikely case of a failure of a valve the box may be exposed to extreme pressures. For this reason the fixture of the glove has been designed in a way that the glove will detach from the glove port before any damage is caused to the box.

WARNING

Risk of injury and damage!

In case of failure of a valve, due to extreme pressure, the glove may detach from the glove port, or the window may break if all glove ports are sealed:

The process materials may be polluted and exposed to ambient air. The ambient air may be polluted by process chemicals.

Adhere to the following guidelines:

Keep at least one glove port in normal operation: glove fixed and glove port not sealed with an inner or outer glove port cover.

If the application requires that materials handled inside the glove box must not be exposed to ambient air in case of an extreme over- or under pressure situation, additional safety measures are required. Please contact the MBRAUN Service Department.

2.3 Intended Use

The purpose of the **MBRAUN** gas purification system, together with a glove box, is for enabling and maintaining a pure inert gas atmosphere inside a hermetically sealed enclosure.

The intended application is for product protection. Materials that are sensitive to moisture and/or oxygen are handled by using the attached gloves or additionally specially designed handling systems.

MBRAUN system is intended for professional use only.

DANGER

Risk of injury and damage!

The system is designed to be operated with inert gas to protect products and production processes from moisture, oxygen, and nitrogen (option).

► Only use the system as described in the Operating instructions.

The system will require modification and safety installation for any application for personnel protection when working with delicate or dangerous materials, such as:

1. **Working with substances that will lead to dangerous situations if they escape to the ambient atmosphere in case of a failure of the system.**
2. **Working with substances that can burn or explode if in contact with air in case of a failure of the system.**
3. **Pharmaceutical or nuclear applications.**
4. **Strongly poisonous or unhealthy materials.**

► In addition the system will require modification for the following application:

- **Very expensive materials that might be destroyed if exposed to air in case of a failure of the system.**

Please contact the MBRAUN service or sales department should your application fall within one of the categories that require modification.

2.4 Improper Use

	**WARNING** **Risk of injury and damage!** **MBRAUN standard systems are not equipped with any safety measures to secure personnel protection in case of failure of a system component.** **► The system and the accessories are not allowed to be modified or changed without authorisation.** **► The bridging of limit switches, valves, and other control components is forbidden.** **► The system may only be used within the parameter limits as defined in this user manual or any additional technical documentation or system specification.** **► All malfunctions and damage indicated by the system or determined by other means must be reported and rectified without delay.** **► Only personnel who meet the requirements defined in the Operating instructions are permitted to be employed on the unit.**

2.5 Basic Safety Instructions

2.5.1 General

	**WARNING** **Risk of injury and damage!** **► In normal operation the system is only permitted to be operated if all safety devices are present, correctly installed and fully functional.** **► Maintenance work - other than that described in the chapters Trouble Shooting, Maintenance and Service and Spare Parts List - is only permitted to be performed by MBRAUN service personnel.**

2.5.2 Emergencies

WARNING

Risk of injury and damage!

In an emergency immediately shut down the system:

- ► **Turn the main power switch to the off-position.**
- ► **Disconnect the system from all gas supplies.**
- ► **If working with toxic, explosive, noxious materials refer to the material safety data sheets for information on treating the emergency.**
- ► **Contact the appropriate emergency response personnel.**

CAUTION

Risk of damage!

Do not disconnect the water supply for systems containing components requiring a cooling water source.

Prior to restarting, the system must be fully checked for safety, contact the **MBRAUN** Service Department after the emergency has been rectified.

2.5.3 National Rules and Regulations

In addition to the guidelines and information contained within this manual, it is the responsibility of the user to follow all local health, safety and environmental guidelines with regards to the handling and disposing of substances that may be injurious to health.

2.5.4 On-Site Requirements

DANGER

Risk of injury!

There is a risk of suffocation when working with high inert gas concentrations. High concentration of inert gas may lead to unconsciousness, injury or death.
Adhere to the following guidelines:

- **The selected location should have a “room” volume that is significantly larger than the glove box interior volume.**
- **The system should be located in a well ventilated area. This is especially important during a purging procedure or when opening an active system (i.e. antechambers, etc.).**
- **All exhaust fumes should be vented through an adequate disposal/ventilation system.**

Contact MBRAUN if it is not possible to adhere to all the recommendations mentioned above.

CAUTION

Risk of injury and damage!

For data on the on-site requirements, e.g.

- **Ambient conditions**
- **Floor characteristics, floor loading capacity**
- **Mains electricity, compressed gas, cooling and other connections**

See Chapter 1.9. Storage and 3.1. Site Location

2.5.5 Observe the Operating Instructions

WARNING

Risk of injury and damage!

- **The personnel must read, understand and always work to the operating instructions: This includes any person charged with operation, transport, storing, installation, commissioning and maintainance.**
- **Always keep the manual within reach on the machine.**
- **In addition to the safety instructions in this manual, also observe the safety instructions in all other manuals provided with the system.**

To ensure safe operation of the system and to maintain a safe working environment, the information contained within “Chapter 2 Safety” must be adhered to by all users of the system. Advice contained in this chapter is intended to supplement, not supersede, the safety advice given in other chapters of this manual and the general safety regulations and guidelines prevailing in the user’s workplace.

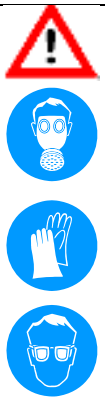
2.5.6 Qualification of the personnel

WARNING
Risk of injury and damage! ➢ **As a matter of principle, working on the system without the personal protective equipment (PPE) stipulated in the operating instructions for this task is forbidden.** ➢ **The system is permitted to be operated and maintained by personnel specially instructed and who have reached the minimum age stipulated by law.** ➢ **Work on electrical equipment on the machine and the related accessories is only permitted to be performed by suitably qualified electricians or by instructed persons under the supervision of an electrician as per electrical regulations.*** ➢ **Personnel operating the system temporarily or who are to be trained, instructed, or taking general training are only permitted to work on the system under the continuous supervision of an experienced person.**

* A suitably qualified person is anyone who due to his/her specialist training, as well as knowledge of the applicable stipulations, can assess the work assigned to him/her and can recognize possible hazards.

!	**Note!** **To reduce the cause of hazards, a single person must operate the system. In case the system needs to be operated by two or more persons, conduct the operation in such a way as to ensure each individual’s respective task does not influence other tasks in any way!**

2.5.7 Disposal



WARNING

Risk of injury!

Risk of polluting the environment!

In case of workings for the disposal of hazardous substances, adhere to the following safety measures:

- **Wear personal protective equipment (PPE):**
- **Proper protective safety mask, protective gloves and safety goggles.**
- **Observe relevant safety regulations as well as material safety data sheets (MSDS) and additional advice provided by the supplier.**

The following components and materials may be polluted with toxic substances and harm the environment, if not properly disposed of.

None of the following components and substances is permitted to enter environment atmosphere, mains drainage, ground water, or soil:

- **Gas Purification System**
  Dispose of all components and compressor oil as per the applicable national regulations.
- **Filters**
  Dispose of used filters at the local collection point for hazardous waste or in accordance with the locally applicable national regulations.
- **Solvent Vapour Filter**
  Dispose of the polluted filter medium (charcoal) as per the applicable national regulations depending on the substances used within the glove box and/or as specified in the material safety data sheets.
- **Exhaust fumes**
  All exhaust fumes should be vented through an adequate disposal/ventilation system.

MBRAUN is not responsible for pollution of the environment and resultant serious health problems.

2.6 Hazards and Safety Measures

2.6.1 Risk of Suffocation

DANGER

Risk of injury!

There is a risk of suffocation when working with high inert gas concentrations. High concentration of inert gas may lead to unconsciousness, injury or death.

- **Do not enter or reach out into the active glove box via the antechamber.**
- **During purging, ensure a good ventilation of the ambient air.**
- **Before maintenance of the interior of an active glove box it is necessary for the glove box atmosphere to be completely replaced with ambient room air.**
- **To release the inert gas, remove one glove to allow a slow equalization of the glove box interior atmosphere with the ambient room air.**

Note: On request, **MBRAUN** can recommend a portable personal gas alarm instrument that alerts the operator to a reduction of oxygen content in the ambient air.

2.6.2 Mechanical

WARNING

Risk of squeezing, shearing and cutting, catching and winding, stretching of extremities!

Freely moving parts may cause injury.

- **Keep hands and arms out of the hazard area.**

Risk of injury!

When handling materials with mechanical, pneumatic or vacuum systems it is possible that materials may be ejected.

Keep hands and arms out of the hazard area.

- **Avoid contact with ejected materials**

Risk of injury!

The system may not be opened during processing or power failures.

- **Do not remove safety covers, panels, panes, windows or doors (except for service).**
- **Do not open the antechamber during process or power failure.**
- **If any safety facility fails or is not present: decommission the system and inform the service personnel.**

2.6.3 Electrical

DANGER

Hazardous electrical voltage!

Risk of electric shock on direct and indirect contact with live parts with the possibility, involuntary muscle reaction, muscle paralysis, burnt tissues and organs, or death.

- **► The electrical cabinet is only allowed to be opened by an electrician or trained maintenance personnel. Prior to opening the switching cabinet, the main switch must be turned to the off-position.**
- **► There are still live parts and charged capacitors when the main switch is off.**
- **► All works on the electrics is only allowed to be performed by an electrician. This includes the connection to the main power supply. Prior to working on the electrics, disconnect from the power supply.**
- **► Never operate the system with the electrical cabinet door open.**

WARNING

Hazardous electrical voltage and current!

Risk of electric shock and damage to the system.

- **➢ Never use makeshift fuses and/or short circuit fuse holders.**
- **➢ Never interchange current bearing wires.**

Connection to the main power supply has to meet the demands of local area guidelines. All neutral and ground wires must be connected accordingly. *See Chapter 13 Wiring Diagrams*.

2.6.4 Electrostatic Discharge

DANGER

Risk of damage or injury due to electrostatic discharge!

Electrostatic discharge can occur while touching and working with plastic parts, hoses and pipes, wiring and the system as a whole. This can cause solvents and process chemicals to ignite when not within an inert gas atmosphere.

- **► To prevent electrostatic charges, ensure sufficient grounding of the entire system, *see Chapter 13 Wiring Diagrams***

2.6.5 Handling of Electronic Components

CAUTION

Risk of damage to electronic components of the system due to electrostatic discharge!

- ► **Wear a grounded wrist strap or work on a grounded static-dissipating work surface. If this is not possible touch an adjacent earth ground (i.e. central heaters or water pipes) before handling electronic components or printed circuit boards.**
- ► **Leave electronic components and printed circuit boards in their original packaging until final installation.**
- ► **Handle electronic components by their body or case, avoid touching of leads.**
- ► **Keep electronic components and printed circuit boards away from such static generating materials as vinyl, plastic bags, etc.**

2.6.6 Solvents, Chemicals and Gases

Solvents, chemicals and gases used in the system are not supplied by **MBRAUN**. Any substances handled within in the glovebox are provided and applied by the system user.
Note: The safe handling of flammable or explosive gases in an inert gas glove box requires additional safety measures that are not included in the standard configuration of a **MBRAUN** glove box system. Please contact the **MBRAUN** service department if you intend to handle these kind of substances inside the glove box and need a safety upgrade for your system.

DANGER

Risk of damage or injury!

Materials used may be flammable, explosive and/or toxic.

Released chemicals may react with each other, leading to unwanted and/or unknown substances, which may cause additional risks.

Solvents may destroy gaskets of the glove box or other system components (e.g. freezer gaskets) or the rubber material of the gloves.

Solvent vapor is also absorbed by the reactor material and may diminish its capacity for water vapor.

Adhere to the following guidelines:

- **Proper handling of chemicals, corrosives, solvents and gases is the user's responsibility.**
- **Ensure the all relevant Control of Substance Hazardous to Health guidelines such as DIRECTIVE 98/24/EG, COSHH (UK) or any other applicable Rules are followed;**
- **Observe relevant safety regulations as well as material safety data sheets (MSDS) and additional advice provided by the supplier.**
- **Wear personal protective equipment (PPE): protective safety mask, protective gloves and safety goggles.**
- **Mark all containers and supply lines of chemicals (i.e. containers of media and waste) with appropriate labels and warning signs.**
- **Ensure proper ventilation and exhaustion of vapors.**
- **Do not inhale gases.**
- **Keep away from ignition sources. Do not smoke.**
- **When working with organic solvents inside the glove box at regular intervals, the system should be equipped with a solvent vapor removal filter.**

DANGER

Risk of damage or injury when handling flammable or explosive gases!

Hydrogen can burn or explode above a concentration of 4 % in the presence of oxygen (for example in air)!

- **Hydrogen-Oxygen mixtures should always be below this safety concentration.**
- **The user is responsible that these safety concentrations are never exceeded!**

2.6.7 Fire Fighting

DANGER

Hazardous electrical voltage!

Risk of electric shock when extinguishing fires on the system when it is still live if conductive extinguishing media are used.

- **Match the extinguishing medium and the extinguishing equipment to the general conditions on site.**
- **Turn the main switch to the off-position.**
- **During fire fighting observe the locally applicable national regulations.**

2.6.8 Damage of the system

WARNING

Risk of injury and damage!

The system is considered unsafe for operation if:

- ➢ **there is any visible damage**
- ➢ **it fails to perform according to specification**
- ➢ **it has been subject to prolonged storage under unfavorable conditions it has been subjected to severe transport stress**

If the system meets any or all of the above:

- ► **make it inoperable**
- ► **secure it against any unauthorized or unintentional operation**
- ► **Contact the MBRAUN Service Department**

Chapter 3

3.1 Installation and Commissioning of the Glove Box System

3.2 Gases Used by the System

3.3 Equipment for Connections

3.4 Connecting the System

3. Installation

The accessories described in this chapter (gases, pressure-reducing valves) are required for connecting the system. They are not included in the system's delivery package.

	CAUTION
	Risk of accident while handling gases! ► **Competent and experienced personnel should only carry out connection of systems.** **MBRAUN standard systems are not suited for using radioactive or toxic agents. In such a case, special equipment components are required as well as special methods for the connections and precautions have to be observed. These are NOT described in this technical documentation. If necessary, the MBRAUN service department will provide you with the pertinent information!**

See also 2.3 Intended Use and 2.4 Improper Use.

3.1 Installation and Commissioning of the Glove Box System

3.1.1 Preparation

Before delivery and installation of the system, the customer receives a checklist "Delivery and Installation Preparation" to determine the premises for transport and the conditions for media connections. The customer provides all media connections required by the system.

3.1.2 Site Location

Selecting the site for an **MBRAUN** system or any part of a multi-unit system should be carried out applying the following guidelines. If in doubt, contact the **MBRAUN** service department for assistance.

Prerequisites:

Room	Dry atmosphere with a temperature between +15 °C and +30 °C, well ventilated.
Surface Conditions	Firmly structured floor Level positioning bearing capacity: approx. 550 kg/m²
Clearance	Minimum distance of 600 mm from surrounding walls Allow sufficient working area where glove ports, antechambers, etc. require access.
Room volume	Room size (volume) significantly larger than enclosure volume of glove box

If the **MBRAUN** system is only part of a larger complete unit, the requirements of the other system components have to observed as well.

3.1.3 Installation and Commissioning

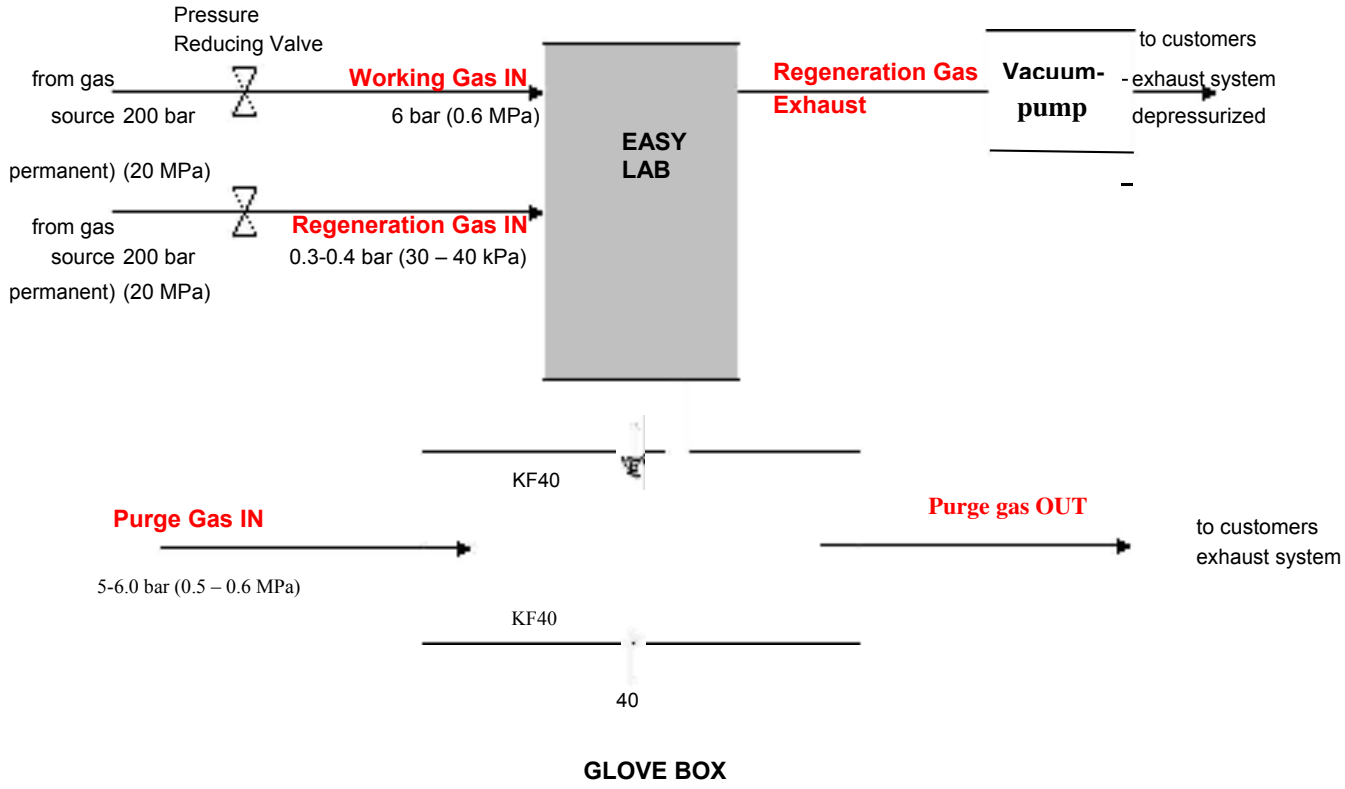
We recommend, that a **MBRAUN** technician installs the system and performs the first commissioning. If the customer does the installation and first commissioning by himself, please adhere to the following instructions.

3.1.4 Final Inspection

A final inspection and specification test is performed by a **MBRAUN** technician if the installation is made by **MBRAUN**. If the customer does the installation and first commissioning by himself, **MBRAUN** recommends to perform a complete system and specification test prior to operating the system.

3.2 Gases Used by the System

3.2.1 Overview



3.2.2 Working Gas

Use	Building up and maintaining the ultra-pure gas atmosphere: pressure regulation & purging. Pressure gas for electro pneumatic valves and pneumatic drives. Purging and filling the system with the desired inert working gas (when commissioning for the first time and after servicing or repairs of the system.)
Gas type*	Nitrogen, Argon or Helium
Purity	Medium Purity (4.8 or better); from bottles or other gas supply facilities.
Quantity	Permanent supply for the system's operation (e.g. for pressure compensation, control of electro-pneumatic valves, and automated purging).

Use	Reprocessing saturated H2O/O2 purifier columns.
Gas type*	Nitrogen/Hydrogen mixture (90-95% N2 with 10-5% H2- portion) when Nitrogen is used as the working gas Argon/Hydrogen mixture (90-95% Ar2 with 10-5% H2- portion) when Argon is used as the working gas Helium/Hydrogen mixture (90-95% He with 10-5% H2- portion) when Helium is used as the working gas.
Purity	Medium Purity (4.8 or better); from bottles or other gas supply facilities.
Quantity	Approx. 3.5 m^3 for each Regeneration.

!	**NOTE!** **Gas Type* – Other gas mixtures, including those with carbon dioxide and hydrogen, are possible. These require special preparation by MBRAUN. Preparation to facilitate the use of such gases is not included in the standard system – therefore only gas mentioned in table above should be used.**
!	**NOTE!** **MBRAUN recommends that the same base for both regeneration and working gases are used (e.g. when using Argon as the working gas, then the additional purge gas must be Argon; likewise, the regeneration gas should be an Argon/Hydrogen mixture.**

3.3.3 Additional Purge Gas

Use	Purging and filling the system with the desired inert working gas (when commissioning for the first time and after servicing or repairs of the system.)
Gas type*	Same as Working Gas
Purity	Medium purity (4.8 or better); from bottles or other gas supply facilities.
Quantity	Approx. 10 - 12 m^3/m^3 box volume for purging the system when commissioning the system for the first time or intermediately purging the system.

3.3.4 Regeneration Gas

3.3 Equipment for Connections

3.3.1 Preparation

Prior to delivery of the system, the user will receive an information sheet specifying the necessary accessories required to make the connections. The following specifications are a general overview.

3.3.2 Equipment for Working Gas Connections

Pressure Reducing Valve for Working Gas:

Use	Working gas pressure control system.
Pressure, Flow rate	200 bar (20 MPa) primary, 6 bar (0.6 MPa) secondary, with a flow rate of 250 l/min
Connection Type	Ø 10 mm Swagelok fitting.

Supply Piping for Working Gas:

Use	Connecting the working gas source with the **Working Gas IN** system connection.
Material	Optional (length as required): Either Ø 10 mm copper pipe or Ø 10 mm stainless steel pipe.
Connection Type	Ø 10 mm Swagelok fitting.

3.3.3 Equipment for Additional Purge Gas

!	**NOTE!** **Required only for the "manual purging" method. When using the MBRAUN Automatic Purge method no preparations are required, in this case the working gas connection is used.**

Pressure Reducing Valve for Purge Gas:

Use	Pressure control of the purge gas when manual purging is applied.
Pressure, Flow rate	200 bar (20 MPa) primary, 5-6 bar (0.5 – 0. 6 MPa) secondary, with a flow rate of 200 l/min
Connection	Ø 9 mm hose or Ø 10 mm Swagelok fitting.

Supply Piping for Purge Gas:

Use	Connecting the purge gas source to the purge hose (**Purge Gas IN**)
Material	Ø 9 mm reinforced hose, 3 mm wall thickness length as required.

Supply Piping for Exhaust Purge Gas:

Use	Connecting the **Purge Gas OUT** to the customers exhaust facility
Material	The hose for the exhaust purge gas may directly be connected to the customers exhaust facility or it may be extended with a copper pipe with a length of 100 mm and 42 mm outer diameter using two hose clips.

3.3.4 Equipment for Regeneration Gas Connections

!	**NOTE!** **MBRAUN recommends the use of a special pressure reducing valve fitted with a non-standard secondary gauge that is calibrated between** **0 – 1.5 bar (0 – 0.15 MPa).** **This is available from MBRAUN – Part No. 2411006.**

Pressure Reducing Valve for Regeneration Gas:

Use	Regeneration pressure control system.
Pressure, Flow rate	200 bar (20 MPa) primary, 0.3-0.4 bar (30 – 40 kPa) secondary, flow rate of approximately 1.25 m³/h
Connection Type	Ø 9 mm hose or Ø 10 mm Swagelok fitting.

Supply Piping for Regeneration Gas:

Use	Connecting the working gas source with the **Regeneration Gas IN** system connection.
Material	Optional (length as required): Either Ø 9 mm reinforced hose, 3 mm wall thickness and adapter, or Ø 10 mm copper pipe or Ø 10 mm stainless steel pipe
Connection Type	Ø 9 mm hose nozzle or Ø 10 mm Swagelok fitting.

3.3.5 Equipment for Vacuum Pumps

Disposal Piping for Vacuum Pump Waste Gas:

Exhaust Outlet for Waste Regeneration Gas:

Use	Connecting the **Regeneration Gas Exhaust** system connection with vacuum pump
Material	Optional (length as required): either Ø 9 mm reinforced hose, 3 mm wall thickness and adapter, or Ø 10 mm copper pipe or Ø 10 mm stainless steel pipe
Connection Type	Ø 9 mm hose nozzle or Ø 10 mm Swagelok fitting.

Use	Connecting the vacuum pump exhaust (oil mist and waste gas) with the customer's waste gas disposal facility (depressurized exhaust outlet).
Material	Optional (length as required): eith er: Ø 25 mm reinforced hose and Ø 25 mm hose nozzle or: Ø 25 mm copper pipe as well as flange and clamp or: Ø 25 mm stainless steel pipe as well as flange and clamp.

3.4 Connecting the System

	CAUTION **Risk of damage!** **► Exact pressure setting required.** **Overpressure will damage the system - low pressure will cause malfunction.**
!	**NOTE!** **Large systems may require having the working gas split into Working Gas and Control Gas connections.**

3.4.1 Connecting the Working Gas

► Connect the pressure-reducing valve to the working gas source (Follow the manufacturer's instructions for its

► Make a supply line between the working gas source and the **Working Gas IN** system connection. (The Working gas IN system connection is labelled with the exact value for the supply pressure)

► Set pressure reducing valve to this value and open valve.

3.4.2 Connecting the Regeneration Gas

► Connect the pressure reducing valve to the regeneration gas source: (Follow the manufacturer's instructions for its connection)

► Connect the regeneration gas source with the **Regeneration Gas IN** system connection using the supply pipe (The Regeneration Gas IN system connection is labelled with the exact value for the supply pressure)

► Set pressure reducing valve to this value and open valve.

3.4.3 Connecting the Disposal Piping for Used Regeneration Gas

► Connect the disposal piping between the **Regeneration Gas Exhaust** system connection and the vacuum pump.

DANGER

Risk of injury and damage, risk of polluting the environment and risk of a bad smell may be noticed when spent regeneration gas escapes to the surroundings.

► **It is the customer's responsibility to ensure that any required exhaust system is provided.**

MBRAUN is unaware of environmental pollution or effects detrimental to health caused by the spent regeneration gas, but these cannot be excluded. The manufacturer does not assume any liability.

► **When using toxic or radioactive material, there must be no discharge of the gas to surroundings.**

See chapter 2.3 Intended Use

3.4.4 Connecting the Disposal Piping for Vacuum Waste Gases

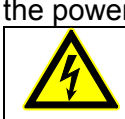
► Connect the disposal piping between the vacuum pump exhaust and the customer's disposal facility (exhaust). Follow the manufacturer's instructions for the vacuum pump connections.

Connection must be depressurized.

!	**NOTE!** **Depending on the place where the vacuum pump is used an oil mist filter can be used instead of the disposal piping. Contact MBRAUN Service for information.**

3.4.5 Power Connection

The connection needs to be made to protected (fused) power supply that is equipped with a CPC (earth conductor). The required values for connection: *see the type plate*. For Easylab the power supply is 1 ph 220V AC 16A.

	DANGER **Hazardous electrical voltage!** **Risk of electric shock on direct and indirect contact with live parts with the possibility, involuntary muscle reaction, muscle paralysis, burnt tissues and organs, or death.** ► **All works on the electrics is only allowed to be performed by an electrician. This includes the connection to the main power supply.**

Chapter 4

4. 1 Safety instructions

4. 2 System connection

4.1 safety instruction

We suggest professional trained staff to finish this initial installation.

Notice:
Careless manipulation of the gas system may cause danger.
System connection should be finished by experienced professional staff.
MBRAUN standard system is not suitable for processing of poisonous gas or radioactive substance.
If need to process, you need use specialized assembly units and method to connect the system, meanwhile, you must obey safety precaution.
This handbook has no detailed description for this part. If you need, MBRAUN after-sale service department will provide you relevant information.
（email：service@mbraunchina.com）

4.2 System connection

4.2.1 Connect working-gas

1.	To connect working air source reducing valve. Please refer to manufacturer instruction book.
2.	To connect gas source and “Working Gas INLET” and refer to chapter “Installation preparation”
3.	“Working Gas INLET” marks system required pressure, setting reducing valve as required, then open it.

Notice:
Setting pressure correctly as required.
Too high pressure will cause system damage, too low pressure will cause system unable to run

4.2.2 Connect regeneration gas

1.	To connect regeneration air source reducing valve. Please refer to manufacturer instruction book.
2.	“Regeneration Gas INLET” To connect regeneration gas source and “Working Gas INLET” and refer to chapter “Installation preparation”
3.	“Regeneration Gas INLET” marks system required pressure, setting reducing valve as required, then open it.

Notice:
Setting pressure correctly as required.
Too high pressure will cause system damage, too low pressure will cause system unable to run

4.2.3 Connect regeneration gas OUTLET

1.	Connect “Regeneration gas OUTLET” with exhausting device or port which provide by customer
2.	Exhausting pipe line inside must be negative pressure

Notice:

When regeneration gas exhausts, it will produce terrible gas. It is no pollution to the environment and no harm to body. However, regeneration gas shouldn’t be exhausted directly to the room inside. Manufacturer isn’t responsible for this behavior.
When use polluted or radioactive material, gas of the box cann’t be exhausted to room inside.

4.2.4 Connect vacuum pump OUTLET

1	Use piping to connect vacuum pump OUTLET with customer exhausting system. Refer to manufacturer vacuum pump connection instruction
2.	Exhausting pipe line inside must be setting negative pressure

Notice:

According to vacuum pump different using situation, you can use oil fog filter to instead of exhausting system. Details please refer to service@mbraunchina.com

4.2.5 Connect main switch

Main power connection must be equipped with ground protection. Desired voltage is marked on the nameplate of equipment.

Chapter 5

5．1 Preparation

5．2 Starting up

5．3 Initial interface

5．4 Power off

Diagram:

5.1 Preparation

- ☑ Read all previous chapters
- ☑ Working gas already connected well
- ☑ Regeneration gas already connected well
- ☑ Regeneration gas OUTLET already connected well
- ☑ Quick cleaning gas already prepared done
- ☑ Vacuum pump OUTLET already connected well
- ☑ Main switch already connected well
- ☑ Verify all piping and connector well

5.2 Starting up

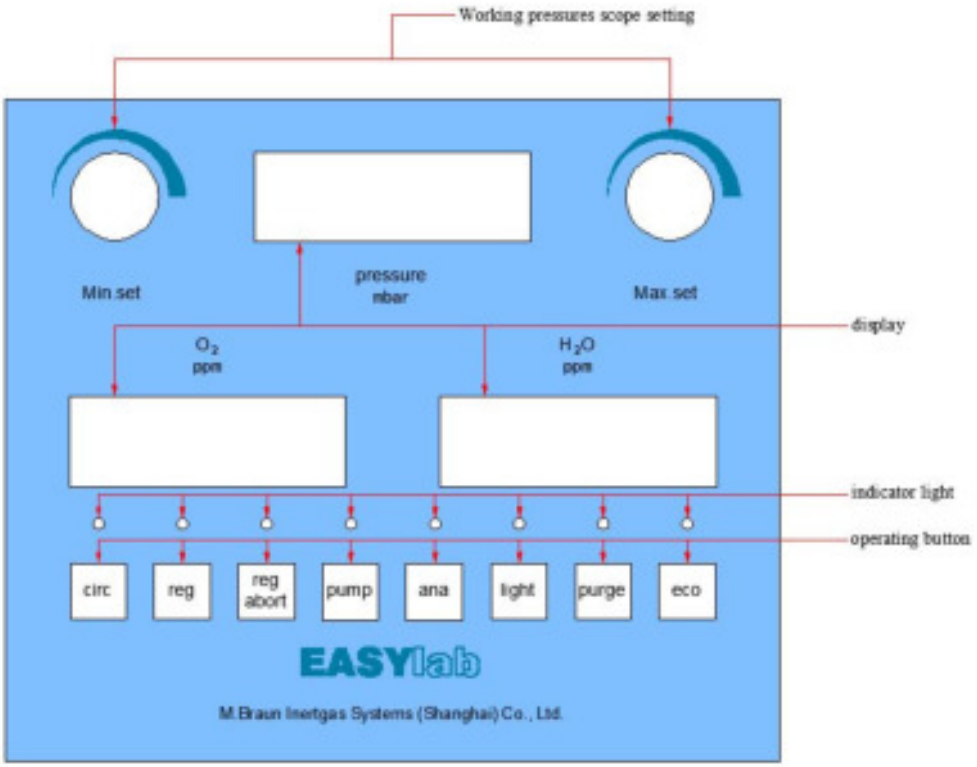
Dia. 1：Main power switch

Main switch is on electric cabinet
starting up
Turn rotary knob from position “O OFF” to “I ON ”

Dia. 1

5.3 Initial interface

MBRAUN standard glovebox is equipped with touch-tone operation panel
After startup, system will run self-inspection



Dia. 2: Initial interface

Above graph is operation interface of Easylab system
Above-mentioned system contains:

1 RKM
1 Circulation blower

Contents on the display screen reflect basic function and indicator for box pressure, moisture and oxygen condition .
Function is controlled by function key

When system is on, display screen and indicate light reflect current situation of the system

5．4 power off

System should be turned off after close the circulation or finish the Regeneration.

Notice:

Don’t shut down the power when the circulation or regeneration is on

Main power switch is on the electric cabinet of system , refer to chapter“ power on”

power off:
Turn “I ON” to “ O OFF”

Chapter 6

6．1 Summary

6．2 Display screen

6．3 Function keys

6．4 Setting keys

6．5 Parameter input

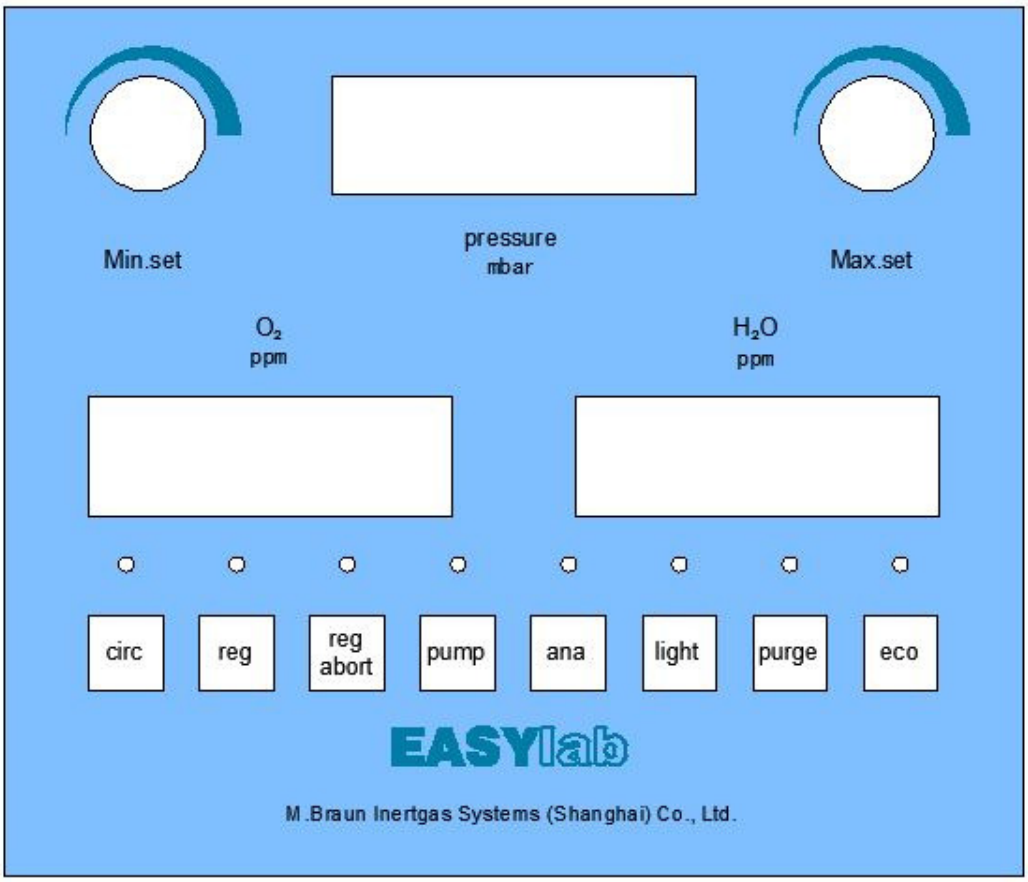
Diagram

Dia. 1：touch-tone operation panel

6.1 Brief introduction

Touch-tone operation panel is the system display and control unit , installed on the body side of Easylab.

Dia. 1



6．2 Displayer

Touch-tone operation screen contains segment code display interface

6．3 Function key

Glovebox function is controlled by function keypad

On the screen, corresponding location marks function name of function keypad

Circulation- press this button to open box circulation, the corresponds indicator light will be always on .

Regeneration- press this button, the corresponding light flashed, this moment the system do regeneration test, press key, ensure regeneration gas is ok, the corresponding light is on, that means regeneration process starts.

Regeneration cancel- click this button. After first click, indicator light flashes, If you want to cancel this button, system skiped to step 8.you can skip the step of heating and ventilating, regeneration will be finished in 30mins

Vacuum pump- click this button to start system vacuum pump, the corresponds indicator light will be always on.

Analyzer- click this button to start system Moisture and Oxygen analyzer, the corresponds indicator light will be always on.

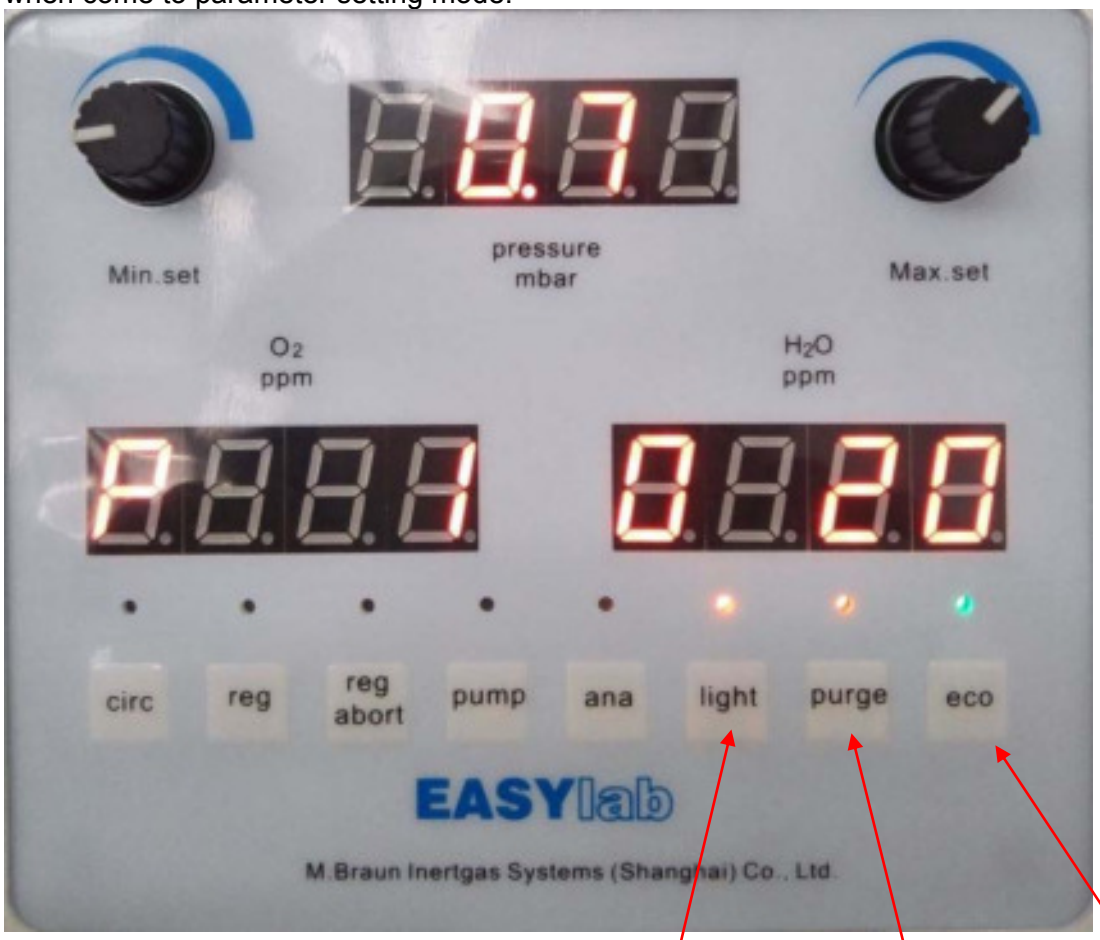
Lighting- click this button to start system lighting, the corresponds indicator light will be always on.

Quick purge- click this button to start box quick cleaning, the corresponds indicator light will be always on.

ECO mode- click ECO mode button, system will enter into ECO-mode.

6. 4 SETTING KEYS

The function of these three buttons “Illumination, quick purging, and ECO mode” is different when come to parameter setting mode.



Press to increase the value

Press light button for 5S to enter setting mode

Press to decrease the value

Press lighting button 5s to parameter setting interface

Set O_2 alarm limit valve Goes to P1

set H_2O alarm limit valve Goes to P2


Min.set
pressure
mbar
Max.set
O2
ppm
H2O
ppm
circ
reg
reg
abort
pump
ana
light
purge
eco
EASYlab
M.Braun Inertgas Systems (Shanghai) Co., Ltd.
Press to decrease the value
Press to increase the value

Chapter7

7．1 summary

When gloves is installed first time or open the box to maintenance, box inside is full of air.
You must clean the box with N2, Argon & Helium to do air replacement.
Cleaning is to replace air of box. The gas for cleaning is same as gas for working.

7．2 When to clean

In principle, you need do the cleaning when O2 value is above 100ppm.

The reason of oxygen content too high is as following:

Initial installation and debugging
After maintainance
Mal-operation will cause air come into box
Breakage and leakage will cause air come into box

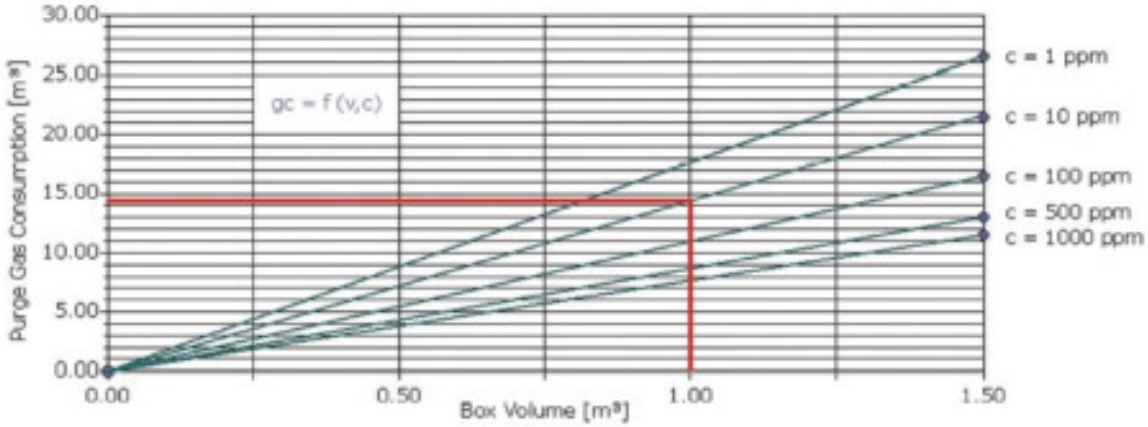
Notice:

You need clean glovebox with working gas until O_2 <100ppm, it will break purification system if you start circulation when O2 content is too high.

7．3 Gas for cleaning

Clean the system with working gas
Middle class purity N2/Ar/He, bottled gas or pipeline gas etc

Dia. 1
Gas content for cleaning



As the graph showing above, if you want achieve 10 ppm purity, 1 m^3 box need 14.5 m^3 gas to clean.

7．4 Manual cleaning

Notice:
It will cause terrible smell gas to the air when you clean the box, it will cause the pollution to the environment. Manufacturer is not responsible for this. You need use special method to clean when using poisonous or radioactive substance.

7．4．1 Requirement

- ☑ Finish reading all chapter above
- ☑ All ports are connected well
- ☑ Circulation and regeneration are all closed
- ☑ All antechambers are all closed
- ☑ Manual cleaning tube are connected well, refer to chapter “Installation preparation”
- ☑ Enough working gas, about 10-12 times volume of box

7．4．2 Cleaning process

Refer to diagram 2

·First setting box pressure between 3mbar-6mbar

·Connect decompression valve of cleaning gas bottle

·Connect flexible pipe used for cleaning

·Open flange blind plate of glovebox

·Put flexible pipe to the box from open hole

·Open decompression valve, set the pressure to 0.3---0.5 MPa

Through glove, clean the box from up to down back and forth with the gas in the flexible box, especially corner and place pf loading parts

·When the system equips fridge or hermetic cavity, you need open the cover when you do the cleaning (be sure that fridge switch is off, fridge is room temperature)

·Air and clean gas from the box will exhaust from opening flange port.

·Cleaning the box until O_2 < 100ppm

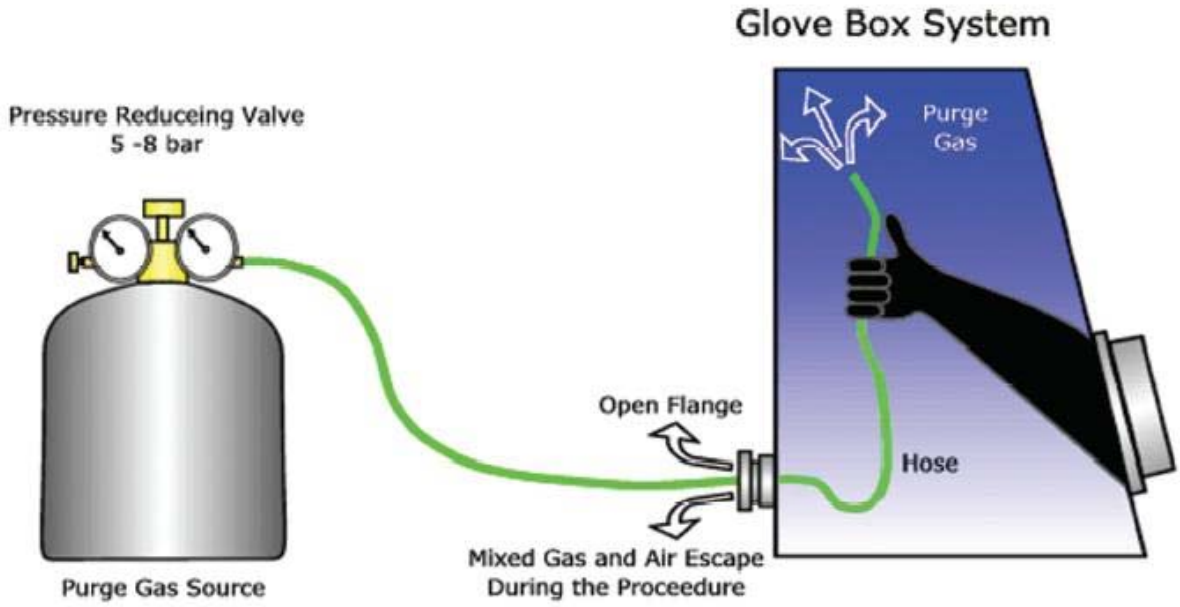
It takes 10-12 m^3 purging gas to drop to this value per m3 box .

Oxygen analyzer equipped by system can measure O_2 content precisely. We suggest to start oxygen analyzer for a while to measure O_2 content during cleaning process.

When O_2< 100 ppm, take flexible pipe out from box, seal the blind plate with flange port immediately.

Close cleaning gas.

Dia. 2： manual cleaning



Chapter 8

8．1 General Information

8．2 Principle

8．3 Noun Explanation

8．4 Change the box pressure within the limit of work pressure

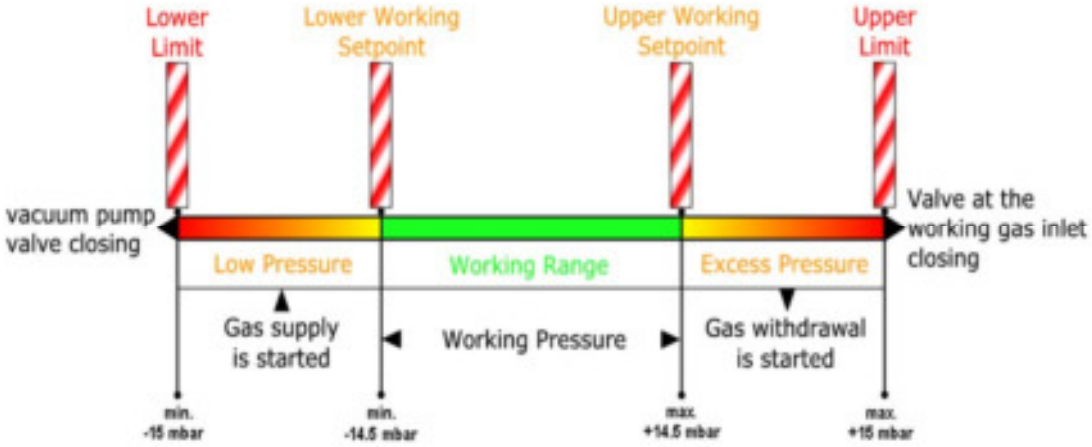
Diagram

8.1 General Information

The system of MBRAUN Glovebox equipped with automatic pressure control of PLC

8.2 Principle

Dia.1 **Theory of pressure control**



8.3 Noun Explanation

Box pressure	Current pressure
Working pressure	Expect pressure
Pressure Range	Work pressure between upper and lower limit by auto-control
Upper and lower working limit	Set working pressure between-14.5mbar and 14.5mbar, the system will automatically compensate pressure when it over. The upper pressure is higher more than the lower at least 1mbar. Factory set to: Upper working limit:+4mbar Lower working limit:-4mbar Modify the setting working pressure limit please reference parameter Setting Section.
Limiting	In order to ensure the system security, the limit of working pressure should not exceed-15mbar to +15mbar. Once the box pressure exceeds this limit, working gas inlet value or exhaust value will shut down immediately. Factory set to: Upper working limit:+15mbar Lower working limit:-15mbar Modify the setting working pressure limit please reference parameter Setting Section.

8.4 Change the box pressure within the limit of working pressure

MBRAUN glovebox series has pedals. Box pressure can be set through the pedals in work pressure between the upper and lower adjustment.

8.4.1 Operation of pedals

Touch right pedal	Increase the pressure within the set limit.
Touch left pedal	Reduce the pressure within the set limit.

Dia. 2

Chapter 9

9．1 General Information

9．2 The state of the purification column

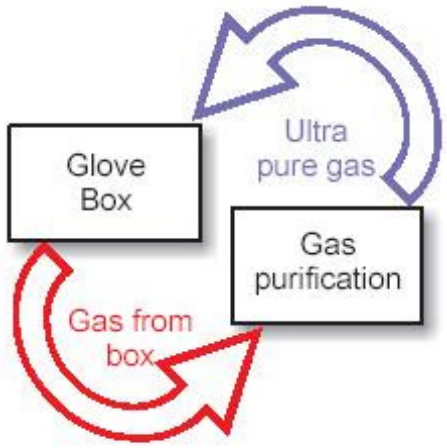
9．3 Necessary condition

9．4 Circulation mode

9．4．1 Open and close circulation mode

Diagram:

9.1 Profile



MBRAUN Glove Box remove water an oxygen through gas cycle, that means the working gas cycle in box and purification column constantly .This way can guarantee system stability, economic effectively to purify gas.

Notice:
The circulation mode must be keep opening when Glovebox is used .Only in this way can make the box gas purification constantly to keep water/oxygen levels remain <1ppm.

Circulation mode can operate through control panel button and indicate working state through the light.

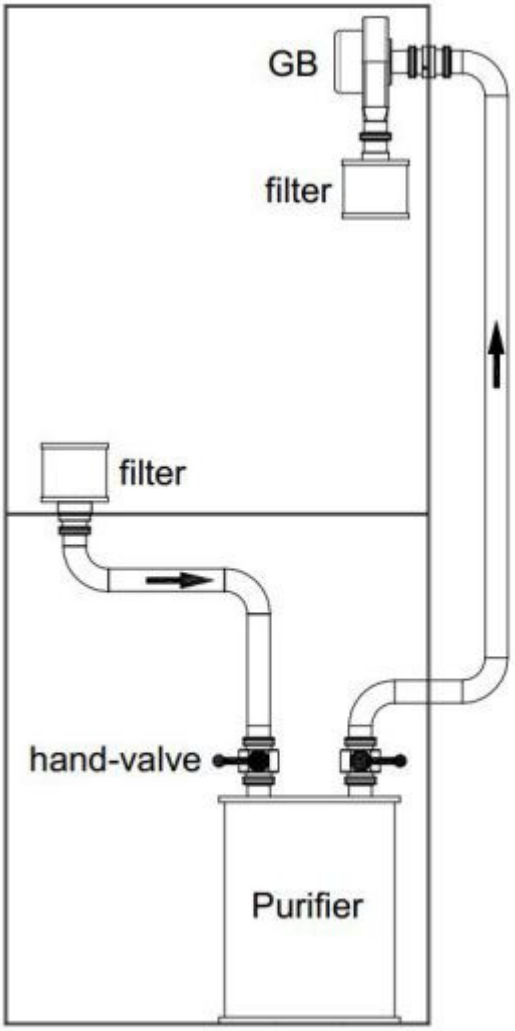
Dia.1

Oxygen/moisture levels will rising when purification column is used after a period of time. So purification column should regeneration regularly, at least when seeing oxygen/moisture content rise up then active the regeneration process. Please refer to “regeneration section”. While doing regeneration, the circulation should be turned off.

9.2 Necessary condition

- ☑ Read all of the above chapters already.
- ☑ All of the interface is connected well
- ☑ All doors are closed
- ☑ Box has been cleaned
- ☑ System has been turned on
- ☑ Purification column without regeneration state.

9.3 Circulation mode



Picture shows the gas flow patter in circulation mode (simple purifier).

Dia. 2

Attention:
Circulation function can be used directly when the Glovebox is tested on the first time, because the purifier has been regeneration before shipment.

9.4.1 Open and close circulation mode

Open butterfly valve on purifier before turn on circulation.
The circulation function will active after touching the circular button.

Attention:
The cycle can start only after purifier regeneration end.

The red light above circular button will on when the circulation mode is started.

Regeneration function will be locked until the circulation end and the cycle can be carry out.

Circulation mode will be terminated when click the circulation button again.

Chapter 10

10．1 General information

10．2 Necessary condition

10．3 Regeneration program

10.1 General information

After the purifier working a period of time, Oxygen/moisture is saturated in purifier. Now in order to recover the ability on removing moisture and oxygen, it should perform regeneration program.

Regeneration regularly, especially the content of water and oxygen rising .Regeneration of interval depend on the status and using of customers.

Confirm the regeneration cycle by following methods: Do the regeneration when the content of moisture and oxygen can't remain below 1ppm and record running time, also this time minus 10 hours as the time of the next regeneration.

10.2 Necessary condition

- ☑ Read all of the above chapters already
- ☑ All of the interface is connected well
- ☑ Enough regeneration gas
- ☑ System has been turned on
- ☑ Loop closed

10.3 The regeneration program

10.3.1 Active regeneration program

Attention;
Make sure there is enough regeneration gas and working gas before start reg. program and check the flow when click regeneration button the first time.

Attention:
The cycle program must shut down before regeneration and also purifier inlet and outlet of the butterfly valve need to manually shut down.

Please shut down circulation by clicking circulation button when the circulation is active, and then regeneration button is effective, meanwhile the VPG keeps running.

Manually close the two butterflies at purifier in and out port (The valve handle should be parallel to the ground)

Start reg. program by clicking regeneration button, then the indicator light will flash and system will test. Clicking the button again if the gas vent is verified.
It shows that regeneration program is running if the light of regeneration button become red.

10.3.2 Perform of regeneration program

The paragraph shows the regeneration process .All of the steps are automated.

step	time	movement
0 zero	begin	end
1 NO.1		Reg. gas test begin
2 No.2		Reg. gas test end
3-16 NO.3-16		perform automatic regeneration program
18 NO.18	after 16 hours	program end

Attention:

Please make sure there is enough regeneration gas before perform automatic regeneration program .Refer to the debug and installation chapter.

Attention:

If power off during regeneration process, it will rerun after power on and perform the steps that has been carried out automatically. So please make sure enough regeneration gas before power on.

10.3.3 Regeneration process stop

It will complete all regeneration process automatically after performing regeneration.

Open the purifier inlet and outlet butterfly valve manually and start circulation by clicking circulation button when regeneration is finished.

Chapter 11

11．1 Parameters setting of glovebox

11．2 State information

Alarm interface

11.1 Parameters setting of glovebox

11.1.1 General information

On the operation panel , it shows the system all the information、variables and parameter. The system has been sated appropriate parameters, but user can change this parameter if necessary.

11.1.2 Initial display

The system will enter the initial state interface once power on. The operation panel will show pressure and the condition of each button.

The paragraph above shows the current box pressure real-time.

11.1.3 Original interface- box status display

Start interface as shown on the left ,it shows the box the current atmosphere, these data are real-time measurement by installed on the box body probe

Attention: The circulation and the analyzer must be active at the same time to ensure that measurements are accurate value of the current state of the box.

11.1.4 Working pressure limit

 	Working pressure settings interface as shown on the left, it shows the limit on the box are allowed to work pressure, 14.5mbar represent positive pressure 1450pa, -14.5mbar represent negative pressure 1450pa. The picture above shows the corresponding maximum working pressure limit through the right side of the knob to adjust. The right hand up, left handed down The picture below shows the corresponding minimum working pressure limit, through the left side of the knob to adjust. The left hand up, rig handed down.

11.1.5 Box oxygen index value alarm

The left paragraph shows oxygen index value alarm, P1 parameters used to set the upper limit of the box oxygen alarming index, the system will alarm prompts on the display screen out oxygen when actual situation more than the set value

The system will change to the setting P parameter if you keep touch 5s. P parameters switch automatically back and forth from P1 to P3 if continue to click shortly light.

Click on the quick cleaning button and then the limit up(Long press for 3 seconds, bits to ten and wait 3 seconds to bits)

Click on the ECO mode button and then then limit down(Long press for 3 seconds, bits to ten and wait 3 seconds to bits)
Attention: Maximum allowable alarm value is 200 ppm

11.1.6 Box moisture index value alarm

Water alarm parameters interface as shown in the left, P2 is used to set the upper limit of the inland waters of the warning index, when actual situation than the set value, the system will jump out of the oxygen on the display screen alarm prompt

Clicking light button for 5 seconds, the system will turn to the police P parameter settings interface. Touching shortly light button, P parameters automatically from P1 to P3 switch back and forth.

Click on the quick cleaning button, limiting up(Long press for 3 seconds, bits to ten and wait 3 seconds to bits)

Click on the ECO mode button ,limiting down(Long press for 3 seconds, bits to ten and wait 3 seconds to bits)

Mark: Maximum allowable alarm value is 200 ppm

11.1.7 Zero calibration of box pressure

Zero pressure parameters interface as shown on the left,
P3 parameter is used to set the box pressure of zero adjustment

Press light button for 5 seconds, the system will turn to the police P parameter Settings interface. Continue clicking button, until P3 parameter appears.

Open the glovebox to atmosphere(air) Press “ECO mode” button to do zero calibration.

Attention：Only allowing first installation or pressure gauge shows that there was an obvious deviation value than the actual value of zero adjustment

11.1.8 Parameter setting

Attention : Parameter setting reference 6.3/6.4 chapter.

11.8.9 ECO mode

By clicking ECO mode button on the screen can active the ECO mode of the glovebox system.

Under ECO mode, the realizable functions as follows:

Vacuum pump shut down automatically, until the glovebox has the exhaust demand the pump will be turned on automatically again .Then the system will count a certain time to shut down the pump again.

After 30 minutes the system will automatically shut down box lighting.

Under ECO mode, the system will set automatically box pressure lower limit to 2 mbar, upper limit will be setting to 6 mbar .Box working pressure should be better setting to 1 mbar - 5 mbar.

Box internal pressure can be obtained by rapid VV electromagnetic valve. If box pressure exceeds limit on, the system will exhaust by VV valve, until the box pressure is 0.5 mbar lower than upper pressure limit.

Under ECO mode, if box pressure exceed the upper pressure limit alarm, the system will automatically shut down the circulation blower, turn on the vacuum pump and gas exhaust through the VV valve.

11.2 State information

Alarm interface

	As shown on the left by oxygen content display, the operator can see the alarm information, if system has an alarm, the alarm code will show automatically every two seconds one time. According to the alarm code, users can find the corresponding fault information, such as E3 is oxygen value exceeds the warning line. Fault code content detailed in section 18.2.

Chapter12

12．1 Summary

12．2 Working Principle

12．3 Important notes

12．4 Transferring Material into the Box

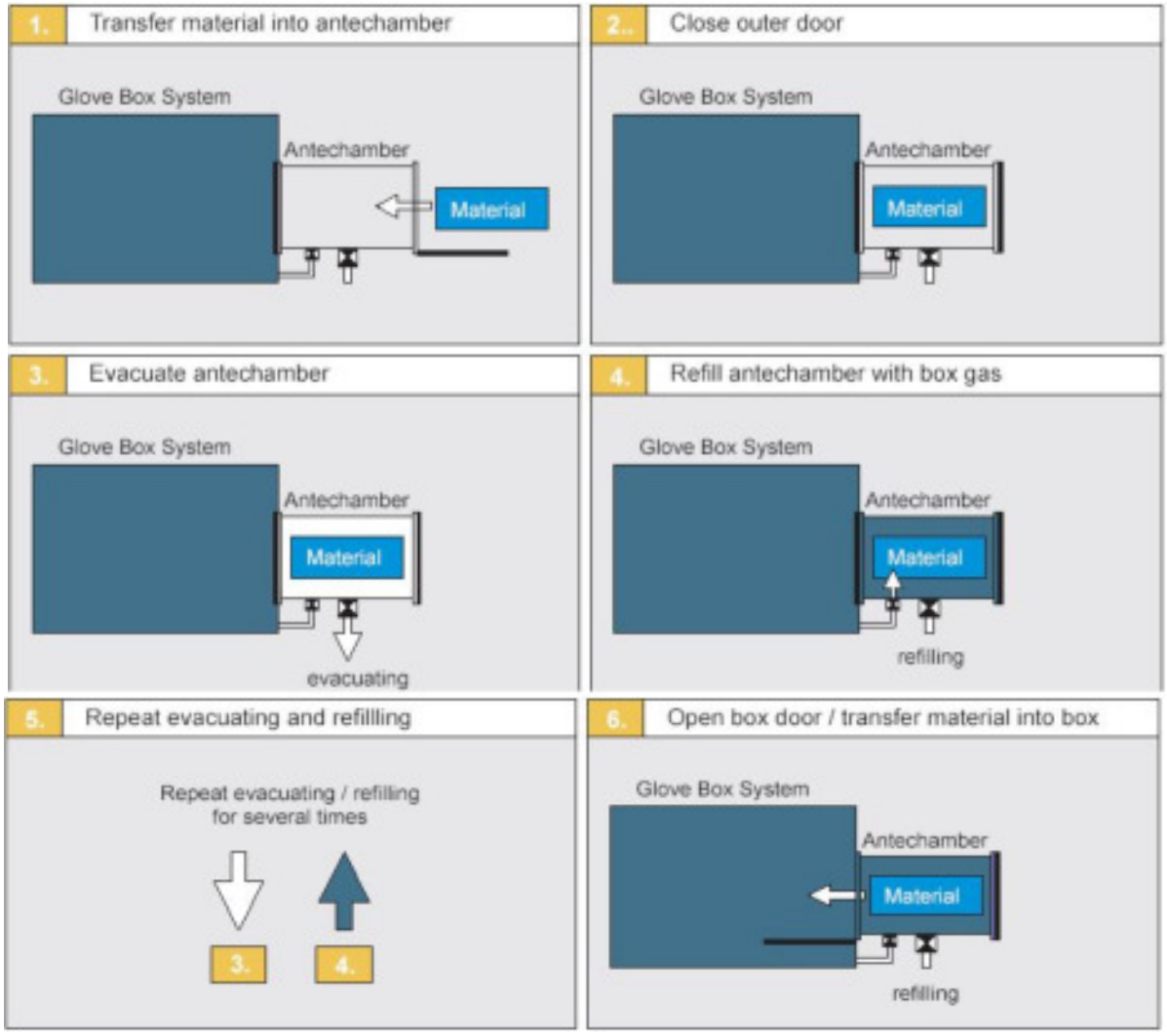
12．5 Transferring Material out of the Box

Diagram

12．1 Summary

Antechambers are designed for transferring material into or out of the inert glove box without polluting the inert box internal atmosphere during the respective procedures.

12．2 Working Principle



Dia. 1

12．3 Important notes

Risk of damage!

► An evacuated antechamber cannot be opened. The attempt to open a door of an evacuated antechamber may damage the door locking mechanism.

► Never open inner and outer antechamber doors simultaneously and

► Never open the inner door of an antechamber filled with ambient atmosphere.

Note!
If the system is equipped with a separate vacuum pump, MBRAUN recommends that the pump is switched off using the control panel when not required. The pump will be restarted automatically on the next evacuation/refill cycle.

12．4 Transferring Material into the Box

12．4．1 Preparation

► Observe Item “Important Notes” in this chapter.

► The antechamber door located inside the box is closed.

► Open the outer antechamber door.

► If a sliding tray is available: Pull out sliding tray; lay material on tray; then slide the tray together with the material into antechamber.

►If no sliding tray is available: Transfer the material directly into antechamber.

►Then close outer antechamber door.

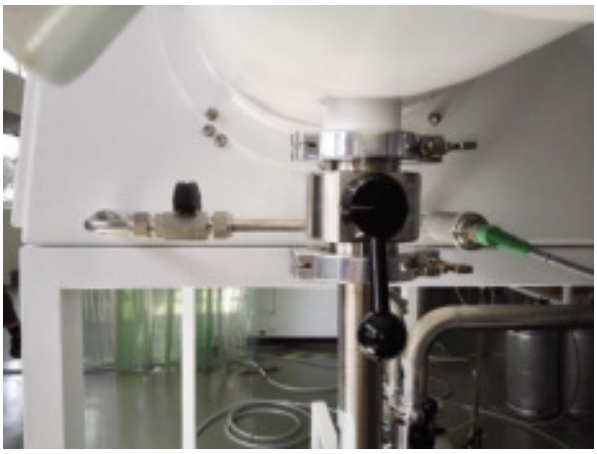
Attention：

Before putting a closed enclosure into the antechamber 。Please confirm the enclosure can afford the vacuum limit.（Vacuum limit<3Pa）。

If possible，open the enclosure （e.g.：the cover of the bottle），to be sure the inside the

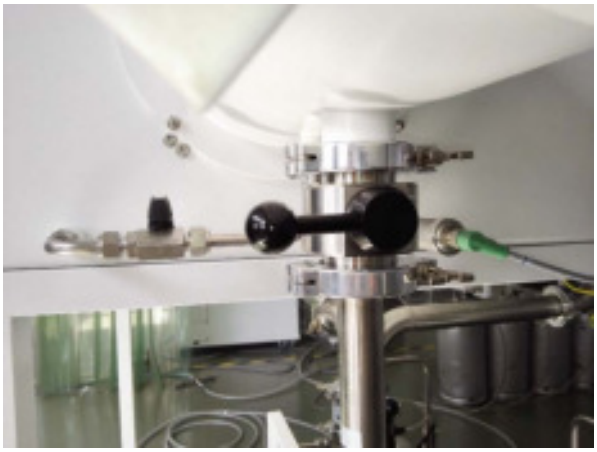
12．4．2 Evacuate

Dia. 2



Open the hand valve on the evacuate piping（DN40）。

Suggestion：
MBRAUN suggest that at least the vacuum of antechamber be evacuated to <0.5mbar。



Close hand valve

12．4．3 Refill

Dia. 3

Open the hand valve on refilling line（DN10）。

Close hand valve (DN10)

12．4．4 Take material out of antechamber

·Open inner door
·If a sliding tray is available: Pull out sliding tray; take out material from the tray; then slide the tray into antechamber.
·If no sliding tray is available: Transfer the material directly into box
·Close inner door

Suggestion:
The antechamber valves must be returned to closed-position after each step of the antechamber operation.
Both the inner door & outer door should keep closed when the antechamber is not in using.
After opening the outer door, the antechamber should be evacuated at least once, to prevent the atmosphere of the glovebox.

12.5.1 Preparation

► Observe Item “Important Notes” in this chapter.

► The antechamber door located outside the box is closed.

► Open the inner antechamber door.

► If a sliding tray is available: Pull out sliding tray; lay material on tray; then slide the tray together with the material into antechamber.

►If no sliding tray is available: Transfer the material directly into antechamber.

►Then close inner antechamber door.

12.5.2 Take material out of antechamber

·Open outer door

·If a sliding tray is available: Pull out sliding tray; take out material from the tray; then slide the tray into antechamber.

·If no sliding tray is available: Transfer the material directly into box

·Close outer door

Risk of injury and pollution of environment!

Annoyance by bad sme`ll is expected as soon as any waste gas from inside the glove box escapes to the surroundings. Environmental pollution and effects detrimental to health, however, are not known in any standard applications, but cannot be excluded, depending on the chemicals handled inside the glove box. The manufacturer does not assume any liability. Refer to section 2.5.6 of this manual for general remarks concerning the safe handling of chemicals and gases.

When using toxic, radioactive, or material that may burn in air ensure, that the gas enclosed in the antechamber after opening and closing of the inner antechamber door escapes by no means to the environment.

When opening doors of large antechambers be sure that the enclosed volume of the antechamber is still small compared to the volume of the room. Make sure that the room is well ventilated. (Does not apply to standard systems – the enclosed volume of a standard antechamber is approx. 70 l). For information about alternative methods please contact the MBRAUN service department.

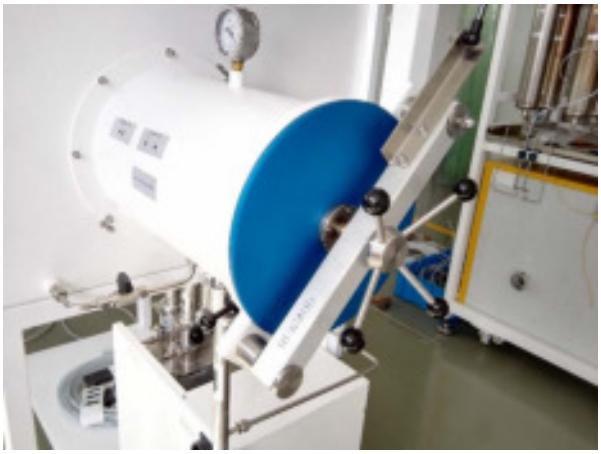
Note!

If the system is equipped with a separate vacuum pump, MBRAUN recommends that the pump is switched off using the control panel when not required. The pump will be restarted automatically on the next evacuation/refill cycle.

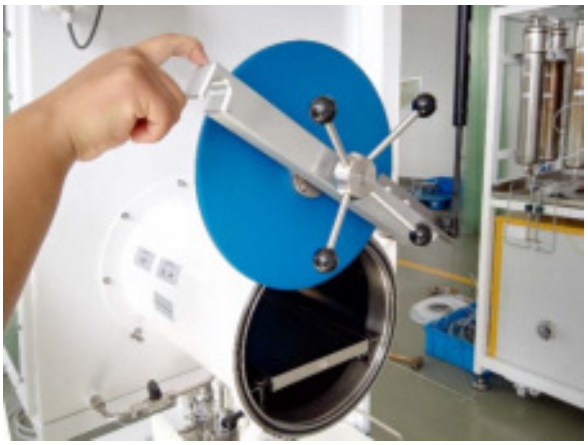
12. 6 Round antechamber

12.6.1 Open/Close antechamber door

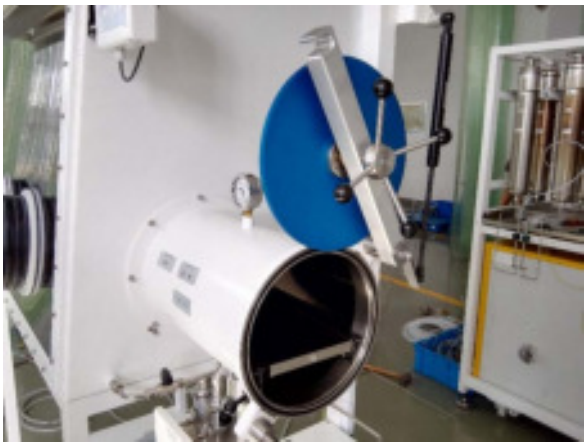
Risk of damage!
An evacuated antechamber cannot be opened. The attempt to open a door of an evacuated antechamber may damage the door locking mechanism.
Never open inner and outer antechamber doors simultaneously and
Never open the inner door of an antechamber filled with ambient atmosphere.
This would result in pollution of the box atmosphere and possibly in damage of measuring instruments and material within the box.



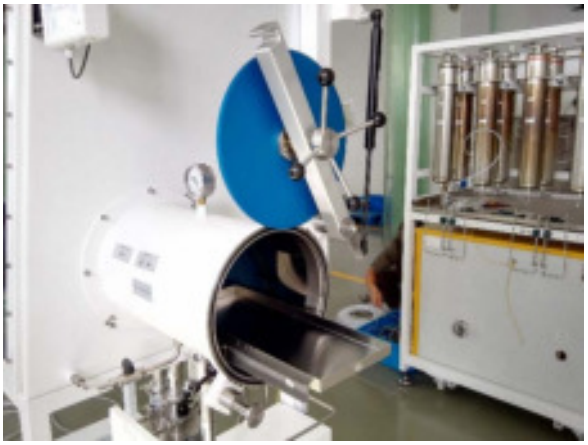
► Turn the locking mechanism anti-clockwise, until the antechamber door is free.



► Carefully open the antechamber door in upward direction



► The antechamber door is supported by the pneumatic spring mechanism.



► Pull out sliding tray slowly

To close:

Turn the locking mechanism clockwise, until the antechamber door is closed. Ensure that the door is fully lowered before sealing the antechamber door. Do not over tighten the antechamber door locking mechanism. This would damage the door seals and the locking mechanism.

Chapter13

13．1 General informations

13．2 Calibration

13．3 Oxygen analyzer （MB OX-SE-1）

13．4 Moisture analyzer（MB MO-SE-1）

Diagram

13．1 General informations

NOTE!

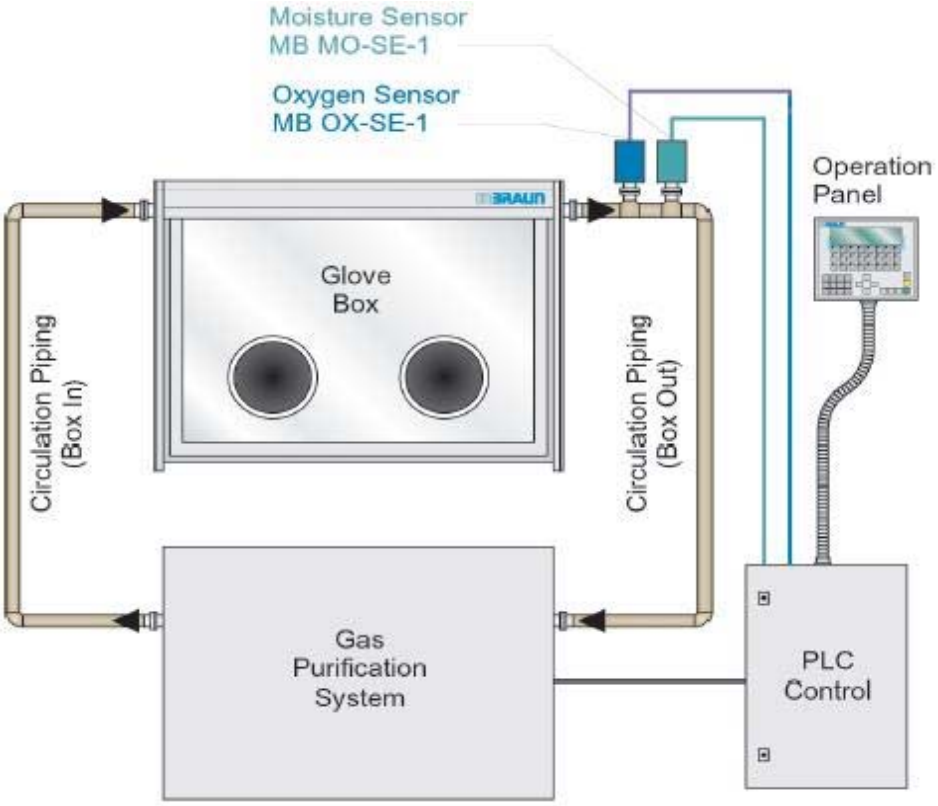
Both oxygen& Moisture sensors are option.

The measured H2O and/or O2 values are shown on the operation panel display.

	
MB-MO-SE-1®	MB-OX-SE-1®

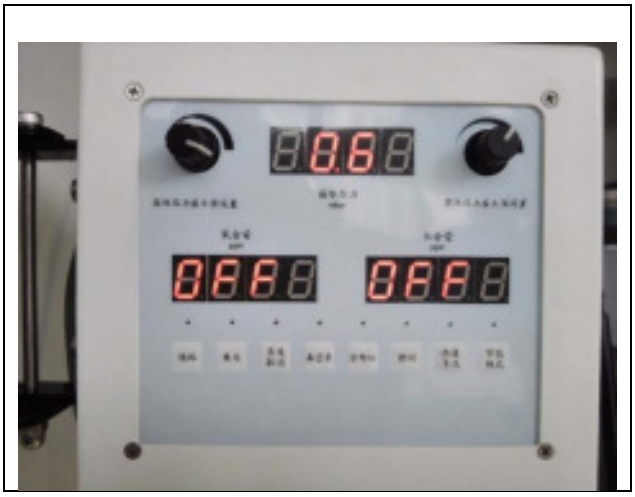
13．1．1　Connect the analyzer

Usually both analyzers will be assembled on the gas outlet of glovebox, to make sure the sensors will always measure the worst atmosphere of the whole box .This design will be good for controlling the pure N2/Ar atmosphere of the glovebox.



13．1．2 Turn on the analyzer

NOTE!
Operating the sensor at oxygen levels of >1000 ppm (e.g. in air) does not damage the sensor element irreversibly, but it should be avoided. If exposed to air, it will take several hours until the sensor will measure low oxygen levels correctly in Inert Gas.



When turn on the system, the analyzer is in off status.

Turn on the analyzer：Press the Analyzer button can turn on the Oxygen and Moisture sensors.

The measurement value will be displayed on the panel as follows.

Pressure xxxmbar

H2O xxxppm*

O2 xxxppm**

13．1．3 Turn off the analyzers

Click the analyzer button again can turn off both the sensors.

13．2 Calibration

Calibration of Sensors

All MBRAUN sensors have a certified calibration before shipping.

The calibration cycle depends on the demand for accuracy as well as on the conditions of the gas to be measured (purity, spurious gases etc.).

NOTE!

MBRAUN recommends that sensors are calibrated annually by MBRAUN technicians.

Quotation on request from MBRAUN Service Department.

13.3 Oxygen Analyser (MB-OX-SE-1)

13.3.1 General

The **MB-OX-SE-1** sensor has been designed to control the atmosphere of MBRAUN Systems for residual Oxygen content. The measuring range is 0 to 1000 ppm. The measuring range from 0 – 100 ppm is linear. The measurement range is calibrated for use below 1000 ppm as the sensor output, above 100 ppm, not truly linear.
The semiconductor sensor made of Zirconium dioxide is specific for oxygen, but because of the high sensor temperature and the catalytic activity of the platinum coating of the sensor there are low cross-sensitivities for hydrogen as well as possible reactions with aggressive gaseous substances, that can reduce the operational life of the sensor.

Mechanical	Length over all:	190 mm, height 80 mm, depth 58 mm
	Sensor-part:	length 45 mm, diameter 26 mm
	Flange:	NW 40 KF
	Weight:	0.7 kg
Electrical	Supply voltage:	24 VDC ± 10%
Environment	Ambient temperature:	+15 to +27 °C
	Pressure:	800 to 1200 mbar (Differential pressure sensor to electronics max. ≈100 mbar)
Measuring	Range:	0 - 1000 ppm oxygen
	Sensitivity:	10 mV / ppm
	Response time (0 - 90 %):	approximately 10 sec (0 - 90 %)
	Warm-up time:	10 min (for < 10 ppm approx. 6 hr)
	Accuracy[1)]:	2 % of displayed value ±1 ppm up to 100 ppm
	Drift at 10 ppm:	10 % / year
	Sensor life[2)]:	ca. 5 years

Operating the sensor at oxygen levels of >1000 ppm (e.g. in air) does not damage the sensor element irreversibly, but it should be avoided. If exposed to air, it will take several hours until the sensor will measure low oxygen levels correctly in Inert Gas.

13.3.2 Construction

The **MB-OX-SE1** consists of the sensor and the special electronics separated by a gas-tight NW40 clamp flange. The sensor is protected against physical damage by a protective cage. The sensor leads are connected to the electronics by a vacuum-tight feed-through. The electronics are contained in an airtight box mounted directly to the back of the NW40 flange.

13.3.3 Technical Data

1. In clean argon-atmosphere, without interfering gases like H_2O or CO_2
2. In absence of reactive gases (contact MBRAUN Service for further advice)

13.3.4 Connection

The connection for the Oxygen Sensor is made with an RJ45 (8-pole) Socket Connector. The pin layout is shown in the table below.

Pin-No.	Contact
1	Supply Ground
2	Switching ON/OFF 24 V
3	Signal Ground
4	Live bit (O2)
5	Not Connected
6	Signal 0 - +10 V
7	Supply +24 V
8	Supply Ground

Installation

The oxygen probe is mounted on an appropriate vacuum-tight NW40 flange by means of a centring ring and a clamp. The plug connection to the control unit should not be made before the whole box-system has been purged sufficiently with inert gas. The operation of the probe

as well as the display of the measured values is controlled from the operator panel.

13.3.6 Trouble-shooting

The oxygen probe does not contain user-serviceable parts. Therefore, in case of defects the probe has to be returned complete and unopened to MBRAUN or the authorized representative. On request, MBRAUN may offer exchange probes.

Description of Malfunction	Possible Solution
The display measuring value comes very slowly below 10 ppm, whereas it is certain that the real value is much lower (Check, whether this is really the case or the display is correct).	The sensor is still charged with oxygen by a previous operation at high oxygen concentrations or long storage in air. In this case operate the sensor for some hours in clean inert atmosphere and it will come down. The sensor has a very stable zero-point, so before sending the probe for repair you must exclude the possibility that e.g. hydrogen in ppm-levels is present or was present in higher levels.

13.4 Moisture Analyser (MB MO-SE-1)

13.4.1 General

The MB-MO-SE1 has been designed to control the atmosphere of the MBRAUN Systems for residual moisture content. The measuring range is 0 to 500 ppm. The measuring range from 0 – 50 ppm is linear. The measurement range is calibrated for use below 500 ppm, as the sensor output above 50 ppm, is not truly linear.

The sensor element is a “double helix” made of platinum wire fixed on a special insulation material, or printed ceramic. The sensor is coated with phosphoric acid that is totally dehydrated. Water molecules in the gas penetrate the acid layer and the electrolysis of the resulting H+ and OH- ions to H2 and O2 produces an electric current. Therefore, the water molecules coming to the sensor surface are removed and the resulting current is depending on the concentration of the water molecules in the gas. The primary signal is compensated for temperature and amplified.

13.4.2 Construction

The MB-MO-SE1 consists of the sensor and the special electronics separated by a gas-tight NW40 clamp flange. The sensor is protected against physical damage by a protective cage. The sensor leads are connected to the electronics by a vacuum-tight feed-through. The electronics are contained in an airtight box mounted directly to the back of the NW40 flange. Electronics and Sensor Element have been factory-calibrated with certified calibration gases; there are no user-accessible adjustment points.

13.4.3 Technical Data

Mechanical	Length over all:	205 mm, height 80 mm, depth 58 mm
	Sensor-part:	length 42 mm, diameter 14 mm
	Flange:	NW 40 KF
	Weight:	0.7 kg
	Electrical	
	Supply voltage:	24 VDC ±10%
Environment	Ambient temperature:	+15 to +27 °C
	Pressure:	800 to 1200 mbar (Differential pressure sensor to electronics max. ≈100 mbar)
Measuring	Range:	0 - 500 ppm moisture
	Sensitivity:	20 mV / ppm
	Response time (0 - 90 %):	approximately 120 sec. (0 - 90 %)
	Warm-up time:	10 min (for < 10 ppm approx. 6 hr)
	Accuracy[1)]:	
	High precision range (0 - 10 ppm):	better than 5 % of value
	Wide range (10 - 100 ppm):	better than 20 % of value
	Drift at 10 ppm	10% / year
	Sensor life[2)]:	ca. 5 years

1) without interfering gases like NH_3
2) with regular maintenance

13.4.4 Connection

The connection for the Moisture Sensor is made with an RJ45 (8-pole) Socket Connector. The pin layout is shown in the table below.

Pin-No.	Contact
1	Supply Ground
2	Switching ON/OFF 24 V
3	Signal Ground
4	Not Connected
5	Live bit (H2O)
6	Signal 0 - +10 V
7	Supply +24 V
8	Supply Ground

13.4.5 Installation

The Moisture Sensor is mounted on an appropriate vacuum-tight NW40 flange by means of a centring ring and a clamp. The plug connection to the control unit should not be made before the whole box-system has been purged sufficiently with inert gas. The operation of the Sensor as well as the display of the measured values is controlled from the operator panel.

13.4.6 Sensor Cleaning

	⚠ CAUTION
	Risk of damage to process materials! **The Moisture Analyser must be cleaned every 2000 hrs. A reminder is given as a warning when this service work is due.**

To achieve optimal moisture measurements the sensor is recommended to be closely inspected within a period of three months.

	DANGER **Risk of injury!** **The sensor element is continuously exposed to the box gas and therefore is at risk from contamination.** ► **Ensure that all local and national safety guidelines are followed when handling potentially contaminated materials.**
!	**NOTE!** **MBRAUN recommends a maintenance cleaning procedure every 3 months.**
	CAUTION **Risk of damage!** **When cleaning the sensors it is important that contamination from the ambient atmosphere is prevented. Therefore, MBRAUN recommends that the box parameters are set to a pressure of between +1.0 and +5.0 mbar (*see parameters chapter*) and that the circulation mode is switched OFF.For Glove Box systems that must remain at a negative pressure, special procedures may be required. Contact MBRAUN service for advice.**

This routine maintenance consists in cleaning the platinum winding of the **MB MO-SE-1** and moistening it with phosphorous acid H3PO4. The following aids are required for disassembling and maintaining the **MB MO-SE-1.**

- Tool for disassembly (screwdriver)
- Soft, absorbent, lint free cloth (cotton)
- Small quantity of phosphorous acid (H3PO4).
- Protective clothing, including gloves and goggles
- One dummy plug for the open circulation piping (DN40)

⚠	CAUTION **Risk of injury!** **Be cautious when handling phosphorous acid. Wear protective gloves and goggles.** ► **Any phosphorous acid getting in contact with your skin should immediately be rinsed off using running water.** ► **When getting in contact with your eyes, the acid should immediately be rinsed also using running water; afterwards you should immediately consult a doctor.**

1

Disconnect plug connector.

2

Loosen clamp.

3  Insert dummy plug.	4  Tighten flange clamp.
5  Unscrew protective cover.	6  Moisten sensor with distilled water.
7  Carefully clean and dry winding.	8  Moisten winding with phosphorous acid.

9

Remount protective cover.

10

Remove clamp and dummy plug.

11

Insert measuring probe and re-clamp.

12

Tighten clamp.

13

Insert plug connector.

Chapter14

14．1 General information

14．2 Technical data

14．3 Exchanging dust filters

14．3．1 Method for exchanging the filter

Diagram

Dia. 1 Replacing the box HEPA - Filter

14. 1 General information

MBRAUN glove boxes are equipped with dust filters at the gas outlet, as well as, at the gas inlet piping. The former protects the gas purification system against dust particles the maybe generated by the user inside the glove box. The latter filter ensures optimal particle free incoming gas.

14. 2 Technical data

The filter that is commonly used within the **MBRAUN** Glove Box system has the following characteristics:-
The standard filter is of a HEPA format (class H13) - i.e. filtering 99.999% of particles – typically down to 0.3 microns

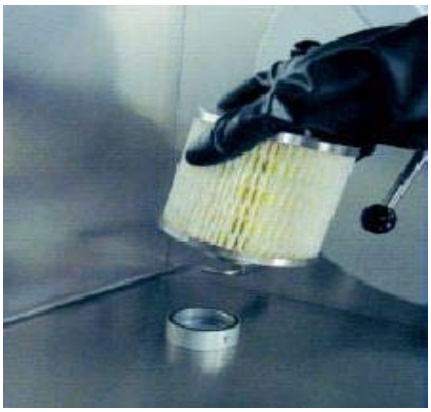
MBRAUN can also supply finer filters (e.g. Class U15 – Filtering 99.99995% of particles), filters charged with Activated Carbon (for absorbing certain

14. 3 Exchanging dust filters

Depending on the usage of the glove box system, the filters need to be exchanged at least once a year.

14. 3. 1 Method for exchanging the filter

Dia. 1



►Unscrew used dust filter.

► Screw new dust filter in place.

Note:
Depending upon the substances used inside the glove box, the replaced filter may need to be treated with care outside of the glove box atmosphere.
Please refer to all local Environmental, Safety and Health guidelines that may apply for the type of substances used within the glove box.

Chapter15

15. 1 Generation information

15. 2 Technical data

15. 3 Replacing gloves

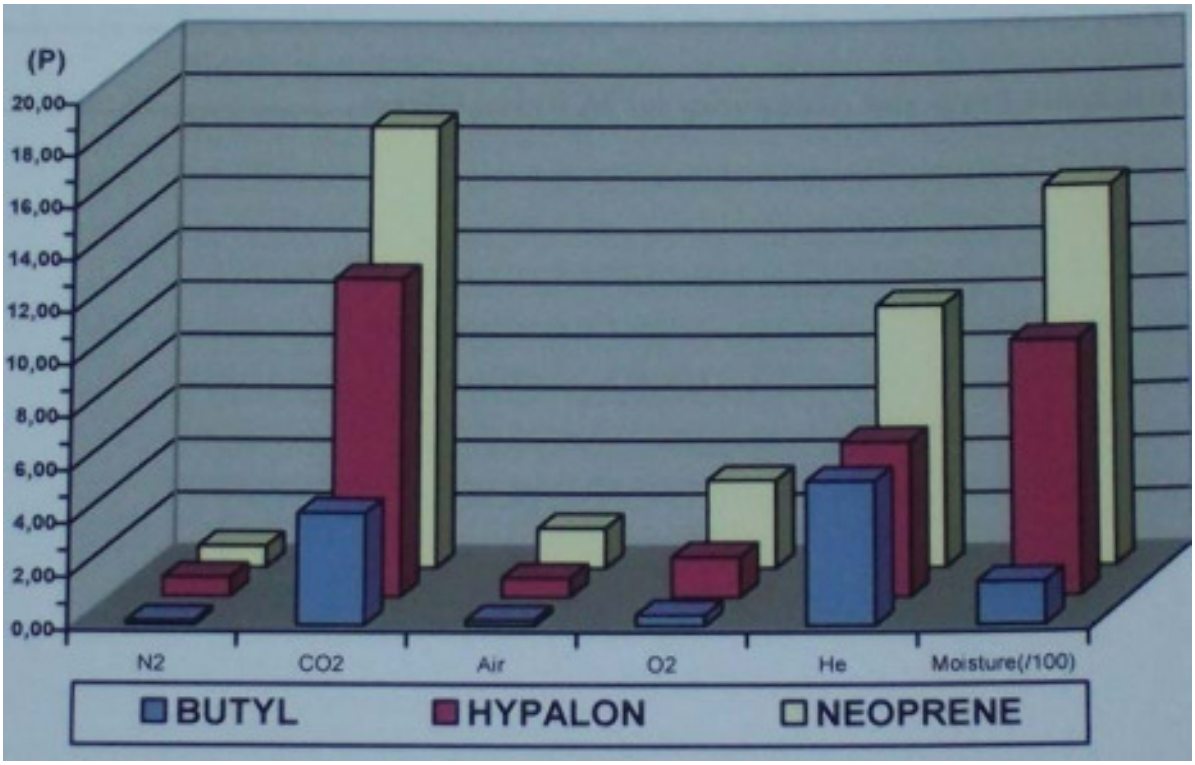
15. 4 Glove port covers

15. 5 Standard Spare Parts and Accessories for MBRAUN Gloves

15. 1 General informations

MBRAUN exclusively uses gloves made of butyl. A feature of this flexible material is the good comfortable grip even at low temperatures (Temperature range from -40 °C to +90 °C). The following graphic chart shows, that butyl compared to hypalon and neoprene evidently has the most favourable values regarding the permeability for different gases and for water vapour.

Note:
For working with higher temperatures, MBRAUN also offers gloves made of butyl with a hypalon layer.



Permeability Constant (P) = gas flow through a material of 1cm thickness at a standard pressure and temperature.
It is measured at a rate of 10-9 *cm*3*gas/s*

15. 2 Technical data

Product: ..... MB Gloves.

Type: ..... Special gloves made of broom-butyl for Glove Box Systems.

Design: ..... Various diameters, sizes and shapes.

15．3 Replacing gloves

Note：
MBRAUN recommends that the gloves be replaced at regular intervals. The gloves must be changed upon signs of wear and tear that may or have caused Before changing gloves ensure that, the glove box is atmosphere is safe to breathe. If necessary, purge and fill the glove box with ambient air before attempting to change gloves

The Gloves are secured by two O-rings.

To remove the gloves remove the O-rings and removes the glove as shown

To replace the glove -
place the glove over the port so that the rim of the glove locates in the port's innermost groove
(the outer 2 grooves are for locating the O-rings that secure the glove).

Note：

Ensure that the correct type of glove

Check that the glove is orientated correctly
and replace with new O-rings.

Notice

After the changing of gloves, the glove box atmosphere will require purging to remove any undesired oxygen and/or moisture. (see chapter on Purging the System)

15．4 Glove port covers

Glove Port Covers

MBRAUN glove port covers are available as an option. The glove port covers are for

standard round glove ports and are available for either interior or exterior fitting.
The inner-glove port covers allow for the changing of gloves whilst preventing the influx of the outer-atmosphere into the glove box.
The outer-glove port prevents un-required gloves from being an obstruction when operating the box above atmospheric pressure.
Glove port covers can be ordered from MBRAUN Service Department

Glove port cover

15.5 Standard Spare Parts and Accessories for MBRAUN Gloves

Table 8.5: Spares and Accessories for MBRAUN Gloves

Nr.	Bestell-nummer	Beschreibung	Description
1	2405004	Manometer	Manometer
2	2400171	O-Ring für Minischleusendeckel	O-ring for cover of mini antechamber
3	7003367	Minischleusendeckel (innen und außen)	Inner and outer antechamber door
4	2200480	3-Wege-Kugelhahn – 10mm MS	3-Way ball valve – 10 mm BS
5a	7003702	Gewindebuchse	Door shock spacer
5	3240327	Gasdruckfeder	Gaspiston for antechamber
6	7003674	Schleusendeckel	Antechamber door
7a	9005225	Schleusendeckel komplett (rechts)	Antechamber door complete right
7b	9005226	Schleusendeckel komplett (links)	Antechamber door complete right
8	7040131	Schaltkreuz komplett	Antechamber door handle, complete
9	2400176	O-Ring für Schleusendeckel	O-ring for antechamber door
10a	6000034	Schleusenbalken / Türhalter (rechts)	Door arm complete (right)
10b	6000035	Schleusenbalken Türhalter	Door arm complete (left)
11	3240521	2-Wege-Kugelhahn 3/8“	2-way ball valve 3/8“
12	9004501	Handventil (DN40 VA)	Hand valve (DN40KF SS)

Other gloves, as well as O-Rings, are available by request from **MBRAUN** Service Department.

Chapter16

16. 1 Components of Third-Party Manufacturers

16. 2 Regular Maintenance and Service

16. 3 Quarterly and Annual Maintenance and Service

16. 1 Components of Third-Party Manufacturers

MBRAUN Glove Box systems are partly equipped with third-party manufacturers' components such as:

- Vacuum pump(s)
- Compressor(s) for the system's compressor cooling
- Compressor(s) for refrigerator systems
- PLC control components (Siemens)
- TOUCH Screen Operation Panel (Siemens)

The original third-party manufacturers' documents, in which the maintenance and service of the components are described, are included in the systems delivery.

16. 2 Regular Maintenance and Service

Main glove box and window	Clean the exterior using conventional detergents (do not use caustic detergents); for this purpose use a soft, lint free cloth; or a vacuum cleaner if available, using a brush attachment.

Note: If the box is equipped with an MBRAUN Clean-Jet unit then the interior of the box and window may also be vacuumed with a brush attachment.

Gloves	Check the gloves for damage; in addition, use linen gloves to avoid humidity in the box gloves.

Caution :Do not use powder within the box or within a clean room environment.
Replace gloves when damaged
- by no means attempt to repair gloves.

Antechambers	Check antechamber seals for damage. If the antechamber doors are difficult to open or to close, grease or lubricate threads lightly.

Caution: Some areas of the system must be left without grease or lubrication. In this case, grease or lubricants should not be used.

Connections leak free.	Check connections for firm seat and are
Components	Observe the maintenance instructions of the optional equipment components, such as analyser and refrigerator. Observe the third-party manufacturers' maintenance instructions.

16. 3 Quarterly and Annual Maintenance and Service

Type of System	Quarterly	Annuall
Glove Box	• Check the Omega sealing for the windows • Check the gloves and glove ports • Check the magnetic valves • Complete leakage test • Function test	• Check and if necessary replace the sealing for the windows • Check the Omega sealing of the windows • Check the gloves and glove ports • Check the illuminating equipment • Check and if necessary replace the dust filters • Check and if necessary replace the magnetic valves
Gas Purification System	• Check the magnetic valves • Check the blower • Check the vacuum pump • Complete leakage test • Function Test	• Check the vacuum pump • Check and if necessary replace the circulation blower • Check and if necessary replace the filter medium • Dismantle pipe-work and clean it. Replace all Viton seals • Check and if necessary replace the valve seals • Check the cooling system • Check the cooling fluid
Analyzers	• Check the sensors • Check the flow rate meter • Complete leakage test	• Check and if necessary replace sensors • Check the vacuum pump • Leak test piping • Complete leakage test • Check calibration

Chapter17

17．1 General information

17．2 Warning and alarm message

17．3 Explain of the fault message

17.1 General information

On the Oxygen value display，there will immediately be an alarm whenever the system has a fault.

17.2 Warning and alarm message

System warning or alarm information will appears in the O2 display every 2 seconds.

17.3 Explain of the fault message

POS	Fault cord	explanation	Cause
1	E1	Moisture lever exceed the limit	
2	E2	Moisture sensor failure	
3	E3	Oxygen lever exceed the limit	
4	E4	Oxygen sensor failure	
5	E5	Box upper pressure exceed limit	
6	E6	Box under pressure exceed limit	
7	E7	Box pressure sensor failure	
8	E8	VPG\Lighting\EH Breaker active	
9	E9	VHE \VHA valve not open during circulation	
10	E10	VHE \VHA valve not open during regeneraiton	
11	E14	Box pressure reduce too fast	
12	E15	Box pressure increase too fast	
13	E16	Power supply not connected	

Solutions:

Alarm E1：First step check if the circulation works, to make sure it is Homogeneous atmosphere inside glovebox. Second step is to rise up the box pressure to 10mbar, to check if there is a leak of the glovebox. The third step is to do regeneration to the column, if the moisture still high after regeneration , and still the warning E1 comes, please contact service department of MBRAUN .

Alarm E2：When warning E2 comes, please contact service department of MBRAUN .

Alarm E3：First step check if the circulation works, to make sure it is Homogeneous atmosphere inside glovebox. Second step is to rise up the box pressure to 10mbar ,to check if there is a leak of the glovebox. The third step is to do

regeneration to the column, if the moisture still high after regeneration , and still the warning E1 comes, please contact service department of MBRAUN .

Alarm E4：When warning E2 appears, please contact service department of MBRAUN .

Alarm E5：First step check the VPG if it's working . Second step check the VV valve if it works Or shut down the system , contact service department of MBRAUN .

Alarm E6：Check the gas supply if there is enough gas in bottle. If there is no problem of gas supply , shut down the system , contact service department of MBRAUN

Alarm E7：When warning E7 appears, please contact service department of MBRAUN .

Alarm E8：Check if there is oil leak of the VPG, If the oil level is normal , please contact service department of MBRAUN .

Alarm E9：Check if the hand valve of the RKM column opened completely. If it's completely opened , contact service department of MBRAUN .

Alarm E10：Check if the hand valve of the RKM column opened completely. If it's completely opened, contact service department of MBRAUN .

Alarm E14：Check if the operator ware the glove and enter the glovebox too fast, this will cause the box pressure rising up fast , and result to the warning . If normal operation still comes out this alarm, please contact service department of MBRAUN .

Alarm E15：Check if the operator ware the glove and enter the glovebox too fast, this will cause the box pressure rising up fast , and result to the warning . If normal operation still comes out this alarm, pl**ease contact service department of MBRAUN .**

Alarm E16：When warning E2 comes, please contact service department of MBRAUN .

Chapter18

18.1 Common spare parts

18.1 Common spare parts list

Power feedthrough:1500439

Liquid feedthrough:**C910003/4**

BNC connector:**9005181**

150mm Rotary cover:**9002012**

Inner Gloveport cover:**9002371**

Solvent filter：**9004451**

Charcoal ：**2604519**

Copper catalyst：**2600839**

Dust filter:**9004513**

Flow meter:**3240052**

Electromagnetic valve：**4600977**

Glove port：**7067141/7067142**

220mm gloves：**3000047**

Static remover：**1500522**

Molecular sieve：3240262

Butterfly valve：**9004501**

Clamps

KF40 clamp **3200055**

KF25 clamp **C300002**

Vacuum pump：**470013**

Filter core for solvent filter

Moisture sensor：**1500685**

Oxygen sensor：1500686

40mm blind：**C570002**

Centering O ring 2400309

O ring for Gloveport 239X7 2603048

250X4 2400138

O ring for chamber：280X4 2400273