Operation Manual Index

For Project 4052C

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Contents

1.1. General Information

This technical documentation is not liable to any obligations on the part of the manufacturer. The manufacturer **MBRAUN GmbH** 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: ..... Operating Instructions for **MBRAUN** – Systems with TOUCH Screen Operation Panel (TP270)
Edition: ..... 2003 / See Title Page for System Type

1.2. Entries Referring to the System

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.

1.3. General Safety Notice

MBRAUN inert gas boxes are operated with inert gas, in order to ensure that the Glovebox interior chamber is able to handle substances that are sensitive to oxygen and/or moisture. If the customer works with substances injurious to health, inside one the box, then the responsibility for all relevant safety regulations in respect to handling these substances need to be considered by the customer. This also applies to the disposal of all components, which come in contact with the gas flow; the box output filter as well as the further filtering mediums and the pump oil.

If strongly poisonous or radioactive substances are to be used inside the Glovebox, then certain requirements to the overall system need to be considered. These are not contained in standard systems and must be co-ordinated before acquisition of a system with **MBRAUN**.

Note:
Furthermore the following general safety reference must be considered:

Danger of asphyxiation when working with high inert gas concentrations.

Therefore the following advice is given:

Notes:

- The selected location should have a "room" volume that is significantly larger than the Glovebox interior volume.
- The location should as far as possible be ventilated, especially during a purging procedure or when opening an existing installed Glovebox.
- Before opening an installed Glovebox at least one glove should always be removed first. This is to allow a slow equalisation of the Glovebox interior atmosphere with the ambient room air.
- Before execution of service work in the Glovebox interior the operator must ensure that the interior Glovebox atmosphere is completely replaced with ambient room air.

If it is not possible to adhere to all the above recommendations the customer must report this to **MBRAUN** before acquisition of the system, since it is possible to equip the system with additional safety devices.

On request **MBRAUN** can recommend a personal measuring instrument which alerts the operator to a reduction of oxygen content in the ambient air.

1.4. Addresses

Important service addresses:

MBRAUN GmbH
Dieselstraße 31
85748 Garching
Germany

Telephone: +44 (0)89 32669-230
Fax: +44 (0)89 32669-235

E-Mail: service@mbraun.de
Internet: www.mbraun.com

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Contents

Chapter 2 Transport / Site Selection / Modification

2.1. Transport of a System

The preparations for transporting a MBRAUN System should be carried out by a MBRAUN technician only.

The transport of the system should be done by a forwarding agency specialized solely for this purpose.

If the system is part of another system line, the instructions of this system line are also valid.

2.2. Site Selection for a System

Selecting the site for a MBRAUN System of the series should be carried out by MBRAUN technicians only.

If the system is part of a system unit in addition the instructions of the unit are also valid.

Prerequisites:

Room:	Room temperature +15 °C to +30 °C, dry and well ventilated.
Surface conditions:	Firmly structured floor, no oblique position.
Clearance:	Minimum clearance from the walls is 600 mm plus sufficient access and working space where glove ports, antechambers etc. require access.

2.3. Modification of a System

In principle changes and modifications of any kind on **MBRAUN** Glove-Systems of the series should be made by **MBRAUN** technicians only.

For exceptions of any kind a written confirmation is required.

Any unauthorised change or modification to the system will cause all claims under warranty and those to liability to expire.

If the system is part of another system line, the instructions of this system line are also valid.

Contents

3.1. General Information

The accessories described in this chapter are required for connecting the system. They are not included in the system's delivery package.

3.2. Working Gases

3.2.1. Working Gas

Use	Building up and maintaining the ultra pure gas atmosphere and pressure gas for electropneumatic valves.
*Gas type**	Nitrogen, Argon or Helium.
Purity	Medium Purity (4.8 or better); from bottles or other gas supplies.
Quantity	Permanent supply for the system's operation (e.g. for pressure compensation.)

3.2.2. Regeneration Gas

Use	Reprocessing saturated H_2O/O_2 purifier columns.
*Gas type**	Depending on the type of application: Nitrogen/Hydrogen mixture (90-95% N_2 with 5-10% H_2- portion) when Nitrogen is used as the working gas or Argon/Hydrogen mixture (90-95% Ar_2 with 5-10% H_2- portion) when Argon is used as the working gas or Helium/Hydrogen mixture (90-95% He with 5-10% H_2- portion) when Helium is used as the working gas.
Purity	Medium Purity (4.8 or better); from bottles or other gas supplies.
Quantity	Approx. 3,500 Litres for each Regeneration.

3.2.3. Purge Gas

Use	Getting the system filled up and purged with working gas (when commissioning for the first time and after servicing or repairs of the system.)
*Gas type**	Working gas (nitrogen, argon or helium.)
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.

Note:
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.

3.3. Equipment for Connections

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.

3.3.1. Equipment for Working Gas Connections

Pressure Reducing Valve for Working Gas

Use	working gas pressure control system.
Material	200 bar primary, 5.5-6.0 bar secondary, with a flow rate of 200 l/min
Connection type	Ø 9 mm hose or Ø 10 mm Swagelok® fitting.

Supply Piping for Working Gas

Use	Connecting the working gas source with the "Working Gas INLET" system connection.
Material	Optional (length as required): either: Ø 9 mm reinforced hose, 3 mm wall thickness and adapter, Ø 9 mm hose nozzle with Ø 10 mm Swagelok® fitting or: Ø 10 mm copper pipe and Ø 10 mm Swagelok® fitting or: Ø 10 mm stainless steel pipe and Ø 10 mm Swagelok® fitting.
Connection type	Ø 9 mm hose nozzle or Ø 10 mm Swagelok® fitting.

3.3.2. 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 mbar.
This is available from MBRAUN – Part No. 2411006.

Pressure Reducing Valve for Regeneration Gas

Use	Regeneration pressure control system.
Material	200 bar primary, 0.3-0.4 bar secondary, with a flow rate of 20 l/min
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 INLET" system connection.
Material	Optional (length as required): either: Ø 9 mm reinforced hose, 3 mm wall thickness and adapter, Ø 9 mm hose nozzle with Ø 10 mm Swagelok® fitting or: Ø 10 mm copper pipe and Ø 10 mm Swagelok® fitting or: Ø 10 mm stainless steel pipe and Ø 10 mm Swagelok® fitting.
Connection type	Ø 9 mm hose nozzle or Ø 10 mm Swagelok® fitting.

Exhaust Outlet for Waste Regeneration Gas

Use	Connecting the "Regeneration Gas OUTLET" system connection with the customer's disposal facility (exhaust outlet).
Material	Optional (length as required): either: Ø 9 mm reinforced hose, 3 mm wall thickness and adapter, Ø 9 mm hose nozzle with Ø 10 mm Swagelok® fitting or: Ø 10 mm copper pipe and Ø 10 mm Swagelok® fitting or: Ø 10 mm stainless steel pipe and Ø 10 mm Swagelok® fitting.
Connection type	Ø 9 mm hose nozzle or Ø 10 mm Swagelok® fitting.

3.3.3. Equipment for Purge Gas

Pressure Reducing Valve for Purge Gas
Required only for the "manual purging" method.
When using the optional "**MBRAUN** QuickPurge" purging method no preparations are required, in this case the working gas connection is used.

Use	Pressure control of the purge gas when manual purging is applied.
Material	200 bar primary, 5-6 bar secondary, with a flow rate of 200 l/min
Connection type	Ø 9 mm hose or Ø 10 mm Swagelok® fitting.

Supply Piping for Purge Gas
Required only for the "manual purging" method.
When using the optional "**MBRAUN** QuickPurge" purging method no preparations are required, in this case the working gas connection is used.

Use	Connecting the purge gas source to the purge hose.
Material	Ø 9 mm reinforced hose, 3 mm wall thickness length as required.

3.3.4. Equipment for Vacuum Pumps

Disposal Piping for Vacuum Pump Waste Gas

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): either: Ø 16 mm reinforced hose and Ø 16 mm hose nozzle or: Ø 16 mm copper pipe as well as flange and clamp or: Ø 16 mm stainless steel pipe as well as flange and clamp.

3.3.5. Equipment for the Water Cooling

Not applicable for systems with no cooling or equipped with compressor cooling.

Cooling Water

Use	System cooling	
Material	**Mains water**	
	Temperature:	18 °C – 25 °C (* must be above condensation point)
	Flow rate:	30 l/min at 18 °C
	Inlet pressure:	2.0 bar max.
	Outlet pressure:	Depressurised (max 0.5 mbar)
	Conductivity (@ 25°C)	0.3 – 10 mS/cm
	[resisitvity (@ 25°C)]	[3 – 0.1 MΩ*cm]
	pH	7 - 8
	Particulate contamination	filtered to a particle size (diameter) of ≤ 30 µm
	Micro-biologicals (algae. bacteria, fungi)	none
	Total dissolved solids	≤ 50 ppm

Supply Piping for Water Cooling (supply and drain piping)

Material	Optional (length as required):	
	either:	Ø 9 mm reinforced hose, 3 mm wall thickness and adapter, Ø 9 mm hose nozzle with Ø 10 mm Swagelok® fitting
	or:	Ø 10 mm copper pipe and Ø 10 mm Swagelok® fitting
	or:	Ø 10 mm stainless steel pipe and Ø 10 mm Swagelok® fitting.

3.3.6. Power Connection

For systems, equipped with a MB200, a HT3 oven and a pump fill station with plasma burner the power connection must meet the criteria below:

50 kW @ 400 V 50/60 Hz.

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Contents

4.1. Safety Instructions

It is recommended that only a competent MBRAUN technician complete the initial system installation.

Caution:
Risk of accident whilst handling gases. Connection of systems should only be carried out by competent and experienced personnel.

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!
(e-mail: service@mbraun.de)

4.2. Connecting the System

4.2.1. Connecting the Working Gas

1. Connect the pressure-reducing valve to the working gas source.
   Follow the manufacturer's given instructions for its connection.
2. Make a supply line between the working gas source and the "Working Gas - INLET" system connection.
   Follow "Preparing the connections" chapter.
3. The "Working gas INLET" system connection is labelled with the exact value for the supply pressure.
   Set pressure reducing valve to this value and open valve.

Caution:
Exact pressure setting required.
Overpressure will damage the system - low pressure will cause malfunction.

4.2.2. Connecting the Regeneration Gas

1. Connect the pressure reducing valve to the regeneration gas source.
   Follow the manufacturer's given instructions for its connection
2. Connect the working gas source with the "Regeneration Gas INLET" system connection using the supply pipe.
   Follow Chapter "Preparing the Connections"
3. The "Regeneration Gas INLET" system connection is labelled with the exact value for the supply pressure.
   Set pressure reducing valve to this value and open valve.

Caution:
Exact pressure setting required.
Overpressure will damage the system - low pressure will cause malfunction.

4.2.3. Connecting the Disposal Piping for Used Regeneration Gas

1. Connect the disposal piping between the "Regeneration gas OUTLET" system connection and the customer's disposal facility (exhaust).
2. Connection must be depressurised.

Caution:
A foul bad smell is to be expected, as soon as any spent regeneration gas escapes to the surroundings. Neither environmental pollution nor effects detrimental to health are known. However, these cannot be excluded. The manufacturer does not assume any liability.
When using toxic or radioactive material, there should be no discharge of the gas to surroundings.

4.2.4. Connecting the Disposal Piping for Vacuum Waste Gases

1. 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.
2. Connection must be depressurised.

Note:
Depending on the place where the vacuum pump is used an oil mist filter can be used instead of the disposal piping. Important information and supply details may be obtained from: service@mbraun.de

4.2.5. Connecting the Cooling Water

Not required in systems without cooling or fitted with compressor cooling.

1. Connect the "Cooling water INLET" system connection to the cooling water source.
   Follow "Preparing the Connections" chapter.
2. Connect the "Cooling water OUTLET" system connection to the depressurized water disposal.
   Follow "Preparing the Connections" chapter.
3. Turn on the cooling water. The cooling water flow rate setting depends on the available water temperature, see "Preparing the Connections " chapter.

4.2.6. Electric 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 should be taken from the type plate.

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Contents

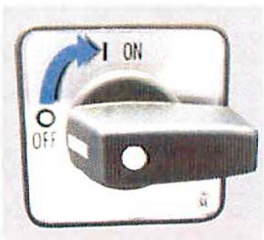
Table of Figures

5.1. Prerequisites

- ☑ All previous chapters observed
- ☑ Working gas connection properly made
- ☑ Regeneration gas connection properly made
- ☑ Exhaust facility for waste regeneration gas properly made
- ☑ Purge gas connection properly made
- ☑ Exhaust facility for vacuum pump waste gas properly made
- ☑ Cooling water connection properly made, if required
- ☑ Power connection properly made
- ☑ All piping and connections checked for its condition and firm mounting.

5.2. Activating the System

Figure 1: Main Switch



The main switch is located at the system's electrical cabinet.

Activating the system:
Turn the main switch from the "**O** OFF" to position "**I** ON".

5.3. Start Messages

MBRAUN-Systems provided with the ***TOUCH*** Panel in the standard design have the panel located in a clearly visible central position.

After being activated, the system runs a self-test

Figure 2: Touch Panel

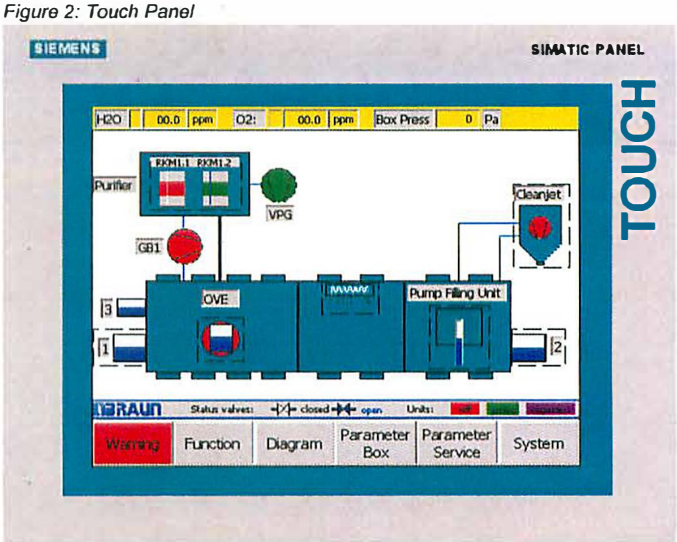
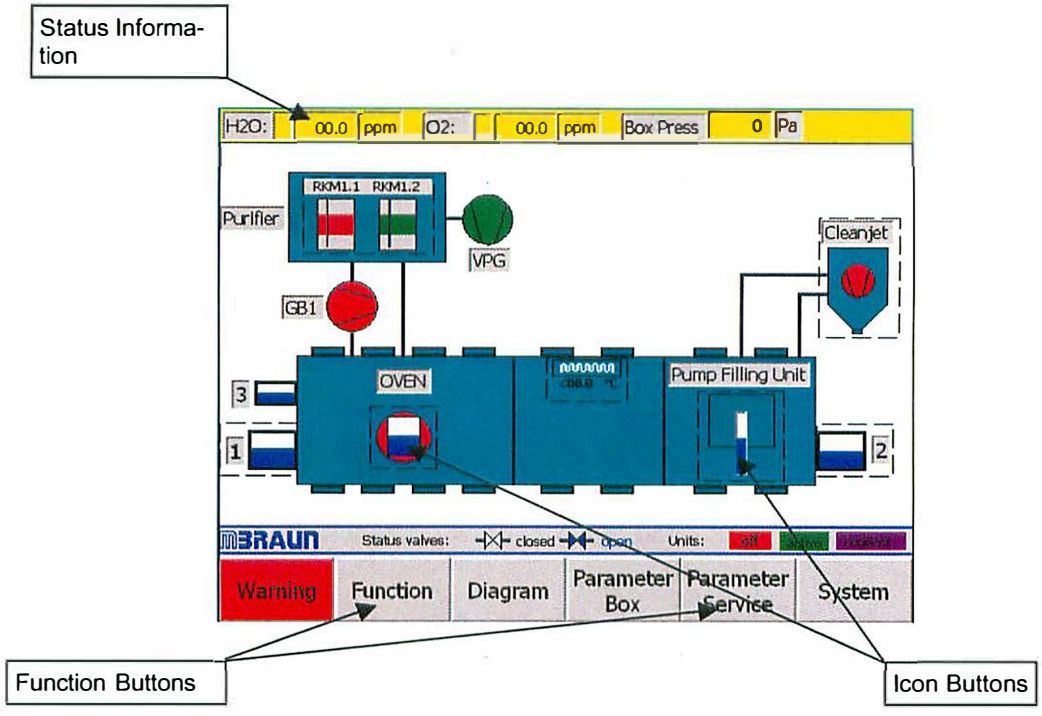


Figure 3: Start Screen



The Diagram above shows a typical "Start Screen". The various icons will change depending on the system chosen.
The system above would have the following:

- Antechamber controls
- Clean-Jet
- Pump filling unit
- Oven

The Touch Screen consists of a pictorial representation of the System.

The Functions are controlled by means of "Function Buttons" or "Icon Buttons".

Upon start-up, the Start Screen is displayed. The Start Screen displays an overview of the Cleanjet status in an information field.

5.4. Deactivating the System

The system should not be deactivated until all running procedures, such as circulation and regeneration have been completed and deactivated.

Caution
Do not deactivate the system with procedures running (circulation, regeneration.)

The main switch is located on the system's wiring cabinet, see subsection "Activating the system".

Deactivating the system:
Turn main switch from "**I** ON" Position to "**0** OFF".

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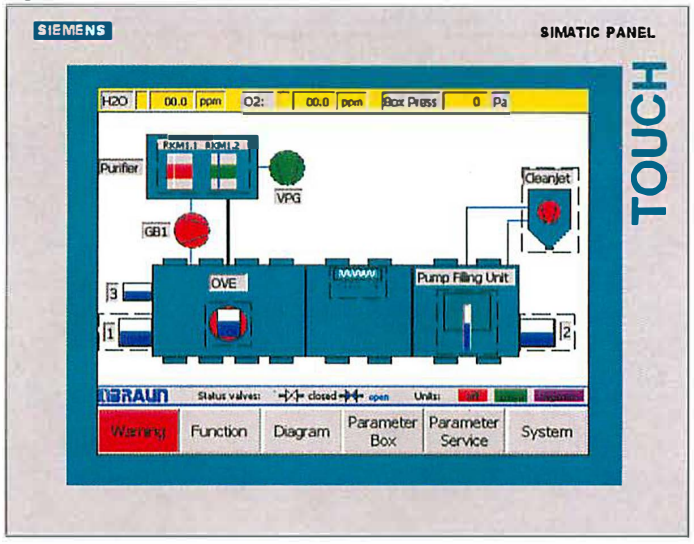
Contents

Table of Figures

6.1. Overview

The *TOUCH* Panel is the system's central operation and display unit. This unit is located at a clear and well accessible position.

Figure 1: Touch Panel



6.2. Display

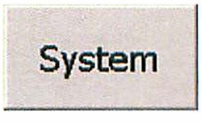
The Touch Screen consists of a pictorial representation of the System.

6.3. Function Buttons

The Functions can be controlled by means of "Function Buttons" or "Icon Buttons".

The Function Buttons are labelled with an appropriate description for its function.
As shown below:

Function - this button will open the Functions screen.



System – this button will open the system settings screen.

6.3.1. Status of Function

The TOUCH panel also allows for the Function status to be displayed. This feedback is relayed to the user by varying the colour of the Function Button as below:

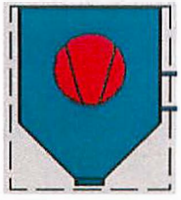
RED Not Active

GREEN Active

GREY Function not available (Function Locked)

6.4. Icon buttons

The Icon Buttons are a pictorial representation of the item that it controls.



Clean-Jet

Pump Filling Unit

6.5. Navigation Buttons

The *TOUCH* panel utilises the same colours and labels for navigation from screen to screen throughout. The buttons and their function are as below:

NEXT – If this button is displayed within a screen then there are more screens to follow. Selecting this button will present you with a new screen of options within the function series.

BACK – This button will always take you to the previous screen in the function series. The last step backwards will return you to the Start Screen.

END – This button will always return you to the Start Screen.

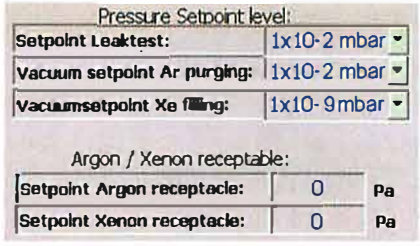
Alarm – This button will always open the Alarm/Error Message Screen. If the Alarm button is flashing then there is a message that needs to be acknowledged on the Alarm/Error Message Screen.

6.6. Input Fields and Buttons

All input fields are shown with blue text on a light grey background.

For entering Passwords, setting the system parameters or alarms, or selecting certain options the TOUCH panel utilises Input field as shown below.

Figure 2: Input Fields



There are three types of Input field.

The first type, shown in figure 2, has a pull-down menu. If the screen area for this field is touched in the input area then an options menu will be displayed. The required option is selected by touching the screen. The entry is confirmed by the pull-down menu being removed from the display, and the required selection being displayed in the input field. E.g. "yes" or "no" appears in the input field.

The second type, shown in figure 2, is an alpha/numeric input field. If the screen is touched in the input area then an alpha/numeric pad will be displayed, see Figure 3. Entry of the required data is made buy pressing each button and then must be confirmed by selecting the "Enter Button". On confirmation that the data is correct the keypad is removed from the display and the up-dated value is entered into the input field.

Figure 3: Keypads

Enter Button

The third type of input field takes the form of a pull-down menu. This is selected by touching the arrow to the right of the input field and selecting the required value. In fields when there are multiple options it may be required to scroll up or down to the desired input value.

Contents

Table of Figures

7.1. General Information

Glove-Box systems either newly installed or opened for reasons of service contain ambient air. The prerequisite for the gas purification is a pure gas atmosphere of nitrogen, argon or helium within the box. Thus, at the beginning of the system's commissioning the ambient air should be replaced by nitrogen, argon or helium of medium purity.

Displacing the ambient air from the system is called purging. Working gas is used as purging gas.

7.2. When is Purging Necessary?

On principle, a system should be purged, when the O_2 portion in the box atmosphere exceeds 100ppm.

The reasons for too high oxygen values are as follows:

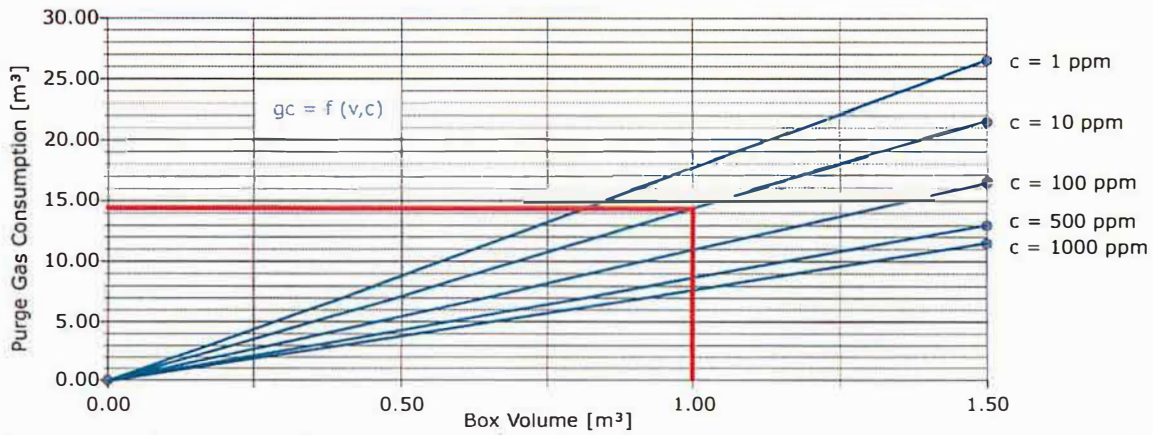
- first commissioning of a system
- servicing
- air influx due to faulty operation
- air influx due to damage (leaks)

Caution:
A Glove-Box system should be purged using working gas until the O_2 portion within the box atmosphere has decreased to a value of <100 ppm. Operating the system with higher oxygen value may result in damaging the gas purification system.

7.3. Purge Gas

Working gas is used for purging the system;
Nitrogen, argon or helium - medium purity - from bottles or any gas supply facilities.

Figure 1: Example of Purge Gas consumption



In the example, it shows that if a purity of 10 ppm is required, then about 14.50m³ of purge gas is required for 1 m³ box volume.

7.4. Manual Purging

Caution:
Annoyance by bad smell is expected as soon as any spend purge gas escapes to the surroundings. However, environmental pollution and effects detrimental to health are not known, but cannot be excluded. The manufacturer does not assume any liability.
When using toxic or radioactive material manual a special purging facility is required .

7.4.1. Prerequisites:

☑	Having observed all previous chapters.
☑	All connections have been properly made.
☑	The system functions "Circulation" and " Regeneration" are **not** activated
☑	All antechamber doors are closed.
☑	The connections for manual purging have been made, refer to chapter "Preparations for connections".
☑	Sufficient working gas (i.e. purge gas) is available. Required quantity approx. 10 – 12 m^3/m^3 box volume.

7.4.2. Purging Procedure:

(See figure 2)

- Set-up purge gas source (working gas) with pressure reducing valve.
- Connect reinforced hose to purge gas source.
- Open "blind flange" on Glove-Box.
- Feed one end of the reinforced hose through the open flange into the glove.
- Set the pressure reducing valve on the purge gas source between 3-5 bar and open valve.
- Using the gloves, take hold of the reinforced hose and purge the box interior from top to bottom using a circular motion. Carefully purge corners, edges and box fittings.
- Systems equipped with freezers, or have areas that may be protected by covers, will need to be open during the purging process (ensure that freezers are switched off and at room temperature.)
- Air and excess purge gas escapes through the flange opening.
- Purge until the box O_2 value has reached <100 ppm.

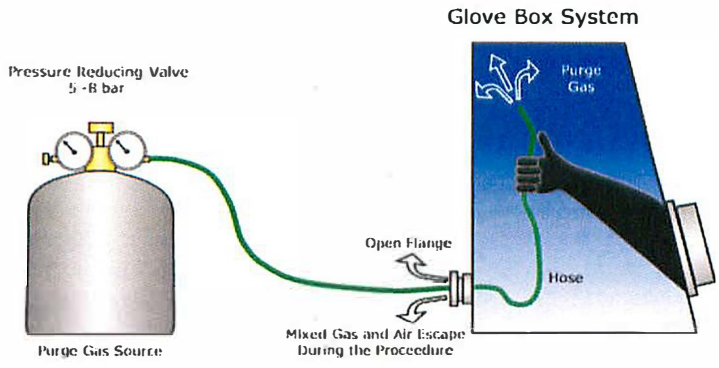
To reach this value it may require between 10 - 12 m^3/m^3 box volume of purge gas

With systems that have analysers the actual O_2-value can be precisely controlled. It is recommended that the O_2 analysers are switched on for a short time to allow a reading to be taken during the purge process. The measurement may settle at a higher H_2O/O_2-concentration.

After reaching an O_2-value of <100 ppm the reinforced hose may be removed from the box and the flange **immediately** closed.

- Turn off purge gas flow.
-

Figure 2: Manual Purging Procedure



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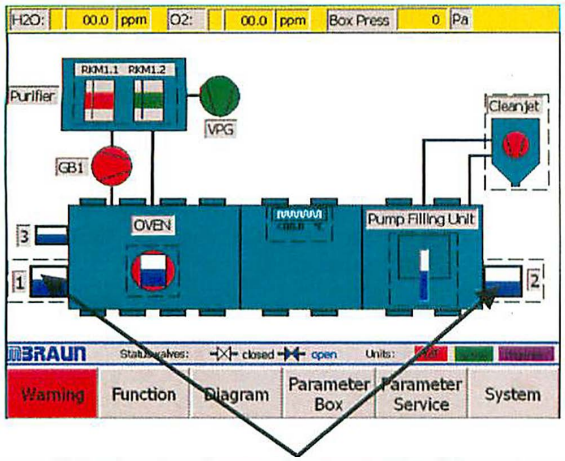
Contents

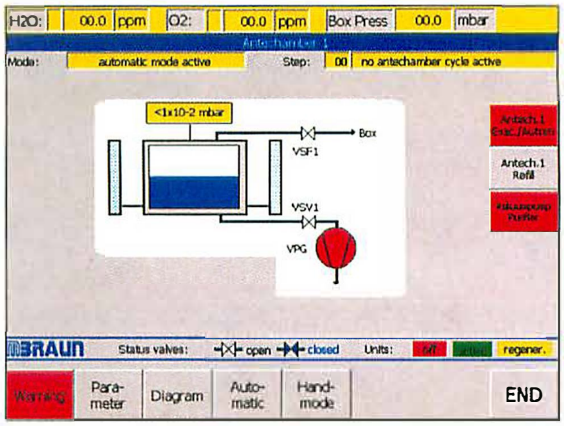
Table of Figures

8.1. General Information

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



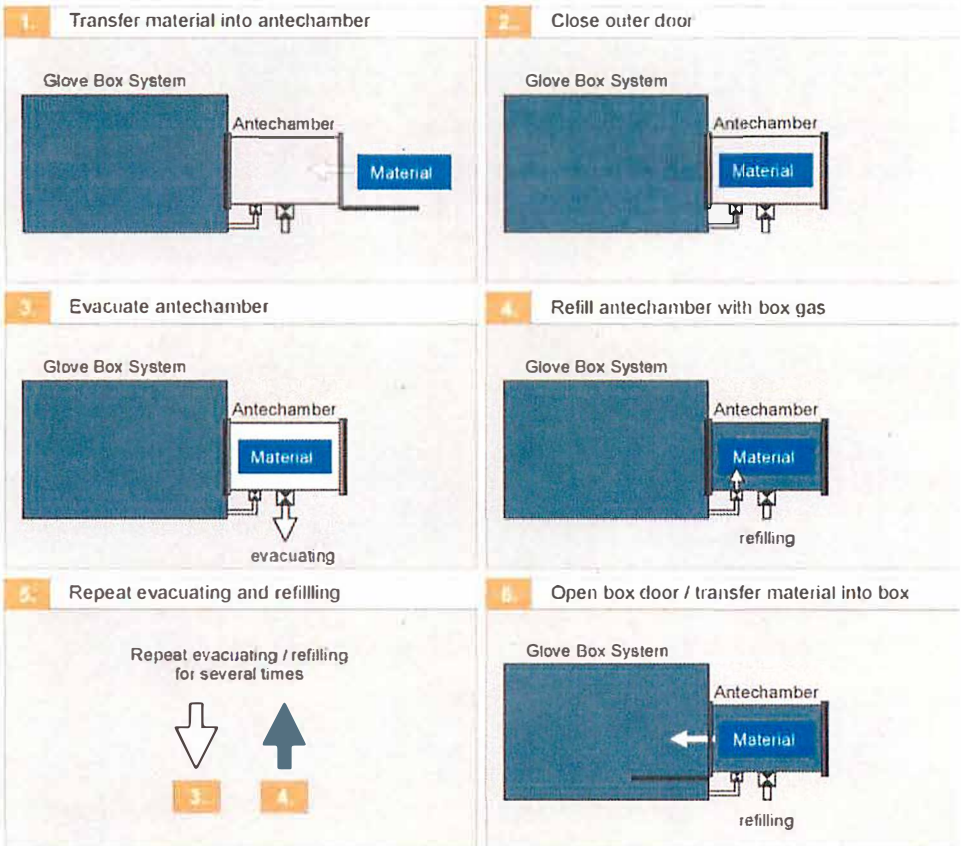
Antechamber Icons shown on Start Screen



Antechamber Screen

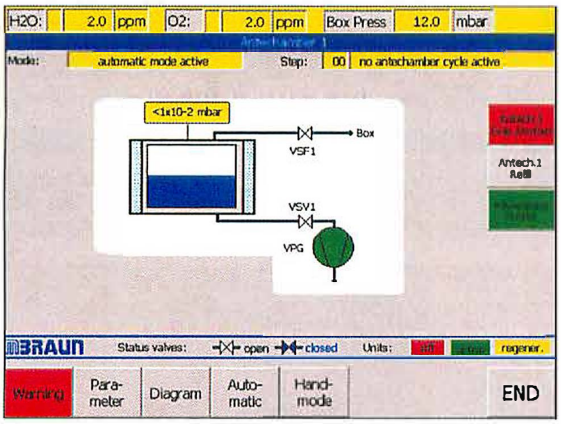
8.2. Principle

Figure 1: Principle of Antechamber Operation

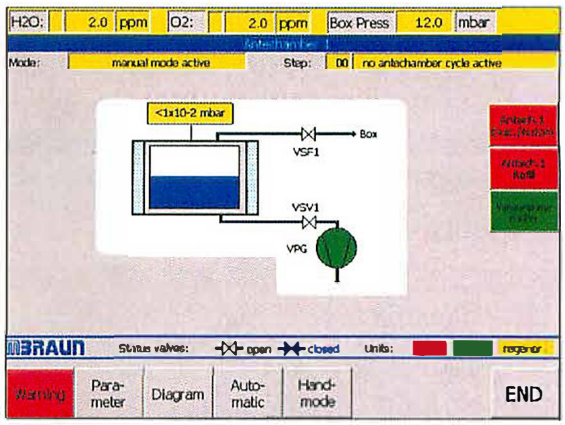


8.3. Overview

Figure 2: Antechamber Control Screens



Antechamber in Automatic Mode



Antechamber in Handmode

8.3.1. Handmode (Standard) Antechamber Operation

Handmode operation means that the functions of "Antechamber Evacuation" and "Antechamber Refilling" should be started and completed manually.

8.3.2. Automatic Antechamber Control

The automatic antechamber control is a control software option. With this program available the evacuating/refilling cycles are automatically executed and controlled.

Recommendation:
MBRAUN recommends the use of Automatic Antechamber Operation, if available

8.4. Push Button Operation

Located near to the antechamber door are two push buttons. These buttons act as repeater button/indicators for the same functions (***Evac/Autom*** and ***Refill***) in the antechamber Screen.

The indication of the function status is shown in the following manner:

Function Status	Button Colour (in touch panel)	Button Status (near antechamber door)
Active (On)	Green	Illumined
Deactivated (Off)	Red	Flashing
Not Available (Blocked)	Grey	Not illuminated (Black)

8.5. Important Notes

The pressure within the antechamber may be given by:

- A manometer mounted onto the antechamber, and/or
- A pressure reading being displayed within the antechamber screen (Yellow box above antechamber Icon)

Caution:
Never open box and outer antechamber doors simultaneously.
An evacuated antechamber cannot be opened.
Attempting to open an evacuated antechamber may damage the door locking mechanism. Never open a box 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. Mechanical parts and seals should be checked regularly and protected against any contamination.
When handling gases always keep to the national and international guidelines.

Recommendation:
If the system is equipped with a separate 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.

8.6. Transferring Material into the Box

Note:
Applies to systems without optional automatic antechamber control.

8.6.1. Preparation

- Observe Item "Important Notes" in this chapter.
- The antechamber door located inside the box is closed.
- The outer antechamber door is open.
- 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.

Caution:
If you transfer material with enclosed gaseous volume into the box the material should be able to withstand the pressure difference during the antechamber purge process (evacuation and refilling cycles).
If possible open up any seals to enclosed gaseous volume – e.g. lids of bottles – so that the enclosed gases will also be exchanged during the pump/fill cycle.

8.6.2. Evacuation in Manual Mode

Press the Evacuate/Start Autom button to start evacuation.

The antechamber is being evacuated.
Status indicator of the "Evacuate/Start Autom" button is green, an appropriate status message appears at the top of the Antechamber screen and the "Blue Bar" in the antechamber icon will decrease to show current status.

Recommendation:
MBRAUN recommends an evacuation of the antechamber up to a value of <0.5 mbar.

Pressing the "Evacuate/Start Autom" button again will stop the process.

8.6.3. Refilling in Manual Mode

Press the "Refill" button to start refilling the antechamber.

The antechamber is being refilled with gas from the box atmosphere.
Status indicator of the "Refill" button is green, an appropriate status message appears at the top of the Antechamber screen and the "Blue Bar" in the antechamber icon will increase to show current status.

Note:
Refill antechamber until pressure compensation between glove box and antechamber is attained.

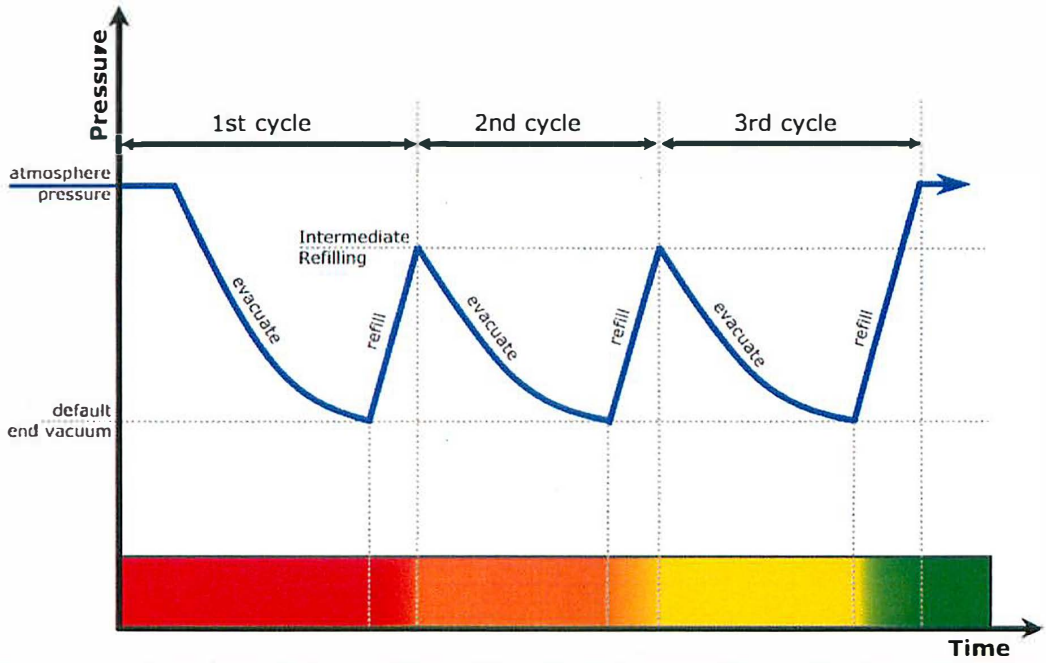
Pressing the "Refill" button again will close the valve between the antechamber and the box.

Caution:
For obtaining a high degree of purity, the antechamber should undergo repeated evacuation and refilling procedures.
In this case for intermediate refilling a pressure of approximately 200 mbar is sufficient. The last refilling step always has to be back to box pressure.

8.7. Information About the Automatic Antechamber Control

Note:
Applies only to systems equipped with an optional automatic antechamber control.

Figure 3: Principle of Automation Antechamber Cycles



The diagram above shows how the intermediate refilling affects the atmosphere within the antechamber.

The parameters of the automatic antechamber control have optimally been matched with the antechamber by the manufacturer. If required, they can be changed by the user. For information about changing the parameters refer to "Antechamber Parameters" Section.

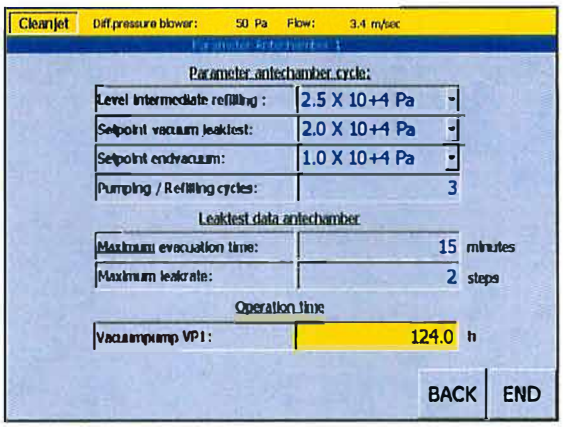
Press the Evacuate/Start Autom button to start Automatic evacuation.

The antechamber is being evacuated.

The "Evacuate/Start Autom" button will release when the process has finished.

8.8. Antechamber Parameters

Selecting the Parameters button from the "Antechamber" screen will open the parameters screen.



8.8.1. Parameter Definitions

Intermediate refilling Level: ..... Up to this value the oven is flooded with inert gas.

Setpoint vacuum leaktest: ..... At this pressure the vacuum leaktest will be started.

Setpoint endvacuum: ..... Up to this pressure the antechamber will be evacuated.

Pumping/refilling cycles: ..... Number of evacuation and refilling cycles.

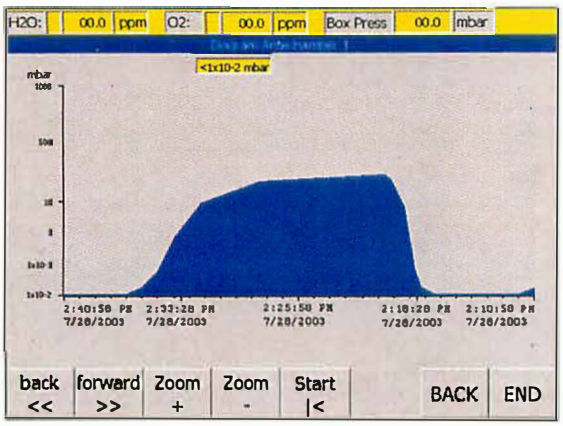
Max. evacuating time [min]: ..... If the set value "setpoint vacuum leaktest" is not reached in this time the automatic antechamber cycle will be stopped and the warning:
"pumping time exceeded" will be displayed

Max. leakrate [step value]: ..... Parameter of the maximum pressure increase during the 2 steps of the vacuum leaktest within the measuring time frame.
Example: 2x10-1 mbar to 4x10-1 mbar.
If the parameter value is exceeded the antechamber process will be stopped and the warning: "antechamber leaking" will be displayed.

8.9. Trends for Antechamber

All graphs are similarly designed. The measurements are displayed on a time-line graph.

The trend graph for the antechamber is accessed by selecting the "Diagram" button in the "Antechamber" screen.



The first trends screen displays the atmosphere pressure within the antechamber.

The current atmosphere pressure is displayed in the box, top centre of the main screen area.

There are 5 buttons on all graph displays. With the ***back*** and ***forward*** buttons you can move along the time axis. With the ***zoom*** buttons you can select a narrower or broader time frame. The ***Start*** (re-set) button returns you to the current time.

X - Axis = Timescale – details in hours and minutes
Y - Axis = Measurement in mbar (pressure) or °C (temperature)

8.10. Transferring Material Out of the Box

8.10.1. Preparation

- Observe Item "Important Notes" in this chapter.
- The outer antechamber door is closed.
- The antechamber door located inside the box is open.
- 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.

8.10.2. Removal of Material from Antechamber

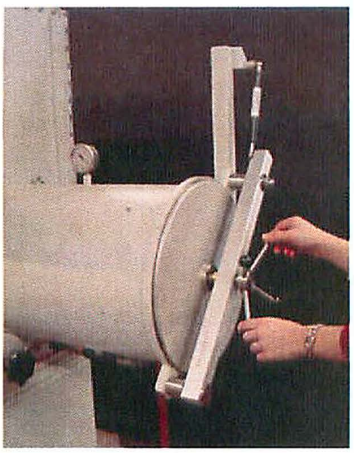
- Open the antechamber door located outside the box.
- If a sliding tray is available: Pull out sliding tray; remove material from tray; then slide the tray back into antechamber.
- If no sliding tray is available: Transfer the material directly out of the antechamber.
- Then close the outer antechamber door.

Caution:
Annoyance by bad smell is expected as soon as any waste purge gas is escaping to the surroundings. Environmental pollution and effects detrimental to health, however, are not known, but cannot be excluded. The manufacturer does not assume any liability.
When using toxic or radioactive material manual, by no means the gas should escape to the environment. Information about pertinent alternative methods: service@mbraun.de

Recommendation:
Ensure that both outer and inner doors of the antechamber are closed when material is not being transferred through the antechamber.
After having the outer antechamber door opened, it is recommended that at least one evacuation and refill cycle is completed for the antechamber to prevent possible condensation being deposited on the interior antechamber walls.

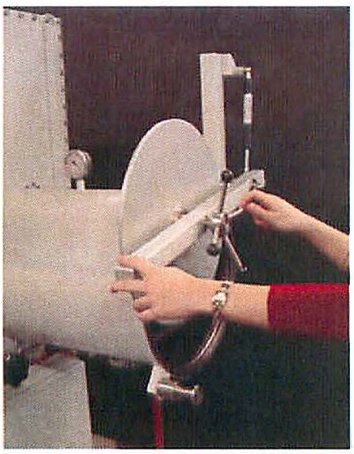
8.11. Circular Antechambers

8.11.1. Opening and Closing the Antechamber Door Outside the Box

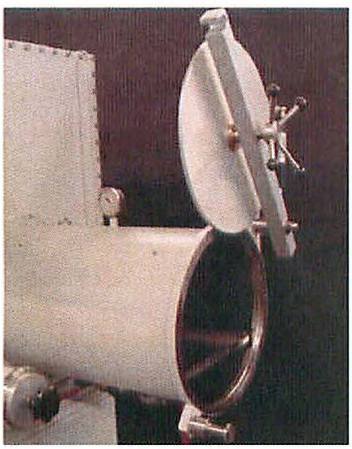


Observe all items of this chapter.
Turn the locking mechanism until the antechamber door is free.

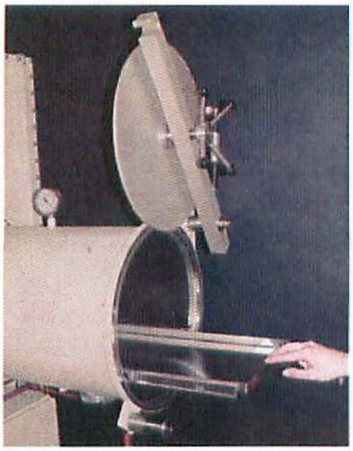
Caution:
Antechamber under vacuum cannot be opened. If you try to open the antechamber under vacuum the opening mechanism can be damaged.



Carefully open the antechamber door in upward direction.



The antechamber door is held by the spring mechanism. It stays in the position (see picture).



Carefully pull out sliding tray.

Closing the outer door is done in reverse order.

8.11.2. Opening and Closing the Antechamber Door Inside the Box

After execution of the evacuation/refill cycles: Opening and closing of the antechamber door inside the box is done in the same way as described for the outer door.

Caution:
By no means open the inner door of an antechamber filled with air. This will result in polluting the inert box atmosphere and possibly in damaging measuring instruments and any material. Antechamber under vacuum cannot be opened. If you try to open the antechamber under vacuum the opening mechanism can be damaged.

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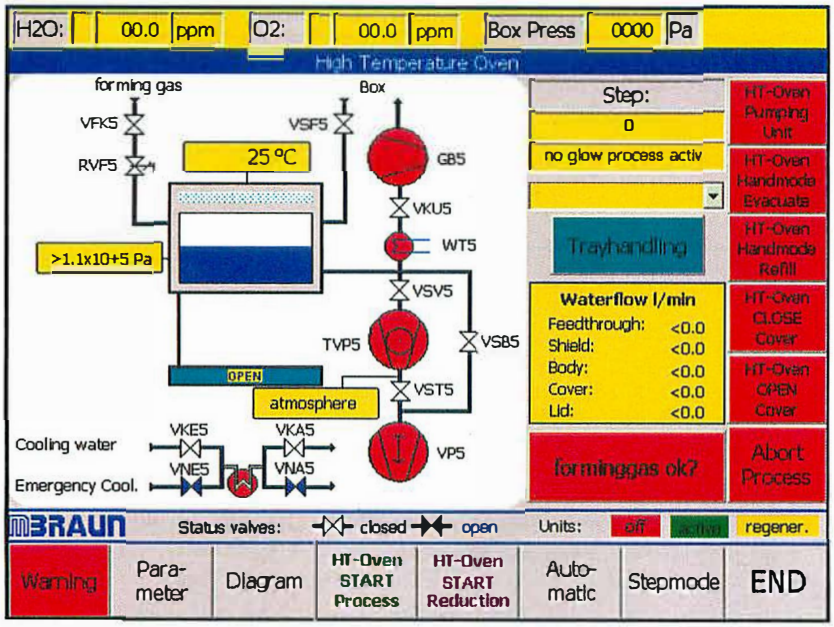
Contents

9.1 Main Panel Operation

Fig. 1: Main panel "Process Oven" screen



The picture shows the schematic diagram of the process oven. The yellow status fields show various observed values or process steps.

On the right-hand side are the oven functions. Each Softkey button can be branched in the screen for the parameters or the status screens.

Operation of the oven antechamber can be done with or without the heating cycle via the softkey "heating on" (this is found on the yellow pull-down menu status field below the process step display.

Description of control elements of "Process Oven Screen"

HT-Oven Pumping Unit	This button switches the pumping system ON /OFF.
HT-Oven START Process	This button starts the automatic glow process. The pumping unit must be switched on.
HT-Oven START Reduction	This button starts the automatic reduction process. The pumping unit must be switched on.
Abort Process	The automatic oven process can be aborted at any time by use of this button. After pressing the button the oven will be refilled, if refill temperature is reached.
HT-Oven Handmode Evacuate	This button starts the manual evacuation of the process oven. It can only be operated, when all automatic functions are inactive.

This button starts the manual refilling of the process oven. It can only be operated, when all automatic functions are inactive.

Pressing this button the oven cover can be closed manually

Pressing this button the oven cover can be opend manually, when no process or manual function (evacuate / refill) is activ.

9.2 Parameters

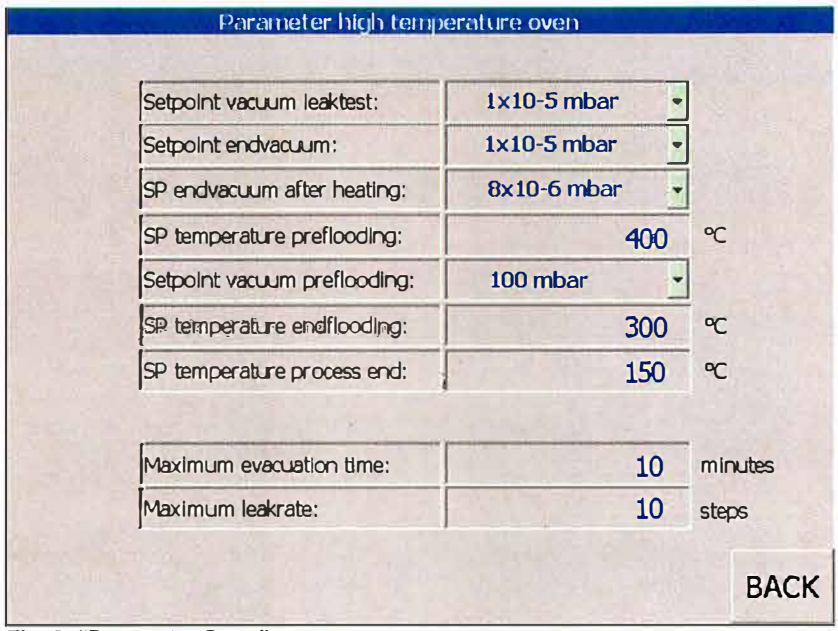


Fig. 2: "Parameter Oven" screen

Explanations:	
Setpoint Vacuum Leaktest:	At this pressure the vacuum leaktest will be started
Setpoint endvacuum:	Up to this pressure the antechamber will be evacuated.
SP endvacuum after heating:	The oven antechamber will be pumped to this level after the heating process.
SP temperature preflooding:	The oven must cool to this level after the heating process; following this it may be flooded to the pre-flood pressure.
Setpoint Vacuum Preflooding:	Up to this pressure the oven will be pre-flooded.
SP temperature endflooding:	The oven must cool to this level after the heating process; following this it may be flooded to the atmospheric pressure. After the pre-flood cycle has completed the oven door lowers to the "Quick cool" position and begins the "Quick cool" process.
SP temperature process end:	On reaching this temperature the "Quick cooling" process will end and the oven door will fully open. This completes the heating process.

Explanations:	
max. evacuation time:	If the set value "setpoint vacuum leaktest" is not reached in this time the automatic antechamber cycle will be stopped and the warning: "pumping time exceeded" will be displayed.
maximum leakrate:	Parameter of the maximum pressure increase during the 2 steps of the vacuum leaktest within the measuring time frame. Example: 20 Pa to 40 Pa If the parameter value is exceeded the antechamber process will be stopped and the warning: "antechamber leaking" will be displayed.

9.3 Diagrams

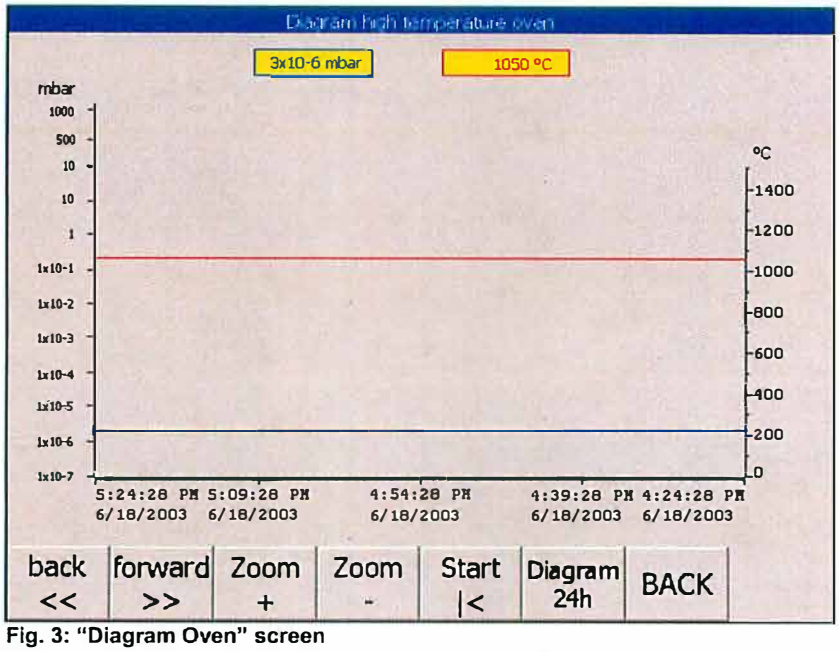


Fig. 3: "Diagram Oven" screen

All graphs are similarly designed. The measurements are displayed on a time-line graph.

There are 5 buttons on all graph displays. With the ***back*** [<<], ***forward*** [>>] you can move along the time axis. With the ***Zoom*** [+] and ***Zoom*** [-] you can select a narrower or broader time frame. The [|<] button returns you to the current time.

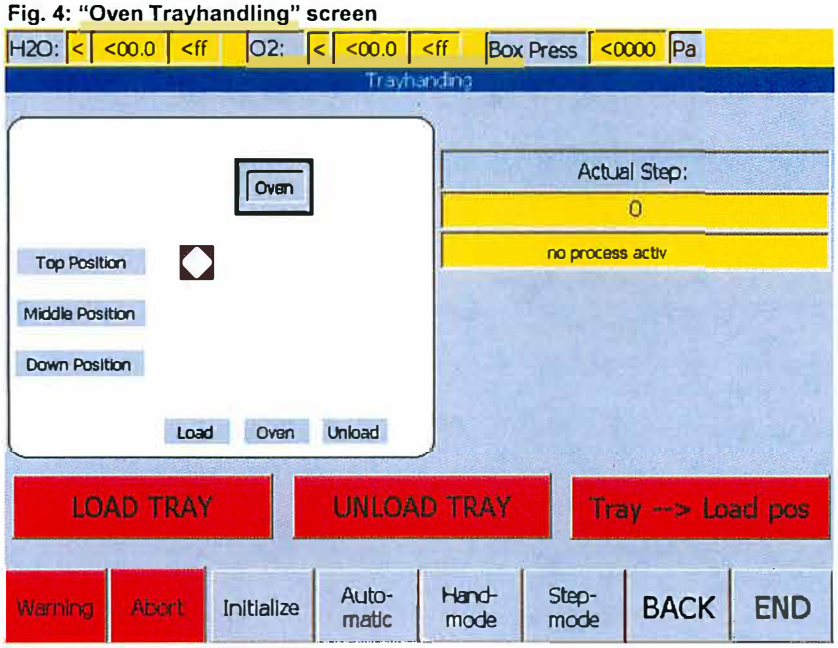
X - Axis = Timescale – details in hours and minutes
Y - Axis = Measurement in mbar (pressure) or °C (temperature)

Also the measurement is displayed as a digital reading in the yellow field.

9.4 Oven Trayhandling

With this button, in the "Oven process screen" you can select the "Trayhandling screen". In the "Trayhandling" screen" all the loading and unloading functions for the oven are available.

Fig. 4: "Oven Trayhandling" screen



This screen also displays the position of the oven handler and the gripper. The yellow status field displays the current process step.

With the "Load Tray" function the Charge-carrier would be transferred from the load position to the oven. After the tray is set down the handler moves onto the Unload position.

With the "Unload Tray" function the Charge-carrier would be collected from the oven and set down in the Unload position.

This function returns the Charge-carrier from the Unload position to the Load position.

Note:
All loading and unloading functions are only available, if the oven cover is completely lowered !

With this button the process chain would be set back a step. The Oven handling would remain in its last resting position.

By selecting this function the Oven handling would be set to its starting position.

Procedure: Both Hub cylinders are raised
Oven-handling set to load position
Both Hub cylinders are lowered
Gripper opens.

The "Load Tray" function is not released until after the Oven handling has returned to its initial position.

These buttons control the operation mode of the Oven handling. Hand-mode and Step-mode are for Service personnel only and are password protected.

Contents

10.1. General Information

10.1.1. Design of the MBraun Pumping Filling System

The MBraun Pumping Filling System is designed to:

- Evacuate, purge and fill quartz lamp tubes with user selectable gases at pressures customisable below atmospheric pressure.
- Seal the tubes after filling by melting with a plasma burner system.
- Operate in a high purity Argon glove box.

After loading the tube into the pump filling station the entire process, including melting is fully automatic and can be initiated by just a press of a button.

10.1.2. Main components of the system

- Main panel (Touch Panel Control), Start Footswitch
- Pumping filling head with tube holder/gripper
- 3-torch plasma burner system, Plasma controller MB-PL-C4, Cooling system
- SiO_2 removal system (Clean-JET particle absorber, Pipe blower)

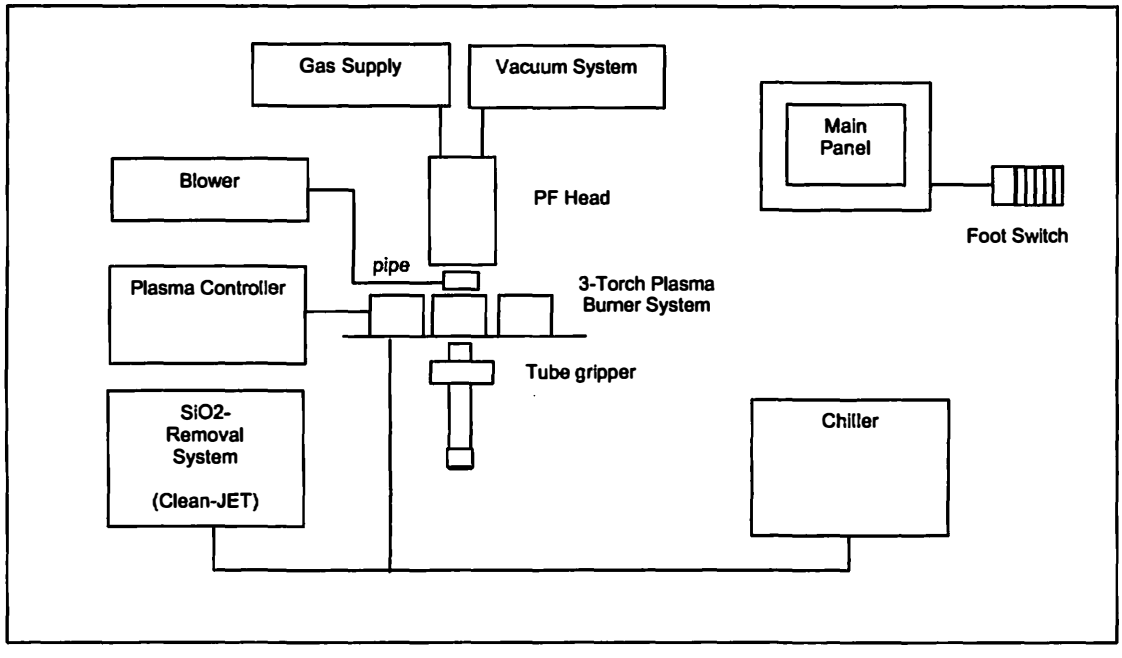


Fig. 1: System overview (schematic)

10.2. Main Panel Operation

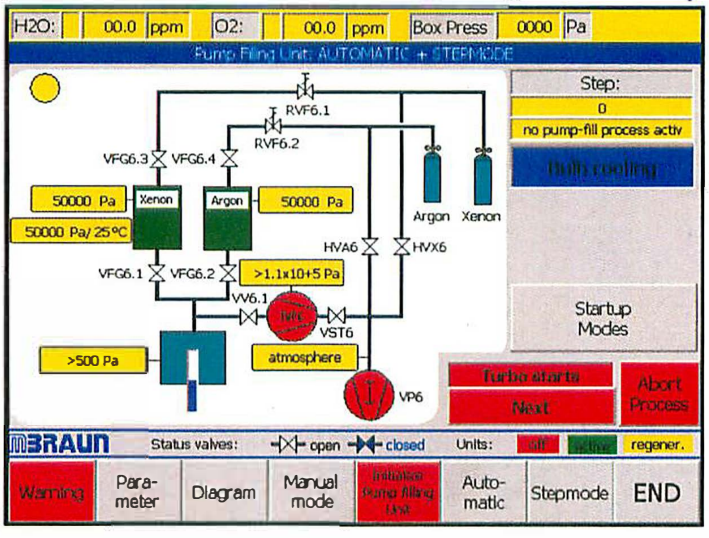
10.2.1. System Overview

The pumping filling station is controlled by the main panel (Siemens Touch Panel TP270).
To get to the "Pump Filling Unit"- screen from the main screen tap on the symbol of the PF-Unit on the main screen. The pump filling unit allows the following modes of operation:

- Fully automated pump filling process (+melting) of quartz lamp tubes
- Loading / unloading of tubes, start pumping filling process manually
- Cleaning of Argon/Xenon piping (e.g. necessary after exchange of gas bottles)
- Setting (lowering/raising) of purging / filling pressure
- Display of pressure profile for filling
- Control of turbo pump / pre pump (on/off)
- Setting pump filling parameters
- Service operations :
    - plasma burner service position
    - step mode

Filling pressures, vacuum values, process steps, status of devices (pumps) and box parameters are also displayed on this screen.

Fig. 2: Main panel "Pump Filling Unit" screen



10.2.2. Pump-Filling Process

10.2.2.1. Process Description

A complete pump filling process involves the following steps:

1. Load:

The tube is manually loaded into the pump-fill head. The gripper is closed around the tube which fixes the tube in place.

2. Pump + Fill:

1. Evacuation
2. Leak Test / Gross
3. Evacuation / Leak test
4. Purging (Argon)
5. Evacuation, steps 4+5 are repeated according to number of purging cycles entered on parameter screen
6. Leak test
6. Filling (Xenon)
7. (Optional refilling of Argon/filling gas receptacle)
8. Burning / Melting
9. Bulb cooling

If in any of the steps listed above an error occurs (e.g. leak) the whole process is aborted and an error message is generated.

3. Unload:

The tube is released from the head and the gripper is opened. The tube can be removed manually from the PF head.

10.2.3. Operation Modes

There are two possible modes of operation to fill / melt a lamp tube:

a) Automatic:

This mode will fix the lamp tube, pump, fill and seal the quartz tubes.

b) Manual Mode (Panel operation)

This function is password protected for advanced user options.
See section Manual Mode and Password Settings.

10.2.3.1. Automatic Mode

10.2.3.1.1. Pump Filling / Preparation

Before starting the pump fill processes check the following items:

- ☑ **The Cooling unit is switched on and operates at nominal temperature.**
- ☑ **The Particle absorber (Clean-JET) is switched on and operates at nominal flow.**
- ☑ **Plasma jet Controller (MB-PL-C4) is switched on**
- ☑ **All three burners are switched on and operated at low plasma current.**
- ☑ **The gripper is ready for loading.**
- ☑ **The Pump station is switched on and the turbo pump is up i.e. running at high speed (the symbols for VP6 and TVP6 are green, no warning that the turbo pump is running up).**

Carefully insert a tube into the PF-head. Make sure that the tube is inserted up to upper stop in the PF-head. Now the system is ready to start the pump fill cycle.

10.2.3.1.2. Start Pump-Filling

The start foot switch for the pump-fill cycle is placed outside the glovebox. The operator can trigger the automatic pump-fill cycle with this foot switch after loading the lamp-pistons into the PF-head.

After starting the process described in section 10.2.2.1 runs automatically to its end. If there is any malfunction an error message is generated, the process is aborted and the 3-colored signal light is illuminated red. If the process is completed successfully, the signal light is illuminated green. During the process there is a yellow light.

10.2.3.1.3. Pump-Filling details

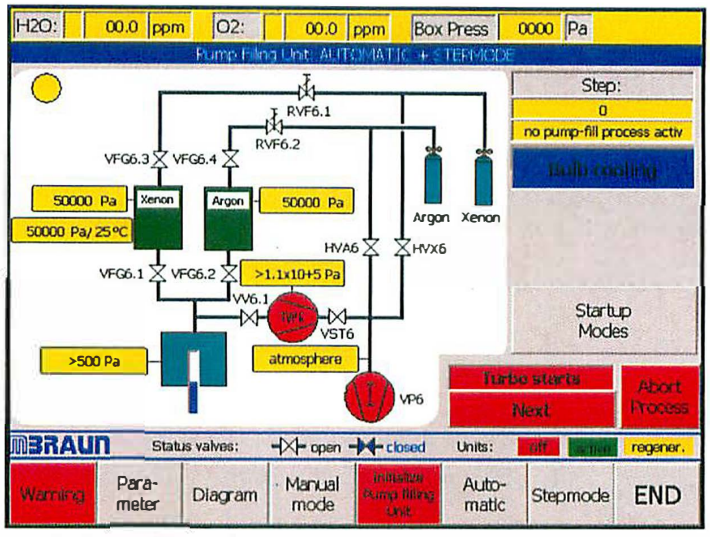


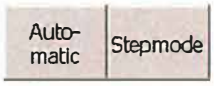
Fig. 3 : Pump Filling Unit screen

Description of control elements of "Pump Filling Unit Screen"

The automatic Pump-fill process can be aborted at any time by use of this button. After pressing the button all valves will be closed. The lamp tube may then be unloaded.

With this button the pumping unit filling station is switched on.

This button selects the Manual Operation Mode. The Manual functions are password protected at a supervisor level.



These buttons switch the operation mode of the Pump-fill unit. The Step-mode is for service personnel only and is password protected.

10.2.3.2. Manual Mode

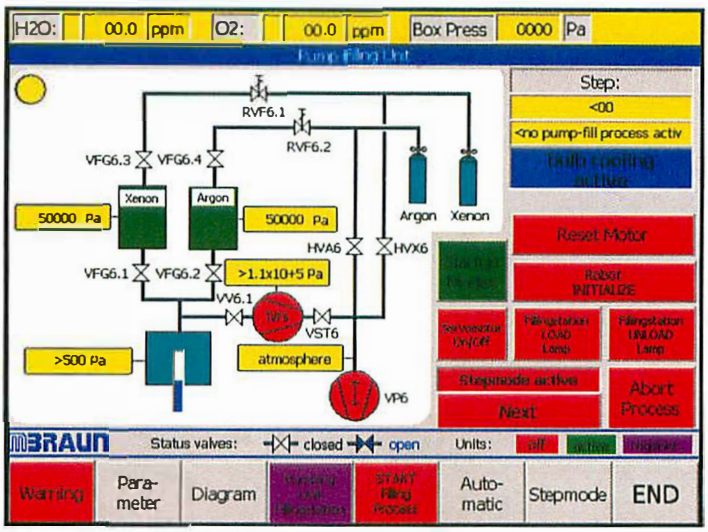


Fig. 4 : Pump Filling Unit screen

Description of control elements of "Pump Filling Unit Screen"

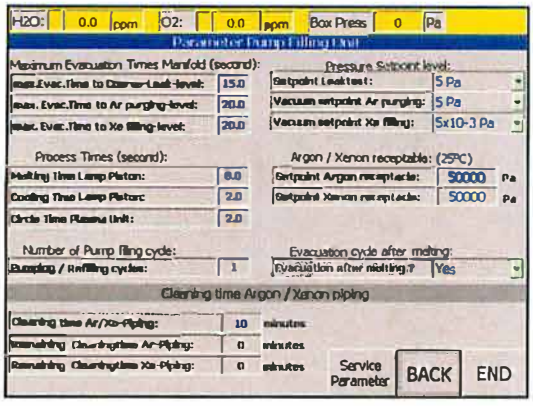
Para-meter	Selecting this button will open the "Manual Mode" parameters screen.
Diagram	Selecting this button will open the Trends screen for the Pump Fill Head.
Pumping Unit On/Off	This button manually switches the pumping system ON /OFF.
START Filling Process	This button starts a single filling process. **Note:** A lamp must be inserted into the pump head and the gripper must be closed before this function is activated.
Servomotor On/Off	This button switches the servo-controller and power supply for the load utility ON or OFF. During pump-fill processes, this function always must be switched on.
Fillingstation LOAD Lamp	With this function you load the lamp piston manually. Process: gripper close + lock tube in PF-head.
Fillingstation UNLOAD Lamp	With this function you unload the lamp piston manually. Process: unlock PF-head + gripper open.
Robot INITIALIZE	When this button is pressed the servomotor drives into reference position (uppermost position). For driving back into load postion, button "Fillingstation Unload Lamp" must be selected. **The initialize function should only be activated when the servomotor has lost its reference position.**
Reset Motor	**When this button is pressed the Alarm message from the Servo booster is deleted. The Servomotor must be "Reset" to its reference position (see above)**

The Pump-fill process can be aborted at any time by use of this button. After pressing the button all valves will be closed and the lamp piston will be unloaded.

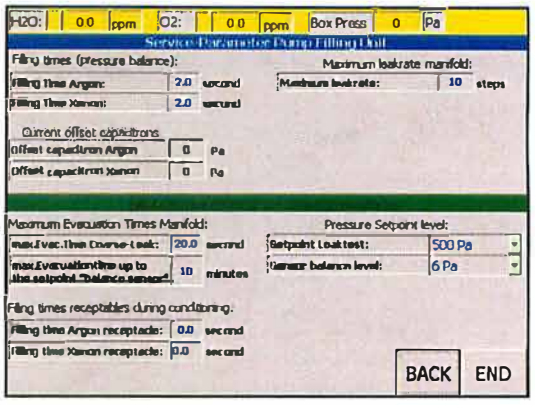
These buttons switch the operation mode of the Pump-fill unit. The Step-mode is for service personnel only and is password protected.

10.2.4. Parameter Setting for Pump-Filling Unit

Selecting the "Parameter" button calls the Parameter screens for the Pump-Filling Unit.



Pump filling unit parameters



Service Pump filling unit parameters

Fig. 5 : Pump Fill Unit Parameter screens

The parameters can be adjusted be touching the input field. An on-screen keyboard is then displayed to enter new values.

10.2.4.1. Pump Filling Unit Parameter description

Maximum Evacuation Times Manifold	
Max.Evac.Time Coarse-Leak:	Time allowed for Coarse-Leak detection. If this time is exceeded the process would be aborted with the alarm message "Coarse-Leak".
Max.Evac.Time Ar purging:	Max Evacuation time to reach the vacuum setpoint before Argon purging. If this time is exceeded the process is aborted with the error message "fine leak".
Max.Evac.Time Xe filling:	Max Evacuation time to reach the vacuum setpoint before Argon filling. By exceeding the set-up time the process is aborted with the error message "fine leak".
Process Times	
Melting Time Lamp Piston:	Plasma-high time for melting.
Cooling Time Lamp piston:	Adjustable cooling time for the lamp pistons after melting process. After running the cooling time the process will end.
Circle Time Plasma Unit:	Time for operating the control cylinder for plasma burner rotation. Enter "0" to switch off rotation.

Number of Pump Filling Cycles	
Pumping / Refilling cycles:	This parameter gives the number of Argon purge cycles that will occur before filling with Xenon. When "0" is entered the lamp piston is only evacuated and filled with Xenon.
Pressure Setpoint Level:	
Setpoint Leaktest:	At this working pressure the leak test would be started.
Vacuum setpoint Ar purging:	Up to this setpoint the lamp piston would be evacuated before being purged with Argon.
Vacuum setpoint Xe filling:	Up to this setpoint the lamp piston would be evacuated before being filled with Xenon.
Argon / Xenon Receptacle:	
Setpoint Argon receptacle:	Argon reservoir filling pressure. Up to this pressure the reservoir for the Pump Fill Cycle is filled. This pressure is also applied for the initialisation cycle.
Setpoint Xenon receptacle:	Xenon reservoir filling pressure. Up to this pressure the reservoir for the Pump Fill Cycle is filled. This pressure is also applied for the initialisation cycle. The value given here relates to a temperature of 25°C. It is corrected automatically by the system for actual working temperature.
Evacuation Cycle after Melting:	
Evacuate after melting	This parameter gives the option to evacuate the tube after the melting process (yes or no)
Cleaning time Argon / Xenon Piping	
Cleaning time Ar/Xe –piping:	Time span for evacuation of Ar/Xe piping.
Remaining Cleaningtime Ar piping:	This is the time taken until completion of purging the Ar piping (display only).
Remaining Cleaningtime Xe piping:	This is the time taken until completion of purging the Xe piping (display only).
Filling Times (Pressure balance):	
Filling time Argon:	Opening time for the Argon filling valve VFG 6.2.
Filling time Xenon:	Opening time for the Xenon filling valve VFG 6.1.

Maximum Leakrate Manifold:	
Maximum Leakrate:	This is the maximum allowable leak rate before Xe filling, given in pressure steps. *Example:* *An increase in pressure from 2x10-3Pa to 4x10-3Pa would give 2 steps.* If the parameter value is exceeded the filling process will be stopped and the warning: "Fine leak" will be displayed.
Current Offset Capacitrons	
Offset Capacitron Argon:	Offset value for the Argon reservoir pressure sensor (display only).
Offset Capacitron Xenon:	Offset value for the Xenon pressure sensor device (display only).
Maximum Evacuation Times Manifold:	
Max.Evac.Time Coarse-Leak:	Time allowed for Coarse-Leak detection. When Overstepping this time the process would be interrupted with the alarm message "Coarse-Leak".
Max.Evacuationtime up to the setpoint "balance sensor":	Maximum evacuation time allowed for reaching the pressure balance setpoint. Overstepping the time will interrupt the process with the warning "Evacuation time overrun".
Pressure Setpoint Level:	
Setpoint Leaktest:	Pressure at which leak test is performed
Sensor Balance Level:	Balance of capacitron sensor
Filling Times Receptacles During Conditioning:	
Filling time Argon receptacle	Opening time for the Argon reservoir filling valve VFG 6.4 during operation cycle
Filling time Xenon receptacle	Opening time for the Xenon reservoir filling valve VFG 6.3 during operation cycle

10.2.5. Pump-Filling Unit Start-up Modes and Cleaning Piping

10.2.5.1. Selecting Start-up Modes and Cleaning Piping Screen

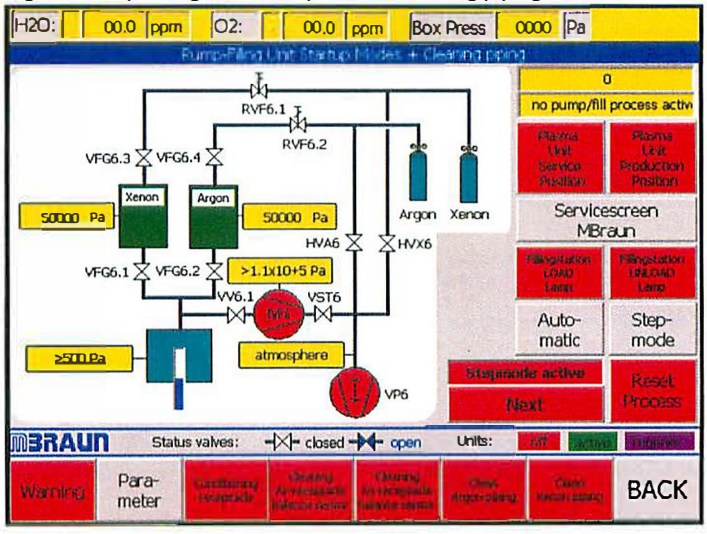
This screen is accessed by selecting the "Start up Modes" button. On opening the screen the functions for the Pump Filling Station are switched off.

The screen is used for the following operations:

- Cleaning of Argon and/or Xenon piping after exchange of gas bottles
- Alterations of filling pressure (lower/raise)
- Reset zero adjustment point for pressure measuring tubes of purge/filling gas receptacles (pressure balance)
- Set the plasma burner unit to service / production position

Note:
The PF unit is switched off automatically if you enter this screen. A warning message is shown, which indicates to wait until the turbo pump has calmed down. After return to main PF screen you have to switch on the Pumping System by pressing the "Initialize Pump Filling unit",

Fig. 6 : "Pump Filling Unit Startup Mode + Cleaning piping" screen



Description of control elements of "Pump Filling Unit Startup Mode + Cleaning piping"

Startup Modes
This button calls the "Pump.Filling Unit Start-up Mode" screen

Adjust filling pressures for Pump-Fill Unit
This function will check the input gas pressure, and that the Argon and Xenon reservoirs are filled to their preset pressures. When the reservoir pressure for the start-up cycle is greater than the targets for the reservoirs, then they are pumped off automatically.

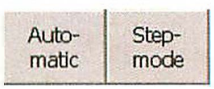
Cleaning Cycle for Argon receptacle
This function evacuates the Argon reservoir to the preset pressure (balance setpoint). After attaining the setpoint, the pressure measuring tube CTR90 will be balanced at 1mbar.

Cleaning Cycle for Xenon receptacle
Function is identical in operation as for cleaning of Argon reservoir (see above)

Cleaning Cycle for Argon Piping
This function evacuates the Argon piping for a preset time.

Cleaning Cycle for Xenon Piping
Function is identical in operation as for cleaning cycle of Argon piping (see above)

This button will abort the Start-up and the cleaning cycles. The Alarm message in the "Warnings" screen can be reset with the ACK button.



These buttons switch the operation mode of the Pump-fill unit. The Step-mode is for service personnel only and is password protected

10.2.5.2. Clean Piping Operation

There are two cleaning piping functions, one for the Argon line (purge gas) and one for Xenon line (filling gas). They are independent from each other but are working exactly the same way. The functions evacuate the Argon/Xenon piping for a preset time. This is needed, e.g. after the gas cylinders are exchanged. Depending on the amount of gas contamination that got into the piping system, this function must be executed several times in conjunction with the "Conditioning receptacles" function. (MBraun recommends at least 3 cleaning cycles after exchange of a cylinder.)

The following steps are necessary to clean Argon or Xenon piping:

1. Select the "Pump Filling Unit Startup Mode + Cleaning piping"-screen. By pressing the "Startup Modes" button. The pumping system is switched off automatically and you have to wait for 4 minutes until the turbo pump has stopped
2. Press the "Cleaning Ar Piping" respectively "Cleaning Xe Piping" button to start the pumping off.
3. A message box appears that explains which valves are to be opened or closed (needle valves, gas bottle valves, Ar resp. filling gas). Open/Close the valves according to the message and confirm the message.
4. The pump is switched on. You have to wait until the preset evacuation time has ended.
5. Start the refilling of the gas receptacles with the "Conditioning receptacle" button. The receptacles are now refilled up to the set pressure value.
6. Repeat steps 2 to 5 at least once
7. Press the "Back" Button to return to "Pump Filling Unit" screen
8. Switch on the PF Unit ("Initialize Pump Filling Unit") and wait for the turbo pump to run up

We recommend to carry out steps 2 to 5 at least three times after exchanging a gas cylinder to ensure that the piping and receptacles are purged with the gas and do not contain impurities anymore.

10.2.5.3. Clean Receptacles Operation

There are two functions for cleaning the receptacles, one for the Argon line (purge gas) and one for Xenon line (filling gas). They are independent from each other but are working exactly the same way. The functions evacuate the Argon/Xenon reservoirs to the given pressure setpoint (balance pressure). After attaining the balanced setpoint the pressure measuring tube CTR90 would be balanced at 1mbar. The balance set point should be set at less than $1x10^{-3}$ Pa (default $7x10^{-4}$Pa) in the parameters screen.
Note: For this function a sealed, leak-tight lamp tube must be inserted into the PF head. A message is displayed on the screen which must be confirmed when a tube is inserted.

The following steps are necessary to clean Argon or Xenon receptacles and balance sensors

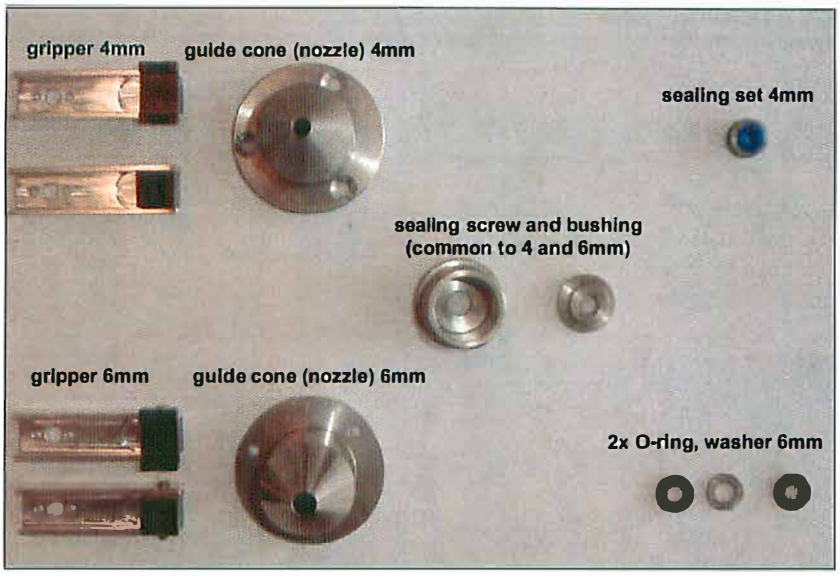
1. Select the "Pump Filling Unit Startup Mode + Cleaning piping"-screen. By pressing the "Startup Modes" button. The pumping system is switched off automatically and you have to wait for 4 minutes until the turbo pump has stopped
2. Press the "Cleaning Ar Receptacle / balance sensor" respectively "Cleaning Xe receptacle / balance sensor" button to start the pumping off.
3. A message box appears that explains which valves are to be opened or closed (needle valves). Open/Close the valves according to the message and confirm the message.
4. The pump is switched on. You have to wait until the preset balance pressure is reached.
5. Start the refilling of the gas receptacles with the "Conditioning receptacle" button. The receptacles are now refilled up to the set pressure value.
6. Press the "Back" Button to return to "Pump Filling Unit" screen
7. Switch on the PF Unit ("Initialize Pump Filling Unit") and wait for the turbo pump to run up

10.2.5.4. Burner Adjustment

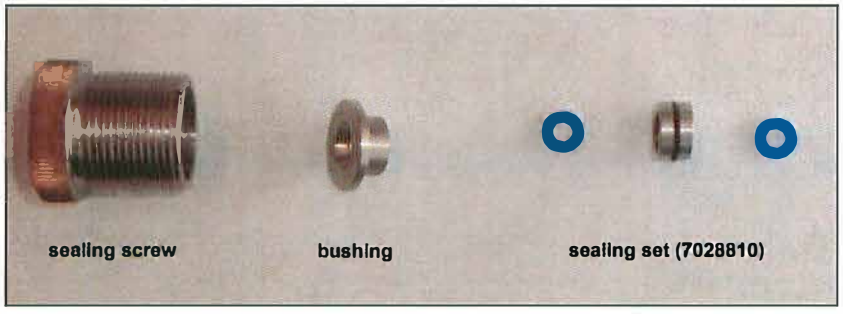
To make adjustments of the plasma burners you can set the plasma burner holding plate to the service position by means of the "Plasma Unit Service Position" pushbutton. For description of burner adjustment see Section for plasma burner system. After finishing service the plate must be driven back to the working position using the push button "Plasma Unit Production Position"

10.2.6. Preparing the Pump Filling System for 4 or 6 mm Tubes

The PF-System is prepared to be operated with quartz tubes that are 4 mm or 6 mm in diameter. The following picture shows the parts relating to different tube diameters.



10.2.6.1. Parts Required for 4 mm Tubes

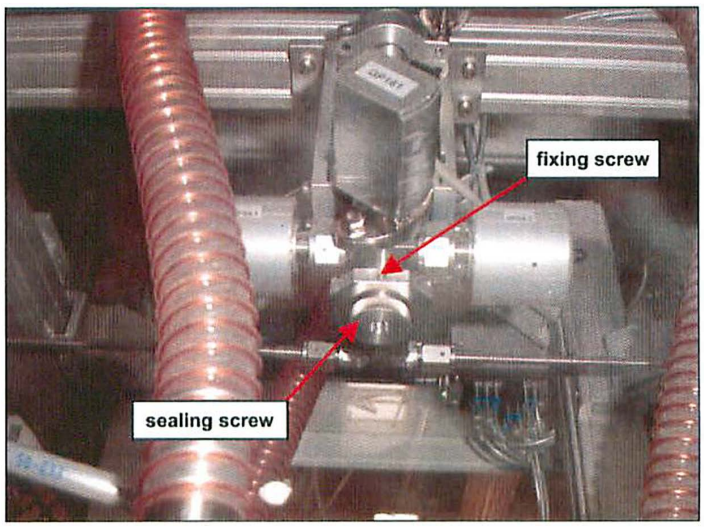


10.2.6.2. Parts Required for 6 mm Tubes

10.2.6.3. Interchange of Pump Fill Head Seals (4 / 6mm)

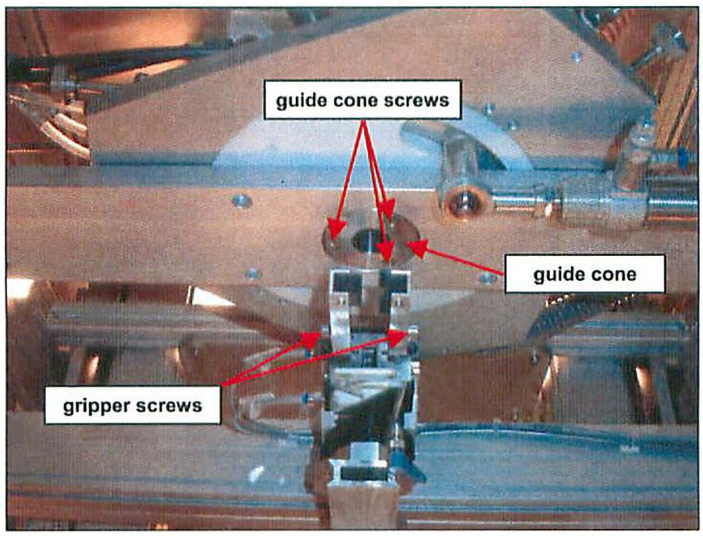
To interchange the seals necessary for 4 or 6 mm tubes work through the following steps:

1. Set the plasma burner plate to the service position (Startup-modes screen).
2. Loosen the fixing screw for the sealing screw.



3. Remove the sealing screw by turning it counter-clockwise, the bushing is loose inside the screw.
4. Remove the seal from the PF-head by using a small screwdriver.
5. Insert the sealing kit (for 4 mm) or 2x O-rings + washer (for 6 mm) in the order indicated in the pictures in the section "Parts Required for 4/6 mm Tubes".
6. Insert sealing screw and bushing, fasten it by turning clockwise.
7. Secure the sealing screw by gently tightening the fixing screw.
8. Set the burner plate to working position.

10.2.6.4. Interchange of Guide Cone and Gripper (4 / 6 mm)



To interchange grippers and guide cones proceed as follows:

1. Ensure the burner plate is in the working position.
2. Remove the 2 screws from the gripper, and remove the gripper.
3. Mount the selected gripper (4 or 6mm), secure it in place with the 2 screws.
4. Remove the 3 guide cone screws.
5. Remove the guide cone be sliding it downwards.
6. Insert the selected guide cone (4 or 6mm).
7. Secure the guide cone with the 3 screws.

Note:
Do not apply excessive force in any of the steps described. All parts must slide gently into position.

10.3. MBRAUN Plasma Burner System

10.3.1. Overview

The 3-torch plasma burner system is intended for the melting off of quartz glass tubes after filling it with gas at the pumping filling head. The system consists of:

1. **The Plasma-jet Controller** (MB-PL-C4), the control electronics that is the central part of the system. It contains all electronics including a micro-PLC and relays to control the burners and DC-power supplies as well as cooling water. For the Argon gas supply to the burners it is equipped with pressure control, electric valves and flow-meters with integrated needle valves for flow adjustment. It can be operated from 115 to 240 VAC. Remote control can be performed with potential-free relays.

2. **The Plasma Burners** (MB-PL-B1) that emits Argon plasma to heat up non-conductive material (like quartz). It is constructed for long term operation and has only 3 parts to be exchanged if needed. The burner is water-cooled.

3. **The DC-Power Supply**, which is a standard TIG power supply with remote control option.

4. **The Feedthrough-Plate** that supplies a gas-tight barrier between the inner clean Argon atmosphere and the outside air. It contains all connections (water, Argon and DC-power) necessary to operate the plasma burners inside the box.

5. **The Flow Limit Switch** to monitor the cooling water flow.

6. **The control cables** to and from the controller including a foot switch.

7. **The DC-Power cables** to the burners.

8. **The cooling system** which provides the cooling water for the plasma burners.

10.3.2. Technical Specifications

10.3.2.1. Plasma jet Controller MB-PL-C4

- Dimensions: 19" Rack-mount (4 HU) 48.5cm x 17.7cm x 26cm
- Weight: 7.6 kg
- Power. 115 – 240 VAC, 50/60 Hz, max 100 VA
- PLC: LOGO 24
- Lines: up to 4
- Operation temperature (environment): +10 - +35 °C

10.3.2.1.1. Connectors:

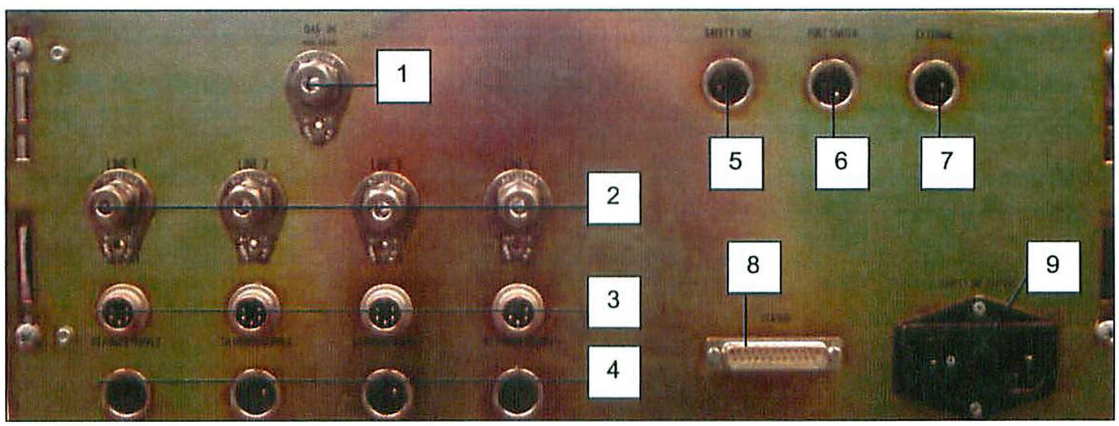


Fig. 7: MB-PL-C4 / rear view

1	**Gas-in:**	Argon 5.0 (99.999%) or better, 0.20 to 0.25 MPa (2.0 to 2.5 bar), app. 100 l/h per plasma burner line (gas high).
2	**Gas out:**	One line per plasma burner at approx. 100 l/h (gas high), gas flow adjustment by needle valve and flow meter, minimum gas flow adjusted internally by a needle valve (common to all lines)
3	**To Power Supply:**	5-pin male socket for control cable to the TIG power supply
4	**Current:**	5-pin female socket for cable to current-shunt (1 mV per A)
5	**Safety-Line:**	3-pin female socket for cable to cooling water limit switch (can be linked to other safety switches by daisy chain).
6	**Foot Switch:**	4-pin female socket for cable to Foot Pedal
7	**External:**	4-pin female socket for cable to an external command unit (must supply a potential-free contact ,NO)
8	**Status:**	25-pin (D-Sub) male socket. It supplies relay outputs (COM, NO, NC) for the status of Power On, Burner On (each line separately), Plasma High and FAIL. Maximum rating : 24 V (DC or AC), 1 A
9	**Power:**	DIN Socket for power line with integrated fuses and ON-OFF switch.

10.3.2.1.2. User Controls and Displays:

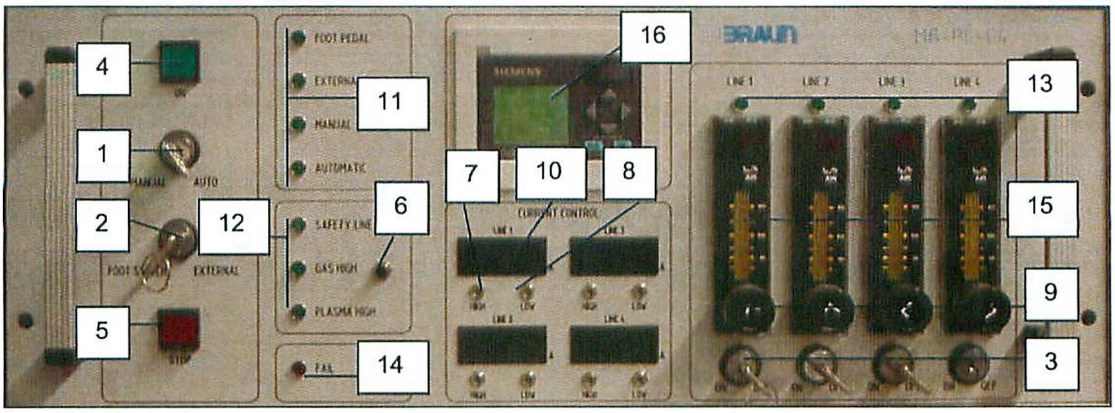


Fig. 8: MB-PL-C4 / front view

Key-lock Switches:

1	**Manual / Auto**	Selects operating mode in the PLC
2	**Foot Switch / External**	Selects input of "Start" command to PLC
3	**ON / OFF**	Each line can be activated or deactivated separately. Working of the plasma burners depends on the PLC status and program.

Push Buttons:

4	**ON**	Starts plasma burning. If plasma is ON, green light is on
5	**OFF**	Stops plasma burning. If plasma is OFF, red light is on
6	**Gas high**	Test for high gas flow valves

Controls:

7	**High**	Trim-Potentiometer to preset the upper (High) plasma current
8	**Low**	Trim-Potentiometer to preset the lower (Standby) plasma current
	High Current Fail	Internal Trim-Potentiometer to preset the fail threshold of the high plasma current
	Low Current Fail	Internal Trim-Potentiometer to preset the fail threshold of the low plasma current
9	**Argon flow**	Regulator valves for "Gas High" Argon flow

Displays Meters:

10	**Meters:**	Display of actual plasma current in A for each line (+- 1A)

Display LEDs:

11	**Foot pedal**	
	External	Indication of corresponding switch positions
	Manual	
	Automatic	
12	**Safety line**	Green if safety line is ok (Argon pressure and water flow)
	Gas high	Green if gas flow is high
	Plasma high	Green if plasma current is high
13	**Line 1 – 4**	Green if corresponding line is active (on)
14	**Fail**	Red in case if failure
15	**Flow meters**	Display of Argon flow
16	**PLC-Display/Controls**	See separate description below

10.3.2.2. Plasma Burner MB-PL-B1

• **Overall length : (except spare length of cathode)**	145 mm
• **Width:**	48 mm
• **Height:**	73 mm
• **Weight:**	1.4 kg
• **Cathode:**	Tungsten (LaOx) diameter 3.2 mm
• **Cathode tip angle:**	30°
• **Anode:**	Mo / Cu
• **Argon:**	5.0 or better at 0.2 Mpa (2 bar) (80 to 100 l/h)
• **Water: *)**	100 l/h at 0.2 MPa (2 bar), max. 0.4 MPa (4 bar) (min. drinking water quality), back pressure < 0.05 MPa (0.5 bar) Max. temperature (inlet) 25 °C Max. electric conductivity: 0.1 µS/m (1e-6 mmho/cm) pH value > 7
• **Plasma current (Standby)**	5.5 – 10 A
• **Plasma current (High)**	50 – 110 A (Pulse mode 50% duty cycle) max 10 sec.
• **Expected lifetime of Cathode**	> 80 hours (Total High Current time at 80 A, 40% duty cycle)
• **Expected lifetime of Anode**	> 300 hours (Total High Current time at 80 A, 40% duty cycle)
• **Operation temperature (environment):**	+10 - +40 °C

*) We recommend a separate electrically cooled cold well filled with distilled water for the cooling water supply of the burner heads.

10.3.2.3. DC-Power Supply Kemppi Mastertig 1500

Note:
For details and Safety Instructions refer to Operating Instructions of Kemppi Mastertig 1500

- Dimensions: 385 mm x 152 mm x 410 mm
- Weight: 14 kg
- Mains Voltage: 220 – 240 VAC 50 / 60 Hz
- DC – Current Output: 150 A at 20% ED
105 A at 60% ED
75 A at 100% ED
- Open Circuit Voltage: 80VDC
- Operation temperature: -20 - +40 °C
- Degree of protection: IP23C

Warning:
The shunt to measure the plasma current is mounted on top of the DC Power Supply. The shunt metal becomes hot; avoid touching it. One of the cables from the shunt has to be connected to case or frame at a point not far from the unit.

10.3.2.4. Feedthrough Plate

Note:
The size of the plate may vary due to specific needs of a customized project.

- Size: Stainless steel = Ø225 mm 3 mm thick
- Water in: Swagelok® vacuum-tight Feedthrough for 10 mm tubing
- Water out: Swagelok® vacuum-tight Feedthrough for 10 mm tubing
- Argon in: Swagelok® vacuum-tight Feedthrough for 6 mm tubing (1 per line)
- Current: High current vacuum-tight Feedthrough with socket on both sides (2 per line)

The plate is fixed to the glovebox body by 8 bolts (M8) and tightened with silicon or rubber seal.

10.3.2.5. Water Flow Switch

The water flow switch is usually put into the water outlet line of the Feedthrough plate and monitors the cooling water flow. It is connected to the safety line.

- Upper threshold (contact closes): 2 - 3 l/min (for one Burner – Multiply by number of burners for total flow!)
- Lower threshold (contact opens): 1.5 – 2 l/min (for one Burner – Multiply by number of burners for total flow!)

10.3.2.6. Control Cables

The control cables are made to measure.

- Cable to water flow switch (Safety Line)
- Cable to foot switch (Foot Switch)
- Cable to DC-Power Supply (To Power Supply)
- Cable to shunt at power supply (Current)

The cables to external control and status have to be made by the customer. The plug for control cable is supplied with the controller.

10.3.2.7. DC Power Cables

The power cables are made to measure. They are copper cables with a cross section of 16mm² and furnished with the necessary plugs. The insulation material of the cables is silicon. The surface of the cables can get warm (max. 50 °C) especially at high plasma currents of 100A and more and long "high" periods.

10.3.2.8. Cooling System

Neslab chiller, operated with distilled water, flow is monitored by flow switch, insufficient flow creates a failure to the safety line on the plasma controller (MB-PL-C4)

10.3.3. System Description

The MBraun Plasma Burner System has been designed for safe automatic operation. All adjustments and selections are made at the central controller.

A system overview is given below (Fig. 9).

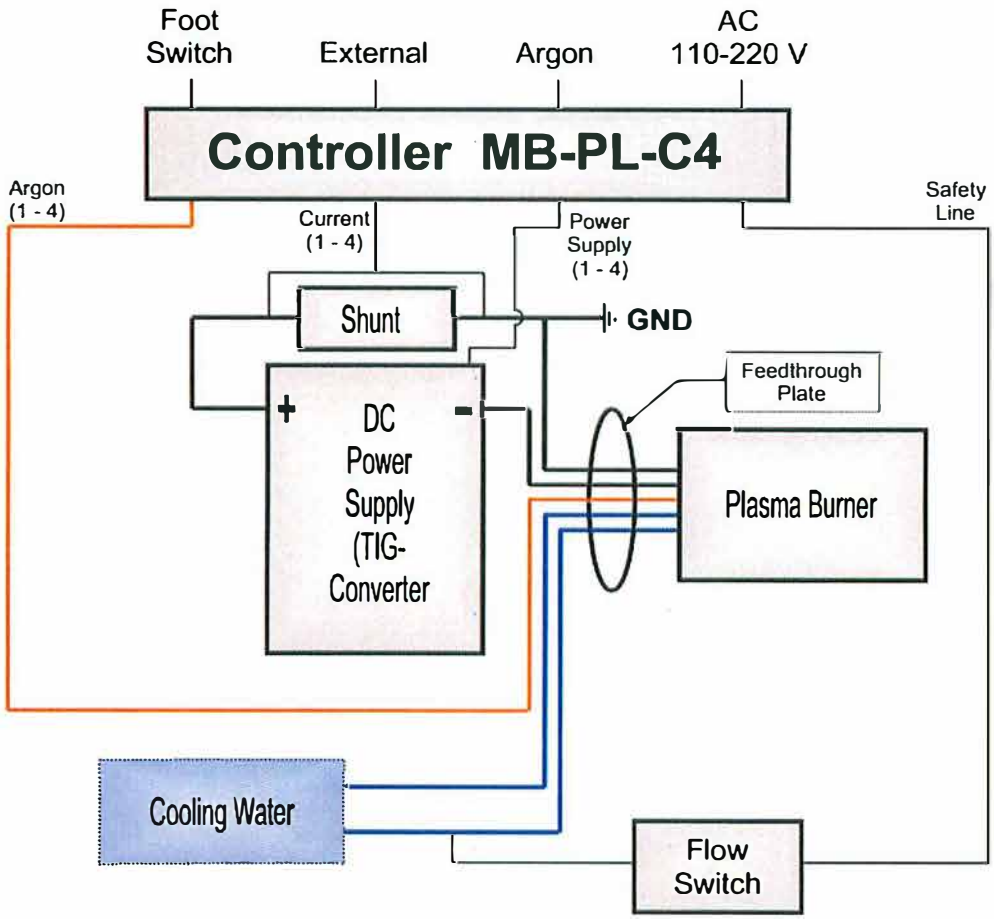


Fig. 9: Plasma Burner System Schematic

Warnings:
The MBraun Plasma Burner system has been designed especially for use of an Argon plasma flame in an Argon filled glove box. Use in other atmospheres may alter the specs and/or damage the burner head. The burner must not be operated in ambient air for any circumstances.

The plasma burners need a very clean (particles as well as ions) and cold water for long operational life. We recommend a separate electrically cooled cold well filled with distilled water for the cooling water supply of the burner heads.

The Plasma Burners emit an extremely hot plasma "flame" (several thousand degrees centigrade!) that may destroy material in less than a second and can cause severe burnings of skin (even through gloves, which melt immediately when exposed to the plasma!) The use of the plasma is fully under responsibility of the customer (operator) and only experienced or trained people should handle it. Additional shielding and safety switches may be necessary to protect operators.

The plasma emits an extremely intensive visible and UV radiation. Do not operate the plasma burner unless the eyes of the operators are protected (protection grade as for TIG welding!). Plastic and rubber material directly exposed to the UV radiation may rapidly age and become brittle and mechanically unstable. Proper shielding of the radiation is highly recommended.

The Plasma Burner electrodes are mounted on an insulation plate. Do not connect any of the metal parts of the Anode to other ground parts to avoid ground loops! Keep away any metal parts from the Cathode at least 50 mm to avoid spurious plasma ignition.

The plasma burners have two modes of operation: stand-by mode (Plasma Low) and working-mode (Plasma High). Normally the burners are in stand by mode to prolong the life of the electrodes and to save power and gas. They can run for long time in this "Low Current" state. So the critical ignition of the plasma with the high frequency high voltage has to be done only after longer intervals where the whole system is switched off. The preset of the low current can be done with the "LOW" potentiometer. The burners are switched to work mode only for a short time when melting of quartz tubes is in progress. Adjustment of the high current is done with the "HIGH" potentiometers.

When the controller MB-PL-C4 is powered, the red "STOP" light is on indicating that the plasma burners are off. The "ON" push button does not work in this state.

If the cooling water flow and the plasma Argon pressure are within the specified range, the "Safety Line" LED is on (green). This safety line can be daisy chained and has the highest priority behind mains power to control whether the plasma can be on or off.

The plasma burner lines can be activated or deactivated line by line by the key switches. If this switch is ON, the gas valve for the respective line opens. When operating the pushbutton "GAS HIGH" the flow-meter shows the Argon flow through the burner; the flow can be adjusted with the needle valve below. A small gas flow bypasses the "GAS HIGH" valve to allow the low plasma operation (stand by), but if the line is switched OFF with the key, there is no flow at all. This has been made to save Argon gas.

Note:
Activating a line by means of the key switch does not automatically mean to switch on the plasma of this line, but only puts this line into the main cycle. Deactivating a line means switch the burner off independent of the main cycle.

Activating the pushbutton "ON" when the safety line is ok will start the plasma burners (Ignition) that are switched on and will set them to standby mode. The pushbutton "ON" lights green and also the LED's of the activated lines are on. If the plasma of an activated line does not burn within the preset current limits, "FAIL" will be indicated (red light) and the system goes into the "OFF" state within 1 second. OFF state means that all burners of the controller are OFF. The "Fail" condition is reset with the "ON" pushbutton

To activate the plasma burner for the high current operation, the DC-Power Supply gets the preset value from the "HIGH" potentiometer. The FAIL-electronics also switches to the higher threshold to watch the high plasma current. The controller allows two procedures to perform the "HIGH CURRENT" operation of the plasma burner:

1. **Set the key switch to "MANUAL"**
   The gas flow stays HIGH all the time. During activation of the foot pedal or external relay (contact) the plasma of the burner(s) works with the HIGH current. If the contact is deactivated, the plasma burns with the LOW current. Adjustment of the high current is easily done for each line in this mode.

2. **Set the key switch to "AUTO"**
   The gas flow stays low. When the foot pedal or the external relay is activated, an automatic cycle starts independent of the duration of the activation signal: The gas switches to HIGH, after a time interval t_1 the plasma goes HIGH for a time t_2, and then the gas stays HIGH for another time interval t_3. The time intervals are programmed in the PLC (LOGO).

If one of the following conditions occurs:

- The safety line is disabled (water, gas)
- The "OFF" pushbutton is pressed
- The FAIL condition occurs (plasma current too low)

While the system is in any status described above or during the standby mode all burners are switched off immediately and after one second the gas flow is set to LOW.

The DC Power Supplies operate with the controller and do not need any operator activity. If they do not work, the FAIL signal will indicate that no plasma current is present.

The actual plasma current is displayed for each line by a front panel display. This display as well as the control circuits of the plasma current uses the voltage drop (in mV) across a shunt of 1 mΩ that is mounted on top of the TIG power supply. So 1 mV corresponds to 1 A.

Warning:
The remote control of the Kemppi power supplies by the controller is only possible when all front switches of the Kemppi Mastertig 1500 are set properly (see also warning label at the power supply). A wrong setting can disable the shutoff possibility described above. This could destroy the burner completely and bring water into the glovebox

10.3.4. Operation (Software 8V1.0)

10.3.4.1. First Setup

Note:
The description in this paragraph assumes that all electrical, gas and water connections are installed properly by **MBRAUN** and the box is still open to facilitate the mounting of the burners.

1. Check that all control cables to the controller unit (see encl. drawing "Plugs and Sockets") are connected properly. Each TIG Power Supply has own control cables (Line 1, 2, 3). The sockets at the rear side of the controller are different to avoid wrong connections.
   Check carefully that Line 1 control cables go to Line 1 TIG power supply etc.

2. Check connection of the foot switch to the socket "Foot Switch"

3. Check connection of the DC power lines from TIG power supply to the Feedthrough plate.

4. **Check carefully, that:** Line 1 plugs are in Line 1 sockets etc.
   (+) and (-) plugs are in the respective sockets.

5. Check connection of the protective ground cable of the DC power line to the box (screw). This cable is connected with the + cable coming from the shunt.

6. Check connection of gas lines (GAS OUT) of Line 1 to the Feedthrough plate Line 1, etc.

7. Connect the Argon gas (Quality 5.0 or better) to the controller GAS IN. Use high quality pressure reducers suited for high purity gas! Adjust the gas pressure to 0.2 MPa (2.0 bar) up to 0.3 MPa (3.0 bar).

   Note:
   If you use a new gas bottle it is recommended to apply a cleaning cycle several times: Open the bottle valve for a second while having the outlet of the pressure reducer closed. Let the gas stabilize for some seconds, then open the outlet valve until the pressure is zero. Close the outlet valve. - This procedure removes oxygen even from the cavities of the pressure reducer and assures the quality of the Argon that is in the bottle.

8. Switch on the power of the controller. The red light of the pushbutton "OFF" must be on.

9. Switch lines to be used to ON (line 1 to 3) by means of the key switches.

10. Press the small button "GAS HIGH". Now the flow-meters of all lines must show a flow of around 100 l/h. If not, check the gas supply line to the controller and the gas pressure! Release the button and switch mains off.

11. Check connection of the burners inside the box with the DC power lines. Watch the Line number and the polarity! Check connection of Water-In, Water-Out and Argon hoses to the appropriate connectors. Watch the Line number, too! Be sure the Swagelok® connectors are securely fastened and tight. Do not apply too much force!

12. Check the cooling water line outside the box. The line must be connected to the chiller operated with distilled water (recommended) or a clean and cool water supply (see data 10.3.2.2). Activate the cooling water supply and check the pressure. Check the water connections inside the box for tightness!

13. Now the box should be hermetically closed, flushed and operated under Argon.

Warning:
The plasma burner must not at all be operated under air or gas containing more than 100 ppm of Oxygen. Even if the Argon supplied to the burner is Oxygen-free the plasma flame sucks Oxygen from the side and so the tip (Nozzle) will be oxidized and destroyed.

10.3.4.2. First operation

It is assumed that the box is under Argon and the Oxygen content is below 100 ppm.

Warning:
The plasma burners now must be in a safe operation position! This includes the safety distance to the tip of the burner as well as the necessary shielding against light and UV-radiation of the plasma flame. (see also 10.3.3: Warnings)

1. Switch on the power of the controller (power switch on rear panel). The red light "OFF" must be on.
2. Apply the Argon at nominal pressure
3. Switch on the cooling water (chiller)
4. Now the LED "Safety Line" must be on. If not:
   Check the control cable "Safety line" from the back to the flow switch.
   Check the cooling water flow and pressure
   Check the Argon pressure (all valves open?)

Note:
The flow switch for the cooling water has been adjusted for a minimum flow-rate of approx. 0.75 l/h for each line, so 2.25 l/h for the three-line assembly. It can be checked by removing the plug of the flow-switch and measuring whether the switch is closed (enough flow-rate) or opened. Usually the pressure of the water is too low when the switch is not activated. One reason can be that the back-pressure of the cooling water at the outlet of the flow-switch is too high. This results in a lower differential pressure of the cooling water between water In and Out and so in a lower flow-rate.

5. Set the key-switch AUTO / MANUAL to MANUAL (check corresponding LED).
6. Set the key switch FOOT SWITCH / EXTERNAL to FOOT SWITCH (LED!)
7. Set the switch of Line 1 to on. Press the "GAS HIGH" pushbutton for at least 1 minute to flush all gas lines with clean Argon. Watch the flow meter; if necessary readjust the flow rate with the needle valve. The gas flow of line 1 must be at 100 l/h.
8. Switch the power (mains) of the TIG DC Power Supply of Line 1 to ON (Green light in the power switch must be on).
9. Press the foot switch down and hold it.
10. Now press the pushbutton ON. The plasma of line 1 must start immediately with a current of more than 50 A. If FAIL comes (and there is no bright plasma flame) check all steps above! Is Safety Line still on? If there is a flame but FAIL comes, the current fail threshold is higher than the actual plasma current. (see 10.3.4.5 and 10.3.4.6)
11. Release the foot switch; the plasma burns at low current (approx. 5 A). The flame may look unstable as the current is too low to fill the plasma chamber, this is normal.
12. Activate the foot switch again and the plasma burns immediately at high current.
13. Repeat from step 7 for the other lines (2 to 3).
14. Set the mode switch to AUTO. Watch the gas flow: it comes down to almost zero. The GAS HIGH LED is off.
15. Activate the foot switch. The gas flow will go up (GAS HIGH LED on), and then the plasma will go to HIGH (LED). The automatic cycle ends, when the foot switch is released. (The GAS HIGH will go down after a short delay).

10.3.4.3. External control

The 4-pin socket "EXTERNAL" of the controller allows starting the PLASMA HIGH cycle by an external potential-free relay contact. The MB-PL-C4 has to be switched to EXTERNAL by means of the key switch. This disables the "FOOT SWITCH" input and enables the EXTERNAL input. For the pumping filling system "EXTERNAL" is the normal mode of operation. The automatic cycle is started by a signal from the main panel of the pumping filling system.

Warning:
Do not apply any voltage to the EXTERNAL INPUT. Do not ground any of the pins! Keep the input potential-free.

Depending on the position of the key switch MANUAL / AUTO activation (contact closed) of the external signal starts an action:

1. Set the key switch to "MANUAL"
   The gas flow stays HIGH all the time. During activation of the foot pedal or external relay (contact) the plasma of the burner(s) works with the HIGH current. If the contact is deactivated, the plasma burns with the LOW current. Adjustment of the high current is easily done for each line in this mode.

2. Set the key switch to "AUTO"
   The gas flow stays low. When the foot pedal or the external relay is activated, an automatic cycle starts, dependent on the duration of the activation signal. The gas switches to HIGH, after a time interval t_1 the plasma goes HIGH as long as the external signal/foot switch is high. After the signal goes to low, the gas stays HIGH for another time interval t_3. The time intervals are programmed at the PLC (LOGO).

10.3.4.4. Setting the times in automatic mode (LOGO 8V1.0)

The PLC (LOGO) display in normal operation shows the state of inputs and outputs. A high [TRUE] input is shown in reverse mode, an activated output [HIGH] is also shown in reverse mode. This makes diagnostics easier in case of problems with the control unit.

Starting with LOGO firmware Version 8V1.0 there are no user settable parameters for the LOGO PLC. Adjustment of melting time is done from the Parameters screen of the pumping filling system.

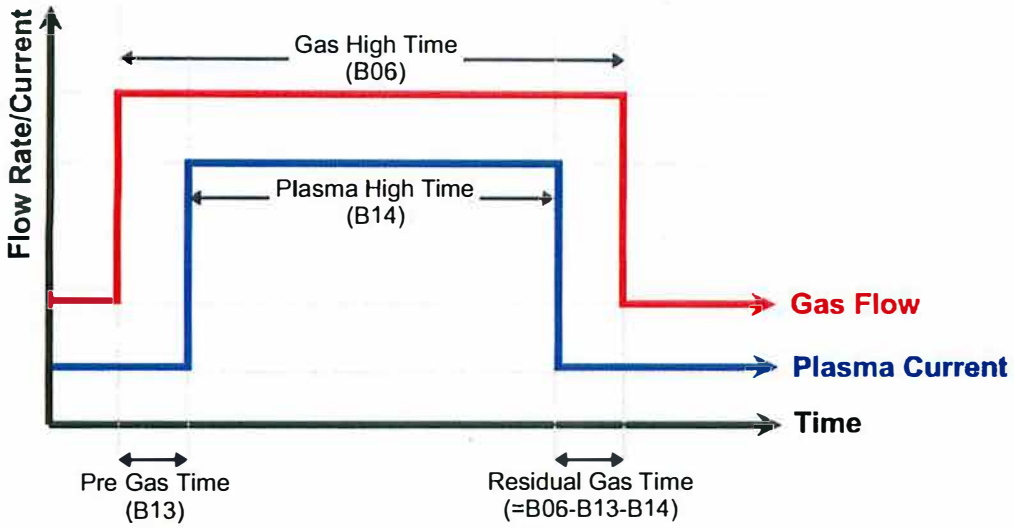


Fig. 10 : Plasma Controller automatic mode timing

10.3.4.5. Plasma Current setting

The TIG converter supplies a stabilized DC current. The setpoint of this current is adjusted by the two front panel potentiometers HIGH and LOW that are located on the Plasma jet Controller (MB-PL-C4).

To adjust a new setpoint, the plasma must be ON (burning). Use a small screwdriver for tuning of the current potentiometers. Don't turn the potentiometers over the minimum and maximum stops.

- Setpoint LOW: turn clockwise to increase the current to the desired value. Watch the reading of the meter.
- Setpoint HIGH: Set switches to MANUAL and FOOT-Pedal. Switch on key-switch only for the line you wish to adjust. Activate foot-pedal, watch the PLASMA HIGH LED. Now the HIGH current can be adjusted. Make sure not to operate the plasma at high current for to long to avoid damages to the pumping filling system by overheating (<= 30sec is safe). Release foot pedal.

Note:
If the plasma current is below the limit value, a fail condition occurs! To operate the plasma burner at very low currents it may be necessary to adjust the limit values. (See 10.3.4.6)

10.3.4.6. Current Limit Value Setting (FAIL – condition)

Warning:
The operations described below are not necessary for normal plasma burner operation. Since change of these settings can invalidate safety features, we recommend contacting MBRAUN service for these operations.

For safety reasons the controller MB-PL-C4 contains an independent control electronic to monitor the plasma current and to trigger an alarm (FAIL) if one of the lines is working at a too low current. If FAIL occurs, the controller is set to OFF mode, i.e. all burners are switched off immediately. Activating the ON pushbutton resets FAIL and starts the burners, but if the FAIL-condition is still valid, FAIL is set again after 1 – 2 seconds.

Note:
FAIL is not activated by any failure condition of the SAFETY LINE. A failure condition on the safety line sets the controller into OFF mode only and so also switches off all burners.

The control electronic has two limit values for each line, one for the LOW plasma current and one for the HIGH plasma current. Switching the plasma between HIGH and LOW also switches the limit values of the control electronic. The actual value for the current is taken from the shunt in the + line of the burner's current cable. 1A corresponds to 1 mV across the shunt. This value is also used for the display of the actual current.

The values are factory set to 5 A LOW and 50 A HIGH. Accuracy is +- 5% (or 1A, if greater).

Notes:
The FAIL thresholds are not designed to control the accuracy of the plasma current! They should be only used to trigger at major faults. So it is strongly recommended to set the thresholds not higher than 90% of the nominal current (better 80%).

To change the limit values the controller MB-PL-C4 has to be disconnected from all rear connectors and after loosening the 4 front screws pulled out of the table top case.

Warning:
The following procedure has to be performed only by skilled electronic experts. Special care has to be taken to avoid electric hazard, as near the mains connector and at the short line to the 24 V power supply the mains voltage is present. All other parts of the controller only operate with 24 VDC, but may be delicate electric or electronic parts.

The electronic board is located at the right side of the controller (seen from front). The board contains four pairs of potentiometers (one pair for each channel) and a single potentiometer that should not be changed.

The LEDs beside the potentiometers are ON if the actual current is less the limit value.
The LED HIGH is on when the thresholds HIGH are active.
The LED FAIL indicates that the FAIL condition comes (short pulse)
The Jumper JP1 allows switching to the HIGH condition when connected.
Below each pair of potentiometers there is a test pin, the reference ground pin is near to the front.

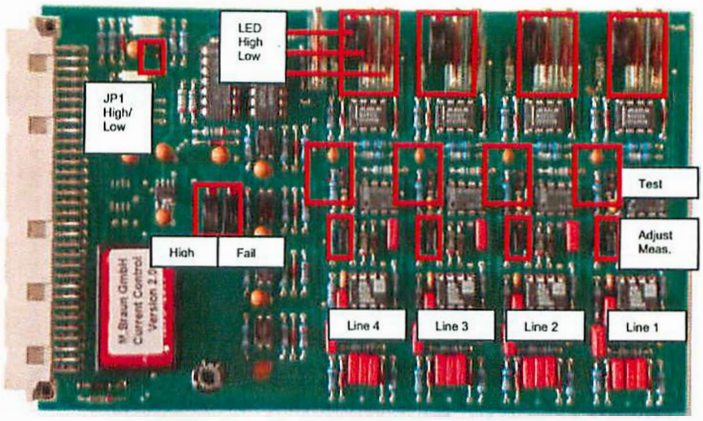


Fig. 11 : Plasma Controller PCB

Adjustment procedure:

1. Connect the controller to mains. **See warning above.**

2. Connect a high impedance digital voltmeter between GND pin (⊥) and test pin (+) of line 1. There are jumpers right in place below each line. If the jumper is in the lower position (away from the pots) the front display shows measured values (in A), if it is in the upper position the display shows the failure threshold value (in A).
   Set the jumper of line1 to upper position.

3. Check that Jumper JP1 High/Low is open (LED HIGH is off)

4. Adjust the Low-Pot of Line1 to the desired value displayed in display Line1.

5. Set the jumper to the two pins of JP1 High/Low (LED HIGH is on)

6. Adjust the High-Pot of Line1 to the desired value displayed in display Line1 to set HIGH limit current (the limit current is always the lowest current that does not yet trigger a FAIL condition! So LOW and HIGH indicate the current in the Plasma LOW and Plasma HIGH mode!)

7. Repeat steps 3 to 6 for all Lines that are supplied in the specific controller. The board has always four lines!

8. Remove the High/Low jumper JP1

9. Set all other jumpers to the Lower Position, then measured values are displayed instead of the threshold values (That is: Now all lines must display 0 A (+- 0,5 A))

Then the controller MB-PL-C4 can be reinstalled to the original position and connected to all electric and gas lines.

Note:
It is recommended to perform a test after reinstallation (do not forget to flush the Argon line carefully before starting a plasma).

10.3.5. The Plasma Burner MB-PL-B1

10.3.5.1. Description

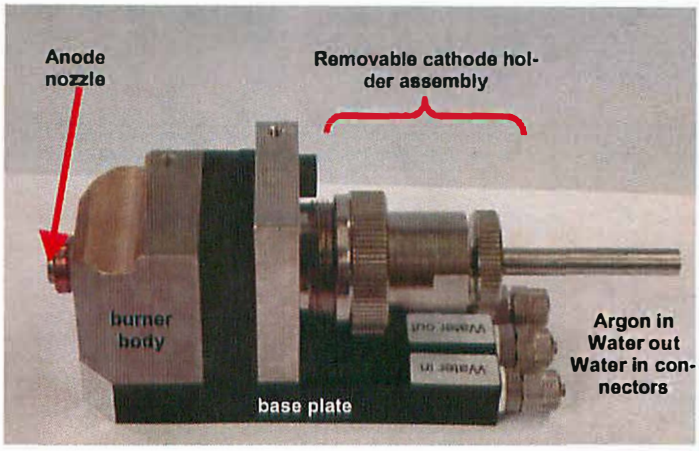


Fig. 12 : Plasma Burner MB-PL-B1

The MB-PL-B1 consists of the Burner body and the removable cathode holder assembly.

The body has a base plate made of Delrin®. The base plate has the connectors for cooling water and Argon. It has inner pipes to conduct the water and gas to the metal parts. The base plate supplies two holes M6 to hold the whole burner and so insulate the burner electrodes from ground. Usually the Anode potential is near to ground level (+ approx. 100 mV); the (hot) cathode level is at approx. –10 to –20 VDC referred to ground. High frequency ignition is always at cathode.

Notes:
Do not connect any of the metal parts of the Anode to other ground parts to avoid ground loops
Keep any metal parts away from the Cathode at least 50 mm to avoid spurious plasma ignition.

The two M6 holes are 75 mm from front end of the baseplate at 36 mm distance from each other (symmetrical to the long axis of the baseplate)

Warnings:
All other screws are for manufacturing purpose only! Never loosen any of the screws. There are no serviceable parts inside the burner.

Do not drill other holes to hold the burner.

The baseplate is fixed to the anode/cathode block. The larger anode has a central opening for the insulator and the cathode rod. The cooling water flows near to the Anode nozzle to remove the heat efficiently. The fixed part of he cathode holder is also water-cooled and separated from the anode by an insulator. The plasma gas (Argon) flows into a chamber between anode and cathode and then passes through the insulator pipe (ceramic) to the nozzle.

The cathode holder assembly consists of three parts (and the Tungsten rod) and allows fixing the cathode rod even outside the box, so that adjustment of the cathode is not necessary inside the box. The standard welding rods are longer than necessary and have enough spare length for many times grinding the tip.

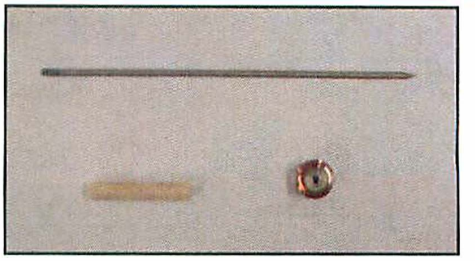
The fixed parts of anode and cathode have holes and screws to connect the 16 mm² Copper cables for the plasma current.

Warning:

Do not connect any of the electrodes to ground. The protective ground for the burner is at one point near the power supply only.

There are only three parts for replacement or field service:

1. The Cathode Rod
   Standard is MBraun Part Number 701 2010
2. The Ceramic Insulator
   Standard is MBraun Part Number 701 2011
3. The Anode Tip (nozzle)
   Standard is MBraun Part Number 701 2042

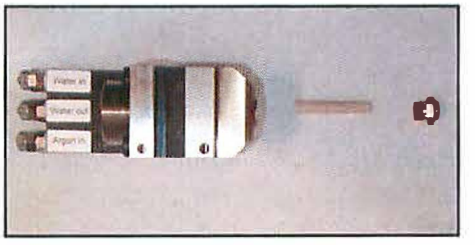


Note:
The plasma burning chamber is fully integrated inside the Anode Tip, so even "spurious burning" may only affect the exchangeable Anode Tip and not the anode body.

10.3.5.2. Exchange of the Anode Nozzle (Tip)

The anode nozzle is a bimetal device with a centre part made of Molybdenum and a screw part made of Copper. This has been designed to increase the heat transfer between the nozzle and the anode body.

The nozzle can be loosened and tightened using a 15mm open-ended wrench. To screw in a new nozzle do not use a tool but do it with the hand first. The new nozzle should fit easily and without force, so that a wrench is needed only for the last degrees of turning. Be sure that the ceramic insulator is in place.



Warning:
Do not use too much force to tighten the nozzle. The Copper screw and its Copper counterpart are quite soft metals and will be destroyed by high force.

Note:
The ceramic insulator tube must slip into the nozzle when the nozzle is screwed in. If there is a higher resistance when screwing the nozzle manually, take the nozzle and the insulator tube out and try how the tube fits into the back of the nozzle. It should easily slip into the copper part until it reaches the Molybdenum part. If it is too narrow, the copper opening has to be machined to 8 mm (+0.8 mm) inner diameter.

10.3.5.3. Exchange of the Ceramic Insulator

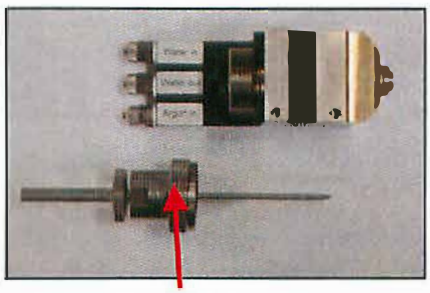
The ceramic tube can be easily exchanged when the Anode nozzle has been removed (see 10.3.5.2). When inserting a new tube, be sure that it slides into the anode easily, otherwise check for foreign particles in the bore hole.

Note:
The Ceramic material is very hard but brittle. Avoid mechanical shock.

10.3.5.4. Exchange of the Tungsten Cathode Rod / Grinding and Adjustment

Step 1: Remove cathode assembly

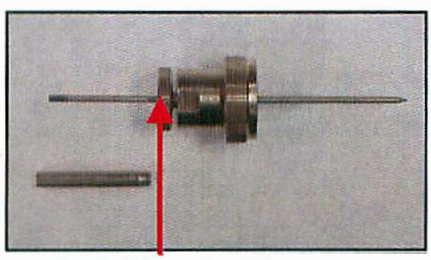
Remove the whole cathode assembly by unscrewing the large knurled screw and pulling out the Tungsten rod completely. The cathode assembly can be taken out of the glove box, so that the adjustment can be done outside the box.



cathode assembly knurled screw

Step 2: Remove cathode

Remove the cathode protection tube and loose the cathode holder knurled screw. Remove the cathode rod.



cathode holder knurled screw

Step 3: Grinding the Tungsten Rod

The standard grinding angle is 30° (factory delivery). Different angles may be used depending on special plasma shape and current. The grinding should be lengthwise parallel to the axis of the rod to have longest stability of the tip. A special grinding machine with automatic rotation of the rod is available.

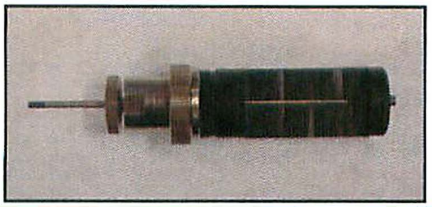
Step 4: Adjustment of Cathode (Tungsten) Rod

Note:
The correct burning of the plasma and the long life of cathode and anode of the burner depends strongly on the accurate adjustment of the cathode tip in relation to the anode nozzle.

Step 4a: Longitudinal Adjustment:

Note:
It is essential that the plasma burns primarily inside the Anode nozzle. Therefore the tip of the Tungsten rod must be behind the surface of the anode but still within the limits of the Molybdenum nozzle.

First fasten the cathode assembly without the Tungsten rod. Then insert an accurately ground tungsten rod until it touches the adjustment screw. Turn the rod by hand and look for straightness of the rod.



Note:
If the rod is bent, the tip of the rod cannot be centred in the anode nozzle! Then use a new cathode rod.

Fasten the rod with the smaller knurled screw. Then unscrew the large knurled screw and pull the assembly out of the tool. Remount the cathode protection tube.

The cathode assembly is now properly adjusted and ready to be mounted on the plasma burner by just inserting the Tungsten rod and fastening the large knurled screw.

Note:
If you use the adjustment tool for the first time it is recommended to adjust the tool with a well working cathode assembly prior to removal of the rod.

The tip of the cathode rod must be centred in the anode nozzle hole. Small misalignment can be changed by loosening and turning the whole cathode assembly and fastening it again. Eventually the procedure must be done several times

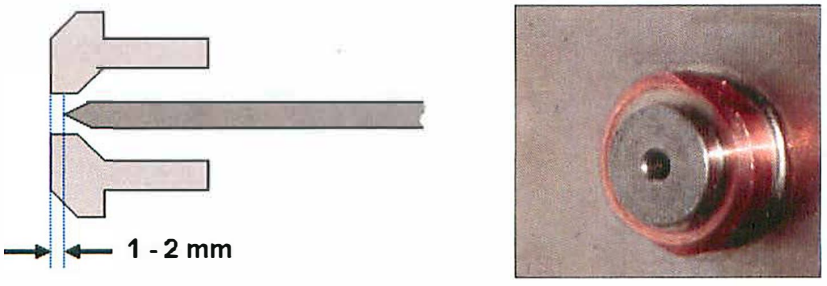


Fig. 13 : Correct position of cathode tip

Step 4b: Centring Adjustment

Usually this adjustment is not necessary as narrow manufacturing limits automatically bring the Cathode tip into the centre of the Anode Nozzle. In some cases, however, there are minor misalignments that can be easily adjusted properly when the Cathode Assembly is rotated until the tip is centred.

To do this:

- Be sure that the longitudinal adjustment has been done properly
- Open the large knurled screw of the cathode assembly one turn (**Attention:** Do not loosen the small knurled screw as this would destroy the longitudinal adjustment!)
- Turn the whole cathode assembly until the Tungsten tip is centred best.
- Fasten the large curled screw again.

10.3.5.5. Adjustment Tool

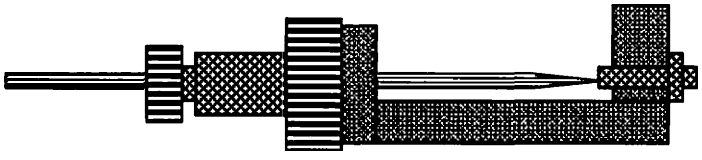


Fig. 14 : Adjustment Tool with the cathode assembly

The cathode assembly adjustment tool is first set up in the factory. However it may be necessary to readjust the tool. Use a new and well working complete cathode assembly (with the Tungsten rod); fasten it to the Adjustment Tool. Then adjust the small screw of the tool so that it just touches the Tungsten tip. Fasten the lock nut. Remove the cathode assembly.

Now the tool is ready to reproduce the accurate length of the Tungsten rod in the plasma burner. There is no need any more to adjust it in the burner (with gloves in the box).

10.3.5.6. Skew / Distance adjustment of plasma burners (3 torch system)

The distance from the centre and the skew angle of the burners in a three burner system can be adjusted for every single burner independently. The distance from centre is adjusted by means of a knurled screw. To do this it is necessary to loosen/remove the screws that fix the burner sledge first.

The skew angle can be adjusted be loosing the fixing screw (8mm open ended wrench) and shifting the rear of the burner in horizontal direction. After adjustment the screw must be tightened again.

It is recommended to set the plasma burner holding plate to the service position by means of the main panel push buttons for the adjustment operations described above.

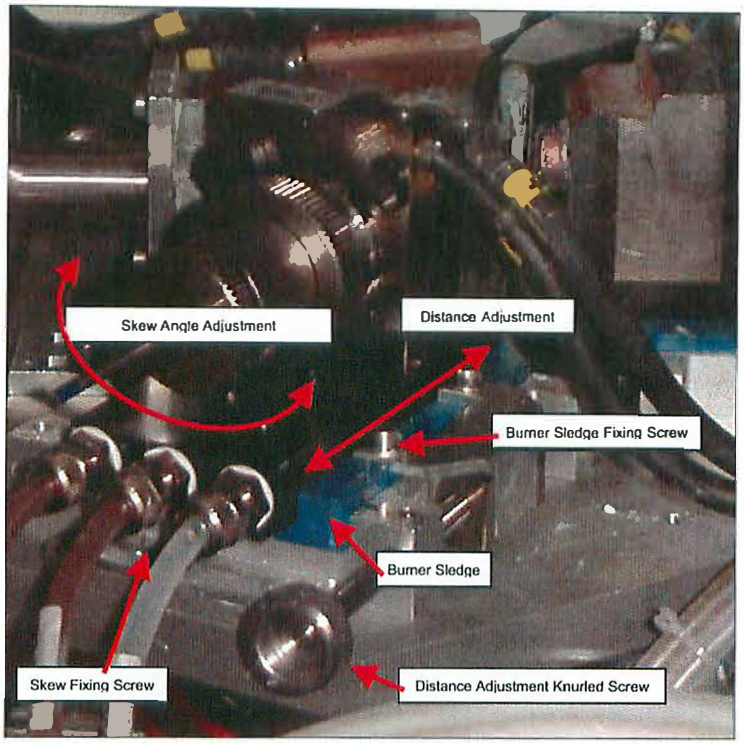


Fig. 15 : Plasma burner skew and distance alignment

The distance from centre should be the same for all the 3 burners. To ensure this, a burner adjustment spacer (made of Aluminium) was provided with your system. To adjust the burners apply the following steps:

1. Set the plasma holder plate to service position
2. Un-mount the SiO2-removal pipe
3. Set the plasma holder plate to working position
4. Insert a sample tube into the pumping filling head
5. Set the plasma holder plate to service position again
6. Loose the burner sledge fixing screws, use the knurled screws to set the all 3 burners to maximum distance from centre
7. Remove the tube from the head, but hold it in hand, slide the adjustment spacer over the tube and reinsert the tube into the head. The spacer is now in the room before the 3 plasma nozzles.
8. Use the distance knurled screws to shift every single burner to the centre so that the burner nozzles just touch the spacer
9. Loose the skew fixing screws and adjust the burners that the nozzles are centred exactly to the middle of the sample tube. Fix the skew screws.
10. Remove the sample tube and spacer
11. Remount the blower pipe
12. Set the plasma holder plate to working position

Each burner should now have the same distance from centre. Now only little corrections should be necessary to achieve a regular melting of the quartz tubes. Exact position of burners can be found be use of sample tubes and observation of the plasma flame by means of a welding view protection glass while the burner plate is in the service position (Use foot switch for manual operation of plasma burners).

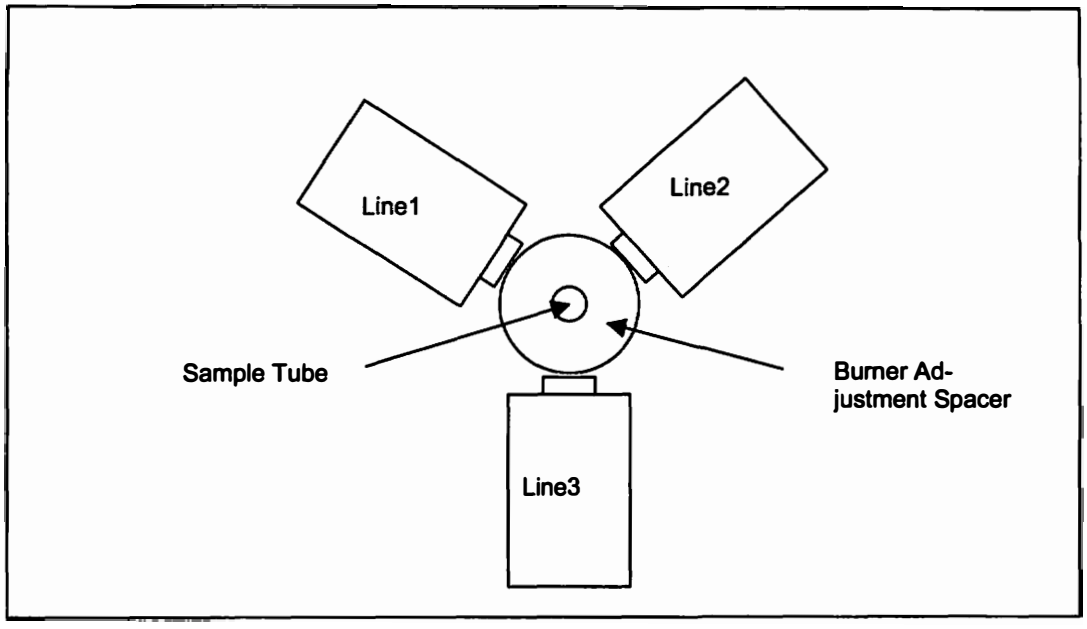


Fig. 16 : Alignment of 3-torch system

10.3.6. The Power Supply MASTERTIG 1500

For detailed data see MASTERTIG 1500 Operation Instructions!

Warning:
The safe operation and control of the MASTERTIG 1500 in combination with the MBraun Controller MB-PL-C4 and the Plasma Burner MB-PL-B1 depends on the correct setting of the front panel switches of the MASTERTIG 1500! Always check the correct setting before first operation! We recommend to seal the front window with a tape after connection of the control cable, so that any change of the setting is made impossible

10.3.6.1. Setting of the controls:

- All potentiometers must be at zero (left turn until stop)
- The Upper Right Switch must be in DOWN Position (in Manual Mastertig it is Switch S22, Page 4 and 11). This is the **2-Function position**, where a closed contact (X21 socket) starts the current and an open contact immediately stops the current.

Warning:
Wrong position of this switch (4-Function Position) disables the control of the ON-OFF function of the MB-PL-C4 controller and especially disables the failure-shutdown ability. This can lead to complete destruction of the burner and to water in the box.

- The Lower Right Switch must be in the MIDDLE position (in Manual Mastertig it is Switch S21, Page 4 and 11). This is the **"Spark Ignition" Position**, where a high voltage high frequency spark starts the plasma. Wrong position will not enable plasma in the burner.
- The Lower Middle Switch must be in the right position ("Remote Control") (in Manual Mastertig it is Switch S12, Page 2 and 10). Wrong position will set the plasma current to the value selected on potentiometer R11 (that should be at zero according to first point above – and so no plasma current will flow). In this wrong position it is not possible to select either HIGH or LOW current in the controller.

10.3.6.2. Operation

The Mastertig 1500 must be switched on before starting the plasma **(see 10.3.4.2 Point 8)** with the Power ON switch at the rear panel and the green Power light must be on. If the Mastertig is OFF or fails, the FAIL lamp (and relay output) in the controller will be triggered when the plasma is set to ON.

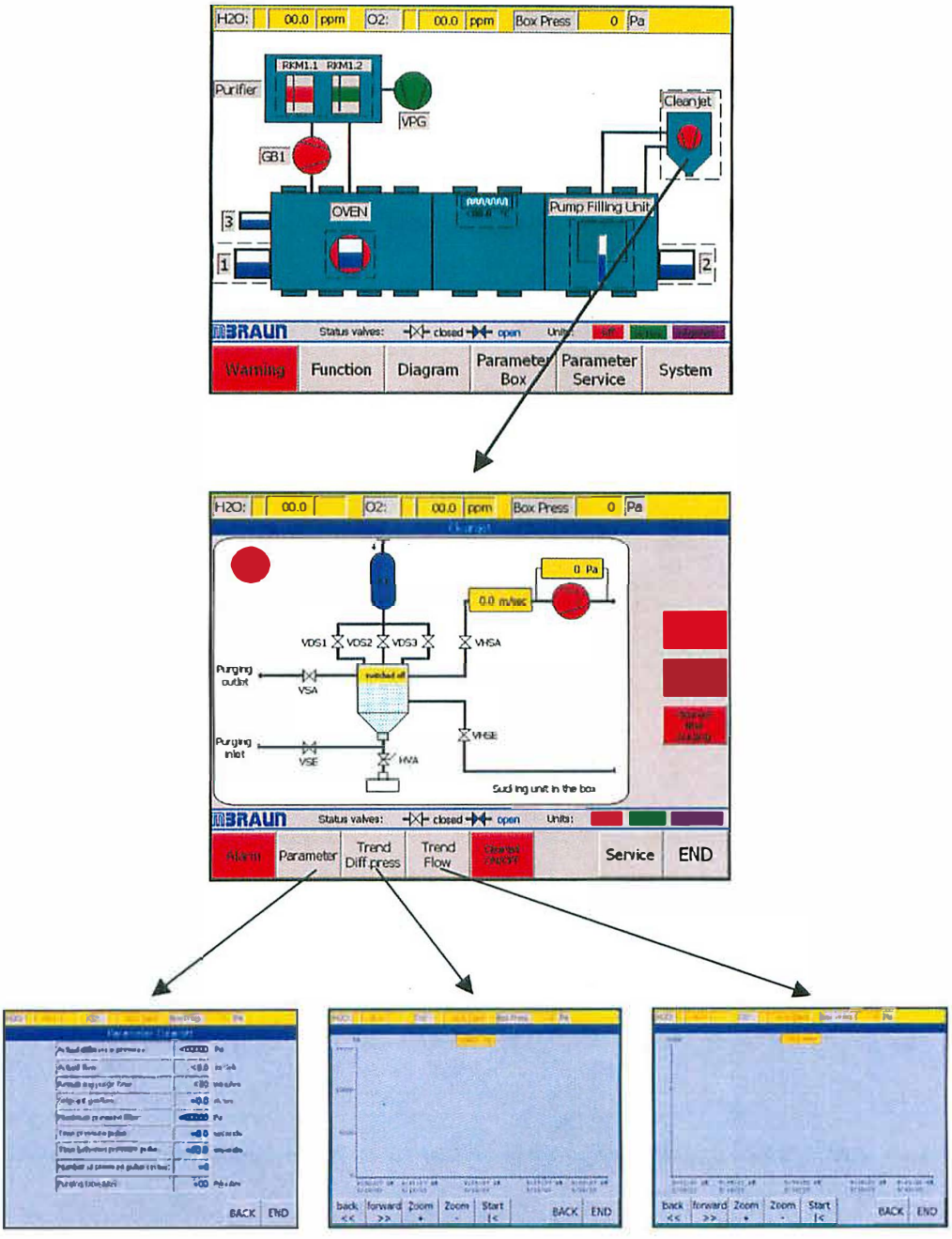
Warning:
Pay attention to the current / time limitations of the Mastertig (see operating instructions). When you exceed the rated power limits (in time) the Mastertig will shut down. In combination with the plasma burner, however, this is no practical limitation as the burner is also used in a pulsed mode at high current and in the continuous mode works only with a very low current.

10.3.7. Enclosures

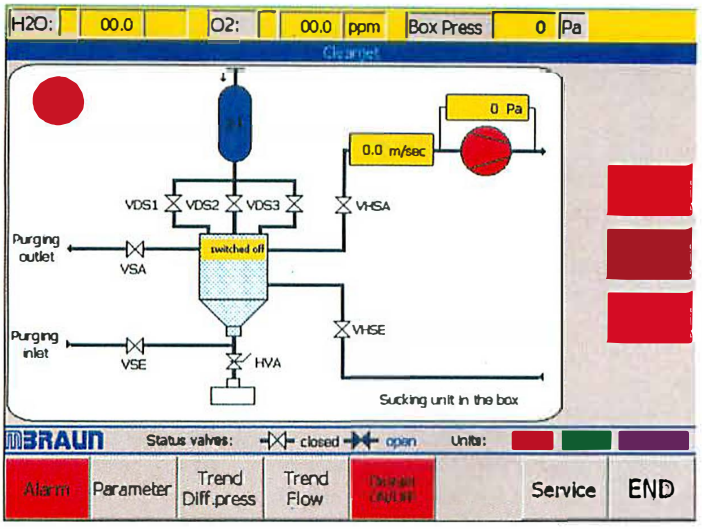
- **Mastertig 1500 Operating Instructions**
- **Logic Drawing of LOGO-Plasma5 V 2.13 Software**
- **Electric Drawing of Controller**
- **Status socket MB-PL-C4**
- **Control cable circuit drawings**
  - ***To Power Supply Cable***
  - ***Safety Line Cable to water flow switch***
  - ***Current control cable to shunt***
  - ***Foot-Switch cable (same as EXTERNAL)***

Contents

11.1 Overview of the Screens

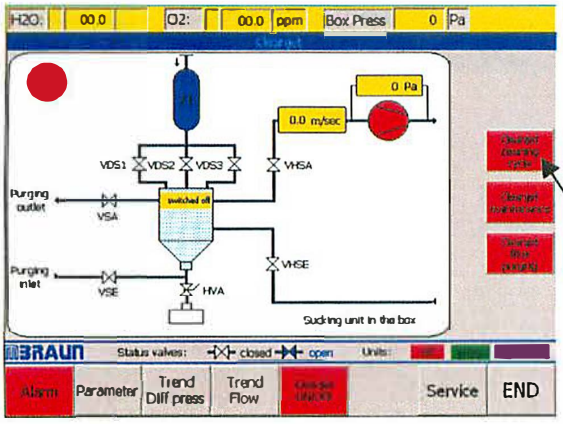


11.2 Main Screen – Clean-JET



The main screen displays an overview of the **Clean-JET** system.

The functions for activating/deactivating **Clean-JET** are made by selecting the "Cleanjet ON/OFF" button.

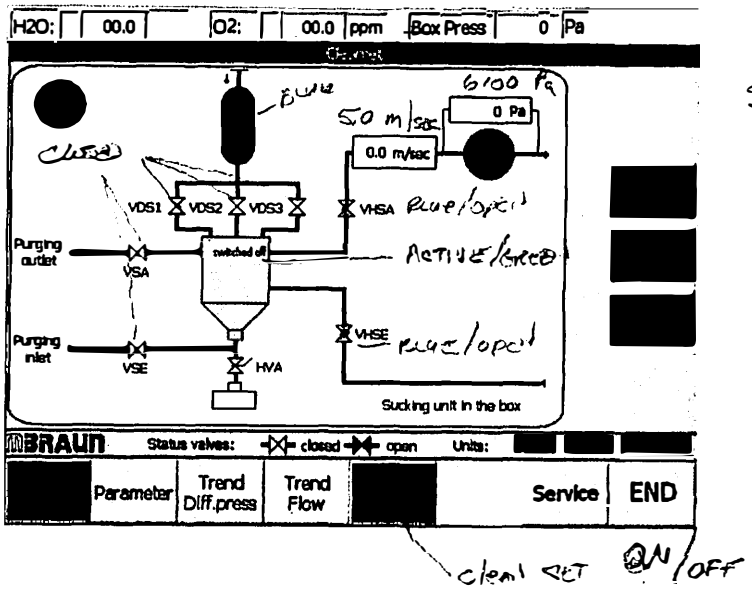


When the filter is exhausted there would be an increase in the differential pressure over the filter. If this difference pressure exceeds the setpoint "Maximum pressure filter" a warning will given on the Alarm/Warning Screen. This warning will indicate that the filter may require a cleaning process.

Before cleaning the filter the operator have to switch off the **Clean-JET**.

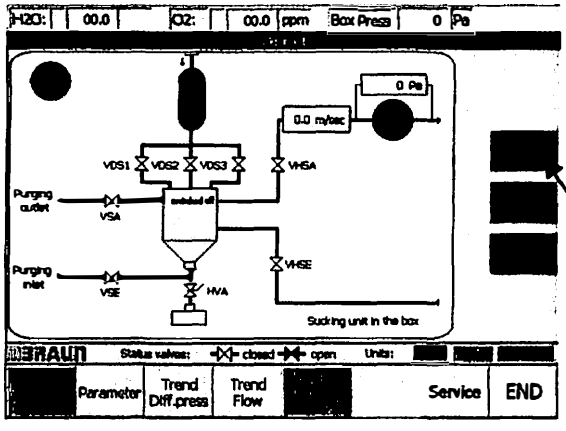
The "Cleanjet Cleaning Cycle" button starts cleaning process for the filter.

11.2 Main Screen – Clean-JET



The main screen displays an overview of the **Clean-JET** system.

The functions for activating/deactivating **Clean-JET** are made by selecting the "Cleanjet ON/OFF" button.

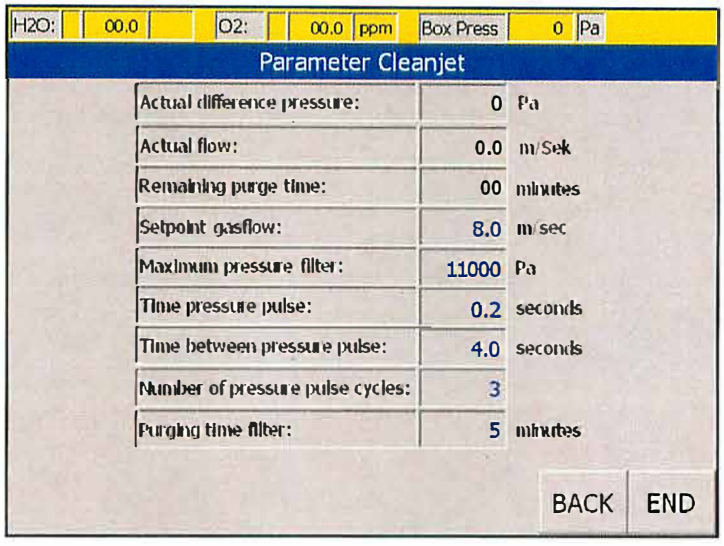


When the filter is exhausted there would be an increase in the differential pressure over the filter. If this difference pressure exceeds the setpoint "Maximum pressure filter" a warning will given on the Alarm/Warning Screen. This warning will indicate that the filter may require a cleaning process.

Before cleaning the filter the operator have to switch off the **Clean-JET**.

The "Cleanjet Cleaning Cycle" button starts cleaning process for the filter.

11.3 Parameters Screen



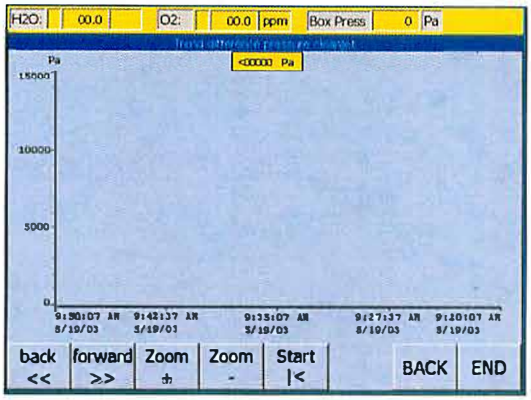
The "Parameters" screen is accessed by selecting the "Parameters" button on the main **Clean-JET** screen. The screen allows the user to define the settings for the **Clean-Jet** system.

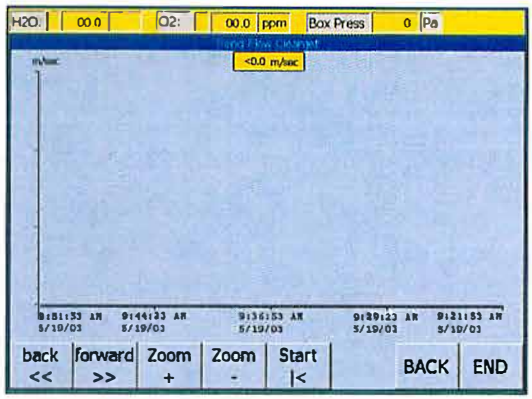
11.3.1 Parameter Definitions

Actual difference pressure:	Shows the difference pressure of the **Clean-JET** blower
Actual Flow:	Shows the gas flow through the **Clean-Jet** system
Remaining Purge Time:	Shows the remaining time for the **Clean-JET** purging process
Setpoint Gasflow:	This is the desired setpoint for the rate of gas flow through the **Clean-JET**. The default setting is 5 m/s. An extreme gas flow, either too high or too low, will inhibit the performance of the **Clean-JET.**
Maximum pressure filter:	On reaching this pressure a warning "Cleanjet filter is full, please clean the filter" will be displayed. Before cleaning the filter with the button "Cleanjet Cleaning Cycle" the operator has to switch off the **Clean-JET.**
Time Pressure Pulse:	Duration of pressure pulse
Time Between Pressure Pulse:	Duration of lapse between pressure pulses
Number of Pressure Pulse Cycles:	Number of cleaning cycles to complete on regeneration (cleaning) process. Range 1 - 9
Purging Time Filter:	Setpoint for total "Purging Time" for the **Clean-Jet** cleaning cycle.

11.4 Trends for Clean-Jet

The Trends screens for the **Clean-JET** are accessed from the Main **Clean-JET** Screen. The Screens are laid out in the same manner – each screen having the same function button available.





The trends screens are in the form of a time graph.

There are 5 buttons on all graph displays. With the ***back<<***, ***forward>>*** you can move along the time axis. With the ***Zoom+*** and ***Zoom-*** you can select a narrower or broader time frame. The **Start |<** button returns you to the current time.

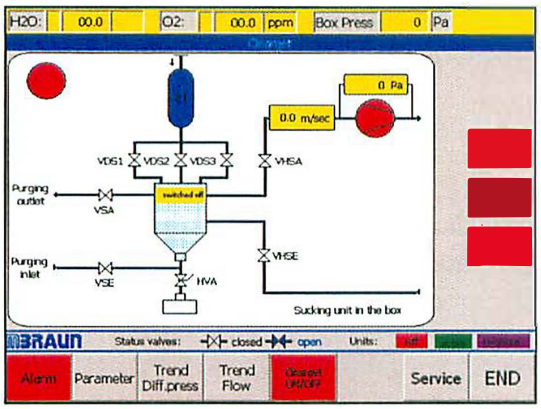
Above the "graph" area is a yellow information box that displays the current value for the difference pressure or flow-rate through the **Clean-JET** as appropriate.

The smallest time frame for the X-axis is 1 minute.

11.5 Clean-JET Filter Replacement

Caution:
Before exchanging the filter ensure that the system can not be operated.

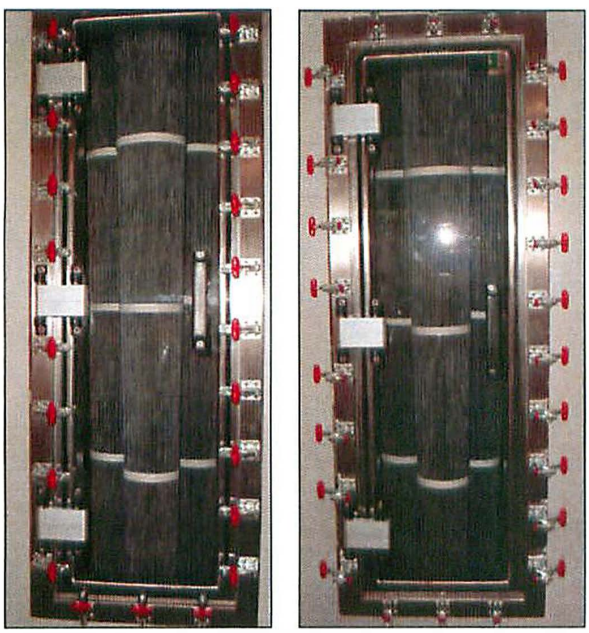
Note:
Tools and equipment required are –
Screwdriver, Allen key, Spanner, Dust Mask, Gloves and disposal container.
Refer also to local Health and Safety and Environmental Safety and Health Guidelines.



From the "Start Screen" on the main panel, select "**Clean-JET**" screen by selecting the "**Clean-JET**" icon

Switch off clean jet by selecting the "Clean-Jet ON/OFF" button at the bottom of the screen.

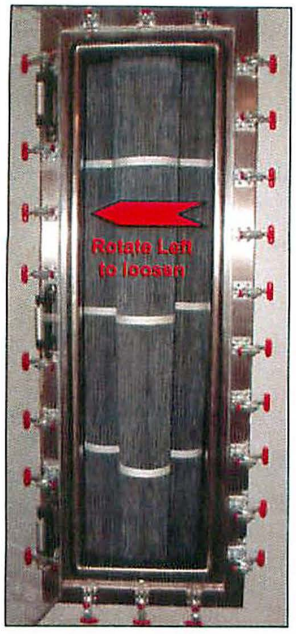
NOTE:
All pumping filling operations are blocked whilst the "**Clean-JET**" is switched off



Open all the quick release levers.

Open the front access door.

Using an industrial vacuum cleaner remove the loose dust from the filters and filter enclosure.



Remove the foremost filter by rotating it to the left, support the filter by holding the upper strap.

Lower the filter to rest on the cabinet floor, tilt it towards the cabinet door and carefully slide it out of the cabinet.

The other filters may now be accessed and removed in the same manner.

Remove dust from inside the cabinet and the front door using a vacuum cleaner.

Clean the Door Seal with lint free cloth and lightly smear with high vacuum grease.

Insert the new filters start from the rear left.

Ensure that each filter is carefully tightened, by rotating it to the right before inserting the next filter.

Close the front door.

Ensure that all the quick connect levers are correctly securing the door.

Caution:
Ensure that all threads and seals are both correctly aligned and tightened.

11.5.1 Purging the Clean-JET after filter maintenance

Note:
After exchanging the filters, the **Clean-JET** has to be purged because excess Oxygen flowing into the piping.

Removal of the Oxygen from the piping is carried out as follows:

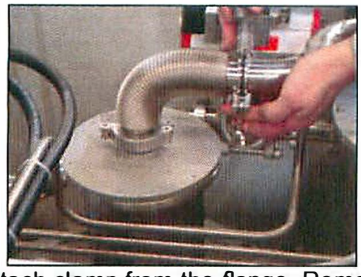
- On the main panel **Clean-JET** screen press "purge **Clean-JET**"
- wait for the preset purging time (parameter screen), recommended time: 15min
- switch on **Clean-JET** to continue pumping filling operation

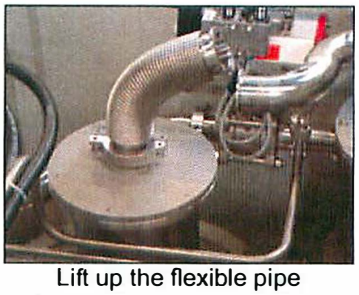
The **Clean-JET** is now prepared to continue operation.

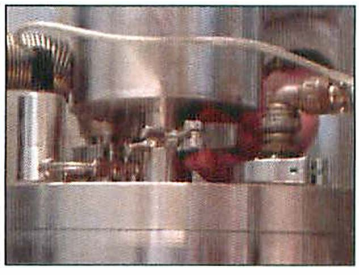
11.6 Clean-JET Safety Filter Replacement

1. Carefully remove the screws for the lower side access panel

2. Remove the cover.

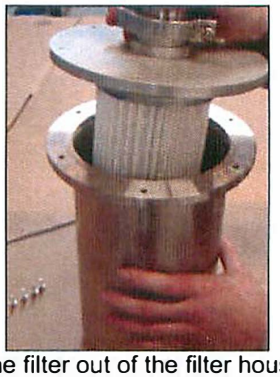
3. 
Detach clamp from the flange. Remove centering ring and O-ring seal cautiously

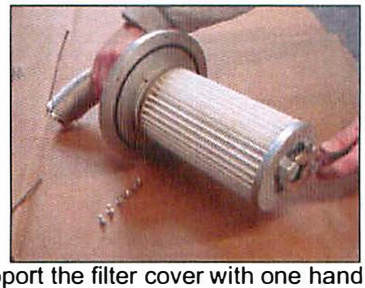
4. 
Lift up the flexible pipe

5. 
Detach clamp from the flange. Remove centering ring and O-ring seal cautiously.

6. 
Remove the filter housing carefully

7. 
Remove the Allen screws with a correct fitting Allen key

8. 
Lift the filter out of the filter housing.

9. 
Support the filter cover with one hand and loosen the filter with a spanner. Turn the filter counter clockwise until it is completely removed.

10. 
Take the new filter and turn the filter clockwise on to the filter cover

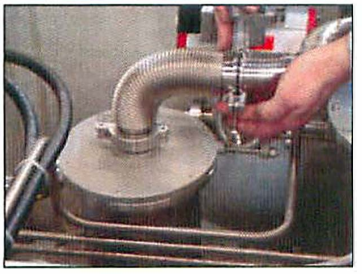
Fitting of the new filter unit is completed by completing the sequence in reverse

11.7 Purging the Clean-JET

Note:
After commissioning the system or exchanging safety filters, the **Clean-JET** has to be purged because excess Oxygen flowing into the piping.

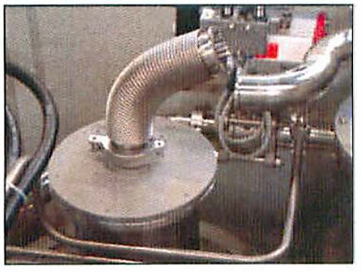
Removal of the Oxygen from the piping is carried out as follows:

1. Set the Glove Box to + 10mbar overpressure

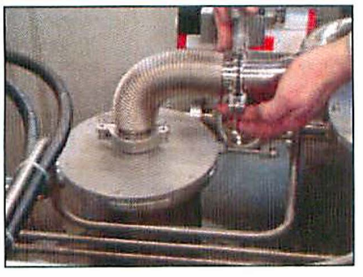
2. 

   Detach clamp from the flange that connects the Safety Filter's flexible hose to the Main filter inlet pipe.
   (this pipe usually runs to the to of the Clean-JET cabinet in order to connect to the filter head).

   Carefully remove the centering ring and O-ring seal.

3. 

   Leave the pipe open for at lease 2 minutes to allow the excess Oxygen flow out of the pipe.

4. 

   Replace the centering ring and O-ring seal, and re-clamp the flange connection.

The **Clean-JET** is now prepared to continue operation.

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Contents

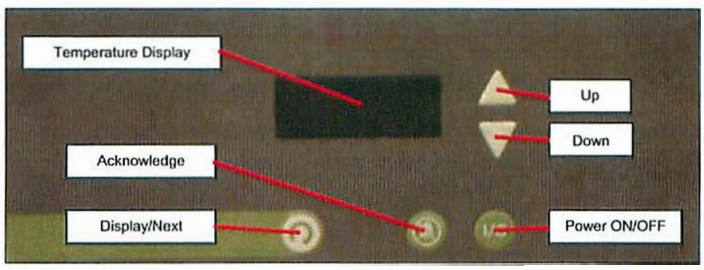
12.1. General Information

The NESLAB M25 chiller is a compact refrigerated recirculator used in the MBraun Plasma Burner System to cool the plasma burners by water circulation. There is one chiller for all three burners.

12.2. Operating Instructions

The chiller parameters are preset by **MBRAUN** to match the requirements of the plasma burner system. The information given here are only short instructions to operate the chiller and to set essential parameters. For detailed information refer to the manual of the manufacturer of the chiller which is part of your documentation package.

12.2.1. Front Panel



12.2.2. Power On/Off

First make sure that the main power switch located at the rear side of the chiller is switched to on (upper position).

Power on the chiller by pressing the on/off key on the front panel. The chiller pump starts and the actual temperature is displayed on the front panel display.
To switch off press the button again.

12.2.3. Parameter Display / Change

During normal operation the actual temperature is displayed on the front panel. The displayed value should be near/equal to the set point temperature.

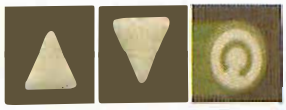
To display the other parameters press the menu/display key. By pressing the key the display cycles trough the values for set/low/high/actual temperature

Working temperature set point.
(recommended value : 20°C)

Lower warning level
(recommended value : 10°C)

Upper warning level
(recommended value : 35°C)

To change the values of parameters use the up/down keys. To set the new value press the menu/display key



12.2.4. Warning

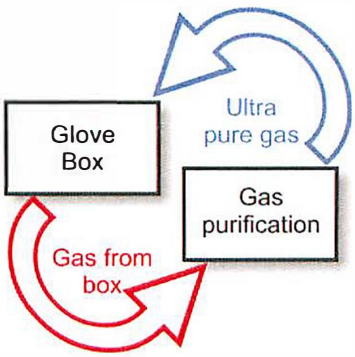
If the low or high warning level is exceeded the chiller sends an acoustic warning signal. This signal can be reset by pressing of the acknowledge key.

Contents

13.1. General Information

13.1.1. Circulation Mode

Figure 1: Principle of Circulation



MBRAUN systems work by the principle of gas circulation, i.e. the working gas permanently circulates between the glove box and the H_2O/O_2 gas purification system. This process guarantees absolutely stable values of gas purity and cost-efficient processing.

Caution:
When operating the Glove Box system the circulation mode should always be activated. Only in this case the atmosphere within the glove box is continuously purified to values down to < 1 ppm with regard to moisture and/or oxygen.

The circulation mode is PLC-controlled and is operated and displayed via the *TOUCH* Operation Panel.

When used for quite a long period in the circulation mode the purification unit gets exhausted resulting in a drop of the purification performance leading to increasing H_2O/O_2 values. For this reason, the purifier column should be regenerated regularly or at the latest when there is a visible drop in performance. Refer to the "Regeneration" chapter.

The circulation mode should be deactivated while the regeneration procedure is running.

In systems with 2 purifier columns circulation mode can run via one purifier column while the other purifier column is undergoing regeneration.

13.1.2. Regeneration Mode

If a purifier column is saturated after having been used for a longer period, using the standard regeneration process will reactivate the column.

Regenerating the purifier column in regular intervals is recommended. Do not wait, until a drop in the purification performance is visible. These intervals between the respective regeneration procedures result from an experimental value, which differs depending on the respective system, way and time of use.

Recommendation:
Apply the following method for determining the reasonable intervals for regeneration: Regenerate the purifier column after its first commissioning only when a drop of performance is visible. If such a drop occurs, write the operating hours run down. The operating hours reading minus 10 hours can be used as a reference value for the intervals between the respective regeneration procedures.

13.2. Status of Purifier Filters

The Status of the Purifier Filters can be seen at all times on the start screen. The Icon for the filter differs for each mode. As show in figure 2.

Figure 2: Status of Purifiers

Purifier inactive

Purifier in Circulation (Active)

Purifier in Regeneration

13.3. Prerequisites

13.3.1. Circulation

☑	All preceding chapters have been observed
☑	All connections are properly made.
☑	All antechamber doors are closed.
☑	The Glove Box system has been purged.
☑	The system is activated.
☑	No regeneration of the purifier column.

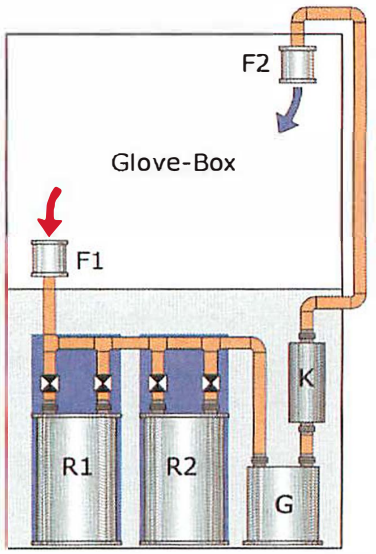
13.3.2. Regeneration

☑	All preceding chapters have been observed
☑	All connections are properly made.
☑	All antechamber doors are closed.
☑	The Glove Box system has been purged.
☑	The system is activated.
☑	No regeneration of the purifier column.

13.3. Circulation Mode

Note:
The two purifier system allows greater flexibly in operation of the box by allowing one filter to be regenerated whilst the other is in circulation (purifying) Mode.
The position of buttons with the Touch Panel is the same for both systems. However only those relevant to the system supplied are displayed.

Figure 3: Circulation in Box



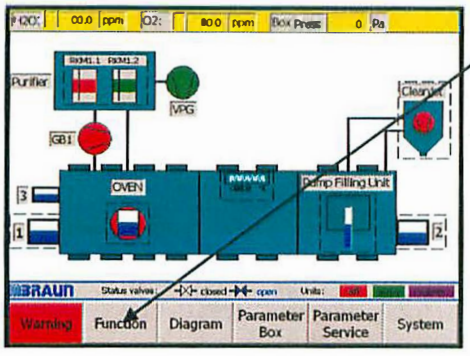
The diagram shows the gas flow in the circulation mode:
(2 Purifier Column System)

- Glove Box
- Dust filter (F1)
- purifier column
  either:
  H_2O/O_2-Purifier column 1 (R1) in circulation mode
  H_2O/O_2-Purifier column 2 (R2) can be regenerated
  or:
  H_2O/O_2-Purifier column 2 (R2) in circulation mode
  H_2O/O_2-Purifier column 1 (R1) can be regenerated
- Blower unit (G)
- Heat exchanger (K)
- Dust filter (F2)

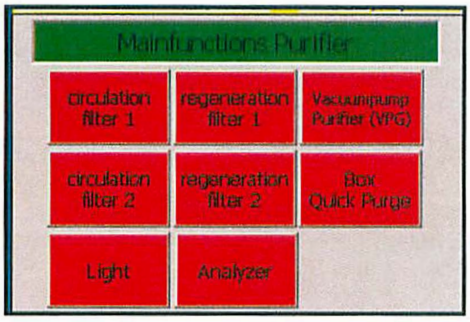
Note:
Circulation cannot run simultaneously through both columns.

Note:
When commissioning the system for the first time, the circulation mode can be run via Purifier column 1, which was regenerated by the manufacturer prior to delivery.
Purifier column 2 should be regenerated before being used in circulation mode.

13.4. Activating the Circulation Mode



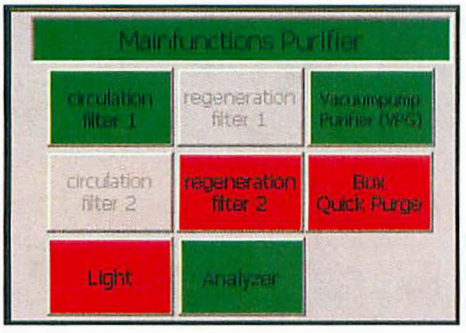
Select the "Function" button on the Start screen



Select the Circulation Purifier button (red) to start the Circulation Mode.

Note:
Circulation can only be made via one purifier at any time.

Note:
If a filter is in Regeneration Mode the regeneration must finished before switching the filter into Circulation Mode.

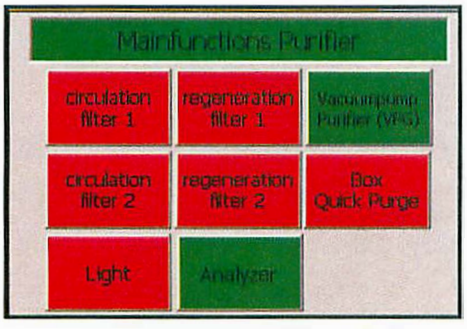


To acknowledge that the purifier is in Circulation Mode the button will change to green.

Note:
The Vacuum Pump activates automatically, if not previously activated.

The regeneration function for the selected filter will become blocked (button will display grey) until circulation over the filter is cancelled.

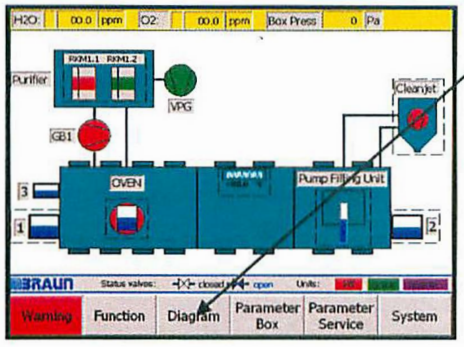
Note:
If the system has a second filter option this will have its circulation function blocked. Regeneration of second filter is still available.



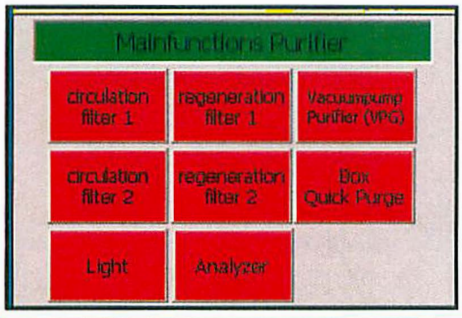
Selecting the Circulation Filter button a further time will switch off the circulation over the first purifier column.

13.5. Activating the Regeneration Mode

Note:
Ensure that there is enough regeneration gas before selecting the regeneration program.
A button will appear in the "purifier screen" to confirm the regeneration gas flow.



Select the Functions button on the Start Screen.



Select the Regeneration button (red) to start the regeneration mode.

Note:
Regeneration can only be made via one purifier at any time.
For system with one filter, the Circulation mode will need to be stopped before the "Regeneration" Button is released.

To acknowledge that the purifier is in Regeneration Mode the button will change to green.
The circulation function for the selected filter will become blocked (button will display grey) until Regeneration of the filter is finished.

13.6. Executing the Regeneration Program

The following table explains the various steps of the regeneration cycle. On activation of the program all the steps are run automatically.

Figure 4: Regeneration Program Table

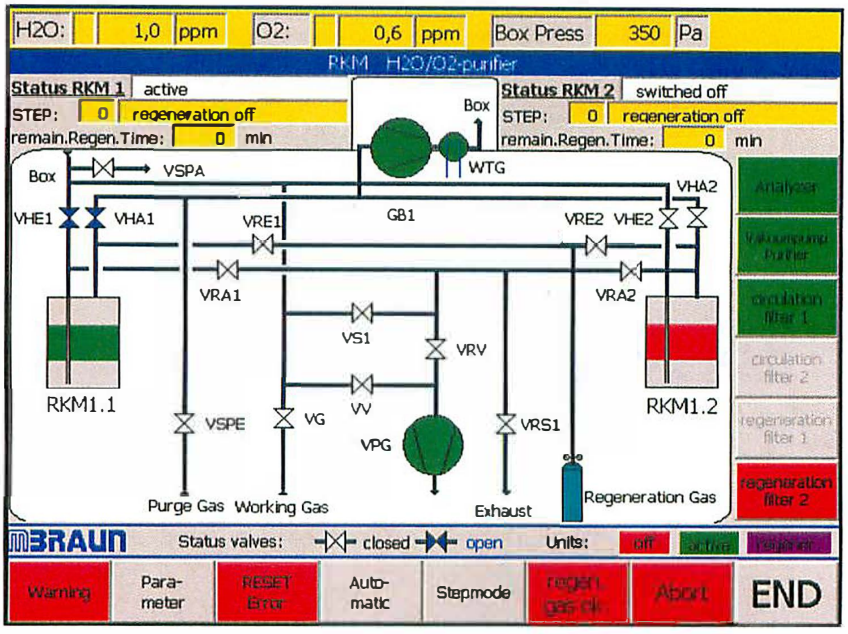
Step		Time	Action
0	↓	Start 0 min.	Regeneration deactivated
1			Regeneration gas test ON
2			Regeneration gas test OFF
3 - 16	↓		Activation of the regenerated filter with proprietary intermediate steps
17	↓	after 960 min.	Program completed

Caution:
By no means should the regeneration program be interrupted. Before activating the regeneration program make sure that sufficient gas supply is available. Refer to the "Preparing the connections" as well as the "Installation" chapters.

Note:
In case of power failure the Automatic Regeneration System switches back to the activation level, which means, with the power supply restored, the complete regeneration procedure is rerun - regeneration levels already executed will be repeated. Therefore, prior to the restoration of power, ensure that a sufficient gas supply is available. The program will restart automatically.

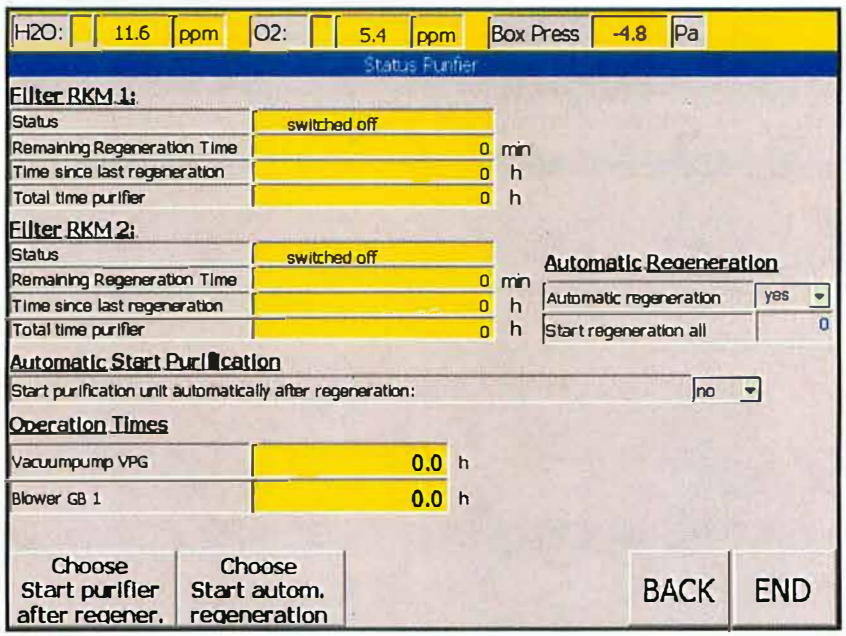
13.7. Purifier Screen

In the Purifier Screen you can see: the actual status of the units
the regeneration Step and
the remaining time in the regeneration process



On the right-hand side of the screen are found the buttons for controlling the RKM and below are those for screen branching and for the functions.

13.8. Parameters



This screen displays: the status of each filter
the remaining regeneration time (only when regeneration is active)
the operation time since the last regeneration
the total time that the purifier has been in operation.

With the key "*Choose Start Purifier after regener.*" being selected, the filter would change over into operation straight after regeneration.

The key "*Choose Start autom.regeneration*" allows the automatic regeneration to be switched ON or OFF. When it is switched ON, a changeover would take place after a time interval (Regeneration Interval All), the active filter will be closed down and regenerated; the 2nd filter would be activated.

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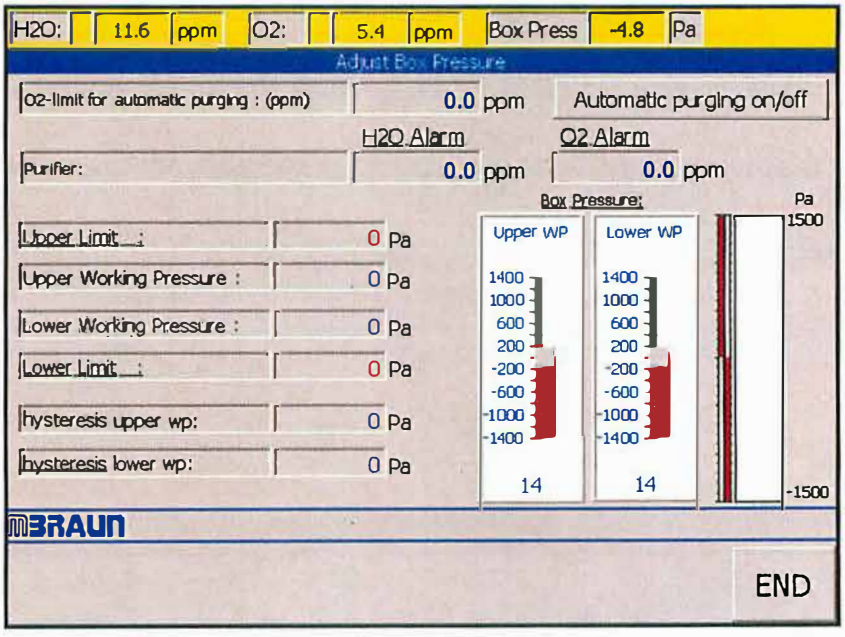
Contents

14.1. Box Parameter



14.1.1. Automatic Purging

Selecting the "Automatic purging on / off" button activates / deactivates the function "Automatic purging"
The active status is displayed by changing the color of the button from grey to green.
Function activated:
In case of exceeding the O2-limit setpoint for automatic purging, box circulation will be interrupted and purging the box starts automatically.

14.1.2. Gas Purification Alarm Limits

Alarm limits may be entered here for the gas purification. As soon as the limits are exceeded a message is issued.

14.1.3. Setting the box pressure:

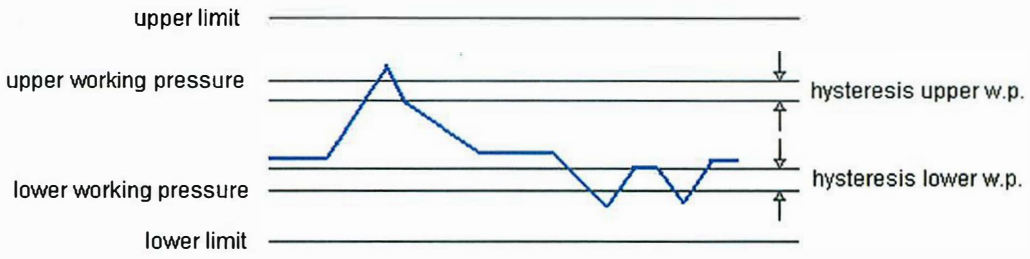
With this Display selected, the box pressure control is deactivated.

You can enter the upper and lower working limit directly via the numeric keypad or by using the arrow-buttons "up" and "down".

The upper working limit cannot be set higher than the upper alarm limit, and vice versa the lower working limit cannot be set lower than the lower alarm limit.

How the box pressure control works is visible in the graphic chart shown below.
If the working limit is exceeded or the pressure falls below the lower limit, evacuation takes place for a short time or gas is refilled, until the pressure falls within the working limit of the value of the adjusted parameters.
The parameters for the upper and the lower limit can be set independently from each other.

Example: Box Pressure Control



The alarm limits can only be altered in the "Parameter Service" screen.
This screen is password-protected.
Qualified service personnel of the M.Braun company may only alter settings within the Service Screen. (data relevant to security)

14.1.4. Parameter Service

Functions within the service parameter are for M.Braun service personnel only – No description is given.

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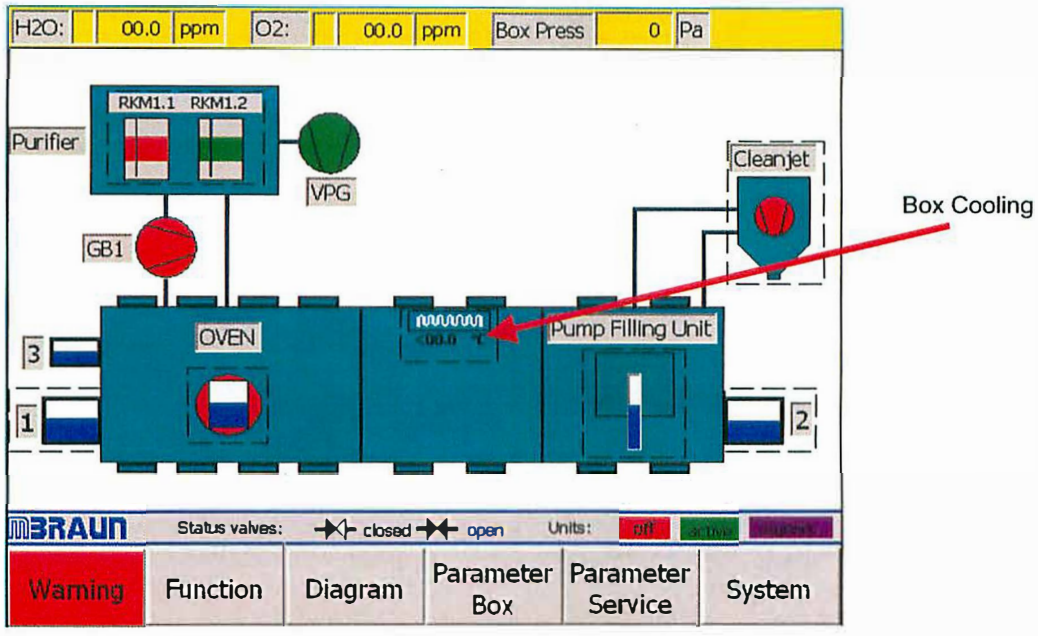
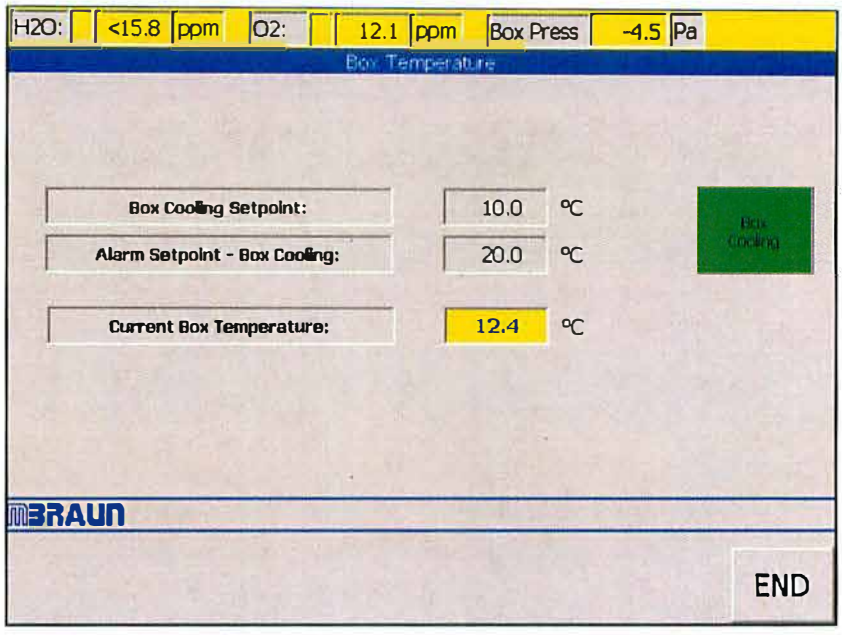
Contents

15.1. Box Cooling



The current temperature of the box is displayed in the centre of the startscreen. By touching the area, indicated above, the Box Cooling Parameters screen is opened.

15.2. Box Cooling Parameter



Box Cooling Setpoint: If the Box Temperature rises to this level the Box Cooling will activate if the unit is switched on.

Alarm Setpoint – Box Cooling: If the Box Temperature rises to this level then the alarm would be issued.

Current Box Temperature: This shows the current Box Temperature. The value is also repeated on the Start Screen.

15.3. Activating / Deactivating Box Cooling

Selecting the "Box Cooling" button activates / deactivates the cooling unit

The Button displays the status of the Cooling Unit operation mode - either green (ON) or red (OFF) – as shown below.

Box Cooling in active mode.

Box Cooling in deactivated mode.

Note:
It is only when the Box Cooling Unit is active that the Box will be cooled when the interior temperature rises to the "Box Cooling Setpoint"

Warning:
The "Alarm Setpoint - Box Cooling" is inactive when the "Box Cooling unit" is switched off.

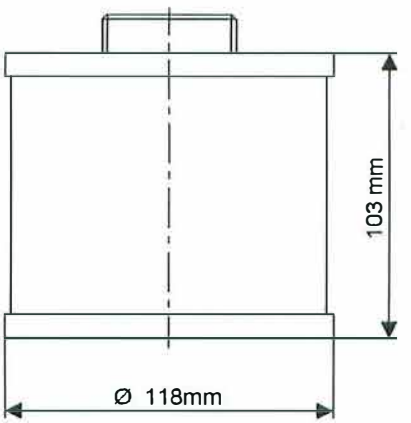
Contents

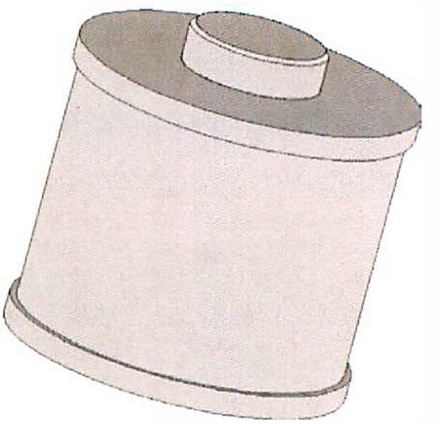
16.1. General Information

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.

16.2. Technical Data

The filter that is commonly used within the M.Braun Glove Box system has the following characteristics:-





The standard filter is of a HEPA format (class H14)- i.e. filtering 99.995% of particles – typically down to 0.2 microns.

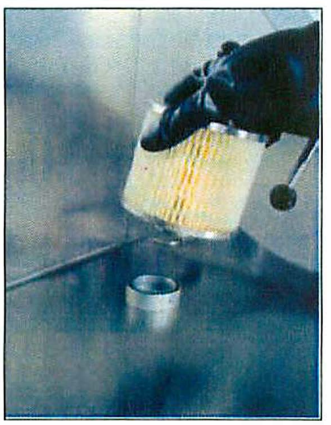
Note:
MBRAUN can also supply finer filters (e.g. Class U15 – Filtering 99.9995% of particles) upon request.

16.3. Exchanging Dust Filters

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

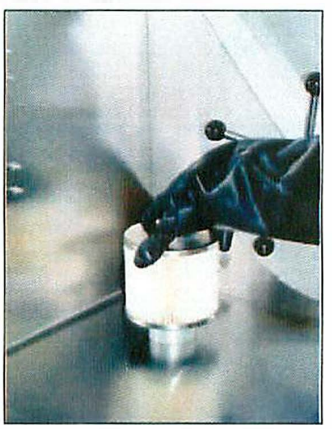
16.3.1. Method for Exchanging the Filter:

Figure 1: Removing Filter



Unscrew used dust filter.

Figure 2: Replacing 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.

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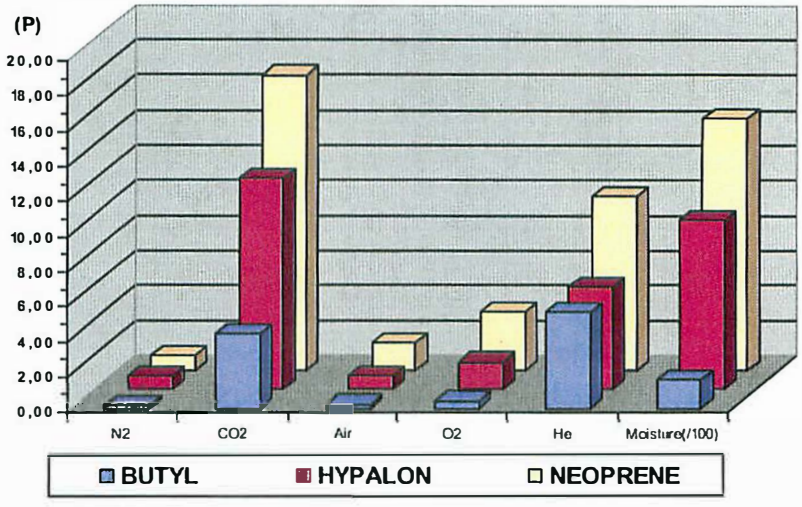
Contents

17.1. General Information

M.BRAUN 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 **M.BRAUN** also offers gloves made of butyl with a hypalon layer.

Gas Permeabily Constant Comparison Chart



Note:
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.

17.2. Technical Data

Product: .....MB Gloves.

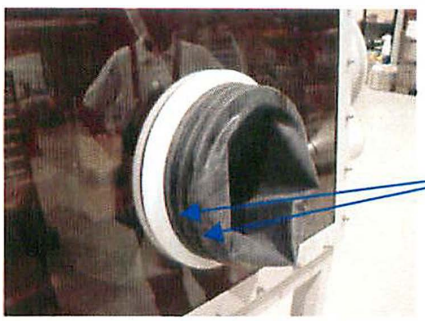
Type:.....Special gloves made of brom-butyl for Glove Box Systems.

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

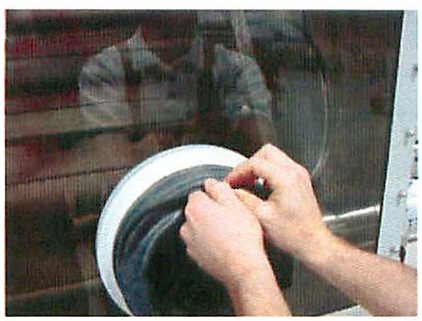
17.3. Replacing Gloves

Recommendation:
M.BRAUN recommends that the gloves are replaced at regular intervals. The gloves must be changed upon signs of wear and tear that may or have caused a leak.

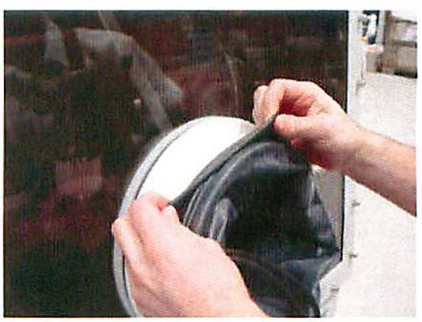
Caution:
Before changing gloves ensure that the glove box is atmosphere is safe to breathe. If necessary purge and fill the glove box with ambient air before attempting to change gloves.



The Gloves are secured by two O-rings.

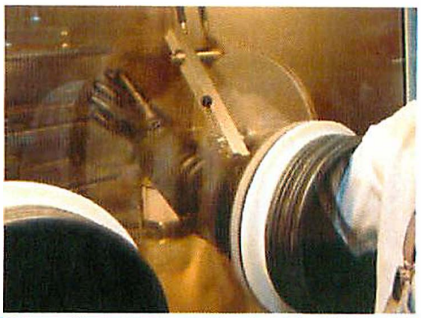


To remove the gloves remove the O-rings and removes the glove as shown



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).

Caution:
Ensure that the correct type of glove is chosen e.g. left or right hand, or ambidextrous and of the correct size



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

Note:
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)

17.4. Glove Port Covers

M.BRAUN 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 glove port covers allow for the changing of gloves whilst preventing the influx of the outer-atmosphere into the glove box.
Glove port covers can be ordered from M.Braun Service Department

17.5. Standard Spare Parts and Accessories for M.Braun Gloves

M.Braun Order No.	Description	Connection Diameter	Glove Thickness	Size
3000047	Brom-butyl anatomical Glove	220 mm	0.4 mm	Large
3000048	Brom-butyl anatomical Glove	220 mm	0.8 mm	Large
3240567	Brom-butyl ambidextrous Glove	220 mm	0.4 mm	Large
2340568	Brom-butyl ambidextrous Glove	220 mm	0.8 mm	Large
3000018	Brom-butyl anatomical Glove	220 mm	0.4 mm	Medium
3005010	Hypalon anatomical Glove	220 mm	0.4 mm	Large
3005009	Hypalon ambidextrous Glove	220 mm	0.4 mm	Large
3000050	Brom-butyl anatomical Glove	160 mm	0.4 mm	Large
3000051	Brom-butyl ambidextrous Glove	160 mm	0.4 mm	Large
3005008	Brom-butyl ambidextrous Glove	Oval	0.4 mm	Large
2600239	O-Ring for Gloves	220 mm		
2600240	O-Ring for Gloves	160 mm		
9002371	Internal Glove Port Cover	220 mm		
7019882	External Glove Port Cover	220 mm		
7024831	Internal Glove Port Cover	160 mm		
7024791	External Glove Port Cover	160 mm		
9004663	Glove Port Feed-Through	220 mm		
2400138	O-Ring (250*4) for Inner Glove Port Feed-Through	220 mm		
2400117	O-Ring (244*7) for Outer Glove Port Feed-Through	220 mm		
9004667	Glove Port Feed-Through	160 mm		

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

Contents

18.1. 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.

Caution:
The third-party manufacturers' maintenance and service instructions should be followed.

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

18.3. Quarterly and Annual Maintenance and Service

Type of System	Quarterly	Annually
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 • Complete leakage test • Function test
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 • Complete leakage test • Function test
Analysers	• 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

CONTENTS

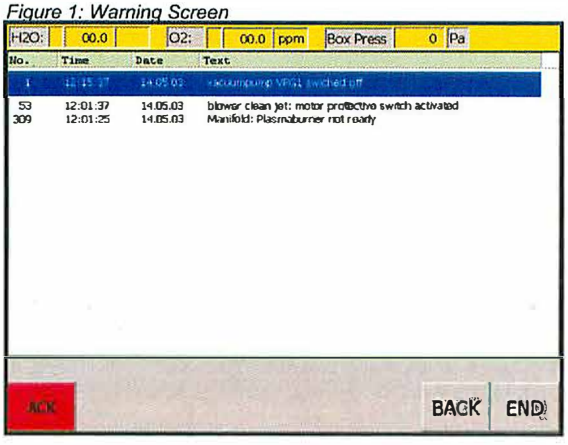
19.1. General Information

On the screens of the TP270B Operation Panel (*TOUCH* Screen) appears the Alarm icon. As soon as a fault or an error occurs the "Alarm" button will flash

19.2. Alarm and Warning Messages

To view the error messages, push the "Alarm" button. This will open the Warnings Screen. The "Alarm" Button appears in each screen.

Figure 1: Warning Screen



The messages that appear in the screen are in order of occurrence. The most recent message is the uppermost.

To acknowledge that a message has been read, select the message by touching the screen. The message will become highlighted on the screen. Select the Acknowledge button.

Messages that are no longer valid (e.g. the moisture sensor reading is again within the alarm limit range) will be removed from the screen upon being acknowledged.

Selecting the "Back" button will return to the previous screen.

19.3. Definition of Error Messages

Warning Number	Warning Description	Possible Explanations	Solutions
2	motor protective switch vacuum pump VPG 1 activated	Vacuum pump faulty Coarse-leak in the piping (vacuum pump overworked due to size of the leak)	Replace vacuum pump Eliminate Coarse-leak Vacuum pump check from MBraun - Service
3	blower GB1: motor protective switch activated or error frequency controller	Main blower faulty Main piping stopped up	Replace main blower Eliminate Constipation Blower check from MBraun - Service
4	purifier 1: filter 1 input main valve not open	Main valve faulty Control pressure too low	Replace main valve Set control pressure to 6 bar
5	purifier 1: filter 1 output main valve not open	Main valve faulty Control pressure too low	Replace main valve Set control pressure to 6 bar
6	purifier 1: filter 2 input main valve not open	Main valve faulty Control pressure too low	Replace main valve Set control pressure to 6 bar
7	purifier 1: filter 2 output main valve not open	Main valve faulty Control pressure too low	Replace main valve Set control pressure to 6 bar
8	purifier 1: pressure working gas too low	Working gas pressure too low Pressure-supervision defective or put in incorrectly	Set working gas pressure to 6bar Pressure supervision reset Adjust pressure-supervision switch
9	purifier 1: pressure purging gas too low	Pressure purging gas too low Pressure-supervision defective or put in incorrectly	Set purging gas pressure to 6bar Pressure supervision reset Adjust pressure-supervision switch
10	purifier 1: box purging outlet not open	Purging valve faulty Control pressure too low	Purging valve Replaces Set control pressure to 6 bar
11	purifier 1: box purging in operation	Operator-hint	No action required
12	purifier 1: fuse filter heater activated	Filter heater faulty	Heater check from MBraun - Service
41	Cleanjet is switched off --\> no plasmaburning possible	Operator hint	Operator has to switch on the Clean-JET
42	Manifold: protection switch plasmaburner activated	Power supply plasma burner faulty	Replace plasma burner supply Check from MBraun-Service

Warning Number	Warning Description	Possible Explanations	Solutions
43	Manifold: protection switch plasma controller activated	Plasma burner controller faulty	Replace plasma burner controller Check from MBraun-Service
45	motor protective switch vacuum pump VP1 activated	Vacuum pump faulty Coarse-leak in the piping (vacuum pump overloaded due to size of the leak)	Replace Vacuum pump Eliminate Coarse-leak Vacuum pump check from MBraun - Service
46	motor protective switch vacuum pump VP2 activated	Vacuum pump faulty Coarse-leak in the piping (vacuum pump overloaded due to size of the leak)	Replace Vacuum pump Eliminate Coarse-leak Vacuum pump check from MBraun - Service
52	compressor box cooling: motor protective switch activated	Compressor box cooling faulty	Replace Compressor Compressor check from MBraun - Service
53	blower clean jet: motor protective switch activated	Blower or frequency converter faulty Main piping stopped up	Replace blower or frequency converter Eliminate Constipation Blower check and frequ.converter check from MBraun - Service
54	fast cooling blower: Error frequency converter	Blower faulty Main piping stopped up	Replace blower Eliminate Constipation Blower check and frequ.converter check from MBraun - Service
55	oxygen-level too high: automatic box purging is active	Operator-hint :Oxygen-measurement over O2-limit level → Box purging starts automatically	No action required
56	box pressure to high: purging output valve is open	Gas hose broken in the box	Dsconnect leaking gas supply
57	box pressure to low: automatic purging is active	Vacuum valve antechamber has not closed Refill valve antechamber has not closed Vacuum valve purifier has not closed	replace faulty valve
58	Error Servo-controller Montech	Servo controller or Servo motor faulty	Servo unit check from MBraun - Service
59	Servo-controller Montech not ready	No power supply montech controller Servo controller or Servo motor faulty	Check power supply montech controller Servo unit check from MBraun - Service
60	cooling unit manifold: motor protective switch activated	Cooling unit faulty	Replace Cooling unit Cooling unit check from MBraun - Service
61	Process oven 1: protection switch turbo controller activated	Turbo controller faulty	Turbo controller check from MBraun - Service
65	vacuum pump off - box pressure too low	Vacuum valve antechamber has not closed Refill valve antechamber has not closed Vacuum valve purifier has not closed	Replace faulty valve and switch on vacuum pump

Warning Number	Warning Description	Possible Explanations	Solutions
66	Error Fieldbus Network	Fieldbus connector or cabel faulty Fieldbus slave faulty	Check fieldbus cabel and connector replace Fieldbus slave Fieldbus check from Mbraun - Service
96	Clean the H2O-sensor - Refer to instruction manual	Maintenance time H2O-Sensor overstepped	Clean H2O-Sensor Reset maintenance time H2O-Sensor
97	purifier 1: filter 1 input main valve not closed	Main valve purifier 1 faulty Control pressure too low	Replace Main valve Set control pressure to 6 bar
98	purifier 1: filter 1 output main valve not closed	Main valve purifier 1 faulty Control pressure too low	Replace Main valve Set control pressure to 6 bar
99	purifier 1: regeneration filter 1 in operation	Operator hint	No action required
100	purifier 1: regeneration filter 1 service mode	Operating hint	No action required
101	Purifier 1: proof flow regeneration gas - ok?	Regeneration gas confirmation by the customer	Check gas flow regeneration gas and confirm condition
102	purifier 1: filter 2 input main valve not closed	Main valve purifier 2 faulty Control pressure too low	Replace Main valve Set control pressure to 6 bar
103	purifier 1: filter 2 output main valve not closed	Main valve purifier 2 faulty Control pressure too low	Main valve Replaces Set control pressure to 6 bar
104	purifier 1: regeneration filter 2 in operation	Operator hint	No action required
105	purifier 1: regeneration filter 2 service mode	Operator hint	No action required
106	purifier 1: H2O alarm	H2O-Measurement exceeds alarm-threshold: Antechamber leaky , piping leaky Introduced item contains much moisture	Eliminate leakage Complete more pump-refill-cycles for the introduced item Regenerate filter, use regenerated filter
107	purifier 1: H2O sensor defective	H2O-sensor faulty H2O-sensor unplugged	Replace H2O-sensor Plug-in H2O-sensor
108	purifier 1: O2 alarm	O2-Measurement exceeds alarm-threshold: Antechamber leaky , piping leaky Introduced item contains much oxygen	Eliminate leakage Complete more pump-refill-cycles for the introduced item Regenerate filter, use regenerated filter

Warning Number	Warning Description	Possible Explanations	Solutions
109	purifier 1: O2 sensor defective	O2-sensor faulty O2-sensor unplugged	Replace O2-sensor O2-sensor plug in
110	purifier 1: blower pressure sensor defective	Blower-pressure-sensor faulty Blower-pressure -sensor unplugged	Replace Blower-pressure -sensor Plug-in Blower-pressure -sensor
111	purifier 1: blower pressure too low	Main-blower does not run: Main-blower unplugged Main-blower faulty	Plug in main-blower Replace Main-blower
112	purifier 1: blower pressure too high	HEPA-filter contaminated	Replace HEPA-filter
113	purifier 1: pressure sensor regeneration gas defective	**Option: pressure sensor regeneration gas** pressure sensor regeneration gas faulty	Replace pressure sensor regeneration gas
114	purifier 1: regeneration gas pressure too low	**Option: pressure sensor regeneration gas** Gas supply empty Pressure attitude too low	Change gas bottle Adjust gas pressure (0,3 – 0,5 bar)
115	purifier 1: regeneration gas pressure too high	**Option: pressure sensor regeneration gas** Pressure attitude too high	Adjust gas pressure (0,3 – 0,5 bar)
116	purifier 1: error sensor O2-percent	**Option: sensor O2-percent** O2-sensor faulty O2-sensor unplugged	Replace O2-sensor O2-sensor plug in
160	antechamber 1: atmosphere sensor defective	Atmosphere-sensor faulty Atmosphere -sensor unplugged	Replace Atmosphere-sensor Atmosphere-sensor plug in
161	antechamber 1: vacuum sensor defective	Vacuum-sensor faulty Vacuum -sensor unplugged	Replace Vacuum-sensor Vacuum-sensor plug in
162	antechamber 1: inner door not closed	**Option: door switch** Door switch not activated: Door switch faulty or Door not completely closed	Replace Door switch Close door
163	antechamber 1: outer door not closed	**Option: door switch** Door switch not activated: Door switch faulty or Door not completely closed	Replace Door switch Close door
164	antechamber 1: pumping time exceeded	Antechamber leaky Vacuum piping leaky Rank gases too strongly	Eliminate leak Increase max. evacuation-time
167	antechamber 1: antechamber leaking	Leakiest was not ok: Fine leak antechamber Fine leak piping	Eliminate leak

Warning Number	Warning Description	Possible Explanations	Solutions
175	antechamber 2: atmosphere sensor defective	Atmosphere-sensor faulty Atmosphere -sensor unplugged	Replace Atmosphere-sensor Atmosphere-sensor plug in
176	antechamber 2: vacuum sensor defective	Vacuum-sensor faulty Vacuum -sensor unplugged	Replace Vacuum-sensor Vacuum-sensor plug in
177	antechamber 2: inner door not closed	**Option: door switch** Door switch not activated: Door switch faulty or Door not completely closed	Replace Door switch Close door
178	antechamber 2: outer door not closed	**Option: door switch** Door switch not activated: Door switch faulty or Door not completely closed	Replace Door switch Close door
179	antechamber 2: pumping time exceeded	Antechamber leaky Vacuum piping leaky Rank gases too strongly	Eliminate leak Increase max. evacuation-time
182	antechamber 2: antechamber leaking	Leakiest was not ok: Fine leak antechamber Fine leak piping	Eliminate leak
212	sensor box pressure defective	Box pressure-sensor faulty Box pressure -sensor unplugged	Replace Box pressure -sensor Box pressure -sensor plug in
213	box pressure too low	Vacuum valve antechamber has not closed Refill valve antechamber has not closed Vacuum valve purifier has not closed	Remove faulty valve
214	box pressure too high	Gas hose broken in the box If the mistake appears with box purging: gas supply too high	Disconnect leaky gas supply Throttle gas supply
231	Cleanjet: Error frequency controller	Frequency controller faulty Difference pressure level too high --> blower gets too warm and stops operation	Replace Frequency controller Reduce setpoint: Max pressure filter Clean filters
232	Cleanjet: Difference pressure blower too high	Piping or filter stopped up	Clean piping and filters Check/replace filters
233	Cleanjet: No difference pressure blower	Blower faulty	Replace blower
234	Cleanjet: Error difference pressure sensor	Difference pressure sensor faulty Difference pressure sensor unplugged	Replace difference pressure sensor Plug in sensor
235	Cleanjet: Inlet valve VHSE not open	Valve faulty Control pressure not ok Valve locked up	Replace valve Adjust control pressure to 6 bar Clean valve

Warning Number	Warning Description	Possible Explanations	Solutions
236	Cleanjet: Inlet valve VHSE not closed	Valve faulty Control pressure not ok Valve locked up	Replace valve Adjust control pressure to 6 bar Clean valve
237	Cleanjet: Outlet valve VHSA not ok	Valve faulty Control pressure not ok	Replace valve Adjust control pressure to 6 bar
238	Cleanjet: Purge outlet valve VSA not open	Valve faulty Control pressure not ok	Replace valve Adjust control pressure to 6 bar
239	Cleanjet: Difference pressure filter too high	Operator hint: filter is full	Clean filters
240	Process oven 1: PLF Alarm Thyristor controller	Thyristor controller faulty	Thyristor controller check from Mbraun Service
241	Process oven 1: Collective-Alarm Thyristor controller	Thyristor controller faulty	Thyristor controller check from Mbraun Service
242	Process oven 1: vacuum sensor backing chamber TPR265 faulty	sensor faulty sensor unplugged	Replace sensor sensor plug in
243	Process oven 1: atmospheric sensor faulty	sensor faulty sensor unplugged	Replace sensor sensor plug in
244	Process oven 1: vacuum sensor ITR090 faulty	sensor faulty sensor unplugged	Replace sensor sensor plug in
245	Process oven 1: thermo couple faulty	thermo couple faulty thermo couple unplugged	Replace sensor sensor plug in
246	Process oven 1: backing valve faulty	Valve faulty Control pressure not ok	Replace valve Adjust control pressure to 6 bar
247	Process oven 1: roughing valve faulty	Valve faulty Control pressure not ok	Replace valve Adjust control pressure to 6 bar
248	Process oven 1: gate valve faulty	Valve faulty Control pressure not ok	Replace valve Adjust control pressure to 6 bar
249	Process oven 1: error vacuumpump	prevacuum pump turbo unit faulty	replace vacuum pump Vacuum pump check from MBraun - Service

Warning Number	Warning Description	Possible Explanations	Solutions
250	Process oven 1: error turbo controller	turbo controller faulty turbo pump faulty	pumping unit check from MBraun Service
251	Process oven 1: start procedure vacuum pump	Operator hint: startup time pumping unit	
252	Process oven 1: turbo speed too low	Startup turbo pump not finished turbo pump faulty	Wait until start up is finished Replace or check turbo pump from MBraun Service
253	Process oven 1: cover not closed	door switch not activated: Door switch faulty or Door not completely closed	Replace Door switch Close door
255	Process oven 1: pumping time exceeded	oven leaky vacuum piping leaky rank gases too strongly	Eliminate leak Increase max. evacuation-time
257	Process oven 1: oven is leaking	Leaktest was not ok: Fine leak oven Fine leak piping	Eliminate leak
259	Process oven 1: temperature alarm / sensor faulty Eurotherm controller 2408	maximum temperature exceeded temperature sensor faulty	Check heater from Mbraun Service Check sensor cable and connector Replace temperature sensor
260	Process oven 1: temperature alarm / sensor faulty security display 2108	maximum temperature exceeded Safety temperature sensor faulty	Check heater from Mbraun Service Check sensor cable and connector Replace temperature sensor
261	Process oven 1: emergency stop oven heater activated	Emergency stop button activated from operator	Deactivate emergency stop button after trouble shooting
263	Process oven 1: no pressure emergency cooling	Emergency cooling water too low	Check emergency cooling water supply
264	Process oven 1: analyser not activ or O2/H2O alarm	Analyser switched off O2 / H2O level too high	Swich on Analyser Check gas purification system
265	Process oven 1: water flow electrical feed too low	Cooling water too low Valve cooling water faulty	Check cooling water supply Remove faulty valve
266	Process oven 1: water flow shield too low	Cooling water too low Valve cooling water faulty	Check cooling water supply Remove faulty valve
267	Process oven 1: water flow oven body too low	Cooling water too low Valve cooling water faulty	Check cooling water supply Remove faulty valve

Warning Number	Warning Description	Possible Explanations	Solutions
268	Process oven 1: water flow cover too low	Cooling water too low Valve cooling water faulty	Check cooling water supply Remove faulty valve
269	Process oven 1: water flow lid too low	Cooling water too low Valve cooling water faulty	Check cooling water supply Remove faulty valve
270	Process oven 1: safety light barrier activated	Gloves are in the box	Put gloves outside the box
285	Manifold: Error vacuum sensor ITR090	Sensor faulty Sensor unplugged	Replace sensor Plug in sensor
286	Manifold: Error prevacuum sensor TPR265	Sensor faulty Sensor unplugged	Replace sensor Plug in sensor
287	Manifold: Error bulbsensor TPR265	Sensor faulty Sensor unplugged	Replace sensor Plug in sensor
288	Manifold: Error receptaclesensor Argon CR090	Sensor faulty Sensor unplugged	Replace sensor Plug in sensor
289	Manifold: Error receptaclesensor Xenon CR090	Sensor faulty Sensor unplugged	Replace sensor Plug in sensor
290	Manifold: Error backing valve	Valve faulty Control pressure not ok	Replace valve Adjust control pressure to 6 bar
291	Error prevacuum pump	Vacuum pump faulty Coarse-leak in the piping (vacuum pump overworked due to size of the leak)	Replace vacuum pump Eliminate Coarse-leak Vacuum pump check from MBraun - Service
292	Manifold: Error turbocontroller	Turbo pump faulty Turbo controller faulty Long operation with a big load (leakage pump fill head)	Eliminate leakage MBraun check pumping unit
293	Manifold: turbo startcycle	Operator hint: Turbo pump accelerates	
294	Manifold: turbo speederror	Speed turbo pump too low –> operation with load –> turbo controller faulty –> turbo pump faulty	Eliminate leakage MBraun check pumping unit
295	Manifold: Montech servo controller handling system faulty	Servo motor faulty Servo controller faulty	Servo system check from MBraun Service

Warning Number	Warning Description	Possible Explanations	Solutions
296	Manifold: emergency stop activated	Emergency stop button activated from operator	Deactivate emergency stop button after trouble shooting
299	Manifold: Error pressur Argon supply	Pressure argon supply too low	Adjust argon supply pressure
300	Manifold: Error pressur Xenon supply	Pressure xenon supply too low	Adjust xenon supply pressure
301	Manifold: Course leak	Lamp leaky Sealing (O-ring) leaky	Eliminate leakage
302	Manifold: Evacuation time exceeded	Lamp leaky Sealing (O-ring) leaky	Eliminate leakage
304	Manifold: Fine leak	Lamp leaky Sealing (O-ring) leaky	Eliminate leakage
305	Manifold: Receptacle Argon --\> Pressure not ok	The needle valve is too finely closed and the argon Receptacle can not reach the operational pressure	Adjust (open) the needle valve
306	Manifold: Receptacle Xenon --\> Pressure not ok	The needle valve is too finely closed and the xenon receptacle can not reach the operational pressure	Adjust (open) the needle valve
307	Manifold: Error: Plasmaburner	Plasma controller not in operation Plasma controller faulty Safety conditions plasma burner not ok	Switch on Plasma controller Replace plasma controller Check safety line plasma burner
308	Manifold: Can't start burning --\> Cleanjet not operational	Clean-JET faulty or not in operation	Check Clean-JET operation/switch on Clean-JET
309	Manifold: Plasmaburner not ready	Plasma controller not in operation Plasma controller faulty Safety conditions plasma burner not ok	Switch on Plasma controller Replace plasma controller Check safety line plasma burner
310	Manifold: Receptacle Argon sensor: Offset too big	Setpoint for the "sensor balance level" is too high. (Default = 8 Pascal) Pressure Sensor Argon receptacle faulty	Adjust the setpoint "sensor balance level" Replace Argon receptacle sensor CR090
311	Manifold: Receptacle Xenon sensor: Offset too big	Setpoint for the "sensor balance level" is too high. (Default = 8 Pascal) Pressure Sensor Xenon receptacle faulty	Adjust the setpoint "sensor balance level" Replace Xenon receptacle sensor CR090
320	Oven-Handling: Verticalcylinder -Top not down	cylinder faulty Position indicator switch faulty	Cylinder check from Mbraun Service replace position indicator switch check adjustment position indicator switch

Warning Number	Warning Description	Possible Explanations	Solutions
321	Oven-Handling: Verticalcylinder -Top not up	cylinder faulty Position indicator switch faulty	Cylinder check from Mbraun Service replace position indicator switch check adjustment position indicator switch
322	Oven-Handling: Verticalcylinder - Bottom not down	cylinder faulty Position indicator switch faulty	Cylinder check from Mbraun Service replace position indicator switch check adjustment position indicator switch
323	Oven-Handling: Verticalcylinder -Bottom not down	cylinder faulty Position indicator switch faulty	Cylinder check from Mbraun Service replace position indicator switch check adjustment position indicator switch
324	Oven-Handling: Horizontalcylinder 1 – not in unload position	cylinder faulty Position indicator switch faulty	Cylinder check from Mbraun Service replace position indicator switch check adjustment position indicator switch
325	Oven-Handling: Horizontalcylinder 1 – not in middle position	cylinder faulty Position indicator switch faulty	Cylinder check from Mbraun Service replace position indicator switch check adjustment position indicator switch
326	Oven-Handling: Horizontalcylinder 2 – not in load position	cylinder faulty Position indicator switch faulty	Cylinder check from Mbraun Service replace position indicator switch check adjustment position indicator switch
327	Oven-Handling: Horizontalcylinder 2 – not in oven position	cylinder faulty Position indicator switch faulty	Cylinder check from Mbraun Service replace position indicator switch check adjustment position indicator switch
328	Oven-Handling: Gribber not closed	Gribber faulty Position indicator switch faulty	Gribber check from Mbraun Service check adjustment Position switch indicator
329	Oven-Handling: Gribber not open	Gribber faulty Position indicator switch faulty	Gribber check from Mbraun Service replace position indicator switch check adjustment position indicator switch