

# Para Hydrogen Generator

BPHG 90  
Service Manual  
Version 001



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# Contents

<b>1</b>	<b>About</b>	<b>5</b>
1.1	This Manual	5
1.2	Policy Statement	5
1.3	Symbols and Conventions	5
<b>2</b>	<b>Introduction</b>	<b>7</b>
2.1	Main Components and Part Location	7
<b>3</b>	<b>Safety</b>	<b>9</b>
3.1	General	9
3.2	Intended Use	9
3.3	Owner's Responsibility	9
3.4	Personnel Requirements	11
3.4.1	Qualifications	11
3.4.2	Unauthorized Persons	11
3.4.3	Instruction	12
3.5	Personal Protective Equipment	12
3.6	Location of the Safety Label	12
3.7	Basic Dangers	12
3.7.1	General Workplace Dangers	14
3.7.2	Dangers from Electric Power	15
3.7.3	Mechanical Dangers	16
3.7.4	Dangers from Magnetic Fields	16
3.8	Signage	17
3.9	Spare Parts	17
<b>4</b>	<b>Maintenance</b>	<b>19</b>
4.1	Parahydrogen Generator Overview	20
4.2	Repair and Maintenance	20
4.3	Recommended Tools	21
4.4	Periodic Maintenance	21
4.5	Generator Cover Removal	21
4.6	Radiator Cleaning	21
4.7	Coolant Circulation Pump Replacement	22
4.8	Cooling Fluid Level Switch	22
4.9	Cooling Fluid Flow Switch	24
4.10	Flow Switch Installation	24
4.11	Radiator Fan Removal	25
4.12	Fan Installation	25
4.13	Coolant Temperature Sensor Removal	26
<b>5</b>	<b>Vacuum Components</b>	<b>27</b>
5.1	Vacuum Gauge	27
5.2	Diaphragm Pump Removal	27
5.3	Diaphragm Pump Replacement	28
5.3.1	Pump Settings	28
5.4	Pump Removal	29
5.5	Cryostat Vacuum Valve Removal	29
5.6	Cryocooler and Conversion Chamber Assembly	29

<b>6</b>	<b>Coolant Fluid Circuit</b> .....	<b>31</b>
6.1	Draining the Coolant Reservoir .....	31
6.2	Cleaning the Reservoir .....	31
6.3	Filling the Cooling Fluid Reservoir.....	31
<b>7</b>	<b>Gas Circuit Components</b> .....	<b>33</b>
7.1	Inlet or Outlet Gas Pressure Sensor Replacement .....	33
7.1.1	Pressure Indication Unit .....	34
7.1.2	Pressure Switch Setting .....	35
7.2	Solenoid Valve Removal.....	35
7.3	Gas Valve Installation .....	35
7.4	Hydrogen Gas Purifier Cartridge Replacement .....	36
7.5	Gas Purifier Cartridge Installation.....	36
<b>8</b>	<b>Electrical Components</b> .....	<b>39</b>
8.1	Hydrogen Gas Sensor Test .....	39
8.2	Phoenix Electronic Controller Module Removal .....	39
8.3	Power Line Fuses Replacement.....	41
8.4	Cryocooler Controller Fuse Replacement .....	42
8.5	Vacuum Gauge Fuse Replacement.....	42
8.6	Cryocooler Controller Board Replacement.....	43
<b>9</b>	<b>Software</b> .....	<b>45</b>
9.1	Firmware Update .....	45
9.2	Service Menu.....	45
<b>10</b>	<b>Spare Parts List</b> .....	<b>47</b>
<b>11</b>	<b>Contact</b> .....	<b>49</b>
	<b>List of Figures</b> .....	<b>51</b>
	<b>Index</b> .....	<b>53</b>

# 1 About

## 1.1 This Manual

---

This manual is planned for use by the service engineer in the installation of the device or accessory, and for the user in performing existing experiments and for the setup of new experiments.

This manual is an integral part of the device, and must be kept in close proximity to the device where it is permanently accessible to personnel. In addition, instructions concerning labor protection laws, operator regulations tools and supplies must be available and adhered to.

**Before starting any work, personnel must read the manual thoroughly and understood its contents.** Compliance with all specified safety and operating instructions, as well as local accident prevention regulations, are vital to ensure safe operation.

The figures shown in this manual are designed to be general and informative and may not represent the specific Bruker model, component or software/firmware version you are working with. Options and accessories may or may not be illustrated in each figure.

## 1.2 Policy Statement

---

It is the policy of Bruker to improve products as new techniques and components become available. Bruker reserves the right to change specifications at any time.

Every effort has been made to avoid errors in text and figure presentation in this publication. In order to produce useful and appropriate documentation, we welcome your comments on this publication. Support engineers are advised to regularly check with Bruker for updated information.

Bruker is committed to providing customers with inventive, high quality products and services that are environmentally sound.

## 1.3 Symbols and Conventions

---

Safety instructions in this manual are marked with symbols. The safety instructions are introduced using indicative words which express the extent of the hazard.

In order to avoid accidents, personal injury or damage to property, always observe safety instructions and proceed with care.



**DANGER**

**Danger indicates a hazardous situation which, if not avoided, will result in death or serious injury.**

This is the consequence of not following the warning.

► This is the safety condition.

1. This is the safety instruction.

## **WARNING**



**Warning indicates a hazardous situation, which, if not avoided, could result in death or serious injury.**

This is the consequence of not following the warning.

- ▶ This is the safety condition.
- 1. This is the safety instruction.

## **CAUTION**



**Warning indicates a hazardous situation, which, if not avoided, may result in minor or moderate injury.**

This is the consequence of not following the warning.

- ▶ This is the safety condition.
- 1. This is the safety instruction.

## **NOTICE**

**NOTICE indicates a property damage message.**

This is the consequence of not following the notice.

- ▶ This is a safety condition.
- 1. This is a safety instruction.



**This symbol highlights useful tips and recommendations as well as information designed to ensure efficient and smooth operation.**

## 2 Introduction

This manual provides reference information for servicing the BPHG 90 parahydrogen generator (P/N W118752). It contains information for the authorized service personnel, servicing, and repairing this product. The **BPHG 90** parahydrogen generator is an instrument designed to enrich the content of parahydrogen ( $p\text{-H}_2$ ) in normal hydrogen gas.

### 2.1 Main Components and Part Location

---

The BPHG 90 consists of the following components, contained in a single metal cabinet:

- Solenoid valves making up the gas distribution circuit.
- A conversion chamber attached to a cryocooler cold head inside a vacuum enclosure.
- A vacuum pump.
- A closed loop water cooling circuit for the cryocooler.
- The control electronics.
- The instrument is connected to the mains power supply and a high purity hydrogen gas supply.



Figure 2.1: BPHG 90 Front View



*Figure 2.2: BPHG 90 Rear View*

## 3 Safety

This section provides an overview of all the main safety aspects involved in ensuring optimal personnel protection and safe and smooth operation.

Non-compliance with the action guidelines and safety instructions contained in this manual may result in serious hazards.

### 3.1 General

---

Before you start any repair inside of the device, be aware of the high 230/115V voltages. Even if these voltages are protected by security features to avoid any physical contact, it is still possible that the voltage sources can be unintentionally touched with a tool, object, etc.

Therefore, always check if you really need the power supply to be switched on during your work. Otherwise turn the device off and disconnect the power cable from the wall socket to the device. Safeguard that no one is able to re-power the system without your approval.

### 3.2 Intended Use

---

The device has been designed and constructed solely for the intended use described here.

Intended use also includes compliance with all specifications within this manual.

Any use which exceeds or differs from the intended use shall be considered improper use.

No claims of any kind for damage will be entertained if such claims result from improper use.

### 3.3 Owner's Responsibility

---

#### Owner

The term 'owner' refers to the person who himself operates the device for trade or commercial purposes, or who surrenders the device to a third party for use/application, and who bears the legal product liability for protecting the user, the personnel or third parties during the operation.

#### Owner's Obligations

The device is used in the industrial sector, universities and research laboratories. The owner of the device must therefore comply with statutory occupational safety requirements.

In addition to the safety instructions in this manual, the safety, accident prevention and environmental protection regulations governing the operating area of the device must be observed.

In this regard, the following requirements should be particularly observed:

- The owner must obtain information about the applicable occupational safety regulations, and - in the context of a risk assessment - must determine any additional dangers resulting from the specific working conditions at the usage location of the device. The owner must then implement this information in a set of operating instructions governing operation of the device.

- During the complete operating time of the device, the owner must assess whether the operating instructions issued comply with the current status of regulations, and must update the operating instructions if necessary.
- The owner must clearly lay down and specify responsibilities with respect to installation, operation, troubleshooting, maintenance and cleaning.
- The owner must ensure that all personnel dealing with the device have read and understood this manual. In addition, the owner must provide personnel with training and hazards information at regular intervals.
- The owner must provide the personnel with the necessary protective equipment.
- The owner must warrant that the device is operated by trained and authorised personnel as well as all other work, such as transportation, mounting, start-up, the installation, maintenance, cleaning, service, repair and shutdown, that is carried out on the device.
- All personnel who work with, or in the close proximity of the device, need to be informed of all safety issues and emergency procedures as outlined in this user manual.
- The owner must document the information about all safety issues and emergency procedures in a laboratory SOP (Standard Operating Procedure). Routine briefings and briefings for new personnel must take place.
- The owner must ensure that new personnel are supervised by experienced personnel. It is highly recommended to implement a company training program for new personnel on all aspects of product safety and operation.
- The owner must ensure that personnel are regularly informed of the potential hazards within the laboratory. This is all personnel that work in the area, but in particular laboratory personnel and external personnel such as cleaning and service personnel.
- The owner is responsible for taking measures to avoid inherent risks in the handling of dangerous substances, preventing industrial disease, and providing medical first aid in emergencies.
- The owner is responsible for providing facilities according to the local regulations for the prevention of industrial accidents and generally accepted safety regulations according to the rules of occupational medicine.
- All substances needed for operating and cleaning the device samples, solvents, cleaning agents, gases, etc. have to be handled with care and disposed of appropriately. All hints and warnings on storage containers must be read and adhered to.
- The owner must ensure that the work area is sufficiently illuminated to avoid reading errors and faulty operation.
- The owner must ensure that the laboratory is equipped with an oxygen warning device, in case the device is operated with nitrogen.

Furthermore, the owner is responsible for ensuring that the device is always in a technically faultless condition. Therefore, the following applies:

- The owner must ensure that the maintenance intervals described in this manual are observed.
- The owner must ensure that all safety devices are regularly checked to ensure full functionality and completeness.

## 3.4 Personnel Requirements

---



Only trained Bruker personnel are allowed to mount, retrofit, repair, adjust and dismantle the unit!

---

### 3.4.1 Qualifications

---

This manual specifies the personnel qualifications required for the different areas of work, listed below:

#### Laboratory Personnel

Laboratory personnel are health care professionals, technicians, and assistants staffing a research or health care facility where specimens are grown, tested, or evaluated and the results of such measures are recorded. Laboratory personnel are able to carry out assigned work and to recognize and prevent possible dangers self-reliant due to their professional training, knowledge and experience as well as profound knowledge of applicable regulations.

The workforce must only consist of persons who can be expected to carry out their work reliably. Persons with impaired reactions due to, for example, the consumption of drugs, alcohol, or medication are prohibited from carrying out work on the device.

When selecting personnel, the age-related and occupation-related regulations governing the usage location must be observed.

### 3.4.2 Unauthorized Persons

---

#### **WARNING**

##### **Risk to life for unauthorized personnel due to hazards in the danger and working zone!**

Unauthorized personnel who do not meet the requirements described in this manual will not be familiar with the dangers in the working zone. Therefore, unauthorized persons face the risk of serious injury or death.

1. Unauthorized persons must be kept away from the danger and working zone.
2. If in doubt, address the persons in question and ask them to leave the danger and working zone.
3. Cease work while unauthorized persons are in the danger and working zone.

### 3.4.3 Instruction

Personnel must receive regular instruction from the owner. The instruction must be documented to facilitate improved verification.

Date	Name	Type of Instruction	Instruction Provided By	Signature

### 3.5 Personal Protective Equipment

Personal protective equipment is used to protect the personnel from dangers which could affect their safety or health while working.

Personnel must wear personal protective equipment while carrying out the different operations at and with the device.

This equipment will be defined by the head of the laboratory. Always comply with the instructions governing personal protective equipment posted in the work area.

### 3.6 Location of the Safety Label



**Note:** The laboratory supervisor is responsible for ensuring that all the warning labels are maintained in their proper place any time that the device is used.

### 3.7 Basic Dangers

The following section specifies residual risks which may result from using the device and have been established by means of a risk assessment.

In order to minimize health hazards and avoid dangerous situations, follow the safety instructions specified here as well as in the following chapters of this manual.



#### **DANGER**

##### **Danger of injury from flammable gas**

Hydrogen is an extremely flammable gas that burns with an invisible flame. It can form explosive mixtures with air. The Lower Explosion Limit / Lower Flammability Limit (LEL/LFL) is 4%.

1. The device should be installed in a sufficiently spacious, well ventilated room equipped with a permanent H<sub>2</sub> alarm gas sensor.
2. The user is referred to MSDS safety data sheets for hydrogen gas for further information.

 **DANGER** **Danger of Suffocation from Hydrogen Gas**

If excessive amounts of H<sub>2</sub> gas is released in an enclosed space, hydrogen will decrease the amount of available oxygen and may cause suffocation.

1. The device should be installed in a sufficiently spacious, well ventilated room equipped with a permanent H<sub>2</sub> alarm gas sensor.
2. The user is referred to MSDS safety data sheets for hydrogen gas for further information.

 **WARNING** **Danger of injury from electrical shock!**

A life threatening shock may result when the housing is open during operation.

1. Only qualified personnel should open the housing.
2. Disconnect the device from the electrical power supply before opening the device. Use a voltmeter to verify that the device is not under power!
3. Be sure that the power supply cannot be reconnected without notice.

 **WARNING** **Danger to life from strong magnetic fields!**

Strong magnetic fields may cause serious injuries or death and significant damage to property.

1. Persons fitted with heart pacemakers must be kept away from the device. The functionality of the heart pacemaker could be compromised.
2. Persons with metal implants must be kept away from the device. Implants may heat up or be subject to magnetic attraction.
3. Ferromagnetic materials and electromagnets must be kept away from the magnetic source. Such materials could be subject to magnetic attraction and may fly around the room, injuring or killing people. Minimum distance 3 meters.
4. Remove magnetic items (jewelry, watches, pens etc.) before carrying out maintenance work.
5. Keep electronic equipment away from the magnetic source. Such equipment could be damaged.
6. Keep storage media, credit cards etc. away from the magnetic source. Data could be erased.



**Note:** The device doesn't produce a high magnetic field.

## 3.7.1 General Workplace Dangers

### **WARNING**



#### **Danger to life from nonfunctional safety devices!**

If safety devices are not functioning or are disabled, there is a danger of serious injury or death.

1. Check that all safety devices are fully functional and correctly installed before starting work.
2. Never disable or bypass safety devices.
3. Ensure that all safety devices are always accessible.

### **CAUTION**



#### **Danger of injury from tripping over dirt and scattered objects!**

Dirt and scattered objects may cause people to slip or trip, resulting in personal injuries.

1. Always keep the work area clean.
2. Remove objects which are no longer required from the work area and particularly from the floor.
3. Indicate unavoidable hazards using marking tape.

### **NOTICE**

#### **Material damage due to a software error!**

Samples or the device may be damaged due to a software error causing malfunction of the control system. Users may also be shocked by abrupt malfunction or unexpected system start.

1. Dummy samples must be used during installation and service.
2. Personnel should be alerted to unexpected malfunctions.

### **NOTICE**

#### **Material damage hazard due to impacting the magnet!**

Impacting the magnet may result in a quench.

1. Mount the device carefully on the magnet.
2. Avoid banging the magnet during installation and operation, e.g. when replacing the sample carousel.

### **NOTICE**

#### **Material damage due to the use of genuine samples during installation and maintenance!**

Using genuine samples during installation and maintenance may result in material damage.

1. Use only dummy samples during installation and maintenance.

### 3.7.2 Dangers from Electric Power

#### **DANGER**

##### **Danger to life from stored charges!**

Electric charges may be stored in electrical components even after the system has been switched off and disconnected from the power supply. Contact with these components may result in serious or fatal injury.

1. Before working on the specified components, ensure that they have been completely disconnected from the power supply.
2. Allow 10 minutes to elapse in order to ensure that the internal capacitors have been fully discharged.

#### **WARNING**

##### **Danger of injury from electrical shock!**

A life threatening shock may result when the housing is open during operation.

1. Only qualified personnel should open the housing.
2. Disconnect the device from the electrical power supply before opening the device. Use a voltmeter to verify that the device is not under power!
3. Be sure that the power supply cannot be reconnected without notice.

#### **WARNING**

##### **Danger to life from residual electrostatic potentials!**

Friction between material being conveyed may result in significant development of electrostatic potential. Therefore, contact with parts immediately following the conveying operation may be life-threatening.

1. Potential equalisation must be ensured before making contact with parts, unless such equalisation is provided by the customer.



Electrostatic discharge from friction may occur, resulting in an electric spark and loud bang. Use ESD flooring and wear ESD shoes.

#### **WARNING**

##### **Danger to life from contact voltage!**

Absent or faulty protective earth conductor may result in contact voltage. This may pose a risk of injury or death.

1. Before the initial commissioning of the device, connect the main power supply to the socket and verify the complete functionality of the protective earth conductor.

## 3.7.3 Mechanical Dangers



### CAUTION

#### Accident hazard from movement of mechanical parts!

The fingers or hand may be pinched due to movement of mechanical parts.

1. Shut off the device before accessing.



### CAUTION

#### Accident and material damage hazard from falling objects!

Equipment may fall down during assembly, retrofitting, or dismantling. This may result in personal injury or equipment damage.

1. If necessary, assemble/disassemble the device in multiple parts.
2. Use a platform with railings instead of a ladder to reach the assembly area.
3. Avoid working over the head. When this can not be avoided, wear a protective hard hat.
4. Follow the mounting instructions in the installation manual.

## 3.7.4 Dangers from Magnetic Fields



### WARNING

#### Danger to life from strong magnetic fields!

Strong magnetic fields may cause serious injuries or death and significant damage to property.

1. Persons fitted with heart pacemakers must be kept away from the device. The functionality of the heart pacemaker could be compromised.
2. Persons with metal implants must be kept away from the device. Implants may heat up or be subject to magnetic attraction.
3. Ferromagnetic materials and electromagnets must be kept away from the magnetic source. Such materials could be subject to magnetic attraction and may fly around the room, injuring or killing people. Minimum distance 3 meters.
4. Remove magnetic items (jewelry, watches, pens etc.) before carrying out maintenance work.
5. Keep electronic equipment away from the magnetic source. Such equipment could be damaged.
6. Keep storage media, credit cards etc. away from the magnetic source. Data could be erased.



The magnetic field of the device does not cause any personal injuries or property damage. For further information see the manual of the magnet used.

## 3.8 Signage

---

The following symbols and information signs can be found in the work area. They refer to their immediate surroundings.



The identification and placement of warning labels are included in the manual. The laboratory supervisor is responsible for ensuring that all the warning labels are maintained in their proper place any time that the device is used.

---

### Electrical Voltage



Only qualified electricians are permitted to work in a work room marked by this sign. Unauthorized persons must not enter the workplaces thus marked and must not open the marked cabinet.

### Danger Spot



Warning indicating a danger spot in work rooms.

The warning label may be ordered using Bruker Part Number 67470.

## 3.9 Spare Parts

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### Loss of Guarantee

The use of non-approved spare parts will invalidate the manufacturer's guarantee.

Purchase spare parts from authorised dealers or directly from the manufacturer. See Contact for manufacturer's address.



## 4 Maintenance

### WARNING



#### **Danger of injury from electrical shock!**

A life threatening shock may result when the housing is open during operation.

1. Only qualified personnel should open the housing.
2. Disconnect the device from the electrical power supply before opening the device. Use a voltmeter to verify that the device is not under power!
3. Be sure that the power supply cannot be reconnected without notice.

**Bruker BioSpin** offers on-site service contracts that are designed to provide extended life and minimal down-time for your generator. For more information, contact our Bruker Service Department.

Use the following safety guidelines to help protect your generator from potential damage and to help ensure your own personal safety.

Before you begin any of the procedures in this section, follow the safety instructions given in the **BPHG 90 User Manual**, part number Z33081.



Installation, initial commissioning, retrofitting, repairs, adjustments or dismantling of the device must only be carried out by Bruker Service or personnel authorized by Bruker. Damage due to servicing that is not authorized by Bruker Biospin is not covered by your warranty.

### NOTICE

#### **Danger of component damage due to improper handling.**

Improper handling of components or electronic boards may lead to damage.

- ▶ Do not touch the components or contacts on a board.
  - ▶ Do not hold a board by its metal mounting bracket.
  - ▶ Do not hold a component such as a processor by its pins.
1. Always hold a board or component by its edges.



**Note:** To disconnect a network cable, first unplug the cable from your generator and then unplug it from the network device.

## 4.1 Parahydrogen Generator Overview

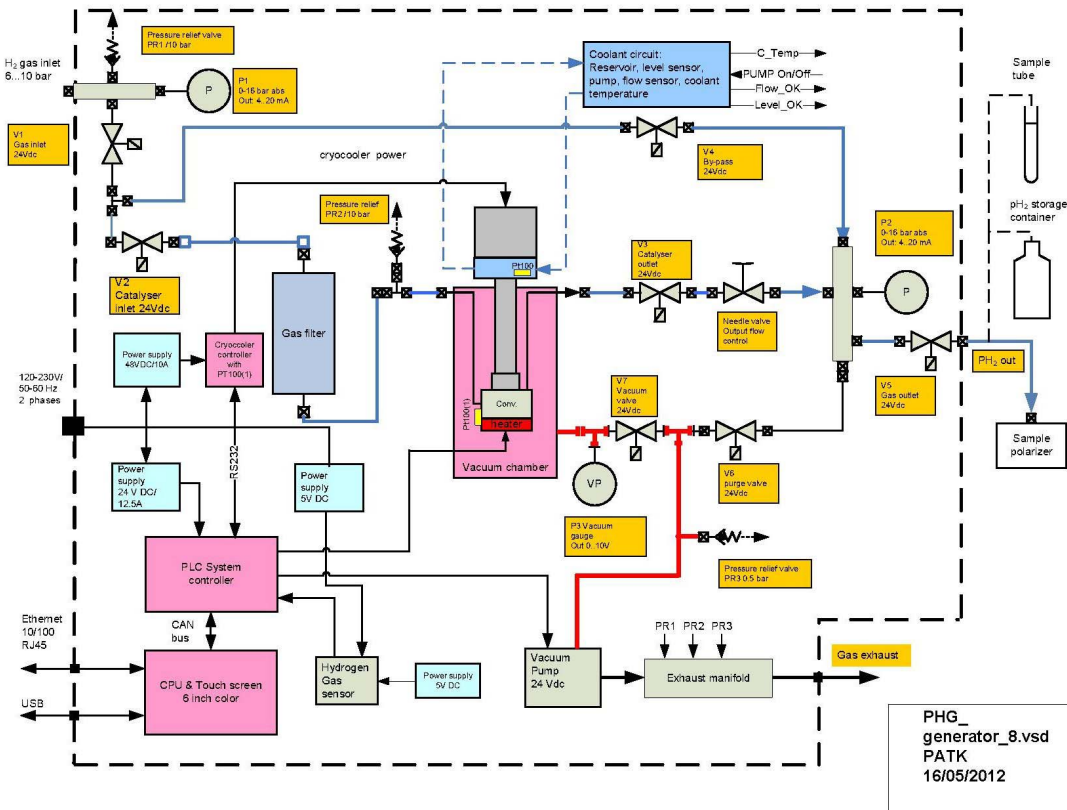


Figure 4.1: BPHG 90 Block Diagram

The BPHG generator contains various components:

- Gas circuit components including solenoid valves and pressure sensors.
- Electrical components: system controller and power supplies.
- Vacuum components and a diaphragm pump.
- A cryocooler with conversion chamber in a cryostat.
- A coolant circuit with a pump.

## 4.2 Repair and Maintenance

The BPHG 90 is a low maintenance instrument and the critical components have been chosen to ensure a long operating life time. Periodic maintenance should be carried out on a yearly basis by trained service personnel. The periodic maintenance actions are summarized in section Periodic Maintenance [▶21].

User maintenance is limited to cleaning the instrument, ensuring an adequate level of coolant fluid for cryocooler, and replacing fuses when needed.

### 4.3 Recommended Tools

---

For service and repair you may need some of the following tools:

- Small and medium flat-tip screwdriver.
- Phillips screwdriver medium.
- Multi-meter.
- Flat wrenches (for brass fittings, imperial size 7/16" and 9/16" and for stainless steel fittings, metric 14 and 12 mm) for gas valves replacement.
- Soldering iron and solder wire.
- PTFE tape.

### 4.4 Periodic Maintenance

---

The following maintenance on BPHG90 generator should be done yearly.

- Coolant replacement.
- Gas purifier cartridge replacement.
- Internal hydrogen gas detector testing.
- Radiator cleanliness inspection.

### 4.5 Generator Cover Removal

---

1. Remove all 4 screws from the rear side of device.
2. Pull the hood back horizontally about a centimeter.
3. Lift the hood off vertically.
4. Disconnect the protective grounding cable from the hood.
5. Remove the hood.

### 4.6 Radiator Cleaning

---

For proper operation, the BPHG needs to pull substantial amounts of air through a finned radiator.

The frequency of cleaning depends on the operating environment. It is recommended that a visual inspection of the radiator fins be made every 6 months.

If the radiator is dirty, the heat produced by the cryocooler device cannot be correctly evacuated, which leads to an increase of the cryocooler device internal temperature.

This increase causes a decrease of parahydrogen conversion performance, or even a shutdown of the BPHG generator if the coolant temperature becomes too high.

## 4.7 Coolant Circulation Pump Replacement

---

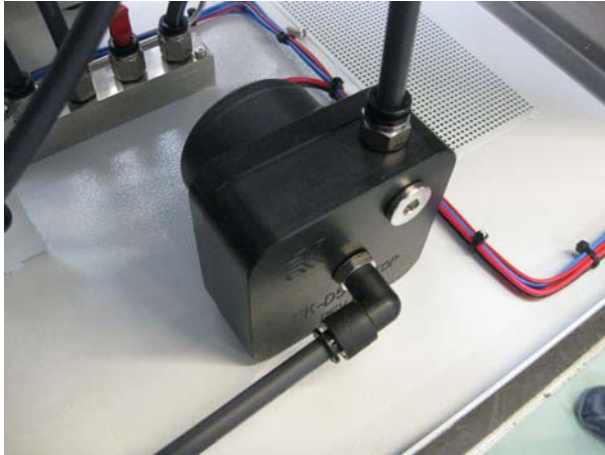


Figure 4.2: Coolant Fluid Pump

1. Drain the cooling fluid (see drain section).
2. Cut the pump's electrical wires about 10 cm away from the pump.
3. Solder the wires for the new pump.
4. Unplug the hoses from the pump.
5. Remove the pump screws from underneath cabinet.

## 4.8 Cooling Fluid Level Switch

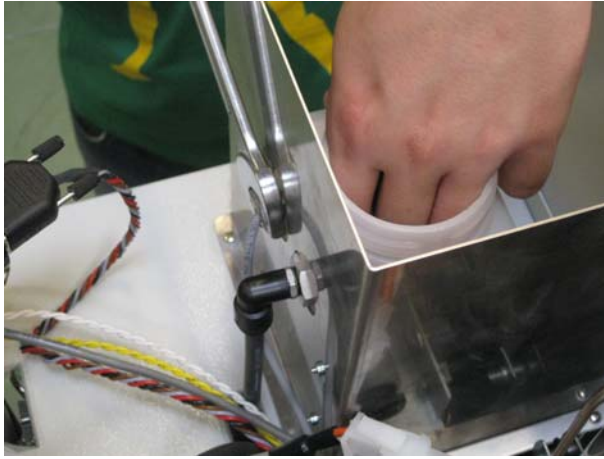
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Figure 4.3: Coolant Fluid Level Switch

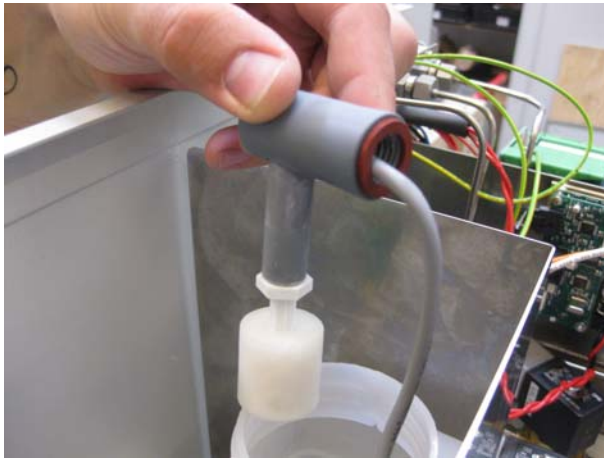
The coolant level switch assembly (the sensor is the white cylinder) is located inside the cooling liquid reservoir.

1. Drain the cooling fluid (see Reservoir draining [▶31]).
2. Unscrew the reservoir lid.
3. Disconnect the sensor wires from the controller electronics module #8 (3.1 and 3.2).
4. Using a wrench, unscrew the level switch while holding the sensor with one hand inside the reservoir.



*Figure 4.4: Unscrew Coolant Level Sensor*

5. Remove the level sensor assembly and install the new level switch with red seal.



*Figure 4.5: Coolant Level Sensor View*

## 4.9 Cooling Fluid Flow Switch

The flow switch is located below the coolant reservoir. This sensor is used to detect the coolant circulation when the cryocooler is functioning.



Figure 4.6: Coolant Flow Switch

1. Drain the coolant fluid (see Draining the Coolant Reservoir [▶31]).
2. Disconnect the sensor cable from the controller module.

## 4.10 Flow Switch Installation

1. Wrap two turns of PTFE tape on both sensor end threads to prevent water leakage.
2. The arrow on the flow sensor represents the flow direction, it must be directed upwards.
3. Firmly screw the water fittings on both sides of the sensor. Connect the water hoses.
4. Connect the sensor cable to the controller module.
5. Start the coolant pump in service menu and check for water leaks.

## 4.11 Radiator Fan Removal

---



Figure 4.7: Radiator Fans

The generator has two fans located on the rear side of the coolant radiator.

1. Remove the four M3 screws from the fan.
2. Disconnect the fan wires from the controller module.

The fan has a speed sensor that is monitored by the system controller, replace the fan only with a fan of the same model.

## 4.12 Fan Installation

---

1. Install the fan with a protective grid on the radiator using the 4 screws provided.



**Note:** Using too long screws may puncture the radiator fins and damage the radiator.

---

2. Connect the electrical fan cable to the controller module.

## 4.13 Coolant Temperature Sensor Removal



**Note:** The PT100 temperature sensor is a very fragile component, do not pull on the thin sensor wires.



Figure 4.8: Coolant Temperature Sensor

1. Lift the copper platelet with a screwdriver.

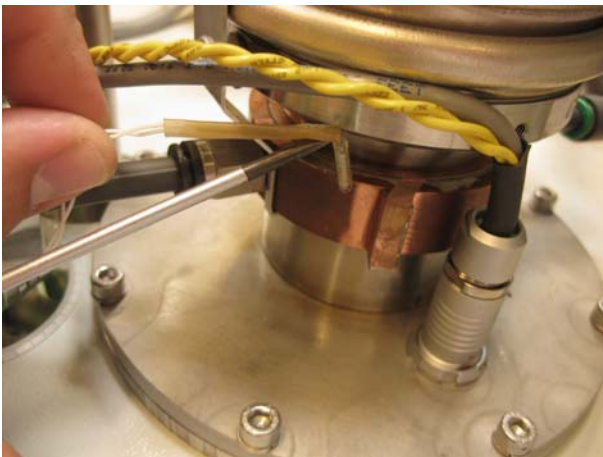


Figure 4.9: Removing the Coolant Temperature Sensor

2. Cut the sensor wires approx. 10/15 cm away from the sensor.
3. Carefully pry out the sensor from the copper block using a small screwdriver.
4. Put some vacuum grease on the sensor and insert it in the copper block. Grease makes a good thermal contact with the block.
5. Bend the copper platelet to block the temperature sensor.
6. Solder the sensor wires and insulate the wire connections.

# 5 Vacuum Components

## 5.1 Vacuum Gauge

---



*Figure 5.1: Cryostat Vacuum Gauge*

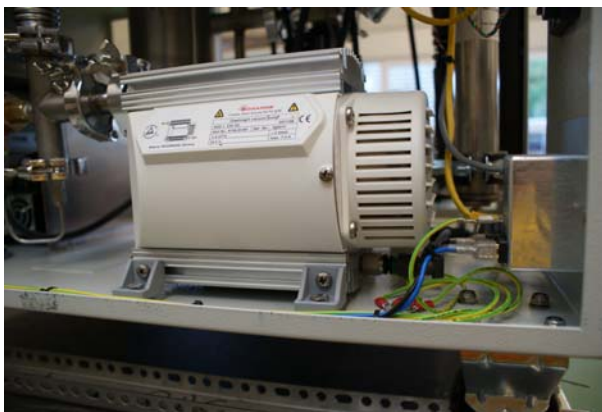
The vacuum gauge measures the vacuum inside the cryostat. It is located near the cryocooler and fixed with a KF25 clamp and seal. To replace the fuse:

1. Power off the generator.
2. Remove the electrical connector from the sensor.
3. Open the vacuum clamp and slowly remove the sensor to release the vacuum pressure.
4. The power supply of the gauge is protected by a F4 fuse, replace with the same type.

## 5.2 Diaphragm Pump Removal

---

The diaphragm pump creates a good vacuum inside the cryostat. The pump doesn't require periodic maintenance, as it only operates a few minutes before the cryocooler is started. In principle, the pump membranes should be replaced after 8000 hours of pump operation.



*Figure 5.2: View of the Diaphragm Pump*

In case of a vacuum pump failure, a new diaphragm pump should be installed.

## 5.3 Diaphragm Pump Replacement



**Note:** The diaphragm pump must be configured for a soft start, i.e. the two switches must be set on the pump internal electronic board.

### 5.3.1 Pump Settings

A new diaphragm pump must be configured prior to installation (the soft start mode must be selected by placing two switches on the internal printed circuit).

1. Remove the on the connector side of the pump cover panel, and push the cover towards the right side.

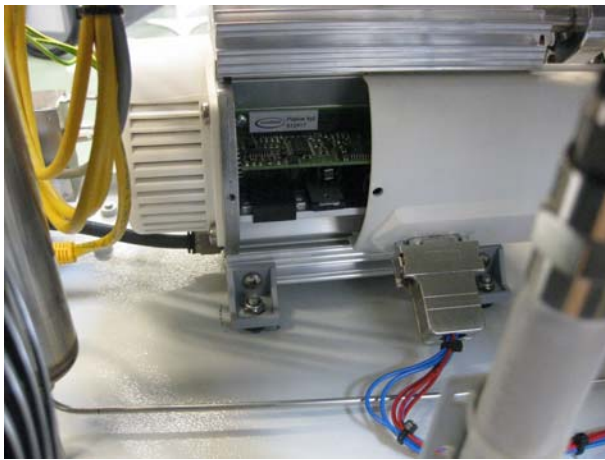


Figure 5.3: Pump Side Panel Open

2. Locate and move the small switches to the correct position with a small screwdriver.



Figure 5.4: Configuration Switches on the Printed Circuit Board

3. Close the cover and install the vacuum pump in the cabinet.

## 5.4 Pump Removal

---

1. Power off the generator.
2. Remove the hose clamp on the suction side and disconnect the vacuum stainless steel flexible hose.
3. Remove the four nuts below the cabinet using a flat 10 mm wrench. Disconnect the exhaust tube located on the rear side of the pump.
4. Unscrew and disconnect the electrical cable from the pump.
5. Install the configured pump.

## 5.5 Cryostat Vacuum Valve Removal

---

The vacuum valve is a DN10 solenoid valve that closes the cryostat. It keeps the vacuum inside the cryostat when the BPHG is turned off.

1. Remove the electrical connector from the valve.
2. Remove the KF25 clamps on both sides of the valve.

## 5.6 Cryocooler and Conversion Chamber Assembly

---



**Note:** The conversion chamber assembly is attached to the cryocooler cold head inside the cryostat, it cannot be serviced on site.

---

The BPHG 90 can be repaired at the factory if one of the following failures occurs:

- Conversion chamber temperature sensor is defective.
- A warm-up heater failure (heater open circuit or shorted, the normal resistance value is 12 ohm +/- 1 ohm).
- A cryocooler failure, such as insufficient cooling power, whereas the cooler is unable to reach very low temperature.
- The conversion chamber is completely blocked (no gas flow through it), even after warming-up.
- A low percentage of parahydrogen is produced by the generator.



# 6 Coolant Fluid Circuit

## 6.1 Draining the Coolant Reservoir

---

The cooling should only be drained when the pump is in the “OFF” state and the device power supply is disconnected.

The following are required to drain the reservoir:

- A short plastic tube (50 cm) equipped with a fitting.
- A container with at least a 1 liter capacity (a shallow or flat container can be used).

1. Connect one end of the tubing should to be placed over the container.
2. The other end of the tube on the fitting marked “**Drain**”.
  - ⇒ The cooling fluid liquid will then flow out immediately.
3. When the cooling fluid flow stops, disconnect the draining tube from the drain port.

## 6.2 Cleaning the Reservoir

---

A periodic reservoir cleaning is necessary, we recommend that a visual inspection of the reservoir be made monthly after initial installation:

1. Open the rear panel of the reservoir to view the coolant reservoir.
2. If necessary, drain the reservoir before cleaning.

## 6.3 Filling the Cooling Fluid Reservoir

---

1. Remove the rear side panel, including all screws, and disconnect the protective grounding cable.
2. Unscrew the reservoir cap.
3. Fill the reservoir to about 2 cm below the cap using distilled water (with some drops of algicide).
4. Avoid spilling cooling fluid inside the device.
5. A watering can with a narrow neck can be used to fill the tank up to the “high” limit. Turn ON the water pump to start the coolant flow (the pump can started in the service menu).
6. Visually check that the coolant fluid returns to the reservoir when the pump is running.
7. Turn off the pump and recheck the reservoir level, refill if necessary.
8. Close the reservoir cap.

### Algae

To restrict the growth of algae in the fluid reservoir, it is recommended to keep the cap on the reservoir closed.

### Algicide

Bruker recommends the use of Chloramine-T Algicide to reduce the growth of algae.



# 7 Gas Circuit Components

## 7.1 Inlet or Outlet Gas Pressure Sensor Replacement



**Note:** Release the gas pressure from the internal lines and disconnect the external H<sub>2</sub> gas supply line.



Figure 7.1: Gas Pressure Sensors Rear View



Figure 7.2: Stainless Steel Tube Removal

1. Unscrew the fitting and disconnect the stainless steel line on the rear side of sensor using two 17 mm wrenches. Use one wrench to turn the tube nut while using the other to firmly hold the sensor nut.
2. Remove the holding plate.
3. Disconnect the pressure sensor cable from module 15 or 16 of the controller (pin 1.3).
4. Disconnect the power supply wires from the right side of the connection block.

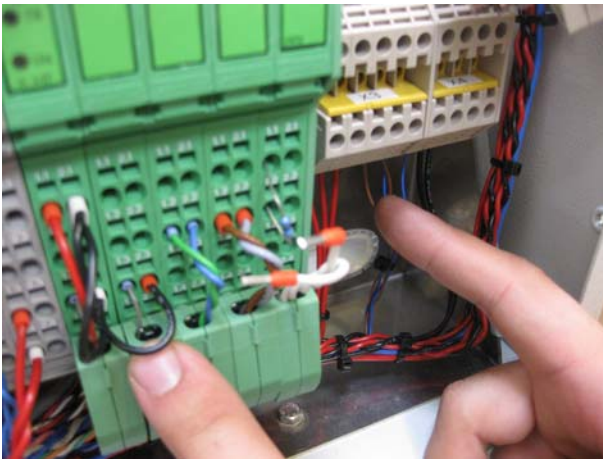


Figure 7.3: Gas Pressure Sensor Wire Connections

5. Install the new pressure sensor. Note that the pressure sensor must be configured, select the “**bar**” indication unit, and set the display pressure **threshold** to 6 bar.

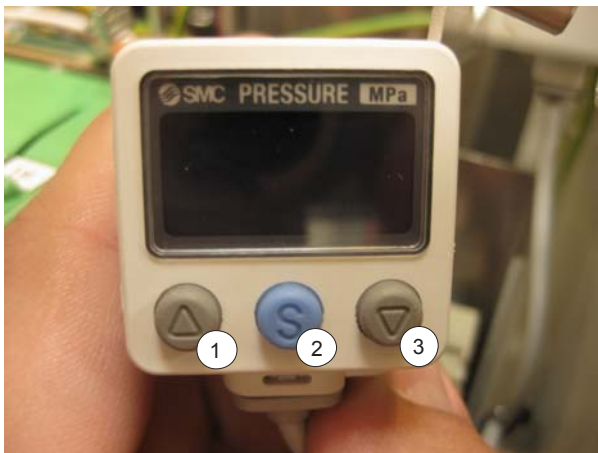


Figure 7.4: Pressure Sensor Keypad

1	Up Button	2	S Button	3	Down Button
---	-----------	---	----------	---	-------------

## 7.1.1 Pressure Indication Unit

To display the pressure:

1. Press the blue **S** button for at least 2 seconds to display [F0].
2. Press the **up** or **down** button to select [F0].
3. Press the **S** button.
  - ⇒ The unit moves to the unit conversion function, and displays the “**Uni**” and the **set value** alternately.
4. Press **up** or **down** button until **bar** is displayed.
5. Press the **S** button to return to the function selection.
  - ⇒ The (F0) function is complete.

6. Press **S** for at least 2 seconds to return to the measurement mode and to display the pressure.

## 7.1.2 Pressure Switch Setting

---

The BPHG 90 requires a hydrogen inlet pressure above 6 bar. If the gas pressure is below the pressure threshold (6.0 bar) the display indication is **RED** and above the display turns to **GREEN**.

1. Press the **S** button once in measurement mode.
  - ⇒ The [P\_1] and set value are displayed alternately.
2. Press the **up** or **down** button to change the value to **6.0 bar**.
3. Press the **S** button for 2 sec to finish the setting and return to measurement mode.

## 7.2 Solenoid Valve Removal

---



Figure 7.5: Gas Valve with Electrical Connector

1. Remove the electrical connector with a screwdriver.
2. Open both fittings using two wrenches (for brass fitting imperial size 7/16 and 9/16" and for stainless steel metric 14 and 12 mm).
3. Note the flow orientation of the valve (the "1" mark on the valve is normally the pressure inlet).
4. Remove valve from holding plate.

## 7.3 Gas Valve Installation

---

1. Install the valve, making sure it is in the correct flow direction.
2. Firmly tighten the fittings by hand and then tighten with a wrench (make only 1 ¼ turn).
3. Attach the electrical connector to the solenoid valve.



**Note:** All of the BPHG gas valves are identical.

---

### 7.4 Hydrogen Gas Purifier Cartridge Replacement

The gas purifier cartridge should be replaced every 8000 hours (approximately 12 months of continuous operation), or if the conversion chamber becomes blocked often due to frozen contaminants. The BPHG 90 monitors the operating time of the device and gives a maintenance warning when the cartridge approaches its maximum life time.



Figure 7.6: Gas Purifier Cartridge

1. Release the internal pressure from all the internal tubing.
2. Turn off the generator.
3. Open the rear panel to access the cartridge.
4. Open the Swagelok fittings at both ends of cartridge.
5. Open the holding clamps.
6. Remove the purifying cartridge.

### 7.5 Gas Purifier Cartridge Installation



**Note:** Once open, the gas purifier cartridge should **immediately** be installed. It contains a desiccant and molecular sieves that can catch moisture and some gases species from air when open and reduce the lifetime of the cartridge.

The gas flow direction arrow on the cartridge must point **downwards**.

1. Open the rear panel to access the cartridge.
2. Secure the cartridge with its clamps.
3. Remove the upper rubber cap from the cartridge.
4. Connect the upper fitting.
5. Remove the lower rubber cap from the cartridge.
6. Attach the lower fitting.



## 8 Electrical Components

### 8.1 Hydrogen Gas Sensor Test

---



*Figure 8.1: Hydrogen Gas Sensor.*

The internal hydrogen gas sensor must be tested every 12 months by a qualified service technician. It is located inside the cabinet on the rear panel over the diaphragm pump.

Spray some hydrogen gas on the sensor and check the sensor response. If the generator is not responding by an alarm on screen, replace sensor.

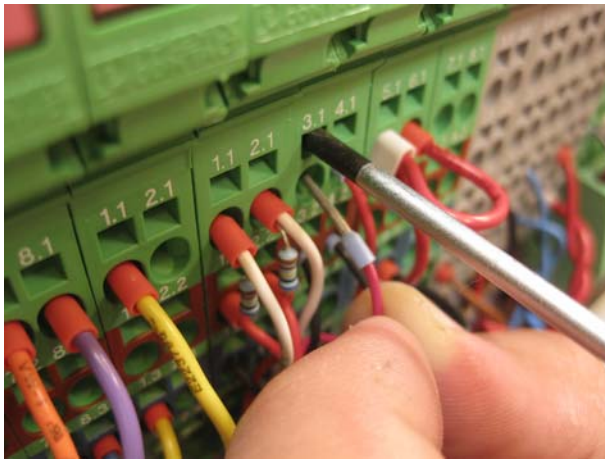
The hydrogen gas sensor is powered by 5 Vdc.

### 8.2 Phoenix Electronic Controller Module Removal

---

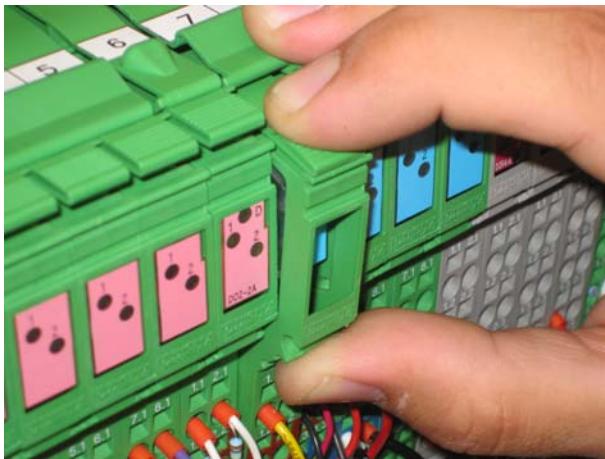
It is not necessary to remove the wires attached on the interconnecting block because the interconnecting block can be removed with all the wires attached.

- To remove a interconnecting block, unlock and lift the wire block.
- To remove a wire from a block, insert a small screwdriver in the square hole above wire and pull out the wire.



*Figure 8.2: Removing a Wire from an Interconnection Block*

- To unlock interconnecting block, press on top and bottom side and pull it out.



*Figure 8.3: Removing an Interconnecting Block*

- To remove a module press on top and bottom and remove module from DIN rail.

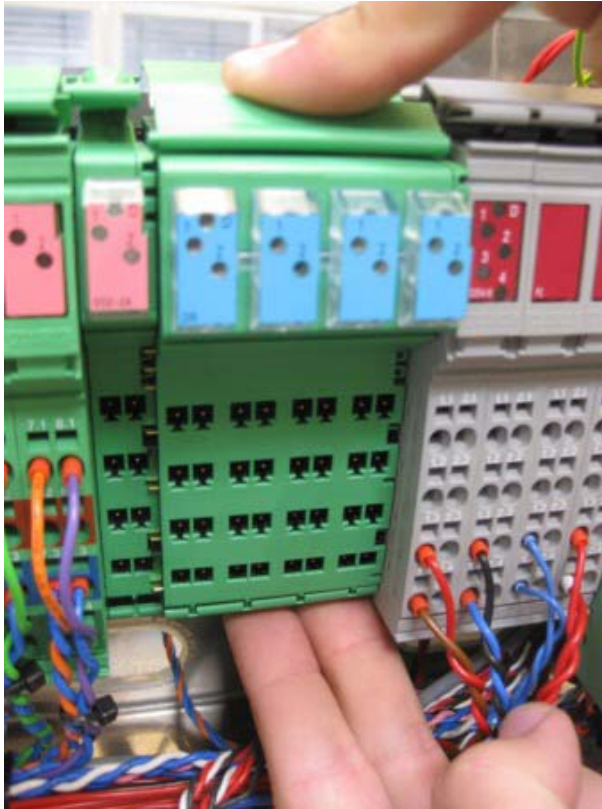


Figure 8.4: Removing an Electronic Module

## 8.3 Power Line Fuses Replacement



Figure 8.5: Opening the Line Fuses Holder

1. Power off the generator and remove the power cable from the plug.
2. Use a small flat screwdriver to open the fuse holder.
3. Remove both fuses.
4. Install the new fuses (P/N 2257).
5. Close the fuse holder.

## 8.4 Cryocooler Controller Fuse Replacement

---



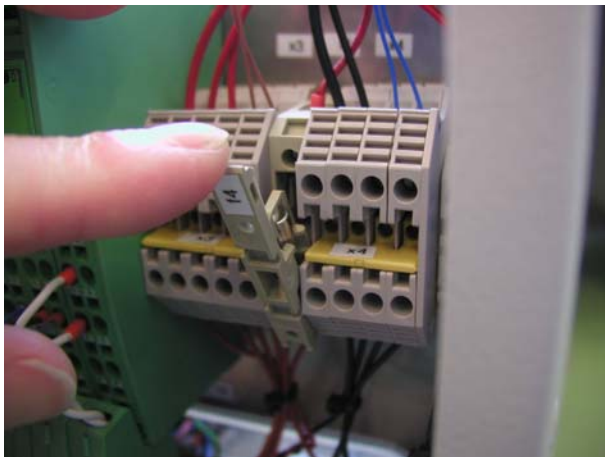
*Figure 8.6: Cryocooler Controller Fuse Holder*

The power supply (red wire, +48V) for the controller board is protected by a single fuse located on the rear side of the cabinet. To replace the fuse:

1. Turn off the generator.
2. Unscrew the fuse holder with a flat screwdriver and remove the fuse.
3. Install the new fuse (P/N 1808869).
4. Close the fuse holder.

## 8.5 Vacuum Gauge Fuse Replacement

---

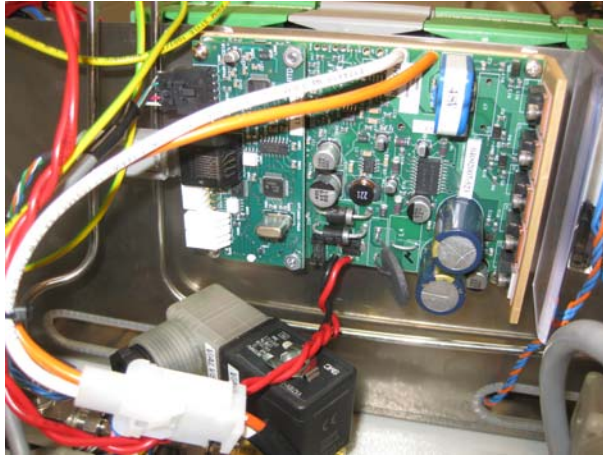


*Figure 8.7: Vacuum Gauge Fuse*

The vacuum gauge is protected by a fuse (F4) located on the connecting block close to the system green electronic modules. To replace the fuse:

1. Turn off the generator.
2. Pull to open the fuse holder.

## 8.6 Cryocooler Controller Board Replacement



*Figure 8.8: Cryocooler Control Board*

To replace the cryocooler controller board:

1. Turn off the generator.
2. Disconnect all the cable connectors from the printed circuit board.
3. Remove the screws from the controller board.
4. Remove the board and un-solder power supply wires (red and black wires) from the board (bottom of printed circuit, as shown in the figure above).
5. Solder the power supply wires onto the new controller board and reinstall the board.

### **See also**

- 📄 [Cryocooler Controller Board Replacement \[▶43\]](#)



# 9 Software

## 9.1 Firmware Update

---

The controller software can be updated using a USB memory stick.

1. Plug the USB memory stick containing the new software into the USB connector on the rear side of the device.
2. The memory stick should be automatically detected. Follow the upload instructions for the new firmware on the main screen.

## 9.2 Service Menu

---

The service menu access is protected by a password and is intended for service technicians only.

In the service menu, some system components can be tested, for example:

- The cryocooler coolant pump.
- The gas valves and cryostat vacuum valve.

The service menu also allows the following information to be read:

- The inlet and outlet gas pressure.
- The temperature sensor readings (coolant temperature, conversion chamber temperature).



# 10 Spare Parts List

Bruker Part Number	Description	Comments
2257	Fuse 5 x 20 mm 4AT/250V.	Main line power fuses.
1808869	Fuse 5 x 20 mm 10.0AT/250V.	Cryocooler controller fuse.
2271	Fuse 5 x 20 mm 1AF /250 V.	Fuse F4 vacuum gauge.
1804507	Hydrogen purifier cartridge.	Inlet H <sub>2</sub> gas purifier.
1803593	Coolant pump assembly.	Cooling fluid pump for cryocooler.
1802704	Gas digital pressure sensor.	Measures inlet or outlet H <sub>2</sub> gas pressure.
78822	Coolant flow switch.	Monitors coolant fluid flow.
W136780	Coolant level switch assembly.	Located inside cooling liquid reservoir.
1803014	Diaphragm pump.	Cryostat vacuum pump.
56728	Vacuum gauge.	Monitors cryostat vacuum.
1803017	Hydrogen gas sensor.	Internal hydrogen gas sensor.
1802706	Solenoid gas valve.	24V <sub>DC</sub> gas valve.
1803110	Solenoid vacuum valve DN10.	24V <sub>DC</sub> cryostat vacuum valve.
W136781	PT100 temperature sensor assembly.	Measures coolant temperature.



# 11 Contact

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## Figures

Figure 2.1:	BPHG 90 Front View .....	7
Figure 2.2:	BPHG 90 Rear View.....	8
Figure 4.1:	BPHG 90 Block Diagram .....	20
Figure 4.2:	Coolant Fluid Pump.....	22
Figure 4.3:	Coolant Fluid Level Switch .....	22
Figure 4.4:	Unscrew Coolant Level Sensor .....	23
Figure 4.5:	Coolant Level Sensor View .....	23
Figure 4.6:	Coolant Flow Switch.....	24
Figure 4.7:	Radiator Fans.....	25
Figure 4.8:	Coolant Temperature Sensor .....	26
Figure 4.9:	Removing the Coolant Temperature Sensor .....	26
Figure 5.1:	Cryostat Vacuum Gauge .....	27
Figure 5.2:	View of the Diaphragm Pump.....	27
Figure 5.3:	Pump Side Panel Open.....	28
Figure 5.4:	Configuration Switches on the Printed Circuit Board.....	28
Figure 7.1:	Gas Pressure Sensors Rear View.....	33
Figure 7.2:	Stainless Steel Tube Removal.....	33
Figure 7.3:	Gas Pressure Sensor Wire Connections.....	34
Figure 7.4:	Pressure Sensor Keypad.....	34
Figure 7.5:	Gas Valve with Electrical Connector.....	35
Figure 7.6:	Gas Purifier Cartridge.....	36
Figure 8.1:	Hydrogen Gas Sensor.....	39
Figure 8.2:	Removing a Wire from an Interconnection Block .....	40
Figure 8.3:	Removing an Interconnecting Block.....	40
Figure 8.4:	Removing an Electronic Module.....	41
Figure 8.5:	Opening the Line Fuses Holder.....	41
Figure 8.6:	Cryocooler Controller Fuse Holder.....	42
Figure 8.7:	Vacuum Gauge Fuse.....	42
Figure 8.8:	Cryocooler Control Board .....	43



# Index

## A

Algae .....	31
Algicide .....	31

## B

BPHG 90	
Factory Repair .....	29
Maintenance warnings .....	36
Pressure Switch Setting .....	35
Repair and Maintenance .....	20
User maintenance .....	20
BPHG generator	
Components .....	20
BPHG Generator	
Shutdown .....	21

## C

conversion chamber	
Blockage .....	29
Coolant .....	21, 47
Coolant Flow Switch	
Installation .....	24
Removal .....	24
Coolant Fluid Pump .....	22
Coolant Level Switch .....	22
Coolant Temperature Sensor .....	26
Installation .....	26
Removal .....	26
Cooling Reservoir	
Algae reduction .....	31
Cleaning .....	31
Drainage .....	31
Filling .....	31
Cryocooler .....	7
Failure .....	29
Cryocooler Controller Board	
Replacement .....	43
Cryostat Vacuum .....	29, 47
Cryostat Vacuum Valve .....	45

## D

Diaphragm Pump .....		47
Removal .....		27
Replacement .....		28
Diaphragm Pump Membrane		
Replacement .....		27

## E

Electronic Controller Module	
Removal .....	39

## F

F4 Fuse .....	27
Firmware Update .....	45
Fuse	
Cryocooler .....	47
F4 fuse .....	42
Power line fuse replacement .....	41
Fuse Holder .....	42

## G

Gas Pressure Sensor .....	33
Gas Pressure Sensor Wire .....	34
Gas Purifier Cartridge	
Installation .....	36
Replacement .....	36
Gas Valve	
Installation .....	35
Removal .....	35

## H

H2 Gas Purifier .....	47
H2 gas supply line .....	33
Heater Failure .....	29
Hydrogen Gas Supply .....	7

## I

Interconnection Block .....	40
Internal Hydrogen Gas Sensor	
Test interval .....	39

## K

KF25 Clamp ..... 27

## L

Laboratory Personnel..... 11

Level Switch ..... 47

    Installation ..... 23

    Removal..... 22

## M

Magnetic Field..... 13

Maintenance ..... 19

Maintenance Warning ..... 36

## P

Parahydrogen

    Decrease in conversion performance ..... 21

    Low percentage produced by the generator .. 29

Personal Protective Equipment..... 12

Personnel Qualifications ..... 11

Power Line Fuse

    Replacement..... 41

Product Liability..... 9

PT100 Temperature Sensor ..... 26

Purifier Cartridge..... 47

## R

Radiator ..... 21

Radiator Cleaning ..... 21

Radiator Fan

    Installation..... 25

    Removal..... 25

    Speed Sensor ..... 25

Radiator Fins

    Damage ..... 25

Risk Assessment ..... 9

## S

Safety guidelines..... 19

service contracts ..... 19

Service Menu ..... 45

Solenoid Valves ..... 7

SOP ..... 10

Spare Parts ..... 47

Standard Operating Procedure ..... 10

Swagelok Fittings..... 36

## T

Temperature Sensor ..... 26, 47

    Defective..... 29

Tubing ..... 36

## V

Vacuum Gauge ..... 27, 42, 47

Vacuum Pump ..... 7

    Failure..... 27





# End of Document

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