EAPD II

Electronic Atmospheric Pressure Device II

User Manual

Version 001

Innovation with Integrity

NMR

This manual was written by

Bruker BioSpin AG

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Manual

Electronic Atmospheric Pressure Device II

for Bruker Cryostats

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1 Introduction

Electronic Atmospheric Pressure Device II EAPD Z102597

Due to the excellent sensitivity of NMR systems, the magnetic field is quite sensitive to changes in atmospheric pressure.

Rapid changes in the atmospheric pressure caused by weather changes may result in a high helium boil off (falling atmospheric pressure) or a zero helium boil off (increasing atmospheric pressure). These pressure changes will affect the helium temperature inside the cryostat and result in different drift rates. Large changes in drift rate is also influence the homogeneity of the magnet.

We recommend the use of Electronic Atmospheric Pressure Devices II (EAPD) for all high field NMR systems (600 MHz and above), when running long term experiments in locations with large changes in atmosperic pressure.

The EAPD is able to stabilize the helium atmosphere within the helium vessel of the cryostat at a constant pressure of 1030 hPa (1030 mbar) or to a customer preselected point. Due to the very sensitive pressure sensor and the high tech proportional valve, this regulation does not produce any additional vibrations in the cryostat. The optimum pressure for stable operation is about 1030 hPa, but this setting may be adjusted by the Bruker service personnel or the customer depending to the local barometric pressure. The minimum setting with for the regulator is 5 mbar and **maximum is 1060 mbar.**

The EAPD is equipped with a regulator valve, which is fully open if the power fails. If an electrical failure occurs, the valve will open and slowly release the excessive helium pressure into the atmosphere.

Before refilling the helium, the excess pressure in the cryostat needs to be released with a needle valve or simply by switching off the EAPD.

Building up the pressure after the refilling procedure will take about 6-24 hours.

The proportional regulator valve manufacturer can garantee a long term stability of < 0.7% FS / year (FS = Full Scale = 1060 hPa). This provides for a maximum variation in offset point of approximately 7.5 mbar per year.

2 Safety precautions

Always keep the EAPD outside of the 0.5 mT (5 G) stray field line. There is a transformer and a magnetically controlled proportional valve inside which could be affected by the magnetic field.

Never disconnect the EAPD inlet or the gas tubing at the side of the magnet before the cryostat is depressurized. The pressure in the helium vessel is stabilized about 30-70 hPa (mbar) over the ambient pressure. A spontanious pressure decrease cause the magnet system to expierience a high helium boil off, as well as a quench.

The EAPD must be checked yearly for its offset point. A high discrepancy in the offset point could end up in high drift rates at the magnet system.

Always connect the EAPD after the one way valve.

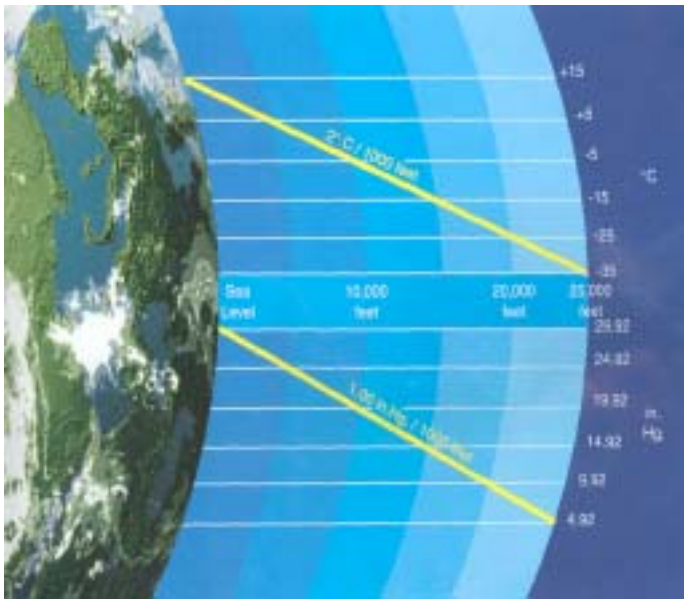
Never connect the EAPD during magnet charging or cryoshimming. A high helium flow can destroy the membrane of the proportional valve.

We recommend always installing the EAPD at the end of the line (after the helium flow meter or gas counter).

3 Operating Principles

The EAPD is able to stabilize the pressure of the helium atmosphere in the cryostat of the magnet system to a constant pressure of 1030 hPa.

Due to the very sensitive proportional regulator valve, the EAPD will not create any additional vibrations in the helium towers of the cryostat.



Atmospheric pressure conditions:

The weight of the atmosphere generates a pressure in the air, which decreases as the distance from the earth's surface increases.

Near the earth's surface (<10 000m) we can calculate with a linear decline of **100 Pa (1 mbar) for every 8 m** increase in elevation, when we assume a constant temperature.

(This calculation is comparable with **1.0 inch Hg / 1000 feet.)**

Strictly speaking the atmospheric pressure is reacting by the confirmity to Boyle-Mariotte. It is droping down by an exponential function starting at 1013,25 hPa (0 °C).

$$p_h = p_o \cdot e^{-\frac{\rho_o g h}{p_o}} \quad ; \text{at } 0° \text{ C}$$

p_h = Atmospheric pressure at h meters above sea level

p_o = Atmospheric pressure at sea level = 1013.25 hPa = 1013mbar = 29.92 inch Hg

e = 2.71828 (Euler constant)

ρ_o = Air density at earth surface = 1.293 kg/m^3 at 0° C and 1013 hPa

g = Acceleration of gravity = 9.81 m/s^2

h = Altitude in m above sea level

General Information:

Be aware that the Isobar diagrams with the meteo news are always calculated to sea level.

4 Installation

For the following installation tools you will need:

-nothing

4.1 Unpacking

The Electronic Atmospheric Pressure Device II Z102597 includes:

- EAPD

- 5 m power cable (Schucko plug)

- 6 m plastic tubing

- 2 pieces tubing reduction 8mm/5mm

- Manual EAPD

- 2 x Manual Bronkhorst with calibration certificate

4.2 Power Supply

100 - 240 Volts / 50 - 60 Hz

The EAPD contains a power supply with a wide operational range from 100 V up to 240 V at 50 - 60 Hz. Connect the EAPD to the 240 V plug at the console of the spectrometer when there is no other receptacle available. The power consumption for the EAPD is approximately 40VA.

There is 2 A T / ClassB, Group1 fuse at the line input for protection.

Operating range: 0...50 °C.

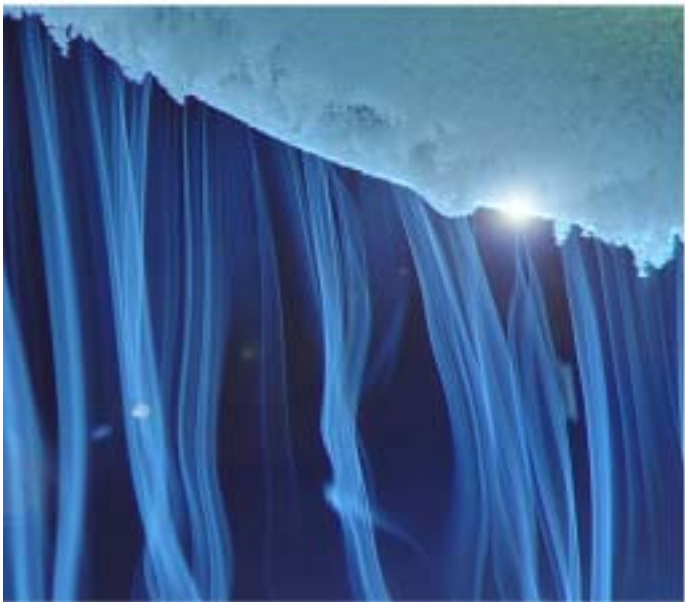
4.3 Connecting to the Cryostat

To connect the EAPD to the Cryostat, use the 6m plastic tube. For security reasons don't remove the one way valve.

Connect the outlet of the EAPD to an additonal tube and bring the helium gas outside of the spectrometer room or close to the air conditioning. The long term effect of helium buildup is that the vacuum of the magnet system will go soft (due to the helium molecules being very small) and the liquid helium boil off will start to increase.

There a two special tubing reductions for the EAPD to connect the plastic tube.

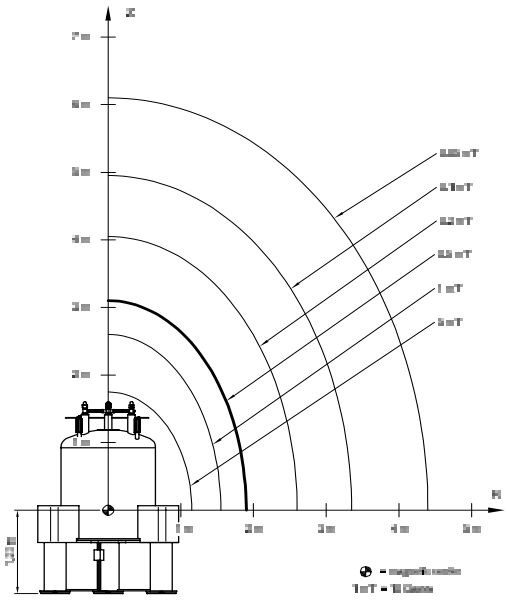
4.4 Connection to Helium Recovery System



Before you connect the outlet of an EAPD to a recovery system, you must garantee that an overpressure will not affect the regulator.

Keep in mind that the EAPD regulator operates only when the pressure at the outlet is at least 15 hPa (15 mbar) lower.

4.5 Distance to the magnet



- Always keep the EAPD away from the magnetic field. Use the 5 mT (5G) stray field as a guideline for protecting the magnet system against hazardous flying objects.

- There is a transformer and a magnetically controlled proportional valve inside the housing.

- The valve can of course also be influenced by the magnetic field of the magnet system and therefore a save operation cannot be guaranteed.

5 Activate the EAPD

By switching on the main power switch on the back side you will activate the EAPD.

For standard operation please keep the red shorting plug (Flow-Bus) connected.

6 System Check

When activating the main power switch, the EAPD will run through a self test program.

1. Loading Parameters

2. Bronchost Hi-Tec

3. Checking flowbus

Please Wait

4. Checking flowbus

Ready

5. Single Channel

Style

6. System Check

Instrument Not Available

(looking for instrument)

6. Measure mode

Calibration

7. Measure Mode = Normal Function

(Instrument located)

Without any magnet system connected, the EAPD will display you now the actual atmospheric pressure (+/- 1%).

For additional information please check also the Bronkhorst Manual.

7 Altering the Operating Pressure (set point)

The factory setting for the operating pressure is 1030 hPa. When your customer is located where the average pressure is much lower or higher, than it may make sense to change the set point.

For an optimum regulation the cryostat pressure should be ~15 hPa (~15 mbar) above the highest atmospheric pressure you obtain.

We recommand as maximum set point 1050mbar, because 1060 mbar is the upper end for the regulator.

Edit set point:

Within the normal operation mode (measure menu) you press the

and the display will change to the set point menu.

With the left  and right  key you can jump to the digit you like to change.

The up  and down  keys will help you find a new set point.

 This is the key to store the new set point.

8 Analog Input/Output Signals

The function and the pin configuration of the external 9-pin D-connector and the flow bus RJ45 connecter is described in the Bronkhost "Instruction Manual".

Also a lot of additional features are described within these manuals.

9 Maintenance

The long term stability of the Bronkhorst regulator is 0.7% (~7.5 hPa) per year. These regulators normally drift to one side, within a few years it can end up with a high offset point, but still running within specification. For this reason the EAPD must be checked once a year.

The inlet tube can be blocked, whereas the display must show the ambient pressure. For details refer to chapter 6, “System Check,” on page 8.

With a pressure difference (ΔP) of more ~20-30 hPa the equipment can be shipped back to Bruker for readjustment.

10 Troubleshooting

-No display: Check the fuse, the power line and the power supply.

-No regulation: The membrane inside the Bronkhorst regulator for picking up the input pressure is very sensitive to overpressure. In case of a quench it can brakedown and the unit will no work under the standard conditions.

-High boil off: Check the EAPD's offset point. The display will stay on 1030 hPa, but the input pressure could rise to a much higher point, due to a drifting offset. Go for chapter 9, "Maintenance," on page 11.

A high helium boil off can only occur when the EAPD is connected. Use helium flow meter to check for a gas oszillation inside the gas tube. Start removing the one way valve. Exchange the gas tube with a longer/shorter one.

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