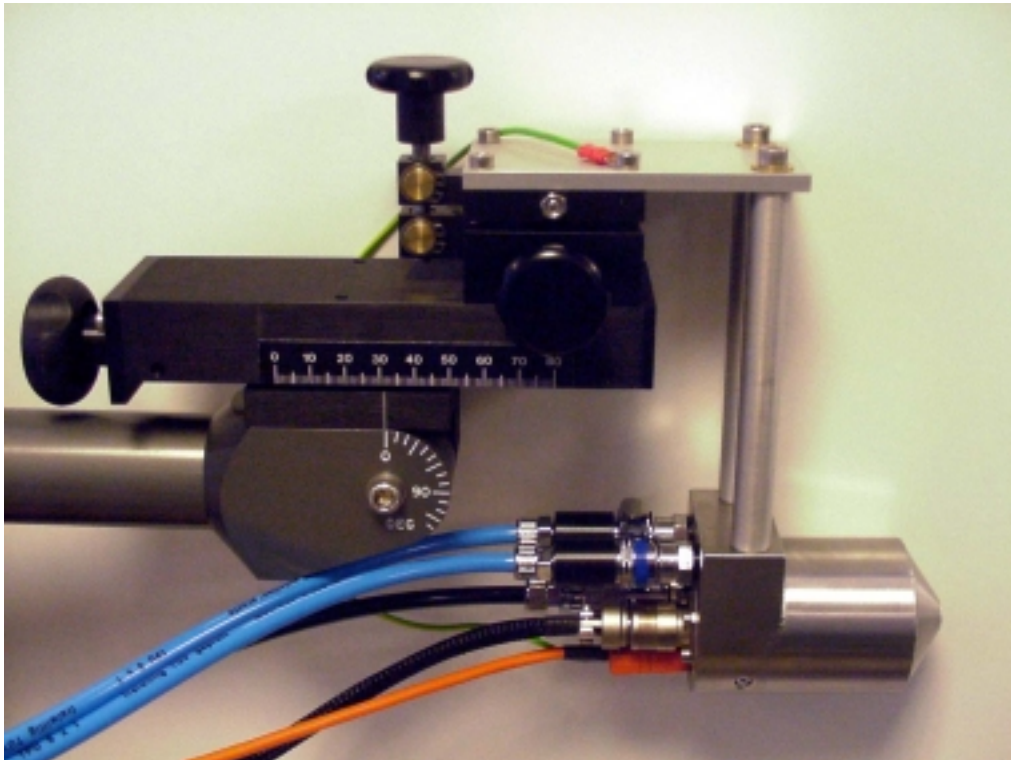


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GAS BLOWER

User manual



April 2004

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TECHNICAL INFORMATIONS

- Control unit

Dimensions: L=550 mm, l=450 mm, h=270 mm

- Gas blower

Diameter=50 mm

Height=80 mm

Weight=680 g

Materials: inox, aluminium, alumina and alumina fibers

Power : 220 V - 1000 W (fuse 10A)

Gas supply : 6 bars, 600 l/h maximum flow

Water cooling supply : maximum 6 bars, water flow 30 l/h minimum, inlet temperature 25 °C.

Features and limits

- Maximum temperature : 1000 °C with a gas flow set to 500 l/h (air).
- Repeatability in the isotherm zone : $\leq \pm 2^{\circ}\text{C}$
- Stability during temperature dwell : $\pm 0.5^{\circ}\text{C}$
- The sample temperature corresponding to the setpoint temperature must be defined by a calibration. The calibration must take into account:
 - the emissivity of the sample
 - the geometry
 - the position in the flux
 - the gas flow

SAFETY RULES

Do not use hydrogen or any toxic gas.

Watch out for fire risks.

The use of the gas blower in a closed room increases the fire risk as it increases the oxygen content.

This device is hazardous, it can burn people or put fire to objects even away.

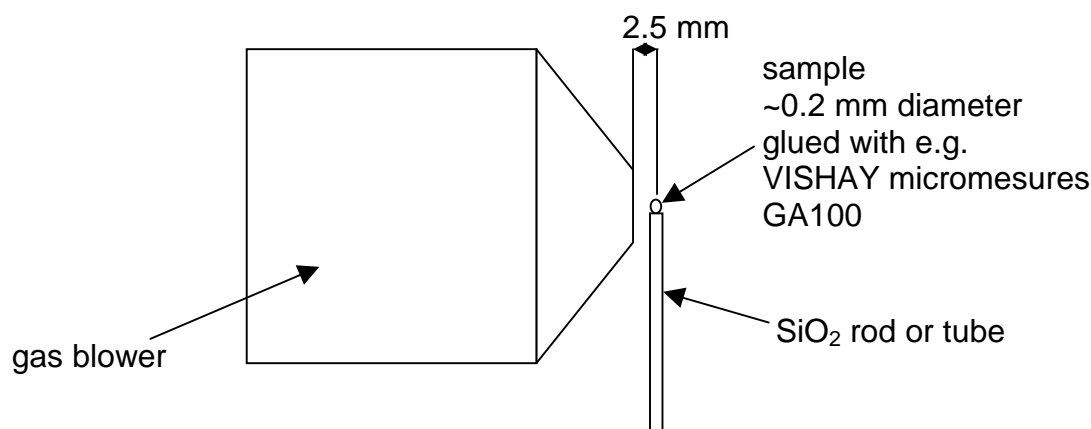
The hazardous zone is set along the axis of the gas blower on a distance of 500 mm and a diameter of 150 mm. For example never put any X-ray detector along the axis of the gas blower.

The water flow meter must be compulsory connected to the water circuit. In case of water leak or low water flow it switches off the power supply of the heating element and switches off the Eurotherm 902P temperature controller.

Suitable gas above 1000°C are air, argon and oxygen.
Never use nitrogen above 500 °C.

PRACTICAL ADVICES

This device is meant to be set on 4 circle diffractometer with a spherical sample of up to 0.3 mm in diameter. The sample can be set very close to the output of the gas blower, the maximum distance being 3.5 mm. The drawing bellows shows a typical setting of the sample.



In order to avoid "over-shooting" when changing the temperature setpoint it is best to use the "program mode" of the Eurotherm 902 temperature controller. **Let increase the temperature slowly (<10 °C/minute).**

High temperature performance is dependant on the gas flow. At low rates the temperature at the sample position can be influenced by air draughts deflecting the gas stream.

Under certain conditions an excessive flow can make the sample vibrating.

Increasing the flow of gas reduces the radial isothermal plateau and increases the isothermal area in the axial direction.

INSTALLATION

- **Before connecting or disconnecting any element of this equipment, always check that the control cabinet is switched off.**

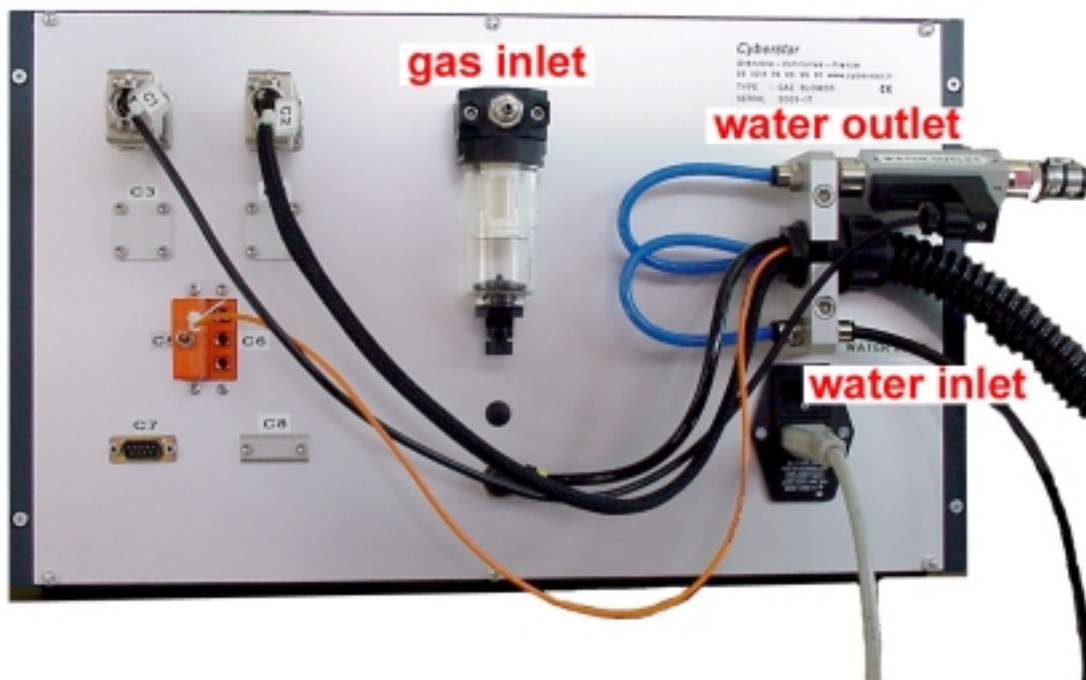
On the rear rack panel, connect C5 (thermocouple), C2 (heating element power supply). C7 is the RS232 connector.

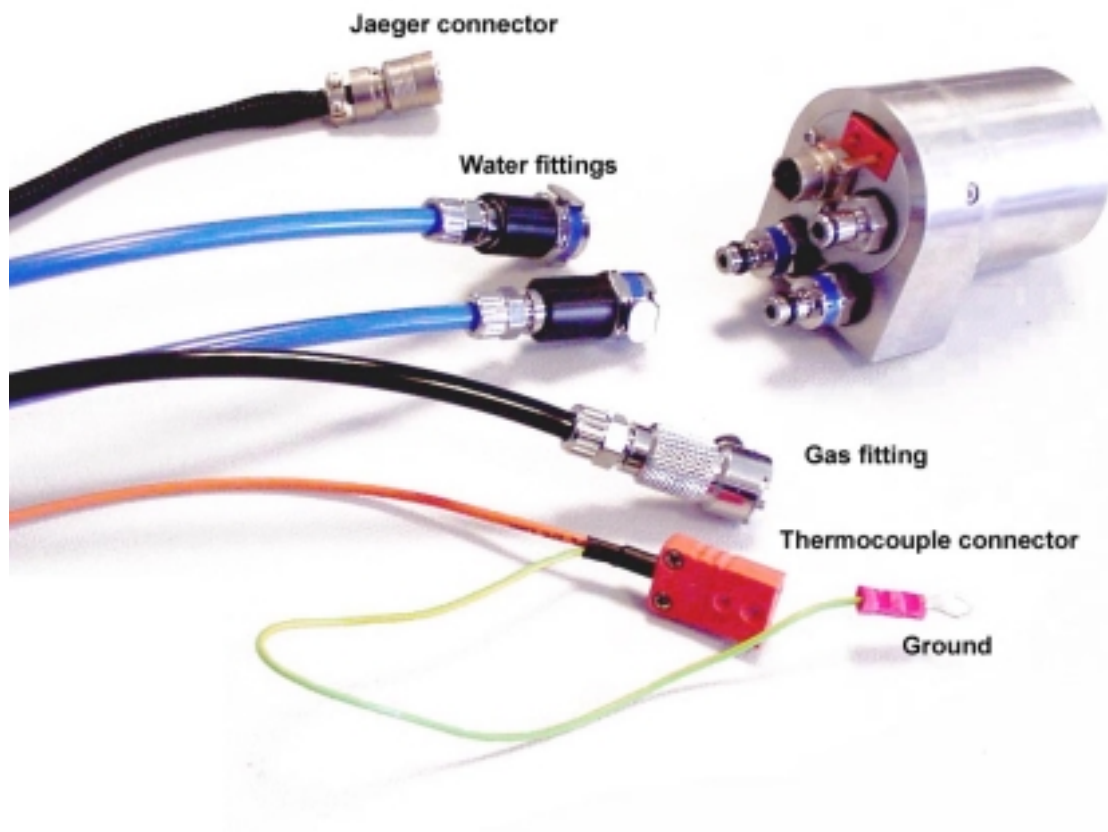
Connect the gas supply to the filter on the rear rack panel under the mention "GAS INLET". Pressure must be 6 bars oil free. The gas tubing must be 4 mm internal diameter and 6 mm external diameter.

Connect the rack to a 230 V - 50Hz mains socket minimum power 1KVA using the standard cable.

Connect the gas blower to a 4 bars water cooling system, minimum flow is 1 l/mn. Mentions "WATER INLET" and "WATER OUTLET" are set on the rear rack panel.

A water safety device is connected into the water cooling circuit between the gas blower and the water outlet.











On the gas blower, connect the thermocouple connector, the gas fitting, the water fittings and the small Jaeger connector

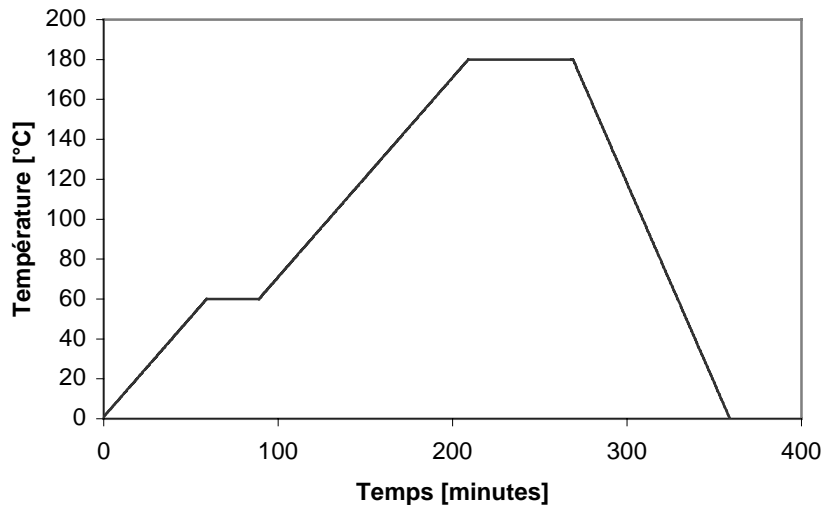
USER MANUAL

To use the gas blower device:

- open the water circuit
- open the gas
- set the float level typically at 350 l/h on the gas flow meter (the gas blower can work without gas flow);
- press the green button to switch on the Eurotherm 902P;
- the power supply of the heating element is on. The LEDs "POWERED" and "WATER COOLED" must be on.
- enter in the Eurotherm 902P the temperature program (see below example, see section 3 - commission 7.0 enter a programme page 9 in the 902P user manual)
- execute the program (see below).
- The LED "TEMPERATURE APPLIED" is on when $T > 80^{\circ}\text{C}$.



























Programming the 902P temperature controller










Before programming the Eurotherm 902 check that the automatic mode is set and not the manual mode. If MAN is displayed, the manual mode is set, press then the button . Check that no program is already running. "Ramp" or "hold" must not be displayed. Otherwise press simultaneously the buttons  and . This will stop the running program. **Watch out that the temperature setpoint is correct.** Otherwise modify fastly the setpoint by pressing simultaneously on , and on  or .



The program described herebelow corresponds to the temperature cycle shown on the above picture.




Programming:


- press and hold  till OpEr is displayed
- press on , PrOG is displayed
- press on , Pr1 is displayed
- press on  and  to select 1 °C per minute as rate for the first ramp.
- press on , PI1 is displayed
- press on  and  to select 60 °C as final setpoint.
- press on , Pd1 is displayed
- press on  and  to select 0.5 hour as dwell time.
- press on , Pr2 is displayed
- press on  and  to select 1 °C per minute as rate for the second ramp.
- press on , PI2 is displayed
- press on  and  to select 180 °C as final setpoint.
- press on , Pd2 is displayed
- press on  and  to select 1 hour as dwell time.
- press on , Pr3 is displayed
- press on  and  to select 2 °C per minute as rate for the last ramp.
- press on , PI3 is displayed
- press on  and  to select 0 °C as final setpoint.






- press on , Pd3 is displayed
- press on  and  to select 0 hour as dwell time.
- press on , Pr4 is displayed.
- press on  and  to select End
- press on , Pt0 is displayed
- press on  and  to select 1 as number of cycle.

Wait until the 902P goes back in the operation mode.

Running the programm

Before running a programm check that the automatic mode is set and not the manual mode. If MAN is displayed, the manual mode is set, press then the button . Check that no program is already running. "Ramp" or "hold" must not be displayed. Otherwise press simultaneously the buttons  and . This will stop the running program.

To run the program press on . The next press will hold and restart the program.

To stop the running program press simultaneously the buttons  and . **Watch out that the temperature setpoint is correct.** Otherwise modify fastly the setpoint by pressing simultaneously on , and on  or  (see section 2 - operation 3.0 setpoint page 24 in the 902P user manual).

902P heating program software

Software installation with Windows™

- 1) Insert the floppy disk HEATING PROGRAM in drive A:
- 2) Click on the **Start** button and select **Run**.
- 3) Type **a:setup** and click on the **OK** button.
- 4) The default directory is **C:\Demo**, you can not change it. Then click on the **Ok** button.
- 5) After a while you will get the following message : Setup has installed the software successfully and added the application(s) to the Program Manager. Click on the **OK** button.

To run this program click twice on the Programmes/Cyberstar/"Heating program" icon.

The Temperature program button can be pressed to define and/or run the heating temperature programs loaded in the 902P temperature controller driving the furnace heating element.

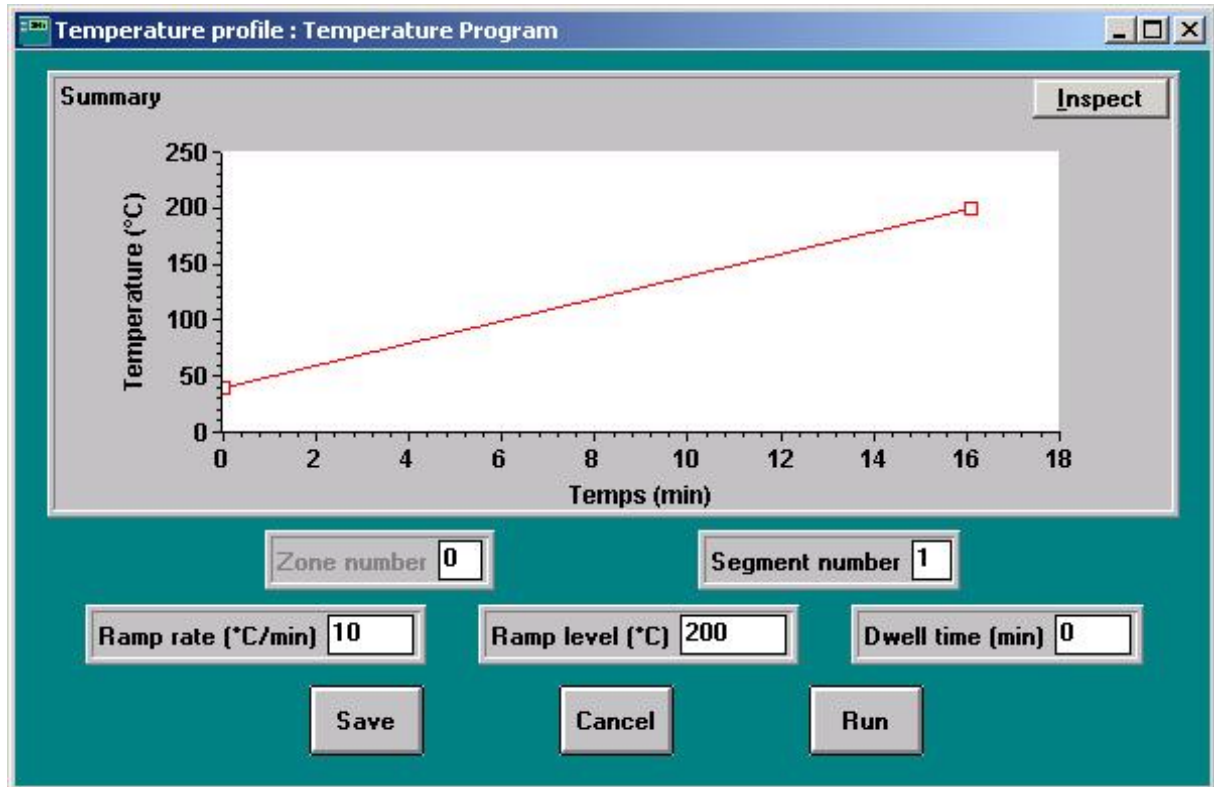
The current program is plotted on the screen (see picture below). Every time a value is modified, the plot is updated. You can define up to 8 segments (ramp and dwell). A ramp rate of -0.2 means end of program (see Eurotherm documentation for further explanation).

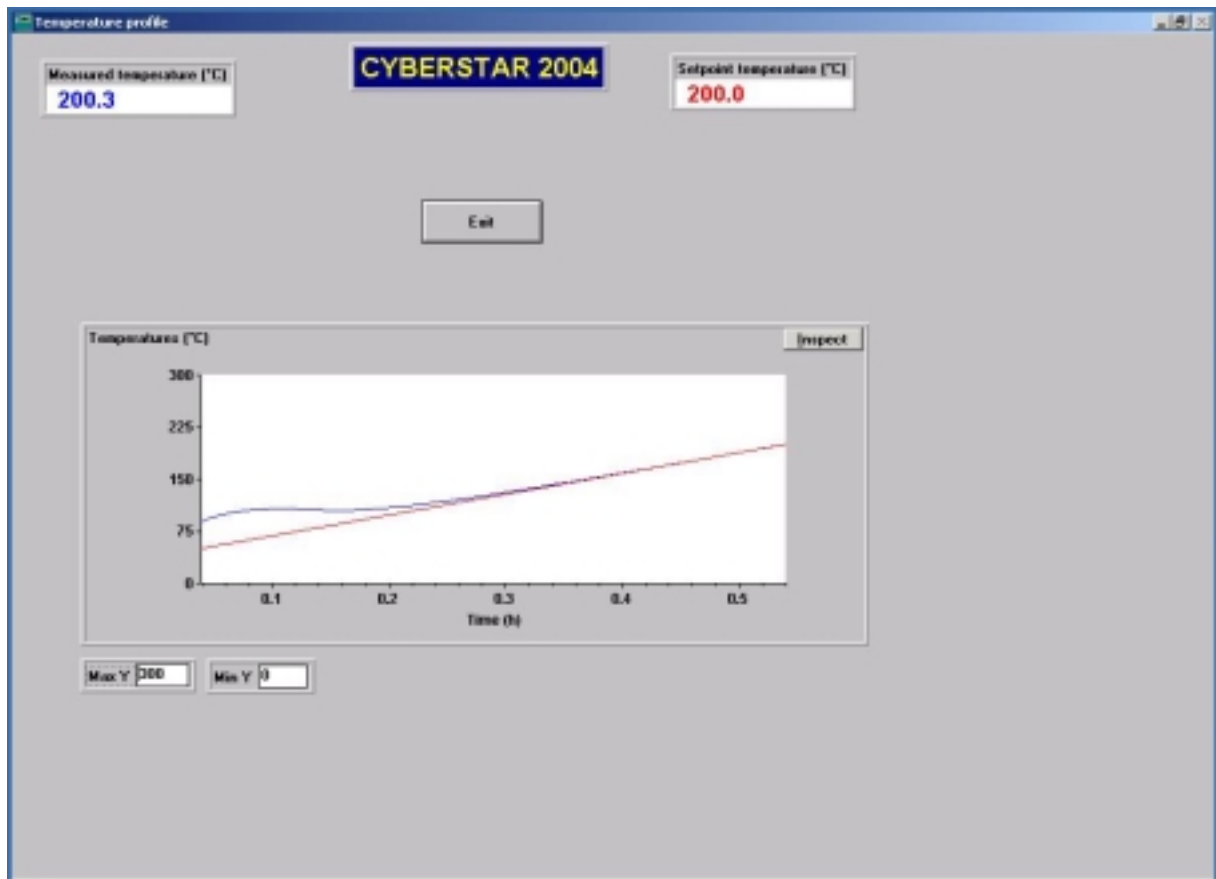
The **Save** button allows to update the defined programs on the hard disk (C:\TESTPT\DEMO\HEAT.TXT file).

The **Cancel** button allows not to take into account any modification.

The **Run** button allows to start immediately the defined program if necessary. All measurements are stored on the hard disk (C:\TESTPT\DEMO\DATA.TXT file).

The **Exit** button ends the program.





REGULATION PARAMETERS

The following parameters for the Eurotherm 902P are advised to obtain a temperature stability of +/-0.5 °C:

- Pb=5.7%
- Ti=40
- Td=6.6
- Cbl=Non
- Cbh=Non
- C1h=23.3%
- Maximum power HI=100%
- Maximum temperature setpoint Sph=1000°C

Watch out, as factory settings the ramps rate are defined in °C/minute.

In order to avoid damaging the device it is advised not to use ramp rate higher than 10°C/minute.

The factory settings are the following:

- C3 = 2400
- C6 = 0111
- C7 = 0000
- AI1 = 80°C
- Add = 0

GAS FLOW METER

The graduation of the gas flow meter is l_n/h Air @ 20°C. The full scale is 600 l_n/h Air @ 20°C. The graph float travel as a function of the flow is given hereafter.

To define the graduation corresponding to gas flow of other gas than air a conversion factor is used:

$$\text{Gas flow (l}_n\text{/h)} = \text{graduation} * (\mu_{\text{air}} / \mu_{\text{gas}})^{1/2}$$

Where μ_{air} is the air volumic mass, μ_{gas} is the gas used volumic mass.

$$\mu_{\text{air}} = 1.293 \text{ g/l}$$

$$\mu_{\text{nitrogen}} = 1.251 \text{ g/l}$$

$$\mu_{\text{argon}} = 1.784 \text{ g/l}$$

Exemple:

To set a gas flow of 340 l_n/h Argon, the graduation must be set to:
 $\text{graduation} = 340 / (\mu_{\text{air}} / \mu_{\text{argon}})^{1/2} = 340 / (1.293/1.784)^{1/2} = 399.4$

CALIBRATION

For information the temperature has been measured by means of a tiny thermocouple type K set on the axis of the gas blower 3.5 mm away from the device (see drawing next page).

Ramp from up to 900 °C with a rate of 10°C/minute.

The gas flow was set to 340 l/h (argon, graduation 45).

More information on the calibration, i.e. using crystalline transition of SmAlO₃ and K₂SO₄ is described in the paper “Soufflette à Haute température Pour l’Etude de Monocristaux aux Rayons X et aux Neutrons jusqu’à 1400 K” here attached.

Table

Temperature measured by the thermocouple K as a function of the temperature setpoint

Temperature setpoint	Measured temperature
300	306
400	405
500	499
600	589
700	672
800	751
900	829

