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9. ERROR RESOLUTION

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9.6 Error Resolution

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9.99 Error Resolution
Specifications

Temperature control modes are selectable. A thermocouple accurately measures temperature of substrate. Open or closed loop regulation can be selected.

A field proven controller will provide LCD terminal control interface with automatic and manual operations.

A keypad allows easy loading/unloading and maintenance of operations. Lamp array and isolation window are mounted in a rotating top lid, thus allowing full accessibility to the chamber.

Maximum 6" water-cooled and a powerful multizone halogen lamp fixture.

Housed in a bench top frame, a system includes a cold wall reaction chamber with dedicated for lab research purposes.

The ATR-EJEET system is a low capital and maintenance cost RTF processor.

Generalities

II. System Overview

I. General Overview
Recipe: Multi-step (temp. dwell).

Gas: Lp or gases (l standard gas line).

Vacuum: Possibility to connect the reactor to a pumping unit. The system is provided with a vacuum valve.

K thermocouple (optional) preferred.
Ambient to 1250°C.
Room temperature to 1250°C.

1.2 Performances

The thermocouples signals (°C) are available on the rear face.
All the connections (power supply, water, air, gases (optional), vacuum (optional),)

Rear Side (sec § 3.1)

- Power blocks
- Flexible pipe to connect the vacuum pumping unit (optional)
- Air circuit
- Water circuit
- Gas circuit (optional)
- Place the quartz pins, the thermocouples

Lower part. The quartz are located:
- Quartz window
- Reaction chamber
- Air lamps ventilation system
- Furnace lamps

Lifted part. The quartz are located:
- Receptor part

are directly made by JLP, ELEC.

The various components are industrial and are easily available. PCs and lamps control

- Terminals
- Transformer
- Circuit breaker
- Contactors
Two gas connections permit to open manually the reactor and to load the water on the plan.

Located on the edge of the plan, is installed the device.

Another thermocouple is installed under the water through a O-ring.

The temperature control thermocouple is installed under the water through a O-ring.

The water is placed on 3 beveled quartz pipes.

There is no risk of pollution of the reaction chamber because of water cooled walls.

Through the flexible pipe, gas is injected under the plan. If circulations around the water and the exhaust is done.

The chamber is made of aluminum. It is water cooled and mirror polished.

An infrared window sandwiched with Viton O-ring separate the chamber and the furnace.

It is in 2 parts: the chamber process.

See fig. 2.

Reactor

An solenoid valve controls air cooling.

At the back side an extractor, connected to a stainless steel box evacuates the hot air.

Two loops with a range holes (supporting the lamps) permit the lamps ventilation by air.

It is possible to lift-up the furnace thanks to a hinge (useful for maintenance operations).

On its upper side: electrical connection for lamps, safety heat sensor.

Equipped with 18 angular infrared heating lamps.

Fully water cooled, mirror polished.

Made of stainless.

It is accessible after removing the water box.

Located in the upper part of the system.

See fig. 2 next page.

2.1 Furnace

2. SYSTEM DESCRIPTION
A circuit breaker on the rear side protects furnace.

Features:
- Electrical

2.4.3 Electrical/Electronics

Changes once a year.

User's recipes are stored in a RAM memory supplied by two batteries that must be changed once a year.

SAIA Programmable controller providing detailed control over subsystems, processes.

Features:
- Programmable

2.4.2 Programmable

- OFF push-button (red)
- ON push-button (green)
- Operator terminal with keyboard and LCD display

Features:
- See fig. 3 next page

2.4.1 Front Page

2.4 Commands

During atmospheric processes, gases go out of the chamber by the gas exhaust line.

Stainless steel hose, a check valve avoids back streaming from the gas exhaust line.

During vacuum processes, gases are pumped down through the vacuum valve and the vacuum chamber.

The system can perform both atmospheric and vacuum processes.

- Solenoid valve
- Ball flow meter with needle valve
- Swagelok flange
- Polished stainless steel components

Features of the gas lines:

The system is provided with 4 gas lines and up to 4 gas lines.

See fig. 9 next page

2.3 Vacuum and Gas
Gas and Vacuum Circuit

Diagram with various components such as gas lines, valves, and a pneumatic valve.
It is possible to install 2 thermocouples. One for the regulation, and another only for reading.

Install easily the thermocouples:

Two stainless steel ladders with Vision O-type located under the plane permitt to

Thermocouples threads are K type (chrome/alumel), Ø 0.127 mm.

Thermocouples threads are K type (chrome/alumel), Ø 0.127 mm.

The thermocouples give a few millivolt signal for a measured temperature. This voltage is amplified by the PCB to obtain 0-10 V on output signal for 0-1300°C.

See fig. T next page.

2.4.4 Thermocouples

<table>
<thead>
<tr>
<th>CI125</th>
<th>Temperature Transmitter card</th>
</tr>
</thead>
<tbody>
<tr>
<td>CI134</td>
<td>Temperature control</td>
</tr>
<tr>
<td>CI121</td>
<td>Electronics supply</td>
</tr>
</tbody>
</table>

II. ELECTRONICALLY-MADE PCBs are designed for:

Class Electronics

Maximum power: 36 kW, 3 x 220 V + CT (95A per phase)

and the function:

A power controller supplies the furnace during the process.

Circuit breakers inside the equipment protect the different subsystems.
Pumping by NW16 stainless steel pipe connected under the platen.

Polished stainless steel 316L pipe (inner Ø 6.35) are recommended.

The machine is delivered with stainless steel fittings.

3.1.4 Vacuum and gas

2 bar and must be checked before any new start-up. A pressure reducing valve controls the water pressure. This pressure must never exceed 2 bars. Higher pressure may damage the system.

**WARNING**

Max pressure at water outlet: 1 bar

Max pressure at water inlet: 4 bar

Water flow: 10 l/min

Water inlet (rubber pipe, inner Ø 10 mm)

3.1.3 Water (see Fig. 6 next page)

Ø 8/8 mm pipe: 9.6 bars

Flow: 6 m³/h (for a sufficiently air cooling of the lamps)

Pressure: 6 bars

3.1.2 Compressed air (see Fig. 5 next page)

Use the big gland to connect the main power cable 4 x 25 mm² in the machine.

The user must install a bipolar 100 A circuit breaker to protect the system. The junction equipment is equipped with a circuit breaker to protect the system.

3 x 220 V + G, 36 kW, 60 Hz

3.1.1 Electrical

3.1 Connections

3. INSTALLATION PROCEDURE
Pressure on the pressure gauge.

Tighten the screw of the pressure reducing valve until you achieve ~ 2 bars.

Supply the water on the cooling circuit.

Unscrew completely the pressure reducing valve placed at the rear machine.

If the water outlet is at atmosphere follow this procedure:

and outlet must be about 2 bars.

To run in good condition the water pressure drop in the system (between water inlet

and outlet) is necessary to check and adjust the water pressure in the water circuit.

Prior to any start-up or whenever the machine has been idle for an extended period of

Adjusting the water pressure

3.2.1 Adjusting the reducing pressure valve and the water flow controller.

3.2 Adjustments

Some subsystems are powered inside the system. These operations should be

CAUTION

<table>
<thead>
<tr>
<th>Shielding</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>PIN</td>
</tr>
<tr>
<td>+ signal</td>
<td>1</td>
</tr>
</tbody>
</table>

CONNECTOR WIRING

The use of a shielded cable is recommended. Minimum impedance to connect : 1 kΩ

\[ V_{oc} = V_{oc} \text{ (Volts, Temperature in °C)} \]

Thermocouples. These signals are linear and correspond to the following equation:

If delivers a 0-10 A signal proportional to the temperature measured by the

3.1.5 Thermocouples connectors (see Fig. 4)

at each step of a recipe.

The vacuum valve and the gas valves are recipe controlled and can be opened or closed

Exhaust by a 1/4" stainless steel pipe with Swagelok fittings.
Reinstall the metallic panel.

- The screws until you obtains this result.

- 6 bars. Lead N02 or controller must be at 4 bars. It must be off. Adjust with
  pressure between blue and red marks.

- Use the brass screw on the pressure switch to adjust if the screw is placed
  Power up the system.

- The compressed air switch (X4) is near the mains terminals

- Remove the metallic panel on the right side.

- Supply the system with compressed air.

Procedure:

The compressed air pressure must be around 6 bars to insure good cooling of lamps.

3.2.2 Adjusting air pressure switch

- Reinstall the metallic panel.

- Tighten the 2 screws of controller.

- Check that water flow is between 5 and 10 l/min.

- Position of the black connector until the level height.

- Check that Lead N03 on controller is on when water is flowing. If not, adjust the
  pressure PI to open the water valve.

- Select maintenance mode and then valves control.

- Power on the system.

- Supply the system with air.

- Remove the metallic panel on the low left side of the system (exclusion by
  maintenance). The water flow controller is the brass box with black connector.

- Adjust the air flow switch before water flow controller.

Adjusting the water flow controller

- If water outlet exceed 1 bar please contact supplier.

- Water outlet must not exceed 1 bar to be sure the water flow will be sufficient.

- Pressurize on the pressure gauge.

- Tighten the screw of the pressure reducing valve till you achieve ~ 2 bars

- Supply the water on the cooling circuit.

- Unscrew completely the pressure reducing valve placed at the rear machine.

- If the equipment is connected to a cold water network:
The system can be used with the terminal or from the computer by using the PMS software. When the system is used with the computer, the terminal is no more activated.

To select an option press the corresponding function key (example: "F1" for Edit).

<table>
<thead>
<tr>
<th>F4 PMS</th>
<th>F3 Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>F2 Run Process</td>
<td></td>
</tr>
<tr>
<td>F1 Edit Recipes</td>
<td></td>
</tr>
</tbody>
</table>

After a few seconds the terminal displays the main menu.

Press the green push button.

Power up the rear circuit breaker.

Check electrically, water, air and gas supplies.

4.2 Start-up

To install around the water.

Three bevelled quartz pins hold the water (3 different heights). Three other quartz pins.

Be careful, quartz pins are fragile.

Place the quartz pins with tweezers or with fingers (using gloves).

Lift the reactor box. The planet appears.

The Jefcoate system is delivered with 1 set of quartz pins for 4" water. Three sizes are

Quartz pins installation (see Fig. 8 next page)

Check all the connections: Electrically, gasses, Air, Water.

Before start-up read all the user’s manual.
Installing quartz pins

3 heights: \( H = 7.5 \text{ mm}, H = 10 \text{ mm}, H = 12.5 \text{ mm} \).

3 sets of bevelled quartz are delivered with.
The mosocouple temperature control mode
Promoter temperature control mode
Sensor for temperature control

(by 10)

Mode 1/10 second, step duration will be divided
N : no
X : yes

Open loop temperature control
N : no
X : yes

Time 0 to 2000 seconds
0 to 1300°C

For each step parameters are:

<table>
<thead>
<tr>
<th>G4</th>
<th>G3</th>
<th>G2</th>
<th>G1</th>
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<tbody>
<tr>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>L</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>T</td>
<td>0°</td>
<td>2°C</td>
<td>0°C</td>
</tr>
</tbody>
</table>

Step : 1

Recipe : 1

Recipe number is valid, the terminal displays:

If the recipe number is a wrong one, enter an other one to reset it.

Enter the recipe number and continue with key „Esc“.

It is still possible to return to main menu pressing key „Esc“.

Recipe number 0

EDIT RECIPES

EDIT RECIPES

Recipe number.

When main menu is displayed press „F1“ to choose „Edit Recipe“. Terminal asks for

controller RAM memory. Each recipe is made of 30 steps (1 to 10).

Each cycle is called recipe. It is possible to save up to the recipes (number 1 to 10) in the

The Edit Recipes mode allows to create, to modify, to display or to delete a recipe.

4.3.1 To create a recipe

4.3 Edit Recipes

The control is described in Chapter 7.
This mode allows to count down step duration 10 times faster. (Example: if duration is Tenth, parameter it is possible to change the value using key "F1", then confirm with key "F2". When cursor is on the parameter, press key "F2" to select it (use arrow keys), when cursor is on the parameter. At 100% a s in ion wa ter will melt in a few seconds.

**CAUTION**

It is possible to choose the open loop mode without temperature control, mode control : N (NO). In standard mode the system is in temperature control mode, control : Y (YES). It is possible to count down the time to time faster see: ten.

**Step:**

The sample will be destroyed if the temperature is above the displayed temperature.

During process temperature component can be ramping or dwell. The initial temperature of the step is the final temperature of the previous step or ambient temperature for first step. The final temperature of the step is open during the step.

Vacuum valve is open during the step: Yes : Y
Vacuum valve is closed during the step: No : N

Gas valve 1 is open during the step: Yes : Y
Gas valve 1 is closed during the step: No : N

Gas valve 2 is open during the step: Yes : Y
Gas valve 2 is closed during the step: No : N

Gas valve 3 is open during the step: Yes : Y
Gas valve 3 is closed during the step: No : N

Gas valve 4 is open during the step: Yes : Y
Gas valve 4 is closed during the step: No : N

Vacuum valve is open during the step: Yes : Y
Vacuum valve is closed during the step: No : N

Tenth
It is possible to change this parameter with key "F3" in the same way than previous one.

**TC (Thermocouple or Pyrometer control)**

This mode allows to choose the sensor for the temperature control mode.

The thermocouple is used for low temperature processes and to perform the pyrometer calibration. The thermocouple cannot be used with active gases (H₂) because they reduce its life time.

The pyrometer is usually used for most of the processes.

During the process, the system will display the temperature from the control sensor.

**Vacuum valve**

The vacuum valve can be opened at each step of a recipe for purge or vacuum process. If the vacuum is closed the gas will go out of the chamber through the exhaust line.

**Gas 1**

The gas 1 valve is a solenoid valve allowing or not the gas to enter the chamber. The gas flow is controlled by the needle valve and the ball flow meter on the front side of the system.

**Gas 2**

The gas 2 valve is a solenoid valve allowing or not the gas to enter the chamber. The gas flow is controlled by the needle valve and the ball flow meter on the front side of the system.

**Gas 3**

The gas 3 valve is a solenoid valve allowing or not the gas to enter the chamber. The gas flow is controlled by the needle valve and the ball flow meter on the front side of the system.

**Gas 4**

The gas 4 valve is a solenoid valve allowing or not the gas to enter the chamber. The gas flow is controlled by the needle valve and the ball flow meter on the front side of the system.

**Keys functions**

Cursor indicates the current parameter. The functions of different keys are :

"F1" to return to previous step
"F2" to go to next step
"F3" to change a parameter (control or 1/10 s mode)
"F4" to delete a recipe
Use key "ESC" to return to recipe selector and once more to return to main menu.

Pressing key "F2" will display previous step.

Pressing key "F1" will display the following steps.

The terminal will then display parameters of step 1.

Confirm with key "= ."

Select "Edit Recipes" mode and enter the recipe number.

4.3.2 To display a recipe

| 0 |
| 0001 |
| 001 |
| 10 |
| 1 |

Automatic reset
Value < 1000

| 0 |
| 006 |
| 06 |
| 6 |
| 0 |
| 0 |

Example: entering a temperature value:

If no value is entered before pressing "= " the parameter is reset.

When parameter is selected it is possible to modify it by entering a new value. If the value exceeds the upper limit the parameter is reset. When you have entered the proper value, press "" or "" to confirm and the cursor indication then the following parameter to specify.

"ESC" to return to previous menu.
To confirm a parameter
"" or "" (or ""
To go to previous parameter
"" or "" to next parameter
**Temperature Setpoint**

<table>
<thead>
<tr>
<th>C : X</th>
<th>T : N</th>
<th>V : N</th>
<th>P : 1000 mbar</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

**R : 20°C**

**S : 0°C**

**Recipe : I**

The terminal displays:

The process starts immediately.

As soon as recipe number is confirmed water valve and air valve (for lamp ventilation) are opened.

Choose Run process mode and select recipe number.

Load the water.

Push the green push button.

Power up to circuit breaker on the rear side.

Check that all connections are operational.

4.4.1 Running a process

**4.4 Utilization**

Pressing key "ESC" will return to recipe number choice saying the value of parameters.

Pressing key "F4" will reset all the recipe parameters.

P4 = Yes ESC : No

DELETE RECIPE

To delete a recipe you must first display one step of the recipe. Then press key "F4" and terminal will display:

4.3.4 To delete a recipe

When cursor is in the right parameter enter new value and confirm with key "F4".

Use "F1" to go step by step and arrow keys to select the parameter you want to modify.

Process like for displaying a recipe.

4.3.3 To modify a recipe
Pressing "ESC" will return to main menu.

F4: Calibration
F3: Gas Valves controlled
F2: Valve control
F1: Manual heating

When calibration mode is selected, terminal displays:
- to enter calibration labels
- to control valves
- to heat without temperature control

Manual mode allows:
This mode is dedicated to maintenance operations and adjustments.

4.5 Maintenance Mode

After process the furnace is cooled down for 3 minutes.
Process can be stopped at any time by pressing key "F4".
Pressing key "F1" once more will return to the previous screen.

Pressing key "F4" of the keyboard will display the gas valves status:

<table>
<thead>
<tr>
<th>G4</th>
<th>N</th>
<th>G3</th>
<th>N</th>
<th>G1</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas Valves</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recipe: 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Pressing key "F4" of the keyboard will display the gas valve status:

<table>
<thead>
<tr>
<th>VV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vacuum valve status</td>
</tr>
</tbody>
</table>

| Y |
| Thermocouple |

| TC |
| Time basis (1 second or 10 seconds) |
| Temperature control or not |
| Pressure inside the chamber |
| Time to go for the current step |

| T |
| Temperature reading from the temperature control sensor |

| R |
| Temperature reading from the temperature control sensor |

| P |
| Temperature reading from the temperature control sensor |

| C |
| Temperature control or not |

| T |
| Time to go for the current step |

| L |
| Time basis (1 second or 10 seconds) |

| TC |
| Temperature reading from the temperature control sensor |

| P |
| Pressure inside the chamber |

| C |
| Temperature control or not |

| R |
| Temperature reading from the temperature control sensor |

| T |
| Time to go for the current step |

| L |
| Time basis (1 second or 10 seconds) |

| TC |
| Temperature reading from the temperature control sensor |

| P |
| Pressure inside the chamber |

| C |
| Temperature control or not |

| R |
| Temperature reading from the temperature control sensor |

| T |
| Time to go for the current step |

| L |
| Time basis (1 second or 10 seconds) |

| TC |
| Temperature reading from the temperature control sensor |

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| L |
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| Temperature reading from the temperature control sensor |

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| R |
| Temperature reading from the temperature control sensor |

| T |
| Time to go for the current step |

| L |
| Time basis (1 second or 10 seconds) |

| TC |
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| P |
| Pressure inside the chamber |

| C |
| Temperature control or not |

| R |
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| L |
| Time basis (1 second or 10 seconds) |

| TC |
| Temperature reading from the temperature control sensor |

| P |
| Pressure inside the chamber |

| C |
| Temperature control or not |

| R |
| Temperature reading from the temperature control sensor |

| T |
| Time to go for the current step |

| L |
| Time basis (1 second or 10 seconds) |

| TC |
| Temperature reading from the temperature control sensor |

| P |
| Pressure inside the chamber |

| C |
| Temperature control or not |

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| Temperature reading from the temperature control sensor |

| T |
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| Time basis (1 second or 10 seconds) |

| TC |
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| P |
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| L |
| Time basis (1 second or 10 seconds) |

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| P |
| Pressure inside the chamber |

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| T |
| Time to go for the current step |

| L |
| Time basis (1 second or 10 seconds) |

| TC |
| Temperature reading from the temperature control sensor |

| P |
| Pressure inside the chamber |

| C |
| Temperature control or not |

| R |
| Temperature reading from the temperature control sensor |

| T |
| Time to go for the current step |
The pressure inside the chamber is displayed on the last line. To open the gas valves and pressurize before performing a process (opening vacuum valve and one of the gas valves), the key is pressed. One key is needed to open the gas valves. Each time key "P1" is pressed, a new gas valve is opened if the keys are closed. If the keys are closed, key "P0" is used to open the gas valves. Each key press changes the status of the gas valves.

The status of the vacuum valve is changed by pressing key "P2", pressing "P2" once will close the valve, the valve is displayed: "C = Closed", pressing "P1" once more will open the valve, the valve is displayed: "C = Open".

The status of the water valve is changed by pressing key "P1", pressing "P1" once allows to open and close the valves of your system: water valve, vacuum valve, gas valve, 1000 mbar.

When key "ESC" is pressed, system is cooled down for 3 minutes.

CAUTION

Nothing will be displayed. The user must check himself that everything is correct. If possible, the interval is activated with the time delay mode. The manual heating must be used only for adjustments and with low power. Some sensitive substrate materials will be damaged if you can damage your substrate in a few seconds, the manual heating must be used only for adjustments and with low power. (100% or even less), you can damage your substrate in a few seconds.

When heating finishes, press "F0" to stop heating. Then enter a new value of press "ESC" to return to manual mode menu.
Calibration curve will be made by interpolation between 2 couples of values. Each calibration table is made of 30 temperature / volatage couples. The software allows to enter and save calibration curves for both thermocouple and Pt 100. Each thermocouple depends on substrate and may be layers on its surface. For the pyrometer volatage is a function of temperature and emissivity of the substrate. So

\[
\text{Temperature} \ (in \ ^\circ C) = \text{volatage} \ (in \ volts) \times 130.
\]

\[
\text{Temperature} \ (for \ K \ thermocouple) = 0 \text{ volatage} \ (in \ volts) + 273.15
\]

The calibration curve for K thermocouple is known and can not be modeled. The calibration curve gives the temperature function of sensor volatage.

The temperature can be controlled either by the special pyrometer or by a thermocouple.

Read before chapter 5: Sensors and temperature control.

4.5.4 Calibration

Pressing “ESC” will close all the valves and return to manual mode menu.

Value status is displayed: C = closed, O = Open

If “F1” will open Gas I valve, Pressing “F1” once more will close Gas I valve.

The status of the valves is changed by pressing the corresponding function key (example:

| C: | Gas 4 valve | P4 |
| C: | Gas 3 valve | P3 |
| C: | Gas 2 valve | P2 |
| C: | Gas 1 valve | P1 |

Terminal displays:

This mode allows to open and close the gas valves of the system.

4.5.3 Gas values control

Pressing “ESC” will close all the valves and return to manual mode menu.

Pressing key “F2” several times will open respectively:

1. Gas valve 1
2. Gas valve 4
3. Gas valve 3
4. Gas valve 2
5. Gas valve 1
When calibration mode is selected terminal displays:

When calibration is ended, connect wire 500 back on the right terminal (with an orange

It is now possible to use calibration mode

Terminals controller cover and metallic panel

Disconnect orange wire 500 from terminal and connect it on card 1 terminal 7 on the

Remove the S/A controller cover just by pulling at the four corners.

Remove the right side panel over decennial part

Proceeding:

The calibration mode is enabled after changing position of a wire on the controller:

Adding existing value of different from 0.

Operator has to calculate the error percentage (0 to 200 %: 0 to 200 per thousand)

Because of temperature control system, a difference may appear between the setpoint

Values and function keys has the same functions.

The calibration mode is used like the edit recipe mode. A keyboard allows to enter the

Select the right table using corresponding key.

<table>
<thead>
<tr>
<th>F2 : Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1 : Thermocouple</td>
</tr>
</tbody>
</table>

CALIBRATION
Each couple Thermocouple/Voltage must be taken into the calibration table so that the
thermocouple temperature/voltage is considered to be the actual temperature curve (see § 5.3).

The operator must perform a multistep process (50°C by 50°C for example) in
the same time. The thermocouple gives the water temperature for a voltage of the
same signal at the thermocouple and the pyrometer signals at the
same time.

If it is possible for the user to enter in the system a calibration curve of the pyrometer made
of 29 steps of linear interpolation of the actual curve.

4.5.4.2 Pyrometer calibration

Go back to the main using key "ESC".

Temperature just over 550°C : 601°C
The operator has to add this value to current correction for this segment (line with
line correction will be 2°C/550°C ≈ 3%)
Example : if segment is 550°C and actual temperature during process is 548°C the
value of the segment correction is between 0 and 200 %
The value of the segment correction depends on the part of the curve and must be entered for each line of

| Correction : 0% |
| Voltage : 0 mV |
| Temperature : 0°C |

LINE 1

Terminal displays:

Only the segment correction can be modified.

The calibration curve for the Thermocouple is known and can not be modified.

4.5.4.1 Thermocouple calibration

If no value is entered before pressing "<" the parameter will be reset

When parameter is selected it is possible to enter a new value. If value exceeds the upper
The water supply is off.

Possible causes:

The water flow sensors detect a low flow. The system stops.

4.6.1 Water Failure

Prior to any new process, solve the problem.

Press Reset to stop the alarm, the safety cycle starts. Follow the instructions displayed on the screen to debug the failure origin. The alarm relay is activated.

If any utilization condition is not fulfilled, the system is protected by an alarm and...
4.6 Temperature control failure

- Temperature control failure. The system stops.

**Possible causes:**
- Water flow is not sufficient.
- Water temperature switch on furnace has detected an overtemperature.

4.6.5 Overheating

Thermocouple of the temperature control mode. If the thermocouple temperature control, the thermocouple is broken. Change either the thermocouple failure. The system stops.

4.6.4 TE failure

- One power block does not work.
- One power fuse is burned.
- One lamp filament is broken.

**Possible causes:**
- The controller detects a bad balance between the current of the two zones. The system stops.

4.6.3 Lamp failure

- The pressure switch is not well adjusted.
- Compressed air pressure is below 6 bars.
- No compressed air supply.

**Possible causes:**
- The air pressure switch detects an air failure and stops the system.

4.6.2 Air failure

- A water leak in the circuit.
- The water sensor is not well adjusted.
- The water pressure is not sufficient.
Vacuum pump failure.

Possible causes:

- Circuit breaker was not switched on.

The process asks to open the vacuum valve, and the circuit breaker of the vacuum pump.

4.6.8 Vacuum pump failure

- CT25 failure
- Preamplifier failure
- Pyrometer disconnected

Possible causes:

The system receives no signal from the pyrometer.

4.6.7 Pyrometer failure

- Lumem supply failure
- CI 134 PCB failure
- Pyrometer failure
- No water in the chamber

Possible causes:
The rear side connectors T1 and T2 deliver thermocouple signals (0-10V).

Water

It is possible to readjust the thermocouple position to have a good contact with the

- Label "READ" for temperature reading cable (T2)
- Label "REG" for temperature control cable (T1)
- Connect the male plug to the female one.

To install thermocouple see paragraph 6.3.

Cable READ is for thermocouple T2. For reading only.

The thermocouple for temperature control (T1) must be connected to cable REG.

- Connected through the readthrough placed under the flange.
- Chronaid/Aambil - Type K

Temperature measurement

Two thermocouples are used for pyrometer calibration, temperature control and low

5.2 Thermocouples

Temperature of the substance

use the rear pyrometer connector to record a 2-10V signal proportional to the

its calibration must be controlled periodically.

model (through a BFE2 window), the pyrometer receives no lamp signal.

Temperature measurement range 400°C - 1300°C or 1000°C - 10000°C depending on

on the rear side of pyrometer.

The pyrometer looks at the rear side of the water. Emissivity is adjusted by thumb wheels

RECONE MODLINE optical pyrometer (see literature in appendix).

5.1 Optical Pyrometer (optional)

Temperature measurement is ensured by 11P ELECT PCD 125.

- Two thermocouples for pyrometer calibration and low temperature
- An optical pyrometer for process temperature measurement.

The system is equipped with 3 temperature sensors.

5. SENSORS AND CONTROLLERS
6. Plot the curve temperature in function of pyrometer voltage.

The chart recording (130°C VOH for the thermocouple),

pyrometer. The voltage of pyrometer and the thermocouple temperature are read on

When cycle is finished, prepare the table of temperature function of voltage for the

recorder.

4. Start process an monitor the thermocouple in pyrometer signal both on a chart

signal.

3. Connect the thermocouple and pyrometer signals (available on rear panel) to a chart

reducer. The thermocouple delivers a 0-10 V signal, and the pyrometer a 2-10 V

the range of temperature needed for calibration.

2. Place a water in the chamber and the thermocouple as described, and check it is in

container with the water.

1. Prepare for calibration procedure.

not been changed.

change check that the pyrometer window is clean, and that the pyrometer emissivity has

usually the calibration does not change for the same type of substrate. If calibration

way, the thermocouple can see the lamps through the water at low temperature.

Notice that silicon and glass are transparent for infrared at low temperature. In the same

the substrates that have to be processed in the system.

The calibration must be always performed with a substrate with the same thermal "past".

they reach some temperature levels. Some substrates, especially gases, may have their optical properties dependent on

The calibration has to be performed whenever the type of substrate is changed.

Temperature of substrate

Name of layers on substrate surface

Substrate name (silicon, glass, graphite, etc.)

depends on :

The pyrometer measure a quantity of infrared radiation. The quantity of radiation

result from the quality of calibration. Pyrometer calibration is an essential operation. A good temperature measurement will

5.3.1 Why pyrometer calibration?
5.4 Temperature Control

7. Extract a series of segments of line that will be the interpolation of the calibration curve.

8. Select calibration mode.

9. Enter the temperature/velocity couples for each segment. (see paragraph 4) and do not forget to note parameter emissivity.

10. Check calibration performance a process with some steps. Adjust the calibration table if the result is not perfect.

For more information, contact jf@jpf.com.

For some substances, the adjustment of the PCB may be different. Contact jf@jpf.com.
If necessary, re-position the screws.

Open the water circuit and reset the instrument (manual mode).

Place the screws and tighten them carefully. Do not forget to pull the handle axis in this hole.

Connect the chamber with the upper flange.

Thread the reactor.

Place the window on the chamber flange (check there is the Viton O-rings)

Check the cleaning of all the pieces otherwise clean them with alcohol.

6.1 Installing the Window

Remove the window.

Remove the flange chamber.

Unscrew the 8 CHC M5 screws (see fig. 2).

Thread the reactor.

Disconnect all power to the system.

6.2 Removing the Window

See fig. 2.

6.3 Cleaning the Window

Do not forget the isolating sheath on each lamp wire.

Rinsing lamps using the same procedure in reverse order.

Never touch the lamps with bare fingers; otherwise clean them with alcohol.

Remove electrical connections of lamps and gently remove lamps (using gloves).

Remove the stainless steel furnace protection.

Remove the metallic reactor box.

Disconnect all power to the system.

See fig. 2.

6. Maintenance

Some parts inside the system may remain powered up. These operations must be carried out only by factory-trained technicians.
MICRO
AA
LR03 (REO)

Batteries are normalized type.

Calibration labels in RAM.

The SAVA PCD2 controller uses two 1.5 V batteries to save users recipes, and

6.5 Changing controller batteries

- Pull the thermocouples and the gasket from the plate.
- Use a scotter because of the O-ring.
- Clean the chamber and the window with a lint free duster and alcohol or Isopropanol.
- Lift up the chamber.
- Disconnect all power to the system.

6.4 Cleaning the reactor

Terminal 3 : shielding
Terminal 2 : signal
Terminal 1 : + signal

Use the rear side connectors to record the thermocouples signal (0-10 V).

Follow the same procedure in reverse order to remove the thermocouples.

It is possible to reach the thermocouple position to have a good contact with the

Label "READ" for reading cable.
Label "REG" for regulation cable.
Connect the male plug to the female one.

Screw the nut to have the tightness.

Push this all the threads welding touch the water installed on the gasket plugs.
Place this assembly inside the feed through very carefully.
Take the thermocouple place primary the nut, then the rings and finally the O-ring.
Remove the nut, the small metal ring and the O-ring.
Under the plug is situated 2 stainless steel feed through with O-ring.
Remove the left metallic panel ( fixation by magnets).

See fig. 6.

6.3 Installing the thermocouples
We recommend to change the set of lamps as soon as one filament is broken.

<table>
<thead>
<tr>
<th>6.1.3</th>
<th>PERIODICITY</th>
<th>PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Year</td>
<td>Controlling the connections</td>
<td></td>
</tr>
<tr>
<td>(s)</td>
<td>Replacing lamps</td>
<td></td>
</tr>
<tr>
<td>OPERATIONAL</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6.2 Fuinace</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>5.3</th>
<th>PERIODICITY</th>
<th>PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Year</td>
<td>Controlling the plate &quot;O-Tings&quot;</td>
<td></td>
</tr>
<tr>
<td>2 months</td>
<td>Calibrating the pyrometer</td>
<td></td>
</tr>
<tr>
<td>1 year</td>
<td>Cleaning the pyrometer window</td>
<td></td>
</tr>
<tr>
<td>when needed</td>
<td>Cleaning the processing chamber</td>
<td></td>
</tr>
<tr>
<td>6 months</td>
<td>Cleaning the reactor windows</td>
<td></td>
</tr>
<tr>
<td>OPERATIONAL</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6.4 Reactor

Personal interventions on a powered system must be executed by authorized and trained personnel.

During maintenance or adjustments, power must be off.

The metallic housings protect the operator from contact with powered parts.

Respect the periodicity of maintenance operations.

6.6 Periodicity of maintenance operation

4. Reinstall controller cover and metallic panel.

Same direction.

3. Batteries are in front of you. Remove the old one and install the new one in the same direction.

2. Remove the SIVA controller cover just by pulling at the four corners.

1. Remove the right side metallic panel.

Procedure:

We recommend to change batteries every year.

Batteries can be replaced without risk of data loss until controller is supplied.

UCAR

ENGANCED

Use industrial batteries with minimum capacity of 1000 mA like:
<table>
<thead>
<tr>
<th>Quantity</th>
<th>Reference</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>P0004</td>
<td>Pylemeter window</td>
</tr>
<tr>
<td>1</td>
<td>P13770</td>
<td>O-ring for reflector</td>
</tr>
<tr>
<td>4</td>
<td>P13010</td>
<td>O-ring for reflector</td>
</tr>
<tr>
<td>1</td>
<td>P13760</td>
<td>Large O-ring for upper range</td>
</tr>
<tr>
<td>3</td>
<td>P12120</td>
<td>O-ring for pyrometer window seal</td>
</tr>
<tr>
<td>1</td>
<td>P12640</td>
<td>Plane cover Large O-ring</td>
</tr>
<tr>
<td>1</td>
<td>P12270</td>
<td>Plane cover small O-ring</td>
</tr>
</tbody>
</table>

6.7.2 Other Spare Parts

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Reference</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>P8007</td>
<td>O-ring for thermocouple feedthrough</td>
</tr>
<tr>
<td>2</td>
<td>SSTM21</td>
<td>Thermocouple with connector flg. 99/33</td>
</tr>
<tr>
<td>2</td>
<td>SSTM304</td>
<td>Thermocouple with connector flg. 76/10</td>
</tr>
<tr>
<td>3</td>
<td>SSTP36</td>
<td>Special gasket pins for 4&quot; Warren</td>
</tr>
<tr>
<td>3</td>
<td>SSTP34</td>
<td>Outer gasket pins 21 mm high</td>
</tr>
<tr>
<td>3</td>
<td>SSTP33</td>
<td>High bevelled gasket pins 18.5 mm high</td>
</tr>
<tr>
<td>3</td>
<td>SSTP14</td>
<td>Medium bevelled gasket pins 16 mm high</td>
</tr>
<tr>
<td>3</td>
<td>SSTP13</td>
<td>Small bevelled gasket pins 13.5 mm high</td>
</tr>
<tr>
<td>1</td>
<td>P12720</td>
<td>Lower O-ring for quartz window</td>
</tr>
<tr>
<td>1</td>
<td>P12720</td>
<td>Upper O-ring for quartz window</td>
</tr>
<tr>
<td>1</td>
<td>P25760</td>
<td>O-ring plane</td>
</tr>
<tr>
<td>18</td>
<td>PL006</td>
<td>Halogen lamps</td>
</tr>
<tr>
<td>1</td>
<td>SST005</td>
<td>Quartz window 0 247 x 10</td>
</tr>
</tbody>
</table>
Steps

The operator must first create a recipe and then can enter the parameters for the different
steps.

Thirty steps.

A comment.

An associated calibration table if the chosen according to the sample to process.

A name (up to 10 characters).

Each recipe is made of:

When the EDIT mode is selected, the screen displays the Recipe Programming screen.

This mode is for creating, modifying, deleting or displaying recipes.

7. Exit

6. EXIT:

5. PARAMETERS:

4. HISTORICAL:

3. MAINTENANCE:

2. RUN PROCESSES:

1. EDIT RECIPES:

The software is organized in menus and sub-menus. The main menu offers 6 options:

undertlined letter of the key in the same time.

Software options can be chosen either with mouse and pressing the left button when key

Store process data and monitor them again after process.

Receive data and get visualization during process.

Save process parameters to the system controller.

The controller is the interface between the system and the operator and allows to:

Jetfirst

To use the PIMS controller, the operator must select this mode in the main menu of the

PIMS software provides easy programming control and monitoring of the Jetfirst.
Enter the new recipe name:

The screen will ask for a new recipe name when the „Save as“ button is selected.

An other way to create a new recipe is to use „Save as“ option.

Save as:

A message:

If the recipe is not saved, it is not possible to display the steps and the screen will display:

Save the recipe (key „Save“)

Enter other parameters if needed (they are optional).

Select a calibration table in the list.

Enter recipe name (up to 10 characters).

Select a new recipe (the screen will erase the old parameters and place the.

To create a new recipe:

Other parameters do not need to be provided to the system.

Calibration table name.

Recipe name.

Non optional parameters are:

When creating a new recipe, some parameters have to be entered and the others are

30 steps.

A comment.

An associated calibration table.

Each recipe has a name and several parameters:

To open or not vacuum and gas valves.

Temperature control mode.

Duration of step.

Temperature (dwell or ramp).

For each step the operator can select:
To select options, use the mouse and click with the left button. Click on to change the status of the option. Click on once more to return to previous status.

To enter numerical values, use the keyboard. If the value is out of range, the screen will display a message with the correct range for the parameter.

**Time:**
0:00:00

**Temperature:**
0:1300°C

The ranges for parameters are:

Your samples or melt them in a few seconds. If power is too high, when using power mode there is no temperature control and you may damage CAUTION

The power can be set from 0% to 100%.

Without any feedback from temperature sensors, when no temperature control mode is chosen, the system will run in power mode.

- To open or not the vacuum valve
- To open or not the gas 4 valve
- To open or not the gas 3 valve
- To open or not the gas 2 valve
- To open or not the gas 1 valve

Time base (1 second or 1/10 second)

Temperature control sensor: Pyrometer of thermocouple

Temperature control mode: closed loop or open loop (no temperature control)

It is also possible to choose some options:

Temperature for step one, and it is final temperature of the previous step. For others,

ending temperature is entered. The initial temperature of the step is the ambient temperature may change in ramps or stay on steady steps. For each step, only the step.

**Press** parameters:

"Step" to enter the process parameters. The screen will display step 1 parameters.

When the new recipe has been saved, it is possible to go to the step one (pressing key Save it. All the parameters will remain the same as in the first recipe except the name.

"Step" to enter the process parameters. The screen will display step 1 parameters.

When the new recipe has been saved, it is possible to go to the step one (pressing key Save it. All the parameters will remain the same as in the first recipe except the name.

"Step" to enter the process parameters. The screen will display step 1 parameters.

When the new recipe has been saved, it is possible to go to the step one (pressing key Save it. All the parameters will remain the same as in the first recipe except the name.
Before running a process, check:

- Compressed air supply
- Water supply

7.2 Run Process

Press "Cancel" if you do not want to delete the recipe. The computer will ask to confirm. Press "Delete" to confirm. The recipe is now deleted.

Press key "Delete".

Select Edit mode and then select the recipe to delete.

7.3.4 To delete a recipe

exit step parameter will be saved automatically.

If you need to change a parameter in a step, display this step, change the parameter and

by pressing key "Save".

If you change comments or another parameter of the first page (recipe), you must save it.

Choose and select the recipe following procedure described above in § 4.2.1.2.

7.3 To modify a recipe

"Exit" will return to the menu.

and previous step. You can then display the steps of the recipe by using keys "step", "next step", and then "next step".

Select the recipe with keys "<<", ">>", or enter the name and press key "End".

Choose the editing recipes mode.

7.2 To display a recipe

When pressing one of the keys "next step", "previous step", "insert step", or "delete", the

number decremented by 1.

When a step is deleted, the next step takes its number and all the following have a step.

and a new step with all parameters equal to zero is inserted (step 0 is deleted).

When a step is inserted the following steps will have their step number increased by 1.

If it is possible to insert or delete a step by using corresponding keys.

Click on "next step" to go to the next step and key "previous step" to go to the previous.
During process, the screen displays all the parameters:

\[ \text{Temperature from Pyrometer and Thermocouple} \]
\[ \text{Pressure} \]
\[ \text{Calibration table name} \]
\[ \text{Current step} \]
\[ \text{Recipe name} \]

7.2.2 Process monitoring

Process starts immediately.

When „Start Process“ is selected once more, the screen will display the process form and immediately:

- When downloading has been performed, press key „Start Process“.
- The system will ask if it is possible to return to the main menu by using key „Exit“.

To download a recipe:

Select key „Download“.

Select a recipe to download in the list with the mouse.

If the recipe to process is different from the last recipe downloaded, then downloading must be done before operation.

Caution: If a parameter of the step has been changed the recipe must be downloaded again before operation.

If the operator chooses process mode, the system will display the Start Process form.

The system will ask for downloading of a recipe and beginning of a process.

When the operator chooses process mode, the system will display the Start Process form.

7.2.1 Downloading recipes

Select process mode with key „Run Process“.

- Vacuum pump
- Gas supply
The maintenance mode allows:

This mode is dedicated to maintenance operations and adjustments.

7.3 Maintenance mode

To the main menu.

When the process has been saved or if saving is not needed, press key "Exit" to return.

The name of "Historicals" directory must not be changed, because it is the default directory used by the software.

To read the historicals from any directory or drive in the historical mode, the historicals are saved on the floppy disk or in other directories by using Windows facilities. It will be possible to read the historicals from any drive or directory.

To save the process:

Press key "Save".

Enter a common name (optional).

Enter historicals name up to 10 characters.

7.2.3 Saving Process

Process can be stopped at any time by using key "End of Process".

Green: the valve is open.

Red: the valve is closed.

White: the valve is not provided on this system.

The valve status indicators:

Power to the lamps:

Yellow: TC2

Amber: TC1

Red: Parameter

Green: Section

White: Temperature

On the left part of the screen, a pointer monitors the curves of the section's temperature sensors and the power to the lamps.
Manual control

Manual control allows performing a process. This mode can be used for maintenance operations and to set the gas flows before.

7.3.2 Manual control

Exit will return to the maintenance menu after a cooling cycle.

Heating must be stopped prior to change to power support.

Press "Stop heating" to stop heating.

CAUTION

Displaced. The user must check himself that everything is correct.

The sequence is activated (wafer, air, overheat, etc.) in case of failure, cooling will stop.

The manual heating must be used only for adjustments and with low power. Some At full power (100%) or even less, you can damage your substrates in a few seconds.

Heating will start immediately.

To start heating, enter a power setpoint (0 to 100%) and press key «start heating». The

When manual heating mode is selected, the system closes the chamber and sets cooling.

Power (feedback from system).

Temperature from TC2.

Temperature from TC1.

Temperature from Pyrometer according to calibration table.

Controller and

during manual heating, the screen displays the calibration table which is loaded in the

The manual heating mode allows to power the lamps at a fixed setpoint.

7.3.1 Manual heating

To choose the language (English or French).

To display controller inputs status.
The curve which has been entered by the operator
is made of 20 temperature / voltage couples. The calibration curve is used in conjunction with the
29 couples of values. The thermocouple is difficult to use if it is not within the
29 couples of values. The operator has to enter 2 to 4
pairs of different nature.

The software allows to create several calibration labels that may be used to process
substrates of different nature.

Substrate surface depends on substrate materials and can be varied on its
surface. So the calibration curve is a function of the temperature and the emissivity of the
substrate. For the Pyrometer, the voltage is function of the temperature and the emissivity of the
substrate. The calibration table can be controlled either by the optical Pyrometer or by a
thermocouple.

2.4.1 Pyrometer calibration

Table 2.4.1 Pyrometer calibration

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas name</td>
<td></td>
</tr>
<tr>
<td>Temperature compensation table</td>
<td></td>
</tr>
<tr>
<td>Thermocouple calibration table</td>
<td></td>
</tr>
<tr>
<td>Pyrometer calibration table</td>
<td></td>
</tr>
</tbody>
</table>

The parameters menu allows to enter in the system.

7.4 Parameters

When the language is selected, the program is stopped and must be restarted.

English •
French •

This option allows to choose the language for this PMS software control.

7.3.4 Language

This option displays the status of the inputs and the outputs of the controller.

7.3.3 Inputs / Outputs

The system also displays pressure inside the chamber.

Going back to the menu will close all the values.
To print the compensation table parameters on the color printer:

Print

delete

To delete a compensation table. The computer will ask for confirmation to

Delete

Press «Save»
Enter a new name.

Save as:

To save a compensation table with a new name.

Other functions available:

The correction factor may vary from 0 to 200.

Each couple temperature / voltage must be entered in the calibration table so that the

§ 5.3)

in the thermocompensator control mode. In order to get the actual calibration parameters (see

displacement, the operator must perform a multi-step process (50°C by 10°C for example)

Then you have to enter the values for recording thermocompensator and pyrometer signals at

You can enter a comment (optional):

Select «New Table» and enter a name (up to 10 characters).

To enter a new table:

By this way, it is possible to adjust the temperature control very accurately.

must be increased by 3/850 = 3.4%. The correction factor is only 847°C, the correction can be adjusted

If process is performed at 850°C (under pyrometer temperature control) and if the

Example:


correct value to enter this value in the calibration table. This value must be added to the existing

two hundredths per thousand (between the step 0°C and the actual temperature and then

During the process, the operator has to calculate the error percentage (0 to 200 % - zero

Compensate this difference, which is the difference between the step performed and the actual temperature used in the system. There is an offset between the input signal and the actual temperature that the signal will reach

Because of the temperature control, the system used in the thermostat has an offset

Seponti correction
To display the list of alarm events.

- To display historical records of processes which have been saved.

**This mode allows:**

### 2.6 Histories

<table>
<thead>
<tr>
<th>First system</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is important to set one gas name for each gas line actually provided on the indicator.</td>
</tr>
<tr>
<td>When the gas name is entered, the system will set the corresponding valve status.</td>
</tr>
</tbody>
</table>

**Important Notice:**

This mode allows to enter the gas name for each gas line.

### 2.5 Configuration

- "Exit" will return to the parameters menu.
- The "Print" key will print the thermocouple calibration table.
- The "Delete" and "Table" keys allows to reset all the collection parameters.

Select thermocouple calibration, and save the values when they have been changed.

**Procedure:**

For different levels of temperature, the software only allows to enter and save the setpoint correction for the thermocouple. The software only allows to enter and save the setpoint correction for the thermocouple. This value must be added to the existing correction value.

The calibration table. This value must be added to the existing correction value.

The temperature measurement. The calibration mode permits to compensate this difference between the setpoint and the actual measurement.

Because of temperature control system, a difference appears between the setpoint and the actual measurement. The calibration curve for the K thermocouple is known and it cannot be modified. The temperature of temperature control system.

The calibration curve offers the temperature from the sensor function of sensor volume.

The temperature can be controlled either by the optical pyrometer or by the thermocouple.

## 2.4.2 Thermocouple Calibration Table

<table>
<thead>
<tr>
<th>Volume (Vols)</th>
<th>130</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equation:</td>
<td></td>
</tr>
<tr>
<td>Temperature (C) = Volume (Vols) x 130</td>
<td></td>
</tr>
</tbody>
</table>

**Exit:** To return to the parameters menu.
The "Alarms" Key in Historicals menu allows to display the list of all alarms events that have appeared on the system.

2.6.2 Alarms

Promoter calibration table.

Promoter calibration key allows to display the Promoter Voltage at the cursor position instead of the temperature. This is useful to get the temperature vs voltage values to enter in the calibration.

Calibration key

Parameter:
The values at the current place are given in the top of the screen for each process.

A value of the shift in seconds can be set in the white place. In this case, the cursor shift "→" and "←" seconds for keys "→" and "←"

If no value is set in the white place the arrows keys the cursor will shift of:

"→" and "←", or "→" and "←"

A cursor is available to display the values of the parameters at one time value. The cursor can be moved by using the keys "→", "←", "→", and "←". The cursor is available to display the values of the parameters at one time value. The cursor can be moved by using the keys "→", "←", "→", and "←".

Use "Prev" to print the current page on the color printer.

Use keys "Next Page" and "Previous Page" to go on record part before or after the current screen.

Use the keys "Next Page" and "Previous Page" or "Open" to come back to the initial size of the chart size. Use the keys "Open" to display the chart size and "Close" to decrease or increase the chart size. If it is impossible to use the key "Open" and "Close", the chart size will display the first 3 minutes of the recorded data.

When historicals are loaded, the screen will display the first 3 minutes of the recorded data. If you want to delete a record, select "Delete". The system will ask to confirm "Delete".

When historicals are loaded, the screen will display the first 3 minutes of the recorded data. If you want to delete a record, select "Delete". The system will ask to confirm "Delete".

Select the Historical to display in the list on the left side and then select "Load". The directory on hard disk C:

The right disk drive and in the right directory. The default option is "Historicals". When this mode is selected the system displays a screen allowing to find the record on historical records.

2.6.1 Historical records

Exit will Return to the main menu.

(Procесс records) or "Alarms" (alarm events) Select "Historicals" and the screen will display a new form asking for "Historicals".
The alarm, time and date are saved in the alarm list. For more details on alarms causes,

Prior to any new process, solve the problem.

Press "Reset" to stop the alarm, the safety cycle starts. Follow the instructions displayed on the screen to unload the water.

The screen displays the failure origin.

If any utilization condition is not fulfilled, the system is powered by safety:

- Temperature control and temperature sensors
- Lamps (in case of filament failure)
- Temperature inside the system
- Compressed air pressure
- Cooling water flows

During process, the system provides detailed control over:

7.7. Statistics

"Exit" will return to historical menu.

Use "Print" key to print alarm events list.

Use "Delete" key to reset the alarm events list.
Formules de calcul des débitmètres Brooks

Les débitmètres de type Brooks sont utilisés pour mesurer le débit de gaz. Les formules suivantes permettent de calculer le débit de gaz en fonction de la pression et de la température de mesurage.

La formule générale est :

\[ Q = \frac{6,31 \times 10^{-6} \times \left( \frac{P}{101,3} \right)^{0.268} \times \left( \frac{T}{273} \right)^{0.326} \times \left( \frac{1}{M_w} \right)} {1 + 0.00362 \times \left( \frac{P}{101,3} \right)^{0.268}} \]

Où :
- \( Q \) : débit de gaz en m³/h
- \( P \) : pression de mesurage en kPa
- \( T \) : température de mesurage en °C
- \( M_w \) : masse molaire de l'hydrogène

La formule est utilisée pour des gaz non compressibles et non réactifs. Elle suppose que les conditions de pression et de température sont préservées tout au long de la ligne de débitmètre.

Le débitmètre de type Brooks est également équipé d'un compensateur de température pour corriger les variations de température à l'entrée du débitmètre. La formule de correction est :

\[ Q_{corr} = Q \times \left( 1 + \frac{\Delta T}{10} \right) \]

Où :
- \( Q_{corr} \) : débit de gaz corrigé
- \( \Delta T \) : différence de température entre la température de mesure et la température de référence.
Debit en l/n/h d'air mesure STP
Lecture \( x \) = l/n/h de gaz :
mesuré sous \( P = \), \( T = \) °C