AET THERMAL

RAPID THERXAL PROCESSOR
RX

II - OPERATION

These instructions are addressed to clean room operators and to any other user, once the machine has been connected.
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1/ SAFETY INSTRUCTIONS

Several gases can be used with the RX machines, either in sequence or mixed.
The constructor draws your attention to the risk of explosion presented by
certain mixtures (O2 and H2 and NH3, for example).
These risks are also present if the gases are used in sequence.
The RX machines are used in R&D. It is obvious that all the gases have not been
tested and that consequently the user must take every precaution necessary to
prevent certain mixtures from occurring.

The constructor declines all responsibility for any incidents which could occur
through insufficient precautions or handling errors, and their consequences.
On account of the use of certain toxic gases and of the thermal decomposition
products, special attention must be paid to the user's protection. The constructor
specifies that his machine has no protection against any possible toxic emanations.

The responsibility for installing the machine in an environment which complies with
the relating legislation is left entirely to the initiative and charge of the user, who is
considered to be aware of the effects of the gases that he uses, as well as those
of the decomposition products and gases generated by the processes in opera-
tion.

The constructor specifies, for this purpose, that the machine's operating enclosure
is made of quartz, a fragile material which cannot be guaranteed free from ac-
cidental rupture.

In order to avoid any contamination of the machine leading to a deterioration in
the quality of the process, the user should only handle the quartz elements with
clean room gloves.

Finally, note that the RX runs at high voltage and that under no circumstances
should an unskilled person interfere with the interior of the machine.

AET-ADDAX recommends the assignment of a quartz chamber and a quartz sup-
port to each type of process carried out.

The user should be familiar with the computer keyboard.
2/ OPERATING CONDITIONS

The machine has been designed for processes up to 1200°C for a maximum period of 3 minutes. For any overstepping of these conditions, please contact AET-ADDAX.

When the thermocouple is in use, the regulation range extends from room temperature to 1200°C.

The lifetime of the thermocouple degraded rapidly above 1000°C. However, regulation by pyrometer will not be operating below 450°C and is recommended for high temperatures.

NB:
The quality and the consistency of the process results will depend, among other things on variations in conditions, such as:

- process conditions (temperature, duration)
- interruption time between two runs.

Thus, after a lengthy interruption time, it is advisable to "condition" the lamps and the furnace by performing 3 or 4 runs, each lasting for 20 seconds or so, under the expected process conditions (this conditioning can be progressive, according to the importance of the required temperatures).
3/ GENERAL PRESENTATION OF THE RX MACHINES

The RX machines are part of the family of manual furnaces for rapid annealing by infrared radiation.

Depending on their configuration, they can be used for the following processes:

- implant annealing
- oxidation/nitriding
- silicide formation
- etc..

The RX is entirely controlled by an external microcomputer which controls the following functions:

- Programming of the recipes with a full screen graphic editor for:
  - temperature steps
  - gas selection and flow steps.
  - pressure steps (when option installed)
- Control of the machine for the execution of the process with actual data graphically displayed in real time.
- Storage and retrieval of all or part of the process data.
- Automatic calibration.
DESCRIPTION (See schematic hereafter)

Furnace
The furnace is composed of a water cooled, internally gold plated, aluminum enclosure.
One bottom row of quartz halogen lamps ensure the infrared irradiation of the whole quartz chamber.

Quartz Chamber
The quartz chamber guarantees a closed space having the conditions of cleanliness required for wafer processing.
According to the equipment configuration, it can be performed under vacuum or under atmospheric pressure.
ATTENTION ! under no circumstances should the absolute pressure authorized in the chamber exceed 1.2 atmosphere
The chamber is supported and rendered leak tight by the furnace flange (water cooled) and by the door flange (water cooled) and by the back connection.
The door is water cooled and locked and sealed by O-ring during the cycle.

Quartz Support
The quartz support, with specific dimensions according to the wafers to be treated, is integrated into the door for easy loading.
Three support pins assure optimum support of the wafers.

Temperature Measurement And Regulation
There are three ways to read and control the temperature:
   - by thermocouple, located on the door
   - by a single high temperature infrared pyrometer
   - by two, high and low temperature, pyrometers

Gas Rack
The gas rack can be made up of 1 to 8 gas lines. The air operated valves and the mass flow controller(s) are operated by the computer.
The process gases can be neutral or aggressive. Thus, certain precautions must be taken when bringing them into operation.

Gas Evacuation System
The gases are evacuated by the chamber's rear tube. Depending on the configuration, the RX machine is equipped with an exhaust line, a primary vacuum pump and a turbomolecular vacuum pump
4.2 - Mounting the Quartz Tray

Reminder: handle the quartz with gloves. Very fragile material.

1. open the door completely
2. check that the chamber is set up
3. slightly loosen the 4 screws of the clamping plates so as that they rotate
4. place the quartz support in its housing, reposition the clamping plates
5. center the support
6. tighten the 4 screws gradually

* to dismantle the support, do the same thing in the reverse order.
4/ OPERATIONS

4.1 - Starting up the machine

The operator must make sure that all the different fluids necessary for the machine's operation are present, according to the specifications in the installation manual.
- compressed air.
- water supply and evacuation.
- gas supply.
- atmospheric gas exhaust.
- Instruments power 200/220V operating control lights located on the front face

Engage the isolating switch situated at the front of the machine
Press the "START" button

The door of the system is normally locked when the machine is not powered, for safety reasons. Do not attempt to open it until the computer is in on and in communication with the equipment, you just may damage the door.
This is why we briefly describe how to establish this communication. For a more detailed description of the software see the specific chapter.

Hook up and turn on the computer.
The program should be started automatically by DOS, with the AUTOEXEC.BAT file.
If you want to start it manually from DOS, go to the DOS directory where the RTP software is located (With RTPINSTALL it will be in the directory AET\RTP\Vmmddyy) and type XXX.

After the display of the Logo AET you will get two questions: (see program description for more details)
- DATE: enter the 6 digits of the date, with the format MMDDYY without any separator
- OPERATOR CODE: enter your Code (or the one that AET-ADDAX has assigned to you).
If you enter Y when prompted if your entries are correct, you get the display of the MAIN MENU.
At the MAIN MENU select the number 5 for START/STOP the System. If you confirm that you want to start the system, the Software will
- establish the serial communication with the machine,
- open the Water valve
- start the pump (if installed)
- open the door of the furnace
and come back to the MAIN MENU.

You will have to execute the same START/STOP procedure at the end of the day (or of the processing session) to stop the pump and the water.
You can now access the furnace to install the chamber (if not already installed), the thermocouples (if not already installed), the wafer, and the machine is ready for process.
4.3 - Mounting the thermocouples

The thermocouple used as a regulation sensor must be connected to holder located on the right-hand side of the door. The other line is used for the "reading" thermocouple.
The machine is delivered with entry channels for type K thermocouples mounted on the door.

Thermocouple type K (Chromel/Alumel)
the (+) pole of the two wire compensated wire is yellow (Chromel)
the (-) pole of the two wire compensated wire is violet (Alumel) and is magnetized.

Installation

1) open the door
2) release the screw of the quartz tube support
3) locate the thermocouple (-) magnetic wire so as to have it on your left.
4) Introduce 2 wires into the quartz tube holder and slide the quartz tube in its support. Rotate slightly the quartz tube in its holder so that the wires exit from each side, the magnetic wire on the left and hand tight gently the screw of the quartz tube holder.
5) Attach each wire to its connector by wrapping it around and tightening the screw.
4.4 - Loading a wafer

Open the door
Note: During the cycle, and when the machine is off, the furnace door is locked by an actuator operated by the computer. Any attempt to open the door in this situation may damage the mechanism and interfere with the unlocking system.

. Place the wafer delicately on the 3 support pins of the quartz support, flat side oriented towards the door.

. The thermocouple can be positioned on the face up of the wafer, or on the face down by spring effect. Make sure that when you slightly take the thermocouple away from the surface the spring effect will bring it back in contact with the surface. Position the regulation thermocouple (on the right-hand side of the door) as close as possible to the center of the wafer.
ATTENTION ! make sure that the thermocouple wires are not short-circuited.

. Close the door
5 / TROUBLE SHOOTING

5.1 - The machine won't start up normally

- check all the points related to the starting up of the machine (paragraph 4.1)
- check that the emergency stops at the front and the back of the machine are not in operation
- check that the gas detector plug in the back of the machine, if there is no gas detector hooked up, is should be short.
- check the circuit breakers and the fuses located on the left hand side of the machine in the power supply zone
- check that the PC connection cord is correctly plugged in.

5.2 - The door won't open

During the cycle, and when the machine is off, the furnace door is locked by an actuator. Any attempt to open the door in this situation may damage the mechanism and interfere with the unlocking system.

If the door still won't open:
- check that the machine is on
- check the compressed air pressure (60 psi minimum)
- check fuse F7 which protects the installation (power supply zone, left hand lateral panel)

5.3 Interlocks

The system is equipped with hardware interlocks, that will shut down the system and send a message to the PC for:
- Lamps defect:
  In each group of 6 lamps (a bank) the intensity used by three lamps is constantly compared to the intensity used by the other 3 lamps. In case a lamp breaks or its resistance changes significantly, the hardware would detect it.
- Loss of communication with the PC. No message on the PC for this interlock
- Overheating: Temperature of wall furnace above set point (120°C)
- Air defect: Compressed air pressure has fallen below set point
- Water defect: Water flow has fallen below set point
- TC open: Thermocouple is either not connected or broken.