

SuperVap™ Concentration System

Instructions Manual

FMS

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TABLE OF CONTENTS

Warning/Cautions.....	
Technical contact.....	
Specifications.....	
Installation.....	
Power up & set up	
Operation.....	
Important Notes.....	
Appendix A.....	
Appendix B.....	

WARNINGS / CAUTIONS

The SuperVap must be used according to this manual, otherwise safety may be impaired.

Unplug all power cables from the mains outlet before servicing the SuperVap.

In some applications, the solvents being concentrated by the SuperVap may be flammable, and hazardous to human health. Confirm that the SuperVap exhaust fan is operational before the beginning of every concentration process, as a non functional exhaust fan will cause hazardous solvent fumes to spread in the lab. Care must be taken to connect the SuperVap exhaust tube to the exhaust port. The other end of the exhaust tube must go to a fully operational fume hood.

Only High purity or ultra high purity Nitrogen must be used by the SuperVap.

User should check for correct temperature probe reading by comparing the temperature probe reading of a temperature source against the reading of the same source by a functioning thermometer once a week to ensure the proper functioning of the SuperVap.

1. The SuperVap is flexible, yet highly sensitive instrument. Read this User's Manual before use.
2. Only adequately trained personnel should operate the system. A documented training program based on training received during the installation/training session from installation engineers is highly recommended

3. Do not shut off the system main power switch, and the computer switches while the system is running.
4. Do not connect or disconnect connector (s) while the system power is on.
5. Always, replace fuses with the same type and value to protect against fire hazard.
6. Always operate the system under specified electrical specifications.
7. Always wear protective eyewear and gloves when operating the system.
8. Always observe safe laboratory practices and rules when operating the system.
9. When handling solvents, samples and other chemicals, or operating the system, always observe good laboratory practices.
10. When using the system, follow generally accepted procedures for quality control and methods development.
11. When handling solvents, replacing glass tubes or other components, and during operation, always observe good laboratory practices. Know the physical and chemical properties of solvents and refer to the Material Safety Data Sheets for appropriate handling precautions.
12. Replace glass tubes when concentration is finished in a timely fashion, to prevent loss of samples.
13. To prevent contamination carry over, clean the glass tubes after every concentration.
14. Changes or modifications to this system without written consent from the manufacturer may void warranties.
15. Do not touch the inside of the heater blocks.
16. Glass tubes should always be placed in the glass tube chambers to prevent solvent spill inside the chambers, for this could cause damage to the liquid level sensors.
17. In case of sample spill on the SuperVap, wipe clean with a piece of kimwipe wetted with the same solvent as the sample.

For technical help please contact:

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Note: The only maintenance measure the user is allowed to perform is the calibration of the temperature probe. All other maintenance/service must be done by FMS personnel.

Specifications:

Configuration: Dry, 6 tube configuration using 200ml glass concentration tubes w/1ml or 0.5ml tip,
Special 200ml glass concentration Tubes attachable to Waters GC vials.

Environmental ratings.....5°C min-30°C max, 65% RH max (laboratory conditions)

Nitrogen pressure range1-25 psi

Heater block Temp.....Room temp to 80 °C

Dimensions 10”(25cm)W X 13”(33cm) H X 15”(38cm) D

Weight30 lb (13kg)

Power120 VAC/ 60 Hz; or 230 VAC/50 Hz

Power consumption.....SuperVap: 400watts

Main heater block: 210W

(24VAC at 9amps)

Bottom heater block: 360W

(110VAC/220VAC at 3amps)

Accessories.....-2inch temperature probe, RTD type

-200ml glass concentration tubes (quantity=6)

-200ml Glass tube attachable to Waters GC vial

-Tefzel GC vial union

-Waters GC vial

Pneumatic requirements... N2 at 100psi

Control.....Internal processor control

1. Installation

1.1 Unpacking and Inspection

Prior to opening the shipping containers, inspect it for damage or evidence of mishandling. If it has been damaged or mishandled, notify the manufacturer before opening the container. Once the container is opened, inspect the contents for damage. Any damage should be reported to the manufacturer immediately. Save the shipping container. Check the contents against the packing list.

1.2 Location/Environment

The preferred environment for the SuperVap is normal laboratory conditions. The area should be clean and contaminant free. The instrument should be located on a stable flat surface with surrounding space for ventilation and the necessary electrical and N2 connections.

1.3 Electrical Connections

Unpack the SuperVap and check the voltage setting on the Power Entry Module on the back of the SuperVap. Make certain the voltage setting agrees with the power to be supplied to the unit. A system which is connected to a 100-120Vac voltage source should have a voltage setting of “110VAC”, and a system connected to a 220-240Vac voltage source should have a voltage setting of “220VAC”.

If the voltage setting is correct, plug the SuperVap into a properly grounded electrical outlet.

WARNING: Do not bypass the safety ground connection as a serious shock hazard could result.

If the SuperVap does not have the correct voltage configuration, notify the manufacturer or your local distributor.

2. Power up & set up

- 2.1 Turn the SuperVap. power switch on.
- 2.2 Connect the SuperVap. nitrogen line to a nitrogen tank (with a 1/8 tube outlet). The nitrogen tank must be set at 50-100 PSI. The SuperVap regulator should be set at no more than 25PSI.
- 2.3 Connect the exhaust tube to the SuperVap exhaust port. Using the exhaust tube strap Tighten the exhaust tube connection. Place or connect the other end of the exhaust tube To a fume hood.

3. Construction

The SuperVap is intended to be used to concentrate liquids.

The SuperVap plumbing is constructed from stainless steel and Teflon or Polyethylene materials.

The materials of construction make the SuperVap resistant to solvent spills. However, care must be taken to keep the SuperVap away from spills.

The SuperVap is constructed of heating mechanism, Nitrogen injection mechanism, and pressure controls, as well as exhaust mechanism. These are all controlled electronically by the SuperVap processor board.

4. Operation overview

The SuperVap system uses pressure of up to 25 psi and temperature of up to 80 degrees C to do concentration of different extracts and fractions.

WARNING: Due to the operational characteristics of the SuperVap, i.e. high temperature, extra care must be taken to operate the system according to the specifications and instructions in this manual.

Prior to the concentration process the SuperVap can and should be preheated to the temperature at which the fraction or extract is to be concentrated.

After sample has been loaded into the SuperVap tube, it is placed in the SuperVap. The cover is then closed.

The concentration tubes are heated and Nitrogen is injected onto the surface of the liquid creating a vortex. The vortex creates a bigger surface area. The bigger surface area along with nitrogen flow would speed up evaporation.

The Exhaust fan acts as a sort of vacuum. It pulls the fumes created by the evaporation into the exhaust tube to be directed to a fume hood or condenser.

The SuperVap top cover has filters installed on its walls. These filters are constructed from layers of HEPA and carbon filters. As the exhaust fan pulls the fumes, it also pulls air from outside. This air goes through the filters, which filter out particles as well as organic contaminants.

As soon as the fraction or extract for any tube is concentrated down to 0.5ml the liquid level sensor for the corresponding tube will send a signal to the processor. The processor will then send a signal to the valve control circuitry to close the corresponding Nitrogen valve, thereby shutting off Nitrogen flow. The alarm buzzer will then sound to alert the user that an extract or fraction is ready.

The tube containing the concentrated extract or fraction should be promptly removed and replaced with an empty tube.

5. How to do Concentration on the SuperVap:

5.1 Turn the SuperVap on.

5.2 Under "Main Menu" hit "Run"

5.3 Hit "Continue"

This sequence of actions will open the "Run" window.

The last program that was open will be displayed in the "Run" window.

If the application requires a different program to accomplish the concentration then follow the steps below:

5.4 Hit "Open". This will open "Open Existing" window.

This window displays the complete list of all the programs saved previously.

5.5 Hit the desired program filename on the list, then hit "OK". This will open the selected program in the "Run" window.

An evaporation program may include a preheating step and a concentration step. The preheating step would work in “Time” mode, run for a specified amount of time and basically preheat the SuperVap to get it ready for the concentration step.

The concentration step may work in “Sensor” mode or “Time” mode.

5.6 Hit “ALL” to execute the program.

The first step of the program is usually the preheat step. The tubes containing the sample should be placed in the SuperVap only when the user is ready to start the concentration step and not during the preheating step.

6. A description of “Main Menu” selections

The following menu selections are under “Main Menu” :

6.1 “Editor”: This window is used to create new program files as well as open existing ones.

6.2 “Run”: This window is used to execute a selected program file.

6.3 “Log Viewer”: This window is used to set high and low scale of the log window as well

As to view the logfile of the run in real time.

6.4 “Calibration”: This window is used to calibrate the temperature probe for accuracy.

6.5 “Configure”:

6.6 “Continue”: This command is used to select the highlighted menu selection.

7. Description of SuperVap windows

This section of the operator’s manual will describe the menu items and windows of SuperVap.

7.1 “editor” :

Under “Main Menu” hit “Editor” then hit “continue”. This will open the “Editor” window.

The following comprise the sections in this window:

7.1.1 “File” field:

The “file” field is located on top of the “Editor” window. The program filename that is Open is displayed in this field.

7.1.2 “Open” tab:

This tab is used to open an existing program file, as well as to create a new program file. It is located on the right of the “File” field.

7.1.2.1 “Open Evaporator File” window:

This window is used to open either the “Create new file” window or the “Open Existing” window.

7.1.2.1.1 “Create New file” window: This is used to create a new program file.

This window consists of the following sections:

- A- “Filename” field: This field is where the filename for the new program file is typed in.
- B- Keypad: The keypad is used to type in the filename.
- C- “OK” tab: This tab is used to process the filename and open it in the editor window.
- D- “Cancel” tab: This tab is used to return to the “Editor” window.

7.1.2.1.2 “Open Existing” window: This is used to open an existing program

file for editing or execution. The following comprise the sections of this window:

- A- Program file list screen: A list of all saved program files is displayed in this screen.

- B- “OK” tab: This Tab is used to open the program file which is highlighted in the program file list screen.
- C- “Cancel” tab: This tab is used to return to the “Editor” window.
- D- “Delete” tab: This Tab is used to delete a program file which is highlighted in the program file list screen.

7.1.3 “Close” or “X” tab:

This tab is used to close an open program file.

7.1.4 Program file display section:

This section is located in the middle of the “Editor” window, and is used for editing as well as displaying the open program file.

It consists of four different parameters under the following headings:

- STP (step)
- Time (in minutes)
- TMax (in centigrade)
- Description

The program file display section displays the first 8 consecutive steps of the open program File. You can scroll up/down using the scroll bar located on the right side of this section to Access different steps of the program file.

7.1.4.1 “STP”: Displays the step number of the open program file.

7.1.4.2 “Time”: this field displays the specified allotted time for the selected step. Time is used in “time” mode programming only.

7.1.4.3 “TMax”: This field displays the final temperature for the selected step.

7.1.4.4 “Description”: this field displays the description of the selected step.

7.1.5 “Editing” buttons: This section consists of 4 buttons as follows:

- “Delete” button
- “Copy” button
- “Save” button
- “Edit” button

7.1.5.1 “Delete” button: This button is used to delete a selected step of an open program.

By hitting this button the selected (highlighted) step in the display Section is deleted.

7.1.5.2 “Copy” button: This button is used to copy the step that is selected (highlighted).

Example: Highlight step 2, click on “Copy line”. step 2 is copied as step 3 and the previous step 3 moves to become step 4; step 4 becomes step 5; and so on.

7.1.5.3 “Save” button: This button is used to save the changes made to the program File being displayed in the program file display section.

7.1.5.3 “Edit” button: This button will take you to the “Step Editor” window to edit the Selected (highlighted) step.

7.1.6 “Exit” button: Hit this button to exit the “Editor” window.

7.1.7 “Tube array”: The “Tube array” under the heading “Tube” is used to select all or some of the SuperVap glass tubes for the selected step in the “program file display section”.

7.1.8 “Heat” box: The “Heat” box under the heading “Heat” is used to the heater On or off For the selected step in the “program file display section”.

7.1.9 “Mode” section: The “Mode” section is used to determine the mode in which the selected step will be executed; time or sensor mode.

7.2 “Run” :

Under “Main Menu” hit “Run” then hit “continue”. This will open the “Run” window.

The following comprise the sections in this window:

7.2.1 “File” display field:

The “file” display field is located on top of the “Run” window. The program filename that is Open is displayed in this field.

7.2.2 “Open” tab:

This tab is used to open an existing program file.

It is located on the right of the “File” display field.

7.2.3 Active step bar:

This section is located below the “File display field”, and displays the active step.

An active step is a step which is either being executed (running) or can be executed.

This field consists of four different parameters under the following headings:

- STP (step)
- Time (in minutes)
- TMax (in centigrade)
- Description

You can scroll up/down using the up/down arrows located on the right lower corner of this Bar to activate the different steps of the program file.

7.2.3.1 “STP”: Displays the step number of the active step.

7.2.3.2 “Time”: this field displays the specified allotted time for the active step.

7.2.3.3 “TMax”: This field displays the final temperature for the active step.

7.2.3.4 “Description”: this field displays the description of the active step.

7.2.4 “Status display” fields:

7.2.4.1 “Temperature” display field: This is where the temperature of the heater is
Displayed in real time while the program is running.

7.2.4.2 “Elapsed time” display field: This is where the elapsed time of the step that is
Running is displayed.

7.2.5 “Program execution” section:

This section consists of 4 buttons:

7.2.5.1 “Stop” button is used to stop the running program.

7.2.5.2 “All” button is used to run a selected program from start to finish.

7.2.5.3 “Offset” button is used to run a selected program starting from a selected
step to the end. You can select a particular step by scrolling up/down and
highlighting it (by hitting on it), then hitting “Offset”.

7.2.5.4 “Single” button is used to run a single selected step.

7.2.6 “Log View” tab: This tab is used to open the “Log View” window.

7.2.7 “Tube array”: The “Tube array” under the heading “Tube” displays the
SuperVap glass tubes selected for the step that is being
Displayed in the “Active Step Bar”.

7.2.8 “Heat” box: The “Heat” box under the heading “Heat” displays the
SuperVap heater status for the step that is being
Displayed in the “Active Step Bar”. If checked the heater
Would turn on for the corresponding step.

7.2.9 “Mode” section: The “Mode” section displays the mode in which the step
That is being displayed in the “Active Step Bar” will be
Executed; “Time” or “Sensor” mode.

7.2.10 “Exit” button: Hit this button to exit the “Run” window.

7.3 “Log Viewer” :

Under “Main Menu” hit “Log Viewer” then hit “continue”. This will open the “Log Viewer” window. This window displays the SuperVap heater temperature log for the present run or the last run in graphic format.

The following comprise the sections in this window:

7.3.1 “Log graph” screen: This screen displays the log graph for the present run or the last run.

7.3.2 “Real Time Temperature” display:

This field displays the SuperVap heater temperature in real time.

It is located at the upper most right hand corner of the window.

7.3.3 “Time Elapsed” display:

This field displays the elapsed time of the present run.

It is located at the upper most right hand corner of the window.

7.3.4 “Viewr” fields:

7.3.4.1 “Temperature Viewer” display:

This field displays the SuperVap heater temperature at a given point of the log graph. It is under the heading “Viewer”.

7.3.4.2 “Time Elapsed Viewer” display:

This field displays the elapsed time at a given point of the log graph.

It is located right below the “Temperature Viewer” display field.

7.3.4.3 “Scale” tab:

This tab is used to open the “Set Log Scales” window.

7.3.4.3 “Close” tab:

This tab is used to close the “Log Viewer” window, and open the “Run” Window.

7.4 “Set Log Scale” window :

In “Log Viewer” window hit the “scale” tab to open the “ Set Log Scale” window.

This window is used to set the log low and high scales for the log graph screen.

It consists of the following sections:

7.4.1 “Low Scale” selection box:

This box is used to select the “Low Scale Field” for editing. It is located in the top left corner of the window.

7.4.2 “High Scale” selection box:

This box is used to select the “High Scale Field” for editing. It is located in the top right corner of the window.

7.4.3 “Low Scale” field:

This field is used to type in the low scale value.

It is located below the “Low Scale” box.

7.4.4 “High Scale” field:

This field is used to type in the High scale value.

It is located below the “High Scale” box.

7.4.5 Keypad:

The keypad is used to type in the values for low and high scale.

7.4.6 “Apply” tab:

The “Apply” tab is used to process the low and high scale values entered.

7.4.7 “OK” tab:

The “OK” tab is used to save the low and high scale values.

7.4.8 “Cancel” tab:

The “Cancel” tab is used to close the “Set Log Scale” window and return to the “Log Viewer” window.

7.5 “Calibrate”:

Under “Main Menu” hit “Calibrate” then hit “continue”. This will open the “Calibration” window. This window is used to calibrate the SuperVap temperature Probe for accurate monitoring of the heater temperature.

The following comprise the sections in this window:

7.5.1 Monitoring section:

7.5.1.1 “mv Read” field:

This field displays the millivolt reading from the temperature probe in real Time.

7.5.1.1 “cal Read” field:

This field displays the actual temperature reading from the temperature probe in real time. This value corresponds to the millivolt reading. It may or may not be correct depending on the system calibration status. If the temperature probe is calibrated accurately then the reading is correct.

7.5.2 Calibration section:

This section is used to enter calibration data.

7.5.3 Keypad:

The keypad is used to type in the calibration data in the calibration section.

7.5.4 “OK” tab:

The “OK” tab is used to save the calibration data.

7.5.5 “Cancel” tab:

The “Cancel” tab is used to close the “Calibration” window and return to the “Main Menu”.

8. Instructions for operating the SuperVap

8.1 How to create a new program file:

The following example will demonstrate how to create a new program file to concentrate 6 SuperVap tubes with liquid inside.

this program will have two steps. The first step preheats the SuperVap to the necessary temperature. The second step keeps the heat on and turn the nitrogen valves on to inject nitrogen onto the liquid surface. Follow the steps below to create the new program file:

8.1.1 In “Main Menu” hit “Editor” then hit “continue”. This will open the “Editor” window.

8.1.2 In “Editor” window hit the “Open” tab. This opens the “Open Evaporator File” window.

8.1.3 In “Open Evaporator File” window hit “Create New” then hit “continue”. This will open the “Create New File” window.

Note: To return to the “Editor” window hit the “Cancel” tab.

We will name the new program file “concentrate 6”.

8.1.4 Type in the new program filename; “Concentrate 6”, Using the touch screen keypad.

and hit the “OK” tab. This will return you to the “Editor” window and the number “01” appears in the “program file display” section of the “Editor” window, under “STP” (“STP” stands for step). The new filename (Concentrate 6) is now displayed in the “File” field.

Note: If the new filename already exists a warning message will appear as follows:

“File with same name already exists!
Do you want to overwrite?”

If you want to overwrite the existing program file, hit “OK”, and if not hit “Cancel”, and type in a different name.

8.1.5 Hit the “Edit” tab. The “Step Editor” window opens.

8.1.6 Click inside the box to the left of “Time(minutes)” to check it.

8.1.7 Type in “40”. This is the time allotted to this step. In other words this step would run for 40 minutes.

8.1.8 Hit the “Apply” tab.

8.1.9 Click inside the box to the left of “Temp(Max)” to check it.

8.1.10 Type in “60”. This is the set (final) temperature for this step. In this step the SuperVap would be preheated to 60 degrees centigrade.

8.1.11 Hit the “Apply” tab.

8.1.12 Hit the “OK” tab. This will return you to the “Editor” window.

You will notice that the number 40 and 60 are displayed under “Time” and “TMax” respectively.

8.1.13 Click inside the “Heat” box (to the left of “H”).

8.1.14 Click inside the “Time” box (to the left of “T”).

Step 1 of the new program file is now created.

8.1.15 Hit the “Copy” tab. This will copy step 1. The program has 2 identical steps now.

8.1.16 To edit step 2, hit the “Edit” tab. This opens the “Step Editor” window once again.

The time allotted to this step is not of consequence since the SuperVap ignores it for any step that is written in sensor mode.

8.1.17 Click inside the box to the left of “Temp(Max)” to check it.

8.1.18 Type in “60”. This is the set (final) temperature for this step. In this step the SuperVap would concentrate the extract at 60 degrees centigrade.

8.1.19 Hit the “Apply” tab.

8.1.20 Hit the “OK” tab. This will return you to the “Editor” window.

8.1.21 Click inside the “Heat” box (to the left of “H”).

8.1.22 Click inside the “Sensor” box (to the left of “S”).

8.1.23 Click inside the boxes 1 through 6 in the “Tube array”.

8.1.24 Hit the “Save” tab.

The program file “Concentrate 6” is saved and ready for use.

8.2 How to open a saved program file:

8.2.1 In “Main Menu” hit “Editor” then hit “continue”. This will open the “Editor” window.

8.2.2 In “Editor” window hit the “Open” tab. This opens the “Open Evaporator File” window.

8.2.3 In “Open Evaporator File” window hit “Open Existing” then hit “continue”. This will open the “Open Existing” window. A list of all the saved program files are displayed in this window.

8.2.4 Hit the desired program filename, then hit the “OK” tab on the bottom of the window.

The program file opens in the “Editor” window.

8.3 How to do concentration (run a program) on the SuperVap:

8.3.1 How to run the complete program:

8.3.1.1 In “Main Menu” hit “Run” then hit “continue”. This will open the “Run” window.

8.3.1.2 In “Run” window, hit the “Open” tab. This will open the “Open Existing” window.

8.3.1.3 Hit the desired program filename in the “Program file list screen”, then hit the “OK” Tab. The selected program file opens in the “Run” window.

8.3.1.4 Hit “All” tab to run the program file from start to finish.

8.3.2 How to run a program starting from an offset point:

8.3.2.1 Scroll the program up/down using the up/down arrows to activate the starting step. this is called the offset step.

8.3.2.2 Hit the “Offset” tab. This will start the program with the offset step and finish with the last step of the program.

8.3.3 How to run a single step of a program:

Scroll the program up/down using the up/down arrows to activate the desired step.

Hit the “Single” tab. This will only run the selected step.

8.4 How to calibrate the temperature probe:

To calibrate the temperature probe two known temperature sources are needed; one with a high temperature (preferably between 80-100 degrees centigrade) and the other with a substantially lower temperature (between 5-10 degrees centigrade). You can use a cup of hot water & one cup of ice water.

8.4.1 In "Main Menu" hit "Calibrate" then hit "continue". This will open the "Calibration" window.

8.4.2 Place the temperature probe in the "high temperature source".

8.4.3 Monitor the "mv read" field to ensure the reading is stable.

8.4.4 When stability of the mv reading is reached, Using the keypad, type in the actual temperature (in centigrade) of the "high temperature source" inside the "process 1" field, and hit the "Process 1" tab.

8.4.5 Place the temperature probe in the "low temperature source".

8.4.6 Monitor the "mv read" box to ensure the reading is stable.

8.4.7 When stability of the mv reading is reached, Using the keypad, type in the actual temperature (in centigrade) of the "low temperature source" inside the "process 2" field, and hit the "Process 2" tab.

8.4.8 Hit the "OK" tab.

9. Pressure control

The nitrogen pressure must be set so that the sample would not splash and the vortex is not violent or the volatile and semi volatile compounds in the sample would be lost

The pressure regulator is used to adjust the nitrogen pressure which is monitored on the pressure gauge.

The pressure regulator can be adjusted by turning the knob located on top of the pressure regulator.

Turning clockwise will increase the set pressure and counter clockwise will decrease it.

WARNING: Please make sure to double check the pressure reading on the SuperVap mechanical pressure gauge to make sure the pressure is set correctly.

10. Temperature control

The SuperVap monitors, displays, and controls the heating. It receives the temperature probe signals from SuperVap heater and according to the temperature set point specified in the program will turn the heater on or off to maintain the temperature as specified.

To do this accurately the temperature probe for each channel must be calibrated according to the instructions in this manual.

Appendix A: Switches, etc.

1. The Main Power Switch: located on the rear of the Power-Vap.
2. Heater control switch. This is a 3 pole toggle switch.
In the up position the heater is controlled automatically through the software.
In the middle position the heater is disabled.
In the down position the heaters are controlled manually (They stay on until turned off by user).
3. Nitrogen valve control switches:
There are six 3 pole toggle switches to control the nitrogen valves for tube 1 through 6.
In the up position the valves are controlled automatically through the software.
In the middle position the valves are disabled.
In the down position the valves are controlled manually (They stay on until turned off by user).
4. Reset switch:
This is a momentary push button switch to reset the alarm buzzer.

Appendix B: Indicator LED'S:

1. Fuse, voltage, & control indicator LED'S:
 - 2.a Voltage indicator LED'S are green and their "ON" state indicate that this particular voltage supply is functioning properly.
 - 2.b Fuse indicator LED'S are yellow and their "ON" state indicates that the particular fuse is good.
 - 2.c Sensor "Tube1" through "Tube6" indicator LED's are red and correspond to the sensors for tubes 1 through 6. Their "ON" state indicates that the liquid inside the corresponding concentrator tube has been concentrated to below the sensor level.
 - 2.d Nitrogen "Tube1" through "Tube6" indicator LED's are red and correspond to the nitrogen valves for tubes 1 through 6. Their "ON" state indicates that nitrogen is blowing into the corresponding concentrator tube.
 - 2.e The "HEATER" indicator LED is red and its "ON" state indicates that the heater is on.

Appendix C: Indicator FUSES:

- 1- Line fuse1 (AC power): 5A, fast blow**
- 2- Line fuse2 (AC power): 5A, fast blow**
- 3- 10VAC (transformer secondary) fuse: 4A, fast blow**
- 4- 14VDC fuse: 4A, fast blow**
- 5- Heater fuse: 10A, fast blow**

