

# NOVAWAVE

*A new category of Automated Microwave Digestion*

**User Manual**

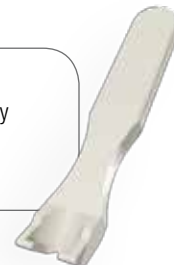


# Options



## Spacer Rack

Required to complete a system with 14 racks (FA model).  
(Qty: One)  
Cat. # 010-600-017



## Venting Tool

Required to manually release the safety pressure cap after digesting samples.  
(Qty: One)  
Cat. # 010-600-080



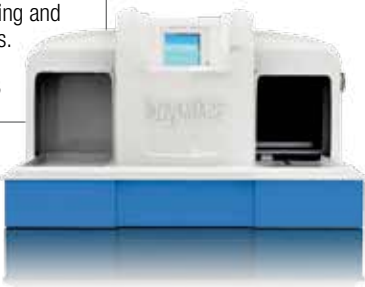
## Barcode Reader

Barcode reader and probe to enter Sample ID's.  
(Qty: One)  
Cat. # 010-600-034



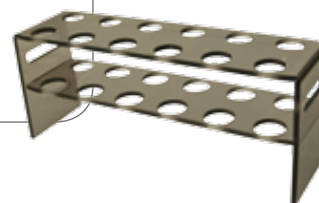
## Fluoropolymer Cap Liners

Required to protect safety caps from sample contamination.  
(pk/6)  
Cat. # 010-600-032



## Transporter

Required to upgrade a **NOVAWAVE** SA to FA model. With Forced Air Cooling and Auto-Venting stations.  
(Qty: One)  
Cat. # 010-600-003



## Transfer Rack Stand

12 position polycarbonate support stand for vessels and Transfer Rack.  
(Qty: One)  
Cat. # 010-600-040

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EN61326-1 :2006, CISPR 11 :2003 + A2 :2006, IEC 61000-4-2:2001, IEC 61000-4-3:2002, IEC 61000-4-4:2004, IEC 61000-4-5:2001, IEC 61000-4-6:2003, CISPR 11, 47CFR chapter 1 FCC part 18, FCC part 18.305, 21 CFR part 1030.10 c) 1,2,3, FCC OST/MP-5 :1986 and IEC 61010-1:2001(2<sup>nd</sup> edition).

Power Density Test/Report According to 21 CFR Par 1030.10 C) 1,2,3 and IEC 61010-1 Clause 12.4 ICES-001, CISPR11, EN55011 and EN61326-1.

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# 1 Introduction

**NOVAWAVE** is a new, fully automated, sample digestion tunnel with microwave cavities to simultaneously process samples in Quartz or Fluoropolymer vessels. **NOVAWAVE** delivers a dramatic improvement in sample throughput and speed of digestion plus a major reduction in labor and human intervention compared to any other digestion system. Speed and flexibility are built-in with the capability of running a rack of samples with individual sample temperature programs.

Sample vessels are placed in racks and capped, then the pressure safety system closes over the top of the 12 samples. The rack enters the tunnel and 12 dynamic microwave mini cavities are formed, delivering energy to each mini cavity according to the digestion method selected. In the **NOVAWAVE** FA model, when the rack exits the tunnel, the rack proceeds to the Cooling Station and a second rack enters the tunnel to begin its digestion sequence. Once the digestions in the second rack are completed, the rack moves to the Cooling Station with the first rack moving to the Auto-Venting Station. Here, vessels are safely vented automatically when they reach a pre-assigned temperature pre-set in the method.

## Unpacking

The system weighs approximately 150 lbs / 75 kg. The **NOVAWAVE** is attached to the packaging with 4.5 inch bolts. Remove them prior to lifting the system out of the box. It is OK to lay the system on its back and install the 4 feet provided. It will take a minimum of two people, lifting from the bottom to place the system on the horizontal surface where it will be used. Be sure that the surface can accommodate 75 kg. Save the packing material for further use. Ensure all parts have been delivered; some parts may be in other boxes.

## Inspection

Ensure all of the parts are included in the packaging. There may be some accessories that have been packaged in the same box as the **NOVAWAVE**. If damage is observed, contact the service department (see page 3 for contact information).

## Instrument Description

This manual covers the use and operation of both models of the **NOVAWAVE**:

### Model SA

A Stand Alone **NOVAWAVE** Microwave Tunnel Digestion System with all available software and operational parameters including the flexibility of unique, individual method assignments for each sample in a 12 sample rack.

### Model FA

A Fully Automated **NOVAWAVE** Microwave Tunnel Digestion System with all the software and operational parameters employed in the Model SA; plus the Transporter, Auto-Cooling and Auto-Venting Stations to complete the automation. The Model FA provides unattended, automatic processing of up to 14 racks totaling 168 samples.

Model SA can be upgraded at any time to a full Model FA through the acquisition of the Transporter and additional racks, vessels and Fluoropolymer caps.

Speed and flexibility are built-in with the capability of running racks of samples with individual sample temperature programs. Simultaneously, water and soil samples in the same rack can be digested with an optimized digestion program employed for each sample! Racks can be left on the Transporter after processing, as in an after-hours run, or removed immediately for sample analysis once the rack leaves the Auto-Venting Station.

## Accessories for Quartz Vessels



**Complete Rack 50 ml  
Cal. Quartz Vessels**  
(Qty: One)  
Cat. # 010-600-055

**Complete Rack 75 ml  
Cal. Quartz Vessels**  
(Qty: One)  
Cat. # 010-600-075

**Rack for 50 ml Vessels**  
(Qty: One w/o Tubes)  
Cat. # 010-600-056

**50 ml Quartz Vessels**  
Calibrated at 50 ml  
(Qty: Pack of 6)  
Cat. # 010-600-051



**75 ml Quartz Vessels**  
Calibrated at 45  
and 50 ml  
(Qty: Pack of 6)  
Cat. # 010-600-071



**Fluoropolymer Liners**  
(Qty: Pack of 6)  
Cat. # 010-600-032



**Fluoropolymer Caps**  
For quartz vessels  
(Qty: Pack of 6)  
Cat. # 010-600-030



## Accessories for Fluoropolymer Vessels



**Complete Rack 50 ml  
Fluoropolymer Vessels**  
(Qty: One)  
Cat. # 010-600-057

**Complete Rack 75 ml  
Fluoropolymer Vessels**  
(Qty: One)  
Cat. # 010-600-077

**Rack for 75 ml Vessels**  
(Qty: One w/o Tubes)  
Cat. # 010-600-076

**50 ml Fluoropolymer  
Vessels**  
Uncalibrated vessels  
(Qty: Pack of 6)  
Cat. # 010-600-053  
+  
**Support Sleeves**  
For 50 ml  
Fluoropolymer  
Vessels  
(Qty: One Pack of 6)  
Cat. # 010-600-054



**75 ml Fluoropolymer  
Vessels**  
Uncalibrated vessels  
(Qty: Pack of 6)  
Cat. # 010-600-073  
+  
**Support Sleeves**  
For 75 ml  
Fluoropolymer  
Vessels  
(Qty: One Pack of 6)  
Cat. # 010-600-074



**Fluoropolymer Liners**  
(Qty: Pack of 6)  
Cat. # 010-600-032



**Fluoropolymer Caps**  
For Fluoropolymer vessels  
(Qty: Pack of 6)  
Cat. # 010-600-031



## 2 Installation

**NOVAWAVE** should be installed on a stable lab counter top which provides easy access considering the height of the lab's operators. The exhaust vent of the **NOVAWAVE** must be connected to a fume hood to prevent noxious fumes from entering the lab in the event of the venting of a digestion vessel.

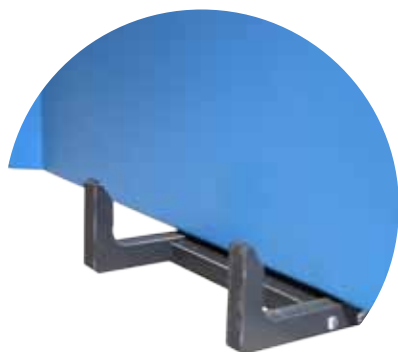
### Installation Location

To install **NOVAWAVE** select a location that:

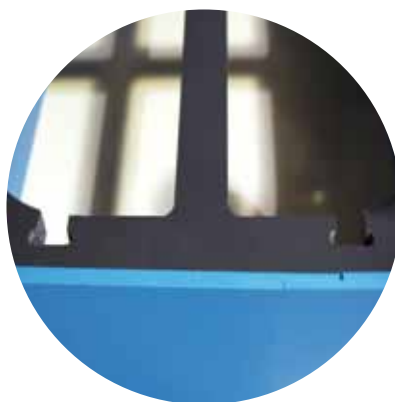
1. Is in close proximity to lab exhaust (a proper laboratory fume hood).
2. Provides a minimum clearance of 3 in. (7.5 cm) space on all sides.
3. Provides adequate bench space for IN and OUT staging tables or **NOVAWAVE** FA.
4. Provides a mounting surface of inflammable material capable of supporting 75 kg.
5. Is free from vibration of large equipment.
6. Provides close access to a properly grounded electrical outlet (30A, 230V, single phase)(receptacle provided).
7. **NOVAWAVE** should be operated on a stabilized constant voltage AC power supply, and the voltage must be within  $\pm 5\%$  of the specified level.
8. Should be lifted from bottom by 2 or 3 people.
9. Do not lift by the side panels or door openings.

### **NOVAWAVE** SA

Install the IN and OUT staging tables by ensuring the tongue of the staging table connectors are installed and fixed to the bottom of the **NOVAWAVE** frame. Level the tops by placing a straight edge inside the tunnel. Turn the adjustable feet up or down to the point that the bottom edge of the straight edge is touching the top of the staging tables. Adjust the front feet until the side panels are level with the table top. Connect the exhaust tubing to the exhaust port of the **NOVAWAVE**. The system is now ready to be plugged in.



Staging Table Connectors



Bottom of Staging Table



Correct Position of Staging Table

## **NOVAWAVE** FA

Place the **NOVAWAVE** SA in the position where you plan to use the system allowing at least 28 inches (72 cm) on each side for the Transporter.

Use a straight edge to ensure the top of the Transporter is level with the bottom of the tunnel. This is accomplished by placing the straight edge in the tunnel parallel to the back wall of the tunnel. Using the leveling feet, adjust the system to the correct height by turning the feet. Clockwise lowers the table top and counter clockwise lifts the Transporter top. Adjust the back feet first to the point where the straight edge touches the top of the Transporter top along the entire length of the straight edge. Do this on both the right and left hand sides. Position the right and left hand sides into place by ensuring the tongues of the Transporter tops are centered within the door openings. Use the straight edge along the back wall of the tunnel and the back rail of the left hand Transporter module to ensure that the Transporter it is aligned along the length of travel.

Connect the bridge between the left and right side Transporter modules and ensure that the alignment pins are pushed together snugly. Raise or lower the feet on the front of the Transporter to level the right and left Transporter modules.

Install the cooling and venting module on the right hand side of the **NOVAWAVE**. Install the cooling duct by screwing it in the threaded hole on the right side of the SA. Connect the flexible duct to a fume hood.

### **NOTE**

It is important to ensure that the exhaust hose is vented into a fume hood or to the outside.

Install the left hand cover unit using the hole and guide pins for alignment.

### **Precautions To Avoid Possible Exposure To Excessive Microwave Energy**

(a) Do not attempt to operate this instrument with the door open since open-door operation can result in harmful exposure to microwave energy.

It is important not to defeat or tamper with the safety interlocks.

(b) Do not place any object between the instrument front face and the door or allow soil or cleaner residue to accumulate on sealing surfaces.




(c) Do not operate the instrument if it is damaged. It is particularly important that the tunnel door close properly and that there is no damage to the:

(1 ) Door (bent), (2 ) door seals and sealing surfaces.

(d) The instrument should not be adjusted or repaired by anyone except properly qualified service personnel.



# 3 Cautions, Notes and Symbols

Symbol	Description	Symbol	Description
V	Voltage	I	Mains on
~	Alternating current	O	Mains off
A	Current		Attention, consult accompanying documents
Hz	Frequency		Caution, hot surfaces
F	Fast-acting fuse		Protective conductor terminal

Cautions, warnings and notes are included throughout this manual.



## CAUTION

A caution is used to emphasize information pertaining to procedures that, if not strictly followed, may result in damage or destruction to the instrument or improper instrument operation.



## WARNING

A warning is used to emphasize information about dangerous or hazardous conditions relating to the operation, cleaning or maintenance of the instrument that may result in personal injury.



## NOTE

A note is used to emphasize procedures or conditions that may be misinterpreted or overlooked, and to clarify potentially confusing situations.

# 4 Racks & Vessels

The round bottom quartz digestion vessel allows the analyst to place the vessel directly onto the balance for weighing samples with the tube support supplied. Once weighed, the digestion media may be added. The 75 ml vessel is calibrated at 45 ml for quick addition of the sample and 50 ml for acid addition as per EPA 3015. The 50 ml vessel is calibrated at 50 ml for normalization after the digestion. The calibrations are to Class A specifications  $\pm 0.25$  ml.



Never use a quartz digestion vessel which appears cracked or damaged.

After weighing the sample in a quartz vessel and adding acid, place the PTFE Fluoropolymer cap on top of the vessel. The Fluoropolymer cap seals on the intersection of the quartz vessel and tapered edges of the PTFE cap. The PTFE cap is held into place when the Safety Pressure Cap is screwed into place.

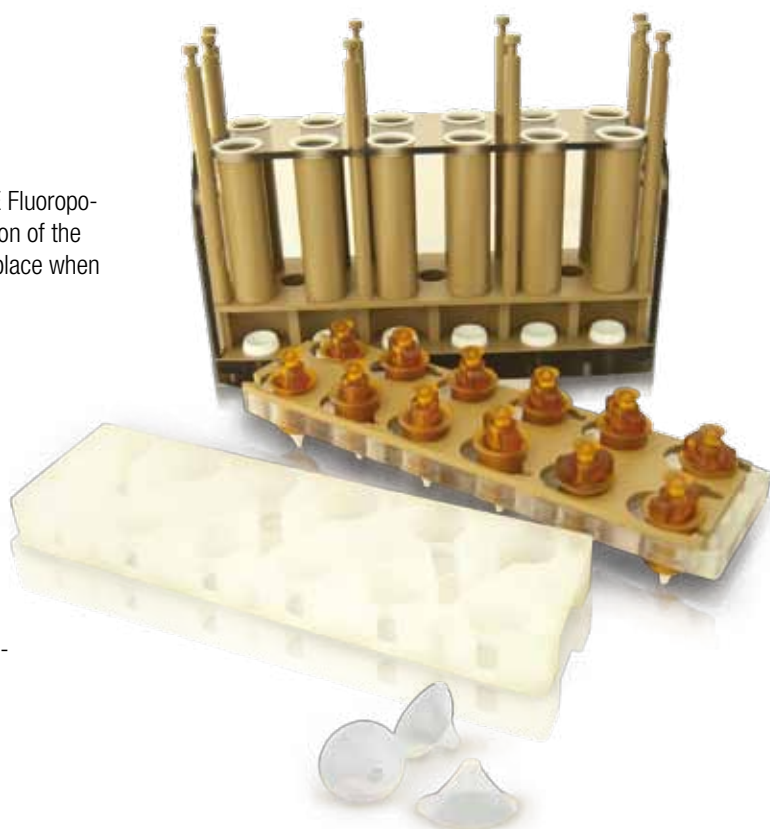
Place the vessels in the 'Transfer Rack' (010-600-038).



The Transfer Rack only fits one way. The positions (1 through 12) are marked on the rack. Insert the Transfer Rack into the appropriate size instrument rack, i.e., 50 ml vessels in a 50 ml rack etc.

Place a Fluoropolymer liner in each vessel cap prior to placing the Safety Pressure Plate on top of the rack.

Push the locking mechanism as shown in the picture below. If the locking mechanism does not pop into place, unscrew each of the Safety Pressure Caps a  $\frac{1}{2}$  turn and try to re-lock the safety pressure plate.



Once the Safety Pressure Plate is in the correct position, tighten each of the Safety Pressure Caps until they do not turn.

The rack is now ready to be inserted in the *NOVAWAVE*. Place the loaded rack onto the 'IN Staging Table'. The locking mechanism should be oriented furthest from the door.

Once prompted by the program, firmly push the rack into the tunnel until the rack is engaged on the 'IN GEAR'. The *NOVAWAVE* software will complete the remaining digestion processes as programmed (See software operation for programming).

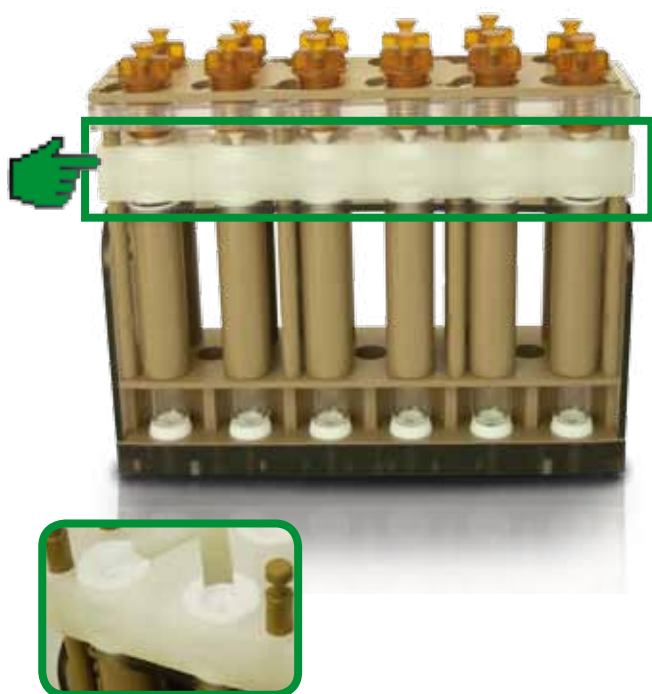
To unlock the Safety Pressure Plate, release the 'Safety Pressure Caps' using the hand-venting tool in a fume hood. The rack should be cooled to room temperature prior to releasing the Safety Pressure Caps. Once all of the Safety Pressure Caps have been vented, loosen the safety pressure caps about 1½ turns. Push on the locking mechanism to release the Locking Mechanism Plate while holding the other end steady with your other hand. The Safety Pressure Cap Plate may be removed by lifting the entire plate.



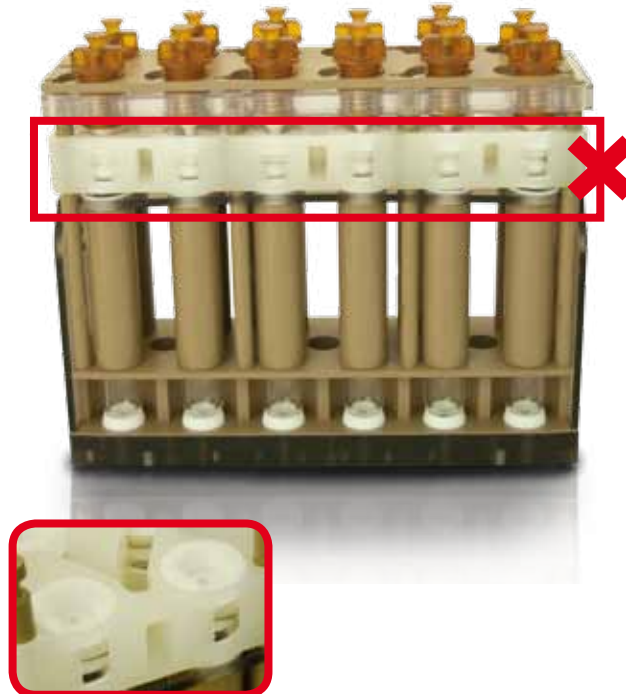
Always allow the vessels to cool prior to venting and wear appropriate eye protection and gloves prior to performing this operation. This should only be done in a fume hood.

#### Orientation for Placement in Tunnel

**Correct**



**Wrong**



Remove and rinse the Fluoropolymer liners and caps. The vessels may be removed from the rack using the Transfer Rack. Using the vessel volume calibration lines, samples can be normalized directly in the vessel.

Using the Transporter Rack the vessels can be moved to an Auto Sampler for processing.

# 5 Software Operation



**NOVAWAVE** software has been designed with 3 levels of password protected operations allowing accessibility to various parts of the software by different individuals. This feature protects the laboratory from inadvertently changing or erasing important settings and / or data.

		USER LEVEL		
Tab	Button	Administrator	Operator	Service
Program	Add Cycle	Y	Y	Y
	Add Rack	Y	Y	Y
	Delete	Y	N	Y
	Manual	Y	Y	Y
	Start	Y	Y	Y
	Show Keyboard	Y	Y	Y
	Hide Keyboard	Y	Y	Y
	Save	Y	Y	Y
	Load	Y	Y	Y
	Method Select	Y	Y	Y
	Vessel Type Select	Y	Y	Y
	Start Digestion	Y	Y	Y
	Sample List	Y	Y	Y
Digestion	Operational after the 'Start Digestion' button is pressed			
	Stop	Y	Y	Y
Methods	Delete	Y	N	Y
	New	Y	N	Y
	Edit	Y	N	Y
View	Copy	Y	N	Y
Reagent	Add	Y	Y	Y
	Delete	Y	Y	Y
	Edit	Y	Y	Y
Reports	Delete	Y	N	Y
	Print	Y	Y	Y
	Send	Y	Y	Y
Utilities	Status - Initialize	Y	Y	Y
	Calibration	Y	N	Y
	-Vessel Type	Y	N	Y
	-Read New Data	Y	N	Y
	-Send to MicroB	Y	N	Y
	-Save	Y	N	Y
	-Save to USB	Y	N	Y
	User	Y	N	Y
	-User Group	Y	N	Y
	-Change Password	Y	N	Y
	-Add new user	Y	N	Y
	-Delete selected user	Y	N	Y
	Network - Apply	Y	N	Y
	Report - day change	Y	N	Y
Diagnostic	Log	Y	Y	Y
	Operation	Y	N	Y
Logout	exit	Y	Y	Y
	Reboot	Y	Y	Y
	Shutdown	Y	Y	Y
User		admin	user	root
Passwords		zxc	asd	secret

## “Program” Run

### Cycle

This is the tab where a digestion run is created. It starts by creating a 'cycle', where 'racks' are then added to the cycle.

A cycle is used when programming several racks with the same method for all of the tubes per rack. It may also be used when a second digestion is required after the addition of a second reagent.

Sample IDs	
1	12
2	11
3	10
4	9
5	8
6	7

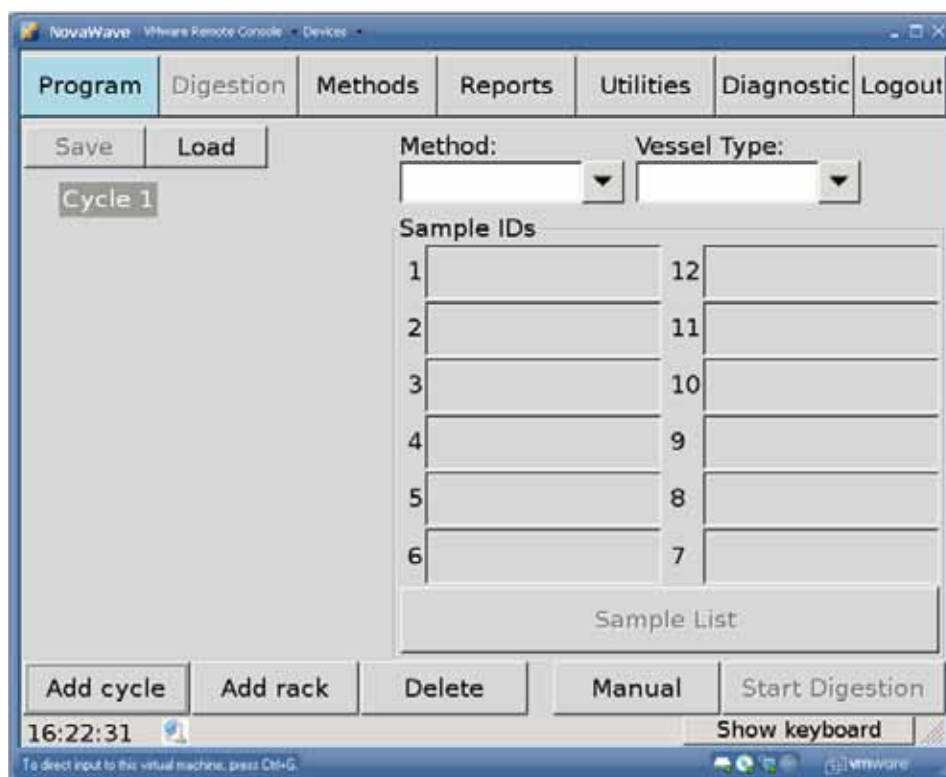
Press the button 'Add cycle'.

Stored runs can be loaded by pressing the 'Load' button and selecting a previously stored run.

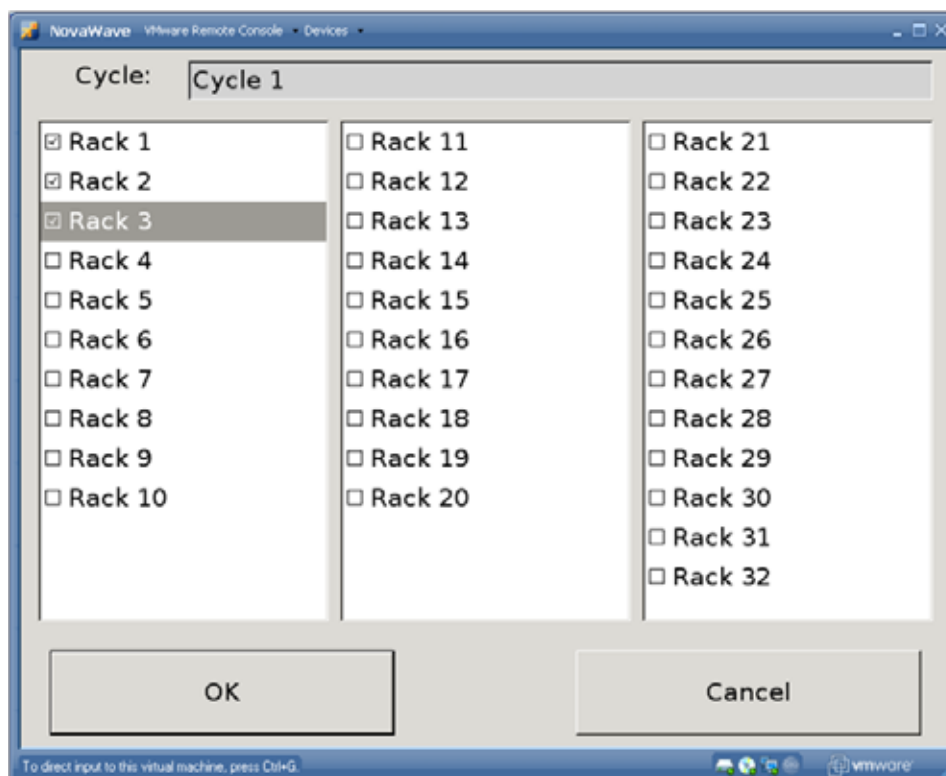
'Delete' is to remove selected racks or cycles.

'Manual' is to operate the doors and applicators manual, etc.

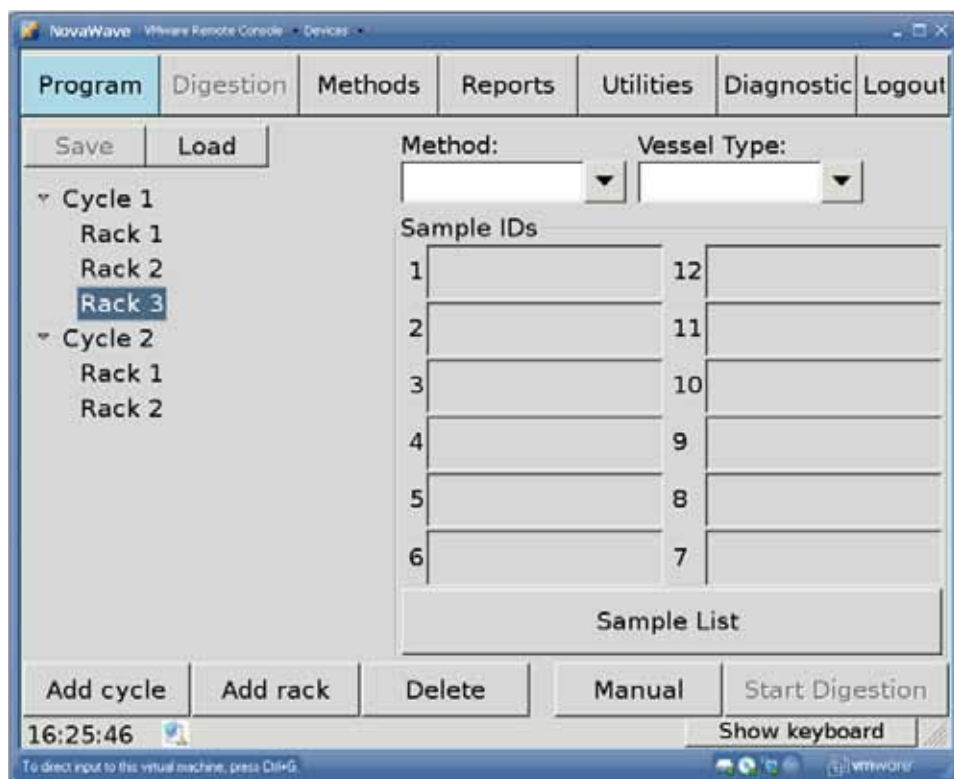
'Start Digestion' is to start digestion.



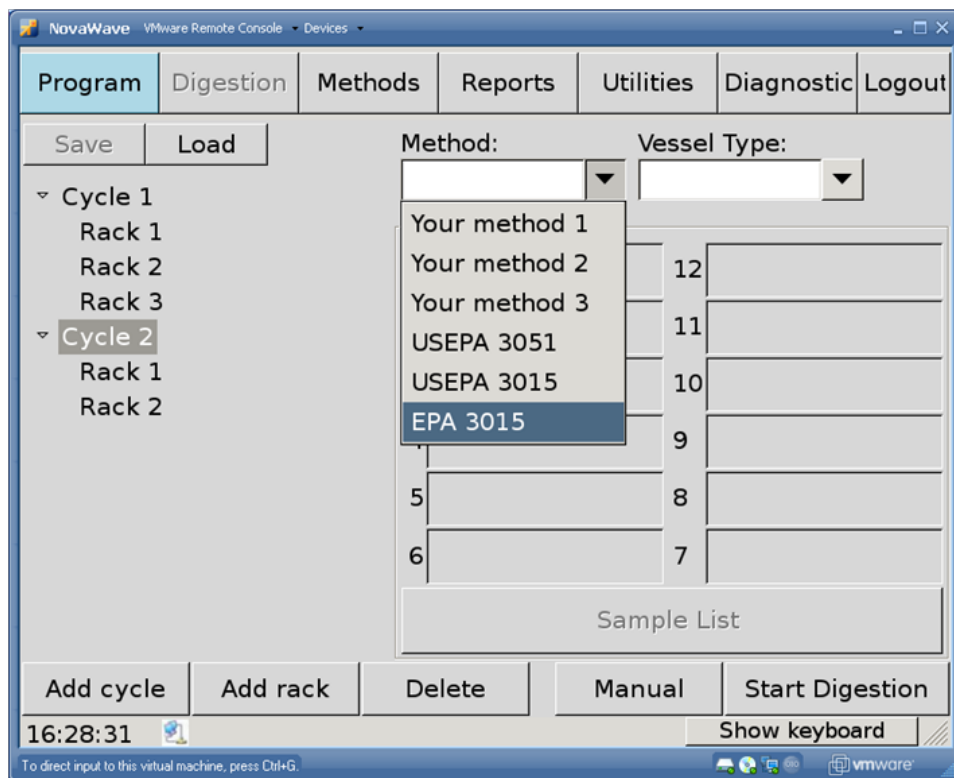
Select 'Add rack' up to 32 racks per cycle.



Highlight the rack number in which the samples will be digested or extracted. The racks with a check mark will be saved to the list. To delete a rack, click on the rack number to delete. Press **OK** to input the selected racks in the cycle list.



It is possible to add several 'cycles' with different rack ID's for each cycle. It is also possible to use the same rack ID for each 'cycle' selected.



By selecting **Cycle 2**, and selecting a method from the Method pull down tab, the **NOVAWAVE** will assign the same selected method for all of the racks in the cycle selected. Select one of the pre-programmed methods or user created methods. (See Methods to Create New Methods.)



**Program** | Digestion | Methods | Reports | Utilities | Diagnostic | Logout

Save | Load

Method: USEPA 3051 | Vessel Type: **Quartz**

Sample IDs

1	
2	
3	10
4	9
5	8
6	7

Sample List

Add cycle | Add rack | Delete | Manual | Start Digestion

16:41:24 | Show keyboard

To direct input to this virtual machine, press Ctrl+G.

After a method is selected, a vessel type needs to be selected for the system to operate correctly. Select one of the pre-programmed vessel types from the **Vessel Type** pull down tab. If the **Cycle** is highlighted, the vessel type will be assigned to all of the racks for this cycle.

**Quartz** vessels are either 50 ml or 75 ml vessels.

**Fluoropolymer** vessels are either 50 ml or 75 ml vessels.

**Other** is reserved for future use.

**Notube** is selected if the position in the rack is intentionally left blank. Vessel selection is used to set the IR temperature sensor parameters.

## Sample Position

**Program** | Digestion | Methods | Reports | Utilities | Diagnostic | Logout

Save | Load

Method: USEPA 3051 | Vessel Type: Quartz

Sample IDs

1		12	
2		11	
3		10	
4		9	
5		8	
6		7	

Sample List

Add cycle | Add rack | Delete | Manual | Start Digestion

16:42:37 | Show keyboard

To direct input to this virtual machine, press Ctrl+G.

To program a digestion by rack position, a cycle with racks must be created first. Highlight the rack number with the different samples to digest. Select the **Sample List** button. On this page, to select a position to program, select all of same type of samples by clicking on the rack position (**Pos**) button. Select a method from the **Method** pull down tab; select a vessel type from the **Vessel Type** pull down. Click on the **Enter Value** tab to populate table. If a second method is required select the position to program in the same manner as above. Method and vessel type may vary by position. If the vessel position is not populated the **NOVAWAVE** will consider that there is no vessel in that position.

# Sample List



Pos is the vessel position in the rack.

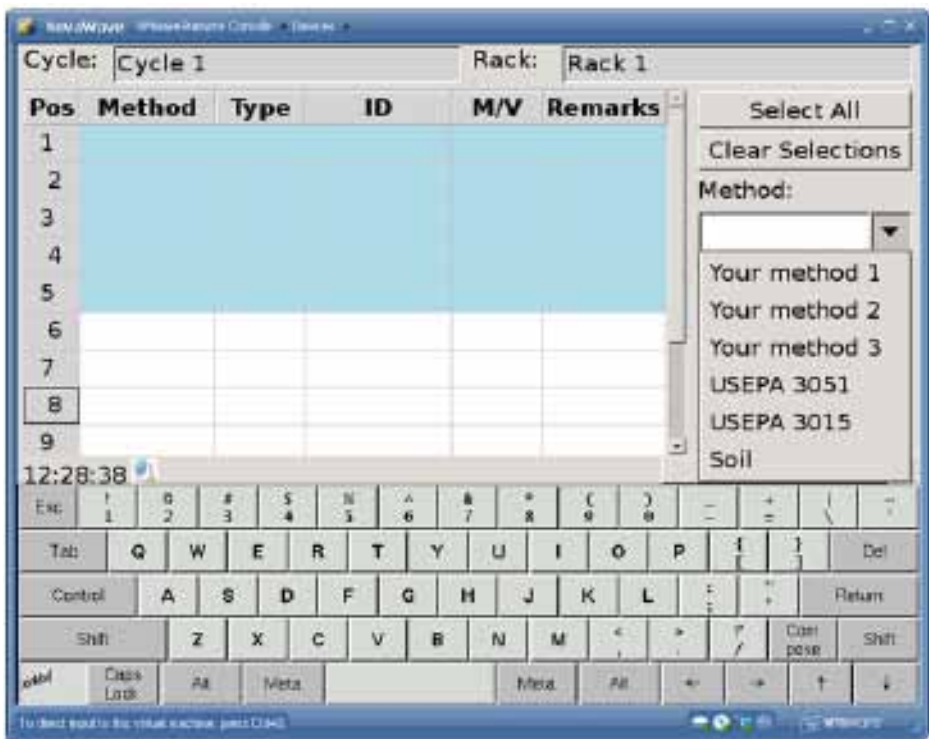
Method is selected from the pull down methods tab.

Type is vessel type select quartz or Teflon® from the pull down tap.

ID is an independent sample identification.

M/V is the mass or the volume of the sample.

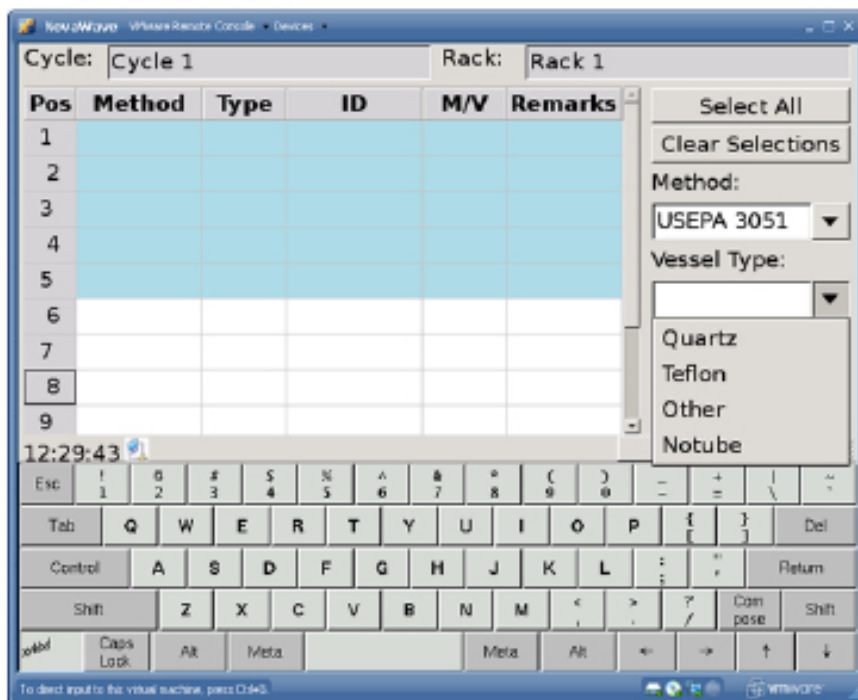
Remarks is for other comments required on the samples.



Highlight the rack position by pressing on the Pos 1...12 for each position of the positions that are being digested using the same method.

Select the Method from the pull down tab.

All of the rack positions that are using the same method may be highlighted at the same time.



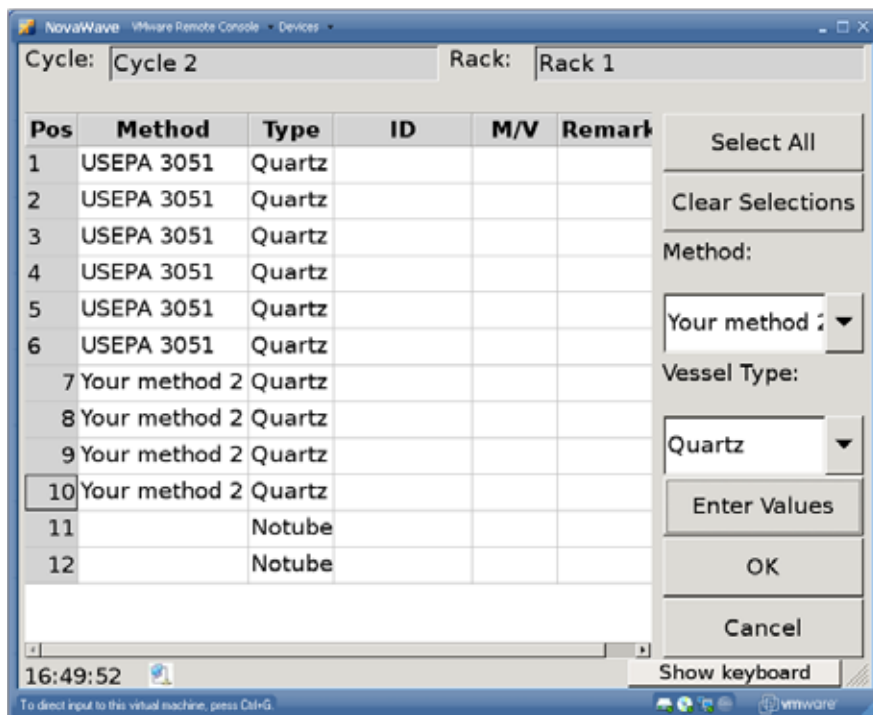
Select the **Vessel Type** from the pull down tab.

**Quartz** is for either 50 ml and 75 ml Quartz Vessels.

**Teflon** is for either 50 ml and 75 ml fluoropolimer vessel in quartz sleeves.

**Other** is released for future use.

**Notube** is for selecting empty vessel or no digestion to take place.



Press **Enter Values**.

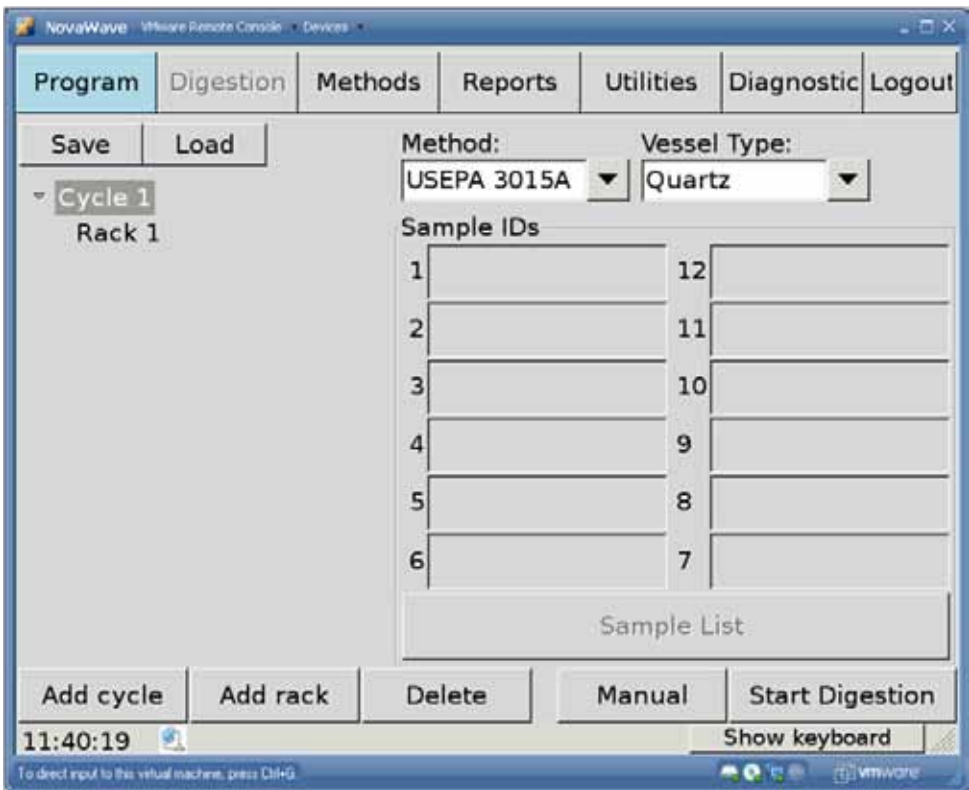
More information may be inputted from this screen. Sample ID, M/V mass or volume of sample. An extra column has been provided for remarks.

The **Sample List** page shows which **Method** and vessel **Type** has been selected for this particular cycle and rack. Input Sample **ID** as an alpha numeric value. The **M/V** mass or volume used may be inputted with units of measure.

Press **OK** to return to the **Program** tab.

## Entering Sample ID

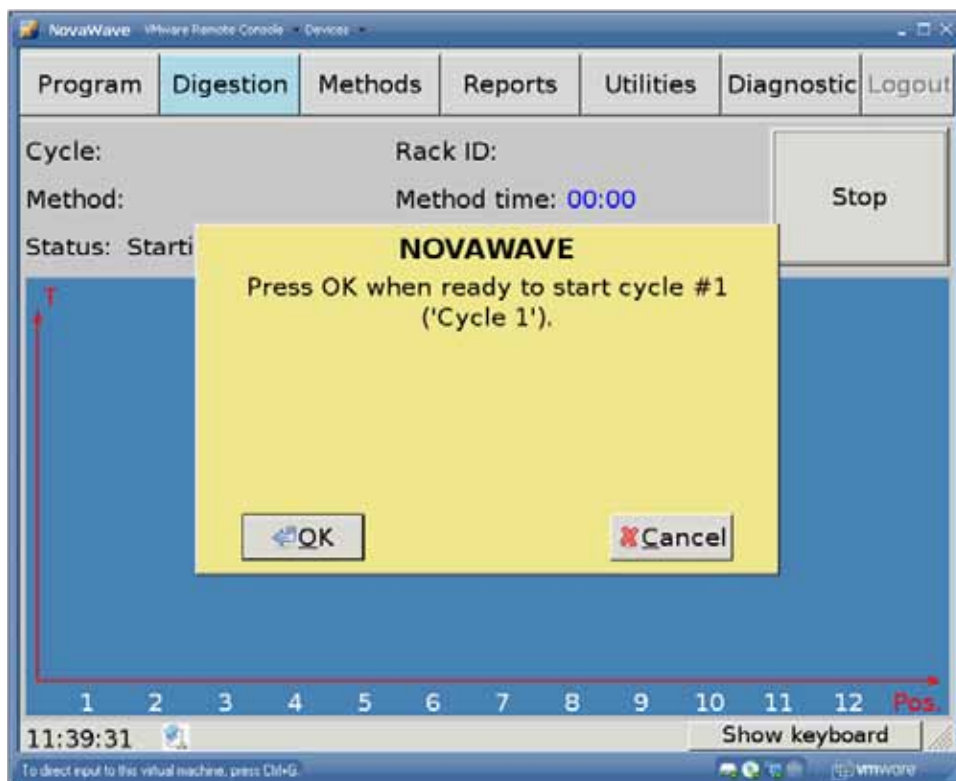
Individual sample IDs can be entered by assigning them individually from the Sample IDs tab by clicking the Sample List button, or may be entered using the remote bar code reader from this page by selecting Rack #. The barcode reader plugs into the USB connection at the front panel. The rack to be programmed must be selected first. The bar code reader will populate a sample ID position and then move to the next sample. The bar code reader will run through the sequence from the sample ID selected to the next numeric sample. To skip a spot, touch the position that the particular sample will reside for the digestion.



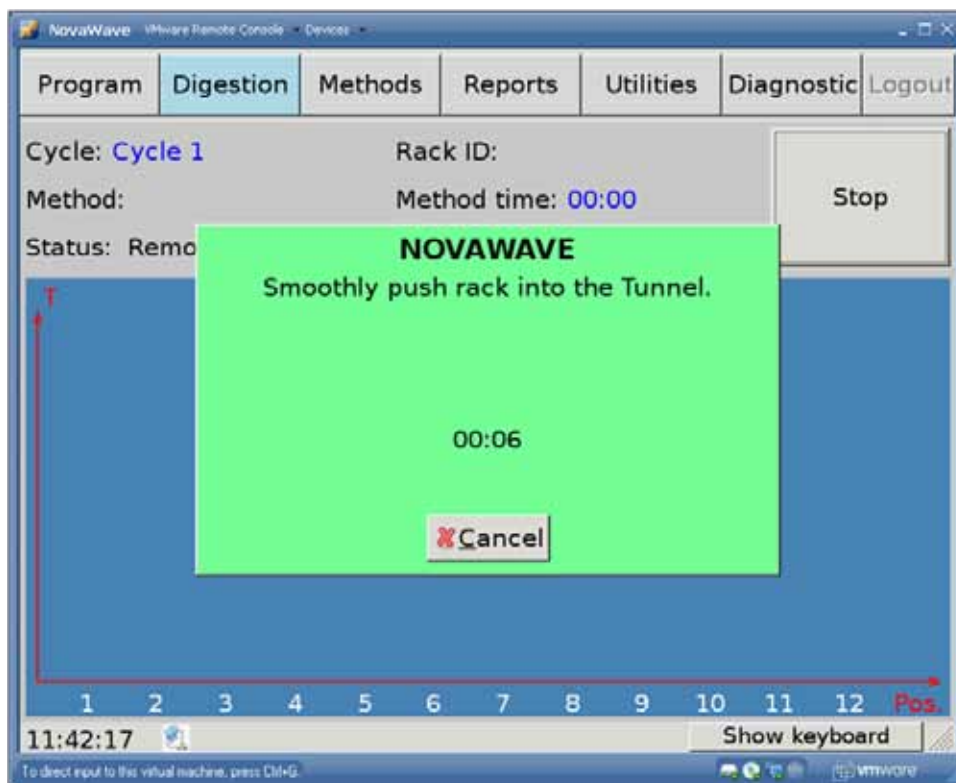
Other information may be entered in the Remarks column from the touch screen keyboard from the Sample List page.

Press Start Digestion button this will take the system to the digestion tab.

## Digestion

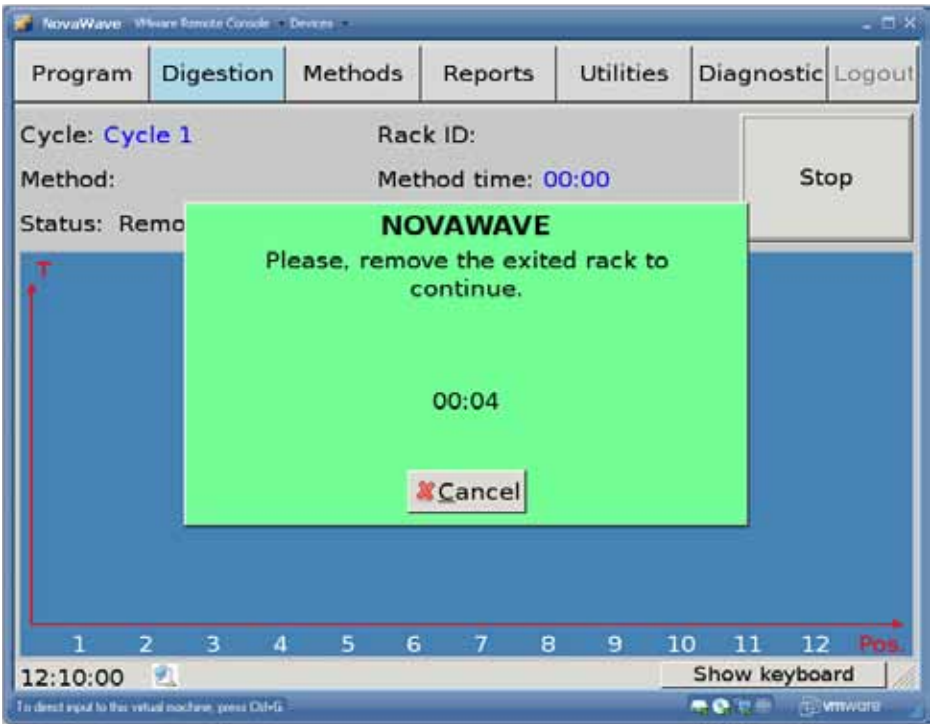


Press **OK** when ready, start the digestion.



Follow the prompts as they come up on the Touch Screen. Firmly push the rack into the tunnel until the rack engages with the 'In Gear' of the tunnel. **NOVAWAVE** will position the rack in the correct position, close the in and out doors. **NOVAWAVE** will close the applicators to complete the mini microwave cavities around each of the vessel positions of the rack. The software will run the program method for each of vessels in the rack.

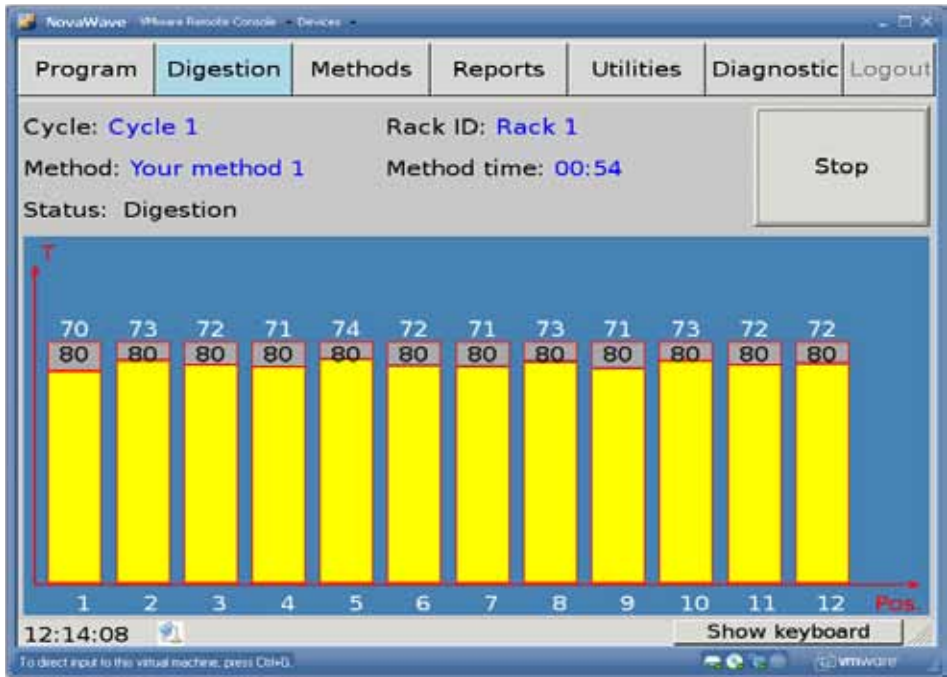




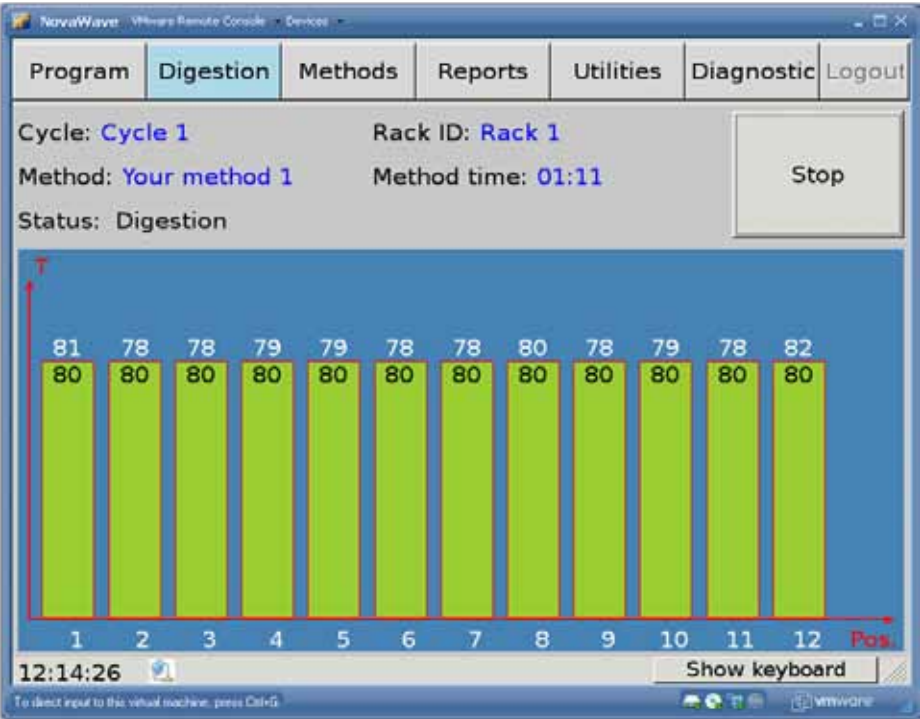
If a rack was in the tunnel prior to starting a digestion, the **NOVAWAVE** will move the current rack in the tunnel to the out position prior to allowing the next rack to be processed.

## Digestion Method Creation

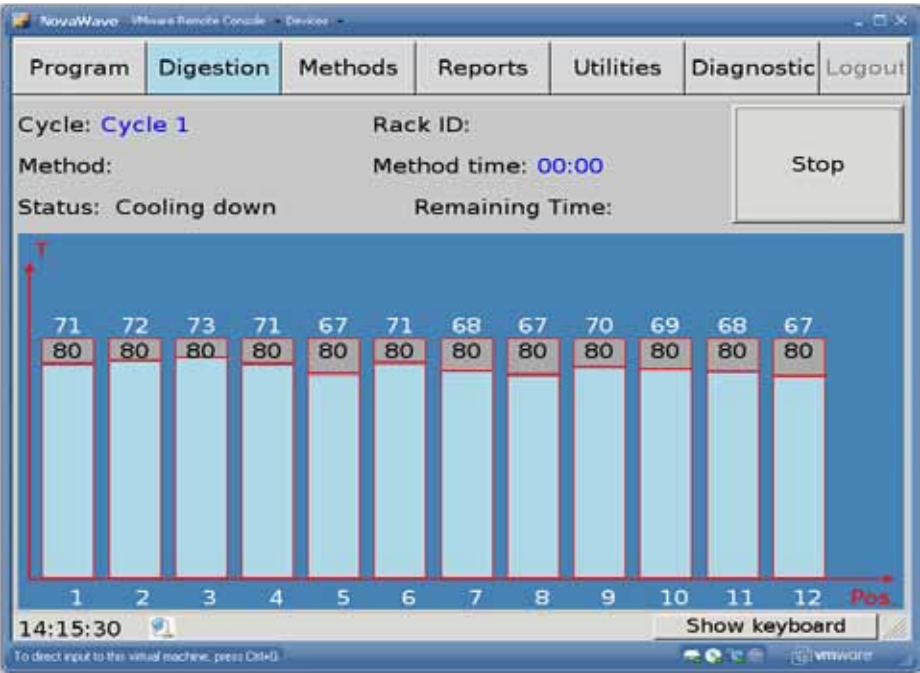
### “Methods”



At the start of digestion the system displays the sample temperature in white. The yellow bars represent the temperature when the sample is coming to temperature.



The green bars represent that the temperature has reached set point temperature and is in the 'Time at Temperature' state.



The blue bars represent that the system has completed the digestion method for the particular position. The system will display the temperature as the rack is cooling in the tunnel.

# Method Creation Methods

This tab allows for the design of the heating profile desired to digests samples.

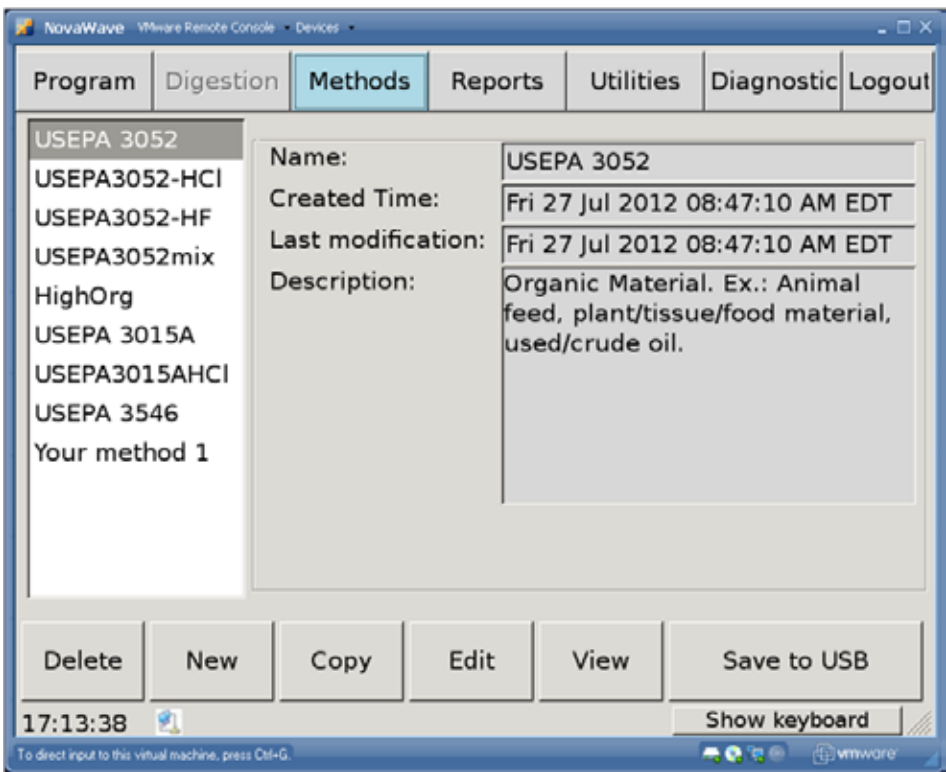
Select **New** to create new heating profiles.

**Edit** to make corrections to an existing method.

**Copy** to copy a factory programmed method or a previously user defined method.

**Delete** to permanently delete highlighted method.

**View** is for the operator to view the parameters of the method.



Methods Screen.



**Name:**  **Description:**

Reagents		
	Name	Vol(mL)
	<input type="text"/>	<input type="text"/>

**Method parameters**

	Time to Temp(min)	Temp(°C)	Time at Temp(min)
1	<input type="text"/>	<input type="text"/>	<input type="text"/>

**Cooling:**

☒ By time Tunnel

☐ By temperature Cooling

16:53:35

Buttons: Add, Delete, Edit, OK, Cancel, Save to USB, Show keyboard

Upon clicking **New**, the program new method screen will appear.

**Name:** Soil **Description:**

Reagents		
	Name	Vol(mL)
1	<input type="text"/>	<input type="text"/>

**Method parameters**

	Time to Temp(min)	Temp(°C)	Time at Temp(min)
1	<input type="text"/>	<input type="text"/>	<input type="text"/>

**Cooling:**

☒ By time Tunnel(mn) 1.00

☐ By temperature Cooling(mn) 0.00

11:53:44

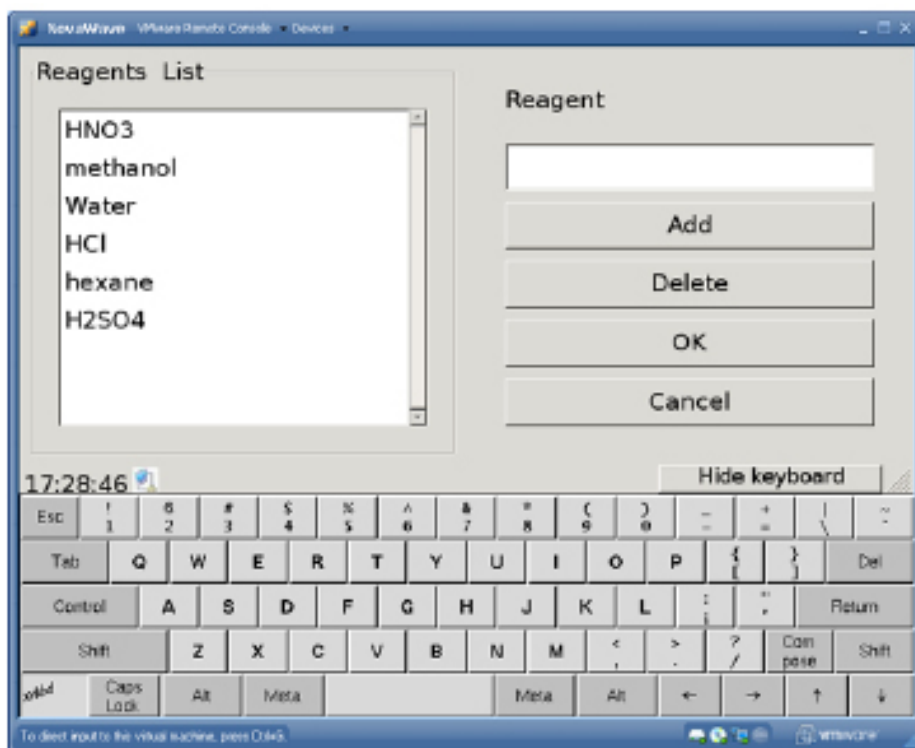
Buttons: Add, Delete, Edit, OK, Cancel, Save to USB, Show keyboard

To add reagents click the **Add** button, then click the pull down tab to select the reagent that will be added to the digestion. Input the volume.

To delete a line, highlight the line by clicking on the line number **(2)** to be deleted and click **Delete**.

**NOTE** The addition of the volume helps the system to predict 'Safety Messages' during digestions.

To add additional reagents that are not on the list click the **Edit** button. The following screen will appear.



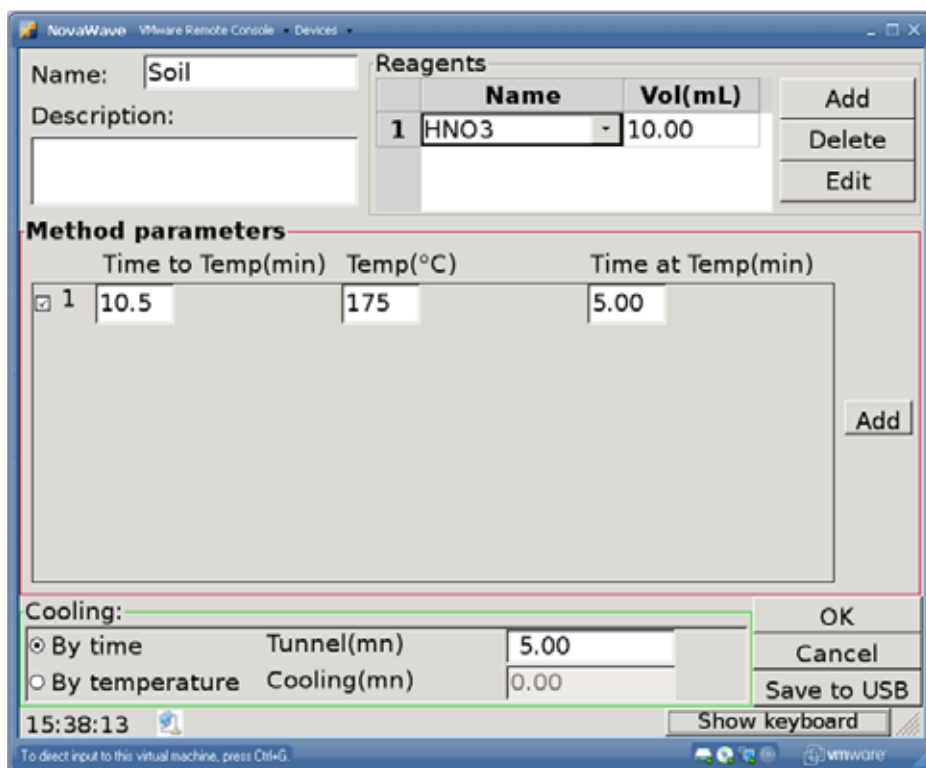
Reagents list - adds other names for reagents.

**Add** is used to populate the drop down list for reagent used.

**Delete** is used to remove the reagent from the drop down list. Highlight the line by highlighting the reagent name in the **Reagents** box prior to clicking delete.

**OK** will save any changes made and return to the previous page.

**Cancel** will disregard any changes made and return to the previous page.



Method Parameters.

Input the **Time to Temp(min)** in whole or half minutes. For example: 10.5 minutes.

Input the set point temperature in whole degrees. For example: 175°C.

Input the **Time at Temp(min)** in whole or half minutes. For example: 5.00 minutes.

Click **Add** to input extra steps in a heating profile.

To delete a heating program profile line, click the checked ☒.

The screenshot shows the NovaWave software interface. At the top, there's a 'Name' field with 'Your Method' and a 'Remarks' field. Below these is a 'Reagents' table with columns 'Name' and 'Vol(mL)'. The table contains one entry: '1 HNO3' with a volume of '10'. To the right of the table are 'Add', 'Delete', and 'Edit' buttons. Below the reagents is a 'Method parameters' section with fields for 'Time to Temp(min)' (5.5), 'Temp(°C)' (170), and 'Time at Temp(min)' (9.5-). There are 'Add' and 'Delete' buttons for this section. Below the method parameters is a 'Cooling' section with two radio buttons: 'By time' (selected) and 'By temperature'. There are also 'Tunnel' and 'Cooling' fields, both with the value '15'. 'OK' and 'Cancel' buttons are to the right. At the bottom, there's a virtual keyboard and a status bar showing the time '12:35:39' and a 'Hide keyboard' button.

With a **NOVAWAVE** SA unit the cooling of the rack may take place in the tunnel either **By time** or **By temperature**.

**Cooling** is to determine where the first stage of cooling takes place. If **By time** is selected, it will use the internal exhaust fan to cool for the time period entered. If **By temperature** is selected, the system will monitor and wait until all samples are cooled to this set temperature.

#### NOTE

The system cannot cool below ambient temperature.

If zero time is selected the racks will move to the out position after the last step in the heating profile is complete.

**OK** saves the changes made and returns to the previous page.

**Cancel** returns to the previous page without saving the changes made.

A **Name** for a method must be populated. **Remarks** are used for additional comments. These comments will be printed on the reports page.



10 ml of acid requires 5-6 minutes to reach 175°C; conversely 50 ml of acidified water requires approximately 10 minutes to reach 170°C.

In Summary methods are created by:

- Inputting a methods name.
- Reagents and volume used.
- Time required to go to temperature.
- Time at set point temperature.
- Temperature is input in 1 degree increments.
- Time is inputted in 0.5 minute increments.
- Select which type of cooling method is to be employed:
  - Tunnel is used for the **NOVAWAVE** SA - control by time or temperature or exit immediately after digestion.
  - Sample racks in **NOVAWAVE** FA may be controlled by time or by temperature.



The system cannot cool below ambient temperature. It is recommended to cool to 10 to 30 degrees Celsius above ambient temperature prior to taking the samples to the fume hood for venting.

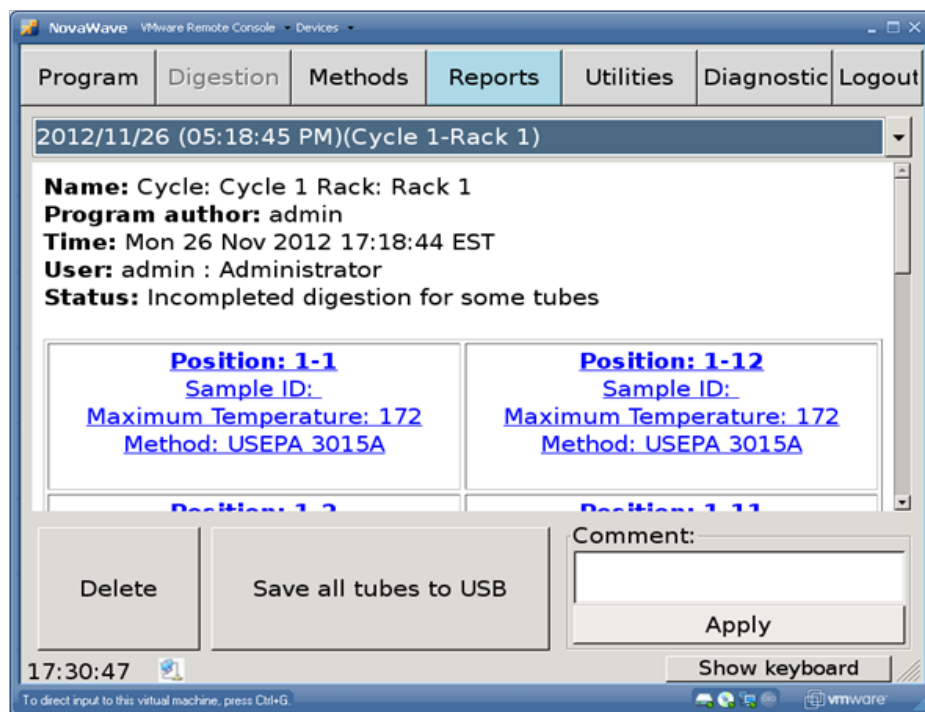


In **NOVAWAVE** FA, there must be a sample in rack position 4 to monitor the cooling of the sample when it is located in the vessel venting position.

Only when the preset temperature is reached will the FA system commence venting of the vessels. If venting of this particular rack has not been turned off.

## Reports

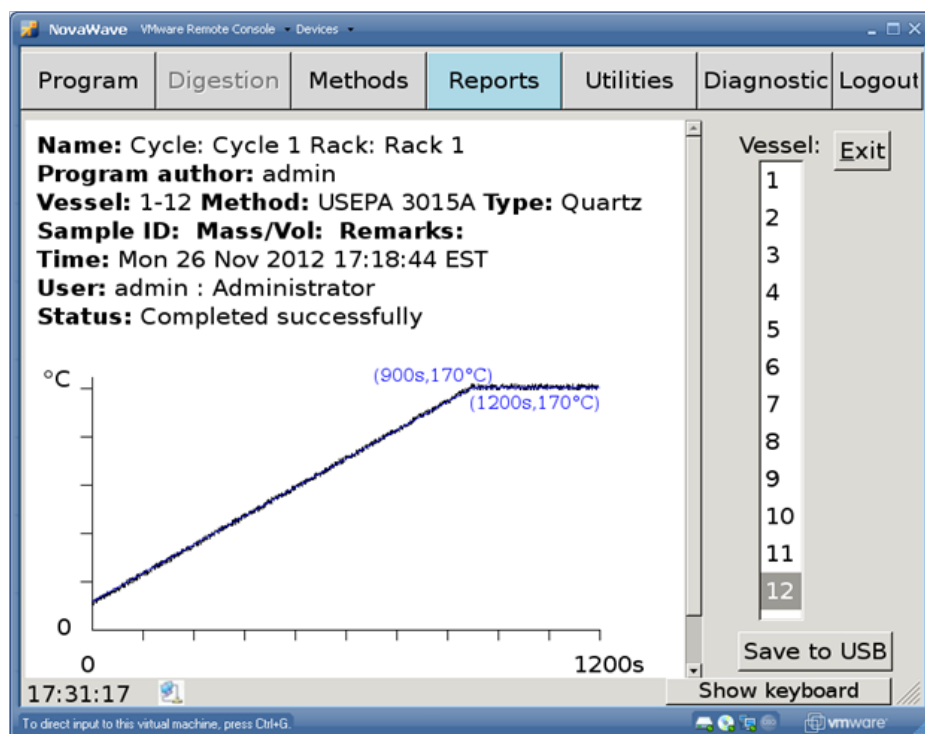
The individual temperature profiles for all of the positions for this particular run may be accessed from this tab.



**Delete** removes all of the information for the run shown.

**Comments** - allows the user to add comments to each rack.

**Save all tubes to USB** - is used to transfer all rack position data to a USB key for historical data (PDF format).



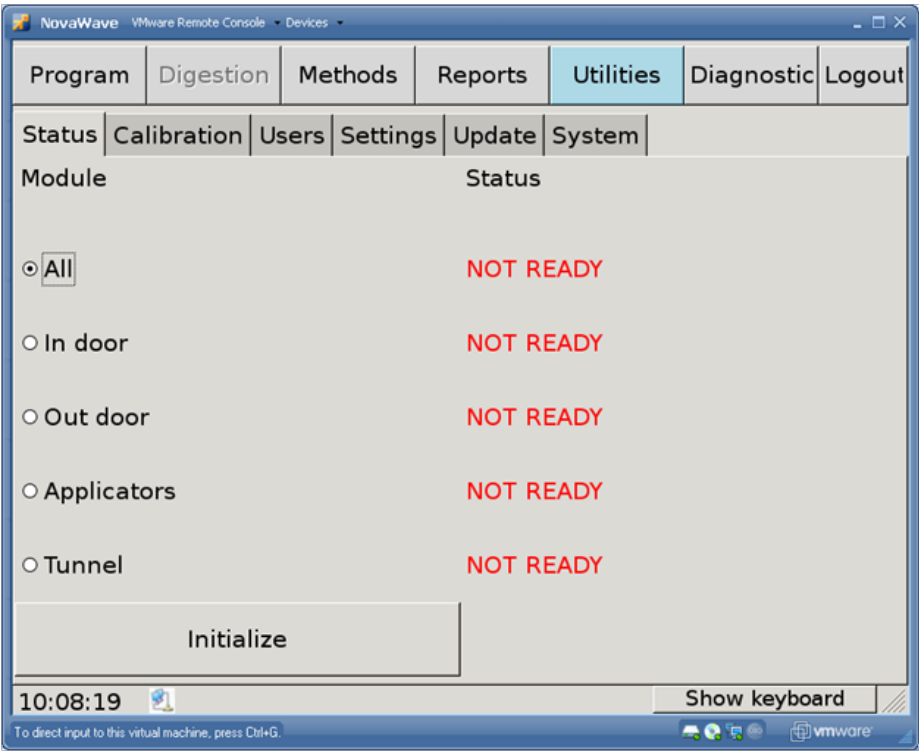
The graph represents the actual digestion temperature profile. (900s, 170°C) represents the time to temperature and the set point temperature.

The second set (1200s, 170°C) represents the total time requested for the digestion and the set point temperature.

Blue line represents the predicted curve.

Black line represents the actual temperature profile obtained.

Utilities



The **Status** tab is used to manually **Initialize** the system. The initialize command will verify the position of the doors, the applicators and whether or not a rack is in the tunnel.

**All** - initializes all of the components.

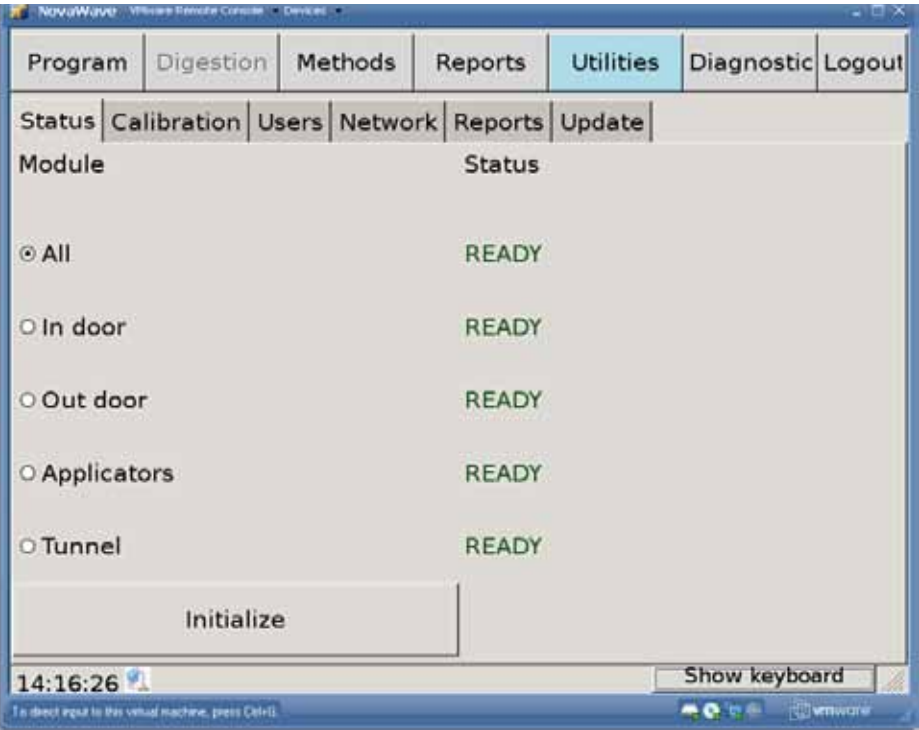
**In & Out door** - initializes the door position to the position.

**Applicators** - initializes the position is the open position.

**Tunnel** - verifies if there is a rack in the tunnel.

**NOTE**

The radial buttons when selected individually only initialize that component.



Once **Initialize** has been pressed, the **Status** tab shows all moveable components have been checked for home position.

## IR Calibration

	Tube1	Tube2	Tube3	Tube4	Tube5	Tube6	Tube7	Tube8	Tube9	Tube10	Tube11	Tube12
P1	23	23	23	23	23	23	23	23	23	23	23	23
P2	98	98	98	98	98	98	98	98	98	98	98	98
P3	131	131	131	131	131	131	131	131	131	131	131	131
P4	188	188	188	188	188	188	188	188	188	188	188	188
P5	234	234	234	234	234	234	234	234	234	234	234	234

**Read New Data** once the thermopile calibrating device is connected, press this button to calibrate the **NOVAWAVE**. **NOVAWAVE** is factory calibrated, and should be calibrated every 6 months during a preventive maintenance visit by a trained Service Engineer.

**Send to MicroB** once the data is verified, the information needs to be uploaded to the CPU.

**Save** is used to save the data to the graphical user interface (GUI).

**Save to USB** a log of the calibration data can be stored to a USB key.

The values select displayed in **P1** to **P5** are the target values of each IR sensor to. The calibration is a 5 point calibration. The values shown in the table are not representative of a true calibration as the table. Values should be random.

Please verify the following 3 steps:

- 1-Calibrator has been well placed inside the cavity.
- 2-The USB cable has been well connected to the GUI.
- 3-Its power supply has been well connected and switched on.

Click Yes, if it's all set.  
Click Cancel, to return to the main screen.

By pressing **Read New Data** the following prompt comes up.

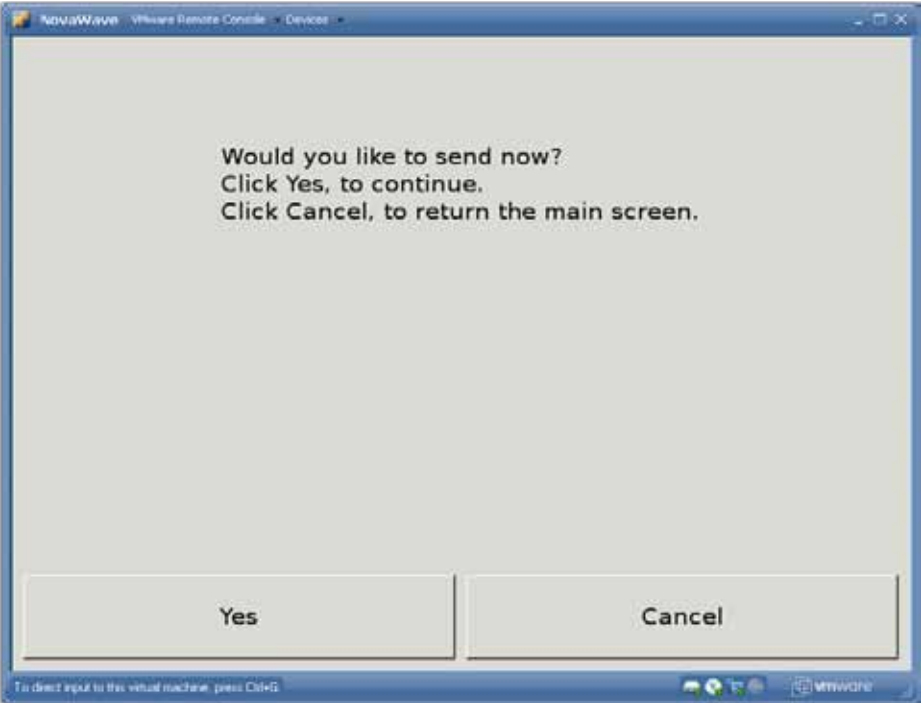




The system shows its progress in real time.



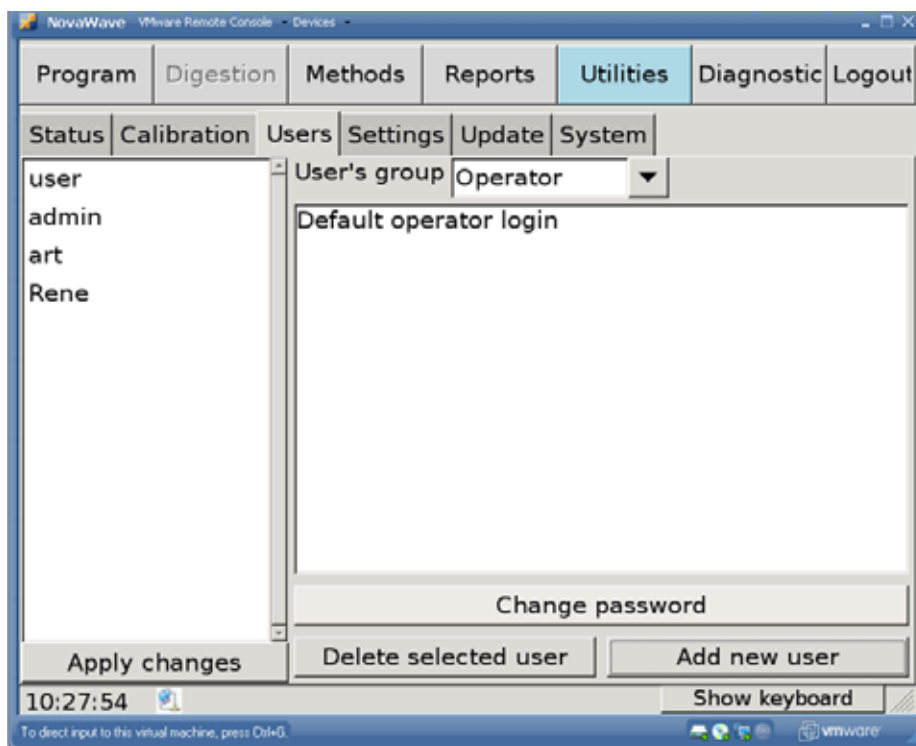
The system should only be calibrated in “quartz tubes. Teflon® calibration is done automatically by the system after the calibration is completed for quartz. The Calibration device uses a quartz covered thermal wire to create the IR energy at 5 different levels for calibration.



Prompt shown when sending data to the MicroB.



## Users

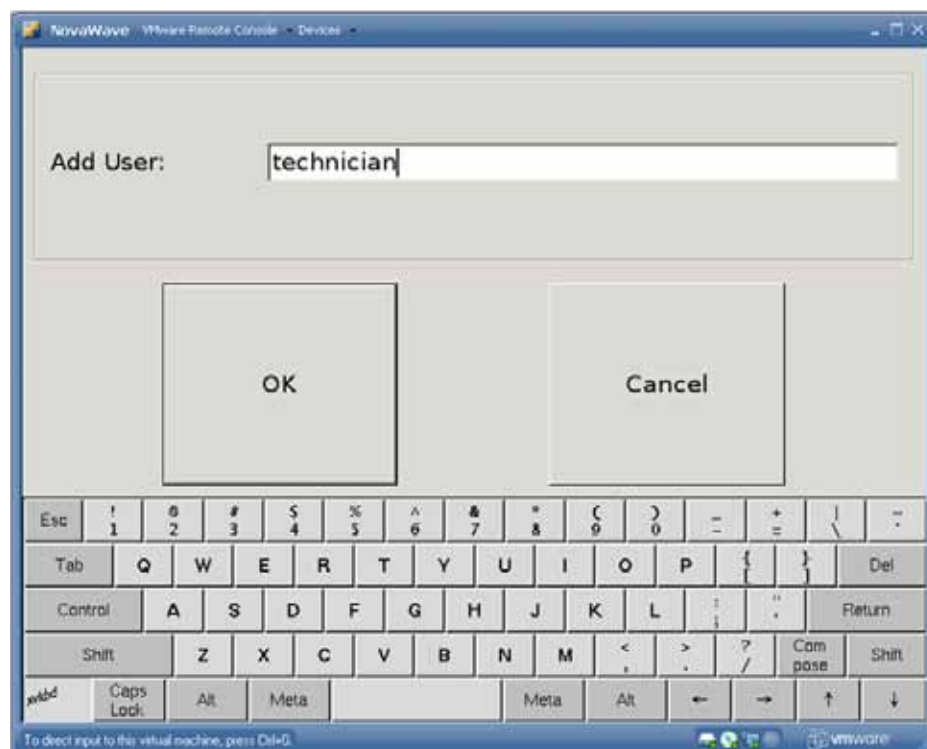


**Users** This window is used by Service to give or delete Administrator rights, or by Administrators to give or delete Operator rights and by Operators to change their password.

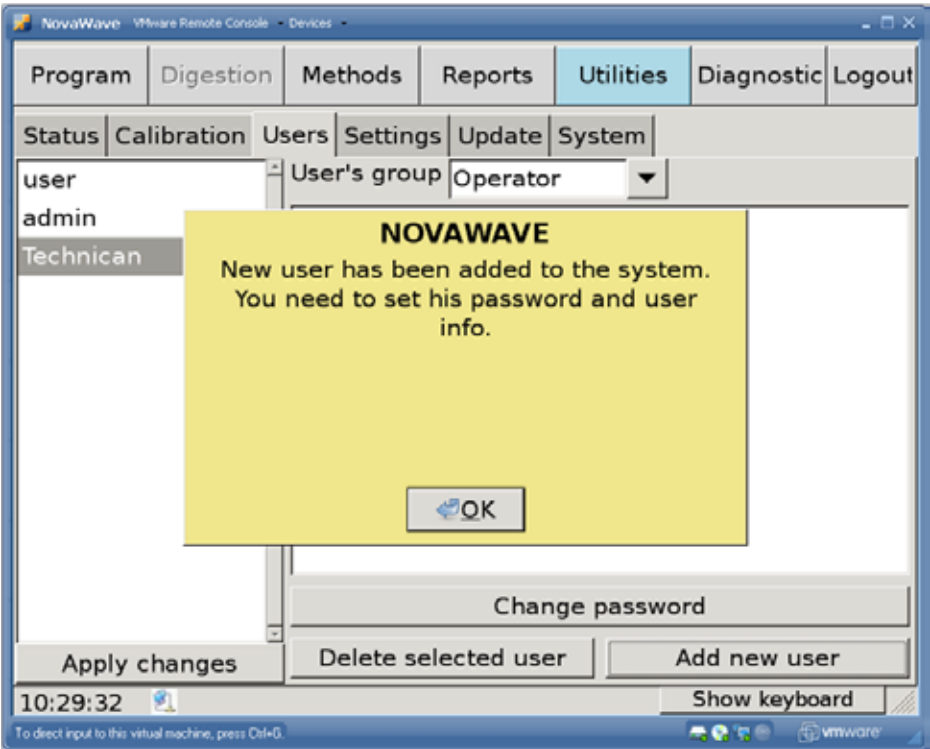
To add a new user, click **Add new user**, enter a name, click on the added name, click **Change Password**, enter your name and password.

To delete a user, click on the name to delete, click **Delete selected user**.

To change from user's group OPERATOR to ADMINISTRATOR, click the appropriate title in the **User's group** pull down tab, then click **Apply changes**. This selection is required to establish a password for new user.

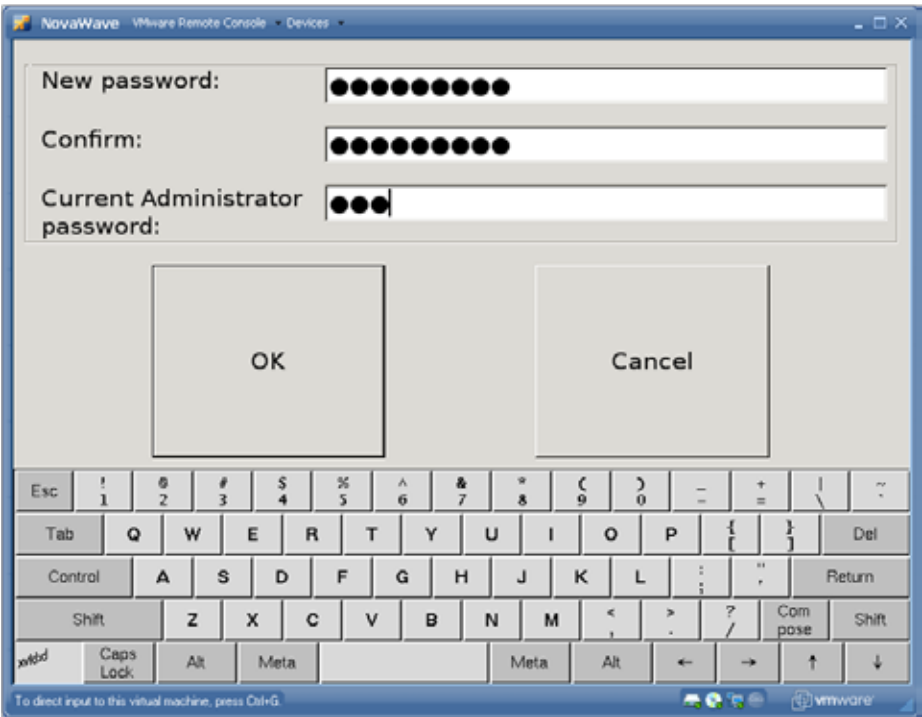


Input user name without spaces.



Click on **OK** then select **Change password**. The following screen will pop up. Fill in the data required, then press **OK**.

**Apply changes** is used to change from the 'operator' to 'administrator' User's Group.



Enter the password as required; it requires the **Current Administrator password** to accept the changes.

Press **OK** to continue.

## Settings

This page is used to set the date and time for the appropriate geographic location.

**Language** selects the language of your choice.

**Reports** sets the number of days to purge your reports.

**Network** is to configure the **NOVAWAVE's** IP address.

**Refresh** is to return to the previous values prior to pressing **Apply**.

**Apply** is to save the current changes made.

**Delete All Now** is used to completely clean out the reports file.

**CAUTION** The system will automatically purge the reports once the instrument is powered up. Select the instrument's length of time for deleting reports. If the file is full, it will write over the oldest record in the registry.

## Updating the Software

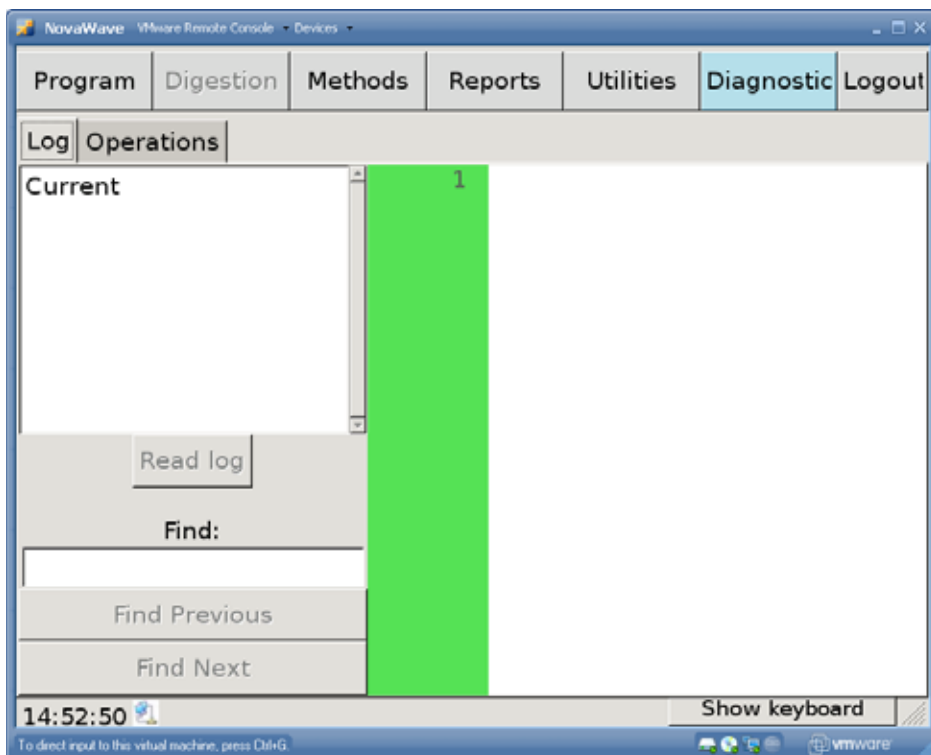
**Update from server** is important - not implemented at this time. Customer updates can be uploaded from a USB. The system will automatically search for the folder on the USB.

## System



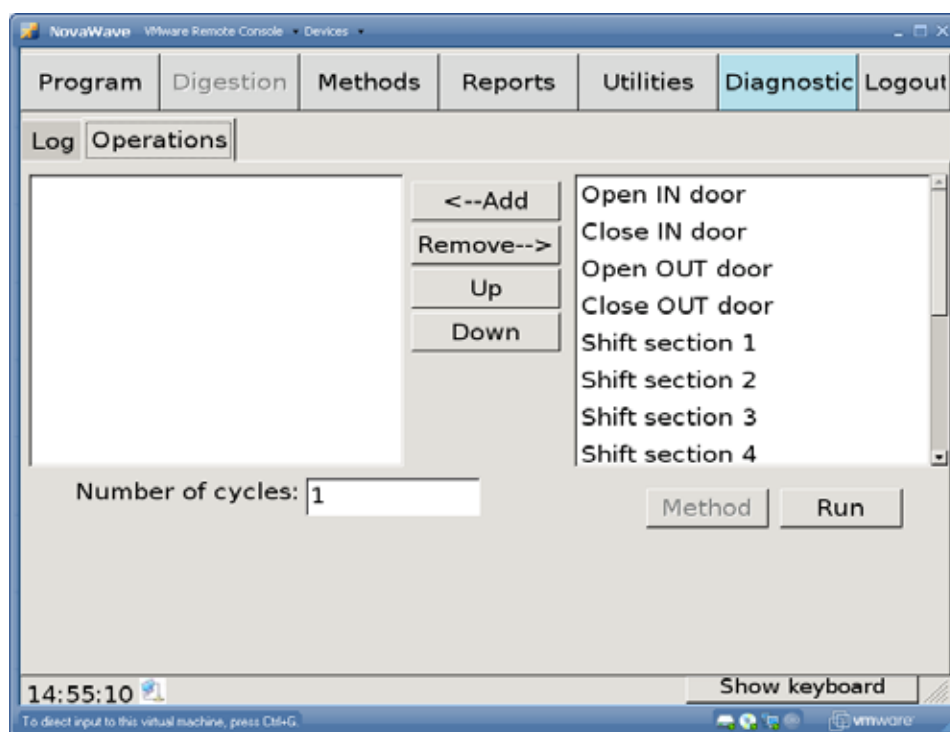
Used to change FA to SA **Mode**. The **NOVAWAVE** recognizes the current configuration FA or SA. The system displays information based upon the model displayed in the **Mode**.

## Diagnostic



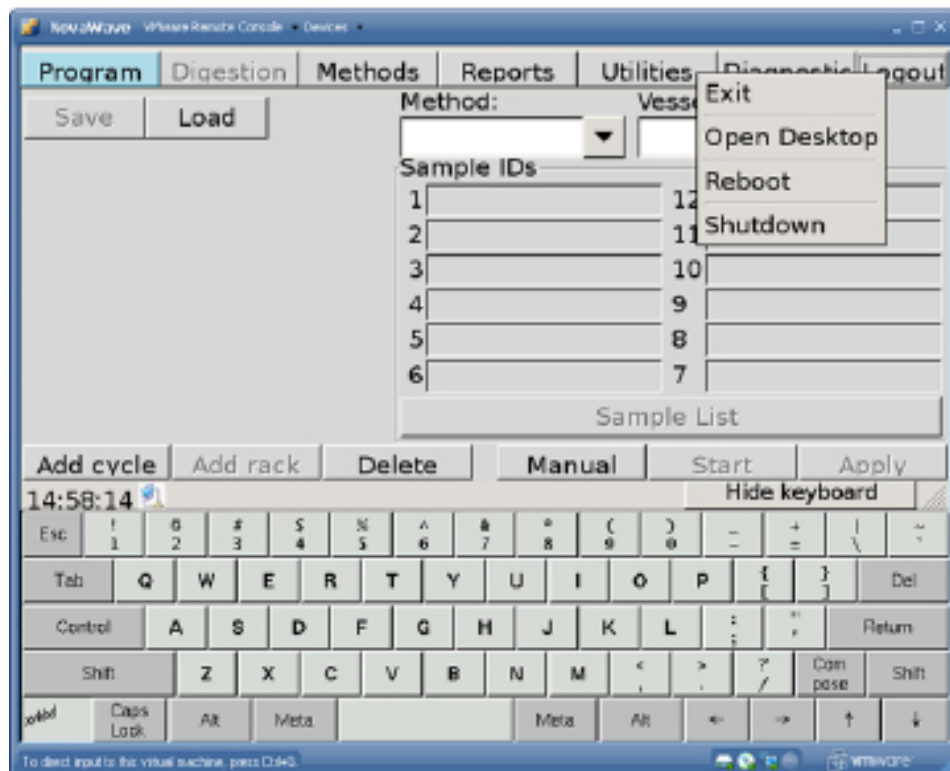
The **Log** tab allows the service engineer to review the collected data for trouble shooting purposes.

The **Operations** tab is used to test individual components as required by a service engineer.



The **Operations** tab allows for **NOVAWAVE** SA and FA components to be tested.

## Logout



**Exit** is used to return to the main screen, i.e. to change users level.

**Open Desktop** is used for calibration at the touch Screen of **NOVAWAVE**.

**Reboot** To reboot the system when software changes are completed or to re-initialize the system after power failure.

**Shutdown** is used to power down the Graphical User Interface prior to powering off the system. When 'system halted' is displayed it is fine to turn off the main power switch.

# 6

## Cleaning / Maintenance of System

### Cleaning of Vessels

The quartz and Fluoropolymer vessels may be washed in a lab dishwasher or soaked overnight in dilute  $\text{HNO}_3$ . The quartz outer support of the Fluoropolymer vessels may be washed in the dishwasher or soaked in acid. All vessels should be dry prior to its use in the microwave. quartz vessels that show cracks or chips must not be used.

### Cleaning of Fluoropolymer Liners, Caps and Safety Pressure Caps

Fluoropolymer caps should be replaced when they show signs of wear. To determine if the Fluoropolymer cap is overused: Place the Fluoropolymer cap on the quartz tube and if the bottom portion of the top ring of the cap touches the tube, the cap should be replaced.

### Pressure

Safety Caps have been calibrated to appropriate settings in the factory. Calibration settings of the caps should only be adjusted by an authorized **SCP SCIENCE** technician. It is highly recommended that Safety Caps be tested and re-calibrated if necessary every 6 months.

### Cleaning the Tunnel

Under normal operating conditions, if a tube vents during the digestion, the fumes are typically whisked away by the exhaust blower. If the rack is wet when it is removed from the tunnel, then the floor of the tunnel should be checked and wiped dry with a dry paper towel while wearing the appropriate safety gloves and safety glasses. If the floor of the tunnel becomes soiled, it may be wiped out with a damp cloth.

If a vessel has accidentally ruptured in the tunnel, carefully remove the broken quartz parts by hand. The liquid may be cleaned up with a paper towel, then damp wipe the inside of the tunnel. The tunnel has been coated with Fluoropolymer and the IR sensors are protected by a plastic plug. If plugs have been compromised, they should be changed immediately.

Wear appropriate equipment if the tube is vented or cracked while using HF acid.

### Cleaning the GUI

Wipe with a clean damp cloth to remove fingerprints and dust monthly.

### Cleaning the Rack

Clean the bottom of the rack if it becomes wet due to a tube breaking or accidentally sat in a liquid.



The system has not been tested with perchloric acid. It is not recommended to use perchloric acid.

# 7

## Warranty & Safety Information

**SCP SCIENCE** warrants this product free from defects in workmanship and materials for one (1) year from date of purchase.

1. Should the unit malfunction, please contact **SCP SCIENCE**'s Service Department or your local distributor for further instructions.
2. There are no user-serviceable parts in this unit. The warranty is void if the instrument shows evidence of tampering or is subjected to excessive moisture, heat, corrosion or other misuse.
3. **SCP SCIENCE** shall not be responsible for any damage or losses, however caused, which may be experienced as a result of the improper installation or misuse of this product.
4. Products are supplied for laboratory use only and should not be used for any household, medical or therapeutic application. **SCP SCIENCE** presumes that only trained and qualified individuals, familiar with procedures suitable for the safe operation of these instruments, will handle them. Our customers are solely responsible for the safe operation, handling and use of these products.

A minimum of safety considerations must be followed when working with **NOVAWAVE** microwave digestion system in order to maintain good laboratory practice:

- Do not place the **NOVAWAVE** on a surface containing flammable material.
- **NOVAWAVE** requires a clearance of 3 inches (7.5 cm) on all sides.
- **NOVAWAVE** should be vented into a fume hood with the exhaust hose provided.
- **NOVAWAVE** system must be plugged into a three-prong grounded outlet (receptacle provided).
- Always wear safety glasses when handling samples.
- Never use quartz vessels if they appear cracked or damaged.
- Never tamper with the calibration settings of the safety caps. These have been pre-calibrated to appropriate settings in the factory.
- Use 2 or 3 people to lift the system.

## Safety Messages

Safety messages may occur during system operation due to a variety of conditions as included below. For further assistance, consult your lab manager or **SCP SCIENCE** Service Department or your local distributor.

### List of Safety Messages:

1. Tube Number # did not reach target temperature
  - a. Safety pressure cap not sealed correctly
  - b. Sample tube vented
  - c. Time to temperature plus time at temperature has been exceeded without reaching set point temperature  
Solution: increase time to temperature
2. Temperature is rising too slowly in the tube number #
  - a. Sample vented
  - b. Pressure cap not sealed properly
  - c. Applicators not closed properly
  - d. Magnetron error
  - e. Thermopile error
3. Microwave cable number # overheats
  - a. Tube has boiled dry
  - b. Insufficient acid in vessel
  - c. Applicator failure
4. Temperature in tube number # is rising too quickly
  - a. Exothermic reaction
5. Alarm from High Voltage PCB number #
  - a. PCB over heating
  - b. Fans stopped running
  - c. Air vents plugged
  - d. Cooling fans not running



### CAUTION

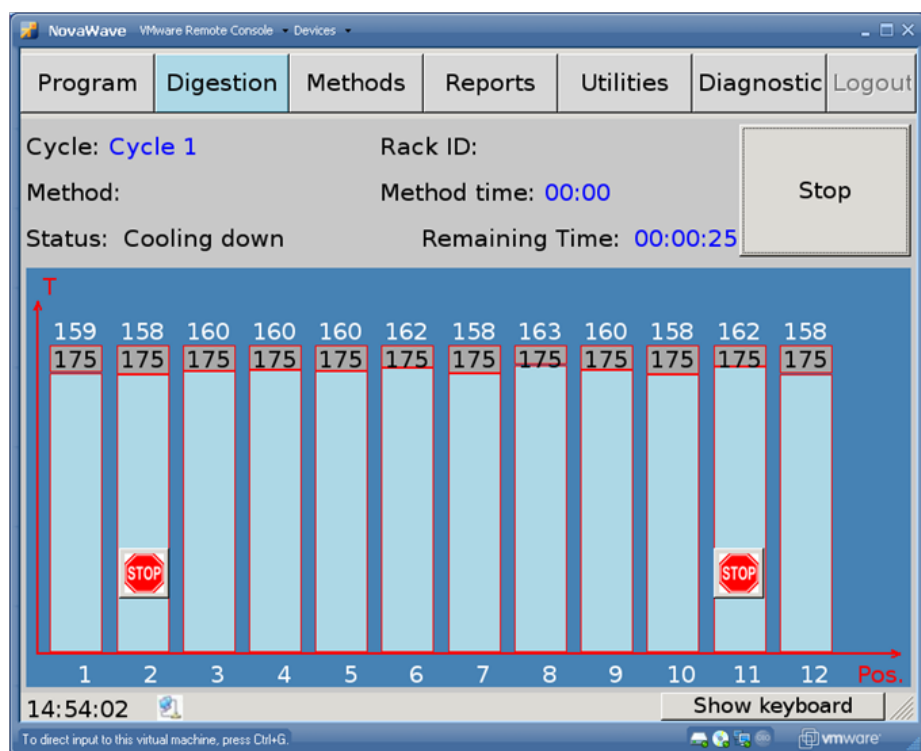
If the reason for the safety message is unclear contact **SCP SCIENCE** Service Department or your local distributor.

## SAFETY MESSAGES FROM THE POWER MANAGEMENT BOARD

1. Power Management has reset
2. Thermal Switch has failed
3. 24V supply has failed
4. Keep Alive signal from FPGA has been lost
5. 5V supply has failed
6. MicroBlaze is updating
7. GUI is shutting down

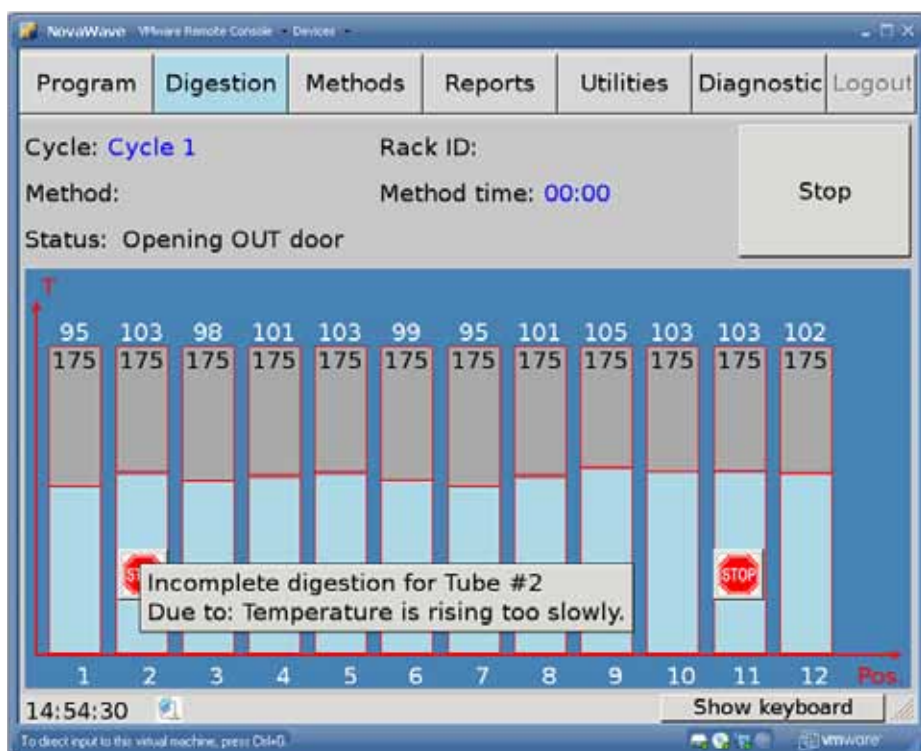
If any of the safety messages are displayed in RED on the touch screen, please call your local distributor or contact **SCP SCIENCE's** Service Department. Contact information is located at the back of this manual.





An Example of a Safety Message:

Safety messages displayed during a digestion.



By pressing the **Stop** sign, the message will be displayed. It will disappear in a few seconds. This channel has been shut down, but the rest of the channels will continue their digestions.

By touching the message, it will disappear.

# 8 Specifications

## Environmental

Relative Humidity	30% to 80%
Altitude	up to 2000 m
Installation	Category II
Pollution	Degree 2
Ambient Operating Temperature	-5°C to 40°C

## Safety

### EMC Tested and Approved

- o EMC Emissions and Immunity Tested covering: ICES-001, CISPR11, EN55011 and EN61326-1

### Product Safety \*

- o Certified UL 61010-1
- o Certified CSA 61010-1 NRTL/C

### Radiation Hazard

- o Power Density Tested according to 21 CFR Par 1030.10 C) 1,2,3 and IEC 61010-1 Clause 12.4
- o 21 CFR1030 report filed for FDA

## Electrical

Model Number	<b>NOVAWAVE</b>
Voltage	230 volts
Current	25 Amps
Watts	3600
Volt Amps	4600
Frequency	50/60 Hz

Position	Rating	Description
1	3A 250V	3AG SLOW-BLOW
2	4A 250V	3AG SLOW-BLOW
3	4A 250V	3AG SLOW-BLOW
4	4A 250V	3AG SLOW-BLOW
5	4A 250V	3AG SLOW-BLOW
6	3A 250V	3AG SLOW-BLOW
7	4A 250V	3AG SLOW-BLOW
8	3A 250V	3AG SLOW-BLOW
9	4A 250V	3AG SLOW-BLOW
10	4A 250V	3AG SLOW-BLOW

\* Fuses must be replaced with the same type and rating.

\*\* Fuses are located behind the back panel on the Novawave.

\* All safety critical components used in the **NOVAWAVE** are CSA certified and UL Recognized. All polymeric materials used in the **NOVAWAVE** are UL Recognized and have the appropriate flammability rating. Vessels are tested to three times pressure venting maximum.

	<b>Toxic or hazardous substances and elements</b>				
Part name	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr6+)	Polybrominated Diphenyl Ether (PBDE)
Skins	○	○	○	○	○
Frame	○	○	○	○	○
Electronic boards	○	○	○	○	○
Feet	○	○	○	○	○
Wiring Harness	○	○	○	○	○
Motors	○	○	○	○	○
Gear Boxes	○	○	○	○	○
Fasteners	○	○	○	○	○
HV boards	○	○	○	○	○
Magnetrons	○	○	○	○	○
Applicators	○	○	○	○	○
Co-axial cable	○	○	○	○	○
Touch Screen	○	○	○	○	○
Ribbon Cables	○	○	○	○	○
Housings	○	○	○	○	○

O: Indicates that the toxic or hazardous substance contained in all the homogenous materials for this part, according to EIP-A, EIP-B, EIP-C, is below the limit requirement in SJ/T11363-2006.

X: Indicates that the toxic or hazardous substance contained in all the homogenous materials for this part, according to EIP-A, EIP-B, EIP-C, is above the limit requirement in SJ/T11363-2006.

# 9 Troubleshooting

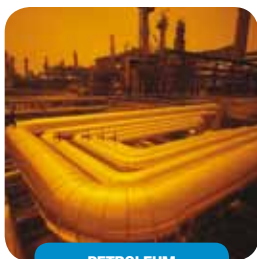
Messages may occur during system operation due to operator error or component failure. For further assistance, contact **SCP SCIENCE** Service Department or your local distributor.

## List of Error Messages:

No.	Error Message	Description
1	COM.ERROR	Unrecognized packet.
2	ERROR! ID=Stalled DESC= Section 1 (2,3,4) is stalled. FA	Rack is stalled at B-F section.
3	ERROR!!! ID= Timed Out. DESC= Section Operation has timed out. FA	Operation B-F timed out. (R-L, F-B or L-R).
4	ERROR COM Timed out! FA	No response from MB.
5	ERROR No OK received from MB. FA	OK not received from MB.
6	Process terminated with exit code #. Press OK to restart.	GUI crashed code number #. Press OK to resume.
7	DIGESTION.RUN TUBE 01 E_CODE=02	Never reached target temperature.
8	DIGESTION.RUN TUBE 01 E_CODE=03	Temperature rising too slowly in tube number #.
9	DIGESTION.RUN TUBE 01 E_CODE=04	Tube number # overheats.
10	MB_SYNTH	System initialize.
11	ERROR Digestion Operation has timed out!	Digestion operation has timed out on tube number #.
12	ERROR DIGESTION_ALARM_ERROR Magnetron is alarmed.	Magnetron number # has an alarm.
13	DIGESTION_OVERHEAT_ERROR Magnetron overheated	Magnetron number # overheats.
14	ACTUATOR_STALLED_ERROR	Actuator is stalled.
15	ACTUATOR_OPERATION_TIMEDOUT_ERROR	Actuator operation has timed out.
16	CAVITY_STALLED_ERROR	Tunnel motor is stalled.
17	CAVITY_UNKNOWN_RACK	Please remove unknown rack from tunnel.
18	CAVITY_OPERATION_TIMEDOUT_ERROR	Tunnel operation has timed out.
19	CAVITY_OBSTRUCTED_ERROR	Tunnel is obstructed.
20	CAVITY_NOT_INITIALIZED_ERROR	Tunnel motors need initialization.
21	CAVITY_NOT_NOW_ERROR	This command cannot be performed.
22	CAVITY_ORIENTATION_FAILED_ERROR	Unknown rack orientation.
23	CAVITY_INTERNAL_ERROR	An error occurred in tunnel.
24	RACK ID FAILED	
25	RACK IN REVERSE POSITION	
26	PMB	Thermal switch has failed.

## NOTES

[illegible]



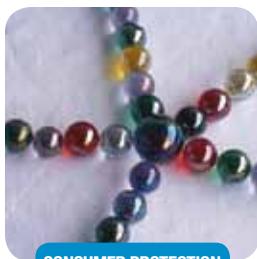
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