CEM

MARS 6

Microwave Reaction System

Operation Manual

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Manufactured in the
United States of America

600284
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WARNING

All CEM microwave digestion instruments are to be operated using CEM designed vessels and vessel components. All CEM supplied vessels and components are manufactured to exact specifications in order to provide a product that is reliable and safe to work in conditions that include high temperatures and pressures. The use of vessels and vessel components other than original CEM parts will put operators and equipment at risk. CEM will not assume any liability for use of these parts and all warranties, either written or implied, will immediately become void. CEM vessels can only be purchased direct from CEM or through its authorized dealer network. CEM vessels are covered by worldwide patents including US patents 8,480,981 and 6,136,276.

Table of Contents

Operating Precautions

The MARS 6 must be grounded. In the event of an electrical short circuit, grounding reduces the risk of electric shock by providing an escape wire for electric current. This instrument is equipped with a cord having a grounding wire with a grounding plug. The plug must be plugged into an outlet that is properly installed and grounded. Consult a qualified electrician or service technician if the grounding instructions are not completely understood or if doubt exists as to whether the instrument is properly grounded. If it is necessary to use an extension cord, use only a 3-wire extension cord that has a 3-blade grounding plug and a 3-slot receptacle that will accept the plug from the instrument. The marked rating of the extension cord must be equal to or greater than the electrical rating of the instrument.

The possibility of instrument-induced electromagnetic interference (EMI) is minimal if the instrument is operated as outlined in this manual. The instrument should not be placed close to any electrical device susceptible to EMI. It is suggested by the manufacturer that the user post a sign warning pacemaker wearers that a microwave device is in operation. If the instrument is suspected of inducing EMI, a microwave leakage measurement should be performed as outlined in this manual. Leakage measured above the legal limit of 5 mW/cm^2 should be reported to the CEM Service Department.

Cardiac pacemakers require magnets to control their operation during checkout. If the instrument is equipped with an optional magnetic sample stirrer which contains very high static magnetic fields, some danger exists if a pacemaker is positioned in close proximity of the instrument cavity (such as placing the head into the instrument cavity to perform a visual inspection). If the instrument is suspected of interfering with the operation of a pacemaker, the instrument should be turned off or the pacemaker wearer should move away from the instrument.

This instrument utilizes high voltages and microwave radiation. Instrument service and repair should be performed only by those trained in repair and maintenance of high voltage and microwave power systems.

Warnings, cautions and notes are included throughout this manual and should be read thoroughly and strictly follows.

WARNING: A warning is inserted for essential information used to emphasize dangerous or hazardous conditions to the operation, cleaning and maintenance of the instrument which may result in personal injury.

CAUTION: A caution is inserted for essential information used to emphasize procedures which, if not strictly followed, may result in damage or destruction to the instrument or improper instrument operation.

NOTE: A note is inserted for emphasis of procedures or conditions which may otherwise be misinterpreted or overlooked and to clarify possible confusing situations.

WARNING

If the MARS 6 is used in a manner not specified by CEM Corporation in this manual, the protection provided by the instrument may be impaired.

This instrument complies with United States Code of Federal Regulations 21CFR Part 1030.10 (C) for microwave leakage. A verification report is on file. This instrument complies with FCC Requirements in the United States Code of Federal Regulations (47CFR Part 18) - Industrial, Scientific and Medical (ISM) Equipment - emissions requirements. A verification report is on file.

The name “Teflon” is used throughout this manual. Teflon® is a registered trademark of the E.I. DuPont Company.

This product has been tested to the requirements of CAN/CSA-C22.2 No. 61010-1, second edition, including Amendment 1, or a later version of the same standard incorporating the same level of testing requirements.

Introduction

The Microwave Accelerated Reaction System, Model MARS 6®, is designed for laboratory use in digesting, dissolving, hydrolyzing, extracting or drying a wide range of materials. Its primary purpose is the rapid preparation of samples for analysis by atomic absorption (AA) and inductively coupled plasma (ICP) emission spectroscopy and gas or liquid chromatography.

The MARS 6 System brings a remarkable intelligence and ease of use to microwave sample preparation. The One Touch Technology is like having a chemist built into the system. It combines more than 30 years of microwave chemistry experience with today's most advanced software and hardware technologies to give laboratories the most accurate, easiest-to-use microwave sample preparation system ever designed.

The MARS 6 consists of

- a microwave power system with operator selectable output of 0 - 1800 watts ±15%, by IEC Method 705-1988
- a fluoropolymer-coated microwave cavity,
- a cavity exhaust fan and tubing to vent fumes,
- a digital computer programmable for unlimited programs consisting of up to five stages each,
- an alternating or continuous mode turntable system,
- 3 door safety interlocks and an interlock monitoring system to prevent microwave emission when the door is open.

The MARS 6 uses microwave energy to heat samples. Compounds such as water and other polar liquids absorb microwave energy rapidly. A sample placed inside a microwave transparent vessel with a polar liquid or ionic solution (usually an acid) in the MARS 6 is subjected to rapid heating and elevated pressures, causing the sample to digest or dissolve in a short time.

At full power, the MARS 6 delivers approximately 1800 watts of microwave energy at a frequency of 2450 MHz. A microcomputer controls and monitors operations.

WARNING

All CEM microwave digestion instruments are to be operated using CEM designed vessels and vessel components. All CEM supplied vessels and components are manufactured to exact specifications in order to provide a product that is reliable and safe to work in conditions that include high temperatures and pressures. The use of vessels and vessel components other than original CEM parts will put operators and equipment at risk. CEM will not assume any liability for use of these parts and all warranties, either written or implied, will immediately become void. CEM vessels can only be purchased direct from CEM or through its authorized dealer network. CEM vessels are covered by worldwide patents including US patents 8,480,981 and 6,136,276.

General Safety

Microwave sample preparation imposes a unique set of safety considerations beyond the basics of good laboratory practice. General guidelines for safe operation of laboratory microwave systems are presented below.

All vessel components must be dry and free of particulate matter. Drops of liquid or particles will absorb microwave energy, causing localized heating which may char and damage vessel components, leading to possible vessel failure.

Never heat liquids in a sealed vessel or container that is not equipped with a pressure relief device.

CEM does not recommend use of Parr Microwave Acid Digestion Bombs inside MARS 6 systems. Such usage constitutes unreasonable operating conditions because Parr bombs cannot be connected to the pressure and temperature control mechanisms of the MARS 6 and all software safeguards and safety relief devices are bypassed. CEM will not be responsible for damage to the MARS 6 Microwave Digestion System or personal injuries resulting from use of Parr microwave acid digestion bombs.

Never attempt to digest samples larger than 0.5 grams if the organic content and composition of the sample is unknown. Unknown samples should be predigested for a minimum of 15 minutes in an unsealed vessel without any heating prior to attempting a closed vessel digestion.

Minimum volume for the MARS 6 cavity is 10mL of acid or 50mL of water.

Microwave heating of alkaline or salt solutions in open or closed vessels will concentrate these solutions, causing precipitation of salts and formation of crystal deposits on vessel walls. These crystal deposits will absorb microwave energy, causing localized heating which may char and damage vessel components, leading to possible failure.

Never install a MARS 6 inside a laboratory fume hood. Acid and chemical fumes may attack the electrical components, resulting in possible damage and malfunctioning of the cavity door safety interlocks. The proper method for installation of the system and connection to a laboratory fume hood are described in this manual.

This instrument utilizes high voltages and microwave radiation in its operation. Instrument service and repair should be undertaken only by technicians trained in repair and maintenance of high voltage and microwave power systems.

Daily, remove the ESP-1500 Plus cable connection from the bulkhead connection and thoroughly clean the connector with a paper towel or soft cloth. Wipe and clean both the inside and outside surfaces of the connector. If necessary, dampen the towel with isopropyl alcohol. To assist in cleaning.

If the MARS 6 is equipped with a sample stirrer, some danger exists if a pacemaker is positioned in close proximity to the instrument cavity.

If the MARS 6 is equipped with IR sensors, each IR window or lens in the cavity floor should be cleaned weely or after any spillage by wiping each lens with a damp soft cloth.

Compounds Unsuitable for Closed Vessel Microwave Digestion

WARNING

Acid decomposition of certain chemical compounds or types of samples constitutes unreasonable, hazardous misuse of CEM microwave digestion systems. The classes of compounds listed below are unsuitable for closed vessel microwave digestion because they are highly reactive with oxidizing acids and/or may become nitrated and potentially explosive. Absence of a particular chemical compound from this list does not imply microwave acid decomposition of such a sample is safe under all conditions. CEM will not be responsible for damage to equipment and facilities or personal injuries resulting from microwave digestion of such compounds/samples.

- Explosives (TNT, Nitrocellulose, etc.)
- Propellants (Hydrazine, Ammonium Perchlorate, etc.)
- Pyrophoric chemicals
- Hypergolic mixtures (Nitric Acid and Phenol, Nitric Acid and Triethylamine, Nitric Acid and Acetone, etc.)
- Animal Fats (Esters of glycerol capable of nitration and the formation of nitroglycerin or other nitrated organic compounds)
- Aviation Fuels (JP-1, etc.)
- Acetylides
- Glycols (Ethylene Glycol, Propylene Glycol, etc.)
- Perchlorates (Ammonium, Potassium, etc.)
- Ethers (Cellosolve - Ethylene Glycol Phenyl ether, etc.)
- Lacquers
- Alkanes (Butane, Hexane, etc.)
- Ketones (Acetone, Methyl Ethyl Ketone, etc.) and alcohols (methanol, etc.)

Chemical Safety Concerns at High Temperature

Mineral Acids

Perchloric	Dangerous hot Explosive as dry salt with organics Decomposes to Cl_2 gas
Sulfuric	Dehydrating agent
Hydrofluoric	Biological irritant/very dangerous
Aqua Regia	Nitrosyl chloride gas irritant

Alkaline Hydroxides

NaOH, KOH, LiOH	Caustic, dehydrating, biological irritants

Peroxides

Hydrogen	Potent oxidizer
Organic Ethers	Explosive

Organic Solvents ..... Toxicity, explosiveness, flammability, volatility

Installation

The MARS 6 instrument should be installed on a laboratory work bench with access to a fume hood or other means of fume disposal.

Tools Required

Lab Coat
Gloves
Eye Protection

Installation Site

To install the MARS 6, choose a location that:

- provides at least 8 in. (20 cm) space on each side and 6 in. (15 cm) space in the rear for proper ventilation.
- is free from vibration of large equipment and/or walk-through traffic.
- is away from the primary laboratory exits and walk-through traffic.
- provides a temperature range of 41°F (5°C) to 104°F (40°C).
- provides adequate bench space for sample handling and printer placement (if applicable).
- permits the instrument to be connected to a dedicated, grounded outlet. The MARS 6 instrument should be operated on stabilized, constant voltage AC power supply, and the voltage must be within ±10% of the specified level. (Refer to Instrument Specifications in this manual.)

  Note: Measure line voltage to ensure that it meets system specifications.

CAUTION

Line voltage fluctuations greater than 10% will affect instrument performance.

- provides access to a fume hood or other means of fume disposal.

CAUTION

Never install an MARS 6 system inside a laboratory fume hood. Acid and chemical fumes may attack electrical components, resulting in possible damage and malfunctioning of the cavity door safety interlocks.

NOTE

The MARS 6 system is supplied with eight (8) ft. of flexible exhaust hose (3-1/8” OD x 2-13/16” ID). The inboard exhaust mechanism will push fumes through the hose at 125 CFM. To properly vent the MARS 6, the fume hood or exhaust line must draw at least 125 CFM at the point of connection. The system must be located within 8 feet of a hood or exhaust line for proper ventilation.

Instrument Setup

1. Carefully open the shipping carton, using caution to avoid puncturing or tearing the foam packaging. Remove the foam stabilizers from the carton.

NOTE

Retain all packing material for use if returning the instrument to the manufacturer for service.

2. Remove the outer box.
3. With at least two people for lifting, locate the hand-hold cutouts on each side of the inner box and lift the instrument from the shipping carton and place it on the floor in front of the laboratory bench where the instrument is to be placed.
4. Open the inner box and remove all packaging materials including the plastic wrap from the instrument.
5. Lift the instrument onto the laboratory bench within 8' of the exhaust source.

Note: The instrument requires 26" clearance.

6. Remove the contents from the instrument cavity. Install the elbow and exhaust hose on the back of the instrument. Plug the power cord into the MARS 6 and the dedicated electrical outlet.

Verify that all accessories listed below have been included:

- Detachable Power Cord
- Exhaust Hose Kit
  - 8' x 3" Hose
  - 3" Elbow
  - Hose Clamp
  - Drain Line Fitting
  - 5' Silicone Drain Tubing
  - 3 Plastic Pipe Plugs
- 15A Fuse (2)
- Operation Manual on USB flash drive
- Quick Start Guide
- General Guidelines to Assist with Microwave Digestion Method Development
- Power Cord (60 Hz instrument)

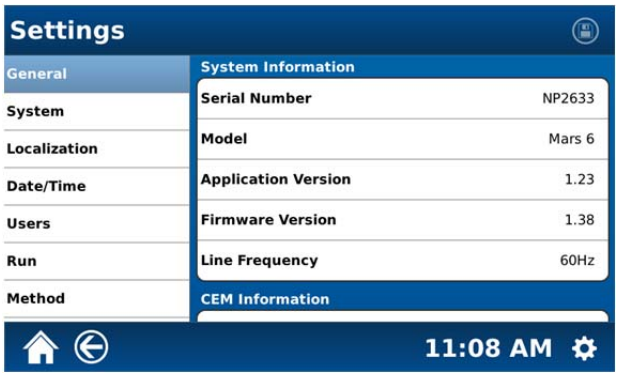
Note: Optional items such as digestion vessels, turntable, or capping system may have been included in the shipment. Carefully check the packing list(s) and the contents of shipping cartons to verify that all items listed are included. If any items are missing, notify CEM Corporation or a local subsidiary or distributor in the appropriate area of any discrepancies.

7. Position the power switch to the "On" position.
8. Once the instrument initializes, the following screen will appear.

9. Select "OK."

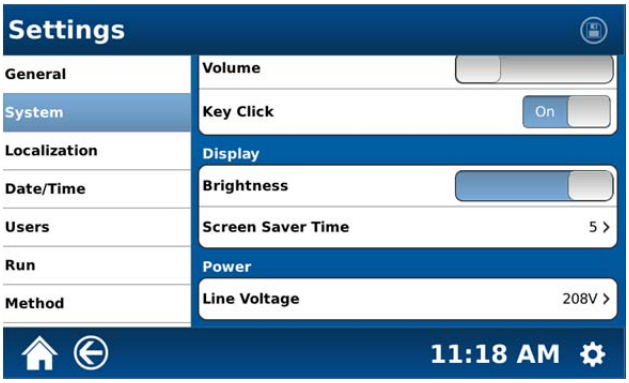
10. Select the “System Menu” icon in the bottom right corner of the screen.

11. Select “**Settings**.”

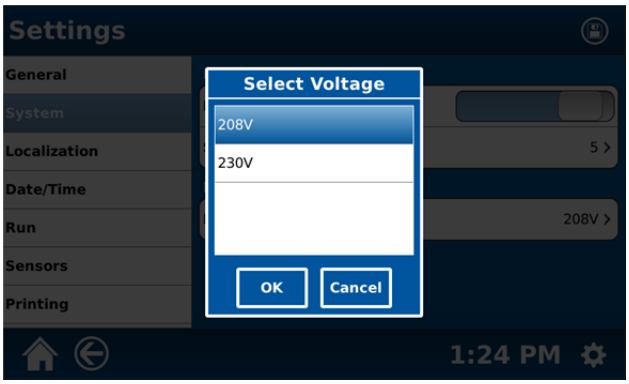


12. Select “**System**.”

13. Scroll the System screen to display “Power.”



14. Select “Line Voltage.”



15. Select and highlight the proper voltage for the instrument – 208V or 230V.

Voltage 200 – 220 Volts – Select 208V
Voltage 221 – 240 Volts – Select 230V

16. Select “OK.”
17. Select the “Save” icon in the upper right corner of the screen to save the proper line voltage.

Note: The MARS 6 instrument requires 208/230 VAC, 60 Hz, 15A @ 208 VAC or 220/240 VAC, 50 Hz, 15A @ 240 VAC, single phase power. It requires a non-locking 15 Amp, 250 volt rated receptacle (NEMA 6-15R or a 250 volt. 20 Amp rated receptacle (NEMA 6-20R).

Inspection

Inspect the instrument for any cracks, dents, or warping.

Inspect the door for any damage and for proper alignment. When closed, the door should seat firmly against the front of the microwave cavity.

WARNING

If damage is noted, do not attempt instrument operation.

If the instrument has been damaged in shipping, contact the freight carrier to report damage and to file a damage report. Contact the CEM Service Department or the local subsidiary or distributor to report damage and to request service information.

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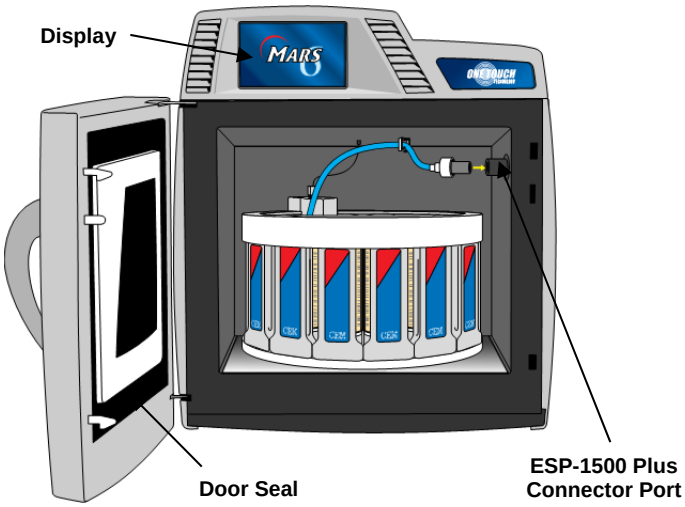
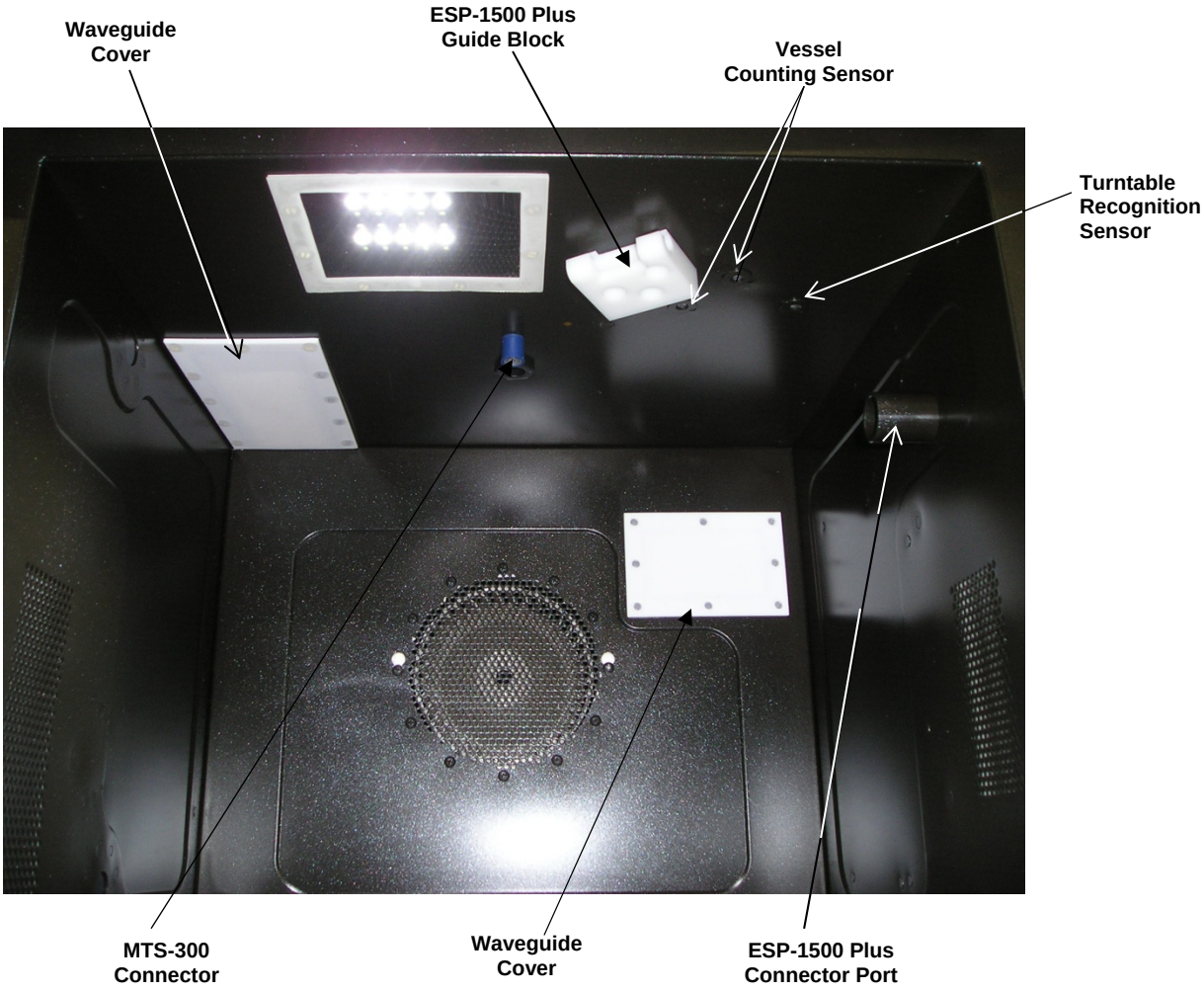
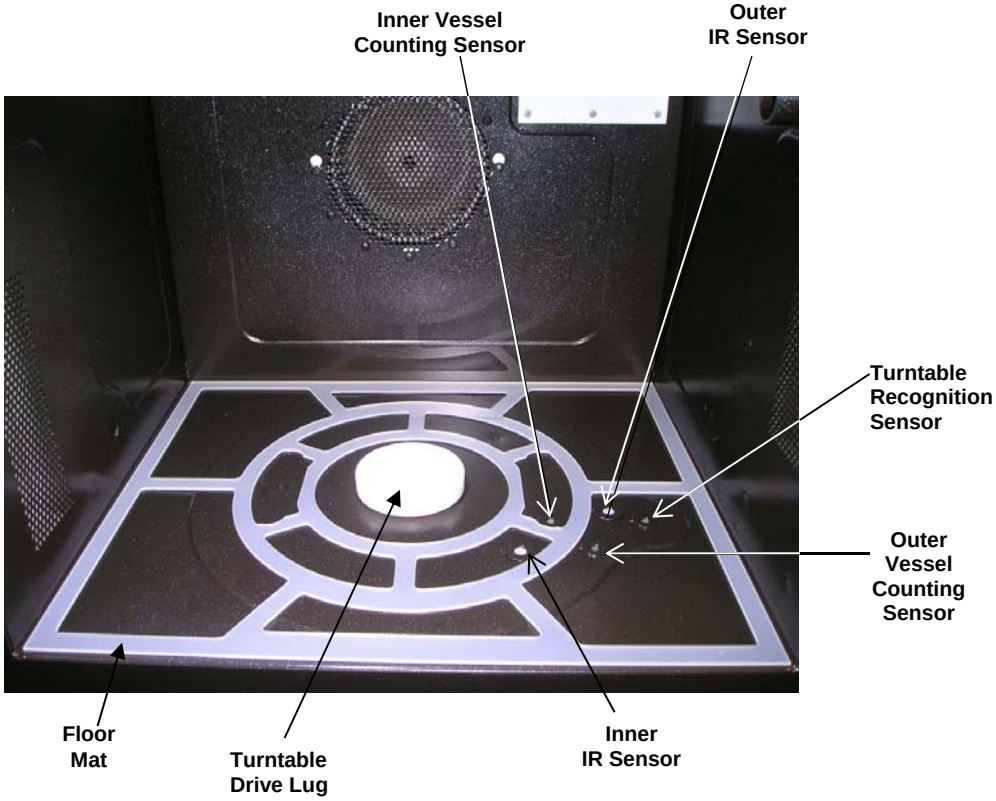
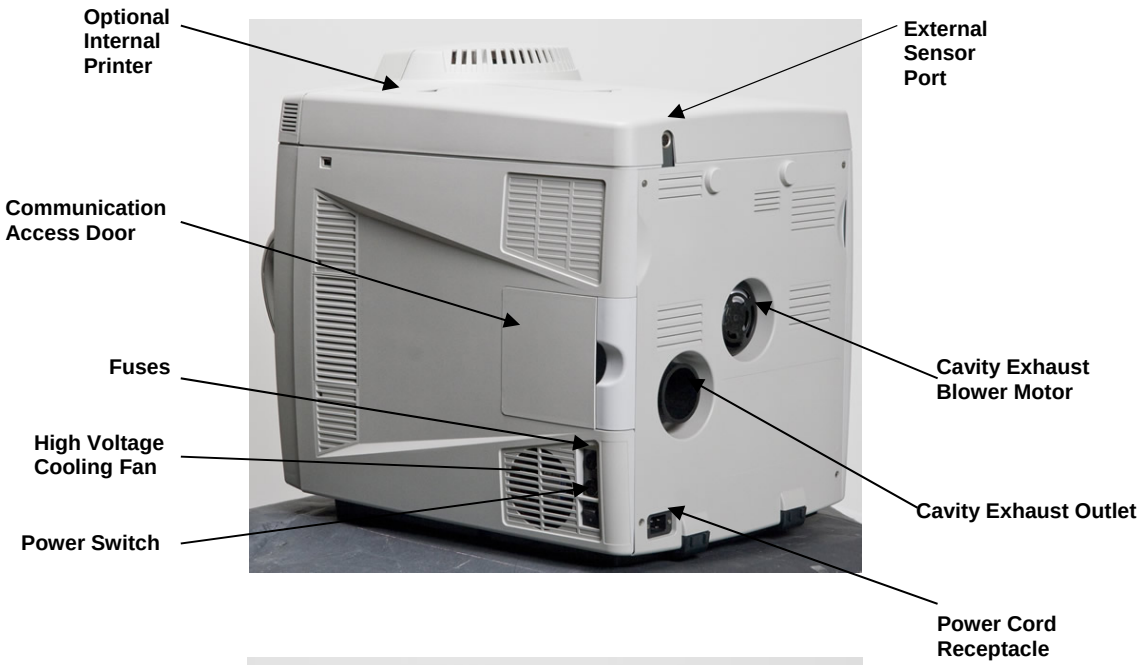
Instrument Description

- **Touch Screen Display** - shows menus, method parameters, etc.
- **Door Seal** - ensures tight fit between door and interior cavity of the MARS 6 to prevent microwave leakage.
- **Turntable Drive Lug** - allows the turntable drive shaft to pass through the cavity floor and engage the turntable.
- **Door Handle** – permits ease of opening instrument door.
- **Internal Printer (Optional) -** permits printing of method parameters, graphs and/or method data
- **Waveguide Covers** – evenly distribute microwaves into instrument cavity
- **IR Sensors –** Measure temperature at bottom of vessels
- **Turntable Sensor –** detects type of turntable
- **Vessel Counting Sensor –** counts number of vessels in the turntable




Waveguide Cover
ESP-1500 Plus Guide Block
Vessel Counting Sensor
Turntable Recognition Sensor
MTS-300 Connector
Waveguide Cover
ESP-1500 Plus Connector Port


Inner Vessel Counting Sensor
Outer IR Sensor
Turntable Recognition Sensor
Outer Vessel Counting Sensor
Floor Mat
Turntable Drive Lug
Inner IR Sensor



- **Power Switch** - turns AC power on and off to the instrument.
- **Cavity Exhaust Outlet** - exhausts fumes from the microwave cavity.
- **Cavity Exhaust Blower Motor** - directs air from the microwave cavity to the exhaust outlet.
- **Nameplate** - lists model, serial number, operating voltage, frequency, and current draw.
- **High Voltage Cooling Fan** - draws room air past the magnetron.
- **Power Cord Receptacle** - receives the female end of the power cord.
- **Fuses** - prevent electrical power overload.
- **External Sensor Port** - permits interface of optional instrument features.
- **Communication Access Port** – permits access to USB, Ethernet and RS232 ports.

Turntable Drive System

The MARS 6 is furnished with an alternating and/or continuous turntable drive system. Rotational configuration is automatically selected by the vessel choice. During sample heating in alternating style, the turntable rotates 355º, then reverses direction to prevent pressure sensing or fiber optic temperature sensors from becoming entangled and damaged. The turntable always operates when the microwave power is on. The turntable stops rotating when the microwave sample preparation cooling cycle ends, when “Stop” is selected, or when the instrument door is opened.

Exhaust Blower

The MARS 6 is equipped with an exhaust blower to remove corrosive or harmful fumes and flammable vapors from the cavity. The blower moves air at the rate of 3.6 m^3/minute (125 ft^3/minute).

Optional Sample Stirrer

The optional sample stirrer is a rotating magnetic field in the bottom of the instrument which works in conjunction with stirring bars placed in the vessel liners to ensure a homogeneous sample.

WARNING

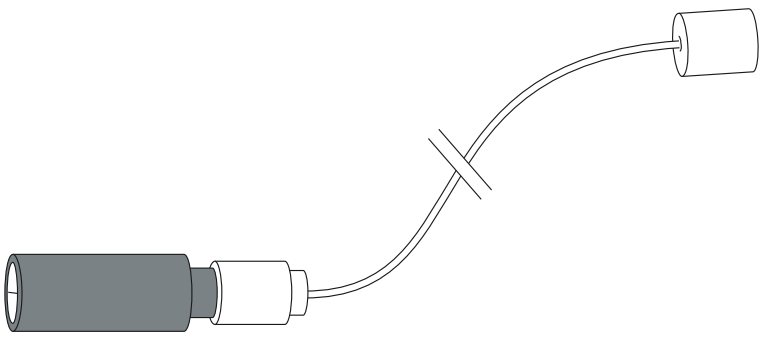
Because cardiac pacemakers require magnets to control operation during checkout, if the MARS 6 instrument is equipped with an optional sample stirrer, some danger exists if a pacemaker is positioned in close proximity to the instrument cavity. If the instrument is suspected of interfering with the operation of a pacemaker, the instrument should be turned off or the pacemaker wearer should move away from the instrument.

Standard Pressure Control System

The standard pressure control system for the MARS 6 is the ESP-1500 Plus (Electronic Sensor – Pressure) which monitors and controls pressure conditions inside sample vessels. The instrument is equipped with a quick-disconnect connection for the ESP.

The ESP-1500 Plus consists of two parts: 1) the control electronics and connector which are included in the instrument, and 2) the ESP sensor which is mounted to the control vessel. The connector is located in the upper front right-hand corner of the cavity. The ESP sensor consists of a pressure sensing load-cell mechanism and a pressure line. During system operation, the sensor should be mounted securely to the cavity connector. The ESP is designed for use with the HP-500 Plus, Easy Prep, Easy Prep Plus, and GreenChem Plus vessels.

During system operation, the ESP-1500 Plus measures pressure as forces inside the vessel are transmitted via the pressure line and press directly on the load cell. It sends a pressure signal from the load cell mechanism to the MARS 6 electronic control which determines microwave energy delivery based on method heating requirements. Pressure is displayed graphically and digitally on the display screen.



ESP-1500 Plus Pressure Sensor

Standard Temperature Control System

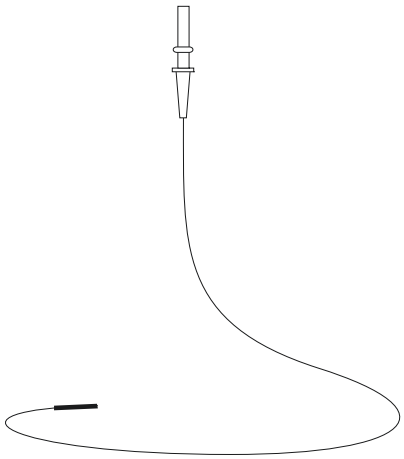
The standard temperature control system for the MARS 6 is the MTS-300 which monitors and controls temperature conditions inside sample vessels.

A microwave transparent temperature probe is inserted into the thermowell of a sample vessel and connected to a snap-in port in the center of the roof of the instrument cavity. From there the signal extends to a special temperature control on the system controller board.

A feedback single from the MTS-300 probe to the magnetron of the system regulates microwave power output to maintain a selected temperature parameter.

CAUTION

The MTS-300 probe and the thermowell are both fragile. Exercise care when handling either of them.



MTS-300 Temperature Sensor

Optional Temperature Control System

The MARS 6 system is also designed for use with an optional infrared control system. This system is optional for use with certain vessel sets. With this system, two infrared temperature sensors are located below the cavity floor.

ReactiGuard Cavity Sensing System

The MARS 6 is equipped with an audible sensing system to detect the occurrence of a vessel event inside the microwave cavity. When an event (such as the venting of a vessel relief device) is detected, an embedded software safeguard pauses the microwave heating program.

WARNING

Exercise extreme caution while attempting to identify the underlying cause(s) of a detected vessel event. Proper precautions must be taken to avoid contact with reagents or reagent vapors. Protective gear should be worn as outlined in the user's safety program for hazardous materials and the reagent manufacturer's material safety data sheet. Refer to these guidelines for proper handling and disposal of reagents.

Once the cause of the event has been determined, press "Resume" or restart the method.

The function of ReactiGuard is to protect against secondary instrument damage due to an undetected vessel event and continued heating of released liquids/vapors inside the cavity.

WARNING

ReactiGuard alerts the operator to the occurrence of an event with a vessel inside the cavity; therefore, CEM recommends that the ReactiGuard be "On" at all times.

Normal operating status of this safeguard is "on." However, the ReactiGuard may be deactivated (turned "Off") if the user elects to disable this feature.

Optional TempGuard™/DuoTemp™ Sensor

The optional TempGuard™ sensor is a safety device for measurement of temperature inside each vessel in the system. An infrared lens and sensor are located in the front right corner of the cavity floor. As the vessels rotate over the sensor, the temperature of each vessel is measured.

If the temperature in any vessel surpasses the maximum allowable temperature programmed during a method, the instrument software stops microwave production and indicates the position of the vessel in which the temperature has exceeded the programmed limit.

WARNING

Because excessive temperature can damage vessel components, exercise extreme caution when removing a vessel which has exceeded TempGuard limits. Proper precautions must be taken to avoid contact with reagents or reagent vapors. Protective gear should be worn as outlined in the user's safety program for hazardous materials and the reagent manufacturer's material safety data sheet. Refer to these guidelines for proper handling and disposal of reagents.

This sensor also permits the use of DuoTemp™ control for XP, HP, EasyPrep, EasyPrep Plus and Xpress Plus vessel sets. This feature utilizes the infrared sensor and the MTS-300 fiber optic sensor to control the hottest vessel in any method. Fiber optic temperature control MUST be installed and selected in order for the TempGuard/DuoTemp to function.

Optional Internal Printer

The optional internal thermal printer permits printing of method parameters, graphs and/or method data at any time that the "print" icon is displayed on the screen during method performance or when viewing method information and previous method performance data.

Printer Drivers

1. Access the website http://www.openprinting.org/printers.
2. Select the print driver manufacturer from the list titled "Model."
3. Select "Show this Printer" to display the printer information.

The top of the displayed page will show the printer support status as "Perfectly," "Mostly," "Partially," or "unknown."

Perfectly – These printers should work with the MARS 6, but may require testing of various drivers to install. Printers in this category are the only printers that CEM recommends that the user attempt to install.

Mostly and Partially – These printers MAY work with the MARS 6 in a limited capacity. They must be tested to determine whether or not the functionality required for the instrument is available.

Unknown – These printers ordinarily will not work with the MARS 6.

Note: The driver that will actually work with the printer may not be named the same as the printer manufacturer. For example, a Brother printer may actually require an Hewlett Packard driver to operate.

Testing/Installing a Printer

1. Turn on the MARS 6 instrument.
2. Once the instrument has completed the startup, turn on the printer and plug the USB cable from the printer into a USB port on the MARS 6.
3. Select “Settings,” then “Printing.”
4. The screen which will appear will be divided into two sections: “Current Printer” and “Found Printers.” All potential print drivers for the connected printer will be displayed under “Found Printers.” Select one of the drivers. **Note:** For “All-In-One” printers, several drivers with the same name may be shown. Test each one to determine which driver is for the printer. Faxes and scanners are not supported by the MARS 6.
5. Follow the instructions on the screen to select a printer driver and install it.
6. Once the install is completed, immediately select “Print Test Page.” Note: This step is critical since the driver selected may not operate properly with the instrument.
7. Once the test page has printed, select “Yes” or “No” as to whether the page printed properly.
8. If the test page did not print or printed improperly, answer “No” and select a different driver.
9. If the test page printed properly, answer “Yes.” On the following screen, select “Yes” or “No” to make the printer the current printer for the instrument.

The MARS 6 will complete the printer installation and display the new printer as the current printer on the screen accessed in steps 3 and 4 above.

Software Icon and Keyboard Reference Guide

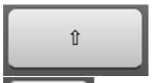
Perform (Start) Method

Method Error (Prevents Method Start)

Emergency Stop

Pause Method

Continue Method



Shift Capital/Lower Case Letters

Display Numbers

Alt + Shift- Display Symbols

Backspace (Delete)

Hide Keyboard

Subscript

Methods created by the CEM Corporation Laboratory are displayed with a CEM folder.

Methods created by a current operator are displayed with a blue silhouette of a person.

Methods created by someone other than the current user or CEM are displayed with a white silhouette of a person in a blue folder.

One Touch Methods vs. Classic Methods

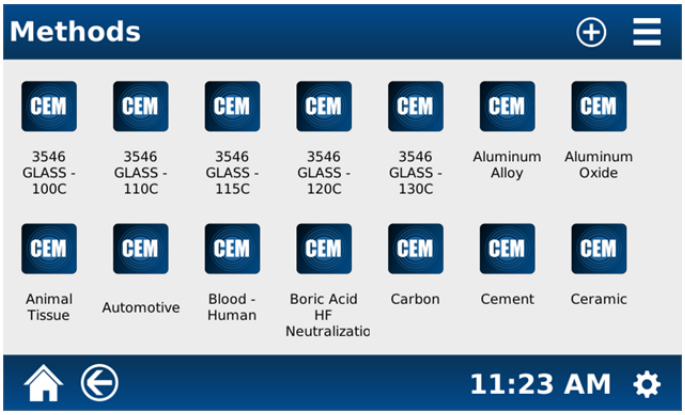
One Touch Methods supplied with a MARS 6 are methods created by CEM Applications Specialists. This takes the guesswork out of method creation and sample preparation. With these methods, one touch (selecting the method) determines all of the parameters, adjusts power output, and performs the digestion for all major sample types. One Touch Methods can also be created and saved by the user. Instructions for creating a One Touch method are included in this manual.

Classic methods are created by the user. Instructions for creating a classic method are included in this manual.

Note: Throughout the text of this manual, the word “select” is used to indicate “touch.”

One Touch Methods and Classic Methods can be arranged in either a list or a grid.

1. Select either “One Touch Methods” or “Classic Methods.”



Note: The above screen illustrates One Touch Methods.

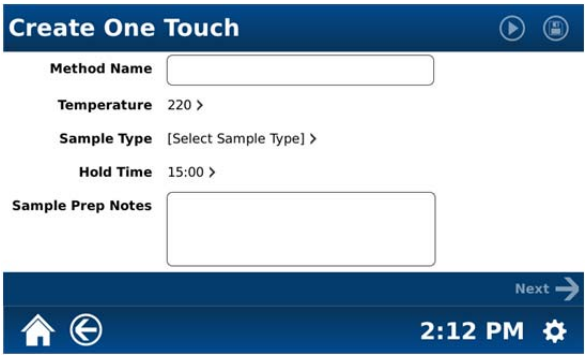
Create One Touch Method

Creation of a method for use in the MARS 6 requires knowledge and selection of the method control type, vessel type, and sample type for some vessels as well as temperature and pressure control options.

Note: Throughout the text of this manual, the word “select” is used to indicate “touch.”

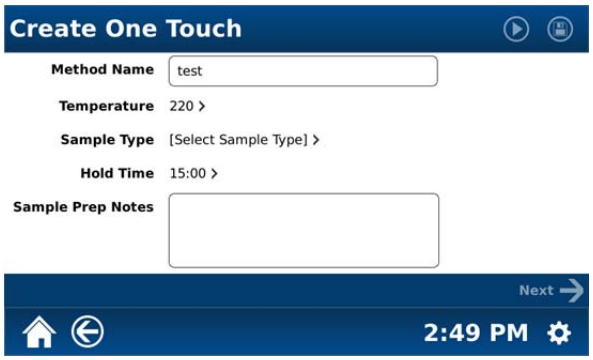
1. From the MARS 6 home screen, select “One Touch Methods.”

2. To create a one touch method, select “+” at the top of the screen.

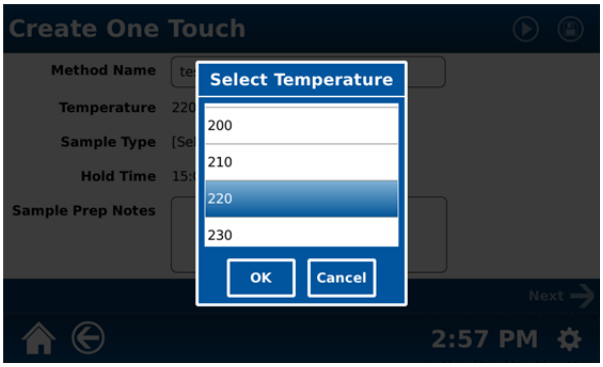


3. Select “Method Name.”

4. Using the keypad, select the name of the method being created. **Note:** To toggle between upper and lower case letters for the method name, select the “shift” key on the keypad. To toggle to numbers and symbols for the method name, select “alt” on the bottom of the keypad. To insert a subscript, use the “sub” key. Use the backspace “del” (delete) key to delete unwanted letters and/or numbers. Use the space bar to enter a space in the method name. Once the name is properly selected and displayed, select “Hide” to close the keypad.



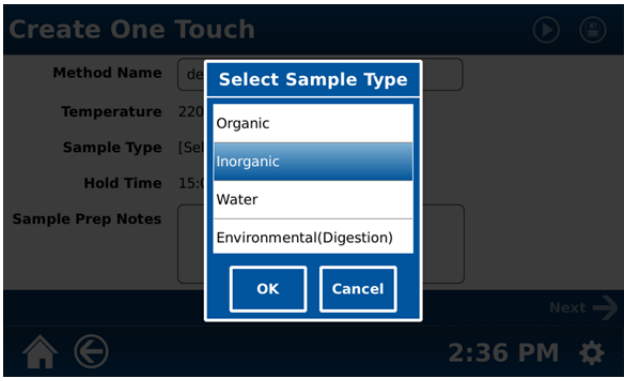
5. Select “Temperature.”



6. Select the desired temperature for the method (100 ºC – 270 ºC).

7. Select “OK.”

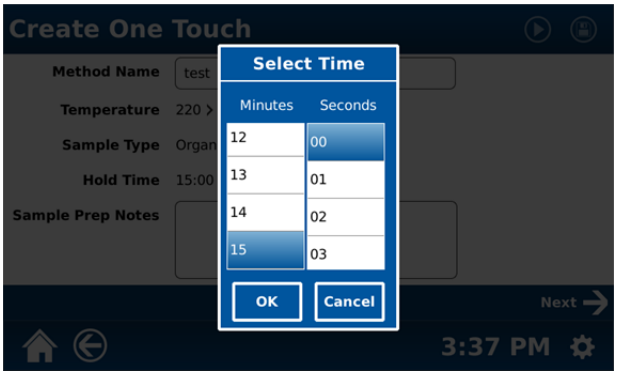
8. Select “Sample Type.”



9. Select the appropriate sample to be used for the method (Organic, Inorganic, Water, Environmental {Digestion} Environmental {Extraction}, or Environmental {Glass}).”

10. Select “OK.”

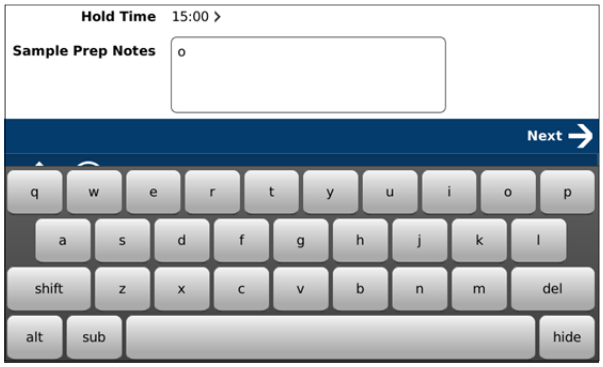
11. Select “Hold Time.”



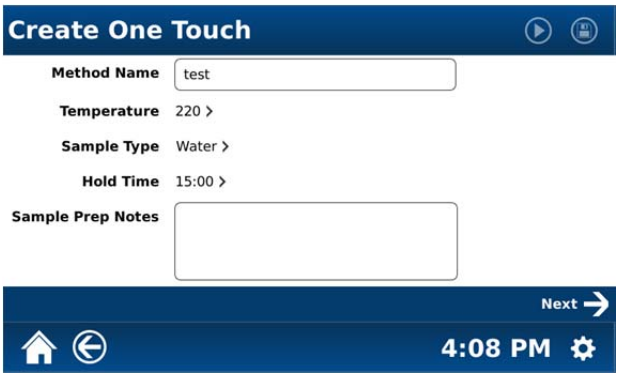
12. Select the appropriate time (0 – 59 minutes and 59 seconds) to hold the sample at the temperature chosen in step 6.

13. Select “OK.”

14. If applicable, select “Sample Prep Notes.”



15. Using the keyboard, enter any specific notes for the method. **Note:** To toggle between upper and lower case letters for the notes, select the “shift” key on the keypad. To toggle to numbers and symbols for the notes, select “alt” on the bottom of the keypad. Use the backspace “del” (delete) key to delete unwanted letters and/or numbers. To enter a subscript, use the “sub” key. Use the space bar to enter a space in the notes. Once the notes are properly displayed, select “Hide” to close the keypad.



16. Select “Next.”

17. If any parameters require revisions, select “Previous.” Once the method parameters are entered properly, the MARS 6 will complete all other necessary information to perform the method with one touch.

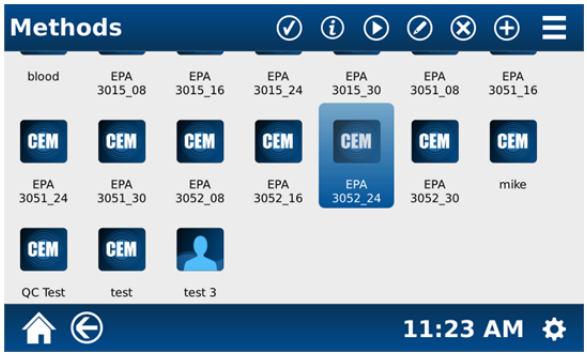
18. Save the method by selecting the disk icon at the top of the screen. Once the method is saved, the disk icon will be grayed out.

Create Classic Method

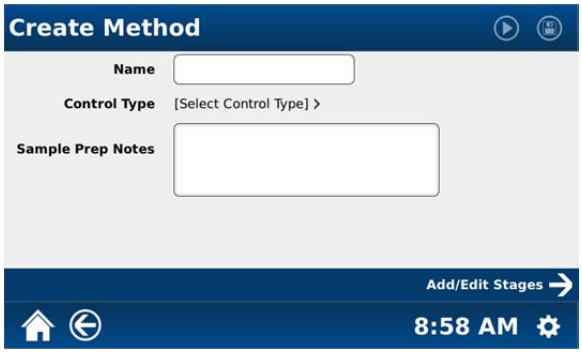
Creation of a method for use in the MARS 6 requires knowledge and selection of the method control type, vessel type, and sample type for some vessels as well as temperature and pressure control options.

Note: Throughout the text of this manual, the word “select” is used to indicate “touch.”

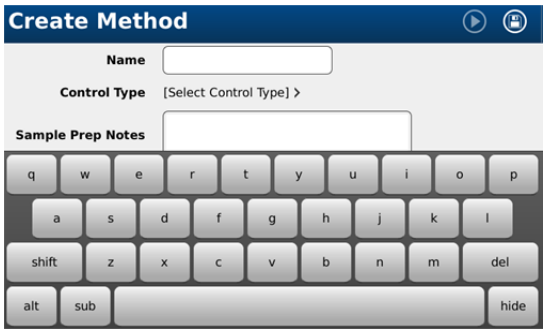
1. From the MARS 6 home screen, select “Classic Methods.”



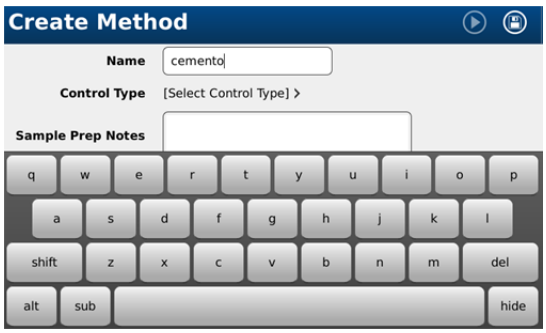
2. To create a classic method, select “+” at the top of the screen.



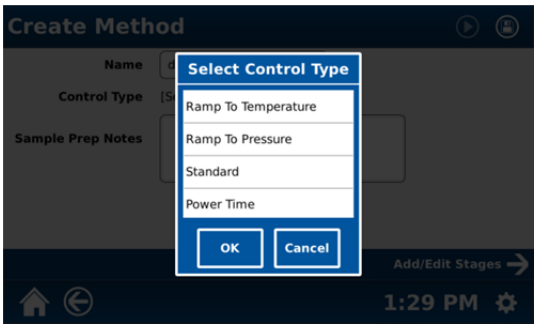
3. Select “Name” to name the method being created. The keypad will appear on the screen.



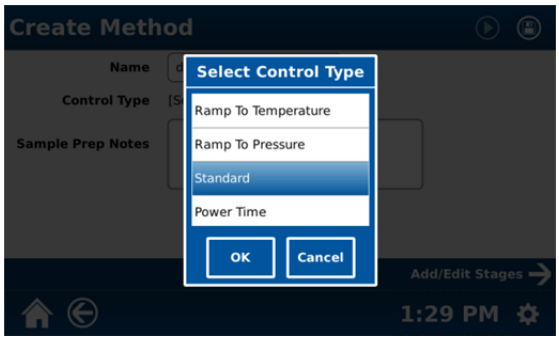
4. Using the keypad, select the name of the method being created. **Note:** To toggle between upper and lower case letters for the method name, select the “shift” key on the keypad. To toggle to numbers and symbols for the method name, select “alt” on the bottom of the keypad. To use a subscript, select the “sub” key. Use the backspace “del” (delete) key to delete unwanted letters and/or numbers. Use the space bar to enter a space in the method name. Once the name is properly selected and displayed, select “Hide” to close the keypad.



5. Touch “Select Control Type” to select the desired control type for the method (Ramp to Temperature, Ramp to Pressure, Standard, Power Time, or Evaporation).



6. Select and highlight the desired control type.

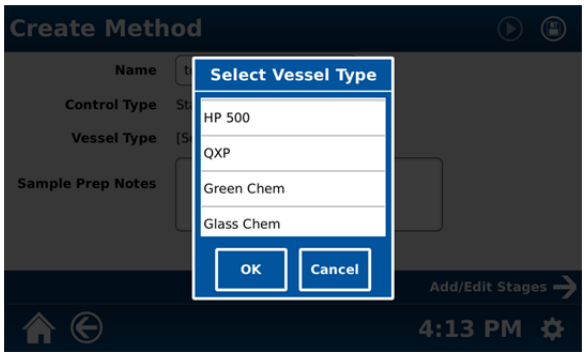


7. Select “OK.”

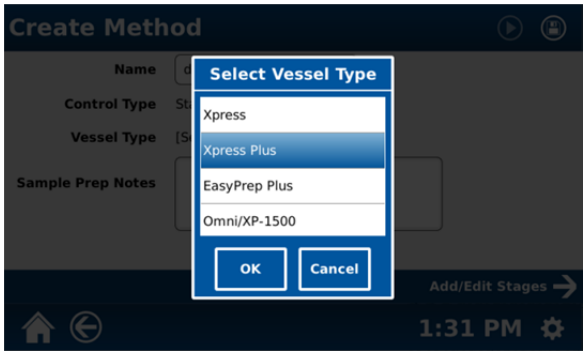
Note: If the MARS 6 is equipped with an MTS-300 or Xpress temperature control, CEM recommends the use of “Ramp to Temperature” control.

8. Touch “Select Vessel Type” to select the desired vessel to be used with the method (Xpress, Xpress Plus, Omni/XP 1500, HP 500, QXP, GreenChem, GlassChem, ACV/LEV/QDV, UDV/HDV, PFA, CleanChem, HTV, EasyPrep, EasyPrep Plus, UltraPrep or Beaker). Touch and scroll the vessel choices, based on the selected control type, to choose the desired vessel.

Note: If Evaporation is selected as the control type in step 6 above, selection of vessel type will not be applicable. Proceed to step 12.

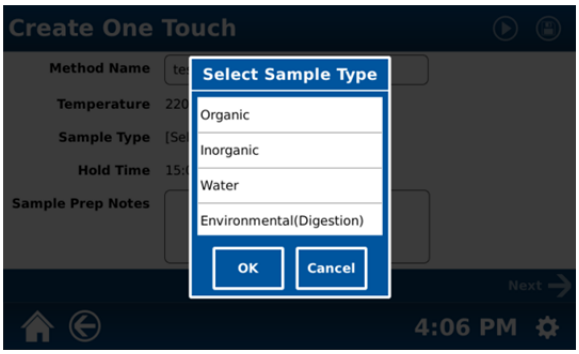


9. Select and highlight the desired vessel type.

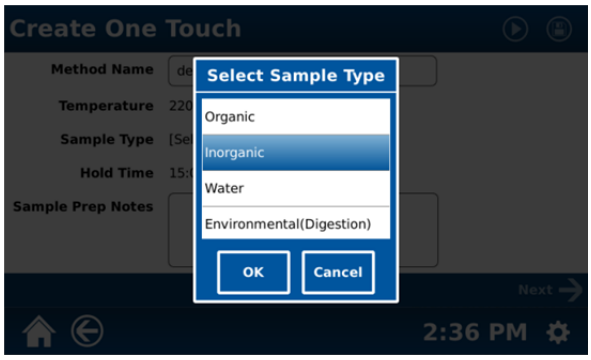


10. Select “OK.”

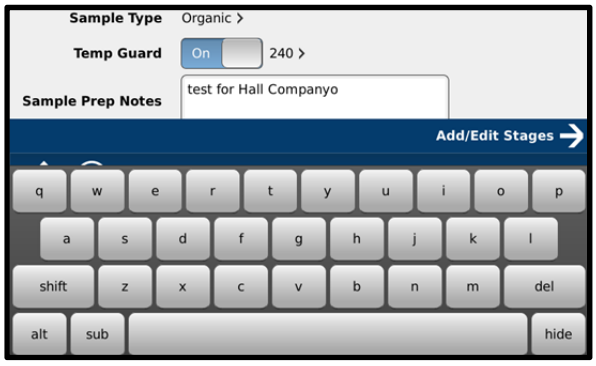
Note: The selected control type and vessel type (Xpress, Xpress Plus, Easy Prep Plus, Omni/XP-1500, HP-500, QXP, Green Chem, Glass Chem, ACV/LEV/QDV, PFA, Clean Chem, HTV or Beaker) determine the appearance of the next screen. If the selected vessel is “Xpress” or “Xpress Plus,” selection of the sample type will be required.



11. Select the desired sample type [Organic, Inorganic, Water, Environmental (Digestion), Environmental (Extraction), Environmental (Glass)].



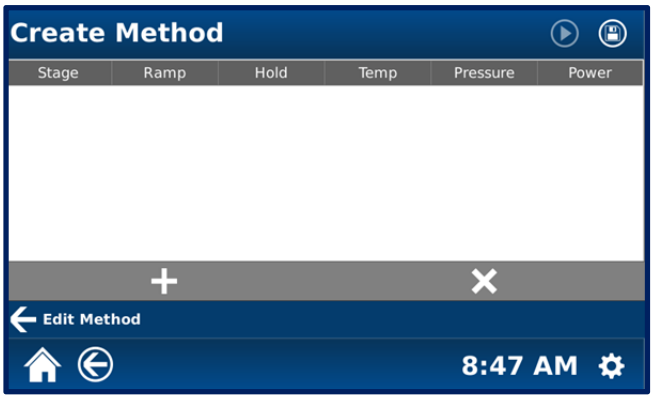
12. If applicable, select “Sample Prep Notes.”

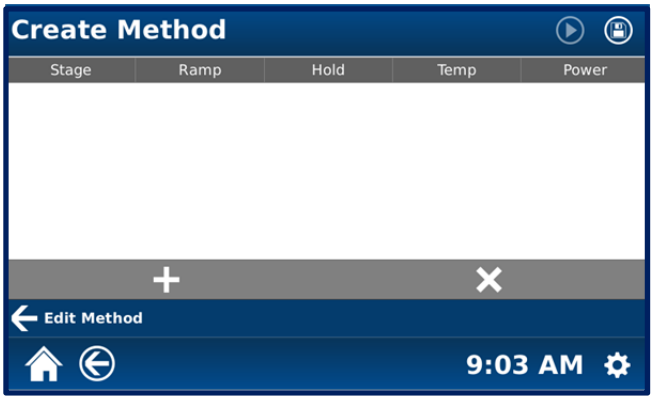


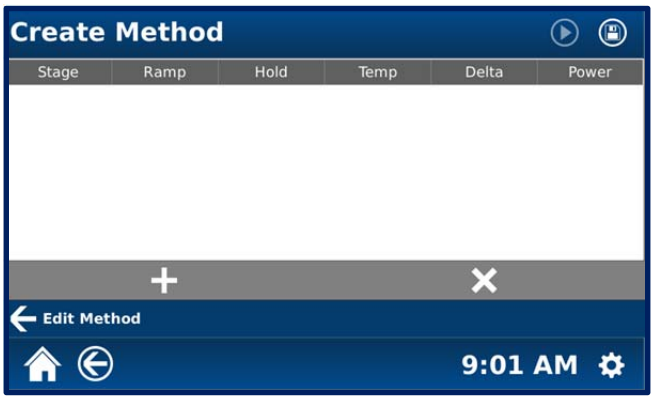
13. Using the keyboard, enter any specific notes for the method. **Note:** To toggle between upper and lower case letters for the notes, select the “shift” key on the keypad. To toggle to numbers and symbols for the notes, select “alt” on the bottom of the keypad. Use the backspace “del” (delete) key to delete unwanted letters and/or numbers. To input a subscript, select the “sub” key. Use the space bar to enter a space in the notes. Once the notes are properly displayed, select “Hide” to close the keypad.

14. Once the method is named and the control, vessel and sample type (if applicable) are selected, the following screen will appear.

15. Select “Add/Edit Stages” to enter method parameters based on the control type selected for the method as illustrated in the screens below.

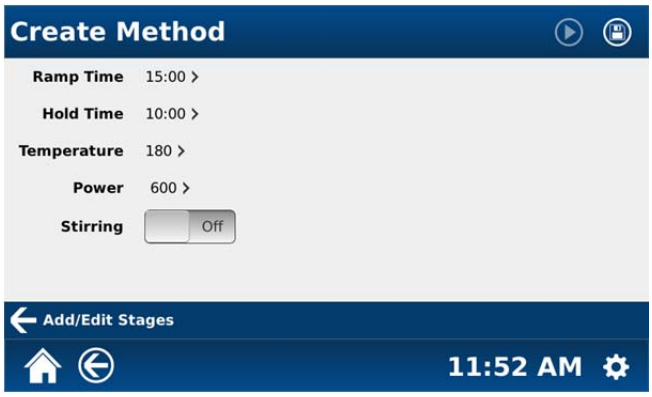






Note: If Evaporation is selected as the control mechanism, the Pressure column will be replaced by a programmable temperature delta as illustrated in the above screen. Refer to the MicroVap Instructions for additional information.

16. Select “+” to add a stage to the method.



17. Based on the control type selected, enter method parameters as follows:
    a. Scroll and select the desired ramp time minutes (0 – 60 minutes).
    b. Scroll and select the desired ramp time seconds (0 – 59 seconds).
    c. Scroll and select the hold time minutes (0 – 60 minutes).
    d. Scroll and select the hold time seconds (0 – 59 seconds).
    e. Scroll and select the desired temperature (0 – 300 ºC in increments of 1).
    f. Scroll and select the desired pressure (0 – 800 psi in increments of 50).
    g. Scroll and select the desired temperature delta (0 – 50 C in increments of 5) –**when using Evaporation only**
    h. Scroll and select the desired power (0 - 1800 watts in increments of 10).
    i. Toggle the stirring option to the desired setting (on or off).

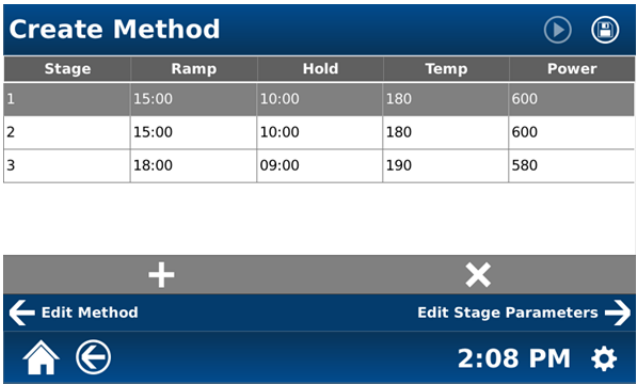
Note: General guidelines for 100% power are as follows:

1 - 2 Framed Vessels	400 watts	8 – 12 MARS Xpress Vessels	800 watts
3 - 6 Framed Vessels	800 watts	13 – 20 MARS Xpress Vessels	1200 watts
7 - 12 Framed Vessels	1600 watts	21 – 40 MARS Xpress Vessels	1800 watts

Note: Based on the vessel type chosen for the method, the instrument will allow the user to scroll only from the minimum to the maximum pressure and temperature. If no control is selected, the instrument will not accept any pressure or temperature. The following table indicates the maximum pressure and temperature for each vessel which can be utilized in the MARS 6 instrument.

Vessel Type	Maximum Temperature (ºC)	Maximum Pressure (psi)
Omni/XP-1500	240 260 280 300	800 600 200 100
HP-500	210	350
QXP	300	600
GreenChem	200	200
UDV/HDV	200	600
Xpress/Xpress Plus	260	
HTV	120	
ACV/LEV/QDV	200	200
GlassChem	200	
PFA	200	120
CleanChem	200	100
EasyPrep/EasyPrep Plus	300	800
UltraPrep	310	
Beaker	300	

18. Once all parameters are properly selected, select the “save” icon to save the entered data or select “Add/Edit Stages” to add stage data.



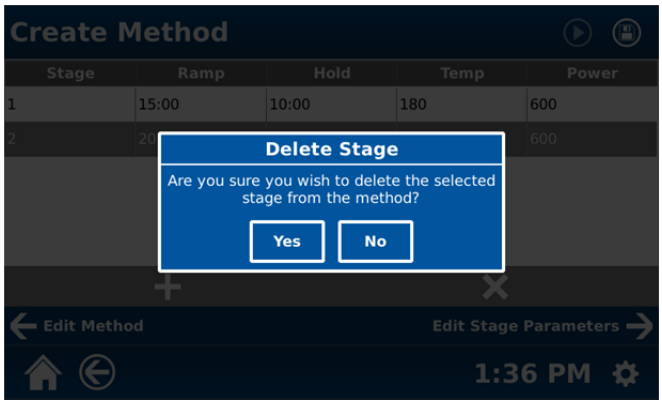
19. To add an additional stage for the method, touch the “+” on the screen.

20. Repeat the above steps for each stage (5 maximum) of the method.

21. To edit the initial method parameters, select “Edit Method.”

22. To edit the parameters of a stage, select (touch and highlight) the appropriate stage. Select “Edit Stage Parameters.”

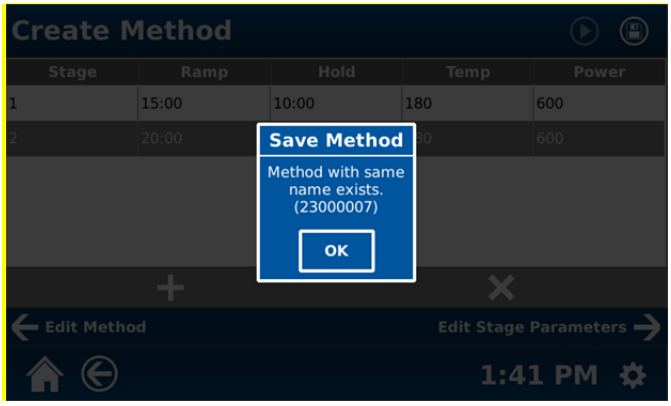
23. To delete a stage, select (touch and highlight) the stage to delete and then select the “X” on the screen.



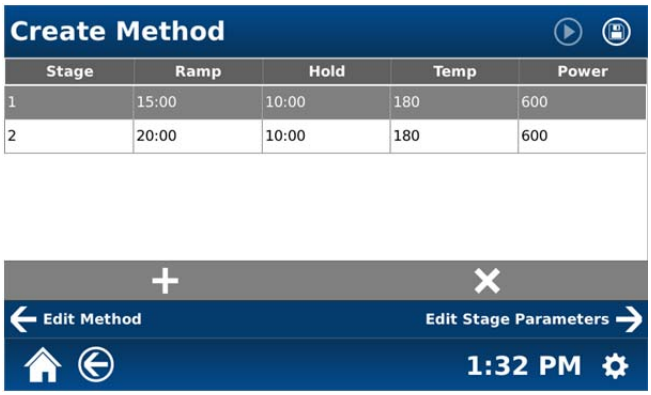
24. To delete the stage, select “Yes.” If the stage is not to be deleted, select “No.”

25. Once the method parameters are entered properly, the method can be saved by selecting the disk icon at the top of the screen. Once the method is saved, the disk icon will be grayed out.

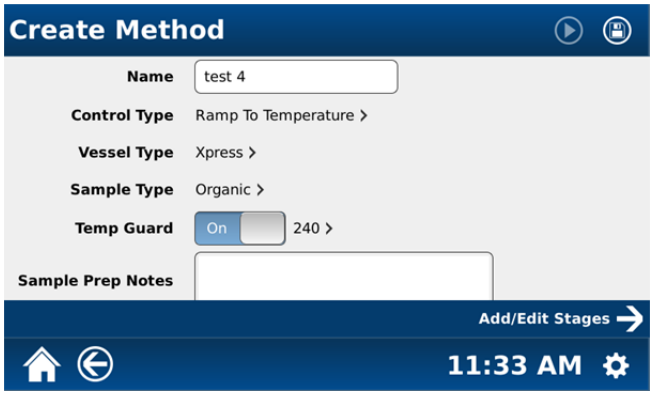
26. If the method name is a duplicate, the following screen will appear.



27. Select “OK” to return to the following screen.



28. Select “Edit Method.”

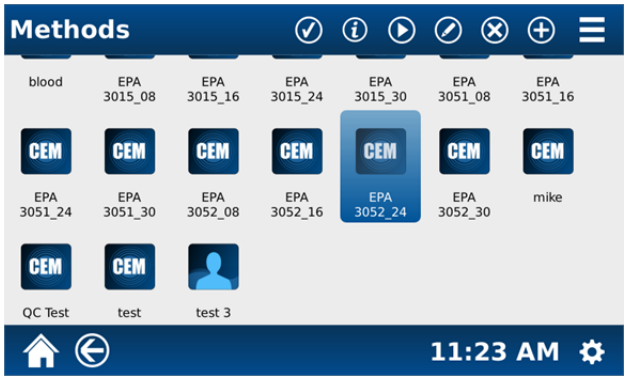


29. Select “Name” and rename and save the method using the instructions outlined.

Edit Method

1. From the MARS 6 home screen, select “Classic Methods.”

2. Scroll through the methods until the desired method is visible. Touch and hold (long touch) the method to be edited.



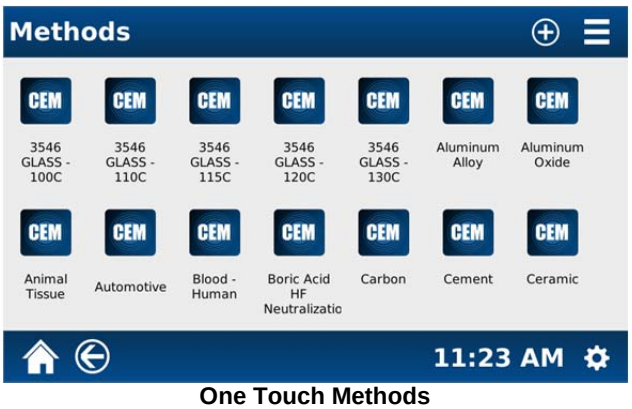
3. Select the edit icon (pencil) at the top of the screen.

4. To edit the selected method, refer to instructions in the Create Method and the Edit Method sections of this manual for entering method parameters. Once the name and/or parameters are edited as desired, select the disk icon at the top of the screen to save the edited method.

> **CAUTION**
>
> When a method is edited and saved, the original method is no longer available in the instrument memory.

Review Method Information

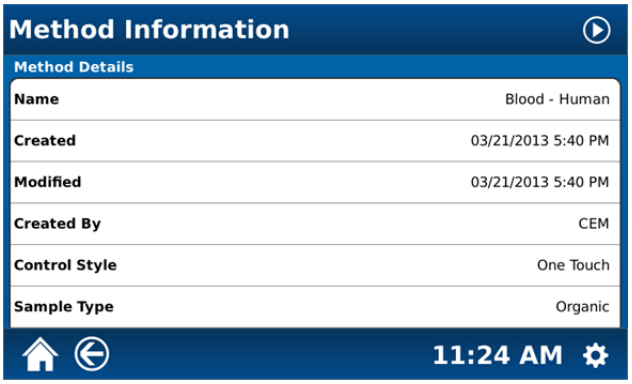
1. From the MARS 6 home screen, select “Classic Methods” or “One Touch Methods.”



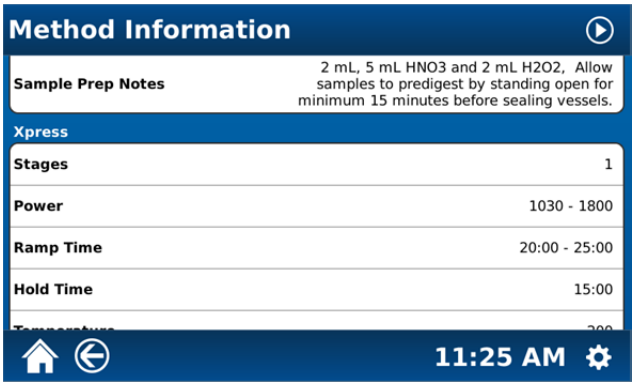
One Touch Methods

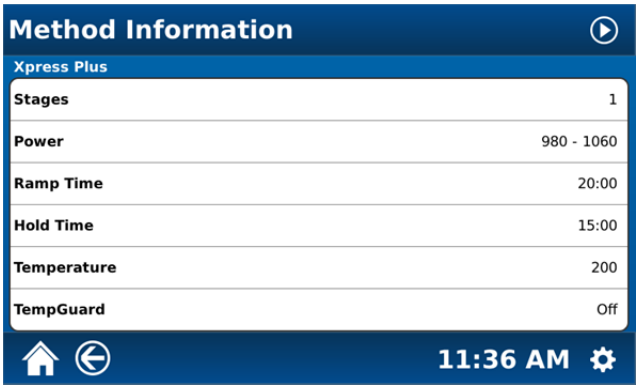
2. Scroll through the methods until the desired method is visible. Touch and hold (long touch) the method to be reviewed.

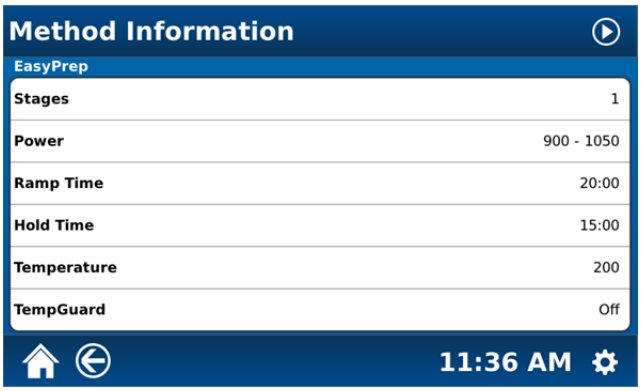
3. Select the “Information” icon at the top of the screen.

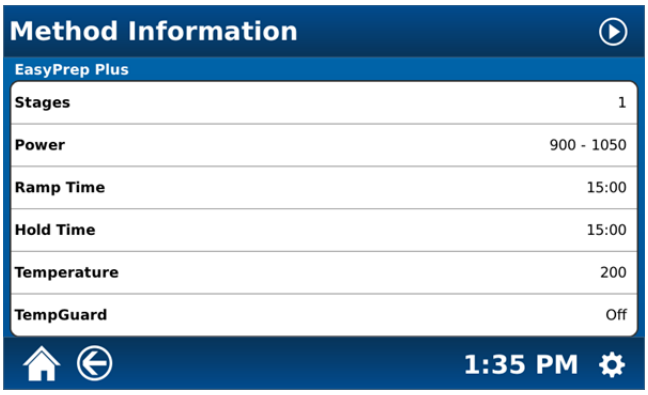


4. Scroll the “Method Information” screen to view the remainder of the method information as illustrated below.





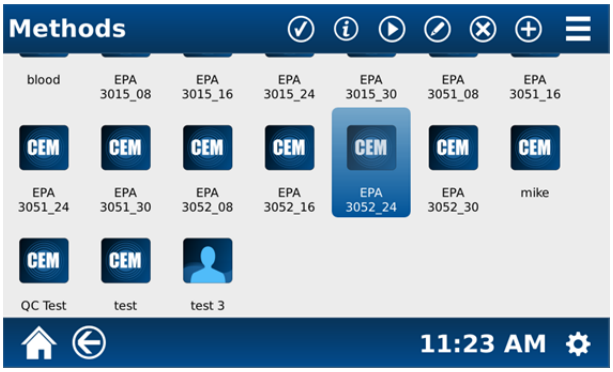




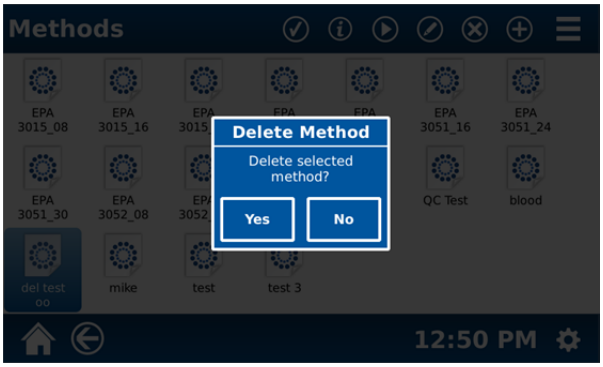
Delete Method

1. From the MARS 6 home screen, select “Classic Methods.”

1. Scroll through the methods until the desired method is visible. Touch and hold (long touch) the method to be deleted.



2. Select (touch) the “X” icon at the top of the screen. The following screen will appear.



3. Select “Yes” to continue and delete the method. If the method is not to be deleted, select “No.”

Perform Method

WARNING

CEM Recommends that a post-method cool down time be used for each digestion performed in the MARS 6 instrument to prevent the possibility of operator burns or acid spills

Proper precautions must be taken to avoid contact with reagents or reagent vapors. Protective gear should be worn as outlined in the user's safety program for hazardous materials and the reagent manufacturer's material safety data sheet. Refer to these guidelines for proper handling and disposal of the reagent.

ReactiGuard alerts the operator to the occurrence of an event within a vessel; therefore, CEM recommends that ReactiGuard be "on" at all times.

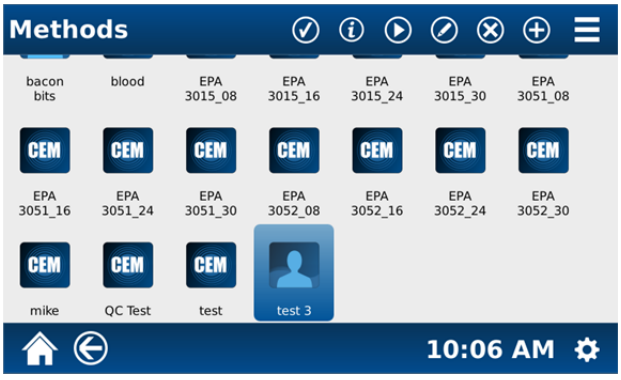
Use extreme caution while attempting to identify the underlying cause(s) of a detected vessel event. Always wear protective gear such as gloves, a lab coat, eye protection, etc.

CAUTION

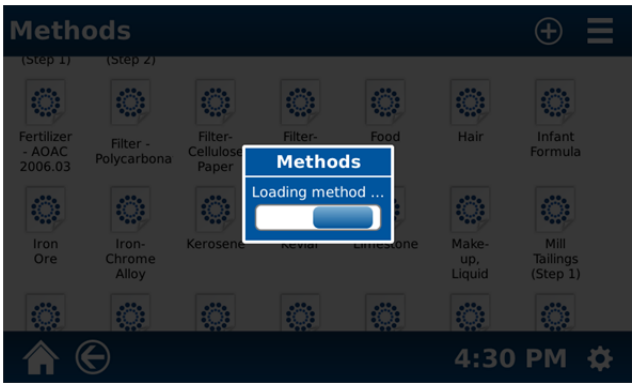
To lengthen the lifetime of the display, CEM recommends that a screen saver time be used at all times.

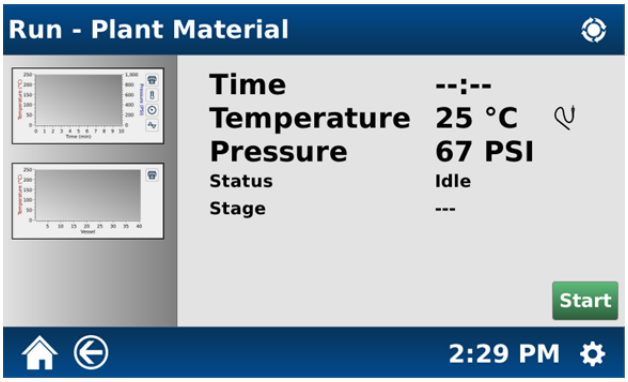
1. Prepare the vessels selected for the digestion in accordance with procedures outlined in the vessel manual. **Note:** Minimum volume for the MARS 6 cavity is 10 mL of acid or 50 mL of water.

2. From the MARS 6 home screen, select either "One Touch Methods" or "Classic Methods."



3. Scroll through the methods until the desired method is visible. Select the method to be performed.

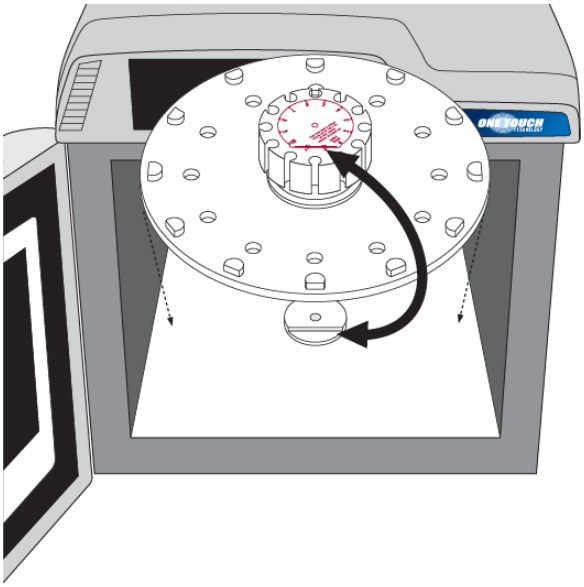




WARNING

Because cardiac pacemakers require magnets to control operation during checkout, if the MARS is equipped with a sample stirrer, some danger exists if a pacemaker is positioned in close proximity to the instrument cavity. If the instrument is suspected of interfering with the operation of a pacemaker, the instrument should be turned off or the pacemaker wearer should move away from the instrument.

4. Install the turntable into the instrument, ensuring that the flat edge on the bottom of the turntable corresponds with the flat edge of the turntable lug. **Note:** The vessels can be installed into the turntable prior to turntable installation into the instrument cavity.



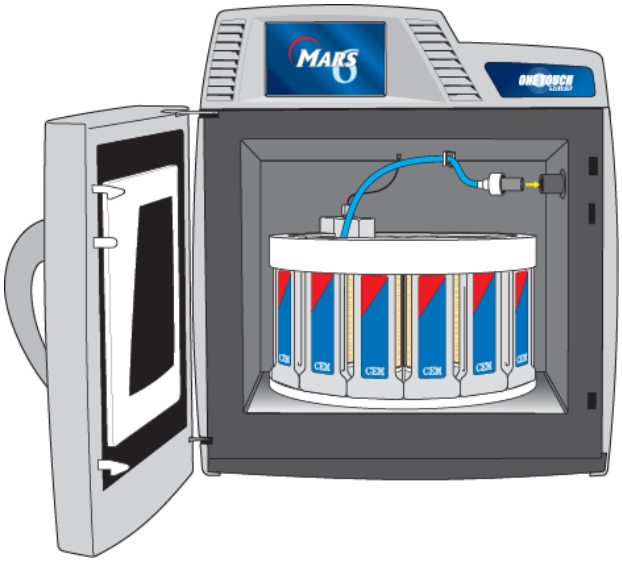
5. If using temperature and/or pressure control, ensure that the appropriate sensors are installed in the control vessel prior to placing the control vessel into the MARS 6 cavity.

6. Install the vessels in the turntable. Place the ESP Plus into the center of the turntable with the pressure line attached to the control vessel. Select the turntable icon at the top of the screen to rotate the turntable for ease of vessel position. If all positions of the turntable are not utilized, arrange the vessels symmetrically. (Refer to the MARS 6 User Guidelines (600288) for assistance with a microwave digestion method development.

WARNING

All CEM microwave digestion instruments are to be operated using CEM designed vessels and vessel components. All CEM supplied vessels and components are manufactured to exact specifications in order to provide a product that is reliable and safe to work in conditions that include high temperatures and pressures. The use of vessels and vessel components other than original CEM parts will put operators and equipment at risk. CEM will not assume any liability for use of these parts and all warranties, either written or implied, will immediately become void. CEM vessels can only be purchased direct from CEM or through its authorized dealer network. CEM vessels are covered by worldwide patents including US patents 8,480,981 and 6,136,276.

7. If the vessel set has a retaining ring, place the vessel retaining ring on the vessels with the notch of the retaining ring resting on the control vessel.



8. Align the ESP-1500 Plus with the connector port. Rotate the ESP while gently pushing it into the connector port until it slips into the correct position. This rotation is to align the ESP-1500 Plus and the connector port. Once the connector is properly aligned, push the ESP into the connector port until the polypropylene guard is fully seated against the connector port.

CAUTION

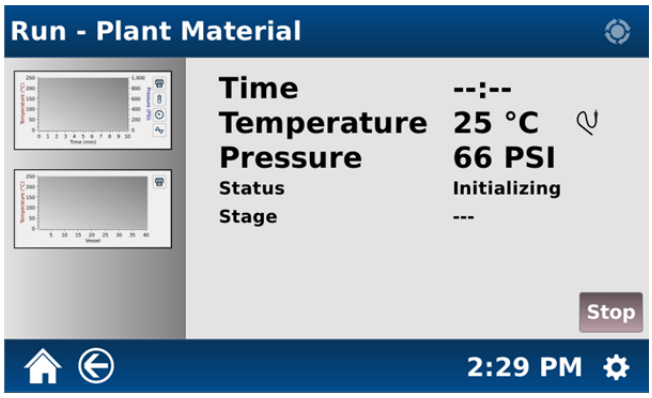
During installation of the ESP-1500 Plus, use caution to prevent loosening the pressure line nut which can cause leakage, leading to corrosion of the connections on the sensor and the bulkhead fitting.

Ensure that the pressure line of the ESP-1500 Plus does not become entangled in the MTS-300 temperature controller.

9. Without crossing over the pressure tubing, snap the MTS-300 into the connector located in the center of the roof of the cavity.

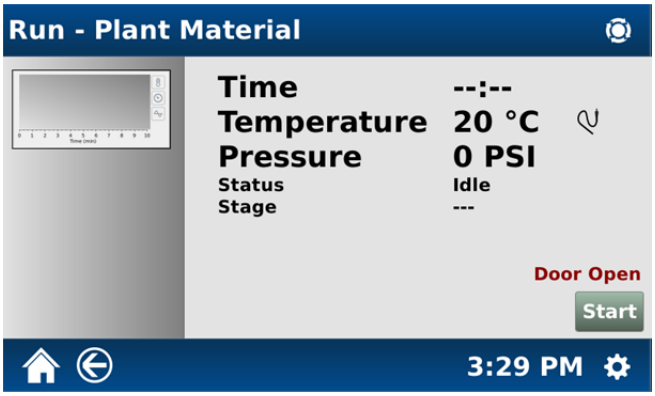
10. Position the pressure tubing in the guide ring mounted on the roof of the cavity.

11. Select “START.” The instrument will begin the method according to the selected parameters – initializing, ramping, holding, cooling, etc.

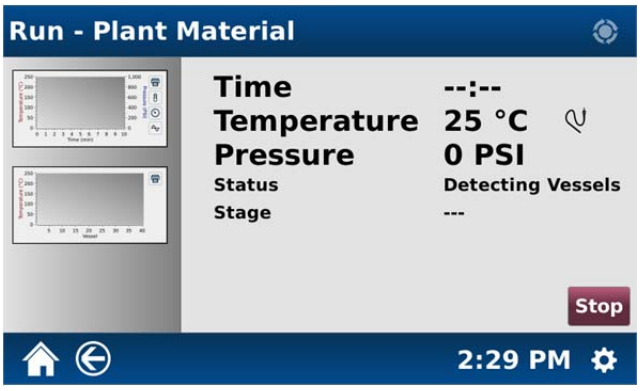


MTS-300 Temperature Control

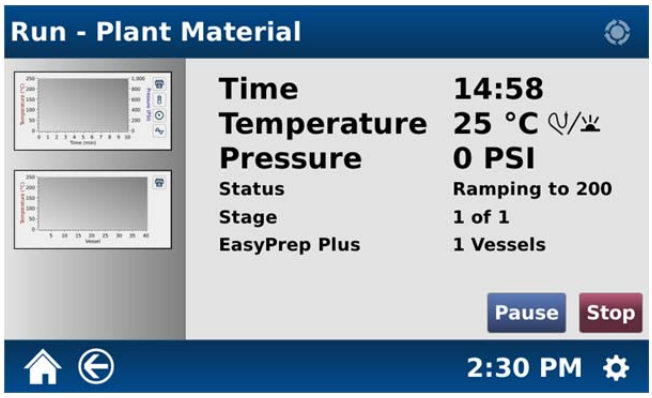
12. If the instrument door is not properly closed or is opened during performance of a method, the following screen will be displayed.



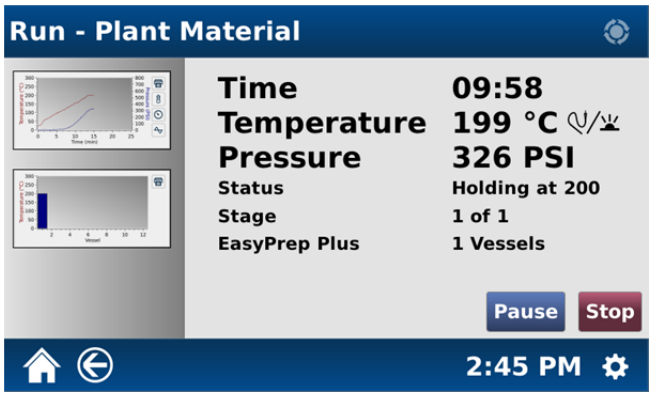
13. Ensure that the door is properly closed and select “Start” to resume the method. During the method, the following screens may appear.



Detecting Vessels

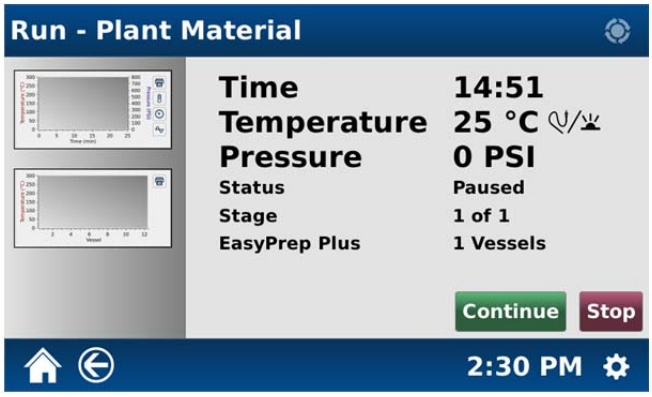


Duo-Temp (MTS-300 and Infrared) Control
Ramping to Specified Temperature

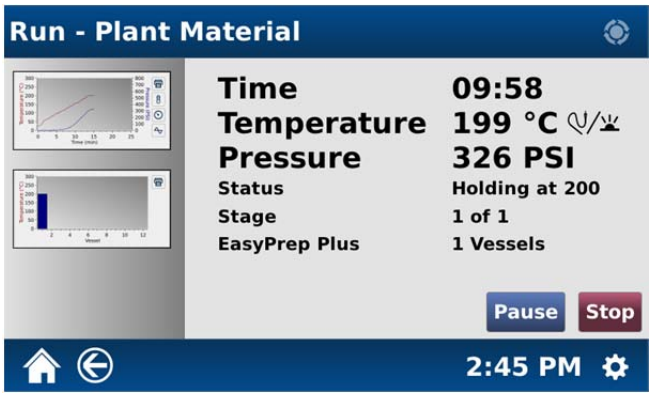


Holding at Specified Temperature

14. If “Pause” is selected during performance of a method, the following screen will be displayed.

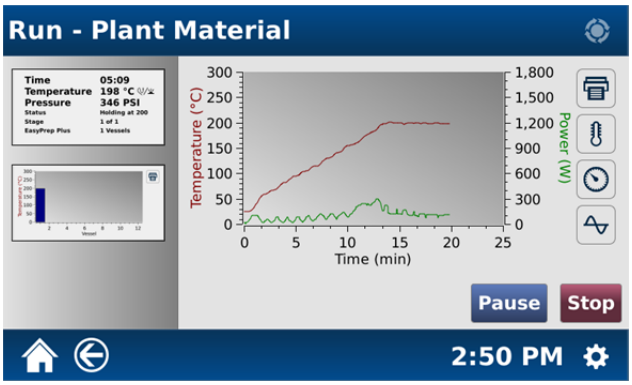


15. Select “Continue” to resume the method following a pause.

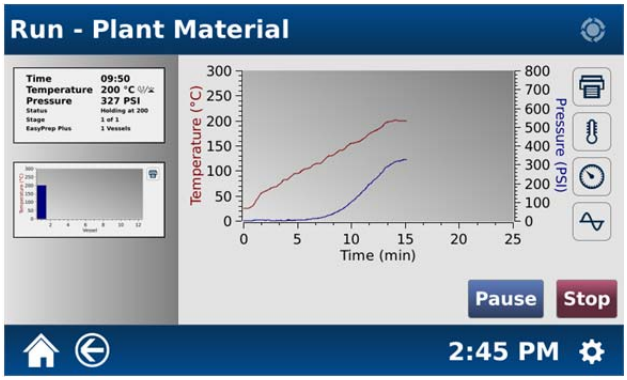


16. To display a graph of the current status of the method on the screen, select the applicable graph on the left side of the screen or the applicable icon on the right side of the screen.

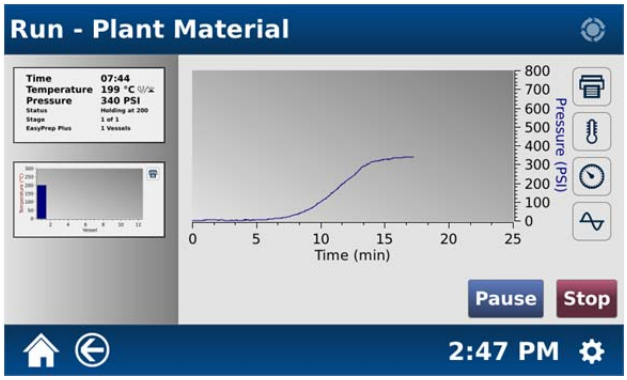
17. To print the method information displayed on the screen using the optional internal printer at any time during the method performance, select the “print” icon on the right side of the screen.



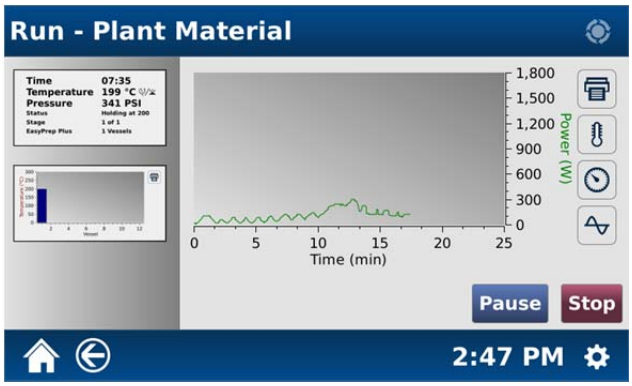
Temperature/Power/Time Graph



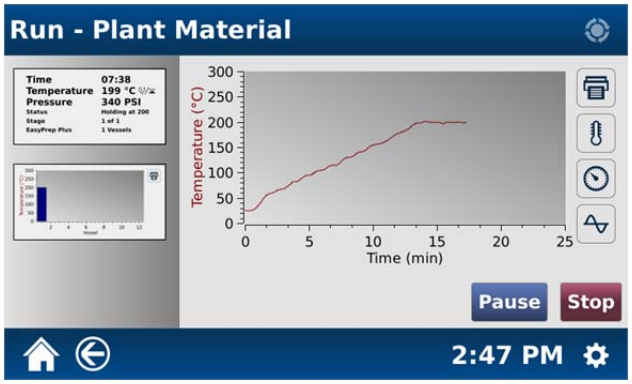
Temperature/Pressure/Time Graph



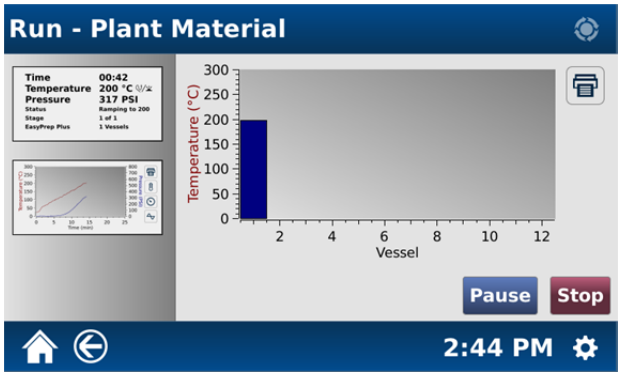
Pressure/Time Graph



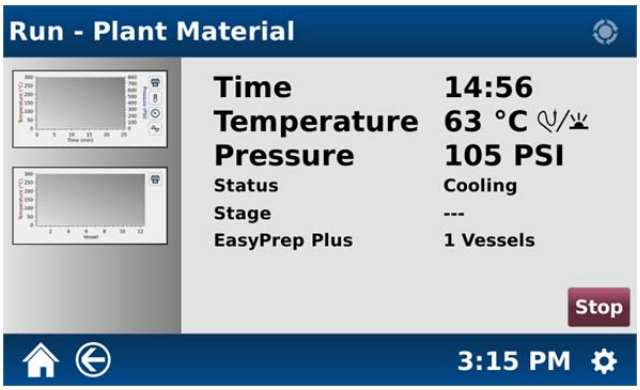
Power/Time Graph



Temperature/Time Graph



Temperature in Vessel Graph



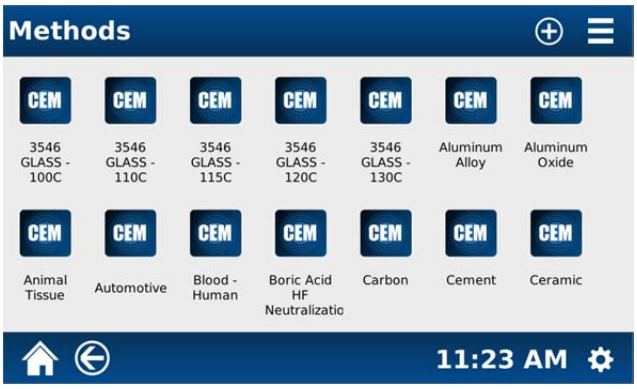
18. Once the method is complete or if “Stop” is selected, the instrument will proceed to the post-method cool down operation if it is turned on in the system setup procedure.

WARNING

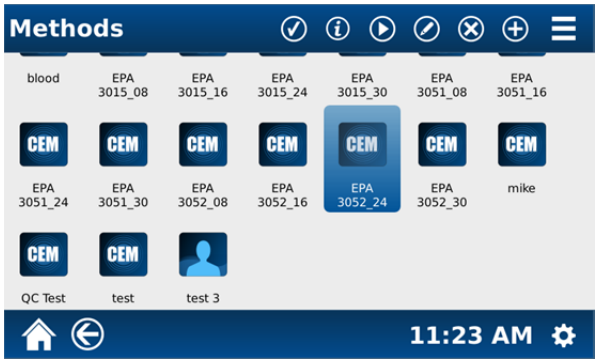
CEM Corporation recommends that a post-method cool down time be used for each digestion performed in the MARS 6 instrument to prevent the possibility of operator burns or acid spills.

Retrieve Data from Previous Method Performance

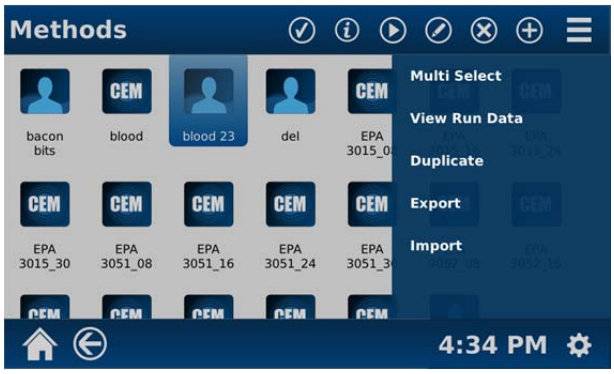
1. From the MARS 6 home screen, select “Classic Methods” or “One Touch Methods.”



2. Scroll through the methods until the desired method is visible. Touch and hold (long touch) the method from which the data is to be used.

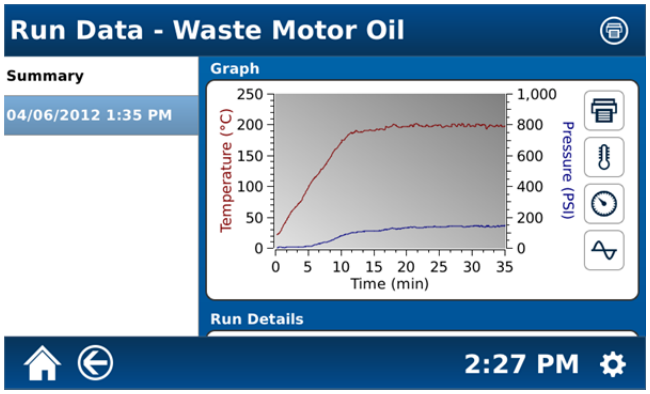


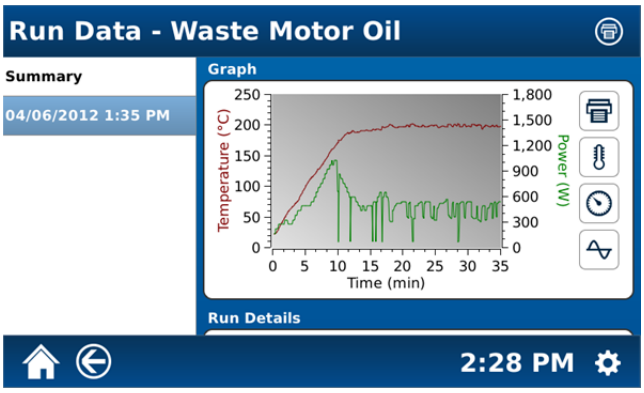
3. Select (touch) the “Screen Context Menu” icon at the top right of the screen. The following screen will appear.



4. Select “View Run Data.”

5. Scroll through the method run data screen to view all available information. If the instrument is equipped with a printer, select the “print” icon at top of the screen to print any of the run data information.

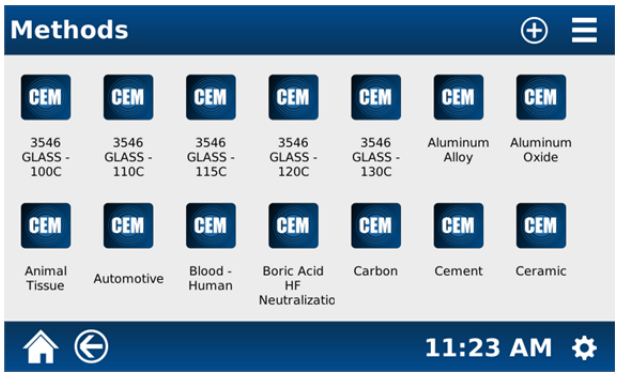




Selection of Single or Multiple Methods for Export and/or Deletion

Export Single/Multiple Methods

1. From the MARS 6 home screen, select “Classic Methods” or “One Touch Methods.”



2. Scroll through the methods until the first desired method is visible. Touch and hold (long touch) the method.

3. Select (touch) the “Screen Context Menu” icon at the top right of the screen. The following screen will appear.

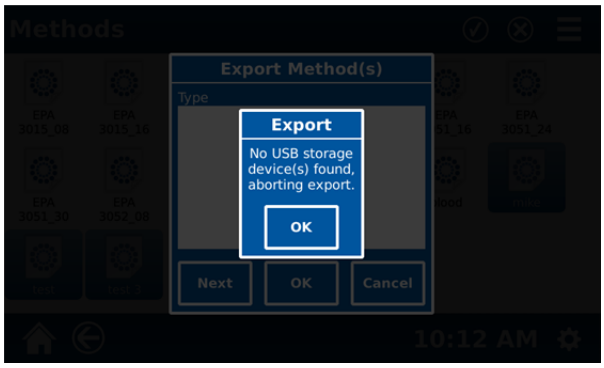
4. Select “Multi Select.”

Note: If a single method is to be exported or deleted, select (touch) “Single Select.” The last method selected will be the only method to remain selected.

5. Select (touch) the previous method selected in step 3.
6. Select (touch) the additional desired methods to export or import.

7. Select (touch) the “Screen Context Menu” icon at the top right of the screen.

8. Install a USB flash drive in one of the USB ports.
9. Select “Export” from the Screen Context Menu to export the selected methods to the USB flash drive.
10. If a USB flash drive is not installed, the following screen will appear.



Note: TempGuard™ value exports with the method.

DeleteSingle/ Multiple Methods

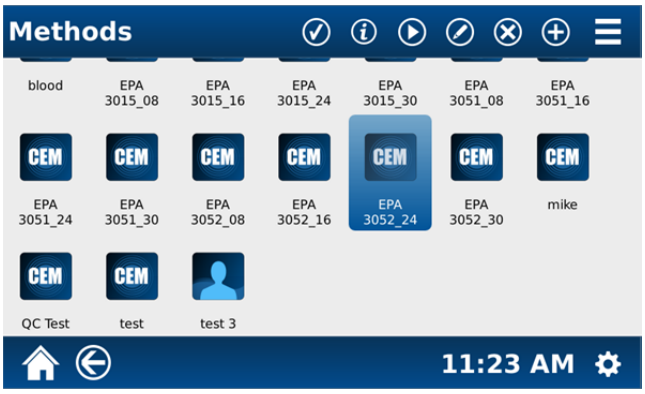
11. Follow steps 1 through 10 above.

12. Select the “X” (delete icon) at the top of the screen to delete the method(s). To export the method(s), follow steps 8 through 10 above.

Print Method Data

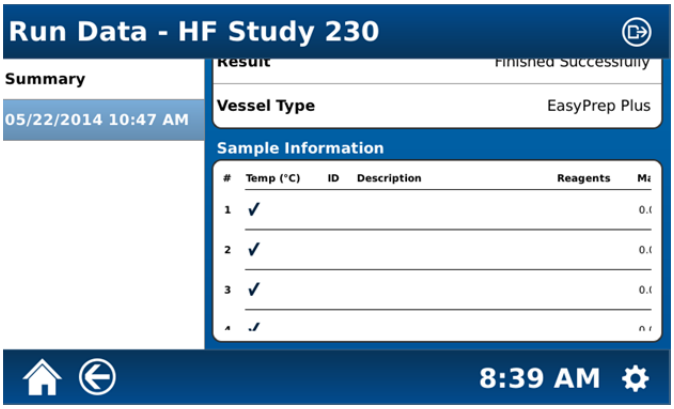
1. Refer to the “Settings/Run” section of this manual to select the items to be included in the printed data report.
2. From the “Home Screen” select either “One Touch” or “Classic” methods.

3. Select the method (touch and hold the icon) to be used for the data report.



4. Select “Start.” Once the method is complete, press the “Home” icon.
5. From the “Home Screen,” select the “One Touch” or “Classic” (touch and hold) method performed in step 4.
6. Touch the Screen Context Menu icon.

7. Select “View Run Data.”
8. Select the date and time of the method tested. Scroll the View Run Data screen upward to display “Sample Information.”



9. Touch inside the “Sample Information” section of the screen.
10. Enter the applicable information. If any field applies to all samples, select “Apply All.”

System Menu

Tools

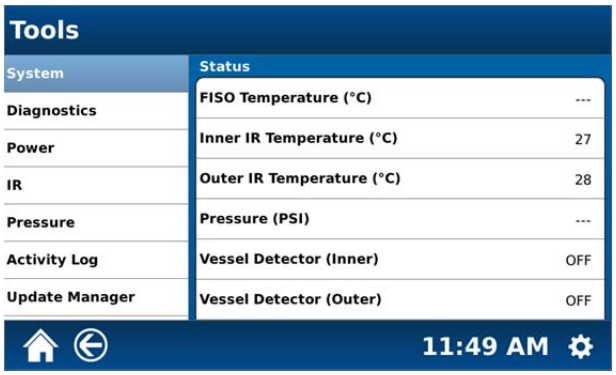
From the MARS 6 home screen, select (touch) the “System Menu” icon in the bottom right corner of the screen.

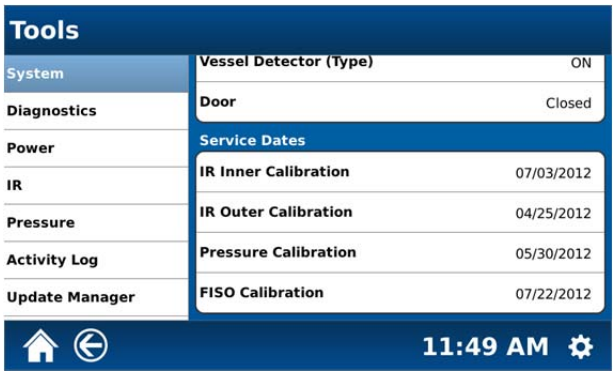
1. Select “Tools.”

2. Select “**System**.” Touch and scroll through the “System” information to view “Status” and “Service Dates.”

NOTE

The “System” screen provides instrument information including temperature and pressure readings, door status (open or closed), calibration dates, and instrument history. This information is for information purposes only and cannot be revised except by a certified CEM Service Engineer.

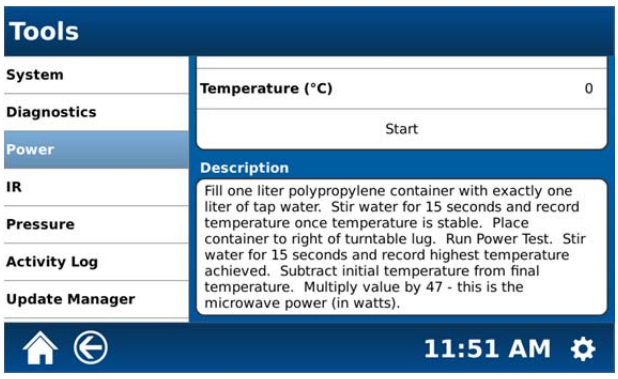




3. Select "**Diagnostics**."

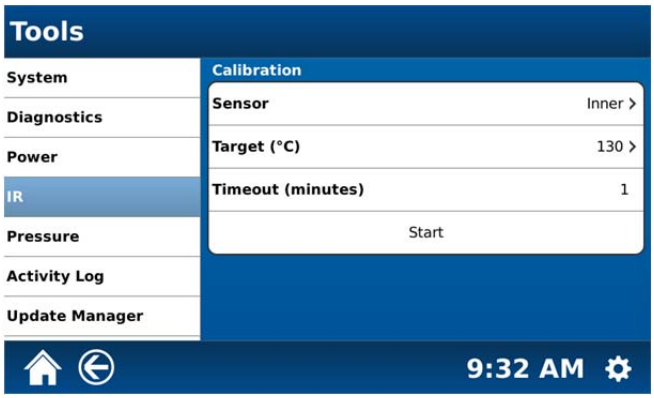
4. To test the turntable rotation, cavity blower, mag fans and/or stirrer, toggle (select) "On. The applicable component will turn on. Select "Off" to stop the test. To turn the cavity lights on or off, toggle the "On" or "Off" selection.

5. Select "**Power**."



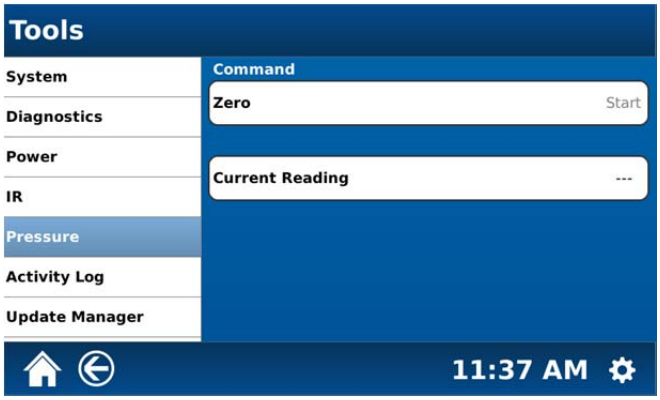
6. The Power selection is used to perform a manual power test. Refer to "Microwave Power Measurement" in the "Maintenance, Troubleshooting and Service" section of this manual for instructions for performing a power test.

7. Select “**IR**.”



8. The IR tool is provided for calibration of the IR sensors. Refer to “Temperature Calibration (IR Sensors) in the “Maintenance, Troubleshooting and Service” section of this manual for instructions for performing calibration of the IR sensors.

9. Select “**Pressure**.”

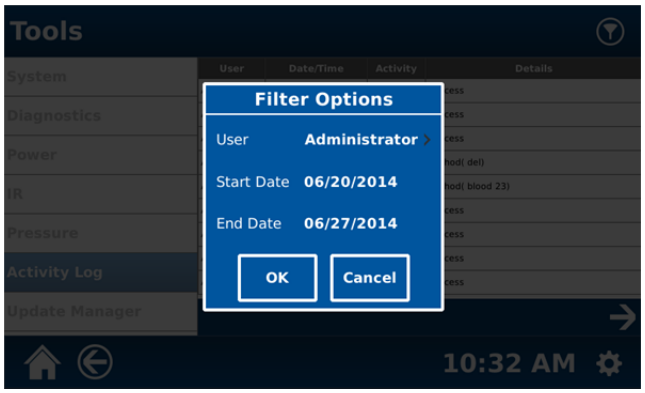


10. The Pressure tool is provided for calibration of the pressure device. Refer to “Pressure Calibration” in the “Maintenance, Troubleshooting and Service” section of this manual for instructions for performing pressure calibration.

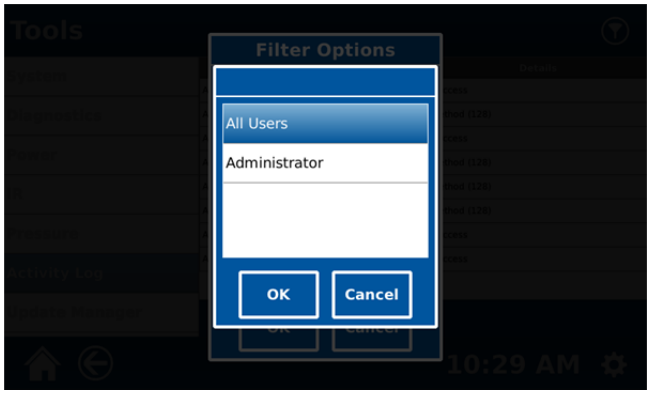
11. Select “**Activity Log**.”

Note: The activity log displays a history of instrument use. It displays the user, the date and time, the activity and details of use.

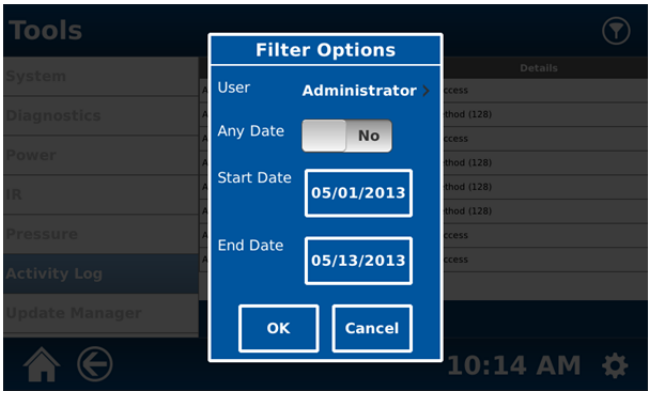
12. Select the “filter” icon in the top right hand corner of the screen to select options for display of the activity log.



13. To select a user rather than an administrator, select “Administrator.”



14. Select either “All Users.” “Administrator” or a specific user. Once the user is selected, the following screen will appear.



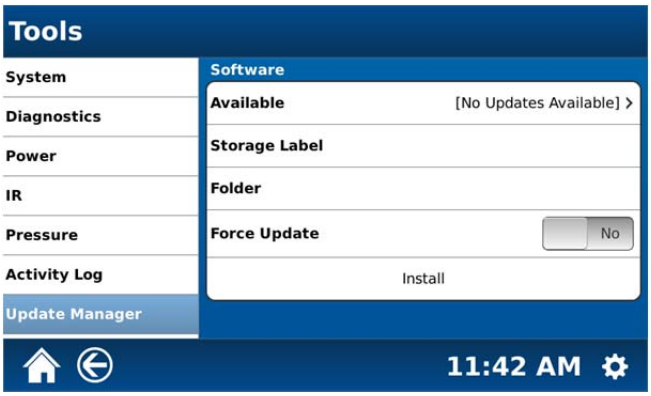
15. To check activity during specific dates, select “Start Date.”

16. Select the month, day and year. Select “OK.”

17. Repeat this procedure to select the “End Date.” Select “OK.”

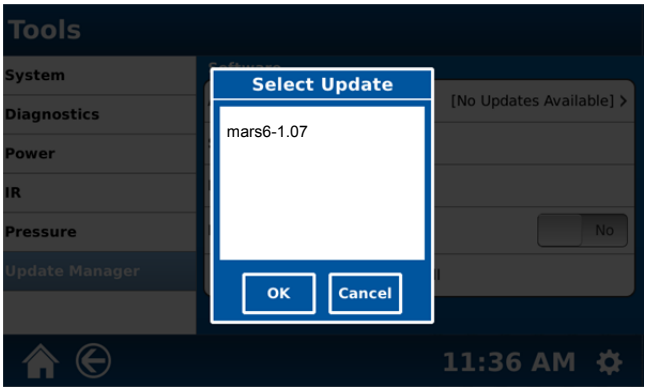
18. Once the user and start and end dates are selected, select “OK” to return to the Activity Log screen.

19. Select “**Update Manager**.”



20. Install a USB flash drive into one of the USB ports.

21. Select “Select Update.”



22. Select (highlight) the software version to be installed.

23. Select “OK.”

24. Select “Install.” The software will be automatically updated. **Note:** The software may power the instrument on/off several times during the installation process. The update may take as much as 20 minutes to complete. The update is complete when the home screen is displayed.

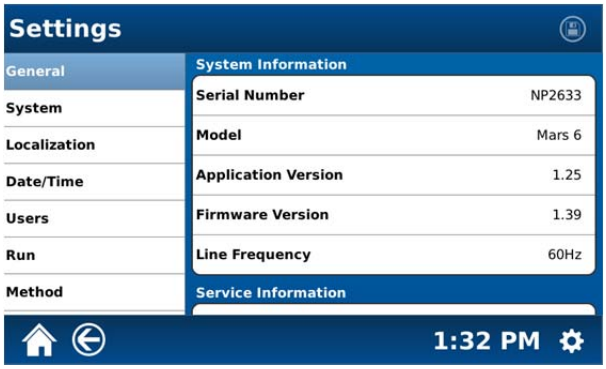
Settings

NOTE

Information and instrument parameters in the “Settings” portion of the MARS 6 software can be revised only by a user with Administrator rights.

25. From the MARS 6 home screen, select (touch) the “System Menu” icon in the bottom right corner of the screen.

26. Select “Settings.”

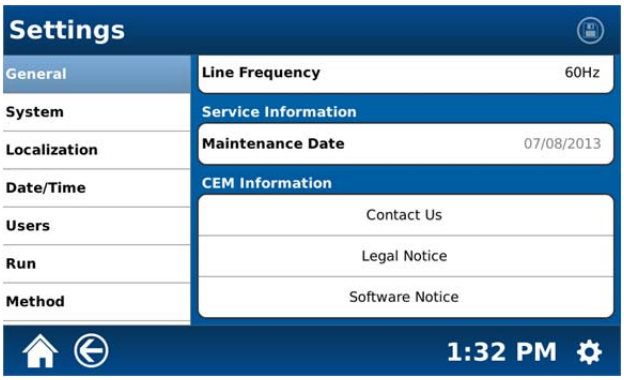


27. Select “**General**.” The above screen provides legal system information including the instrument serial number, the instrument software and firmware versions, and the electrical line frequency.

CAUTION

This legal information including the maintenance date can be revised only by a CEM Certified Service Engineer.

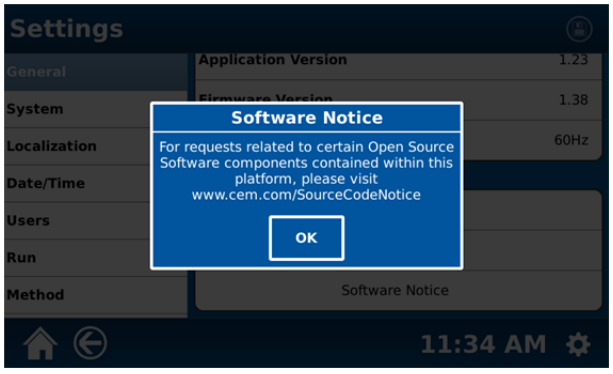
28. Scroll the General screen to reveal the Service “Maintenance Date” and “CEM Information” screen. The maintenance date can be revised only by a CEM Certified Service Engineer.



29. Select “Contact Us” for CEM contact information.

30. Select “Legal Notice” for the copyright information pertaining to the software installed in the instrument.

31. Select “Software Notice” for questions relating to software information.



Note: Select “OK” to exit any of the above screens.

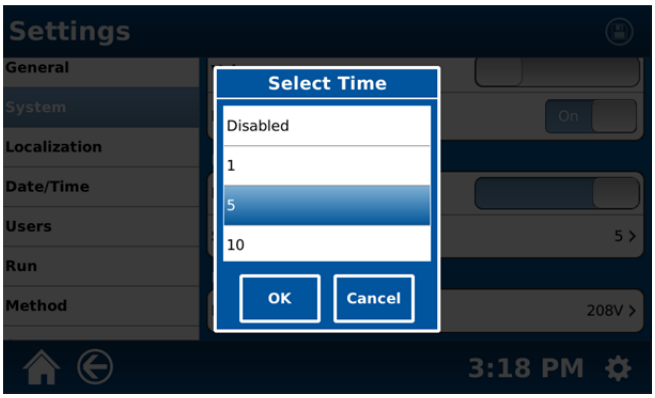
32. Select “**System**.”

33. Touch and move the slider to adjust the volume.

34. The Key Click is an audible “beep” each time the keypad is used to enter information into the system. It can be turned on and off. Select “on” or “off.” When the key click is turned on, adjust the volume to the desired level by sliding the control on the volume slider.

35. Touch and move the slider for the display contrast scale to adjust the screen contrast.

36. The screen saver time (if enabled) is set to determine the length of time the instrument can be idle prior to the screen saver appearing on the screen. Screen saver time can be set from 1 to 120 minutes in increments of 5. Default screen saver time is 5 minutes. To adjust the screen saver time, select the arrow to display the screen saver time menu and select the desired screen saver time. To disable the screen saver, select “Disabled” from the following screen.



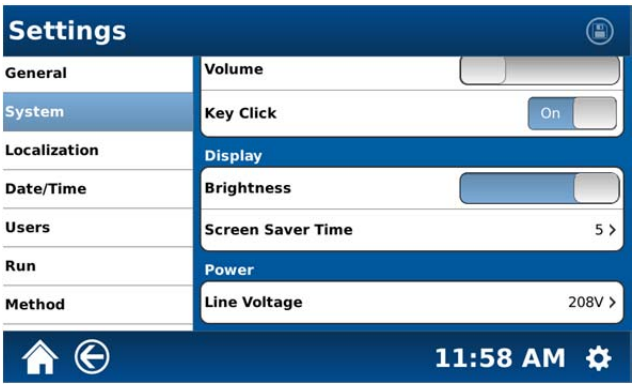
37. Select “OK.”

38. Once the audio, key click, display, and screen saver parameters are selected, touch the disk icon at the top of the screen to save the system settings. Once the settings are saved, the disk icon will be grayed out.

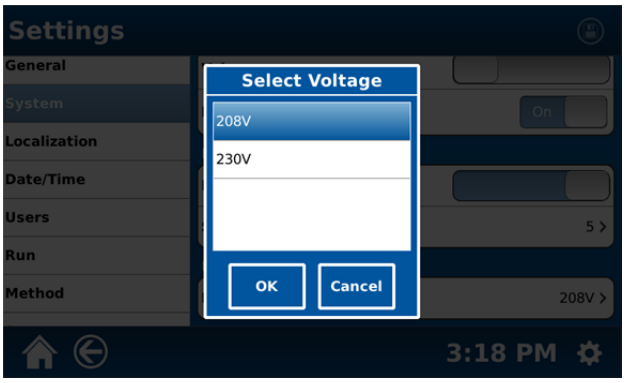
CAUTION

To lengthen the lifetime of the display, CEM recommends that a screen saver time be used at all times.

39. Scroll the System screen to display “Power.”



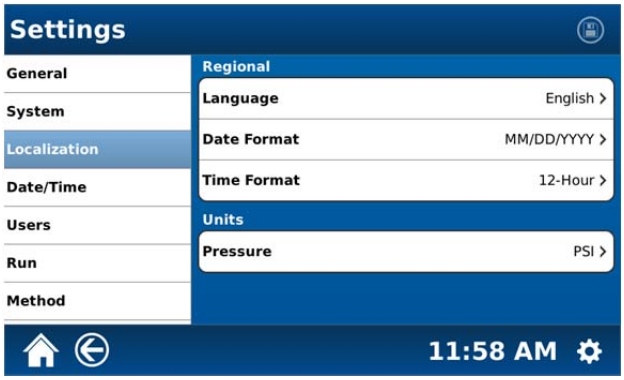
40. Select “Line Voltage.”



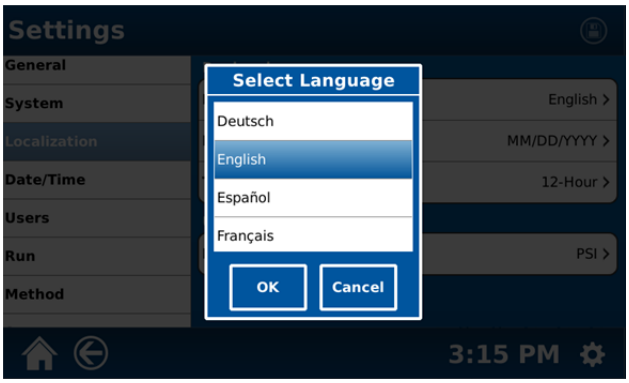
41. Select and highlight the proper voltage for the instrument – 208V or 230V.

42. Select “OK.”

43. Select “**Localization**.”



44. To display the available languages (Deutsch, English, Spanish, French, Italian, Chinese, Russian, or Japanese), select the drop-down menu by touching the displayed language.

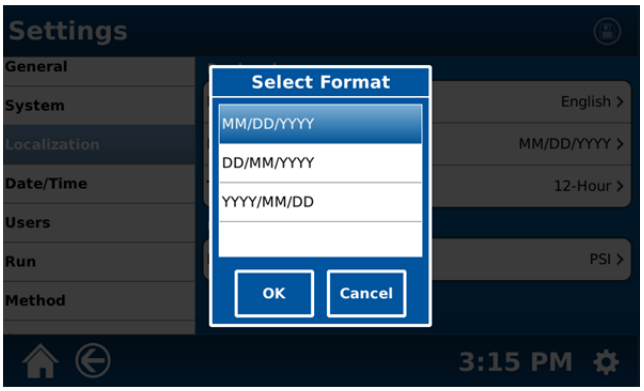


45. Select the desired language.

46. Select “OK.”

47. Select “Date Format.”

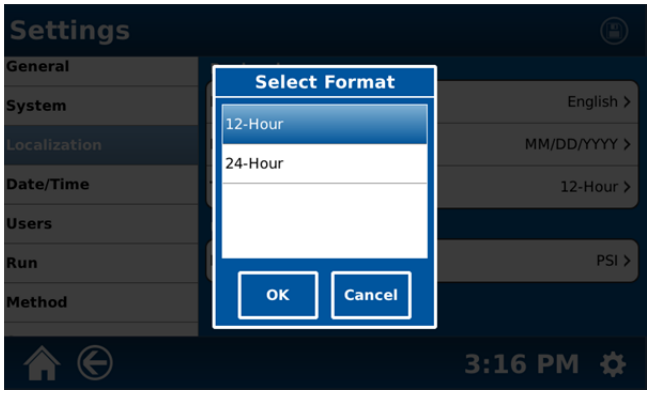
48. To display the available date formats - select the drop-down menu by touching the displayed date format.



49. Select the desired method for displaying the date - MM/DD/YYYY (Month/Day/Year) DD/MM/YYYY (Day/Month/Year), or YYYY/MM/DD (Year/Month/Day)

50. Select “OK.”

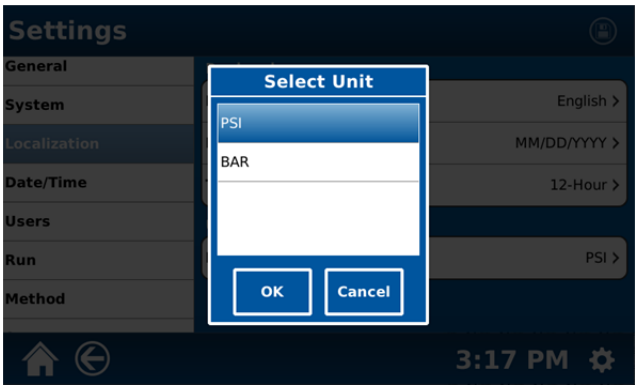
51. Select “Time Format.”



52. Select the desired format (12 hour or 24 hour).

53. Select “OK.”

54. Select “Pressure.”

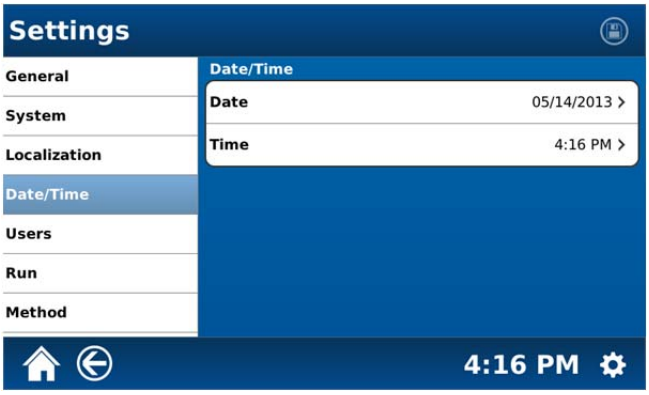


55. Select the desired format for displaying method pressures (PSI or BAR).

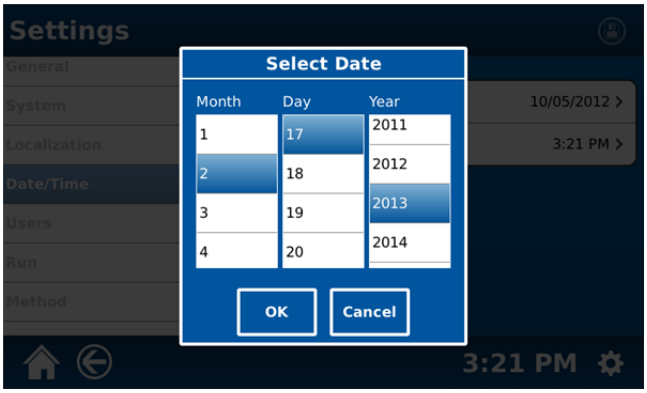
56. Select “OK.”

57. Once all regional and unit parameters are selected, touch the disk icon at the top of the screen to save the selected parameters. Once the parameters are saved, the disk icon will be grayed out.

58. Select “**Date/Tiime**.”



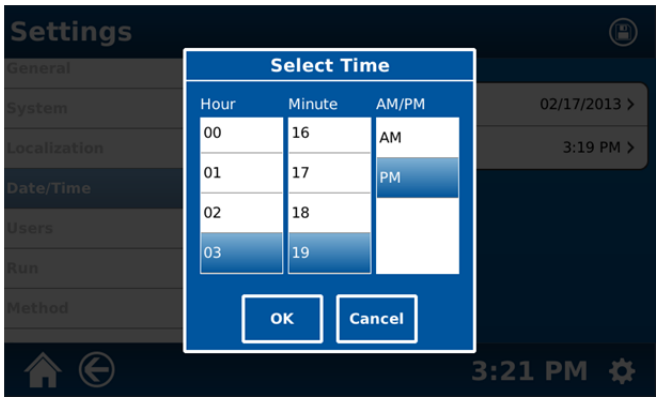
59. If the date displayed on the screen is incorrect, select “Date.”



60. Scroll through the month, day and year and select the appropriate date.

61. Select “OK.”

62. If the time displayed on the screen is incorrect, select “Time.”



63. Scroll through the hour, minute and AM or PM and select the appropriate time.

64. Select “OK.”

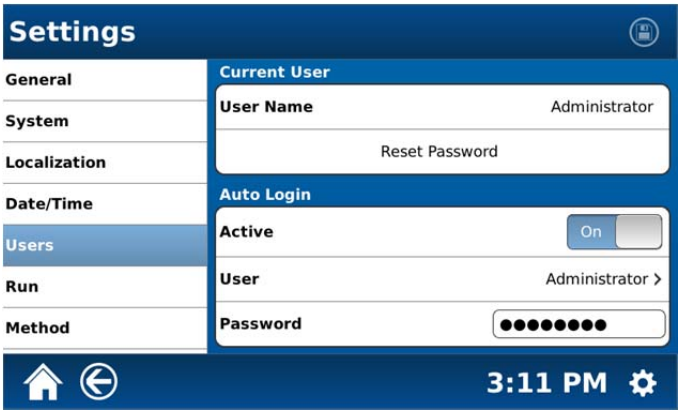
65. Once the date and time are properly displayed, select the disk icon at the top of the screen. Once the date and time are saved, the disk icon will be grayed out.

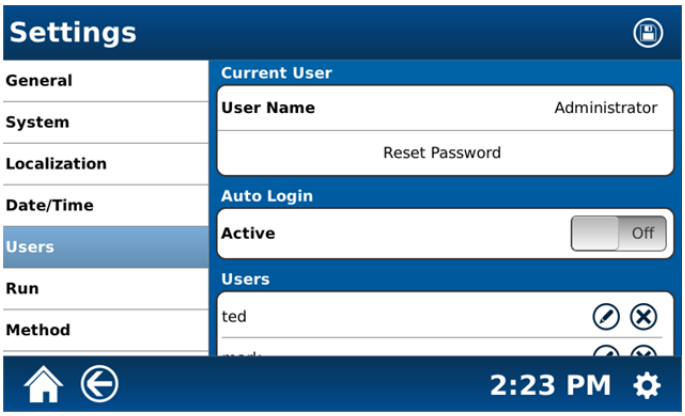
66. Select “**Users**.”

67. **Note:** If the auto login is turned on, the first screen shown below will appear. If the auto login is turned off, the second screen below will appear. Only the Administrator can change the “Auto Login” to on or off.

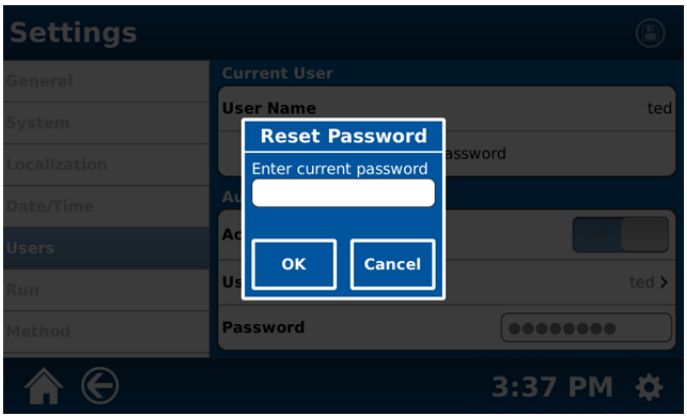
CAUTION

Do Not turn “Auto Login” off unless a password is to be required to activate the system operating software.





68. To reset the password for the user or administrator who is logged in, select “Reset Password” from either of the above screens.



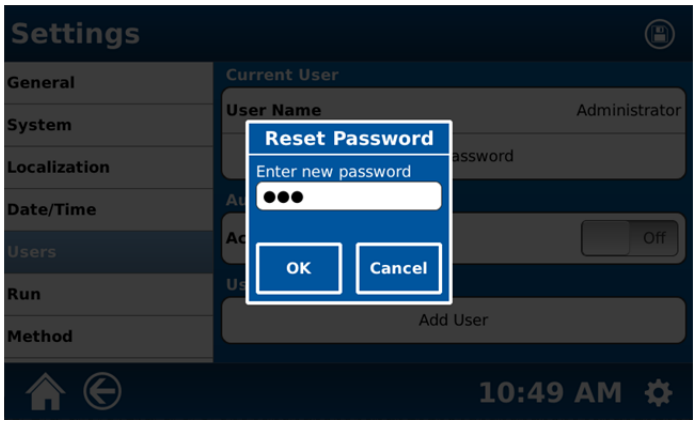
69. Select (touch) “Enter current password.”

70. Using the keypad, enter the current administrator or user password.

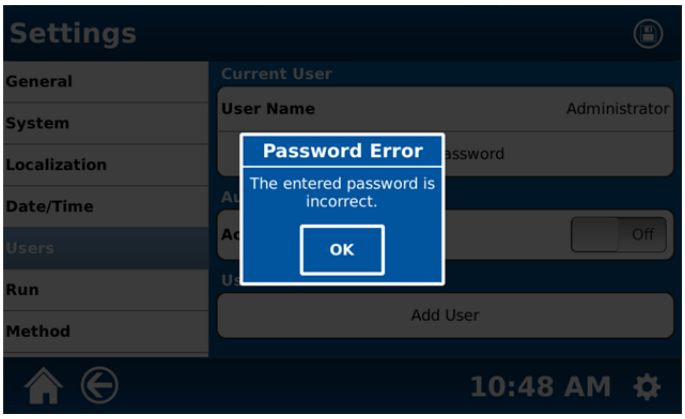
71. Once the current password is entered, select “hide” to close the keypad.

72. Select “OK.”

73. If the password is entered correctly, the following screen will appear.



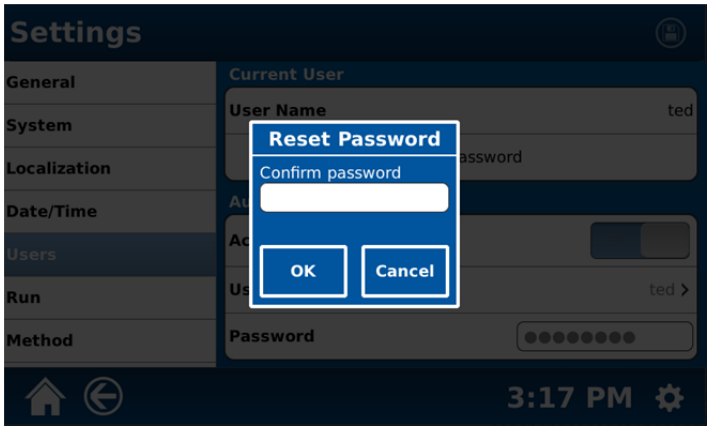
74. If the password is entered incorrectly, the following screen will appear.



75. If an incorrect password has been entered, select “OK” and return to the Reset Password screen to enter the correct password.

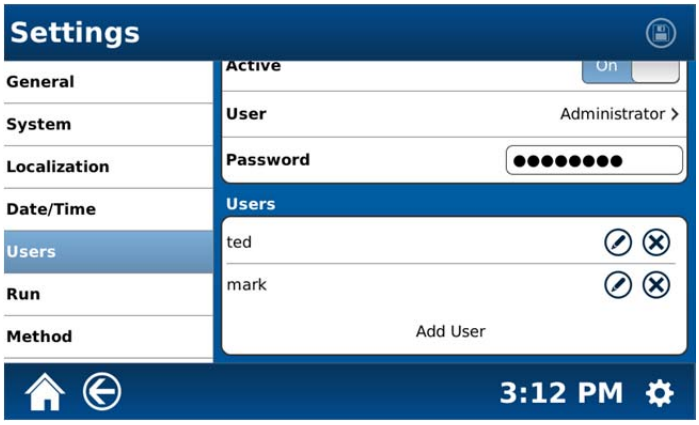
76. If the password has been entered correctly, the Reset Password screen will appear as illustrated above in step 72. Using the keyboard, enter the new password.

77. Select “OK.”

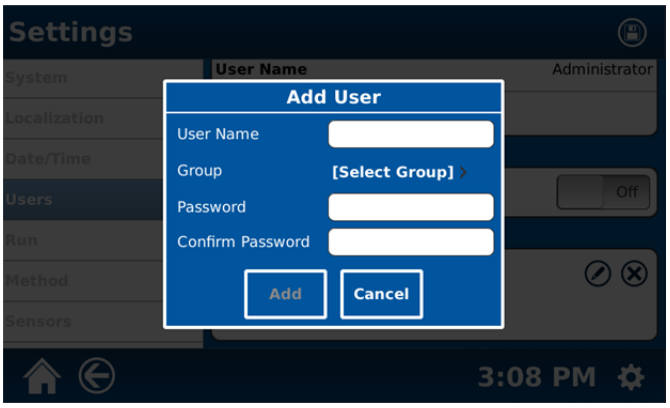


78. Using the keyboard, enter the new password again to confirm the password.

79. Select “OK.” The new password will be saved in the instrument software and return to the “Users” screen.



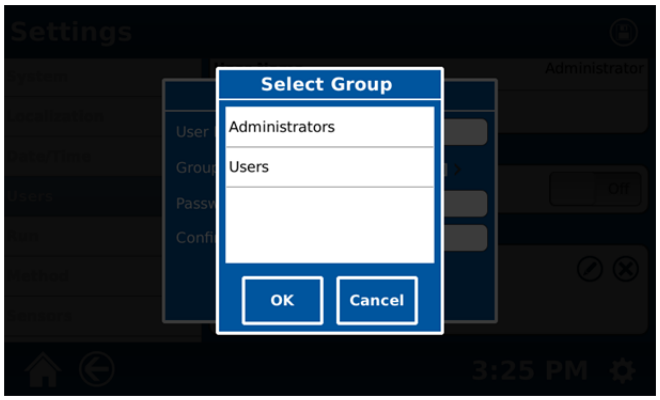
80. To add a new user, select “Add User.”



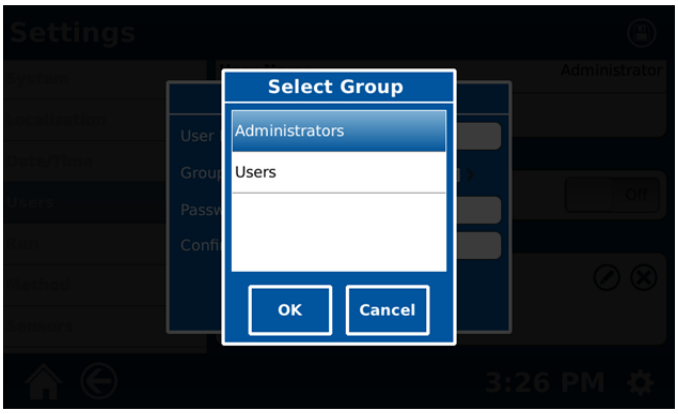
81. Select “User Name.”

82. Using the keypad, enter the appropriate user name. Once the user name is entered, select “hide” to close the keypad.

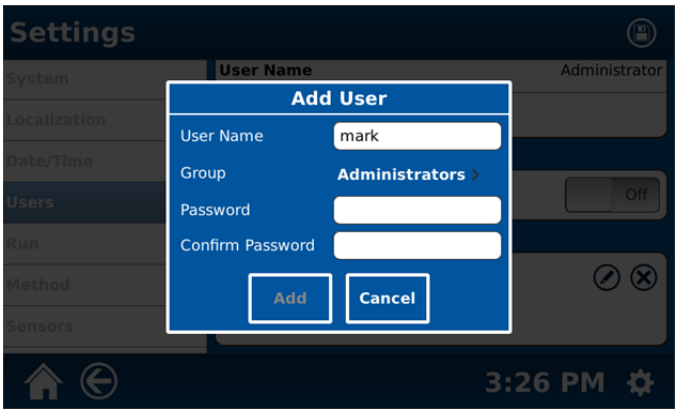
83. Select the arrow beside “Select Group.”



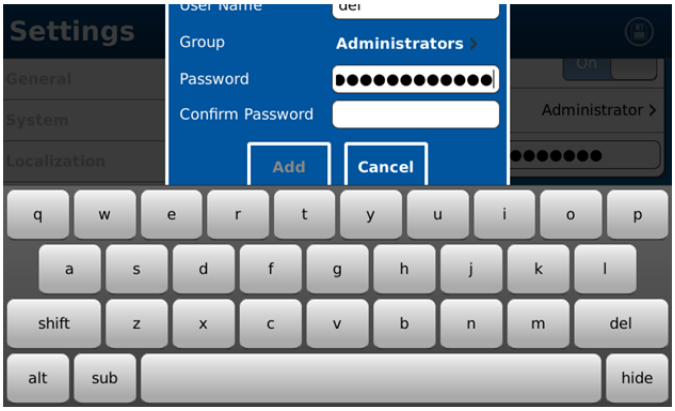
84. Select the appropriate level for the user – Administrator or User.



85. Select “OK” to return to the “Users” screen.



86. Select “Password.”



87. Using the keypad, enter the user password.

88. Select “hide” to close the keypad.

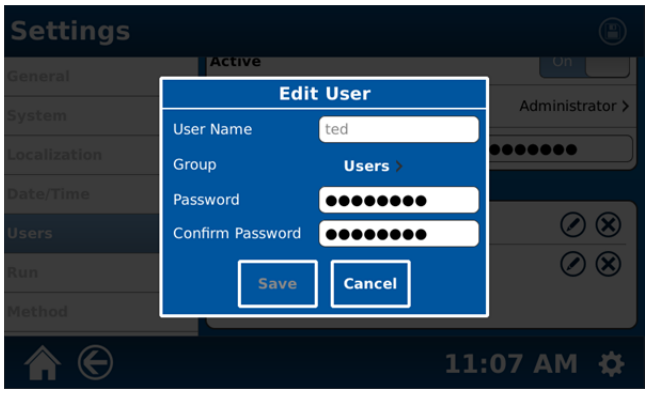
89. Select “Confirm Password.”

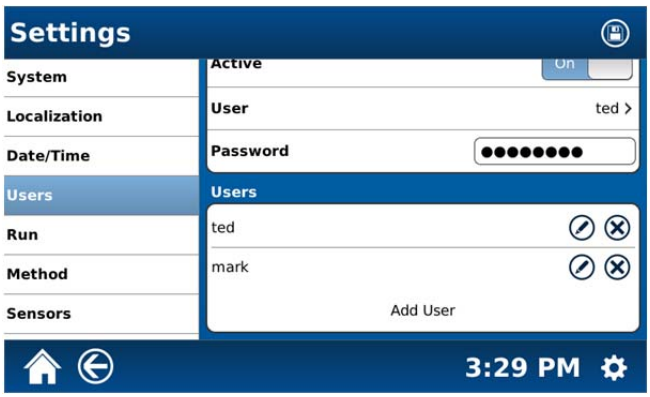
90. Using the keypad, enter the user password to confirm its usage.

91. Select “hide” to close the keypad.

92. Once all information is entered properly, select “Add” to add the user to the instrument software.

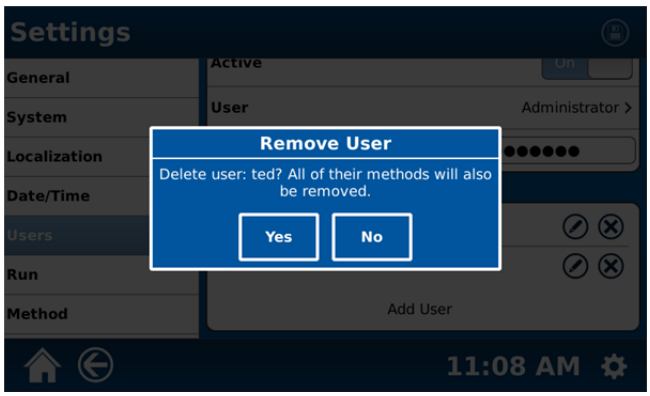
93. To edit a user’s information, select the edit icon for the user.





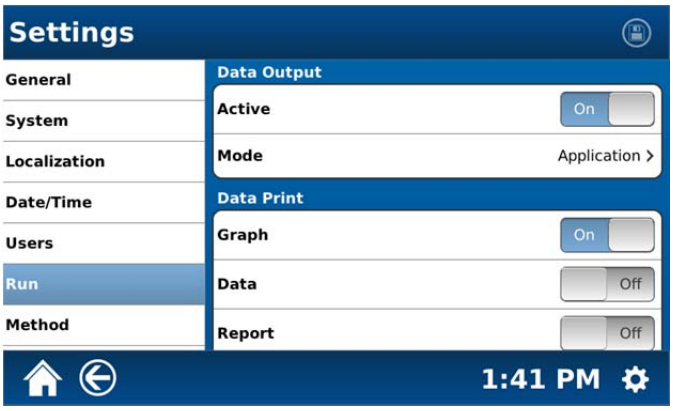
94. Edit the user’s information as outlined above for adding a user.

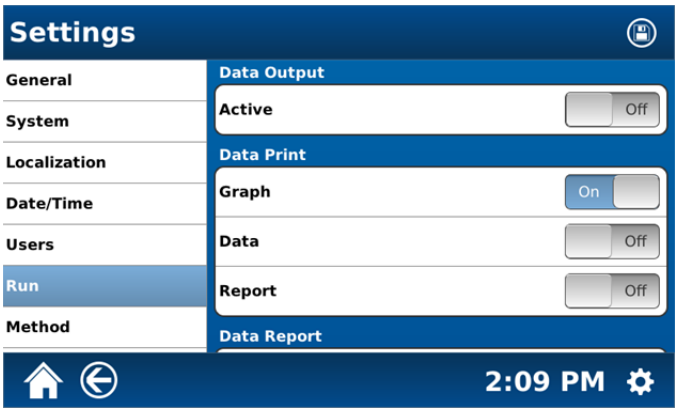
95. To delete a user, select the “Delete” icon for the user.



96. Select “Yes” to delete the user’s ability to access the instrument data.

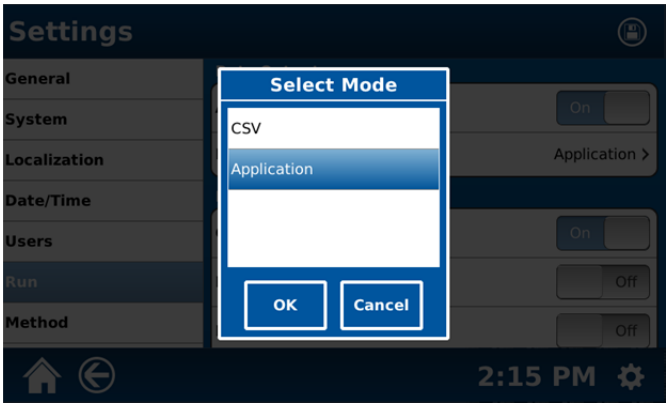
97. Select “**Run**.” Based on the setting for the Data Output, one of the two following screens will appear.





98. Data output can be sent to a PC or USB flash drive. Select “On” or “Off” for data output.

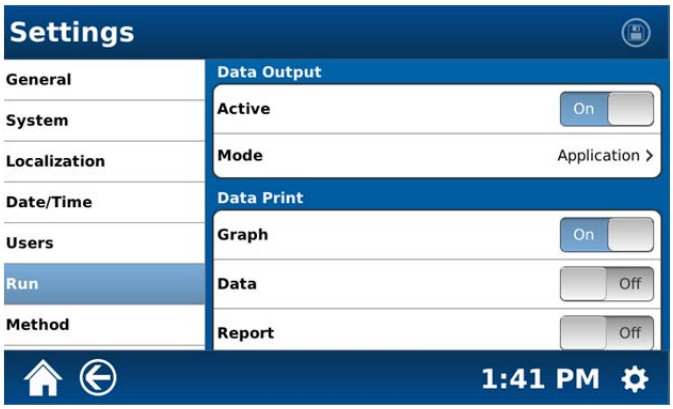
99. Select “Mode.”

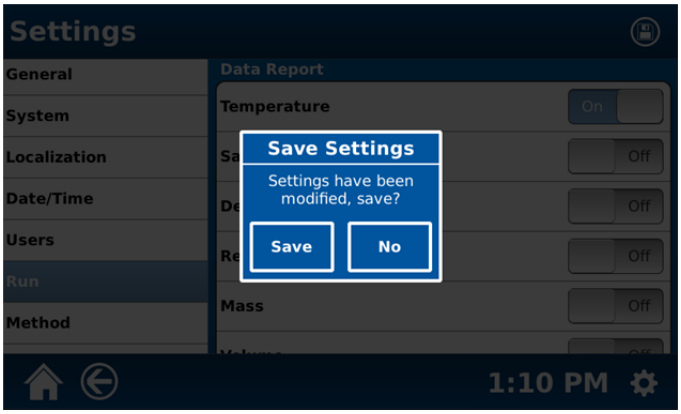


100. Select either “CSV” or “Application” as the mode of data output.

101. Select “OK.”

102. The method of printing data can be selected by turning “Graph,” “Data,” and/or “Report” “On” or “Off.”

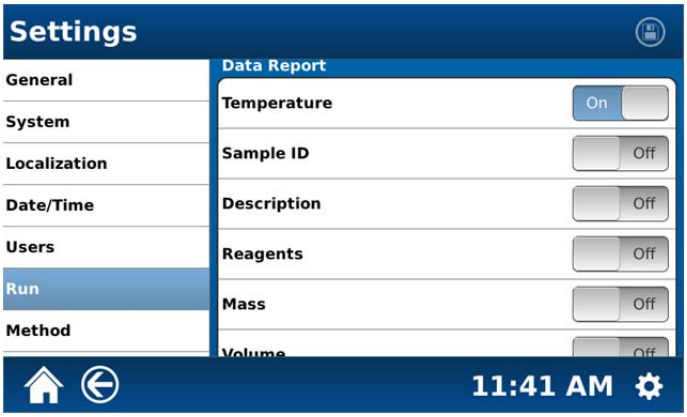




103. Once the method of printing is selected, select “Save.”

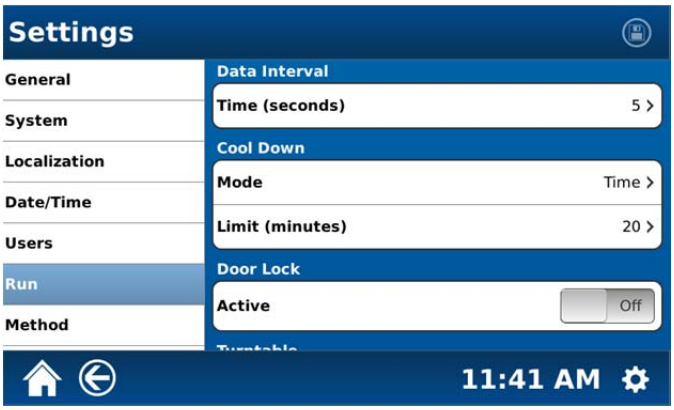
104. Scroll the “Run” screen upward to display the selections for “Data Report.”

105. Select “On” or “Off” for the items to be included in the data report – “Temperature,” “Sample ID,” “Description,” “Reagents,” “Mass,” and “Volume.”

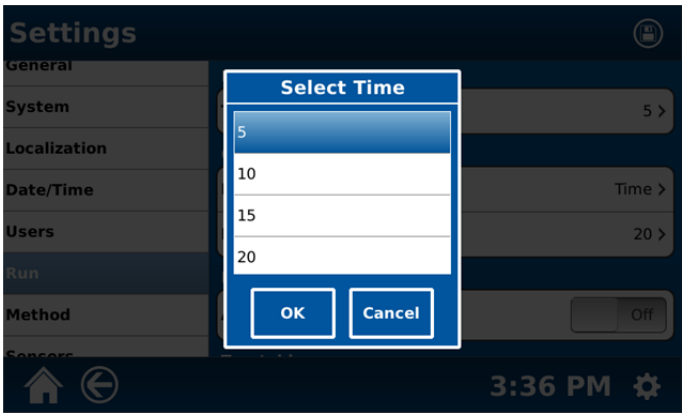


106. Once the items to be included in the data report are selected, select the disk icon at the top of the screen. When the data report selections are saved, the disk icon will be grayed out.

107. Scroll the “Run” screen upward to display “Data Interval,” “Mode,” and “Door Lock.”

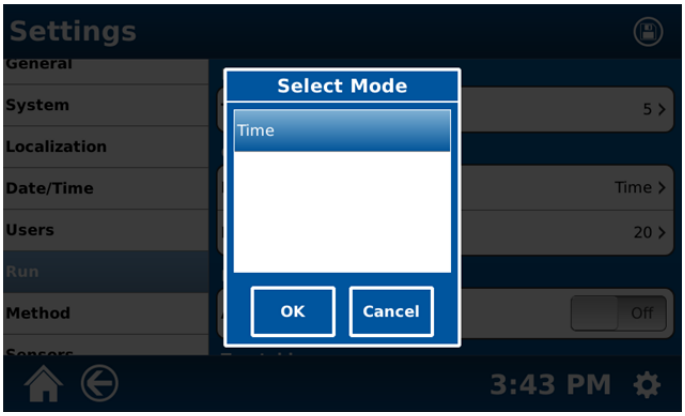


108. Select the Data Interval “Time” – 5 to 60 seconds in increments of 5.



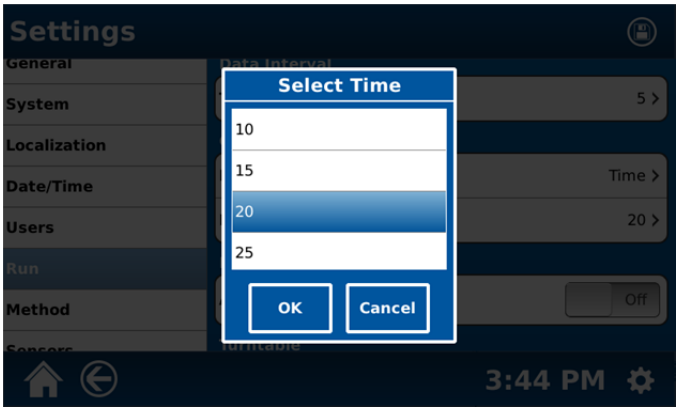
109. Select “OK.”

110. Select the Cool Down “Mode.”

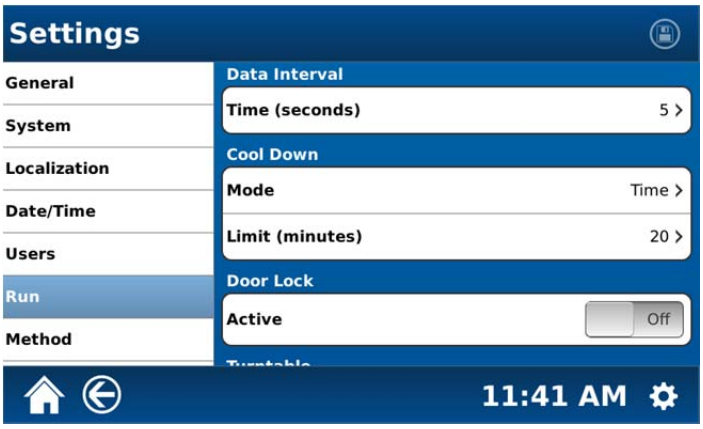


111. Select “OK.”

112. Select the Cool Down “Time” – 20 to 120 in increments of 5.

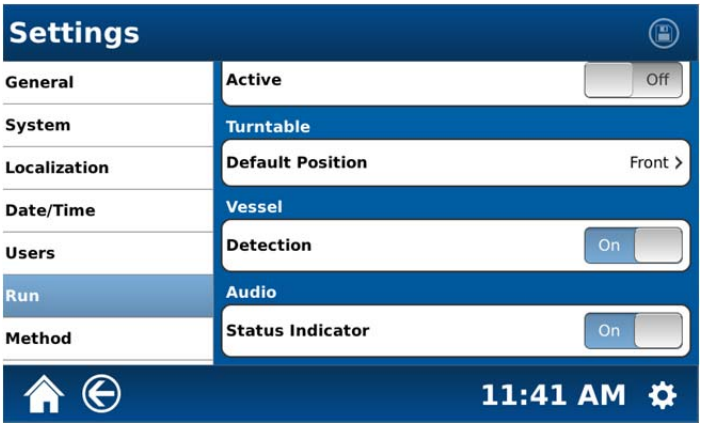


113. Select “OK.”

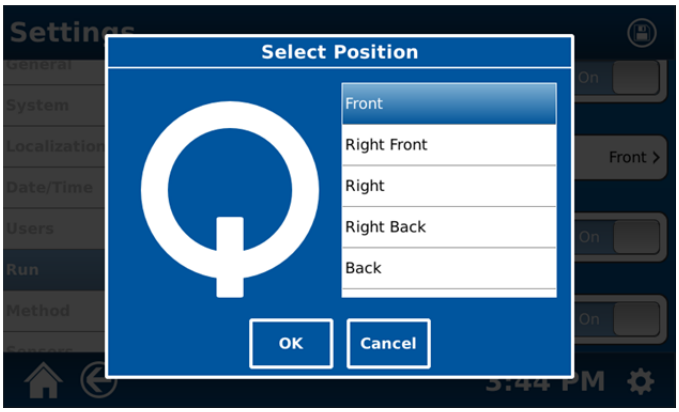


114. Toggle the Door Lock “On” or “Off.”

115. Scroll the Run screen upward to reveal the “Turntable,” “Vessel,” and “Audio” selections.



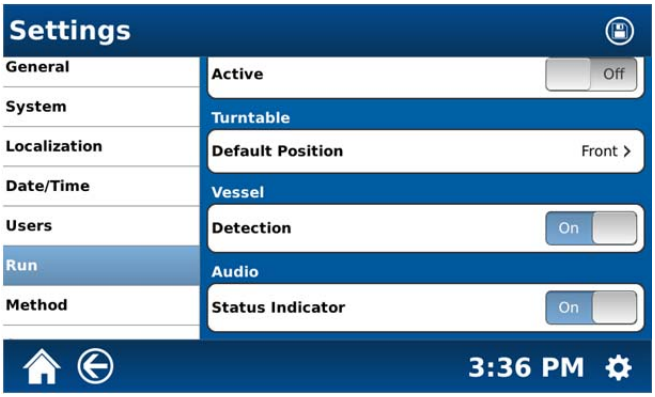
116. Select the turntable “Default Position.”



Note: The turntable default position is based on the user’s preference for loading and unloading the vessel turntable.

117. Select the desired turntable default position (Front, Right Front, Right, Right Back, Back, Left Back, Left, and Left Front).

118. Select “OK.”



Note: Vessel detection sensors recognize the type and number of vessels that have been placed in the instrument cavity.

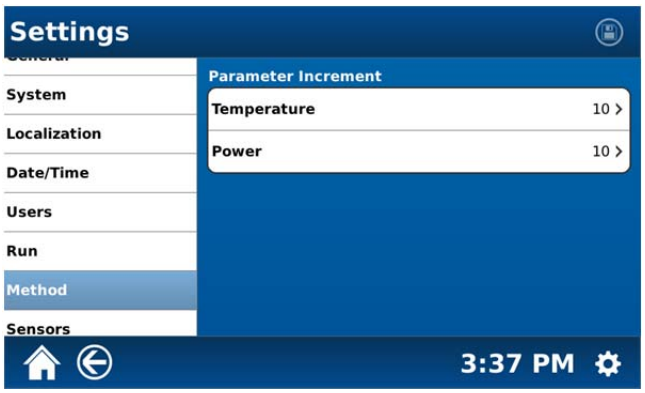
Note: Audio status indicator is an audible chime between stages of a method and at the end of a digestion.

119. Select “On” or “Off” for vessel detection.

120. Select “On” or “Off” for the audio status indicator.

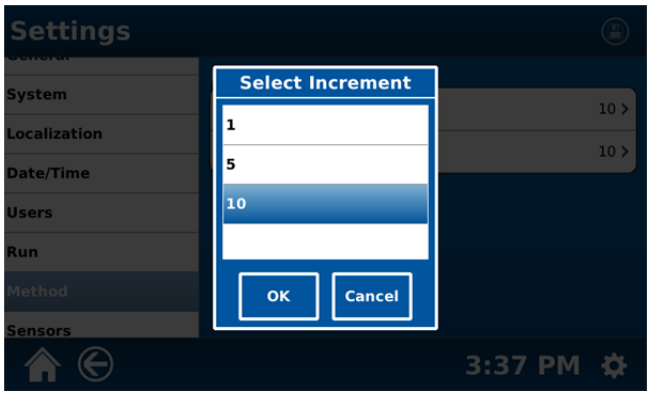
121. Select the disk icon at the top of the screen. Once the “Run” settings are saved, the disk icon will be grayed out.

122. Select **“Method”** from the Settings screen to set the allowed method parameter increments.



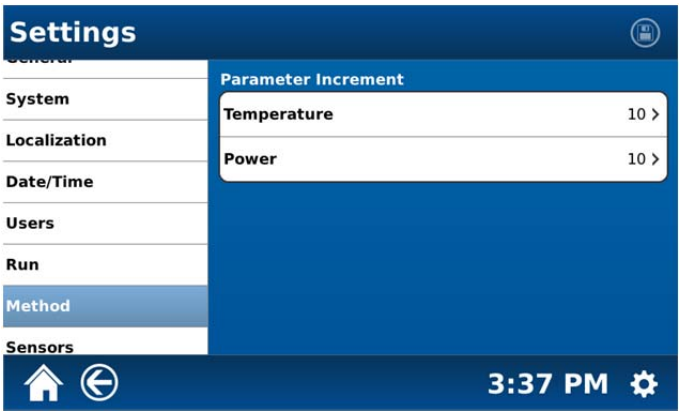
123. Select “Temperature.”

Note: The temperature increments are 1, 5 or 10. If the temperature parameter increment is set for 1, when programming a method, the temperature can be chosen in 1 degree increments. If the temperature parameter increment is set for 5 or 10, the temperature can be selected in 5 or 10 degree increments, etc.



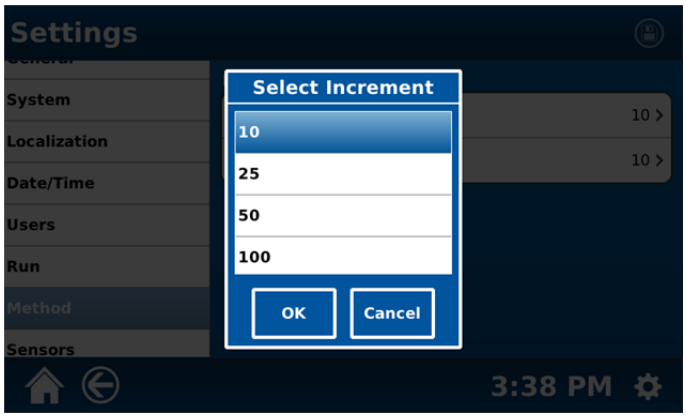
124. Select the appropriate temperature parameter increment (1, 5 or 10).

125. Select “OK.”



126. Select “Power.”

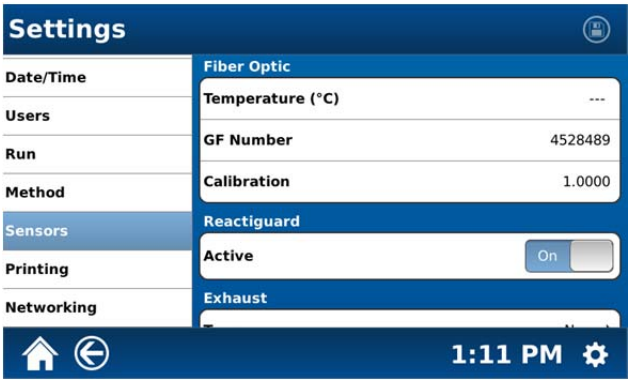
Note: The power increments are 10, 25, 50 or 100. If thepower parameter increment is set for 10, when programming a method, the temperature can be chosen in 10 degree increments. If the power parameter increment is set for 25, 50 or 100, the temperature can be selected in 25, 50 or 100 degree increments, etc.



127. Select the appropriate temperature parameter increment (10, 25, 50 or 100).

128. Select “OK.”

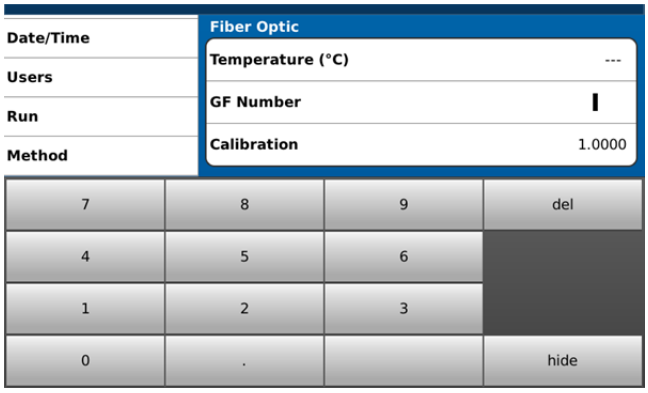
129. Select “**Sensors**.”



Note: The sensor screen permits identification, on/off settings and calibration for the system sensors (Fiber Optic, Reactiguard, Exhaust, IR and Pressure).

130. If a fiber optic probe is installed in the instrument, the above screen will display the GF number of the sensor.

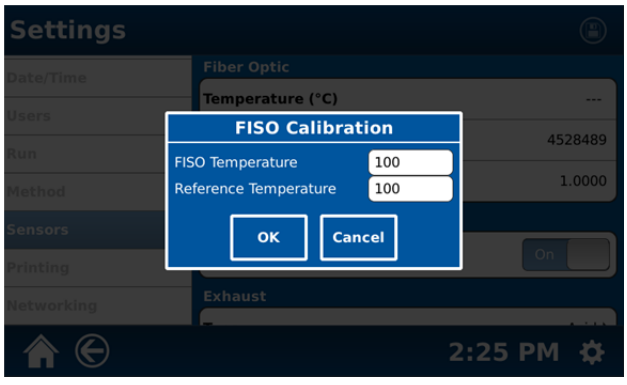
131. If a GF number (found on the fiber optic probe) needs to be entered, select “GF Number.”



132. Using the keyboard, enter the GF Number of the fiber optic probe installed in the instrument. Once the number is properly entered, select “hide” to close the keyboard.

133. To calibrate the fiber optic probe, select “Calibration.”

Note: The fiber optic probe should be removed prior to removal of the control vessel from the instrument.

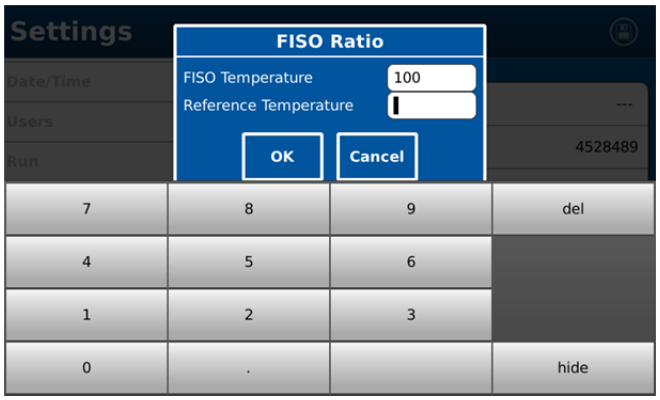


134. Place a beaker with approximately 250 mL of room -temperature water in the instrument cavity. Place the fiber optic probe in the water to measure the temperature. Record the measured temperature on the probe.

135. Using the keyboard, enter the temperature of the fiber optic probe measured and recorded in step 126.

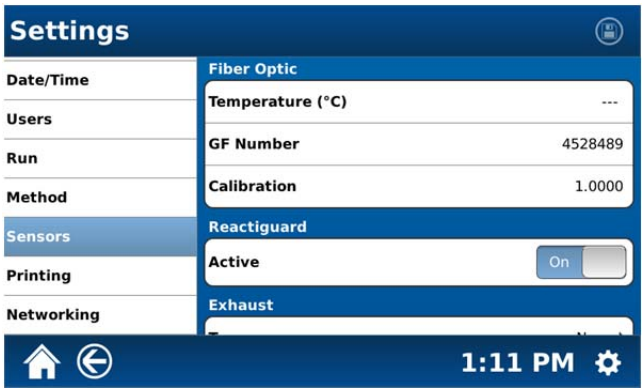
136. Place a thermometer in the beaker of water to measure the temperature of the water. Record the measured temperature on the thermometer.

137. Select the “Reference Temperature.”



138. Using the keyboard, enter the temperature of the fiber optic probe measured and recorded.
139. Select “On” or “Off” for the ReactiGuard.

Note: ReactiGuard detects and alerts the user to an event in a vessel.



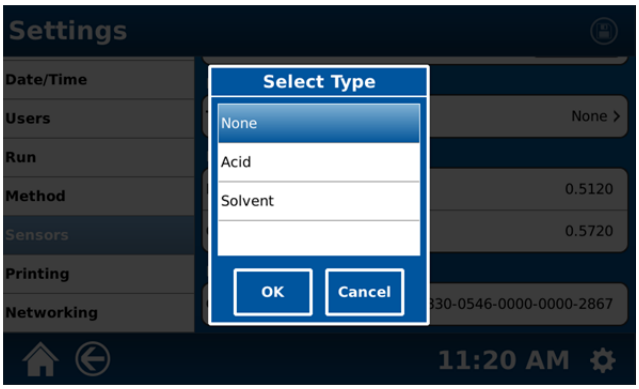
140. Scroll the Sensor setting screen to reveal additional information.

141. Select Exhaust “Type” to select the type of sensor installed on the exhaust (None, Acid or Solvent).

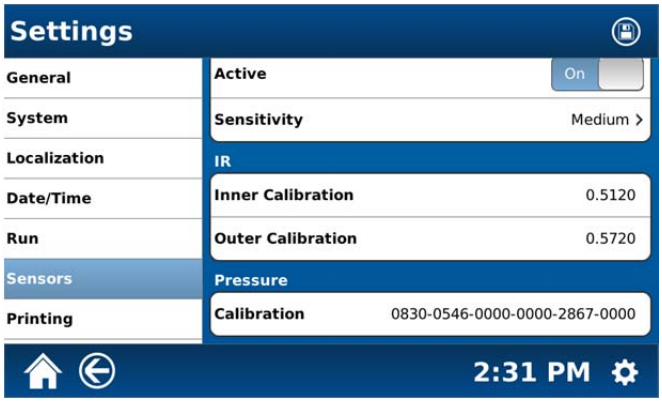
No Sensor

Acid Sensor

Solvent Sensor

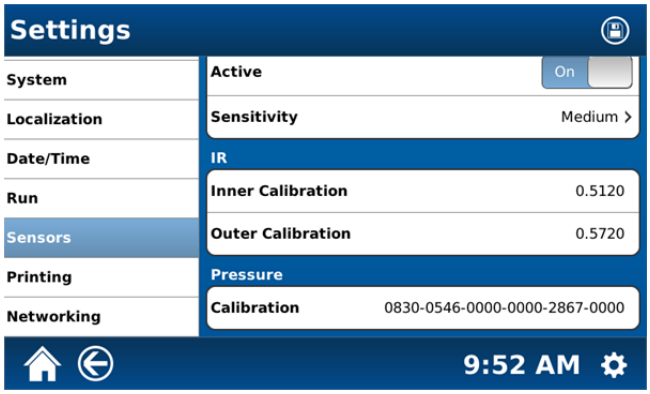


142. Scroll the Sensor setting screen to reveal IR and Pressure information.

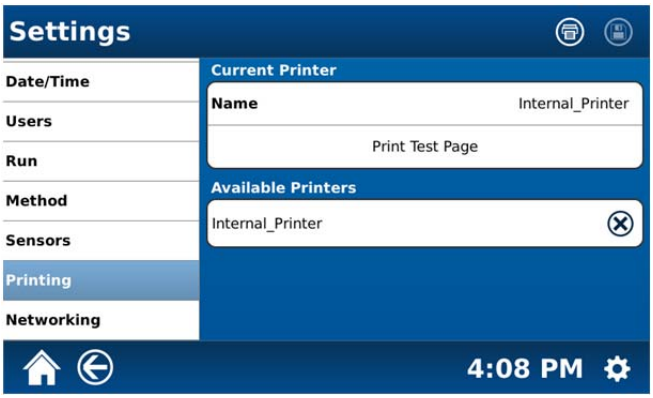


Note: The “IR” and “Pressure” sections of the Sensors screen provide the IR sensor(s) and pressure calibrations. Refer to the calibration documentation in the “Maintenance, Troubleshooting and Service” section of this manual.

143. Scroll the Settings section of the above screen to reveal additional selections.



144. Select “**Printing**.”



145. Select “Print Test Page” to print a test page to ensure that the optional internal printer is operating properly.

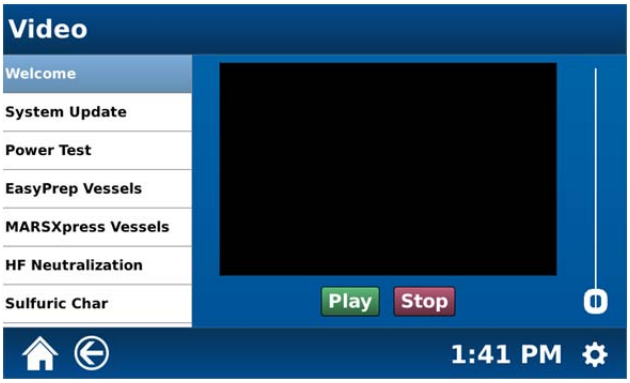
146. Select “**Networking**” to display the IP address of the instrument.

147. From the MARS 6 home screen, select the “System Menu” icon in the bottom right corner of the screen.

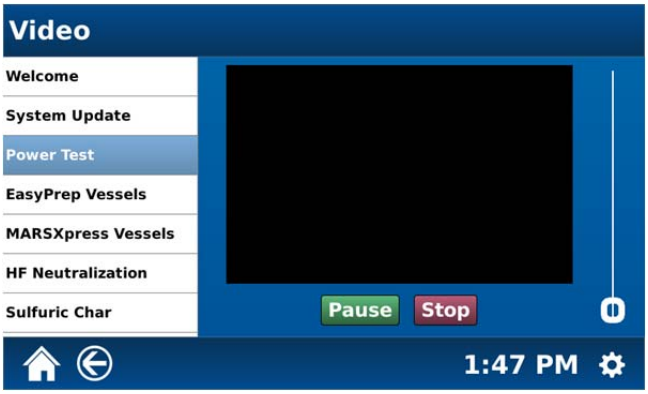
Video

148. Select “**Video**.”

149. Select the title of the video to view (ex. “EP Cntrl Vessel”).



150. Select the title of the video to view (Power Test”).



151. Once the video is selected, select “Play.”

152. During the video, select “Stop” to stop the video or “Pause” to pause it.

153. To adjust the volume of the video, touch and move the slider upward to increase the volume or downward to decrease the volume.

NOTE

The volume selected for the video determines the volume of all audio output of the instrument. Ensure that the volume is adjusted accordingly prior to exiting the video screen.

Maintenance, Troubleshooting and Service

This section covers routine maintenance, troubleshooting and minor parts replacement. For service and repair, contact the CEM Service Department or local CEM subsidiary or distributor. A routine preventive maintenance program is recommended to ensure optimum performance of the MARS 6.

WARNING

This instrument utilizes high voltages and microwave radiation. Instrument service and repair should be performed only by technicians trained in repair and maintenance of high voltage and microwave power systems.

Proper precautions must be taken to avoid contact with reagents or reagent vapors. Protective gear should be worn as outlined in the user's safety program for hazardous materials and the reagent manufacturer's material safety data sheet. Refer to these guidelines for proper handling and disposal of reagents.

Routine Maintenance and Cleaning

After Each Sample Test - When using Omni Vessels, Xpress Vessels, Easy Prep Vessels, Easy Prep Plus Vessels or open-vessel technology, wipe the entire cavity with warm water applied with a soft cloth. If necessary, use a mild cleanser, but rinse thoroughly to avoid leaving any residue or reagents

Daily - Remove the ESP Plus cable connection from the connector port and thoroughly clean the connector with a paper towel or soft cloth. Thoroughly wipe and clean both the inside and outside surfaces of the connector. If necessary, dampen the towel with isopropyl alcohol to assist in cleaning.

Weekly - Clean and dry Omni, Xpress, Easy Prep, Easy Prep Plus and open vessels.

Weekly - When using vessel types other than Omni, Xpress, Easy Prep, Easy Prep Plus or open vessels, wipe the cavity with warm water applied with a soft cloth. If necessary, use a mild cleanser, but rinse thoroughly to avoid leaving any residue on the cavity. Do not use abrasive cleansers because they may scratch the fluoropolymer cavity coating, degrading its ability to resist corrosive vapors. Rinse and thoroughly dry all cleaned areas.

Weekly - Clean the exhaust outlet by removing the exhaust hose and wiping the space inside the exhaust outlet with a paper towel or disposable cloth. To clean the exhaust hose, disconnect it from the blower exhaust duct, flush it with water and allow it to dry before reconnecting it to the blower duct.

WARNING

Acid tends to condense and collect inside the blower duct and can cause severe skin burns. Wear rubber gloves when cleaning the cavity exhaust outlet and/or hose.

Weekly - Examine the door, cavity edge and door interlocks to verify that they are clean and working properly. Ensure there has been no loosening of or damage to the door hinges or latch. Ensure that the door closes securely.

Monthly – Clean vessels as outlined in this manual.

As Required for Optional Internal Printer – Replace printer paper. Lift the printer cover. Position the paper into the printer, ensuring that the paper is properly positioned to exit the printer. Install the printer cover.

Microwave leakage measurement - Refer to the outlined instructions in this section of this manual.

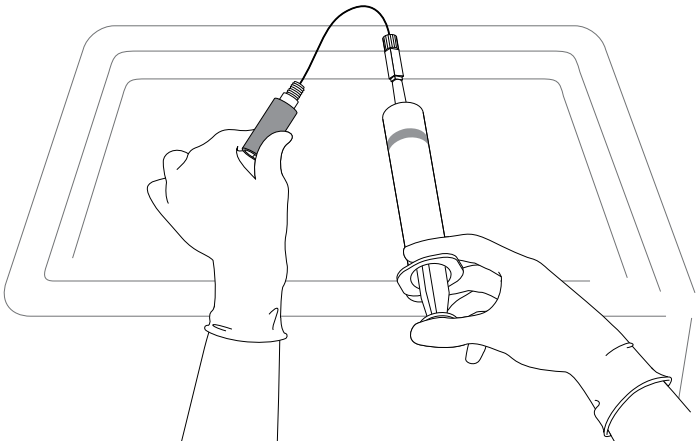
Microwave power measurement - Refer to the instructions outlined in this section of this manual.

Easy Prep and Xpress Vessel Cleaning

1. Place 10 mL of acid used in digestion methods in each vessel to be cleaned.
2. Seal each vessel as outlined in the appropriate vessel documents.
3. Select the appropriate One Touch Method for the vessels (EasyPrep Clean or Xpress Clean). The MARS 6 instrument will perform the vessel cleaning.

ESP-1500 Plus Cleaning

1. Prepare a 60cc syringe fitted with a 7" length of 0.060" diameter Teflon tubing.
2. Remove the pressure line from the ESP-1500 Plus.
3. Fill the syringe with 20mL of deionized water. Insert the tubing attached to the syringe into the ESP-1500 Plus until it touches the bottom of the pressure fitting.
4. Ensuring that the ESP-1500 Plus is placed so that any excess water will be safety contained, flush the ESP-1500 Plus with the entire 20mL of deionized water.
5. Remove the tubing and syringe from the ESP-1500 Plus. Fill the syringe with air.
6. Reinsert the tubing into the ESP-1500 Plus. To assist in removing the excess water, use the syringe to push the air into the ESP.



Microwave Leakage Measurement

1. The door and cavity are very durable and are designed for reliable operation under severe laboratory conditions. External radiation checks are performed on the MARS 6 at several points in the manufacturing process, ensuring that leakage from the finished instrument is only a fraction of that allowed by U.S. law (5 mW/cm2).
2. The door of the MARS 6 is equipped with a safety interlock system which stops the generation of microwave energy when the door is opened or ajar. If the interlock system fails, a monitoring mechanism will blow the fuse(s) through which power is supplied to the magnetron, rendering the microwave power system inoperable.
3. To verify that door seals and interlocks are working properly, the MARS 6 should be tested periodically for microwave leakage. Use the following procedure to measure microwave leakage:
    a. Create a method using a beaker as the selected vessel, 1800 watts, 100% power, 2 minutes ramp time, 0 pressure, 240°C temperature, stirrer off, and 0 hold time, naming it "Leak Test." Save the method.
    b. Place a beaker containing 100mL of water in a vessel position of the turntable.
    c. Select the created method and press "Start" to begin the method.

d. Use a suitable RF field strength meter (microwave detector) such as the Holaday Model HI-1500 (available from CEM Corporation, P/N 300500). Slowly move the RF probe around the door perimeter and around the fan grills to check for microwave leakage.

NOTE

CEM does not recommend use of meters available in electronics stores because they are prone to give erroneous readings and lack the necessary sensitivity to properly test an instrument for microwave leakage.

The U.S. Government defines excessive microwave leakage as 5 mW/cm2. If the instrument shows excessive microwave leakage, do not attempt further operation. Contact the CEM Corporation Service Department or the local CEM subsidiary or distributor for further instructions.

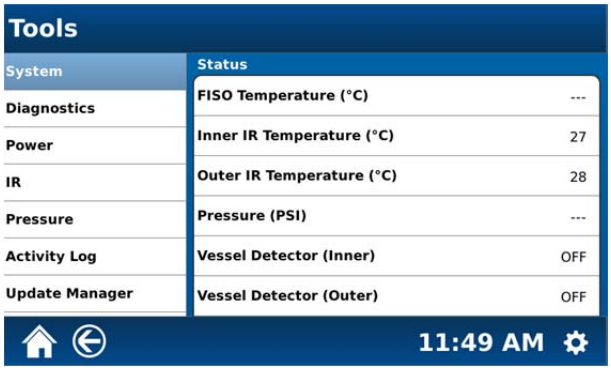
Microwave Power Measurement

Use the following procedure to determine actual power output wattage.

1. Install the turntable in the microwave cavity.

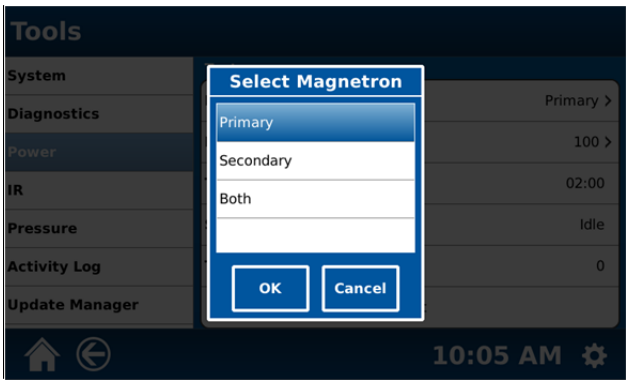
2. From the MARS 6 home screen, select the “System Menu” icon in the bottom right corner of the screen.

3. Select “Tools.”

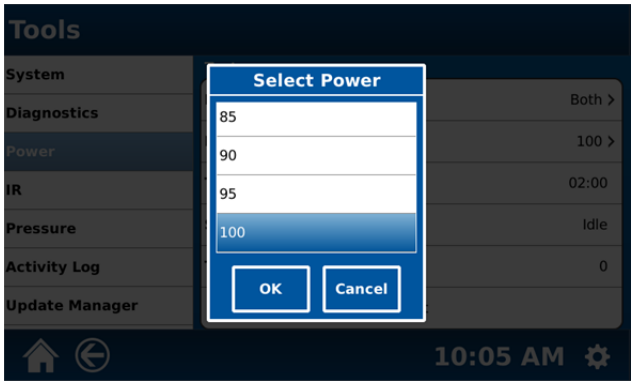


4. Select “Power.”

5. Select “Mag (Magnetron).”



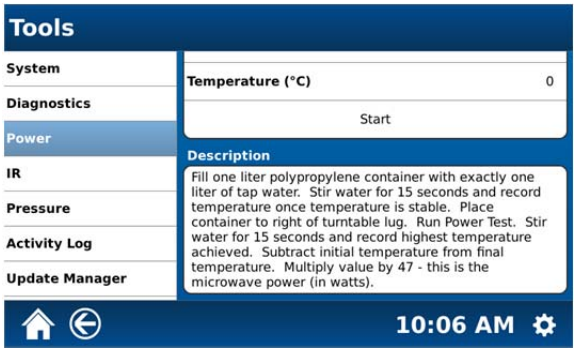
6. Select the desired magnetron(s) for performing the power test (Primary, Secondary or Both).
7. Select “Both.”
8. Select “OK.”
9. Select “Power (%).”



10. Select the desired percentage of power to be used for the power test (0 – 100 in increments of 5). CEM Corporation recommends the use of 100% power for the power test.

11. Select “OK.”

Note: Follow the procedures outlined below to complete the power test. A description of the power test is also provided on the instrument screen.



12. Place 1 liter of ambient temperature (18 – 22 ºC) tap water in a 1 liter Teflon® or polypropylene beaker.
13. Stir the water for at least 15 seconds.
14. Using a thermometer with 0.1 °C gradations, measure and record the initial water temperature, T_i. Ensure that the thermometer is immersed to its indicated immersion line prior to reading the temperature.
15. Remove the thermometer from the beaker. Carefully place the beaker in vessel #1 position of the EasyPrep turntable. If an EasyPrep turntable is not available, carefully place the beaker to the right of the turntable lug (not on the lug). Gently close the door to avoid spilling any of the water.
16. Select “Start.”
17. At the end of the programmed time (2 minutes), remove the beaker from the microwave cavity. Stir the water thoroughly for 15 seconds, then measure and record the peak temperature reading. This is the final temperature, T_f.

The microwave power output is calculated as follows:

$$\textbf{Power in Watts} = 47 (T_f - T_i)$$

18. If the measured power is below 1600W, repeat the microwave power measurement. If the power remains less than 1600W, the instrument is not producing adequate microwave power.
19. Repeat steps 5 through 12 to test the microwave power for the primary and secondary magnetrons.
20. The power output from the primary magnetron should be 1000W. If the measured power is below 890W, the primary magnetron is not producing adequate microwave power.
21. The power output from the secondary magnetron should be 800W. If the measured power is below 712W, the secondary magnetron is not producing adequate microwave power.

If one or both of the magnetrons is not producing sufficient wattage, refer to the Troubleshooting Guide in this manual.

Note: In order to perform an IEC power test, specialized equipment is required. CEM Corporation has provided this power test as a means of comparison between MARS 6 instruments. The above power test incorporates a factor to convert the results of this test into an IEC wattage. Actual IEC power tests using specialized equipment are performed at CEM Corporation headquarters.

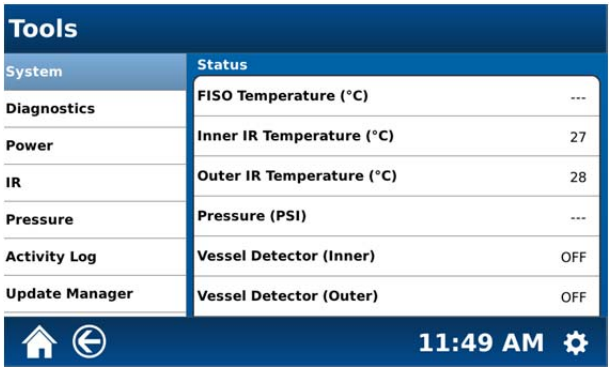
Temperature Calibration (IR Sensors)

Note: The Intelli-Temp Calibrator Kit (CEM part # 907330 – 120V or 907340 – 240V) which includes the calibrator and adaptor is required to perform an IR calibration on the instrument. The Intelli-Temp Calibrator emits a temperature of 130 ºC.

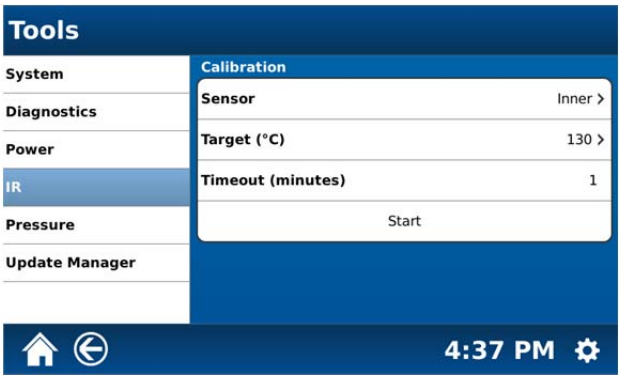
1. The instrument must be plugged into an electrical outlet and turned on.
2. Remove the plastic floor mat from the floor of the instrument.
3. Plug the Intelli-Temp calibrator into an electrical outlet close enough to the instrument for it to be placed on the instrument floor. Permit the calibrator to warm until the “Ready” light is illuminated.

4. With the MARS 6 home screen displayed, select the System Menu icon at the bottom right corner of the screen.

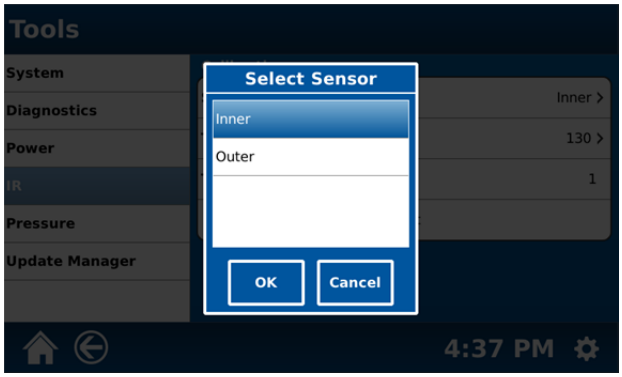
5. Select “Tools.”



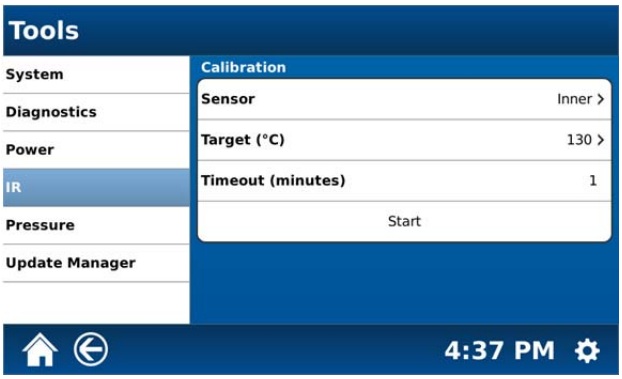
6. Select “IR” to perform an IR sensor calibration.



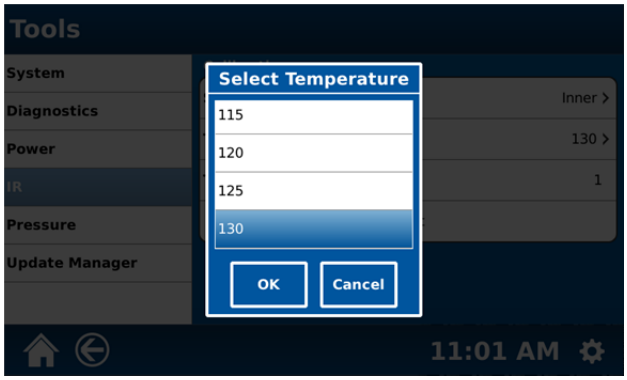
7. Select “Sensor.”



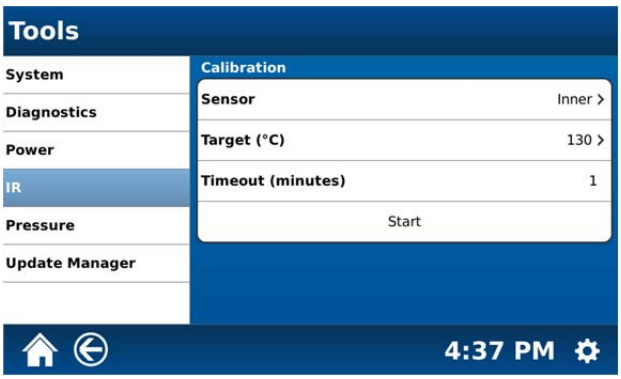
8. Select the sensor (Inner or Outer) to calibrate.
9. Select “OK.”



10. Select “Target (ºC”).



11. Select the desired target temperature (40 ºC – 150 ºC in increments of 5). The default temperature is 130 ºC and should be used for the IR calibration.
12. Select “OK.”



13. The MARS 6 defaults to a 1-minute timeout.
14. Ensure that the “Ready” light on the Intelli-Temp calibrator is illuminated. Place the calibrator adaptor over the inner and outer IR sensors with the calibrator support ring positioned directly over the sensor being calibrated. Place the Intelli-Temp calibrator over the adaptor (calibrator positioned upside down with the opening mating with the opening of the adaptor).
15. Press “Start.” Wait for a stable reading.
16. Repeat the above steps to calibrate the second sensor.

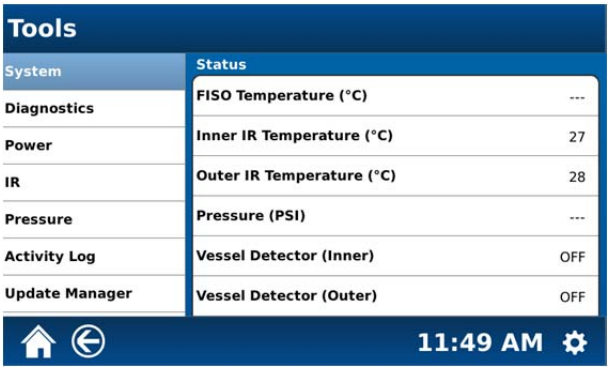
Verification of IR Sensor(s) Calibration

Note: The Intelli-Temp Calibrator Kit (CEM part # 907330 – 120V or 907340 – 240V) which includes the calibrator and adaptor is required to perform an IR calibration on the instrument.

1. The instrument must be plugged into an electrical outlet and turned on.
2. Remove the plastic floor mat from the floor of the instrument.
3. Plug the Intelli-Temp calibrator into an electrical outlet close enough to the instrument for it to be placed on the instrument floor. Permit the calibrator to warm until the “Ready” light is illuminated.

4. With the MARS 6 home screen displayed, select the System Menu icon at the bottom right corner of the screen.

5. Select “Tools.” The inner and outer IR temperatures will be displayed on the “Status” menu.



6. Ensure that the “Ready” light on the Intelli-Temp is illuminated. Place the calibrator adaptor over the inner and outer IR sensors with the calibrator support ring positioned directly over the sensor being calibrated. Place the Intelli-Temp calibrator over the adaptor (calibrator positioned upsode down with the opening mating with the opening of the adaptor).
7. Wait for the temperature to stabilize.
8. The temperature should read 130 ºC ±3 ºC. If it is outside this range, perform the Temperature Calibration for IR sensors.

Pressure Calibration

Pressure calibration should be performed only by a CEM Certified Service Representative. Contact CEM Service (800-726-5551).

Update Firmware

The MARS 6 firmware should be updated when a revised version is released. The firmware can be obtained from CEM's website www.cem.com. One user should be responsible for updating the firmware.

1. Create a CEM user account. If a CEM user account has been created previously, proceed with step 2.

    a. Access the CEM website www.com.com.
    b. Locate "Signup" in the blue bar located at the top of the screen.
    c. Providethe applicable customer and product information. The product tag is located on the serial tag on the left side panel of the instrument.
    d. Once all information has been entered, select "Register."

NOTE: If the product tag cannot be located, contact the CEM Corporation Synthesis Department at 800-726-3331 or 704-821-7015.

2. Log into the CEM website www.cem.com.

3. Select the applicable instrument model from the "Products" menu.

4. Select "Resource Library." Scroll down to the "Software Updates" section. The most current version of firmware will be available for download.

5. Using a computer, create a folder titled "CEM" on the USB flash drive.

> **CAUTION**
>
> Only the USB flash drive supplied with the Discover SP is compatible with the instrument software.

6. Copy the supplied firmware file into the "CEM" folder created on the USB flash drive.

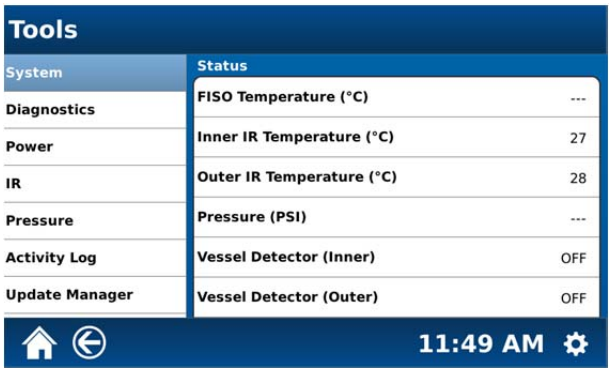
NOTE: Firmware files will follow the "Evolution_XX.XX" format.

7. Turn the instrument off.

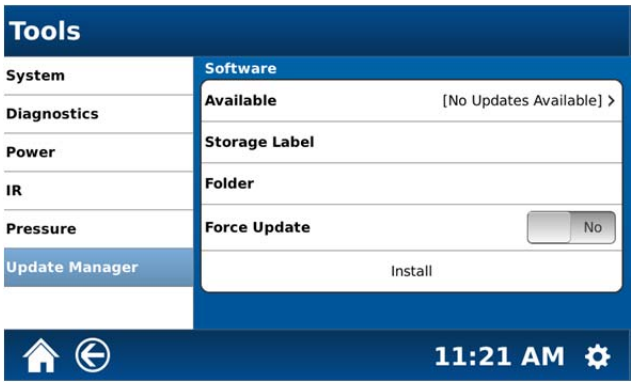
8. Install the USB flash drive containing the latest Mars 6 firmware into a USB port on the side of the instrument.

9. With the MARS 6 home screen displayed, select the System Menu icon at the bottom right corner of the screen.

10. Select “Tools.”



11. Select “Update Manager.”



12. If any update(s) is available, select the firmware version to download from the “Available” area of the above screen.

13. Press “Install.”

CAUTION

Firmware update requires approximately 10 - 20 minutes for completion. The system will reboot several times and may at times display a blank screen. **DO NOT** turn the instrument off during the loading process.

Troubleshooting Guide

Instrument Inoperative	Instrument not plugged into electrical outlet Power switch not in “on” position Blown fuse Loose connection to power switch Faulty power switch
No Microwave Power	Instrument door ajar Incorrect percentage of power selected Interlock(s) not properly adjusted or faulty Faulty controller board Faulty thermal switch Faulty high voltage component
Low Microwave Power	Low line voltage Incorrect wattage parameter Incorrect percentage of power selected Faulty high voltage component
Fuse Blows When Door is Opened	Interlock(s) not properly adjusted Faulty interlock(s)
Fuse Blows Repeatedly During Operation	Low line voltage Faulty high voltage component Faulty DC power supply Faulty controller board
Inoperative Turntable	Faulty turntable drive assembly Faulty controller board
Turntable Not Alternating	Faulty turntable drive assembly
No Display	Loose or broken wiring connections Loose or faulty interface cable Faulty display Faulty controller board
Inoperative Vessel Stirring Motor	Loose or broken stirring motor belt Faulty Stirring motor
Erratic Pressure (ESP-1500 Plus)	Incorrect setting Leakage from vessel Loose vent fitting Loose bulkhead connector Improper grounding connection Faulty ESP-1500 Plus Faulty controller board
Erratic Temperature (MTS-300)	Broken thermowell Faulty MTS-300 Faulty controller board

Microwave Leakage	Improperly adjusted instrument door Damaged instrument door
Inoperative Cavity Light	Faulty LED assembly Loose connection(s) Faulty connection(s)
Tangled Pressure Sensing Line	Control vessel not positioned properly in turntable Turntable not alternating
Vapors in Laboratory	Loose drain valve Leakage from vessel Ruptured membrane Vent hose to fume hood not installed Faulty blower assembly
No Rise in Pressure in Control Vessel	Leakage at vent fitting Rupture membrane not installed Thermowell loose in vessel ESP-1500 Plus unattached or faulty Sample does not absorb microwave energy Liquid does not generate pressure upon heating Vessels improperly torqued
No Rise in Temperature in Control Vessel	Sample does not absorb microwave energy Temperature probe inserted incorrectly Temperature probe connected incorrectly
Ruptured Optional Vessel Membrane	Excessive amount of reactive organic sample Leakage from control vessel resulting in abnormal pressure buildup in other vessels
Venting Relief Valve	Excessive amount of reactive organic compounds Two-way valve in incorrect position
Loose Pressure Sensing Tube in Control Vessel	Tubing not fully inserted and sealed into mating fitting with ferrule nut Closed microwave transparent valve
Instrument shuts down during test	Fiber optic sensor malfunctions or stops operation One or both IR sensors cease operation

Repair and Service

WARNING

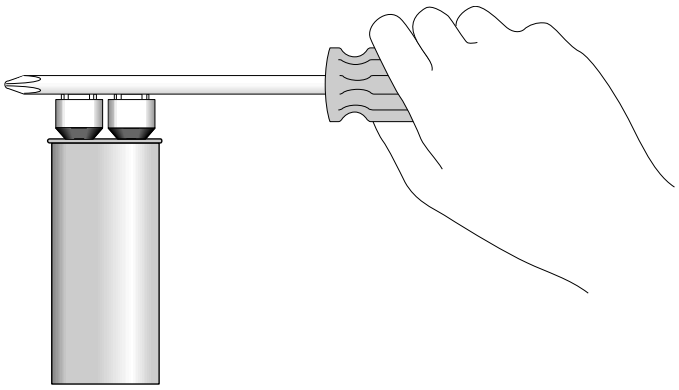
This instrument utilizes high voltages and microwave radiation in its operation. Instrument service and repair should be undertaken only by technicians trained in repair and maintenance of high voltage and microwave power systems.

The MARS 6 is constructed in modular form to facilitate troubleshooting and repair. It is recommended that troubleshooting and repair by the user be limited to identifying and replacing parts such as printed circuit boards, fans, lamps or motors.

WARNING

Disconnect the instrument from the AC power source prior to performing any service procedure.

Prior to any troubleshooting or service procedures in the high voltage section or area, bridge the contacts of the high voltage capacitors using the metal shaft of a well-insulated screwdriver to discharge the residual voltage in the capacitors. This will prevent exposure to high voltage discharge during troubleshooting or service.



Before replacing the high voltage plate assembly after any service procedure involving the microwave generating components, visually check the magnetrons, transformers, triac, and high voltage capacitor to ensure that the electrical connections are secure.

Any service to or inspection of the MARS 6 which requires

- Removal of the high voltage plate assembly or
- Replacement of components in the
  - door,
  - interlock mechanism,
  - microwave generation system, or
  - microwave transmission system

should be followed by a microwave leakage measurement to verify that leakage is less than 5 mW/cm2.

Ordering Information

For assistance and pricing of replacement parts and microwave sample preparation accessories, contact:

CEM Corporation
Service Department
P.O. Box 200
3100 Smith Farm Road
Matthews, NC 28106-0200 USA
800.726.5551 (phone within USA)
01.704.821.7015 (phone outside of USA)
Fax: 704.821.4369
service@cem.com (email)
www.cem.com/support (web Site)

Germany Subsidiary
CEM GmbH
Carl-Friedrich-Gauss Strasse 9
47475 Kamp-Lintfort
Germany
49.2842.96440 (phone)
49.2842.964411 (fax)
info@cem.de (email)
www.cem.de (web site)

France Subsidiary
CEM µWave S.A.S.
Immeuble Ariane
Domaine Technologique de Saclay
4, rue René Razel
91892 ORSAY Cedax
France
(33-1) 69.35.57.80 (phone)
info.fr@cem.com (email)

Ireland Subsidiary
CEM Ireland
Sky Business Centre
9a Plato Business Park
Demastown
Dublin 15
Ireland
353 (0) 1-885-1752 (phone)
Info.ireland@cem.com (email)

Italy Subsidiary
CEM S.r.l.
Via Dell'Artigianato, 6/8
24055 COLOGNO AL SERIO (bg)
Italy
390.35.896224 (phone)
390.35.891661 (fax)
info.srl@cem.com (email)

Japan Subsidiary
CEM Japan K.K.
2-18-10 Takanawa
Minato-ku
Tokyo 108-0074
81-3-5793-8542 (phone)
81-3-5793-8543 (fax)
info@cemjapan.jp (email)
www.cemjapan.co.jp (web site)

United Kingdom Subsidiary
CEM Microwave Technology Ltd.
2 Middle Slade
Buckingham Industrial Park
Buckingham MK18 1WA
United Kingdom
44.1.280.822873 (phone)
44.1.280.822342 (fax)
info@uk@cem.com (email)

Specifications:

Overall Dimensions	25 in. (63.5 cm) height x 21 in. (53.3 cm) width x 25 in. (63.5 cm) depth
Weight	140 lbs (63.6 kg)
Touch Screen	7 in. (800 x 480) TFT-LED glass capacitive touch screen display
One Touch	A combination of vessel recognition and vessel counting sensor technology, software technology, and applications knowledge that enables a user to select a One Touch method that matches the sample type. Based on the sample type, One Touch Technology determines the vessel type and count, digestion temperature, ramp and hold times, and microwave power input.
PowerMAX	Power control technology provides the optimum amount of energy to the sample to ensure complete digestions
Ports	5 USB (1 side, 4 rear), 2 Ethernet, 1 USB-B, 1 RS-232
Sensors	All sensors, including pressure and temperature sensing devices located within the microwave cavity, are microwave-transparent or shielded to ensure accurate readings and to eliminate arcing (ignition) hazards.
Languages	Software available in English, German, French, Italian, Spanish, Chinese and Japanese
Sample Stirring	In-vessel magnetic stirring of samples
Turntable Design	PerfectCircle™ design provides absolute radial symmetry. Turntable operates in alternating or continuous mode.
Inlet/Outlet Ports	Standard 0.500” I.D. port or optional 0.3125” I.D. ports for 0.250” (6mm) tubing
Microwave Cavity	Heavy-duty, multi-layer Teflon® coating
Electrical Requirements	208/230 VAC (207-253 VAC), 60 HZ, 15A @ 208 VAC 220/240 VAC (202-250 VAC) 50 Hz, 15A @ 220 VAC
Magnetron Frequency	2450 MHz
Power Output	1800 watts – continuous power available at all power levels to provide more control for reactions (IEC 705 Method – 1988)
Magnetron Protection	Solid-state isolator (US patent 4,835,354) to protect magnetron from reflected energy, ensuring constant power output
Speakers	8 Ω, 2 W, 86 dB
Printer	Optional on-board thermal printer and USB-B compatible printer port
Safety Features	Three independent door safety interlocks, including an interlock monitoring system plus three independent thermal switches, are used in each instrument to prevent instrument operation and microwave emissions in case of improper door closure or misalignment. The instrument complies with HHS standards under 21 CFR, Part 1030.10, Subparts (C)(1), (C)(2) and (C)(3). Reactiguard continuously monitors the cavity and disables the magnetron if disturbances occur inside the cavity.
Emissions and Safety Approvals	Conforms to Globally Harmonized EN61010-1 Standard for Safety Requirements for Electric Equipment for Measurement, Control and Laboratory Use Part 1: General Requirements (CAN/CSA-C22.2 No. 1010.1-1992).
Patents	CEM microwave systems and vessel designs may be covered by any one of the following US patents: 04835354, 04080168, 05369034, 04672996, RE034373, 05230865, 04877624, 04672996, 05206479, 05427741. Other patents pending.

United States
Complies with FCC Part 18 regulations (47CFR part 18: Industrial, Scientific and Medical Equipment)
Canada...Complies with FCC Part 18 regulations (47CFR part 18: Industrial, Scientific and Medical Equipment)

US Safety Approval to UL61010-1 (ETL Testing Laboratories)
Canadian Safety Approval to CAN/CSA C22.2 No. 61010.1

European Community and Remainder of the World:

Conforms to EN61010-1 (Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use Part 1)
Conforms to EN61326-1 (EMC requirements for Electrical, Control and Laboratory Use)

Warranty

What Is Covered:

CEM Corporation warrants that the instrument will be free of any defect in parts or workmanship and will, at its option, replace or repair any defective part (excluding consumables) or instrument.

For How Long:

This warranty remains in effect for 365 days from date of delivery to the original purchaser.

What Is Not Covered:

This warranty does not cover parts or workmanship damaged due to:

- Neglect, abuse or misuse,
- Damage caused by or to test samples,
- Damage incurred during instrument relocation,
- Damage caused by or to any attached equipment,
- Use of incorrect line voltages or fuses,
- Fire, flood, "acts of God" or other contingencies beyond the control of CEM Corporation,
- Improper or unauthorized repair, or
- Any other damage caused by purchaser or its agents.

Responsibilities of Purchaser:

To ensure warranty coverage, the purchaser must:

- Use the instrument according to directions,
- Connect the instrument properly to a power supply of proper voltage,
- Replace blown fuses,
- Replace consumables and
- Clean the instrument as required.

How to Get Service:

Purchaser should contact the Service Department of CEM Corporation or the nearest CEM subsidiary or distributor for return authorization and for proper crating and shipping instructions to return instrument, freight prepaid, for service. On-site repairs by an authorized service technician are available through the CEM Service Department. Travel costs will be charged to the purchaser for on-site repairs.

Within the U.S.	**Outside the U.S.**
CEM Corporation	CEM Corporation
3100 Smith Farm Rd.	3100 Smith Farm Rd.
Matthews, NC 28105-5044	Matthews, NC 28105-5044
(800) 726-5551	(704) 821-7015
Fax: (704) 821-4368	Fax: (704) 821-4368

Warranty Disclaimer:

CEM Corporation hereby excludes and disclaims any warranty of merchantability or fitness for any particular purpose. No warranty, express or implied, extends beyond the face hereof. CEM Corporation shall not be liable for loss of use of instrument or other incidental or consequential costs, expenses or damages incurred by the purchaser or any other user. This warranty is not transferable.

Purchaser's Rights under State Law:

This warranty gives the purchaser specific legal rights, and the purchaser may also have other rights which vary from state to state.

CEM Corporation

Corporate Headquarters
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Service Department
PO Box 200
3100 Smith Farm Road
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Ireland
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CEM Japan K.K.
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Tokyo 160-0022
Japan
03.5368.2507 (phone)
03.5368.2508 (fax)
info@cemjapan.co.jp (email)
www.cemjapan.co.jp (web site)

United Kingdom Subsidiary
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2 Middle Slade
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Buckingham MK18 1WA
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