



replacement parts industries, inc.

***A PRIMER ON TABLETOP STERILIZER
REPAIR & MAINTENANCE***

TechNation Webinar, November 2014



Presented by
Neil Blagman
Product Development
Replacement Parts Industries, Inc.



This presentation will focus on the history and inner workings of tabletop sterilizers – both manual and automatic styles – with emphasis on the following:

- Employing a Midmark UltraClave® sterilizer, a presentation of cycle steps and their relationship to individual systems will be discussed.
- Comparisons with both bulk sterilizers and manual tabletop sterilizers will be drawn.
- Troubleshooting tips, repair techniques and planned maintenance steps will be provided.



Many Tabletop Sterilizers Currently in Use

- AMSCO/STERIS
- BARNSTEAD
- MDT (HARVEY)
- MDT•RITTER•CASTLE
- MIDMARK•RITTER
- NATIONAL APPLIANCE
- PELTON & CRANE
- PRESTIGE / KAVO
- RITTER•CASTLE
- S.S. WHITE
- SCICAN
- SPECTROLINE
- TUTTNAUER
- VERNITRON





Examples of Pressure Pot Sterilizers





From the most simple manual tabletop autoclave to the largest automated bulk sterilizer, there are the 3 parameters necessary to produce sterilization.

1. Temperature

Controlled manually or electrically the preset sterilization temperature must be maintained during the entire sterilization section of the cycle. The temperature control can be verified using a max registering lag thermometer.

2. Pressure

An indicator for the functional quality of the sterilizer, proper pressure can only be produced in a leak-tight machine that has enough water in the chamber to produce saturated steam throughout the entire length of the cycle.

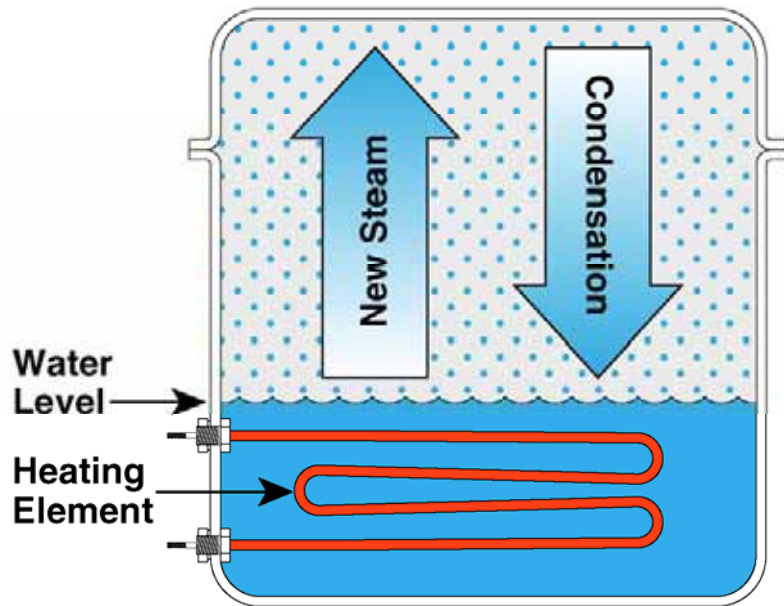
3. Time

The exposure time recommended by the sterilizer manufacturer is designed to produce a 100% kill rate for all types of spore forming bacterium. The exposure time should start once the sterilizer has reached a stable operating temperature and pressure.

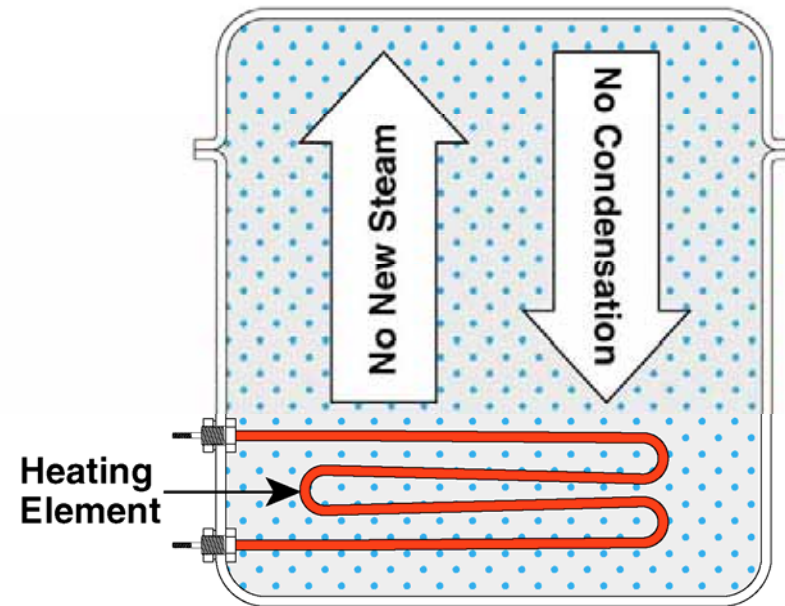


Saturated vs. Superheated Steam Graphic

SATURATED STEAM



SUPERHEATED STEAM





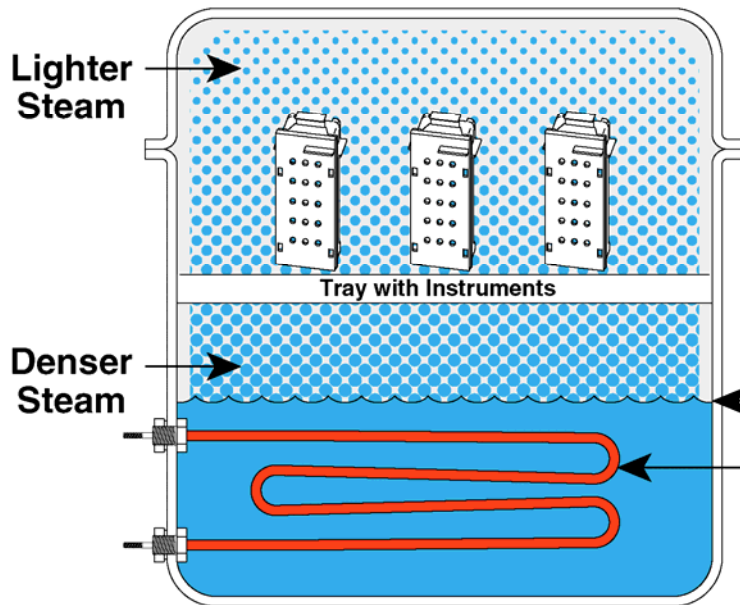
Pressure / Temperature Chart

PSI	°C	°F	PSI	°C	°F
0	100.0	212.0	16	122.0	251.6
1	101.9	215.4	17	123.0	253.4
2	103.6	218.5	18	124.1	255.4
3	105.3	221.5	19	125.0	257.0
4	106.9	224.4	20	126.0	258.8
5	108.4	227.1	21	126.9	260.4
6	109.8	229.6	22	127.8	262.0
7	111.3	232.3	23	128.7	263.7
8	112.6	234.7	24	129.6	265.3
9	113.9	237.0	25	130.4	266.7
10	115.2	239.4	26	131.3	268.3
11	116.4	241.5	27	132.1	269.8
12	117.6	243.7	28	132.9	271.2
13	118.8	245.8	29	133.7	272.7
14	119.9	247.8	30	134.5	274.1
15	121.0	249.8			

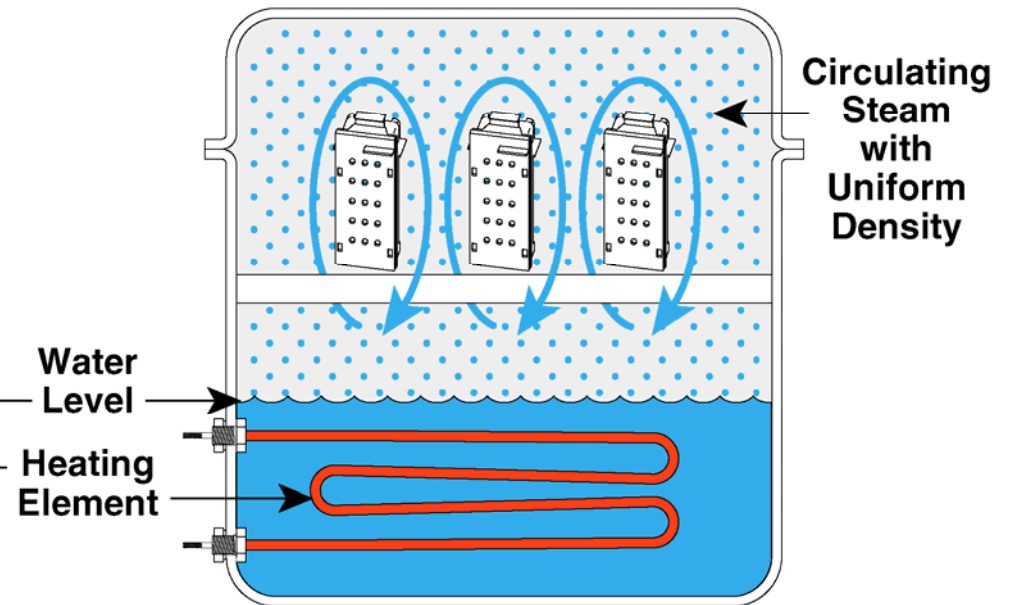
*Chart indicates steam pressure only.
250°F to 270°F is the normal steam sterilizing range.
Note: Air in the sterilizer negates temperature readings.*



WHAT WE HAVE

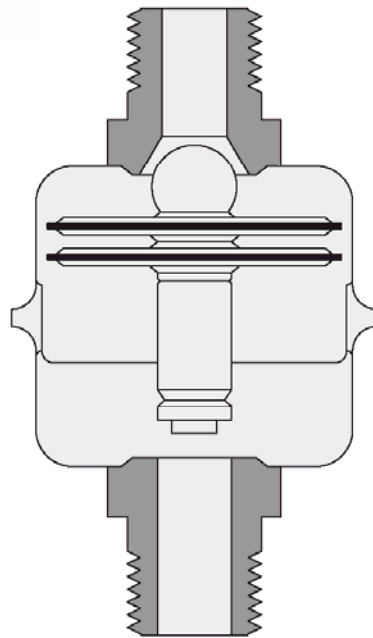


WHAT WE WANT





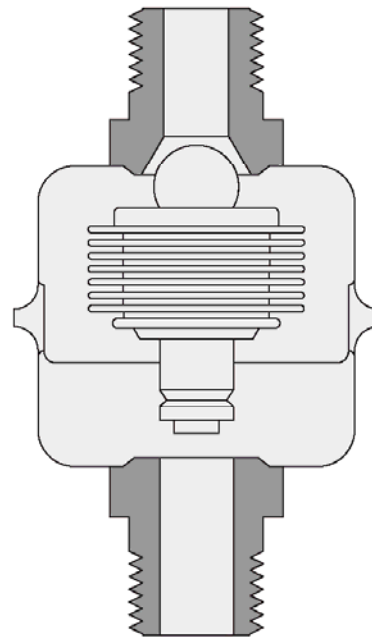
Different Styles of Mechanical Bellows



Diaphragm Style

RCB089

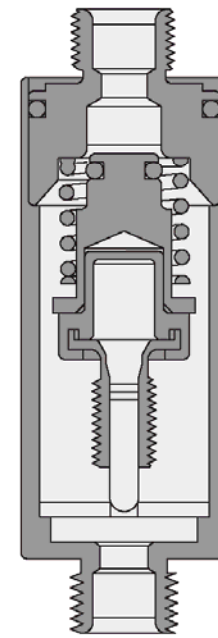
↑
FLOW



Bellows Style

RCB100

↑
FLOW



Steam Trap Style

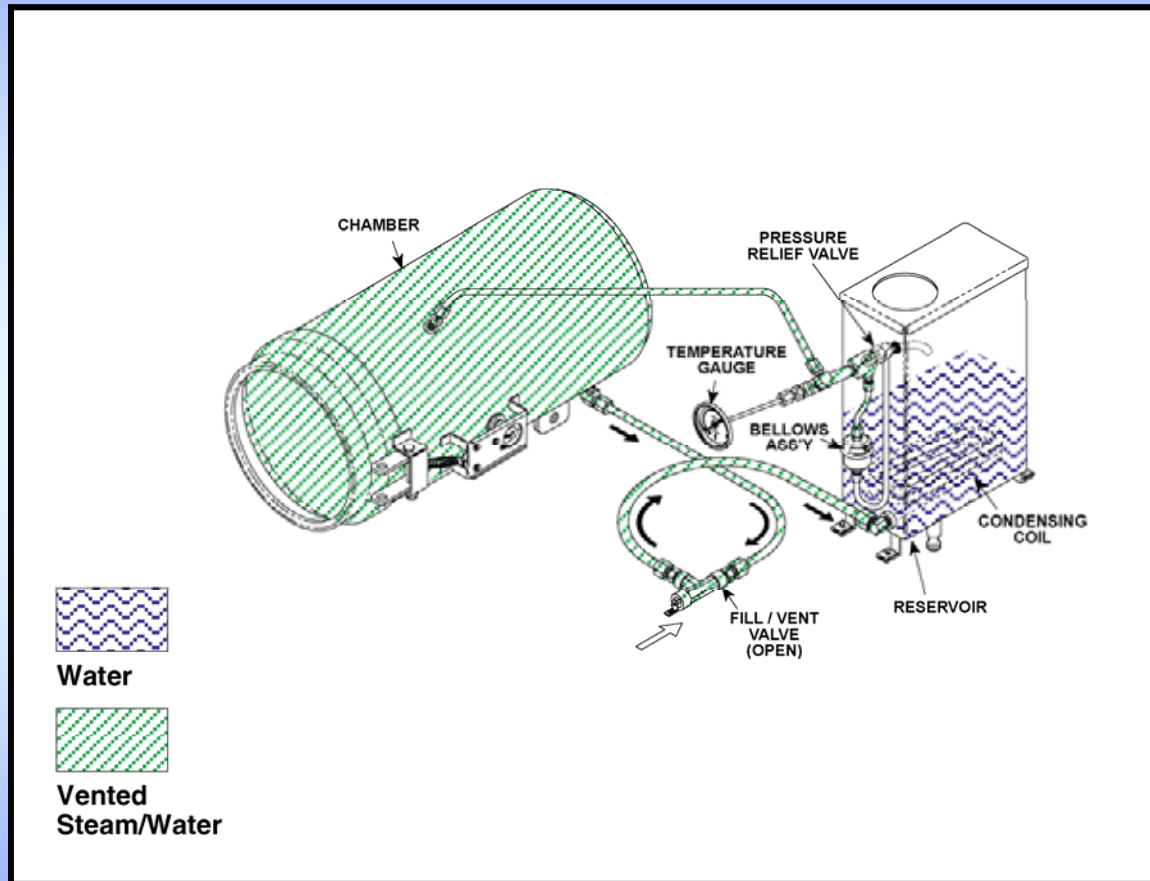
MIV081

↑
FLOW

Understanding the function of a bellows or steam trap is important to diagnosing sterilizer problems – a functional bellows will release a large amount of air and condensed water during startup and should seal to the point where water is released 2-3 drops every few seconds.

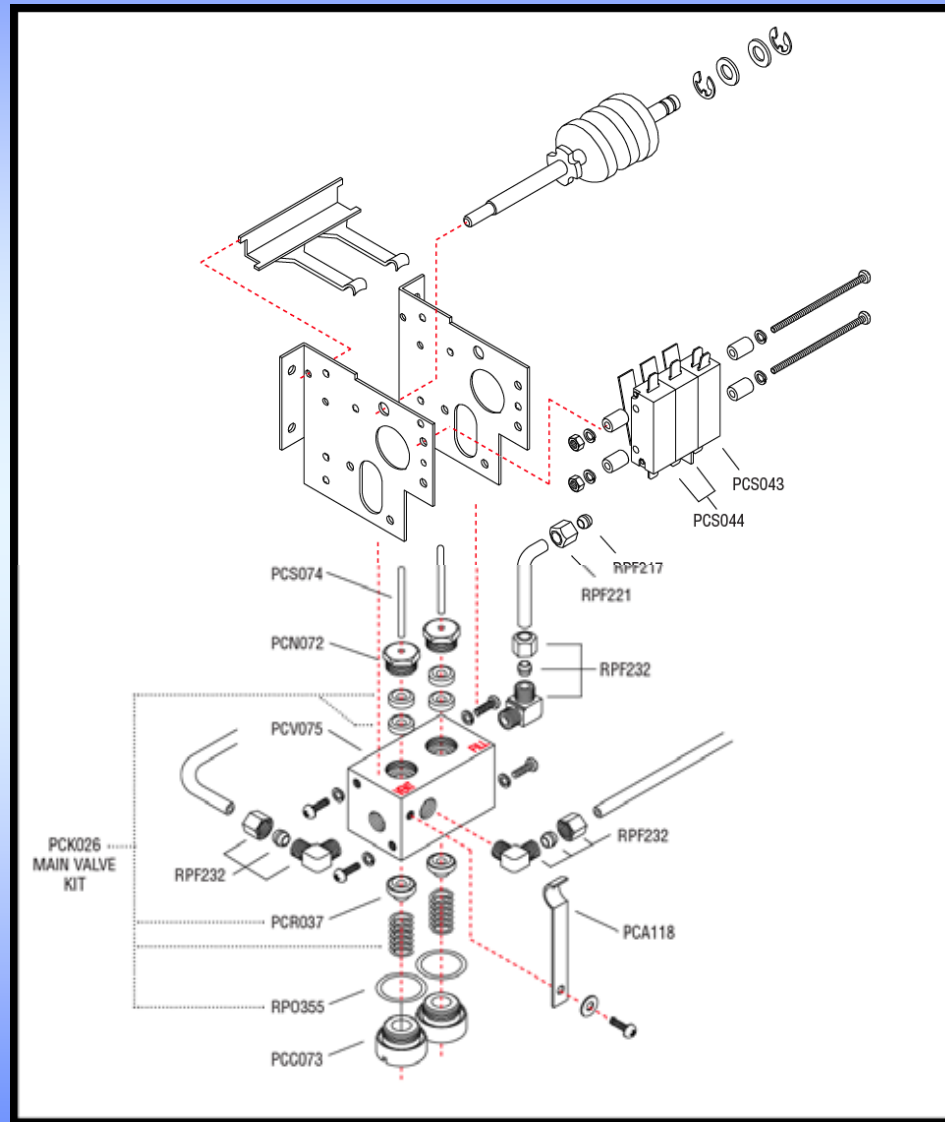


Example of a Manual Sterilizer Valve System





Example of a Manual Sterilizer Valve System





Tabletop Sterilizers: Automatic vs. Manual (Similarities)

The newer automatic type sterilizers basically work on the same principle as the older manual machines. The following are some of the similarities between the two types.

Sterilization Cycles	Sterilization cycles are between 250° F (121° C) and 275° F (134° C).
Water to Steam to Water	Water is stored in a reservoir and a condensation coil takes steam after each cycle and condenses it back into water.
Use of a Triac	Both types of sterilizers utilize a triac to supply the high current to the heaters.
Use of Solenoid Valves	A mechanical or electrical (solenoid valve) air bellows is used to maintain the saturated steam inside the chamber.
Output Devices	Output devices such as gauges (manual) or LED displays (automatic) are used to display temperature and pressure.
Timers	Mechanical timers (manual) or programmable timers (automatic) are used to monitor the length of the sterilization cycle.
Safety Devices	Safety devices for pressure (safety relief valves) and temperature (bi-metallic or snap action switches) are utilized.
Door Gaskets	Door gaskets are used to seal the chamber of the sterilizer.
Valves	Mechanical valves (manual) or solenoid valves (automatic) are used to fill the chamber of the sterilizer.
Filters	Filters are used to filter the water to the chamber from the reservoir and from the chamber back into the reservoir.



Tabletop Sterilizers – Automatic vs. Manual (Differences)

Features of an automatic sterilizer not found on a manual sterilizer

- Self-diagnostic software.
- Display codes to assist you with trouble-shooting the unit when it will not operate properly.
- Heater circuit is microprocessor controlled and automatically changes from FILL to STERILIZE to DRYING cycle and powers down at the end of the drying cycle.
- Timing circuits that actuate solenoid valves to allow a premeasured volume of water for each cycle, thus eliminating operator errors in filling the chamber.
- Additional electronic surface temperature monitoring to prevent damage to the chamber because of low water conditions.

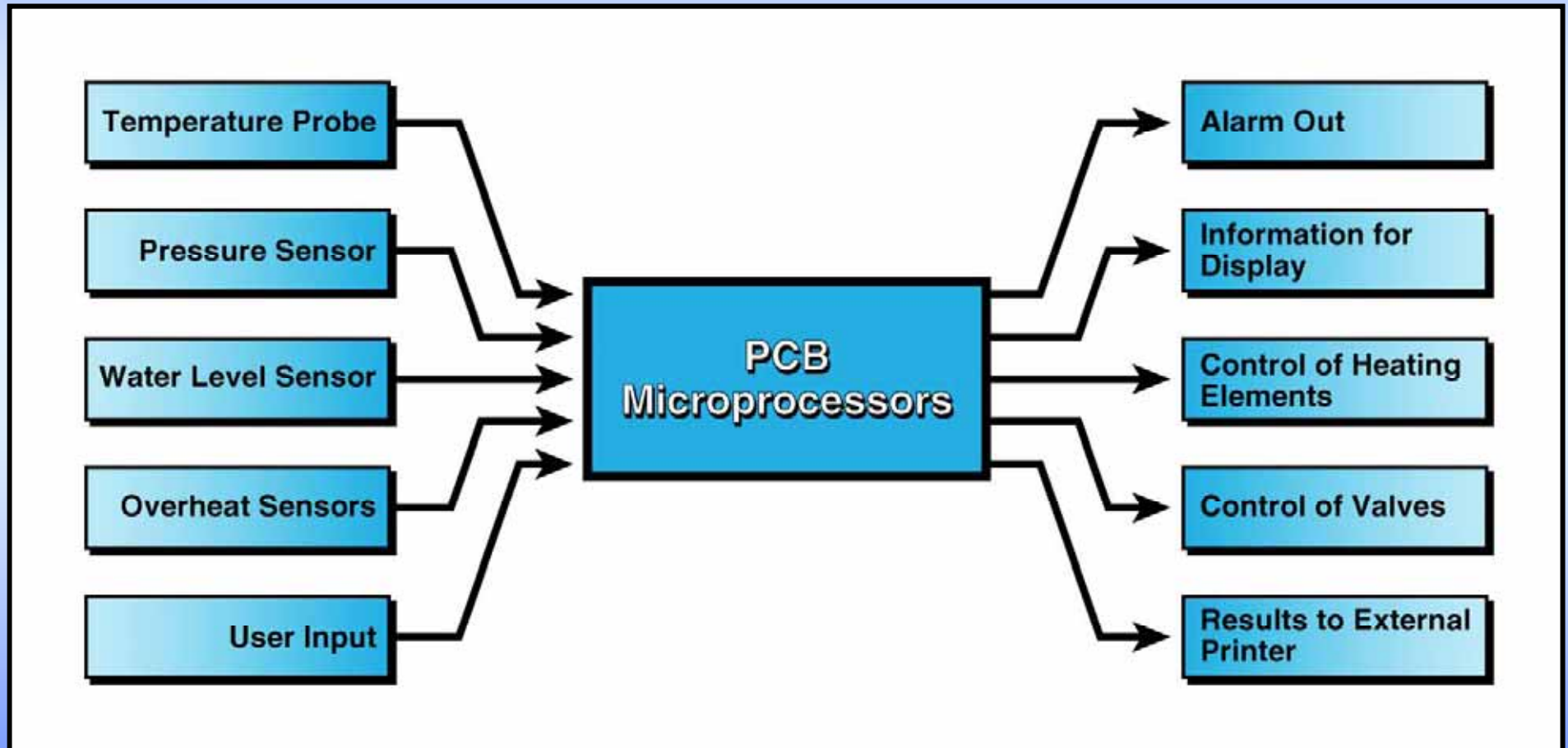
Other features of some automatic sterilizers not found on manual sterilizers

- Dams or water guards that prevent condensate from dripping on counter tops.
- Additional solenoid valve ports to expedite the venting of the sterilizer.
- Automatic door release feature (pulse solenoid latch) to prevent wet packs from occurring because the door was not cracked open.



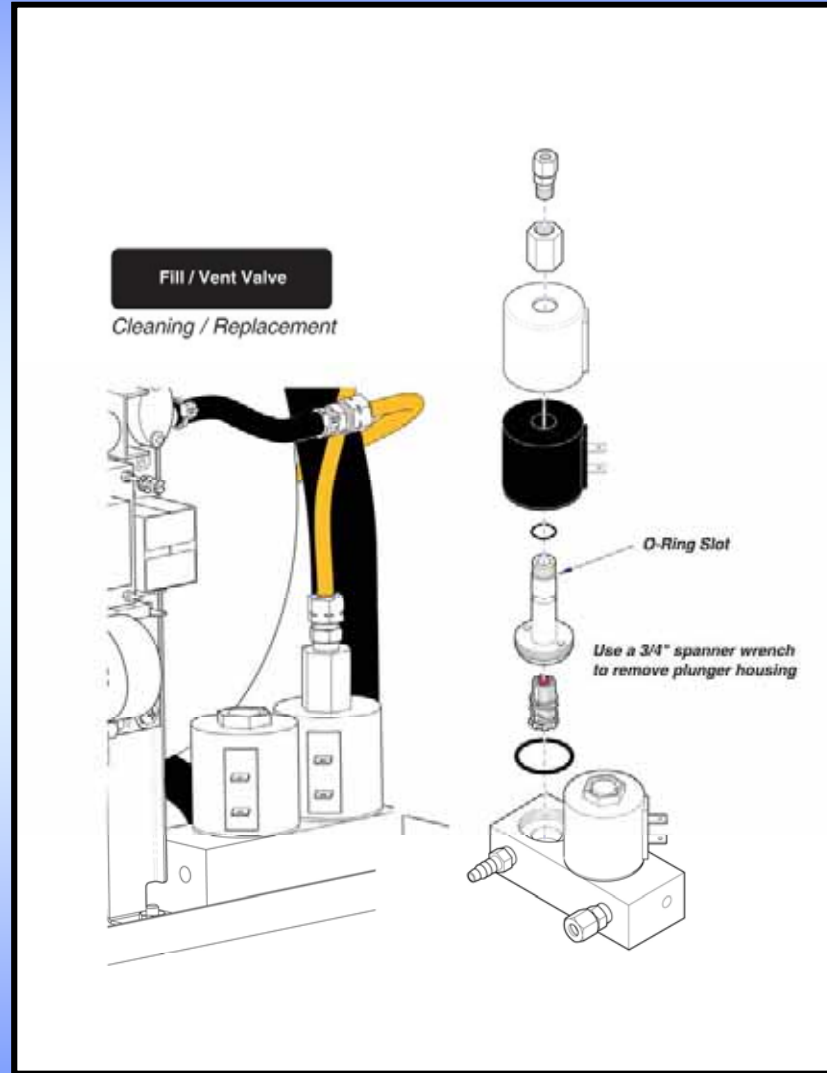


Sterilization Input and Output via the PCB Microprocessors



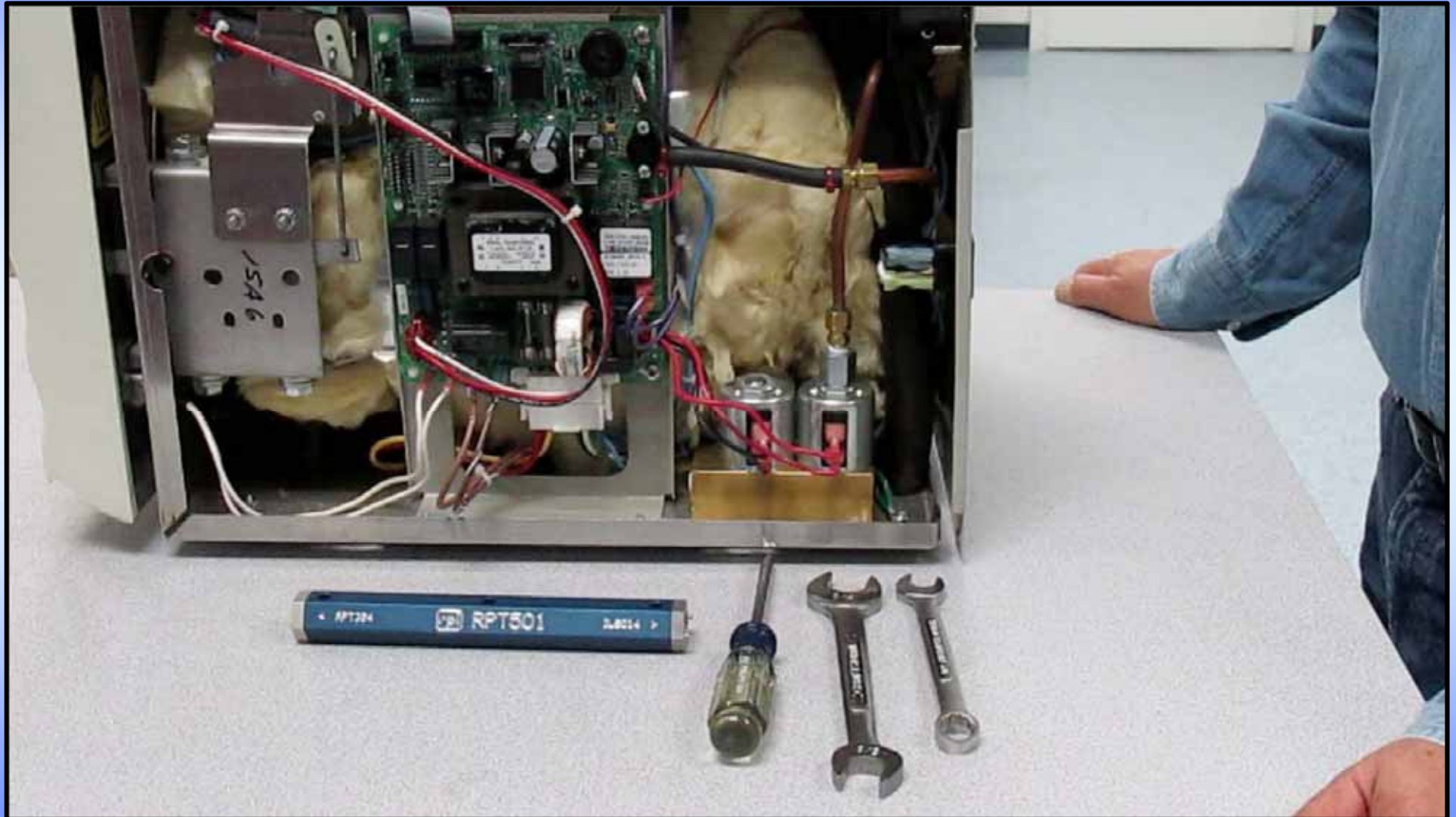


Example of an Automatic Sterilizer Valve System





Disassembly of Solenoid Valves



Disassembly of the Valve Block on the New Style Midmark M9 & M11



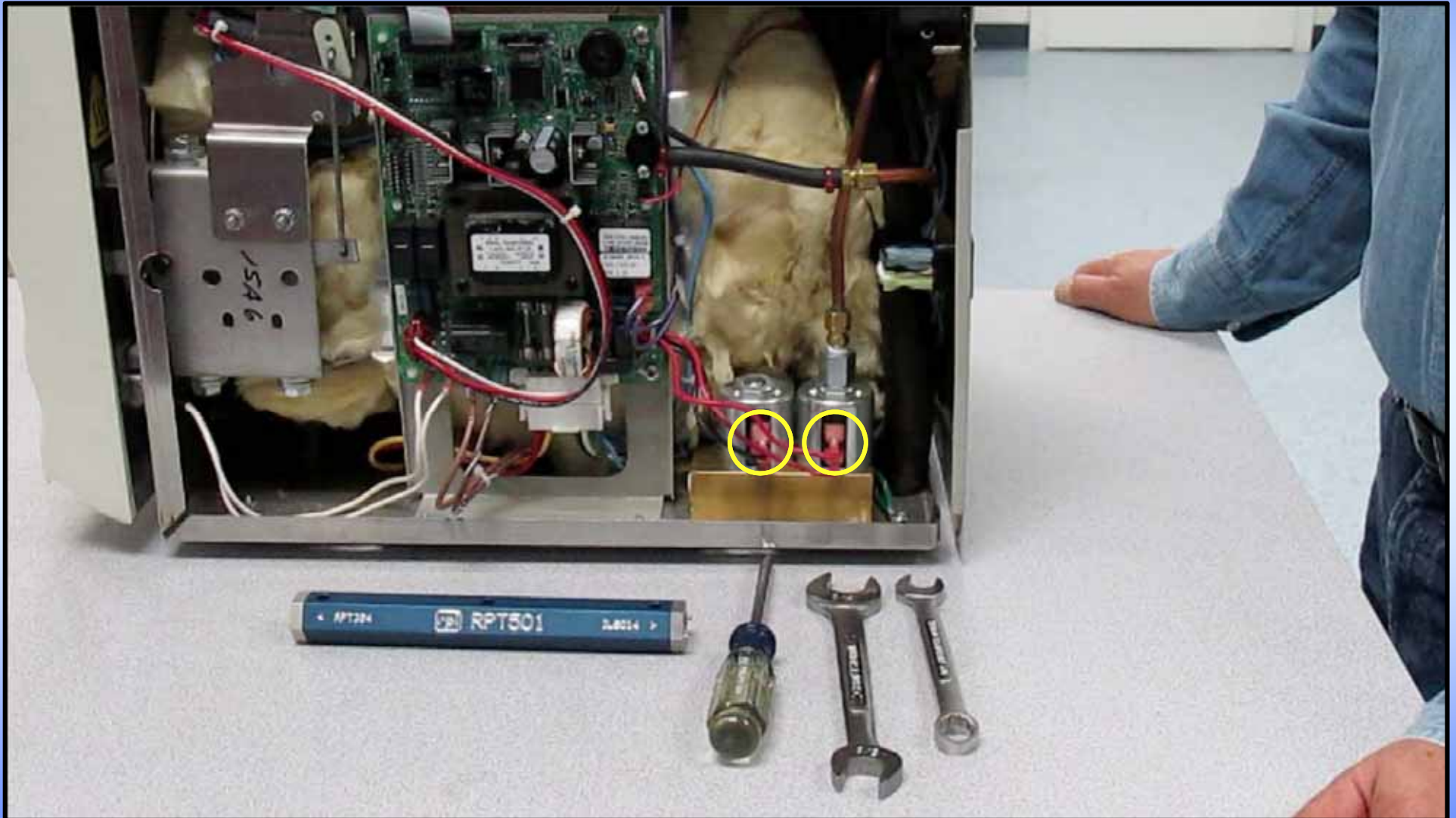
1. 1/2" Box End Wrench
2. 3/4" Box End Wrench
3. Phillips Screwdriver
4. Spanner Nut Wrench



The four tools needed when disassembling the Valve Block



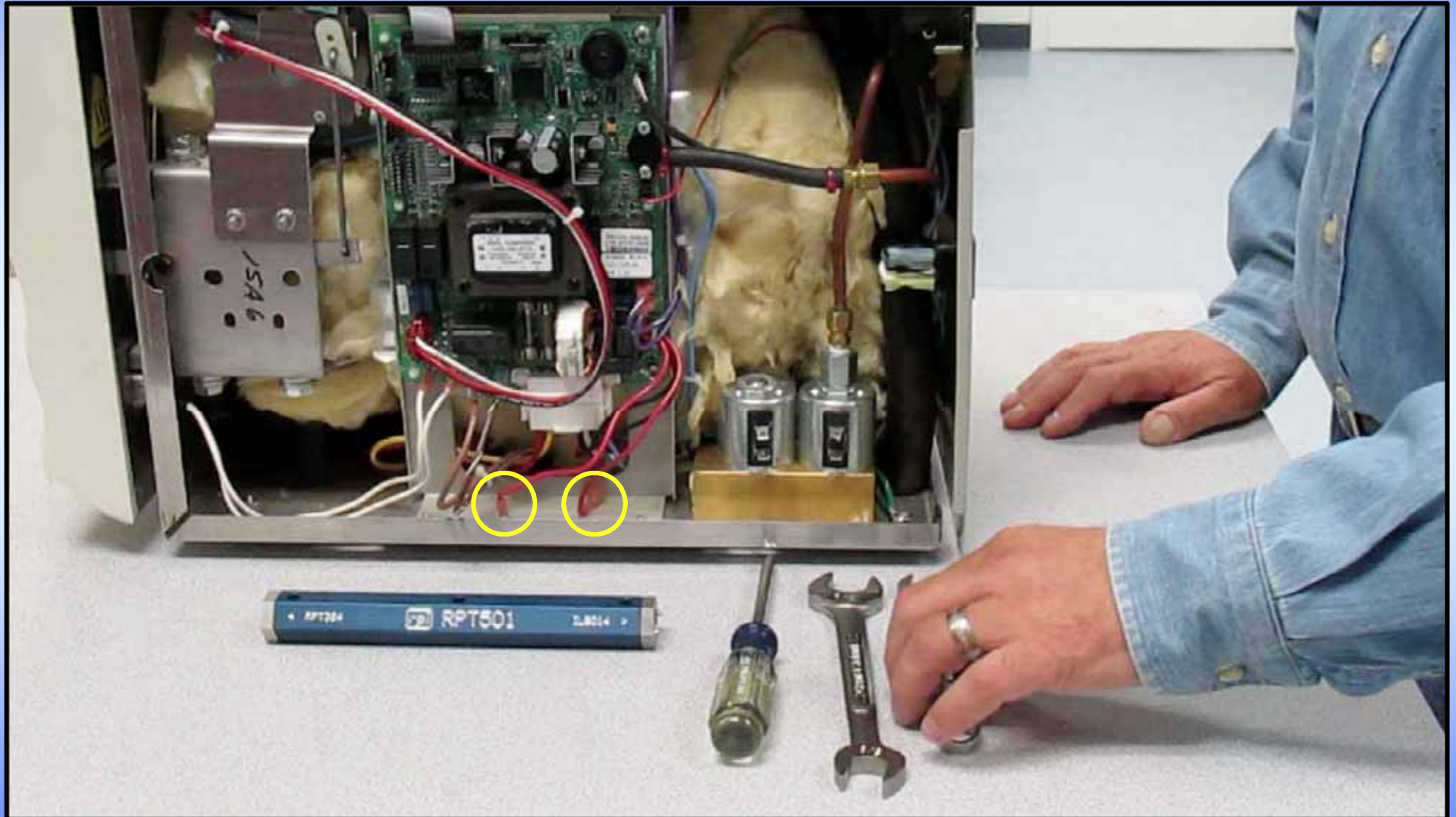
Disassembly of Solenoid Valves



Unplug the two wires connected to the Fill and Vent Valves and carefully move them out of the way, just to the left.



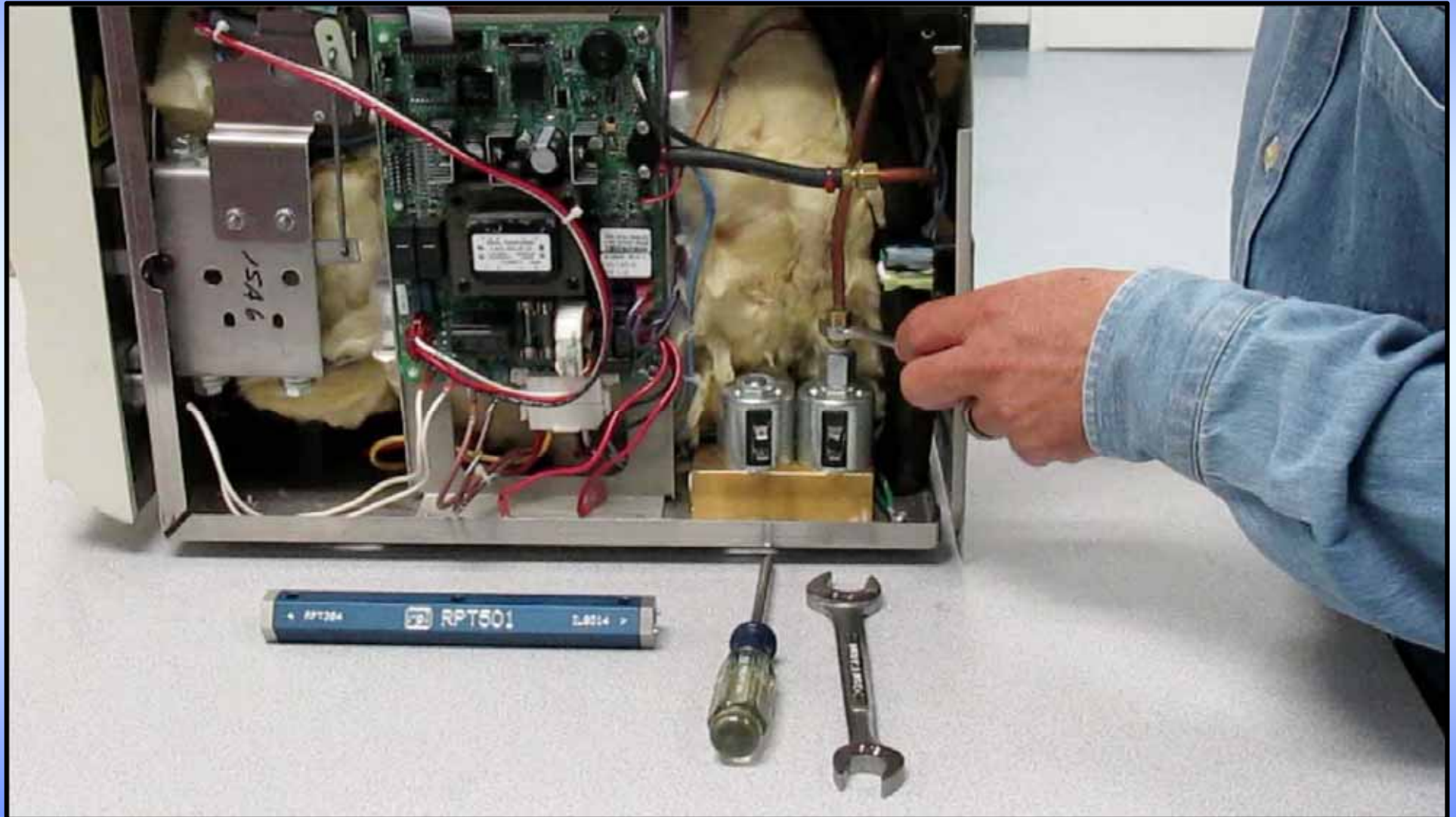
Disassembly of Solenoid Valves



Unplug the two wires connected to the Fill and Vent Valves and carefully move them out of the way, just to the left.



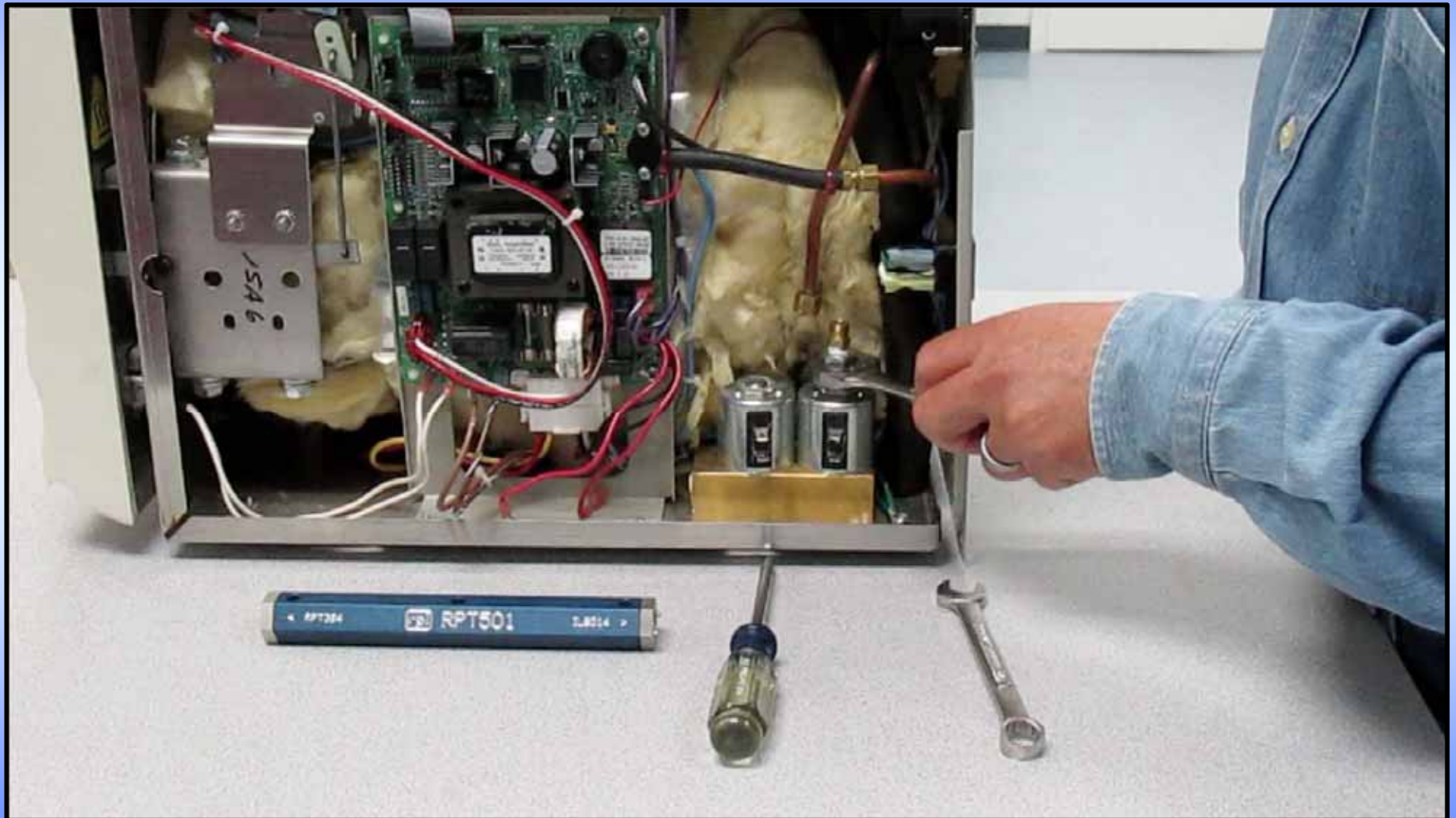
Disassembly of Solenoid Valves



Remove the Copper Fitting on top of the Vent Valve with a 1/2" Box End Wrench.



Disassembly of Solenoid Valves



Remove the Adaptor on top of the Vent Valve with a 3/4" Box End Wrench.



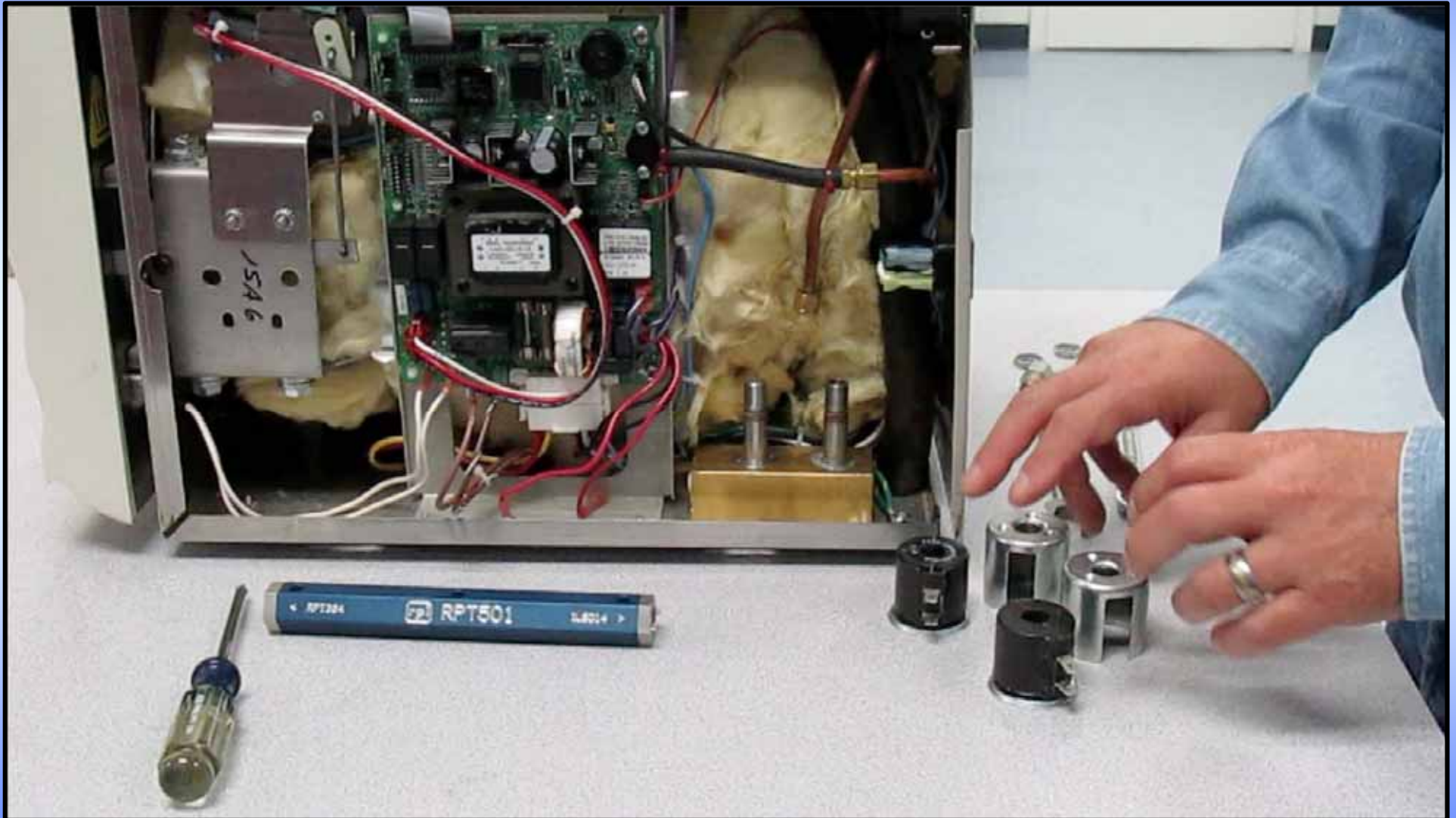
Disassembly of Solenoid Valves



Remove the Nuts on top of both the Fill and Vent Valves with a 3/4" Box End Wrench.



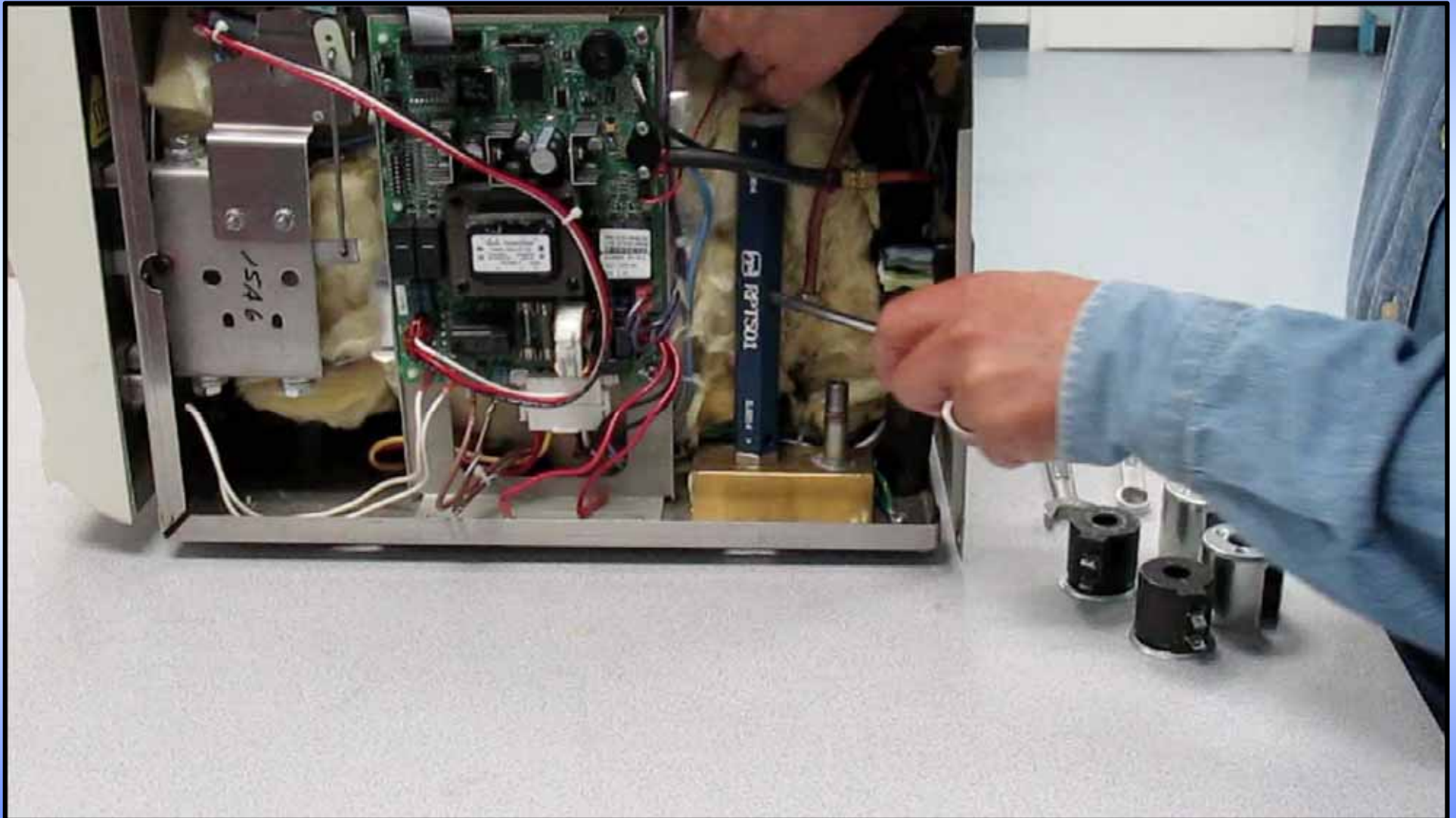
Disassembly of Solenoid Valves



Remove the Metal Housings and Coils from both of the Valves.



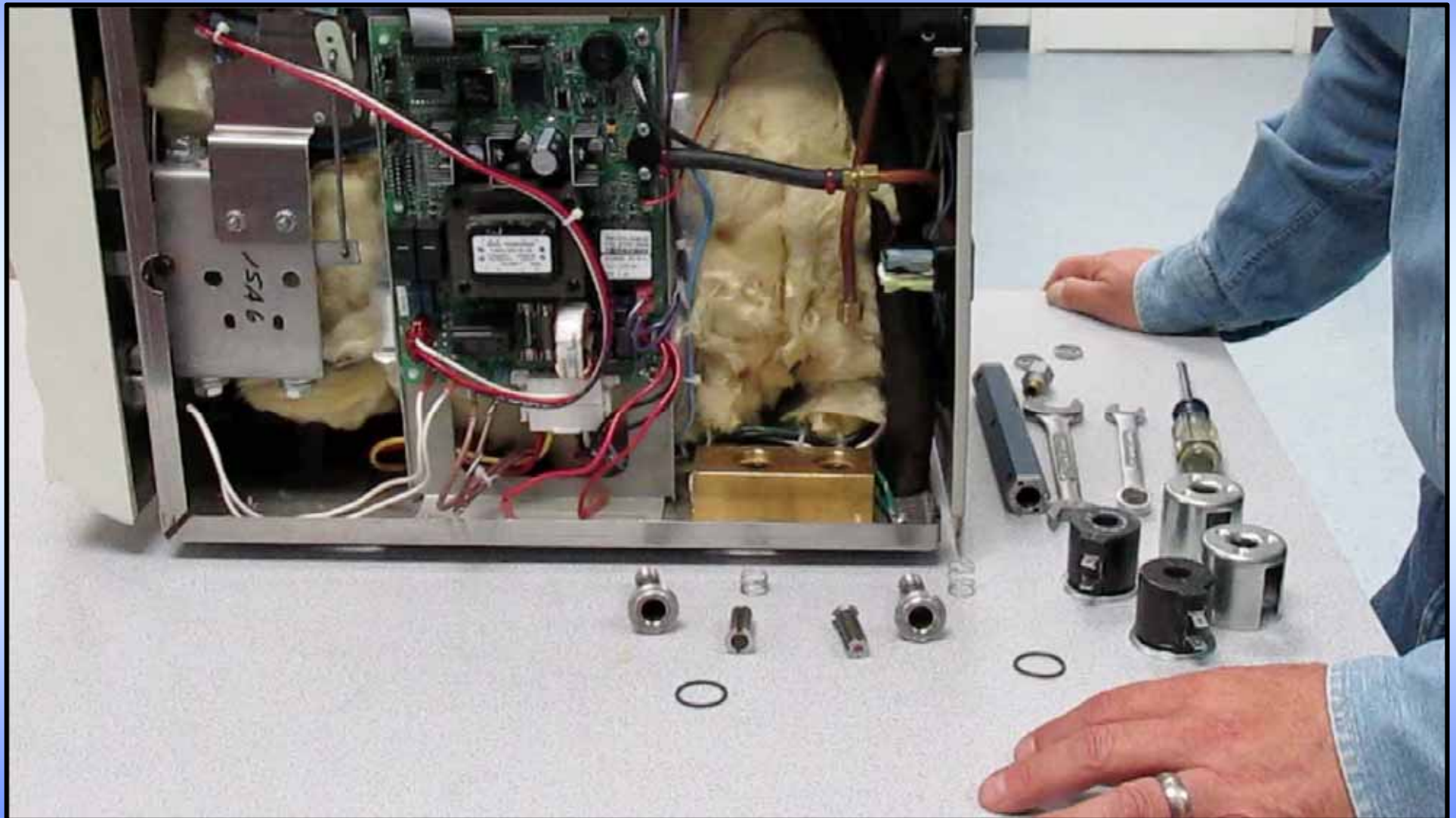
Disassembly of Solenoid Valves



To loosen the Valve Stems, use a Spanner Wrench (RPI Part #RPT501) with a screwdriver as a breaker bar. Then unscrew the Valve Stems the rest of the way using your fingers.



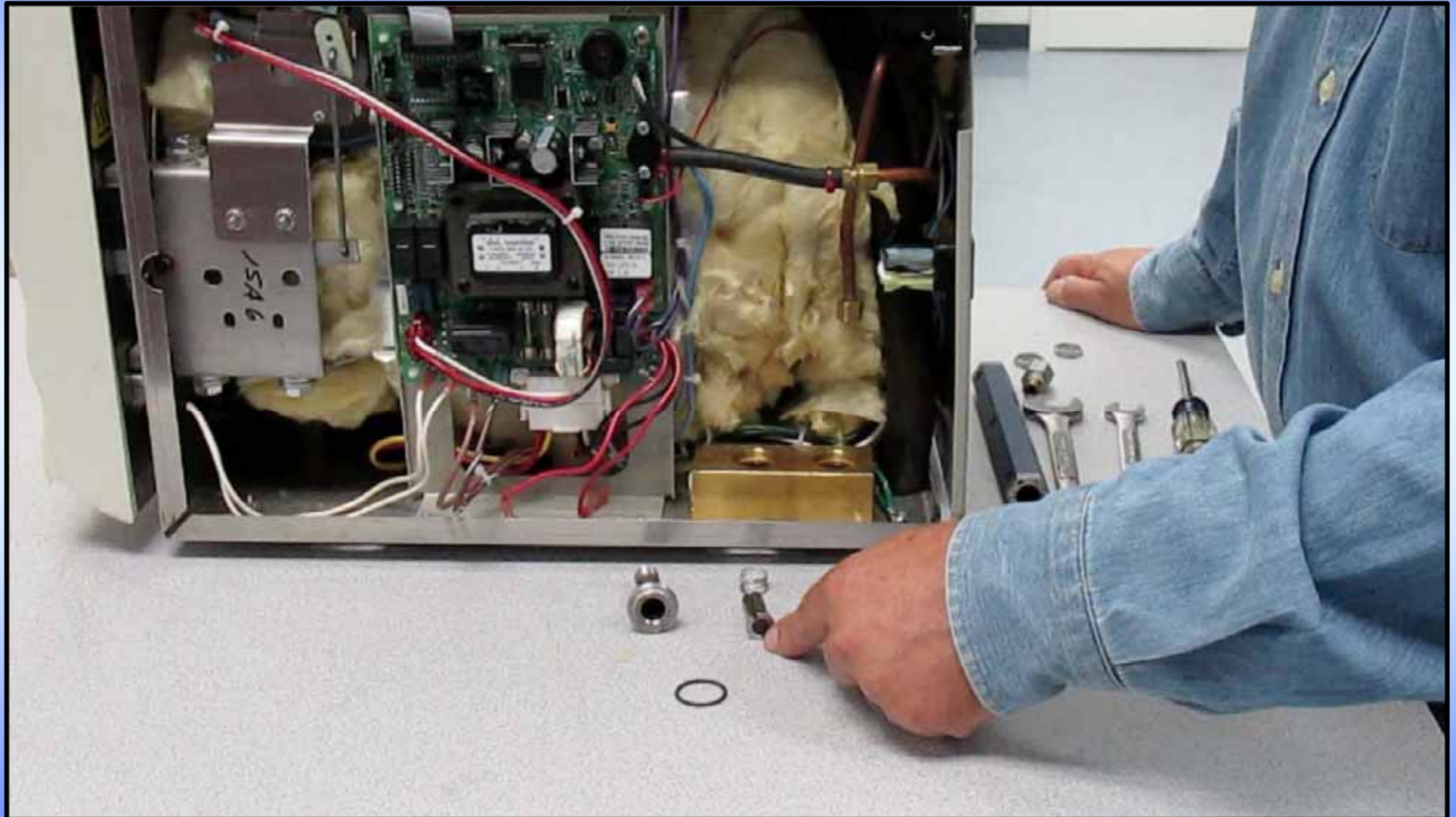
Disassembly of Solenoid Valves



Remove the Valve Stem, Piston, Spring, and O-ring from both the Fill and Vent Valves.



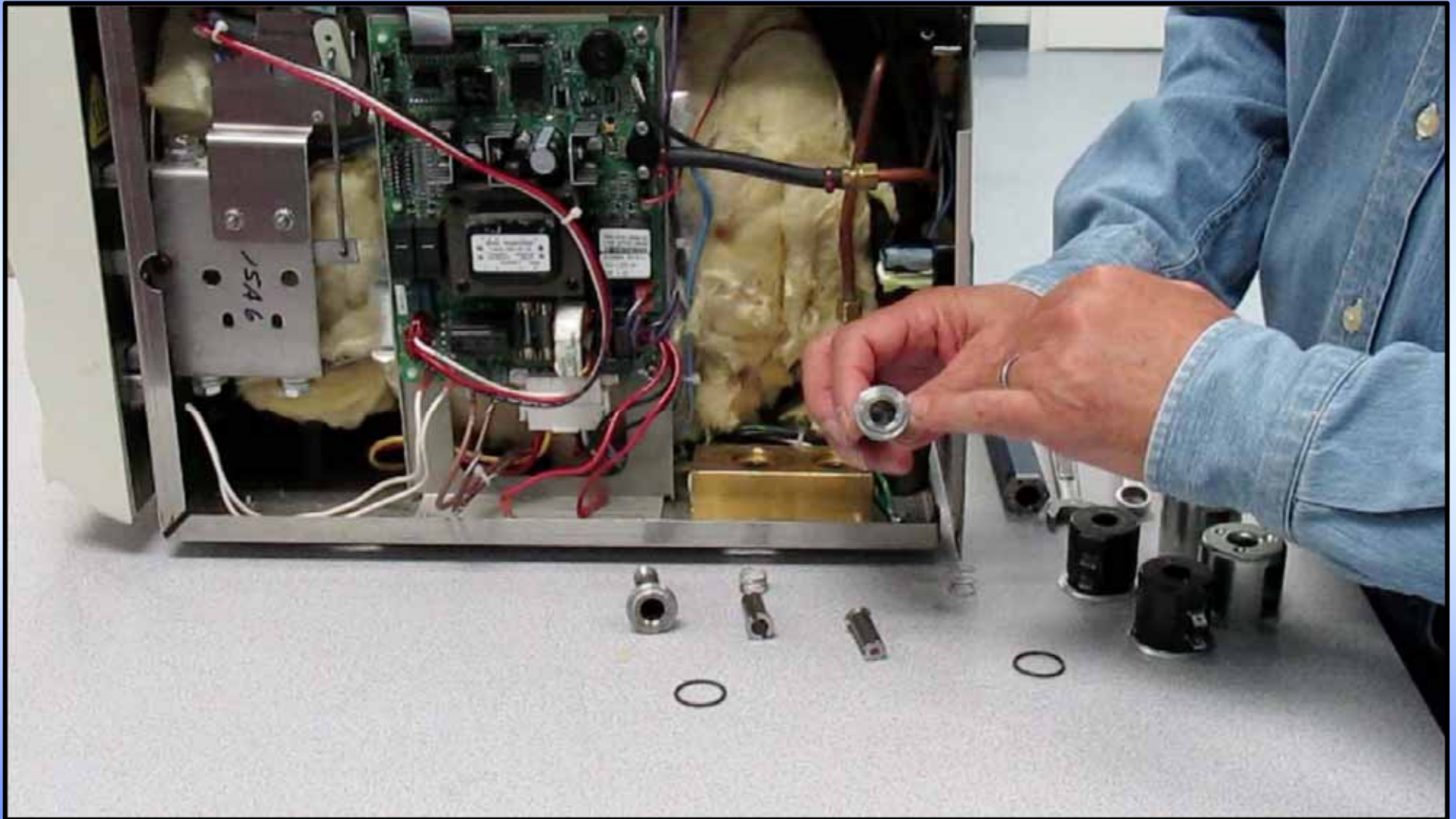
Disassembly of Solenoid Valves



The Fill Valve – The sealing surface is the black part on the bottom of the Piston and inside the Valve Block. This means it is a Normally Closed Valve.



Disassembly of Solenoid Valves



The Vent Valve – The sealing surface is the red spot on the top of the Piston and inside the Valve Stem. This means it is a Normally Open Valve.



Distinguishing Old vs. New Style M9 & M11



**Front Panel
Older Style M9 & M11**

**Red
LED Display**

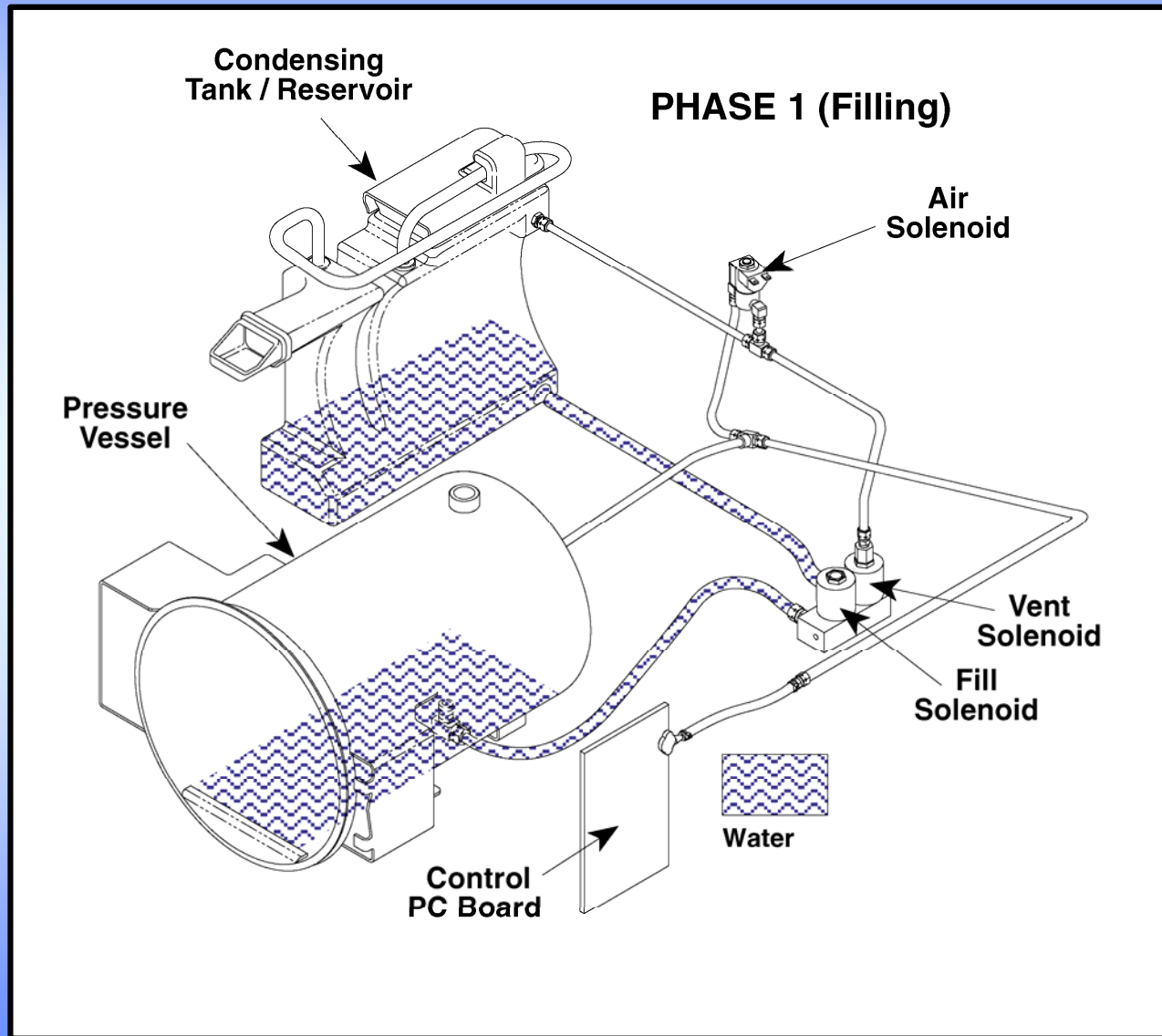


**Front Panel
Newer Style M9 & M11**

**Green
LCD Display**



Sterilizer - Phase 1 (Filling)





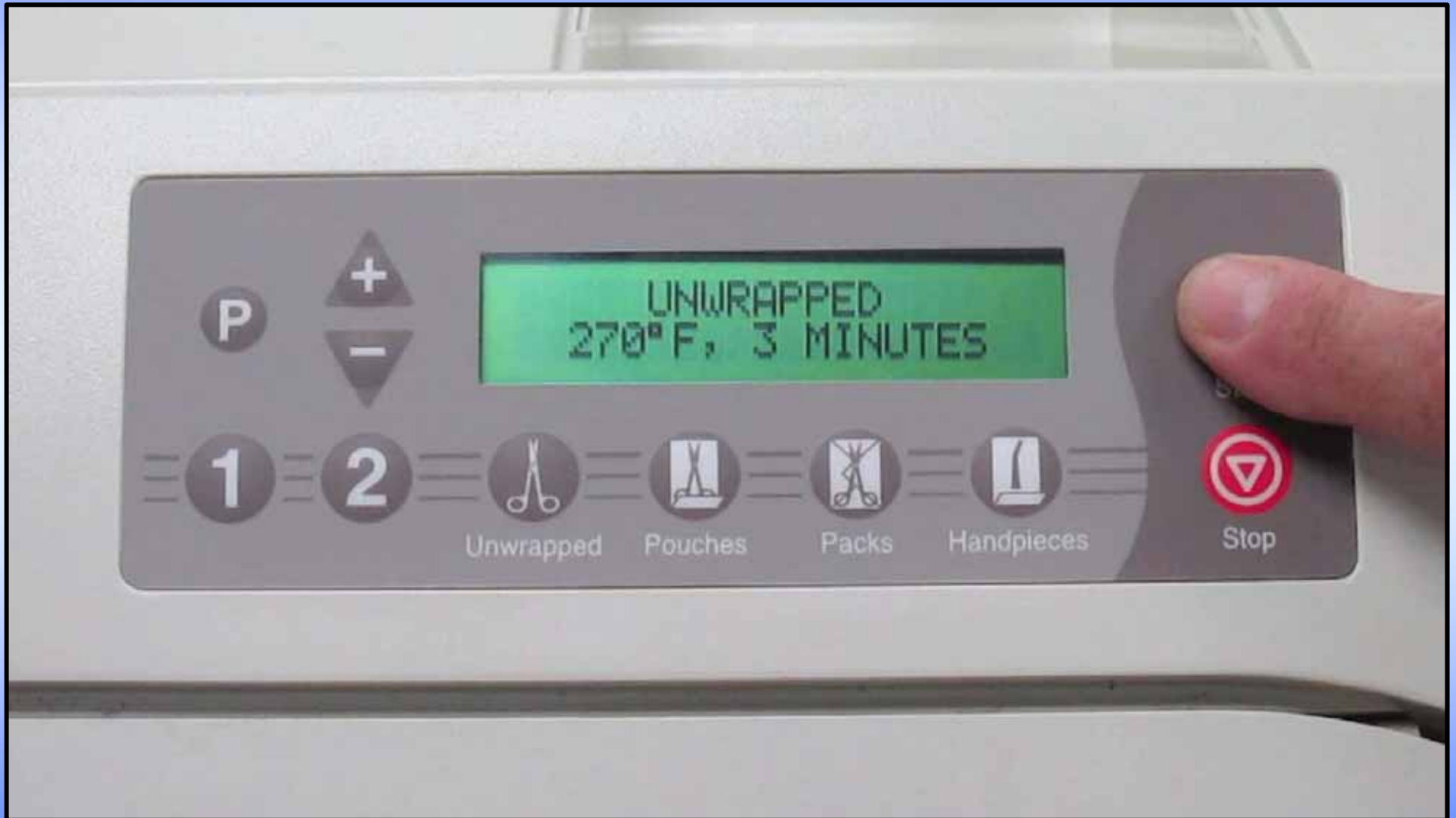
Sterilizer - Phase 1 (Filling)



Select an unwrapped cycle by pressing the Unwrapped Button.



Sterilizer - Phase 1 (Filling)



Press the Start Button to begin the cycle.



Sterilizer - Phase 1 (Filling)



The Chamber begins to fill with water.



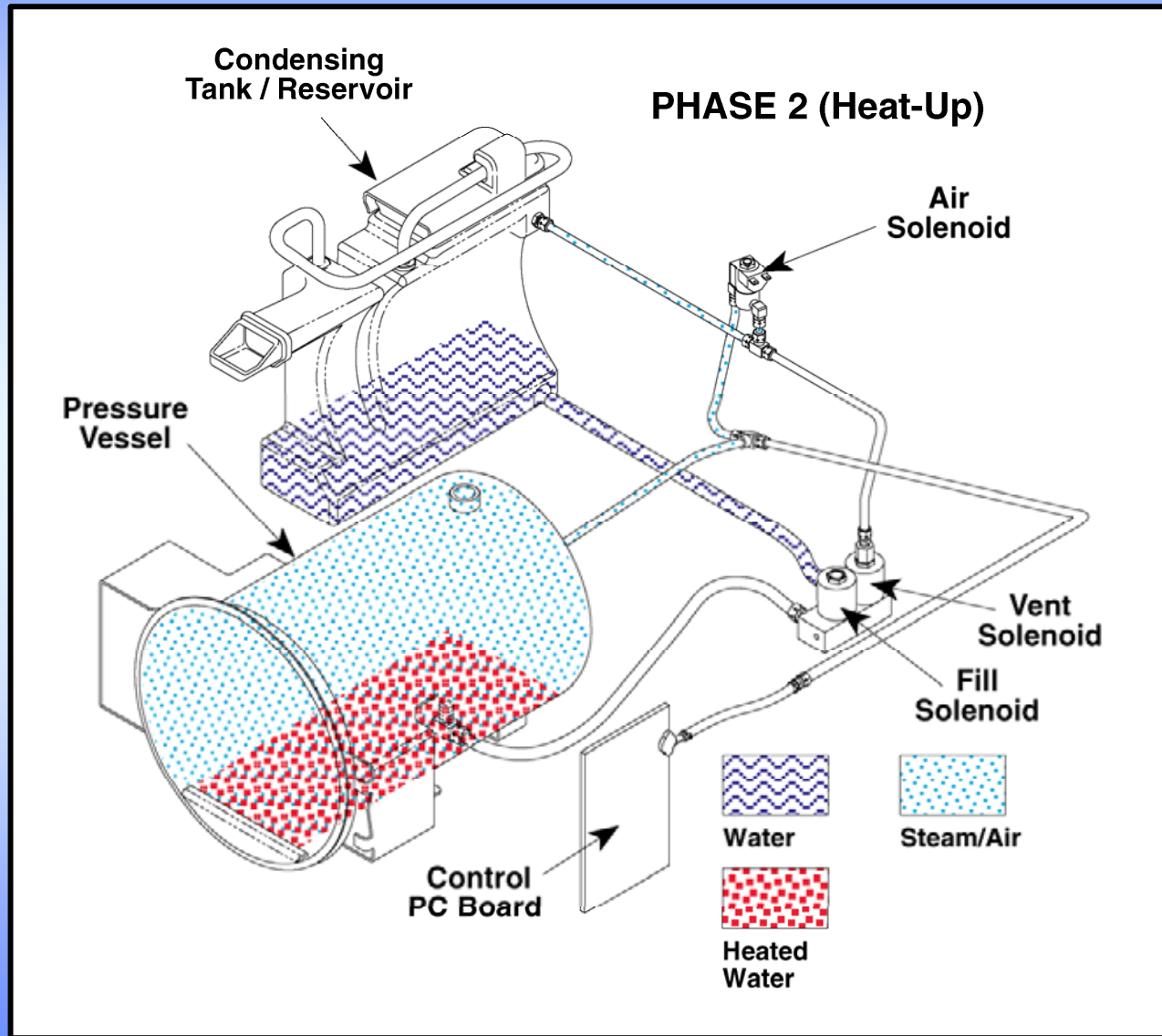
Sterilizer - Phase 1 (Filling)



The Chamber is full and is ready for Phase 2.



Sterilizer - Phase 2 (Heat-Up)





Sterilizer - Phase 2 (Heat-Up)



During the Heat-Up Phase, listen for the sound of the Vent Valve as it opens 3 different times to expel cooler air. The first time will occur around 4 minutes and 30 seconds.



Sterilizer - Phase 2 (Heat-Up)





Sterilizer - Phase 2 (Heat-Up)





Sterilizer - Phase 2 (Heat-Up)





Sterilizer - Phase 2 (Heat-Up)





Sterilizer - Phase 2 (Heat-Up)





Sterilizer - Phase 2 (Heat-Up)



The second time the Vent Valve opens will occur around 6 minutes and 53 seconds.



Sterilizer - Phase 2 (Heat-Up)





Sterilizer - Phase 2 (Heat-Up)





Sterilizer - Phase 2 (Heat-Up)



HEATING - UNWRAPPED
240° F 12.3PSI

P



1

2



Unwrapped

Pouches

Packs

Handpieces



Start



Stop

Elapsed Cycle Time

6:55



Sterilizer - Phase 2 (Heat-Up)





Sterilizer - Phase 2 (Heat-Up)



HEATING - UNWRAPPED
239°F 11.7PSI

P

+
-

1

2



Unwrapped

Pouches

Packs

Handpieces



Start



Stop

Elapsed Cycle Time

6:57



Sterilizer - Phase 2 (Heat-Up)



The third time the Vent Valve opens will occur around 8 minutes and 22 seconds and then the pressure and temperature will stabilize for the Sterilization Phase.



Sterilizer - Phase 2 (Heat-Up)





Sterilizer - Phase 2 (Heat-Up)





Sterilizer - Phase 2 (Heat-Up)





Sterilizer - Phase 2 (Heat-Up)



HEATING - UNWRAPPED
244°F 12.4PSI

P

+
-

1

2



Unwrapped

Pouches

Packs

Handpieces



Start



Stop

Elapsed Cycle Time

8:26



Sterilizer - Phase 2 (Heat-Up)



P

+
-

HEATING - UNWRAPPED
243°F 12.2PSI

Start

1

2

Unwrapped

Pouches

Packs

Handpieces

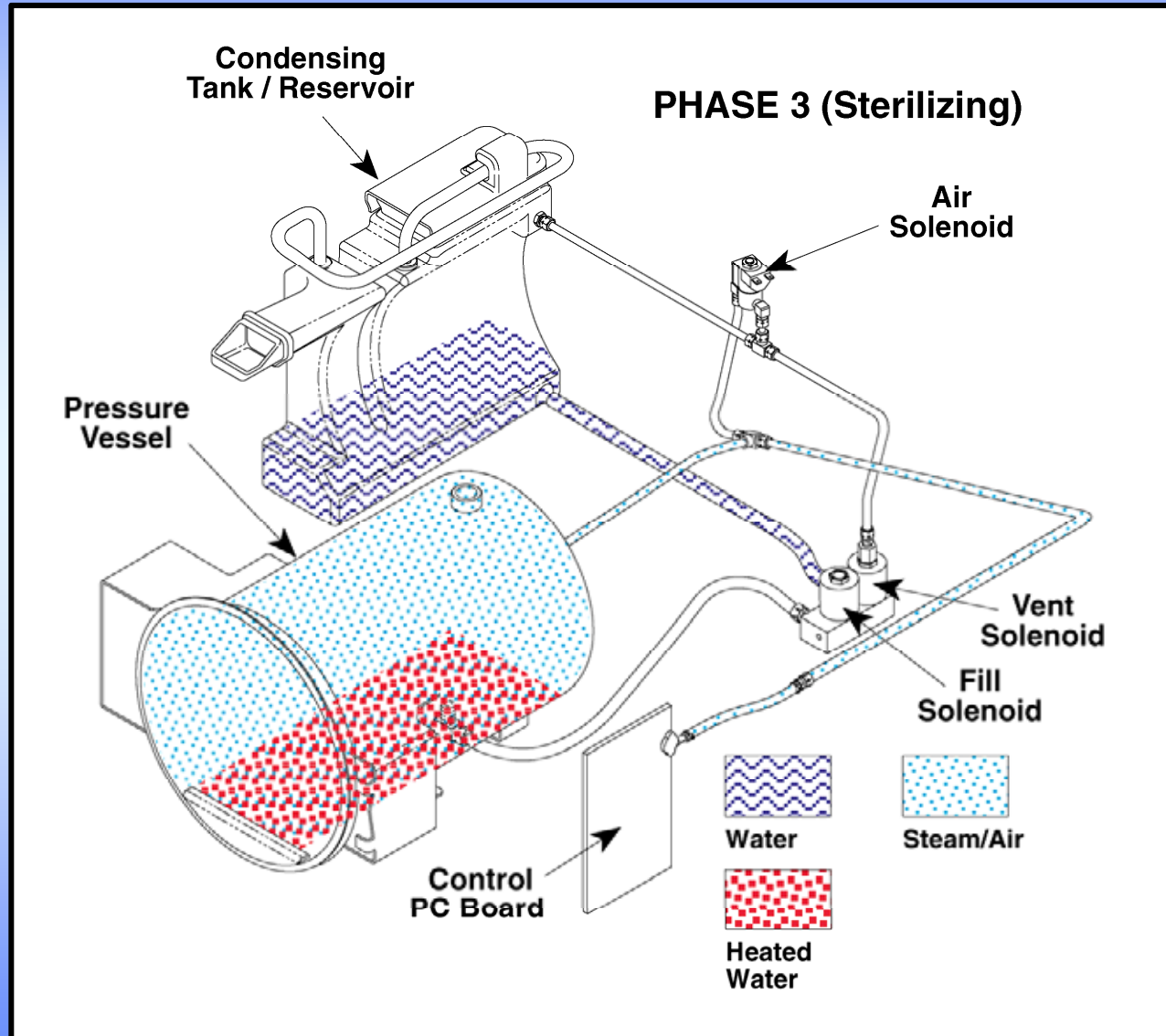
Stop

Elapsed Cycle Time

8:27



Sterilizer - Phase 3 (Sterilizing)





Sterilizer - Phase 3 (Sterilizing)



The Sterilization Phase will begin and last for 3 minutes.



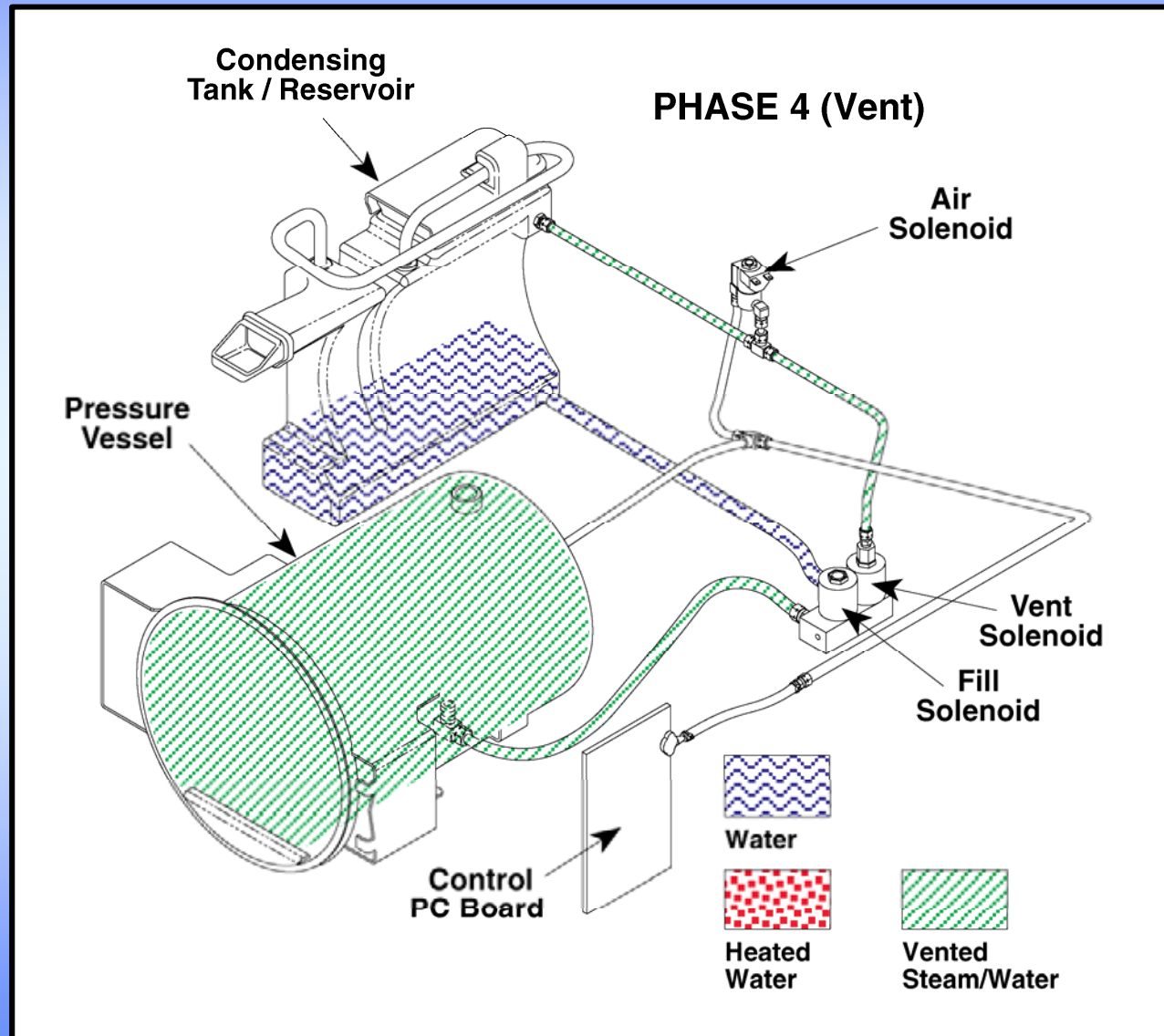
Sterilizer - Phase 3 (Sterilizing)



The Sterilization Phase is complete and the sterilizer is ready for the final phase.



Sterilizer - Phase 4 (Vent)





Sterilizer - Phase 4 (Vent)



The sound of the Vent Valve opening for the final time signals the beginning of Phase 4.



Sterilizer – Phase 4 (Vent)



The Door will automatically open after the Vent Valve has released all of the pressure in the Chamber.



Sterilizer - Phase 4 (Vent)



The Drying Cycle begins.



Sterilizer - Phase 4 (Vent)



The Cycle is complete.



Tech Tips: Midmark M9 Bottom Panel

Heating Element Connections and Installation



Tech Tip #1

When working under the machine be sure to check the heating element connections for oxidation and clean or repair as needed – oxidation on these connections can cause the element to produce additional unwanted heat which can lead to false failures of the over temperature switches as well as the failure of the connectors and wire jacketing.

Tech Tip #2

When replacing the heating element the order of the hardware is important – the fiber washer is always installed inside the chamber, the metal plate and the over temperature switches are installed next (on the outside), then the flat washer, lock washer and nut are installed last – there should be nothing installed between the chamber and the metal plate.



Tech Tips: Midmark M9 Bottom Panel

Over Temperature Switches

Tech Tip #3

These devices are automatically resettable thermal switches and can be trouble shot by measuring their resistance when cold – low resistance measurement means a functioning part while high or infinite resistance indicates a failed switch.





Tech Tips: Midmark M9 Bottom Panel

Chamber Fitting

Tech Tip #4

When working on the underside of the machine, check this fitting for corrosion. Rusting around this fitting could indicate the beginnings of a chamber failure – sterilizer chambers can not be repaired or re-welded - they must be replaced to maintain ASME certification.





Tech Tips: Midmark M9 Side Panel

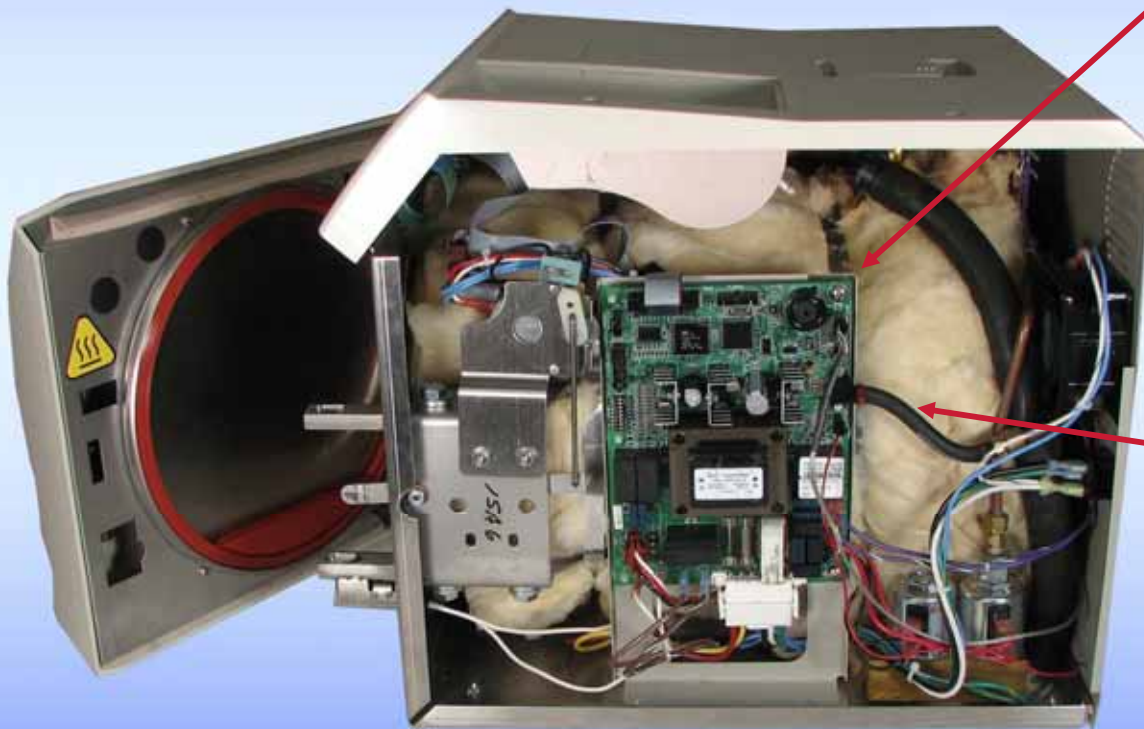
Main Circuit Board

Tech Tip #1

Verify all temperature and pressure readings during the service and calibration procedures with an independent gauge, thermocouple or lag thermometer. On the Midmark M9, an exterior gauge can be connected between the chamber and the pressure sensor at the main circuit board. When making these measurements, it is important to always use tie wraps at all connections.

Tech Tip #2

When reinstalling the rubber hose running from the chamber to the pressure transducer be sure to use new high temperature tie wrap and be sure there are no leaks at either end of the hose – a small leak at this point can make the board impossible to properly calibrate.



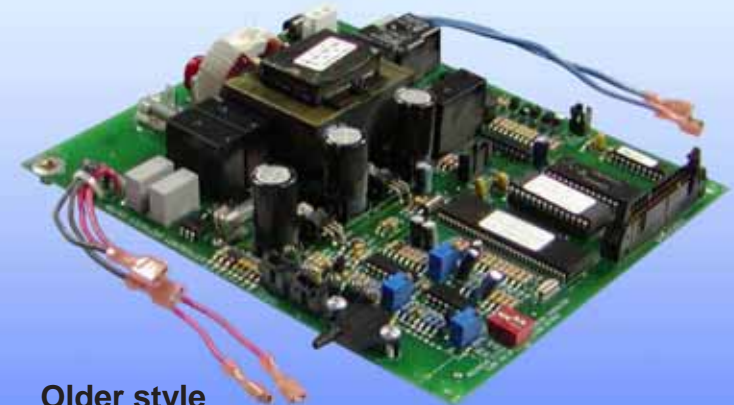
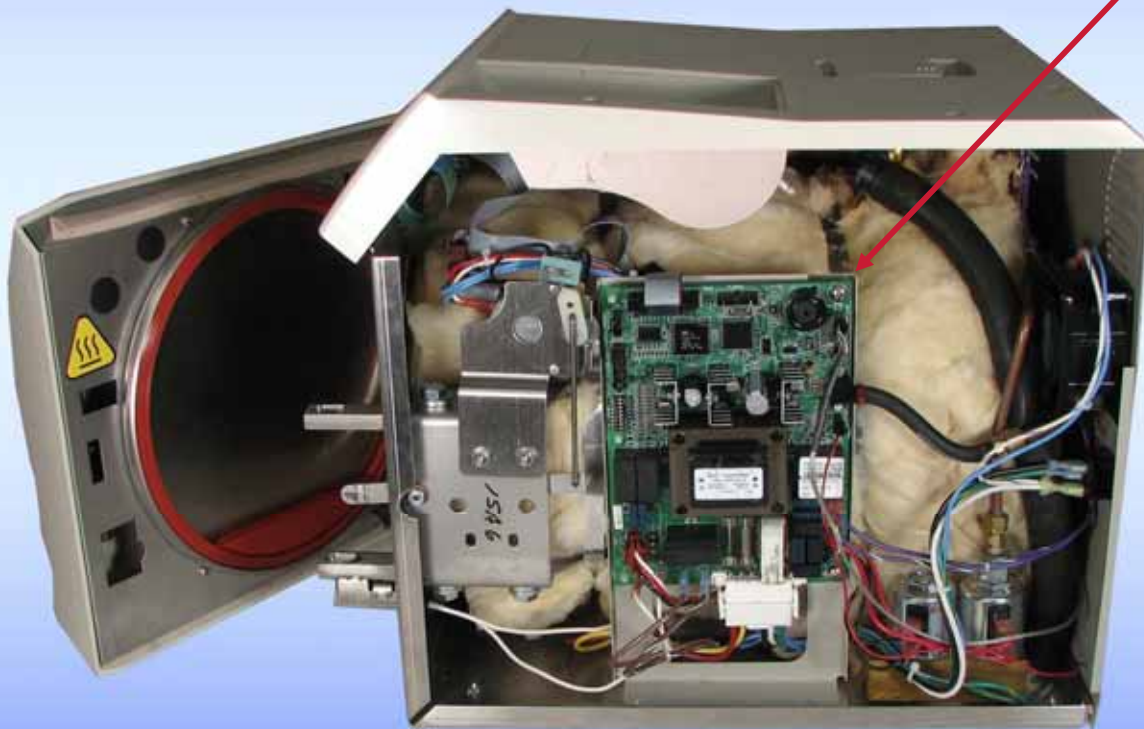


Tech Tips: Midmark M9 Side Panel

Main Circuit Board

Tech Tip #3

Before replacing the main circuit board on the older style M9/M11 remove the main circuit board mounting bracket and check for rust between the bracket and the case of the machine – rust at this point can interfere with the ground path leading to the board. When reinstalling the main circuit board be sure to install all mounting hardware including any stainless steel screws – these screws form the ground path to the board and without them installed, the board can produce filling as well as calibration errors.



Older style Main Circuit Board

Check all board connections for oxidation – many of these wires carry large amounts of current and can fail to the point that the board will be damaged.

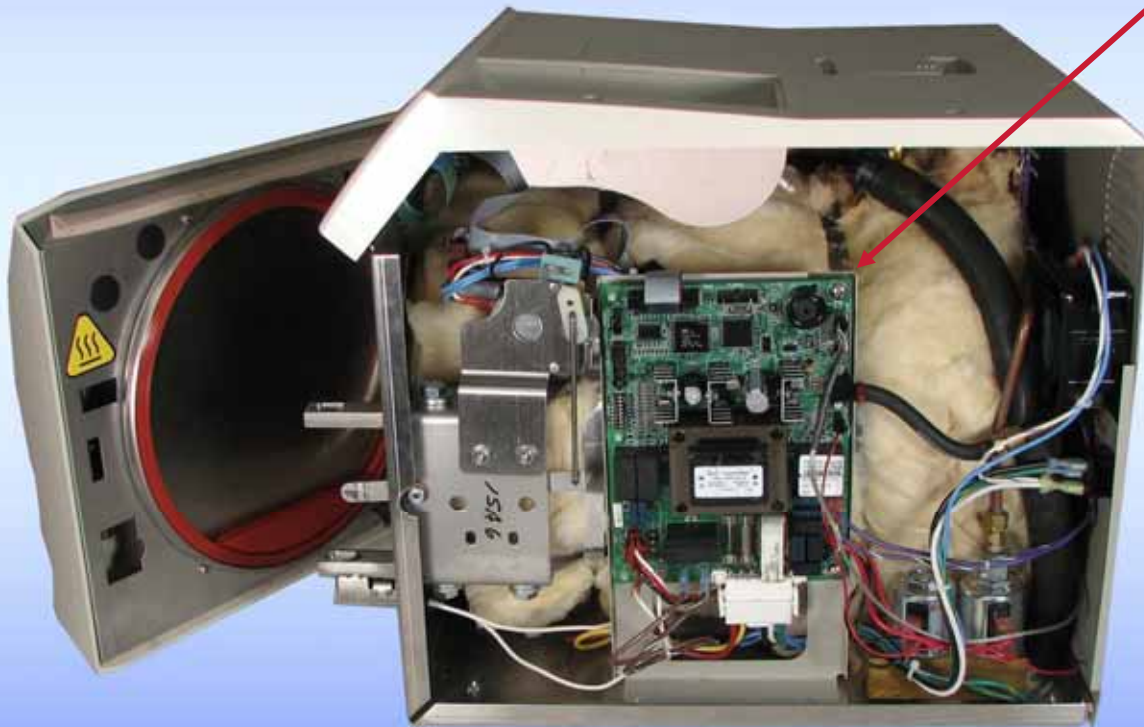


Tech Tips: Midmark M9 Side Panel

Main Circuit Board

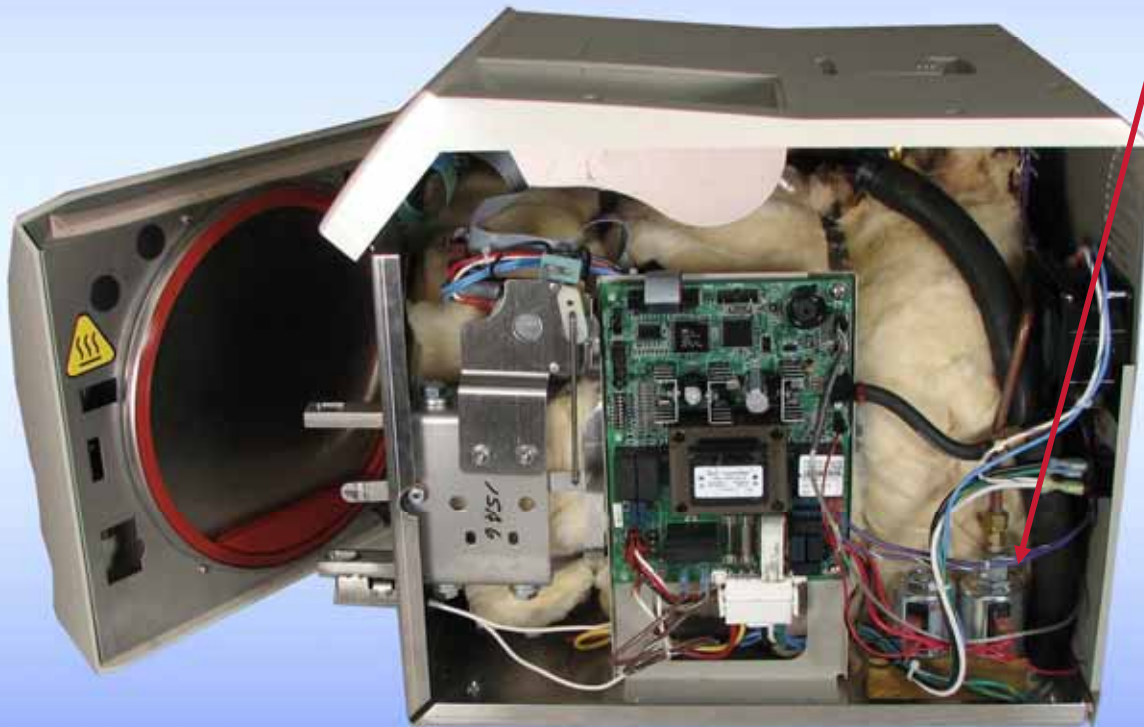
Tech Tip #4

Blown fuses on this circuit board often indicate problems with components external to the board. Before installing a replacement board, check the heating element, the valve coils and the door motor or pulse solenoid for internal shorts or shorts to ground.





Tech Tips: Midmark M9 Side Panel



Valve Assembly

Tech Tip #5

Failure of the fill valve can lead to water entering the chamber when the sterilizer is idle. Failure of the vent valve can lead to pressure or over temperature problems.

Tech Tip #6

When working on the solenoid valves never use a pair of pliers to open the valve body. A spanner wrench of the correct size will avoid crushing the valve bonnet.

Tech Tip #7

When working within any valves (manual or electrical) ensure that all seals and seats are clean and free of chips or cracks. Whenever possible replace all o-rings and gaskets to ensure a tight seal.

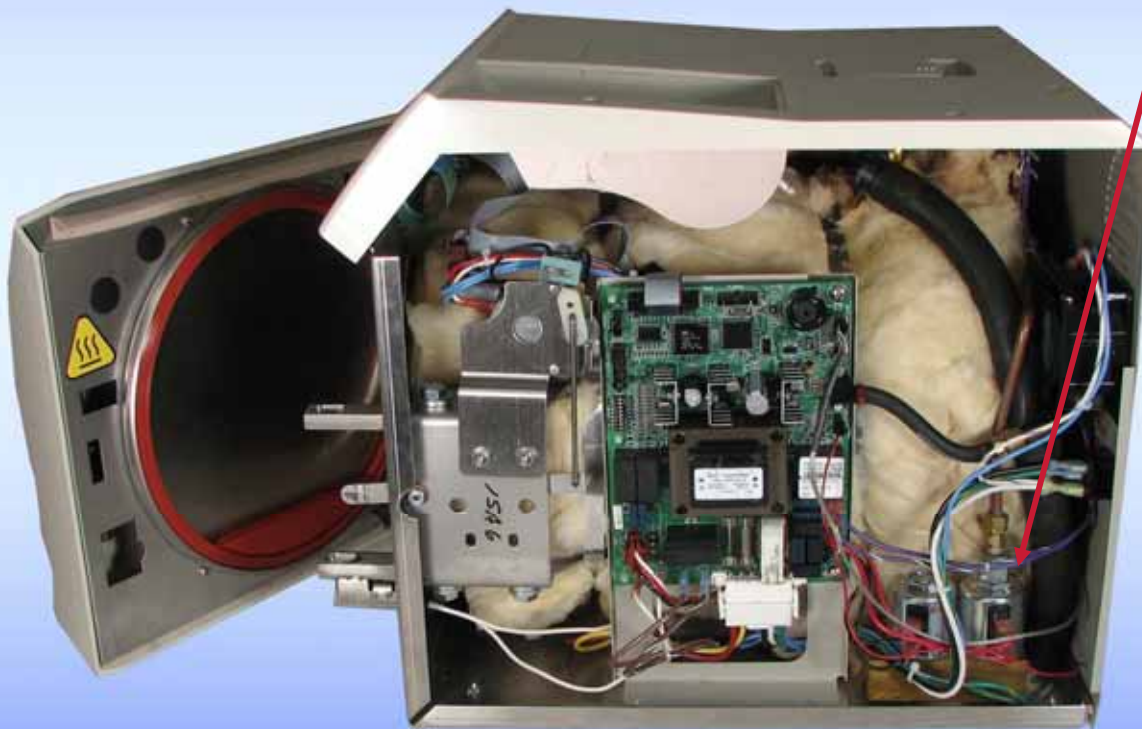


Tech Tips: Midmark M9 Side Panel

Valve Assembly

Tech Tip #8

When checking the coil in an electrical valve be sure to read the specifications printed on the body of the valve – if the letters “FWR” appear as part of the voltage specification this indicates the presence of a full wave rectifier within the coil. A full wave rectifier within the coil will prevent you from measuring the resistance of the coil directly – the resistance of a functional full wave rectified coil should be approximately 3 to 4 Meg Ohms.



“FWR” on the label of a coil indicates that a full wave rectifier is present within the coil.





Tech Tips: Midmark M9 Side Panel

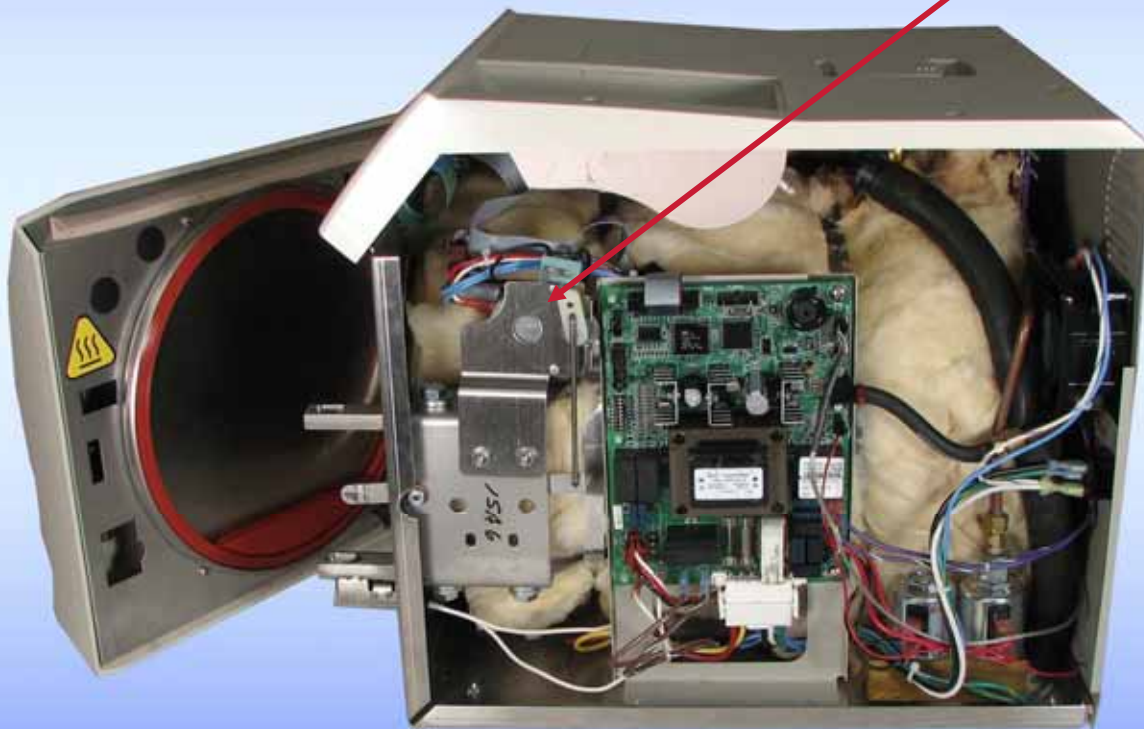
Door Motor Assembly

Tech Tip #9

The presence of a door motor (or a pulse solenoid in the older models) is the difference between the M9, M11 and the M9D, M11D. The D style sterilizers have manually operated doors.

Tech Tip #10

Sold as a complete kit, the door motor has two mounting positions for the cam based on the size of the chamber – setting the cam to the wrong position will damage both the cam and the motor.





Tech Tips: Midmark M9 Door Panel

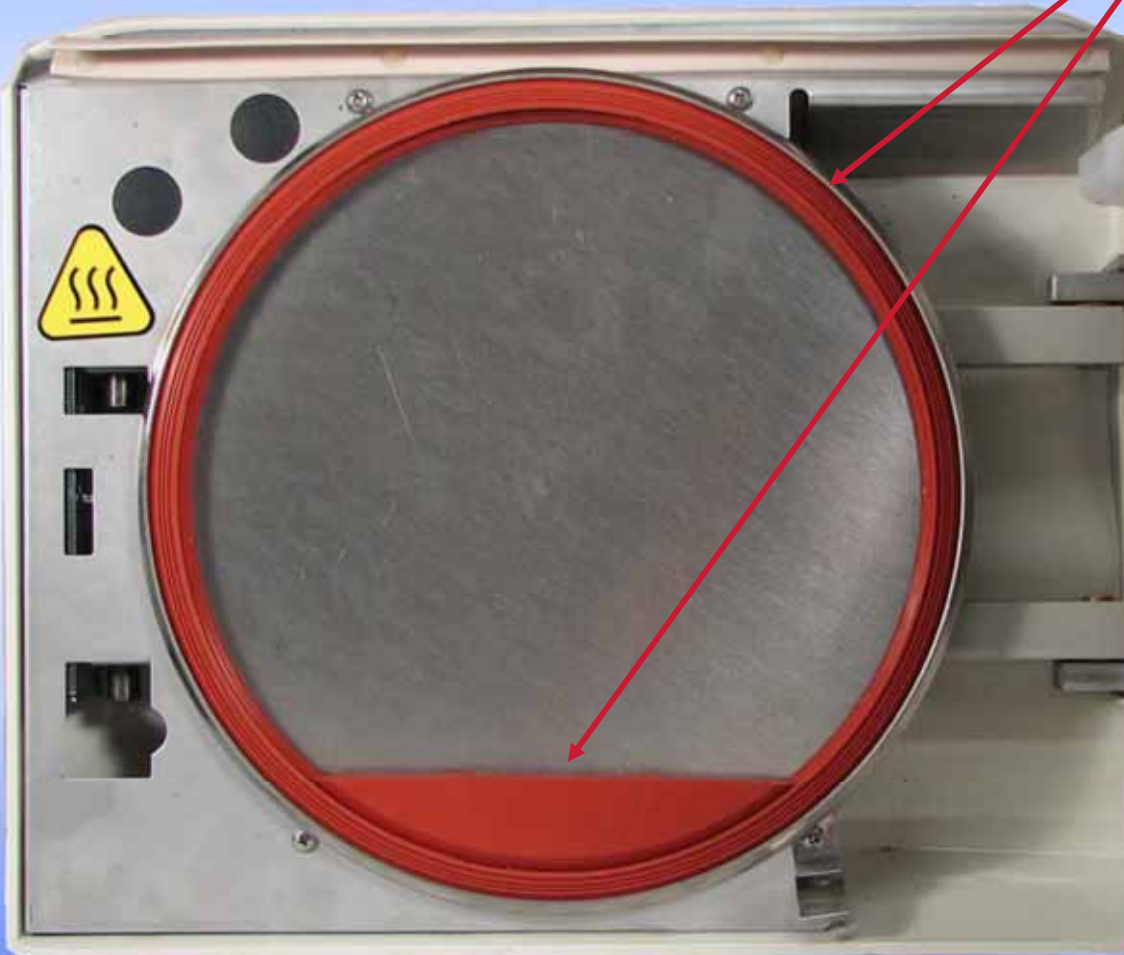
Door Gasket and Water Dam

Tech Tip #1

When troubleshooting a leaking door gasket - remember that door gaskets can be reversed and rotated 90 degrees as a possible solution to stopping small pressure leaks.

Tech Tip #2

Part of the Planned Maintenance Kit, the door gasket and water dam should be replaced yearly. During the process of replacing the door gasket, clean water and a mild soap solution should be used with a fiber pad to clean the face and interior of the gasket groove or race.



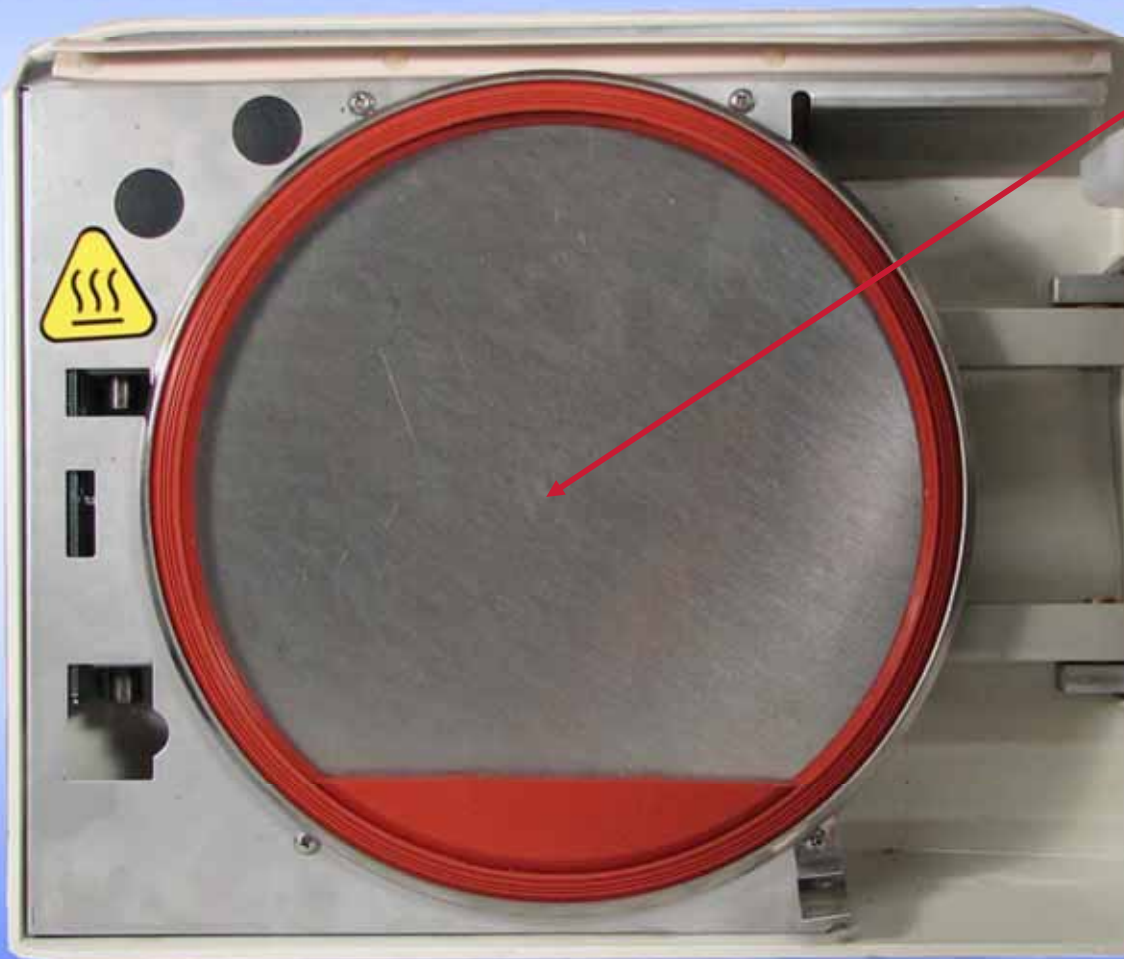


Tech Tips: Midmark M9 Door Panel

***Insulation Pad
(Not visible In photo)***

Tech Tip #3

A leaking door that cannot be fixed by repeatedly replacing the Door Gasket could be caused by compression of this pad. Located between the door pan and the door frame, the insulation pad helps to keep steam within the chamber from condensing on the inside of the door.





Tech Tips: Midmark M9 Door Panel

Door Spring

Tech Tip #4

Replaced yearly as part of the Planned Maintenance Kit these steel springs can be doubled to increase the amount of kick they give the opening door.





Tech Tips: Midmark M9 Chamber

Water Fill and Level / Drain Tube



Tech Tip #1

Water quality matters. Never use mineral, spring or “drinking” water to fill the sterilizer – their high mineral content will lead to deposits in the chamber, reservoir, valves and air jets - a good quality distilled water is ideal. Never use deionized water either, the lack of free ions in the water will leach metal from the chamber, tubing, fittings and valves causing various failures.

Also, be sure that the water level is in the green zone and not filled to the top before running a cycle.



Tech Tips: Midmark M9 Chamber

Door Switch



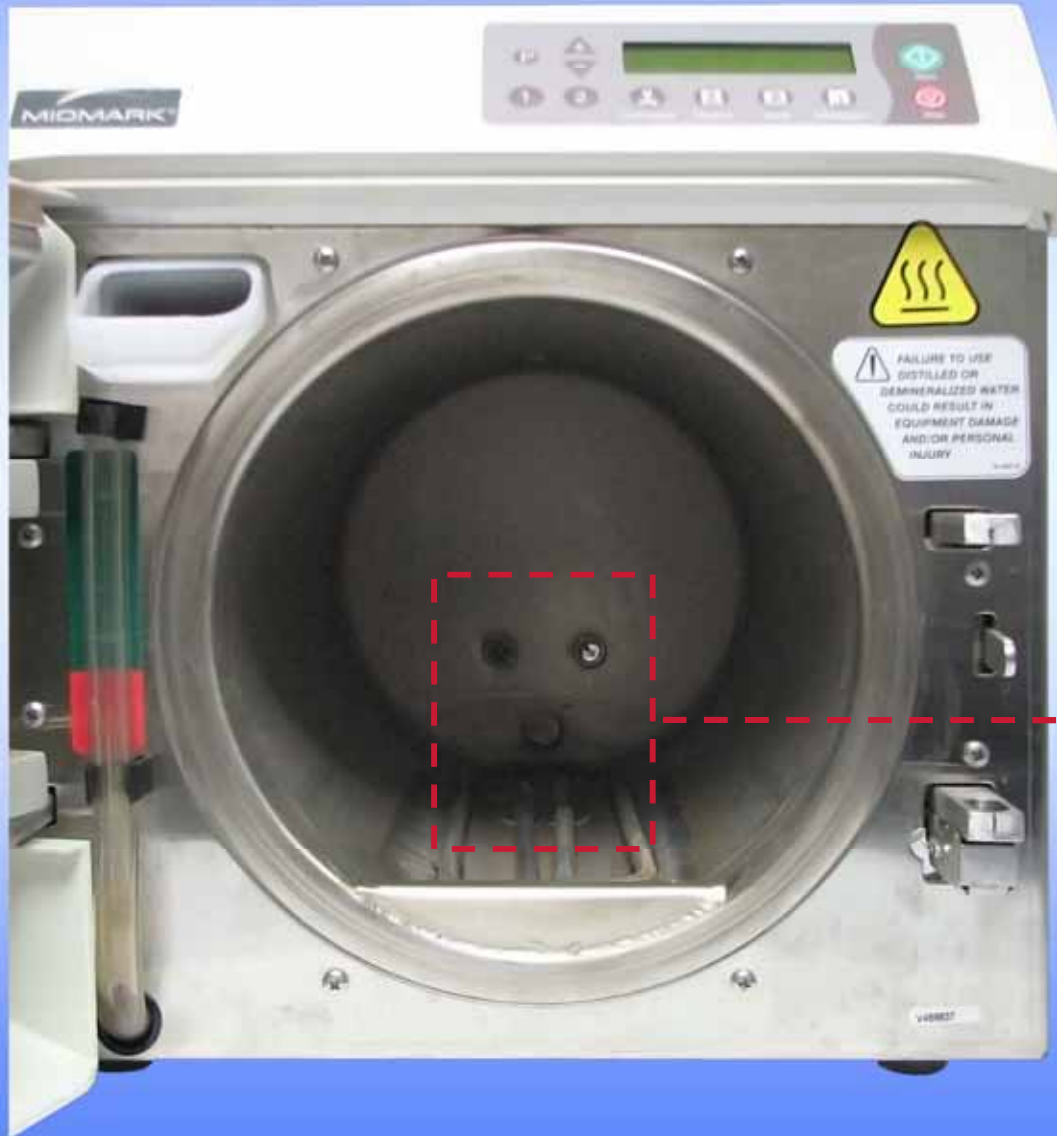
Tech Tip #2

Door switch problems can also indicate a broken spring arm. The spring arm, a thin steel plate with a right-angled bend at its end may have cracked preventing activation of the door switch.



Tech Tips: Midmark M9 Chamber

Chamber Filter



Tech Tip #3

Part of the annual Planned Maintenance Kit, the chamber filter(s) can also be cleaned with a stiff brush or in an ultrasonic cleaner.





Tech Tips: Midmark M9 Chamber

Chamber Face and Interior



Tech Tip #4

Never scrub the inside of a sterilizer's chamber with a product that smells like or contains chlorine bleach. Chlorine will remove the passivation layer applied to the interior of the chamber and will lead to rusting, pitting and eventual chamber failure.

Tech Tip #5

To remove gasket residue from the chamber face, and any residue that a chamber cleaner may leave behind inside the chamber, use a fiber pad with a simple solution of clean water and a mild soap.



Tech Tips: Midmark M9 Chamber

Chamber Face and Interior



Tech Tip #6

Used as part of the user's monthly maintenance requirements, chamber cleaners are designed specifically for each manufacturer's sterilizers. They must be used as directed by the manufacturer and should not be interchanged.

Qualification testing (Biological Indicators or Spore Tests) should be performed after all service or maintenance procedures to ensure the proper functionality of the sterilizer. Color changing or chemical indicators do not guarantee sterilization, they should only be used as a visual indicator that the instruments have been exposed to steam.



Tech Tips: Midmark M9 Chamber

Heating Element

Tech Tip #7

When inspecting the heating element look for small cracks, pits and burned spots – these are indicators of heater failures.

Sterilizers do not always do well with ground fault circuit interrupters (GFCI). Whenever possible install sterilizers on dedicated lines without any other large current draws (such as a compressor). If a GFCI is unavoidable one of the major causes of the leakage current involves the heating element – changing the element may lower the measured leakage current.





Tech Tips: Midmark M9 Chamber

Water Level Sensor



Tech Tip #8

Electrically isolated from the chamber the Water Level Sensor tells the Main PC Board when the chamber is full. Over time it can become covered with deposits which can be cleaned with a mild soap solution and a cleaning pad.

Tech Tip #9

If the Water level Sensor becomes shorted to the chamber the sterilizer will proceed directly from the fill phase of the cycle to the sterilize phase without any water entering the chamber – this condition can lead to overheat errors.



Tech Tips: Midmark M9 Chamber

Temperature Sensor



Tech Tip #10

When checking the interior of the chamber look for deposits on the temperature probe and clean them off if present. These deposits could indicate the use of poor quality water. The deposits affect the sensitivity of the probe and can lead to overheat errors.

Tech Tip #11

The temperature sensor is a negative coefficient resistive device – at room temperature the probe should read approximately 1 Meg Ohm resistance and when warmed the resistance should drop.



Tech Tips: Midmark M9 Chamber

Chamber Temperature Verification

Tech Tip #12

For diagnostic purposes, use a Maximum Register Thermometer (RPI Part #RPT113) for temperature verification. The thermometer registers the highest temperature it has been exposed to inside the chamber, and holds that temperature indication until reset. Therefore, do not forget to reset the thermometer by shaking it down before use. Read the thermometer in an upright position and only after it has cooled to ambient temperature or you may obtain a falsely high reading.

Be sure to place the thermometer on the instrument tray during temperature verification (do not place directly onto the chamber surface).



RPI Part #RPT113
Maximum Register Thermometer



RPI Technical Assistance Center

Replacement Parts Industries, Inc. (RPI) has been the leader in replacement parts since 1972.

Service Technicians have come to rely on RPI for our valuable technical assistance, including:

- **One-on-One Tech Help**
 - Available via Phone, Fax, and Email (*Monday – Friday, 8:00 am – 4:30 pm, Pacific Time*)
- **RPI Website – “FREE” Technical Assistance Center**
 - “Quick Search” feature to help identify parts needed
 - “Create a Parts Listing” feature to identify all parts available for a specific equipment model
 - Troubleshooting Guides, Exploded Views and Installation Instructions
 - Tech Talk and Service Tip Articles
 - At-a-glance Cross References and Quick Reference Guides
- **RPI Planned Maintenance Kits and Posters**
 - Kits specifically for planned maintenance of a variety of tabletop and bulk sterilizers
 - Informative posters featuring planned maintenance service tips and technical assistance articles



Phone (800) 221-9723 or (818) 882-8611 • Fax (818) 882-7028
Email: techsupport@rpiparts.com • Website: www.rpiparts.com



Thank You

Thank you for joining us today.

Please note that a recording of this presentation will be available on the RPI website as of November 14, 2014. You may also download a copy of the presentation from our website.

www.rpiparts.com

Replacement Parts Industries, Inc. (RPI) has been the leader in replacement parts since 1972. Should you have questions or need additional information, please contact us. We look forward to hearing from you.

***Phone (800) 221-9723 or (818) 882-8611 • Fax (818) 882-7028
Email: techsupport@rpiparts.com • Website: www.rpiparts.com***