LF-8165-TM

Technical Manual

Q-FOG Controlled Relative Humidity (CRH) Cyclic Corrosion Tester

For Q-FOG Models:

CRH1100-HSC	CRH600-HSC
CRH1100-HTC	CRH600-HSCR
CRH1100-HSCR	
CRH1100-HTCR	

Serial Numbers: XX-XXXXX-55

Q-LAB

Revision Date
08 Dec 2021

Table of Contents

1. Purpose (Nov 2021)

- This Technical Manual provides detailed information on the operation and maintenance of the Q-FOG® CRH cyclic corrosion tester.
- The Q-FOG CRH performs salt spray, Prohesion, and cyclic corrosion testing with full variable humidity control through the use of an innovative air control module which adjusts the amount of moist and dry air that circulates through the test chamber (see Section 7.2).
- An Air Preconditioner removes moisture from ambient air to supply either cool or warm dry air to expand the chamber operating temperature and relative humidity range (Section 8.15).
- Additionally, this model includes a programmable shower feature (Section 7.3) for compatibility with most major automotive corrosion test standards, such as GMW 14872, SAE J2334 and others from Ford, ISO, VW, Volvo, Chrysler, Renault, etc. (Section 11.3).
- This technical manual can also be accessed online at Q-Portal Documents.

Q-FOG model numbers covered in this guide:

Q-FOG/CRH1100-HSC	Q-FOG/CRH600-HSC
Q-FOG/CRH1100-HTC	Q-FOG/CRH600-HSCR
Q-FOG/CRH1100-HSCR	
Q-FOG/CRH1100-HTCR	

Model number nomenclature:

- Q-FOG/CRH - Base model.
- 600 or 1100 - Test chamber volume, either **600** L or **1100** L.
- H - All models have controlled Relative **H**umidity.
- S or T - All models can deliver a solution shower, either a center-mounted **S**tationary Shower Module (SSM) or a **T**op-Mounted Swaying Shower Bar (TSSB) (see Section 7.3).
- C - All models have an Air Preconditioner, also known as a **C**hiller.
- R - Models can be equipped with a **R**apid Ramp Heater for faster heating capabilities.
  - o Models with rapid ramp heaters provide all of the capabilities of standard heater models plus the ability to meet the transition times specified in test standards like JASO M609, CCT-I, and CCT-IV.
  - o Only 3-phase CRH testers have Rapid Ramp Heaters. 1-phase CRH testers have flat plate heaters (see Section 6.4).
- The tester model number is shown on the nameplate ( ) attached to the rear of the chamber.
- Tester electrical requirements are also shown on the nameplate. See Section 6.4 for more information.

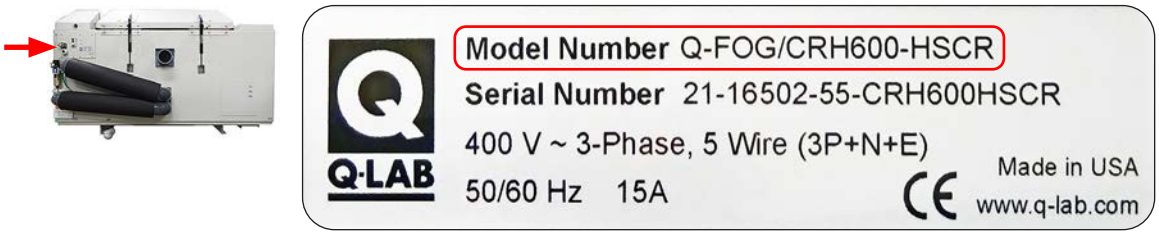


Figure 1: Q-FOG nameplate showing model number.

2. Specifications, Classifications, Symbols (Jun 2020)

Specifications, Classifications

- Replacement (Make-up) Air: 60 CFM.
- Transportation and Storage Temperature: -40 to 80 °C.
- Installation Category: Category II for transient over-voltages.
- Pollution Control: Pollution Degree 2.
- Sound Pressure Level: Sound Pressure Level does not exceed 75 dBA.
- Altitude: 2000 meters or less.
- Operation: Continuous Rating.
- Supply Connection: Permanently connected or plug/socket connection (industrial type per IEC 6309 or twist lock type in North America).
- External Disconnect: Required for all connections.

Symbols

Electrical Shock Hazard

Hot Surfaces Hazard

Attention

Finger/Hand Crushing Hazard

Local Waste & recycling regulations per the WEEE Directive 2002/96/EC on Waste Electrical and Electronic Equipment

3. Safety (Aug 2021)

Q-Lab accepts no responsibility for the consequences if the user fails to comply with the instructions in this document. Q-Lab will accept responsibility for defective parts or components only if the machinery was defective at the time that the tester was shipped.

- This document does not claim to address potential safety issues, if any, associated with the use of this product.
- It is the responsibility of the user of this manual to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to use.
- If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment safety devices may be impaired.
- The Q-FOG conforms to the European Low Voltage Directive 2014/35/EU using the primary standard EN 61010-1:2010 (Third Edition), “Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements”.
- The Q-FOG conforms to the European Electromagnetic Compatibility Directive 2014/30/EC using the primary standard EN 55011:2016 Radiated and Conducted Emissions.
- Do not use gases such as SO_2 in the Q-FOG. Do not use hazardous or petroleum based organics (solvents). Purge the chamber of airborne mist or fog before opening the chamber lid.
- Use only parts that have been supplied or recommended by Q-Lab.

Safety Devices

- Chamber Cabinet Residual Current Device
- Chamber Cabinet Electrical Power Circuit Breakers
- Chamber Over Temperature Cut-out
- Bubble Tower Over Temperature Cut-out
- Bubble Tower Low Water Level Indicator
- Bubble Tower High Water Level Indicator
- Bubble Tower O-Rings and Compression Springs
- Bubble Tower Pressure Relief Valve
- Solution Reservoir Low Level Indicator
- Solution Reservoir Empty Indicator
- Chamber Heater Over Current Switch
- Control Top Protected Area Tool Access

4. Operating Environment

The Tester Must Be Located in a Suitable Environment

- All Q-Lab test chambers are sophisticated scientific instruments.
- All tester models must be operated in a suitable controlled environment (Section 4.1).
- Operating the tester in an unsuitable environment (Section 4.2) will void the warranty.

4.1. Suitable Environments (Jun 2020)

Ambient Laboratory Temperature and Humidity

- The recommended ambient operating temperature and relative humidity (RH) for Q-FOG testers is 23 ± 5 °C and 50 ± 25% RH.
- Operating outside the recommended range (or in rare cases, even within it), certain standards or test cycle conditions may not be achievable.
- Operating outside the recommended range can result in the tester producing chamber temperature and/or humidity faults.
- Never operate a Q-FOG tester in lab temperatures >40 °C or >80% RH.
- Consult with Q-Lab for more specific information about achievable chamber temperature/humidity values based upon various ambient lab conditions.

Physical Environment

- A room that is dry, clean and free of dust, particles, gases or salt fog.
- A room with an HVAC (heating/ventilation/air-conditioning) system.
- A location away from windows or HVAC vents.
- A location that provides the necessary minimum clearances as specified in Section 6.1.

4.2. Unsuitable Environments (Nov 2021)

Salt Fog or Other Airborne Contamination

- Always wait at least fifteen (15) minutes for the purge blower to clear the chamber of mist or fog before opening the Q-FOG test chamber lid.
- Do Not install Q-FOG corrosion chambers in a room with Q-SUN xenon testers or QUV weathering testers (Figure 4.2a).
- Do Not locate Q-FOG in a room with machines or processes that generate dust, particles, vapors, gases, etc (Figure 4.2b).

Figure 4.2a: Do not install with Q-SUN or QUV testers.

Figure 4.2b: Do not locate in room with dust, particles or gases

Uncontrolled Temperature and Humidity

- Do not operate the tester in a room with uncontrolled temperature and humidity.
- Do not locate tester near sources of cold or hot air (Figure 4.2c).

Figure 4.2c: Do not locate Q-FOG near open windows.

Figure 4.2d: Keep tester away from sources of hot or cold air.

Other Unsuitable Environments

- **Outdoors:** Rain and dust will corrode or short out electrical components.
- **Metal Dust / Metal Chips:** Do not locate the tester near metal cutting machines or metal grinding machines. Conductive metal dust or metal chips in the air will damage electronic components.
- **Carbon Fibers:** Do not operate the tester where carbon fibers or carbon reinforced plastic are being cut. The conductive carbon fibers will damage electronic components.
- **Conductive Pigments:** Do not operate the tester where carbon black or other conductive pigment dust is in the air. The conductive dust will damage electronic components.
- **Other Corrosive Gases:** Do not expose the tester to acid fog, SO_2 gas, or other corrosive gases.
- **Excessive Voltage:** The electrical supply to the tester must be no more than 10% higher than the voltage listed on the nameplate.
- **Low Voltage:** Recurring “brown-outs” or voltages less than 90% of the rated voltage will damage electrical components.
- **Water Leaks from Ceiling:** Water leaking onto the tester will damage electrical components.

For further detail on laboratory environment requirements, please contact Q-Lab Repair and Tester Support.
See Section 8 for contact information.

5. Uncrating

5.1. Test Chamber (Jun 2020)

Carefully read these instructions before uncrating the tester.
Follow all local, OSHA, EHS, and other applicable equipment operation and material handling safety requirements, recommendations, and practices.

- All Q-FOG testers are shipped in one of two types of crates (Figure 5.1a) and Figure 5.1b).
- Labels on the crate indicate the location of the instructions to be opened first (Figure 5.1c).
- Instructions for uncrating and setting up the tester are located in the envelope shown in Figure 5.1d.

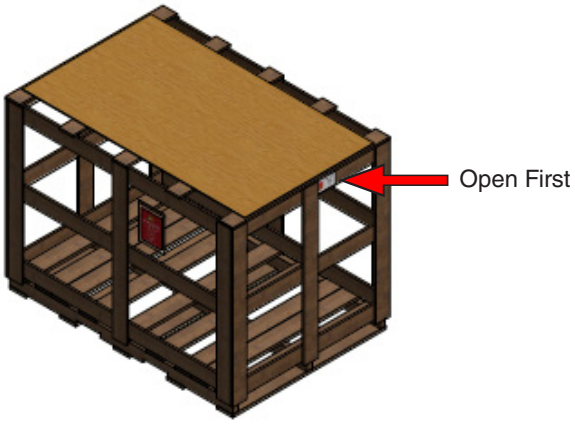


Figure 5.1a: This crate has a flat top.

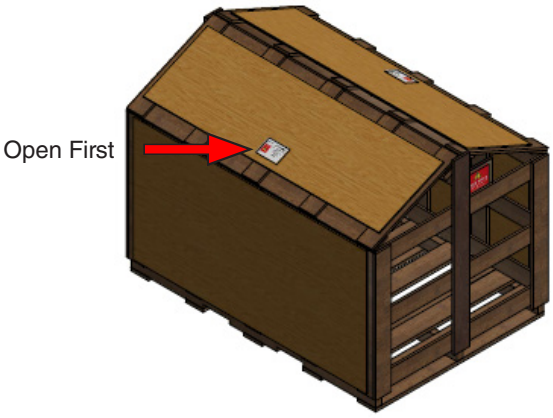


Figure 5.1b: This crate has a peaked top.

Figure 5.1c: Crate labels indicate open first envelope.

Figure 5.1d: Important - open first.

Shipping Weights (Approximate)	CRH600	CRH1100	Air Preconditioner
Q-FOG in Crate	390 kg (860 lb)	472 kg (1040 lb)	175 kg (385 lb)
Q-FOG Only	333 kg (734 lb)	378 kg (834 lb)	91 kg (200 lb)

Tools Required

Phillips Screwdriver	Ratchet
Utility Knife	15 mm (9/16") Socket
Fork Lift*	11 mm (7/16") Socket
Step Stool or Small Ladder	Pry Bar

*A fork lift or other mechanical lifting device is recommended for use in moving the crated tester to the installation location.

- For flat top crate uncrating instruction go to Section 5.2.
- For peaked crate uncrating instructions go to Section 5.3.

Use extreme care when uncrating to avoid damaging the Q-FOG cabinet.

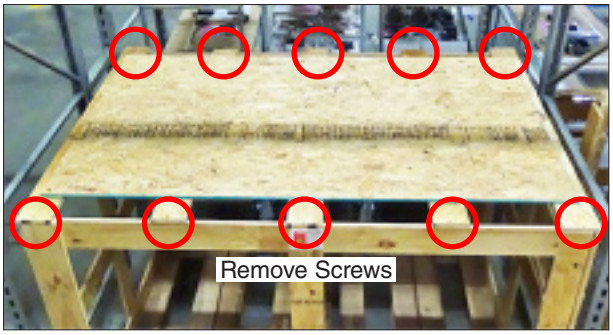
Do not attempt to remove the chamber lid without special instructions. Contact Q-Lab Corporation Repair and Tester Support for detailed instructions (Section 8).

5.2. Flat Top Crate for Container Shipping (Aug 2021)

1. Uncrating instructions are located in this envelope attached to the tester. Remove and read first.

2. Uncrating instructions are located in the red envelope attached to the top of the tester. Remove the envelope and read the instructions.

Remove Screws



3. Remove the screws along the top front and back edges of the crate in areas shown.

Right End of Crate

Remove Screws

4. Remove the screws at the top right end of the crate.

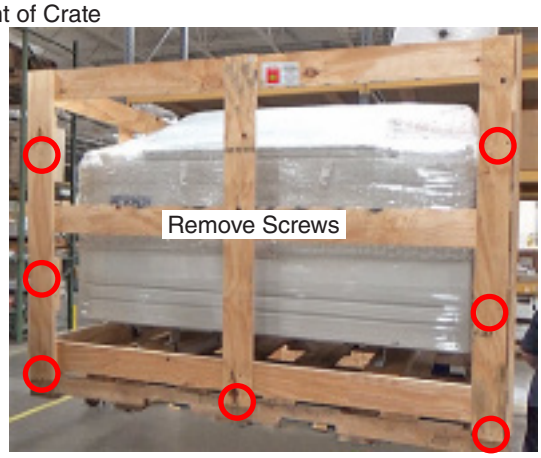
Left End of Crate

Remove Screws

5. Remove the screws at the top left end of the crate.

6. **IMPORTANT:** Use two persons. Lift off the top of the crate. The top may be discarded.

Front of Crate



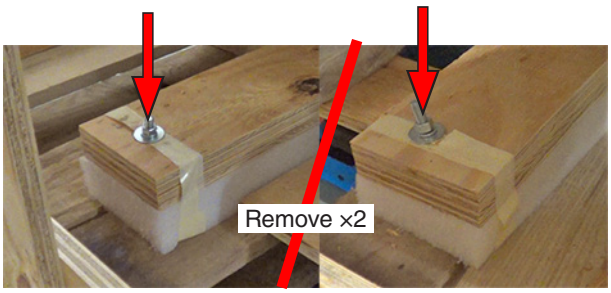
7. Remove the screws in the front side of the crate in the areas shown.

8. Remove the front side of the crate. The front side may be discarded.

Front of Q-FOG

9. Remove the two (2) 15 mm (9/16") bolts and nuts holding the front of the Q-FOG to the pallet.

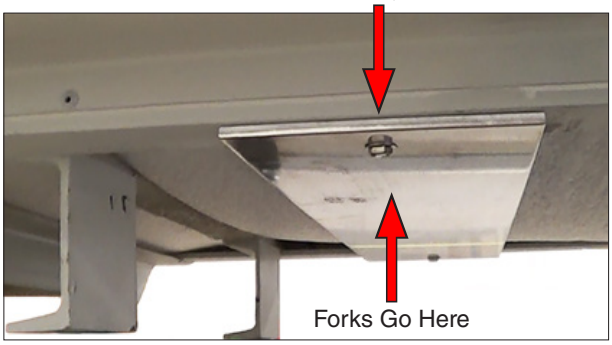
Rear of Q-FOG



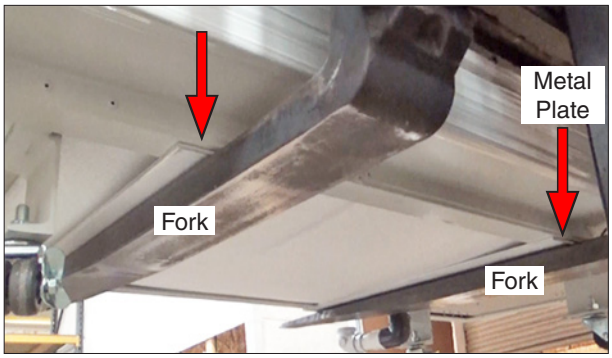
10. Remove the two (2) 15 mm (9/16") bolts and nuts holding the rear of the Q-FOG to the pallet.

11. **IMPORTANT:** Locate the forklift labels on the front of the Q-FOG chamber.

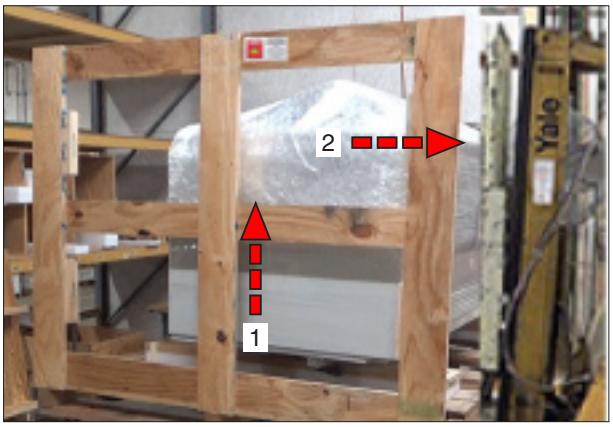
12. Location of lift plates under Q-FOG.



13. Make sure lift forks are under the metal plates on the bottom of the Q-FOG.



14. **USE EXTREME CAUTION: Forks can easily damage the Q-FOG. Make sure forks are under metal plates before lifting.**



15. Use a forklift to lift Q-FOG up off the pallet. Move the Q-FOG away from the crate.

16. Use a 15 mm (9/16") wrench to remove the 2 nuts from the bolts in the left angle brackets under the Q-FOG cabinet.

17. Use a 15 mm (9/16") wrench to remove the 2 nuts from the bolts in the right angle brackets under the Q-FOG cabinet.

18. Lift the Q-FOG a few inches and remove the bolts, both boards and the foam pieces from the tester. Discard.

19. Carefully move the Q-FOG to the installation location and lower into position.

20. Use a utility knife to carefully remove the plastic wrapping. Use care to avoid scratching the Q-FOG cabinet.

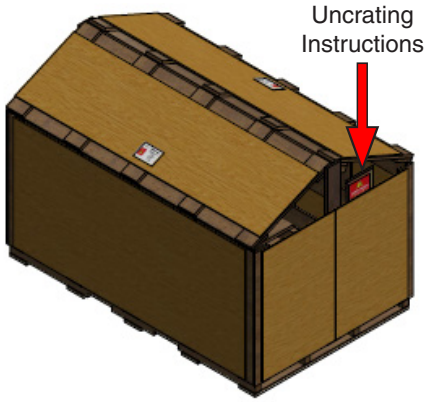
21. Q-FOG cabinet uncrating is complete.

22. If any accessories are attached to the pallet, remove them and remove the plastic wrap.

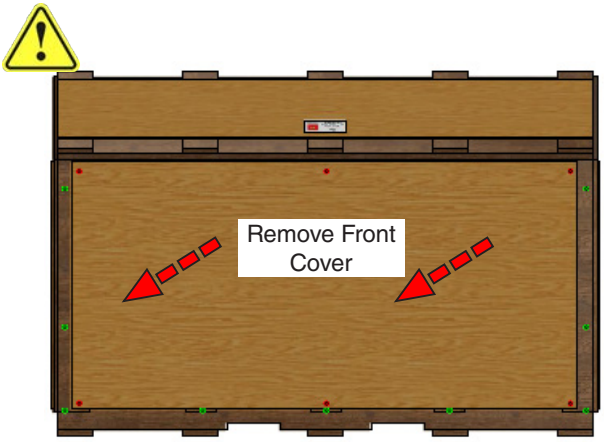
23. Go to Section 5.4 for Air Preconditioner uncrating instructions.

5.3. Peaked Crate for Domestic and Air Shipping (Aug 2021)

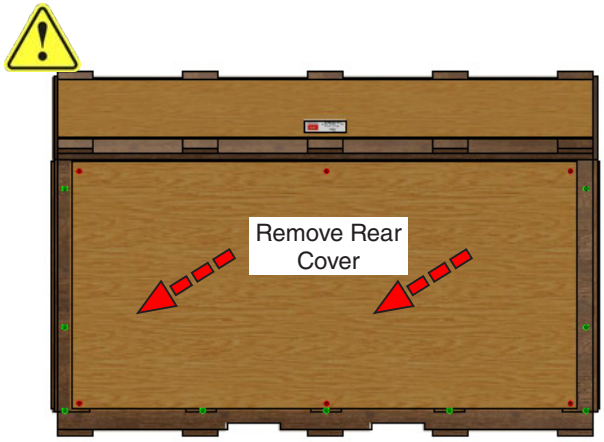
1. Uncrating instructions are in this envelope attached to the end of the tester. Remove and read first.



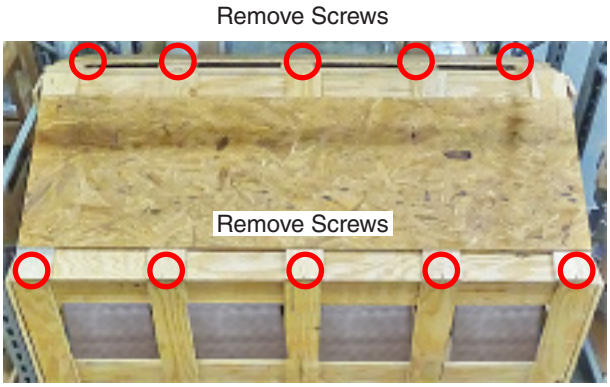
2. Uncrating instructions are located in the red envelope attached to the end of the tester. Remove the envelope and read the instructions.



3. Carefully pry the front cover off of the crate.



4. Carefully pry the rear cover off of the crate.

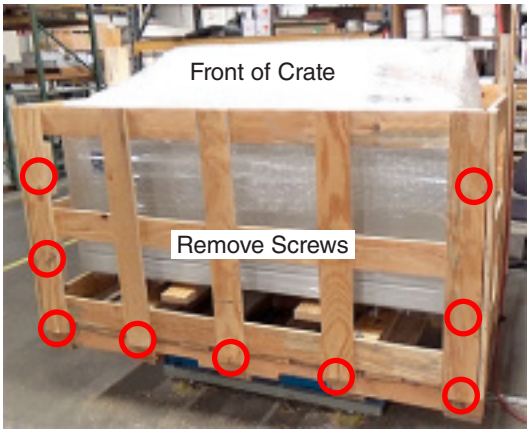


5. Remove the screws along the top front and back edges of the crate in areas shown.

6. Remove the screws in the vertical support at the right end of the crate.

7. Remove the screws in the vertical support at the left end of the crate.

8. **IMPORTANT:** Use two persons. Lift off the two sides of the top of the crate. Set aside.



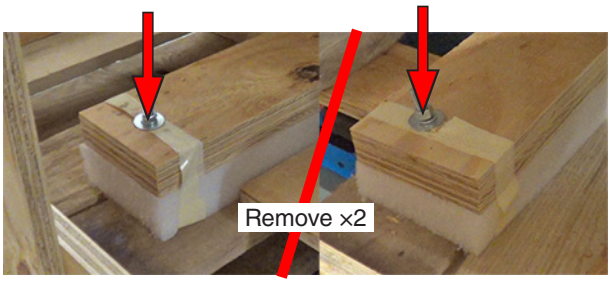
9. Remove the screws in the front side of the crate in the areas shown.

10. Remove the front side of the crate. The front side may be discarded.

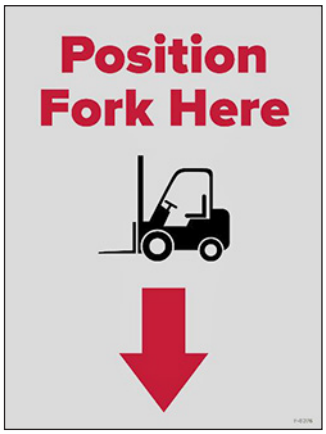
Front of Q-FOG

11. Remove the two (2) 15 mm (9/16") bolts and nuts holding the front of the Q-FOG to the pallet.

Rear of Q-FOG

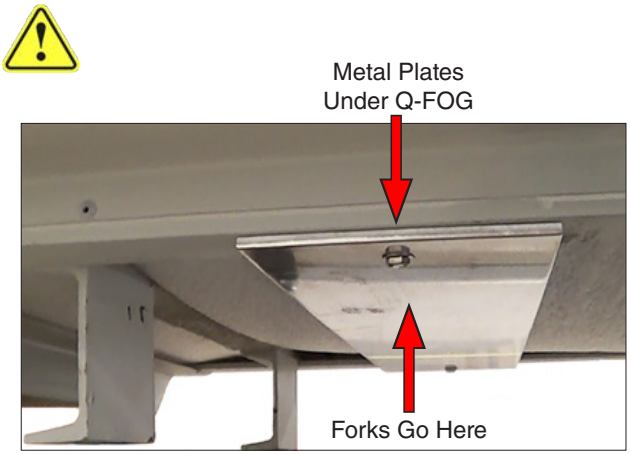


12. Remove the two (2) 15 mm (9/16") bolts and nuts holding the rear of the Q-FOG to the pallet.

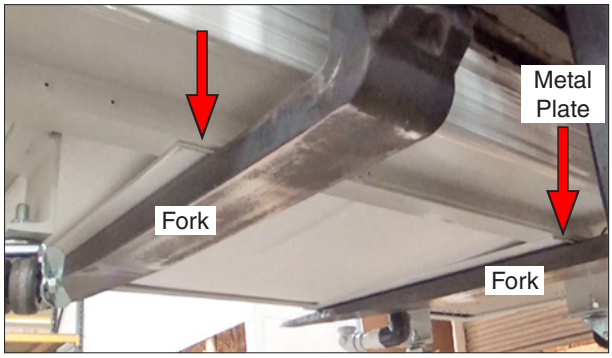


13. **IMPORTANT:** Locate the forklift labels on the front of the Q-FOG chamber.

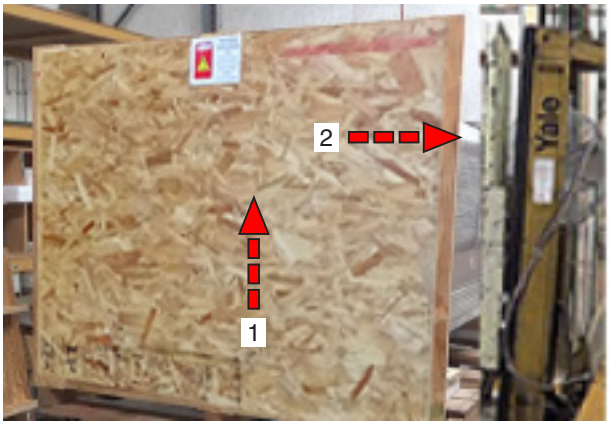
14. Location of lift plates under Q-FOG.



15. Make sure lift forks are under the metal plates on the bottom of the Q-FOG.



16. **USE EXTREME CAUTION: Forks can easily damage the Q-FOG. Make sure forks are under metal plates before lifting.**



17. Use a forklift to lift Q-FOG up off the pallet. Move the Q-FOG away from the crate.

18. Follow Step 16 through Step 22 in Section 5.2 to complete cabinet uncrating.

19. Go to Section 5.4 for Air Preconditioner uncrating instructions.

5.4. Air Preconditioner (Jul 2017)

- The Q-FOG CRH Air Preconditioner is shipped in a separate packaging assembly.
- The Air Preconditioner can be shipped with or without a wooden crate.
- Two persons are needed to unpack the Air Preconditioner.
- Follow the steps below to uncrate the Air Preconditioner.

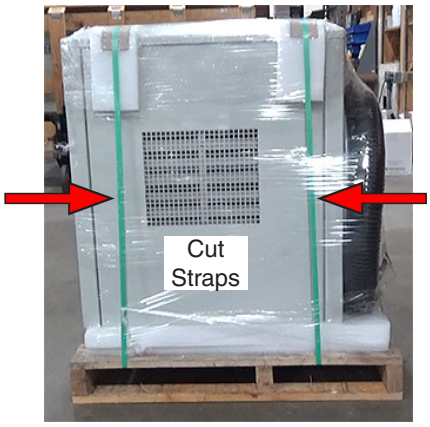
Use extreme care when uncrating to avoid damaging the Air Preconditioner cabinet.

1. If the Air Preconditioner is packaged in a wooden crate, remove the screws from around the bottom of all four (4) sides of the crate.

2. If the Air Preconditioner is packaged in a wooden crate, use two (2) persons to lift the crate off of the Air Preconditioner.

3. Cut the plastic straps securing the fiberboard carton to the pallet.

4. Lift the carton straight up and remove the carton from the pallet.



5. Cut the plastic straps securing the Air Preconditioner to the pallet. Remove the plastic wrap.

6. Use two (2) persons to remove the Air Preconditioner from the pallet. See Section 6.1 and Section 6.2 to complete Air Preconditioner setup.

7. Go to Section 5.5 for accessory unpacking.

5.5. Accessories (Nov 2021)

- Accessory parts and kits needed for Q-FOG operation and maintenance are packed in the test chamber.
- Open the Q-FOG lid to remove the accessories (Figure 5.5). Remove all tape and packaging material from the chamber.
- See Figure 5.5 below for a list of accessory items and location of setup instructions.
  NOTE: Not all accessories shown below come with every tester.

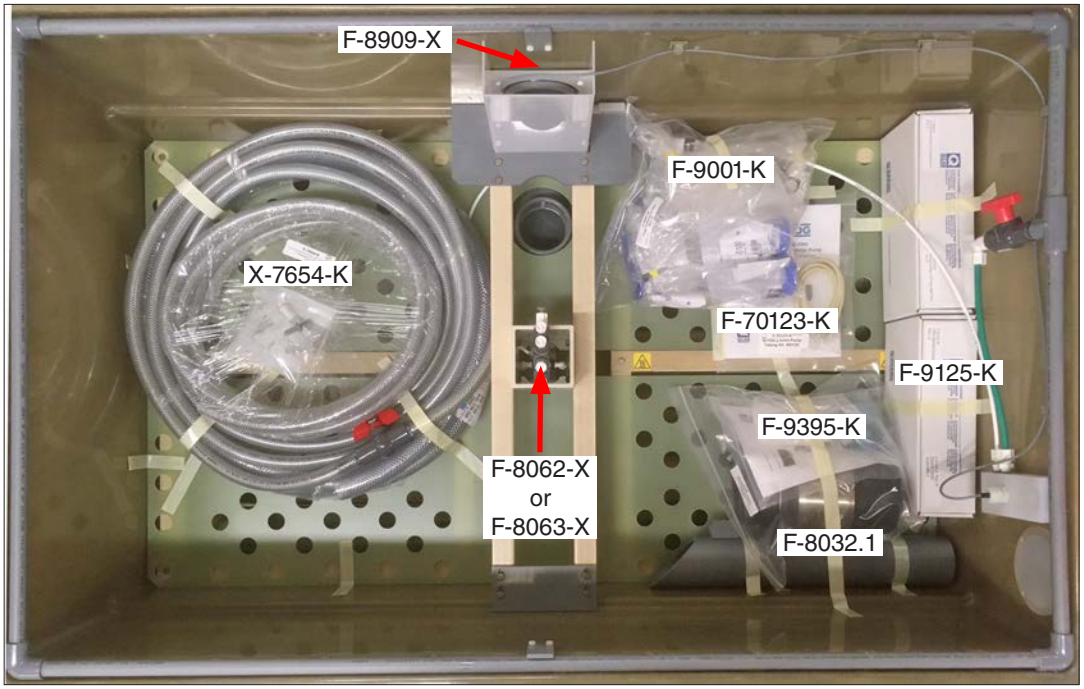


Figure 5.5: Q-FOG test chamber lid open to show accessories.
NOTE: Stationary Shower Module model and optional wall wash assembly shown.

Part Number	Description	Installation / Use Instructions
X-7654-K	Drain Connection Accessories Kit	Section 6.7
F-70123-K	2.4 mm Pump Tubing Kit	Section 14.1
F-9125-K	Q-FOG CRH Maintenance Kit	Section 14
F-8032.1	Return Tube	Section 6.9
F-9001-K	Fog Collection Kit	Section 11.4.1
F-8909-X	Chamber Temperature Sensor Assembly	Section 6.9
F-9395-K	Q-FOG CRH Temp Sensor Calibration Kit	Section 12
F-8062-X, F-8063-X	Stationary Shower Module - “S” Models Only	Section 8.10

Table 5.5: Accessory parts and kits packed in the Q-FOG test chamber with set up instruction location.

6. Setup

6.1. External Dimensions and Space Requirements (Nov 2021)

- Figure 6.1a shows the external dimensions of the Q-FOG CRH main test chamber.
- Figure 6.1b shows the external dimensions of the Air Preconditioner.
- Installation location space requirements are shown in Figure 6.1c.

Dimensions

	CRH600 Models		CRH1100 Models	
A	184 cm	73"	221 cm	87"
B	187 cm	74"	224 cm	88"
C	187 cm	74"	200 cm	79"
D	126 cm	50"	131 cm	52"
E	84 cm	33"	100 cm	40"
F	103 cm	41"	121 cm	48"
G	107 cm	43"	125 cm	50"
H	120 cm	47"	138 cm	54"

NOTE: All dimensions approximate. Vertical dimensions vary based upon caster (leveling feet) adjustment.
Dimension **C** is overall height of tester with lid in 90° open position.
Dimension **D** is overall height of tester with lid closed.
Dimension **H** is overall depth of tester with lid in 90° open position.

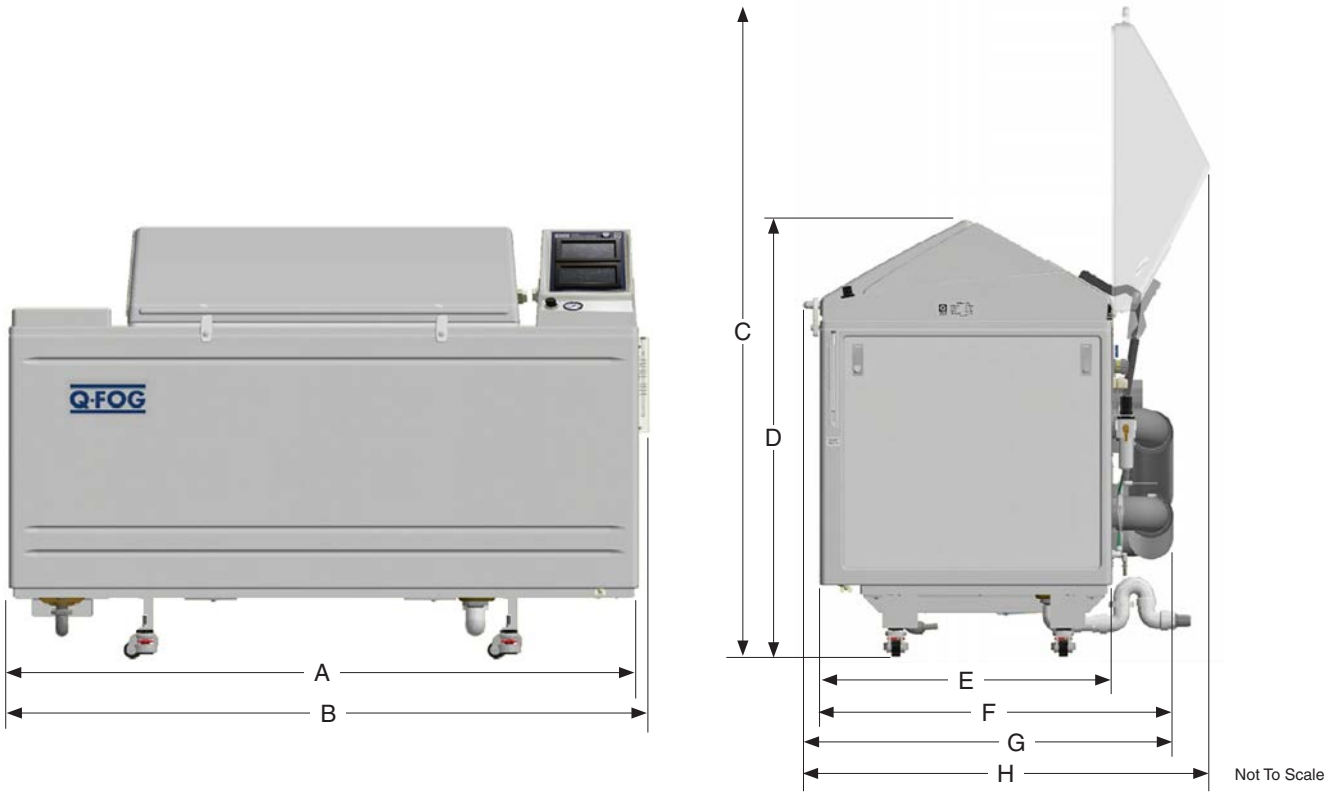


Figure 6.1a: Q-FOG CRH external dimensions.

Air Preconditioner Dimensions

Figure 6.1b: Q-FOG Air Preconditioner external dimensions.

Space Requirements

- The Q-FOG CRH test chamber and Air Preconditioner should be positioned as shown in Figure 6.1c below to allow sufficient room to operate the unit and for proper ventilation.
- The Air Preconditioner is attached to the Q-FOG chamber by a 96" (244 cm) flexible hose.
- The Air Preconditioner is mounted on casters and may alternatively be positioned in front of or behind the Q-FOG test chamber.
- The Air Preconditioner may be moved to open the Q-FOG test chamber right side access panel.
- An Air Preconditioner hose and cable extension is kit (F-8169-K) is available to enable positioning of the air preconditioner at the left end of the Q-FOG test chamber.

	CRH600 Models		CRH1100 Models	
Minimum length of dimension A in Figure 6.1c	275 cm	108.1"	311 cm	122.4"

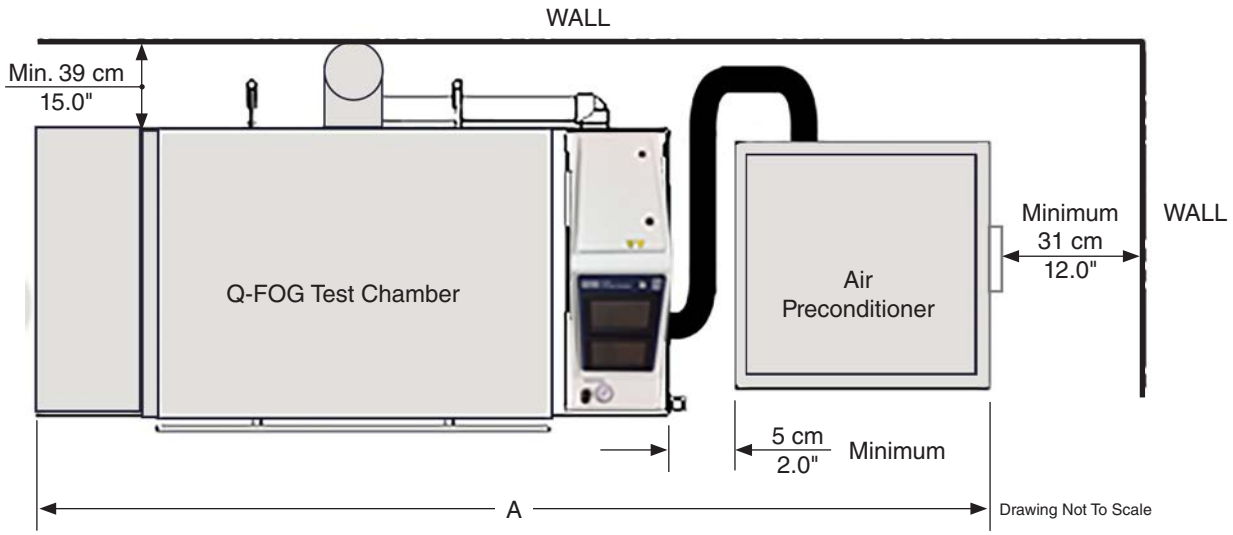


Figure 6.1c: Q-FOG CRH space requirements.

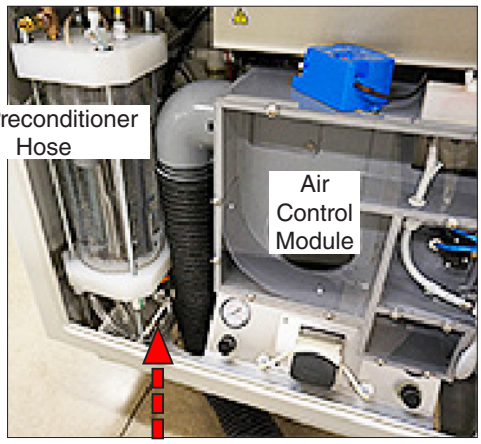
6.2. Air Preconditioner Connection (Feb 2016)

1. Press down on the bottom of the 2 latches on the Q-FOG access panel to open the latches.

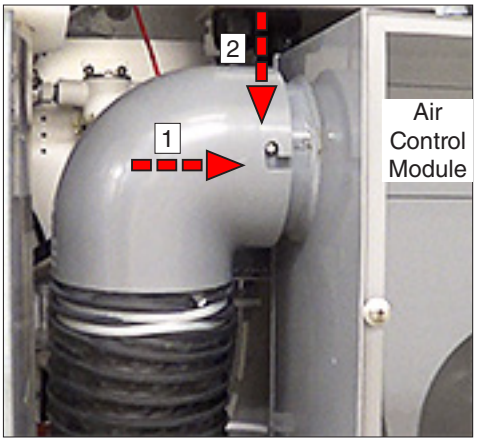
2. Remove the Q-FOG access panel.

Air Preconditioner Rear View

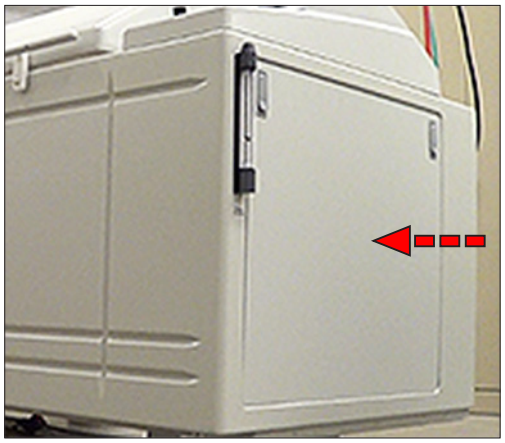
3. Cut the ties on the Air Preconditioner hose and power cable.



4. Route Air Preconditioner hose through the hole in the Q-FOG cabinet, to the air control module as shown.



5. Connect hose to the air control module.



6. Replace the access panel. Close the latches by pressing on the lever that popped out when the latches were opened.

6.3. Leveling (Nov 2021)

- The Q-FOG must be leveled correctly to assure a proper lid seal and prevent leakage of corrosive fog into the laboratory.
- The Q-FOG is a fiberglass chamber and, therefore, it is not perfectly rigid. Because of this, the chamber can flex a small amount.
- Flexing can cause the lid seal to leak if the Q-FOG chamber is not properly adjusted.
- The Q-FOG is equipped with leveling casters that can be adjusted to level the chamber (Figure 6.3a).
- An optional leveling pad kit (Part Number F-8977-K) is available (Figure 6.3b).
- Be sure to follow the Instructions for Leveling the Q-FOG to Prevent Leakage so that the lid seals properly.

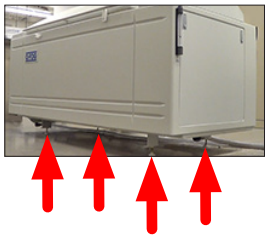


Figure 6.3a: Standard leveling caster.

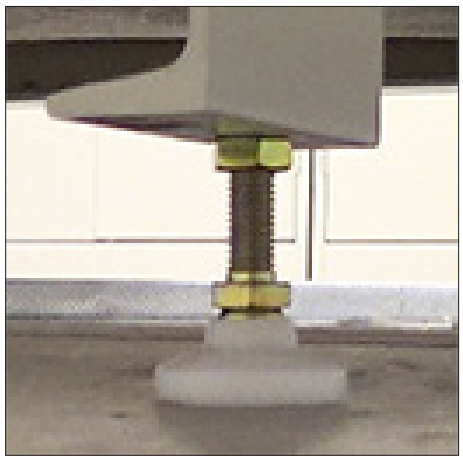


Figure 6.3b: Optional leveling pad.

Do not use other leveling devices. Contact Q-Lab Repair and Tester Support for more information.

Instructions for Leveling the Q-FOG to Prevent Leakage

1. Position the Q-FOG in its operational location. The floor should be flat and level.
2. Close the lid and close the lid latch by rotating the latch counter-clockwise until it fully engages with the center lid handle post.
3. Adjust the leveling casters support feet (or optional leveling pads) so the Q-FOG is reasonably level and all four casters touch the ground (does not rock). The leveling casters or pads are adjusted using a wrench.
4. To check for leakage, put a light inside the chamber and look for light escaping. The Q-FOG CRH has a light built in. The power cord for an external inspection light may exit through the air exhaust pipe.
5. Make sure the lid is closed and latched. Look all along the lid seal for light escaping between the lid seal and the chamber.
6. If light is escaping from the left side of the lid, lift the left front corner of the chamber by adjusting the left front support caster or pad. If light is escaping from the right side of the lid, lift the right front corner of the chamber by adjusting the right front caster or pad. The adjustments should be made just enough to prevent light from escaping the chamber.
7. After adjustment, the Q-FOG may rock because only three feet are touching the ground. If it rocks, extend the caster or pad that is not touching until it touches the ground. The caster or pad should be extended just enough to touch the ground. Too much extension may create another leak.

6.4. Electrical (Aug 2021)

IMPORTANT: Do not switch main power ON until the other services have been connected.

Q-FOG Test Chamber

- The Q-FOG chamber power requirements are listed in Figure 6.4a.
- This voltage requirement was specified by the purchaser at the time the chamber was ordered.
- The input voltage is shown on the nameplate attached to the rear of the chamber, Figure 6.4b.
- It is very important that the cabinet be connected to the correct voltage.
- If the voltage is too low, the chamber will not heat up quickly enough.
- If the voltage is too high, it could cause damage to the chamber.

Power Cord Not Supplied

- The power cord connection between the facility main power supply and the Q-FOG main power circuit breaker **IS NOT** supplied with the Q-FOG (see the Mains Power Installation section).

Model	Voltage	Maximum Current	Frequency
CRH600-HSC	208 V± 10%, 1-Phase	32 A	50/60 Hz
	230 V± 10%, 1-Phase		
CRH600-HSCR	208 V± 10%, 3-Phase, 4-Wire (3P+E)	28 A	
	230 V± 10%, 3-Phase, 4-Wire (3P+E)	25 A	
	400 V± 10%, 3-Phase, 5-Wire (3P+N+E)	15 A	
CRH1100-HSC CRH1100-HTC	208 V± 10%, 1-Phase	38 A	
	230 V± 10%, 1-Phase		
CRH1100-HSCR CRH1100-HTCR	208 V± 10%, 3-Phase, 4-Wire (3P+E)	44 A	
	230 V± 10%, 3-Phase, 4-Wire (3P+E)	39 A	
	400 V± 10%, 3-Phase, 5-Wire (3P+N+E)	24 A	

Figure 6.4a: Q-FOG electrical power requirements.

Q-FOG Rear View

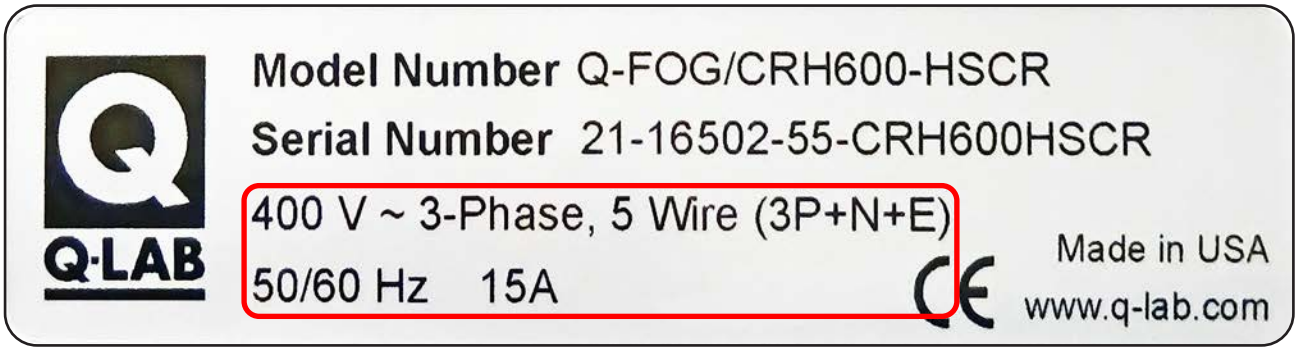


Figure 6.4b: Q-FOG nameplate showing electrical power requirements.

Mains Power Installation

- A power cord for connecting the facility main power supply to the Q-FOG **IS NOT** supplied with the tester.
- A qualified electrician should connect the mains according to local codes using approved disconnect and over-current protection.
- On the rear of the Q-FOG is a Main Power Circuit Breaker and a Residual Current Device (RCD), Figure 6.4c.
- Near the breaker is a hole with strain relief for the mains power entry, Figure 6.4c.
- The electrician can enlarge this hole to accept the chosen electrical conduit or power cord.
- The mains wires should be connected to the breaker, Figure 6.4d through Figure 6.4i.
- Wire used for connection is required to be rated for 90 °C or higher.
- Make sure that power cord, plugs, receptacles, or connectors are rated for the specified voltage and current.
- For detailed electrical wiring information see *LF-8165-SO Q-FOG CRH System Overviews*.

Figure 6.4c: Mains power entry and circuit breaker locations.

208/230 V 1-Phase

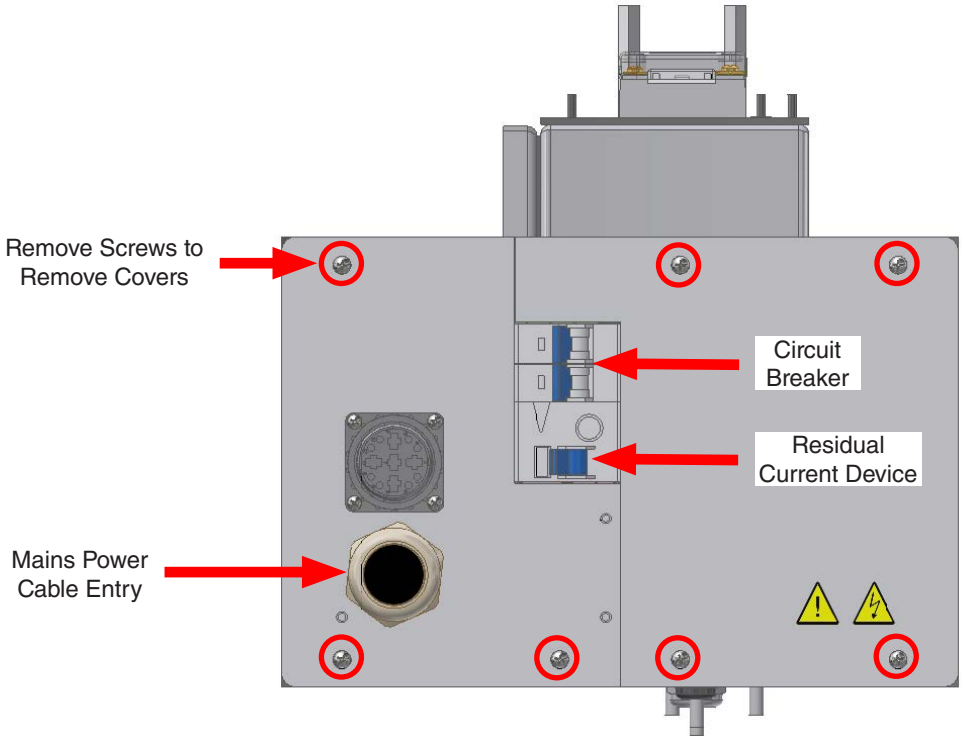


Figure 6.4d: 208/230 V 1-phase electrical power entry and circuit breakers with covers.

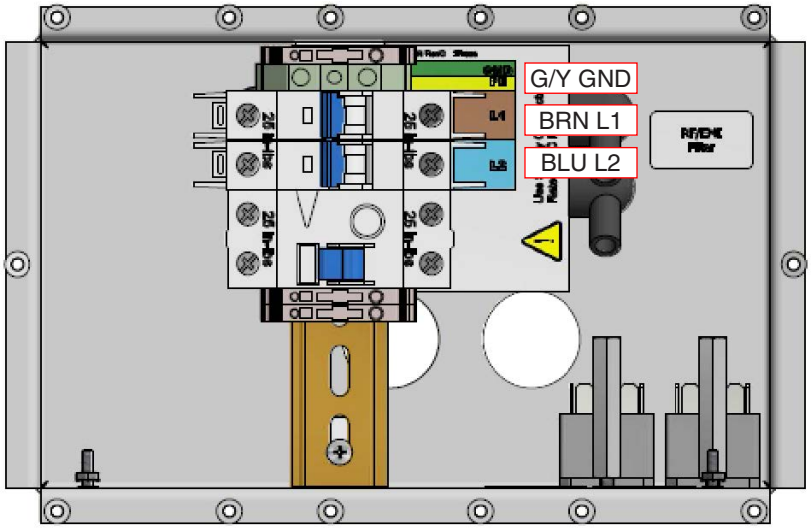


Figure 6.4e: 208/230 V 1-phase electrical power entry and circuit breakers with covers removed.

208/230 V 3-Phase

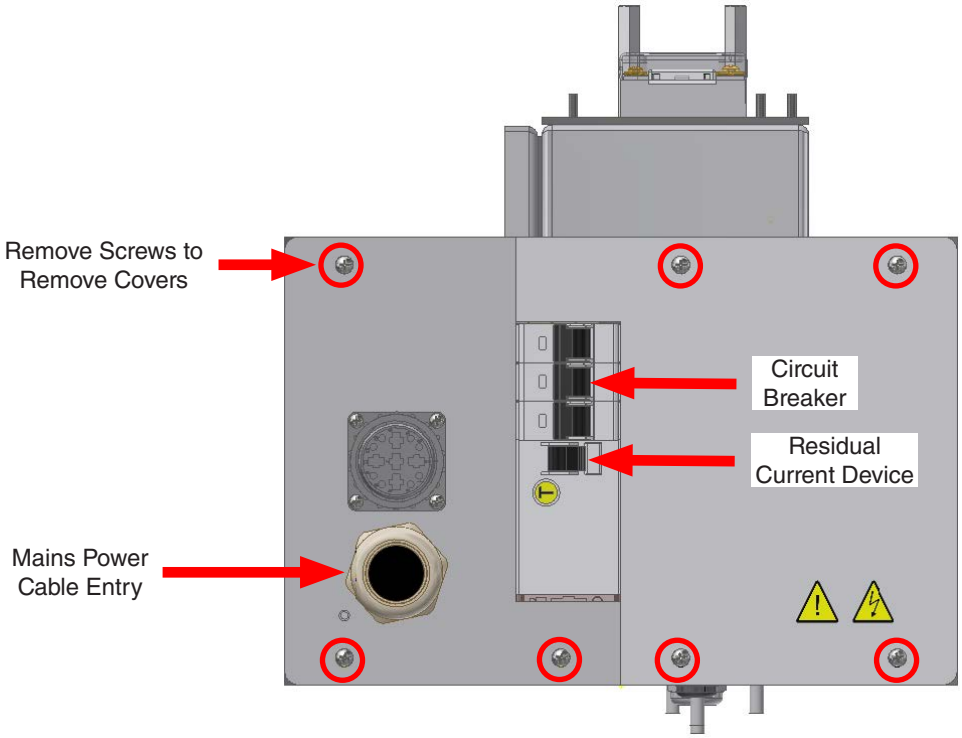


Figure 6.4f: 208/230 V 3-phase electrical power entry and circuit breakers with covers.

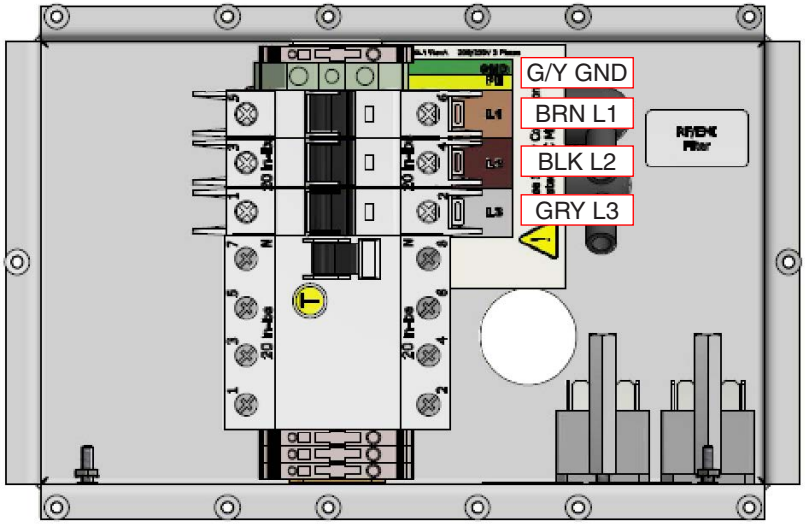


Figure 6.4g: 208/230 V 3-phase electrical power entry and circuit breakers with covers removed.

400 V 3-Phase

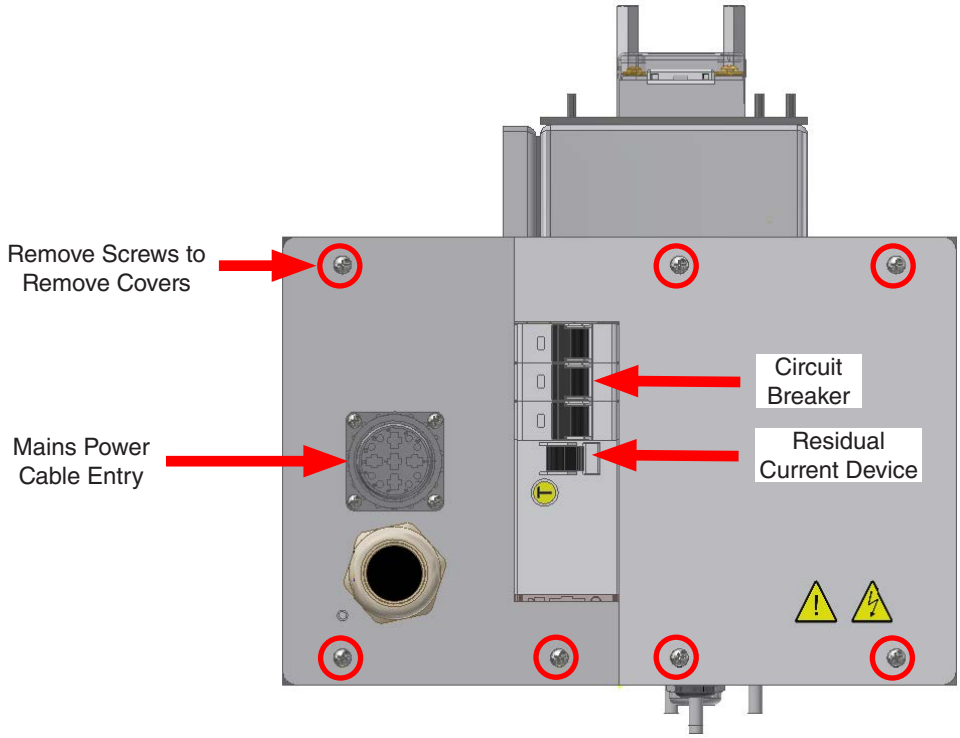


Figure 6.4h: 400 V 3-phase electrical power entry and circuit breakers with covers.

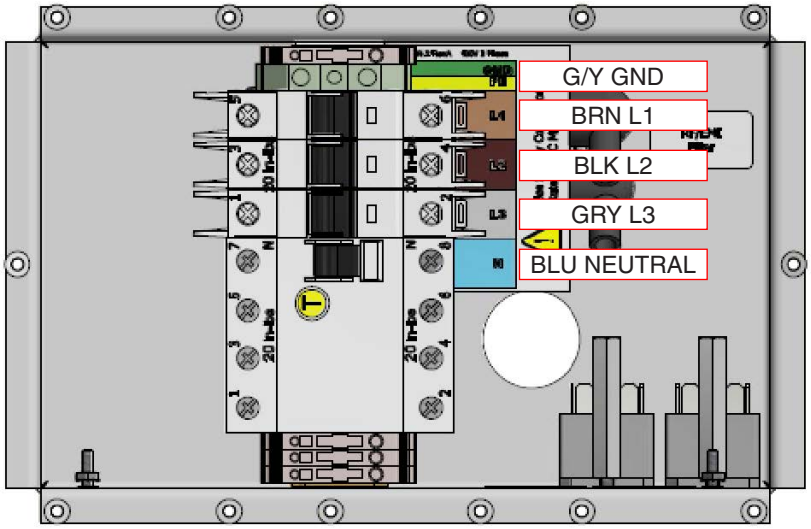


Figure 6.4i: 400 V 3-phase electrical power entry and circuit breakers with covers removed.

Air Preconditioner Power Connection

- The input voltage is shown on the nameplate attached to the rear of the Air Preconditioner (Figure 6.4j).
- The Q-FOG test chamber supplies the power to the Air Preconditioner as follows: 208 V ± 10% or 230V ± 10%, 1-Phase, 50/60 Hz, 18 A.
- An Air Preconditioner power connector is located at the rear of the Q-FOG cabinet (Figure 6.4k).
- Remove the cover from the power connector.
- Connect the Air Preconditioner power cable to the Q-FOG connector (Figure 6.4l).
- An Air Preconditioner hose and cable extension is kit (F-8169-K) is available to enable positioning of the Air Preconditioner at the left end of the Q-FOG test chamber or other positions within the length of the extensions, approximately 4.6 m (15.0').

Figure 6.4j: Power requirements on Air Preconditioner nameplate.

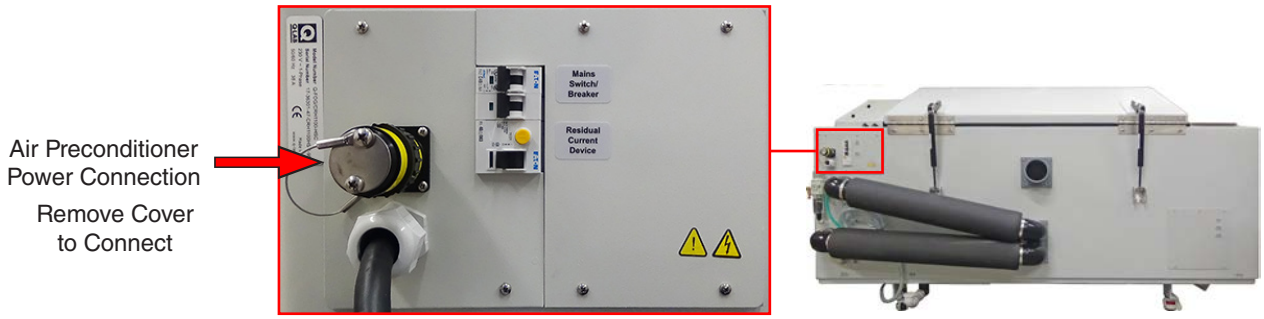


Figure 6.4k: Air Preconditioner connector on Q-FOG cabinet rear.
NOTE: If the Air Preconditioner is not connected the cover should remain in place.

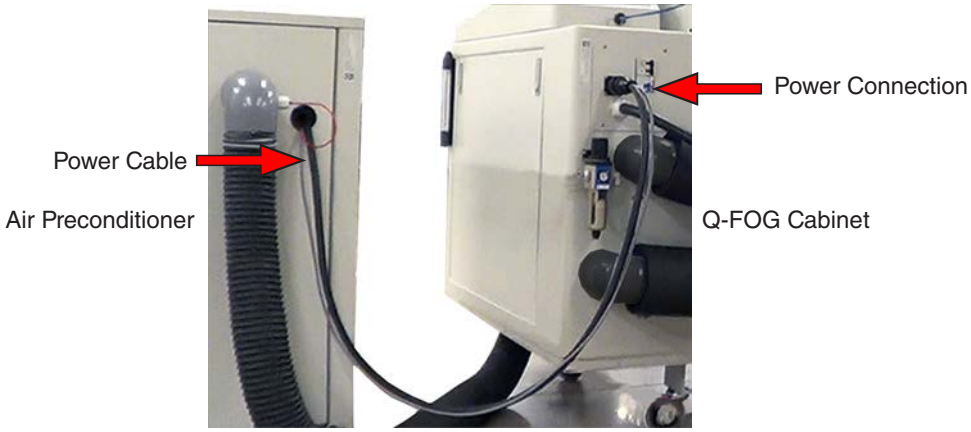


Figure 6.4l: Air Preconditioner power cable connection.

6.5. Compressed Air (Aug 2021)

Purity

- Compressed air must be supplied to the Q-FOG via an inlet at the rear of the cabinet (Figure 6.5a).
- The compressed air supply must be clean, dry, and oil-free.
- The presence of solid impurities, water, oil, or other contaminants in the compressed air may affect test results.
- Do not add a lubricator to the compressed air system.
- Oil in the air will reduce the corrosive effects of the electrolyte on the test specimens.
- Pollutants in the air may increase the corrosive effects.
- Impurities in the air supply may also clog the spray nozzle, solenoid valves or check valves and cause maintenance problems.
- The Q-FOG CRH is equipped with a moisture filter to improve the incoming compressed air quality.
- As moisture accumulates, the filter purges to a water drain.

Figure 6.5a: Compressed air inlet and moisture filter.

Installation

- Pressure: 60-150 psi (4-10 bar).
- The Q-FOG CRH is equipped with a pressure regulator and gauge (Figure 6.5b).
- Set pressure regulator to 60 psi
- Volume: 3.5 CFM (1.7 LPS) maximum.
- 9 mm (3/8") inside diameter compressed air supply tubing is required to connect to the air inlet at the rear of the cabinet (Figure 6.5c).
- Optionally, for connection to 10 mm compressed air supply tubing, a metric installation kit (part number F-70099-K) is available.

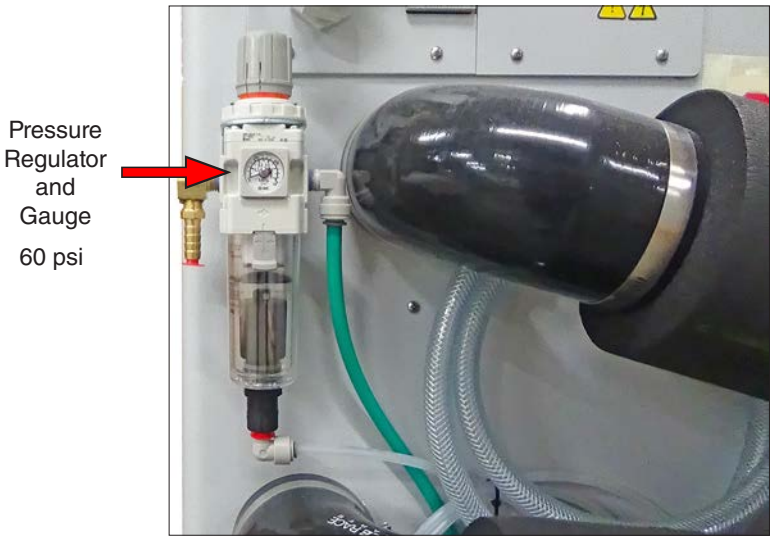


Figure 6.5b: Compressed air pressure regulator.

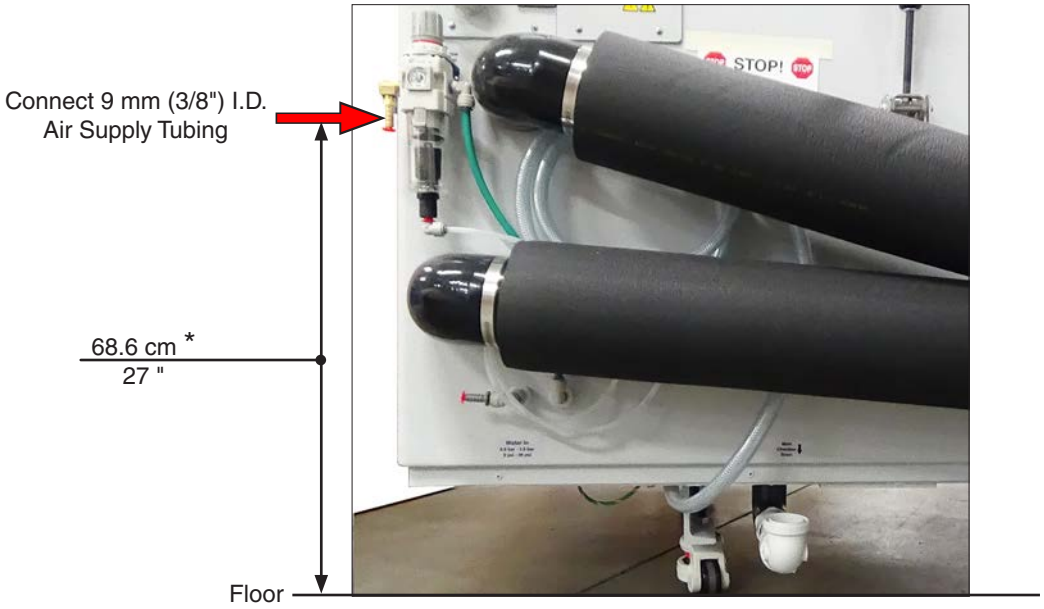


Figure 6.5c: Compressed air connection.

*Distance from floor to compressed air inlet on tester varies based upon adjustment of leveling feet or installation of optional casters. Measure tester to determine actual height.

6.6. Water Supply (Nov 2021)

Purity

Important Caution: The Q-FOG CRH tester requires purified water.

The Q-FOG tester warranty is voided if this condition is not met.
Water purity requirements are listed below.

- The Q-FOG tester requires a supply of pure water for the bubble tower.
- Pure water is used for saturating the compressed air with water vapor during the fog function.
- Q-FOG CRH tester also needs pure water for producing chamber humidity, for water line refresh (see below), wet bulb wick flush, and the optional wall wash system (see Section 8.18).
- The reverse osmosis / deionized (RO/DI) water system described on the next page produces water pure enough for Q-FOG CRH testers.
- **This type of RO/DI system is required for Q-FOG CRH testers:**

Pressure	Maximum Flow Rate	Maximum Volume	Resistivity	Conductivity	Silica	Total Dissolved Solids	pH
9-56 psi (0.6-3.9 bar)	0.4 liter/min.	5 liters/hour	> 5M ohm•cm	< 0.2 µS/cm	< 0.1 ppm	< 0.1 ppm	6-8

- Remove Solid Particles: > 20 µm.
- If line pressure is greater than 3.9 bar (56 psi), install a pressure regulator.
- Maximum consumption rates are during the RH function; typical consumption will be much lower.
- Additionally, the purified water system must be sized to accommodate maximum peak demand during short duration bubble tower refill step at 0.4 liters/minute.

Recirculation

- To avoid the build-up of organic contaminants in the water supply system, Q-Lab recommends the use of a recirculating RO/DI system.
- Contact Q-Lab Repair and Tester Support. See Section 19 for contact information.

Water Line Refresh

- When the tester is turned on, and has not been operated for a minimum of 168 hours (one week), or has been running steps other than RH for more than 168 hours, water line refresh is initiated.
- Water line refresh replaces possibly stagnant or contaminated water in the water feed assembly and associated supply lines with fresh clean water for the RH generator nozzles, the shower purge water circuit, and the wet bulb water supply tube.
- Refresh runs for 600 seconds (10 minutes) delaying the start of a test cycle until the refresh is complete.
- During this time, a stream of water flows from the RH generator nozzles and water drips from the shower nozzles (if a shower module is installed).
- During the refresh process Water Line Refresh and XX Seconds Remaining are displayed on the Status Screen.

Reverse Osmosis / Deionization System

- The reverse osmosis / deionized (RO/DI) water system shown in Figure 6.6a and Figure 6.6b produces water pure enough for spray systems.
- RO/DI water output by Stage E is required for Q-FOG CRH testers.

Important: Use Type I, not Type II anion in the mixed bed tanks of the RO/DI system.

The Strong Base **Type I** Anion resin in the mixed bed tanks is the most important part of these systems to prevent water spotting. This is because strong base Type I anion resin is the only resin that can effectively remove suspended silica. **Suspended silica is the major cause of specimen spotting.** Type I anion is much better at removing suspended silica than Type II.

Unfortunately, Type II is the most common anion. So be sure to insist that your water purification supplier installs Type I, not Type II. The cost for Type I anion is about the same as Type II. Note that Type I anion is only necessary in the mixed bed "polishing" stages of the deionization, not in the initial "rough" purification stages.

- Figure 6.6a shows an effective Reverse Osmosis / Deionized Water System with Anion Type I Resin for spray water silica removal.
- For more information on water purification systems contact the Life Science business of Merck KGaA, Darmstadt, Germany. The Life Science business of Merck KGaA, Darmstadt, Germany operates as MilliporeSigma in the USA and Canada.

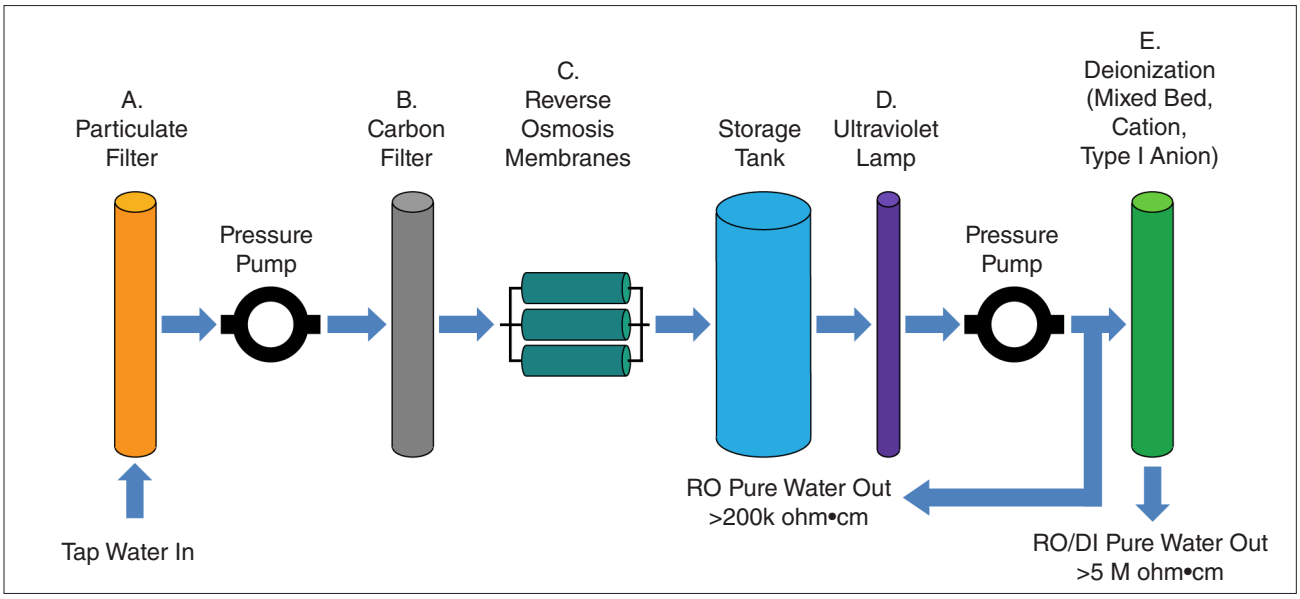


Figure 6.6a: Reverse Osmosis / Deionized water system.

Stage	Purpose	Outgoing Purity	Notes
A. Particulate Filter	Remove small particles		Replace once per year
B. Carbon Filter	Remove chlorine		Replace once or twice per year
C. R/O Membranes	Remove dissolved solids, colloidal silica, organic and biological contaminates	>200k ohm•cm	Produces pure (RO) water
D. Ultraviolet Lamp	Disinfect water		Any bacteria or algae from the storage tank is removed
E. Mixed Bed Tank	Final polishing to remove positively and negatively charged ions	>5 M ohm•cm	Produces ultra pure (RO/DI) water required for the Q-FOG CRH

Figure 6.6b: Additional RO/DI system information.

Installation

Flush out the water supply line prior to connecting to the Q-FOG tester.

- A 9 mm (3/8") inside diameter purified water supply hose is required to connect to the water inlet at the rear of the cabinet (Figure 6.6c and Figure 6.6d).
- Optionally, for connection to 10 mm water supply tubing, a metric installation kit (part number F-70099-K) is available.
- The water supply connection should be fitted with a stop valve.

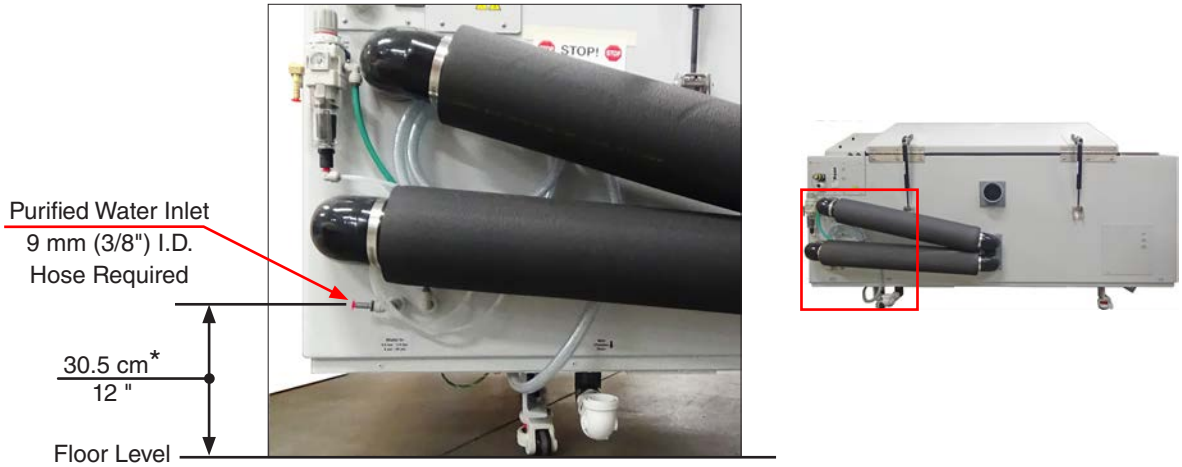


Figure 6.6c: Purified water inlet location.

* Actual distance from the floor to the center of the chamber drain will vary based upon adjustment of leveling feet or installation of optional casters. Once the tester is in position, measure the distance to determine the actual height.

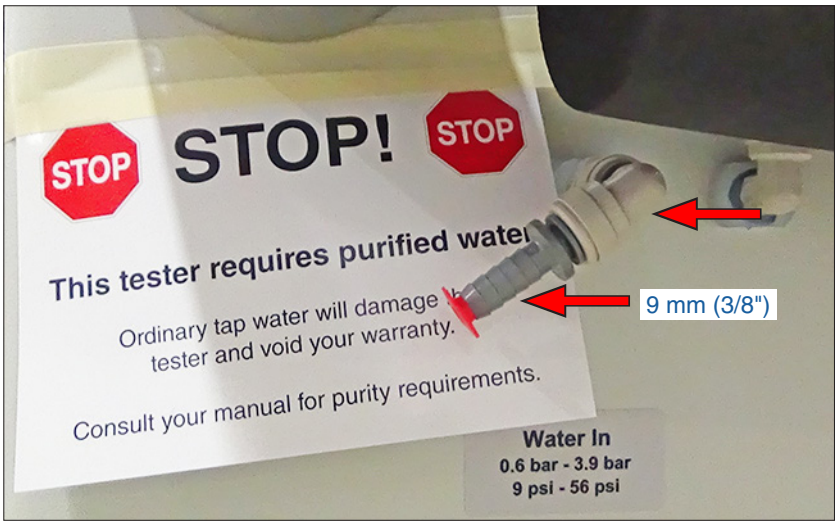


Figure 6.6d: Supplied hose barb and elbow for water connection.

IMPORTANT: When electrical, compressed air, and purified water have been connected, turn on the air and water, and check for leaks at the connection points.

6.7. Water Drainage (Aug 2021)

A floor drain is required.

- The Q-FOG tester has multiple drains (Figure 6.7a through Figure 6.7j).
- Waste water disposal must be made in accordance with local ordinances regarding chemical disposal.
- Usually simple salt water is not regulated. Check local disposal regulations.

Q-FOG Drain Connections

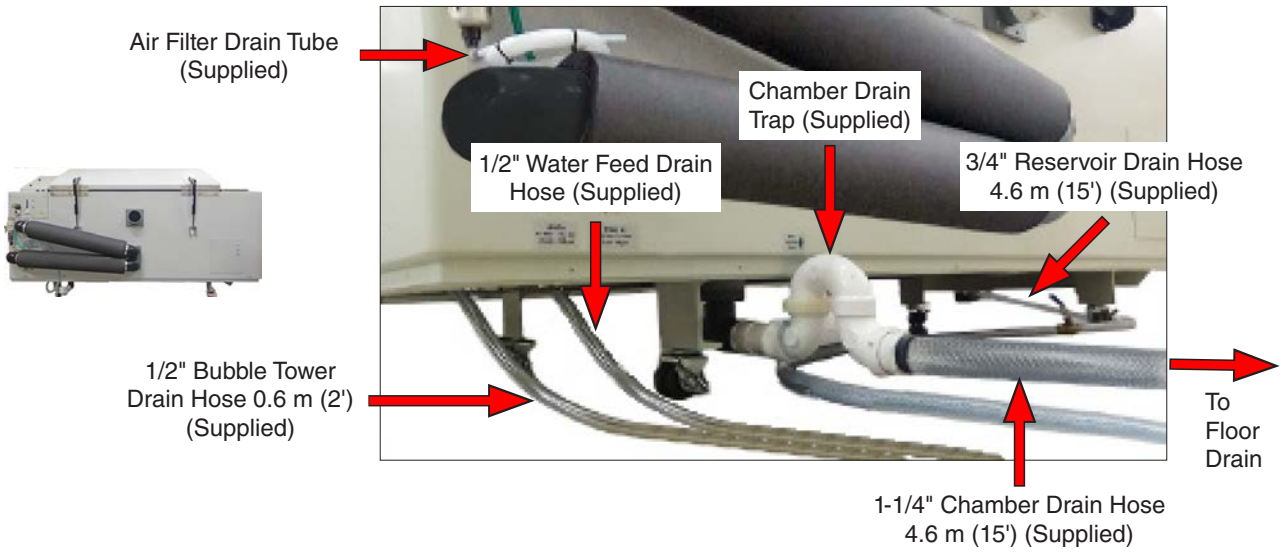


Figure 6.7a: Water drainage connections.

Chamber Drain

- The main testing chamber is fitted with a drain to enable excess solution to go to a sanitary sewer drain.
- A supplied trap must be installed on the drain so that corrosive vapors cannot escape (Figure 6.7b through Figure 6.7d).
- Run the supplied hose from the trap to a drain.

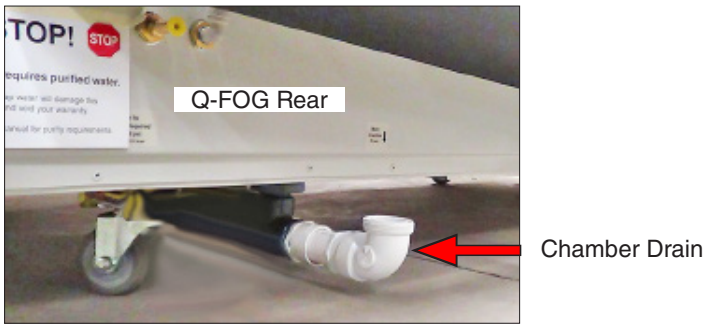


Figure 6.7b: Chamber drain.

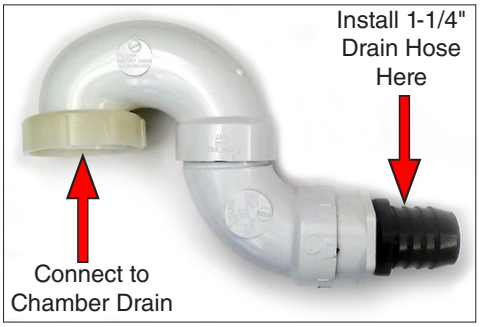


Figure 6.7c: Chamber drain trap (supplied).

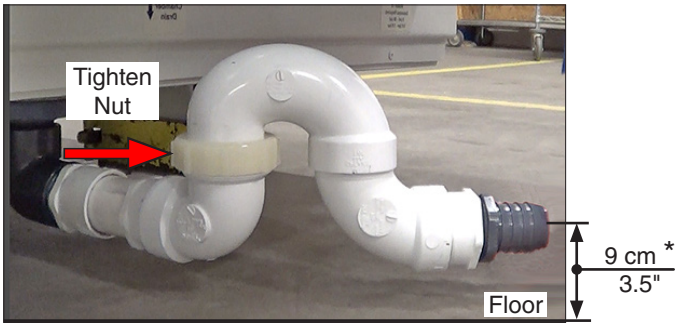
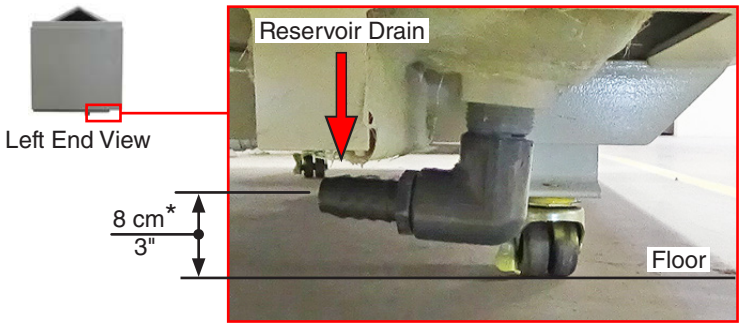


Figure 6.7d: Chamber drain trap installed.

*Distance from floor to center of chamber drain varies based upon adjustment of leveling feet or installation of optional casters. Measure tester to determine actual height.

Solution Reservoir Drain

- The user must attach a 19 mm (3/4") hose and ball valve shut off (all supplied) to the reservoir drain (Figure 6.7e).
- This hose is used only when cleaning out the reservoir and does not have to be run to a drain.
- However, for convenience, we recommend that this hose be connected to a drain.
- The user may want to supply their own plastic pipe and plumb all the drains permanently into a sanitary drain.
- Make sure the ball valve is attached and closed before filling the reservoir.



*Distance from floor to center of reservoir drain varies based upon adjustment of leveling feet or installation of optional casters. Measure tester to determine actual height.

Figure 6.7e: Solution reservoir drain location.

Water Feed Assembly Drain

- This 13 mm (1/2") hose (Figure 6.7f) is connected to the water feed assembly (Section 8.17) overflow port.
- Route the hose under the lower duct. Unroll the hose and connected to a floor drain (Figure 6.7g).

Figure 6.7f: Water feed assembly drain hose.

Figure 6.7g: Unroll and connect to drain.

Air Filter Drain

- The end of the supplied 1/4" tubing from the bottom of the air filter should be placed into a floor drain (Figure 6.7h).

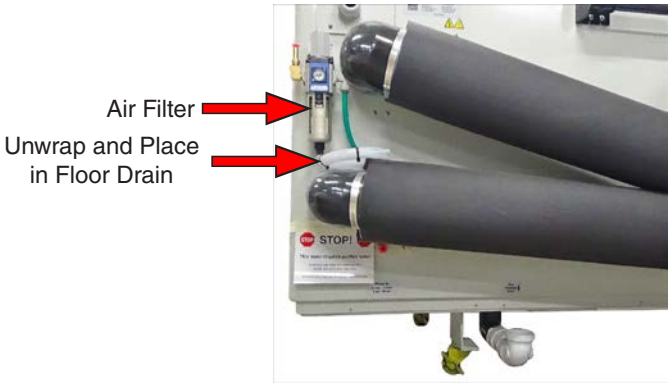


Figure 6.7h: Air filter drain.

Bubble Tower Drain

- This system consists of a 13 mm (1/2") hose. See Figure 6.7i.
- This hose is used only when cleaning out the Bubble Tower and does not have to be run to a drain.
- However, for convenience, we recommend that this hose be connected to a drain.

Figure 6.7i: Bubble tower drain connection.

Air Preconditioner Drain Connection

- The end of the Air Preconditioner drainage hose should be connected to a floor drain (Figure 6.7j).

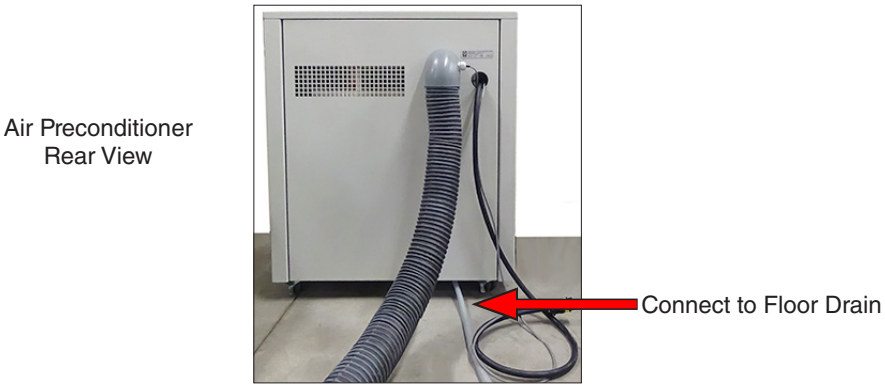


Figure 6.7j: Air Preconditioner drain hose location.

6.8. Venting (Dec 2021)

- Be sure to comply with all local regulations regarding chemical exhaust. Usually simple salt water is not regulated.
- The Q-FOG exhausts air from the test chamber at a rate of approximately 60 CFM.
- For proper operation of the venting system, 60 CFM of replacement (make up) air must be available to the room where the Q-FOG is installed.
- The heat load dissipation is 2000 W for CRH600 models and 2500 W for the CRH1100 models.
- Proper venting will prevent corrosive mist from entering the laboratory and assure correct performance of the Q-FOG tester.
- Air venting from the chamber is done via a 114 mm (4.5") outside diameter vent tube (Figure 6.8a).
- The customer must connect an exhaust system with a 102 mm (4.0") inside diameter (minimum) vent line.
- Optionally, for connection to an exhaust system having 100 or 110 mm outside diameter tubing, a metric installation kit (part number F-70099-K) is available. See Figure 6.8b through Figure 6.8d for various metric installation configurations.
- Because of the typically corrosive nature of the exhaust, plastic vent tubing is strongly recommended.
- The length of the venting system must be less than 30 meters (100 feet) and contain fewer than 10 elbows (i.e. 90° turns).
- If it must be longer, or if it must contain more turns, there could be significant back pressure on the chamber and this might cause corrosive mist to enter the laboratory and/or reduce the tester's performance capabilities.
- A "tee" is recommended at the end of the vent to reduce the risk of periodic back-pressure from the wind.
- Place a screen over the vent to discourage birds and small animals.

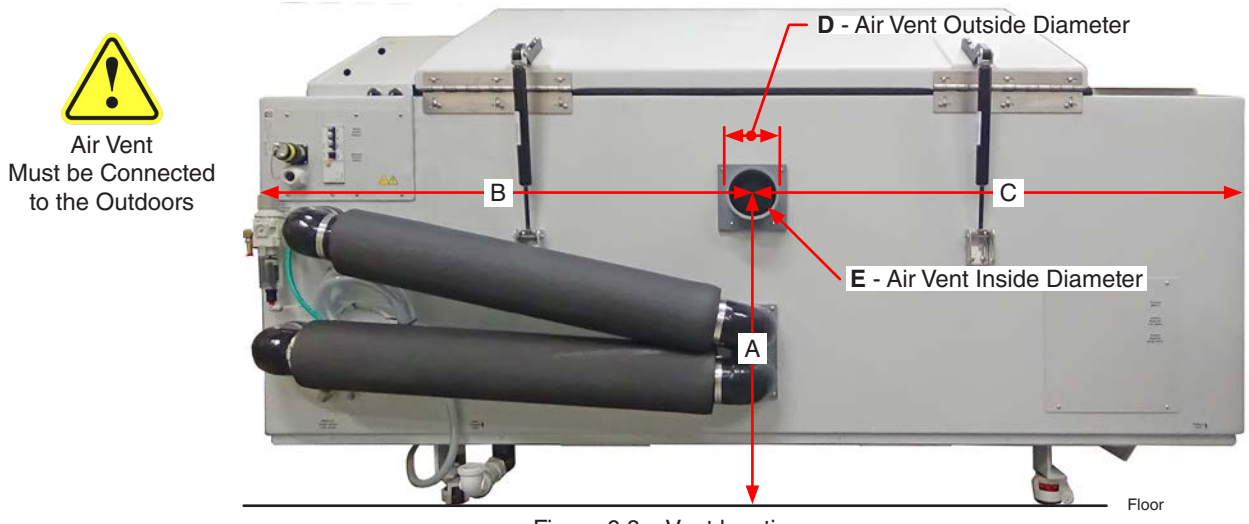


Figure 6.8a: Vent location.

Air Vent Location				
	Model 600		Model 1100	
A*	71.1 cm	28.0"	71.1 cm	28.0"
B	90.2 cm	35.5"	109.2 cm	43.0"
C	91.4 cm	36.0"	110.5 cm	43.5"
D	11.4 cm	4.5"	11.4 cm	4.5"
E	10.2 cm	4.0"	10.2 cm	4.0"

* Distance from floor to center of vent varies based upon adjustment of leveling feet and installation of optional casters. Measure tester to determine actual height.

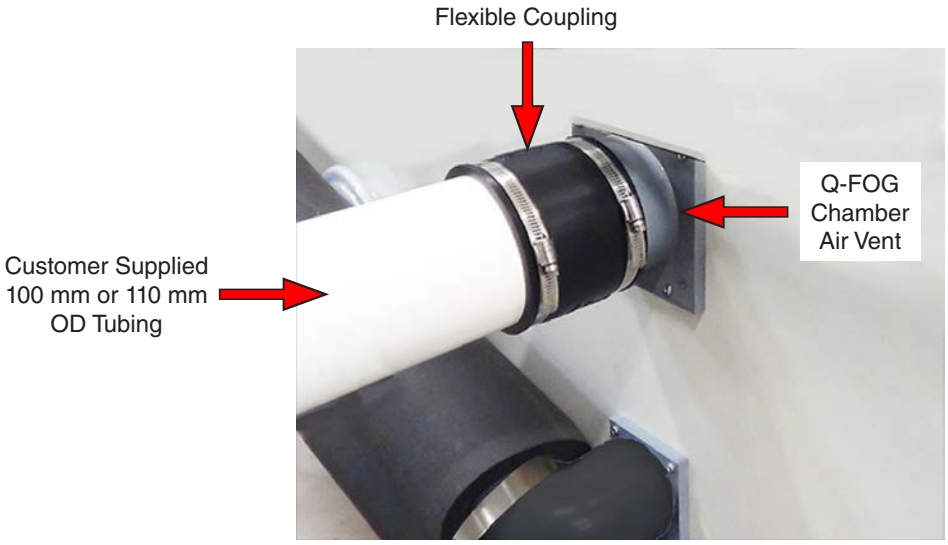


Figure 6.8b: Metric kit straight-out venting installation.

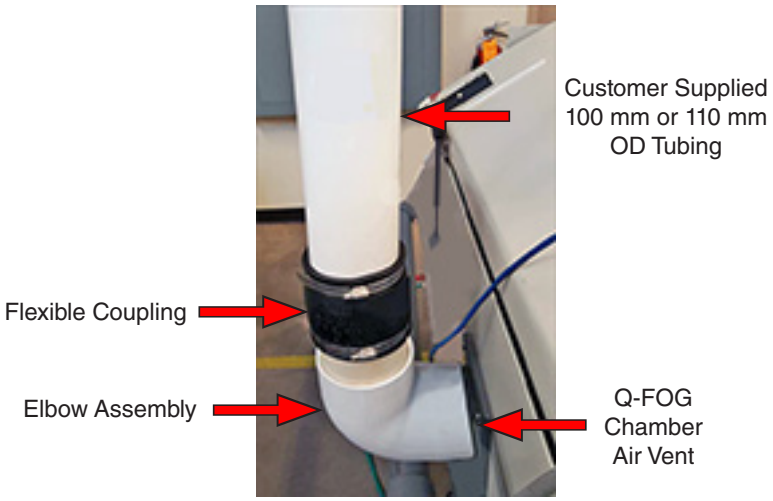


Figure 6.8c: Metric kit vertical venting installation.

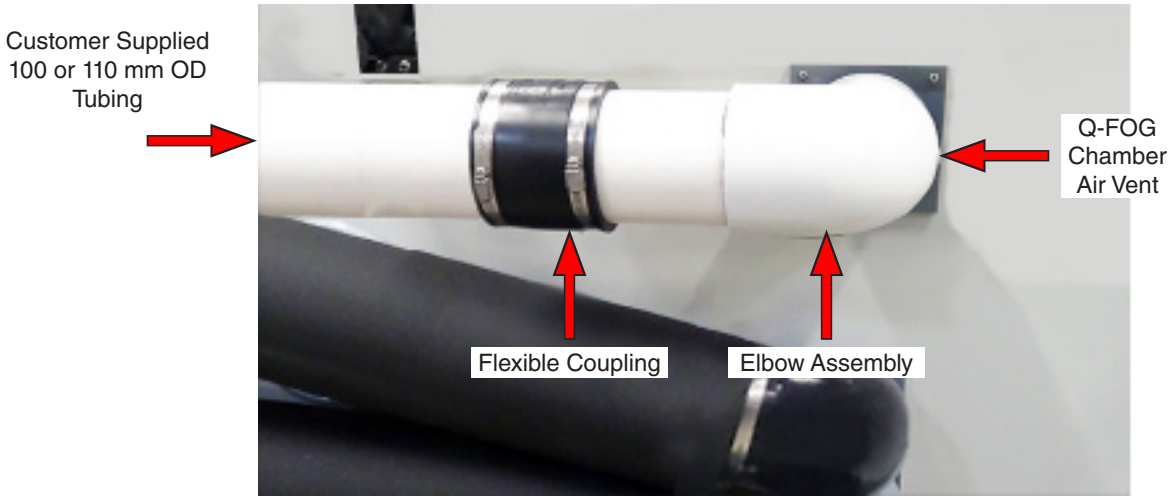


Figure 6.8d: Metric kit horizontal venting installation.

Connections

- The Q-FOG must be vented to the outdoors. See Figure 6.8e.
- Mechanical Extraction Ventilation systems are not recommended for use in Q-FOG vent installations.
- Because some liquid from the salt fog may condense on the inside of the vent tube, we recommend that all sections of the vent tube have a slope either back toward the chamber or away to a drain. See Figure 6.8f
- Otherwise, liquid may build up in the vent tube and cause problems with back pressure.
- Avoid all installations that could create moisture traps. See Figure 6.8g.
- Flexible vent tubing is not recommended due to the potential for creating moisture traps.
- Excessive amounts of moisture build up can create a weight load on the vent tubing.
- Figure 6.8f and Figure 6.8g illustrate correct and incorrect ways to connect the Q-FOG chamber vent.
- When venting variations are necessary, please consult Q-Lab Corporation for recommendations.
- A One-Way Valve Kit (F-70629-K) is available from Q-Lab to enable the venting of multiple Q-FOG testers together.
- See Section 18 for Q-Lab contact information.

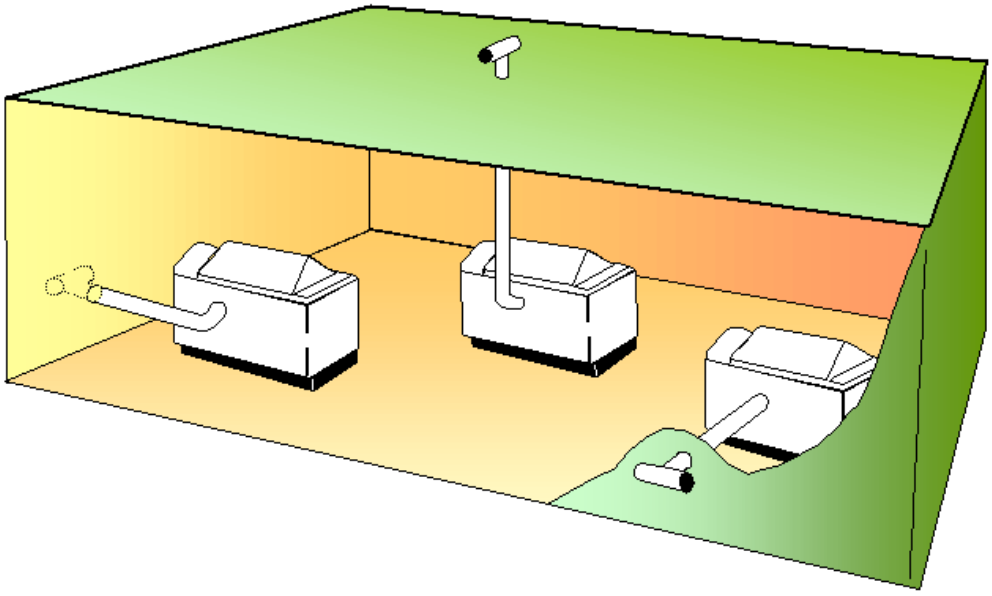


Figure 6.8e: Recommended outdoor venting configurations.

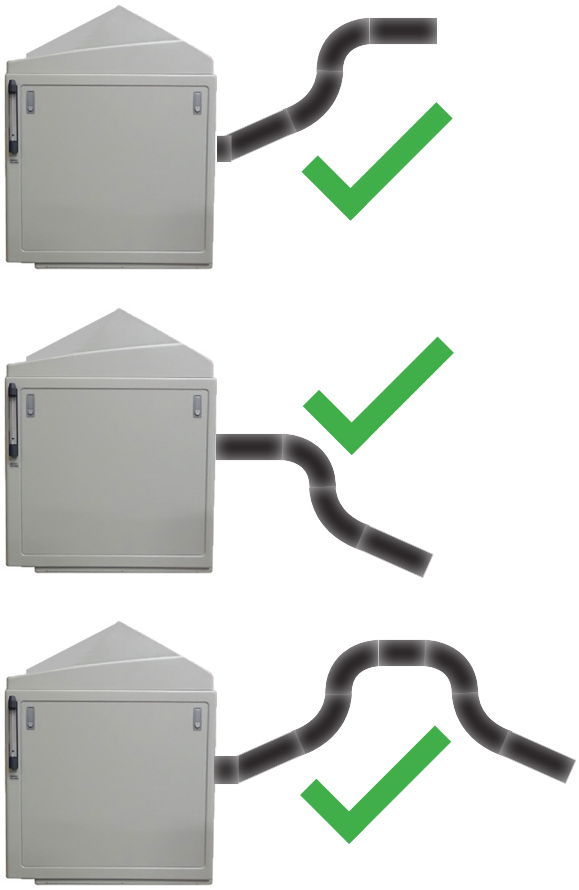


Figure 6.8f: Correct vent installations.

Make sure the vent is installed so that moisture cannot build up and create a trap as shown below.

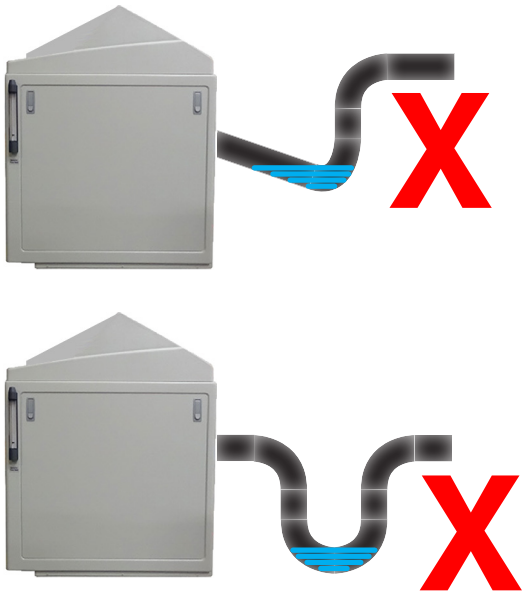


Figure 6.8g: Incorrect vent installations.

6.9. Test Chamber (Aug 2021)

Return Tube

- The return tube (Figure 6.9a) is packed with the accessories in the test chamber (see Section 5.5).
- The Stationary Shower Module (if in use) should be installed before installing the return tube (see Section 5.5).
- Install the return tube in the chamber elbow coupling with the sensor bracket toward the rear of the chamber as shown in Figure 6.9b.

Figure 6.9a: Return tube.

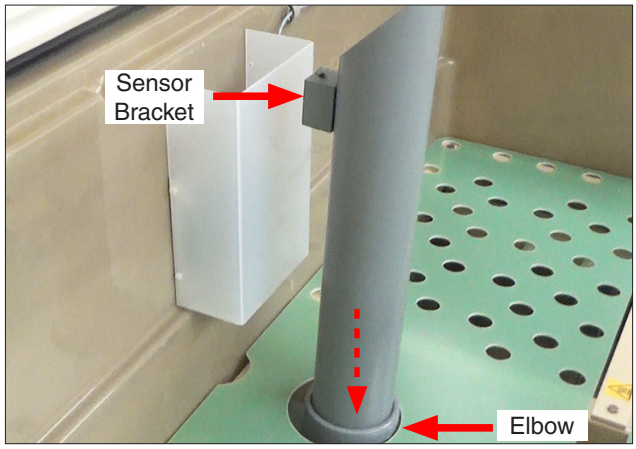


Figure 6.9b: Install the return tube in the test chamber with the bracket toward the rear as shown.

Chamber Temperature Sensor Assembly

- The chamber temperature sensor is shipped in the purge outlet baffle in the test chamber (Figure 6.9c).
- Remove the sensor from the baffle (Figure 6.9d).
- Install the sensor in the chamber temp sensor bracket on the return tube as shown in Figure 6.9e.
- Make sure the sensor cable is installed in the clips on the chamber wall as shown in Figure 6.9f.

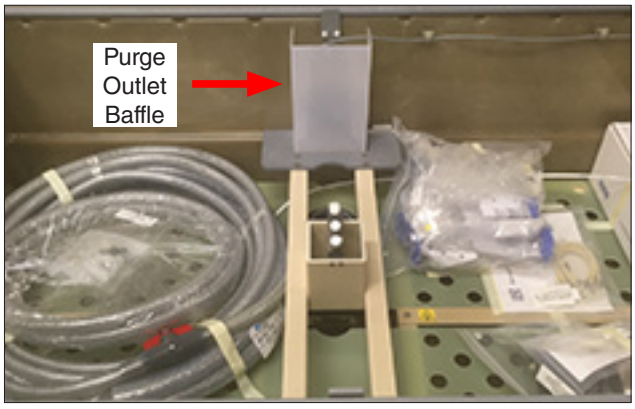


Figure 6.9c: Sensor packed in purge outlet baffle.
NOTE: Stationary Shower Module model shown.

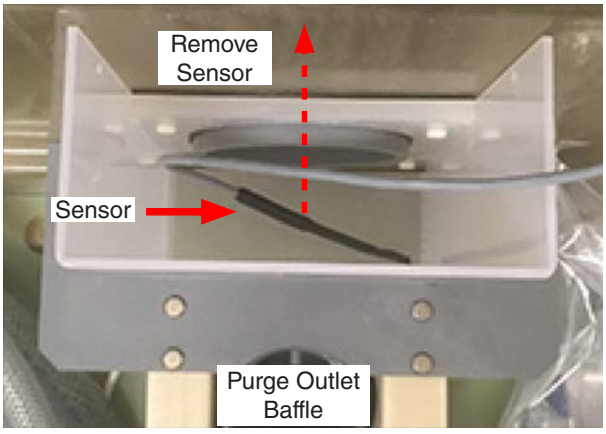


Figure 6.9d: Remove sensor from purge outlet baffle.

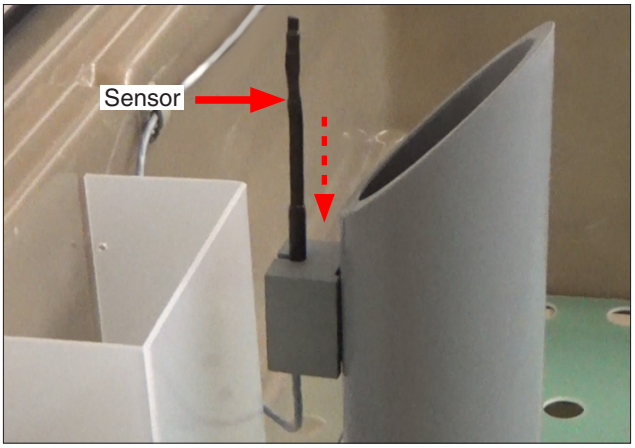


Figure 6.9e: Install the sensor as shown.

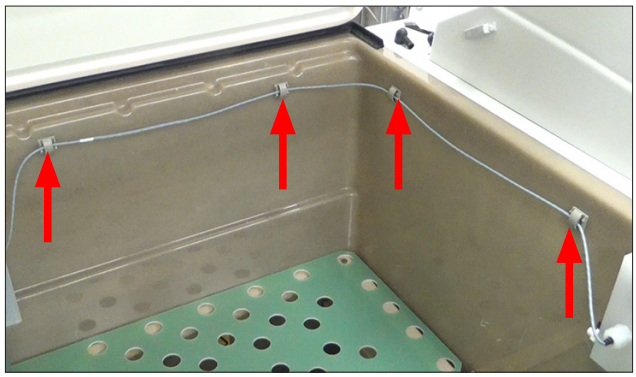


Figure 6.9f: Sensor cable installed in clips.

Chamber Configuration

- Test chamber configuration ready for specimen mounting is shown in Figure 6.9g.
- See Section 10 for specimen mounting options.

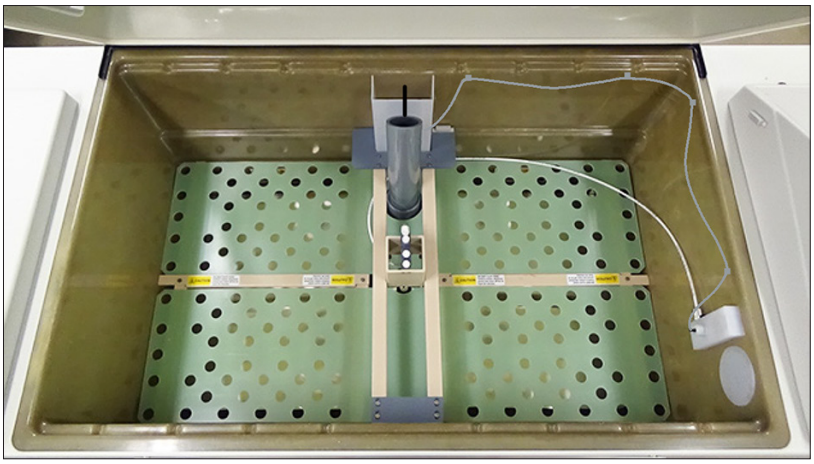


Figure 6.9g: Test chamber ready for specimen mounting.
Shown with Stationary Shower Module installed.

6.10. Data Communication (Nov 2021)

Connections

- An Ethernet connector is located on the rear of the control top (Figure 6.10) to connect the Q-FOG to a network or directly to a personal computer for displaying test parameter data using VIRTUAL STRIPCHART™ software from Q-LAB.
- See *Specification Bulletin L-4035 VITRTUAL STRIPCHART Data Logging Software for Q-Lab Testers* for more information on VIRTUAL STRIPCHART™ software.
- A USB connector is also located on the rear of the control top to enable tester data export and software upgrades.
- Both connectors have removable covers to protect against corrosion.

Figure 6.10: Data Connections Location

7. Functions

- In Q-FOG corrosion testers, specimens are exposed to a series of different environments in a repetitive cycle that mimics the outdoors.
- Q-FOG CRH testers can cycle between these functions:
  - Fog - Section 7.1
  - RH - Section 7.2
  - Shower - Section 7.3
  - Fog and Shower functions cannot be run in the same cycle
- Simple cycles, such as Prohesion, may consist of cycling between salt fog and dry conditions.
- More sophisticated automotive methods may call for multi-step cycles that incorporate humidity or condensation, along with salt spray and dry-off. Many of these methods can only be performed with the CRH model.
- Test conditions and timing are controlled by a built-in microprocessor.
- A simple, dual full-color touchscreen interface allows for easy programming and operation.
- The operator can quickly create new cycles, or run any of the programmed cycles.
- The Q-FOG controller includes complete self-diagnostics, including warning messages, routine service reminders and safety shut down.
- See LF-8165-SO Q-FOG CRH System Overviews for detailed information on Q-FOG CRH functions.

7.1. Fog Function (Oct 2021)

The Fog function sprays a fine mist of corrosive solution throughout the chamber. The system works as outlined below.

- The peristaltic fog pump sends solution from the reservoir (Section 8.1) to the fog spray nozzle (Section 8.6).
- Pump speed is selected via the Main Menu touchscreen using the Machine Configuration menu. The flow rate is displayed on the flow meter.
- The air solenoid valve (Section 8.16) sends compressed air through the bubble tower (Section 8.2) and then to the spray nozzle where it atomizes the solution.
- The air supply pressure is set via the fog pressure regulator located on the control panel. The pressure is displayed on the pressure gauge.
- The chamber heaters (Section 8.4) maintain the chamber temperature.
- The first time a Fog step is run after initial setup, it can take 15-45 minutes for the solution to start spraying out of the fog nozzles. This time can be shortened by opening the peristaltic pump head (see Section 8.5). Then close the pump head when the solution starts flowing.
- See Section 11.4 for more information on setting air pressure and pump speed.

NOTE: When changing solution type, run a fog step for 45 minutes before adding test specimens to purge the old solution.

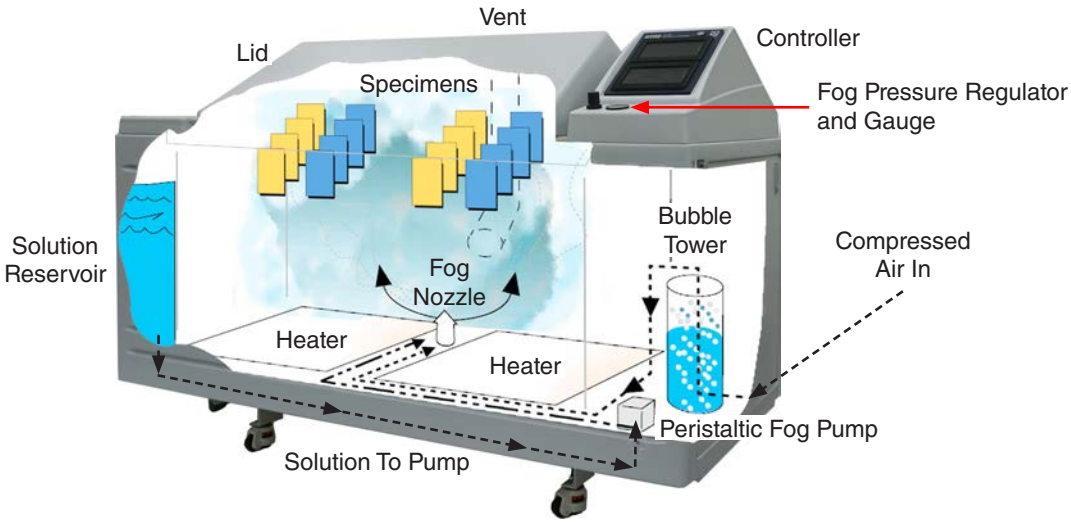


Figure 7.1a: Fog system.

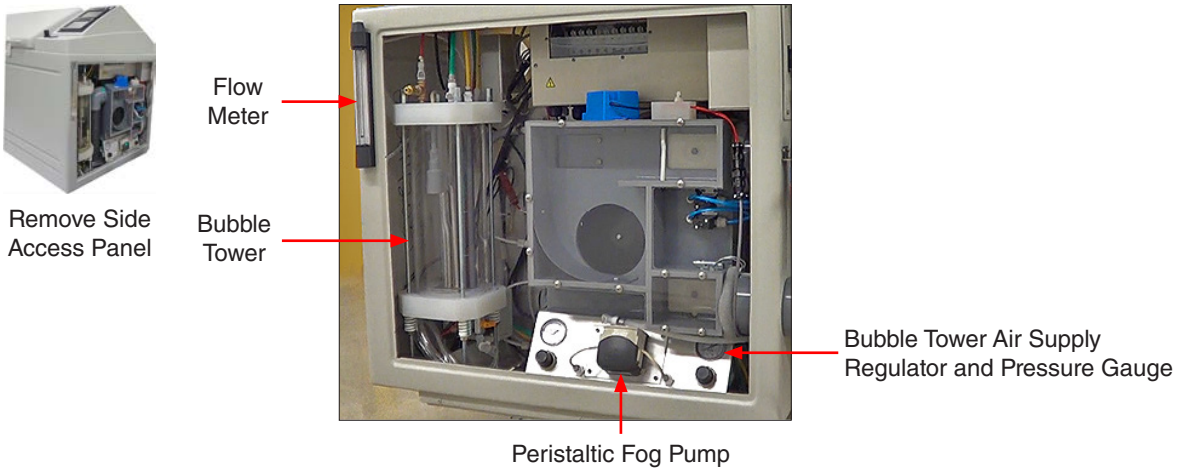


Figure 7.1b: Fog system components.

7.2. Controlled Relative Humidity (RH) Function (Oct 2021)

The RH function allows the operator to control the relative humidity and temperature of the test chamber. The system works as outlined below.

- The RH generation system (Figure 7.2a) injects atomized pure water into the air stream to control the RH level.
- The controller senses chamber relative humidity and pulses the RH generator nozzles to inject the correct amount of moisture into the chamber.
- The air control module (Section 8.12) recirculates air through the chamber and adjusts the amount of outside air brought into the chamber.
- Outside air may be pre-conditioned (Section 8.14) to allow lower temperature and relative humidity settings than otherwise possible.
- Dry-off of specimens can be achieved by programming low relative humidity (e.g. < 30%) conditions.
- The chamber heaters (Section 8.4) and Air Preconditioner heater maintain chamber air temperature.
- The operator can choose one of three ramp modes when programming a controlled RH step:
  - **Linear:** When a LINEAR ramp is selected, a time must also be selected (the minimum time is 10 minutes). This is the time it will take to go from the set point of the previous step to the set point of the current step. The temperature and/or RH is ramped by creating one minute incremental temperature and/or RH set points. The incremental set points are determined by taking the change in temperature and/or RH and dividing by the ramp time (Figure 7.2b).
  - **Auto:** The controller achieves the RH and temperature setpoints as quickly as possible while also minimizing overshooting the temperature (Figure 7.2c).
  - **Less Than:** User inputs the maximum transition time specified by the standard and the controller operates maximum heating, cooling, and/or drying until those conditions are met, without regard to possible overshooting of conditions. This generally achieves faster transitions than AUTO. If the conditions are not met within a tolerance, an alarm is displayed but the test is not interrupted (Figure 7.2c).

NOTE: If an RH step is programmed with a linear ramp, the linear ramp will NOT work correctly if the step is interrupted. If an RH step with a linear ramp is interrupted, the test must be restarted in the previous step to perform the linear ramp correctly.

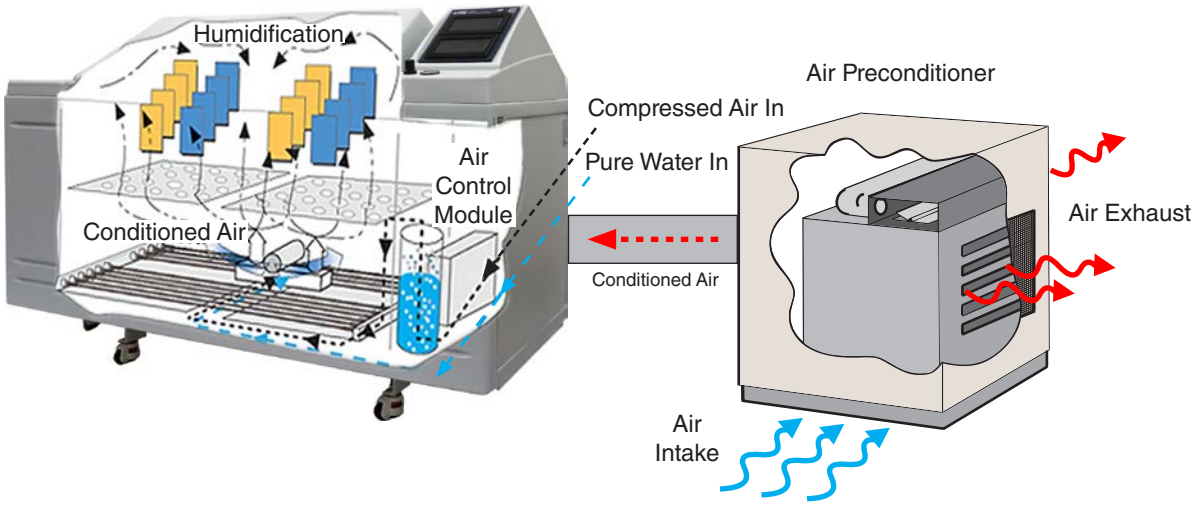


Figure 7.2a: Controlled relative humidity system.

RH Function - Linear Ramp Mode Example*

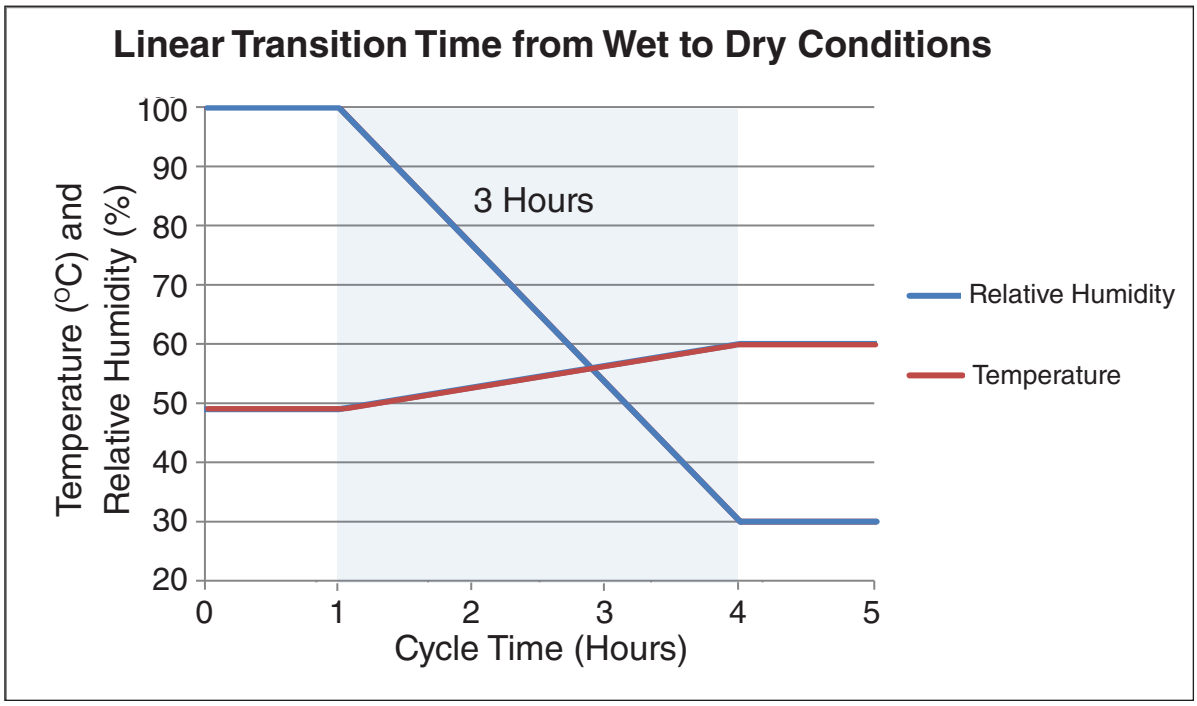


Figure 7.2b: Linear ramp.

RH Function - Auto Ramp Mode Example*

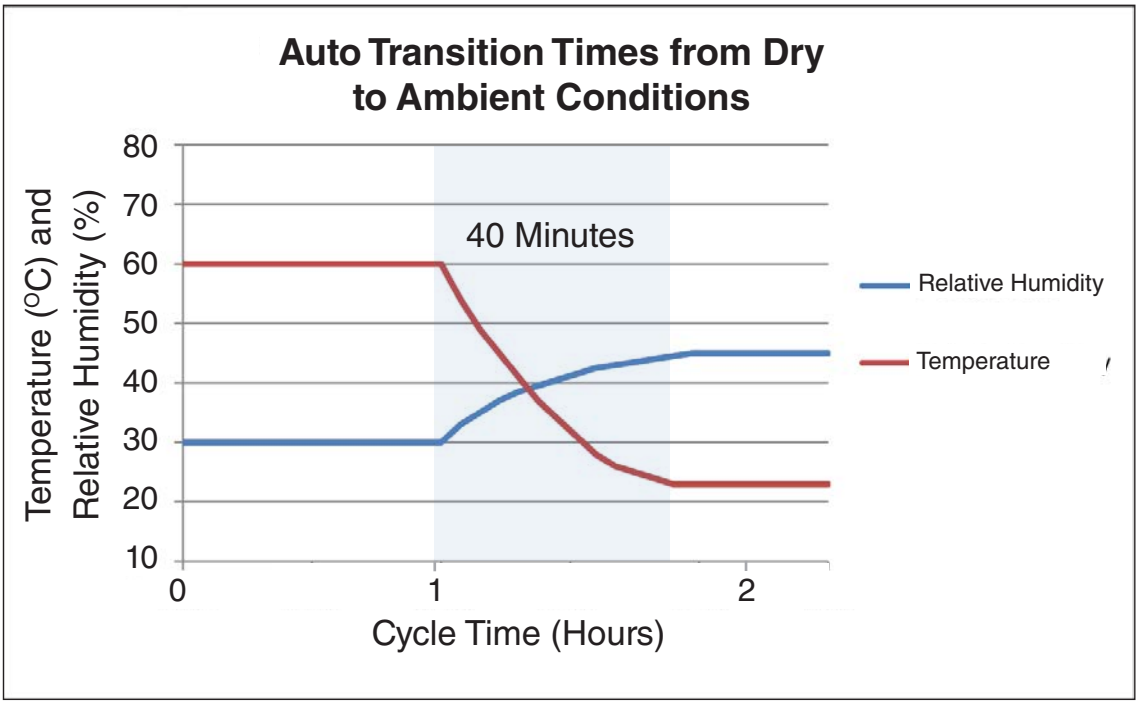


Figure 7.2c: Auto ramp. A Less Than ramp is very similar to this but a little more aggressive and may overshoot target values slightly.

*These examples for illustrative purposes only.

7.3. Shower Function (Oct 2021)

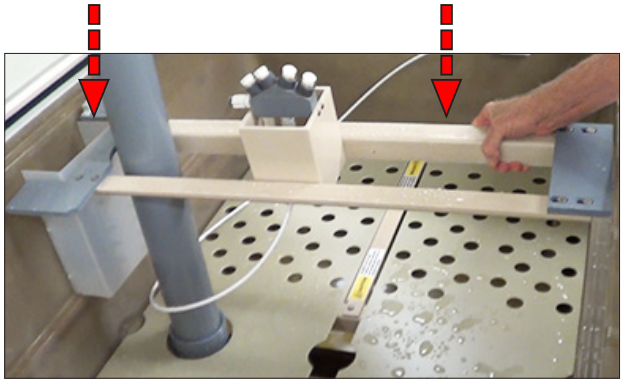
- The Shower function is used in GMW 14872 and other automotive test specifications (see Section 11).
- The Shower function is used in place of the Fog function (see Section 7.1).
- Shower and Fog functions can not be performed in the same test step.
- The Q-FOG CRH may be equipped with either the Stationary Shower Module (SSM) in the “S” model testers (Section 7.3.1), or the Top-Mounted Swaying Shower Bar (TSSB) in the “T” model testers (Section 7.3.2).
- The shower pump sends solution to four (4) non-atomizing spray nozzles in the SSM or TSSB that spray drops of liquid solution onto test specimens.
- A user-adjustable (using the shower pump regulator) volume of solution is uniformly sprayed onto specimens through the nozzles (see Section 8.10). See Section 12.3.2 for more information on setting the shower pump regulator.
- Spray droplets are much bigger, flow rates are much higher, and step times are much shorter as compared to the atomized solution mist produced by the fog function.
- The shower nozzles are self-cleaning.
- The shower flow rate is constantly monitored and an alarm is sounded if flow is not within acceptable limits. See Section 12.5.
- An automatic flow rate detection circuit detects plugged spray nozzles or substantial leaks.
- The shower pulse rate can be changed in the Calibrate menu on the Menu Screen. See Section 12.3.2.
- Mass loss rates of corrosion coupons can be adjusted by increasing or decreasing shower pulse rate.
- See Section 12.3.2 for more information on setting shower pump regulator.

7.3.1. Stationary Shower Module - “S” Models Only

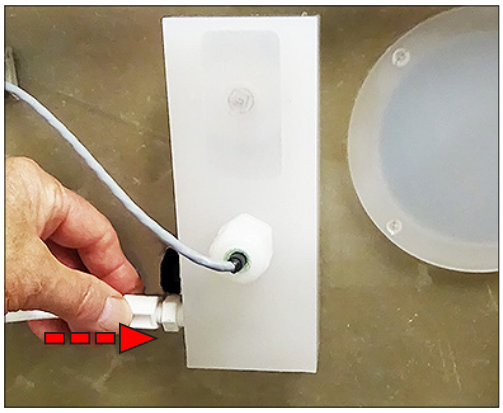
- The user installs the SSM in the bottom of the of the test chamber (Figure 7.3.1) over the existing fog spray nozzle. See Stationary Shower Module Installation.
- The stationary shower nozzles spray solution in an arc pattern over the specimens.
- Shower volume is user-adjustable using the shower pump regulator system.
- The SSM must be removed from the Q-FOG chamber to run a fog step.
- See Section 8.10 for more information of the SSM.

Figure 7.3.1: Stationary Shower Module system.

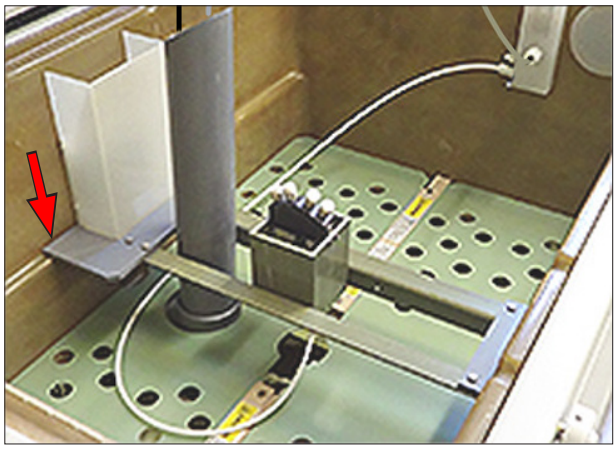
Stationary Shower Module Installation



1. To install the SSM, lower the module into chamber over the vent stack as shown.



2. Connect the SSM solution supply tube to the solution supply fitting at the right end on the test chamber.



3. The installed SSM rests on the rack level grate shelf.

7.3.2. Top-Mounted Swaying Shower Bar -"T" Models Only

- The Top-Mounted Swaying Shower Bar (TSSB) satisfies the language in Ford standard CETP 00 00-L-467 and Volvo standard VCS 1027, 1449 for a swaying spray bar.
- The TSSB is factory-installed at the top of the Q-FOG lid, positioned over the test samples (7.3.2).
- An actuator mounted on the outside of the chamber lid causes the TSSB shower nozzles to oscillate (sway) between the chamber front and rear, uniformly spraying salt solution down onto test specimens in the chamber.
- Shower volume is user-adjustable using the same shower pump regulator as found in the Stationary Shower Module SSM.
- The TSSB does not need to be removed from the Q-FOG chamber to run a Fog step. However, a Fog step can not be run in the same cycle with a Shower step.
- The TSSB solution supply tube connects to the solution supply fitting at the right end on the test chamber.
- See Section 8.11 for more information on the TSSB.

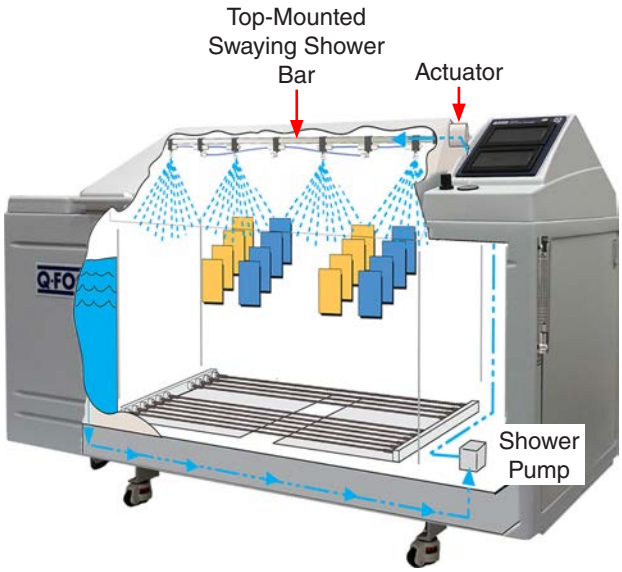


Figure 7.3.2: Top-Mounted Swaying Shower Bar system.

8. Major Components

- This section provides detailed information on the major components of the Q-FOG corrosion tester.
- Many of these components are available as replacement parts. See Section 16 for ordering information.
- See *LF-8165-SO Q-FOG CRH System Overviews / Diagrams* for additional component details and interactions.
- The major components are:

  - Solution Reservoir (Section 8.1)
  - Bubble Tower (Section 8.2)
  - Diffusers (Section 8.3)
  - Chamber Heaters (Section 8.4)
  - Peristaltic Fog Pump (Section 8.5)
  - Fog Spray Nozzle (Section 8.6)
  - Lid Interlock Switch (Section 8.7)
  - Chamber Air Temperature Sensor & Over Temperature Switch (Section 8.8)
  - Laboratory Temperature and Humidity Sensor (Section 8.9)
  - Stationary Shower Module (Section 8.10)
  - Top-Mounted Swaying Shower Bar (Section 8.11)
  - Shower Pump (Section 8.12)
  - Air Control Module (Section 8.13)
  - Controlled Relative Humidity RH Generator (Section 8.14)
  - Air Preconditioner (Section 8.15)
  - Solenoid Valves (Section 8.16)
  - Water and Salt Solution Filters (Section 8.17)
  - Shower, Fog Flow Switch, Water Valve (Section 8.18)
  - Wall Wash System (Section 8.19)

8.1. Solution Reservoir (Oct 2021)

- The salt solution reservoir, with a removable lid, is built into the left end of the Q-FOG cabinet (Figure 8.1a).
- The 120 liter (31.6 gallon) reservoir holds enough solution for five days of continuous salt spray.
- A label attached to the rear wall indicates the volume of solution in the reservoir (Figure 8.1b)
- Sensors detect when the solution level gets too low and will automatically stop the test when the reservoir is empty.
- A salt solution kit (F-9155-K) is available to make the ASTM B117 salt solution or the ISO 9227 salt solution.
- See Section 14.5 for important solution reservoir cleaning information.

IMPORTANT: Only use deionized water for preparing solutions. When changing solution type, run a fog step for 45 minutes before adding test specimens to purge the old solution.

Figure 8.1a: Solution reservoir located inside left end of cabinet.

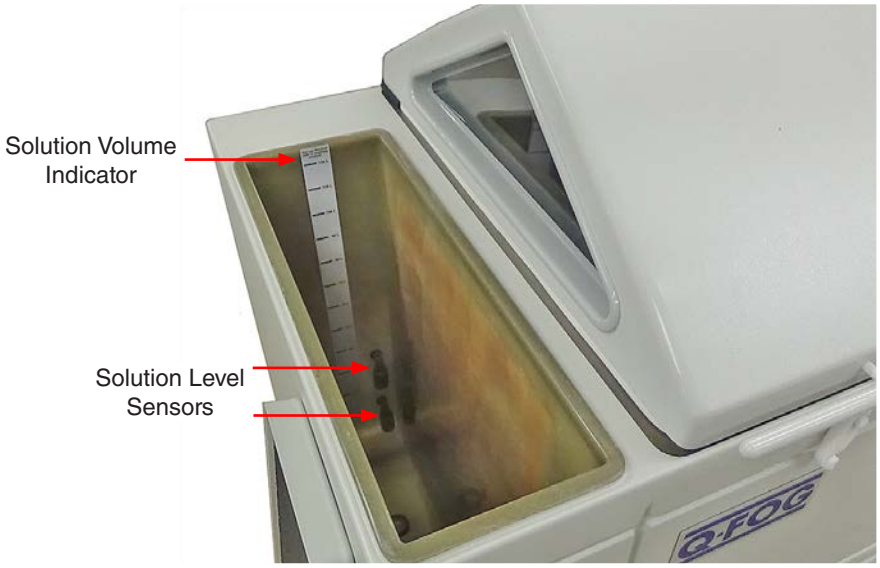


Figure 8.1b: Solution reservoir with lid removed.

8.2. Bubble Tower (Oct 2021)

- The purpose of the bubble tower is to saturate the compressed air used to atomize the salt solution.
- The bubble tower also acts as a filter to remove oil from the compressed air.
- The bubble tower contains a heater to keep the water 12 °C hotter than the chamber temperature during fog steps.
  - Water temperature is adjustable in software when necessary. Contact Q-Lab Repair and Tester Support for assistance.
- The water level in the bubble tower is automatically maintained by the level switches and water fill solenoid valve.
- The bubble tower is accessed by removing the right side access panel (Figure 8.2a).
- See Section 14.1 for important bubble tower maintenance information.

Safety Features

- The bubble tower incorporates the following safety features (Figure 8.2a):
  - Pressure Relief Valve
  - Compression Springs
  - Thermal Fuse
  - Tube Gaskets
  - Water Level Float Switches
  - Temperature Sensor

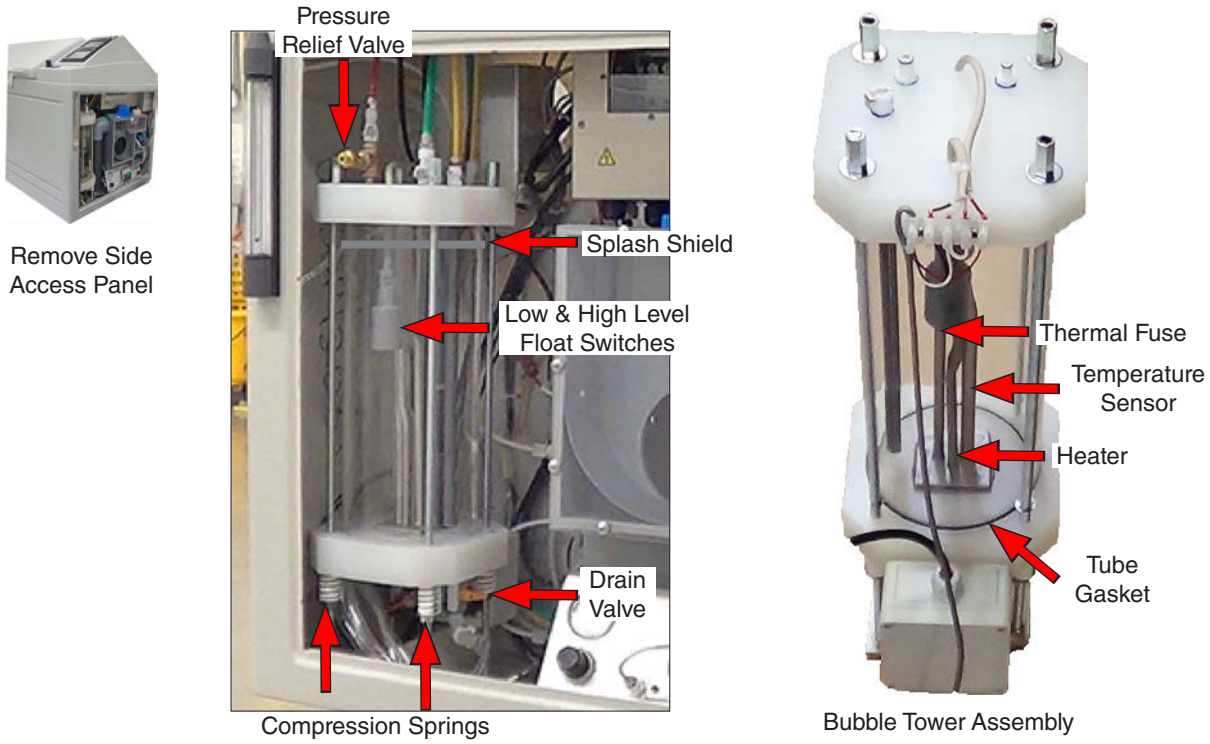


Figure 8.2a: Bubble tower installed.

8.3. Diffusers (Dec 2021)

- Diffusers are perforated fiberglass sheets (Figure 8.3a and Figure 8.3b) positioned above the chamber heaters.
- The diffuser sheets help diffuse heat during the fog function and spread air circulated during the RH function.
- The diffusers also protect users from touching the hot chamber heaters below.
- If necessary, the diffuser plates can be removed to access the heaters.
- The diffusers are not intended to hold test specimens. Use panel racks or hanging rods to hold test specimens. See Section 10.2 for specimen mounting options.

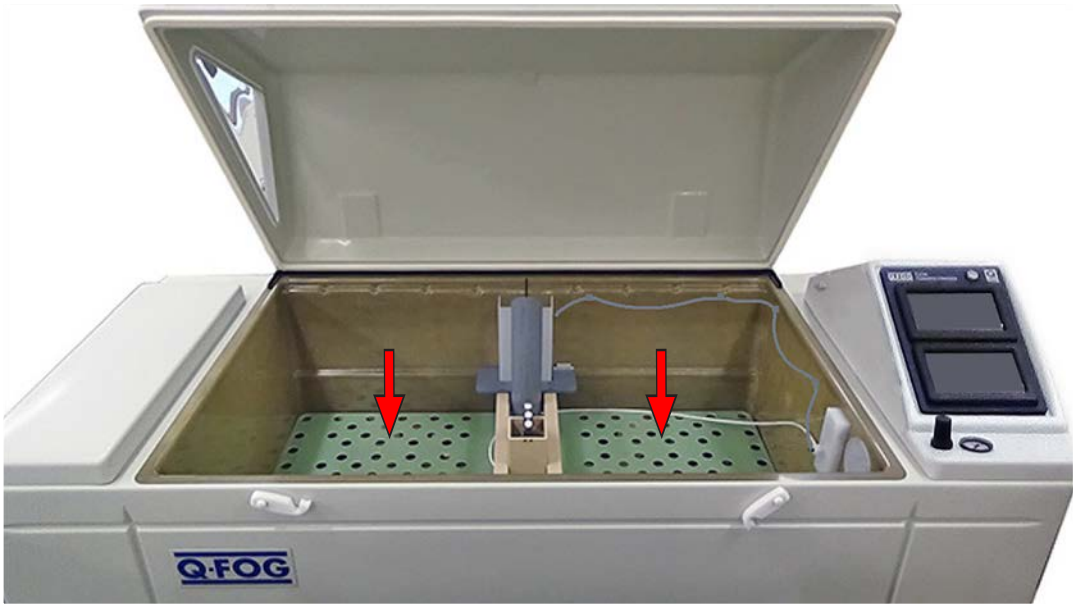


Figure 8.3a: Diffuser location. SSM Model shown, same location for TSSB models.

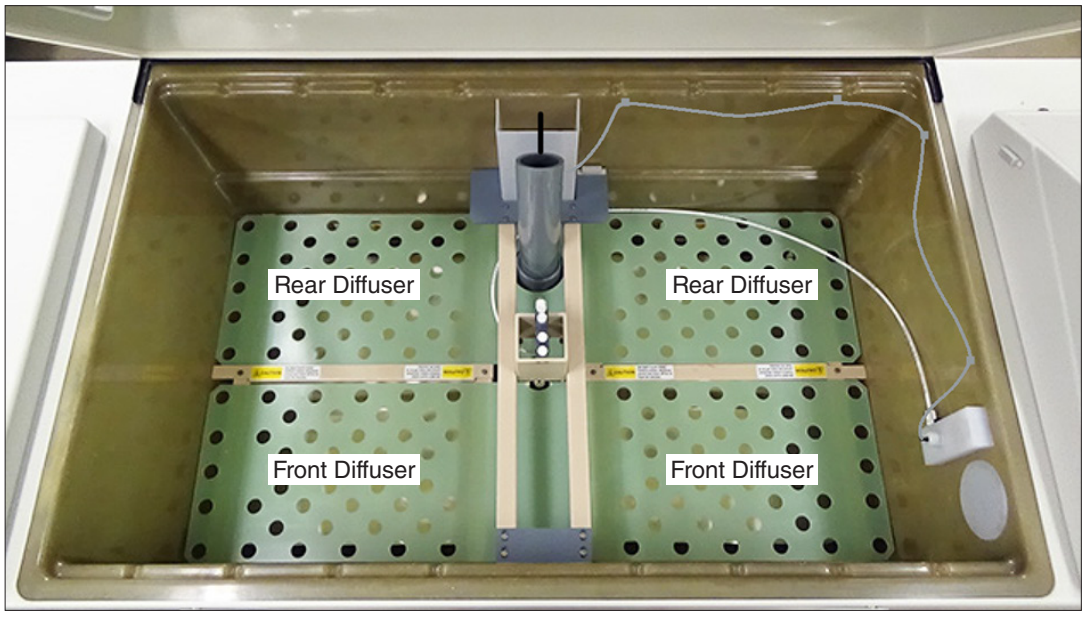


Figure 8.3b: Diffusers in chamber (shown with Stationary Shower Module installed)

8.4. Chamber Heaters (Dec 2021)

- The Q-FOG chamber heaters are located under the diffuser plates at the bottom of the chamber (Figure 8.3b).
- Q-FOG chambers are equipped with one of two types of heaters.
  - Models CRH600-HSC, CRH1100-HSC, and CRH1100-HTC have plate-type heaters (Figure 8.4a).
  - Models CRH600-HSCR, CRH1100-HSCR, and CRH1100-HTCR have tube-type (Rapid Ramp) heaters (Figure 8.4b).

Figure 8.4a: HSC or HTC model plate heaters, diffusers removed.

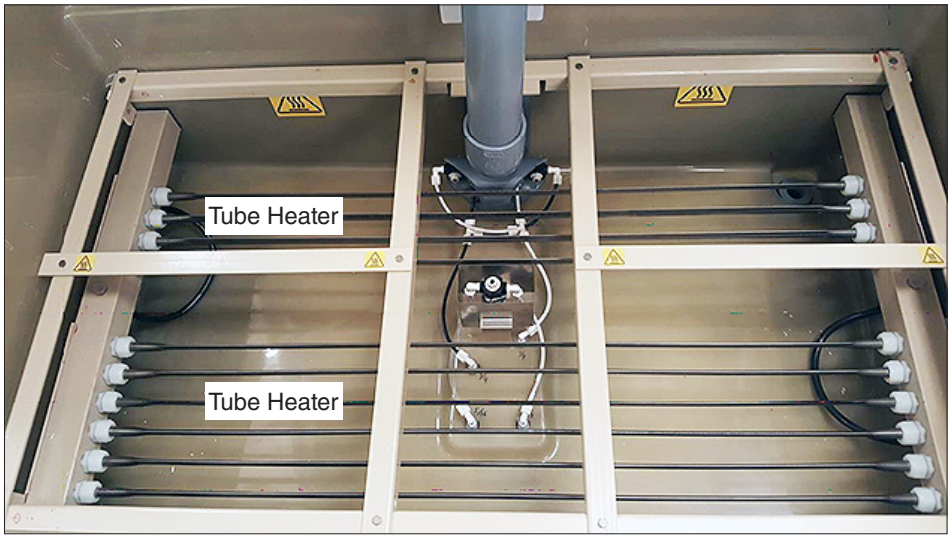
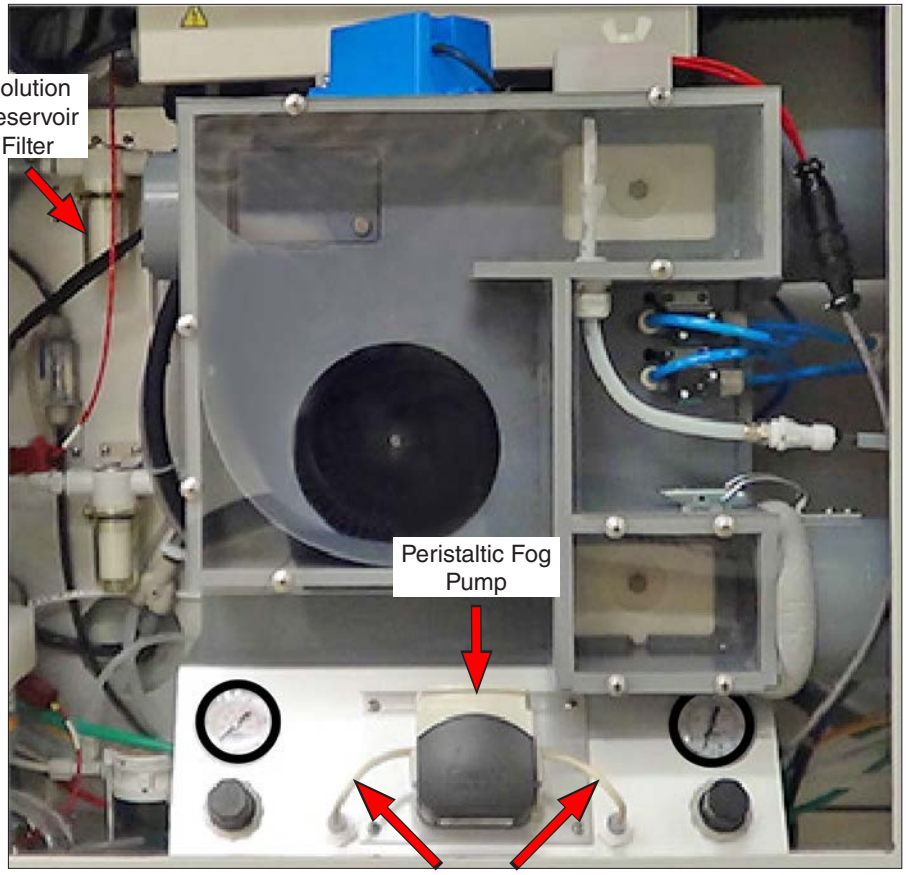


Figure 8.4b: HSCR or HTCR model rapid ramp tube heaters, diffusers removed.

CAUTION: Chamber heaters may be hot.

8.5. Peristaltic Fog Pump (Nov 2021)

- A peristaltic pump is used to supply salt solution to the fog nozzle (see Section 8.6).
- The peristaltic pump is accessed by removing the Q-FOG right-side access panel (Figure 8.5).
- The solution reservoir filter before the pump prevents particles or contaminants from entering the pump and spray nozzle.
- The standard peristaltic pump tubing has a 1.6 mm inside diameter.
- The standard tubing should be used for running all tests except Renault D17-2028 (2014) - *Corrosion Test by Automatic Phase Change Salt Spray Humidity and Drying (ECC1)* .
- To run the Renault D17-2028 test, use the 2.4 mm Peristaltic Pump Tubing Kit (order part number F-70123-K).
  - Testers pre-programmed with ECC1 will already have the larger 2.4 mm peristaltic pump tubing installed.
  - See Section 11.3.8 for more information on the Renault D17-2028 test.



Pump Location

Figure 8.5: Peristaltic pump location.

8.6. Fog Spray Nozzle Assembly (Nov 2021)

- The Fog Spray Nozzle is located at the bottom center of the test chamber below the diffusers (Figure 8.6a).
- For “S” model testers, the Stationary Shower Module (SSM) is installed above the Fog Spray Nozzle (Figure 8.6b).
- Fog and Shower steps cannot be run in the same test cycle, even in a “T” model tester where the shower system doesn’t obstruct fog.
- Salt solution enters on the right side of the nozzle and compressed air enters on the left side (Figure 8.6c and Figure 8.6d). As they mix, the compressed air atomizes the salt solution into a fine mist (see Section 7.1 and *LF-8165-SO Q-FOG CRH System Overviews*).
- The The Fog Spray Nozzle can be disassembled for cleaning (Section 14.4), removed for replacement (part number F-70352-X), or realigned to adjust fog spray uniformity (Section 12.3).

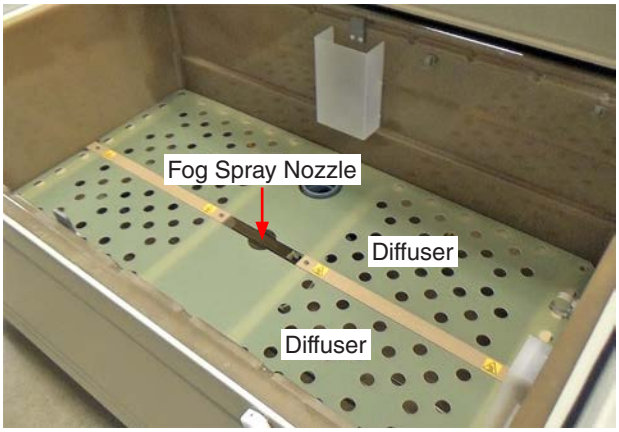


Figure 8.6a: Fog Spray Nozzle located at chamber bottom under diffusers.

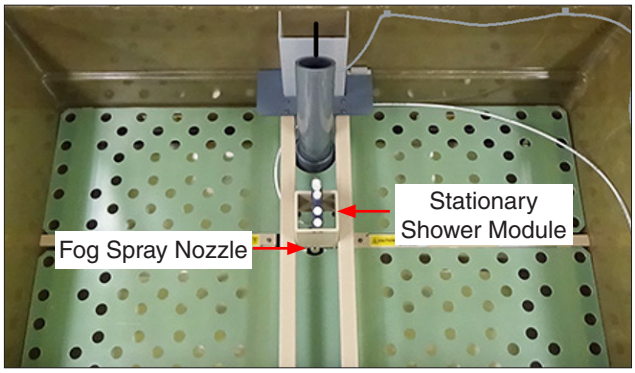


Figure 8.6b: SSM installed above Fog Spray Nozzle in “S” models.

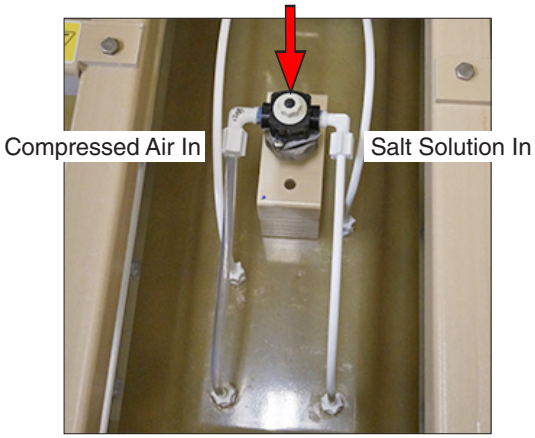


Figure 8.6c: Diffusers removed to show Fog Spray Nozzle in HSC and HTC models.

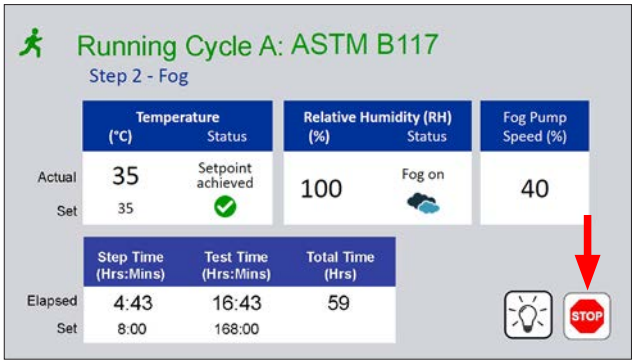
Figure 8.6d: Diffusers removed to show the Fog Spray Nozzle in HSCR and HTCR models.

8.7. Lid Interlock Switch (Nov 2021)

- When the lid is opened the interlock switch (Figure 8.7a) will open and the pump, blower, and heaters will stop.

Figure 8.7a: Lid interlock switch location.

If the lid is opened in a fog step, the chamber will be full of salt fog and this will escape into the room. **Do not** open the lid during a Fog step. If the tester is in a Fog step, first follow the steps below to allow the chamber to become clear of salt fog before opening the lid.



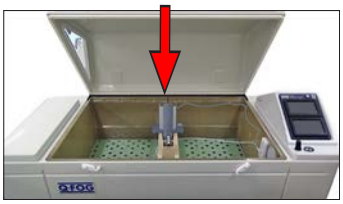
1. Touch the **STOP** icon on the status screen to stop the fog step.

2. Wait at least 15 minutes.

3. Open the test chamber lid.

8.8. Chamber Air Temperature Sensor & Over Temperature Switch (Oct 2021)

- The chamber air temperature sensor is mounted in a flexible probe on the vent tube at the rear of the chamber (Figure 8.8a).



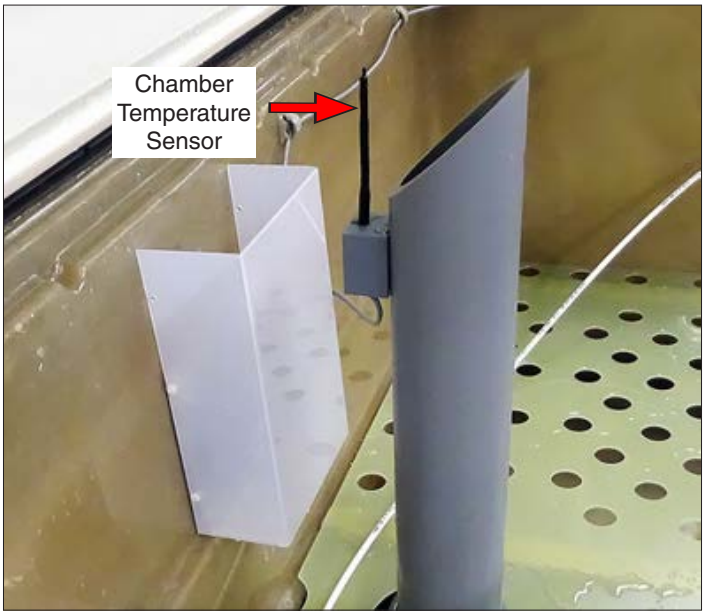
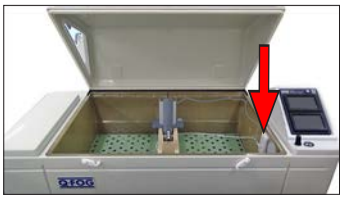


Figure 8.8a: Chamber temperature sensor location.

- An over temperature switch is mounted on the right side of the chamber to protect the chamber from excessive heat (Figure 8.8b).



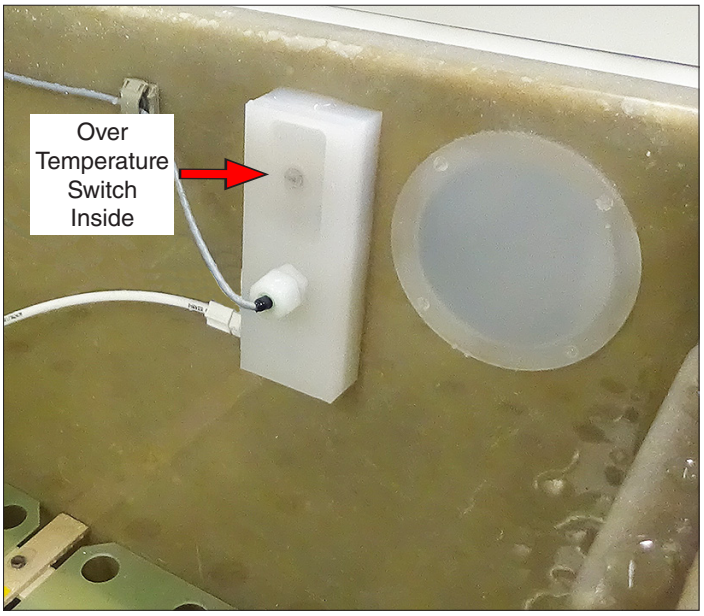


Figure 8.8b: Over temperature switch located inside cover.

8.9. Laboratory Temperature and Humidity Sensor (Oct 2021)

- A temperature and relative humidity (RH) sensor is mounted under the front right corner of the Q-FOG test chamber (Figure 8.9a and Figure 8.9b).
- This sensor measures both the ambient temperature and humidity in the laboratory and can be used to help troubleshoot miscellaneous faults that might occur.

Figure 8.9a: Laboratory temperature and RH sensor location.

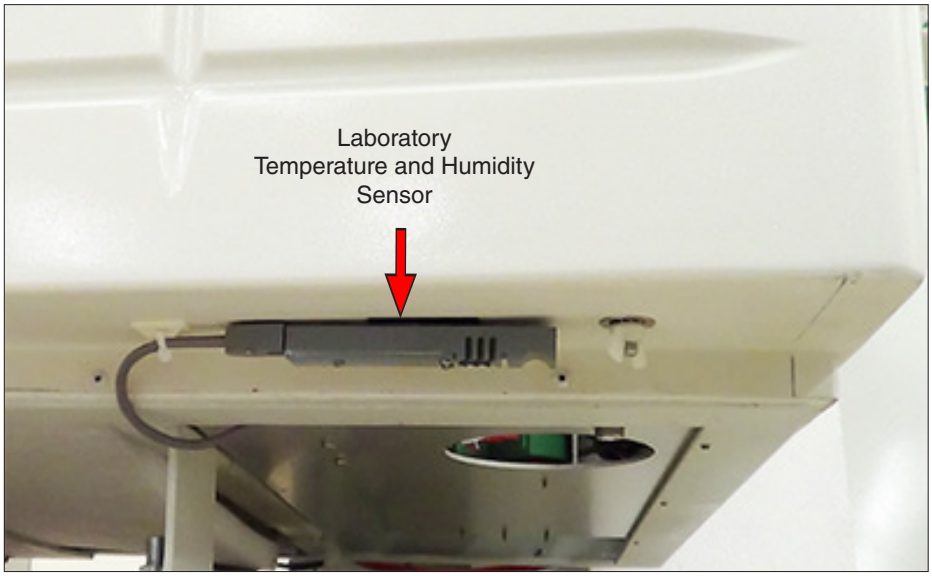


Figure 8.9b: Laboratory temperature and RH sensor detail.

8.10. Stationary Shower Module - “S” Models Only (Oct 2021)

- These “S” model Q-FOG CRH testers include a Stationary Shower Module (SSM):
  - Q-FOG/CRH600-HSC
  - Q-FOG/CRH600-HSCR
  - Q-FOG/CRH1100-HSC
  - Q-FOG/CRH1100-HSCR
- The SSM assembly includes a frame, spray nozzles, and a solution supply tube (Figure 8.10a and Figure 8.10b).
- This shower module is called “Stationary” because it is stationary during testing, in contrast to the moving TSSB (Section 8.11).
- To run a Shower step the SSM must be installed directly over the fog nozzle (Figure 8.10c).
  - The SSM must be removed from the test chamber to run a Fog step.
- The nozzles are self-cleaning and eliminate most clogging problems, but may still require periodic cleaning (see Section 14.5). A shower nozzle cleaning kit, F-8064-K, is provided with the tester.
- See Section 7.3.1 for more information on the SSM.

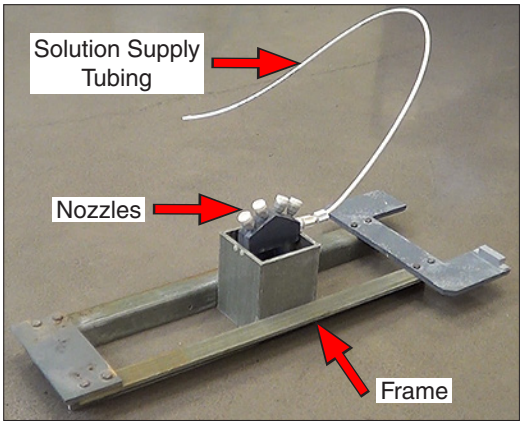


Figure 8.10a: SSM assembly removed from tester.

Figure 8.10b: SSM nozzle detail.

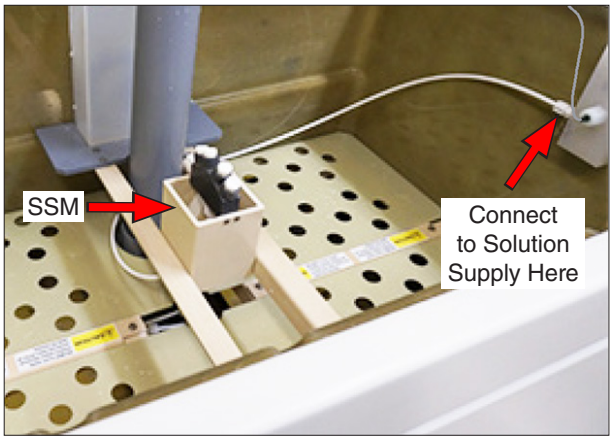


Figure 8.10c: SSM installed in tester.

8.11. Top-Mounted Swaying Shower Bar -"T" Models Only (Dec 2021)

- These "T" model Q-FOG CRH testers are equipped with a Top-Mounted Swaying Shower Bar (TSSB).
  - o Q-FOG/CRH1100-HTC
  - o Q-FOG/CRH1100-HTCR
- The TSSB assembly includes a shower bar with spray nozzles, actuator assembly, pneumatic and solution supply tubes, and sensor wire harnesses (Figure 8.11a through Figure 8.11d).
- The pneumatically-driven actuator assembly mounted on the outside of the chamber lid causes the shower bar with nozzles to oscillate (sway) between the chamber front and rear.
- Position sensors inside the actuator assembly sense the forward and rear positions of the shower bar to ensure uniform shower delivery to the specimens.
- The Top-Mounted Swaying Shower Bar does not need to be removed from the test chamber to run a Fog step; however, a Fog step and a Shower step cannot both be run in the same test cycle.
- Q-FOG testers with the TSSB use panel racks different from models with the SSM (see Section 10.2).
- The nozzles are self-cleaning and eliminate most clogging problems,but may still require periodic cleaning (see Section 14.5). A shower nozzle cleaning kit, F-8064-K, is provided with the tester.
- See Section 7.3.2 for more information on the TSSB.

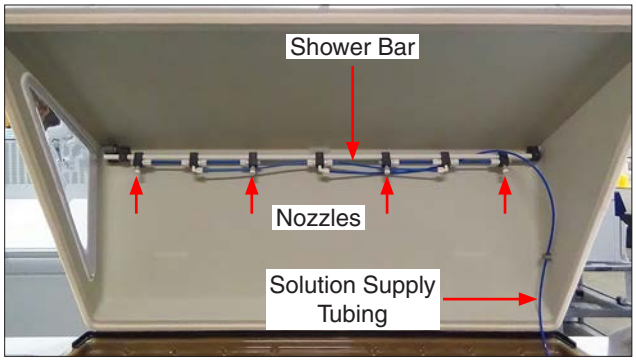


Figure 8.11a: TSSB Assembly.

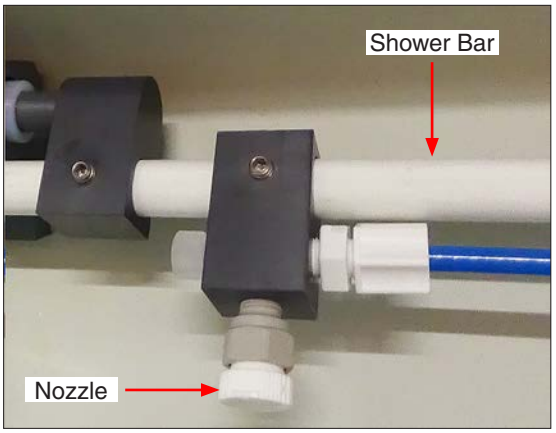


Figure 8.11b: TSSB nozzle detail. **IMPORTANT:** The shower nozzle angle should not be adjusted.

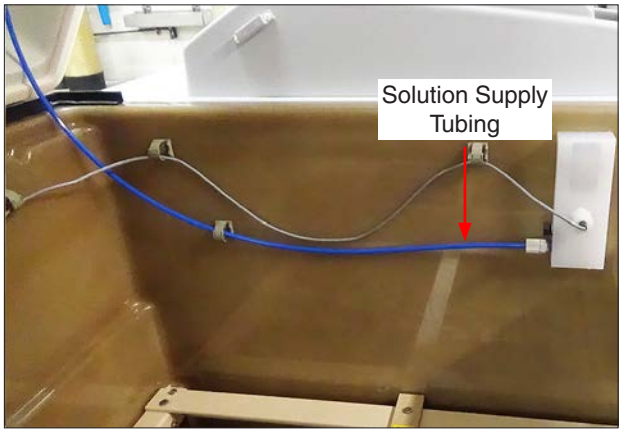


Figure 8.11c: The TSSB supply tube connection to the solution supply fitting.

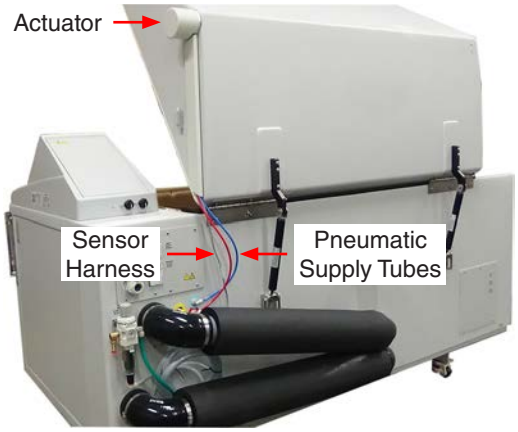


Figure 8.11d: The TSSB actuator, pneumatic supply tubes, and sensor harness.

8.12. Shower Pump (Dec 2021)

- A pump is used to supply solution to the shower module (Figure 8.12a and Figure 8.12b).
- The shower pump is located under the air control module (See Section 8.13).
- The air control module must be removed to access the shower pump (See Section 14.3).

Figure 8.12a: Shower pump located under air control module.

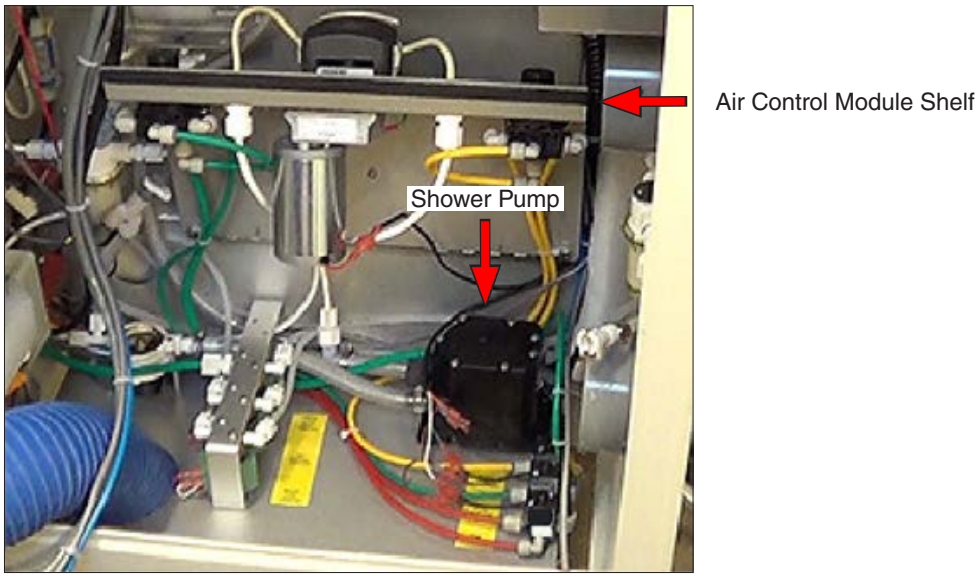


Figure 8.12b: Remove air control module, raise shelf to access pump.
NOTE: HSC/HSCR model shown, HTC/HTCR models similar.

8.13. Air Control Module (ACM) (Nov 2021)

- The air control module (also known as a Blower Module) is the main control mechanism for the Q-FOG RH function (Figure 8.13a through Figure 8.13c).
- The ACM controls the circulation of moist and dry air through the test chamber.
- The ACM also contains wet and dry bulb thermometers to monitor test chamber relative humidity.
- The ACM provides recirculation of chamber air and injection of air from the Air Preconditioner (Section 8.15) as required to adjust chamber temperature or relative humidity.
- An ambient damper is used to control the flow of air from the Air Preconditioner into the air control module.
  - If the ambient damper is not set properly, the preconditioner can freeze up or the test chamber may not be able to reach high temperatures in an RH step.
  - The Calibrate menu on the Menu Screen is used to set the correct position of the air control module damper (see Section 12.6).
  - Damper adjustments can only be done by a factory-trained Q-Lab technician. Contact Q-Lab Repair and Tester Support for assistance.

Air Control Module Location

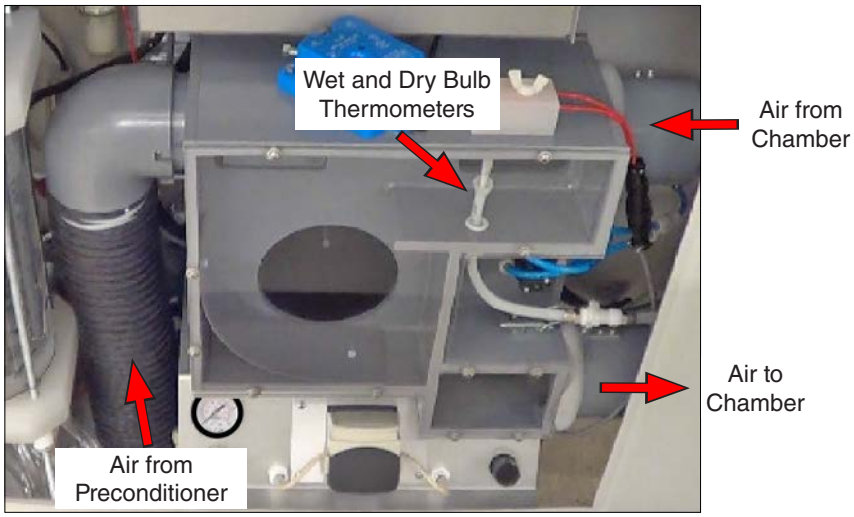


Figure 8.13a: Air control module detail.

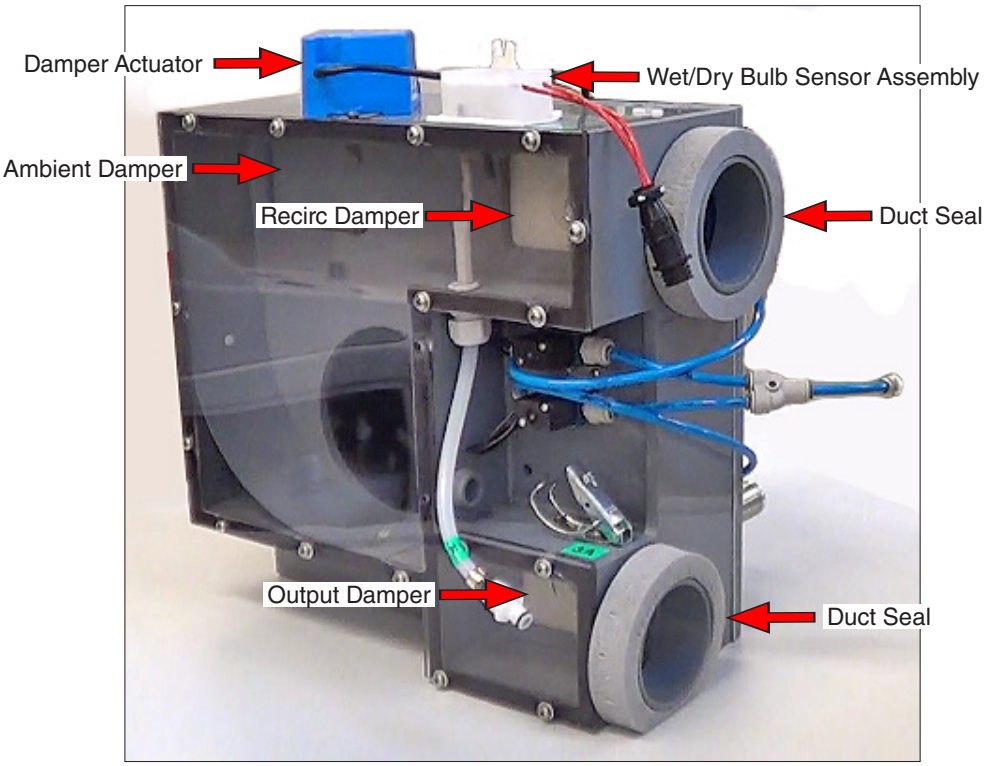


Figure 8.13b: Air control module front.

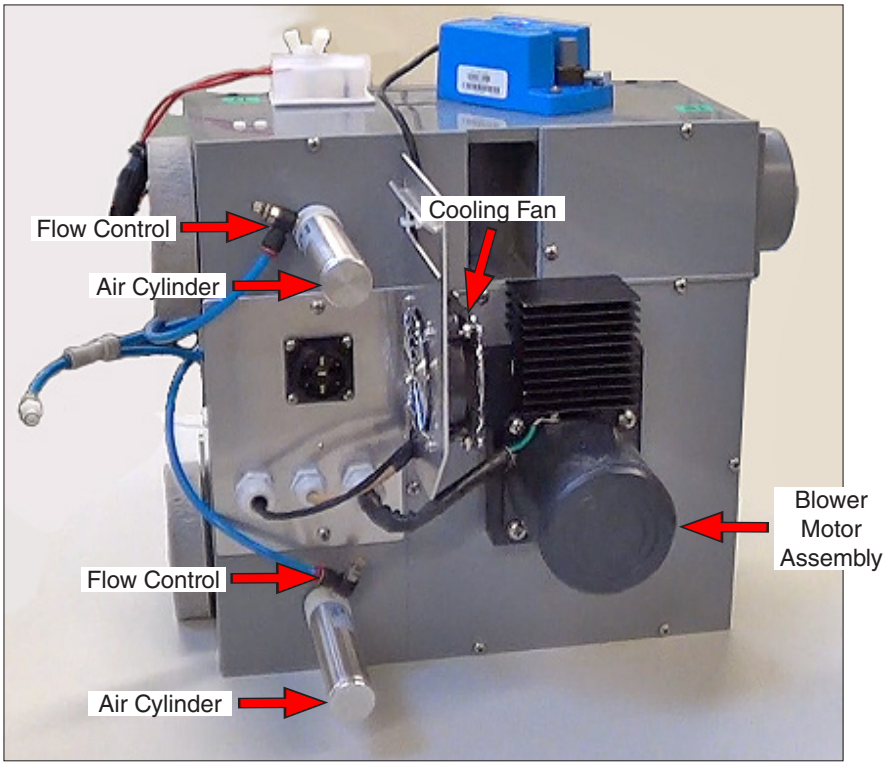


Figure 8.13c: Air control module rear.

8.14. Relative Humidity (RH) Generator (Nov 2021)

- The RH generator is located at the center rear of the chamber under the diffuser plates at the base of the vent tube (Figure 8.14a, Figure 8.14b).
- Deionized water enters on the right side of the RH generator and compressed air enters on the left side (Figure 8.14c).
- As they mix, the compressed air atomizes the water into a fine mist, which evaporates to increase the RH in the chamber.
- The nozzles can be disassembled for cleaning (see Section 14.5). A nozzle cleaning kit, F-8064-K, is provided with the tester.

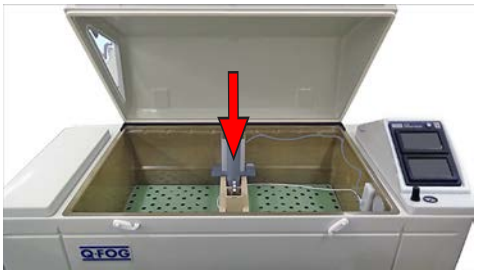
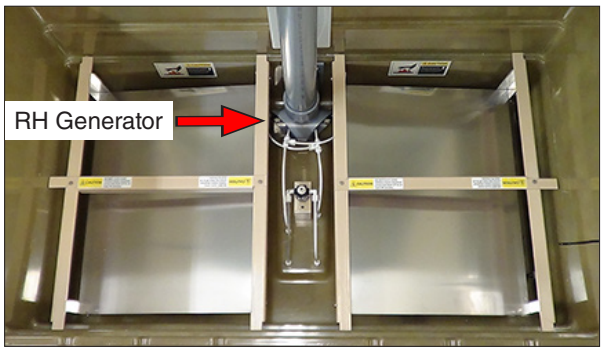


Figure 8.14a: RH generator located under diffuser plates.

HSC and HTC Models



HSCR and HTCR Models

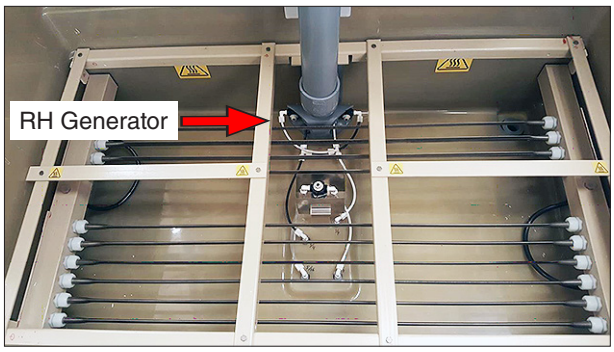


Figure 8.14b: RH generator under diffuser plates (removed).

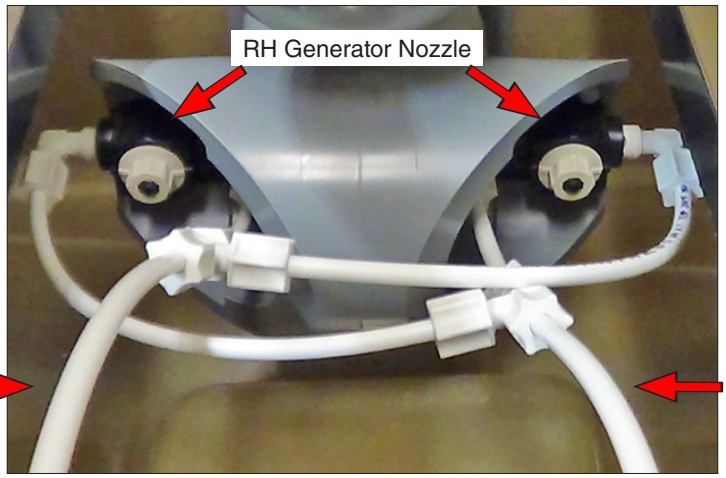


Figure 8.14c: RH generator assembly.

8.15. Air Preconditioner (Nov 2021)

Description

- The Air Preconditioner (Figure 8.15a) provides dry, temperature-regulated air to the Q-FOG test chamber during the RH function if necessary.
- The Air Preconditioner output is sent to the test chamber via a connecting hose (see Section 6.2).
- The Air Preconditioner primary components are a chiller that cools and dries ambient air, an air heater, and control unit (Figure 8.15b).
- The refrigerant used in the Air Preconditioner chiller is listed on the chiller specification label (Figure 8.15c).
- Depending on programmed test and laboratory ambient conditions, the air may be heated prior to being blown into the test chamber.
- Ambient air is pulled into the Air Preconditioner through the air filter at the bottom of the unit (Figure 8.15b) and exhausted through vents at the top of the right and rear panels. The air intake and exhaust areas must not be blocked (see Section 7.2).
- Internal temperature sensors and switches maintain accurate Air Preconditioner operating conditions (Figure 8.15d).

Dampers

- Dampers located inside the control unit are used to control the flow of air in the Air Preconditioner (Figure 8.15e).
- If the Air Preconditioner dampers are not set properly, the preconditioner can either freeze up or not cool the air enough.
- The Calibrate menu on the Menu Screen is used to set the correct position of the air preconditioner hot and cold dampers (see Section 12.6). Damper adjustments can only be done by a factory-trained Q-Lab technician. Contact Q-Lab Repair and Tester Support for assistance.

Figure 8.15a: Air Preconditioner

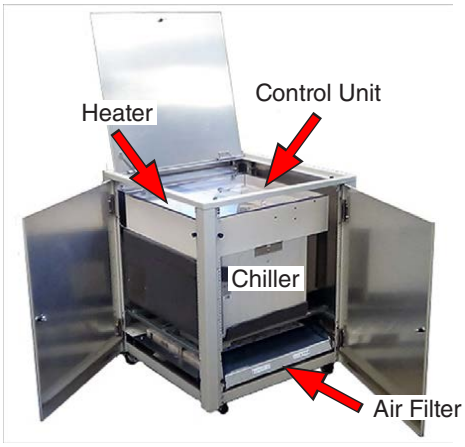


Figure 8.15b: Air Preconditioner major components.

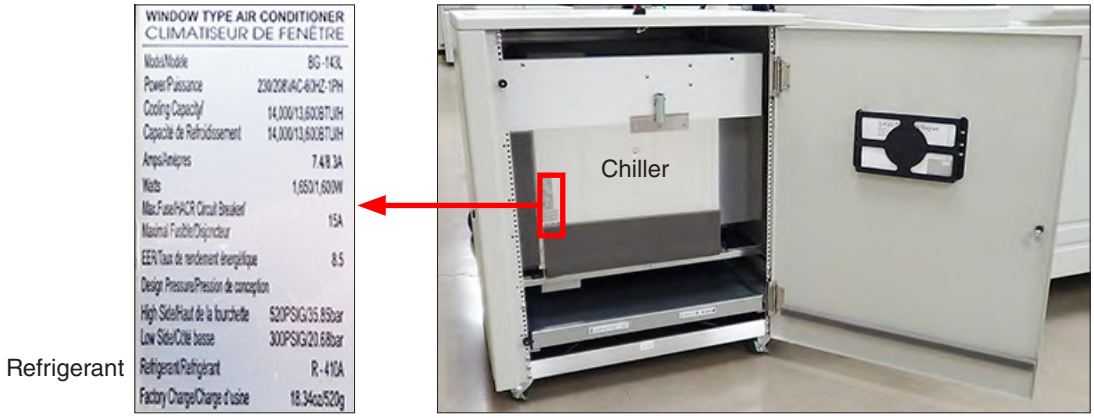


Figure 8.15c: Air Preconditioner chiller specification label location.

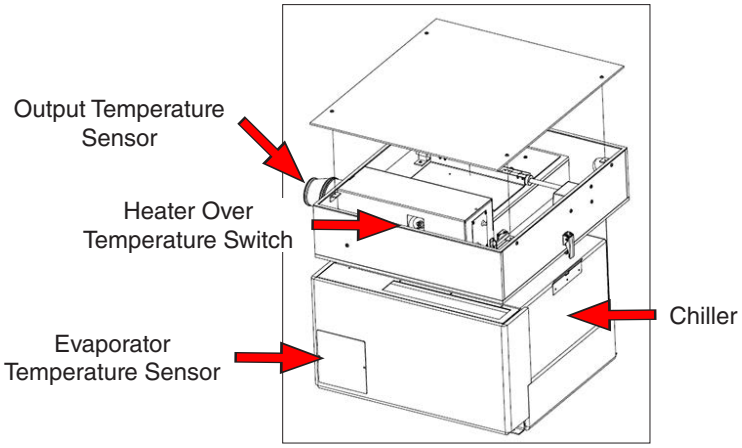


Figure 8.15d: Schematic showing temperature control devices.

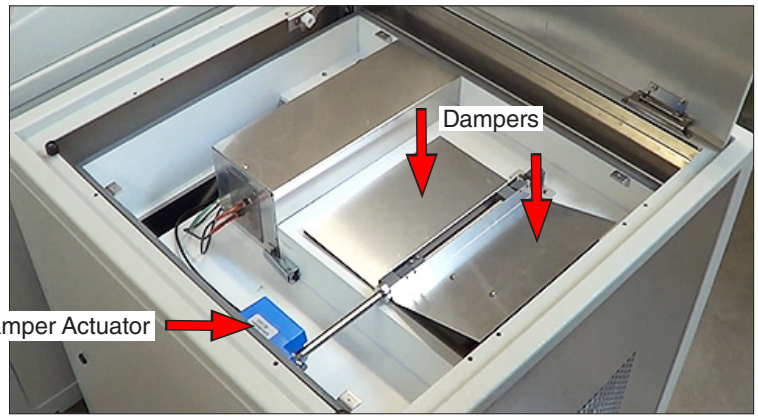


Figure 8.15e: Air Preconditioner dampers in control unit.

8.16. Solenoid Valves (Dec 2021)

- Solenoid valves control the flow of air and water to the fog, shower, and RH components, as well as the optional Wall Wash System (Section 8.19).
- Remove the Q-FOG right side access panel (Figure 8.16a) and the air control module (ACM) (see Section 14.3) to access these solenoid valves.
- The solenoid valves are located under the shelf below the ACM.
- Figure 8.16b through Figure 8.16d show solenoid valves found in both the Stationary Shower Module (SSM), “S” model testers and the Top-Mounted Swaying Shower Bar (TSSB), “T” model testers.
- Figure 8.16e shows two (2) air solenoid valves found only in TSSB, “T” model testers.
- Two solenoid valves mounted on the ACM control air to open and close the recirculation and output dampers (Figure 8.16f).
- See Section 16 for solenoid valve replacement part numbers.

Figure 8.16a: Solenoid valve location under the ACM shelf.

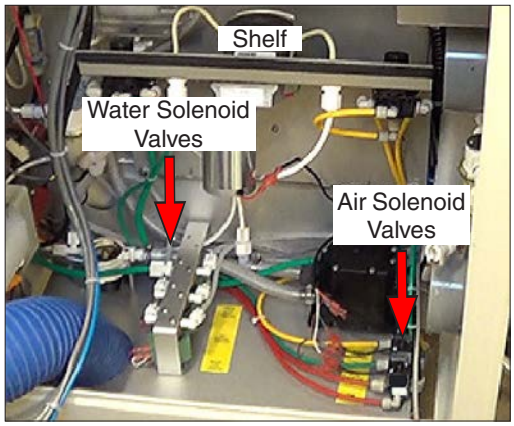


Figure 8.16b: Solenoid valves - ACM removed, shelf raised. **NOTE:** HSC/HSCR model shown, HTC/HTCR models similar.

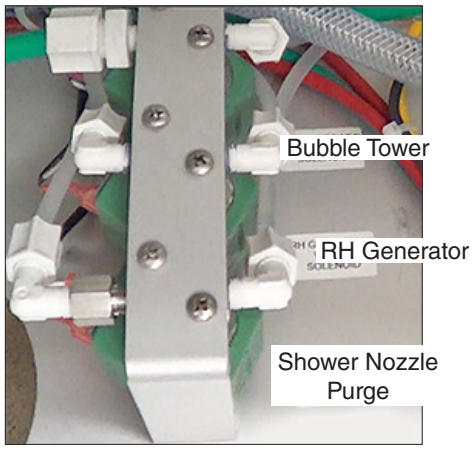


Figure 8.16c: Water solenoid valves detail. **NOTE:** HSC/HSCR and models with optional Wall Wash only.

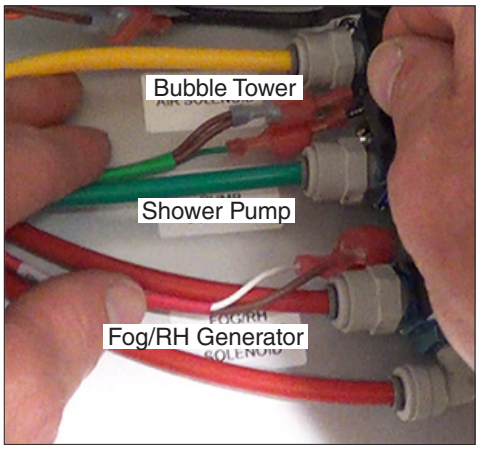


Figure 8.16d: Air solenoid valve detail. **NOTE:** HSC/HSCR and models with optional Wall Wash only.

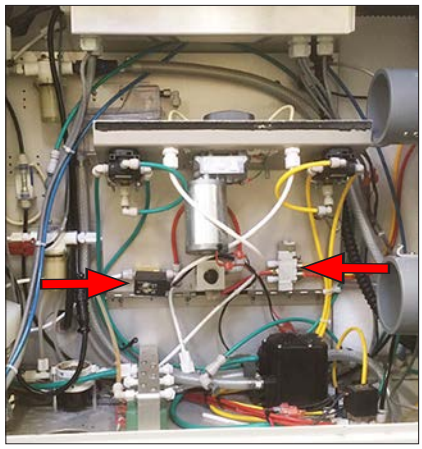


Figure 8.16e: Solenoid valves found only in Top-Mounted Swaying Shower Bar (TSSB), “T” model testers.

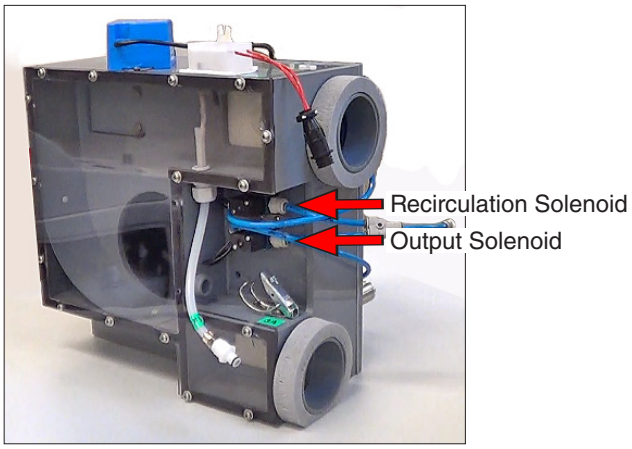


Figure 8.16f: Air control module recirculation and output solenoid valves.

8.17. Water and Salt Solution Filters (Nov 2021)

- A filter is used to remove contaminates from the main water supply line (Figure 8.17a). See Section 6.6 for water purity requirements.
- Two (2) filters are used to filter the salt solution from the reservoir to remove contaminates before the shower nozzles and the fog spray nozzle (Figure 8.17a).
- Remove the right-side access panel to access the filters (Figure 8.17b).
  - The hose from the Air Preconditioner must be disconnected from the air control module to access the two solution filters.
- See Section 14.5 for important filter cleaning information.

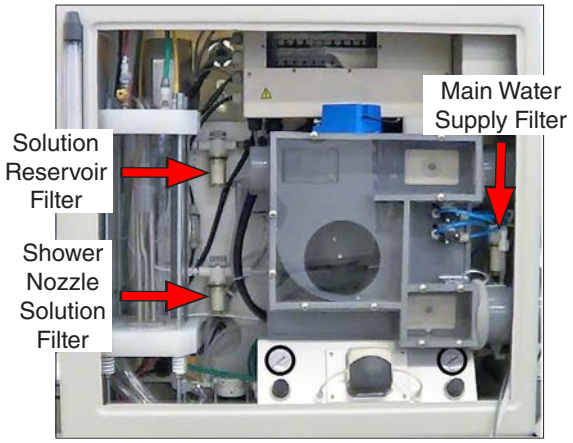


Figure 8.17a: Location of filters. Air Preconditioner hose removed to see solution filters.

Figure 8.17b: Remove right-side access panel. Disconnect the Air Preconditioner hose to access solution filters.

8.18. Shower Flow Sensor, Fog Air Flow Switch, Water Feed Valve (Dec 2021)

- Remove the right-side access panel to access these components (Figure 8.17b).
- Remove the air control module (see Section 14.3) and raise the shelf to locate these components (Figure 8.18a).
- The fog air flow switch monitors air flow to the bubble tower and then to the spray nozzle (Figure 8.18b).
- The flow rate of the shower pump is monitored by the shower flow sensor (Figure 8.18c).
- The water feed valve (Figure 8.18d) controls water to the wet bulb temperature sensor (see Section 8.13).
- See Section 12.2 for important water feed valve adjustment information.

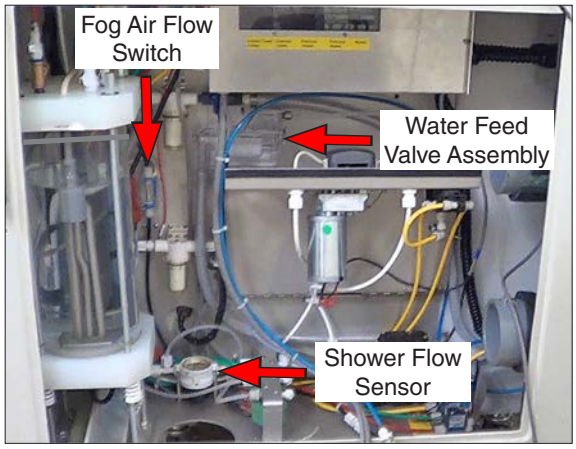


Figure 8.18a: Component locations. **NOTE:** HSC/HSCR model shown, HTC, HTCR models similar.

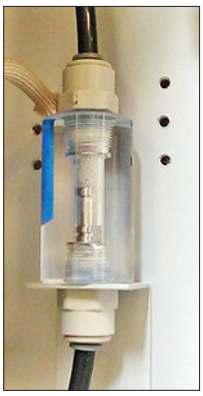


Figure 8.18b: Fog air flow switch.

Figure 8.18c: Shower flow sensor.

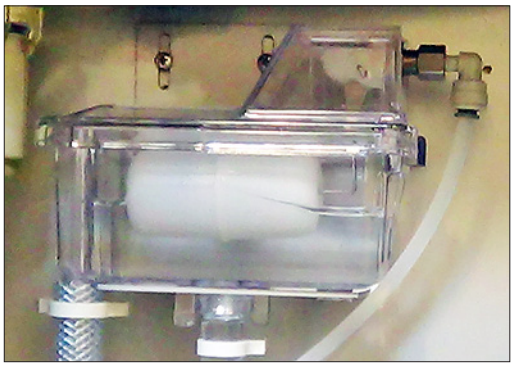


Figure 8.18d: Water feed valve assembly.

8.19. Wall Wash System - Optional (Nov 2021)

- This option includes all necessary components to automatically rinse off the Q-FOG test chamber walls with clean water (Figure 8.19a).
- The wall wash system meets the wall rinse portion of the Renault D17-2028 (ECC1) test method (See Section 11.3.8).
- The wall wash system consists of a wall wash manifold, and the plumbing components.
- The manifold runs around the top of all four chamber walls to rinse off the walls.
- The system includes a shut off valve which should be open when running the Renault test method and closed for all other test methods (Figure 8.19b and Figure 8.19c).
- When the wall wash system is installed, a RINSE function can be programmed. See Section 9.6.4.
- The wall wash system is available for both 600 models (F-70001-K) and 1100 models (F-70002-K).
- The wall wash system should have been factory-installed if ECC1 (see Section 11.3.8) was specified at the time of purchase.

NOTE: The wall wash is required in the language of ECC1, and the intent of the standard is to wash off any salt buildup. But Q-FOG CRH heaters are not in the chamber walls and salt does not build up on the walls even without the wall wash option.

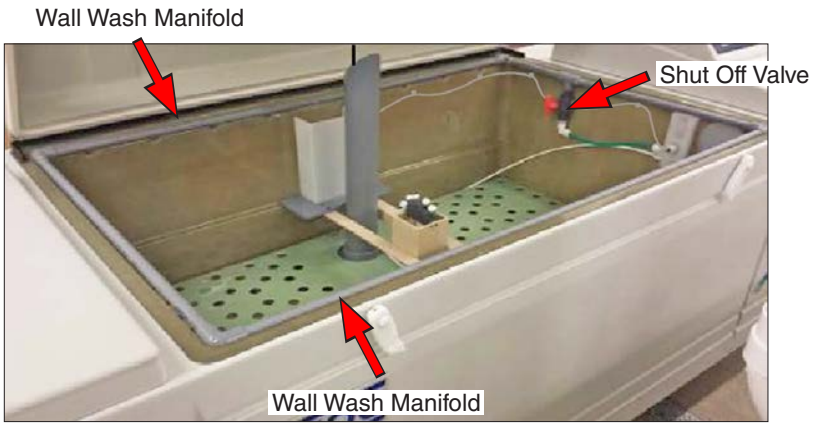


Figure 8.19a: Wall wash system.

Figure 8.19b: Shut off valve open for ECC1 test.

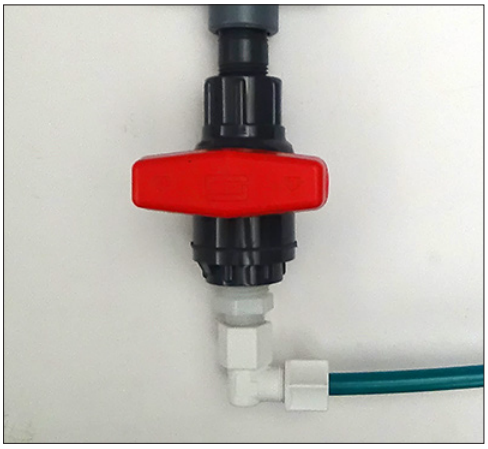


Figure 8.19c: Shut off valve closed for all other tests.

9. Main Controller Operation

9.1. Overview (Nov 2021)

Purpose

- The main controller located in the Q-FOG control top (Figure 9.1a) controls all functions of the Q-FOG.
- Interactive software allows easy programming and operation using dual, full-color touch-screen displays.
- Customer-requested test cycles have been pre-programmed. Custom test cycles can be easily created.
- The main controller continuously displays all test status conditions and continuously monitors for errors. The main controller will automatically stop a test if an error is detected.
- New software revisions can easily be downloaded and installed.
- System configuration and performance data can be exported to assist in troubleshooting.
- The controller can store up to 10 test cycles of 50 steps each.
- Each step consists of:
  - A step Function: Fog, Controlled Relative Humidity (RH), or Shower (see Section 7)
  - Chamber Air Temperature (CAT)
  - RH
  - Step Time: range 1 minute to 99 hours 59 minutes.
  - For RH steps only, Ramp Type and Ramp Time are specified

Display Screens

- Two touch-screen monitors mounted on the Q-FOG control top are used to control tester operation and to display test status (Figure 9.1b).
- The Status Screen (Figure 9.1c) is on the top and the Menu Screen (Figure 9.1d) is on the bottom.
- The Status Screen displays tester current running conditions.
- The Menu Screen is the main interface for operator control of the tester, including settings, programming, and calibration.
- The screens are activated when the tester is powered on.
- After an interval of inactivity, the screens will automatically deactivate. Just tap a screen to reactivate (Figure 9.1e).
- The touch-screens should be cleaned with a soft cloth and alcohol. Do not use water to clean the screens.
- The screens can be operated using a stylus. Many operators prefer using a stylus with the touch-screens.
- A large LED indicator, above the status screen and visible from a distance, changes colors to indicate current status of the test (see Overall Test Status).

Figure 9.1a: Q-FOG control top.

Figure 9.1b: Touch-screens and LED location on control top.

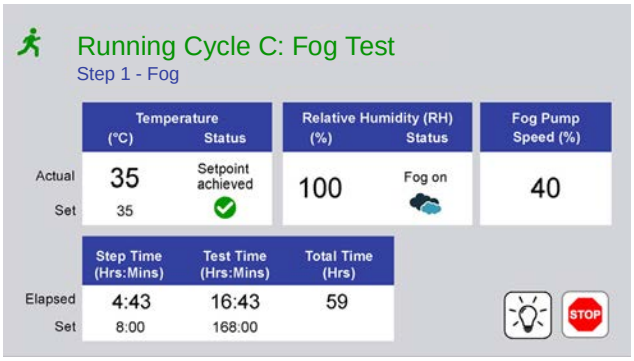


Figure 9.1c: Status Screen displaying typical operating conditions.

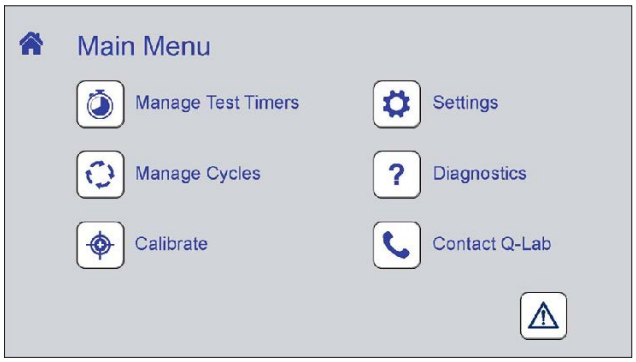


Figure 9.1d: Menu Screen displaying the main menu.

Figure 9.1e: Touch either screen to activate.

9.2. Status Screen (Nov 2021)

Displays

- The Status Screen examples (Figure 9.2a through Section 9.2) display:
  - The status icon and state, which indicate the overall status of the tester (see Overall Test Status).
  - The cycle ID (identification) and the name of the test being run.
  - The current test step number and type (function) of step.
  - Step actual and set point values.
  - Status of step.
  - Other relevant step operational parameters.
  - Elapsed and set step time, elapsed and set test time, and tester total operation time.
  - RUN / STOP button. Touch this icon to RUN (RUN) or STOP (STOP) a test.
  - Touch the Light Bulb icon to turn the test chamber light ON or OFF.

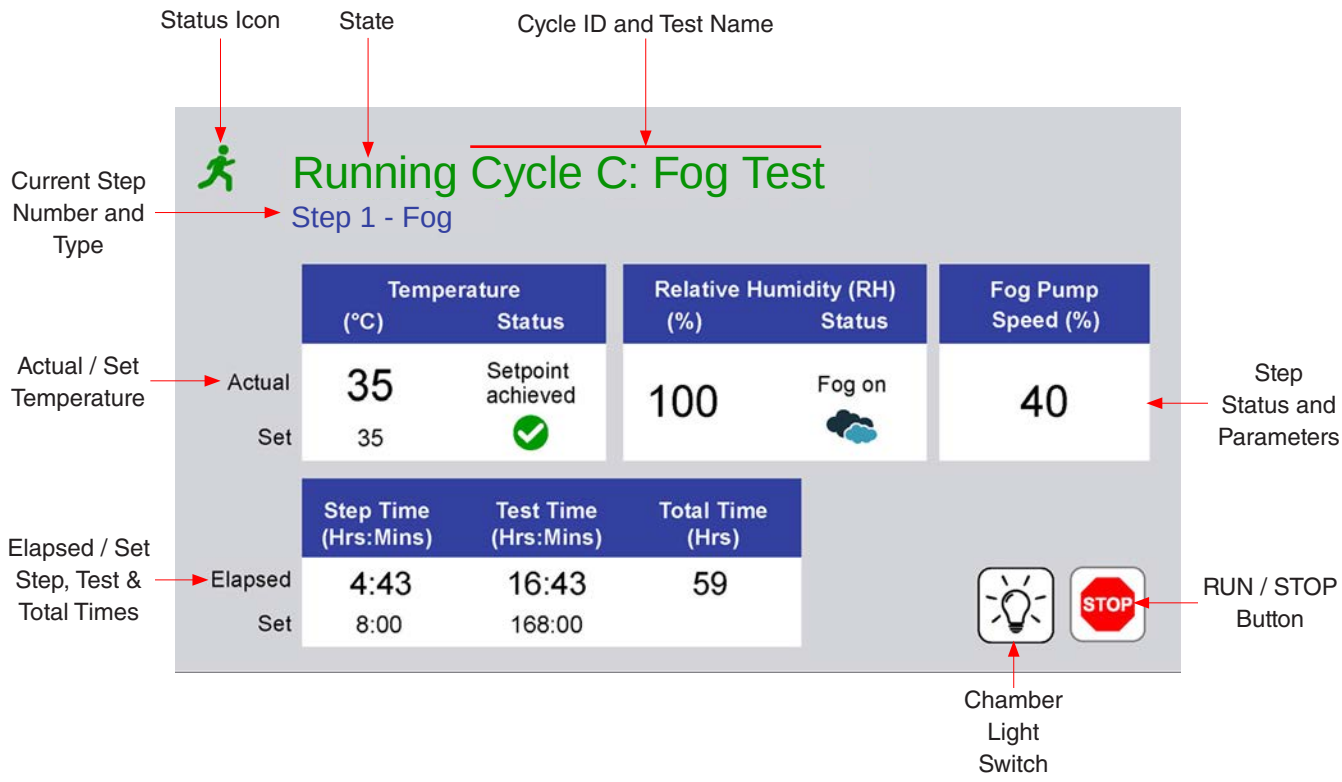


Figure 9.2a: Status Screen display identifying display elements.

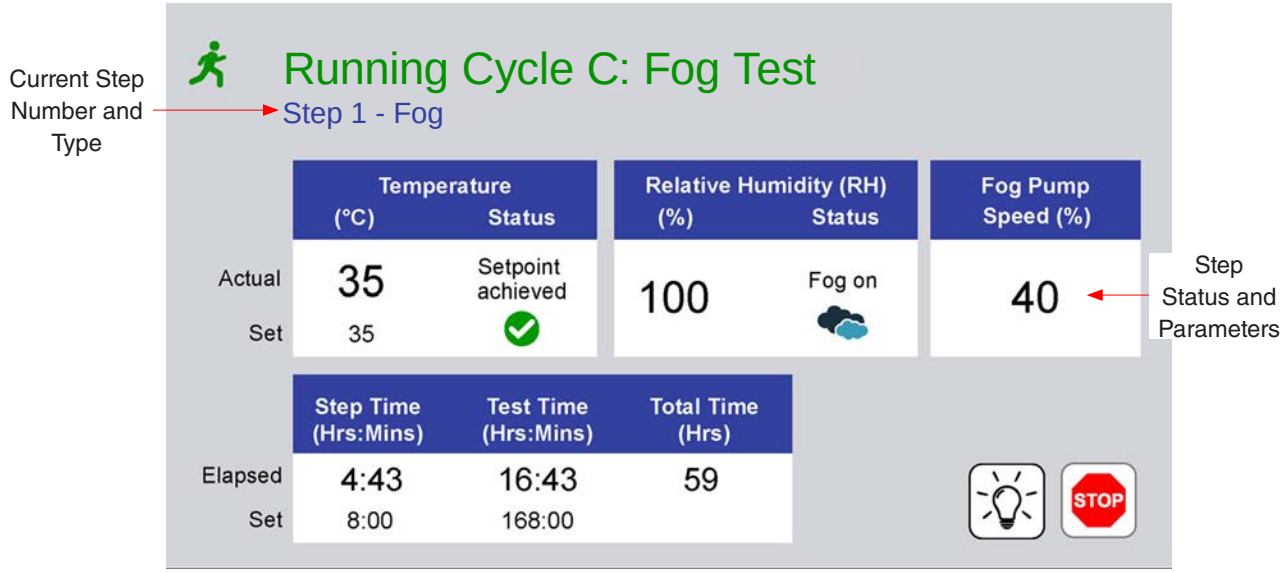


Figure 9.2b: Example Status Screen display during a fog step.

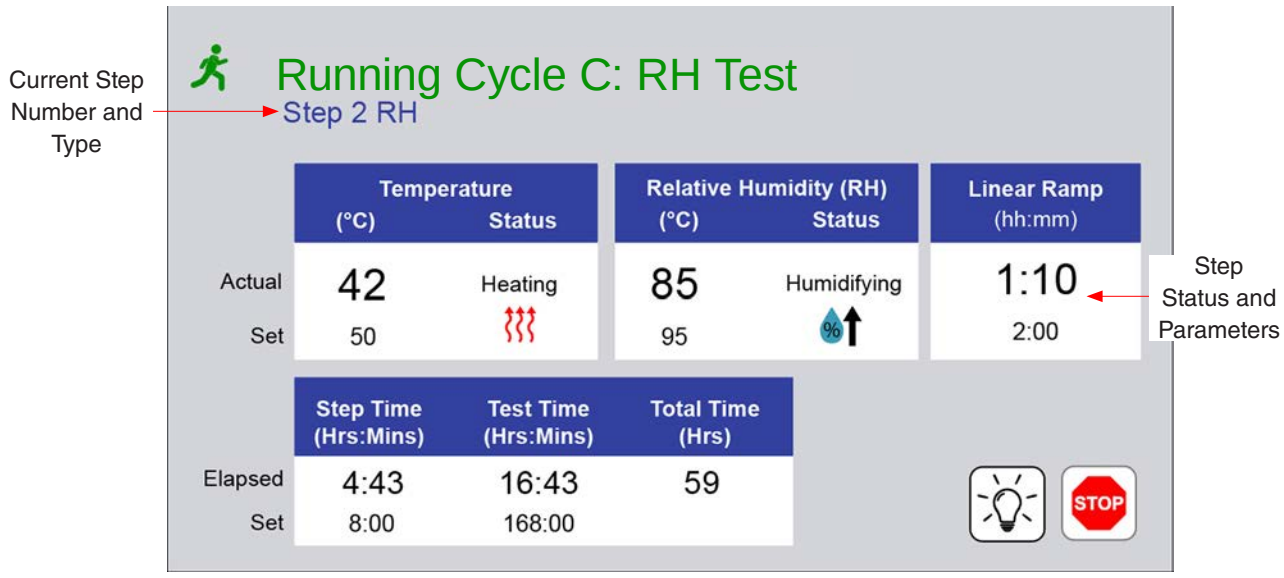


Figure 9.2c: Example Status Screen display during a RH step.

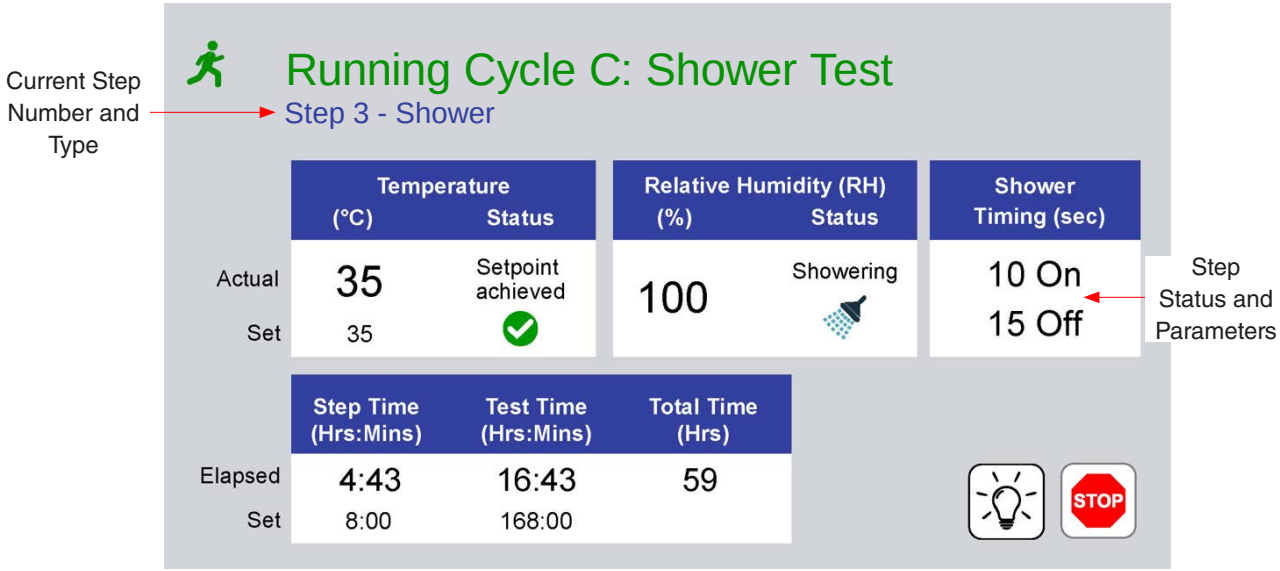


Figure 9.2d: Status Screen display during a Shower step.

Overall Test Status

- A colored icon and state at the top of the screen indicate the overall status of the test (Figure 9.2e, Figure 9.2f).
- Icons in the lower right corner of the screen can be used to stop or run the test.
- The state also shows the test cycle letter and the name of the test cycle.
- The LED status indicator changes color corresponding to the icon and state status.
- Figure 9.2g summarizes all status conditions and indicators.

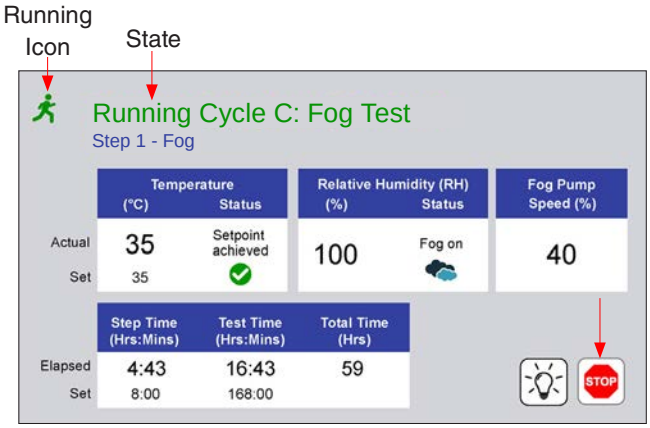


Figure 9.2e: Status icon and state when test running.

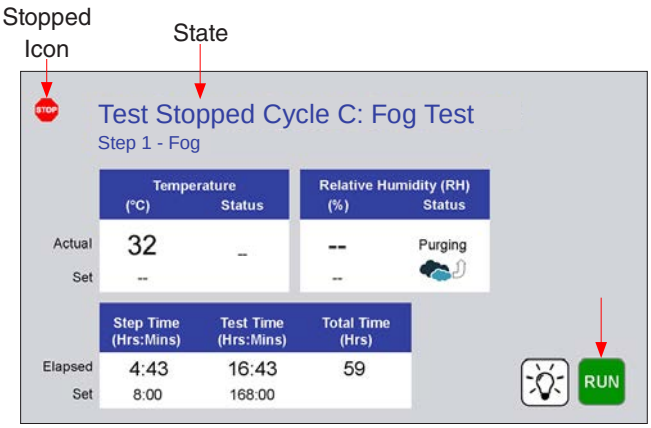


Figure 9.2f: Status icon and state when test stopped.

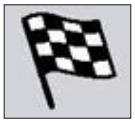
Icon	State (color)	LED (color, condition)	Status
	Running Cycle (Green)	(Green, Static)	Test running normally, no active notifications.
	Test Completed (Blue)	(Blue, Flashing)	Test completed.
	Running Cycle (Green)	(Yellow, Flashing)	Test running, one or more notifications. Icon display alternates.
	Test Stopped (Blue)	(White, Static)	Power on, stopped, no active notifications (standby).
	Test Suspended (Red)	(Red, Flashing)	Error, test stopped. Check Notifications on the menu screen.
Does not affect the icon.	Does not affect the title.	(Magenta, Static)	Software Install or VSC transfer using USB port.

Figure 9.2g: Status indicator summary.

9.3. Main Menu Screen (Sep 2021)

- The Main Menu is the home display for the menu screen (Figure 9.3).
- The Main Menu screen provides access to all other operator controls for the tester.
- The Main Menu displays icons to access these functions:
  - Notifications (Section 9.4)
  - Manage Test Timers (Section 9.5)
  - Manage Cycles (Section 9.6)
  - Calibration (Section 12)
  - Settings (Section 9.7)
  - Diagnostics (Section 9.8)
  - Contact Q-Lab (Section 9.9)

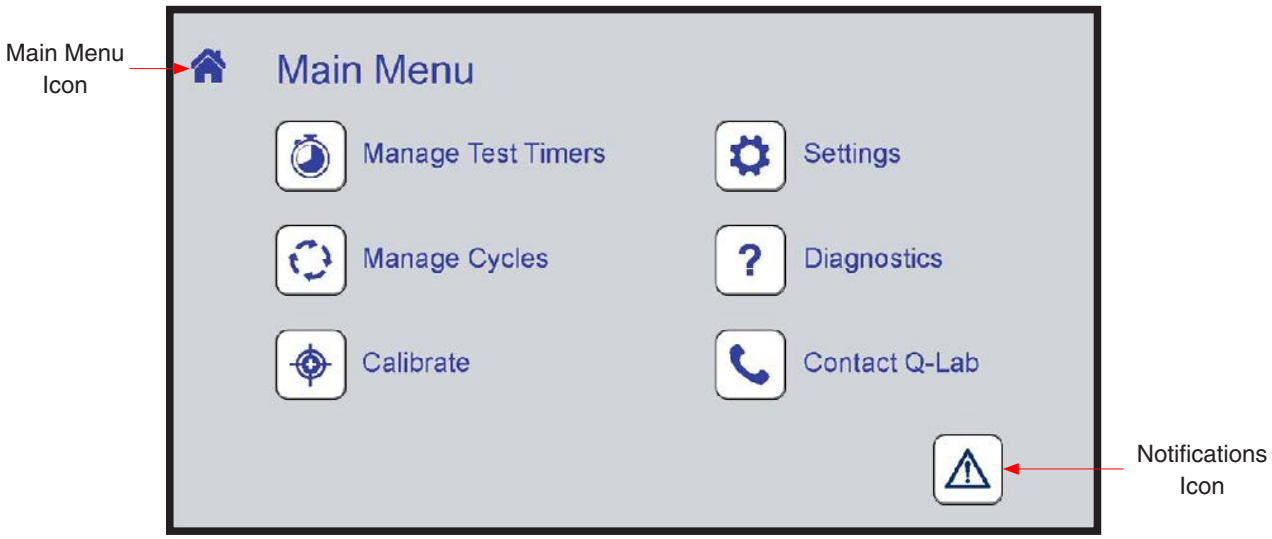


Figure 9.3: Main Menu screen.

9.4. Notifications (Nov 2021)

- Notifications provide useful diagnostic information for technicians and repair personnel.
- Notifications show significant tester events and errors that occurred in the recent past.
- Up to 50 notifications are automatically stored by the Q-FOG main controller.
- On the Main Menu screen, touch the notification icon to display the Notifications Screen (Figure 9.4a).
- The type, information icon, identification code (ex. M49), and name are displayed for each notification (Figure 9.4b).
- "Active" and "Cleared" notifications are listed separately, in chronological order, most recent at the top of the list (Figure 9.4c, Figure 9.4d).
- Color-coded attention icons indicate the type of notification (Figure 9.4e).
  - o A red triangle indicates an error occurred that stopped the test.
  - o A yellow triangle indicates an event that did not stop the test, such as a maintenance reminder.
  - o A blue triangle indicates the successful completion of a test or software installation.
- Touch the notification information icon to display details (Figure 9.4f and Figure 9.4g).
- See Section 15.1 for a complete list of notifications.

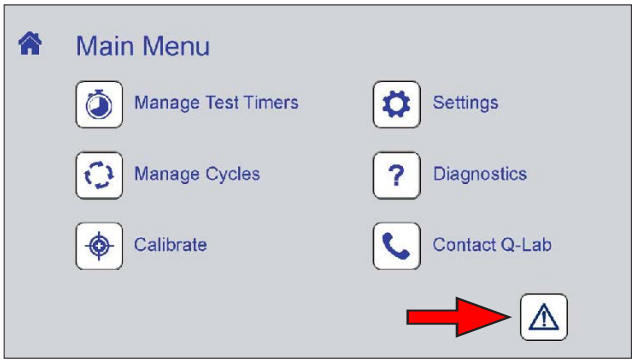


Figure 9.4a: The notifications icon. Icon color changes depending on notification status.

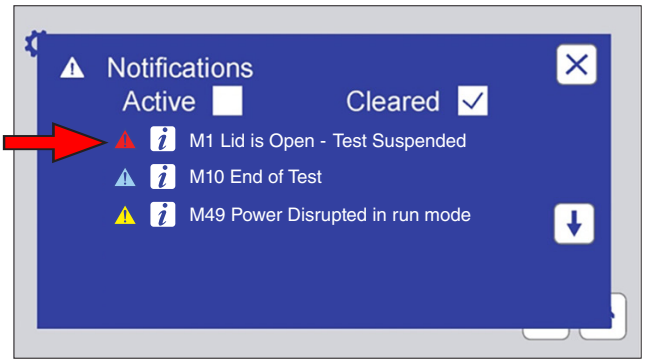


Figure 9.4b: The Notifications Screen lists notification information.

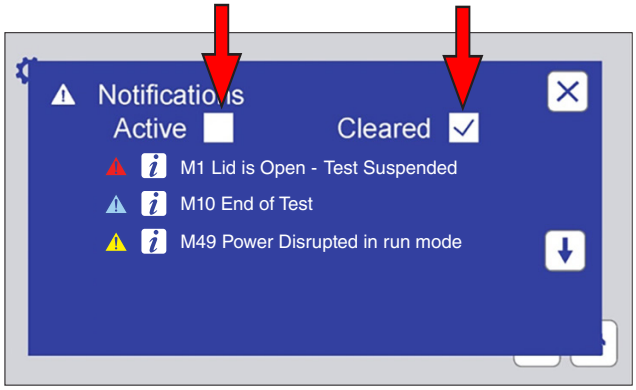


Figure 9.4c: Touch the Active or Cleared check box to view active or cleared notifications.

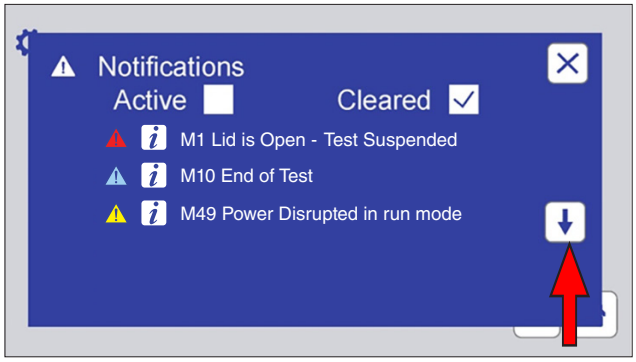


Figure 9.4d: Touch the scroll button(s) to move down or up the notification list.

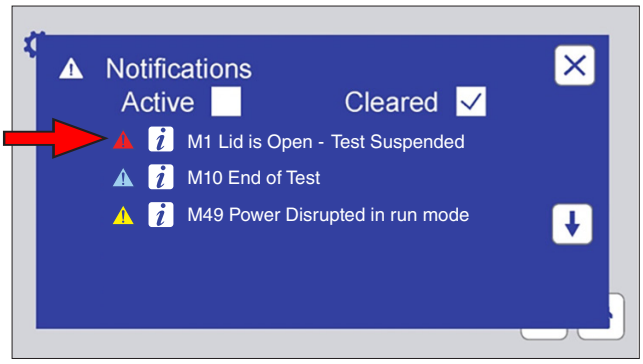


Figure 9.4e: Color coded icons show notification type.

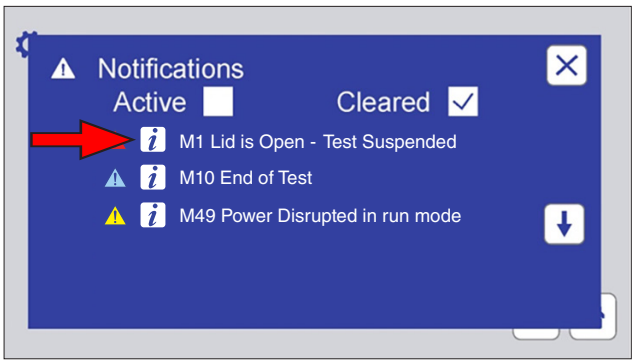


Figure 9.4f: Touch the information icon to display notification details.

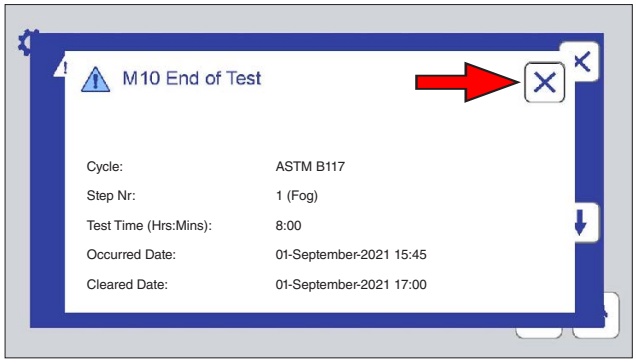


Figure 9.4g: Notification details. Touch the Close icon to return to the Notifications Screen.

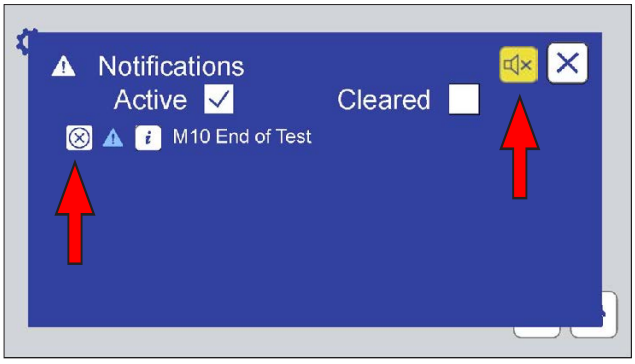


Figure 9.4h: If the alarm is active, touch the yellow mute icon to silence. When the notification has been resolved, touch the icon to the left of the notification to clear it.

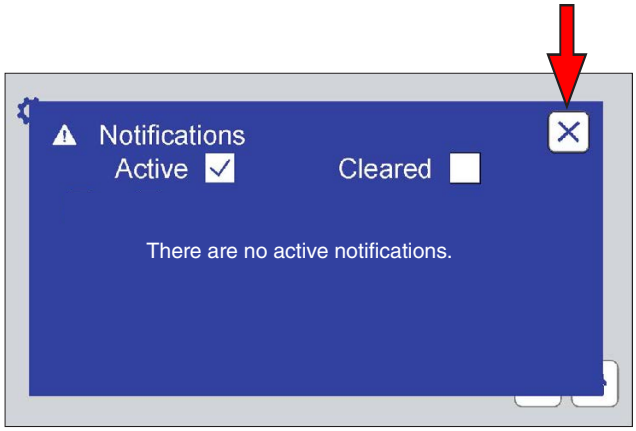


Figure 9.4i: Touch the Notification Screen close icon to re-display the main menu.

Code	Message	Condition & Recommended Action
M1	CHAMBER DOOR IS OPEN	If the chamber door is closed and the M1 error message appears, the chamber door interlock is defective or needs adjustment.
M2	LAMP DOOR IS OPEN	If the lamp door is closed and the M2 error message appears, the lamp door interlock is defective or needs adjustment.
M10	END OF TEST	Appears at the end of a test if you have chosen the MESSAGE ONLY action in your program. There will be no alarm, and the machine will continue to run. The user must shut off the machine manually.
M11	END OF TEST	Appears at the end of a test if you have chosen the ALARM action in your program. The alarm will sound, but the machine will continue to run. The user must shut off the machine manually.
M12	END OF TEST SHUTDOWN	Appears at the end of your test if you have chosen the STOP action in your program. There will be no alarm. The machine will shut off automatically.
M13	END OF TEST SHUTDOWN	Appears at the end of a test if you have chosen the STOP + ALARM action in your program. The alarm will sound. The machine will shut off automatically.
M14	TIME TO REPLACE LAMP	1500 Light Hours have elapsed since this message appeared previously.
M15	TIME FOR ROUTINE SERVICE - SEE MANUAL	2000 Operation Hours have elapsed since this message appeared previously. Refer to Section 13 of this manual for preventative maintenance information.

Figure 9.4j: A complete list of notifications and their meaning is given in Section 15.1.

9.5. Manage Test Timers (Oct 2021)

- On the Main Menu screen touch the Manage Test Timers icon to display the Manage Test Timers screen (Figure 9.5a).
- The Manage Test Timers screen provides three functions:
  1. Specify what action the tester should perform at the end of a test (Figure 9.5b and Figure 9.5c).
     - Stop
     - Message only
     - Alarm only
     - Stop and alarm
     - None
  2. Set the elapsed time for the current test (Figure 9.5d through Figure 9.5f).
  3. Set the duration time for the current test (Figure 9.5d through Figure 9.5f).

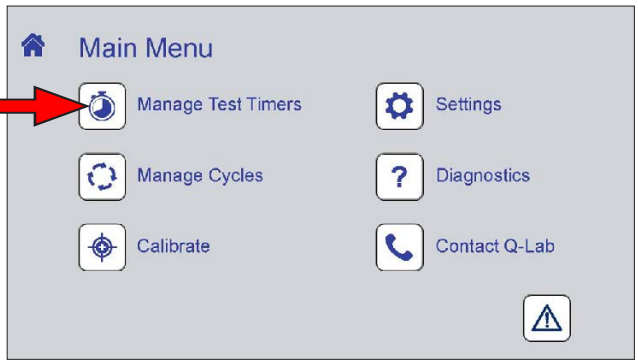


Figure 9.5a: Manage Test Timers icon.

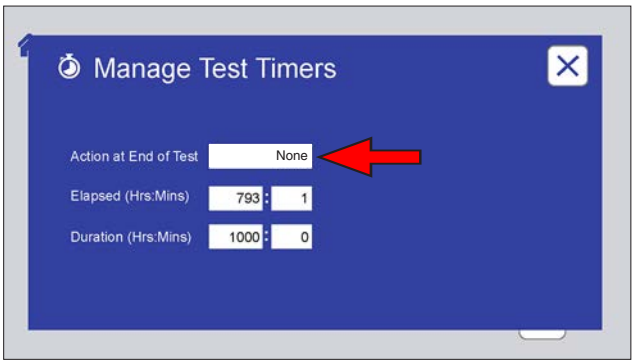


Figure 9.5b: Manage Test Timers screen. Touch the Action at End of Test text box to specify the action.

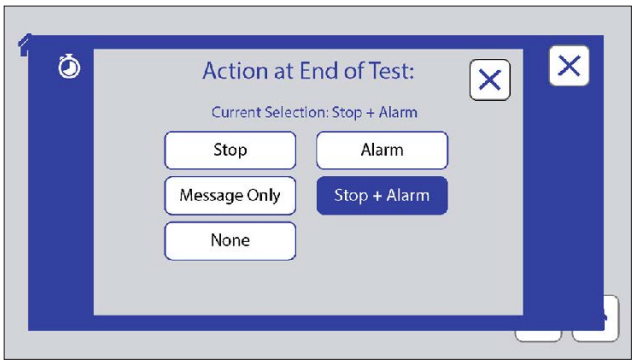


Figure 9.5c: Action at End of Test screen. Touch an action button to select that action.

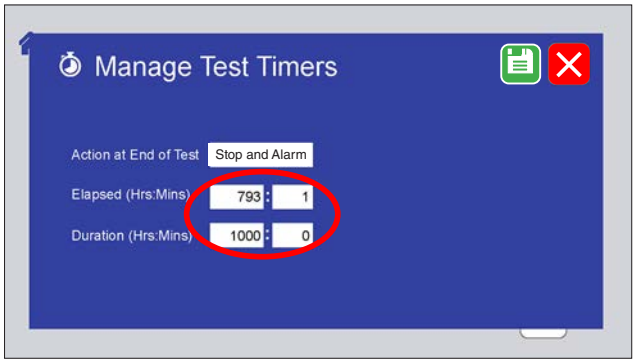


Figure 9.5d: Touch the Elapsed or Duration text box(s) to enter the new values.

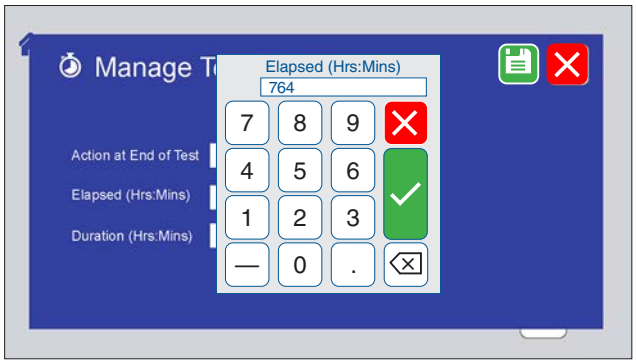


Figure 9.5e: Enter the new values using the numeric keypad. Touch the check mark to accept, or the X to cancel changes.

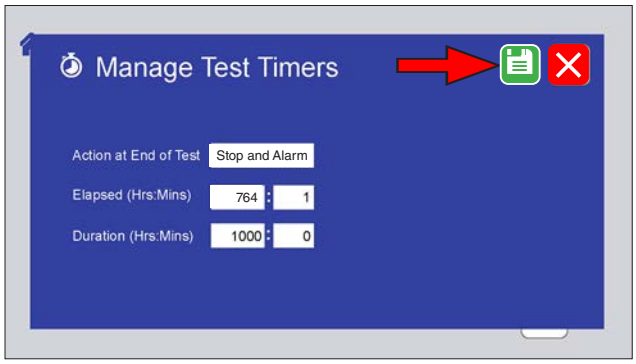


Figure 9.5f: If any changes have been made, touch the save changes icon or the cancel changes icon to re-display the Main Menu screen.

9.6. Manage Cycles (Nov 2021)

- On the Main Menu screen touch the Manage Cycles icon (Figure 9.6.1a) to display the Manage Cycles screen.
- The Manage Cycles screen is displayed showing the active test cycle and the steps in the cycle, with the currently executing step indicated (Figure 9.6.1b).
- Each cycle is stored with an alphanumeric (A through J) identification tab (Figure 9.6.1b).
  - o Touch a tab to select a cycle.
    - The cycle name (ex. ASTM B117) along with step number, function, irradiance and temperature set points, and time are shown for each step in the cycle.
- Each lettered cycle tab provides controls to:
  - o Delete a cycle (Figure 9.6.2a through Figure 9.6.2c).
    - An actively running cycle cannot be deleted.
    - Deleting an inactive cycle will create a blank cycle with only a final step.
  - o Lock a cycle to prevent unauthorized changes (Figure 9.6.3a through Figure 9.6.3e).
  - o Add, edit, or delete steps in a cycle (Figure 9.6.4a through Figure 9.6.6d). **NOTE:** Pre-programmed test cycles cannot be edited (they can be deleted).
  - o Create a new cycle (Figure 9.6.7a through Figure 9.6.7e).
  - o Run a cycle from any of its steps (Figure 9.6.8a through Figure 9.6.8d).
- The Q-FOG main controller can store ten (10) test cycles.
- A test cycle can consist of up to fifty (50) steps.

9.6.1 Select a Cycle

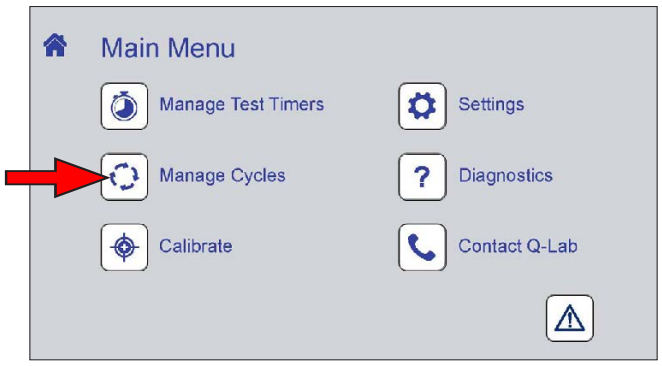


Figure 9.6.1a: Manage Cycles icon.

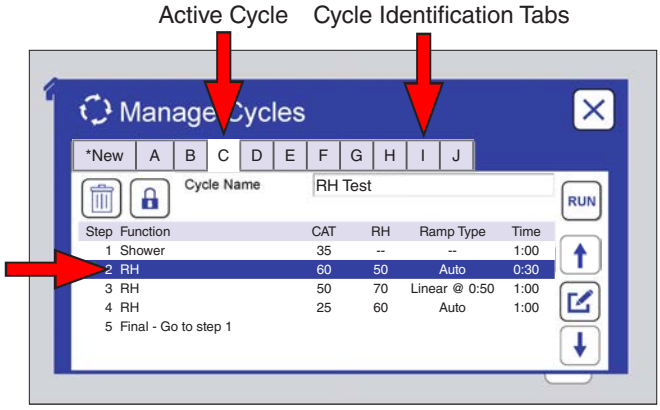


Figure 9.6.1b: Manage Cycles screen. The active cycle is displayed. The currently running step is indicated. From here you can run that cycle, or perform other actions described in the next sections

9.6.2 Delete a Cycle

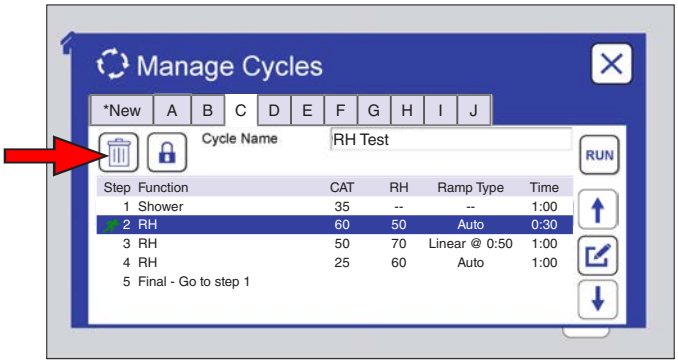


Figure 9.6.2a: Touch the Delete icon to delete the selected cycle.

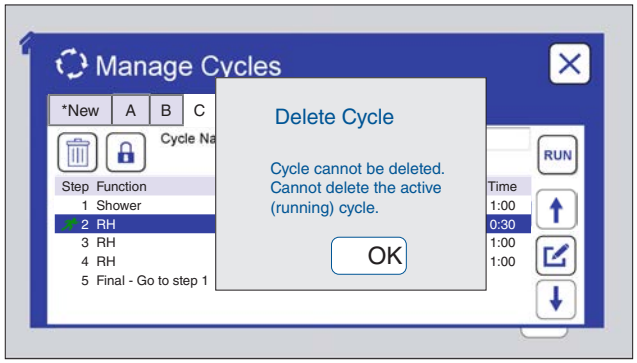


Figure 9.6.2b: The active running cycle cannot be deleted. Touch OK to clear message.

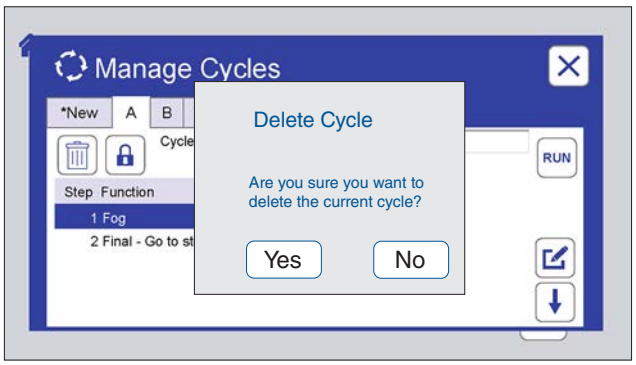


Figure 9.6.2c: To delete an inactive cycle, the operator is prompted for verification. Touch No to cancel delete. Touch Yes to create a blank cycle.

9.6.3 Lock a Cycle

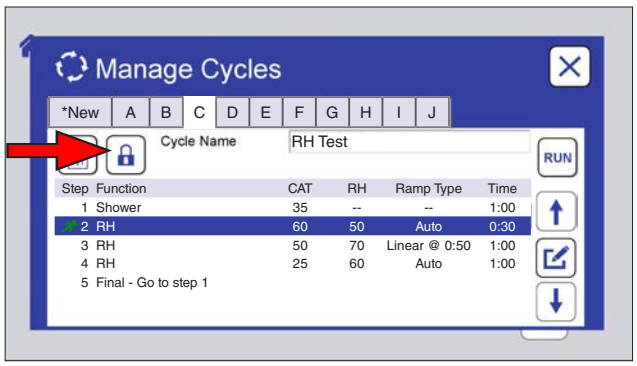


Figure 9.6.3a: Touch the Lock icon to lock the cycle.
NOTE: Pre-programmed test cycles are locked from editing by Q-Lab.

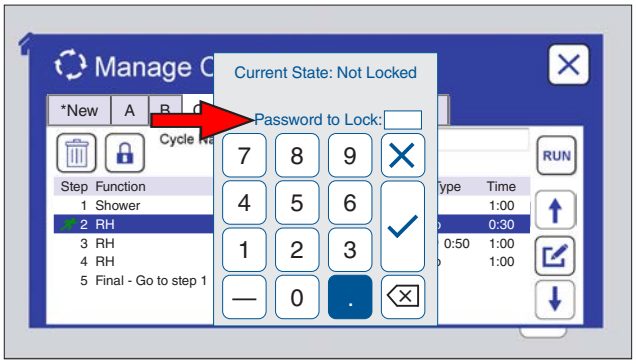


Figure 9.6.3b: The numeric keypad is displayed. A password must be entered to lock the cycle.

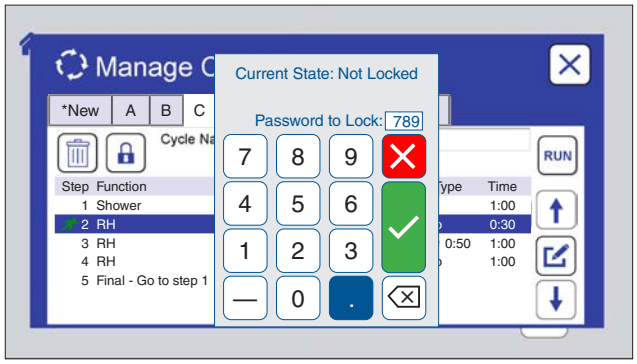


Figure 9.6.3c: Enter the numeric password. Touch the Check Mark button to save, or the X button to cancel setting the password.

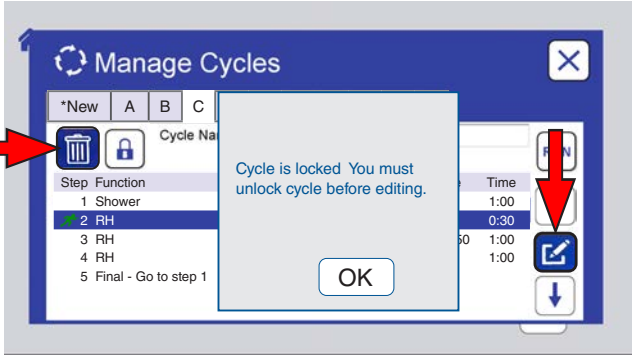


Figure 9.6.3d: This message is displayed if a delete or edit icon is touched on a locked cycle.

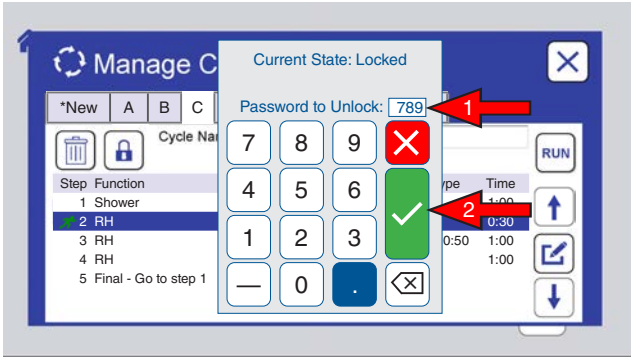


Figure 9.6.3e: To unlock a cycle, touch the lock icon, enter the password, then touch the Check Mark button. If the password has been forgotten, program a different test cycle or contact Q-Lab for password reset.

9.6.4 Add a Step to a Cycle

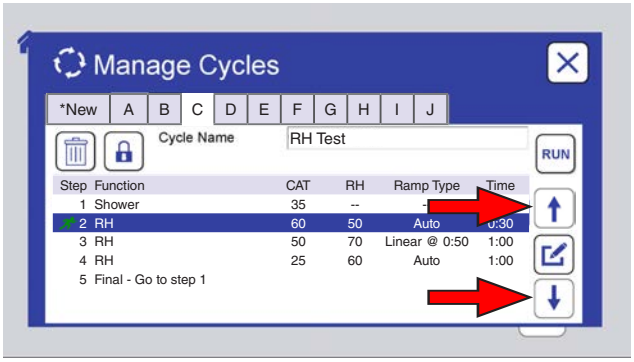


Figure 9.6.4a: For any cycle, a new step can be added before or after an existing step. Use the Up and Down Arrow icons to select the step.

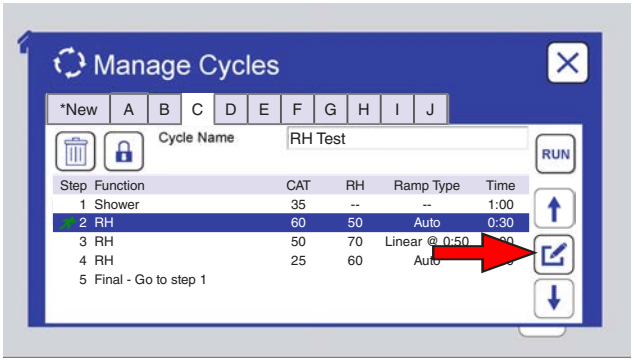


Figure 9.6.4b: Touch the Edit icon.

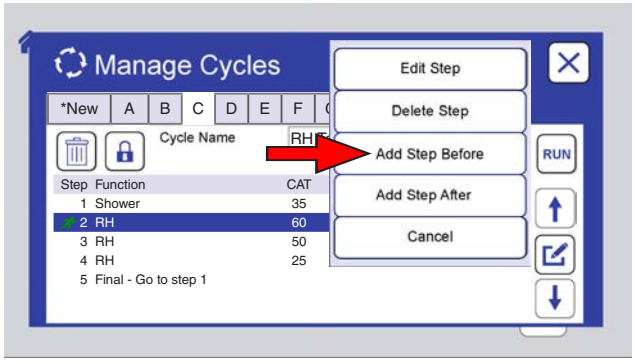


Figure 9.6.4c: The step revision control is displayed. Touch Add Step Before or Add Step After. In this example a step will be added.

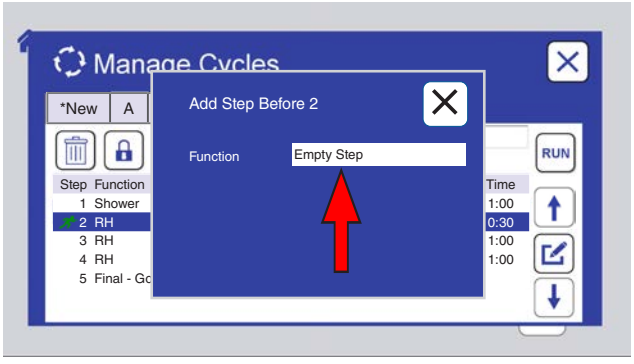


Figure 9.6.4d: Touch the function text box to select a function.

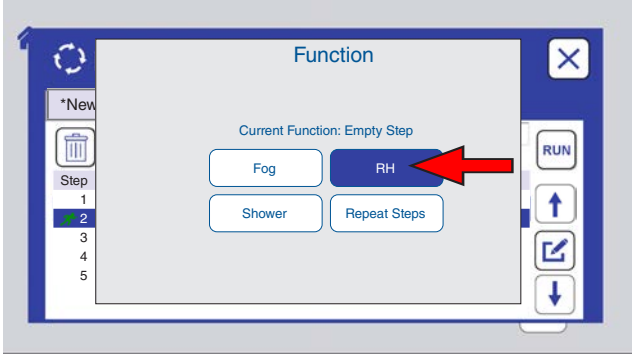


Figure 9.6.4e: Touch the desired function. In this example an RH step will be added.

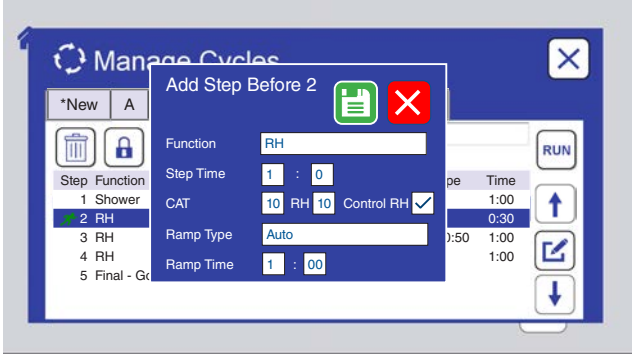


Figure 9.6.4f: Step values must be entered. Touch the Step Time (Hrs:Mins), CAT (Chamber Air Temperature) (°C), Control RH, Ramp Type, and Ramp Time text boxes to select.

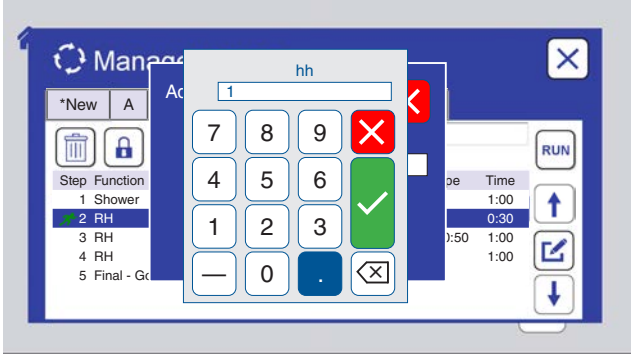


Figure 9.6.4g: Use the numeric keypad to enter the values for each parameter. Touch the Check Mark button to accept those values or the X button to cancel.

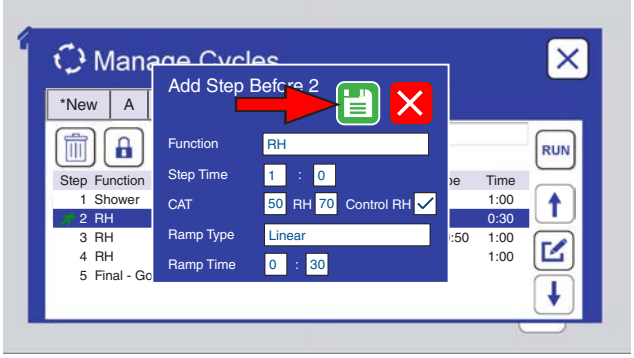


Figure 9.6.4h: The new step values are displayed. Touch the Save icon to save the new step.

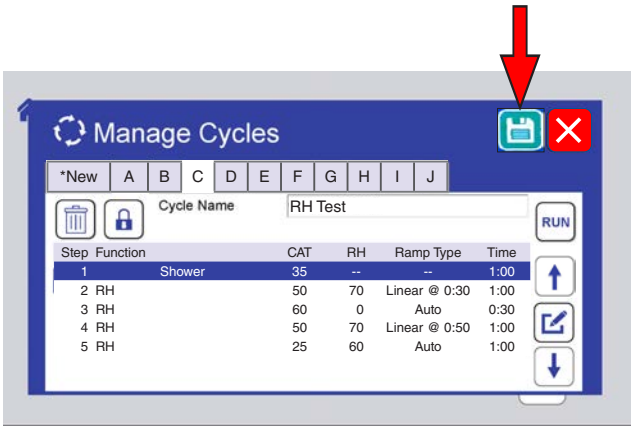


Figure 9.6.4i: The new step is shown for the cycle. Touch the Save icon to save the modified cycle.

9.6.5 Edit a Step

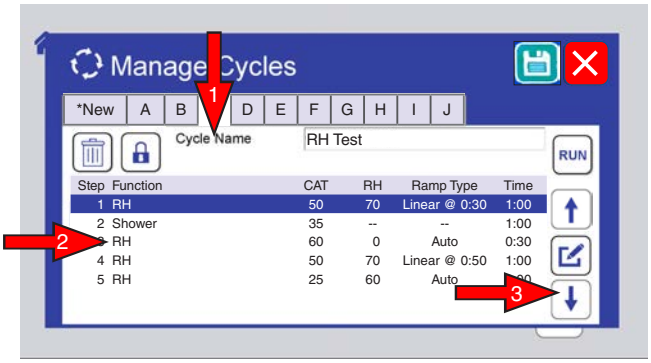


Figure 9.6.5a: To edit a step, touch the cycle ID tab, touch the step to edit, then touch the Pencil icon. **NOTE:** Steps cannot be moved in the test cycle, a Step must be edited to change function sequence in the test cycle.

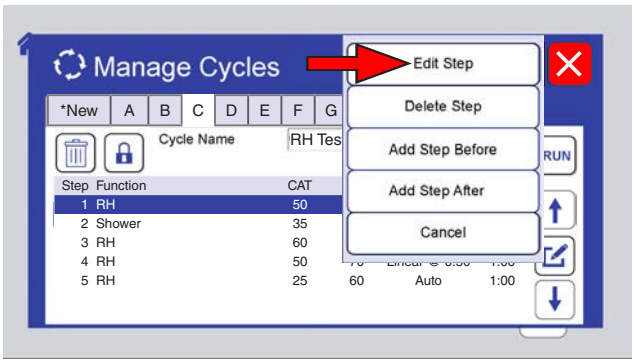


Figure 9.6.5b: Touch the Edit Step button.

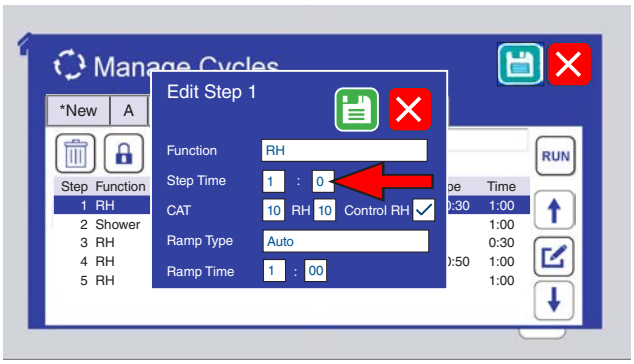


Figure 9.6.5c: Touch any of the parameter text boxes to select. Step Time minutes will be edited in the example.

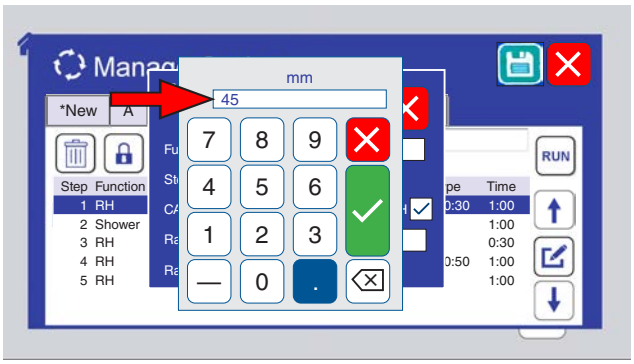


Figure 9.6.5d: Use the numeric keypad to enter the new values for the selected step. Touch the Check Mark button to accept those values or the X button to cancel.

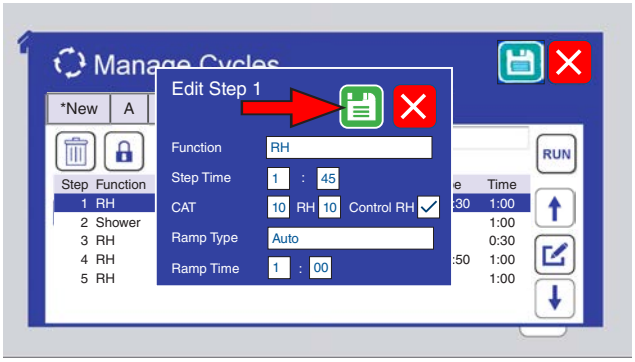


Figure 9.6.5e: Touch the Save icon to save the edited step.

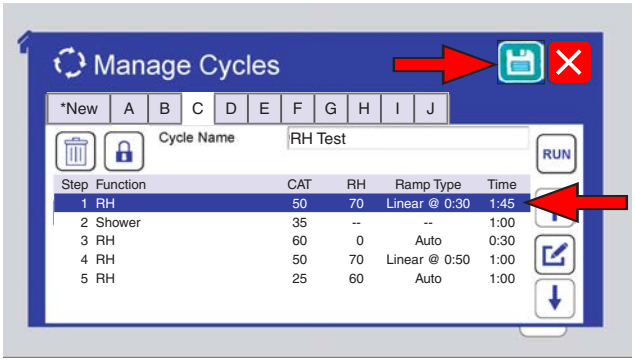


Figure 9.6.5f: The edited step is shown for the cycle. Touch the Save icon to save the edited cycle. **NOTE:** pre-programmed test cycles cannot be edited.

9.6.6 Delete a Step

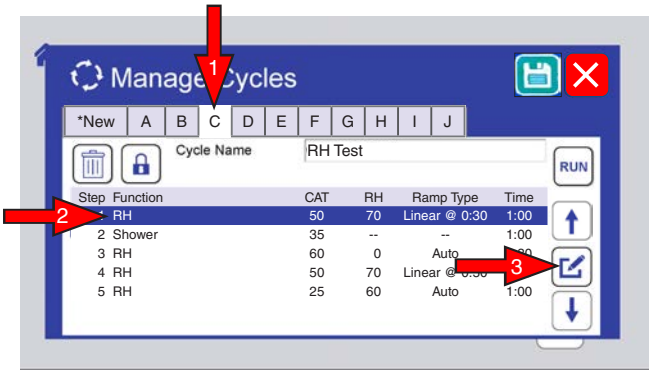


Figure 9.6.6a: To delete a step, touch the cycle ID tab, touch the step to delete, then touch the pencil icon.

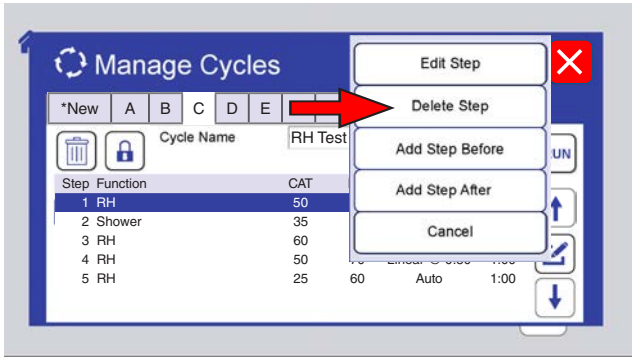


Figure 9.6.6b: Touch the Delete Step button.

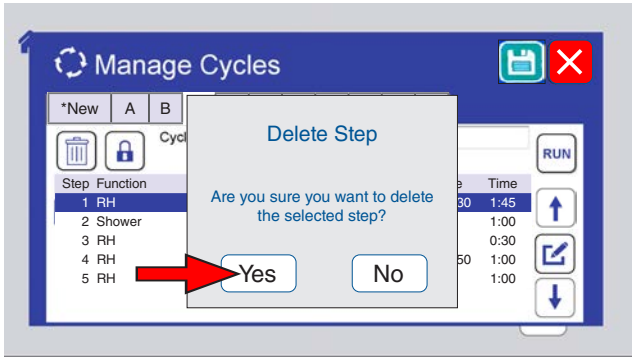


Figure 9.6.6c: Touch the Yes button to delete the step or touch the No button to cancel delete.

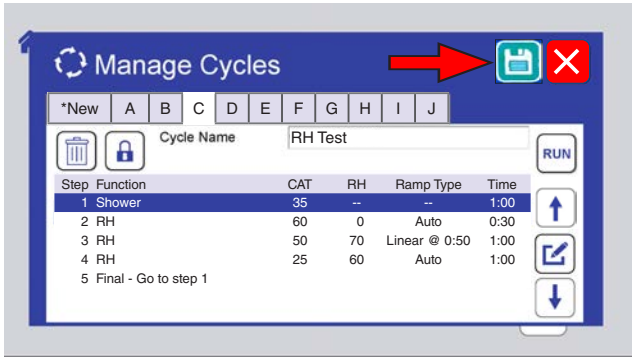


Figure 9.6.6d: Touch the Save icon to save the edited cycle.

9.6.7 Create a New Cycle

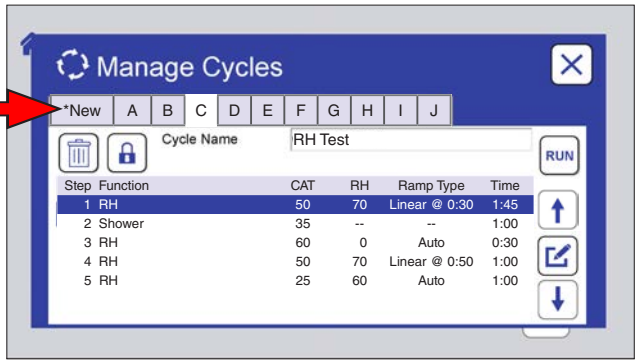


Figure 9.6.7a: To create a new cycle, touch the *New tab.

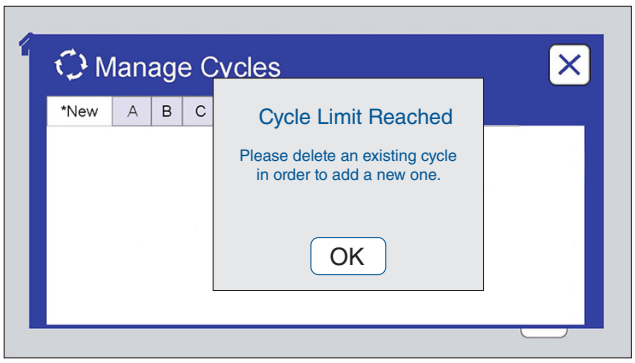


Figure 9.6.7b: If all available (10) cycles are programmed, this message is displayed. Touch the OK button. See Section 9.6.2 to delete a cycle.

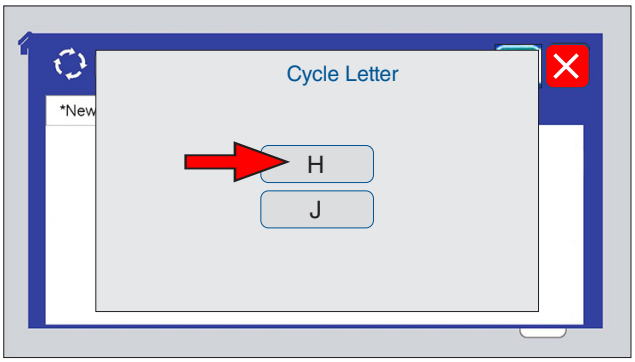


Figure 9.6.7c: If there are open cycles, the available cycle letters are displayed. Touch a letter to program that cycle.

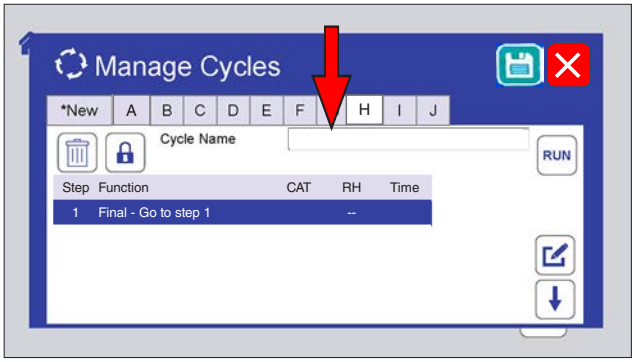


Figure 9.6.7d: An empty cycle is created with only a final step. Enter a name for the new cycle.

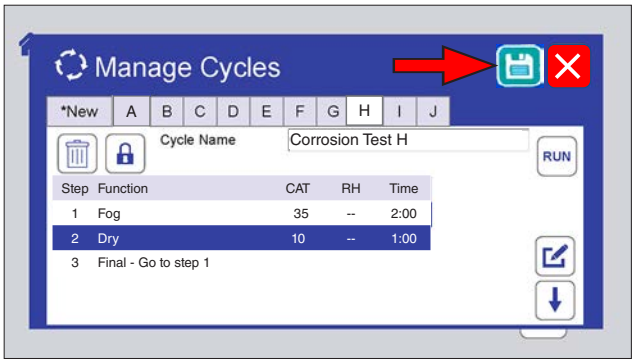


Figure 9.6.7e: Follow Figure 9.6.4a through Figure 9.6.4i to add steps and save the new cycle.

9.6.8 Run From Step

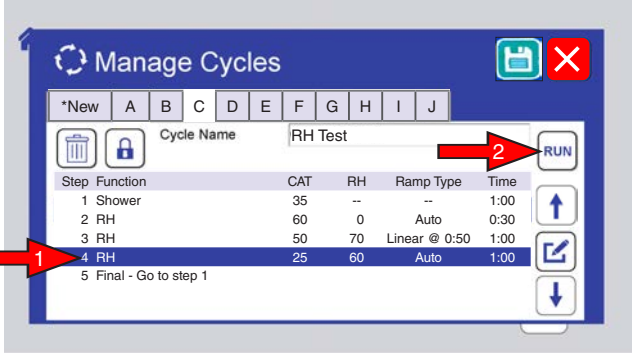


Figure 9.6.8a: A cycle can be run from a specified time in one of its steps. Select the step, then touch the RUN button

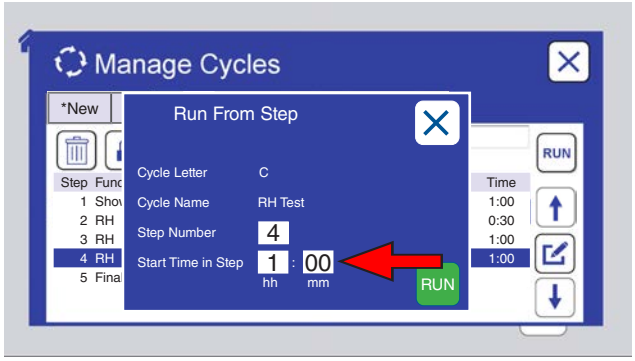


Figure 9.6.8b: Touch the start time hh (hours) text box or the mm (minutes) text box to set the time. Start time can be set to 0 to start at the beginning of the step.

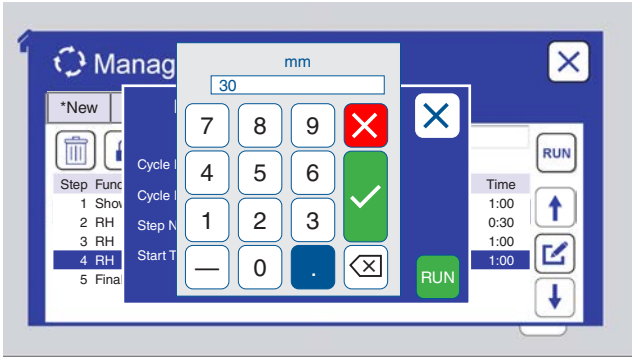


Figure 9.6.8c: Use the numeric key pad to set the time. Touch the check mark button to accept those values or the X button to cancel.

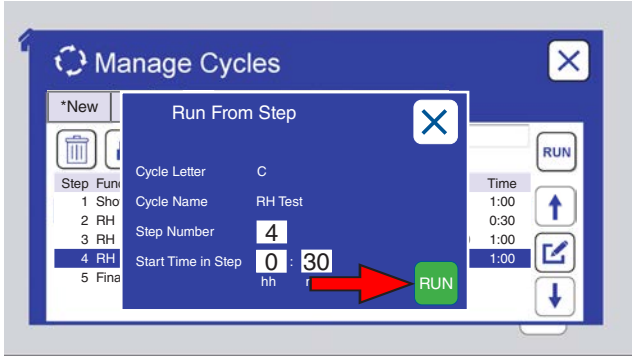


Figure 9.6.8d: Touch the Run icon to run the step from the time entered.

9.7. Settings (Nov 2021)

- On the Main Menu screen touch the Settings icon (Figure 9.7a) to display the Settings screen.
- The Settings screen displays user-selectable machine parameters (Figure 9.7b)
  - Volume (Figure 9.7c and Figure 9.7d).
    - Alarm
    - Touch
  - Display Options (Figure 9.7e through Figure 9.7h)
    - Status Screen Brightness
    - Menu Screen Brightness
    - Sleep Time
  - Language (Figure 9.7i through Figure 9.7l), available are:
    - English, French, Spanish, German, Italian, Chinese, Japanese, Korean, Czech, Dutch, Polish, Portuguese, Russian, Swedish, Thai, Turkish, and Vietnamese
  - Date/Time (Figure 9.7m through Figure 9.7p).
  - Ethernet (Figure 9.7q through Figure 9.7t).
  - Machine Configuration (Figure 9.7u and Figure 9.7v). Contact Q-Lab Repair and Tester Support for more information on using this setting.
- The Q-FOG can be operated using just one screen.
  - In the event of the failure of either screen, the controller will automatically reconfigure to use just the functioning screen to maintain full operation of the tester. This will be indicated by the appropriate error message M900, M901, and/or M902 (see Section 15.1).
  - A button appears in the upper right corner of the screen to toggle the remaining screen between Main Menu and Status displays (see Figure 9.7x through Figure 9.7aa).

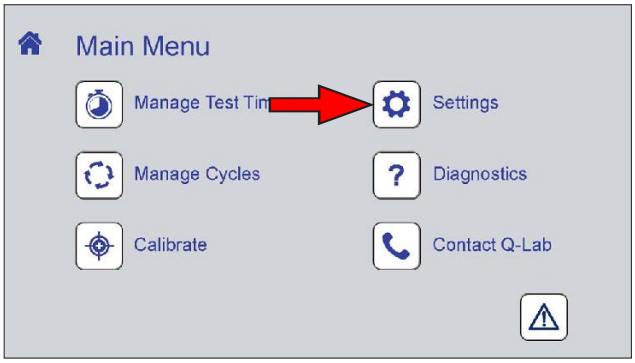


Figure 9.7a: Touch the Settings icon on the Main Menu screen to display settings controls.

Settings

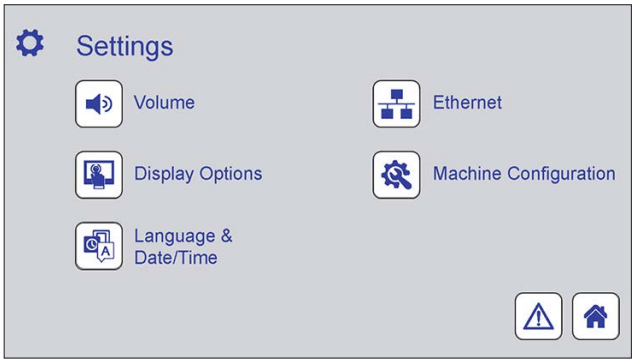


Figure 9.7b: Settings screen. Touch any icon to display controls for that function. The notification screen (Section 9.4) and the home screen can also be displayed.

Volume

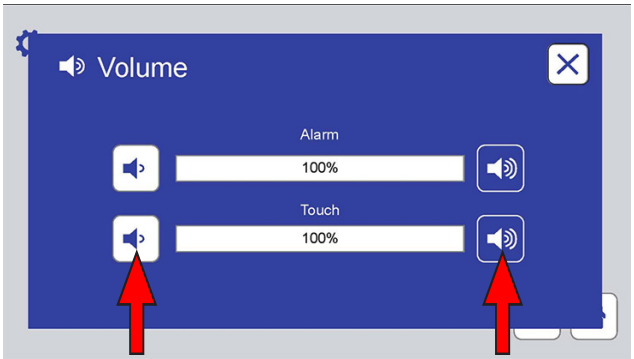


Figure 9.7c: The Volume screen provides controls to set volume (0 to 100) for machine alarms and for the screen touch indicator. Touch a volume icon to adjust.

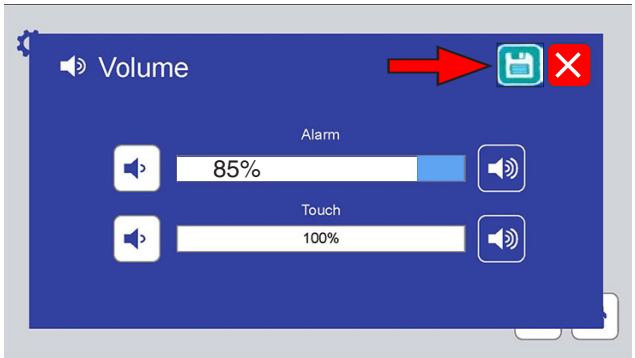


Figure 9.7d: If a volume is changed, touch the save icon to save the new volume level.

Display Options

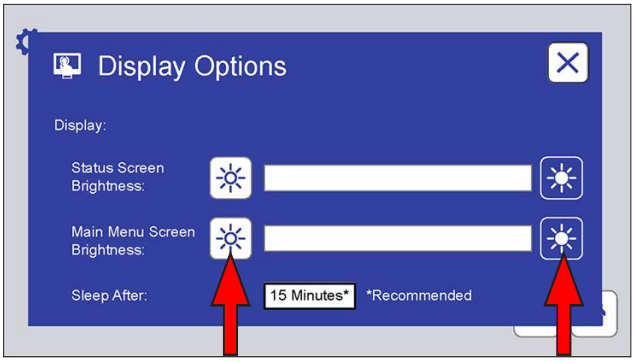


Figure 9.7e: The Display Options screen provides controls to adjust the brightness of the status and menu screens. Touch a brightness icon to adjust.

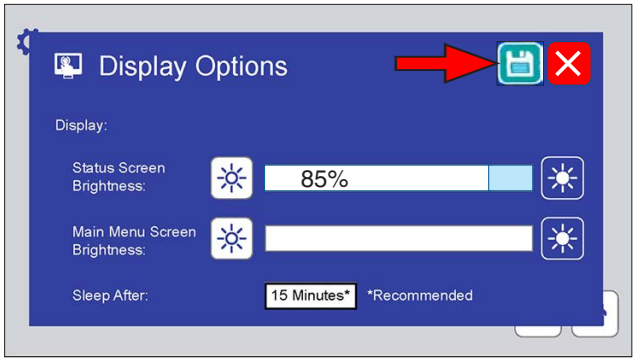


Figure 9.7f: If a brightness is changed, touch the save icon to save the new brightness level.

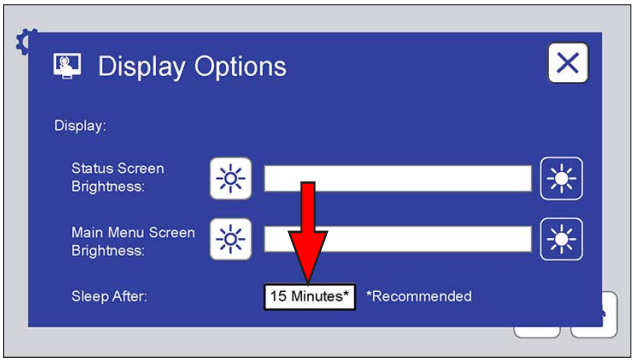


Figure 9.7g: The Display Options screen can also be used to adjust the inactive time that elapses before the screens "go to sleep" (i.e. deactivate). 15 minutes is recommended.

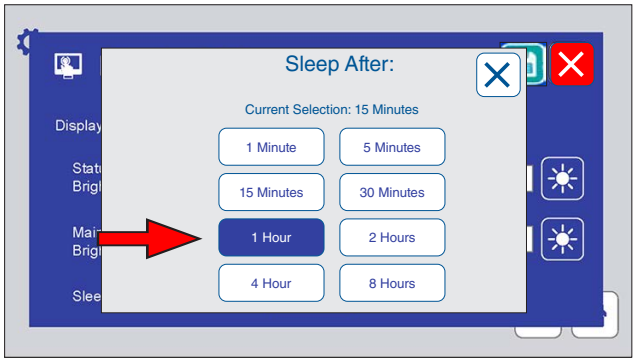


Figure 9.7h: Touch a time button to change the time before screens go to sleep. If changed, touch the save icon to save the new time.

Language

Figure 9.7i: This screen displays controls to select the control interface language.

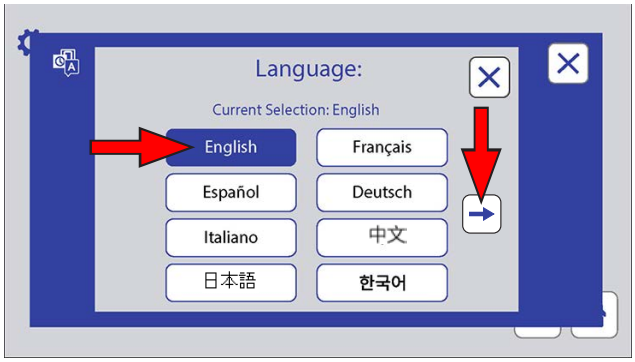


Figure 9.7j: Touch the language text box to select the control display language. Touch the Right Arrow icon to display additional available languages.

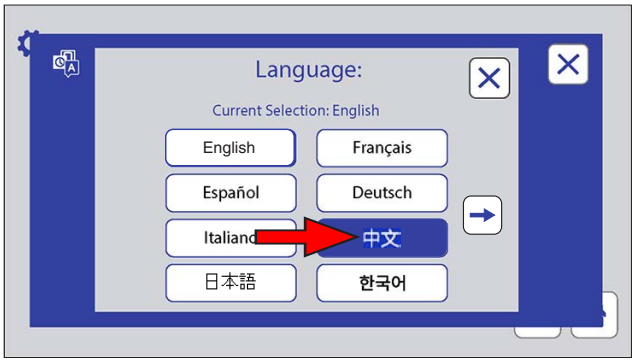


Figure 9.7k: Touch the text box for the desired language.

Figure 9.7l: All text on both screens will be in the selected language. Touch the save icon to save the selection.

Date/Time

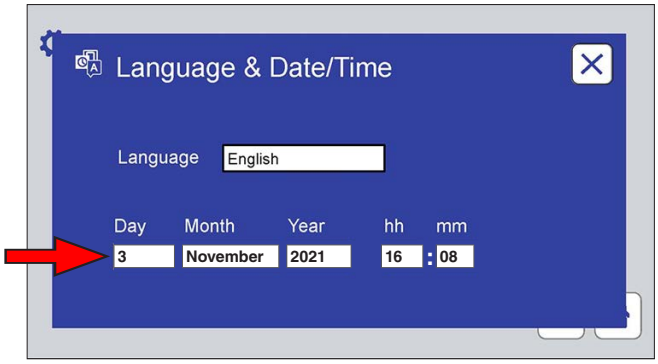


Figure 9.7m: This screen displays controls to set the date and time. Touch a text box to set Day, Month, Year, hh (hour) or mm (minute). hh display is always 24 hour time.

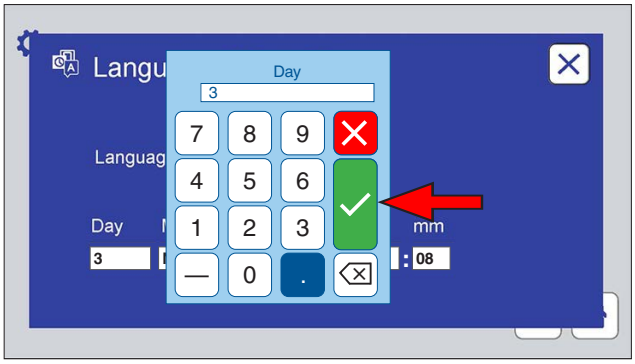


Figure 9.7n: The numeric keypad is used to set Day, Year, hh, and mm. Enter the number, then touch the check mark button.

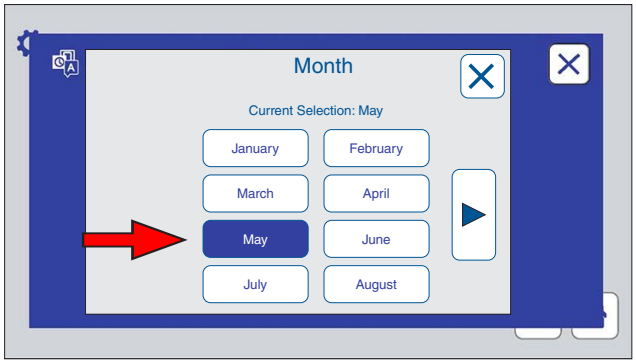


Figure 9.7o: Touch the month button to select the month on this display. Touch the right arrow button to display the remaining months.

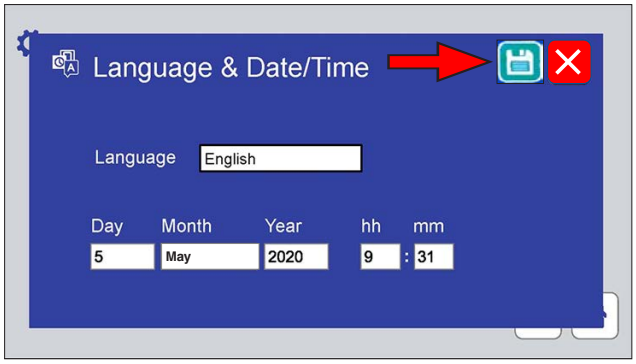


Figure 9.7p: Touch the save icon to save any changes to the Language & Date/Time. **NOTE:** The controller does not automatically adjust for Daylight Savings Time.

Ethernet

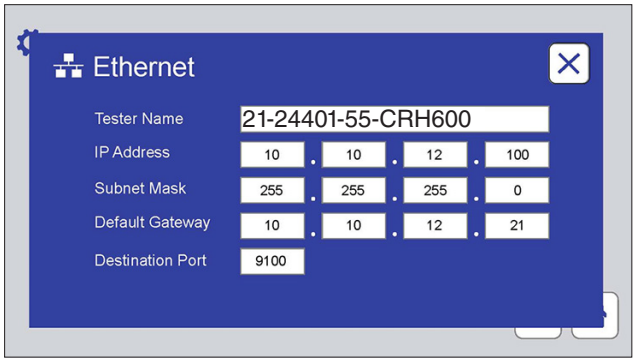


Figure 9.7q: This screen displays and provides text boxes to enter Ethernet connection parameters. This information is used for VSC Desktop (see Section 13.1)

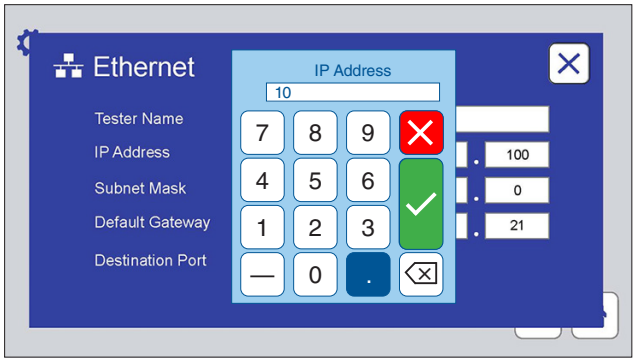


Figure 9.7r: Touch any text box to use the numeric keypad to input the parameter.

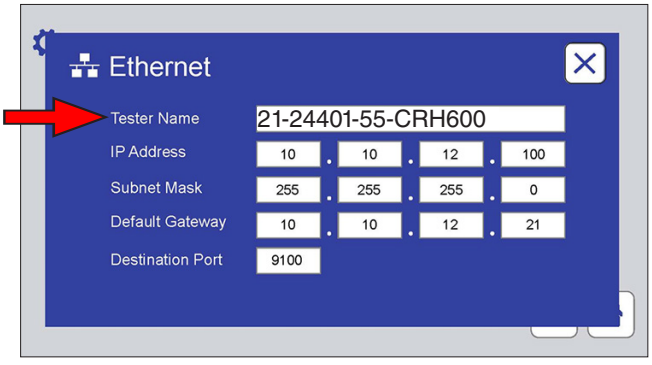


Figure 9.7s: Additionally, this screen has the name of the tester as it would appear on a network, if using the VIRTUAL STRIPCHART network version.

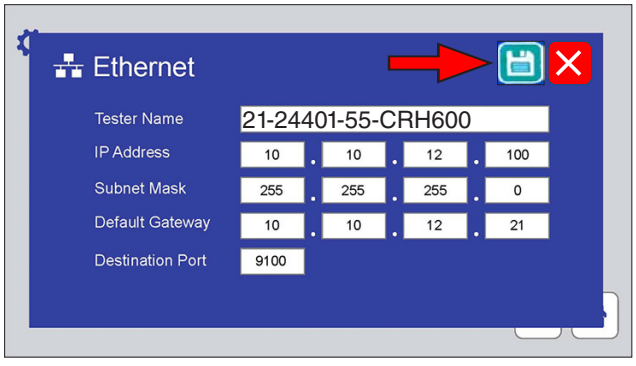


Figure 9.7t: Touch the save icon to save any changes to Ethernet parameters.

Machine Configuration

- On the Settings screen touch the Machine Configuration icon to display the screen (Figure 9.7u and Figure 9.7v).
- Machine Configuration includes several operator-accessible parameters listed in Figure 9.7w.
- Contact Q-Lab Repair with questions about Machine Configuration.

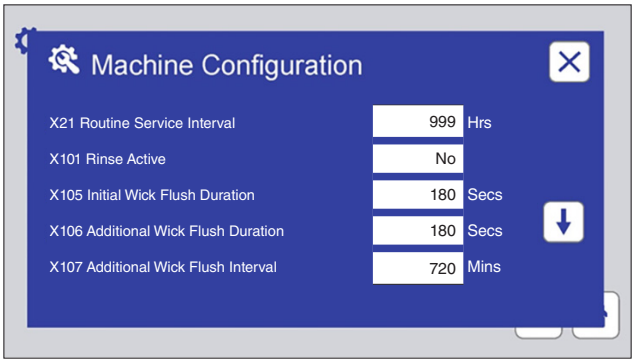


Figure 9.7u: Touch the down arrow to display additional parameters. Touch the parameter text box to change the value.

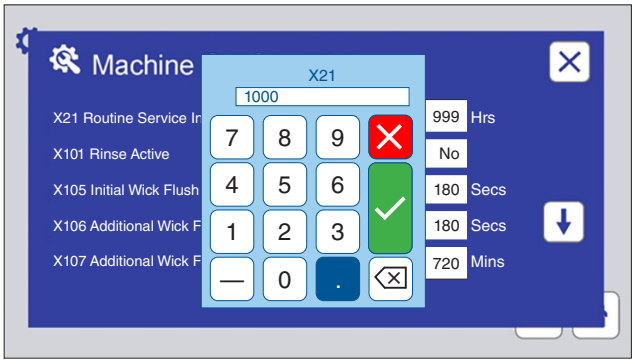


Figure 9.7v: Use the numeric keypad to enter a value, then touch the check mark button. Touch the Machine Configuration Save Icon to save the changes.

No.	Name	Unit	Range	Description
X21	Routine Service Interval	Hrs	0-5,000	This is the time interval between “M14 Perform Routine Service” reminders. See Section 15.1.
X101	Rinse Active	Yes/No		Determines whether a Rinse function (Wall Wash) can be selected when programming test cycles. This should only set to Yes when the Wall Wash feature is installed and the Rinse function is needed, e.g. for Renault D17 (ECC1).
X105	Initial Wick Flush Duration	Secs	0-999	This is the amount of time the wet bulb wick gets flushed at the beginning of every RH step when the RH step is preceded by a fog or shower step.
X106	Additional Wick Flush Duration	Secs	0-999	This is the amount of time the wet bulb wick gets flushed during additional flushes (not the initial flush). This occurs at the interval set by X107.
X107	Additional Wick Flush Interval	Mins	20-999	This is the amount of time between the initial wet bulb wick flush and all additional wet bulb wick flushes when in the same RH step.
X108	Max Additional Wick Flushes Per Step	#	1-99	This is the maximum number of additional wet bulb wick flushes that take place during the same RH step.
X109	Water Line Refresh Duration	Secs	0-999	This is the amount of time the water lines are flushed out with clean water to prevent stagnation. This happens when power is turned on, or run is pressed and the RH generator has been inactive (with the controller on) for longer than the time set in X110.

No.	Name	Unit	Range	Description
X110	Idle Time To Enable Refresh	Hrs	1-999	This is the amount of time the RH generator must be inactive (while the controller is on) to trigger a water line refresh.
X135	Does M2 Lid Open Self-Clear	Yes/No		If an M2 message has occurred will it self-clear. X135 is Yes by default.
X141	Pump Speed	%	0-100	The speed of the Peristaltic Fog Pump. See Section 8.7.
X142	Shower Pulse Rate On	Secs	0-60	The time the shower is pulsed on.
X143	Shower Pulse Rate Off	Secs	0-60	The time the shower is pulsed off.
X500	Serial Number Year	—	##	Two-digit year of tester manufacture from serial number
X501	Serial Number Unique ID	—	#####	Five-digit unique tester ID from serial number
X502	Serial Number Series	—	###	Two- or three-digit tester series from serial number

Figure 9.7w: Complete list of accessible Machine Configuration parameters.

Single Screen Operation

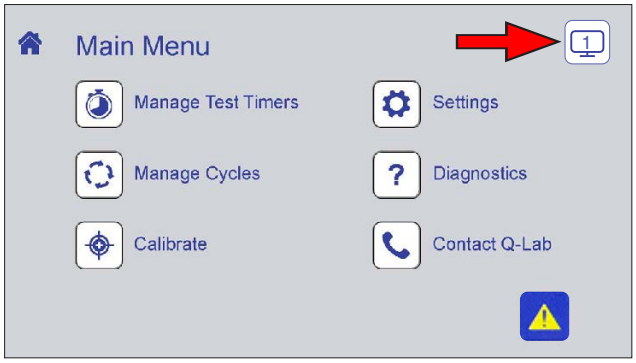


Figure 9.7x: Main Menu in single screen mode. Touch the screen icon.

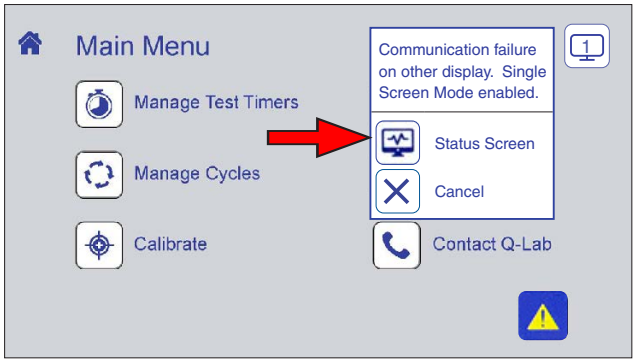


Figure 9.7y: Touch the Status Screen icon to display the Status Screen.

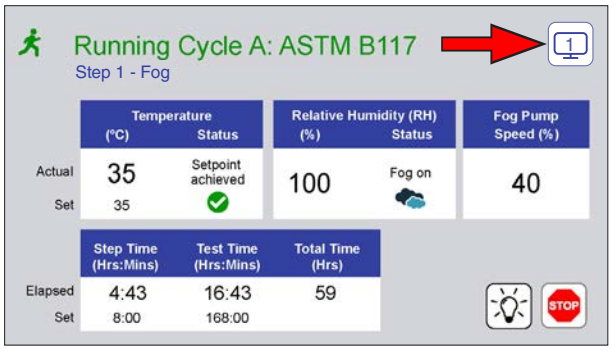


Figure 9.7z: Status Screen in single screen mode. Touch the screen icon.

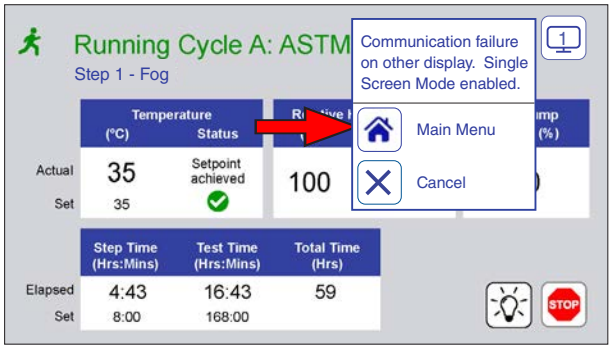


Figure 9.7aa: Touch the Menu Screen icon to display the Menu Screen.

9.8. Diagnostics (Nov 2021)

- Diagnostics are a list of tester current operating conditions.
- Diagnostics are an important tool to assist in troubleshooting tester conditions.
- On the Main Menu screen, touch the Diagnostics icon (Figure 9.8a) to display the Diagnostics screen (Figure 9.8b).
- Press the UP or DOWN arrows to scroll through the diagnostics.
- There are no editable values on these screens.
- Checking the diagnostic information will not interrupt the test cycle in any way.
- See Figure 9.8c for a complete list of Diagnostics.

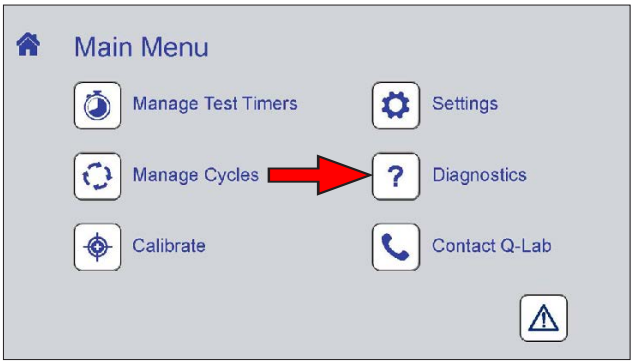


Figure 9.8a: Touch the Diagnostics icon on the Main Menu screen to display diagnostic information.

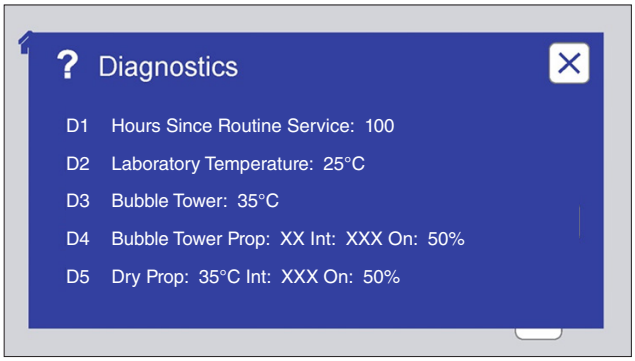


Figure 9.8b: The Diagnostics screen displays current machine operating conditions.

No.	Diagnostic Message	Description
D1	Hours Since Routine Service: XXXX	This shows the number of hours since the M14 PERFORM ROUTINE SERVICE alarm was last cleared.
D2	Laboratory Temperature: XX°C RH: XX%	This shows the current lab temperature and humidity.
D3	Bubble Tower: XX°C	This shows the current temperature of the water inside the bubble tower. See Section 8.2.
D4	Bubble Tower Prop: XX Int: XX On: XX%	This shows the settings for controlling the water temperature inside the bubble tower and the percentage of time the bubble tower heater is on.
D9	Fog Prop: XX°C Int: XX On: XX%	This shows the settings for controlling the chamber temperature in a fog step and the percentage of time the chamber heater is on. See Section 7.1.
D11	Controller Temperature: XX°C	This shows the current temperature of the controller.
D12	Version: 6.XXX Checksum: XXXXX	This shows the software version and checksum. The checksum can be used to determine if there is a compiling error.
D13	Bubble Tower Water Level: Hi/Medium/Low	This shows how much water is in the bubble tower. High if the high level switch is closed, medium if the high level switch is open and the low level switch is closed, low if the low level switch is open.
D14	Run Power Relay: On/Off	This shows if the run power relay should be on or off.
D17	RH Prop: XX°C Int: XX On: XX%	This shows the proportional band and integral settings for controlling the chamber RH in a RH step and the percentage of time the RH generator is on.

No.	Diagnostic Message	Description
D18	Shower Prop: XX°C Int: XX On: XX%	This shows the proportional band and integral settings for controlling the chamber temperature in a shower step and the percentage of time the chamber heater is on.
D19	Wet Bulb Temperature: XX°C	This shows the current temperature of the wet bulb.
D20	Dry Bulb Temperature: XX°C	This shows the current temperature of the dry bulb.
D21	Preconditioner Temp: XX°C PC Heat: XX%	This shows the current temperature of the air exiting the preconditioner and the percentage of time the preconditioner heater is on.
D22	Evap Temp: XX°C Evap Damp Out: XX%	This shows the current temperature of the evaporator coil inside the preconditioner and how much the preconditioner damper is open.
D23	Ambient Dmpr Out: XX%	This shows how much the ambient damper is open.
D24	Ramp Setpoints: XX°C XX%RH	This shows the temperature and RH setpoints and during a linear ramp step. It shows the setpoints as they change every minute during the ramp.
D25	Shower Flow: XX Normal: XX	This shows the current shower flow rate and what it was (Normal) when it was last set (see Section 12.4).
D26	MAC Address: XX:XX:XX:XX:XX:XX:	Displays the media access control (MAC) address for the tester (see Figure 9.7q).
D27	Chamber Temp Sensor Offset: XX.X°C	This shows the difference (or offset) between the uncalibrated chamber temperature sensor output and the calibrated value.
D28	Wet Bulb Temp Sensor Offset: XX.X°C	This shows the difference (or offset) between the uncalibrated wet bulb temperature sensor output and the calibrated value.
D29	Dry Bulb Temp Sensor Offset: XX.X°C	This shows the difference (or offset) between the uncalibrated dry bulb temperature sensor output and the calibrated value.
D30	Serial Number: XX-XXXXX-XX-CRHXXXX-MODEL	This shows the complete serial number of the tester, needed for software updates and troubleshooting (see Machine Configuration).
D31	CHMBR HTR CIR 1 PWR Duty Cycle: XXX%	-HSCR and -HTCR models, factor used to multiply the chamber heater PID output by to determine the actual chamber heater circuit 1 output.
D32	CHMBR HTR CIR 1 Actual On Time: XXX%	-HSCR and -HTCR models, result of the PID output multiplied by the power duty cycle factor.
D33	CHMBR HTR CIR 2 PWR Duty Cycle: XXX%	-HSCR and -HTCR models, factor used to multiply the chamber heater PID output by to determine the actual chamber heater circuit 2 output.
D34	CHMBR HTR CIR 2 Actual On Time: XXX%	-HSCR and -HTCR models, result of the PID output multiplied by the power duty cycle factor.
D35	CHMBR HTR CIR 1 MEAS Current: XX.XA	-HSCR and -HTCR models, last current measurement of chamber heater circuit 1.
D36	CHMBR HTR CIR 2 MEAS Current: XX.XA	-HSCR and -HTCR models, last current measurement of chamber heater circuit 2.
D37	TSSB Front-to-Back: X.XX Sec	-HTC and -HTCR models, time it takes for the TSSB to complete a front-to-back movement.
D38	TSSB Back-to-Front: X.XX Sec	-HTC and -HTCR models, time it takes for the TSSB to complete a back-to-front movement.

Figure 9.8c: Q-FOG diagnostics list.

9.9. Contact Q-Lab (Sep 2021)

- Touch the Contact Q-Lab icon on the Menu Screen (Figure 9.9a).
- The Contact Q-Lab screen (Figure 9.9b) displays the link to Q-Lab Repair and Tester Support on q-lab.com.

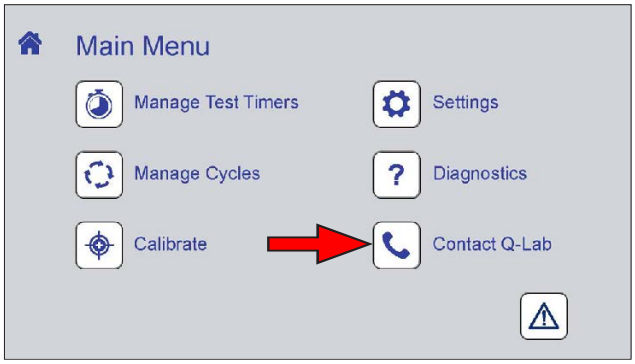


Figure 9.9a: Touch the Contact icon on the Main Menu screen to display Q-Lab contact information.

Contact Q-Lab

Figure 9.9b: Scan the code on this screen for Q-Lab contact information.

10. Test Chamber Capacity and Specimen Mounting

- This section provides detailed information on test chamber capacity and specimen mounting options.

10.1. Test Chamber Capacity (Feb 2021)

- Q-FOG test chamber internal dimensions listed in the table below correspond with dimensions shown in Figure 10.1a.
- Test chamber volumes are listed in Figure 10.1b .

Chamber Internal Dimensions					
	Specimen	Model 600		Model 1100	
Dimension	Mounting Level	cm	inches	cm	inches
A	Rack	69.0	27.2	84.7	33.3
B	Diffuser	64.6	25.4	80.4	31.7
C	Rack	30.4	12.0	30.4	12.0
D	Diffuser	45.7	18.0	45.7	18.0
E*	Diffuser	74.0	29.1	79.0	31.1
F	Rack	108.1	42.6	144.9	57.0
G	Diffuser	107.6	42.4	144.3	56.8

* Vertical distance from the diffuser level to the inside peak of the closed lid.

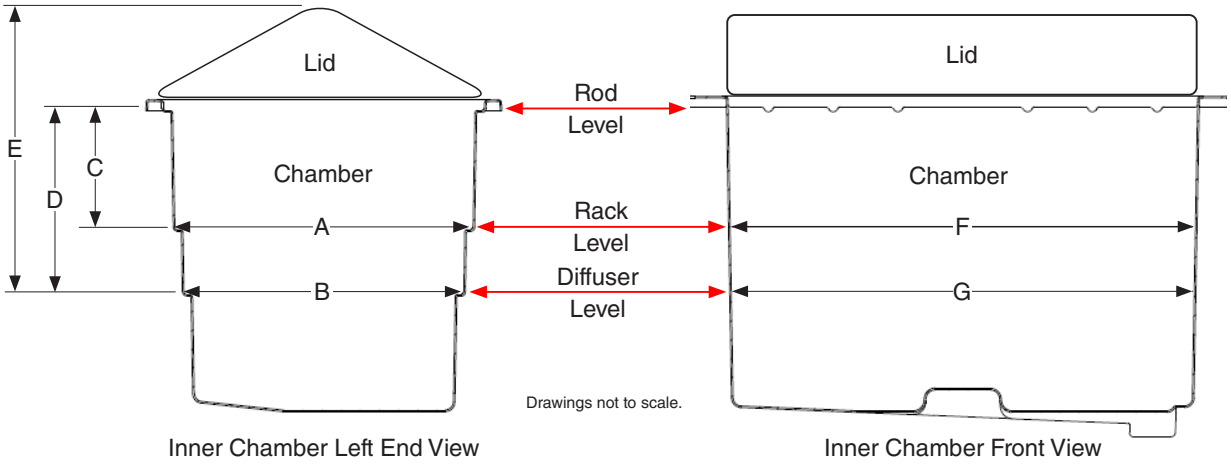


Figure 10.1a: Chamber internal dimensions.

Chamber Volumes				
Volume	600 Models		1100 Models	
Excluding Lid	511 liters	18.0 ft^3	857 liters	30.2 ft^3
Including Lid	640 liters	22.6 ft^3	1103 liters	38.9 ft^3

Figure 10.1b: Chamber volumes.

10.2. Specimen Mounting Options (Dec 2021)

- There are three primary methods of mounting specimens in the Q-FOG test chamber.
  1. Panel Racks
  2. Hanging Rods
  3. Grates

⚠ **IMPORTANT:** Maximum total weight of test specimens in the chamber must not exceed 544 kg (1200 lb).

Panel Racks

- Typically, flat standard test panels are mounted in panel racks in the Q-FOG test chamber.
- To optimize shower spray uniformity throughout the test chamber, “T” model testers with the Top-Mounted Swaying Shower Bar (TSSB) use panel racks different from the “S” Model testers with the Stationary Shower Module (SSM).
  - In “S” models, panels are angled towards the front of the chamber (see Section 10.2.1).
  - In “T” models, panels are angled towards center of the chamber (see Section 10.2.2).
- Visit the Q-Lab web site for detailed information on available Q-PANEL® standard test panels.

10.2.1 For Q-FOG CRH-HSCR and -HSC Model Testers

- Panel racks for “S” model 600 L and 1100 L testers have mounting slots facing the front of the chamber, angled at either 6° or 15° from vertical (Figure 10.2.1a through Figure 10.2.1c). See Section 16 for these panel rack part numbers.

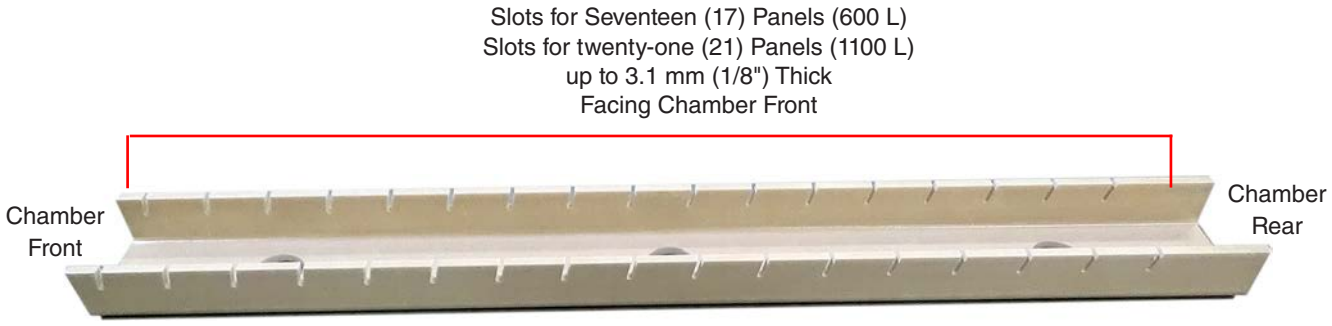


Figure 10.2.1a: Panel Rack for “S” model testers.

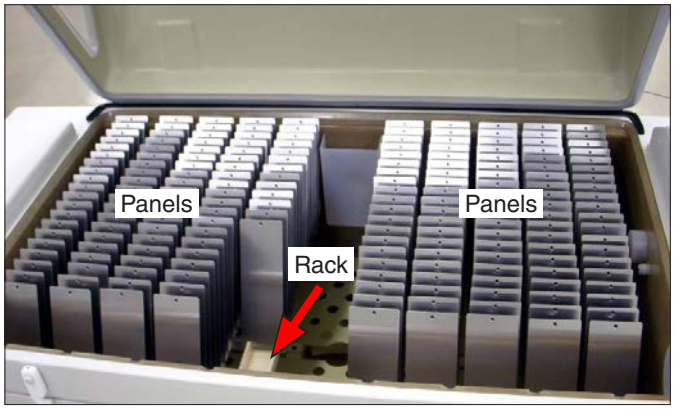


Figure 10.2.1b: Panels mounted on racks in “S” model tester chamber.

Panel Rack Specifications for “S” Model Testers		
	600 L Models	**1100 L Models**
Rack Length	70 cm (27.5")	85 cm (33.5")
Maximum Weight per Rack	113 kg (250 lb)	
75 × 150 mm (3 × 6") Panel Capacity		
Racks per Chamber	10*	12*
Panels per Rack	17*	21*
Panels per Chamber	170	252
100 × 300 mm (4 × 12") Panel Capacity		
Racks per Chamber	8*	10*
Panels per Rack	17*	21*
Panels per Chamber	136	210

* These are the maximum number of racks per chamber and panels per rack that will fit in the chambers. For more typical spacing, the racks per chamber and panels per rack would be fewer than listed here.

Figure 10.2.1c: Rack specifications and capacities for “S” model testers.

10.2.2 For Q-FOG CRH-HTCR and -HTC Model Testers

- Panel racks for "T" model 1100 L testers have mounting slots facing the center of the chamber, angled 15° from vertical (Figure 10.2.2a through Figure 10.2.2c). See Section 16 for these panel rack part numbers.

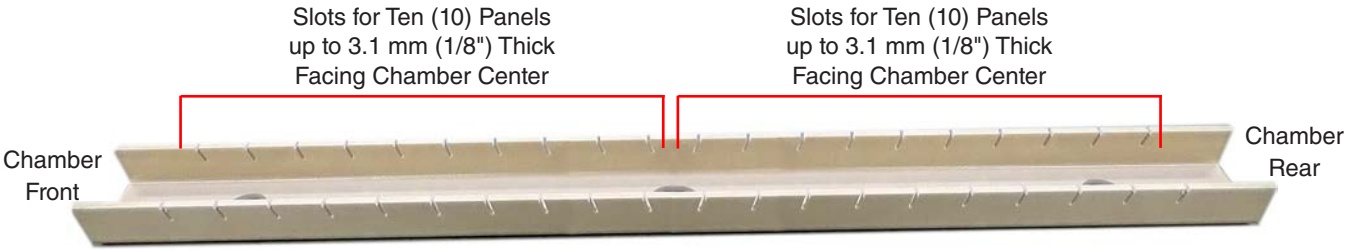


Figure 10.2.2a: Panel Rack for "T" model testers.

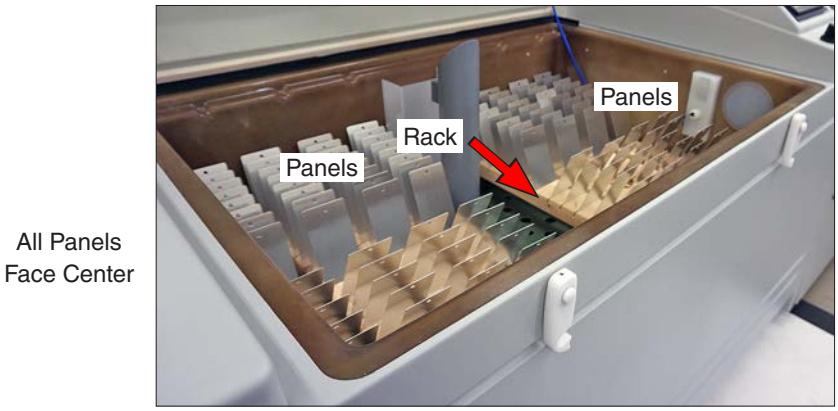


Figure 10.2.2b: Panels mounted on racks in "T" model tester chamber.

Panel Rack Specifications for "T" Model Testers	
	1100 L Models*
Rack Length	85 cm (33.5")
Maximum Weight per Rack	113 kg (250 lb)
75 × 150 mm (3 × 6") Panel Capacity	
Racks per Chamber	12**
Panels per Rack	20**
Panels per Chamber	240
100 × 300 mm (4 × 12") Panel Capacity	
Racks per Chamber	10**
Panels per Rack	20**
Panels per Chamber	200

* "T" model testers are available only in 1100 L capacity.

** These are the maximum number of racks per chamber and panels per rack that will fit in the chambers. For more typical spacing, the racks per chamber and panels per rack would be fewer than listed here.

Figure 10.2.2c: Rack specifications and capacities for "T" model testers.

10.2.3 Hanging Rods

- Three dimensional (3D) parts can be suspended from hanging rods (Figure 10.2.3a and Figure 10.2.3b).
- Hanging rods are the same for both “S” model and “T” model testers.
- See Section 16 for available hanging rods.

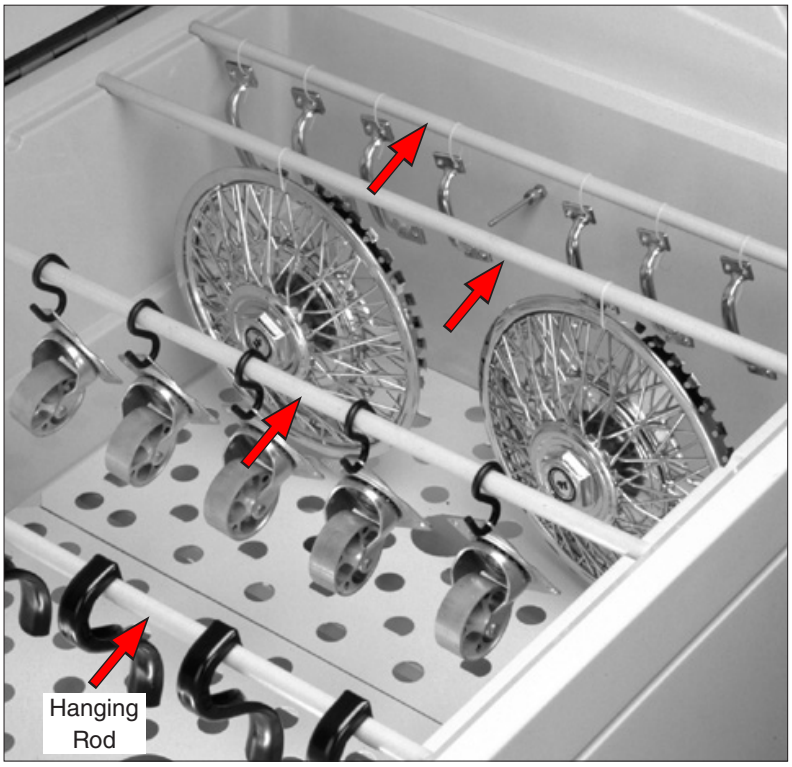


Figure 10.2.3a: 3D parts suspended from hanging rods in chamber.

Hanging Rod Specifications		
	600 Models	**1100 Models**
Hanging Rod Length	75 cm (29.5")	91 cm (36")
Number of Rods per Chamber	6	8
Maximum Weight per Rod	45 kg (100 lb)	

Figure 10.2.3b: Hanging rod specifications and capacities.

10.2.4 Grates

- Very large parts can be mounted on grates installed in the chamber.
- Two different grates are available.
  1. Rack level grates (Figure 10.2.4a through Figure 10.2.4c) mount at the same height as the panel racks (see Figure 10.1a). Use the rack level grates if possible.
  2. Diffuser level grates (Figure 10.2.4d through Figure 10.2f) mount at the same height as the diffuser panels (see Figure 10.1a). Use the diffuser level grates if parts are too tall for the rack level grates.
- Grates are the same for both “S” model and “T” model testers.
- See Section 16 for grate part numbers.

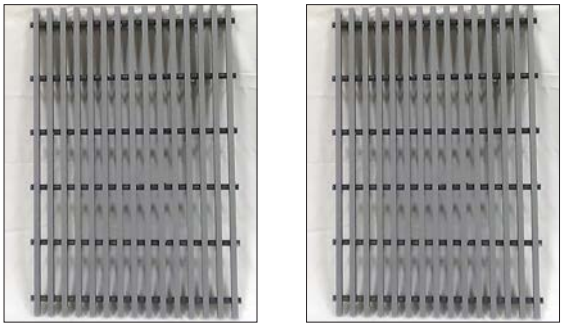


Figure 10.2.4a: Rack level mounting grates.

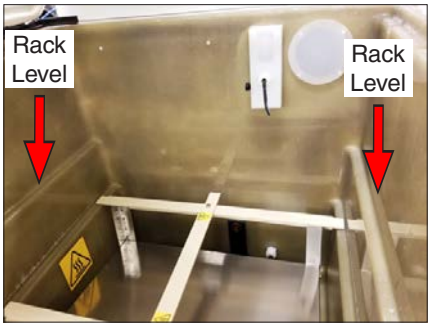


Figure 10.2.4b: Chamber interior showing rack grate mounting level.

Rack Level Grate Specifications			
Model	**Grate Length × Width**	**Maximum Weight per Grate**	**Grates per Chamber**
600 L	69 cm (27.3") × 38 cm (15.0")	272 kg (600 lb)	2
1100 L	85 cm (33.6") × 57 cm (22.5")	272 kg (600 lb)	2

Figure 10.2.4c: Rack level grate specifications and capacities.

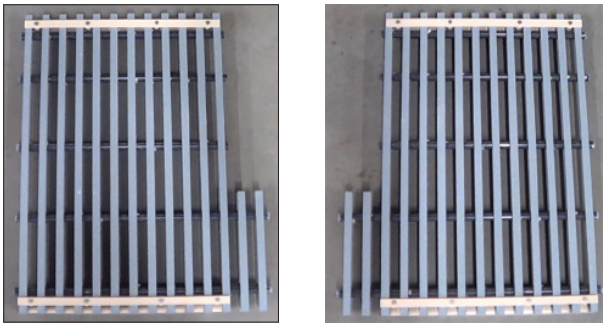


Figure 10.2.4d: Diffuser level mounting grates.

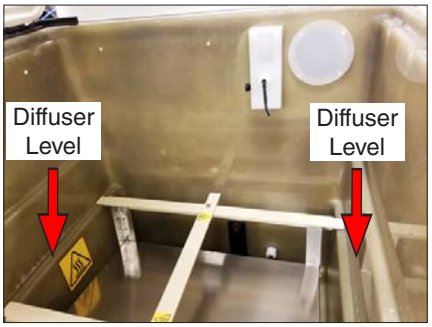


Figure 10.2.4e: Chamber interior showing diffuser grate mounting level (diffusers removed).

Diffuser Level Grate Specifications			
Model	**Grate Length × Width**	**Maximum Weight per Grate**	**Grates per Chamber**
600 L	65 cm (25.6") × 54 cm (21.2")	272 kg (600 lb)	2
1100 L	81 cm (31.8") × 72 cm (28.3")	272 kg (600 lb)	2

Figure 10.2f: Diffuser level grate specifications and capacities.

11. Running a Test

11.1. Overview (Nov 2021)

To start running a test follow the steps listed below:

1. Mix salt (electrolyte) solution. See Section 7.1 and Section 8.1.
2. For “S” Model testers with the Stationary Shower Module (SSM), install shower module if programming a Shower step or remove shower module if programming a Fog step.
   See Section 7.3 and Section 8.10.
3. Program a test cycle. See Section 9.6 for test cycle programming information.
   - See Section 11.3.1 through Section 11.3.11 for examples of standard test cycles.
   - For custom test cycles, see the Chamber Temperature and RH Range charts, Figure 11.2a and Figure 11.2b for attainable chamber air temperature and relative humidity.
4. Calibrate temperature sensors. See Section 12.
5. For cycles with Fog steps, set the pump speed and the fog air pressure. See Section 12.
6. For cycles with Shower steps, set the shower pump pressure and the spray pulse rate. See Section 12.
7. Run a deposition test. See Section 12 for fog deposition and Section 12 for shower deposition. You may need to adjust the fog pump speed and fog pressure or shower pulse rate and shower pump pressure based on results of the deposition test.
8. Mount test specimens. See Section 10.2.
9. Set test time. See Section 9.6.
10. Start the test. See Section 9.2

NOTES: The first time a Fog step is run after initial setup, can take 15-45 minutes for the solution to start spraying out of the fog nozzles. This time can be shortened by opening the peristaltic pump head (see Section 8.5), then close the pump head when the solution starts flowing.

When changing solution type, run a fog step for 45 minutes before adding test specimens to purge the old solution.

11.2. Chamber Temperature and RH Range (Nov 2021)

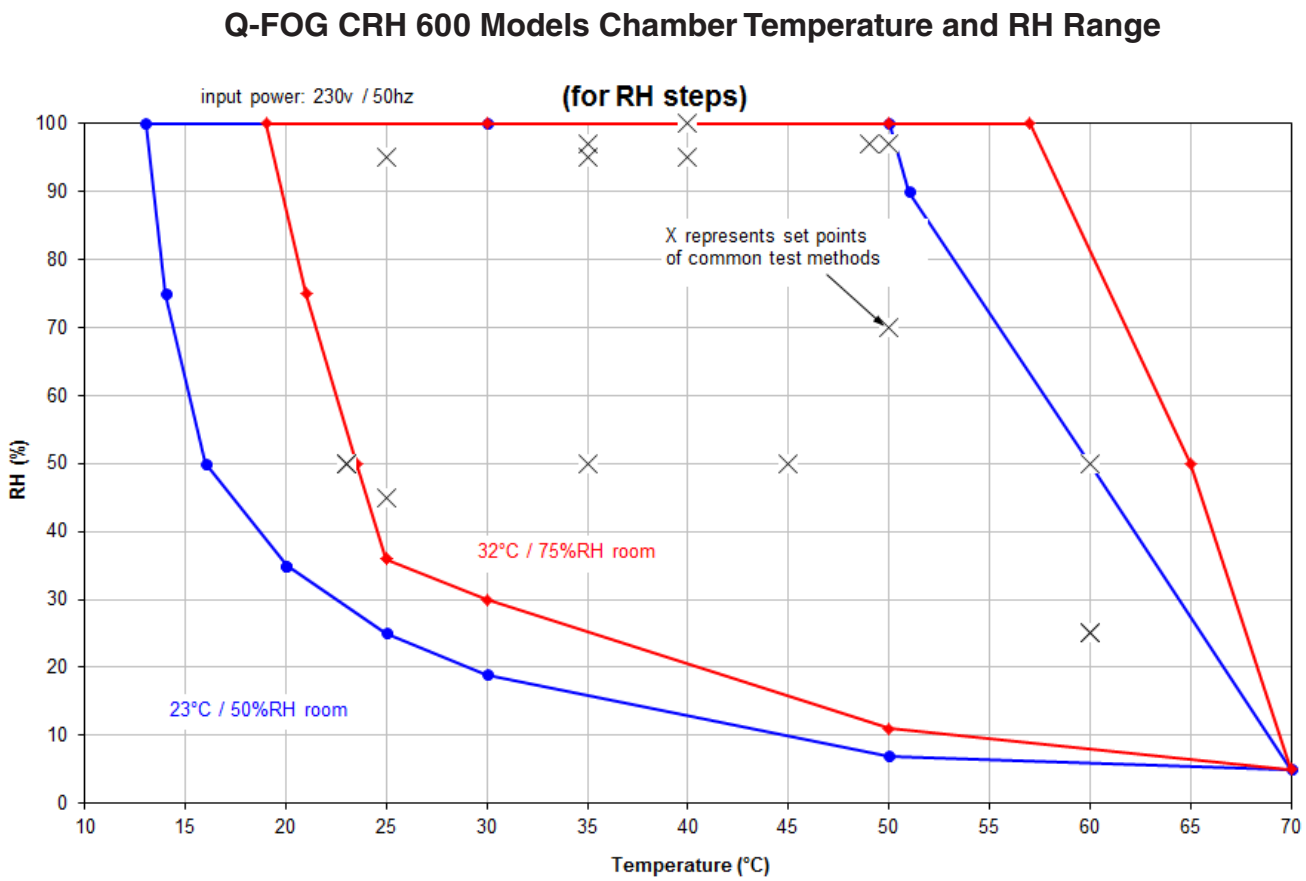


Figure 11.2a: Q-FOG CRH 600 temperature and RH range.

IMPORTANT: The boundaries shown in this graph should be considered typical but Q-Lab cannot guarantee all machines will operate at these limits.

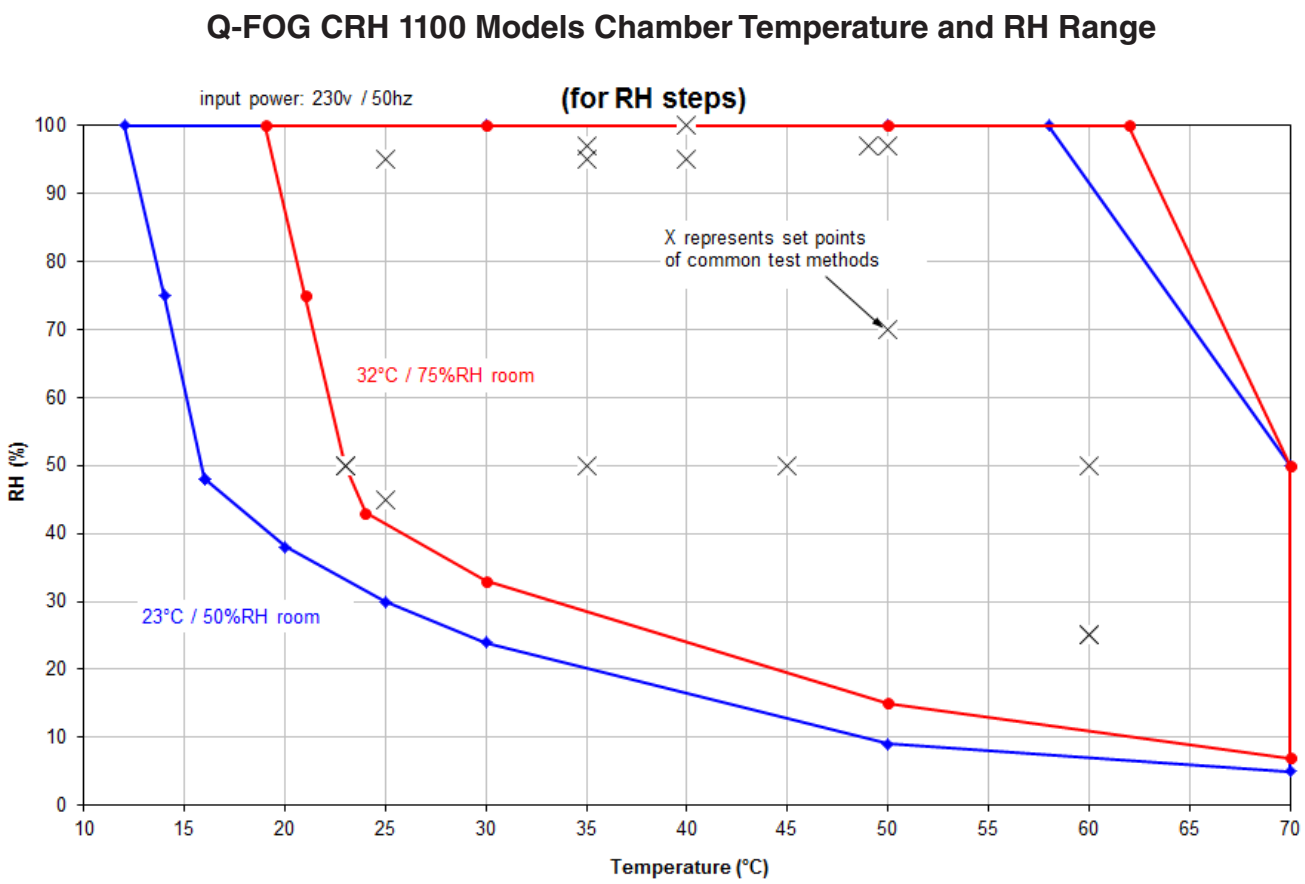


Figure 11.2b: Q-FOG CRH 1100 temperature and RH range.

IMPORTANT: The boundaries shown in these graphs should be considered typical but Q-Lab cannot guarantee all machines will operate at these limits.

11.3. Standard Test Cycles (Nov 2021)

- The sections below provide detailed information on programming Q-FOG CRH models to perform some of the most common corrosion test standards.
- All Q-FOG CRH testers come pre-programmed with any test(s) specified at the time of ordering.
- Additional information on these and many other test standards can be found by contacting Q-Lab or your local Q-Lab representative.

11.3.1 ASTM B117 (Nov 2021)

- ASTM B117 is the most widely-used corrosion test procedure but it is not a cyclic corrosion test. Samples remain wet at all times.
- Despite over 100 years of use, there has long been general agreement that ASTM B117 test results do not correlate as well with the corrosion seen in actual atmospheric exposures as cyclic tests do.
- This standard can be performed in all Q-FOG CRH Models.

ASTM B117

STEP	FUNCTION	Chamber Air Temp (°C)	RH (%)	Step Time (hh:mm)	Ramp	Ramp Time (hh:mm)
1	Fog	35		24:00		
2	Final Step – Go To Step 1					

Notes

Solution: 5% sodium chloride*

pH: 6.5 - 7.2*

*As measured in the collection vessels. The concentration and acidity of the solution are changed by heating and spraying. Adjust the mixture in the reservoir to achieve these values in the collection vessels.

Deposition Rate: 1 to 2 milliliters/hour

Fog Spray Pressure: Approximately 15 psi

Flow Rate: Approximately 0.45 liters/hour (model 600)

Approximately 0.7 liters/hour (model 1100)

11.3.2 ASTM G85 Annex 5 “Prohesion” (Dec 2021)

- The Prohesion test was developed in England for industrial maintenance coatings. The solution is much more dilute than traditional salt fog.
- This standard can be performed in all Q-FOG CRH Models.

ASTM G85 Annex 5						
STEP	FUNCTION	Chamber Air Temp (°C)	RH (%)	Step Time (hh:mm)	Ramp	Ramp Time (hh:mm)
1	Fog	25		1:00		
2	RH	35	25*	1:00	Auto	
3	Final Step – Go To Step 1					

* Indicates no value specified in the test method but a value is programmed into the tester

Notes

Solution: 0.05% sodium chloride & 0.35% ammonium sulfate*

pH: 5.0 - 5.4*

*As measured in the collection vessels. The concentration and acidity of the solution are changed by heating and spraying. Adjust the mixture in the reservoir to achieve these values in the collection vessels.

Deposition Rate: 1 to 2 milliliters/hour of fog time

Fog Spray Pressure: Approximately 15 psi

Flow Rate: Approximately 0.45 liters/hour (model 600)

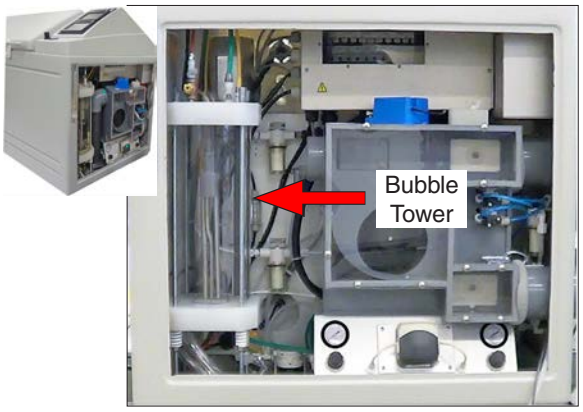
Approximately 0.7 liters/hour (model 1100)

IMPORTANT: Although the ASTM G85 standard requires use of non-humidified air for the Prohesion test (Annex 5) by bypassing or draining the bubble tower, Q-Lab’s own tests show minimal effect, if any, on chamber conditions or test results.

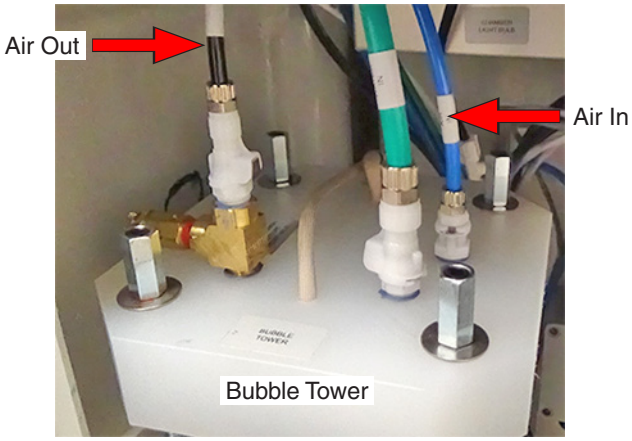
Additional Information:

- The primary benefit of the bubble tower is final filtration of compressed air, which can contain oil or other impurities if not thoroughly filtered.
- Bypassing the bubble tower introduces the possibility of these contaminates clogging the atomizing spray nozzle or reaching test specimens.
- Therefore, caution is advised when following the instructions below to bypass the bubble tower.
- See the next page for bubble tower bypass instructions.

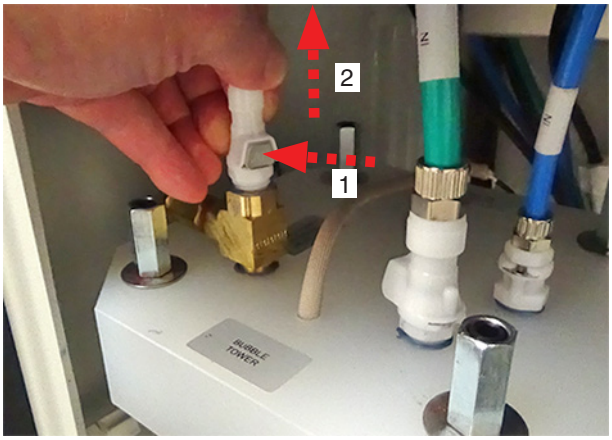
To Bypass the Bubble Tower



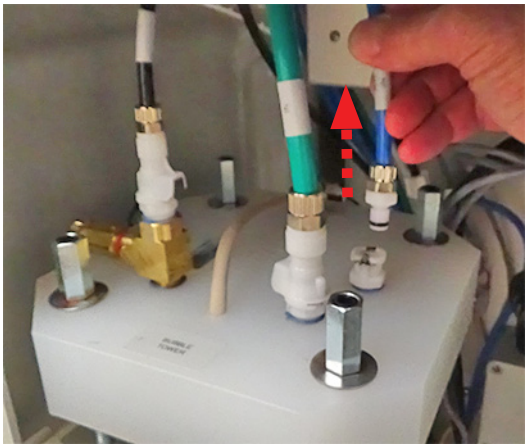
1. **IMPORTANT:** Turn off and lock out the air supply before proceding with these instructions. Remove the Q-FOG right side access panel.



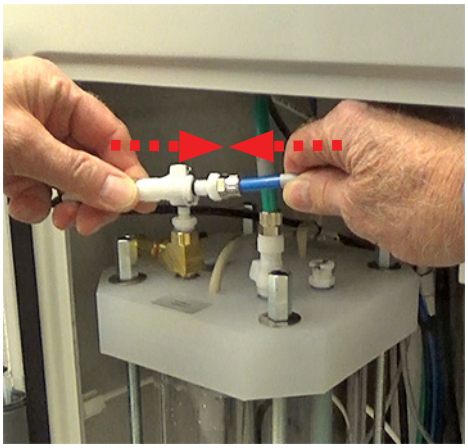
2. Locate the air in and the air out lines on the top of the bubble tower.



3. Disconnect the air out line from the bubble tower. Press in the fitting release tab to disconnect the line.



4. Disconnect the air in line from the bubble tower. Press in the fitting release tab to disconnect the line.



5. Connect the air lines together.

6. Replace the access door.

11.3.3 CCT-I (Nov 2021)

- CCT-I is in many standards. It is also sometimes called CCT-A.
- Sometimes ramp times are specified, sometimes they are not. Nissan NES M0007 requires them; MES M0158 does not.
- Users need to read the standard carefully. If there is a transition time requirement, then the rapid ramp heater (-HSCR, -HTCR models) are needed to meet the ramp times.

CCT-I

STEP	FUNCTION	Chamber Air Temp (°C)	RH (%)	Step Time (hh:mm)	Ramp	Ramp Time (hh:mm)
1	Fog	35		4:00		
2	RH	60	25*	2:00	Less Than	0:30
3	RH	50	95*	2:00	Less Than	0:15
4	Final Step – Go To Step 1					

* Indicates no value specified in the test method but a value is programmed into the tester.

Notes

Solution:	5% sodium chloride*
pH:	Not specified* *As measured in the collection vessels. The concentration and acidity of the solution are changed by heating and spraying. Adjust the mixture in the reservoir to achieve these values in the collection vessels.
Deposition Rate:	1 to 2 milliliters/hour of fog time
Fog Spray Pressure:	Approximately 15 psi
Flow Rate:	Approximately 0.45 liters/hour (600 models) Approximately 0.7 liters/hour (1100 models)
Additional Information:	HSCR and HTCR models meet the ramp times specified in this standard. HSC and HTC models do not meet the specified Step 2 to Step 3 ramp time. Because non-RRH models can't make the transitions, an Auto Ramp may need to programmed to avoid alarms.

11.3.4 JASO M609 (Nov 2021)

- JASO M609 is very similar to CCT-I, though the step times are different.
- JASO M609 always requires the step times to be met, unlike as with some versions of CCT-I.
- All Q-FOG CRH models can meet the conditions in each step, but CRH models with the Rapid Ramp Heater (-HSCR, -HTCR) are is needed to meet the ramp times.

JASO M609

STEP	FUNCTION	Chamber Air Temp (°C)	RH (%)	Step Time (hh:mm)	Ramp	Ramp Time (hh:mm)
1	Fog	35		2:00	Less Than	00:30
2	RH	60	25	4:00	Less Than	00:30
3	RH	50	100	2:00	Less Than	00:15
4	Final Step – Go To Step 1					

Notes

Solution: 5% sodium chloride

pH: 6.5 - 7.2

Deposition Rate: 1 to 2 milliliters/hour of fog time

Fog Spray Pressure: Approximately 15 psi

11.3.5 Ford CETP: 00.00-L-467 (Dec 2021)

- Conditions in this standard can be met in all Q-FOG CRH models; the language in the standard requiring that solution be directed downward onto specimens, however, requires the use of a Q-FOG/CRH1100-HTCR or -HTC model.

Ford CETP 00.00-L-467

STEP	FUNCTION	Chamber Air Temp (°C)	RH (%)	Step Time (hh:mm)	Ramp	Ramp Time (hh:mm)
1	Subcycle Repeat Steps 2-10, 5×					
2	Shower	25		0:10		
3	RH	25	95	0:20	Auto	
4	Shower	25		0:03		
5	RH	25	95	2:27	Auto	
6	Shower	25		0:03		
7	RH	25	95	2:54	Auto	
8	Shower	25		0:03		
9	RH	40	95	0:30	Less Than	0:30
10	RH	50	70	17:30	Linear	2:00
11	RH	50	70	48:00	Auto	
12	Final Step – Go To Step 1					

Notes

Solution: Sodium Chloride (NaCl): 0.50%*

pH: Not specified

*As measured in the collection vessels. The concentration and acidity of the solution are changed by heating and spraying. Adjust the mixture in the reservoir to achieve these values in the collection vessels.

Shower Deposition Rate: Local – each collection vessel must be within 3-15 L/m^2 after running the 19 minutes of shower time in steps 1-7. This is equivalent to 24-118 ml if using 10 cm diameter funnels to collect the solution.

Average – the average of all collection vessels must be within 5-10 L/m^2 after running the 19 minutes of shower time in steps 1-7. This is equivalent to 39-79 ml if using 10 cm diameter funnels to collect the solution.

Shower Pulse Rate: Spray ON / OFF is set in Machine Configuration.
Q-FOG/CRH1100-HTCR or -HTC: 9 seconds ON, 27 seconds OFF.

Shower Pump Pressure: Q-FOG/CRH1100-HTCR or -HTC: 40 psi

11.3.6 GMW 14872, GM9540P (Nov 2021)

- This standard can be performed in all Q-FOG CRH Models.

GMW 14872, GM9540P						
STEP	FUNCTION	Chamber Air Temp (°C)	RH (%)	Step Time (hh:mm)	Ramp	Ramp Time (hh:mm)
1	Subcycle Repeat steps 2-4 4×					
2	RH	25	45	0:27	Auto	
3	Shower	25		0:03		
4	RH	25	45	1:30	<	
5	RH	49	100	7:30	Linear	1:00
6	RH	49	95	0:30	Auto	
7	RH	60	25	8:00	Linear	3:00
8	Final Step – Go To Step 1					

Notes

Solution: Sodium Chloride (NaCl): 0.9%

Calcium Chloride ($CaCl_2$): 0.1%

Sodium Bicarbonate ($NaHCO_3$): 0.075%

pH: Not specified

Shower Pulse Rate: Spray ON / OFF is set in Machine Configuration.
CRH600: 18 sec. ON 12 sec. OFF.
CRH1100: 13 sec. ON 17 sec. OFF.
Spray ON time may be increased or decreased to adjust mass loss rates of coupons.

Shower Pump Pressure: 50 psi

Additional Information: Calcium Carbonate ($CaCo_3$) precipitate is created by the solution used in this test. This precipitate will build up inside the Q-FOG reservoir and can clog the shower system filters, hoses and nozzles. Calcium carbonate is not soluble in water.

Therefore, do not attempt to mix precipitate seen in the reservoir back into the solution. If a premixed solution is used, do not pour visible precipitate into the reservoir. See Section 14.5 for shower system cleaning directions.

11.3.7 ISO 16701, GB/T 20853 (Nov 2021)

- This standard can be performed in all Q-FOG CRH Models.

ISO 16701, GB/T 20853

STEP	FUNCTION	Chamber Air Temp (°C)	RH (%)	Step Time (hh:mm)	Ramp	Ramp Time (hh:mm)
1	Subcycle Repeat Steps 2-3 3×					
2	Shower	35		0:15		
3	RH	35	97	1:45	Auto	
4	RH	35	50	4:00	Linear	2:00
5	RH	35	95	2:00	Linear	2:00
6	Subcycle Repeat Steps 7-9 6×					
7	RH	35	95	4:00	Auto	
8	RH	35	50	6:00	Linear	2:00
9	RH	35	95	2:00	Linear	2:00
10	Final Step – Go To Step 1					

Notes

Solution: Sodium Chloride (NaCl): 1.0%*

pH: 4.1 - 4.3*

*As measured in the collection vessels. The concentration and acidity of the solution are changed by heating and spraying. Adjust the mixture in the reservoir to achieve these values in the collection vessels.

Shower Deposition Rate: 80 to 160 milliliters/hour.

Shower Pulse Rate: Spray ON / OFF is set in Machine Configuration.
CRH600: 25 seconds ON, 35 seconds OFF.
CRH1100: 20 seconds ON, 40 seconds OFF.

Shower Pump Pressure: CRH600: 40 psi
CRH1100: 80 psi

11.3.8 Renault D17-2028 (ECC1) (Nov 2021)

- This standard can be performed in all Q-FOG CRH Models.

Renault D17-2028 - Corrosion Test by Automatic Phase Change Salt Spray Humidity and Drying (ECC1)						
STEP	FUNCTION	Chamber Air Temp (°C)	RH (%)	Step Time (hh:mm)	Ramp	Ramp Time (hh:mm)
1	Fog	35		0:35		
2	Rinse*	35		0:05		
3	Fog	35		0:05		
4	RH	35	20	1:40	Linear	1:30
5	RH	35	55	1:35	Auto	
6	Subcycle Repeat Steps 7-8, 5×					
7	RH	35	90	1:20	Auto	
8	RH	35	55	2:40	Auto	
9	Final Step – Go To Step 1					

Notes

Solution: Sodium Chloride (NaCl): 1.0%
As measured in the collection vessels. The concentration and acidity of the solution are changed by heating and spraying. Adjust the mixture in the reservoir to achieve these values in the collection vessels.

pH: 4.0

Deposition Rate: 4 to 6 milliliters/hour of fog time

Fog Spray Pressure: Approximately 12 psi (model 600)

Approximately 16 psi (model 1100)

Additional Information: * This test requires the wall wash accessory (see Section 8.19). Testers ordered to run ECC1 should have these accessories factory-installed. If the wall wash option not installed, a retrofit is available, part number F-70001-K or F-70002-K.

It is highly recommended that the two-point RH adjustment be performed before running this test. Contact Q-Lab Repair and Tester Support for more information.

Contact Q-Lab for important information about setting the fog purge time.

The test method requires a larger diameter peristaltic pump tube (2.4 mm instead of 1.6 mm) than all other test methods. The larger diameter pump tube is included in kit number F-70123-K.

11.3.9 SAE J2334, SAE J2721 (Sep 2019)

- This standard can be performed in all Q-FOG CRH Models.

SAE J2334, SAE J2721						
STEP	FUNCTION	Chamber Air Temp (°C)	RH (%)	Step Time (hh:mm)	Ramp	Ramp Time (hh:mm)
1	RH	50	100	6:00	Auto	
2	Shower	25		0:15		
3	RH	60	50	17:45	Linear	2:00
4	Final Step – Go To Step 1					

Notes

Solution: Sodium Chloride (NaCl): 0.5%*

Calcium Chloride ($CaCl_2$): 0.1%*

Sodium Bicarbonate ($NaHCO_3$): 0.075%*

pH: Not specified

*As measured in the collection vessels. The concentration and acidity of the solution are changed by heating and spraying. Adjust the mixture in the reservoir to achieve these values in the collection vessels.

Shower Deposition Rate: Not Specified

Shower Pulse Rate: Spray ON / OFF is set in Machine Configuration.
CRH600: 25 seconds ON, 35 seconds OFF.
CRH1100: 20 seconds ON, 40 seconds OFF.

Shower Pump Pressure: CRH600: 40 psi
CRH1100: 80 psi

11.3.10 Volkswagen PV 1210 (Mar 2015)

- This standard can be performed in all Q-FOG CRH Models.

Volkswagen PV 1210						
STEP	FUNCTION	Chamber Air Temp (°C)	RH (%)	Step Time (hh:mm)	Ramp	Ramp Time (hh:mm)
1	Subcycle Repeat Steps 2-4 5×					
2	Fog	35		4:00		
3	RH	23	50	4:00	Auto	
4	RH	40	100	16:00	Auto	
5	RH	23	50	48:00	Auto	
6	Final Step – Go To Step 1					

Notes

Solution: Sodium Chloride (NaCl): 5.0%*

pH: 6.5 - 7.2*

*As measured in the collection vessels. The concentration and acidity of the solution are changed by heating and spraying. Adjust the mixture in the reservoir to achieve these values in the collection vessels.

Fog Deposition Rate: 1 to 2 milliliters/hour of fog time

Fog Spray Pressure: Approximately 15 psi

Flow Rate: Approximately 0.45 liters/hour (model 600)
Approximately 0.7 liters/hour (model 1100)

11.3.11 Volvo VCS 1027,14; 1027,149; 423-0014 (Dec 2021)

- Conditions in this standard can be met in all Q-FOG CRH models; the language in the standard requiring that solution be directed downward onto specimens, however, requires the use of a Q-FOG/CRH1100-HTCR or -HTC model.

Volvo VCS 1027,14; 1027,149; 423-0014						
STEP	FUNCTION	Chamber Air Temp (°C)	RH (%)	Step Time (hh:mm)	Ramp	Ramp Time (hh:mm)
1	Subcycle Repeat Steps 2-3 3×					
2	Shower	35		0:15		
3	RH	35	97	1:45	Auto	
4	RH	45	50	4:00	Linear	2:00
5	RH	35	95	2:00	Linear	2:00
6	Subcycle Repeat Steps 7-9 7×					
7	RH	35	95	4:00	Auto	
8	RH	45	50	6:00	Linear	2:00
9	RH	35	95	2:00	Linear	2:00
10	Subcycle Repeat Steps 11-12 3×					
11	Shower	35		0:15		
12	RH	35	97	1:45	Auto	
13	RH	45	50	4:00	Linear	2:00
14	RH	35	95	2:00	Linear	2:00
15	Subcycle Repeat Steps 16-18 5×					
16	RH	35	95	4:00	Auto	
17	RH	45	50	6:00	Linear	2:00
18	RH	35	95	2:00	Linear	2:00
19	Final Step - Go To Step 1					

Notes

Solution: Sodium Chloride (NaCl): 1.0% ± 0.1% by weight*

pH: ~ 4.2*
*As measured in the collection vessels. The concentration and acidity of the solution are changed by heating and spraying. Adjust the mixture in the reservoir to achieve these values in the collection vessels.

Shower Deposition Rate: 80 to160 milliliters/hour of shower time

Shower Pulse Rate: Spray ON / OFF is set in Machine Configuration.
Q-FOG/CRH1100-HTCR or -HTC: 9 seconds ON, 27 seconds OFF.

Shower Pump Pressure: Q-FOG/CRH1100-HTCR or -HTC: 40 psi

11.3.12 Volvo VCS 423-0014 (Dec 2021)

- Conditions in this standard can be met in all Q-FOG CRH models; the language in the standard requiring that solution be directed downward onto specimens, however, requires the use of a Q-FOG/CRH1100-HTCR or -HTC model.

Volvo VCS 423-0014						
STEP	FUNCTION	Chamber Air Temp (°C)	RH (%)	Step Time (hh:mm)	Ramp	Ramp Time (hh:mm)
1	RH	35	95	4:00	Auto	
2	RH	45	50	6:00	Linear	2:00
3	RH	35	95	2:00	Linear	2:00
4	Subcycle Repeat Steps 5-6 3x					
5	Shower	35		0:15		
6	RH	35	97	1:45	Auto	
7	RH	45	50	4:00	Linear	2:00
8	RH	35	95	2:00	Linear	2:00
9	Subcycle Repeat Steps 10-12 7×					
10	RH	35	95	4:00	Auto	
11	RH	45	50	6:00	Linear	2:00
12	RH	35	95	2:00	Linear	2:00
13	Subcycle Repeat Steps 14-15 3×					
14	Shower	35		0:15		
15	RH	35	95	1:45	Auto	
16	RH	45	50	4:00	Linear	2:00
17	RH	35	95	2:00	Linear	2:00
18	Subcycle Repeat Steps 19-21 4×					
19	RH	35	95	4:00	Auto	
20	RH	45	50	6:00	Linear	2:00
21	RH	35	95	2:00	Linear	2:00
22	Final Step - Go To Step 1					

Notes

Solution: Sodium Chloride (NaCl): 1.0% ± 0.1% by weight*

pH: ~ 4.2*
*As measured in the collection vessels. The concentration and acidity of the solution are changed by heating and spraying. Adjust the mixture in the reservoir to achieve these values in the collection vessels.

Shower Deposition Rate: 80 to160 milliliters/hour of shower time

Shower Pulse Rate: Spray ON / OFF is set in Machine Configuration.
Q-FOG/CRH1100-HTCR or -HTC: 9 seconds ON, 27 seconds OFF.

Shower Pump Pressure: Q-FOG/CRH1100-HTCR or -HTC: 40 psi

12. Calibration

Several types of calibration are required for Q-FOG CRH testers:

- Chamber Temperature Sensor, Wet and Dry Bulb Thermometer Calibration (Section 12.1)
  - Wet Bulb Water Level Adjustment (Section 12.2)
- Deposition Verification (Section 12.3)
  - Fog (Section 12.3.1)
  - Shower (Section 12.3.2)
- Set Shower Flow Alarm Rate Limit (Section 12.4)
- Damper Adjustment (Section 12.6)

12.1. Chamber Temperature Sensor, Wet / Dry Bulb Thermometer Calibration (Nov 2021)

- For accurate temperature and relative humidity readings, the chamber air temperature sensor and chamber relative humidity wet and dry bulb thermometers must be calibrated.
- Calibrate the thermometers every six months in accordance with ASTM E220.
- The Q-FOG CRH Temp Sensor Calibration Kit (see Tools Required below) is supplied with the tester for use in calibrating the chamber air temperature sensor and chamber relative humidity wet and dry bulb thermometers.
- The Q-FOG CRH Wet/Dry Wick Replacement Kit (see Tools Required below) is supplied with the tester for replacing the wet/dry bulb wick after sensor calibration. The kit includes instructions for wick replacement.
- After calibration the wet bulb water supply level must be measured and adjusted if necessary.

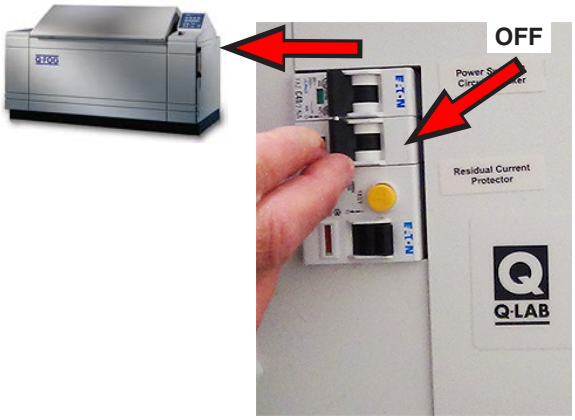
Tools Required

Reference Thermometer	Ruler or Scale	Temperature Sensor Calibration Kit (F-9395-K)
Hot Water	Phillips Screw Driver	Wet/Dry Bulb Wick Kit (F-8017.5-K)

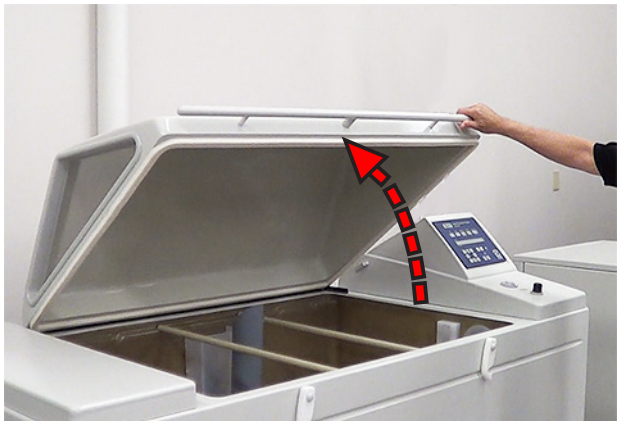
- Follow the procedure below to calibrate the thermometers.

1. Touch **STOP** on the Status Screen.

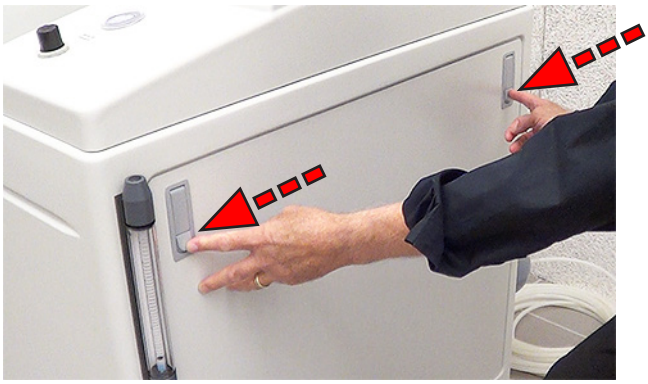
2. Wait at least **15 minutes** for the purge blower to clear the chamber of mist or fog.



3. Power the tester **OFF.**

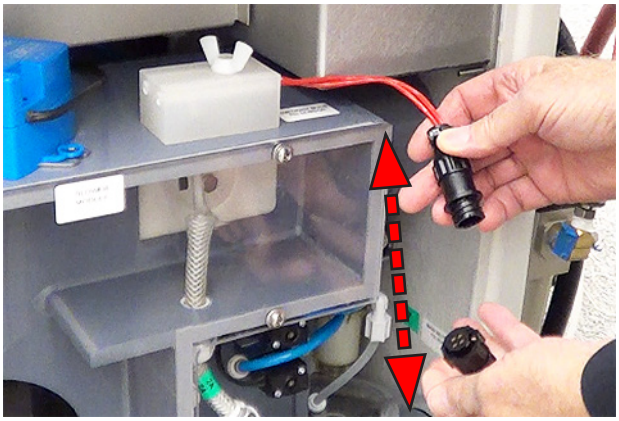


4. Undo latches and open the Q-FOG chamber lid.

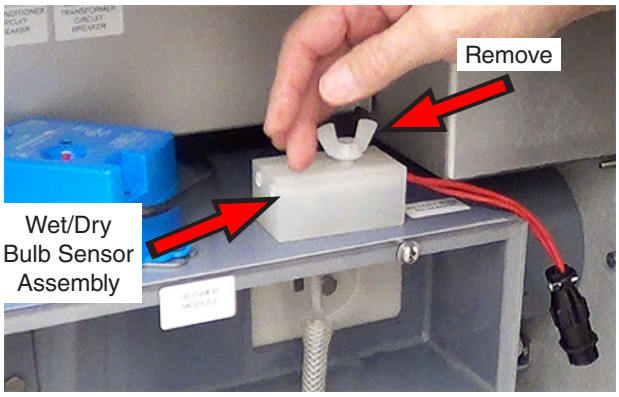


5. Open the latches on the Q-FOG side access panel.

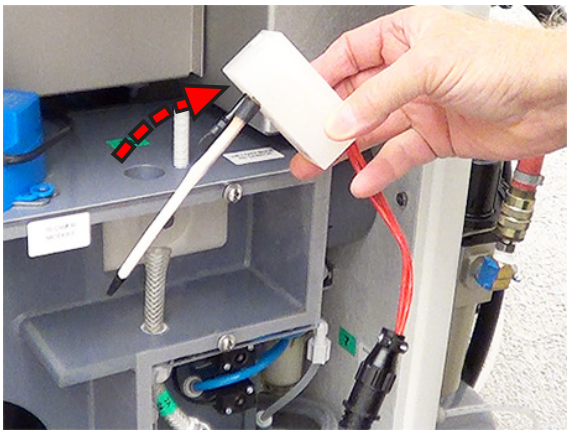
6. Remove the panel.



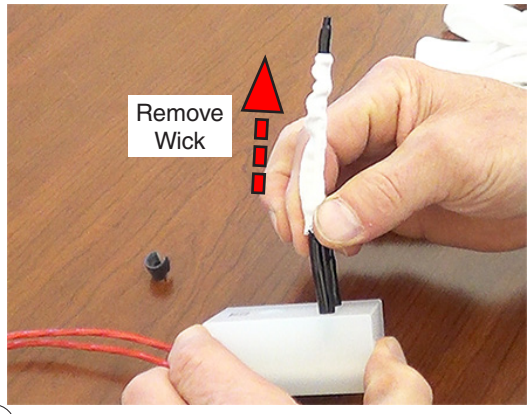
7. Disconnect the wet/dry bulb sensor cable.



8. Remove the wing nut on the wet/dry bulb sensor assembly. Save the nut.



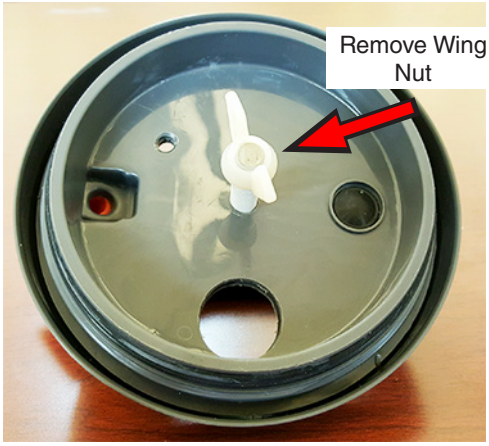
9. Remove the wet/dry bulb sensor assembly from the tester.



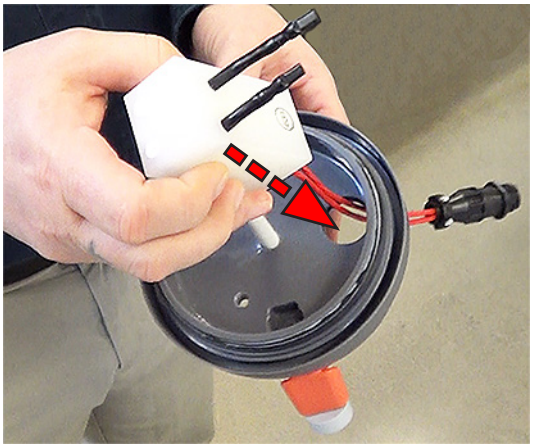
10. Remove the wick from the wet/dry bulb sensor. See *F-8017.5-L CRH Wet/Dry Bulb Wick Replacement* (supplied with the tester) for wick removal instructions.

11. Locate the insulated calibration container in the kit.

12. Remove the insulated calibration container lid.

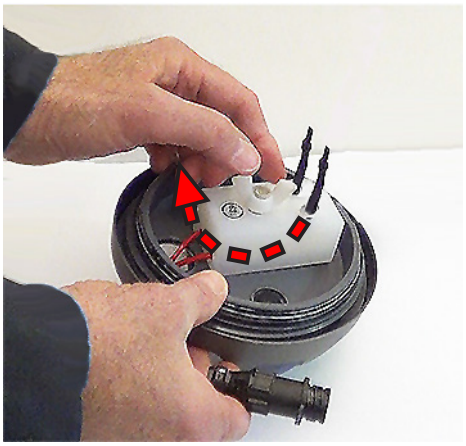


13. On the bottom of the lid remove the wing nut from the mounting stud. Set aside.



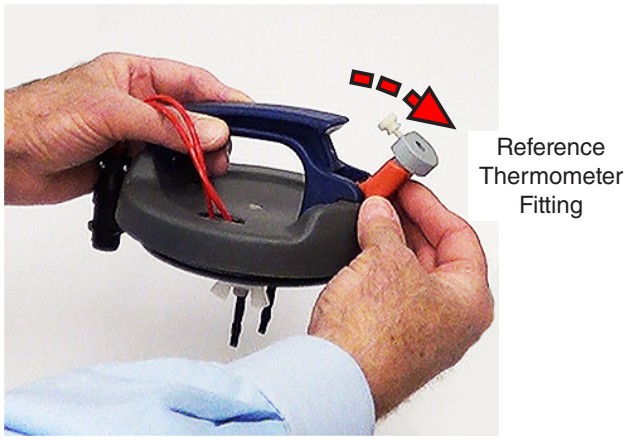
14. From the inside of the lid, run the wet/dry bulb sensor cable through the large opening in the lid.

15. Install the wet/dry bulb sensor on the threaded stud in the lid.

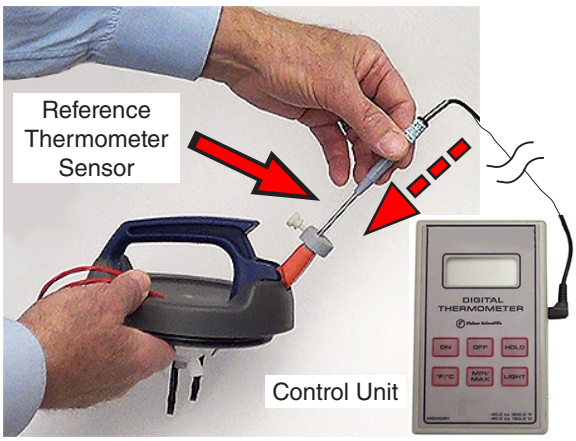


16. Align the sensor block as shown. Reinstall the wing nut on the stud. Hand tighten.

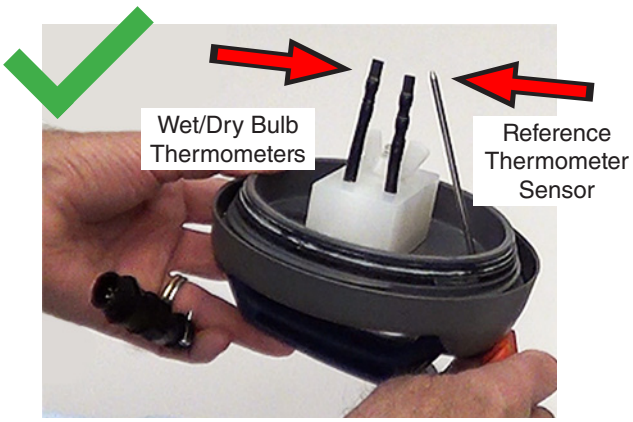
17. Fill the container to 20 mm below the top with hot water. The water should be approximately the same temperature as the highest temperature programmed in the test cycle.



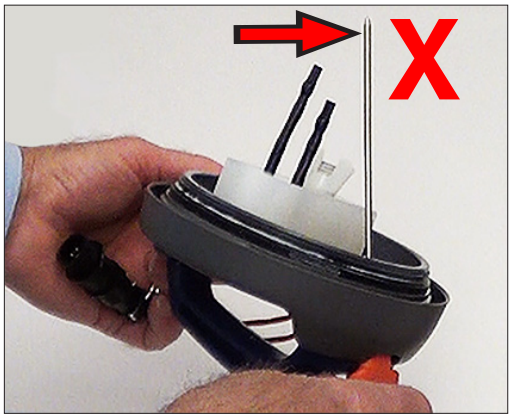
18. Rotate the reference thermometer fitting away from the handle on the insulated calibration container lid.



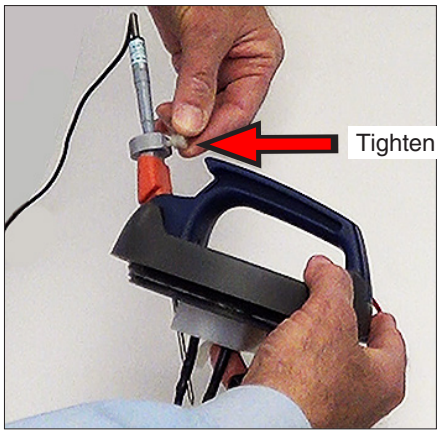
19. Insert the reference thermometer sensor into the reference thermometer fitting in the lid.



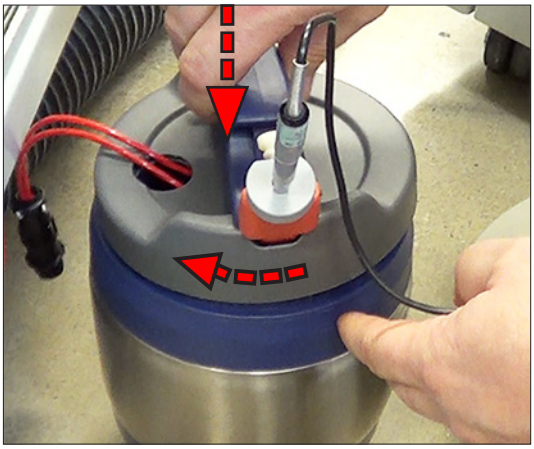
20. Make sure that the reference thermometer sensor extends out of the lid about the same distance as the wet and dry bulb thermometers.



21. Make sure that the reference thermometer sensor **does not** extend past the wet and dry bulb thermometers.

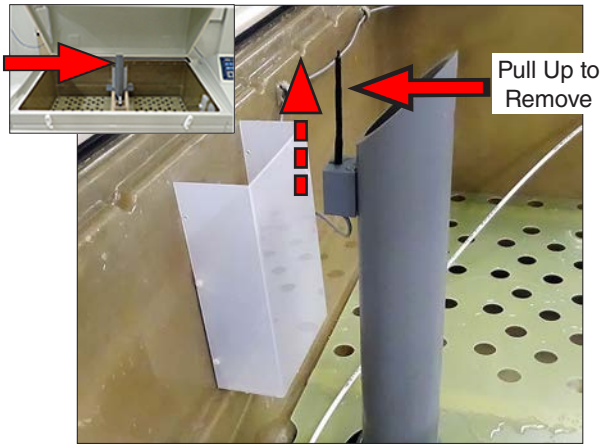


22. Hand tighten the reference thermometer fitting thumbscrew to hold the reference thermometer sensor in place.

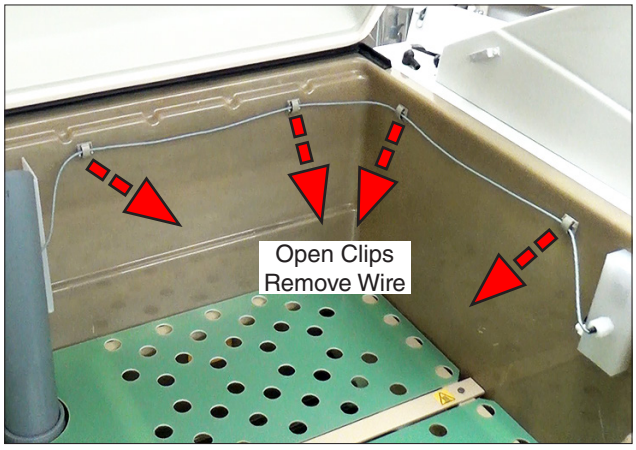


23. Replace the lid on the insulated calibration container. Tighten the lid.

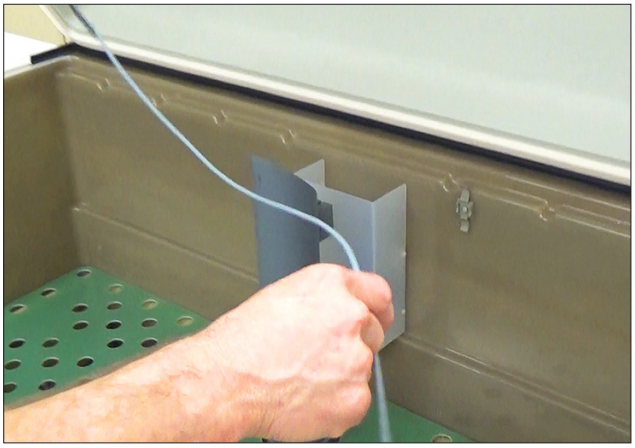
24. Reconnect the wet/dry bulb sensor cable.



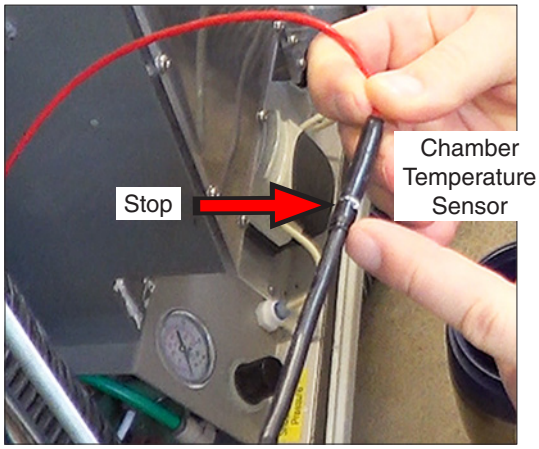
25. Remove the chamber temperature sensor from its mount on the vent inside the chamber.



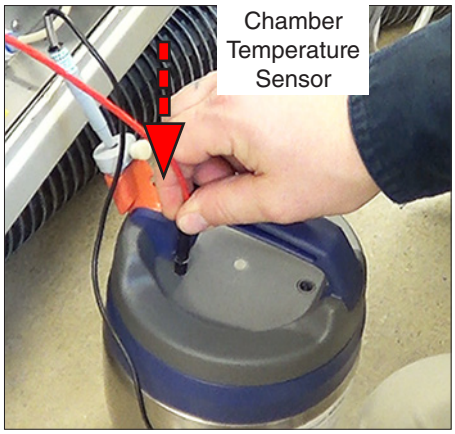
26. Remove the chamber temperature sensor wire from the four (4) clips on the chamber wall.



27. Carefully lift the sensor and wire out of the chamber.



28. Locate the stop on the sensor.

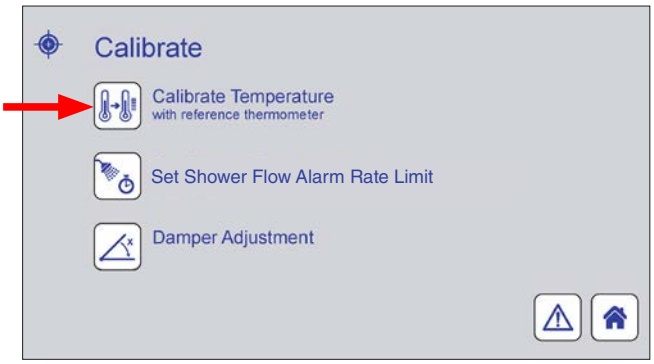


29. Insert the sensor into the small hole in the insulated calibration container lid. Push the sensor down until the sensor stop contacts the lid.

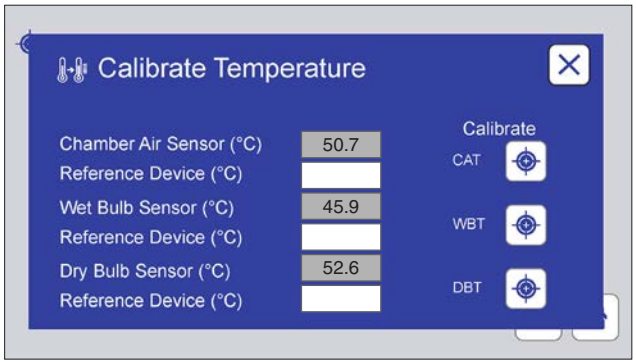
30. Power Q-FOG **ON**.

31. Before continuing you **MUST** wait a minimum of 15 minutes for the sensors to stabilize.

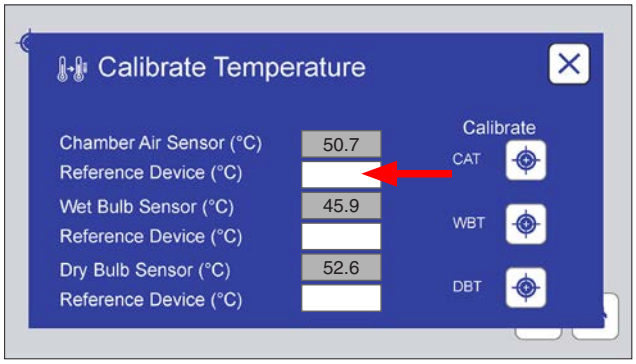
32. Touch the Calibrate icon on the Main Menu screen.



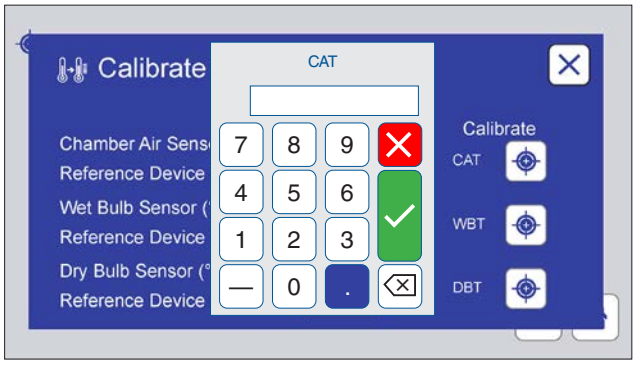
33. The Calibrate screen is displayed. Touch the Calibrate Temperature icon.



34. The Calibrate Temperature screen is displayed. The current reading of the chamber air, wet bulb, and dry bulb sensors is displayed.

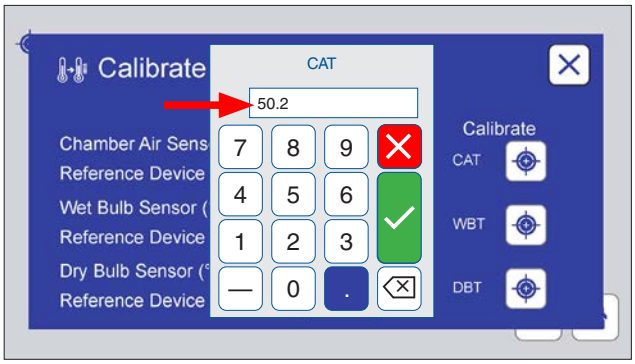


35. Touch the Reference Device text box immediately below the Chamber Air Sensor test box.

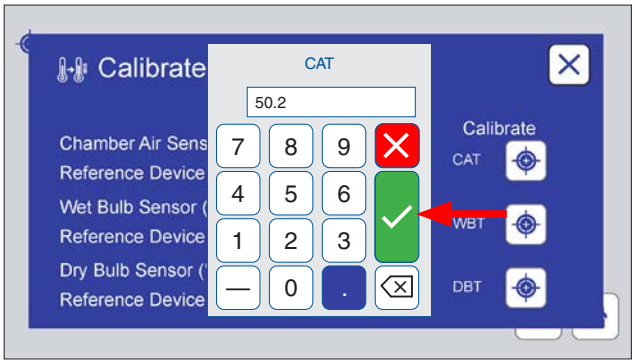


36. The Reference Device temperature entry keypad is displayed.

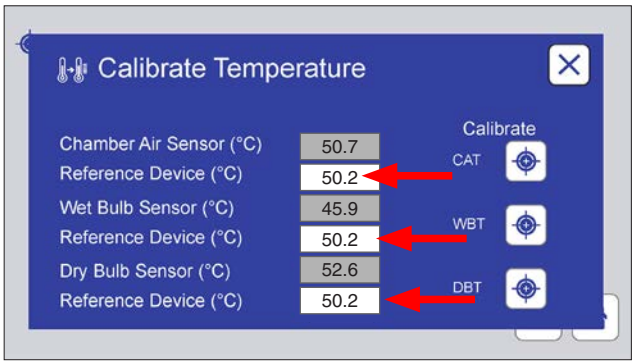
37. Read the temperature displayed on the reference thermometer.



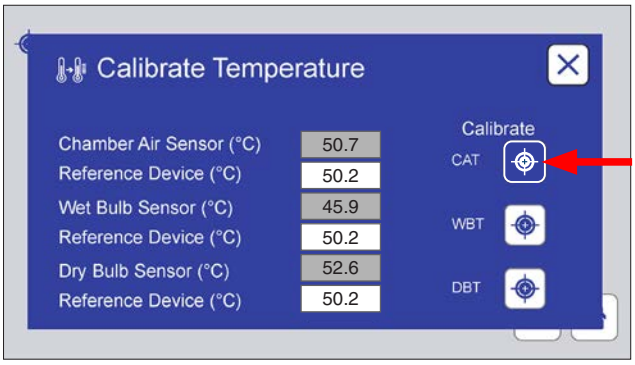
38. Use the keypad to enter the reference temperature into the Reference Device text box.



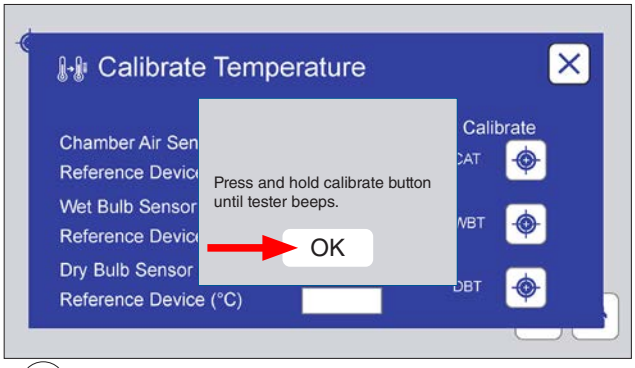
39. Touch the Check Mark icon. The keypad is closed.



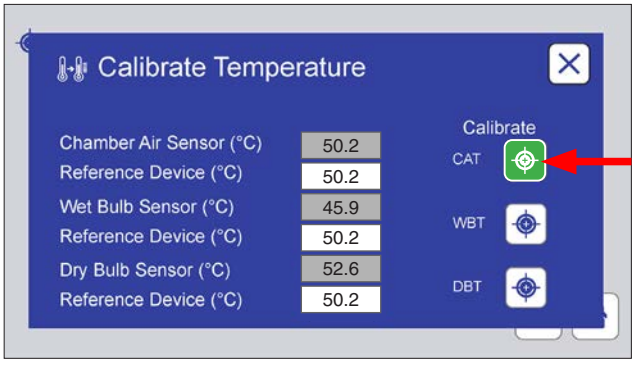
40. The reference temperature is in the Reference Device text boxes.



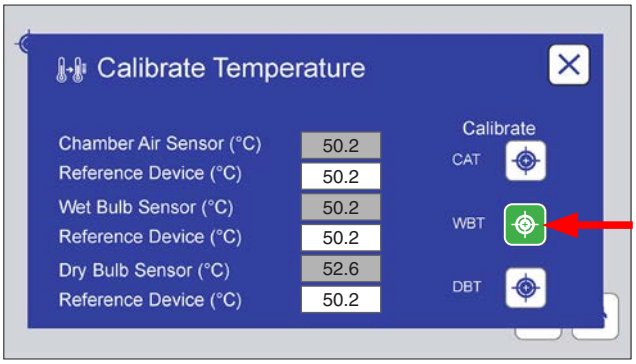
41. Press and hold the CAT Calibrate icon until the tester beeps.



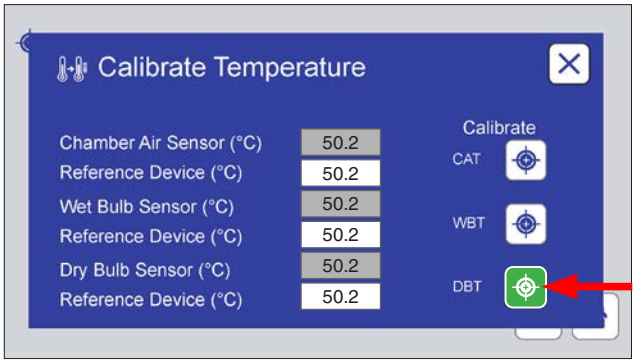
42. If the button is not pressed long enough, this message is displayed. Touch the OK button to close the message. Press and hold the calibrate button again until the tester beeps.



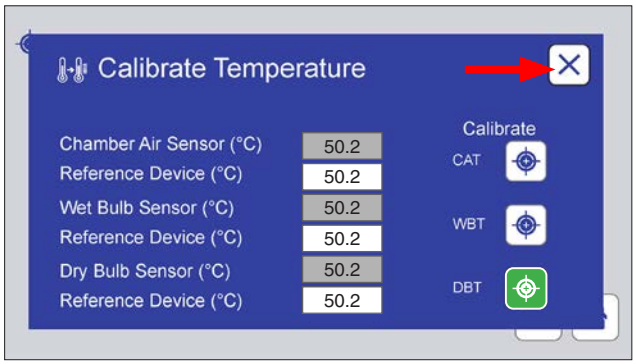
43. The Calibrate icon turns green indicating successful temperature sensor calibration.



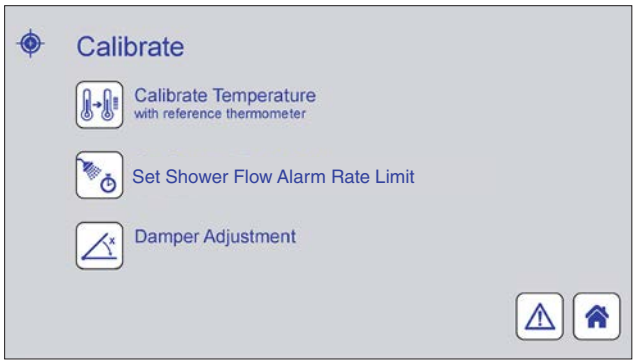
44. Repeat Step 35 through Step 43 to calibrate the Wet Bulb Sensor.



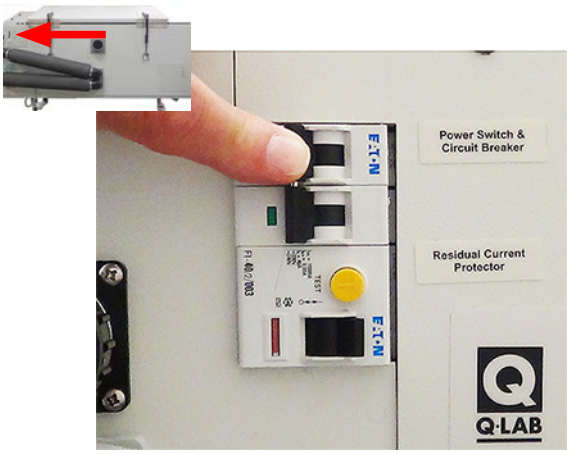
45. Repeat Step 35 through Step 43 to calibrate the Dry Bulb Sensor.



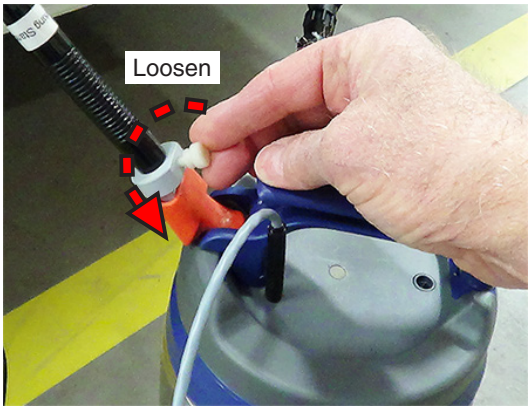
46. Touch the X icon to close the Calibrate Temperature screen.



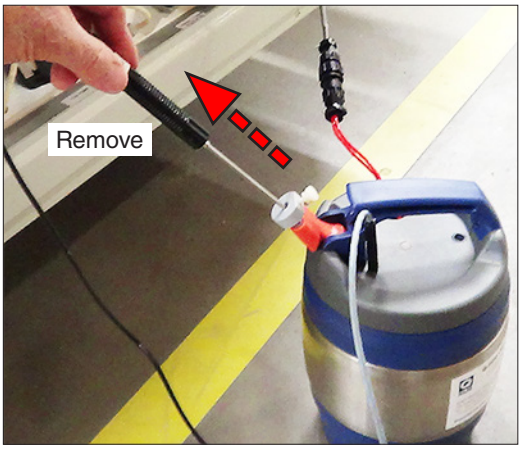
47. The Calibrate screen is displayed.



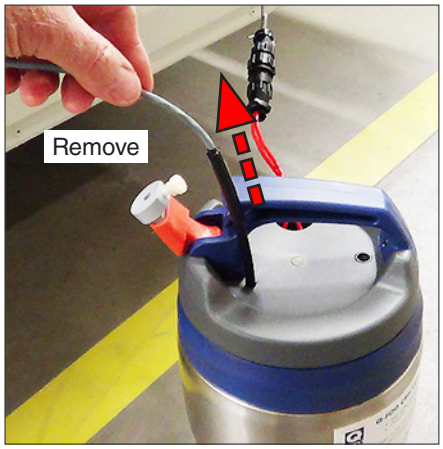
48. Power **OFF** the Q-FOG.



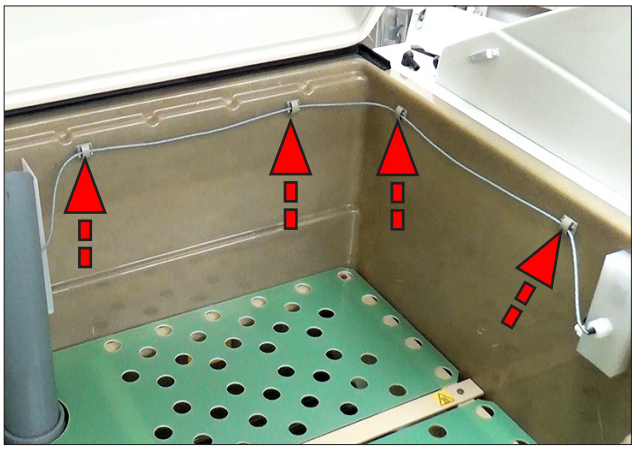
49. Loosen the thumbscrew on the reference thermometer sensor fitting on the insulated calibration container lid.



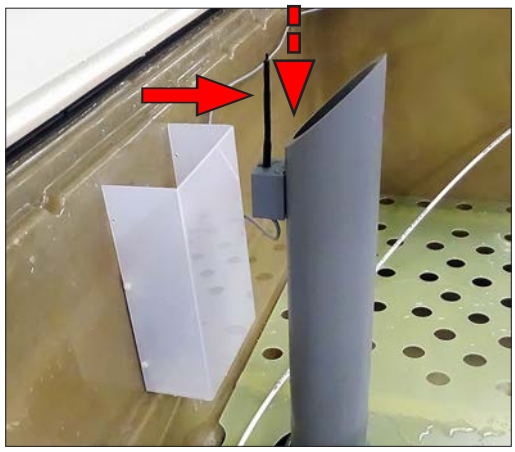
50. Remove reference thermometer sensor from the insulated calibration container.



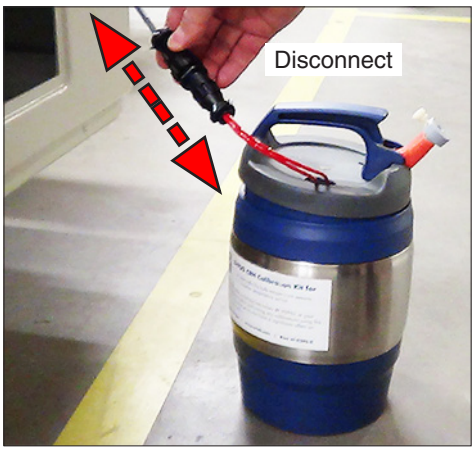
51. Remove the chamber temperature sensor from the insulated calibration container.



52. Install the chamber temperature sensor wire in the clips on the chamber wall. Close the clips.

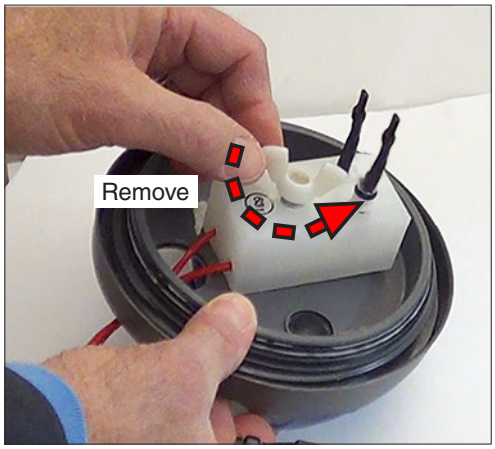


53. Insert the sensor in the slot on the mounting block on the vent tube.

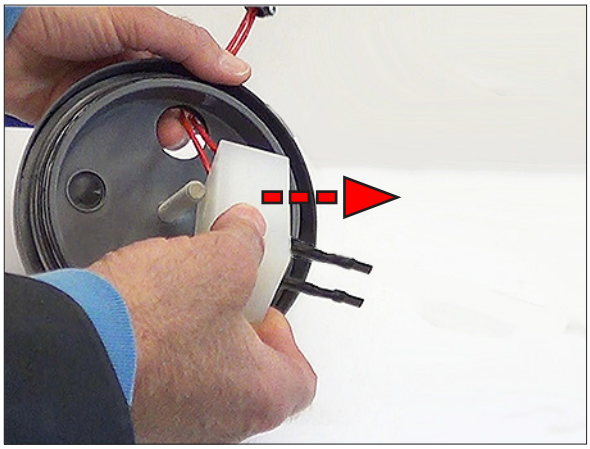


54. Disconnect the wet/dry bulb sensor cable.

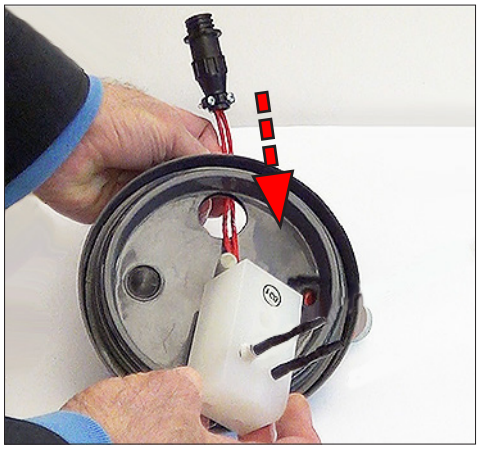
55. Remove the lid from the insulated calibration container.



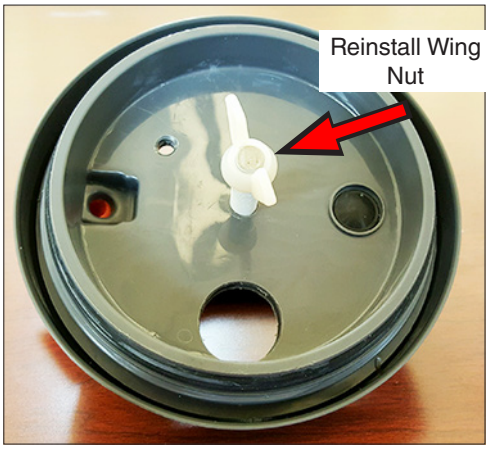
56. Remove the wing nut from the stud through the sensor block.



57. Remove the sensor block from the threaded stud.

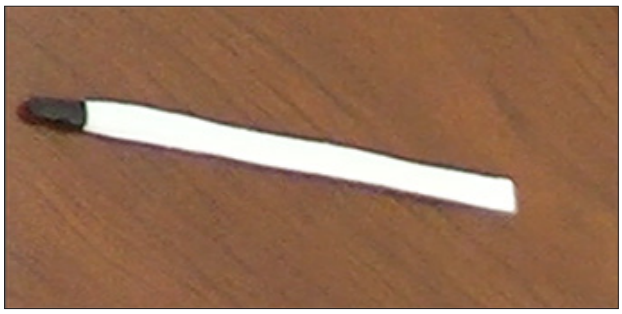


58. Pull the sensor cable out of the hole in the lid.



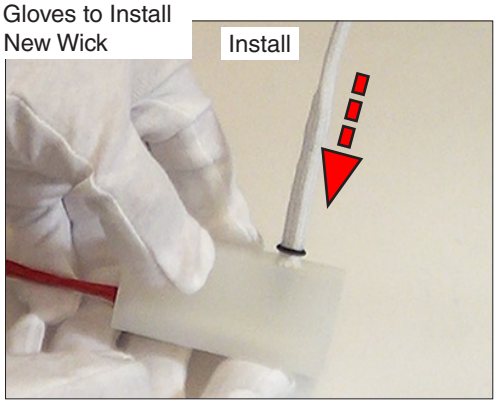
59. Reinstall the wing nut on the mounting stud.

60. Empty the water from the insulated calibration container and replace the lid. Save the insulated calibration container for future calibrations.



61. Locate a new wick in the Q-FOG CRH Wet/Dry Bulb Wick Replacement kit. (F-8017.5-K)

Wear Gloves to Install New Wick



62. Install a new wick on the wet/dry bulb sensor. See *F-8017.5-L CRH Wet/Dry Bulb Wick Replacement* (supplied with the tester) for wick installation instructions.

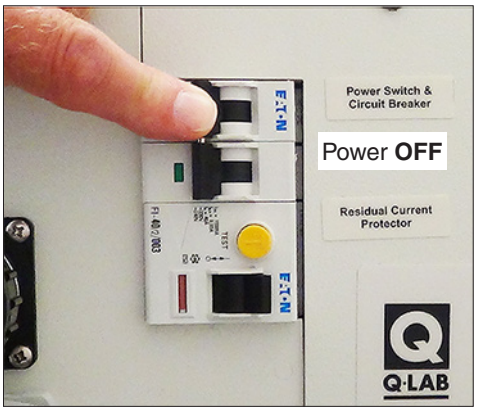
After temperature calibration, the wet bulb water supply level must be measured and adjusted if necessary.

Continue with the Wet Bulb Water Level Measurement and Adjustment instructions (Section 12.2).

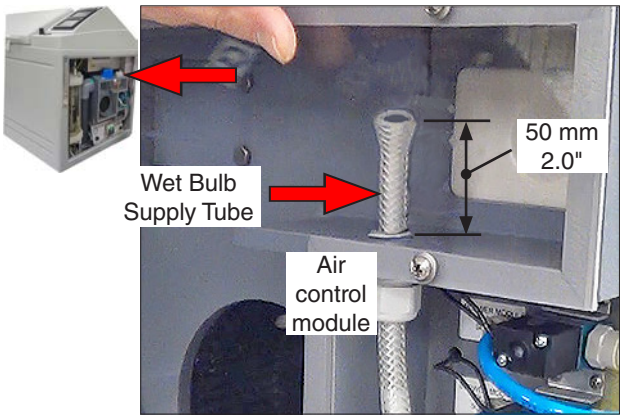
63. Go to the section indicated above.

12.2. Wet Bulb Water Level Measurement and Adjustment

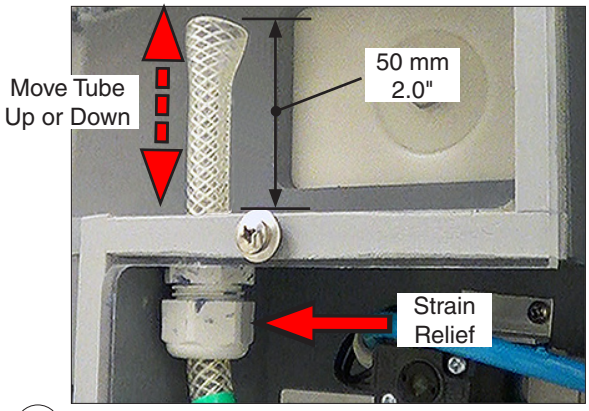
- Follow the instructions below to measure and adjust the wet bulb water supply level.



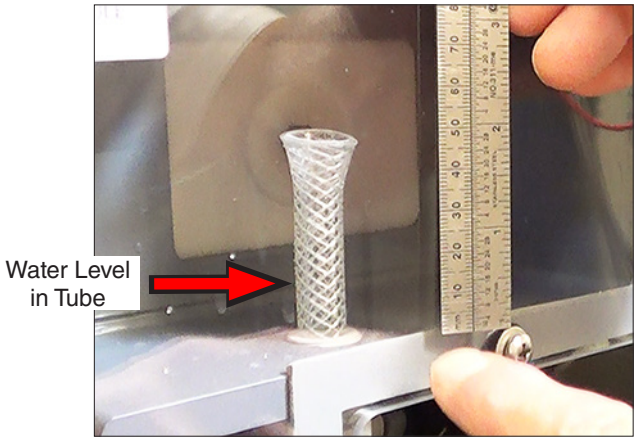
1. If not already **OFF**, power **OFF** the Q-FOG. Remove the Q-FOG right-side access panel.



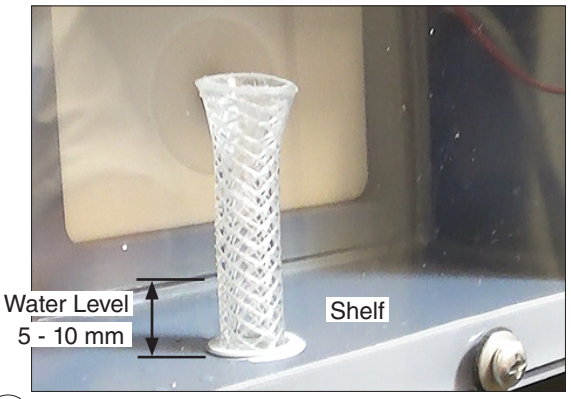
2. Use a millimeter scale to measure the height of the wet bulb supply tube. The top of the tube should be 50 mm (2.0") above the air control module opening.



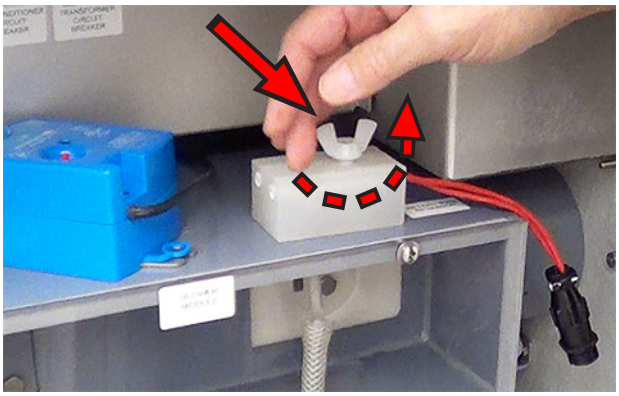
3. If necessary, loosen the strain relief and move the tube up or down so the top of the tube is 50 mm (2.0") above the air control module opening. Re-tighten the strain relief.



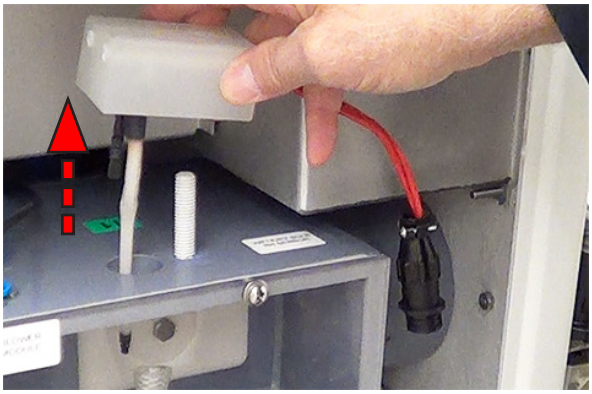
4. Use a millimeter scale to measure the height of the water in the wet bulb supply tube.



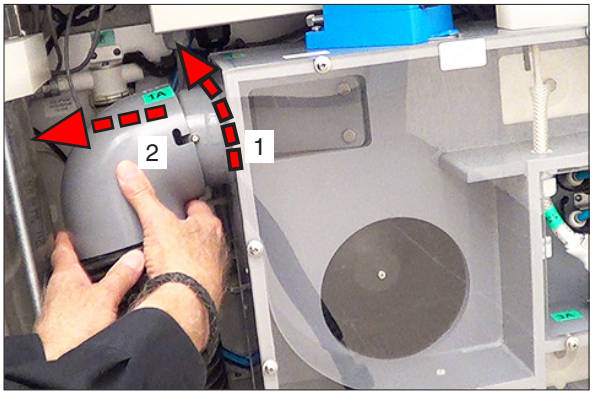
5. If the water level is **NOT** 5 to 10 mm above the shelf the level **MUST** be adjusted. Go to Step 6. If the water level is 5 to 10 mm above the shelf, no adjustment is needed. Go to Step 20.



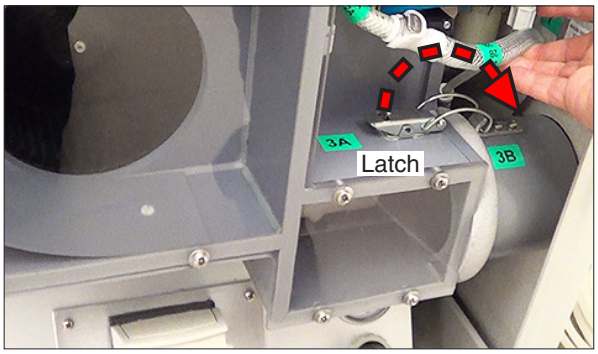
6. Remove the wing nut on the wet-dry bulb sensor assembly.



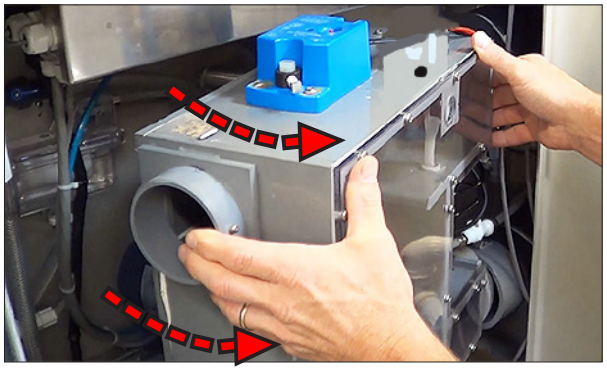
7. Remove the wet-dry bulb sensor assembly from the Q-FOG air control module.



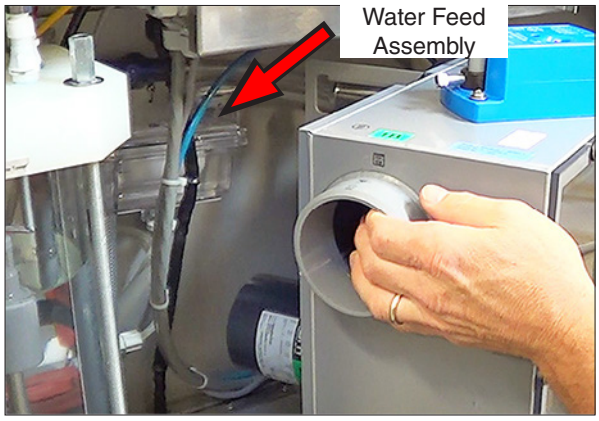
8. Rotate the elbow on the Air Preconditioner hose counter clockwise. Pull the hose to the left to disconnect the hose from the air control module.



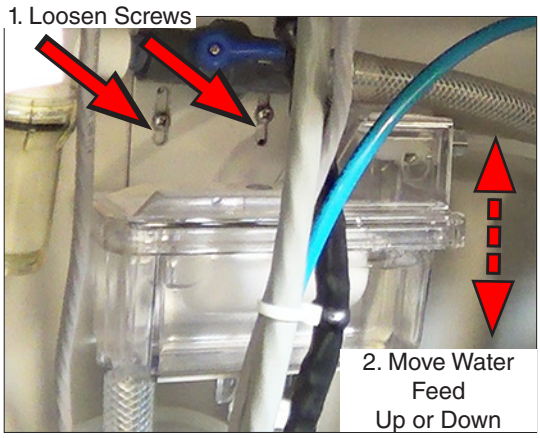
9. Locate the latch at the lower right side of the air control module. Open the latch.



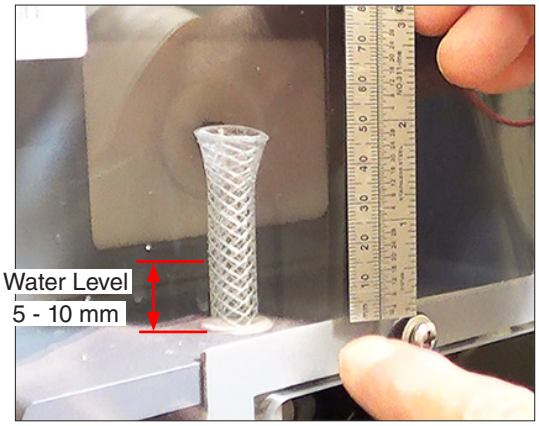
10. Rotate the air control module out away from the enclosure rear wall as shown.



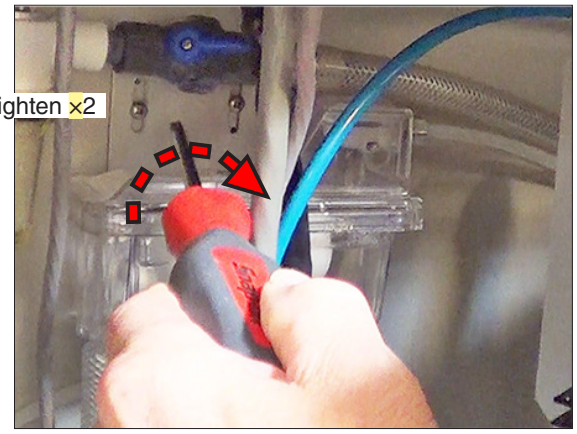
11. Locate the water feed assembly mounted on the wall behind the air control module.



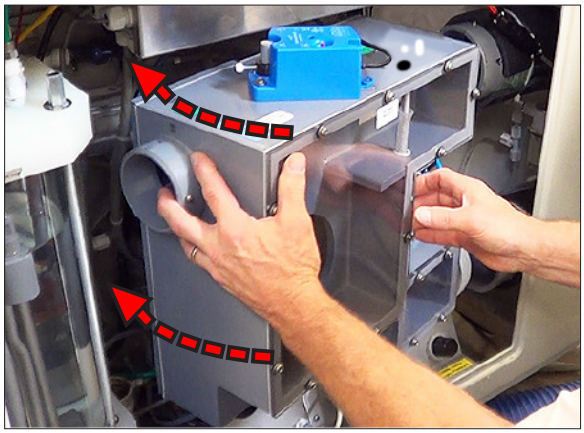
12. Loosen screws on water feed mounting bracket. Move water feed up or down to adjust water level in wet bulb supply tube.



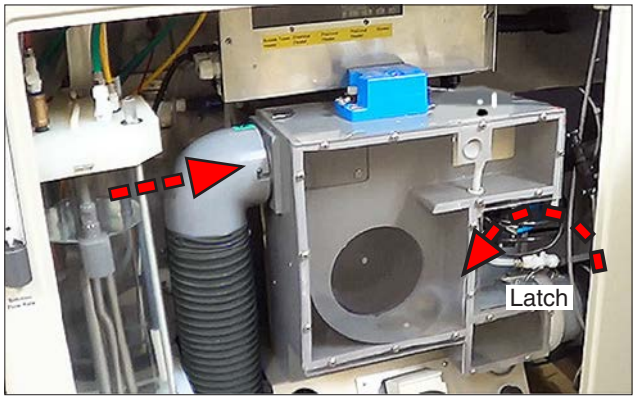
13. Measure water level in tube. Adjust water feed up or down until water level in tube is 5 to 10 mm (0.2 - 0.4") above the shelf.



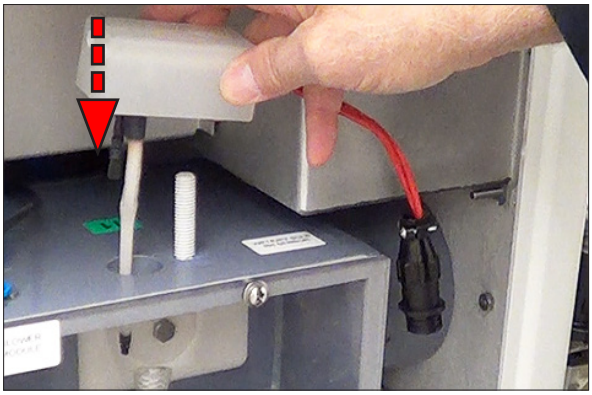
14. Tighten the screws in the water feed mounting bracket.



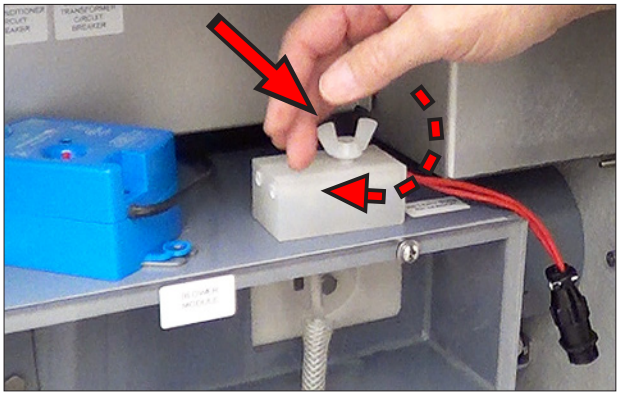
15. Rotate the air control module back into operational position.



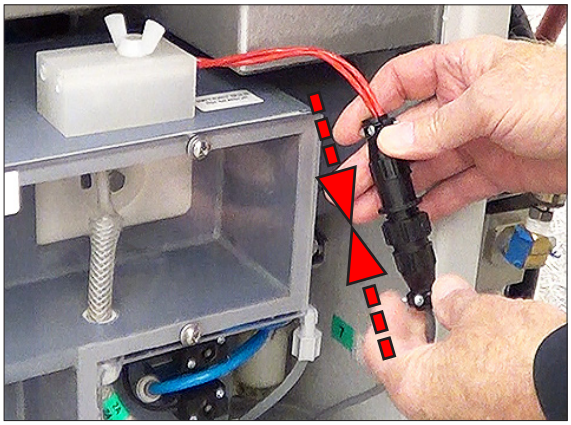
16. Connect the hose and close the latch.



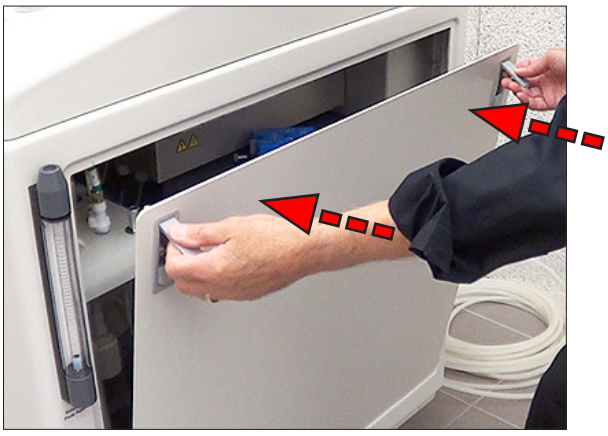
17. Reinstall the wet-dry bulb sensor assembly in the Q-FOG air control module. Make sure the wick goes into the water supply tube.



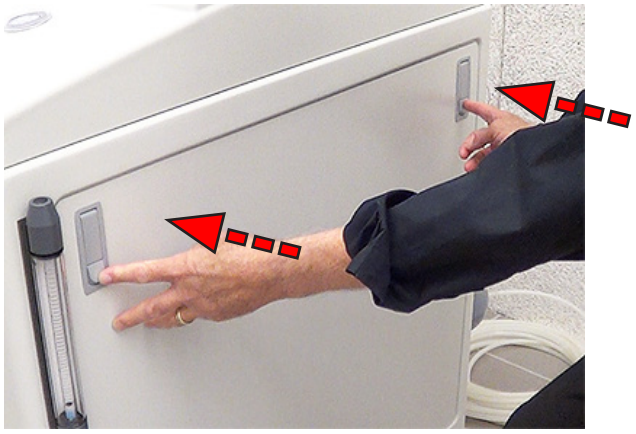
18. Reinstall the wing nut on the wet-dry bulb sensor assembly.



19. Reconnect the wet/dry bulb sensor cable.

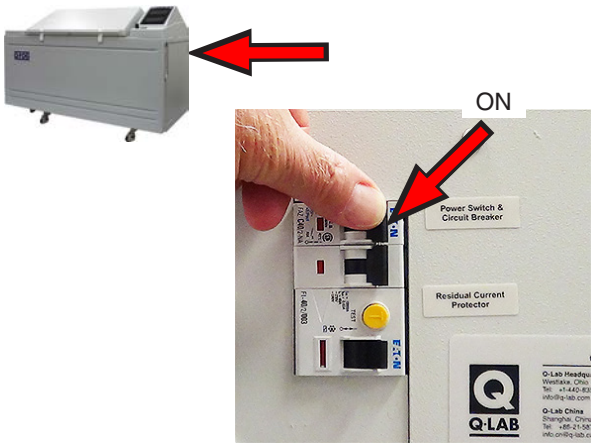


20. Reinstall the Q-FOG access panel.



21. Close the latches.

22. Close the Q-FOG chamber lid. Close the latches.



23. Power **ON**.

24. Press **RUN**.

12.3. Fog / Shower Deposition Verification (Nov 2021)

- If running a Fog or Shower step in a test cycle that requires evaluation of solution deposition, the uniformity and quantity of the solution deposition should be verified before each test.
- Deposition verification steps include the collection of solution deposited during a fog or shower step and then adjusting the Q-FOG controls to achieve the required quantities and uniformity throughout the test chamber.

Solution Deposition Collection Methods

- Solution deposition can be collected using either standard in-chamber collection vessels (graduated cylinder plus funnel) or the optional external collection system.

Standard in-Chamber Deposition Collection Vessels (Graduated Cylinders)

- Solution Deposition verification is performed by placing collection vessels in the test chamber.
- Q-Lab recommends the use of 6 collection vessels, which are available in a Fog Collection Kit (F-9001-K).
- The collection vessel consists of a 10 cm diameter funnel and a graduated cylinder.
- The recommended placement is one of these vessels in each corner of the test chamber with at least a 5 cm gap between the edge of a funnel and the wall, and a vessel on each side of the fog spray nozzle approximately 15 cm from the nozzle (see Figure 12.3a).

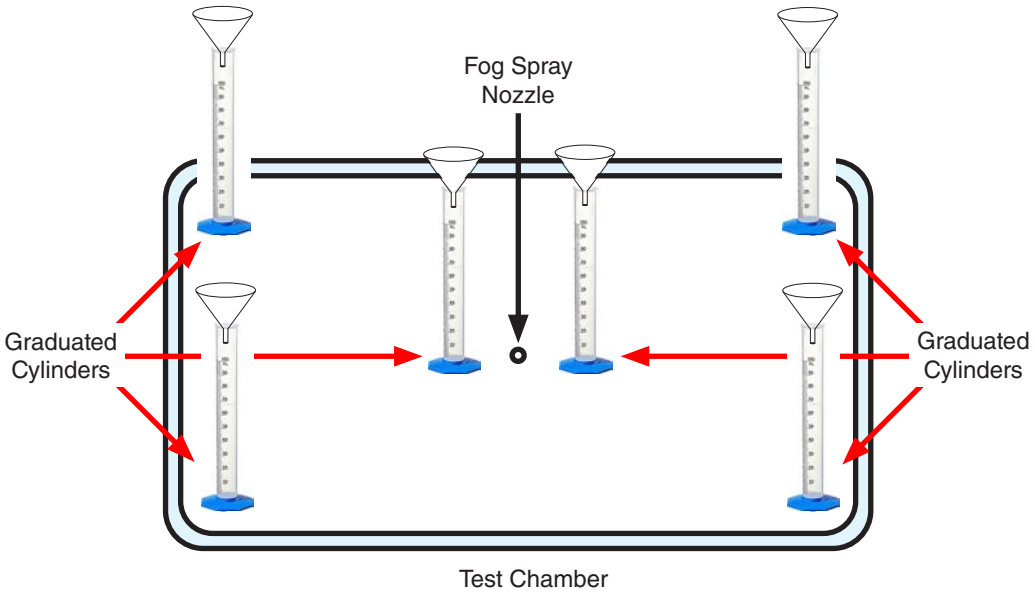


Figure 12.3a: Collection vessel placement - test chamber top view.

- Place the vessels on top of the diffuser plate (with racks removed) or through the holes in panel racks. (See Figure 12.3b or Figure 12.3c).
- If the vessels are placed in panel racks, remove the bases on the vessels and put an O-ring around the neck of each cylinder to hold them in the rack.
- Make sure that the test specimens do not shield the funnels.
- The Fog Solution Deposition verification process is detailed in Section 12.3.1.
- The Shower Solution Deposition verification process is detailed in Section 12.3.2.

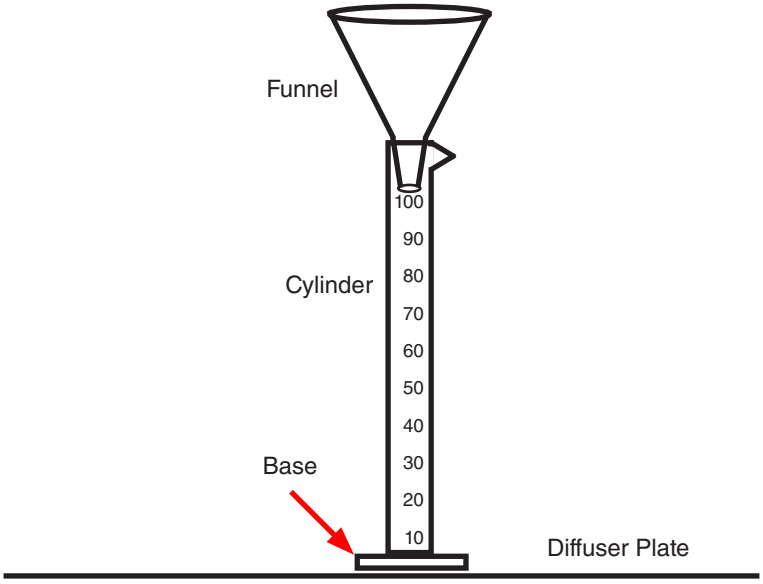


Figure 12.3b: Graduated cylinder with base attached placed on diffuser plate.

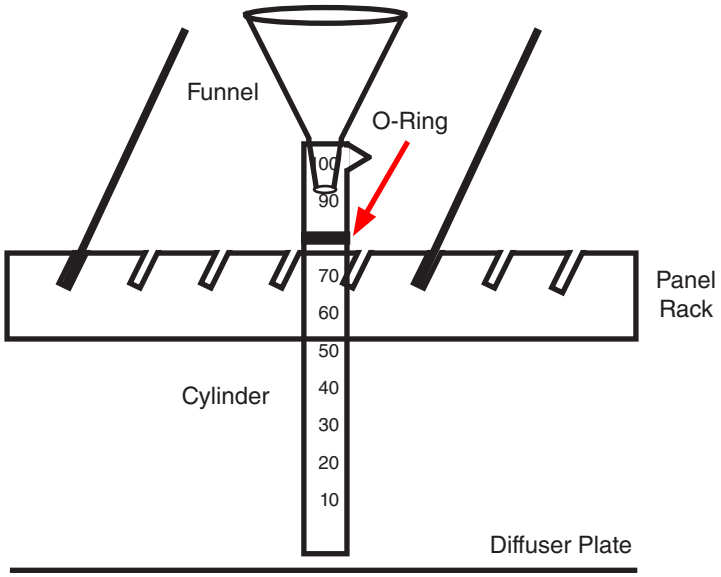


Figure 12.3c: Graduated cylinder with base removed resting in panel rack (held in place with O-ring positioned on 80 ml mark).

Optional External Collection System (Graduated Cylinders)

- Q-Lab offers an optional external deposition collection system to enable collections without having to open the lid and interrupt the test. The external deposition collection system part number is F-70207-K for 600 L models and F-70206-K for 1100 L models.
- The external deposition collection system includes six (6) graduated cylinders in a holder assembly mounted on the front of the outer shell of the Q-FOG chamber (Figure 12.3d).
- On the inside of the chamber, deposition is collected in up to 6 funnels. A tube is connected to the bottom of each funnel. The tubes pass through a bulkhead assembly into the graduated cylinders on the front of the chamber (Figure 12.3e).

Figure 12.3d: External collection cylinders on chamber front.

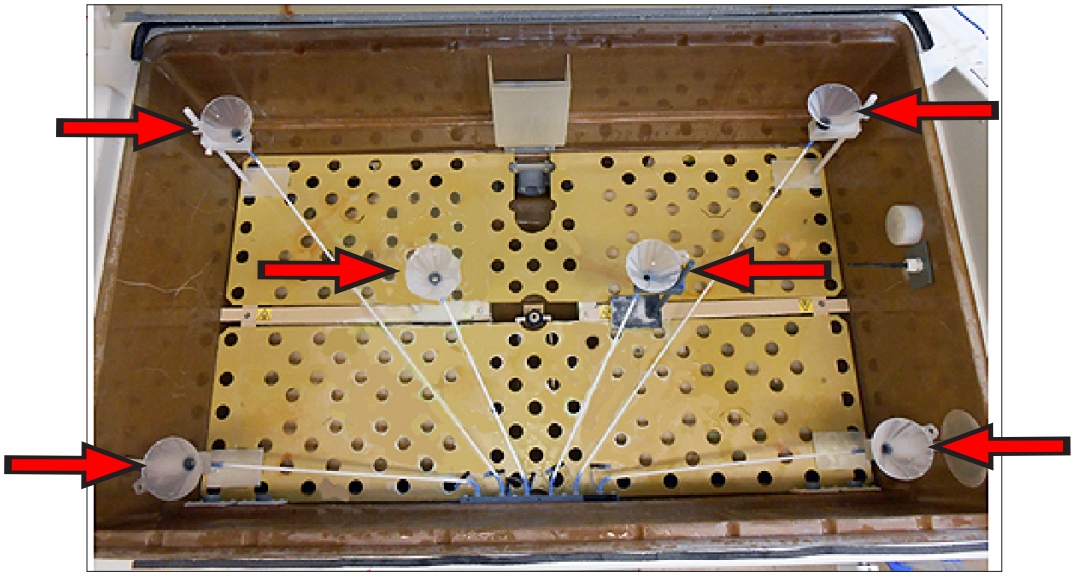


Figure 12.3e: Funnels with tubes inside the chamber.

12.3.1 Fog Deposition Verification

- Fog deposition Quantity is controlled by the speed of the peristaltic pump (see Section 8.5).
  - Pump speed is adjusted using the Q-FOG Machine Configuration menu.
  - Adjusting pump speed changes the fog flow rate and thus the deposition quantity.
  - The flow rate in liters per hour is displayed on the solution flow meter. (Figure 12.3.1).
- Fog deposition Uniformity is controlled by fog spray pressure and nozzle alignment.
  - Fog deposition Uniformity is adjusted using spray air pressure.
  - The fog spray pressure is set by the fog pressure regulator and shown on the fog pressure gauge (Figure 12.3.1).

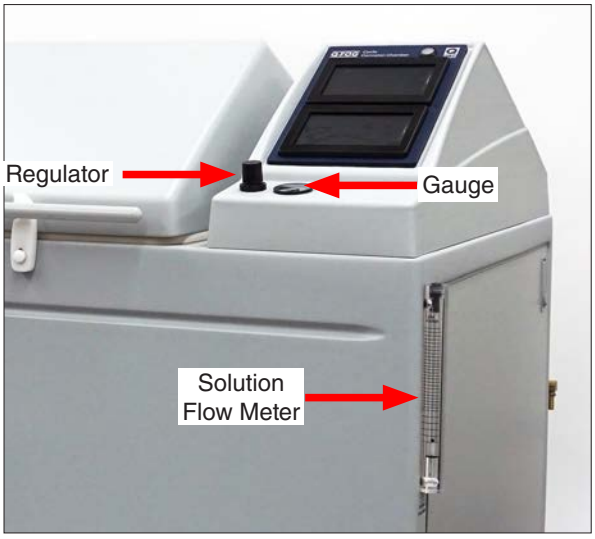
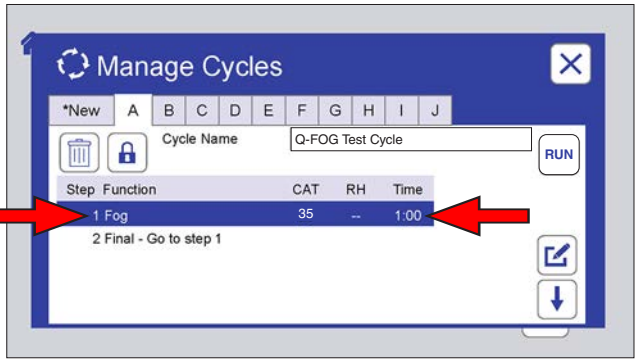


Figure 12.3.1: Fog Spray Pressure Regulator, Pressure Gauge and Flow Meter.

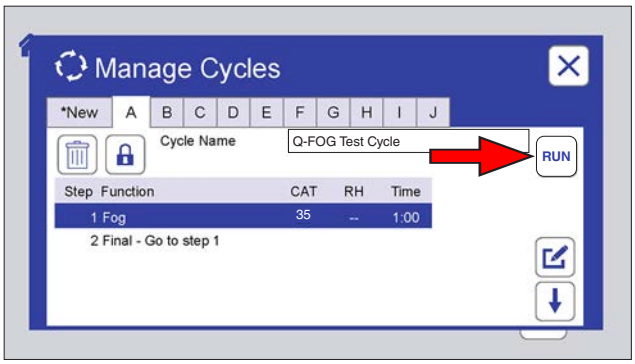
- Follow the steps below to run a fog step, collect fog deposition, and adjust deposition quantity and uniformity.

Set up the deposition collection vessels as described in Section 12.3.

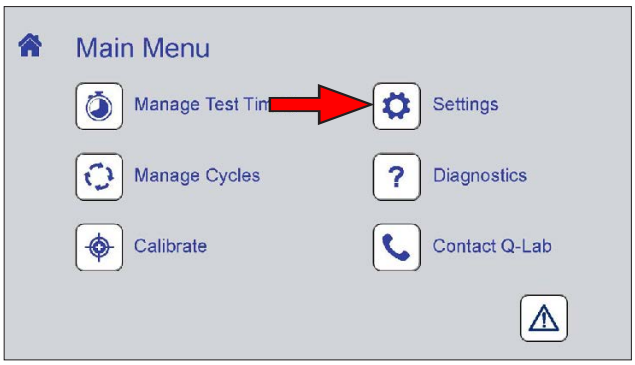
1. Set up the in-chamber or external collection system.
2. Close the Q-FOG lid.



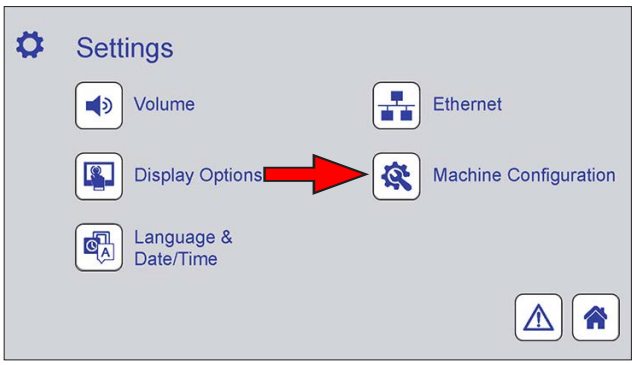
3. Program a test cycle with a fog step, if there isn't one already programmed. Set the step time as specified in the relevant test standard.
See Section 11.3.



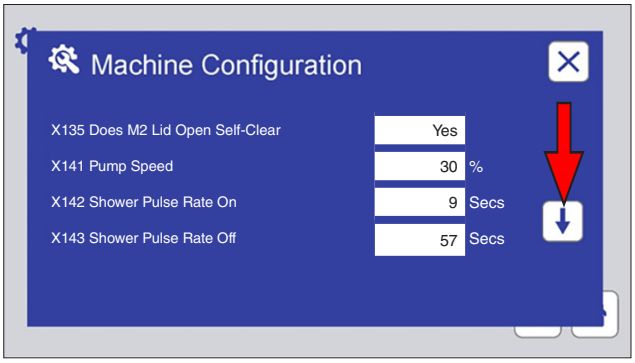
4. **RUN** the fog step.



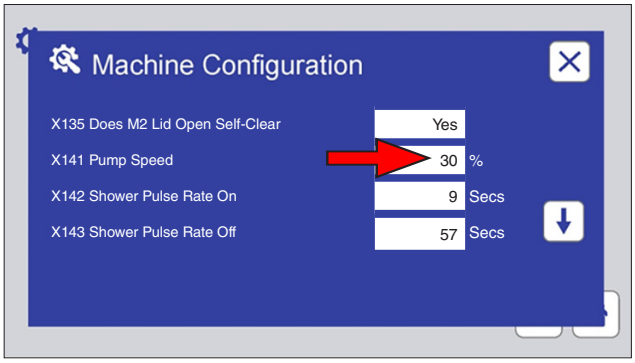
5. On the Main Menu screen touch the Settings icon.



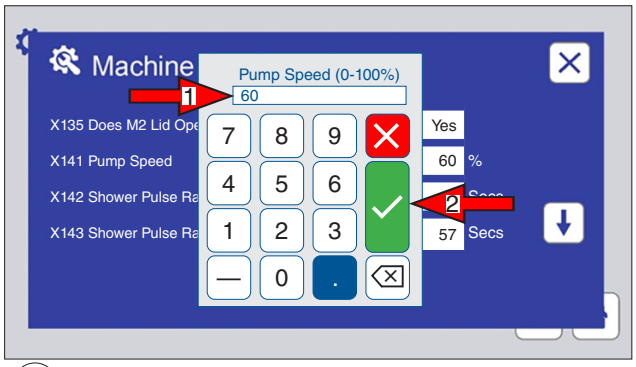
6. On the Settings screen touch the Machine Configuration Icon.



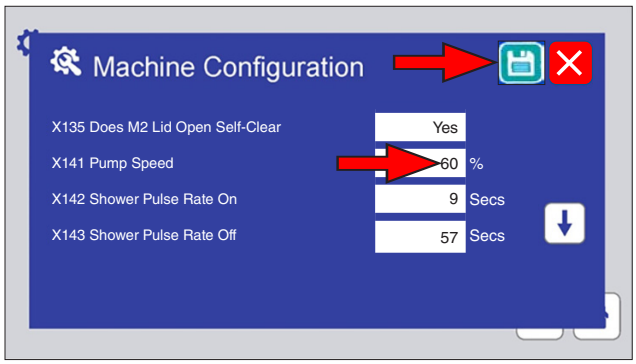
7. On the Machine Configuration screen touch the down arrow to scroll to the X141 Pump Speed parameter.



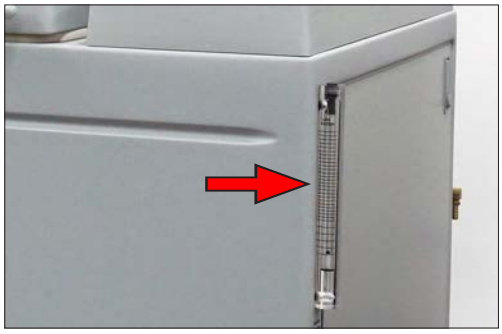
8. On the Machine Configuration screen touch the X141 Pump Speed text box.



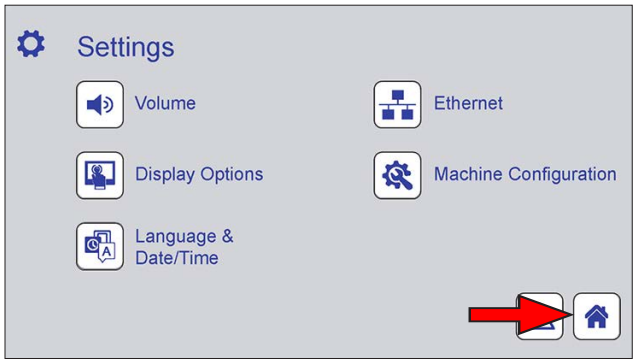
9. Use the keypad to enter the new pump speed. **NOTE**: the speed must be between 0 and 100 %. Touch the Check Mark icon to accept the new speed.



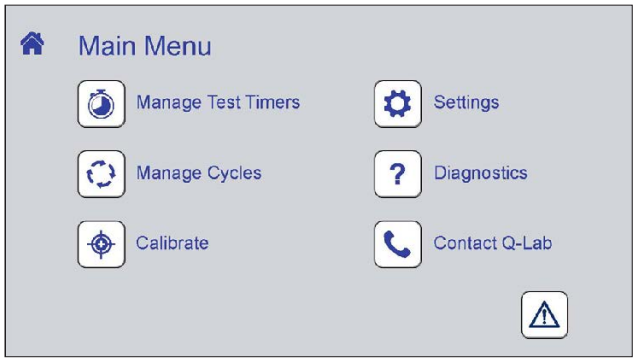
10. The new pump speed is displayed. Touch the Save icon to save the new speed.



11. Check the flow rate on the flow meter. Repeat Step 8 through Step 10 to adjust the flow rate. Standards often specify collections requirements, check section 11.3 or ask Q-Lab for recommendations on flow rate and pressure to achieve those.



12. On the Settings screen touch the Home Icon.



13. The Main Menu is displayed.

14. Use the fog pressure regulator to set the fog spray pressure to the recommended level.

15. When the fog step has run for the specified time, touch the **STOP** icon on the Status Screen.

16. Wait at least **15 minutes** for the purge blower to clear the chamber of fog.

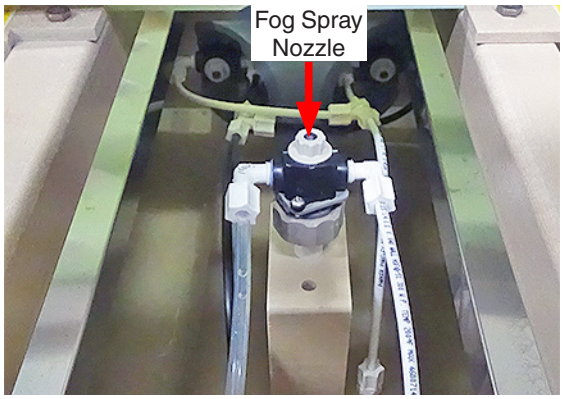
17. Undo latches and open the Q-FOG chamber lid.

Graduated Cylinder Position	Deposition (ml)
Left Front	
Left Rear	
Left Center	
Right Front	
Right Rear	
Right Center	

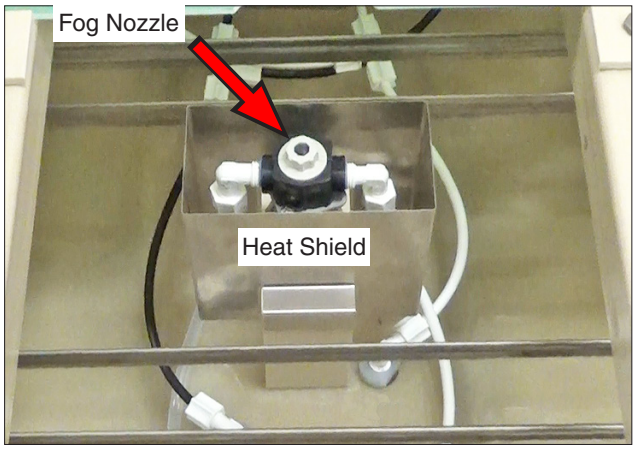
18. Record the amount of fog deposited in each of the graduated cylinders (example recording form shown).

Graduated Cylinder Position	Deposition (ml)
Left Front	6 ✓
Left Rear	6 ✓
Left Center	6 ✓
Right Front	6 ✓
Right Rear	6 ✓
Right Center	6 ✓

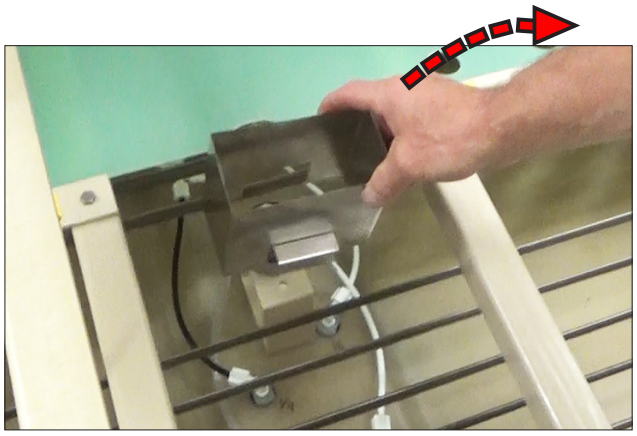
19. If the deposition amounts are within the specified quantity range and are uniform, verification is complete. If quantity is not in the specified range, or deposition amounts are not uniform, continue with Step 20.



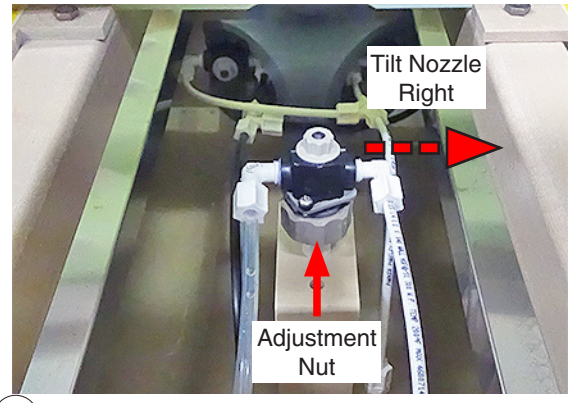
20. If deposition is more on one side of the chamber than the other, the fog spray nozzle (Section 8.6) can be tilted to make fog spray deposition uniform.



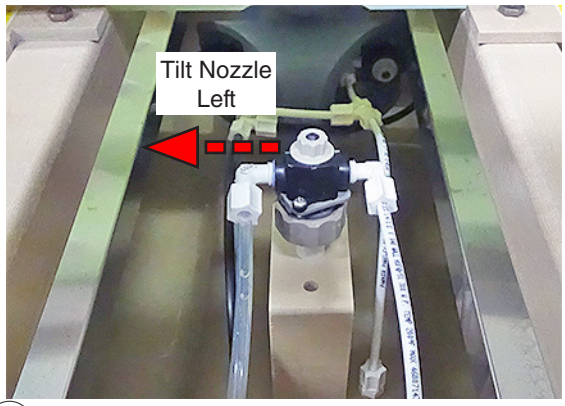
21. HSCR and HTCR models are equipped with a heat shield around the fog nozzle.



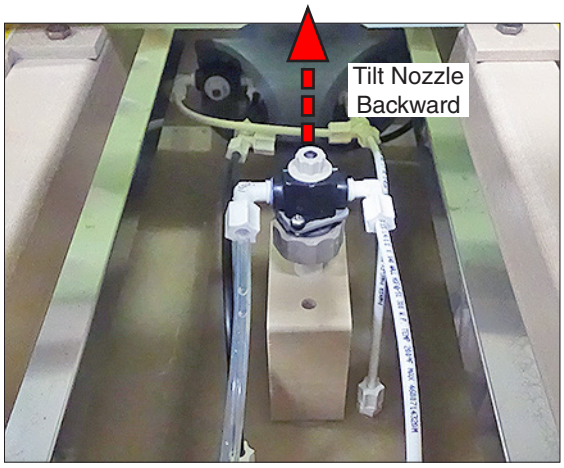
22. For HSCR and HTCR models remove the heat shield to adjust the fog nozzle. Set the heat shield aside.



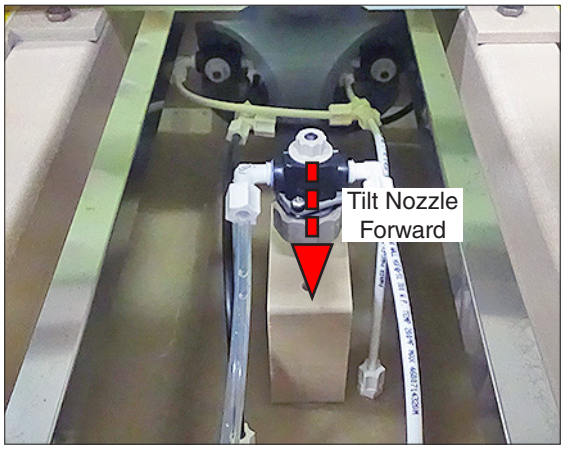
23. If the left side of the chamber has more deposition than the right, loosen the large adjustment nut under the nozzle, tilt the nozzle to the *right*, then re-tighten the nut.



24. If the right side of the chamber has more deposition than the left, loosen the large adjustment nut under the nozzle, tilt the nozzle to the *left*, then re-tighten the nut.

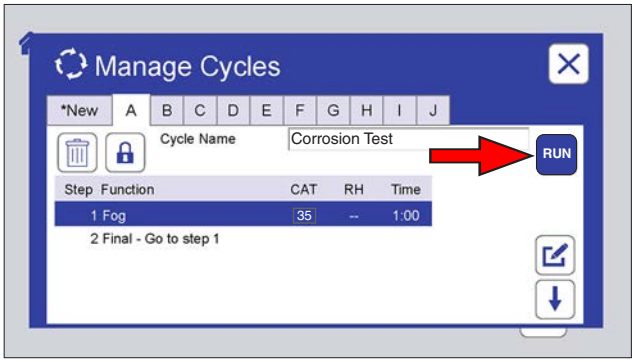


25. If there is too much deposition in the front, tilt nozzle backward.

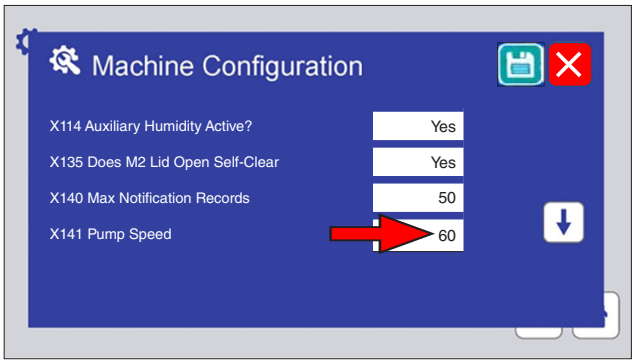


26. If there is too much deposition in the back, tilt nozzle forward.

27. Close the Q-FOG lid.



28. Re-run the fog step.



29. If there was too little or too much deposition overall, repeat Step 7 through Step 14 to increase or decrease the pump speed.

30. If the deposition in the outer vessels is less than the inner vessels, use the fog pressure regulator to increase the pressure to deposit more fog farther from the nozzle.

31. If the deposition in the outer vessels is more than the inner vessels, use the fog pressure regulator to decrease the pressure to deposit more fog closer to the nozzle.

- Repeat the verification process until all deposition parameters are within the test specifications.
- Remove collection vessels from the test chamber.
- For HSCR and HTCR models, replace the fog nozzle heat shield.
- Replace specimens in test chamber.

32. Contact Q-Lab with any questions on fog deposition verification.

12.3.2 Shower Deposition Verification / Corrosion Rate

- Shower deposition Quantity is controlled by the Q-FOG shower pulse rate.
  - The shower pulse rate is adjusted with the Q-FOG Machine Configuration menu.
- Shower deposition Uniformity is controlled by the Q-FOG shower pump pressure.
  - The shower pump pressure is set by the shower pump regulator (Figure 12.3.2).
  - The shower pump pressure is shown on the shower pump pressure gauge (Figure 12.3.2).
- Corrosion rate is an alternative way of verifying the uniformity and quantity of solution deposited.
  - Corrosion coupons (also known as mass-loss coupons) are used as reference specimens.
  - The mass loss by the coupons is compared with the mass loss recommended in the standard to verify the rate of corrosion.
  - Corrosion coupon kits including thirty (30) coupons are available from Q-Lab (see *LP-0862-C Corrosion Test Coupons* for which mass-loss coupons are used in which test standards).

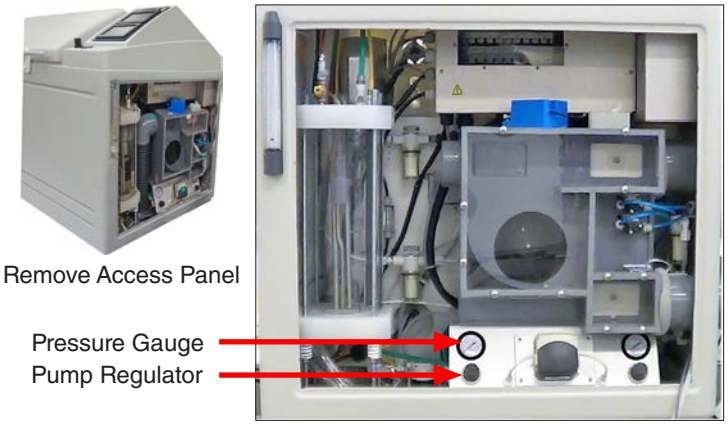
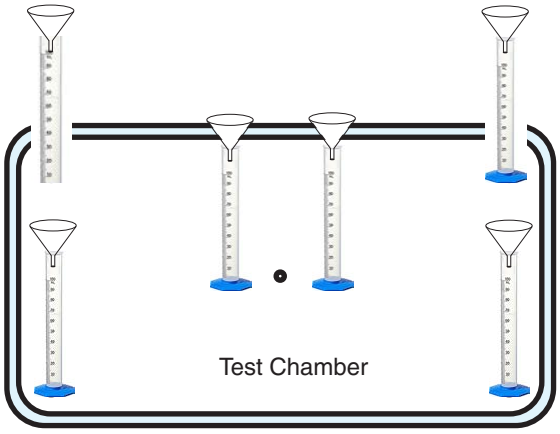


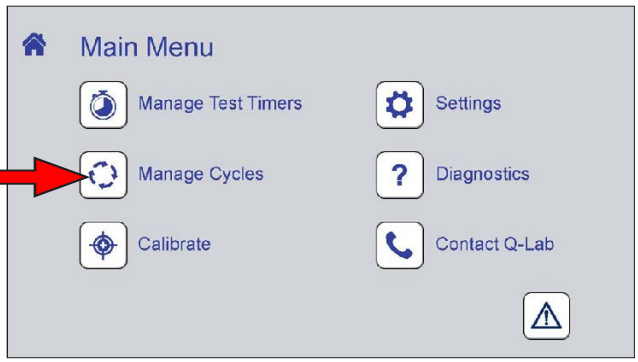
Figure 12.3.2: Shower pump pressure gauge and regulator.

- Follow the steps below to run a shower step, collect shower deposition, and adjust deposition quantity and uniformity.
- The shower deposition verification process is exactly the same for both “T” model testers with the Top-Mounted Swaying Shower Bar (TSSB) and “S” model testers with the Stationary Shower Module (SSM).
- This process does not have to be performed using salt water; normal deionized water can be used.

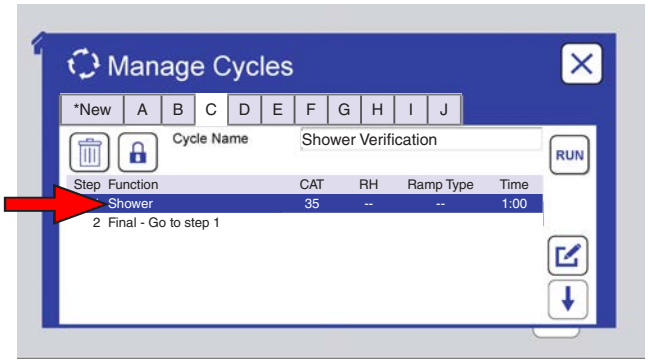


1. Set up the in-chamber or external deposition collection system as described in Section 12.3.

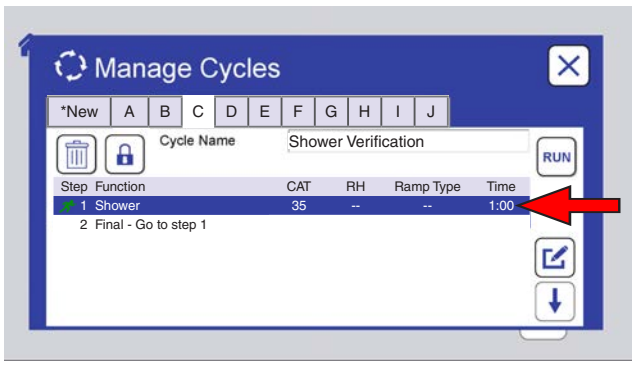
2. Close the Q-FOG lid.



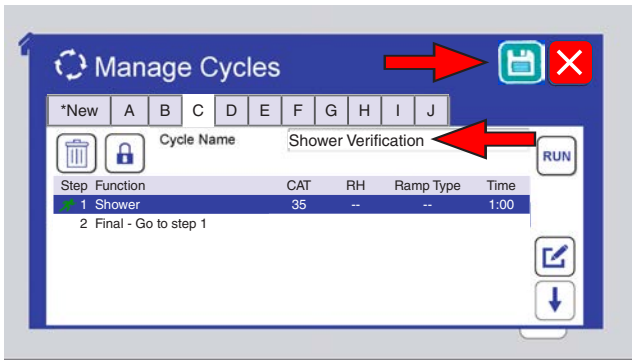
3. From the Main Menu touch the Manage Cycles icon.



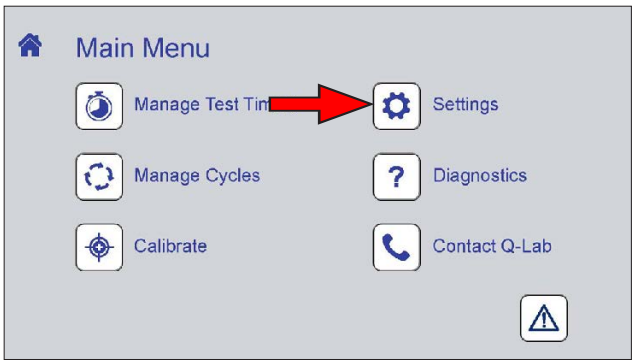
4. Program the test cycle with a shower step, if there isn't one already programmed. See Section 9.6.4 for programming information.



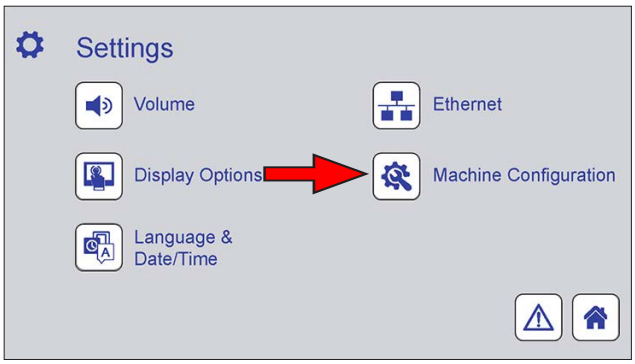
5. Set the step time as specified in the relevant test standard, see Section 11.3.



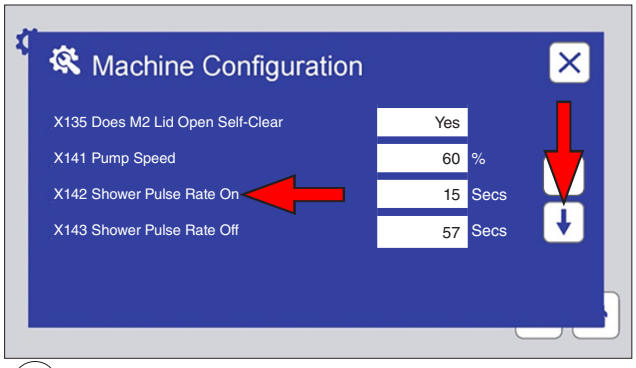
6. Save the test cycle.



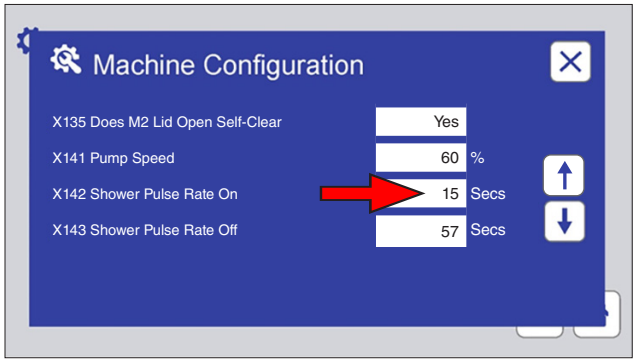
7. On the Main Menu screen touch the Settings icon.



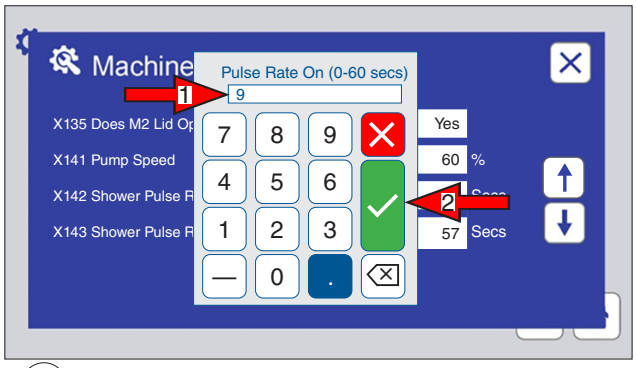
8. On the Settings screen touch the Machine Configuration Icon.



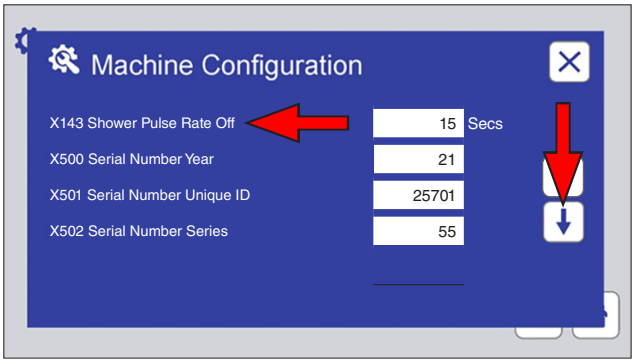
9. On the Machine Configuration screen touch the down arrow to scroll to the *X142 Shower Pulse Rate On* parameter.



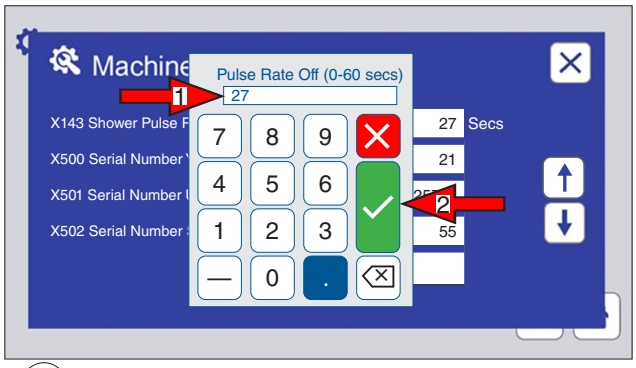
10. On the Machine Configuration screen touch the *X142 Shower Pulse Rate On* text box.



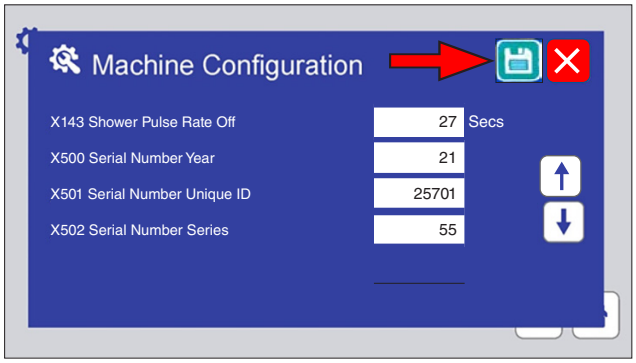
11. Use the keypad to enter the recommended shower pulse rate ON time. The pulse rate must be between 0 and 60 seconds. Touch the Check Mark icon to accept the new time.



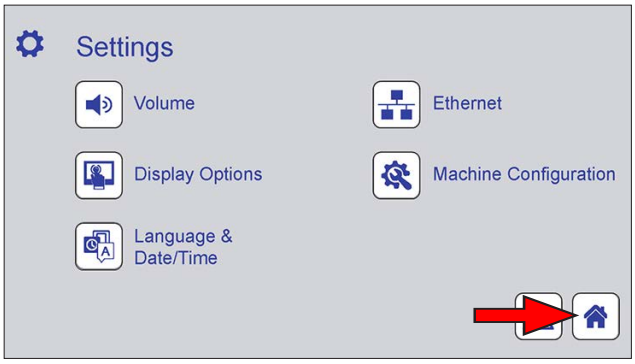
12. On the Machine Configuration screen touch the down arrow to scroll to the *X143 Shower Pulse Rate Off* parameter.



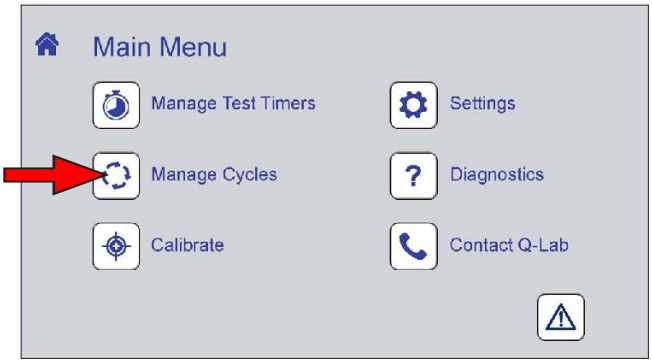
13. Use the keypad to enter the recommended shower pulse rate OFF time. The pulse rate must be between 0 and 60 seconds. Touch the Check Mark icon to accept the new time.



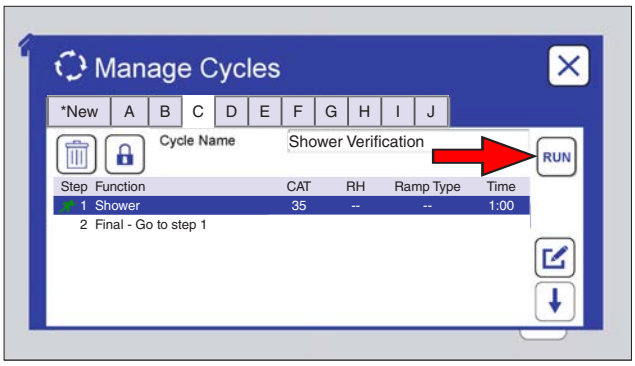
14. Touch the Machine Configuration Save icon to save the new shower pulse rate on and off times.



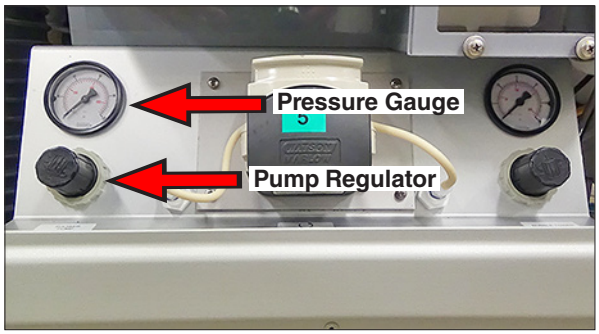
15. The setting screen is displayed. Touch the Home icon to display the Main Menu.



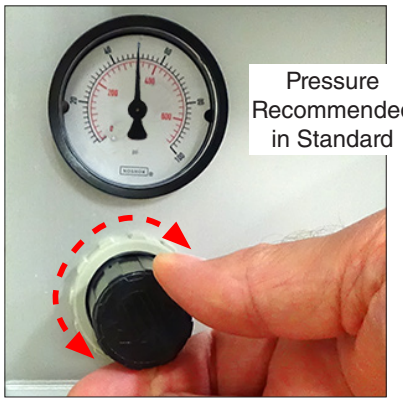
16. Touch the Manage Cycles icon.



17. **RUN** the shower verification test cycle.

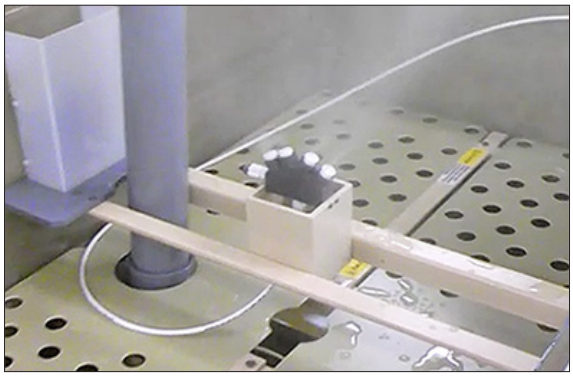


18. Go to the shower pump regulator and pressure gauge.



19. Use the shower pump regulator to set the shower pump pressure to the recommended pressure. See Section 11.3.

20. Turn the test chamber light on and look through the window in the Q-FOG lid to see the shower pattern.



21. Be sure that the nozzles are spraying with a uniform pattern and are not plugged. For nozzle cleaning see Section 14.5. SSM shown. In testers with the TSSB, the spray will come from the top of the lid.

22. When the shower step has run for the specified time, touch the **STOP** icon on the Status Screen.

23. Undo latches and open the Q-FOG chamber lid.

Graduated Cylinder Position	Deposition (ml)
Left Front	
Left Rear	
Left Center	
Right Front	
Right Rear	
Right Center	

24. Record the amount of shower deposited in each of the graduated cylinders (example recording form shown).

Graduated Cylinder Position	Deposition (ml)
Left Front	120 ✓
Left Rear	120 ✓
Left Center	120 ✓
Right Front	120 ✓
Right Rear	120 ✓
Right Center	120 ✓

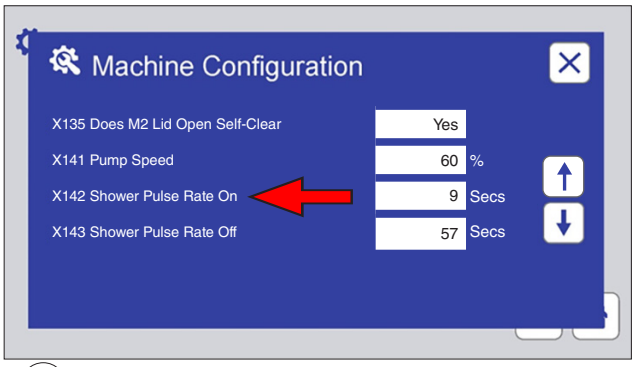
25. If the deposition amounts are within the specified quantity range and are uniform, verification is complete. If quantity is not in the specified range, or deposition amounts are not uniform, continue with Step 20.

Increase Pressure

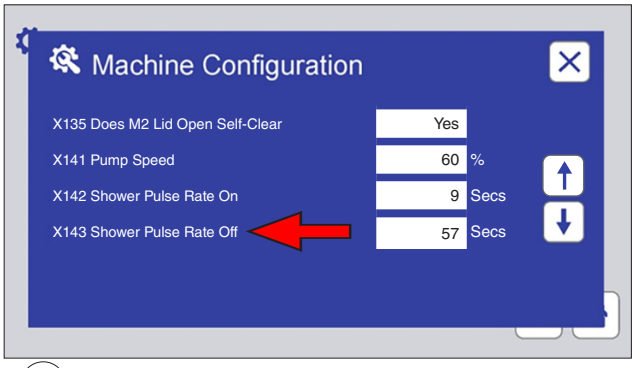
26. If the shower deposition in the outer vessels is less than the inner vessels, use the shower pump regulator to increase the pressure to deposit more shower away from the center of the chamber.

Decrease Pressure

27. If the shower deposition in the outer vessels is more than the inner vessels, use the shower pump regulator to decrease the pressure to deposit more shower in the center of the chamber.



28. If there is too little deposition overall, increase the shower pulse rate ON time. Likewise, if there is too much deposition overall, decrease the shower pulse rate ON time (see Step 7 through Step 11).



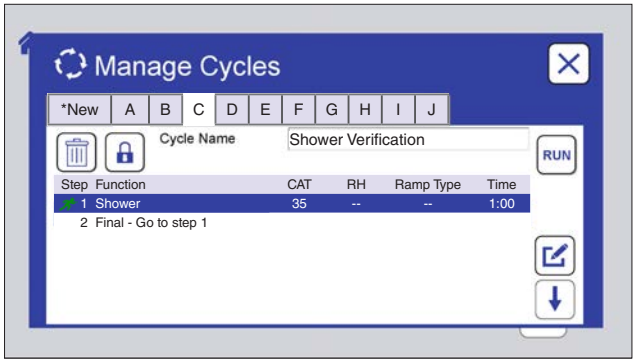
29. Alternatively, if there is too little deposition overall, decrease the shower pulse rate OFF time. Likewise, if there is too much deposition overall, increase the shower pulse rate OFF time.

- Repeat the verification process until all shower deposition parameters are within the test specifications.
- Remove collection vessels from the test chamber.
- Replace specimens in test chamber.

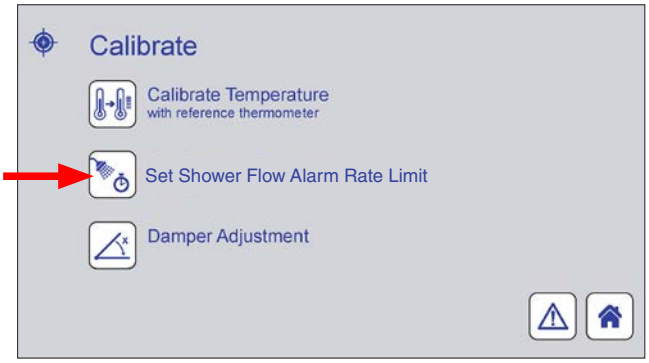
30. Contact Q-Lab Repair and Tester Support with any questions on shower deposition verification.

12.4. Set Shower Flow Alarm Rate Limit (Nov 2021)

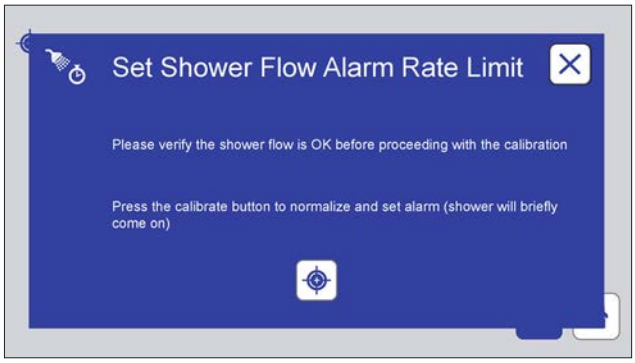
- After the shower flow uniformity and quantity are properly set using the Shower Deposition Verification process detailed in Section 12.3.2, the shower flow alarm rate limit should be set so that the controller can sound an alarm if the flow rate changes by more than 15%.
- The Set Shower Flow Alarm Rate Limit function is used to determine the normal rate of shower flow in the Q-FOG CRH tester.
- The shower flow alarm rate limit is the amount of shower flow above or below the normal flow rate set in the previous bullet for which the tester will issue a notification.
  (*M72 Shower Flow Too High* and *M73 Shower Flow Too Low*, see Section 15.1).
- Follow the steps below to set the Shower Flow Alarm Rate Limit.



1. **RUN** a shower step.

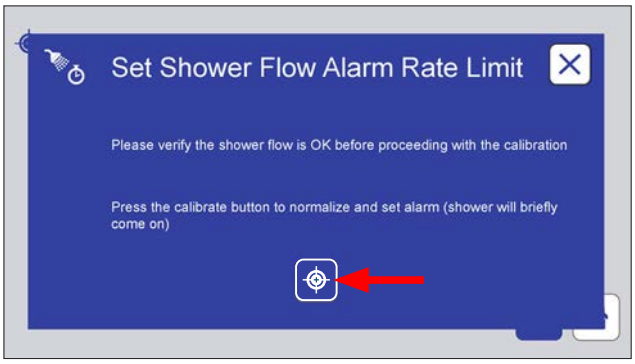


2. On the Calibrate screen touch the Set Shower Flow Rate icon.

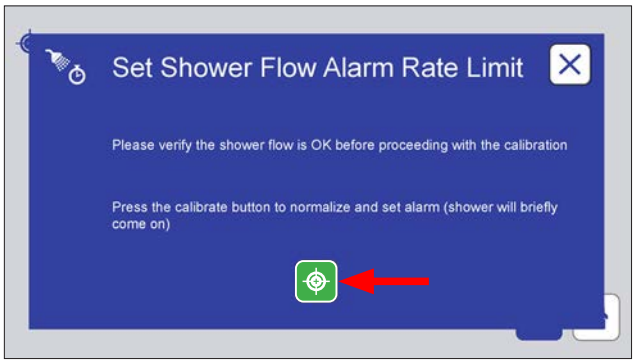


3. The Set Shower Flow Alarm Rate Limit screen is displayed.

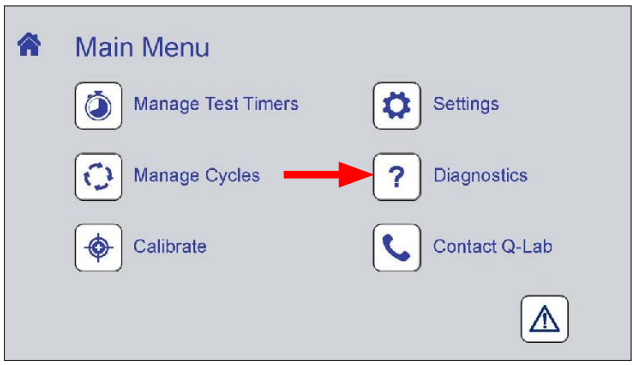
4. Turn the test chamber light on and look through the window in the Q-FOG lid to verify that the shower is flowing.



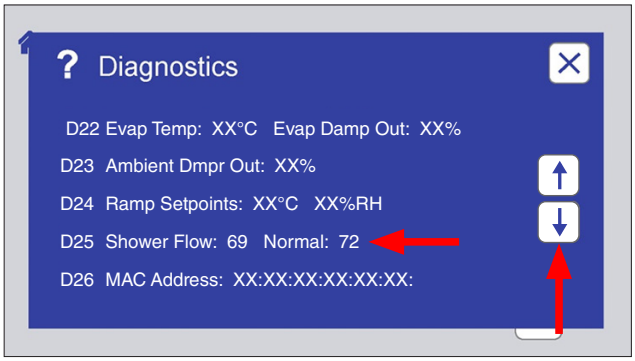
5. Press and hold the Calibrate icon until the tester beeps.



6. The Calibrate icon turns green indicating successful setting of the Shower Flow Rate Limit.



7. To view the value (a unitless value used only for normalization purposes) the tester assigned to the shower flow limit and the actual shower flow, touch the Diagnostics icon on the Main Menu screen.



8. Use the Up and Down Arrows to display the D25 Shower Flow actual and Normal values. See Section 9.8 for more information on tester Diagnostics.

12.5. Shower Flow Monitoring (Nov 2021)

- When the Q-FOG is running a shower step the shower flow is monitored by the main controller.
- If the shower flow is not within ±15% of the normal flow set by the Set Shower Flow Alarm process detailed above, an alarm and Notification will be generated.
  - The test is not stopped. The alarm indicates that shower flow is not normal and the operator should determine the cause of the abnormal flow.
  - See Figure 12.5a through Figure 12.5c for test status indication and Notification information for Shower Flow Monitoring.
  - Possible causes include water supply pressure fluctuations, clogged shower nozzles, and shower module malfunction. See Section 15.1 for troubleshooting information.
  - Check for clogged nozzles and loose connections. See Section 14.5 for nozzle cleaning instructions.
- If the shower is performing correctly, follow the instructions in Section 12.4 to reset the Shower Flow Alarm Rate Limit.

Figure 12.5a: The LED status indicator changes color to yellow indicating a Notification has been generated, but the test is not stopped. See Overall Test Status in the Controller Section.

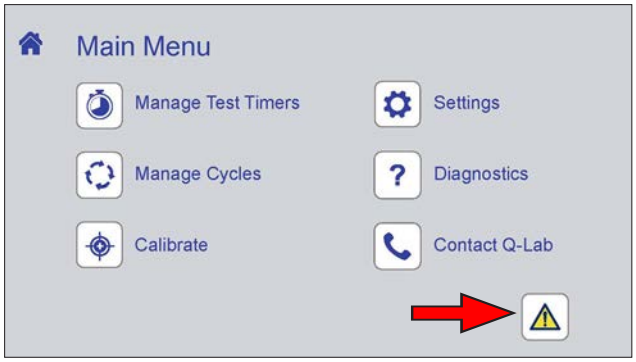


Figure 12.5b: On the Main Menu screen the notifications icon changes color to yellow. Touch the icon to display the Notifications screen.

Figure 12.5c: If the shower flow is too high, the Notifications Screen lists the M72 notification. Touch the information icon for details. See Section 9.4 and Section 15.1 for more information on Notifications.

Figure 12.5d: If the shower flow is too low, the Notifications Screen lists the M73 notification. Touch the information icon for details. See Section 9.4 and Section 15.1 for more information on Notifications.

12.6. Damper Adjustment (Nov 2021)

- The Damper Adjustment function adjusts the Air Control Module (Section 8.13) and the Air Preconditioner (Section 8.15) dampers.
- Damper Adjustment must be performed by a Q-Lab trained technician.
- A password is needed to access the Damper Adjustment Function.
- Contact Q-Lab Repair and Tester Support for more information.

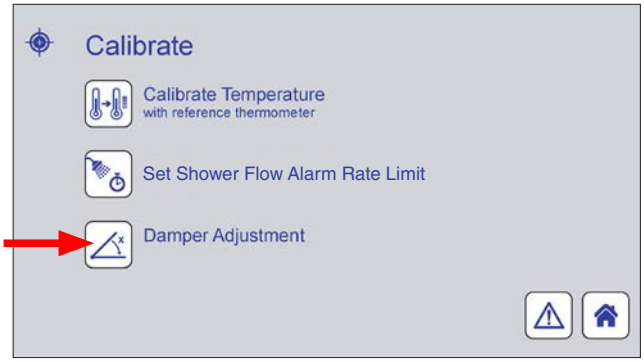


Figure 12.6a: On the Calibrate screen touch the Damper Adjustment icon.

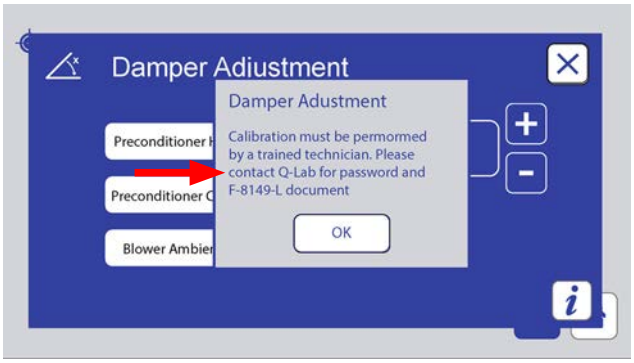


Figure 12.6b: Contact Q-Lab Repair and Tester Support for assistance with Damper Adjustment.

13. Data Storage and Transfer

13.1. Ethernet Communications (Nov 2021)

- The Q-FOG main controller has the capability to transfer data via Ethernet (Figure 13.1).
- Q-Lab can supply a VIRTUAL STRIPCHART (VSC) program that runs on a PC.
  Contact Q-Lab Repair and Tester Support.
- The VSC software offers advanced troubleshooting with remote diagnostics.

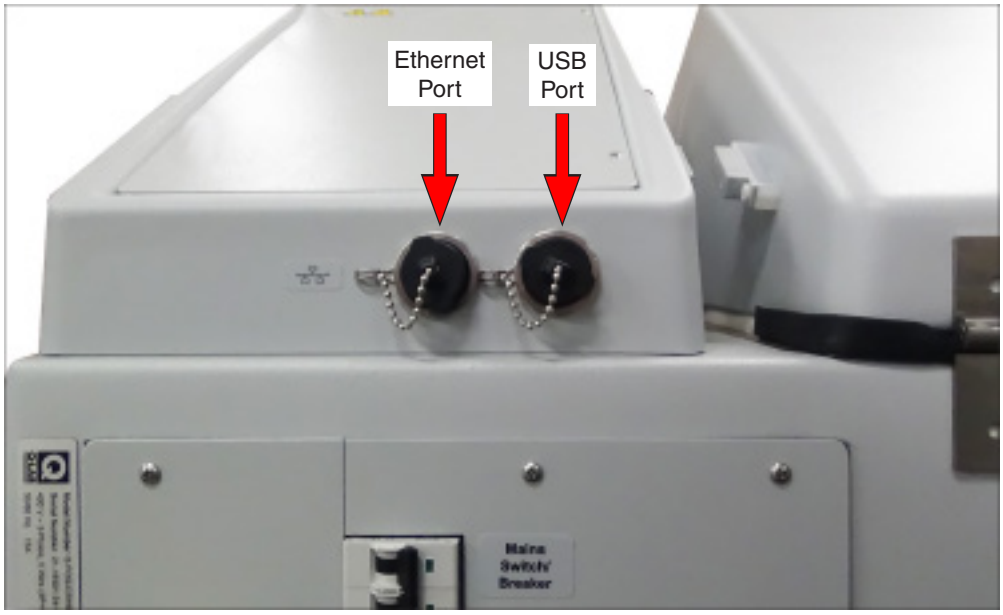


Figure 13.1: Ethernet and USB ports located on rear of control top.

13.2. Secure Digital (SD) Card (Nov 2021)

- All tester information, i.e. timers, expert parameters, error messages, set points, actuals, test cycles, and other system configuration information is written to an SD card every minute.
- All tester operating parameters written to the SD card are automatically being saved.
- The operating parameters can be viewed by the customer or by Q-Lab Repair and Tester Support using the export feature later in this section.
- If the main controller fails, the SD card can be transferred to a new controller and all tester information will be preserved.
- The user does not have to re-enter the serial number and date/time, test cycles, expert parameters, or timer values.
- The information on the SD Card can also be copied and emailed to Q-Lab Repair and Tester Support.
- That information can be copied to another SD Card so the original tester's configuration can be "cloned" by Q-Lab Repair and Tester Support for analysis.

13.3. Export Diagnostics (Nov 2021)

- The Export Diagnostics function transfers the full set of VSC parameters.
- These include the most recent two weeks (tester time) of data, recorded every minute as a .vsc file.
- The complete system configuration is also transferred in this operation.
  - This includes tester operational information like timers, expert parameters, set points, actuals, heater percentages, test cycles, and error messages.
- A USB flash drive is used to export diagnostic parameters (Figure 13.3a)
- Connect the USB drive to the USB port at the rear of the Q-FOG control top (Figure 13.3b).
- The USB Options screen will be displayed (Figure 13.3c).
- Touch the Export Diagnostics button to begin the export process (Figure 13.3d).
- The exported files (Figure 13.3e and Figure 13.3f) can be uploaded to the Q-Portal Asset Center where customers can view basic operational data and Q-Lab personnel can view extended operational data.

Figure 13.3a: USB drive needed to export diagnostics. Q-Lab recommends the use of an unencrypted, standard-formatted (FAT 32) USB drive.

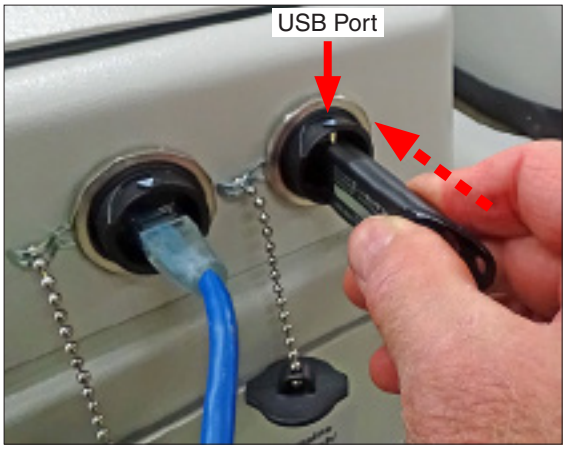


Figure 13.3b: Connect the drive to the USB port at the rear of the Q-FOG control top.

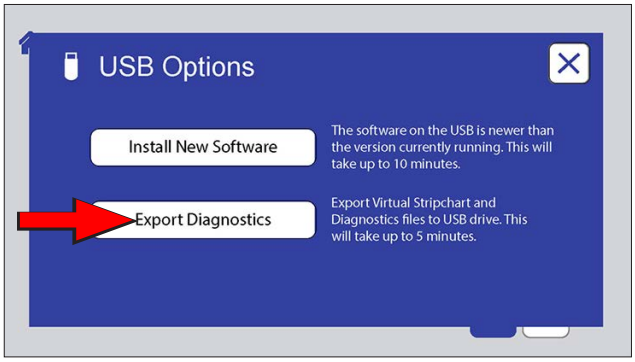


Figure 13.3c: USB Options screen showing the Export Diagnostic button.

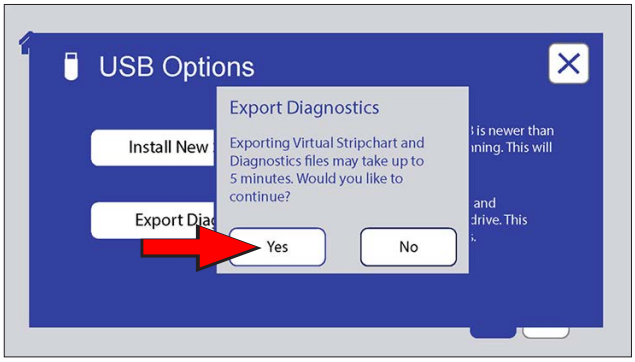


Figure 13.3d: Touch Export Diagnostics then the Yes button to begin export.

Figure 13.3e: Insert the USB drive into a Windows computer to display the list of files

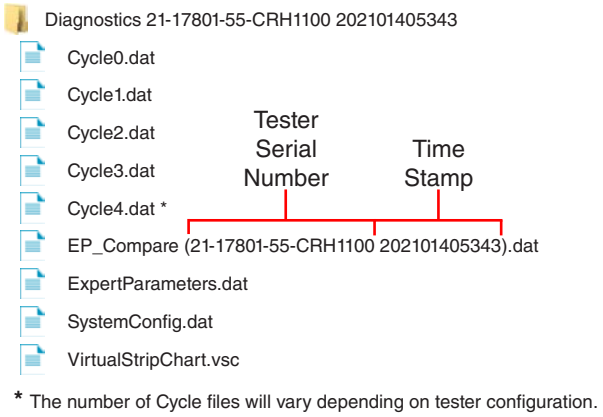


Figure 13.3f: The USB drive will have a folder with the diagnostic data files exported from the tester.

IMPORTANT NOTE: All files except EP_Compare are readable only by the tester. Do not try to open the other files on a PC.

- The .vsc file is the most important file because it contains the actual tester operational data.
- See Section 13.4 or contact Q-Lab Repair and Tester Support for instructions on importing .vsc files to the Q-Portal Asset Center for analysis.

13.4. Import VIRTUAL STRIPCHART Data (Nov 2021)

- At the Q-Lab Q-Portal Asset Center, customers can register their Q-FOG testers.
- Once a tester is registered, customers can access important information relating to the tester as well as view, customize, export, and create .pdf files of their virtual stripchart data .
- The .vsc files must first be downloaded using the Export Diagnostics function (see Section 13.3).
  Contact Q-Lab Repair and Tester Support for more information.

14. Maintenance

14.1. Preventive Maintenance (Nov 2021)

- All corrosion chambers require regular maintenance for proper operation.
- A preventive maintenance kit (part number F-9125-K) is included with the tester.
- Normal maintenance items are listed below.

Before Each Test:

- Inspect wet bulb wick and replace if discolored.
- Clean the chamber interior—use a sponge and warm water.
- Check the fog and shower uniformity—clean fog nozzle and shower nozzles if needed.
- Check solution concentration and pH.
- If test conditions have changed, calibrate chamber thermometer and wet/dry bulb thermometers. See Section 12 for the calibration procedure.

Every 1000 hours

The Q-FOG is equipped with a Routine Service Timer. Every 1000 hours of operation, the message " M14 Perform Routine Service" is displayed. Power the tester **OFF** and disconnect the tester main power before performing any maintenance.

- Access to some components requires removal of the Air Control Module (ACM). See Section 14.3 for ACM removal instructions

The items listed below should be inspected, and serviced if necessary:

- **Air Control Module:** inspect for salt buildup (Figure 14.2). See Section 14.2 for cleaning instructions.
- **Peristaltic Pump Tubing:** (Figure 14.1a and Figure 14.1b) check for leaks or wear, replace if necessary.
- **Bubble Tower:** (Figure 14.1a and Section 8.2) drain and allow to refill with clean water.
  - The bubble tower may be cleaned, but disassembling the bubble tower for cleaning requires the installation of new gaskets.
  - See *F-8542-L Q-FOG Bubble Tower Service Instructions* for detailed instructions on bubble tower cleaning.
  - New gaskets and installation instructions are included in *F-8555-K Bubble Tower Gasket Kit*.
  - Use only deionized water or mild solution of dish soap to clean the bubble tower.
  - Do not use solvents such as Acetone or Isopropyl Alcohol to clean the bubble tower.
- **Chamber:** (Figure 14.1c) clean salt build-up, especially on the -HSC and -HTC model plate chamber heaters (see Section 8.4).
- **Deionized Water Supply:** check for proper purity and neutral pH. See Section 6.6.
- **Air Preconditioner Filter:** if the tester is equipped with a disposable 25" × 25" air filter, replace as necessary. See Figure 14.1d. If equipped with a washable filter see Section 14.7 for filter washing instructions.
- **Compressed Air Filter:** inspect and clean as necessary. See Section 6.5.
- **Main Water Filter:** (Figure 14.1a) unscrew bowl, remove, and clean or replace cartridge.
- **Solution Filter:** (Figure 14.1a) unscrew bowl, remove, and clean or replace cartridge.

- **Shower Nozzle Filter:** (Figure 14.1a) unscrew bowl, remove, and clean or replace cartridge.
- **Fog Spray Nozzle:** inspect and clean. See Section 8.6.
- **Shower Nozzles:** inspect and clean. See Section 14.5.
- **Wet Bulb Wick:** remove old wick and replace (*F-8017.5-K, Wet/Dry Bulb Wick Kit* contains new wicks and installation instructions). *F-9125-K Q-FOG CRH Maintenance Kit* includes F-8017.5.
- After performing the routine service:
  - Reconnect the main power.
  - Power the tester **ON**.
  - On the tester control panel, press CLEAR and then ENTER to reset the alarm.

Every 6 Months (4000 hours):

- Calibrate chamber thermometer (see Section 8.8) and wet/dry bulb thermometers (see Section 8.12). See Section 12 for the calibration procedure.
- Check chamber lid and air control module seals for leaks.
- Drain and clean solution tank. See Section 14.6.

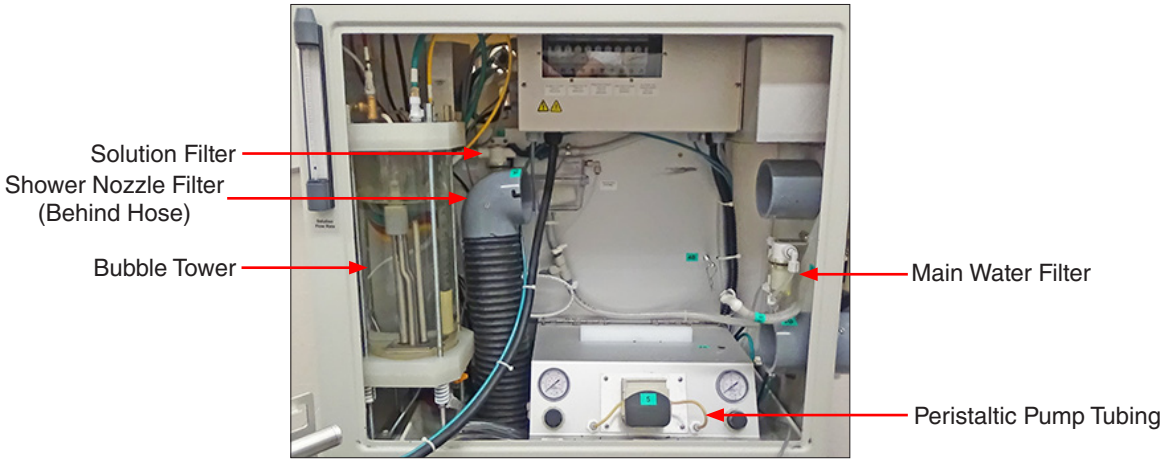


Figure 14.1a: Location of components requiring maintenance (ACM removed).

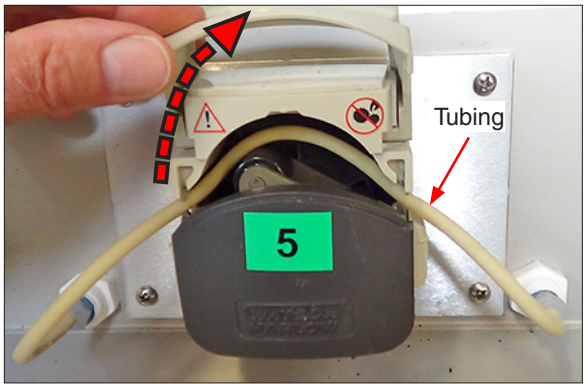


Figure 14.1b: Open peristaltic pump to check tubing.

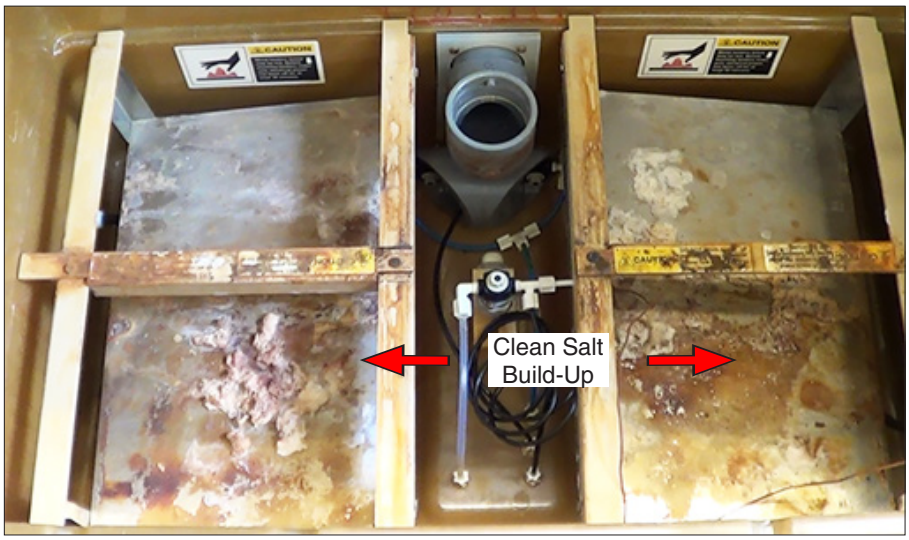


Figure 14.1c: -HSC and -HTC plate heaters with salt buildup (diffusers removed).

Figure 14.1d: Air Preconditioner air filter location. Standard washable air filter shown.

14.2. Salt Buildup Inside the Air Control Module (Nov 2021)

Excessive salt buildup inside the Air Control Module (ACM) (Figure 14.2) can cause the blower wheel to become unbalanced and lead to premature wear of the blower motor bearings. When excessive salt buildup is noticed, a cleaning cycle should be performed. The ACM does not need to be removed from the tester for cleaning.

Cause

- During cyclic testing, air is circulated through the ACM only during RH steps.
- Salt-contaminated air can enter the ACM during RH steps if the test specimens retain wet salt solution from the previous Fog or Shower step.
- A purge event is embedded in the last few minutes of Fog and Shower steps to dry specimens, but may not completely dry the specimens in all cases.
- When the moist salt-contaminated air passes through the ACM during the subsequent RH step, the solution-wetted air will dry and leave salt deposits on the inner surfaces of the ACM.

Cleaning

- Program and run a ACM cleaning step that incorporates 95-100% RH at a low chamber temperature such as 35 °C, for 1 hour. See Section 9 for programming information.
- The ACM will be cleaned through the circulation of the condensed water.
- The contamination will be carried out of the ACM and deposited in the chamber where it can go to drain.
- If necessary, repeat running the cleaning step until the salt buildup is removed.

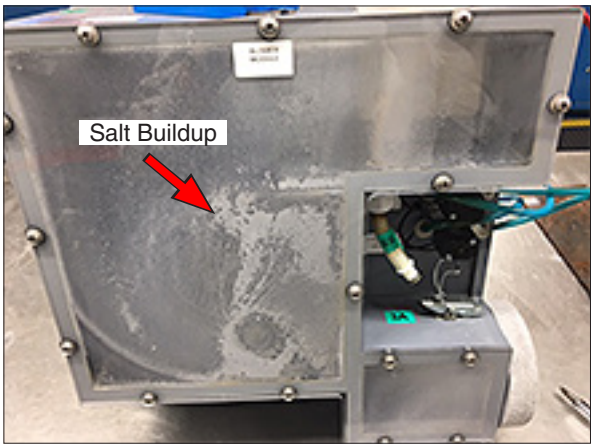
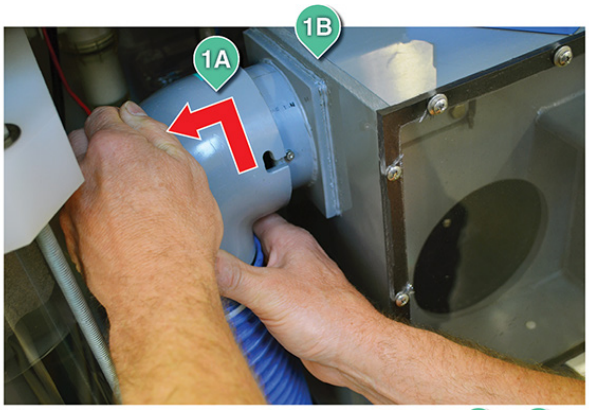
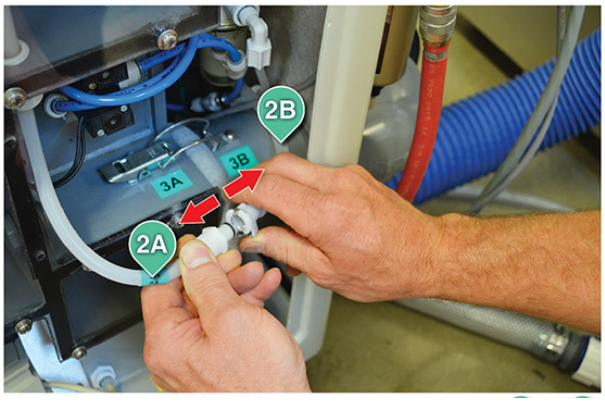


Figure 14.2: Air Control Module with salt buildup.

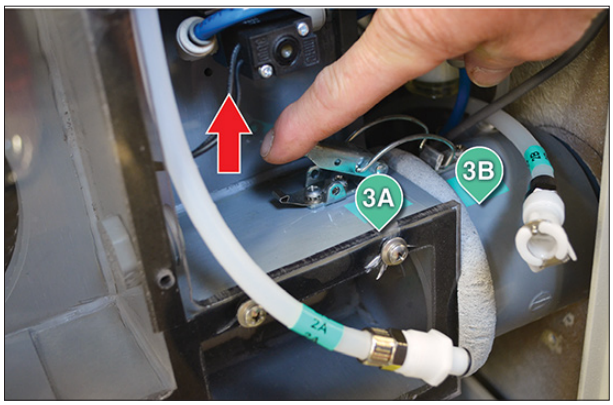
14.3. Removing the Air Control Module (ACM) (Mar 2021)



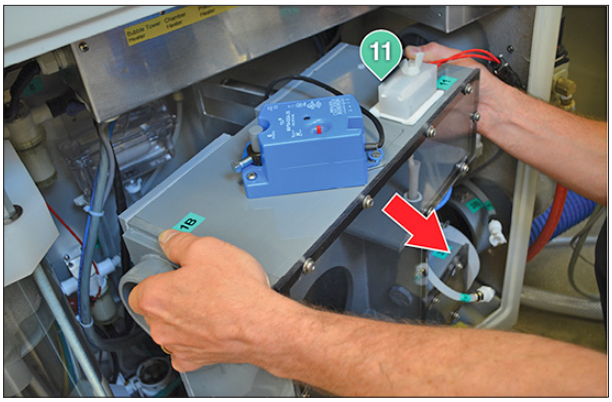
1. Disconnect Air Preconditioner hose (1A) from the ACM (1B).



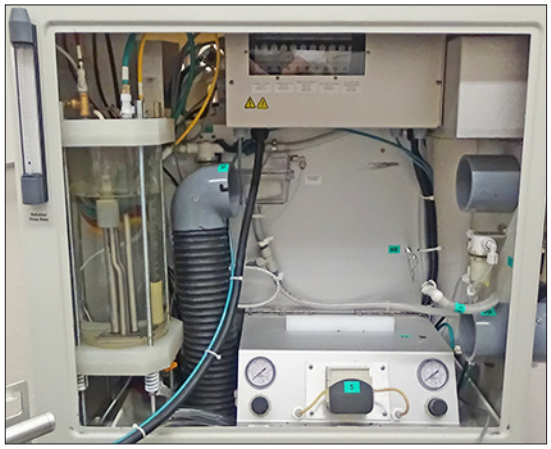
2. Disconnect wet bulb water supply tube (2A, 2B).



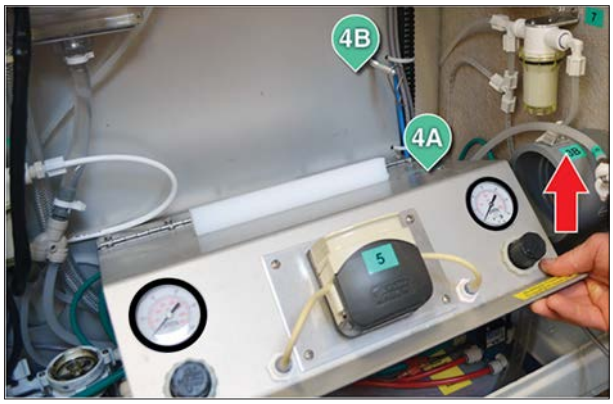
3. Unlatch the ACM (3A, 3B).



4. Remove the ACM (11) from the Q-FOG cabinet.



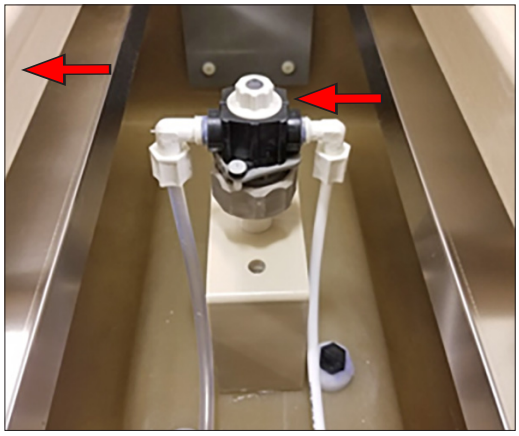
5. ACM removed from Q-FOG cabinet.



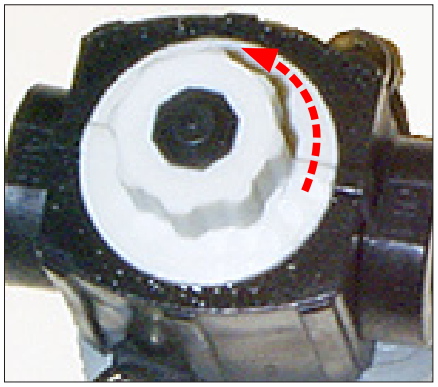
6. Lift (4A) and latch (4B) shelf for access to bottom components.

14.4. Fog Spray Nozzle Cleaning (Nov 2021)

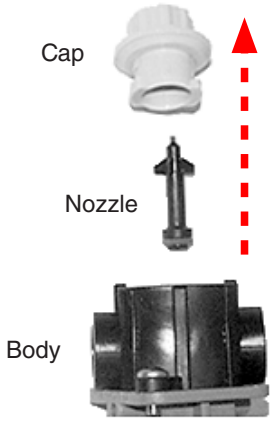
- The fog spray nozzle can be disassembled for cleaning. Follow the steps below to clean the fog spray nozzle.
- Tools required:
  - Small plastic cup
  - Distilled white vinegar, 5% acidity
  - Paper towels
- To access the fog spray nozzle:
  - For “S’” model testers, if the Stationary Shower Module (SSM) is installed, remove the SSM (see Section 7.3.1).
  - Remove the vent pipe.
  - Remove the diffusers (Figure 8.3a, Figure 8.3b).
  - For “R” model testers, remove the spray nozzle heat shield



1. Remove the panel racks, vent tube, and diffuser plates to access the fog spray nozzle.



2. Turn the nozzle cap counter clockwise 1/4 turn.



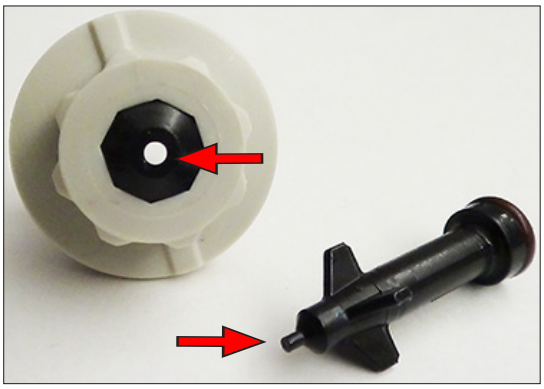
3. Remove the cap and nozzle from the spray body

4. Fill a small cup about half full with distilled white vinegar.

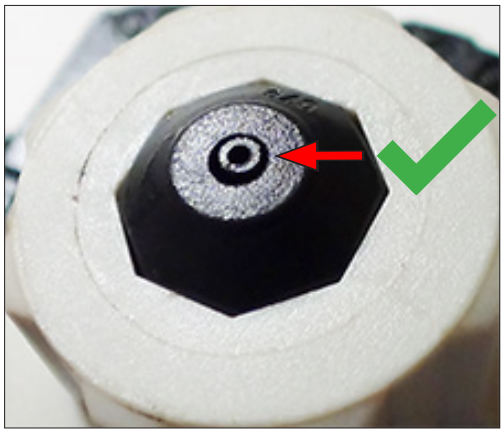
5. Drop the cap and nozzle into the cup. Soak for five (5) minutes.

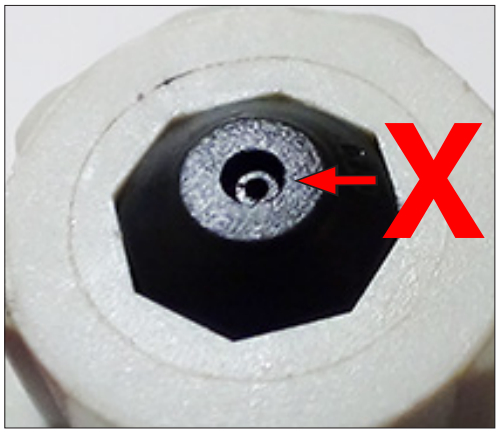
6. Under running clean tap water, fill the cup to overflowing.

7. Empty and refill the cup with clean water 4 times to throughly rinse nozzle and cap.



8. Dry the nozzle and cap. Make sure tip of nozzle and aperture in cap are clean and free of debris.



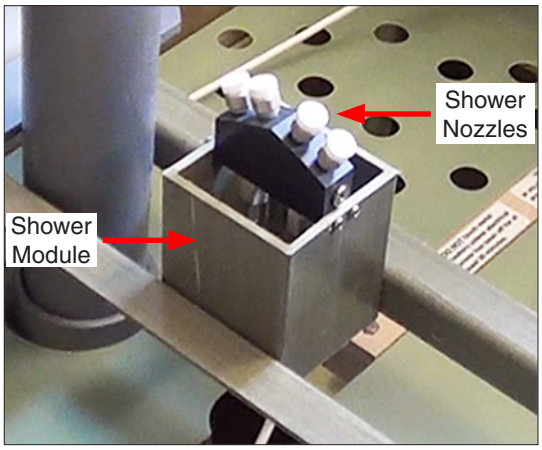


9. Reassemble the nozzle in the cap. **IMPORTANT:** Make sure tip of nozzle extends through hole in cap when reassembling.

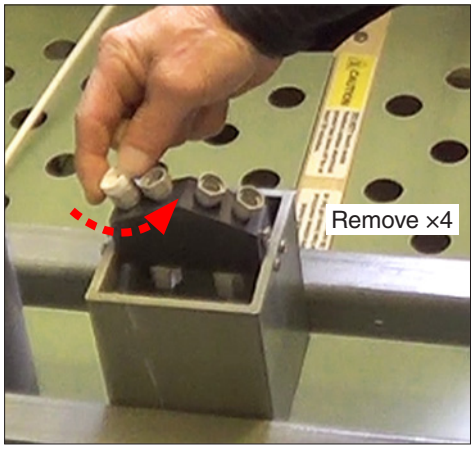
14.5. Shower Nozzle Cleaning (Dec 2021)

- The Q-FOG CRH may be equipped with either the Stationary Shower Module (SSM) in the “S” model testers (Section 7.3.1), or the Top-Mounted Swaying Shower Bar (TSSB) in the “T” model testers (Section 7.3.2).
- The shower nozzles are removed and cleaned in the same way for either shower type.
- Follow the steps below to remove and clean the shower nozzles.

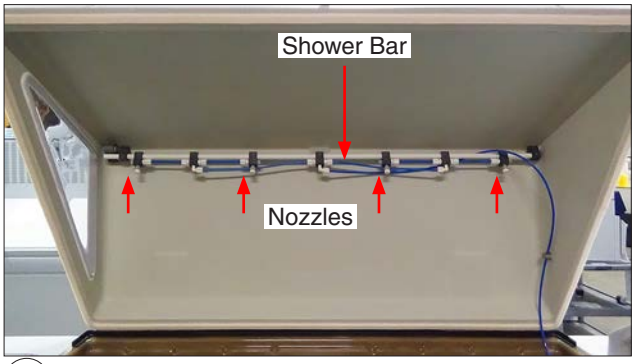
1. Open the Q-FOG chamber lid.



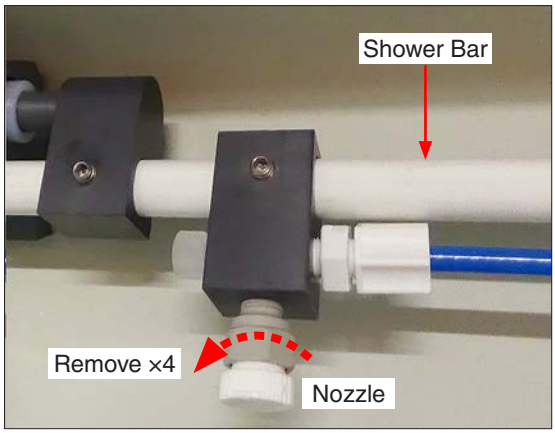
2. For testers with a SSM, locate the shower module and nozzles in the bottom center of the chamber.



3. Turn nozzles counter clockwise **1/4 turn** to remove them from the SSM. Remove all 4 nozzles.

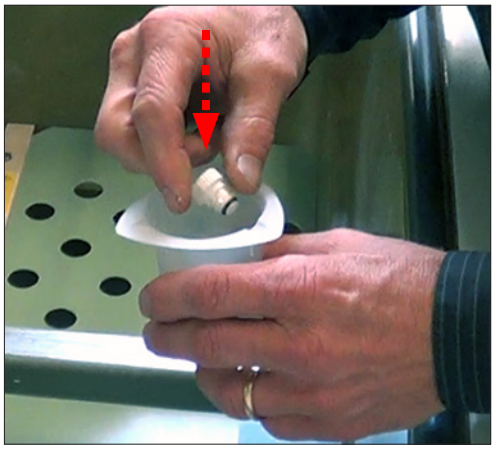


4. For testers with an TSSB, locate the shower bar and nozzles in the top of the chamber lid.



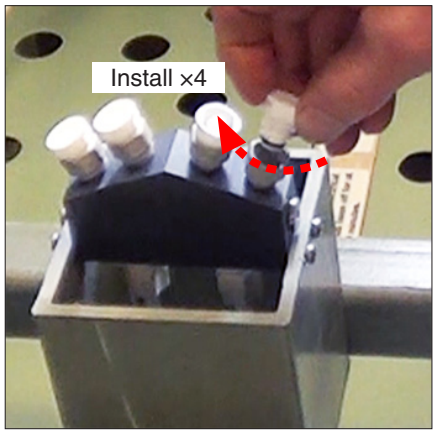
5. Turn nozzles counter clockwise **1/4 turn** to remove from them the TSSB. Remove all 4 nozzles.

6. Locate the beaker in the kit (F-8064-K).

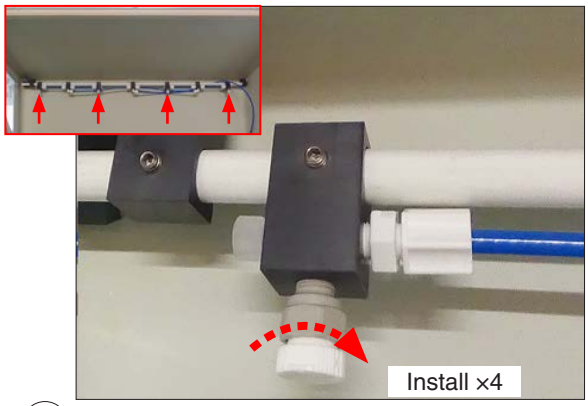


7. Place 4 old nozzles into the beaker.

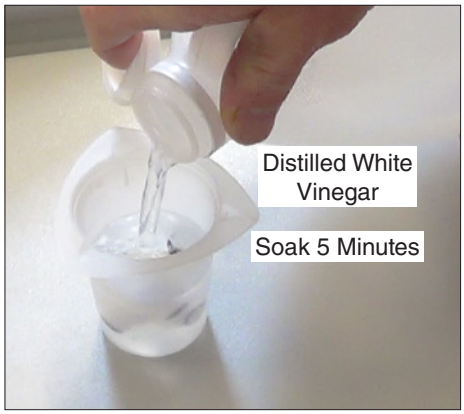
8. Locate 4 new nozzles in the kit.



9. For testers with a SSM, install 4 new nozzles in the shower module. Turn clockwise **1/4 turn** by hand to tighten.



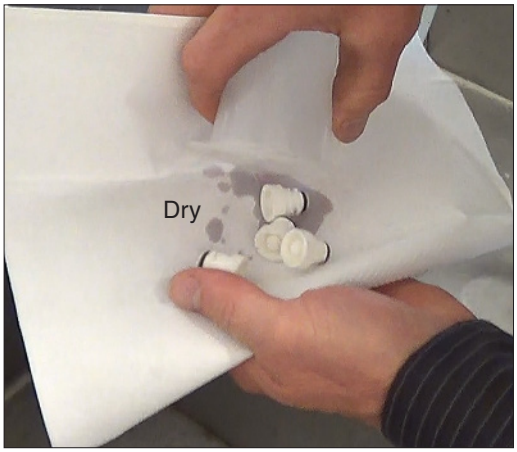
10. For testers with an TSSB, install 4 new nozzles in the shower bar. Turn clockwise **1/4 turn** by hand to tighten. **IMPORTANT:** do not attempt to adjust the angle of the shower nozzles.



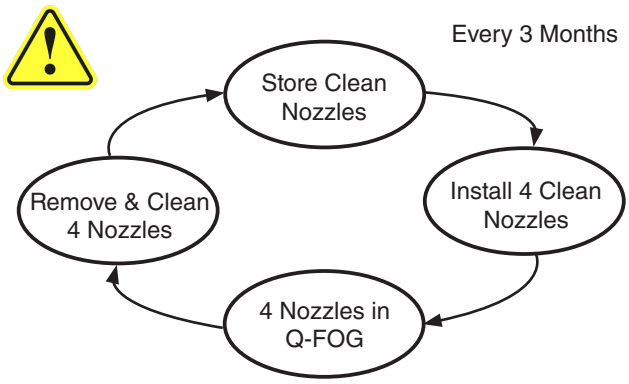
11. Fill the beaker with old nozzles 1/2 full (50 ml) of distilled white vinegar. Soak 5 minutes.

12. Under running clean tap water, fill the beaker to overflowing.

13. Empty and refill breaker with clean water 4 times to throughly rinse nozzles.



14. Dry nozzles with paper towels.



15. Store clean nozzles. Replace 4 nozzles in shower module every 3 months with clean nozzles from storage. Also see F-8064-L *Shower Nozzle Cleaning*.

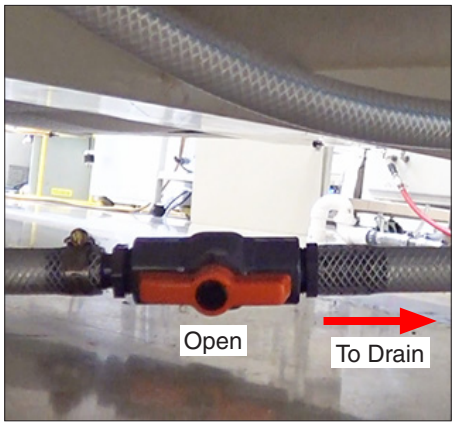
14.6. Solution Reservoir and Shower System Cleaning (Dec 2021)

- The solution reservoir (Section 8.1) and shower system (Section 8.10) should be cleaned every six (6) months or after every 4000 hours of Q-FOG operation.
- More frequent cleaning may be necessary when running GMW 14872 (see Section 11.3.5).
  - The solution specified in GMW 14872 creates a precipitate, calcium carbonate ($CaCO_3$).
  - This precipitate will build up inside the reservoir and can clog the shower system filters, hoses and nozzles.
  - Calcium carbonate is not soluble in water, so distilled vinegar is used to dissolve the calcium carbonate.

Tools Required:

- 7.6 liter (2 gallon) white vinegar
- Small bucket
- Long handled circular brush (Do not use a wire brush)
- Safety Glasses
- Clean water supply
- Phillips screwdriver

Clean the Reservoir



1. Make sure the solution reservoir drain hose goes into a drain (see Section 6.7).
2. Open solution reservoir drain valve under the reservoir.
3. Allow all solution to drain out of reservoir.
4. Clean reservoir drain hose.

5. Use a long handled circular brush (nylon or plastic, not wire) to remove calcium carbonate deposits from sides and bottom of reservoir.
6. Use clean water to wash loose particulate material out of reservoir.
7. Use shop vacuum to remove any remaining loose particulate material.
8. Use clean water to flush out any particulate material that may have accumulated in reservoir outlet.
9. Close reservoir drain valve.

NOTE: Wear safety glasses when working with vinegar

10. Pour 1/2 gallon of white vinegar into reservoir, wetting reservoir sides as vinegar is poured into reservoir.

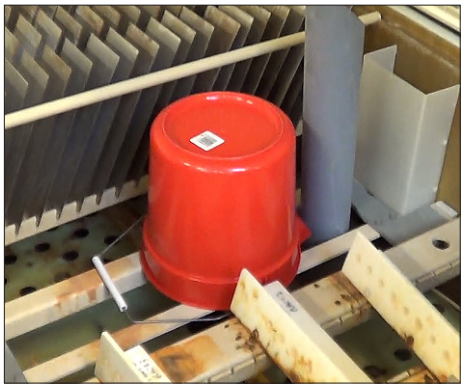
11. Use the brush to scrub sides and bottom of reservoir with vinegar.
12. Allow vinegar to soak in reservoir for about 30 minutes.
13. Open reservoir drain valve.
14. Allow all vinegar to drain out of reservoir.

15. Use clean water to rinse sides and bottom of reservoir
16. Repeat Step 9 through Step 15 as necessary.

Clean Shower Pump System

1. Close reservoir drain valve.

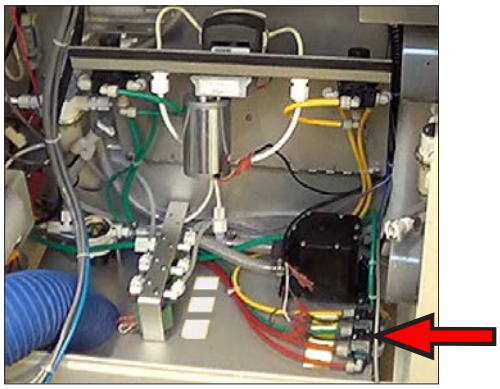
2. Pour 1/2 gallon of white vinegar into reservoir.
3. Remove shower nozzles from shower nozzle assembly (see Section 8.10).



Bucket Over SSM

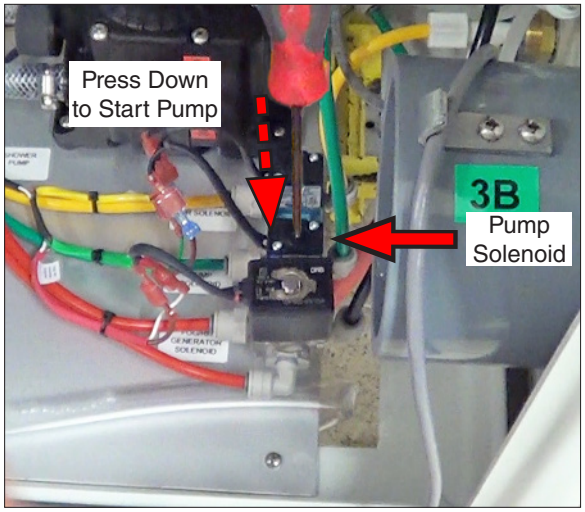
TSSB Close Lid

4. For testers with a SSM Invert bucket over shower nozzle assembly. For testers with an TSSB close the tester lid.
5. Remove Q-FOG right side access panel.
6. Remove air control module. See Section 14.3.



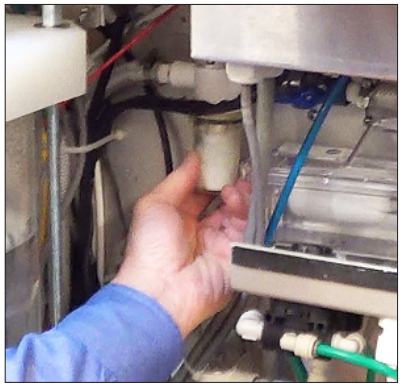
Solenoid Valves

7. Lift shelf to access solenoid valves. See Section 14.3. HSC/HSCR model shown, HTC/HTCR models similar.

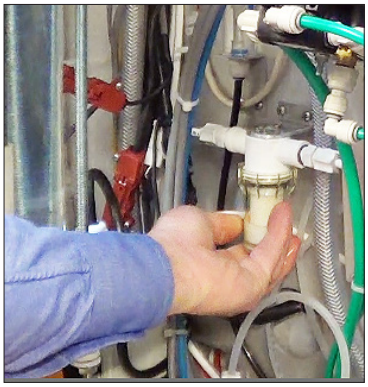


8. Insert screwdriver into shower pump solenoid (see Section 8.15) manual override and press down to start shower pump.
9. Pump vinegar through shower system for about 30 seconds.

10. Stop pump.
11. Allow vinegar to soak in shower system for about 30 minutes.
12. Insert screwdriver into shower pump solenoid manual override to start shower pump.
13. Pump all vinegar remaining in reservoir through shower system.
14. Stop pump.



15. Remove solution reservoir filter and cartridge.



16. Remove shower nozzle filter and cartridge.
17. Clean particulate material from filter bowls and cartridges with clean water.
18. Reinstall cartridges in filters.
19. Reinstall bowls on filters.
20. Close solenoid access shelf.
21. Reinstall air control module.
22. Reinstall Q-FOG access panel.
23. Open reservoir drain valve.

24. Use clean water to rinse sides and bottom of reservoir

25. Close reservoir drain valve.

26. Fill the reservoir with DI water.

27. Program the Q-FOG to run a 15 minute shower step (see Section 9.6).

28. Run shower step.

29. Open reservoir drain valve.

30. Drain any remaining water out of reservoir.

31. Close reservoir drain valve.

32. Fill reservoir with normal test solution.

33. For testers with a SSM, remove bucket from shower nozzle assembly. For testers with anTSSB, open the tester lid.

34. Clean shower nozzles (see Section 14.5 and Service Instruction F-8064-L *Shower Nozzle Cleaning*).

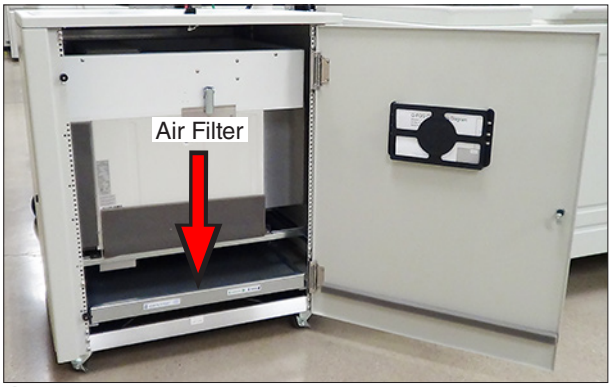
35. Replace shower nozzles.

36. Shower system cleaning process is complete.

14.7. Air Preconditioner Washable Air Filter Cleaning (Jun 2020)

- See F-9386-L Q-FOG CRH Washable Air Filters for more information.

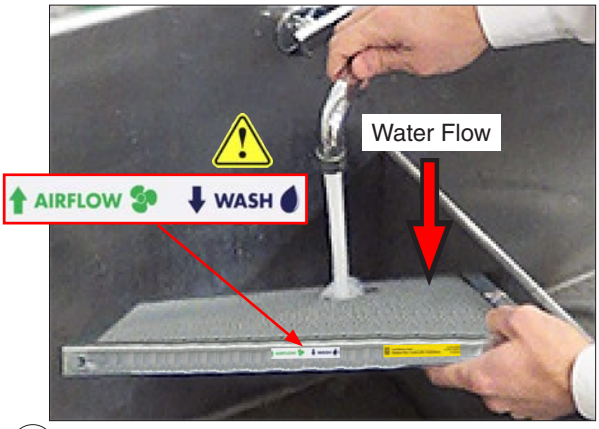
Air Preconditioner



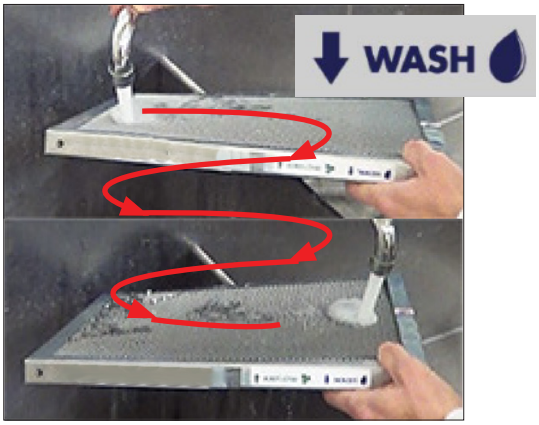
1. Open the Air Preonditioner front access door. Locate the washable air filter at the bottom of the enclosure.

2. Remove the washable air filter from the Air Preconditioner.

3. Locate **WASH** label on edge of filter.



4. Hold the air filter under **CLEAN** running water. **IMPORTANT:** Water flow MUST BE in direction of **WASH** arrow.

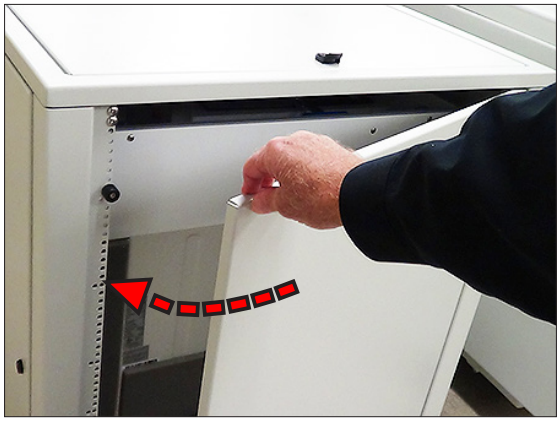


5. Wash entire air filter. **NOTE:** If rinsing with water does not remove dirt, use an electrostatic air filter cleaner spray.

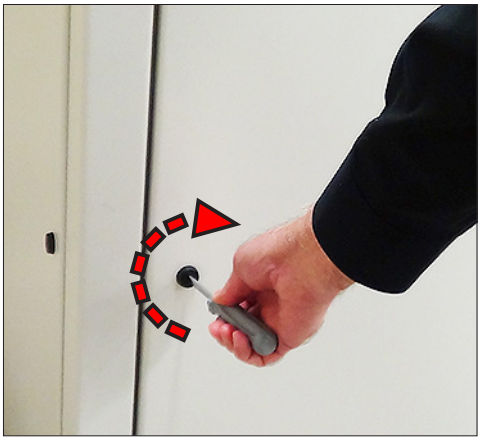
6. Drain water from the air filter.

7. Install the clean air filter in the air preconditioner. **IMPORTANT:** Make sure arrow on the airflow label is pointing up.

8. DO NOT install the air filter with the airflow label pointing down.



9. Close the air preconditioner door.



10. Close the latch. Washable air filter cleaning is complete.

14.8. Q-FOG Software Updates (Nov 2021)

- Q-Lab periodically updates the software that runs the Q-FOG to improve tester performance.
- Q-Lab recommends that customers check www.q-lab.com/software for new software versions every year to determine if any required or recommended software updates have been released and should be installed.
- The files required to perform software updates can only be obtained by contacting Q-Lab.

Software Version and Tester Serial Number

- The currently-installed Q-FOG software version number and tester serial number are required to determine if a software update needs to be performed.
- The Q-FOG serial number and the software version are listed in the Diagnostics screen (Section 9.8) accessed from the controller main menu.
- See Section 9.8 for instructions to display the tester serial number (diagnostic D30) and software version (diagnostic D12).
- The serial number can also be found on the nameplate attached to the rear of the Q-FOG cabinet (Figure 14.8a).

Software Types

- Once you have the tester serial number and software version number, visit www.q-lab.com/software.
- The most recent versions of Q-FOG software will be listed and identified as either **Required**, **Recommended** or **Optional**.
  - **Required** updates must be installed immediately, as they address issues that may strongly affect tester performance and/or pose a safety concern.
    - If a Required software version is more recent than the version currently installed on the Q-FOG (see previous section), that software needs to be installed.
    - More recent software versions are indicated by a higher version number (e.g. 6.110 and 6.200 would both be more recent than 6.100).
  - **Recommended** updates should be installed as soon as possible, as they offer a significant improvement and/or make an important correction.
  - **Optional** updates should not be installed unless Q-Lab personnel have directed you to do so.

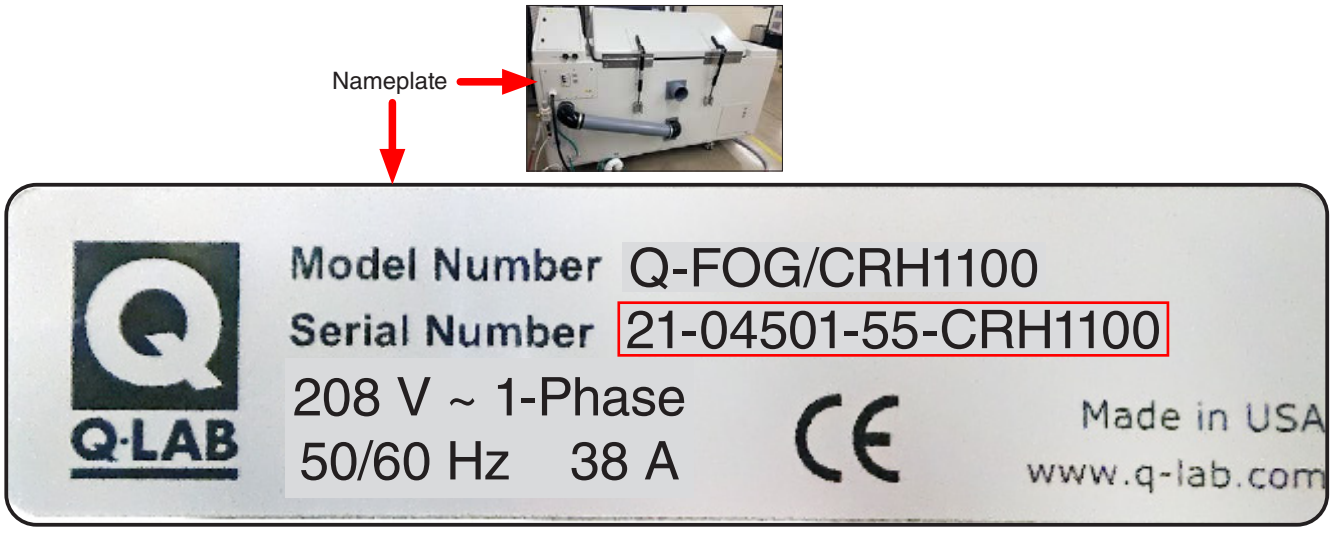


Figure 14.8a: Serial number on nameplate.

Software Update

- The appropriate software update file can be obtained either by contacting Q-Lab Repair directly or by filling out the web-based form on www.q-lab.com/software.
- Q-Lab Repair and Tester Support personnel will contact you to discuss your situation and, when applicable, provide you with necessary software files and instructions to perform an update.
- Copy the software files (file format must be .ff4) into the root directory (not a subfolder) on a USB flash drive (Figure 14.8b). Q-Lab recommends the use of an unencrypted, standard-formatted (FAT 32) USB drive.
- Connect the drive to the tester USB port of the control panel (Figure 14.8c).
- If a valid software file is on the USB drive, the controller will determine if that version is newer, the same as, or older than the software installed on the tester.
- On the USB Options screen, the software button label will reflect the relative software version (Figure 14.8d).
  - *Install New Software* means the software version on the USB drive is newer than the version on the tester
  - *Install Current Software* means the software version on the USB drive is the same as the version on the tester.
  - *Install Older Software* means the software version on the USB drive is older than the version on the tester.
- Touch the software install button to begin the software update process.
- Touch OK to confirm software installation (Figure 14.8e).
- If at any time during the software upgrade process a problem occurs with the USB drive or the data storage card on the main controller board, an error message will be displayed on the tester control panel.
- See Section 18 for Q-Lab Repair and Tester Support contact information.

Figure 14.8b: Copy Q-FOG software to a USB drive.

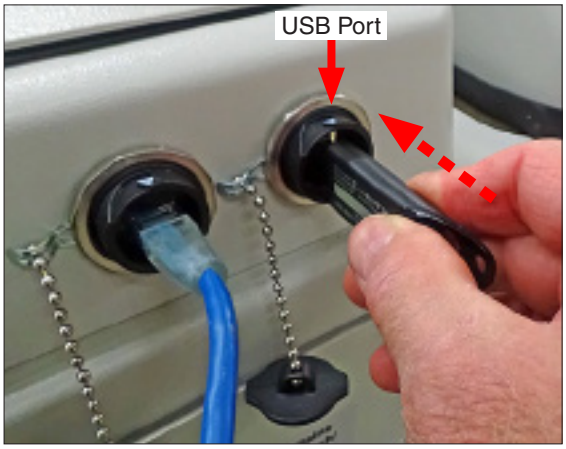


Figure 14.8c: Connect the drive to the USB port at the rear of the Q-FOG control top.

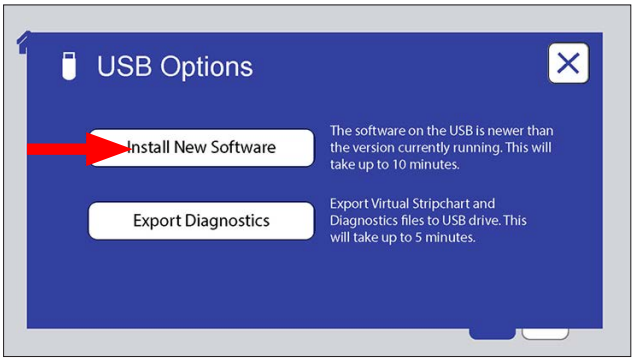


Figure 14.8d: The USB Options screen displays the software installation button.

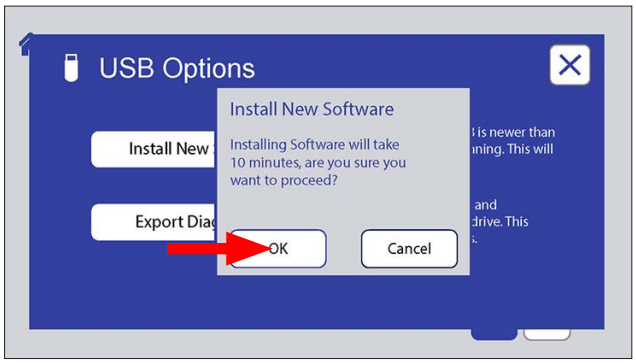


Figure 14.8e: Touch OK to proceed with software installation.

15. Troubleshooting and Repair

- The Q-FOG CRH tester is designed so that virtually all repairs can be made by the user.
- Use only parts that have been supplied or recommended by Q-Lab (see Section 16).
- Q-Lab accepts no responsibility for the consequences of the use of non-approved parts.
- Please contact Q-Lab Repair and Tester Support with any questions regarding tester troubleshooting and repair.
- Or contact the nearest international office by telephone Monday through Friday from 8:30 AM to 5 PM or email for technical support.
- For immediate assistance, please contact us directly at +1-440-835-8700 (US), +44-1204-861616 (UK and Europe), +49-681-857470 (Germany/Austria/Switzerland), or +86-21-5879-7970 (China).
- Visit www.q-lab.com to register your tester to access additional useful troubleshooting guides, operating manuals, and technical information.
- The Q-FOG software includes functions to export data that can be used to help diagnose tester problems (see Section 13.3).

For sales, technical, or repair support please visit:

Q-Lab.com/support

Westlake, Ohio USA • Homestead, Florida USA • Buckeye, Arizona USA
Bolton, England • Saarbrücken, Germany • Shanghai, China

15.1. Notifications (Nov 2021)

- Notifications provide useful diagnostic information for technicians and repair personnel.
- Notifications show significant tester events and errors that occurred in the recent past.
- See Section 9.4 for more information on displaying and clearing Notifications.
- The table below lists all Q-FOG Notification descriptions along with possible diagnostic actions.

If there are no Suggested Actions for a message description, you don't feel comfortable performing the Action, or you've tried unsuccessfully, then please contact Q-Lab Repair and Tester Support.

Code	Message	Icon	Test Status	Description • **Suggested Actions**
M1	Lid is open - Test suspended		Stopped	The lid has been opened when the tester is in Stop mode. • Close the lid
M2	Lid is open - Stop test		Stopped	The lid was opened when the tester was in Run mode. • Avoid opening the lid when the tester is running • Close the lid
M10	End of Test		Complete	Test completed successfully. No alarm is generated. • *No action required*

Code	Message	Icon	Test Status	Description • Suggested Actions
M11	End of Test		Complete	Test completed successfully. An alarm, as set in Section 9.5, is generated. • *No action required*
M12	End of Test Shutdown		Complete & Stopped	Test completed successfully. No alarm is generated. • *No action required*
M13	End of Test Shutdown		Complete & Stopped	Test completed successfully. An alarm, as set in Section 9.5, is generated. • *No action required*
M14	Perform Routine Service		Running	Time interval for tester maintenance has been reached. • See Section 14 for maintenance information
M20	Chamber High Temperature Fault XX°C		Stopped	Chamber air temperature is greater than the setpoint by more than the allowable value. • Check that chamber heater or vapor generator heater relays are not stuck closed • Check chamber temperature sensor
M21	Chamber Low Temperature Fault XX°C		Stopped	Chamber air temperature is less than the setpoint by more than the allowable value. • Check chamber heater circuit breaker • Check chamber over-temperature switch • Check chamber temperature sensor • Check that run power and chamber heater relays are not stuck open • Check the chamber heaters (wiring diagram shows correct resistance values)
M22	Bubble Tower High Temp Fault XX°C		Stopped	Bubble Tower temperature is greater than the setpoint by more than the allowable value. • Check that bubble tower heater relay is not stuck closed • Check bubble tower temperature sensor
M23	Bubble Tower Low Temp Fault XX°C		Stopped	Bubble Tower temperature is less than the setpoint by more than the allowable value. • Check that run power and bubble tower heater relays are not stuck open • Check bubble tower temperature sensor • Check bubble tower thermal fuse • Check bubble tower heater (resistance should be 75 Ω and current should be 3 amps)
M30	Fog Step Temperature Fault		Running	Informative message that a temperature setpoint was not reached by the end of the Fog step. • *No action required*
M33	RH Step Temperature Fault		Running	Informative message that a temperature setpoint was not reached by the end of the RH step. • *No action required*

Code	Message	Icon	Test Status	Description • Suggested Actions
M38	Lab RH at Time of Alarm XX%		Running	This notification is not an error by itself; it notes what the laboratory RH was at the time a different, stopping fault occurred. • *No action required*
M39	Lab Temp at Time of Fault XX°C		Running	This notification is not an error by itself; it notes what the laboratory temperature was at the time a different, stopping fault occurred. • *No action required*
M42	Chamber Temp Too Hot XX°C		Stopped	The chamber temperature has exceeded the maximum allowable temperature. • Check that chamber heater or vapor generator heater relays are not stuck closed • Check chamber temperature sensor
M43	Bubble Tower Too Hot XX°C		Stopped	The Bubble Tower temperature is greater than 75 °C. • Check that bubble tower heater relay is not stuck closed • Check bubble tower temperature sensor
M44	Controller Too Hot XX°C		Stopped	The Controller temperature is greater than 55 °C. • Check room temperature • Check overheating of relays
M45	Preconditioner Defrosting		Running	The Air Preconditioner (see Section 8.15) temperature has exceeded the allowable temperature with the preconditioner on and the preconditioner heater off. • Check for blocked air flow around air preconditioner openings • Check shutter adjustment • Check actuator adjustment • Check ambient damper actuator for failure or adjustment • **NOTE:** Damper adjustments can only be done by a factory-trained Q-Lab technician. • Check evaporator sensor for failure, out of position, foam insulation out of place, or warm air leaking around sensor • Check Air Preconditioner damper actuator for failure
M46	Preconditioner Heater Circuit Open		Running	No Air Preconditioner heater current detected when heater is on. • Check over temperature device on heater housing • Check thermal fuse on air heater • Check ambient damper operation

Code	Message	Icon	Test Status	Description • Suggested Actions
M49	Power Disrupted		Running	This message indicates power was off and then came back on during a RUN step. The message appears if power goes out for any reason, including if the user turns power OFF when the tester is in RUN mode. • Always press STOP before powering the Q-FOG off to prevent the M49 message from being displayed when the Q-FOG is powered back on
M50	Replace Battery		Running	The Main Controller battery voltage is less than the low limit. • Replace the battery (V-4086) on the main controller circuit board See Section 16
M53	RH Too High XX%		Stopped	The RH is greater than the setpoint by more than the allowable value. • Check water supply to wet bulb, see Section 12.2 • Make sure air control module blower and dampers are operational • Make sure compressed air supply is left ON, if cycled ON/OFF daily may create an air bubble in the wet/dry bulb supply line
M54	RH Too Low XX%		Stopped	The RH is less than the setpoint by more than the allowable value. • Check calibration of wet/dry bulb temperature sensors • Check incoming air pressure • Check RH/Fog solenoid assembly • Check water supply to wet bulb, see Section 12.2
M55	Chamber Temp at End of Ramp XX°C		Running	The chamber temperature is not within the allowable limits at the end of a Linear or Less Than ramp.
M56	Chamber RH at End of Ramp XXX%		Running	The chamber RH is not within the allowable limits at the end of a Linear or Less Than ramp.
M61	Bubble Tower Fill Failure		Stopped	The Bubble Tower did not fill. • Check that water supply is turned on • Check bubble tower water solenoid • Check bubble tower hi water level sensor
M62	Bubble Tower Water Level Sensor Fail		Stopped	The Bubble Tower high level switch is on but the low level switch is off. • Check bubble tower level sensors
M65	Install Stationary Shower Module (SSM)		Stopped	In an “S” model tester a test cycle with a shower step cannot be run if the SSM is not installed. • Install the SSM in the proper position, see Section 8.10 • Applies to “S” model testers only, does not apply to testers with TSSB

Code	Message	Icon	Test Status	Description • Suggested Actions
M66	Remove Stationary Shower Module (SSM)		Stopped	In an “S” model tester a test cycle with a Fog step cannot be run if the SSM is installed. • Remove the SSM from the test chamber, see Section 8.10 • Applies to “S” model testers only, does not apply to testers with TSSB
M67	Cannot Run Fog & Shower in One Cycle		Stopped	A test cycle with both a Shower and a Fog step cannot be run. • Reprogram the test cycle to have a Shower step or a Fog step but not both • See Section 9.6 for test cycle programming information
M68	Preconditioner Heater Relay Failure		Stopped	The air preconditioner heater relay has failed. • Replace air preconditioner heater relay, part number F-8385-K (see Section 16)
M70	Solution Reservoir Low		Running	The solution in the reservoir is below the low level sensor. • Fill Solution Reservoir (see Section 8.1)
M71	Solution Reservoir Empty		Stopped	The solution reservoir is empty. • Fill Solution Reservoir (see Section 8.1)
M72	Shower Flow Too High		Running	The shower flow is not within ±15% of the normal flow set by the Set Shower Flow Alarm. • Check for loose connections or nozzles • Recalibrate shower flow limits (see Section 12.4 and Section 12.5)
M73	Shower Flow Too Low		Running	The shower flow is not within ±15% of the normal flow set by the Set Shower Flow Alarm. • Clean shower nozzles (see Service Instruction F-8064-L) • Recalibrate shower flow limits (see Section 12.4 and Section 12.5)
M74	No Spray Air Flow		Stopped	There is no compressed air going through Bubble Tower in a fog step. • Check that compressed air is turned on • Check air solenoid • Check that spray nozzle is not blocked • Check spray air flow switch
M75	Air Valve Leak		Stopped	There is compressed air going through bubble tower in a non-fog step. • Check spray air solenoid • Check spray air flow switch
M80	Flash Memory Failure		Stopped	The checksum test on Main Controller software failed.
M81	Flash Data Corrupt		Stopped	Tester parameter and setup data is corrupted.
M82	RAM Corrupted, RAM Reloaded		Stopped	Error in RAM data, data is reloaded from flash.

Code	Message	Icon	Test Status	Description • Suggested Actions
M90	Evaporator Temperature Sensor Fail		Stopped	Air Preconditioner evaporator temperature is less than 0 °C or greater than180 °C. • Replace Sensor
M91	PC Output Temperature Sensor Fail		Stopped	Air Preconditioner temperature is less than 0 °C or greater than 180 °C. • Replace Sensor
M92	Chamber Temperature Sensor Fail		Stopped	Chamber temperature is less than 3 °C or greater than 180 °C.
M93	Bubble Tower Temperature Sensor Fail		Stopped	Bubble Tower temperature is less than 3 °C or greater than 180 °C. • Check bubble tower temperature sensor
M96	RH Sensor Fail		Running	Wet bulb temperature is greater than dry bulb temperature +1 °C. • Replace Sensor • Air Control Module major leak or dampener not closing • Recalibrate wet/dry bulb sensor, see Section 12.2 • No water in wet/dry bulb supply line
M97	Wet Bulb Temperature Sensor Fail		Stopped	Wet bulb temperature is less than 3 °C or greater than 180 °C. • Replace Sensor
M98	Dry Bulb Temperature Sensor Fail		Stopped	Dry bulb temperature is less than 3 °C or greater than 180 °C. • Replace Sensor
M99	Lab Temperature Sensor Fail		Running	Lab temperature is less than 3 °C or greater than 99 °C. • Replace Sensor
M101	SD Card Missing		Running	SD Card is missing.
M103	System Auto-Reboot		Running	System restarts because of fail-safe intended to prevent system locking up.
M104	Chamber Htr Circuit 1 Low Pwr Fault		Running	“R” (Rapid Ramp Heater) Models Only - Chamber heater circuit 1 power is below the low power parameter and the Power Duty Cycle is at 100%.
M105	Chamber Htr Circuit 2 Low Pwr Fault		Running	“R” (Rapid Ramp Heater) Models Only - Chamber heater circuit 2 power is below the low power parameter and the Power Duty Cycle is at 100%.
M106	Chamber Htr Circuit 1Hi Pwr Fault		Stopped	“R” (Rapid Ramp Heater) Models Only - Chamber heater circuit 1 power is above the high power parameter and the Power Duty Cycle is below 50%.
M107	Chamber Htr Circuit 2 Hi Pwr Fault		Stopped	“R” (Rapid Ramp Heater) models only - chamber heater circuit 1 power is above the high power parameter and the Power Duty Cycle is below 50%.

Code	Message	Icon	Test Status	Description • Suggested Actions
M108	AC Current Too High		Stopped	“R” (Rapid Ramp Heater) models only - an AC current sensor has measured current at or above the AC fault current parameter.
M109	Chmbr Htr Cir 1 On, Should be Off		Stopped	“R” (Rapid Ramp Heater) models only - current sensed in chamber heater circuit 1 but heater was not commanded to turn on.
M110	Chmbr Htr Cir 2 On, Should be Off		Stopped	“R” (Rapid Ramp Heater) models only - current sensed in chamber heater circuit 2 but heater was not commanded to turn on.
M112	Run Relay Stuck On		Stopped	The run power relay is stuck on.
M113	Chmbr Htr Cir 1 Relay Stuck On		Stopped	“R” (Rapid Ramp Heater) models only - the chamber heater circuit 1 relay is stuck on.
M114	Chmbr Htr Cir 2 Relay Stuck On		Stopped	“R” (Rapid Ramp Heater) models only - the chamber heater circuit 2 relay is stuck on.
M115	TSSB Front Sensor ON Should Be OFF		Stopped	“T” (Top-Mounted Swaying Shower Bar) models only - the Shower Bar Motion Solenoid valve is ON, and the Shower Bar at Front Switch is OFF. **or** “T” (Top-Mounted Swaying Shower Bar) models only - the Shower Bar Motion Solenoid valve is OFF, and the Shower Bar at Front Switch is ON.
M116	TSSB Rear Sensor ON Should Be OFF		Stopped	“T” (Top-Mounted Swaying Shower Bar) models only - the Shower Bar Motion Solenoid valve is ON, and the Shower Bar at Rear Switch is ON. **or** “T” (Top-Mounted Swaying Shower Bar) models only - the Shower Bar Motion Solenoid valve is OFF, and the Shower Bar at Rear Switch is OFF.
M117	Software Install Completed Successfully		Running	The tester has successfully installed software and restarted. • *No action required*
M118	Notification Center Data Error. Please Contact Q-Lab		Running	Data corruption has occurred in the Notification Center.
M119	Non-Matching Displays Detected		Running	Displays from two different vendors are installed. • Adjust screen brightness if necessary
M120	TSSB Front Sensor OFF Should Be ON		Stopped	“T” (Top-Mounted Swaying Shower Bar) Models only.
M121	TSSB Rear Sensor OFF Should Be ON		Stopped	“T” (Top-Mounted Swaying Shower Bar) Models only.
M122	TSSB Motion Failure		Stopped	“T” (Top-Mounted Swaying Shower Bar) Models only.
M900	Status Screen Communications Failure		Running	Communication lost between main controller and Status Screen. Tester will enter single-screen mode. • Check for loose cable between main controller and the display. Reseat cable.

Code	Message	Icon	Test Status	Description • **Suggested Actions**
M901	Main Menu Screen Communications Failure		Running	Communication lost between main controller and Menu Screen. Tester will enter single-screen mode. • Check for loose cable between main controller and the display. Reseat cable.
M902	Main Controller Communications Failure		Running	Message that appears on a screen that has experienced M900 or M901. • *No action required*