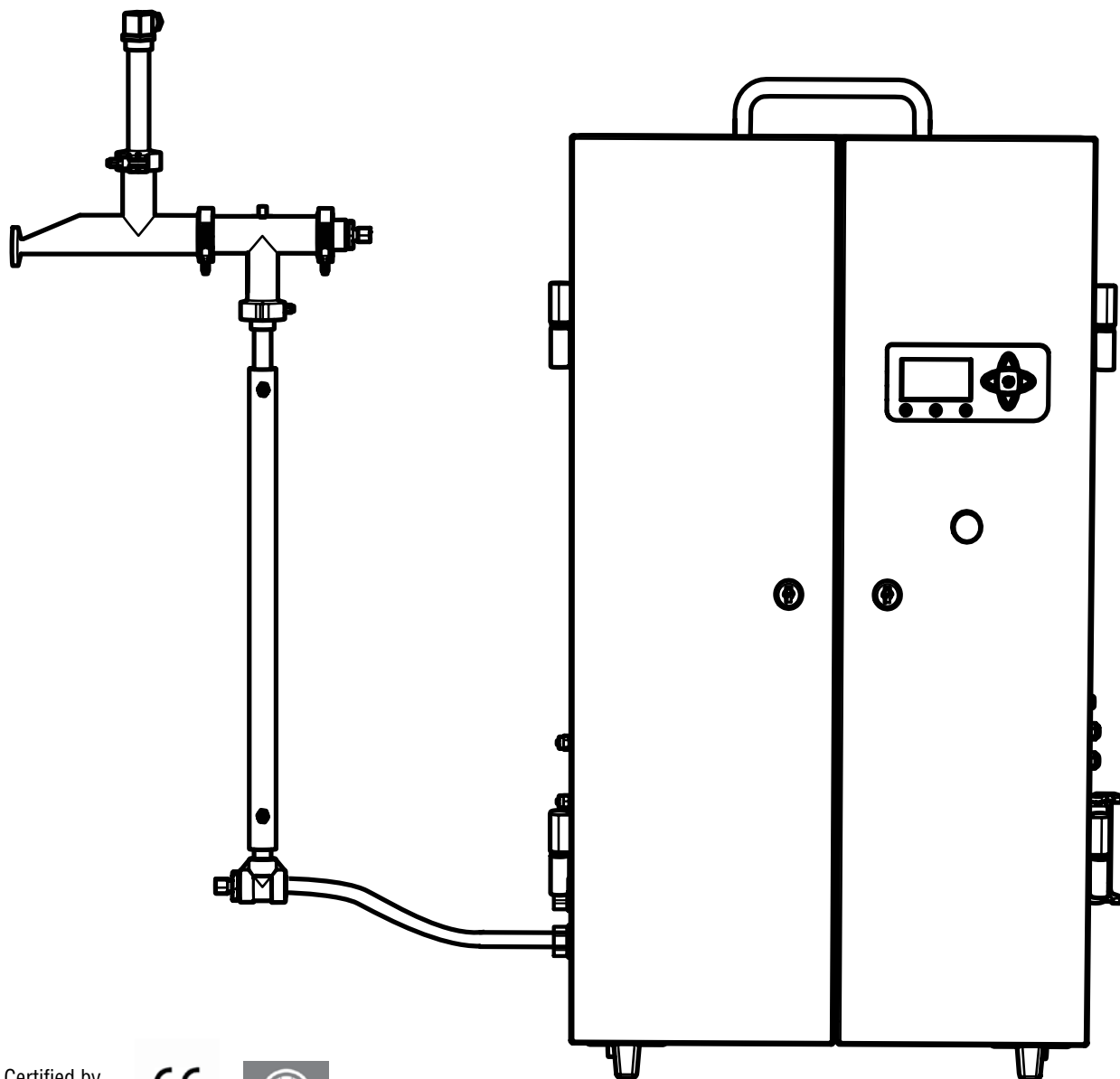




STEAM QM-3
Steam Quality Monitor

CALIBRATION MANUAL



Certified by



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Revision History

Version	Release Date	Description of Changes
1.0	20/02/2014	Initial
1.1	21/03/2014	Temperature transmitter T (T1, T2, T3) - Design Modification
2.0	17/03/2016	Tee and Adapter - Design Modification: pages 5, 6, 8, 9. Page 4, General Information Section. Update of the list of material needed The following have been removed: Decade box (calibrated), 5 volt generator or adjustable power supply (0-10VDC), M12 digital for decade box The following have been added: Oil bath, Thermometer (calibrated), Pressure generator, Manometer (calibrated). Page 6, Recalibration Procedure Section Point 3 has been added (Remove the Temperature Sensor T1 after unplugging it and plug it back in before install it in oil bath). - "Calibrating the Temperature Sensors (Simulated Measurement Method)" has been updated as "Calibrating the Temperature Transmitter". - Chart with the data of the 3 temperature sensors is deleted. Pages 6 - 8: Calibrating the temperature transmitter and the pressure transmitter procedures have been updated. Page 12: Text modifications, Point 1(Disconnect the expansion coil from the bottom of the NCG burette. To avoid damaging the expansion coil, loosen bottom nut on expansion coil and remove top nut). Point 13 (o force open the EV1 valve to allow discharge move the arrow to the EV1 line then move the arrow to left of 1 and press OK).

Safety

Icon Legend



Indicates Power On



Indicates Power Off



Indicates important information concerning potential for personal injury or damage to equipment



Indicates electrical hazard



Indicates hot surface



Burn hazard! Uninsulated components upstream of cabinet may be hot.

- Do not touch when unit is working.
- Allow to cool before moving or servicing unit.

Live steam will cause burns; condensate water may cause them. Skin exposure to 140 °F (60 °C) water for only five seconds may cause a second degree burn.

Keep unit away from heat-sensitive equipment and installations.



Shock hazard! High voltages present inside equipment.

- Electrical installation must be performed by qualified personnel.
- Disconnect power before performing any electrical service.



Read this manual. It contains important information.

This device must be installed in accordance with appropriate local, national, and international standards, codes, and practices.

Installation should always be accompanied by competent technical assistance.

Improper installation, start-up, operation, maintenance, or service may void warranty.

You are encouraged to contact Armstrong International or its local sales representative for additional information.

Service must be performed by a qualified person.



Equipment must be disposed of according to applicable environmental requirements.

Abbreviations and Acronyms

Term	Meaning	Explanation
ΔP	Differential Pressure	$\Delta P1$: Difference between water column in NCG vessel and atmosphere. $\Delta P2$: Difference between water column in condensate vessel and atmosphere.
AI	Alarm	Indicates an out-of-limit situation, but has no impact on operation. AI1: Dryness below user-defined set point longer than two seconds. AI2: Four consecutive calculations of NCGs are over the user-defined limit. This calculated value is displayed on the main screen and updated every 30 seconds. AI3: T1 above 257 °F (125 °C) longer than two seconds.
C	Celsius	
cm	Centimeter	
Df	Default	Indicates failure. Turns off power to heating element and opens EV0 to drain. Df4: T3 above 185 °F (85 °C) longer than two seconds. Df5: No condensate from condenser in last ten minutes. Df6: T2 above 356 °F (180 °C) longer than two seconds.
DIN	Deutsches Institut für Normung eV	
dP	Differential Pressure	
EC	European Community	
EEC	European Electrotechnical Commission	
EN	European Norm	
EV	Electronic Valve	
F	Fahrenheit	
gal	Gallon	
h	Hour	
imp	Imperial [measure]	
in	Inch	
kg	Kilogram	
L	Liter	
lb(s)	Pound(s)	
max	Maximum	
min	Minimum	
mm	Millimeter	
NCG	Non-Condensable Gases	NCGmax is the limit of the NCG rate. Alarm 2 indicates the limit has been exceeded. Range is 0–15%. Default is 3.5%.
P	Pressure	P is steam pressure upstream of calibrated orifice. Modbus sends data as bar even with imperial measure selected.
ppm	Parts per Million	
psi(g)	Pounds per Square Inch (gauge)	
Q	Steam Flow	
QM	Quality Monitoring	
R	Resistance	Shown as watts.
R/O	Reverse Osmosis	
sec(s)	Second(s)	
SI	International System of Units	
S_T	Superheat	
T	Temperature	T1: Temperature after pressure reduction to atmosphere. T2: Temperature after heating resistance. T3: Temperature after condenser.
X	Dryness Fraction (sometimes called steam quality or moisture content)	Xmin is the lower dryness limit. Alarm 1 indicates the limit has been exceeded. Range is 0.85–0.95. Default is 0.95.



General Information

This document will walk a technician through the steps necessary to calibrate/recalibrate the Steam QM-3. It is estimated this process will take between two to four hours. Once recalibration has begun, all components must be recalibrated before returning the unit to service.

Recalibration is required annually or whenever any component is changed.

What to expect:

Temperature sensors:

There are three temperature sensors which can be calibrated either by simulated measurement method or true measurement method.

- Simulated measurement method—simulates the resistance that should be created by the temperature sensor.
- True measurement method—place the temperature sensors in the oil bath and recreate the actual temperatures for calibration. This method is not covered in this document.

Pressure transmitter:

The pressure sensor is calibrated by simulating the voltage created at a specific pressure.

Heating Element:

It is important to calibrate the natural resistance of the heating element and cable with the Steam QM-3 computer. This is done by measuring the actual resistance.

Condensate Flow Meter:

Measure the average amount of condensate discharged per cycle of the EV2 valve.

Gas Flow Meter (NCG flow meter):

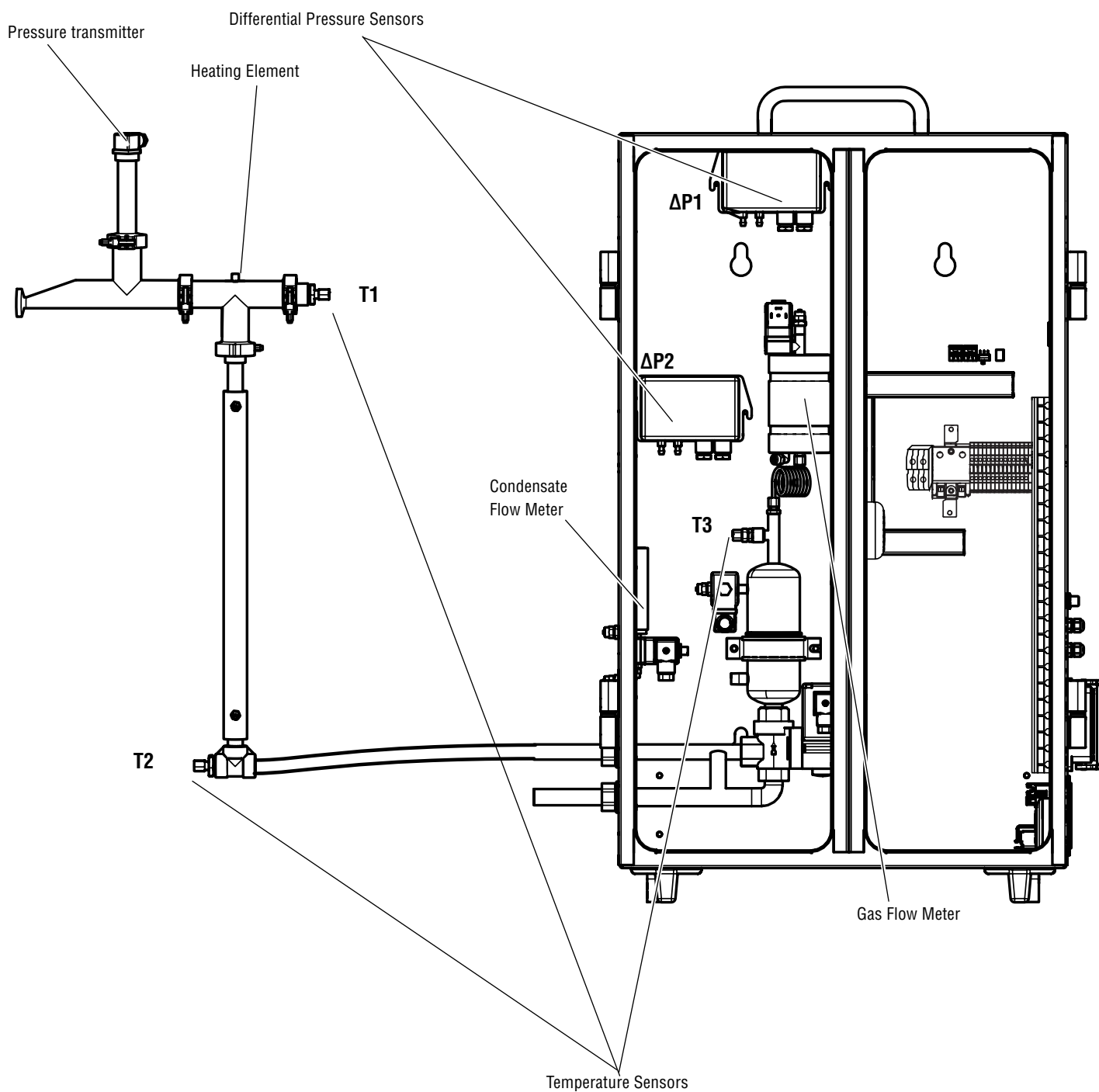
Measure the average amount of non-condensable gasses (NCGs) discharged per cycle of the EV1 valve.

Materials needed:

- Balance (calibrated)
- Ohmmeter (calibrated)
- 10mm wrench
- 11mm wrench
- 14mm wrench
- Adjustable wrench
- NCG calibration kit
 - Open vessels for collecting liquids
 - 500ml vessel
 - 50ml vessel
 - Draw vessel cap 1L
 - NCG injector syringe
 - Multimeter
- Oil bath
- Thermometer (calibrated)
- Pressure generator
- Manometer (calibrated)

There are a total of nine instruments that need to be calibrated on the Steam QM-3. The instruments are:

- 3 temperature sensors
- 1 pressure transmitter
- 1 heating element
- 1 condensate flow meter
- 1 gas flow meter (NCG meter)
- 2 differential pressure sensors



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Recalibration Procedure



Turn off the steam to the Steam QM-3 and allow to cool

Code Menu

Access menu by pressing ◀ and ▶ at same time.

Navigate between digits by pressing ◀ or ▶.

Change value for digit by pressing ▲ or ▼.

Press « OK ».

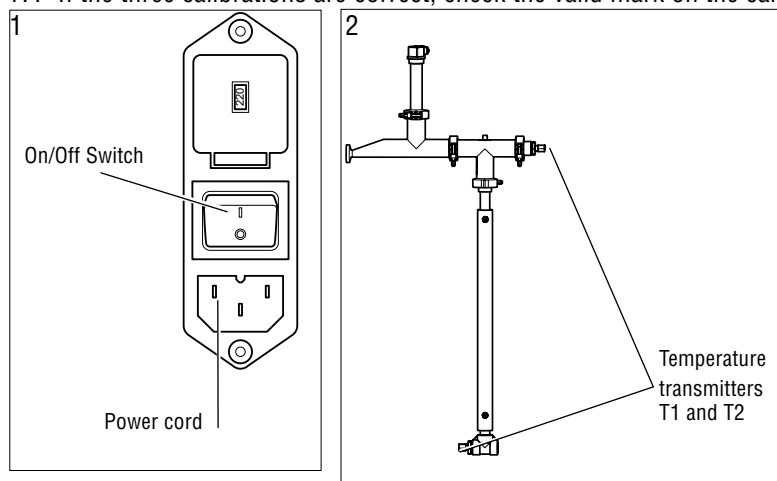


Version

Calibrating the Temperature Sensors

Calibration #1: Calibrating T1, T2, T3 Temperature Sensors¹

1. Turn off the Steam QM-3 and be sure it is cold. Check that the voltage switch is in the correct position for the voltage being used.
2. Unplug the Temperature Sensor T1 from the QM-3.
3. Remove the Temperature Sensor T1 after unplugging it and plug it back in before install it in oil bath.
4. Install the oil bath on stable area close to the device.
5. Place the probe and the calibrated thermometer in the oil bath (as close as possible)
6. Set the oil bath at 80 °C
7. Wait that the oil bath is stabilized. And adjust its temperature to have 80 °C on the calibrated thermometer.
8. Turn on the QM-3.
9. On the Steam QM-3 display pad, press up and down arrows simultaneously to access the Debug sensor menu.
10. Write the value of T1 on the calibration certificate. If T1 is $\pm 0,7^{\circ}\text{C}$ regarding the set point (80°C), the sensor is considered as valid (go to the point 14). If not, you must adjust the sensor.
11. On the Steam QM-3 display pad, press left and right arrows simultaneously to access the code menu.
12. Enter 234 using the up and down arrows to change numbers and the left and right arrows to change the position to access temperature calibration menu, and press OK.
13. Move the arrow to left of 80 °C on T1, press OK and wait for check mark.
14. Write 80 °C on the adjusted column of the calibration certificate.
15. Restart the procedure from point 5 with 140 °C instead of 80 °C.
16. Control the calibration with random temperature between 80 °C and 140 °C (restart the procedure from point 5) and write it on the calibration certificate.
17. If the three calibrations are correct, check the valid mark on the calibration.



Calibration		T Sensor
T1	80 °C	140 °C
T2	80 °C	140 °C
T3	40 °C	80 °C

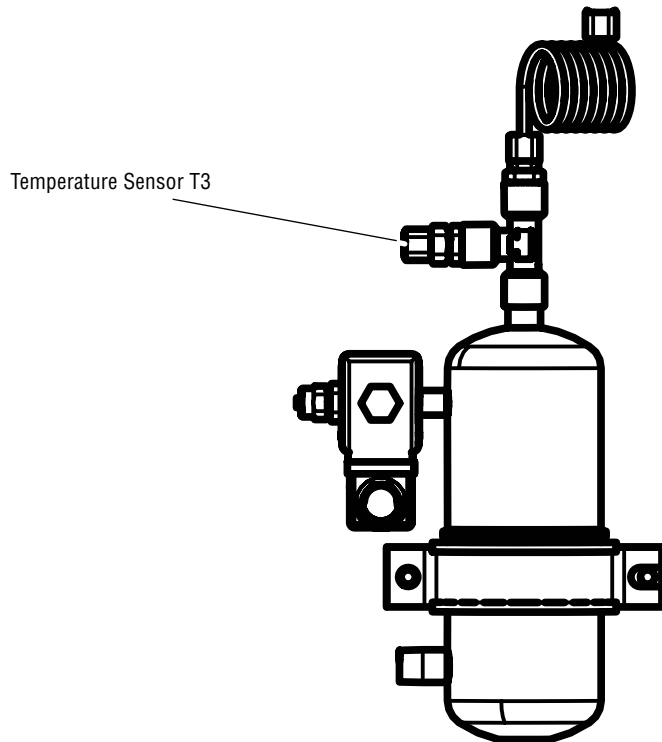
Temperature Calibration Menu 234

Calibration #2: Calibrating T2 Temperature Sensor¹

Repeat previous procedure in step #1 for T2 Temperature sensor.

Calibration #3: Calibrating T3 Temperature Sensor²

Repeat previous procedure in step #1 for T3 Temperature sensor.



NOTE: Any corrections to the calibration certificate must be done following good documentation practices. The error is crossed through by a single line. The correction is written alongside with an explanation if necessary. The correction is signed and dated.

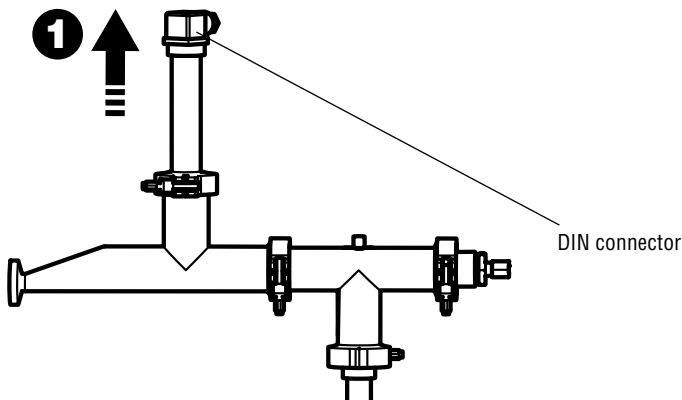
1 To reduce the time, part of calibration can be done simultaneously.

2 To reduce the time, part of calibration can be done simultaneously.

Calibrating the Pressure Transmitter

Calibration #4: Calibrating the Pressure Transmitter

1. Remove the pressure sensor at the sanitary fitting.
2. On the Steam QM-3 display pad, press up and down arrows simultaneously to access the Debug sensor menu.
3. Write the value of P1 on the calibration certificate. If P1 is $\pm 0,1$ bar regarding the set point (0 barg), the calibration point is considered as valid. If not, you must adjust the sensor (see point 8 to 10).
4. Connect the pressure sensor and the calibrated manometer on the pressure generator.
5. Generate a pressure of 3 barg (control it with the calibrated manometer).
6. On the Steam QM-3 display pad, press up and down arrows simultaneously to access the Debug sensor menu.
7. Write the value of P1 on the calibration certificate. If P1 is $\pm 0,1$ bar regarding the set point (0 barg), the calibration point is considered as valid. If not, you must adjust the sensor (see point 8 to 10).
8. If you must adjust the value : On the Steam QM-3 display pad, press left and right arrows simultaneously to access the code menu.
9. Enter 152 using the up and down arrows to change numbers and the left and right arrows to change the position to access pressure calibration menu, and press OK.
10. Move the arrow to left of 3 barg, press OK and wait the check mark.
11. Confirm calibration via the debug sensor menu around 1 barg and 2 barg and write the value on the calibration certificate.

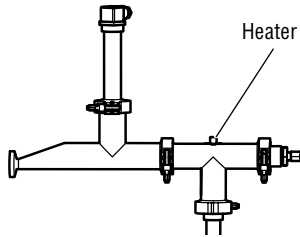


Calibration	P Sensor
P1	0 barg
EV1	3 barg
	0
	1
	115
	230

Pressure calibration menu 152

Calibrating the Heater

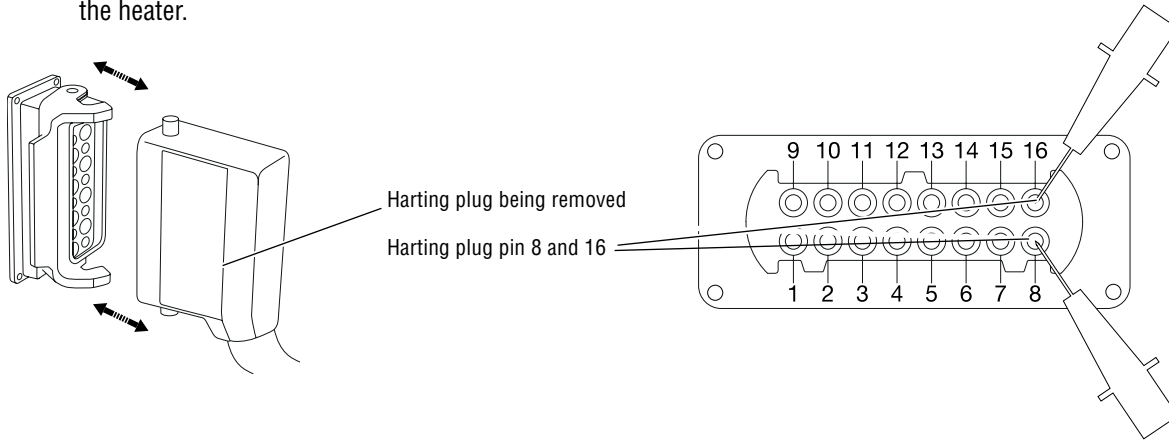
Calibration #5: Calibrating the Heater



Turn off Steam QM-3 and unplug from power source.

Release latch on Harting connector and unplug from the Steam QM-3 cabinet.

With a calibrated ohmmeter measure the resistance between pin 8 and 16 on the Harting plug. The reading should be between 100Ω and 200Ω (normal is about 150Ω). If the reading is lower than 100Ω or higher than 200Ω replace the heater.



4. If the reading is in accepted range, record it. The reading will need to be entered after the Steam QM-3 is powered up.
5. Plug the Harting plug into the Steam QM-3 cabinet, plug in the power cord, and turn on the Steam QM-3.
6. On the Steam QM-3 display pad, press left and right arrows simultaneously to access the code menu.
7. To access the resistance calibration menu, enter 069 using the up and down arrows to change numbers, and the left and right arrows to change the position.

Calibration	Rheater	
P	10W	30W
Rheater	146	
T3 $\bar{m}$	65 β	01

Resistance calibration menu 069

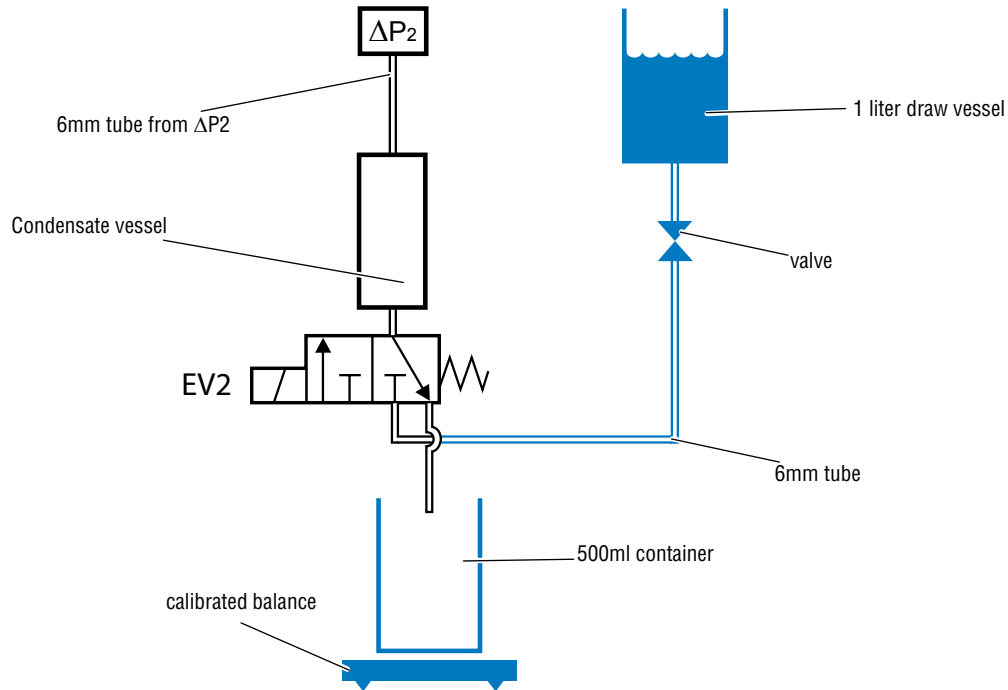
8. Move the arrow to the Rheater line (using up and down arrows).
9. Move the arrow to left of value and enter measured value rounded to nearest whole ohm value (example 153.3 is entered as 153).
10. Confirm the re-calibration of the resistance of the heater by signing the relevant box on the re-calibration certificate.

NOTE: Any corrections to the calibration certificate must be done following good documentation practices. The error is crossed through by a single line. The correction is written alongside with an explanation if necessary. The correction is signed and dated.

Calibrating the Condensate Flow Meter

Calibration #6: Calibrating the Condensate Flow Meter

1. Locate the 6mm tube coming from ΔP_2 going inside the condensate vessel on top of EV2 and pull it out.
2. Confirm the 6mm tube is cut on an angle.
3. Replace tube back inside condensate vessel.



4. Ensure Steam QM-3 cabinet is level.
5. Locate the 6 mm tube coming out of the bottom of EV2.
6. Follow the tube to the end and remove it where it connects to the tee on the condensate return line. Place the end of the tube in the waste water vessel.
7. Disconnect the 6mm tube from the inlet of EV2 (coming out of the NCG burette).
8. Place the 1 liter draw vessel filled with tap water on top of the Steam QM-3 so as to have good gravity flow.
9. Connect the 6mm tube from the 1 liter draw vessel filled with tap water to the inlet to EV2.
10. Position and level a calibrated balance (scale).
11. Record the dry weight of a 500ml container.
12. Turn on the power to the Steam QM-3.
13. Open the valve from the draw vessel (slowly) to establish a cycle rate of the EV2 valve of approximately 30 seconds. One cycle is from opening to closure of valve, you should be able to hear this.. If the environment prohibits hearing go to the control panel and press up and down arrows to access sensor menu and watch ΔP_2 value. it will climb from 0 to about 400 then when it opens it will drop back to 0.
14. After the proper flow rate is established, let it cycle one more time and remove the tube from the waste container (be careful not to shake out any remaining water from the tube).
15. Place the tube in the 500ml container (from step 11).
16. Allow the EV2 valve to cycle exactly 20 times (keep track of the number of cycles).
17. After exactly 20 cycles remove the tube (be careful not to shake out any remaining water from the tube).
18. Record the mass of the water and container together to nearest tenth of a gram, and calculate using the following formula:

$$20 = \frac{(\text{water} + \text{container}) - \text{the dry weight of container}(\text{step 11})}{\text{average mass of water per cycle}}$$
19. On the Steam QM-3 display pad press left and right arrows simultaneously to access the code menu.

20. To access the flow sensor calibration menu enter code 123 using the up and down arrows to change numbers, and the left and right arrows to change the position.

Calibration	Q Sensor
-> Q	20.3
NCG	1.3

Flow sensor calibration menu 123

21. Move arrow to the right of Q and enter mass per cycle (using up and down arrows) then move the arrow back to left of Q.
22. Confirm the re-calibration of the condensate flow burette by signing the relevant box on the recalibration certificate.

NOTE: Any corrections to the calibration certificate must be done following good documentation practices. The error is crossed through by a single line. The correction is written alongside with an explanation if necessary. The correction is signed and dated.

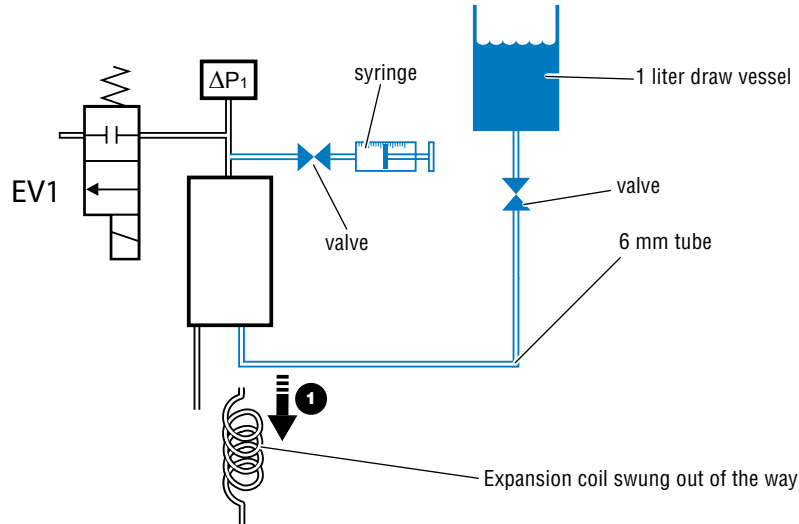
23. Place the 1 liter draw vessel below the EV2 valve and disconnect the 6mm tube from the inlet to the EV2 valve.
24. Reconnect the 6mm tube coming from the NCG Burette to the inlet on the EV2 valve and leave the 6mm tube coming out of the EV2 valve in the waste container as we will use this for the calibration of the NCG Flow Meter.

Calibrating the NCG Flow Meter

Calibration #7: Calibrating the NCG Flow Meter



- I. Disconnect the expansion coil from the bottom of the NCG burette. To avoid damaging the expansion coil Loosen bottom nut on expansion coil and remove top nut.—use two wrenches 10mm and 11mm to ensure no damage to the NCG burette occurs—and swing out of the way.



2. Place the 1 liter draw vessel filled with tap water on top of the Steam QM-3 so as to have good gravity flow.
3. Connect the 6mm tube coming from the 1 liter draw vessel to the bottom of the NCG burette (where the expansion coil was connected—use two wrenches 10mm and 11mm to ensure no damage to the NCG burette occurs).
4. Disconnect the 6mm tube coming from P1 where it connects to the top of the NCG burette.
5. Connect the NCG injector assembly tee to the top of NCG burette.
6. Connect the 6mm tube that was disconnected from the top of the NCG burette to the top of injector tee.
7. To avoid damage to P1 by creating a vacuum, always remove the NCG injector syringe before resetting to 2ml.
8. With the NCG injector syringe disconnected, reset the syringe to 2ml.
9. Connect the NCG injector syringe to the middle of the NCG injector assembly tee with a 6mm tube.
10. Force open the EV1 valve using the pressure calibration menu 152.
11. On the Steam QM-3 display pad, press left and right arrows simultaneously to access the code menu.
12. To access the pressure calibration menu, enter code 152 using the up and down arrows to change numbers, and the left and right arrows to change the position.



Calibration		P Sensor
P1	0 barg	3 barg
EV1	0	1
	115	230

Pressure calibration menu 152

13. To force open the EV1 valve to allow discharge move the arrow to the EV1 line then move the arrow to left of 1 and press OK.
14. Open the valve on the 1 liter draw vessel to fill NCG burette and allow water to run into the waste container.
15. Close the valve on the 1 liter draw vessel.
16. Close the EV1 valve using menu 152 on the control panel, move the arrow to left of 0 and press OK.



17. To avoid damage to P1 by creating a vacuum, always remove the NCG injector syringe before resetting to 2ml.

18. Using the NCG injector syringe set at 2ml, very slowly (at a rate 1 tenth of a ml every second) inject air until EV1 valve opens.
Tip: use a stethoscope to hear the EV1 valve cycle.
19. Record amount of air injected to the nearest tenth ml. If your readings are below 0.5 or above 1.5, the QM3 cannot be calibrated. Contact an Armstrong representative for assistance.
20. Move the arrow to left of 1 and press OK.
21. Repeat this process for exactly 10 cycles.
22. Add the 10 cycles together and divide by 10 this will give you the average ml injected.
23. Record the average number of ml injected that will be entered in the flow sensor calibration menu.
24. On the Steam QM-3 display pad, press left and right arrows simultaneously to access the code menu.
25. To access the flow sensor calibration menu enter code 123 using the up and down arrows to change numbers, and the left and right arrows to change the position.

Calibration	Q Sensor
-> Q	20.3
NCG	1.3

Flow sensor calibration menu 123

26. scroll to the NCG line (using up and down arrows) and move the arrow to right of value and enter your average number of ml injected.
27. Move the arrow back to left of NCG.
28. Write the average volume injected on the calibration certificate and confirm by signing the relevant box.

NOTE: Any corrections to the calibration certificate must be done following good documentation practices. The error is crossed through by a single line. The correction is written alongside with an explanation if necessary. The correction is signed and dated.

Return to Service

The calibration procedure for the Steam QM-3 is now complete. Please follow the steps below to insure the Steam QM-3 back in operating condition.

1. Place the 1 liter draw vessel below the NCG burette and open the valve on the 1 liter draw vessel to drain the water from the NCG burette and injection assembly.
2. When all water has drained from system, close the 1 liter draw vessel valve.



3. Remove the 6mm tube coming from the 1 liter draw vessel connecting to the bottom of the NCG burette—use two wrenches 10mm and 11mm to ensure no damage to the NCG burette occurs. Reconnect the expansion coil to the bottom of the NCG burette—use two wrenches 10mm and 11mm to ensure no damage to the NCG burette occurs.
4. Remove the NCG injector assembly from the top of the NCG burette.
5. Reconnect the 6mm tube coming from $\Delta P1$ to the top of the NCG burette.
6. Reconnect the 6mm tube coming from the EV2 valve out to the tee on the condensate return line.
7. Recheck all connections are properly tightened.
8. Slowly turn on the steam to the Steam QM-3 and check that there are no leaks.
9. The Steam QM-3 is now ready to resume operation.