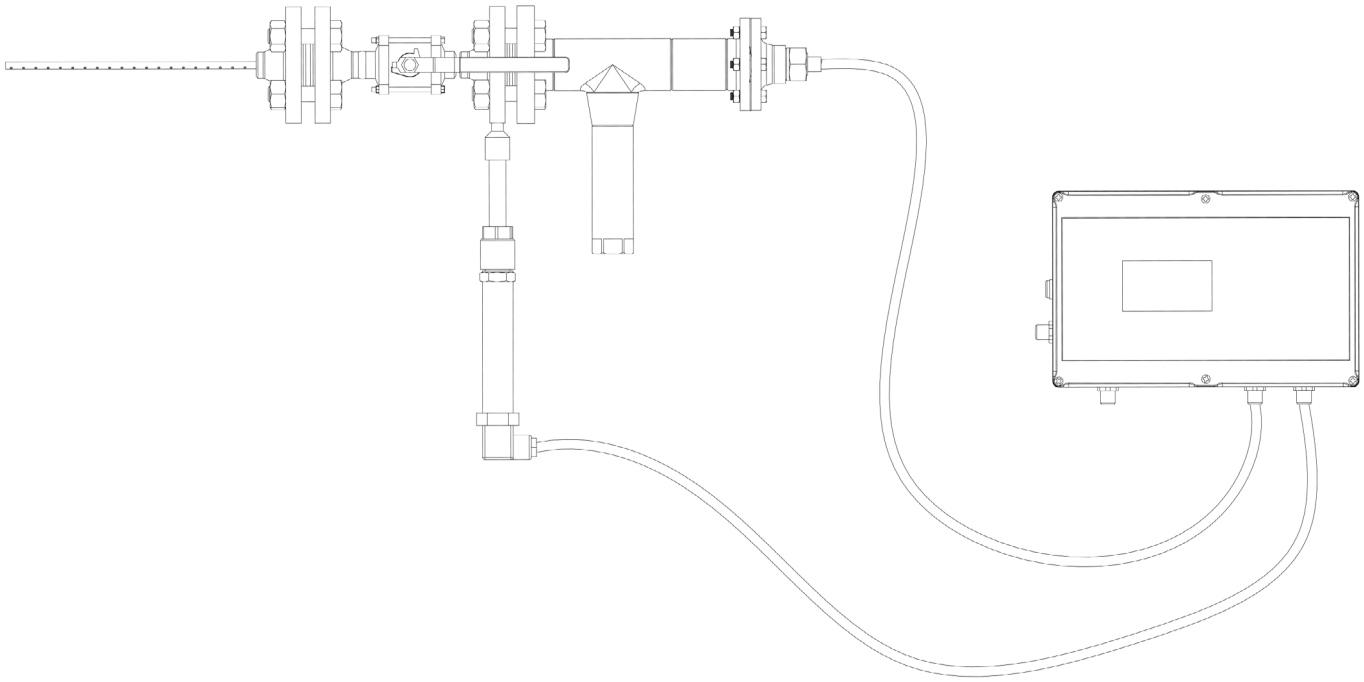
Steam QM-1 Steam Quality Monitor Installation and Operation Manual



CE Certified

Intertek

247-EN V1.17

Keep this manual with equipment for future reference.

Armstrong

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Table of Contents

Revision History

Version	Release Date	Description of Changes
1.0	May 12, 2014	Initial
1.1	June 3, 2014	Page 4, chart with tiltle: Specification, 5th line with electrical information: "12 VAC or 15 - 24 VDC 5 W" replaced by " 12VAC 50/60Hz or 15-24 VDC / 30W" Page 4, bottom of the page. The remark : "The product must be powered by an isolated external power supply in low voltage." has been added. Page 21, Appendix one: wiring diagram. "F1 : 1A" replaced by "F1 : 1AT 250V"
1.2	October 22, 2014	Page 1, updated drawing Page 4, updated specifications table Page 7, updated cabinet drawings Page 9, added drawing to start-up procedure Page 18, added recalibration procedure Page 19, revised the 5 volt drawing Page 23, Modbus slave and master connection
1.3	March 25, 2015	Page 13, added serial mode information on screen section Page 21, updated standard comformity list with UL 61010-1 Page 23, added address and updated mode on chart Parameters / Value added slave information on charts (Function 0x02 and Funcitons 0x04) Contents, updated pages nr.
1.4	August 25, 2016	Page 8, modification of the ambient temperature. IOM reference update: 1249 turn to 247.
1.5	April 5, 2017	Page 4, updated specifications Page 24, updated max pressure
1.6	January 22, 2018	Page 20, item nr. updated: D60740 to D94998 Page 23, update to the chart **Function 0x04 Read Inputs Registers** remove (barre) as it is a misprint Page 24, Appendix 3, minimum value of the dryness fraction graphic update
1.7	August 9, 2018	Page 5: graph has been updated. Flange information is now: EN 1092-1 DN15 PN100 Page 20: components list updated. Part Nr. updated: D60722 to D60738 spare part and components lists updated: for D94998 and D60738 PN40RF becomes PN100RF
1.11	April 29, 2020	Cover, updated image All pages - Version update from 1.6 to 1.8, psi and bar to psig and barg Page 4, updated specifications and warning statement, 12VAC changed to 15VAC Page 5, updated image and some callouts Page 6 & 7, updated image Page 8, updated image and added callouts, changed hose to pipe in warning statement Page 9, added callout and extended Note copy Page 10 updated image, changed hose to pipe in copy, additional statement added to waring symbol. Page 13, changed specific minutes to x-xx Page 15, changed flexible hose to discharge pipe Page 17, updated Pressure transmitter and Materials needed statements. Added 'or dry well' to Caibration Procedure Page 18, updated statement 2 and removed 'caution' statement Page 19, updated image, added callouts 7 and 8 to image and table Page 22, added copy for supply drawing Page 23, replaced entire Modbus Connection page Page 24, added startement regarding graph values

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!
- 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

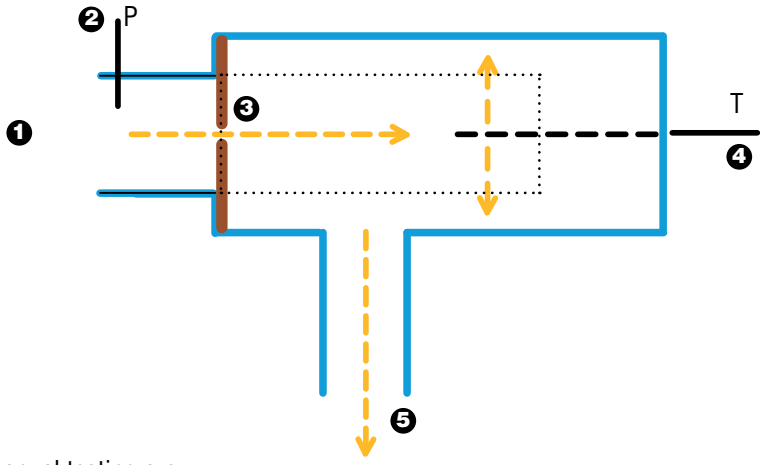
Term	Meaning	Explanation
AI	Alarm	Indicates an out-of-limit situation, but has no impact on operation. AI: Dryness below user-defined set point longer than two minutes.
C	Celsius	
cm	Centimeter	
DIN	Deutsches Institut für Normung eV	
EC	European Community	
EEC	European Electrotechnical Commission	
EN	European Norm	
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	
P	Pressure	P is steam pressure upstream of calibrated orifice.
psig	Pounds per Square Inch (gauge)	
QM	Quality Monitoring	
sec(s)	Second(s)	
SI	International System of Units	
T	Temperature	T: Temperature after the calibrated orifice.
X	Dryness Fraction (sometimes called steam quality or moisture content)	Xmin is the lower dryness limit. Alarm indicates the limit has been exceeded.

General Description

Steam QM-1 is intended to replace manual testing of steam dryness and provide real-time data proving that steam quality meets applicable requirements.

Principle of operation:

❶ A sample of steam is taken continuously.
❷ Steam pressure is measured.
❸ Steam passes through a calibrated orifice and expanded to atmospheric pressure.
❹ Steam temperature is measured.
❺ Sample of steam is discharge to drain (atmospheric pressure).
❻ Dryness fraction is determined according to the Mollier Diagram.



Advantages over manual testing are:

- Improved safety
- Ease of use
- Real time results
- More accurate and objective results
- Ability to trend data over time

Armstrong recommends that the Steam QM-1 unit be installed in one location and not used as a portable unit.

Data from Steam QM-1 can be integrated in a control system using a data historian with Modbus output (see appendix two for connection information.)

Materials of construction comply with all standards known at the time of manufacture.

Specifications

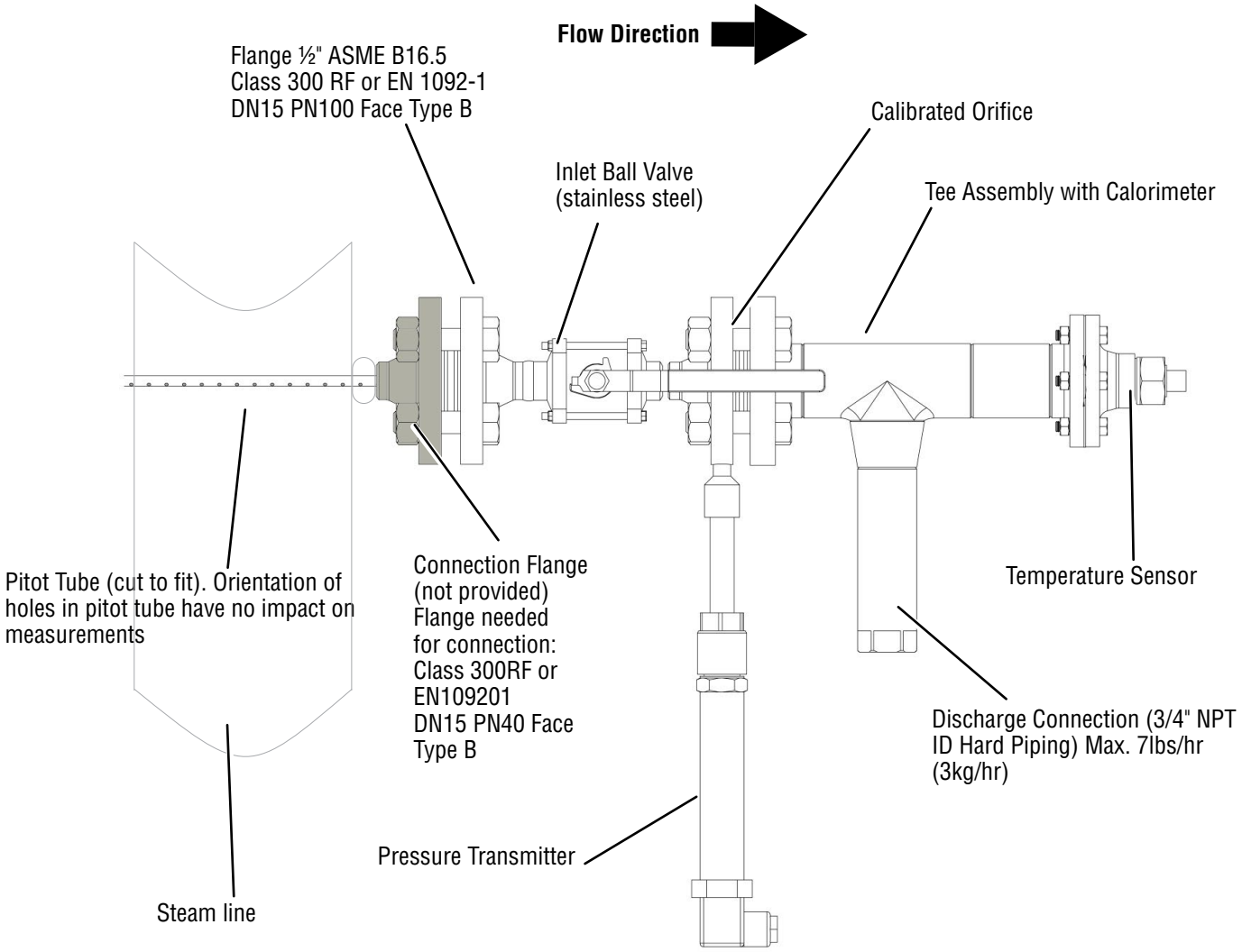
Parameter	Specification
Maximum Operating Pressure	465psig @ 500°F (32.1barg @ 260°C)
Maximum Allowable Pressure	465psig (32.1barg)
Maximum Allowable Temperature	500°F (260°C)
Dryness fraction	See Appendix 3
Electrical	15VAC* 50/60Hz or 15-24 VDC/30W

The product must be powered by an isolated external power supply in low voltage.
*If supplied with less than 15VAC, unit will still operate, however all measurements/readings will be incorrect!

Armstrong reserves the right to make design or specification changes without notification.

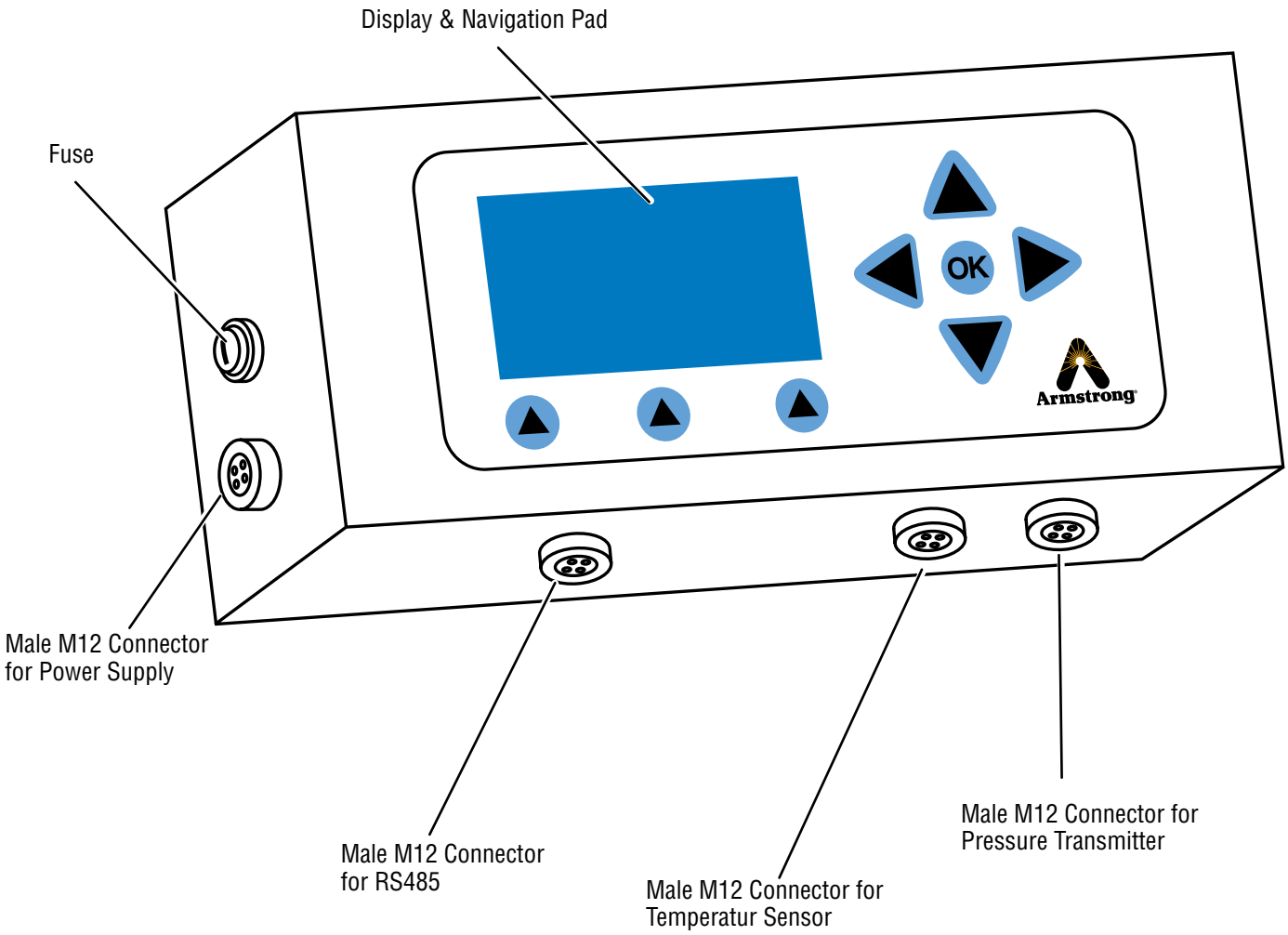
Assembly

Note: The assembly shown below is configured to be mounted horizontally.
Assembly (without flange) weighs approximately 20 lbs (9 kg).



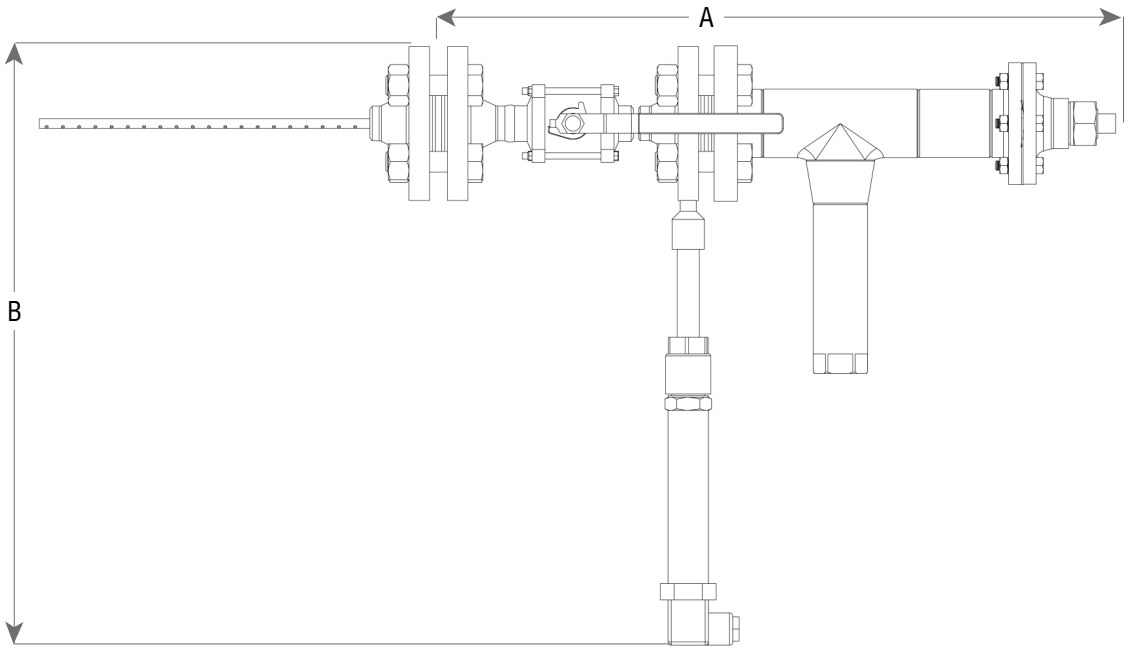
Cabinet

Cabinet weighs approximately 2 lbs (0,9 kg)

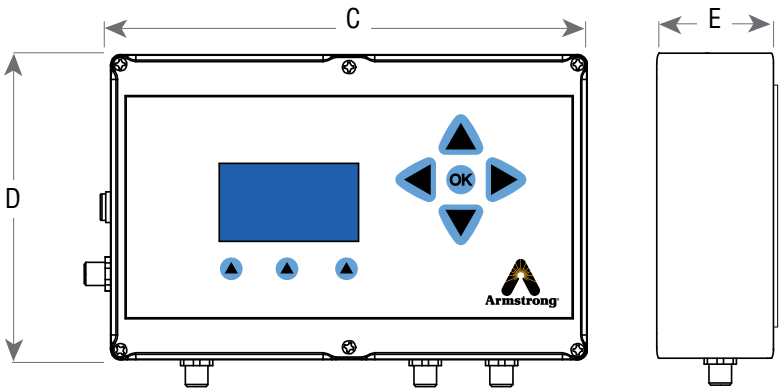


Dimensions (approx.)

Assembly



Cabinet



Dimensions & Weight		
	in	mm
A – Assembly Width	20	500
B – Assembly Height	15	375
C – Cabinet Width	10	250
D – Cabinet Height	6.5	160
E – Cabinet Depth	2.5	60
Assembly Weight	20 lb	9 kg
Cabinet Weight	2 lb	0.9 kg

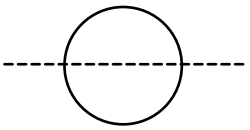
Installation

General Considerations (Site Selection)

Ambient temperature must be 5–40 °C (41–104 °F)
Relative humidity must be 30–80%
Altitude must not exceed 2000 m (6562 ft)
Indoor Use
Pollution Degree 2

Connection to vertical steam line is optimal.
The steam sample can be taken from horizontal and vertical steam lines, as long as the steam sampling tube is in a horizontal plane.

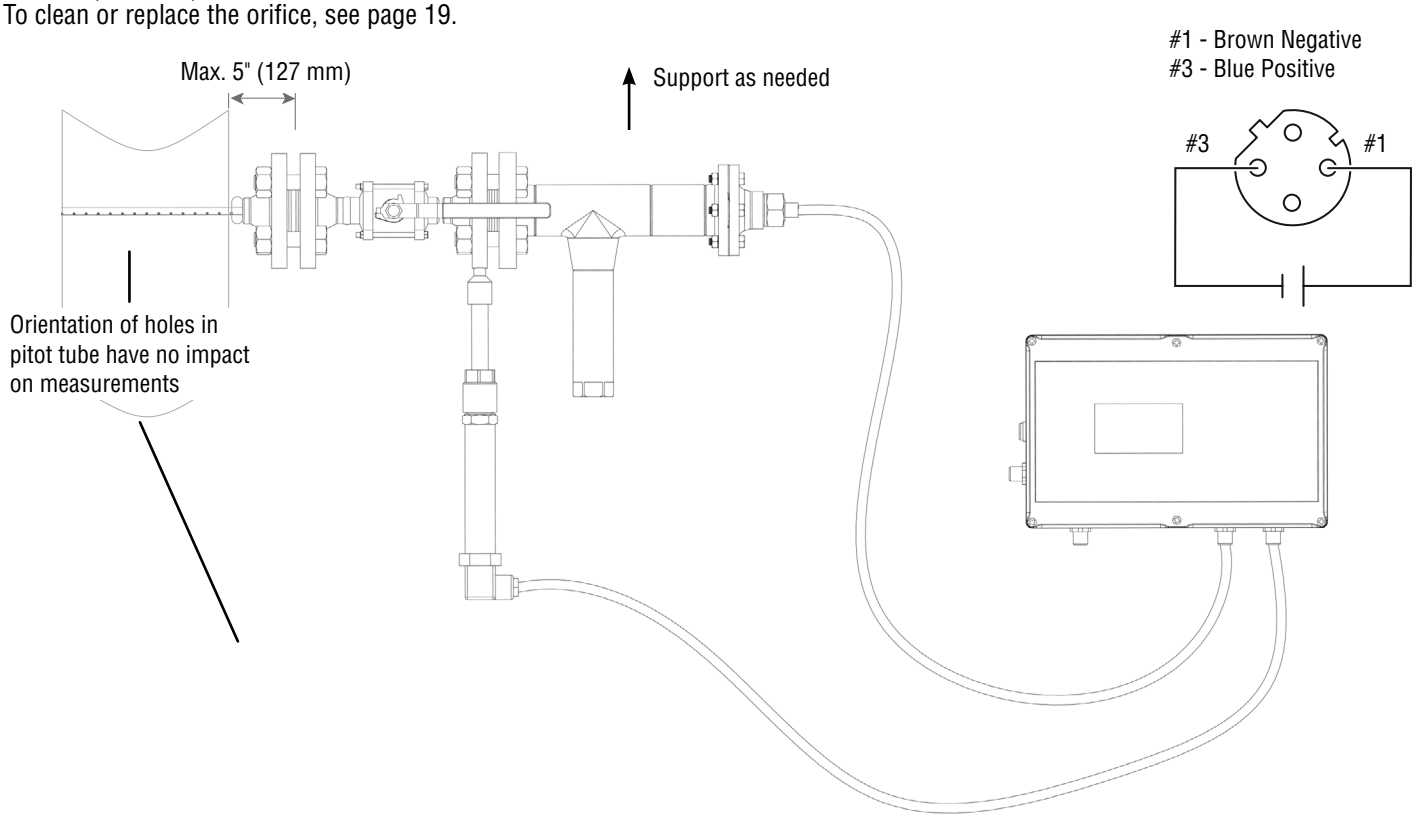
Connection into horizontal steam line must be at center line.



Typical Installation

At first use, fill pressure transmitter tube with water.

By default, orifice 0.5mm is installed. For pressure below 10 barg (150 psig), use the 0.8mm orifice provided.
To clean or replace the orifice, see page 19.



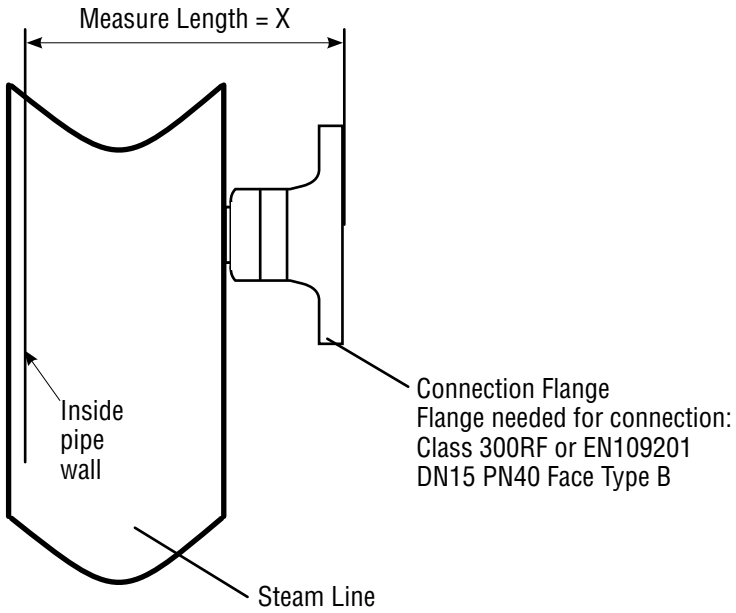
To insure accuracy the discharge tubing must discharge to atmospheric pressure.
Warning: Steam and condensate up to 320 °F (160 °C) will flow from the discharge. Precautions to safely discharge the steam and condensate must be taken.
Note: Orientation of the holes in the pitot tube have no impact on the measurement
Note: Shortening or replacing a cable will require recalibration.
Note: See page 9 for details to cut pitot tube if necessary.

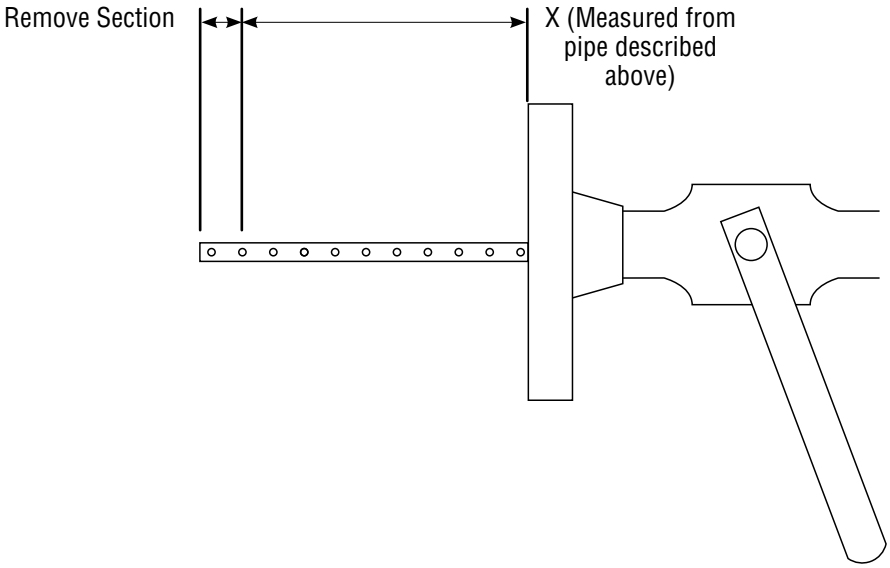
A blocked steam discharge pipe is a safety hazard as the parts after the orifice are not designed for pressure.

The inlet ball valve is not designed to carry the weight of the assembly especially if a heavy steam discharge hose is connected. It is recommended to support the end of manifold.

Pitot tube must be cut accordingly if the diameter of the line is less than 6".

Measuring the length of the pitot tube.

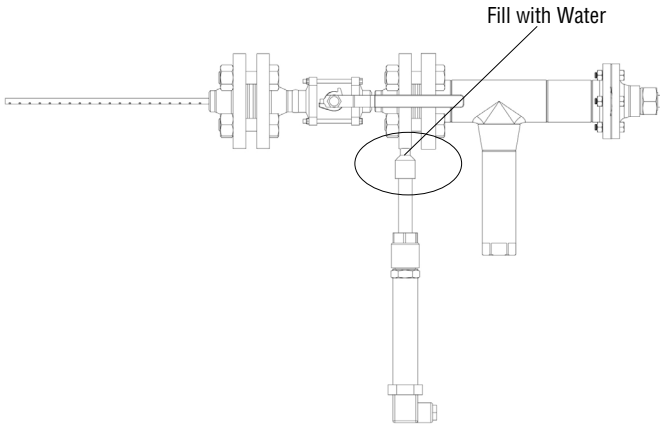




Note: If pilot tube is shorter than the measured length, then it is not necessary to cut the tube. It can be installed without any modifications. Orientation of holes in pitot tube have no impact on measurements.

Start-Up Procedure

1. To prevent damage to the pressure sensor, be sure to fill the tube before it with water before start-up



2. Confirm all connections:
   - Power
   - Drainage
   - Sensor connections

3. Turn power onto the Steam QM-1. The main screen will display

4. Slowly open the inlet ball valve, to allow steam to flow into the assembly.

Caution: Uninsulated components will become hot once steam is applied.

Note: Parameters will display in about 10 minutes.

5. Check for leaks and tighten connections as necessary

6. Check that steam or water flows through the discharge pipe (up to 7 lbs/hr (3 kg/h) depending on the steam pressure)

7. In the settings menu, set the Xmin, the unit, the time and altitude (see pages 11 and 12)

8. If you are using the ModBus Connections, follow instruction in appendix 2

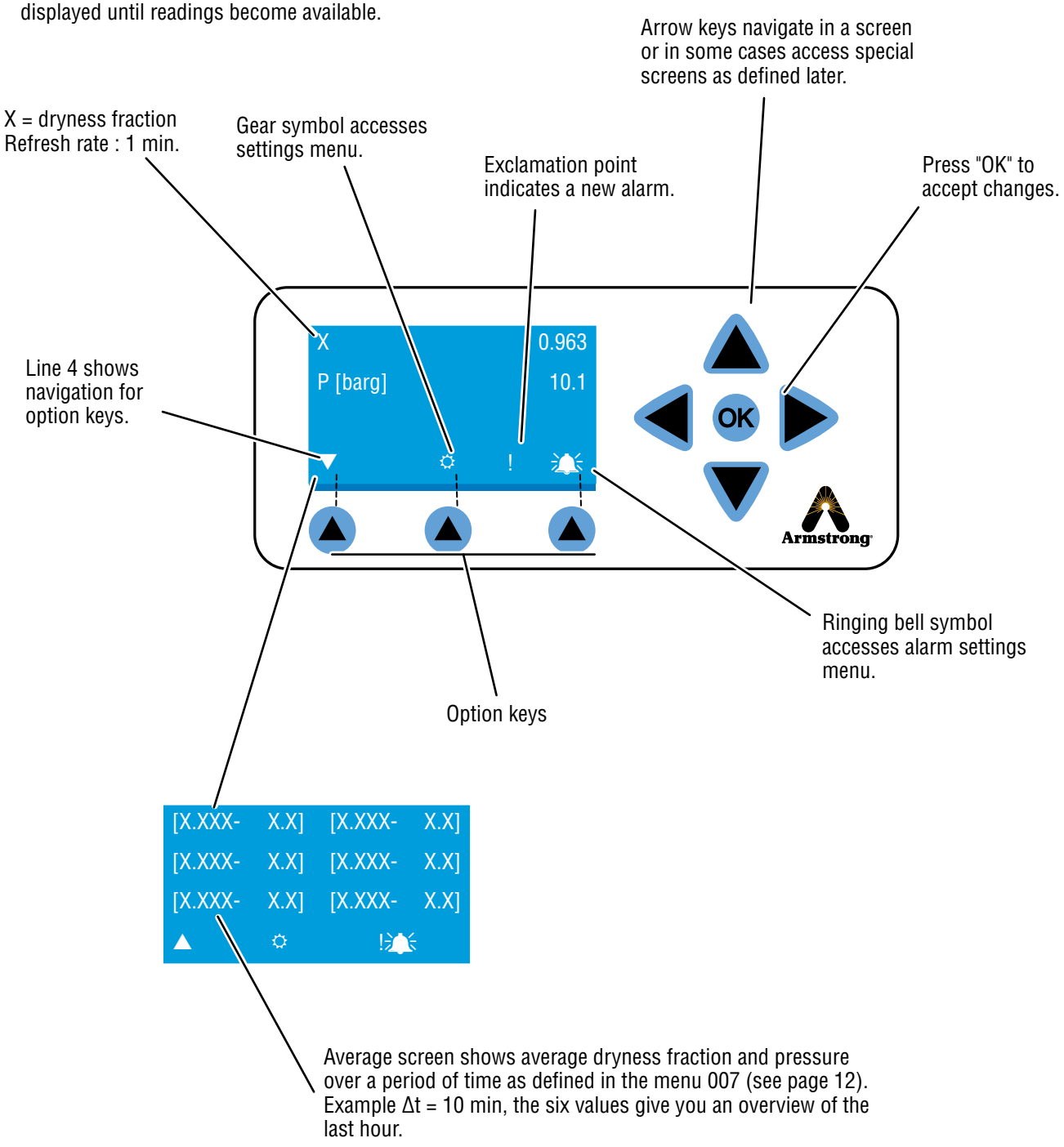
A blocked steam discharge pipe is a safety hazard as the parts after the orifice are not designed for pressure. Do not cover ball valve handle in insulation due to inherent safety risk.

Software Navigation

Standard Screens

Main Screen

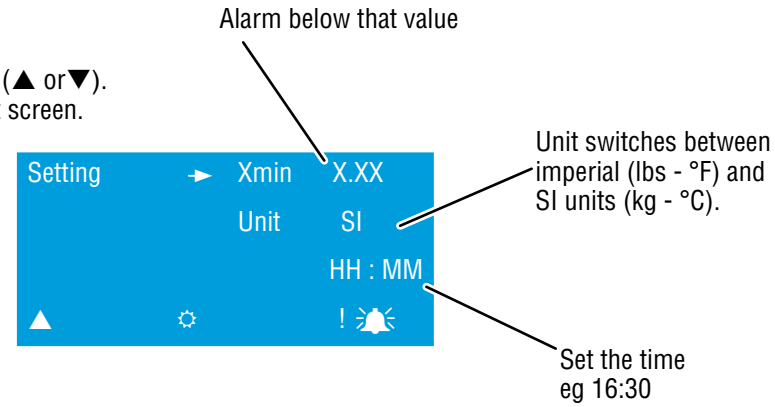
Note: During initialization, a progress bar is displayed until readings become available.



Settings Menu

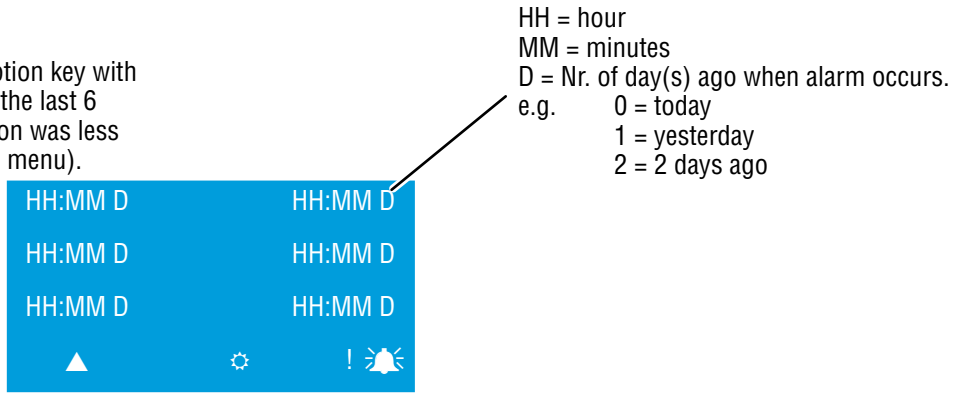
To get to the settings menu press the option key with the ☼ symbol. Scroll through the settings using up/down arrows (▲ or▼). Move arrow to value (activate selection) by pressing right arrow (▶).

Change value by pressing up/down arrows (▲ or▼). To save change press left arrow (◀) or exit screen.



Alarm Menu

To get to the alarm menu, press the option key with the symbol. The alarm menu lists the last 6 instances the measured dryness fraction was less than the Xmin value (from the settings menu).



Alarm indicated on main screen (exclamation point) will reset automatically when consulting this screen.

Special Screens

Code Menu

Access menu by pressing ◀ and ▶ at same time.

Navigate between digits by pressing ◀ or ▶. Change value by pressing ▲ or ▼.

Ener access code here

Press OK after screen code is entered to proceed.

Software Version

Advanced Setting Menu

Access code is 007.

"logger Add" specifies Modbus address of data logger (default is "1").

This can be Master or Slave. For more details see Appendis 2 Modbus communication.

Δt for the average screen (average value calculated during that period). Value from x-xx minutes

Calibration Menu Screen

Access code is 152.

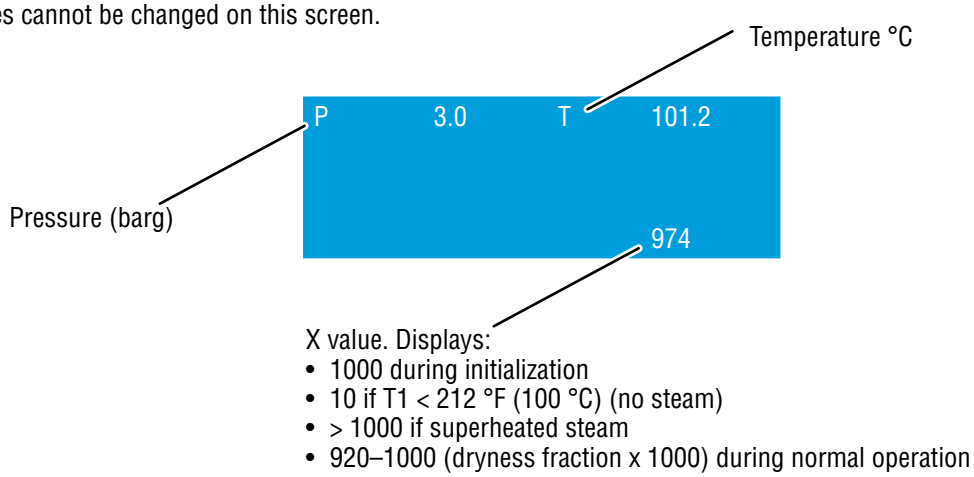
Altitude: value from x-xx meters. (only metric value)

Select only ALT on this screen. If P or T are selected, calibration will be lost and the QM-1 will have to be recalibrated before returning to service.

Sensor Information Screen

Access screen by pressing ▲ and ▼ at same time.

Note:
- Information displayed are real time values, which may be irrelevant if unit is not connected to steam.
- This screen is for information only, and is intended for use during commissioning, debugging, etc. Values cannot be changed on this screen.



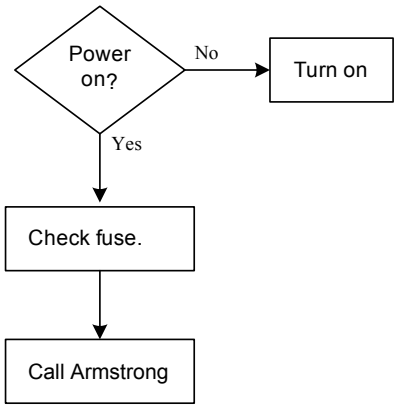
Troubleshooting

Components and water may be hot.

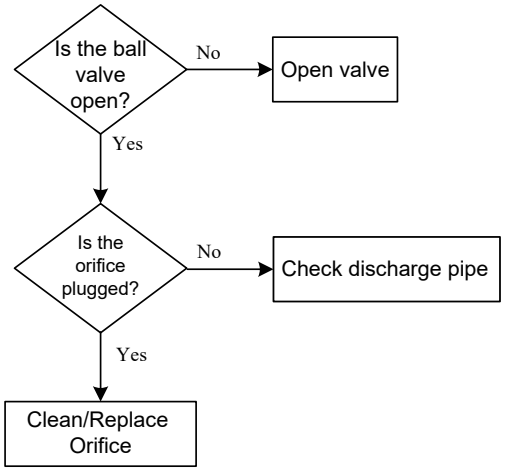
Disconnect power before performing electrical work.

If problem cannot be resolved, contact Armstrong.

Display Off

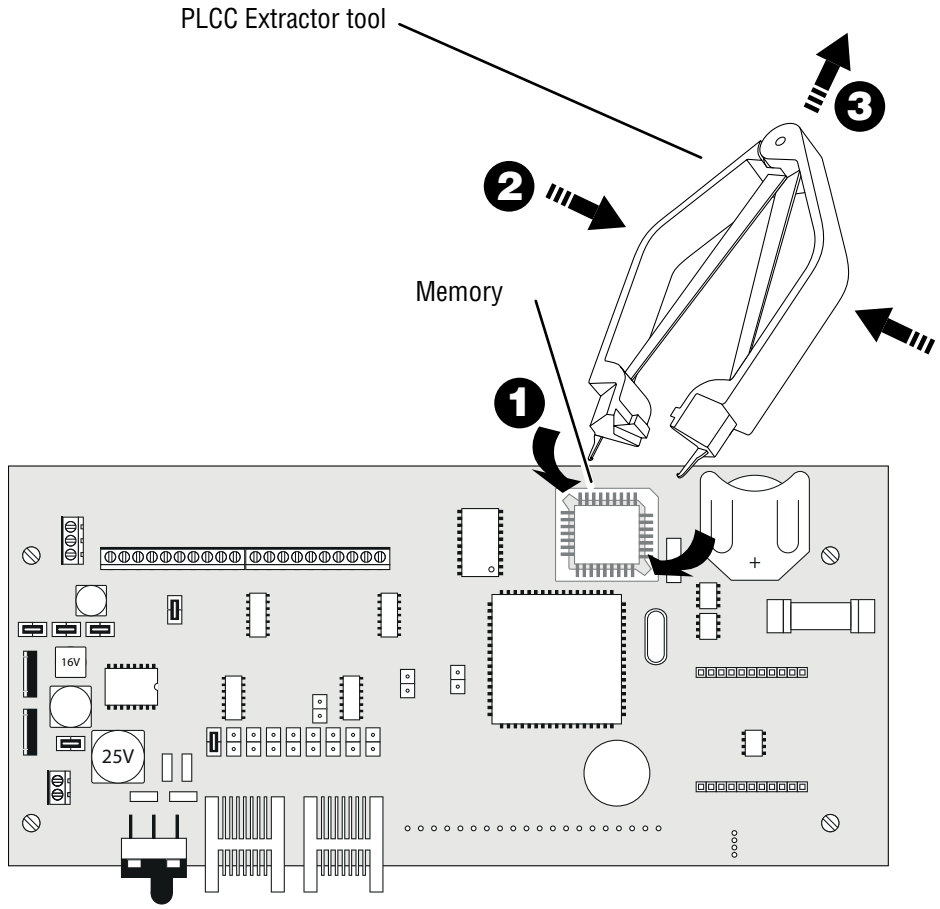


No steam or water through discharge pipe



Software Update

1. Unplug all M12 connector starting with unplugging the power supply.
2. Open cabinet.
3. Find the electronic board.
4. Remove cautiously the memory with the adapted tool (like a PLCC extractor).



5. Replace the memory (with your thumb, push cautiously respecting the coded pin).
6. Plug and turn on the QM-1, light is ON and screen is activated.
7. Check the version software in the code menu (press simultaneously on ◀ and ▶).

Note: Recalibration is not required with code updates.

Calibration

This chapter will walk a technician through the steps necessary to calibrate/recalibrate the Steam QM-1. It is estimated this process will take one hour. 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:

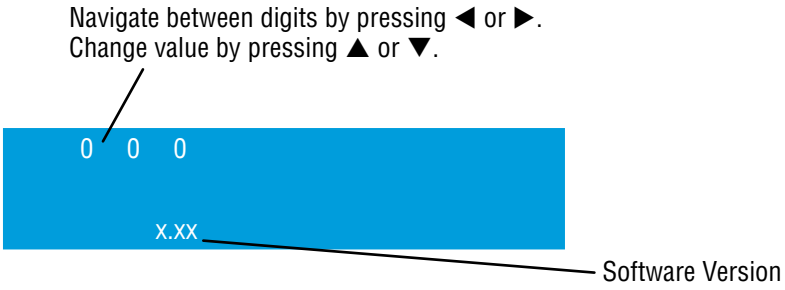
Temperature Sensors:
The temperature sensor is calibrated by true measurement method.

Pressure Transmitter:
The pressure sensor is calibrated by using a calibrated reference gauge.

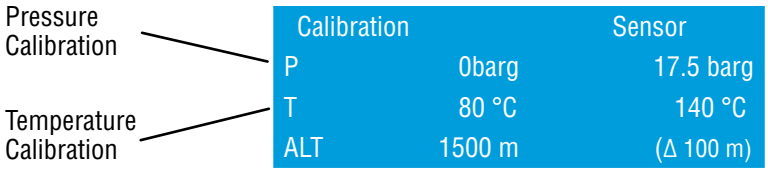
Materials Needed:
- Calibrated oil bath or dry well
- Calibrated reference pressure and temperature gauge

Calibration Procedure

Code Menu
Access the code menu by pressing < and > at the same time.



In the code menu, enter code 152 and press OK.



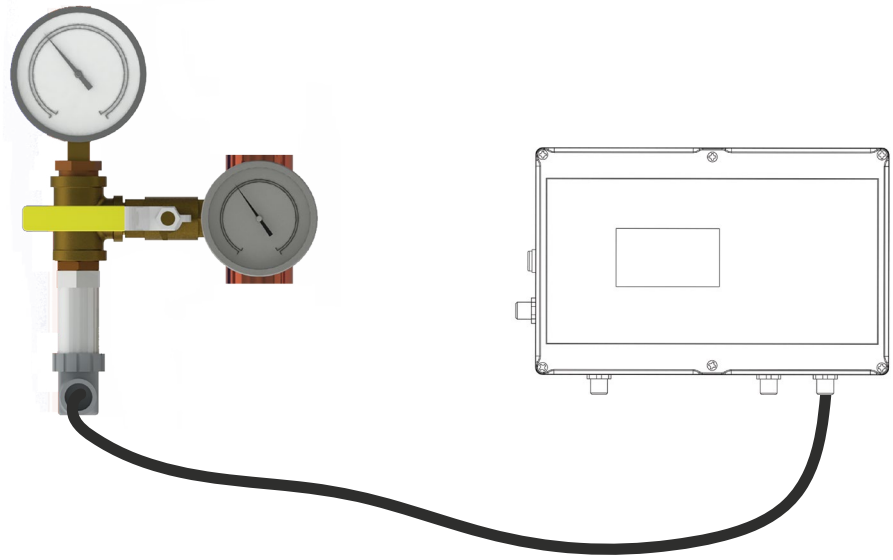
Calibrating The Temperature Sensor:
1. Remove the temperature sensor from QM-1 with a 27 mm wrench.
2. Place the tip of the temperature sensor in the calibrated oil bath or dry well.
3. Set the oil bath or dry well on 80°C
4. When the oil bath or dry well temperature has stabilized, move the arrow to the left of 80°C and press OK.

5. Set the oil bath or dry well on 140°C.
6. When the oil bath or dry well termperature has stabilized, move the arrow to left on 140°c and press OK.

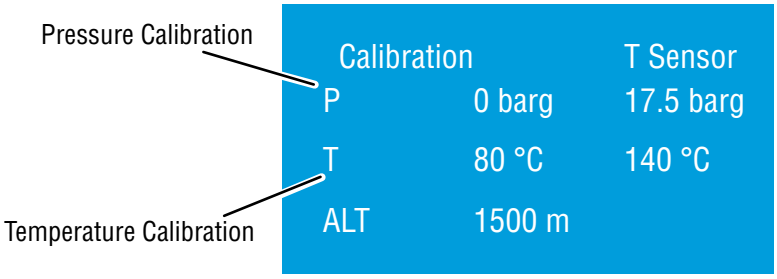
7. Reconnect the temperature sensor on the QM-1.

Calibrating the Pressure Transmitter

1. Remove the screw on top of DIN connector and unplug the DIN connector from the pressure transmitter.
2. Attach the pressure transmitter to the calibrated reference gauge.

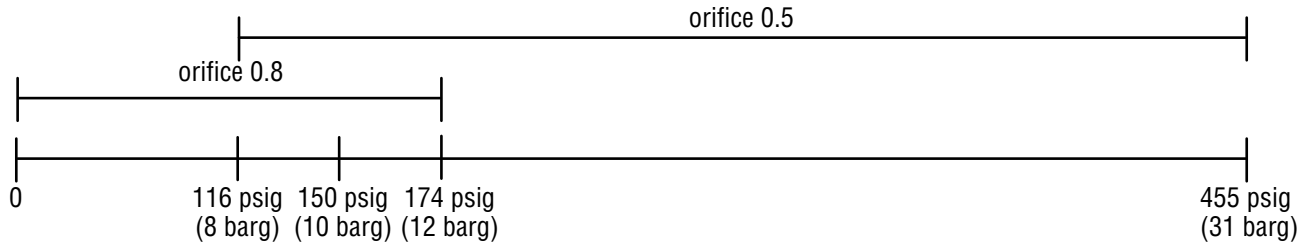


3. In the code menu, enter code 152 and press OK. (If already in the calibration menu, skip this step.)
4. Select 17.5 barg.
5. Press OK, wait for the check mark.



Code Menu 152

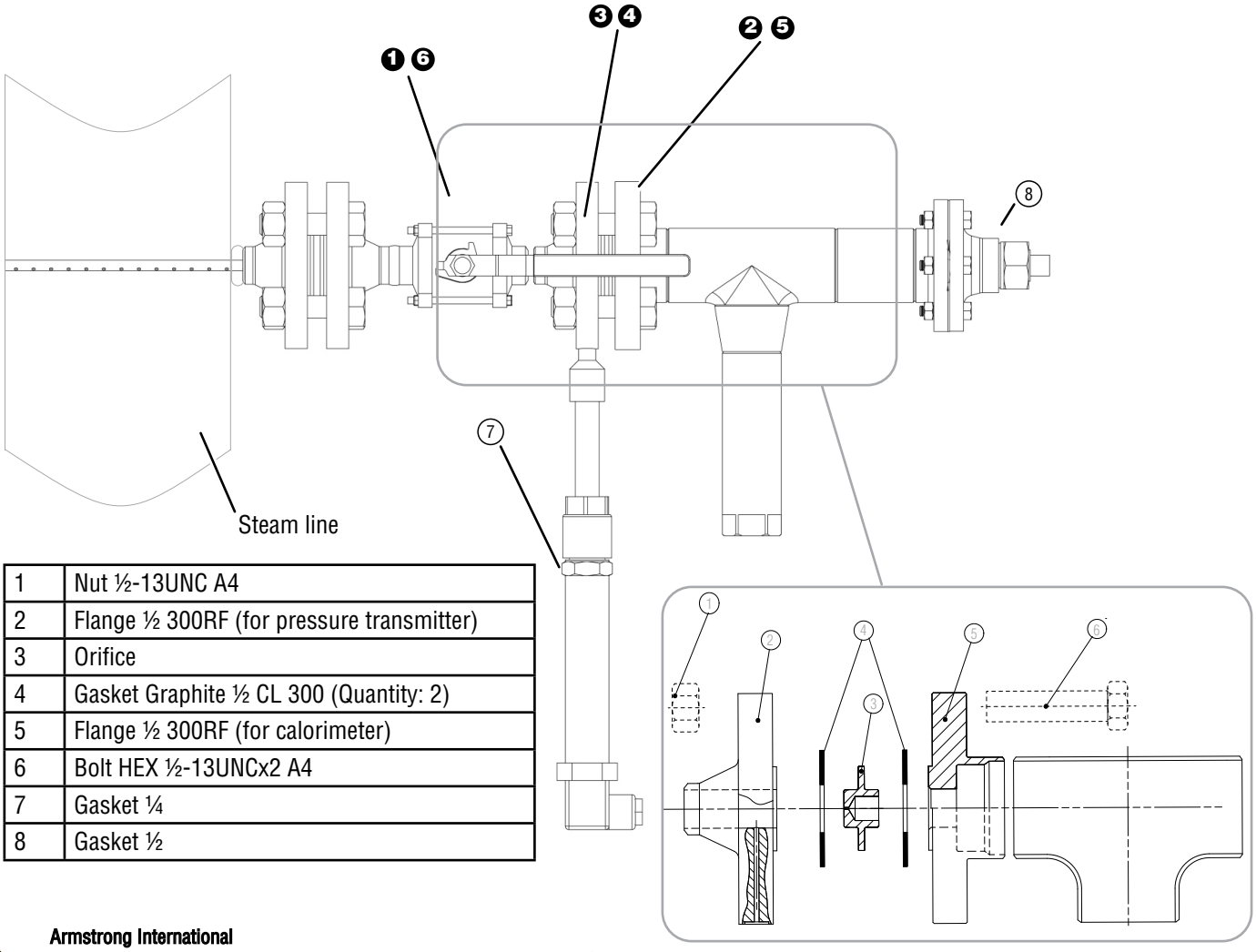
Orifice Pressure Range



Clean / Replace Orifice

Components and water may be hot.
Disconnect power before performing electrical work.
Failure to isolate the system from the steam supply can expose the technician to line pressure steam. Take all necessary precautions to insure system is isolated.
If problem cannot be resolved, contact Armstrong.

1. Close inlet ball valve and wait for the QM-1 to cool down.
2. Disassemble the flange on the outlet of the ball valve (shown below).
3. Remove the orifice located between the flanges.
4. Clean/Replace the orifice (take care not to damage or lose the gaskets).
5. Reassemble the four (4) bolts following bolting best practices and tight them.
6. Open the ball valve slowly and check for leaks.



1	Nut ½-13UNC A4
2	Flange ½ 300RF (for pressure transmitter)
3	Orifice
4	Gasket Graphite ½ CL 300 (Quantity: 2)
5	Flange ½ 300RF (for calorimeter)
6	Bolt HEX ½-13UNCx2 A4
7	Gasket ¼
8	Gasket ½

Component and Parts List

Components

Number	Description
D60739	Steam Quality Monitor QM-1 ½ 300RF Package
D94998	Steam Quality Monitor QM-1 DN15 PN40RF Package

Spare Parts

Number	Description
D59649	QM-1 ½ 300RF Assembly
D60474	QM-1 DN15 PN100RF
D60738	QM-1 Cabinet
D59910	Insulation Jacket
D62786	Pitot Tube Assembly
D64302	Tube Assembly for Pressure transmitter
D14109	Gasket 1/2 300RF
D14087	Gasket DN15 PN40
D59625	Orifice 0.5mm
D60473	Orifice 0.8mm
D44124	Main Board with Display
D44110	Temperature Sensor (T)
D59029	Pressure Transmitter (P)
D60723	Glass Fuse 1A
D60719	3m shielded cable with 1 x M12/1 x DIN connector for Pressure transmitter
D60720	3m shielded cable with 2 x M12 connector for Temperature Sensor
D60721	5m cable with 1 x M12 connector for Power Supply or RS485

Product Certifications

CE Directives

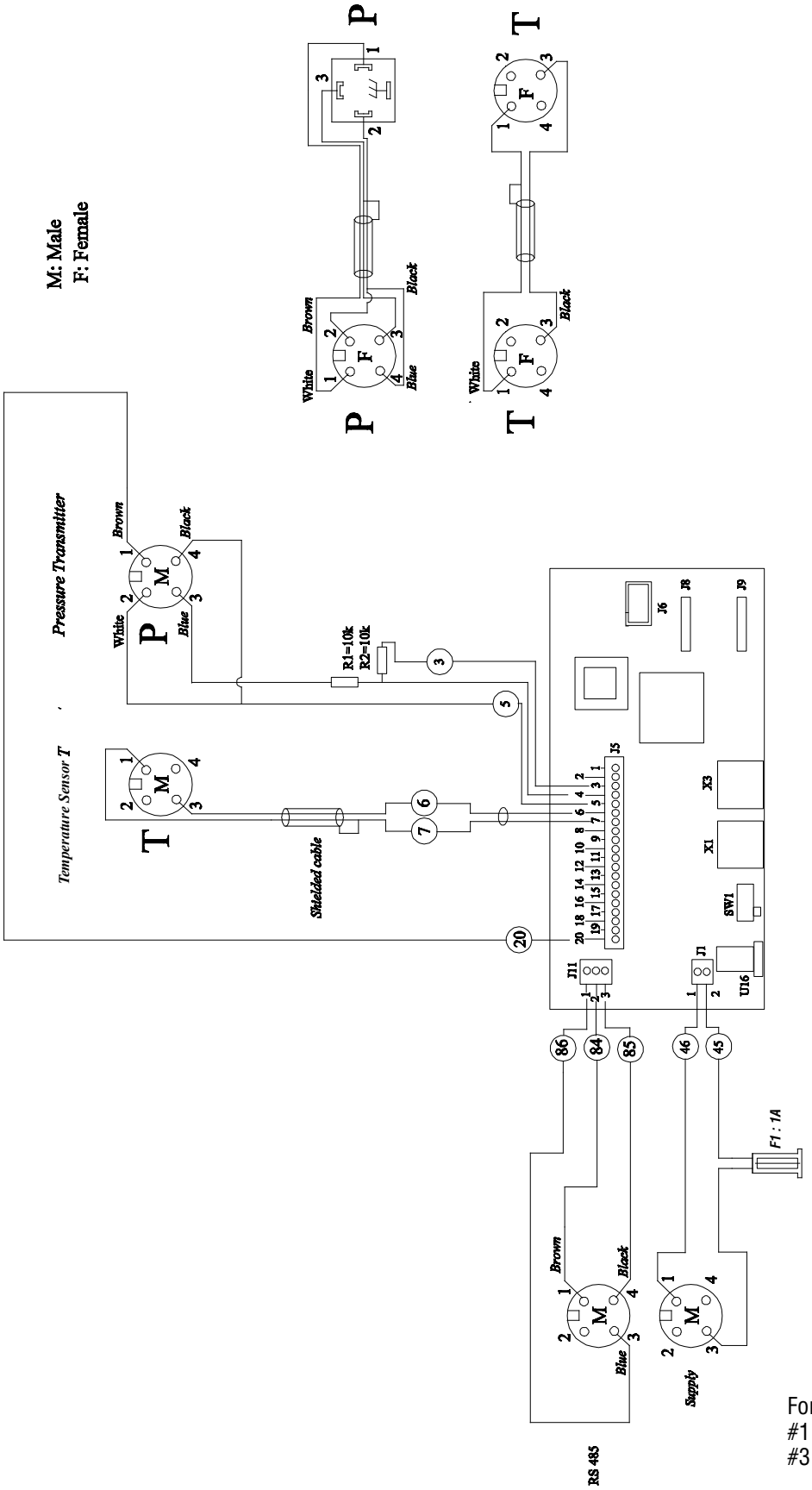
Intertek

Electromagnetic Compatibility Directive: 89/336/EEC, 2004/108/EC
Low Voltage Directive: 73/23/EEC, 2006/95/EC
Machinery Directive: 98/37/EC Amending Directive 89/392/EEC

Conforms to the following standards:

- EN 61000-6-3: Electromagnetic compatibility generic requirements (residential, commercial and light industries)
- EN 55022: class B (conducted and radiated emission limits)
- EN 61000-6-2: Electromagnetic compatibility (EMC) – Generic standards – Immunity for industrial environments
- EN 61000-4-3: Radiated, radio frequency, electromagnetic field immunity test
- EN 61000-4-6: Immunity to conducted disturbances induced by radio frequency fields
- EN 61000-4-4: Electrical fast transient/burst immunity test
- EN 61000-4-5: Surge immunity test
- EN 61000-4-2: Electrostatic discharge immunity test
- EN 60204-1: Safety of machinery – Electrical Equipment of machines – Part 1: General requirements
- EN 292 Parts 1 & 2: Safety of machinery basic principle mechanical design
- UL 61010-1: Electrical Equipment for Measurement, control and laboratory use

Appendix One: Wiring Diagram



Appendix Two

Modbus RTU Connection

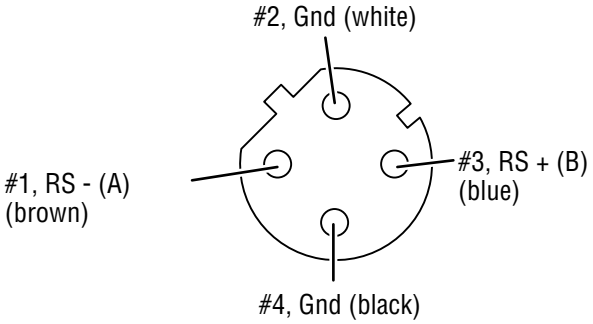
Note: The information on this page applies to any control system or data logger.

A 9 ft (3 m) cord is provided with an M12 connector for Steam QM-1 cabinet connection.

Modbus Settings

Note: : The slave address is defined in the Steam QM-1's Advanced Setting Menu see p. 13.
The Modbus type (slave or master) is defined in the Steam QM-1's Advanced Setting Menu, see p. 13.

Parameter	Value
Baud Rate	9600 bauds/sec
Data Length	8 bits
Parity	None
Handshaking	N/A
Timeout	2.5 sec
Time between request (polls)	150ms
Address	From 1 to 80
Mode	Master or Slave



SQM Set In Master Mode In The Setting Menu:

The data is sent by the SQM in different registers as shown in the table below using Modbus function 16 (0x10: write multiple holding registers). All values are SI units (kg - °C). If conversion is required, it must be done manually. Decimal values are not used. Readings are shown as whole numbers, e.g., 19.2 will show as 192.

SQM Set In Slave Mode In The Setting Menu:

In slave mode you can send query's with function 0x02 (read discrete input) and 0x04 (read input register). According those register maps. **Note:** The length of the query and response must remain less than 23 bytes.

Master Mode	Slave Mode			Factor	Unit	Description
Registers	Registers	Function	Address			
40 001	30 001	0x04	0	x 1000	N/A	last minute average dryness fraction
40 002	30 002	0x04	1	x 10	barg (a)	last minute average pressure
40 003	30 003	0x04	2	x 10	°C	last minute average temperature
40 004	30 004	0x04	3	x 1000	N/A	last average cycle dryness fraction
40 005	30 005	0x04	4	x 10	barg (a)	last average cycle pressure
40 006	30 006	0x04	5	-	min	time period for the average calculation. Possible value 5 - 120 min
40 007	10 001	0x02	0	0: disable 1: enable		toggle to 1 when the unit is measuring a dryness fraction below the minimum calculable or below the minimum set in setup menu.

Modbus Tip: In case of frame error, reverse RS+ and RS- could fix the error.

Appendix Three

Depending on the operating pressure, the min value of the dryness fraction that can be calculated by the QM-1 is approximate in the graphic below.

Actual values may differ slightly from those shown on graph based on actual operating conditions.

Steam Pressure	Xmin
43 psig (3 barg)	0.97
145 psig (10 barg)	0.95
460 psig (32 barg)	0.9275

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