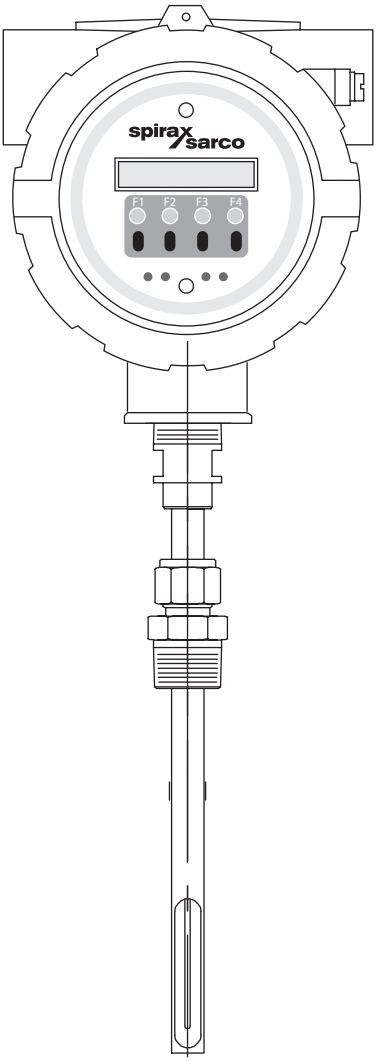
IM-S65-01-US
Issue 1

Thermal Mass Flowmeter and Temperature Transmitter MTI10 Insertion and MTL10 Inline

Installation and Maintenance Instructions



This publication must be read in its entirety before performing any operation.

Failure to understand and follow these instructions could result in serious personal injury and/or damage to the equipment.

Should this equipment require repair or adjustment beyond the procudures given herein, contact the factory at:

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1150 Northpoint Boulevard
Blythewood, SC 29016
Phone: 800.883.4411
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Please note that Spirax Sarco. reserves the right to change and/or improve the product design and specification without notice.

All Spirax Sarco Manuals and software for the MTI10/MTL10 are available in English only.

Symbol meanings

Caution! - (refer to accompanying documents): Please follow the specified instructions and general safety practices.

Indicates compliance with the WEEE Directive. Please dispose of the product in accordance with local regulations and conventions.

CE

Indicates compliance with the applicable European Union Directives for ATEX (2014/34/EU), Safety LVD (Low Voltage Directive 2014/35/EU), EMC (Electromagnetic Compatibility Directive 2014/30/EU), and PED (Pressure Equipment Directive 2014/68/EU).

IP67 Enclosure Protection Classification per IEC 60529: Protected against the ingress of dust and Immersion.

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1. Introduction

Thank you for purchasing the Spirax Sarco MTI10 insertion or MTL10 inline Thermal Mass Gas Flowmeter and Temperature Transmitter. The Model MTI10/MTL10 is one of the most technically advanced flowmeters in the world. The MTI10/MTL10 utilize the same sensor and electronics. The MTL10 includes a company supplied flow tube, while the MTI10 is inserted into an existing pipe. Extensive engineering effort has been invested to deliver advanced features, accuracy measurement performance and outstanding reliability.

This Instruction Manual contains the electrical and mechanical installation instructions as well as details for programming, maintaining and troubleshooting the meter.

This manual is divided into the following sections: Introduction, Installation, Wiring, Operation, Calibration Validation, Modbus, Maintenance, Troubleshooting, and Appendices.

1.1 Theory of operation

The MTI10/MTL10 is an innovative Thermal Mass Gas Flowmeter and Temperature Transmitter. It is microprocessor-based and field programmable. The MTI10/MTL10 thermal sensor operates on the law that gases absorb heat. A heated sensor placed in an air or gas stream transfers heat in proportion to the stream's mass velocity. There are two sensor elements connected to a balanced bridge circuit. One sensor element detects the gas temperature and a second element is maintained at a constant temperature above the gas temperature. The energy applied to the heated sensor to maintain a constant temperature differential (constant Δ T) is directly proportional to the mass flow velocity. The MTI10/MTL10 flowmeter maintains accurate flow measurement over a large temperature and pressure range.

1.2 Mass flow

The Model MTI10/MTL10 measures mass flow; an advantage over other flowmeters which measure volumetric flow rate. Volumetric flow is incomplete because temperature and pressure are unknown and must be measured separately. For example, the mass flow of a gas depends on its temperature and pressure.

As temperature and pressure changes, the gas volume changes but not its mass. Therefore a device measuring mass flow is independent of temperature and pressure. The Model MTI10/MTL10 provides a direct measurement of gas flow in Mass units (kg/hr, lb/hr), standard units (SCFM, SLPM) or normal units (NM3/hr, NLPM) with no additional temperature or pressure measurements required.

1.3 Calibration validation

Spirax Sarco has developed a method to validate the calibration of the flowmeter in the field. This method is called Calibration Validation and it is made up of two distinct tests: CAL-V™ and Zero CAL-CHECK®. The goal of Calibration Validation is to provide operators with the ability to verify that the meter is capturing accurate data at scheduled recalibration times - or at any time - instead of sending the meter back to the factory for recalibration.

By performing CAL-V™ in the field, operators can verify that the meter is running accurately by testing the functionality of the sensor and its associated signal processing circuitry. This test can be done in the pipe and in normal processing conditions. The second test, Zero CAL-CHECK®, ensures the effectiveness and sensibility of the sensor at a "no flow" condition.

1.4 Flow calibration

Spirax Sarco maintains instrument calibration records on every flowmeter. This data can also be accessed via a computer using MTI10/MTL10 View software within the instrument. Computer-generated calibration documents describe specific instrument details that can be sorted by serial number, tag number or customer purchase order.

Calibration files include details on process conditions, calibration fluid, line size and other information. All NIST-traceable equipment utilized for the calibration procedure is identified, as is the calibration history of all reference equipment.

In addition to the Calibration Certificate, a certified flow table that correlates current outputs with scaled units of flow is produced for each calibrated device.

1.5 I/O Description

The MTI10/MTL10 feature two galvanically isolated 4-20 mA analog outputs: one isolated digital output that can be used for frequency or alarm, one programmable switch input and a USB connection for communication with a computer.

The first 4-20 mA output is for flow rate. The second 4-20 mA output can be configured either for flow rate or process gas temperature. Both 4-20 mA outputs can be scaled by the user. The frequency output is programmable to represent flow rate and can be scaled for maximum flow/maximum frequency, units-per-pulse or pulse-per-units. The maximum frequency is 100 Hz. An isolated 24 Vdc output power option is provided for use with these outputs. It can supply a 42 mA maximum total load (do not use for other external devices).

MTI10/MTL10 View interfaces to the USB port and is a free PC-based software program that displays flowmeter readings and permits flowmeter configuration.

Modbus RTU (RS485), an industry standard communication option, is available on the MTI10/MTL10 flow meter.

1.6 Optional display panel and configuration panel

The configuration panel allows the user to change a variety of settings. The display is 2 lines x 16 characters with 4 mechanical and 4 IR (infrared) buttons.

The IR and mechanical buttons perform the same function but the IR buttons can be used without opening the cover. The IR buttons can be calibrated (p. 60) for better operation in the field or disabled (p. 60) when the meter is used in snow or ice in order to avoid false key detection.

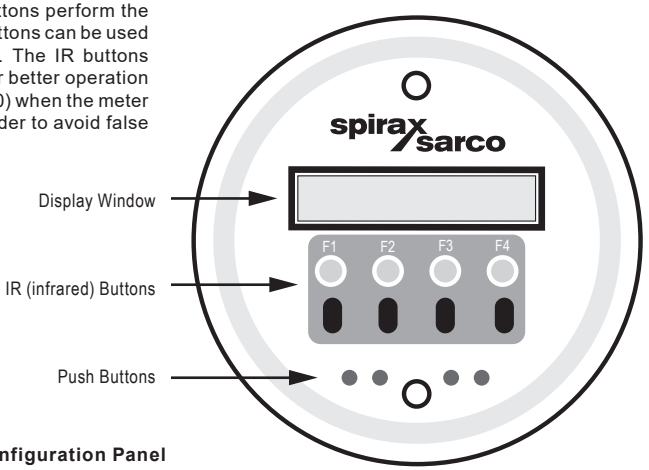


Fig. 1 -
Optional Display and Configuration Panel

1.7 Functional Diagram

An optional on-board display is available to view flow rate, total flow, elapsed time, process gas temperature and alarms. The display is also used in conjunction with the Configuration Panel for field configuration of flowmeter settings such as 4-20 mA scaling, pulse output frequency scaling, pipe area, zero flow cutoff, flow filtering or damping, display configurations, diagnostics and alarm limits.

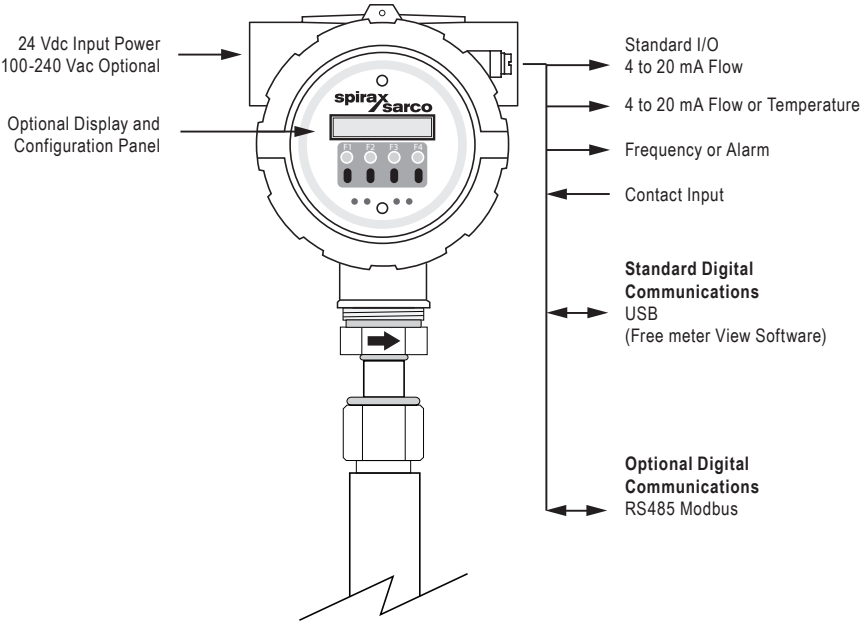


Fig. 2 - Functional Diagram

2. Installation

2.1 General

2.1.1 Scope

This section describes how to install the Spirax Sarco MTI10/MTL10 Flowmeter and how to get started. Installation methods will vary according to the flowmeter type (insertion or inline).

For Insertion Types (MTI10):

1. Determine lateral position on the pipe
2. Sensor installation depth
3. Sensor orientation in relation to sensor length and direction of flow
4. Proper tightening of compression fitting for mounting meter

For Inline Types (MTL10):

1. Determine lateral position on the pipe
2. Flow body orientation in relation to direction of flow in pipe
3. Proper tightening of compression fitting

Installation procedures must be performed using a combination of the end user's best engineering practices, in compliance with local codes, and manufacturer's recommendations.

2.1.2 General Precautions

The following general precautions should be observed:

1. Exercise care when handling the flowmeter to avoid damaging the probe, sensor or enclosure.
2. Close any unused conduit openings in the enclosure with plugs certified for your application.
3. The enclosure covers must be closed except during installation.
4. Mounting MTI10 or MTL10 in direct sunlight can cause the temperature inside the enclosure to increase beyond design limits, resulting in failure of LCD display and reduced component life. It is recommended that a sunshade be installed to avoid direct sunlight.
5. Ensure the flow direction arrow points in the direction of flow.
6. Do not install the MTI10 or MTL10 enclosure near an igniter, igniter-controller or switching equipment.
7. Do not install an external power supply in a cabinet containing an igniter-controller or switching equipment.
8. Ensure that good engineering practices and applicable industry codes are followed throughout the installation process.
9. For accurate flow measurement: review flowmeter placement instructions before installation to ensure a proper flow profile in the pipe.

2.2 Insertion type

2.2.1 Instructions for Insertion Flowmeter Lateral Placement

Install the Model MTI10 Insertion style flowmeter so that it is far enough away from bends in the pipe, obstructions, or changes in line sizes to ensure a consistent flow profile. Fifteen diameters of straight pipe upstream and ten downstream are recommended.

For example, a 2" pipe would require 30" upstream and 20" downstream, but a 4" pipe would require 60" upstream and 40" downstream.

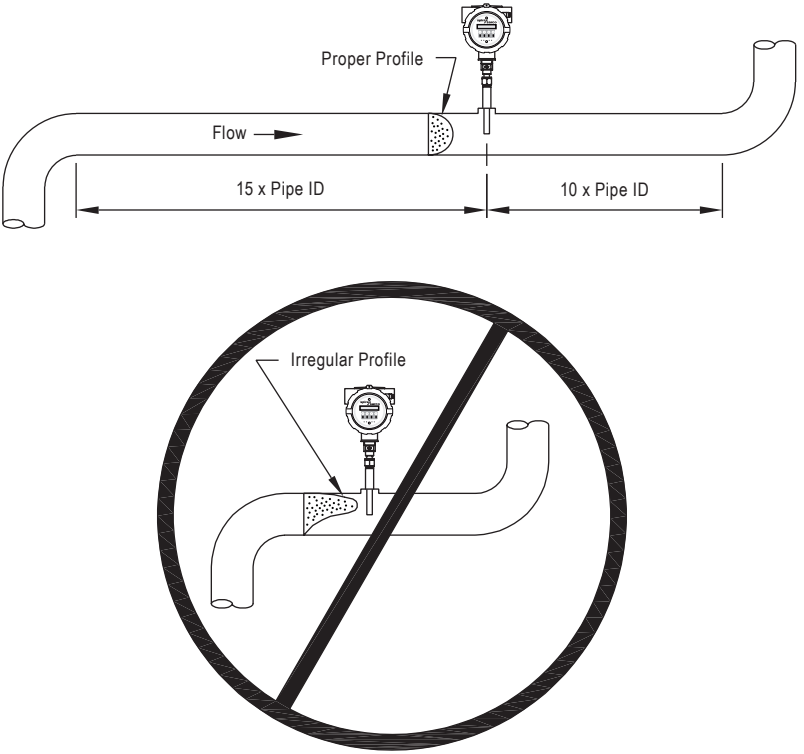


Fig. 3 - Upstream and Downstream Pipe IDs for Insertion Meters

Specific Conditions of Use:

- The flameproof joints of the equipment are not intended to be repaired.
  Consult manufacturer if dimensional information on the flameproof joints is necessary.
- Follow the manufacturer's instructions to reduce the potential of an electrostatic charging hazard.

2.2.2 Installation Depth

The installation depth of the sensor in the pipe is dependent on the pipe size. To get the most accurate reading, proper placement of the sensor window within the pipe is necessary.

As shown in Fig 2.2, the end of the sensor window should be 22 mm (0.87") past the center line of the pipe.

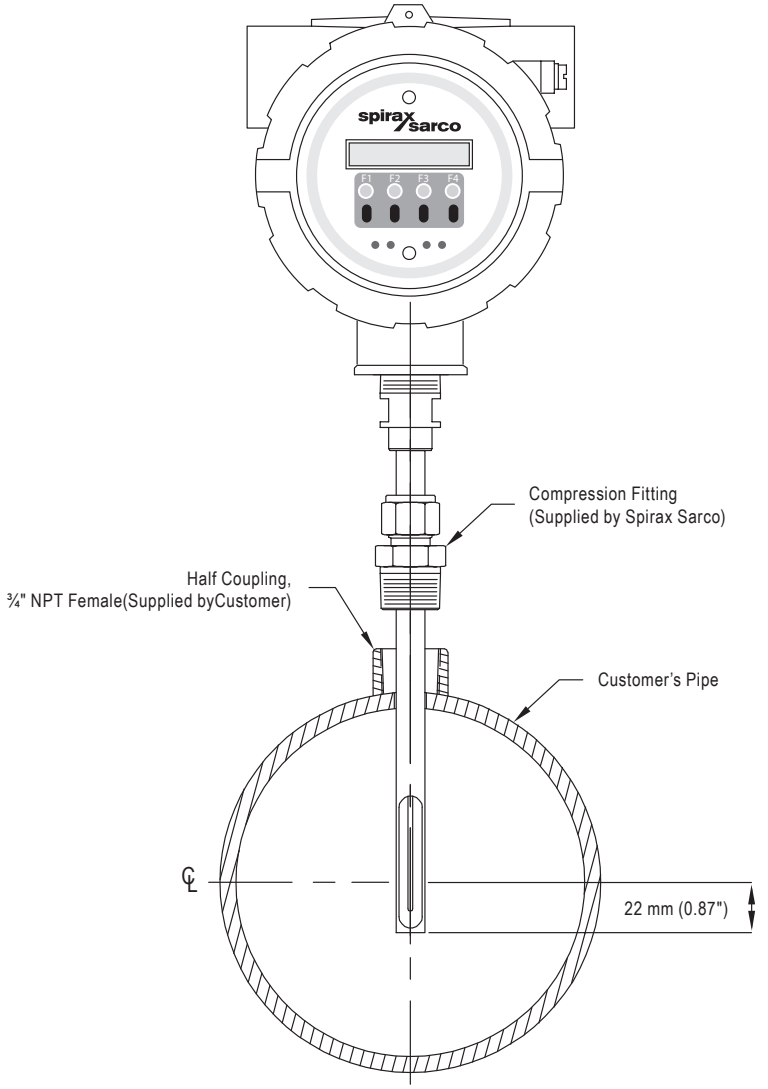


Fig. 4 - Cross Section of Insertion Sensor Depth in Pipe

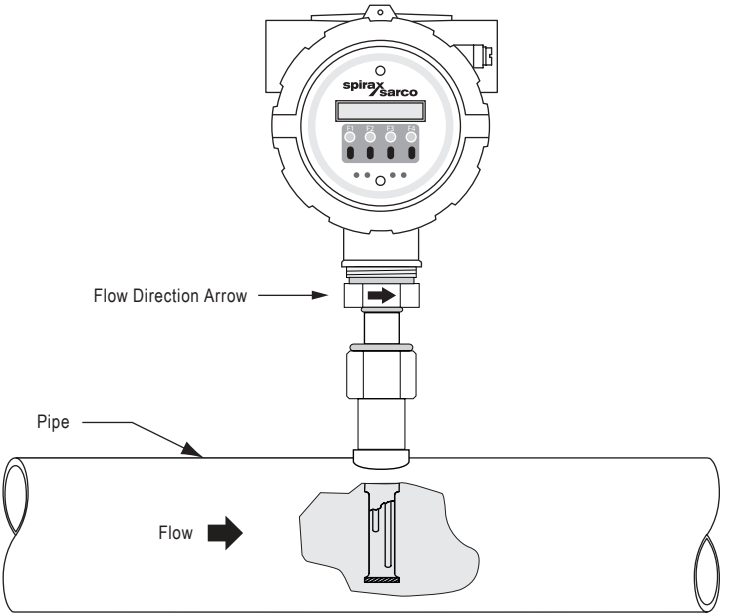


Fig. 5 - Orientation of MTI10 Insertion Type Flowmeter

Note!

Some flowmeters are shipped with the sensor elements that are offset (see figure 6). Others are shipped with sensors that have equal length elements (see figure 7). The sensor type supplied was selected at the factory to be the best suited for your application. Follow the appropriate sensor orientation instructions.

2.2.3 Unequal Length Sensor Elements

Install the shorter sensor element upstream from the longer one.

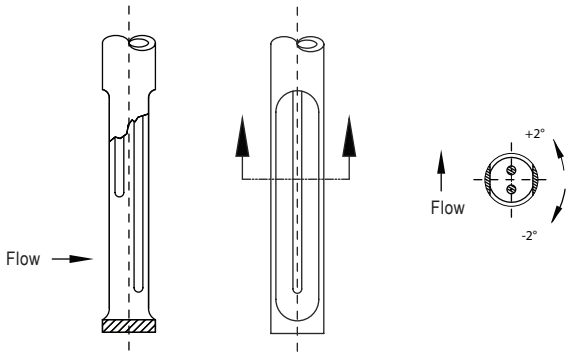


Fig. 6 - Unequal Length Sensor Elements

2.2.4 Equal Length Sensor Elements

Install flowmeter with both sensor elements facing the flow stream within ±3 mm (0.1").

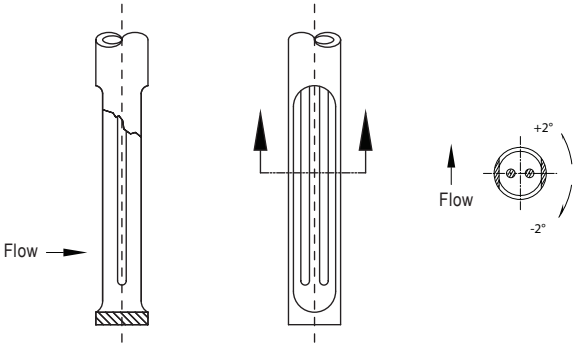


Fig. 7 - Equal Length Sensor Elements

2.2.5 Insertion Mounting Instructions - Compression Fittings

The MTI10 is mounted through a ¾" hole and a ¾" female NPT half coupling provided in the customer's pipe. Insertion style flowmeters are not designed for use in pipes smaller than 1½".

- Install the compression fitting into the ¾-inch female NPT half coupling.
- When installing in a 50 mm (2") pipe or larger, install the end of the probe 22 mm (0.87") past the center line of the pipe and tighten the compression fitting nut (refer to Figure 4 on page 11).
- When installing into a 40 mm (1.5") pipe carefully install the probe into the pipe until it touches the opposite wall and pull back 3 mm (0.1"). Tighten the compression fitting nut.

Caution

Once the compression fitting is locked onto the probe, the probe can be removed or rotated, but the insertion depth is locked in place.

Note!

Do not overtighten compression fitting.

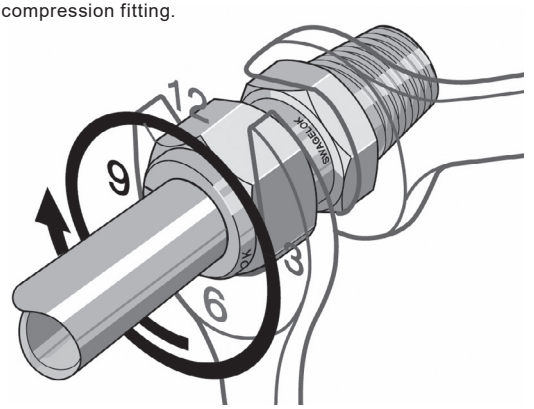


Fig. 8 - Proper Tightening of the Compression Fitting Nut

While holding the fitting body steady, tighten the nut one and one-quarter turn to the 9 o'clock position.

2.3 Inline type

2.3.1 Instructions for Inline Flowmeter Placement

Install the MTL10 Inline style flowmeter so that it is far enough away from bends in the pipe, obstructions, or changes in line sizes to ensure a consistent flow profile. Eight diameters of straight pipe upstream and four downstream are recommended (for ¼" meters: 6" (152 mm) of straight, unobstructed pipe upstream and downstream are required).

For example, a 2" pipe would require 16" upstream from the edge of the flow body and 8" downstream from the other end of the flow body, whereas a 4" pipe would require 32" upstream and 16" downstream.

The MTL10 is welded, threaded or flanged to the customer's pipe. Care should be taken to ensure that the diameter of the mating pipe is the same diameter as the MTL10 flow body or errors in flow readings can occur. The installation procedure should be a combination of the end user's best engineering practices, in compliance with local codes, and the manufacturer's recommendations.

See Figure 9 for a detailed look at upstream and downstream pipe diameters for inline meters.

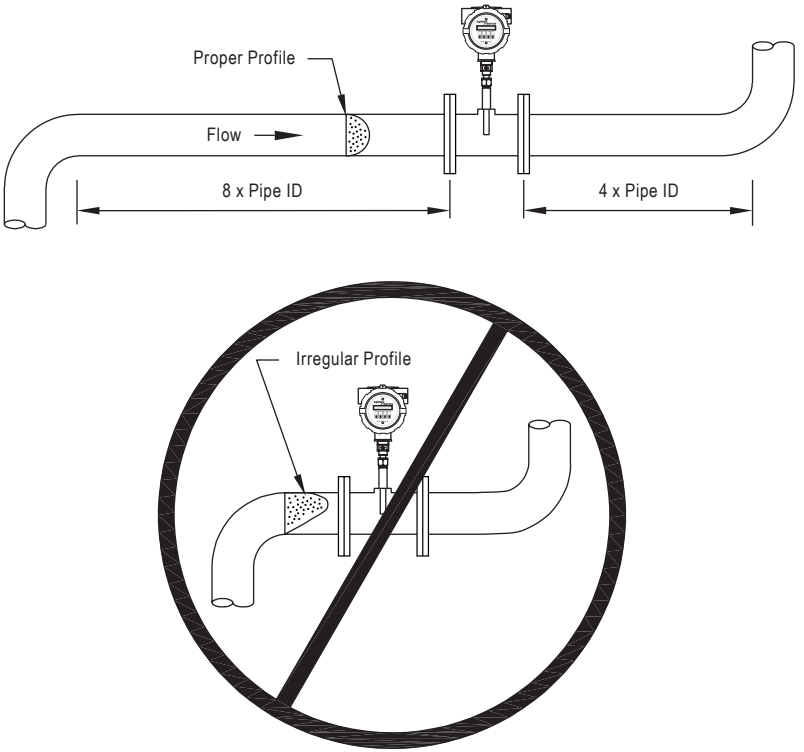


Fig. 9 - Upstream and Downstream Pipe IDs for Inline Meters

2.3.2 Inline Orientation

Install the flow body so that the engraved arrow on the fitting and the arrow on the flow body are pointing with the direction of flow.

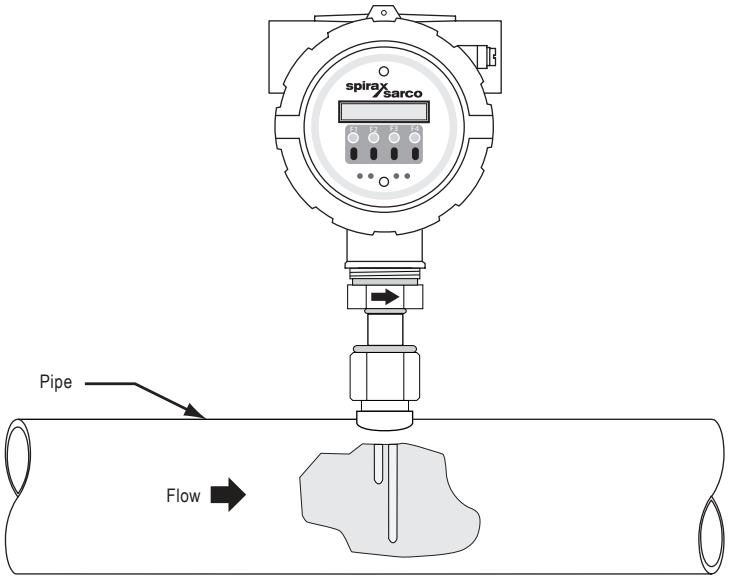


Fig. 10 - Orientation of an Inline Meter - Directional Arrows

2.3.3 Tightening Compression Fittings

The compression fitting has been placed according to the proper depth in the flow body by Spirax Sarco factory technicians. After the flow body has been correctly fitted to the process pipe, the compression fitting may need to be tightened correctly (Figure 8 on p. 14).

Note!

- Refer to the Spirax Sarco Calibration Validation Chapter for information on setting the field baseline for Zero CAL-CHECK® tests if you plan to perform these tests in the pipe.
- Please save the PVC sensor cover that was shipped with your meter. It will be needed to perform Zero CAL-CHECK® tests out of pipe.

3. Wiring (electrical)

3.1 General

3.1.1 Wiring Instructions

Wire the MTI10/MTL10 by opening the rear enclosure cover, bringing customer-supplied wires in through the conduit openings and connecting to the terminal blocks. The MTI10/MTL10 has two conduit openings to maintain separation between AC input power and output signal wiring. To eliminate the possibility of noise interference, use a separate conduit for AC power and cut all wires short for a minimum service loop.

3.1.2 Wiring Precautions

- WARNING - DO NOT OPEN WHEN ENERGIZED OR AN EXPLOSIVE ATMOSPHERE IS PRESENT.
- All plumbing and electrical installations of flowmeters must be in compliance with local codes, the end user's best engineering practices, and manufacturer's recommendations.
- An external power disconnect and 16A over-current protection are required for the AC and DC powered MTI10/MTL10
- Do not install the MTI10/MTL10 enclosure near an igniter, igniter-controller or switching equipment.
- Do not install an external power supply in a cabinet containing an igniter controller or switching equipment.
- This flowmeter contains components that can be damaged by static electricity. You must discharge yourself by touching a grounded steel pipe or other grounded steel material prior to working inside this flowmeter.
- For the remote sensor option, the serial number of the electronics enclosure must match the remote sensor probe.
- Close any unused entries using suitably certified plugs

3.1.3 Power Wiring

For power wiring, use stranded copper wire, no larger than 16-gauge. If an external 24 Vdc power source is used, twisted pair shielded cable is recommended. Supply connection wiring must be rated for at least 90°C (194°F).

3.1.4 Grounding

The enclosure must be properly grounded with a quality earth ground. 16 gauge, stranded wire is recommended.

3.1.5 Signal Wiring

For signal wiring, the recommended wire gauge is 18 to 22 AWG. Always use twisted pair shielded cable. The cable shield should not be connected at the flowmeter, it should be connected at the power supply AC ground terminal or instrumentation AC ground. Do not route the power and signal wires in the same conduit. Power wires must enter left-hand conduit entry. Signal and remote sensor (where applicable) must enter right-hand conduit entry.

3.1.6 Serial Communication Wiring

If you have purchased the RS485 communication option, please refer to the Modbus section of this manual.

3.1.7 Remote Sensor Wiring

Note!

Remote wiring is only required when the Remote Electronics options is provided. Five wire shielded cable required, the recommended wire gauge is 18AWG. Make sure that the cable length does not exceed 100 feet and the wire resistance does not exceed one ohm. Do not connect the cable shield at the electronics enclosure end.

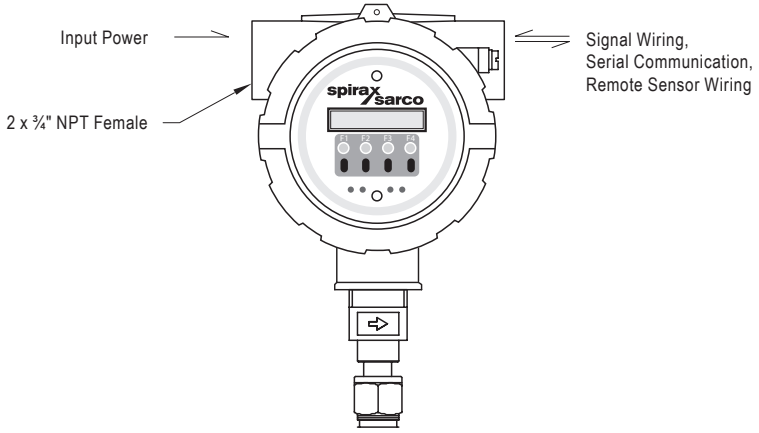


Fig. 11 - MTI10/MTL10 Wiring

Note!

Serial numbers: If you have more than one meter, you must ensure that the serial numbers of the probe/J-Box, remote electronics, housing, and/or flow body match one another. These items have been manufactured and calibrated to operate as a unit and cannot be mismatched.

Installation wiring: Obtain the correct length for the MTI10/MTL10 power and signal wires using one of these methods

- Trim the wires to extend 2.5 inches out of the enclosure after the conduit and wires are routed to the MTI10/MTL10 (preferred method).
- Trim the wires to extend 6 inches from the end of the conduit before it is attached to the MTI10/MTL10.

3.2 Input power

3.2.1 Power Input Requirements: 24 Vdc Supply

External DC power supply must provide 24 Vdc ± 10%, at 0.7 Amps minimum.

The enclosure must be properly grounded with a quality earth ground. Sixteen (16) gauge, stranded wire, is recommended for power and earth ground.

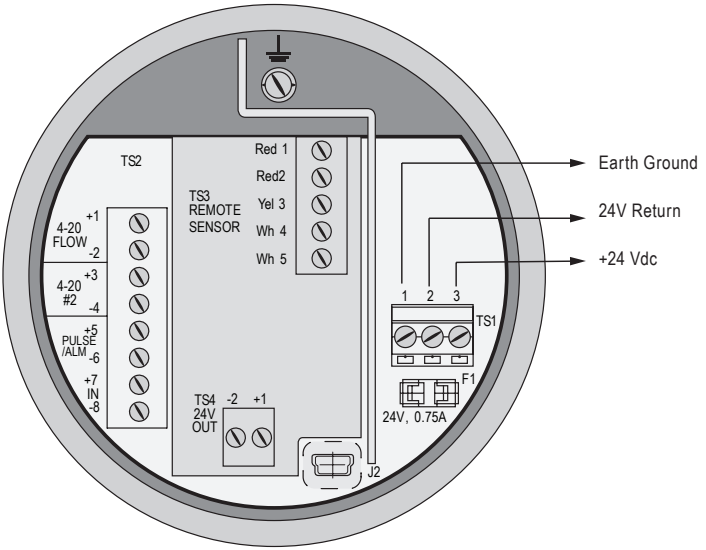


Fig. 12 - Connections for 24 Vdc Supply

Caution

Supply connection wiring must be rated for at least 90°C (194° F).

Note!

A power failure or resetting the total will cause the Contract Time to change. Data Logger with a Real Time Clock (RTC) option should be used to avoid this.

3.2.2 Power Input Requirements: 100 to 240 Vac Supply

If the MTI10/MTL10 has the AC power option, the AC power must provide 100 to 240 Vac -15% / +10% (85 to 264 Vac) at 0.2 Amps minimum.

The enclosure must be properly grounded with a quality earth ground. Sixteen (16) gauge, stranded wire, is recommended.

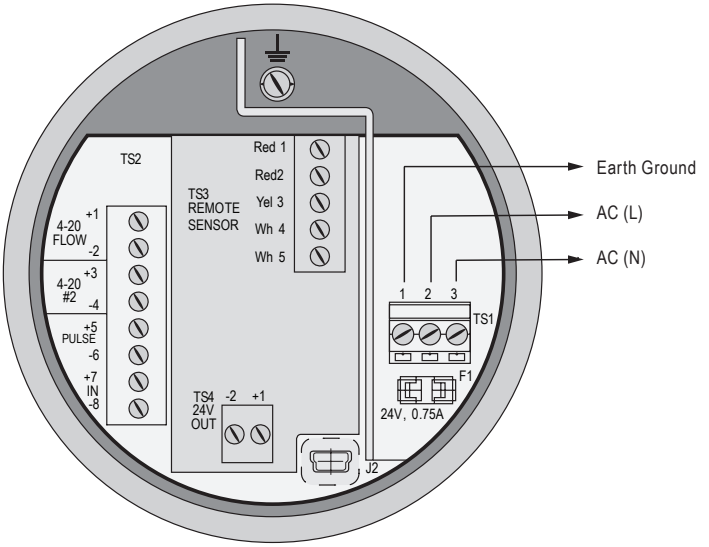


Fig. 13 - Connections for optional AC Power

Caution

Supply connection wiring must be rated for at least 90°C (194° F).

3.3 Signal wiring

3.3.1 4-20 mA Output Wiring: Customer-Supplied Power Source

Bring the 4-20 mA wiring in through the right-hand conduit hub. Connect FLOW RATE 4-20 mA wiring to TS2, 1(+) and 2(-). Connect 4-20 mA output #2 wiring to TS2, 3(+) and 4(-).

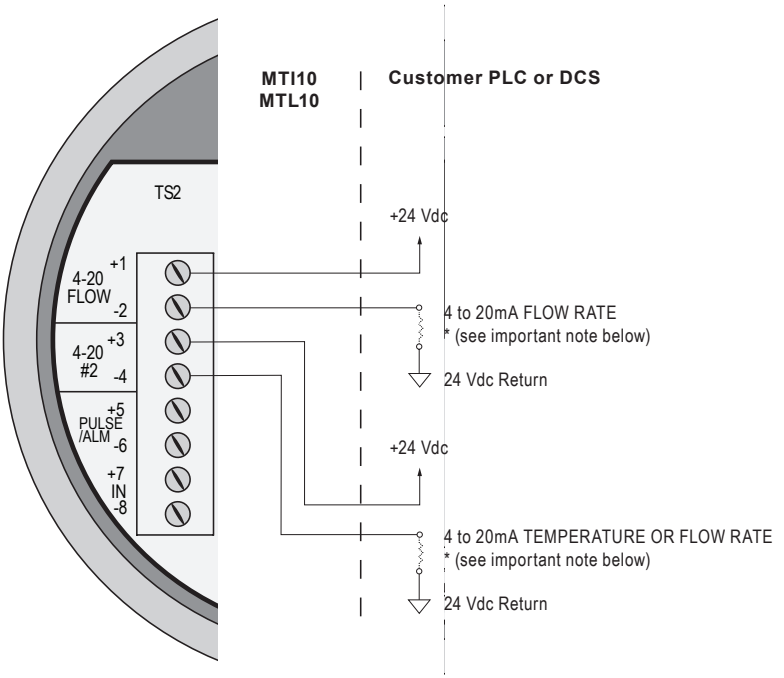


Fig. 14 - 4-20 mA Output Wiring for Customer-Supplied Power Source

Note!

The load resistor on the MTI10/MTL10 Flowmeter 4-20 mA signal is typically 250 ohms and is located in or at the customers PLC or DCS. A 250 ohm resistor in the 4-20 mA line will result in a 1 to 5VDC signal to the PLC or DCS. Some PLC/DCS equipment has the load resistor built in to the unit; please refer to the PLC/DCS technical manual.

Do not exceed a 600 ohm load on the MTI10/ MTL10 Flowmeter 4-20 mA signal.

3.3.2 4-20 mA Output Wiring: Loop Power Provided by MTI10/MTL10

Bring the 4-20 mA wiring in through the right-hand conduit hub. Connect the 4-20 mA wiring to terminal blocks TS2 and TS4 as shown in the diagram below.

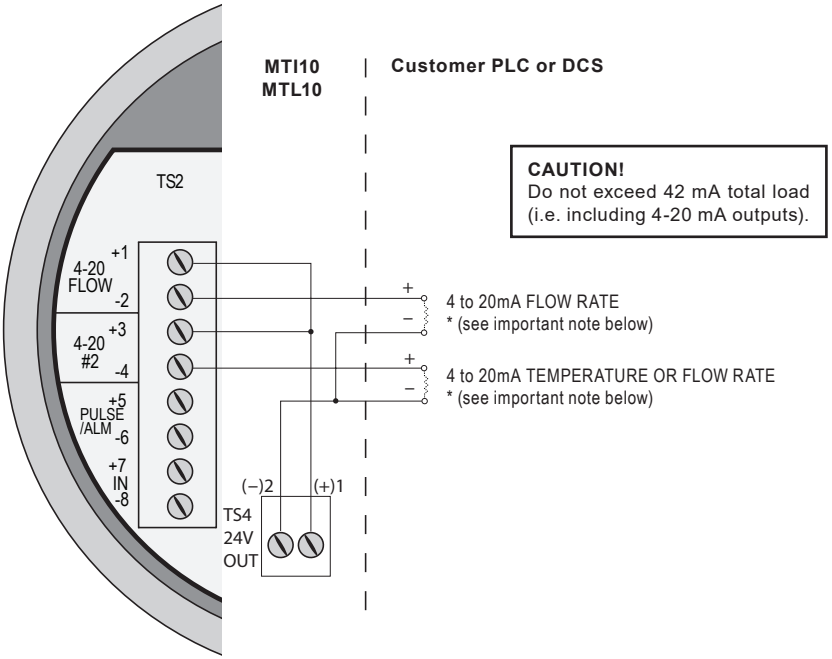


Fig. 15 - 4-20 mA Output Wiring for Loop Power Provided by MTI10/MTL10

Note!

The load resistor on the MTI10/MTL10 Flowmeter 4-20 mA signal is typically 250 ohms and is located in or at the customers PLC or DCS. A 250 ohm resistor in the 4-20 mA line will result in a 1 to 5VDC signal to the PLC or DCS. Some PLC/DCS equipment has the load resistor built in to the unit; please refer to the PLC/DCS technical manual.

Do not exceed a 600 ohm load on the MTI10/ MTL10 Flowmeter 4-20 mA signal.

3.4 NE-43 alarms

3.4.1 Setting Up the NE-43 Alarms

The MTI10/MTL10 flowmeter supports the NAMUR specification NE-43 for alarms on the 4-20 mA output.

Caution

Configure the MTI10/MTL10 with the following setup when using the 4-20 mA output to control equipment in a failsafe application.

3.4.2 4-20 mA Failsafe Wiring: NAMUR NE-43

When the 4-20 mA output is used to control equipment in failsafe applications:

- Wire the 4-20 mA output in series with the Alarm output as shown in Figure 16.
- Configure the Pulse/Alarm output to Alarm and select System Alarm as shown in the "Setting Up the NE-43 Alarms" on page 24.

The System Alarm output is designed to allow current to flow during normal operation and interrupts current when power to the meter is lost or in a System Alarm condition.

In the 4-20 mA Failsafe Wiring configuration of Figure 3.6, the 4-20 mA signal goes to 0mA if power to the MTI10/MTL10 is lost or a System Alarm occurs.

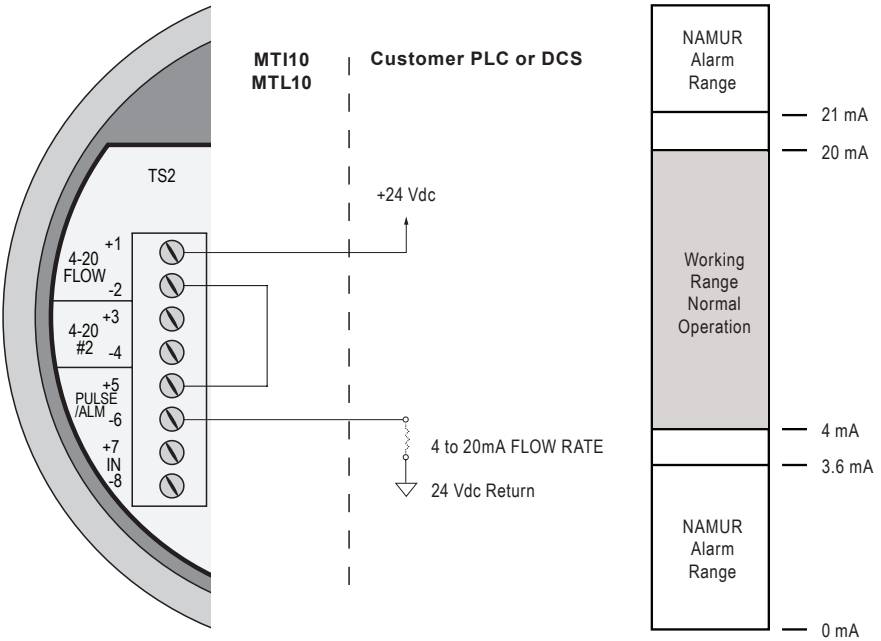
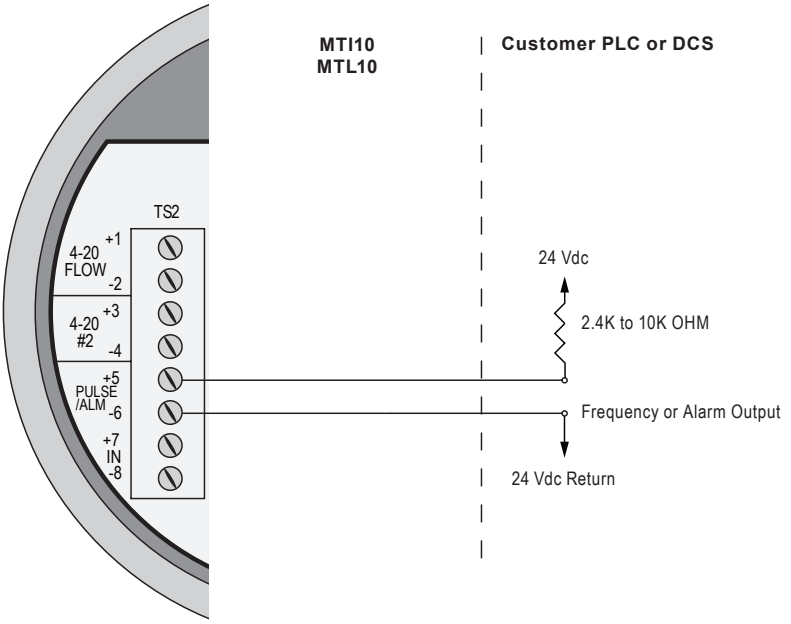


Fig. 16 - 4-20 mA Failsafe Wiring and Range of 4-20 mA Output for NAMUR Alarm

3.5 Frequency/Alarm Output Wiring

3.5.1 Setting Up the NE-43 Alarms

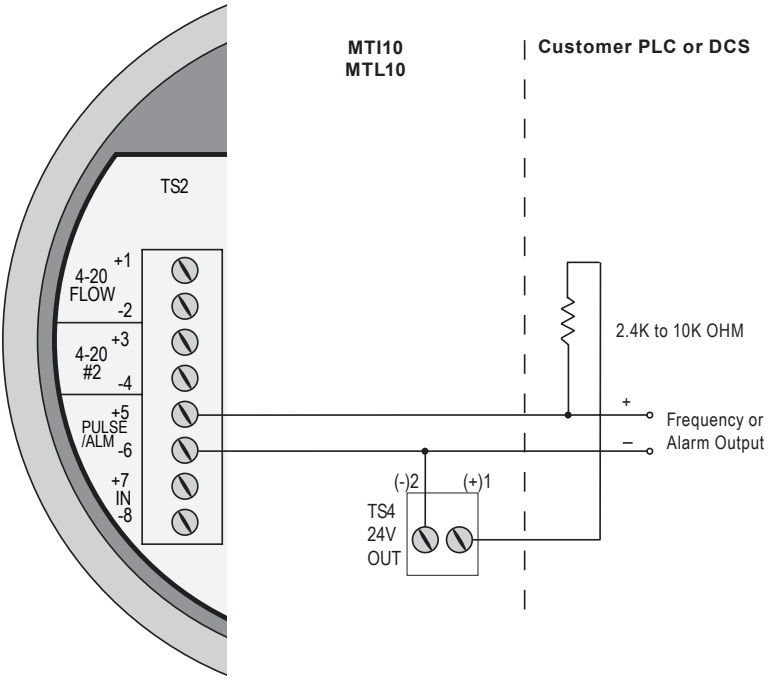
Bring frequency/alarm wiring in through the right-hand conduit hub. Connect to TS2, 5(+) and 6(-). The frequency/alarm output is an open collector circuit capable of sinking a maximum of 20mA of current. Frequency or Alarm selection is programmed using the display. Only one option, frequency or alarm, can be active at a time.



Note!

The MTI10/MTL10 Frequency/Alarm output is typically used to drive digital circuitry or solid-state relays. The output of a solid state relay may, in turn, operate loads such as electromechanical relays or alarm indicators.

Fig. 17 - Frequency/Alarm Output Isolated (Recommended)



Caution

Do not exceed 42 mA total load on the 24V Output TS4 (i.e. including 4-20 mA outputs).

Fig. 18 - Frequency/Alarm Output Local +24V Power Option

3.6 Remote switch

3.6.1 Remote Switch Wiring

A remote switch can be used to reset the Totalizer and elapsed time, if enabled in the programming settings. There is no polarity requirement on these connections. Use TS2, 7(+) and 8(-).

When the 2 gas curve option is ordered, the switch can be used to switch between curves.

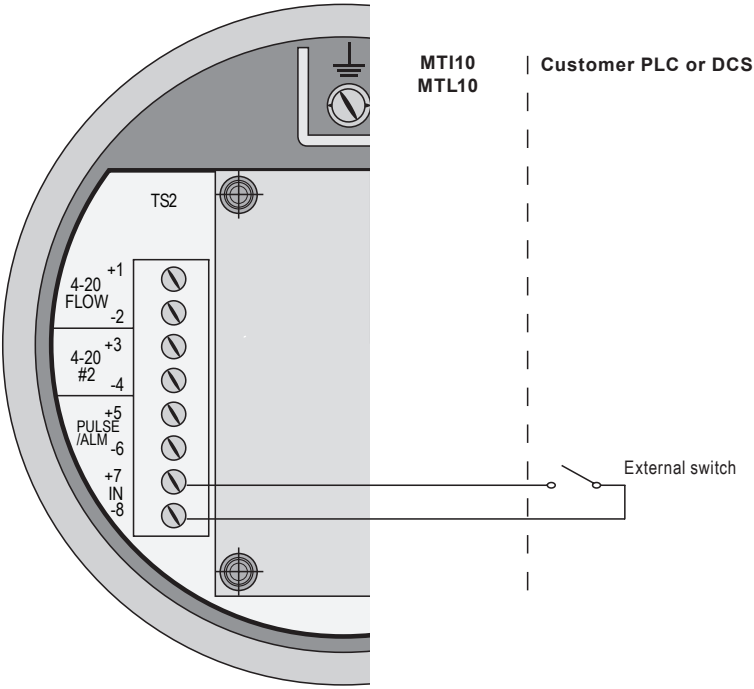


Fig. 19 - Remote Switch Wiring

If you have purchased Modbus RTU (RS485) communications, please refer to the Modbus chapter in the manual.

3.7 Remote sensor option

3.7.1 Remote Wiring

Remote wiring will be the same for both MTI10 insertion and MTL10 inline flowmeters.

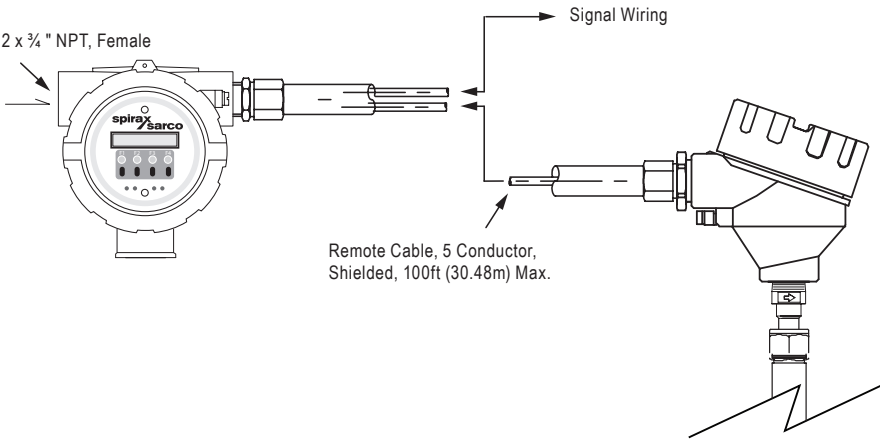


Fig. 20 - Remote Wiring

Signal Wiring includes:
4-20 mA, pulse, alarm output, contact input, remote switch, USB, and communications options. Power input is 24 Vdc or optional 100-240 Vac (+10% / -15%).

Note!

Remote wiring is only required when the Remote Electronics option is provided.

Five wire shielded cable required. The shielded cable should be run through a separate grounded steel conduit (no other cables or wires in the conduit). If you are using your own cable, make sure that the cable length does not exceed 100 feet and has a wire resistance that does not exceed one ohm (18 AWG recommended).

Do not connect the cable shield at the electronics enclosure end.

Use an extension cable to connect the terminals of the remote probe enclosure to connector TS3 of the electronics enclosure as shown in Figure 21 and Table 1.

3.8 Remote switch

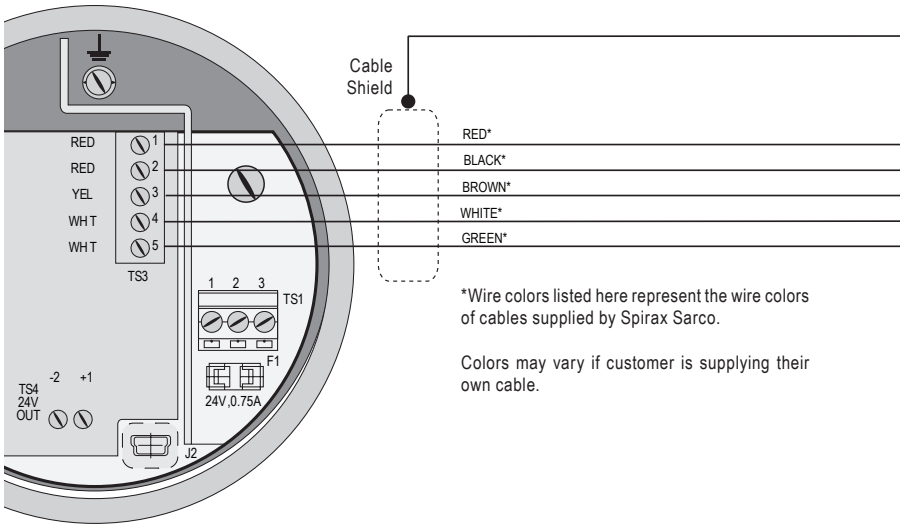
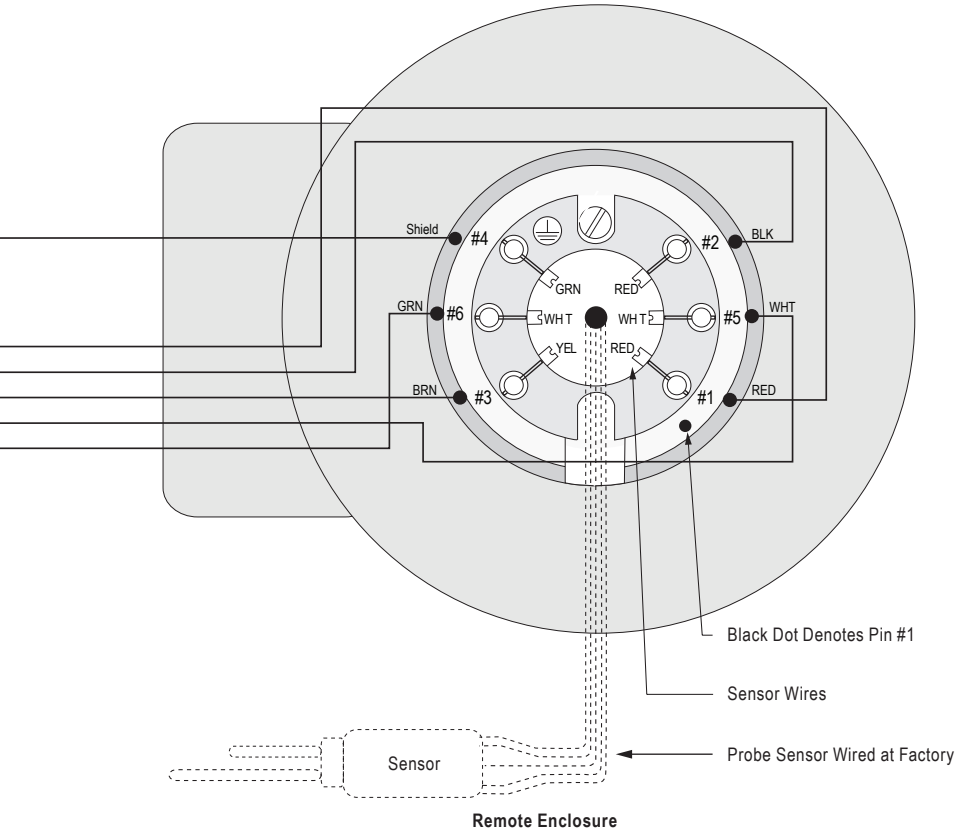


Fig. 21 - Remote Sensor Wiring

Table 1 - Remote Sensor Cable Wiring

Electronics Enclosure Terminal Numbers	Extension Cable Wire Color	Remote Enclosure Terminal Numbers	Sensor Wire Color
1	Red	1	Red
2	Black	2	Red
3	Brown	3	Yellow
No Connection	Shield	4	Green
4	White	5	White
5	Green	6	White



Remote Enclosure

4. Operation

4.1 Start-up

4.1.1 Start Up Sequence

The program automatically enters the Run/Measure mode after power up. If the Local display is installed, the screen will show the software versions for the MTI10/MTL10 and the display module during power up. Programming of the flowmeter can also be accomplished using a Windows-based PC program called MTI10/ MTL10 View.

4.1.2 USB Interface

The USB interface is a standard feature which allows communication to a PC in order to monitor readings and configure settings. MTI10/MTL10 View, is a free application program from Spirax Sarco that connects to the USB interface and allows data monitoring, configuration setting, data logging to Excel®, and an option to save and recall MTI10/MTL10 configuration data. A serial communication manual is available for users who want to create their own PC application.

4.1.3 MTI10/MTL10 Optional Display Panel and Configuration Panel

The MTI10/MTL10 display is a 2 line x 16 character display with 4 mechanical and 4 IR (infrared) buttons. The IR and mechanical buttons perform the same function but the IR buttons can be used without opening the cover. The IR buttons can be calibrated for better operation in the field or disabled (p. 60) when the meter is used in snow or ice in order to avoid false key detection.

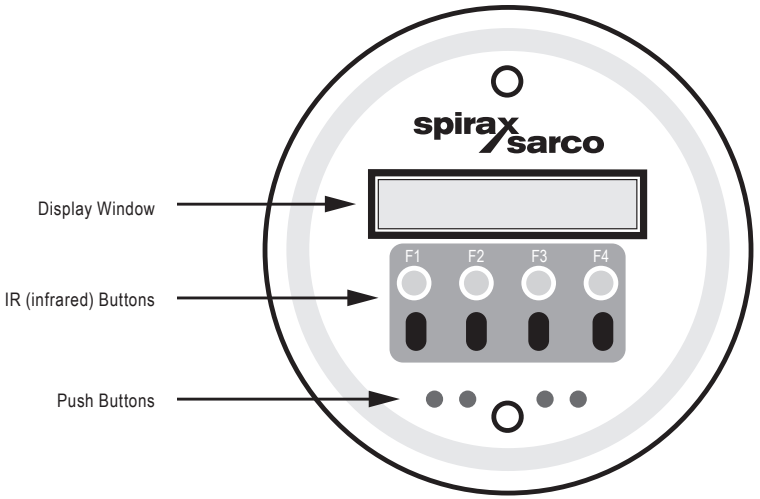


Fig. 22 - MTI10/MTL10 Optional Display and Configuration Panel

4.2 Display screens

4.1.1 Measurement Mode

In the measurement mode, there are four different display screens (display 1, 2, 3 and a prompt screen to enter the programming mode), two display screens are user programmable (refer to Display Setup). Scrolling through the display is accomplished by pressing the F1 or F2 key to view the next or previous screen. Pressing the F1 and F2 keys at the same time enters the Engineering Menu screens (display 10 through 26). Keys F1 and F2 are used to scroll through the different screens and key F4 in order to exit to Display #1. Pressing the F3 and F4 keys at the same time brings up the Reset Total screen prompt.

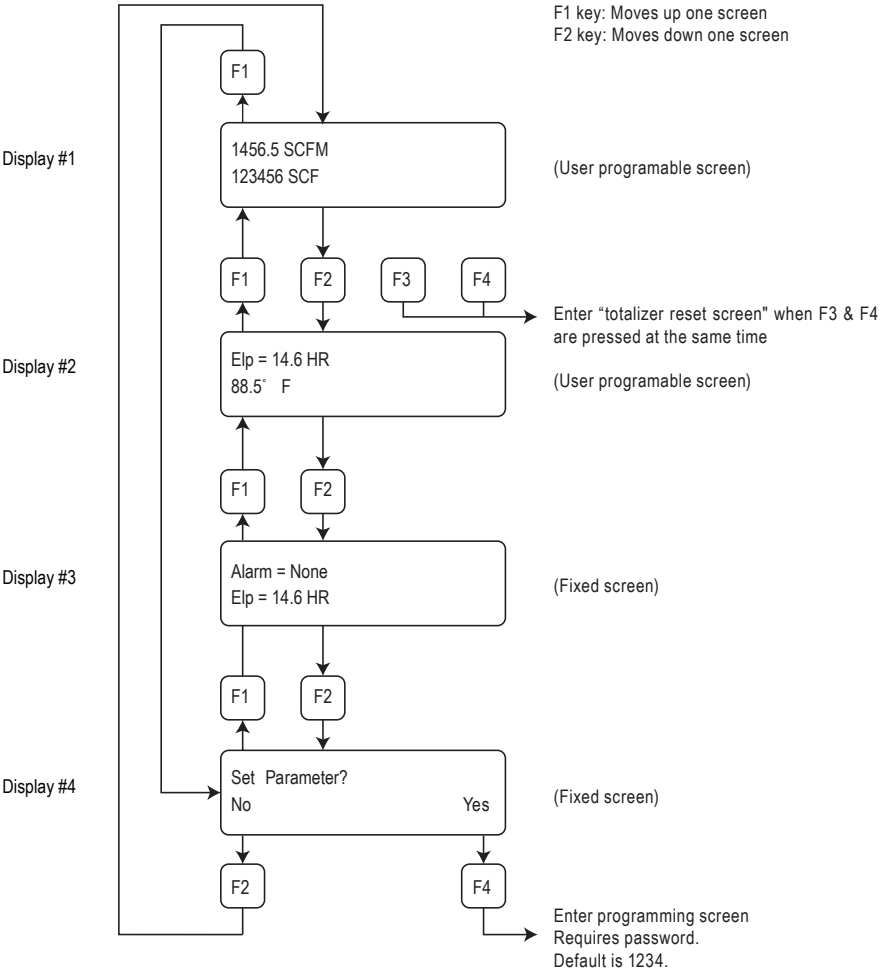


Fig. 23 - MTI10/MTL10 Display Screen Navigation

4.3 Engineering displays

4.1.1 MTI10/MTL10 Engineering Displays

Pressing the F1 and F2 keys at the same time in the normal mode, brings up the engineering displays. These displays show internal parameters of the MTI10/MTL10 which are used by Spirax Sarco service technicians. Press F4 to exit. Use the F1 and F2 keys to navigate.

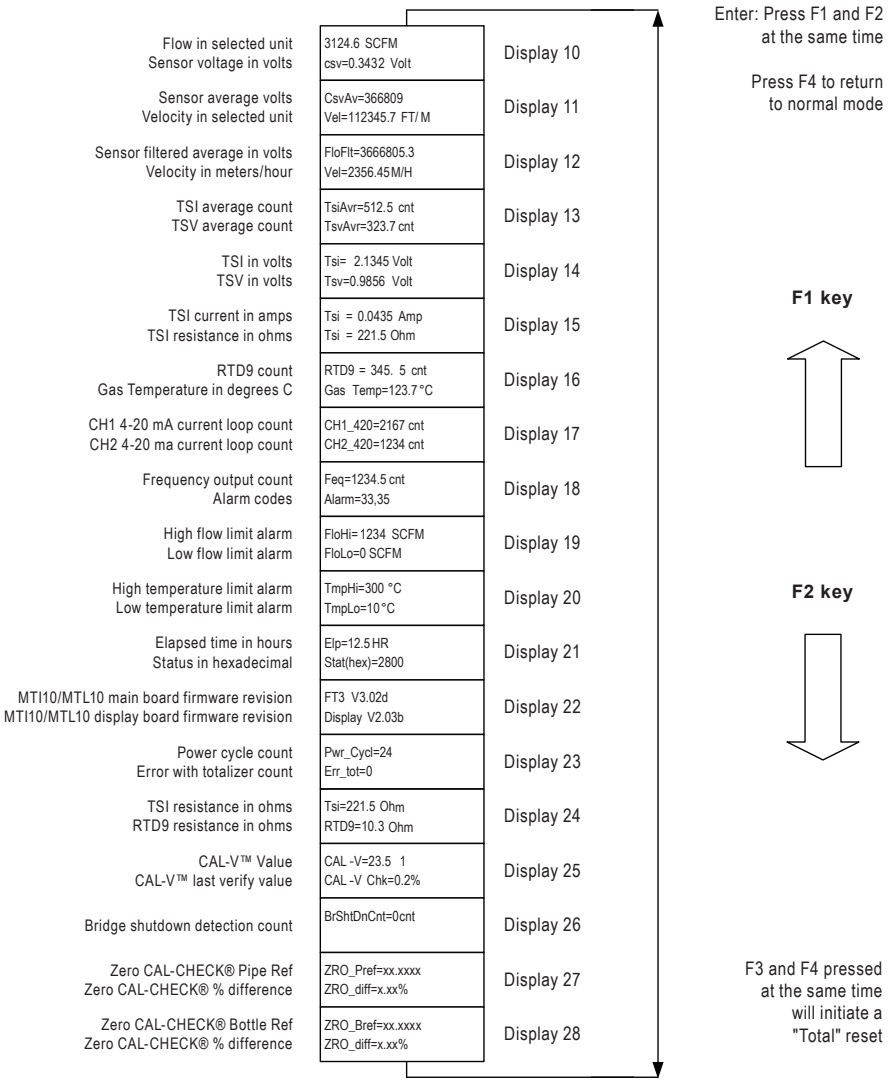


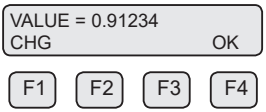
Fig. 24 - MTI10/MTL10 Engineering Displays

4.4 Programming

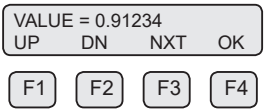
4.1.1 Data Entry using the local display module

There are 2 basic types of menu entries: one for changing value or string and one for selecting from a selection list.

To Change a Value or String :



Press **CHG (F1)** key to change the value, **OK (F4)** to accept the value.



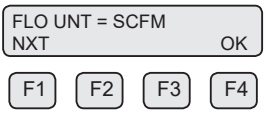
Press the **UP (F1)** or **DN (F2)** key to select a new digit or character, the cursor points to the selected digit.

Press **NXT (F3)** to select the next digit and **OK (F4)** to accept the entry.

Note!

If the **UP (F1)** or **DN (F2)** key is held down for more than 1 second, the program will progressively select new digits at increasing speed as time increases.

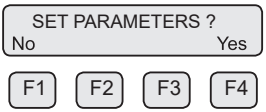
To Select from a List:



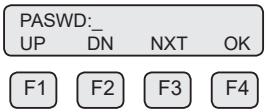
Press **NXT (F1)** key repeatedly until the correct selection is made and **OK (F4)** key to accept the entry.

Entering the Programming Mode

To enter the programming mode, press the F1 or F2 key repeatedly in the normal running mode until the following screen is shown:



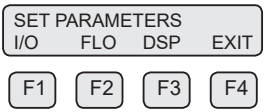
Press **YES (F4)** and the following screen will prompt the user to enter the password if it is active:



Enter the correct password, then follow the instructions for changing a value as specified above. The default Level 1 password is “1234".

If the wrong password is entered, the message “Wrong Password" will be displayed for a few seconds and then returns to the programming entry screen.

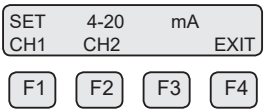
If the password is accepted, the base programming screen will be shown:



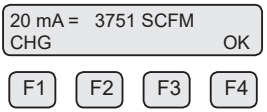
This is the base screen for the programming mode.

Press **EXIT (F4)** repeatedly until “Normal Mode" is seen briefly to exit the programming mode.

Analog 4-20 mA Output
The following menu allows the scaling of the analog 4-20 mA outputs.
From the base screen, press **I/O (F1)** and then in the next screen press **420 (F3).**



Select **CH1 (F1)** to program channel 1.

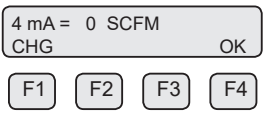


Enter the value for the 20mA and press OK (F4) key to accept the setting.

Note!

When the flow rate exceeds the programmed value for the 20mA set point, the analog output will stay at 20mA and an alarm code will be generated.

Then the following screen will display:



Enter the value for the 4mA and press **OK (F4)**.

Note!

4mA is normally set to 0.

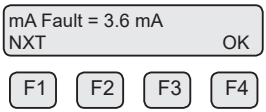
The following menu item allows the user to select an alarm level on the 4-20 mA output when a serious issue is detected that is preventing the calculation of a correct flow value.
The options are:

- Force the 4-20 mA signal to 3.6mA
- Force the 4-20 mA signal to 21mA
- Do not force 4-20 mA signal (not used)

Caution

When using the 4-20 mA output to control equipment in a failsafe application, use the wiring configuration to set the Pulse/Alarm Output to System alarm as shown in "Setting Up the NE-43 Alarms" .

After setting the 4mA output value, choose the mA fault value:



The following events will set the output to 3.6mA or 21mA if the alarm level is selected:

- Sensor resistance above high limit
- Bridge Shutdown

When the 4-20 mA output is wired through the System Alarm, the following cause the output to go to 0 mA:

- Power to the Microprocessor is lost
- Sensor or electronics failure

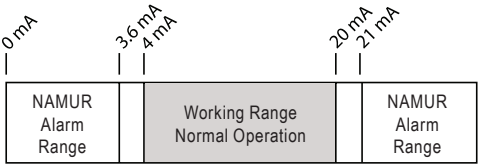
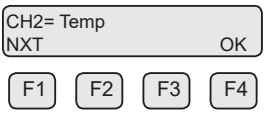


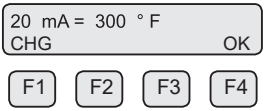
Fig. 4.4: Range of 4-20 mA Output and NAMUR Alarm

Press (**F4**) repeatedly until “Normal Mode" is seen briefly to exit the programming mode.

Select **CH2 (F2)** to program channel 2.
Channel 2 is programmable for flow (CH2=Flow)or temperature (CH2=Temp).



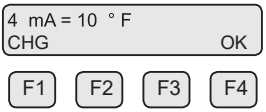
Press **NXT (F1)** to select Flow or Temperature and then press **OK (F4).**



Enter the value for the 20mA and press **OK (F4)** key to accept setting.

Note!
When the flow rate exceeds the programmed value for the 20mA set point, the analog output will stay at 20mA and an alarm code will be generated.

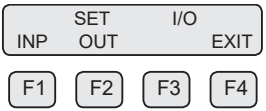
Then the following screen will show:



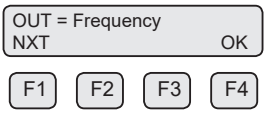
Enter the value for the 4mA and press **OK (F4).**

Press **EXIT (F4)** repeatedly until “Normal Mode" is seen briefly to exit the programming mode.

Frequency Output
From the main menu, press **I/O (F1), I/O (F2)** and then **OUT (F2)**

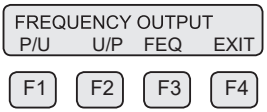


Press **OUT (F2)** to select output and the following screen may show:



Press **NEXT (F1)** to cycle through output options until you have the selection for "OUT=Frequency" and press **OK (F4).**

The frequency output can be configured in one of three ways:
(1) specifying a maximum frequency to a defined maximum value of flow rate, (2) specifying how many flow units total per pulse, U/P (i.e., 0.1 SCF per pulse) or (3) specifying how many pulses per unit, P/U (i.e., 10 pulses per SCF). All of these approaches are equivalent.



Use **P/U (F1)** to enter pulse per unit, **U/P (F2)** for Unit per pulse or **FEQ (F3)** to enter the flow and maximum frequency to scale the frequency output.

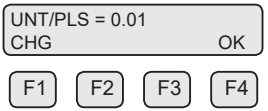
Note!
When data is entered with any of the three described methods, the other values will be re-calculated according to the settings.

Entering data in Pulse per Unit:
Press **P/U (F1)** and the following screen will show:

Press **CHG (F1)** to change the setting and then **OK (F4)** to accept entry.

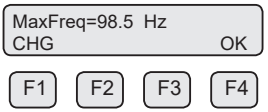
The value entered is in pulse per selected flow unit total (i.e., 10 pulses per SCF)

Entering data in Unit per Pulse:
Press **U/P (F2)** and the following screen will show:



Press **CHG (F1)** to change the setting and then **OK (F4)** to accept entry. The value entered is in unit per pulse (i.e. 0.01 flow unit total per pulse)

Entering data with flow and maximum frequency:
Press **FEQ (F3)** and the following screen will show:

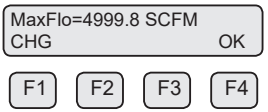


Enter the maximum pulse rate (frequency) and press **OK (F4).**

Caution

Maximum pulse rate (frequency) cannot exceed 100 Hz.

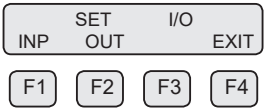
The next screen will show:



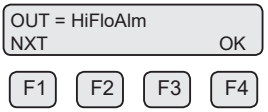
Note!

If the flow rate exceeds the maximum pulse rate (frequency), the output will stay at 100 Hz and the MTI10/MTL10 will issue an alarm code.

Alarm Output
To program the Alarm output, press **I/O (F1)** key from the "SET PARAMETERS" menu screen, then select **I/O (F2)** and the screen will show:.



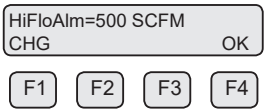
Then press **OUT (F2)** and the screen may show:



Then press **NXT (F1)** to select the correct alarm and press **OK (F4).**

Selections are:

HiFloAlm	=	High Flow Alarm
LoFloAlm	=	Low Flow Alarm
HiTempAlm	=	High Temperature Alarm
LoTempAlm	=	Low Temperature Alarm
System Alm	=	System Alarm
Not used		Frequency



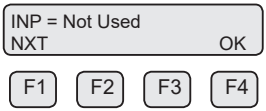
Enter the value for the limit by pressing **CHG (F1)** and then **OK (F4).**

Note!

There is only one output to operate as a frequency output or an alarm output. Both cannot operate at the same time.

Switch Input Settings:

From the main menu, press **I/O (F1)** and then **I/O (F2)** and then **INP (F1)** key to select input. The following menu will display:



Press NXT (F1) repeatedly until the correct selection is shown and then press OK (F4) to accept the setting.

Selections are:

Not used

Tot Reset = Reset the totalizer

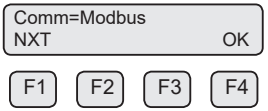
Switch Crv = Switch between calibration curve 1 and 2 (only if 2 gas curve ordered)

Press EXIT (F4) repeatedly until you exit programming mode.

Serial Communication Settings
To program the Serial communication settings, press **I/O (F1)** key from the base menu.

NOTE!
Power cycle is required for the new settings to take effect.

Press **COM (F1)** to select Serial communication:



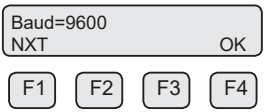
Options for serial communication are:

Not Used

Modbus

Any selection other than “Not Used" requires installation of an option board for the selected communication type. If Modbus is selected, you will be asked to enter Baud rate, parity, stop bit and address.

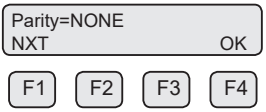
Baud rate (for Modbus selection only)



Press **NXT (F1)** to select the baud rate and press **OK (F4)**

Selections are: 19200
9600
4800
2400
1200

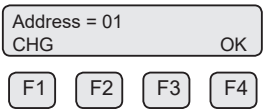
Parity (for Modbus selection only):



Press **NXT (F1)** to select the parity and press **OK (F4)**

Selections are: NONE
ODD
EVEN

Address (for Modbus selection only)



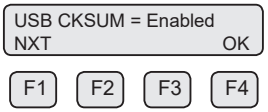
Press **CHG (F1)** to change the Modbus address and then press **OK (F4).**

To avoid conflicts on the Modbus this must be a unique address

Enabling/Disabling USB Serial communication checksum

The USB serial communication checksum may be enabled or disabled using the display keypad.

Disabling the communication checksum is sometimes useful in order to use a simple serial communication program such as HyperTerminal to communicate with the meter.

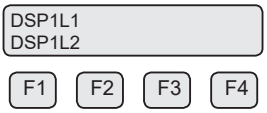


Press **NXT (F1)** to enable or disable the USB checksum and press **OK (F4).**

Display Setup

There are four display screens that you can cycle through in normal operating mode. Two of the four display screens are fixed and cannot be changed (displays #3 and 4). The other two screens are programmable to show the information that you prefer and are discussed in this section.

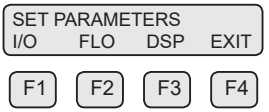
Display #1

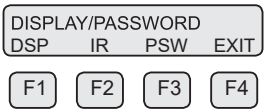


Display #2

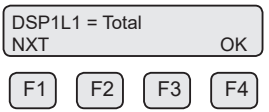
Selections are:	DSP1L1	Display 1, Line 1
	DSP1L2	Display 1, Line 2
	DSP2L1	Display 2, Line 1
	DSP2L2	Display 2, Line 2

To Program Display Screens #1 and 2
From the base programming menu press **DSP (F3)** to select the display menu:





Press **DSP (F1)** key. The display will show:

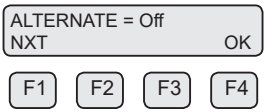


These are the selections for the display #1 line #1:

Flo rate	Flow rate
Total	Total mass
Elps	Elapsed time
Temp	Temperature
Alarm	Error codes

When the selection is correct, press **OK (F4)** to accept. The display will then go through the same process for all 4 lines of the 2 programmable displays (DSP1L1, DSP1L2, DSP2L1 and DSP2L2).

After the last line of display 2 is accepted, the display will show the following menu:



This menu allows you to alternate between menu display 1 and 2 every few seconds.

Selections are: On
Off

Press **OK (F4)** to accept selection.

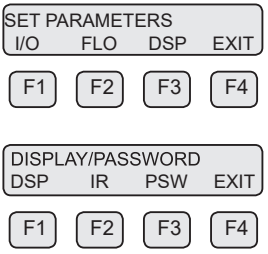
Press **EXIT (F4)** repeatedly until “Normal Mode" is seen briefly to exit the programming mode.

Password
There are two user level passwords, only **Level 1** is programmable and gives access to all the normal settings.

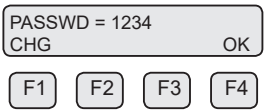
The second password is used to allow access to calibration factors and should normally never be changed unless advised by the Spirax Sarco Technial Support, or to set a new password in the event that the user forgets the **Level 1** password.

Default **Level 1** password is “1234", and **Level 2** password is “9111". The Level 1 programmable password can be disabled by setting it to “0".

From the base programming menu press **DSP (F3)** to select the display menu:



To Program the Password
Press **PSW (F2)** key to select password.



This screen displays the current Level 1 password.
Press **CHG (F1)** key to change the password and enter new value (see the start of this section for further details).

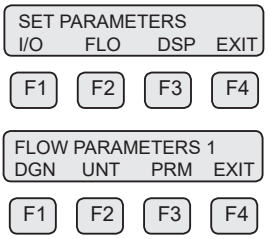
Press **OK (F4)** to accept new data and exit programming by pressing **EXIT (F4)** key repeatedly until out of the programming mode.

Note!
Password can be number or letter characters up to 4 digits.

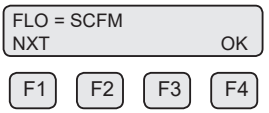
Units Settings
This menu is used to set the units for mass flow, temperature, pressure reference and the settings of reference temperature, reference pressure and density of gas when using Lbs/time or Kg/time.

These values will be set at Spirax Sarco, using the Application Data Sheet values. If the customer changes the application, these values can be changed to match the new application. Check with Spirax Sarco Technical Support before changing the application gas.

The unit setting is accessed from the base programming menu by pressing **FLO (F2):**



Press **UNT (F2)** for Unit selection:



Press **NXT (F1)** to change selection and **OK (F4)** to accept.

Selections for Flow unit are:	SCFM	LBS/H	SFPM	MT/H
	SCFH	LBS/M	MMSCFD (MMCFD)	NM3/D
	NM3/H	LBS/S	LBS/D	MMSCFM (MMCFM)
	NM3/M	NLPH	SLPM	SCFD
	KG/H	NLPM	NLPS	SM3/M
	KG/M	SMPS	MSCFD (MCFD)	SM3/D
	KG/S	NMPS	SM3/H	

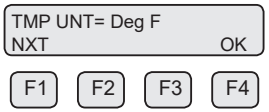
Note!
The totalizer must be reset immediately after changing the flow units setting.

Note!
The totalizer will roll over when reaching a certain value. The maximum value is dependent on the unit selected. For maximum total rollover values, please see "Totalizer Rollover".

Warning!

The MTI10/MTL10 re-calculates area, 4 and 20mA values, maximum flow for the frequency output and zero flow cutoff when changing flow units except for velocity units. When going to or from velocity units, the MTI10/ MTL10 will not recalculate these values and these values must be re-entered manually.

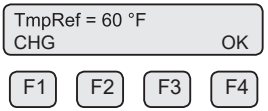
After pressing **OK (F4)** to accept the Flow unit the display will prompt for the temperature unit setting:



Press **NXT (F1)** to change selection and **OK (F4)** to accept.

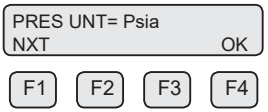
Selections for Temperature unit are: Deg C
Deg F

After pressing **OK (F4)** to accept the temperature unit setting, the display will prompt for temperature reference in selected unit.



Press **CHG (F1)** to change the reference and **OK (F4)** to accept.

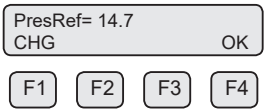
After pressing **OK (F4)** to accept the reference temperature, the display will prompt for the pressure unit selection:



Press **NXT (F1)** to select next entry and **OK (F4)** to accept.

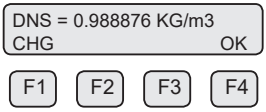
Selections are:	mmHG	Millimeters of mercury
	Psia	Pounds per square inch atmosphere
	bara	Bar atmosphere

After the pressure unit selection is made, the display will show a menu to enter the pressure reference:



Press **CHG (F1)** to change it and **OK (F4)** to accept.

After the pressure reference is accepted, the display will prompt for the gas density if LBS or KG was selected for flow unit:



Press CHG (F1) to change and OK (F4) to accept.

Note!

The density entry is only used when KG/time or LBS/time is selected for flow rate units. Density conditions are referenced to 0 C° at 760 mmHg.

Flow Parameters

This is the menu used to set various flow parameter values.

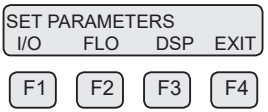
They are: Flow cutoff

Pipe area

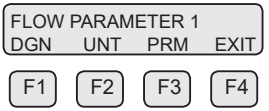
Filter

High and low alarm for flow and temperature

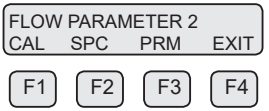
Accessing the Flow Parameters



The menu is accessed from the base programming menu by pressing FLO (F2):



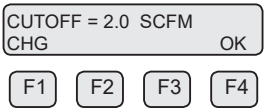
Then press **PRM (F3):**



Note!

The CAL and SPC function key will only appear and be accessible from a Level 2 password. Then press **PRM (F3).**

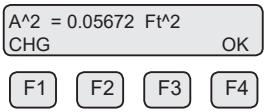
Flow Cutoff



Enter the value for the percent low flow cutoff and then press **OK (F4).**

When the flow rate falls below the zero flow cutoff, the flowmeter will display a flow value of zero.

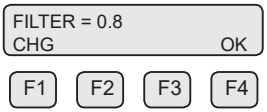
Pipe Area



Enter the pipe area in **square meters** or square feet and then press **OK (F4).**

Use square meter for metric flow unit selection and square feet for English flow unit selection.

Filter



The filter value is also referred to as a dampening factor and is used to quiet the readings. The filter value is an exponential filter that dampens the noise and is used as follows:

Flow Value = (FA * new value) + (FB * average)

Where FA = filter value, FA + FB is equal to 1.0.

A lower filter value will increase dampening of the flow rate and smooth the reading. A lower filter value will also slow the meter's response.

For example, if we enter a filter of 0.8, the weight ratio for new average is:

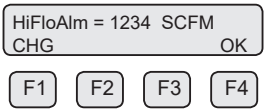
New average = (80% new sample) + (20% last average)

Filter range is 0.01 to 1.0, 0.01 being a high filter value and 1.0 = no filter.

Enter the filter value and then press **OK (F4).**

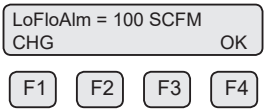
Filter	Response (Sec.) 65% of Target
0.09	0.10
0.8	0.15
0.7	0.20
0.6	0.25
0.5	0.30
0.4	0.35
0.3	0.40
0.2	0.60
0.1	1.00
0.05	2.00
0.03	3.00
0.01	10.3

High and Low Alarm Limits for Flow and Temperature



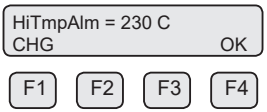
This is the upper flow limit alarm value that can be associated with a discrete output. An alarm code is generated when the flow value exceeds this limit. If no checking is needed, this value should be set to zero.

Press **OK (F4)** to accept the value.



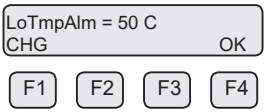
This is the lower flow limit alarm value that can be associated with a discrete output. An alarm code is generated when the flow value is below this limit. If no checking is needed, this value should be set to zero.

Press **OK (F4)** to accept the value.



This is the upper temperature limit alarm value that can be associated with a discrete output. An alarm code is generated when the value exceeds this limit. If no check is needed, this value should be set to zero.

Press **OK (F4)** to accept the value.



This is the lower temperature limit alarm value that can be associated with a discrete output. An alarm code is generated when the temperature value is below this limit. If no checking is needed, this value should be set to zero.

Press **OK (F4)** to accept the value.

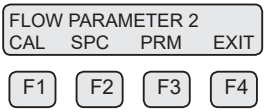
Note!

If the programming menu was entered with a Level 2 password, then more menus will be shown that deal with factory set parameters that should not be changed.

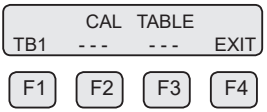
Calibration Parameters
This menu allows changing the factory calibrated setting of the flowmeter and is accessible with a Level 2 password.

Calibration parameter values are set for temperature and pressure at 0 degree C and 760 mmHg.

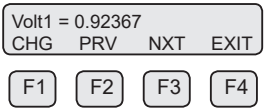
Note!
These settings should normally never be changed except by Spirax Sarco personnel at the factory. This menu is entered from the base menu and pressing FLO, PRM and CAL.



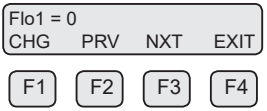
Press **CAL (F1)** then the display will show:



Press **TB1 (F1)** then the display will show:



Press **NXT (F3)** then the display will show:



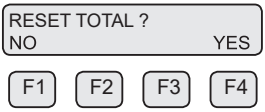
Use the **CHG (F1)** key to change the entry, **PRV (F2)** to move to the previous entry, **NXT (F3)** to move to the next entry and **EXIT (F4)** to return.

Pressing the **NXT (F3)** key will show the data point voltage and then mass velocity and then go to the next data point. The number after Volt (i.e., Volt1) or Flo (i.e., Flo1) indicated the data point number.

The calibration table can hold up to 20 data pair points.

Each data point has a voltage and mass velocity associated with it.

Reset Total and Elapsed Time
The resetting of the totalizer and elapsed time is accomplished by pressing the F3 and F4 keys at the same time in the normal running mode.



Press **YES (F4)** to reset total and **NO (F1)** to cancel.

Note!
This feature is not available on non-resettable units.

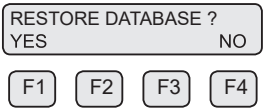
Note!
A power failure or resetting the total will cause the Contract Time to change. Data Logger with a Real Time Clock (RTC) option should be used to avoid this.

Totalizer Rollover
The MTI10 and MTL10 has an automatic roll-over function. The unit will begin roll-over as follows:

Most flow units:	99,999,999,999
MSCFD:	999,999,999
MMSCFM:	9,999,999
MMSCFD:	999,999

Restore Database
Restoring the original factory settings is accomplished from the “Flow Parameter 2" menu by entering a Level 2 password “9111" and pressing the **SPC key (F2).**

Upon pressing **OK (F4)**, an option to restore the database will follow:

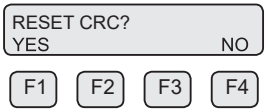


Press **YES (F1) ONLY** if you want to restore your database to the initial factory setting that the meter was shipped with. All current user-entered settings will be overwritten.

The green LP1 LED will flash at a faster pace until the recall is performed.

The "RESET CRC" screen will follow "RESTORE DATABASE".

Reset CRC
If the NVRAM CRC check fails (Error Code 36), the programmed settings values will need to be verified and corrected before clearing the error. Call Spirax Sarco Technial Support if you need assistance.



Press **YES (F1) ONLY** if you want to reset the CRC and generate a new CRC value.

Simulation
This menu allows for the simulation of flow rate, temperature and flow input voltage. It should only be used for testing and demonstration purposes.

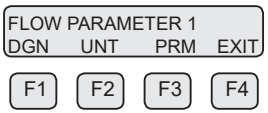
Make sure to return all of these simulation values to zero, before returning to the normal mode of operation.

Note!
Simulated values are only enabled when not set to zero.

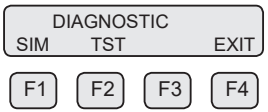
Caution

If the 4-20 mA and/or the pulse outputs are connected to controllers, set the controllers to “manual". This will ensure that the simulated signals do not cause false controller action.

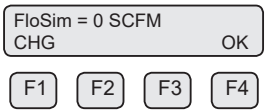
The menu is accessible from the main programming menu by pressing **FLO**, and **DGN (F1)**:



Pressing **DGN (F1)** will show:



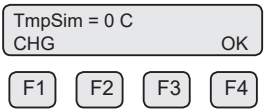
Pressing **SIM (F1)** will show:



Enter the value and then press **OK (F4).**

Note!

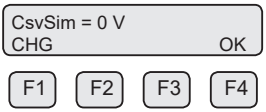
Enter zero to disable this feature.



Enter the value and then press **OK (F4).**

Note!

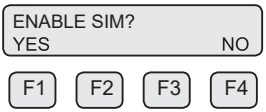
Enter zero to disable this feature.



Enter the value and then press **OK (F4).**

Note!

This value is used to simulate the Current Sense Voltage (CSV) and should be set to zero for normal mode.



Press **YES (F1)** to start the simulation mode, otherwise press **NO (F4).**

Upon pressing either key, the program will return to the FLOW PARAMETER 1 menu.

Note!

Simulation Mode will be cleared if the power is cycled.

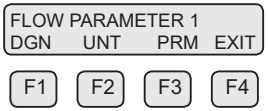
CAL-V™ - Calibration Validation Test 1

This menu allows the user to confirm the calibration of the MTI10/MTL10 by verifying the functionality of the sensor and sensor signal processing circuitry. During the CAL-V™ calibration validation test, the microprocessor adjusts current to the sensor elements and determines the resulting electrical characteristics.

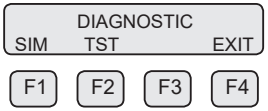
These site characteristics are compared with the data that was collected at the factory during the original meter calibration. Matching data within established tolerances confirms the meter is accurate. This test can be performed under no flow or normal flow conditions. The test takes up to four minutes to complete.

At the conclusion of the test, a Pass or Fail message will be displayed. Press F4 at the conclusion of the test to return to normal measuring mode or to terminate the test.

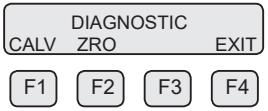
Press **FLO (F2)** from the main menu. The display will show:



Press **DGN (F1).** The display will show:



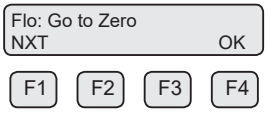
Press **TST (F2).** The display will show:



Press **CALV (F1)** to perform the CAL-V™ verification test.

Note!

The MTI10/MTL10 will stop measuring flow when performing this test. Press EXIT (F4) to exit if you do not wish to continue.

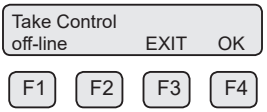


To select what the flow output will do during a CAL-V, choose from these options:

Go To Zero: Flow output will be zero during the test (i.e. 4mA)

Hold Value: Flow will hold last value during the test

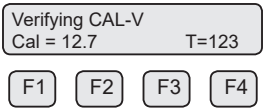
Select the option and press OK (F4).

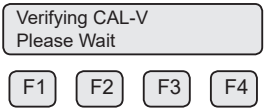


Warning!

If you are using a closed loop control, the system needs to be taken off-line during the test.

Press **OK (F4)** to start CAL-V™. CAL-V™ test screen:





This test will take up to 4 minutes (less time if there is flow) and will show the Cal value changing as the power to the sensor is adjusted. The T=xxx is a count down timer indicating how much time is left to finish the test. A “Please Wait" message will be flashing on and off on line 2 during this test.

Upon test completion, the final CAL-V™ value will be displayed along with a Pass/Fail message.

Caution

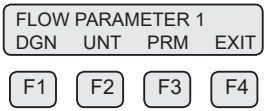
- The CAL-V™ test is valid for checking the calibration accuracy of flowmeters installed in the applications for which it was calibrated including the gas/gas mixture, calibration range and pipe size shown on the calibration certificate.
- For applications with temperature exceeding 250°F (121°C), CAL-V™ test results may vary.
- Periodic inspection for damage and cleaning of the sensor elements is required.

Zero CAL-CHECK® - Calibration Validation Test 2
The Zero CAL-CHECK® test is a companion test to CAL-V™.Unlike CAL-V™, which may be performed in the pipe and at process conditions, Zero CAL-CHECK® must be performed at zero flow to ensure a valid test result.

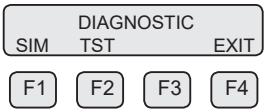
This test is used to confirm that the flowmeter still retains its original NIST-traceable calibration at zero flow and that the sensor is free of film or residue that may affect readings. The test takes less than 5 minutes to complete. At the conclusion of the test, a Pass or Fail message will be displayed. Press F4 at the conclusion of the test to return to normal measuring mode or to terminate the test.

See Calibration Validation User's Guide for more details.

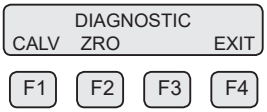
Press **FLO (F2)** from the main menu. The display will show:



Press **DGN (F1).** The display will show:



Press **TST (F2).** The display will show:



Press **ZRO (F2)** to enter the Zero CAL-CHECK® menu.

If performing the test in the pipe, a "no flow" condition must be met. If performing out of the pipe, the meter must be removed and the sensor protected by the PVC sensor cover originally shipped with the meter from the factory.

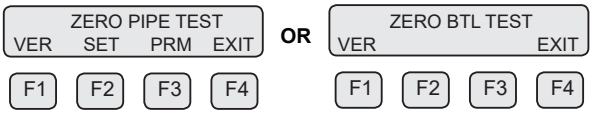
Note!

- The field baseline for a Zero CAL-CHECK® test performed in the pipe ("ZERO PIPE TEST") must be set before performing the test.
- See the Calibration Validation Chapter for details on performing all diagnostic tests.
- Please use the PVC sensor cover that was shipped with your meter perform Zero CAL-CHECK® tests out of pipe ("ZERO BTL TEST").

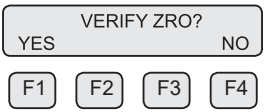
Press **PIP (F1)** to choose to perform the test in the pipe.

Press **BTL (F2)** to choose to perform the test out of the pipe.

The display will show:



Press VER (F1) key to verify the Zero CAL-CHECK®.

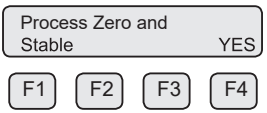


Press **YES (F1)** key to verify the Zero CAL-CHECK®.

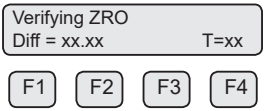
Warning!

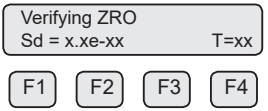
If you are doing a "Pipe" test, you must verify that there is a no flow condition before proceeding. If you are performing the test in a bottle, be sure to isolate the sensor in a bottle - any air movement (even from a fan) can result in a false "fail" result.

Once process is stable, press **YES (F4)** key to begin the Zero CAL-CHECK®.

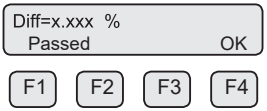


This test will take less than 5 minutes. The T=xx is a count down timer indicating how much time is left to finish the test.

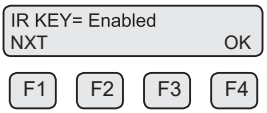




Upon test completion, the final percentage value will be displayed along with a Pass/Fail message.



Enabling/Disabling the Infrared Keypad (IR Buttons)
The IR buttons may be disabled from the menu to avoid being triggered by frost or snow on the window. This menu is accessed by pressing DSP (F3) from the main menu then IR (F2):



Press NXT (F1) key to enable or disable the IR buttons.

Note!

After selecting “Disable" and pressing OK (F4), the IR buttons will no longer operate. It will be necessary from now on to open the cover and operate the configuration panel using the mechanical push buttons. To return to the normal display mode, use mechanical buttons or wait for the programming mode timeout.

Calibrating the Infrared Keypad (IR Buttons)
The IR buttons are calibrated in the factory before shipment, but conditions in the field may alter the way the buttons read.

To allow the IR buttons to perform better, it may be necessary to calibrate the keys in the field.

Use your finger to activate the IR buttons using this process:

Note!
Your finger must activate each button approximately 0.1" to .5" from the surface of the glass.

Press the (**F1**) button until the display shows 'SET PARAMETER?' Then use YES (**F4**).

Use buttons (**F1**) (**F2**) and (**F3**) to enter "1111" (up/down and next).

Use buttons (**F1**) (**F2**) and (**F3**) to enter "0000" then press OK (**F4**).

Turn OFF power to the MTI10/MTL10.

Turn ON power to the MTI10/MTL10 while placing your finger on the (**F1**) IR key.

4.5 Menu tree

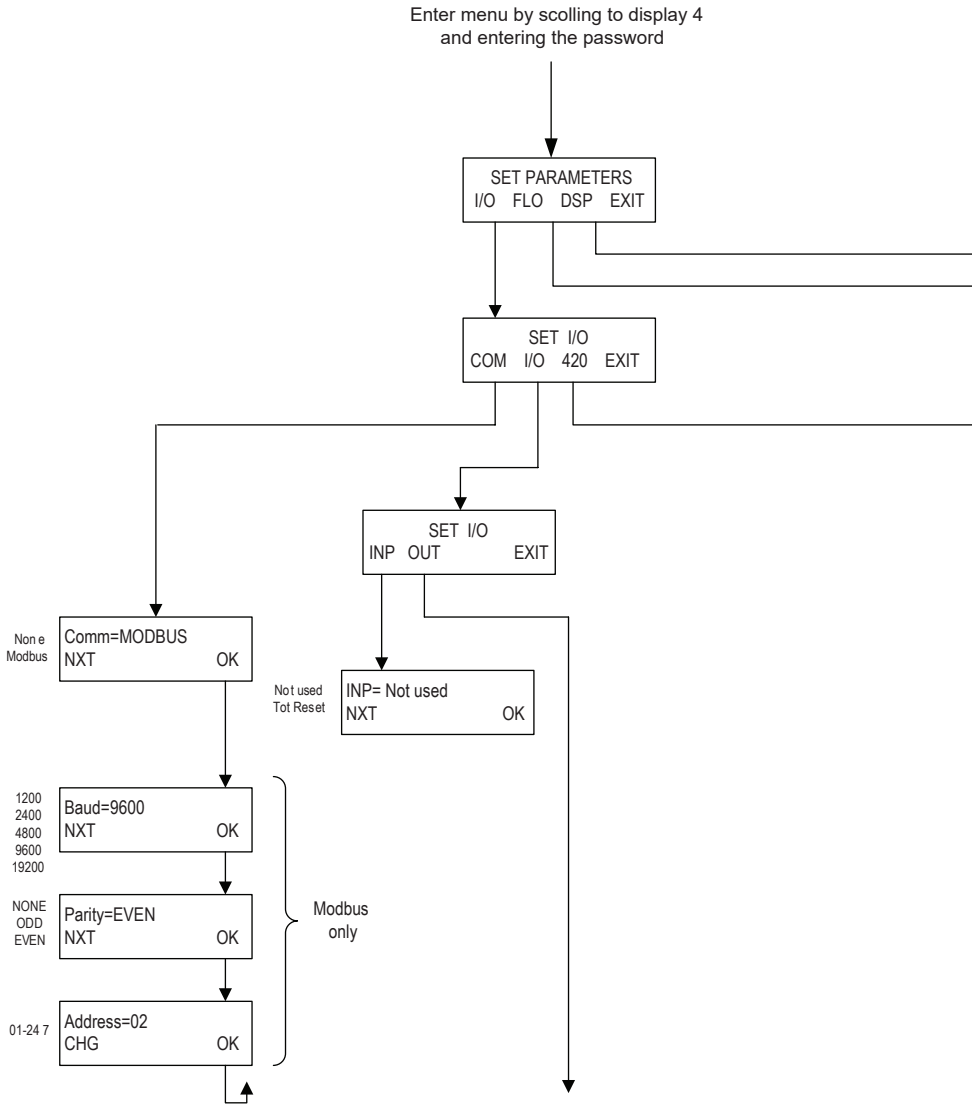
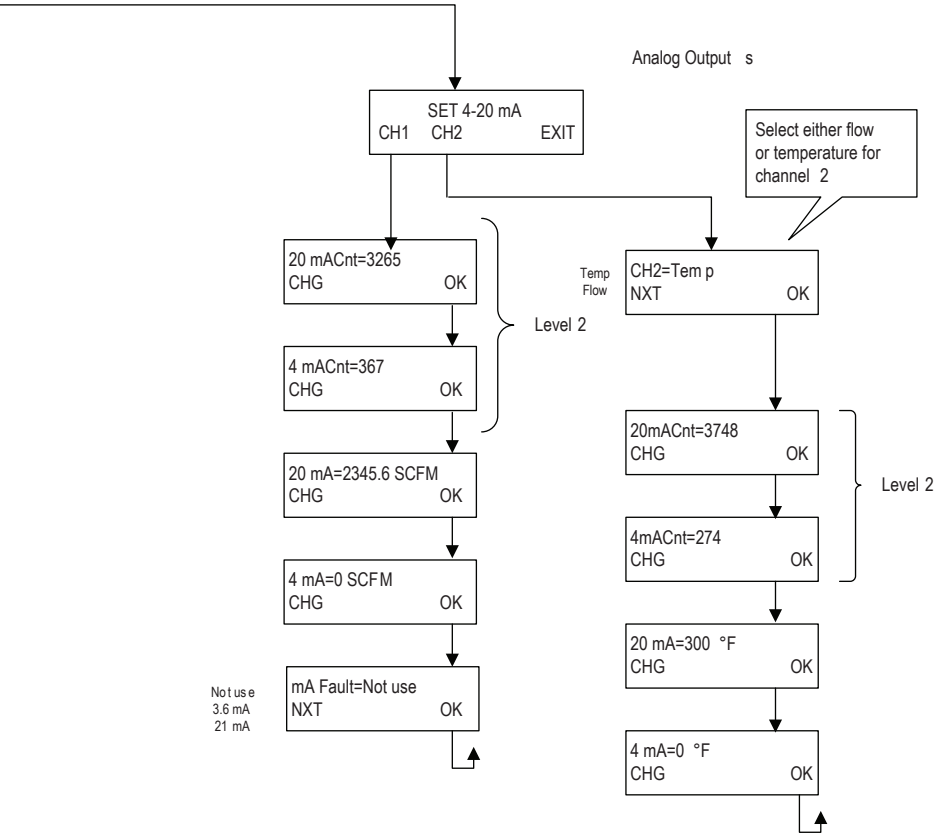


Fig. 25 - MTI10/MTL10 Menu Tree - Main Menu

Display Menu, p. 70

Flow Parameters 1 Menu, p. 66



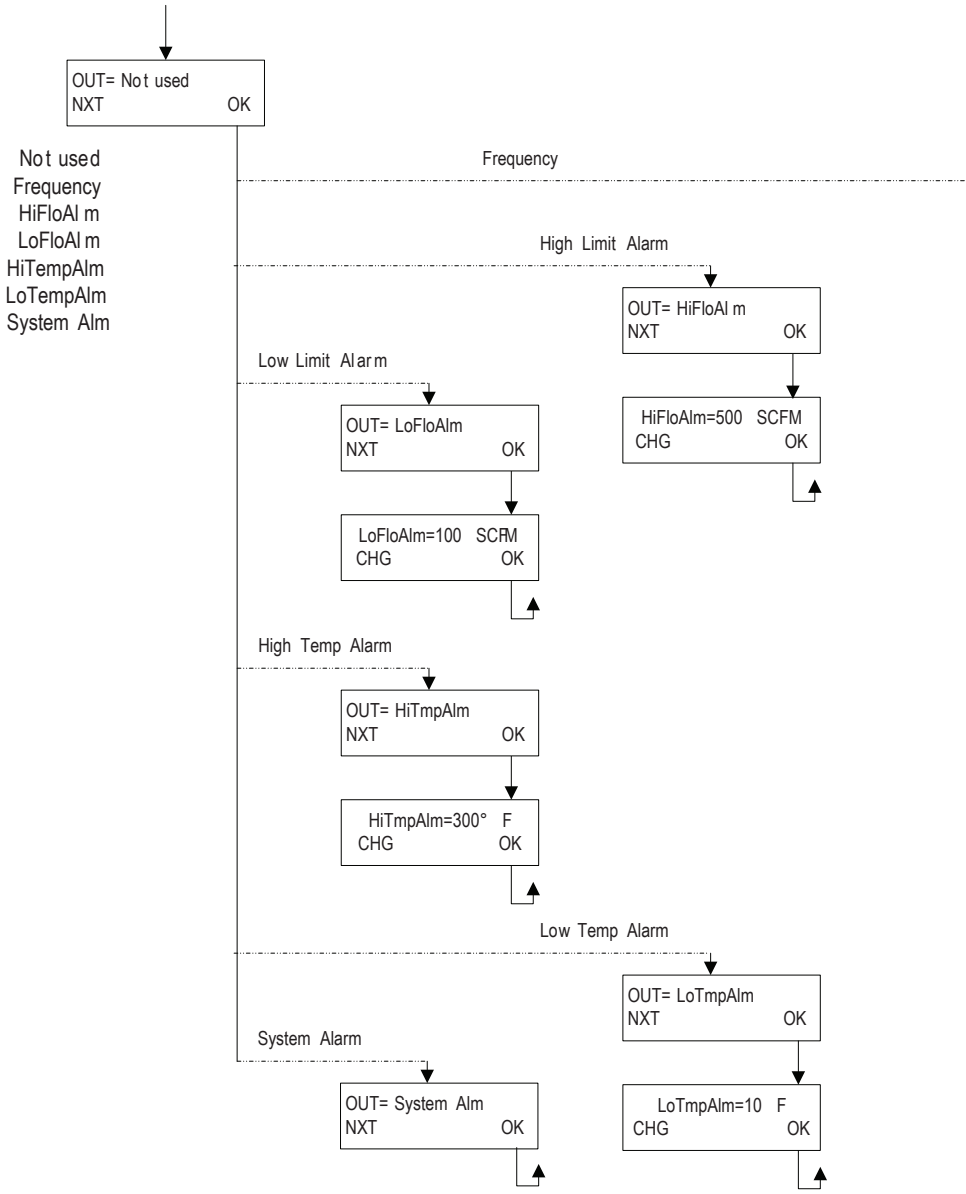
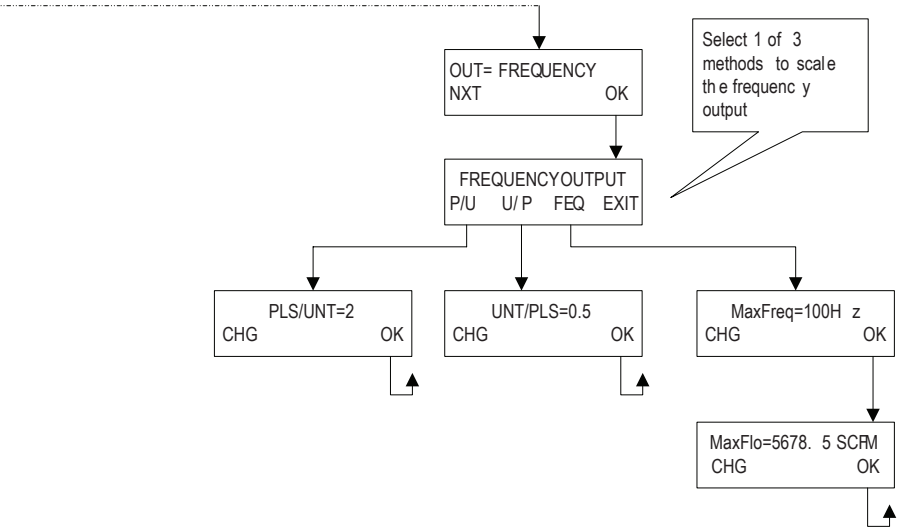


Fig. 26 - MTI10/MTL10 Menu Tree - Digital Output


OUT= FREQUENCY
NXT OK
Select 1 of 3 methods to scale the frequenc y output
FREQUENCY OUTPUT
P/U U/P FEQ EXIT
PLS/UNT=2
CHG OK
UNT/PLS=0.5
CHG OK
MaxFreq=100H z
CHG OK
MaxFlo=5678. 5 SCFM
CHG OK

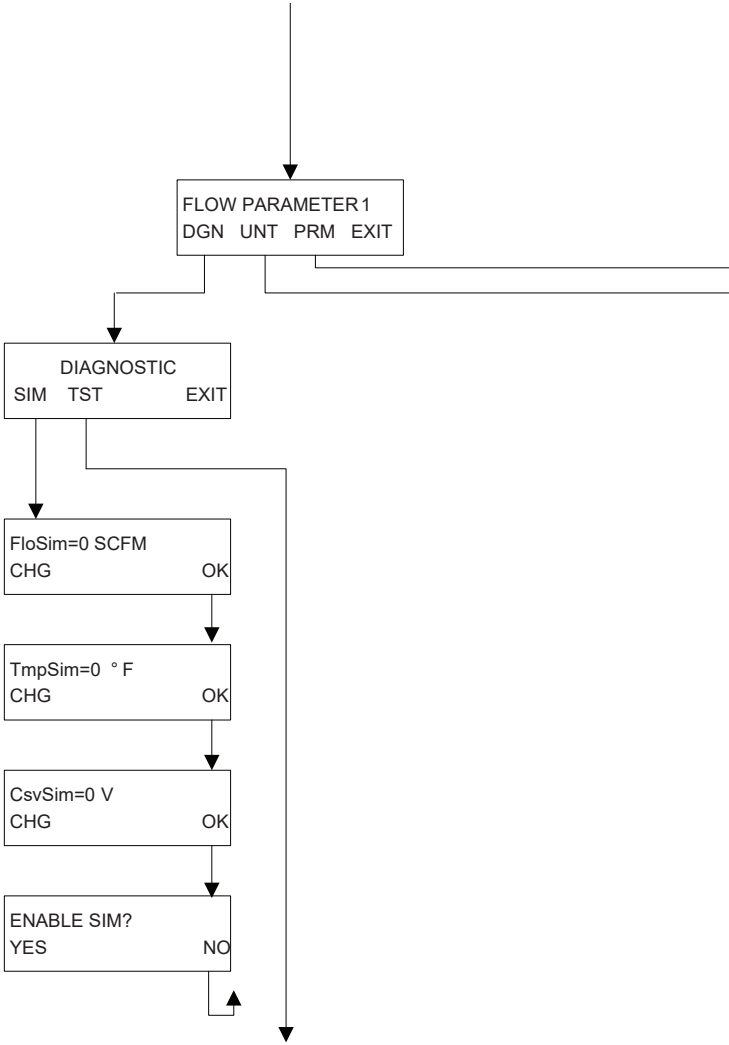
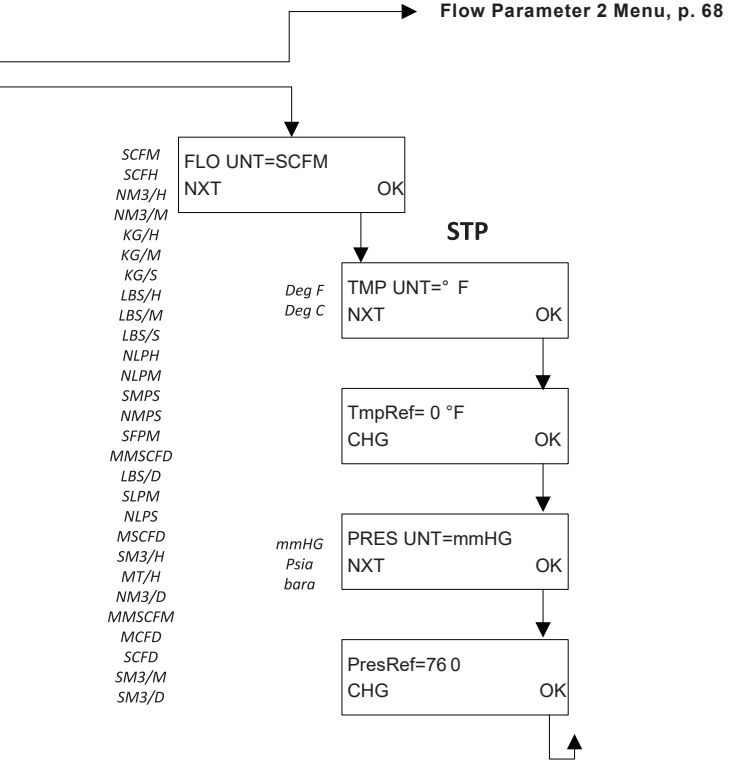


Fig. 27 - MTI10/MTL10 Menu Tree - Parameter Menu 1


Flow Parameter 2 Menu, p. 68
SCFM
SCFH
NM3/H
NM3/M
KG/H
KG/M
KG/S
LBS/H
LBS/M
LBS/S
NLPH
NLPM
SMPS
NMPS
SFPM
MMSCFD
LBS/D
SLPM
NLPS
MSCFD
SM3/H
MT/H
NM3/D
MMSCFM
MCFD
SCFD
SM3/M
SM3/D
FLO UNT=SCFM
NXT
OK
STP
Deg F
Deg C
TMP UNT=° F
NXT
OK
TmpRef= 0 °F
CHG
OK
mmHG
Psia
bara
PRES UNT=mmHG
NXT
OK
PresRef=76 0
CHG
OK

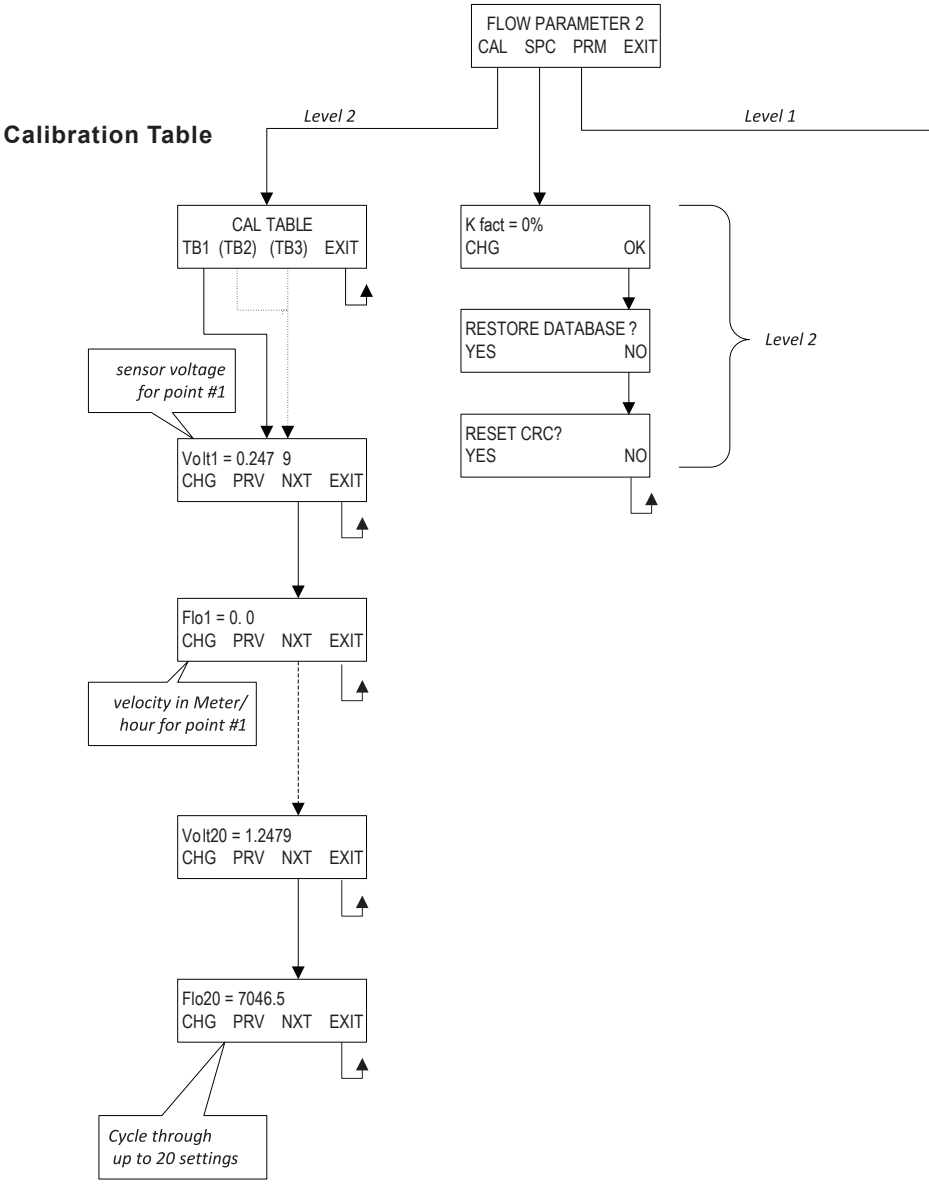
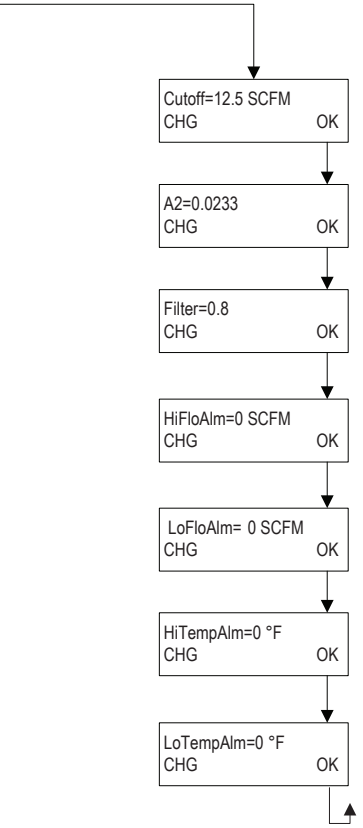


Fig. 28 - MTI10/MTL10 Menu Tree - Parameter Menu 2

Parameters



Flow cutoff in selected unit

Pipe Area im M2 or FT 2

Flow Exponential Filter

High Flow Alarm in selected unit

Low Flow Alarm in selected unit

High Temperature Alarm in selected unit

Low Temperature Alarm in selected unit

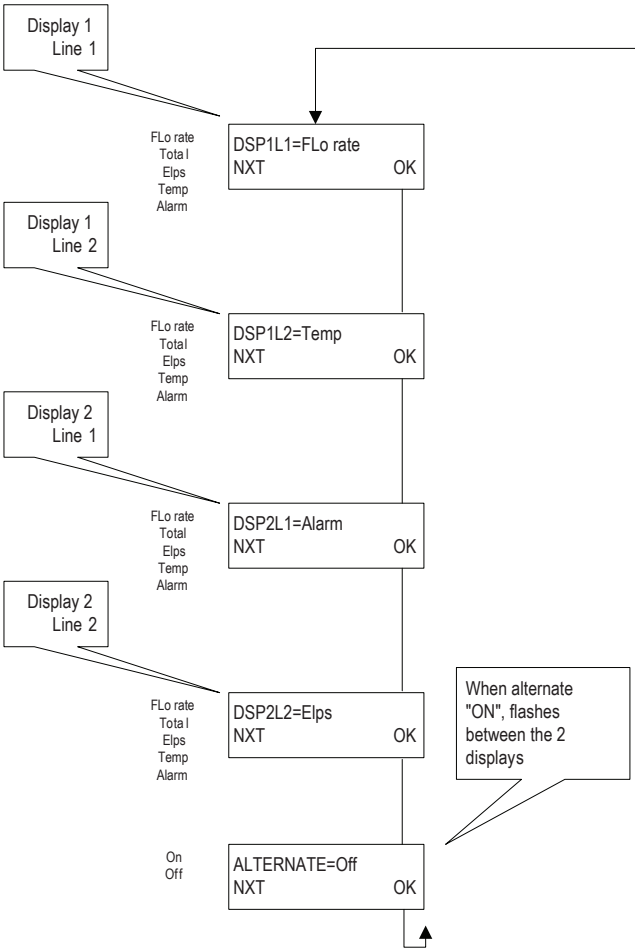
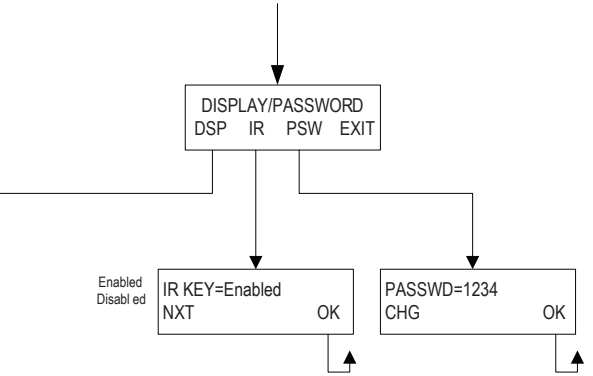


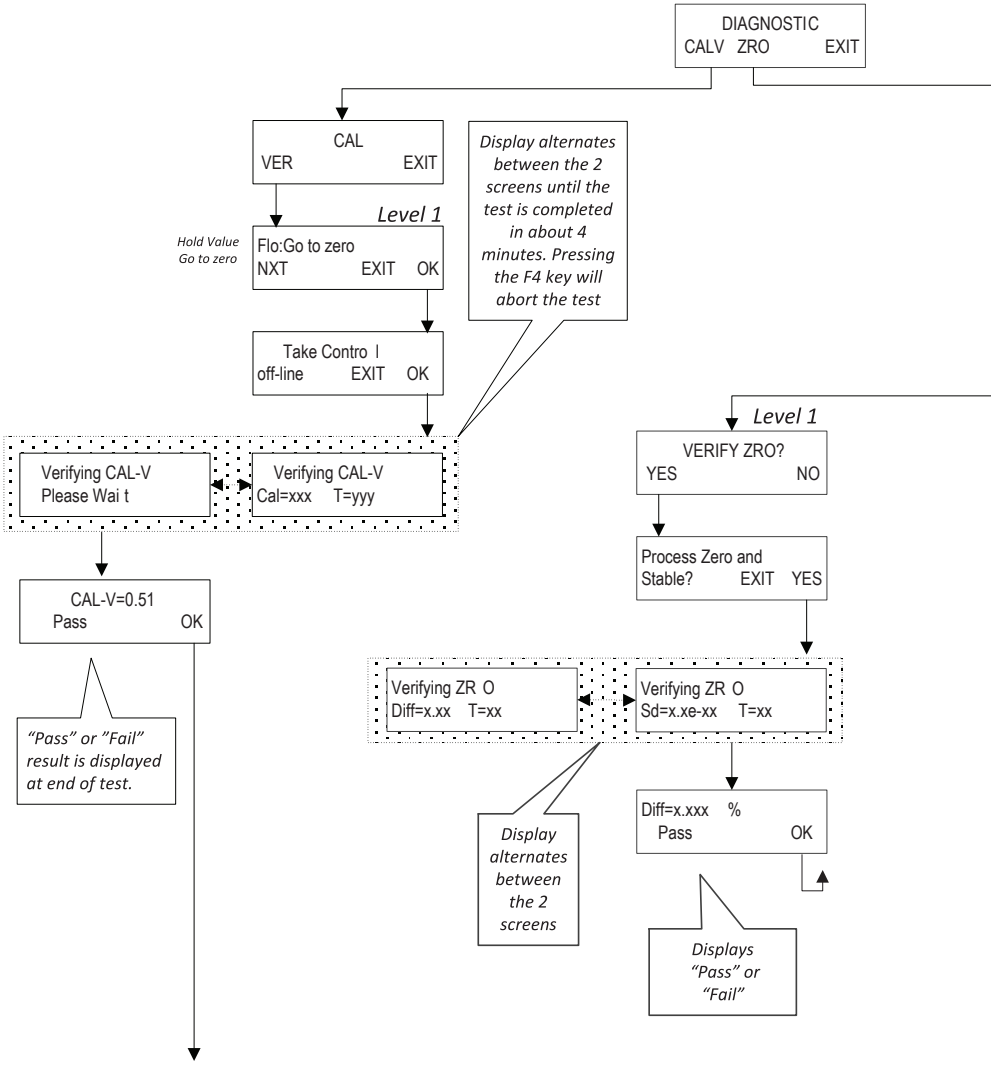
Fig. 29 - MTI10/MTL10 Menu Tree - Display Menu



Note!

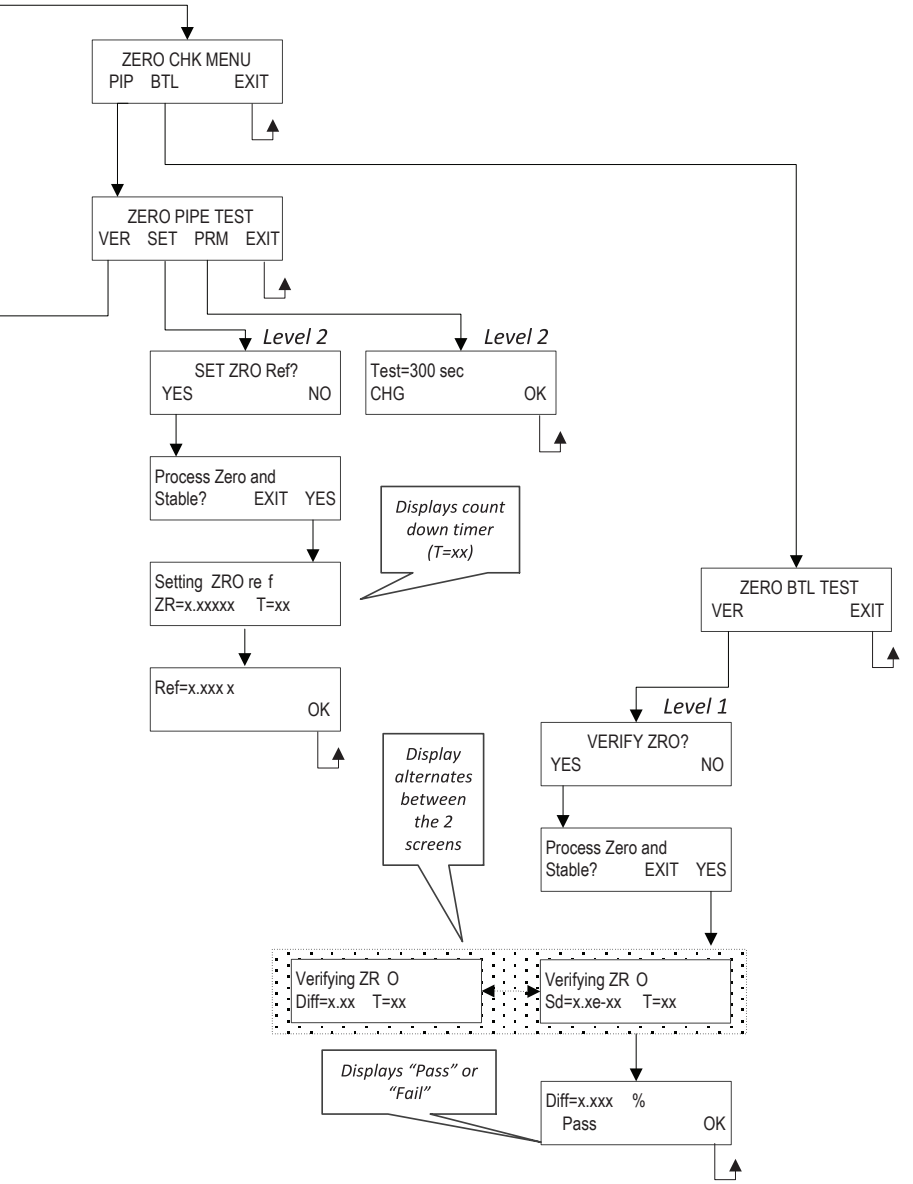
All readings updated every second

- Flo Rate = Flow rate of process gas
- Total = Total flow of process gas
- Elps = Elapsed time since reset of flow total
- Temp = Temperature of process gas
- Alarm = High/Low Flow Rate or Temperature Alarm



Flow Parameter 1 Menu, p. 66

Fig. 30 - MTI10/MTL10 Menu Tree - Diagnostic Tests Menu


ZERO CHK MENU
PIP BTL EXIT
ZERO PIPE TEST
VER SET PRM EXIT
Level 2
SET ZRO Ref?
YES NO
Level 2
Test=300 sec
CHG OK
Process Zero and
Stable? EXIT YES
Displays count down timer (T=xx)
Setting ZRO re f
ZR=x.xxxxx T=xx
Ref=x.xxx x
OK
ZERO BTL TEST
VER EXIT
Level 1
VERIFY ZRO?
YES NO
Process Zero and
Stable? EXIT YES
Display alternates between the 2 screens
Verifying ZR O
Diff=x.xx T=xx
Verifying ZR O
Sd=x.xe-xx T=xx
Displays "Pass" or "Fail"
Diff=x.xxx %
Pass OK

5. Calibration

The Spirax Sarco MTI10/MTL10 View software allows users to easily display data and configure the MTI10/ MTL10 to their specific application parameters. Then, log flow/temperature data to an Excel® file. The software can also activate the Spirax Sarco CAL-V™ and Zero CAL-CHECK® diagnostic functions.

This section contains the operation instructions for the Calibration Validation diagnostic tests: CAL-V™ and Zero CAL-CHECK®.

5.1 Calibration of the Spirax Sarco MTI10/MTL10 flowmeter

To ensure that all flowmeters meet specified performance parameters and provide accurate, repeatable measurements in the field, all calibrations are performed with NIST-traceable flow standards. Each meter is shipped from the factory with a Spirax Sarco Calibration Certificate.

5.2 Calibration Validation

Validating the calibration of your MTI10/MTL10 flowmeter is simple and easy. By performing two simple tests in the field, operators can verify that the meter is running accurately by testing the functionality of the sensor and its associated signal processing circuitry.

The first test, CAL-V™, tests the functionality of the sensor and its associated signal processing circuitry and can be done in the pipe and in normal processing conditions (see "CAL-V™ Calibration Validation Test"). The second test, Zero CAL-CHECK®, ensures the repeatability and cleanliness of the sensor (see "Zero CAL-CHECK® Calibration Validation Test").

See Figure 5.1 on the following page to understand Calibration Validation with these two tests.

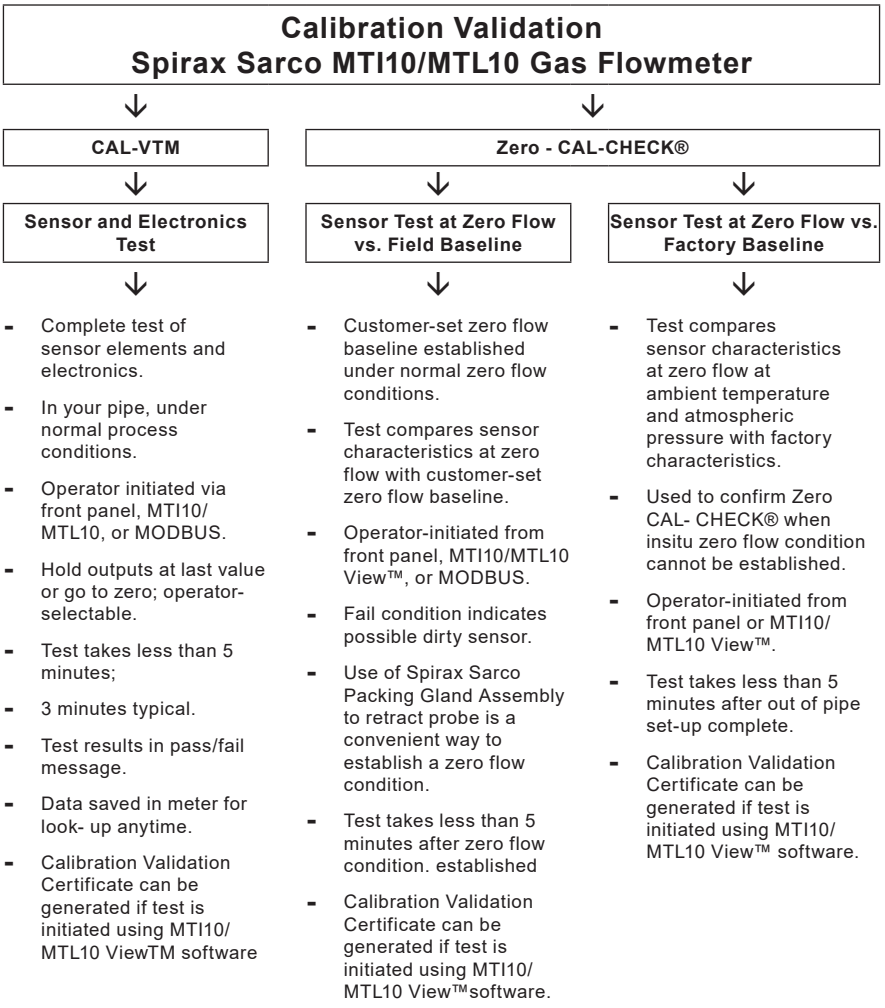


Fig. 31 - Total Calibration Validation

The figure above illustrates the Calibration Validation feature and a summary of the details for each of the two tests.

Spirax Sarco has developed Calibration Validation, using the CAL-V™ and Zero CAL-CHECK® tests to help our customers avoid sending the meter back for annual or biennial re-calibrations.

Using Calibration Validation allows our customers to validate the accuracy and functionality of the meter in the field with a push of a button.

5.3 CAL-V™ Calibration Validation Test

This menu allows the user to confirm the calibration accuracy of the MTI10/MTL10 Flowmeter by verifying the functionality of the sensor and sensor signal processing circuitry. During the CAL-V™ calibration validation test, the microprocessor adjusts the current to the sensor elements and determines the resulting electrical characteristics. These site-determined characteristics are compared with the data that was collected at the factory during the original meter calibration. Matching data within established tolerances confirms the meter is accurate within published accuracy specifications.

This test can be performed under no flow or normal flow conditions. The test takes about 4 minutes to complete. At the conclusion of the test, a Pass or Fail message will be displayed.

Note!

If the CAL-V™ test is performed using the MTI10/MTL10 View™ Software, at the completion of the test, a CAL-V™ Certificate may be printed for a record of the test. This certificate will display the CAL-V™ values and a pass/fail result.

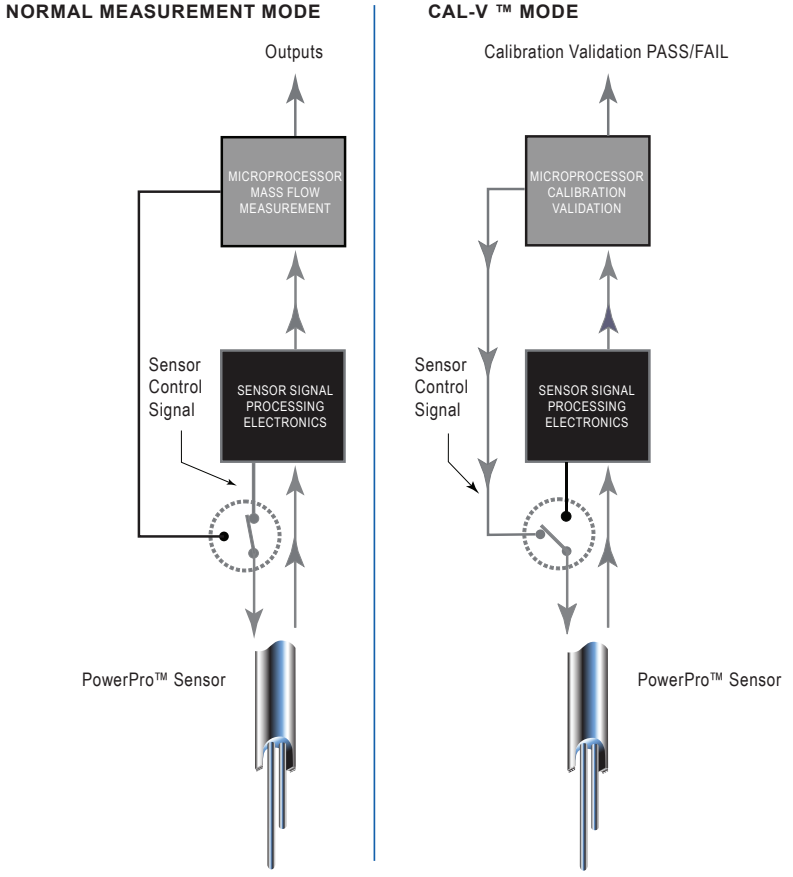


Fig. 32 - Normal Mode vs. CAL-V™ Mode

5.4 Zero CAL-CHECK® Calibration Validation Test

The Zero CAL-CHECK® test is used to ensure that the flow meter still retains its original NIST-traceable calibration at zero flow. If zero flow can be established, the sensor does not need to be removed and the procedure can be done in the pipe. Alternatively, a Packing Gland Assembly can be used to remove the sensor from the gas stream to create a “no flow" condition.

Note!

If the Zero CAL-CHECK® test is performed using the MTI10/MTL10 View™ Software, at the completion of the test, a Zero CAL-CHECK® Certificate may be printed for a record of the test. This certificate will display a pass/fail result

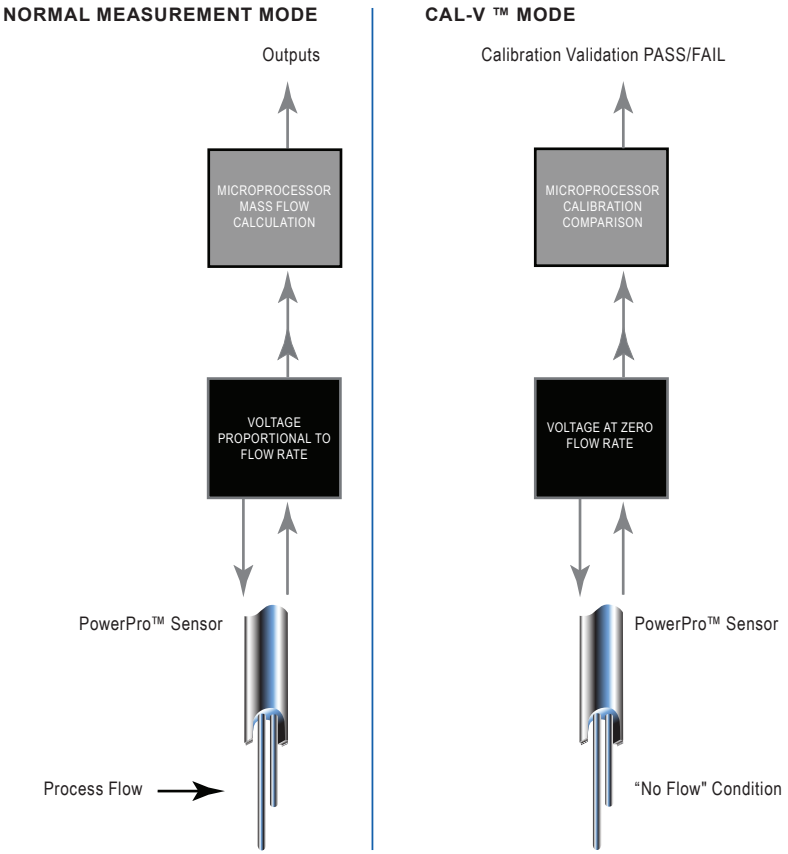


Fig. 33 - Normal Mode vs. Zero CAL-CHECK® Mode

5.5 Starting Up CAL-V™

CAL-V™ may be performed at any time after installation and at any flow rate, including zero flow. You do not need any extra equipment or paperwork to perform a CAL-V™ test. Refer to "Performing a CAL-V™ Calibration Validation Test" on p. 71 of this User's Guide to start CAL-V™.

5.6 Starting Up Zero CAL-CHECK®

There are a few ways that Zero CAL-CHECK® is different than CAL-V™:

- The Zero CAL-CHECK® test must be performed at a "no flow" condition (ie zero flow)
- If the Zero CAL-CHECK® test is to be performed in the pipe, the field baseline must be set before an actual test can be performed (see "Setting Field Baseline for In-Situ Zero CAL-CHECK® Tests" on p. 79).
- If the Zero CAL-CHECK® test is to be performed out of the pipe, the meter must be set upside-down (probe pointing up) and the PVC sensor protector that the meter was shipped with must be placed back over the sensor to achieve the factory baseline that the meter has been set with.

5.7 Techniques for Achieving Zero Flow - In the Pipe

In-situ (in the pipe) Zero CAL-CHECK® testing can be achieved in one of two common ways:

1. **Packing Gland Assembly**

   The first in-situ option is achieved through the use of the Packing Gland Assembly that may be ordered as an option for most inline- or insertion- type meters. The assembly allows the operator to retract and isolate the sensor from the process in order to conduct the Zero CAL-CHECK® test. This is particularly beneficial for applications in which the process is not easily stopped.

2. **Pipe Bypass / Valving-Off**

   The second in-situ option, if space allows, is to redirect the flow through a bypass pipe section or valve off the meter in order to isolate the meter's sensor in the place where it has been installed. While the flow is redirected, the Zero CAL-CHECK® test can be performed. Once the test is complete, the valves to the bypass may be closed and flow may be directed back to the meter's sensor where flow monitoring can continue as normal.

5.8 Achieving Zero Flow - Out of Pipe

If space limitations prevent in-situ testing at zero flow as listed above, then Out of Pipe testing must be performed. With this configuration, the meter must be removed from the process, the test performed, and then the meter returned to the process after testing has been completed.

Due to the high sensitivity of the PowerPro™ sensor, it is necessary to isolate the sensor once the meter has been removed from the pipe. Therefore, Spirax Sarco provides a sensor cover when the meter is shipped to the customer. An alternative to the sensor cover is to use a bottle or other closed container in order to isolate the sensor and achieve the "no flow" condition necessary to perform the Zero CAL-CHECK® test.

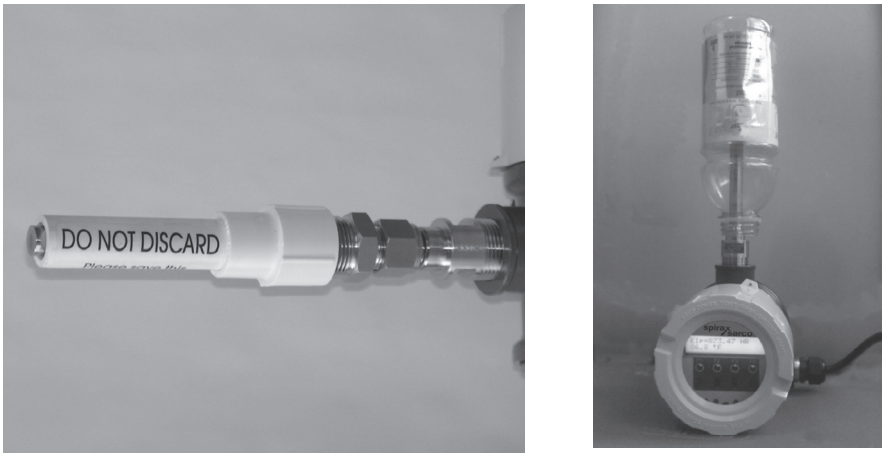


Fig. 34 - Factory-Supplied PVC Sensor Protector vs. Plastic Bottle

Note!

For best results:

1. Use the factory-supplied PVC sensor protector shipped with the meter (see Figure 34 above).
2. Place the meter upside-down on a flat, solid surface before starting the test.
3. Do not allow the meter to get jostled - make sure the meter is stable and the sensor completely isolated.

5.9 Setting Field Baseline for In-Situ Zero CAL-CHECK® tests

After calibration of every MTI10/MTL10 flowmeter, a lab technician sets the factory baseline for Zero CAL- CHECK® tests. If you are planning on removing the meter from the process to perform the test, you do not have to set the baseline; however, if you plan to perform the test in-situ (in the pipe) or using the Packing Gland Assembly, you must set the field baseline before performing the test.

5.10 Using the Packing Gland Assembly

The following are the instructions for using the Packing Gland Assembly to set the field baseline for - or performing - an in-situ Zero CAL-CHECK® test. If you are not using the Packing Gland Assembly, move ahead to "Starting the Field Baseline Set" on p. 83.

Note!

If you need information on the installation of the Packing Gland Assembly, refer to the Document 105440.

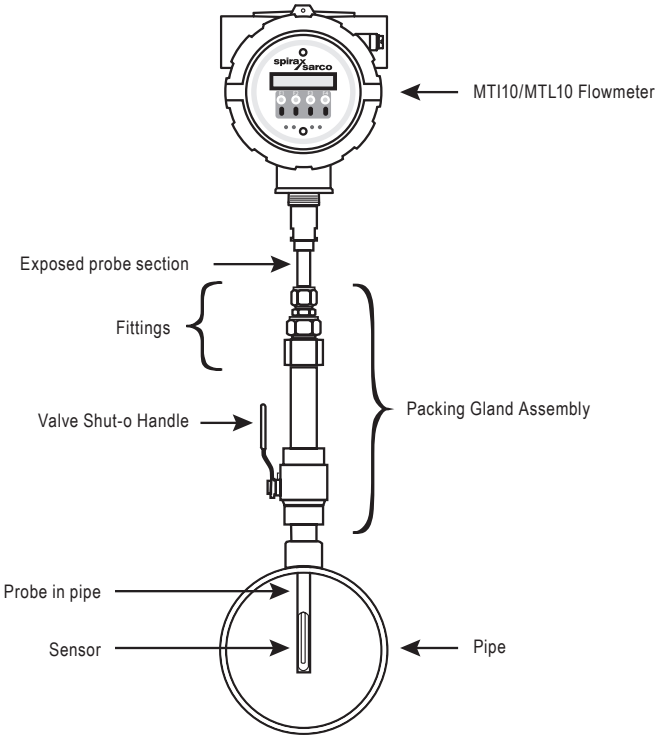


Fig. 35 - MTI10/MTL10 and Parts of the Packing Gland Assembly

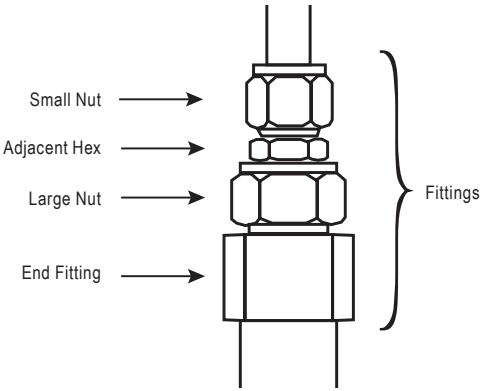


Fig. 36 - Close-Up: Fittings of the Packing Gland Assembly

In order to isolate the sensor, it must be retracted from the pipe. Loosen the small nut of the compression fitting using 7/8" and 13/16" wrenches. Once loosened, the probe will be able to slide upwards (see below).

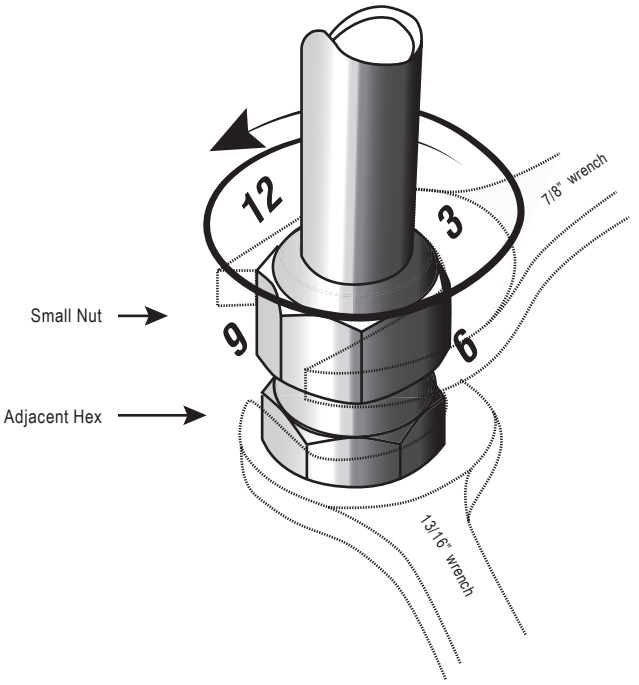


Fig. 37 - Loosening the Compression Fitting

With one hand supporting the meter, slide the probe up through the packing Gland Assembly until the internal stop makes contact. Close the Valve Shut-off handle by turning the lever 90˚clockwise to isolate the sensor within the chamber of the Packing Gland Assembly. Then slightly tighten the compression fitting to keep a seal in the chamber.

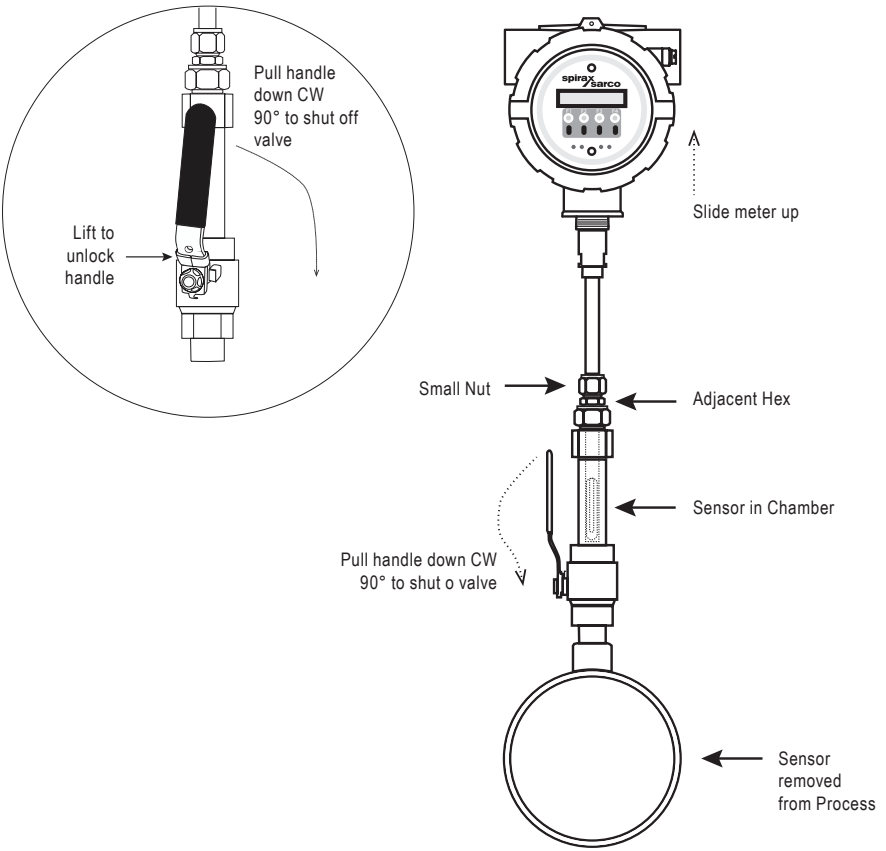


Fig. 38 - Isolating the Sensor in Packing Gland Assembly Chamber

Now that the sensor is isolated in the chamber of the Packing Gland Assembly, the MTI10/MTL10 flowmeter is ready to either perform the Zero CAL-CHECK® test or set the Field baseline for future tests.

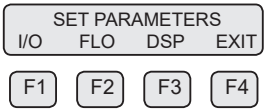
When the meter has completed the test, be sure to open the shut-off valve, slide the meter downward until the ferrule rests in the fittings, and tighten the small nut of the fittings in order to seal the probe in the stream again.

Check to be sure the meter has returned to normal operation

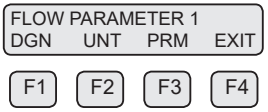
5.11 Starting the Field Baseline Set

After the meter has been installed and wired correctly (see the Wiring Instruction section of this manual), power on the meter.

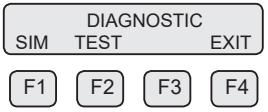
The meter should default to display #1. Press "F1" to program the meter. Press Yes (F1) to set Parameters and you will be prompted to enter the password. Use a Level 2 password (9111). The display will show:



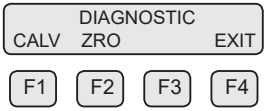
Press **FLO (F2)** to go to the Flow Parameter 1 Menu.



Press **DGN (F1)** to go to the Diagnostic Test Menu.

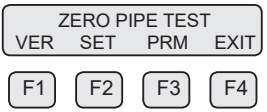


Press **TST (F2)** to get to the Diagnostic Test Sub-Menu.

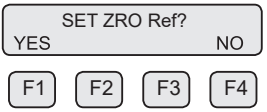


Choose **ZRO (F2)** for Zero CAL-CHECK®.

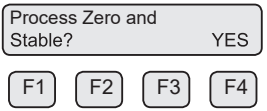
Choose **PIP (F1)** for in-situ Zero CAL-CHECK®.



To set the field baseline, choose **SET (F2).**



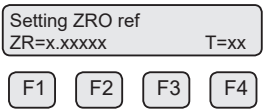
Choose **YES (F1)** to set the field baseline.



Note!

At this point, you must make sure that there is a no flow condition in the pipe (see "Techniques for Achieving Zero Flow - In the Pipe" on p. 78). Also be sure that the meter will be stable for the duration of the setting process.

If there is no flow and the meter is stable, press **YES (F4).** The display will show:



As the meter is setting the field baseline, the meter will display the reference value for the Zero baseline (ZR=xx.xxxx) and a countdown timer (T=xx) to approximate the time until the completion of the set.

Depending on the meter configuration, the set may take between 5-15 minutes to complete.

Note!

Do not interrupt the set by touching the meter or changing conditions in the pipe. At the conclusion of the set, the display will show:

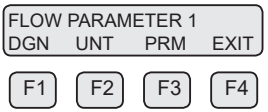
Press **OK (F4)** to return to the Zero CAL-CHECK® menu.

The meter may now perform Zero CAL-CHECK® tests at the Field Baseline at any time.

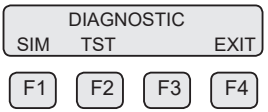
5.12 Performing the CAL-V™ Calibration Validation Test

This menu allows the user to confirm the calibration of the MTI10/MTL10 by verifying the functionality of the sensor and sensor signal processing circuitry. During the CAL-V™ calibration validation test, the microprocessor adjusts current to the sensor elements and determines the resulting electrical characteristics. These site characteristics are compared with the data that was collected at the factory during the original meter calibration. Matching data within established tolerances confirms the meter is accurate. This test can be performed under no flow or normal flow conditions. The test takes up to four minutes to complete. At the
conclusion of the test, a Pass or Fail message will be displayed. Press F4 at the conclusion of the test to return to normal measuring mode or to terminate the test.

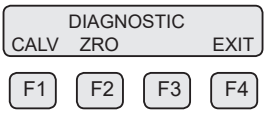
Press **FLO (F2)** from the main menu. The display will show:



Press **DGN (F1).** The display will show:



Press **TST (F2).** The display will show:



Press **CALV (F1)** to perform the CAL-V™ verification test.

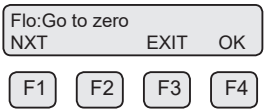
Note!

The MTI10/MTL10 will stop measuring flow when performing this test. Press EXIT (F4) to exit if you do not wish to continue.

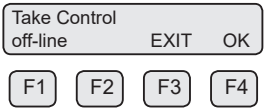
To select what the flow output will do during CAL-V™, choose from these options:

Go To Zero: Flow output will be zero during the test (ie 4mA)

Hold Value: Flow will hold last value during the test



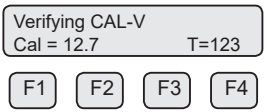
Select the option using **NXT (F1)** and then press **OK (F4).**



Warning!

If you are using closed loop control, the system needs to be taken off-line during the test.

Press OK (F4) to start CAL-V™. CAL-V™ test screen:

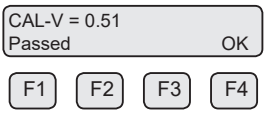


This test will take up to 4 minutes (less time if there is flow) and will show the Cal value changing as the power to the sensor is adjusted.

Caution

- The CAL-V™ test is valid for checking the calibration accuracy of flow meters installed in the applications for which it was calibrated including the gas/gas mixture, calibration range and pipe size shown on the calibration certificate.
- For applications with temperature exceeding 250°F (121°C), CAL-V™ test results may vary.
- Periodic inspection for damage and cleaning of the sensor elements is required.

The T=xxx is a count down timer indicating how much time is left to finish the test. A “Please Wait" message will be flashing on and off on line 2 during this test.

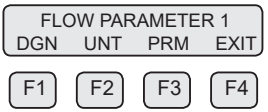


Upon test completion, the final CAL-V™ value will be displayed along with a Pass/Fail message.

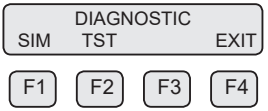
5.13 Performing the Zero CAL-CHECK® Calibration Validation Test

The Zero CAL-CHECK® test is a companion test to CAL-V™. Unlike CAL-V™, which may be performed in the pipe and at process conditions, Zero CAL-CHECK® must be performed at zero flow to ensure a valid test result. This test is used to confirm that the flow meter still retains its original NIST-traceable calibration at zero flow and that the sensor is free of film or residue tat may affect readings. The test takes less than 5 minutes to complete. At the conclusion of the test, a Pass or Fail message will be displayed. Press F4 at the conclusion of the test to return to normal measuring mode or to terminate the test.

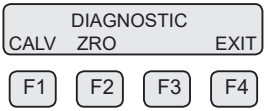
Press **FLO (F2)** from the main menu. The display will show:



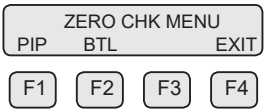
Press **DGN (F1).** The display will show:



Press **TST (F2).** The display will show:

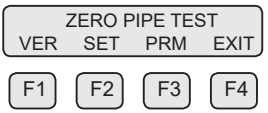


Press **ZRO (F2)** to choose the type of Zero CAL-CHECK® test. If performing the test in the pipe, a "no flow" condition must be created. If performing out of the pipe, the meter must be removed and the sensor protected by a bottle



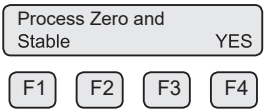
5.14 Performing the Zero CAL-CHECK® - In the Pipe

Press **PIP (F1)** to choose to perform the test in the pipe. The display will show:



Press **VER (F1)** key to verify the Zero CAL-CHECK®.

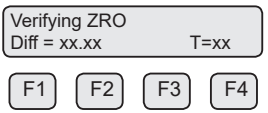
Press **YES (F1)** key to verify the Zero CAL-CHECK®.



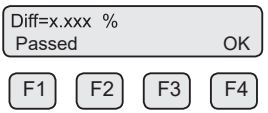
Warning!

If you are using "Pipe" test, you must verify that there is a no flow condition before proceeding. If you are performing the test in a bottle, be sure to isolate the sensor in a bottle - any air movement (even from a fan) can result in a false "fail" result.

Once process is stable, press **YES (F4)** key to begin the Zero CAL-CHECK®.



This test will take less than 5 minutes. The T=xx is a count down timer indicating how much time is left to finish the test.



Upon test completion, the final percentage value will be displayed along with a Pass/Fail message.

5.15 Performing the Zero CAL-CHECK® - Out of Pipe

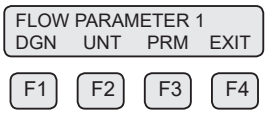
Remove the meter from the pipe and isolate in an area that will allow the test to go undisturbed (see note below).

Press **FLO (F2)** from the main menu. The display will show:

Note!

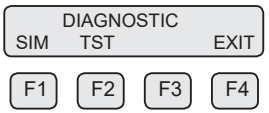
For best results:

1. Use the factory-supplied PVC sensor protector shipped with the meter (see Figure 34).
2. Place the meter upside-down on a flat, solid surface before starting the test.
3. Do not allow the meter to get jostled - make sure the meter is stable and the sensor completely isolated.

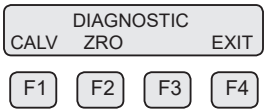


Press **DGN (F1).**

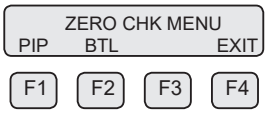
The display will show:



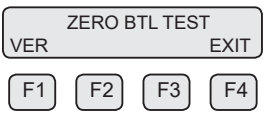
Press **TST (F2).** The display will show:



Press **ZRO (F2)** to choose the type of Zero CAL-CHECK® test.

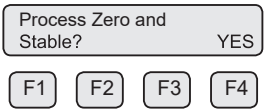


Press **BTL (F2)** to choose to perform the test out of the pipe. The display will show:



Press **VER (F1)** key to verify the Zero CAL-CHECK®.

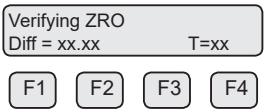
Press **YES (F1)** key to verify the Zero CAL-CHECK®.



Warning!

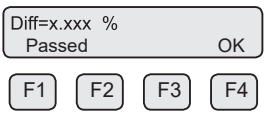
You must verify that there is a no flow condition before proceeding. Be sure to isolate the sensor completely - any air movement (even from a fan) can result in a false "Fail" result.

Once process is stable, press **YES (F4)** key to begin the Zero CAL-CHECK®.



This test will take less than 5 minutes.

The T=xx is a count down timer indicating how much time is left to finish the test.



Upon test completion, the final value will be displayed along with a Pass/Fail message.

5.16 Troubleshooting CAL-V™

If the MTI10/MTL10 Flowmeter fails a CAL-V™ Calibration Validation test, the meter must be returned to the factory for evaluation. See the "Returning Your Meter" section in the Appedix of this Installation and Instruction Guide or contact Spirax Sarco Applications at 1-800-883-4411 for information on how to return the meter.

5.17 Troubleshooting Zero CAL-CHECK®

If the MTI10/MTL10 Flowmeter fails a Zero CAL-CHECK® Calibration Validation test, there are a few reasons that could be the cause:

1. **The sensor may be dirty**
   - Try cleaning the sensor and try the test again
   - If the meter fails again, move to #2

2. **The sensor may not be properly covered/isolated**
   - Out of Pipe:
   - Wind currents (fans in room included) could be affecting the sensor
   - For best results, be sure to use the factory-supplied PVC sensor cover (see Figure 34)
   - If the factory-supplied PVC sensor cover is unavailable, use a clean dry plastic beverage bottle
   - In Pipe:
   - If using the Packing Gland Assembly, be sure that the Shut-off valve has been closed
   - Make sure that there is a "no flow" or zero flow condition on the meter's sensor
   - Try the test again
   - If the meter fails again, move to #3

3. **The meter may not have stabilized properly**
   - Make sure the meter is not being affected by vibrations or other movement
   - Allow the meter to stabilize without being moved or touched for 15 minutes
   - Try the test again
   - If the meter fails again, contact Spirax Sarco Applications at 1-800-883-4411

6. MODBUS

6.1 Scope

This section describes the Modbus RTU (RS485) implementation for the Spirax Sarco MTI10/MTL10 Mass Flow Meter based on the Modicon Modbus Protocol (PI-MBUS-300 Rev. J).

Modbus RTU (RS485) is an application layer messaging protocol that provides client/server communications between devices. Modbus is a request/reply protocol and offers services specified by function codes.

The size of the Modbus Protocol Data Unit is limited by the size constraint inherited from the first Modbus implementation on Serial Line network (max. RS485 Application Data Unit = 256 bytes). Therefore, Modbus PDU for serial line communication = 256 – Server address (1 byte) – CRC (2 bytes) = 253 bytes.
RS-485 ADU = 253 + Server address (1 byte) + CRC (2 bytes) = 256 bytes. For more information on Modbus go to the web site http://www.modbus.org/

6.1.1 Command Request:

<Meter Address> <Function code> <Register start address high> <Register start address low>
<Register count high> <Register count low> <CRC high> <CRC low>

6.1.2 Command Response:

<Meter Address> <Function code> <Data byte count> <Data register high> <Data register low>…
<Data register high> <Data register low> <CRC high> <CRC low>

Note!

The data shown in brackets < > represent one byte of data.

6.1.3 MTI10/MTL10 Commands supported

The MTI10/MTL10 supports the following commands:

1. Function 03: Read holding registers.
2. Function 04: Read input register.
3. Function 06: Preset single register.

6.2 Read Holding Registers (command 03)

This command reads the basic variables from the MTI10/MTL10 and has the following format:
Command Request:
<Meter Address> <Function code=03> <Register start address high> <Register start address low>
<Register count high> <Register count high> <CRC low> <CRC low>

6.2.1 Command Response:

<Meter Address> <Function code=03> <Byte count> <Data high> <Data low>…
<Data high> <Data low> <CRC high> <CRC low>

Table 2 - MTI10/MTL10 Modbus register assignments for command 0x03

Register Address	Modbus Address	Data type	Scaling	Comment
0x00	40001	Flow in selected units (low)	No	Mass flow in selected unit
0x01	40002	Flow in selected units (high)	No	
0x02	40003	Total (low)	No	Total in selected unit
0x03	40004	Total (High)	No	
0x04	40005	Temperature (low)	*10	Temperature in selected unit * 10
0x05	40006	Temperature (high)	*10	
0x06	40007	Elapsed time (low)	*10	Elapsed time in hours * 10
0x07	40008	Elapsed time (high)	*10	
0x08	40009	Velocity (Low)	No	Velocity in Nm/hr
0x09	40010	Velocity (high)	No	
0x0A	40011	Flow in selected units * 10	*10	Mass flow in selected unit * 10
0x0B	40012	Flow in selected units *100	*100	Mass flow in selected unit * 100
0x0C	40013	Total *100	*100	Total in selected unit * 100
0x0D	40014	Total2 (low, 2 gas curves only)	No	Total #2 for 2 gas curves
0x0E	40015	Total2 (high, 2 gas curves only)	No	Total #2 for 2 gas curves
0x0F	40016	Status	No	Status
0x10	40017	Status2	No	Status 2
0x11	40018	Spare/ Not used		
0x12	40019	Spare/ Not used		
0x13	40020	Flow in Eng Unit (float, upper 16 bits)	No	Mass flow in selected unit
0x14	40021	Flow in Eng Unit (float , lower 16 bits)	No	Mass flow in selected unit
0x15	40022	Total in Eng Unit (float, upper 16 bits)	No	Total in selected unit
0x16	40023	Total in Eng Unit (float, lower 16 bits)	No	Total in selected unit
0x17	40024	Total#2 for 2 gas curve (float, upper 16 bits)	No	Total in selected unit
0x18	40025	Total#2 for 2 gas curve (float, lower 16 bits)	No	Total in selected unit
0x19	40026	Temperature in selected units (float, upper 16 bits)	No	Temperature in selected unit
0x1A	40027	Temperature in selected units (float, lower 16 bits)	No	Temperature in selected unit

Register Address	Modbus Address	Data type	Scaling	Comment
0x1B	40028	Elapsed time in hours (float, upper 16 bits)	No	Elapsed time in hours
0x1C	40029	Elapsed time in hours (float, lower 16 bits)	No	Elapsed time in hours
0x1D	40030	Velocity in selected units (float, upper 16 bits)	No	Velocity in selected unit
0x1E	40031	Velocity in selected units (float, lower 16 bits)	No	Velocity in selected unit
0x1F	40032	CAL-V Diff (float upper 16 bits)	No	CAL-V Diff
0x20	40033	CAL-V Diff (float lower 16 bits)	No	CAL-V Diff
0x21	40034	CAL-V Set (float upper 16 bits)	No	CAL-V Set
0x22	40035	CAL-V Set (float upper 16 bits)	No	CAL-V Set
0x23	40036	Spare/ Not used		
0x24	40037	Total 24 hrs, Last total record, low register	No	Tot24hrs: Last total record
0x25	40038	Total 24 hrs, Last total record, high register	No	Tot24hrs :Last total record
0x26	40039	Total 24 hrs, Current Day (0-6)	No	Tot24hrs :Current Day
0x27	40040	Total 24 hrs, Current Hour (0-23)	No	Tot24hrs: Current Hour
Register Address	Modbus Address	Data type	Scaling	Comment
0x28	40041	Total 24 hrs, Record day 1 , low register	No	Tot24hrs: Record day 1
0x29	40042	Total 24 hrs, Record day 1 , high register	No	Tot24hrs: Record day 1
0x2A	40043	Total 24 hrs, Record day 2 , low register	No	Tot24hrs: Record day 2
0x2B	40044	Total 24 hrs, Record day 2 , high register	No	Tot24hrs :Record day 2
0x2C	40045	Total 24 hrs, Record day 3 , low register	No	Tot24hrs: Record day 3
0x2D	40046	Total 24 hrs, Record day 3 , high register	No	Tot24hrs :Record day 3
0x2E	40047	Total 24 hrs, Record day 4 , low register	No	Tot24hrs :Record day 4
0x2F	40048	Total 24 hrs, Record day 4 , high register	No	Tot24hrs :Record day 4
0x30	40049	Total 24 hrs, Record day 5 , low register	No	Tot24hrs: Record day 5
0x31	40050	Total 24 hrs, Record day 5 , high register	No	Tot24hrs: Record day 5
0x32	40051	Total 24 hrs, Record day 6 , low register	No	Tot24hrs :Record day 6
0x33	40052	Total 24 hrs, Record day 6 , high register	No	Tot24hrs :Record day 6
0x34	40053	Total 24 hrs, Record day 7 , low register	No	Tot24hrs :Record day 7
0x35	40054	Total 24 hrs, Record day 7 , high register	No	Tot24hrs: Record day 7

Register Address	Modbus Address	Data type	Scaling	Comment
0x36	40055	Total 24 hrs, Last Total , low register	No	Tot24hrs :Last Total
0x37	40056	Total 24 hrs, Last Total , high register	No	Tot24hrs :Last Total
0x38	40057	Zero Check Mean (float, float upper 16 bits)	No	Zero Check Mean value
0x39	40058	Zero Check Mean (float, float lower 16 bits)	No	Zero Check Mean value
0x3A	40059	Zero Check Stdev (float, float upper 16 bits)	No	Zero Check Standard deviation
0x3B	40060	Zero Check Stdev (float, float lower 16 bits)	No	Zero Check Standard deviation
0x3C	40061	Zero Check Pipe Ref (float, float upper 16 bits)	No	Zero Check Pipe Reference
0x3D	40062	Zero Check Pipe Ref (float, float lower 16 bits)	No	Zero Check Pipe Reference
0x3E	40063	Zero Check Pipe Diff (float, float upper 16 bits)	No	Zero Check Pipe Difference %
0x3F	40064	Zero Check Pipe Diff (float, float lower 16 bits)	No	Zero Check Pipe Difference %
0x40	40065	Zero Check Bottle Ref (float, float upper 16 bits)	No	Zero Check Bottle Reference
0x41	40066	Zero Check Bottle Ref (float, float lower 16 bits)	No	Zero Check Bottle Reference
0x42	40067	Zero Check Bottle Diff (float, float upper 16 bits)	No	Zero Check Bottle Difference %
0x43	40068	Zero Check Bottle Diff (float, float lower 16 bits)	No	Zero Check Bottle Difference %
0x44	40069	Zero Check Test Time (integer, lower 16 bits)	No	Zero Check Test Time (sec)

* The data in registers with scaling must be multiplied by 10 or 100 as indicated to be scaled properly.

Note!

Registers A, B and C are provided to get more resolution for low flow and total. When the value exceeds the maximum value of the 16 bit registers, they will be frozen with all 16 bits set. It is also possible to use the velocity to calculate the flow in engineering units by using the pipe area and conversion factor for the selected unit.

Example:

Request data register at starting address 0x0000 and specifying only 1 register:
<0x01> <0x03> <0x00> <0x00> <0x00> <0x01> <0x0a> <0x84>

6.2.2 Command Response:

<0x01> <0x03> <0x02> <xx> <xx> <CRC high> <CRC low> Where xx xx is the data register value.

6.3 Read Input Register (MTI10/MTL10 status and status 2 command 04)

This command is used to report the MTI10/MTL10 status information. It is a READ ONLY command.

6.3.1 Command Request:

<Meter Address> <Function code=04> <Register address =0> <Register address =0>
<Register count =0> <Register count =1> <CRC high> <CRC low>

6.3.4 Command Response:

<Meter Address> <Function code=04> <Byte count-=2> <Status High><Status Low>
<CRC high> <CRC low>

The MTI10/MTL10 supports only reading of the MTI10/MTL10 status. The register address must be set to zero (Modbus Address 30001) and the register count must be set to 1.

Table 3 - Status bits definitions (Modbus Address 30001)

Bit	Definition	Comment
0	Power up indication	Reset when out of the power up sequence
1	Flow rate reached high limit threshold	Set limit to zero to disable
2	Flow rate reached low limit threshold	Set limit to zero to disable
3	Temperature reached high limit threshold	Set limit to zero to disable
4	Temperature reached low limit threshold	Set limit to zero to disable
5	Sensor reading is out of range	Check sensor wiring
6	Velocity flow rate outside of calibration table	Check sensor wiring
7	Incorrect Settings	Check settings
8	In simulation mode	Set simulation value to 0 to disable
9	Frequency output is out of range	Check frequency output settings
10	Analog 4-20 mA for flow is out of range	Check analog output settings
11	Analog 4-20 mA for temperature is out of range	Check analog output settings
12	Busy	Check wiring from RS485 to Anybus IC
13	Bridge Shutdown	Check RTC
14	CRC error	Check parameters and reset CRC
15	Tot Error	Reset total

Table 4 - Status 2 bits definitions (Modbus Address 30002)

Bit	Definition	Comment
0	CAL-V in progress	CAL-V in progress
1	ADC12<>ADC24 too far apart	Internal ADC calibration out of range
2	CAL-V Diff out of range	CAL-V Diff out of range
3	Curve #2 Selected (for 2 gas curve only)	Curve #2 Selected (2 gas curve only)
4	Zero Check Failed	Zero Check Failed
5	CAL-V/Zero Check Aborted	CAL-V/Zero Check Aborted

6.4 Preset Single Register (command 06)

This command is used to perform miscellaneous functions such as clearing the totalizer and initiating diagnostic operations. The register address is 0x0a (10 decimal, Modbus=40011) and the data to write is described on the following page.

6.4.1 Command Request:

<Meter Address> <Function code=06> <Register address high=0x00> <Register address low=0x0a> <Register data high=0x00> <Register data low =0x02> <CRC high> <CRC low>

6.4.2 Command Response:

<Meter Address> <Function code=06> <Register address =0x00> <Register address =0x0a> <Register data=0x00> <Register data =0x02> <CRC high> <CRC low>

6.4.3 Reset Total:

Address = 40011, data = 0x02
This command is used to clear the Totalizer and elapsed time registers

6.4.4 Reset 24 hours Total:

Address=40011, data = 180 (0xB4)
This command reset the 24 hours 7 days record including the day and hours counters

6.4.5 Reset 24 hour time:

Address=40011, data = 181 (0xB5)
This command reset the 24 hours day and hours counters

6.4.6 24 hours Event:

Address=40011, data = 182 (0xB6)
This command generates a 24 hours event, the same way as when the 24 hours counter rolls over. This may be useful to record total over a shorter period.

6.4.7 CAL-V Verify:

Address=40011, data = 161 (0xA1)
This command initiates a “CAL_V Verify. This operation may take 4 minutes to complete and will stop the meter from calculation flow. The Status2 bit D0 may be monitored to check for completion.

6.4.8 Zero Check In-Pipe Verify:
Address=40011, data = 173 (0xAD)
This command initiates a “Zero Check In-PipeVerify". This operation does not affect flow calculations. The register 40069 may be monitored to check for completion.

6.4.9 Zero Check In-Bottle Verify:
Address=40011, data = 176 (0xB0)
This command initiates a “Zero Check In-BottleVerify". This operation does not affect flow calculations. The register 40069 may be monitored to check for completion.

6.4.10 Switch to Curve #1:
Address=40011, data = 170 (0xAA)
This command initiates a command to switch to gas curve 1 when configured for 2 gas curves. Make sure that the input contact is not programmed for curve switching

6.4.11 Switch to Curve #2:
Address=40011, data = 171 (0xAB)
This command initiates a command to switch to gas curve 2 when configured for 2 gas curves. Make sure that the input contact is not programmed for curve switching

The RS-485 Modbus communication wiring connections are made to terminal block TS5 of the MTI10/MTL10 RS-485 board. The Tx/Rx+ signal must connect to pin 1, Tx/Rx- must connect to pin 2, communication common to pin 3, and the cable shield to pin 4 as show in Figure 39.

6.5 RS-485 Termination Resistor

Connect a termination resistor across the receive/transmit signals of the last device on the RS-485 communication line. To connect the 121ohm termination resistor on the MTI10/MTL10, set jumper JP1 to the TERM position.

Disconnect the termination resistor on all other external RS-485 devices. The termination resistor of the MTI10/MTL10 is disconnected by setting jumper JP1 to the NC (Not Connected) position. See Figure 39.

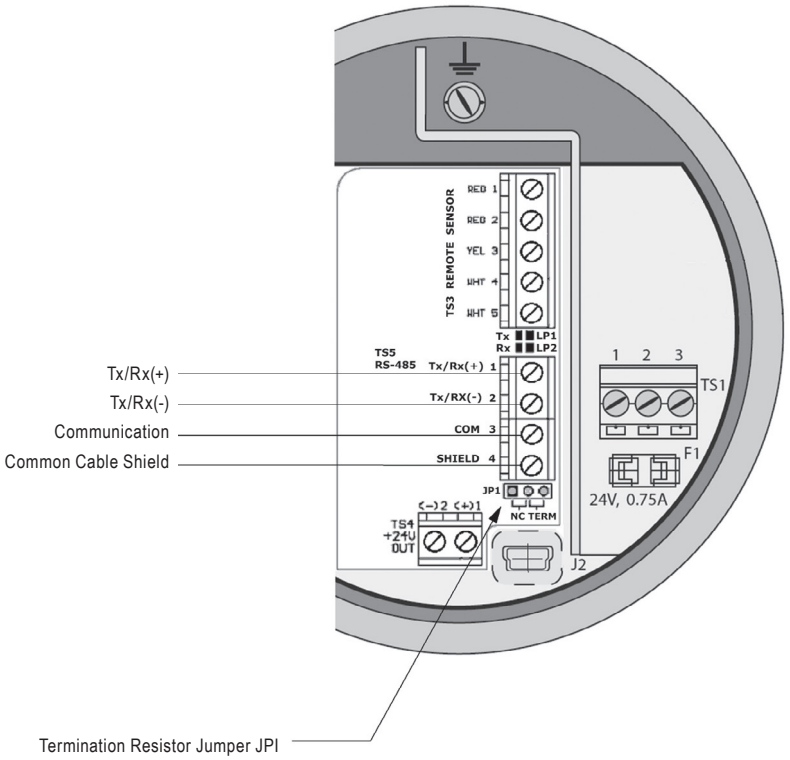
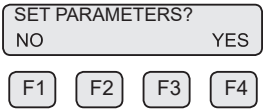


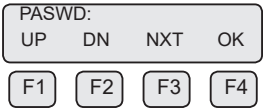
Fig. 39 - RS-485 Wiring and Termination Resistor Configuration

6.6 Entering the programming mode

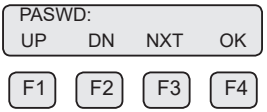
To enter the programming mode, press the F1or F2 keys repeatedly in the normal running mode until the following screen is displayed.



Press YES (F4) and the following screen will prompt the user to enter the password if enabled:



Enter the correct password (NOTE! the default password for Level 1 is 1234).

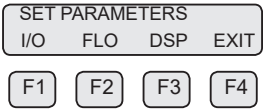


Press the UP (F1) or DN (F2) keys to scroll to a new digit or character. The cursor indicates the selected digit. Press NXT (F3) to select the next digit and OK (F4) to accept the entry.

Note!

If the UP (F1) or DN (F2) keys are held down for more than 1 second, new digits will be selected at an increasing rate.

If an incorrect password is entered, the message “Wrong Password" will be displayed for a few seconds and then return to the programming entry screen. If the password is accepted, the following screen will be displayed:

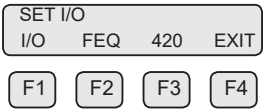


This is the base screen of the programming mode.

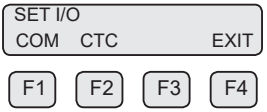
Note!

If the programming mode must be exited, press EXIT (F4) repeatedly until the “Normal Mode" screen is displayed.

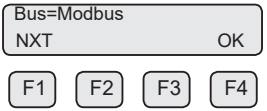
To program the communication parameters, press I/O (F1) key from the base screen of the programming mode.



Then press I/O (F1) again:



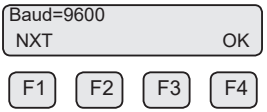
Then press COM (F1) to select communication parameters Set Bus protocol:



Press NXT (F1) repeatedly until the correct selection is shown and then press OK (F4) to accept the setting.

Selections are: “Modbus"
“None"

Set Baud Rate communication parameter:



Press NXT (F1) repeatedly until the correct Baud Rate is shown and then press OK (F4) to accept the setting.

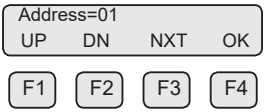
Selections are: “19200"
“9600"
“4800"
“2400"
“1200"

Press NXT (F1) repeatedly until the correct Parity is displayed and press OK (F4) to accept the setting.

Selections are: “NONE"
“ODD"
“EVEN"

Set Unit Address:

Press CHG (F1) key to change the Modbus communication Address.



Press the UP (F1) or DN (F2) keys to select the value for the Modbus Address. The cursor points to the selected digit. Press NXT (F3) to select the next digit and OK (F4) to accept the entry.

Note!

If the UP (F1) or DN (F2) keys are held down for more than 1 second, new digits will be selected at an increasing rate.

It is very important that there are not two devices with the same Modbus address. To avoid conflicts, each Modbus slave must have a unique address. Range is from 1 to 247.

Note!

Power to the MTI10/MTL10 must be cycled off and on for new Modbus settings to take effect.

7. Maintenance

7.1 Precautions

Precautions

GB

WARNING! BEFORE ATTEMPTING ANY MAINTENANCE, TAKE THE NECESSARY SAFETY PRECAUTIONS BEFORE REMOVING THE PROBE FROM THE DUCT (EXAMPLE: PURGE LINES OF TOXIC AND/OR EXPLOSIVE GAS, DEPRESSURIZE, ETC...).

WARNING! EXPLOSION HAZARD. DO NOT REMOVE OR REPLACE COMPONENTS OR FUSES UNLESS POWER HAS BEEN DISCONNECTED WHEN A FLAMMABLE OR COMBUSTIBLE ATMOSPHERE IS PRESENT.
WARNING! EXPLOSION HAZARD. DO NOT DISCONNECT EQUIPMENT WHEN A FLAMMABLE OR COMBUSTIBLE ATMOSPHERE IS PRESENT.
WARNING! TURN OFF INPUT POWER BEFORE REMOVING OR INSTALLING A CIRCUIT BOARD ASSEMBLY FROM THE ENCLOSURE.

Access to Electronics
Accessing electronics is not normally required for maintenance purposes. If a loose connection is suspected, unscrew the rear end-cap of the meter enclosure to access the terminations

CAUTION! BE SURE POWER TO METER IS SWITCHED OFF BEFORE ATTEMPTING TO ACCESS ELECTRONICS. If there is a problem and a loose connection is not found, please contact Spirax Customer Service for technical assistance at (800) 356-9362.

Precauciones

ES

¡ADVERTENCIA! ANTES DE INTENTAR CUALQUIER MANTENIMIENTO, TOME LAS PRECAUCIONES DE SEGURIDAD NECESARIAS ANTES QUE RETIRAR LA SONDA DEL DUCTO (EJEMPLO: PURGUE LAS LÍNEAS DE GASES TÓXICOS Y/O EXPLOSIVOS, DESPRESURICE, ETC...).
¡ADVERTENCIA! PELIGRO DE EXPLOSIÓN. NO RETIRE O REEMPLACE COMPONENTES O FUSIBLES A MENOS QUE LA ENERGÍA HAYA SIDO DESCONECTADA SIEMPRE QUE ESTÉ PRESENTE UNA ATMÓSFERA INFLAMMABLE O COMBUSTIBLE.

¡ADVERTENCIA! PELIGRO DE EXPLOSIÓN. NO DESCONECTE NINGÚN EQUIPO CUANDO UNA ATMÓSFERA INFLAMABLE O COMBUSTIBLE ESTÉ PRESENTE PRONTO.

¡ADVERTENCIA! DESCONECTE LA ENERGÍA DE ALIMENTACIÓN ANTES DE REMOVER O INSTALAR UN ENSAMBLE DE TARJETA DE CIRCUITO DEL GABINETE.

Acceso a la Electrónica
Normalmente no se requiere tener acceso a la electrónica para propósitos de mantenimiento. Si se sospecha de una conexión suelta, desatornille la tapa posterior de la caja del medidor para tener acceso a las terminales
PRECAUCIÓN: ASEGÚRESE QUE LA ALIMENTACIÓN DEL MEDIDOR ESTE DESCONECTADA ANTES DE INTENTAR EL ACCESO A LA ELECTRÓNICA. Si existe algún problema y no se encuentra ninguna conexión suelta, por favor póngase en contacto con el Servicio al Cliente de Spirax para asistencia técnica al número (800) 356-9362.

Précautions

FR

AVERTISSEMENT ! AVANT TOUTE TENTATIVE DE MAINTENANCE, OBSERVER LES CONSIGNES DE SECURITE NECESSAIRES AVANT DE RETIRER LA SONDE DE LA CONDUITE (PAR EXEMPLE, PURGER LES LIGNES DES GAZ EXPLOSIFS/ TOXIQUES QU'ELLES POURRAIENT CONTENIR, DEPRESSURISER LE CONTENEUR, ETC.).

AVERTISSEMENT ! RISQUE D'EXPLOSION. NE PAS RETIRER NI REMPLACER DES COMPOSANTS OU DES FUSIBLES SI LA SOURCE D'ALIMENTATION N'A PAS ETE DEBRANCHEE DANS UNE ATMOSPHERE INFLAMMABLE OU COMBUSTIBLE.

AVERTISSEMENT ! RISQUE D'EXPLOSION. NE PAS DEBRANCHER UN EQUIPEMENT DANS UNE AMBIANCE COMBUSTIBLE OU INFLAMMABLE.

AVERTISSEMENT ! COUPER L'ALIMENTATION AVANT DE RETIRER OU D'INSTALLER UN ENSEMBLE DE CARTE DE CIRCUITS IMPRIMES DU BOITIER.

Accès aux composants électroniques
L'accès aux composants électroniques n'est généralement pas nécessaire dans le cadre de la maintenance. Si une connexion lâche est suspectée, dévisser le capuchon d'extrémité arrière du boîtier du compteur pour accéder aux terminaisons

ATTENTION : S'ASSURER QUE L'ALIMENTATION DU COMPTEUR EST COUPEE AVANT D'ACCER AUX COMPOSANTS ELECTRONIQUES. En cas de problème et qu'aucune connexion lâche n'est détectée, veuillez contacter le service client de Spirax pour obtenir une assistance technique au (800) 356-9362.

Vorsichtsmaßnahmen

DE

ACHTUNG! BITTE ERGREIFEN SIE DIE ERFORDERLICHEN SICHERHEITSMAßNAHMEN, BEVOR SIE IRGENDWELCHE WARTUNGSARBEITEN DURCHFÜHREN UND DIE MESSSONDE AUS DEM ROHR ENTFERNEN (BEISPIEL: LEITUNGEN ZUR ENTFERNUNG VON GIFTIGEN UND/ ODER EXPLOSIVEN GASEN REINIGEN, DRUCK SENKEN, USW.).

ACHTUNG! EXPLOSIONSGEFAHR. KOMPONENTEN ODER SICHERUNGEN BITTE ERST DANN ENTFERNEN ODER AUSTAUSCHEN, WENN DER STROM GETRENNT WURDE, FALLS EINE ENTZÜNDLICHE ODER BRENNBARE ATMOSPHÄRE VORHANDEN IST.

ACHTUNG! EXPLOSIONSGEFAHR. GERÄT NICHT VOM STROM TRENNEN, WENN EINE ENTZÜNDLICHE ODER BRENNBARE ATMOSPHÄRE VORHANDEN IST.

ACHTUNG! EINGANGSLEISTUNG AUSSCHALTEN, BEVOR LEITERPLATTENBAUGRUPPEN AUS DEM GEHÄUSE AUSGEBAUT ODER IN DIESES EINGEBAUT WERDEN.

Zugriff auf die Elektronik
Der Zugriff auf die Elektronik ist zu Wartungszwecken normalerweise nicht erforderlich. Falls eine lose Verbindung vermutet wird, schrauben Sie die hintere Endkappe des Messgerätgehäuses ab, um auf die Anschlüsse zugreifen zu können.

VORSICHT: STELLEN SIE SICHER, DASS DER STROM AN DAS MESSGERÄT AUSGESCHALTET IST, BEVOR SIE VERSUCHEN, AUF DIE ELEKTRONIK ZUZUGREIFEN.
Falls Probleme auftreten und keine lose Verbindung gefunden werden kann, wenden Sie sich bitte zwecks technischer Unterstützung an den Spirax-Kundendienst unter der Nummer (800) 356-9362.

7.2 Broken or Damaged Probe

If the sensor is broken or damaged, the probe and electronics must be returned to the factory. A new sensor will be installed and calibrated. Refer to "Returning Your Meter" on p. 131.

7.3 Flow Calibration and Calibration Validation

To ensure continued high accuracy of your MTI/MTL10 flow meter, he factory provides a full NIST-traceable calibration. The MTI/MTL10 also features on-board calibration validation diagnostics called CAL-V™ and Zero CAL-CHECK®. If the CAL-V™ and Zero CAL-CHECK® tests pass, the sensor is measuring accurately and the meter does not require recalibration. However, if your quality or metrology systems require periodic recalibration in an NIST-traceable lab, it is recommended that the meter be returned to he factory for evaluation and calibration after every two years of operation.

7.4 Fuse Replacement

Verify the fuse is defective by measuring it with an Ohm Meter (Two replacement fuses are provided with each unit). The fuse F1 is located near the power terminal block and can be removed by using tweezers or needle- nose pliers. Replacement fuse is Littelfuse part number 0454.750MR.

Warning!

- Turn input power OFF before removing or installing a fuse. Use only recommended fuse replacements.
- It is the user's responsibility to install the flow meter in an appropriately designed system with adequate safety protections.
- DO NOT remove the flow instrument from the flow body while the system is under flow conditions.
- This product may experience temperatures from as low as -40 °F (-40 °C) and as high as 649 °F (343 °C). It is the user's responsibility to take safety precautions regarding operating temperature of the flow meter.
- If large flow body has been purchased, user is advised to use a double sling to prevent rotation of flow body during installation or other method to prevent damage of flow instrument.

7.5 Sensor Wiring

Note!

Sensor terminations are performed at the factory except when the Remote Electronics option is used or ordered.

7.6 Sensor Cleaning

The sensor is insensitive to small amounts of residue, but continued use in dirty environments will necessitate periodic cleaning. To inspect the sensor, remove power from electronics and remove the unit from the pipe or duct, exposing the sensor elements. If they are visibly dirty, clean them with water or alcohol (ethanol) using an appropriate brush until they appear clean again. Even though the sensor elements are rugged and breakage resistant, avoid touching them with any solid object and use a light touch while cleaning them.

8. Troubleshooting

8.1 General

Caution

The electronics, sensor and sensor interconnect wires supplied by Spirax Sarco are calibrated as a single precision mass flowmeter. Interchanging sensors or sensor wiring will impair the accuracy of the flowmeter. If you experience any problem with your MTI10/MTL10, call Spirax Sarco Technical Support at 800-883-4411.

Problem	Possible Cause	Action
Display-Main Bd Comm. Error	Display and main board not communicating	Check status of LP1 on the Main Board and LP6 on the display board. Are green LEDs blinking once per second? If LEDs are not blinking, cycle power to reset meter. Call Spirax Sarco Tech Support.
Meter does not read up to full scale	Calibration table may be corrupted	- Check the calibration table for a corrupted location. - Enter the password 9111. - Start on p. 41 of the MTI10/MTL10 manual and follow the steps to get to Flow Parameters 2 menu screen. - Select CAL (F1) - Select NXT (F1) to cycle through calibration table to verify entries match calibration certificate. - Check for CRC error code
Velocity measurement seems low	1. Probe not oriented properly 2. Sensor dirty	1. Orient probe per installation sections: Insertion (p. 11), Inline (p. 15). 2. Clean sensor (p. 105)
Unit will not power-up	a) No power input b) Bad fuse c) Bad Power supply	- Check fuse (F1) located next to TS1 on main board. - Check for correct power supply voltage at TS1 on main board. If fuse is OK and unit still won't power up, call Spirax Sarco for additional assistance
Meter does not initialize	Electromechanical interference	- Check meter power cycles. - Press and release F1 and F2 at the same time; the display will enter Engineering screens. - Press F1 to get to screen #23; record power cycle value. - Press F4 to return to normal operation; monitor meter until problem returns. - Return to screen #23 to see if power cycles have increased; microprocessor is resetting due to EMI electrical noise entering the meter. - Check Power input and output cables grounding and routing.

Problem	Possible Cause	Action
Velocity measurement is erratic or fluctuating	1. Very turbulent flow	1. Increase dampening (see filter settings in "Flow Parameters" on p. 50)
	2. Sensor dirty	2. Clean sensor (Refer to Maintenance section, p. 103)
	3. Sensor broken	3. Return flowmeter to Spirax Sarco for repair (Refer to p. 131 for shipping instructions)
	4. Probe not mounted securely	4. Remount probe (see Installation section, p. 11 and p. 15); must be mounted securely without vibration. If vibration persists, choose a new mounting location without location.
	5. Malfunction in flowmeter	5. Return flowmeter to Spirax Sarco for repair (Refer to p. 131 for shipping instructions)
	6. Meter installed incorrectly	6. Re-install meter according to instructions (Refer to installation section, p. 11 and p. 15)

8.2 Installation Problems

The following is a summary listing of problems that may be encountered with the installation of the MTI10/ MTL10 Thermal Mass Flowmeter.

1. **Improper wiring connections for power and/or 4-20 mA output signal.**

   The MTI10/MTL10 require a separate power source for the main board and the two 4-20 mA output signals. Two wires supply 24 Vdc power to the main board. Two wires are used for each of the 4-20 mA output signals. Refer to Figure 12 (p. 19) and Figure 13 (p. 20).
   Also refer to "Wiring Precautions" and "Helpful Hints" in Wiring section (p. 17) for further guidance.

2. **Inadequate power source.**

   For those models that are powered by 24 Vdc, a 24 Vdc ±10%, 0.75 amp or greater power supply is recommended. If the voltage supplied is not within this range or if the power supply is not rated for 25 watts minimum, a variety of problems can occur including inaccurate flow readings, dim display and faulty programming action. The input voltage must be within the range of 23 to 25VDC as measured at the power input terminals of the flowmeter electronics.

3. **Flow measurement seems inaccurate.**

   - Check to ensure that the flowmeter is installed so that the Flow Direction Arrow engraved on the flat surface of the fitting below the electronics housing is properly pointing in the direction of flow. Refer to Figure 10 (p. 16). If not, change orientation of meter.
   - If you have a MTI10 insertion type flowmeter, check that the insertion depth of the sensor/ probe is correct. The end of the probe should be adjusted as per Figure (p. 11).
   - For inline meter types, ensure that there are a minimum of ten diameters of straight pipe upstream of the sensor and five diameters downstream (¼" meters: 6" [152 mm] of straight, unobstructed pipe upstream and downstream required). For insertion meter types, ensure that there are a minimum of fifteen diameters of straight pipe upstream of the sensor and ten diameters downstream. If complex flow disturbances are upstream of the sensor, extension of the straight pipe may be required to ensure accurate flow measurement. Contact Spirax Sarco for assistance.
   - Ensure that pipe area data in the meter matches data on the Spirax Sarco Calibration Certificate. The pipe internal cross sectional area is programmed into the flowmeter through the front panel (see Flow Parameters, p. 46). This area is programmed in square feet or square meters. The Calibration Certificate delivered with the flowmeter contains the area that was programmed into the flowmeter at the Spirax Sarco factory. Check to ensure that this area is correct.

4. **Erratic flow reading especially a flow reading spiking high.**

   This may be a symptom of moisture in the flow stream. MTI10/MTL10 flowmeters are designed to work in relatively dry gas applications only. Contact Spirax Sarco to discuss resolutions to this problem.

5. Flowmeter is not responding to flow.

This problem could be caused by a number of reasons:

- Check to ensure adequate power is supplied to the flowmeter as described above. If things appear to be correct, an easy functional test can be performed. Carefully remove the probe and sensor from the pipe or flow body. Caution: the sensor is HOT. For those flowmeters with a display - and if the display is reading zero - blow on the sensor to see if a response occurs. If nothing happens, take a damp rag or sponge and place it in contact with the sensor. A reading should occur. Contact Spirax Sarco Technical Support with this information.
- A corrupted calibration table may lead to a zero flow reading. Verify that all Cal Flow Parameter settings are correct by accessing the "Calibration Parameters" information on meter (see p. 52). Check meter data for any non-whole numbers and call customer service for assistance.

6. Display and/or 4-20 mA signal reading above zero flow when no flow is occurring in the pipe.

If the reading is less than 5% of full scale, it is likely this is a normal condition caused by convection flow created by the heated sensor. It does not mean that the zero of the instrument is improperly set. The Spirax Sarco, sensor is extremely sensitive to gas flow and can even read the small flow caused by convection. If this is an unacceptable condition, please contact Spirax Sarco Technical Support for alternatives.

7. Mismatched serial numbers

If you have more than one meter, you must ensure that the serial numbers of meter, remote, and/or flow body match one another. These items have been manufactured and calibrated to operate as a unit and cannot be mismatched.

8.3 Alarm Codes

Information to diagnose and clear alarm codes is on p. 64 under the Menu Tree section. Enter password (9111) and follow the block diagram to get to the section affected by the error code.

Alarm Code	Reason	Action
13	Flow rate above high limits	Refer to the PARAMETER MENU 2 section on p. 48 of this Manual to verify limit is within range. Check ALM = HiFloAlm under PRM.
14	Flow rate below low limits	Refer to the PARAMETER MENU 2 section on p. 48 of this Manual to verify limit is within range. Check ALM = LoFloAlm under PRM.
15	Temperature above high limits	Refer to the PARAMETER MENU 2 section on p. 48 of this Manual to verify limit is within range. Check ALM=HiTempAlm under PRM.
16	Temperature below low limits	Refer to the PARAMETER MENU 2 section on p. 48 of this Manual to verify limit is within range. Check ALM = LoTempAlm
22	Sensor out of range	Refer to the ENGINEERING DISPLAY MENU on p. 32 of this Manual and the Spirax Sarco factory Calibration Certificate to check CSV voltage. Compare Display 10 value to Calibration Certificate CSV voltage and verify it's within range.
23	Velocity out of calibration table range	Refer to the ENGINEERING DISPLAY MENU on p. 32 of this Manual and the Spirax Sarco factory Calibration Certificate to check CSV voltage. Compare Display 10 value to Calibration Certificate CSV voltage and verify it's within range.
24	Check settings	One or more internal settings are corrupted or out of spec. Contact Spirax Sarco Service for instructions to verify settings.
25	Simulation mode	Meter is in Simulation Mode. Refer to the PARAMETER MENU 1 section on p. 54 of this Manual. Use the SIM Section under Diagnostics to return to normal operation.
26	Frequency output over range	Refer to the DIGITAL OUTPUT MENU on p. 64 of this Manual. Verify the Frequency Output settings are within limits.
32	4-20 mA for flow rate is out of range	Refer to the MAIN MENU on p. 62 of this Manual. Use the Set I/O section to verify range limits under FLO Set 4-20 mA.
33	4-20 mA for temperature is out of range	Refer to p. 35 of this Manual. Use the Set I/O section to verify range limits under FLO Set 4-20 mA. Channel #2 can be set for flow or temperature.
34	Busy	Meter is recalculating new parameters.

Alarm Code	Reason	Action
35	Sensor Bridge Shutdown	The MTI10/MTL10 probe is getting too hot. Open sensor circuit and check sensor wiring.
36	Database CRC Error	Refer to the PARAMETER MENU 2 section on p. 48 of this Manual to reset CRC. Use SPC section of menu to reset CRC. Contact Spirax Sarco Technical Support for possible causes.
37	Totalizer Error Detected	See "Reset the Total and Elapsed Time" on p. 53 for steps to clear Error Code. Contact Spirax Sarco for possible causes.
38	CAL-V™ in progress	Wait until the CAL-V™ or Cal Set is finished.
39	ADC12 versus ADC24 too far	The tolerance between the 2 ADC is out of specification. Recalling manufacture default may correct the problem.
40	CAL-V™ Diff Fail	The CAL-V™ Diff Failed. Check sensor wiring and verify that the sensor's resistance is correct. Call Tech Support.
41	Zero CAL-CHECK® Fail	Allow meter to stabilize for 15 minutes and perform the test again. If another "Fail" test results, call Tech Support.

9. Appendices

9.1 Specifications

9.1.1 Performance Specs

Flow Accuracy: MTL10 Inline Flowmeter: ± 1% of reading ± 0.2 % of full scale.

¼" size: 6" (152 mm) of straight, unobstructed pipe upstream and downstream required.

All other sizes: 8 diameters of straight, unobstructed pipe upstream and 4 downstream required.

MTI10 Insertion Flowmeter: ± 1% of reading ± 0.2 % of full scale.

15 diameters of straight, unobstructed pipe upstream and 10 downstream required.

Flow Repeatability: ± 0.2% of full scale

Flow Response Time: 0.9 seconds (one time constant) Temperature Accuracy:

± 1.8° F (± 1.0° C) -40 to 250° F (-40 to 121° C); ± 3.6° F (± 2.0° C), 250 to 650° F (121 to 343° C); 60

SFPM minimum.

Calibration: Factory Calibration to NIST traceable standards

CAL-V™ and Zero CAL-CHECK®: In situ, operator-initiated calibration validation

9.1.2 Operating Specs

Units of Measurement (field selectable): SCFM, SCFH, NMPS, NM3/M, NM3/H, NM3/D, NLPS, NLPM, NLPH, SCFD, MSCFD, MMSCFD, MMSCFM, SMPS, SM3/H, SM3/D, SM3/M, LB/S, LB/M, LB/H, LB/D, KG/S, KG/M, KG/H, SLPM, SFPM, MT/H, MCFD

Flow Rates for MTI10 Insertion Flowmeter: 15 to 60,000 SFPM (0.07 to 280 NMPS) - Air at 70°F (20°C) and 1 ATM

Turndown: up to 1000:1; 100:1 typical

Typical Flow Ranges for Insertion Flowmeters		
Pipe size	**SCFM**	**NM3/hr**
1.5" (40 mm)	0 - 840	0 - 1,325
2" (50 mm)	0 - 1,400	0 - 2,210
2.5" (63 mm)	0 - 2,000	0 - 3,150
3" (80 mm)	0 - 3,100	0 - 4,890
4" (100 mm)	0 - 5,300	0 - 8,360
6" (150 mm)	0 - 12,000	0 - 18,930
8" (200 mm)	0 - 20,840	0 - 32,870
10" (250 mm)	0 - 32,800	0 - 51,740
12" (300 mm)	0 - 46,600	0 - 73,500

Full Scale Flow Ranges for Inline Flowmeters:		
Size	**SCFM**	**NM3/hr**
0.25"	0 - 7.5	0 - 11.8
0.5"	0 - 125	0 - 200
0.75"	0 - 220	0 - 350
1"	0 - 360	0 - 570
1.25"	0 - 625	0 - 990
1.5"	0 - 840	0 - 1,325
2"	0 - 1,400	0 - 2,210
2.5"	0 - 2,000	0 - 3,150
3"	0 - 3,100	0 - 4,890
4"	0 - 5,300	0 - 8,360
6"	0 - 12,000	0 - 18,930

Note!

Standard conditions of air at 70°F and one atmosphere. Consult factory for other gases and for flow ranges above those listed. Inline meters above 2,500 SCFM (4,250 NM3/H) air may require third party Calibration. Contact Spirax Sarco.

Gas Pressure (maximum): Insertion: 500 psig (34.5 barg)
Inline (1/4" through 6"): NPT 500 psig (34.5 barg); 150lb flange 230 psig (16 barg) Check with factory for higher pressure options.

Note!

Pressure ratings stated for temperature of 100°F (38°C).

Relative Humidity: 90% RH maximum; non-condensing

Temperature: ST sensor: -40 to 250°F (-40 to 121°C)

HT Sensor: -40 to 650°F (-40 to 343°C)

Enclosure: Without display or AC power supply: -40 to 158°F (-40 to 70°C)

With display and/or AC power supply: -4 to 158°F, (-20 to 70°C)

Remote sensor junction box: -40 to 212°F (-40 to 100°C).

Input Power: 24 VDC - (± 10%), 0.7 Amps (standard DC power)

100 to 240 Vac~(+10%/-15%), 50-60Hz, 0.2 Amps (with AC power option)

Note!

Fluctuations of AC and DC power supply are not to exceed ± 10% of rating.

Class I Equipment (Electrical Grounding Required for Safety). Installation (Over-voltage) Category II for transient over-voltages.

Outputs: Two isolated 4-20 mA outputs (output one is for flow rate and output two is programmable for flow rate or temperature); fault indication per NAMUR NE43.
Isolated pulse output 0 to 100Hz, 5 to 24 volts p/p for flow (the pulse output can be used as an isolated solid state output for alarms); 20mA max.

Serial Communication: USB communication port is standard. The free PC-based software tool - MTI10/MTL10 View™ - provides complete configuration, remote process monitoring, and data logging functions.
Optional serial communication: Modbus RTU (RS485).

4-20 mA Loop Verification: Simulation mode used to align 4-20 mA output with the input to customer's PLC/DCS.

9.1.3 Physical Specs

Sensor material: 316 stainless steel standard; Hastelloy C276 optional

Enclosure: NEMA 4X (IP68), aluminum, dual conduit entries with ¾" NPT or optional M20 x 1.5mm. Cabling to remote enclosure: 5-conductor, 18 AWG, twisted, shielded, 100 feet maximum.

Retractor Assemblies: Packing gland assembly: 125 psig (8.6 barg) max.
High pressure (crank) retractor: NPT 600 psig (41.4 barg), ANSI 150 flange and ANSI 300 flange, no valve supplied.

Insertion Flowmeter Installation: Spirax Sarco-supplied compression fitting connects to customer-supplied ¾" female coupling welded to pipe.

9.2 Agency Approvals

CE: Approved
EMC Directive; 2014/30/EU
Electrical Equipment for Measurement, Control and Lab Use: EN61326-1:2013 Low Voltage Directive (LVD): 2014/35/EU
Product Safety Testing: EN 61010-1: 2010 Pressure Equipment Directive: 2014/68/EU
Weld Testing: EN ISO 15614-1 and EN ISO 9606-1, ASME B31.3

ATEX (FM12ATEX0034X): Approved
II 2 G Ex db IIB+H2 (T6, T4, or T1*) Gb Ta = -20°C to 70°C; IP67
II 2 D Ex tb IIIC (T85°C, T135°C, or T450°C*) Db Ta = -20°C to 70°C; IP67

IECEx (IECEx FMG 12.0010X): Approved
Ex db IIB+H2 (T6, T4, or T1*) Gb Ta = -20°C to 70°C; IP67 Ex tb IIIC (T85°C or T135°C*) Db Ta = -20°C to 70°C; IP67**

ATEX and IECEx Standards:
EN 60079-0: 2012 + A11:2013 IEC 60079-0: 2011
EN 60079-1: 2014 IEC 60079-1: 2014
EN 60079-31: 2014 IEC 60079-31: 2013
EN 60529: 1991, +A1: 2000 IEC 60529: 2001

Model Code		Temperature Code Marking (Gas)		Temperature Code Marking (Dust)	
Enclosure	**Sensor Type**	**Main Enclosure**	**Remote Enclosure**	**Main Enclosure**	**Remote Enclosure****
E1	ST	T4	N/A	135°C	N/A
E2	ST	T4	N/A	135°C	N/A
E3	ST	T6	T4	85°C	135°C**
E4	ST	T6	T4	85°C	135°C**
E3	HT	T6	T1	85°C	450°C**
E4	HT	T6	T1	85°C	450°C**

*Temperature code ratings for Zones are dependent on external process temperature factors and equipment enclosure configuration. See the table above for specific temperature code ratings.
**The IECEx dust rating does not apply to the Remote Enclosure.

Note!
The EU Pressure Equipment Directive (PED) requires that the minimum ambient and fluid temperature rating for carbon steel flow bodies not be below -29C.

9.3 MTI10/MTL10 with 2 Gas Curves

9.3.1 Scope

This section describes added features to the standard MTI10/MTL10 flowmeter when using the 2 gas curves firmware option.

9.3.2 MTI10/MTL10 2 Gas Curves

The 2 Gas Curves firmware allows the use of two different calibration tables when running with different gases.

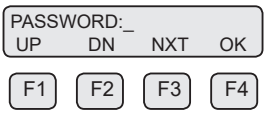
One of two methods can be used to switch between the two calibration curves:

1) Use of Contact Input:
When the contact input is programmed for curve switching, an open contact will select curve #1 and a contact closure will select curve #2.

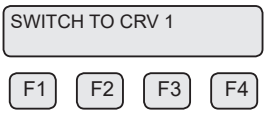
2) Use of the Keypad:
If the contact input is not programmed for curve switching, pressing F2 and F3 simultaneously will prompt an operator to manually switch curve upon entering a password and confirming the action by pressing the appropriate key.

Pressing F2 and F3 simultaneously:

Password needs to be entered if active (default: 1234):



After entering a valid password, a brief confirmation message will be displayed for 1 second:



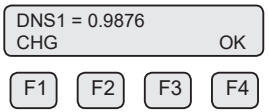
3) Programming Contact Input for Curve Switching:
Enter the menu using steps outlined in "Switch Input Settings" section (p. 40) and select "Switch CRV". Please note that the flowmeter needs to be programmed for 2 gas curves at the Spirax Sarco factory before you can select this function. Flowmeters are shipped with pre-programmed user requested settings.

Selections are: "Not used"
"Tot Reset"
"Switch Crv"

Helpful Hint:
From normal display mode, press F4 to view the current gas curve selection.

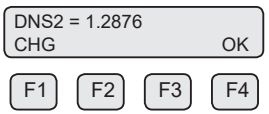
4) Programming Densities for Curve 1 and Curve 2:
When the selected flow unit is mass/time, two different densities will be used for each curve if the meter has been programmed for 2 gas curves. To change the densities:

Go to the unit menu following "Unit Settings" section.



DNS1 is the density associated with curve 1.

Change it as needed and press OK.

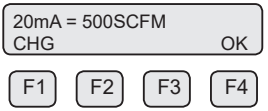


DNS2 is the density associated with curve 1.

Change it as needed and press OK.

5) Programming 4-20 mA settings for Curve 1 and Curve 2:
When the meter has been programmed for 2 gas curves, 2 sets of 4-20 mA settings for flow rate are used.

To program these settings:
Go to the 4-20 mA setting following the "Analog 4-20 mA Settings" section.

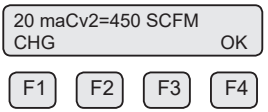


20mA is the upper limit associated with curve 1.

Change it as needed and press OK.

4mA is the lower limit associated with curve 1.

Change it as needed and press OK.



20 maCv2 is the upper limit associated with curve 2.

Change it as needed and press OK.

4 maCv2 is the lower limit associated with curve 2.

Change it as needed and press OK.

6) Operation:

- To avoid confusion, only one of two techniques is enabled. If the contact input is assigned to switch gas curves, then the ability to switch using the F2 and F3 function keys on the front panel is disabled.
- Two totalizers (Total 1 and Total 2) and two elapsed time counters are available on the display and through the USB serial communication. The reset function will reset all totalizers and elapsed time counter to zero.
- In the event of a power failure, the software will remember the last curve in use. Upon powering up again, the MTI10/MTL10 unit will continue to use that curve.
- Switching between gas curves will require a password unless the password is set to "0", which disables it.
- The calibration certificates for order with 2 gas curves will identify which gas is Gas 1 and Gas 2.
- When measuring in mass units, a density value must be entered for each gas curve.

9.4 Dimensions

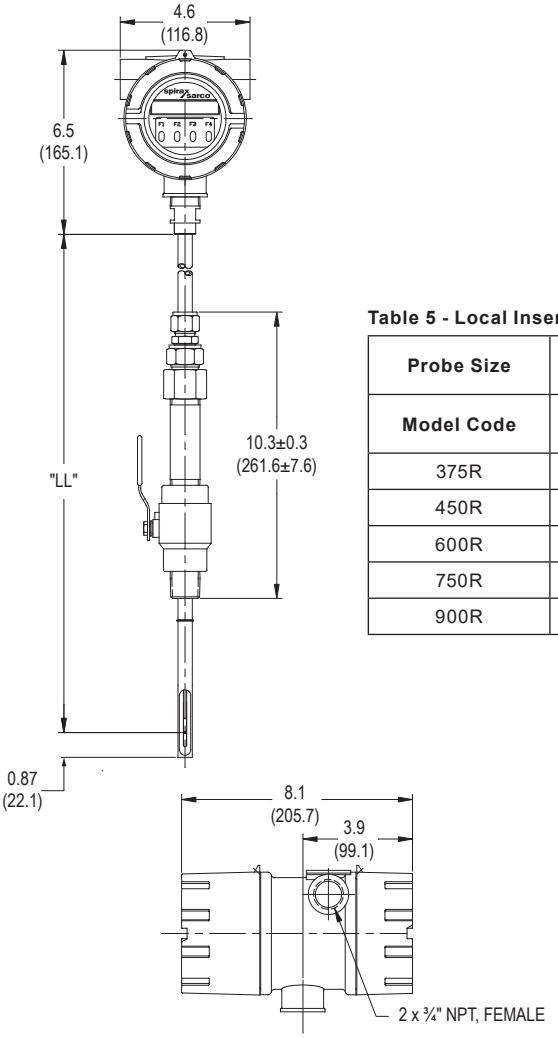
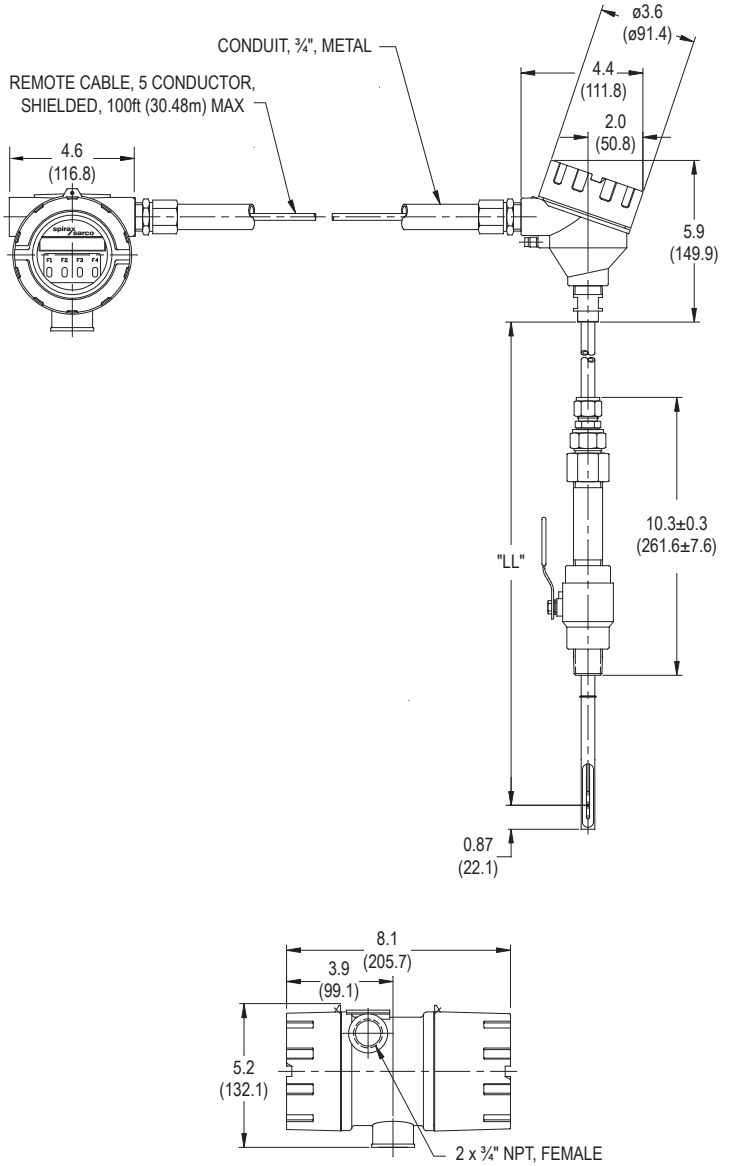


Table 5 - Local Insertion Meter with Retractor

Probe Size	Probe Size	Dimension "LL" ± .01
Model Code	mm (inches)	mm (inches)
375R	375 (15)	381 (15)
450R	450 (18)	457.2 (18)
600R	600 (24)	609.6 (24)
750R	750 (30)	762 (30)
900R	900 (36)	914.4 (36)

Fig. 40 - Local Insertion Meter with Retractor Dimensions


ø3.6
(ø91.4)
CONDUIT, ¾", METAL
REMOTE CABLE, 5 CONDUCTOR,
SHIELDED, 100ft (30.48m) MAX
4.4
(111.8)
2.0
(50.8)
4.6
(116.8)
5.9
(149.9)
10.3±0.3
(261.6±7.6)
"LL"
0.87
(22.1)
8.1
(205.7)
3.9
(99.1)
5.2
(132.1)
2 x ¾" NPT, FEMALE

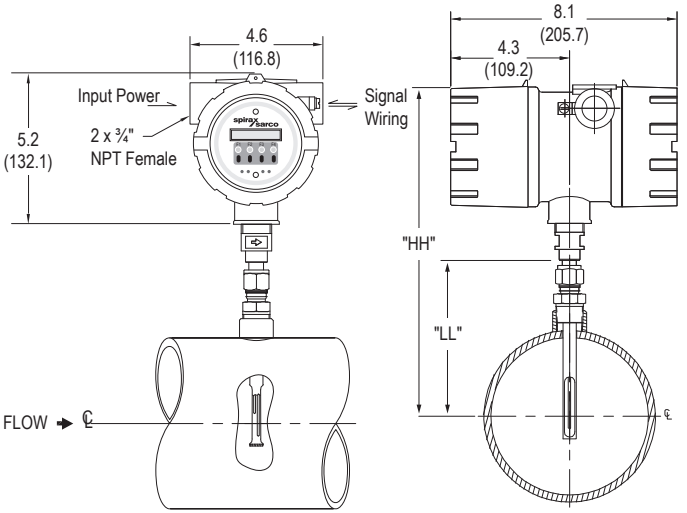


Fig. 41 - Insertion Meter Dimensions

Table 6 - Insertion Meter with 316 stainless steel probe

Probe Size	Probe Size	Dimension "LL"	Dimension "HH"
Model Code	mm (inches)	mm (inches)	mm (inches)
100I	150 (6)	152.4 (6)	317.5 (12.5)
225I	225 (9)	228.6 (9)	393.7 (15.5)
300I	300 (12)	304.8 (12)	470 (18.5)
375I	375 (15)	381 (15)	546.1 (21.5)
450I	450 (18)	457.2 (18)	622.3 (24.5)
600I	600 (24)	609.6 (24)	774.7 (30.5)
750I	750 (30)	762 (30)	927.1 (36.5)
900I	900 (36)	914.4 (36)	1080 (42.5)

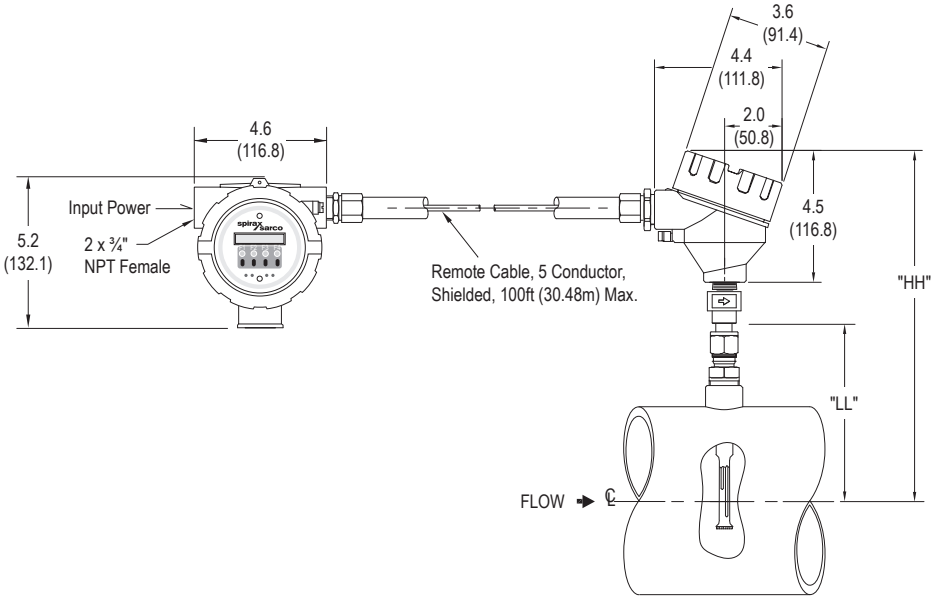


Fig. 42 - Insertion Remote Meter Dimensions

Table 7 - Insertion Remote Meter with 316 stainless steel probe

Probe Size	Probe Size	Dimension “LL"	Dimension “HH"
Model Code	mm (inches)	mm (inches)	mm (inches)
100I	150 (6)	152 (6)	302 (11.9)
225I	225 (9)	229 (9)	378 (14.9)
300I	300 (12)	305 (12)	455 (17.9)
375I	375 (15)	381 (15)	531 (20.9)
450I	450 (18)	457 (18)	607 (23.9)
600I	600 (24)	610 (24)	760 (29.9)
750I	750 (30)	762 (30)	912 (35.9)
900I	900 (36)	914.4 (36)	1064 (41.9)

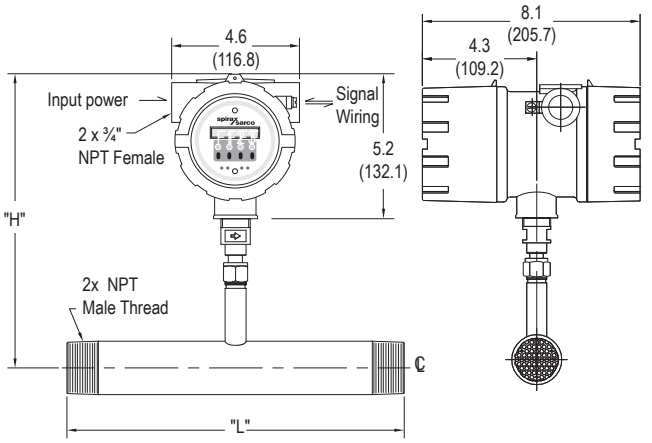


Fig. 43 -
Inline Meter with 316 Stainless Steel Flow Body and NPT End Connections Dimensions

Table 8 - Inline Meter with 316 stainless steel flow body and NPT End Connections

Body Size	Body Size	Dimension "L"	Dimension "H"
Model Code	mm (inches)	mm (inches)	mm (inches)
8	8 (0.25)	147 (5.8)	267 (10.5)
15	15 (0.50)	305 (12)	267 (10.5)
20	20 (0.75)	305 (12)	267 (10.5)
25	25 (1.00)	305 (12)	267 (10.5)
32	32 (1.25)	305 (12)	267 (10.5)
40	40 (1.50)	305 (12)	267 (10.5)
50	50 (2.00)	305 (12)	267 (10.5)
65	65 (2.50)	457 (18)	269.2 (10.6)
80	80 (3.00)	457 (18)	317.5 (12.5)

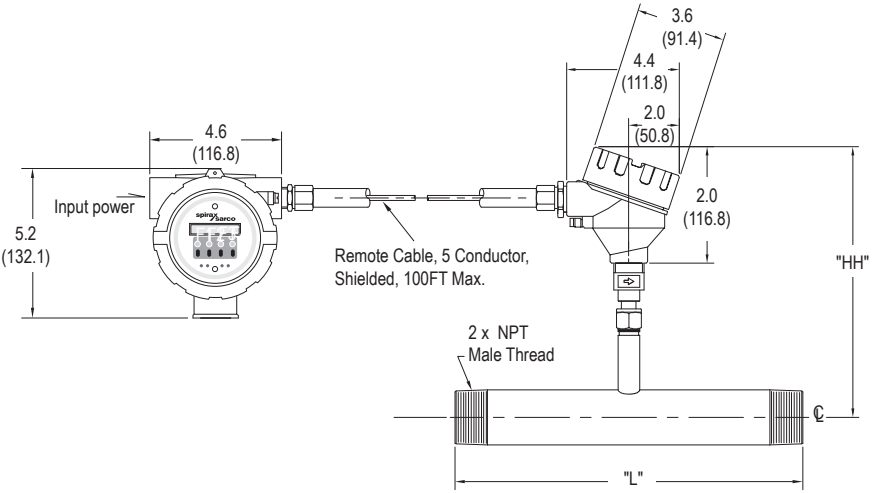


Fig. 44 -
Inline Remote Meter with 316 Stainless Steel Flow Body and NPT End Connections Dimensions

Table 9 - Inline Remote Meter with 316 stainless steel flow body and NPT End Connections

Body Size	Body Size	Dimension "L"	Dimension "HH"
Model Code	mm (inches)	mm (inches)	mm (inches)
8	8 (0.25)	147 (5.8)	267 (10.5)
15	15 (0.50)	305 (12)	267 (10.5)
20	20 (0.75)	305 (12)	267 (10.5)
25	25 (1.00)	305 (12)	267 (10.5)
32	32 (1.25)	305 (12)	267 (10.5)
40	40 (1.50)	305 (12)	267 (10.5)
50	50 (2.00)	305 (12)	267 (10.5)
65	65 (2.50)	457 (18)	270 (10.6)
80	80 (3.00)	457 (18)	317.5 (12.5)

* Also available in A106 Grade B carbon steel pipe (20PC, 25PC, 30PC, and 40PC model codes)

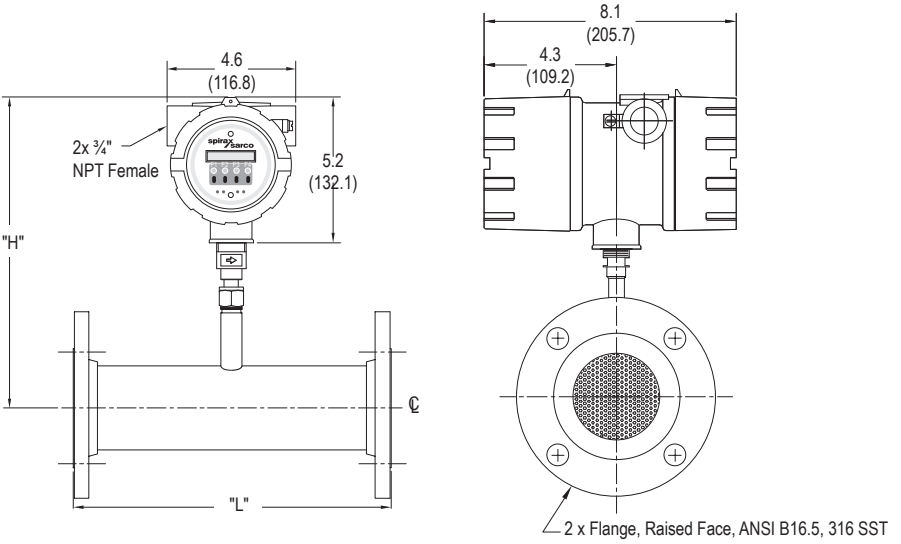


Fig. 45 -
Inline Meter with 316 Stainless Steel Flow Body and 150lb RF Flange End Connections Dimensions

Table 10 -
Inline Meter with 316 stainless steel flow body and 150lb RF Flange End Connections

Body Size	Body Size	Dimension "L"	Dimension "H"
Model Code	mm (inches)	mm (inches)	mm (inches)
15	15 (0.50)	305 (12)	267 (10.5)
20	20 (0.75)	305 (12)	267 (10.5)
25	25 (1.00)	305 (12)	267 (10.5)
32	32 (1.25)	305 (12)	267 (10.5)
40	40 (1.50)	305 (12)	267 (10.5)
50	50 (2.00)	305 (12)	267 (10.5)
65	65 (2.50)	457 (18)	269.2 (10.6)
80	80 (3.00)	457 (18)	317.5 (12.5)
100	100 (4.00)	457 (18)	317.5 (12.5)
150	150 (6.00)	610 (24)	317.5 (12.5)

* Also available in A106 Grade B carbon steel pipe with A105 flanges (20FC, 25FC, 30FC, and 40FC model codes)

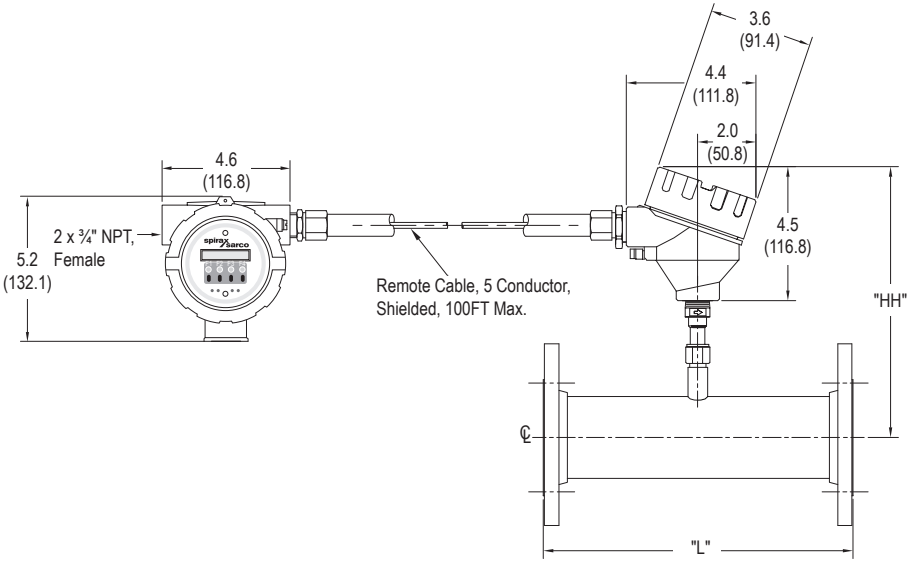


Fig. 46 -
Inline Remote Meter with Stainless Steel Flow Body and 150lb RF Flange End Connections Dimensions

Table 11 -
Inline Remote Meter with stainless steel flow body and 150lb RF Flange End Connections

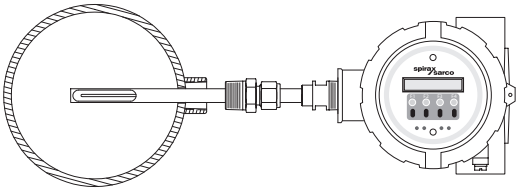
Body Size	Body Size	Dimension "L"	Dimension "HH"
Model Code	mm (inches)	mm (inches)	mm (inches)
15	15 (0.50)	305 (12)	267 (10.5)
20	20 (0.75)	305 (12)	267 (10.5)
25	25 (1.00)	305 (12)	267 (10.5)
32	32 (1.25)	305 (12)	267 (10.5)
40	40 (1.50)	305 (12)	267 (10.5)
50	50 (2.00)	305 (12)	267 (10.5)
65	60 (2.50)	457 (18)	269.2 (10.6)
80	80 (3.00)	457 (18)	317.5 (12.5)
100	100 (4.00)	457 (18)	317.5 (12.5)
150	150 (6.00)	610 (24)	317.5 (12.5)

* Also available in A106 Grade B carbon steel pipe with A105 flanges (20FC, 25FC, 30FC, and 40FC model codes)

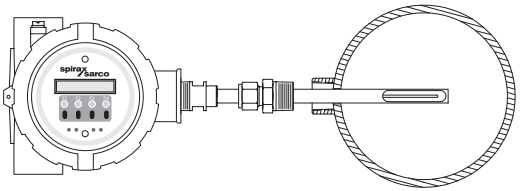
9.5 Installation Variations (moisture)

These variations on installations help prevent moisture and condensation from forming on the sensor and disrupting accurate flow measurement. Spirax Sarco recommends 180° installation, if possible.

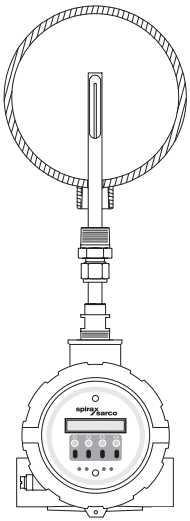
Tilt Installation at 90°, CW



Tilt Installation at 90°, CCW

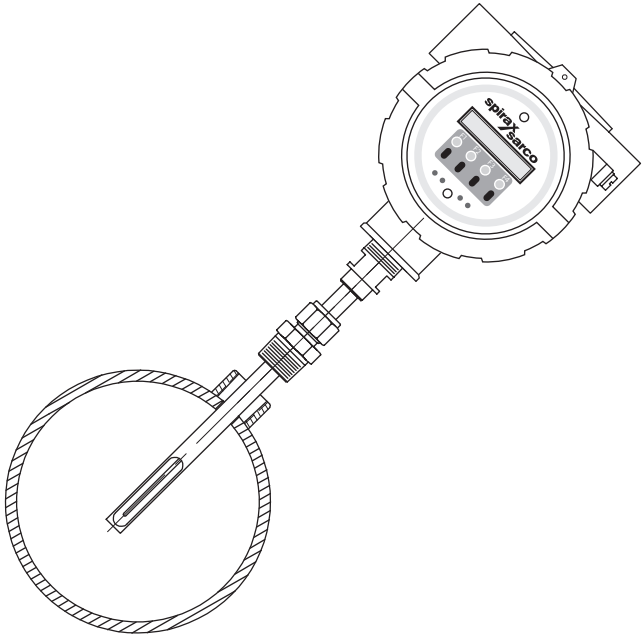


Tilt Installation at 180°



9.6 Installation Variations (limited space)

Tilt Installation at 45°
When restricted physical installation space exists, the MTI10/MTL10 can also be installed at a 45° angle. Please note that the display's orientation will remain aligned with the top of the meter.



NOTE! Displays are rotatable only in 90° angle increments.
For more information about display configurations, visit www.spiraxsarco.com/us/products-services/products/flowmeters.asp to view other display configurations.

9.7 Warranty

LIMITED WARRANTY AND REMEDIES. Spirax Sarco warrants to Purchaser that the products of Spirax Sarco's own manufacture supplied hereunder will, for a period of 12 months from the date of shipment, unless otherwise specified, to Purchaser, be free from defects in material and workmanship under normal and proper operating conditions and service.
The obligation of Spirax Sarco and Purchaser's sole and exclusive remedy pursuant to this warranty shall be, at Spirax Sarco's option, to repair or replace any product or part thereof which is returned to Spirax Sarco, Inc., 1150 Northpoint Boulevard, Blythewood, SC 29016, with transportation charges prepaid that is determined by Spirax Sarco to be defective. Notwithstanding the foregoing, Spirax Sarco shall have no obligation hereunder if all payments due from Purchaser have not been made, or the product or part becomes defective in whole or in part as the result of repairs not made by Spirax Sarco or Purchaser, or as the result of removal, improper use, operation above rated capacities, or misapplication thereof after it has been delivered to the Purchaser.

Products, parts components and accessories, irrespective or attachment or assembly, made by other manufacturer's are warranted only to the extent of the original manufacturer's warranty to Spirax Sarco. If the product sold is described as "used", it is sold "as is, where is" without any guarantee or warranty whatsoever.

EXCEPT AS SET FORTH HEREIN, SPIRAX SARCO MAKES NO OTHER WARRANTIES, EXPRESS, IMPLIED OR STATUTORY , INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. PURCHASER ACKNOWLEDGES THAT THIS IS NOT RELYIN G UPON SPIRAX SARCO'S SKILL OR JUDGMENT TO SELECT OR FURNISH GOODS SUITABLE FOR ANY PARTI CULAR PURPOSE OR UPON ANY AFFIRMATIONS OR FACT OR PROMISES OF SPIRAX SARCO WHICH EXTEND BEYOND SPECIFICATIONS MUTUALLY AGREED UPON IN WRITING BY SPIRAX SARCO AND PURCHASER. IN NO EVENT SHALL SPIRAX SARCO BE LIABLE TO PURCHASER FOR DAMAGES beyond the cost of repair or replacement of defective products, punitive damages, OR FOR SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO, INTERRUPTION OF OPERATIONS, LOSS OF ANTICIPATED PROFITS, OR DAMAGE TO PURCHASER'S BUSINESS REPUTATION.

Warranty Claims and Return Procedure. Products returned to Spirax Sarco by Purchaser for a credit or under a warranty claim will not be accepted for exchange or credit without Spirax Sarco's prior written authorization in accordance with the Return of Product / Material Procedure in effect at the time of the claim.

9.8 Out of Warranty Conditions

This policy has been established to cover repair or replacement of equipment sold by seller which as exceed the warranty expiration date. Seller agrees to repair or replace such equipment at Buyer's expense under the following terms and conditions:

1. All equipment must be returned to Seller's plant at Buyer's expense and risk.
2. Invoices on equipment which is repaired and returned to Buyer will be based on the direct and indirect labor, materials and overhead costs associated with repair, tests, inspections, etc.
3. The warranty set forth in Seller's warranty policy for its equipment applies to new equipment only. No warranty, express or implied, applies to equipment repaired and returned under provisions of this policy.
4. Buyer will be notified immediately if Seller determines the repair cost per item will exceed 50% of the current selling price of a new replacement. Buyer's advice to repair the defective item must be received before any further action is taken.
5. All export taxes, fees and duties connected with out-of-warranty shipments outside the continental United States will be the responsibility of the Buyer.
6. A minimum charge of $150 will be charged to Buyer for all out-of-warranty repairs.

9.9 Returning Your Meter

The Spirax Sarco Applications Group (phone 800-883-4411) can help you through the process of returning a meter for service.

If it becomes necessary to return a Spirax Sarco flowmeter for service or recalibration, please follow these steps:

1. Please have your meter's serial number(s) ready so that we can find the records for your meter(s) quickly.
2. Read the Spirax Sarco RMA Request Form carefully for detailed instructions on the RMA process.
3. Fill out the Spirax Sarco RMA Customer Information Form.
4. Obtain a Return Material Authorization (RMA) Number from the Spirax Sarco Applications Group.
5. Unless specifically instructed to do otherwise, the entire flowmeter must be returned, including all electronics. (For remote units or flow bodies, ALL serial numbers must match their corresponding meters.)
6. Clean and decontaminate all wetted parts before returning to Spirax Sarco.

What to expect while your meter is being serviced

Depending on the type of meter, there are varying turnover times for servicing a meter. The average time needed to service the meter is 10 - 14 days (not including shipping or peak production times).

If you have already shipped your meter to Spirax Sarco for servicing and would like to check the status of your meter, please contact the Applications Department.

Rush recalibration service is available for a fee. Restrictions apply.

Spirax Sarco Technical Support Department
Toll Free at: 1-800-883-4411

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1150 Northpoint Boulevard
Blythewood, SC 29016
Phone: 800.883.4411
www.spiraxsarco.com/us