MTS

Level Plus®

Liquid-Level Transmitter
Model M-Series
Analog Output

Operation and Installation

550720 Revision F

TABLE OF CONTENTS

Notices used in this book

This book contains notices to highlight specific information as follows:

Notes

These notices provide important tips, guidance, or advice.

Important

These notices provide information that might help you avoid inconvenient or problem situations.

Attention

These notices indicate possible damage to programs, devices, or data. An attention notice is placed just before the instruction or situation in which damage could occur.

Caution

These notices indicate situations that can be potentially hazardous to you. A Caution notice is placed just before a description of a potentially hazardous procedure, step, or situation.

Related publications

The following publications are available in Adobe Acrobat Portable Document Format (PDF) at http://www.mtssensors.com.

550731 Installation sheet, M-Series Electronics Module
550677 Product Specification, Level Plus M-Series Analog
550537 Product Specification, Level Plus M-Series Floats and Accessories

For information about safe work procedures, refer to the following documentation:
National Electric Code ANSI/NFPA 70

How this book is organized

Getting information, help, and service

Ordering information and software updates

You can get the latest ordering information and software updates by using the World Wide Web. Go to *www.mtssensors.com.*

For information relating to HART® Communication Foundation , go to *www.hartcomm.org*.

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9390 Research Blvd., Suite I-350
Austin TX 78759

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1.0 INTRODUCTION

MTS is recognized as the pioneer, innovator and leader in magnetostrictive sensing. The Level Plus® M-Series transmitter design represents a continuation of our on-going effort to provide effective, innovative and reliable products to the liquid-level marketplace.

Throughout this document, the following “short names” are used:

- Level Plus M-Series Transmitter is referred to as *M-Series transmitter* or *transmitter*
- Transmitter electronics interconnect board is referred to as interconnect board.
- HART hand-held converter is referred to as *HART converter*
- Electronics module is referred to as *puck*
- Housing is referred to as *enclosure*
- Bottom-fixing weight, magnet or hook is referred to as *retaining hardware*

Go to www.mtssensors.com for:

- Current Level Plus M-Series model numbers.
- Detailed ordering information.
- Ordering online using our interactive application worksheets.
- Downloading Software updates.

2.0 PRODUCT DESCRIPTION

The Level Plus M-Series transmitter is multi-functional with two 4-20 mA loops that utilize Highway Addressable Remote Transducer (HART) communications. It provides up to two analog outputs of level, interface, or temperature. An optional electronics module displays simultaneous readouts of level, interface, or temperature. The optional electronics module is designed with three push buttons for local setup of all parameters. Outputs can be monitored using 4-20 mA signal output, when you use a *RS-232* to *HART Hand-Held Converter* with an optional integral display or MTS PC-compatible *M-Series Field Setup* software.

Level Plus M-Series transmitters can be housed in three types of enclosure configurations:

- NEMA 4X electropolished
- Stainless steel with I.S. approval
- Single cavity or dual-cavity explosionproof enclosure with epoxy-powder coating.

The outer pipe is constructed of a variety of configurations (Contact factory for other materials):

- 5/8 in. diameter rigid outer pipe of 316L stainless steel
- 5/8 in. diameter rigid outer pipe of polished 316L stainless steel with sanitary process connection and end-plug.
- 7/8 in. diameter flexible pipe of 316L stainless steel

M-Series transmitters utilize a special sensor element which allows easy removal or replacement while the tank or vessel is in service, leaving the tank connection or seal intact. This design allows the sensor element to be installed or removed in situations where there is a low overhead clearance.

A temperature sensing function is optional with the M-Series transmitter. The temperature sensing device is a Resistive Temperature Device (RTD) mounted inside the transmitter's outer tube assembly. The RTD is a 1000 ohm platinum film device.

2.1 Level Plus M-Series transmitter specifications

PARAMETER	SPECIFICATION
LEVEL OUTPUT	
Measured variable:	Product level and interface level
Output:	4-20 mA, 2 loops with HART interface
Full range:	Flexible gauges: 120 to 480 in. (3050 to 11890 mm) Rigid gauges: 20 in. to 300 in (508 mm to 7620 mm)❖▼ **Notes:** Rigid sensor pipes have a rigid sensor element. Flexible sensor pipes have a flexible sensor element. Flexible sensor elements are available for rigid pipe configuration as an option.
Non-linearity:	Flexible gauges: 0.035% F.S. (independent BSL) or 1/32 in. (0.794 mm)★ Rigid gauges: 0.020% F.S. (independent BSL) or 1/32 in. (0.794 mm)★
Repeatability:	Flexible gauges: Up to 0.01% F.S. or 0.015 in. (0.381 mm)★ Rigid gauges: Up to 0.005% F.S. or 0.005 in. or (0.127 mm)★
Sensor operating temperature:	-40 to 257 °F (-40 to 125 °C) (Consult factory for higher temperature applications.)
GAUGE LOOP	
Input voltage range:	10.5 to 36.1 Vdc
Reverse polarity protection:	Series diode
Transient protection:	Stage 1: Line-to-ground surge suppressors; 2500 Amps peak (8/20 µsec) Stage 2: Line-to-line and line-to-ground transient suppressors; 1500 Watts peak (10/1000 µsec)
CALIBRATION	
Zero adjust range:	Anywhere within the active length
Span adjust range:	Full scale ≥ 0.5 ft. (152 mm) from zero
TEMPERATURE OUTPUT	
Type:	4-20 mA from 1,000 ohm platinum RTD at 0 °C
Repeatability:	±0.18 °F (0.1 °C)
Accuracy:	±2.7 °F (±1.5 °C)
Drift:	±0.9 °F (0.5 °C) per year
Zero adjust:	-40 to 255 °F (-40.to 124 °C)
Span adjust:	45 °F (7.2 °C) minimum, full scale (maximum) = 300 °F (149 °C)
ENVIRONMENTAL	
Humidity:	0 to 100% R.H., non-condensing
Electronics operating temperature:	-30 to 160 °F (-34 to 71 °C)
Vessel pressure:	Dependent on float pressure rating, refer to MTS document part number 550537 for more information.▲
Materials (wetted parts):	316L stainless steel ●
FIELD INSTALLATION:	
Length (including housing):	20 in to 40 ft. (508 to 12,192 mm)❖▼
Mounting:	3/4 in. NPT adjustable fitting (rigid pipe) 1 in. NPT adjustable fitting (flex pipe)
Wiring:	2-wire connection, shielded cable or twisted pair to screw terminals through a 3/4 in. NPT conduit opening. NEMA 4X: 15 ft. (457 cm) pigtail integral cable or Daniel Woodhead (part number 70807SS) 6-pole Male 1/4 in.-18 MNPT key-way receptacle.
DISPLAY (Optional)	
Measured variables:	Level 1, Level 2 and temperature.
Update rate:	3 second
Size:	0.5 in. (12.7 mm)
Number of digits:	16
HART communications	
Method of communication:	Frequency Shift Keying (FSK) conforms with Bell 202 Modem Standard with respect to baud rate and digital "1" and "0" frequencies.
Baud rate:	1200 bps.
Digital "0" frequency:	2200 Hz.
Digital "1" frequency:	1200 Hz.
Data-byte structure:	1 Start bit, 8 data bits, 1 odd parity bit, and 1 stop bit
Digital process variable rate:	Poll/Response Midel 2.0 per second

PARAMETER	SPECIFICATION	
AGENCY/SAFETY Approval:	FM/CSA: Explosion-proof Class I, Groups B,C,D Class II, Groups E,F,G Division 1, NEMA 4X Models: Explosion-proof housing req.	FM/CSA: Intrinsically Safe Class I, Groups A,B,C,D Class II, Groups E,F,G Division I, NEMA 4X Models: All

★ *Whichever is greater*
★★*Must specify at time of order, not on all units*
▼*Contact factory for longer lengths.*
● *Contact factory for other materials*
▲ *Contact factory for higher pressure ratings.*
❖ *Flexible sensor elements are available for rigid pipe configurations as an option.*
All Specifications are subject to change. Please contact MTS for specifications critical to your needs.

2.2 Accuracy

The absolute accuracy of the transmitter is a function of the manufacture of the waveguide. That is, any imperfections in the waveguide are reflected in the linearity of its output. MTS tolerances reflect a maximum non-linearity of 0.035% of full scale. Due to its high degree of repeatability, the differential accuracy is extremely high.

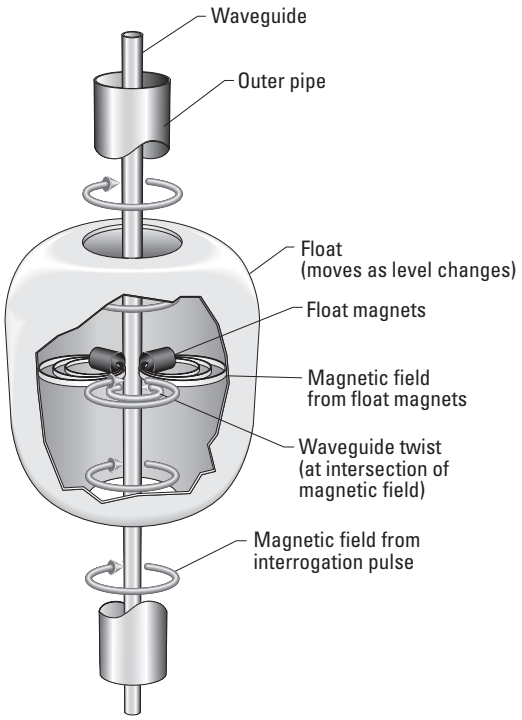
2.3 Theory of operation

The magnetostrictive Level Plus M-Series transmitter will precisely sense the position of an external float by applying an interrogation pulse to a waveguide medium. This current pulse causes a magnetic field to instantly surround the waveguide. The magnet installed within the float also creates a magnetic field. Where the magnetic fields from the waveguide and float intersect, a rotational force is created (waveguide twist). This, in turn, creates a torsional-sonic pulse that travels along the waveguide as shown in *Figure 2-1 "Principal of magnetostriction"*.

The head of the sensing element houses the sensing circuit, which detects the torsional-sonic pulse and converts it to an electrical pulse. The distance from a reference point to the float is determined by measuring the time interval between the initiating current pulse and the return pulse and precisely knowing the speed of these pulses. The time interval is converted into a 4-20 mA loop signal.

The Level Plus M-Series transmitter offers level, interface, or temperature outputs. There are two current loops available; any output may be assigned to either of the two loops.

Figure 2-1
Principle of magnetostriction



2.4 Enclosure options fora Level Plus M-Series transmitter

There are three M-Series transmitter enclosure options: NEMA 4X, single-cavity and dual-cavity enclosure. The NEMA 4X enclosure is constructed of 316L stainless steel. The single and dual-cavity enclosures are rated NEMA 7 explosionproof. Enclosure dimensions are shown in *Figure 2-2a, 2b and 2c* below.

Figure 2-2 M-Series transmitter enclosure dimensions

Figure 2-2a
NEMA 4X enclosure

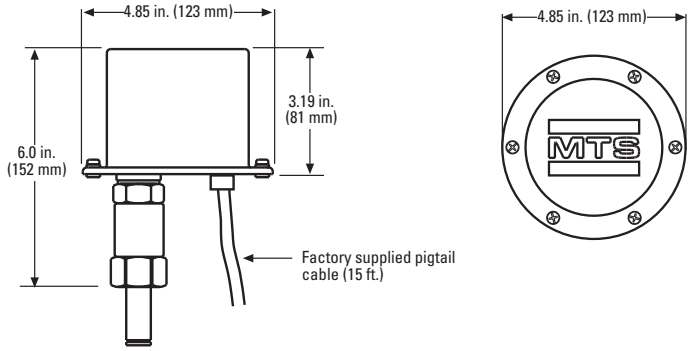


Figure 2-2b
Single-cavity explosionproof enclosure

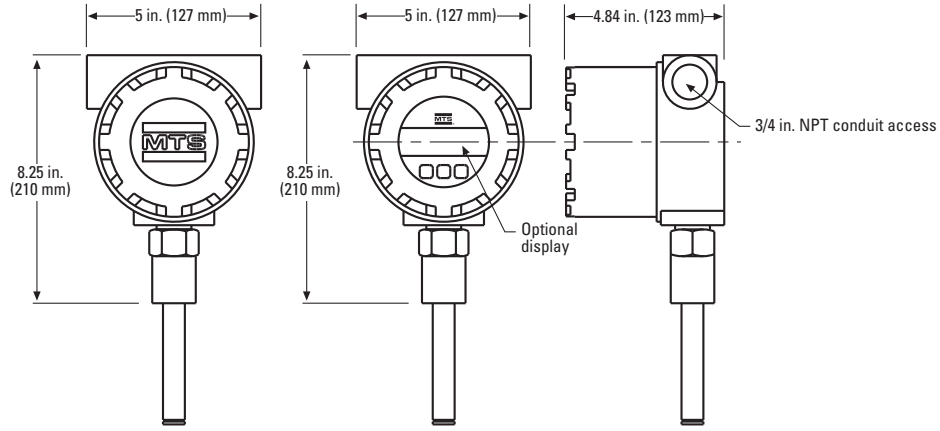
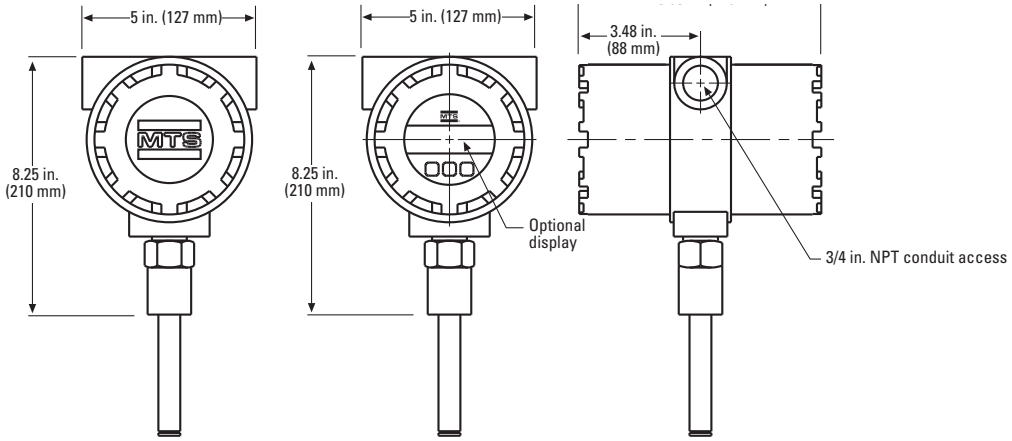


Figure 2-2c
Dual-cavity explosionproof enclosure



3.0 INSTALLATION AND MOUNTING

The method you use to mount the M-Series transmitter is dependent on the vessel or tank in which it is being used, and what type of sensor is being mounted. Most applications will require one of two methods; threaded or flange mounting, as shown in *Figure 3-1a "Threaded-flange mounting for rigid and flexible pipe"* and *Figure 3-1b "Welded-flange mounting for rigid and flexible pipe"*. (For detailed information about Sanitary application mounting, go to *3.2 "Sanitary Sensor Mounting"* on page 8.)

3.1 Rigid and flexible transmitter mounting options

3.1a Threaded-flange mounting

In applications with smaller vessels and tanks, the transmitter can be mounted directly to the tank or flange by using a threaded *NPT fitting*, assuming there is a proper threaded connection available. If the float will not fit through the *tank flange*, there must also be some means to mount the float on the transmitter from inside the vessel; this may require a *float access port* nearby the entry point of the transmitter (as shown in *Figure 3-1a "Threaded-flange mounting for rigid and flexible pipe"* on page 6).

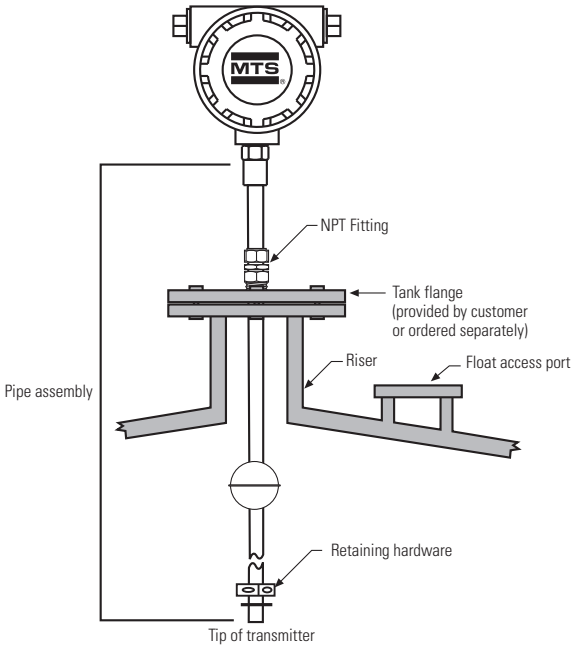
Complete the following steps to mount the transmitter using the threaded-flange method:

1. Remove the float(s) *retaining hardware*, then remove the transmitter.
2. Insert the *transmitter tip* through the threaded vessel opening or flange.

> **Important:**
> Before you completely insert the transmitter to the bottom of the vessel, you must remount the float(s) through an access port and also reattach the float retaining hardware.

3. The *transmitter tip* can now be lowered to the vessel bottom and the connection can be made from the threaded *NPT fitting* to the vessel. In general, there should not be more than 12 inches of the transmitter's *pipe assembly* extending above the vessel.

Figure 3-1a
Threaded-flange mounting
for rigid and flexible pipe

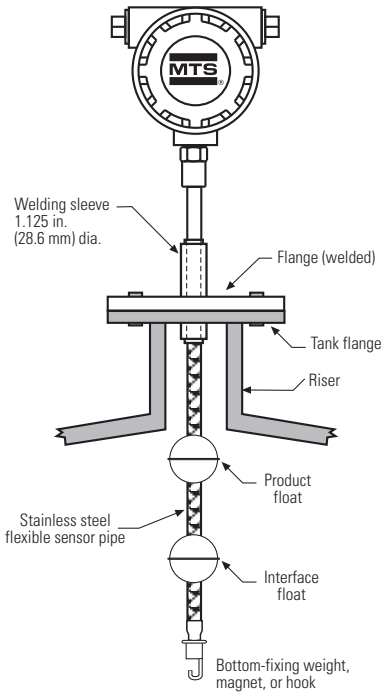


3.1b Welded-flange mounting

The M-Series transmitter can also be mounted to a tank flange as shown in *Figure 3-1b "Welded-flange mounting for rigid and flexible pipe"*. Complete the following steps to mount the transmitter onto a tank flange:

1. Install the *product* and *interface floats* onto the *flexible-sensor pipe*.
2. Install the *bottom-fixing weight, magnet or hook* (also referred to as retaining hardware) on to the tip of the transmitter.
3. To complete the installation, mount the transmitter, *tank flange*, *flexible-sensor pipe* and *product/interface floats* as an assembled unit in to the tank.

Figure 3-1b
Welded-flange mounting
for rigid and flexible pipe

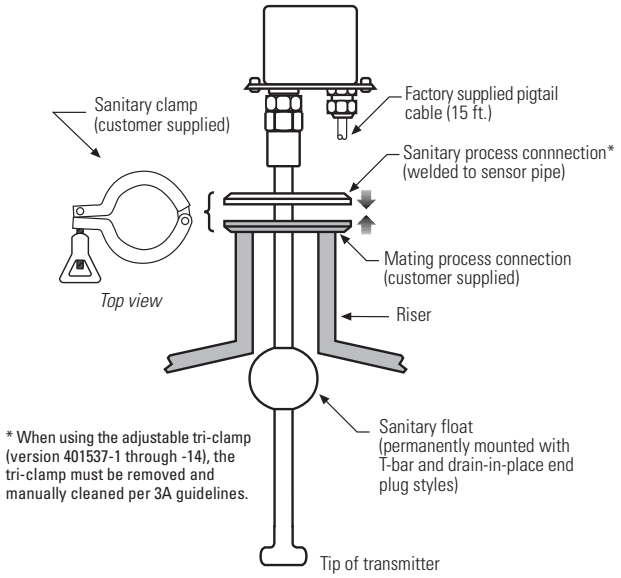


Note:
In general, there should not be more than 12 inches of the transmitter's sensor pipe length extending above the vessel.

3.2 Sanitary transmitter mounting

In sanitary applications, the M-Series transmitter is mounted to the tank using a standard *sanitary process connection* and *sanitary clamp** as shown in *Figure 3-2 "M-Series transmitter, tank-mounted sanitary connection"*. In most cases, it is not necessary to remove the *sanitary float* as the sanitary *end-plug fitting* is sized to allow installation with the float in place. Please note that some sanitary end-plug styles have the float(s) permanently mounted.

Figure 3-2
M-Series transmitter, tank-mounted sanitary connection



3.3 Installing a flexible sensor pipe with a bottom-fixing weight or magnet

Important:
When assembling and installing the M-Series transmitter, be careful not to allow the flexible hose to kink or be coiled in less than an 16-inch diameter.

To ensure proper and safe assembly and mounting of the transmitter, a minimum of two (2) individuals are required. Gloves are also required.

Complete the following steps to install a flexible sensor pipe with a bottom-fixing weight or magnet:

Attention:
Be careful not to drop the flange on flexible sensor pipe as damage may result.

1. With assistance, feed the *flexible sensor pipe* through the NPT opening of the tank flange until the flange is positioned at the rigid section of flexible sensor pipe near the top of the transmitter. Insert the threaded portion of the adjustable fitting into the customer flange (apply pipe thread sealant if required). See *Figure 3-1a "Threaded-flange mounting for rigid and flexible pipe"* on page 6.

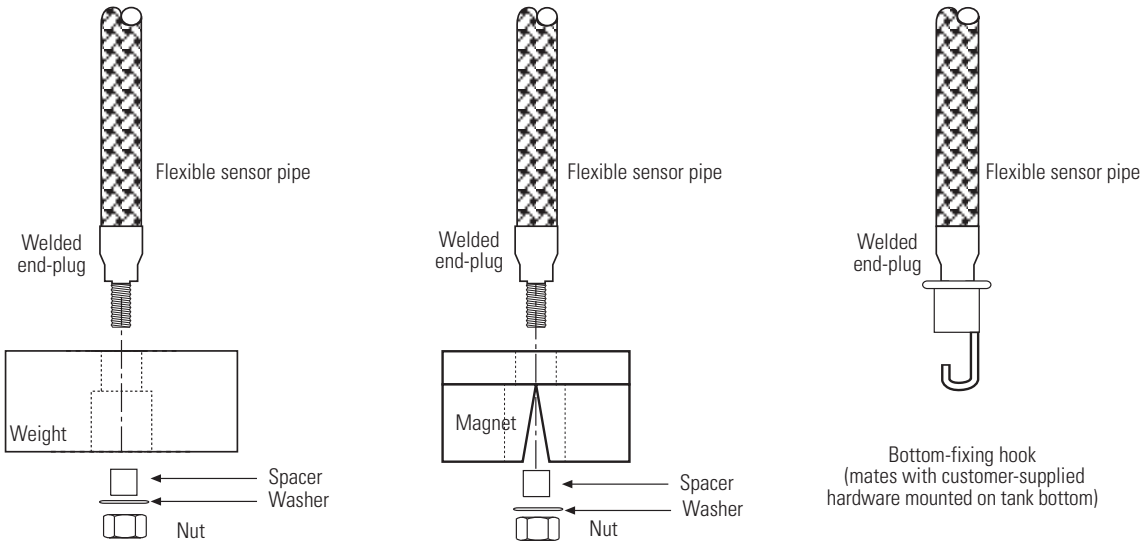
   Attention:
   Do not drop the float(s) or allow them to free fall along the flexible sensor pipe as damage may result.

2. Slide the *product float* onto the flexible sensor pipe. See *Figure 3-1b "Welded-flange mounting for rigid and flexible pipe"* on page 7.
3. Slide the *interface float* (optional) onto the flexible sensor pipe. *Figure 3-1b "Welded-flange mounting for rigid and flexible pipe"* on page 7.
4. If you are using a *weight* or *magnet*, mount the weight or the magnet to the *welded end-plug* section of the flexible sensor pipe (this is the bottom rigid section of the flexible sensor pipe) using the supplied *nut*, *spacer* and *washer* as shown in *Figure 3-3 "Retaining hardware"* on page 9. Securely tighten mounting nut using 1/2-inch wrench.

Attention:
Do not kink or bend the flexible sensor pipe in less that a 16-inch diameter as damage may result.

5. Slide the float(s) back down to the *weight* or *magnet* to prevent them from free falling during installation into the tank. Insert the flexible sensor pipe (with floats) through the tank riser pipe and lower the transmitter assembly into the tank until it rests on the bottom. DO NOT DROP OR DAMAGE THE PIPE.
6. If you are using a flexible sensor pipe with a *bottom-fixing hook*, fasten the bottom-fixing hook to the appropriate *customer-supplied mating hardware* at the tank bottom.
7. Secure the flange onto the tank riser pipe.

Figure 3-3
Retaining hardware



Gauge retention using weight | Gauge retention using magnet | *Gauge retention using hook*

8. Pull the flexible sensor pipe upward to straighten the pipe until the resistance of the weight or magnet is felt without raising the weight or magnet off the floor of the tank. Tighten the adjustable fitting to hold the sensor in place.
9. Terminate the field-wire cables noting proper wire orientation.

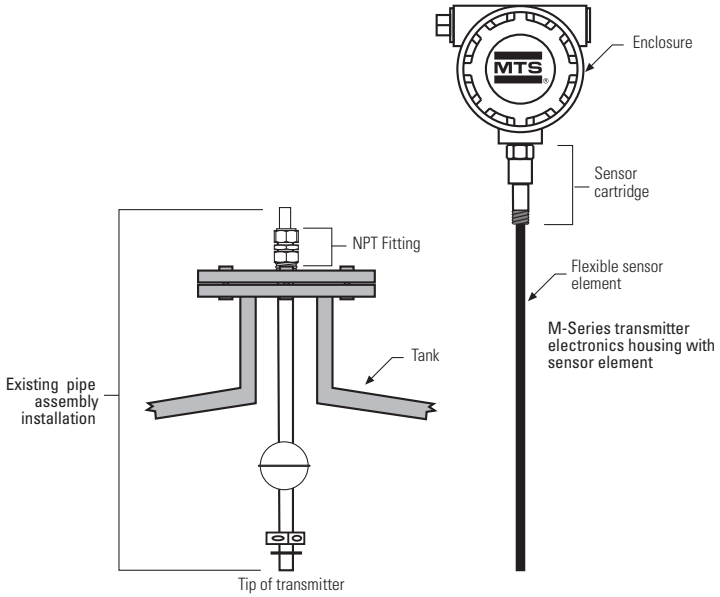
3.4 Installing a flexible sensor element

Attention:
- Do not bend flexible sensor element to less than a 16-inch bending diameter or damage may result.
- Always use safe handling procedures when handling electronics equipment.
- Be sure that the inside of the existing outer pipe is clean and dry, and free of debris before installing the M-Series transmitter.

Complete the following steps to replace an *transmitter electronics housing* and flexible sensor element into an existing pipe assembly:

1. Sensor pipe and floats should already be installed (see *3.2 "Sanitary Sensor Mounting"* on page 8). The electronics housing and sensor element portion of the gauge should be separate from the sensor pipe, as shown in *Figure-3-4 "Flexible sensor element installation"*.

Figure 3-4
Flexible sensor element installation



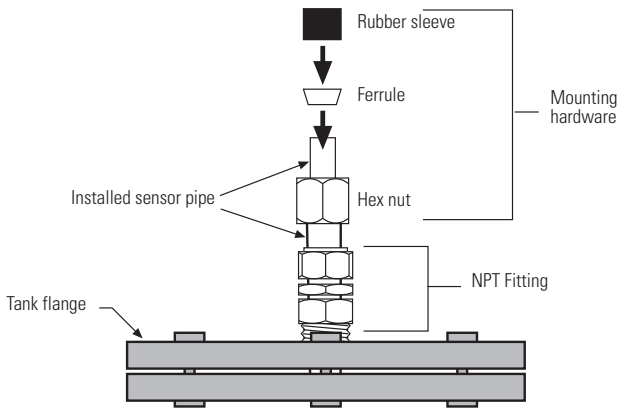
The M-Series transmitter is shipped with the following *mounting hardware* (as shown in *Figure 3-5 "Installing the mounting hardware"*):

1 hex nut
1 ferrule
1 rubber sleeve

Important:
The mounting hardware must be installed in a specific order, and when installed, the ferrule and rubber sleeve collapse inside of the hex nut.

2. Install the *hex nut* onto the existing *sensor pipe* to ensure the threads on the inside of the hex nut are facing up.
3. Install the *ferrule* onto the sensor pipe, ensuring that the tapered end is down.
4. Install the *rubber sleeve* onto the sensor pipe and push the rubber sleeve down into the hex nut.

Figure 3-5
Installing the mounting hardware



5. Mount the *sensor element* into the existing sensor pipe. Do not damage or kink the flexible sensor element in less than a 16-inch bend diameter while installing the element. Guide the sensor downward until the mating surface of the *enclosure* installs over the existing sensor pipe, as shown in *Figure 3-6a*.

Figure 3-6a

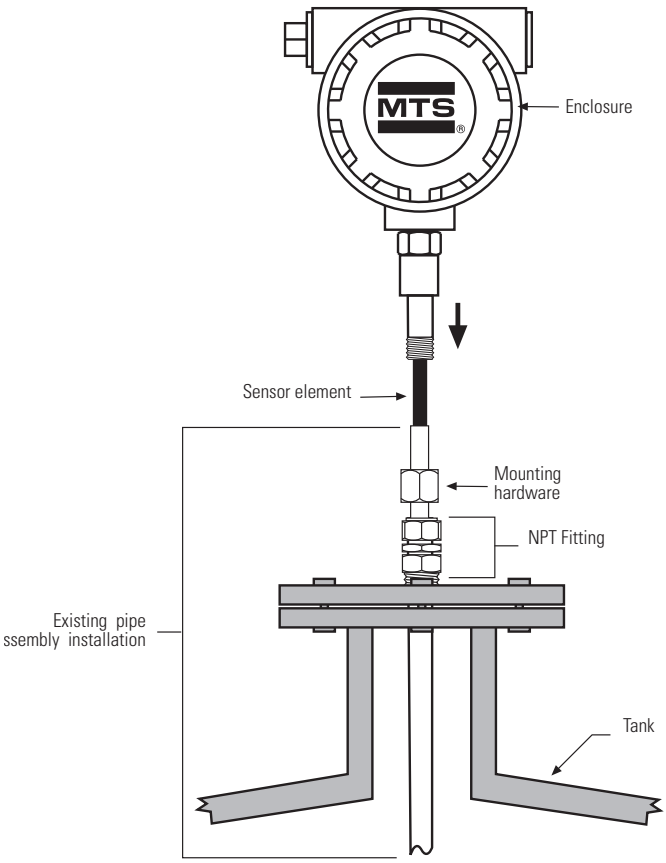
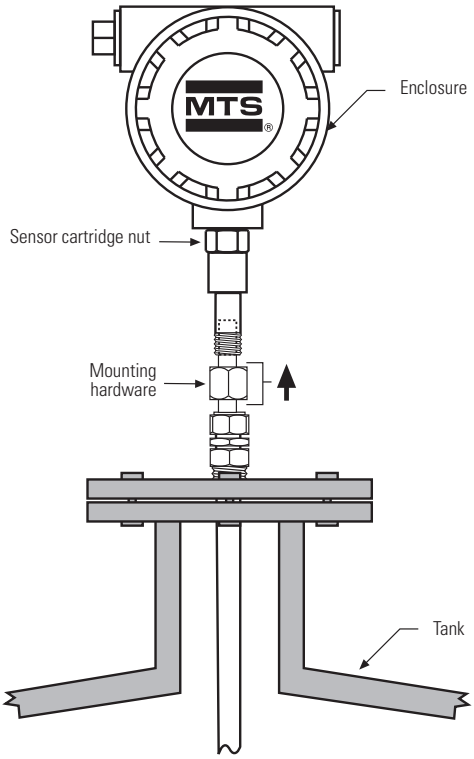


Figure 3-6b



6. Make sure that the sensor pipe seats firm against the *sensor cartridge nut* and then pull up the *mounting hardware* to engage it with the threads of the sensor cartridge, as shown in *Figure 3-6b*. Ensure that you are not cross-threading as you begin to screw the hex nut onto the threads.
7. Hand tighten the *mounting hardware* and tighten another two full turns with a wrench. Hold the sensor cartridge nut while tightening the mounting hardware to ensure that the electronics housing does not swivel with the turning of the wrench.
8. Ensure that the enclosure and existing pipe assembly are properly tightened; pull up on the enclosure, the enclosure and pipe assembly should not move.

4.0 ELECTRICAL CONNECTIONS AND WIRING PROCEDURES

A typical intrinsically-safe connection for the Level Plus transmitter includes protective safety barriers, a power supply, and a reading or monitoring device. Refer to MTS drawing number 650805 (Revision D) in section *4-1a and 4-1b* on pages 13 and 14 for detailed installation and wiring information.

If you are using an integral connector with a NEMA 4X Intrinsically safe enclosure, see section *4-1b "Installation drawing, M-Series transmitter with NEMA 4X enclosure"* on page 14 MTS drawing part number 650805 for wiring information.

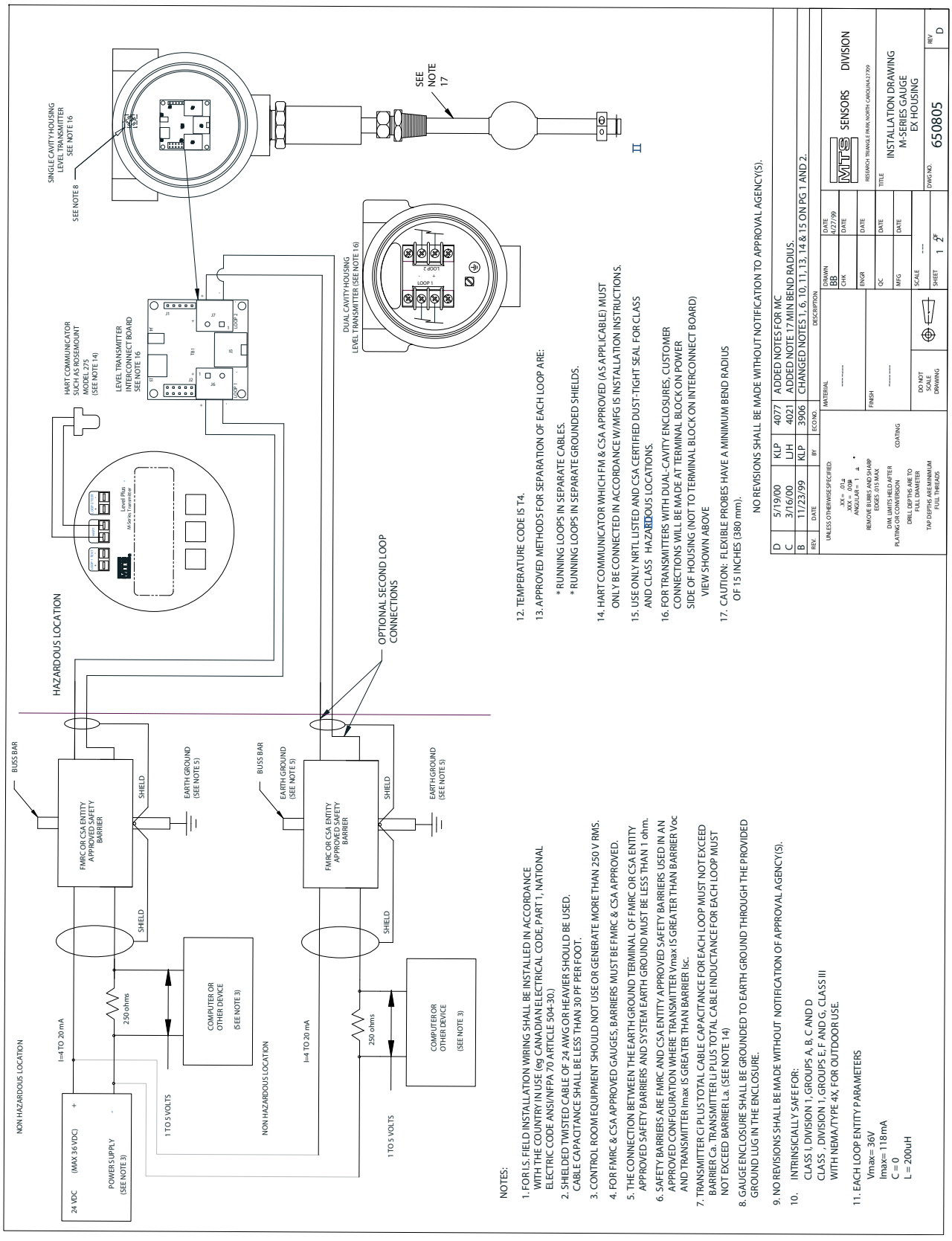
A typical explosionproof connection for the Level Plus transmitter includes a power supply and a reading or monitoring device connected using an explosionproof conduit (see section *4.1 "Agency controlled drawing references, M-Series Analog"* on page 13 for a typical conduit installation). Refer to MTS engineering drawing number 650805 (Revision D) for detailed installation and wiring information. See also section 4.2 "*Electrical Conduit installation*".

Notes:

1. Loop #1 must be powered on for the M-Series transmitter to operate properly.
2. For explosionproof installation, safety barriers are not required and wiring must be installed in accordance with the National Electric Code ANSI/NFPA 70.

4.1 Agency controlled drawing references, M-Series analog

4.1a. Installation drawing, M-Series transmitter with explosionproof enclosure, 650805 (Revision D) sheet 1 of 2



NOTES:

1. FOR I.S. FIELD INSTALLATION WIRING SHALL BE INSTALLED IN ACCORDANCE WITH THE COUNTRY IN USE (eg CANADIAN ELECTRICAL CODE, PART 1, NATIONAL ELECTRIC CODE ANSI/NFPA 70 ARTICLE 504-30.)
2. SHIELDED TWISTED CABLE OF 24 AWG OR HEAVIER SHOULD BE USED. CABLE CAPACITANCE SHALL BE LESS THAN 30 PF PER FOOT.
3. CONTROL ROOM EQUIPMENT SHOULD NOT USE OR GENERATE MORE THAN 250 V RMS.
4. FOR FMRC & CSA APPROVED GAUGES, BARRIERS MUST BE FMRC & CSA APPROVED.
5. THE CONNECTION BETWEEN THE EARTH GROUND TERMINAL OF FMRC OR CSA ENTITY APPROVED SAFETY BARRIERS AND SYSTEM EARTH GROUND MUST BE LESS THAN 1 ohm.
6. SAFETY BARRIERS ARE FMRC AND CSA ENTITY APPROVED SAFETY BARRIERS USED IN AN APPROVED CONFIGURATION WHERE TRANSMITTER Vmax IS GREATER THAN BARRIER Voc AND TRANSMITTER Imax IS GREATER THAN BARRIER Isc.
7. TRANSMITTER Ci PLUS TOTAL CABLE CAPACITANCE FOR EACH LOOP MUST NOT EXCEED BARRIER Ca. TRANSMITTER Li PLUS TOTAL CABLE INDUCTANCE FOR EACH LOOP MUST NOT EXCEED BARRIER La. (SEE NOTE 14)
8. GAUGE ENCLOSURE SHALL BE GROUNDED TO EARTH GROUND THROUGH THE PROVIDED GROUND LUG IN THE ENCLOSURE.
9. NO REVISIONS SHALL BE MADE WITHOUT NOTIFICATION OF APPROVAL AGENCY(S).
10. INTRINSICIALLY SAFE FOR:
    CLASS I, DIVISION 1, GROUPS A, B, C AND D
    CLASS , DIVISION 1, GROUPS E, F AND G, CLASS III
    WITH NEMA/TYPE 4X, FOR OUTDOOR USE.
11. EACH LOOP ENTITY PARAMETERS
    Vmax= 36V
    Imax= 118mA
    C = 0
    L = 200uH
12. TEMPERATURE CODE IS T4.
13. APPROVED METHODS FOR SEPARATION OF EACH LOOP ARE:
    * RUNNING LOOPS IN SEPARATE CABLES.
    * RUNNING LOOPS IN SEPARATE GROUNDED SHIELDS.
14. HART COMMUNICATOR WHICH FM & CSA APPROVED (AS APPLICABLE) MUST ONLY BE CONNECTED IN ACCORDANCE W/MFG IS INSTALLATION INSTRUCTIONS.
15. USE ONLY NRTL LISTED AND CSA CERTIFIED DUST-TIGHT SEAL FOR CLASS II AND CLASS III HAZARDOUS LOCATIONS.
16. FOR TRANSMITTERS WITH DUAL-CAVITY ENCLOSURES, CUSTOMER CONNECTIONS WILL BE MADE AT TERMINAL BLOCK ON POWER SIDE OF HOUSING (NOT TO TERMINAL BLOCK ON INTERCONNECT BOARD) VIEW SHOWN ABOVE
17. CAUTION: FLEXIBLE PROBES HAVE A MINIMUM BEND RADIUS OF 15 INCHES (380 mm).

NO REVISIONS SHALL BE MADE WITHOUT NOTIFICATION TO APPROVAL AGENCY(S).

REV.	DATE	BY	ECO NO.	DESCRIPTION
D	5/19/00	KLP	4077	ADDED NOTES FOR MC
C	3/16/00	LJH	4021	ADDED NOTE 17 MIN BEND RADIUS.
B	11/23/99	KLP	3906	CHANGED NOTES 1, 6, 10, 11, 13, 14 & 15 ON PG 1 AND 2.

UNLESS OTHERWISE SPECIFIED: XX= ±0.2, XXX= ±0.08, ANGULAR= ± 1°. REMOVE BURRS AND SHARP EDGES .015 MAX. DIM. LIMITS HELD AFTER PLATING OR CONVERSION. DRILL DEPTHS ARE TO FULL DIAMETER. TAP DEPTHS ARE MINIMUM FULL THREADS.

MATERIAL: ---- ------
FINISH: ------ ----
COATING

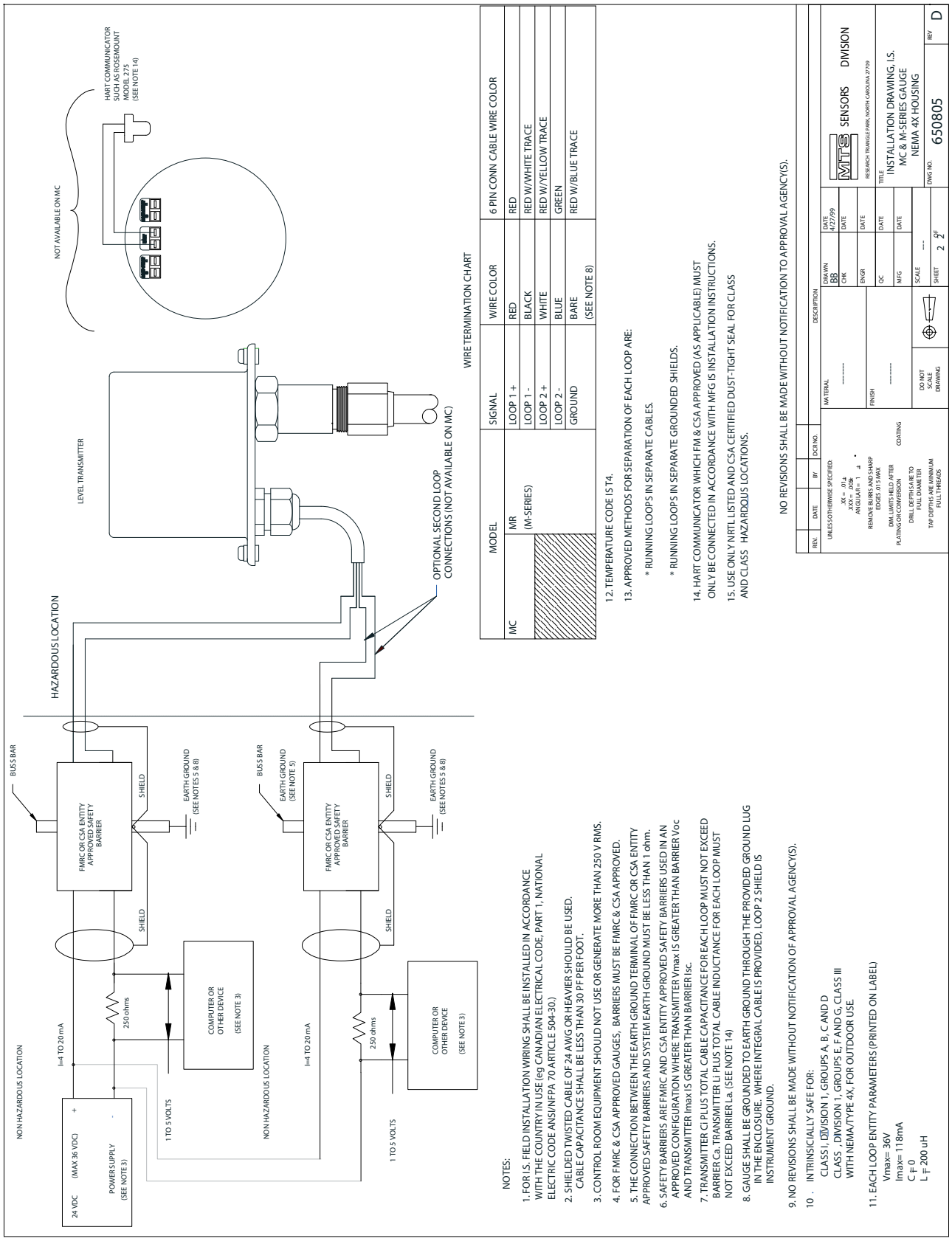
DRAWN BB 4/27/99 | CHK | ENGR | QC | MFG | SCALE ---
DO NOT SCALE DRAWING
SHEET 1 OF 2

MTS SENSORS DIVISION
RESEARCH TRIANGLE PARK, NORTH CAROLINA 27709

TITLE: INSTALLATION DRAWING M-SERIES GAUGE EX HOUSING

DWG NO. 650805 REV D

4.1b Installation drawing M-Series transmitter with NEMA 4X enclosure, 650805 (Revision D) sheet 2 of 2



WIRE TERMINATION CHART

MODEL		SIGNAL	WIRE COLOR	6 PIN CONN CABLE WIRE COLOR
MC	MR (M-SERIES)	LOOP 1 +	RED	RED
		LOOP 1 -	BLACK	RED W/WHITE TRACE
		LOOP 2 +	WHITE	RED W/YELLOW TRACE
		LOOP 2 -	BLUE	GREEN
		GROUND	BARE (SEE NOTE 8)	RED W/BLUE TRACE

NOTES:

1. FOR I.S. FIELD INSTALLATION WIRING SHALL BE INSTALLED IN ACCORDANCE WITH THE COUNTRY IN USE (eg CANADIAN ELECTRICAL CODE, PART 1, NATIONAL ELECTRIC CODE ANSI/NFPA 70 ARTICLE 504-30.)
2. SHIELDED TWISTED CABLE OF 24 AWG OR HEAVIER SHOULD BE USED. CABLE CAPACITANCE SHALL BE LESS THAN 30 PF PER FOOT.
3. CONTROL ROOM EQUIPMENT SHOULD NOT USE OR GENERATE MORE THAN 250 V RMS.
4. FOR FMRC & CSA APPROVED GAUGES, BARRIERS MUST BE FMRC & CSA APPROVED.
5. THE CONNECTION BETWEEN THE EARTH GROUND TERMINAL OF FMRC OR CSA ENTITY APPROVED SAFETY BARRIERS AND SYSTEM EARTH GROUND MUST BE LESS THAN 1 ohm.
6. SAFETY BARRIERS ARE FMRC AND CSA ENTITY APPROVED SAFETY BARRIERS USED IN AN APPROVED CONFIGURATION WHERE TRANSMITTER Vmax IS GREATER THAN BARRIER Voc AND TRANSMITTER Imax IS GREATER THAN BARRIER Isc.
7. TRANSMITTER Ci PLUS TOTAL CABLE CAPACITANCE FOR EACH LOOP MUST NOT EXCEED BARRIER Ca. TRANSMITTER Li PLUS TOTAL CABLE INDUCTANCE FOR EACH LOOP MUST NOT EXCEED BARRIER La. (SEE NOTE 14)
8. GAUGE SHALL BE GROUNDED TO EARTH GROUND THROUGH THE PROVIDED GROUND LUG IN THE ENCLOSURE. WHERE INTEGRAL CABLE IS PROVIDED, LOOP 2 SHIELD IS INSTRUMENT GROUND.
9. NO REVISIONS SHALL BE MADE WITHOUT NOTIFICATION OF APPROVAL AGENCY(S).
10. INTRINSICIALLY SAFE FOR:
    CLASS I, DIVISION 1, GROUPS A, B, C AND D
    CLASS , DIVISION 1, GROUPS E, F AND G, CLASS III
    WITH NEMA/TYPE 4X, FOR OUTDOOR USE
11. EACH LOOP ENTITY PARAMETERS (PRINTED ON LABEL)
    Vmax= 36V
    Imax= 118mA
    C = 0
    L = 200 uH
12. TEMPERATURE CODE IS T4.
13. APPROVED METHODS FOR SEPARATION OF EACH LOOP ARE:
    * RUNNING LOOPS IN SEPARATE CABLES.
    * RUNNING LOOPS IN SEPARATE GROUNDED SHIELDS.
14. HART COMMUNICATOR WHICH FM & CSA APPROVED (AS APPLICABLE) MUST ONLY BE CONNECTED IN ACCORDANCE WITH MFG IS INSTALLATION INSTRUCTIONS.
15. USE ONLY NRTL LISTED AND CSA CERTIFIED DUST-TIGHT SEAL FOR CLASS AND CLASS II HAZARDOUS LOCATIONS.

NO REVISIONS SHALL BE MADE WITHOUT NOTIFICATION TO APPROVAL AGENCY(S).

REV.	DATE	BY	DCN NO.	DESCRIPTION

UNLESS OTHERWISE SPECIFIED: XX = .01 XXX = .005 ANGULAR = 1° MATERIAL ---------- FINISH ---------- REMOVE BURRS AND SHARP EDGES .015 MAX DIM. LIMITS HELD AFTER PLATING OR CONVERSION COATING DRILL DEPTHS ARE TO FULL DIAMETER TAP DEPTHS ARE MINIMUM FULL THREADS DO NOT SCALE DRAWING SCALE --- SHEET 2 OF 2

DRAWN BB 4/27/99 CHK DATE ENGR DATE QC DATE MFG DATE

MTS SENSORS DIVISION
RESEARCH TRIANGLE PARK, NORTH CAROLINA 27709

TITLE: INSTALLATION DRAWING, I.S. MC & M-SERIES GAUGE NEMA 4X HOUSING

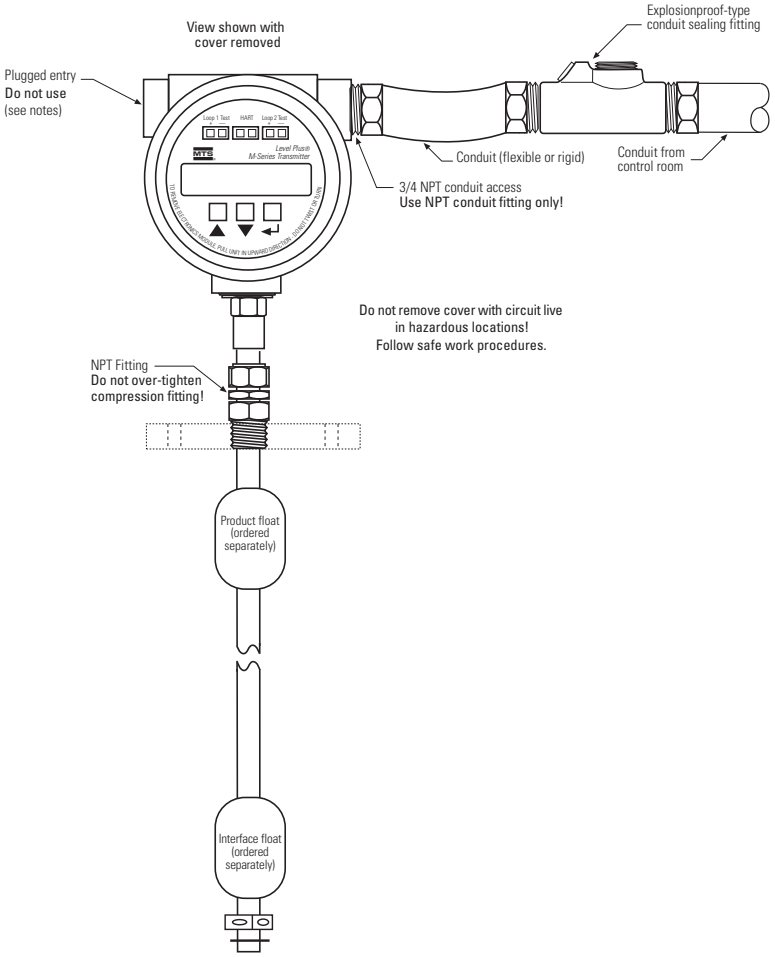
DWG NO. 650805 REV D

4.2 Electrical conduit installation

Attention:

- Use an explosionproof type conduit sealing fitting.
- Tighten housing cover (both front and back covers if dual cavity) to full stop against "O" ring.
- Do not over-tighten compression fittings.
- Use side conduit entry only.
- Do not use plugged housing entry for termination of conduit.
- In high humidity areas, use a breather drain type conduit sealing fitting to minimize moisture intrusion.

Figure 4-2
Typical transmitter installation



4.3 Cable specifications

The following section lists cable parameters and specifications for the M-Series transmitter. The list is not inclusive of all cable types and cable manufacturers and should serve only as a guideline when choosing cables. Other cable types can be selected that meet the requirements.

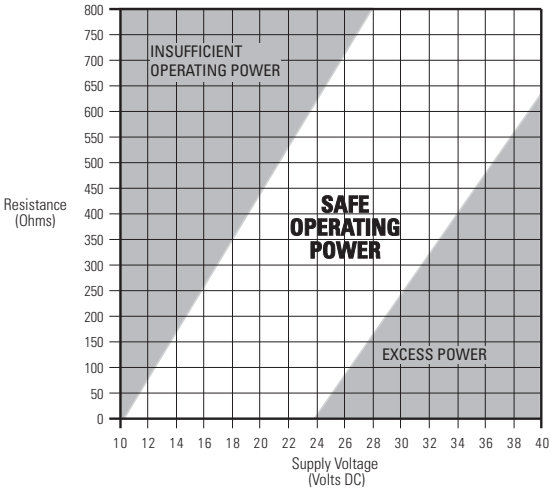
Parameter	***Specification***
Minimum cable size:	24 AWG or heavier (0.51 mm diameter) *Contact MTS for additional assistance in selecting proper cable*
Cable type:	Single pair shielded or multiple pair with overall shield
Maximum cable length:	Twisted pair: 10,000 ft. (3,048 m) Multiple twisted-pair: 5,000 ft. (1,524 m)
Maximum cable length formula:	Use the following formula to determine the maximum cable length for a specific application: **$L = [(65 \times 10^6) \div (R \times C)] - [(C_f + 10{,}000) \div C]$** *Where:* L = Length in feet or meters R = Resistance in ohm, current sense resistance plus barrier resistance C = Cable capacitance in pF/ft, or pF/m C_f = Maximum shunt capacitance of smart field devices in pF *Example:* Assume a high performing smart transmitter, a control system, and a single pair of shielded wires. R = 250 ohm C = 50 pF/ft C_f = 5,000 pF **$L = [(65 \times 10^6) \div 250 \times 50)] - [(5{,}000 + 10{,}000) \div 50]$** **L = 4,900 ft (1,494 m)**

4.4 Safety guidelines for the M-Series transmitter

Be sure you:

* Follow any applicable local and national electrical codes and observe polarity when making electrical connections.
* Never make electrical connections to the M-Series transmitter when it is powered on.
* Check that no wire strands are loose or sticking out of the *terminal block* connection on the *interconnect board* which could short and cause a problem. see *Figure 7-2a "Transmitter electronics interconnect board"* on page 20/.
* Check that no wire strands, including shield, are in contact with the electronics module or interconnect board.
* Ensure that the electronics module is grounded through interconnect board and electrically isolated from the explosionproof enclosure.
* Refer to the safe operating power chart in *Figure 4-4 "Loop resistance vs power supply"* which shows the relationship between loop resistance and operating voltage.

Figure 4-4
Loop resistance vs power supply



4.5 Safety Barriers for IS Installation

Figure 4-5, "Safety barrier types for the M-Series transmitter" illustrates passive/active safety barriers. See page 13 and 14 for wiring and entity parameters.

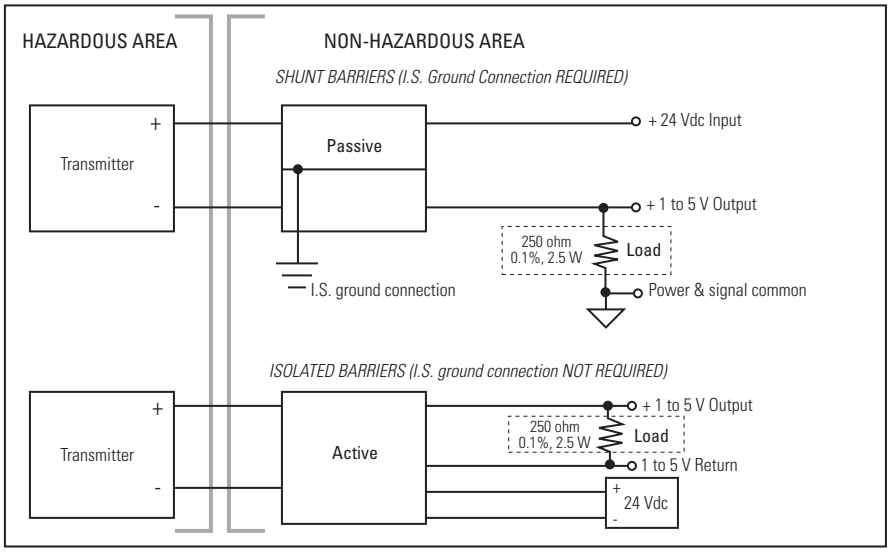


Figure 4-5
Safety barrier types for the M-Series transmitter

Notes:

- *When selecting barrier types, the electrical specifications for the M-Series transmitter are:*
  Vmax = 36.1 Vdc, Imax = 118 mA (total current), Ci = 0.0 µF, Li = 0.0 µHy
- *MTS stocks Stahl barriers 9001/01-280-100-10 (MTS part number 560669).*

5.0 SYSTEM CHECK

After you complete the M-Series wiring, complete the following steps to perform the system check:

1. Apply power to the transmitter.
2. Using a DC volt meter, measure the voltage at loop #1 connections. The voltage must be ≥ 10.5V. If loop #2 is being used, measure the voltage at the loop #2 connections, it also must be at ≥ 10.5V. If the voltage levels are too low, turn off power to the transmitter..
3. Check for shorts, power supply voltage, and excessive loop resistance. Refer to *Figure 4-4,"Loop resistance vs power supply"* on page 17) which shows the relationship between loop resistance and operating voltage.

5.1 Performing a loop #1 test

To test loop #1, lay the transmitter on a flat surface and move the float along the operational range of the M-Series transmitter. If the transmitter is functioning properly, the output current will change as the float moves.

If the output current is less than 4 mA or greater than 20 mA, this could indicate a problem with the M-Series transmitter.

5.2 Performing a loop #2 test (if applicable)

If you are using loop #2, complete the following steps to test the loop (the following test varies depending on the configuration):

1. To access loop #2, power on loop #1.
2. If loop #2 is set for level measurement, test the transmitter in the same manner as defined in section *5.1, "Performing a loop #1 test"* on page 18.
3. If loop #2 is assigned to measure temperature, first read the output current. Then, if the setpoint values are known, calculate the temperature using the following formula:

$$T = [(T_{20mA} - T_{4mA}) \div 16] (I - 4) + T_{4mA}$$

Where:

T = Temperature

T_{20mA} = Temperature @ 20 mA setpoint (Factory Setting: 300 °F)

T_{4mA} = Temperature @ 4 mA setpoint (Factory Setting: -30 °F)

I = Output current (in mA)

The M-Series transmitter's sensing Resistance Temperature Device (RTD) is located at approximately three inches from the transmitter's tip. Measure the temperature near the tip to see if it is an approximation of the calculated value. If the output current is less than 4 mA or greater than 20 mA, there may be a problem with the sensing RTD (i.e., it may be shorted or open).

6.0 FLOATS

For information about floats, go to www.mtssensors.com and refer to the float specification, MTS part number 550537. For float application information, please contact the MTS Level Plus Applications Engineering.

When contacting MTS for assistance on floats, please have the following information available:

- Specific gravity of liquid(s) being measured
- Process temperature
- Vessel pressure

7.0 MAINTENANCE

M-Series transmitter assemblies use magnetostrictive technology and only have one moving part, the float. This technology ensures no scheduled maintenance or recalibration is required. However, it is necessary that you check the sensor pipe annually for build up of process material. Floats should move freely along the sensor pipe. If they do not, routine cleaning should be performed.

7.1 Replacing an M-Series electronics module (puck) or interconnect board

The M-Series *electronics module*, also referred to as a *puck*, is modular in design. The puck or *interconnect board* can be replaced in the field without onsite MTS Applications Engineering Support.

7.1a Replacing an M-Series electronics module (puck)

Complete the following steps to install the puck:

Attention:
Ensure that all power is disconnected and that all lockout procedures are followed prior to opening the M-Series instrument housing.

1. Remove any dirt, debris, or liquid from the top of the *instrument enclosure* (*see Figure 7-1a, "Instrument enclosure"*).
2. Remove the instrument *housing cover* (*see Figure 7-1a, "Instrument enclosure"*).
3. Remove the existing *puck* by grasping the perimeter of the puck and lifting upward. the puck will slide free from the two *female interconnects* that are mounted on the *transmitter electronics interconnect board* (*see Figure 7-1b, "Electronics Module (puck)"*)
4. Remove the replacement puck from its package. To ensure that the new puck installs correctly, align the interconnects on the back of the puck with the *male interconnects* on the interconnect board as shown in *Figure 7-1c, Transmitter electronics interconnect board"*. Secure the puck into the instrument housing by pressing down around the parameter of the puck face. The puck should feel secure and not "rock".
5. install the instrument housing cover.
6. Continue with section *8.0, "Using the keypad to calibrate M-Series transmitters"*, on page 21 for calibration and setup instructions.

Figure 7-1a
Instrument enclosure

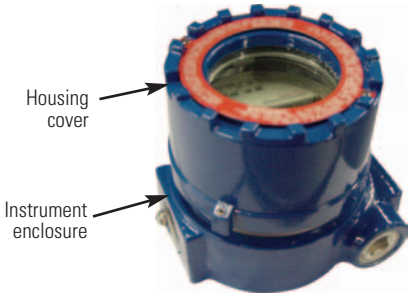


Figure 7-1c
Transmitter electronics (baseboard)

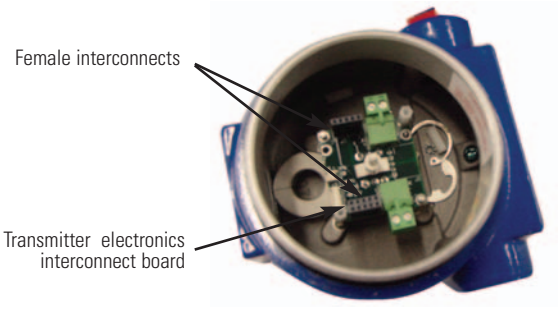


Figure 7-1b
Electronics module (puck)

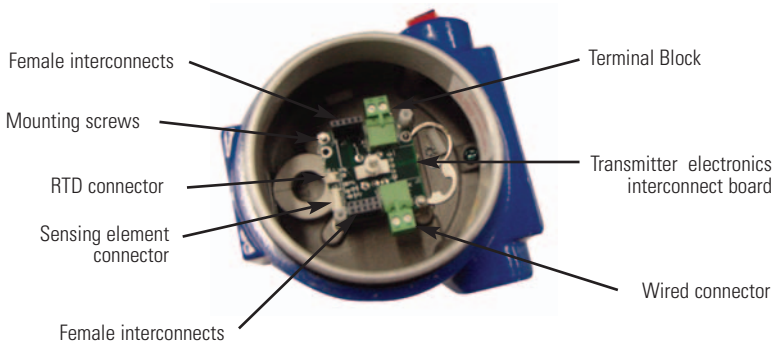
7.1b Replacing the interconnect board

Complete the following steps to replace the transmitter electronics interconnect board:

Attention
Before you begin, ensure that all power is disconnected and that all lockout procedures are followed prior to opening the M-Series instrument housing.

1. Remove any dirt, debris, or liquid from the top of the instrument enclosure.
2. Remove the instrument housing cover (*see Figure 7-1a "Instrument enclosure"* on page 19.
3. Remove the existing *puck* by grasping the perimeter of the puck and lifting upward (*see Figure 7-1b, "Electronics Module (puck)"* on page 19. The puck will slide free from the two *female interconnects* that are mounted on the *interconnect board (see Figure 7-2a "Transmitter electronics interconnect board components"*. Place the puck in a safe area.
4. Disconnect the *terminal block connector* (replacement included if needed) and *wired connector see Figure 7-2a.*
5. Disconnect the *sensing element connector* and *RTD cable connector* if present *(see Figure 7-2a)*.
6. Unscrew the four *standoffs* and remove the *interconnect board* from the instrument enclosure *(see Figure 7-2a)*.
7. Remove the replacement interconnect board from its package. line the board up with the four *mounting screws (see Figure 7-2a).* Secure the interconnect board to the instrument enclosure with four standoffs (included with kit).
8. Connect the *wired connector* and the *terminal block connector (see Figure 7-2a)*.
9. Connect the *sensing element connector* and *RTD cable connector*.
11. To install the new puck, Using even pressure, press down firmly on the face of the puck until the *male* and *female interconnects* engage fully. Ensure that the new puck is installed correctly in the instrument housing by pressing down around the parameter of the puck face. The puck should feel secure and not "rock".
12. Replace the instrument housing cover.

Figure 7-2a
Transmitter electronics
interconnect board components



8.0 USING THE KEYPAD DISPLAY TO CALIBRATE THE LEVEL PLUS M-SERIES TRANSMITTER

The M-Series transmitter can be calibrated by using the HART communications protocol or it may be manually calibrated using the optional *keypad display*. This section explains modes of operation and the steps you need to perform to calibrate your transmitter manually using the keypad display.

8.1 Modes of operation

The M-Series transmitter runs in one of the following modes of operation. You can use these modes to calibrate and set up various operating parameters.

Run mode

Run mode is the primary mode of operation. This mode will perform measurements, display data, and respond to HART commands. The run mode can be configured for various output options. The minimum configuration will only perform a single-level measurement. More complex configurations will perform a second float measurement (interface), or temperature measurements.

Program mode

The program mode is only applicable to M-Series transmitter with the keypad display option. Enter this mode by pressing any of the three keys, *Up keypad*, *Down keypad*, and *Enter keypad* as shown in *Figure 8-2, "M-Series keypad display"*. Menus guide the user through various programming options. When in the program mode, HART communications are not functional. An automatic timeout feature is provided so that the transmitter does not remain inadvertently in program mode.

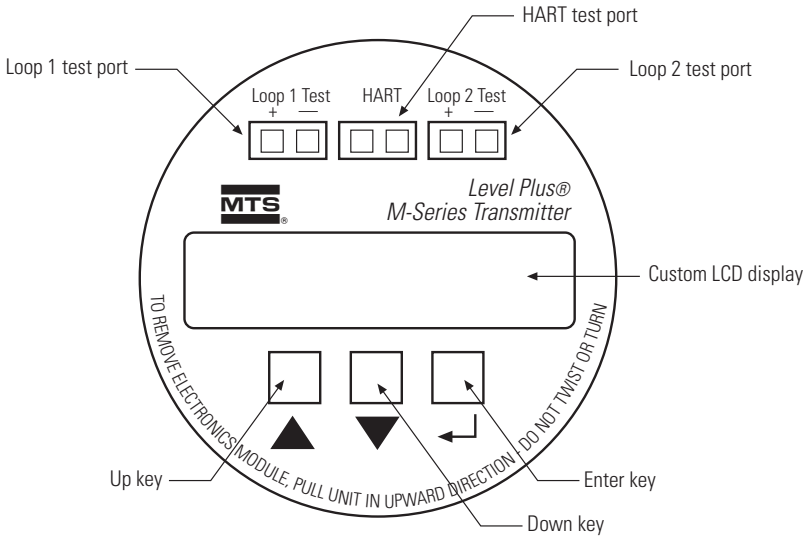
Display test mode

This mode is invoked through the keypad.

Keypad display usage in program mode

The M-Series transmitter can be configured by pressing three keys, the *Up keypad*, *Down keypad*, and *Enter keypad* as shown in *Figure 8-2, "M-Series keypad display"*. This gives the user a means to calibrate and set up various operating parameters.

Figure 8-2
M-Series keypad display



The three keypads are identified with "▼" "", and "<—┘". The "▲" keypad may be used to indicate **Up** responses, the "▼" symbol indicates **Down** responses, and "<—┘" indicates an **Enter** response. Normally, the M-Series transmitter will remain in *run mode*. When you press any three keys, the transmitter will enter *program mode*. In program mode, the electronics module menu displays options that you can scroll through using the **Up** and **Down** keypads. To select an option, press **Enter**.

Note:
In program mode, the transmitter will not respond to incoming HART commands. This function will prevent a user at a remote terminal from overwriting a parameter that is being entered at the same time from a local site.

Program mode Timer

After you enter the programming mode, a one-minute timer is started. Each time you press a button, the timer is reset. If you do not press a menu button within one minute, the timer will expire and the transmitter will return to the *run mode* (See *"run" mode on page 21)*.

Loop #1 and loop #2 test ports

Using a standard multi-meter set the meter to DC current and attach across the terminals, loop current can be read directly from ports #1 and #2 see *Figure 8-2, "M-Series keypad display"*. The current read on the meter should correspond with the data being displayed. These ports allow the loop current to be read directly without having to interrupt power.

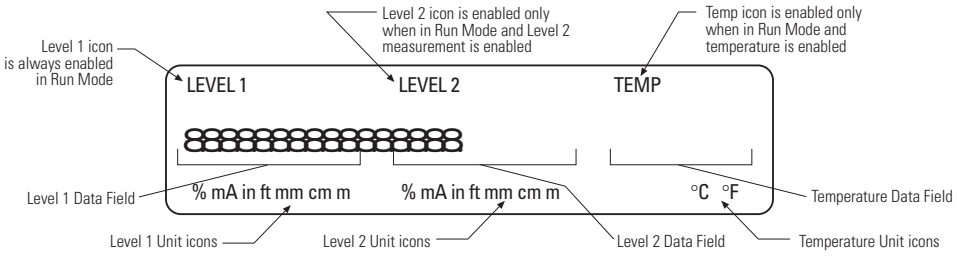
HART port

This port allows for direct connection of the Rosemount-275 or 375 field calibrator or other HART host device as long as there is a load on loop 1.

8.2 LCD display and keypad (optional)

A sixteen character, seven-segment LCD display and three button keypad option is available. Level and temperature measurements are displayed when the transmitter is in run mode. When power is applied to the transmitter, a *Start* message displays. When the transmitter is in run mode, the display is refreshed every three seconds. There are three data fields on the display; *Level 1*, *Level 2* and *Temperature* see *Figure 8.2 "M-Series keypad display"*. If a measurement is not available, dashes (- - - - -) will display in the corresponding field.

Figure 8-2
M-Series keypad display LCD display



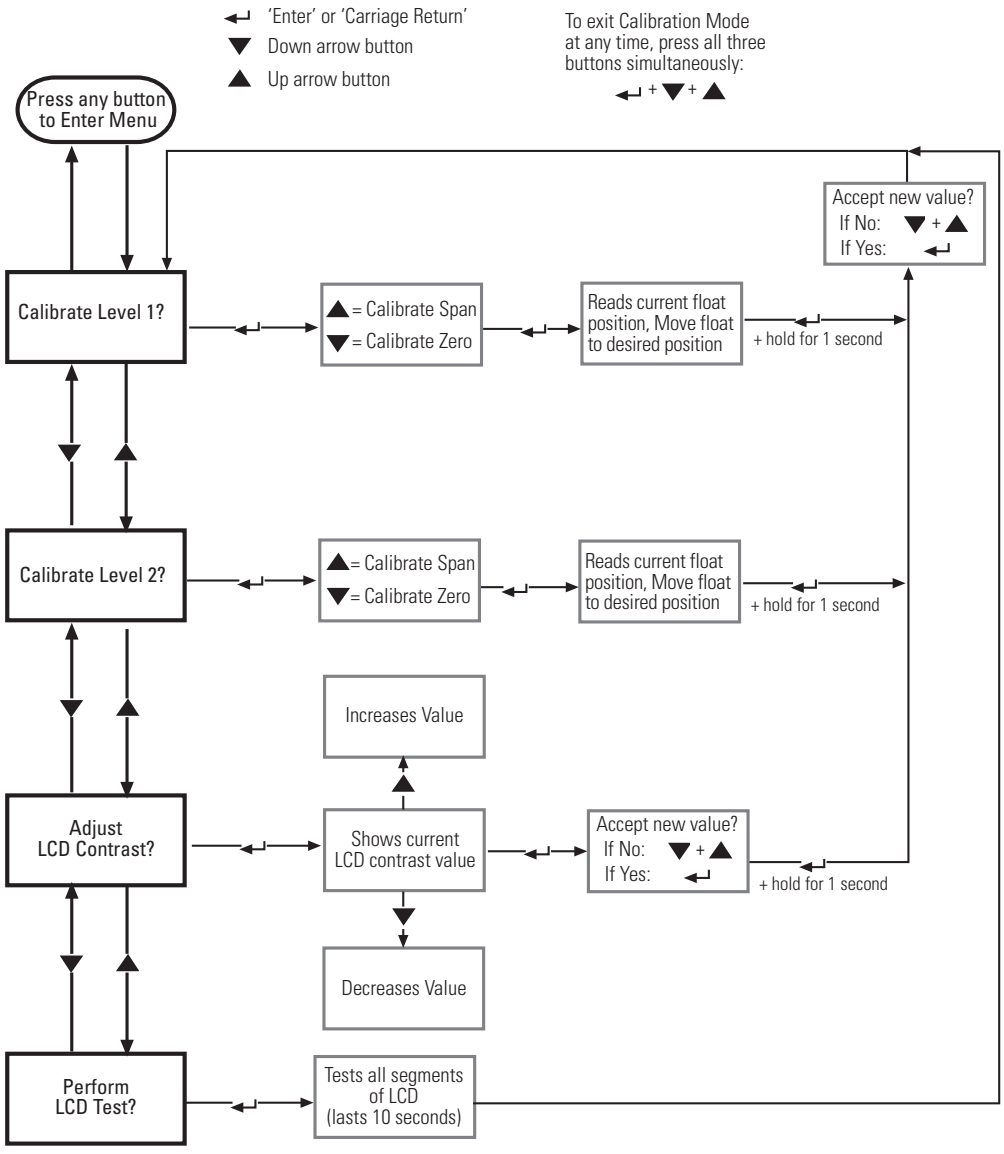
8.3 Alarm settings

When a fault condition is detected by the internal microprocessor, the 4 to 20 mA current will go to the current selected. If in the 4 mA alarm mode when a fault is detected, the output will be continuous at 3.8 ± 0.1 mA. If in the 20 mA alarm mode when a fault is detected, the output will be continuous at 21.5 ±0.2 mA.

8.4 Manual calibration

Figure 8-4, "Manual calibration matrix" illustrates the procedure to enter *calibration mode* and modify levels 1 and 2, adjust LCD contrast and perform a LCD test.

Figure 8-4
Manual calibration matrix



9.0 USING THE HART COMMUNICATION PROTOCOL TO CALIBRATE THE LEVEL PLUS M-SERIES TRANSMITTER

Refer to the documentation that comes with the HART Model 275 and 375 Hand-Held Terminal for specific sensor calibration information. This section describes how the HART protocol is applied to the Level Plus M-Series transmitter only.

Using the HART interface allows for calibration without having to remove the transmitter from the process and position of the floats. You can perform this function by using HART commands 35 and 65.

Any measured output may be assigned to any variable. Loop #1 is always the primary variable (PV); level one is usually assigned to loop #1. Loop #2 is always the Second Variable (SV); usually represents temperature or level 32. The Third Variable (TV) and Fourth Variable (FV) may be assigned to any remaining output such as, level 2, temperature. Analog output codes are 0, 1, and 2 respectively.

Calibration set points for level are given as the absolute displacement (in the appropriate units) from the tip of the sensor pipe. For example, if the *Zero (LRV)* position for level 1 is given as 5 inches, the transmitter will produce 4 mA when the float is 5 inches from the tip of the sensor pipe. If the *Span (URV)* position for level 1 is given as 30 inches, the transmitter will produce 20 mA when the float is 35 inches from the top of the sensor pipe. To calibrate the temperature set points, the *Zero (LRV)* and *Span (URV)* points are given in degrees. For temperature, the *Zero (LRV)* value (in degrees) must always be less than the *Span (URV)* value (in degrees).

9.1 Preparing the transmitter for re-calibration

The M-Series transmitter can be re-calibrated by using the HART model 275 and 375 hand-held terminal. Complete the following procedure to reset the low and high values for loop #1 (only loop #1 can be calibrated with the HART hand-held terminal using the generic XMTR type driver. To access both loops as well as other parameters, the MTS device driver must be purchased and installed in to the 275/375 hand-held device. For more information about the HART device driver, go to *HARTcomm.org*.

Attention:
Be sure you have loop #1 connected to a load of 250 to 500 ohm. A transmitter installed in a control loop is a good example of the loop load. You might also use a load resistor in the range of the above value.

Before you begin, do the following:

1. Connect the transmitter to a clean 24 Vdc power supply. Use a linear supply, switching types does not provide ripple-free power. HART cannot tolerate more than a 25 mV voltage ripple.
2. If the unit is installed in a live application, place your automatic controllers in manual mode and be advised that the output current will change during calibration.
3. Follow safe working procedures for working on live equipment in a hazardous location before you remove the housing cover.
4. Connect the HART hand-held terminal to the terminals that are labeled HART located on the front panel display of the Level Plus transmitter.
5. Press the black and white I/O button on the HART terminal. The HART terminal will perform an automatic self test. The Main window displays. If the device is not connected properly, the message “No device found” displays.
6. In the Main window, press the **key #1**, the Device Setup window displays.
7. In the Device setup window, press **Key #3**. The Basic Setup window displays.

8. In the Basic Setup window, press **Key #3**. The Range Values window displays.

9.2 Setting the low value

Complete the following steps to set the low value:

1. To set the *low value*, Process Variable, Low Range Value (PV LRV) to 4 mA, select **Key #1**. The PV LRV window displays the current low value. Below the highlighted value located under the current value, key in the *low value* you want (*example* 3.00 in. is shown; if 4 inches is the value you want, key in 4.) and press **Enter (F4)** located below the LCD display.
2. To write the changed lower value to memory, press the **Send** key.
3. Two *Warning messages* will display before the new values take affect; if your new *low values* are correct, respond to the Warning messages by pressing **OK** when prompted. This action resets the Low Range Value, or 4 mA position into the transmitter's memory.
4. Go back to the **Range Values** window to verify that the new parameters have been accepted into the transmitter's memory.
5. Do one of the following:
   5.a Exit program mode.
   5.b To reset the upper value, continue to 9.3 "*Setting the Upper Range Value*".

9.3 Setting the Upper Range Value

Complete the following steps to set the Upper Range Value:

Caution:
DO NOT enter a high value that exceeds the active length of the sensor.

1. Open the **Range Values** window. To set the 20 mA *Upper Range Value*, press **Key #2**. The Process Variable, Upper Range Value (PV URV) window displays.
2. As shown the **Lower Value** window, the current value displays with a highlighted number below the value displayed. To change the upper value, key in the new value. You can use whole numbers or whole numbers and decimals (*example,* 40 = 40 inches, or 40.5 = 40.50 inches.) Whole numbers will be converted as decimal equivalents automatically by the HART terminal.
3. Key in the new *Upper Range Value* and press **Enter** or **(F4)**. The **Range Values** window displays.
4. Verify that the upper and lower values are correct. If the values are correct, press **Send**.
5. You will be prompted with two Warning messages, press **OK** in response to both warnings.

10.0 INSTALLING AND USING THE M-SERIES FIELD SETUP SOFTWARE V1.01 (CD-ROM) TO SETUP PARAMETERS AND ADJUST CALIBRATION

Adjustments to the calibration and setup parameters of the transmitter may be done using the *M-Series Field Setup software v1.0* and a RS-232 to HART converter (SMAR HI-311, MTS Part # 380068). Be sure you are installing the latest software package, go to www.mtssensors.com for more information. The following parameters can be viewed or modified when using the M-Series Field Setup software:

Basic: Manufacturing information
Advanced: Gauge length, Gradient, Head Adder, Enable Display, Enable Loop 2, and Set Alarm Output to Low or High
Calibration: Level 1 Span and Offset. Level 2 Span and Offset, Temperature Span and Offset
Output: Level 1 Units of Measure, Level 2 Units of Measure, Temperature Units of Measure, Output Units of Measure, Output Designations and View Output Data

10.1 Installing the M-Series Field Setup software

Before you begin, do the following:

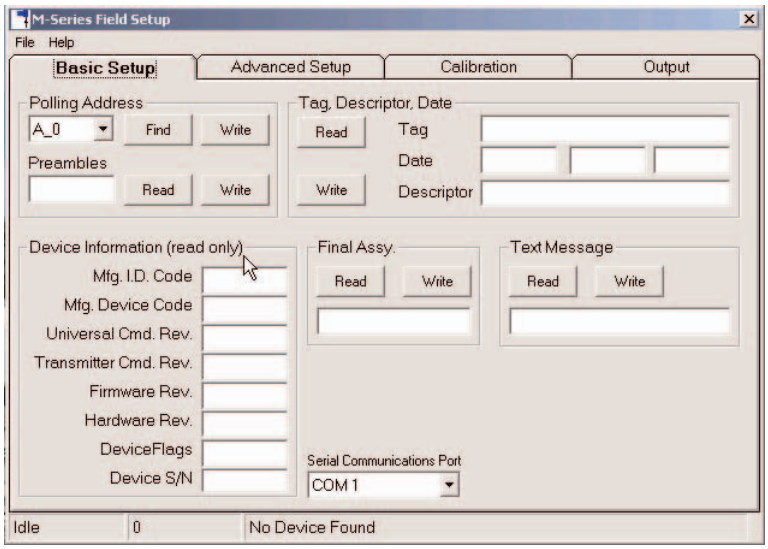
1. Obtain a *Linear Power Supply*, *Multi-meter*, *PC* and a *HART RS-232 Converter*.
2. Complete the following steps to install the *M-Series Field Setup Software* package and/or modify calibration and setup parameters:
   a. Insert the CD into the proper drive.
   b. Browse to to CD-ROM drive and run **setup.exe**.
   c. Follow the instructions on screen to install the program.
3. Connect the amp meter, power supply and transmitter. Set the proper scale on the meter. Ensure a 250 ohm resistor is installed in the line to enable uninterrupted communication.
4. Connect the HART adapter/converter to the RS-232 COM port on the back of the PC.
5. Attach the HART converter to the HART connection pins located on top of the M-Series Electronic module (puck) or across the resistor.
4. Connect HART adapter/converter clip leads to HART port on M-Series Electronic module (puck).
5. Apply power to the M-Series Transmitter and PC.

10.2 Calibration and setup parameters

1. From your desktop double-click the **MSeries Field Setup** icon to start the software.

2. Setup will automatically search and receive configuration data from the transmitter. The M-Series Field Setup window displays as shown in *Figure 10-1 "M-Series Field Setup software - Basic Setup window"*, click the **Basic Setup** tab to review the data. If there is no data, assign a different serial communications port and click the **Find** button in the top left corner to rerun the search program.

Figure 10-1
M-Series Field Setup software - Basic Setup window



3. In the M-Series Field Setup window as shown in *Figure 10-2 "M-Series Field Setup software-Advanced setup window*, click the **Advanced Setup** tab. Confirm that the *Gradient*, *Length*, and *Head Adder* have been received from the level transmitter. If the information does not display, click the **Read** button at the bottom of the window and manually enter the missing data. The sensor information fields are defined as follows:

Sensor information:
Gradient: Is slightly different for each transmitter. It can be found on sensor element head.

Units: Determines the units of measure for *Length* and *Head Adder*. This is used when writing new values of *Order Length* and *Head Adder* to the transmitter. Click the **Output Tab** to change units of measure for all data.

Length: Is equal to the order length of the transmitter being used.

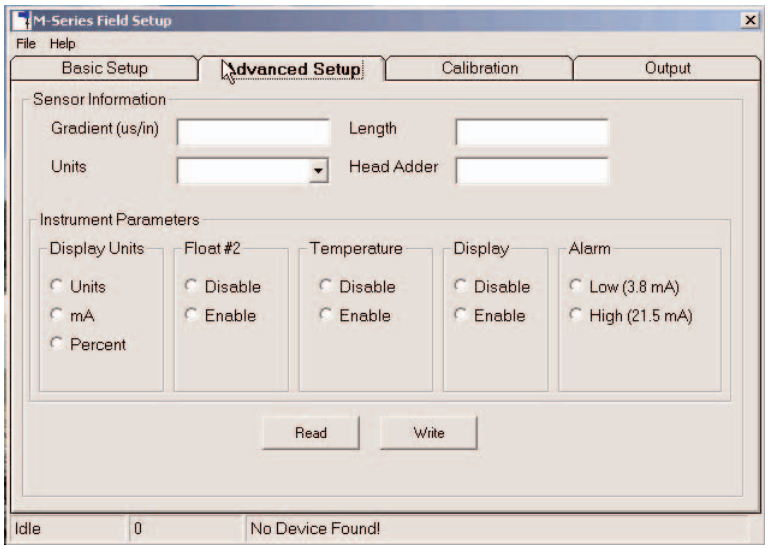
Head Adder: Is the distance between the sensing element and the order length. Each model has a slightly different adder as follows:

Gauge Style:	Length in Inches:
NEMA 4X housing, standard rigid pipe	4.3 to 4.5
Explosionproof housing with/without display with rigid pipe	5.6 to 5.7
NEMA 4X housing with flex pipe < 10 feet	14.0 to 14.5
Explosionproof housing with or without display with flex pipe < 10 feet	14.0 to 14.5.

10.3 Instrument parameters:

Display Units: Type of level data displayed on the optional LCD display; *Units*, *mA* and *Percent*.
Float #2: optional float #2; *Enable*/*Disable* .
Temperature: optional temperature data; *Enable* and *Disable*.
Display: optional LCD display; *Enable* and *Disable*.
Alarm: Output current value defined as *Low (3.8 mA)* or *High (21.5 mA)*, if the float(s) or temperature sensor should fail.

Figure 10-2
M-Series Field Setup software - Advanced Setup window



4. In the M-Series Field Setup window as shown in *Figure 10-3 "M-Series Field Setup software - Calibration Setup window"*, click the **Calibration** tab. Adjust the *Zero (LRV)* value and Press the **Write** button. Adjust the *Span (URV)* value and *Units* value from the appropriate channel and press the **Write** button.

The Calibration window fields are defined as follows:

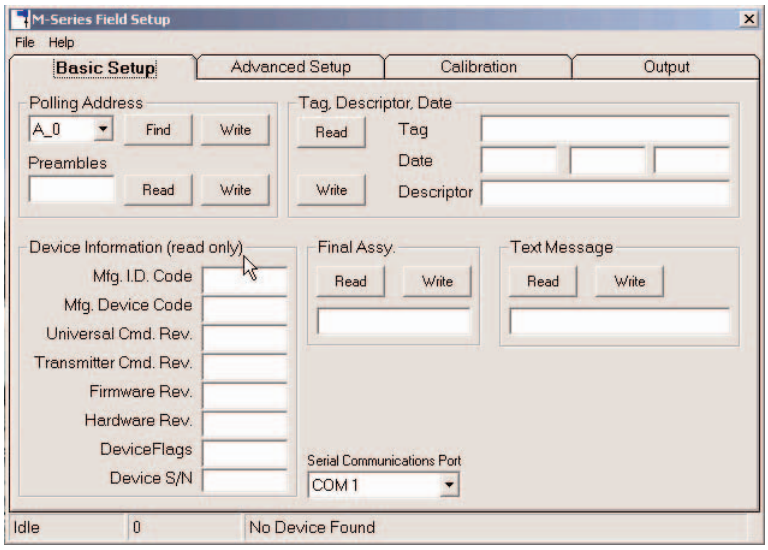
The Calibration window contains the **Zero (LRV)** and **Span (URV)** set points for all three variables. To change a value, type in the new value and press the **Write** button to save your change. To confirm the value change, press the **Read** button.

The *Units* field shows the units of measure for the *Zero (LRV)* and *Span URV).* To change the units of measure for the Zero(LRV) and Span (URV) press the arrow and select from the pull down menu. Press the **Write** button to confirm any changes to the settings. Press the **Read** button to confirm that the transmitter has accepted the new value.

The *Offset* field is used for making adjustments to the optional LCD display, not the current output.

Example: If the float is at the 4-mA point, but the display reads +.25 inches. Enter in -.25 inches in the block and press the **W** key to save, Now the display will read 0.00 inches even though the current has remained at 4 mA.

Figure 10-3
M-Series Field Setup software - Calibration Setup window



Part Number: 10-04 550720 Revision F

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