



MS2500E Transmitter Operator's Manual

Metal Samples Company

A Division of Alabama Specialty Products, Inc.

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I. General Description

A. Introduction

The development of the MS2500E Transmitter provides the corrosion engineer with a simple, lowcost, computer-compatible corrosion monitoring instrument. Designed to be incorporated into a 20 mA current loop, the MS2500E Transmitter uses the principle of electrical resistance to determine the corrosion rate of a metal specimen immersed in a process stream. The electrical resistance of a metal specimen is a physical property dependent on the specimen's physical dimensions (length and cross section) and on the metal's inherent resistivity. If all other factors remain constant, any decrease in the cross section of a metal specimen will increase its resistance.

The MS2500E Transmitter is used in process systems for which appropriately designed electrical resistance probes are available. Such systems include, but are not limited to nonaqueous, nonconductive process streams, process streams where erosion-corrosion occurs and process streams having either a predominant liquid or vapor phase. Examples of industries where such process streams are found include chemical plants, refineries, gas plants, oil and gas production systems, paper mills, power plants and tank farms.

B. General Description

The MS2500E Transmitter provides a two-wire interface between a single electrical resistance probe and a customer-supplied process computer, recorder, or control system, or between a probe and the MS2510 Receiver (ordered separately). The MS2510 Receiver and the MS2500E Transmitter function together as a stand-alone, single-station monitoring system.

The current loop connecting the Transmitter and the data receiving station may be up to 11 miles in length for circuits that do not include safety barriers and up to 1 mile for intrinsically safe circuits (circuits that do include safety barriers or their equivalent). A customer-supplied DC power source energizes the monitoring system. Probe signals representing metal loss are processed by the Transmitter and are relayed to the data receiving station as a 4-20mA signal.

Unlike similar devices available from other manufacturers, the MS2500E Transmitter does not require factory modification to accommodate different probe types. A simple field calibration procedure permits the MS2500E to be used with any electrical resistance probe. The MS2500E will accommodate all Metal Samples electrical resistance probes and most of the electrical resistance probes of other manufacturers.

The MS2500E Transmitter is available in one enclosure style. This style is mounted on any flat surface up to 5 feet from the probe and is connected to the probe via a special cable, model Cb-8140 (included).

C. Principles of Operation

Electrical resistance probes contain a continuous sensing device that is divided into “elements” connected in series. These elements include a measuring element and a reference element. The measuring element is exposed to the corroding environment. The resulting loss of metal decreases the measuring element’s thickness and causes an increase in this element’s resistance. The reference element is protected from the corroding environment and retains its original thickness and resistance. The MS2500E Transmitter is powered by a customer-supplied 10-35V DC power source. As the probe’s measuring element corrodes, the Transmitter sends to the data receiving station a proportional 4-20mA signal that represents the element’s metal loss.

The measurement technique employed by the Transmitter eliminates electrical resistance changes due to temperature fluctuations by measuring the ratio of the exposed measuring element’s resistance to that of the protected reference element’s resistance exposed. This ratio then regulates Transmitter output current (4-20mA) such that it represents the metal lost by the exposed element. For example, a Transmitter output current of 4mA indicates 0 (zero) corrosion. An output current measurement of 20mA indicates the end of probe life.

The Transmitter’s 4-20 mA current range is “divided” into 1,000 probe reading units. A single unit represents 0.001 of probe life. Probe life is equivalent to the amount of metal that the measuring element can lose during the useful life of the probe. Initial probe measurements taken when the probe is first installed will be at approximately 0 to 100 units. The maximum probe measurement (20 mA) is equivalent to 1000 units.

Expected probe life for elements presently available from Metal Samples are listed in the table below.

Element Type	Thickness (mills)	Effective Life (mills)
Tubular Loop	4	2
	8	4
Wire Loop	40	10
	80	20
Cylindrical	10	5
	20	10
Flush Disc	5	2.5
	10	5

D. Technical Specifications

Model

MS2500E - Loop-Powered ER Transmitter (Ordering # IN2500)

Physical Data

Instrument Weight: 5.02 lb. (2.28 Kg)
Total Weight w/ Accessories: 7.08 lb. (3.21 Kg)
Instrument Dimensions: 5.81"H x 4.5"W x 4.81"D (14.76cm x 11.43cm x 12.22cm)

Case Specifications: Explosion Proof (FM, CSA, CENELEC, UL)
Class I, Groups B, C, D, Class II, Groups E, F, G, Class III,
CENELEC: Eexd IIC
NEMA 4X, 7BCD, 9EFG

Mounting Specifications: 0.728"H x 1.756"W (1.85cm x 4.46cm) Bolt Pattern with 1/4-
20 Tapped Mounting Holes, or May Be Mounted on a 1/2" to
2" (1.27cm to 5.08cm) Pipe Using Supplied Hardware

Operating Temperature: 0° to 140°F (-18° to 60°C)
Storage Temperature: -40° to 176°F (-40° to 80°C)

Performance Data

Measurement Type: ER measurement using any standard ER probe type (Wire
Loop, Tube Loop, Cylindrical, Flush, Strip, etc.)

Range: 0-100% of probe life
Resolution: 0.4% of Full Scale
Cycle Time: 1 Minute

Electrical Data

Power Requirements: 10 to 35 VDC
Maximum Probe Cable Distance: 5 ft (1.52 m)
Output Specifications: 4-20mA Current Loop Output
Intrinsic Safety: Certified to CAN/CSA
STD E9-0-95 & E79-11-95
Class I, Division 1,
Groups C and D, T4

Special Features

- Switch selectable probe type (wire loop, tube loop, cylindrical, etc.)
- Loop powered

Accessory Items

5' Probe Cable (attached), Meter Prover, Mounting Hardware, Operation Manual

II. Installation and Operation

A. Receiving the MS2500E Transmitter

Check the MS2500E Transmitter for damage when it is first received. Obvious damage to the shipping carton should be brought to the attention of the responsible carrier's agent.

When the MS2500E is unpacked, verify that the shipping carton contains the following items:

1. MS2500E Transmitter
2. 5' Cb-8140 Probe Cable (attached to housing)
3. Meter Prover
4. MS2500E Transmitter Operator's Manual

B. Installation

Installation of the MS2500E Transmitter involves the following three procedures:

1. Mechanical Mounting
2. Electrical Connection
3. Calibration

Caution: If the transmitter is to be installed in a safe area, complete the three installation procedures in the order listed above. However, if the transmitter is to be installed in a hazardous area, complete the calibration procedure first; then follow with the mechanical mounting procedure and the electrical wiring procedure.

1. Mechanical Mounting

The MS2500E must be mounted on a flat surface connected to earth ground. Locate it within 5 feet of the installed probe and connect the transmitter to the probe via Cb-8140 connection cable. The transmitter will not function properly if cable other than Cb-8140 is used or of extension cable is added.

Note: If the transmitter is to be located in a nonhazardous area, allow sufficient vertical clearance for the removal of the enclosure top so that wiring and calibration procedures can be completed. See Drawing 1 for MS2500E dimensions.

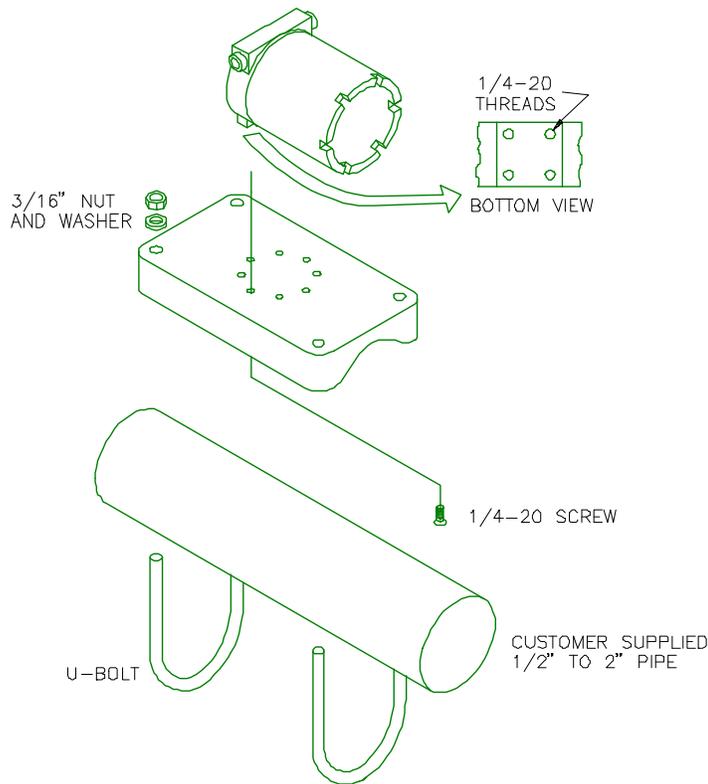


Figure 1. Preferred Installation

2. Electrical Connection

The current loop cable used to connect the MS2500E Transmitter with its power supply must be a twisted pair, shielded, industrial gauge cable. The current loop cable enters the MS2500E via the Transmitter's 1/2-inch NPT access hole and is connected to the two loop connection terminals located within the Transmitter enclosure. Polarity is critical when attaching the cable to the MS2500E loop connection terminals. The loop connection terminals are easily accessed by unscrewing the top of the Transmitter's enclosure.

Caution: Do not connect cable shielding to the Transmitter. The shield must remain floating at the Transmitter.

The maximum permissible length of the current loop cable that connects the Transmitter and its power supply is determined by the power supply voltage, the electrical resistance of the current loop cable and the load of the receiver/CPU. If the Transmitter is to be installed in a safe area, refer to the paragraph Safe Area Wiring for details; if the Transmitter is to be installed in a hazardous area, refer to Hazardous Area Wiring instructions.

C. Safe Area Wiring

For basic safe area wiring information, refer to the circuit diagram shown in Drawing 2. Use the following equation to determine maximum permissible cable length:

$$D = \frac{V_s - 10}{(4 \times 10^{-5}) (R)}$$

Where:

D = Max. cable length in feet.

V_s = Power supply voltage.

R = Cable resistance in ohms per 1000 feet.

Example:

V_s = 24 Volts

R = 16.1 (22 AWG cable)

$$D = \frac{24 - 10}{(4 \times 10^{-5}) (16.1)} = 21,739 \text{ feet}$$

D. Hazardous Area Wiring

Whenever an electrically driven sensor or measuring device is used in a potentially explosive environment the measuring system must be installed in such a way that electrical energy is either effectively isolated from the explosive environment (via explosive-proof containers, cable conduits, etc.) or the amount of electrical energy produced in the hazardous area must be limited to an intrinsically safe level.

Limiting electrical energy is the most practical method of protecting the MS2500E measuring system when the Transmitter is installed in a hazardous area. In the MS2500E system, electrical energy limits are maintained by the use of a repeater safety barrier (or its equivalent) installed in the 4-20 mA current loop per standard practice. The safety barrier must be located in the safe area near the boundary between the safe and hazardous areas. The safety barrier will

repeat the signal current generated by the Transmitter and will relay the signal to the data receiving station.

Caution: When a safety barrier is used with the MS2500E system, the current loop cable must be connected to the barrier's hazardous area terminals. All other connections must be made to the barrier's safe area terminals.

The type of repeater safety barrier employed in the MS2500E system depends on the specific classification of the hazardous environment in question. Metal Samples will provide, upon request, assistance and technical advice in the selection of a repeater safety barrier or its equivalent.

For most installations, Metal Samples recommends the intrinsically safe MTL 2441 Repeater Power Supply.

The maximum length of the current loop cable that connects the MS2500E Transmitter to the repeater safety barrier is as follows:

Example:

17.5 Volts

22 AWG Cable = 5,434 feet maximum

16 AWG Cable = 21,788 feet maximum

1. Probe Selection Terminals

Housed within the MS2500E enclosure are probe selection terminals which correspond to specific element types and which are used in the calibration procedure outlined below. The probe selection terminals permit the Transmitter to be used with all Metal Samples ER probes and with electrical resistance probes available from other major manufacturers, regardless of probe element type or element thickness.

2. Calibration

For routine calibration checks, a meter prover is provided. These units are factory calibrated before shipment and being solid potted exhibit no drift with time unless mechanically damaged. The meter prover is stamped with a three-digit number that represents percent of full scale (to one decimal place). Instruments should be checked against the meter every six months by disconnecting the instrument probe cable from the probe and plugging the meter prover into the probe cable connector. The instrument should be allowed to perform measurements on the

prover for 12 minutes. The value of the meter prover should be reproduced by the instrument $\pm 0.5\%$. The relationship between the recorded loop current and the meter prover value is:

$$P = \frac{x - 4}{16} \times (1000)$$

x = Loop current (Milliamps)

P = Prover value

Should the instrument be outside the calibration limits, the following recalibration should be carried out before rechecking with the meter prover

Refer to the figure below while completing the following calibration procedure for the MS2500E Transmitter.

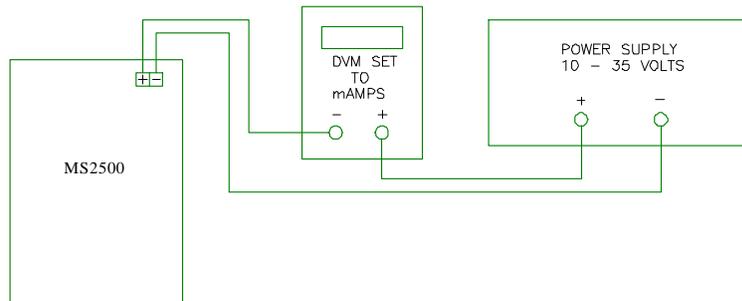


Figure 2. Calibration Connections

1. Unscrew the instrument cover.
2. Connect the 4-20mA current loop as in the figure.
3. Set the selector switches to "4mA" (see table below). Adjust the calibration potentiometer R22 until the ammeter reads 4.00mA.
4. Set the selector switches to "20mA" (see table below). Adjust the calibration potentiometer R20 until the ammeter reads 20.00mA.
5. Replace instrument cover.
6. The MS2500E is now calibrated.

	Setting	Switch 1	Switch 2	Switch 3
Operating Positions	Tube Loop / Flush	UP	UP	DOWN
	Wire Loop	UP	DOWN	DOWN
	Cylindrical (Special)	DOWN	UP	DOWN
Test & Calibrate Positions	Test	DOWN	DOWN	DOWN
	4mA	UP	UP	UP
	4-20mA Sweep (Fast)	UP	DOWN	UP
	20mA*	DOWN	UP	UP
	4-20mA Sweep (Slow)	DOWN	DOWN	UP

* 20mA setting is illustrated in Figure 3 below.

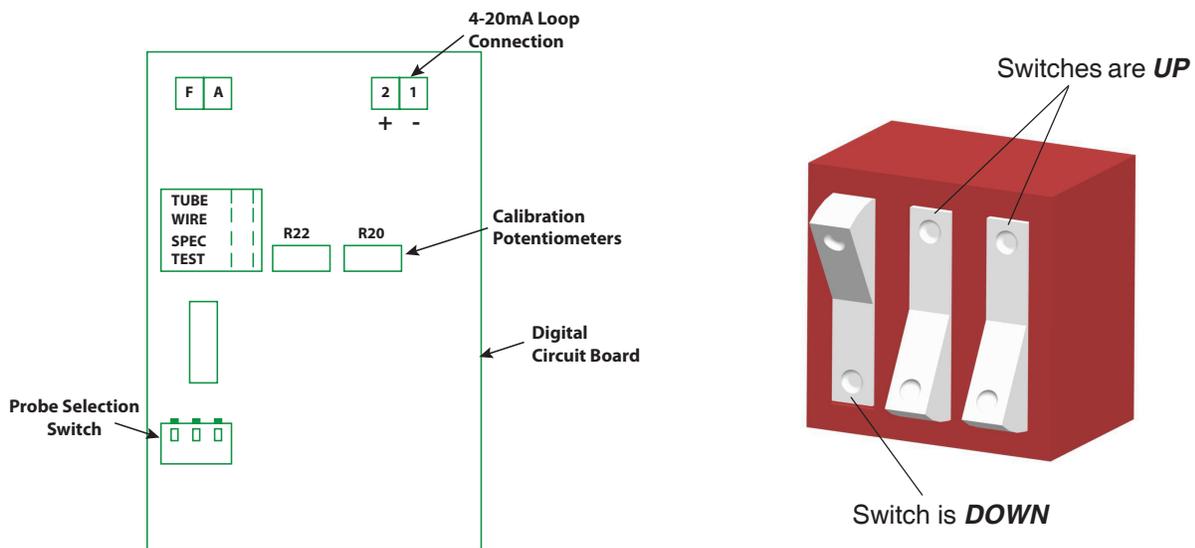


Figure 3. Switch Locations and Orientation

3. Operation

As shown in Figure 4, the transmitter output is linear. Initial Transmitter current output begins at 4mA and increases to a maximum of 20mA. The maximum output of 20mA indicates that the measuring element has been completely corroded and that the probe must be replaced.

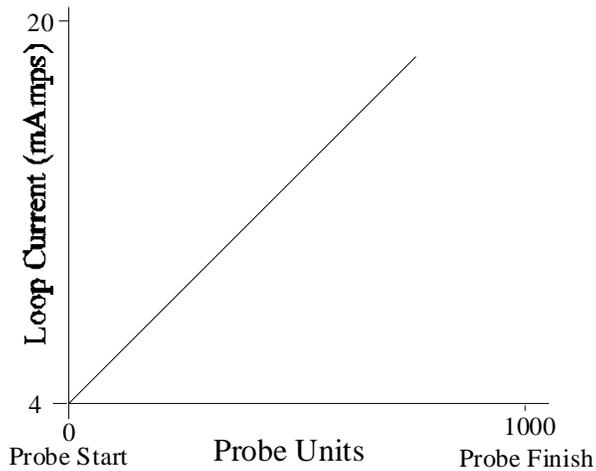


Figure 4. Output Linearity Relationship

4. Determining the Corrosion Rate

Use the following formula to determine the corrosion rate occurring at the installed probe:

$$\text{Corrosion Rate} \frac{\text{(mils)}}{\text{(year)}} = \frac{\Delta \text{ Probe Reading (mA)}}{16 \text{ (mA)}} \times \frac{\text{Effective Probe Life (mils)}}{\Delta \text{ Time (days)}} \times \frac{365 \text{ (days)}}{\text{(year)}}$$

E. Selecting the Probe

To avoid premature probe failure, match the expected probe operating lifetime to the process system's expected corrosion rate. This will permit probe replacement during scheduled shut-downs.

1. Probe Replacement Calculation

A probe replacement calculation is as follows:

$$T = \frac{L \times 365}{(R)}$$

Where:

L = Effective life in mils.

R = Expected corrosion rate in mils per year.

T = Replacement period in days.

Since the initial estimation of expected corrosion rate prior to monitoring may be in error, definitely replace probe if transmitter output reaches 20 mA.

F. Maintenance

Once installed, the MS2500E does not require maintenance. However, if malfunctions occur which cannot be attributed to the data receiving station, power supply, or safety barrier, proceed as follows:

1. Ensure that the probe is operational and is not completely corroded.
2. Examine all electrical connections for proper electrical connections, signs of corrosion and to ensure that the connections are environmentally protected.
3. Recalibrate the MS2500E Transmitter following the calibration procedure.
4. Contact Metal Samples for technical assistance if the Transmitter continues to malfunction following recalibration or if the Transmitter is obviously damaged. If advised to return the MS2500E for repair, follow the Instructions for Returning the Instrument for Repair.

G. Returning the Instrument for Repair

Complete the following procedures to ensure the fastest possible repair and return cycle:

1. If possible, pack the instrument in the original shipping carton. If the original carton is not available, pack the instrument in a rigid cardboard or wooden carton. Surround the instrument with a minimum of three inches of resilient packing material such as foam rubber or shredded newspaper.

2. Ship the instrument prepaid via Air Freight or Air Express to:

Metal Samples
152 Metal Samples Road
Munford, AL 36268

3. Contact Metal Samples by telephone (256) 358-4202 or by fax (256) 358-4515 and inform your sales representative of:

a. the name of the airline carrying the instrument

b. the flight number

c. the estimated time of arrival

d. the waybill number and delivery instructions

4. When the instrument is packed, include a copy of the form on the next page, filled in as required, to expedite the repairs.

III. Maintenance and Repair Instructions

This form may be photocopied for use when returning instruments to Metal Samples for repair. Please fill in all known information. Enclose a copy of the filled in form with the instrument.

1. CHECK ONE:

_____ Repair this instrument under warranty.

_____ Repair this instrument regardless of problem or cost of repair.

_____ Inspect the instrument and advise the customer of the approximate cost of repairs if the instrument is not covered under warranty. (Note - this procedure may delay the return of the instrument to you.)

2. INSTRUMENT IDENTIFICATION:

Instrument Model Number:

Serial Number:

Date of Purchase:

Company's Purchase Order Number for Original Sale:

3. RETURN THE INSTRUMENT TO:

Company Name:

Address:

Telephone Number:

4. INVOICE INSTRUCTIONS:

5. DESCRIPTION OF TROUBLE:

(A clear description of the problem may shorten the repair time.)

6. URGENCY OF REPAIR:

Shipping Address:

Metal Samples
152 Metal Samples Road
Munford, AL 36268

IV. Warranty Information

Metal Samples warrants that any part of the MS2500E and accessories which proves to be defective in material or workmanship within one year of the date of original shipment to Purchaser will be repaired or replaced, at Metal Samples option, free of charge. This warranty does not cover (1) probe assemblies, (2) items expendable in nature, or (3) items subject to damage from normal wear, misuse or abuse, or failure to follow use and care instructions.

All damaged items are to be shipped at Purchaser's expense to and from Metal Samples which shall have the right to final determination as to the existence and cause of a defect.

The foregoing shall constitute the sole and exclusive remedy of any purchaser of Metal Samples products for breach of warranty and IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED OR STATUTORY, INCLUDING THE IMPLIED WARRANTIES OR MERCHANTABILITY AND FITNESS. IN NO EVENT SHALL METAL SAMPLES BE LIABLE FOR SPECIAL OR CONSEQUENTIAL DAMAGES, OR FOR ANY DELAY IN THE PERFORMANCE OF THIS WARRANTY DUE TO CAUSES BEYOND ITS CONTROL.

Orders or request for additional information should be addressed to:

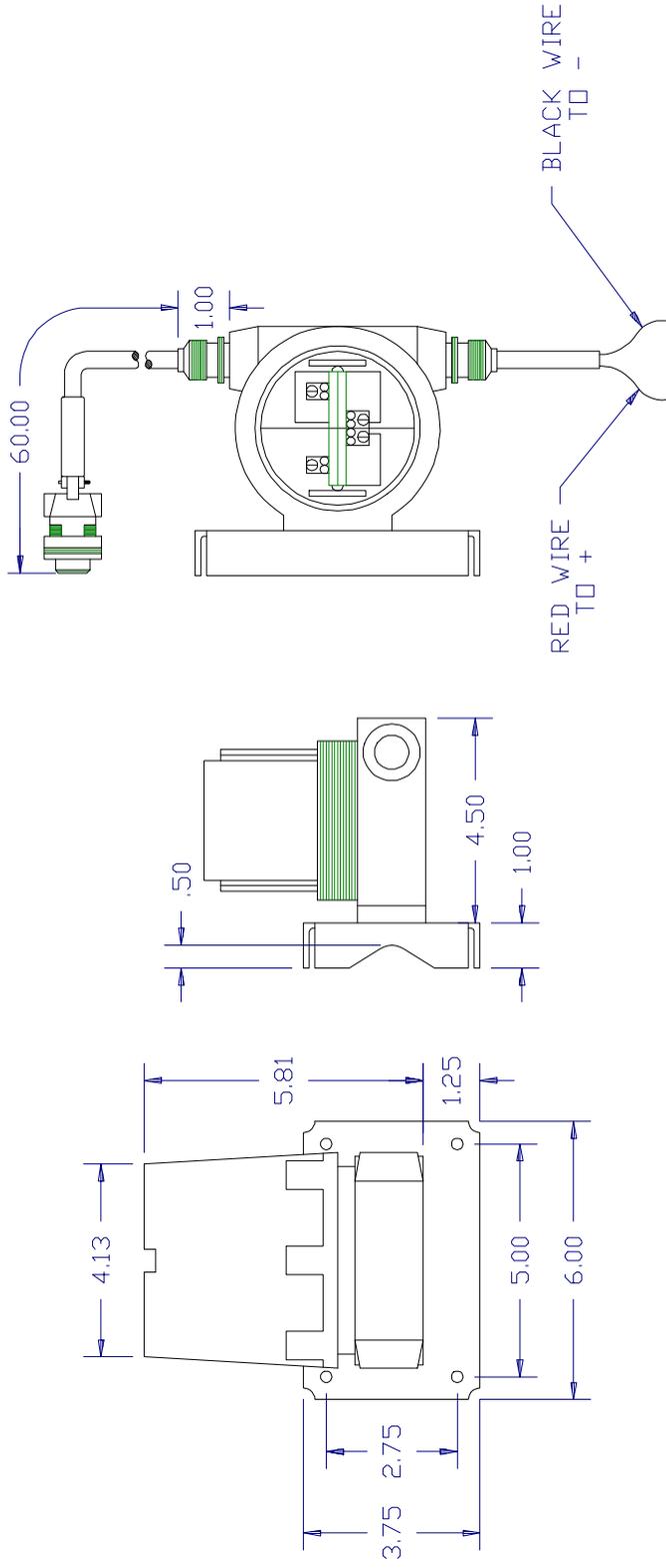
Metal Samples
P.O. Box 8
Munford, AL 36268
Telephone: (256) 358-4202
Fax: (256) 358-4515

The technical information and suggestions contained herein are believed to be reliable, but they are not to be construed as warranties since conditions of use are beyond our control.

Shipping Address

Metal Samples
152 Metal Samples Road
Munford, AL 36268
Telephone: (256) 358-4202
Fax: (256) 358-4515

REVISIONS
& DATE



DIMENSIONAL DRAWING WITH FIELD
WIRING CONNECTION.

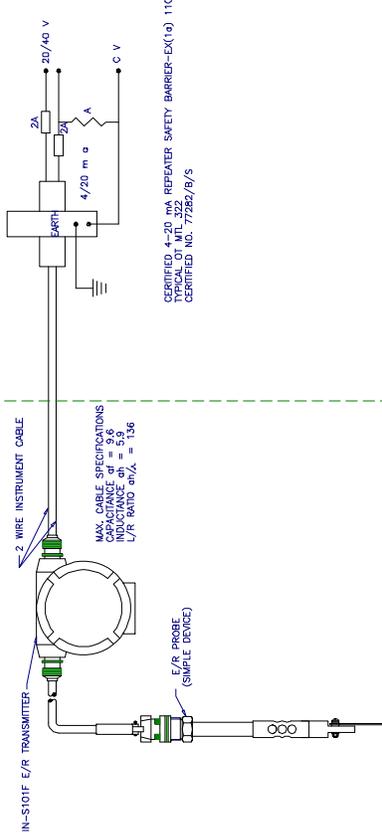
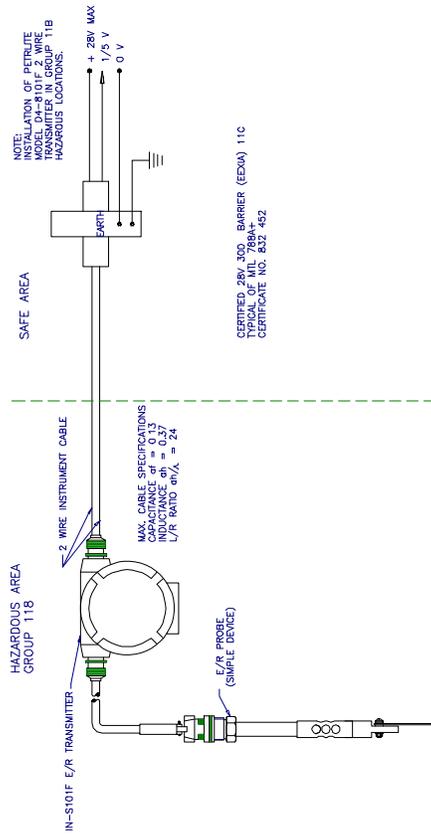
ALABAMA SPECIALTY PRODUCTS

Metal Samples Co.
152 Metal Samples Road
P.O. Box 8
Manford, Alabama 36268
USA
Phone (205) 358-4202
Fax (205) 358-4515

TOLERANCES (UNLESS OTHERWISE NOTED)	
DECIMALS	FRACTIONAL
X ±.020	± 1/32
.XX ±.010	ANGULAR
.XXX ±.005	± 1 DEG

SCALE	DATE	DRAWING
DRAWN	CHECKED	MATERIAL
ENGINEERING	QA	PROCESS / FINISH
		REVISION
		SHEET

REVISIONS
& DATE



ALABAMA SPECIALTY PRODUCTS

Metal Samples Co.
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USA
Phone (205) 358-4202
Fax (205) 358-4515

TOLERANCES
(UNLESS OTHERWISE NOTED)

DECIMALS	FRACTIONAL
X ±.020	± 1/32
.XX ±.010	ANGULAR
.XXX ±.005	± 1 DEG

SCALE

DRAWN

ENGINEERING

DATE

CHECKED

QA

DRAWING

MATERIAL

PROCESS / FINISH

REVISION

SHEET