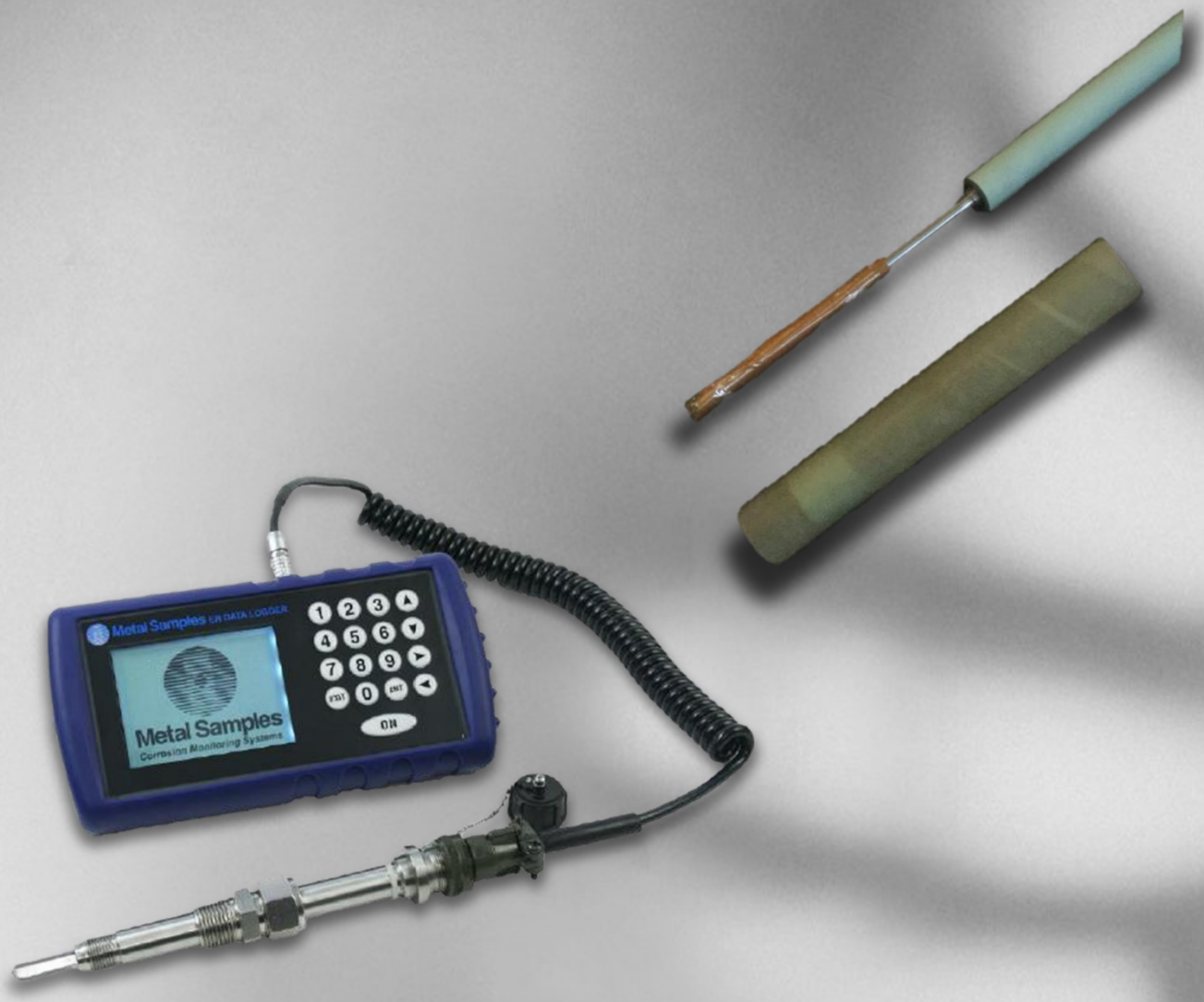
Protectolast®

1025-PLT-24

Introduction to Corrosion Monitoring System

Protectolast®

Corrosion Monitoring System



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INTRODUCTION

Corrosion monitoring is crucial for maintaining the integrity and safety of oil and gas storage tanks, with soil-side corrosion being a significant concern due to its hidden nature and potential for severe damage. Corrosion can lead to leaks, environmental contamination, and costly repairs. This type of corrosion occurs at the interface between the tank's bottom and the underlying soil, where various factors such as moisture, soil composition, and microbial activity can accelerate the corrosion process. Monitoring soil-side corrosion is crucial to ensure the structural integrity and safe operation of storage tanks.

One of the most effective methods for monitoring soil-side corrosion is the use of Electrical Resistance (ER) probes. ER probes are designed to measure the rate of metal loss due to corrosion by utilizing a metallic element that corrodes at the same rate as the tank's material. This element's electrical resistance increases as it corrodes, providing a direct measure of the corrosion rate.

Working of ER Probes

ER probes consist of a metallic sensing element, typically made of the same material as the tank, which is buried in the soil near the tank's bottom. As the sensing element corrodes, its cross-sectional area decreases, leading to an increase in electrical resistance. This change in resistance is continuously monitored and recorded, allowing for real-time assessment of the corrosion rate.

Advantages of ER Probes for Soil-Side Corrosion Monitoring

- *Continuous Monitoring:* ER probes provide continuous, real-time data on corrosion rates. This helps in detecting early signs of soil-side corrosion, enabling timely maintenance and preventing potential tank failures.
- *Ease of Installation*: ER probes are relatively easy to install and can be strategically placed in the soil around the tank's perimeter. This allows for comprehensive monitoring of different areas that might experience varying corrosion rates.
- *Data Analysis:* The data collected by ER probes can be transmitted to a central monitoring system for analysis. Advanced data analysis techniques can identify trends, predict future corrosion rates, and suggest appropriate maintenance actions. According to a study by NACE International, proactive corrosion monitoring can reduce maintenance costs by up to 20% and extend the lifespan of equipment by up to 30%.
- *Versatility:* ER probes are versatile and can be used in various soil conditions, including highly corrosive environments. This adaptability makes them suitable for different types of storage tanks and soil compositions.

Proactive corrosion monitoring using ER probes can lead to significant cost savings. According to the National Institute of Standards and Technology (NIST), implementing corrosion monitoring systems can improve operational safety and reduce unplanned shutdowns by up to 50%. A survey conducted by the Oil & Gas Journal found that more than 70% of industry professionals consider ER probes to be one of the most reliable methods for monitoring soil-side corrosion in storage tanks.

In summary, ER probes are an effective and reliable method for monitoring soil-side corrosion in oil and gas storage tanks. By providing real-time data on corrosion rates, these probes help maintain the structural integrity of storage tanks, preventing leaks and environmental hazards, and reducing maintenance costs. Their ease of installation, continuous monitoring capability, and adaptability to different soil conditions make them a valuable asset in the oil and gas industry’s efforts to ensure safe and efficient storage operations.

Enhancing Tank Preservation with Protectolast WS-VCI

The Protectolast WS VCI, is a water-soluble powder designed to create a protective layer on metal surfaces, effectively preventing corrosion. This inhibitor spreads easily and adheres to metals, offering long-term protection without the need for forced drying after pressure tests, thus reducing the risk of issues like valve seizing and pipework blockages. Its versatility allows it to protect metals in hard-to-reach areas, making it ideal for the underside of storage tanks facing the soil. By providing up to 24 months of continuous protection, Protectolast WS VCI ensures the longevity and integrity of storage tanks, reducing maintenance costs and enhancing safety.

Learn More About our Protectolast WS-VCI.

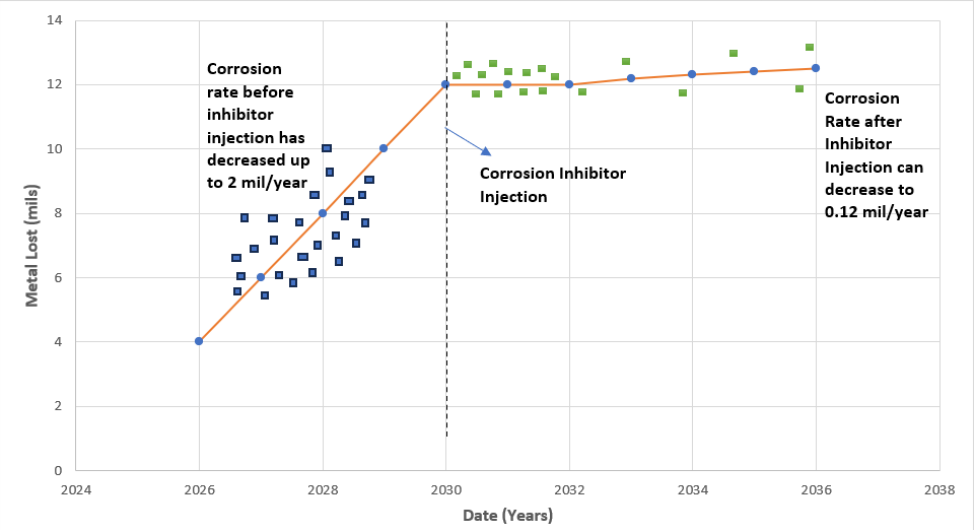

Figure 1 Metal loss in mills through the years before and after VCI injection

What is VCI Technology?

Vapor Corrosion Inhibitors (VCIs) work by releasing molecules that form a protective layer on metal surfaces. When exposed to air, these molecules create a vapor-phase barrier that adheres to the metal, blocking moisture and corrosive agents from making contact. This barrier prevents oxidation and corrosion by interrupting the electrochemical reactions that lead to metal degradation.

Protectolast® Corrosion Monitoring System

Protectolast® Corrosion Monitoring System (CMS) are tailor-made corrosion monitoring solutions to providing accurate corrosion monitoring & analysis of the equipment utilizing advanced sensors and real-time data analysis. Protectolast® CMS continuously assesses corrosion levels, detecting early signs of degradation before significant damage occurs. This proactive approach allows for timely intervention and maintenance, minimizing downtime and repair costs. Protectolast® CMS's precise monitoring capabilities ensure optimal operational efficiency and safety, enhancing the longevity and reliability of critical assets in various industrial sectors.

At present, the techniques used to determine the corrosion rate on the lower plates of an aboveground storage tank (AST) facing the soil involve methods like Saturated Low Frequency Eddy Current (SLOFEC), Magnetic Flux, and Ultrasonic Thickness Scanning System, as per the inspection intervals specified in API 653. These methods typically necessitate taking the tank out of service, resulting in data collection at periodic intervals, often spanning several years.

Given the extended duration required for internal tank scans, it's advisable to explore alternative online corrosion rate monitoring devices to assess the corrosive nature of the soil-side bottom environment of the tank.

Electrical Resistance Probes (ER Probes)

To establish a reference point for corrosion rates, it is advised to install a combination of ER probes and metallic coupons beneath each tank's floor, comprising a carbon 1010 steel element or equivalent. This installation is recommended to take place 3 to 6 months before the injection of any VCI. Should this not be operationally available, the first base line readings should be collected from the data taken from the initial installation through the data logger / transmitter.

Collecting data regularly provides the most comprehensive insights into corrosion rates at the measuring element of the probes. Plotting the loss of metal against time can yield the corrosion rate value, represented by the slope of the line between readings. We recommend that the readings be taken at intervals to determine these values. One approach to determine this value involves applying linear regression to a sufficient number of data points over a reasonable timeframe.

Ports through the ring wall of the targeted asset should be used for the installation of these units, and a data logger should be employed post-installation to record data collected from each probe.

In cases where ports for ER probe installation are absent or not usable, it is advised to drill them prior to project commencement by the client and/or contractor.

Data recording and logging once a week using a transmitter to provide continuous update on corrosion rate after the corrosion inhibitor application can be done for a period of almost 8 to 10 weeks considering that ER probes are installed prior to the application of the corrosion inhibitor by 3 - 6 months period. The recorded data should be forwarded to SKPS for analysis.

ER Probe Data for VCI Replenishment Timeline

An example of how VCI data can be plotted to monitor and determine the replenishment timelines.

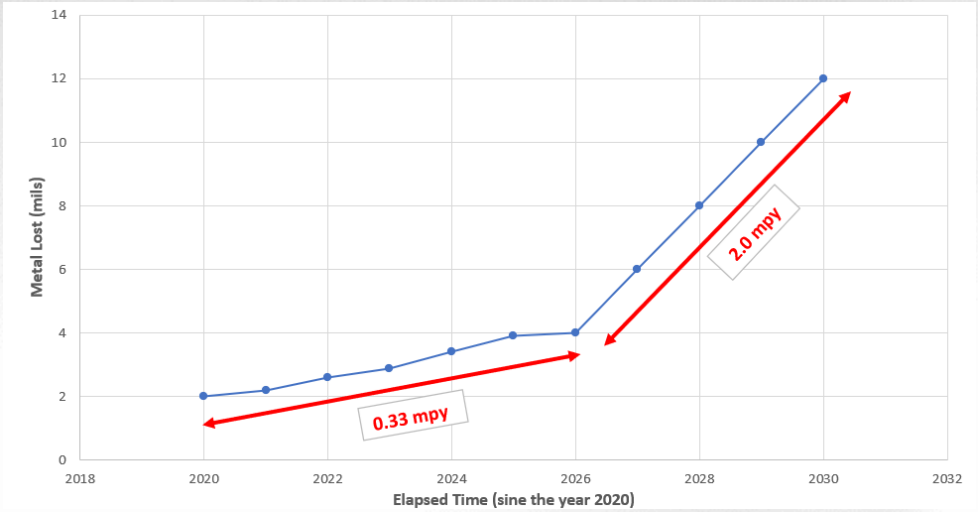

Figure 2 Metal loss vs. Elapsed time

From ER probe data analysis for underside corrosion protection of above ground tanks using VCI solutions, several key inferences can be drawn:

- *Corrosion Rate Monitoring:* ER probe data provides insights into the corrosion rates over time. By analysing this data, trends in corrosion activity can be identified.
- *Effectiveness of VCI Penetration*: The data can indicate how well the VCI s olution penetrates and protects the underside of the tanks. Higher corrosion rates may suggest areas where the VCI coverage is insufficient or where moisture ingress is still a concern.
- *Localized Corrosion Areas*: ER probe analysis can pinpoint localized areas of accelerated corrosion, which may require targeted application or adjustments in VCI deployment to ensure uniform protection across the tank underside.
- *Long-Term Protection Trends*: Trends in corrosion rates over extended periods offer insights into the long-term effectiveness of the VCI solution. Consistent low corrosion rates indicate robust protection, while increasing rates may signal degradation of the VCI layer or other factors affecting protection.
- *Optimization of Maintenance*: By correlating ER probe data with maintenance schedules, optimal intervals for VCI re-application or supplementary corrosion protection measures can be determined, optimizing maintenance efforts and costs.

Protectolast® CMS - Technical Data Sheets

1. Electrical Resistance Probe (ER0500)

3.2
Model ER0500
Electrical Resistance Probe
For Under Ground Service

The Model ER0500 corrosion probes are designed for heavy duty service conditions such as underground and structural monitoring of pipelines, vessels, above and below ground storage tanks and structures - whether cathodically protected or not.

The surface strip element assembly is suited to the "construction site" environment.

Surface Strip Element

The cylindrical element is economical and durable. Its slim profile is convenient for locations with restricted access such as concrete bridge structures and other infrastructure applications.

Cylindrical Element

Both probes provide good sealing of the reference element and the check element provides confidence in the continued performance of the corrosion sensor.

Either probe may be connected to a cathodically protected structure using the attached grounding lead. This allows the probe to measure the effectiveness of the Cathodic Protection (C.P.) System under operating conditions.

If left unconnected from the structure, the probe monitors the direct corrosivity of the soil or environment. The grounding lead is installed at the connector end, unless otherwise specified. This enables connection to the C.P. System to be made as required even after probe installation.

Specifications			
	Surface Strip	**Cylindrical & Wire Loop (Standard Service)**	**Cylindrical (High-Temp Service)**
Probe Body	PVC / Epoxy	FRP / Epoxy	Stainless Steel
Cable	High-Density Polyethlene Jacket Rated for Direct Burial		Teflon® FEP
Temperature Rating	176°F (80°C)		392°F (200°C)

A DIVISION OF BAC CORROSION CONTROL
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MEMBER OF granitor

3.2
Model ER0500
Electrical Resistance Probe
For Under Ground Service

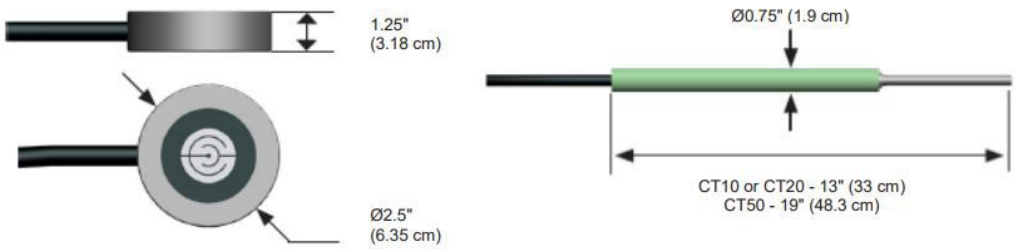
Model ER0500 Ordering Product Code Generation					
AP	Electrical Resistance Probe				
	Type				
	31	Underground surface strip without ground strap			
	40	Underground cylindrical with ground strap			
	61	Underground surface strip with ground strap			
	70	Underground cylindrical without ground strap			
	AO	High-temperature underground cylindrical with ground strap			
	50	Underground wire loop element			
		Element Thickness			
		10	10 mil thickness (5 mil useful probe life) - cylindrical or surface strip		
		20	20 mil thickness (10 mil useful probe life) - cylindrical or surface strip		
		40	40 mil thickness (20 mil useful probe life) - surface strip & wire loop (10mil life) only		
		50	50 mil thickness (25 mil useful probe life) - cylindrical only		
			Element Alloy		
			XXX	Use Code in Alloy Chart	
				Cable Length (various lengths available in 10ft increments)	
				10	10ft cable
				20	20ft cable
AP	**31**	**40**	**375**	**20**	**Example of Probe Ordering Product Code**

Probe Element Alloy Chart					
Code	**Description**	**UNS#**	**Code**	**Description**	**UNS#**
375*	C1010**	G10100	159	316L S.S	S31603
538	5Cr 1/2Mo	K42544	A12	C276	N10276
541	9Cr 1Mo	K90941	602	Alloy 625	N06625
186	410 S.S	S41000	419	CDA110	C11000
141	304 S.S	S30400	434	CDA443	C44300

Note: Not all alloys are available with all element types and seals.
* For CT50 cylindrical elements use alloy code 378 instead of 375.
** Chemically equivalent to standard pipe-grade carbon steels.

For alloys, sizes, or other special requirements not listed, please contact our sales department.

Installation/Clearance Dimensions:



All pictures are for illustrative purposes only, supplied product may differ.

2. Data Logger (MS4500E & MS4500E-HC)

5.7
Models MS4500E & MS4500E-HC
Portable High Resolution Data-Loggers For Electrical Resistance Probes

The Model MS4500E and MS4500E-HC are hand-held, battery powered, corrosion meters capable of measuring and storing data from all types of electrical resistance (ER) corrosion probes.

The instrument is light weight, microprocessor-based and features a simple, menu-driven interface using a keypad and a backlit graphical LCD display.

Corrosion rate measurements are made using the electrical resistance method.

Probe shown in photo not included with corrosion meter

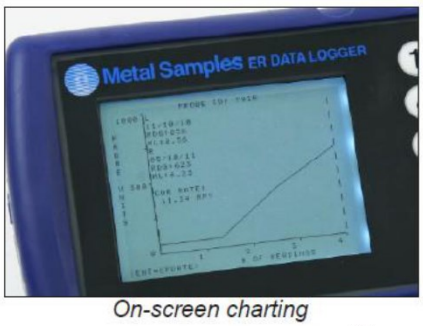
Essentially, the instrument measures the resistance of the probe element which changes over time, as metal loss occurs. The rate of change is directly proportional to corrosion rate. This method finds a wide variety of applications since it can be used in conductive and nonconductive environments such as petroleum, chemical, water, soil, or even atmosphere.

The new high-resolution measurement of the instrument detects smaller increments of metal loss, providing faster response than traditional ER instruments.

After taking a reading, the instrument displays metal loss in mils and corrosion rate in mils per year (mpy). The reading can then be stored to memory or discarded. All stored readings are automatically time and date stamped. Readings are stored to non-volatile Flash memory which retains data without the need for a battery backup.

The instrument can store 16,000 readings per probe on up to 250 different probes (4 million total). Stored data can be downloaded down-loaded to a USB Flash ("jump") drive in safe area or to a certified USB flash drive if downloading in a hazardous area. Data can be downloaded directly to a PC via certified USB cable with barrier.

Data can be opened and charted using the provided CDMS software, or can be imported into any standard data analysis (spread-sheet) program such as Microsoft Excel. Data can also be reviewed and charted on the instrument's LCD display for quick reference.



On-screen charting

Transfer data directly to USB Flash drive

Pictures are for illustrative purposes only

The MS4500E-HC has a high capacity battery, for increased battery life.

5.7
Models MS4500E & MS4500E-HC
Portable High Resolution Data-Loggers For Electrical Resistance Probes

Model MS4500E & MS4500E-HC Technical Specifications

MS4500E - High Resolution ER Data-Logger, Portable
MS4500E-HC - High Resolution ER Data-Logger, Portable, With High Capacity Battery

Physical Data	MS4500E	MS4500E-HC
Instrument Weight:	0.78kg (1.71lb.)	1.00kg (2.21lb)
Total Weight With Case & Accessories:	3.16 kg (6.96 lb.)	3.38kg (7.46lb)
Instrument Dimensions:	21.77cm x 11.53cm x 5.59cm (8.75"L x 4.54"W x 2.20"D)	
Carry Case Dimensions:	36.83cm x 28.89cm x 14.92cm (14.50"L x 11.38"W x 5.88"D)	

Performance Data	MS4500E	MS4500E-HC
Measurement Type:	ER measurement using any standard ER probe type (Wire Loop, Tube Loop, Cylindrical, Flush, Strip, etc.)	
Operating Temperature:	-20°C to 60°C (-4°F 140°F)	-20° to 70°C (-4° to 158°F)
Storage Temperature:	-20°C to 70°C (-4°F to 158°F)	-40° to 70°C (-40° to 158°F)
Range:	0-25,000 probe life units (displayed as 0.00 to 1000.00 PLU's in 0.04 increments)	
Resolution:	0.004% of Probe Life	
Repeatability:	+/- 0.1% of Full Scale	

Electrical Data	MS4500E	MS4500E-HC
Power Requirements MS4500E:	Four AA Batteries - Duracell PC1500 (or Duracell MN1500)	Two 'C' size 3.6V Lithium Batteries (Xeno Energy XL-145F or Tadiran TL4920)
Maximum Probe Cable Distance:	61m (200ft)	
Download Method:	Directly to USB Flash drive To PC using certified barrier	

Hazardous Location Certifications	MS4500E	MS4500E-HC
Intrinsic Safety USA/ Canada	For use in Class I Zone 0 AEx ia [ia] IIC T4 Ga Ex ia [ia] IIC T4 Ga Class I, Division 1, Groups A,B,C & D, T4 Provides outputs to Class I, Division 1 [Ex ia]	
	-25°C ≤ Ta ≤ +60°C	-40°C ≤ Ta ≤ +70°C
Intrinsic Safety Europe and Worldwide (ATEX and IECEx)	II 1 G Ex ia [ia] IIC T4 Ga	
	-25°C ≤ Ta ≤ +60°C	-40°C ≤ Ta ≤ +70°C
	ATEX Certificate No: **ITS18ATEX203161X** IECEx Certificate No: **IECEx ETL 18.0007X**	

Special Features

- High resolution ER measurement for rapid response
- Data storage capacity of 16,000 readings per probe on 250 different probes (4 million total)
- Backlit graphical LCD display (320 x 240 pixel resolution)
- On-screen charting
- Automatic data-logging
- Non-volatile Flash memory
- Multilingual menu (English, Spanish, Portuguese, French)
- Portable

Included Accessories

Carrying Case, Probe Cable (1' coiled - 6' extended), Meter Prover, Operation Manual, Corrosion Data Management Software, Protective Boot

Optional Accessories

Product Code: ET1650 - Certified USB Flash Drive
Product Code: ET1867 - Certified USB Barrier

3. Certified USB Barrier (ET1867) & USB Flash Drive (ET1650)

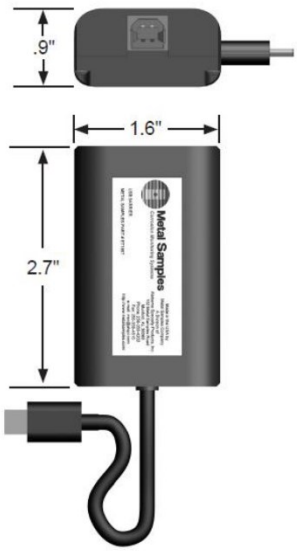
5.11
ET1867 – Certified USB Barrier

The ET1867 is a certified USB barrier which allows portable, certified instruments models MS4500E and MS4500E-HC to be connected directly to a PC via the USB port.

The barrier protects the certified instrument from potential damage caused by excessive energy that could enter through the PC's USB port.

This barrier is required to connect the MS4500E or MS4500E-HC directly to a PC. The USB barrier connects to the instruments using a standard USB mini-B connector and connects to a PC using a standard USB-A to USB-B (printer) cable.

The certified USB barrier must be connected and used in accordance with the control drawing for the MS4500E or MS4500E-HC instrument..



Specifications:

Operating Temperature: -40° C to 70° C

Storage Temperature: -40° C to 85° C

Humidity: 10-90% RH, non-condensing

Housing: ABS Polycarbonate

USB Class: 1.1 or 2.0

USB Type: Type B (To PC Interface) USB Mini-B (To Instrument)

Protection Class: II 1 (1) G Ex ia[ia]IIC T4 Ga

Certified to use with Metal Samples MS4500E and MS4500E-HC Instruments at Non-Hazardous locations

Certificate: ITS18ATEX203161X
IECEx ETL 18.0007X

Connection Parameters	
$U_{o\ max}$	≤ 6.0

5.10
ET1650 – Certified USB Flash Drive

The ET1650 Certified USB flash drive is a data transfer unit (DTU) which is certified for use in hazardous locations when used in conjunction with MS35XX, MS36XX, MS4500E, MS4500E-HC, and MS50XX data-loggers.

The certified DTU allows the user to collect data from the listed data loggers without having to remove the product from the classified area.

The DTU incorporates non-volatile flash memory and has sufficient memory to store millions of readings.

It can be connected to any standard PC using the industry standard USB Type-A connector. The certified DTU must be connected and used in accordance with the control drawing for the appropriate instrument.

Specifications:

Storage Capacity: 8 GB

Operating Temperature: -40° C to 70° C

Storage Temperature: -40° C to 85° C

Humidity: 10-90% RH, non-condensing

Housing: ABS Polycarbonate

USB Class: 1.1 or 2.0

USB Type: Type A

Operating System: Windows 7, Windows 8, Windows 10

Protection Class: II 1 (1) G Ex ia[ia]IIC T4 Ga

Certificate: ITS18ATEX203161X
IECEx ETL 18.0007X

Connection Parameters	
$U_{o\ max}$	≤ 6.0
$I_{o\ max}$	≤ 747.5mA
$P_{o\ max}$	≤ 923.1mW
C_o	12.71µF
L_o	0.37µH