



MS4500E

High Resolution ER Data Logger Operator's Manual



Metal Samples Company

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Table of Contents

I. Introduction	1
A. General Description	1
B. Principles of Operation	1
C. Technical Specifications	3
II. Start Up and Operation	4
A. Receiving the MS4500E Data Logger	4
B. Start Up	4
1. Port Details and Probe Connection	4
2. Power Up.....	5
a. Safe Area Usage	6
b. Hazardous Area Usage	6
c. Battery Replacement.....	8
3. Setup and Operation.....	9
a. Select Probe	9
i. New Probe	10
ii. Existing Probe	10
iii. Delete Existing Probe	11
b. Make Measurement.....	12
c. Recall Readings.....	13
d. Delete Readings	15
e. Set Time & Date	16
f. Set Measurement Timer	17
g. Communications	18
h. File Transfer (USB).....	25
i. Language	26
j. Backlight On/Off.....	26
k. Power Off	26
C. Maintenance	27
1. Testing the MS4500E High Resolution Data Logger with the Meter Prover	27
D. Troubleshooting.....	28
III. Service and Warranty Information.....	29
A. Warranty	29
B. Obtaining Service and Returning the Instrument for Repair	29
C. Instrument Repair Form	30
Appendix A – Revision History	31
Appendix B – Hazardous Area Certification Details	32
Appendix C - Drawing.....	33
Control Drawing (Hazardous Area Wiring Diagram)	34

I. Introduction

A. General Description

The MS4500E is a hand-held, battery powered, corrosion meter 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. 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 MS4500E 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 MS4500E High Resolution ER Data Logger can store 16,000 readings per probe on up to 250 different probes (4 million total). Stored data can be downloaded directly to a USB Flash (“jump”) drive in non-hazardous areas. Data can be opened and charted using the provided CDMS software, or can be imported into any standard data analysis (spreadsheet) program such as Microsoft Excel. Data can also be reviewed and charted on the instrument’s LCD display for quick reference.

B. Principles of Operation

The MS4500E High Resolution ER Data Logger operates on the Electrical Resistance (ER) technique and is used in conjunction with an ER probe. The ER probe utilizes a resistive sensing element manufactured from the material of interest (or a close approximation) which is exposed to a corroding environment. This is called the Exposed or Corroding Element. The resistance of the Exposed Element is directly related to its thickness, so as the element corrodes the resulting loss of metal causes a proportional increase in the element’s resistance. The probe also contains an internal Reference Element which is used to compensate for the influences of temperature on the Exposed Element.

The MS4500E High Resolution ER Data Logger is designed to work with any standard ER probe, but it is recommended that Cylindrical and Large Flush type probes be used to ensure optimum performance. Their physical design places the Reference Element in closer proximity to the Exposed Element compared to other probe types, providing more effective temperature compensation and thus reducing the effects of thermal noise.

Because they are designed to corrode, ER probes are sacrificial in nature. Each ER probe will have a finite life that is based on the element thickness. ER probes are available in a number of geometries and thicknesses designed to suit a wide variety of applications. Table 1 lists the common ER element options available from Metal Samples and the effective life of each.


Element Type		Compatibility	Thickness	Probe Life (Span)
	Tubular Loop	Compatible	4	2
			8	4
	Wire Loop	Compatible	40	10
			80	20
	Flush (Small)	Compatible	4	2
			8	4
			20	10
	Cylindrical	Preferred	10	5
			20	10
			50	25
	Flush (Large)	Preferred	5	2.5
			10	5
			20	10
			40	20

Table 1. Standard ER Probe Elements

The MS4500E High Resolution ER Data Logger measures an ER probe utilizing a high-resolution, 16-bit measurement. This allows the unit to detect much smaller amounts of metal loss, thus responding faster to corrosion events and upsets. At 16-bit resolution the MS4500E ER Data Logger can measure metal loss amounts as small as 0.004% of the probe life. For highly sensitive probes such as the 5-mil large flush shown above, that results in a detection limit of less than one angstrom.

C. Technical Specifications

Model MS4500E High Resolution ER Data Logger

Physical Data

Instrument Weight (w/ boot):	1.71 lb. (0.78 kg)
Total Weight w/ Case & Accessories:	6.96 lb. (3.16 kg)
Instrument Dimensions (w/ boot):	8.75"L x 4.54"W x 2.20"D (21.77cm x 11.53cm x 5.59cm)
Instrument Dimensions (w/o boot):	7.50"L x 4.00"W x 2.00"D (19.05cm x 10.16cm x 5.08cm)
Carrying Case Dimensions:	14.50"L x 11.38"W x 5.88"D (36.83cm x 28.89cm x 14.92cm)
Operating Temperature:	-4° to 140°F (-20° to 60°C)
Storage Temperature:	-4° to 158°F (-20° to 70°C)
Operating Humidity Range:	30% - 95%

Performance Data

Measurement Type:	ER measurement using any standard ER Probe Types Preferred Probe Types: Cylindrical, Flush(Large) Compatible probe types: Tube Loop, Wire Loop, Flush (Small)
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
Cycle Time:	25 Seconds

Electrical Data

Power Requirements:	Four (4) AA Batteries - Duracell PC1500 (or Duracell MN1500)
Maximum Probe Cable Distance:	200 ft. (61 m)
Download Method:	Directly to USB Flash drive (in non-hazardous areas only)

Hazardous Location Certifications – 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

Europe and Worldwide (ATEX and IECEx)

II 1 G Ex ia [ia] IIC T4 Ga
- 25°C ≤ Ta ≤ + 60°C
ATEX Certificate No: ITS18ATEX203161X
IECEx Certificate No: IECEx ETL 18.0007X

Included Accessories

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

Optional Accessories

Certified Data Transfer Unit
Certified USB Barrier

II. Start-up and Operation

A. Receiving the MS4500E High Resolution ER Data Logger

Check the MS4500E High Resolution Data Logger for any shipping damage when it is first received. When the unit is unpacked, verify that the following items are included:

- Carrying Case
- Data Logger
- Meter Prover
- User's Manual
- Probe Cable

In the event of shipping damage, quantity shortage, or missing items, it is recommended that the event is documented immediately and that digital photographs are taken. Any shortages or missing items should be reported to Metal Samples immediately. In the event of shipping damage, a claim should be opened with the responsible carrier.

B. Start-Up

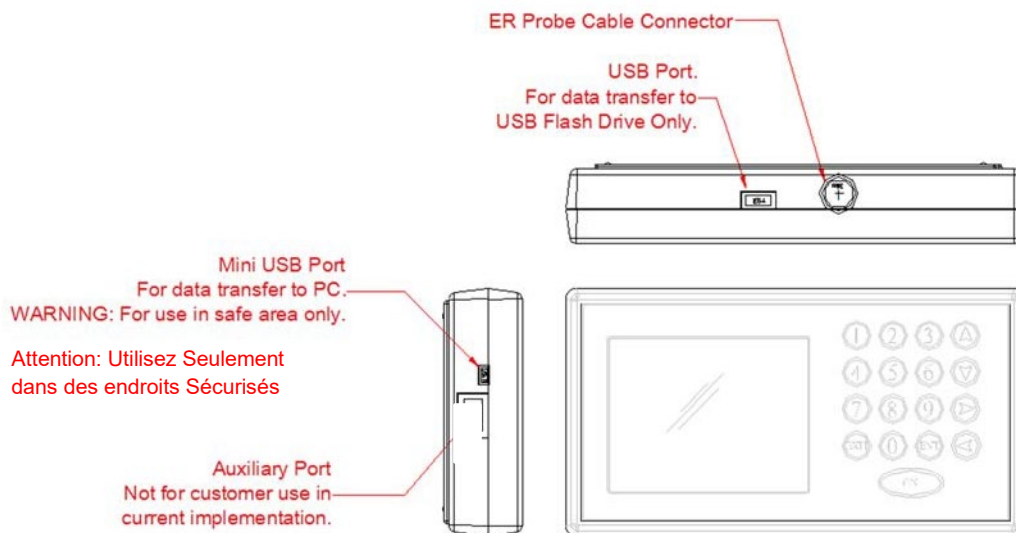
CAUTION: Using this product in any way other than that specified within this manual may impair the intrinsic safety protection.

ATTENTION : l'utilisation de ce produit de toute autre manière que celle spécifiée dans le présent manuel peut altérer la protection de sécurité intrinsèque.

Start-up of the MS4500E High Resolution Data Logger involves the following steps:

1. Port Details and Probe Connection
2. Power-Up
3. Setup and Operation

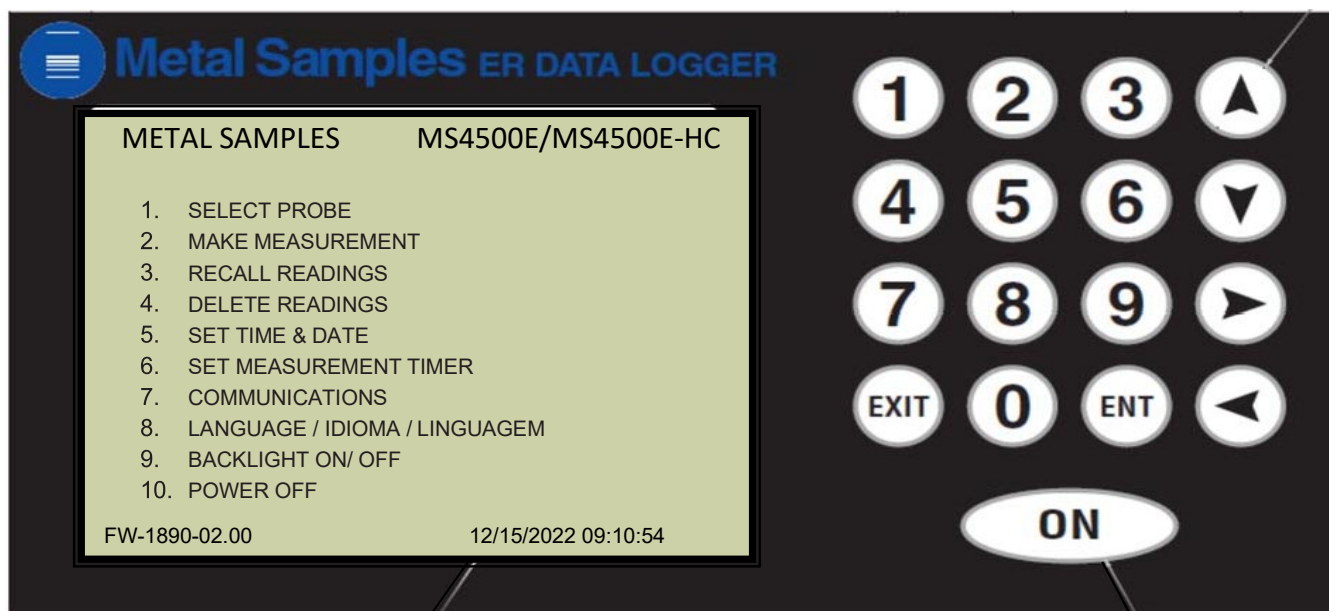
1. Port Details and Probe Connection



The MS4500E High Resolution Data Logger is supplied with a probe cable and it can be connected to the probe whose metal loss value needs to be measured, no additional hardware is necessary. Connect the probe cable 'Lemo' connector end to the data logger probe connector 'J9' available on top of the data logger. Connect the other end of the probe cable i.e. probe connector (MS Connector) to the probe.

2. Power-Up

The unit is supplied with 4 AA batteries installed. The instrument can be powered up by pressing the 'ON' button on the Keypad . The Start-up screen with the Metal Samples logo will appear on the screen; the start-up screen confirms the software version currently running and the SD card status.



Display Window

Power On Button

a. Safe Area Usage

The MS4500E High Resolution Data Logger is approved for use in hazardous areas, but can be used in non-hazardous areas as well.

The data transfer from the unit to PC should be done in a safe area. A certified USB isolator should be used between the unit and PC for data transfer.

b. Hazardous Area Usage

CAUTION: *This section provides general guidelines for hazardous area usage. However, regardless of anything stated here, the MS4500E High Resolution Data Logger must be used in full compliance with the control drawing located in Appendix A and all of the local area requirements. The entity parameters of the unit are given below.*

ATTENTION : Cette section fount des directives générales pour l'utilisation en zone dangereuse Toutefois, et indépendamment de toute déclaration faite ici, L'enregistreur de données de haute résolution MS4500E doit être utilise en pleine conformité avec le schéma de contrôle donne en page 20 et avec toutes les exigences du locale zone dangereuse.

J9-USB Port

$U_o = 4.94V$
 $I_o = 0.332A$
 $P_o = 0.410 W$
 $C_o = 1.0 \mu F$
 $L_o = 100 \mu H$

J5 – Mini USB Port Entity Parameters:

$U_o = 4.94V$
 $I_o = 0.215A$
 $P_o = 0.322 W$

SPECIAL CONDITIONS

- Connection of the equipment to the ET1867 USB barrier (or any other certified barrier used with the equipment) may only be made while both the barrier and the equipment are located in the non-hazardous area.
- External non-metallic materials utilize a conductive coating to prevent the risk of electrostatic charging. The equipment shall be removed from service if damage to this coating is observed. Refer to the manufacturer's instruction manual for further information on the durability and any chemical vulnerability of this coating.

CONDITIONS PARTICULIERES

- La connexion de l'équipement à la barrière USB ET1867 (ou toute autre barrière certifiée utilisée avec l'équipement) ne doit être effectuée que lorsque la barrière et l'équipement sont situés dans une zone non dangereuse.
- Les matériaux externes non métalliques utilisent un revêtement conducteur pour éviter le risque de charge électrostatique. L'équipement doit être retiré du service si des dommages à ce revêtement sont observés. Reportez-vous au manuel d'instructions du fabricant pour plus d'informations sur la durabilité et la vulnérabilité chimique de ce revêtement.

CAUTION:

1. Mini USB port to transfer the data from the Data Logger to PC allowed only in safe area through certified USB barrier.
 2. Connection of the equipment to the Metal Samples # ET1867 USB barrier (or any other certified barrier used with the equipment) may only be made whilst both the barrier and the equipment are located in the non-hazardous area.
 3. Only Certified USB flash drives are allowed to use in Hazardous locations.
 4. Conductive coating utilized on the equipment is permanently static dissipative and humidity independent, no further maintenance is necessary. The unit needs to be returned to manufacturer if any damages/scratches noticed on the outer surface of the equipment.
- **DO NOT USE CHEMICAL SOLVENTS TO CLEAN THE OUTER SURFACE OF THE EQUIPMENT OR BOOT.**

ATTENTION:

1. Mini port USB pour transférer les données de l'enregistreur de données au PC autorisé uniquement dans une zone sûre grâce à une barrière USB certifiée.
 2. Connexion de l'équipement aux échantillons métalliques # ET1867 La barrière USB (ou toute autre barrière certifiée utilisée avec l'équipement) ne peut être fabriquée que si la barrière et l'équipement sont situés dans une zone non dangereuse.
 3. Seuls les lecteurs flash USB certifiés sont autorisés à utiliser dans des endroits dangereux.
 4. Le revêtement conducteur utilisé sur l'équipement est en permanence antistatique et indépendant de l'humidité, aucun entretien supplémentaire n'est nécessaire. L'unité doit être retournée au fabricant si des dommages / rayures ont été constatés sur la surface extérieure de l'équipement.
- **N'UTILISEZ PAS DE SOLVANTS CHIMIQUES POUR NETTOYER LE SURFACE EXTERNE DE L'ÉQUIPEMENT OU DE LA BOTTE.**

c. Battery Replacement

The battery compartment is located on the back of the instrument. You must first remove it to access the battery compartment.

To replace the batteries, first loosen and remove the cover screw, then remove the battery cover to expose the batteries. Remove the old batteries and replace them with four new 1.5V 'AA' size batteries, being sure to follow the polarity (+/-) symbols in the battery compartment. Replace the battery cover and cover screw.

WARNING:

- Do not mix old and new batteries.
- Do not mix batteries of different types (such as alkaline and lithium.)
- Duracell PC1500 battery is required for intrinsic safety.
- The cover screw is used to prevent unauthorized tampering of the batteries and is required to ensure intrinsic safety.
- Do not over-tighten the cover screw, as this may damage the instrument case.

ATTENTION:

- Avertissement ! Ne mélangez pas des piles neuves et usées.
 - Avertissement ! Ne mélangez pas des piles de types différents (telles que des piles alcalines et des piles lithium.)
 - Avertissement ! La pile Duracell PC1500 est requise pour la sécurité intrinsèque.
 - Avertissement ! La vis du couvercle est utilisé pour éviter toute manipulation non autorisée des batteries, et est nécessaire pour assurer la sécurité intrinsèque.
 - Avertissement ! Ne pas trop serrer les vis du couvercle, pour ne pas endommager le boîtier de l'instrument
-

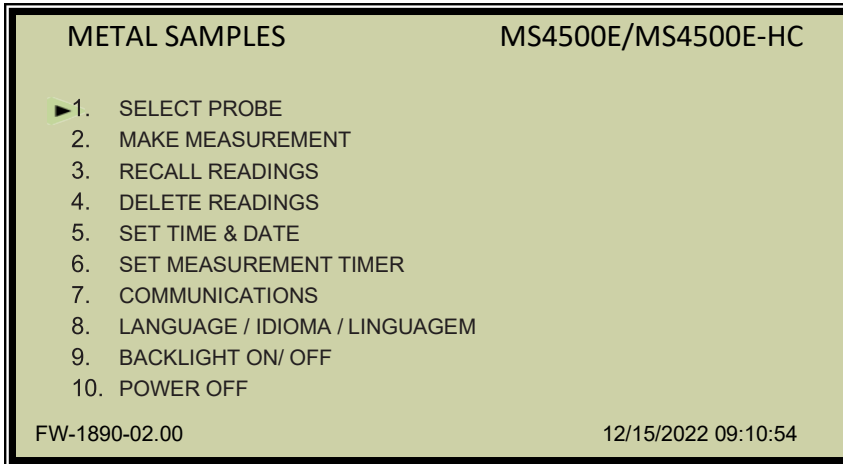


Battery Compartment Lock Screw

3. Setup and Operation

MAIN MENU

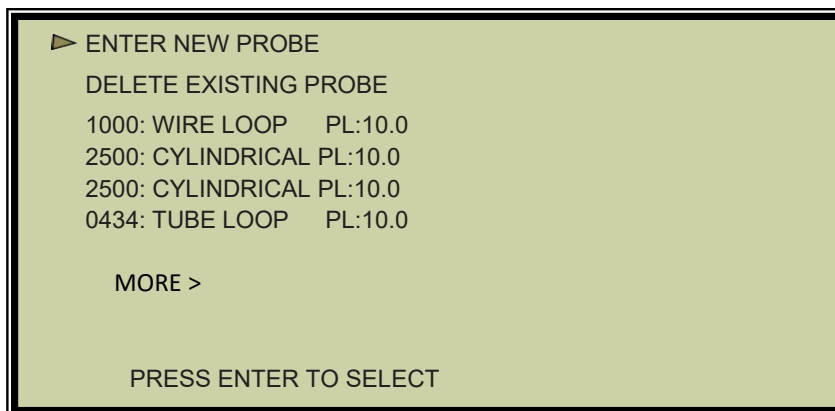
The MS4500E allows you to measure metal loss and corrosion rate. Review this section which describes the functions that display on the Main Menu:



Select the functions by using the up or down arrow and pressing ENTER or directly selecting the number using the keypad and press ENTER. Pressing 'EXIT' will return the selection to the first item of the Main Menu.

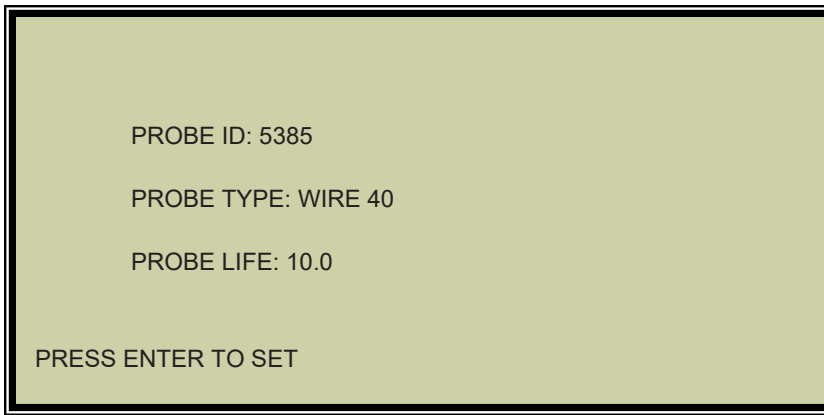
a. Select Probe

The display will show as below if you select 'SELECT PROBE' menu from the main menu. You can enter a new probe, delete a probe, or select an existing probe from this section.



ENTER NEW PROBE - To enter the ID of a new probe, select 'ENTER NEW PROBE'; the next screen allows you to enter the ID number and the type.

1. Enter the Probe ID using the number keys. (Use the Up/Down arrows to scroll between alphanumeric characters. Use the Right/Left arrows to advance to the next character or go back to the previous character.) When a 4-digit Probe ID is entered the cursor automatically advances to the Probe Type field.
2. Use the Up/Down arrows to select the Probe Type. Use the Right arrow to advance to the Probe Life field.
3. Enter the Probe Life using the numberkeys.
4. Press ENTER.



PROBE ID: 5385

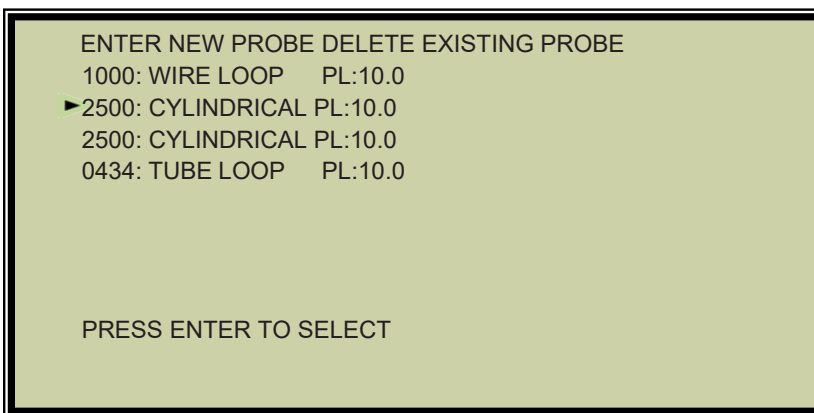
PROBE TYPE: WIRE 40

PROBE LIFE: 10.0

PRESS ENTER TO SET

SELECT EXISTING PROBE

To assist you with selecting a probe ID, the screen displays a list of all probe IDs currently in memory. Select from the list of probes in memory the one for which you wish to run a function (Make Measurement, Recall Readings and Delete Readings).



ENTER NEW PROBE DELETE EXISTING PROBE

1000: WIRE LOOP PL:10.0

▶2500: CYLINDRICAL PL:10.0

2500: CYLINDRICAL PL:10.0

0434: TUBE LOOP PL:10.0

PRESS ENTER TO SELECT

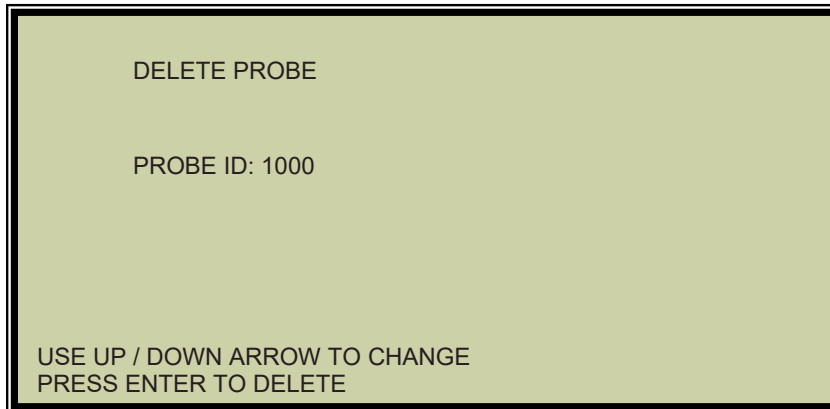
- Press the arrow key to select a probe ID.
- Press ENTER.

DELETE EXISTING PROBE

It is occasionally necessary to remove the ID of a probe from memory, for example:

- When the memory bank is full
- When a probe is no longer used

To delete the ID of a probe in memory, select DELETE EXISTING PROBE.



1. Enter the probe ID - use Up/Down arrow keys to change.
2. Press the Enter Key when you've entered the correct IDnumber.

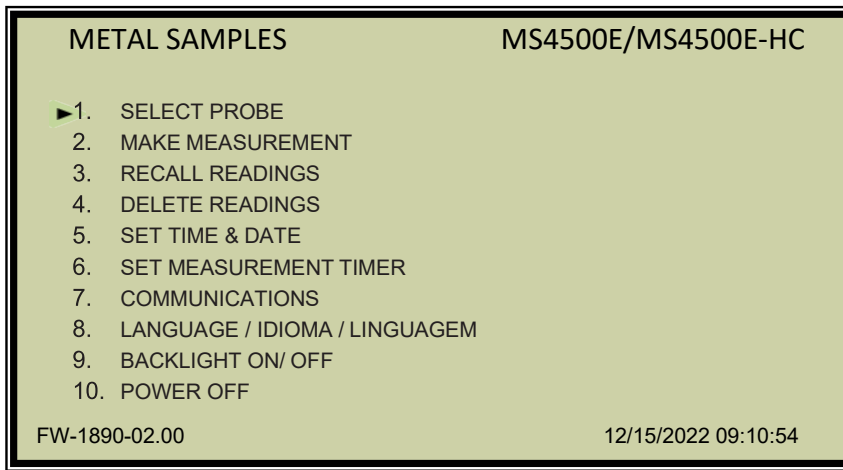
The instrument will delete your choice of probe ID from memory.

b. Make Measurement

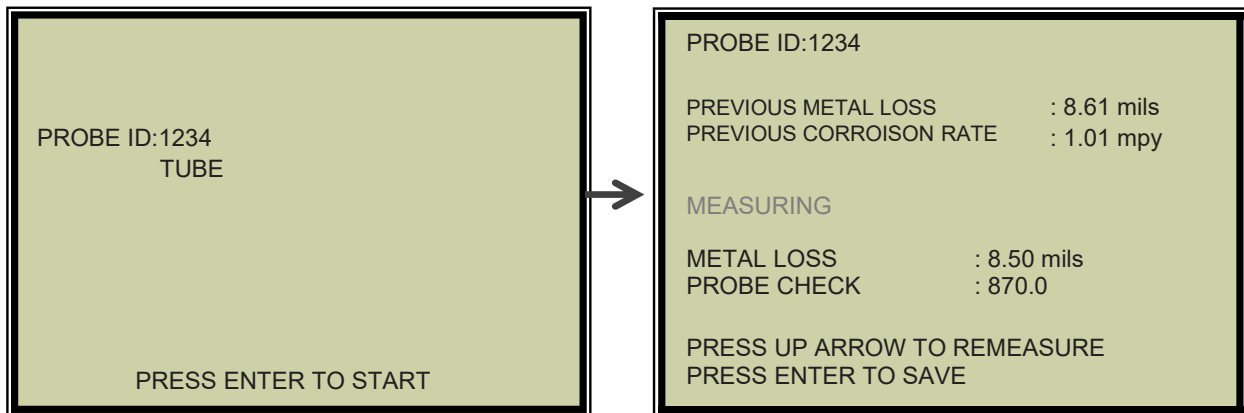
Select a probe before you run the function

In order for you to run 'MAKE MEASUREMENT' 'RECALL READINGS' & 'DELETE READINGS', you must have already selected a probe from memory. See 'SELECT PROBE' from the Main menu (page 8).

To take measurement from probes in memory, select 'MAKE MEASUREMENT' menu from the Main Menu:



The next screen displays the probe ID that you selected earlier from the Main Menu item 'SELECT PROBE'.

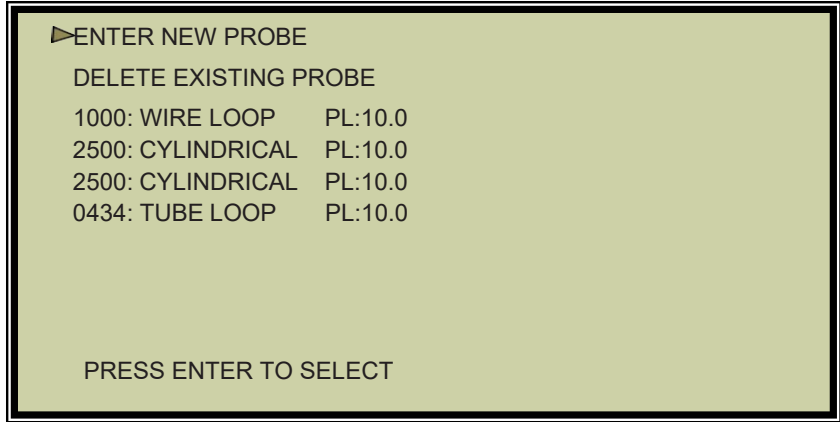


Press 'ENT' button to start measuring the probe value. During measurement 'MEASURING..' message displays on the screen. On completion of measurement the display shows the probe reading.

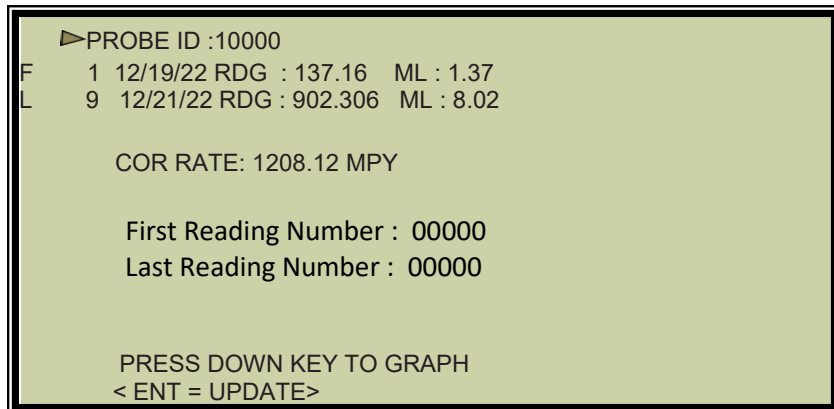
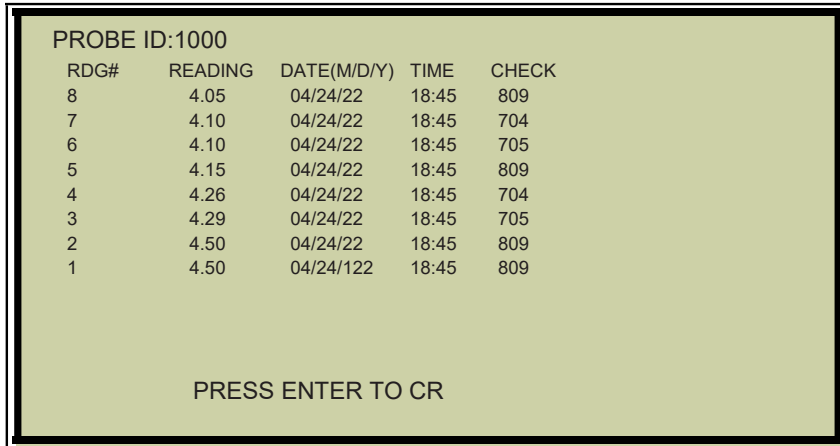
Press 'ENT' button to save the reading. Press 'Up' Arrow to re-measure the probe again.

c. Recall Readings

Select '**RECALL READINGS**' to look at data from different dates.

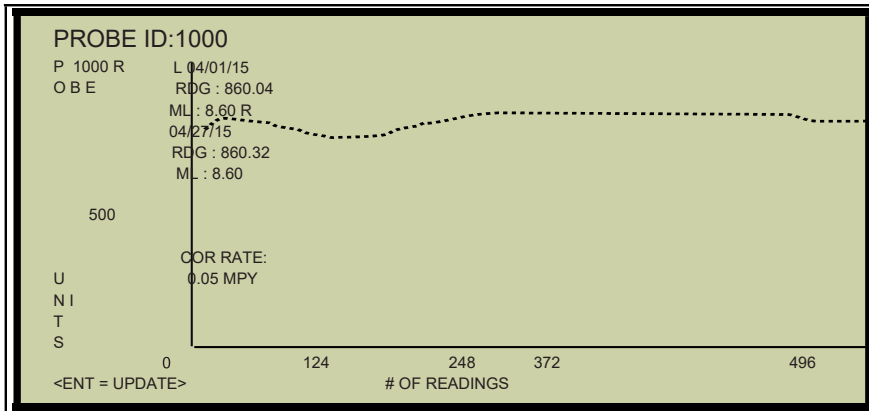


Select the probe if it is not already selected to look in to the readings by using up/down arrows and press 'ENT' button. The readings of the selected probe will be displayed in the next screen.



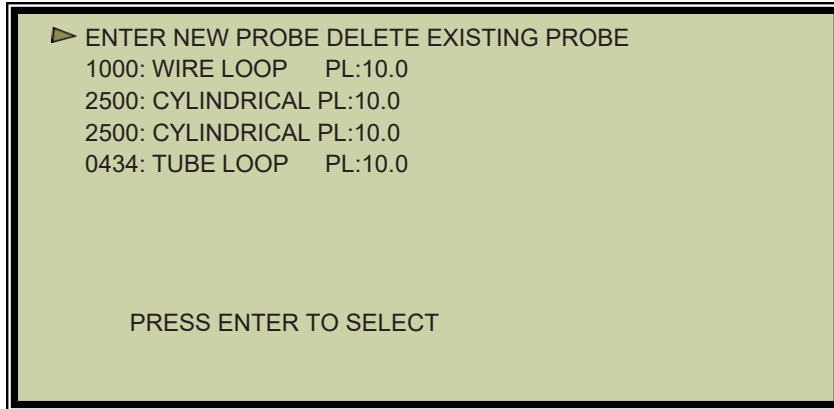
Enter First number and Last reading number to calculate Corrosion Rate and Press Enter.
Press Down arrow on the keypad to plot the graph of the selected probe. The graph will be displayed on the next screen.

- The corrosion rate page appears as the image below:

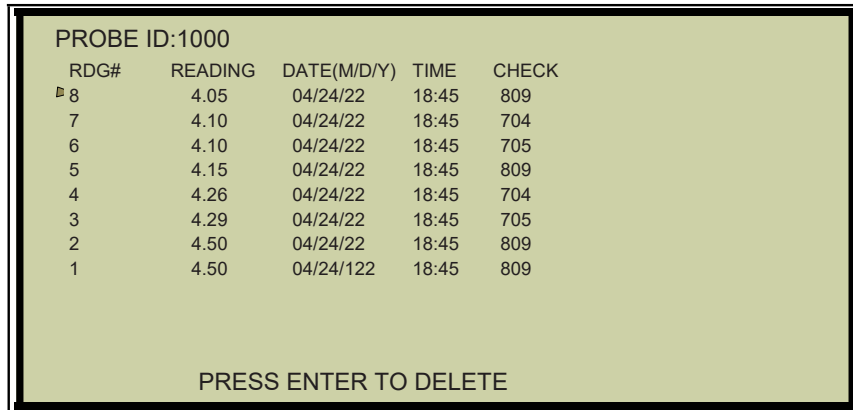


d. Delete Readings

Select '**DELETE READINGS**' from Main Menu to erase a reading from memory. Periodically delete readings to create more free storage area in memory.



Select the probe from which the readings need to be deleted by using up/down arrows and press 'ENT' button. The readings of the selected probe will be displayed in the next screen.



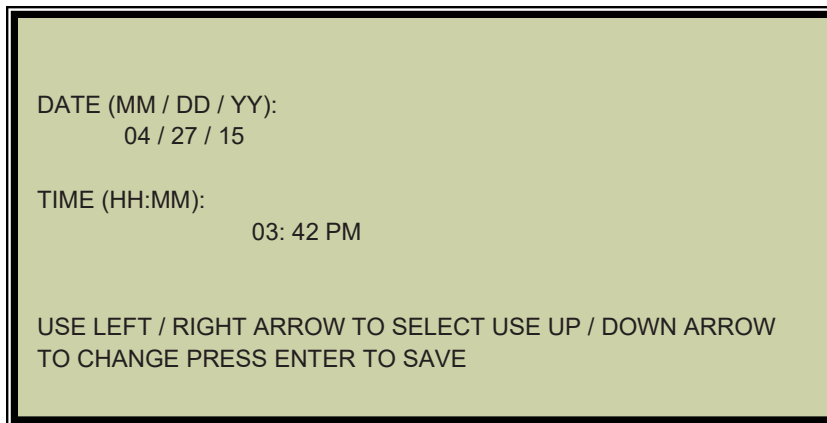
Select the probe reading (RDG#) number which needs to be deleted by using up/down arrows and press 'ENT' button. The selected probe reading will be deleted permanently from the instrument memory.

e. Set Time & Date

Select '**SET TIME & DATE**' from Main Menu to set the internal clock of the MS4500E Data Logger. In order for information in memory to be useful and accurate, be sure the time and date are accurate.

CAUTION: *The Time and Date are set at the factory, but may need to be adjusted to your time zone. Also, if you try to change the Date or Time and it conflicts with stored information, the MS4500E will display N/A.*

ATTENTION : *l'heure et la date sont définies à l'usine, mais ils peuvent être ajustées à votre fuseau horaire. Aussi, si vous essayez de changer la date ou l'heure et que ce ci conflit avec l'information mémorisée, le MS4500E affichera N/A.*



Use the numbers on the keypad and the arrow keys to make changes to the time and date.

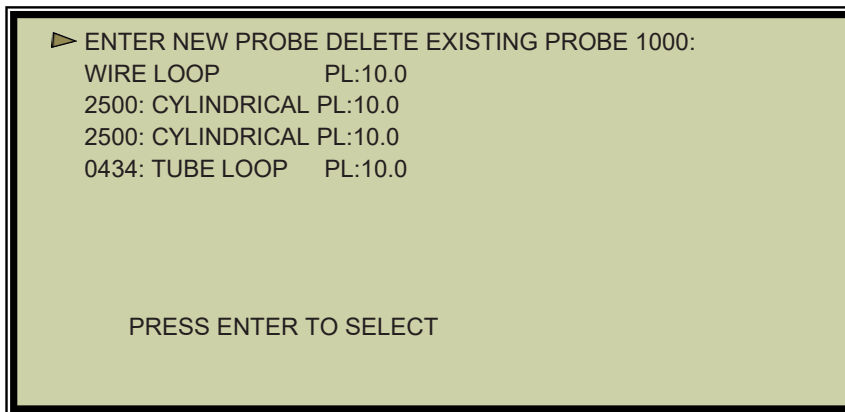
Press '**ENT**' button on the keypad to confirm your changes and return to the Main Menu , or Press '**EXIT**' button to discard the changes.

f. Set Measurement Timer

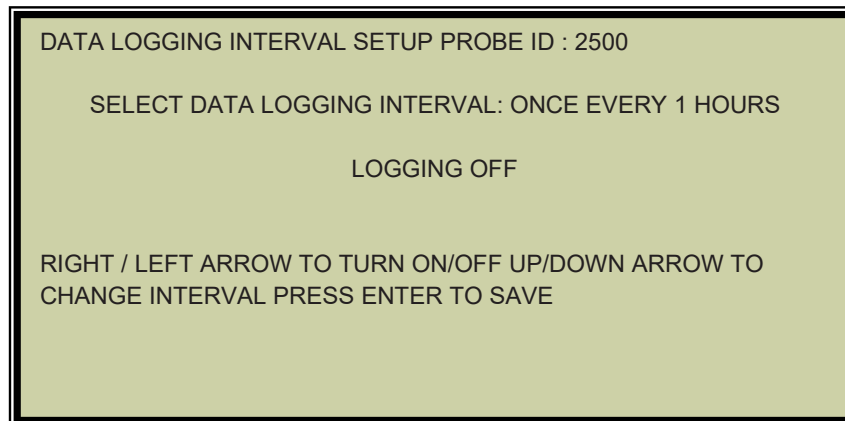
Select '**SET MEASUREMENT TIMER**' from Main Menu to set automatic probe reading at set intervals. The MS4500E Data Logger periodically wakes up and takes the measurement and stores the reading.

Select a probe before you run the function

*In order for you to run MAKE MEASUREMENT, you must have already selected a probe from memory. See **Select Probe ID** from the Main menus (see page 8).*



If probe is not selected earlier, select the probe from the display. Use Up/Down arrow keys to select the probe and press 'ENT' button.

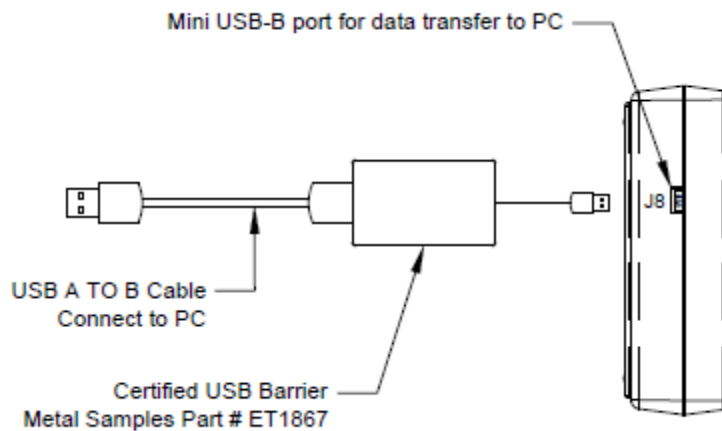


Use Right/Left arrow keys to turn on/off the data logging. Use Up/Down arrow to change data logging interval. Minimum can be set as 1 Hours and maximum can be set as 99 Days. The unit takes the reading once per the set interval.

g. Communications

The MS4500E Data Logger has the ability to store readings as they are taken. These readings can later be transferred to your PC via USB port. To transfer data to a PC it is necessary to install the Corrosion Data Management Software (included).

To connect to the MS4500E to PC, the use of the Certified USB Barrier Metal Samples Part #ET1867 must be used while in in the Non-Hazardous Area only. The connection is made via J5 on the MS4500E-XX to download the Data to the PC.



Warning: Connection shall only be made while both equipment and barrier are located in a non-hazardous area.

WARNING:

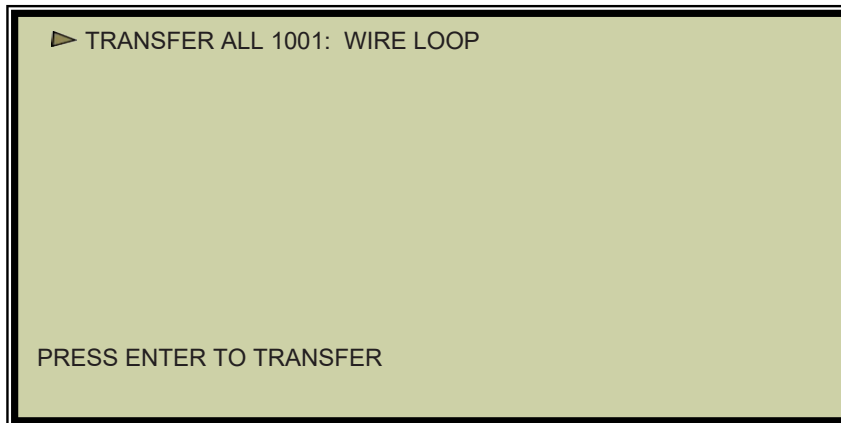
Improper connection to the PC may cause permanent damage to the MS4500E.

AVERTISSEMENT:

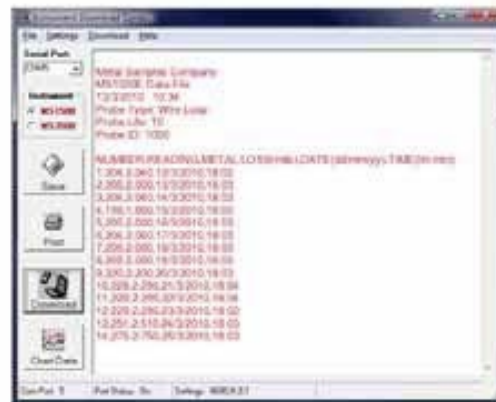
Une mauvaise connexion au PC peut causer des dommages permanents au MS4500E.

To download data from an instrument:

- Connect the instrument to an available PC USB port .
- Turn the MS4500E on.
- Run the Corrosion Data Management Software
- Open the Instrument Download Center
- Select the serial port and instrument
- Click the *Download* button, then **“Connect”** (ensure that Part Status toggles to **“On”**).
- Select **‘COMMUNICATIONS’** menu from the Main Menu of the instrument.
- Select **‘TRANSFER ALL’** or Select the Probe data you wish to download.



Data will begin to transfer from the instrument to the PC, and will appear in the data window of the Instrument Download Center as shown below. If the data appears garbled, the wrong instrument type has been selected. Select another instrument type and try again.



If data does not appear in the data window at all, verify that:

- The instrument is connected to a valid serial or USB port
- All cables are securely connected
- The message “Port Status: On” appears in the status bar
- There are no errors on the instrument
- If using a USB adapter, ensure that the device drivers have been installed.

Selecting a Serial Port

When the MS4500E is connected to the USB port it will appear as a virtual COM port. Use the *Serial Port* selection box to select the virtual COM port number. If the COM port number is unknown, it can be found in Windows Device Manager under “Ports (COM & LPT)”.

Selecting an Instrument

Use the *Instrument* option box to select the model of Metal Samples instrument being downloaded. This sets the appropriate communication parameters, which will be displayed in the status bar at the bottom of the window (“9600,N,8,1” for an MS1500, “2400,N,8,1” for an MS3500).

Downloading Data

To toggle the selected port on and off, click the *Download* button. Toggling the port on and off will also clear the data window.

Once a valid serial port and instrument have been selected, click the *Download* button to turn the port on and enable the computer to receive data. If a valid serial port has been selected, the status bar at the bottom of the window will display the message “Port Status: On”.

If an invalid serial port has been selected, an error message will appear, and the status bar will display the message “Port Status: Off”. If this happens, another serial port should be selected.

Saving Data

To save the data in the data window, click the *Save* button. The data is comma-delimited ASCII text. It can be saved to a standard text (.txt) file, or it can be saved to a comma-separated values (.csv) file, which greatly simplifies the process of importing the data into some spreadsheet programs such as Excel[®] or Quattro Pro[®].

Printing Data

To print the contents of the data window, click the *Print* button. A print dialog box will be displayed to allow printer selection and setup.

Charting Data

To chart the contents of the data window, click the *Chart Data* button. If the data has not yet been saved, the user will be prompted to do so before the charting process begins. For more information on charting data, see the Data Analysis section.

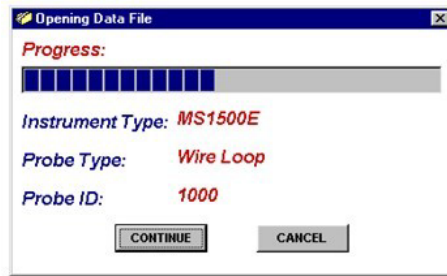
Data Analysis

The DataAnalysis utility is a convenient tool for charting data from Metal Samples ER and LPR data logger instruments. The DataAnalysis utility can be opened from the Main Menu, or it can be opened directly from the Instrument Download Center.

If the DataAnalysis utility is opened from the Instrument Download Center, the contents of the data window will be loaded into the chart. However, if the DataAnalysis utility is opened directly from the Main Menu, a valid data file must be loaded. The *Select File* box will open to allow selection of a data file.

Loading a Data File

After selecting a data file (or clicking the *Chart Data* button from the Instrument Download Center) a status window will display the progress of the file being opened, along with the Instrument Type, Probe Type, and Probe ID for the data file.



Data Table

After a file has been successfully loaded, the data will be displayed in the Data Table for review. By default, all data points will be included in the chart. However, data points can be turned off, or excluded, from the chart. If the "Excluded" flag appears in the status column for a data point that data point will not appear in the chart. To toggle the exclude/ include status of a data point, double-click the data point, or select the data point and click *Exclude/Include* in the *Options* menu.



The screenshot shows a window titled "Data Table" with a menu bar containing "Options" and "Help". The main area contains a table with the following data:

READING #	METAL LOSS (mil)	DATE (MM/DD/YY)	PROBE ID	PROBE TYPE	STATUS
1	2.040	12/3/2001	1000	Wire Loop	
2	2.000	13/3/2001	1000	Wire Loop	
3	2.040	14/3/2001	1000	Wire Loop	
4	1.960	15/3/2001	1000	Wire Loop	
5	2.000	16/3/2001	1000	Wire Loop	
6	2.040	17/3/2001	1000	Wire Loop	
7	2.060	18/3/2001	1000	Wire Loop	
8	2.080	19/3/2001	1000	Wire Loop	
9	2.200	20/3/2001	1000	Wire Loop	
10	2.290	21/3/2001	1000	Wire Loop	
11	2.290	22/3/2001	1000	Wire Loop	Excluded
12	2.290	23/3/2001	1000	Wire Loop	Excluded
13	2.510	24/3/2001	1000	Wire Loop	Excluded

At the bottom of the window, there are two buttons: "Chart Data" and "EXIT".

Printing Data

The data table can be printed by clicking *Print* in the *Options* menu. A print dialog box will be displayed to allow printer selection and setup.

Creating A Chart

To chart the selected data, click the *Chart Data* button, or select *Chart Data* from the *Options* menu. The chart will be displayed in a new window.



Printing a Chart

A chart can be printed using the *Print Chart* option in the *File* menu.

A print dialog box will be displayed to allow printer selection and setup.

Exporting a Chart

A chart can be exported to other applications using the *Copy Chart* option in the *File* menu. This will copy both the chart and the raw data to the Windows® Clipboard. The chart can then be inserted into other applications using the *Paste* function. Note: In some applications, using the *Paste* function will insert the raw data instead of the chart. In this case, use the *Paste Special* function, then select *Picture* to insert the chart.

Chart Tools

• Statistical Data

The *Statistical Data* tab at the bottom of the Data Chart window will display a page with statistical information about the chart data. If the Statistical Data page is visible, this information can be printed by clicking *Print Statistical Data* in the *File* menu.



- **Finding A Data Points Value**

While viewing the chart, the value of any data point can be determined by simply clicking it. The value will be displayed in the charts tool-tip box (a small text box that is displayed near the mouse pointer). If the tool-tip box does not appear immediately after clicking the data point, hold the mouse pointer stationary over the chart background for a moment.

- **The Tools Menu**

The *Tools* menu contains a collection of utilities for viewing and manipulating the chart. The *Tools* menu can be accessed by clicking *Tools* on the menu bar, or by right-clicking anywhere on the chart.

Hide <u>D</u> ata Markers	Ctrl+D
Show <u>M</u> ean Value	Ctrl+M
Show <u>T</u> rend Line	Ctrl+T
Title/ <u>F</u> ootnote Setup	Ctrl+F
<u>P</u> lot Setup	Ctrl+O
Data Series <u>C</u> olor	Ctrl+L
<u>Z</u> oom <u>I</u> n	F5
<u>Z</u> oom <u>O</u> t	F6
<u>C</u> alculate Corrosion Rate	F7

- **Data Markers**

Show Data Markers toggles the data markers on and off.

- **Mean Value**

Show Mean Value toggles the mean value line on and off.

- **Trend Line**

Show Trend Line toggles the trend line on and off.

- **Title/Footnote Setup**

Title/Footnote Setup displays a window that allows the chart title and footnotes to be toggled on and off, and to be modified.

- **Plot Setup**

Plot Setup displays a window that allows configuration of Y-axis scaling, and of the chart type.

The Y-axis can be scaled to default values by checking the *Auto Scaling* option box. The Y-axis can be scaled to manual values by un-checking the *Auto Scaling* box, then entering the desired values in the *Minimum* and *Maximum* fields.

The chart type can be set to *Line Chart*, *Bar Chart*, or *Area Chart* by selecting the appropriate button in the *Chart Type* box. The default chart type is *Line Chart*.

- **Data Series Color**

Data Series Color displays a color selection box, which allows the user to select the brush color for the plot line. The default color for the plot line is Blue.

- **Zoom In**

Zoom In allows a region of the chart to be enlarged so that it may be viewed in greater detail. To enlarge a region of the chart, click on the two data points that define the left and right boundaries of the region.

In zoom mode, the mouse pointer will change to a cross- hair. When zoom mode ends, the mouse pointer will return to its normal state.

To cancel zoom mode, click *Cancel Zoom In* from the *Tools* menu, or simply press the *Esc* key.

- **Zoom Out**

Zoom Out restores the initial view of the chart, which displays the full data set.

- **Calculate Corrosion Rate**

If the chart contains ER data, the *Calculate Corrosion Rate* option will become available under the *Tools* menu. This option allows the corrosion rate to be calculated between any two data points on the chart. To calculate the corrosion rate click *Calculate Corrosion Rate*, then click two data points. The corrosion rate between those two data points will be displayed.

In calculate mode, the mouse pointer will change to an arrow/question mark. When calculate mode ends, the mouse pointer will return to its normal state.

To cancel a calculation, click *Cancel Calculate* from the *Tools* menu, or simply press the *Esc* key.

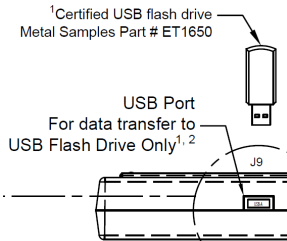
h. File Transfer USB

The J9 Connector on the top side of the device allows for transferring of data onto USB flash drives.

Hazardous Area

In the hazardous area, the Metal Samples Part# ET1650 Certified USB flash drive can be used. All other non-certified drives must be used in the safe area.

Connection:



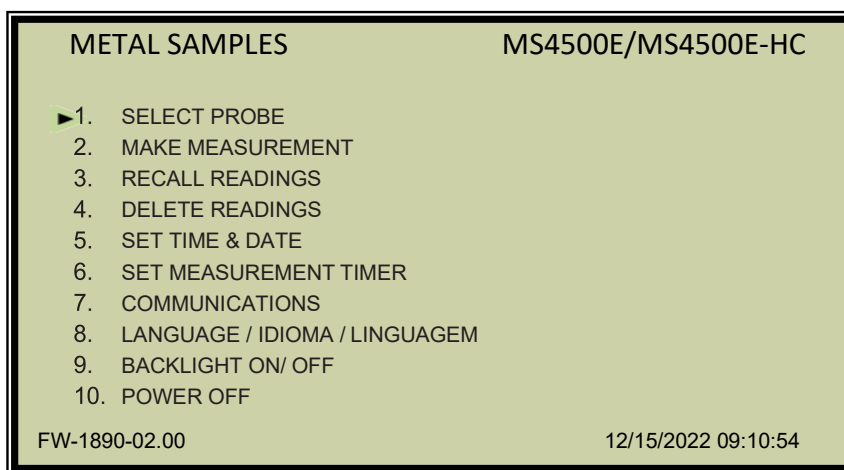
CAUTION:

Only certified flash drives may be connected and used in the hazardous location.

ATTENTION:

Seuls les lecteurs flash certifiés peuvent être connectés et utilisés dans l'emplacement dangereux.

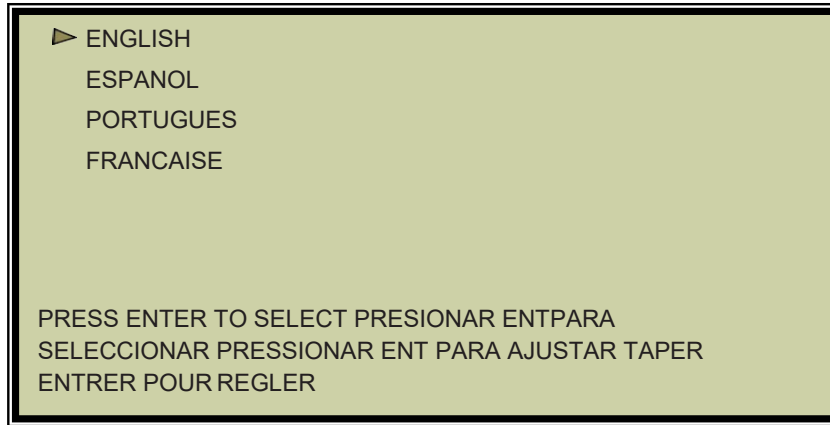
To download the Data from the "Main Menu" select 7. Communications after installing the USB drive in J9.



The up arrow can be pressed, and you can select download all by pressing 'ENT' or you can individually select the probe you are interested in by scrolling through the list with the arrow keys and selecting the probe(s) of interest by pressing 'ENT' on each one.

i. Language / Idioma / Linguagem

Select '**LANGUAGE / IDIOMA / LINGUAGEM**' from Main Menu to select the language.

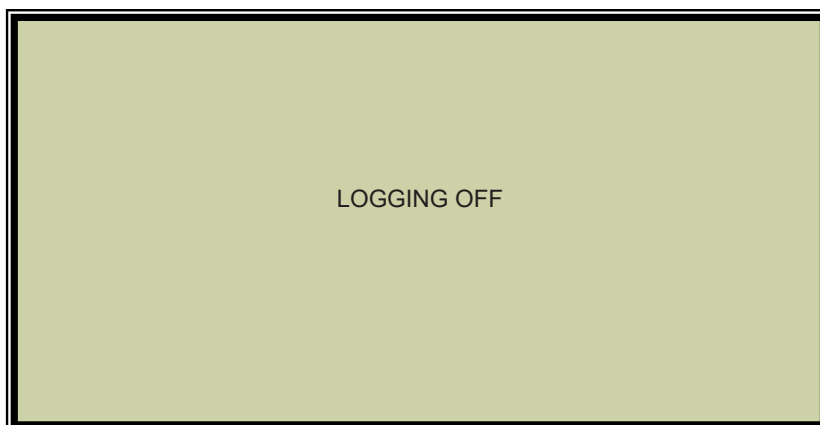


j. Backlight On/Off

Select '**BACKLIGHT ON/OFF**' from Main Menu to turn the backlight for the LCD display on or off.

k. Power Off

Select '**POWER OFF**' from Main Menu to turn off the unit.



C. Maintenance

Once installed, the MS4500E High Resolution ER Data Logger requires no maintenance. However, it is important to verify the following items periodically to ensure continued safe operation.

CAUTION: Before performing any tests or maintenance on the MS4500E High Resolution ER Data Logger, ensure that all hazardous area requirements are met.

ATTENTION: Avant d'effectuer tout essai ou entretien de l'enregistreur de données de haute résolution MS4500E, il faut d'abord s'assurer que toutes les exigences de zone dangereuse soient remplies.

Inspection Item	Frequency
Inspect the rubber boot for any signs of damage. Replace as necessary.	Annually
Inspect the probe cable / connector for any signs of damage. Replace as necessary.	Annually
Replace the Batteries	As needed

Contact Metal Samples for replacement parts or if instrument repair is necessary.

Testing the MS4500E High Resolution ER Data Logger with the Meter Prover

A Meter Prover is provided to allow routine checks of the MS4500E High Resolution ER Data Logger. The Meter Prover simulates a Wire Loop type probe at a fixed value. To test the unit with the Meter Prover:

- 1) Connect the Meter Prover to the probe connector .
- 2) Turn on the MS4500 data logger by pressing the 'ON' button
- 3) Select probe type as Wire Loop.
- 4) Set mils to 10
- 5) Select MAKE MEASUREMENT From main menu .
- 6) Press 'ENT' button to start measuring the probe value. During measurement 'MEASURING.' message displays on the screen. On completion of measurement the display shows the Meter Prover reading. The output should closely match the value printed on the Meter Prover label.

If the Data Logger output matches the Meter Prover value, the instrument can be used for probe measurement by selecting the appropriate PROBE ID and connecting to the respective probe. If the Data Logger output shows a significant difference compared to the Meter Prover value, further troubleshooting may be required. Refer to page 28 for troubleshooting or contact the factory for further assistance.

D. Troubleshooting

If the MS4500E High Resolution ER Data Logger does not seem to perform as expected, check the following items:

CAUTION: *Before performing any tests or maintenance on the MS4500E High Resolution ER Data Logger, ensure that all hazardous area requirements are met.*

ATTENTION : *avant d'effectuer tout essai ou d'entretien sur l'MS4500E haute résolution ER Enregistreur de données, s'assurer que toutes les conditions sont remplies pour zone dangereuse.*

1. Ensure that the probe is operational and is not completely corroded. This can be done in two ways.
 - a. Test the probe with another portable ER meter if available.
 - b. Test the probe with a portable resistance or continuity meter as follows:
 - i. Connect one test lead to pin 'A' of the probe's 6-pin connector.
 - ii. Measure continuity to each of the other pins. There should be continuity (low resistance) to each pin.

NOTE: Continuity on each pin does not ensure that the probe is good. However, if you find an open circuit on any pins then it is almost certain that the probe is bad and should be replaced.
2. Ensure the battery voltage.
3. Test the MS4500E High Resolution ER Data Logger transmitter using the supplied Meter Prover (see page 27.)

These basic checks should indicate the source of any problem (probe, power supply, wiring, etc.). If it is determined that the MS4500E High Resolution ER Data Logger is malfunctioning, or if you need further assistance in troubleshooting, contact Metal Samples Technical Support.

CAUTION: *If the MS4500E High Resolution ER Data Logger transmitter shows any signs of damage, remove it from service immediately and consult the factory.*

ATTENTION: *Si l'Émetteur de l'Enregistreur de données de haute résolution présente des signes de dommages, Alors il faut le retirer du service et consulter l'usine.*

III. Service and Warranty Information

A. Warranty

Metal Samples warrants that any part of the model **MS4500E High Resolution ER Data Logger** 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.

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.

B. Obtaining Service and Returning the Instrument for Repair

If you experience problems with your instrument please contact the factory at 256-358-4202 and ask for customer support for instrumentation. Our customer support department will assist you in troubleshooting your instrument.

Most issues can be resolved over the phone, but in some cases it may be necessary to return your instrument for further evaluation and repair. In this case, please obtain a Return Materials Authorization (RMA) number from the sales person or support technician. This RMA number will ensure that your instrument is routed to the correct department when it is received at the factory.

After receipt of an RMA number you may pack your instrument for return. Be sure to pack your instrument in a sturdy box and to pad it sufficiently to avoid damage during transit. Also be sure to complete the "Instrument Repair Form" on the next page and include a copy with your repair. This will ensure that the repair department has sufficient information regarding the problems you are experiencing with your instrument, as well as the billing, contact, and return shipping details for the repair.

Once you have obtained an RMA number, completed the "Instrument Repair Form", and packed your instrument securely, please ship it prepaid to the following address:

Metal Samples
152 Metal Samples Road
Munford, AL 36268
ATTN: RMA# _ _ _ _ _

NOTE: Be sure to list your RMA number in the attention line (shown as blanks in the example above.)

C. Instrument Repair Form

This form may be photocopied for use when returning an instrument to Metal Samples for repair. Please fill in all known information and enclose a copy of the completed form with the instrument.

General Information

Model Number		Serial Number	
RMA Number		Date of Purchase*	

**If known.*

Contact Information for Repair

Contact Name		Company	
Phone Number		E-mail Address	

Return Shipping Information

Recipient Name*		Company*	
Return Address			

**If different than above.*

Reason for Return. (Provide as much detail as possible. Attach additional pages if required.)

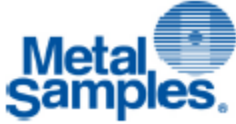
Invoice Instructions (For non-warranty repairs)

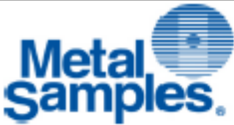
<input type="checkbox"/>	Invoice me for the repair <i>(Requires an open account with Metal samples.)</i>	Reference PO#
<input type="checkbox"/>	Contact me for credit card information <i>(For security purposes, do not list credit card information on this form..)</i>	

Appendix A: Revision History

Revision	Date	Changes
0	8/15/2014	Initial Release
A	5/22/2015	Mini USB entity parameters changed
B	6/01/2015	Mini USB entity parameters changed
C	7/19/2015	Marking information added for America
D	8/04/2015	Warning statements added in French & Temperature ratings
E	10/06/2016	Backlight On/Off added to main menu
F	4/09/2019	New Hazardous Location standards added
G	05/31/2019	Changes to Technical Specifications page
H	07/25/2022	Certification details updated.
I	01/26/2023	Picture representation corrected

Appendix B: Hazardous Area Certification Details

	MS4500E-XX HAZARDOUS AREA CERTIFICATION - INTRINSIC SAFETY DETAILS	Doc.Number	EXDOC-000014
		Revision	E
		Date	07/25/2022
		Page	1 of 3
<p>USA / Canada</p> <p>Class 1, Zone 0, AEx ia [ia] IIC T4 Ga Model : MS4500E-HC $-40^{\circ}\text{C} \leq \text{Ta} \leq +70^{\circ}\text{C}$ Only with Xeno Energy XL-205F Cells and Tadiran TL-4920 Cells Model : MS4500E $-25^{\circ}\text{C} \leq \text{Ta} \leq +60^{\circ}\text{C}$ Only with Duracell PC1500 /MN1500 Cells</p> <p>Worldwide and Europe</p> <p>Ex ia [ia] IIC T4 Ga Model : MS4500E-HC $-40^{\circ}\text{C} \leq \text{Ta} \leq +70^{\circ}\text{C}$ Only with Xeno Energy XL-205F Cells and Tadiran TL4920 Cells Model : MS4500E $-25^{\circ}\text{C} \leq \text{Ta} \leq +60^{\circ}\text{C}$ Only with Duracell PC1500 /MN1500 Cells</p> <p>ATEX Cert. No: ITS18ATEX203161X IECEx Cert. No: IECEx ETL 18.0007X X – See special Conditions below</p> <p>Special Conditions Connection of the equipment to the ET1867 USB barrier (or any other certified barrier used with the equipment) may only be made whilst both the barrier and the equipment are located in the non-hazardous area</p> <p>La connexion de l'équipement à la barrière USB ET1867 (ou à toute autre barrière certifiée utilisée avec l'équipement) ne peut être effectuée que lorsque la barrière et l'équipement sont situés dans la zone non dangereuse.</p> <p>External non-metallic materials utilize a conductive coating to prevent the risk of electrostatic charging. The equipment shall be removed from service if damage to this coating is observed. Refer to the manufacturer's instruction manual for further information on the durability and any chemical vulnerability of this coating.</p> <p>Les matériaux externes non métalliques utilisent un revêtement conducteur pour éviter le risque de charge électrostatique. L'équipement doit être retiré du service si des dommages à ce revêtement sont observés. Reportez-vous au manuel d'instructions du fabricant pour plus d'informations sur la durabilité et toute vulnérabilité chimique de ce revêtement.</p>			



MS4500E-XX HAZARDOUS AREA CERTIFICATION -
INTRINSIC SAFETY DETAILS

Doc.Number	EXDOC-000014
Revision	E
Date	07/25/2022
Page	2 of 3

Hazardous Area Installation

CAUTION : This section provides general guidelines for hazardous area wiring. However, regardless of anything stated here, the MS4500E-XX transmitter must be installed in full compliance with the control drawing provided Annexure-C and all of the local area requirements.

ATTENTION : Cette section fournit des directives générales pour le câblage en zone dangereuse. Cependant, indépendamment de tout ce qui est indiqué ici, le transmetteur MS4500E-XX doit être installé en totale conformité avec le schéma de contrôle fourni à l'Annexe-C et toutes les exigences locales.

Entity Parameters

J11: at Probe (common for all models)

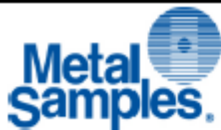
Uo: 4.94V
Io: 0.332A
Po: 410mW
Ci: 0μF
Li: 0μH
Co: 1.0μF
Lo: 100μH

J9: USB Flash Drive (common for all models)

Uo: 4.94V
Io: 747.5mA
Po: 923.1mW
Ci: 39.394μF
Li: 1.8μH
Co: 12.71μF
Lo: 0.37μH

J8: mini USB

Uo: 4.94V
Io: 0.215A
Po: 0.322W



MS4500E-XX HAZARDOUS AREA CERTIFICATION -
INTRINSIC SAFETY DETAILS

Doc.Number	EXDOC-000014
Revision	E
Date	07/25/2022
Page	3 of 3

- 1 When replacing the battery packs in Hazardous area, discharge the static charge from the body using ground strips or other methods.
- 2 Use gas analyzers or other type of equipment to ensure the area is non-hazardous before changing the batteries. Cells in the batteries not allowed to replace in hazardous areas.
- 3 Use only with recommended batteries
- 4 MS4500E-HCEquipment is intended for use only with Xeno Energy model XL-145F and Tadiran TL-4920 cells. Use of any other battery in this device may impair intrinsic safety.
- 5 MS4500E equipment is intended for use only with Duracell PC1500/MN1500
- 6 Do not replace cells unless area is known to be Non-Hazardous.

- 1 Lors du remplacement des batteries dans une zone dangereuse, déchargez la charge statique du corps à l'aide de bandes de masse ou d'autres méthodes.
- 2 Utilisez des analyseurs de gaz ou un autre type d'équipement pour vous assurer que la zone n'est pas dangereuse avant de changer les piles. Les cellules des batteries ne peuvent pas être remplacées dans les zones dangereuses.
- 3 Utiliser uniquement avec les piles recommandées
- 4 L'équipement MS4500E-HCE est destiné à être utilisé uniquement avec les cellules Xeno Energy modèle XL-145F et Tadiran TL-4920. L'utilisation de toute autre batterie dans cet appareil peut compromettre la sécurité intrinsèque.
- 5 L'équipement MS4500E est destiné à être utilisé uniquement avec Duracell PC1500/MN1500
- 6 Ne remplacez pas les cellules à moins que la zone ne soit connue comme étant non dangereuse

Appendix C: Drawing

Control Drawing (Hazardous Area Wiring Diagram)

Model MS4500E/L ER/LPR Data Logger

For use in dry locations.
Suitable for use in ordinary locations.
Intrinsically safe for use in the following areas:
Ex ia [ia] IIC T4 Ga
-25°C ≤ Ta ≤ +60°C
Class 1, Zone 0, AEx ia [ia] IIC T4 Ga
Class 1, Division 1, Groups A,B,C,&D, T4
Provides outputs to Class 1, Division 1 [Ex ia]

Conforms to the following standards:
ANSI/UL Std. 60079-0, 60079-11 & 61010-1
Cert. to CAN/CSA 60079-0, 60079-11 & CAN/CSA C22.2 No. 61010-1

ATEX Cert. No: ITS18ATEX203161X
IECEX Cert. No: IECEX ETL 18.0007X

The user must read and follow all instructions found in the MS4500E/L Users Manual.

Warning! Classification requires the use of Duracell PC1500/MN1500, size AA batteries. Use of any other battery in this device may impair intrinsic safety.
Warning! To reduce the risk of explosion do not mix old batteries with new batteries, mix batteries from different manufacturers, or mix batteries of different types.
Warning! To reduce the risk of ignition of a flammable or explosive atmosphere, batteries must be changed only in a location known to be non-hazardous.
Warning! Substitution of components may impair intrinsic safety.

Pour une utilisation dans des endroits secs
Convient pour une utilisation dans des lieux ordinaires.
Intrinsèquement sûr pour l'usage dans les secteurs suivants:
Ex ia [ia] IIC T4 Ga
-25°C ≤ Ta ≤ +70°C
Class 1, Zone 0, AEx ia [ia] IIC T4 Ga
Class 1, Division 1, Groups A,B,C,&D, T4
Provides outputs to Class 1, Division 1 [Ex ia]

Conforme aux normes suivantes:
ANSI/UL Std. 60079-0, 60079-11 & 61010-1
Cert. to CAN/CSA 60079-0, 60079-11 & CAN/CSA C22.2 No. 61010-1

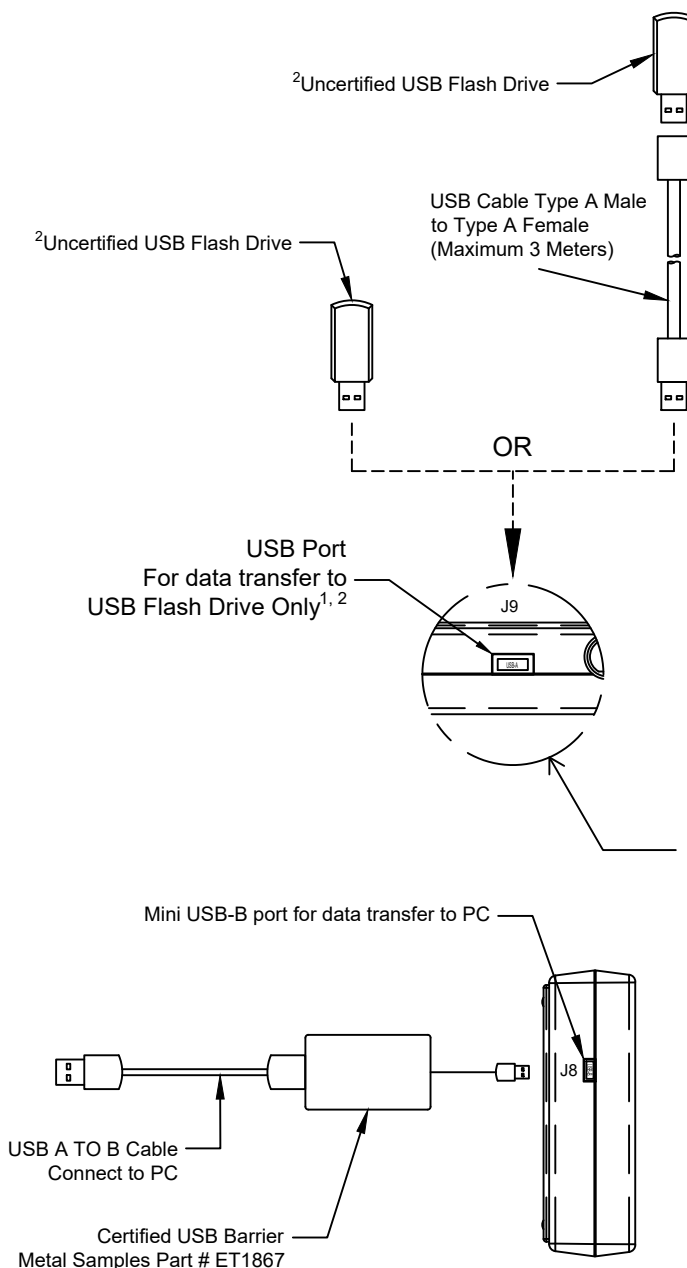
L'utilisateur doit lire et suivre toutes les instructions dans le manuel d'utilisateur MS4500E/L.

Avertissement : La classification exige l'usage de Duracell PC1500 /MN1500 ou piles d'AA de taille. L'usage d'aucune autre pile dans cet appareil peut diminuer la sécurité intrinsèque.
Avertissement : Pour réduire le risque d'explosion ne mélange pas de vieilles piles avec les nouvelles piles, les piles de mélange des fabricants différents, ou les piles de mélange de types différents.
Avertissement : Afin de prévenir l'inflammation d'atmosphères dangereuses, ne changer les batteries que dans des emplacements désignés non dangereux
Avertissement : La substitution de composants peut compromettre la Sécurité intrinsèque

Note: External metallic materials are composed of ≤15% in total Al, Mg, Ti and Zr and ≤7.5% in total Mg, Ti and Zr

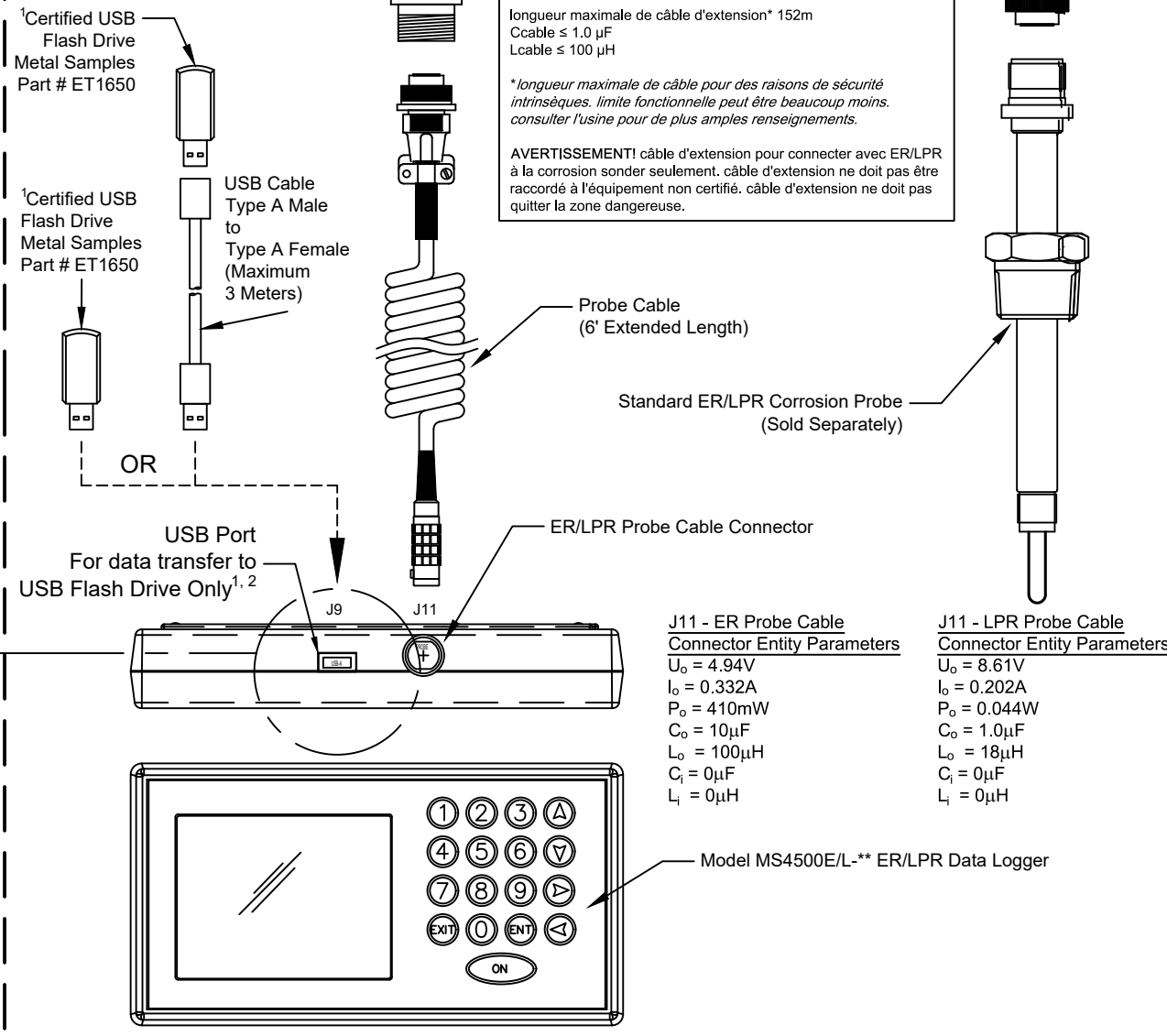
NON-HAZARDOUS LOCATION
Zone non dangereuse

Note 2
Warning! Uncertified consumer flash drives for use in safe area only. Do not use uncertified flash drives in hazardous location.
Avertissement : les lecteurs flash non certifiés doivent être utilisés seulement en zone non dangereux. ne pas utiliser les lecteurs flash dans des locations dangereuses.



HAZARDOUS (CLASSIFIED) LOCATION
Zone dangereuse

Note 1
Warning! Only certified flash drives may be connected and used in the hazardous location.
Avertissement : Seuls les lecteurs flash certifiés peuvent être connectés et utilisés dans l'emplacement dangereux.



J11 - ER Probe Cable Connector Entity Parameters
U_o = 4.94V
I_o = 0.332A
P_o = 410mW
C_o = 10μF
L_o = 100μH
C_i = 0μF
L_i = 0μH

J11 - LPR Probe Cable Connector Entity Parameters
U_o = 8.61V
I_o = 0.202A
P_o = 0.044W
C_o = 1.0μF
L_o = 18μH
C_i = 0μF
L_i = 0μH

AutoCAD PARAMETRIC		UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES AS FOLLOWS				ENGINEERED BY BP	CHECKED BY BKF	Q.C. SDP	TITLE: Control Drawing MS4500E/L Hand Held Data Logger USB A	PROJECT ID	PART NUMBER				
DRAWING TYPE CRT	.X ± .020	.XX ± .010	.XXX ± .005	FRACTIONS ± 1/32	ANGLES ± 1°	DRAWN BY EEW	DATE 02/18/15			CUSTOMER	SCALE N/A	SHT. NO. 1	TOT. NO. 1	DRAWING NUMBER EXWDB-000085	REV. F

ALABAMA LASER TECHNOLOGIES

ALABAMA RESEARCH AND DEVELOPMENT

Alabama LASER

Metal Samples

ALABAMA SPECIALTY PRODUCTS INC.

REV	DATE	DESCRIPTION	BY	CHKD	REV	DATE	DESCRIPTION	BY	CHKD
C	07/21/15	Modified Entity Parameters in NOTE	EEW	BP	F	07/25/12	LPR option and USB cable option added	MT	BP
B	06/01/15	Added Entity Parameters to NOTE for all removed Unit from NOTE 1 and 2a	EEW	BP	E	04/05/16	New Certification Details Added	BP	SAK
A	05/22/15	Deleted NOTE 3 and USB Isolator and updated all parameters	EEW	BP	D	09/04/15	T4 Temperature modified and T3 added	MSR	BP