

THE WORLD LEADER IN CLEAN AIR SOLUTIONS

SAAFShield®

Reading Unit Real-Time Reactivity Monitor

INSTALLATION, OPERATION, AND MAINTENANCE INSTRUCTIONS

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Read and Save These Instructions!

- Note:**
1. Read and understand all operating instructions before installing and using the SAAFShield Reading Unit.
 2. Save this manual for future reference.

This instruction manual provides important information on the installation and operation of the SAAFShield Reading Unit Real-Time Reactivity Monitor. These instructions must be carefully followed in order to operate the unit safely and correctly. If there are any questions regarding the use or care of this unit, please contact AAF at 888-223-2003 or by email at SAAFShield@aafintl.com for assistance.

1.0 Principles of Operation

The SAAFShield Reading Unit (RU) in combination with the Detecting Unit (DU) is part of the system that allows users to monitor atmospheric corrosion in real time or on a periodic basis. This monitoring can be used to display and trend corrosion data over time, allowing users to evaluate operational procedures, environmental factors, or other items that occur at specific times, as well as their impact on producing a corrosive environment. The SAAFShield system utilizes Quartz Crystal Microbalance (QCM) technology to measure metal corrosion due to reactions with the environment.



2.0 Components

- Graphic LCD with backlight
- Integrated temperature sensor and humidity sensor
- 3 power input option – USB bus power, adaptor power and battery power
- Real time G-class and S-class monitoring with data logging capability
- Ability to read and save 500 sets of mounting unit data under battery mode
- Built-in real time clock and calendar chip
- USB 2.0 – thumb drive (mass storage class)
- Dry contact for Programmable Logic Controller (PLC) interfacing

The SAAFShield Reading Unit and its main components are shown in Figure 1.

Further details on packaging and physical specifications can be found in the specification sheet.

The Reading Unit portion of the SAAFShield device is used to read, record, compute, and log corrosion data.

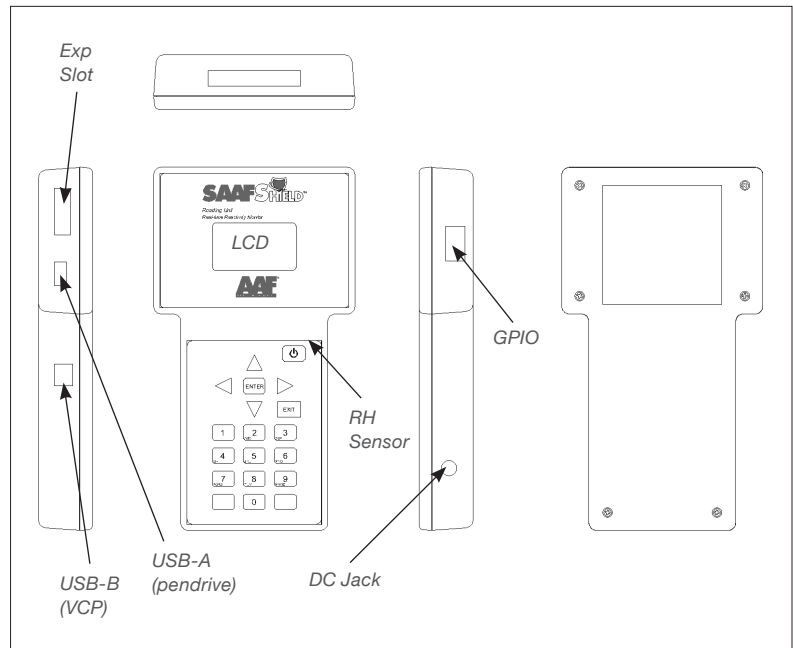


Figure 1 – Major components of the SAAFShield® Reading Unit

3.0 Menu System

The various options available within the Reading Unit are detailed through the menu system as below:

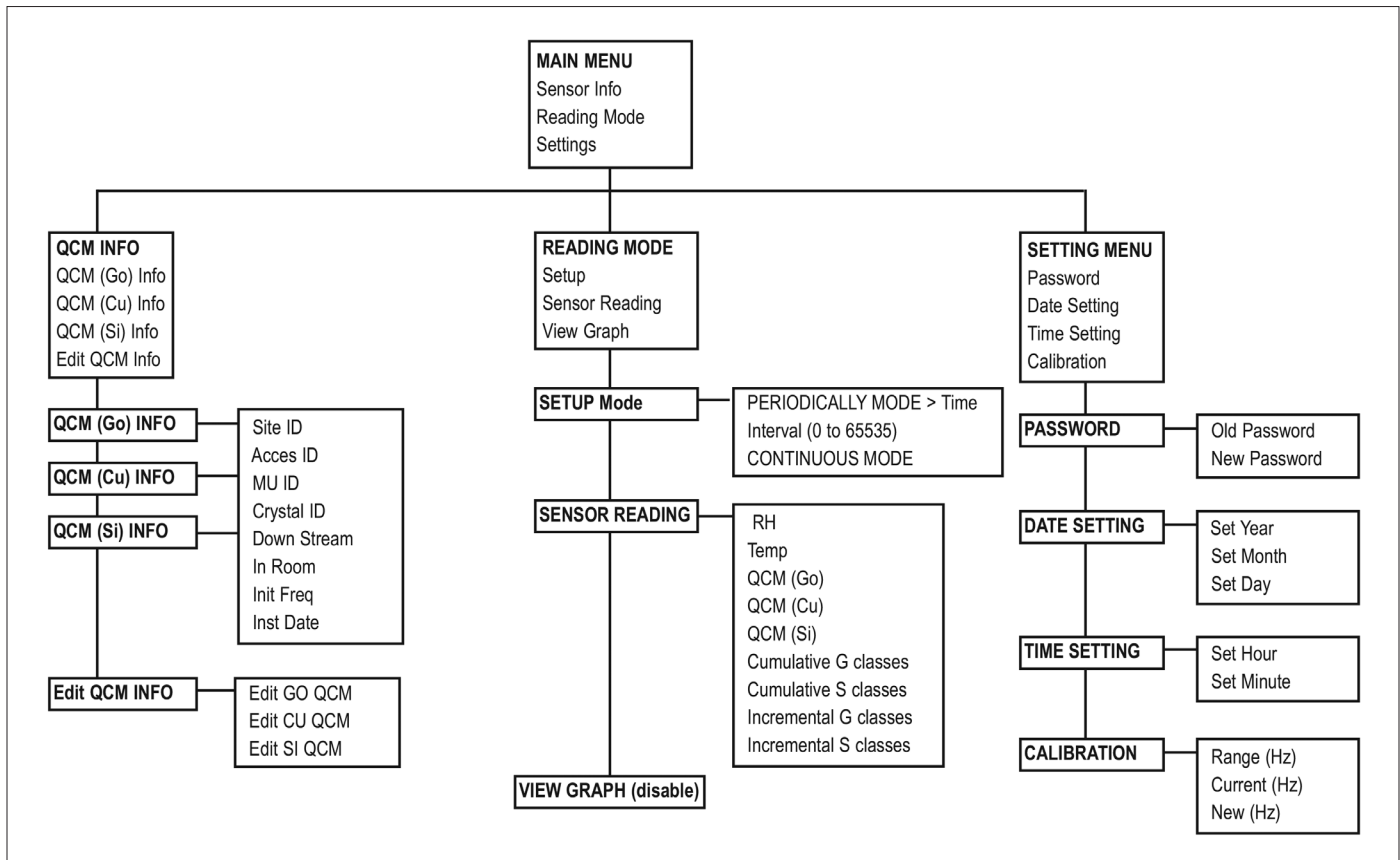


Figure 2 – Details of the menu system used in the SAAFShield® Reading Unit.

3.1 Menu System Functions

Quartz Crystal Microbalance (QCM) Information: This refers to the information stored on the flash memory chip of each QCM. This information is recorded on the flash memory chip when the QCM is initialized.

Setup Mode:

- Continuous Mode: Set a time interval (in seconds) at which the Reading Unit will take a frequency reading. The maximum allowable time interval is 65,535 seconds (i.e. a reading every ~18.2 hours)
- Periodic Mode: In this mode, a single reading is taken once the Reading Unit and Detecting Unit are connected together. Thus, the data table will only be updated at a single instant in time.

Please note that it is sufficient to allow the Reading Unit to remain in the continuous mode (with a short time interval) and disconnect the device once a reading is taken. This will serve the same purpose as using the device in the periodic mode.

Sensor Reading: Using this menu provides a snapshot of the current readings that are being taken. These readings are: Relative Humidity, Temperature, QCM Frequencies (of all three crystals), Cumulative and Incremental Corrosion Rates, and Classes.

Settings Menu

- Password: This menu is used to reset the password. The factory default password is 0000. Reset the password using any four (4) numeric characters.
- Date: Set the date, including year, month, and day. See Figures 3, 4 and 5.
- Time: Set the time, including hour, 0-23, and minute, 0-59. See Figures 5 and 6.
- Calibration: Please do not modify this menu. This menu should be modified only by the factory.

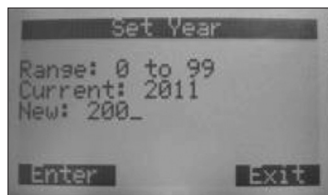


Figure 3 – Date Menu, Set Year Function

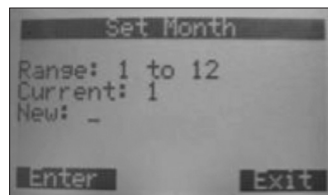


Figure 4 – Date Menu, Set Month Function

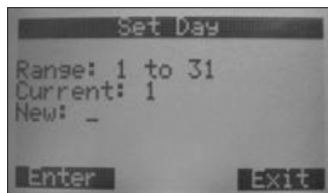


Figure 5 – Date Menu, Set Day Function

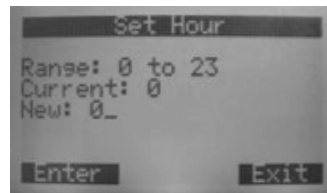


Figure 6 – Date Menu, Set Hour Function

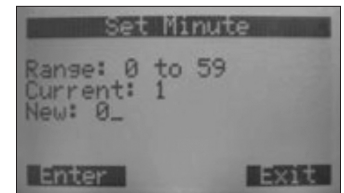


Figure 7 – Date Menu, Set Minute Function

4.0 General Purpose Input Output (GPIO) Ports

The GPIO ports are used to send logic signals (either on or off), based on the corrosion class determined by the incremental corrosion rate to a PLC/BMS control system or alarm. Note that depending on the option chosen, the GPIO ports allow for an output of either copper or silver corrosion classes at a time, not both.

Input Output Ports are used to send logic signals based on the corrosion class to a PLC/BMS (Building Management System) control system. The menu system for GPIO is found under the settings menu. See Figures 8-13. Each screen is explained further below.

1. Screen 1 (Figure 8): Additional GPIO function under “Setting Menu.” GPIO is now in OFF mode.
2. Screen 2 (Figure 9): Optional setting for each corrosion type
 - “1. Incr Corr (Cu)” – Copper incremental corrosion.
 - “2. Incr Corr (Si)” – Silver incremental corrosion.
 - “3. GPIO OFF” – GPIO turned to off.
 - “4. GPIO Test” – GPIO test mode only.



Figure 8



Figure 9

3. Screen 5 (Figure 10): Showing GPIO has been set to [I-Cu] (Copper incremental corrosion).
 - This will give Copper incremental corrosion output as G1, G2, G3 or GX.
4. Screen 6 (Figure 11): Showing GPIO has been set to [I-Cu] (or Silver incremental corrosion).
 - This will give Silver incremental corrosion output as S1, S2, S3 or SX.



Figure 10

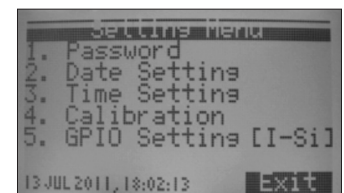


Figure 11

These GPIO ports that connect to a PLC system have a (typical) 24VDC input line and corresponding 4-channels of 24VDC output. The output is an on-off “logic” type output. This means that depending on the corrosion class being G1, G2, G3, or GX, each channel will either output 0V (off position) or 24VDC (on position). This allows for reporting of a corrosion event.

The typical operating voltage and current for PLC systems are 24V and 10mA respectively. The SAAFShield GPIO ports can operate under a range of parameters, listed below in Table 1.

Table 1: Definition for the different ports used:

Input Voltage (min-max)	1V-50V
Input current (min-max)	8mA-90mA
Output Voltage (min-max)	1V-50V
Output current per port (min-max)	8mA-90mA

5.0 Method of Operation for the GPIO Port

You will need to install the supplied GPIO connector into the GPIO port.



Figure 12 – Exploded view of GPIO connectors.

- Connect incoming input power (24V) to pin-6, which is an external power source.
- Connect output signal Port1, Port2, Port3 and Port4 to PLC, BMS or any other open system interfaces.
- Corrosion classes can be selectable on the menu system as discussed above:

- Incremental G-classes
- Incremental S-classes

- Method Selection of Output:

- Refer to Figure 9. Key 4 is pressed, which sets the GPIO to Silver incremental corrosion rate.
- Signal output from Port1 to Port4 will give output of corrosion classes (S1,S2,S3,SX) based on Silver incremental corrosion rates ONLY.

- Operational:

- If corrosion level G1/S1 detected, Port1 will send a signal continuously (HIGH), while others ports remain LOW.
- If corrosion level G2/S2 detected, Port2 will send a signal continuously (HIGH), while others ports remain LOW.
- If corrosion level G3/S3 detected, Port3 will send a signal continuously (HIGH), while others ports remain LOW.
- If corrosion level GX/SX detected, Port4 will send a signal continuously (HIGH), while others ports remain LOW.

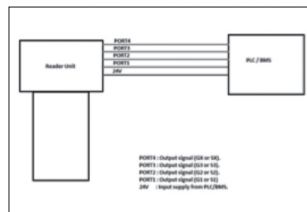


Figure 13 – Schematic showing GPIO wiring to PLC/BMS.

Table 2: Definition for the different ports used:

Pin Defines	Classes	Type
Port4	G1 / S1	Incremental
Port3	G2 / S2	Incremental
Port2	G3 / S3	Incremental
Port1	GX / SX	Incremental
NC	No Connection	–
24V	Voltage input	–

6.0 View Graph

In this screen, the user can view a real-time rolling plot of incremental corrosion rates as it is being collected and computed under the continuous operation mode. This is representative information and allows the user to visualize quick trending over time of corrosion values.

7.0 Firmware Update

The bootloader function allows the SAAFShield Reading Unit to be updated to use the latest firmware available from AAF, in order to ensure smooth operation at all times. The following steps are used to do this.

- Download application firmware file (.hex file format) from authorized AAF personnel and save it onto a standard flash drive. Email AAF at SAAFShield@aaafintl.com to obtain the updated firmware file.
- Turn off the power on the SAAFShield RU. Keep the power adaptor connected at this time.
- Press Exit key, followed by Power key, to enter Bootloader function. A screen shot will then appear as in Figure 14.
- Insert the flash drive, which has already been loaded with application firmware (.hex file format).
- The LCD screen changes as noted in Figure 15.
- After the firmware upgrade is complete, the LCD screen will then display the Main Menu screen directly.
- Remove flash drive and continue operating the SAAFShield as normal.

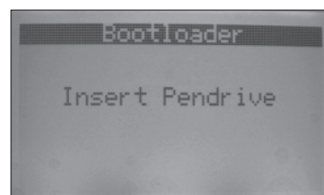


Figure 14 – Screen shot displayed when the RU is available to accept the application firmware file.

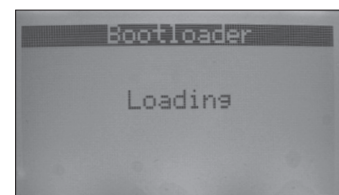


Figure 15 – Screen shot displayed when the application firmware is being updated.

8.0 Battery Remaining Life Check

The remaining battery life on the CR9V battery can be determined under the battery check menu option. Figure 16 and 17 show examples where adequate battery life is remaining and the battery power remaining is low. Once the battery is low, it is time to replace this battery with a factory specified replacement (Part # 392-803-200).

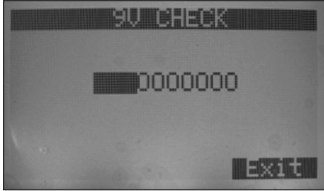


Figure 16 – Battery life available screen shot.



Figure 17 – Battery life low screen shot.

9.0 Operating Instructions

Follow these steps before powering up the SAAFShield units and installing QCMs for the first time:

IMPORTANT!! To open the package prior to installing the QCM, please carefully follow the instructions supplied carefully. Mishandling the QCM can cause irreparable damage.

Step 1: Do not power up the SAAFShield DU or the SAAFShield RU at the beginning of the process.

Step 2: If not installed already, please insert the coin battery for the real time clock (RTC) function. If not, every time power is turned off/on, the user has to key in time setting.

Step 3: Power up the SAAFShield RU and key in the Date & Time setting. After completing this, the date and time will display and will be stored. Now, power off the SAAFShield RU.

Step 4: Fix the QCM PCBs into the respective slots in the SAAFShield DU. See brochure GPF-3-116.

Step 5: Before powering up, connect the SAAFShield DU and RU and make sure that the QCM PCBs are inserted in the appropriate slots. Power on the SAAFShield RU, and the installation process will begin. The first screen will show the password (default: 0000), and the second screen will show Measure Frequency.

Step 6: After the Measure Frequency process is complete, please key in the parameters for the data table (Site ID, Room ID, Detecting Unit ID, Downstream, In Room) for the 3 QCM PCBs.

Step 7: Please check the information on the QCM portion under the Settings menu. It should show the Initialized frequency and installed date—these values cannot be edited. If this information does not show up, the QCM will need to be reprogrammed at the factory.

Step 8: If all the values are entered as above, the SAAFShield units can be used to start collecting information.

NOTE: If before the installation process, the SAAFShield DU (without the QCM inserted) and SAAFShield RU is connected and powered up, the Initialization Frequency and Installation Date will display 0 Hz and the default setting respectively. This will require the QCM to be reprogrammed.

10.0 Using the USB Drive

Always have a USB drive connected to the RU when there is a need to log data. The RU is compatible with USB 2.0 devices up to a storage capacity of 16 GB.

10.1 To Record Data on the USB Drive

Plug in the USB drive when the RU is turned on.

Select a mode of monitoring (periodic or continuous). Once the mode is selected, data collection begins immediately.

Once a monitoring mode is selected, a *.CSV table is created within the USB drive. The *.CSV table has a unique identifier, which is based on the SAAFShield Detecting Unit ID that is encoded within the flash memory on the QCM (Refer to 11.3 File System Maintenance on the USB Drive).

10.2 Ejecting the USB Drive

Once the readings have been taken, please exit to the main menu and press “9.” The “safe to remove” text will appear, and the drive can be ejected.

10.3 File system maintenance on the USB drive

Each data log file on the USB drive is uniquely identified by the SAAFShield Detecting Unit ID. It is important to maintain unique identifiers for each SAAFShield Detecting Unit within a facility. Please make a note of the ID on the unit to ensure traceability.

Once a USB drive is inserted into the SAAFShield Detecting Unit, the SAAFShield Reading Unit automatically creates a file with a pre-assigned filename. The SAAFShield Detecting Unit ID that is stored on the QCM-PCB will be used as the unique filename identifier. For example, if you have a SAAFShield Detecting Unit with an ID of 99, the corresponding filename would be M0000099.CSV. This will be the filename that is locked for this particular SAAFShield Detecting Unit.

Do not change the filename that has been assigned by the SAAFShield Reading Unit.

If this is the first time that data is being collected for this SAAFShield Detecting Unit, a new file will be created in the same format, as listed in “Parameters stored.”

If this is not the first time that data is being collected for this SAAFShield Detecting Unit, data will be appended onto the existing *.CSV file on the USB drive. It is important to have the existing *.CSV file on the USB drive. If the existing data file is not available on the USB drive, the SAAFShield Reading Unit will create a new data file and continue logging. This would affect data continuity in the system.

On the USB drive that logs data, 31 parameters will be stored in *.CSV format. The format and explanation of the parameters as stored are listed in the following table.

Table 3:
Data Parameters and Information Stored on the USB Drive

No.	Column ID	Format	Explanation
1	Date	DD/MM/YYYY	Current measurement date
2	Time	HH:MM:SS	Current measurement time
3	QCM (Au) site ID	Alphanumeric (4 char)	Customer ID for the site (Gold)
4	QCM (Cu) site ID	Alphanumeric (4 char)	Customer ID for the site (Copper)
5	QCM (Ag) site ID	Alphanumeric (4 char)	Customer ID for the site (Silver)
6	QCM (Au) room ID	Alphanumeric (4 char)	Room ID within the site (Gold)
7	QCM (Cu) room ID	Alphanumeric (4 char)	Room ID within the site (Copper)
8	QCM (Ag) room ID	Alphanumeric (4 char)	Room ID within the site (Silver)
9	Mounting unit ID	Alphanumeric (8 char)	Unique ID for the unit
10	QCM (Au) ID	Numeric (4 char)	Factory entered ID
11	QCM (Cu) ID	Numeric (4 char)	Factory entered ID
12	QCM (Ag) ID	Numeric (4 char)	Factory entered ID
13	MU at downstream	Yes/No	Is the unit installed down-stream of a gas-phase filter?
14	MU in room	Yes/No	Is the unit installed within a room?
15	QCM (Au) initial freq	Numeric (6 char)	Initialization frequency (Gold)
16	QCM (Cu) initial freq	Numeric (6 char)	Initialization frequency (Copper)
17	QCM (Ag) initial freq	Numeric (6 char)	Initialization frequency (Silver)
18	QCM (Au) installed date	DD/MM/YYYY	Date unit installed (Gold)
19	QCM (Cu) installed date	DD/MM/YYYY	Date unit installed (Copper)
20	QCM (Ag) installed date	DD/MM/YYYY	Date unit installed (Silver)
21	QCM (Au) installed time	HH:MM:SS	Time unit installed (Gold)
22	QCM (Cu) installed time	HH:MM:SS	Time unit installed (Copper)
23	QCM (Ag) installed time	HH:MM:SS	Time unit installed (Silver)
24	QCM (Au) type	Alphabet (2 char)	Au
25	QCM (Cu) type	Alphabet (2 char)	Cu
26	QCM (Ag) type	Alphabet (2 char)	Ag
27	QCM (Au) freq	Numeric (6 char)	Measured frequency (Gold)
28	QCM (Cu) freq	Numeric (6 char)	Measured frequency (Copper)
29	QCM (Ag) freq	Numeric (6 char)	Measured frequency (Silver)
30	Humidity	Numeric (2 char)	Measured Relative Humidity (in %)
31	Temperature	Numeric (2 char)	Measured Temperature (in°C)

11.0 SAAFShield Reporting Software

A key feature of the SAAFShield Reading unit is the ability to automatically prepare reports on corrosion data using AAF's SAAFShield report generating software. To use this feature, please follow these instructions.

- 1) Make sure you have Adobe Reader installed. If not, please download from www.adobe.com.
- 2) Log on to saafshield.aafintl.com.
- 3) Enter the customer name and customer location in the given text boxes.
- 4) Upload your raw data files in .CSV format (either a single file or multiple files at the same time).
- 5) Select an option for the date range that you would like to use:
 - a. **All Dates** – uses the entire period monitored
 - b. **Last 30 Days** – gives information for the last 30 days monitored alone
 - c. **Selected Date Range** – allows you to specify the date range
Note: This feature will not work when multiple files are selected, since monitoring dates could vary for each unit.
- 6) Select an option for the report:
 - a. **Plots Only** – this option would only present Corrosion Thickness, Incremental Corrosion Rate and Temperature/Relative Humidity plots, where applicable.
 - b. **Plots and Data** – this option would present the above plots and all the accompanying data that goes with it. Note that the resulting data could be several pages long, depending on the time period monitored.
- 7) Click the “Generate SAAFShield Report” button.
- 8) The output is an Adobe PDF document. If multiple files were selected, all the reports would be appended into a single PDF file. Each PDF file would have the filename at the bottom for easy identification.
- 9) It is recommended that you save the PDF with an unique file name.

The key features of the report are noted in Figures 18 and 19.

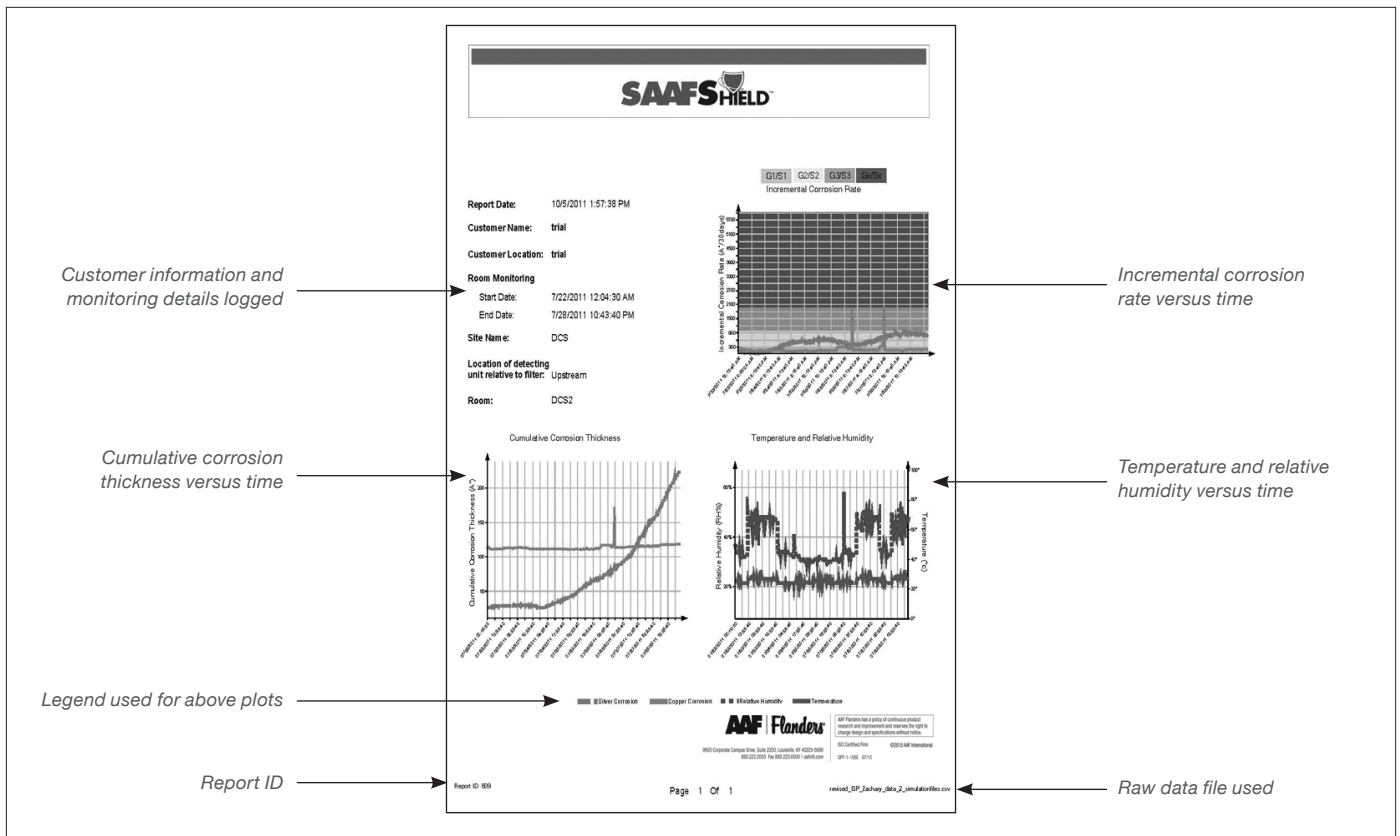


Figure 18 – Key features of the SAAFSHIELD® report – page 1.

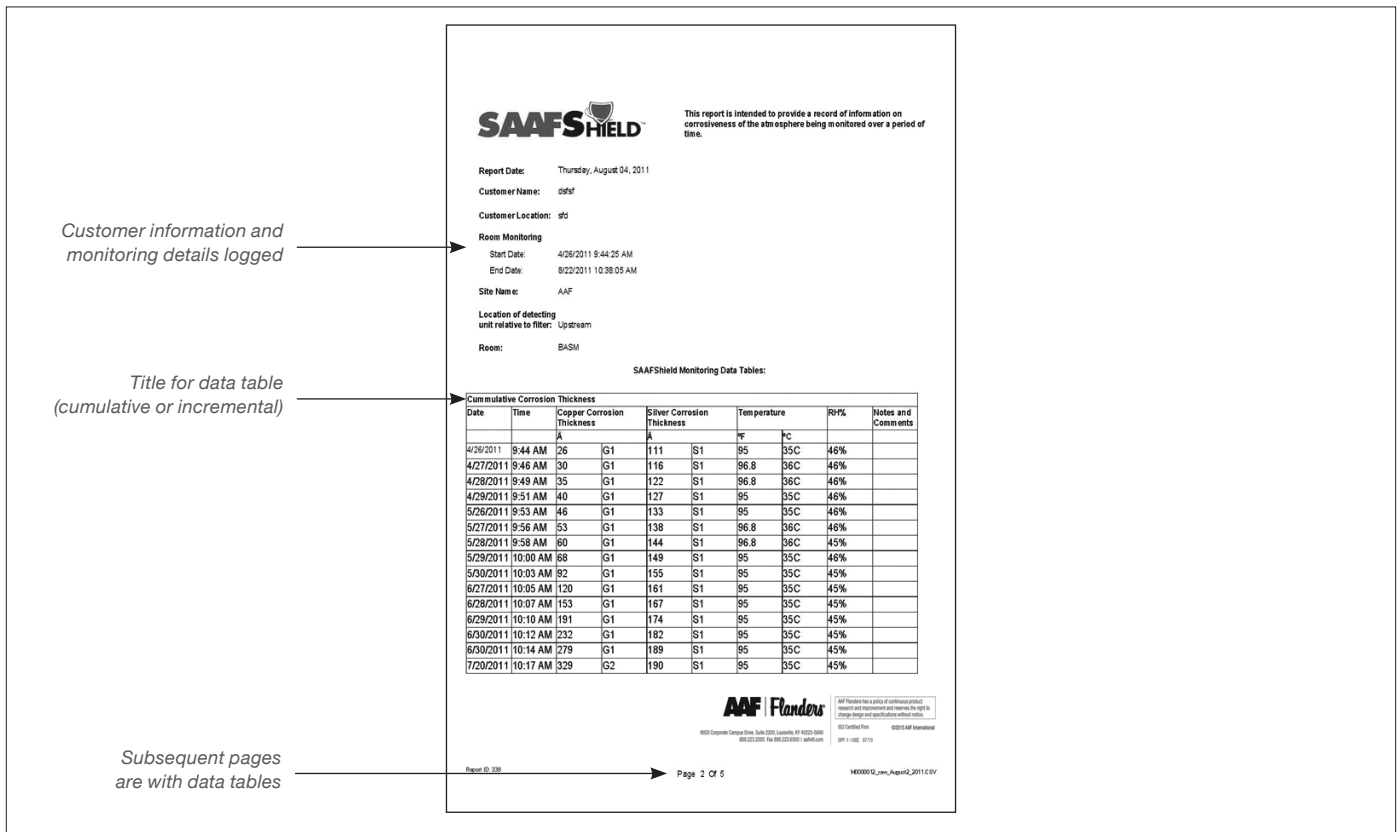


Figure 19 – Key features of the SAAFSHIELD® report – page 2 and subsequent pages.

SAAFShield® Reading Unit

11.1 Report Sections

Customer Information and Monitoring Details:

Information reported in this section is listed in the following table:

Parameters	Explanation
Report Date	Date of report generation
Customer name and location	Entered by the customer/user uploading the data
Room monitoring start and dates	Date and times that room end monitoring started and ended in MM/DD/YYYY HH:MM:SS AM/PM format
Site name	Customer's site name
Location of unit	Positioning of SAAFShield DU relative to the chemical filter used (if any)
Room	ID for the room

Incremental Corrosion Rate Plot:

This plot details the incremental corrosion rate versus time for the period monitored. Note that the plot automatically adjusts the colors in the "swim lanes" to show what the corrosion classification is for copper and silver corrosion rates. Color codes used are listed in the legend.

The incremental corrosion rate plot will only be displayed once a minimum of 24 hours of corrosion readings are collected.

This data can be used to determine if there have been instances where the corrosion rate (and corresponding corrosion class) in an atmosphere was ever in non-attainment.

Cumulative Corrosion Thickness Plot:

This plot is of the buildup of corrosion products (in terms of thickness) over time on the surface of the copper and silver QCMs. The corrosion thickness can accumulate 4000 Angstroms of corrosion buildup, since the reactive metals (copper and silver) have a coating thickness of 4000 Angstroms.

Temperature and Relative Humidity Plot:

This plot is of the temperature and relative humidity over the entire period of time monitored.

Data Tables:

Following the plots, the data tables list out all the information contained with the plots. This information can be retained for record-keeping purposes.

12.0 Troubleshooting

1	No frequency reading	QCM not plugged in
2	Large variations in frequency readings	QCM at end of life

13.0 Spare Parts List

It is recommended that the following spare parts be stored at the installation site for replacement purposes. Consult with your AAF representative to determine actual quantities required.

AAF Part Number	Description
392-803-101	SAAFShield Reading Unit with USB Drive
392-803-200	9V Battery
392-803-300	1GB USB drive

To order replacement parts call: **1-800-223-2003**.



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ISO Certified Firm

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