

Operation Manual

7000RMS Microbial Detection Analyzer



7000RMS Microbial Detection Analyzer
30 412 772 Rev A

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1 Safety instructions

This manual includes safety information with the following designations and formats.

1.1 Definition of equipment and documentation symbols and designations



CLASS IIIB LASER
ENCLOSED INSIDE
DO NOT OPEN CASE



WARNING: RISK OF ELECTRICAL SHOCK.

CAUTION: possible instrument damage or malfunction.

WARNING: The 7000RMS laser assembly module utilizes an internal Class IIIB laser capable of causing severe injury to eyes and skin. Do not open or attempt to service the laser module.

WARNING: Indicates a laser product is present.

NOTE: Important operating information.

On the instrument indicates: There is alternating current present.

The following is a list of general safety instructions and warnings. Failure to adhere to these instructions can result in damage to the equipment and/or personal injury to the operator.

- Follow all warnings, cautions, and instructions indicated on and supplied with this product.
- Install equipment as specified in this instruction manual. Follow appropriate local and national codes.
- Use only factory documented components for repair. Tampering or unauthorized substitution of parts and procedures can affect the performance and cause unsafe operation of your process as well as void factory warranties.
- Protective covers must be in place unless qualified personnel are performing maintenance.
- If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment against hazards may be impaired.
- Prior to shipping analyzer back to the factory for repair or re-calibration, water **MUST** be drained from analyzer to avoid damage due to freezing.

WARNINGS:

- The analyzer should be opened by qualified personnel only.
- Do not attempt to repair, modify, or otherwise alter the 7000RMS analyzer or its components. Unauthorized repair or modification will void the user warranty and create a safety hazard.
- The 7000RMS analyzer is certified as a Class 1 laser product. The 7000RMS unit contains a Class 3B Laser System.
- DO NOT run the analyzer in Online Mode with the 7000RMS online shutoff valve in the closed position.
- DO NOT run the 7000RMS when no liquid is flowing through the analyzer.
- The 7000RMS weighs approximately 32 kg (70 pounds). If for any reason it must be lifted or relocated, take the necessary precautions prior to and during the movement of the analyzer. Incorrect lifting could cause serious injury.
- Use of the 7000RMS analyzer in any manner other than or in excess of those specified by METTLER TOLEDO Thornton can impair the built-in safety protections creating a hazard.

For questions regarding the Safety Warnings or any other safety concerns of the 7000RMS, contact:
Mettler-Toledo Thornton, Inc
900 Middlesex Turnpike, Bldg 8
Billerica, MA 01821

1.2 Safe chemical handling

Consult the Material Safety Data Sheet for each material and the precautions listed in this manual where the materials are used.

1.3 Correct disposal of the unit

When the Analyzer is finally removed from service, observe all local environmental regulations.

2 Introduction

2.1 Overview

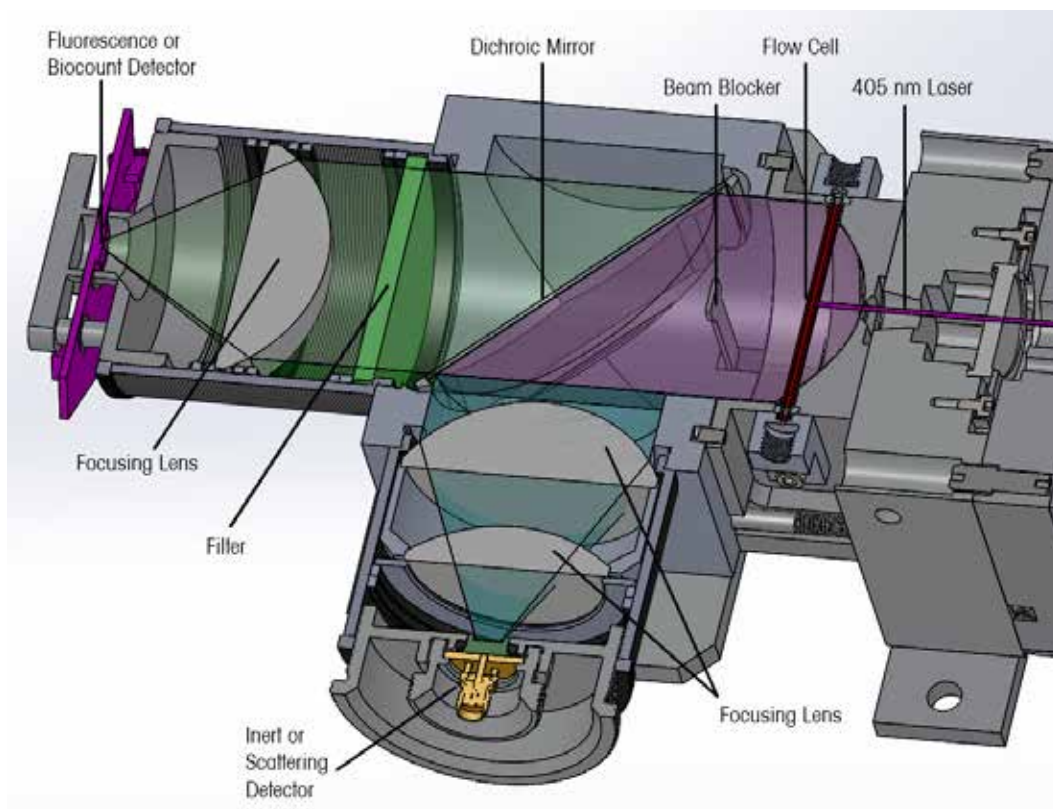
The METTLER TOLEDO Thornton 7000RMS (Real-time Microbial Detection System) is suitable for monitoring microbial contamination in high purity water systems such as Purified Water (PW) and Water For Injection (WFI) systems by the synchronized optical detection of particle scattering and fluorescence from bacteria metabolites. The various wavelengths of light are optically separated. This proprietary optical detection technology is capable of quantifying microbes with minimal operator interaction. The 7000RMS operating software allows for real-time data collection and customized screen display, along with various means of analog and digital outputs with user-configurable alert, action and breach levels.

The 7000RMS wall-mountable cabinetry provides protection from moisture, dust, oil, and other non-corrosive materials, making it safe for use in damp, wet, or warm manufacturing environments. The integrated thermoelectric cooling system maintains ideal operating temperature inside the stainless steel enclosure. The 7000RMS provides an efficient, cost-effective solution for today's microbial monitoring requirements. Samples can be delivered from a pressurized water system or they can be delivered from individual batch samples.

2.2 Principle of Operation

The 7000RMS operates on the principle of simultaneously detecting and measuring laser-based metabolite fluorescence and Mie-scattering as bacteria pass through the flow cell.

A flowing stream of water from a pressurized line (or from a batch sample) passes through the flow cell, and it is illuminated by a 405 nm laser. The laser generates Mie-scattered light of particulate-like matter, including bacteria. All bacteria also have the property of containing metabolites such as NADH and riboflavin, each of which is fluorescent with appropriate excitation. When a bacteria is irradiated at 405 nm as it passes through the flow cell, it will fluoresce. A cross-section view of the optical excitation and detection system is shown below.



With the high sampling rate utilized in the 7000RMS, the detection of specific fluorescence and scattering at the same time identifies this synchronous activity as a bacteria, and it is reported as an Auto-Fluorescent Unit (AFU). Typically, the 7000RMS sampling reports the AFU per second (AFU rate) on the display. At a fixed flow rate, the AFU rate is converted to critical measurements of AFU per volume, typically AFU/mL or AFU/100 mL.

3 Installation

The 700RMS analyzer is designed for a wide range of applications and sets of conditions; however, optimum performance can be obtained only by following the basic guidelines listed below. If any of the following guidelines are not followed, there could be a safety risk to the analyzer or operator thereafter. Please contact METTLER TOLEDO Thornton regarding specific concerns of any guideline or situation.



CAUTION: DO NOT subject the 700RMS analyzer to any severe thermal or humidity fluctuations because such fluctuations may cause damage.

For safety measures, the 700RMS analyzer should be connected to an uninterrupted power supply (UPS) system to provide backup power in the event of a power outage, accidental cord disconnection or brownout. Refer to the UPS manufacturer instructions for proper connection, expected run time of battery backup, and safety warnings.

Handle the analyzer with care. Dropping the analyzer, bumping it, or subjecting it to any other mechanical shock could damage the internal components requiring recalibration or service.

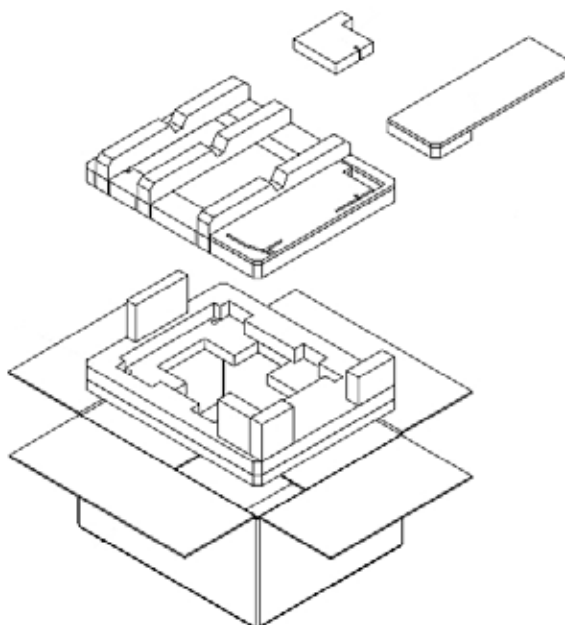
Install the 700RMS away from any AC noise sources.

Isolate the 700RMS from vibration during operation.

700RMS is designed to analyze pure and ultrapure water samples. Colored liquid may impact performance and are not recommended without thorough applications development. Particles larger than 50 μm may impact performance and are not recommended.

3.1 Unpacking and Inspection of the 700RMS

On receipt of the package containing your 700RMS, inspect the shipping box for visible signs of damage to the shipping container. Notify the shipping company if damage is evident. While unpacking, inspect the contents thoroughly. If there is any doubt concerning the integrity of the components, contact METTLER TOLEDO Thornton immediately.



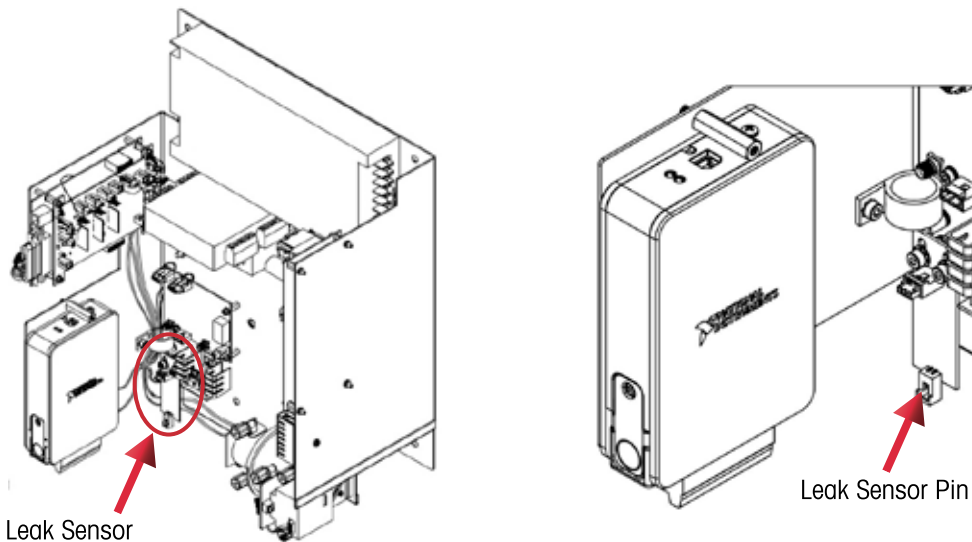
3.2 Shipping Checklist

Please verify that your shipment contains the items listed on your sales order. The shipment should contain the standard set of components listed below unless otherwise noted.

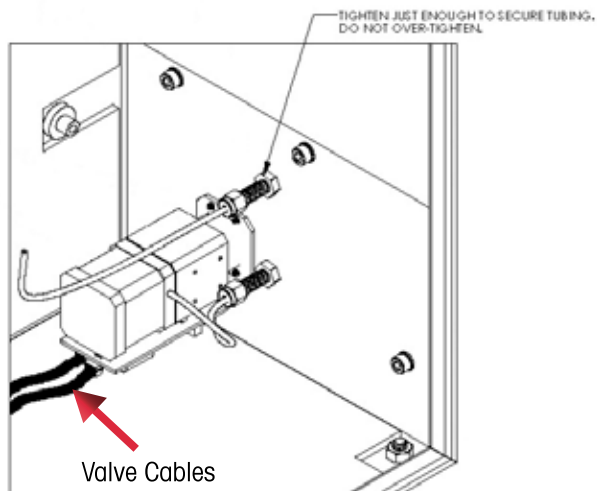
- Power Cord
- USB Hub, 4 port
- Mouse
- Keyboard
- Sample Input Tube Assembly Kit
- Waste Tube Assembly
- Needle kit
- 12"x12" Sterile Dry Wipes
- Cable Analog output
- Enclosure Key
- Certificate of Calibration
- USB Flash Drive

If items are missing or a shipping container is damaged, notify METTLER TOLEDO immediately.

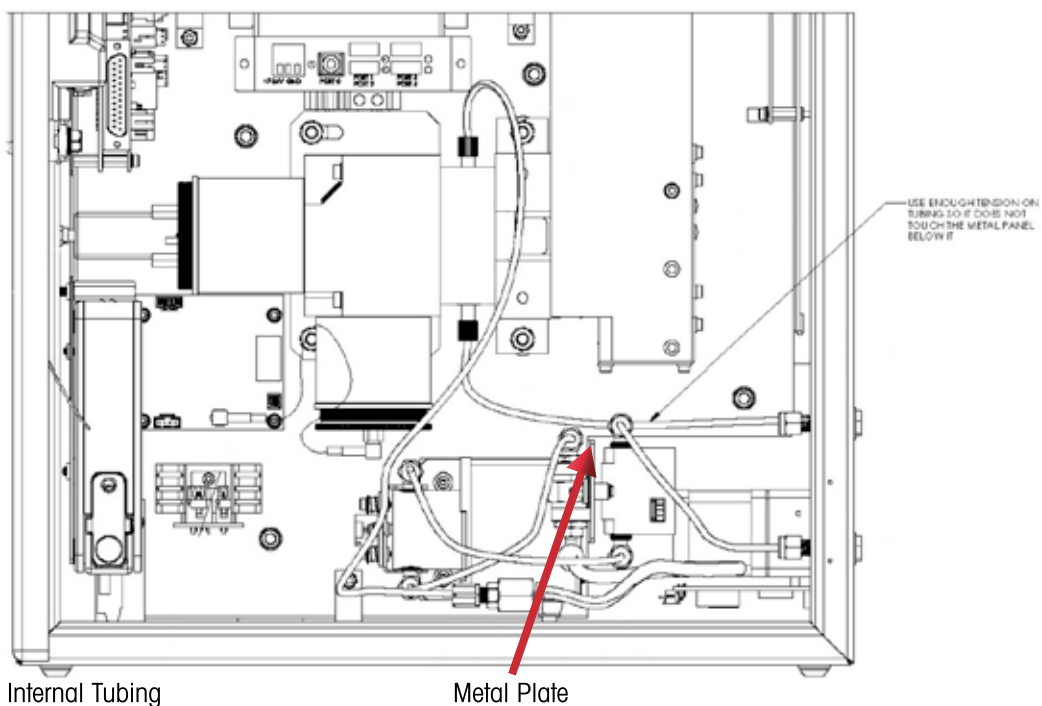
1. Open the 7000RMS enclosure and carefully remove the five (5) pink foam pieces protecting the inside



2. Ensure that the leak sensor pin is not bent and is seated flush against the bottom of the enclosure. If necessary, install the leak sensor using the provided hardware and plug it in.



3. Ensure that the valve cables are fully seated.



3.3 Mounting the 7000RMS

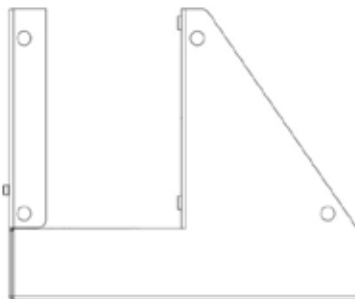
The 7000RMS can be wall mounted or installed on a on a stable surface. Prior to installing the instrument, ensure the location and position of the instrument allows for easy access to the AC input, LAN, USB and analog output ports.

Electrical power outlets and the water that is to be tested should be in close proximity. A drain or sample catchment vessel, which is open to atmosphere, needs to be available for the discharge of the tested samples and overflow waste.

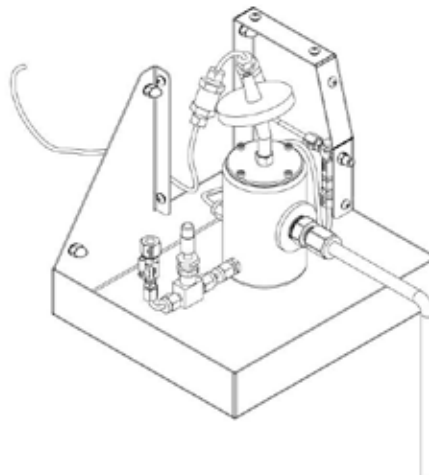
If the 7000RMS is required to be installed on a surface, extra attention should be given to the surface stability. The 7000RMS is top heavy and should be situated on a dry level surface preferably out of the way of other activities. A clearance distance of 76.2 cm (30") should be provided to the right of the analyzer for operator activities, and a distance of 7.6 cm to 12.6 cm (3 to 5") around the rest of the analyzer for air flow.

For permanent and/or process environment installations, the 7000RMS must be wall mounted using the Anti-Vibration Shelf (58079700) available from METTLER TOLEDO Thornton or an authorized service center. The kit enables safe mounting of the enclosure onto engineering rails or a similar rigid structure. The included set of vibration isolators minimize the impact of mechanical disturbances from the environment. Refer to the instructions below to install and wall mount the analyzer.

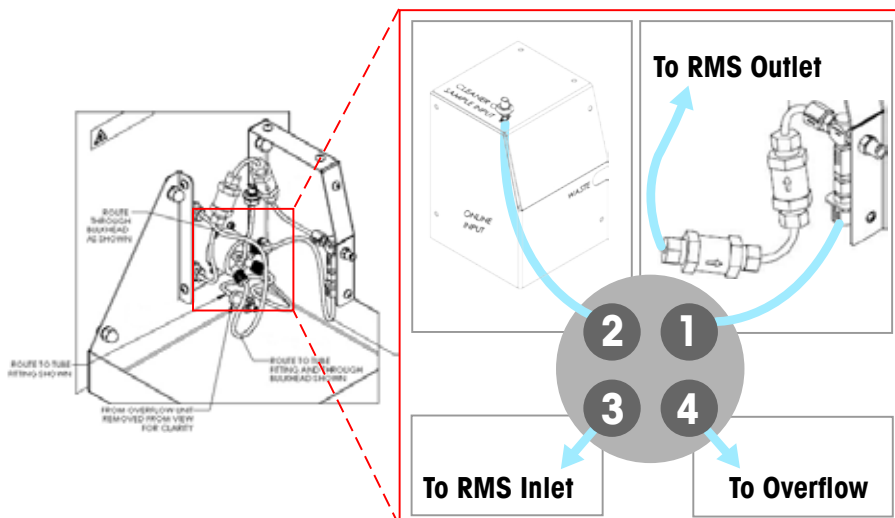
3.4 Tray Assembly



1. Mount the solvent tray to the unit enclosure or Anti-Vibration Shelf.
 - a. If using the Anti-Vibration Shelf, return to these instructions after the analyzer has been wall mounted.
 - b. Refer Section 4.4 Mounting the Analyzer



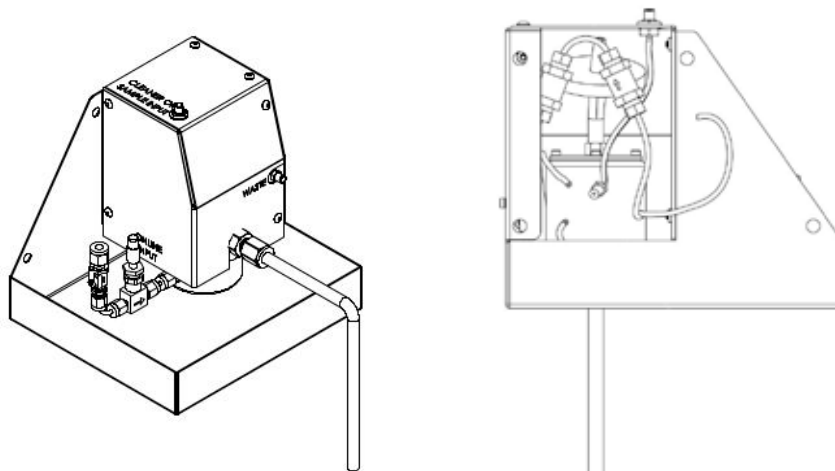
2. Place the assembled Overflow chamber onto the tray.
3. Connect the Overflow outlet to the 4-way valve in position #4.
4. Connect the RMS inlet to the 4-way valve in position #3.
5. Connect the bypass tube to the 4-way valve in position #1.
6. Thread the tray cover hose barb fitting into the 4-way valve in position #2 and attach the Tygon tube.



7. If desired, replace the Online Input and Waste fittings with compression fittings provided with the analyzer. Connect the RMS outlet to the waste manifold. Tighten any fittings to ensure a leak-tight fit.

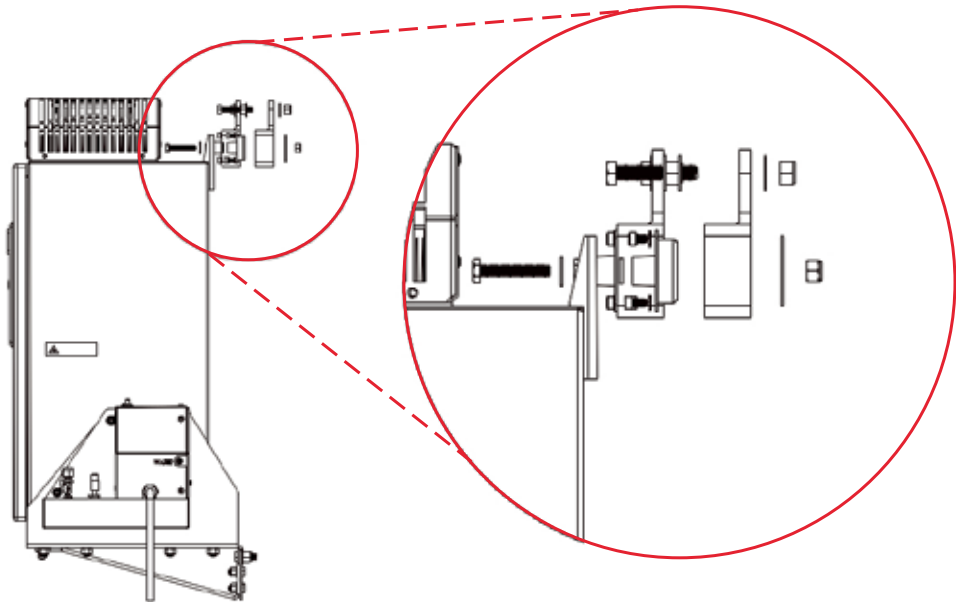
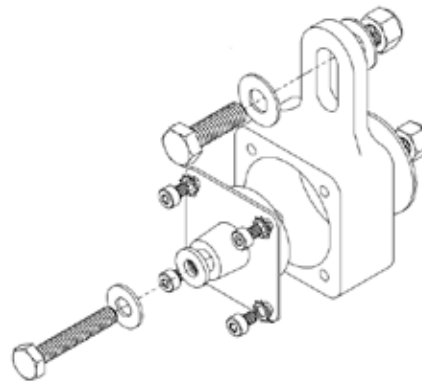


8. Install the solvent tray cover.

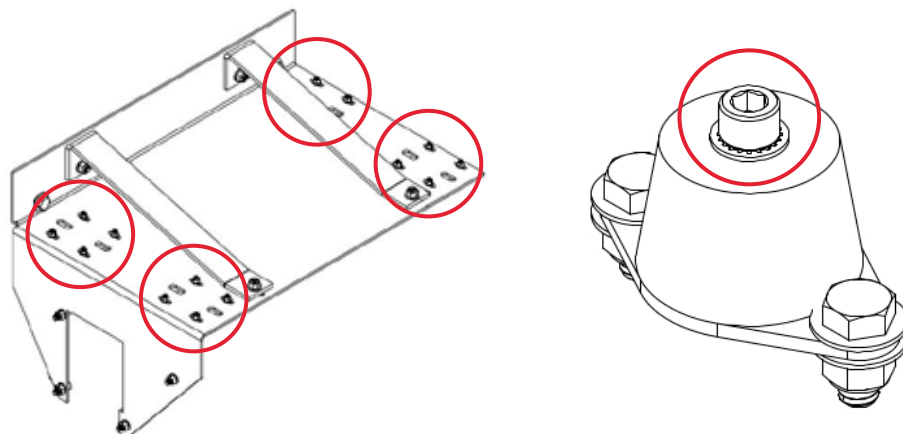


3.5 Mounting the Analyzer

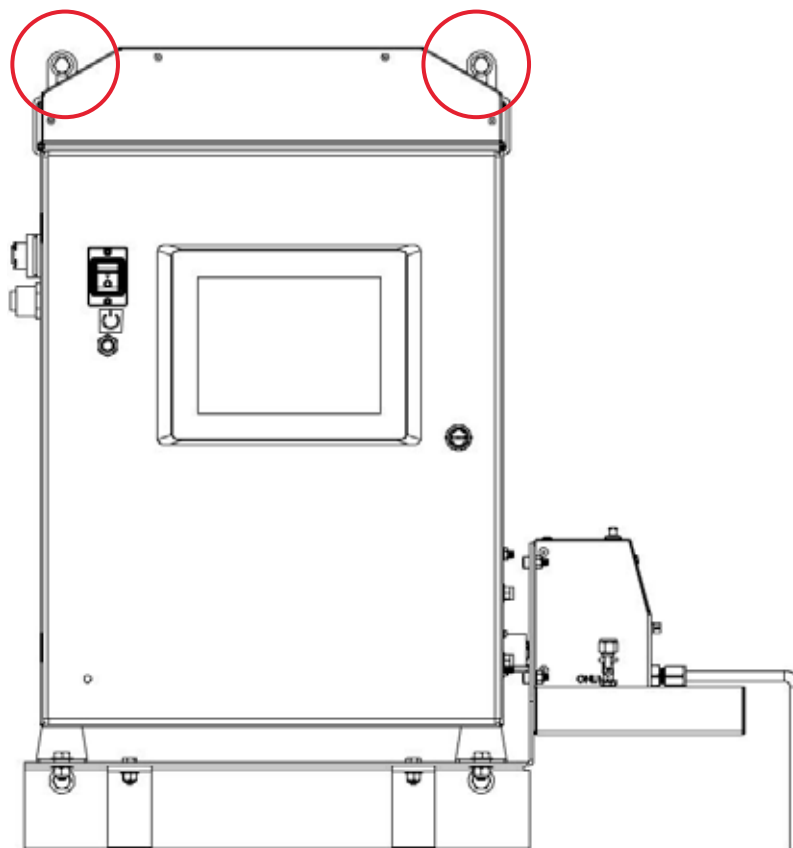
1. Assemble and install top isolators onto enclosure's mounting tabs



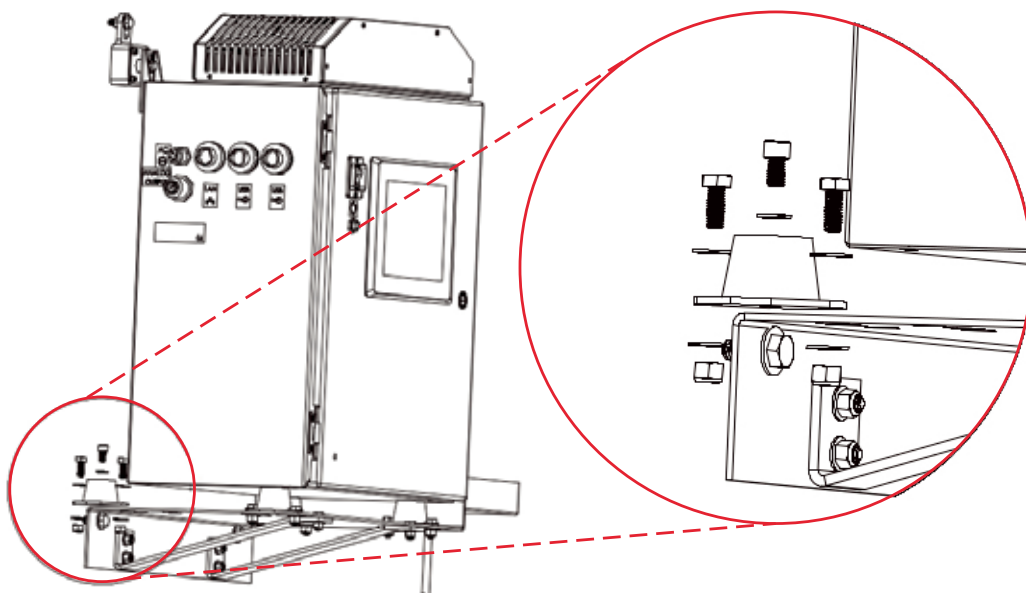
2. Mount Anti-Vibrational Shelf to the structure and remove the center washer and screw from all four of the mounting isolators. Tighten bottom isolators on mounting shelf.



3. Place unit enclosure onto mounting shelf and ensure it is level.
4. Fasten top isolators to structure removed previously.

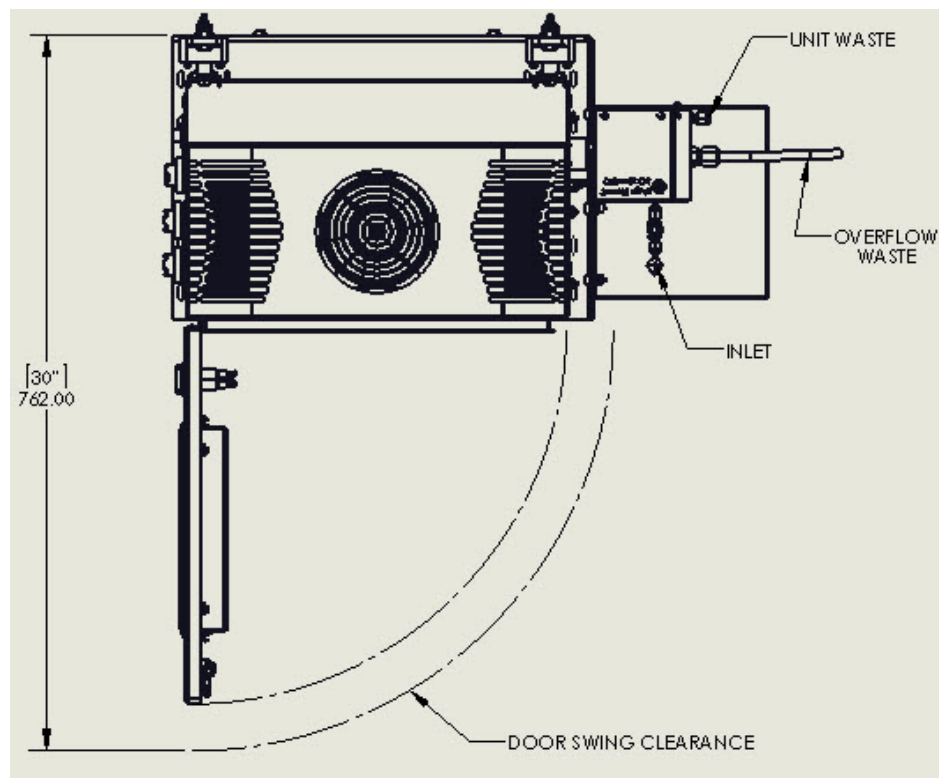
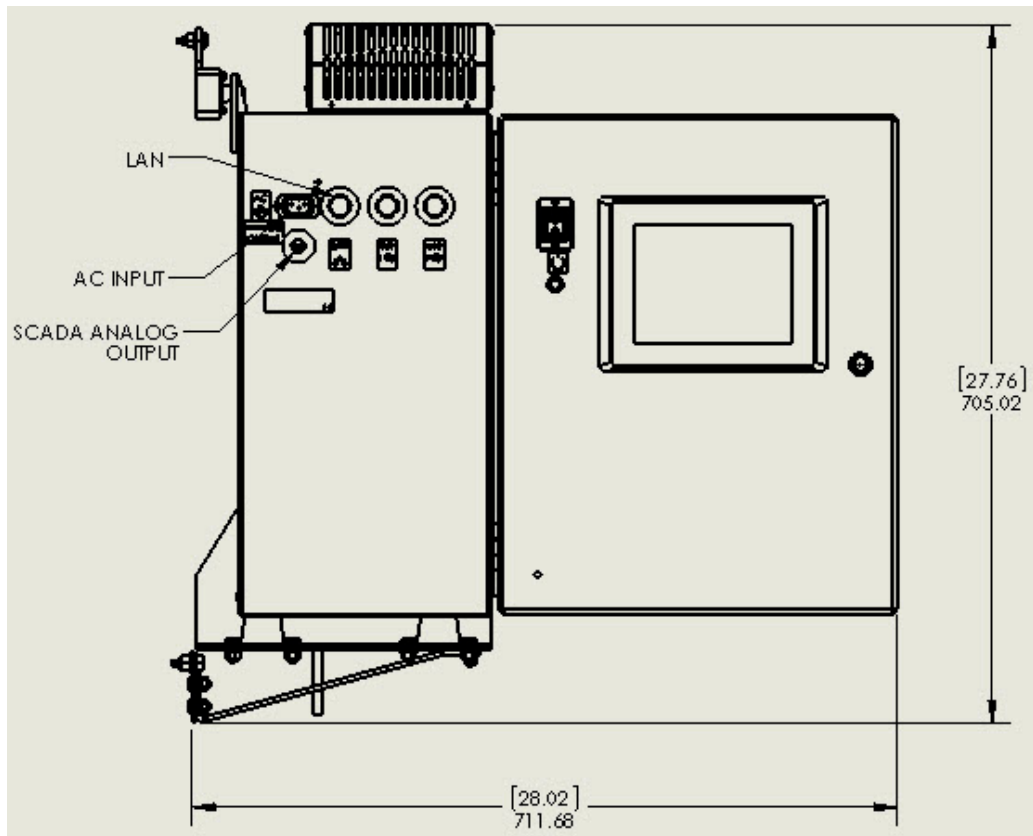


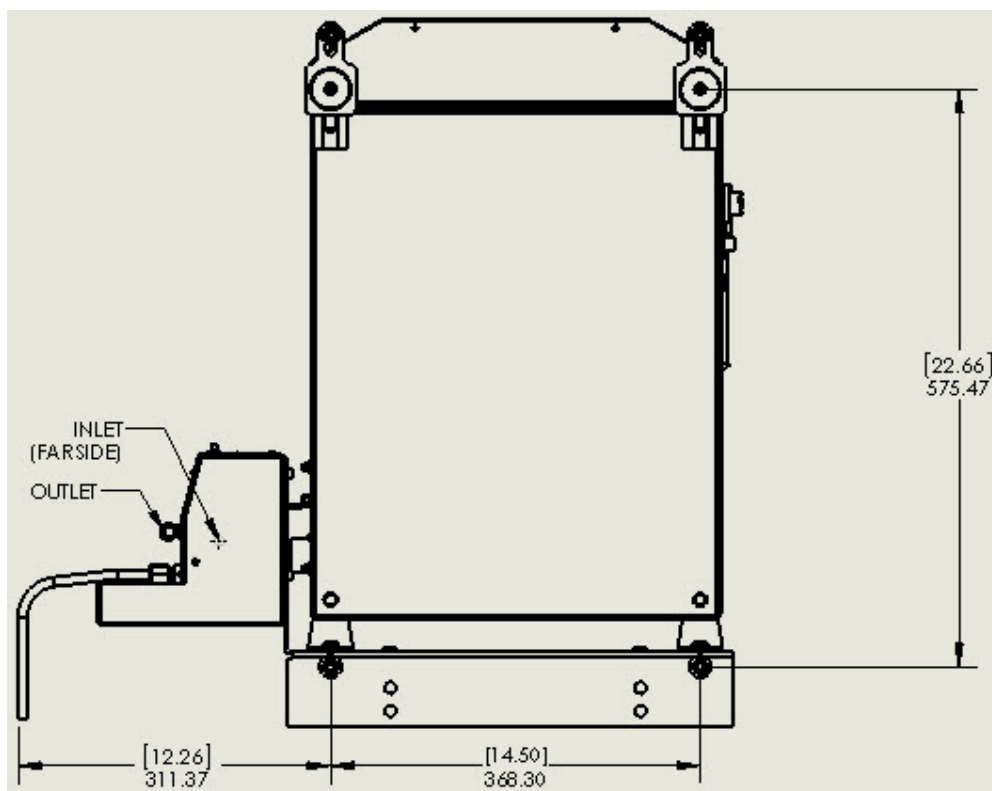
5. Fasten the back two mounting isolators through unit enclosure using screws and washers.



6. Return to Section 4.3 Tray Assembly

3.6 Dimensional Drawings





3.7 Plumbing Setup

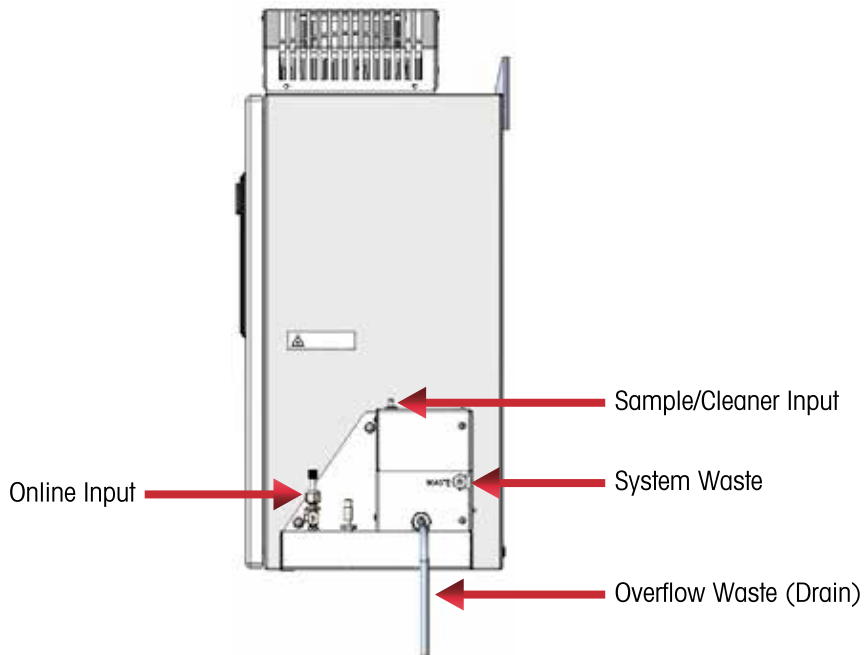
The recommended materials for connecting the unit to an online sample source are: (The following materials are not provided by METTLER TOLEDO Thornton. Installation should be performed by qualified technicians arranged by the responsible party).

- Source shutoff valve, properly rated for the application.
- Water supply pressure regulator and pressure gauge rated for the pressure of the water supply.
- ¼" OD (6 mm OD) tubing rated for a minimum 8.6 bar (125 psi) and compression fittings.

Typical materials are stainless steel, PFA and copper.

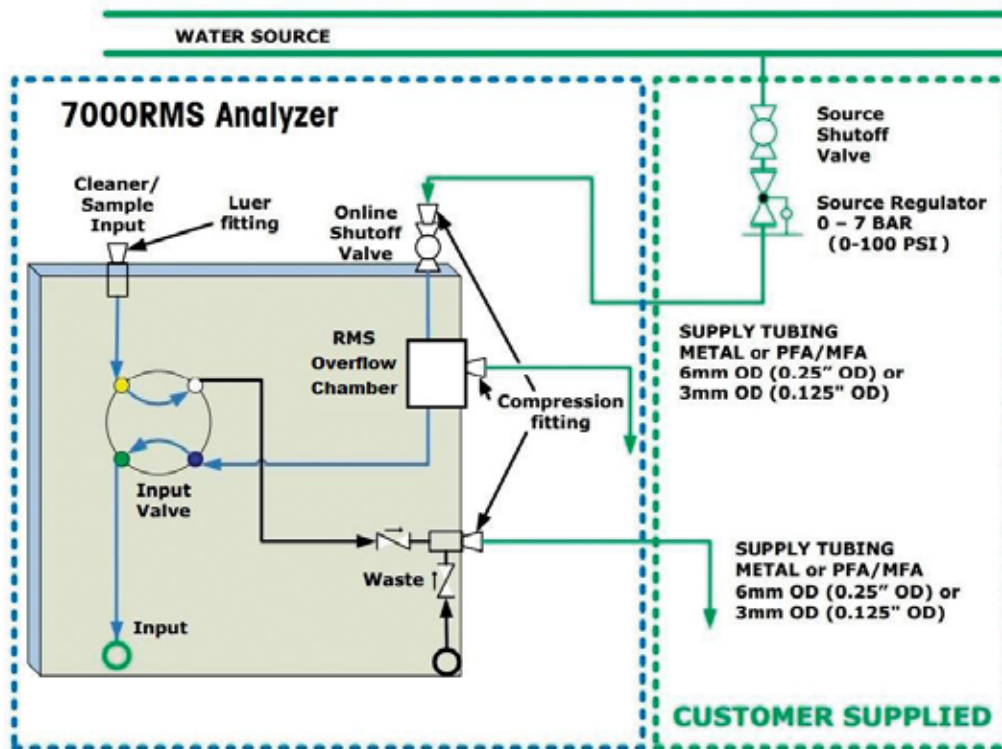
Before connecting the 7000RMS unit to the online source, flush the source connection assembly to remove debris and adjust the source regulator to the appropriate pressure setting:

1. Place the source tubing into a waste container or drain.
2. Slowly open the source shutoff valve to initiate fluid flow.
3. Adjust the source pressure regulator to fewer than 7 bar (100 psi).
4. Allow sufficient liquid to flow to ensure complete removal of any materials from the installation process, a minimum of several liters (gallons).
5. Close the source shutoff valve.
6. Close the 7000RMS online shutoff valve. The closed position is when the valve actuator handle (red) is perpendicular (90 degrees) to the fluidic flow path. The open position is when the valve actuator handle (red) is inline (parallel) to the fluidic flow path.
7. Attach the online source tubing into the provided compression fitting above the 7000RMS online shutoff valve on the port labeled ONLINE INPUT, as shown in the image below. Tighten the compression fitting to ensure a leak-tight fit.

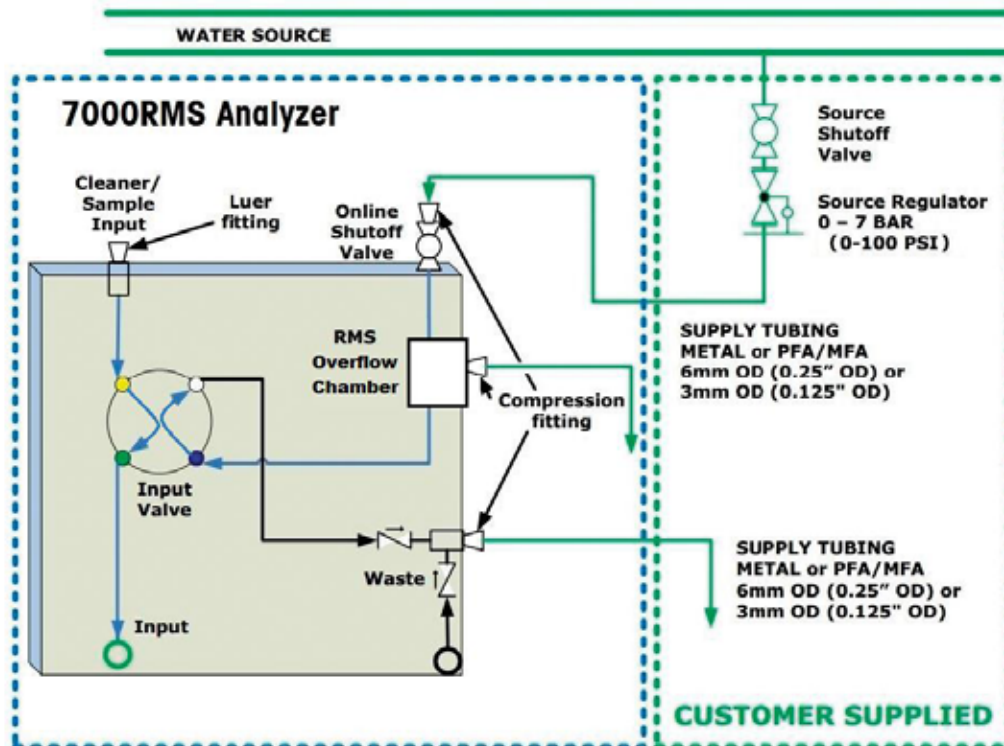


The typical fluidic connection configurations depicting Online Mode and Sample Mode flow paths are shown in the schematics below.

3.7.1 Online Mode



3.7.2 Sample Mode



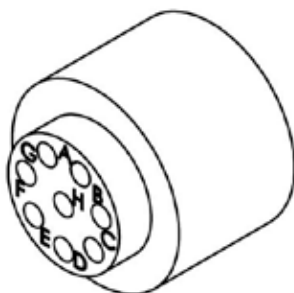
3.8 Power, Data and Analog Output Installation

1. (Optional) Connect the USB 4-port hub / extender to the USB connector on the left side of the 7000RMS.
2. (Optional) Connect the optical mouse to the USB 4-port hub.
3. (Optional) Connect the keyboard to the USB 4-port hub.
4. (Optional) Insert the flash memory drives into the two remaining ports on the USB 4-port hub.
5. Insert the power cord connector into the receptacle on the left side of the 7000RMS and plug into the AC power source.
6. (Optional) Insert the ethernet cable into the LAN receptacle on the left side of the 7000RMS.
7. (Optional) The external communications cable should be securely attached to the analog output port located on the left side of the 7000RMS.

The 7000RMS has two functioning 4 – 20 mA outputs. Below is the wiring schematic for the external communications cable (PN 58 XXX XXX) that connects to 7000RMS for analog output. Channel 1 is designated for output signals of the recorded AFU values, and Channel 2 is designated for output signals of the recorded Inert Particle values. Do not connect control system ground to the ground of the provided cable due to concerns of ground loops. The output and power connections should only be made by a qualified electrician.

The Analog Output settings may be configured by Administrative level users in CONFIG>SUPPOR>SCADA. Refer to section 7.15.3 Activating Analog Output.

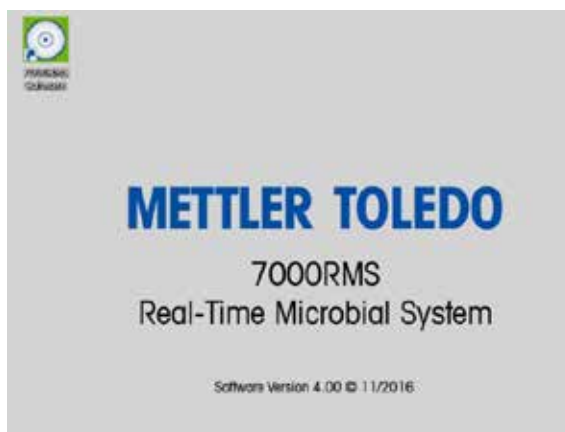
Pin Letters	Wire Color	Output	SCADA Tab Channel
A	Red	4 – 20 mA V0 (+)	Channel 1 (AFU)
B	Black	4 – 20 mA RTN (-)	
C	White	4 – 20 mA V1 (+)	Channel 2 (Inert)
D	Green	4 – 20 mA RTN (-)	
E	Orange	4 – 20 mA V2 (+)	Not Used
F	Blue	4 – 20 mA RTN (-)	
G	Reserve	Reserve	
H	Reserve	Reserve	



4 Startup and Shut Down Procedure

4.1 Startup/Warm-up Sequence

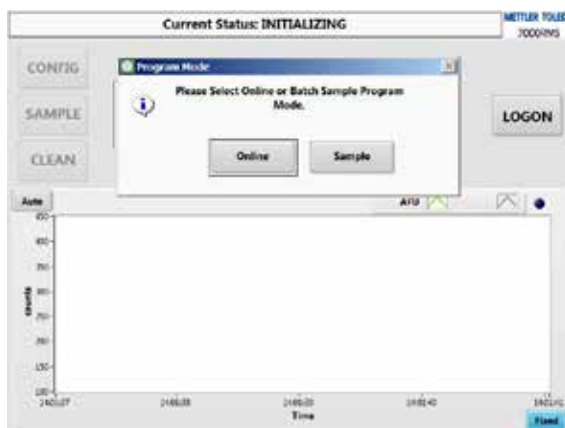
1. Flip the power switch, located on the front panel, to the ON position.
2. Insert the sampling needle into a clean water source (sample mode) or turn ON the 7000RMS online shutoff valve to the analyzer (online mode) prior to initializing the software.
3. System will automatically boot onto user account in Windows.
4. The METTLER TOLEDO Thornton software will automatically begin after Windows start up. Please note that the alternative activation method is double clicking the METTLER TOLEDO Thornton icon in the upper left hand corner.



5. Upon initial startup, the METTLER TOLEDO Thornton End User License Agreement (EULA) will appear. Please read the EULA carefully and select AGREE if the terms and conditions are met. Selecting QUIT will exit the METTLER TOLEDO Thornton software and display the Windows interface (Shown above).



6. The main screen will appear with the program mode pop-up opened.



7. Please ensure that the analyzer is properly setup for the operational mode before selecting either the online or sample mode. If using sample mode, ensure that a sufficient volume of sample fluid is present in the bottle housing the sampling needle.
8. Let the analyzer run for a minimum of 10 minutes before beginning the testing process. Make sure the liquid level is maintained in the sample bottle to ensure flow through the analyzer. An authorized user must log on if using sample mode to initialize.

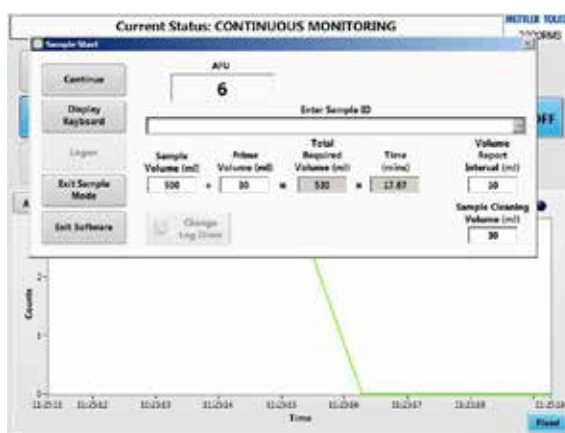


CAUTION: The 700ORMS should never be run without liquid. See error section under CONFIG SCREEN-SUPPORT.

4.2 Shut Down Procedure

To properly shut down the analyzer, please follow the following procedure:

1. Run a minimum of 30 mL of a sanitizing solution through the 700ORMS to properly remove sample residuals.
2. Follow the cleaning operation with a thorough flush of the analyzer with pure or ultrapure water. A minimum of 300 mL (~10 minutes run time) is recommended to sufficiently flush the cleaning solution from the analyzer.
3. If the analyzer is to remain idle or in storage for an extended period, "lock" the analyzer by running a minimum 50 mL of $\leq 6\%$ hydrogen peroxide through the 700ORMS using the sample mode. At the completion of the sample processing, select EXIT SOFTWARE to exit the application. This will leave the fluidics of the 700ORMS filled with lock solution when it is not in use.



4. Shut down the Windows environment by selecting START in lower left corner and then selecting SHUT DOWN.
5. Wait until the screen goes blank.

6. Turn off the power switch located on the front of the 7000RMS.
7. Disconnect power if desired.
8. If in online mode, close the 7000RMS online shutoff valve. The closed position is when the valve actuator handle (red) is perpendicular (90 degrees) to the fluidic flow path.

4.3 Config – Quit

The QUIT button exits the 7000RMS control software, ending any testing session in process. Quitting the software disables the pump and laser; and activates the input valve to redirect online water flow to waste. To restart the software, click on the METTLER TOLEDO Thornton icon on the Windows desktop and the main screen will appear (for the recommended shut down procedure, refer to Shut Down Procedure section).

5 Configuration

5.1 Operational Testing Modes

Operations may be conducted in either online mode or sample mode. The online processing of a water source can be viewed on the main screen without any LOGON. Sample mode operations can only be accessed by users with administrator or operator level access.

Follow the appropriate procedure for the selected mode.



CAUTION: To ensure accurate test results, discharge water or other product samples should not be recirculated.

5.1.1 Online Test Mode

In Online Mode the analyzer is connected to a continual flow of water or in-process sample. It interrogates the sample for AFUs and inert particles at a rate of 30 ml per minute.

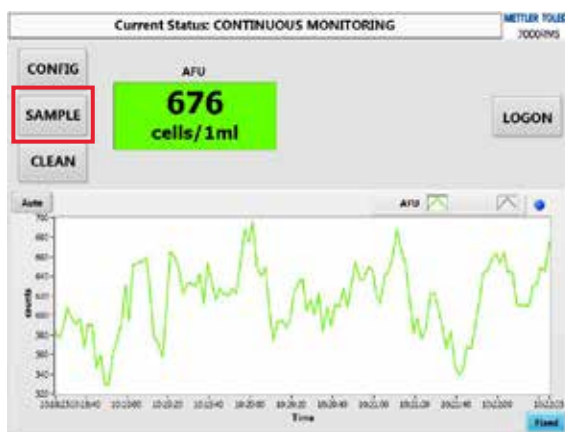


CAUTION: Do not power up 7000RMS in online mode unless the 7000RMS online shutoff valve is open.

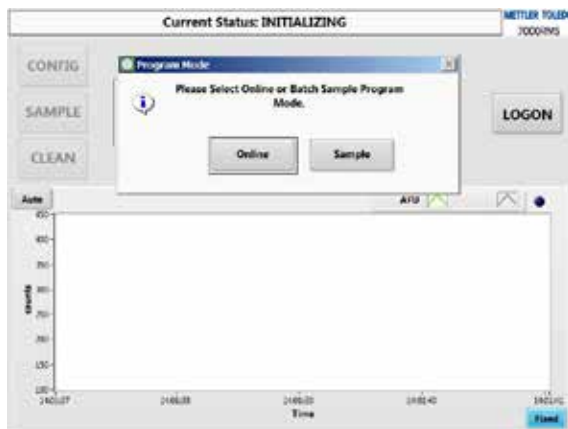
1. Follow the installation sequence, such that step 1 includes connecting tubing from an online source supply to online input. Open the 7000RMS online shutoff valve.
2. Follow the instructions of the startup / warm-up sequence.
3. File logging for online mode will begin immediately after the software initializes. The log file will record data based on the settings on the CONFIG tabs. To activate logging with new parameters (report number, sample ID, operator, monitoring station, log file write interval, and / or log file duration) the user must not only enter the new information, but also press the START NEW LOG button.

5.1.2 Sample Mode

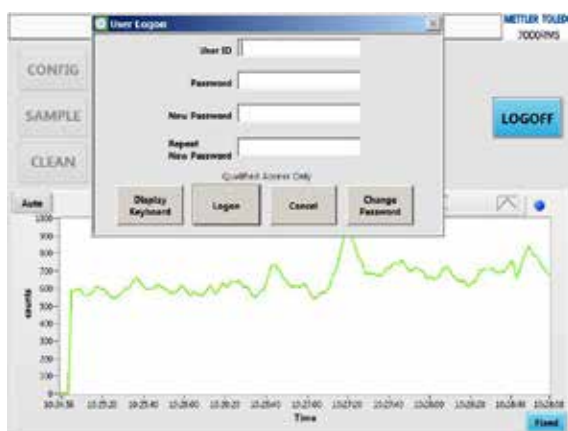
In sample mode the analyzer bypasses water from online input, if connected, and draws liquid from the sample / cleaner input port at a rate of 30 ml per minute to interrogate for biological cells and inert particles discontinuously for user-defined volumetric intervals. Sample mode also facilitates cleaning within a batch sampling session, and allows for customizable intra-sample reporting intervals.



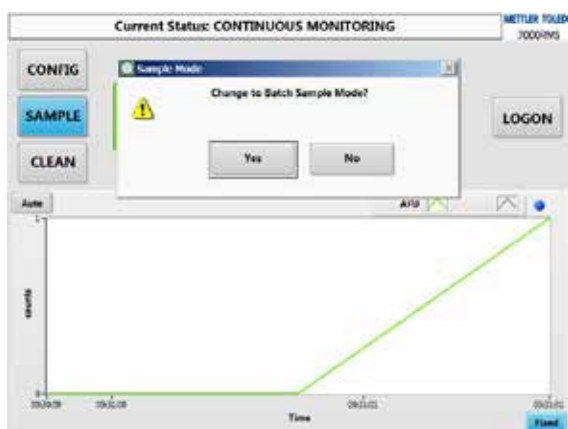
1. Begin the software following the startup / warm-up sequence above.
2. On the program mode selection screen displayed on power up, choose SAMPLE.



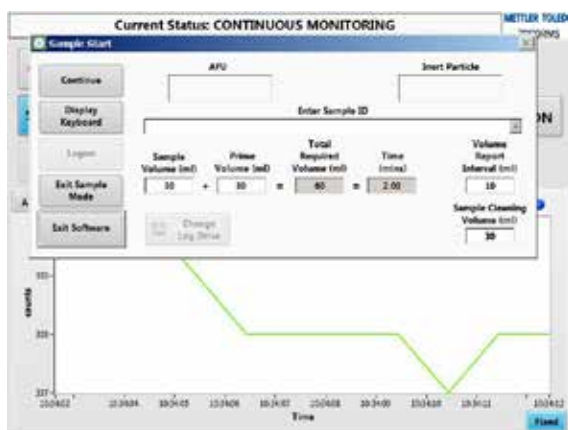
3. A user log on pop-up will appear, requiring the user to fill in the user ID and password fields. (An administrator must set up user accounts for sample mode to be accessible by operator level users)



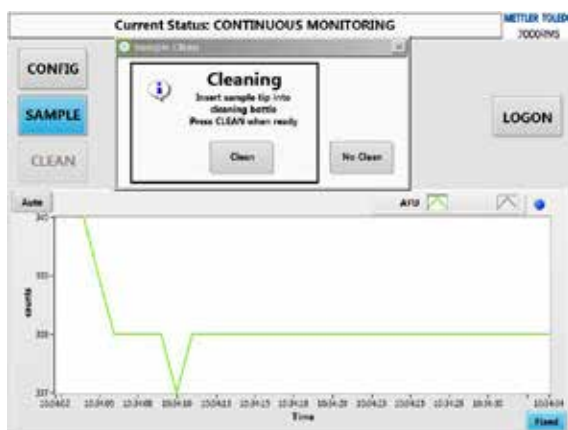
4. Alternatively if you have already operated in online mode, you can enter sample mode by selecting the SAMPLE button on the left hand side of the main screen. Then a pop-up screen will ask "Change to Batch Sample Mode?" Select YES to proceed.



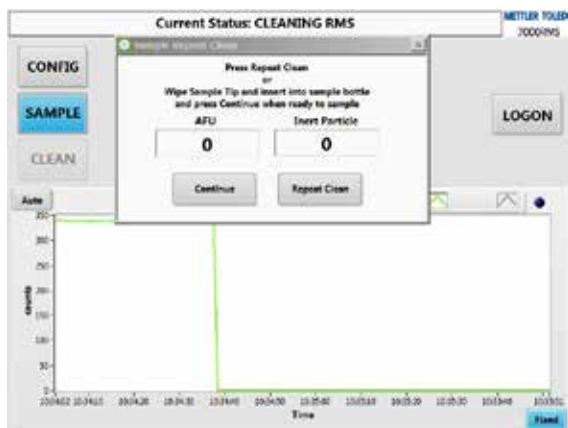
5. On the sample start pop-up, enter sample ID and verify or set the batch sample volume. To enter data using the on-screen keyboard, select DISPLAY KEYBOARD. Choose CONTINUE to proceed in batch sample mode. Choose EXIT SAMPLE MODE to initiate online mode operations. Choose EXIT SOFTWARE to shut down the analyzer.



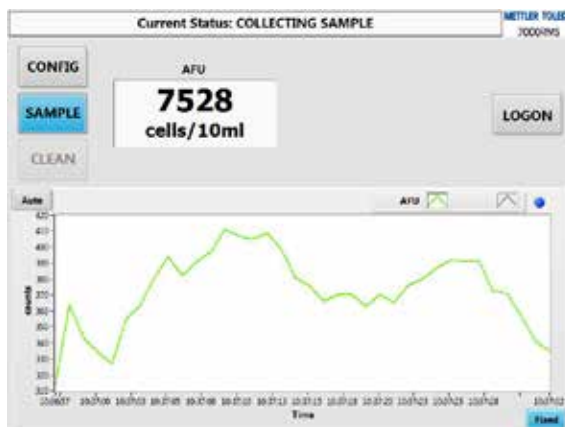
6. After choosing CONTINUE, a sample clean window provides cleaning options. Select CLEAN to proceed with a cleaning cycle and prevent cross contamination between samples. The cleaning volume (ml) is specified on the CONFIG screen, so it is important to have a sufficient volume of cleaning solution available for each cleaning operation. The software will prompt you to insert the sampling needle into a cleaning bottle with sufficient volume of solution.



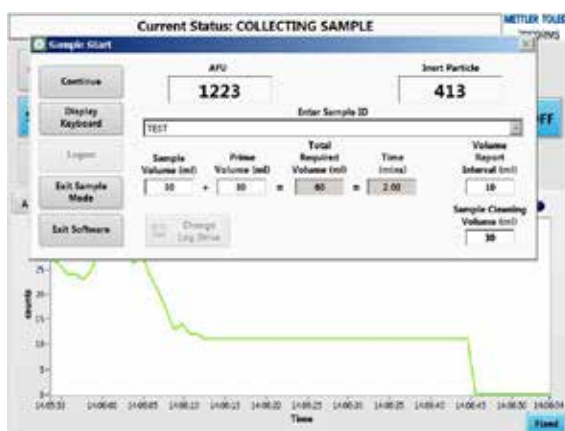
7. After the cleaning cycle has been completed, a pop-up will ask to repeat the cleaning process, or continue to execute a sample test. To continue with sample testing, wipe the sample needle tip and insert into the sample bottle before pressing CONTINUE. To repeat clean, verify that there is sufficient cleaning liquid in the cleaning bottle and select REPEAT CLEAN. If the cleaning cycle is skipped, a window will prompt the user to insert the sample needle tip into the sample bottle.



8. Upon selection of the CONTINUE button, the sample process will execute immediately. At the completion of the sample processing, a unique log file will be generated for that sample. Also, the results for the processed sample will be displayed on the main screen count feed for reference.



9. The analyzer will return to step 4 – enter new sample parameters and press CONTINUE to resume sampling, or select EXIT SAMPLE MODE.



AFU: This field becomes populated with the enumeration of AFU found within the batch sample volume.

Inert Particle Count: This field becomes populated with the enumeration of inert particles found within the batch sample volume.

Enter Sample ID: This field will identify a particular sample within the sample log file. All sample IDs analyzed consecutively are placed in the same sample log file.

Sample Volume (ml): This user-defined parameter indicates the intended sample volume for analysis with 700ORMS.

Minimum Required Volume (ml): Based on the batch sample volume, this field calculates the total volume required to process the sample, inclusive of the sample priming volume, a user-defined parameter in CONFIG-SUPPORT.

Process Time (mins): Based on the 700ORMS's calibrated flow rate of 30 ml / min, this field calculates the total time required to process the sample, inclusive of the sample priming volume, a user-defined parameter in CONFIG-SUPPORT.

Volume Report Interval: is a user-defined parameter within sample mode that allows operators to subdivide enumeration of AFUs and inert particle counts of a particular sample into smaller reporting volumes, of which the sample volume must be divisible by. When enabled, the sample log file will include enumeration data from the entire sample volume as well as from the individual report intervals that comprise it, facilitating a way to gauge consistency of the sample liquid and of the sampling methodology.

Batch Cleaning Volume: This user-defined parameter establishes the volume of cleaning solution that may be run through the analyzer after or between samples, if the user opts to initiate a batch clean cycle.

Sample Mode Prime Volume (mls): This value determines the sample priming stabilization volume utilized in sample mode. The volume (mls) configured by the administrator indicates how long a sample will run through the 7000RMS before analysis and data logging begins. The required minimum prime volume is 1 minute which equals 30 ml.

Current Drive: This field displays the current logging drive in which the sample log file will be created and stored.

Continue: Selecting this button proceeds with sample interrogation using the parameters entered on the screen.

Display Keyboard: Selecting this button toggles the virtual keyboard.

Exit Sample Mode: Selecting this button exits sample mode and begins a transition into analysis in online mode.

Exit Software: Selecting this button exits the METTLER TOLEDO Thornton 7000RMS software.

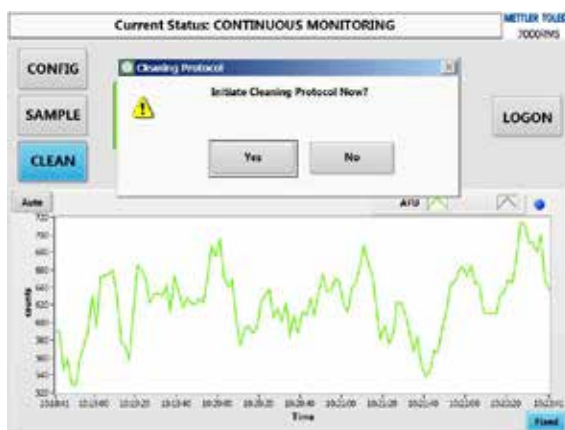
Change Log Drive: Selecting this button changes the current logging drive. If selected in the middle of a batch sample session, the previously active sample log on the current logging drive is terminated and a new one is generated on the new logging drive. The blue LED on the current USB flash drive will turn off indicating it is safe for removal.

5.2 Clean Function Online Mode

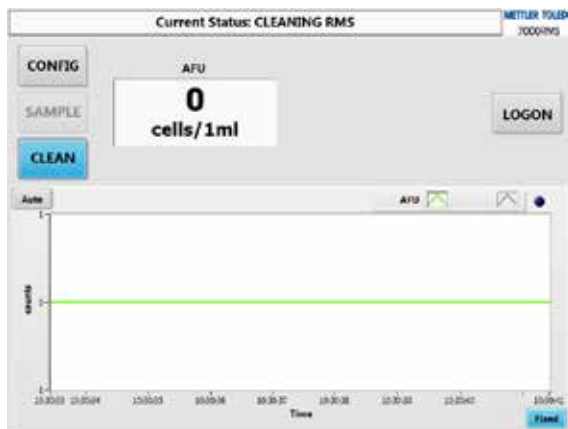
The CLEAN button located on the main screen allows the user to manually activate the online mode cleaning operation. The cleaning will execute using the parameters configured in the CONFIG-CLEAN tab.



CAUTION: Verify the cleaning bottle is appropriately attached to cleaner / sample input and verify that there is sufficient liquid in the cleaning bottle for any cleaning operations. Cleaning liquid will exit the waste concurrent with the bypassed online water flow.



1. Pressing the CLEAN button on the main screen will open the cleaning protocol activation pop-up window.
2. Select NO to exit and continue online mode operations. Select YES to initiate the cleaning operations. The alarm features will be disabled and the cleaning operation as specified in the CONFIG-CLEAN tab will be executed.
3. The input valve will switch position, diverting the online water flow to waste and starting the flow from cleaner or sample input into the analyzer.



4. The cleaning operation will flow the cleaning volume (ml) as specified in the CONFIG-CLEAN tab, 30 ml in the example below.

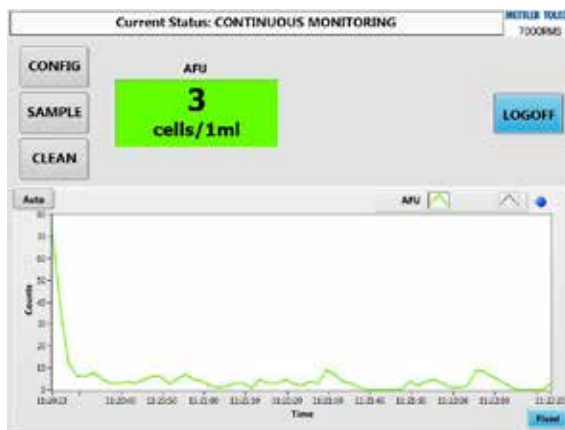


5. After processing the cleaning volume (ml) the 7000RMS will execute the online post cleaning stabilization step. The input valve will switch position, stopping the flow of cleaning solution into the analyzer and starting the flow of water from online input. Logging and status will still be specified as cleaning mode to ensure proper stabilization after the cleaning operation. The analyzer will run the online post cleaning stabilization volume specified, 30 ml in the example above.
6. If at the end of the clean cycle the analyzer still shows excessive counts/ml, then it is recommended to repeat the procedure as required.

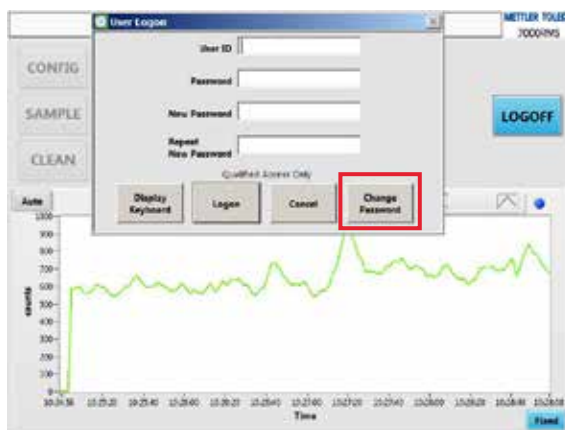
6 System

6.1 Operator Main Screen and Config Tab Access

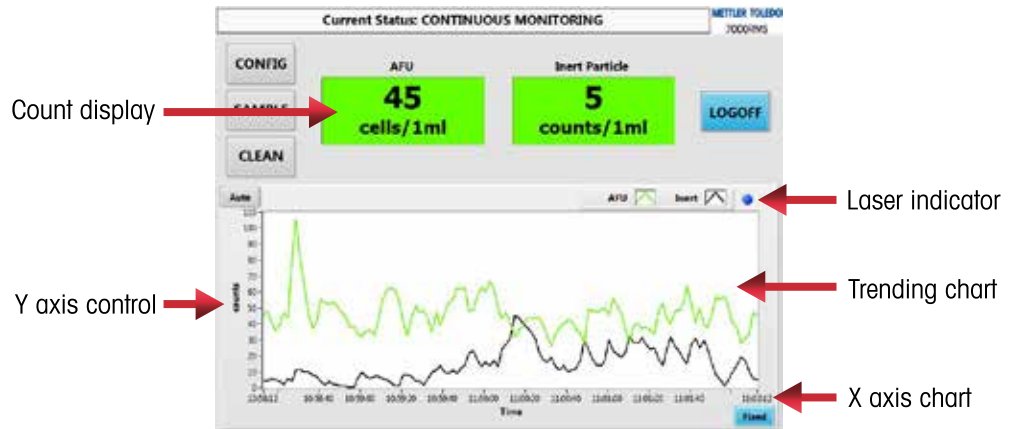
The operator level access allows the user to perform sample and cleaning functions on the main screen. Please reference sections for sample mode and cleaning operations. Access to cleaning in the CONFIG tab is enabled; however, the user will have limited ability to edit fields.



An operator can change the accounts password by entering their existing and a new password, and then selecting the Change Password button.



6.2 Main Screen



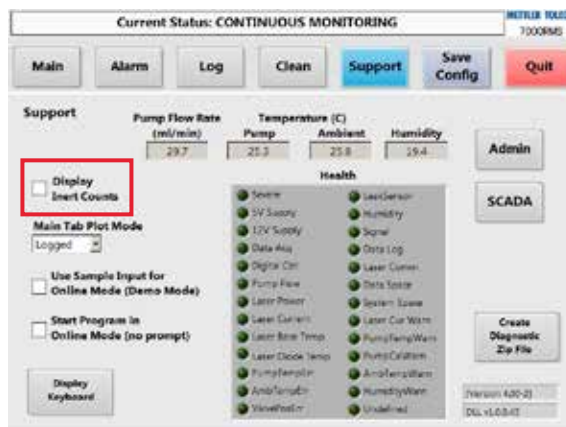
The main screen displays instantaneous results of the auto-fluorescence units being detected. The Trending Chart displayed in the center of the screen shows the historical record of detected cts / sec of the auto-fluorescence units over time.

Axis Controls: The scale of the x (minutes) axis and scale of the y (cts / sec) axis of the chart can be changed based on the user's requirements. The X axis control button allows the user to choose either an automatic scaling setting of the x axis to display the maximum number of results possible or to display a configured specified time interval by selecting "Fixed" (see CONFIG-LOG screen to enter user-defined fixed values). The Y axis control button functions similarly. When "Auto" is selected, the scale will automatically increase the range on the y axis to allow the user to see all of the data in that time period. When "Fixed" is selected the configured specified cts/ sec data interval will be displayed (see CONFIG-LOG screen to enter user-defined fixed values). If the amount of particles detected exceeds the range's upper bound, the peak will go off the chart and cannot be seen, i.e. the trending chart will not show data peaks with values greater than the set range. "Fixed" axis features are useful for zooming in on a specific data range of interest. The "Auto" settings are preferred for general continuous monitoring.

Trending Chart: The trending chart shows the historical data for detection of AFUs and inert particles. The chart can be configured (in CONFIG-SUPPORT-ADMIN-OPTIONS tab) to display in counts per sample volume (LOGGED mode) or in counts per second (REAL TIME mode). The number of AFUs / unit is displayed in green, while the number of inert cts / unit is displayed in black. The trending chart clears when laser activity is suspended and resets itself when laser activity resumes. See "Laser Indicator" for further information.



NOTE: If desired, the inert particle count display and trending data in the trending chart can be turned off (by an administrator) in the CONFIG-SUPPORT tab. Toggle the DISPLAY INERT COUNTS check box to turn inert particle data display OFF or ON.



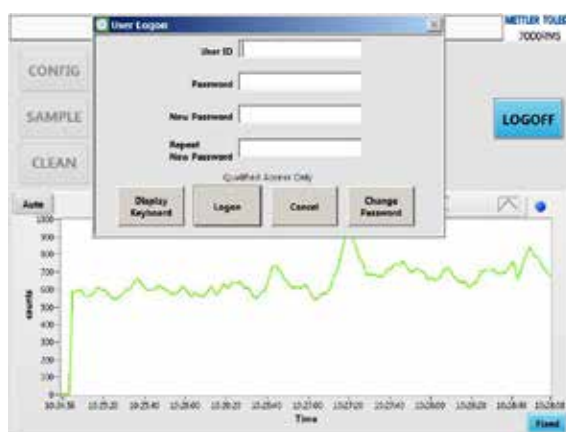
Count Display: The real time AFU and Inert Particle prevalence per unit volume are displayed on the main screen and recorded in the log file. The user can specify the volume units in the CONFIG-LOG screen by adjusting the log file Interval (in the example above it is 10 mL). The count display backgrounds will change colors when an alert, alarm or a breach occurs. The thresholds are user-defined to meet the needs of the user's regulations or alarm criteria. The threshold values can be changed in the CONFIG-ALARM tab by an administrator.

Laser Indicator: This virtual LED will illuminate when the laser is active. When unstable flow or the presence of bubbles are detected by the 7000RMS, the laser will become disabled until inlet sample conditions improve sufficiently.

Status	Color	Indication
Normal	Green	Number of cells / volume does not exceed a set threshold defined in the CONFIG-ALARM tab
Alert	Yellow	Detected cells / volume has exceeded a set Alert threshold defined in the CONFIG-ALARM tab.
Action	Red	Detected cells / volume has exceeded a set Action threshold defined in the CONFIG-ALARM tab.
Breach	Black	Detected cells / volume has exceeded a set Breach threshold defined in the CONFIG-ALARM tab.

6.3 Log on

At the initial installation of the software, an administrative level user must be present in order to set up user accounts. The default User ID is "admin". METTLER TOLEDO Thornton technical support will provide the default password to the designated system administrator. Upon entering the default information, the administrator can enter a new password for future use. Once user accounts are initially established, administrative level users may configure passwords to automatically expire after a length of time, in days, specified in CONFIG-ADMIN. There, administrative level users may also configure the software to remember a number of previously employed passwords. When passwords expire, users are required to enter their old password along with their new password and confirmation before selecting the CHANGE PASSWORD button on the LOGON screen. After this point, the user may begin to use their newly created password.

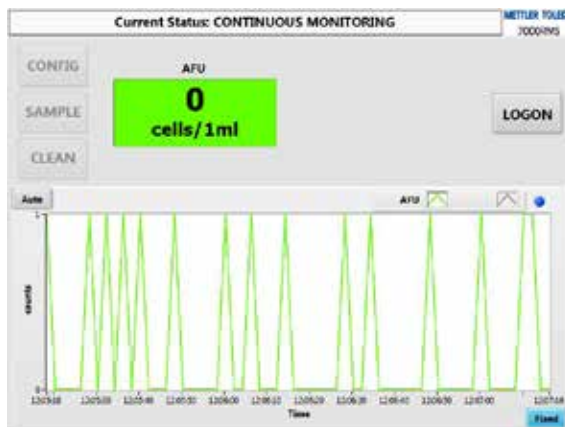


After supplying the appropriate log on credentials, the administrator has access to the full range of the sample and clean functions as displayed on the main screen. The administrator level user also has access to change and configure the config tabs when necessary for specific applications.

When a user determines to end an active session with the METTLER TOLEDO Thornton software, the

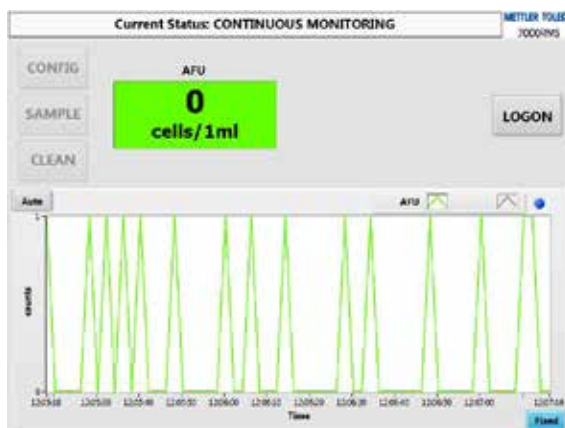
LOGOFF button located on the main screen should be pressed. The METTLER TOLEDO Thornton software also includes an automatic LOGOFF feature, which is an administrator defined field located in the Admin Tab within CONFIG- SUPPORT.

The Inactive Screen is shown below when a user presses the LOGOFF button. To enable and access other functions of the software, a user with access must log on.



6.3.1 Guest Main Screen Access

A guest has the ability to change the X and Y axis from auto scaling values or to preset fixed values (administrator defined fields). The LOGON button will always be enabled to accept user authentication.

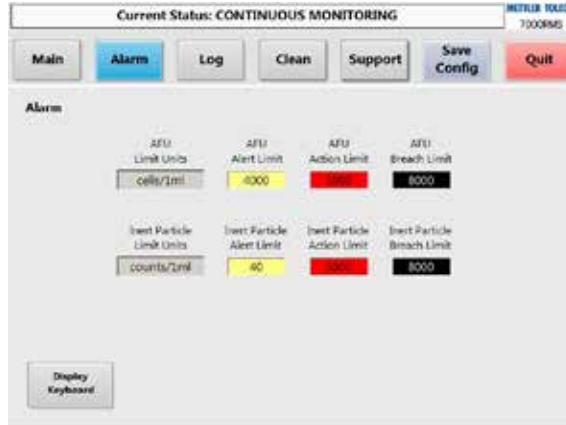


6.4 Config Tabs

When the user clicks on the CONFIG button in the upper left corner of the main screen, tabs appear to allow the user to select between ALARM, LOG, CLEAN, and SUPPORT tabs.

The CONFIG tabs allow the user to customize the analyzer settings which represent the specifications and parameters needed for testing operations and data processing. Any changes to the parameters will be used immediately after entry. To save the changes as the default values to be utilized on initialization, press the SAVE CONFIG button in the upper right corner of the screen

6.5 Config - Alarm Tab



The ALARM tab allows the user to set the alarm parameters by identifying the thresholds for both the AFUs and Inert Particles. The threshold values are used to notify the user. If an alarm is triggered, a notification will appear in the log file.

Alert Limit: Indicated by the color yellow in the Count Display on the Main Screen, and shows the user that the detected AFUs / volume has exceeded the set threshold. This level is primarily a notification to the user both on the MAIN screen and in the log file. This indicator should enact a response from the user.

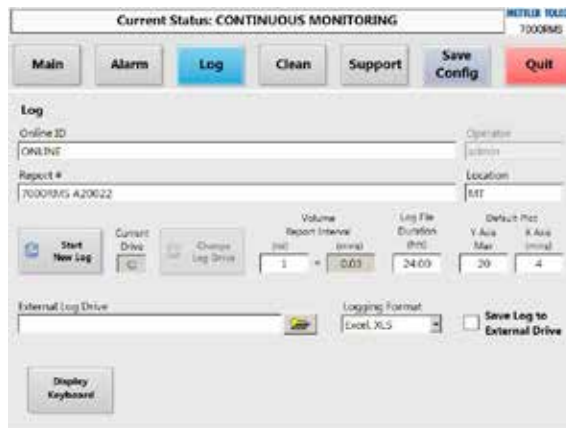
Action Limit: indicated by the color red in the count display on the main screen, and shows the user that the detected AFUs / volume has exceeded the set threshold.

Breach Limit: indicated by the color black in the count display on the main screen, and shows the user that the detected AFUs / volume has exceeded the set threshold.



NOTE: The editing of the log file write interval on the LOG tab will result in the changing of the units utilized for the alarms, main screen count display, and SCADA Modbus / TCP. Thorough examination of alarm settings is recommended when changing the log file write interval parameter.

6.6 Config - Log Tab



The 7000RMS analyzer is configured to have a mirrored data logging structure to prevent data loss due to log drive errors or technical issues. The data is actively stored in both the METTLER TOLEDO Thornton USB flash drive and an archive folder on the computer hard drive. The data can be concur-

rently stored to an external drive if activated and configured in the CONFIG-SUPPORT-ADMIN-OPTIONS tab. The data is stored in the format specified in the CONFIG-SUPPORT tab. The health of the data logging operation is monitored by the software to ensure proper logging operations. If there is not sufficient data logging drive space or loss storage drive availability for logging an error will be generated to notify the user.

Online ID: This field is used in naming the data file and will be displayed as header information in each data file. The OnlineID field is used as the primary text descriptor in the log file name, right before the Report # field. For example, the text in the CONFIG-LOG tab shown above would generate a log file name similar to , "7000RMS A20022_ONLINE_20170812-180420_Online" In sample mode operations this field is replaced by the Sample ID information entered and the log file name is terminated with "Sample".

Report #: This field is used in naming the data file and will be displayed as header information in each data file. The Report # field is used as the primary text descriptor in the log file name. For example, the text in the CONFIG-LOG tab shown above would generate a log file name similar to , "7000RMS A20022_ONLINE_20170812-180420_Online".

Location and Operator: This information is used as header information in each data file. It is intended to uniquely identify the analyzer location and primary control operator.

Start New Log: This button closes the current log file and activates a new log file using the parameters in this screen. To ensure no data is lost during the closing process, the analyzer will wait until the next data log step completes before closing the file. The longest potential delay would be the active log file Write Interval (mins).

Current Drive _____: This field displays the drive designation currently being used for active logging. Active logging will only occur on flash drives that are illuminated.

Change Log Drive: This button facilitates the changing of the flash drives being used for active logging to facilitate moving the data. The button initiates a protocol to enable the exchange and / or removal of USB flash drives effectively. The button only becomes available for usage when there are two flash drives installed on 7000RMS. See "Change Log Drive" section below for detailed description of the process.



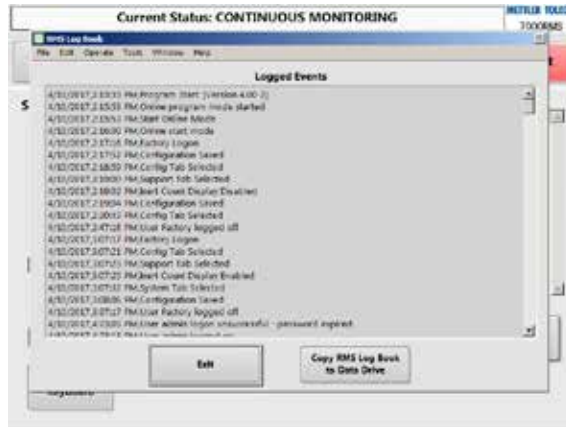
CAUTION: Removal of USB drives without executing change log drive feature may generate warnings or severe log errors. Always use the change log drive feature prior to removal of the USB drives from the 7000RMS.

Log file Write Interval (ml): This field defines the volume interval (ml) at which data will be written to the log file. For each volume interval, the measured analysis data is logged. The editing of the log file write interval will result in the changing of the units utilized for all alarms, count displays on the main screen, and SCADA analog output. Thorough examination of all settings is recommended when changing the log file write interval.

Log File Duration (hours): This field enables the user to define the maximum time for which a log file will accumulate data in Online Mode. After the set duration the current log file will close, and a new log file will open. This cycle will continue until the user quits the software or selects the START NEW LOG button on this screen.

X Axis (mins): This field defines the width scaling of the trending chart on the main screen when the user selects "Fixed" rather than "Auto" on the x axis.

Y Axis: This field defines the height scaling of the trending chart on the main screen when the user selects "Fixed" rather than "Auto" on the y axis.

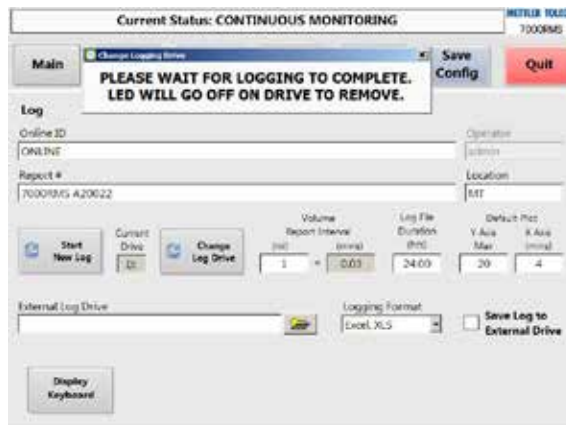


6.7 Change Log Drive Function

At least one METTLER TOLEDO Thornton USB flash drive should be connected to the analyzer at all times for reliable operations. Other USB storage devices may be used however there may be functional difficulties associated with using other USB storage devices; consult METTLER TOLEDO Thornton support prior to attempting usage.

Use this procedure to safely change the USB flash drive to which the data is actively saved. On the CONFIG-LOG tab or in the Sample Mode popup:

1. Insert a new USB flash drive into the port and wait until the CHANGE LOG DRIVE button is highlighted to enable usage.
2. Select the CHANGE LOG DRIVE button located on the bottom row, and select YES on the pop-up to proceed.
3. A new popup will appear with "Please Wait for Logging to Complete, LED will go OFF on Drive to Remove".
4. Wait for the Change Drive pop-up to prompt that it is "Safe to remove the drive with the blue LED off." Press CONTINUE to proceed. Depending on the log write interval this may take a few seconds to several minutes. For example, if the log file write interval is set to 30 ml the remaining volume of that interval must complete processing prior to closing that data report and thus making the drive available for removal. When complete, the current drive designation should now have changed and the LED of the original flash drive should be unlit. It is now safe to remove this flash drive.





6.8 Config - Clean Tab



Online Cleaning Volume (ml): This field defines the volume (ml) of cleaning solution that the analyzer processes during an online cleaning operation. The analyzer will switch the position of the Input Valve to use the liquid connected to CLEANER OR SAMPLE INPUT.

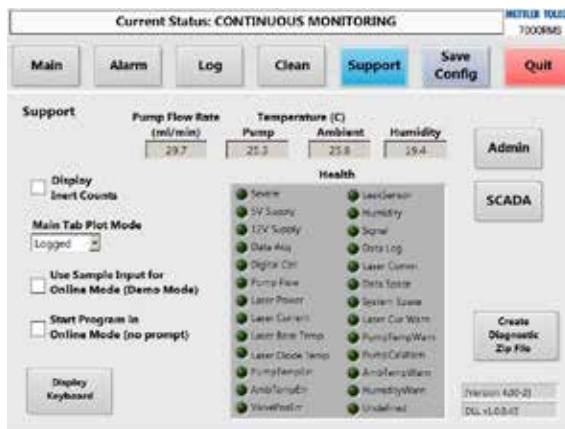
Online Cleaning (mins): This field represents a calculation of the total time (mins) that cleaning solution runs through the machine for each online cleaning operation.

Online Post Cleaning Stabilization (ml): This field defines the volume (ml) that the analyzer runs in online mode after a cleaning operation and before the analyzer starts to record data to prevent false data logging of cleaning fluids.

Total Online Cleaning (mins): This field represents a calculation of the total time (mins) to perform a cleaning operation including cleaning and post cleaning stabilization.

6.9 Config - Support Tab

The CONFIG-SUPPORT screen offers the user configuration control, an indication of the analyzer performance and additional information about errors if they occur.



Create Diagnostic Zip File: This button is used as a diagnostic tool. By selecting this feature, you will write a .zip diagnostic archive containing screenshots and calibration information of 700ORMS onto the internal storage, which can only be opened and interpreted by METTLER TOLEDO Thornton support personnel.

Pump Flow Rate (ml / min): This displays the liquid flow rate (ml/min). The 700ORMS programmed flow rate is 30 ml / min and is required for nominal operations.

Temperature (C): This real-time temperature display indicates the pump temperature as well as the ambient temperature within the 700ORMS. If a temperature sensor is not installed, NA will be displayed.

Humidity (% RH): This displays the percent relative humidity present inside the 700ORMS chassis in real time. If a humidity sensor is not installed, NA will be displayed.

Logging Format: This selection determines the log file format to be used for the all active logging data files stored:

- Text, CSV: data files will log data in text format with comma separated variable structure. This is a common file structure enabling importing into many different data processing software technologies. This format can be imported into Excel.
- Excel, XLS: data files will log data in Excel compatible format to facilitate opening directly with Excel without utilizing the Import file process.

Display Inert Counts: This toggle enables or disables the inert particle count display as shown below



Admin: This button opens a tab for managing user access permissions. The admin tab can only be opened by a user with an administrator level of access. See CONFIG – SUPPORT – ADMIN tab section for detailed information.

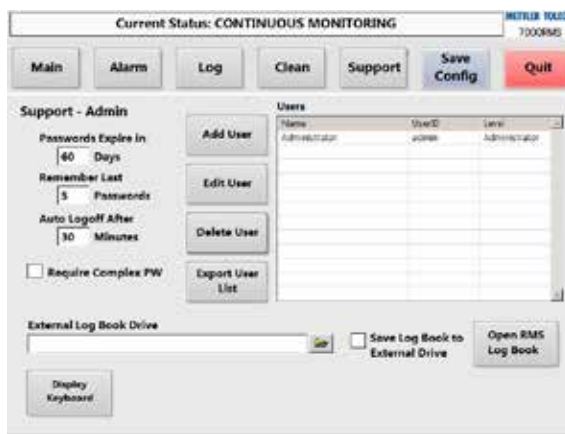
SCADA: This button opens a tab for configuring Modbus / TCP and PLC analog output settings for

supervisory control and data acquisition (SCADA). See CONFIG – SUPPORT – SCADA tab for detailed information.

Health Panel: Centered on the CONFIG-SUPPORT screen, this panel informs users of the source of any errors that may be identified by the software during operation. Indicators will turn red when an error has occurred for the specified analyzer component. This panel is useful when diagnosing system issues when the user is alerted to an error. See System Health Errors and Warnings section for detailed information.

6.10 Config - Support - Admin Tab

The CONFIG – SUPPORT – ADMIN screen offers the administrator level user an in-depth control of the analyzer user profiles.

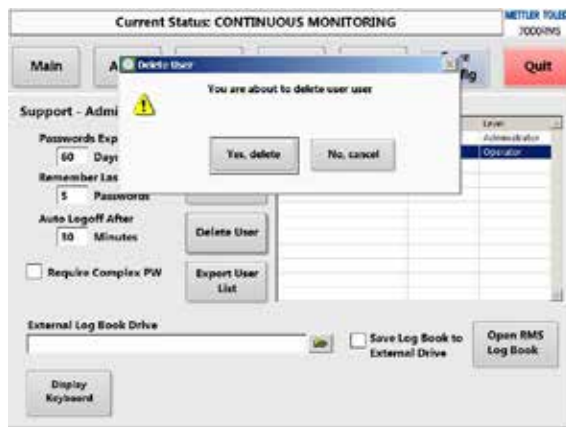


Add User: If the administrator selects the ADD USER button, a pop-up will appear requiring information for the following fields: User name, user ID, user level, and password. Press the OK button to create the user's profile.



Edit User: An administrator can edit a user's profile by highlighting the user in the chart and pressing the EDIT USER button. The user name, user ID, user level, and password can all be altered. Pressing the OK button will initiate any changes made.

Delete User: An administrator can delete the user by highlighting the user's profile in the chart and pressing the DELETE USER button.



Export User List: Selecting this button an administrator can export the current user list to the active USB flash drive for archiving or offline review.

The Information below applies to all of the user profiles that appear in the User Profile Data Set:
Passwords Expire in ___ Days: The value entered in this field will determine the number of days after resetting until a user's password expires. As shown above, the value '60' dictates that after 60 days have passed from a password reset, the user's password will expire. The expiration time of a password begins when a user is created or when the password is altered.

Remember Last ___ Passwords: The value entered in the field prevents the user from using the same passwords in succession. As shown above, the value '5' in this field dictates that the user cannot re-use the same password until it has been changed five times. After the user changes the password five times, the ability to use the original password becomes available.

Auto Logoff After ___ Minutes: The value entered in this field dictates the period of time before a user's active session is automatically terminated.

Require Complex PW: Selecting this option requires users to have a complex password, comprised of characters from at least three of the following four character types: uppercase, lowercase, numbers, and symbols.

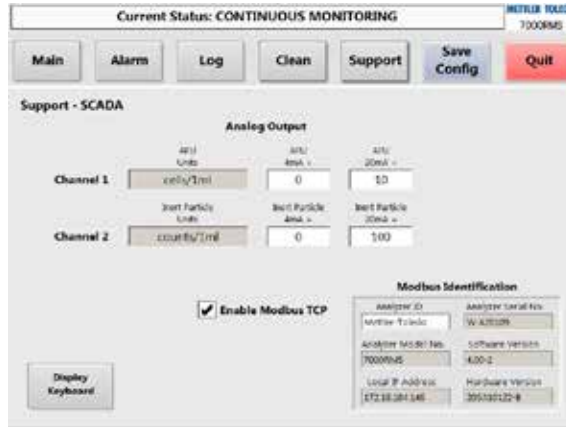
Open RMS Log Book: This button enables a pop-up to appear which lists logged events by the METTLER TOLEDO Thornton software. The date and time the event occurred is also provided. This file can be copied to a UBS flash drive by selecting the Copy 700ORMS Log Book to Data Drive button.

Save Log Book to External Drive: By selecting this option and browsing to save path using the adjacent External Log Book Drive field, the 700ORMS Log Book file will be saved at this custom location. Use it to specify an local path, or a UNC network path. It may be necessary to map the UNC path as a drive using the Windows file explorer.

6.11 Support - SCADA Tab

SCADA: This button opens a tab for configuring Modbus / TCP and PLC analog output settings for Supervisory Control and Data Acquisition (SCADA). The analog output panel on the left side of the SCADA tab provides two channels to send a 4 to 20 mA range of current for AFUs and inert particles, respectively. The log file write interval (ml) from the CONFIG-LOG tab dictates the volumetric interval for output current (mA). Scaling parameters for 4 mA and 20 mA can be populated with application-specific critical values as upper and/or lower bounds in any configuration.

Enable Modbus TCP: This check box activates the Modbus / TCP protocol for data communication. See Modbus Protocol section for detailed explanation.



6.12 Config - Save Config

The SAVE CONFIG button allows the user to save the user-defined parameters in the CONFIG tabs as the default values to be utilized on restart or initialization. When a user has selected the SAVE CONFIG button the following prompt will appear to verify that the user intends to overwrite the existing settings. Select YES, CONTINUE to save the current configuration as the new default or select NO, CANCEL to keep the existing saved configuration as the default.



NOTE: Any edits to the user-defined parameters will be lost during a shut down if the configuration settings are not saved using the SAVE CONFIG process



6.13 System Health - Errors and Warnings

System health errors and warnings indicators are located on the Health Panel: Centered on the CONFIG-SUPPORT screen, this panel informs users of the source of any errors that may be identified by the software during operation. Indicators will turn red when an error has occurred for the specified analyzer component. This panel is useful when diagnosing system issues when the user is alerted to an error or warning.



6.13.1 Severe Errors

If any severe indicator on the health panel is red, the 7000RMS software will prompt the user: "A severe program error has occurred and logging has stopped." The user must either RESTART or EXIT the software. This error will occur if any of the following indicators become red:

5V Supply: Secondary power for optical components has malfunctioned.

12V Supply: Secondary power to data components has malfunctioned.

Data Acq: The sensor signal processor has malfunctioned.

Digital Ctrl: The control processor has malfunctioned.

Pump Flow: The flow rate is not in the acceptable operating range of 30 ml / min. Check that the 7000RMS fluidics fittings are properly connected, the tubing is not pinched or obstructed and that fluids are available for required operations. Also check that online input source valves and regulators are properly configured and are turned on.

Laser Power: The power of the laser is not operating properly.

Laser Current: The laser current has deviated from its calibrated value for the duration of the error delay time window.

Laser Base Temp: The base temperature of the laser has deviated from its calibrated value.

Laser Diode Temp: The diode temperature of the laser has deviated from its calibrated value.

PumpTempErr: The pump temperature exceeds the maximum operating temperature, typically from processing hot water. Severe error issue.

AmbTempErr: The temperature inside of the 7000RMS exceeds the maximum operating temperature. Remove the analyzer from excessively hot environment. Severe error issue.

ValvePosErr: The input valve is not positioned correctly.

LeakSensor: A water leak or condensation has been detected inside the chassis of 7000RMS. Severe error issue.

Humidity: Excessive humidity has been detected inside the analyzer chassis and has remained present for the duration of the error delay time window.

Signal: A flat-line in signal has been detected.

6.14 Warnings

If any warning indicator on the health panel is red, the 7000RMS software header will prompt the user with the warning indication information. The system will continue to operate normally. The warning is intended to provide information to the user to enable the resolution of the issue prior to a severe error occurring. The warning error will occur if any of the following indicators become red:

Data Log: The data logging process is not operating properly. Recommend installing or replacing the USB Flash drive(s).

Data Space: The removable flash drive memory limit has been exceeded. Copy files onto a larger external hard drive and then delete the files from the USB flash drive.

System Space: The internal memory limit has been exceeded and data may be lost. Contact METTLER TOLEDO Thornton support for assistance.

PumpTempWarn: Temperature of the pump is approaching the severe error limit. Verify the sample source is of proper temperature. Not severe, operations will continue.

AmbTempWarn: Temperature inside the 7000RMS is approaching the severe error limit. Verify the ambient environment is properly regulated. Not severe, operations will continue.

Humidity Warn: Excessive humidity has been detected inside the analyzer chassis.

Undefined: The error has undefined origins. If this error continues to occur after you have restarted the system with correct assembly, please contact METTLER TOLEDO Thornton support.

6.15 Data Output

6.15.1 Data Log Files

The data log file format is written as CSV (text file) and / or (Microsoft) MS Excel compatible spreadsheet based on the configuration selection in the CONFIG-SUPPORT tab. Logging will begin automatically when the software initiates online mode. The log file will continue until the time specified by log file duration (hours) in the LOG tab of the CONFIG screen, at which point, a new log file will be created. Alternatively, a new file may be created on the active logging directory by selecting "Start New Log" in the LOG tab. The 7000RMS performs data logging in real time, therefore the volume report interval and Online ID column information may change within a single log file depending on the respective interface setting at the time of data collection.

Report Number: 7000RMS A20022										
Sample ID:	ONLINE									
Location:	MT									
Operator:	admin									
File Start:	4/12/2017 13:20:14									
Date	Time	AFU Cell Cnt	Inert Crit	Alarm	Mode/Status	SamplD	Volume Report Interval (ml)	Temperature Ambient	Temperature Pump	Humidity
4/12/2017	13:20:14	0	0		Online	ONLINE	1	24.4	24.4	21.3
4/12/2017	13:20:16	0	0		Online	ONLINE	1	24.9	24.9	21.6
4/12/2017	13:20:18	2	159		Online	ONLINE	1	24.9	24.9	21.6
4/12/2017	13:20:20	2	290	Inert.Alert	Online	ONLINE	1	24.9	24.9	21.6
4/12/2017	13:20:22	1	292	Inert.Alert	Online	ONLINE	1	23.9	25.8	21.5
4/12/2017	13:20:24	0	246	Inert.Alert	Online	ONLINE	1	23.9	25.8	21.5
4/12/2017	13:20:26	1	348	Inert.Alert	Online	ONLINE	1	24.9	24.4	21.5
4/12/2017	13:20:28	0	428	Inert.Alert	Online	ONLINE	1	24.9	24.4	21.5
4/12/2017	13:20:30	1	362	Inert.Alert	Online	ONLINE	1	24.9	24.4	21.5
4/12/2017	13:20:32	0	307	Inert.Alert	Online	ONLINE	1	24.9	24.4	21.8
4/12/2017	13:20:34	2	244	Inert.Alert	Online	ONLINE	1	24.9	24.4	21.8
4/12/2017	13:20:36	1	216	Inert.Alert	Online	ONLINE	1	24.4	24.4	22.1
4/12/2017	13:20:38	1	198		Online	ONLINE	1	24.4	24.4	22.1
4/12/2017	13:20:40	1	195		Online	ONLINE	1	24.4	24.4	22.1
4/12/2017	13:20:42	1	178		Online	ONLINE	1	24.9	24.4	21.9
4/12/2017	13:20:44	2	176		Online	ONLINE	1	24.9	24.4	21.9
4/12/2017	13:20:46	0	186		Online	ONLINE	1	24.9	24.4	21.9
4/12/2017	13:20:48	1	192		Online	ONLINE	1	24.9	24.4	21.9

The online log file illustrated above is logged in 1 ml volume report intervals with alert thresholds for AFU and inert set at 10 and 200 respectively.

The online log file above is an example of a log file formatted in Excel. The file header specifies the report number, sample ID, monitoring station, and operator as it had been entered via the CONFIG-LOG tab. The file start (date and time) is also logged as header information.

Date and Time: This value is recorded for each log file line.

AFU Cell Count and Inert Cnt: These values report counts for the log file write interval specified by the user in the CONFIG-LOG tab.

Alarms: Notifications are recorded for the specified volume interval(s) in which the threshold was surpassed, as shown in the first, fifth and seventh lines in the example.

Status: This column records any errors or issues that may have occurred during operation. A list of possible issues can be found under the CONFIG-SUPPORT tab.

Mode: This reports the operational mode as online, sample, clean or collect.

Volume Report Interval (ml): This column records the user specified parameter log file write Interval in the CONFIG-LOG tab, which indicates the volume for which the recorded data is observed. For the example above, the Volume Report Interval is 1 ml indicating that the AFU and inert counts would be recorded as counts / 1 ml.

Sample ID: This column contains the online ID identifier set in the CONFIG-LOG tab.

Temperature Ambient (in Celsius): This column records the ambient temperature inside the chassis of the analyzer.

Temperature Pump (in Celsius): This column records the temperature of the internal pump.

Humidity (in %RH): The column records the relative humidity inside the chassis of the analyzer.

The file illustrated below is a sample mode log. Sample mode log files report a final summary of data with the total counts for the sample volume specified. Defining a Volume Report Interval during sample mode subdivides AFU and inert particle enumeration into smaller intervals, in addition to reporting resulting for the full sample volume.

Report Number: 7000RMS A20022										
Sample ID:		SAMPLE								
Location:		MIT								
Operator:		admin								
File Start:		4/12/2017 13:47:25								
Date	Time	AFU Cell Cnt	Inert Cnt	Alarm	Mode/Status	SampleID	Volume Report Interval (ml)	Temperature Ambient	Temperature Pump	Humidity
4/12/2017	13:48:25	48	1526		SampCleanEnd	SAMPLE-Int 1	34.2	24.9	24.4	22.6
4/12/2017	13:48:26	48	1526		Clean	SAMPLE	34.2	24.9	24.4	22.6
4/12/2017	13:50:08	71	3042		Sample	SAMPLE-Int 1	9.9	24.9	23.9	22.2
4/12/2017	13:50:28	94	3768		Sample	SAMPLE-Int 2	10	24.9	24.9	21.9
4/12/2017	13:50:48	206	2893		Sample	SAMPLE-Int 3	10	24.9	24.9	21.5
4/12/2017	13:51:08	195	2798		Sample	SAMPLE-Int 4	10	24.9	24.4	21.8
4/12/2017	13:51:28	192	2892		Sample	SAMPLE-Int 5	10	24.9	24.4	21.6
4/12/2017	13:51:48	233	2665		Sample	SAMPLE-Int 6	10	25.8	25.3	21.9
4/12/2017	13:52:08	111	2658		Sample	SAMPLE-Int 7	10	23.9	24.9	21.8
4/12/2017	13:52:28	53	2984		Sample	SAMPLE-Int 8	10	25.3	25.3	21.9
4/12/2017	13:52:48	70	3985		Sample	SAMPLE-Int 9	10	24.9	24.9	21.8
4/12/2017	13:53:07	125	4138		Sample End	SAMPLE-Int 10	9.5	25.3	24.4	21.9
4/12/2017	13:53:08	1350	31823		Sample	SAMPLE	99.5	25.3	24.4	21.9

In the file illustrated above, a 100 ml sample was taken with 10 ml volume report intervals. At the beginning of the data depicted, a clean cycle was conducted from within Sample Mode.

Successive sample runs and cleaning operations performed in sample mode will be appended to the same log file. Exiting sample mode will close writing to the sample log file and generate a new online log file using the identification parameters found on the CONFIG-LOG tab. To start a new sample log file, EXIT SAMPLE MODE and start a new sample; or QUIT the METTLER TOLEDO Thornton software and restart it in sample mode.

6.15.2 Modbus Protocol

This section provides a detailed explanation of the Modbus / TCP registers utilized by the 7000RMS analyzer. The Modbus protocol is a messaging structure used for master-slave or client-server communication. Please refer to the Modbus organization website (www.modbus.org) for information regarding the latest Modbus / TCP specifications. Modbus devices communicate using transactions (queries) initiated by one device (master / client). The other devices (slaves / servers) respond with the requested data to the master. The 7000RMS is referenced as a slave device in the Modbus structure as it will send out data as requested from master devices. The 7000RMS will not accept any external inputs via Modbus protocol.

Modbus / TCP

Modbus / TCP is a messaging structure that uses the TCP / IP (transmission control protocol/internet protocol) protocols to transmit the data of the Modbus structure to compatible devices. The Modbus / TCP protocol supports many types of data transactions, from readings single bits to advanced object oriented operations. To ensure maximum compatibility, the 7000RMS utilizes the simplest function set available.

The Modbus / TCP interface attached to the TCP / IP stack implemented within the 7000RMS analyzer will listen to all communications that come in on Modbus / TCP registered port 502. The Modbus / TCP Client uses standard TCP methods to communicate with the driver and allows multiple connections to the analyzer, with a maximum of 10 concurrent connections.

Identification Registers

The identification register addresses and information are shown in the following table. These read-only registers are updated by the analyzer during the initial power-on sequence.

Address	Description	Size (16-bit words)	Data Type
0000	Instrument ID	15	String
0015	Model Number	10	String
0025	Serial Number	5	String
0030	Software Version	4	String
0034	Hardware Version	4	String

Analysis Data Registers

The analysis register addresses and information are shown in the following table. These read-only registers are updated by the analyzer when the record data is written to the data log file. Prior data is not maintained in the analyzer registers once the most recent record data is written to both the data log files and The Modbus registers.

Address	Description	Size (16-bit words)	Data Type
0300	Record Date	2	Date
0302	Record Time	2	Time
0304	AFU Value	2	32-bit Integer
0306	Inert Count Value	2	32-bit Integer
0308	Alarm	20	String
0328	Mode / Status	40	String
0368	Online ID / Sample ID	15	String
0383	Volume Report Interval (ml)	4	Double Float
0387	Temperature Ambient (°C)	4	Double Float
0391	Temperature Pump (°C)	4	Double Float
0395	Humidity (%RH)	4	Double Float

6.15.3 Activating Analog Output

The 7000RMS has two activated 4 – 20mA outputs. Select the output ranges for the 4 – 20 mA analog outputs by following the steps below:

1. Verify connection of the external communications 4 – 20 mA cable to the external analog output port on the 7000RMS analyzer.
2. Follow proper startup procedure for intended mode for use. Analog Output functionality is fully active in only in Online Mode.
3. In the METTLER TOLEDO Thornton software, click on CONFIG button. In the SUPPORT tab, select the SCADA button. The SCADA tab displays to the user two channels. Channel 1 represents the AFU parameters, and Channel 2 represents the Inert Particle. Each channel has user-defined lower and upper bounds for the 4 – 20 mA range.
4. The user should have a desired range for the AFU and inert particle. These values should be entered in the appropriate field.
5. The current signal will be produced after the volume report interval (user-defined value set in CONFIG- LOG) has been interrogated by the 7000RMS.

The screenshot shows the 'Support - SCADA' configuration window. At the top, it says 'Current Status: CONTINUOUS MONITORING' and 'METTTLER TOLEDO 7000RMS'. There are navigation buttons: Main, Alarm, Log, Clean, Support, Save Config, and Quit. The 'Support - SCADA' section is active, showing 'Analog Output' configuration for two channels.

Channel	AFU (unit)	AFU Zmin	AFU Zmax	Inert Particle (unit)	Inert Particle Zmin	Inert Particle Zmax
Channel 1	cfu/50ml	0	10			
Channel 2	counts/60ml	0	100			

Below the table, there is a checkbox for 'Enable Modbus TCP' which is checked. To the right, there is a 'Modbus Identification' section with the following fields:

Field	Value
Analyzer ID	191420118
Analyzer Serial No.	191420118
Analyzer Model No.	7000RMS
Software Version	1.00-2 bit
Local IP Address	192.168.1.1
Hardware Version	10M5001

A 'Display Keyboard' button is located at the bottom left of the configuration area.

7 Maintenance

METTTLER TOLEDO provides performance, calibration and maintenance services for all 7000RMS Analyzers

8 Appendix 1 - Specifications

General Specifications

Sample flow rate	30 mL/min
Biological detection limit	1 AFU (Auto Fluorescent Units)
Minimum detection size	≥0.5µm
Measurement range	0 – 10,000 total counts/mL
Data report interval	2 seconds (1mL)
Data Communication	Ethernet – standard RJ 45 / WIFI Capable SCADA connectivity via ModBus TCP 2 Analog Output channels; 4 – 20 mA standard, user software with configurable output ranges
Operational environment (noncondensing)	Up to 37°C (99°F)

Sample Water Requirements

Sample Temperature (noncondensing)	5 – 90°C (41 – 194°F)*
Online Inlet Pressure	0 – 7 bar (0 – 100 psig)

Installation/Power/Enclosure

Power	100-240 VAC, 5A, 50-60Hz Up to 8.2ft (2.5 meters) SJ cord length provided standard
Physical dimensions (W × H × D)	22.2'(56.4cm)W × 24.25'(61.6cm)H × 12'(30.5cm)D
Monitoring location	For continuous at-line monitoring panel, wall mounting tabs kit standard
Enclosure material	Stainless steel
Weight	70.4 lbs (33.3 kg)

*Temperature about 45 °C requires Sample Conditioning Coil (included)

9 Appendix 2 - Troubleshooting Guide

If ...	Do	Refer to
The analyzer does not power on	<ul style="list-style-type: none"> – Verify that the power cord is fully inserted and locked into the jack located on the side of the analyzer. – Verify that the power cord is plugged in to an appropriate power supply. 	<ul style="list-style-type: none"> – Installation – Startup / warm-up sequence
Windows or METTLER TOLEDO Thornton credentials are not accepted	<ul style="list-style-type: none"> – Verify that CAPS LOCK and / or NUM LOCK are not enabled on the USB keyboard and / or on the virtual keyboard. – Verify that the valid default administrator and / or user passwords were provided by METTLER TOLEDO Thornton technical support: 1-781-301-8600 	<ul style="list-style-type: none"> – Startup / warm-up sequence
The analyzer does not respond to touch input	<ul style="list-style-type: none"> – Make sure to press intently on the screen with a stylus or fingernail, as light presses with pads of fingers may not register on the resistive touchscreen. – Clean the touchscreen with an appropriate microfiber cloth. – If cleaning is unsuccessful, power cycle the analyzer. – Use the PenMount configuration utility on the RMS PC to calibrate the touchscreen. 	
The analyzer does not display the on-screen keyboard	<ul style="list-style-type: none"> – Be sure to firmly press the DISPLAY KEYBOARD button only a single time. – Allow up to 30 seconds for the keyboard to open. – It may be necessary to power cycle the analyzer. 	
The analyzer leaks	<ul style="list-style-type: none"> – Verify that luer and / or compression fittings are snug and secure. – Verify that external fluidic plumbing is secure and not damaged. – Verify that the sample input port is not being used for pressurized source input. 	<ul style="list-style-type: none"> – Installation – Online Connection Setup – Activating Online Mode Operations – Appendix: Sample Processing
ONLINE MODE The analyzer does not pass initialization and / or exhibits persistent pump flow errors	<ul style="list-style-type: none"> – Verify that the online shutoff valve is in the open position. – Verify that the source shutoff valve is in the open position. – Verify that tubing and external fluidic connections are connected securely and free from occlusions, debris, and / or kinks. – Avoid using excessively long sample, online and waste tubing – Verify that the pressurized source is properly connected to the ONLINE INPUT. – Make note of the flow rate in the CONFIG-SUPPORT tab to assist in troubleshooting. The flow rate should be 30mL / min. 	<ul style="list-style-type: none"> – Installation – Online / Sample Connection Setup – Activating Online Mode Operations – Appendix: Sample Processing
SAMPLE MODE The analyzer does not pass initialization and / or exhibits persistent pump flow errors	<ul style="list-style-type: none"> – Verify that tubing and external fluidic connections are connected securely and free from occlusions, debris, and / or kinks. – Avoid using excessively long sample and waste tubing. – If air segments are observed in input or waste tubing, make sure the needle is submerged in sample liquid. – Verify that luer and external fluidic connections are secure. – Make note of the flow rate in the CONFIG-SUPPORT tab to assist in troubleshooting. The flow rate should be 30 mL/min. 	<ul style="list-style-type: none"> – Installation – Online / Sample Connection Setup – Activating Sample Mode Operations – Appendix / Sample Process

If ...	Do	Refer to
The analyzer does not log to attached USB drives	<ul style="list-style-type: none"> – Verify that the LED on the USB drive is illuminated. – Verify that at least 1 USB flash drive is fully inserted prior to powering on the analyzer. – Make sure to follow the drive ejection procedure specified in the user manual. – Verify that the drive has available storage capacity. – On a separate PC, check the drive for errors and if necessary reformat the drive. 	<ul style="list-style-type: none"> – CONFIG-LOG
The analyzer does not find or write to the remote logging directory	<ul style="list-style-type: none"> – Verify that an Ethernet cable securely connects the LAN port of the analyzer to a router, switch, or hub of the network hosting the remote logging directory. – Make sure that file sharing is enabled on the network or bridge computer. – Verify that the analyzer is connected to the local area network and has appropriate IP and DNS settings. – It may be necessary to assign the analyzer a static IP address. – It may be necessary to configure the network share as a mapped drive. – Verify that the correct credentials for domain, username, and password of the remote directory are saved on the analyzer at the time of configuration. – Verify that analyzer's user account(s) have write privileges in the intended share directory. – Ensure that device and / or network firewalls and antivirus suites permit communication to and from the analyzer and respective folders. – Additional network infrastructure and / or configuration may be required. 	<ul style="list-style-type: none"> – CONFIG-SUPPORTADMIN-OPTIONS
The analyzer does not communicate via Modbus TCP	<ul style="list-style-type: none"> – Verify that the Enable Modbus TCP box is checked in the SCADA screen of the CONFIG-SUPPORT tab, select the SAVE CONFIG button and the analyzer has been power cycled. – Verify that an Ethernet cable securely connects the LAN port of the analyzer to a router, switch, or hub of the internal network. – Verify that the analyzer is connected to the local area network and has appropriate IP and DNS settings. – It may be necessary to assign the analyzer a static IP address. – Ensure that TCP port 502 is not blocked, or correctly forwarded if connecting from an external network. – Ensure that device and/or network firewalls and antivirus suites permit communication to and from the analyzer. – Additional network infrastructure and / or configuration may be required. 	<ul style="list-style-type: none"> – CONFIG-SUPPORT-SCADA – Modbus Protocol
The analog output equipped analyzer does not send current	<ul style="list-style-type: none"> – Verify that the analog output cable is securely attached to the analog output port on the side of the analyzer – Verify that the scaling parameters found in the CONFIG-SUPPORT-SCADA have been set – Verify that the analyzer model supports analog output functionality – Recall that changes to analog output current are ONLY sent after the entire volume of the log file write interval defined in CONFIG-LOG has been processed. Employ a smaller log file write interval, if necessary. 	<ul style="list-style-type: none"> – CONFIG-SUPPORT-SCADA – Installation: Analog Output – CONFIG-LOG

If ...	Do	Refer to
The main screen trending chart does not display data	<ul style="list-style-type: none"> – Verify that initialization has completed and the main screen banner indicates the analyzer is in continuous monitoring. – Data points will be displayed immediately after entering continuous monitoring ONLY if the analyzer is configured for Real-time display mode. In the Logged display mode, data points are displayed on the trending chart ONLY after the entire volume of the log file write interval defined in CONFIG- LOG has been processed. 	<ul style="list-style-type: none"> – CONFIG-SUPPORT- ADMIN-OPTIONS – CONFIG-LOG
The analyzer is making atypical audible noises	<ul style="list-style-type: none"> – Verify that tubing and external fluidic connections are connected securely and free from occlusions, debris, and / or kinks. – If in the online mode, from the main screen, press the SAMPLE button, press YES, then press EXIT SAMPLE MODE. Observe if the noise persists. 	

- Brazil** **Mettler-Toledo Ind. e Com. Ltda.**
Avenida Tamboré, 418 – Tamboré,
BR - 06460-000 Barueri / SP, Brazil
Phone +55 11 4166 7400
e-mail mtbr@mt.com
- France** **Mettler-Toledo Analyse Industrielle S.A.S.**
30, Bld. de Douaumont, FR-75017 Paris, France
Phone +33 1 47 37 06 00
e-mail mtpro-f@mt.com
- Germany** **Mettler-Toledo GmbH**
Prozeßanalytik, Ockerweg 3, DE -35396 Gießen
Phone +49 641 507-444
e-mail prozess@mt.com
- Switzerland** **Mettler-Toledo (Schweiz) GmbH**
Im Langacher, CH-8606 Greifensee
Phone +41 44 944 47 60
e-mail ProSupport.ch@mt.com
- United States** **Mettler-Toledo Thornton**
900 Middlesex Turnpike, Bld. 8, Billerica, MA 01821, USA
Phone +1 781 301 8800
Freephone +1 800 352 8763
e-mail mtprous@mt.com

For more addresses of METTLER TOLEDO Market Organizations please go to:
www.mt.com/pro-MOs

Mettler-Toledo Thornton, Inc.
900 Middlesex Turnpike, Bldg. 8
Billerica MA, 01821
Tel. +1-781-301-8600
Fax +1-781-271-0214

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