Software User Guide

iC Process for FBRM™ 4.4

Real-Time Monitoring of Particle Systems

METTLER TOLEDO

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Introduction

The iC Process™ for FBRM® web application is the software that defines, controls, and reports data captured from a ParticleTrack G600 or ParticleTrack E25 instrument that is a dedicated industrial process monitoring system. The software controls the instrument as it tracks critical particle system characterization distributions in real time using in situ, Focused Beam Reflectance Measurement (FBRM) technology.

The iC Process for FBRM software connects to the ParticleTrack field unit to enable instrument configuration, monitoring of real-time process data and information, and post-processing reporting. Only authorized users can change the FBRM instrument configuration in iC Process and approve process methods based on templates provided with the software.

Note:	iC FBRM 4.4 is a separate, optional software program that is recommended for advanced analysis and creation of customized templates for method development. A 'Process' task pane in iC FBRM enables a particle scientist to analyze iC Process for FBRM data from a PC or laptop.

If you are viewing this document electronically, click any blue-colored link to go to the related information and instructions.

Should you have questions that are not addressed in this document, please contact your local METTLER TOLEDO office or our Customer Care Department using the information under "Service and Technical Assistance" on page 8.

Related Documents

The following publications are related to the use of iC Process with ParticleTrack G600 or ParticleTrack E25 instruments. Software documents are in the iC Process for FBRM Documentation Portfolio that is installed on the control computer desktop.

- "iC Process for FBRM 4.4 Install Guide for Administrators"
- Quick Reference—"For Operators of iC Process for FBRM"

A Hardware Documentation Portfolio ships with each FBRM instrument and includes hardware manual and hardware documents. The latest portfolios can be downloaded from the AutoChem Customer Community website (https://community.autochem.mt.com).

About ParticleTrack

All ParticleTrack instruments feature the latest FBRM technology and provide the ability to measure the rate and degree of change in particle and droplet systems with precision and sensitivity at full process concentration. ParticleTrack instruments, in addition to FBRM

measurement technology, also feature onboard Smart Chip technology for storage of critical calibration and system configuration information. This provides better security and traceability in experimental and process FBRM data.

Note:	Earlier versions of G600 (FBRM G600 systems) may be compatible with iC Process for FBRM with a ParticleTrack ACIO hardware upgrade. Contact METTLER TOLEDO for upgrade information (page 8).

Software Upgrades

When applicable, software upgrades are available for iCare subscribers at no additional charge. When a new release or service pack is available, all iCare subscribers with a valid subscription will be notified via email so they can download the installer from the AutoChem Community website, https://community.autochem.mt.com. Access to the site requires a password that you can request from the home page. You can also contact Customer Care or your METTLER TOLEDO Technology and Applications Consultant (TAC) using the information under "Service and Technical Assistance".

Non-iCare subscribers may request a quote for an upgrade by contacting their local salesperson or Customer Care.

Training Programs

Training for the hardware and software is available through the users' website (see link above) and through your METTLER TOLEDO TAC. Use the contact information under "Service and Technical Assistance" on page 8.

Service and Technical Assistance

METTLER TOLEDO has offices around the world. Contact the Mettler-Toledo AutoChem, Inc. headquarters in the USA for technical support or service. To arrange for specific application assistance from a METTLER TOLEDO Technology and Applications Consultant or to schedule service from a METTLER TOLEDO FSE, or for general for assistance, contact CustomerCare through the email or toll-free number below.

Mettler-Toledo AutoChem, Inc. (Columbia, MD headquarters) http://www.mt.com/iCProcess http://www.mt.com/FBRM	Tel: **+ 1.410.910.8500** Fax: **+1.410.910.8600** Email: AutoChemCustomerCare@mt.com Toll Free: **+1.866.333.6822**

2

Getting Started

This chapter provides a checklist of prerequisites that must be complete before implementation of the ParticleTrack process instrument and iC Process for FBRM software.

The instructions in this chapter assume the iC Process for FBRM instrument is already installed by a qualified METTLER TOLEDO Field Service Engineer (FSE). The iC Process for FBRM software should already be installed and, if required by your IT department, iC Process for FBRM user groups created with the authorized users assigned to the appropriate group (see page 9).

Getting Started Checklist

The following table lists the prerequisite actions that must already have been completed before using iC Process for FBRM software:

Table 2-1   Getting Started Checklist

	Task	Performed by:	Reference Document
1	Install iC Process web application Server	IT personnel and METTLER TOLEDO engineer	"iC Process for FBRM 4.4 Install Guide for Administrators"
2	(optional) Set up iC Process for FBRM user groups and security according to your organization's SOP	IT personnel	
3	Create iC Process for FBRM archive file folder	IT personnel, or iC Process for FBRM Technician or Administrator	
4	Establish Client URL.	IT personnel	"iC Process for FBRM 4.4 Install Guide for Administrators" Default is http://localhost/ when control computer and server are on the same PC.
5	Install FBRM instrument	METTLER TOLEDO engineer	Hardware manual, ServicePac installation document (IPac StarterPac, or, if purchased, the iPac QualityPac document)

Review the basic terminology in Appendix E, "Glossary and Workflow Illustrations" that is used throughout this guide and in the software.

Three Roles for iC Process for FBRM Users

iC Process for FBRM is designed with three roles to control user permissions.

■ Administrator (all permissions)
■ Operator (process operation and calibration validation permissions)

■   Technician (testing and servicing)

The role associated with a user login by your IT department determines the actions that user can perform.

Note:	By default, iC Process for FBRM security grants all roles to all users. As required, your IT department can associate user logins with one or more of the three roles. (Refer to "iC Process for FBRM 4.4 Install Guide for Administrators" for detailed instructions.)

The following table lists the specific task that can be performed by each user role:

Table 2-2   User Roles and Permissions

Permissions	Link	Administrator	Operator	Technician
Chapter 4, "Operating iC Process for FBRM"				
Select a method	page 44	✓	✓	
Start a batch/run		✓	✓	
Stop a batch/run	page 44	✓	✓	
Pause a run		✓	✓	
Resume a run		✓	✓	
Capture a reference distribution during a run	page 53	✓	✓	✓
Create a report		✓	✓	✓
Run calibration validation	page 63	✓	✓	✓
Capture reference distributions during calibration validation		✓	✓	✓
Chapter 7, "Using Service Mode in iC Process for FBRM"				
Capture reference distributions during calibration	page 65	✓		✓
Perform service tests		✓		✓
Enter service mode	page 87	✓		✓
Exit service mode		✓		✓
Chapter 3, "Implementing iC Process for FBRM"				
Add an instrument	page 17	✓		✓
Delete an instrument		✓		✓
Configure an instrument	page 17	✓		✓
Manage reference distributions for an instrument	page 79	✓		✓
View instrument diagnostics		✓		✓
Run system calibration	page 70	✓		✓
Create a method		✓		
Manage methods		✓		
Select reference distributions to use in methods	page 30	✓		
Approve a method		✓		
Unapprove a method		✓		

iC Process for FBRM Software Overview

iC Process for FBRM software includes three components installed by a single installation program.

iC Process for FBRM Client

The iC Process for FBRM Client is the user interface for real-time monitoring with ParticleTrack process analytical instruments. iC Process for FBRM Client can be run on the same computer as the iC Process for FBRM Server, or it can be launched on any computer that can access the iC Process for FBRM server through the Internet or LAN.

iC Process for FBRM Server

In most cases, your IT personnel install the iC Process for FBRM server on a computer that is connected directly to the FBRM process instrument. This service communicates to the FBRM Server service for data acquisition and to external control systems using Modbus, OPC UA, and WITSML communication protocols.

FBRM Server

This component is automatically installed on the same PC as the iC Process for FBRM server. The FBRM Server operates the ParticleTrack process instrument and manages the real-time data collection.

Introducing iC Process for FBRM User Interface

The iC Process for FBRM user interface is a webpage in a browser and consists of:

■ Left navigation menu,

■ Title (instrument name and status),

■ Main display, and

■ Toolbar.

For many menu options, the main webpage includes individual tabs that display different views related to the main page.
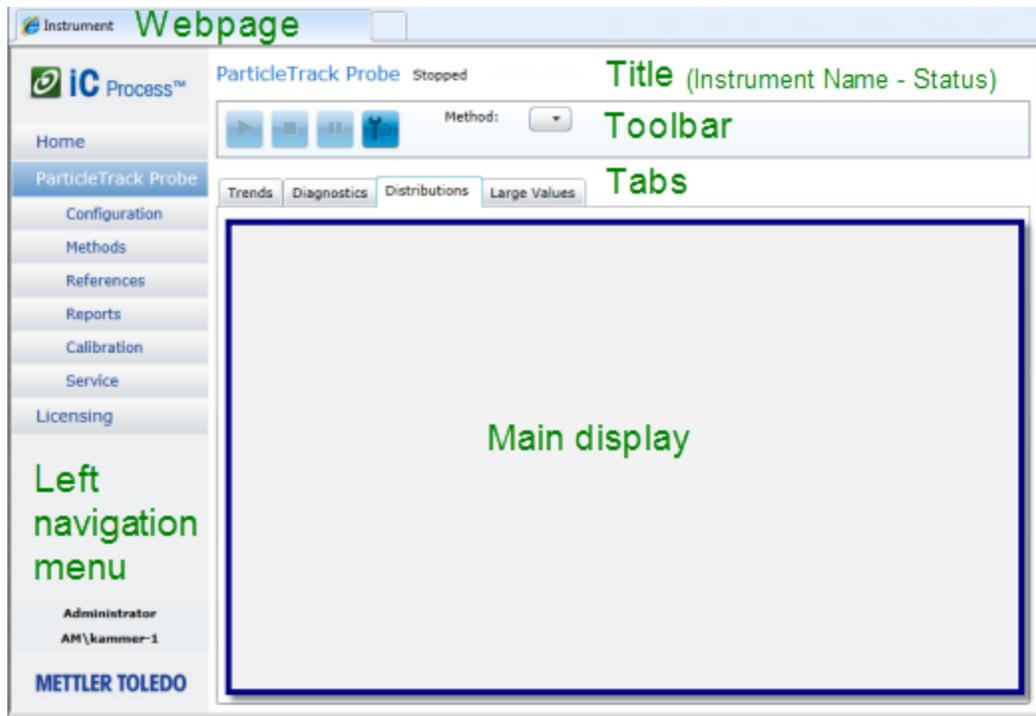
Figure 2-1 iC Process webpage parts

After an Administrator or Technician completes the initial implementation of instrument configuration and method creation/approval, an Operator can select an approved method, start a batch or continuous run, and begin monitoring a particle or droplet system. Instructions begin under "Launching iC Process for FBRM" on page 41.

Figure 2-2 shows the main instrument display during a batch run and identifies additional parts of the user interface that are common in daily operation.

Figure 2-2 iC Process main instrument display—labeled

Left Navigation Menu—Provides instrument selection and a submenu of options. When you select an instrument, the name expands to show the submenu options.

Instrument Submenu—Lists options for Configuration, Methods, References, Reports, Calibration, and Service.

Toolbar—Provides selection options for starting, pausing, or stopping batch or continuous process methods with the selected instrument as well as selecting the method. To start a batch run, name the batch and start/stop it from the toolbar. The toolbar also tracks the count of distribution samples measured.

Main Display—Shows the main content such as trends (default view), distributions, and a Large Values display of current trend values. The main display is based on the submenu selection and, if applicable, the selected tab. Figure 2-2 shows three tabs on main display that change the views among Trends, Distributions, and Large Values options. An additional tab (Diagnostics) appears to users logged in with the Administrator or Technician role.

Tab Views—Separates related information into individual 'tabs' so a user can quickly select the desired view information or settings. Tabs in Figure 2-2 show real-time process data.

Time Window—Enables selection of discrete time segments of trends up to 24 hours in a single view (on Trends tab and Diagnostics tab only). Use the scroll bar to the left of the Window selection button to view data as far as back as10 days.

3

Implementing iC Process for FBRM

This chapter provides comprehensive instructions on the initial implementation of the iC Process for FBRM software. Steps include adding and configuring an FBRM instrument, defining methods, and approving the methods for use in batch and continuous processes. These are basically one-time setup activities except for method adjustment or new method development.

Notes:	■ This chapter is intended for users with the Administrator or Technician role.
	■ For details about permissions for each role, refer to Chapter 2, "Getting Started" on page 9.
	■ For illustrations of the overall process, refer to "Workflow Illustrations" on page 131.

Access the iC Process for FBRM software on the control computer by opening a Microsoft© Internet Explorer© window and specifying the web application URL. If the client and server are on the same computer, simply click the iC Process for FBRM icon on the desktop.

Logging In (if applicable)

A login may be required based on how iC Process for FBRM was installed and on how your IT department implements user authentication. If a login prompt appears, enter your network login ID and password.

Introducing iC Process for FBRM

An Administrator or Technician completes the initial configuration of an instrument in iC Process for FBRM to prepare the ParticleTrack instrument for monitoring particle and droplet systems. As an introduction, the following section helps you become familiar with the Home page. An introduction to the instrument main page is on page 12. If you are already familiar with the user interface, skip this section and go to "Adding a Process Instrument" on page 17.

iC Process for FBRM Home Page

The Home page identifies the logged-in user and user role. It also provides the following information and functions:

Left navigation menu—Home page and Licensing are the only options that appear before an instrument has been added. The licensing function is described under "Activating Licenses" on page 81.

Add new instrument—Instructions begin on page 17.

iC Process Version—Identifies the software release.

Send System Logs—Instructions are on page 84.
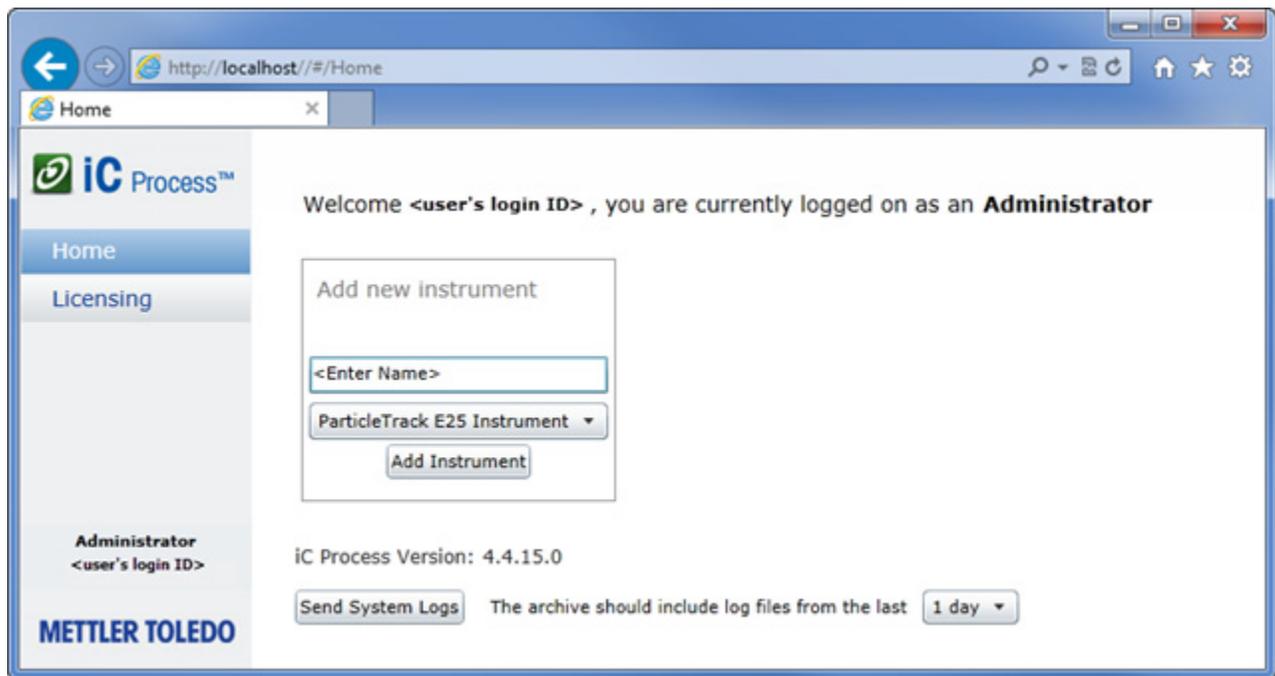
Figure 3-1 iC Process for FBRM Home page—BEFORE instrument added

The 'add' function only appears before an instrument is added. After an instrument has been added, the Home page displays the instrument status box and the name of the instrument appears in the left navigation menu (Figure 4-2 on page 43).

Adding a Process Instrument

An FBRM instrument should already be added and configured as part of the system installation process. However, instructions are repeated here for reference.

1. On the iC Process for FBRM Home page, enter a unique name for the new instrument in the Add new instrument box.

Figure 3-2   Add new instrument

2. Select the type of ParticleTrack instrument from the drop-down list.
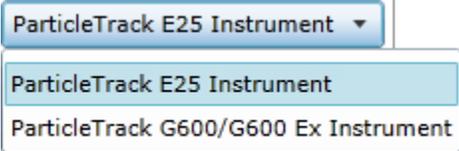
Figure 3-3   Instrument type selection list

ParticleTrack is the brand name for all instruments manufactured after January 1, 2013 featuring FBRM technology. ParticleTrack instruments include onboard Smart Chip technology for storage of critical calibration and system configuration information.

3. Click **Add Instrument**.

When you add an instrument, the Configuration page—Instrument Settings tab appears automatically to enable setting one or more required fields and reviewing the settings.

Configuring a Process Instrument

When an Administrator or Technician adds a process instrument, the Instrument Configuration page appears. The initial implementation step is to configure that instrument. The top section of the Instrument Configuration page contains general settings and action buttons for the configuration. Details and instructions are in the following sections:

- "Specifying Archive Folder Location (required)"
- "Establishing General Instrument Settings" on page 19
- "Instrument Settings Tab Details" on page 20

Specifying Archive Folder Location (required)

The **Archive folder location** is a required entry for all instruments. It is the location where all files from iC Process for FBRM continuous and batch run are saved. Also saved in the folder is an auto-generated daily report of trend charts for each statistic defined in the method.

The required folder location should be established during software installation and entered on the Instrument Configuration page after an instrument is added to iC Process for FBRM.

<Instrument Name> : Instrument Configuration

Archive folder location: [   ] **Archive folder cannot be empty.**

☑ Simulation   ○ Batch Mode   ⦿ Continuous Mode

[Save]   [Reset]

Figure 3-4 Initial Instrument Configuration—Required entry

1. Type the full path where the batch or continuous process files will be saved as iC FBRM experiment files (*.icFBRM).

Note:	**Archive folder requirements**
	■ Archive folder must already exist on the computer where the iC Process for FBRM server is installed.
	■ Administrator must have 'write' access to the Archive folder.

You cannot Save the instrument configuration until the archive location for process files is established.

About archive file format—Archived files have the .icFbrm extension so they can be opened in iC FBRM software for review and analysis, as well as used for creation of new customized templates for process methods.

About archive file size—Maximum archive experiment file size is 10,800 measurements. The 10,800 file size translates to the following approximate amount of run time in an archive, based on measurement interval:

Table 3-1 Archive File Related to Sample Interval

Amount of Run Time in Archive File	When Sample (Measurement) Interval is...
Up to 30 hours	10 seconds
Up to 90 hours	30 seconds
1 week	1 minute

If a process run or batch exceeds 10,800 measurements, the system creates multiple archive files for the same 'batch.'

About archive file names—Archive files from the same continuous run or batch run have the same name, but a different time stamp.

• **Time stamp** is in 24-hour clock format.

- **File Name Prefix**—The file name prefix will be one of the following, depending on the processing mode:

  For Batch mode, the Batch name becomes the prefix for the archive file name. Refer to *"Starting a Batch Run" on page 45* to see where batch name entry occurs.

  [Batch Name]_2012-10-11_16-52.icFBRM

  For Continuous mode, the Method name is the prefix.

  (Default)_E25_01Primary_R1000_Log_2012-10-11_16-40.icFBRM

  For Continuous mode processing, the date/time is always in the file name.

Establishing General Instrument Settings

The Configuration page has two tabs of configuration information—Instrument Settings and WITSML Interface Settings.

Note: WITSML is a specialized communication protocol for drilling rigs and offshore platforms. Please refer to Appendix C for configuration instructions on how to complete the WITSML Interface Settings tab.

This section describes Instrument Settings. Since most configuration settings are automatically transferred from the instrument, the key setting is whether the instrument will be processing in batch or continuous mode.

1. Select **Configuration** from the left navigation submenu for a selected instrument.
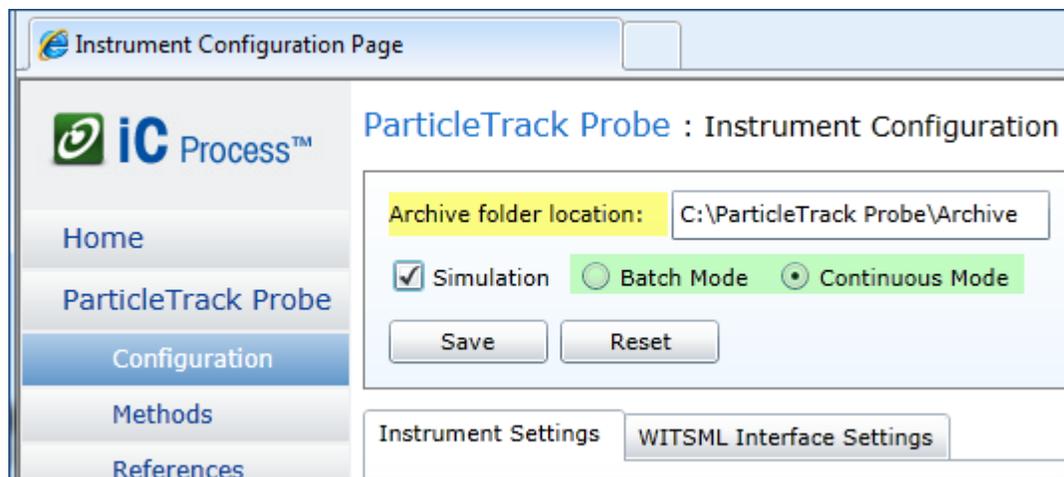
Figure 3-5 Configuration page—General settings

The field highlighted yellow was required when the instrument was initially added to the system and should already be filled in (see *"Specifying Archive Folder Location (required)" on page 18*).

Check one of the fields highlighted green to define the type of particle system processing (batch or continuous). By default, the instrument is in Continuous processing mode.

Verify Simulation is Not Checked

By default the Simulation check box in Instrument Configuration should be unchecked when the control computer is connected to an instrument. The Simulation option is only for systems that do not have an instrument connected.

Note: Clear this check box when you connect to a ParticleTrack instrument.

Configure for Batch Mode or Continuous Mode

◉ **Continuous Mode**—By default, the software processes particle and droplet systems in continuous mode, meaning an online instrument is continually collecting data until a user clicks the Stop button.

◯ **Batch Mode**—To set the instrument to process in batches, select **Batch mode**. When an Operator clicks the Start button, the instrument begins continuous processing and the Batch Start/Stop buttons appear in the instrument toolbar, along with a Name text box. When an Operator clicks the Batch **Start** button, an official batch begins (page 45). The batch ends when the Operator clicks the Batch **Stop** button. Refer also to the glossary on page 127.

Archive data between batches
This field only appears if you select Batch mode.

Figure 3-6 Configuration page—General settings (batch mode)

▣ Unchecked—The system only creates archive files for batches. The archive will not include data collected before or after a batch.

☑ Checked—The system creates an archive file that includes the data collected before, after, and between batches in addition to the regular batch archive. In other words, archive files will be created from the time the instrument is started to the time it is stopped.

2. Save the general settings and proceed to "Developing a Method" on page 23.

Instrument Settings Tab Details

All ParticleTrack instrument settings are stored in the instrument as set at the factory and by the METTLER TOLEDO Field Service Engineer (FSE) during installation. Stored configuration information transfers directly to the Instrument Settings tab (Figure 3-7) from the connected instrument.
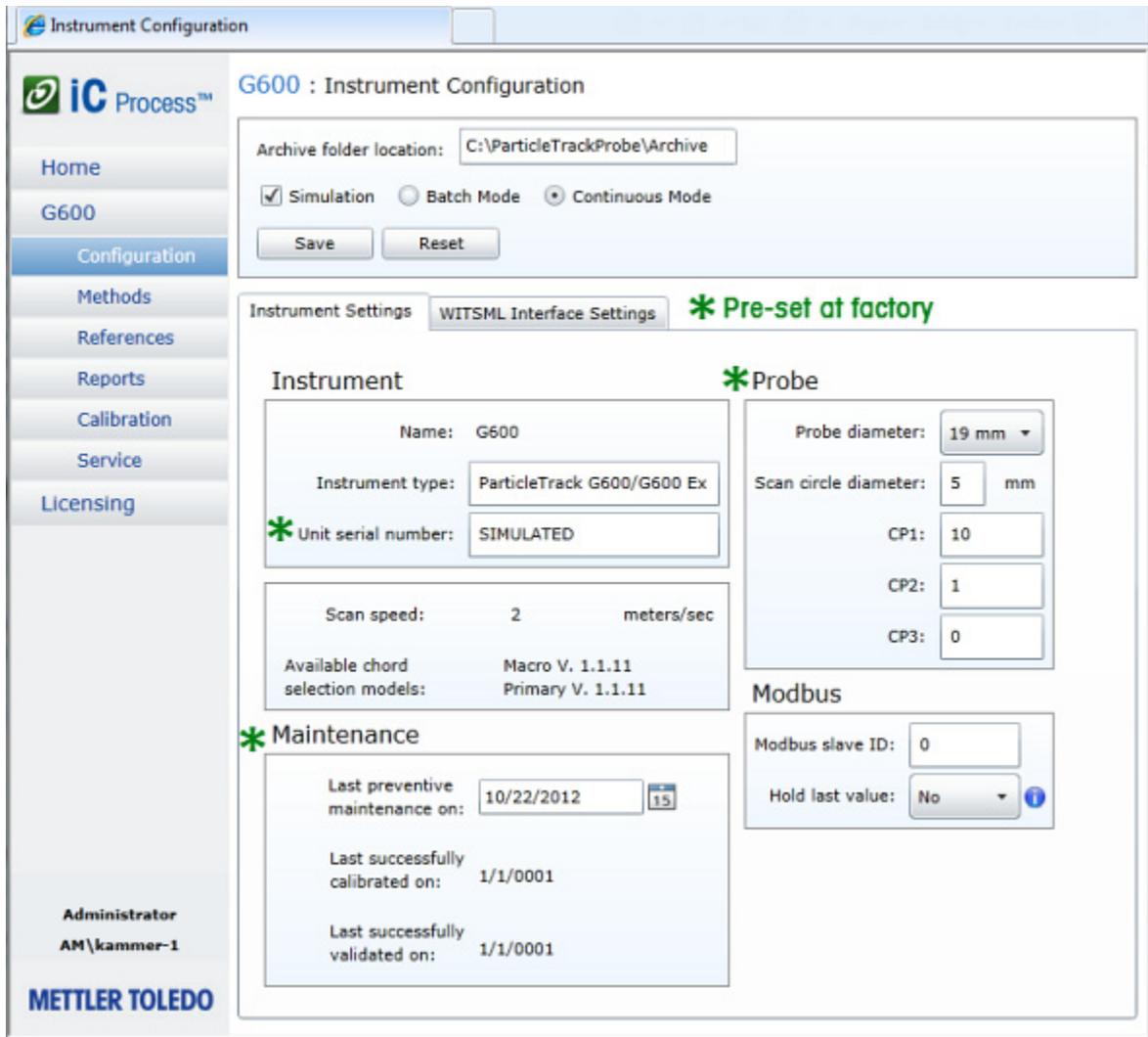
Figure 3-7 Configuration—Instrument Settings tab

Details about Each Setting

The upcoming section describes each field on the Instrument Settings tab. Separate tables correspond to the parts of the page—Instrument, Maintenance, Probe, and Modbus.

Instrument

Table 3-2 describes each field in the Instrument section of the Instrument Settings tab.

Table 3-2 Configuration Settings—Instrument

Field Name	Description
Name	The name created when an Administrator added the instrument to iC Process for FBRM cannot be changed. To change the name, you must delete the instrument and add it again with a new name.
Instrument Type	The type of instrument selected when the instrument was added to the software appears by default: **ParticleTrack G600** or **ParticleTrack E25**. The field can be edited, so you can add information such as the probe model for G600 instruments (P, R, T, X) or Ex for G600.

Table 3-2 Configuration Settings—Instrument (continued)

Field Name	Description
Scan Speed (m/sec)	Determines how many meters per second the instrument scans the particle system. Scan speed is instrument specific and the standard for each instrument appears by default. If optional scan speeds have been purchased, the instrument firmware will include the speed for the given instrument. Standard speed is bold in the following list: ParticleTrack G600—**2** or 4 ParticleTrack E25—**2**
Available Chord Selection Models	Displays the CSMs available for ParticleTrack instruments. The selection comes from the template selected for a given method (see "Selecting a Template" on page 24).

Probe

Table 3-3 Configuration Settings—Probe

Field Name	Description
Probe Diameter	Probe diameter is pre-set at the factory for all ParticleTrack instruments. ParticleTrack G600—19 or 25 mm ParticleTrack E25—25 mm
Scan Circle Diameter	Calibration tuning parameters set during system calibration procedure. Do not adjust these settings unless directed by a METTLER TOLEDO engineer.
CP1	
CP2	
CP3	

Maintenance

Table 3-4 Configuration Settings—Maintenance

Field Name	Description
Last preventive maintenance on:	By default, the date the instrument was tested at the factory appears in this field. A METTLER TOLEDO FSE resets the reminder after completing Preventive Maintenance service by entering a new date in this field and saving the configuration. The software displays a reminder message on the Home page with the date that the next Preventive Service is due.
Last successfully calibrated on:	This date resets each time the System Calibration process is performed.
Last successfully validated on:	This date resets each time the Calibration Validation procedure is performed on the instrument and the result is 'Pass.'

Maintenance reminders appear on the Home page (see "Example 3—Maintenance Reminders" on page 125).

Modbus

Table 3-5 Configuration Settings—Modbus

Field Name	Description
Modbus Slave ID	iC Process for FBRM can be a Modbus TCP/IP slave that communicates with your Distributed Control System (DCS) operating as a Modbus TCP/IP master. To activate communication via Modbus TCP/IP, change this to a unique number between 1–254 that identifies the specific instrument. The Modbus master will need the control server IP address and Slave ID to communicate with the FBRM instrument. Default (0) indicates no Modbus communication is configured. See Appendix A on page 107 for details.
Hold Last Value	Modbus input register values (trend values and diagnostic values) are typically updated at every measurement whenever the instrument is online and every five minutes when stopped. However, if the instrument is paused and the software has been configured to Hold Last Value, the software continues to return the last value before the instrument was paused.

After initial addition of an instrument and completion of the required Instrument Settings, the last implementation task is developing one or more methods for use during processing.

Developing a Method

Before the iC Process for FBRM can be used to collect particle or droplet system data, an Administrator must create and approve executable methods for the instrument. A method is essentially an SOP for the FBRM instrument that defines the instrument and measurement configuration to ensure consistent data collection, display, recording, and reporting. An operator simply executes the method when ready to monitor a batch or continuous process. If multiple methods exist, the operator selects the appropriate method based on the SOP.

Templates: Methods are easily created through the use of templates, which provide default settings for the measurement configuration. A template is a predefined or customized experiment file from iC FBRM that defines:

■ Data treatments, and

■ Statistical and diagnostic trends using,

■ A specific Chord Selection Model.

A template may also include:

■ Reference Distributions (a Target and multiple References), and

■ Y-axis range for trend graphs.

Default templates—iC Process for FBRM software includes default templates (refer to "Template Selection Tables" on page 25).

Custom templates—An advanced iC FBRM software user can develop iC FBRM experiments for use in iC Process web application method development. A custom template should be copied to the appropriate folder to be used in iC Process for FBRM (see Figure 3-12).

Creating a Method

1. Select **Methods** from the left navigation instrument submenu.

Figure 3-8   Methods selected from instrument submenu

2. In the "Create method from an experiment or template" section, click **Select Template**.
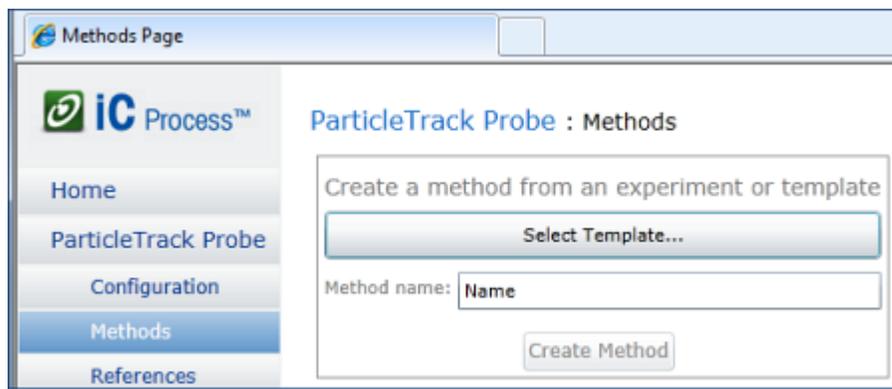
Figure 3-9   Methods main page—Select template

Selecting a Template

1. Select a template from those provided with iC Process for iC Process for FBRM. Depending on how iC Process for FBRM was installed, method template selection will be by one of the following procedures:

   • Click **Select Template** and choose one of the templates provided with iC Process for FBRM for the currently configured instrument. Refer to "Template Selection Tables" on page 25 for information on each template for a specified instrument.

   • If the **Select Template** drop-down list is empty, navigate to the Templates file installed with the iC Process for FBRM software. The folder location is:

     Windows 7 and 8: C:\ProgramData\METTLER TOLEDO\iC Process for FBRM\4.4\Templates

     a. Select the Experiment Templates subfolder.
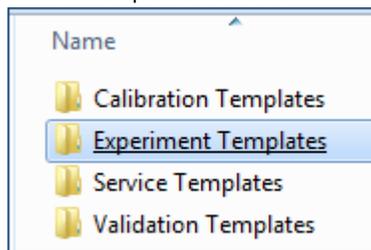
Figure 3-10   Experiment Templates subfolder

   b. Select the folder for the currently configured instrument.
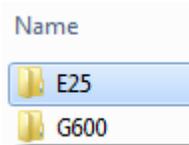
Figure 3-11   Instrument subfolder

c. Choose a template for the method. To decide on a template, refer to the "Template Selection Tables" section for the currently configured instrument.
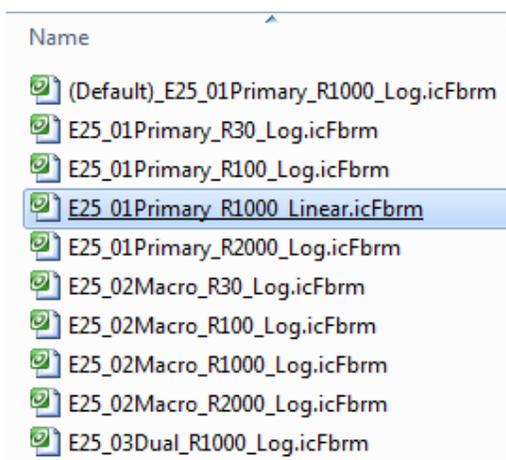
Figure 3-12 Experiment templates for a selected instrument

2. After choosing a template, continue to .

Template Selection Tables

Use the upcoming tables to select the best template for method development based on the type of ParticleTrack instrument, anticipated particle/droplet size, and the distribution CSM (including a dual option). In addition to the CSM, the distribution display has one of the following options:

- **Logarithmic**—This is the standard presentation of FBRM distribution data to optimize the display. Typical particle and droplet applications use this display.
- **Linear**—Only use this display for special applications, as directed by your METTLER TOLEDO Technology and Applications Consultant (TAC).

Template names are in the following format:

Instrument Model_CSM_Range_ChannelGroupingSpacing_ScanSpeed
(250 Hz Scan Speed only appears in G600, 4 meters per second template)

ParticleTrack G600 Templates for Method Development (2 m/sec)

Table 3-6 Provided Templates (ParticleTrack G600)

Template (*.icFbrm)	CSM	Measurement Range (microns)	Distribution Display
(Default)_G600_01Primary_R1000_Log	Primary	0–1000	Logarithmic
G600_01Primary_R30_Log		0–30	
G600_01Primary_R100_Log		0–100	
G600_01Primary_R1000_Linear		0–1000	Linear (special)
G600_01Primary_R2000_Log		0–2000	Logarithmic
G600_02Macro_R30_Log	Macro	0–30	
G600_02Macro_R100_Log		0–100	
G600_02Macro_R1000_Log		0–1000	
G600_02Macro_R2000_Log		0–2000	
G600_03Dual_R1000_Log	Both CSMs	0–1000	

ParticleTrack G600 Templates for Method Development (4 m/sec)

Table 3-7 Provided Templates (ParticleTrack G600—4 m/sec Scan Speed))

Template (*.icFbrm)	CSM	Measurement Range (microns)	Distribution Display
(Default)_G600_01Primary_R1000_Log_250Hz	Primary	0–1000	Logarithmic
G600_01Primary_R30_Log_250Hz		0–30	
G600_01Primary_R100_Log_250Hz		0–100	
G600_01Primary_R1000_Linear_250Hz		0–1000	Linear (special)
G600_01Primary_R2000_Log_250Hz		0–2000	Logarithmic
G600_02Macro_R30_Log_250Hz	Macro	0–30	Logarithmic
G600_02Macro_R100_Log_250Hz		0–100	
G600_02Macro_R1000_Log_250Hz		0–1000	
G600_02Macro_R2000_Log_250Hz		0–2000	
G600_03Dual_R1000_Log_250Hz	Both CSMs	0–1000	

ParticleTrack E25 Templates for Method Development

Table 3-8 Provided Templates (ParticleTrack E25)

Template Name (*.icFbrm)	CSM	Measurement Range (microns)	Distribution Display
(Default)_E25_01Primary_R1000_Log	Primary	0–1000	Logarithmic
E25_01Primary_R30_Log		0–30	
E25_01Primary_R100_Log		0–100	
E25_01Primary_R1000_Linear		0–1000	Linear (special)
E25_01Primary_R2000_Log		0–2000	Logarithmic
E25_02Macro_R30_Log	Macro	0–30	Logarithmic
E25_02Macro_R100_Log		0–100	
E25_02Macro_R1000_Log		0–1000	
E25_02Macro_R2000_Log		0–2000	
E25_03Dual_R1000_Log	Both CSMs	0–1000	

3. In the **Method name** box, modify the default name, if desired. Provide a unique name that identifies the method.
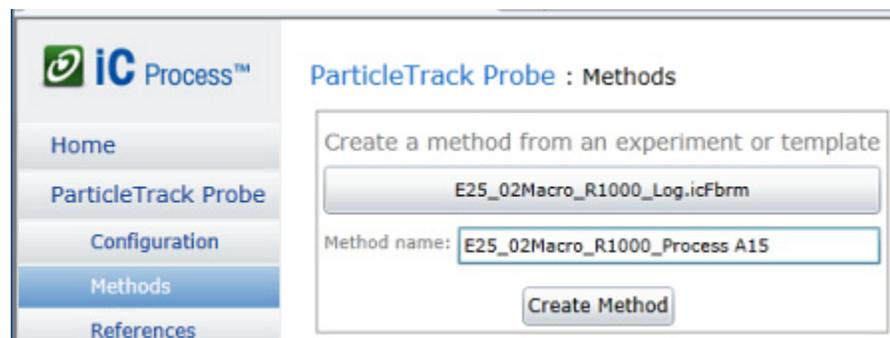

Figure 3-13 Methods main page—Template selected and renamed

4. Click **Create Method**.

The Overview tab for the newly created method appears and the method is added to the main Methods list (Figure 3-14).

Figure 3-14 Methods list—Main page

The list identifies which methods are approved along with the date/time and login name of the person who last approved a method.

The Method Name and the **Edit** button are links to the Method details page (described under *"Viewing and Editing Method Settings" on page 28*)

5. At this point, you can click **Approve** to make the method available for continuous or batch process runs.

Method Compatibility

1. Verify compatibility between the selected template and the instrument configuration settings. A check mark in the Compatible column indicates that the key details from the template agree with the Instrument Configuration settings.

- If a check mark appears, Chord Selection Model requirements are verified (read note below).
- If a check mark does not appear, verify the template selection and choose a compatible template.

2. Review the method details and complete the necessary settings for trend alarm high and low limits, optional external outputs (such as to a Modbus DCS, OPC UA, or WITSML trend curves.). Instructions begin in the next section.

Compatibility is required between the Method and the instrument Configuration. If compatibility does not exist, a message appears on the Method configuration page. A red system notification message appears in certain conditions, however, these conditions do not make the template and method incompatible. Instead, overrides occur, as follows:

Note: **Template contains multiple Chord Selection Models**—System notifies you that the method will only use the CSM selected for display in the template.

IMPORTANT!—If a template is tagged as incompatible with the instrument configuration, it can still be saved, but not run. Only approved and compatible methods appear to the Operator for use in a batch or continuous process.

Viewing and Editing Method Settings

When a new method is added, the method page (Overview tab) appears automatically for viewing and editing method options. The new method also appears in the list on the main Methods page (Figure 3-14). Choose a method from the list to view or edit details.

Notes:
- Methods remain unapproved until an Administrator releases them for use by an Operator.
- Settings cannot be modified for Approved methods. The user must unapprove a method to make changes. See page 35.
- Method deletion steps are on page 36.

1.   From the Methods list on the main Methods page (Figure 3-13), click the name of the one to view or edit.

The Overview tab displays information about the method template. Additional method development details are separated into six tabs of information shown below.
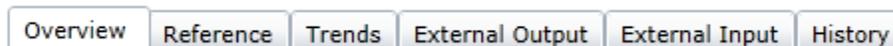
Figure 3-15   View/edit tabs for a selected method

General Settings and Actions for a Method

The top section of the page for a selected method includes general settings and three action buttons—**Approve/Unapprove**, **Report**, **Save Changes**. The general settings come from the template, but can be modified during method development.
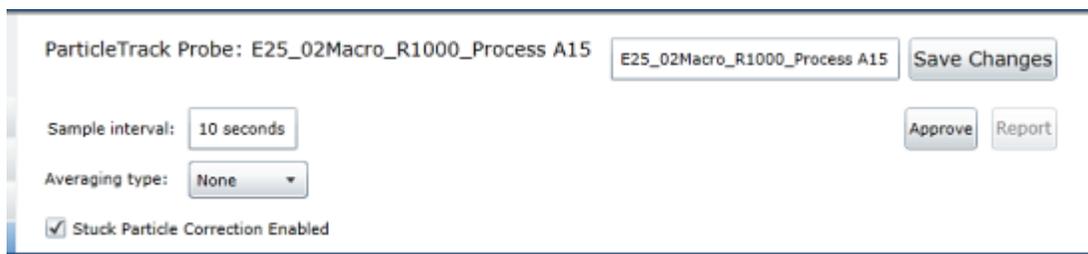
Figure 3-16   Method development—General settings

General settings are defined below and discussed in detail under "Developing a Method".

2. *"Sample Interval" on page 37*—Accept the default from the iC FBRM template or adjust the interval for the method, depending on the particle or droplet system in production.

   The Sample Interval is the number of seconds, minutes, or hours between each FBRM measurement. The interval from the iC FBRM experiment template appears by default.

3. *"Averaging Type" on page 38*—Accept the default from the template or select the Averaging option that best meets the requirements for the particle or droplet system in production. Averaging is a statistical data treatment that should be used with caution.

4. *"Stuck Particle Correction" on page 40*—Accept the default from the template or disable the mathematical correction.

Overview Tab

The Overview tab (Figure 3-17) lists the settings from the imported template, as they were defined in iC FBRM—For example: Statistics and Chord Selection Models (CSMs).

Figure 3-17   Methods—Overview tab

1. Review the summary of the method definitions on the Overview tab.

The summary is for information only—no edits can be made from this tab. Data Treatments, Statistics, Reference and Target Distributions can be defined in the iC FBRM temp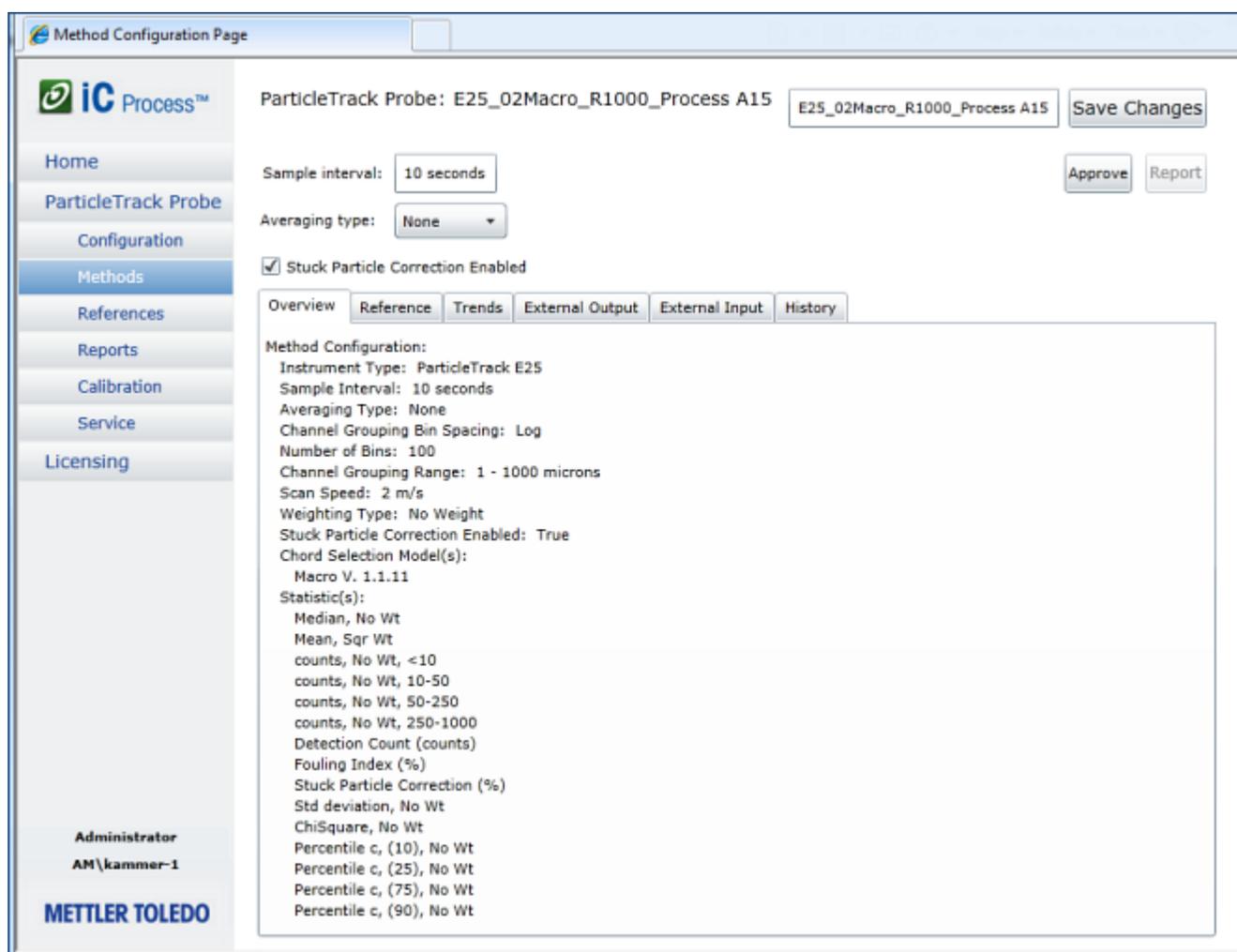late experiment used to create the method. Method configuration also comes from the template, but some editing can be done in the method's general settings (described starting on page 28)

2. Accept the default Sample interval, Averaging type, and Stuck Particle Correction settings, or edit using the information in "More About Method Parameters and Settings" on page 36.

3. Click **Save Changes** and proceed to the Trends tab.

Reference Tab

Use the Reference tab to select the Target Distribution that represents a set point.

Other distributions are representative particle or droplet distributions from historical data for the method and particle/droplet system.

When an Operator selects a method that includes Target and/or Reference distributions, these will appear on the Distributions tab during continuous or batch processing.

Note:	Reference distributions can also come from real-time captures during processing when a user clicks **Save As Reference** on the Distributions tab. Distributions appropriate for the method appear in the selection list.

If the template imported for the method includes reference and target distributions, they will appear in the selection drop-down lists (Figure 3-18). Otherwise, the selections are blank until references are saved during real-time processing.
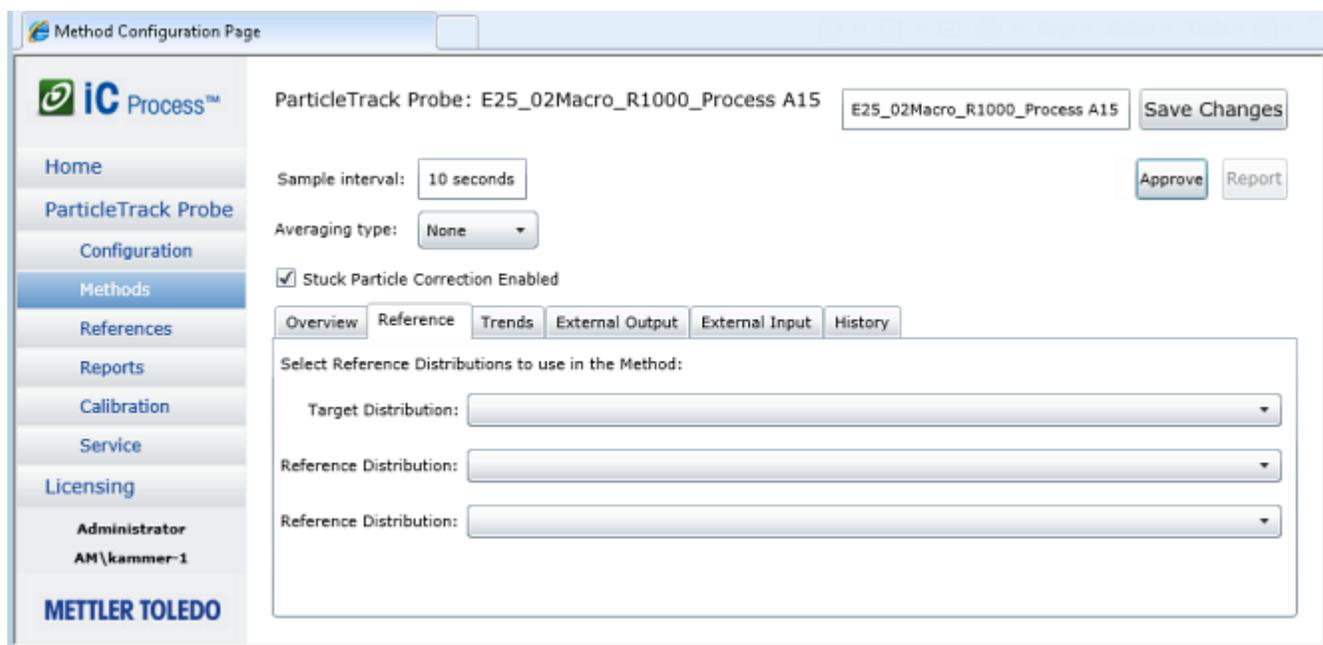

Figure 3-18 Methods—Reference tab

1. Accept the Target Distribution and Reference Distribution(s) that came in with the template, if applicable. If the template did not include a specified target, a user-defined custom template can be created in iC FBRM and imported for a new method.

2. To select a Target and a Reference Distribution from those collected during real-time processing, click the down-arrow next to the type of distribution and choose the one to display to the operator during processing.

3. To select a second Reference Distribution, click the down-arrow in the second Reference Distributions selection list and choose the distribution to display to the operator during processing.

4. Click **Save Changes** or proceed to view/edit the method information and settings on one of the tabs, described in the upcoming sections.

Trends Tab

An iC Process for FBRM method includes a list of statistical trends. This list is derived from the statistics defined in the iC FBRM template that was imported for the method. For each trend listed, you can specify the low and high alarm limits that display during processing. The Trends tab also enables limits to the Y-axis scale on the trend graph.

Figure 3-19 Methods—Trends tab

Use the following steps to establish or edit alarm limits or the y-axis range for each trend in the method:

1. For an unapproved method, select the Trends tab. If necessary, click **Unapprove** to enable changes to the trend settings.

2. Establish alarm limits for one or more trends, as needed.

   Low Alarm—Enter the lowest acceptable value for a trend, in the units shown.

   High Alarm—Enter the highest acceptable value for the trend.

   Dashed horizontal lines display at these limits on the Trends tab during processing. Dashed line color matches the legend color of the selected statistic. By viewing the trend graph or the Large Value display, an Operator can observe that trends representing the particle or droplet system are within limits.
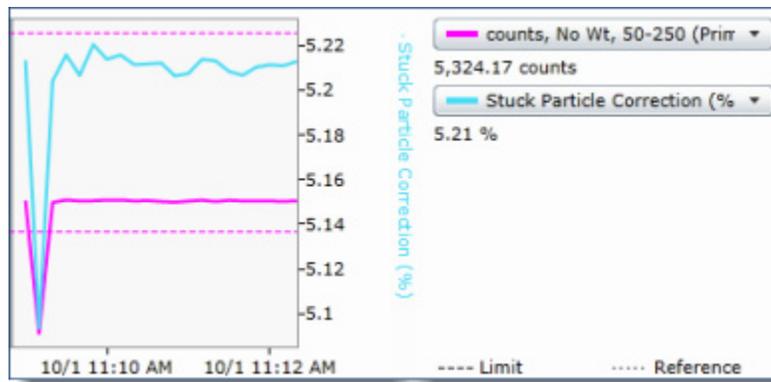
Figure 3-20 Dashed line for Limit

Note:	If a trend falls outside the limits for five consecutive samples, an alarm condition occurs. A red alarm message displays in an alarm panel to the left of the main display. The instrument name also changes to red at the top of the main display area and the trend box changes to red on the Large Values tab. If the alarm condition corrects itself for five consecutive samples, the alarm message stops displaying.

3. Accept the default settings, or change the Y-Axis settings.

   By default, the system automatically scales the trend graph to the data. However, the system will use the y-axis limits defined in the method if they are enabled. If y-axis limits are specified in a template for a trend, the system will use these limits as the default settings in the method.

Note:	Templates provided with the system do not include y-axis limits.

4. Click **Save Changes**, or if you are ready to approve the method for use by Operators, click **Approve** and the changes will be automatically saved.

External Output Tab

Use this tab to assign iC Process for FBRM trends to an external source. Modbus registers or OPC UA variables can be mapped to trends. If WITSML was set up in instrument configuration (see Appendix C), a WITSML column also appears on the External Output tab.

The Trend Mapping drop-down list shows the trends statistics from the Trends tab (see page 31). Trends can include values for key particle system components as well as the high and low limit for that value.

Figure 3-21   Methods—External Output tab

Use the following steps to establish or edit trend mapping for your external source:

1. For an unapproved method, select the External Output tab. If necessary, click **Unapprove** to enable changes to the output settings.

2. In the Trend Mapping column, click in the field and select the trend to be mapped as ProcessVariable1 (ProcessVariable1 is featured in Figure 3-21).

   • For Modbus, the Modbus Registers column shows the corresponding registers for the trend.

   • For OPC UA, the trend name is in the OPC address space in the "ProcessVariable#. Name" address and the value is in the "ProcessVariable#" address. When you map an OPC variable to a trend, the name and value become external output to the OPC UA server.

   • If WITSML is set up, a WITSML Curve column lists the curve names predefined in the WITSML server for the given well and wellbore (refer to Appendix C).

3. Click **Save Changes**.

   Figure 3-22 shows the External Output tab after several process variables have been mapped to Modbus registers and OPC Variables.

Figure 3-22 External Output after mapping (Modbus Registers)

Appendix A, "Modbus DCS with iC Process for FBRM", Appendix B, "OPC UA Server with iC Process for FBRM", and Appendix C, "WITSML with iC Process for FBRM" provide details about the external output options.

4. Click **Approve** to make this an official method that Operators can select to start a process run.

External Input Tab

This tab is for future use.

Figure 3-23   Methods—External Input tab

History Tab

The History tab displays a complete audit log of the changes to a specific method. There are no user settings on this page, but you can view and print a report of the audit log showing method revisions.
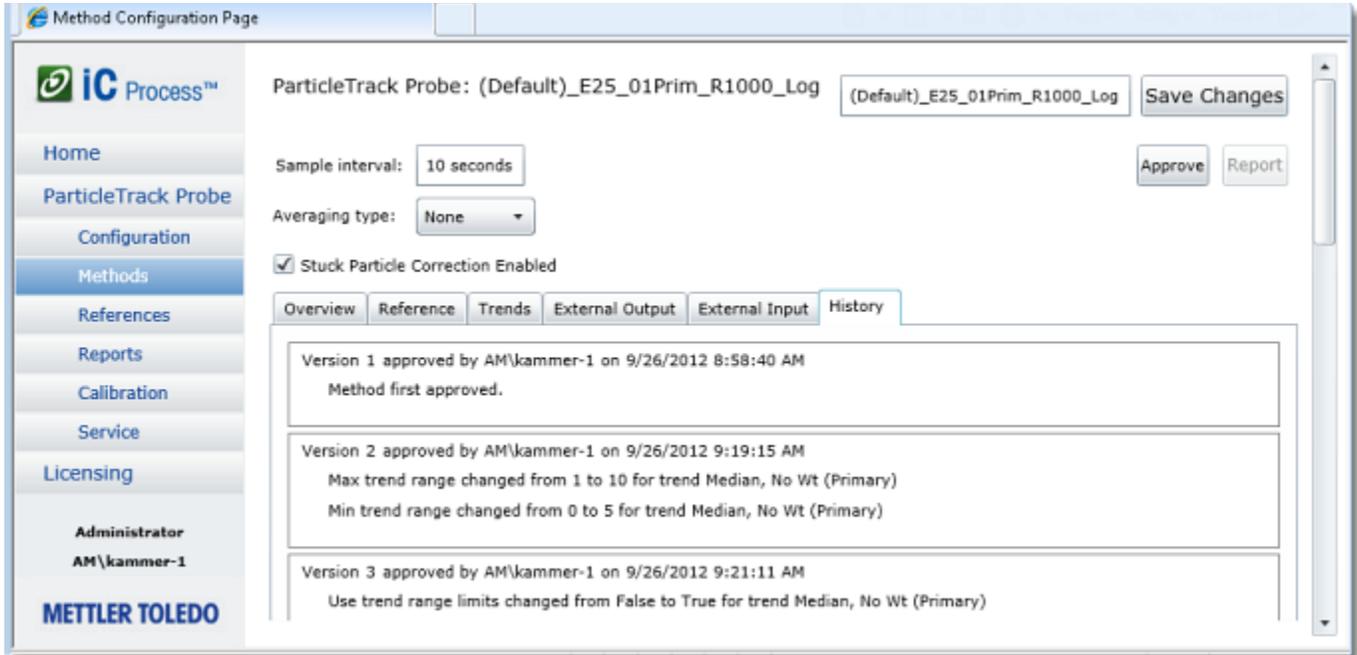
Figure 3-24 Methods—History tab

Approving a Method

Approved and compatible methods appear in the drop-down list that Operators select from when they are ready to start a batch or continuous process.
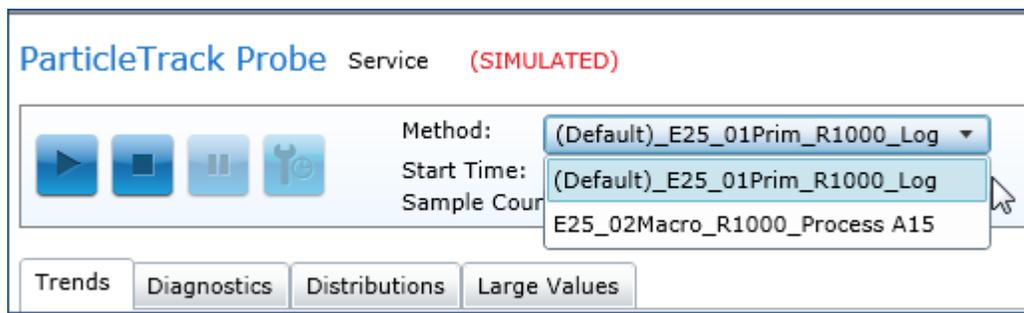
Figure 3-25 Method selection on main instrument page

An Administrator can approve a method from the main Methods page or from the edit/view page of a selected method, as follows:

1. Select **Methods** from the left navigation submenu for a specific instrument.

2. Locate the unapproved method from the main Methods page and follow one of the steps below:
   • Click **Approve** next to the method name.

- Select an unapproved method from the list to view/edit the definition.
  If you selected a method to view/edit, review the settings (see "Viewing and Editing Method Settings") and click **Approve** in the top section of the view/edit page.

Deleting a Method

Only unapproved methods can be deleted. The buttons toggle between approve and unapprove.

1. Locate the method to be deleted from the main Methods list (Figure 3-26).

2. Make sure the method is not currently available for use. If necessary, click the **Unapprove** button to change the status to unapproved.

Figure 3-26   Methods main page—Delete a selected method

3. Click **Delete** for the selected method.

Generating a Method Report

From the Methods page (Figure 3-26), select an approved method to be reported and click **Report**. The report describes the sampling interval, alarm limits, a summary of the Data Treatments, External Outputs, and method configuration, plus the method approval history.

More About Method Parameters and Settings

After template selection, a method can be immediately approved and used in a batch or continuous process. However there are many common parameters and settings in methods that an Administrator can adjust according to the particle or droplet system or process. This section provides facts about methods along with details about common parameters and settings.

Template Contents

The following information from a template becomes part of the method. This information represents potential processing steps to convert the particle and droplet system data into valuable information for tracking particle initiation, nucleation, and end point.

Data Treatments—Averaging parameters *, Channel Grouping: Number of bins, Resolution, Range of microns, Linear or Logarithmic spacing of bins, Enable Stuck Particle Correction)

User-specified statistical trends—These statistics are available on the Trends tab.

Reference Distributions—Distributions pinned in iC FBRM software and saved as references, plus the type of weighting for the distributions.

Target distribution—The software uses the distribution identified as the target to calculate the %Deviation statistic.

Managing Distributions—An Administrator manages the reference distributions collected during real-time processing and calibration/validation testing on the Configuration > Reference Distributions tab (see "Managing References" on page 79).

Y-Axis settings—The y-axis scale can be set in an iC FBRM experiment that is used as a method template. If a user-customized template with y-axis settings is used for a method, the y-axis settings will become the default in the Method's Trends tab, as described below.

Y Axis Min—Y-axis starting range for the trend data 'Use y-axis limits' is enabled.
Y Axis Max—Y-axis maximum range for the trend data when 'Use y-axis limits' is enabled.
Use Y Axis Limits—If checked, the system will apply the y-axis limits defined for the specific trend. If y-axis limits were defined in the template for a specific trend, the default value will be checked. Otherwise, the default value is unchecked.
Autoscaling—If y-axis limits are defined for a trend, and the trend's values extend outside the bounds of the limits, the system automatically scales the limits to include the values.

Refer to the Trends tab on page 31.

Instrument settings including scan speed and Chord Selection Model (CSM).

Tracking Method Changes

Method changes are tracked—iC Process for FBRM software retains an audit log of all changes to a method on the History tab (page 35).

Note:	* Averaging (smoothing) Data Treatment can be adjusted as part of method definition (see "Averaging Type" on page 38).
	** Reference distributions can also be identified during particle system processing (see "Saving Reference Distribution" on page 53).

Common Method Parameters

Refer to Figure E-1 on page 131 for an illustration of the type of parameters that are included in templates, along with the settings that can be adjusted in iC Process for FBRM method development. Below are the common parameters in method development and how they impact the particle system measurements during an experiment batch or production run.

"Sample Interval" on page 37

"Averaging Type" on page 38

"Stuck Particle Correction" on page 40

Sample Interval

The sample interval determines how often the system takes a measurement during a continuous or bath process run. A sample interval is defined within the selected template and

can be edited from any method development tab. During method development, an Administrator can use the default sample interval provided by the selected template, or change the interval in the 'Sample interval' text box of an unapproved method.
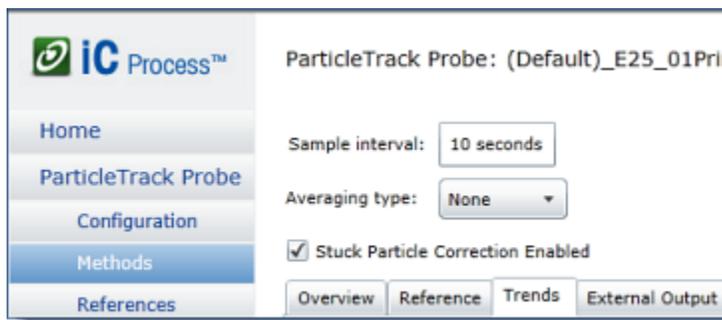

Figure 3-27 Method settings

Note that the instrument is continually measuring chord lengths from the particle system and tabulating them into a histogram recording the number of chord lengths measured within each channel. The sample interval simply determines how often the tabulated results are reported. A longer sample interval will permit collection of a larger sample size of particle chord lengths, and will therefore result in greater statistical stability.

Note:	Recommended minimum interval is 10 seconds. Refer to Table 3-1 on page 18 for examples of how sampling interval affects archive file size.

In general, selecting an optimal sample interval should be based on consideration of three factors: process dynamics, measurement stability, and duration of the batch or continuous run. In many situations these factors will conflict, and the user must optimize based on their requirements. In most cases, process dynamics will have highest priority.

Table 3-9 Sample Interval Considerations

Factors to Consider	Shorter Sample Interval	Longer Sample Interval
Process dynamics—Sample interval should be small to ensure the true process dynamics are measured, and signal aliasing is avoided.	■ Captures more data points in a given time period ■ Better for unstable samples or processes with fast dynamics	■ Captures fewer data points in a given time period ■ Better for stable samples or processes with slow dynamics
Impact on measurement stability—A longer sample interval will record more chord lengths per reported measurement, resulting in greater statistical precision and less measurement-to-measurement variability	■ Fewer particles analyzed per measurement ■ Measurements in low concentration systems may show significant measurement to measurement variability	■ More particles analyzed per measurement ■ Improve measurement stability by increasing the sample interval (and increasing the statistical sample size) ■ Too long a measurement duration may mask process dynamics
Duration of run—Long run duration, combined with a fast sample interval, will result in very large data files that can be cumbersome during data review and analysis.	■ More data points recorded in a given time period will increase the size of associated data files, and will require more processing power/time during analysis	■ Fewer data points recorded in a given time period will reduce the size of associated data files, allowing more efficient review and analysis

Averaging Type

Averaging, also referred to as a 'smoothing method,' is a statistical method to smooth out fluctuations from the measurement data—for both trends and distributions.

The averaging functions improve the statistical robustness of the real-time measurement by averaging the raw signal acquired from the hardware. Note that there is a trade-off between measurement precision and sensitivity to change. While averaging improves measurement precision, it also dampens the dynamic response of the measurement to real-time changes in the trended statistics. Caution should be used to avoid over use of averaging, which can impact measurement sensitivity and reduce the ability to detect change over time.

Each template provides a default setting for Averaging; however the default setting can be optimized and overwritten by an administrator during method development. There are three Averaging types available during method development.
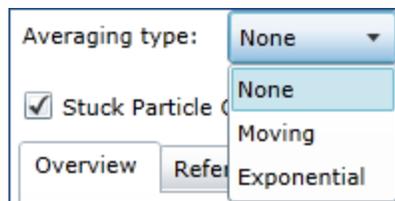
Figure 3-28 Averaging options

- **None**—Displays real time measurement, with no averaging function applied.
- **Moving**—Uses a cumulative moving average calculation based on a user-defined number of unweighted data points in the experiment. The moving average window size is an integer that defines the number of consecutive measurements from 2 to 60 that are averaged to provide the real-time data. For example, a moving average window size of 5 will display a distribution and calculated statistical trends that are the arithmetic average of the most recent raw signals for measurement and the previous four measurements. A higher moving average window size yields a smoother trend.
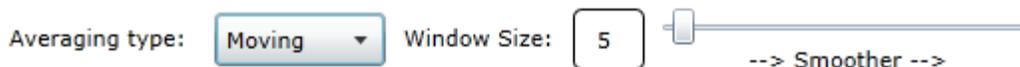
The Moving calculation is as follows:

$$V_t = \frac{1}{n} \sum_{i=0}^{n-1} X_{t-i}$$

where V_t = the calculated moving average at time **t**

n = the user-defined number of unweighted data points

X_{t-i} = the measurement data point at time **t – i**

- **Exponential**—Uses an exponential (low-pass) filter to improve measurement precision. The calculation is based on all of the past data points in the experiment and it applies weighting to all of the data points used in the calculation. The weight of a given data point used in the calculation decreases exponentially with time.

Alpha is set to a value between one (no averaging) and zero (maximum smoothing). The value of alpha (α) determines the ratio of weighting applied to the most recent raw signal for measurement, while the remainder of the weighting (1 - α) is applied to the previous measurement. A lower alpha yields a smoother trend. .

The Exponential calculation is as follows:

$$V_t = \alpha X_t + (1 - \alpha)V_{t-1}$$

where V_t = *the calculated moving average at time* **t**

V_{t-1} = *the calculated exponential average at time* **t – 1**

X_t = *the measurement data point at time* **t**

a = *the weighting coefficient.*

Stuck Particle Correction

Stuck particle correction is an advanced feature of FBRM technology to ensure that a small amount of window fouling does not affect the integrity of the data. Advanced signal processing identifies and removes the repeated chords of a particle that is stuck in the same position within the FBRM scan circle. This avoids oversampling of stuck particles and improves measurement reliability and sensitivity.

By default, stuck particle correction is enabled in all templates. During method development, click to remove the check mark if the particle or droplet systems for the given method do not require the stuck particle correction calculation.

Additional Tabs on Main Instrument Page

When any authorized user selects an instrument from the iC Process for FBRM Home page, the main display for that instrument is the Trends tab. The main display has four tabs for an Administrator or Technician and three tabs for an Operator. The Diagnostics tab only displays to Administrators and Technicians.

Trends	Diagnostics	Distributions	Large Values

If you are an Operator, refer to "Viewing Options on the Main Page" starting on page 46.

If you are an Administrator or Technician, the same four tabs appear when the instrument is online or when it is in service mode. Refer to the information in the following sections based on whether you are considering online results or service mode results:

■ Online Trends, Diagnostics, Distributions and Large Values—Refer to page 46 from the perspective of the instrument running a batch or continuous process.

■ Service mode Trends, Diagnostics, Distributions, and Large Values—Refer to "Running Service Tests" on page 89 for details from the service perspective. The Diagnostics tab is described "Diagnostics Tab" on page 91.

Note: The Diagnostics tab that appears on an instrument main page reports diagnostic values while the instrument is running a process. Diagnostics in the service mode reflect values from running instrument service tests.

4

Operating iC Process for FBRM

iC Process for FBRM software enables direct control and monitoring of the ParticleTrack G600 or ParticleTrack E25 instrument. This chapter provides comprehensive instructions for an Operator on how to use the iC Process for FBRM to monitor continuous or batch particle or droplet processes in production. Before an Operator can start a run, an Administrator or Technician must have completed the initial implementation described in Chapter 3.

Notes:	■ This chapter is primarily intended for users with the Operator role. Administrators can also perform the actions in this chapter.
	■ For details about permissions for each role, refer to Chapter 2, "Getting Started" on page 9.
	■ For an introduction to the user interface, refer to page 12.
	■ Refer to the "QuickRef: For Operators of iC Process for FBRM" in the documentation portfolio.

Launching iC Process for FBRM

Access the iC Process software on the control computer by one of the following procedures:

Desktop icon—If the client and iC Process for FBRM server are on the same PC, double-click the desktop icon on the control computer desktop.

Internet Explorer—If the client is on a remote PC, access iC Process for FBRM, as follows:

1. Open the Internet Explorer browser.

2. In the address bar, enter the web application URL provided by your IT department. The URL entry is case sensitive. It will be in the following format:

   http://<computer name>/

   Replace **<computer name>** with the name of the control computer where iC Process for FBRM is installed.

Logging In (if applicable)

A login may be required based on how iC Process was installed and on how your IT department implemented user authentication. If a login prompt appears, enter your network login ID and password.

A Sample Workflow

Controlled by your Standard Operating Procedure (SOP), the workflow for an iC Process Operator would generally follow the sample below.
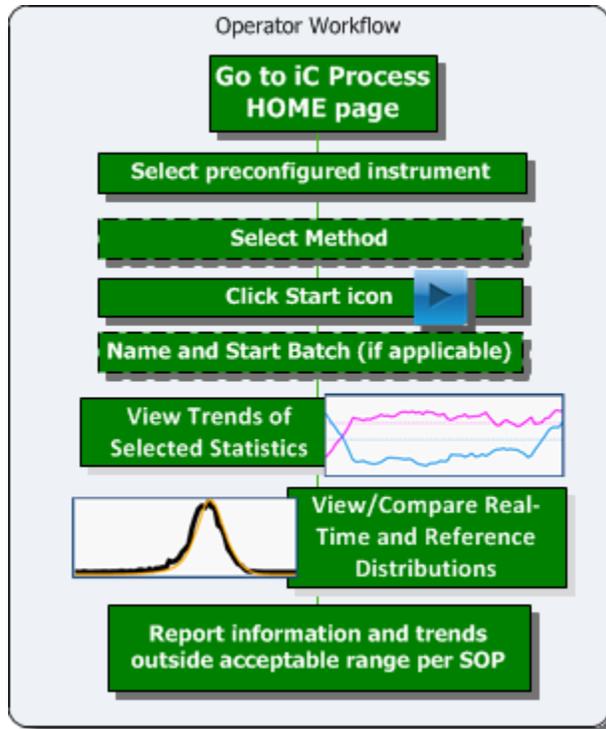
Figure 4-1   Sample of Operator workflow

Selecting Pre-Configured Instrument

The current instrument controlled by iC Process appears on the Home page (launch page of the iC Process Web application) along with the current instrument status. Figure 4-2 shows a sample Home page. The first software step to monitor your particle and droplet system is to select the instrument by one of two methods:

- Click the instrument name in the left navigation menu, or
- Click anywhere inside the instrument status box from the main display.
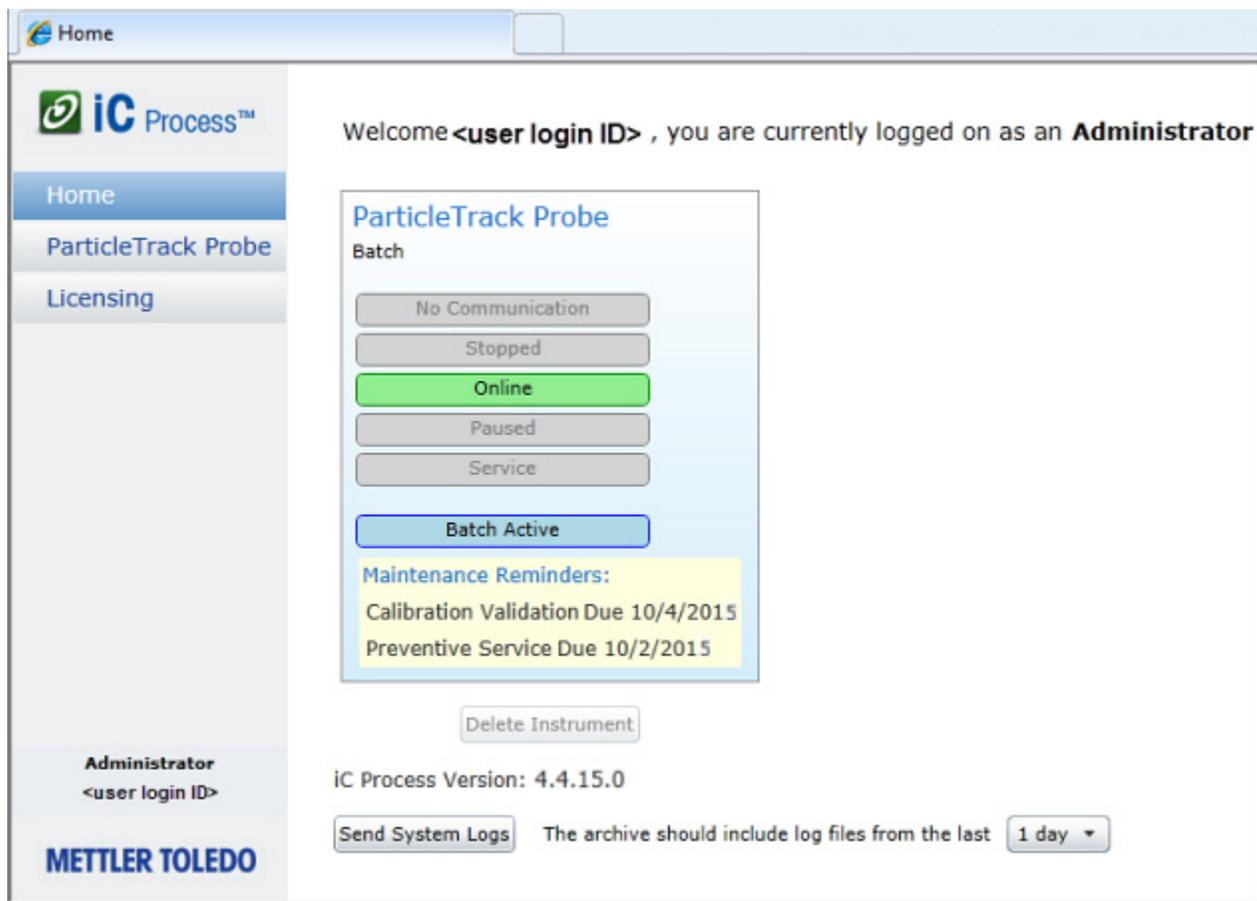
Figure 4-2   Home page example

Viewing Instrument Status on Home Page

The Home page indicates instrument status. Figure 4-2 shows an instrument that is online, meaning it is actively collecting measurements in batch mode.

Table 4-1   Instrument Status

Status	Description
No Communication	Instrument is not currently collecting data, or executing a run, or publishing data to the designated archive location or an external client such as Modbus, OPC UA, or to a WITSML server. When in this status: ■ Check that FBRM Server is running. ■ Check the power connection to the control computer. ■ Check the communications connection between the control computer and the instrument. IMPORTANT: If the software loses communication with the instrument, the system continually tries to reestablish the connection. If a run is in progress when communication is lost, the system attempts to continue executing the current method and run after communication is reestablished.
Stopped	Instrument communication is established, but instrument is not in service mode and there is no method running.

Table 4-1 Instrument Status (continued)

Status	Description
Online	Instrument is actively collecting data and publishing data to an external client such as Modbus or OPC UA, or a WITSML server. This is the active state for Continuous processing **Batch Active**—The system is in batch mode and running.
Paused	Operator has paused the process. The system is collecting data and executing a run, but not publishing data to an external client such as Modbus or OPC UA, or to a WITSML server.
Service	Technician has put the instrument in service mode to collect data for tests. When in service mode, the instrument does not publish data to an external client such as Modbus or OPC UA, or to a WITSML server.

Viewing Preventive Maintenance Reminders

The Home page also shows regular preventive maintenance reminders (Figure 4-2) that prompt you to validate instrument calibration or schedule a preventive maintenance visit. When a reminder appears, contact your Administrator according to your SOP. More information about maintenance reminders is under "Example 3—Maintenance Reminders" on page 125.

Selecting a Method

After selecting the FBRM instrument, select a method applicable to the particle or droplet system in production. This action activates the buttons to the left that enable you to manage a run. Only compatible methods approved by an Administrator appear in the selection list.
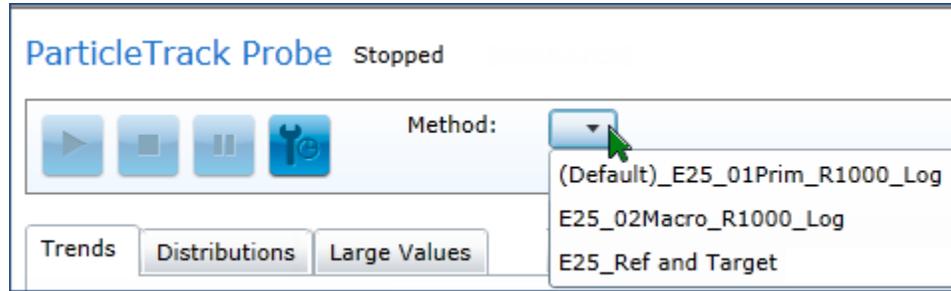
Figure 4-3 Method selection drop-down list

1. On the main instrument page, click the Method drop-down button (Figure 4-3).

2. Select the method to use for the batch or continuous run.

   Follow your SOP or check with the Administrator about the method appropriate for the particle or droplet system to be processed.

   The Start/Resume action button changes to enabled (see Figure 4-4).

Managing a Run

After selecting a method, the next step is to start a run to monitor a particle or droplet system. This action places the instrument online. Data collection, publishing, and archiving begin.

There are two types of runs that you can start in iC Process—continuous or batch.

- In Continuous run mode, the system continually collects distribution measurements based on the selected method.

- In Batch run mode, the system operates in the same manner as a continuous run mode, but data is marked by a batch name, start command, and a stop command from an Operator or external system.

Starting a Continuous Run

1. Click the Start icon from the toolbar.

Figure 4-4 Start icon

2. The instrument begins measuring the particle or droplet system in continuous mode.

Method: (Default)_E25_01Prim_R1000_Log version 2
Start Time: 10/2/2012 3:51:04 PM
Sample Count: 0   Scanning:
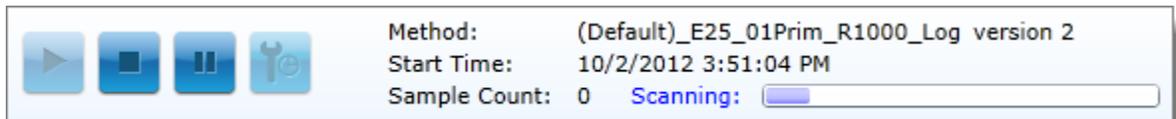
Figure 4-5 Run (in progress)

Starting a Batch Run

If batch runs are desired for the process, an Administrator configures the instrument to batch mode so the batch options (Start/Stop buttons, Name field) appear on the right side of the toolbar (Figure 4-6) after processing is started.

1. Click the Start icon (Figure 4-4) from the main toolbar. This places the instrument in a continuous run mode, with an option to start a batch at any time.

2. If your SOP calls for specific batch names, enter the name first, and then click Batch **Start**. Otherwise, click the Batch **Start** button and leave the Name blank to begin batch with a system-generated name.

Method: (Default)_E25_01Prim_R1000_Log version 2   Batch: Start Stop
Sample Count: 5   Scanning: Name:
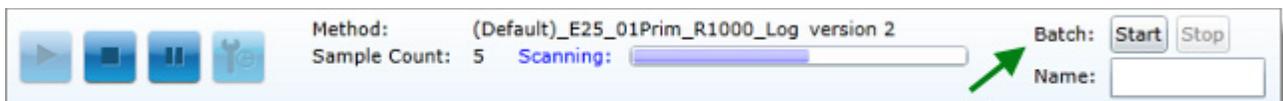
Figure 4-6 Naming and starting a batch run

After a batch starts, the heading bar changes to green and the batch is now actively scanning and collecting data. The instrument is in the "Batch ACTIVE" status.

Method: (Default)_E25_01Prim_R1000_Log version 2   Batch: ACTIVE Start Stop
Start Time: 10/2/2012 4:06:46 PM   Name: Batch A
Sample Count: 2   Scanning:

Figure 4-7 Batch ACTIVE

Pausing a Run

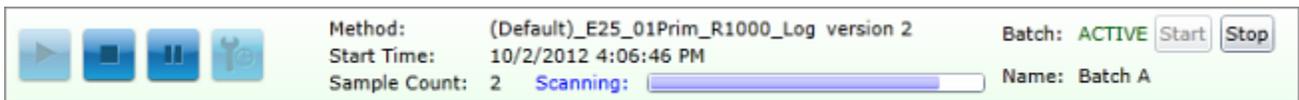When you pause a run (see Pause icon in Figure 4-8), the instrument continues to collect measurements without publishing it to external Modbus, OPC UA, or WITSML clients. To see how a paused run appears in the Trend tab display, refer to "Background Color Indicates Instrument State" on page 51.

Method: (Default)_E25_01Prim_R1000_Log version 2
Start Time: 10/2/2012 4:14:16 PM
Sample Count: 2   Scanning:

Figure 4-8   Pausing a run

Stopping a Run

To stop a batch or continuous run, click the Stop icon in the toolbar:

Method: (Default)_E25_01Prim_R1000_Log version 2
Start Time: 10/2/2012 4:14:16 PM
Sample Count: 24   Scanning:

Figure 4-9   Stopping a run

Viewing Options on the Main Page

After instrument selection, the Trends tab appears by default. When a particle system process is running, select among the other tabs on the main page—Distributions or Large Values—as needed.

Trends | Distributions | Large Values

Figure 4-10 Main display tabs for Operators

If a user with the Administrator or Technician role views the main instrument page, an additional tab for Diagnostics appears.

Viewing Trends

The Trends tab appears as the main iC Process window after you select the instrument. When the instrument is online, trend values from the real-time data acquisition are plotted for each data point over time. The trends appear in three stacked graphs—each with two selected statistics defined in the method. A selection list enables you to change the currently selected trend statistics paired in each of the three stacked graphs.

To select from available trends, follow the steps below.

1. For an active run, allow several measurements to be taken.

2. On the Trends tab, click the statistic selection arrow to the right of a trend graph to see a list of available statistics.Each available statistical trend in the list shows the name of the CSM used to calculate the statistic in parentheses.

3. Select the statistical trend to display.

In some cases, you can view the statistic values based on the selected Chord Selection Model (CSM) used to calculate the distribution. The type of calculation appears in parentheses after the Trend name.

Trends with Alarm Limits

Figure 4-11 shows the stacked graphs from the Trends tab. The second graph includes horizontal, **dashed** lines that show the high and low limits for one of the statistics. The color of the line matches the color of the statistic for ease of reference.

Figure 4-11   Trends tab example

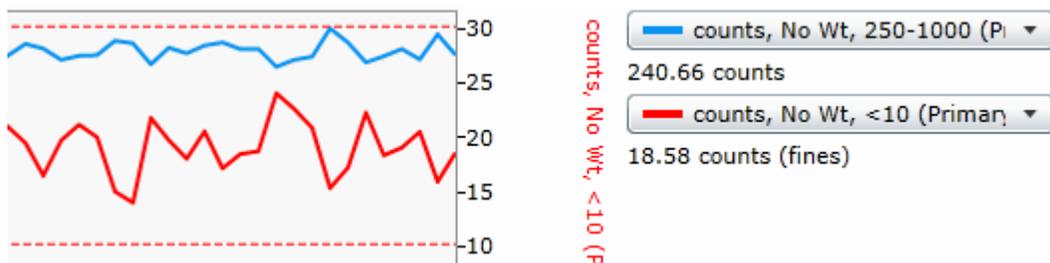Below is a close-up featuring the **dashed** line of alarm limits.

Figure 4-12   Close-up of Trends tab featuring graph with alarm limits (dashed lines)

Trends with Target References

A **dotted** horizontal line represents a statistical value calculated for the target distribution. The example in Figure 4-13 shows a **dotted** line in the same color as the statistic that indicates the Target Reference value.
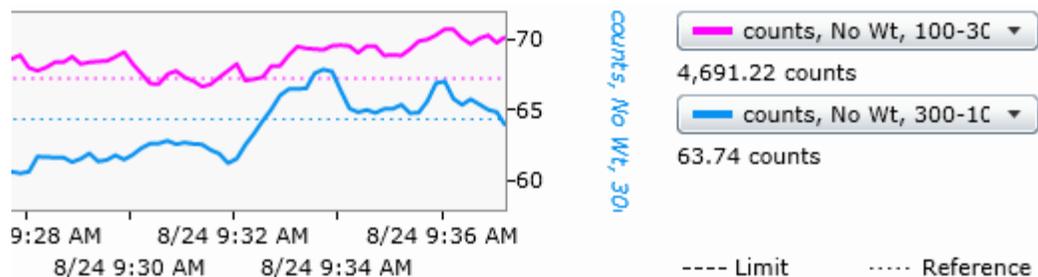

Figure 4-13 Trend tab featuring chart with Reference legend

Setting the Time Window

Two days are accessible in the Trends window. Use the scroll bar below the instrument main display to move the time window and look back at recent trends. You can use the Time Window options to change the period of time that appears in the Trends main display.

■ Select a shorter period of time to see a close-up view of the most recent trends.

■ Select a longer period of time to compress the trend view and see a broader time period.

1. Click the down arrow next to 'Window' to display the selection box

2. Select an option ranging from 15 minutes to 24 hours.

Figure 4-14 Time Window options

The main display changes to show the new time period and automatically scales the trend to show the selected range in the chart. For example, compare the trend view in a 15-minute window (top) to the 30-minute window (bottom) in Figure 4-15.

Figure 4-15 Time window comparison—15 minutes to 30 minutes

3. Use the scroll bar along the bottom of the main display to move back and forth within the two days of particle or droplet system data that appears in the view.

Viewing Details in Stacked Trend Graphs

Move the mouse cursor over any one of the trend graphs and the cursor changes to a vertical reader bar. Detailed data appears to the right of the bar. The data display is interactive and changes in all three stacked trends graphs as you move the cursor.

Figure 4-16 Reader bar in stacked trend view

The information includes details about the statistic, such as the counts or particle measurement in microns at a specific date and time.
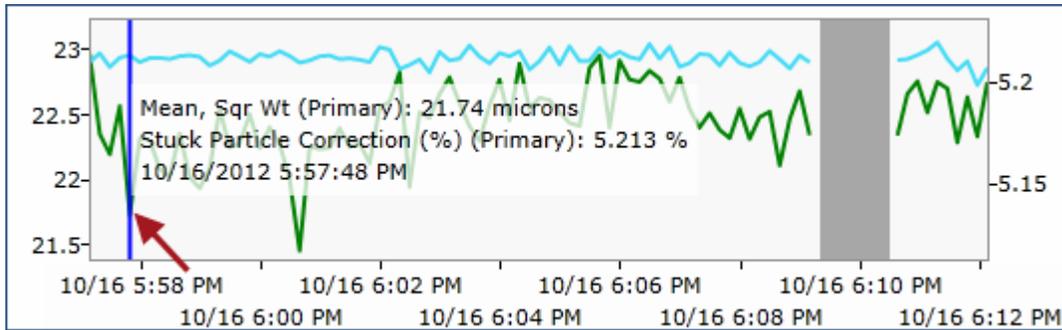

Figure 4-17 Reader bar in stacked trend graphs—Close-up

Viewing Alarm Conditions

The iC Process Web application displays alarm messages in red. For example, if the fouling index is included in the user-specified trend statistics and its trend values exceed the limit set in the method for five consecutive measurements, the name of the instrument changes to red and an alarm box appears to the left of the main display. Also, the corresponding box in the Large Values display changes from green to red.

Appendix D, "Alarms and Messages" starting on page 123 describes the types of messages that can appear along with sample displays.

Viewing Batch Start and Stop Markers

If running a batch process, vertical lines indicate when the batch started and stopped (Figure 4-18).

- Batch started (vertical green dashed line)
- Batch ended (vertical red dashed line)

Figure 4-18 Batch start/stop indicators on trend chart
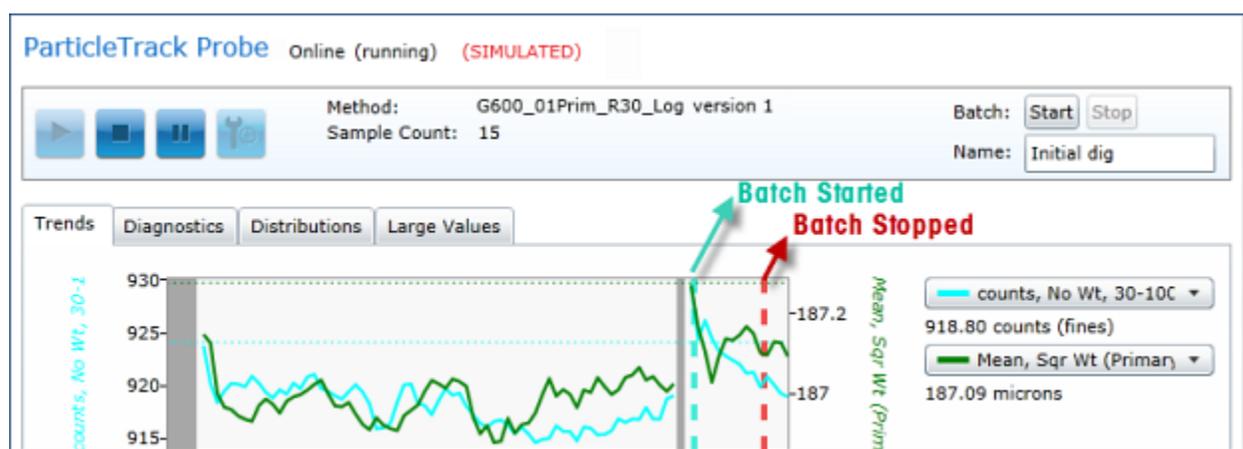
Background Color Indicates Instrument State

As you observe the main display, notice the background can be in three shades of gray. Below are some examples shown in Figure 4-19.

- The instrument is running continuous or batch processing (pale gray background)
- The instrument was offline (dark gray background)
- Data publishing was paused (medium gray background)

Figure 4-19 Grey band indications on trend chart

Viewing Distributions

The Distributions tab shows the real-time distribution from the FBRM instrument measurements. In addition, the tab includes any of the following types of reference distributions:

- Most recent distribution
- Target Distribution defined for the method
- Up to two Reference Distributions defined for the method
- Latest reference distribution captured for the current run

The real-time distribution is black and bold. Target and Reference Distributions appear in color.

Distribution counts automatically update for each measurement, along the time stamp. The formula used for calculation appears in parentheses. Distribution calculations can be Primary or Macro CSM.

When a Target Distribution exists, you can click the **Show % target** check box above the statistical values table (Figure 4-20) to display the percentage difference compared to the target distribution after each statistic.

The Y-axis shows counts by bin and the X-axis shows particle dimensions in microns (μm).
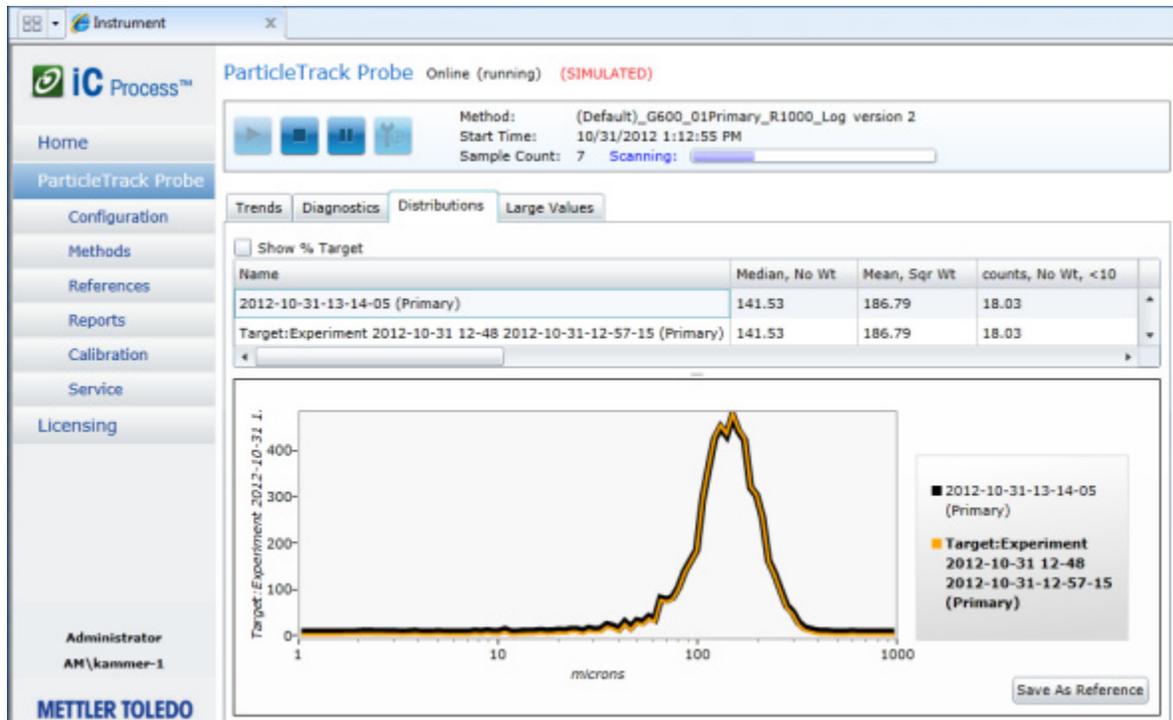
Figure 4-20　Distributions view

Saving Reference Distribution

During a processing run, an operator can save the current live distribution as a reference. Only one reference distribution is saved for a run, so the most recently saved distribution is the one.

1. During a batch or continuous run, select the Distributions tab.

2. Observe the current distribution. When desirable, click the **Save as Reference** button on the bottom right side of the window. The system saves the selected distribution. The live distribution is always bold and black. The reference distributions are in a color. Figure 4-21 shows the message that appears after you save a distribution as a reference.)
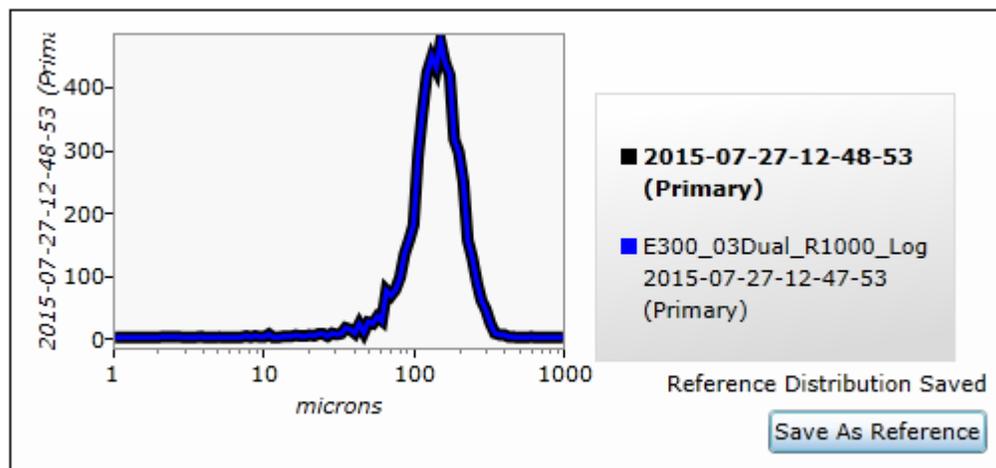

Figure 4-21　Saving a reference distribution during a live run

A user with the Administrator role can choose an applicable reference distribution in the Methods > Select a method > Reference tab (page 30).

All captured distributions for an instrument can be managed by an Administrator or Technician on the Configuration > Reference Distributions tab (page 79).

Viewing Large Values (Trends)

For ease of viewing, the current value for each trend selected on the Trends tab appears in large blocks on the Large Values tab. The size of the blocks changes dynamically based on the number of trends and the size of the Internet Explorer window. Large values are green when the current trend values are within the alarm limits specified in the method.
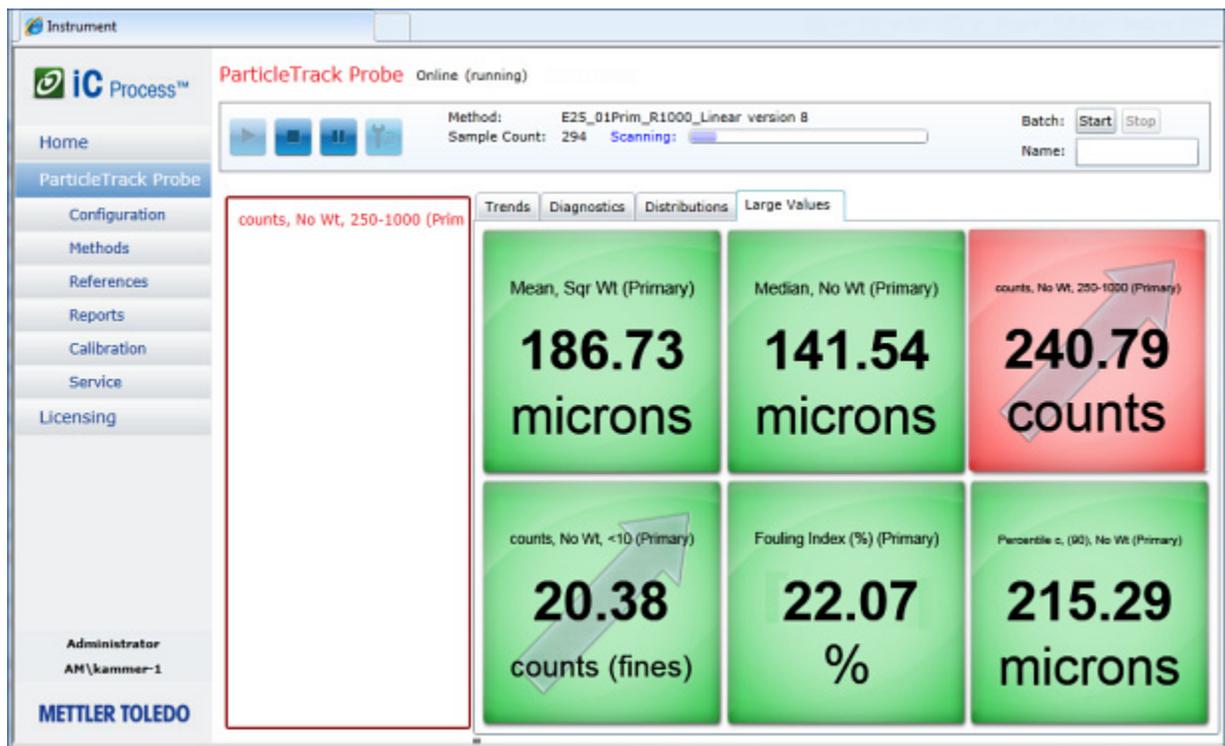

Figure 4-22   Large Values example—With one value outside of limits

| **Notes:** | ■ When the instrument is online, an arrow indicates a trend value that is increasing or decreasing. |
| | ■ Display changes to red if a trend value rises above or falls below alarm limits defined by an Administrator in the method (see page 123). |

Viewing Instrument Submenu Options

The left navigation has three menu items—Home, Instrument main page, and Licensing. Submenu options appear under the Instrument main page. The majority of your time as an operator is spent on the instrument main page. However, most submenu options can be viewed and the Reports and the Calibration check options can be used as they apply to your Standard Operating Procedure (SOP).

Figure 4-23   Instrument submenu on left navigation menu

Viewing Configuration

Instrument configuration has already been defined during initial implementation, however you can select this option and view the details about instrument settings and WITSML settings, if applicable.

Instrument Settings Tab

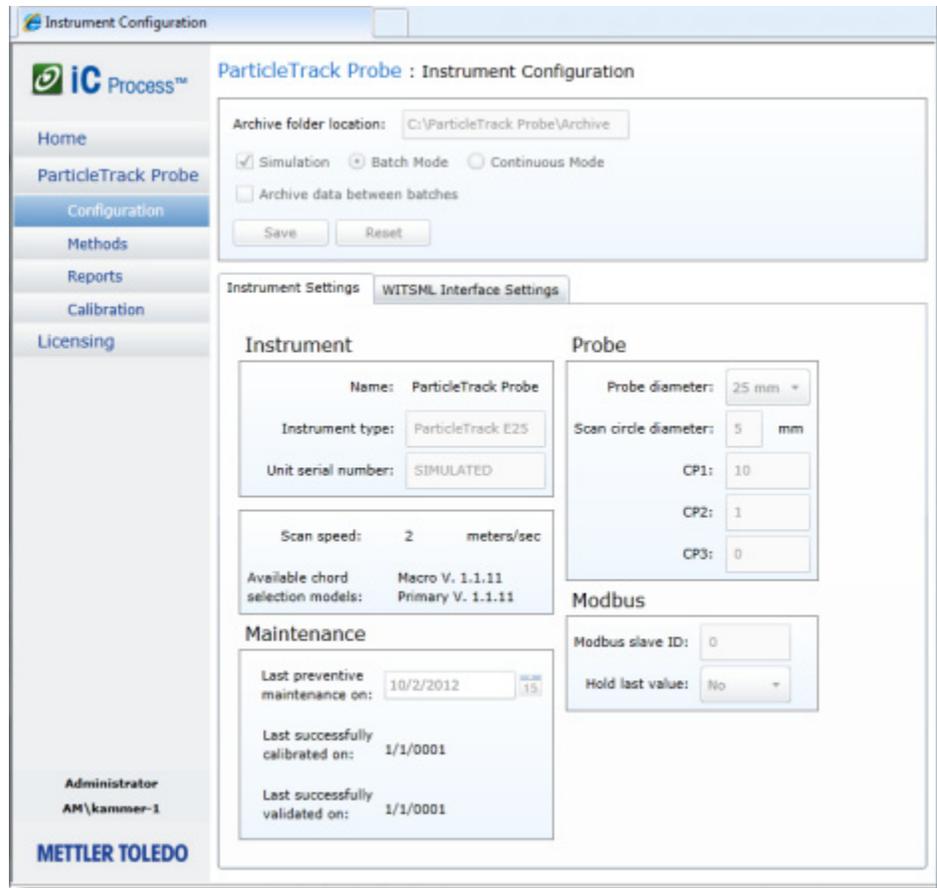Instrument settings are disabled and display for reference only.

Figure 4-24 Configuration submenu example—Operator's view of Instrument Settings

WITSML Interface Settings Tab

If an Administrator has set up Wellsite Information Transfer Standard Markup Language (WITSML), for communication to a drilling site, configuration settings are disabled and appear for reference only.

Viewing Methods

Methods for running processes on an instrument have already been defined during initial implementation, however you can select this option and view the details. Only approved and compatible methods appear in the selection list on the main instrument page. If you select a method, the details appear on the Overview tab:

Figure 4-25 Method—Overview tab for a selected method

The remaining tabs of method information are available, for information only.

Service Submenu (unavailable)

The Service submenu is not available if a run is in progress or the current user does not have permission to run any of the tests. If you click **Service** while service mode is not available, the following message appears:
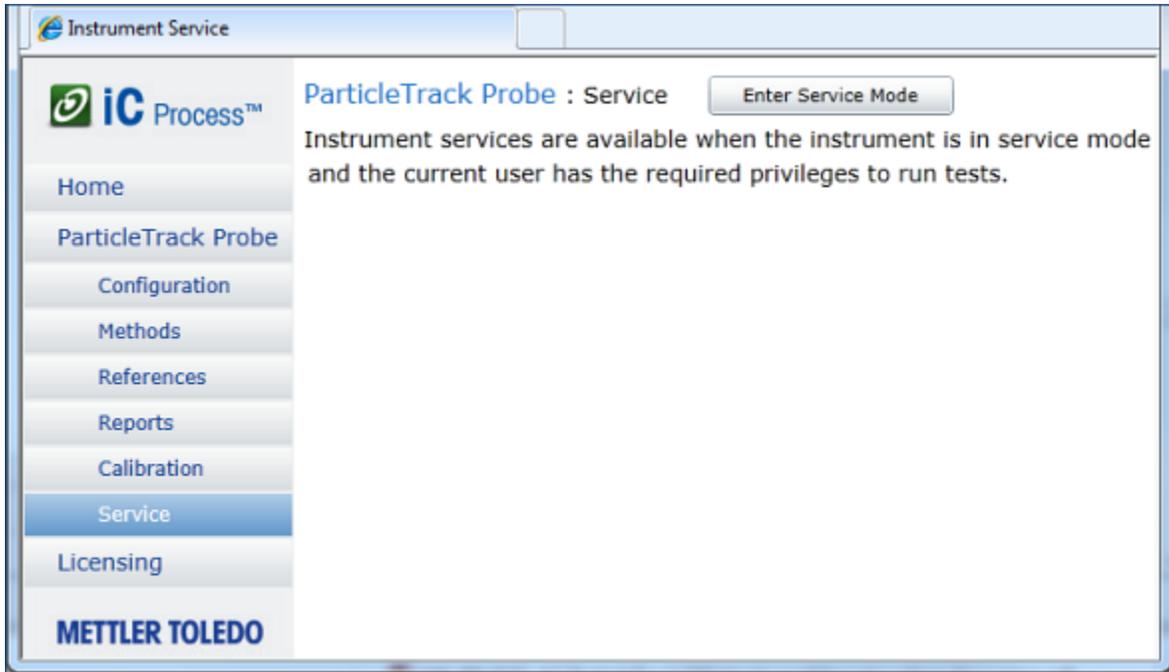
Figure 4-26 Service submenu—No Operator access

Viewing and Generating Reports

Generate reports, as needed, according to your Standard Operating Procedure (SOP). Figure 4-27 shows an example of the Reports main page. The page lists reports run on the system during batch and continuous processing. Service and calibration validation test reports also appear in the list (see example list on page 64). Click a Test report name to view it.
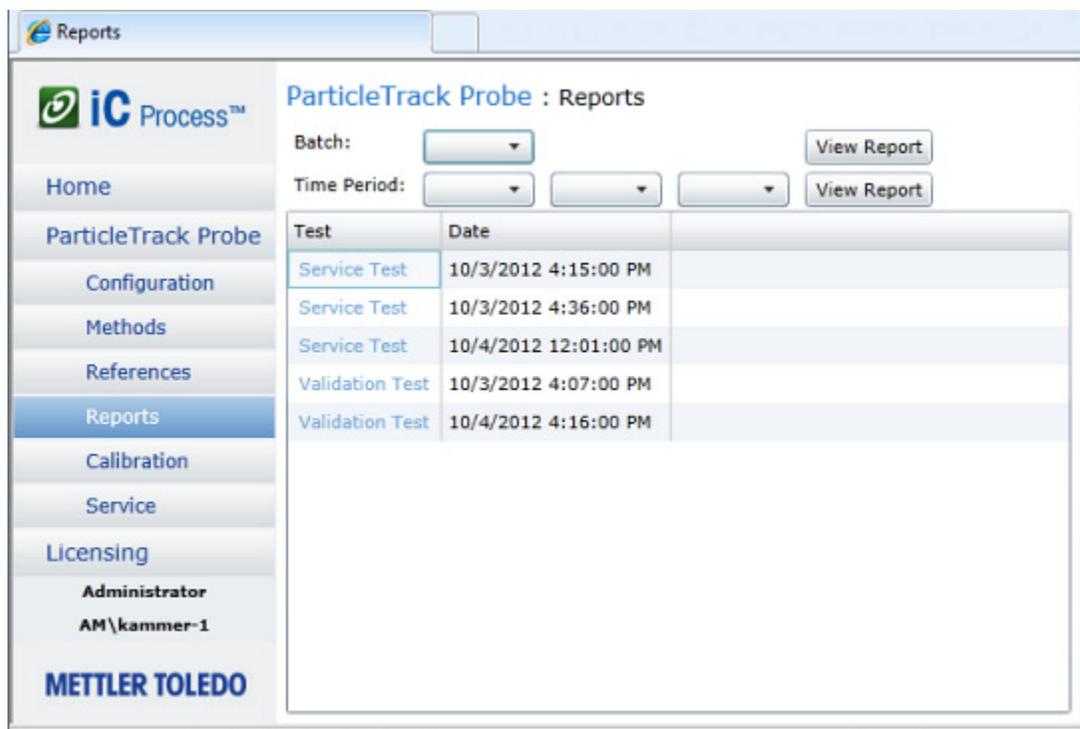
Figure 4-27   Reports main page—Batch report selection menu expanded

Viewing a Batch Report

If batches have been run, a report exists for each batch that has started and completed in the last ten days. To view a report, follow the steps below.

1.   Click the down arrow next the Batch field and select a report from the list.

2. Click **View Report** on the main Reports page to display the selected report in .XPS format. A new browser windows opens where you can view, save, or print the report.
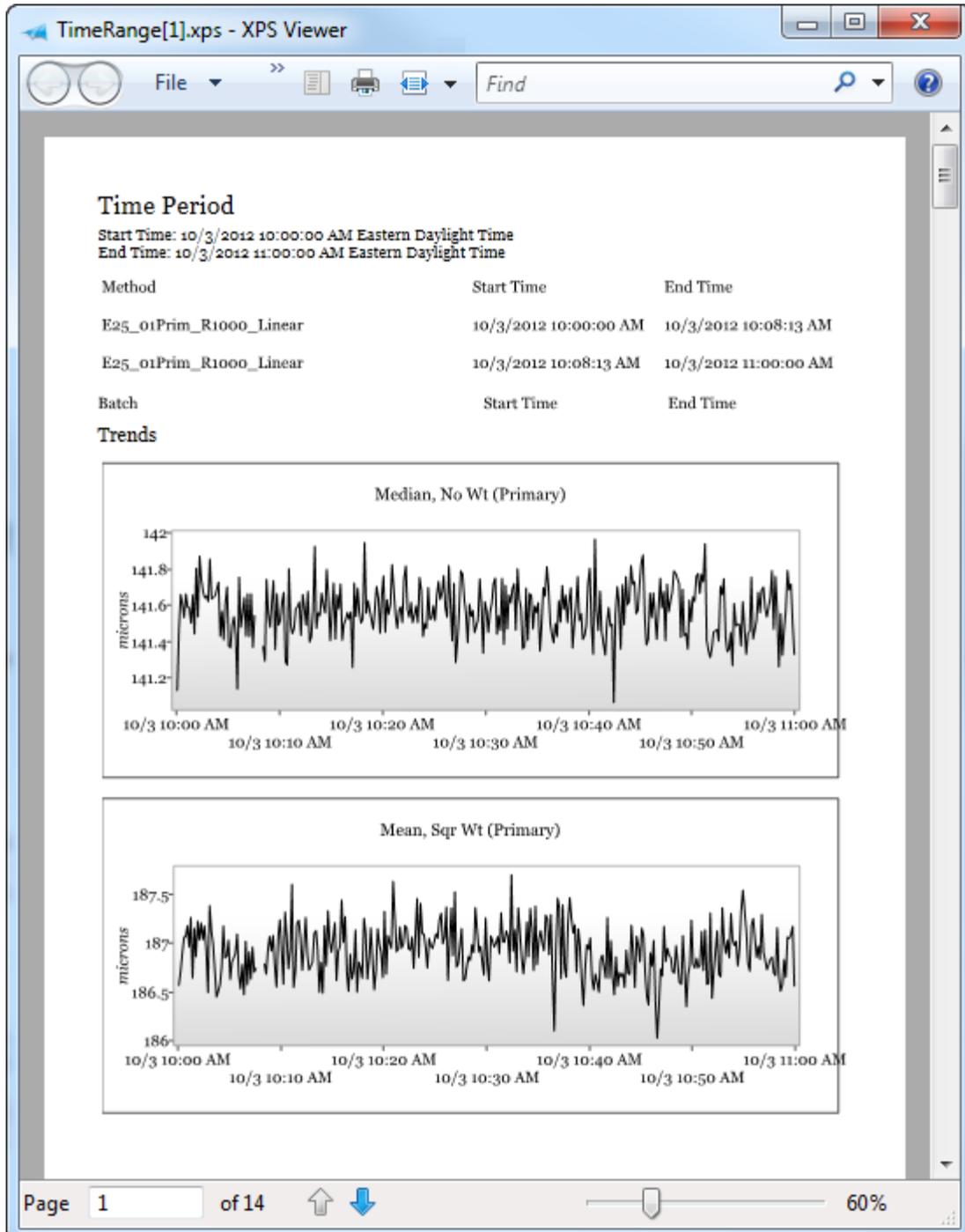
Figure 4-28   Report sample—Batch

In addition to information on the batch start and end times, method, and trend graphs, the report includes:

- Method
- Data Summary table

- Instrument configuration
- Messages generated

Generating a Time Period Report

To generate a report on a continuous or batch run, specify the time period to include in the report, as follows:

Figure 4-29   Reports—Time Period parameters

1. Select a date from the **Time Period** drop-down list.

2. Choose the starting hour from the second drop-down list.

3. From the third drop-down list, set the report duration by selecting the number of hours the report is to cover.

4. Click **View Report**.to display the report in .XPS format. A new browser windows opens where you can view, save, or print the report.
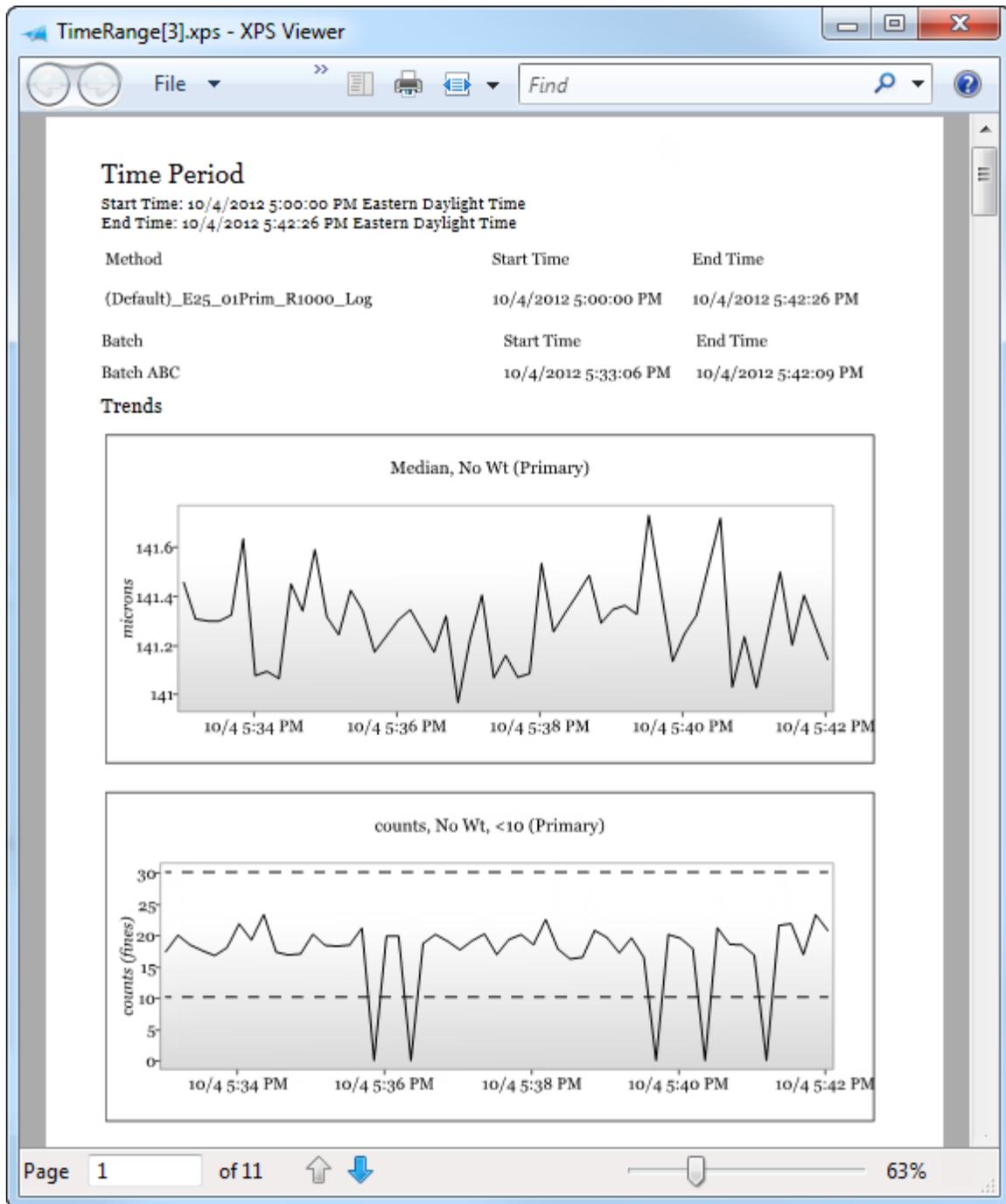
Figure 4-30   Report sample—Time Period

<div style="text-align: right">

5

</div>

Validating/Calibrating an Instrument

The Calibration menu option in iC Process for FBRM provides an easy way to check instrument calibration (Calibration Validation) for all supported instruments. The process involves immersing the probe in a reference sample slurry for comparison to measurements that are traceable to factory reference instruments.

Checking calibration can be a periodic task performed by an iC Process for FBRM user, as directed by a Standard Operating Procedure (SOP). All user roles in iC Process for FBRM can perform a calibration validation, however only an Administrator or Technician can perform a System Calibration.
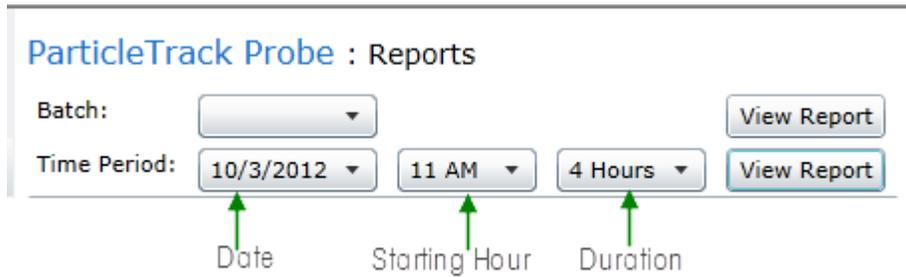
Note:	With annual Preventive Maintenance service, an Field Service Engineer (FSE) checks instrument calibration and re-calibrates, if necessary.

For ParticleTrack G600 instruments, which have an accessible micrometer, a System Calibration feature is included to enable re-calibration of the instrument focal point setting, if necessary. ParticleTrack E25 instruments do not have an accessible micrometer and can only be calibrated by an FSE. Contact METTLER TOLEDO using one of the numbers on page 8.

Prerequisite—The instrument must not be currently running a process

- If the instrument is available for calibration validation testing, the Calibration page appears when you select 'Calibration.'
- If a batch or continuous process is running, calibration validation cannot be run. The following message appears.

ParticleTrack Probe : Calibration (running)

Instrument calibration is available when the instrument is communicating, but not running.

<div style="text-align: center">

Figure 5-1   Message—Calibration validation cannot be performed

</div>

Stop the process by clicking the Stop icon on the main instrument display page:

<div style="text-align: center">

Figure 5-2   Stop icon on main instrument page

</div>

Procedures

This chapter includes procedure documents (embedded in the upcoming pages) on how to check calibration and perform a calibration, where applicable.

MK-PB-0109-AC Calibration Validation in iC Process for FBRM (page 65)

If the Calibration Validation test fails:

- ParticleTrack G600—Perform the System Calibration procedure from the following document:

    MK-PB-0110-AC System Calibration in iC Process for FBRM (page 70)

- ParticleTrack E25—Please contact METTLER TOLEDO using information on page 8.

Viewing Reports through Reports Menu

After validation or calibration procedure been run in iC Process for FBRM, the most recent Calibration Validation and System Calibration report can be viewed from the Calibration pages. However, to view earlier System Calibration reports, select Reports from the left navigation menu.

Figure 5-3 Reports—System Calibration and Calibration Validation

Calibration Validation in iC Process™ for FBRM®

Checking instrument calibration is a periodic procedure to ensure consistent and repeatable instrument measurements.

iC Process for FBRM software guides you through the validation process and provides complete reporting for the instruments listed below:

Instrument	Calibration Validation Procedure
ParticleTrack™ G600 / G600Ex ParticleTrack™ E25	PVC (Polyvinyl Chloride) Reference Sample Comparison

Table 1—Instruments That Use This Procedure

METTLER TOLEDO recommends the procedure be done at regular intervals—monthly or quarterly—or if the instrument is dropped or relocated.

If the calibration validation for ParticleTrack G600 instrument indicates the instrument requires calibration, follow the System Calibration Procedure (MK-PB-0110-AC) in the Hardware Documentation Portfolio. For ParticleTrack E25 instruments, please contact METTLER TOLEDO.

Required Items

- **Fixed Beaker Stand (FBS)**—Accessory with mixer used to validate instrument calibration. The FBS holds the reference sample in a reproducible setup for repeatable measurements.

- **Reference sample**—Original or Replacement slurry of PVC (polyvinyl chloride). The sample should be white in color (no contaminants) and it should not be removed from its original beaker.

- **Target distribution file**—An iC FBRM experiment reference data file associated with the reference sample. This file contains the target distribution.

Figure 1—Target distribution file and PVC reference sample beaker

- **Instrument-specific template** —An iC Process for FBRM experiment file for calibration validation. The file is automatically selected in the software for the currently-configured instrument.

About Target Distribution File and Sample

Two types of target distribution file and sample exist. An original target distribution file is generated from the customer instrument. A replacement is generated from the factory-standard reference instrument.

The target distribution file name identifies whether the file and the associated reference sample are the originals or replacements. Below are examples of the file name with sample ID along with **Table 2** that explains each part of the name.

SN16123-G600-P-2-145622-02.icFbrm (Original file based on serial number of customer instrument)

REF-G600-P-2-145622-02.icFbrm (Replacement file based on factory reference instrument)

File Prefix	Serial Number	Type	Chord Selection Model (CSM)	Scan Speed	Reference Sample ID	Format
SN-Original Sample	16123	G600	P=Primary	2	#######-##	.icFbrm
REF-Replacement Sample		G600	P=Primary	2	#######-##	.icFbrm

Table 2—Target Distribution File Name (Original and Replacement)

Steps to Validate Instrument Calibration

The Calibration Validation steps in iC Process for FBRM software are: A. Warm Up Hardware, B. Set Calibration Validation Parameters, C. Start Validation Test, D. Check Pass/Fail Results, and E. Final Steps.

A. Warm Up Hardware

1.   Turn on the ParticleTrack instrument and allow it to warm up. The probe should be running for a minimum of 30 minutes before acquiring measurements.

2.   Start the iC Process for FBRM software.

B. Set Calibration Validation Parameters

1.   From the iC Process for FBRM Home page, select the instrument.

2.   Select **Calibration** from instrument submenu in the left navigation menu.

3.   Verify the test selection—Test: **Calibration Validation**.

4.   Complete the following required Calibration Validation Parameters:

Figure 2—Calibration Validation (Required parameters)

a.   **Reference Sample ID**—Enter the ID number from the label on the reference sample beaker.

b.   **Target Distribution**—Click **Load** and locate the reference file that was provided with the reference sample that will be used during this test.

c.   Select the appropriate reference sample type:

   •   **Original Sample**—PVC sample shipped with the instrument that was used to calibrate the instrument at the factory.

   •   **Replacement Sample**—PVC sample ordered after the original has been used 10 times or after a year, whichever comes first.

   •   **Other**—If a reference sample other than PVC will be used, select this option and describe the sample in the Material text box that appears.

The software includes pass/fail criteria for the PVC samples. However when selecting the 'Other' option, you must supply the passing criteria for the validation test. Select the 'Pass Limits' tab and enter the high and low limit values for the validation statistics (see "Check Pass/Fail Results" on page 4).

d. **Template**—The software program automatically loads the template for the hardware type.

> **Note:** If you selected 'Other' for the Reference Sample, create a customized template from an iC FBRM experiment and use it for the calibration validation.

e. **Number of Measurements**—Accept the recommended default (15) or set the number of measurements to be taken for the validation test, if you are using a reference sample other than PVC.

5. After cleaning the probe, place the reference sample (original or replacement) in the FBS and check the reference sample as follows.

a. Ensure it is white in color and free of contaminants.

b. Ensure liquid level is **300 mL**.

If necessary, add distilled water to the sample to achieve the 300 mL total volume.

6. Turn on the mixer, set the speed to **400 rpm** and allow five minutes for the sample to disperse.

C. Start Validation Test

1. Click **Start Test**. (The button becomes enabled after the required parameters have been entered.)

Overview Tab—Provides non-editable information on the currently configured instrument and the Calibration Validation template selected for the current test.

Trends Tab—Displays trend charts for the statistics defined in the Calibration Validation template, as the test runs.

Diagnostics Tab—Displays instrument diagnostic trends during the test.

Distributions Tab—Displays the live distribution as a bold black line during the test. The Target Distribution from the Target Distribution file appears in orange. The name of the Chord Selection Model (CSM) appears in parentheses after the live and target distribution names.
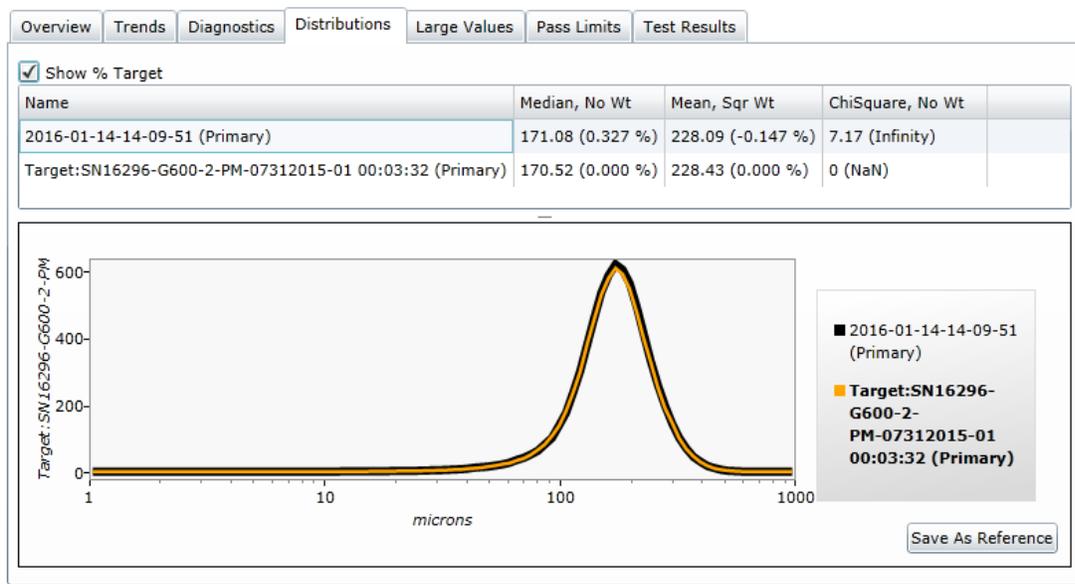
Figure 3—Distributions (% of Target)

Large Values Tab—Displays current statistics from the Trends tab automatically as large values for ease of reading from a distance.

Pass Limits Tab—(**Figure 4**) This shows the passing criteria for the test.

- Where Original/Replacement Sample being used, the criteria is auto defined and read-only.
- Where 'Other' sample is being used, the criteria is user defined.
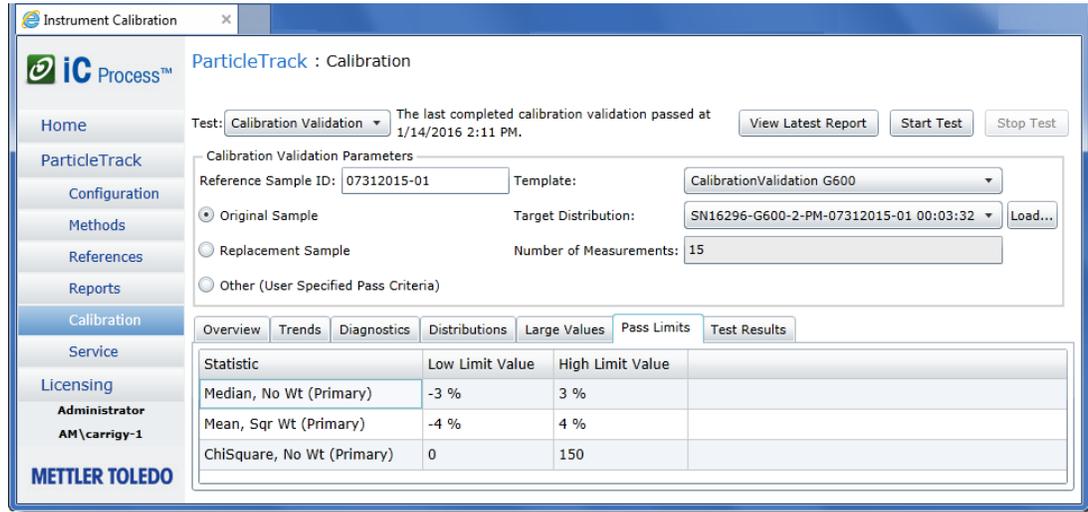
Figure 4—Pass Limits (Percentage variation from template for each statistic)

D. Check Pass/Fail Results

1. To view the results of a validation, select the **Test Results** tab.

   While the test is running, the Current Value appears for comparison to the Pass Criteria. When the test stops, the Pass/Fail column identifies the result as "Pass" or "Fail."
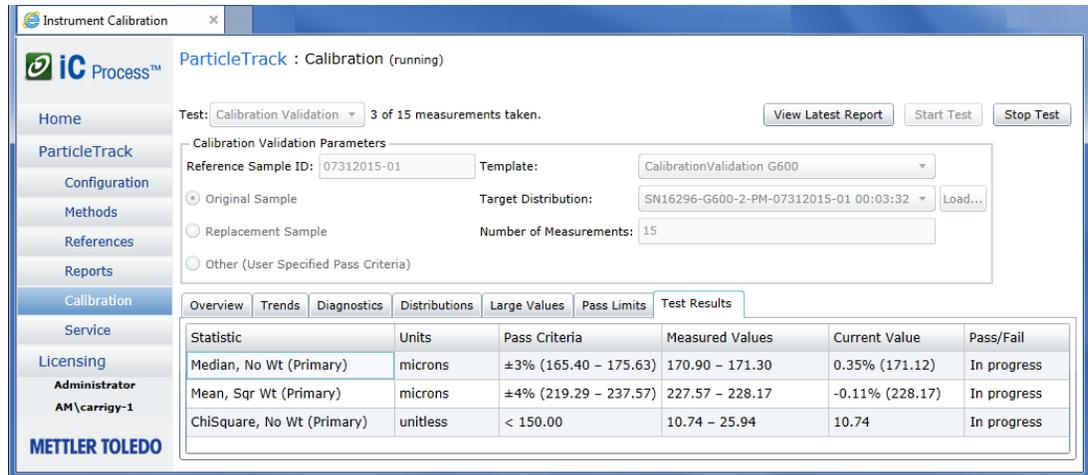
Figure 5—Calibration Validation (Test Results tab, in progress)

2. Observe the Pass/Fail results (**Figure 6**).

  ▪ If the values from the 15th measurement are within the Pass Criteria range, the instrument passes the calibration validation test and **Pass** appears in the Pass/Fail column.
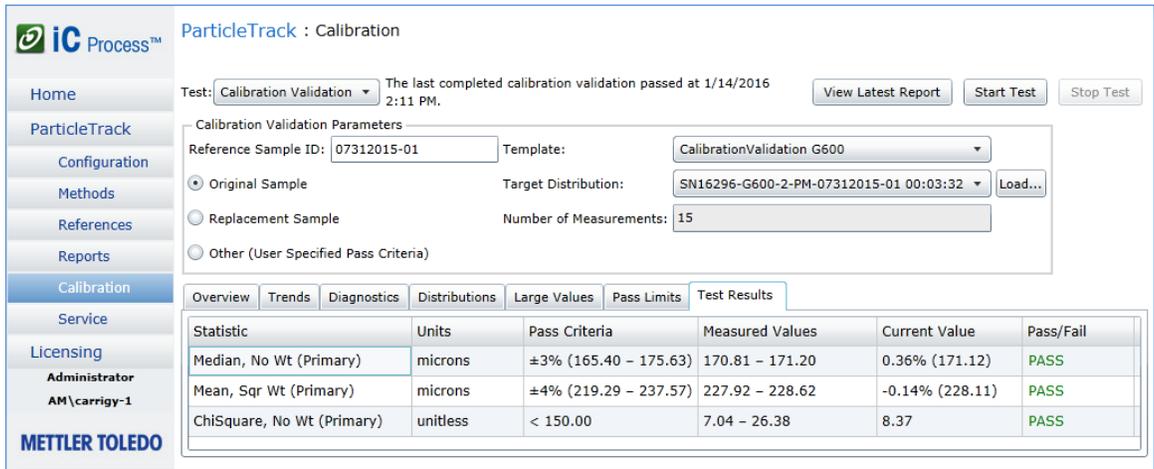
Figure 6—Test Results (Pass)

  • If the values from the 15th measurement are not within the Pass Criteria range, **Fail** appears in the Pass/Fail column. An instructional message appears at the top of the page.

3. If the Calibration Validation test passes, proceed to view and distribute the report per your SOP. Then, complete section E. Final Steps on page 6.

  If the Calibration Validation test fails:

 • ParticleTrack G600: Perform the System Calibration using the instructions in Hardware Documentation Portfolio. Then, repeat this Calibration Validation.

    If, after the System Calibration has been performed and the Calibration Validation has been repeated, the parameters are still outside the specified limits, contact a METTLER TOLEDO Technology and Applications Consultant.

  • ParticleTrack E25: Please contact METTLER TOLEDO.

4. Click **View Latest Report** to see the most recent calibration validation results report form (**Figure 7**). Save or print the report per SOP.
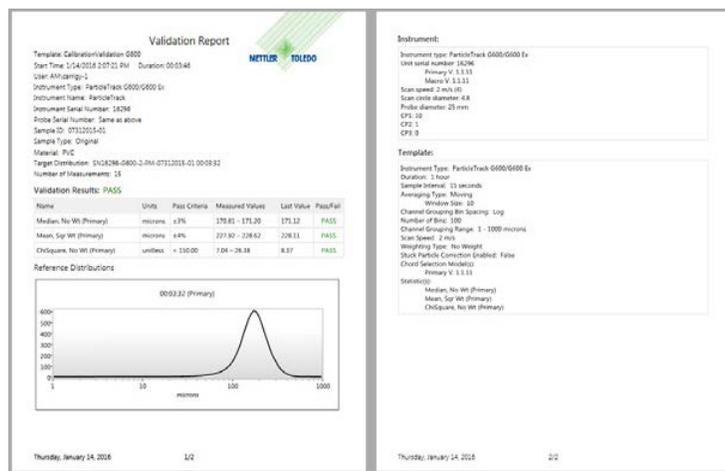
Figure 7—Calibration Validation report

E. Final Steps

After the Calibration Validation test is complete, perform the following post-test procedures:

1. Turn off the mixer and allow the reference sample to settle.

2. Gently remove the sample beaker using a repeated up and down motion. This will maintain integrity of the sample by removing PVC adhering to the probe and impeller.

3. It is recommended to put a few drops (<0.5 g) of bleach in the PVC sample after each use to prevent biogrowth.

4. Record the date used on the label (**Figure 8**).

METTLER TOLEDO

Reference Sample ID : 145622-02
PVC 8.33 % Wt. Concentration
Date 07/24/2015
File ID (Primary) = SN16123-G600-P-2-145622-02
Mixer Speed = 400 RPM

Dates Used:
1._____2._____3._____4._____5._____
6._____7._____8._____9._____10._____

Replace sample after 10th use or one year,
whichever comes first.
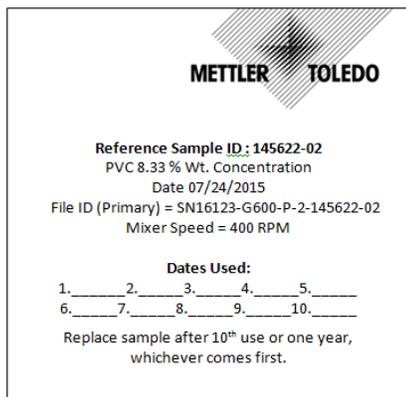
Figure 8—Example of PVC Reference Sample label

5. After its tenth use or one year (whichever comes first), the PVC Reference Sample should be replaced. Contact your local METTLER TOLEDO representative to request a new sample before the sample reaches its end of life.

System Calibration in iC Process™ for FBRM®

If the Calibration Validation procedure (MK-PB-0109-AC) indicates the instrument is out of specification, perform this System Calibration procedure.

Instrument	System Calibration Procedure
ParticleTrack™ G600 / G600Ex	Micrometer Adjustment

Table 1—Instrument That Uses This Procedure

The System Calibration procedure sets the Standard Focal Position relative to the probe window. The measured statistic **Counts < 20 microns (no weighting)** reaches a maximum value when the focal position is located at the Window Reference Position. A factory-specified adjustment is then applied to the Window Reference Position, resulting in the Standard Focal Position.

Required Items

To satisfy consistent reproducibility of precise system calibration, the procedure must be performed as documented, using the materials listed.

- **Fixed Beaker Stand (FBS)**—Accessory used to position the probe for system calibration with the window facing down.
- **Dry-Erase Black Marker**—While most black dry-erasable markers will do, it is best to use the marker provided by METTLER TOLEDO to ensure measurement-to-measurement consistency.
- **Instrument-specific template**—An iC Process for FBRM experiment file for system calibration. The file is automatically selected in the software for the currently-configured instrument.

About Reading/Adjusting the Micrometer

The micrometer on the probe adjusts the focal position. Each mark equals 10 microns (10 µm).

The reference mark engraved on the probe head indicates where to read the current micrometer position. Depending on the instrument, the micrometer can be one of two styles—in line with the probe head (with a protective sleeve, **Figure 1A**), or at the end of the probe head (with a protective cap, **Figure 1B**).

A	B
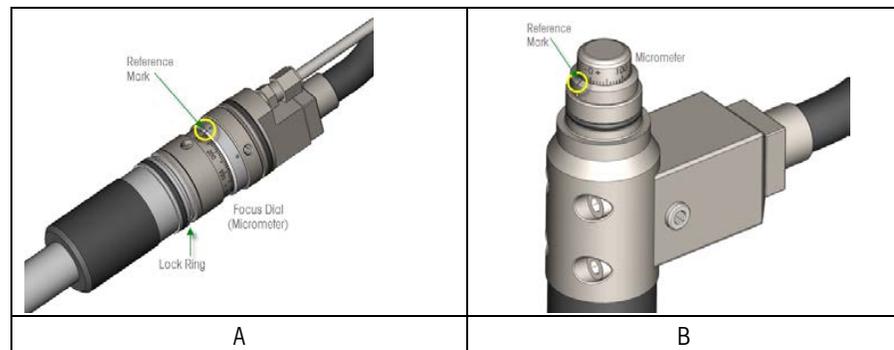
Figure 1—Micrometer (two styles)

- Turning the micrometer clockwise moves the focal point farther into the slurry (positive distance).
- Turning the micrometer counterclockwise moves the focal point back into the probe (negative distance).

Note: To eliminate the effects of hysteresis, always reach the desired micrometer position clockwise. If you pass the desired micrometer position, move the micrometer counterclockwise at least 50 microns (5 marked increments) and then find the correct point by moving the micrometer clockwise.

Steps to Perform System Calibration

System Calibration steps in iC Process for FBRM are:

A. Warm Up Hardware

B. Prepare the Probe

C. Set Up System Calibration Test

D. Locate Window Reference Position

E. Adjust /Set Micrometer to Standard Focal Position

F. Clean Probe Window and Repeat Calibration Validation

G. View System Calibration Results

A. Warm Up Hardware

1. Turn on the ParticleTrack instrument and allow it to warm up. The probe should be running for a minimum of 30 minutes before acquiring measurements.

2. Start the iC Process for FBRM software.

B. Prepare the Probe

1. Using the dry erase marker provided with the instrument, coat the surface of the clean, dry probe window with a uniform, thick layer of ink.

2. Allow two minutes for the ink to dry.

3. Insert the probe in the FBS.

4. Remove the protective cover from the probe micrometer. Depending on the probe design, remove the cap or slide down the cover and unscrew the locking ring.

C. Set Up System Calibration Test

1. In iC Process for FBRM, select the instrument from the Home page.

2. Click **Calibration** from the instrument submenu in the left navigation menu.

3. Click the Test selection button and choose **System Calibration**.

4. Complete the required **Initial micrometer position** entry (for example +20) identified by the red border in **Figure 2**.
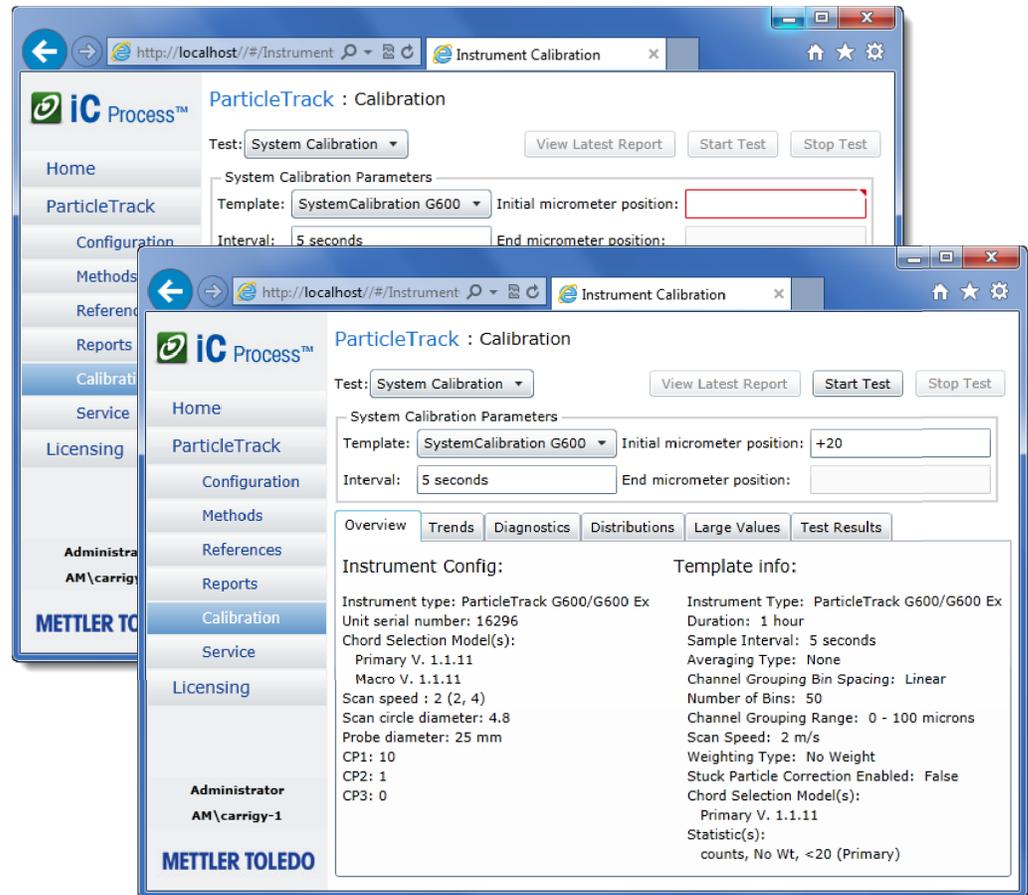
Figure 2—System Calibration (required parameter)

D. Locate Window Reference Position

The System Calibration procedure involves initial micrometer adjustments followed by refined adjustments. The procedure takes approximately 25 minutes and should flow from initial to refined, without interruption. If an interruption occurs, you must clean the probe, coat it with marker, wait two minutes, and start over from step 1 of the initial micrometer adjustments.

Note: The goal is to determine the micrometer positon that yields the maximum value for the Counts < 20 microns (no weighting) statistic.

Perform Initial Micrometer Adjustments

System calibration procedure starts with large initial adjustments (20-micron increments) to quickly reach the first approximation of the final focal position.

1. Make the initial adjustment by turning the micrometer dial to approximately the **–100 μm** position.

2. Click **Start Test**.

3. Click the Trends tab and observe the particle counts in the graph. The value for each measurement also appears to the right of the graph. Wait until at least five measurements have been acquired.
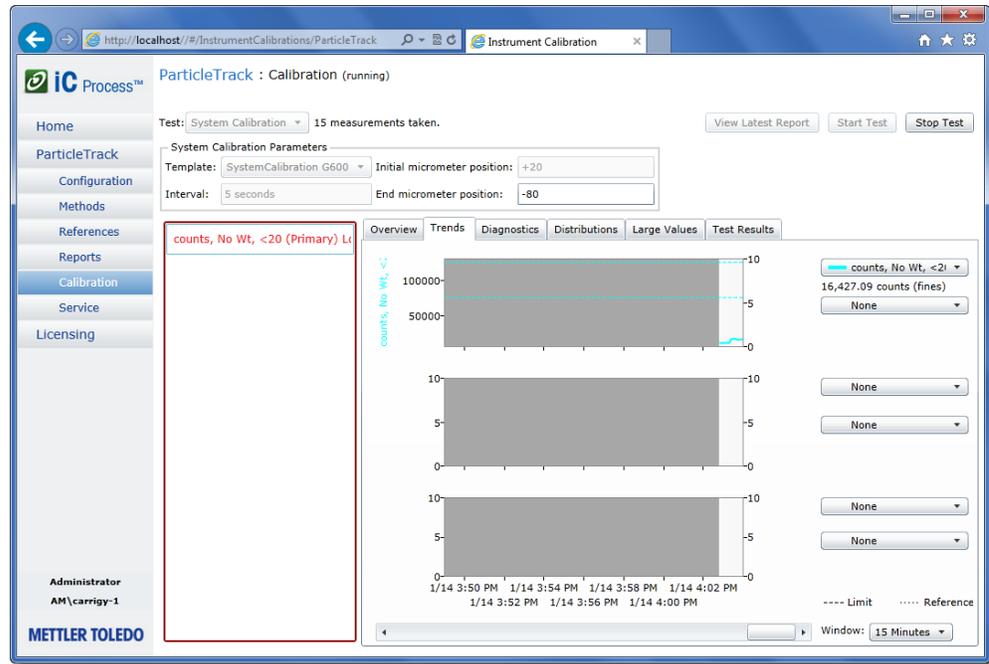
Figure 3—System Calibration (Trends tab)

Note: During calibration, expect a counts, No Wt, <20 error until counts at the window exceed 75.

4. Rotate the micrometer clockwise to increase the micrometer position by 20 microns (two marked increments).

5. Observe the trend graph and wait for at least five more measurements.

Note: An initial adjustment may not show a significant change, however with subsequent micrometer adjustments, the trend graph should begin to show a series of step change increases until a maximum (peak) value is reached, followed by step change decreases.

6. If a clear step change increase appears in the trend graph, enter the current micrometer position in the 'End micrometer position' text box.

7. Repeat steps 4 – 6 until the trend value has reached a clear maximum (peak) value and has begun to decrease with each micrometer adjustment.
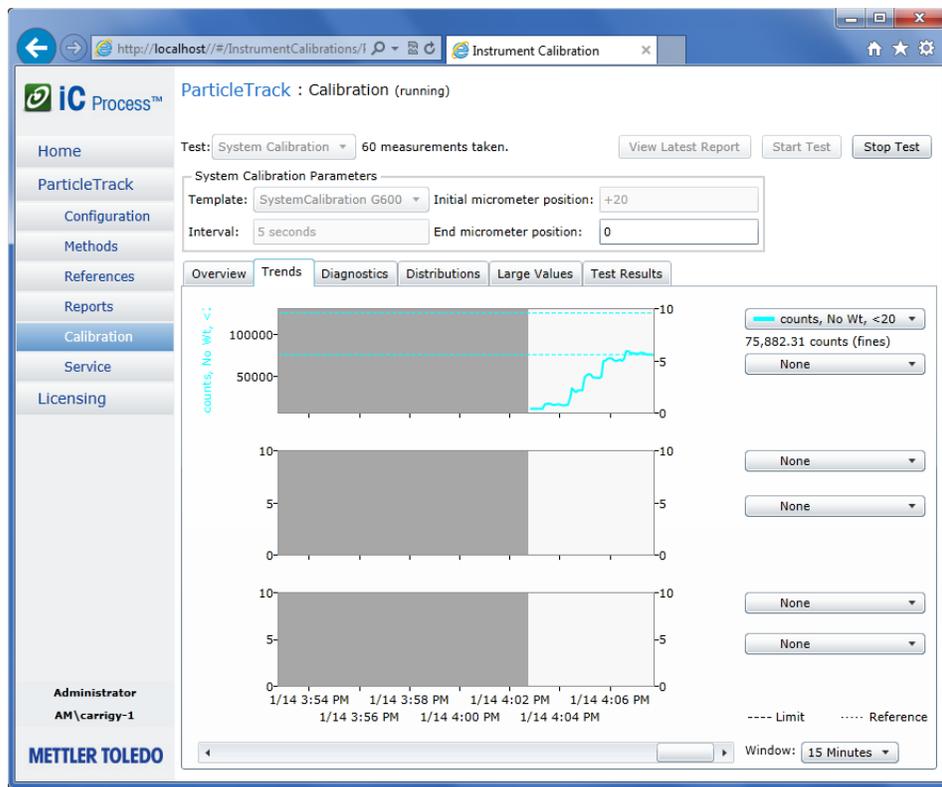
Figure 4—Step increase in trend with micrometer adjustments

8. Note the micrometer position at the maximum location in the trended statistic graph before the trend began to decrease. The final value recorded in the **End micrometer position** text box should be the first micrometer setting that resulted in the maximum trend value.

Perform Refined Micrometer Adjustments

The next phase of system calibration changes to refined (5-micron increments) micrometer adjustments.

1. To begin refined adjustments, rotate the micrometer counterclockwise 50 microns back from the first maximum value attained in the initial adjustments (step 8 above).

2. Rotate the micrometer clockwise to increase the micrometer position by 5 microns (one-half of 1 marked increment).

3. Wait for at least five measurements and observe the overall change in the trend graph.

4. If a step change increase is clearly observed in the trend value, record the current micrometer position in the **End micrometer position** text box (**Figure 5**).

5. Repeat steps 2–4 and adjust the micrometer position by 5 micron increments until a clear maximum value has been shown and the trend value begins to decrease. The final value recorded in the **End micrometer position** text box should be the first micrometer setting that resulted in the maximum trend value.

   Note: This is the **Window Reference Position**.

Note: If counts fluctuate, resulting in multiple peaks, recoat the window with the Dry Erase Marker and repeat the refined micrometer adjustments from step 1.

E. Adjust /Set Micrometer to Standard Focal Position

After finding the Window Reference Position, set the micrometer to the Standard Focal Position by making the factory-specified adjustment to the Window Reference Position specified below.

1. Turn the micrometer counterclockwise 50 microns back from the Window Reference Position.

2. Calculate the Standard Focal Position based on the required factory-specified adjustment of **+ 20 microns** applied to the Window Reference Position.

    For example, if the Window Reference Position is +5 microns, then the Standard Focal Position is +25 microns.

3. Gradually move the micrometer clockwise toward the calculated Standard Focal Position.

4. For ParticleTrack G600 probes with the inline micrometer, hold the focus ring (**Figure 1A**) and carefully tighten the locking nut against it. Monitor the counts while doing this to ensure there is no shift in the focal position. Then, reattach the micrometer protective sleeve.

    ParticleTrack G600 probes with the micrometer at the end of the probe head (**Figure 1B**) do not require a locking step—simply reattach the micrometer protective cap.

5. The probe is now calibrated to the Standard Focal Position.

6. Update the **End micrometer position** (**Figure 5**).
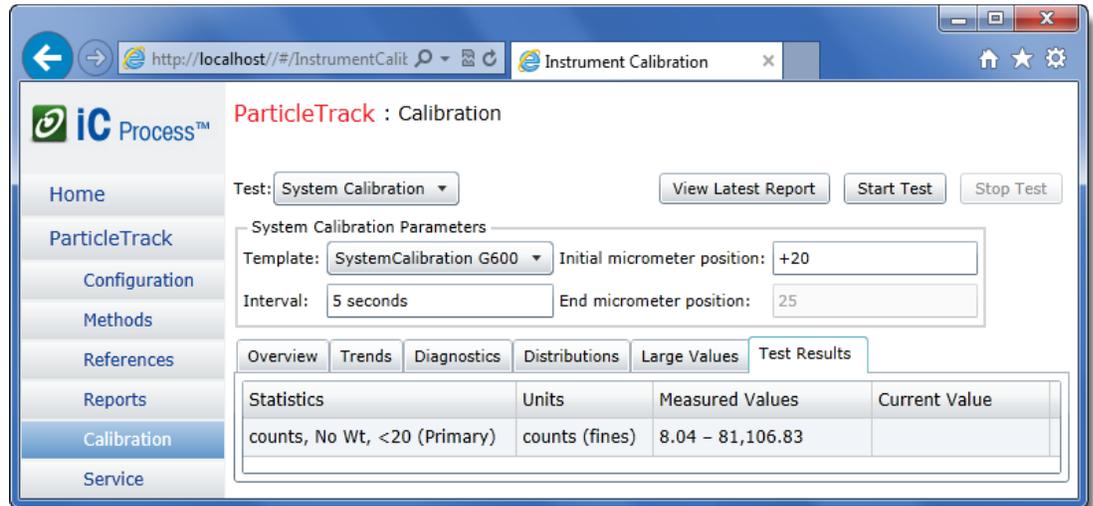
Figure 5—System Calibration (Entering end micrometer position)

Standard Focal Position Repeatability

All measurements of the Standard Focal Position should be within a range of ±5 microns (that is, ±0.005 mm or one-half of an increment on the rotating dial). However, due to inconsistencies in ink application, you should not expect actual counts achieved to be the same each time. Contact a METTLER TOLEDO Technology and Applications Consultant if there is a greater than ±5 micron discrepancy.

F. Clean Probe Window and Repeat Calibration Validation

1. Wipe any residual dry erase marker from the probe window. Use a solvent such as IPA or acetone and a Kimwipe® to clean the window. Rinse off residual solvent with DI water and dry with a Kimwipe.

2. Repeat the Calibration Validation (MK-PB-0109-AC) to confirm the calibration.

G. View System Calibration Results

Calibration results can be viewed from two locations on the System Calibration page—by clicking the Test Results tab or the **View Latest Report** button.

View Results During or After the Test

Click the Test Results tab to observe the range of measured values. During the test, the real-time Current Value also appears on the Test Results tab as well as on the Trends tab. After the test is stopped, only the Measured Values appear on this tab.

View System Calibration Report

To view, print, or save the most recent System Calibration report, click **View Latest Report** from the top of the Calibration page. **Figure 6** shows page one of the reports. Page two summarizes the instrument configuration and the template settings.
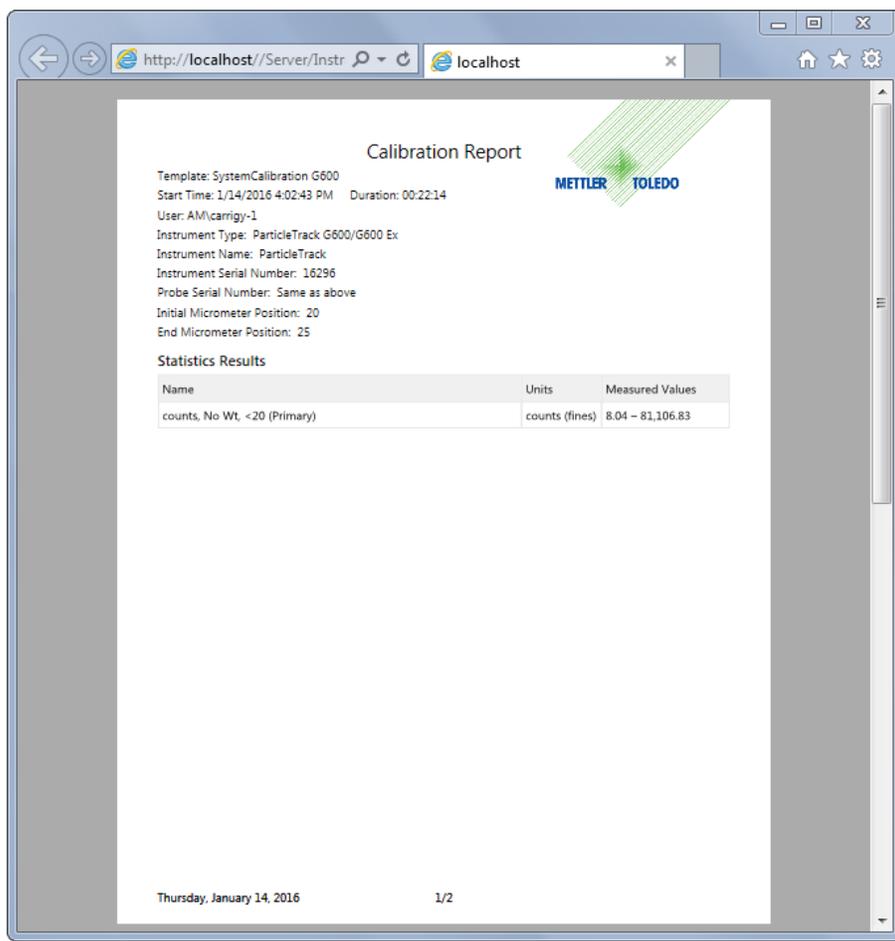
Figure 6—System Calibration Report (page 1 of 2)

The most recent Calibration Validation and System Calibration report is available from the Calibration pages. However, to view earlier System Calibration reports, select Reports from the left navigation menu in iC Process for FBRM.

6

Managing iC Process for FBRM

This chapter provides information on periodic tasks that an Administrator performs after implementation and daily use to manage and maintain the iC Process for FBRM software.

Note:	■ This chapter is intended for users with the Administrator or Technician role.
	■ For details about permissions for each role, refer to Chapter 2, "Getting Started" on page 9.

Managing References

During a process run, an iC Process for FBRM user can compare a real-time measured distribution to Reference Distributions. Up to three Reference Distributions, including one Target, display with the current distribution during an active run.

Reference Distributions can come from the following sources:

■ **Included in Template**—If the template experiment selected for a method includes Reference Distributions and Target Distributions, they become part of the method. This is an effective way to load distributions that can be used to test for process consistency or batch repeatability against a set-point distribution. During processing, the Reference Distributions appear on the chart with the real-time distribution so the Operator can see changes in particle or droplet system distribution.

■ **Captured in real time**—An iC Process for FBRM user can capture a Reference Distribution from an active run (see "Saving Reference Distribution" on page 53) or during calibration/validation tests. This provides an effective way to determine if the current process is stable or looking for real-time comparison of distributions from within the same run.

As an Administrator, a regular task is to manage the collection of Reference Distributions.

The software stores every reference distribution captured during processing on the Runtime tab of the References main page.

The software also stores every reference distribution captured during calibration validation procedures. These are organized on the Calibration tab on the References main page.

Management includes deleting unwanted distributions and naming or adding additional information that makes selection of a distribution during method development easier. An Administrator or Technician can choose up to two reference distributions and a target distribution for an applicable from this list during method creation.

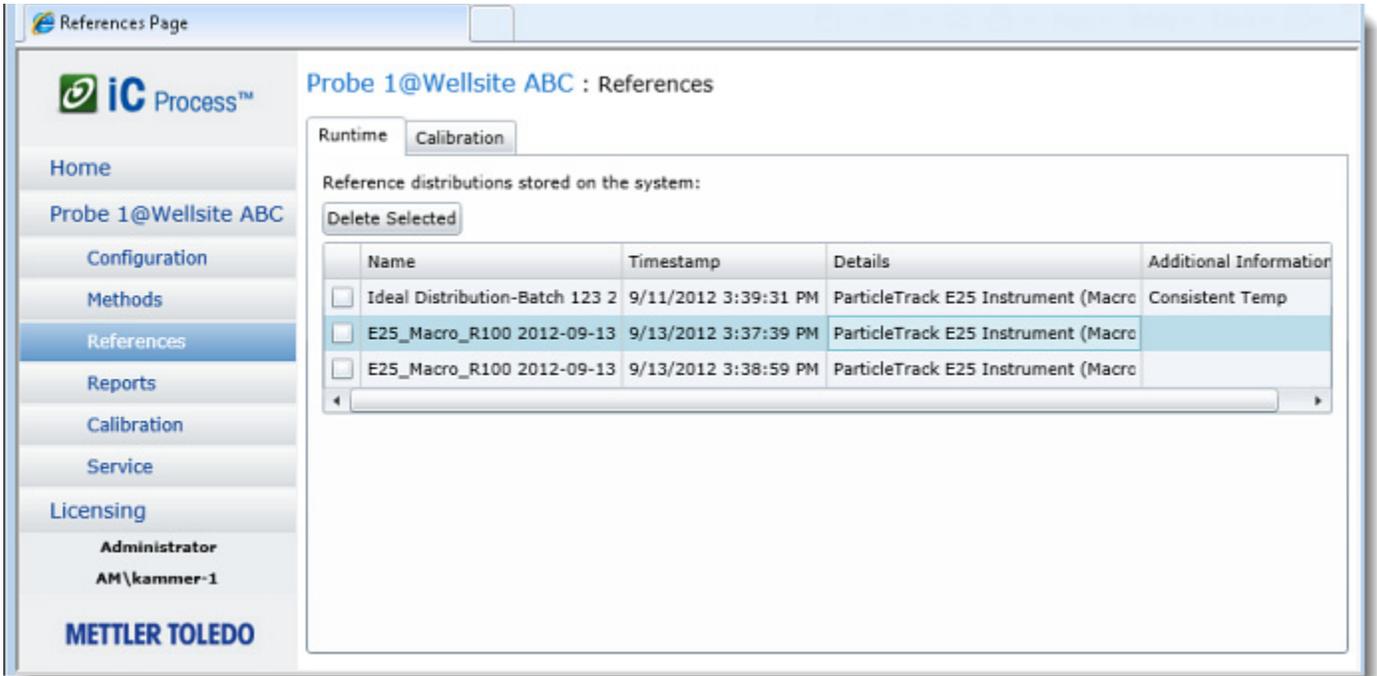1. Click **References** from the left navigation menu.

Figure 6-1 Reference Distributions tab

2. Select one of the following tabs:.

   Runtime—Reference distributions captured during batch or continuous processing runs

   Calibration—Reference distributions captured during Calibration Validation or System Calibration (if applicable).

3. View the list of Reference Distributions captured during processing or testing and perform any of the following actions:

   • To rename a distribution, select it from the Name column and enter the desired name. The default name is the Method Name Date and CSM.

   • To delete a distribution, click the check box next to one or more to be deleted, then click Delete Selected. If a distribution is currently being used as reference in a run, it cannot be deleted.

   • To add a comment or description, type in the Additional Information column. The information can aid an Administrator when selecting a Reference Distribution for a method (page 30).

Maintaining Archive Folders

Based on your Standard Operating Procedure (SOP), include a regularly scheduled task to check the data archive drive that contains files and auto-generated daily reports. Verify the archive file locations (see instrument configuration–page 18) for adequate disk space. Back up the archive location regularly or remove and store archive files as required by your SOP.

Responding to Service Reminders

Notify METTLER TOLEDO if instrument service prompts appear for an instrument. Routine preventive service and special reminders to check the calibration appear on the Home page based on dates that are stored in the instrument Configuration (see page 125).

About System Calibration

An Operator, Administrator, or Technician can run a Calibration Validation test as part of an SOP or as part of regularly scheduled maintenance. If the Validation test does not pass, an Administrator or Technician can run a System Calibration for instruments that have a micrometer.

Note:	Instruments that do not have a micrometer (ParticleTrack E25) can only be calibrated by a METTLER TOLEDO FSE. Contact METTLER TOLEDO by one of the methods on page 8.

Activating Licenses

Two types of licenses can be activated through the iC Process web application—(1) software licenses and (2) Chord Selection Model licenses.

Note:	These steps assume you already have an account set up on the METTLER TOLEDO AutoChem Customer Community website. If you need to create the account, go to the site and do so. Instructions are in the 'iC Process for FBRM Install Guide for Administrators' appendix under Setting Up New User Account.

Software License, Subscription, and CSMs

Activate the software license (or iCare subscription) and CSMs by copying the machine ID from the control computer, then logging on to the AutoChem Customer Community Site where you:

- Enter the license keys shipped with the instrument.
- Generate an activation code.

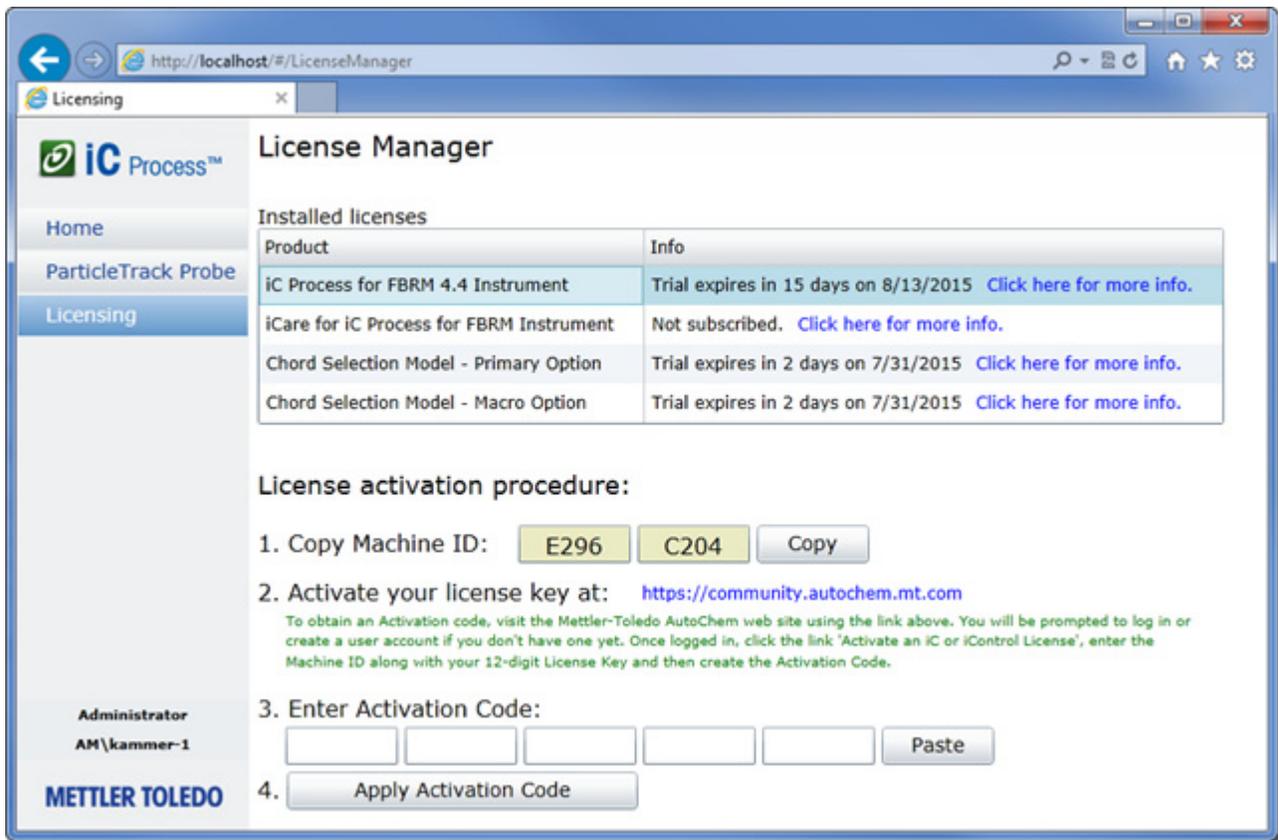■ Return to the License Manager and enter the activation code.

Figure 6-2 License Manager in iC Process—Activating a license

1. Select 'Licensing' from the left navigation menu. Steps below feature the software license.

2. Proceed to activate the software license and CSM license, as applicable.

   a. Have your License Key sheet ready.
      The sheet is a letter-sized paper certificate delivered with the system.

   b. On the License Manager page (Figure 6-2), click **Copy** after step 1 to copy the machine ID to your clipboard.
      The Machine ID that you copied will be used, along with your License Key, to generate an activation code from the Customer Community website.

   c. Click the link: https://community.autochem.mt.com after step 2.

   d. Obtain your Activation Code from the AutoChem Community website, as follow:

      ■ Enter your username and password and then click **Log in**.
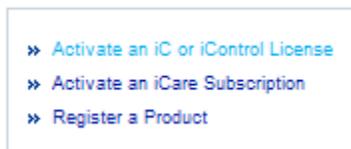
      ■ Click **Activate an iC or iControl License**.

Figure 6-3   Customer Community site—Activate license from menu

- Click **Paste** in the Machine ID row to enter the ID from the clipboard.

Figure 6-4   Customer Community site—License activation procedure

- Enter the License Key and click **Paste**.
- Click **Generate Activation Code**.
- After the code appears, click **Copy** next to the code to save it to the clipboard.

3. Return to the License Manager page in the iC Process for FBRM.

   a. Click **Paste** after the 'Enter Activation Code' text boxes to enter the code from the clipboard.

Figure 6-5   License Manager in iC Process for FBRM—Activation code

   b. Click **Apply Activation Code** to complete the activation. A confirmation dialog box appears.

Chord Selection Model

All FBRM instruments use one or two CSMs to display distributions. The choice of CSM relates to the type of particle or droplet system to be processed.

Follow the same steps, starting on to activate a CSM license. Refer to the glossary for more information on CSMs.

Viewing Instrument Diagnostics

An Administrator or Technician sees a Diagnostics tab on the main display for a selected instrument. The tab shows trend values for all instrument diagnostics.

Note:	Although designed for trained field service engineers, diagnostics appear to Administrators for reference. Contact METTLER TOLEDO with any questions.

Go to "Diagnostics Tab" on page 91 for details about the Diagnostics for instrument health in service mode.

Figure 6-6 Diagnostic tab (with instrument online)

Sending System Log File

As part of system diagnostics, a METTLER TOLEDO service engineer may request that a system log file be sent for analysis. Follow the procedure below to have the software prepare a log file.

1. Go to the iC Process for FBRM Home page.

2. Accept the default time period of **1 day**, or click the button to select a longer time period.

3. Click **Send System Logs**.

4. In the File Download window, click **Save** and navigate to the location.

5. Accept the default file name (logfiles.zip), or name the file.

6. Click **Save**.

7. Send the file to METTLER TOLEDO.

Managing Probe Cleanliness

As part of SOP, periodically remove the probe from the flexible mounting and clean the probe tip by using neat acetone or IP alcohol. Rinse with clean deionized (DI) water and dry with a lint-free wipe.

Below are related window cleanliness features.

■ **Stuck particle correction**—A Data Treatments option included in all method templates that are provided with iC Process for FBRM. The software mathematically removes data from the distribution for particles or droplets that remain stationary in the scan circle over a period of time. An Administrator can turn off the setting in a method (page 40).

■ **Fouling Index**—A statistical trend included in all method templates that are provided with iC Process for FBRM. It provides an estimate of the percentage of the scan circle that may be covered by stationary particles. The percentage can be tracked as a trend. (Refer to the Trends tab as shown on page 46. Select Fouling Index from the trend statistics.

Deleting an Instrument

iC Process for FBRM supports one instrument connection at a time. To connect a different ParticleTrack instrument to the control computer, it is necessary to delete the currently configured instrument. Only an Administrator or Technician can delete an instrument. Deleting an instrument removes it from the iC Process for FBRM, but the archived data remains in the designated location.

1. Locate the instrument selection/status box on the Home page.

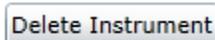2. Click **Delete Instrument** below the selection/status box.

Delete Instrument

Figure 6-7   Delete Instrument button

3. Respond to the Delete Instrument confirmation by selecting one of the options.

Delete Instrument

Are you sure you want to delete this instrument?

No, do not delete this instrument.

Yes, delete this instrument but keep the associated files.

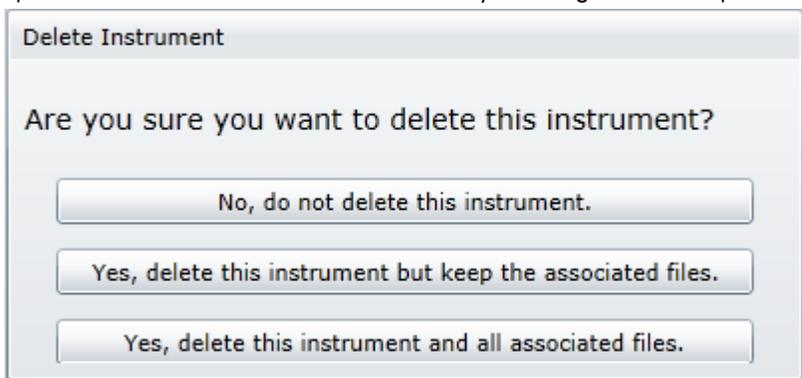Yes, delete this instrument and all associated files.

Figure 6-8   Delete Instrument options

No, do not delete this instrument—Click to cancel the deletion action.

Yes, delete this instrument but keep the associated files—Click to remove the instrument from the Home page, but retain the following:

• Methods
• Reports (Calibration, Validation, and Service)
• Reference Distributions from calibration, validation, and process runs
• Diagnostic logs (of diagnostic trend values)

Note:	Record the exact name given to the instrument. To add the instrument back at a future time, enter the exact same name. When adding the instrument later, the system will prompt you for a new Archive folder location.

Yes, delete this instrument and all associated files—Click to confirm complete deletion of instrument. Only data in the designated Archive folder location remains.

After confirmation to delete, the instrument selection/status box no longer appears on the Home page and the instrument name no longer appears in the left navigation menu. It is replaced with the 'Add new instrument' box.

7

Using Service Mode in iC Process for FBRM

This chapter provides information on how to use the iC Process for FBRM Service submenu. Service mode can only be entered when the selected instrument is stopped. Service mode enables a user to run the service tests and check instrument diagnostics.

Note: Although users with the Administrator or Technician role can access the service section, the service menu is intended for trained METTLER TOLEDO Field Service Engineers (FSEs).

Table 7-1   Service Permissions

Permission to:	Administrator and Technician
View instrument diagnostics	✓
Perform service tests	✓
Enter service mode	✓
Exit service mode	✓

Introducing Service Mode

iC Process for FBRM Service mode consists of a choice of service templates for the types of tests available and a tabbed display similar to the Calibration feature.
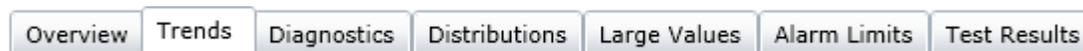
Figure 7-1   Service tabs

Two Ways to Enter Service Mode

- **Service mode button on main instrument page**—When an instrument is stopped, an Administrator or Technician can click the Service icon to put the instrument in service mode. When in service mode, the instrument is unavailable for processing.

Figure 7-2   Toolbar icons—Service mode

■ **Service option from the left navigation menu**—As long as the instrument is Stopped, if you click Service from left navigation menu without first clicking the Service mode icon, an, **Enter Service Mode** button enables you to enter service mode. If a batch or continuous process is running, the button is disabled.
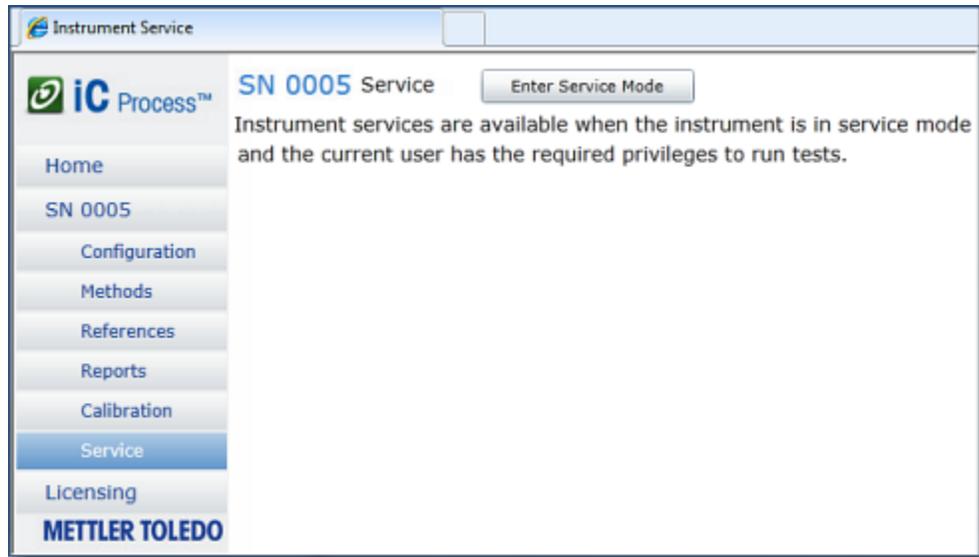

Figure 7-3   Enter Service Mode button

Two Types of Service Tests

Service tests check overall instrument performance before commissioning an instrument to measure particle and droplet distributions in process. A METTLER TOLEDO FSE runs these tests at initial installation as described in the IPac Starter-Pac or IPac Quality-Pac service installation document, as applicable. An Administrator or Technician can run these tests periodically, according to SOP, to check window cleanliness and system measurement.

The initial Service page displays the Trends tab with an instrument-specific Template selection menu for the two types of tests.,
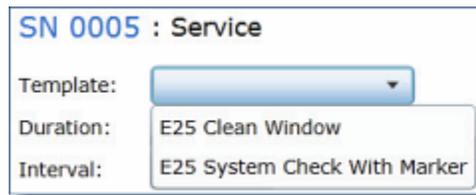

Figure 7-4 Service template options

Clean Window—Basic check of particle or droplet counts to determine sapphire window cleanliness. This test can be run when the probe is available; that is, when it is not installed in the Flexible Mounting System.

System Check with Marker—Basic check of key instrument readings (counts). This test involves using the black marker provided with the system to coat the window and confirm that counts are within limits set in the template.

During both these tests, the instrument diagnostics can be checked to verify that the values are within specification.

Running Service Tests

The Service page includes tabbed views that enable you to view the trends, diagnostics, distributions, large values, alarm limits, and test results from service tests run on an instrument. Diagnostics differ slightly by instrument.

1. From the Service page, select the Clean Window template.

The examples in this section feature the Clean Window test for a ParticleTrack E25 system. Steps are the same for the System Check with Marker, except that the dry erase marker supplied with the instrument is applied to the sapphire window.
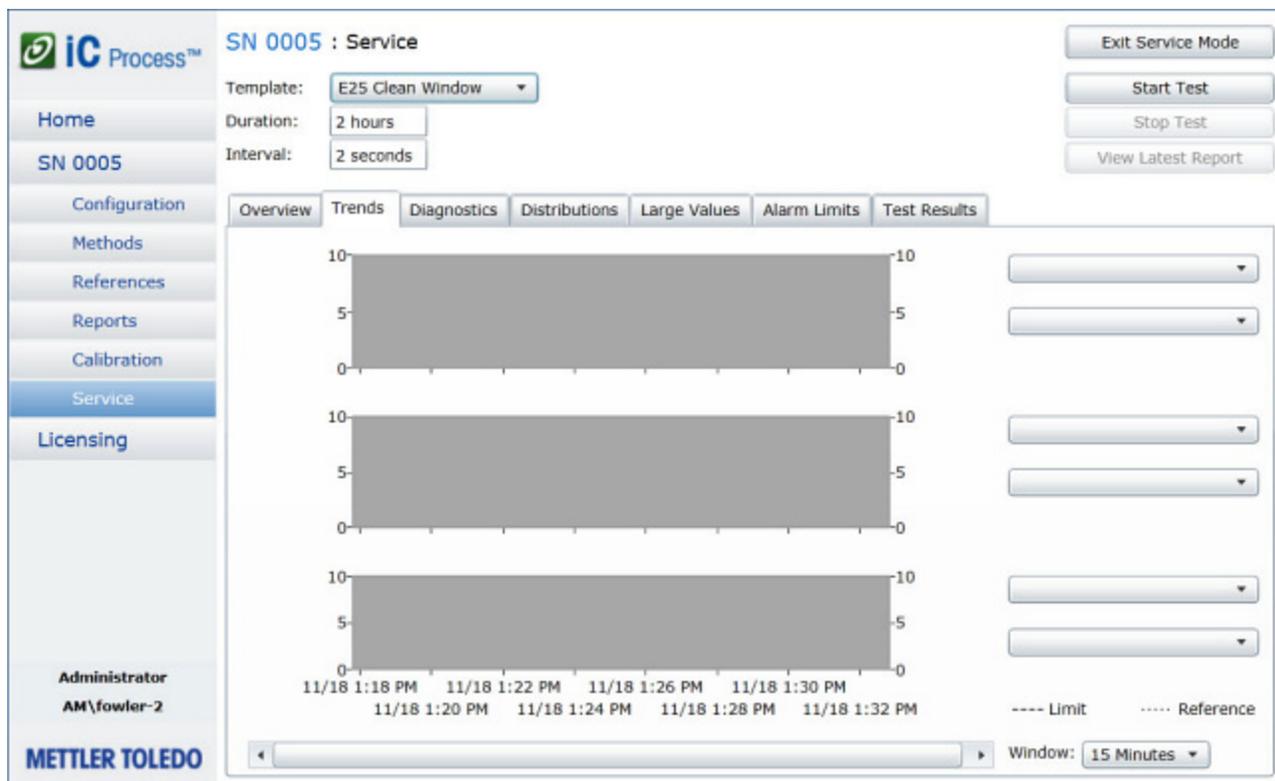

Figure 7-5 Service test template selection

2. Accept the default settings that come from the template, or adjust them as directed.

- Duration is the length of the overall test.
- Interval is the amount of time between measurements.

> **Note:** If you selected the System Check With Marker template, at this point, coat the window surface with a uniform, thick layer of ink and allow it to dry for two minutes.

3. Click **Start Test**.

4. Observe the test in process on one or more of the tabbed views.

Examples in the following section feature the Clean Window service test, and show an alarm condition (counts No Weight High).

Overview Tab

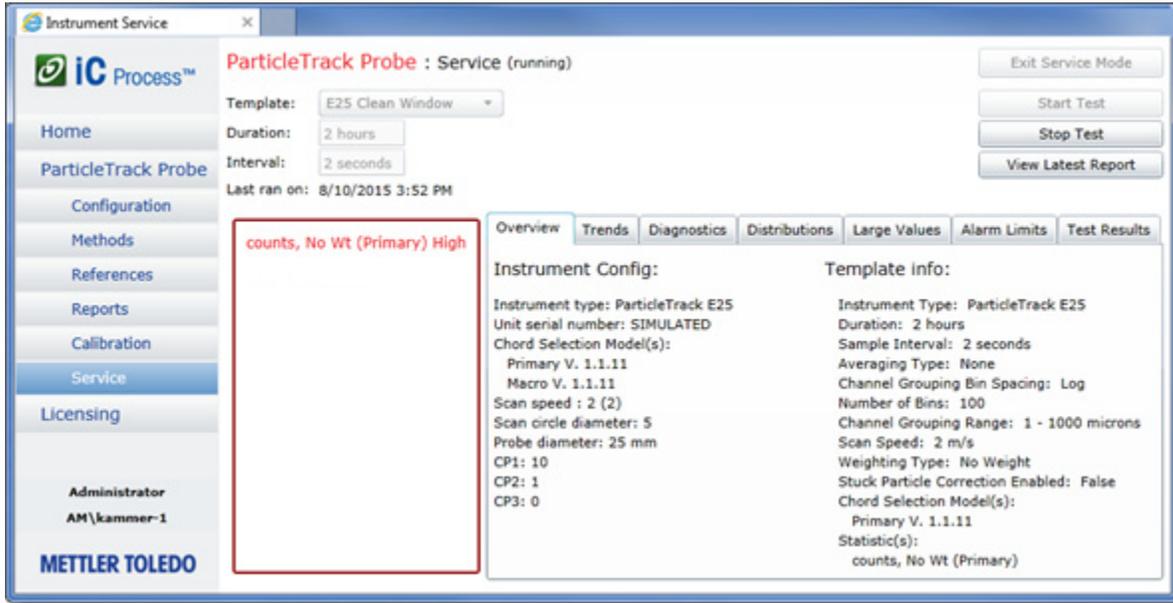For reference only, click the Overview tab to see template and instrument configuration details.

Figure 7-6 Service test— Clean Window (Overview tab)

Trends Tab

The Trends tab is the default view during service tests. Observe the trends and change the time window to see trends in 15- or 30-minute segments or 1- or 2-hour segments. If the counts fall outside the Alarm Limits set in the template, a warning message appears.
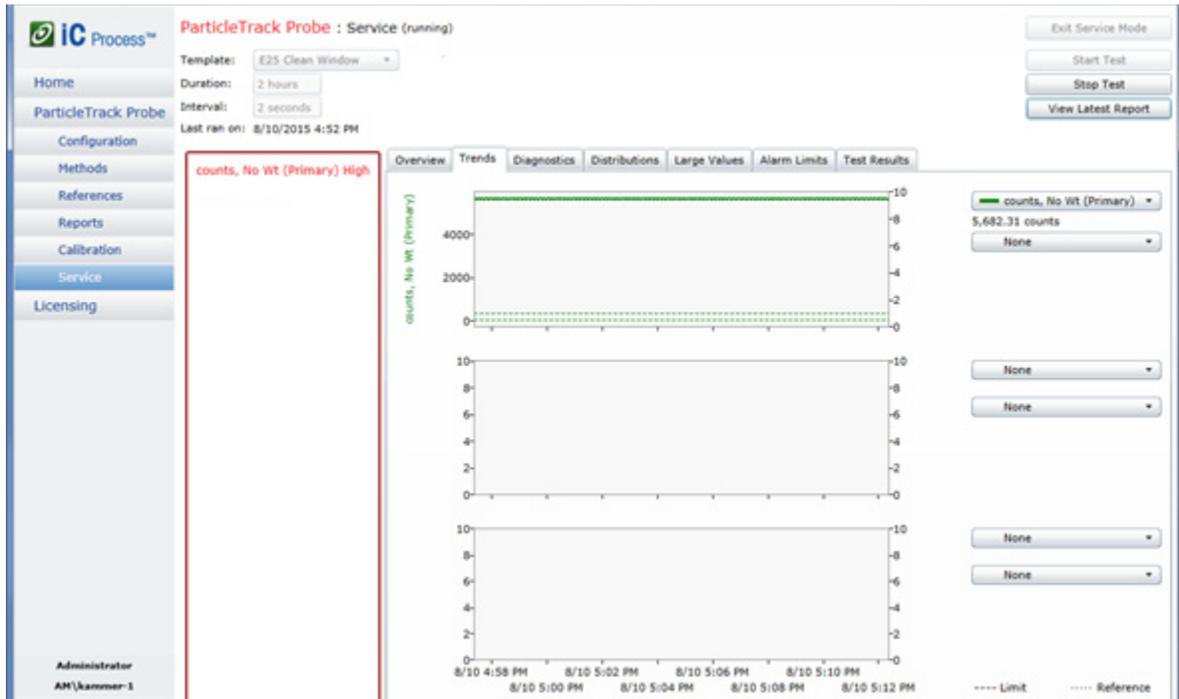

Figure 7-7 Service test—Clean Window (Tends tab)

Diagnostics Tab

The instrument diagnostics track all instrument values, six of which appear by default as set in the template. The values tracked for an instrument vary slightly among instrument types.

Notes:
- The Diagnostics tab in Service mode reports instrument health while the instrument is running service tests.
- Diagnostics are designed for trained field service engineers.
- The Diagnostics tab also appears to Administrators and Technicians in processing mode.

Refer to the Test Results tab (page 94) for details on the measurement units for each diagnostic along with the pass criteria. The Alarm Limits tabs include the low and high limits for each diagnostic value. Contact METTLER TOLEDO for service if diagnostics values are outside the limits (test fails).

To display another diagnostic in one of the graphs, select it from one of the two selection buttons to the right of the graph.
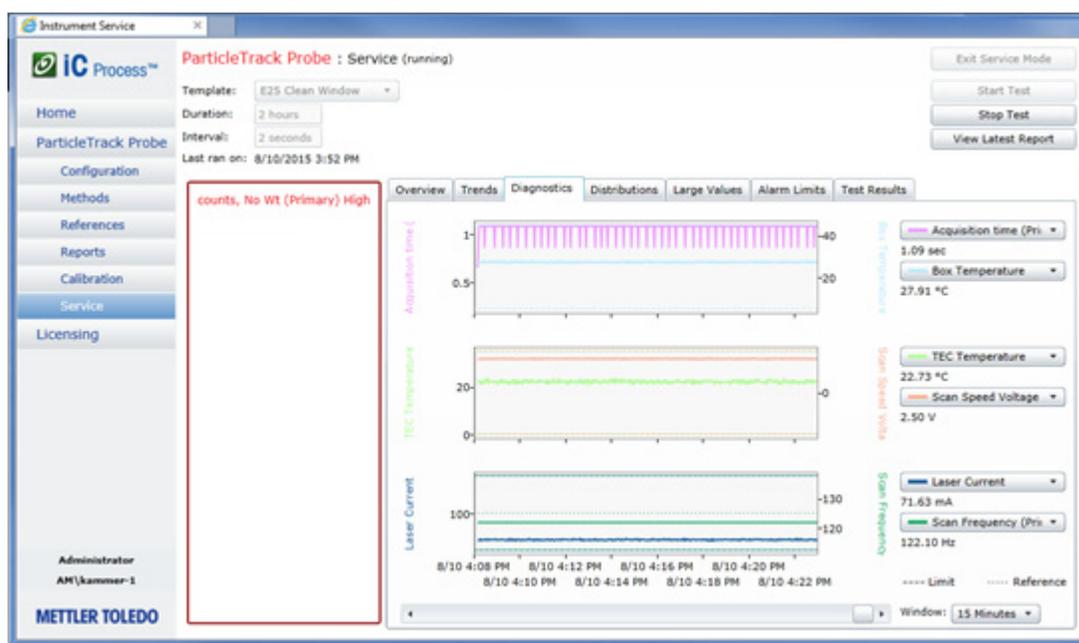

Figure 7-8 Service test—Clean Window (Diagnostics tab)

Distributions Tab

Click the Distributions tab to view the distributions graph for the current test. The counts according to the Chord Selection Model (CSM) in the template. The name of the CSM in use appears in parentheses after the distribution name.
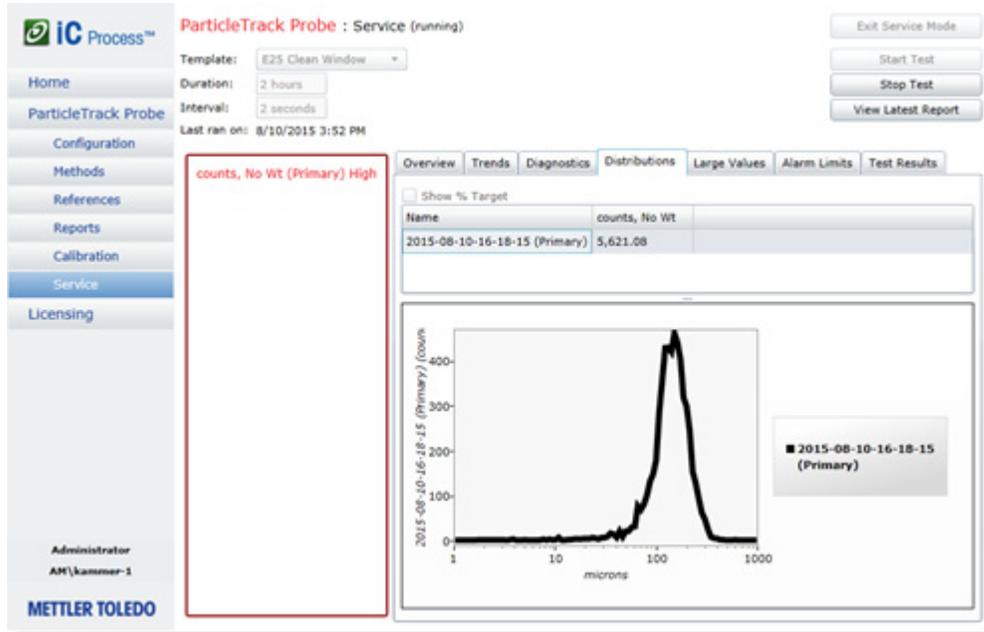

Figure 7-9 Service Test—Clean Window (Distributions tab)

Large Values Tab

Click the Large Values tab to display the counts and selected diagnostics in a size that is viewable from a distance.
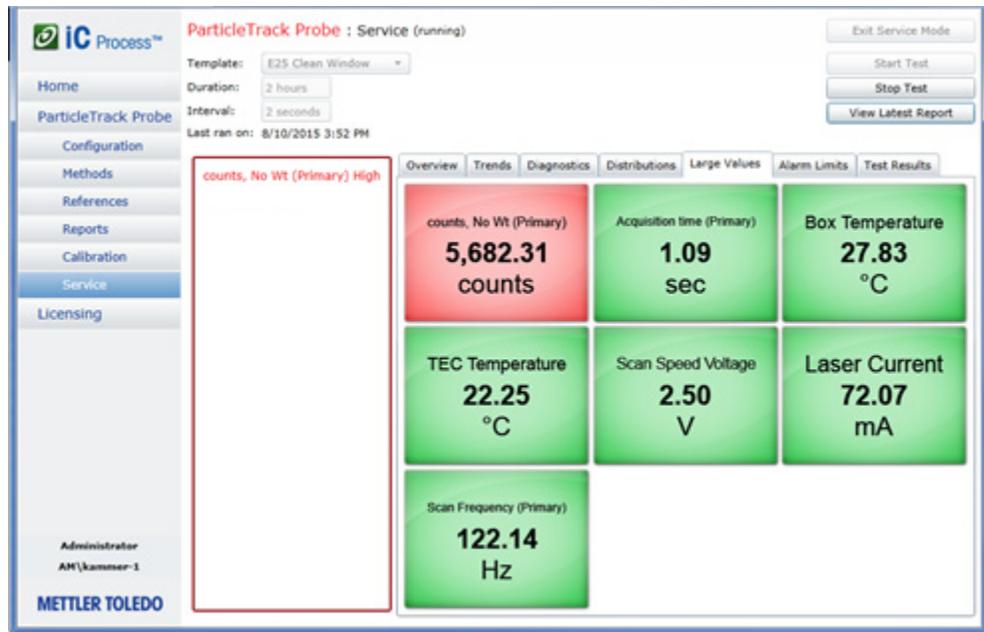

Figure 7-10 Service test—Clean Window (Large Values tab)

Alarm Limits Tab

Click the Alarm Limits tab to view the list of values in the service test along with the Low Limit and High Limit for each statistic and diagnostic.

Figure 7-11 Service test—Clean Window (Alarm Limits tab)

Test Results Tab

Click the Test Results tab to view the list of values in the service test along with the pass criteria for the statistic and diagnostics at the current point in the test. While the test is running, the current value displays dynamically and the Pass/Fail label identifies those results that are outside the pass criteria.

Note: These results are designed for trained field service engineers. Contact METTLER TOLEDO with any questions.
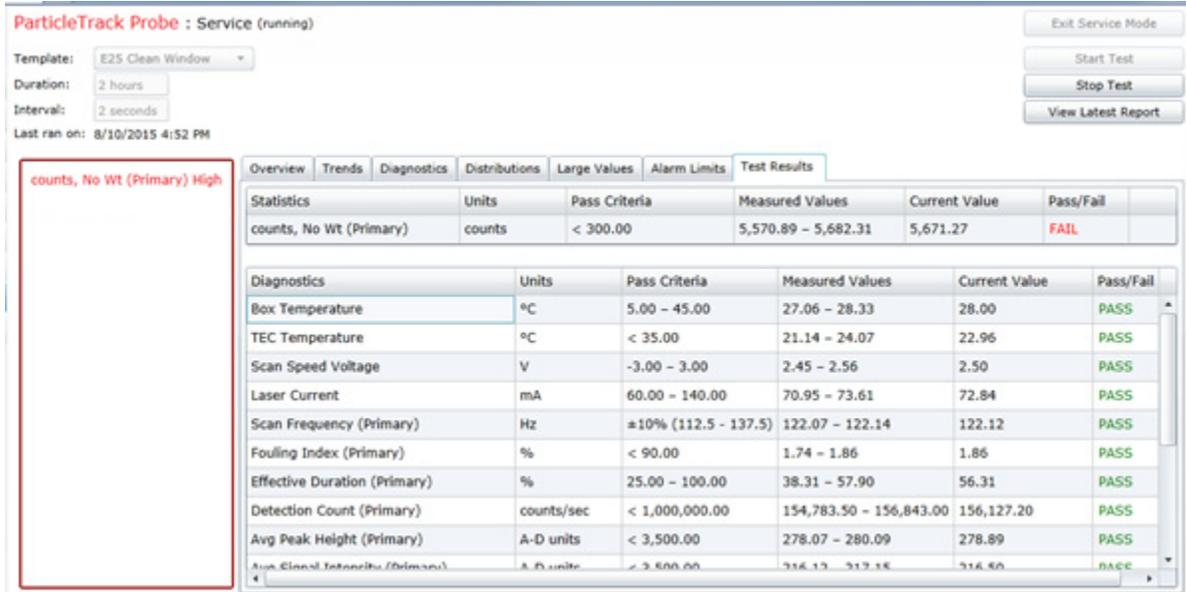

Figure 7-12 Service test—Clean Window (Test Results tab)

Reporting Service Test Results

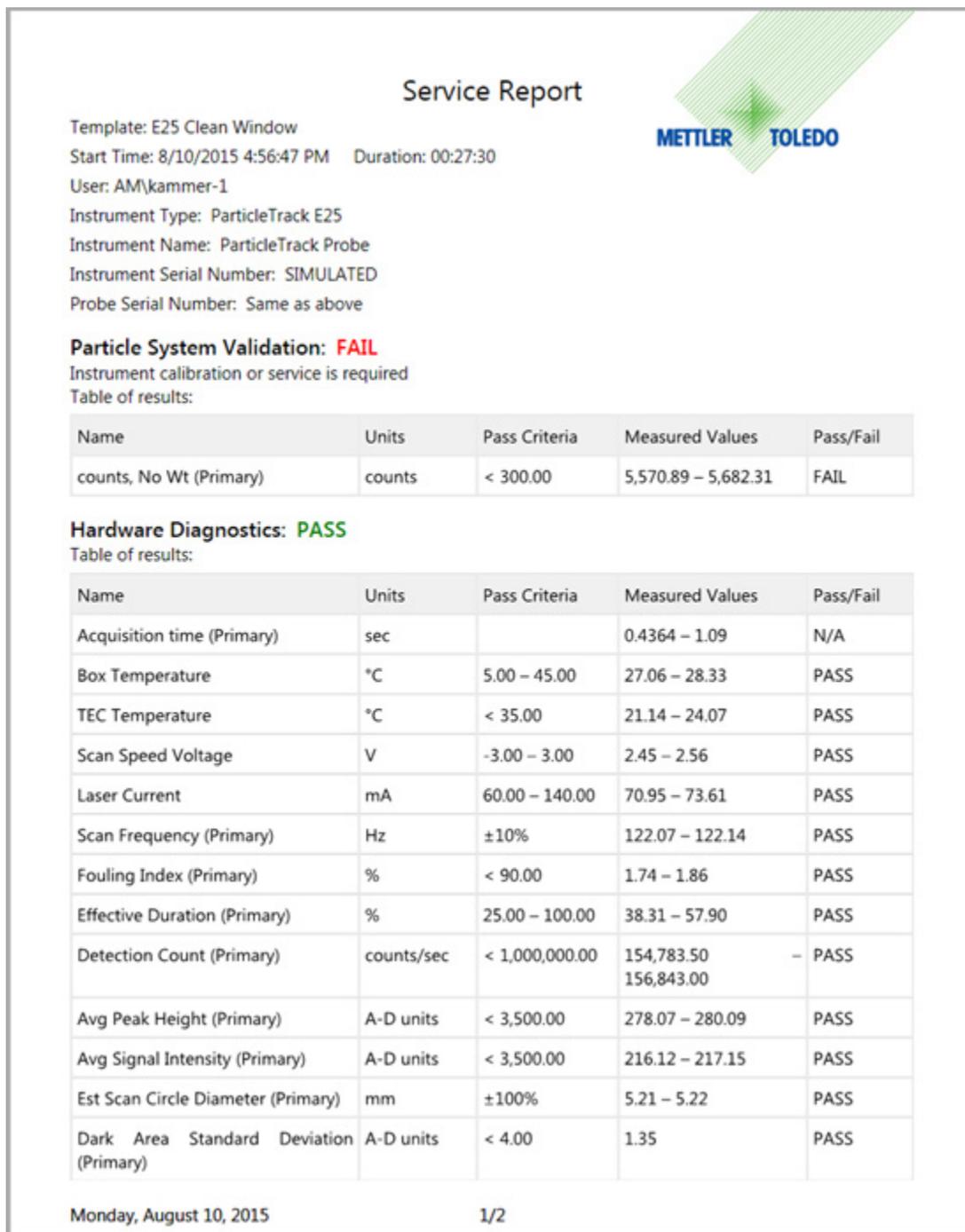Click **View Last Report** to see the results from the previous Service Test.

Service Report

Template: E25 Clean Window
Start Time: 8/10/2015 4:56:47 PM   Duration: 00:27:30
User: AM\kammer-1
Instrument Type: ParticleTrack E25
Instrument Name: ParticleTrack Probe
Instrument Serial Number: SIMULATED
Probe Serial Number: Same as above

METTLER TOLEDO

Particle System Validation: FAIL

Instrument calibration or service is required
Table of results:

Name	Units	Pass Criteria	Measured Values	Pass/Fail
counts, No Wt (Primary)	counts	< 300.00	5,570.89 – 5,682.31	FAIL

Hardware Diagnostics: PASS

Table of results:

Name	Units	Pass Criteria	Measured Values	Pass/Fail
Acquisition time (Primary)	sec		0.4364 – 1.09	N/A
Box Temperature	°C	5.00 – 45.00	27.06 – 28.33	PASS
TEC Temperature	°C	< 35.00	21.14 – 24.07	PASS
Scan Speed Voltage	V	-3.00 – 3.00	2.45 – 2.56	PASS
Laser Current	mA	60.00 – 140.00	70.95 – 73.61	PASS
Scan Frequency (Primary)	Hz	±10%	122.07 – 122.14	PASS
Fouling Index (Primary)	%	< 90.00	1.74 – 1.86	PASS
Effective Duration (Primary)	%	25.00 – 100.00	38.31 – 57.90	PASS
Detection Count (Primary)	counts/sec	< 1,000,000.00	154,783.50 – 156,843.00	PASS
Avg Peak Height (Primary)	A-D units	< 3,500.00	278.07 – 280.09	PASS
Avg Signal Intensity (Primary)	A-D units	< 3,500.00	216.12 – 217.15	PASS
Est Scan Circle Diameter (Primary)	mm	±100%	5.21 – 5.22	PASS
Dark Area Standard Deviation (Primary)	A-D units	< 4.00	1.35	PASS

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Figure 7-13 Service—Clean Window report (page 1)

Stuck Particle Correction (Primary)	%	< 100.00	0	PASS
Dark Area Mean (Primary)	A-D units	< 300.00	173.00	PASS
Algo Time per seg (Primary)	sec	< 10.00	0.1092 – 0.1466	PASS
Scan Circle Diameter (Primary)	mm	1.00 – 100.00	5.00	PASS
CP1 (Primary)		1.00 – 100.00	10.00	PASS

Instrument:

Instrument type: ParticleTrack E25
Unit serial number: SIMULATED
       Primary V. 1.1.11
       Macro V. 1.1.11
Scan speed: 2 m/s
Scan circle diameter: 5
Probe diameter: 25 mm
CP1: 10
CP2: 1
CP3: 0

Template:

Instrument Type: ParticleTrack E25
Duration: 2 hours
Sample Interval: 2 seconds
Averaging Type: None
Channel Grouping Bin Spacing: Log
Number of Bins: 100
Channel Grouping Range: 1 - 1000 microns
Scan Speed: 2 m/s
Weighting Type: No Weight
Stuck Particle Correction Enabled: False
Chord Selection Model(s):
       Primary V. 1.1.11
Statistic(s):
       counts, No Wt (Primary)

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Figure 7-14 Service—Clean Window report (page 2)

If the Clean Window test results in counts above the pass criteria, a red 'FAIL' appears in the Pass/Fail column under the Pass/Fail Validation section. Counts should be below the Pass Criteria value. Clean the probe window according to the instrument hardware manual and repeat the Clean Window test.

Ending Service Mode

Normally, a service test should run for the amount of time set in the template. However you can click **Stop Test** on the Service page to end a test at any time. Perform another service test or end Service mode as follows:
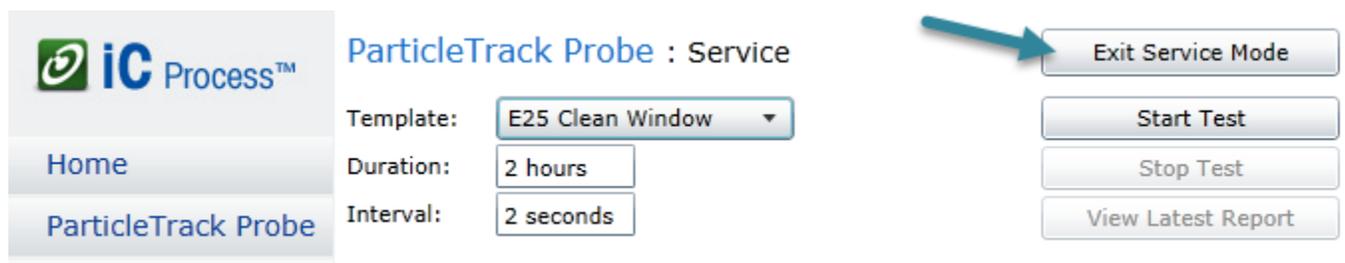
1. Click **Exit Service Mode**.

Figure 7-15 Exit Service Mode button

2. When the main Service page appears, click the instrument name from the left navigation menu to return to the main instrument page.

Service Reminders

The instrument Configuration includes automatic service reminders for overall instrument preventive maintenance and calibration validation. See page 22 for details about the three automatic reminders.

Figure 7-16   Service reminders in instrument configuration

Reminders about service appear on the Home page as shown in Figure D-4 on page 125.

About Calibration Tests

An Operator can run a Calibration Validation test to check instrument calibration and an Administrator or Technician can perform a System Calibration on instruments that have a micrometer. Refer to Chapter 5, "".

8

Using iC FBRM Software

This chapter describes how to access and use the 'Process' task pane in iC FBRMIt is primarily intended for advanced users such as a process engineer who performs post-process analysis and designs data treatments and statistical analysis in iC FBRM that will become templates for an iC Process method.

The iC FBRM™ software system works with the iC Process™ web application as follows:

- In iC FBRM, create custom templates to import for iC Process methods (optional).

- In iC FBRM, connect to an iC Process instrument through the 'Process' task pane to view process particle and droplet system in real time. The task pane must first be enabled by checking the 'Show iC Process task pane' option in Tools > Preferences.

- In iC FBRM, use tools to analyze iC Process web application batch and continuous run data in real time or from historical data files.

Note: Although iC FBRM can control a ParticleTrack G600 or ParticleTrack E25, instrument in a laboratory or scale-up environment, only one software application can control the instrument at the same time, so when iC Process is the control software, iC FBRM can only view the current run through the 'Process' task pane.

When both software programs are running at the same time, iC Process will take full control of the instrument.

The 'Process' task pane provides a seamless interface to the iC Process for FBRM server. Use of the iC Process task pane and the iC FBRM software assumes that you already have a working knowledge of iC FBRM software. Please refer to the iC FBRM online Help or the "iC FBRM Software User Guide" for information. Instructions on using the iC Process web application, are under "Operating iC Process for FBRM" on page 41. Information on how to configure an instrument and define a method are in "Implementing iC Process for FBRM" on page 15.

Starting iC FBRM Software

1. Start the iC FBRM software by clicking a desktop icon. **iC FBRM 4.4**
2. From the Toolbox on the right side of the Start Page, click the **Process** task pane.

Figure 8-1 Process task pane in iC FBRM Toolbox (Start Page)

Introducing the iC FBRM 'Process' Task Pane

The iC FBRM software toolbox includes a 'Process' task pane that provides connection to the iC Process web application and view/import features for the selected ParticleTrack instrument.
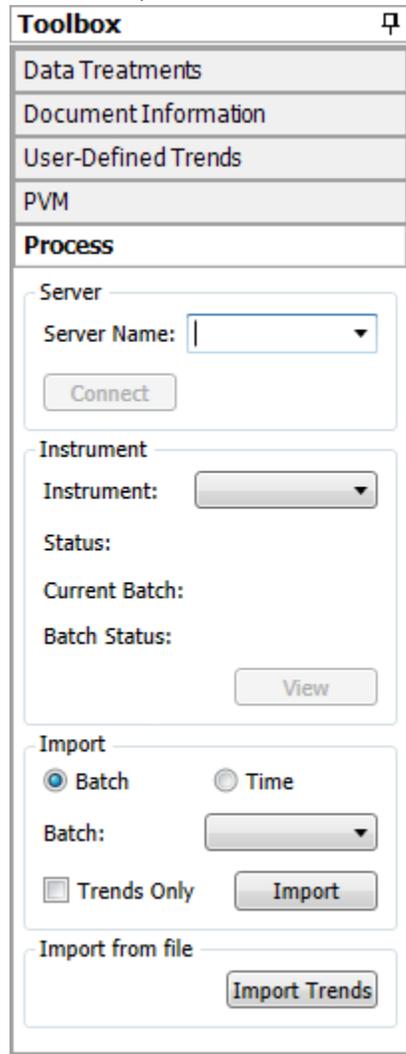

Figure 8-2 iC FBRM 'Process' task pane

The task pane has four sections—Server, Instrument, Import, and Import from file.

Note:	If the 'Process' task pane does not appear, go to Tools > Preferences and select the option to 'Show iC Process task pane.'

Using the Process Task Pane

Use the task pane to connect to, check instrument status, view real-time or batch processing data, import specific data, or import one or more trend files into a Result Set.

Connecting to Server

1. In the **Server Name** box, enter the network name of the network computer where the iC Process web application is running.
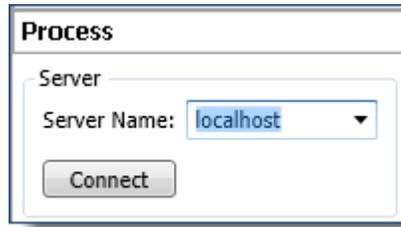

Figure 8-3 iC FBRM 'Process' task pane—Connect to server

- Initial identification—Enter the network name (URL/Machine ID or IP address) for the control computer (server) where iC Process web application is running.

  Note: If the iC FBRM and iC Process for FBRM are on the same computer, the server name is the PC name or 'localhost.'

- If you have already identified the server, select it from the list.
  After a successful connection, the network name will appear in a drop-down list for ease of selection the next time you want to connect.

2. Click **Connect**..

  Note: The server PC must be running iC Process, meaning the iC Process Service is started. By design, the service automatically starts after installation or after a computer restart.

Connecting to ParticleTrack or FBRM Process Instrument

1. In the Instrument section, choose the specific ParticleTrack G600 or ParticleTrack E25 instrument from the Instrument list.

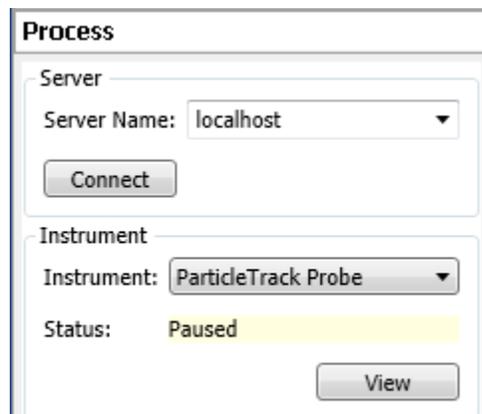 **Note:** The instrument does not have to be online to make the connection.

Figure 8-4 iC FBRM 'Process' task pane—Connect to instrument

2. The status of the instrument identifies it as in one of the following states:

Stopped—Instrument continuous or batch run has been stopped by an operator, administrator, or technician.

Online—Instrument is actively collecting and publishing particle or droplet system data to an external Modbus, OPC UA, or WITSML client.
If the instrument is in batch mode, the following information appears:

- **Batch Status** shows Running or Paused.
- **Current Batch** shows the batch name

Paused—Instrument is actively collecting, but not publishing data to an external client.

Service—Instrument is in service test mode to collect data for tests.

For information on the statuses that appear on the iC Process Home page, refer to Table 4-1 on page 43.

Monitoring iC Process Data In iC FBRM

Live data from an online iC Process instrument can be observed in real time in an iC FBRM experiment linked view. After you establish a connection with the iC Process server, the available instruments appear in the Instruments list. Select the instrument and observe the Status as described in step 2 on page 103.Online instruments display a green Status bar.
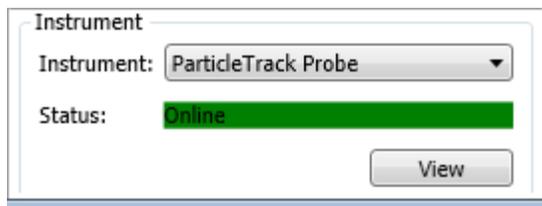

Figure 8-5   iC FBRM 'Process' task pane—Online

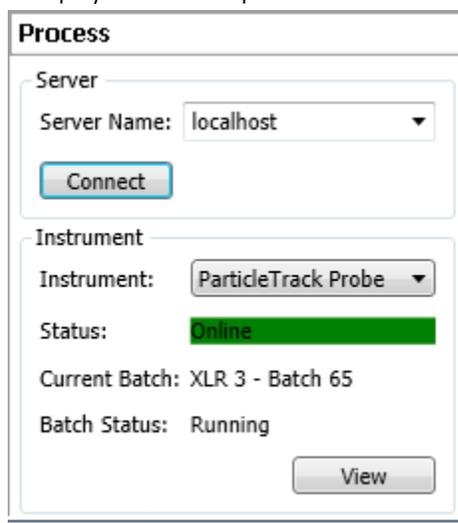Below is how the status displays for a batch process:

Figure 8-6   iC FBRM 'Process' task pane—Batch online

Note: A connection between the iC Process server and an instrument must first be established to view live data (see "Connecting to Server" on page 102).

Viewing Live Experiments in Real Time

Click **View** to display live data from the instrument. When the button is clicked, a new experiment is created in iC FBRM to display the live data from the instrument. The name of the experiment is based on the batch name or the continuous run date/time.

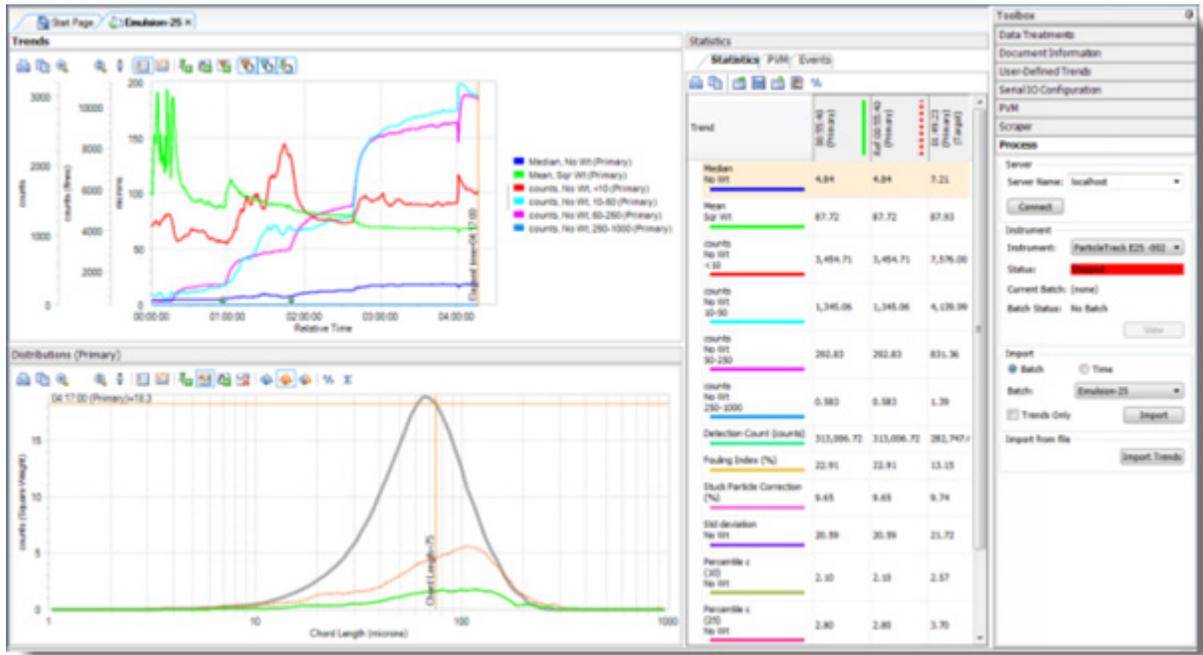**Note:** The **View** button is only enabled for online instruments.

Figure 8-7   iC Process data in a live iC FBRM experiment

When a batch is active, the experiment will start displaying live data from the instrument as distributions are measured.

# Importing iC Process Data in iC FBRM

Data from a completed iC Process batch or continuous run can be viewed in an iC FBRM experiment. To view data, a connection must be opened between the iC FBRM application and the iC Processs server (see "Connecting to Server" on page 102). Note that the instrument does not have to be online to import data.

The import process has different selection options for continuous data and batch data, as described next.

Continuous Data

To import continuous data:

1. In the Import section of the Process task pane, select **Time**.
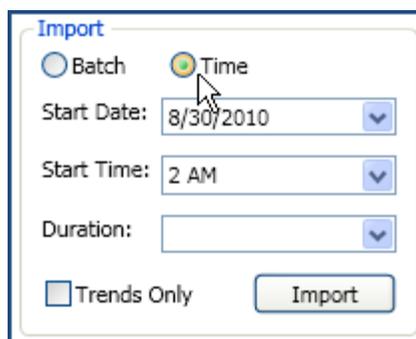
2. Select the **Start Date** of the run from the list. The list shows all dates (within the last 10 days) during which data has been collected for the instrument.

3. Select the **Start Time** for the segment of the continuous run data that you want to view.

4. In the **Duration** list, select the number of hours of data you want to view from the start time forward, up to a maximum of 24.
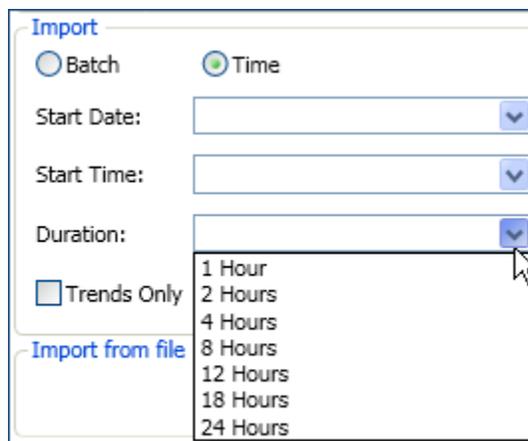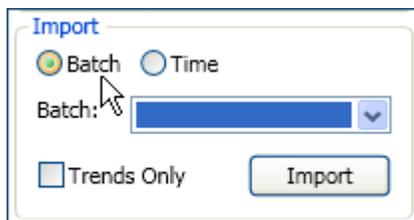
5. Click **Import** to display the process data from your time specification.

Data appears in a new iC FBRM experiment view where you can use the review and analysis features available in iC FBRM. Click 'Trends Only' to import trend data into a result set.
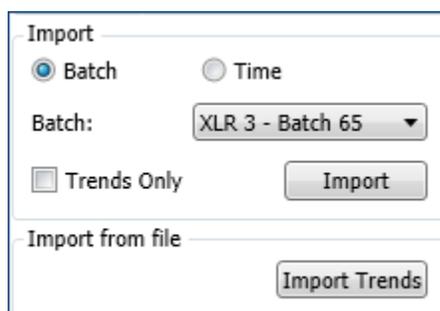
Batch Data

To import data from a completed batch:

1. In the Import section of the Process task pane, select **Batch**.

2. Select the **Batch** name from the list. The list shows all completed batches for the instrument that were started within the last ten days.

3. Click **Import**. A new experiment with the selected data opens in iC FBRM. The experiment name is based on the batch name.

Importing iC Process Trends to an iC FBRM Result Set

For continuous iC Process runs, you may want to view trends for a period of time exceeding the 10,800 measurement limit on iC FBRM archive experiments. There is no such limit for iC FBRM result sets. You can use the Import Trends feature to import trends from multiple *.icFBRM experiment files into a single iC FBRM result set. This is a two-phase process, except in a configuration where the iC Process server and iC FBRM are running on the same control computer. If iC FBRM is running on the same control computer as iC Process, the iC FBRM experiment files already exist as archive files, so Phase 1 does not apply.

PHASE 1: Import iC Process data.

1. Follow the instructions under "Importing iC Process Data in iC FBRM" on page 104 to import specific data. Typically, you would import data one date at a time for each date during the run.

2. Save the experiments on your local hard drive.

PHASE 2: Import batch trends from the saved experiments.

1. Click **Import Trends** on the iC Process task pane ("Import from file" section).

2. Select the files containing the desired trends.

3. Click **Open** to import the trends into a new Result Set.

A

Modbus DCS with iC Process for FBRM

This appendix provides Modbus data model information to assist you in using the iC Process for FBRM with your Distributed Control System (DCS).

iC Process includes a Modbus TCP interface. In Modbus terms, iC Process acts as a "slave" in that it listens for requests from "Modbus masters" and replies to those requests.

iC Process will host a separate instance of a "Modbus slave" for each probe. When a probe is configured, the Administrator assigns a unique "slave ID", which is a number between 1 and 254. If the Administrator does not wish to host a slave for a probe, then the probe can be configured with a "slave ID" of 0 (default).

Each slave (probe) exposes a series of registers that can be written to and read from by a Modbus master. The Modbus standard defines four types of registers with specific data sizes (bit or word) and access rules (read-only or read/write).

Note: The iC Process implementation of the Modbus interface includes support for all four types of registers, but for historical reasons, will not use registers in the 3xxxx range.

The following tables summarizes the Modbus register types, along with the data type and the type of access allowed from a "Modbus master." The table also identifies the valid addressing range for each register type, and the subset of that range that is actually supported by the iC Process implementation.

Table A-1 Modbus Register Types (Primary Tables)

Primary Tables	Data Type	Master Access	Modbus Register Range	iC Process Register Range	Modbus Protocol Range and Packet Address Offset
Coils	Single bit	Read–Write	1–10000	1–100	0–99 (offset=1)
Discrete inputs	Single bit	Read–Only	10001–20000	10001–10100	0–99 (offset=10001)
Input Registers	16-bit word	Read–Only	30001–40000	Not used	Not used
Holding Registers	16-bit word	Read–Write	40001 and up	40001–41078	0–1076 (offset=40001)

The iC Process Modbus interface is based on the TCP/IP protocol. The interface always listens on **port 502**—the standard port reserved for Modbus.

Mapping Each Register for iC Process

The master can 'command' the slave to perform a predefined action by writing a value (0 or 1) to a specific register location.

The master can do the following actions:

■ Determine the current status of a probe by reading the values of specific predefined discrete register locations. This includes an operational and a fault bit for each subsystem, as well as an overall operation and fault status of all subsystems.

■ Obtain measured values, lo limits, and hi limits by reading register pairs of 16-bit registers and converting the resulting value to an IEEE floating point number. The Administrator can map which value or limit is assigned to each register pair. There are 50 pairs of registers available for mapping.

■ Obtain diagnostic values, each of which is also stored in a register pair and can be converted to an IEEE floating point number. The ParticleTrack G600 or ParticleTrack E25 devices support different subsets of the range of all diagnostic values.

■ Provide input to a QUANT model by writing register pairs of 16-bit registers. The Administrator can map which register pair is assigned to each QUANT model input. There are 50 pairs of registers available for mapping.

The input register values (trend values and diagnostic values) are typically updated whenever the instrument is online. However, if the instrument is paused and the interface has been configured to **Hold Last Value** (see configuration setting on), then the interface will continue to return the last value before the instrument was paused.

For example, assume a value is stored in a pair of holding registers 42001/42002 for a slave with a slave address of 1. The offset to the first register of the pair is (42001 − 40001 = 2000). Therefore, a Modbus request packet to read this register should specify a holding register with an address of 2000, as follows:

Table A-2   Example of a Modbus Request Packet

01	(slave address = 1)
03	(read holding registers function code = 3)
07	(register address = 2000) (0720 hex)
20	
00	(number of registers = 2) (0002 hex)
02	

The Modbus interface stores the value of Pi (3.14159) in holding register pair 42001/42002 as a means to verify that a Modbus master is correctly formatting read requests for register pairs and correctly converting the returned data into a floating point value.

Coils (1–10000)

The coils are used by the master to command the slave.

Table A-3 Modbus Coils (1–10000)—Used by Master to Command Slave

Register #	Coil Offset	Use	Explanation
1	0	**Start run**	Starts a new run with the currently loaded method. Method must already be loaded to the probe.
2	1	**Pause run**	Pauses the currently active run. Instrument must be online to pause a run.
3	2	**Resume run**	Resumes a paused run. Instrument must be online and paused to resume a run.
4	3	**Stop run**	Stops an active or paused run. Instrument must be online to stop a run.

Table A-3 Modbus Coils (1–10000)—Used by Master to Command Slave

Register #	Coil Offset	Use	Explanation
5	4	**Start batch**	Starts a batch, if and only if the probe is running and there is not currently a batch in progress. The name of the batch is automatically determined by iC Process
6	5	**Stop batch**	Stops a currently running batch. Instrument must be online with a batch running to stop a run.
7–100	6–99	**unused**	

Note:

The application configuration file (**iCProcessFBRMServiceHost.exe.config**) includes a setting option to require that all coils make a 0-to-1 transition in order to trigger. This option is off ('False') by default. For systems that constantly write values, change the value of this setting to '**True**' to only trigger a corresponding function on a 0-to-1 transition.

```
</setting>
  <setting name="ModbusCoilsTriggerOnlyOnTransition"
  serializeAs="String">
  <value>False</value>
</setting>
```

Discrete Inputs (10001–20000)

The discrete inputs are used by the master to determine the current state of the slave.

Table A-4 Modbus Discrete Inputs (10001–20000)

Register #	Coil Offset	Use	Explanation
10001	0	**Heartbeat**	This value toggles between 0 and 1 every second to indicate the iC Process software and Modbus slave interface are active.
10002	1	**Online**	Set to TRUE when the probe is online or FALSE when the probe is in Service mode or offline.
10003	2	**Service**	Set to TRUE if and only if the probe is in Service mode.
10004	3	**Paused**	Set to TRUE when the probe is online and a run is active, but paused.
10005	4	**Batch Active**	Set to TRUE when a batch is active. The value is set to TRUE even if the batch is currently paused.
10006	5	**Acquisition**	Set to TRUE when an acquisition is in progress (or is about to occur).
10007	6	**Communication**	Set to TRUE when the instrument can communicate with the server.
10008–10009	7–8	**unused**	
10010	9	**System operational**	Set to TRUE if none of the "fault" bits are set to TRUE—indicating there are no faults.
10011	10	**System fault**	Set to TRUE if one or more of the "fault" bits are set to TRUE—indicating there is at least one fault.
10012	11	**Acquisition operational**	Set to TRUE when the acquisition subsystem is operational (not faulted).

Register #	Coil Offset	Use	Explanation
10013	12	**Acquisition fault**	Set to TRUE when the acquisition subsystem is faulted.
10014	13	**Diagnostics operational**	Set to TRUE when the diagnostic subsystem is operational (not faulted).
10015	14	**Diagnostics fault**	Set to TRUE when the diagnostics subsystem is faulted.
10016	15	**Server operational**	Set to TRUE when the iC Process server is fully operational (not faulted).
10017	16	**Server fault**	Set to TRUE when the iC Process server is faulted (for example, low on disk space).
10018–10100	17–99	**unused**	

Holding Registers (40001–50000)

The holding registers are used by the master to retrieve floating point values, lo limits, and diagnostic values from the slave, and to provide QUANT model inputs to the slave.

Table A-5 Modbus Holding Registers (40001–50000)

Register #	Holding Register Pair Offset	Use	Explanation
40001 / 40002	0	**User maps to value, lo limit, or hi limit**	The pair of registers is used to store an IEEE format 32-bit floating point number. First register stores first two-bytes of the floating point value; second register stores last two bytes of the floating point value.
40003 / 40004	2		
...			
40099 / 40100	98	**User maps to value, lo limit, or hi limit**	This is the last of the 50 pairs of registers available for the user to map a process value, lo limit, or hi limit. In all cases, the mapped value is an IEEE format 32-bit floating point number.
40101 / 41000	100–999	**unused**	
41001 / 41002	1000	**Box Temperature Index**	
41003 / 41004	1002	**TEC Temperature**	
41005 / 41006	1004	**Scan Speed Voltage**	
41007 / 41008	1006	**Laser Current**	
41009 / 41010	1008	**Probe Voltage**	
41011 / 41012	1010	**Air Pressure**	For ParticleTrack G600 only
41013 / 41014	1012	**unused**	
Primary:			
41021 / 41022	1020	**unused**	
41023 / 41024	1022	**unused**	
41025 / 41026	1024	**Stuck Particle Scan Circle Percentage Index**	
41027 / 41028	1026	**unused**	
41029 / 41030	1028	**Effective Duration**	

Register #	Holding Register Pair Offset	Use	Explanation
41031 / 41032	1030	**Maxima Count**	
41033 / 41034	1032	**Average Peak Height**	
41035 / 41036	1034	**Average Signal Intensity**	
41037 / 41038	1036	**Est Scan Circle Diameter**	
41039 / 41040	1038	**Dark Area Std Dev**	
41041 / 41042	1040	**Stuck Particle Correction**	
41043 / 41044	1042	**Dark Area Mean**	
41045 / 41046	1044	**Algo Time Per Seg**	
41047 / 41048	1046	**Acquisition Time**	
41049 / 41050	1048	**unused**	
Macro:			
41051 / 41052	1050	**unused**	
41053 / 41054	1052	**unused**	
41055 / 41056	1054	**Stuck Particle Scan Circle Percentage Index**	
41057 / 41058	1056	**unused**	
41059 / 41060	1058	**Effective Duration**	
41061 / 41062	1060	**Maxima Count**	
41063 / 41064	1062	**Average Peak Height**	
41065 / 41066	1064	**Average Signal Intensity**	
41067 / 41068	1066	**Est Scan Circle Diameter**	
41069 / 41070	1068	**Dark Area Std Dev**	
41071 / 41072	1070	**Stuck Particle Correction**	
41073 / 41074	1072	**Dark Area Mean**	
41075 / 41076	1074	**Algo Time Per Seg**	
41077 / 41078	1076	**Acquisition Time**	
41079 / 41200	1078–1199	**unused**	
42001 / 42002	2000	**Stores the value of Pi (3.141593)**	This pair of registers is used to store a known value (Pi) so a Modbus master can verify that it is correctly converting a pair of 16-bit registers into a floating point value.

Modbus Block Summary

Below is a table that lists register block numbers with descriptions:

Table A-6 Modbus Register Block Summary

Register Block	Register Type	Data Type	Use
1–100	Coils	Bit	Used by the master to **command specific events**.
10001–10100	Discrete inputs	Bit	Read by the master to obtain **status**, including operational and fault bits.
40001–40100	Input registers	IEE floating (two registers per value)	Read by the master to obtain **trend values** and **alarm limits**.
41001–41100	Input registers	IEE floating (two registers per value)	Read by the master to obtain **diagnostic values**.
42001–42002	Input registers	IEE floating (two registers)	Contains value of PI (3.14153) to verify that master has correct mapping/float conversion algorithm.

User Interface Mapping Screen

Below is a table that lists register block numbers used by an Administrator or Technician to map process variables to trends in the :

Table A-7 User Interface Mapping Screen—Process Variables

Index	Modbus Register	OPC Name	User-Selected Mapping
1	40001 / 40002	ProcessVariable**1**	(combo box with selected value or limit)
2	40003 / 40004	ProcessVariable**2**	
3	40005 / 40006	ProcessVariable**3**	
4	40007 / 40008	ProcessVariable**4**	
5	40009 / 40010	ProcessVariable**5**	
6	40011 / 40012	ProcessVariable**6**	
7	40013 / 40014	ProcessVariable**7**	
...			
50	40099 / 40100	ProcessVariable**50**	

B

OPC UA Server with iC Process for FBRM

This appendix introduces the OPC Unified Architecture (UA) framework that iC Process for FBRM supports for process control. It provides OPC UA address space details for iC Process for FBRM along with sample code that enables the OPC UA Developer from your IT department to set up iC Process for FBRM in the OPC UA framework.

Facts About OPC UA

The iC Process OPC UA Server is an OPC UA Server embedded within iC Process for FBRM. The iC Process OPC UA Server runs within the context of the iC Process for FBRM server, not as a separate process.

Note: By default, the server is not included (started) as part of the server. Before implementing the OPC UA, refer to the "iC Process for FBRM Install Guide for Administrators" for instructions on how to start the OPC UA server.

After connecting to the server, an OPC UA client can perform the following actions in iC Process for FBRM:

■ Load and run an approved method

■ Start, stop, pause, and resume a probe run

■ Start or stop a batch run

■ Optain current probe status

■ Obtain diagnostic values

■ Read process variables mapped within a method

■ Read weighted and unweighted distributions for default and alternate CSMs

Within the iC Process Web application, an administrator maps process variables to trends for a specific method, During a batch or continuous process, the trends output to OPC UA as process variables. Refer to Chapter 3, "Implementing iC Process for FBRM" starting under "External Output Tab" on page 33.

Address Space (Data Model)

OPC UA Server is not an OPC UA ADI compliant server. That is, it does not implement the ADI address model as defined by the OPC specification for analyzer devices. It is a valid OPC UA server, and therefore, an OPC UA compliant client application (such as Opc.Ua.SampleClient.exe) can connect to and use the capabilities of the server. However, to effectively use the server, the developer of a client application needs to understand the address space (data model) of the iC Process OPC UA Server.

The OPC UA address space for iC Process for FBRM (defined in Table B-1) includes the following standard objects available within any OPC UA server:

Root Object

The root object in the address space is named 'Objects'. The 'Objects' node parents a standard 'Server' object and a 'Probes' object.

Probes Object

The 'Probes' object is the root node of the custom address space of the iC Process OPC UA Server.

The Probes object parents a folder node for each probe of each defined instrument and the folder node is named according to the instrument and probe name.

Data Model for iC Process for FBRM

The diagram in Figure B-1 shows the highest level nodes of the address space for an iC Process for FBRM system that includes two instruments, a single probe instrument named 'TestOpcInstrument' and an instrument named 'MyInstrument.' In Figure B-1, the display name, type, and unique Node ID are displayed for each node.
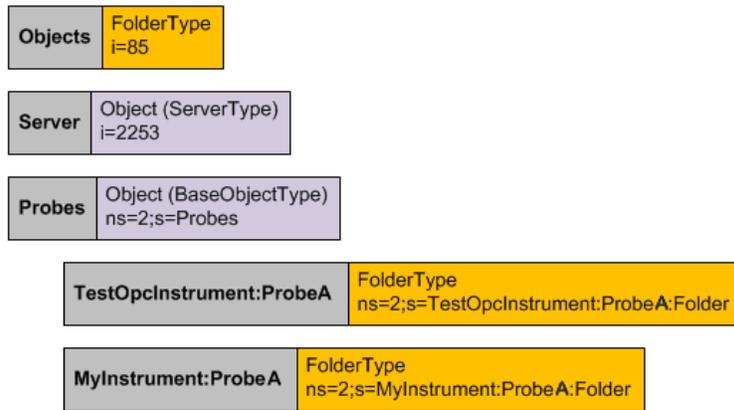
Figure B-1 Data model for iC Process OPC UA Server

Each of the probes displayed in Figure B-1 contains a series of nodes, and each node is named according to its purpose. Table B-1 defines the address space for iC Process for FBRM. The table lists the hierarchy of nodes available for each probe, including the ID for each node. The node ID is unique for each node because it is based upon the probe name.

Note: The 'Probe Tip Temperature' diagnostic applies only to the ParticleTrack E25 instrument and the 'Air Pressure' diagnostic applies only to the ParticleTrack G600 instrument.

Table B-1 OPC UA Address Space for iC Process for FBRM

Display Name	Data Type	Node ID	Write	Permissive (from user role)	Range of values
Probes	Object	ns=2;s=Probes			
MyInstrument	Folder	ns=2;s=MyInstrument:ProbeA:Folder			
Probe Status	Variable (string)	ns=2;s=MyInstrument:ProbeA:ProbeStatus			Offline, Service, Paused, Online
Batch status	Variable (string)	ns=2;s=MyInstrument:ProbeA:BatchStatus			Active, Inactive
Acquisition Status	Variable (string)	ns=2;s=MyInstrument:ProbeA: AcquisitionStatus			Acquiring, Not acquiring
Acquisition Subsystem	Variable (string)	ns=2;s=MyInstrument:ProbeA: AcquisitionSubsystem			Faulted, Operational
Diagnostics Subsystem	Variable (string)	ns=2;s=MyInstrument:ProbeA: DiagnosticsSubsystem			Faulted, Operational
Server Subsystem	Variable (string)	ns=2;s=MyInstrument:ProbeA: ServerSubsystem			Faulted, Operational
Weighted Distribution (Default CSM)	Variable (YArrayItemType)	ns=2;s=MyInstrument:ProbeA: WeightedDistribution(DefaultCSM)			
Unweighted Distribution (Default CSM)	Variable (YArrayItemType)	ns=2;s=MyInstrument:ProbeA: UnweightedDistribution(DefaultCSM)			
Weighted Distribution (Alternate CSM)	Variable (YArrayItemType)	ns=2;s=MyInstrument:ProbeA: WeightedDistribution(AlternateCSM)			
Unweighted Distribution (Alternate CSM)	Variable (YArrayItemType)	ns=2;s=MyInstrument:ProbeA: UnweightedDistribution(AlternateCSM)			
Available Methods	Variable (string[])	ns=2;s=MyInstrument:ProbeA: AvailableMethods			
Run	Method	ns=2;s=MyInstrument:ProbeA:Run		Select Method	
InputArguments (For Run)	Argument (string)	ns=2;s=MyInstrument: ProbeA: Run.InputArguments	X		
Start	Method	ns=2;s=MyInstrument:ProbeA:Start		Select Method	
Stop	Method	ns=2;s=MyInstrument:ProbeA:Stop		Select Method	
Pause	Method	ns=2;s=MyInstrument:ProbeA:Pause		Pause Run	
Resume	Method	ns=2;s=MyInstrument:ProbeA:Resume		Resume Run	
Start Batch	Method	ns=2;s=MyInstrument:ProbeA:StartBatch		Start Batch	
Input Arguments (for Start Batch)	Argument (string)	ns=2;s=MyInstrument:ProbeA: StartBatch.InputArguments	X		
Stop Batch	Method	ns=2;s=MyInstrument:ProbeA:StopBatch		Stop Batch	
Diagnostics	Folder	ns=2;s=MyInstrument:ProbeA:Diagnostics			
Box Temperature	Variable (double)	ns=2;s=MyInstrument:ProbeA: Diagnostics.BoxTemperature			
TEC Temperature	Variable (double)	ns=2;s=MyInstrument:ProbeA: Diagnostics.TECTemperature			

Table B-1 OPC UA Address Space for iC Process for FBRM (continued)

Display Name	Data Type	Node ID	Write	Permissive (from user role)	Range of values
Scan Speed Voltage	Variable (double)	ns=2;s=MyInstrument:ProbeA: Diagnostics.ScanSpeedVoltage			
Laser Current	Variable (double)	ns=2;s=MyInstrument:ProbeA: Diagnostics.LaserCurrent			
Probe Voltage	Variable (double)	ns=2;s=MyInstrument:ProbeA: Diagnostics.ProbeVoltaget			
Air Pressure	Variable (double)	ns=2;s=MyInstrument:ProbeA: Diagnostics.AirPressure			
Primary CSM:					
Scan Frequency (Primary)	Variable (double)	ns=2;s=MyInstrument:ProbeA: Diagnostics.ScanFrequency(Primary)			
Fouling Index (Primary)	Variable (double)	ns=2;s=MyInstrument:ProbeA: Diagnostics.FoulingIndex(Primary)			
Effective Duration (Primary)	Variable (double)	ns=2;s=MyInstrument:ProbeA: Diagnostics.EffectiveDuration(Primary)			
Detection Count (Primary)	Variable (double)	ns=2;s=MyInstrument:ProbeA: Diagnostics.DetectionCount(Primary)			
Avg Peak Height (Primary)	Variable (double)	ns=2;s=MyInstrument:ProbeA: Diagnostics.AvgPeakHeight(Primary)			
Avg Signal Intensity (Primary)	Variable (double)	ns=2;s=MyInstrument:ProbeA: Diagnostics.AvgSignalIntensity(Primary)			
Est Scan Circle Diameter (Primary)	Variable (double)	ns=2;s=MyInstrument:ProbeA: Diagnostics.EstScanCircleDiameter(Primary)			
Dark Area Standard Deviation (Primary)	Variable (double)	ns=2;s=MyInstrument:ProbeA: Diagnostics.DarkAreaStandardDeviation(Primary)			
Stuck Particle Correction (Primary)	Variable (double)	ns=2;s=MyInstrument:ProbeA: Diagnostics.StuckParticleCorrection(Primary)			
Dark Area Mean (Primary)	Variable (double)	ns=2;s=MyInstrument:ProbeA: Diagnostics.DarkAreaMean(Primary)			
Algo Time per seg (Primary)	Variable (double)	ns=2;s=MyInstrument:ProbeA: Diagnostics.AlgoTimeperseg(Primary)			
Acquisition time (Primary)	Variable (double)	ns=2;s=MyInstrument:ProbeA: Diagnostics.Acquisitiontime(Primary)			
CP1 (Primary)	Variable (double)	ns=2;s=MyInstrument:ProbeA: Diagnostics.CP1(Primary)			
Scan Circle Diameter (Primary)	Variable (double)	ns=2;s=MyInstrument:ProbeA: Diagnostics.ScanCircleDiameter(Primary)			
Macro CSM:					
Scan Frequency (Macro)	Variable (double)	ns=2;s=MyInstrument:ProbeA: Diagnostics.ScanFrequency(Macro)			
Fouling Index (Macro)	Variable (double)	ns=2;s=MyInstrument:ProbeA: Diagnostics.FoulingIndex(Macro)			
Effective Duration (Macro)	Variable (double)	ns=2;s=MyInstrument:ProbeA: Diagnostics.EffectiveDuration(Macro)			
Detection Count (Macro)	Variable (double)	ns=2;s=MyInstrument:ProbeA: Diagnostics.DetectionCount(Macro)			
Avg Peak Height (Macro)	Variable (double)	ns=2;s=MyInstrument:ProbeA: Diagnostics.AvgPeakHeight(Macro)			
Avg Signal Intensity (Macro)	Variable (double)	ns=2;s=MyInstrument:ProbeA: Diagnostics.AvgSignalIntensity(Macro)			
Est Scan Circle Diameter (Macro)	Variable (double)	ns=2;s=MyInstrument:ProbeA: Diagnostics.EstScanCircleDiameter(Macro)			

Display Name	Data Type	Node ID	Write	Permissive (from user role)	Range of values
Dark Area Standard Deviation (Macro)	Variable (double)	ns=2;s=MyInstrument:ProbeA: Diagnostics.DarkAreaStandardDeviation(Macro)			
Stuck Particle Correction (Macro)	Variable (double)	ns=2;s=MyInstrument:ProbeA: Diagnostics.StuckParticleCorrection(Macro)			
Dark Area Mean (Macro)	Variable (double)	ns=2;s=MyInstrument:ProbeA: Diagnostics.DarkAreaMean(Macro)			
Algo Time per seg (Macro)	Variable (double)	ns=2;s=MyInstrument:ProbeA: Diagnostics.AlgoTimeperseg(Macro)			
Acquisition time (Macro)	Variable (double)	ns=2;s=MyInstrument:ProbeA: Diagnostics.Acquisitiontime(Macro)			
CP1 (Macro)	Variable (double)	ns=2;s=MyInstrument:ProbeA: Diagnostics.CP1(Macro)			
Scan Circle Diameter (Macro)	Variable (double)	ns=2;s=MyInstrument:ProbeA: Diagnostics.ScanCircleDiameter(Macro)			
Method	Folder	ns=2;s=MyInstrument:ProbeA:Method			
Current Method	Variable (string)	ns=2;s=MyInstrument:ProbeA: Method.CurrentMethod			
Outputs	Folder	ns=2;s=MyInstrument:ProbeA:Method.Outputs			
ProcessVariable1	Variable (double)	ns=2;s=MyInstrument:ProbeA: Method.Outputs.ProcessVariable1			
Name (for ProcessVariable1)	Variable (string)	ns=2;s=MyInstrument:ProbeA: Method.Outputs.ProcessVariable1.Name			
ProcessVariable2	Variable (double)	ns=2;s=MyInstrument:ProbeA: Method.Outputs.ProcessVariable2			
Name (for ProcessVariable2)	Variable (string)	ns=2;s=MyInstrument:ProbeA: Method.Outputs.ProcessVariable2.Name			
...					
ProcessVariable50	Variable (string)	ns=2;s=MyInstrument:ProbeA: Method.Outputs.ProcessVariable50			
Name (for ProcessVariable50)	Variable (string)	ns=2;s=MyInstrument:ProbeA: Method.Outputs.ProcessVariable50.Name			

Sample Client Code Using Data Model

Below is a code example for reading the status of a probe. Note from the earlier discussion of the probe address space, the node ID string to fetch the probe status for ProbeA of an instrument named 'MyInstrument' is:

ns=2;s=MyInstrument:ProbeA:ProbeStatus

```csharp
private void FetchButton_Click(object sender, EventArgs e)
{
    ProbeStatusTextBox.Text = ReadProbeValue(
        m_session, "MyInstrument:ProbeA", "ProbeStatus");
}


private static string ReadProbeValue(
    Session session, string probeName, string fieldName)
{

    // create the collection of nodes to read (just one node in this
example.)
```

```csharp
ReadValueIdCollection nodesToRead = new ReadValueIdCollection();
ReadValueId node = new ReadValueId
    {
        NodeId = new NodeId(String.Format(
            "ns=2;s={0}:{1}", probeName, fieldName)),
        AttributeId = Attributes.Value
    };
nodesToRead.Add(node);

// read all node values.
DataValueCollection results = null;
DiagnosticInfoCollection diagnosticInfos = null;

session.Read(
    null,
    0,
    TimestampsToReturn.Neither,
    nodesToRead,
    out results,
    out diagnosticInfos);

if (StatusCode.IsGood(results[0].StatusCode))
    return results[0].ToString();

return "Error: " + results[0].StatusCode;
}
```

C

WITSML with iC Process for FBRM

This appendix provides information on how to set up an iC Process for FBRM instrument to communicate with a Wellsite Information Transfer Standard Markup Language (WITSML) server.

Completing the WITSML Interface Settings Tab

Establish the communication through the Configuration option on the left navigation menu.

Figure C-1 Instrument configuration—WITSML tab

The WITSML Interface Settings apply to the instrument and do not change for individual methods or runs.

Setting Wellsite Information Transfer Settings

1. Go to Configuration > WITSML Interface Settings tab.

2. Click in the 'Record trend data to WITSML log' check box to activate the entry fields.

3. Enter the identifying name and password for the trend log files that will be transferred to the WITSML server.

   Server

   a. Enter the URL to the WITSML secure server that will receive trend log files from iC Process for FBRM.

   b. Enter the authorized Username and Password.

4. Enter the Well and Wellbore identifying information where the FBRM probe will collect data:

   Well and Wellbore

   a. Name—Enter the official name of the well and the specific bore for that well.

   b. ID—Enter the official ID for the well and the specific bore for that well.

5. Enter the **Section Name**. The log name is automatically calculated from the section name.

6. **Curve Definitions**—Enter the official names of the trend curves to be monitored for the wellsite and bore, along with the units of measure (optional) for each curve.

7. Click **Save** at the top of the Instrument Configuration page to save the settings.

8. Click **Verify WITSML Configuration** to test the server, well, and wellbore entries. If the verification results in errors, recheck the official entries and verify the configuration again. If the configuration still fails verification, save the error that displays and contact the WITSML server representative.

Associating Curve Definitions with Trends

The curve definitions correspond to user-specified statistical trends in iC Process for FBRM as defined in the method. After the WITSML Interface Settings Curve Definitions were saved (step 7 above), a WITSML Curve column appears in the method's External Output tab.

Associate the curve definition to the iC Process for FBRM curve, as follows:

1. Assuming that method development is complete for the wellsite process, go to the Methods > External Output tab (Figure C-2).

   If method development is not yet complete, begin by creating a method for the particle or droplet process at the well site (see "Developing a Method" on page 23.)

2. On the External Output tab, look at the Trend Mapping column and select the specific iC Process for FBRM trend to associate with each WITSML Curve. (refer to "External Output Tab" described on page 33 for more information).
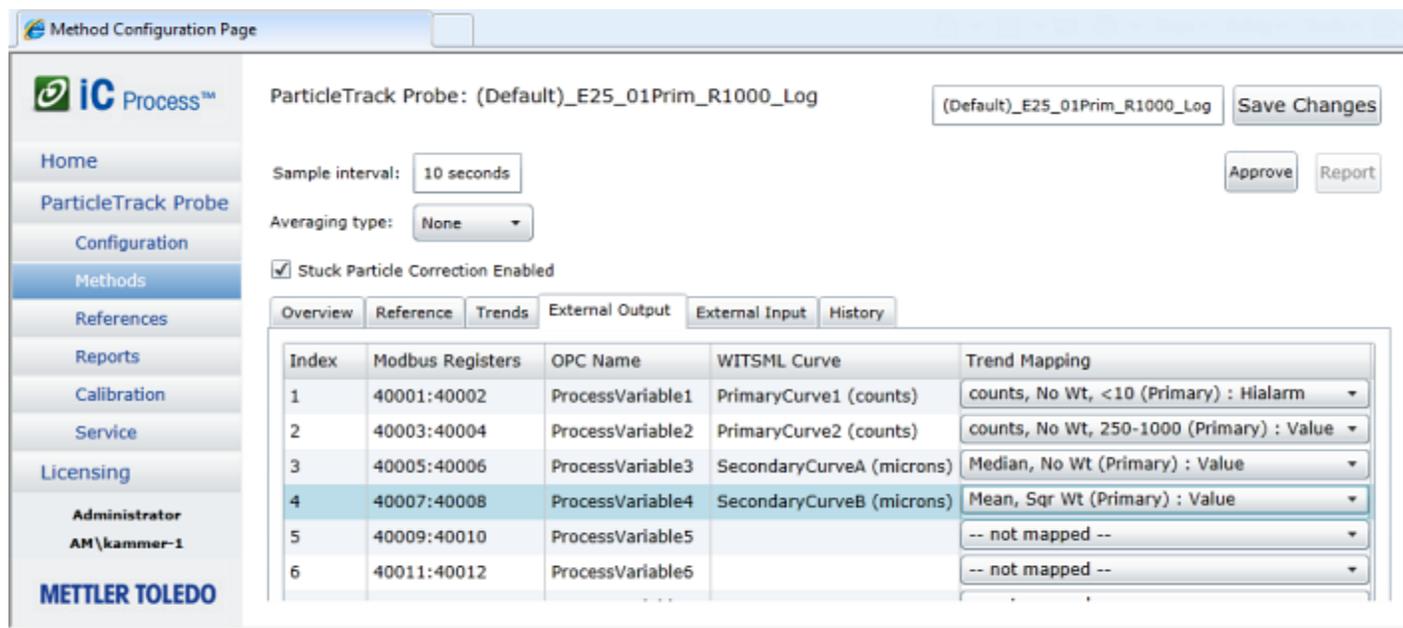
Figure C-2   WITSML Curve association in method—External Output tab

After the WITSML Curve mapping to the iC Process for FBRM trend is configured, when a run starts, the mapped trend value uploads to the WITSML server.

WITSML Alarm Conditions

WITSML Transfer, WITSML Delay, and WITSM Data Loss alarms display a message when the alarm first activates. The detailed alarm message includes the error that caused the alarm condition. Some examples include: Cannot write to server, Message queue length exceeds 20 messages. When the alarm condition clears, another message communicates that the alarm is no longer in effect.

Alarms and Messages

This appendix provides information to assist you in responding to informational and error messages that can appear in the iC Process Web application. Alarms and messages display red description text. If an error alarm occurs, the instrument name also changes to red to reinforce the error condition. For diagnostic errors, the iC Process for FBRM software processes five consecutive measurements at an error condition before displaying the error. For acquisition errors, the software reports the error immediately.

Example 1—Trend Outside Limits

Figure D-1 shows the type of error display when the trend is outside the limits set by an Administrator in the method. Mouse over the trend name displayed in red to see a detailed description.

Figure D-1 Error display from alarm limits set in method

In the Large Values tab, the statistic values change from green to red.

Figure D-2 Trends outside limits—Large Values display

Example 2—Incompatible Template for Method

Figure D-3 shows the type of message that displays to an Administrator during Method creation after importing an iC FBRM template. In this example, the template scan speed is incompatible with the instrument type configured in iC Process.

Notice that the message communicates the incompatibility, but lets you know the scan speed that will be used.
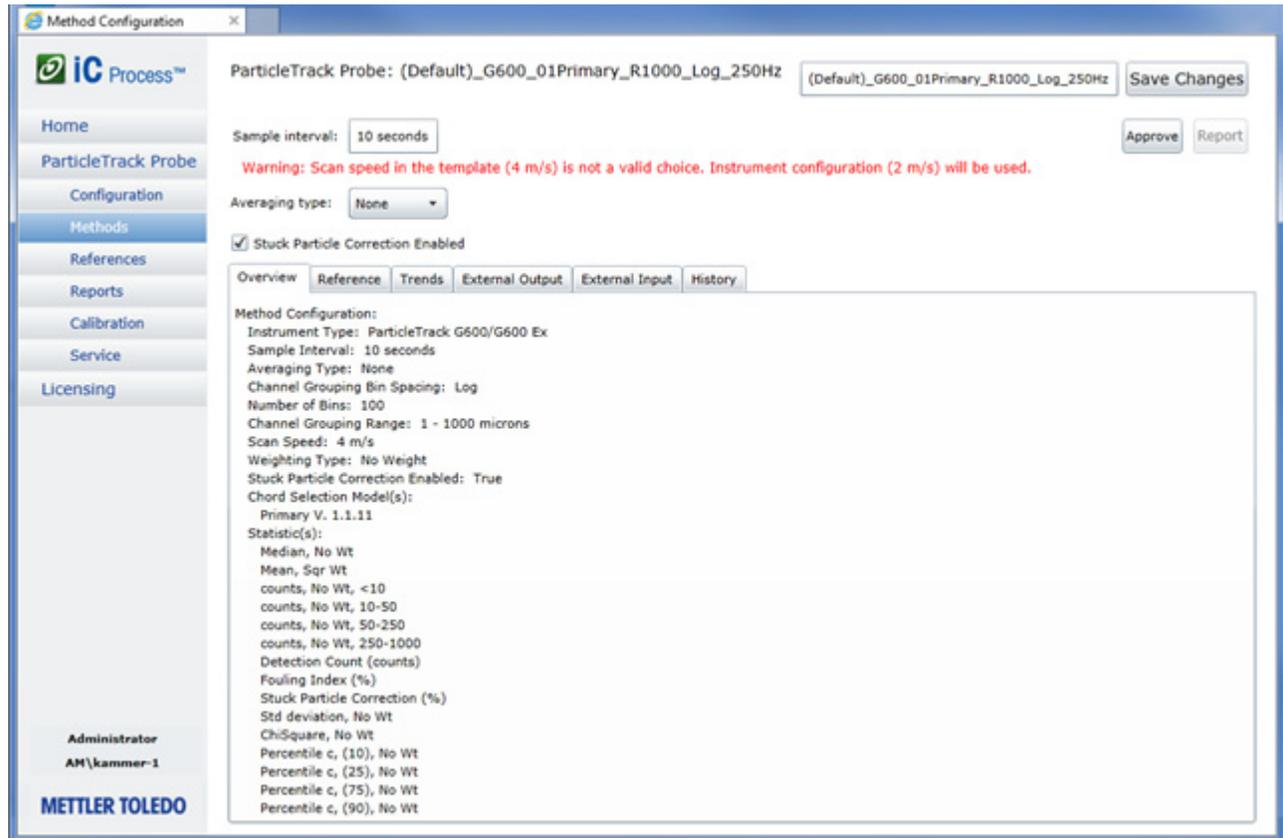
Figure D-3   Incompatibility message during Method creation

Example 3—Maintenance Reminders

Preventive maintenance reminders appear on the Home page in the instrument status box. Common types of reminders include Calibration Validation and Preventive Service.

Calibration Validation—Prompt displays three months from the last passed test. Calibration Validation can be performed by any iC Process for FBRM user. The system updates the date when a Calibration Validation test passes.

Preventive Service—Prompt displays one year from the last METTLER TOLEDO service engineer visit. The engineer updates the visit date in Instrument Configuration. (see page 22).

Figure D-4   Maintenance reminders on Home page

For details about maintenance reminders, refer to "Maintenance" on page 22. For details about the instrument statuses, refer to "Viewing Instrument Status on Home Page" on page 43.

Error Messages

This section describe the overall types of error messages that could display in iC Process and how to respond.

(For WITSML alarm information, see "WITSML Alarm Conditions" on page 121.)

Software Errors and Messages

Table D-1 describes the following software error message:

- **Archive**—Alarm triggered when the system cannot create the data achive file for an instrument. Archive alarms can have a variety of causes. The alarm message identifies the cause.

Table D-1 Error Messages—Archive

Alarm Message	Resolve by:
No write access to archive folder	Check the folder location specified in instrument configuration (see page 18) and ensure that the folder properties grant "Write" access to the SYSTEM.
Disk drive is becoming full	If the disk drive for the specified archive folder location is approaching full, an Archive Fault message occurs:

■ **Acquisition**—Alarms triggered when the system cannot acquire a measurement for the process value. This type of alarm can be caused by instrument hardware failures, communication problems between instrument and software, or errors calculating the Chord Length Distribution. Mouse over the error name in red to view the reason for the failure.
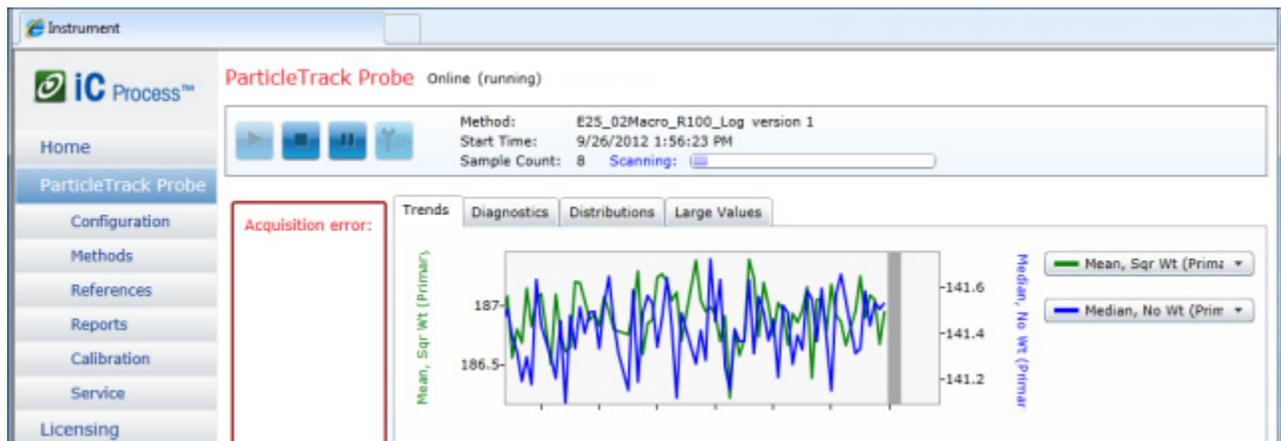
Figure D-5 Acquisition error

Alarms triggered by limits that an Administrator sets in the method can be output to external sources such as Modbus DCS, OPC UA, or WITSML. The output is based on the setup within the method on the External Outputs tab (see "External Output Tab" on page 33).

■ **Trend High/Low**—Alarms triggered if a trend value exceeds its configured high or low limit for FIVE consecutive data samples. Trend alarms clear after the values are within tolerance for FIVE consecutive data samples/diagnostics.

■ **Diagnostic**—Alarms triggered when the FBRM instrument falls outside factory specifications.

E

Glossary and Workflow Illustrations

The terms in this glossary are used throughout this guide to describe the iC Process system. Terms from iC FBRM are also included along with overall workflow illustrations.

General Terms

FBRM®—FBRM (Focused Beam Reflectance Measurement) is the technology used by the ParticleTrack™ systems to track real-time changes in the number, shape, and dimension of particles and droplets as they naturally exist in process, without the need for off-line sampling and dilution (refer to the instrument hardware manual's Product Description chapter for details).

PVM®—PVM (Particle Vision and Measurement) is the technology used by the ParticleView™ PVM systems to display real-time microscope-quality images of crystals, particles, and droplets in iC PVM software without the need for offline sampling. PVM images can be also be viewed in iC FBRM software.

Calibration Validation—A calibration validation procedure (page 65) that uses a factory-supplied calibration reference sample to determine if the instrument meets factory specifications.

System Calibration—A procedure (page 70) that sets instruments to specification through micrometer adjustment and fine-tuning of the focal position. Contact METTLER TOLEDO if calibration validation fails in instruments that do not have an accessible micrometer.

FBRM Software Terms

autostats—AutoStats is an automated analysis function tool in iC FBRM that provides the user with the most amount of information in the least number of statistics. The tool analyzes the currently open experiment or a group of selected experiments to generate an optimized statistics file (AutoStats*.icStats). The file can loaded back into the target experiments to display optimized statistical data.

batch run—A batch run is a period of data collection that requires a user to start and stop the batch. Users may enter a unique name for the batch or use a default time and date stamp.

configuration—A configuration is a collection of parameters for the hardware and software settings used to collect data. The iC Process configuration includes settings and process methods that an Administrator or Technician can adjust to suit a specific particle systems (see "Configuring a Process Instrument" on page 17).

continuous run—A continuous run is a period of data collection from the instrument when online. The start of the run is marked by a change in the method and the end is marked by either another method change or manually taking the instrument offline (stop button).

chord length—A straight line between any two points on the edge of a particle. The real-time measurement of chord lengths provides the fundamental basis of FBRM technology.

Chord Selection Model (CSM)—Advanced signal processing algorithms, only available on newer FBRM and ParticleTrack models, that convert raw FBRM signals to a chord length distribution. Specific CSMs are designed to provide enhanced sensitivity to specific properties of widely varying and often complex particle and particle structures. Below are the standard CSMs.

- **Primary**—CSM designed for maximum sensitivity to individual (primary) crystals, particles, and droplets.

- **Macro**—CSM designed for enhanced sensitivity to particle macro-structures, such as flocs and agglomerates.

count—A measure of a single chord. Each count represents a single chord with an associated chord length in microns.

Data Treatments—Options for analysis and display of FBRM particle system data. Includes the application of averaging to improve measurement-to-measurement repeatability, and the application of channel grouping to select linear or logarithmic channels for optimized resolution to the particle system changes of interest. Templates (iC FBRM experiment files) used to develop iC Process methods for batch and continuous runs include data treatments.

distribution (chord length distribution)—The grouping of chord lengths into bins (or channels) based on the measured dimension is referred to as the chord length distribution. A chord length distribution is graphed by the chord length in microns on the x-axis and the counts on the y-axis. In iC FBRM, the counts can be based on one or more statistical weighting methods and can be displayed on a count basis or normalized and displayed on a percentage basis.

- **reference distribution**—This is a previously recorded and saved distribution used as a comparison against other saved distributions or against the real-time distribution of chord lengths in the particle system being monitored. A reference distribution is also used to validate instrument calibration by comparing the real-time distribution to a distribution saved as the calibration reference. The calibration reference distribution is provided in a data file along with a factory-supplied calibration reference sample, so the instrument calibration can be validated by direct comparison with the factory standard reference instrument.

- **target distribution**—This is a reference distribution that is used for statistical comparison with the current real-time distribution or with other displayed (or pinned) distributions. The relative difference between the real-time distribution and the target distribution can be shown as a % difference for each displayed statistic. In addition, the chi square statistic uses the target distribution to calculate a measure of the overall difference between the distributions.

home—Main page of web application client. The iC Process for FBRM Home page shows the instrument configured to work with the software along with the current state of the instrument. The Home page is also where an Administrator or Technician adds or deletes an instrument.

linked views—iC FBRM software presents linked views where you can see time-synchronized displays of trends, distributions, statistics, data, and event logs. When you select an item in one view, the corresponding linked views change to reflect your selection. Refer to the iC FBRM online Help or software user guide for examples. iC FBRM users can

view real time or post-process particle characterizations in iC Process by connecting to the server through the 'Process' task pane (see "Introducing the iC FBRM 'Process' Task Pane" on page 101).

tabbed views—iC Process for FBRM presents information in tabbed views in several parts of the user interface. These views separate related information into individual 'tabs' so a user can quickly select the desired view information or settings. Two examples: the main instrument display (Figure 2-2) and method development (Figure 3-17).

measurement—When operating, the ParticleTrack or FBRM system continuously measures and accumulates chord length and count data. The resulting chord length distribution data is reported and displayed by the software at a measurement interval that is specified by the user. A single measurement consists of a chord length distribution and associated statistics and diagnostic values reported at a specific point in time. Once a measurement is saved to a data file, it is referred to as a sample. A sample includes all measured data, as well as all instrument configuration information relating to the measurement.

method—A method is a collection of parameters that control how the hardware collects data and how the software converts it to information based on the particle system being analyzed (see "Developing a Method" on page 23). An Administrator can select a different distribution and adjust the Averaging (smoothing) data treatment and y-axis setting within an iC Process for FBRM method.

template—A template is a collection of settings provided with iC Process for FBRM for use in developing a method. User-defined templates can also be created from an iC FBRM experiment file. An Administrator selects a predefined template as the first step in method development. A template can be a predefined or customized iC FBRM experiment file that defines (1) data treatments, (2) statistical and diagnostic trends, and (3) the Y-axis for trends. The template includes (4) two Reference Distributions plus a Target Distribution.

software—There are two iC software products that can control FBRM process instruments. Only one control software can control the instrument at a time.

- **iC Process for FBRM**—Control software designed primarily for tracking particle and droplet processes in real time, with straightforward interface to existing plant DAC (data acquisition and control) systems. Common communication interface options are available including ModBus, OPC UA, and WITSML. Process methods can be developed and refined in iC FBRMnb ghbv and selected and used in iC Process for FBRM.

- **iC FBRM**—Control software for FBRM data acquisition and data analysis. Data is viewed in both distributions (histograms) of chord length data at a given time, and in trends that track the rate and degree of change in particle dimension, shape, and number based on statistics that are selected by the user. iC FBRM also includes customizable statistics and analysis features for advanced and expert users. iC FBRM requires a license for operation and is available in both an instrument version for inline data acquisition using ParticleTrack and FBRM systems, and an office version for off-line data analysis and reporting.

user access—The iC Process system security has three roles that can determine user access: (1) Administrator, (2) Operator, and (3) Technician. See page 9 for more information about the roles and permissions. The Technician role is intended for METTLER TOLEDO Field Service Engineers. Normally, your IT department sets up user access levels based on your organization's user logins. This setup occurs during installation, as described in the "iC Process for FBRM Install Guide for Administrators."

web application—iC Process is a web-based application that installs on a server control computer and runs as a Service. Authorized users access the iC Process client through an Internet Explorer browser.

WITSML—Wellsite Information Transfer Standard Markup Language is an optional interface to a well drilling site server for the petroleum industry.

ParticleTrack and FBRM Hardware Terms

instrument—iC Process can control a ParticleTrack G600 or ParticleTrack E25 instrument. The instrument with probe is referred to as a base or field unit. Together with the control software, the instrument is a complete system.

wetted length—The portion of the probe that may be placed in direct contact with the particle or droplet system. The wetted materials in a ParticleTrack probe consist of the probe alloy, the sapphire window, and o-rings that may be present in certain window or probe mounting designs.

probe tip—Long portion of a probe that is typically 'wetted' in the particle system. The probe tip houses and protects the probe optics, optical fibers, electric or pneumatic motor, and scanning assembly. Probe tips should not be disconnected from the probe back end.

probe back end—Portion of a probe permanently attached to the conduit that does not come in contact with the particle system.

probe window—All ParticleTrack probes measure through an optically clear sapphire window, which is inert to most process chemistry and provides a hard scratch-resistant surface. Standard probe window design includes Kalrez® o-rings to seal against leakage. Alternative probe designs for small scale, sanitary, or high-pressure applications utilize a thermo-mechanical (TM) press-fit window in which the sapphire window is permanently compressed within the probe body.

base unit—Electronics enclosure that houses the power, laser, communication, and other electronics for the probe system. In all ParticleTrack systems, the probe back end is permanently attached to the base unit by a conduit. The term 'base unit' is commonly used for systems intended for use in a laboratory fume hood or on a laboratory bench top.

field unit—A base unit designed for use in an industrial or process environment. ParticleTrack field units are typically built to 4X standards and in configurations that may include a purge/pressurization system. Field unit systems may be rated for use in hazardous environments.

purge/pressurization system—ParticleTrack ATEX and IECEx systems include a purge/pressurization system that ensures that power to the system is only available when the enclosure is pressurized.

scan speed—The speed, in meters per second, at which the focal point of the probe scans across the particle system at the probe window. Depending on the instrument model, the scan speed is controlled at a constant rate using an electric or pneumatic motor. Some ParticleTrack models permit the use of optional scan speeds that provide alternate resolution. Higher scan speeds may provide advantages in particle systems with very high process flow rates or with very large particles. However, higher scan speeds will also reduce resolution to fine particles and droplets. Consult with your Technology and Applications Consultant for guidance in selecting an appropriate scan speed. The scan speed for ParticleTrack instruments is included with the template settings used to define a method in iC Process.

Workflow Illustrations

This section provides information and illustrations about the overall workflow to set up and monitor particle and droplet systems. It also includes an illustration of the optional workflow between iC FBRM software and iC Process for FBRM.

Workflow to Monitor Particle and Droplet Systems

The primary workflow for monitoring particle and droplet systems in production uses iC Process for FBRM software. Figure E-1 shows the workflow to monitor your particle or droplet system for the first time, along with the routine operation. Before iC Process for FBRM can be used to collect particle system data, a system Administrator must create and approve executable methods for the instrument. A method is essentially an SOP for the FBRM instrument that defines the instrument and measurement configuration to ensure consistent data collection, display, recording and reporting.

Workflow in iC Process for FBRM

In iC Process for FBRM, an Administrator creates a method based on one of the standard predefined templates supplied with the software.
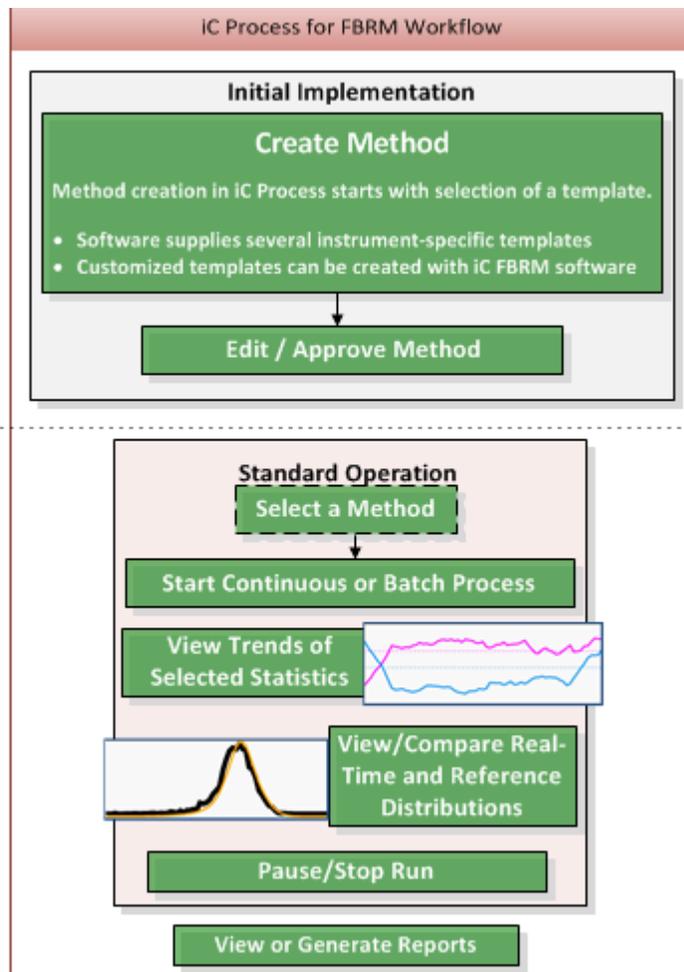
Figure E-1 Workflow—iC Process for FBRM

After method approval, an iC Process for FBRM operator controls the FBRM instrument for collection of particle information using an approved method.

Workflow between iC Process for FBRM and iC FBRM Software

iC Process for FBRM includes templates for method development created from iC FBRM experiments. iC FBRM software can optionally be used to create custom templates for process methods. The template contains instrument-specific statistics and settings that are the basis for method development. Some of the settings can be modified in the method or during processing as shown below.
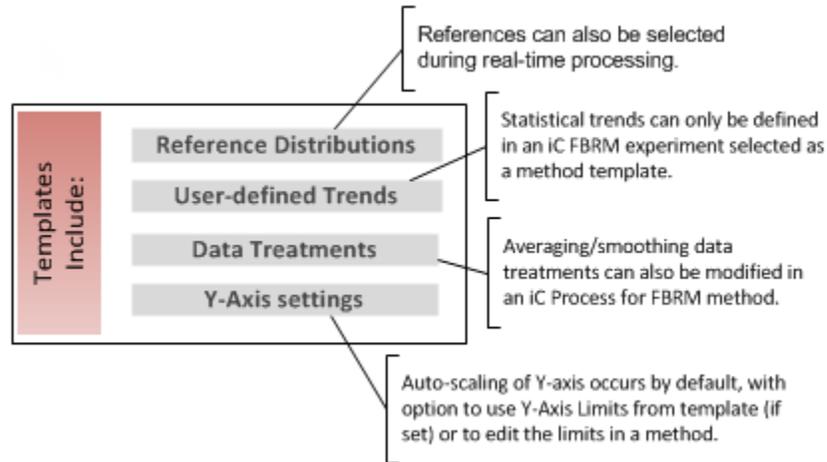
Figure E-2   Templates are iC FBRM experiments with specific settings

iC FBRM software also provides the analyst a view into the live or historical particle system trends and distributions without disturbing the current batch or continuous process run. The analyst can then perform advanced analysis on the live or historical trends and distributions that can lead to refinement of method templates.

| **Note:** | Please ensure the iC Process for FBRM server is 'Stopped' when using iC FBRM as the control software in place of iC Process for FBRM. |

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