



FALEX 430 ETR

**** Ellipsometric Tube Rater ****

Operation Manual
Version: 2.1



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Forward

This manual provides information and procedures to safely install, operate, and maintain the Falex 430 ETR (*also known as the Falex 430 Ellipsometer*). For your own safety and protection from injury, carefully read, understand and observe the safety instructions described in this manual.

Keep this manual with the machine. If you lose this manual or need an additional copy, please contact Falex Corporation. The information contained in this manual was based on machines in production at the time of publication. Falex Corporation reserves the right to change any portion of this information without notice. This operation manual is divided into sections and addenda as listed in the 'Table of Contents'.

Safety Introduction

The following safety precautions are published for your information. This manual does not purport to detail all of the safety concerns, if any, associated with the equipment's use. It is the responsibility of the operator of this equipment to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. This machine is built with operator safety in mind; however, it can present hazards if improperly operated. Follow operating instructions carefully! If you have questions about operating this equipment, please contact Falex Corporation.

Note: *This equipment should only be operated by personnel trained by Falex or a Falex approved distributor.*

Note: *This equipment is to be serviced or repaired by factory authorized personnel only! It is recommended that for any service related issues, this equipment is to be returned to the manufacturer.*

Note: *This equipment is not to be opened or modified in any way by the customer.*

This manual may contain **HAZARD**, **WARNING**, and **CAUTION** callouts, which must be followed to reduce the possibility of personal injury, damage to the equipment, or improper service. This machine must be electronically grounded. Do not change the grounding requirements of the machine.

Machine Safety Labels and Manual Safety Callouts

The following are safety labels may be placed in areas on the test machine that may be hazardous to the operator. These same symbols may be used in the manual to bring attention to safety concerns. Please take caution and understand what these labels indicate before operating the test equipment.



ELECTRICAL SHOCK HAZARD: This symbol indicates hazardous voltage is present. Turn main power button off and switch off the main breaker (*right side of unit*) before taking sides off of unit. This unit is to be serviced by trained personnel only.

Forward



CAUTION OR WARNING SYMBOL: This symbol indicates a general warning or caution. A caution is important for protecting the equipment and performance. A warning is important to protecting yourself, others, and the equipment. Used in manual to bring attention to an important note or comment.



Caution: Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

1: General Information

1.1 Technical Specifications

Machine Weight: approximately 55 pounds (25 kg)

Machine Footprint (with display up): 22" high × 12" wide × 17" deep (56 cm x 30 cm x 43 cm)

Recommended Working Space: The Falex 430 ETR requires bench space of 24" wide x 30" deep (61 cm x 76 cm) to comfortably operate the test machine. The table should be reasonably level (1/32 in. per foot) and should be able to support the test equipment, while being free from any external vibrations.

Utilities Requirements: The Falex 430 ETR requires a 4 amp, 100 - 240 Volt, single phase, 50/60-Hertz power source.

Wiring to test machine should follow federal, state and local wiring codes.

Product Classification: The Falex 430 ETR is a Class 1 laser product.

Note: *Removal of any panels is to be done by factory trained personnel. Before removing any panels, disconnect from power.*



Caution: *Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.*

1.2 Brief Description of Equipment

The Falex 430 ETR test machine is designed to offer consistent, precise, analytical measurement of ASTM D3241 heater tube deposits. It incorporates a laser light source optical detection system for measuring the ellipsometric parameters, a tube handling assembly with an automatic alignment system and computer driven software for analyzing the ellipsometric data for ASTM D3241 heater tube rating.

The following safety features are incorporated into the machine:

- The laser and all laser paths are fully enclosed in a protective housing designed to prevent human body exposure from the laser path or collateral radiation by beam or reflection exposure to laser emissions.
- Wired and software interlocks to prevent operator exposure to laser emissions.
- Complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser notice No. 50.

1: General Information

Falex 430 ETR functionality consists of three (3) main areas (figure 1-1).







Figure 1-1 - Areas of Machine

1. **User Interface** – PC utilizing touchscreen functionality for configuration, control and monitoring of the test.
2. **Control Panel** – consists of measurement process start/stop push-buttons, machine status indicators and data transfer USB port.
3. **Protective Housing** – designed to prevent human body exposure from the laser path or collateral radiation by beam or reflection exposure to laser emissions. Consists of a front, back and two (2) side covers.

1: General Information

1.3 Packing List

Unpack the machine and verify its contents. Each machine comes equipped with a startup kit, which includes all the necessary items required to run the machine. Unpack the startup kit and verify its contents with the listing shown below.

QTY	PART #	DESCRIPTION	PICTURE
1	n/a	Manual / CD or USB drive	 or 
1	650-030-161	Power Cord, 120V	
1	431-103-001	External Power Supply	

1.4 Initial Machine Setup

Carefully uncrate the unit and select an appropriate level bench space. The unit comes fully assembled. The user interface is folded down during shipping to protect it. Once the unit is placed in position on the bench, raise the user interface and adjust it to an angle that allows the operator to view the displays easily and is free from glare.

External Power Supply Installation - Plug the external power supply into the 'Power' connector located on the back of the machine.



Note: *Only connect the external power supply delivered with the unit to the Falex 430 ETR. The use of any other external power supply may damage the Falex 430 ETR and void the warranty. For a replacement external power supply, contact your local Falex Corp. representative.*

1: General Information

Power Cord Installation - Plug the appropriate power cord into the external power supply and then into an outlet appropriate for the plug (120V, 60Hz for North America, 230V 50Hz for Europe). Electrical source must have a good ground or an isolated power with ground.



Note: *The AC power cord connects the external power supply to the wall socket. The plug at the end of the power cord that connects to your electrical outlet can be of two types. The plug type depends on the country where the Falex 430 ETR will be used.*

Printer Installation (optional) - Printing functionality exists, if a printer (*sold separately*) is connected and has been configured. It is recommended that a printer be purchased through Falex Corporation. If the machine was shipped with a printer, the user interface is already configured for the printer. If the machine was not shipped with a printer then the printer has to be configured. It is recommended that the printer be connected to the back USB port (figure 1-4). This allows the front USB port to be available for data transfer to a flash drive.

1.5 Getting to know the Falex 430 ETR



Figure 1-2 – Cabinet (front)

1: General Information

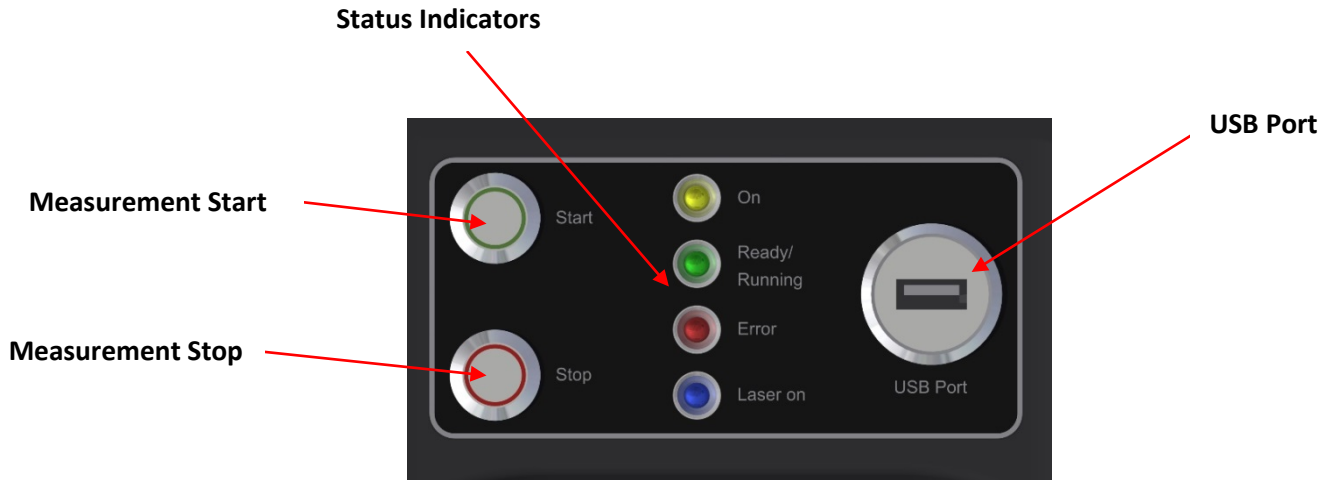


Figure 1-3 – Control Panel

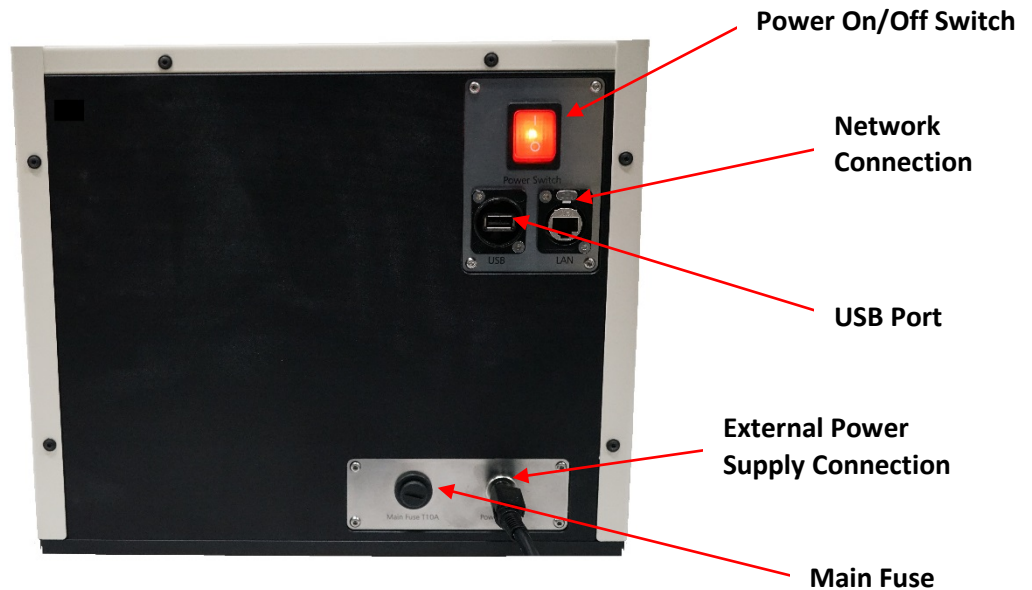


Figure 1-4 – Cabinet (back)

The Falex 430 ETR has the following features:

User Interface: A touch screen computer is located on the top of the electronic cabinet and is used as the user interface for configuration, control, and monitoring of the test.

Automatic Tube Alignment: Internal positioning allows for consistent heater tube alignment and also compensates for warped or slightly bent tubes.

Heater Tube Inlet: Allows access to heater tube loading assembly for positioning of the heater tube.

Control Panel: Consists of measurement process start/stop push-buttons, machine status indicators and data transfer USB port.

1: General Information

Start Button: Initiates the measurement process.

Stop Button: Stops measurement process and stops all other heater tube positioning movements (*after operation confirmation on popup display*).

On Indicator: Indicates main power switch is turned on and 24VDC is supplied to the machine.

Ready/Running Indicator: When 'on', indicates machine is waiting for operator interaction. When 'blinking', indicates machine is measuring, referencing, inserting or ejecting a heater tube.

Error Indicator: Indicates an error occurred.

Laser On Indicator: Indicates when laser emission is active.

USB Port: Two (2) USB ports exist on the machine. One (1) is located on the front control panel of the machine and one (1) is located on the back of the machine.

Power (ON/OFF) Switch: Provides power to the entire test machine, including the user interface.

Network Connection: RJ45 Ethernet connection for standard network file transfer. The Ethernet connection can be used for network connectivity. Any network configuration should only be made by a network administrator and after consulting with your Falex Representative.

External Power Supply Connection: Connection for external power supply. The proper power cord (*120 or 230 VAC*) is then to be connected to the external power supply.

Main Fuse: A 10 amp fuse is located on the back of the machine. This provides protection of the internal electronic components against overcurrent.

1.6 Laser Control Narrative

Initiating Laser Control

In order for the laser beam emission to be turned on, various conditions and sequences must first be satisfied. These conditions and sequences are a combination of operator actions, wired safety interlocks and software interlocks designed to prevent operator exposure to laser emissions. The laser control process is explained below.

1. Measurement Process Initiation

A series of operator actions initiate the measurement process, which lead to laser emission. First, a heater tube is to be successfully inserted into the machine. Then, the 'Measurement' display button is to be selected on the user interface (*which switches the application software into the measurement mode*). Finally, the 'Start' button, located on the Falex 430 ETR front control panel, is to be pressed. Once pressed, a series of interlocks are verified.

1: General Information

2. Laser Emission Interlocks

There are both wiring and software safety interlocks incorporated into the Falex 430 ETR laser system that must be satisfied in order to achieve a laser interlock 'OK' status. They are:

a. Wiring Safety Interlock

A proximity switch is wired into the control system to detect that the heater tube inlet shutter door is closed. If not detected, laser emission will not be allowed. If a proximity switch wire becomes disconnected or broken, the proximity switch will not detect the shutter door closure and the interlock cannot be satisfied providing a fail-safe design.

b. Software Safety Interlock

As discussed in the previous section, the heater tube inlet shutter door proximity switch must indicate the shutter door is closed. When the proximity switch detects that the shutter door is closed, a digital input is turned on within the machine control system. The machine control system then interprets the 'on' state of the digital input as the shutter door being 'closed' and allows other software sequences to occur. Therefore, if the proximity switch does not detect that the shutter door is closed, the software application shutter door 'closed' condition cannot be satisfied.

3. Initiate Laser Emission

Once the above conditions have been satisfied, laser emission is initiated. At this time the operator will be provided a visual 'Laser On' LED indication on the control panel. Laser emission will remain active until the measurement process is interrupted by test completion, test error, loss of power, or the operator presses the 'stop' button on the control panel.

1.7 Laser Safety

The Falex 430 ETR incorporates a laser diode that is CE certified. This Laser Product is designated as Class 1 during all procedures of operation. This section will discuss safety details when operating the laser.

Overview

Laser Parameters:

- Wavelength: 1550nm
- Output power: 8mW
- Operating voltage: 1.4 VDC
- Operating current: 80 mA
- Beam diameter: 9µm
- Divergence: <7 ° (half angle)
- Mode of operation: CW (continuous wave)

1: General Information

Cabinet Housing Construction:

The Falex 430 ETR is designed as a laboratory instrument and will be used within a laboratory controlled environment. The cabinet housing is constructed of high strength injection molded plastic, stainless steel and aluminum alloy that is resistant to rust and corrosion. Specifications of cabinet housing materials are as follows:

- Injection molded plastic
 - Located on front of instrument
 - High impact plastic (PX 223HT)
 - 3 – 5 mm thick
- Stainless steel
 - Located on left side, right side and top of instrument
 - 304 grade
 - 1 mm thick
- Aluminum
 - Located on back of instrument
 - 5 mm thick
- Aluminum
 - Located on bottom of instrument
 - 8 mm thick

The Falex 430 ETR is a stationary instrument and once it is placed within the laboratory it should not be moved. The cabinet housing is not subject to any movable parts and is constructed with overlapping recessed edges, so when assembled, laser reflected emissions are prevented. The cabinet housing is completely closed, so that no laser emissions are accessible during operation. An automatic mechanical shutter is used to close the tube inlet before laser emission. If the shutter is not closed, laser emission is not allowed. As part of the quality control testing that is conducted, full functionality of the instrument is tested and associated safety features are verified. The instrument is inspected prior to shipment for any misaligned cabinet housing panels and corrected if any alignment problems are found.



Note: The laser is never to be operated if the unit shows signs of a defect or if the cabinet housing is damaged. Should you have any safety concerns, please contact Falex Representative or Compass Service.

Operation

Testing

When the system is used to perform typical application testing, the operator will not have direct exposure to the beam. When all inputs to the software are in their correct state (*indicating that the machine is ready*), laser emission is initiated. The desired test can then be initiated using the software application.

1: General Information

Calibration Check

Calibration is not required since the positions of the optical parts are fixed. However, a verification check can be performed to verify that the laser system is functioning accurately. Obtain a Falex NIST Traceable Reference Tube (p/n 430-200-002) to verify accurate functionality. This reference tube comes with one specially designed aluminum tube with two silicon glass wafers. These wafers are NIST (*National Institute of Standards and Technology*) certified in the thickness range of 60nm & 100nm. This tube is housed in a specially designed stainless steel tube that provides a dust-free environment when the tube is not in use. The tube comes with two NIST certificates, one for each wafer that has the certified thickness in Angstroms, these certificates are individually serial numbered, as well as the NIST Traceable Reference Tube. The stainless steel tube also has a permanent sticker on the outside with this information. The determined maximum average thickness should be within $\pm 5\%$ of the known value. If it is not, contact your local Falex Corp representative. It may be determined that your Falex 430 ETR is due for a Calibration, this is performed by your Falex Corp representative or Compass Instruments service technician.



Note: *Service/Calibration is to be done only by a trained technician.*

Laser Safety



Caution: *Use of controls, making adjustments or following procedures other than those specified herein may result in hazardous radiation exposure.*

Modifications that affect any aspect of the product's performance or intended functionality will require re-certification and re-identification of the product in accordance with the provisions of 21CFR 1040.10 and 1040.11. A copy of 21CFR 1040.10 and 1040.11 can be found in FDA website:

<http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?FR=1040.10>

<http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?FR=1040.11>

Labeling

Explanatory Label



Note: *The Explanatory label does not appear on the machine. The contents of this label are included within the Identification/Certification label.*

1: General Information

Identification / Certification Label



2: Typical Test

2.1 Overview



Note: *The following is a general outline to be used along with the ASTM D3241 test method. Some steps may not pertain to the conducted test.*

The following is a general description of a typical test process to be used. More detail on each step can be found in the steps that follow.

1. Prepare the heater tube for installation into the Falex 430 ETR (refer to section 2.2).
2. Install the heater tube into the heater tube assembly (refer to section 2.3).
3. Using the user interface, configure and start a test (refer to section 2.4).



Caution: *Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.*

2.2 Heater Tube Preparation



Note: *Handle the heater tube by the ends only. Do not touch the center section of the heater tube where the deposit is located. Doing so will contaminate the deposit.*

1. Visually inspect the heater tube that is to be tested for any foreign substance (such as dust or lint). If a foreign substance is noticed, gently blow off with clean dry air.




Note: *Do not clean the center section of the heater tube with any cleaner or wipe it with a cloth. Doing so will contaminate or damage the deposit. [Refer to ASTM D3241 for proper cleaning procedure of the heater tube after testing per 11.8 'Disassembly' 11.8.2.2]. No additional cleaning of the tube is required before testing with the Falex 430 ETR.*

2.3 Heater Tube Installation



Note: *Falex 430 ETR must be powered on, the touchscreen application visible and the self-check must be finished. The self-check takes approximately 2 minutes.*

1. On the user interface, select the 'Insert' icon  located in the display header.
2. A message will appear, alerting the operator to wait while internal devices are positioning.
3. The tube inlet shutter door will open.
4. A pop-up window will appear (figure 2-1), alerting the operator to 'Insert the tube'.

2: Typical Test



Figure 2-1 – Insert Tube Pop-up

5. Holding the heater tube that is to be measured by the serial number end, carefully insert the heater tube end **without** the serial number into the tube inlet. (*a gentle push of the heater tube may be necessary to aid in the activation of the tube clamping process*)
6. The heater tube will automatically be pulled into the Falex 430 ETR and properly positioned.
7. The tube inlet shutter door will close.
8. The 'Insert the tube' pop-up window will disappear.
9. The heater tube has now successfully loaded.

2.4 Start Test




Note: *Before starting a test, install the heater tube per the instructions found in the previous sections, review this manual and the method. This section gives a general overview of using the software to run a test. Detailed explanation of the individual application software displays is found in later sections of this manual.*

1. On the user interface, select the 'Measurement' display button at the bottom of the display (*which switches the application software into the measurement mode*).
2. Press the 'Start' button located on the Falex 430 ETR front control panel.
3. The safety interlocks are verified. If they are satisfied, the laser will be turned on as indicated on the Falex 430 ETR front control panel 'Laser on' indicator light.
4. The installed heater tube serial number will automatically be captured.
5. The 'Measurement Information' display will appear (figure 2-2). Fill in the associated test information. It is mandatory that something be entered in the Tube Name, Operator, Tube SN and Description fields. All other fields are optional.

2: Typical Test

Please fill in Measurement Information

Tube Name: Tube SN Picture: 

Operator:

Tube SN:

Description:

Sample Information:

Other Information:

☐ Use last entered information data

Figure 2-2 – Measurement Information display

6. Select the 'Start' button located at the bottom of the 'Measurement Information' display. This will initiate the measurement process. The measurement test takes approximately 18 minutes to complete.
7. The measurement progress can be monitored from the 'Measurement' display (figure 2-3) by referring to the 3D graph, the associated progress bar and the remaining time status.

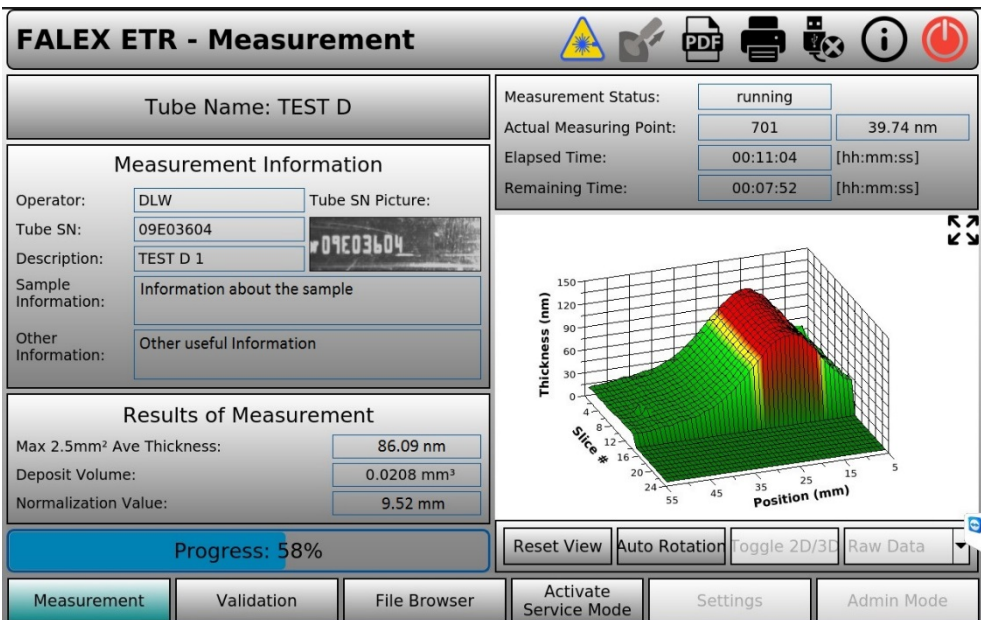


Figure 2-3 – Measurement display

8. The 'Ready/Running' indicator light on the Falex 430 ETR control panel will be blinking during the measurement process.
9. When the measurement process is complete, a 'Measurement Result' pass or fail pop-up window (figure 2-4) will appear on the user interface to let the operator know the test result.

2: Typical Test

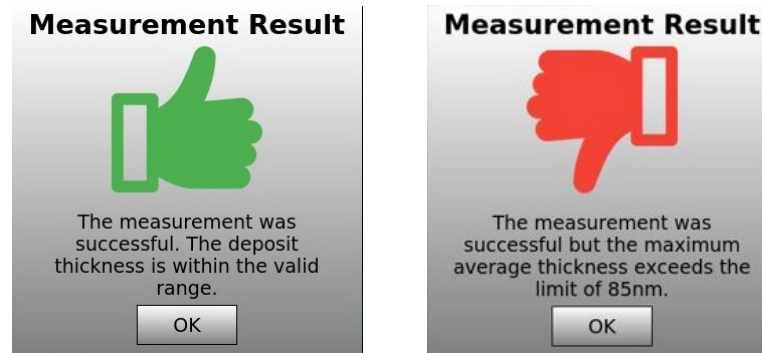



Figure 2-3 – Measurement Result display

10. Select the 'OK' button to close the 'Measurement Result' pop-up window.
11. The measurement data is automatically saved to a data file that is stored.
12. On the user interface, select the 'Eject' icon  located in the display header. The tube inlet shutter door will open and the heater tube will be ejected.
13. Carefully remove the heater by holding it by the end and store it for future reference. The tube inlet shutter door will close.



Note: *The allowable time to remove the tube is one (1) minute. If the tube has not been removed within this time duration, the tube will automatically be re-inserted into the machine and the shutter door closed.*

14. The measurement process is now complete.



Note: *The measurement process can be interrupted at any time by pressing the 'Stop' button located on the Falex 430 ETR front control panel. This will disable the laser and stop the test (after operation confirmation on popup display).*

3: Detailed User Interface Features

3.1 Software Overview

The Falex 430 ETR user interface makes testing easy to setup, repeat and control. It utilizes touchscreen functionality that allows items to be selected by simply touching the item with one’s finger, stylus, or mouse pointer (*if a USB mouse is connected*). During testing, test data is displayed both numerically and graphically.

Software functionality captures data points and their values are saved into a data file. The data file created is saved in a format that can be opened with a standard spreadsheet or document application, once transferred to an external PC.

The user interface software application is automatically started when the machine is powered up. Should the display go to sleep, it can be reawakened by touching somewhere on the touchscreen surface. The software configuration is defaulted for ASTM D3241 testing.

3.2 Display Architecture

The displays are made up of three (3) areas (figure 3-1), with each area having special functionality. The various display areas are:

- Header
- Main display area
- Display selection buttons

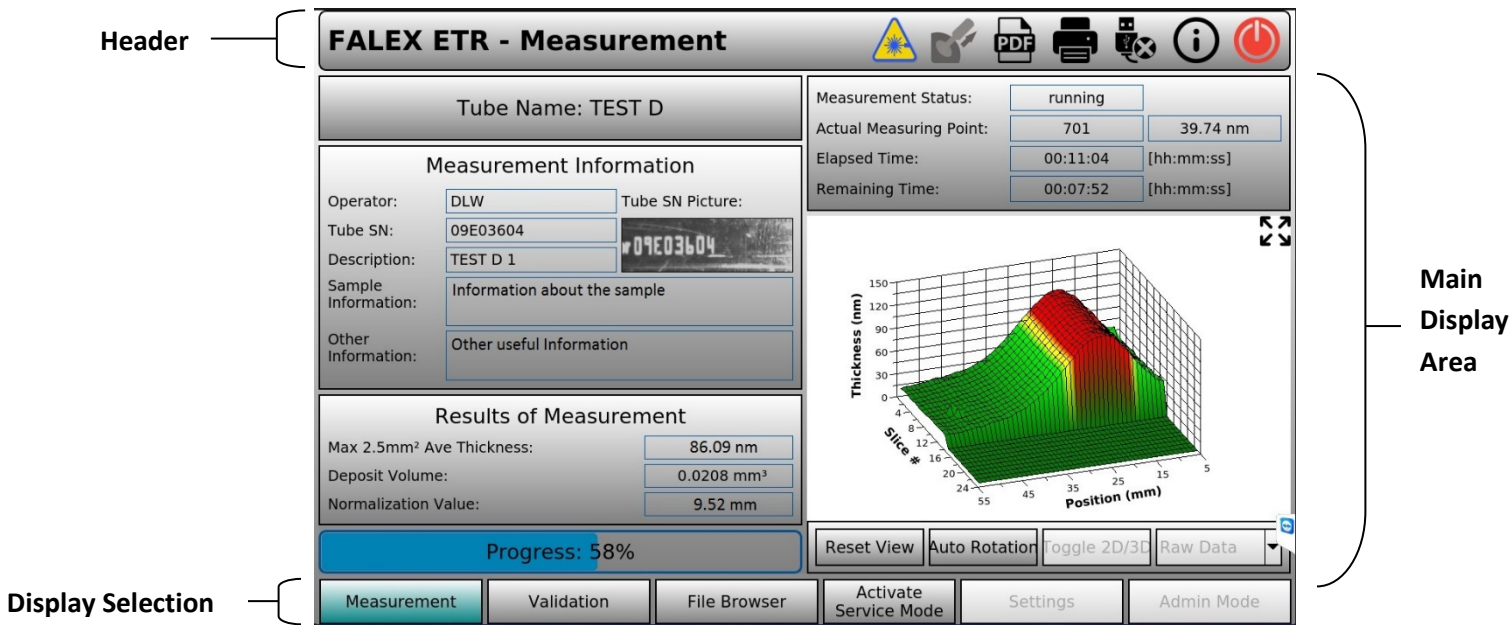









Figure 3-1 - Display Component Areas



3: Detailed User Interface Features

Header

The header area contains the machine/display name and various icon selections that have functionality associated with them (*if enabled*). Possible selections are:

-  **Laser On** – When shown and blinking, the laser is on.
-  **Keyboard** – Calls up an alpha-numeric keyboard so that information can be entered on the display.
-  **Insert** – When shown, will allow the heater tube to be inserted into the machine.
-  **Eject** – When shown, will allow the heater tube to be ejected from the machine.
-  **Convert to PDF** – When selected, the current page will be saved as a .pdf file.
-  **Print Screen** – Allows the operator to print the active screen (*if a printer is connected and configured*).
-  **USB Utility** – Allows operator to safely close USB storage device communications and allow the USB storage device to be safely removed from the user interface. Always eject the flash drive by selecting the USB utility in the header portion of the display

Note: *Do not pull the flash drive out of the USB port without properly closing (ejecting) the flash drive first. Failure to do this could cause user interface lockup and/or corrupt the data stored on the flash drive. Always eject the flash drive by selecting the USB utility at the top of the display.*

-  **About** - When selected, a popup will appear showing the software revision level.
-  **Exit** – Allows the operator to properly exit out of the Falex 430 ETR user interface application before the machine is powered down. This will properly save and close any open files and/or tables before power is removed. (if pressed and the Service or Admin Mode is active, will only close the HMI, otherwise it will close the HMI and power off the ETR)

Note: *It is recommended that the user interface application be properly shutdown prior to removing the machine from power. Powering down the machine without doing so could cause data loss/file corruption and should only be done in an emergency.*

Main Display Area

The main display area contains a 3D graph, numeric data, buttons, and enterable fields to allow the operator to configure, run and manage measurement tests.

3: Detailed User Interface Features

Display Selection Buttons

The display selection buttons allow the operator to open other displays by selecting the associated button. Not all buttons are available to the standard operator.

3.3 Functionality

Buttons, icons and enterable fields can be selected by simply touching the item to be selected with one's finger, stylus, or selecting it with a mouse (*if a USB mouse is connected*).

Buttons and enterable fields that are grayed out are not enabled (figure 3-2). If a grayed out button or enterable field is selected, nothing will happen. Various conditions must be met with the control application software before particular buttons or fields are enabled.

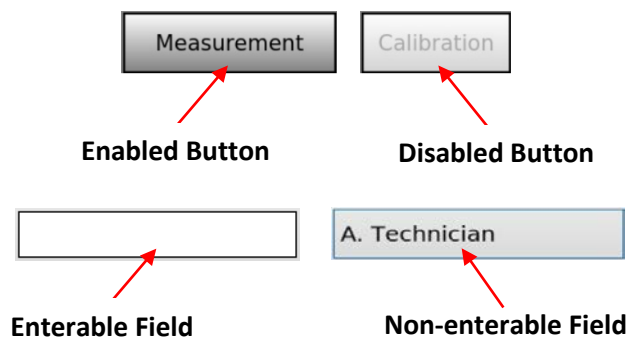



Figure 3-2 – Disabled Functionality

Enterable fields are shown as white rectangular areas (figure 3-2). These fields allow the operator to enter alpha-numeric information. If alpha-numeric information is to be entered into an enterable field on the display, a full keyboard (figure 3-3) pop-up will appear on the display if the keyboard icon  is selected. Select the enterable field and the pop-up keyboard can be used by selecting the desired character using ones finger or stylus to enter the required information. If a USB keyboard is connected to the machine, information can be entered from the keyboard for the selected enterable field.

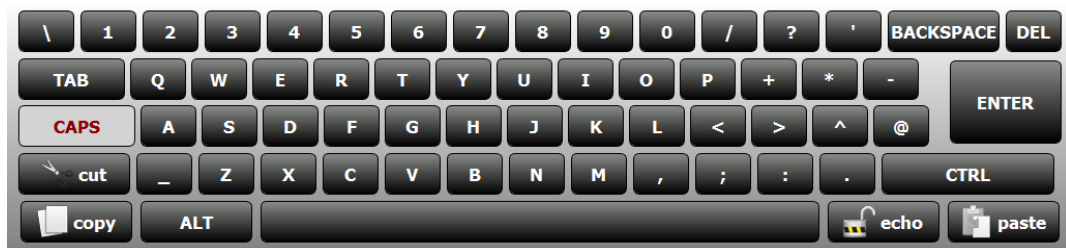


Figure 3-3 – Alpha-numeric Keyboard

Certain actions taken by the operator require a secondary operator verification before the action is executed (figure 3-4). This will prevent accidental selection of critical functionality. Such actions requiring secondary verification are stopping measurement test, file deletion and shutting down (*exiting*) the user interface application.

3: Detailed User Interface Features



Figure 3-4 – Operator Verification Pop-up

3.4 Password Levels

The user interface incorporates two (2) levels of passwords, each level enabling additional functionality above and beyond what is allowed for the typical 'Operator' mode.

Level 1 (Service Mode)

The level 1 password is for factory technicians and authorized personnel use only.

[ETR] (*all letters capitalized*)

Level 2 (Admin Mode)

The level 2 password is for factory technicians and authorized personnel use only.

[F1020] (*all letters capitalized*)

3.5 Display Functionality

The following sections will describe the functionality of each display.

3.5.1 Measurement Display

When the 'Measurement' display button is selected, the 'Measurement' display appears (figure 3-5). This display contains a 3D graph, numeric data, buttons and enterable fields to allow the operator to configure, run and manage tests. A measurement test takes approximately 18 minutes to complete. This is also the display that appears on the user interface when the software application is first booted up (*upon machine power up*). The functionality of the display will be discussed in detail below.

3: Detailed User Interface Features

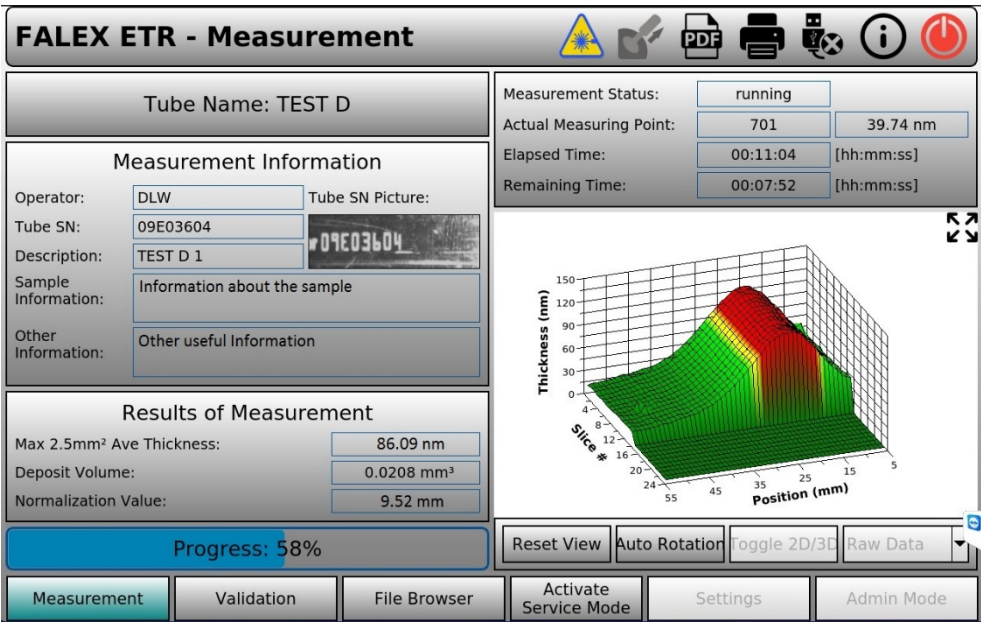


Figure 3-5 – Measurement Display

Measurement Information

Operator - Short alpha-numeric reference given to the Operator or Technician.

Tube SN: - Tube Serial Number taken by internal camera, Serial Number (*not the photo*) will also be in Test Data File.

Description – This reference is added to the data file. This will be useful in locating specific data files.

Sample Information – Additional Information regarding the Sample.

Other Information – Other useful information.

3: Detailed User Interface Features

Results of Measurement

This area of the display is populated with important data results when the measurement test has completed.

- **Max 2.5mm² Ave Thickness** – Value represents the maximum average thickness of the deposit that was found on the heater tube in nm. If this value is >85 nm, the test result is determined to be a failure. Value is determined after the completion of the measurement test.
- **Deposit Volume** – Value represents the total volume of the deposit that was found on the heater tube in mm³. Value is determined after the completion of the measurement test.
- **Normalization Value** – Value represents the minimum 2.5mm² area found. It is used to normalize the rest of the data by subtracting it from every data point. Value is determined after the completion of the measurement test.

Other Information

Tube Name - Short alpha-numeric reference given to the tube that is being measured. This reference is added to the data file name in front of the standard date/time naming convention. This will be useful in locating specific data files. It is limited to ten (10) alpha-numeric characters.

Progress – Shows the percentage of the measurement test that has been completed.

Measurement Status – Shows the status of the measurement test. Possible descriptions are: running, finished, aborted.

Actual Measuring Point – Shows the current measuring point and its corresponding thickness in nm.

Elapsed Time – Shows how much time has elapsed for the current measurement test.

Remaining Time – Shows how much time remains for the current measurement test.

Graph – The graph is a 3D representation of the deposit found on the installed heater tube. The graph can be rotated by selecting it with one's finger, stylus, or mouse pointer (if a USB mouse is connected). The data values displayed will be color coded as follows:

- Green – All data values ≤ 75 nm
- Yellow – Data values > 75 nm and ≤ 85 nm
- Red – 2.5mm² average film thickness is ≥ 85 nm

Reset View – Selection of this button will return the graph to its original appearance.

Auto Rotation – Selection of this button will allow the automatic rotation of the 3D plot to be switched on or off.

3: Detailed User Interface Features

Toggle 2D/3D – Selection of this button will switch the thickness graph between a 2D view and a 3D view. In the 3D view, every measured point is shown (*position 5 – 55mm, slice # 0 – 24*). In the 2D view, the 3D slice data is averaged.

Raw Data – Selection of this button enables a drop down, presenting the operator with five graph display options for viewing the test data.



Note: *If the 6x1 checkbox is enabled from the Settings Screen, the ‘6x1 Avg Data’ option will be shown in the drop down.*



Note: *The 2D view and the view of the normalized data are not available during an active measurement test. They can only be viewed after completion of the measurement test when the normalize value has been determined.*

When a measurement file is loaded using the ‘File Browser’ display, (*double clicking on a selected test file will also open the test file data in the measurement display*) it is shown in the ‘Measurement’ display. In this case, the Measurement Status, Actual Measuring Point (*with corresponding thickness*), elapsed time and remaining time values are not applicable and these fields will be empty.

3: Detailed User Interface Features

3.5.2 Validation Display & Test

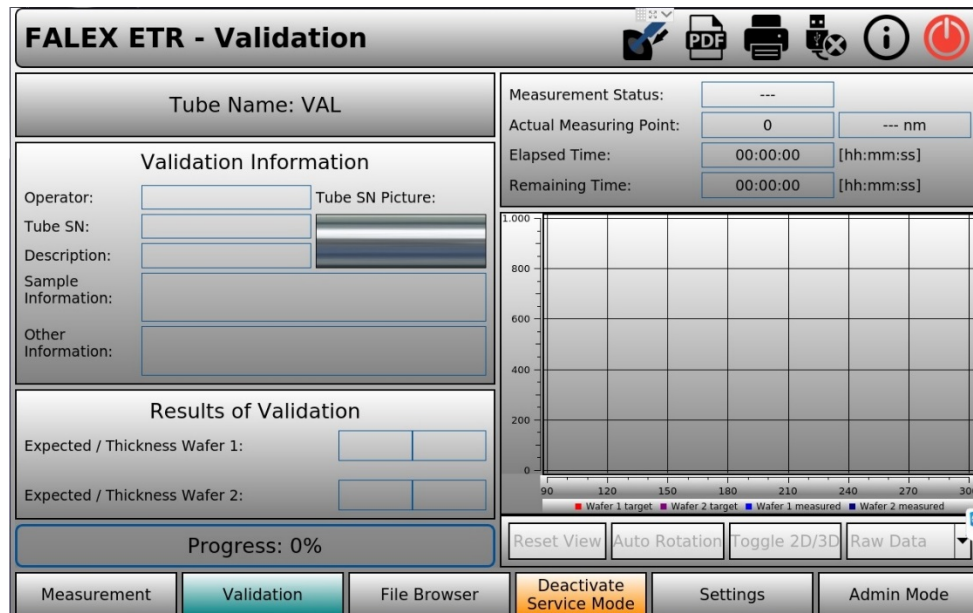


Figure 3-6 – Validation Display

The 'Validation' display (figure 3-6) is used to verify if the machine is measuring the tube deposits with the same accuracy that it had been previously or if the accuracy of the tube deposit readings is in question. Obtain a Falex NIST Traceable Reference Tube (p/n 430-200-002) to verify accurate functionality. This reference tube is a specially designed NIST Traceable Reference Tube that contains two silicon glass wafers. Each wafer is NIST certified with one in the thicknesses range of 60nm and the other 100nm. The NIST Traceable Reference Tube is housed in a stainless steel tube especially designed to create a dust free environment for the silicon wafers when the tube is not in use. The tube contains a sealed entry gasket and a threaded cap to aid in assuring this environment is dust free. The tube comes with two NIST certificates, one for each wafer that has the certified thickness in Angstroms, these certificates are individually serial numbered, as well as the NIST Traceable Reference Tube. The stainless steel tube also has a permanent sticker on the outside with this information. The determined maximum average thickness should be within $\pm 5\%$ of the known value. If it is not, contact your local Falex representative. It may be determined that your Falex 430 ETR is due for a calibration, which is to be performed by your local Falex representative or Falex approved service technician.

Note: *It is important to minimize the exposure time of the silicon wafers to the outside environment. If the silicon wafers encounter dust, finger prints, scratches, etc. of any kind, it will degrade the NIST Traceable Reference Tube accuracy and functionality. Only handle the tube from the ends. If the wafers encounter these types of conditions, great care must be taken in the cleaning of the wafers. Refer to the included recommended cleaning & care of the NIST Traceable Reference Tube.*



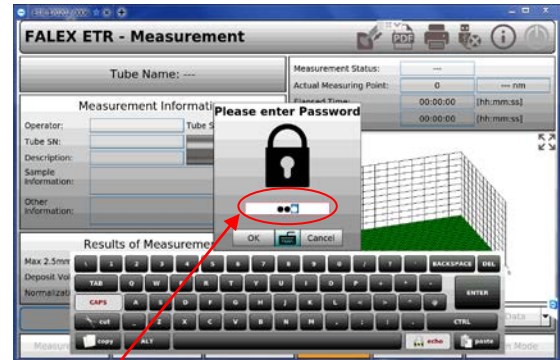
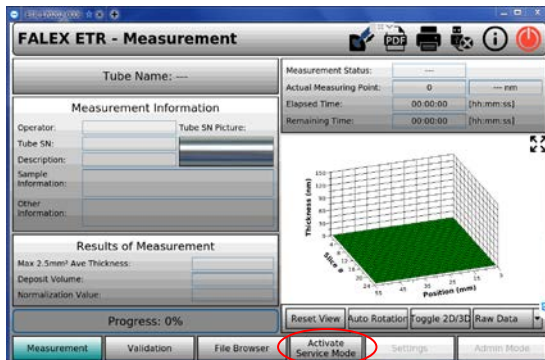
3: Detailed User Interface Features



Note: Before performing a 'Validation' with the NIST Traceable Reference Tube, it is recommended that the Falex 430 ETR be first 'Calibrated' with the NIST Traceable Reference Tube, if not previously done so.

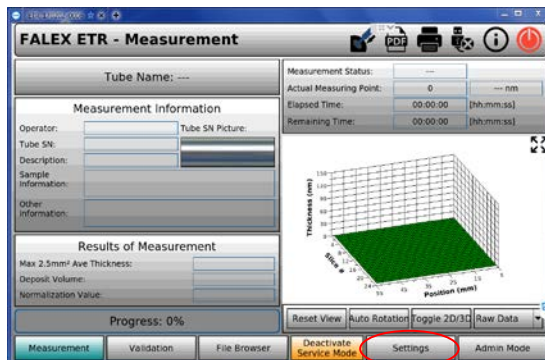
To run a 'Validation' test,

From the 'Measurement' screen, press the 'Activate Service Mode' tab on the lower toolbar. Password: Enter 'ETR' (all letters capitalized) from the touchscreen keyboard, press 'OK' or the 'Enter' key. This will activate the 'grayed' out tabs on the lower toolbar.



'ETR'

Go to the 'Settings' screen [after tabs on lower tool bar have been activated] by pressing the 'Settings' tab on the lower tool bar.

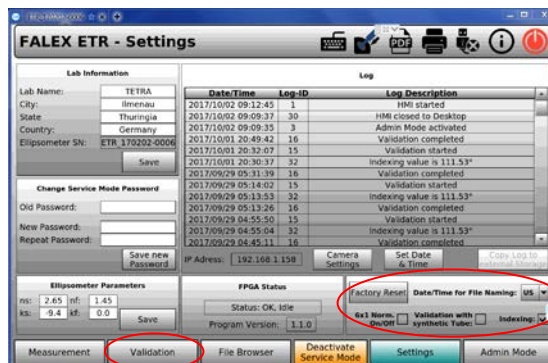


3: Detailed User Interface Features

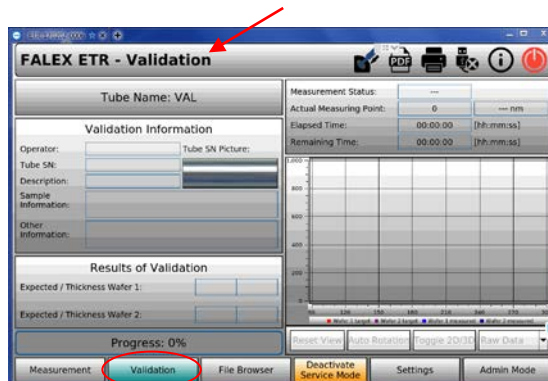
On the 'Settings' screen in the lower right area, verify that the box for 'Validation with synthetic tubes' is unchecked and that 'Indexing' is checked. *Note: If the '6x1 Norm On/Off' is checked, leave it as found.*



Note: For 'Validation with synthetic tubes', the 'Validation with synthetic tubes' box must be checked.



Go to the 'Validation' screen by pressing the 'Validation' tab on the lower tool bar. Carefully remove the 'NIST Traceable Reference Tube' from the stainless steel tube.

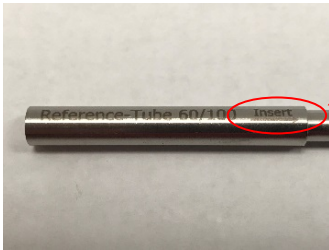


Insert the 'NIST Traceable Reference Tube' by pressing the 'Insert/Eject Tube' icon on the upper tool bar. Once the shutter is open, carefully insert the tube until the tube has begun to be pulled into the unit.

3: Detailed User Interface Features



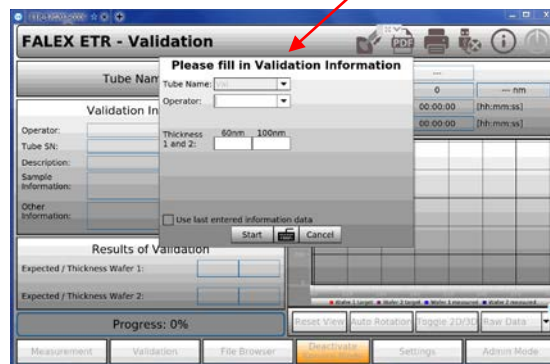
Note: The tube can only be inserted one direction, one end is larger than the other, also there is an 'insert' directional arrow on the end with the tube serial number, non-serial number end is inserted into the unit.



Press the 'Start' button on the front panel. Once the 'Insert Tube' pop-up is gone, the 'Please fill in Validation Information' popup will appear.



Note: The serial number will not be captured by the camera.



Enter required information in the 'Please fill in Validation Information' pop-up. Select keyboard icon to open full-size keyboard.



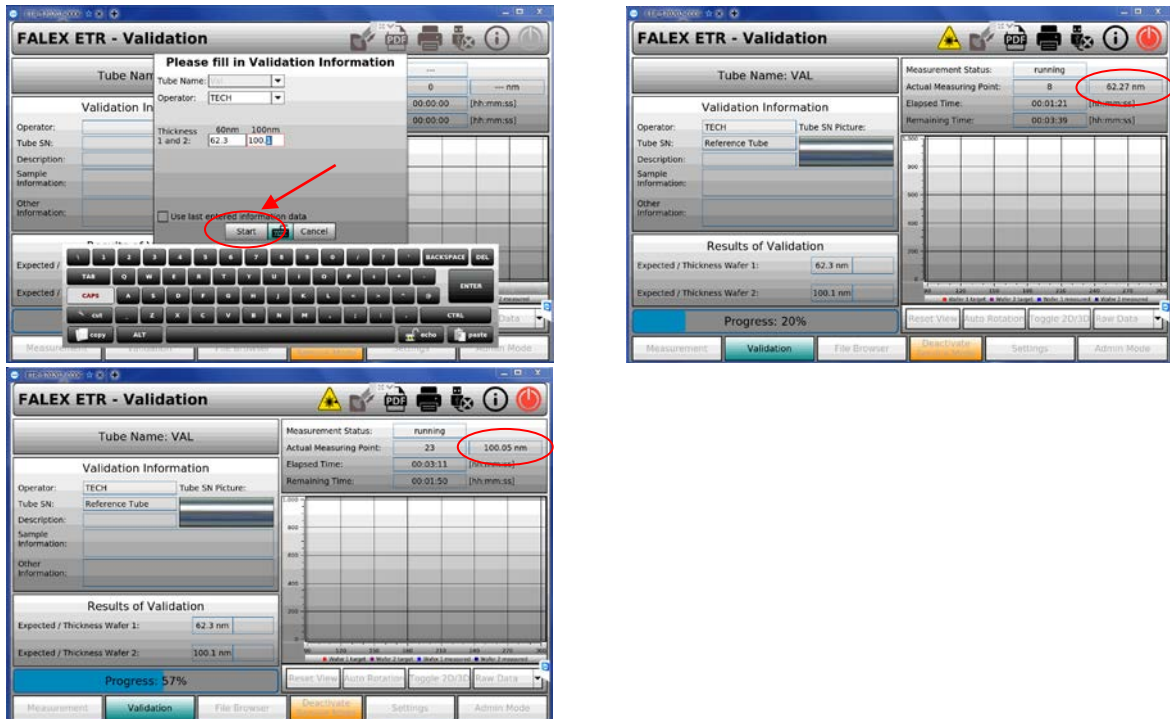
Note: Required information fields are: 'Operator:', 'Thickness:'. 'Tube Name:' is automatically set to 'VAL'. For the 'Thickness' of 60nm & 100nm use the target/expected values from the NIST certificate or the label on the stainless steel tube.

3: Detailed User Interface Features

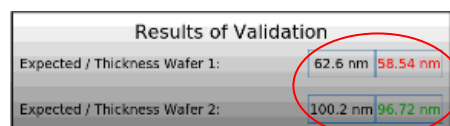
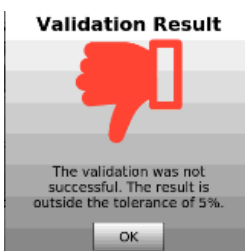
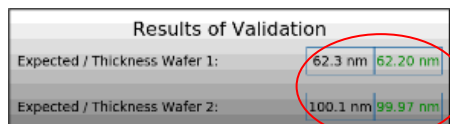
Press 'Start' at the bottom of the pop-up to begin the validation of the 'NIST Traceable Reference Tube' test.



Note: The test will take approximately 5 minutes to complete, this includes indexing, edge detection as well as acquiring 20 measurements for each wafer (60nm & 100nm).



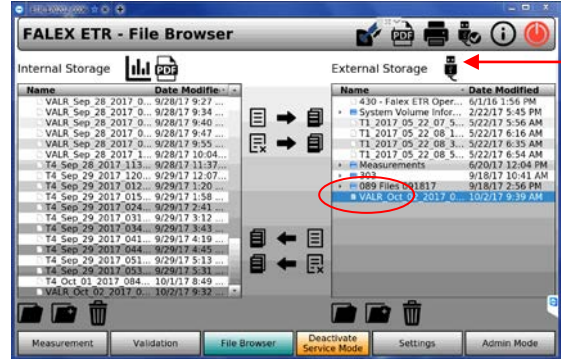
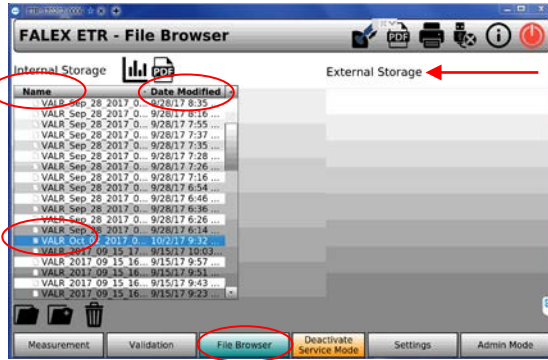
Once the validation test has completed, you will see the 'Validation Result' (pass/fail) pop-up, click 'OK' to close this pop-up. The important information you will be looking for is a 'Pass' (green thumbs up) pop-up and the actual wafer thicknesses in green. (thicknesses in green indicates the measurement is within +/- 5% of the 'Expected Thickness')



3: Detailed User Interface Features

Optional: To verify that the validation test was saved, go to the 'File Browser' screen by pressing the 'File Browser' tab on the lower tool bar. The saved validation test will have the file name of 'VALR' followed by the date/time stamp. (You can click on the 'Name' or 'Date Modified' headers to aid in searching for the saved test)

You can also copy the validation test to an external USB drive.



Eject the 'NIST Traceable Reference Tube' by pressing the 'Insert/Eject Tube' icon on the upper tool bar. Once the shutter is open and the tube ejected, carefully remove the tube. (if needed, gently press in on the exposed end of the tube to aid in releasing from the clamping device) Carefully return the 'NIST Traceable Reference Tube' to the stainless steel tube, taking care not to have the wafers brush against the sealing gasket.



Note: It is recommended to run at least three validation tests using the 'NIST Traceable Reference Tube'. After each test, eject and reinsert the tube. If performing 'back-to-back' validations, perform a manual initialization by using the 'Start Initialization. Button from the Admin screen before the next calibration. This will help with possible errors that sometimes occurs during 'back-to-back' validations. Follow the above procedure to run another validation test for the 'NIST Traceable Reference Tube'. If the validation fails on all three tests, please contact your Falex or Compass representative.

3: Detailed User Interface Features

3.5.3 File Browser Display

The 'File Browser' display (figure 3-7) allows the operator the ability to easily organize the recorded measurement data files and the saved .pdf files. The operator is allowed to search, move, copy and delete selected files. The display is split into two (2) sides: internal storage and external storage. 'Internal Storage' shows the directory structure and associated data files stored within the Falex 430 ETR. If an external USB flash drive is connected to the machine, the 'External Storage' shows the directory structure and associated files stored on that device.

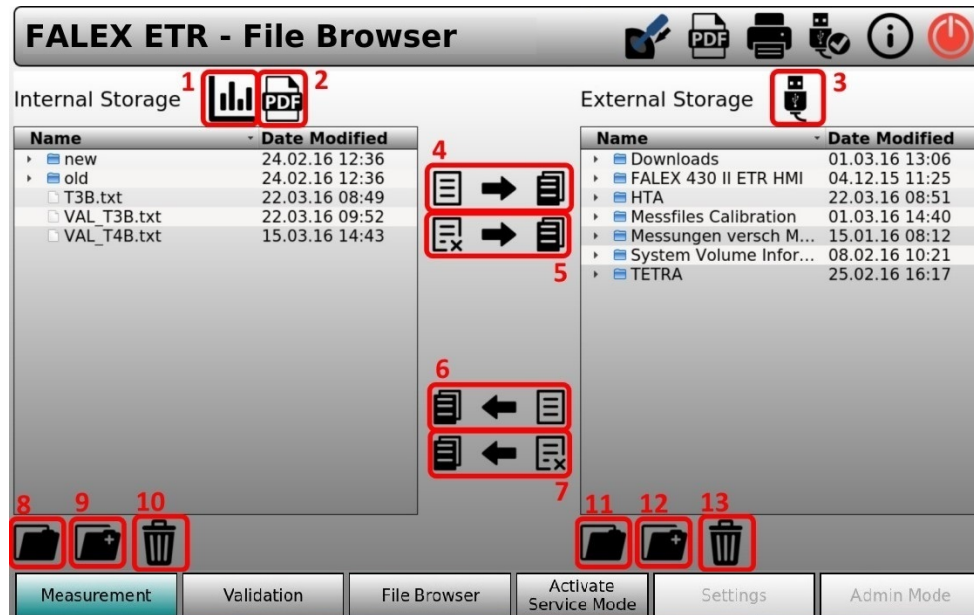


Figure 3-7 – File Browser Display



Note: Only files with the .txt and .pdf extension will be shown in the 'File Browser'. Also, selection of multiple files/folders cannot be moved or copied at the same time.

Associate the numeric red box in (figure 3-7) with the numeric description below for functionality details:

1. Selecting this icon will open the folder for measurement test data storage (*also selects the root of the folder*).
2. Selecting this icon will open the folder for .pdf file storage (*also selects the root of the folder*).
3. Selecting this icon will open the external USB flash drive root directory.
4. Once the internal file is selected and external folder is selected, selecting this button will copy the internal file(s) to the external storage location.
5. Once the internal file is selected and external folder is selected, selecting this button will move the internal file(s) to the external storage location.
6. Once the external file is selected and the internal folder is selected, selecting this button will copy the external file(s) to the internal storage location.
7. Once the external file is selected and the internal folder is selected, selecting this button will move the external file(s) to the internal storage location.

3: Detailed User Interface Features

8. Selecting this icon will open the selected file within the internal storage of the corresponding display, or double clicking the selected file (*Measurement or Validation*).
9. Selecting this icon will open the dialog window pop-up (figure 3-8) for creating a new folder at the selected place within the internal storage.



Figure 3-8 – New Folder Pop-up

10. Selecting this icon will open the dialog window (figure 3-9) for deleting the selected file(s)/folder within the internal storage.



Note: The file(s)/folder will be permanently deleted.

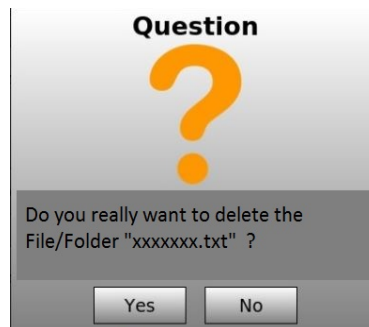


Figure 3-9 – New Folder Pop-up

11. Selecting this icon will open the selected file within the external storage of the corresponding display (*Measurement or Validation*).
12. Selecting this icon will open the dialog window (figure 3-8) for creating a new folder at the selected location within the external storage device.
13. Selecting this icon will open the dialog window (figure 3-9) for deleting the selected file(s)/folder of the external storage device.



Note: The file(s)/folder will be permanently deleted.

3.5.4 Activate Service Mode Display

3: Detailed User Interface Features

Selection of this display button allows factory technicians and authorized personnel to enter a level 1 password, enabling the 'Settings' display. (Refer to Section 3.4 and 3.5.6)



3.5.5 Activate Admin Mode Display

Selection of this display button allows factory technicians and authorized personnel to enter a level 2 password, enabling the 'Admin Mode' display. (Refer to Section 3.4 and 3.5.7)



Note: Use Caution when accessing areas enabled by this password.

3: Detailed User Interface Features

3.5.6 Settings Display

When enabled, selection of this display button allows the operator to change measurement settings.

Note: This display is for factory technicians and authorized service personnel use only.



FALEX ETR - Settings

Lab Information

Lab Name: LAB PROTOTYPE
City: SUGAR GROVE
State: IL
Country: USA
Ellipsometer SN: HTA_154240003
Save

Change Service Mode Password

Old Password:
New Password:
Repeat Password:
Save new Password

Log

Date/Time	Log-ID	Log Description
2017/10/25 16:47:58	1	HMI started
2017/10/24 21:49:17	30	HMI closed to Desktop
2017/10/24 21:42:45	8	USB-Stick inserted
2017/10/24 21:39:40	14	Measurement aborted by user
2017/10/24 21:38:29	12	Measurement started
2017/10/24 21:37:39	32	Indexing value is -1536.2°
2017/10/24 21:33:12	17	Validation aborted by user
2017/10/24 21:21:48	15	Validation started
2017/10/24 21:20:18	32	Indexing value is -1536.2°
2017/10/24 21:15:25	3	Admin Mode activated
2017/10/24 21:02:29	1	HMI started
2017/10/23 22:12:46	2	HMI PC shutdown
2017/10/23 21:31:23	8	USB-Stick inserted

IP Address: 192.168.1.152 Camera Settings Set Date & Time Copy Log to external Storage

Ellipsometer Parameters

ns: 2.65 nf: 1.45
ks: -9.4 kf: 0.0
Save

FPGA Status

Status: OK, Idle
Program Version: 1.1.0

Factory Reset Date/Time for File Naming: US
6x1 Norm. On/Off Validation with synthetic Tube: Indexing: ☒

Measurement Validation File Browser Deactivate Service Mode Settings Admin Mode

Figure 3-10 – Settings Display

In the Settings Display (figure 3-10) you can change parameters for use in the Measurement test as well as others parts of the Falex 430 ETR.

Lab Information – Lab Name, City, State & Country can be modified. The Ellipsometer SN cannot be modified. The keyboard icon will open up a full size keyboard for use in modifying these fields.

Change Service Mode Password – To modify the Service Mode Password you have to type in the current password (default is ETR). In the next text fields you have to type in the new password. If the current password is correct you can click the 'Save New Password' button

Ellipsometer Parameters – These parameters can be modified to change the Ellipsometer Properties. These parameters describe the optical properties of the heater tube (ns, nf) and the deposit film (ks, kf) [default properties is for aluminum ns, nf, ks, kf]. Once modified, the 'Save' button stores the new parameters to be used for the next Measurement test(s).

Note: Incorrect optical properties will result in unreliable measurement results, modify these parameters with caution.

FPGA Status - Shows the actual status of the built-in FPGA firmware and the current version.



3: Detailed User Interface Features

Factory Reset - Will restore the 'Lab Information', 'Service Mode Password' and 'Ellipsometer Parameters' to factory defaults.

Date/Time for File Naming - Can be changed from US to EU for data file naming purposes.

6x1 Norm. On/Off – This enables the selection of including the additional 6x1 Normalized Data when viewing the graph after a Measurement test.



Validation with synthetic Tube - *Enables you to validate with a synthetic coated tube if provided, the default for the validation mode is with the NIST Traceable Reference Tube.*

Indexing – This is for the switching On/Off the indexing function.

Log – This section displays the last 100 log entries. Most actions of the Falex 430 ETR are logged, two log files exist. If one file exceeds 1MB the logging switches to the other file. If the file is already filled it will be overwritten. When a USB device is plugged in, the 'Copy Log to external Storage' button is active. If no USB device is plugged in, this feature will be disabled.

IP Address - is shown if the device is connected to an external network. A network IP Address will only be detected when the device is restarted and the Settings Display is reopened.

Camera Settings - is used to adjust the internal camera for capture of the tube serial number. The default settings are shown below:

Picture Position: Adjusts picture horizontally (*default 20000*) Older Units the Default is 8000

Rotation Speed: Adjusts how fast the tube is rotated for the picture (*default 20*)

Line Nr: Adjusts picture vertically (*default 200*)

LED-Dim: Adjusts the light/shading of the picture (*default 10*)

Full Picture: If checked, a full picture of the tube is taken, this is needed for finding the right Line Nr.

Picture Frequency [Hz]: Typically not adjusted (*default 26*)

3: Detailed User Interface Features

Set Date & Time - opens a dialog where the system 'Date': [Year, Month, Day], 'Time': [Hour, Minute], 'Time Format': [12 or 24 Hr] and 'Time Zone' can be adjusted. Once modified, use the 'Set' button to store the modified settings. Use the 'Cancel' button to restore the settings.



The dialog box is titled "Set Time & Date". It contains the following fields and controls:

- Date:** Three input fields for Year (2017), Month (10), and Day (25). Each field has a "-" button on the left and a "+" button on the right.
- Time:** Two input fields for Hours (09) and Minutes (56). Each field has a "-" button on the left and a "+" button on the right.
- Time Format:** A dropdown menu currently set to "12h".
- Time Zone:** A dropdown menu currently set to "America/Chicago".
- Buttons:** "Set" and "Cancel" buttons at the bottom.

3: Detailed User Interface Features

3.5.7 Admin Mode Display

Selection of this display button allows the Level 2 password [F1020] to be entered, enabling features available for factory technician and authorized service personnel use only. (Refer to Section 3.4 for a complete description of Password Levels)

Note: This display is for factory technicians and authorized service personnel only.



Figure 3-11 – Admin Mode Display

Within the Admin Mode Display (figure 3-11) it is possible to control every part of the Falex 430 ETR manually. This display is separated in ten (10) different areas. The 'Axis Enable' area allows you to Enable or Disable five (5) areas. Each axis has two (2) modes of Motion, you can switch between modes 'Switch Mode' button. Every axis has to be enabled before movement. There are three (3) temperature sensors inside the Falex 430 ETR, only one (1) is displayed. The other areas are for troubleshooting and to verify functionality.

Motion Mode

Step Mode – With 'Step Mode' active, in the text field for the corresponding axis you can type in the 'step width'. The axis will move one 'step' for every click of '+' or '-'.

Velo Mode – With 'Velocity Mode' active, in the text field for the corresponding axis you can type in the 'velocity'. The axis will move as long as the '+' or '-' button is pressed and will stop when the button is released or the axis hits a limit switch.

Note: For every axis, the actual position is shown in 'degrees' for a rotary axis and in 'mm' for a linear axis. The 'rotary' axis has an index mark, the 'linear' axis have limit switches. The light for the indexes will turn green for one second if the axis hits the index mark or limit switch.



3: Detailed User Interface Features

Axis Enable – All five (5) axis has an 'Enable' and 'Disable' associated with the axis. The axis has to be enabled (*the button will display 'Disable' when enabled*) to function. When finished, the axis has to be disabled (*the button will display 'Enable' when disabled*).

Tube Translation – This will move (or *translate*) the Tube forward and reverse between the Front and Rear Limit switches and display the 'Actual Position' in 'mm'.

Tube Rotation – This will rotate the Tube and find the Index Mark as well as display the 'Actual Position'.

Shutter – This will move the Shutter position from the Open to the Closed position. This is indicated as displayed by the Left and Right limit switches and will display the 'Actual Position'.

Compensation – This will move the Compensation motor side to side between the Left and Right Limit switches and display the 'Actual Position' in 'mm'.

Analyzer – This will rotate the Analyzer and find the Index Mark as well as display the 'Actual Position'.

Other Areas

Machine Temperature - There are three (3) temperature sensors inside the Falex 430 ETR, only one is displayed.

Tube Clamping – In this area you can switch on/off the Tube Clamping. When a tube is inside the Falex 430 ETR the 'Tube Inserted' light glows green. When the Tube Clamping is active, the 'Clamping Active' light glows orange.

Laser – The Laser can be switched on/off independently from the laser-enable-signal via the 'Laser On/Off Button'. The 'Laser Enabled' light shows whether the laser is enabled or not. The 'Laser Active' light and the Laser Symbol in the Top-Tool-Bar shows whether the laser is switched On or Off.

Ellipsometer Sensor Value – This is 'Actual Sensor Value' (*in volts*) when the laser is enabled.

Start Initialization – This manually starts an initialization of the Falex 430 ETR. This is used to 'reset' the Falex 430 ETR after troubleshooting the various areas.

4: Data Files – Measurement / Validation

4.1 Data File Overview – Measurement / Validation

Data files are created and stored on the user interface for each measurement test. They contain the data that was collected during the test. The file naming format is as follows:

Measurement Data File

TTTTTT_MMM_DD_YYYY_hhmm [am/pm]_XXXXXXXX.txt

Where,

TTTTTT = operator entered test name designation (*10 characters max*)

MMM = month

DD = day

YYYY = year (i.e. 2018)

hh = hour

mm = minute

am/pm = If 12H selected for 'Time Format'

XXXXXXXXXX = heater tube serial number entered in test configuration

Validation Data File

VALR_MMM_DD_YYYY_hhmm [am/pm].txt

Where,

VALR = fixed Validation test name

MMM = month

DD = day

YYYY = year (i.e. 2018)

hh = hour

mm = minute

am/pm = If 12H selected for 'Time Format'

Data files can be copied from the machine to an external device using the 'File Browser', as discussed in Section 3.5.3. The data files are saved in a format that can be opened within a standard spreadsheet or document application once transferred to an external PC. The data files are saved as a .txt formatted file.

The (*measurement/validation*) data file consists of header information and stored data records (*data table*). The measurement data table is captured and stored based on the configured test parameters (*slices and position*) for the duration of the test. The measurement data table is made up of five (5) parts: non-normalized data, 2x3 normalized data, 3x2 normalized data, 6x1 normalized data and ellipsometric angles. The validation data table is made up of three (3) parts: Angle [deg], Power Wafer 1, Power Wafer 2.

4: Data Files – Measurement / Validation

Measurement Data File

Non-normalized Data

Captured raw data that has not been normalized. The 3D graph is populated during a test with non-normalized data.

2x3 Normalized Data

Each value is a 2.5mm^2 average area value found of six (6) points (2 columns x 3 lines). It will be used to normalize the rest of the data by subtracting it from every data point. Normalization is applied at the end of the test when all data has been collected. The 3D graph shown at the end of the test has been normalized.

3x2 Normalized Data

Each value is a 2.5mm^2 average area value found of six (6) points (3 columns x 2 lines). It will be used to normalize the rest of the data by subtracting it from every data point. Normalization is applied at the end of the test when all data has been collected. The 3D graph shown at the end of the test has been normalized.

6x1 Normalized Data

Each value is a 2.5mm^2 average area value found of six (6) points (1 columns x 6 lines). It will be used to normalize the rest of the data by subtracting it from every data point. Normalization is applied at the end of the test when all data has been collected. The 3D graph shown at the end of the test has been normalized.

Ellipsometric Angles (PSI, DELTA)

These are the ellipsometric angles which are used to calculate the deposit thickness. A psi and delta pair exists for each point on the heater tube.

Validation Data File

Angle [deg]

Angle and degree recorded for calculation in Validation curves.

Power Wafer 1 and Power Wafer 2

Power readings for each Angle and degree of Wafer 1 and Wafer 2 recorded for calculation in Validation curves.

4: Data Files – Measurement / Validation

The header portion contains information that was entered in the ‘Measurement/Validation Information’ portion of the display for the particular test, along with other useful information determined during the test. The header portion of the data file(s) consists of:

Measurement Data File

- Date/Time
- Type (*Measurement*)
- Tube Name
- Operator
- Tube SN (*Serial Number*)
- Description
- Sample Information
- Other Information
- Tube Material
- Test Status
- *ni (refractive index of the air)*
- *ns (refractive index of the tube)*
- *ks (extinction coefficient of the tube)*
- *nf (refractive index of the deposit)*
- *kf (extinction coefficient of the deposit)*
- *DC Offset (offset of the photo diode in the dark)*
- Lab Name
- City
- State
- Country
- Ellipsometer SN (*Serial Number*)
- Total Volume
- Max Ave Thickness
- Normalization Value
- Normalization Position
- Indexing Path
- Calibration Date

Validation Data File

Date/Time
Operator
Expected Thickness 1
Expected Thickness 2
Measured Thickness 1
Measured Thickness 2

The data table portion of the measurement data file consists of thickness data for each slice and position (*as defined in the test configuration*). For an ASTM D3241 test, the 24 slices will be from 0 - 360° (*increments of 15°*) and the position (55 points) will be from 5 – 55 mm (*increments of 1 mm*). Refer to Addendum ‘B’ for a partial sample of a data file.

The data table portion of the validation data file consists of Power for Wafer 1 & 2 for Angles [deg] from 0° thru 360°.



Note: *Slice 0° and 360° represent the same slice.*

5: Maintenance /Service

5.1 Maintenance / Service Overview

General maintenance can be done to clean the user interface touchscreen or to clean the housing. If the tube clamping becomes tight/sticky, there is a procedure to clean the tube tunnel and/or the clamping mechanism. Please contact your Falex Representative or Compass Service for more information. This does not require the laser to be active. There are no maintenance procedures that require the laser to be on. There is no scheduled maintenance necessary to keep the Falex 430 ETR in compliance.

Note: No maintenance is required on the laser system or internal positioning equipment.



Note: Should any issues appear that require service, please contact your Falex Representative or Compass Service. This equipment is to be serviced or repaired by factory authorized personnel only! It is recommended that for any service related issues, the machine is to be shipped back to the manufacturer. The machine is not to be opened or modified by the operator. Doing so will void the warranty.

For any service related issues, contact your local Falex representative obtain an RMA, then ship the machine to:

Falex Corporation
1019 Airpark Drive
Sugar Grove, IL 60554
USA

Make sure all associated equipment is included (*external power supply, power cords*). Please include documented details of the problem.

5: Maintenance /Service

Warning Messages

[This is not a complete list, these are commonly encountered Warning Messages, for any other Warning Messages please contact your Falex Representative or Compass Service]

Message	Condition	Effect	Comments
Device not calibrated. Please Calibrate!	The file 'CalibrationData.cal' doesn't exist in the HMI folder.	No measurement can be started.	Contact Falex Rep/Compass Service
No Camera Settings File Found!	The file 'CameraSettings.param' wasn't found in the HMI folder.	No standard settings for the camera can be loaded in the Camera Settings Screen	Contact Falex Rep/Compass Service
No Parameter File Found!	The file 'DeviceParameters.param' wasn't found in the HMI folder.	Device parameters can't be reset to standard settings.	Contact Falex Rep/Compass Service

Error Messages

[This is not a complete list, these are commonly encountered Error Messages, for any other Error Messages please contact your Falex Representative or Compass Service]

Message	Condition	Effect	Comments
Shutter Not Closed	Shutter is not closed. Left Limit Switch is not triggered.	No measurement can be started.	Refer to Section 3.5.7 'Shutter' Or Contact Falex Rep/Compass Service
Init aborted. Please Restart the device.	Initialization was aborted when HMI was loaded.	Device can be used as Normal, but it is Recommended to Restart the device to Restart the Initialization.	Refer to Section 3.5.7 'Start Initialization' or Contact Falex Rep/Compass Service

5: Maintenance /Service

Specific for Validation with Falex NIST Traceable Reference Tube

Message	Condition	Effect	Comments
Validation aborted because of deviation in measurement data	The deviation of the averaged measurement curve to the single curves is too big (more than 500 increments which are 0.038V)	The Validation will fail, but the measured curves are saved to the HMI folder.	Inspect the Tube for dust/dirt Refer to Addendum C: NIST Reference Validation Tube Care & Cleaning or Contact Falex Rep/Compass Service
Validation aborted because of Timeout during edge detection	Edge Detection lasts longer Than 15 seconds.	The Validation will be aborted.	Refer to Section 3.5.7 'Start Initialization' or Power cycle the unit or Contact Falex Rep/Compass Service
Validation aborted because of Timeout during compensation	A timeout is hit during Compensation.	The Validation will be aborted.	Power cycle the unit or Contact Falex Rep/Compass Service
Validation aborted because of Timeout during Notch search	A timeout is hit during Notch search.	The Validation will be aborted.	Power cycle the unit or Contact Falex Rep/Compass Service
Validation aborted because of Timeout during Wafer alignment	A timeout is hit during Wafer alignment.	The Validation will be aborted.	Power cycle the unit or Contact Falex Rep/Compass Service
Validation aborted because of Timeout during measurement	A timeout is hit during measurement.	The Validation will be aborted.	Power cycle the unit or Contact Falex Rep/Compass Service

5: Maintenance /Service

Specific for FPGA Errors

Message	Condition	Effect	Comments
FPGA Error: Analyzer Index	Timeout at initialization while searching the index of the analyzer axis.	The Initialization will abort.	Power cycle the unit or Contact Falex Rep/Compass Service
FPGA Error: Compensation Error	The maximum sensor value during compensation is below the threshold value.	Running measurement will abort.	Power cycle the unit or Contact Falex Rep/Compass Service
FPGA Error: Edge Detection	During edge detection the tube translation axis will hit the back limit switch or the sensor signal won't be above the threshold value for edge detection	Running measurement will abort.	Refer to Section 3.5.7 'Tube Translation' or Power cycle the unit or Contact Falex Rep/Compass Service
FPGA Error: Measurement Values	The difference between min and max value for one measurement point is smaller than the value for edge detection	Running measurement will abort.	Can happen for very thick Deposits. Power cycle the Unit or contact Falex Rep/Compass Service
FPGA Error: Shutter not closed	Shutter is not closing during Tube insert or eject.	Test will continue	Refer to Section 3.5.7 'Shutter' or Power cycle the unit or Contact Falex Rep/Compass Service
FPGA Error: Shutter, Limit Switches	Both Limit Switches are triggered or there is a timeout when moving the axis.	Running measurement will abort.	Refer to Section 3.5.7 'Shutter' or Power cycle the unit or Contact Falex Rep/Compass Service
FPGA Error: Compensation, Limit Switches	Both Limit Switches are triggered or there is a timeout when moving the axis.	Running measurement will abort	Refer to Section 3.5.7 'Compensation' or Power cycle the unit or Contact Falex Rep/Compass Service
FPGA Error: Tube Rotation, index	Timeout at initialization while Searching the index of the tube Rotation axis.	Running measurement will abort	Refer to Section 3.5.7 'Tube Rotation' or Power cycle the unit or Contact Falex Rep/Compass Service
FPGA Error: Tube Translation, Limit Switches	Both Limit Switches are triggered or there is a timeout when moving the axis.	Running measurement will abort	Refer to Section 3.5.7 'Tube Translation' or Power cycle the unit or Contact Falex Rep/Compass Service
FPGA Error: Tube Translation, Init path	The measured path from one limit switch to another is not within the tolerated range	Running measurement will abort	Refer to Section 3.5.7 'Tube Translation' or Power cycle the unit or Contact Falex Rep/Compass Service

6: Addendums

Addendum A: Parts Listing

PART #	DESCRIPTION
430-200-002	Ellipsometer NIST Reference Validation Tube
431-003-001	Cabinet housing, front
431-003-002	Cabinet housing, top
431-003-003	Cabinet housing, right side
431-003-004	Cabinet housing, left side
431-038-001	User interface (panel PC)
431-103-001	External power supply
431-200-001	Fuse, 10 amp
650-030-161	Power cord, 120V
650-204-074	Stylus

6: Addendums

Addendum B: Sample Measurement / Validation Data File

(Partial data files)

Measurement Date File

Date 2/5/2018 08:26
 Type Measurement
 Tube Name Test 1
 Operator A. Technician
 Tube SN 12345678
 Description Sample Test
 Sample Information Specific test details can be entered here
 Other Information Any other useful information can be entered here
 Tube Material Aluminum
 Test Status Complete - Pass
 ni 1
 ns 2.65
 ks -9.4
 nf 1.45
 kf 0
 DC Offset 0.00112
 Lab Name Falex
 City Sugar Grove
 State Illinois
 Country USA
 Ellipsometer SN ETR_430-DXXXX
 Total Volume 0.0142053
 Max Ave Thickness 86.0872
 Normalization value 9.51562
 Normalization position 48
 Indexing Path 57.4294
 Calibration Date Feb/02/2018 01:38:53 pm

Validation Date File *(NIST Traceable Reference Tube)*

Date Feb/01/2018 04:13:13 pm
 Operator A. Technician
 Expected Thickness 1 xxx.xx nm
 Expected Thickness 2 xxx.xx nm
 Measured Thickness 1 xxx.xx nm
 Measured Thickness 2 xxx.xx nm

Non-Normalized Data

Slice/Position
 5 mm - 54 mm
 0 ° 345 °

2x3 Normalized Data

Slice/Position
 5 mm - 53 mm
 0 ° 345 °

3x2 Normalized Data

Slice/Position
 5 mm - 52 mm
 0 ° 345

6x1 Normalized Data

Slice/Position
 5 mm - 52 mm
 0 ° 345

Ellipsometric Angles (PSI, DELTA)

Slice/Position
 5 mm - 54 mm
 0 ° (psi, delta) ... 345 ° (psi, delta)

Angle [deg] Power Wafer 1 Power Wafer 2
 0 ° 360 ° x.xxxxx x.xxxxx

6: Addendums

Addendum C: NIST Traceable Reference Validation Tube Care & Cleaning



Note: *Handle the heater tube by the ends only. Do not touch the center section of the heater tube where the deposit is located. Doing so will contaminate the deposit.*

Visually inspect the heater tube that is to be tested for any foreign substance (*such as dust or lint*). If a foreign substance is noticed, gently try to blow off with clean dry air.



Note: *Do not clean the center section of the heater tube with any cleaner or wipe it with a cloth. No additional cleaning of the tube is required before testing with the Falex 430 ETR. Doing so will contaminate or damage the deposit. [Refer to ASTM D3241 for proper cleaning procedure]*

If Cleaning is required for the 'NIST Traceable Reference Tube', please refer to the above warnings and follow the below directions:

Care and Cleaning of the Silicon Wafers

Method 1:

Apply one drop of Isopropanol, then quickly blow off the Isopropanol with the pure air (*duster*). If the silicon wafer needs more cleaning, apply one drop of Isopropanol, wipe silicon wafer gently with laboratory grade Q-tip, then quickly blow off the Isopropanol with pure air (*duster*).

Method 2:

First rinse with alcohol (*isopropanol or methanol*), then use a solution of hot DI (*deionized*) water with a few drops of detergent (NIST recommends *JOY* brand), use a natural cotton ball to gently wipe the wafers with the hot detergent solution, rinse with distilled water to remove all detergent residue, finally dry with clean/dry nitrogen.



Note: *Humidity can have an effect on test results, they may change an Angstrom the day after cleaning. Allow the wafers to 'fully' dry before inserting back into the stainless steel container*

6: Addendums

Recommended cleaning products:

. Very Pure Isopropanol (*degree of purity is VLSI*):

http://www.microchemicals.com/products/solvents/isopropyl_alcohol.html

. Air (*pure duster*):

Thorlabs CA4-EU, but there is an US version CA4-US

https://www.thorlabs.com/newgrouppage9.cfm?objectgroup_id=3317&pn=CA4-US

. Q-Tips / Cotton Ball (*cleanroom grade*):

<http://www.iab-reinraumprodukte.de/en/swabs/polyurethane-swabs/swab-pu-3921.html?&listtype=search&searchparam=PU%203921>