

CuDDI™

Copper Digital Detection Imaging Device



User Manual

July 2025

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Document Revisions

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1/24/2016	1.1	2 nd Revision, added updates to semi-automatic mode and calibration
2/18/2016	1.2	3 rd Revision, Diagnostic and Specifications Table updated.
5/3/2016	1.3	4 th Revision, Formatting and typo fixes. JA.
6/12/2017	1.5	Removed motor settings, changed limits on focus range.
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1. General Information

The Copper Digital Detection Imaging Device (CuDDI) is the first high-tech optical-powered device in Ayalytical's suite of visual testing instruments. The CuDDI is powered by sophisticated optics and improves the visual rating of manual rating methods like ASTM D130, ASTM D1838, and ASTM D4048.

Copper strip testing is a critical indicator of persistent sulfur compounds remaining following the petroleum refining process. The CuDDI is a new standard of copper quality analysis for the petroleum industry using a high-resolution camera with optical intelligence. The CuDDI identifies levels of corrosivity present from products through an automated color extraction vision algorithm and classification process. Results are then digitally recorded and seamlessly integrated with LIMS software.

The CuDDI's higher precision, patented design eliminates guesswork and operator bias from copper corrosion detection. The digital detection imaging is achieved through a unique vision algorithm and light box that records, calculates, and displays accurate corrosivity ratings. This standardized measurement of copper quality improves on the current rating, method, and sample handling procedures performed in the current lab tests.

This user manual contains all of the essential information required for standard installation, operation, and maintenance. Please contact your local supplier or VISAYA for information not included in this manual. For the latest versions of documents and firmware navigate to section 9 for instructions on retrieving updates software and documentation.

While every precaution has been taken to ensure adequate and sufficient preparation of this document, VISAYA does not assume any responsibility for technical or printing errors or omissions. Nor is any liability assumed for damages resulting from the use of the information contained within this manual.

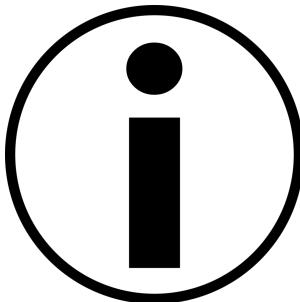
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1.1. Safety

This document does not claim to address all of the safety concerns associated with the use of the CuDDI and its samples. It is the responsibility of the operators to establish health and safety practices and determine the applicability of regulatory limitations prior to use.



Make sure you read and understand all instructions, guidelines, and safety precautions listed in this manual before installing or operating the equipment to ensure proper operation and avoid damage to the equipment or its accessories. If a malfunction occurs, consult the *Errors and Warnings* section. If the problem persists or if there are any questions regarding the operation of the equipment or information in this manual, please contact your local distributor or VISAYA.

The instrument described in this document should be used for automated copper corrosion operations only. The device should only be operated in a laboratory or similar indoor environment for analytical purposes by qualified personnel. If an instrument is used in a manner not specified by VISAYA and this operation manual, the warranty provided by the manufacturer may be voided.

Never operate equipment that is not correctly installed or fully operational. Ensure all operators are fully trained to use the analyzer correctly and safely. Unqualified personnel should not operate the equipment.

It is not advised to remove the chassis to access internal components of the analyzer unless you are qualified to provide service to the equipment. Do not operate the analyzer without the chassis properly installed. Always disconnect the power cord of the equipment before handling internal components to ensure safe handling. Do not use any accessories or wearing parts other than those supplied or approved by the manufacturer. If a problem persists, please call the local distributor or VISAYA. Repair and service should only be carried out by authorized personnel or by the manufacturer.

Follow the precautions below for safe operation:

- Ensure no hindrance to the NFX handle when in motion
- When loading a copper strip, ensure the strip is securely slotted into the dockets
- Nothing should be placed in or around the field of movement of the camera drives
- Do not clean the analyzer with anything other than a clean, dry cloth
- Do not use any fuse other than a 4.0 Amp type "T" slow blow

1.2. Warranty

Any product manufactured by VISAYA is sold to the purchaser on the following basis and none other. All implied warranties of merchantability and fitness for a particular purpose are hereby expressly excluded.

- (a) Products are warranted against defects in material and workmanship for one year (Warranty Period) from the date of purchase.
- (b) VISAYA shall either replace or repair (at its discretion) free of charge any VISAYA-manufactured product (or component or part thereof) which shall be returned to VISAYA within one year from the date of delivery.
- (c) VISAYA shall either replace or repair (at its discretion) free of charge any VISAYA-manufactured product (or component or part thereof) previously repaired or replaced under VISAYA warranty, which shall be returned to VISAYA before the later of the balance of the original one year warranty period or three (3) months after the date of repair or replacement
- (d) VISAYA shall either replace or repair (at its discretion) free of charge any part (sold as such) manufactured by VISAYA which shall be returned to VISAYA within three (3) months from the date of delivery, but only if such product, component, or part does not comply with one of the expressed warranties stated above
- (e) None of the obligations assigned to VISAYA by this paragraph shall apply to any products which have been repaired, altered, or modified at the hand of the customer, unless the customer has disclosed the nature and full extent to any proposed repair, alteration, or modification to VISAYA in writing before it has been effected, and obtained an undertaking from VISAYA that any outstanding warranty obligations in respect of such products will continue to apply to such products despite such repair or alteration. VISAYA retains an unfettered discretion to grant or refuse any such undertaking.
- (f) None of the obligations of VISAYA in this warranty shall apply to any products which have been subjected to misuse, neglect, accident, or (without restricting the generality of the foregoing) any extreme environmental condition or improper handling.
- (g) If defective products are returned to VISAYA, the costs of such return will be borne by the customer, and those of delivering the repaired or replacement products to the customer will be borne by VISAYA. VISAYA's sole liability hereunder shall be to repair or replace any product that proves to be defective. In no event shall VISAYA be liable for any

special, incidental, consequential, indirect, or other similar damages arising from the failure of its products.

(h) Resale Products: Shall carry the warranty offered by VISAYA to the original purchaser, unless specified otherwise in the offering or separately and specifically agreed upon in writing by VISAYA.

1.2.1. Limitation of Remedies

Neither VISAYA nor the customer will be liable to the other for any special, incidental, consequential, indirect, or other similar damages arising from breach of warranty, indemnifications, breach of contract, negligence, strict liability, or any other kind of civil liability. VISAYA's total liability in connection with this agreement shall in no event exceed the amount paid or payable by the Customer in respect of the product that is the cause of such liability on the part of the company.

1.2.2. Obligation of the Customer

The customer agrees, as a condition of purchase of a product from VISAYA, not to reproduce any part of the product. The customer also agrees not to make unauthorized use of the proprietary information that belongs to VISAYA.

1.3. Copyright

The CuDDI and this manual are protected by copyright ©. Reproduction of the unit will result in prosecution. All rights to the manual are reserved. Reproduction of this manual in any form, including in the form of excerpts, shall require express written permission from the copyright owner.

VISAYA reserves the right to make technical and content changes, including without prior notice.

1.4. Disposal

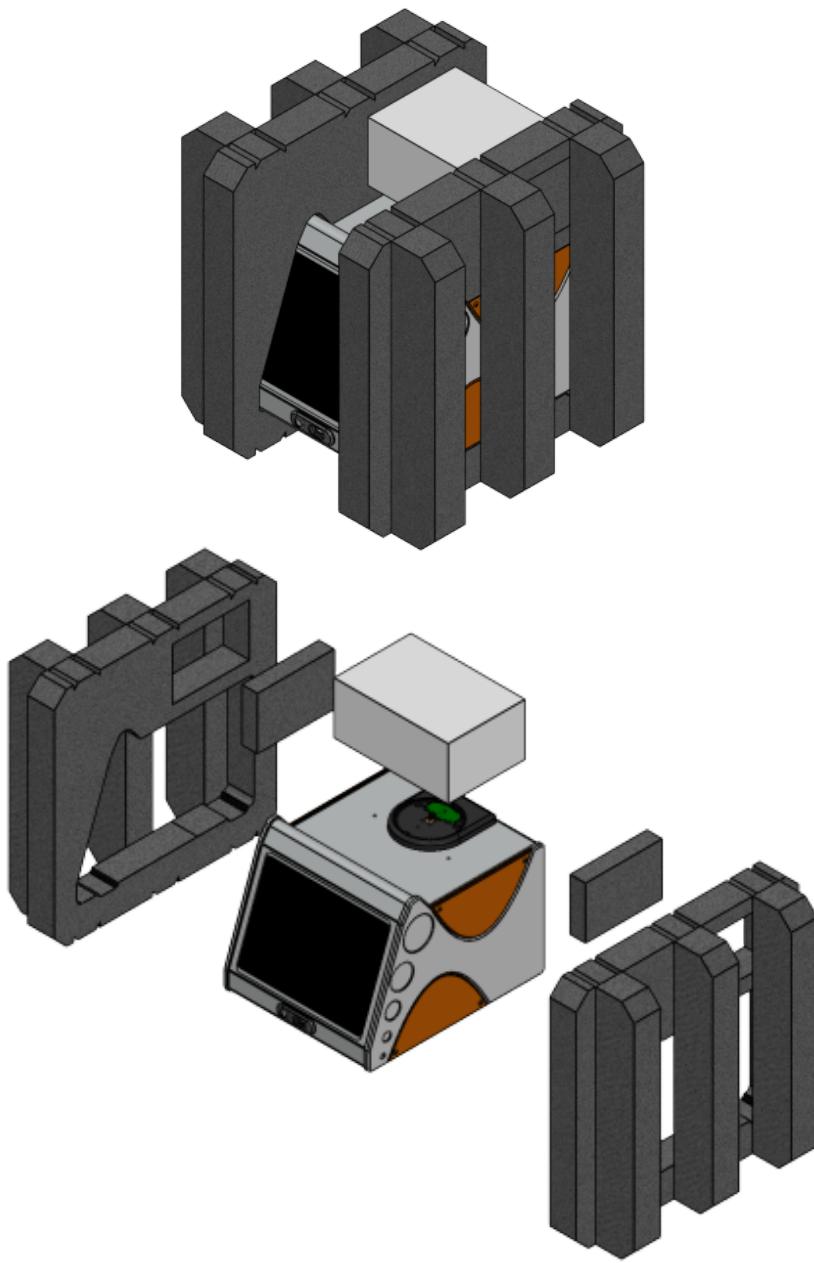
This product shall not be disposed of as municipal waste. Please return this product to VISAYA for disposal. For detailed information, please contact VISAYA before returning this instrument.

2. Unboxing

The standard CuDDI package comes complete with all necessary accessories for easy installation and quick operation. During the unpacking procedure, ensure safe handling to not damaging the instrument or injuring the handler.



Note: Please save shipping boxes and custom foam inserts, as they may serve for future transportation and securing of contents.



2.1. Parts on Arrival

The CuDDI should have arrived with the following parts:

Part Number	Photo	Description
AYA-10-88580		CuDDI Analyzer
AYA-13-88502		NFX Handle
AYA-13-88670		Power Supply Converter and Power Cord
AYA-15-00020		Calibration Standard
N/A		Test Certificate
N/A		User Manual
N/A		USB Memory Stick

If any of these items are missing or damaged, please contact your distributor right away.

2.1.1. Optional Accessories and Consumables

Part Number	Photo	Description
AYA-55-05791		ASTM Color Standard
AYA-10-88621		Aluminum Block Dry Bath
AYA-52-05793		Copper Strip (D130, D1275, D4048)
AYA-52-50072		Copper Strip w/ Hanging Hole (D1838)
AYA-52-50496		Polishing VISE - 5 Strips
AYA-51-05788		Test Tubes, 25-mm x 150-mm, D130, D1275
AYA-51-05789		Viewing Test Tube
AYA-51-50070		Test tube for D4048 Grease Corrosion
AYA-52-05798		Silicon Carbide Sheets, 150-Grit

AYA-52-05797



Silicon Carbide Sheets,
240-Grit

AYA-52-50456



Silicon Carbide
Grains/Powder, 150 mesh

2.2. Storing Accessories

The ASTM color standard (AYA-55-05791) should be stored face-down in a dark location, such as a cabinet or drawer, to preserve the color of the reference standard.

Similarly, copper strips will continually oxidize, so it is recommended to follow the procedure in ASTM D130 to prepare strips before analysis or to purchase prepolished strips.



Note: Strips can be better preserved for a prolonged period by submerging in a volatile, low-sulfur hydrocarbon that shows no tarnish when tested for 3 hours at 50°C (122°F) and stoppered with a cork. Isooctane (2,2,4-Trimethylpentane) with a minimum 99.75% purity is the reference solvent and is the suggested liquid.

2.3. Transportation

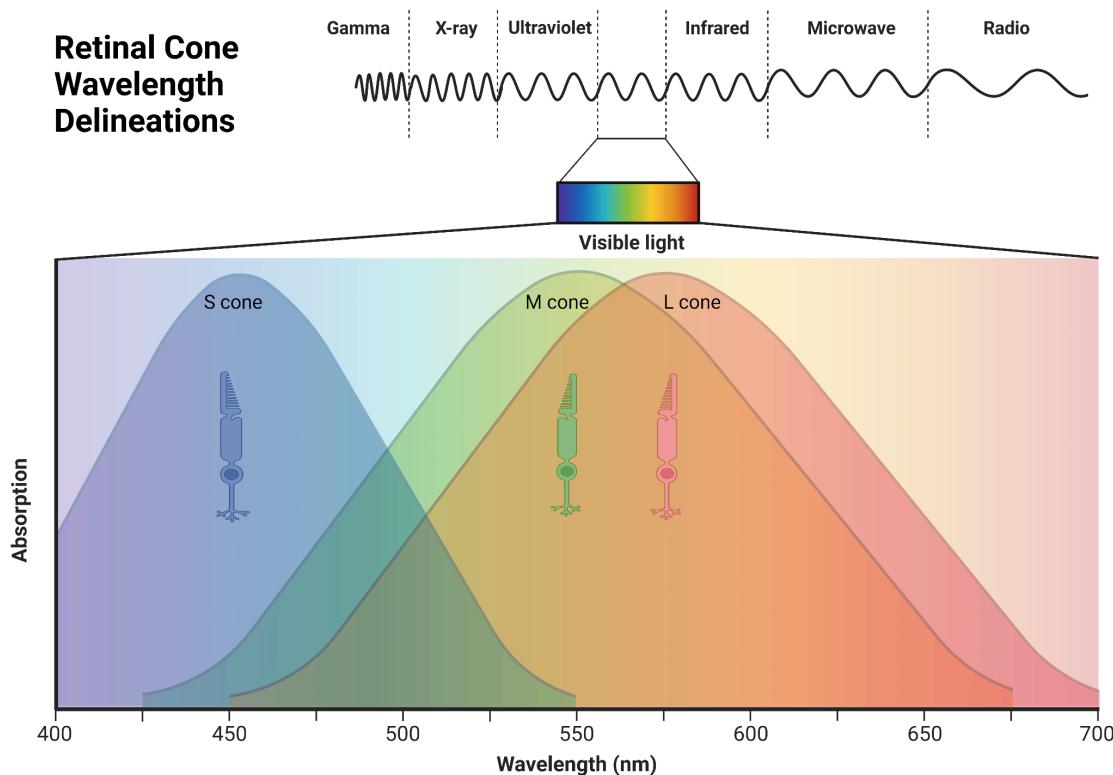
The CuDDI is designed to withstand general jolts and vibrations. However, it is an analytical instrument that contains assemblies that require camera optical alignment for adequate operation and analysis, and is thus subject to damage and misalignment. To ensure that the instrument is not damaged, it is recommended to retain and reuse the shipping boxes and packing materials, as they are designed to provide optimal protection for the equipment during transport in cases such as service.

3. Introduction

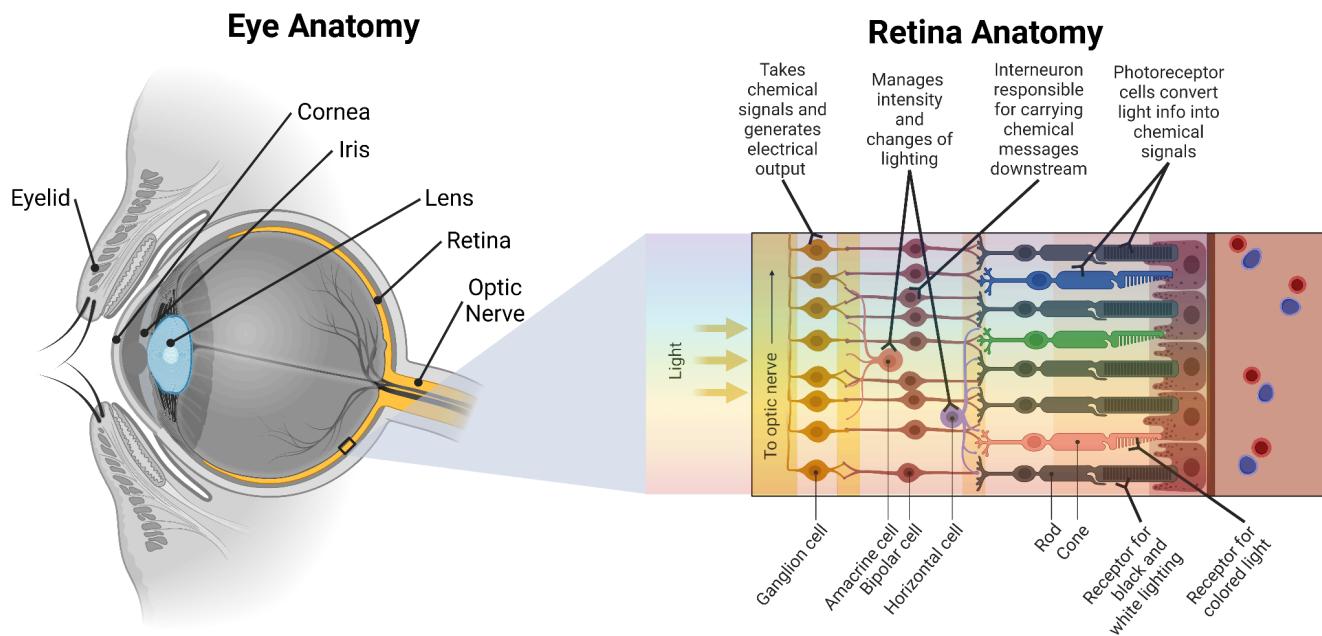
The CuDDI standardizes the process of copper strip corrosion testing with unparalleled precision, reliability, and ease of use. The CuDDI redefines copper corrosion testing by integrating high-resolution camera technology, pixel-by-pixel driven image processing, and waterfall algorithms to eliminate manual guesswork and operator bias. The CuDDI detects corrosivity levels of products in compliance with ASTM standards and provides a solution for laboratories aiming for efficient and accurate results.

3.1. Basis for Development

Color perception is often assumed to be an objective phenomenon; however, it is inherently subjective due to the psychophysical nature of human vision. While standardized terminology allows individuals to communicate color consistently, the actual perception of color varies based on numerous biological, environmental, and cognitive factors. The human visual system relies on three types of cone cells in the retina—L, M, and S cones—which process different wavelengths of light and transmit signals to the brain. Despite the general uniformity of this process, variations in cone sensitivity, ocular health, and neural processing introduce discrepancies in color interpretation among individuals.



Color perception begins when light, composed of different wavelengths, enters the eye. The eye has specialized cells called cones that detect color and send electrical signals to the brain for processing. Cones contain light-sensitive pigments that trigger electrical signals when stimulated by specific wavelengths. The three types of cone cells in the human retina differ in their sensitivity to specific wavelengths of light, allowing humans to perceive a broad spectrum of colors. S-cones are most sensitive to shorter wavelengths around 420 nm, which correspond to blue-violet light. M-cones, with peak sensitivity at approximately 534 nm, detect green light. L-cones respond to longer wavelengths around 564 nm, enabling the perception of red and orange hues.



Each type of cone contains a unique opsin protein that determines its spectral sensitivity. By combining the signals from all three types, the brain processes color information through additive mixing, creating the perception of various colors.

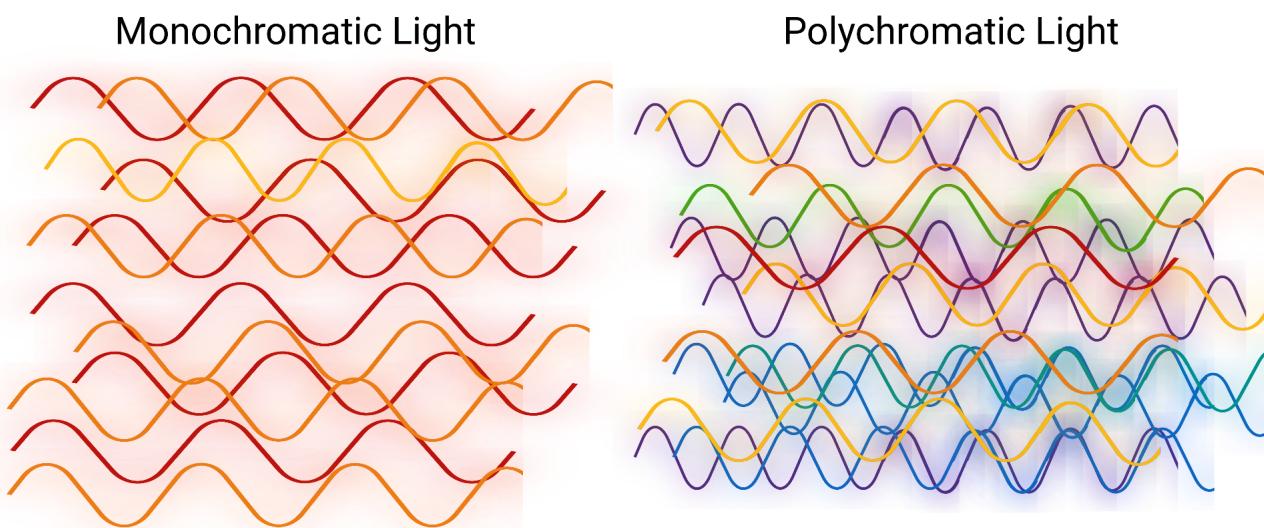
Trichromatic light processing is how the human visual system perceives color. The brain combines signals from cones to create a full spectrum of colors. This theory underlies technologies like RGB displays and explains how we perceive millions of hues from just three primary colors. S-cones only make up about 1-4% of the 6 million cone cells within the retina. The remaining 96-99% is comprised of L and M cones, but the exact ratio

between the two is highly variable. Some people may have an L to M cone ratio of about 1:1, whereas others have been found to have a range of 10:1 to 1:3. This is one reason color vision is so variable within the human population, who are genetically proficient in color vision.

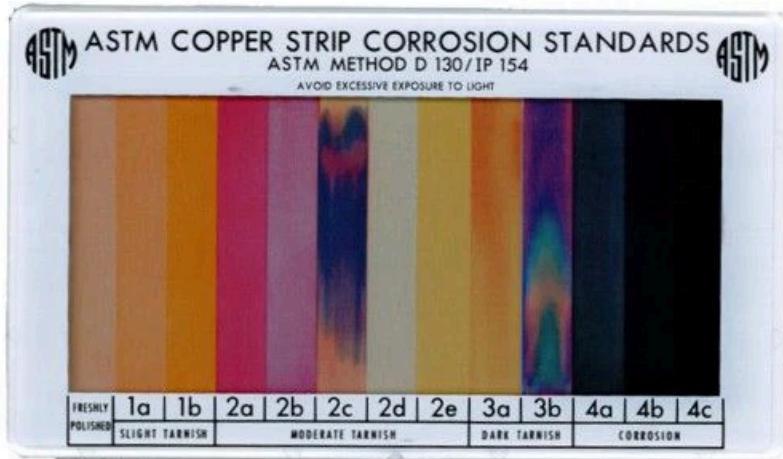
External conditions further influence color perception. Factors such as ambient lighting temperature, illumination intensity, simultaneous contrast effects, and surface texture can alter the way colors appear to an observer. Additionally, genetic differences contribute to variations in color vision, with color vision deficiencies affecting up to 10–12% of the population. These inherent inconsistencies present challenges in fields that depend on precise color evaluation, such as quality control in pharmaceuticals, healthcare diagnostics, and **petroleum product analysis**.

3.2. Measurement Principle

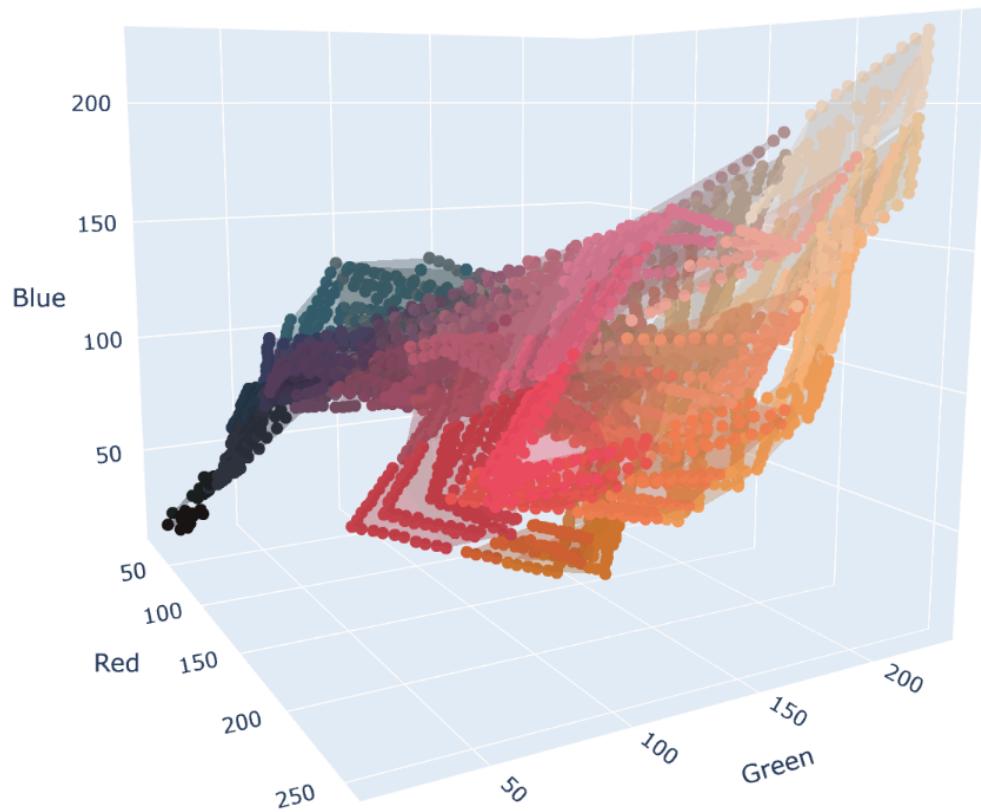
Industries reliant on precise color evaluation attempt to mitigate subjectivity through standardized measurement methods, such as those established by ASTM International. Methods, such as ASTM D130 (Copper Strip Corrosion Test), rely on visual interpretation by operators, leading to inconsistencies in data reproducibility. In petroleum testing, subjective assessments of color changes on copper strips are influenced by lighting conditions, surface texture variations, and individual differences in perception. The method's classification system requires operators to distinguish complex polychromatic hues, such as subtle claret-red undertones beneath dominant yellow and orange hues, making consistent evaluations challenging.



The CuDDI provides an unbiased alternative to the manual vision-rating system by automating the process with an advanced optics system paired with complex pixelization and extraction processes of present colors, and then subsequently undergoing a logic waterfall algorithm to effectively classify the sample on the current ASTM D130-19 scale.



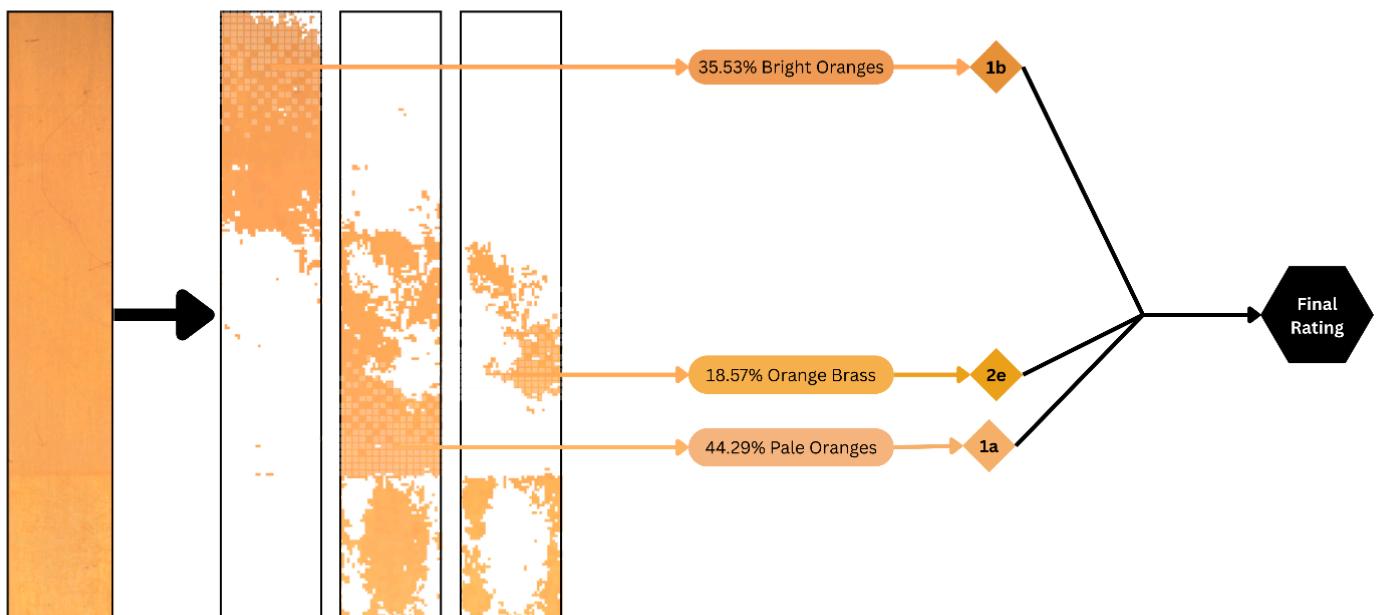
Sixty-six color clusters, each with a multitude of data points in three-dimensional RGB color space, were extracted from the ASTM D130 rating standard as pictured above.



The extracted colors were associated with classifications, and a rating rule and logic system were applied to the algorithm. The system analyzes pixel clusters and assigns RGB values to the extracted colors whilst plotting them against a three-dimensional master classification plot. A peacock filter utilizes a polychromaticity logic system to analyze the variety and quantity of colors to determine if the colors present are representing a multicolor or peacock strip.

3.2.1. Analysis Process

1. The CuDDI scans the copper strip
2. The colors are extracted from the strip in 10x10 pixel groups
3. These colors are plotted in 3D space
4. The scanned results are cross-referenced to the master color plot, and the pixels are assigned color clusters based on the Euclidean distance from the closest clusters
5. The assigned color clusters are analyzed, and the percentage of these clusters is tallied
6. The CuDDI uses the colors found to follow a waterfall logic to assign the colors to classifications
7. The ultimate classification is based on which classifications the colors are assigned to individually



3.3. Specifications

Purpose	Automated copper corrosion color analyses
Technique	Patented CCD Digital Detection
Test Methods	ASTM D130, ASTM D1838, ASTM D4048, IP 411, ISO 2160, and ISO 6251.
Applications	Corrosiveness to copper of fuels, lubricating oils, liquefied petroleum gases, lubricating greases, and other petroleum products
Optical System	Patented Optical Arrangement
Lighting Source	LED 4,250K (White), >90% CRI
Measurement Time	2-3 minutes
Coupon Dimensions	12.5 mm wide, 75 mm long, and 1.5 to 3.2 mm thick
Interfaces	10.1" Projective Capacitance Touch (Multi-Touch)
Software	Windows 11 IOT Enterprise
Storage Database	64 GB SSD Storage
Output	Color Clusters (%), ASTM D130 Rating (0-4c), Pass/Fail, Polychromaticity (Color Groups), Strip Size (mm)
Detection Range	Color Percentage: 0.1-100%, Rating: 0-4c
Export	PDF Summary, XML, Strip Scans (Side A and B), Color Overlays (Side A and B)
Ambient Conditions	10° to 35° C, Up to 85% Non-Condensing
Power Requirements	Auto-switching 90 ~ 264VAC, 47 ~ 63Hz, 280 Watt Power Supply
Dimensions	300x355x230mm, (14x11x9")
Weight	12 kg

4. Installation

The CuDDI is designed to be installed and operated with ease and efficiency.

4.1. Operating Environment

When setting up the analyzer, select a location away from heat, smoke, electrical interference, and avoid any electrostatic discharges (ESD) to the analyzer. The bench top should be a level surface and free of vibration.

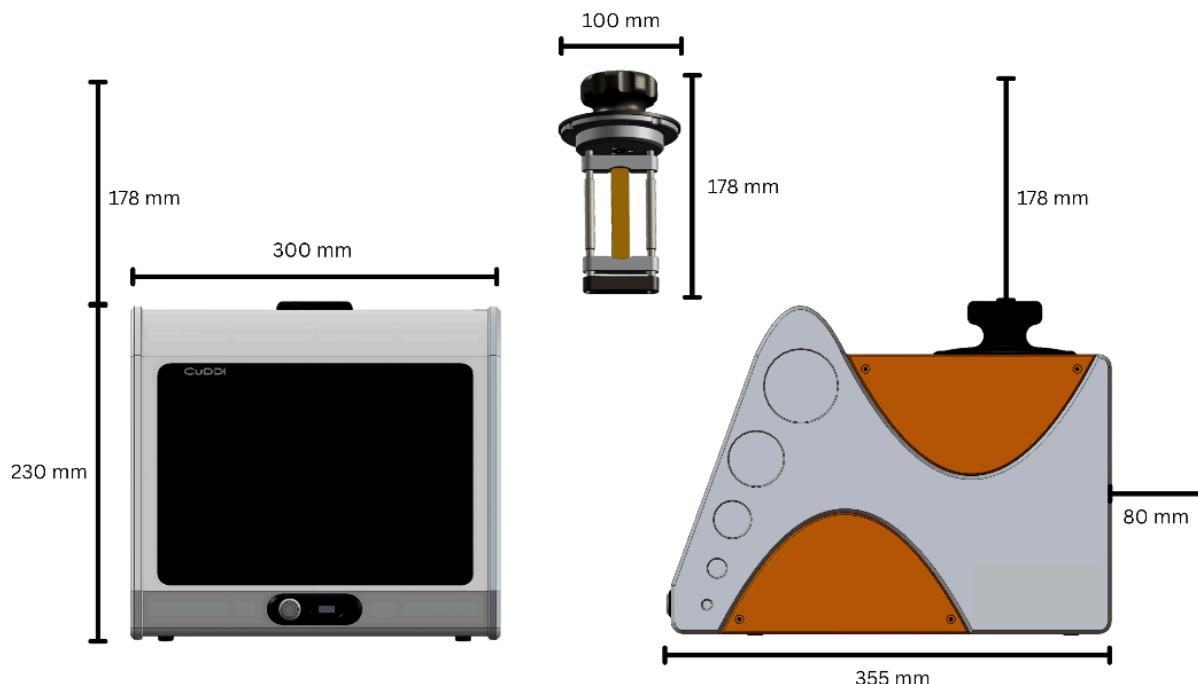
Ensure that the vent holes of the analyzer are not obstructed. The analyzer requires an environment with ambient room temperature in the operational range.

4.2. Dimensions and Space Requirements

The analyzer takes up a space with dimensions of roughly 300x355x230mm.

About 80 mm is required directly behind the analyzer to ensure enough space to plug in the power cord and access the USB port, Ethernet port, and power toggle.

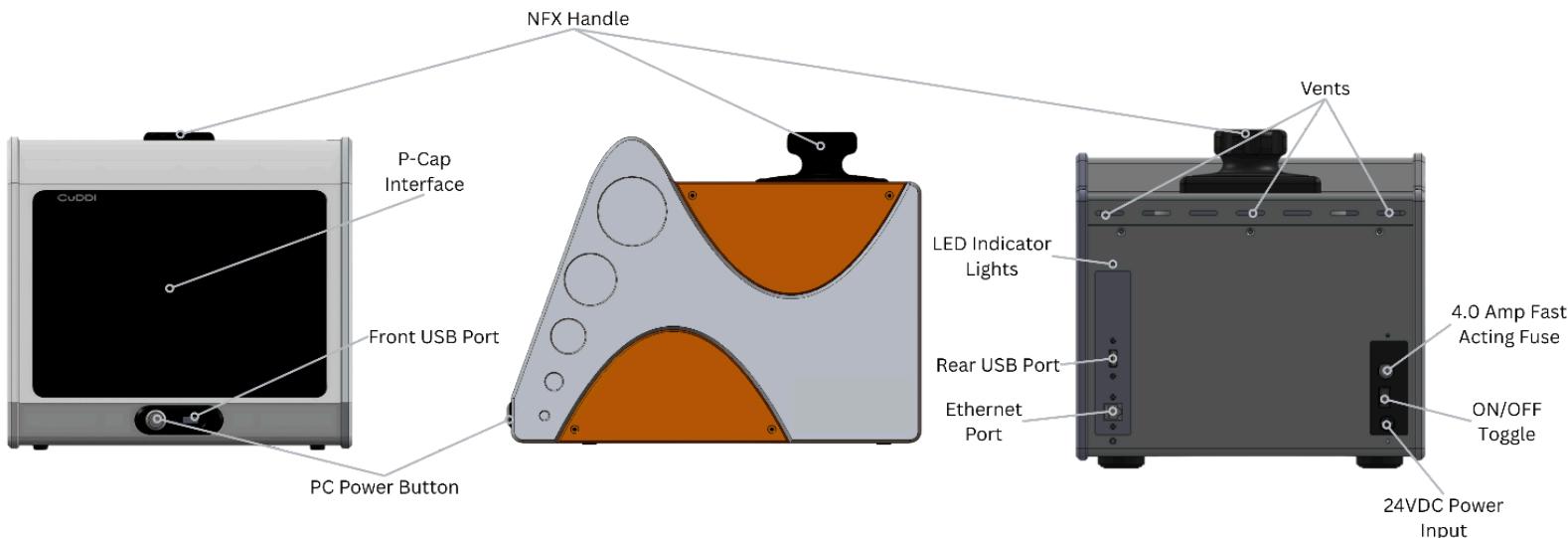
The top of the analyzer needs enough open space to remove and replace the NFX handle from the device. Ensure enough overhead space to comfortably remove the NFX handle.



4.3. Identifying Parts and Controls

The CuDDI features an embedded industrial-grade computer (IPC) with easy-to-use software. Interface to the software is achieved using an industrial-grade large 10.1-inch LCD with an integrated Projective-Capacitance (P-Cap) touch controller. The computer, which runs an embedded version of Windows 11 Enterprise, allows for easy integration with a network and modern LIMS systems.

On the front side of the CuDDI is the P-Cap interface, a USB port, and an IPC Reset button. This button is used to reset the IPC or turn the IPC into sleep mode. To restart or turn off IPC, please use the Power Options in the software (Section 5.7).



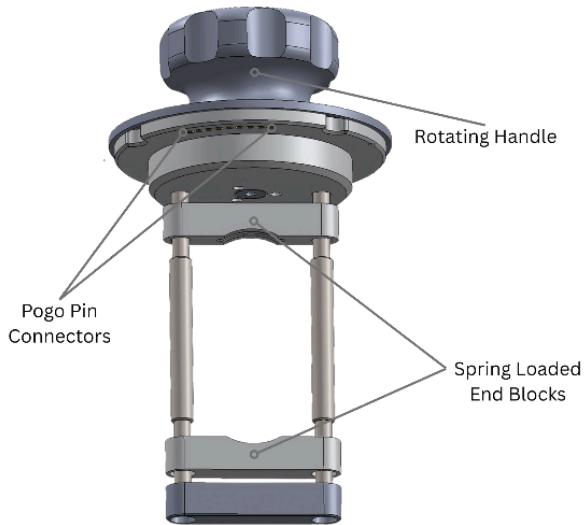
The CuDDI's modern high-end IPC features one Ethernet (RJ-45) port and one USB port on the rear of the analyzer. The USB port can be used to connect an external keyboard, printer, Wi-Fi adapter, a memory stick, and other USB devices supported by Windows 11 Enterprise.

Power supply to the CuDDI is achieved using an external voltage converter. This converter features a universal switching power supply, which can accept power from 90 - 264 VAC and frequencies ranging from 47 - 63 Hertz. A single power connector from this converter is connected to the back of the CuDDI, as pictured in the image above. To protect the CuDDI from power surges and internal shorts, a fast-acting fuse is conveniently placed above the power input. To disconnect the Main Power to the CuDDI, an ON/OFF Toggle switch above the fuse is used.

Ventilation for the CuDDI is achieved using seven vents placed on the top rear panel as pictured above. Please allow a minimum clearance of 80 mm for proper ventilation.

4.3.1. NFX Handle

The patented NFX Handle was designed to hold copper strips in the optimal position for viewing within the CuDDI's optical bench. The innovative handle features an integrated motor and electronics for precise positioning of the copper strip. This ensures repeatable and accurate positioning while allowing for quick serviceability on the electronics and drive.



4.4. Getting Started

To turn on the CuDDI, connect the power plug to the input on the back of the CuDDI. Move the ON/OFF toggle switch to the ON position. Power to the IPC can be confirmed via the front blue illumination of the push button. The screen will turn on after a short delay.

Additional connections, such as Ethernet or printers, can be done at this point.



Certain printers may require drivers, which can be loaded by an administrator. Please contact your distributor or VISAYA for more instructions.

5. Software and Operation

The CuDDI was designed with an internal high-end industrial PC, which allows for the latest advancements in graphical user interfaces. Using a P-Cap screen, interfacing with the software and data entry is easily achieved. The intuitive software typically only requires a few minutes of training for routing operations. Using a unique wizard-driven sample set-up, the CuDDI guides the operator through many of the routine tasks for rating copper strips.

5.1. Main Screen

After proper installation and powering on of the CuDDI, the software will automatically boot onto the main screen. The software is divided into six main sections, with each section represented by an icon. Each icon visually describes the sub-menu and is also labeled accordingly. Navigating within these icons is done by a simple swipe left or right, touching the P-Cap interface. One can also use the drag-and-drop function of an external mouse if preferred. To enter one of these sub-menus, simply use a single touch or single click. To return to the main menu, use the back arrow placed at the top left hand side of the screen.



Main screen navigation is briefly described below and described in detail in subsequent sections:

Inspect: Analysis screen to begin inspection and rating of copper strips.

History: Result archive and database of previous tests

Settings: General settings such as date, time, language, LIMS, network, etc.

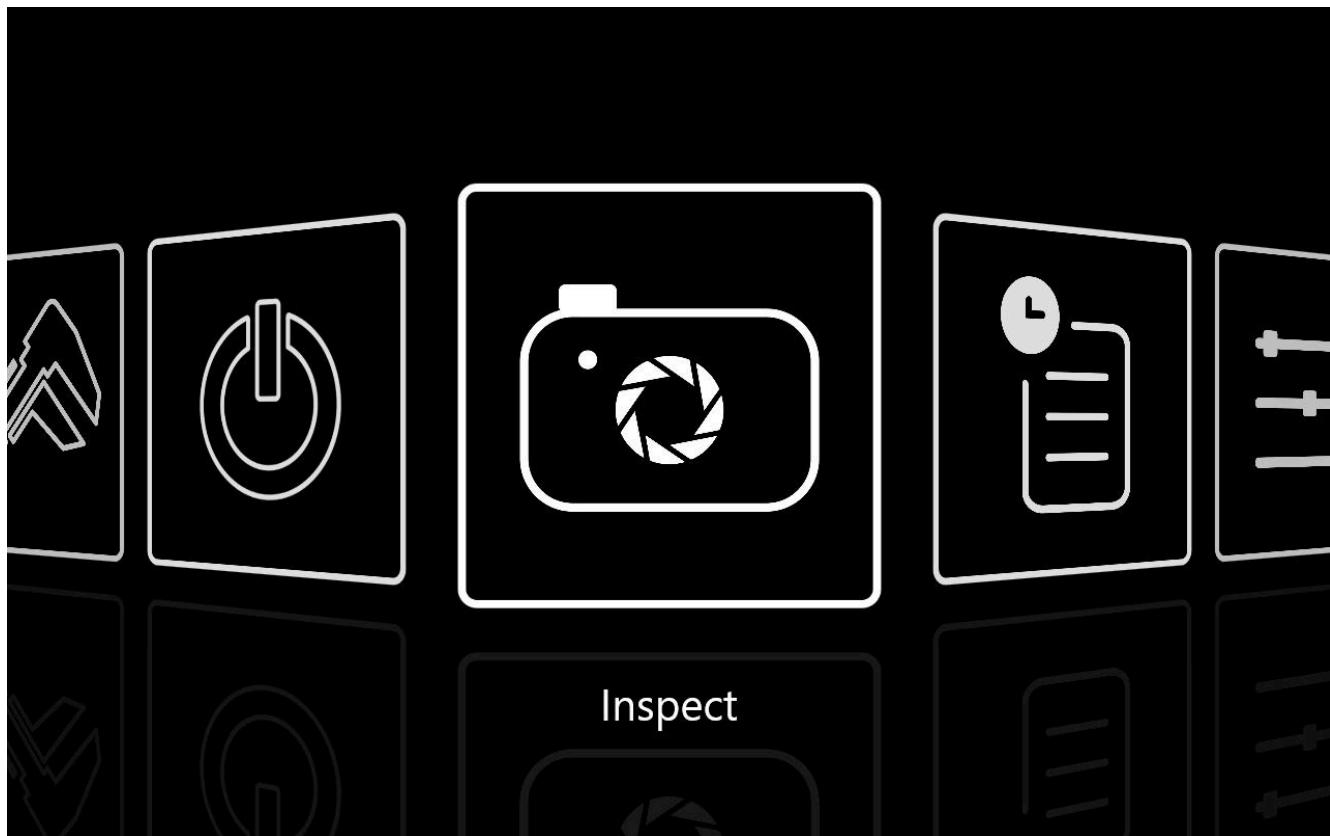
Diagnostics: Screen to check the mechanical, electrical, and I/O of the CuDDI

Calibration: Menu to verify and recalibrate the VISION system of the CuDDI

Power Options: Shut down or restart the CuDDI

5.2. Inspect

The Inspect menu is where operators will conduct copper strip analyses. To start an inspection, simply tap on the Inspect icon from the main menu. Depending on the configuration of the analyzer, the operator would have the ability to run in fully automated mode or semi-automatic mode. The semi-automatic mode prompts the user for the manual rating prior to displaying the automated color rating (Section 5.2.7).



5.2.1. Preparing Strips

Strip preparation should be done following ASTM D130. A summarized version of the protocol can be found below:

Read the protocol in its entirety before beginning to prepare the strips.

Step 1: Copper Strip Preparation

Remove Surface Blemishes

If using a strip from a previous test, inspect for tarnish, oxidation, or contamination.

Polish all six sides of the strip to remove any blemishes.

If using a pre-polished commercial strip, only perform *final preparation*.

Initial Polishing

Use 00 grade or finer steel wool or silicon carbide paper to remove visible scratches.

Progressively polish using finer grades until finishing with 65- μm (240-grit) silicon carbide paper or cloth.

Ensure all marks from previous abrasives are removed to create a uniform surface.

To prevent oxidation before final preparation, immerse the strip in the wash solvent.

Final Preparation

Remove the strip from the wash solvent carefully using forceps or gloved hands (do not touch with bare fingers).

Moisten a cotton pad with wash solvent and pick up 105- μm (150-mesh) silicon carbide grains.

Polish the strip, starting with the ends, followed by the sides, and finally the broad surfaces.

Use a single-direction motion along the length of the strip (avoid circular motions).

Continue polishing until the surface is uniform and free of scratches.

Wipe the strip vigorously with fresh absorbent cotton until no residue remains.

Immediately place the strip into the test sample to avoid oxidation.

Step 2: Testing Process

Prepare Sample

Verify that the sample is clear and free of suspended or entrained water.

Measure ~**30 mL** of the test sample and pour it into a clean, dry 25-mm x 150-mm test tube.

Insert Copper Strip

Within **1 minute** of final preparation, carefully slide the copper strip into the test tube containing the sample.

Ensure the strip is fully submerged and does not touch the test tube walls.

If preparing multiple samples, stopper each test tube with a vented cork before placing them in the bath.

Heat Sample

Place the test tube(s) in a bath maintained at **150°C (302°F)**.

Ensure the test tubes remain upright and fully immersed in the bath.

Maintain test conditions for **3 hours ± 5 minutes**.

Shield the test tube contents from strong direct light.

If running multiple tests, ensure the elapsed time between the first and last sample being placed in the bath is minimal.

Step 3: Examination

Remove Copper Strip

After the test duration, carefully remove the test tube from the bath.

Pour the sample into a receiver and let the strip slide into the beaker gently to prevent breaking glass.

Immediately retrieve the strip using forceps and immerse it in the wash solvent.

Final Cleaning and Inspection

Withdraw the strip from the wash solvent **without delay**.

Blot dry using filter paper or allow it to air dry.

Analyze the strip.

*WASH SOLVENT: 2,2,4-trimethylpentane (isooctane) 99.75% is recommended.

*POLISHING MATERIALS: 00 grade or finer steel wool or silicon carbide grit paper or cloth of varying degrees of fineness, including 65- μm (240-grit) grade; also a supply of 105- μm (150-mesh) size silicon carbide grain or powder and absorbent cotton (cotton wool). A commercial grade is suitable, but a pharmaceutical grade is most commonly available and is acceptable.

5.2.2. Loading the NFX Handle

The NFX Handle was engineered to allow quick and easy loading of copper strips with minimal effort. Loading can typically be done in less than 5 seconds after sufficient practice.

Steps to load a copper strip into the NFX handle can be found below:

Hold the NFX Handle with one hand, and use your thumb to press up on the end block towards the adapter plate.

While continuing to press up, carefully insert the copper strip into the bottom block at a slight angle.

Position the copper strip in line with the top end block, and then release the thumb that is holding the block to secure the block in place.

Carefully position the strip to ensure it is straight.

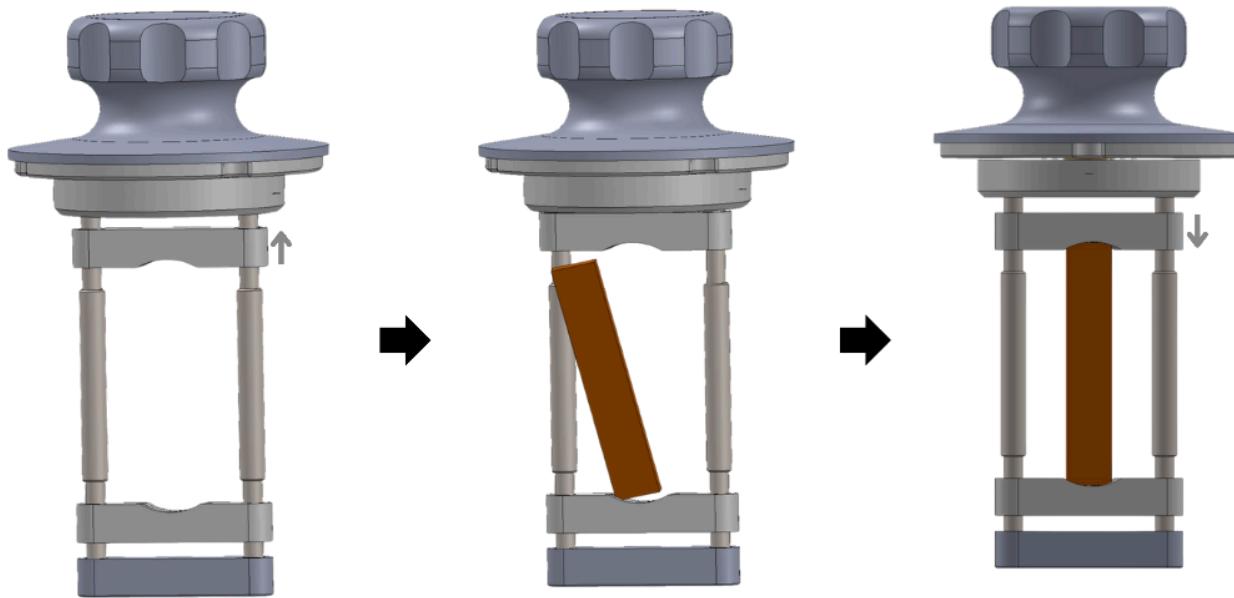


Note: Depending on the polishing procedures, the strip may not be square and therefore may be at a slight angle within the holder. This should not cause any issues, as the software accurately determines angles and compensates for this.

Spin the handle to ensure proper operation of the mechanics.

Insert the handle into the top opening of the CuDDI, taking note to align the gold pins with the pins on the bulkhead opening. Align the white dot with the front center of the CuDDI.

Once loaded, an analysis is ready to be performed.



5.2.3. Running an Analysis

Running an inspection/analysis is achieved using a simple wizard-driven menu. Upon entering the Inspect menu, the user is presented with the option to enter a sample name. The CuDDI conveniently displays the last 12 entered sample IDs for reuse. Alternatively, the user can click or tap in the sample ID section to display an onscreen keyboard for entry of a new sample ID. The keyboard allows the entry of up to 255 characters and accepts standard ASCII characters. Changes and deletions of text can also be made using the keyboard.

↶ Analyze

Name	Enter sample name to continue		
------	-------------------------------	--	--

Last Sample Names:

<u>OT Cud3 65</u>	<u>OT Cud3 5</u>	<u>OT Cud3 20</u>	<u>OT Cud3 41</u>
<u>OT Cud3 46</u>	<u>OT Cud3 67</u>	<u>OT Cud3 1</u>	<u>OT Cud3 13</u>
<u>OT Cud3 6</u>	<u>OT Cud3 47 Rev</u>	<u>OT Cud3 47</u>	<u>Qa69</u>

↶ Analyze

Name	Enter sample name to continue		
------	-------------------------------	--	--

Last Sample Names:

1 Q	2 W	3 E	4 R	5 T	6 Y	7 U	8 I	9 O	0 P	⌫
A	S	D	F	G	H	J	K	L	"	←
↑	Z	X	C	V	B	N	M	;	!	↑
&123	Ctrl	😊							<	>

After successful entry of a valid sample ID, the Next button will become active in the top right hand corner of the screen. Confirmation of the sample ID is confirmed using the Next button located in the top-right-hand corner.

↶ Analyze Next →

Name	TEST_1	X
------	--------	---

Last Sample Names:

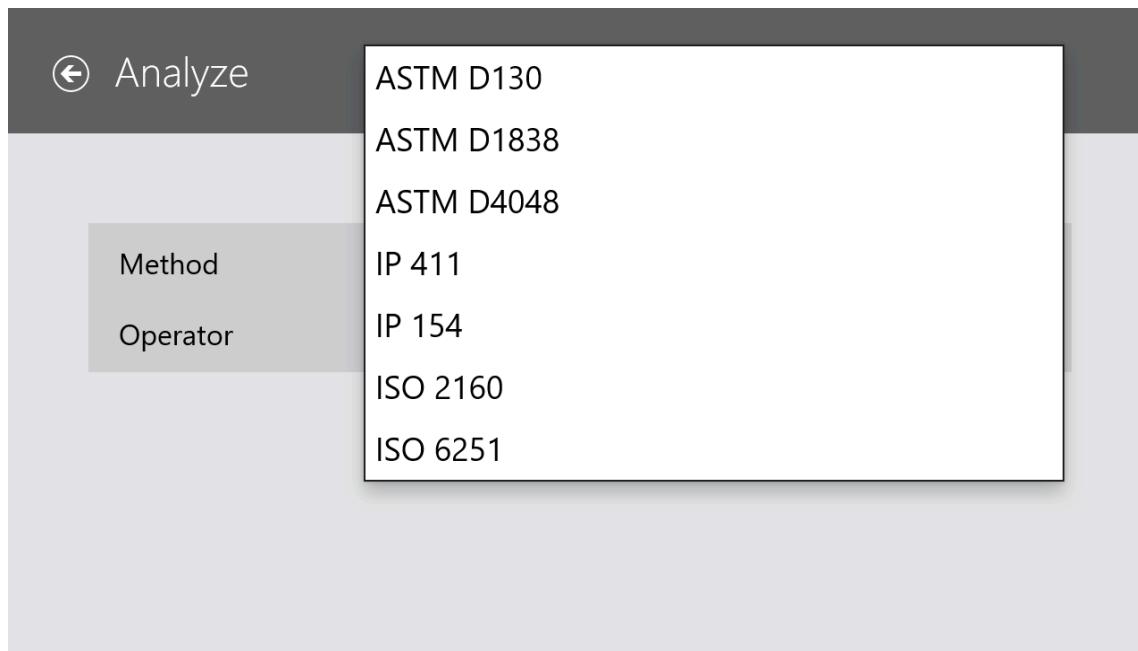
OT Cud3 65	OT Cud3 5	OT Cud3 20	OT Cud3 41
OT Cud3 46	OT Cud3 67	OT Cud3 1	OT Cud3 13
OT Cud3 6	OT Cud3 47 Rev	OT Cud3 47	Qa69

After pressing the Next button, the operator is presented with options to enter a Test Method and Operator Name.

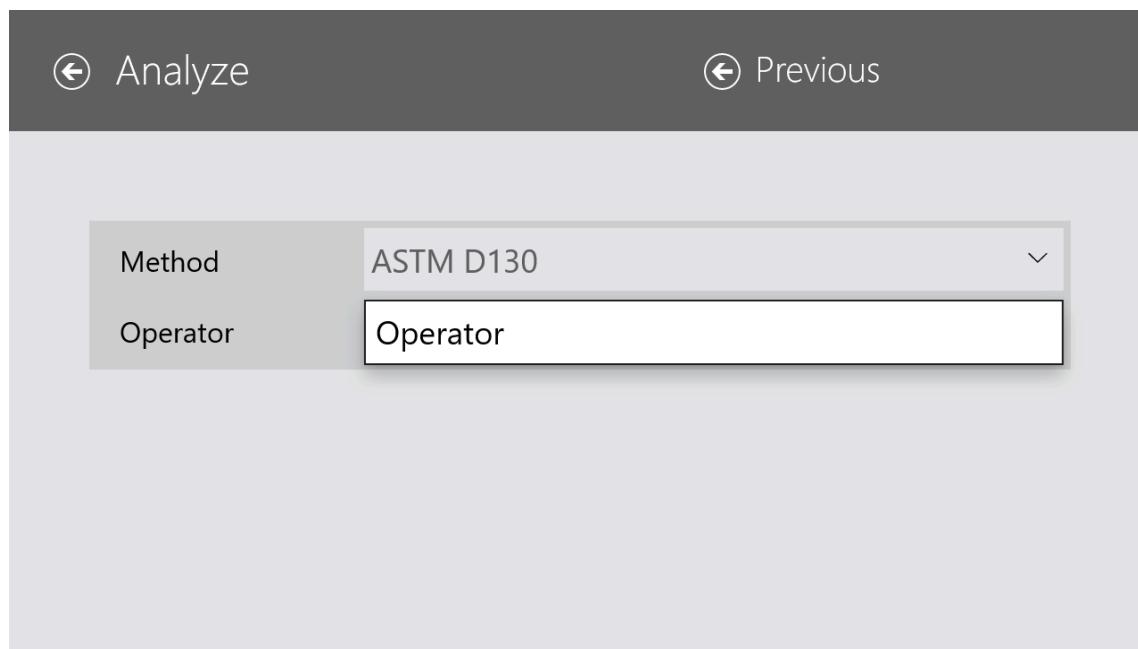
↶ Analyze ⏵ Previous

Method	Select test method to continue	⌄
Operator	Select operator to continue	⌄

Methods are fixed (ie, ASTM D130) and selected using a dropdown box.



Operator names are fixed and selected using a drop-down box. To add new operator names, please consult the Settings section (5.4) of this manual.



The CuDDI conveniently holds the last selection from the previous runs. Operators can change these selections as needed. Once satisfied with the selection, the Next button will be present to allow entry into the next step.

↶ Analyze ↶ Previous Next ↷

Method	ASTM D130	⌄
Operator	Operator	⌄

The next screen presented is optional: Description or comments of a sample inspection. This field is used to enter other information such as notes, ID, special circumstances, etc. To enter a description/comment, simply tap or click on the white entry box to display an onscreen keyboard.

↶ Analyze ↶ Previous Run ↷

Description optional	
-------------------------	--

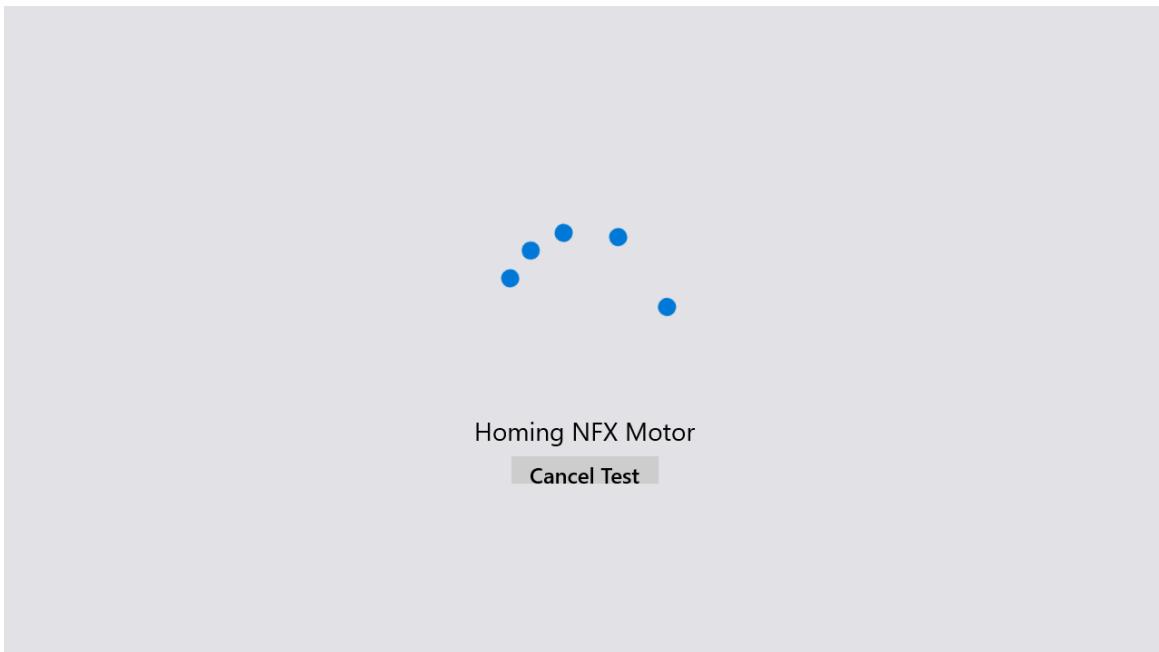


Once complete, press the Next button to proceed with the inspection of the copper strip.

After completing all the necessary sample identifiers (sample ID, operator name, test method, and optional description), the automated visual analysis is started. The CuDDI will automatically run through the following sequence during this phase:

The CuDDI connects to the hardware, which includes the imaging device and drive.

The CuDDI homes the drive positions to ensure accurate and repeatable positions.



The CuDDI moves the strip to Position A, which is the first side of the copper strip.

The CuDDI then moves to Position B, which is a 180-degree rotation of Position A.

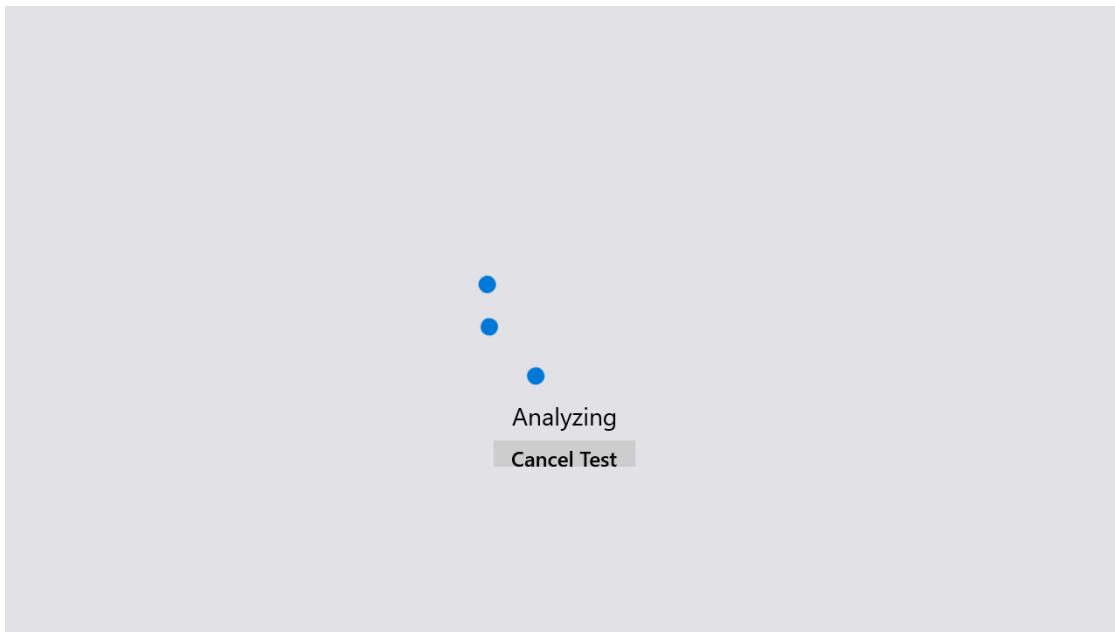
For both positions, the CuDDI scans the entire strip to develop a high-resolution image of the copper strip.



After positioning and scanning, the CuDDI enters into the third phase of the algorithm, where it extracts colors and assigns them to color clusters in a three-dimensional RGB plot derived from known copper corrosion color standards.

The assigned color clusters then undergo a waterfall logic system to assign the color to the classification it can be/is known to belong in.

Concurrently, the device analyzes the presence of polychromaticity using the peacock filter, which effectively isolates color groups to determine whether a strip is multicolored (likely 3b or 2c) or more monochromatic (remaining classifications).



The CuDDI compiles the results and tallies each color and its classification to generate an overall result.

For more information on the algorithm and color classification and clustering, read further to section 5.2.4.

5.2.4. Interpreting the Results

 Analyze Results

Side A	Side B										
											
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>Name</td> <td>TEST_1</td> </tr> <tr> <td>Date</td> <td>7/22/2025, 8:28 AM</td> </tr> <tr> <td>Method</td> <td>ASTM D130</td> </tr> <tr> <td>Operator</td> <td>Operator</td> </tr> <tr> <td>Description</td> <td>Sample 1: 3 hour incubation in oil 31b</td> </tr> </table> <p>See more information ...</p>		Name	TEST_1	Date	7/22/2025, 8:28 AM	Method	ASTM D130	Operator	Operator	Description	Sample 1: 3 hour incubation in oil 31b
Name	TEST_1										
Date	7/22/2025, 8:28 AM										
Method	ASTM D130										
Operator	Operator										
Description	Sample 1: 3 hour incubation in oil 31b										

Rejected



Rating: 3a

The Rating falls outside the range of 0 - 1b

Override rating ...

	Side A	Side B
Blues	<input type="checkbox"/>	<input type="checkbox"/>
Neutrals	<input type="checkbox"/>	<input type="checkbox"/>
Oranges	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Pinks	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Purples	<input type="checkbox"/>	<input type="checkbox"/>

 Print
 Export
 Delete

 Done
...

The results screen that is displayed following an analysis has a variety of information.

The name, date, method, operator, and description/comments are displayed in the center. The scan of both sides of the copper strip is displayed on the left-hand side of the screen. The right-hand side of the screen displays the overall rating of the strip and whether or not the result *passes* or *fails* (Section 5.2.4.3). Below the overall rating is the option to override the rating. On the bottom right-hand side of the screen is the results of the peacock filter (Section 5.2.4.4), and it displays the color groups that were found within the strip (Section 5.2.4.1 & 2).

Clicking “See more information” opens a tab displaying extra information on the test. This includes the individual side’s ratings and the strip dimensions. The copper strip is also determined whether or not it falls within the specifications determined by the ASTM method. If the two sides have different results, this is where each individual rating will be denoted.

Analyze Results

Side A Side B

Name	TEST_1
Date	7/22/2025, 8:28 AM
Method	ASTM D130
Operator	Operator
Description	Sample 1: 3 hour incubation in oil 31b

[See more information ...](#)

Sample within spec.s?	Pass	Side A : 12.8 mm x 77.1 mm
	Pass	Side B : 12.8 mm x 77.1 mm
Side A rating	2a	Moderate Tarnish
Side B rating	3a	Dark Tarnish

Rejected

X

Rating: 3a

The Rating falls outside the range of 0 - 1b

[Override rating ...](#)

Side A	Side B
Blues <input type="checkbox"/>	Blues <input type="checkbox"/>
Neutrals <input type="checkbox"/>	Neutrals <input type="checkbox"/>
Oranges <input checked="" type="checkbox"/>	Oranges <input checked="" type="checkbox"/>
Pinks <input checked="" type="checkbox"/>	Pinks <input type="checkbox"/>
Purples <input type="checkbox"/>	Purples <input type="checkbox"/>

Print
 Export
 Delete
 Done
 ...

The ratings are based on the ASTM D130 reference scale ranging from 0-4c. In the case that the two sides are rated differently, the more corrosive rating takes precedence in the overall rating tab. The general corrosivity ratings can be found below:

0 - Freshly Polished/Untreated

1a - Slight Tarnish

1b - Mild Tarnish

2a - Moderate Tarnish

2b - Deepening Tarnish

2c - Evident Tarnish

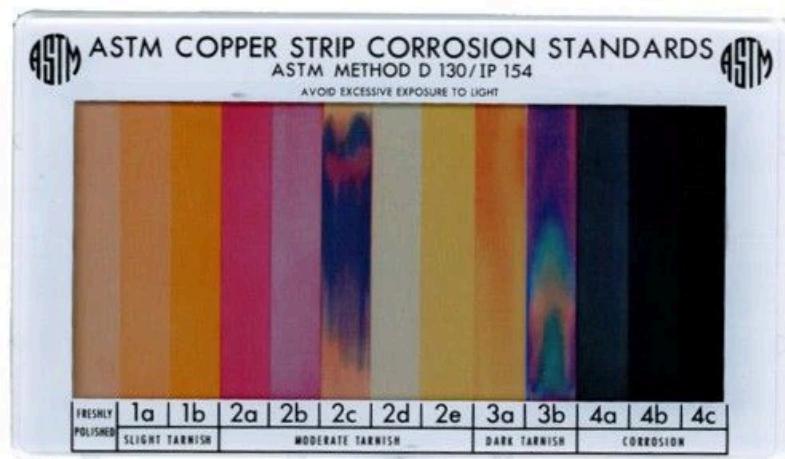
2d - Stripped Tarnish

2e - Extended Tarnish

3a - Intense Tarnish

3b - Extreme Tarnish

4a - Harsh Corrosion



4b - Intense Corrosion

4c - Extreme Corrosion

The ASTM D130 reference scale seen above presents distinct visual classifications, which may falsely suggest a rigid, sequential progression of corrosion. However, this scale is derived from a more complex, three-dimensional color model. Corrosion colors are a product of specific sample and copper chemistry and thus do not progress in isolated steps but rather exist along a spectrum where multiple hues and intensities interact, producing results almost exclusively belonging to multiple different ratings at once.

5.2.4.1. Color Clusters

This complexity makes determining exact classifications difficult. The CuDDI circumvents this issue by extracting colors present in the strip in 10x10 pixels and assigning these pixel groups to one of sixty-six color classifications. The color classifications each represent the cluster center of over 8000 total color values clustered into groups in three dimensional space. The color classifications and cluster center color can be seen below:

Dark Blue	Pink Browns	Pale Neutrals	Orange Coral	Pink Fuschia	Dusky Rouge
Peacock Bluegreen	Muted Pinks	Brassy Gold	Dark Salmons	Lavender Pinks	Coppery Purple
Steel Bluegreen	Muted Peaches	Brassy Peach	Coppery Salmon	Coppery Rouge	Proper Purple
Washed Greens	Dark Coppers	Light Coppers	Barbie Pinks	Deep Pink	Purple Indigo
Coppery Neutrals	Deep Oranges	Coppery Peaches	Classic Pinks	Deep Lavenders	Proper Indigos
Slate Brown	Dark Oranges	Light Salmons	Bright Orange Reds	Purple Plum	Dark Indigo
Brassy Brown	Medium Coppers	Pink Oranges	Bright Pink Reds	Fuschia Purples	Dark Neutral
Darker Neutrals	Coppery Oranges	Red Oranges	Deep Pink Reds	Dusky Rose	Proper Grey
Purple Browns	Light Oranges	Orange Brass	Dark Pinks	Dusky Purple	Dark Grey
Muted Browns	Bright Oranges	Mustard Yellow	Youth Pink	Pink Greys	Slate Black
Brown Blends	Pale Oranges	DarkBrass	LavenderGreys	VioletGreys	DeepBlack

Once the algorithm extracts the colors and assigns them cluster centers determined by their Euclidean distance from their closest data point, a waterfall logic system uses the colors found to assign them to ratings. The table below illustrates where the above color clusters are typically found on the ASTM D130 reference scale:

Color	0	1a	1b	2a	2b	2c	2d	2e	3a	3b	4a	4b	4c
Dark Blue									X	X			
Peacock Bluegreen									X				
Steel Bluegreen									X				
Washed Greens									X	X			
Coppery Neutrals						X		X	X	X			
Slate Brown						X		X	X	X			
Brassy Brown							X	X	X	X			
Darker Neutrals					X	X	X			X	X		
Purple Browns					X	X				X	X		
Muted Browns						X	X	X	X	X	X		
Brown Blends				X	X	X				X	X		
Dark Coppers	X	X	X										
Deep Oranges				X	X								
Dark Oranges				X	X					X			
Medium Coppers	X	X	X				X			X	X		
Coppery Oranges	X	X	X							X			
Light Oranges	X	X											
Bright Oranges		X	X							X			
Pale Oranges	X	X								X			
Pale Neutrals	X						X						
Brassy Gold									X	X			
Orange Brass			X						X				
Mustard Yellow									X				
Dark Brass			X						X				
Brassy Peach	X								X				
Light Coppers	X												

Color	0	1a	1b	2a	2b	2c	2d	2e	3a	3b	4a	4b	4c
Coppery Peaches				X	X				X	X			
Light Salmons			X						X	X			
Pink Oranges			X	X									
Orange Coral				X						X			
Red Oranges				X									
Pink Browns						X					X		
Muted Pinks						X					X		
Muted Peaches						X					X		
Lavender Greys						X	X				X		
Dark Salmons				X		X			X	X			
Coppery Salmon					X	X					X		
Barbie Pinks						X	X				X		
Classic Pinks						X	X				X		
Bright Orange Reds				X							X		
Bright Pink Reds				X									
Deep Pink Reds				X		X					X		
Dark Pinks					X	X					X		
Youth Pink					X	X					X		
Pink Fuschia					X	X					X		
Lavender Pinks					X	X					X		
Coppery Rouge						X					X		
Deep Pink					X	X					X		
Deep Lavenders						X	X				X		
Purple Plum												X	
Fuschia Purples					X	X					X		
Dusky Rose						X					X		
Pink Greys						X					X		
Violet Greys						X	X				X		
Dusky Purple						X					X		
Dusky Rouge						X					X		
Coppery Purple						X					X		
Proper Purple											X		

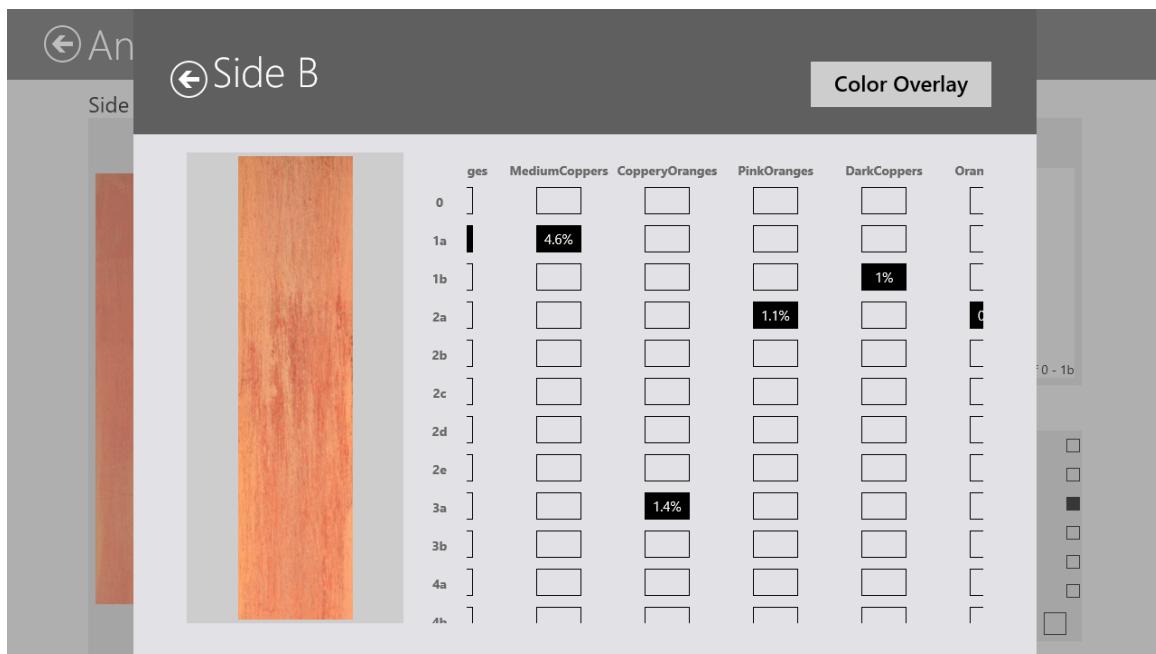
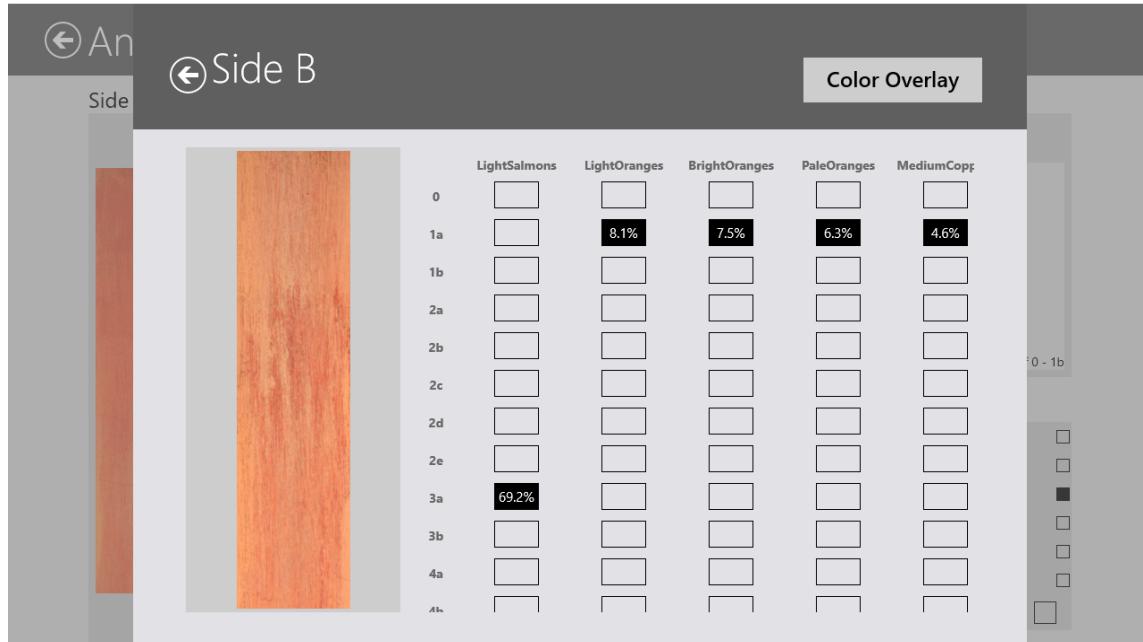
Color	0	1a	1b	2a	2b	2c	2d	2e	3a	3b	4a	4b	4c
Purple Indigo					X				X				
Proper Indigos						X			X				
Dark Indigo											X		
Proper Grey											X		
Dark Neutral											X		
Dark Grey											X	X	
Slate Black												X	X
Deep Black													X
Peacocking							X		X				



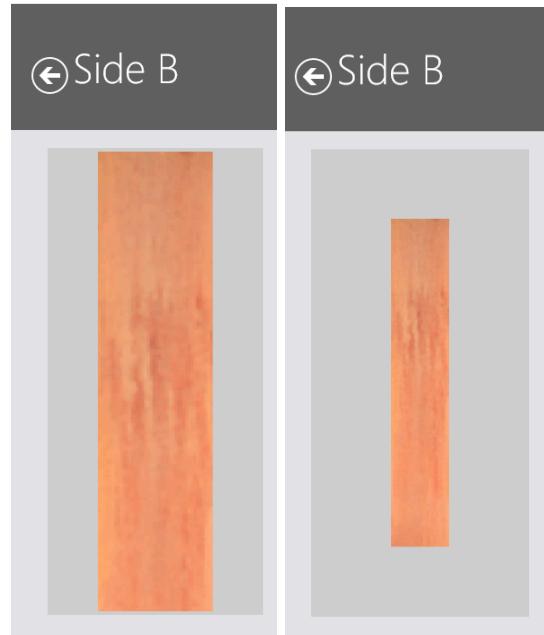
Note: The color cluster nomenclature is arbitrary and should not be taken as an accurate descriptor of the color itself.

5.2.4.2. Color Overlays and Rating Overview

To see the color breakdown and strip data, the operator can click on the scan of either side of the copper strip located on the left hand side of the results screen. The rating overview screen will propagate. This screen will show the exact colors extracted from the scan and the percentage of those colors found. They will also show which classification the percentage of the color cluster was assigned to. The first color listed in the column will be the color cluster with the highest prevalence on the strip. In descending order, the rest of the colors found will be listed. Any color not found in the strip will not be listed. Swipe left on the screen to scroll to the right in case more colors are present than can be displayed at once.

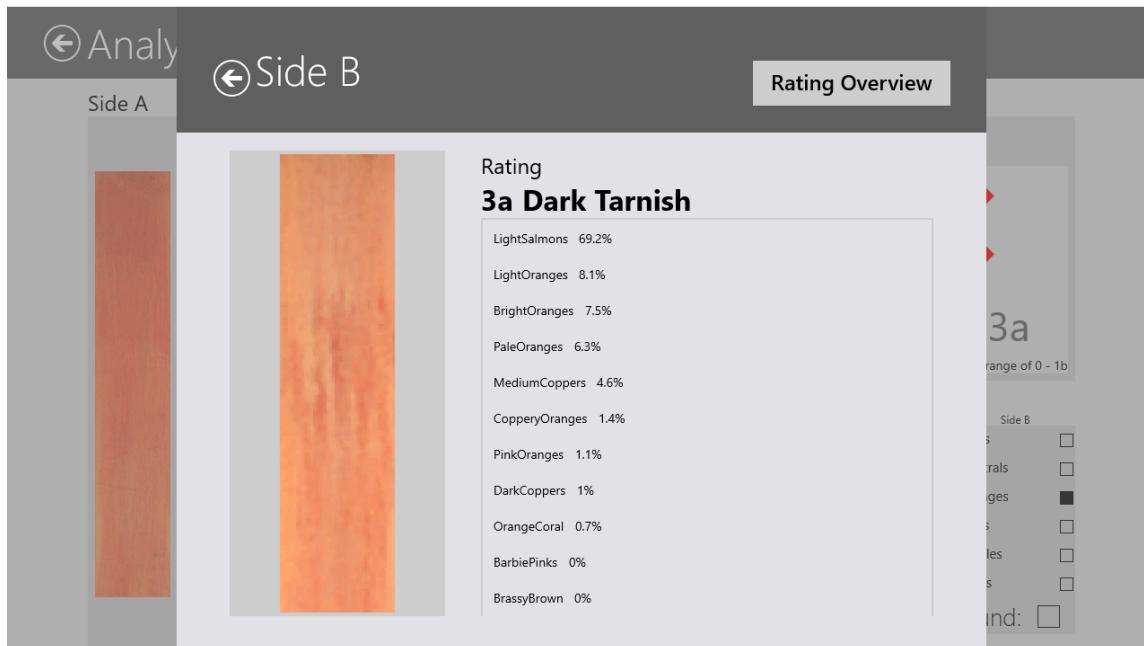


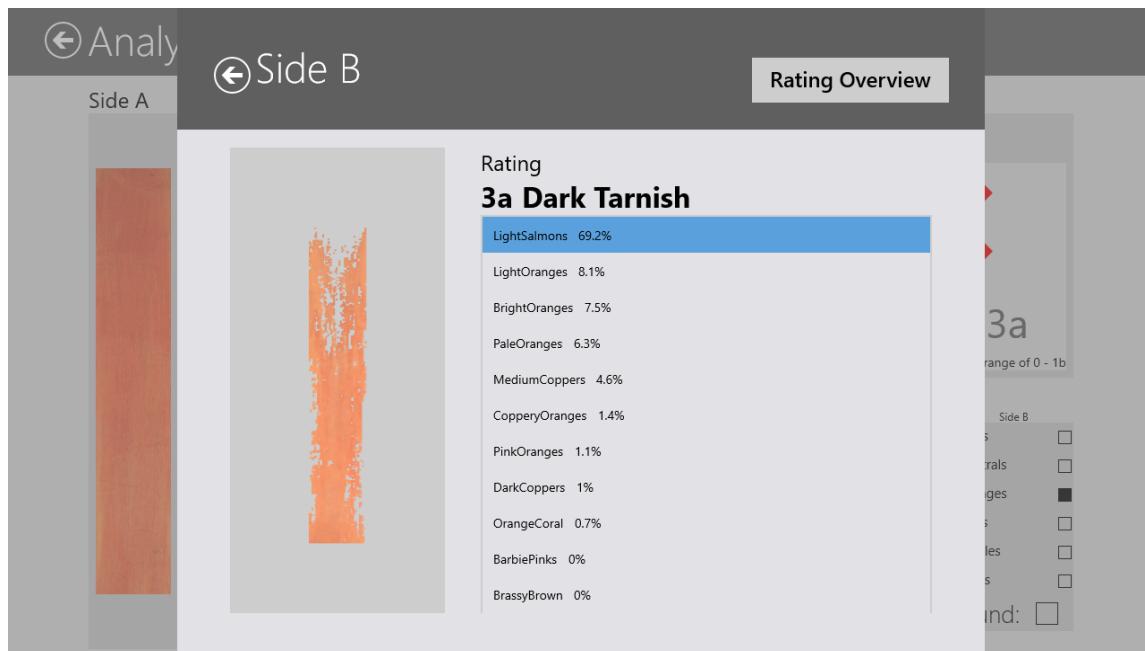
The scan itself can also be zoomed in or out to get a better view of the entire scan or parts of the scan by simply pinching the photo of the strip.



To access the rating overview of the other side of the strip, the operator must exit the current side's rating overview by clicking the back arrow in the top left-hand corner and then selecting the scan of the other side of the strip.

In the top right-hand corner of the rating overview is the “Color Overlay”. When selected, the colors and their corresponding percentages are displayed. By selecting individual colors, the scan will only show where on the strip that color cluster was extracted.





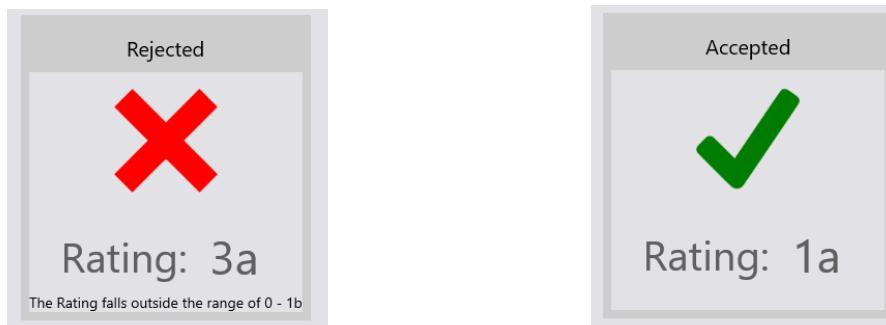
Both scans and overlays can also be zoomed in or out by simply pinching the photo on the left-hand side of the screen.

The combination of both the rating overview and color overlays allows operators to not only validate the results and ratings of the CuDDI, but also use it as data to make educated overrides and visual ratings.

5.2.4.3. Pass/Fail Threshold

The *pass/fail* threshold describes whether the sample used to prepare the strips is within acceptable corrosion limits. The *pass* or *fail* threshold can be changed in the Settings (Section 5.4.1.2). By default, the CuDDI uses the rating of 1b as the threshold, which is currently regarded as the industry standard for acceptable corrosion levels. Section 5.4.1 details how to change this threshold.

If the *pass/fail* threshold is altered or changed, the result will retain the denotation of passing or failing status that was applicable at the time of the test.



5.2.4.4. Peacock Filter

The peacock filter simplifies the waterfall logic by clustering the cluster centers in general groups and analyzing the presence of distinct polychromaticity.

Each color cluster was assigned a general group: Blues (including greens), Neutrals, Oranges, Pinks, Purples, or Darks. Based on the colors found, the rating process is simplified for notably polychromatic strips such as 2c and 3b if 3+ color groups are found.

	Side A		Side B
Blues	<input type="checkbox"/> Blues		<input type="checkbox"/>
Neutrals	<input type="checkbox"/> Neutrals		<input type="checkbox"/>
Oranges	<input checked="" type="checkbox"/> Oranges		<input checked="" type="checkbox"/>
Pinks	<input checked="" type="checkbox"/> Pinks		<input type="checkbox"/>
Purples	<input type="checkbox"/> Purples		<input type="checkbox"/>



Note: Strips with 3+ color groups found may still be rated other than 2c and 3b, depending on the specific color clusters found in the strip.

5.2.5. Override Option

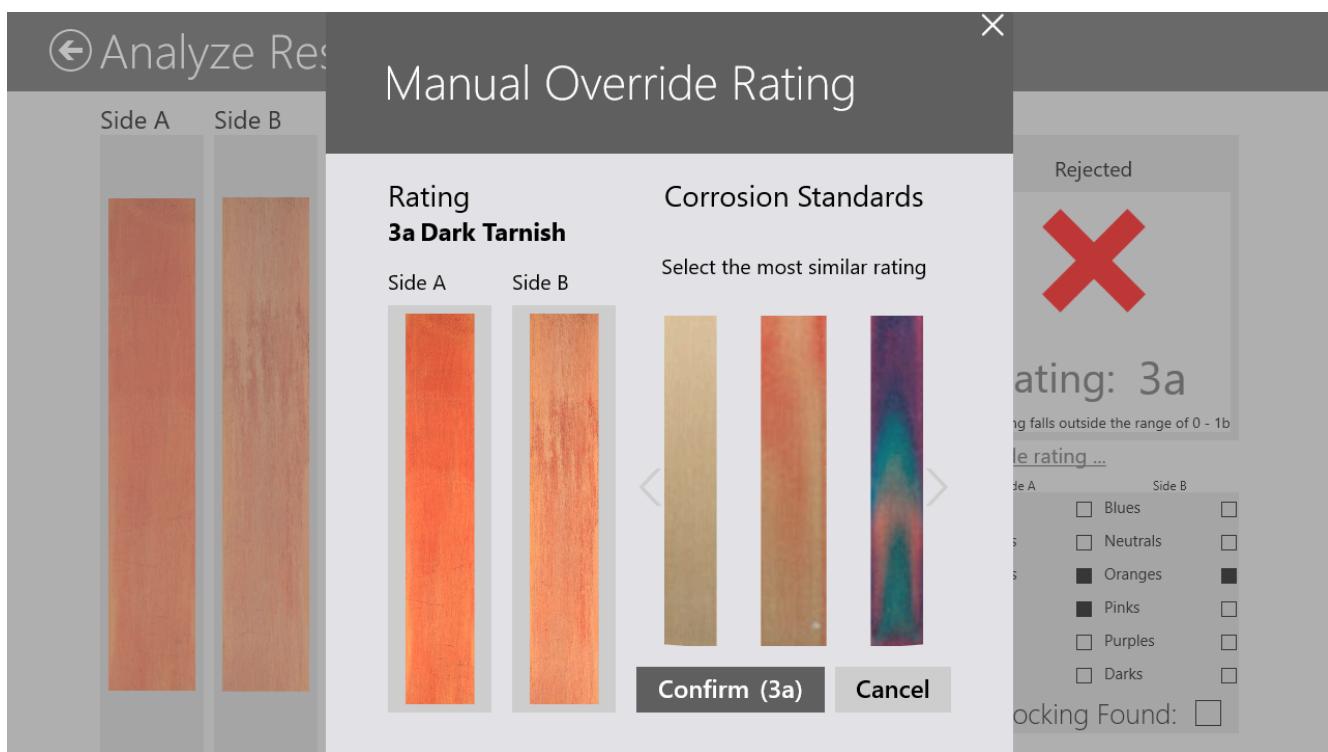
The interpretation of ASTM D130 ratings is complicated by the inherent overlap of colors in corrosion classifications. Recognizing that ratings exist on a spectrum rather than as discrete steps enhances classification accuracy. When using visual or digital methods, it is crucial to consider the multidimensional nature of color interpretation to avoid misclassification. Understanding this complexity ensures a more precise evaluation of petroleum product corrosivity and facilitates improved decision-making in corrosion analysis.

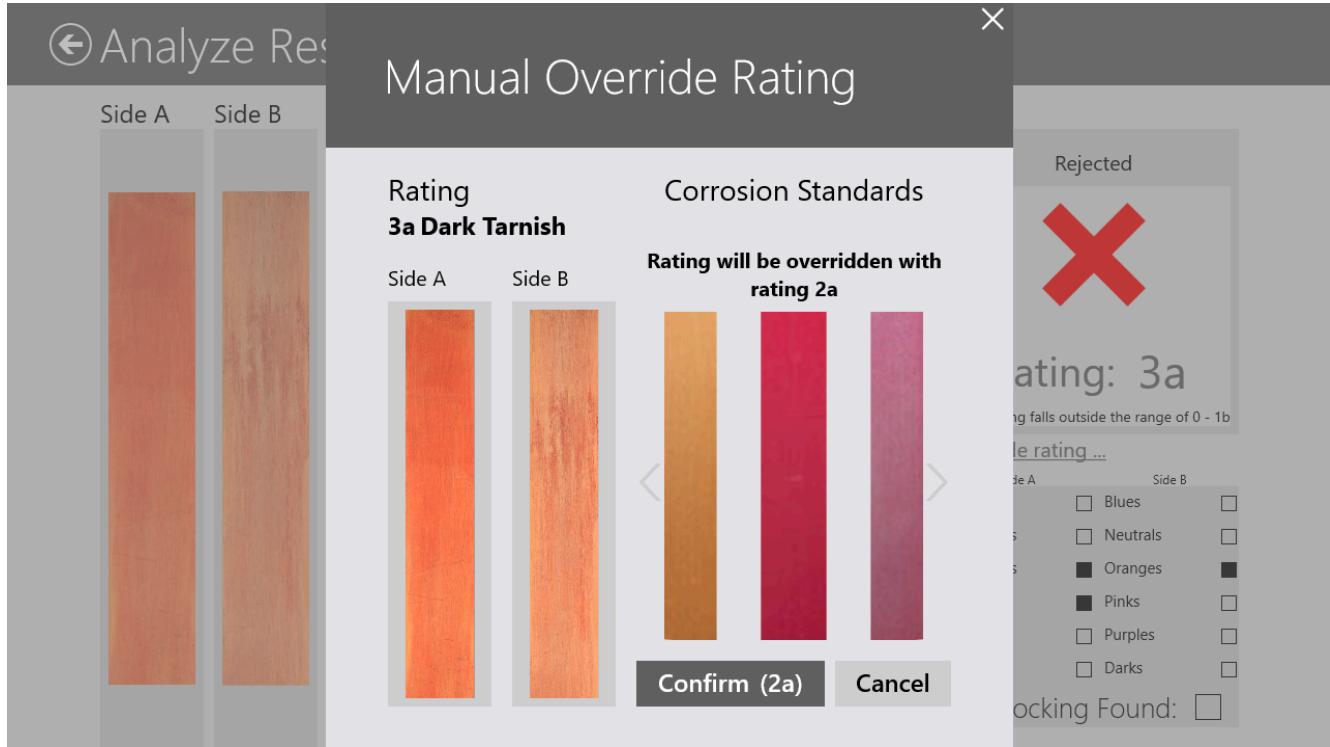
Considering the interdisciplinary nature of the analysis, an override option is available in the case, the operator determines the result is better suited to falling under a different classification.

In order to input an override, the operator simply clicks the override rating option and selects the overall rating they would like to override the automatic rating with.



Note: In order to maintain the integrity of the analysis, the override option is only available directly after an analysis.





Analyze Results

Side A Side B

Name	TEST_1
Date	7/22/2025, 8:28 AM
Method	ASTM D130
Operator	Operator
Description	Sample 1: 3 hour incubation in oil 31b

[See more information ...](#)

Sample within spec.s?	Pass	Side A : 12.8 mm x 77.1 mm
	Pass	Side B : 12.8 mm x 77.1 mm
Side A rating	2a	Moderate Tarnish
Side B rating	3a	Dark Tarnish

Rejected

2a
Overridden 2a
Automatic rating is 3a
The Rating falls outside the range of 0 - 1b

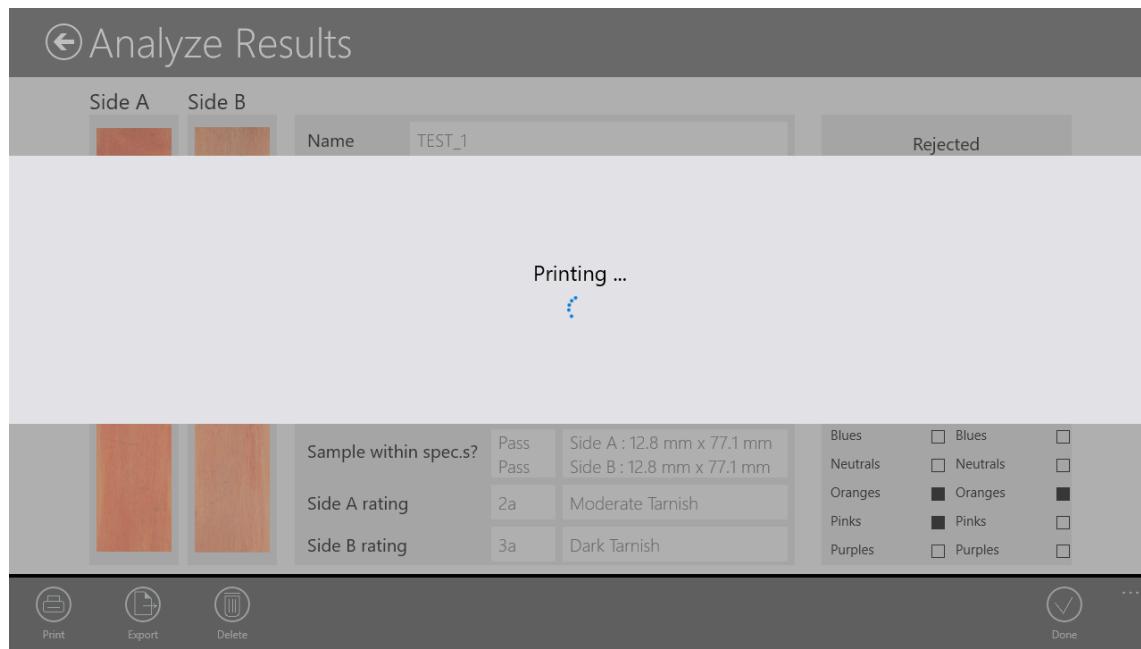
Override rating ...

Side A	Side B
Blues	<input type="checkbox"/> Blues
Neutrals	<input type="checkbox"/> Neutrals
Oranges	<input checked="" type="checkbox"/> Oranges
Pinks	<input type="checkbox"/> Pinks
Purples	<input type="checkbox"/> Purples

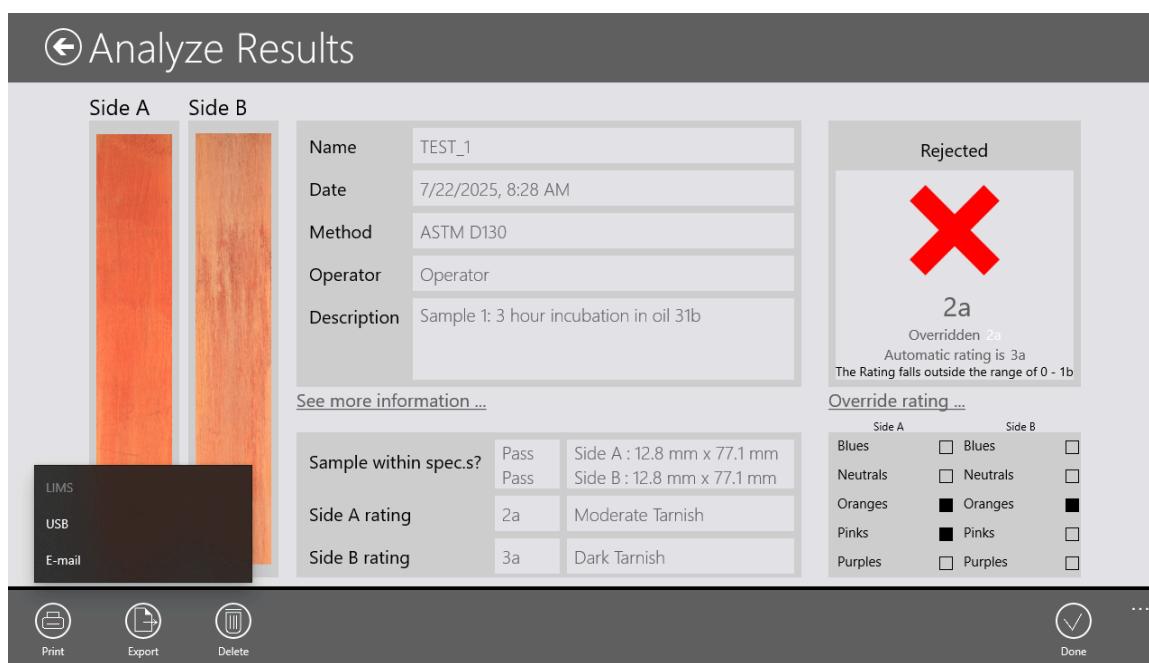
Print Export Delete Done

5.2.6. Saving Result

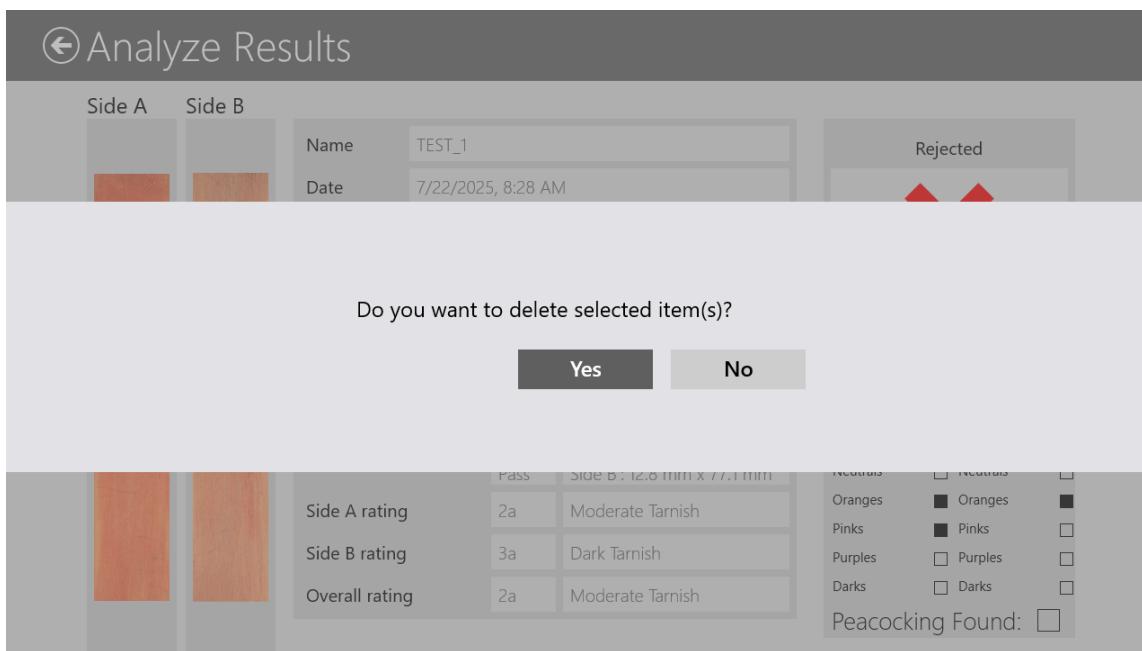
Following an analysis, there are a few options available to save or export the result. The bottom left-hand corner allows the operator to print the result, if there is a printer set up in Settings (Section 5.4).



The operator also has the option to export the result to LIMS or email if they are set up (Section 5.4) and to a USB if there is one plugged into the unit.



The operator will also have the option to delete the result.



To simply save the result to the database, click “Done” in the bottom right-hand corner. To access these results at a later time, go to the History menu (Section 5.3).

Results will be exported as an XML, TXT, PNG, and/or PDF. When exporting a result, a folder containing all necessary information is created at the site of retrieval. This folder contains the PNG files of both sides’ scans and results, the test data in an XML file, all of the color overlays as PNG files in subfolders, and a PDF result summary.

The PDF summary contains the overall rating, the operator, date, sample, and method, the scans of both sides of the strip, the classification breakdowns, the individual side ratings, the strip dimensions, and the color distributions of each side. An example of the resultant PDF can be found below:

Sample Id Semi Auto PDF

Date Monday, July 14, 2025,
9:12:45 AM

Method ASTM D130

Operator Operator

3a

The most corrosive Rating found was 3a - Dark Tarnish.

Side A 3a Dark Tarnish

12.7 x 76.5 mm



0	0%	Freshly Polished
1a	6%	Slight Tarnish
1b	8%	Slight Tarnish
2a	0%	Moderate Tarnish
2b	0%	Moderate Tarnish
2c	26%	Moderate Tarnish
2d	0%	Moderate Tarnish
2e	0%	Moderate Tarnish
3a	57%	Dark Tarnish
3b	0%	Dark Tarnish
4a	0%	Corrosion
4b	0%	Corrosion
4c	0%	Corrosion

Side B 3a Dark Tarnish

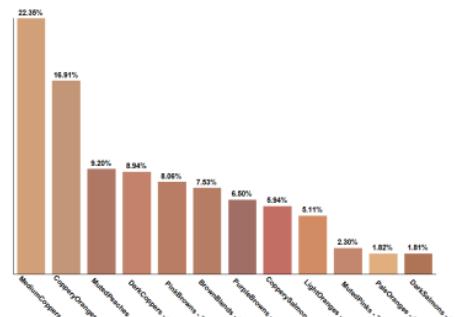
12.7 x 76.5 mm



0	0%	Freshly Polished
1a	0%	Slight Tarnish
1b	11%	Slight Tarnish
2a	0%	Moderate Tarnish
2b	0%	Moderate Tarnish
2c	46%	Moderate Tarnish
2d	0%	Moderate Tarnish
2e	0%	Moderate Tarnish
3a	41%	Dark Tarnish
3b	0%	Dark Tarnish
4a	0%	Corrosion
4b	0%	Corrosion
4c	0%	Corrosion

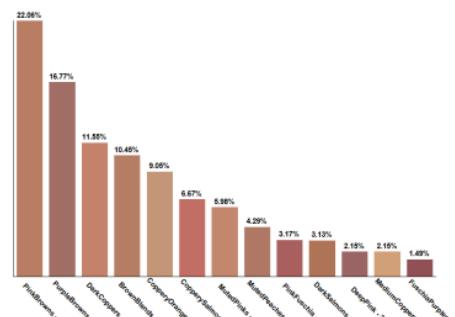
Side A Color Distribution

*Colors in bar chart are not exact.
**Ignoring cuts off percentages smaller than 1%.



Side B Color Distribution

*Colors in bar chart are not exact.
**Ignoring cuts off percentages smaller than 1%.



5.2.7. Semi-Automatic Mode

Semi-automatic mode allows laboratories that require manual interpretation of results, but still want the accuracy, repeatability, and convenience of the CuDDI's many features, such as LIMS connectivity and a cross-verification of ratings. If activated in the Settings menu (Section 5.4.1.1), the CuDDI features the ability to prompt the user for the manual external rating prior to the CuDDI displaying its automated rating. This works similarly to the preceding override function, but selection must be made prior to a run so as not to be influenced by the CuDDI's rating.

Just like the fully automatic wizard, which prompts for a sample ID, method, operator, and optional description prior to a run, the user is presented with an additional option: expected rating, which is confirmed by a tap or click. If selected incorrectly, click on a selection until satisfied. Once complete, click the Run button to initiate a run.

>Analyze Previous

Expected Rating Select expected rating to continue



0 1a 1b 2a 2b 2c 2d 2e 3a 3b 4a 4b 4c

>Analyze Previous Run →

Expected Rating 2a



0 1a 1b 2a 2b 2c 2d 2e 3a 3b 4a 4b 4c

The CuDDI will then run its analysis using the same method as fully automated mode; however, the display of data will include the manual and the CuDDI ratings, and the operator will have the choice to designate either rating as the overall rating.

Analyze Results

Side A Side B

Name	TEST_1
Date	7/22/2025, 8:48 AM
Method	ASTM D130
Operator	Operator
Description	

[See more information ...](#)

Rejected

Manual	Auto
2a	3a

Rating: 3a
The Rating falls outside the range of 0 - 2a

Final **Manual** Auto

Override rating ...

Side A	Side B
Blues	<input type="checkbox"/> Blues
Neutrals	<input type="checkbox"/> Neutrals
Oranges	<input checked="" type="checkbox"/> Oranges
Pinks	<input checked="" type="checkbox"/> Pinks
Purples	<input type="checkbox"/> Purples

Print Export Delete Done ...

Analyze Results

Side A Side B

Name	TEST_1
Date	7/22/2025, 8:48 AM
Method	ASTM D130
Operator	Operator
Description	

[See more information ...](#)

Rejected

Manual	Auto
2a	3a

Rating: 3a
The Rating falls outside the range of 0 - 2a

Final **Manual** Auto

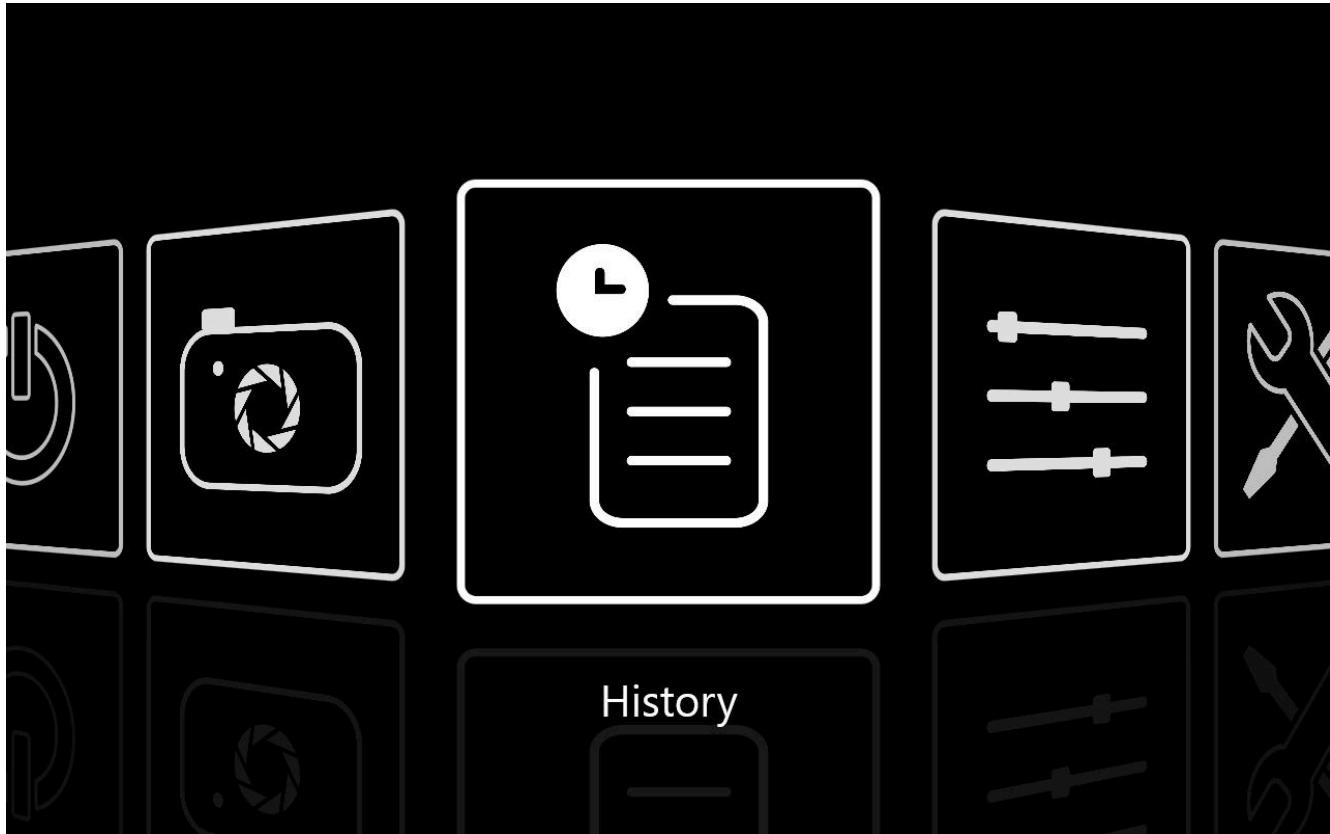
Override rating ...

Side A	Side B
Blues	<input type="checkbox"/> Blues
Neutrals	<input type="checkbox"/> Neutrals
Oranges	<input checked="" type="checkbox"/> Oranges
Pinks	<input checked="" type="checkbox"/> Pinks
Purples	<input type="checkbox"/> Purples

Print Export Delete Done ...

5.3. History

The History menu is the location of the result database.



5.3.1. Database

Entering the History database, the screen will present a list view of all the saved results. Using the summary list view, the operator has the ability to quickly see the sample ID, date, operator, method, and overall rating.

Results shown under the rating column with two results and one with a (**) represent the automatic or manual rating that was overridden. If the semi-automatic mode is activated, the user will also be presented with three different icons to represent the operator's selection:

 Fully Auto

 Semi-Auto

 Manual Override



Note: If a semi-automatic test is conducted, but the operator opts to use the automatic rating as the overall rating, the initial manual rating will be dropped from the result file.

History

Sample Id	Date	Operator	Method	Rating
TEST_1	7/22/2025, 8:57 AM	Operator	ASTM D130	3a
TEST_1	7/22/2025, 8:53 AM	Operator	ASTM D130	3a
TEST_1	7/22/2025, 8:48 AM	Operator	ASTM D130	2a (3a)
TEST_1	7/22/2025, 8:28 AM	Operator	ASTM D130	2a (3a)
OT Cud3 65	7/16/2025, 10:04 AM	Operator	ASTM D130	3a
OT Cud3 5	7/16/2025, 9:48 AM	Operator	ASTM D130	1a
OT Cud3 20	7/16/2025, 9:43 AM	Operator	ASTM D130	1a
OT Cud3 41	7/16/2025, 9:37 AM	Operator	ASTM D130	2a

Print
 Export
 Delete
 Clear filters
 Clear selection
 Select all
...

History

Sample Id	Date	Operator	Method	Rating
TEST_1	7/22/2025, 8:28 AM	Operator	ASTM D130	2a (3a)
OT Cud3 65	7/16/2025, 10:04 AM	Operator	ASTM D130	3a
OT Cud3 5	7/16/2025, 9:48 AM	Operator	ASTM D130	1a
OT Cud3 20	7/16/2025, 9:43 AM	Operator	ASTM D130	1a
OT Cud3 41	7/16/2025, 9:37 AM	Operator	ASTM D130	2a
OT Cud3 46	7/16/2025, 9:28 AM	Operator	ASTM D130	3a
OT Cud3 67	7/16/2025, 9:21 AM	Operator	ASTM D130	3a
OT Cud3 1	7/16/2025, 9:16 AM	Operator	ASTM D130	1a

Print
 Export
 Delete
 Clear filters
 Clear selection
 Select all
...

To view more information:

Simply click the result you want to see

Tap the View button at the bottom of the screen

⟲ History

Sample Id	Date ▾	Operator	Method	Rating
TEST_1	7/22/2025, 8:28 AM	Operator	ASTM D130	✍ 2a (3a)
OT Cud3 65	7/16/2025, 10:04 AM	Operator	ASTM D130	▣ 3a
OT Cud3 5	7/16/2025, 9:48 AM	Operator	ASTM D130	▣ 1a
OT Cud3 20	7/16/2025, 9:43 AM	Operator	ASTM D130	▣ 1a
OT Cud3 41	7/16/2025, 9:37 AM	Operator	ASTM D130	▣ 2a
OT Cud3 46	7/16/2025, 9:28 AM	Operator	ASTM D130	▣ 3a
OT Cud3 67	7/16/2025, 9:21 AM	Operator	ASTM D130	▣ 3a
OT Cud3 1	7/16/2025, 9:16 AM	Operator	ASTM D130	▣ 1a

Print
Export
Delete
View
Clear filters
Clear selection
Select all



Note that the View button is only available when a single sample row is selected. Selecting more than one row at a time will remove the ability to use the View option.

Sample Id	Date ▾	Operator	Method	Rating
TEST_1	7/22/2025, 8:28 AM	Operator	ASTM D130	✍ 2a (3a)
OT Cud3 65	7/16/2025, 10:04 AM	Operator	ASTM D130	▣ 3a
OT Cud3 5	7/16/2025, 9:48 AM	Operator	ASTM D130	▣ 1a
OT Cud3 20	7/16/2025, 9:43 AM	Operator	ASTM D130	▣ 1a
OT Cud3 41	7/16/2025, 9:37 AM	Operator	ASTM D130	▣ 2a
OT Cud3 46	7/16/2025, 9:28 AM	Operator	ASTM D130	▣ 3a
OT Cud3 67	7/16/2025, 9:21 AM	Operator	ASTM D130	▣ 3a
OT Cud3 1	7/16/2025, 9:16 AM	Operator	ASTM D130	▣ 1a

Print
Export
Delete
Clear filters
Clear selection
Select all

Clicking the View button will display results similar to the results page displayed after a test analysis. Operator has the ability to perform print, export, and delete functions, as well as zoom in to images. To ensure data integrity, the following options are not available:

Change sample identifiers

Change method

Override or change final rating

Analyze Results

Side A Side B

Name	TEST_1
Date	7/22/2025, 8:28 AM
Method	ASTM D130
Operator	Operator
Description	Sample 1: 3 hour incubation in oil 31b

Rejected

X

2a
Overridden 2a
Automatic rating is 3a
The Rating falls outside the range of 0 - 1b

Sample within spec.s?	Pass	Side A : 12.8 mm x 77.1 mm
	Pass	Side B : 12.8 mm x 77.1 mm
Side A rating	2a	Moderate Tarnish
Side B rating	3a	Dark Tarnish

Blues	<input type="checkbox"/> Blues	<input type="checkbox"/>
Neutrals	<input type="checkbox"/> Neutrals	<input type="checkbox"/>
Oranges	<input checked="" type="checkbox"/> Oranges	<input checked="" type="checkbox"/>
Pinks	<input checked="" type="checkbox"/> Pinks	<input type="checkbox"/>
Purples	<input type="checkbox"/> Purples	<input type="checkbox"/>

Print Export Delete Done

If the *pass/fail* threshold has been changed, the denotation of passing or failing will be retained from the time the test took place.

History

Sample Id	Date	Operator	Method	Rating
TEST_1	7/22/2025, 11:18 AM	Operator	ASTM D130	3a
TEST_1	7/22/2025, 11:13 AM	Operator	ASTM D130	3a
TEST_1	7/22/2025, 9:02 AM	Operator	ASTM D130	3a
TEST_1	7/22/2025, 8:57 AM	Operator	ASTM D130	3a
TEST_1	7/22/2025, 8:53 AM	Operator	ASTM D130	3a
TEST_1	7/22/2025, 8:48 AM	Operator	ASTM D130	2a (3a)
TEST_1	7/22/2025, 8:28 AM	Operator	ASTM D130	2a (3a)
OT Cud3 65	7/16/2025, 10:04 AM	Operator	ASTM D130	3a

Print Export Delete Clear filters Clear selection Select all

Analyze Results

Side A Side B

Name	TEST_1
Date	7/22/2025, 11:18 AM
Method	ASTM D130
Operator	Operator
Description	

[See more information ...](#)



Rejected

Rating: 3a

The Rating falls outside the range of 0 - 1b

	Side A	Side B
Blues	<input type="checkbox"/>	<input type="checkbox"/>
Neutrals	<input type="checkbox"/>	<input type="checkbox"/>
Oranges	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Pinks	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Purples	<input type="checkbox"/>	<input type="checkbox"/>

 Print
 Export
 Delete
 Done
...

Analyze Results

Side A Side B

Name	TEST_1
Date	7/22/2025, 11:13 AM
Method	ASTM D130
Operator	Operator
Description	

[See more information ...](#)



Accepted

Rating: 3a

	Side A	Side B
Blues	<input type="checkbox"/>	<input type="checkbox"/>
Neutrals	<input type="checkbox"/>	<input type="checkbox"/>
Oranges	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Pinks	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Purples	<input type="checkbox"/>	<input type="checkbox"/>

 Print
 Export
 Delete
 Done
...

5.3.2. Filter Results

Within the History screen, the operator has the ability to filter data shown in the columns. This ability allows the operator to:

Quick search and find results

Sort by a particular method or rating

Sort and display results from a specific date range

Filter a specific data set for export and analysis

The following filter options are available:

Filter by sample ID: Open as a search box that allows you to enter values to search

History

Sample Id	Date	Operator	Method	Rating
Contains	025, 8:28 AM	Operator	ASTM D130	<input checked="" type="checkbox"/> 2a (3a)
	025, 10:04 AM	Operator	ASTM D130	<input checked="" type="checkbox"/> 3a
Confirm	025, 9:48 AM	Operator	ASTM D130	<input checked="" type="checkbox"/> 1a
	025, 9:43 AM	Operator	ASTM D130	<input checked="" type="checkbox"/> 1a
Clear	025, 9:37 AM	Operator	ASTM D130	<input checked="" type="checkbox"/> 2a
OT Cud3 46	7/16/2025, 9:28 AM	Operator	ASTM D130	<input checked="" type="checkbox"/> 3a
OT Cud3 67	7/16/2025, 9:21 AM	Operator	ASTM D130	<input checked="" type="checkbox"/> 3a
OT Cud3 1	7/16/2025, 9:16 AM	Operator	ASTM D130	<input checked="" type="checkbox"/> 1a

 Print
 Export
 Delete
 Clear filters
 Clear selection
 Select all

Date: Displays data by a specific date or range of dates

History

Sample Id	Date	Operator	Method	Rating
TEST_1	7/16/2025, 9:28 AM	Operator	ASTM D130	<input checked="" type="checkbox"/> 2a (3a)
OT Cud3 65	7/16/2025, 9:21 AM	Operator	ASTM D130	<input checked="" type="checkbox"/> 3a
OT Cud3 5	7/16/2025, 9:16 AM	Operator	ASTM D130	<input checked="" type="checkbox"/> 1a
OT Cud3 20	7/16/2025, 9:16 AM	Operator	ASTM D130	<input checked="" type="checkbox"/> 1a
OT Cud3 41	7/16/2025, 9:16 AM	Operator	ASTM D130	<input checked="" type="checkbox"/> 2a
OT Cud3 46	7/16/2025, 9:28 AM	Operator	ASTM D130	<input checked="" type="checkbox"/> 3a
OT Cud3 67	7/16/2025, 9:21 AM	Operator	ASTM D130	<input checked="" type="checkbox"/> 3a
OT Cud3 1	7/16/2025, 9:16 AM	Operator	ASTM D130	<input checked="" type="checkbox"/> 1a

 Print
 Export
 Delete
 Clear filters
 Clear selection
 Select all

Operator: Displays a list of stored operators to filter results from a specific operator

History

Sample Id	Date	Operator	Method	Rating
TEST_1	7/22/2025, 8:28 AM		ASTM D130	2a (3a)
OT Cud3 65	7/16/2025, 10:04 AM		ASTM D130	3a
OT Cud3 5	7/16/2025, 9:48 AM		ASTM D130	1a
OT Cud3 20	7/16/2025, 9:43 AM		ASTM D130	1a
OT Cud3 41	7/16/2025, 9:37 AM	Operator	ASTM D130	2a
OT Cud3 46	7/16/2025, 9:28 AM	Operator	ASTM D130	3a
OT Cud3 67	7/16/2025, 9:21 AM	Operator	ASTM D130	3a
OT Cud3 1	7/16/2025, 9:16 AM	Operator	ASTM D130	1a

Print Export Delete Clear filters Clear selection Select all

History

Sample Id	Date	Operator	Method	Rating
TEST_1	7/22/2025, 8:28 AM	Operator	ASTM D130	2a (3a)
OT Cud3 65	7/16/2025, 10:04 AM	Operator	ASTM D130	3a
OT Cud3 5	7/16/2025, 9:48 AM	Operator	ASTM D130	1a
OT Cud3 20	7/16/2025, 9:43 AM	Operator	ASTM D130	1a
OT Cud3 41	7/16/2025, 9:37 AM	Operator	ASTM D130	2a
OT Cud3 46	7/16/2025, 9:28 AM	Operator	ASTM D130	3a
OT Cud3 67	7/16/2025, 9:21 AM	Operator	ASTM D130	3a
OT Cud3 1	7/16/2025, 9:16 AM	Operator	ASTM D130	1a

Print Export Delete Clear filters Clear selection Select all

Method: Displays a list of methods by which to filter

History

Sample Id	Date	Operator	Method	Rating
TEST_1	7/22/2025, 8:28 AM	Operator	<input type="button" value="Confirm"/>	2a (3a)
OT Cud3 65	7/16/2025, 10:04 AM	Operator	<input type="button" value="Confirm"/>	3a
OT Cud3 5	7/16/2025, 9:48 AM	Operator	<input type="button" value="Confirm"/>	1a
OT Cud3 20	7/16/2025, 9:43 AM	Operator	<input type="button" value="Confirm"/>	1a
OT Cud3 41	7/16/2025, 9:37 AM	Operator	ASTM D130	2a
OT Cud3 46	7/16/2025, 9:28 AM	Operator	ASTM D130	3a
OT Cud3 67	7/16/2025, 9:21 AM	Operator	ASTM D130	3a
OT Cud3 1	7/16/2025, 9:16 AM	Operator	ASTM D130	1a

Print Export Delete Clear filters Clear selection Select all

History

Sample Id	Date	Operator	Method	Rating
TEST_1	7/22/2025, 8:28 AM	Operator	ASTM D130	2a (3a)
OT Cud3 65	7/16/2025, 10:04 AM	Operator	ASTM D1838	3a
OT Cud3 5	7/16/2025, 9:48 AM	Operator	ASTM D4048	1a
OT Cud3 20	7/16/2025, 9:43 AM	Operator	IP 154	(3a)
OT Cud3 41	7/16/2025, 9:37 AM	Operator	IP 411	2a
OT Cud3 46	7/16/2025, 9:28 AM	Operator	ISO 2160	3a
OT Cud3 67	7/16/2025, 9:21 AM	Operator	ISO 6251	1a
OT Cud3 1	7/16/2025, 9:16 AM	Operator		

Print Export Delete Clear filters Clear selection Select all

Rating: Filters by specific rating and analysis mode

History

Sample Id	Date	Operator	Method	Rating
TEST_1	7/22/2025, 8:28 AM	Operator	0	1a
OT Cud3 65	7/16/2025, 10:04 AM	Operator	2a	2b
OT Cud3 5	7/16/2025, 9:48 AM	Operator	2c	2d
OT Cud3 20	7/16/2025, 9:43 AM	Operator	3a	3b
OT Cud3 41	7/16/2025, 9:37 AM	Operator	4a	4b
OT Cud3 46	7/16/2025, 9:28 AM	Operator	4c	
OT Cud3 67	7/16/2025, 9:21 AM	Operator	Auto	Manual
OT Cud3 1	7/16/2025, 9:16 AM	Operator	Overridden	
			ASTM D130	1a

Print Export Delete Clear filters Clear selection Select all

History

Sample Id	Date	Operator	Method	Rating
TEST_1	7/22/2025, 8:28 AM	Operator	0	1a
OT Cud3 65	7/16/2025, 10:04 AM	Operator	2a	2b
OT Cud3 5	7/16/2025, 9:48 AM	Operator	2c	2d
OT Cud3 20	7/16/2025, 9:43 AM	Operator	3a	3b
OT Cud3 41	7/16/2025, 9:37 AM	Operator	4a	4b
OT Cud3 46	7/16/2025, 9:28 AM	Operator	4c	
OT Cud3 67	7/16/2025, 9:21 AM	Operator	Auto	Manual
OT Cud3 1	7/16/2025, 9:16 AM	Operator	Overridden	
			ASTM D130	1a

Print Export Delete Clear filters Clear selection Select all



Note: Activating any of the filters will change the color of the Filter icon for each column from white to blue

History

Sample Id	Date	Operator	Method	Rating
OT Cud3 41	7/16/2025, 9:37 AM	Operator	ASTM D130	2a
Qa46	6/12/2025, 11:45 AM	Operator	ASTM D130	2a
Qa46	6/12/2025, 12:22 PM	Operator	ASTM D130	2a
Qa51	6/12/2025, 1:45 PM	Operator	ASTM D130	2a
Qa67	6/13/2025, 7:39 AM	Operator	ASTM D130	2a
TEST_1	7/22/2025, 8:28 AM	Operator	ASTM D130	2a (3a)

 Print
  Export
  Delete
  Clear filters
  Clear selection
  Select all
 ...

Activating any of the filters will display only relevant data if available. Otherwise, the CuDDI will display a blank screen. Multiple rows or a single row can be selected to export, print or further filter. In addition to these options, the operator also has the ability to:

Clear all filters to return all results to the screen

Clear selection to start over

Select all to easily select all filtered results

History

Sample Id	Date	Operator	Method	Rating
TEST_1	7/22/2025, 8:28 AM	Operator	ASTM D130	2a (3a)
OT Cud3 65	7/16/2025, 10:04 AM	Operator	ASTM D130	3a
OT Cud3 5	7/16/2025, 9:48 AM	Operator	ASTM D130	1a
OT Cud3 20	7/16/2025, 9:43 AM	Operator	ASTM D130	1a
OT Cud3 41	7/16/2025, 9:37 AM	Operator	ASTM D130	2a
OT Cud3 46	7/16/2025, 9:28 AM	Operator	ASTM D130	3a
OT Cud3 67	7/16/2025, 9:21 AM	Operator	ASTM D130	3a
OT Cud3 1	7/16/2025, 9:16 AM	Operator	ASTM D130	1a

 Print
  Export
  Delete
  Clear filters
  Clear selection
  Select all
 ...

5.3.3. Data Options

Filtered results as well as unfiltered results displayed on the History screen can be exported, printed, emailed, and deleted. The operator, upon selection of a result either from default or filtered results, can perform the following:

- Manual export to LIMS
- Save to USB or hard disk space
- Email to user

The operator, upon selection of a result, either from default or filtered results, can delete entries from the database. To delete an entry, simply select a single or multiple results from list view and tap the delete button. The operator will then need to verify the deletion of results on a confirmation screen.



Note: Deletion is permanent and cannot be undone. Please turn on administrator mode for restrictions.

The operator, upon selection of a result, either from default or filtered results, can print entries from the database. To print, simply select a single or multiple results from list view and tap the print button. The CuDDI offers the convenient ability to print simple or multiple results at the same time.

5.4. Settings

The Settings menu allows operators and administrators to set up and personalize the features of the CuDDI. The Settings screen is the CuDDI's central location for defining system-wide parameters such as users, date, e-mail, LIMS, printing, etc. Changes, additions, and navigation are easily performed using the integrated touchscreen and onscreen keyboard. Protection against critical functions of the software is defined within the Settings, using an Admin password.

This is also the location to enable semi-automatic mode and change the pass/fail threshold.



5.4.1. About

The About screen displays basic information about the CuDDI analyzer. This includes:

Model Number: Displays model number and hardware version of the analyzer

Serial Number: Displays serial number, which also appears on the back of the analyzer

Software Version: Software version of GUI or Interface

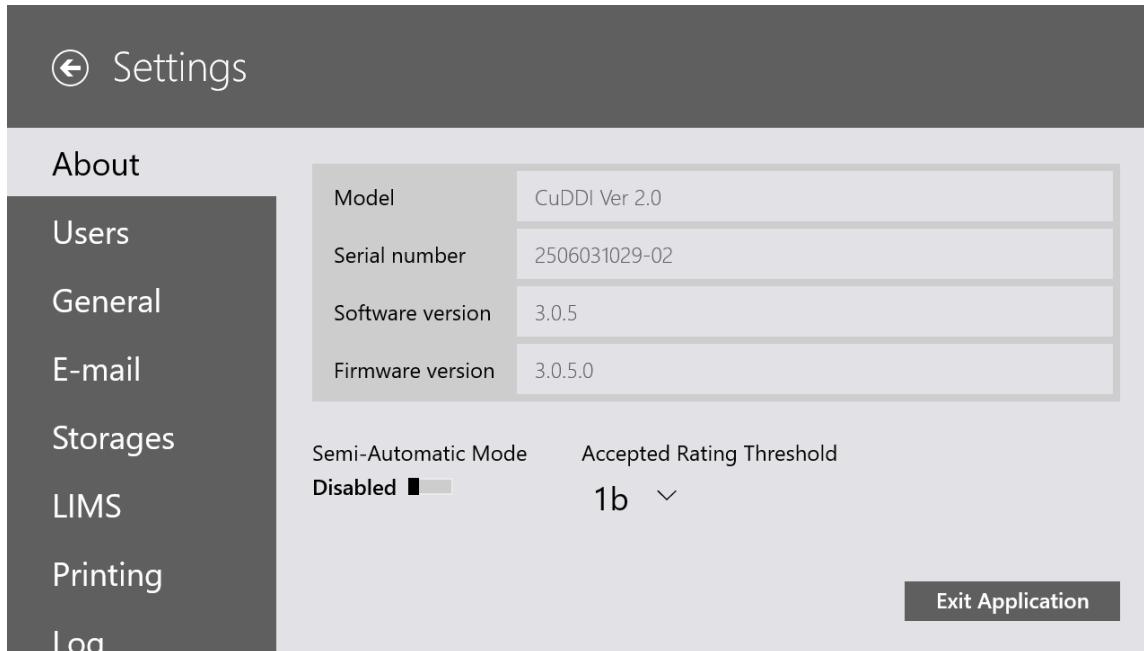
Firmware Version: Hardware control software

The CuDDI is operated in a protected mode called KIOSK or Assigned Access mode. This mode is critical to protect against changes to the software and operating system, as well as to prevent the ability to run malicious programs on the CuDDI. This operating mode allows only the approved CuDDI software to run.

It may be necessary to exit this mode to allow access to the administrator account to perform functions such as adding to the Domain, defining Network Printers, and IP Address functions. To exit the CuDDI's operating mode, press the Exit Application button

and allow the administrator to access a CuDDI Admin account. Please contact VISAYA for more information on making changes and the password for the VISAYA Admin account.

i *Note: The Exit Application Mode button is only available when operating when no Admin mode is activated.*



5.4.1.1. Turn On/Off Semiautomatic Mode

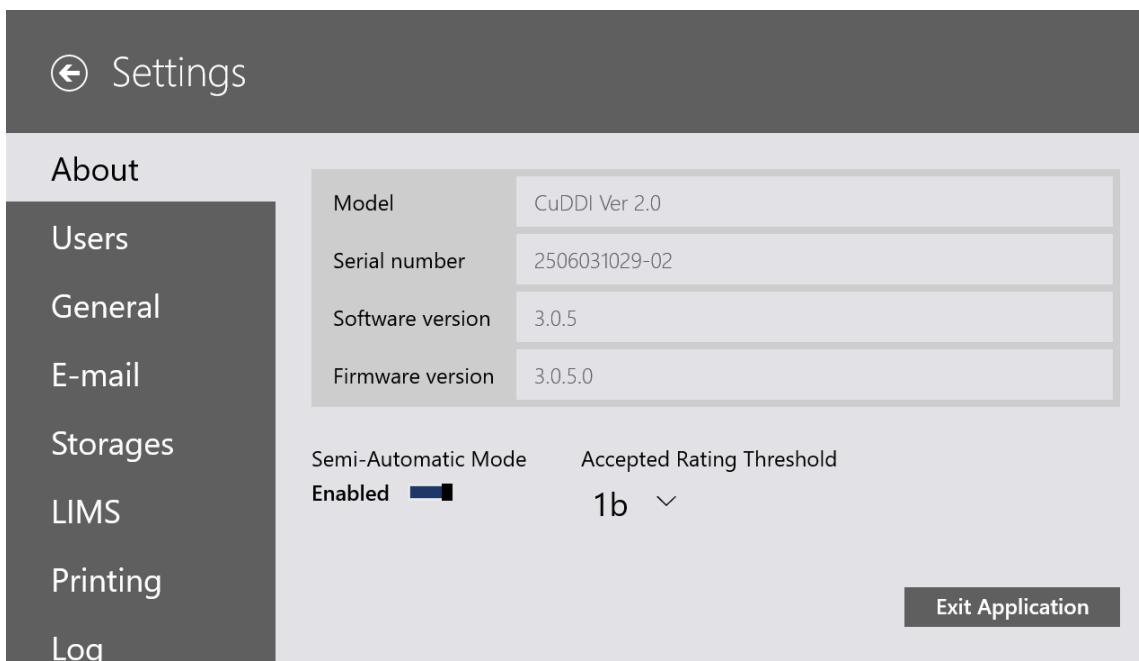
Semi-Automatic Mode can be activated within the About screen. More information on the semi-automatic mode can be found in Section 5.2.7.

To activate or deactivate this mode:

Tap to toggle the mode to Enabled to activate.

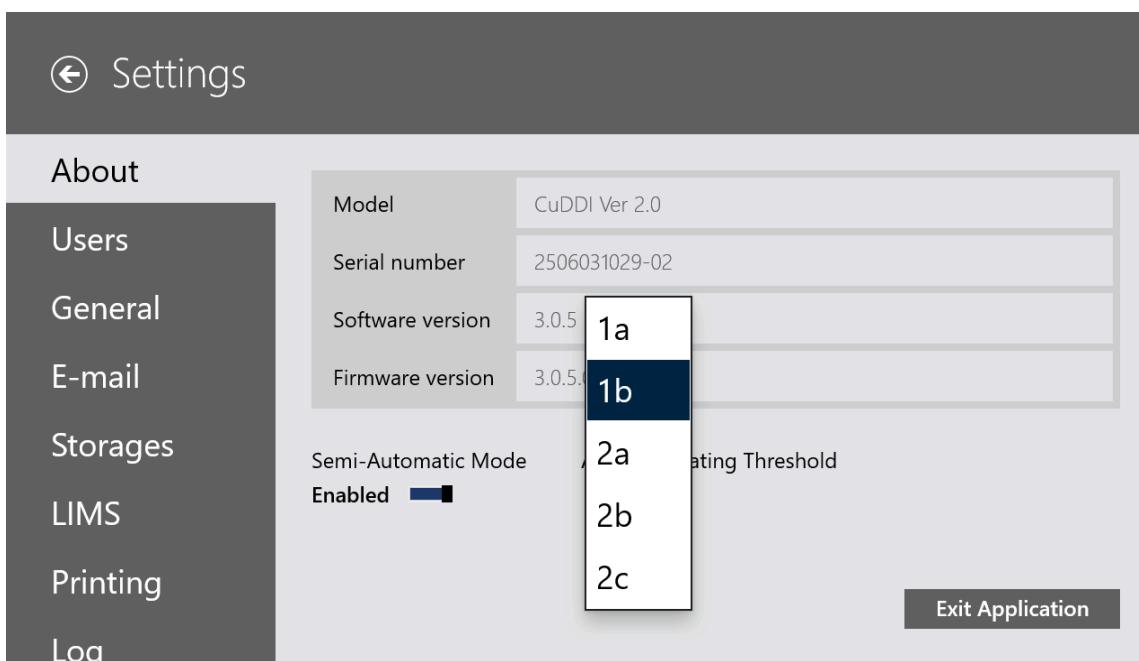
Tap to toggle the mode to Disabled to deactivate.

i *Note: There is no Save button to confirm this change – settings will update automatically.*



5.4.1.2. Change Pass/Fail Threshold

By default, the pass/fail threshold should be set to 1b. If desired, this threshold can be changed to any of the other ASTM D130 ratings. Simply select whichever rating is to be the highest passing rating. The system will automatically update the changes. Previous tests will not be changed to the new pass/fail threshold and will retain the status they were granted when that specific test was run.



⌚ Settings

- About
- Users
- General
- E-mail
- Storages
- LIMS
- Printing
- Log

Model	CuDDI Ver 2.0
Serial number	2506031029-02
Software version	3.0.5
Firmware version	3.0.5.0

Semi-Automatic Mode Accepted Rating Threshold
 4a ▾

Exit Application

For more information on the pass/fail threshold, go to Section 5.2.4.3.

5.4.2. Users

Operators, for use within the Inspect analysis screen and filtering options detailed in History, are defined in this section. To create a new operator:

Click the + next to New Operator

User will be prompted to enter a new Name

 *Note: Name must be unique from other operators and can be alpha-numeric*

Click Confirm to confirm a new entry

New User will be displayed in the Operators List

Once created, an Operator Name can be edited and deleted. To edit and delete a user:

Click on the Edit Icon next to the Operator name to edit

Click on the Delete Icon next to the Operator name to delete

 *Note: It is not necessary to confirm these changes using the Confirm button. All edits are permanent.*

⌚ Settings

- About
- Users
- General
- E-mail
- Storages
- LIMS
- Printing
- Log

Operators list

	New operator	Operator	
<input type="button" value="+"/>		<input type="button" value="✎"/> <input type="button" value="X"/>	

Change admin password

New Password

Confirm Password

Confirm **Cancel**

⌚ Settings

- About
- Operators list
- Change admin password

Create operator

Name

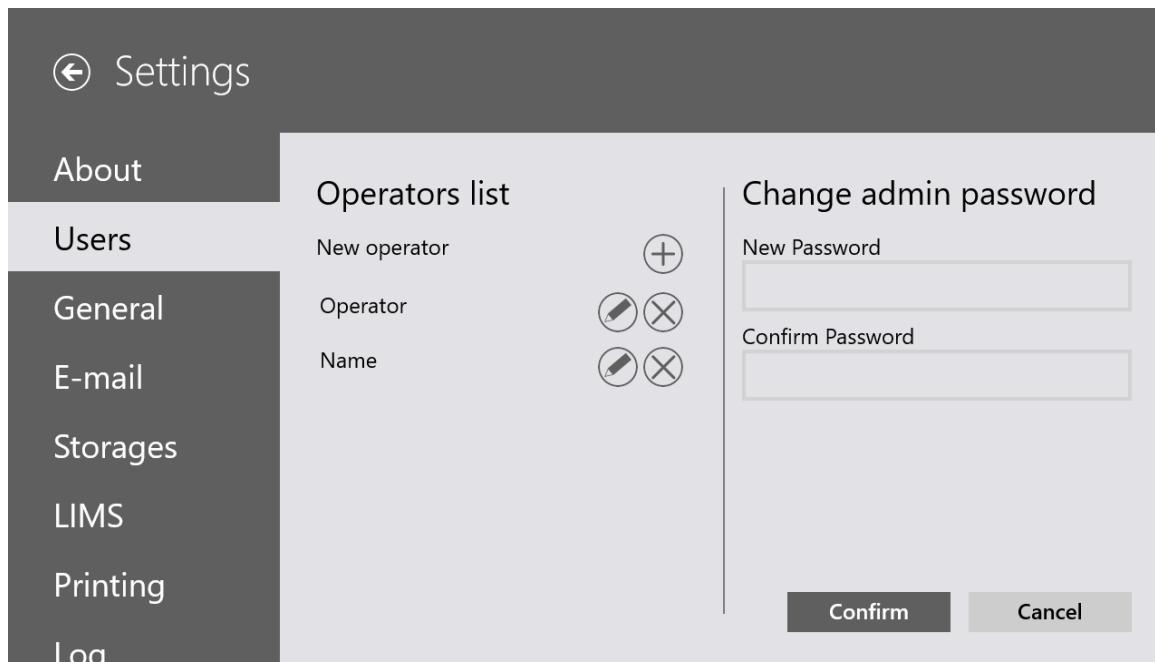
Confirm **Cancel**

LIMS

Printing

Log

Confirm **Cancel**



5.4.2.1. Admin Mode

The CuDDI's software provides an easy-to-use Admin mode to prevent access to critical parts of the software. Any critical functions can be locked with a prompt for a password to allow access and/or changes. To activate this function, simply type a password in the Change Admin fields. Password must be entered a second time to confirm entry. To activate this function, it is necessary to confirm using the Confirm button at the bottom of the screen. Alternately, press cancel to start all over with a new password.

Once this feature is activated, any attempt to enter critical parts of the software will be prompted with a request to enter a password. The operator can enter the Admin password to enter, or cancel to exit the screen. Admin Mode prevents access to the following screens:

Entering the Settings screen.

Advanced Calibration screen.

 Note: User will still have the ability to perform a Calibration Verification procedure.

Admin Mode provides an easy-to-use protection mode without the need for complex usernames and passwords, with various user rights and access levels.

To remove Admin Mode, simply:

Enter Settings Page

Enter Admin Password when prompted

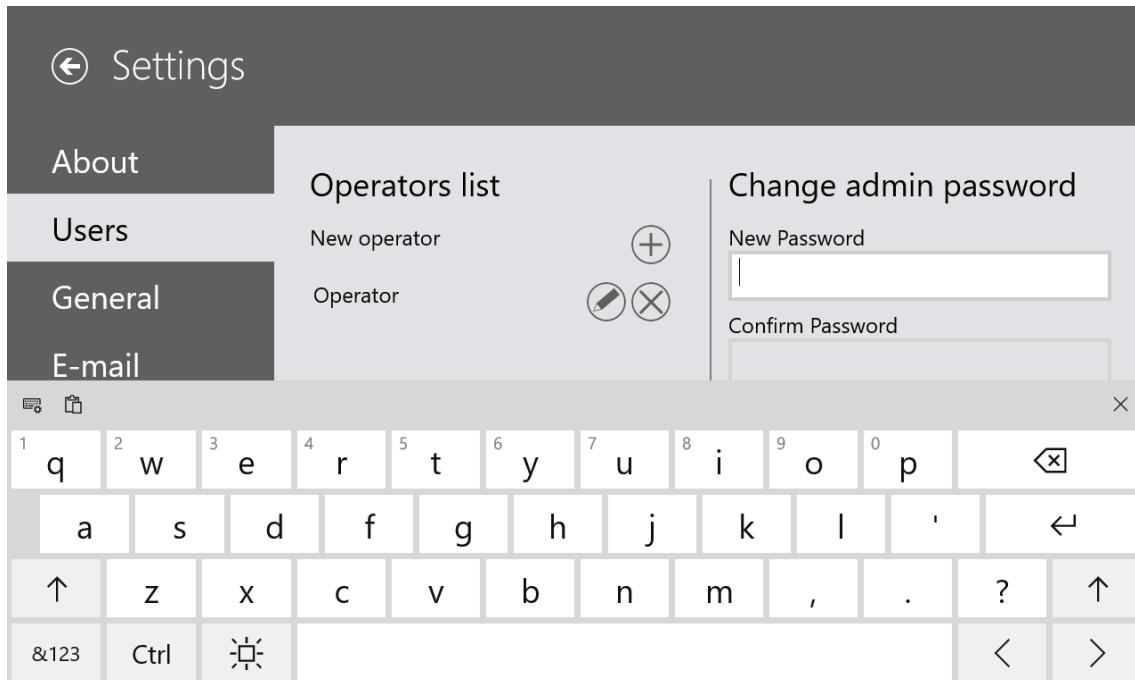
Enter the Users section and

Erase password from both “New Password” & “Confirm Password” fields

Press the “Confirm” button to accept the removal of admin mode



Note: If the Admin password is lost, please contact VISAYA Service for the master password to regain access to the system.



5.4.3. General

The General section of the Settings page is used to view the current system time, change date format, and select language.

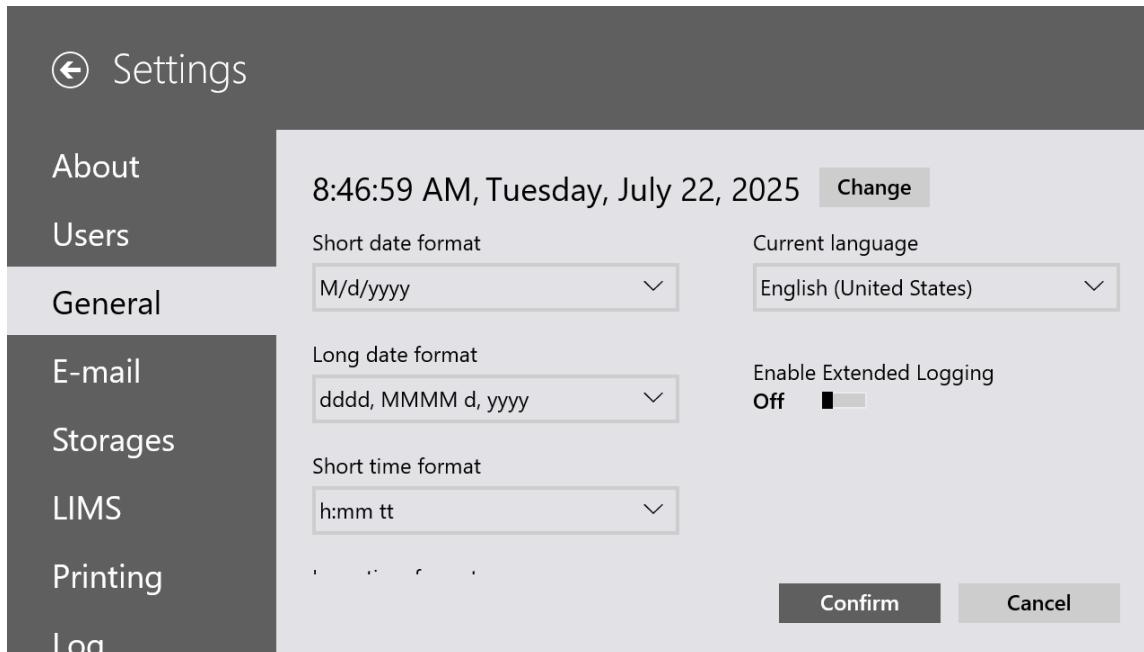
Date/Time Options:

Short Date/Time Format: Displays data in reports and list views used in History.

Long Date/Time Format: Displays data in LIMS and database.

The CuDDI's software features the ability to display in a growing number of languages. To change language files, simply select the desired language from the dropdown box. Upon

selection of a new language, the software will reset within seconds, displaying the software in the new language.



5.4.4. Email

The CuDDI has the ability to send an email upon request via the Results view screen, history, and log files. Configuration of the email server settings must be defined before using this service.

Email: Unique Address

Host: SMTP or IMAP Email Server

Server Port: Server Software Port

Login: User Name

Password: Password for User

SSL: SSL – Turn On/Off

Email Subject and Body text defaults to the following when left blank:

Subject:

“CuDDI Test Results / SN #XXXXXXXX-XX”

Body Text:

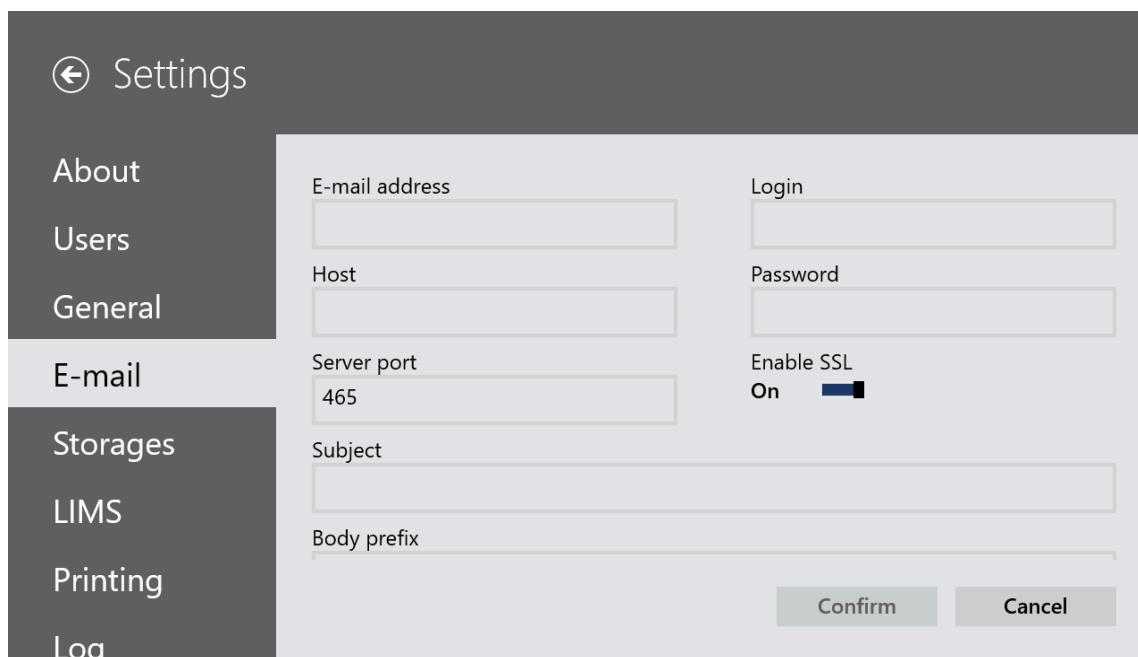
“Dear Lab Manager, Please find attached...

Sincerely, CuDDI Test Results / SN #XXXXXXXX-XX

Sample ID - Filename ID”

If you prefer to use a unique subject line and body text, simply fill in the corresponding fields with custom content.

Within the email, the CuDDI will embed a PDF document containing all the test results along with images. Final rating and messages are also included.



5.4.5. Storages

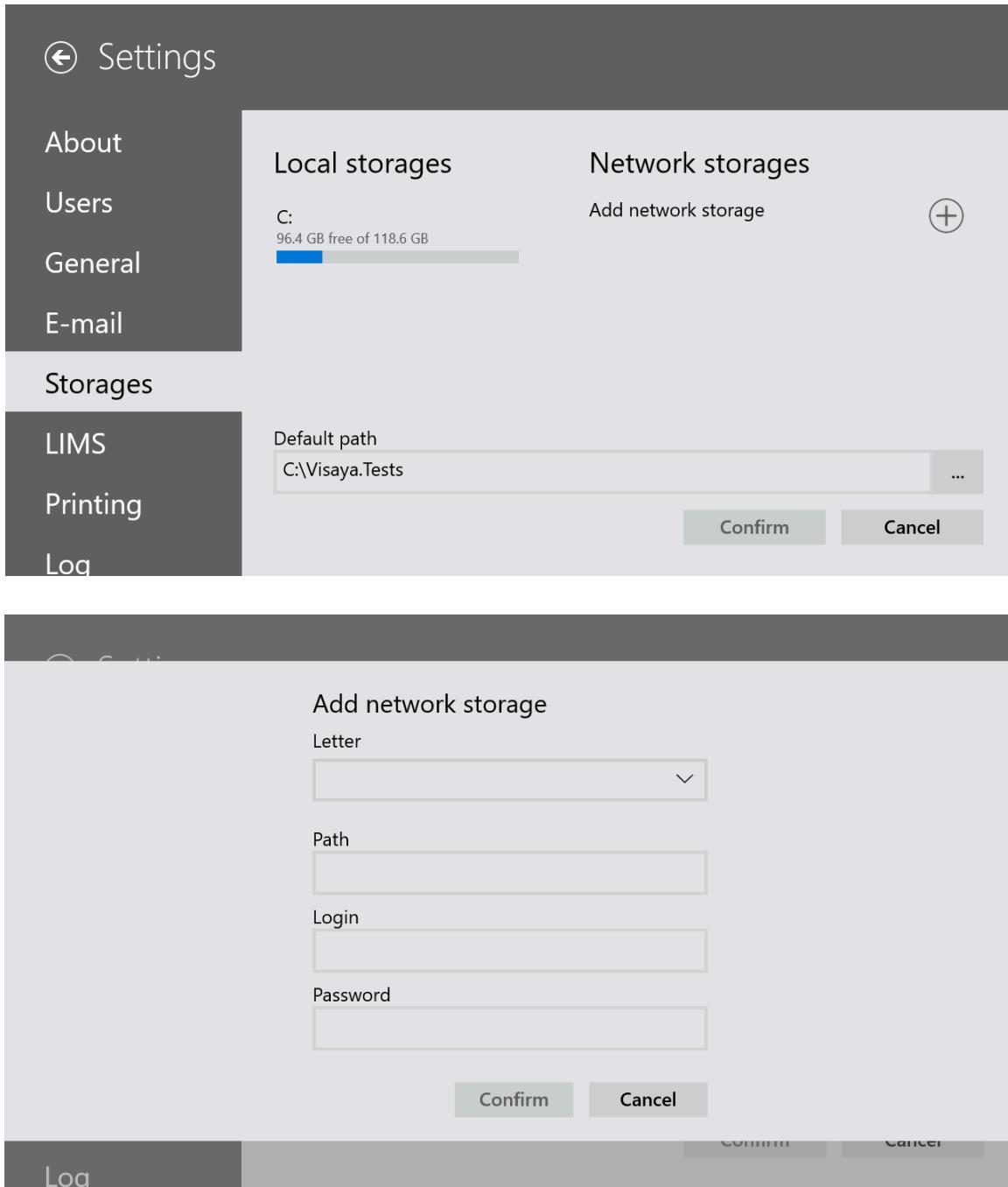
The CuDDI works within a specialized industrial application in a Windows-embedded OS, which uses a solid-state hard drive for the storage of test results.

The blue progress bars show the storage space remaining on the SSD hard drive, always designated by location.

Any additional external hard drives or USB memory devices will also be shown here.

The Default Path displays the default storage location for test results. If needed, the location can be changed by clicking the button at the end of the file path field.

Normally, the integrated hard drive is sufficient. In the event the administrator needs to change the storage location, the ability to add a network storage location, such as a network share, is allowed. Clicking on the Add Network Storage button opens a dialogue page to allow this function. If needed, the Default Path for storage results can be changed to this new location.



The screenshot shows the VISAYA software interface. On the left, a sidebar menu includes 'About', 'Users', 'General', 'E-mail', 'Storages' (which is selected), 'LIMS', 'Printing', and 'Log'. The main area displays 'Local storages' (C: 96.4 GB free of 118.6 GB) and 'Network storages' (with an 'Add network storage' button and a '+' icon). A 'Default path' field is set to 'C:\Visaya.Tests'. At the bottom right are 'Confirm' and 'Cancel' buttons. Below this, a modal dialog titled 'Add network storage' has fields for 'Letter' (dropdown menu), 'Path' (text input), 'Login' (text input), and 'Password' (text input). It also features 'Confirm' and 'Cancel' buttons. The 'Log' tab is visible at the bottom left of the modal.

5.4.6. LIMS

The CuDDI features full LIMS integration with a variety of options to fit virtually every LIMS system and allows for flexibility in the connection options:

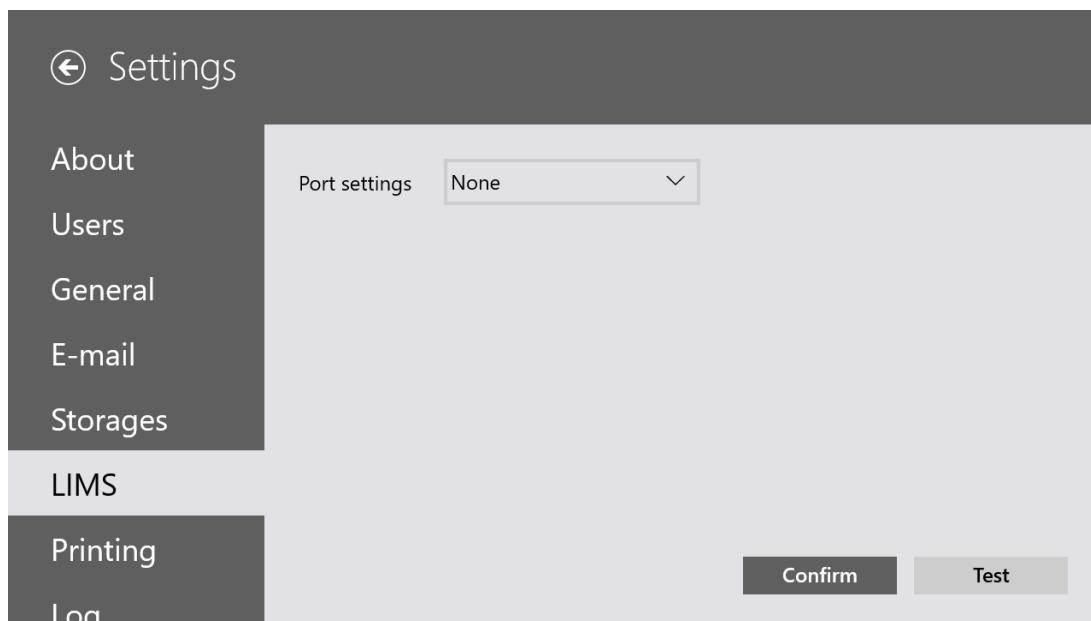
Network Share: Network storage or share

USB Save: Using a USB as a share

USB COM: USB port communication

COM 1: Serial communications

Using the dropdown selection box, simply select the desired mode of communications to access more options pertaining to that mode.



← Settings

- About
- Users
- General
- E-mail
- Storages
- LIMS
- Printing
- Log

Port settings

- None
- Network Share
- USB Save
- USB COM
- COM 1

Confirm **Test**

USB COM and COM 1 LIMS communications work in a similar fashion. COM Communications allows a serial output of the data in a fixed format using a standard 9 PIN RS-232 connection, and USB COM uses a standard USB connection to communicate in a serial fashion. The following parameters need to be defined:

- Baud rate
- Data bit
- Stop bit
- Parity bit
- Handshake control



Note: The Serial port has to be installed for COM 1. Contact VISAYA service for more details.

⌚ Settings

- About
- Users
- General
- E-mail
- Storages
- LIMS
- Printing**
- Log

Port settings: USB COM

 Baud rate: [dropdown]

 Data bit: [dropdown]

 Stop bit: [dropdown]

 Parity bit: None

 Handshake control: None

Confirm Test

⌚ Settings

- About
- Users
- General
- E-mail
- Storages
- LIMS
- Printing**
- Log

Port settings: COM 1

 Baud rate: [dropdown]

 Data bit: [dropdown]

 Stop bit: [dropdown]

 Parity bit: None

 Handshake control: None

Confirm Test

LIMS communication via Network Share and USB Save allows the CuDDI to write results to Network Share or a location on a remote server. Prior to communication with a Network Share, the following parameters must be default:

Server: Address location of server

User: User name credentials

Password: Password of the user

Share: File path or share location

The File Name can be changed to suit the needs of various LIMS systems:

Method Name: Test method name (i.e. ASTM_D130.csv)

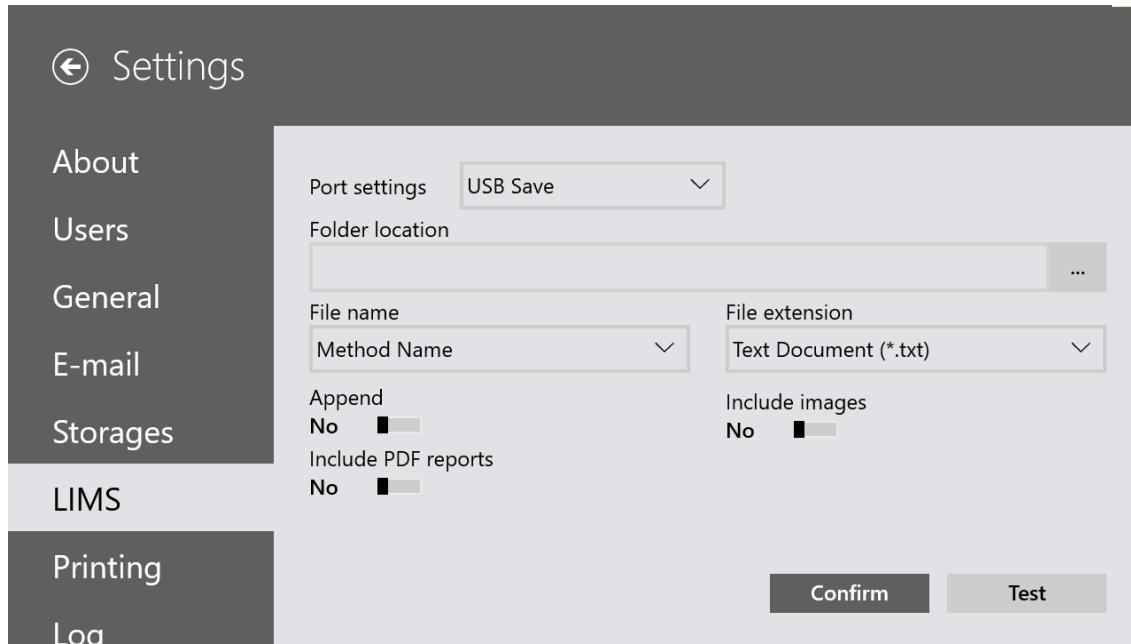
Instrument-SN: Uses serial number of analyzer

LIMS: Automatically assigns LIMS as file name

Select Append to Yes for the CuDDI to write a new data line to the existing file.

Select Append to No for the CuDDI to erase and write a new file for each sample test result.

Select Include Images to Yes to send images to an images folder with a serialized ID.



The screenshot shows the 'Settings' menu with the 'LIMS' tab selected. On the left, there's a sidebar with 'About', 'Users', 'General', 'E-mail', 'Storages', 'LIMS' (selected), 'Printing', and 'Log'. The main panel has several configuration fields:

- Port settings:** USB Save (dropdown menu)
- Folder location:** (Browse button)
- File name:** Method Name (dropdown menu)
- File extension:** Text Document (*.txt) (dropdown menu)
- Append:** No (checkbox)
- Include images:** No (checkbox)
- Include PDF reports:** No (checkbox)

At the bottom right are 'Confirm' and 'Test' buttons.

Settings

- About
- Users
- General
- E-mail
- Storages
- LIMS
- Printing**
- Log

Port settings **Network Share** ▾

Server	User
<input type="text"/>	<input type="text"/>
Share	Password
<input type="text"/>	<input type="text"/>

File name **Method Name** ▾

File extension	Text Document (*.txt) ▾
Append	No <input checked="" type="checkbox"/>
Include images	No <input checked="" type="checkbox"/>
Include PDF reports	

Confirm **Test**

A file format is selectable for best compatibility with various LIMS systems. The CuDDI has the ability to export and select from a variety of formats using a dropdown menu:

Text Document: Simple plain text format with file delimited by a comma.

CSV Format: Comma-separated values with file delimited by a comma.

XML Format: XML output with full markup and identifiers of each field. The best option to use for building a custom PDF with images.

5.4.7. Printing

After an analysis or via the History view, an operator has the ability to print to any network or USB printer. Some settings may require administration assistance, such as driver or network installation.

Default Printer: User-selectable printer. Displays all available printers, either shareable via network or installed.

Page size: Letter, Legal, and A4 selectable file formats for both PDF and printer pages.

.Settings

- About
- Users
- General
- E-mail
- Storages
- LIMS
- Printing
- Log

Default printer
Microsoft Print to PDF ▾

Page size
A4 ▾

Confirm Cancel

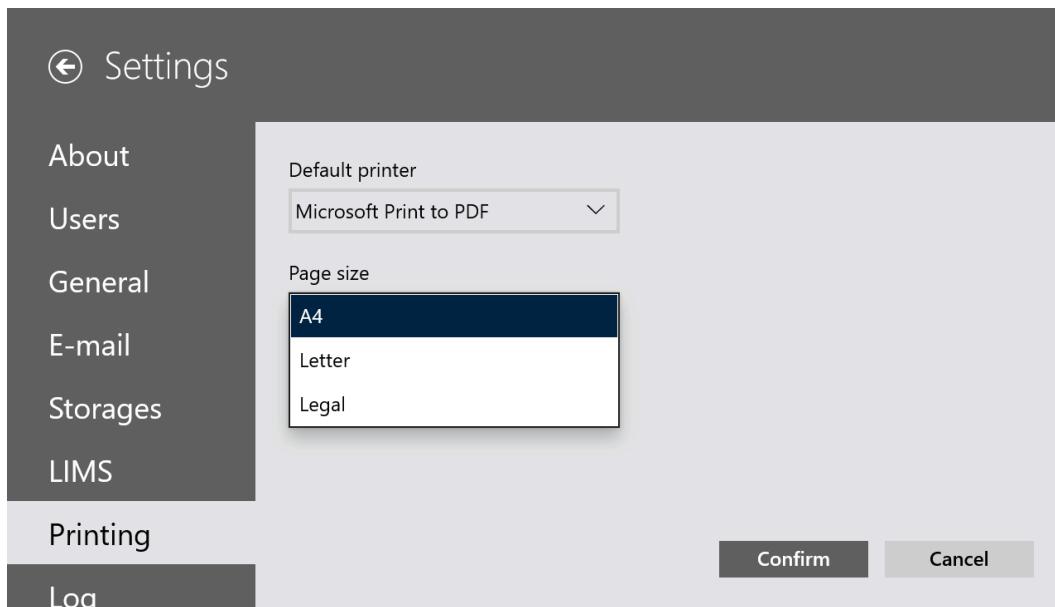
.Settings

- About
- Users
- General
- E-mail
- Storages
- LIMS
- Printing
- Log

OneNote
Microsoft XPS Document Writer
Microsoft Print to PDF
Fax

A4 ▾

Confirm Cancel



5.4.8. Log

The CuDDI features a Log file that stores all the communications between the hardware firmware and software. This log can be viewed, saved, and sent via email.

Save: Saves Results to hard drive or external USB memory.

Send via email: Open a dialogue box to enter the email address to send the log file.

Refresh: Updates display with the latest log entries.

Clear: Clears the screen and log to display only the latest entries.



Note: To send via email, Email Settings must be defined. See Email Settings.

⌚ Settings

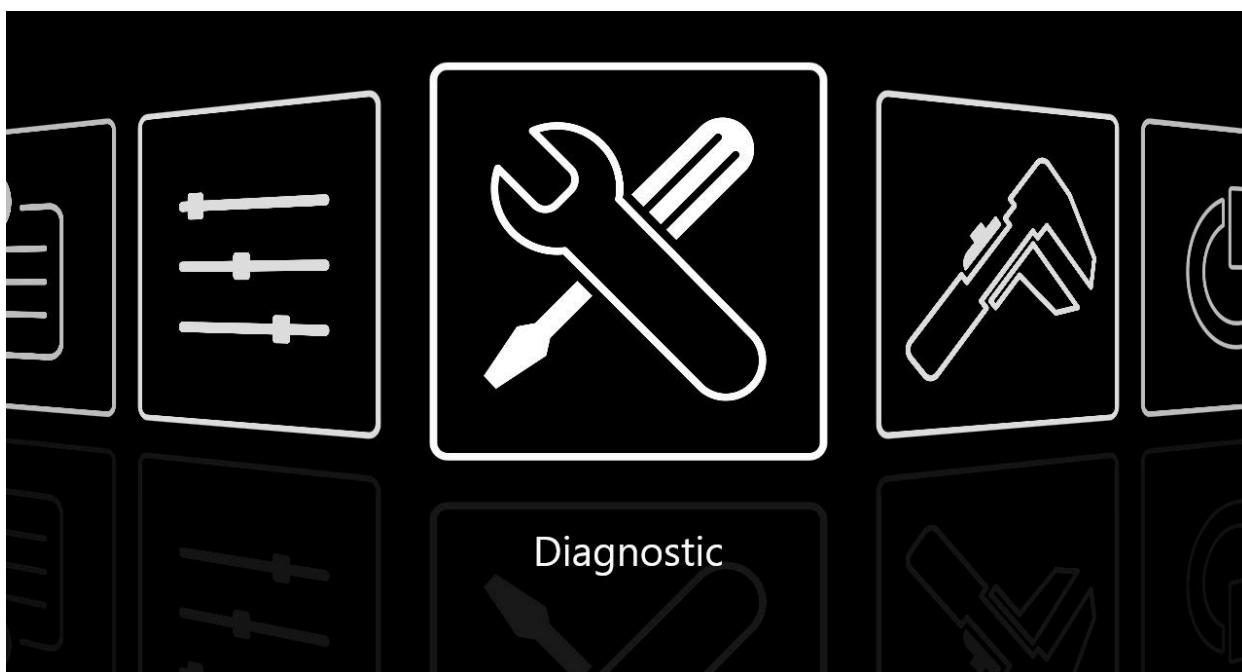
- About
- Users
- General
- E-mail
- Storages
- LIMS
- Printing
- Log**

```
at Visaya.Client.Views.AnalyzeResultsPage.<Print>d__10.MoveNext() + 0xb3
at System.Runtime.CompilerServices.TaskAwaiter.GetResult() + 0x1a
at System.Runtime.CompilerServices.TaskAwaiter.HandleNonSuccessAndDebugge
at System.Runtime.CompilerServices.TaskAwaiter.ThrowForNonSuccess(Task) + 0x
--- End of stack trace from previous location where exception was thrown ---
at System.ServiceModel.Channels.ServiceChannelProxy.TaskCreator.<>c__DisplayC
at System.ServiceModel.Channels.ServiceChannel.EndCall(String, Object[])
at System.ServiceModel.Channels.ServiceChannel.HandleReply(ProxyOperationRu
2025-07-22 08:37:05,836 | ERROR SettingsService - Client: System.ServiceModel.Fa
at System.ServiceModel.Dispatcher.MessageRpc.Process(Boolean isOperationCon
at System.ServiceModel.Dispatcher.ImmutableDispatchRuntime.ProcessMessage1
```

Save **Send via e-mail** **Refresh** **Clear**

5.5. Diagnostics

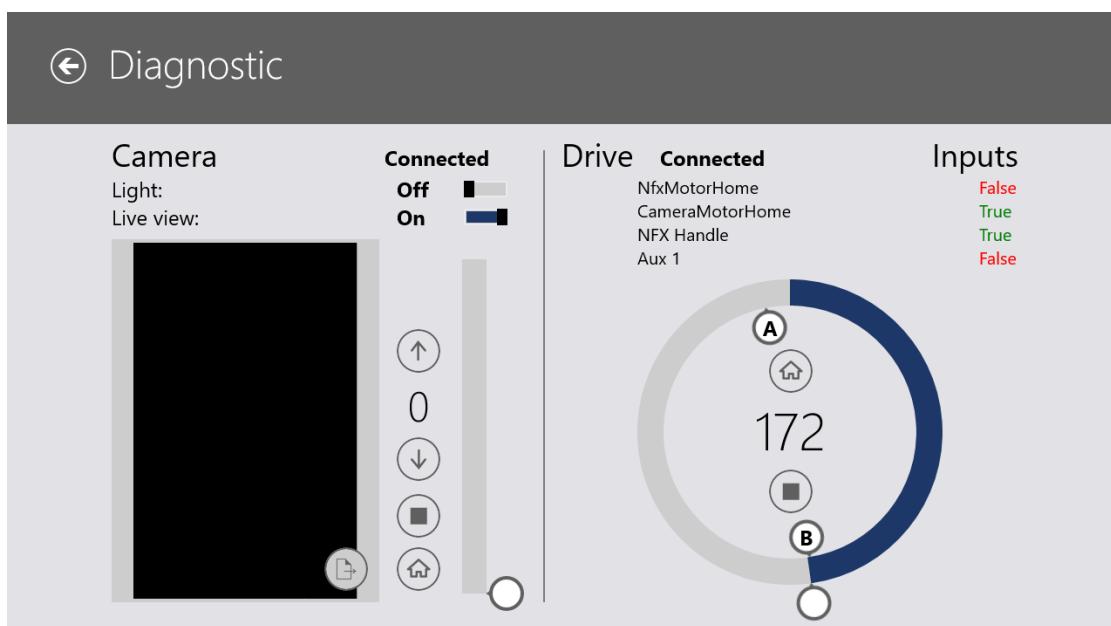
The Diagnostics menu allows operators to test different components of the hardware to ensure proper functionality. The CuDDI's software includes an easy-to-use diagnostics screen for troubleshooting and manual operation/verification of the CuDDI's electro-mechanical devices. This screen is useful for both identifying the source of a fault and for manually demonstrating the functions of the CuDDI.



5.5.1. Camera

The camera portion displays a live view as seen by the CuDDI and advises if the camera is communicating with the CuDDI software. This image is updated a few times per second and can be used for manual visual verifications and to ensure the image is displaying correctly.

The toggle light button allows you to manually turn the light On/Off. By default, the light turns on when you enter this screen.



Located at the bottom right of the image is an export button. This button will export the current view to a select folder/share for sharing or troubleshooting.

The up and down arrows move the camera up and down the strip, respectively. The stop button halts the camera movement. The home button returns the camera to its home position, confirmed by the input CameraMotorHome.

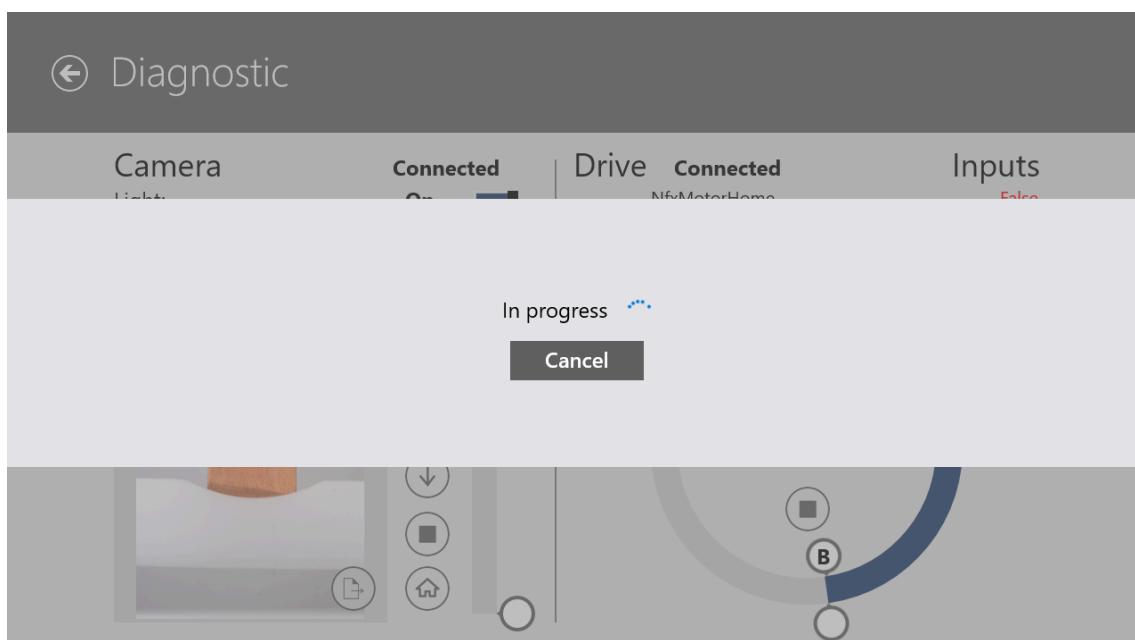
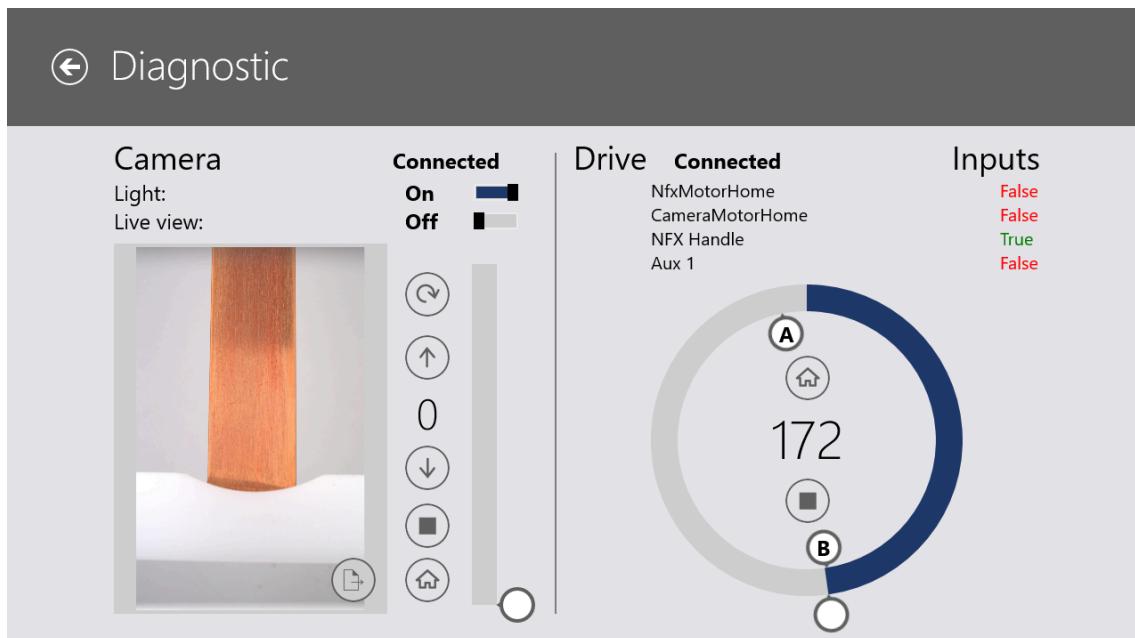


Live View toggles the live video mode On/Off. Toggling this button allows the use of the scan button depicted as the rounded arrow, as noted in the image below. This button is only activated when live mode is Off.

Scan is activated by pressing the scan button, and the CuDDI will scan and display the full image of the entire specimen side. The image can then be viewed and exported, as detailed in the preceding section.



Note: Ensure the specimen is in the correct position. See the Drive section of the manual.

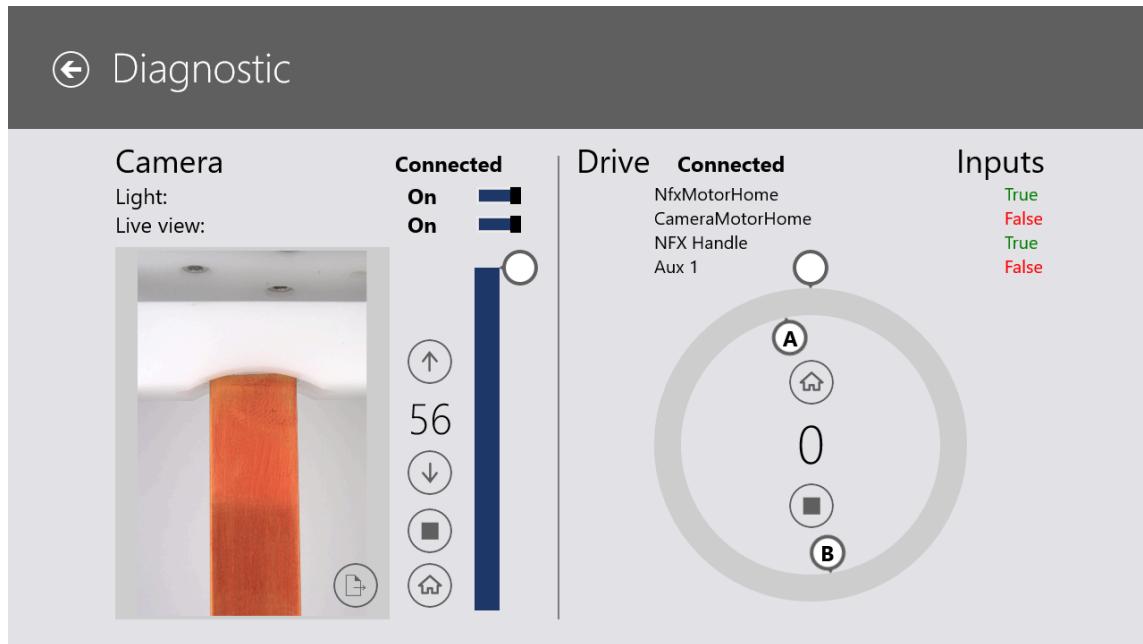
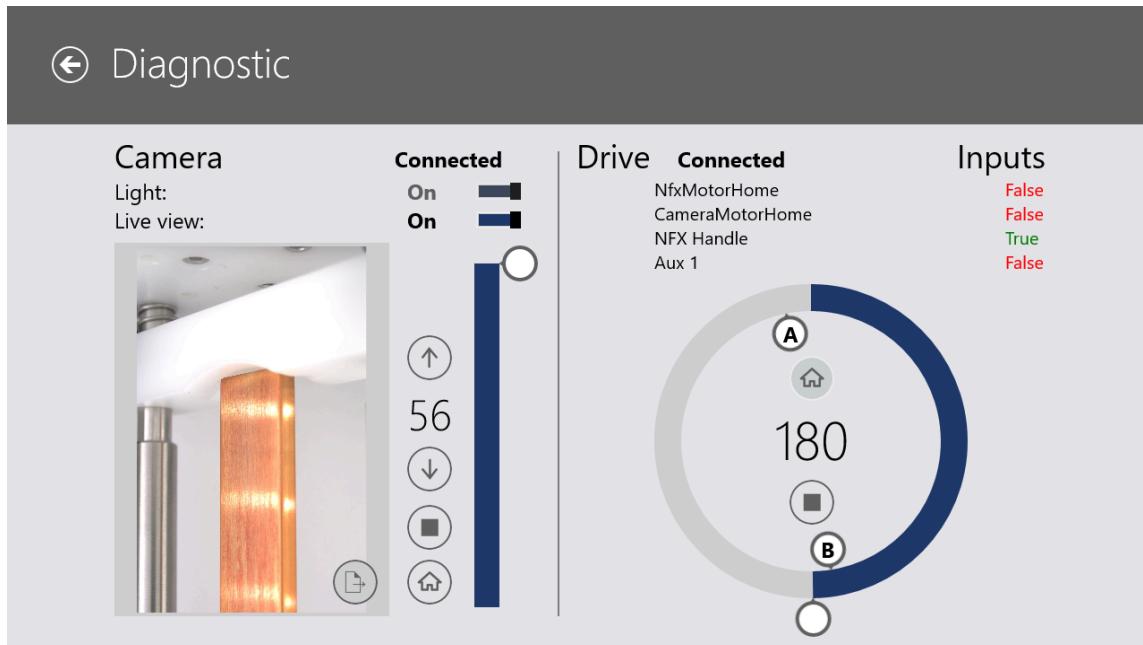


5.5.2. Drive

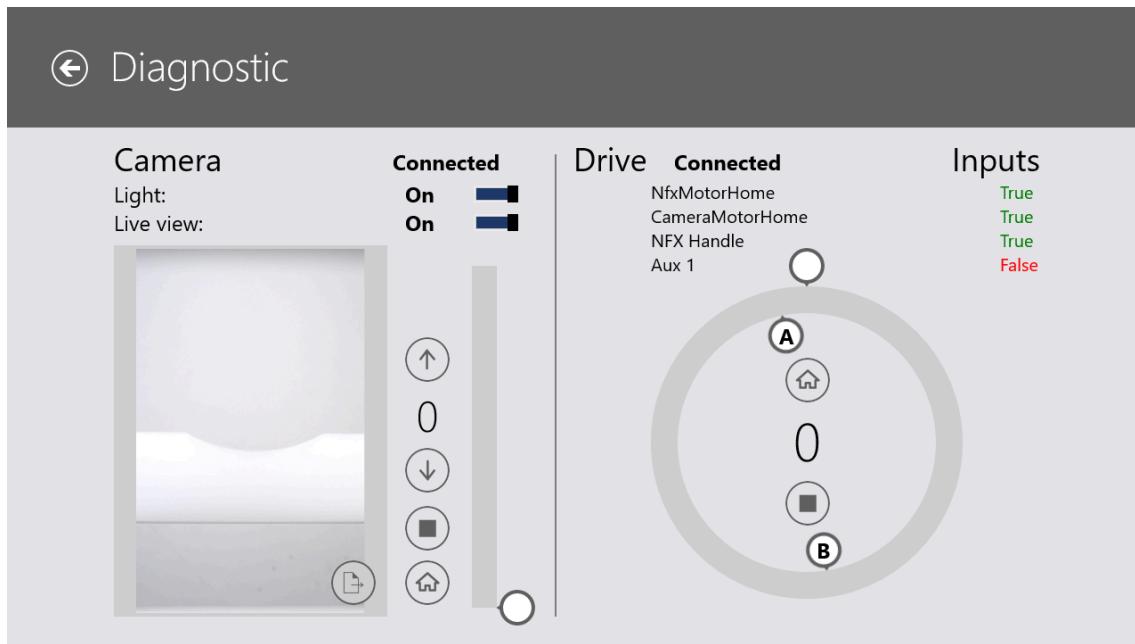
The Drive section displays the current status of the drive. Any faults are detected by this status indication. Under all normal operating conditions, the message will display “Connected.”

The Drive controller also functions as the indicator and controller of the CuDDI’s Inputs & Outputs (IO). This screen was designed to allow the operator or technician to easily view the status of the various IOs.

The Drive section also has the ability to move the CuDDI's two stepper motors manually. The camera motor controls the scanning motor of the camera. The NFX motor controls the NFX handle, which operates the positions of the specimen. This control ensures the copper strip is always in the correct and optimal position for proper analysis of the unknown samples. Manual operation of these drives can be achieved using the controls, as labeled in the image below.

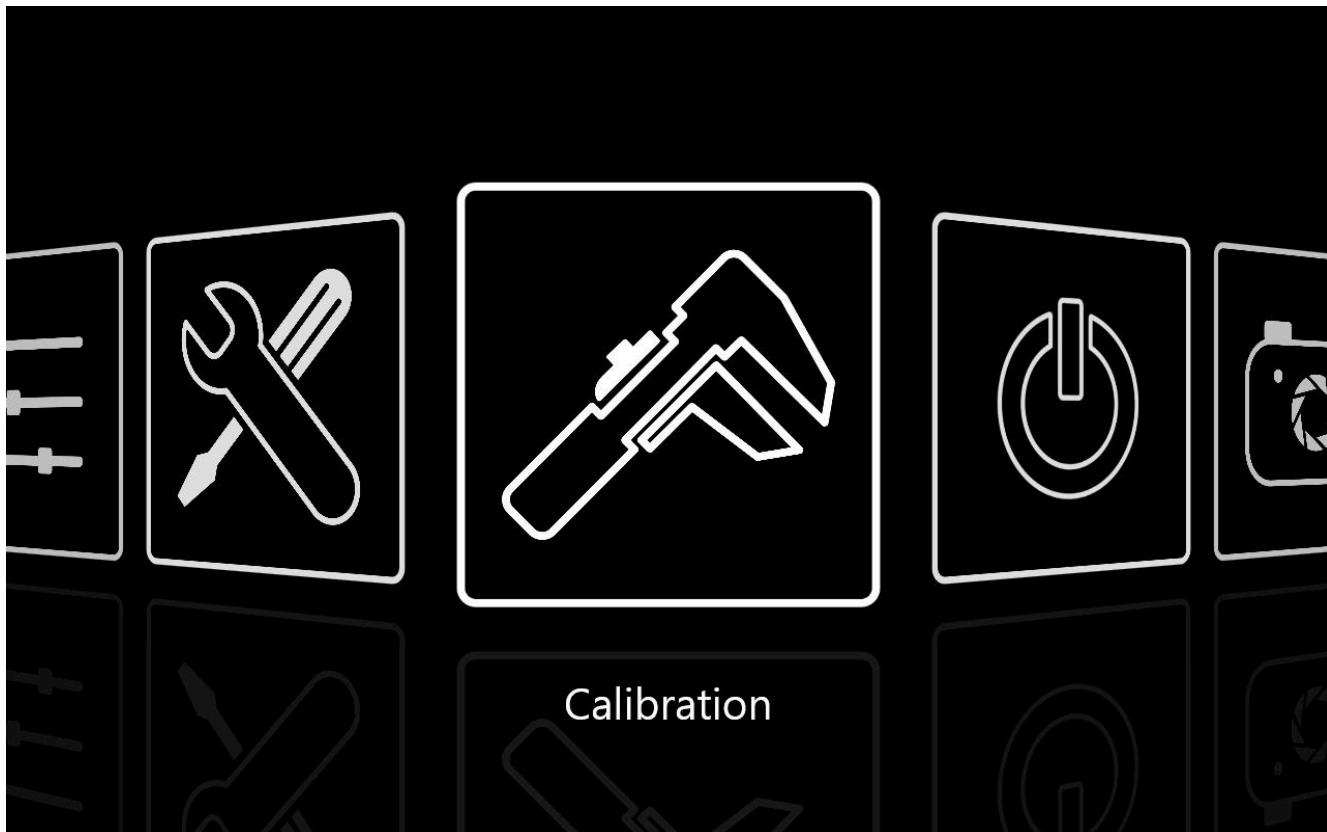


The inputs section describes the home of each piece of the equipment. Aux 1 should say **False** at all times. The remaining inputs should all display **True** when their counterparts are *home*.

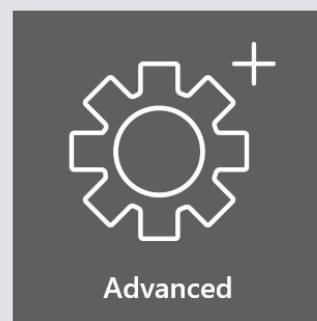


5.6. Calibration

The Calibration menu allows users to verify that the CuDDI calibration is operationally functional. Calibration and verification of the CuDDI is easily achieved via the Calibration screen of the software equipped with the supplied calibration standard. Using an intelligent automated 2-step process, the software automatically determines if calibration is required after a quick verification.



_calibration

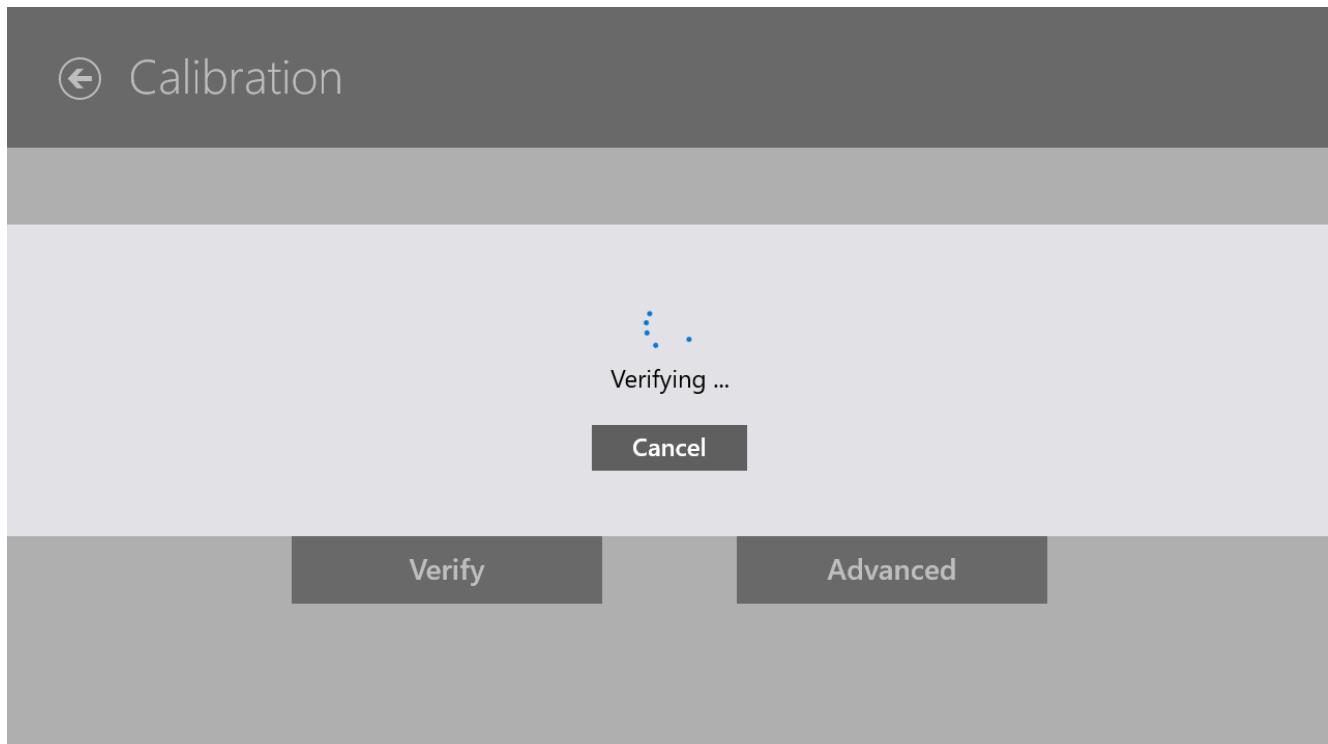


5.6.1. Verification

Calibration is performed in three steps:

Insert the CuDDI calibration strip into the NFX Handle. The software will automatically determine the white versus black side of the strip.

Click Verify to start a sequence of system checks and calibrated set-points. This process can be executed at any given frequency (once per day) to verify the CuDDI is working properly.



Once Verify is performed, the new calibration set-points can be applied by pressing the “Calibrate” button. If any of the points fail, the option to calibrate will be disabled.

Running a Verify Calibration sequence is the preferred step towards diagnosing rating errors. This will typically identify any failures, such as a dirty camera lens or a damaged NFX Handle.

Discard the calibration result to continue without calibrating the CuDDI.

Calibration

Passed

PASSED Light Intensity 254.0 level 0-255
 PASSED Exposure Time Correction 0.0006 (sec.)
 PASSED Camera Transform 0.0000 (deg.)
 PASSED Scan Offset 188.0 (pixel rows)
 PASSED Camera Position X: 609, Y: 1915
 PASSED Pixel Scale 0.0266 mm per pixel(X)
 PASSED Pixel Scale 0.0278 mm per pixel(Y)
 PASSED Pixel Scale 0.0289 mm per pixel(Surface X)
 PASSED Pixel Scale 0.0289 mm per pixel(Surface Y)
 PASSED Camera Motor Scale 0.0017 mm per pulse

Calibrate

Discard

5.6.2. Calibration Failures

Running a Verify Calibration sequence is the preferred step towards diagnosing rating errors. This will typically identify any electrical or mechanical failures. Below is a list of checkpoints and their typical causes:

TEST	PERFORMED	FAILURES
LIGHT INTENSITY & EXPOSURE TIME CORRECTION	The light intensity is measured on the center of the white colored side of the strip	<ul style="list-style-type: none"> • LED lights are not functioning • The camera lens or the light box is not clean • The calibration strip is not clean
PIXEL SCALE	Pixel scale is determined by measuring the overall height and width of the black colored side of the strip, and the small black dot located on the white side.	<ul style="list-style-type: none"> • The calibration strip is not loaded correctly • Calibration strip is out of spec • The Camera Lens is out of focus

CAMERA TRANSFORM	Camera transform is determined by the black dot's location relative to the camera, while the camera is moving vertically.	<ul style="list-style-type: none"> Mechanical misalignment (<i>internal</i>) of the vertical camera axis or the camera's mount.
CAMERA SCAN OFFSET	Camera scan offset is determined by the black dot's location relative to the camera, while the camera is moving vertically.	<ul style="list-style-type: none"> The camera's length of travel is not correct and could be the result of a worn bushing or lead screw. Consult the factory about a replacement of the "Z" Drive.
CAMERA POSITION	Camera location is determined by identifying the X and Y locations of the strip using the black colored side of the strip	<ul style="list-style-type: none"> The calibration strip is not loaded correctly Mechanical misalignment (<i>internal</i>)
NFX MOTOR SCALE	The NFX Motor is calibrated by rotating a complete 360 degrees	<ul style="list-style-type: none"> NFX Handle is not loaded correctly NFX Handle is not making good electrical contact
CAMERA MOTOR SCALE	The camera motor is calibrated by viewing certain features on the black colored side of the calibration strip	<ul style="list-style-type: none"> The calibration strip is not loaded correctly Calibration strip is out of spec The camera lens is out of focus Mechanical misalignment (<i>internal</i>)

Contact VISAYA Service if any of the calibration points persistently fail.

5.6.3. Advanced Calibration

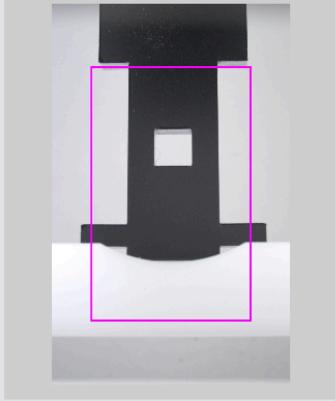
The Advanced Calibration page can be used to further diagnose calibration failures. This page provides real-time feedback on camera focus and light intensity. Please consult with the factory for more information about this screen.

⟲ Advanced

Camera

Status: **Connected**

Light: **On** 



Intensity **0** Failed to read Intensity

Focus **72 %** Valid Range is > 80%.

  **Mid** **Lower** **A** **B**

Last Calibration: **7/22/2025 9:57:37 AM**

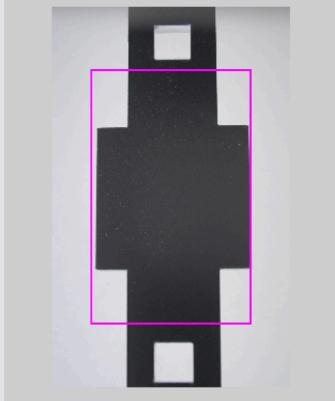
Restore Calibration Defaults

⟲ Advanced

Camera

Status: **Connected**

Light: **On** 



Intensity **0** Failed to read Intensity

Focus **63 %** Valid Range is > 80%.

  **Mid** **Lower** **A** **B**

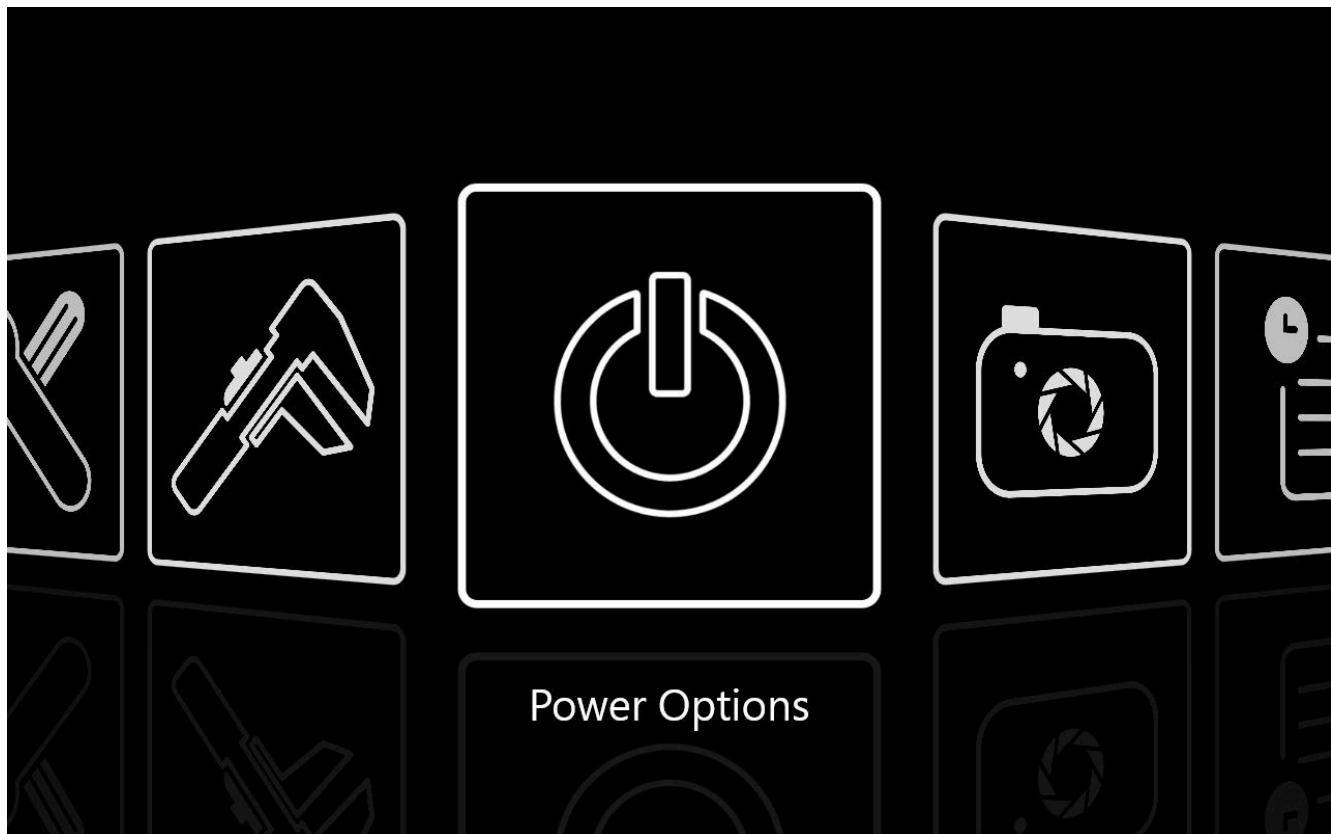
Last Calibration: **7/22/2025 9:57:37 AM**

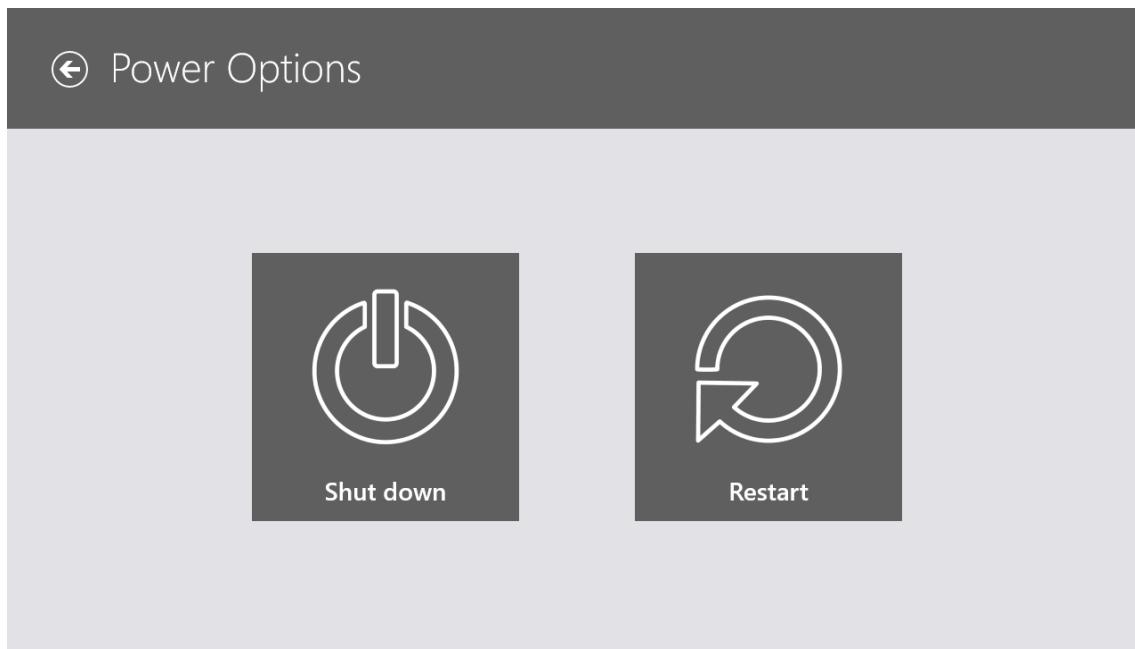
Restore Calibration Defaults

It is currently advised that for calibration failures, please reference the Calibration Troubleshooting (Section 6) and the Service Section (8) for remedy.

5.7. Power Options

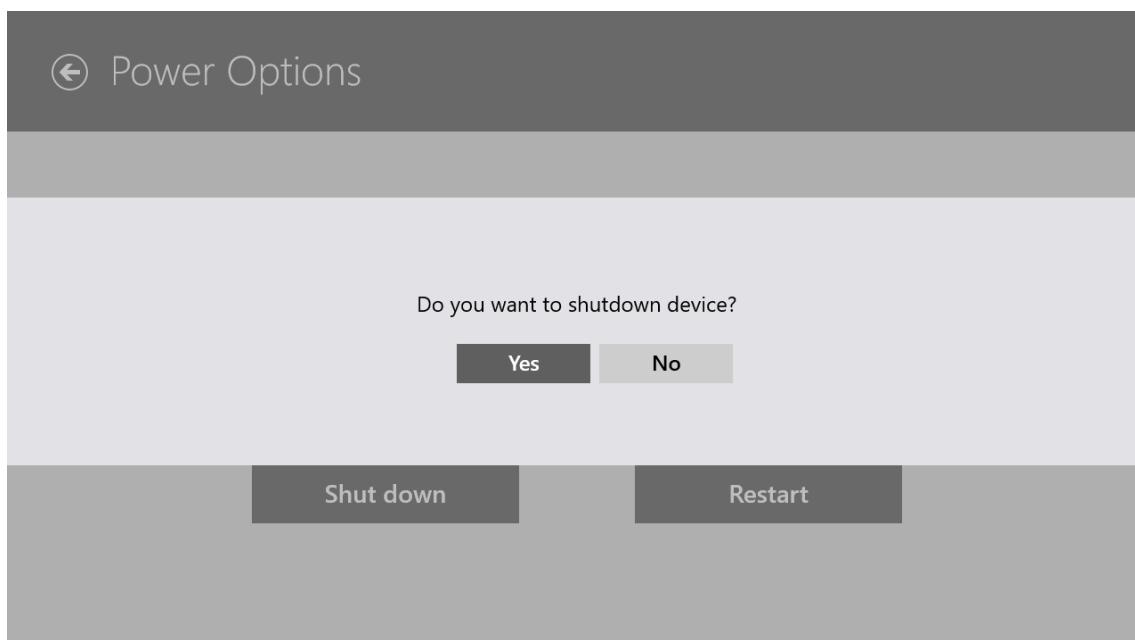
The Power Options menu allows users to restart or shut off the CuDDI via the Main Screen. The CuDDI can be easily powered down and restarted using the Power Options screen. Due to an embedded OS controlling the CuDDI, it is important that the CuDDI is properly shut down and restarted.





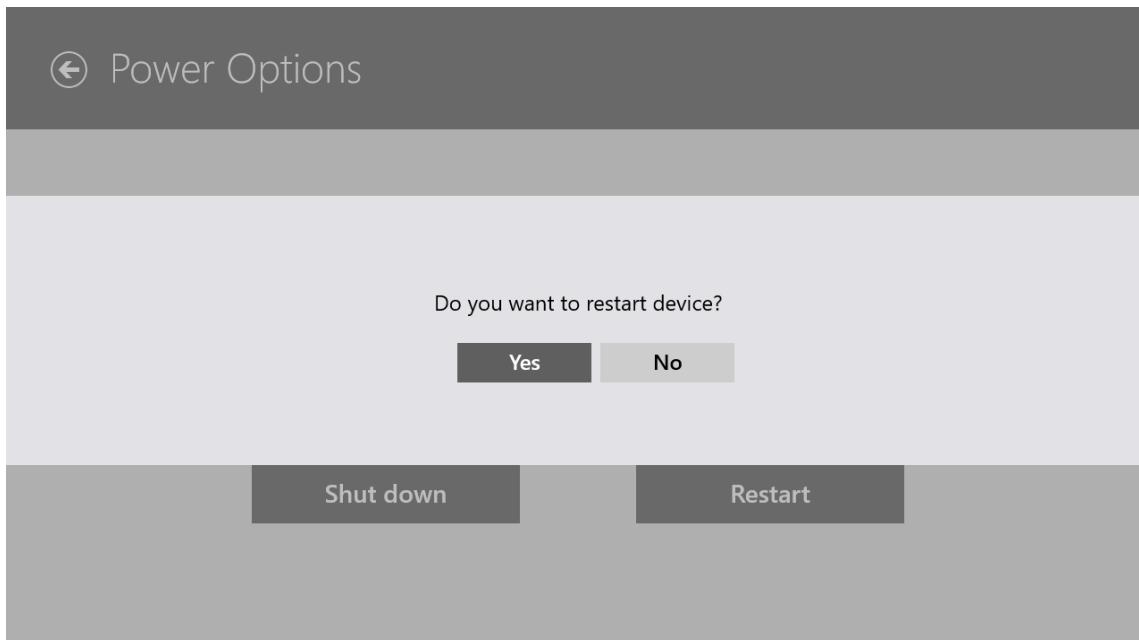
5.7.1. Shut Down

To shut down the CuDDI, press the Shut Down button. You will be alerted with a screen to confirm you would like to shut down the unit. Press the OK button to proceed. This process takes approximately 10 seconds to complete. The rear Power button can now safely be used to completely turn off the unit. To restart the CuDDI, press the Power Reset button on the front panel



5.7.2. Restart

To restart the OS and software, simply press the Restart button. You will be prompted to confirm a restart. Press OK to proceed. This will restart the CuDDI software.



6. Troubleshooting

Issues may occur that may or may not necessarily lead to errors. Answers/options to remedy potential cases are given below.

6.1. Error Messages

Section	Error Message	Correction
Calibration	The Camera Motor failed to go home	Check for a physical obstruction by using the vertical slider to manually move the camera motor up and down. Listen for smooth motor sounds and visually confirm smooth travel in Live View. Investigate for any mechanical misalignment or blockages. If that does not work, check for a misaligned homing flag by Move the Camera Motor to a middle position, then press "Home" in Diagnostics. The camera should lower

		and stop automatically. If the stop flag is misaligned, the motor may overtravel and cause abnormal noise. Check Section 8.2.5.
Calibration	Canceled	No action necessary
Calibration	Failed to acquire an Image	Contact VISAYA Service
Calibration	Failed to calibrate the Camera Motor	Contact VISAYA Service
Calibration	The motor failed to calibrate	Contact VISAYA Service
Calibration	Failed Camera Motor Scale {0} mm per pulse Valid range is {1} to {2}	Contact VISAYA Service
Calibration	Failed Camera Position X: {0}, Y: {1} Valid range is X:{2} to {3}, Y: {4} to {5}	Contact VISAYA Service
Calibration	Failed to identify dark vs light side of the calibration strip	Contact VISAYA Service
Calibration	Failed Light Intensity {0} level 0-255 Valid range is {1} to {2}	Contact VISAYA Service
Calibration	Failed to locate the calibration strip due to an unknown error	Contact VISAYA Service
Calibration	Failed Motor Calibration {0} deg per pulse Valid range is {1} to {2}	Contact VISAYA Service
Calibration	Failed Pixel Scale {0} mm per pixel Valid range is {1} to {2}	Contact VISAYA Service
Calibration	Failed to scan	Ensure the strip is correctly positioned and the NFX handle is correctly aligned, then attempt a scan again
Calibration	Failed to Verify Light Intensity due to an unknown error	Contact VISAYA Service
Calibration	Failed White Balance R:{0}, G:{1}, B:{2} Valid range R:{3} to	Contact VISAYA Service

	{4}, G:{5} to {6}, B:{7} to {8}	
Calibration	The motor failed to go to position	Contact VISAYA Service
Calibration	The handle is either not present, or may not be properly seated	Contact VISAYA Service
Calibration	The NFX Motor failed to go home	Contact VISAYA Service
Calibration	Calibration is already running	No action necessary
Calibration	Verification is already running.	No action necessary
Diag Scan	Canceled	No action necessary
Diagnostics	Failed to start recording	Contact VISAYA Service
Diagnostics	Camera not found	Contact VISAYA Service
Diagnostics	The camera's snapshot is unavailable	Contact VISAYA Service
Email	Failed to create an attachment with a PDF document	Contact VISAYA Service
Email	Failed to send email	Contact VISAYA Service
GeneralError	An error has occurred. Contact your system administrator.	Contact VISAYA Service
NetDrive	Access is denied	Contact VISAYA Service
NetDrive	The local device name is already in use	Contact VISAYA Service
NetDrive	The network name cannot be found	Contact VISAYA Service
NetDrive	The network path was not found	Contact VISAYA Service
NetDrive	The specified username is invalid	Contact VISAYA Service
NetDrive	The device is in use by an active process and cannot be disconnected.	Contact VISAYA Service
NetDrive	Fail to get access to a network resource	Contact VISAYA Service
NetDrive	Fail to mount a network drive	Contact VISAYA Service

NetDrive	Fail to retrieve a list of mounted network drives	Contact VISAYA Service
NetDrive	Fail to unmount a network drive	Contact VISAYA Service
NetDrive	The specified network password is not correct	Contact VISAYA Service
NetDrive	The username or password is incorrect The network path was either typed incorrectly, does not exist, or the network provider is not currently available. Please try retyping the path or contact your network administrator.	Contact VISAYA Service
NetDrive	The network is not present or not started	Contact VISAYA Service
Printer	Print operation is timed out	Contact VISAYA Service
Printer	Fail to set the default printer	Contact VISAYA Service
Printer	The printer is not installed	Contact VISAYA Service
Settings Date/Time	All date format strings must be non-empty	Contact VISAYA Service
Settings Email	E-mail address is invalid	Contact VISAYA Service
Settings Email	Port number is invalid	Contact VISAYA Service
Settings Email	Address, host, login, and password must be non-empty strings	Contact VISAYA Service
Settings Language	Unknown language	Contact VISAYA Service
Settings Lims	Baud rate must be set	Contact VISAYA Service
Settings Lims	The data bit must be set	Contact VISAYA Service
Settings Lims	The stop bit must be set	Contact VISAYA Service
Settings Lims	Server and share must be non-empty strings	Contact VISAYA Service

Settings Lims	Folder location must be a non-empty string	Contact VISAYA Service
Settings Operators	Operator's name cannot be empty	Contact VISAYA Service
Settings Operators	Operator with the same name already exists	Contact VISAYA Service
Settings Storage	Directory not found	Contact VISAYA Service
Settings Storage	You do not have access to write to this directory	Contact VISAYA Service
Settings Storage	Drive letter and network path must be non-empty strings	Contact VISAYA Service
Settings Storage	Path must be a non-empty string	Contact VISAYA Service
Test	Camera Motor failed to go home	Contact VISAYA Service
Test	Checking NFX Handle	Contact VISAYA Service
Test	Failed to analyze	Ensure the strip is correctly positioned and the NFX handle is correctly aligned, then attempt a scan again
Test	Failed to scan	Ensure the strip is correctly positioned and the NFX handle is correctly aligned, then attempt a scan again
Test	NFX is not present.	The NFX handle is not properly inserted into the optical bench. Correctly place the NFX handle and start an analysis. Check and clean the electrical contacts between the handle and socket.
Test	NFX Motor failed to go home.	Contact VISAYA Service
Test	NFX Motor failed to go to the position.	Contact VISAYA Service
Test	Test canceled	No action necessary
Test	Test failed.	Ensure the strip is correctly positioned and the NFX handle is correctly aligned, then attempt a scan again
Test	Test failed: {0}	Ensure the strip is correctly positioned and the NFX handle is correctly aligned, then attempt a scan again
Test	Canceled	No action necessary
Test	Error	Contact VISAYA Service
Test	Failed to locate the sample	Ensure a strip is loaded. If so, check to see if the image is blurry through the

		advanced calibration screen (Section 5.6.3). Check if the LEDs are fully illuminating using the Diagnostic screen.
Test	There is no test to report progress	Contact VISAYA Service
Test	The test is already running	No action necessary
Test Results Screen	Export target is not supported	Contact VISAYA Service
Test Results Screen	You must load test data to change its rating	Contact VISAYA Service
Test Results Screen	Access to the directory '{0}' is denied	Contact VISAYA Service
Test Results Screen	Could not find test data	Contact VISAYA Service
Test Results Screen	Test's save directory not found	Contact VISAYA Service
Test Results Screen	Test's save directory is not specified	Contact VISAYA Service

6.2. Issue Effect Lookup

Symptoms caused by failure modes which may not be categorized to a single alarm message or error.

6.2.1. Test is Not Saved

What this means:

Results are only saved at the end of a test cycle. Mid-test interruptions cause data loss.

What to check:

Power Loss While Testing

→ Restore power and rerun the test.

6.2.2. Touch Screen Problems

What this means:

The CuDDI relies on a proper ground connection to discharge static buildup.

What to check:

No Ground Connection

- Ensure the electrical outlet is properly grounded. Static buildup can cause false touchscreen inputs.

Operating Temperature is too cold

- Move the CuDDI to a warmer environment.

 *Note: Touchscreens tend to be among the first components to malfunction when cold.*

6.2.3. The Unit Will Not Turn On

What this means:

The CuDDI uses an external AC/DC power adapter.

What to check:

No Power During System Startup

- Check the power connection from the outlet to the rear of CuDDI. The external power supply should display a blue LED when powered.

Voltage is too Low

- Correct the input voltage.

Voltage is too High

- Correct the voltage and inspect for power supply damage.

No Power

- Inspect the external power supply for proper function (blue LED).

Rear Toggle Switch is Off

- Turn the switch to ON.

When powered, the lower LED will pulsate if the module is not yet connected.

6.2.4. Calibration is Not Saved

What this means:

At the end of self-calibration, the result is presented to the user. Only when the user presses "Calibrate" is the result actually saved.

What to check:

Power Loss During Calibration

→ Restore power and repeat the calibration.

6.2.5. Display Will Not Turn On

What this means:

The SBC (Single Board Computer with Display) is powered through the internal power board.

What to check:

No Power

→ Investigate the internal power connection.

7. Maintenance

The CuDDI requires little maintenance, but a quality inspection for the instrument should be performed regularly. The self-verification feature allows any operator to perform this check on a daily basis.

Cleanliness is important and likely going to require attention. This frequency will be dependent on how well samples are prepared BEFORE entering the instrument.

Alignment will be maintained after the instrument is set in place, but over time may require some of the adjustment procedures explained in this section. Moving the instrument (ie, shipping) may also trigger the need to make an adjustment.

7.1. Schedule

Self-Verification (Section 5.6.1)

Load the calibration piece and use the Calibration Screen to “Verify” the instrument. Unless an “admin” password exists, the user can apply the new calibration – or simply verify all parameters have passed.

1-7 Days

Clean (Section 7.3)

Inspect the Lightbox and NFX Handle for dirt and debris

Daily

Re-Alignment (Section 8.2.3, 4, & 5)

Camera Alignment Horizontal, Vertical, and Angle

1 year

Lubricate (Section 8.2.1)

Lubricate the Camera Actuator

3-5 years

7.2. Self Verification

Run a verification procedure found in section 5.6.1 to ensure proper operation and functionality of the optics and computing systems.

7.3. Cleaning

The CuDDI requires limited cleaning due to the nature of the test, but general cleaning maintenance is recommended.

7.3.1. Exterior

The exterior enclosure of the instrument can be cleaned using a mild detergent and a non-abrasive cloth. Do not use any detergent on the touchscreen surface.

7.3.2. Touchscreen

Use a soft, lint-free cloth (either dry or dampened with water or eyeglass cleaner or a screen cleaning wipe) to gently wipe the screen. Do not use glass or other chemical cleaners on the touchscreen surface.

7.3.3. NFX Handle

After some use, it may be necessary to clean the end blocks on the NFX handle. Using a mild detergent, carefully clean the blocks using a non-abrasive cloth. Pat dry with a clean cloth when completed. Do not immerse the handle in liquids.

Do not lubricate the shafts of springs. The NFX Handle is engineered in a way as not to require the need for lubrication.

Use “contact cleaner” or reagent-grade isopropyl alcohol to clean the electrical contacts on the NFX Handle and the NFX Bulkhead Receptacle on the instrument.

7.3.4. Lightbox

Only if necessary, the reflector panels can be spot cleaned using a long swath. The material used for the reflector panels is chemically resistant to most common cleaning solutions, including ammonia, 409, soap solutions; not compatible with bleach or caustic. Do not attempt to replace this film without consulting the factory, since this film is special for camera & lighting color balancing.

7.3.5. Camera Lens

Only if necessary, the camera lens can be cleaned using the following tools and procedure.

Before wiping the lens to remove a smudge or fingerprint, remove any dust using a blower or a lens cleaning brush. Avoid using compressed air.

Smudges and/or fingerprints can be cleaned using a lens cleaning tissue or cotton swab. If necessary, use reagent-grade isopropyl alcohol or de-ionized water. When wiping, apply only enough pressure to remove the smudge.

7.4. Alignment

The camera alignment is used to center the sample in the camera's FOV (Field of View). Go to sections 8.2.3, 8.2.4, and 8.2.5 for more information.

7.5. Lubrication

Lubricate the actuator's ball screw. Go to section 8.2.1 for more information.

7.6. NFX Handle Functionality Inspection

The NFX Handle can be inspected for proper functionality:

Springs and shaft: The quantity 4 springs should be present and strong enough to center the sample inside the carrier. No spring-loaded end block should bind while moving up/down and move freely with the spring. When a sample is inserted, they should tightly grab and secure the sample.

Angle: When viewing the adapter sideways, the adapter should sit 90° from the handle.

Spring-loaded end block: The two end blocks that retain the sample should be free of scratches and contamination. These areas are used during the inspection to help register the sample location and size. Marks or dirt on these features may confuse the instrument and result in an “Unable to locate the sample” error.

If either of these qualities is not maintained, the NFX Handle may be damaged and need replacement.

7.7. Preventive Maintenance Checklist

This Preventive Maintenance (PM) Checklist summarizes all listed recovery procedures from the error list (Section 6.1 & 2). Each item reflects a small, regular task — like cleaning, inspection, or replacement that can prevent larger system failures.

PM Checks:

- Inspect and clean NFX Handle electrical contacts.
- Verify proper insertion of NFX Handle (white dot forward).
- Confirm smooth movement of Camera Motor (no obstruction).
- Check the alignment and operation of the Camera Homing Flag.
- Adjust camera focus using Calibration > Advanced if the image is blurry.
- Ensure both left and right LEDs illuminate fully.
- Clean LED lightbox and viewing windows.
- Verify NFX Handle spins freely with ~1mm gap (no friction).
- Inspect and clean NFX Handle socket contacts.
- Inspect and replace internal fixture flags if damaged.
- Confirm external power supply (blue LED ON).
- Check outlet grounding (static discharge prevention).

8. Service

ATTN: Please review the Safety (1.1) and Warranty (1.2) sections of this document before attempting to perform any of the service procedures described in this manual.

8.1. Internal Components

This section explains how to properly open and close the instrument and identify internal components by using the Removable Side Panels. The instrument is designed to function properly without the side panels in place.

8.1.1. Access

To Remove the Side Panels:

Locate and remove the four retaining screws holding both side panels in place.

Gently pull the panels straight out.



Note: You can remove either side or both — no internal linkages tie them together.



To Restore the Side Panels:

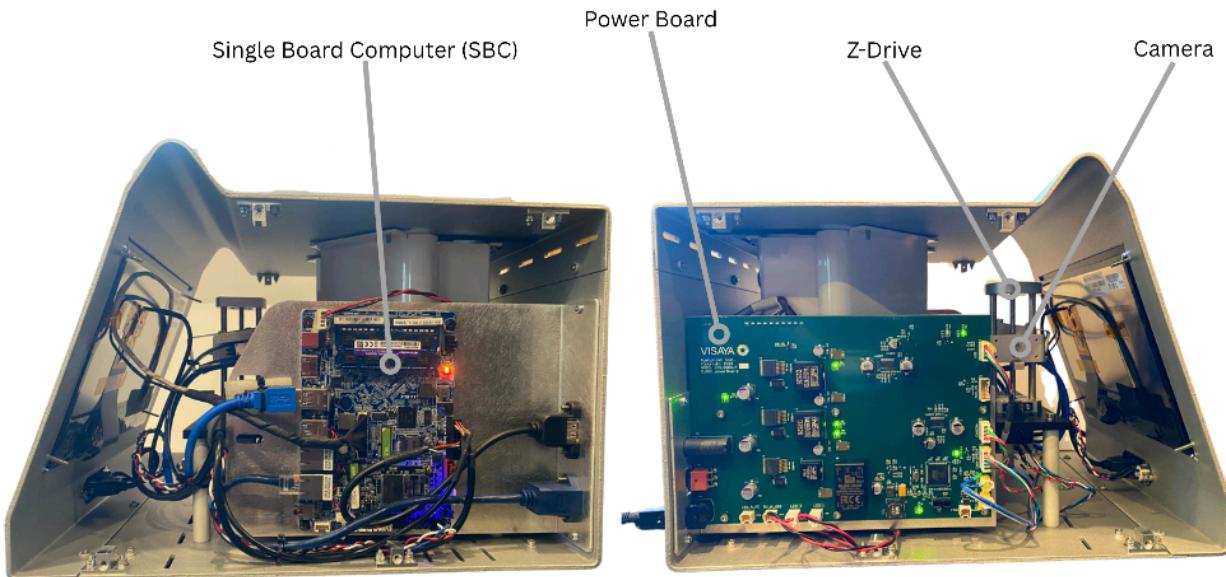
Lay the unit completely on its side so the mounting holes for the panel you're installing face upward.

Align the side panel with the chassis. You'll feel a small lip on the edge of the panel — when correctly positioned, the panel will notch into place.



8.1.2. Identification

The CuDDI with the chassis removed can be seen below with important information regarding internal components.



8.2. Camera

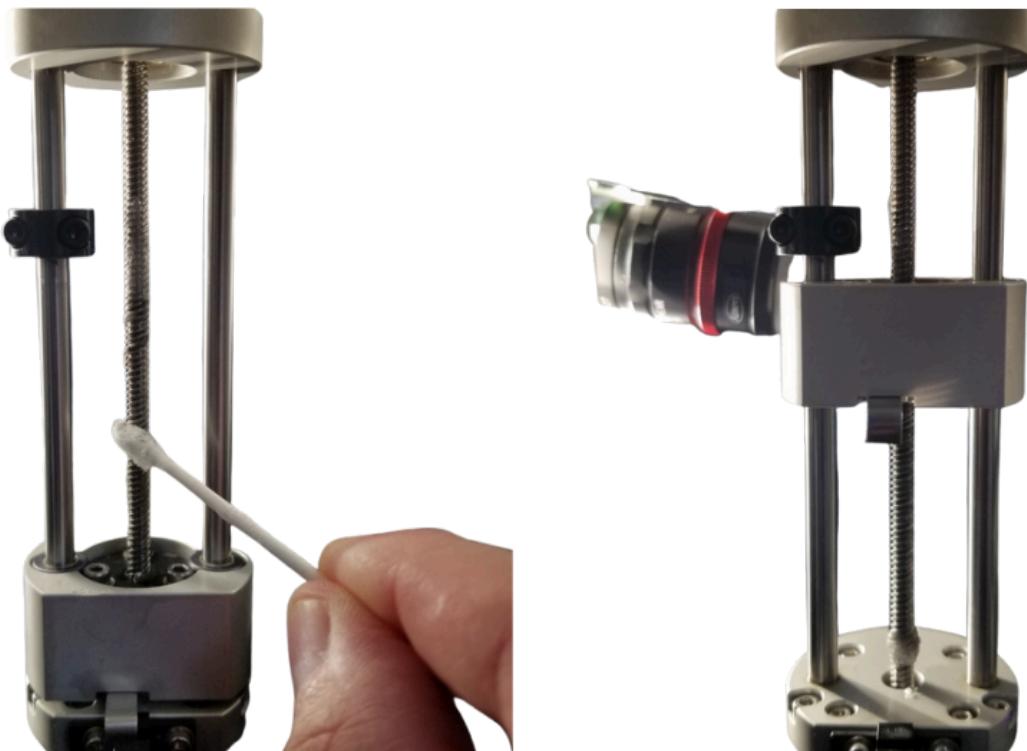
To keep the camera in good condition, general service instructions can be found below. Servicing the camera is critical in this optical system to ensure consistent and accurate

results. Before servicing the camera, check the lens and surrounding areas for dirt and residue to rule out general contamination of the optical system.

8.2.1. Lubricate Actuator

Lubricate the actuator's ball screw by applying a small amount of grease across the threads along the middle section of the screw where the camera would travel across. A moderately soft grease (NLGI Grade 2) is recommended.

Do not lubricate the two outside shafts, since these shafts use a greaseless bearing.

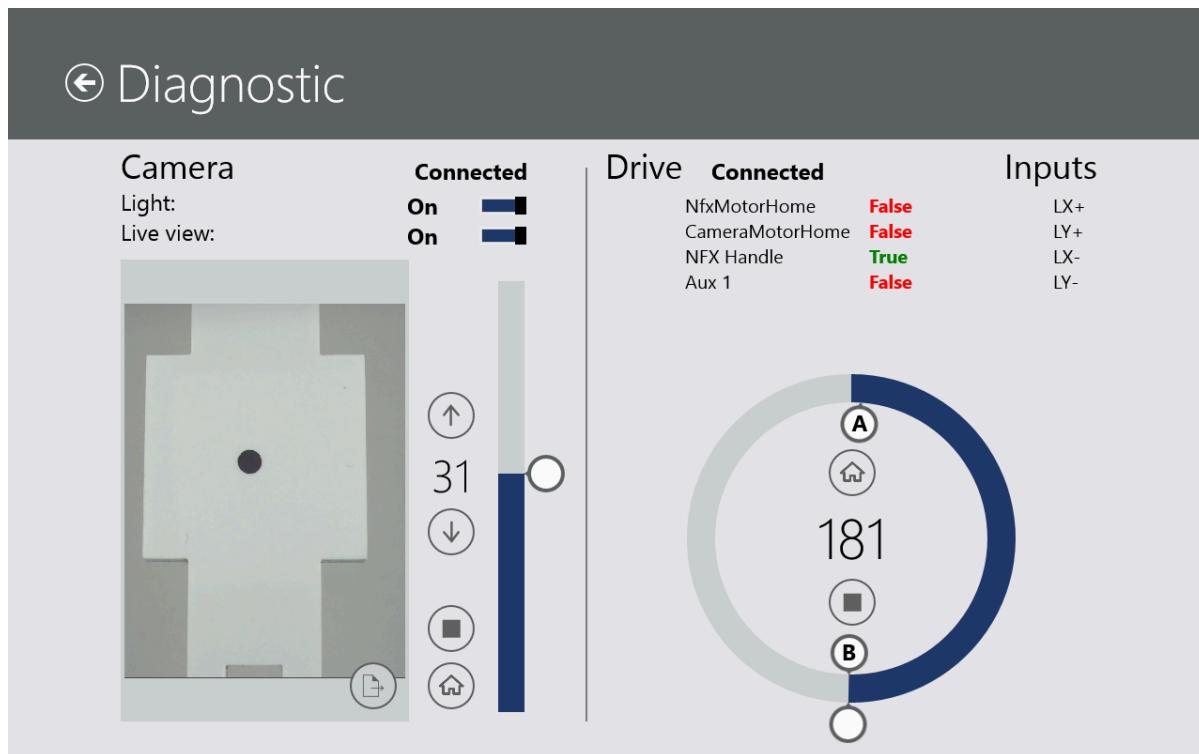


8.2.2. Focus

Load the Calibration Piece to both focus and align the camera.

The camera focus is adjusted manually and uses the calibration strip's black dot as the target surface.

Using the diagnostics screen, position the camera in the middle of its stroke.



Continue to use the screen control and orient the calibration strip such that the dot is in the center of the camera's view.

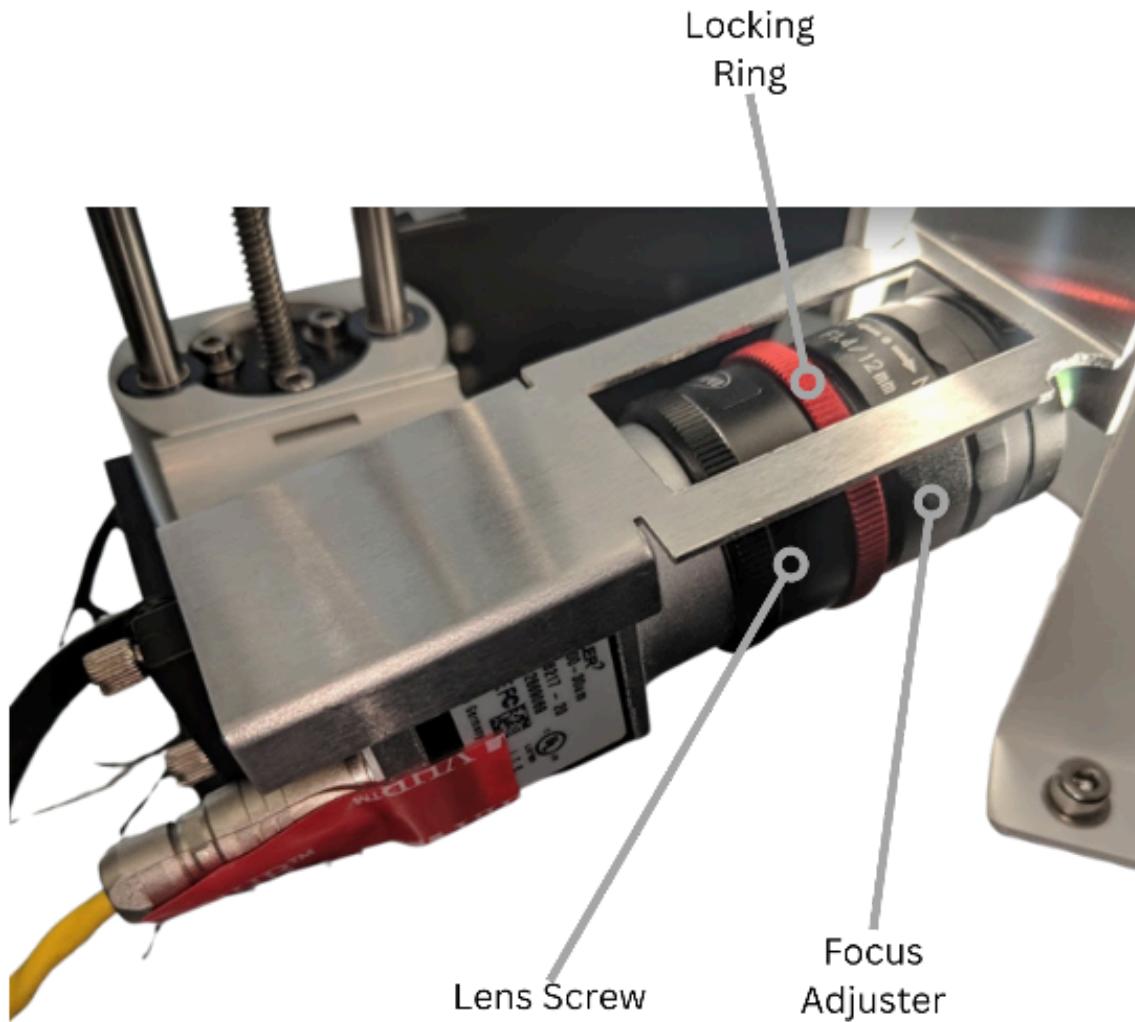
Reaching inside the instrument, locate the lens mounted to the front of the camera. Now, locate the locking ring – and gently loosen it. The ring is a locking nut used to hold the focus in place.



Note: The locking ring can be either RED or BLACK. It will be RED on older cameras and BLACK on newer cameras.

Once loosened, the whole front of the lens can rotate in/out to adjust the focus. Monitor the live feedback on the diagnostics screen while rotating the lens in/out.

Once the focus is complete, carefully rotate the RED colored ring until it stops against the part of the lens that is closest to the camera. The focus is now locked.



Note: Do not adjust the lens screw unless you intend to remove the lens from the camera.

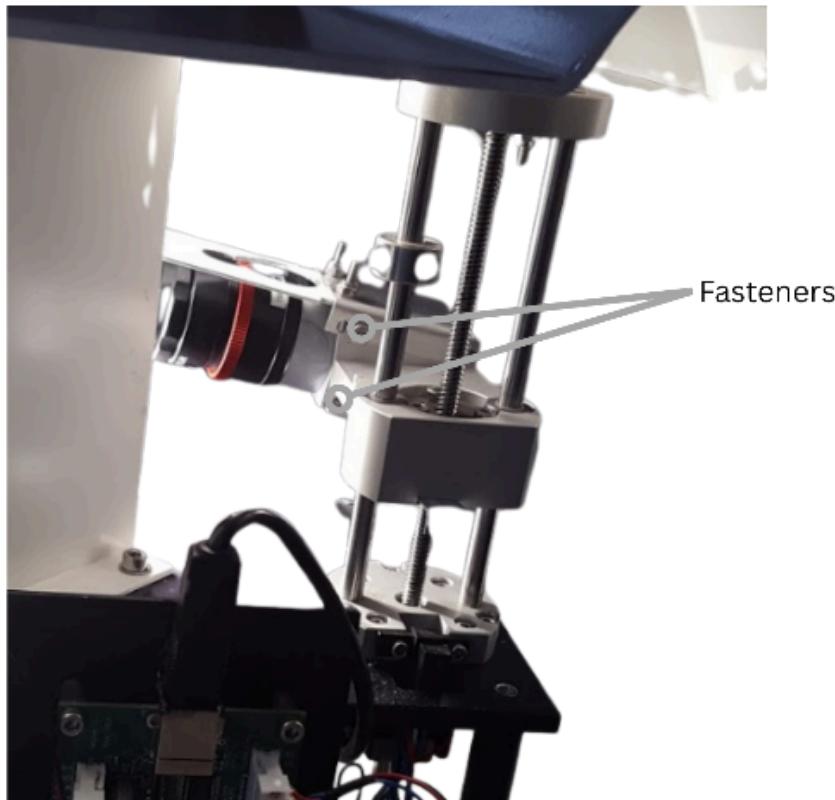
8.2.3. Vertical Alignment

Load the Calibration Piece to both focus and align the camera.

The camera is mounted at an +11 degrees towards the sample and is defined using the bottom edge of the camera bracket. There is no target on the strip that is used for tuning the camera angle, only the bottom of the bracket. The vertical location of the camera relative to the sample can be tuned using the Home Sensor (see Camera Vertical “Home Sensor” Adjustment).

Locate the two fasteners that hold the camera in place.

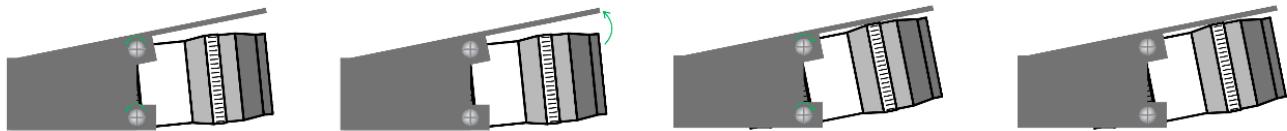
Slightly loosen the two fasteners so that the camera position is adjustable. DO NOT REMOVE THE FASTENERS.



With your right hand controlling the camera location, gently twist the camera upward until it stops. With your left hand, carefully tighten the two fasteners.



Add Loctite compound to each screw (one at a time) if accessible.



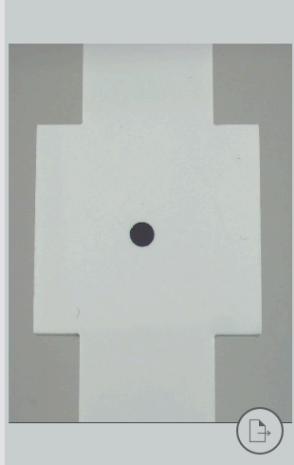
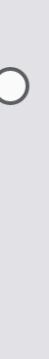
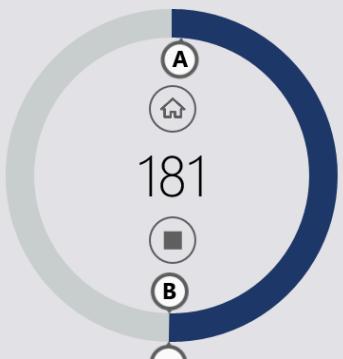
8.2.4. Horizontal Alignment

Load the Calibration Piece to both focus and align the camera.

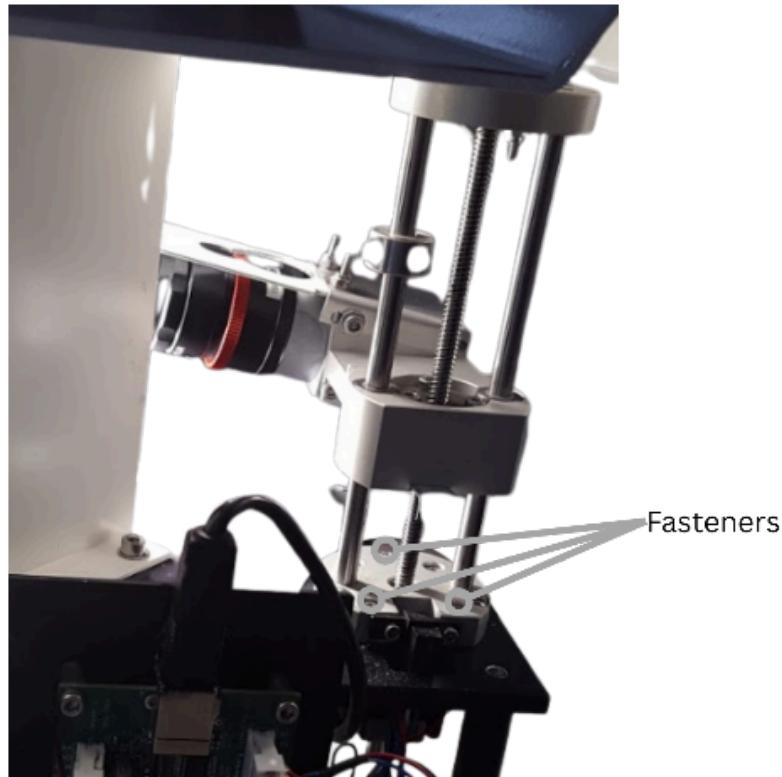
The camera's horizontal alignment is used to center the sample from left to right in the camera's FOV (Field of View).

Using the diagnostics screen, position the camera in the middle location.

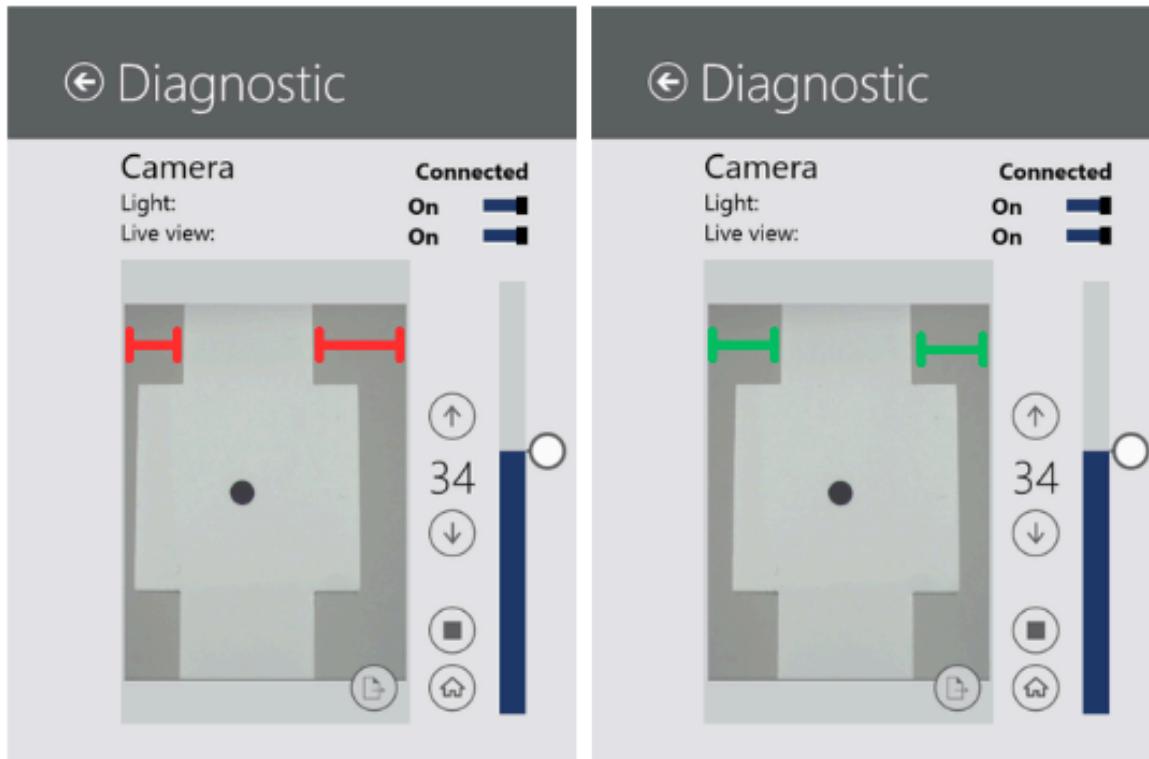
Diagnostic

Camera	Connected	Drive	Connected	Inputs
Light: On	On	NfxMotorHome CameraMotorHome NFX Handle Aux 1	False False True False	LX+ LY+ LX- LY-
Live view: 				

Locate the three fasteners that hold the camera actuator at its bottom base.



Loosen each fastener such that the entire camera and actuator assembly can rotate left and right. Using the live view in diagnostics – aim the camera such that the calibration strip is in the center of the camera's Field of View.

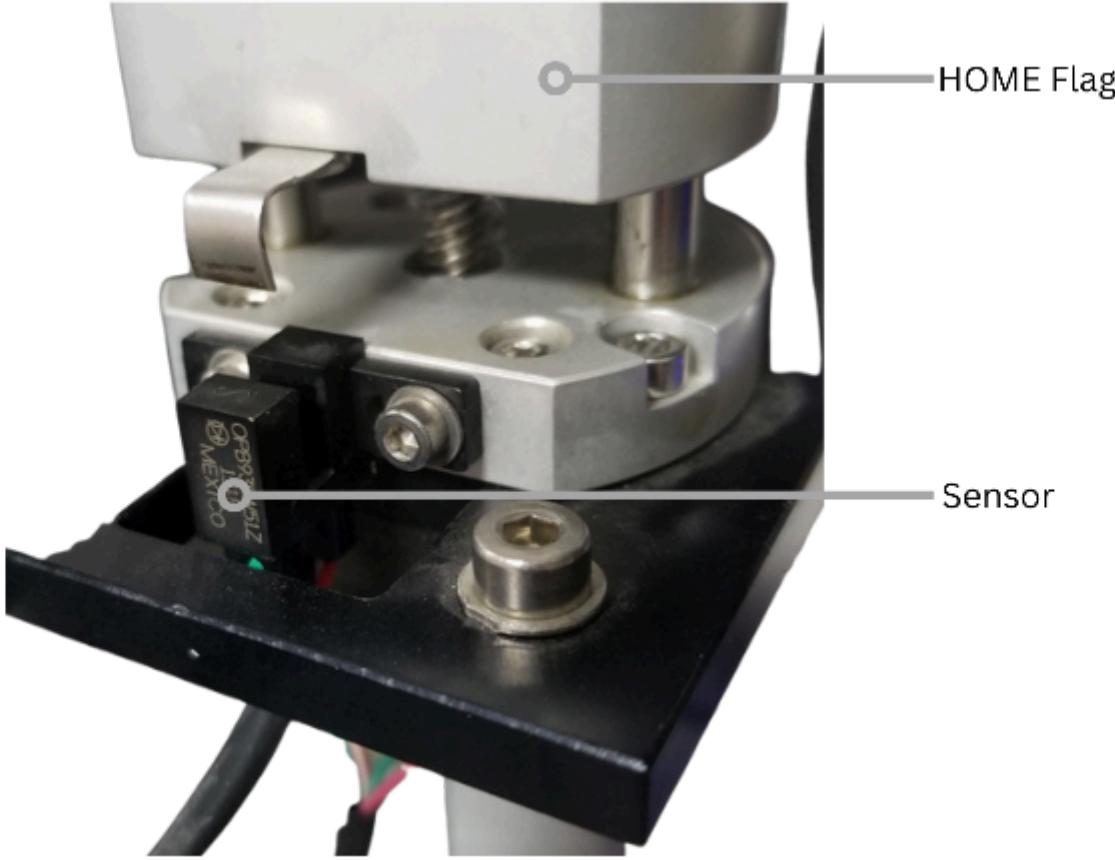


Tighten the three screws at the bottom base of the actuator.

8.2.5. Vertical Stop Adjustment

The camera will travel ~55mm from the bottom location to the top. This entire 55mm stroke should be centered vertically along the sample to ensure the entire part is imaged correctly. When in the bottom location, the bottom of the sample must be visible PLUS extra space below. When in the top location, the top of the sample must be visible PLUS extra space above.

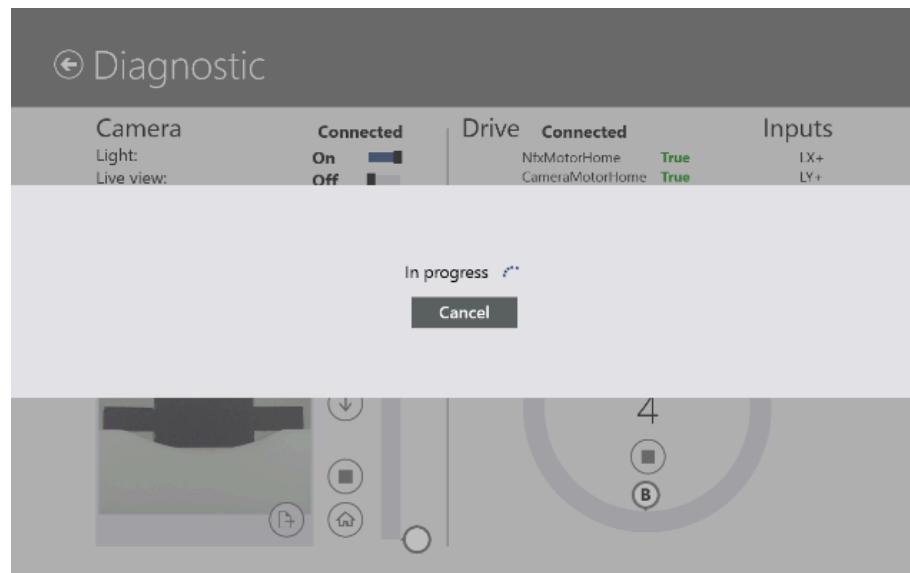
The bottom location (aka HOME location) is defined by a physical sensor and flag:



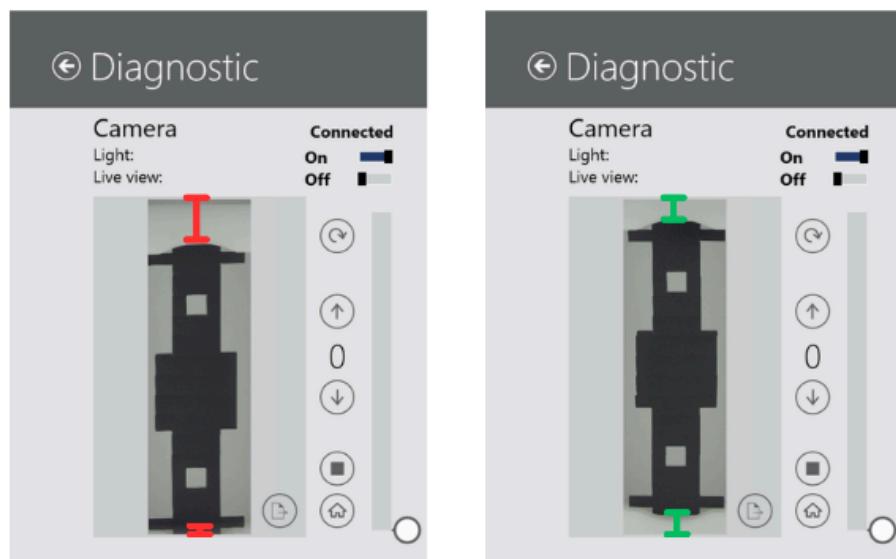
During the Camera Homing Routine, the actuator will lower the camera slowly until the flag triggers the HOME sensor. The location of this sensor & flag is set at the factory during production. But, in the event a component was replaced, realignment may be necessary. The flag may be adjusted using a file to shorten, or pliers to bend and lengthen.

- Making the flag longer = will move the entire 55mm stroke used for the scan up.
- Making the flag shorter = will move the entire 55mm stroke used for the scan down.

Using the diagnostics screen, disable the Live view and press the Scan button:



Review the results:



To make an adjustment, you can raise the camera off the bottom location using the up/down slider on the diagnostics screen. Then, repeat the scan and verify the new location.

8.3. NFX Handle

The NFX handle is designed to be easy to use and handle.



8.3.1. Adjustments

The only adjustment on the NFX Handle is the adapter connection to the handle. A 1mm gap should be maintained between the handle and adapter, and is held using a set-screw. The set-screw is accessible via a small notch on the adapter.



9. Version Updates

For both software updates and updates to documentation, please visit the VISAYA update center: <https://visayaengineering.github.io/cuddi/>

9.1. Software Updates

New software updates are supplied when reasonably necessary for same-generation CuDDIs free of charge by VISAYA.

To acquire the new software update for your analyzer, perform the following steps:

 Navigate to the VISAYA update center via the link above.

 Go to the CuDDI tab

 Download the updated software in the Downloads section onto a USB drive

 Update Only: CuDDI software — the option customers will need 95% of the time to update their CuDDI

 Full Installer: Includes driver/camera/etc. software

To update your analyzer, perform the following steps:

 Plug in the USB drive containing the updated software.

 In the Visaya software go to Settings → About, then click Exit Application.

 Log into VISAYA Admin using password visaya.

 Run the appropriate *.exe installer and follow the prompts (defaults are fine).

 In Windows go to Start → Power → Restart to reboot the LogicBox.

 After reboot, verify version in Settings → About.

To verify successful installation of the new software, navigate to the About screen (Section 5.4.1) and check the current version.



Note: It is highly recommended to perform a backup or download the result archive before the update is installed.

9.2. Updates to the Manual

New versions of the manual are updated when deemed necessary. VISAYA will not distribute new versions of the manual unless directly asked by the customer.

In order to see if there is a new version of the manual available, navigate to the VISAYA update center via the link above, and check the document version for the manual available for download under the Documents section.