



CuDDI™

Copper Digital Detection Imaging

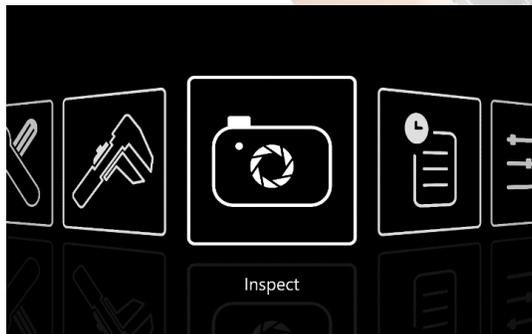


Copper strip testing is a critical indicator of sulphur compounds present after the petroleum refining process. The Copper Digital Detection Imaging (CuDDI) is a new standard of copper quality analysis for the petro industry using a high-resolution camera with optical intelligence. CuDDI identifies exact levels of corrosivity present from petroleum through a 4-step automated vision algorithm and classification process. Results are then digitally recorded and seamlessly integrate with LIMS software.

CuDDI's higher precision, patent pending 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 in a matter of seconds. This standardized measurement of copper quality improves on current rating, method and sample handling procedures performed in current lab tests.

Benefits Over Current Methods

CuDDI's improvements over current test rating output and analysis include:

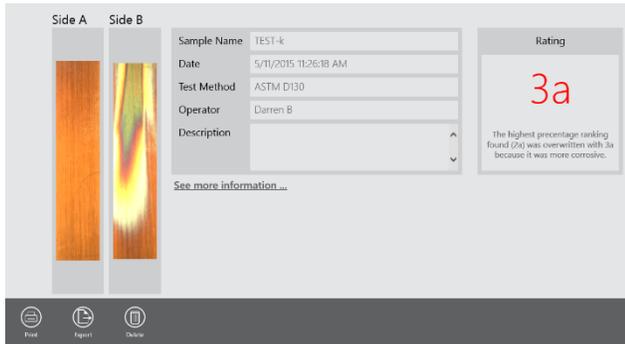


- Easy-to-Use touchscreen driven software
- 1-2-3 Wizard operation
- Easy-to-load NFX Holder
- High repeatability
- USB, HDMI, Ethernet for enhanced connectivity
- Digital image logging complete with operator notes and calculated results for easy sharing of findings
- Integrated industrial computer for easy interface with network

The CuDDI Method

CuDDI's improvements over current test procedures and end results include:

- Elimination of inherent bias with manual rating
- Voltage and current controlled light box for consistent ambient light environment
- Automatic detection of copper strip size
- Long-lasting LED light source
- Auto rotation of strip for recording of both sides



CuDDI uses a highly stable and electronically controlled LED light source, which is stabilized at ~7,000 K and diffused at a 45 degree angle to simulate the “daylight” effect referenced in current methods. This light source method creates a more consistent environment via standardized simulation.

A sample strip is inserted into the patent pending Holder/Loader (NFX Handle™), which allows for single-hand loading of the test specimen. NFX Handle is inserted into CuDDI, and Inspect button is

selected on the touchscreen. Operator selects Sample Name → Test Method → Operator, then enters an optional description or comments, and presses the RUN button.

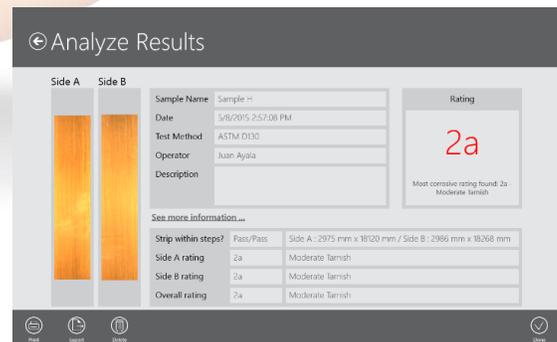
Using visual software detection methods, CuDDI first determines the locations of Side A & Side B of the given test specimen. NFX Handle is then rotated using a high-precision stepper motor to Side A, and various images are collected. NFX Handle is then rotated 180 degrees, where a second set of images is collected. CuDDI’s patent pending algorithm next determines the size and angle of the strip on which to perform its analysis. Algorithm next determines the optimal images to use, which is passed on to the next step of the analysis. Using a predetermined pixel x pixel size (quadrant), the algorithm scans and classifies the color for each quadrant. These colors are tabulated and converted to a percentage based on the size of the strip. The percentage of colors is then used in the final step of the process to classify and determine a highly repeatable Color Rating. In addition to the rating, CuDDI will also alert the operator in occurrences when the strip becomes too small for testing, when the angle is incorrect, and when there are additional data important to the rating.

Result Handling and Reporting

In addition to the improved methodology, CuDDI offers an enhanced alternative to the handling of data and reporting functions necessary in today’s laboratory instruments.

On the standard report, CuDDI displays the following:

- Sample identifiers
- Size of strip
- Rating of both Sides A & B
- Overall rating
- Messages and alerts related to rating
- Images of both sides
- Zoom-able images for closer inspection
- Ability to override automated results



CuDDI digitally stores results in a non-volatile memory. Results include detailed data and images. All data (including images) can be seamlessly transferred to a LIMS system in a variety of formats and methods. CuDDI’s LIMS integration supports .csv, .txt, xml, and PDF files as live streaming data strings, with available support for virtually every LIMS system.



Sample id 67583521-001
Date Tuesday, June 2, 2015, 6:24:23 AM
Test method ASTM D130
Operator John Smith

4a
Most corrosive rating found: 4a - Corrosion

Side A	4a Corrosion	Side B	4a Corrosion
0	0% Freshly Polished	0	0% Freshly Polished
1a	0% Slight Tarnish	1a	0% Slight Tarnish
1b	0% Slight Tarnish	1b	4% Slight Tarnish
2a	23% Moderate Tarnish	2a	53% Moderate Tarnish
2b	1% Moderate Tarnish	2b	1% Moderate Tarnish
2c	0% Moderate Tarnish	2c	0% Moderate Tarnish
2d	7% Moderate Tarnish	2d	3% Moderate Tarnish
2e	0% Moderate Tarnish	2e	0% Moderate Tarnish
3a	1% Dark Tarnish	3a	1% Dark Tarnish
3b	8% Dark Tarnish	3b	3% Dark Tarnish
4a	55% Corrosion	4a	32% Corrosion
4b	0% Corrosion	4b	0% Corrosion
4c	0% Corrosion	4c	0% Corrosion

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At the touch of a button, results can also be shared via PDF, USB, email, LIMS, print and on-screen.

The example on the left is the print function, which can be set to print either automatically or on demand.

The enhanced sharing methods allow results to be emailed with images in a PDF file for instant sharing. This feature allows operators to send stakeholders or laboratory managers any questionable ratings to be analyzed by a more experienced operator.

CuDDI is capable of writing data to an external USB memory stick or drive. Due to its integrated industrial computer running a specialized version of Windows 8.1, CuDDI is able to write data to a network drive or shared for enhanced security and integrity of data.

Improved Sample Handling:

Using the NFX Handle technology, CuDDI's improved sample handling and error mitigation include the following features:

- Enables single-hand loading via copper strip slide holder – NFX Handle
- Eliminates fingerprints and unwanted markings on strips
- Slide holder doubles in functionality as tool for manual verification
- Prompts operator when strip shrinks to unusable size
- Provides auto recognition of Sides A & B



CuDDI's patent pending NFX Handle provides a standardized method for holding the test specimen at the ideal angle and direction for analyses. CuDDI's loading and fastening mechanism eliminates the use of fragile and costly glassware for viewing. The holder also doubles as a manual holder for comparing against the standard ASTM D130 Adjunct Color Chart.

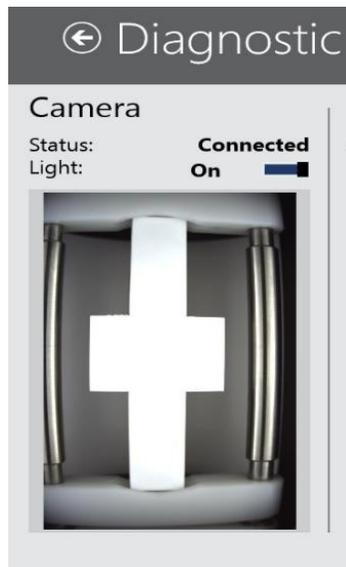
A unique feature of the NFX Handle is the integration of the stepper motor and electronics responsible for proper positioning of Sides A & B. By having the motor integrated into the NFX Handle, essentially all critical moving parts are placed in an easy to replace assembly for quick and easy serviceability.

Proper handling of the sample is critical to an accurate rating both manually and by using the CuDDI technique.



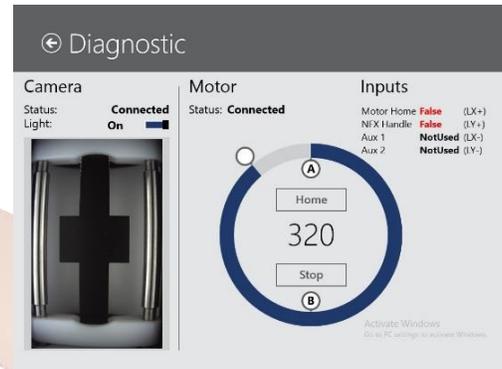
Calibration and Validation

The CuDDI method also includes a special calibration standard, which can be used in the field for periodic verification and calibration of the color and algorithm, thereby ensuring a QC procedure necessary for accredited laboratories.



The calibration standard is precision CNC machined and has both white and black calibration sides. The calibration standard is also machined with a large square in the center. The standard is used together with the NFX Handle and runs through a special verification sequence via CuDDI's software. Using this specially built verification process, an operator can quickly verify the white and black balance of the camera which standardizes the colors, and together with the center square, can verify the measurement or scale reported by the algorithm. CuDDI's software will automatically determine if calibrations are within specifications and prompt the operator when it is time to calibrate, using the same calibration standard.

The quick and easy calibration standard, ensures CuDDI is reporting at the optimal levels.



CuDDI is the first high-tech optical powered device under Analytical's suite of visual testing instruments powered by sophisticated optics, VISAYA, and improves on the visual rating of method ASTM D130 and method ASTM D1838.

Full specs and options are available at www.analytical.com.

About Analytical Instruments and VISAYA

Analytical supplies equipment that accurately tests the quality of fuels, biofuels, biodiesel and lubricants in refineries, pipelines and laboratories worldwide, fully backed by an expert technical service and support team. Analytical's instruments adhere to standard industry test methods such as ASTM, with options that meet the needs of facilities all over the globe. VISAYA houses Analytical's new line of testing equipment powered by sophisticated optics for ensured precision.