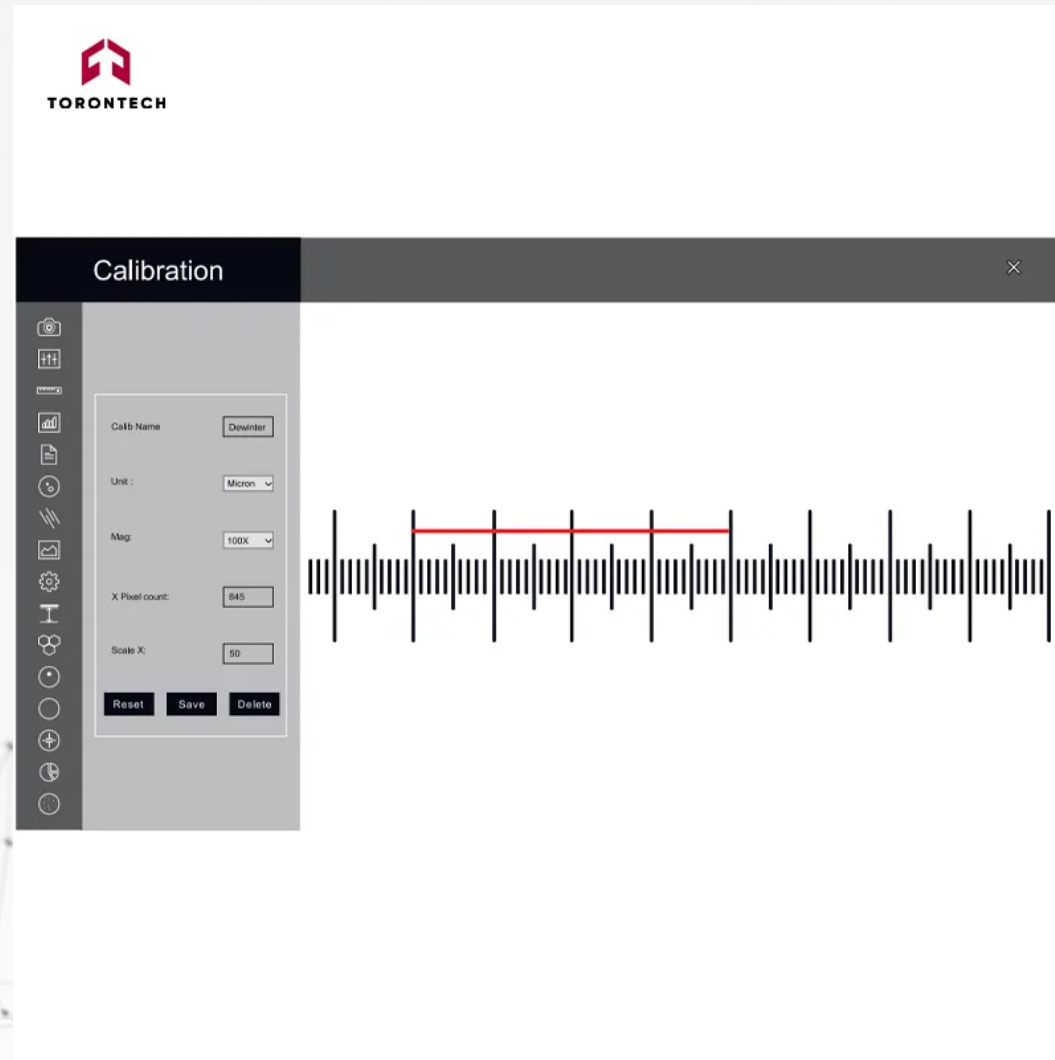




CAST IRON IMAGE ANALYSIS SOFTWARE - TORONF+™

Cast Iron Image Analysis Software - ToronF+™ is a touchscreen-based solution designed specifically for the cast iron industry. It provides a complete set of tools for analyzing graphite structures in cast iron.

APPLICATIONS

Cast Iron Image Analysis Software ToronF+™ identifies nodules, flake size, classification, and count (ranging from 1 to 8) in accordance with ASTM, JIS, and ISO standards. It also includes customizable templates for detailed reporting.

1. Reports can be generated based on ASTM A247-67 or ISO 945-1 standards.
2. Nodules touching the boundary of the field are excluded from analysis.
3. Particles smaller than 10 microns are not considered in the analysis.
4. Nodules are distinguished from non-nodules using predefined spheroidicity criteria.
5. The shape of nodules/flakes (categorized by Roman numerals I to VI) and their size (1 to 8) are reported.
6. Type I graphite flakes are classified by distribution pattern (A to E) and orientation.
7. Pearlite percentage is calculated after excluding graphite areas.
8. The etched sample analysis identifies the presence of pearlite, ferrite, graphite, and carbide.
9. Reports are created based on the international standard selected by the user.
10. The F% value is provided according to the JIS method.

Cast Iron Image Analysis Software ToronF+™

Major Modules of Cast Iron Image Analysis Software ToronF+™

CAMERA

This module allows users to select different display and capture resolutions. Settings such as white balance, brightness,

contrast, hue, and saturation can be adjusted in real time. Once configured, images can be captured and saved in designated folders for detailed analysis.

CALIBRATION

Calibration must be performed for each microscope objective where the digital camera is mounted. This process should only be completed once all hardware components are securely in place. If any part is adjusted or replaced, calibration must be repeated.

MEASUREMENT

This module enables measurements through manually drawn lines, traced shapes, or outlined objects. Data can be logged directly into the results worksheet and then saved, printed, or exported to a spreadsheet for additional analysis or statistical evaluation.

CARBIDE

Iron carbide (cementite) is an intermetallic compound formed from iron and carbon. While commonly found in steels and cast iron, it is also produced as a raw material in iron carbide processing—part of alternative ironmaking technologies.

SG IRON

Spheroidal Graphite (SG) Iron, also known as ductile iron or nodular cast iron, contains graphite nodules formed during solidification. This module analyzes such samples according to ASTM A247-67 and ISO 945-1 standards.

GRAY IRON

Gray iron, a type of cast iron with a graphitic microstructure, is analyzed in this module following ASTM A247-67 and ISO 945-1 guidelines.

SETTINGS

This module is used to configure the software during initial setup. Options include selecting ISO or ASTM standards, customizing report formats, and defining printed image parameters. Once configured, a single click initiates the full analysis process. Settings remain saved unless manually updated—routine changes are not required.

REPORT DATA

All analysis reports are saved in a dedicated folder and can be accessed at any time.

GALLERY

Captured images are organized into four folders for easy reference:

1. Nodularity
2. Flake
3. Carbide
4. Line Measurement

THEORY & METHOD

Camera

You can select different display and capture sizes, and adjust live image settings such as white balance, brightness, contrast, hue, and saturation. Once all settings are configured, the image can be captured and saved to the appropriate folder for analysis.

Cast Iron Image Analysis Software ToronF+™

Calibration

Calibration should be carried out for all microscope objectives where the digital camera is mounted. It should only be done after all hardware components are securely installed. If any part is adjusted or replaced, calibration must be repeated.

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Measurement

The Measurement module allows users to take measurements by manually drawing lines, tracing shapes, or outlining objects. These measurements can be logged into the results worksheet, then saved to a file, printed, or exported to a spreadsheet for further analysis or statistical review.

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Ductile Iron/Nodularity

Ductile iron—also referred to as ductile cast iron, nodular cast iron, spheroidal graphite iron, or SG iron—is a type of graphite-rich cast iron. The Cast Iron Image Analysis Software ToronF+™ uses advanced image processing techniques such as global thresholding, boundary detection, and artificial neural networks to analyze SG iron samples.

Nodules that touch image boundaries and artifacts smaller than 10 microns are excluded from the analysis. Nodules are distinguished from non-nodules based on predefined spheroidicity values.

The software calculates key quality parameters, including:

1. Nodule count
2. Nodule size (categorized by Arabic numerals 1 to 8)
3. Nodule form (classified by Roman numerals I to VI)

All measurements are performed with a single button click.

In the next step, etched samples are analyzed. Once complete, the software automatically determines the percentages of graphite and pearlite. Data from both non-etched and etched samples is directly recorded in the results spreadsheet within

the software.

Reports containing all relevant data and corresponding images are generated instantly with one click.

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Ductile Iron/Nodularity

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Gray Iron/Graphite Flakes

Gray Iron, also known as gray cast iron, contains graphite flakes that form during the cooling process. It gets its name from the gray color of its fractured surface, which results from the presence of graphite.

Cast Iron Image Analysis Software ToronF+™ measures the graphite flake length in gray iron. Shorter Type A flakes are associated with higher strength and improved ductility. The software uses a fully automated, one-click process to quantitatively analyze graphite length in metallographic samples.

Graphite sizes are classified into eight categories (1 to 8) based on ASTM A247-67 or ISO 945-1 standards. The software also identifies graphite flake types—A, B, C, D, and E—based on their orientation in the microstructure.

The percentage of pearlite is calculated by excluding the graphite area, and the matrix composition—including pearlite, ferrite, and graphite—is reported for etched samples.

Reports are generated in accordance with the international standard selected by the user.

Cast Iron Image Analysis Software ToronF+™

Cast Iron Image Analysis Software ToronF+™

Carbide Banding

Iron carbide, also known as cementite, is an intermetallic compound formed from iron and carbon. While commonly found in most steels and cast iron, it can also be produced as a raw material through the iron carbide process—an alternative method within the family of modern ironmaking technologies.

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Settings

The Settings module is designed to configure various parameters during the initial software setup. Options include selecting ISO or ASTM standard calibration, customizing report formats, and defining parameters for printed images in reports. Once configured, a single button click initiates the full analysis process.

All settings are saved and remain active until manually changed. Routine adjustments are not required.

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Clicking the Settings icon opens a new user interface that allows you to configure key software options and streamline your workflow. By selecting the appropriate radio buttons, you can minimize the chance of errors and enable one-click operation.

1. Report Type

Choose the desired reporting format—ASTM or ISO. The selected format will be saved as the default until manually changed.

2. Default Workflow Mode

You can select how you'd like to work:

1. Live Image Mode – Analyze directly from the live camera feed.
2. Captured Image Mode – Capture and store all images first, then analyze them later.

3. Select Calibration

Choose from available calibration profiles stored in the system. Cast iron analysis is typically performed at 100X magnification.

4. Set 100 Micron Scale Line

Choose whether to display a scale bar and additional visual markers on the image:

1. Show Boundary – Displays contours around graphite particles.
2. Show Number – Displays individual graphite counts directly on the image.

5. Set Gallery Path

The gallery path is set by default but can be modified as needed to change where captured images are stored.

6. SG Iron Display Options

Configure how nodules are displayed in SG Iron analysis. Various options are available to show different parameters. If no option is selected, contour outlines will appear by default.

7. Aspect Ratio

This setting is usually fixed. Only modify it if necessary for specific image requirements.

8. Report Templates

Two report layout options are available:

1. With Chemical & Physical Properties – Includes composition and analysis data.
2. Without Chemical & Physical Properties – Focuses only on image analysis results.

Reporting Data

This module provides a report preview, allowing users to review the report before printing or if a printed copy is not required.

Cast Iron Image Analysis Software ToronF+™

Gallery

Captured images are organized into four folders for easy viewing:

1. Nodularity
2. Flake
3. Carbide
4. Line Measurement

Cast Iron Image Analysis Software ToronF+™

Report

1. Flakes appearing in cast iron as Type I are reported based on their distribution pattern (designated by capital letters A to E) and their orientation.
2. The percentage of pearlite is calculated by excluding graphite areas.
3. The matrix composition—including pearlite, ferrite, graphite, and carbide—is reported in etched samples.
4. Reports are generated according to the international standard selected by the user.

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