MAGNATEST® D

Magneto-Inductive Component Testing
for Magnetic and Electrical Properties

FOERSTER

proof.

The Company

FOERSTER is a global technology leader for non-destructive testing of metallic materials. One of the "Hidden Champion" companies, FOERSTER works closely with its worldwide customers through its extensive network of ten subsidiaries and qualified representatives in more than 60 countries.

FOERSTER Component Testing (CT)
Division CT (Component Testing) develops testing instruments as well as customized and fully-automated complete systems for non-destructive quality control of metallic components in the fields of automobile manufacturing and supply.

These devices use the eddy current method to detect and document with maximum sensitivity and repeatability such surface defects as cracks and pores. Contactless operation makes this method ideal for use even on sensitive surfaces.

Another field of application is the testing of material properties to prevent mix-ups and for early detection of incorrect tempering conditions. These magneto-inductive systems are particularly suited for ascertaining surface hardness and hardening depth on diverse component geometries.

The CT testing instruments and systems have been developed specifically to meet the needs of the automotive industry and its first- and second-tier component suppliers. Companies worldwide rely on the superior testing capabilities provided by FOERSTER inspection technologies to verify the integrity of components critical to safety or long service life, such as wheel hubs, brake discs, camshafts, drive shafts and valves.

Magneto-Inductive Testing of Components

Qualitative structure testing made easy

Material mixes can occur even in fully-automated production processes. They can cause significant economic damage not just to tools in the finishing line, but can even result in consequential damages amongst users. The MAGNATEST D is available for automated and non-destructive identification testing in the production of metallic components, e.g. valves, tooth racks and cams. The wide range of sensors with different geometries and diameters allows for a precise adjustment to the material to be tested.

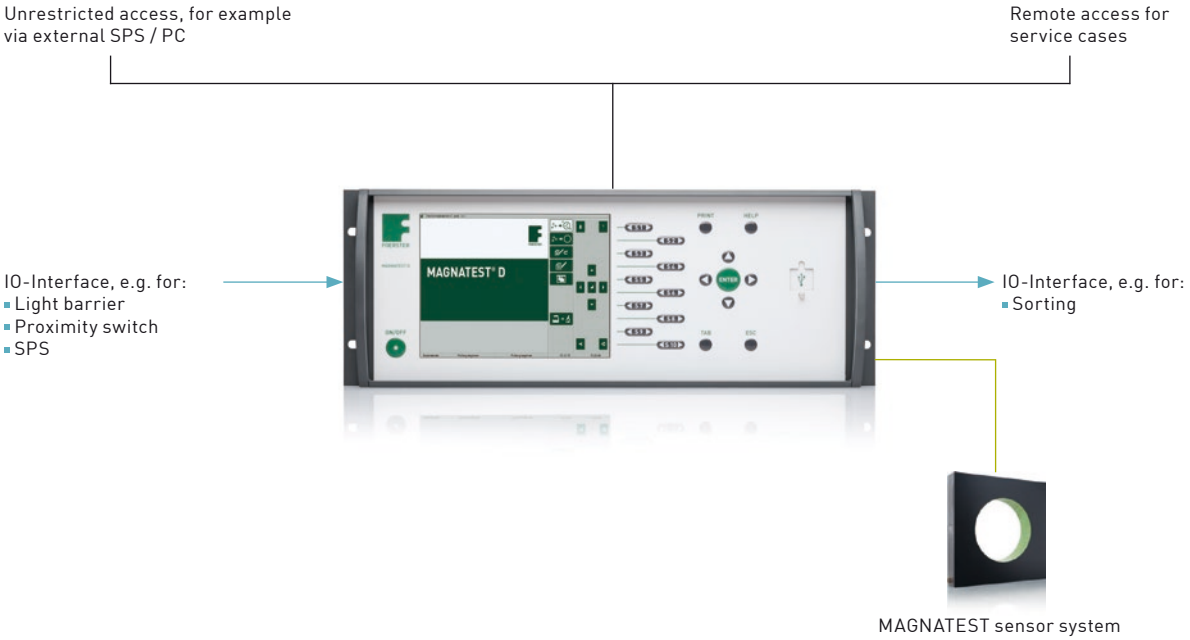
Fully-automated testing with MAGNETST® D

FOERSTER's MAGNATEST D guarantees magneto-inductive testing on the highest level: the system performs material property testing fully automatically. Doing this in the single coil absolute operation makes a comparator coil unnecessary. Even the smallest structure discrepancies can be made visible through the combination of high excitation currents with a complex evaluation electronic. Furthermore, MAGNATEST D offers extensive opportunities for the documentation of the test results such as test piece statistic, histogram display and test data export, which are clearly presented on the big color display. An intuitive operation supports the user during the setup of the instrument.

Advantages of MAGNATEST® D

- Single coil absolute operation, therefore no comparison coil required
- Constant magnetic field strength due to load-independent excitation current
- High excitation current intensity possible for an increased test sensitivity for the magnetic properties through targeted modulation of the hysteresis
- Increased test security due to multi-frequency testing
- Test frequencies ranging from 2 Hz to 128 kHz
- 8 in- and outputs to the line
- Full network integration and remote access for process integration
- Automatic creation of statistically valid sorting thresholds according to the number of calibration pieces
- Continuous increase of statistical certainty through activation of the dynamic calibration mode
- Activation of a trend observation for sorting areas during testing possible
- Integrated operator PC with Microsoft® Windows 7
- Easy to use intuitive function buttons and high resolution TFT color display
- Standardized interfaces for peripheral equipment (keyboard, mouse, printer, USB, network, etc.)
- Easy integration into control cabinets
- Optionally available: multiplexer with 4 channels (expandable to 8 channels)

Integration and Operating Principle

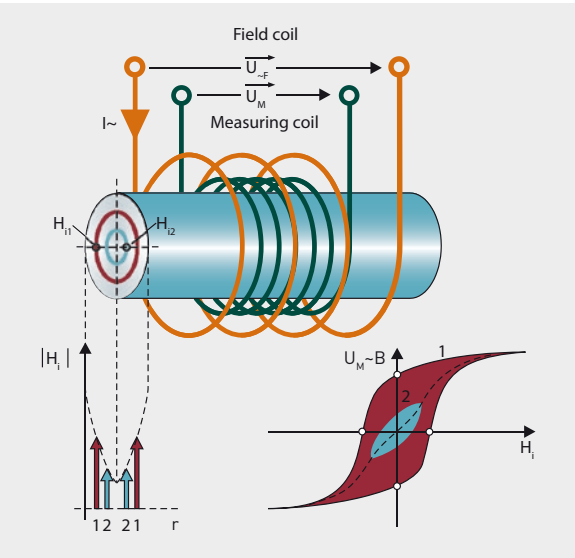


Manual and fully automated testing

The MAGNATEST D can be either integrated into a test line or be used for manual testing in the materials laboratory. Eight digital in- and outputs are available for enabling line integration. The Ethernet connection allows for a remote access to, for example, transfer the current test results to an external PC. Direct operation takes place with the function buttons placed at the front side. Furthermore, it is possible to connect a monitor, a keyboard, a mouse and a printer. The flexible integration possibilities due to a highly compact and robust 4 HU housing make it ideal for the industrial environment.

Checking materials for their properties

For testing of material properties, the specimens are passed through an encircling testing coil. For particular applications, e.g. local checks for surface hardness or hardening depth, specimen-specific sensor systems are used. The voltage detected by the individual sensors results from the magnetic and electric properties of the specimen. The exact voltage is displayed as a measuring point. During calibration, a sorting limit is automatically created through the statistical evaluation of multiple measured values. In subsequent serial testing, all further measuring points are compared against the specified tolerance limits. The parts are sorted according to the respective test results.

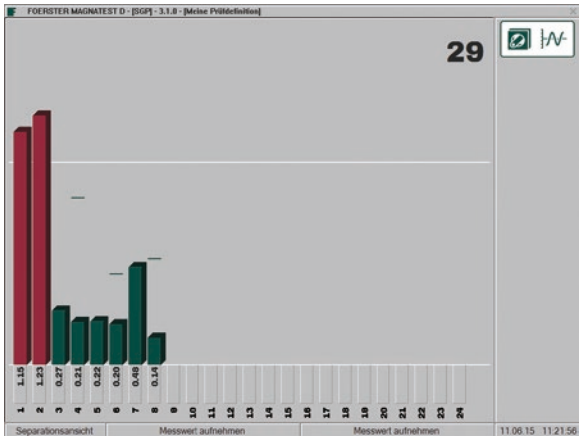


Magneto-inductive testing determines the significant material properties from the electrical and magnetic characteristics of the ferromagnetic components

Multi-frequency testing and harmonic analysis

Multi-frequency testing

The combination of multiple frequencies and magnetization field intensities makes it possible to evaluate different material properties at the same time and/or to selectively suppress disturbance variables. Serial multi-frequency testing works with several different testing frequencies. The individual pieces of test information are determined consecutively in a single testing procedure with the defined frequency settings – and entirely controlled by the automated testing system. As the tests take place in series, the overall testing time is determined by the number of set frequencies.

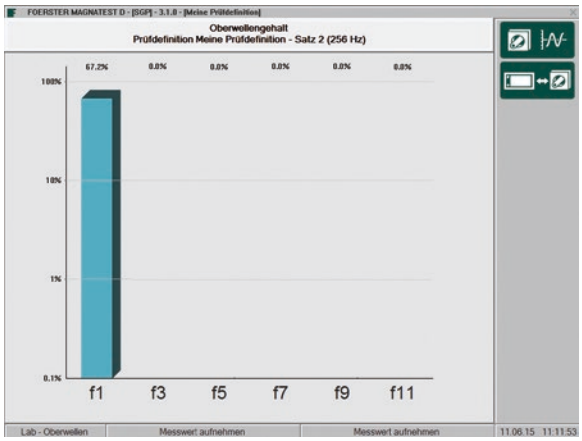


With multi-frequency testing, the results of up to 24 individual frequencies, with their corresponding separation indices, are shown in an overview

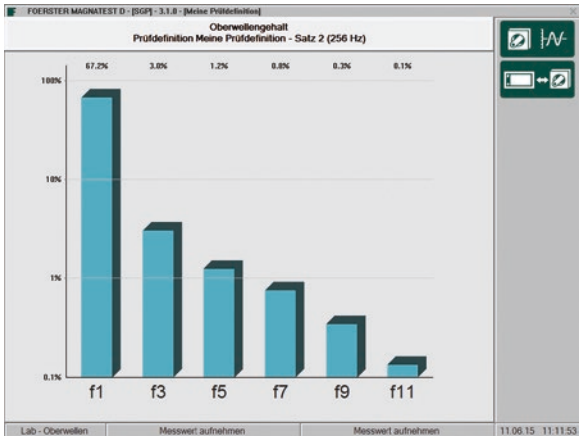
Harmonic analysis

The harmonic analysis method is extremely beneficial when good repeatability is required despite interferences such as variable specimen temperature or misalignment of the piece within the test coil. In contrast to the standard single- or multi-frequency eddy current testing, this method guarantees consistent test results: even a batch or temperature change will not necessitate recalibration.

The strong, linear power amplifier of the MAGNATEST devices provides the basis for harmonic analysis. In high-energy mode, the components to be tested inside the MAGNATEST D coil are penetrated by a strong alternating magnetic field; the resulting magnetization of ferromagnetic parts produces a so-called hysteresis loop, which is a very sensitive indicator of inconsistencies in material structure or grain size. Therefore, using high-energy excitation of the magnetic field, it is possible to evaluate the hysteresis loop of the sample, which the MAGNATEST D device interprets as harmonics (the odd multiples of the transmission frequency). However, the principle of harmonic analysis with many receiving frequencies (one for each transmission frequency) must be distinguished from simple multi-frequency testing with several transmission frequencies.



Spectrum of the received signal with evaluation of the fundamental wave or multi-frequency testing



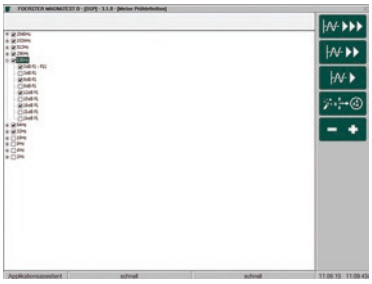
Spectrum of the received signal with high-energy harmonic analysis

Professional software assistance

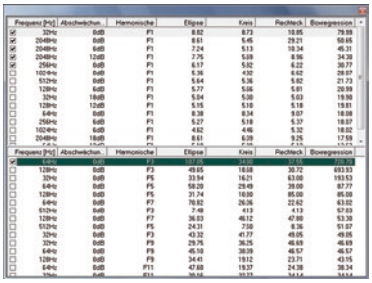
Application assistant reduces operator effort

The capability to separate out substandard parts with magneto-inductive testing depends on the test parameters, especially the test frequency and the magnetic field strength. The application assistant automatically determines the optimum settings for positive material identification based on the preselected parameters, significantly reducing the amount of work for the user.

- Step-by-step operator guidance through the optimization process
- Calculation of the separation after collecting at least five good parts
- Display of the optimum test settings after testing the part to be separated
- The determined test parameters are activated by the operator for routine testing



Display of the possible parameter combinations for test systems MAGNATEST D

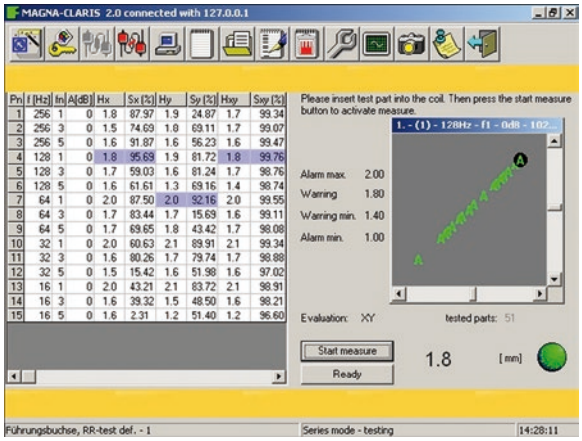


If two separation conditions are possible, the set of parameters with the best separation (highest separation index) is already marked. The separation capability depends on the type of tolerance field, so the value is displayed for all possible test categories

MagnaClaris

The results of magneto-inductive testing depend on the electrical and magnetic properties of the test piece. This factor is closely linked to the technological properties of the material. The nearly linear correlation between the test data from MAGNATEST D and the technological properties of the test pieces permits (after calibration) the determination of a technological value based on a linear regression calculation. Besides the two-dimensional eddy current value, the conventionally determined technological value is also stored.

In a next step, the software calculates the regression line. The quality measure of this correlation is defined as a correlation factor with either a numerical value or a percentage: the higher the value, the more precise the parameter. This means that the technological value of unknown parts can be calculated with the eddy current values. The field of application must be verified in any case.



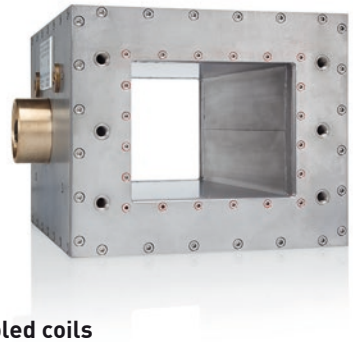
Test result display with MagnaClaris

Robust Sensors for Precise Test Results

FOERSTER Sensors for High-Quality Test Results
As a leading developer of test coils, FOERSTER constantly strives to offer its customers new and innovative solutions to achieve optimal test results. Thus, a variety of sensors for various forms and diameters is available to test safety-relevant and function-critical components for their properties. Proven and in use for decades, the sensors provide reproducible test results in quality assurance and process control.

Coils
The size of the opening of feed-through coils depends on the items to be tested. The coils can be adapted as needed, depending on the shape and cross-section of the test item, thus making it simple to convert the test systems for other functions.

Probes
Wherever an enclosing coil cannot be used, specially-adapted probes are employed. This makes it possible to carry out testing in places that are difficult to access or to determine very local microstructure characteristics.



Water-cooled coils
In order to examine the micro-structural properties of very hot samples, special water-cooled coils are used. Due to their robust design they are ideal for harsh environments, while the integrated cooling circuit significantly increases the life of the coil.

Form-adapted probes
Probes with special shapes are mainly used for testing inside of a sample, for example to check the hardening depth. Compared to conventional coils, the optimized interaction volume produces better separation precision and higher reproducibility of the results.

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