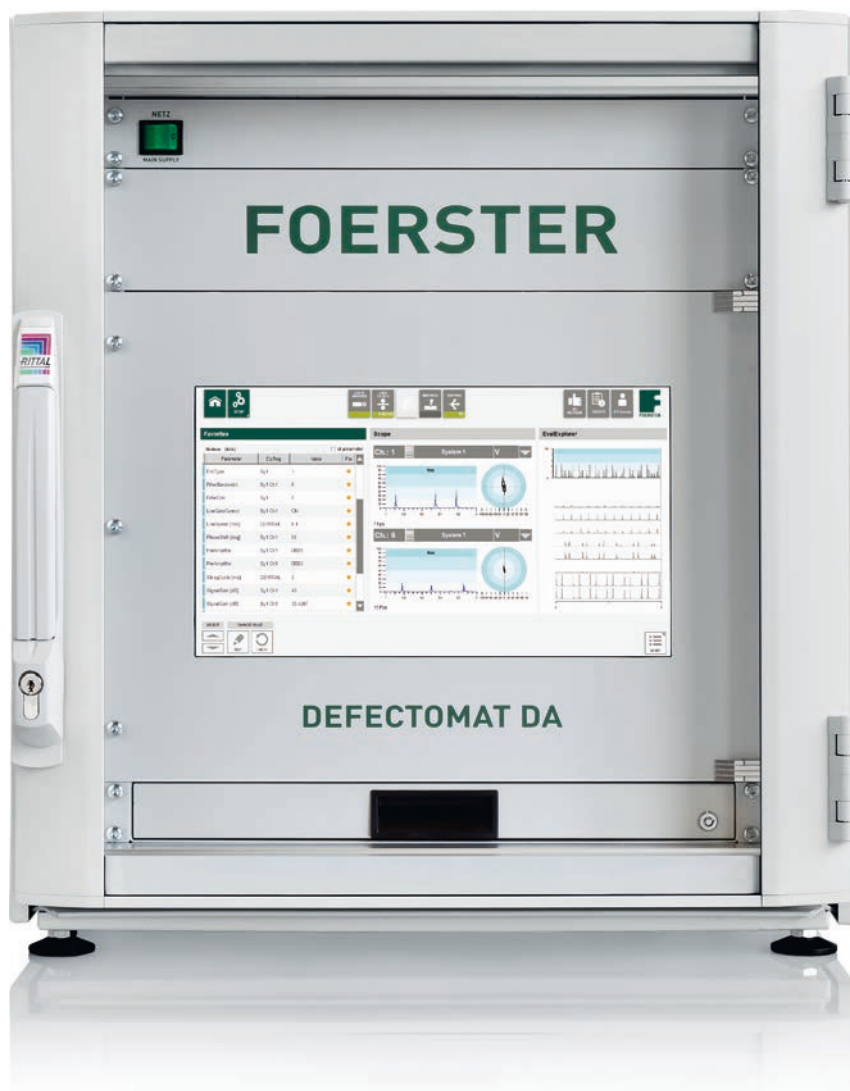


# DEFECTOMAT®

Non-Destructive Eddy Current Testing of  
Long Products like Tubes, Bars, Wires and Profiles



proof.

## The Company

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

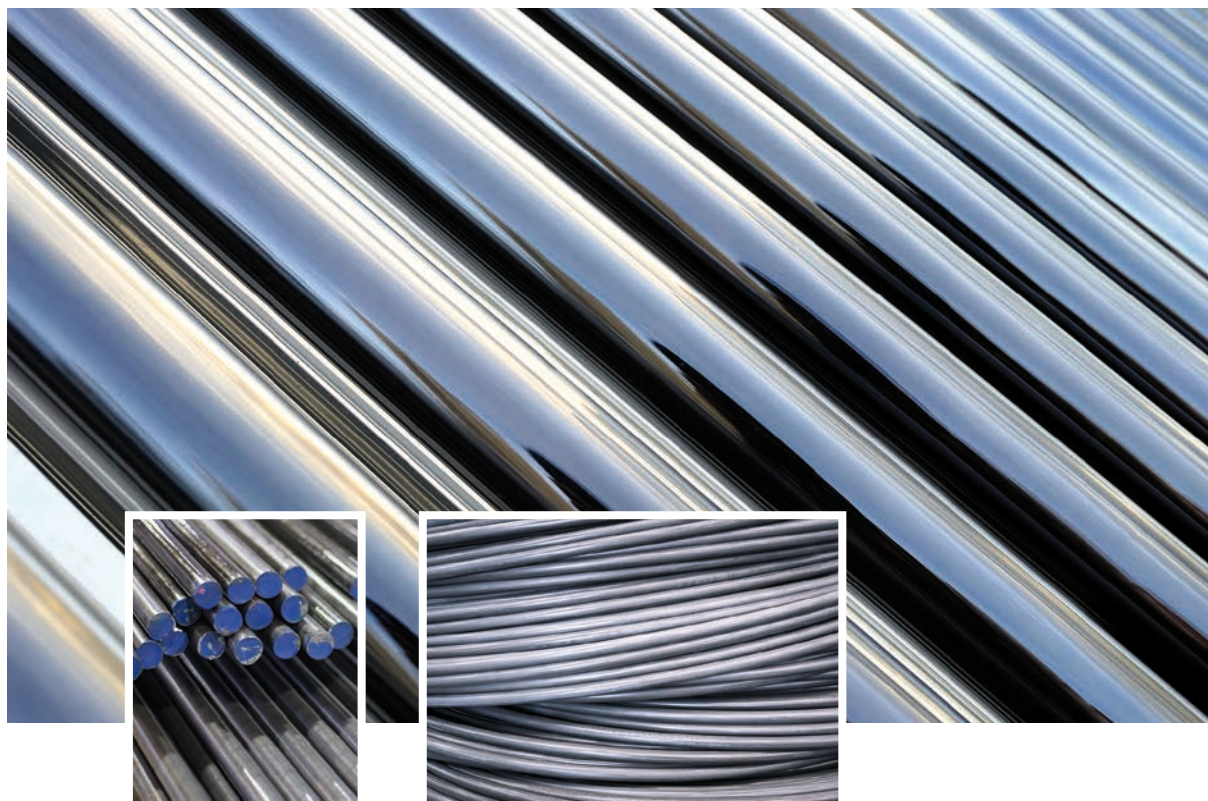
### **FOERSTER Division Testing Systems (TS)**

Division TS specializes in developing and manufacturing technical systems for the automated, non-destructive testing of metallic long products and heavy plates. Electromagnetic methods such as eddy current and flux leakage testing, ultrasound and inductive heat flow thermography are used to inspect these semi-finished products for flaws that are invisible to the naked eye.

These systems are made for the metal producing and metalworking industries, where tubes, wires, bars, billets, profiles, metal sheets and similar items are produced on rolling mills, drawing lines, welding lines or processed in various finishing operations. FOERSTER products perform many critical test applications during these processes.



## Testing Semi-Finished Products with DEFECTOMAT®



### Quality Control and Process Monitoring

FOERSTER's DEFECTOMAT instruments are developed specifically for quality control and process monitoring throughout the entire manufacturing line for long products. Regardless whether testing is performed at very high temperatures or after bright finishing, the surfaces of semifinished products such as tubes, bars and wires of austenitic, non-ferromagnetic or ferromagnetic metals can be tested for defects. The resulting data are important indicators for continuous process optimization.

### Reliable and Reproducible Testing

Employing the eddy current principle, DEFECTOMAT systems are contact-free and non-destructive in operation; they are mainly used to detect short flaws such as pinholes or transversal cracks. Fully-automated, these systems reliably recognize defective material, which can then be marked, classified and automatically rejected based on predefined parameters. These systems can perform 100% tests at high throughput speeds of up to 150 m/s and still maintain outstanding rates of accuracy and reproducibility.

### Cost-Effective Method of Testing

Low operating costs and energy consumption make using the DEFECTOMAT extremely economical. The costs for maintenance, wear parts and consumables are also very low.

### Customized System Configuration

Due to their compact design and adaptability, DEFECTOMAT systems can be set up individually for a specific customer application and can be integrated into virtually any process. Modular design and a large range of compatible sensors permit straightforward reconfiguration for new testing tasks.



## DEFECTOMAT® DA



### State-of-the-Art, Multi-Channel Eddy Current Testing

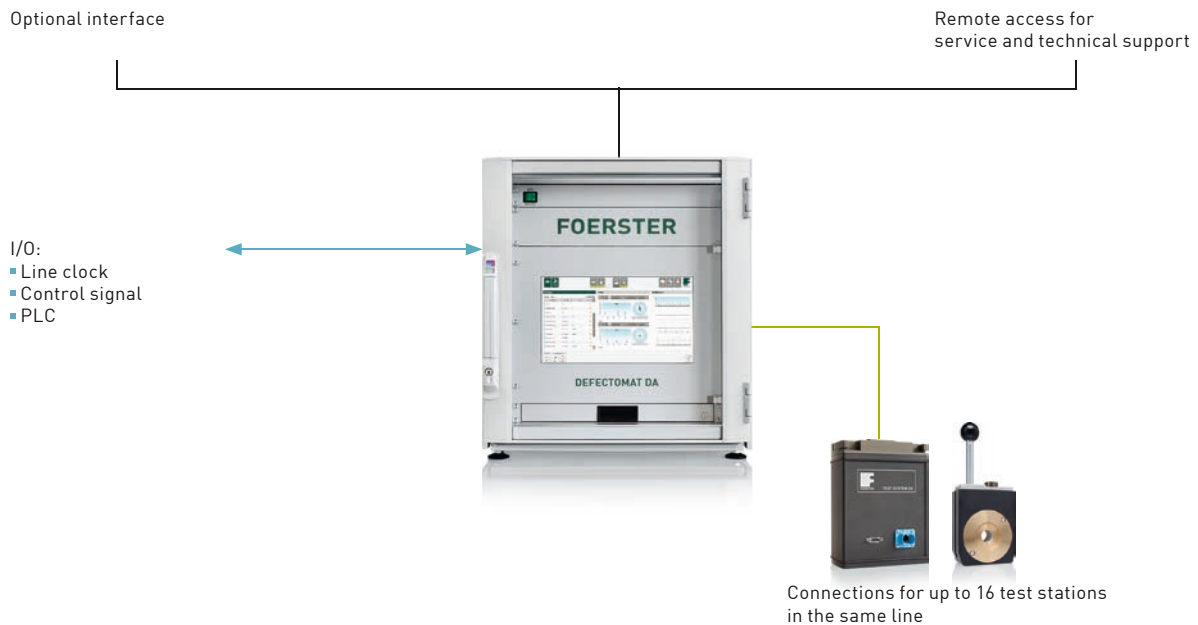
With its DEFECTOMAT DA, FOERSTER sets new standards in non-destructive eddy current testing of long products such as tubes, bars and wires. DEFECTOMAT DA offers unsurpassed reproducibility at high test speeds by combining advanced digital electronics with sophisticated system architecture. Its modular system setup and the resultant expansion possibilities guarantee maximum versatility for fulfilling ever-changing test requirements.

Equipped with the latest technology and intelligent details, the DEFECTOMAT DA can also be integrated into existing production processes. Digitalization takes place directly at the sensor, thereby reducing the length of the analog signal path. System modules are connected with industrial Ethernet cables which can be laid out flexibly. I/O interfaces to the production line can be freely configured and expanded. Operation is controlled via the new software, DEFECTOTEST DA.

### Advantages of the DEFECTOMAT® DA

- Modular system layout offers maximum flexibility for meeting customer-specific requirements
- Contact-free testing at test speeds up to 150 m/s
- Expansion and system optimization possible at any time
- Up to 256 test channels
- Digitalization right at the sensor
- Compatible with all FOERSTER sensors
- Test frequencies continuously adjustable from 1 kHz to 1 MHz
- Patented digital speed shift filter: dynamic adjustment of the filter's position to the test speed
- Easy touchscreen operation
- Multi-user operation interface
- Context-sensitive online help
- Generation of individual test reports
- Archiving of all test results
- Quality testing according to international norms: ASTM, API, DIN, ISO and JSA-JIS, among others

## Fully Digital Test System



### Digitalization for Improved Test Quality

The sensors of the DEFECTOMAT DA system are directly connected to the TEST SYSTEM DA, which first digitalizes the analog signal and then transmits it via Ethernet to the LINE SYSTEM DA. Hence, all data required for the evaluation of test results are available immediately. The close proximity of the TEST SYSTEM DA to the sensor (= short analog cables) minimizes the influence of electromagnetic radiation, resulting in superior test quality.

### Well Protected

The LINE SYSTEM DA and the operation PC are mounted in a compact, 19" cabinet of protection class IP54. Besides the high-resolution touchscreen display, additional input devices such as a keyboard or mouse can also be connected there.

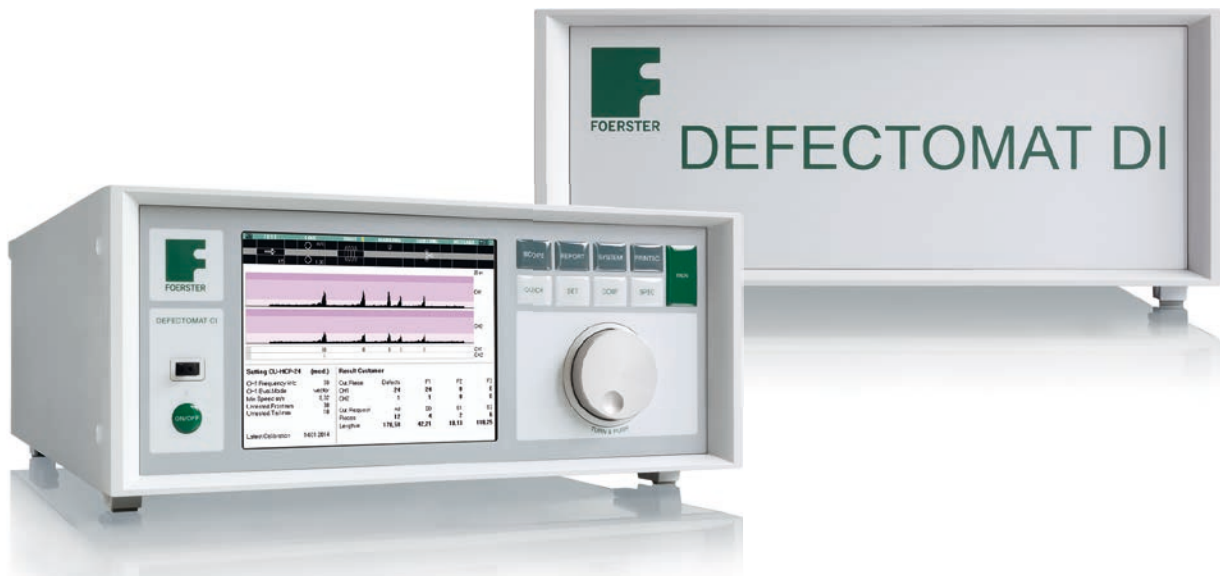
### Easy-to-Use DEFECTOTEST® DA

The operator-friendly DEFECTOTEST DA software is transparently structured and intuitive to use. The modern interface relies on visualization to facilitate operation, clearly separating operator controls and screen elements. Large, easy-to-use buttons enable fast touchscreen input, while consistent color-coding of displayed information aids comprehension and helps prevent operator errors.

### Quick Modernization of Existing Test Systems

Because the DEFECTOMAT DA is modular and compatible with all FOERSTER sensors, it is simple to swap out components or update existing FOERSTER test systems. The easy-to-handle components are quickly installed, ensuring speedy resumption of production. This allows existing DEFECTOMAT DA systems to be expanded and/or modified for new test tasks.

## DEFECTOMAT® CI and DI

**Dual-Channel Eddy Current Testing**

Equipped with up to two fully operational test channels each, the compact DEFECTOMAT CI and DEFECTOMAT DI are perfectly suited for eddy current testing of long products directly in the production line. Because their wide range of functions makes it possible to integrate them into virtually any production environment, they are excellent introductory-level systems for structured quality assurance.

**Advantages of DEFECTOMAT® DI and CI**

- Optional dual-channel evaluation of Diff/Abs, Diff/Diff, Diff/Ferromat
- 12 test frequencies ranging from 1-1000 kHz
- Automatic filter tracking
- Accurate marking
- Sector signal evaluation with three trigger thresholds

**Availability and Service**

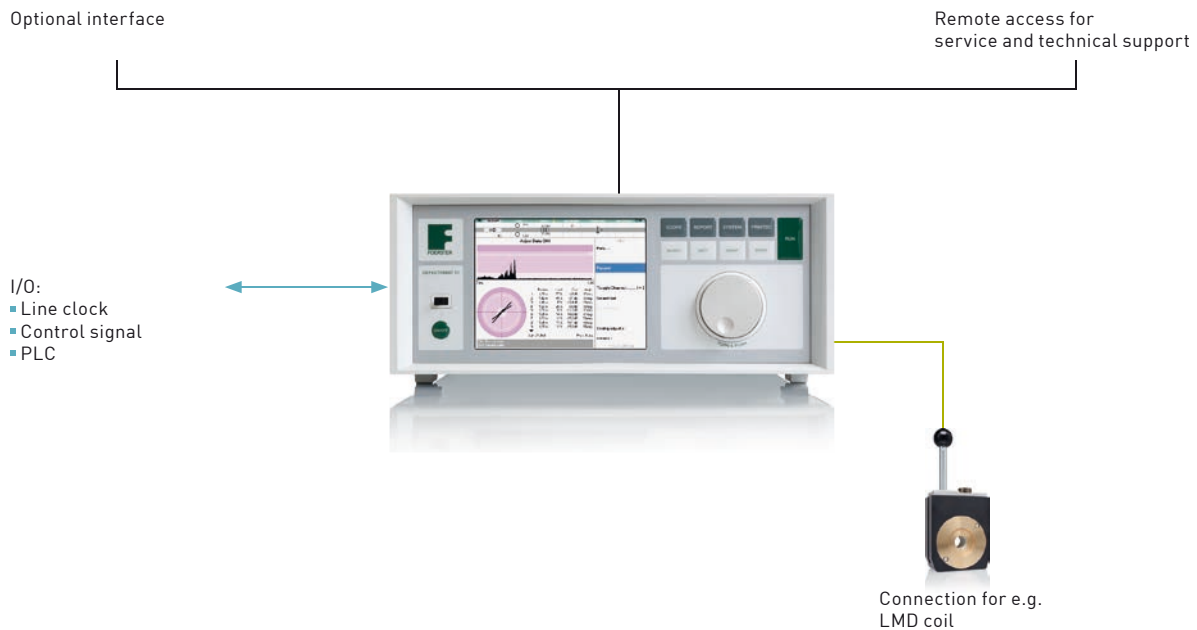
- Sensor monitoring based on noise levels
- Detection of cable breaks and short circuits
- Remote service via telephone or internet
- Protocolled calibration
- Easy swap-out of older models with pin-compatible line and sensor connections

**Base Model DEFECTOMAT® DI**

The DI series covers all functions necessary for the most common application fields. Operation and setting of the DEFECTOMAT DI, as well as the archiving of test results, is conducted comfortably at an external PC connected via Ethernet.

**Advantages of DEFECTOMAT® DI**

- Operation PC can be provided by customer
- Multiple DEFECTOMAT DI instruments can be controlled through the same PC
- Stand alone operation possible
- Price-optimized base system, optional expansion of functionality



### More Convenience with DEFECTOMAT® CI

The modern IT architecture of the DEFECTOMAT CI allows it to be controlled directly at the device. All relevant parameters can easily be set by built-in function keys and a simple “turn-and-push” knob. Keyboard, mouse and display can also be plugged into the instrument. Furthermore, a primary process computer for data exchange can be connected via Ethernet.

### Clear Presentation of the Production Process

All production information is displayed unambiguously on the high-resolution monitor. The status bar, for example, shows the current line speed as well as line outputs for marking and test-piece sorting; from here, the operator can quickly extract all information concerning the current test. Structured data from test signals and test events are exported in real time and at line speed. As desired, the test signals can be displayed in |V|, Y or XY format.

### Test Protocols for Quality Documentation

Test protocols with corresponding test settings and results can be generated for each individual test piece or for a series of test pieces. Protocols can be designed individually and printed automatically, ensuring complete documentation.

### Additional Advantages of the DEFECTOMAT® CI

- Quick operation with “turn-and-push” knob
- Password-protected access levels
- Clearly structured color interface
- Visualization of the test sequence
- Continuous display of the most important parameters
- Unlimited settings archive
- Stored sensor list with features
- Latest computer technology in compact design
- Full network integration
- Remote control of settings
- Transfer of result data
- Connection of various peripherals via USB: flash drive, printer, mouse, keyboard, etc.
- Data export and import via flash drive
- XML document structure for every tested piece and each order displayable with Internet Explorer

## DEFECTOMAT® ECM



### Modular Entry-Level Instrument for Cost-Effective Quality Assurance

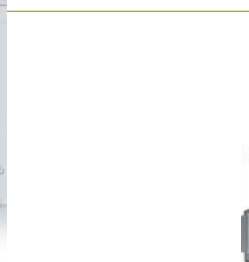
Although the modular DEFECTOMAT ECM is small in size, it boasts many possibilities for integration into common production lines. Designed for easy handling, this compact instrument sorts the test material into good/defective categories. Typical applications include effortless, integrated solutions for tube welding lines and fine wire testing.

Moreover, the DEFECTOMAT ECM can be used for the detection of cross-welding seams between strips, for tube joint detection and for mandrel breakage control.

### Advantages of DEFECTOMAT® ECM

- Cost-effective basic module for eddy current testing with encircling through-type coils
- Various fixed-frequency modules available
- Optional: absolute channel for open seam detection
- Simple operating elements
- One-dimensional signal display via LED bar graph
- Sorting into good/defective categories
- Easy assembly into control cabinets
- Analog output
- Adaptor to store configuration data for quick modification

- I/O:
- Line clock
  - Control signal
  - PLC



Connection for e.g. a segment coil



## Overview DEFECTOMAT® Systems

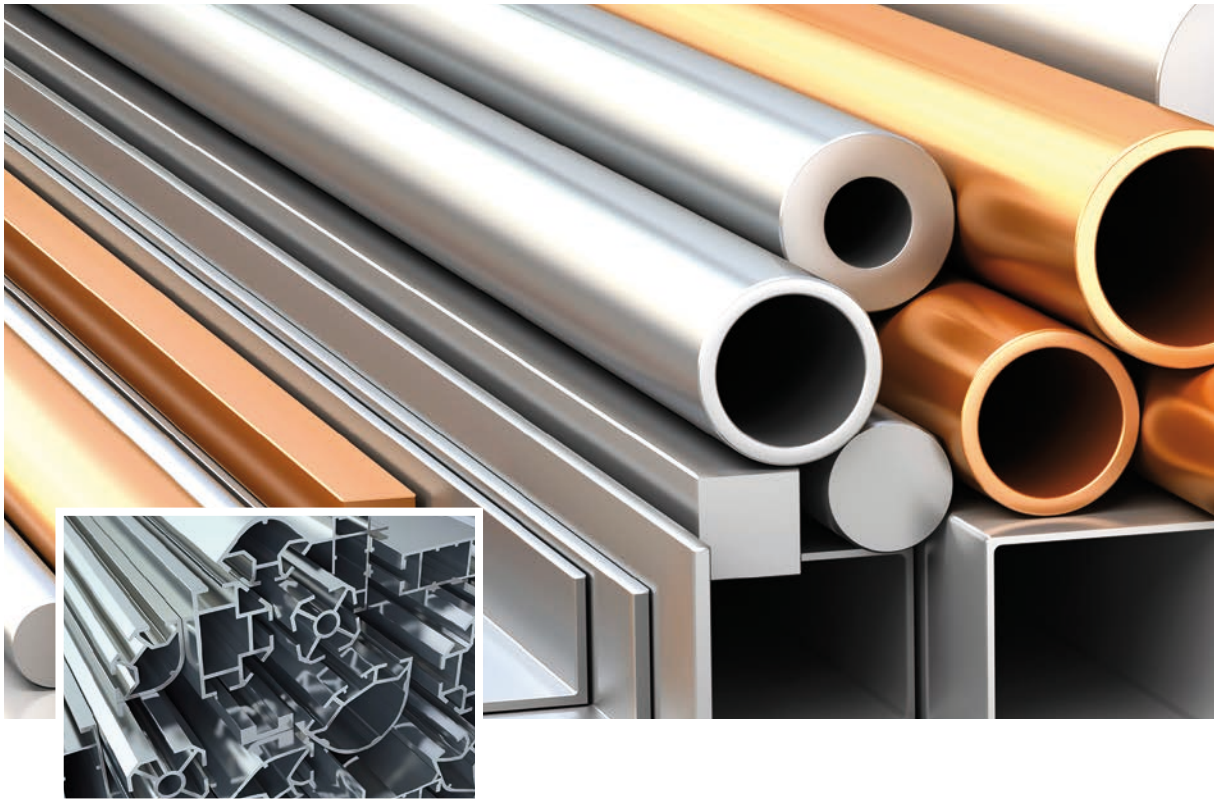
Diverse applications and varying production conditions require test electronics that are precisely tuned to the conditions at hand. To meet customers' needs, FOERSTER provides the following DEFECTOMAT systems:

| DEFECTOMAT    | ECM | DI     | CI | DA  |
|---------------|-----|--------|----|-----|
| Sensor max.   | 1   | 2      | 2  | 32  |
| Channel max.  | 1   | 2      | 2  | 256 |
| GUI           | -   | -      | ✓  | ✓   |
| Database      | -   | -      | -  | ✓   |
| Line function | -   | ✓      | ✓  | ✓   |
| Reports       | -   | option | ✓  | ✓   |

Optionally, the functionality of the systems can be further expanded in order to fulfill additional or changing specifications:

| DEFECTOMAT                 | ECM      | DI     | CI       | DA       |
|----------------------------|----------|--------|----------|----------|
| Analog output              | standard | option | standard | option   |
| Phase selective evaluation | option   | option | standard | standard |
| Speed shift filter         | -        | option | standard | standard |
| Cutting with sorting FIFO  | -        | option | standard | standard |
| Small defect evaluation    | -        | option | standard | standard |
| Automatic adjust           | -        | option | standard | standard |
| Test reports               | -        | option | standard | standard |
| Result investigation       | -        | option | option   | option   |
| Software interface         | -        | option | option   | option   |
| Result export              | -        | option | option   | option   |
| FOERSTERNET                | -        | -      | -        | option   |

## Sensors for the Most Demanding Test Requirements



### High-Quality Sensors – Made in Germany

To provide the appropriate sensor technology for every customer need, FOERSTER is continuously developing new and innovative solutions. This way, FOERSTER is able to offer an extensive portfolio of sensors suited to a wide range of sample forms, dimensions and cross sections to ensure precise defect detection on such semi-finished products as wires, bars, profiles or tubes. Firmly established and in use for decades, these sensors have been delivering reproducible test results for dependable quality and process control. From sensor systems for through-type or segment coils to demagnetization units and probes: FOERSTER's end-to-end systems are assembled from components that achieve real customer objectives, so they integrate perfectly into real-world production lines.

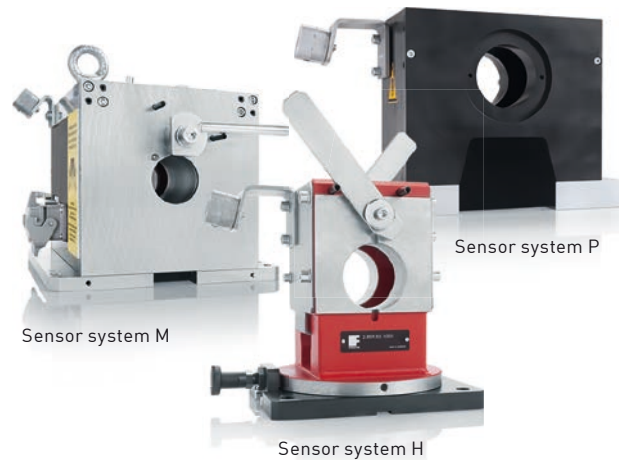
### Encircling Through-Type Coils

Encircling through-type coils are used for testing long products like wires, bars and tubes for surface cracks and hole-like defects.

FOERSTER offers a broad range of coils corresponding to the cross section of the test piece. For cylindrical material, fine gradations are offered for diameters from 1-240 mm, as well as a huge selection of coils for other shapes. Special profile coils can also be custom-made according to customer specifications. The coils are used with the sensor system H, P or M, depending on the test material.



## DEFECTOARRAY® and Sensor Systems



### DEFECTOARRAY® Sensor

The patented DEFECTOARRAY Sensor is a specialized instrument for eddy current testing of cylindrical material. Its innovative layout enables ultra-precise defect detection.

The DEFECTOARRAY Sensor has eight circumferential segments with one clearance winding each, leading to highly dynamic clearance compensation. This significantly increases the reproducibility of test results, reduces false indications and minimizes rejection rates. Moreover, the clearance compensation eliminates the influences of dimension variations and eccentricity, as well as entry and vibration effects. Both the longitudinal and the circumferential coordinates of the defect's position are recorded.

DEFECTOARRAY test coils are available in diameters between 18 and 100 mm. A change of coils and nozzles to accommodate a new test material diameter is only necessary in 3 mm steps. In terms of design, these sensors are otherwise identical to the traditional sensors and, depending on the test material, can be used with sensor systems H, P and M.

### Sensor Systems for Eddy Current Testing

Complementing the through-type coils and sensors are several systems for mounting the coils and sensors. All systems listed here are suitable for eddy current testing with enclosing through-type coils and DEFECTOARRAY Sensors. The selection of a sensor system is based on the type of material to be tested. To ensure optimal results, coils and protective nozzles for all sensor systems are available in many different sizes.

#### Sensor System H

The sensor system H is used for non-ferromagnetic test material with diameters ranging from 1-170 mm.

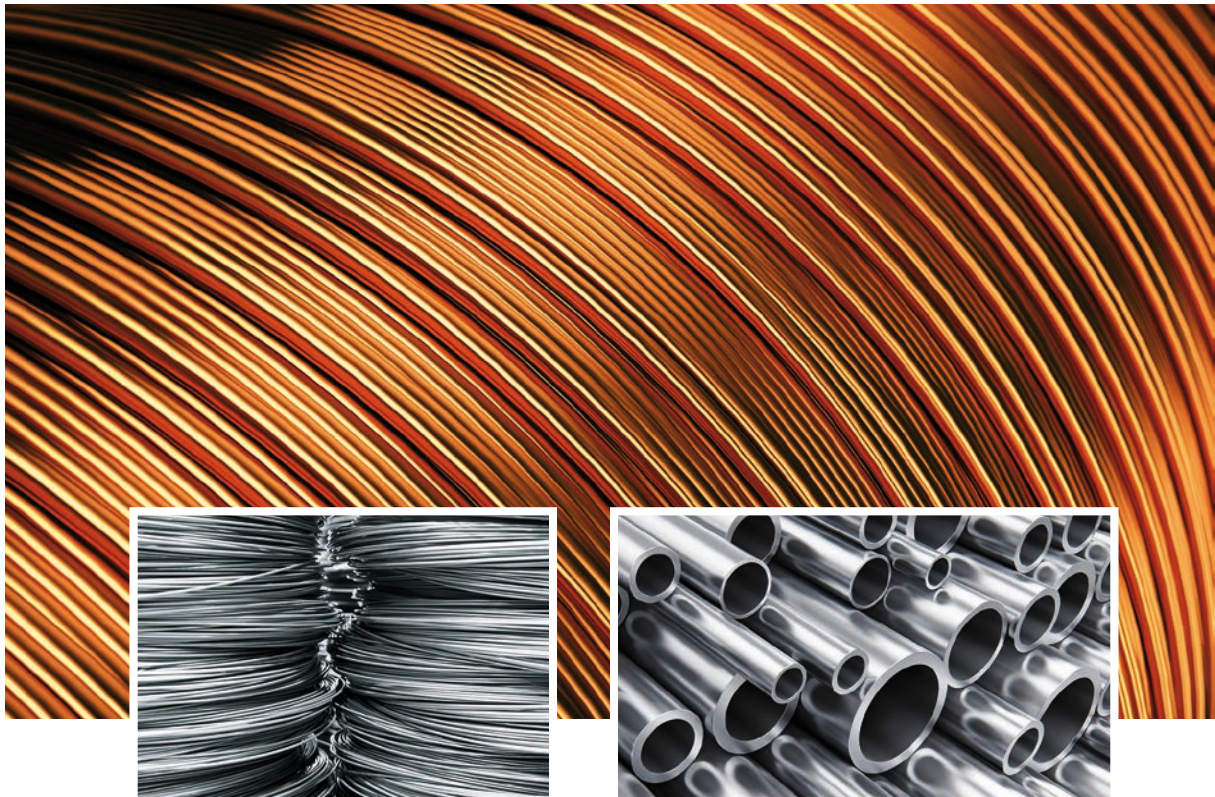
#### Sensor System P

For testing of thin wires, thin-walled tubes or austenitic material, low-power magnetization often suffices. In the sensor system P, this is achieved by permanent magnets. A particular feature of this sensor system is its small installation size.

#### Sensor System M

The sensor system M is used for testing ferromagnetic material. The DC field magnetization leads to a magnetic saturation of the test material, which eliminates disturbing permeability variations. The magnetizing power can be set according to the test task.

## Application-Specific Sensors and Sensor Systems



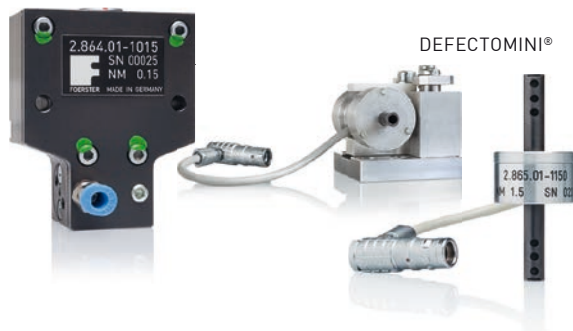
### **Extensive Product Portfolio**

Above and beyond the sensors described here, the FOERSTER product portfolio encompasses further optimized through-type coils, sensors and probes for other recurrent applications; for every customer need, FOERSTER offers the right system. Sensor systems and holders suited to an array of test materials have been developed for integration into respective test lines. Other special sensors are also available on a standard basis.

### **Customized Solutions**

FOERSTER strives to provide the ideal test system for every customer. Application-specific solutions for special purposes are gladly developed upon request.

Working in close cooperation with customers and the in-house engineering department, FOERSTER's application specialists produce detailed system specifications. No matter how tough the challenge, individualized solutions are created by combining highest technological expertise and innovative development ideas.

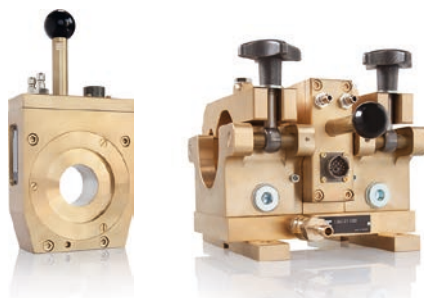


### Coils and Sensor Systems for Small Diameters

Special through-type coils and sensor systems have been developed especially for eddy current testing of fine wires such as light bulb filaments of tungsten or molybdenum. For optimal test results, these coils are available in fine gradations for material diameters ranging from 0.1-2 mm. Their compact sizes facilitate placement into rewinding lines or drawing lines.

### DEFECTOMINI® Sensor and Sensor Systems

The DEFECTOMINI sensor was developed for testing thin wires and tubes with diameters ranging between 0.3 and 4 mm. The use of permanent magnets allows testing of all metals, including ferrous material. The tight build of the corresponding sensor system allows direct installation in wire-drawing machines. The test coil automatically adjusts to the wire and can thus compensate for position changes.



### DEFECTOTHERM® Sensor and Sensor System

Special thermal coils and sensor systems can be used for applications with temperatures as high as 1200°C, making it possible to test steel and copper wires directly in the rolling line. For this, water-cooled test coils are available in fine gradations for material diameters from 5-180 mm.



### Segment Coils and Sensor Systems

For eddy current testing of weld seams, a special segment coil was developed for tube diameters between 10 and 180 mm; for larger tube dimensions (up to 500 mm), special flat segment coils are available. The LSM yoke for segment coils is used for ferromagnetic tubes. The magnetization power can be adjusted according to the test task. If a lower magnetization power is sufficient, the LSP yoke can be used instead.



### Weld Seam Probe and Holder

Regardless of size, longitudinally welded tubes can be tested easily using a weld seam probe and the corresponding holder. The holders are adjustable horizontally up to 200 mm and vertically up to 270 mm; they can furthermore be pivoted up and locked. Their small space requirement allows integration in any welding line, especially since no magnetization is needed.

## Application Lab and Trainings



### Application Lab

To always ensure comprehensive and individual advice in response to special customer requests, FOERSTER runs its own in-house application lab. Equipped with the latest test equipment, the lab is perfectly suited for solving new application scenarios. Using material provided by the customer, the best technical approach and the correct parameters are determined individually.

### Training

FOERSTER training courses focus on the practice-oriented application of FOERSTER test electronics and sensor systems, as well as the configuration of important parameters for adapting the systems to the test procedures and tasks at hand; in-depth training courses for service and maintenance are also offered. The training content can be modified to suit an individual customer's needs and delivered on-site, directly at the test line.

## Global Service



### High-Quality Requirements for Service

When it comes to FOERSTER test instruments, customers can count on top quality. In order to meet these expectations, an experienced service team and highly skilled engineers are available for on-site service and maintenance projects and, as necessary, prompt and effective assistance.

### Worldwide Reach

FOERSTER is a global company. A network of ten subsidiaries and qualified representatives in more than 60 countries guarantees close proximity to customers and rapid response. At the company headquarters in Reutlingen, international service engineers attend regular training courses to enhance their technological know-how; this in turn ensures uniform service quality – worldwide.

### Available Around-the-Clock

Problems often occur outside normal working hours. For that reason, FOERSTER has established a 24-hour emergency hotline that can be reached 365 days a year. Even over the telephone, FOERSTER service engineers can conduct systematic troubleshooting and, if remote access is possible, a quick initial diagnosis can be made and first steps taken to quickly resume full operation.

foerstergroup.de



## Worldwide Sales and Support Offices



### Headquarter

- Institut Dr. Foerster GmbH & Co. KG, Germany

### Subsidiaries

- Magnetische Pruefanlagen GmbH, Germany
- FOERSTER Tecom spol s.r.o., Czech Republic
- FOERSTER France SAS, France
- FOERSTER Italia S.r.l., Italy
- FOERSTER Russland AO, Russia
- FOERSTER U.K. Limited, United Kingdom
- FOERSTER (Shanghai) NDT Instruments Co., Ltd., China
- FOERSTER Japan Co., Ltd., Japan
- NDT Instruments Pte Ltd, Singapore
- FOERSTER Instruments Inc., USA

The FOERSTER Group is being represented by subsidiaries and representatives in over 60 countries – worldwide.

### Institut Dr. Foerster GmbH & Co. KG

#### Division Testing Systems

In Laisen 70

72766 Reutlingen

Germany

+49 7121 140 0

info@foerstergroup.de



Reg.-Nr. 001159 QM08