DEFECTOMAT® DS 2.815

- ✓ Eddy current testing system with digital systems technology for automatic, high-resolution, multi-channel on-line flaw testing of wires, bars and tubes made from ferromagnetic, austenitic steel and nonferrous metal with encircling or segmented through-put coils
- ✓ Universal testing system, adaptable for individual applications and requirements
- ✓ WINDOWS-based operator guidance with application assistants
- ✓ Real-time visualization of the test process with original signal display
- ✓ Comprehensive test documentation for each component and each flaw
- ✓ Continuous monitoring of operating safety

Features

- ✓ The new FOERSTERnet enables free access to the DEFECTOMAT DS by any number of computers
- ✓ An Ethernet interface and TCP/IP protocol enable unrestricted network integration in existing production and quality systems
- ✓ The operating software is based on WINDOWS NT and provides TCP/IP interfaces to other WINDOWS programs
- ✓ Simplified device adjustment based on material and test line data
- ✓ Tested adjustment sets can be stored on the hard disk or centrally in the network
- ✓ Work instructions for the operator can be defined with the adjustment set
- ✓ Comprehensive adjustment and function tests with multi-channel synchronous signal display
- ✓ Continuous process control with display and monitoring of the noise level response
- ✓ The specified test report in accordance with EN12084 can be adapted to meet customer-specific requirements
- ✓ The test results are saved in a database. Additional evaluations can be implemented easily using standard software, e.g. MS ACCESS
- ✓ Sensitivity adjustment can be automated with test flaw or noise level as reference parameters
- ✓ Operator interface protected against unauthorized access by an access code
- ✓ Dialogue language of the operator interface can be extended by loadable translation files
- ✓ Context-sensitive online help with additionally loadable languages

Application

- Eddy-current testing of ferrous, austenite and nonferrous round stock (wires, bars and tubes) for surface flaws (longitudinal flaws) with encircling coils in accordance with DIN 54140
- Testing of profile material (e.g. hexagon bars)
- Replaces leak test for pipes
- Typically with a fixed coil which the test piece is moved through or passed by with a synchronous signal display
- Used typically to evaluate the differential coil signal for highly sensitive flaw testing but can also be used as a test channel for absolute coil testing to detect phase-characteristic material properties at a freely selectable frequency, e.g. to detect coarse material mix
- Location of slowly changing material inhomogeneities or inhomogeneities that have been present for a long time, typically of slit tubes with an absolute channel
- Single-channel or multi-channel design
- Multi-channel design for testing with several sensors in series in a test line
- Single or dual frequency operation
- Connectable sensor systems: all usual coil types (through-put, segment and scanning coils)
- Material diameter according to sensor system:
  - M40/90/170 1 to 40/90/170 mm
  - H40/90/ 1 to 44/100 mm
  - P12/40 0.3 to 15/44 mm
  - S(LSP/LSM) 10 to 500 mm
- Test result logging
  - Event-related with details of each individual flaw or optionally
  - statistics logging of flaw densities, e.g. in the case of wire testing
  - all result information is referenced to the test piece and the test request

Typical applications

Piece testing

The purpose of semi-finished materials testing is not only to determine whether a test part is flawed or flaw-free, but also where exactly which flaws are located, as further processing or use can depend on this.

In many cases, flawed sections can be cut out and the remaining length can be used; or a part can be reused after small flawed spots are ground out; or the parts are sorted in different quality classes with varying surface quality, in which not only flaw depth but also flaw frequency may be relevant.

For all of these cases, the DEFECTOMAT DS supplies the necessary information and control functions in fully automatic mode.

For this purpose, the length and circumference of the flaw occurrences are evaluated. The decisive factor for the flaw length recorded is always the component in the through-put direction (Event Evaluation).

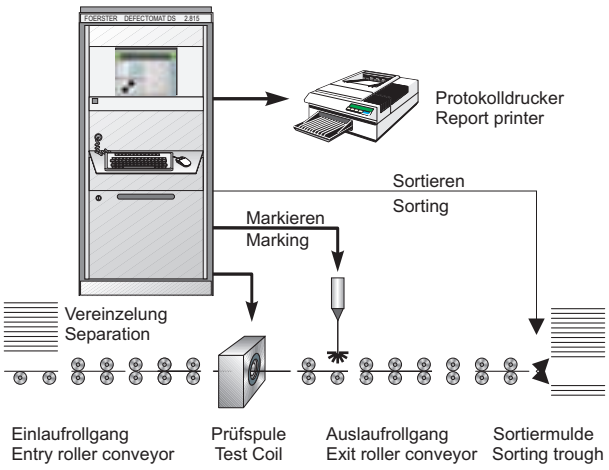


Fig. 1 Piece testing

Continuous testing

Evaluation operating mode for testing continuous material without a subsequent cutter.

The DEFECTOMAT DS adds up the flaw occurrences over sections of preselectable length and evaluates the sections on the basis of the flaw density.

The flaw density is the quotient of the sum of the flaw lengths and the section length, and is stated as a percentage in the protocol.

The evaluation of sections is based on limit values for the flaw density, not on flaw lengths (Statistical Evaluation).

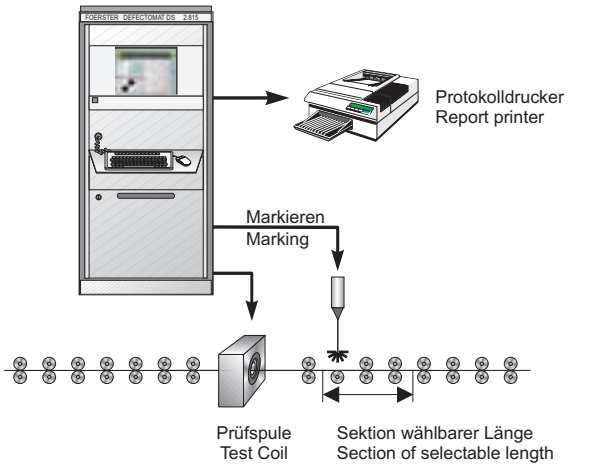


Fig. 2 Continuous testing

Cutting to length

Evaluation operating mode for testing continuous material which will be cut into lengths after testing.

The flaw occurrences are delayed from the test location to the position of the cutter according to the current testing speed, and are summed there. After the pieces have been cut, the accumulated sums are evaluated, so that the same result formation and logging process applies for the pieces cut into lengths as for piece testing (without this delay).

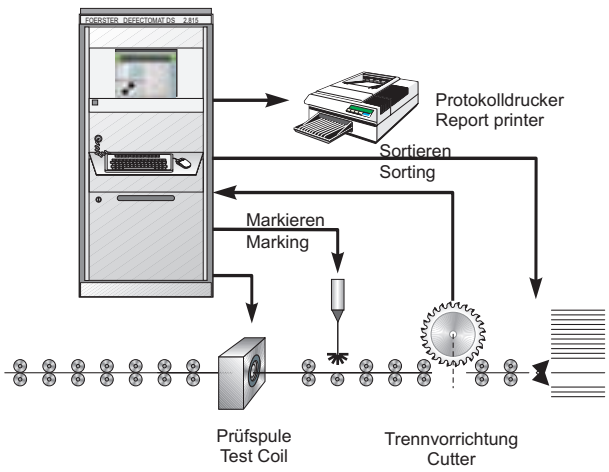


Fig. 3 Cutting to length

Wire testing

Evaluation of flaw occurrences for testing quasi-continuous material, e.g. in winding units.

The evaluation can take place either statistically by section as in the 'Continuous' operating mode, or in relation to events as with piece testing (e.g. in accordance with European Standard EN1971).

Additionally, the remaining section at the end of the coil can be evaluated in relation to the remaining length and an overall statistic can be formed.

This includes the tested length, the number of sections and the total flaw densities, i.e. the total flaw lengths over all sections divided by the tested length.

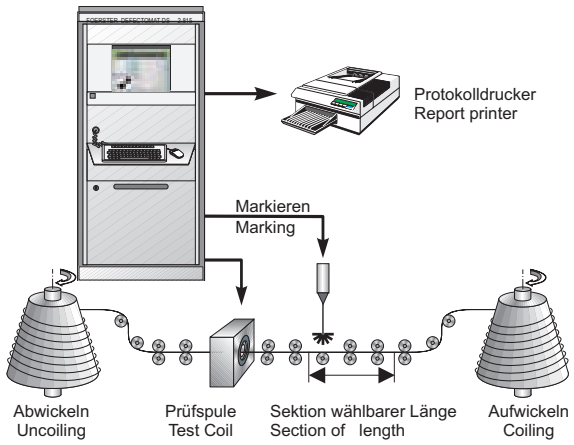


Fig. 4 Wire testing Coil to Coil

Testing for longitudinal and transverse flaws in the finishing stage

The combination of the DEFECTOMAT channel with a CIRCOGRAPH DS provides the highest degree of efficiency.
The CIRCOGRAPH DS has a flaw detection capability for longitudinal cracks, e.g. on polished bars, of approx. 30 µm.

In addition, the DEFECTOMAT channel reliably indicates transverse flaws and short flaws.

See Leaflet CIRCOGRAPH DS 6.430 in relation to this point.

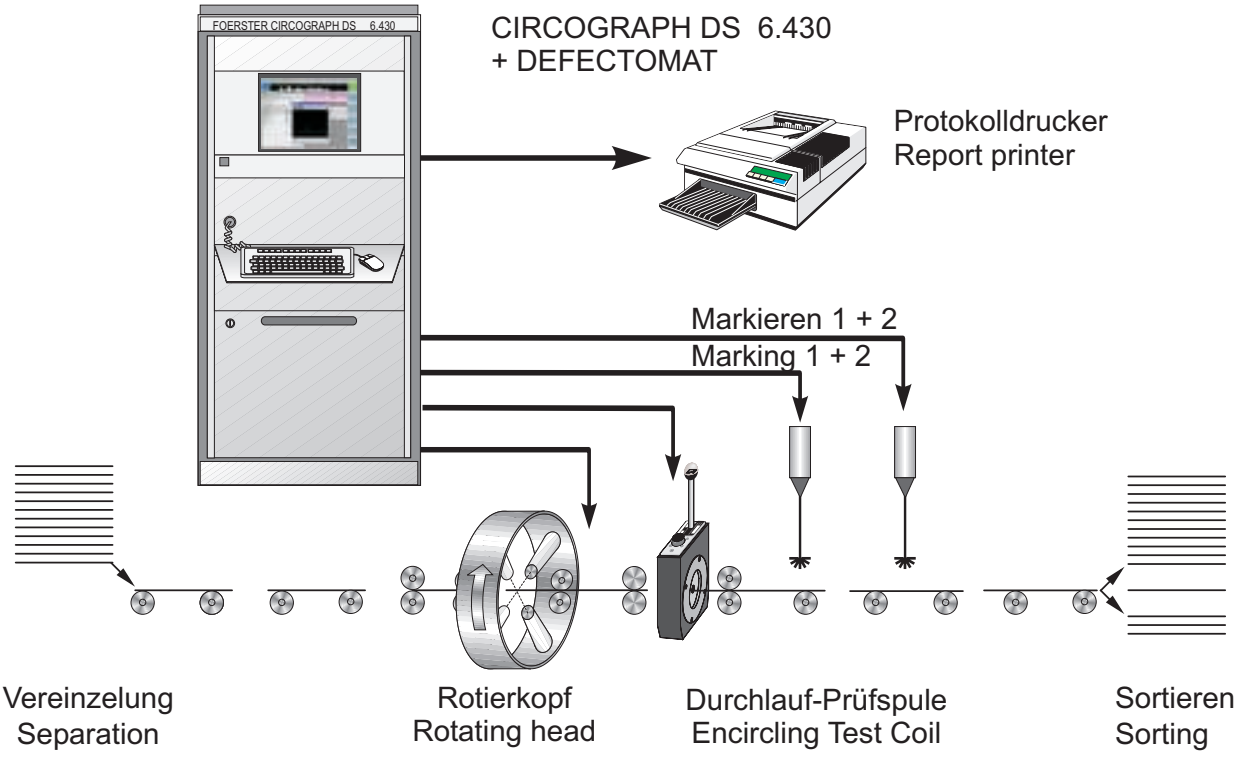


Fig. 5 CIRCOGRAPH with DEFECTOMAT-Channel, Piece testing

Operating principle

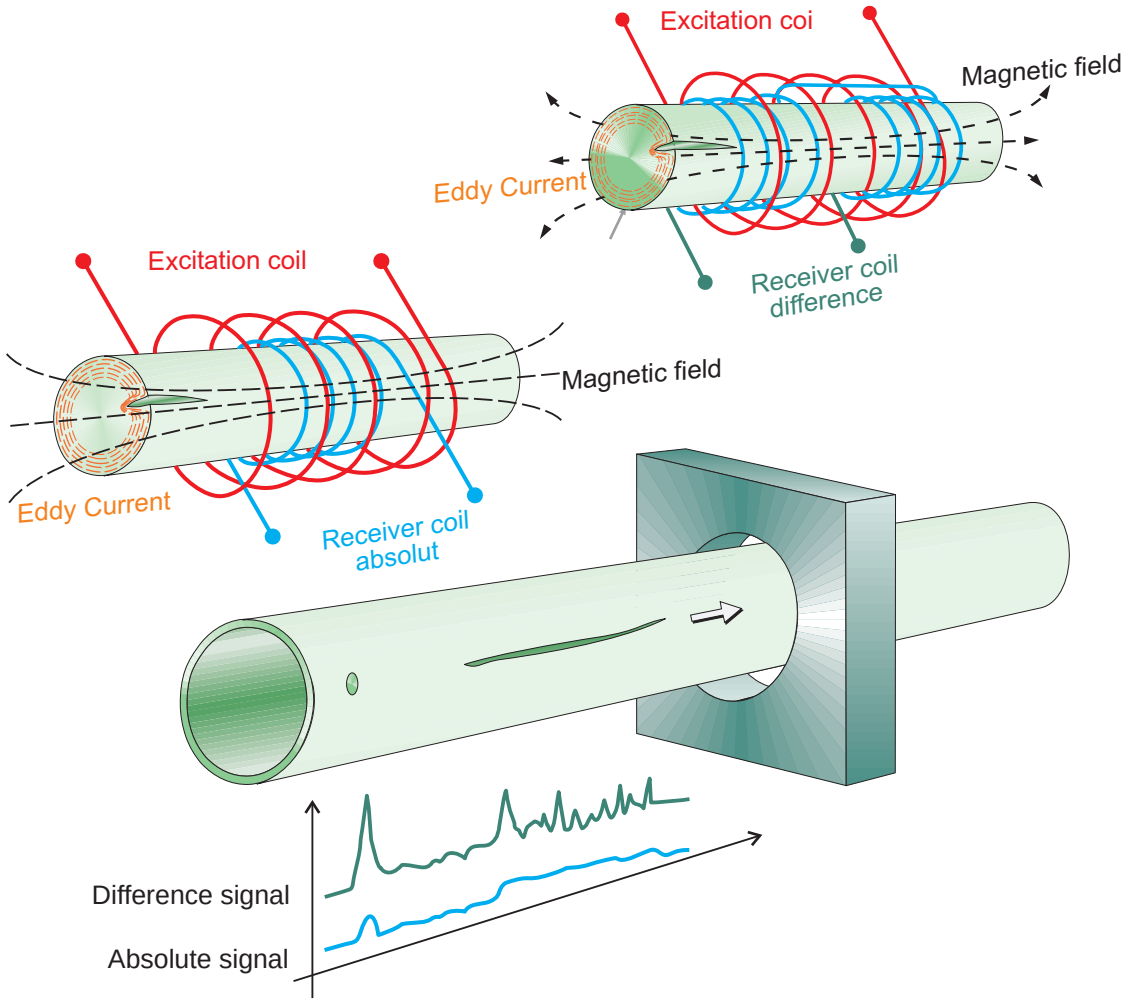


Fig. 6 Through-put coil with differential and absolute winding system

The sensor systems M xxx operate according to the eddy current principle in accordance with DIN 54 140.

The electrical test signals are generated by the electromagnetic interaction between the test object and test coil when the test object passes through the coil.

Encircling test coils in a multi-differential configuration are used for most test tasks. Adjacent metal areas are compared using differential coils. Short surface flaws that run deep into the material are detected by the differential coil with high sensitivity. Elongated flaws are displayed according to their local dimensional difference.

LMD[1] and HMD[2] test coils also contain a separate absolute winding. This absolute winding enables e.g. elongated flaws or 'slit tubes' to be detected on longitudinally seam-welded pipes. The absolute winding can also be used for coarse material mix testing. During testing, the ferromagnetic test object is magnetized by the magnetizing coil installed in the sensor system. This suppresses interference caused by the material permeability.

The field current for powering the coils and the coil output signals is transmitted by cable. Matching amplifiers are inserted for cable lengths > 40 m.

The electronic test unit consists of a processor-controlled electronic testing and evaluation unit featuring interactive operation and convenient display and documentation possibilities.

1 Low-frequency multi-differential (1 - 100 kHz)
2 High-frequency multi-differential (10 - 1000 kHz)

Device structure

A complete testing system consists of the following component devices:

- Electronic test unit (1)
- Operating computer (2)
- Software (3)
- FOERSTERnet (4)
- Housing (5)
- Sensor system (6)
- Magnetisation (7)
- Accessories and options (8)

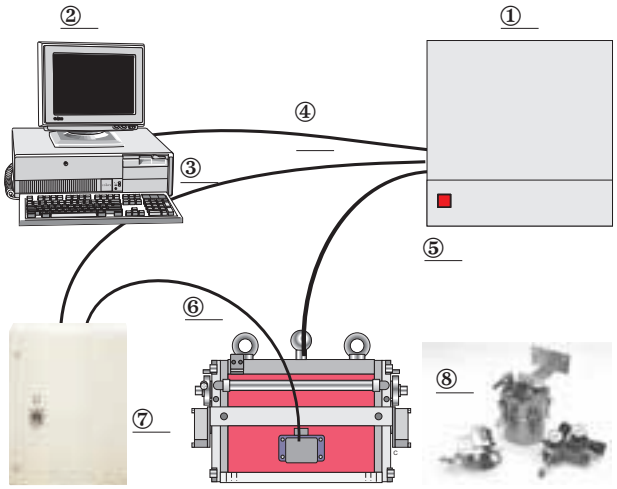


Fig. 7 Structure DEFECTOMAT DS

Electronic test unit

19'' card rack with 8 height units to accommodate the functional units.

- One or several test channels
  - Test channels with
    8 switch-selectable test frequencies
    standard set 1:
    1 - 3 - 10 - 30 - 100 - 300 - 1000 - 3000 kHz
    standard set 2:
    3 - 6 - 10 - 15 - 20 - 30 - 60 - 100 kHz
    other frequency lists on request
  - Automatically adapted filters to the current line speed
  - Phase adjuster

- Digital signal processing
  - Signal evaluation with 3 amplitude thresholds
    Vector signal or
    Y component
  - Alternatively phase-dependent sector evaluation with up to 4 sector areas, each with 3 amplitude thresholds

- Evaluating computer
  - Test evaluation in feed direction with a resolution of 5 mm, up to a transport speed of 3 m/s (increased proportionally for higher test speeds)
  - Selectable recognition of flaw groupings in accordance with the European norm EN1971
  - Flaw designation with maximum amplitude, phase angle, flaw threshold, position on the test piece and extent in feed direction
  - Flaw number evaluation with adjustable flaw separation
  - Part evaluation (sorting class) depends on permissible flaw numbers or accumulated flaw lengths
  - Automatic part recognition as well as selectable masking of part entry and exit
  - Automatic part allocation in the case of cutting to length after the sensor system
  - Direct 3-way sorting with polling signal
  - Speed measurement by measuring running time between 2 light barriers or by sending a timing signal in the range 10 pulses/mm to 1 puls/10 mm
  - Automatic test operation control with test readiness signal and error signal
  - Device and sensor monitoring:
    Continuous noise level monitoring,
    Monitoring of feed rate with clock check,
    temperature monitoring of the sensor system and the electronic test unit
  - All line connections with screw terminals for 24V DC on the rear panel of the electronic test unit, floating, selectable polarity, inc. 24V supply

- Power supply
  230V, 50Hz or 60Hz

Operating computer

PC with WINDOWS NT operating system, Ethernet plug-in card, operating software installed and operational.

- Integrated PC
  Display and operation in cabinet/housing
  - Powerful Pentium computer, all operating elements located in cabinet/housing
  - TFT tilting colour display
  - Hinged keyboard
  - Touch screen operation:
    All mouse functions are triggered by touching the screen directly with fingertips or a pen
  - Standard mouse parallel to the touch screen

- Built-in PC
  Monitor and keyboard separate
  - Powerful Pentium computer installed in cabinet/housing
  - 17" monitor
  - Industrial keyboard and mouse separate for operation on a desk

- Stand alone PC
  Installation on a desk next to the electronic testing unit or as an additional computer for additional operating stations
  - Powerful Pentium computer in the desktop housing
  - 17" monitor
  - Industrial keyboard and mouse

Software

- Base software
  - Operating software on WINDOWS NT for one operator terminal
  - Guided device adjustment
  - Adjustments can be saved
  - Automatic adjustment procedures
  - Original signal display
  - Test result display and logging in a database
  - Automatic administration of the database size to prevent hard disk overflow (holds the last 100,000 pieces)
  - Positionally accurate flaw marking
  - Direct 3-way sorting

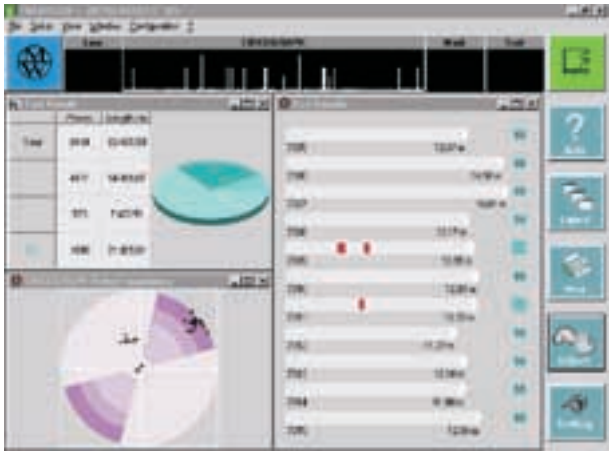


Fig. 8 Dialogue screen

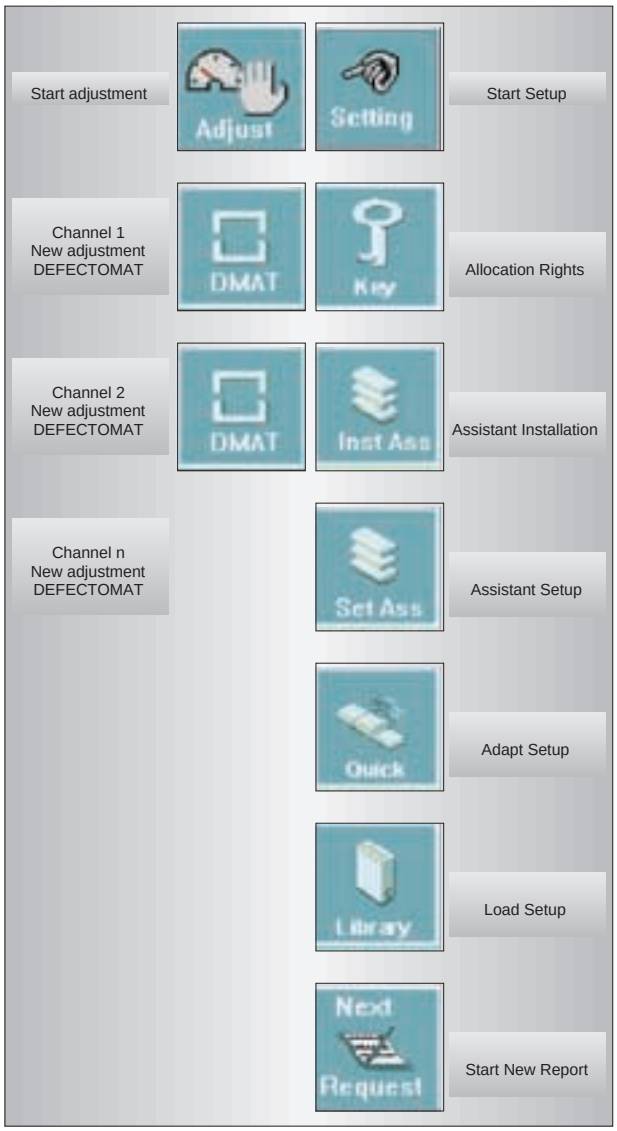


Fig. 9 Prompted operation

- Result investigation (optional)
  - All test results are stored in an open database
  - Grafical research mode using the stored results with every part and every flaw displayed
  - Printout of the stored results in every level of detail
  - Copies of test request result into a MS Access database for saving purpose or for additional evaluation
  - With FOERSTERnet option possible from every PC in the network
- Tail marking (optional)
  - Control of a maximum of 3 marking guns to mark the tails of the test pieces according to the sorting result, independent of and in addition to the standard positionally accurate flaw marking
  - Selectable marking length and position measured from the end of the test piece
  - Compensation of the response delay
  - Possible via the same marking guns in combination with flaw marking
- Report design (optional)
  - The design of test reports can be chosen freely
  - All test results, adjustment data and constant texts can be used
  - Type, size and format can be selected freely
  - Log templates can be saved and used to make a log printout at any time

FOERSTERnet

- Operation of one electronic test unit at several PC or access to several electronic test units at one PC using Ethernet connection (optional)
- Each operator terminal has fully functional access, can be configured and operated independent of the other operator terminals
- Setting mode can be delegated to every PC in the network
- Connection to any TCP/IP-capable network (e.g. Internet) via gateway

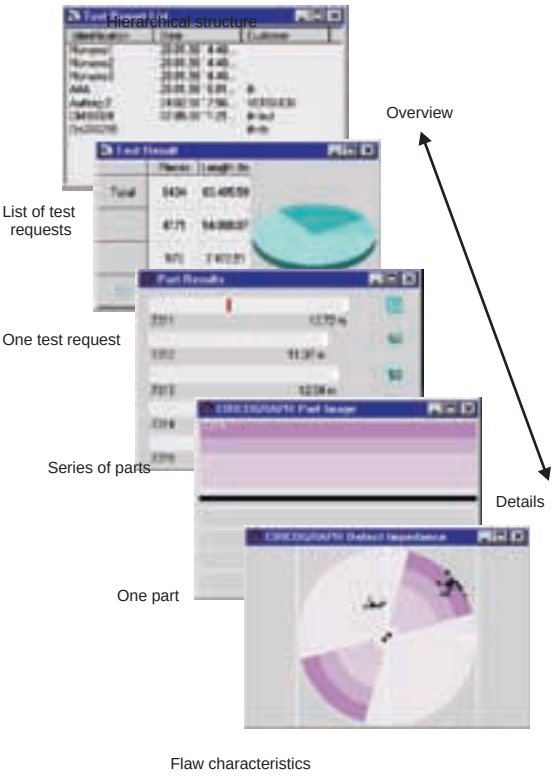
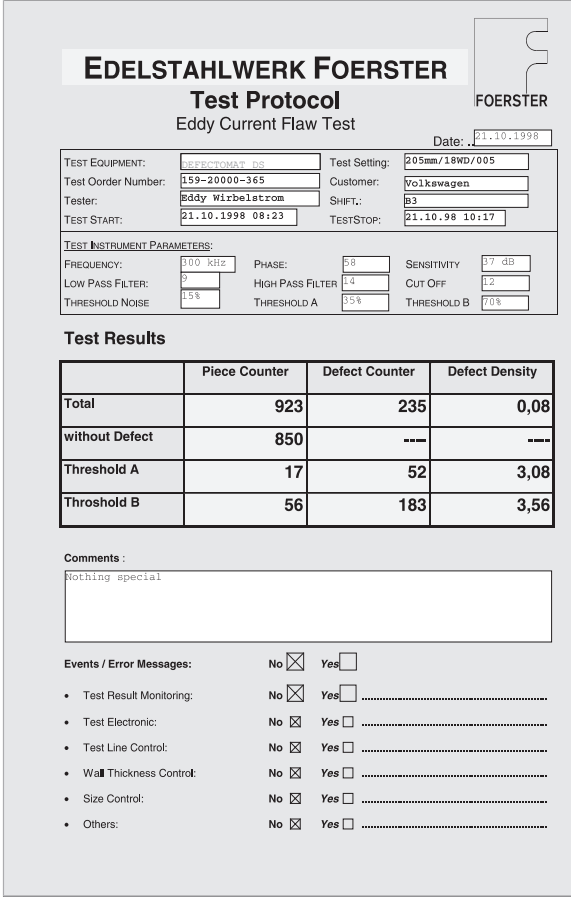


Fig. 10 Test results display



EDELSTAHLWERK FOERSTER

Test Protocol

Eddy Current Flaw Test

FOERSTER

Date: 21.10.1998

Test Equipment:	DEFECTOMAT DS	Test Setting:	205mm/18WD/005
Test Oorder Number:	159-20000-365	Customer:	Volkswagen
Tester:	Eddy Wirbelstrom	Shift.:	B3
Test Start:	21.10.1998 08:23	TestStop:	21.10.98 10:17

Test Instrument Parameters:

Frequency:	300 kHz	Phase:	58	Sensitivity	17 dB
Low Pass Filter:	9	High Pass Filter	14	Cut Off	12
Threshold Noise	15%	Threshold A	35%	Threshold B	70%

Test Results

	Piece Counter	Defect Counter	Defect Density
Total	923	235	0,08
without Defect	850	----	----
Threshold A	17	52	3,08
Throshold B	56	183	3,56

Comments :

Nothing special

Events / Error Messages:	No ☒	Yes ☐
• Test Result Monitoring:	No ☒	Yes ☐ .....
• Test Electronic:	No ☒	Yes ☐ .....
• Test Line Control:	No ☒	Yes ☐ .....
• Wall Thickness Control:	No ☒	Yes ☐ .....
• Size Control:	No ☒	Yes ☐ .....
• Others:	No ☒	Yes ☐ .....

Fig. 11 Report design

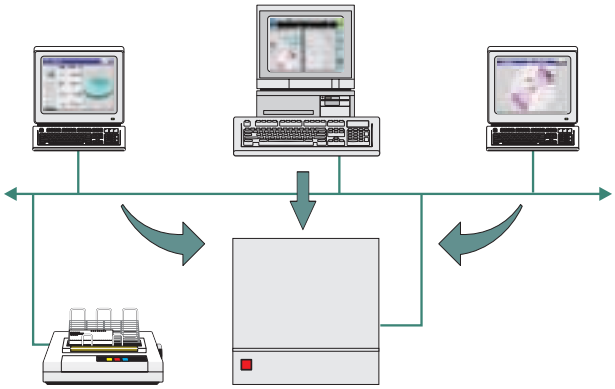


Fig. 12 FOERSTERnet, distributed terminals

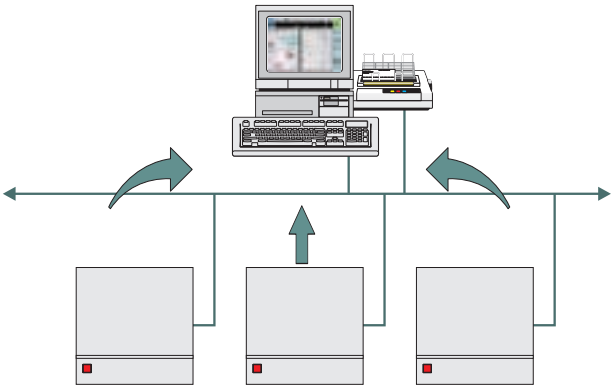


Fig. 13 FOERSTERnet, centralized terminal

- Software interface (optional)
  - Call-up of operating functions from other WINDOWS applications via TCP commands
  - All setting parameters can be read individually or in groups and can be written individually
  - Control of the internal setting archive through remote call-ups
  - Notification of new test results in the result database for synchronization of the result transfer

Housing

- Compact housing
  - Sheet steel housing (12 height units) for the electronic test unit and integrated PC or built-in PC
  - IP54
  - Lockable front glass door
  - W=555 D=700 H=595

- Cabinet housing
  - Steel cabinet (37 height units) for the electronic test unit and integrated PC or built-in PC
  - free cabinet space (25 height units) can be used e.g. for printer drawer
  - IP54
  - Lockable front glass door
  - W=600 D=800 H=1800

- Swivel cabinet
  - Steel cabinet (37 height units) with swivel frame for the electronic test unit and integrated PC or built-in PC, all rear connections accessible from front
  - free cabinet space (20 height units) can be used e.g. for printer drawer
  - IP54
  - Lockable front glass door
  - W=800 D=800 H=1800

- Printer drawer 19“ 6 height units
  For printer up to a maximum of W=400 D=440 H=260
  (only for cabinet housing or swivel cabinet)

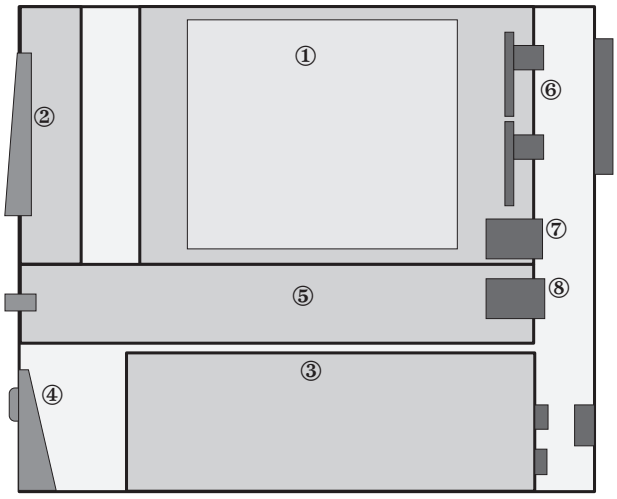


Fig. 14 Compact housing 12 height units, electronic test unit, integrated PC, schematic

1 Electronic test unit PCB
2 TFT-Display
3 PC (Operating computer)
4 Hinged keyboard
5 Power supply
6 Sensor connection and I/O port
7 FOERSTERnet port
8 Power supply

Sensor systems

The various sensor systems have their own leaflets. Detailed information can be found in these leaflets:

	Order no.
Sensor system M40 - M90 - M170	137 363 3
Sensor system P12 - P40 - P40T	138 134 2
Sensor system H40 - H90	137 365 0
Sensor system T60	163 846 7
Sensor system S	136 057 4

The various sensor systems are described below:

- Sensor system M
  Support stand for test coils with magnetizing device for flaw testing of ferromagnetic semi-finished products.
  Three different sizes of the sensor systems M are used in the material diameter range from 1.0 to 170 mm. The next larger sensor system in each case thus also covers the respective overall range of the smaller sensor system. Depending on the largest respective nominal diameter, the sensor systems M 90 and M 170 can be extended downwards to 1.2 mm nominal diameter using suitable coil adapters and nozzle adapters.

  Both, through-put coils and segment coils, can be used in the sensor systems M 40, M 90 and M 170.

  The following are available:
  - Sensor system M 40
    Material diameter from 1.0 to 40 mm
  - Sensor system M 90
    Material diameter from 1.0 to 90 mm
  - Sensor system M 170
    Material diameter from 1.0 to 170 mm
  - Mounting dimension in the line approx. 400/500/600mm

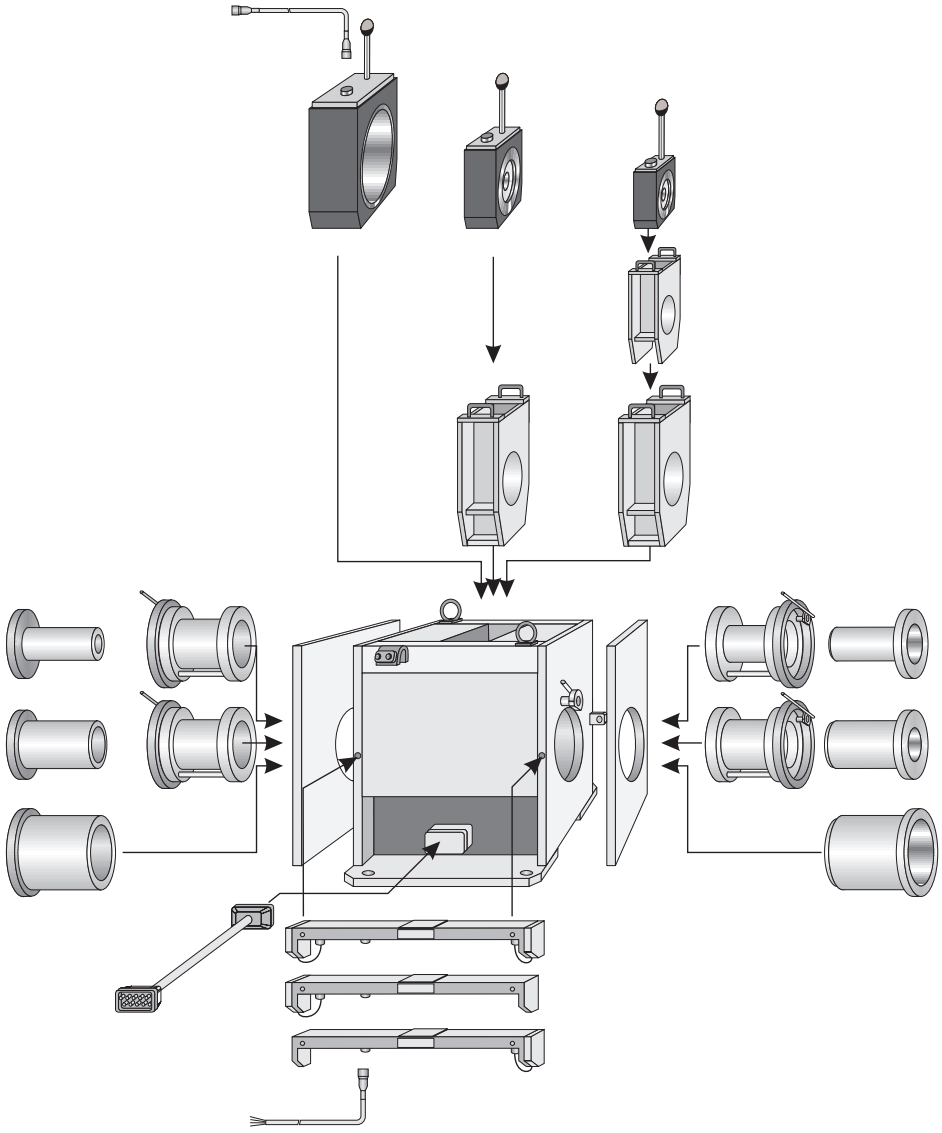


Fig. 15 Sensor system M 170

Fig. 16 Sensor system P 12, P 40, P 40 T

Fig. 17 Sensor system H 40

- Sensor system P
  Support stand for test coils with permanent magnetization for thin-walled iron pipes or wire.
  The following are available:
  - Sensor system P 12
    Material diameter from 0.3 to 15 mm
  - Sensor system P 40
    Material diameter from 0.3 to 44 mm
  - Sensor system P 40 T
    Material diameter from 5.0 to 44 mm
  - Mounting dimension in the line approx. 130/140/110 mm

- Sensor system H
  Support stand for test coils for flaw testing of non-ferromagnetic semi-finished products with a round or profiled cross-section in continuous through-put. With plastic protective nozzles for gentle material guidance.
  The following are available:
  - Sensor systems H 40
    Material diameter from 0.3 to 44 mm,
  - Sensor systems H 90
    Material diameter from 1.2 to 100 mm.
  - Mounting dimension in the line approx. 240/370mm

- Sensor system S
  for testing the weld seam zone of metallic pipes with segment coils
  The following are available:
  - Segment coil support SH 180
  - Segment coil yoke LSP 180
  - Segment coil yoke LSM 180
  - Yoke LS 440
  - Mounting dimension in the line approx. 130130/220/500 mm

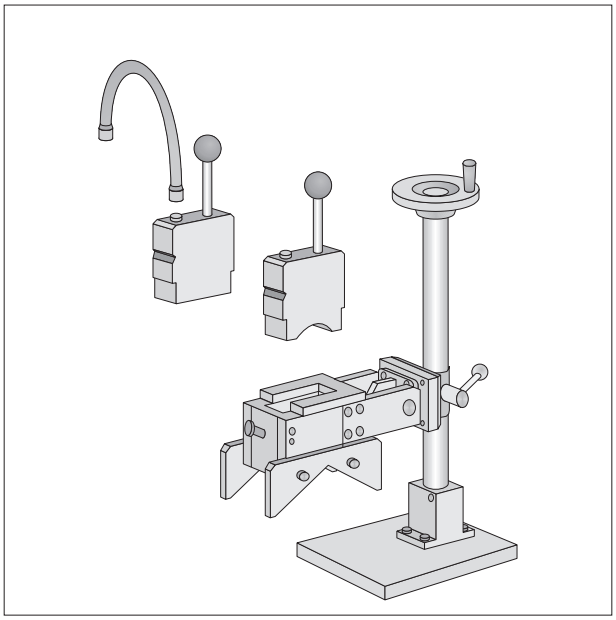


Fig. 18 Sensor system LSP 180
with permanent magnetization

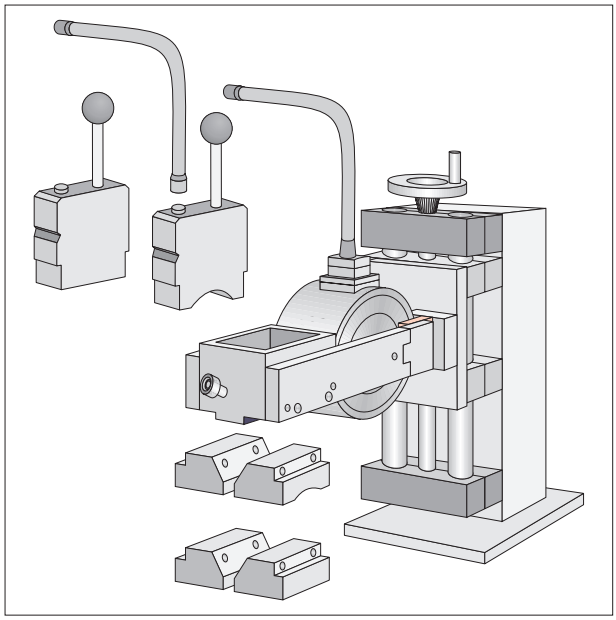


Fig. 19 Sensor system LSM 180
with adjustable magnetization

Magnetization power supply

Selectable current strength, remote controlled by the electronic test unit.
Installed in housing for wall mounting

Accessories and options

- Light barrier
  for measuring the transport speed for each test part
  transport speed range from 0.005m/s to 200m/s

- Motion transducer
  Incremental sensor for determining the transport speed using a running wheel placed on the test piece surface
  Running wheel diameter 160mm
  1 pulse per mm
  Recommended for varying transport speed (accelerated parts)
  Up to a maximum of 3m/s

- Holder for motion transducer
  Support for motion transducer with stepless height adjustment over 200mm

- Lifter for motion transducer with stand
  Pneumatic-electric positioning and lifting of the motion transducer onto the test piece
  Control signal 24V DC from the feeding conveyor control (from the customer)

- Colour marking unit 1.176.11
  To mark the flaw spots on the material, see Leaflet (149 593 3)
  - Connection to electronic test unit
  - Single-channel, no distinction between different types of flaws
  - Two-channel, for distinction between different flaws according to colour

- Demagnetization EMAG M 2.980
  see Leaflet (159 783 3)

- Laser printer with single sheet feeder

- Voltage adaptation
  to local power supply
  - All electronic components are designed for 230V, all power components for 3 x 400V 50/60Hz with ground conductor
  - Adaptation by means of an isolating transformer for deviating supply voltages,
    e.g. 3 x 200V, 3 x 440V, 3 x 500V
  - Suppression of mains interference
    for 3 x 400V
  - Maximum power consumption 7.5kW
  - Fitted in motor control housing (for MOC E separate installation)

- Cooling device for cabinet housing or swivel cabinet
  - With ambient temperature of > 40 to 50EC
  - With high level of air pollution from dust and scale
  - Mounting on the rear door of the cabinet housing or swivel cabinet
  - W=320 D=110 H=600