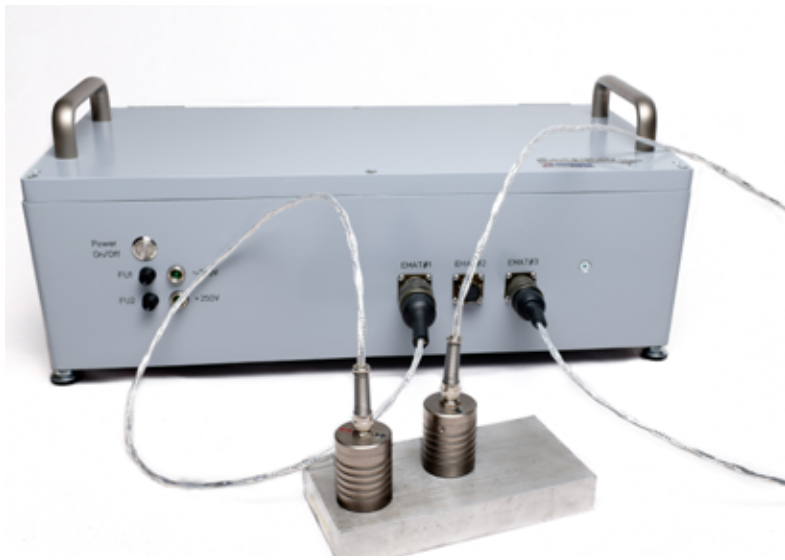
SonaFlex

Set of Portable Multifunctional Equipment for Non-contact Ultrasonic Examination of Materials

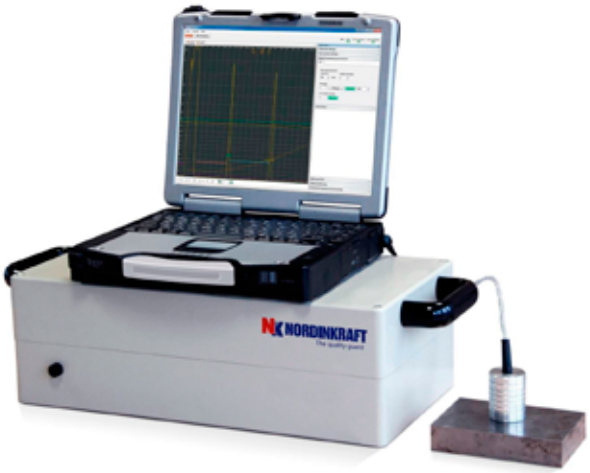


General Overview of the Testing Equipment

“SonaFlex” is a unique intelligent ultrasonic testing system with flexible hardware architecture.
Basic set of equipment could be easily re-configured for generation all possible type of ultrasonic waves for any kind of lab or industrial applications:

- Internal, surface and sub-surface detects detection;
- Precise wall thickness measurement;
- Material Properties evaluation.

The SonaFlex could be used separately or as the part of automatic or semi-automatic ultrasonic testing systems. At that all data from electronics unit will be transferred to computing unit by Ethernet or optical cable.



«SonaFlex» system

This is a high-tech complex set of equipment, realizes a transmitting and receiving of acoustic signals with different parameters as e.g.:

- Type of acoustic wave;
- Frequency;
- Beam angle;
- Etc.

and makes possibility of using this product for creation of relatively small NDT-systems as well as for execution of different types of lab tests. SONAFLEX is available in some variations.

The main application field of SONAFLEX is the execution of ultrasound research works with implication of different sensor types (EMAT, Piezo), that can be used for defect detection or definition of test object’s dimensions.
SONAFLEX can be adjusted in order to achieve exact technical goals and fulfil the customer requirements.

- Up to 3 frequencies within one unit range of 0,5 – 7,0 MHz;
- Different types of sensors can be plugged to SONAFLEX: for generation and receiving of acoustic signals with diverse parameters;
- Up to 16 independent multiprocessing channels may be implemented;
- One- or multi-channel transducers based on EMA or Piezo technology are applicable for the device. Phased array can be applied with this device as well;
- 16 I.O.to external system connections.

All this gives a possibility of wide range using of SONAFLEX.

Key advantages of the system

- Non-contact examination does not require any couplant. No consumption of water, no environmental and technical problems with water recycling;
- No corrosion of test objects as no water is needed;
- Equipment can test the object with really wide range of surface temperatures: from - 50°C up to +650°C;
- Very high notice immunity, achieved by application of sophisticated processing and filtration algorithms of UTE Software;
- Gap, inclination of the EMAT-probe make almost no influence on the test results;
- As a rule, measurements are possible through coating (paint, oil, plastic, glass and etc.);
- Applied “Modular” design of Test Electronics, provide its convenient, timely replacements without long-term interruption of testing procedure;
- Equipment is really ergonomic and allows convenient transportation;
- Because of hard aluminium case - electronic components are perfectly protected from the damages;
- Interface for external systems connections (8 inputs, 8 outputs);
- Light weight and portability.

SonaFlex –

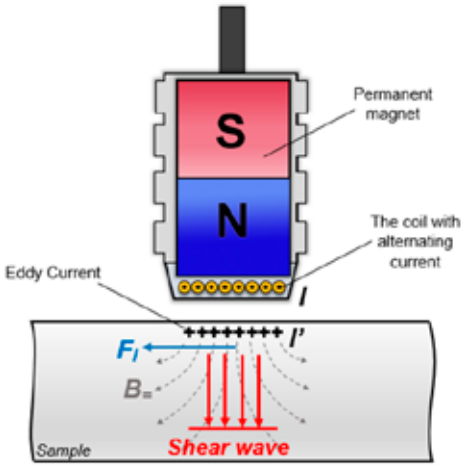
perfect portable instrument

for generation of all kind

of Ultrasonic Waves

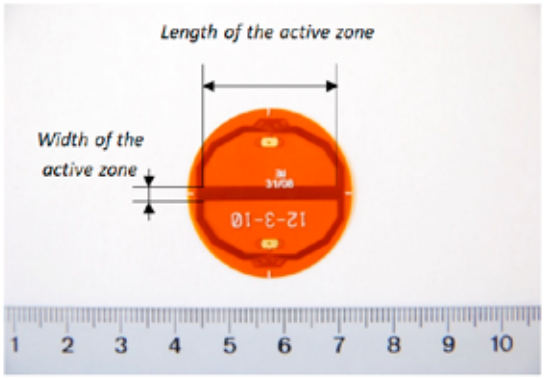
General introduction of the EMAT technology

The ultrasonic flaw detection method is based on well-known physical principles. The specific of the current proposal is applying a very modern and sophisticated technology based on so called EMAT – non-contact ultrasonic probes. These devices allow one to generate and receive ultrasonic waves without coupling, so that no water is needed for ultrasonic inspection.



Principle of generating/receiving of shears waves with EMAT. Waves are generated exactly normal to the surface.

EMAT probe is the best instrument to test metal products for internal imperfections. The EMAT transforms electromagnetic energy into the energy of elastic waves and (after interaction with borders of the material and/or defects in it) performs inverse transformation.
This double transformation is carried out in order to detect defects in a very reliable and intelligent way.
The active element of the EMAT intended for detection of laminations and wall thickness measurement is an electrical coil having a special “butterfly” shape (optimal parameters of these kind of coils are found and patented by Nordinkraft). An example of such coil is represented below:

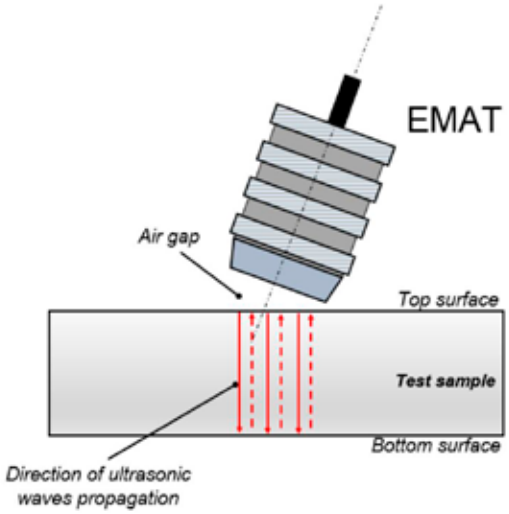


Example of a “Butterfly” coil: the perfect device for transmitting and receiving of ultrasonic waves normal to the surface of the material to be tested.

A pulse of current in the coil induces the respective eddy current of the similar shape in the test object’s surface. Because of the well-known physical phenomena (so called “Lorentz interaction”) some part of the electromagnetic energy is transformed into elastic polarized shear waves. These waves propagate into the material normal to its surface and reflect from its surfaces and/or imperfections. A “Butterfly” coil is the basic element of the EMAT probe for detecting laminations in plates.

One of the key advantages of the EMAT is that the ultrasonic waves are generated into material and received from it without its direct contact with the material; no need in couplant!

The second important advantage of the EMAT is that ultrasound is generated always normal to the material surface so that the direction of transmitting of ultrasonic waves is always perpendicular to its surface: regardless the probe inclination or test object geometry change (see the diagram in Fig. below):

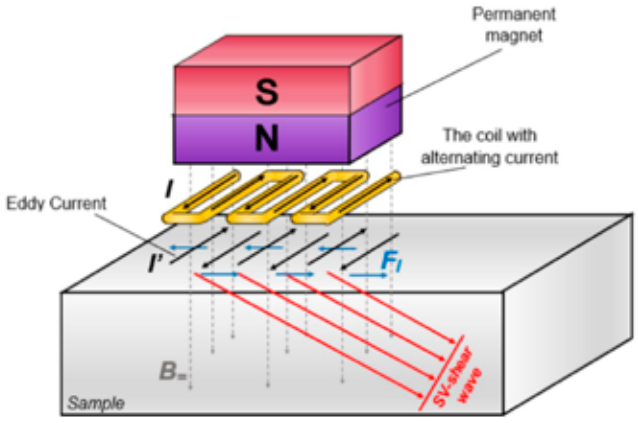


Inclination of the EMAT

EMAT is the most effective instrument to transmit and receive share waves, allowing one to get the best detectability and resolution. This factor assumes one more advantage of the EMAT-technology.

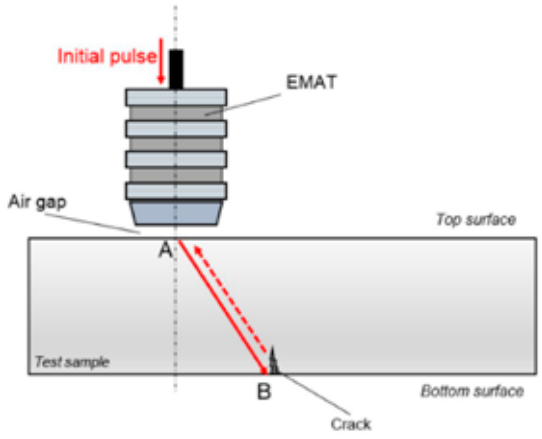
Detecting of Defects by means of SV-share Waves

The physical principle of defect detection is based on receiving and analysis of waves, reflected from the cracks on a top and bottom surface of the sample. These waves are being transform by EMAT to weak electrical signals, which after amplification and processing are displayed in the A–scan.

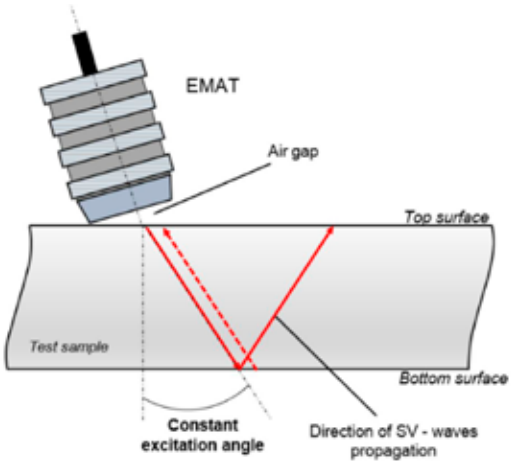


Principle of ultrasonic SV-waves generation with EMAT

For cracks on the bottom surface, signal in the A-scan is correspond with the wave witch propagates from point A, reflects at point B and than being received at A.



Detection of crack on the bottom surface

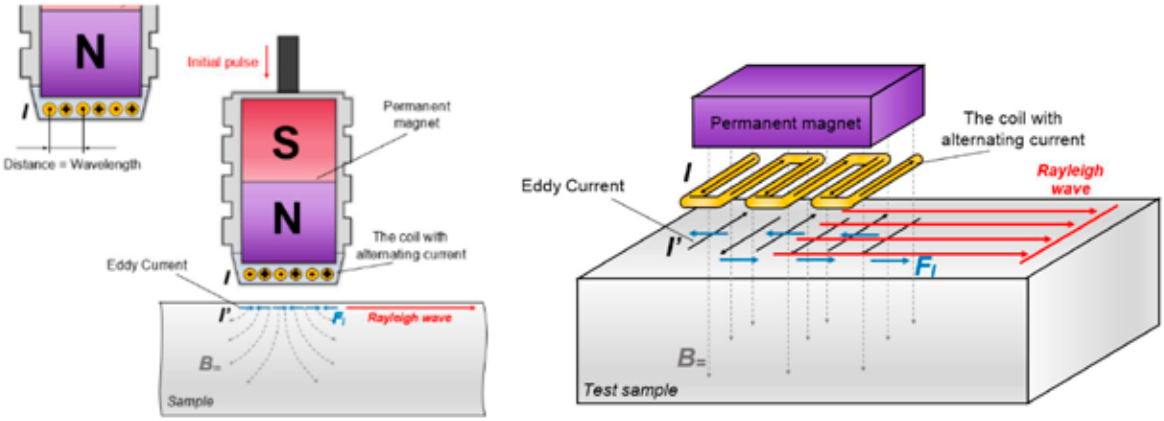


Inclination of the EMAT

It is very easy to keep the angle β stable with the EMAT: the beam angle do not depend on the probe inclination and test object dimensions or shape. On the contrary, a piezo probe will not work in our case: even a little ultrasonic beam inclination or change of the tube shape (that is practically inevitable with piezo probes) will immediately influence the beam angle.

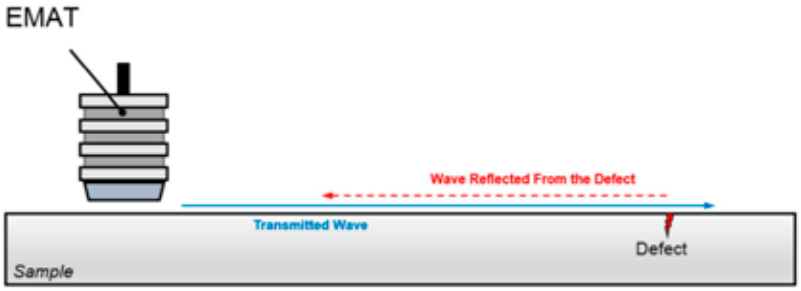
This phenomenon allows one to extend distances for optimal detection of defects located on both sides of the wall. This is a very important feature of the EMAT as it substantially increases an industrial reliability of the test results. This is a great advantage of the EMAT-technology. Thus, SV- waves transmitted by the EMAT are an extremely effective instrument to detect internal and external defects in flat samples, tubes, pipes, cylinders, and etc.

Detecting of Surface Defect by Means of EMAT



Generation of Surface waves by means of EMAT

Based on the physical principle described above, EMAT probes are developed for ultrasonic inspection of surface or subsurface of materials. EMAT transforms electromagnetic energy into the energy of surface elastic waves and (after interacting with defects) performs the inverse transformation. This double transformation is carried out in order to detect surface and subsurface defects in a very reliable and intelligent way without mechanical rotation of probes.

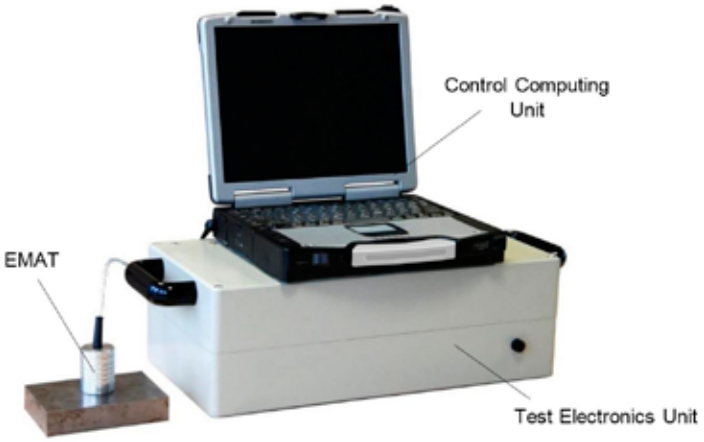


Principle of surface defects detection by EMAT

Equipment Composition

Basic set of SonaFlex equipment consist of the following main components:

- Test Electronics Unit;
- Electromagnetic Acoustic Transducer (EMAT);
- Control Computing Unit with installed UT Software.



SonaFlex composition

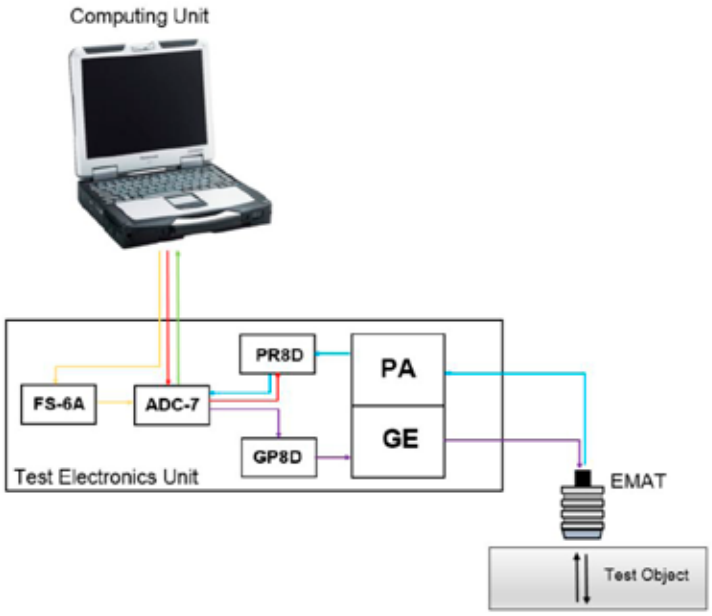
Test Electronics Unit

Test electronics unit is the main part of the equipment. It is intended for generating of initial pulses, pre-amplification, amplification, processing, and filtering signals received from the test object.

All test electronics components are assembled in a well-protected, airtight aluminium case with IP 65 protection level. Depending on the customer request – different configurations of the Test Electronics Unit is available. Basic type of Test Electronics Unit is shown on the figure below:

Test Electronics Unit

The simplified principles of the test electronics operation are shown in the diagram below:



General structure of the test electronics

Computing Unit supplies the FS-6A board with the pre-adjusted algorithm of operation (yellow line in the diagram). Electronic Equipment Controller (EECU) is a part of ADC7 board. Generator GE generates initial tone bursts (violet line in the diagram) in the coil of the probe. Ultrasonic waves are transmitted into the pipe.

Ultrasonic waves are reflected by walls borders and received by the same coil the probe.
The signals are pre-amplified by the preamplifiers PA and go to the PR8B unit for the analog processing. ADC-7 unit controls the gain of the PR8D board. It can be controlled automatically.

After the final amplification, signals are entering the ADC-7 board for being digitalized and processed.
Signals processing contains digital filtering and measuring of the relevant informative parameters.

Digital signal processing includes also up to 64 cycles of coherent accumulation (averaging), detection, filtration, gating and assessment of received signals' peak values.
Data-flow from ADC-7 is transmitted to Computing Unit via the Ethernet (green line in diagram). This data from ADC-7 is entering Computing Unit for secondary processing, storing and representing.

EMAT (electromagnetic-acoustic transducer)

EMAT-probe is a very important component of the equipment. EMAT generates ultrasonic and receives ultrasonic waves in the material by means of the electromagnetic-acoustic transformation. Transmitted ultrasonic waves propagate through the material, reflect from the opposite surface, and come back to the probe. In the receiving mode the EMAT transforms acoustical vibration of the TO surface into electrical signals.

Design of the EMAT

EMAT probe for research/monitoring applications have a common appearance but different internal organization – shape and dimensions of active element as well as configuration of permanent magnet should be specified for generation of different type of Ultrasonic Waves.

Typical probes for Lab applications are shown on the figure below:

EMAT probes for research/monitoring applications

EMAT for wall thickness measurement and lamination detection;

EMAT for angular ultrasound excitation;

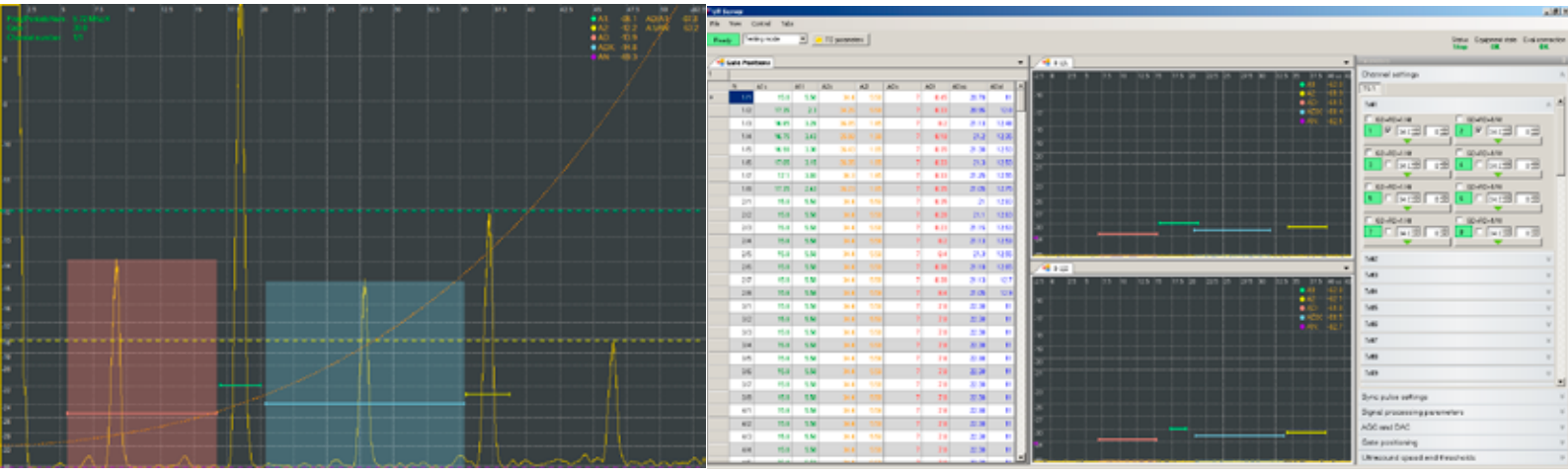
EMAT for surface waves generation/receiving

UTE Software

The flexible UTE-software is an intellectual product of Nordinkraft AG. The same software is applicable for all the equipment produced and developed by Nordinkraft Group.

Main functions of the UTE software are:

- The operation software is based on WINDOWS and provides TCP/IP interfaces to other WINDOWS programs;
- Support of EMAT- and Piezoelectric Probes;
- Support of TR-Probes and Phased Array Probes;
- Wall thickness measurement;
- Support of configurations for inspection of plates, strips, bars, billets and pipes;
- Support of up to 16 zones in the test object with separate testing standards and criteria;
- Fully adjustable test settings;
- Real-time visualization of test process;
- A-scan, B-scan, C-scan for every channel;
- Logging of test results in a database;
- Automatic adjustment of equipment parameters;
- Support of re-evaluation of testing results using new settings;
- Automatic test results saving in PDF format;
- Sensitivity adjustment window;
- "Channel State" window;
- "Test Results" window;
- "DAC" adjustment window;
- A-scan dynamic memory function;
- Test reports in accordance with supported standards.



UTE software: A-scan, gates positions window, channels diagnostics window (for reference)

Main Technical Data of the Equipment

Overall Dimensions	Electronic Unit	600mm x 240mm x160mm (LxWxH)
	EMAT	40mm x 55mm (øxH)
	Computing Unit	To be discussed with the customer
Weight	Electronic Unit	15 kg
	EMAT	178 g
	Computing Unit	To be discussed with the customer
Power Supply	Power voltage	a.c. 110-230 V
	Number of phases	1
	Frequency	50-60Hz
	Power consumption, about	400W
Air temperature		-20°C up to + 50°C
Temperature of the test object		-50°C up to + 650°C
Display of results		In millimetres or inches
Range of wall thickness to be measured		1.5 -100 mm
Typical precision of measurements		0.05mm
Allowed gap between the EMAT and metal (pipe material is to be ferromagnetic)		Up to 4 mm, depends on pipe surface, geometry and physical properties of the material
Type of transmitted/received ultrasonic wave		polarized-share wave
Nominal range of effective working frequency		4 – 7 MHz
Frequency of the initial pulses repetition		Up to 4kHz

We are sure, we'll find the best way for

quality improvement of your engines!

For more information please contact us or send us the description of your technical requirements, in order to define relevant parameters.
info@nordinkraft.de

Plate testing equipment EMATEST-PL / EMASCAN-PL

Pipe testing equipment EMATEST-PI

Bar & billet testing equipment EMATEST-BB

EMATEST – BB Wire

Tube testing equipment EMATEST-TU

Portable EMAT thickness gauge NKD-019E Ultrasonic

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