



Equipment for automatic ultrasonic testing of plates EMATEST-PL





Modern trends in the field of steel plates ultrasonic examination

Steel plates are the most manufactured and commonly used metallurgical products . Their extensive use in industries such as the pipe and ship industries means that more and more are produced every year.

This constant need for high-quality plates has implications for production and testing. Each steel plate designed to have a function in industry needs to meet the highest quality standards. The volume of steel plates that therefore need testing, coupled with the advances made in technology in recent years, means that conventional testing technology often just isn't up to the job.

At the same time, manufacturers need to consider environmental concerns and their corporate social responsibility to the wider society.

For over 20 years, Nordinkraft has been developing generations of plates testing equipment under the name of EMATEST-PL. The non-contact EMAT technology at the core of the product addresses many of the issues in modern day metal plate testing.



EMATEST-PL. Test assembly in the company's workshop in Heimsheim (Germany) before shipment to Alchevsk, Ukraine.



Blocks of EMATs made by Nordinkraft NDT Group for ultrasonic plate inspection. They can resist temperatures of up to +650 °C.

What is EMAT?

Principle of Electromagnetic Acoustic Transformation

EMAT is the abbreviation for Electromagnetic Acoustic Transducer. An EMAT is a non-destructive ultrasonic testing device which has overcome many of the issues faced by the more conventional piezo probe.

An EMAT transducer consists of a case with a socket, an induction coil, a protective cover, a magnetic flux concentrator and a permanent magnet (see Fig.1). Alternate current feeds the induction coil, causing electromagnetic oscillations which, in turn, induce eddy currents on the surface of the test object. Eddy current interferes with the permanent magnetic field, creating ultrasonic waves directly on the surface of the test object. These waves propagate in the test object, reflecting and deflecting from the walls back to the EMAT coil. The picture created by the ultrasonic activity shows up flaws and defects within the test object.

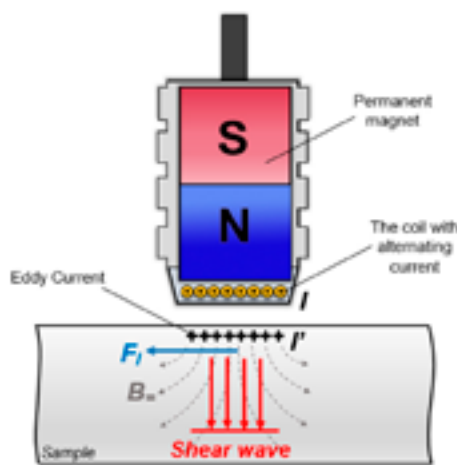


Fig.1. The principle of EMA transformation.

An EMAT is the only device that is able to transmit and receive transversal (shear) waves in this way. Waves transmitted by an EMAT allow much higher resolution and sensitivity to flaws than the longitudinal waves produced by piezo probes.

As the ultrasound source is the surface of the test object itself, tilting the probe or changing the gap between the coil and plate do not affect the acoustic field or the direction in which the ultrasonic waves are generated (see Fig.2). This is a huge advantage of an EMAT over a conventional piezo-probe.

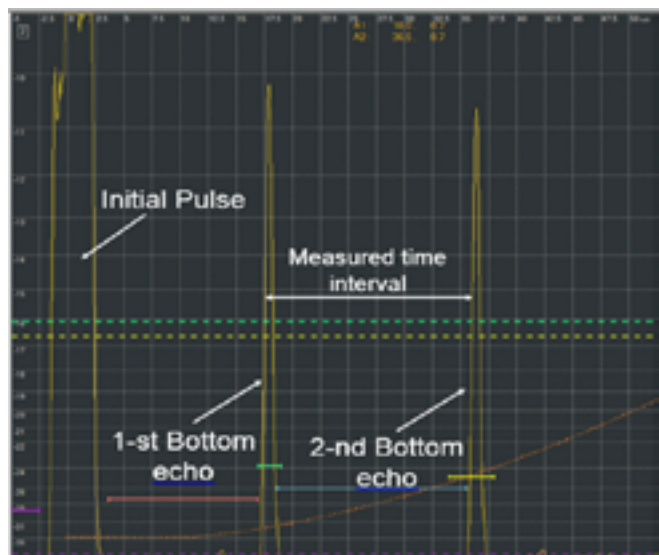
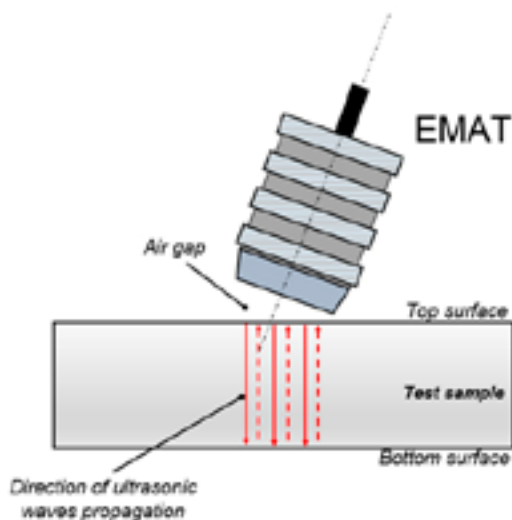


Fig.2. Reasonable inclination of the EMAT or variation of gap do not change either direction of ultrasound, or position of bottom signals in the A-scan. No ultrasound is out of the test object: ultrasonic waves start and end in the material to be tested.



An EMAT transforms electromagnetic energy into elastic wave energy and (after interacting with defects or borders of the material) performs inverse transformation in a very reliable and intelligent way. The active element of the UT-system is a “butterfly”-shaped electrical coil (see Fig.3). The exact symmetry of the coil allows external electromagnetic noise to be nearly completely eliminated (down to a level of -120dB!).

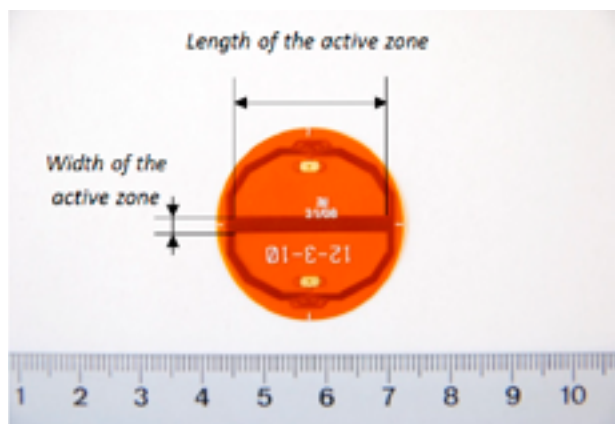


Fig.3. A “butterfly” coil is the perfect device for non-contact transmission and reception of ultrasonic waves normal to plate or strip surface (patented).

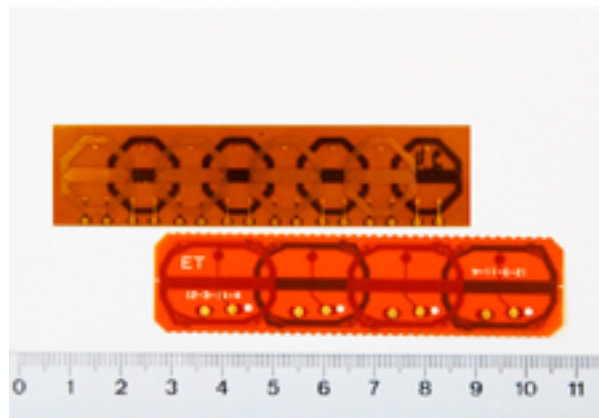


Fig.4. Examples of coil assemblies for plates and strip ultrasonic examination. The coils always overlap in order to avoid untested zones in plates.

Examples of “butterfly” assemblies are show in Fig.4.

The coil assembly is the main element in a multichannel EMAT-probe. The coil’s protective housing keeps it safe from temperature, friction, and mechanical damage (see Fig. 5).

Another Nordinkraft patent is the air cushion. Thanks to a layer of compressed air between the EMAT and the object surface, the EMAT does not actually come into contact with the surface. Instead it “flies” over the plate like a hovercraft. This means that the EMAT probes can last for a number of years.

Furthermore, the EMAT automatically ensures that the waves are always being transmitted perpendicular to the surface, regardless of whether the probe is being tilted, or whether is a change in the test object. This all makes EMAT an extremely effective instrument to detect flaws and perform wall thickness measurement for plates or strips.



Electronic units.

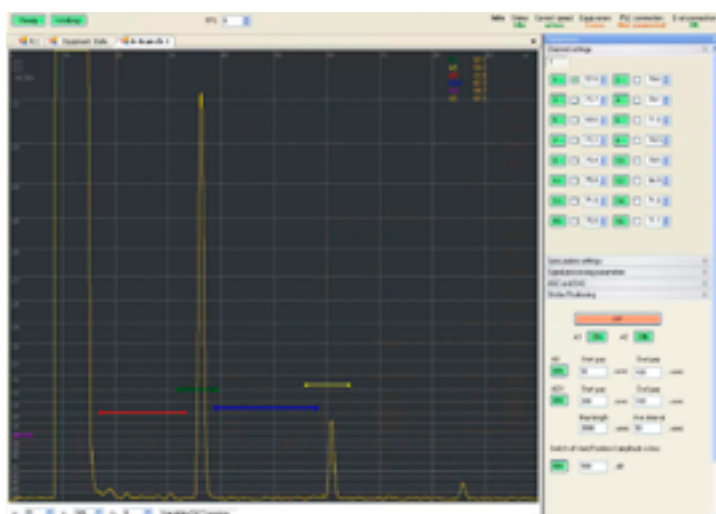


Ematest-PL - 5000. Xiangtan, China.

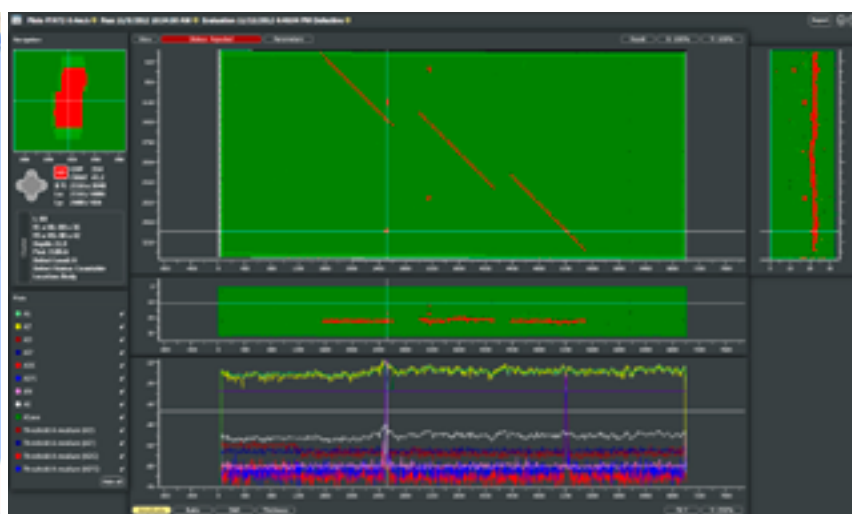
The EMATEST-PL in detail

Main features of the EMATEST-PL are:

- High quality testing equipment: intelligent, accurate and reliable;
- Ease of operation: EMATs are robust, non-contact ultrasonic probes which do not need adjusting or calibrating;
- Low maintenance: The probes do not need servicing, nor do they change their physical properties during the testing procedure;
- Inexpensive operation: the probes do not require a couplant in order to transmit and receive ultrasonic waves;
- Highly sensitive: flaws of 2mm diameter can be detected by the probes;
- Heat resistant: Tests can be conducted at a temperature range of -20°C to +650°C;
- Background noise elimination: immunity that is unattainable for piezo-probes;
- Environmentally-friendly: As water is not need in the testing procedure, several thousand litres of high quality water can be saved a year;
- High productivity: Tests can be run at 2 m/s;
- Kind to metal: No corrosion of plate or strips, no corrosion of roller conveyor or surrounding equipment;
- Kind to electronics: No water evaporation means that sensitive electronics are protected;
- Can cope with slight curves: plates can be tested without being straightened;
- EMAT is also able to transmit and receive Rayleigh waves to detect surface and subsurface defects. It is the next great advantage of the EMAT-technology (see Fig.9).



UTE software main window with A-scan.



Testing result window with 3-D presentation of the defects.



Two Possible Configurations Of The EMATEST-PL

The EMATEST-PL is most often used in “online mode”, as shown in Fig. 10. This permits a high capacity test of up to 60 plates per hour.

However, the equipment can also be run in “offline” mode, as shown in Fig. 11. The “Off-line” EMATEST-PL is actually a scanner which allows testing of 5 – 10 plates per hour.

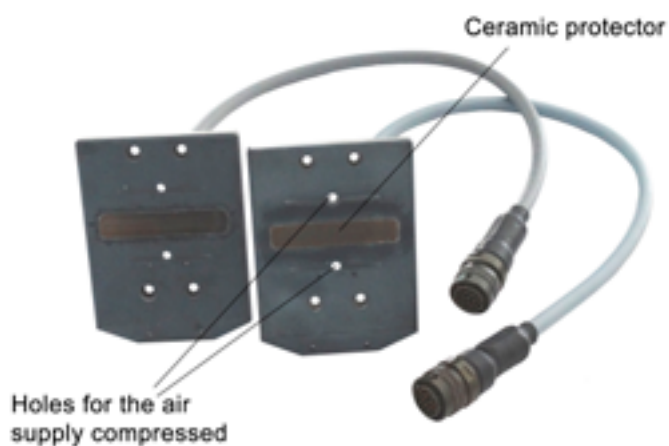


Fig. 5. Eight-channel EMAT unit.



Fig. 6. Magnetic system for EMATEST-PL produced by Nordinkraft.

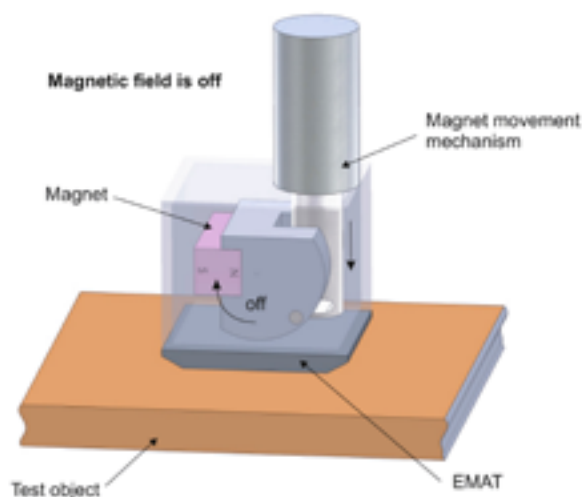


Fig. 7. Magnetic system in “OFF” position.

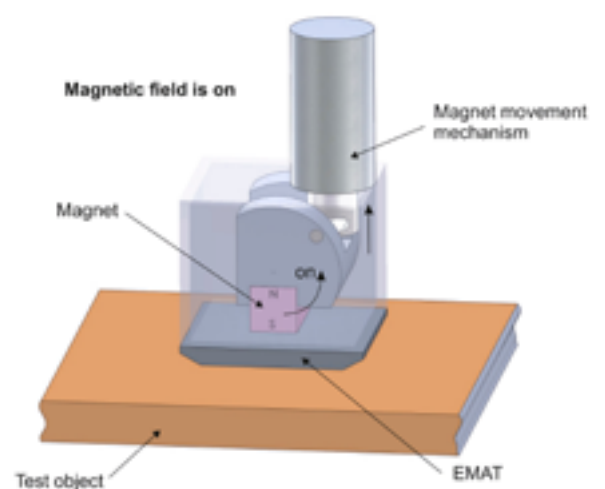


Fig. 8. Magnetic system in “ON” position.

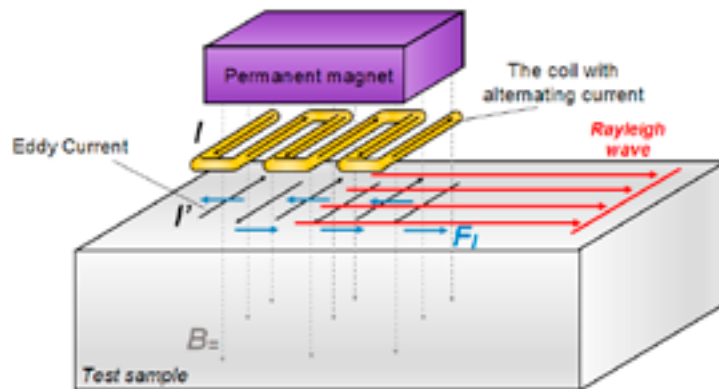


Fig.9. Generation of Rayleigh waves by means of EMAT.

In both cases, the test process and calibration are automatic, requiring minimal human intervention. When testing is finished, the system will print out an analysis of whether the tested plate meets required standards.

The system uses powerful permanent magnets, to allow the best performance. Magnetic system is designed so that the magnetic field may be deactivated automatically after the working cycle is over. The permanent magnet's two positions are shown in Fig.7 and Fig. 8.

Every EMAT unit with an individual magnetization system tests a path of about 70 mm in width (see Fig.6).



Fig.10.EMATEST-PL-3800. Erdemir Steelwork, Turkey.



Fig.11. EMASCAN-PL-5000. JSC Severstal, Russia.



EMATEST-PL-6. Equipment of the sixth generation

The sixth generation of EMATEST-PL is the best performing in the range. This equipment not only meets the latest norms and standards but also anticipates their future.

Each EMAT has a newly designed suspension system which not only decreases the weight of the test unit, but increases the level of automation to fully-automatic.

This has enabled us to substantially increase the sensitivity of the flaw detection equipment.

The new generation of EMAT probes has greater mechanical stability. Nordinkraft was the first company in the world to apply an “air-cushion” to ultrasonic plate inspection (patents RU № 2258218, № 2247978 and № 2247979). The technology perfectly protects transducers from both friction and high temperature.



EMATEST-PL-2800.



Blocks of EMATs assembled with magnetic systems.

The new EMATEST-PL-VI is the first system for non-contact ultrasonic plate testing in the world which is built on a «modular» principle. The system consists of single modules, each actually an independent sub-system (see Fig. 12). Each module contains four non-contact EMAT-probes, plus sets of high-performance electronics, automatics, mechanics and pneumatics.

The EMATEST-PL mark V1 has been designed to be compatible with standard components offered by a number of global manufacturers. This level of unification means that production, delivery and assembly time for the EMATEST-PL-VI has been dramatically reduced.

The EMATEST-PL-VI has also had new software designed for it. The device provides a 3D view of the testing object, practically eliminates untested zones, increases defect sensitivity and allows surface flaws of 0,5 mm to be detected.

Furthermore, new software has been developed for the new EMATEST-PL-VI. A 3-D presentation of defects, almost no untested zones, sensitivity to single defects of FBH-2. The option: longitudinal surface defects of 0,5 mm in depth can be also detected by EMATEST-PL-VI.

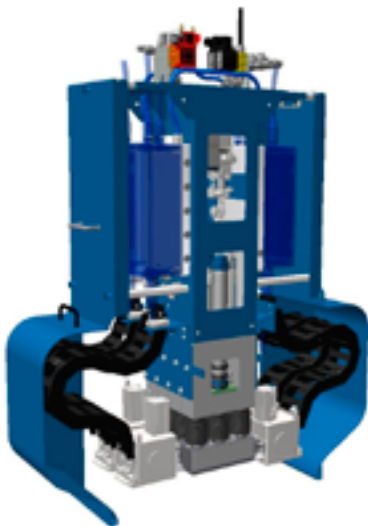


Fig.12. Testing module.



EMATEST-PL-2800.



EMATEST-PL around the world

From 1997 onwards, Nordinkraft NDT Group has designed, produced and put into industrial operation more than 30 systems for automatic ultrasonic inspection of flat products.

These systems are in operation in the plate rolling shops of forms such as JSC «Severstal» (Russia), JSC «Volzhsky Pipe Plant» (Russia), JSC «Magnitogorsk Iron and Steel Works» (Russia), OJSC «Alchevsky Iron and Steel Works» (Ukraine), JSC «Ural Steel» (Russia), JSC «Amurmetall» (Russia), JSC «Chelyabinsk Tube-Rolling Plant» (Russia), Tokyo Steel (Kitakyushu, Japan), JSC «Uraltrubprom» (Russia), Erdemir (Turkey), Nanjing Iron & Steel Co., Ltd. (China), HAEUSLER AG for Kuwait Pipe Industries and Oil Services Company (KPIOS) (Kuwait), Nippon Steel Corporation (Japan) etc.

Our New Products ALUTEST-PL

ALUTEST-PI is a top-of-the-art, revolutionary product for a precise Ultrasonic and Eddy Current examination of Plates – both cast and rolled.

ALUTEST-PI is based on application of the Array and Phase Array technologies allowing a reliable detection of as small as 0,8 mm defects through the whole plate thickness with just little untested zones.
The plates to be tested can be made of different metals as aluminum, titanium, steel etc.

Set of automatic testing equipment ALUTEST-PI is intended for fully automatic, very fast, extremely smart, and precise examination of plates (cast and rolled) according to the strictest internationally accepted norms.
The main field of application of ALUTEST-PI is aerospace industry.



The main features of the equipment are given below:

- Plate thickness, mm: 5 - 800;
- Internal defects to be detected: FBH 0,8 mm through almost the whole thickness;
- Surface defects to be detected: notch 20 mm long, 0,2 mm in depth;
- Reference test capacity, for plates 8000mm x 3000mm:
 - a) At detecting FBH 0,8 mm - three plates per Hour;
 - b) At detecting FBH 2,0 mm – six plates per Hour;
- Drying function after the test is over is available – no corrosion after the test;
- Physical methods applied: Phase Array and Array Ultrasonic (internal and subsurface) and Array Eddy Current (surface);
- Fully Automatic Calibration and operation – no space for a “Human Factor” negative influence!

ALUTEST-PI meets a long least of international and local standards.

The first set of ALUTEST-PL is shipped to one of the biggest world manufacturers of aluminum plates. The final customers: Airbus and Boeing.

Of course, this equipment can be easily configured for testing of plates made of any other metals: titanium, copper, steel etc.

ALUTEST-PI is to be your Quality Guard indeed!!!





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

Alutest-PL

Alutest-BB

EMATEST-WSP

EMATEST-WT

SonaFlex

We are sure, we'll find the best way for
quality improvement of your engines!

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