DELTA TEST

NON-DESTRUCTIVE MATERIAL TESTING

DELTA TEST – We do eddy current.

DELTA TEST – a name that stands for qualified, non-destructive material testing using the eddy current procedure.

Since its foundation in 1988, DELTA TEST has been carrying out state-of-the-art eddy current test services, according to customer requirements and based on respective norms and standards. We are specialised in all kinds of eddy current tests and provide these around the world. Tests of paramagnetic and ferromagnetic heat exchangers play a significant part in this.

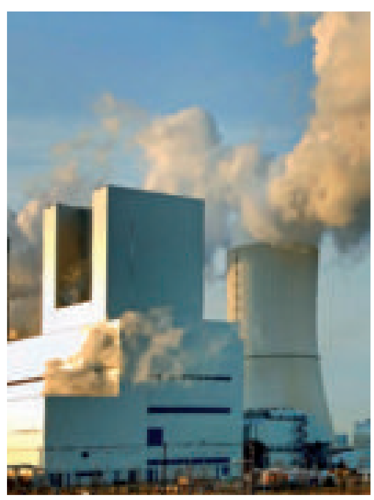
DELTA TEST guarantees short response times from the initial enquiry through to job execution, and furthermore optimally short test times with at the same time high quality test results. Our aim is to provide information through high-quality and reliable test results, which will help you to lower your costs for maintenance and repair in the long-term.

With this reliability and our availability around the clock, we can achieve a relationship of complete trust with our customers. Our national and international success is based on highly motivated, certified and qualified employees and modern equipment, development achievement and the ability to implement innovative ideas for you and with you.

DELTA TEST provides you with the security you require – fast, straightforward und successful! »

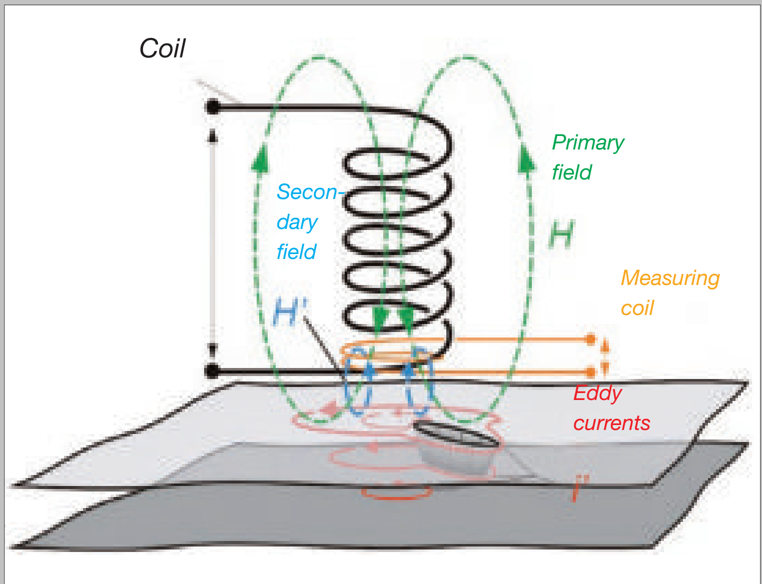
Our comprehensive services in the area of eddy current inspections are performed by certified inspectors directly on site as well as in the company laboratory. Naturally, our customers can contact us and our development department with regard to individual inspection problems at any time.

Services
- Heat exchanger inspections
- Mechanized eddy current inspections with crawlers and scanners
- IRIS inspections
- Videoscope inspections
- Tube leak testing
- Sleeve shaft tests
- Weldolet and hot surface inspections
- Flange sealing surface inspections
- Eddy current inspections of RDB threads and bolts
- Eddy current inspections in confined spaces via 3-axis manipulator
- Boiler and furnace tube inspections
- Surface crack inspections
- Turbine blade inspections
- Rolling bearing inspections
- Brake disc inspections
- Rail inspection
- Eddy current array technique



Industries
- Chemical and petrochemical plants
- Refineries
- Nuclear power plants
- Conventional power plants
- Waste incinerators
- Sugar factories
- Sea water desalination plants
- Oil rigs
- Rail cars/train
- Aircraft industry
- Automotive industry
- Pressure tank industry
- Tube manufacturers

Applications:
- Ferromagnetic tubes
- Condenser tubes
- Air-fin cooler tubes
- High-pressure tubes
- U-bended tubes
- Tube-sheet expansion zones
- Boiler and furnace tubes



Simplified principle of eddy current testing

Google on the Internet is always helpful for answering such questions. If eddy current is entered as a search term, this results in more than 120,000 hits, which is rather a lot and indicates that eddy current is fairly well known.

From our everyday lives we know that there are materials which conduct electric current, like for example cables. These electrically conductive materials are mostly metals like copper, brass, iron and steel. If such materials are brought into a magnetic alternating field, the magnetic field penetrates the material and causes eddy currents within it. They are called "eddy" currents because they usually move on curved lines in the electrically conductive materials and move back and forth to the rhythm of the stimulating magnetic alternating field. So they do have something "eddy" about them, which is why their name reflects their behaviour. Now the electric current is essentially nothing else than the movement of negatively charged electrons in the conductive material. This means that our eddy currents are electrons moving back and forth in the material. Compared to everyday life the material could be a large city, with the electrons moving about like people.

Professor Dr.-Ing. Dieter Stegemann

What are eddy currents?

In non-destructive test methods, eddy current technology increasingly gains in importance. The reason for this is that it is a test method that is flexible in its application and that its probes, usually coils of copper wire, are very adaptable and can be produced fairly easily.

Usually, people that move cause something. Is it the same for electrons? The answer is: Yes. Their movement, which is a current – the eddy current -, causes a magnetic alternating field on their part, which opposes the stimulating magnetic field and weakens it. This magnetic alternating field created by the eddy currents is called secondary field, which occurs as a result of the stimulating magnetic field. The stimulating magnetic alternating field is the primary field. The primary magnetic alternating field is usually created by coils carrying alternating current. These ensure that the primary field enters the material and stimulates the eddy currents. This causes "stimulated" electrons to move back and forth on curved lines. The higher the electrical conductibility of the material, the better the functioning of the eddy current generation. The eddy currents themselves are not passive and create a secondary magnetic alternating field due to their movement, which weakens the primary field and can thus be detected outside of the material. The secondary field can thus give evidence of the behaviour of the eddy currents on the inside of the material. Large cities have it a little easier, as traffic and pedestrian movements can be monitored by video cameras. But the secondary field can also respond quite sensitively to disturbances in the material and is thus a suitable verification tool.

Why can eddy currents be used for non-destructive tests?

Eddy currents are electrons moving back and forth on curved lines in the material. These electrons can serve as "spies" so to speak, indicating whether all is as it should be within the material or whether there are any disturbances. For example, such a disturbance could be a crack in a metal. For the moving electrons this could be a big obstacle which could block their way, so that they would need to find a different route. Coming back to the comparison with a large city, this could for example be a blocked road. Now how does such an obstacle affect the electrons in the material? The electrons cannot move across the obstacle, so there is no eddy current here. This also means that there is no secondary magnetic field at the site of the obstacle, which in turn also means the primary stimulating field is not weakened. This implies that flaws in an electrically conductive material can be detected via the amplitude of the magnetic alternating field resulting from the overlay of stimulating field and secondary field. If the electrons are forced to make a detour due to the obstacle, which requires additional time, this means that – compared to the uninterrupted case – there is a time shift between the primary and the secondary magnetic field. This is called a displacement of phase between the two fields. This can also be measured.

For finding flaws in the material, amplitudes and phases of magnetic field changes caused by the eddy currents are thus available. Different flaws in the material obviously cause different behaviour of the eddy currents and their signals, which makes it possible to differentiate between various flaws. For example, material losses or wall attenuations due to corrosion provide different signal responses than the already mentioned cracks. For this reason, the application of material tests with eddy currents can be quite versatile. The measuring probes used in eddy current technology normally consist of a transmitting coil for creating the stimulating primary field and a receiving coil for measuring the resulting magnetic field. For this reason, the production of coils is relatively simple and cost-effective. Electrical voltages and currents in the frequency range up to a few megahertz are used. Usually, the analogue signals from the probes are transformed to digital signals, so that the eddy current signals can be analysed quickly and easily. As these are electromagnetic signals, their effect is quick, and high test speeds can be achieved. The signals and their processing and analysis enables the creation of fully automatic eddy current test systems for online or inline testing of work pieces during production.

Source:
Der Einsatz von Wirbelströmen für die zerstörungsfreie Werkstoffprüfung
Dieter Stegemann,
em. ord. Professor Dr.-Ing.
Fakultät für Maschinenbau
Leibniz Universität Hannover

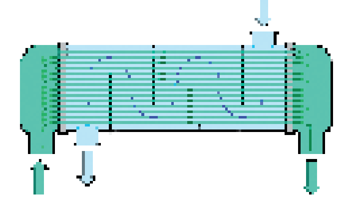
DELTA TEST – We give you security.

Trust is not enough, control is indispensable!

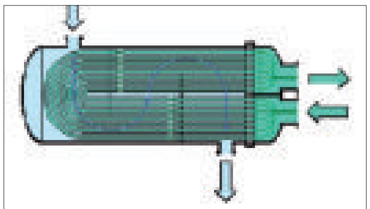
When its about security and the flawless operation of your heat exchanger tubes, this could be your motto! With targeted utilisation of eddy current testing, DELTA TEST can help you to always be on the safe side and to avoid unplanned downtimes for example.

Prevent all risks with regular inspections and instead gain complete security! >>

Heat exchanger tubes



Straight tube heat exchanger



U tube heat exchanger

Frequently, heat exchanger tubes from different material are affected by corrosion.
This can result in leakages, which in turn bear the risk of consequential damages like a longer search for leakages and decreased performance of the system. The worst case scenario is environmental damage. The significant financial damage for the company must also be considered.

With the eddy current inspection procedures used by DELTA TEST, our customers have a problem-oriented detection of tube damages at their disposal. By using the most recent computer technology, our competent technicians and engineers create an overview of the actual situation of each heat exchanger system, and depending on the respective type of damage, the customer can take the required actions for repair. Furthermore, frequently inspections enable tracking of damages, which confirm successfully introduced protective measures as well as allow an estimation of the life cycle.

Heat exchanger tubes are extremely important components, which can be found in all kinds of industrial systems like power or chemical plants. Smooth and faultless functioning of these components is vitally important for whole system parts. DELTA TEST gives its customers security! Through frequently inspections of heat exchangers, unplanned downtimes (breakdowns) can thus be reduced by 95%, and completely new tube systems of heat exchangers as well as storage of replacement tubes can be decreased to a minimum. Adding to this is the risk limitation in the area of environment as well as a further prevention of financial damages due to production downtimes.

The probability of detection (POD) when using our test system is more than 80%, which compared to other test methods like IRIS, RFT or MFL represents significantly higher reliability.

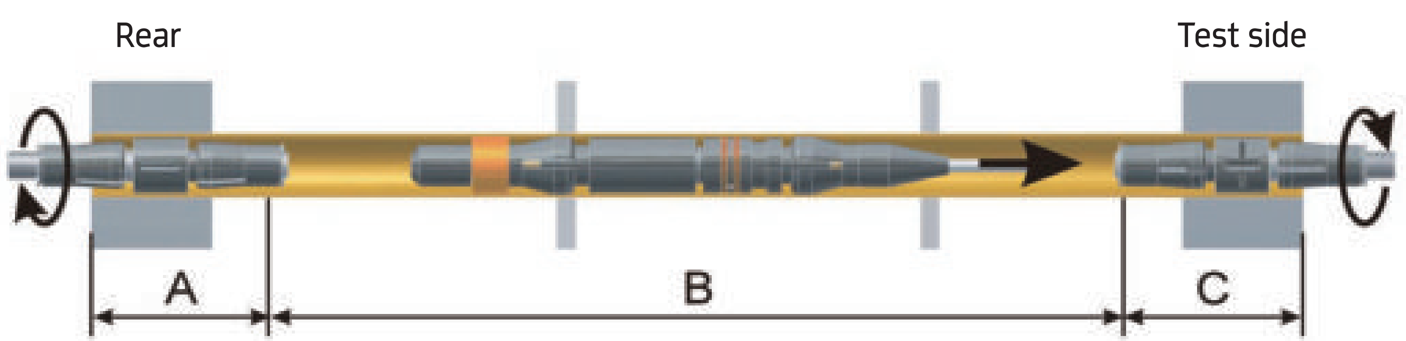
Furthermore, extended inspection system modules like automated signal analysis in the background and a precise position detection system ensure maximum security. In addition, we offer our customers specific expertise when testing ferromagnetic heat exchanger tubes (e.g. carbon steel, duplex, monel). Testing usually takes place with the test object installed, but it can also be used for lose tubes. Due to the immediate signal analysis, test results are immediately available to our customers. This means that possible additional repair measures can be performed immediately and without loss of time.

Applications of tubular inspections

- Ferromagnetic tubes
- Condenser tubes
- Air-fin cooler tubes
- High-pressure tubes
- U-bended tubes
- Tube-sheet expansion zones
- Boiler and furnace tubes

Heat exchanger

Conventional eddy current probe



Eddy current inspections above the tube length of a heat exchanger

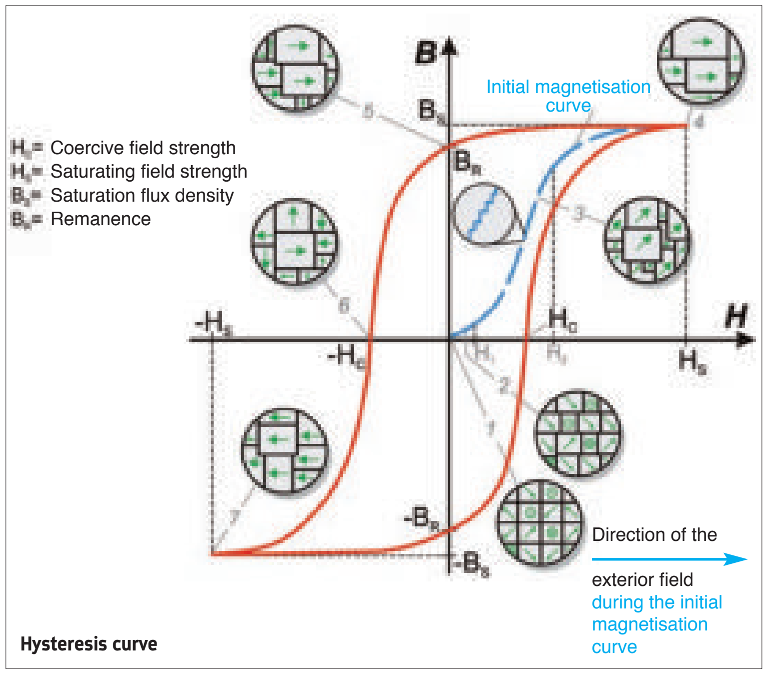
Testing of ferromagnetic tubes

Steel and ferrous material as well as nickel-containing alloys are ferromagnetic within the technically relevant temperature range, i.e. below the Curie temperature.
This means that after switching off an exterior field (magnet), a solid object keeps exhibiting measurable magnetic characteristics, a residual magnetization or remanence. This continuation of an effect after discontinuation of the cause is called hysteresis. Hysteretic properties of ferromagnetic materials hamper eddy current testing severely. DELTA TEST has the required know how for this.

The magnetization of a body depends on the exterior field that magnetizes it. There is a difference in the behaviour of paramagnetic materials, like zinc and aluminium, and ferromagnetic materials, like iron, cobalt and nickel, with regard to their permeability and their response after magnetization is switched off. The permeability of ferromagnetic materials is a decisive interference factor in tube testing, which must initially be minimized as much as possible.
In paramagnetism, the molecular magnets are aligned by an exterior magnetic field so that their alignment matches the exterior stimulating magnetic field. If the paramagnetic material is located in a coil, the molecular magnets are rotated in direction of the exterior field. Once the exterior field is switched off, the molecular magnets return to their original alignment and the solid object does not exhibit any residual magnetic properties on the outside.

For ferromagnetic materials, an almost complete alignment of the molecular magnets also takes place, but this is partly irreversible. This residual magnetization can only be removed by applying an exterior opposing field with a material-dependent field strength, the coercive field strength. The cycle of magnetization, remanence, coercive field strength and back-magnetization is described in the hysteresis graph above.

DELTA TEST has developed a procedure with which eddy current testing can be successfully performed even for ferromagnetic materials like steel tubes. This is possible by applying premagnetization procedures. For this, specifically developed probes are used, which reduce the ferromagnetic properties – the permeability – of the material to a constant level which is a low as possible. The aim is to render the material-dependent relative permeability µr to a value near 1. This causes the eddy currents in the material to behave similar to the behaviour in paramagnetic materials. This enables an evaluation of the eddy current signals by particularly experienced and trained experts. Furthermore, based on technical auxiliary means like automatic locators, special eddy current visualisation software and intelligent automatic signal analysis algorithms precise test results can be achieved, which are almost as good as conventional eddy current test methods for paramagnetic tubes.



Hysteresis curve

Comparison of methods for testing ferromagnetic heat exchanger tubes

Partial Saturated Eddy Current - PSEC

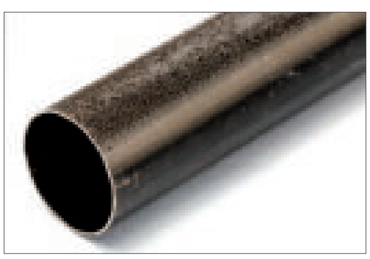
Eddy current test procedures with premagnetization have been developed for detection of internal and external damages in tubes made from ferromagnetic materials like carbon steel, low-alloy steel, duplex or nickel alloys. The central item for this specific challenge are test probes that were especially developed for this task, which can detect local as well as extensive corrosion, cracks and all known erosion types and differentiate between them.
Even damages near by or under vulnerable support plate areas can be determined, and their depth can be identified with fair accuracy. This is a decisive advantage compared to competing NDT procedures like remote field tests (RFT) for instance. Test speeds of up to 70 tubes per hour (average 30 to 40 tubes per hour) can be achieved. Even damages like cracks and corrosion in the tube sheet area are detected with special rotating probes. Fair tube cleaning is still necessary, but by far not as critical as for IRIS testing. Only magnetic and electrical conductive deposits must be removed from the tubes´ interior. Probe access with 1 mm undersize across the entire tube length must be ensured.

Prerequisites / Limitations:
Several types of defects present at the same time make interpretation of the eddy current signals more difficult. For this reason, experienced inspection personnel is required. The depth of external defects can only be determined by signal amplitudes compared to conventional eddy current. The test accuracy resulting from this can be slightly below that of conventional eddy current procedures (depending on the tube material, tube dimension and type of defect).

	ECT Conventional Eddy Current		ECA Conventional Eddy Current Array		PSEC Partial Saturated Eddy Current		IRIS Internal Rotating Inspection System		RFT Remote Field Testing		NFT Near Field Testing		MFL Magnetic Flux Leakage	
	Detect	Size	Detect	Size	Detect	Size	Detect	Size	Detect	Size	Detect	Size	Detect	Size
Cleaning level	fair cleaning (good)		clean surface (limited)		fair cleaning (good)		critical (not suitable)		low level (very good)		low level (very good)		fair cleaning (good)	
Preperation level	low level (very good)		low level (very good)		low level (very good)		high level (not suitable)		low level (very good)		low level (very good)		low level (very good)	
Relative inspection speed	very good		very good		good		slow (not suitable)		good		good		good	
Non-ferromagnetic material	very good	very good	very good	very good	5) good	5) good	6) good	6) good	not suitable	not suitable	not suitable	not suitable	not suitable	limited
Ferromagnetic material	not suitable	not suitable	not suitable	not suitable	very good	very good	very good	very good	very good	very good	very good	very good	very good	limited
Wall thickness < 2 mm	very good	very good	very good	very good	very good	very good	limited	limited	not suitable	not suitable	not suitable	not suitable	very good	limited
Wall thickness > 2 mm < 4 mm	limited	limited	limited	limited	very good	very good	very good	very good	good	good	good	good	very good	limited
Wall thickness > 4 mm	not suitable	not suitable	not suitable	not suitable	limited	limited	very good	very good	very good	very good	very good	very good	very good	limited
Finned tubes	very good	very good	very good	very good	very good	very good	very good	very good	not suitable	not suitable	very good	very good	very good	limited
ID / OD discrimination	very good	very good	very good	very good	very good	good	very good	very good	not suitable	not suitable	not suitable	not suitable	not suitable	limited
ID Pitting	very good	very good	very good	very good	very good	good	5) very good	5) very good	3) limited	3) limited	very good	very good	very good	limited
ID cracking axial	1) very good	1) very good	very good	very good	limited	limited	not suitable	not suitable	limited	limited	limited	limited	not suitable	limited
ID cracking cirumerential	very good	limited	very good	very good	very good	limited	not suitable	not suitable	not suitable	not suitable	not suitable	not suitable	limited	limited
ID general wear	very good	very good	not suitable	not suitable	very good	good	very good	very good	very good	very good	very good	very good	not suitable	limited
OD Pitting	very good	very good	2) limited	2) limited	very good	good	5) very good	5) very good	3) limited	3) limited	not suitable	not suitable	very good	limited
OD cracking axial	very good	limited	2) limited	2) limited	good	limited	not suitable	not suitable	limited	limited	not suitable	not suitable	not suitable	limited
OD cracking cirumerential	very good	limited	2) limited	2) limited	good	limited	not suitable	not suitable	not suitable	not suitable	not suitable	not suitable	limited	limited
OD general wear	very good	very good	not suitable	not suitable	good	good	very good	very good	very good	very good	not suitable	not suitable	not suitable	limited
Defects at tube sheet	1) very good	1) very good	not suitable	not suitable	limited	limited	very good	very good	not suitable	not suitable	not suitable	not suitable	limited	limited
Defects at baffle	very good	limited	not suitable	not suitable	good	limited	very good	very good	4) limited	4) limited	not suitable	not suitable	limited	limited

Very good (green) · good (yellow) · limited (light orange) · not suitable (red)

1) with rotational probe
2) lmited by material and wall thickness
3) volumenous defects
4) only if defect type is known, special probe necessary
5) For analyses, if delta-ferrite is present
6) only suitable, if ECT is not possible



Damages through Corrosion/Erosion

Corrosion

Damage of heat exchangers can be caused by a large number of factors. One of the main causes of heat exchanger damage – the worst case being a leak – is corrosion. Corrosion is described by DIN EN ISO 8044 as „the reaction of a metallic material with its environment, which causes a measurable change of the material and can affect its function (...)". Amongst others, the standard defines 37 types of corrosion, including pitting corrosion, stress corrosion cracking and erosion corrosion.

Pitting corrosion mostly occurs in passivated materials with an electrolyte present. The occurrence is strongly influenced by high temperatures, low electrode potential of the material as well as a low pH-value of the electrolyte, i.e. the fluid, and a low oxygen concentration in the electrolyte. For the occurrence of stress corrosion cracking, three conditions must be met: On the one hand the material must be susceptible to stress corrosion cracking. Furthermore, tensile stresses in the form of residual stresses or externally applied stresses must be present. Moreover, a specific corrosive agent must be present; for austenitic steels these are fluids containing chloride and for copper zinc alloys these are ammonia, amines, nitrites or nitrates.The erosion corrosion not only depends on mechanical material characteristics, but also on current conditions, such as speed and geometry, as well as on possible specific substance conditions like dissolved solid particles in fluids or formation of droplets in gases, which can result in abrasive loss.

Corrosion/Erosion

- Pitting corrosion
- Stress corrosion cracking
- Inlet erosion
- Baffle erosion
- Steam and wet steam erosion
- Droplet erosion

Erosion

By definition, erosion or wear and tear is the progressive loss of material from the surface of a solid object. If mechanical forces affect this base body, i.e. contact and relative movements of a solid, liquid or gaseous counter body, this results in erosion.

Amongst others, this undesired change of the surface occurs on tubes and tubeworks. Wear and tear is one of the main reasons for tube damages and causes the associated downtimes of heat exchangers and their connected components. Erosion on pipes can be manifold, with more or less severe consequences.

Erosion at support plates

This kind of tube damage is a type of erosion that is caused by support plates and insert plates that bang against the tubes. Support plates normally support and stabilise the fitted tubes in common heat exchangers. However, under certain conditions, for example if there is clearance between boring and tube or if other thermal and mechanical influences are present, the tubes can vibrate in the support plates and get damaged due to the banging, and thus wear out. This quickly results in undesired leakages, with associated financial and possible environmental damages.

Inlet erosion

Particularly the first inches of a heat exchanger tube are subject to severe erosion stresses. This is due to the fact that the influx of media is exposed to strong velocities and turbulences on the first few inches. These in turn can result in dangerous thinning out of the inlet area, causing erosion.

Steam and wet steam erosion

Steam erosion is mostly found on the external of heat exchanger tubes, which are subject to steam or condensate. Depending on the design of the cooler or heat exchanger, there could be increased steam concentrations at the support plates or the free tube areas, which in turn results in leakages.

Erosion through deposits and inclusion of foreign objects in tubes

If deposits or foreign objects accumulate in a tube, the inflowing medium washes around these. This results in velocities and turbulences directly behind the point blocking the free flow. In combination with water or abrasive particles, this can lead to severe wear and tear.

Droplet erosion

Erosion through droplets mostly occurs on power plant condensers. Due to condensation, microscopic steam droplets form, which hit the external tube surface with tremendous speed and energy. The force of these droplets can be so high that the tube surface is damaged with pinholes that can result in leakages.

Applications of tubular inspections

Condenser tubes

Condensers are used in power plants, chemical plants as well as various other industrial plants. The paramagnetic tubes of brass, cupron-ickel, stainless steel or titanium usually present are tested highly efficiently using eddy current (up to 700 tubes per shift/team). The accuracy of the test results is at ± 10 %. In addition, the erosion through droplet erosion present in power plants can be detected with a detection limit of approx. 0.2 mm defect size with highly sensitive probes.

Heat exchanger tubes

Heat exchangers can be found in almost all chemical plants. Where other test methods like IRIS or RFT fail at testing airfin cooler tubes, DELTA TEST can competently perform test tasks. The advantage of this inspection method is that the channel of the air cooler does not need to be dismounted for a test. Very precise test results are achieved during inspections of carbon steel tubes, as the cooling fins do not affect testing.

High-pressure tubes

Specifically for high-pressure tubes, i.e. stainless steel pipes with a wall thickness over 5 mm, DELTA TEST has realised a test system for complete control. With this, cracks and material homogeneities are detected in one pass on the internal and external surface of the tube and documented with precise location via C-scan. For this, an adjustable and mobile test device is available in our efficient laboratory.

Tube bends and U tube heat exchangers

The probe systems developed by DELTA TEST enable damage detection in tube sections that are difficult to access. For this, rotating as well as integral probes in a flexible guideway system are used. The probe system is able to pass through several tube bends and overcome changes of the inner tube diameter (swaging). This is difficult to realise with other NDT methods. Testing U tube heat exchangers is very difficult due to the tube sections bent to different degrees. Standard sensors cannot be used in these bends, but specifically adjusted, flexible sensors are required. Additionally, U tube coolers can remain in their casing, which means significantly reduced costs for dismounting.

Air-fin cooler tube

Expanded tube sections

Testing tube ends in expanded or tube sheet areas is a big problem for integral standard eddy current probes. DELTA TEST has developed a rotating probe system specifically for this challenge. It enables us to test paramagnetic as well as ferromagnetic tubes in the tube sheet area for cracks, corrosion or other inhomogeneities. Testing tube ends is very efficient, whereby up to 2,500 tube ends can be inspected, analysed and documented per shift/team. This rotating tube system is of course also available for testing the entire tube length, and for bended tubes.

Tube sheet

Eddy current rotating probe

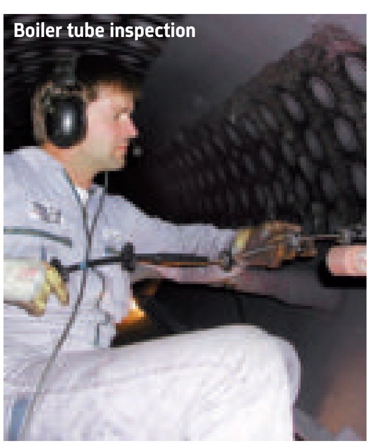
Finned boiler tubes

Probe for boiler tube inspection

Boiler and furnace tubes

Due to a severe steam boiler detonation in October 1994 near Bonn, Germany, at which six people lost their lives, special tests of boiler tubes were called for by the responsible Federal and Federal State Authorities. According to this, at least all three ascending tubes up to and including the first bend were to be subjected to a visual internal test, supplemented by endoscopy. In addition, a radiography test was to be performed at 20% of the bends.

Due to the usually present coatings (protective coating, furring etc.), the endoscopy could not always achieve the required detectability of the damage typical for the accident in Bonn: longitudinally oriented strain-induced crack corrosion. Radiography testing as well as ultrasound testing could also not always be sufficiently performed due to hampered local accessibility. One disadvantage of these test methods is that the insulation must be removed for the test to be carried out properly, and that the resulting measured values do not achieve the required resolution.



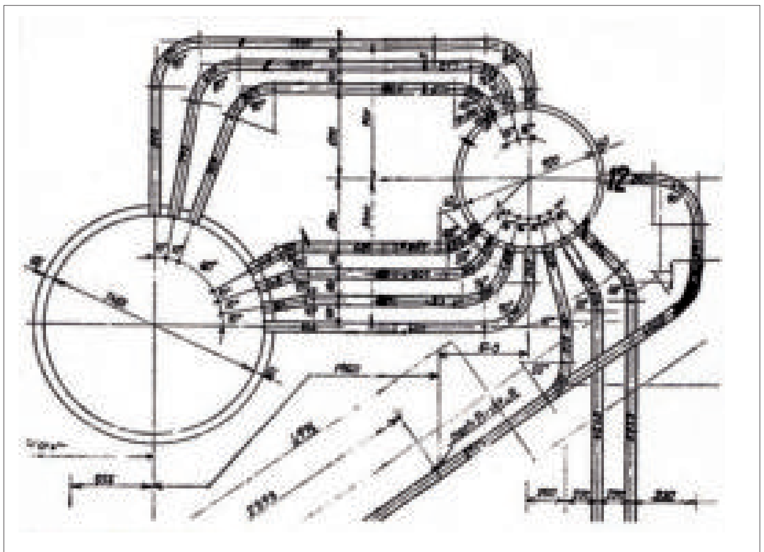
Boiler tube inspection

Ultrasonic testing (e.g. with an IRIS system) for example presupposes that the IRIS system is precisely inserted in the centre of the tube and that the tube to be tested is completely filled with water, to ensure precise connection. Particularly in bent sections, these conditions cannot be met. For the above reasons, together with TÜV Süddeutschland, DELTA TEST has developed an internal test system, based on the eddy current method, which has already been successfully used for more than 10,000 tubes.

This procedure includes an rotating eddy current probe technique, which scans the internal surface of the tubes seamlessly up to an inserting depth of approx. 20 m. This covers the first tube bend and possibly also the complete second one. Normal firmly adherent protective layers do not affect testing. Only crude inhomogeneous deposits may have to be removed with a hydrojet or chemical cleaning before testing. The eddy current probe was designed specifically for the defect type to be detected, so longitudinally oriented crack-like defects from a defect depth of approx. 0.5 mm can safely be detected.

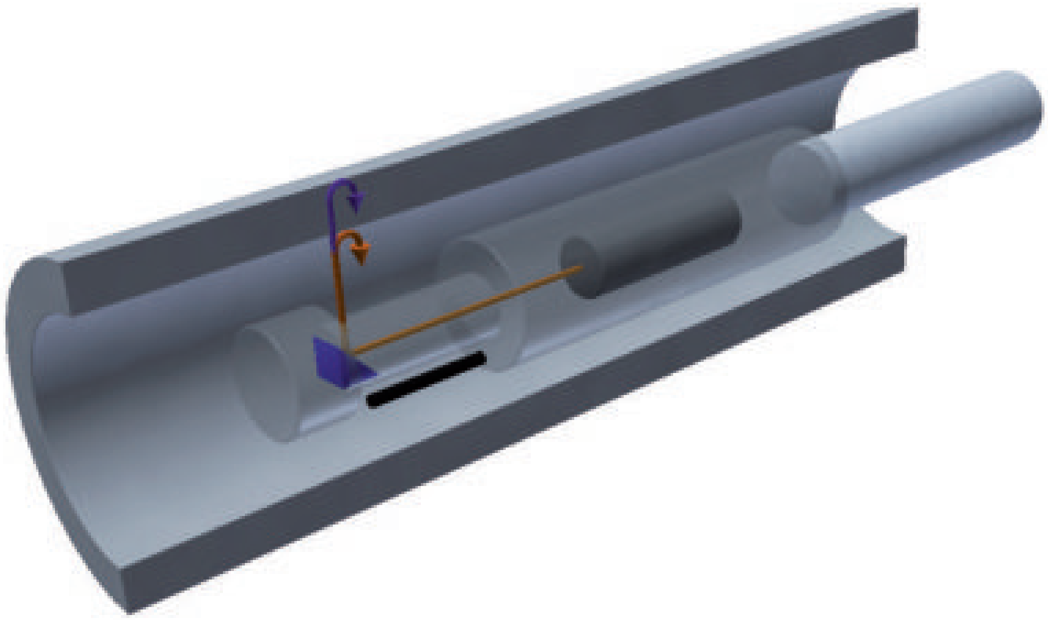
Additionally, also small corrosion pits are detected. The tests results so far on more than 10,000 tubes confirm the excellent detection sensitivity and good interpretability of the eddy current rotating probe method. For this reason we regard the eddy current method as suited to significantly increase the evaluation safety on the integrity of the boiler tubes.
The probe system consists of a number of centering elements on a flexible hose and the rotating sensor itself. These centering elements have a system for automatic self positioning on the surface to be tested.During testing, the detected data are compared to the data of the calibration bodies.

The results of the analysis are stored in a table as well as in the DELTA TEST documentation software.



Technical drawing of a typical test object

Alternative tube testing methods



IRIS – Internal Rotating Inspection System

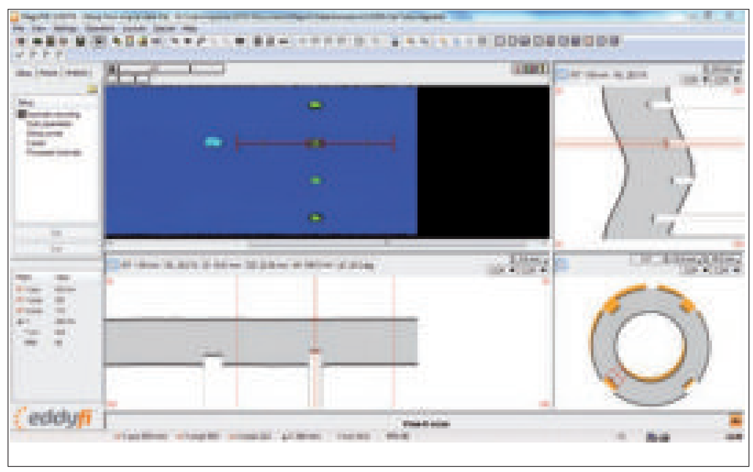
IRIS is a technique that can be applied on both ferrous and non-ferrous materials and even on non-conductive materials like plastics. With IRIS the remaining wall thickness of tubes can be accurately measured. IRIS is more accurate than other tube inspection techniques and has the advantages of presenting information about the geometry of defects. Local defects and wall-loss on both sides of the tube can be accurately measured. Defects under support plates can be measured without any limitations and IRIS allows detection of corrosion and thinning on a wide range of tube diameters (ID 14,5 – 76 mm … 0.57" - 3.0") and wall thicknesses (1.25 - 8.0 mm … 0.06“ - 0.31“) depending on the tube OD.

Fields of Application

The IRIS technology is mainly used as an analysing tool in combination with other techniques such as conventional eddy current or saturated eddy current. Due to its low inspection performance (6 – 12 tubes / h) only few selected tubes shall be IRIS tested in order to analyse or confirm results from other NDT techniques. Furthermore IRIS is the only suitable technique to detect defects within the tube sheet area of heat exchangers with C-steel tubes (air fin coolers).

Theory

The probe used in IRIS examination is made up of a centering device, an ultrasound transducer and a rotating mirror. An ultrasound pulse will be generated in the transducer that is mounted in axial direction, then A 45 degree rotating mirror in the probe will guide the sound bundle towards the tube wall. Next an ultrasound reflection (echo) will take place at the inner and at the outer wall of the tube. These echoes are reflected back and processed by the equipment. The time between these two echoes represents the wall thickness of the tube. Knowing the sound velocity in the material under test enables accompanying wall thickness to be calculated. Water is then used to rotate the probe mirror and is also needed as a couplant between the transducer and the tube wall. A calibration standard of the same material and dimensions as the tubes to be examined is used to check the IRIS system response.

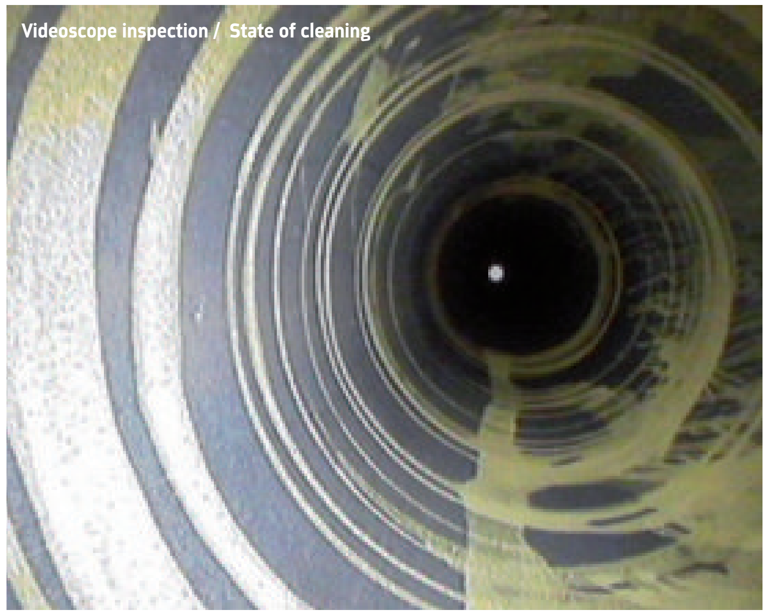


After an inspection an “on-site” report detailing the condition of each tube will be presented to the client.

Limitations

IRIS is not suitable/reliable to detect small pittings and cracks. It is not or only hard to apply in confined space. Bended tubes (U- tubes) cannot be inspected within the bended area. Tubes to be tested have to be perfectly clean to the bare metal in order to acquire adequate data.

Videoscope inspection / Leak



Videoscope inspection / State of cleaning

Videoscope inspection of tubes

The visual inspection or visual testing (VT) in terms of non-destructive testing methods is the optical quality control of a product (tube, shell, weld) through a technician qualified and certified according to ISO 9712. The type of visual inspection can be adapted and defined as per customer's requirements. For instance an inspection can be done for acceptable or rejectable material-inhomogeneities such as corrosion, cracks or leakages or a tube cleaning quality control. The visual inspection is one of the most important tools for the root cause analysis of defects. It can be used to clearly determine defect geometry and orientation to get conclusion on the defect mechanism. Visual testing gives outstanding possibilities to confirm and underline defects or indications, previously found with other NDT methods like eddy current or ultrasonic by means of expressive images.

Because of the fact that integral NDT methods like eddy current or IRIS are much more suitable for a full coverage inspection of larger areas (tubes) we use the visual testing for the verification of defects, cleaning control or random spot check only.

The use of visual testing makes it possible to inspect tubes as well as other components which are difficult to access with conventional tools.

By means of state-of-the-art video technology, combined with qualified personnel certified according to ISO 9712, DELTA TEST guarantees to all clients a competent visual inspection, defect analysis and documentation.

Video probe

Leak testing of tubes

As none of the preferred test methods for tube inspection can detect leaks, DELTA TEST has developed a special system, which can detect or exclude smallest leaks with great accuracy by pressure testing the tubes. In this procedure, the tubes are sealed off at both tube ends with a quick acting closing plug. A sensitive digital gauge is mounted to the system, which in case of a leak can immediately detect a pressure drop in the millibar range.

The plugs developed by DELTA TEST seal the tube to be tested 100% and have a resistibility up to an excess pressure of approx. 6 bar. A sensitive digital gauge is mounted to the equipment, which in case of a leak can immediately detect a pressure drop in the millibar range. Within a few seconds, the tube to be tested is filled (pressurized) with excess pressure air of approximately 2 bar (29 psi). If the tube has a leak, a decrease in pressure will be detected instantly. Otherwise the applied air pressure remains constant through valves in the tester. Due to the extremely quick response time of this system, test speeds of more than 100 tubes per hour can be achieved.

Delta Test is also using vacuum testing equipment for the detection of tube leaks. This leak testing equipment is very safe to use because a vacuum is used instead of excess pressure. By using a handy vacuum gun a negative pressure of approximately -0.9 bar is created within seconds. The use of the vacuum tester is slightly faster than the use of the positive pressure equipment and more than 120 tubes can be tested per hour (depending on the internal tube volume and the leak rate to be detected). The system is very easy to use and does not require special preparations. Just a connection to 6 - 8 bar compressed air is necessary to operate the equipment.

DELTA TEST –
We make surface cracks visible.

Non-destructive testing for surface cracks is particularly required in heavily used areas. This includes surface crack tests, amongst others on tubeworks, boilers, reactors and turbine blades in the secondary and primary area of nuclear power plants, flue gas desulfurising plants and all other industrial plants.

In this difficult area, DELTA TEST can reliably detect even the smallest defects in inaccessible test locations, and document these conclusively. In addition to using state-of-the-art eddy current technology, we use special, high-resolution sensor systems. You can trust DELTA TEST when it comes to safe surfaces. >>

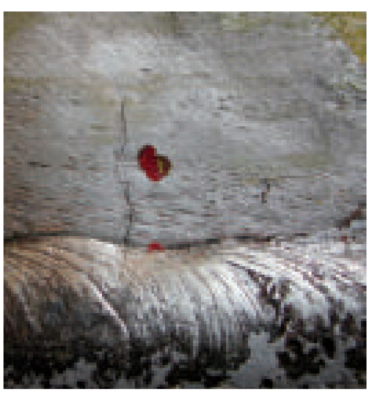
Turbine

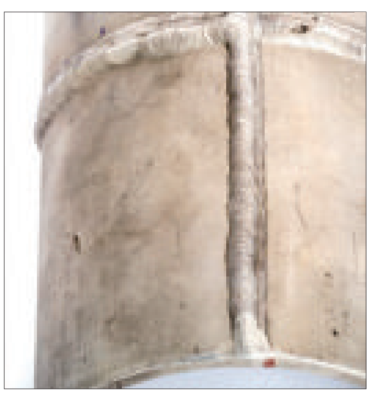
Applications:

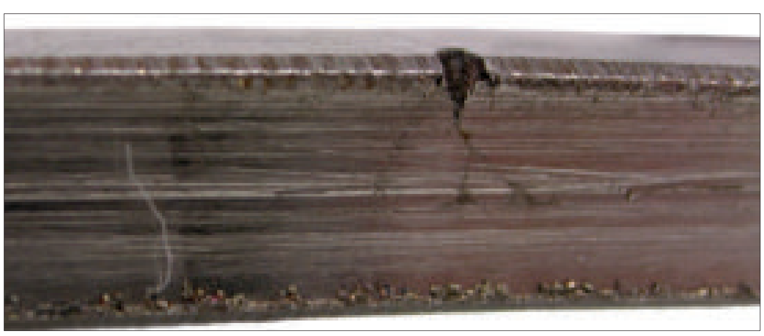
- Turbine blades
- Weldet seams
- Sealing surfaces
- Surfaces and vessels
- Inspection of weldolets or hot surfaces
- Rolling bearing inspection
- Brake discs
- Rail Inspection
- Eddy Current Array technique

Turbine blades

DELTA TEST has many years experience in testing turbine blades in power plants or flue gas desulfurising plants. The non-destructive testing of turbine blades is particularly important in the heavily used areas of small cross sections, i.e. edges. By using necessary cooling systems, the volume able to take a load is reduced again, so that loads and crack probability can increase further. While the large blade surfaces can be inspected easily with conventional eddy current test systems of surface crack tests, special sensor systems are indispensable for the heavily used edges. The edges of the turbine blades in their mounted state are tested for cracks by using special eddy current sensors, and the crack depth of the found flaws is determined. Documentation can be in simple lists with good/bad categories or by graphical display.







Welded seams

Welded seams are an artificial fixed connection between two components. Due to manifold stresses and complex load processes, the area of welded seams is particularly at risk to develop cracks and cause components to fail.

Grinded as well as ungrinded welded seams can be tested with the eddy current probes adjusted to the surface geometry. Wall thicknesses up to 20 mm (material-dependent) and crack depths from 0.1 mm can be reliably detected with suitable test systems. Welded seams of carbon steel, stainless steel as well as INOXYDA have already been successfully tested by DELTA TEST. Even hot tests up to 600 °C can be realised with our test system and respective personal protective equipment.

The inspection of austenitic weld seams was a big challange since many years. Delta ferrite within the weld seam made a serious inspection almost impossible. Delta Test has developed special probes which makes the inspection of austenitic welds for cracks (longitudinal and transversal) possible.

Sealing surfaces

Testing sealing surfaces for cracks and determining the crack depth are also included in DELTA TESTS range of services. To perform the tests, it is vital to guide the probe system coplanar to the test surface and at always the same distance. For this, flange diameters from DN 50 mm up to DN 750 mm, whose orientation and position is arbitrary, are tested. This diversity of tasks was achieved through combination of a probe bracket and guide principle with a very effective sensor guide: with the superposition of translational and rotatory movement of the sensor, faults oriented in any direction are detected.

The same equiment can also be used for the inspection of bores and threads.

Roller bearing inspection

Components for the automotive industry are subject to highest quality standards. Delta Test has developed high-sensible, problem-related inspection techniques to detect even smallest irregularities already prior production.

We inspection ball or rolling bearings (Material 100Cr6) in the area of abutting face or running surface for cracks with a sensibility of 50 µm.

Brake disc inspection

Another part of non-destructive testing in the automotive industry is the inspection of safety-critical components.

Delta Test has a technique for fast and efficient testing of carbon steel brake discs for sub-surface defects in their portfolio since 2012.

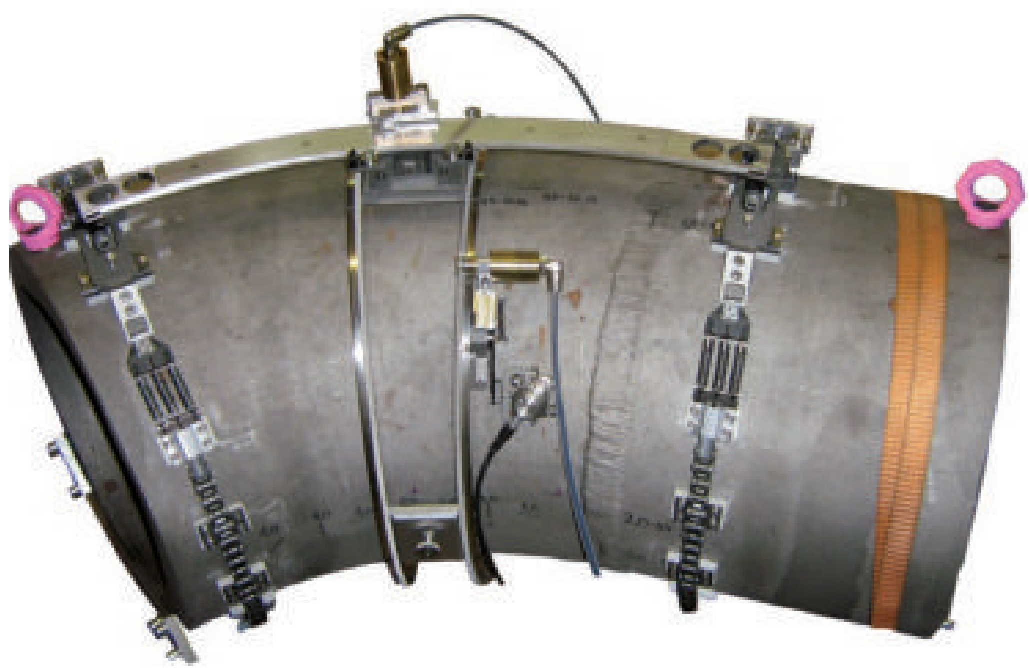
Weldolet inspection with
special personal protective equipment

Inspection of „weldolets“ and hot surfaces

"Weldolets" are butt weld connections which serve minimisation of stress peaks as well as integral reinforcement. The ferritic welded seams are tested for cracks from the outside, whereby the often high operating temperature of up to 540 °C poses a particular challenge to the test system and the testers.
To perform the test, DELTA TEST has developed a simple and robust system which serves as probe guide and enables 3-axis position tracking. The position data and the eddy current test data are fed into the system and processed there as a C-scan. The decisive advantage is that this test is possible during system operation. Cooling down and starting up phases can be avoided and the test is independent of idle phases.

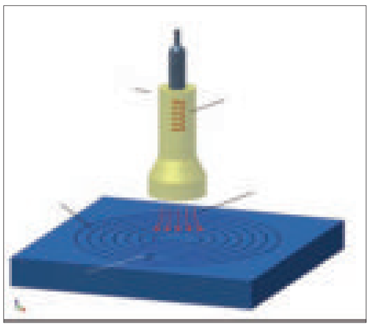
Hot bend testing manipulator

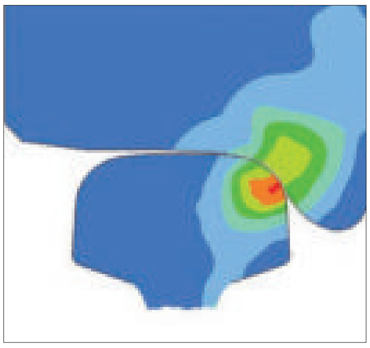
This manipulator is designed for the inspection of the surface of bended pipework with diameter of 6 - 8 inch under hot temperature up to 515° celsius. It can be used on austenitic and ferritic materials. Surface defects as well as sub-surface (only on austenitic material) can be detected within the base material and the weld.



Rail inspection

While in operation railway tracks must meet many different requirements. Passengers expect safe, quiet, comfortable and reasonably priced transportation. To keep the costs low, the operating company is dependent on a long life cycle and long lay-days of rails in the track. In addition, repairs and maintenance expenses of the track system should be as low as possible. However, the rail life cycle is significantly shortened by the formation of cracks, wear or single defects. Since the introduction of the new directive Ril. 821.2007 at the beginning of 2007 eddy current testing for the detection of critical surface defects (Head Checks, Squats etc) has become compulsory.





Rail cross-section

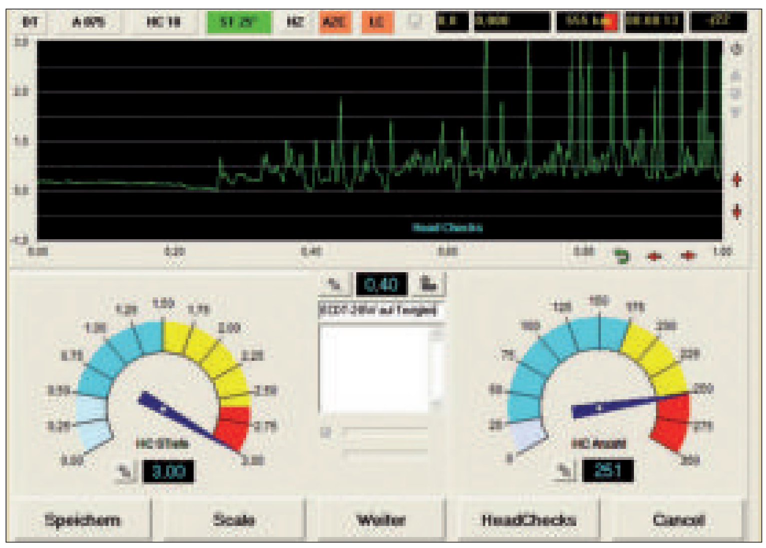
Approach

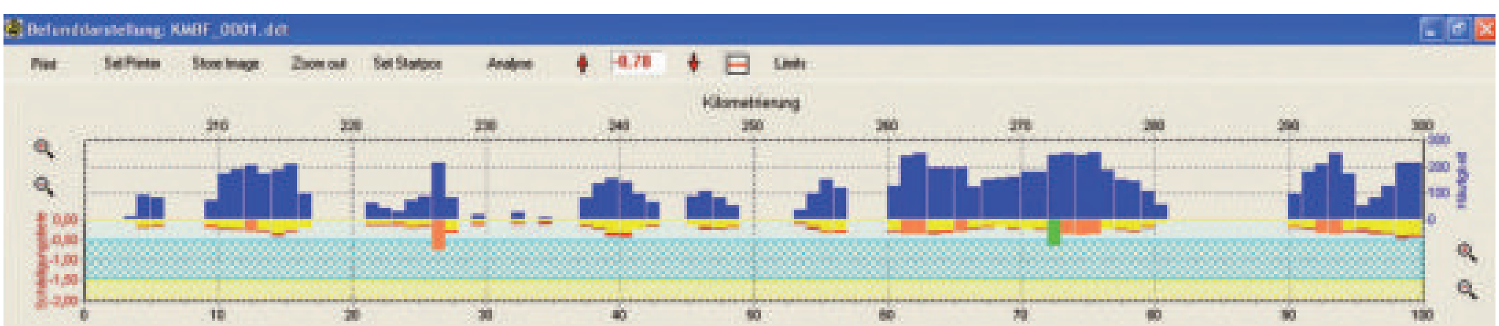
Eddy current testing is a useful enhancement of the proven ultrasonic test. It is able to test those areas of the rail, in which test systems based on ultrasonic are unsuitable due to physical laws. Precisely speaking, it is the surface area up to a depth of approx. 2.7 mm on the upper surface of the rail as well as on the guiding surface that is considered as "Dead Zone" in the ultrasonic field and considered as very critical for surface defects, such as Head Checks, Squats and Belgrospis.

Inspection Technique Applied

With our own measuring draisines (track motor cars) of the PLR company (WPG II = Eddy current test equipment) Delta Test is able to detect and report these near-surface defects in critical areas on main tracks and in switches. Head Checks are displayed graphically via mileage and/or tachometer indications sectioned by number and depths in 1 m areas in evaluation tracks of 100 m length. A GPS receiver enables the allocation to exact locations. The evaluation software makes it possible to assess the data on or offline.

By wear and zero line adjustment the most different rail types can be safely evaluated, no matter if they are new or already worn. Battery operation guarantees utmost mobility combined with an easy assembly of the "draisine" made out of light aluminium and CFRP.

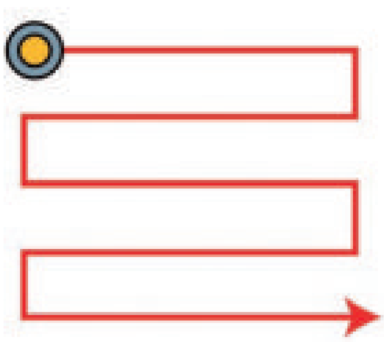


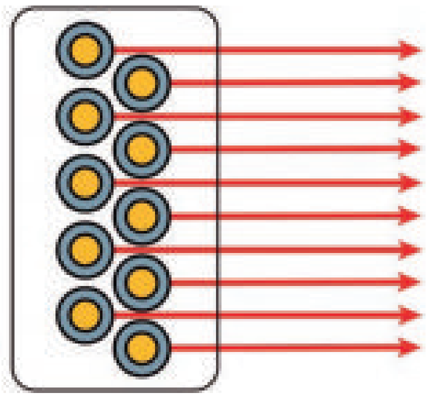


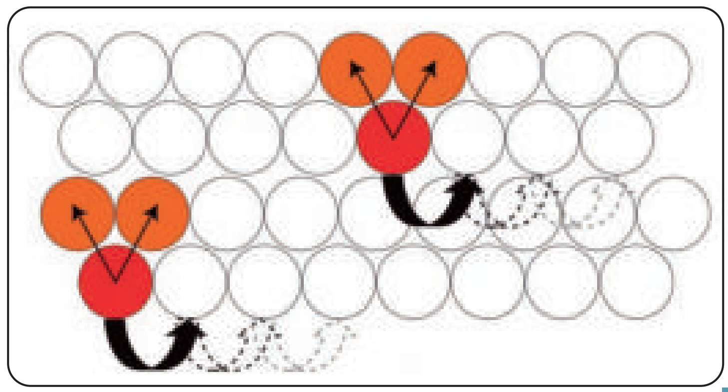
Eddy Current Array Technique (ECA)

The eddy current array technique (ECA) is a derivative of conventional eddy current testing and shares the same electromagnetic/inductive principles of eddy current.

The word "array" means that in comparison to a single coil sensor many adjoining eddy current coils are forming a coherent eddy current assembly. The decisive advantage of ECA probes is their larger coverage compared to single coil probes and thus a faster and more cost efficient scanning for the client.





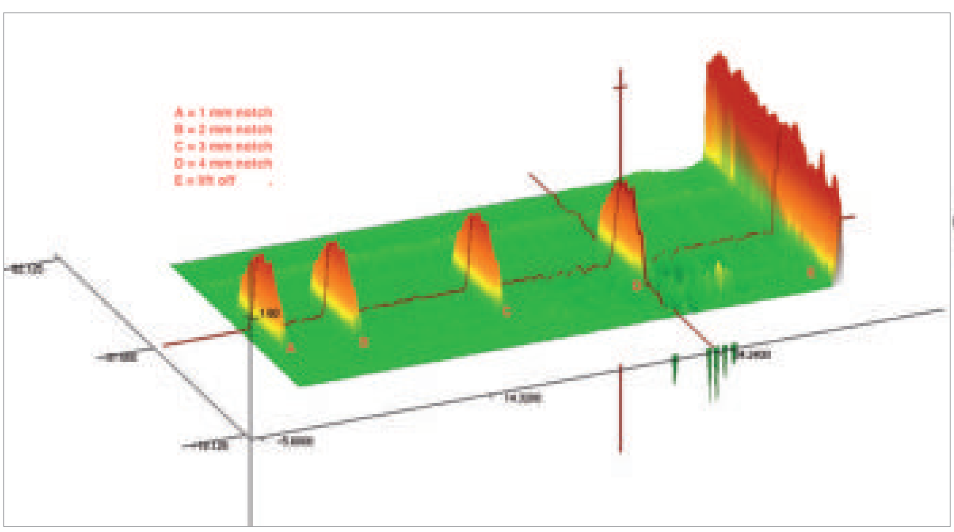


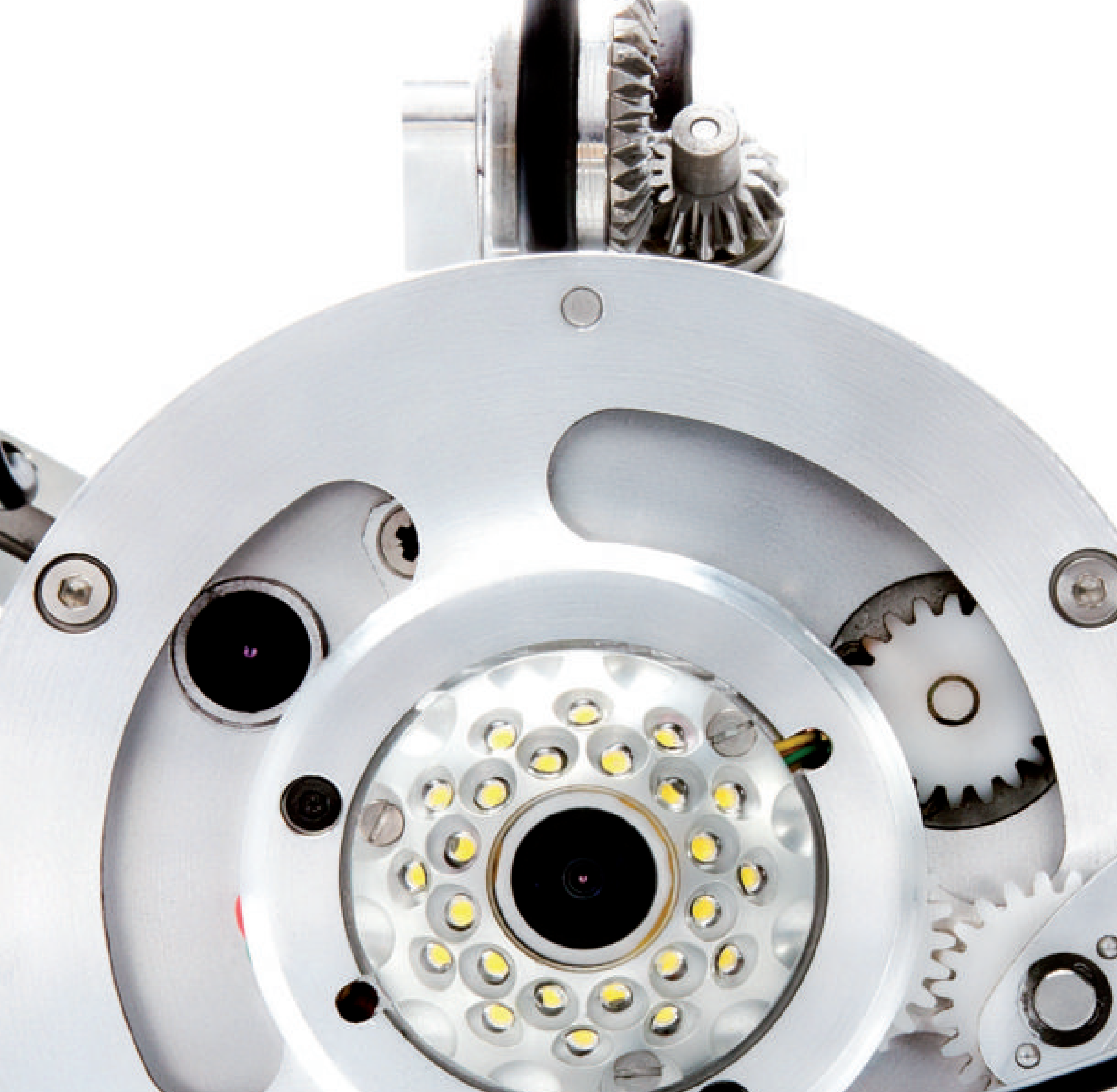
Conventional eddy current vs. **ECA** **Array-Technique T/R-Circuit Mode**

The Eddy Current Array technique uses a multiplexer (MUX) to excite the single coil elements in a predefined scheme to leverage the probe's width. Multiplexing also minimizes the interference between coils in close proximity (mutual inductance) and maximizes the resolution of the probe. Another advantage is the fact that each coil element is able both to transmit and/or receive eddy current signals (transmit/receive circuit). By this means different circuit modes can be realized which enables the technique to detect cracks or corrosion independently of its orientation in a single pass. The data-acquisition is linked to position-encoders. Thus high inspection reproducibility will be archived whereas the risk of untested areas will be minimized at the same time. An expressive full coverage 2D or 3D C-Scan report of all tested areas is another advantage of the ECA technique.

Advantages of ECA

- High inspection speed, rapid scanning
- High probe coverage, high test reliability
- Independent for defect orientation through intelligent multiplexing
- Probes can be adapted to complex geometries
- Inspection without physical movement possible
- Different inspections in one pass
- Expressive 2D and 3D C-Scans for full coverage reports
- High reproducibility
- Encoder-based data acquisition





DELTA TEST – We will find a solution for your inspection problem.

Special tasks require special solutions. For this reason, DELTA TEST is your competent partner in the field of special tests, who meets your individual requirements with reliable solutions. By using state-of-the-art technical equipment, we can perform all compulsory and desired tests on special components – from cylinder bores to screwed connections.

For this purpose, we use wired crawlers for example that can be precisely controlled and positioned and be used with very different tools and probes. You can thus be sure that we will find a solution for each of your components to be tested optimally. >>

Applications:

- Corrugated expansion joint test
- Drive shafts, Axle shafts, Hollow shafts
- Reactor pressure vessel screwed connections

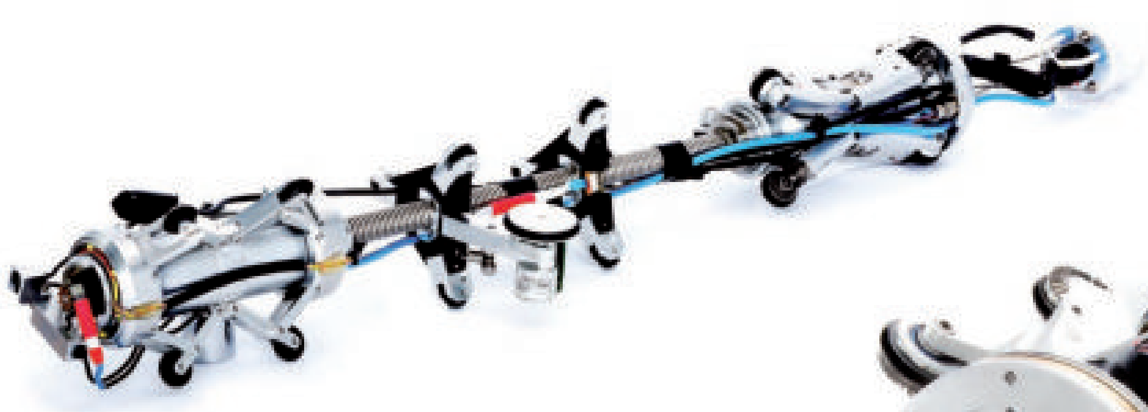
Crawler for inner tube testing

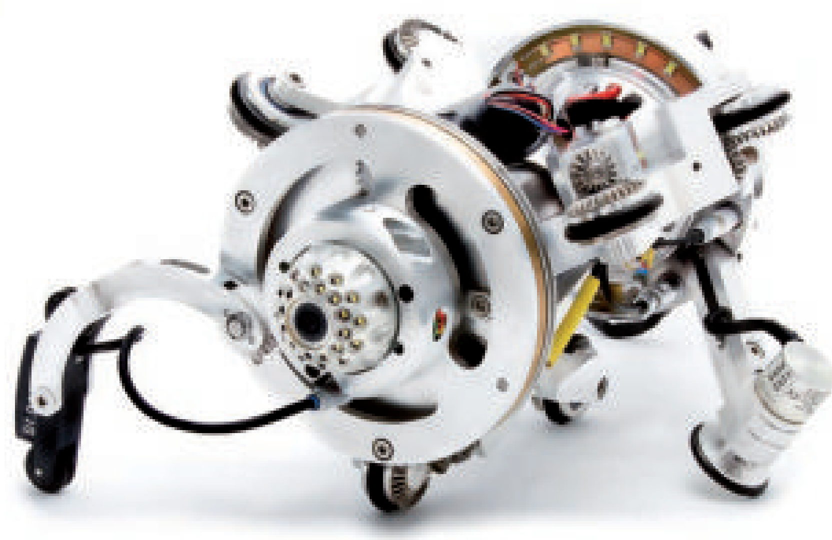
The crawler is used for semi-automatic mechanized testing of internal and external pipe surfaces in pipelines, depending on material and wall thickness. It ensures safety through early detection of pipeline defects such as defects at welding seams and adjacent heat-affected zones as well as imperfections in the base material (corrosion, erosion, cracks and deposits). Due to its compact method of construction driving through and inspection of pipelines with a maximum of 4 bends is possible. In the straight sections, the maximum range is 70 meters.

The manipulator (crawler) will be inserted into the test object trough existing openings and tightened with 6 axes in the pipe interior via compressed air. Each axis has its own drive, which allows the crawler to move around the pipe in the axial direction.

Features

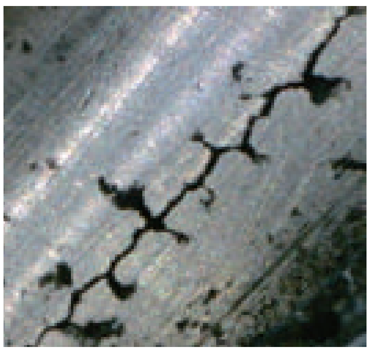
- Available range of diameters: DN 80 - DN 450
- for austenitic and ferritic pipe materials
- insertion on valves or fittings
- can be precisely positioned by means of encoders
- can be moved over branches
- allows the installation and operation of different tools and test equipment:
  - grinding tools
  - cleaning and vacuuming
  - internal visual inspection/ Videoscopy
  - eddy current testing





Characteristics of an eddy current testing system

- the sensor socket is designed modular and is easy to install and therefore all-purpose applicable in crawler systems
- automatic retracting movements of the (test-) tools at power failure
- ovalities of the tube inside surface may be covered by an automatic tracking system
- defects from a depth of 1 mm can be detected regardless of its orientation
- very good signal separation of surface effects (noise) and defect signals
- test coverage = 100% of the tube inside surface
- exact positioning and repeatability by precise encoder
- additional integration of a video system at the crawler
- adjustable lighting for camera orientation/ visual inspection

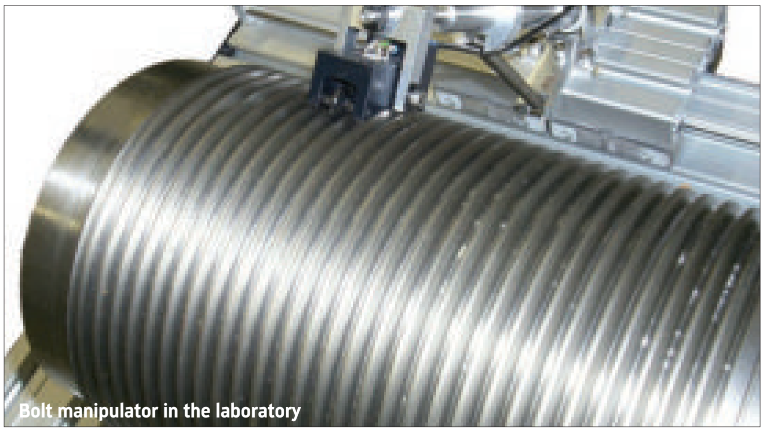


Chemical injection line (CIL) and coil tubing test

Testing chemical injection lines (CIL) with eddy current serves protecting against grooves, cracks and mechanical damages during the production of semi-finished parts and completion, and has already been successfully implemented by DELTA TEST for more than 10 years.
The test device is designed in such a way that the line can be tested during coiling up or down as initial or maintenance inspection without interfering with the normal workflow. For this, the test is performed with several sensors as well as position encoding sensors, so that the position of defects can also be determined retrospectively.
DELTA TEST does also have a special probe system with exchangeable powerful encircling coils for the inspection of special coil tubings mainly used in the oil and gas industry. Coil tubings have a similar design compared to chemical injection lines but a bigger diameter. Our equipment is suitable for ferritic or non-ferritic materials with a diameter range from 19.05 - 50.8 mm (3/4" - 2").

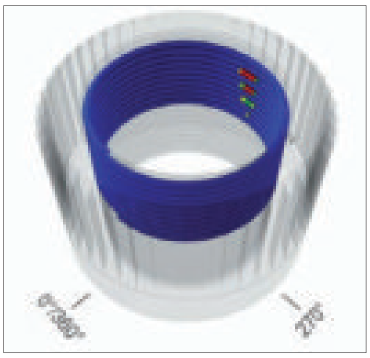
Drive shafts, Axle shafts, Hollow shafts

Testing sleeve shafts (e.g. for helicopter drives and aircraft industry) involves the use of rotation manipulators. With this, straight semi-finished products – shafts and tubes – can be tested seamlessly and fully automatically for internal and external defects by two probe systems that can be navigated separately. Both systems allow the creation of C-scans of the entire tested surface. Test objects up to 3 m in length can be tested. The test device is designed universally, so that similar test objects can be tested with minor adaptation effort.


Bolt manipulator in the laboratory

Reactor pressure vessel screwed connections

Due to official directives in nuclear power plants (KTA 32014), periodic testing of certain components, e.g. screwed connections at the reactor pressure vessel, is compulsory. This includes the bolts, their piston and thread as well as the nuts and the tapped blind hole. Due to the hampered test conditions, fully automatic manipulators are used, which enable qualified testing of the component and pictorial documentation via C-scan. The entire test equipment was developed and produced by DELTA TEST.

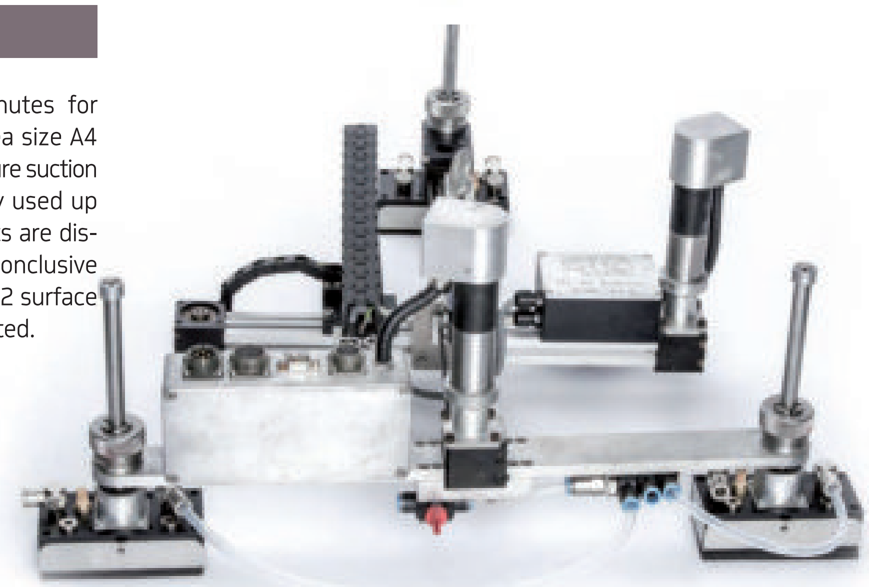


Corrugated expansion joint test

A corrugated expansion joint is a flexible, cylinder shape element made from thin metal sheet for balancing movement in pipeworks which are caused in particular by vibrations or thermal extensions or shortenings. Due to the constant alternating loads, there can be damages in the form of cracks which can cause the component to fail and cause critical leakages. For testing this complex geometry, DELTA TEST has developed a probe system which detects cracks and other material inhomogeneities in the vulnerable areas.

Surfaces and vessels

To be able to test larger surfaces for surface defects independent of their geometry, use of a scanner is recommended. This applies for example to the surface of boilers, vessels or reactors. Our scanners can be used on even, cylindrical and spherical surfaces and require approx. two or four minutes for scanning the nominal area size A4 or A3. Their high-temperature suction cups can be permanently used up to 200 °C. The test results are displayed and analysed as conclusive C-scan images. Up to 8 m2 surface per shift/team can be tested.



DELTA TEST – We help develop the future.

Apart from its range of services in the field of eddy current technology, DELTA TEST is also successful in research and development. For this reason we can offer you a wide range of products and services which we will develop customized to you.

In a continuous development process, our engineers strive to adapt our test methods, database and documentation solutions to the high demands of the industry. Intelligent solutions as well as simple operation and efficiency of the hardware and software are characteristic for our test methods.

To ensure that we can still meet all demands in the future, we can rely on highly qualified employees and engineers in the respective specialist departments for electrical engineering, mechanics and software development. They are all working towards the realisation of our most important objective: to achieve the best for our customers! >>

Eddy current probes for tubular inspection

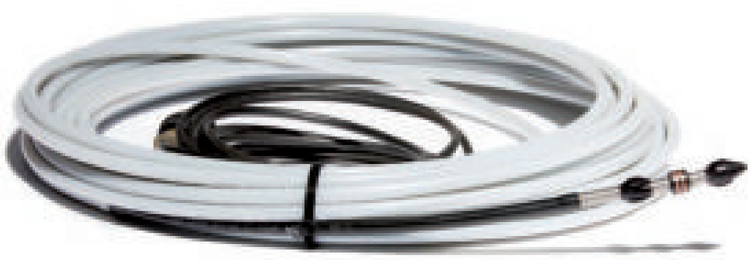
For its own requirements as well as according to customer specification, DELTA TEST produces eddy current probes for testing heat exchanger tubes from paramagnetic and ferromagnetic materials. This includes amongst others austenites, cupronickel alloys, titanium alloys, brass alloys and ferromagnetic materials like steel, compound steel, monel. Furthermore, rotating probes and special probes like flexible probes for bend testing of U tube heat exchangers are produced.

- Eddy current probes
- Special equipment
- Plugs for heat exchanger and condeser tubes
- Certified reference defects for eddy current and ultrasonic inspection
- Eddy current acquisition software with automatic signal analysis algorithm
- Advanced reporting software for tubular inspections
- Advanced 3D-reporting for surface crack inspections

Conventional eddy current probe

Multi differential eddy current probe

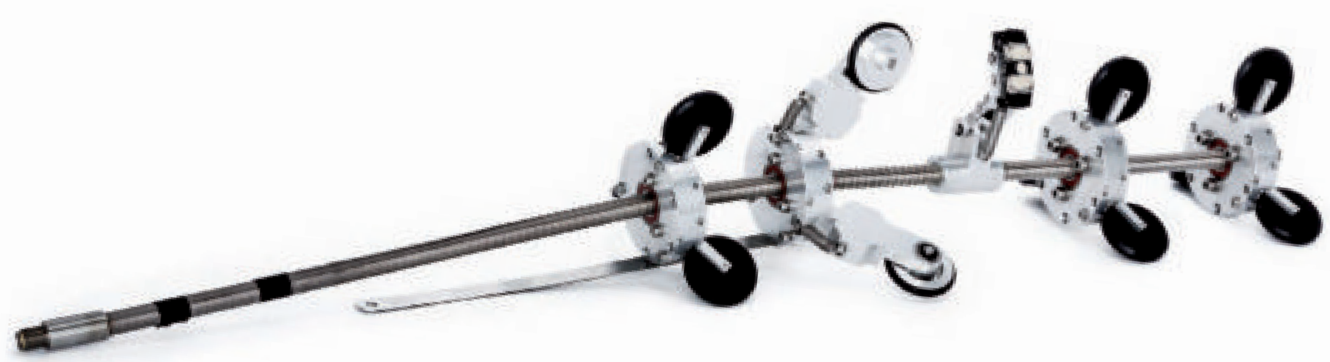
Saturation eddy current probe



Conventional eddy current probe Flexible

Rotational eddy current probe

Encircling eddy current probe with magnetic saturation



Rotational eddy current probe for tube diameter Di 97 – 103 mm

Eddy current probes for surface inspection

Surface scanning probe

Pencil probe

Adjustable (T/R) surface probe

Adjustable (T/R) surface probe

Concav surface probe with electrical magnetization

Concav surface probe with permanent magnetization

High temperature surface probe

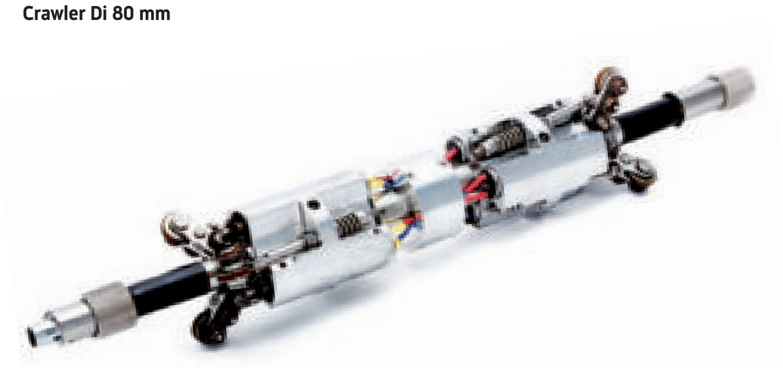
Pencil probe for hard accessible areas

Special inspection equipment

Individual inspection problems require individually developed inspection systems. In case no respective test system is available for your specific task, we design and develop new test systems according to your requirements. Please do not hesitate to contact our qualified employees in the respective specialist departments for electrical engineering, mechanics and software development.

Crawler Di 80 mm

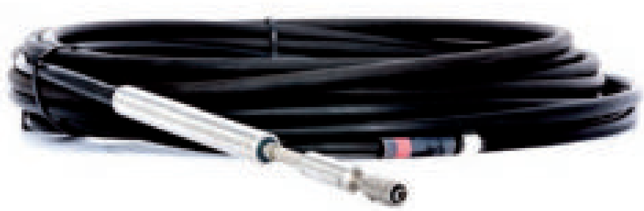
Thread/bore/flange inspection equipment



Powerful probe pusher Di 60 mm

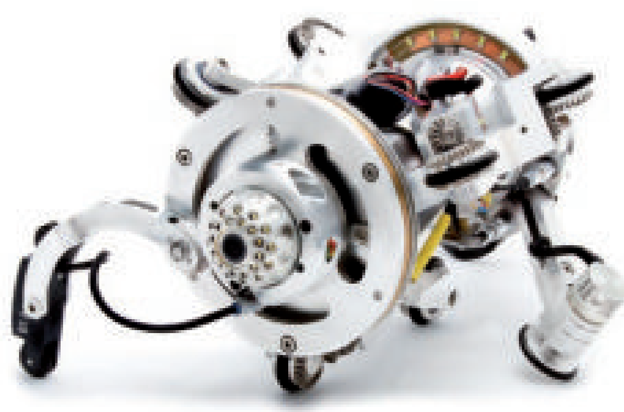
Flexible rotation probe Di 35-70 mm

Probe rotor 27 mm



Small probe rotor 18 mm

Universal power supply and link between eddy current probes and third party instruments



Crawler Di 150–250 mm

Plugs for heat exchangers and condenser tubes

If a tube should be found extremely damaged during inspection, it must either be replaced or sealed off: "plugged".
Conventional sealing options usually include welding up of affected tubes as well as driving or screwing in plugs. DELTA TEST offers its customers a plug system up to max. 140° C operating temperature, with which the plugs can be inserted quickly and easily, and later be removed again without further damage of the tubes or the heat exchanger.

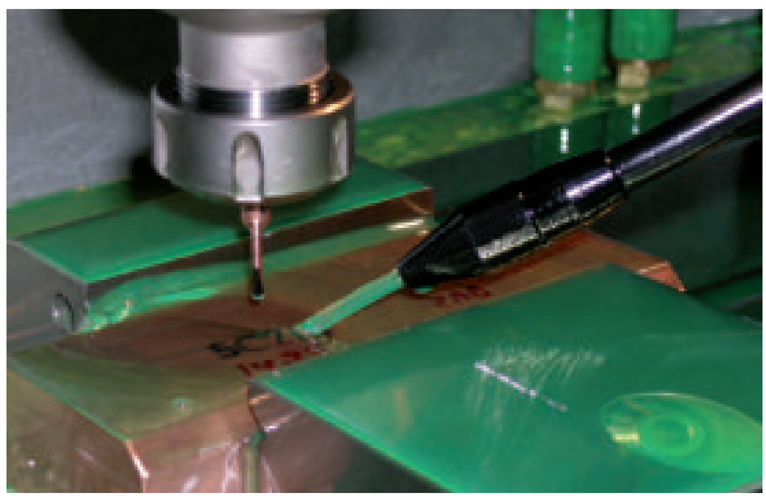
Inserting the plugs for secure sealing of the pipes is fast and straightforward, special tools or personnel is not required. Upon customer request, we seal damaged tubes directly after testing.

Advanages:
- Rapid insertion through screwable design
- Plugs are easily removable
- Special materials for high temperature use or aggressive media

Certified reference standards

For calibrating the test systems, for eddy current tests as well as other NDT methods, certified reference standards with defined adjustment errors are required. For this purpose, DELTA TEST produces certified reference standards from metallic materials through processing by spark erosion machining for its own requirements as well as by customer order.

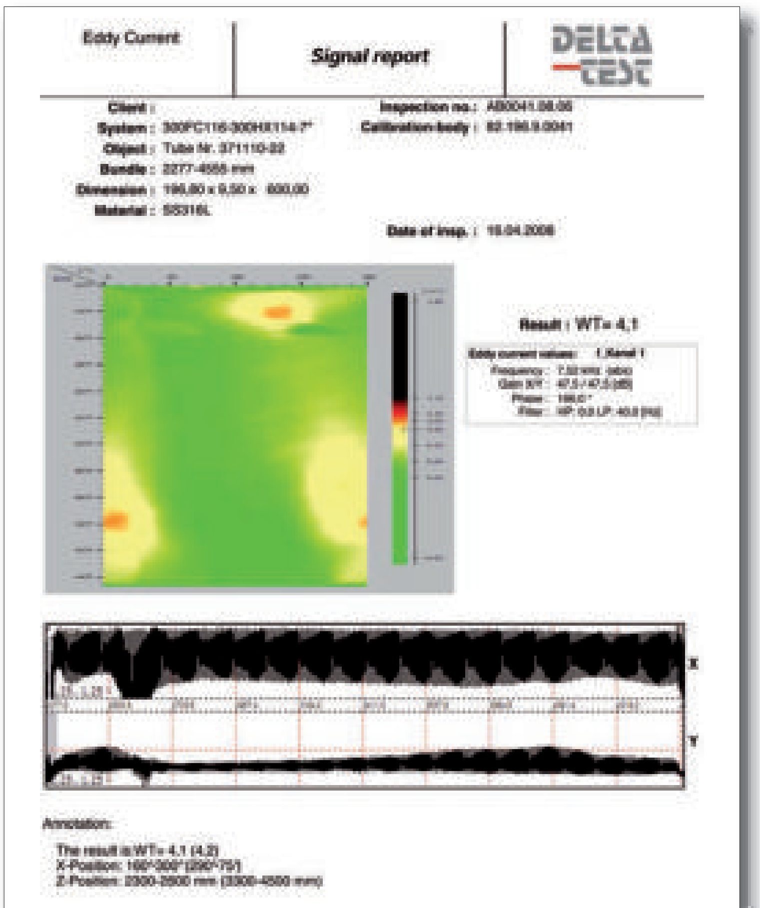
The extent of the artificially created defects follows individual customer specifications and can be adapted to the defects to be expected. For these tasks, a state of the art 3-axis eroding machine and qualified personnel is available.



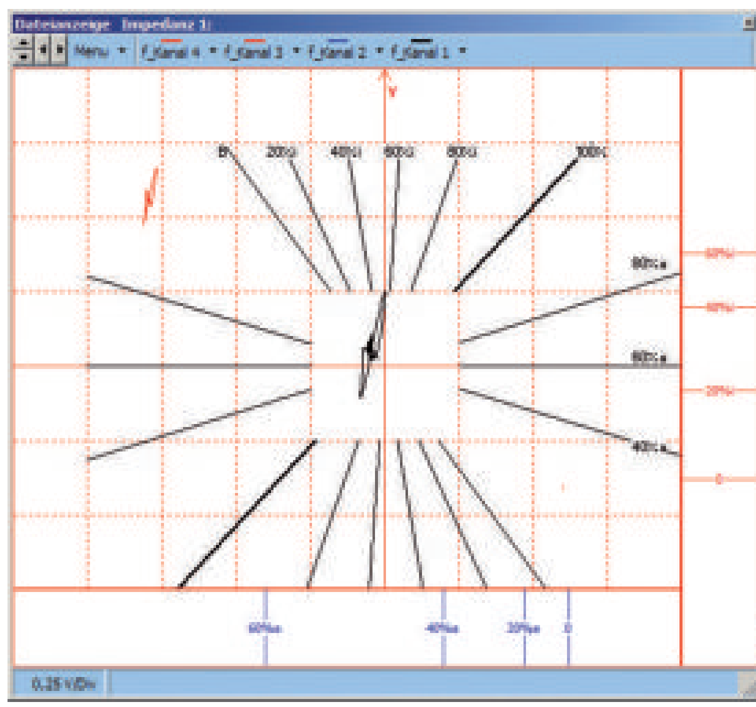
Inspection software for automatic eddy current signal analysis

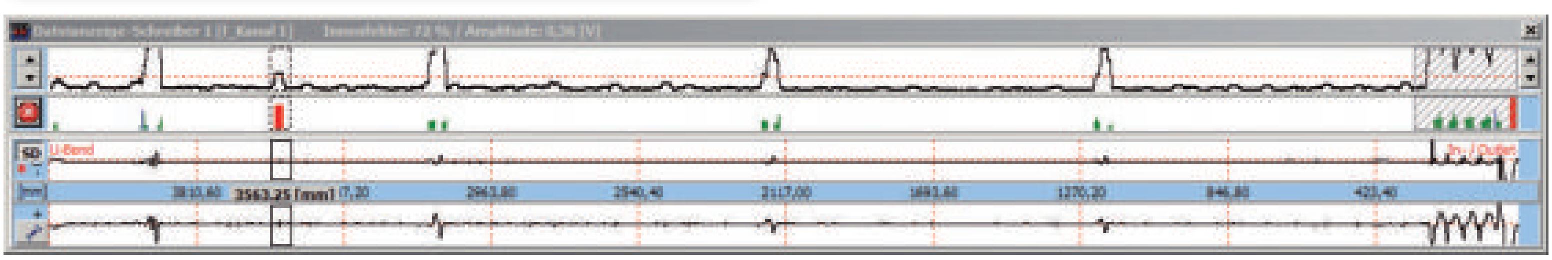
In the area of software development, DELTA TEST constantly works on powerful and highly sophisticated software for signal visualisation and for automatic analysis of eddy current signals. The test software developed by us analyses the available eddy current raw data in realtime and in the background and provides the inspector with an intelligent and reliable tool. This makes testing heat exchangers even more reliable. Human error or signals that are difficult to interpret can thus be reduced to a minimum. Automatic signal analysis during testing of paramagnetic tubes has been a standard procedure for DELTA TEST for many years and is always applied if possible.

The computer-controlled signal analysis on ferromagnetic tubes (carbon steel, duplex, super duplex etc.) is a DELTA TEST development and is only offered by us. For this, special software with artificial intelligence is used, which learns evaluation and decision criteria from the inspector. The software analyses all available test channels in the background in real-time, and evaluates based on an independently learning software algorithm. Even for the challenging testing of ferromagnetic tubes (carbon steel, duplex, super duplex etc.), the best possible test results are achieved with this, and the risk of human error is reduced to a minimum.



Eddy current signal processing and visualization software "EC-View"

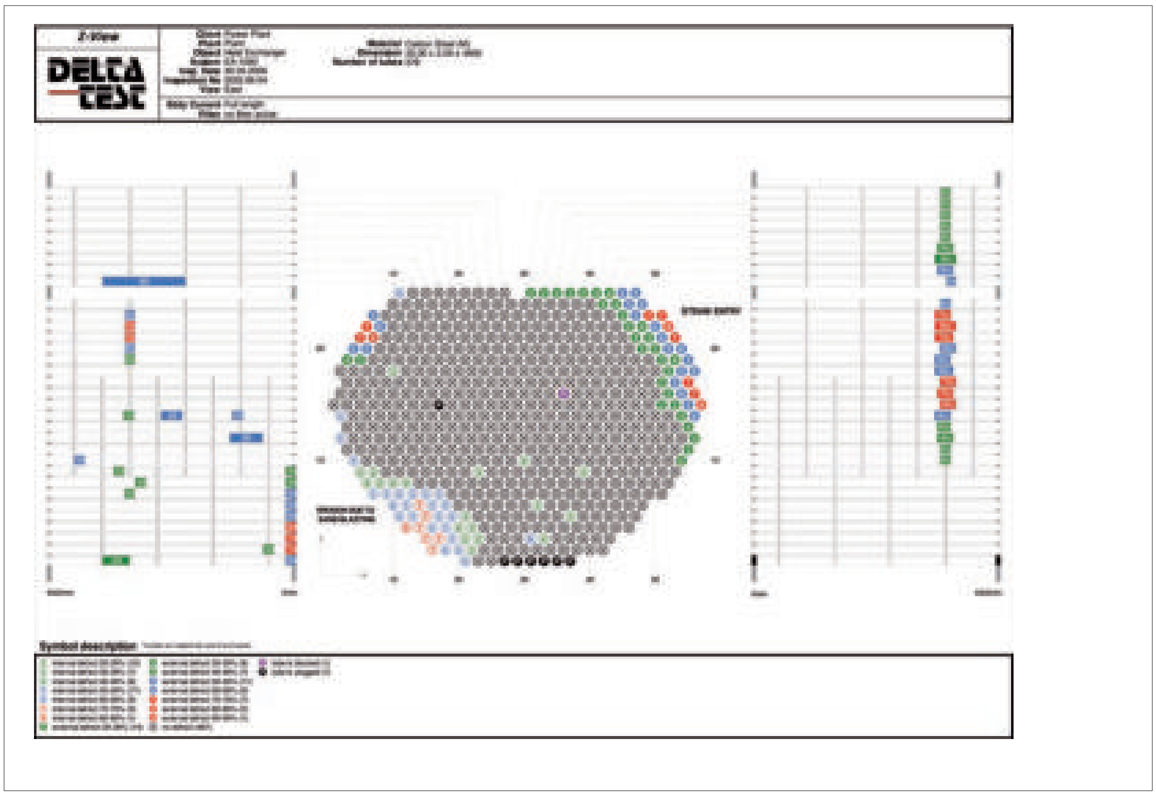




Strip chart with automatic signal analysis

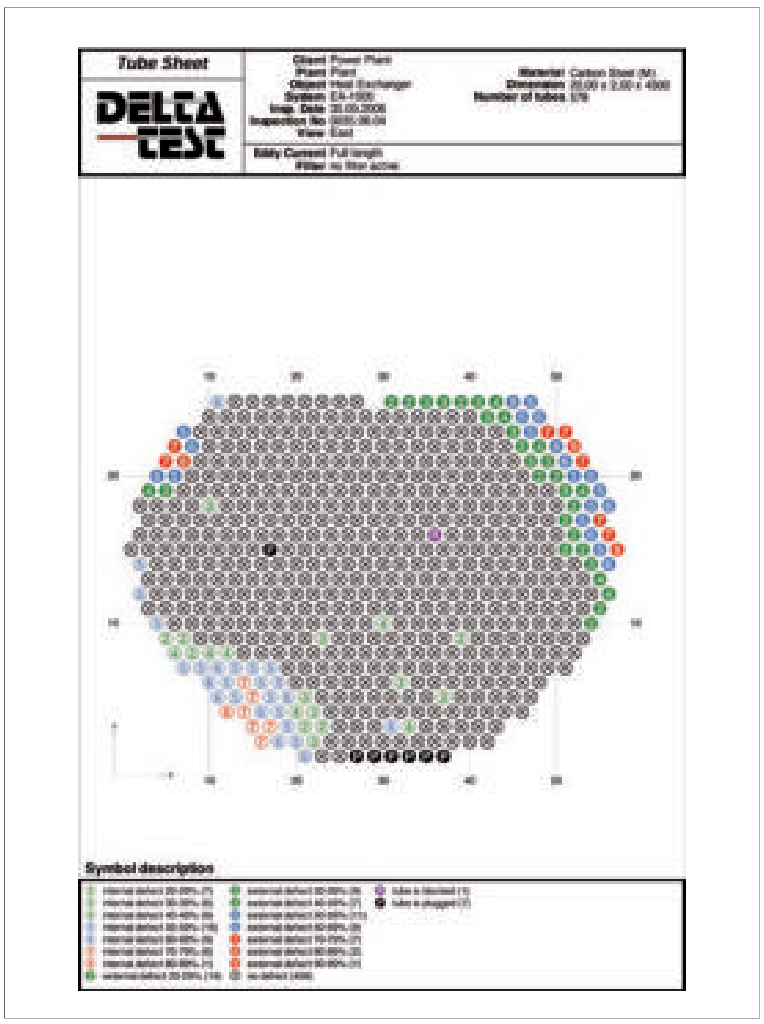
RESEARCH, DEVELOPMENT, PRODUCTION

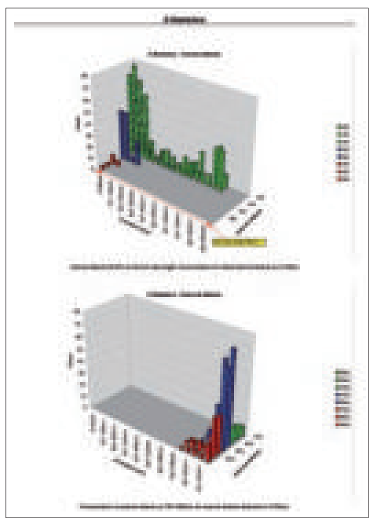
Documentation of heat exchanger inspections

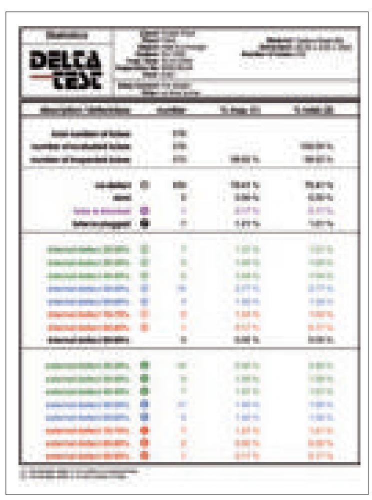


For the benefit of its customers, DELTA TEST pays particular attention to the documentation of eddy current inspection data.
Analysis and reporting of the tube inspection is ensured by our powerful documentation software. Numerous documentation types like statistics, tube diagrams, 2-D views, lists and extended comparisons are available at any time during inspection.
Surface crack inspections on tubing or welded seams are displayed in meaningful and flexible 3-D documentations. All documents are available as hardcopy as well as electronically as PDF.

The documentation of a heat exchanger inspections are provided by software, which is developed and constantly updated by DELTA TEST. This was primarily developed with easy operability in sight, so that the inspector can get a quick and safe overview of the test results on site. This way, customer requests of part results of the test can be met quickly. All test-relevant data are stored in an open database format and handed over to the customer as required together with the documentation for further processing (e.g. in Excel or Access).
Additional features can be realised promptly by our software development team.



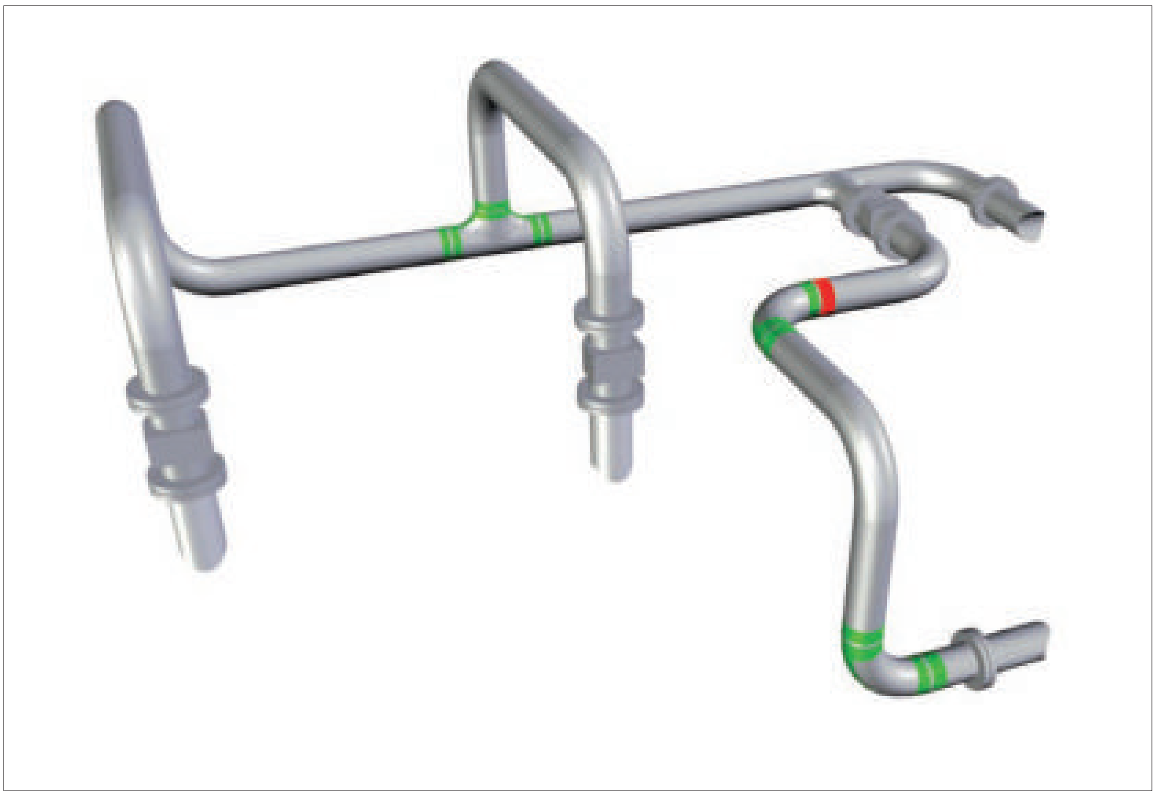


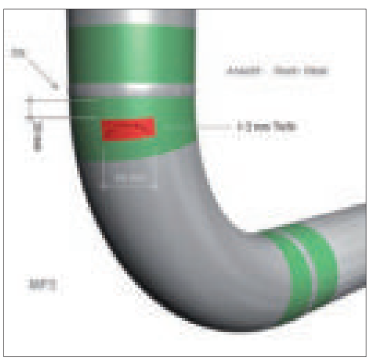


Documentation of a heat exchanger inspection by the "VirtualTube" software developed by DELTA TEST and specifically adapted throughout many years of painstaking work.

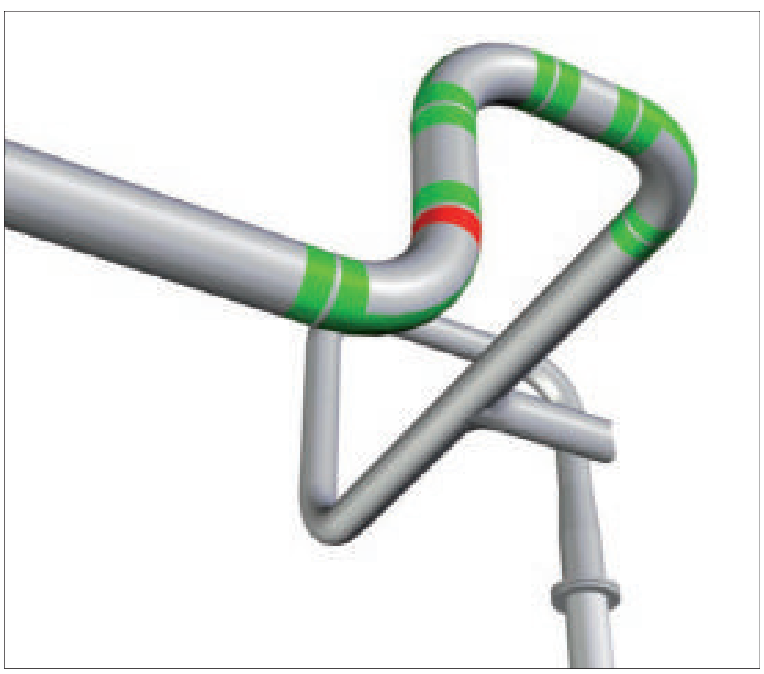
3D-documentation for surface crack inspections

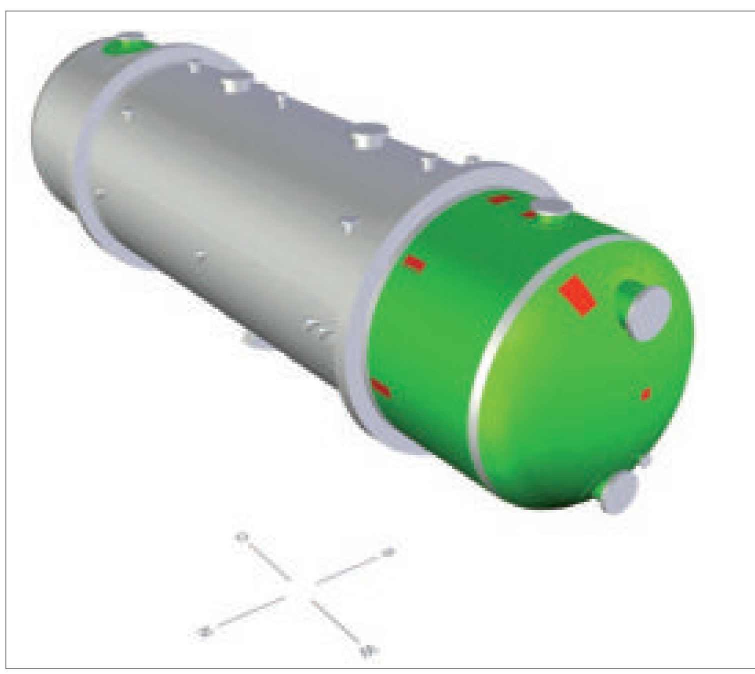
The documentation of surface crack inspections on tubes or welded seams is also created in meaningful and flexible 3-D-documentations. These are available via any Internet browser and are thus easily transferable to the customer.





3-D documentation of pipeworks and vessels through freely scalable CAD drawings. The documentation can be opened by the customer via Internet browser and printed. It is also possible to rotate and enlarge the displayed test objects with the mouse. Detailed photographs can be opened at the click of a mouse.





Worldwide services

DELTA TEST cooperates worldwide with well-known manufacturers, service providers and research institutions, to provide our customers with innovative test methods and test services of the highest quality at all times.

Excellent security

DELTA TEST is a member of the 'Deutsche Gesellschaft für zerstörungsfreie Prüfung' (DGZfP, German Association for non-destructive testing) and certified according to

- ISO 9001
- Accredited testing laboratory ISO/IEC 17025
- SCC
- OHSAS 18001
- KTA 1401
- Certificate of Approval Deutsche Bahn
- Prequalification Sellihca
- Prequalification Connexio
- Prequalification ISNetworld (North America, Canada)

Overview

Founding year
1988

Legal form
GmbH

Share Holders
Werner Sievert
Eckard Köllner
Stefan Köllner
Daniela Sprakties

Employees
60

Trade register
Amtsgericht Lüneburg,
HRB 100387

VAT Reg.No.
DE 115117580

Jurisdiction
Celle

DELTA TEST – What can we do for you?

DELTA TEST – a name standing for qualified, non-destructive material testing by using the eddy current procedure.

Since its foundation in 1988, DELTA TEST has been carrying out state-of-the-art eddy current test services, according to customer requirements and based on respective norms and standards. We are specialised in all kinds of eddy current tests and provide these around the world. Tests of paramagnetic and ferromagnetic heat exchangers play a significant part in this.

DELTA TEST guarantees short response times from the initial enquiry through to job execution, and furthermore optimally short test times with at the same time high quality test results.

Our aim is to provide information through high-quality and reliable test results, which will help you to lower your costs for maintenance and repair long-term.

With this reliability and our availability around the clock, we can achieve a relationship of complete trust with our customers.

Our national and international success is based on highly motivated, certified and qualified employees and modern equipment, development achievement and the ability to implement innovative ideas for you and with you.

We look forward to working with you!

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contact@deltatest.de

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