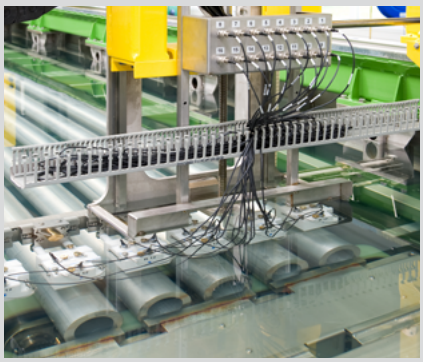
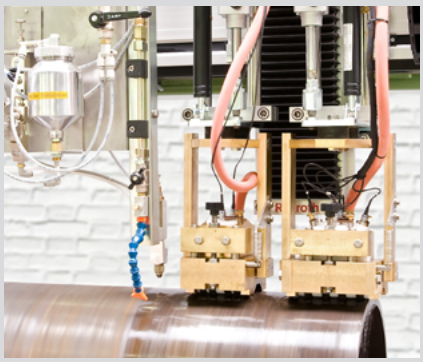
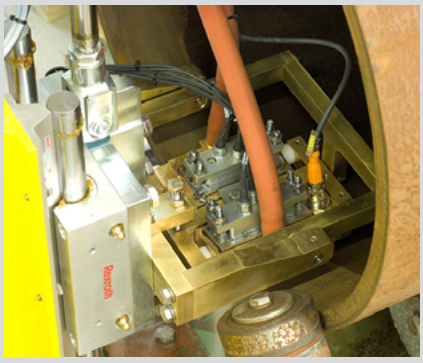
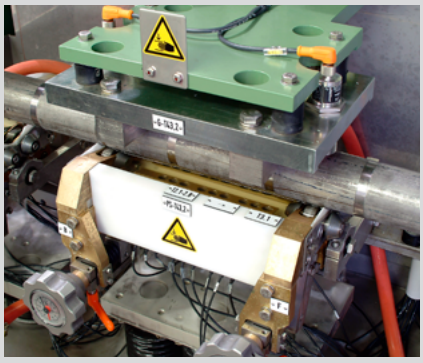
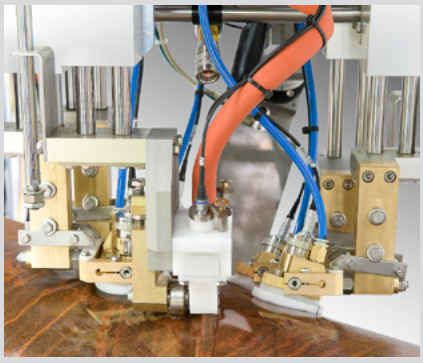
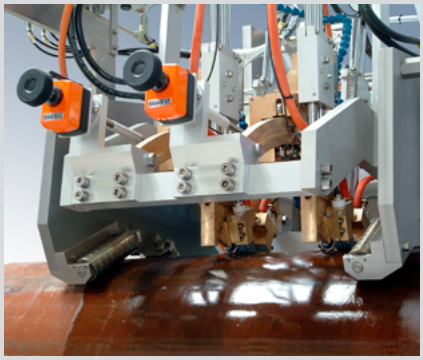
Definitely Tested!






ECHOGRAPH Systems
Automated Ultrasonic Inspection

KARL DEUTSCH

ECHOGRAPH Ultrasonic Testing Systems
Company Portrait

KARL DEUTSCH has developed ultrasonic testing equipment since 1951 and has shipped the first automated inspection system in 1965. Many improvements for the ECHOGRAPH electronics, the robust testing mechanics and the ultrasonic probes have led to our current state-of-the-art.

The company is located in Wuppertal, a city near Duesseldorf and Cologne, Germany. At the moment 130 highly motivated employees work for the company. Additional 20 employees in international sales and service offices support our customers worldwide.

KARL DEUTSCH offers a large product range: Portable testing instruments such as ultrasonic flaw detectors, ultrasonic sensors for manual and automated applications, magnetic particle testing systems, crack detection liquids (magnetic particles and dye penetrants) and systems for dye penetrant inspection. Furthermore the portfolio of KARL DEUTSCH contains phased array testing systems. A strict quality management system according to DIN EN ISO 9001 is maintained.

Works 1 (erected in 1967, extended in 1972) is the headquarters where the administration, the applications lab and electronics R&D are located. Portable test instruments, sensors and crack detection media are produced here.

Works 2 was built to cater to the systems business. The first workshop hall was built in 1978 and extended in 2004, 2006 and 2013.

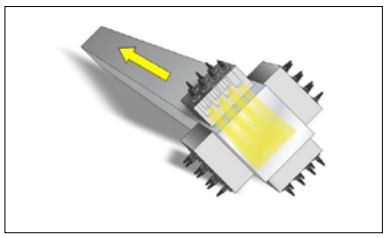
KARL DEUTSCH staff provides testing systems and machines from a single source with an in-house construction department, a mechanical workshop and a department for producing and programming the Siemens-PLC. In total, 1500 m² are available for the systems engineering assembly.

View into a systems workshop where large pipe testing systems are being assembled. The in-house parts production supplies the key components.

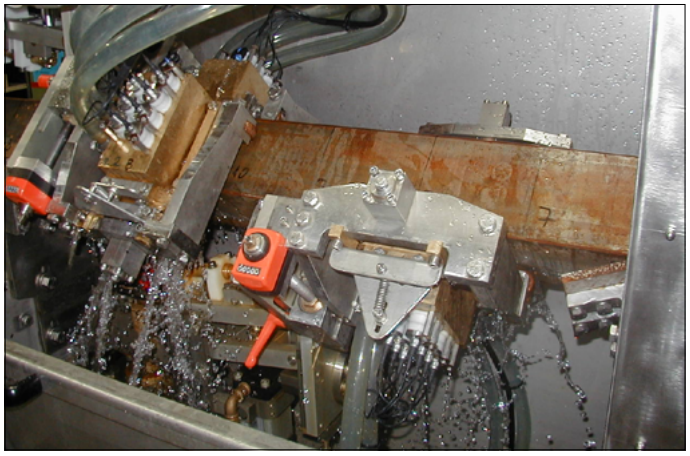
Our laboratory for ultrasonic testing machines is always available for customer-specific trials.

ECHOGRAPH System Types KNPS STPS HRPS
Ultrasonic Inspection of Billets and Bars

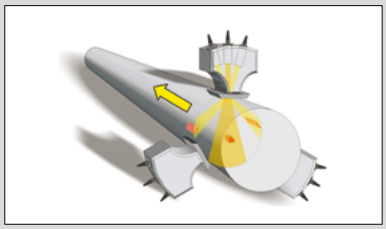
ECHOGRAPH KNPS: Continuously cast billets are regularly tested with ultrasound during the production process. The testing speed of round or quadratic billets with typical dimensions between 50 and 180 mm is 1 m/s. In this process stage especially the quadratic billets exhibit considerable tolerances (convex or concave surfaces, different edge radii and twisted profiles), which demand a flexible guidance of the probe holders on the billet surfaces. By means of spring systems the sensors can be guided along the profile within a working range of several centimetres. While formerly block cast billets were tested with only 2 probes for core defects, nowadays an inspection with the highest possible coverage of the cross section area is required. Therefore today, typically 28 probes are applied. The typical test sensitivity ranges from 1.5 to 5 mm FBH.



Testing of quadratic billets with 28 probes in 4 probe holders

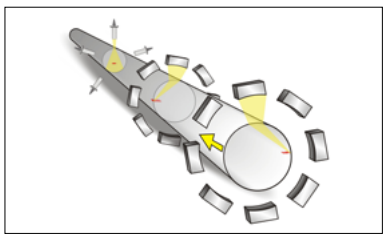


ECHOGRAPH STPS: In a further process stage the billets are rolled to bars, which still have black surfaces. The straightness tolerances in this stage require a guiding of the probes on the surface within a range of several millimetres. Coupling is carried out with water jets (squirters). The typical diameters for this inspection task are 10 to 130 m. The higher the number of probes, the larger is the covered cross section. This type of system can be equipped with 3 to 15 sensors. A phased array solution with 100% coverage is also available. The mechanical design enables a very easy and quick diameter adjustment. The typical testing sensitivities are in the range of 1 and 2 mm FBH.

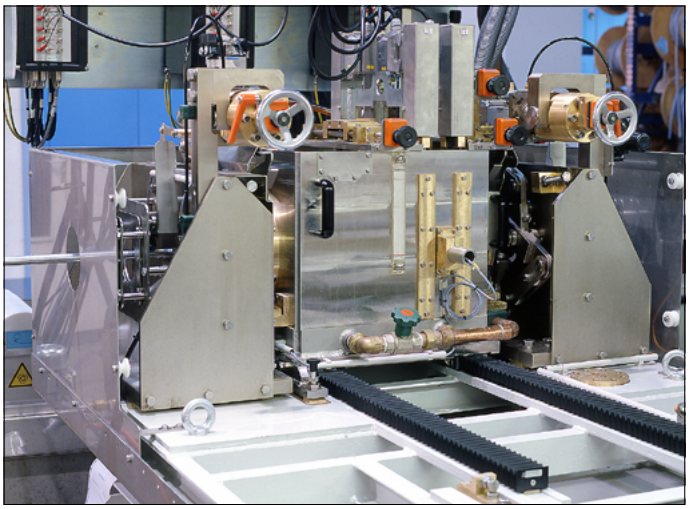


Testing of (e.g. black) bars with 9 probes in 3 probe holders

ECHOGRAPH HRPS: Bars with bright (machined) surfaces are often used as raw material in the automotive and aerospace industry. The ultrasonic coverage is 100 %. For this purpose an immersion tank setup is used with several rings of conventional or phased array probes. The inspection speed is in the range between 1 and 2 m/s. The good surface condition allows accordingly higher inspection sensitivities between 0.7 and 1.5 mm FBH. Currently, this testing concept is suitable for diameters from 10 to 100 mm.

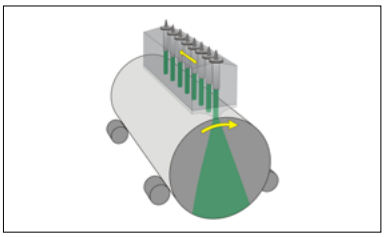


Testing of (e.g. bright) bars with 21 probes in immersion technique

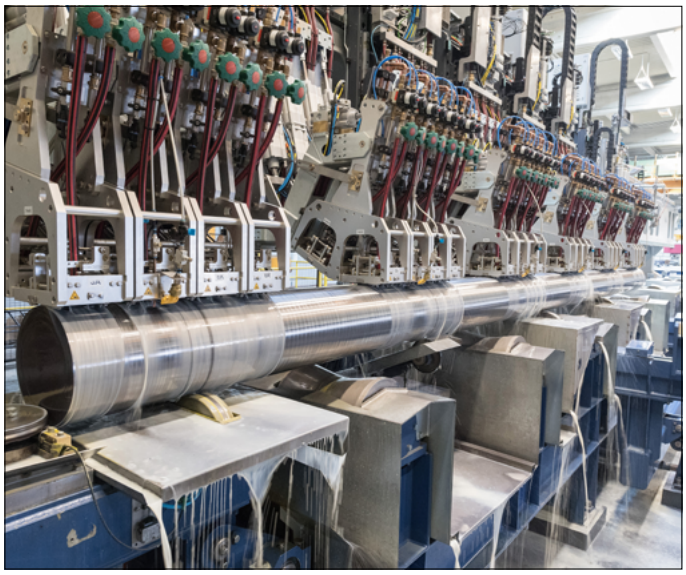


ECHOGRAPH Systems Types RPTS ALPT TTPS
Ultrasonic Inspection of Round Billets

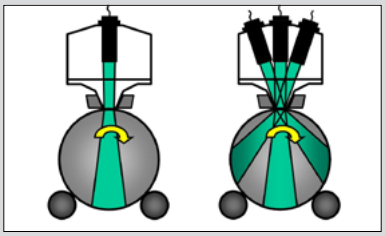
ECHOGRAPH RPTS: Larger bars or billets with round cross sections are inspected with rotation of the billet and linear feeding of the ultrasonic probes. Several probes are used to increase the test speed. For good surface quality, clean-cut billet ends and reasonable straightness, all probes can be mounted into the same probe holder. The probe holder is fitted to a carriage which travels along a testing portal. The typical billet diameters for such test portals starts at 100 mm, i.e. at a range, where systems with linear throughput would require an extremely high number of channels to fully cover the cross section. The testing sensitivity (from 0.8 mm FBH) depends on diameter, material structure and surface condition.



Inspection of billets with rotation of the billet and linear feeding of probes

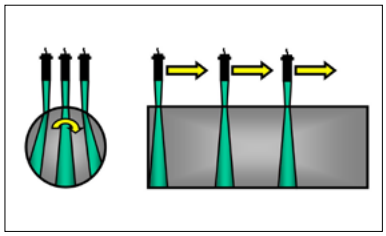


ECHOGRAPH ALPT: For cast aluminium billets with rough surfaces the probes are mounted into several probe holders which are evenly distributed along the billet. Otherwise, the testing concept is similar to the ECHOGRAPH RPTS system. Straight beam probes are used for the core defect detection. In some cases additional angle beam probes are provided to test the near-surface zones. The testing system in the right picture contains 10 straight beam probes for core defect detection in accordance with ASTM B 594-90, i.e. 1.98 mm FBH. Each probe holder also contains angle beam probes to detect surface defects.



Straight beam and angle beam testing for round billets

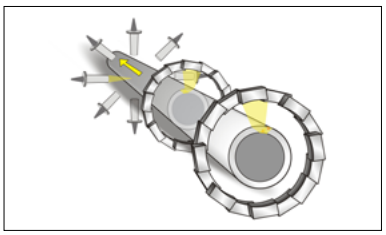
ECHOGRAPH TTPS: The highest testing sensitivity can be achieved with an immersion tank testing system because of the best possible coupling conditions. This test tank is designed for aluminium billets in the aerospace industry. The billet diameters range from 172 to 620 mm and the lengths between 0.3 and 2 m. The test sensitivity is 0.8 mm FBH for the straight beam probes. Additional angle beam probes detect surface flaws. The sensitivity adjustment and TCG-curve recording are carried out fully automatically. The test results are provided in C-scan format.



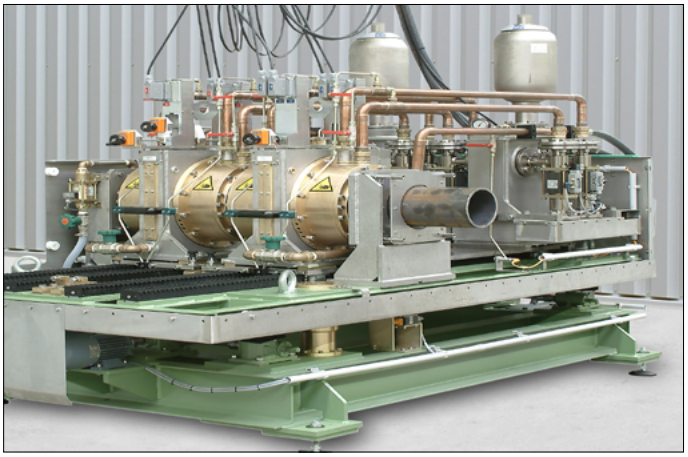
Immersion testing with 3 straight beam probes and 6 angle beam probes

ECHOGRAPH System Types HRPR RPSR RPTR
Ultrasonic Inspection of Seamless Tubes

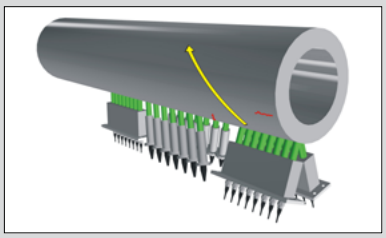
ECHOGRAPH HRPR: The criterion for the selection of the appropriate testing system is the diameter of the tube. The insonification directions depend on the test requirements. The most important inspection task is the detection of longitudinal defects with an angular insonification in both circumferential directions. The tube is surrounded by 2 probe rings with overlapping sound beams. A wall thickness measurement is often carried out with 8 straight beam probes. The detection of transverse defects requires additional probe rings. Tubes with diameters between 10 and 180 mm can be inspected with the system ECHOGRAPH HRPR. The great advantage of this system is the high linear testing speed of up to 2 m/s. The tubes are linearly moved without any mechanical rotation of tubes or probes. The detectability of short defects and little mechanical wear is a special feature of systems with stationary probes.



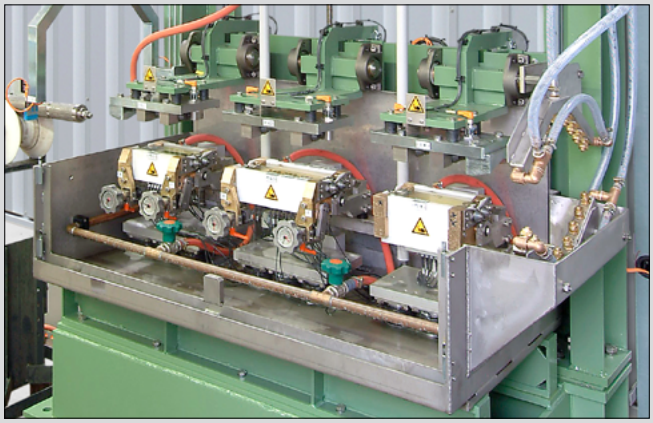
High speed tube testing with stationary probes (40 probes in 3 rings)



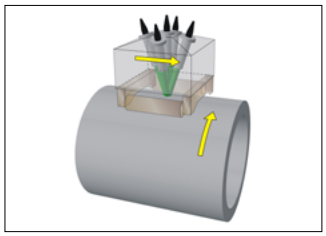
ECHOGRAPH RPSR: Tubes with larger diameters (e.g. up to 610 mm) can be tested in partial immersion with this system. The probes are positioned below the tube in water-filled chambers and remain in their position, while the tube is moved helically over the test chambers. This method also permits a good coupling of larger probes (multi-channel probe batteries or phased arrays). A tube conveyor must be provided, where the helical tube movement works without any slip. Typically, three test chambers are provided: a) longitudinal defects, b) transverse or oblique defects and c) wall thickness measurement and laminations.



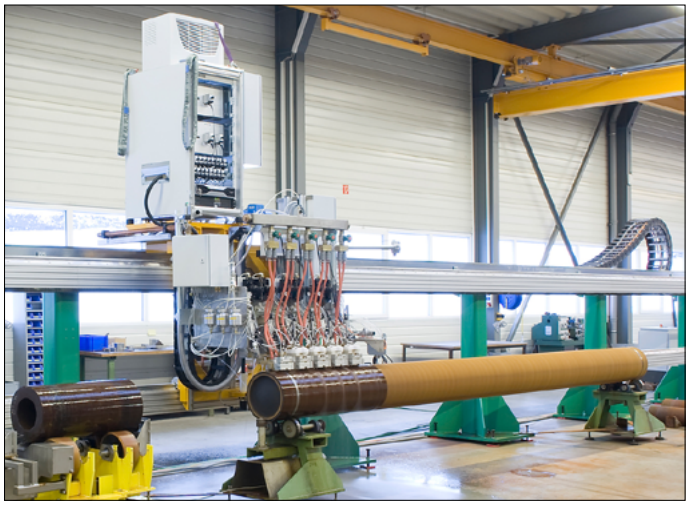
Helical tube testing in partial immersion and three test chambers



ECHOGRAPH RPTR: A third possible testing concept is a portal or bridge system. This system is best suited for an offline inspection. A conveyor system charges the tubes. After the tube is in test position, it becomes rotated by means of roller blocks. The number of probes depends on the required throughput. The probe holders are positioned in the 12 o'clock position and are moved linearly along the tube. Thus the tube is scanned helically. Typical diameters range from 80 to 750 mm. Again, five incidence directions are employed to cover all relevant defects (longitudinal, transverse, oblique defects and laminations) and to measure the wall thickness.

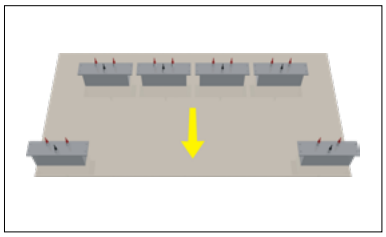


Tube testing with testing portal and multi-probe holders (cluster)

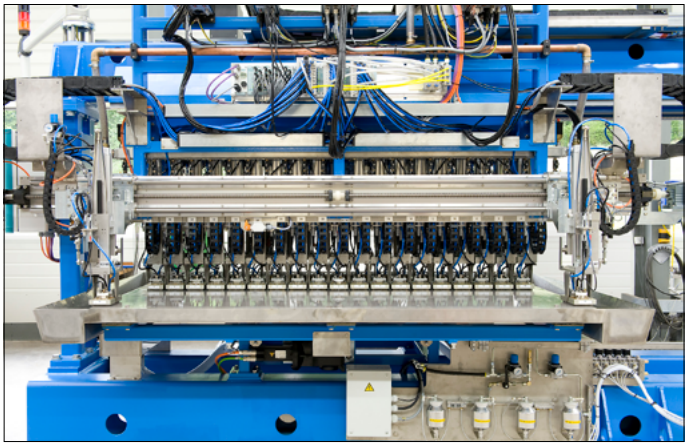


ECHOGRAPH System Types BAPS SNHF RPTR
Ultrasonic Inspection of Electric Resistance Welded (ERW) Pipes

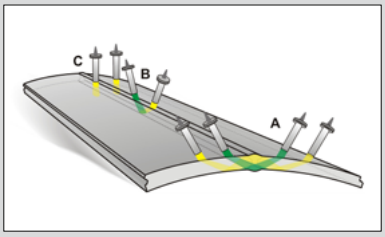
ECHOGRAPH BAPS: The production of ERW-pipes includes several steps of NDT. The usage of NDT has two major goals: Early information about the welding procedure as a feedback for the production line and secondly, the final inspection of the finished pipe. Several ultrasonic systems are typically encountered during the production process. A strip tester is often used for testing the pipe body before welding. The strip edges are tested with separate probe holders and 100 % ultrasonic coverage. Linear test traces for the strip middle probes are used with a coverage of 25 % to 100 %. This example shows a testing system with 42 probe holders. Dual-element probes must be used due to the low strip thickness and to obtain a good near-surface resolution. Each probe uses one transmitter and can contain one to three receiver elements. All probes are mounted to a testing bridge and can be moved offline above a reference with artificial defects plate for dynamic and convenient calibration.



Strip testing with probes for both strip edges and for the strip middle

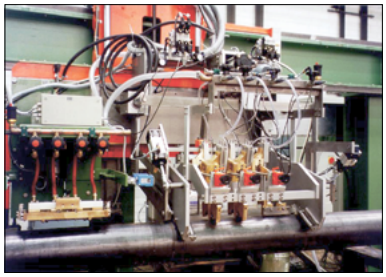


ECHOGRAPH SNHFS: Directly after welding, a first ultrasonic weld inspection is carried out with an online weld testing system. Longitudinal defects are detected with 4 probes (two for external defects and two for internal defects). Optional lamination probes inspect the heat-affected zone. A deburring check using one oscillating straight beam probe is sometimes added to verify the proper descarfing of the internal pipe wall. Typical testing speeds range between 10 and 60 m/min and correspond to the welding speed. Water jet coupling eases the inspection of the hot pipe directly after welding (see picture).



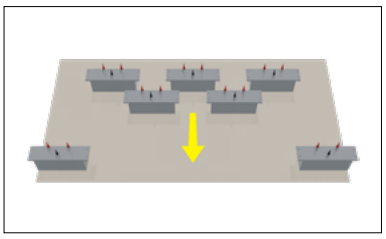
Weld testing with A) longitudinal, B) transverse and C) lamination probes

ECHOGRAPH SNHFT/SNHFB: After pipe cutting and the hydrostatic test, the final weld inspection can be carried out with a testing portal/bridge where the weld is turned into the 12 o'clock position. A portal proves advantageous because the weld is inspected without pipe movement, thus avoiding vibrations which could degrade the test results. Almost similar probe configurations are used for the offline weld test. Optional transverse probes can be provided. Water jet coupling for the angle beam probes allows high testing speeds (typically up to 1...1.5 m/s) and therefore an overall high throughput rate. If no strip testing system is employed, the pipe body test can be performed in a separate testing system (e.g. ECHOGRAPH RPTR) or by providing a second full-body probe carriage (small picture, left side).



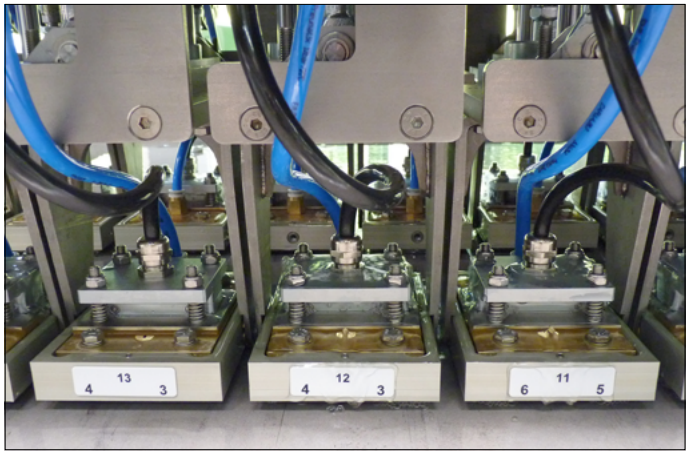
ECHOGRAPH System Types BAPS SNUS SNUL
Ultrasonic Inspection of Submerged Arc Welded (SAW) Pipes

ECHOGRAPH BAPS: Helically welded as well as longitudinally welded pipes have to be inspected with ultrasound if they are intended to be used for the transport of oil and gas. Helically submerged arc welded pipes (HSAW) are manufactured in a continuous process from a virtually “endless” strip. Consecutive strips are connected by means of a butt weld. The ECHOGRAPH BAPS strip testing system must be mounted on a rotatable carrier, which is placed directly after the welding machine. The rotation angle corresponds to the pipe weld angle. Recent requirements suggest solutions with high ultrasonic coverage. An overlapping probe arrangement with 100% ultrasonic coverage is shown in both pictures.

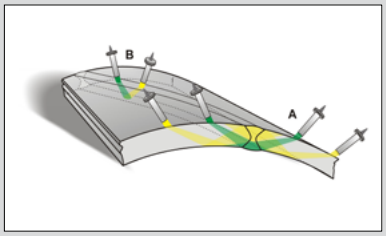


Strip and plate testing configuration with 100% ultrasonic coverage

The heavy plates for SAW-pipes with longitudinal welds are typically tested in the plate mill with approx. 400 testing channels and approx. 100 probes.

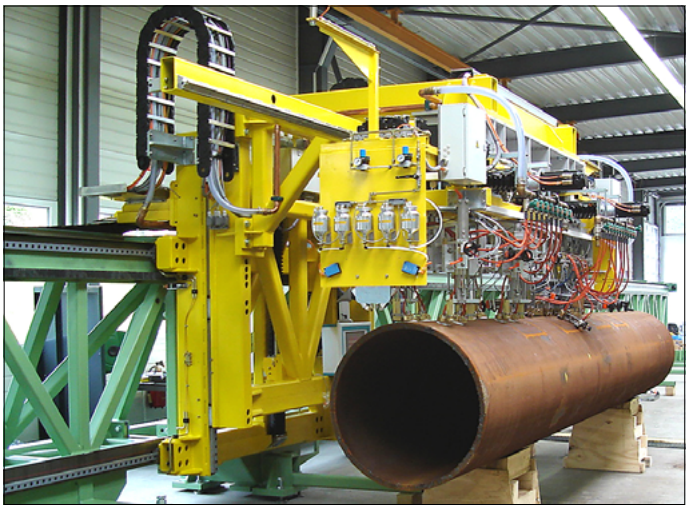


ECHOGRAPH SNUS: The wall thicknesses for HSAW-pipes are limited to max. 20 or 25 mm because of the forming process. Therefore, 4 sensors are typically sufficient for the detection of longitudinal defects. Also, on bead 2 probes are provided to detect transverse defects. These 6 probes (see small figure) are applied during the first online weld test (e.g. on endless pipe directly behind the welding machine) as well as in the final offline system (for the pipes which are already cut to their final length). The detection of delaminations in the heat-affected zone and in the pipe ends are additional inspection tasks for the offline test (picture below).



Angle beam probes for the inspection of HSAW-pipe welds

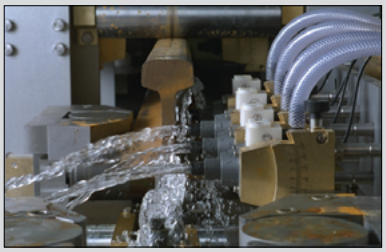
ECHOGRAPH SNUL: Larger wall thicknesses can be produced in case of longitudinally submerged arc welded pipes (LSAW). This often requires further tandem probes in order to reliably detect longitudinal lacks of fusion in mid-seam. Transverse probes can be realised on-bead to avoid the cumbersome calibration of the conventional X-setup. Lamination probes cover the heat-affected zone. Two testing concepts are found. Most common is a machine stand and the inspection of a linearly moving pipe (small picture). Higher throughputs and superior test results can be obtained by means of a testing portal with resting pipe and linearly moving probes (large picture).



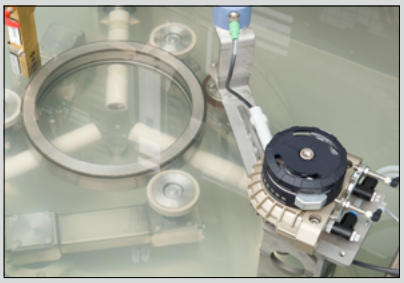
ECHOGRAPH Systems Types STFL SCHN TTPS
Ultrasonic Inspection of Pressure Cylinders, Rails and other Components

ECHOGRAPH STFL: This testing system is designed for rough environmental conditions and high throughput. The system is therefore ideally suitable for the manufacturer of gas cylinders. The cylindrical part of the cylinder is tested in a helical testing trace. Defects of all relevant orientations are detected in one test run. While the cylinder is rotating, the probes are linearly guided along the longitudinal axis of the cylinder. 2 probe holders and 10 probes are typically employed (test principle similar to ECHOGRAPH RPTR).

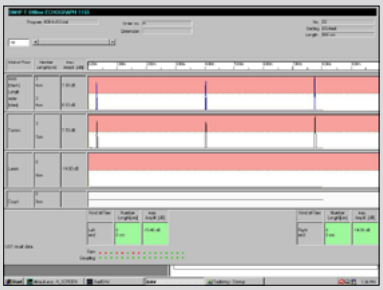
ECHOGRAPH SCHN: The standard configuration of an ultrasonic rail testing system contains 16 probes, where 7 probes are used for the inspection of the rail head, 6 probes for the rail flange and three probes for the rail foot. Straight beam probes are usually chosen. Water jet coupling provides good access to the complex and strongly curved rail profile. The probe holders can be adjusted by hand or fully automatically. The typical testing speed is 1 m/s and the test sensitivity is 1.4 mm FBH.



ECHOGRAPH TTPS: Bearing rings can be inspected in an immersion tank testing system. The bearings could be designated for high-speed trains. Therefore the testing sensitivity in accordance with DIN EN 12080 is 0.5 mm FBH, which imposes the highest requirements on the mechanical precision. This reflector must be detected with straight beam ultrasonic incidence either by direct defect echo evaluation or by observation of the back wall echo reduction. Four similar straight beam probes can be used to increase the throughput. The ring is tested under rotation with helical test tracks.



ECHOGRAPH 1156/1170 Electronics & ECHOVIEW Data Software: The evaluation of the ultrasonic signals is carried out with the digital ECHOGRAPH 1156/1170. These multi-channel ultrasonic electronics are specially designed for automated ultrasonic testing. Four flaw gates, two amplitude thresholds, a programmable TCG (time-corrected gain, sometimes also called DAC for distance amplitude correction) and multiple evaluation parameters are standard. Remote diagnosis and service can be provided via TCP/IP directly from KARL DEUTSCH in Germany. Data exchange with a host computer or an SQL data base is possible as an option.



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