

ECHOGRAPH-RPT.R

Ultrasonic Inspection of Tubes with Testing Portal

KARL DEUTSCH

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Probe Holders for the detection of longitudinal defects, transverse defects and laminations. Also the wall thickness is measured. In this case, a phased array testing electronics is employed.

Ultrasonic tube inspection with testing portal

KARL DEUTSCH has developed ultrasonic testing equipment since 1951 and has shipped the first inspection system for seamless tubes more than 40 years ago. Many improvements for the ECHOGRAPH-electronics, the robust testing mechanics and the ultrasonic probes have led to our current state-of-the-art. All components (testing electronics, testing mechanics, ultrasonic probes) are developed and assembled in-house. KARL DEUTSCH maintains a strict quality management system according to DIN EN ISO 9001:2000 which was firstly certified in 1993!

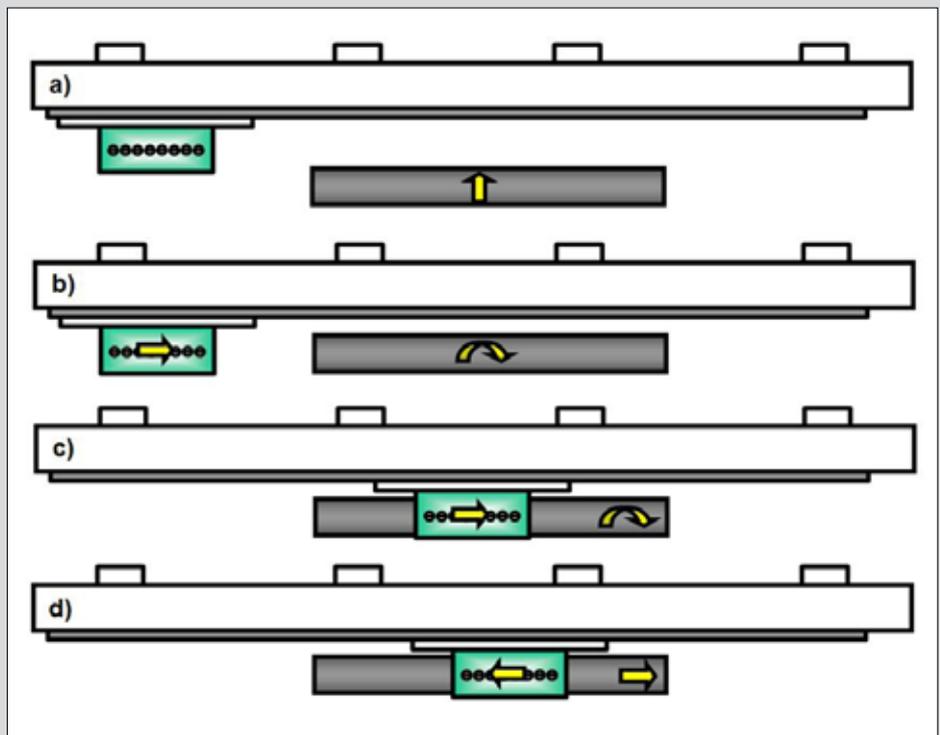
Unique about this testing system is the way to couple the ultrasound into the specimen. Water jet coupling is used, which means that the water path between probe and tube surface is in the order of several centimetres. This method of ultrasonic coupling results in little wear for the probes and the probe guiding devices. Also for a rough tube surface, stable coupling conditions are achieved because the water path can vary more than with gap coupling.

The ultrasonic testing system ECHOGRAPH-RPT.R is designed for rough environmental conditions and a high throughput. This system is especially suitable for an off-line inspection. It consists of a testing portal and several multi-probe holders. The tubes are typically loaded with a transverse conveyor. Once the tubes are placed in the testing portal, rollers put the tubes into rotation. The number of probe holders is chosen in accordance with the desired throughput and the respective testing task(s). The probe holders are linearly moved along the tube and inspect the tube in the 12 o'clock position. Rotational and translatory movements result in helical test traces.

Many testing tasks are possible. ERW-tubes (electric-resistance welded tubes with longitudinal weld seam) are tested for laminations, i.e. with straight-beam probes. Also the wall thickness can be measured with this setup. Seamless tubes are typically tested for longitudinal defects. Ultrasonic incidence is produced in the clockwise and the counter-clockwise direction. Some specifications also ask for the detection of transverse defects. In that case, ultrasonic incidence is produced in both axial directions of the tube.

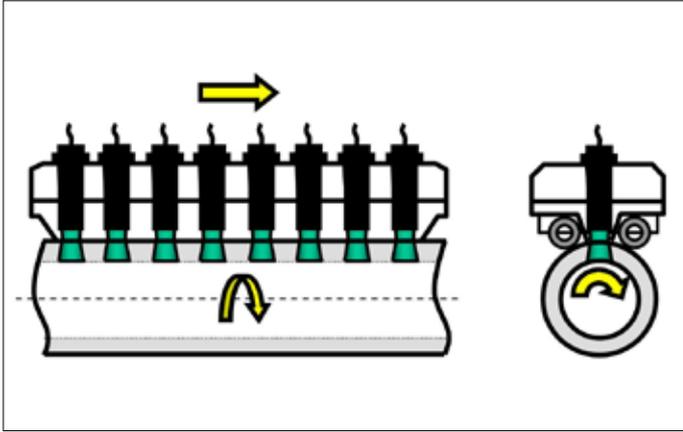
Testing cycle with machine in portal design:

- transverse loading of tube into testing portal
- tube is put into rotation and probe holders are moved towards tube
- testing of tube with helical test traces
- discharging of tube and backwards travelling of probes into the zero position.



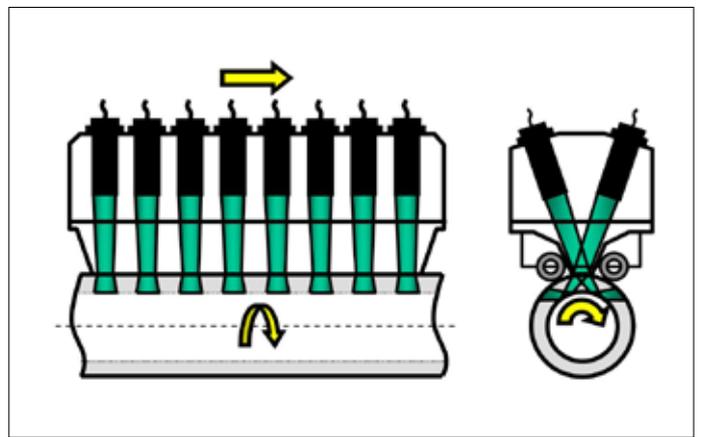
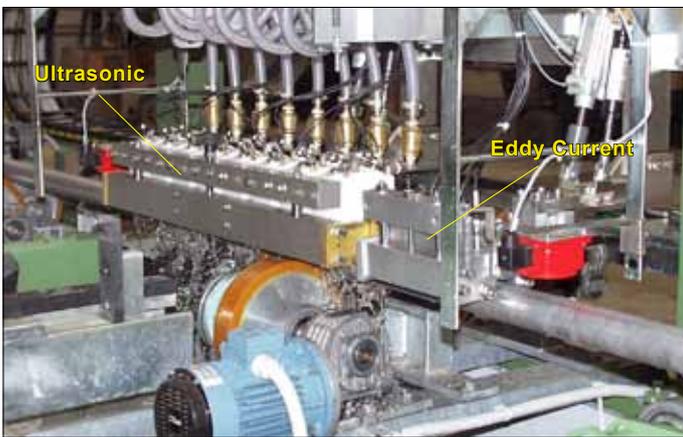
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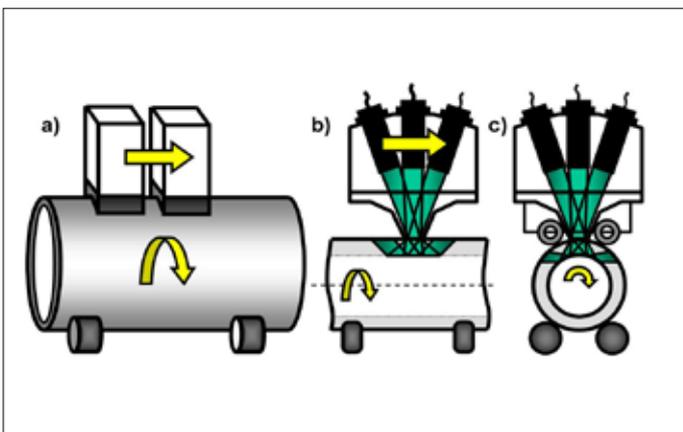
Inspection of tubes with longitudinal weld (ERW tubes):

In this example, eight ultrasonic probes are employed. Depending on the throughput and coverage requirements, either gap coupling with broad-beam dual-element probes or squirter coupling with single-crystal probes is carried out. Each probe holder is flexibly mounted to ensure perfect guidance on the tube surface.



Inspection of tubes for longitudinal defects:

In this example, 16 ultrasonic probes are mounted into one compact probe holder. The testing angle is typically chosen to 45° within the tube material. Water jet coupling is employed to obtain stable coupling conditions. The test tracks of the probes interleave. Therefore, full coverage of the entire tube volume is achieved. In this case, an additional sensor holder (right side of picture) is provided for an eddy current inspection. Thus, a combined inspection for internal and surface defects is carried out.



Inspection of tubes with 5 incidence directions:

In this example, 5 ultrasonic probes are mounted into each probe holder. Each probe holder is individually lowered and lifted for short untested tube ends. Water jet coupling is employed to obtain stable coupling conditions. Longitudinal and transverse defects are detected with angular incidence. The testing angle is typically chosen to 45° within the tube material. Straight-beam testing is used to detect laminations and to measure the wall thickness.

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Tube testing portal during assembly at KARL DEUTSCH system's workshop. A provisional calibration stand (yellow) is used for the sensitivity adjustment of all probes by means of a short tube segment. The probe holders are currently placed onto a production tube. This system was designed for a maximum tube length of 12 m. A modern phased array testing electronics with 192 parallel electronic channels was employed for an electronic beam angle adjustment and overlapping sound beams.

Typical Technical Data

ERW-welded or seamless pipes

Diameter range (D)	216 - 610 mm
Wall thickness (s)	3.2 - 100 mm
Length	5 - 15.3 m
Ovality	± 0.5% of D
Straightness deviation	max. 2 mm/m
Surface condition	no loose scale
Tube ends	machined, no burr

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