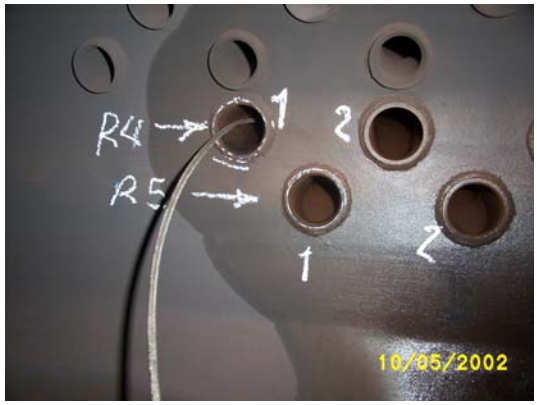
RFT INSPECTION OF TUBES

Remote Field Technique (RFT)

Remote Field is a technique used for the inspection of tubes in e.g. heat exchangers and boilers made of ferrous materials.



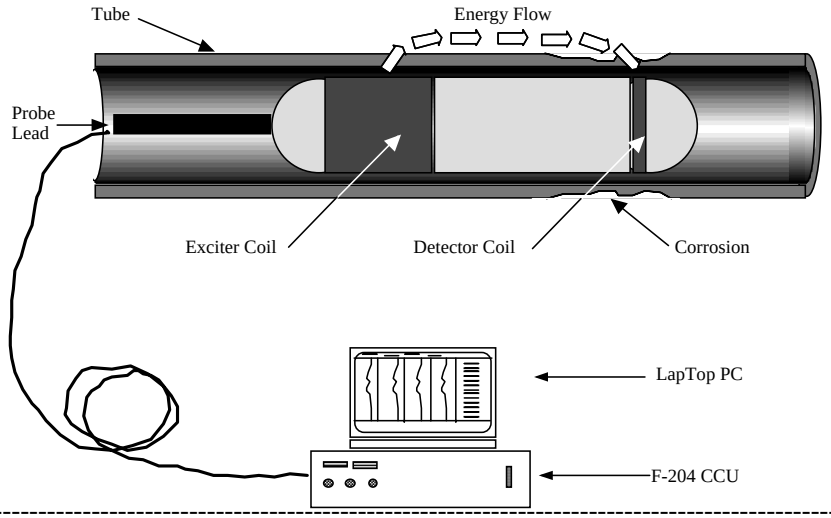
This technique is very suitable for detection and quantification of overall wall-loss. Local defects can be detected and quantified provided that they have some volume (diameter pit >5 mm). RFT can detect both in- and external defects but it is not possible to distinguish between them. Defects under or close to the tube sheet are hard or not possible to detect.

Theory

The probe used in RFT examination contains a send and a receiver coil. In the bigger send coil an alternating magnetic field is generated. This field is indirectly coupled to the receiver coil as a direct coupling between the two coils is shielded by the strong magnetic fields originating from the edddy currents that are being generated in the tube. At a low enough frequency the shielding will lose some of its strength allowing the exciter field to penetrate the tube wall in axial direction. Once the magnetic field reaches the exterior of the tube it will spread rapidly along the tube with little further attenuation. Research found that a portion of the magnetic field re-diffuses back through the pipe wall to the interior of the tube at a certain location. At this position the smaller receiver coil is placed to detect the remaining field. Now the indirect coupling path between send and receiver coil is complete. The magnitude and the phase of the received magnetic field depend on the amount of material that was crossed in the indirect coupling path. If wall-loss occurs in a tube there will be less attenuation and delay of the exciter field before it reaches the receiver coil. The signal on the computer screen represents the changing in the received magnetic field, and thus the condition of the tube.

During signal analysis, the signals acquired during an inspection will be compared to the signals from reference defects. Reference defects are defects with known depth and shape and are machined into a calibration standard. The calibration standard needs to be of the same material and dimensions as the tubes to be examined.

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



Equipment

For Remote field inspection Dacon Inspection uses the Corestar Omni 100 tester or the Russel Ferroscope 204. These tools are designed for metal loss assessment of tubes in the diameter range from 1/4” to 3”. The RFT signals are presented on a laptop computer and all inspection data is automatically stored to hard disc. The equipment operates on 220 V, 50 Hz.

Overview of possibilities and limitations of the Remote Field Technique

- Remote field testing is a method to inspect ferrous tubes (e.g. carbon steel and CrMo). This method is a very suitable method for detection and quantification of overall wall loss. Remote field testing is less sensitive to local defects than conventional Eddy Current.

- Holes with a diameter of 5 mm or pits with the same volume as a 5 mm hole are normally detectable. This counts for tubes with an internal diameter smaller than appr. 30 mm. In bigger tubes sensitivity goes down a little bit. How much depends a lot on the situation (when pitting is expected a calibration standard will be used to determine senstivity).

- Overall wall-loss is detectable from 10% of the nominal wall thickness and up.

- Defect depths are being reported in defect classes with a width of 10% of the nominal wall thickness (e.g. defect class 3: 30- 40 % wall-loss).

- Although this method can detect both internal and external defects it can not distinguish between internal and external defects.

- It's possible to detect defects under support plates unless the defect has a fairly big volume (approx. 20 % circumferential). A pit under a support plate can not be detected. Determination of defect depth is more difficult for defects under support plates. Nevertheless good results have been achieved.

- Defects just behind the tube sheet can only be detected when a special dual exciter probe is used. Defect under the tube sheet cannot be detected (dual exciter probes are not standard).

- Examination of very big tube diameters is possible (probes are not standard).

- The size of the probe in relation to the internal diameter (fill factor) is not so critical.

- Inspection of finned tubes has a lot of limitations, unless the finns are orientated in axial direction.

Remark: *Named values concerning sensitivity and accuracy have been generalised. In particular sensitivity is very dependend on the signal to noise ratio during the examination.*