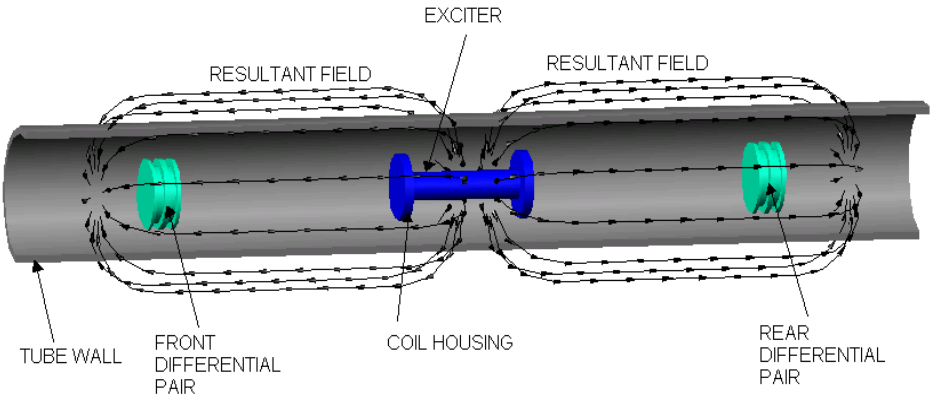
CARBON STEEL INSPECTION, INC
VERSA INTEGRITY GROUP

CSI Tech Brief

Which Probe Type to Use?

We at Carbon Steel Inspection are often asked to provide a general description or background information on Remote Field Testing. There are many different manufacturers of Remote Field Testers, probes, and reference standards. This Tech Brief only addresses our implementation of the technology from our perspective and bias and does not imply the capabilities or limitations of any manufacturer or vendors' performance.

RIGID DUAL PICK-UP PROBE

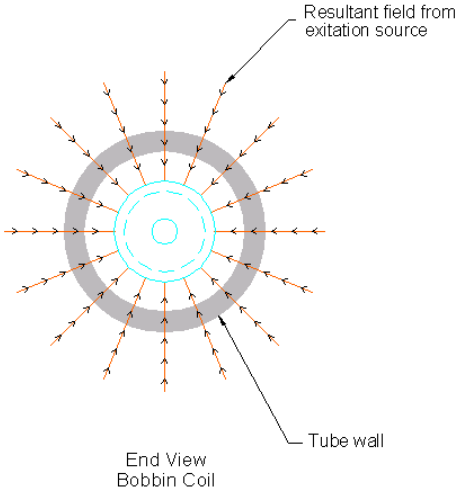


BACKGROUND

For ID tube testing, the terminology of coil types is for the most part universal. The three main coil types are Bobbin, Pancake and Radial. The arrangement of the coils can be wired in absolute, differential or compensating modes. The energized and passive sensors coils are known as exciters and detector (pick-up) coils, respectively. The air gap between the coil and tube wall is known as the fill factor. It is an area ratio of the probe diameter to the tube ID. The fill factor is a percentage that is often referred to in industry standards and codes for providing a minimum response to known flaw types. Remember, each coil has their own capabilities and limitations and should be used for the correct inspection application.

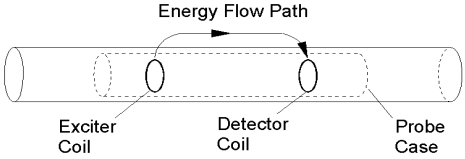
BOBBIN GENERAL DESCRIPTION

A bobbin coil is wound with magnet wire wrapped around a housing that looks similar to a seamstress's bobbin used for sewing thread. Typically, the bobbin coil centerline is positioned such that it's center is in-line with the tube axis. This creates complete



circumferential coupling between the electromagnetic field and the tube wall because the entire coil is facing the tube wall. In other words, in-line or parallel with the tube axis. The efficiency of the coupling is maximized when the coil is perfectly centered and matches the axis of the tube. As the gap between the coil and tube increases, a lower fill factor, the performance of the probe diminishes. In most applications a bobbin coil provides a volumetric inspection because it has sensitivity to both ID and OD originating defects. As the bobbin coil traverses the tube, it senses 360 degrees around the tube in a single pass. Sensitivity and quantification are based on the averaging affect that a disturbance, from a defect, produces as compared to the volume of nominal tube wall has background induced voltage. Bobbin probes are good for general purpose inspections but may not offer the sensitivity of other coils.

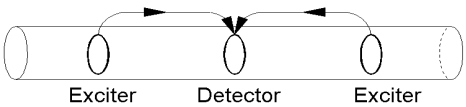
The basic RFT bobbin probes have at minimum a single exciter and pick-up coil which are separated from each other by a factor of several tube

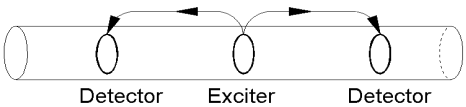


diameters. See CSI Tech Brief No. 1.

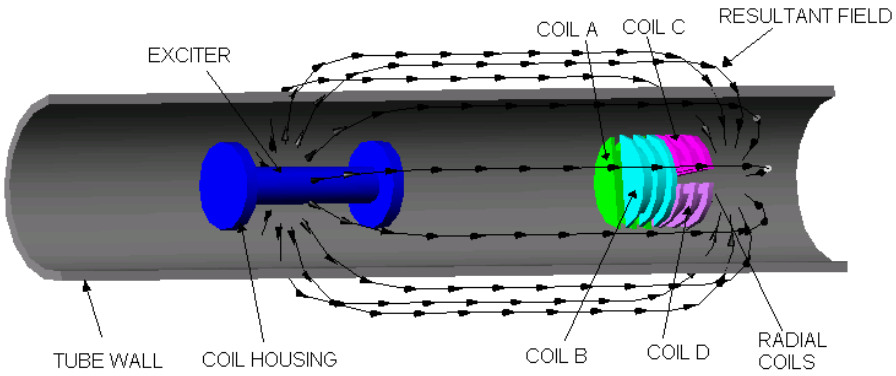
When only one pick-up or detector coil exists it is referred to as an absolute coil. Absolute coils sense the overall condition of the tube from the start of the examination by referencing any previous examined point within the tube. Absolute mode is usually preferred for detecting long gradual type flaws or changes in metallurgical properties. When two pick-up coils are located next to each other and their sensing areas compared or differentiated, the coils are said to be differential. By definition, a differential coil implies a pair that discerns a specific region without any reference to previously examined points. Differential mode is used primarily for detecting sharp flaws.

This basic RFT probe, consisting of a single exciter with a single differential pair has several disadvantages. The first, is at external structures such as a baffle or support plate whereby the structure blocks or suppresses the majority of the field produced from the exciter. Consequently, sensitivity is greatly diminished on one side of the structure as well as the opposite end of the tube from where the probe was inserted. Secondly, the signal response of the external structures are much larger in amplitude, which have a tendency to mask a small amplitude response from an isolated pit or crack. To overcome these disadvantages two other common types of probes can be used. They are shown below; the Dual Exciter and the Dual Pick-Up.



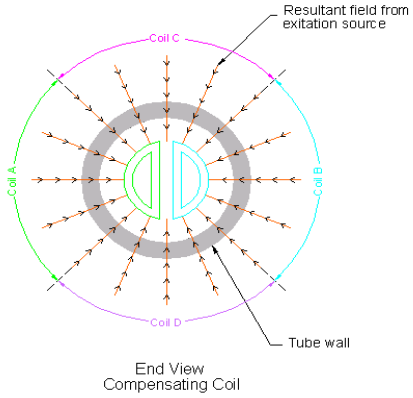


COMPENSATING PROBE



COMPENSATING GENERAL DESCRIPTION

Pancake and Radial coils are wound with magnet wire wrapped on housings similar to bobbin coils. The difference is how the coils are positioned which will effectively reduce their coupling area as compared to bobbin coils. Normally pancake and radial coils are smaller in



End View
Compensating Coil

size in an effort to increase sensitivity by decreasing the amount of tube wall sensed from the coil. Usually multiple(4 or more) pancake or radial coils are required to achieve sensitivity around the complete circumference of the tube. They are said to be compensating when every other coil is wound in the opposite direction, clockwise versus counterclockwise producing a summation of positive and negative voltage. Then placed circumferentially in line and wired in series. The result is a single channel input that eliminates concentric responses such as baffles, tube supports and degradation. The benefit is an increase in sensitivity by eliminating the large analog response of the external structure as compared to the bobbin probes. However, there are some significant disadvantages because of the increased analysis complexity requires a more skilled and experienced technician. Also there is a loss of signal response from concentric defects and external references for verifying location via known landmarks.

DESIGN

RFT probe design is affected by many considerations and variables. Probes are designed for specific applications and may or may not be suitable for testing other materials, sizes or wall thicknesses. The probe length can vary depending on design but is typically a factor of 4 to 5 times the OD of the tube/pipe that is to be inspected. Preparation is advised and customers should consult their vendor to discuss component history prior to the inspection.

By: Gary Kroner