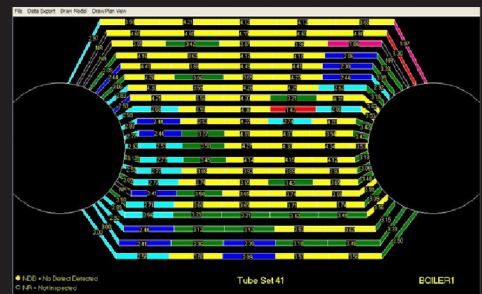


### Boiler and Heat Exchanger Tube Inspection

Boiler and Heat Exchanger tubes are subject to various biological, chemical and physical stress causing a number of defect mechanism such as erosion, corrosion, cracking and other forms of material loss to occur.

Frequent inspection of these tubes can reduce unplanned shutdowns as well as other more serious breakdowns. By utilising the correct inspection techniques for each application and by using advanced methods of reporting the engineers are able to make adjustments to the process and extend the life of these and other units in the plant.



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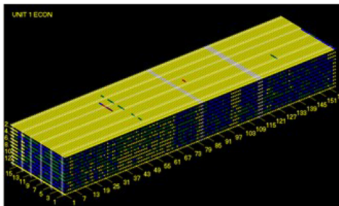
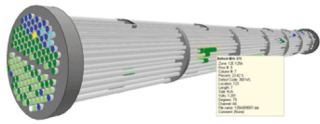
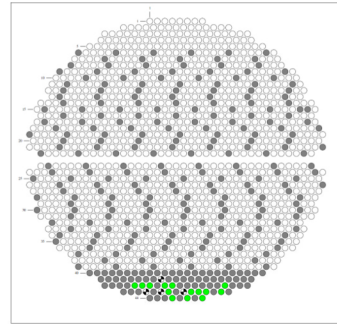
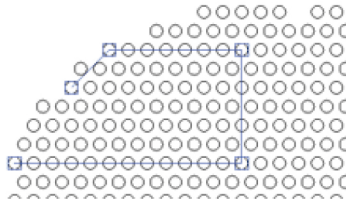
Sonomatic has offices in strategic global locations so we can respond quickly to customer's requirements wherever they may be situated. Our high quality products are matched only by our customer service. In addition to our field services, we offer training and consultancy at our sites in the UK or at client's premises anywhere in the world.

Sonomatic is committed to improving asset performance through applied and innovative technology; to delivering these benefits to our customers in the products and services that we provide; and to working with our customers, as value-added partners, to realise the maximum benefits of inspection technology.

## Standard Reporting

The client is issued with a interim report when the inspection is completed. This will contain a tube map displaying the deepest defect indication found in each of the tubes inspected and will be divided into defect depth ranges of 20%. The interim report will also include a description of the defect indications found during the inspection as well as information regarding the unit inspected.

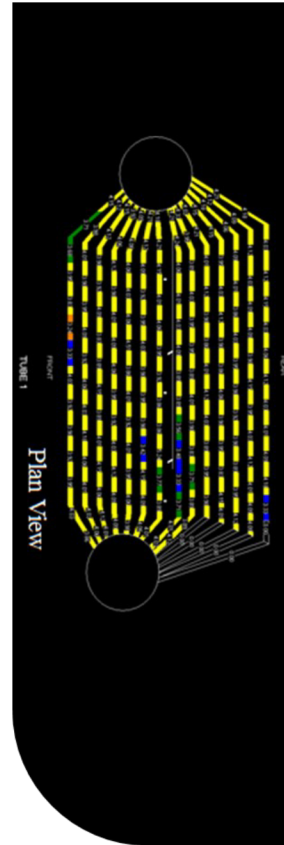
A final report will be issued from the Sonomatic office containing more detailed information of the inspection, the technique used and the results from the inspection. Photos of the unit and tube sheet will also be included when available.



## Advanced Reporting

More advanced reporting options are also available. These can include from spreadsheets with minimum remaining wall thickness measurements from IRIS inspections to detailed 3D representation of the results showing defect indication positions in each tube.

Due to the time required for 3D inspections and 3D reporting various options are available at different resolution and levels of information.



## Techniques and Applications

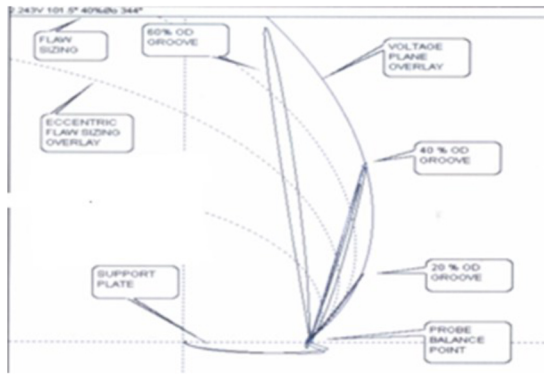
Application	Boiler Tubes		Heat Exchangers and Chillers				Fin Fan Coolers		
	Remote Field Eddy Current	IRIS	Eddy Current	Magnetic Bias Eddy Current	Remote Field Eddy Current	IRIS	Eddy Current	Magnetic Bias Eddy Current	IRIS
<b>Ferromagnetic Material</b>	✓	✓		✓	✓	✓		✓	✓
<b>Non Ferromagnetic Material</b>			✓			✓	✓		✓
<b>Capability of Detection</b>	General Wall Loss and Large Volume Corrosion	General Wall Loss and localised Pitting	General Wall Loss, Localised Pitting, Baffle Wear and Cracking (Orientation Dependant)	Localised Pitting and Cracking (Orientation Dependant)	General Wall Loss and Large Volume Corrosion	General Wall Loss and localised Pitting  Results may be limited in thin tubes.	General Wall Loss, Localised Pitting, Baffle Wear and Cracking (Orientation Dependant)	Localised Pitting and Cracking (Orientation Dependant)	General Wall Loss and localised Pitting  Results may be limited in thin tubes.
<b>Normal production average for 12 hours</b>	300-500 tubes	75to100 tubes  150to300 tubes when the boiler is flooded with water	400-600 tubes	300-500 tubes	300-500 tubes	100to150 tubes	400-600 tubes	300-500 tubes	75to100 tubes
<b>Cleaning Requirements</b>	70% Fill Factor is required for the probe and scale needs to be non magnetic.	100% as this is an Ultrasonic Technique.	90% Fill Factor is required for the probe and scale needs to be non magnetic.	90% Fill Factor is required for the probe	70% Fill Factor is required for the probe and scale needs to be non magnetic.	Bare Metal as this is an Ultrasonic Technique.	90% Fill Factor is required for the probe and scale needs to be non magnetic.	90% Fill Factor is required for the probe	100% as this is an Ultrasonic Technique.
Always remember that better tube cleaning ensures higher quality inspection with lower equipment wear and less chance for delays due to probe failure.									

## QA and HS&E

It is Sonomatic's ongoing commitment to supply services and products, through the application of technical and engineering excellence, which complement both the customer's and our own QA and HS&E requirements.

Sonomatic's commitment to quality is maintained through continuous assessment and review of our Quality Management Systems to BS EN ISO 9001:2008. Sonomatic actively promotes the development, implementation and improvement of our QMS as a part of our ongoing drive to enhance customer satisfaction by meeting or exceeding customer requirements. In 2009 Sonomatic achieved UKAS accreditation as an Inspection Body to BS EN ISO/IEC 17020 (UKAS IB4276).





## Remote Field Eddy Current

The RFT system uses the principle of the “Remote Field Effect”. The phase response of an input signal is changed in proportion to the wall thickness. Exciter and detection coils are typically separated by 3 to 5 times the tube diameter.

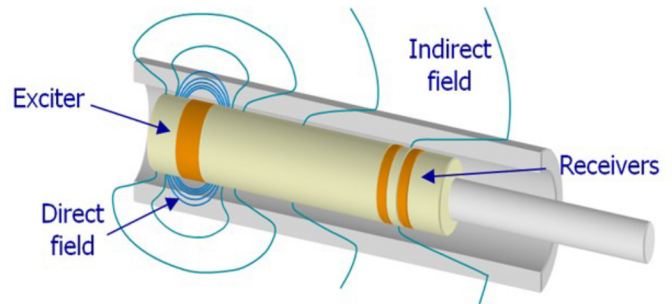
**THE DISTANCE BETWEEN COILS IS SUCH THAT WE ARE OPERATING OUTSIDE THE “DIRECT FIELD” IN THE “INDIRECT FIELD”.**

### Disadvantages of Remote Field Eddy Current Inspection

- Not sensitive to small defects.
- Not sensitive to defects at tube ends or under baffle plates.
- Over sensitive to fins. Defect are masked by fin signals so fin tubes can't be tested.

### Advantages of Remote Field Eddy Current Inspection

- About 300 - 500 tubes inspected per shift
- Very effective in detecting Generalised wall loss.
- Ideally suited for thick wall tubing as in boilers
- Flexible probes for inspecting bends in boilers
- Range of 10mm – 150mm ID can be inspected



## Magnetic Bias Eddy Current

### Principles of the Magnetic Bias Eddy Current inspection technique for Tube Inspection:

When standard eddy current is applied to ferrous tubes the eddy current field is affected by the magnetic properties of the material. The Magnetic Bias probe creates a magnetic field in the material and is set to exactly the correct intensity in order to limit the effects of the magnetic properties of the material. This allows enough of the eddy currents to bypass the skin effect and penetrate the material. Defects in the material will cause a change in the permeability of the material at that position as well as the amount of eddy currents at that point. The detector coil will then pick up this change in eddy currents and the system will then visually present that information on the computer screen.

### Advantages of Magnetic Bias Eddy Current Inspection

1. It is a very quick screening technique for Ferro Magnetic Materials. The Magnetic Bias eddy current technique can measure localised defects (pits) as small as 2mm can be detected and sized to an accuracy of  $\pm 10\%$  of the wall thickness.
2. 300 TO 500 tubes inspected per shift.
3. Although cleaning is still required only a 90% fill factor is required for the inspection.

### Disadvantages of Magnetic Bias Eddy Current Inspection

1. The Technique is only sensitive to localised defects such as pitting. Generalised wall loss can't be detected.
2. Defect Indication need to be backed up by other techniques as spurious indications can be caused by inclusions in the material.
3. Tube sizes are limited to internal diameters between 12mm and 32mm and wall thickness less than 3mm for ID's greater than 17 and 2.11 for ID's smaller than

## QA and HS&E

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