

## Case Study

### ***Inspection of Inter Cooler Tubes in MEG Plant using Eddy Current Technique at one of the Petrochemical Company in India***

**Eddy Current Inspection** of Inter Cooler tubes was carried out by Testex NDT India Pvt. Ltd. in December 2007 with **Testex make TX - 4400 system** by Differential, Absolute and Multi Frequency method for determination of tube wall thickness and detection of flaws in the cooler tubes.

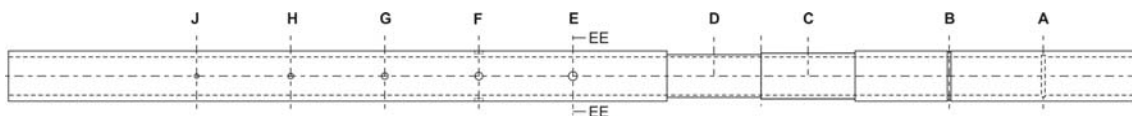
The unit details were as follows,

❖ <b>Inter Cooler No.</b>	N-HX-3301 to 3312
❖ <b>No. of heat exchanger tested</b>	12 Numbers
❖ <b>Tube O.D.</b>	19.05 mm
❖ <b>Tube Thickness</b>	2.11 mm
❖ <b>Tube Material</b>	SS304
❖ <b>No. of Tubes</b>	304
❖ <b>No. of Tubes Plugged</b>	3

Tube Inspection was carried out using bobbin type differential probes with suitable ID (85% Fill Factor), which has two sensing coils wound in opposite direction and investigating different regions of the material being tested.

**Eddy Current technique** works on the principle of Electromagnetic Induction. In this technique a probe is inserted with a sinusoidal alternating current to induce eddy currents in an electrically conducting material such as stainless steel, aluminum etc being tested and the change in impedance is measured. Discontinuities such as defects, material property variation, and surface characteristics distort the Eddy Current flow and in turn alter the coil impedance. The change in coil impedance is measured and correlated with the dimensions of the discontinuity.

**Calibration standard** was fabricated on same material and dimensions as per ASME Section V Article 8 Appendix 1 prior to inspection.



**Tube Material :** SS – 304  
**Tube Dimensions:** 19.05 mm OD x 2.11 mm thk.

<b>Identification</b>	<b>Description</b>
A	10% ID Ring
B	10% OD Ring
C	25% Gradual Wall loss (OD)
D	50% Gradual Wall loss (OD)
E	20% Pit (4 pits placed circumferentially in one plane)
F	40% Pit
G	60% Pit
H	80% Pit
J	1.3mm Hole

**Discussions:**

Inter Coolers were in service for nearly 4 years and were having frequent leakage history. The cause of failure was not known and it was decided that they should be inspected by Eddy Current Technique.

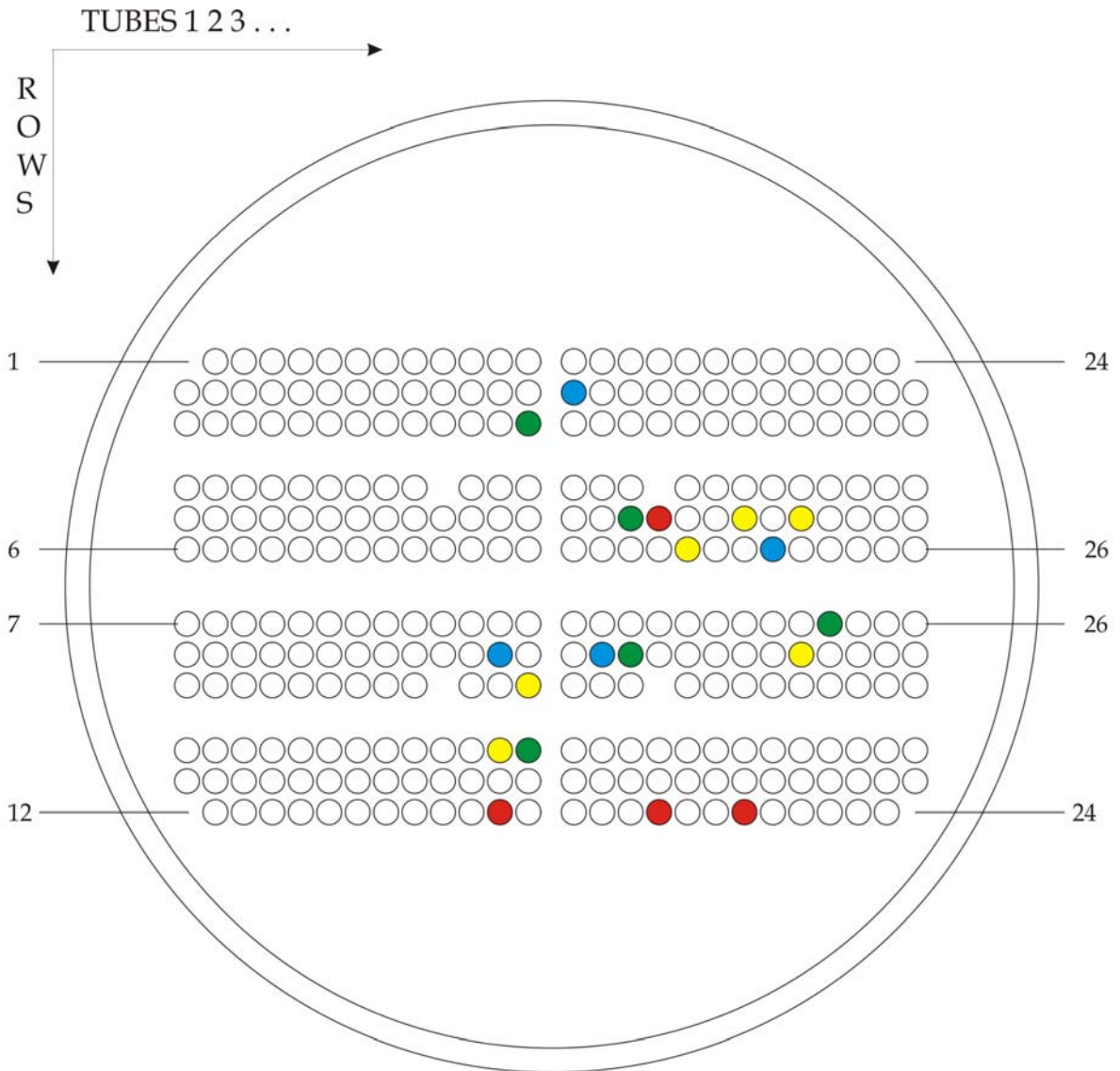
**Conclusion:**

On inspection it was observed that 83 numbers of tubes were showing Baffle Fretting type defects.

All the 83 tubes were pulled out for verification and severe Baffle Fretting damage was observed on all the tubes. Few tubes which were not showing any flow indications during inspection were also pulled out for verification and no defects were observed on those tubes.

Sample waveforms along with the photographs are enclosed along with this case study.

## Color Coded Tube Sheet layout of one of the Inter Cooler

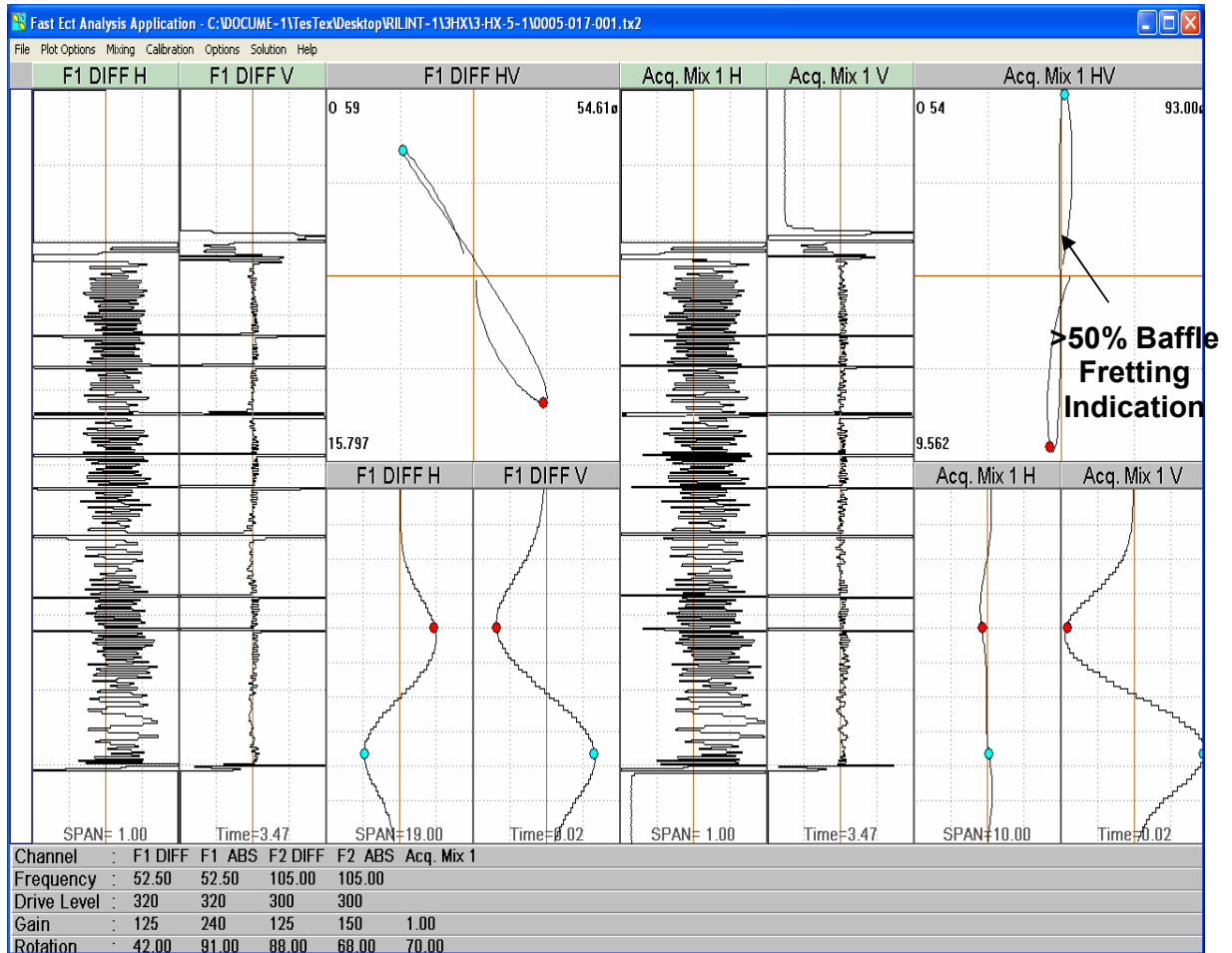


Denotes

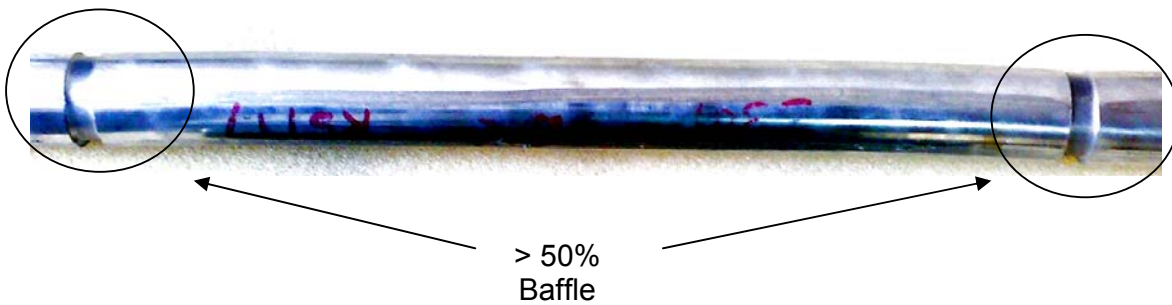
- |                    |                    |                    |
|--------------------|--------------------|--------------------|
| ○ Wall Loss 0-20%  | ● Wall Loss 21-30% | ● Wall Loss 31-40% |
| ● Wall Loss 41-50% | ● Wall Loss >50%   | ● Plugged          |

Inspection Date: 15 December 2007

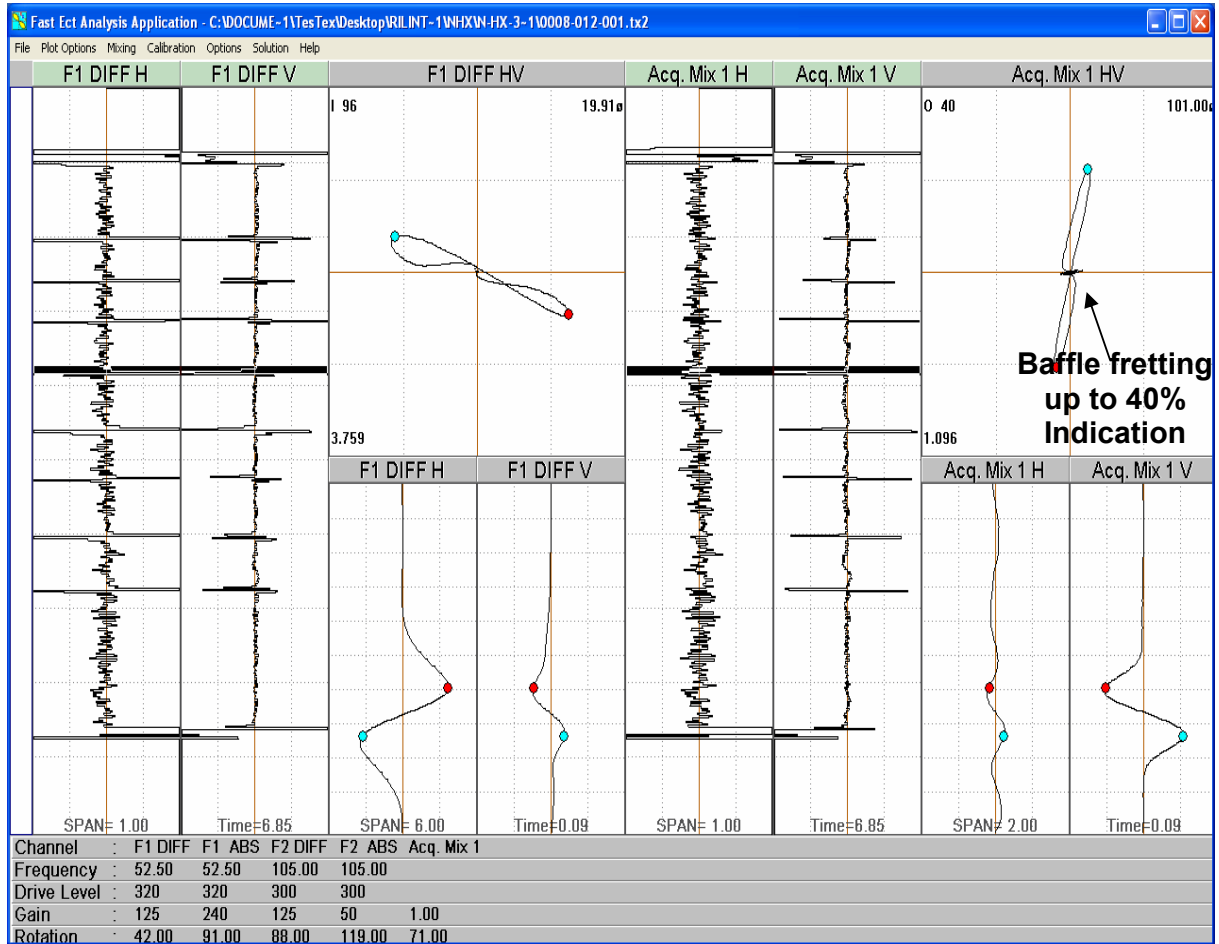
## SAMPLE WAVEFORMS WITH PHOTOGRAPHS FOR DEFECTIVE TUBES



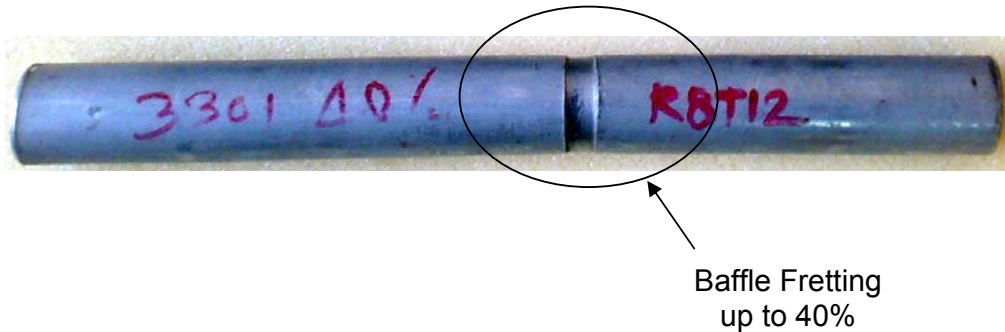
Above waveform from Row # 5 Tube # 17 showing baffle fretting like indication >50% with reference to calibration standard.



Actual Tube from Row # 5 Tube # 17 showing Baffle Fretting



Above waveform from Row # 8 Tube # 12 showing baffle fretting like indication up to 40% with reference to calibration standard.



Actual Tube from showing Baffle Fretting