



EAGLE 2000 PLUS MULTICHANNEL NDT SYSTEM FOR TUBE INSPECTION FROM THE I.D.

LOCATE TUBE DEFECTS IN HEAT EXCHANGERS OR DRUM TO DRUM BOILERS BEFORE THEY CAUSE FAILURES WITH THE **EAGLE 2000 PLUS MULTICHANNEL NDT SYSTEM**. USING THE REMOTE FIELD ELECTROMAGNETIC TECHNIQUE (RFET) METHOD, THE **EAGLE 2000 PLUS** DETECTS AND QUANTIFIES CORROSION, EROSION, PITTING, CRACKING, AND MECHANICAL DEFECTS TO PREVENT COSTLY AND DANGEROUS TUBE FAILURES. THE **EAGLE 2000 PLUS** TESTS STRAIGHT AND U-BEND HEAT EXCHANGER TUBES, BENT BOILER TUBES, FINNED OR UNFINNED TUBES, FERROUS OR NON-FERROUS TUBES, AND SMALL DIAMETER PIPES.

The Eagle 2000 Plus Multichannel NDT System is a fast, accurate, cost effective, and field proven system for tube examination from the I.D. It can be used in single channel mode, differential mode, or multichannel mode depending upon the type of inspection required. A full 100% circumferential test is performed over the tube's full length, not just at finite points, as with some other NDT methods. The system can be used to test virtually any tube-constructed type of process equipment such as boilers, heat exchangers, air coolers/fin fans, air heaters, etc. The Eagle 2000 plus can also test small diameter process piping and provide baseline evaluation of new or stock tubes. The Eagle 2000 Plus not only detects flaws in such tubes, but also quantifies and characterizes them.



Assortment of various rigid and flexible RFET probe styles and sizes



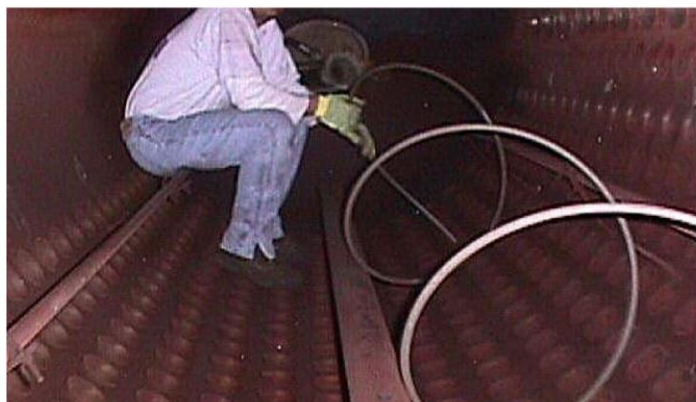
Eagle 2000 Plus electronics module

Advantages

- Requires no couplant
 - Uses no magnets
 - I.D. or O.D. scale have no signal impact
 - Standard probe sizes from 0.320" (8mm) to 6" (150mm)
 - Tests approximately 300 tubes per shift
 - Fill factor is not critical (can be as low as 40%)
 - Full circumferential coverage over entire length
 - Minimal tube preparation
 - Wide frequency range allows ferrous or non-ferrous testing
 - Real time display with advanced signal processing
 - High Resolution 3-D color graphics
 - Modular system is easily packed for transport
- Single channel probes can operate in either absolute or differential modes
 - Multichannel probes allow for smarter defect detection with accurate sizing
 - The system can test boiler tubes from either the mud or the steam drum. Using flexible probes allows the bends to be tested with full detection/quantification capabilities. (The inner and outer radius of boiler bends are very susceptible to defects)
 - Special flex probes are available for testing U-bend bundles
 - Fill Factor is not critical with RFET technology (unlike standard eddy current technique). One size of probe will test many different sizes of tubing, making many inspections possible with only a few standard size probes
 - Calibration tubes can be manufactured for virtually any flaw type. This aids in flaw detection through pattern recognition, and allows quantification of defect depth and diameter.

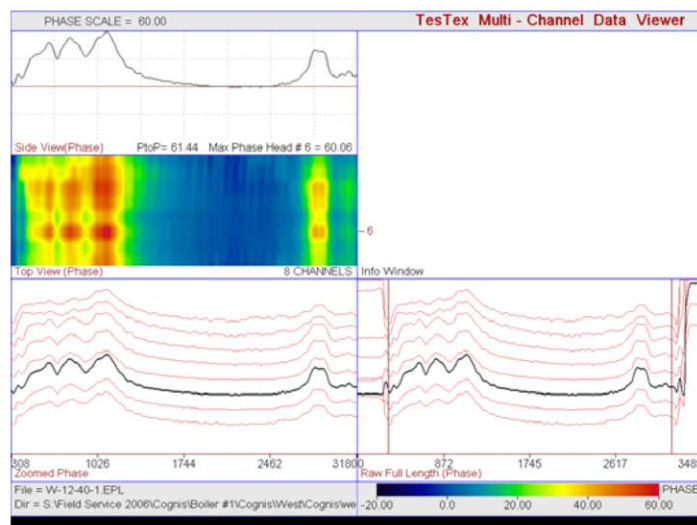
System Versatility

Full Length Boiler Tube Inspection

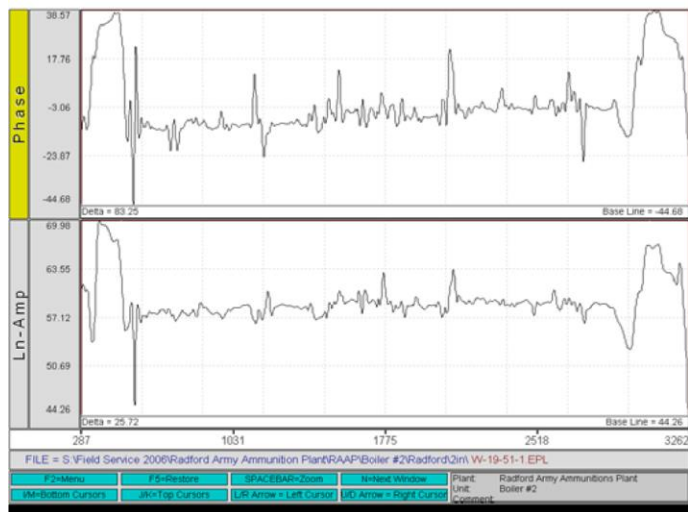


Probe insertion/retraction from a boiler steam drum

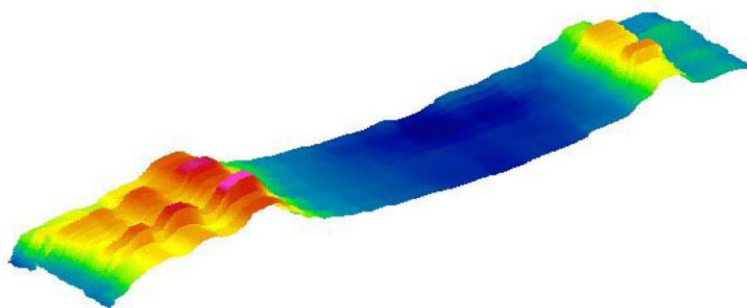
Boiler inspections are performed on drum to drum type boilers as well as straight tube boilers. These tests are full length examinations from the tube I.D. giving a quantitative evaluation of each tube. Applications include power boilers, recovery boilers, waste heat boilers, fire tube boilers, dowtherm boilers, and related boiler components such as tubular air heaters, etc. With the flaw characterization process, defects such as areas of wall thinning, pitting, cracking, erosion/corrosion, soot blower thinning, flue gas thinning, etc. are exposed and evaluated.



Multichannel drum to drum boiler data showing 65% to 70% wall loss near the mud drum bend



Single channel drum to drum boiler data showing 35% to 40% wall loss



3D representation of the above waveform showing the 65% to 70% wall loss near the mud drum bend

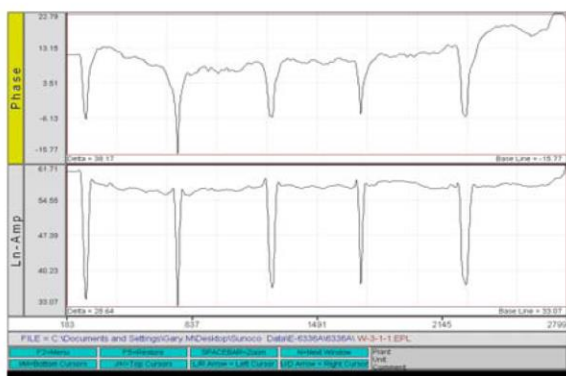
Heat Exchanger Tube Inspections



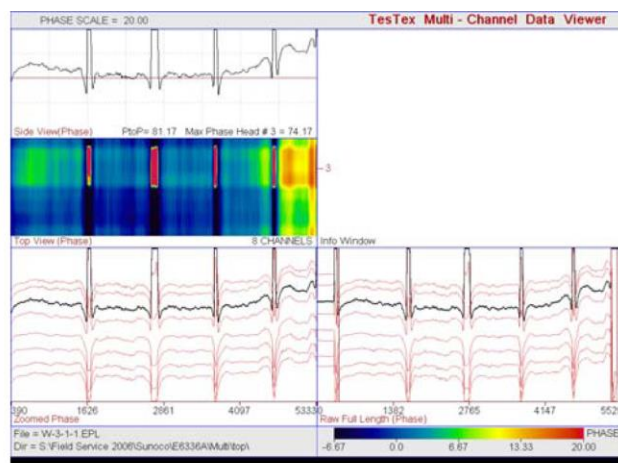
Inspection of a heat exchanger

Heat Exchanger inspections are performed on straight shell and tube exchangers, U-bend bundles, and finned tube exchangers. Applications include feedwater heaters, air coolers/fin fans, chillers/coolers, air heaters/ pre heaters, MSR's, reformers/ultraformers, condensers, reactors, reboilers, etc. Types of defects located in these units are wall thinning, pitting, cracking, vibration/fret wear, erosion/corrosion, steam cutting, etc.

Single Channel and Multichannel



Single channel heat exchanger data showing wall thinning near the tube sheet



Multichannel view of the same waveform showing wall thinning near the tube sheet

Software Features

- User-friendly, menu driven, keyboard-controlled functions
- Separate Data Collection and Data Analysis modes
- Real-time signal processing
- Advanced post collection signal processing techniques
- High Resolution 3-D display with rotating views
- Zooming algorithms for small or hidden defects
- Screen capture utility for printouts
- On-screen help menu

Design Features

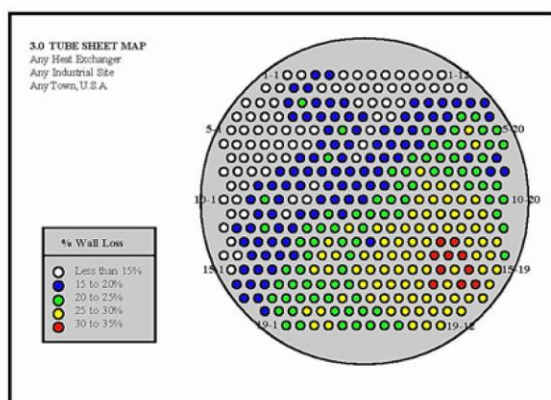
- Modular PC-based system
- Low signal to noise ratio
- Digital electronics immune to signal drift problems of analog systems
- Durable long life probe design

Field Services

TesTex has been performing NDT inspection services for over 15 years. Through this experience, we have developed the most state of the art, versatile systems in the field today. With service branches at locations around the world, and the ability to mobilize staff from any of these locations, TesTex offers complete professional services for any of your NDT needs. Preliminary reports are given on site after every inspection. Results on the condition of your process equipment are available immediately, allowing you to perform repairs and get the equipment up and running again quickly.



Field inspector analyzing data and preparing field report



Sample heat exchanger tube sheet map as included in the final

Detection Capabilities

Using a standard 8 channel rigid probe, a 0.039" (1mm) diameter pit, 30% deep, can be detected in a 1" O.D., 0.083" wall carbon steel tube. Other small defects such as circumferential and axial cracks can be detected and quantified using a calibration standard prepared with EDM notches. All defects are sized by phase and amplitude response and number of channels affected.

Technical Specifications

Electronics

Electronics base	Digital/DSP based
Frequency range	5Hz to 30KHz
Channels	1 to 8 channels
Power Consumption	Max 15VA
Line Voltage	110 or 240 VAC at 50 or 60 Hz (self adjusting)
Dimensions	13" (330mm) L x 11" (290mm) W x 3.5" (90mm) H
Weight	5 lbs. (2.25kg)

Probes

Channels/Sensors	1 to 8 channels provided by 1 to 16 sensors
Sizes	Start at 0.250" (6mm)
Length	U to 100 ft (30m) with no amplification*
Method	RFET (Remote Field Electromagnetic Technique)
Fill Factor	As Low as 40%
* Longer probes can be made with amplification	

Materials Tested

Carbon Steel, Cast Iron, Chrome Moly, Stainless Steel, Nickel, Copper, Brass, and other various alloys.

The system is operated using a laptop Pc acquiring data through its' serial port connection. The modular system is easily packed and can be taken anywhere within the plant.