MILES AHEAD TECHNOLOGY
SMILES AHEAD SERVICES

SERVICES OFFERED

Types Non destructive testing services:

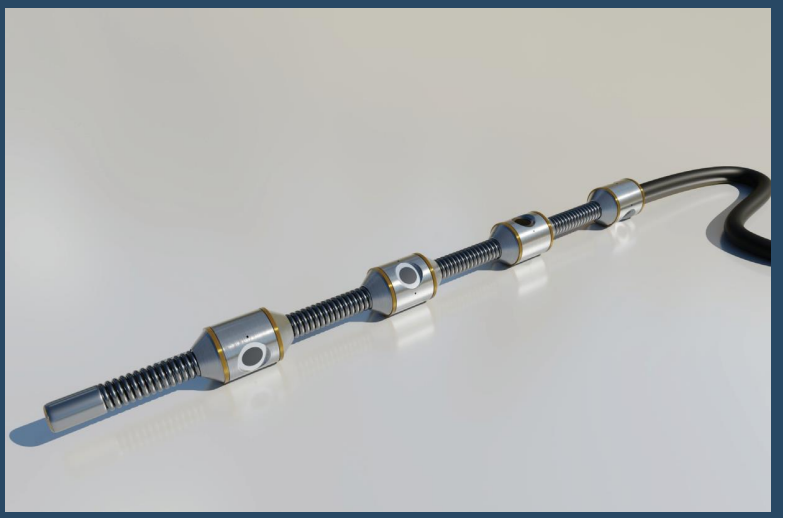
- **Conventional NDT services**
- **Advanced NDT services**
- **Specialized application driven technology & solutions**

Our qualified inspection specialists are on call to provide expert services 24 x 7 a week. We utilize the broadest inventory of the most advanced inspection technologies, so that inspection results are quick, efficient and reliable.

Our in house R&D department is serving the industry for delivering the advanced technologies to difficult to reach areas for inspection.

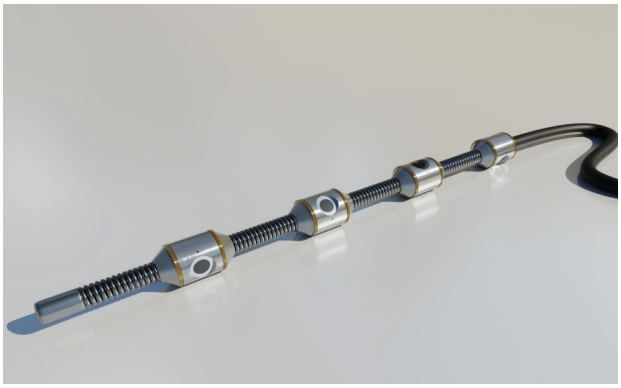
- Reformer Tube / Centrifugally Cast Tube Inspection
- Tethered Ultrasonic Pigging for coils/ tubes / heater tubes/ convection sections (1.2 " to 4" ID)
- Coke Drum Bulge Mapping – as per API 934-G
- Tank Ovality Inspection – as per API 650
- Refractory Erosion Mapping for FCCU Cyclones
- HRSG Boiler Tube Inspection
- Boiler Water Wall Tubes Inspection
- Drum to Drum / Smoke Tube Boiler Inspection
- Advanced Remote Visual Inspection
- Remote Visual Inspection
- In-Water Survey – SHIP HULL (UT, AET, Visual)

TETHERED INTELLIGENT PIGGING FOR NON-PIGGABLE PIPELEINES (1.2 INCH – 4 INCH)



TETHERED INTELLIGENT PIGGING FOR NON-PIGGABLE PIPELEINES (1.2 INCH – 4 INCH)

Boiler components such as economizers, superheater coils, and convection coils play a critical role in industrial processes, but they are susceptible to various types of damage due to their operating conditions. These challenges primarily include:



Video

1. **Corrosion:** Boiler tubes are exposed to both water and combustion gases, making them susceptible to different types of corrosion. Waterside corrosion and Fireside corrosion.

2. **High Operating Temperatures:** The components are subjected to elevated temperatures, especially superheater coils, which can lead to material degradation over time.

3. **Failure Types:** Failures in these components can manifest in various ways, including **corrosion thinning**, where the tube material becomes thinner due to corrosion processes. **Pitting** involves localized corrosion, creating small holes in the tubes. **Erosion** occurs when particles suspended in the fluid flow cause physical wear on the tube surfaces.

4. **Access Constraints:** One major challenge is inspecting these components thoroughly. Due to their complex placement within the boiler system, accessing and inspecting them can be difficult. Traditional inspection methods may not be feasible due to limited access points.

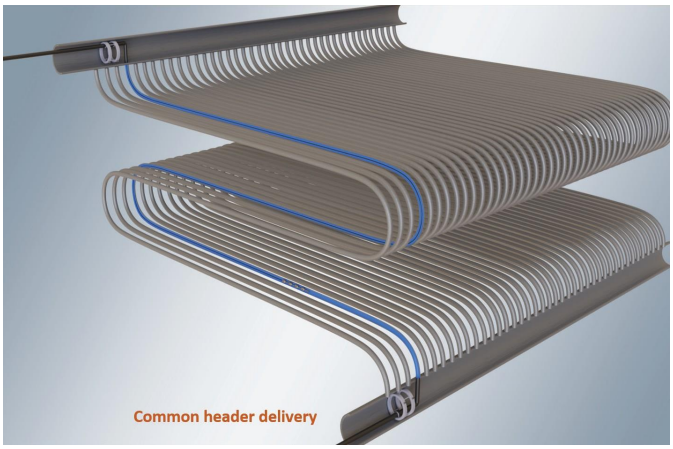
TECHNOLOGY

NDT Technologies, have indigenously developed a delivery system for the inspection of Boiler coils in IN-situ condition using multiple technologies - Immersion Ultrasonic testing and Visual inspection.

1. **Immersion Ultrasonic corrosion mapping technology.**
2. **HD camera for Visual inspection from ID.**
3. Tethered technology, so high defect location accuracy.
4. Access to live visual & ultrasonic signal feed during the pigging process.
5. Up to 32 UT sensors can be mounted onto the PIG.
6. **Diameter range from 30mm ID to 100mm ID.**
7. **Travel length 100 meters from one end, 200 meters from both ends.**

ACCESS FOR INSPECTION

1. **Top & Bottom Header end cut OR**
2. **Top & Bottom tube cut**



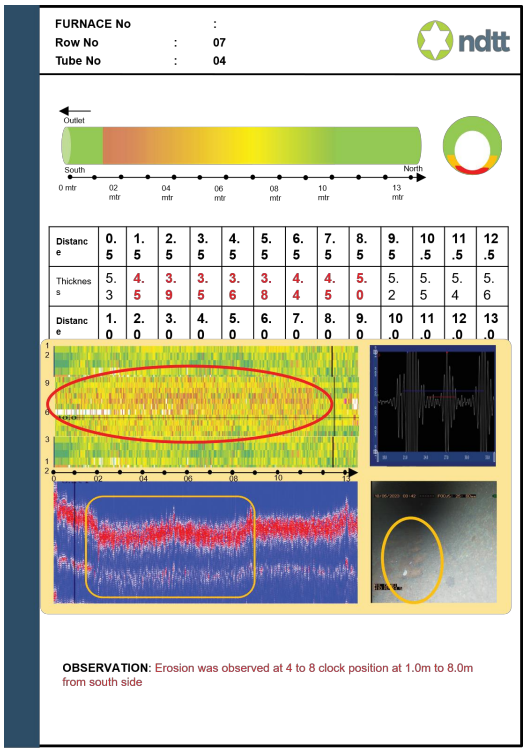
DEFECTS

1. **Internal corrosion**
2. **Wall loss or thinning**
3. **Pitting**

APPLICATIONS

1. **Boiler coils – Economiser, Superheater, Re-heater, etc.**
2. **Heater tubes**
3. **Convection section of Reformer/ Heaters**
4. **Tubes with multiple short radius bends**

REPORTING FORMAT

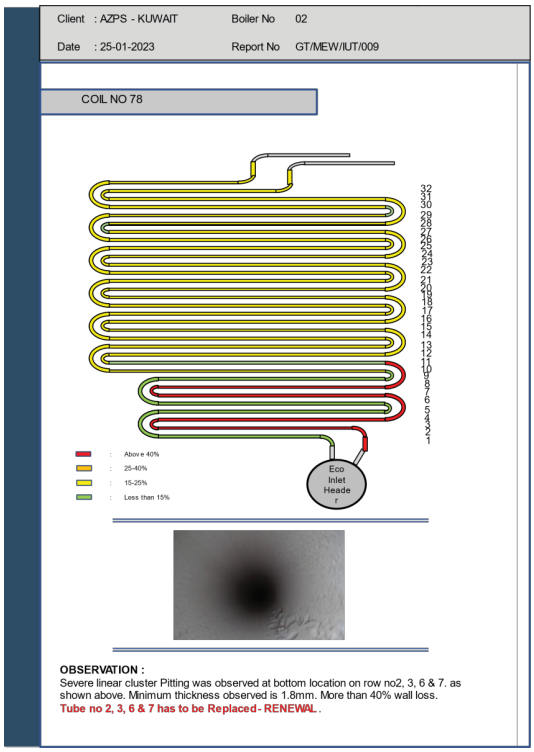


FURNACE No :
Row No : 07
Tube No : 04

Outlet
South
North
0 mtr 02 mtr 04 mtr 06 mtr 08 mtr 10 mtr 13 mtr

Distance	0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5
Thickness	5.3	4.5	3.9	3.5	3.6	3.8	4.4	4.5	5.0	5.2	5.5	5.4	5.6
Distance	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0

OBSERVATION: Erosion was observed at 4 to 8 clock position at 1.0m to 8.0m from south side



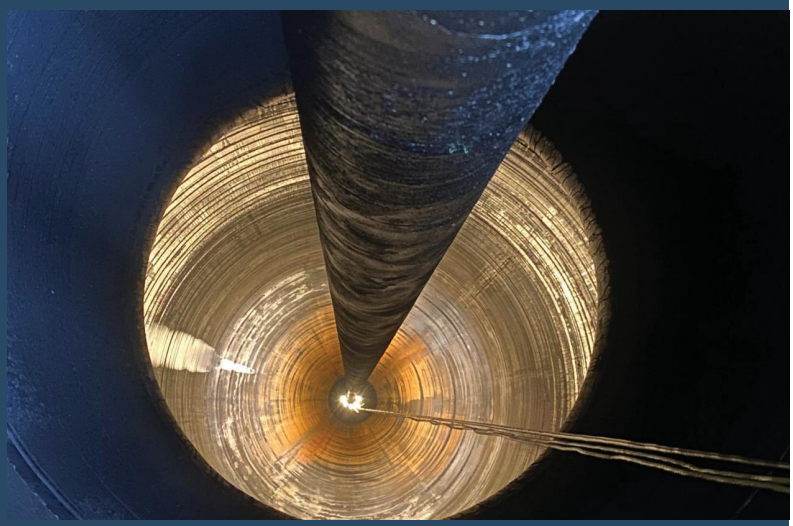
Client : AZPS - KUWAIT Boiler No 02
Date : 25-01-2023 Report No GT/MEW/IUT/009

COIL NO 78

Above 40%
25-40%
15-25%
Less than 15%
Eco Inlet Header

OBSERVATION :
Severe linear cluster Pitting was observed at bottom location on row no2, 3, 6 & 7. as shown above. Minimum thickness observed is 1.8mm. More than 40% wall loss.
Tube no 2, 3, 6 & 7 has to be Replaced - RENEWAL .

CONDITION ASSESSMENT OF VARIOUS INDUSTRIAL EQUIPMENT USING AR-SCAN TECHNOLOGY



FCC CYCLONES

Fluid Catalytic Cracking Units (FCC Cyclones) are the principal technologies that enable the critical process within heavy oil refining of converting the heavy oils into more valuable gasoline and lighter products.

Unit mainly consists of

1. Reactor Cyclones
2. Regenerator Cyclones
3. Secondary Cyclones
4. Risers

Refractory linings are used to protect all the equipment from extremely high temperatures, corrosive materials, and mechanical stress.

WHY REFRACTORY INSPECTION

Here are some reasons why inspection of refractory linings is important:

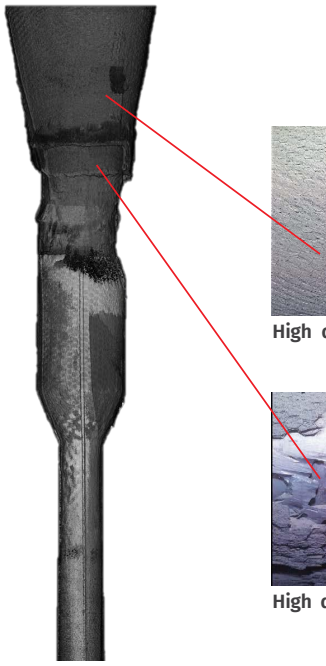
1. **Preventing Unplanned Downtime:** Refractory failures can lead to unexpected shutdowns, which result in significant production losses.
2. **Ensuring Safety:** Refractory failures can compromise the safety of both equipment and personnel.
3. **Optimizing Efficiency:** Damaged refractory linings can lead to inefficient heat transfer, reduced combustion efficiency, and altered process conditions.
4. **Extending Equipment Lifespan:** Properly maintained refractory linings can extend the overall lifespan of equipment.
5. **Cost-Effectiveness:** While inspections and maintenance incur costs, they are generally more cost-effective than dealing with unplanned failures. The expenses associated with emergency repairs, downtime, and potential legal or environmental issues can far exceed the costs of regular maintenance.
6. **Root Cause Analysis:** Inspections provide an opportunity to understand the root causes of refractory failures. This insight can lead to process improvements, material selection adjustments, and engineering changes to mitigate similar issues in the future.

AR-SCAN

- AR-Scan is a laser based - 360 degree rotating scanner which collect high-precision measurement data and high definition images simultaneously from ID or OD of an equipment.
- The collected data provides a detailed **3D point cloud model with superimposed images.**
- Data generated from the system are processed in a software to examine any equipments or structures leading to recommendations and approaches for any required maintenance and repairs as per ASME/API standards.
- Report presentation will give 3-Dimesional design with measurements and images of the equipment.
- Cloud access for all the reports generated for the equipment.

CYCLONE - REFRACTORY

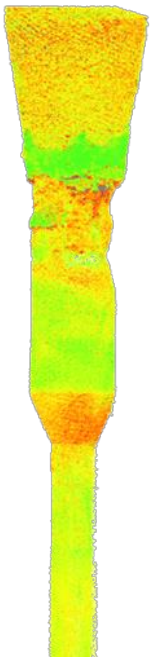
Video



3D data

High definition Panoramic image

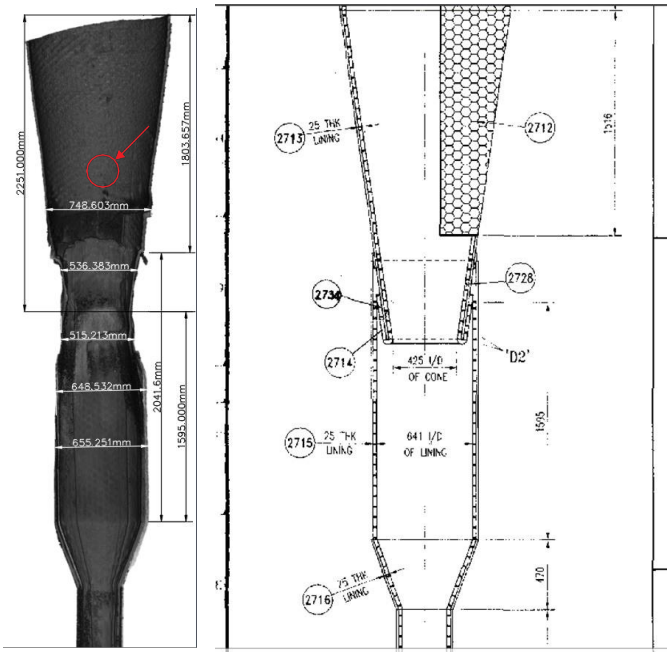
High definition Panoramic image - Erosion



Erosion map

CYCLONE - REFRACTORY

Video

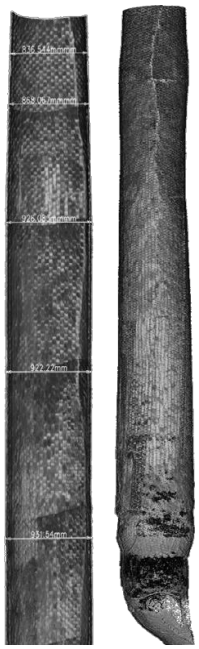


Refractory erosion comparison with as-build drawing

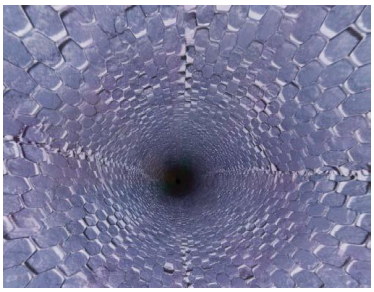
High definition image - Erosion

Colour Map of Cyclone with minimum erosion

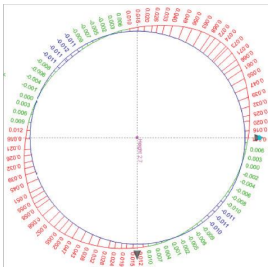
RISER - REFRACTORY

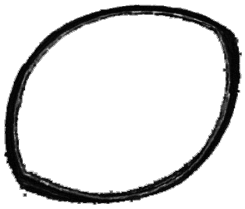


Presenting Riser pipe deformation from original ID of Riser

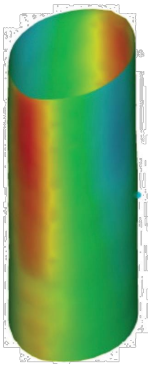


High definition images

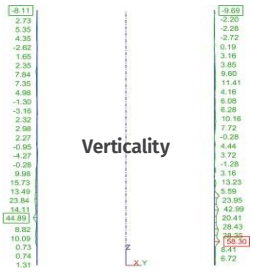


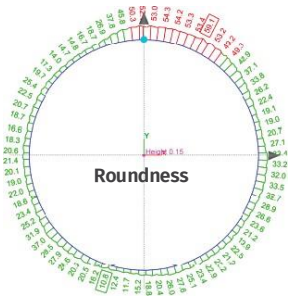


Top view

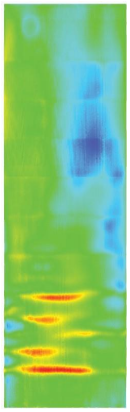


COKEDRUM SCANNING FOR BULGE MAPPING

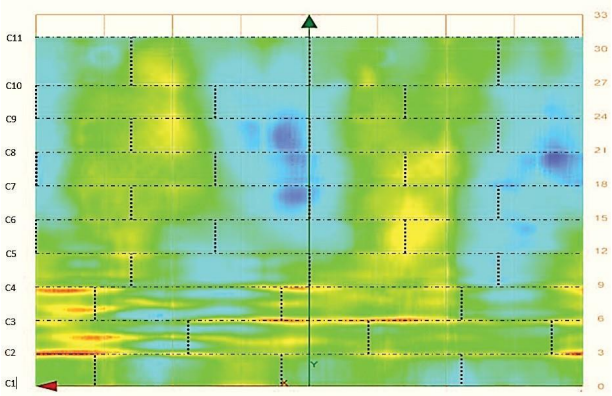




3D Data

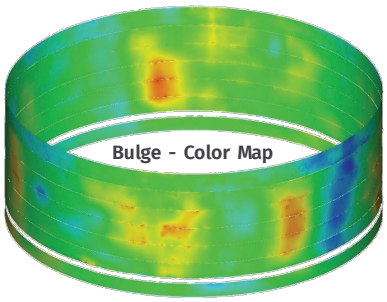


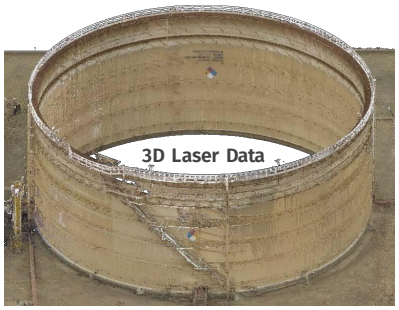
Tan to Tan Bulging Color Map

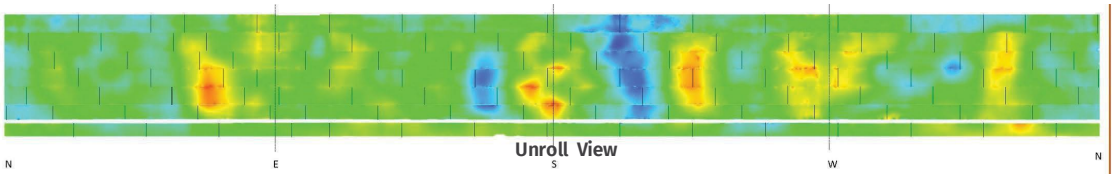


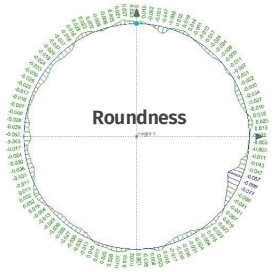
Bulging Color Map Unroll View

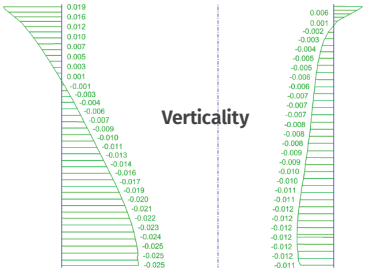
STORAGE TANK – DEFORMATION ANALYSIS



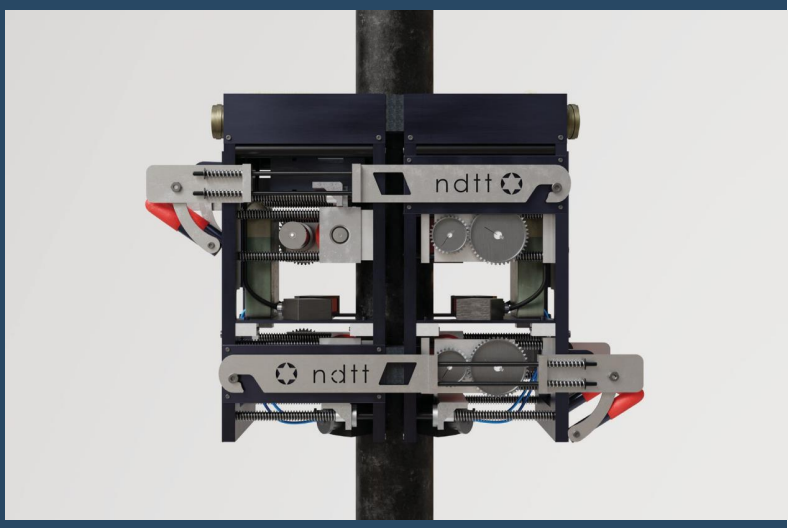








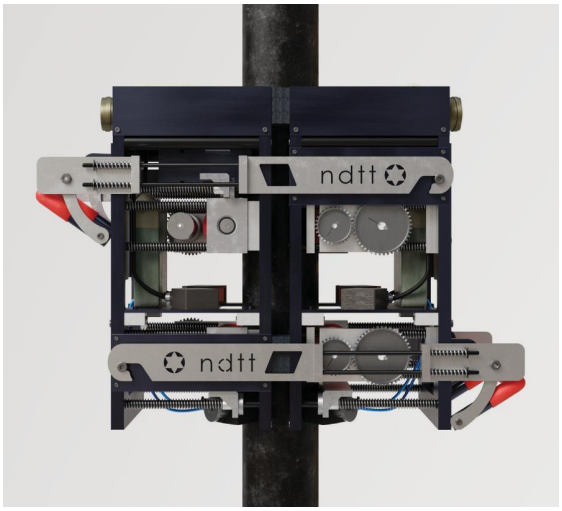
CONDITION ASSESSMENT OF CENTRIFUGALLY CAST TUBES USING reF-SCAN CRAWLER SYSTEM



reF- SCAN INSPECTION FOR CENTRIFUGAL CAST TUBES

Centrifugal cast tubes mainly with composition of Chromium-Nickel alloy in furnaces are the core of many plants used in the production of

Ammonia
Methanol
Ethylene
Hydrogen
Syngas



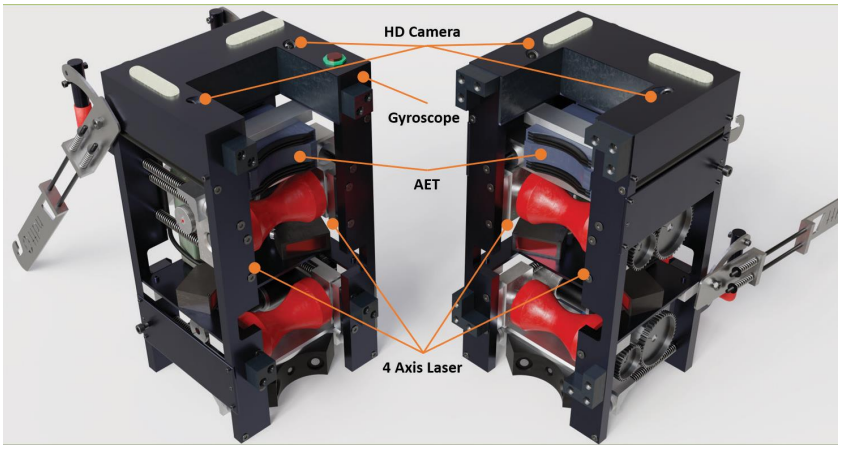
The tubes used in the Furnace are manufactured by the centrifugal casting process.

These tubes are prone to various degradation mechanisms like creep, hydrogen attack, corrosion, fatigue, etc. and inspection of these tubes are very critical to avoid any damages during production.

reF-SCAN SYSTEM

- Advanced Electromagnetic - Carbide precipitation assessment
- Advanced Electromagnetic - Creep assessment
- Advanced Electromagnetic - Carburization detection
- 4- Axis laser - OD measurement
- Gyroscope - Bowing measurement
- HD camera - Tube surface assessment

Advanced electromagnetic technique is sensitive to any kind of changes in structure of the tube material caused due to pro-longed service period.

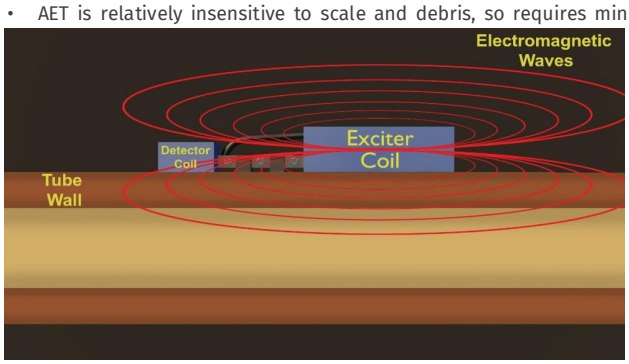


ADVANCED ELECTROMAGNETIC TECHNIQUE

AET testing is based on a electromagnetic principle. The technique uses Electro magnetic waves generated in the tube wall by excitor coils at high frequencies for detecting the material property changes caused due to the service defects, **i.e. any change in the structure of the material can be detected by Advanced Electromagnetic Technique. AET works on any metal, i.e. both Ferrous and Non-ferrous material.**

The change in the structure of the material causes the fields to distort and this deviation is recorded by the detector coil, resulting a change in signal phase and amplitude.

- AET is a non-contact technique, so the probes have minimal friction with the material wall and requires no couplant.
- AET is equally sensitive to ID and OD defects. Maximum penetration of 18mm.
- AET is relatively insensitive to scale and debris, so requires minimum cleaning.



ADVANTAGES

- 4 technologies in Automated crawler system
- Inspection of each tube with in 5 minutes
- Evaluation on basis of results from multiple technologies
- Inspection of tubes from minimum OD of 50mm to maximum OD of 300mm

Analysis Group	AET Analysis	Laser Profilometry	Bowing
Group 1 (LS)	Signal at 20%-35% (Carbide precipitation-Isolated cavities)	< 2%	< 0.1X of tube diameter
Group 2 (MS)	Signal at 35% to 50% (Carbide precipitation – Aligned cavities)	2 to 3%	Up to 0.5X of tube diameter
Group3 (HS)	Signal at 50% to 70% (Micro Cracking)	3 to 5%	Up to 0.8X of tube diameter
Group 4 (HS)	Signal at > 70% (Macro Cracking)	> 5%	> 1X of tube diameter

APPLICATIONS

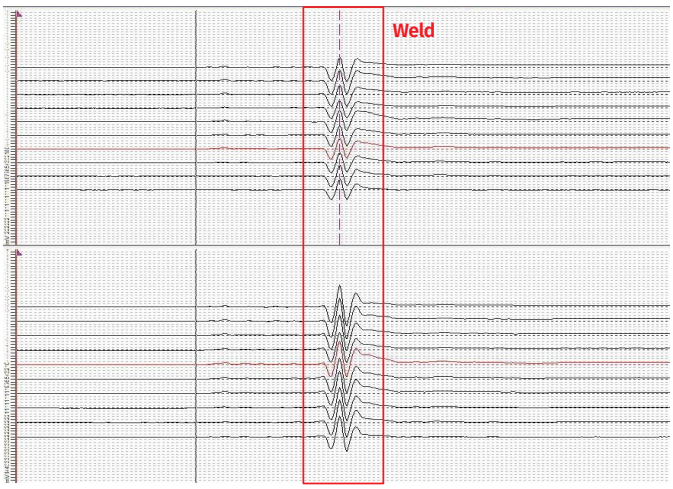
- Hydrogen cracking tubes
- Ethylene cracking tubes
- Naphtha cracking tubes
- Platformer heater tubes

TUBE REMAINING LIFE ASSESSMENT

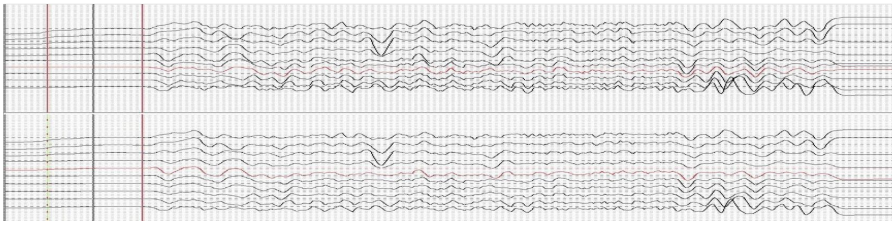
Inspection data from reF SCAN of each tube with Internal Pressure, Thermal Stress Gradient, Operating Temp.& Cyclic Operation data will assessed as per API 579-1. for life assessment of tubes.

AET SIGNAL CONFIRMATION WITH THE MICRO STRUCTURE ANALYSIS FROM VARIOUS SAMPLES

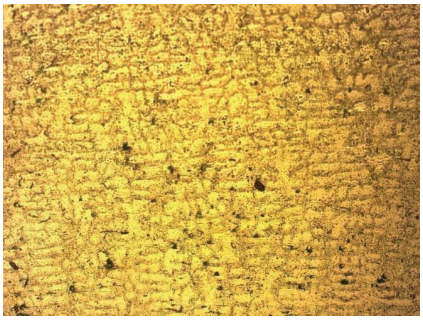
Signal from a tube with no structural changes - Good tube Indication



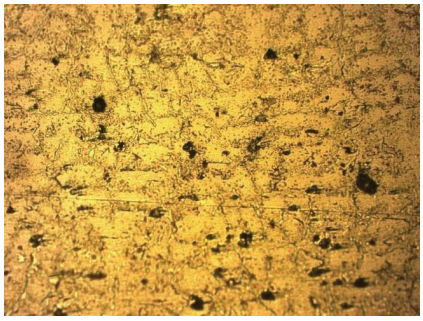
Signal of tube with Carbide precipitation in the form of Isolated cavities – GROUP1 or LS tubes



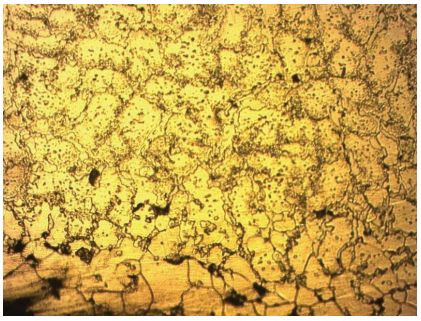
Destructive testing results



100X –Etched-OD



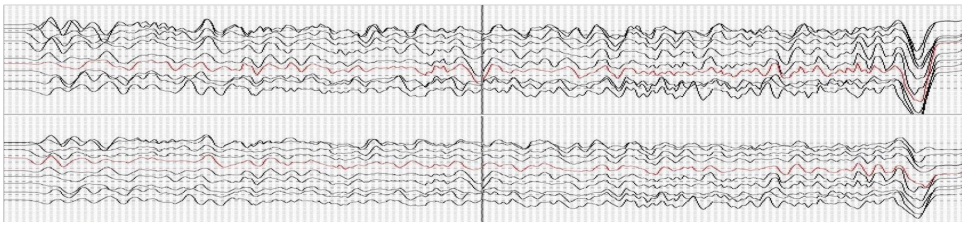
200X-Etched—mid wall with creep cavities



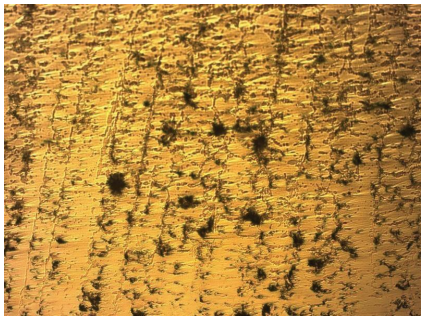
Etched ID showing details of carbide precipitates both around and within austenitic grains

Figures above show microstructures at different zones of OD, mid wall and ID. In some - black patches are seen - which are creep cavities that deflects the electromagnetic signals. AET— categorized as LS or GROUP 1

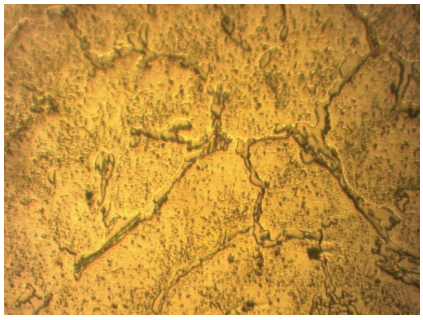
Signal of tube with Carbide precipitation in the form of Aligned Cavities – GROUP2 or MS tubes



Destructive testing results



Microstructure at OD- edge (as polished) showing creep cavities closed to chilled

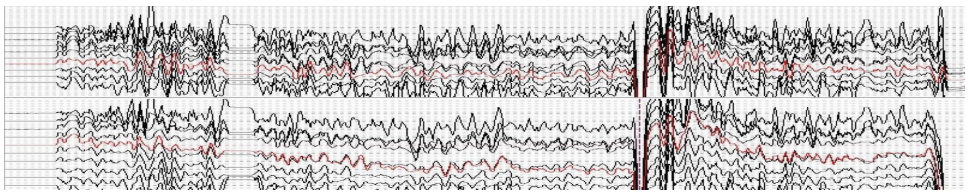


Microstructure at mid-wall showing presence of small creep cavities; obtained after etching

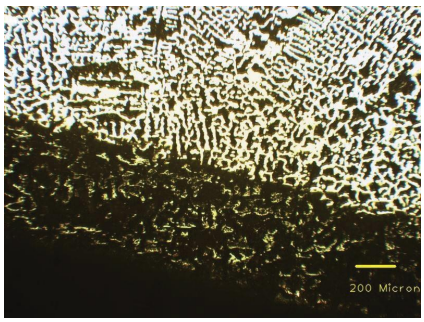
Microstructure at ID showing creep cavities; obtained after etching in 10% oxalic acid

Figures above show microstructures at different zones of OD, mid wall and ID. In some - black patches are seen - which are creep cavities that deflect the electromagnetic signals. AET— categorized as MS or GROUP 2

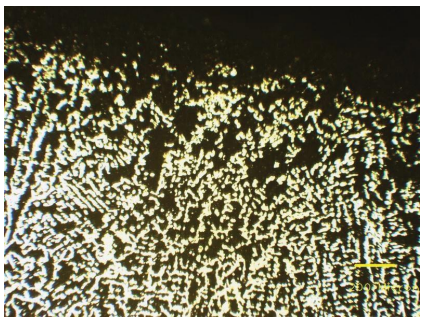
Signal of tube with Micro cracks and high Carburization – GROUP3 or HS tubes



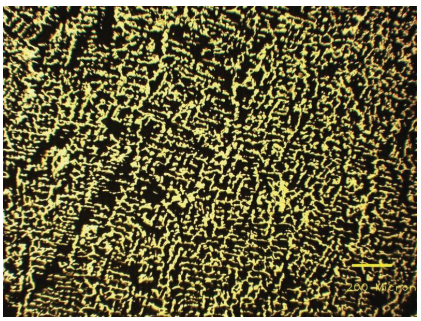
Destructive testing results



Micrograph of ID regions showing thick carburized zone



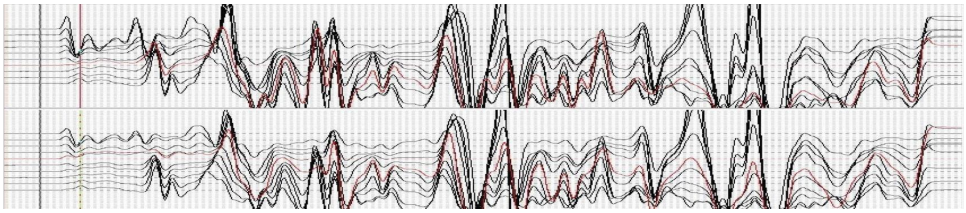
Low magnification micro photographs showing OD, mid wall and ID surfaces. It appears both ID & OD are enriched with carbon content



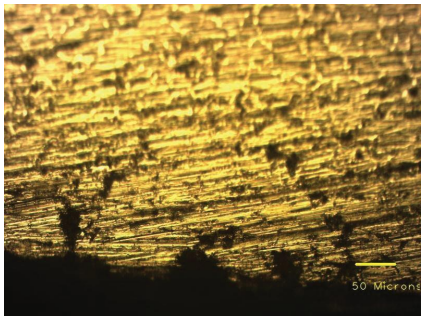
Micrograph of mid wall regions showing dendritic type grains with Micro cracks

This ring has picked up carbon from both OD and ID sides. OD sides C pick up is little surprising. As such there are some fine fissures seen at ID and OD edges. These defects are the prime sources for emanating defective signals. AET - categorized as HS or GROUP 3

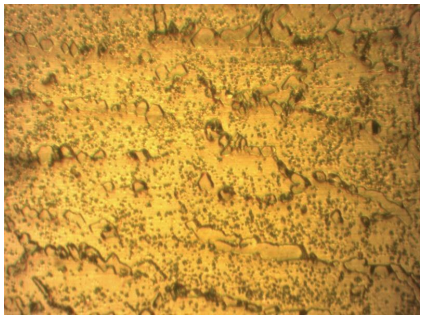
Signal of tube with Micro cracks – GROUP4 or HS tubes



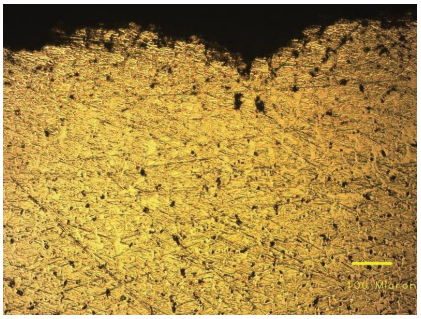
Destructive testing results



Structure at OD edges showing cracks about 100-200 micron deep. 200X



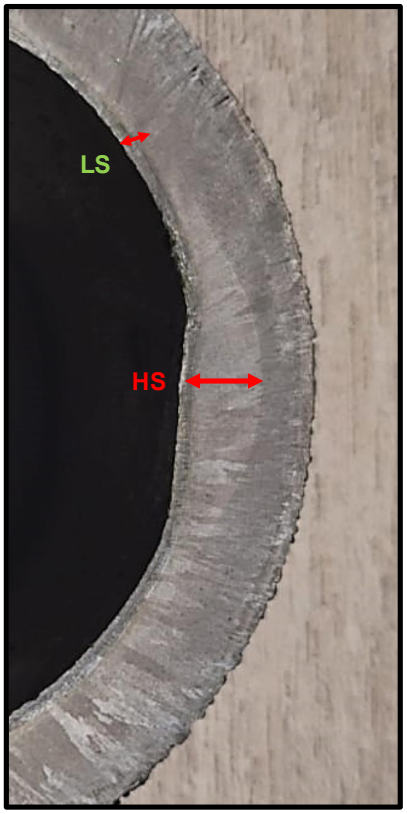
showing austenite grains surrounded with blocky type thick carbide precipitates. In addition, carbide precipitates are also present within grains. 500X

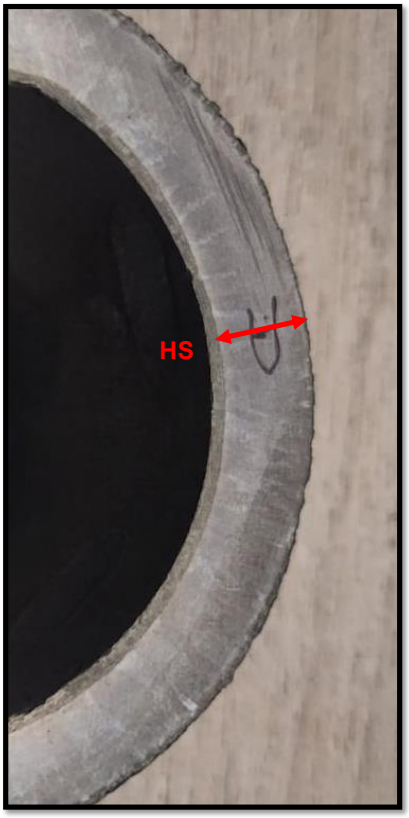


Structure at ID edges showing cracks about 100-200 micron deep. 100X

Microstructure examination exhibited presence of micro fissures/cracks and creep cavities at regions that generated high strength (HS) signals. Remaining regions of the elliptical tube sample showed no physical cracks or defects.

Different Levels of Carburization detected by AET





THANK YOU