TesTex
TESTEX NDT INDIA PVT. LTD.

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for Non-Destructive Testing
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# Case Study

## *Above Ground Storage Tank Floor Plates Scanning using Low Frequency Electromagnetic Technique (LFET)*

Above Ground Storage Tank Floor Plate Scanning work was carried out by **TesTex** using **Low Frequency Electromagnetic Inspection** in December 2010 in one of the Refinery Tank Farm and the same tank was again inspected in November 2014 with **TesTex make Falcon Mark-II System** to detect, locate and measure the extent of corrosion and pitting from top side as well as under side, if any in the tank plates.

Tank details were as follows,

- **Tank Diameter** — 30 mtrs.
- **Type of Tank** — Fixed Roof
- **Product Stored** — Fuel Oil
- **Surface Preparation** — Sand Blasted
- **Total number of Sketch Plates** — 41 Nos.
- **Nominal Thickness of Sketch Plates** — 8.0mm
- **Total number of Annular Plates** — 28 Nos.
- **Nominal Thickness of Annular Plates** — 12mm

Equipment used for Scanning purpose were Falcon 2000 DSP based **Tank Floor Inspection System** developed and manufactured by **TesTex Inc., U.S.A.** consists of Falcon Sr. (32 channel) Scanner and Falcon Jr. (16 channel) hand held scanner for inspecting hard to reach areas.

Both scanners use the principle of **Low Frequency Electromagnetic Technique**.

Low Frequency Electromagnetic Field, which is generated by the system, penetrates through the plate thickness and the sensors detect any abnormal variation in the plate thickness whenever the scanner approaches the flaw. This can also be observed viewing the LED display on the scanner.

These abnormal variations are so small that it becomes necessary to use Digital Signal Processing (DSP) to enhance the resulting signals, which are in the form of phase, and amplitude signals.

8.0 mm thick calibration plate with machined flaws Representing Following Dimensions

- 5.0mm Diameter 30% & 60% deep Pits.
- 8.0mm Diameter 30% & 60% deep Pits.

Inspection was carried out in the following sequence,

- Tank Plates were visually inspected for any surface defects.
- Tank Plates were numbered according to the clients specifications.
- Plates were scanned using Falcon Mark II system and defects were marked for further verification.
- Actual Thickness of the defective area was verified by UT.

## EQUIPMENTS USED

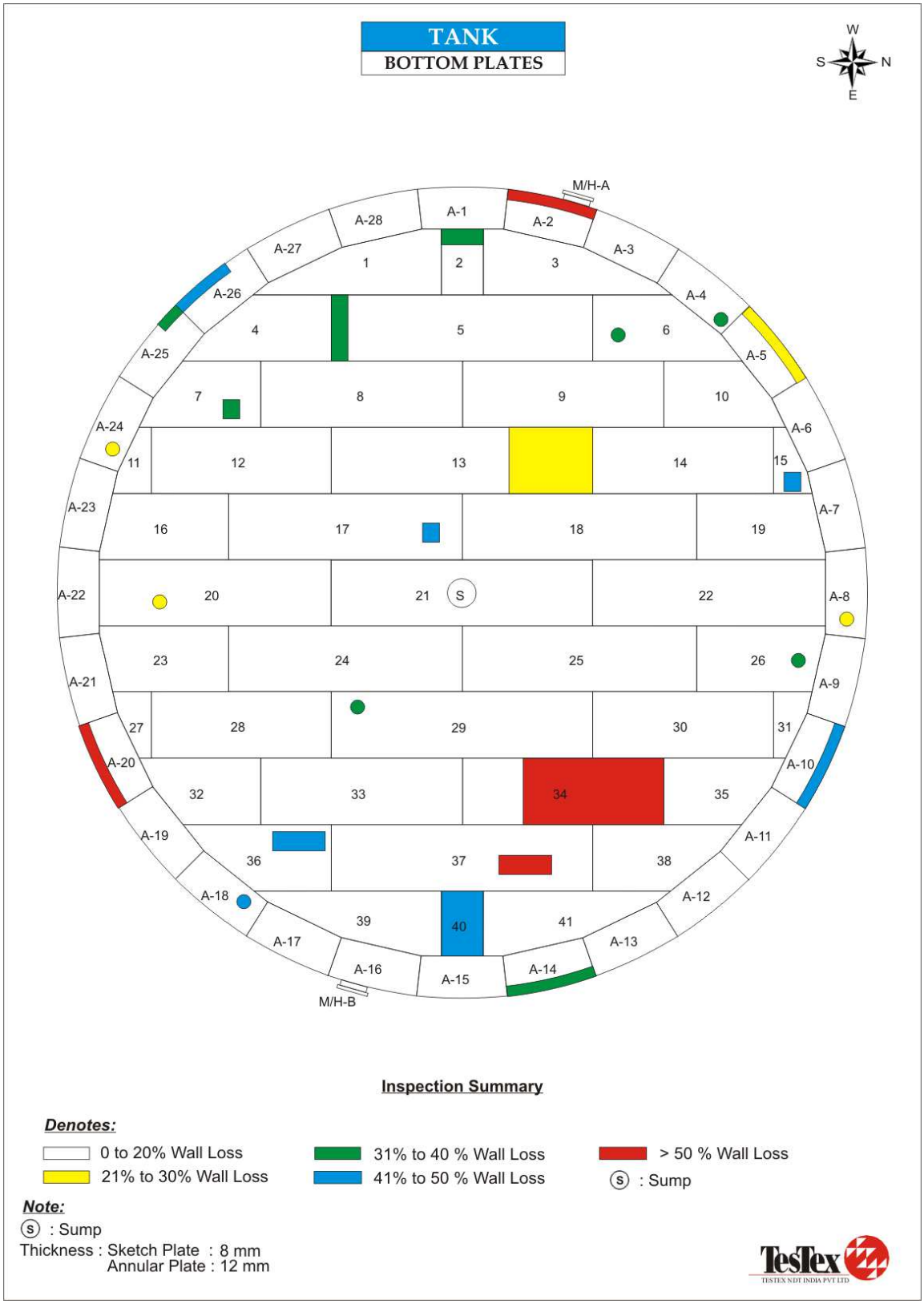
### Falcon Senior

*Falcon Integrated system for one man operation*

### Falcon Junior


*Falcon 2000 Jr. Hand Scanner used for Scanning hard to reach areas*

# Color Coded Tank Bottom Plate layout (Inspected in 2008)




**Inspection Summary**

***Denotes:***

- 0 to 20% Wall Loss
- 21% to 30% Wall Loss
- 31% to 40 % Wall Loss
- 41% to 50 % Wall Loss
- > 50 % Wall Loss
- (S) : Sump

***Note:***

(S) : Sump

Thickness : Sketch Plate : 8 mm
Annular Plate : 12 mm

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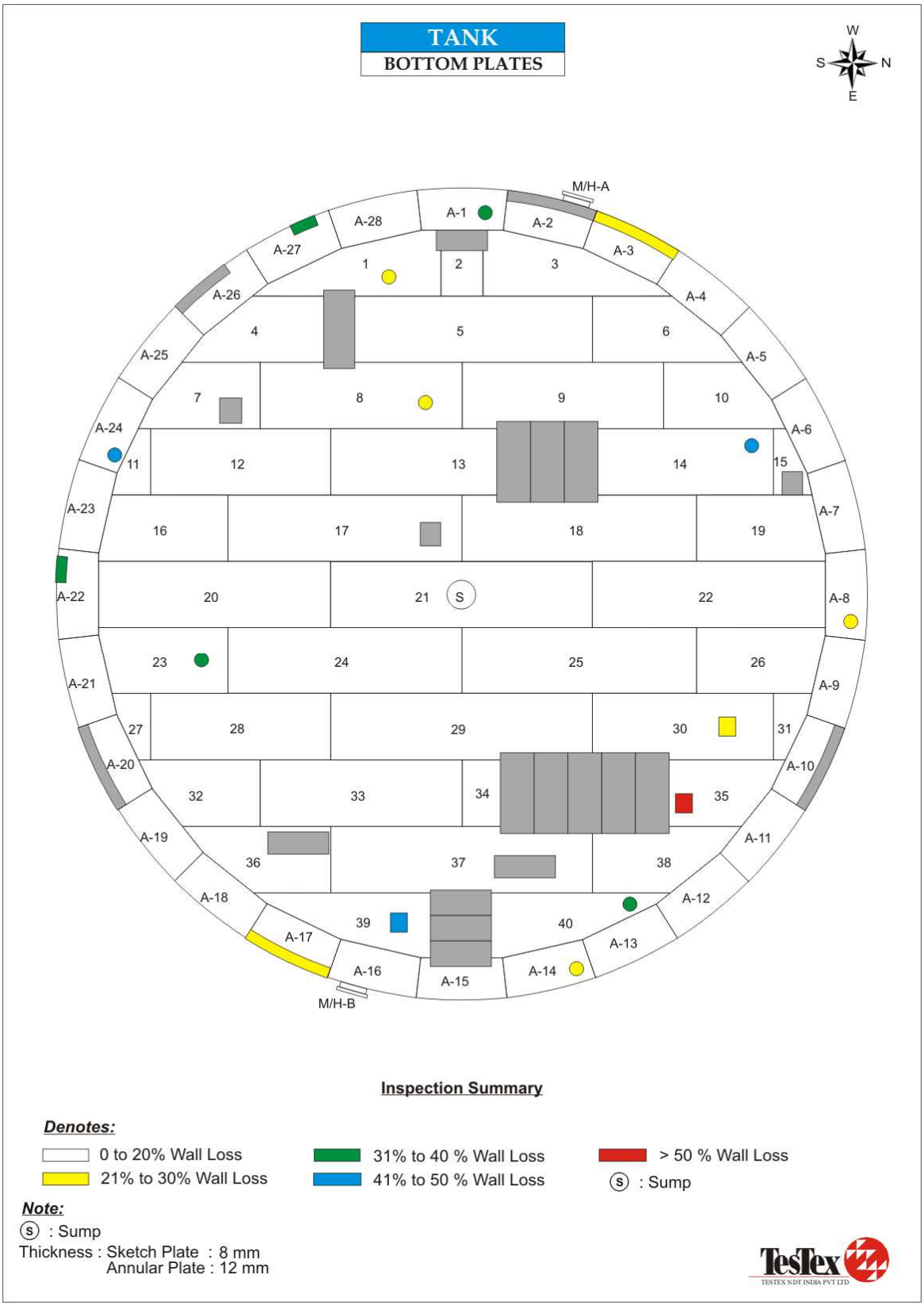
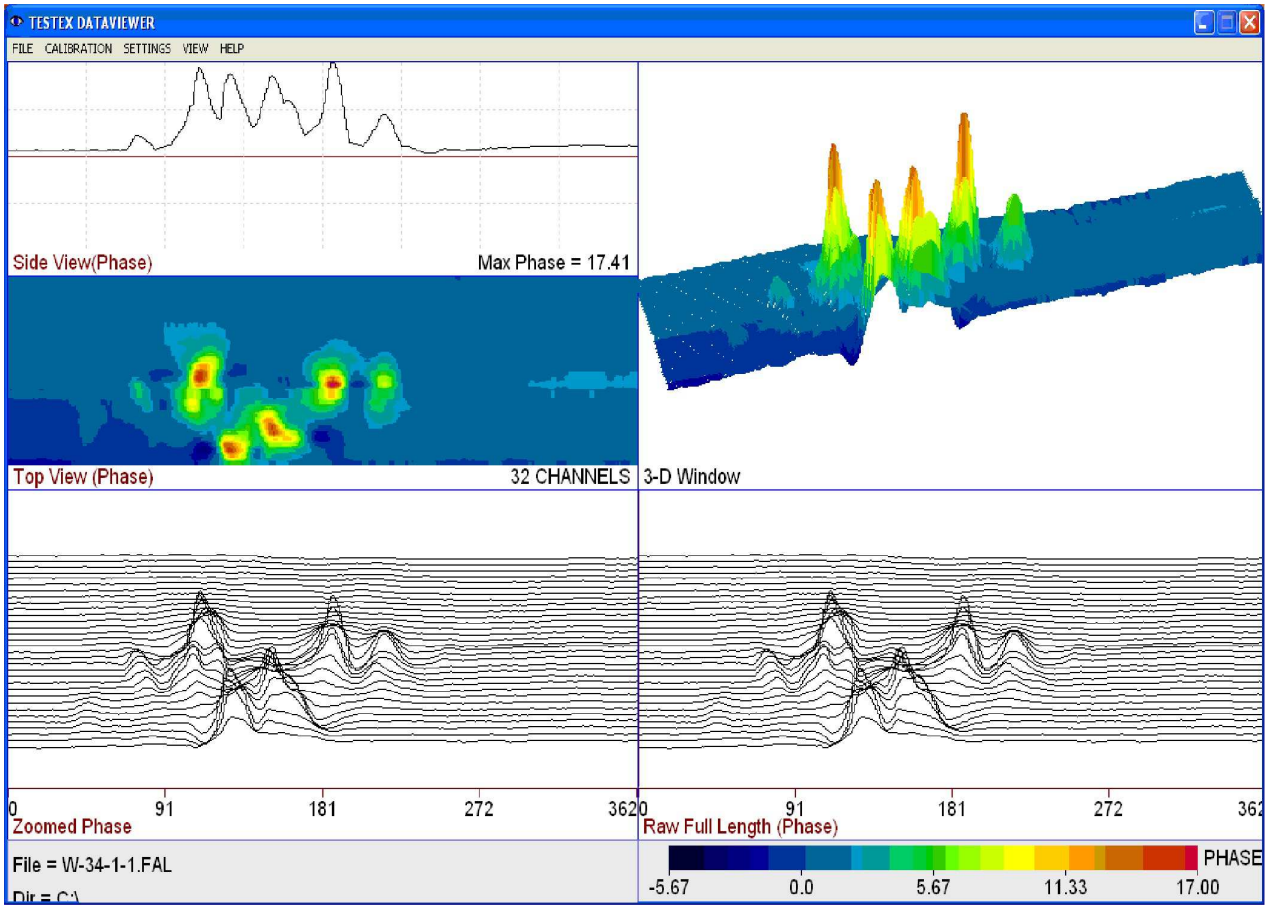
# Color Coded Tank Bottom Plate layout (Inspected in 2014)



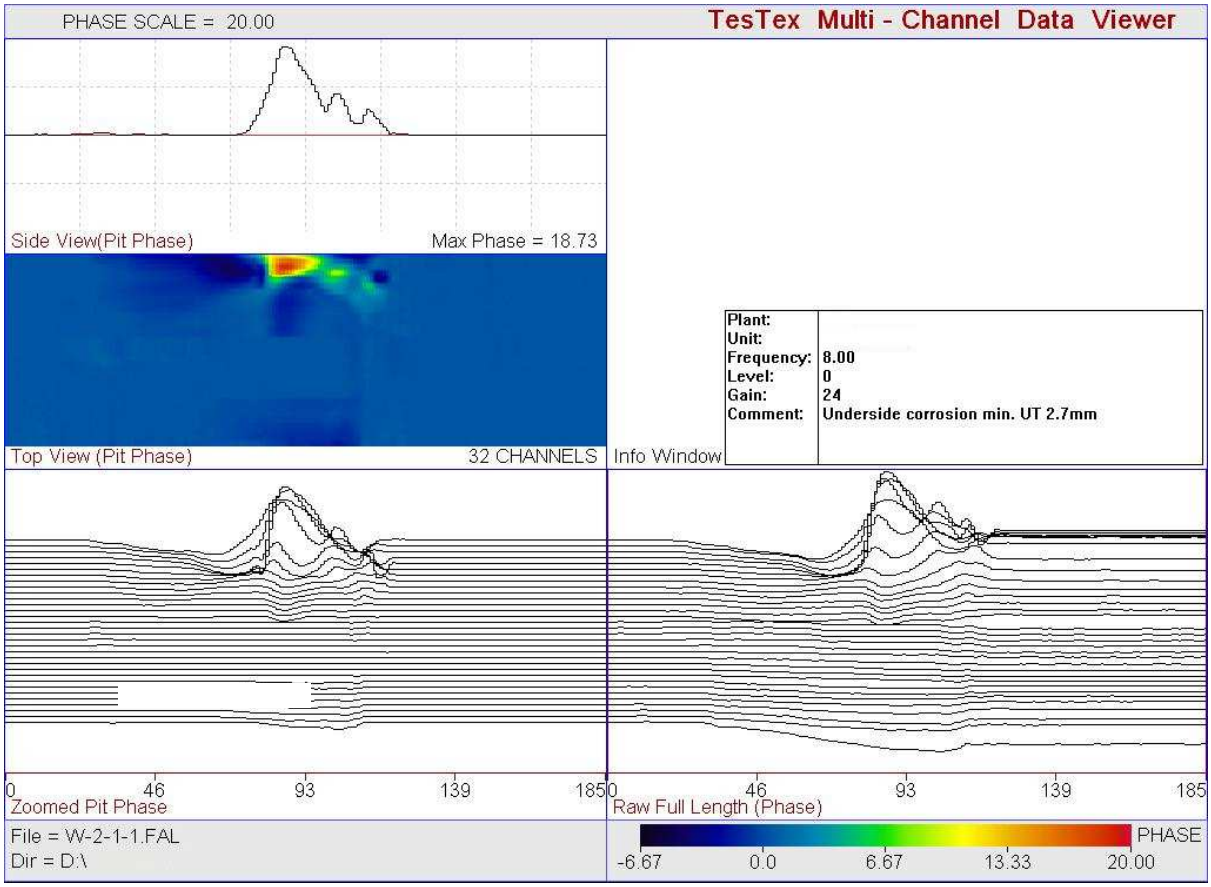
# Sample Waveforms of Defective Plates




*Sketch Plate # 34, Showing Underside Corrosion Min. UT reading 4.8 mm.*

| PRODUCT SIDE | SOIL SIDE |
|---|---|
|  |  |

Photos of Sketch Plate # 34, showing product and soil side.




*Annular Plate # 2 Showing Underside Corrosion Min. UT: 2.7mm*

Soil Side Corrosion

# Photographs Showing Defective Plates in Tank

## *Soil side corrosion leading to pinholes from Product side*

**Discussions:**

Above tank was taken out of service after 4 years of operation on commissioning in the year 2008 with a suspected leak however actual location of the leak was not known. Visual / Ultrasonic inspection did not confirm the leak area in the tank.

Tank was offered for scanning and **Low Frequency Electromagnetic Technique** was used. On scanning severe under side (soil side) corrosion patches were detected on the North-East side of the tank. Further investigation confirmed tiny holes which were extending from the corrosion patched. Few of the annular plates were also affected as shown in the above sketch.

Tank was put back in service after removing the effected sketch plates and replacing them with the new plates.

After years of service tank was once again suspecting leakage. Once again visual inspection did not confirm the areas of leakage. Scanning activity was undertaken. Surprisingly this time soil side corrosion patches were detected in north east portion of the tank and several holes were identified in that region during scanning.

**Conclusion:**

Periodic inspection of tanks is very much required as in the Indian environment soil side corrosion is a major concern as seen in the above case. 5 years inspection period is generally followed by the industry but in certain cases it extends beyond 7 to 8 years.

Conventional techniques like Ultrasonic Thickness checks does not give the actual condition of the tank floor plates as it not even covers 0.1% of the floor area. Since the soil side plate is not accessible these UT readings are taken randomly and almost all the time misses the active corrosion areas which lead to leakages in the running operations.

In the above case it was concluded that during 2008 leakage the product must have traveled and remained in northwest region leading to corrosion. By deploying the above Inspection Technique the extent of damage was exactly mapped and actions were taken based on the scanning results.