



HIGH TEMPERATURE – ONLINE INSPECTION TECHNIQUES

TCR Arabia Company Limited

High Temperature Inspection - Techniques

| Sl. | Service Description |
|-----|--|
| 01 | Automated High Temperature Corrosion Mapping |
| 02 | Automated High Temperature Time Of Flight Diffraction UT (ToFD) |
| 03 | Automated High Temperature Phase Array Ultrasonic Testing (PAUT) |
| 04 | Hydrogen induced Crack Examination (HIC) |
| 05 | Stepwise Crack Examination (SWC) |

High Temperature Applications / Online Inspection Techniques

High Temperature ToFD and PAUT Ultrasonic inspection is a non-destructive testing method to inspect Plant Equipment/piping welds and parent metal while in-service for corrosion and In-service defects. The benefit of this technology is the ability to detect and monitor corrosion and In-service defects of Plant piping & Equipment operating at elevated temperatures up to 700⁰ F (350°C).

The primary applications of High Temperature PAUT (HT), ToFD (HT) and Corrosion Mapping are in-service Piping, Vessels and Tanks. High temperature PAUT (HT), ToFD (HT) and ultrasonic inspection systems can also be used to locate wall thinning, determine corrosion rates and monitor defect growth rates for engineering evaluations. Determining corrosion rates and defect growth rates while equipment is on-stream can assist Engineers and Operational personnel to schedule T&I's and equipment repairs and replacement, therefore lowering the overall risk to the facility.

High Temperature Applications / Online Inspection Techniques

Benefits;

- Reduced down time of the plant, by improved maintenance planning
- Reduced shutdown time by improved RBI input
- Reduced production losses as inspection of an industrial plant can be carried out online
- Determine corrosion rates and monitor defect growth rates for FFS -engineering evaluations
- Monitoring of cracking growth and corrosion spots during production.
- Inspection of on-line repaired areas, in accordance with ASME code case
- Wall thickness mapping of the area, before making hottaps
- Accurate corrosion monitoring and defect detection up to 350 deg C, on critical positions
- Significant reduction of risks on weld repairs during the construction phase of heavy wall vessels or “golden” welds at elevated temperature.
- Provides immediate feedback.
- Digitised inspection records for future reference and verification
- Highest consideration of your health, safety and environment (HSE) rules

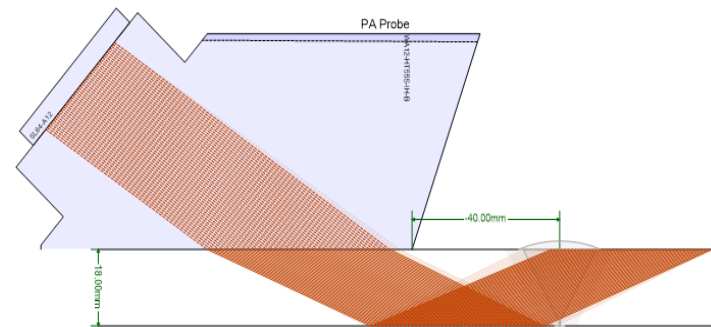
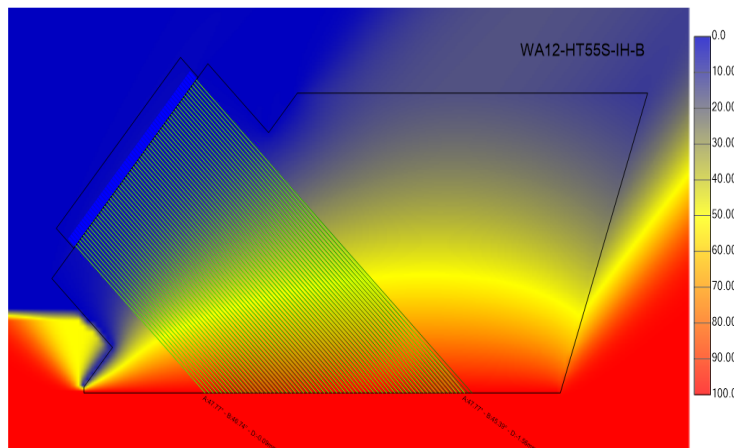
High Temperature Inspection - Resources

| TECHNIQUES | Number of AUT Scanner | Number of Approved Technician | Number OF Olympus Equipment | Number of TD Handy scan Equipment |
|--|-----------------------|-------------------------------|-----------------------------|-----------------------------------|
| Automated High Temperature Corrosion Mapping | 2 | 4 | 2 | 2 |
| Automated High Temperature PAUT | 2 | 4 | 2 | 2 |
| Automated High Temperature ToFD | 2 | 4 | 2 | 2 |
| Stepwise Crack Examination (SWC) | 2 | 4 | 2 | 2 |
| Hydrogen induced Crack Examination (HIC) | 2 | 4 | 2 | 2 |

Use of ES Beam Tool 7 for phased array inspections and ToFD inspection at elevated temperatures to compensate for thermal gradient effects, based on BeamTool 7 newly enhanced high temperature add-on module. The module provides:

- Temperature distribution visualization inside the wedge at the inspection temperature.
- Advanced focal law calculator to calculate focal laws for generation of plane waves and focused beams in a hot test piece compensating for thermal gradient effects inside the wedge.
- Wedge delay calculation based on skewed beam paths inside the wedge with updated velocity of the piece at high temperatures.
- Law file export tool to transfer calculated high temperature focal laws and wedge delays to the phased array instrument for efficient beam formation at elevated temperatures.

High temperature law files generated by BeamTool can be used along with high temperature wedges to facilitate phased array inspections at elevated temperatures for technicians to perform accurate inspection with compensations of temperatures effects on the scan results leading to accurate indication detection and positioning at elevated temperatures.



High Temperature Inspection – Scanner

Specifically designed to operate in the demanding inspection environments up to 350°C, the automated solution scanner kit incorporates the Temp-Master wedge kit for both corrosion mapping and weld inspection. The durable design allows for extended periods of exposure at 350°C while limiting the operator's exposure to harsh environments increasing safety, scan quality and repeatability. The scanner is operated from a remote laptop preloaded with the operational software and cooled by a dedicated pressurized air supply system. Add the optional 12" or 18" inspection arms and increase the automated inspection capabilities to size-constrained inspection regions.



High Temperature Inspection – Probes & Wedges

Custom made high temperature probes and wedges are built from plastics resistant to high temperature degradation, and equipped with a cooling jacket around the array or cooling irrigation holes for air and water flow.

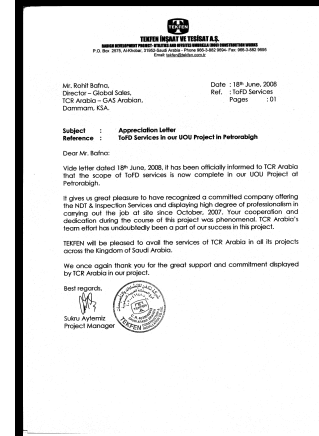
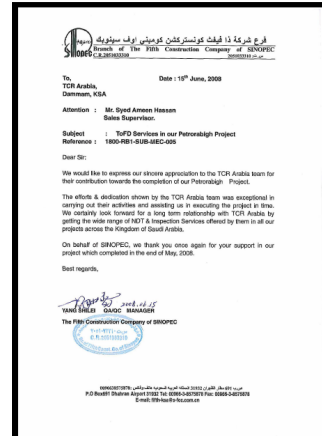
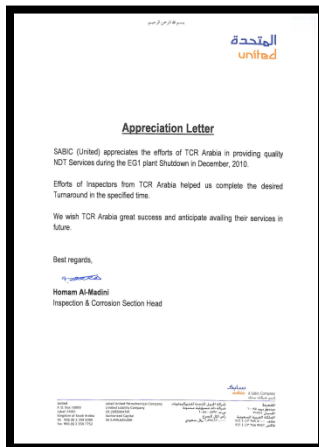
- Heat resistant material engineered to handle temperatures up to 350°C.
- Vastly increased inspection angle range and sizing accuracy.
- Improved water jacket design, compatible with corrosion mapping and weld.
- inspection wedges that achieves increased cooling capacity of probe mounting face.



High Temperature Inspection – Projects

| Client | Location | Technique | Inspection Purpose |
|-------------------------|-----------------|-----------------------------|---|
| Petrorabigh | Rabigh | HT Corrosion Mapping | Detection of Corrosion & H2S Cracks at 150°C |
| Northern Cement Factory | Turaif | HT PAUT | Detection of in-service cracks on kiln tyres at 200°C |
| Saudi Aramco | Safaniya | HT Corrosion Mapping | Inspection of KO Drum for HIC detection at 150°C |
| Saudi Aramco | Ras Tanura | HT Corrosion Mapping | Inspection of in-service lines for HIC detection at 180°C |
| Saudi Aramco | Safaniya | Automated Corrosion Mapping | Detection of Corrosion rate at normal temp. |
| Saudi Aramco | Hawiyah NGL | Automated Corrosion Mapping | Detection of Corrosion rate at normal temp. |
| Saudi Aramco | Jeddah Refinery | Automated Corrosion Mapping | Detection of Corrosion rate at normal temp. |

Appreciation Letters from Clients



Staff Trainings:

| Training / Seminar Title | Attended By | Organized by | Location |
|--------------------------|---|----------------------------|--------------------|
| Corrosion Mapping | <ul style="list-style-type: none"> Nagesh Shinde Mohammed Ehsanulla | Technology Design | Chershire, UK |
| Thermography Services | <ul style="list-style-type: none"> Abdul Raheem Dinesh Gupta | Scanstar | Chennai, India |
| Phased Array UT | <ul style="list-style-type: none"> TCR Team | Eclipse Scientific, CANADA | Jubail, KSA |
| High Temp PAUT | <ul style="list-style-type: none"> TCR Team | Eclipse Scientific, CANADA | TCR Office, Dammam |
| Tube Inspection | <ul style="list-style-type: none"> TCR Team | EIS Inspection, INDIA | TCR Office, Dammam |



Major Clients:



أرامكو السعودية
Saudi Aramco



التصنيع TASNEE

