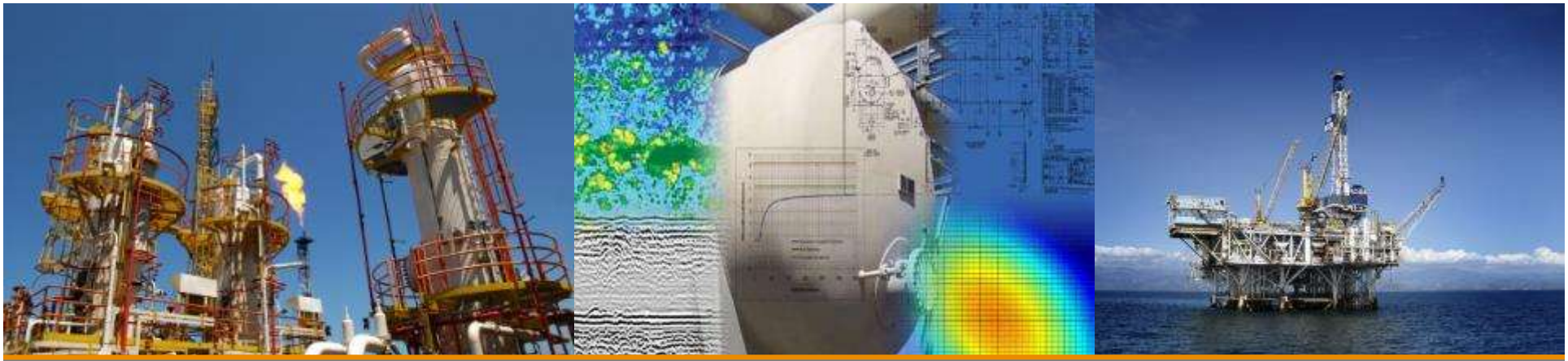
Microwave Inspection of Composites and Other Dielectric Materials

sonomatic®
innovative inspection technologies

microwave inspection technologies



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Sonomatic - Innovative Inspection Technologies

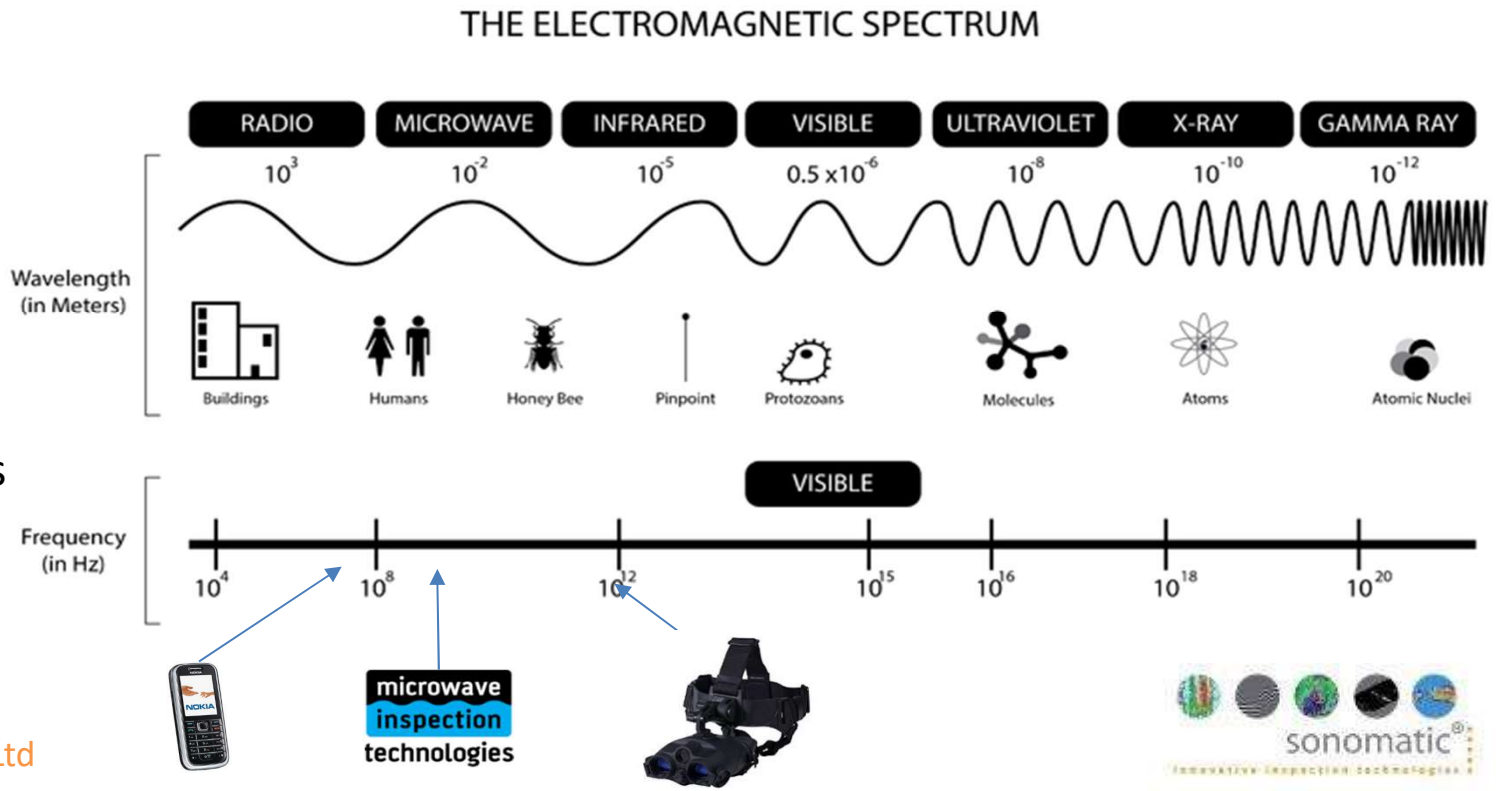
Sonomatic is a worldwide organisation whose expertise in ultrasonic inspection design, development and application, dates back more than 30 years to our roots in the nuclear sector.

Today the company has widened its focus and provides proven yet pioneering services to customers in defence and power generation but our largest client base is in the challenging oil and gas industry, both upstream and downstream.

With a staff of over 100, operating from 11 locations worldwide, Sonomatic is perfectly placed to support our client base.

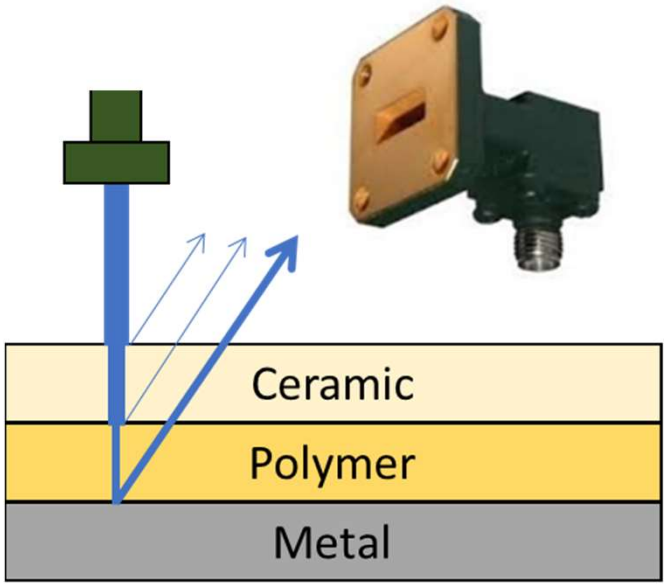
Microwaves

- GHz range.
- Very low power (<1 mW.).
- Excellent on non-conductive materials.
- Many difficult to inspect materials are non-conductive.



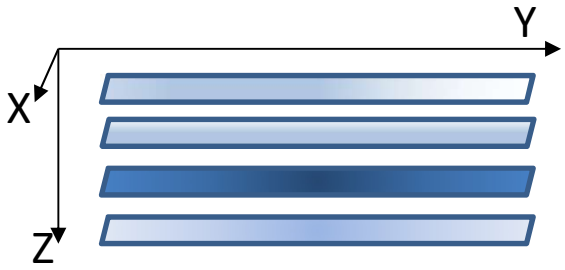
How does it work?

- Firing a swept, broadband beam of microwaves from the waveguide at a sample.
- The microwave energy is transmitted through the nonconductive materials with reflections from dielectric boundaries.
- Probe is raster scanned over surface.
- Sonomatic's technique extracts depth and amplitude information resolving indications and features in x, y and z.
- Microwaves are reflected by conductive materials (e.g. metals).



Data Presentation

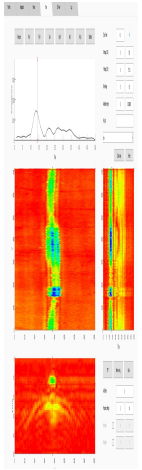
Data plotted in layers x.y position and z, amplitude
Layer increment 2 – 4 mm (0.080 – 0.120”)



Summed layers

C scan

D scan



E scan

Scan of acceptable HDPE butt fusion weld

Materials

- Glass FRP laminates
- Honeycomb structured composites
- Thermoplastics
- Reinforced and non-reinforced rubber
- Ceramics
- Any other bulk dielectric

Defect

- Delaminations
- Disbonds
- Foreign material inclusions
- Incorrect mix/extrusion
- Voids
- Changes in thickness
- Moisture or other liquid contamination
- Mechanical damage
- Physical changes due to chemical attack

Product forms

- Piping
- Vessels
- Tanks
- Coatings
- Complex composite structures
- Virtually any component which is made of inspectable material

Equipment

- Equipment is small and portable
- No couplant is required
- Scan can be in contact or near contact with specimen
- Scanning can be done on complex geometries

Application to HDPE butt welds and GRP

HDPE thermal butt fusion

Typical HDPE Butt weld field fabrication machine

A completed HDPE Butt Weld

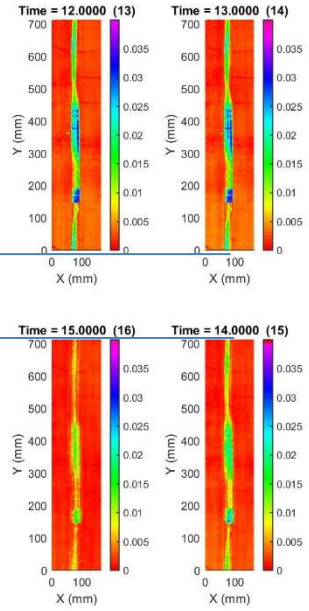
- Butt Fusion joins two pipe ends together by heating the ends and bringing them together under pressure
- This causes the molten HDPE to flow and co-mingle at the interface
- Once co-mingled, the joint cools and re-crystallizes across the melt zone
- The re-crystallization process determines the joint strength and ductility

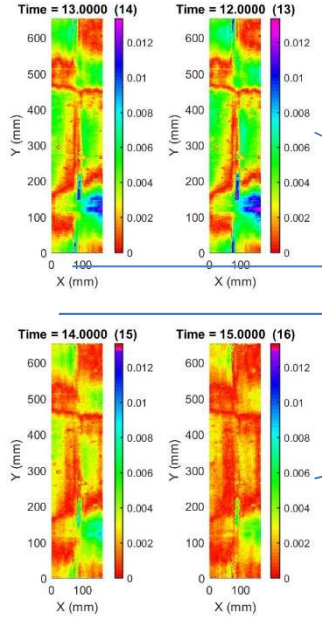
Inspection

Data plots at different depths through the weld

Typical inspection equipment set up

Good weld cross section



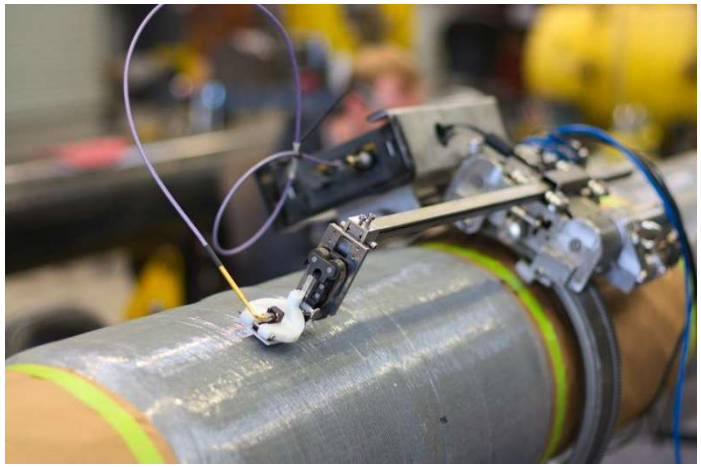


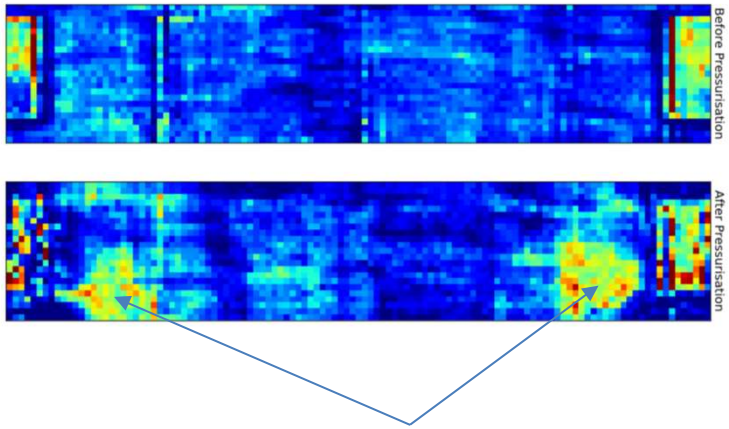
Poor weld cross section

Note: weld cross sections are for illustration only. The displayed scans are not from the weld cross sections.

Composite Repairs

- Samples are inspected, then hydro-tested.
- Creates realistic failures, which can be detected with Microwave



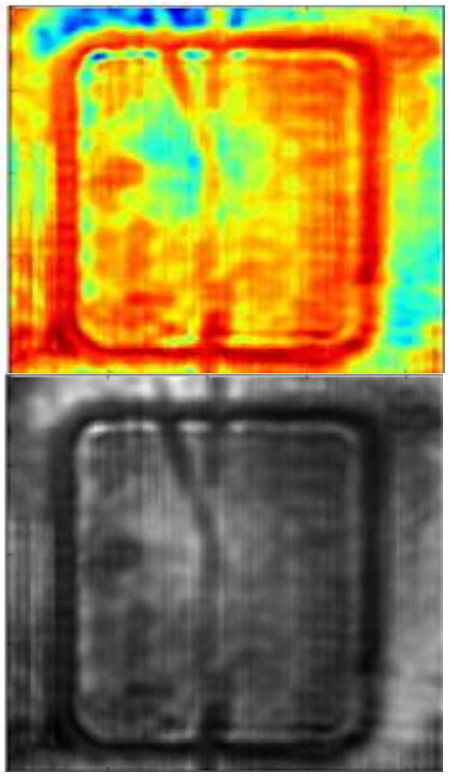


Before

After

Delaminations

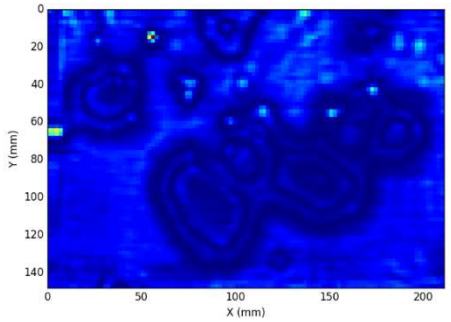
Composite Repairs

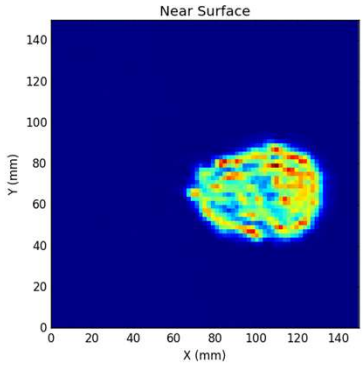


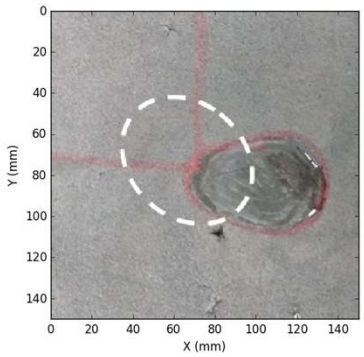
- Screening scan revealed area of interest.
- Detailed follow-up scan revealed milled pocket with strain gauges.

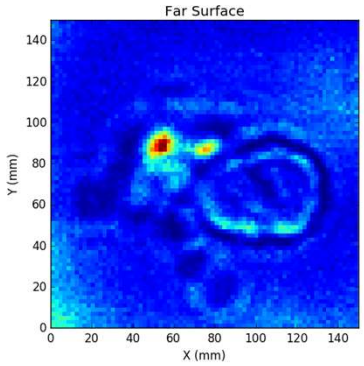
Corrosion Under Insulation (CUI)

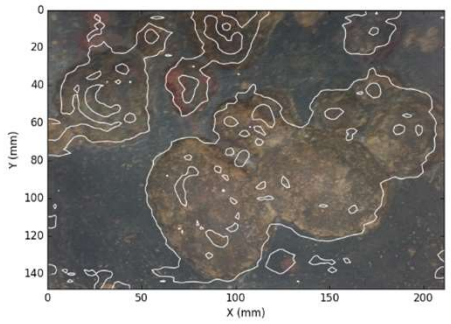
- Microwave can penetrate non-metallic insulation.
- Can be used to profile the surface of the metal.
  - Detect wall loss
  - Detect corrosion blisters.
- Can also be used to detect the presence of water/moisture.





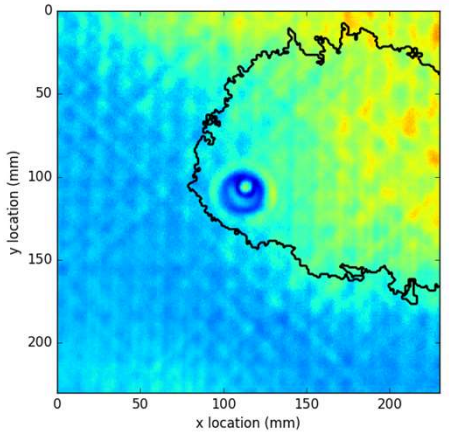






Composite Repairs

- Steel plate, wrapped with 5mm of Technowrap 3K.
- Delaminated by applying pressure through a hole in the back of the sample.
- Microwave inspection able to identify delaminated area.
- Black contours show DRS results.



Summary

Current status

- Offshore, North Sea, composite wrap integrity inspection programme for life extension.
- Offshore, South America, in conjunction with DRS, composite wrap and underlying pipe integrity inspection programme for life extension, replacement scheduling after winning a technology application competition.
- EPRI HDPE butt fusion round robin.

Summary

- Inspect Fibreglass, HDPE, Flexible pipes and any other non-conductive material.
- Can image composite wraps and the surfaces beneath them.
- Non hazardous.
- Fast scan speed
- Fast data analysis/reporting

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