COMPOSITE WRAP REPAIRS

GENERAL

While welding repairs are time and resource consuming processes, composite wrap repairs are fast and convenient and when applied correct it gives good assurance to system integrity. There are many good composite wrap solutions on the market but few good inspection solutions to verify quality and condition of the wrap repair.

This application note concerns inspection of composite wrap repairs for:
- Process Piping
- Process Vessels
- Corrosion Protection

PROBLEM

Welding repairs requires a full shut-down of the process-plant. When completed the repair is considered permanent and there are well established inspection methods for quality control of new welds and in-service monitoring to follow up future integrity.

Composite Wrap Repairs do not require a shut down but the limited quality control methods available, both for the final repair and the is-service monitoring, gives the repair a temporarily status. The consequence is that the plant must plan for a future, permanent welding repair.

Interferometrical technology for inspecting composite products is well established within several industries. EG: avionics and automotive industries. The traditional systems are sensitive to vibrations, noise and do require stable surroundings. Thermal excitation of object is often applied as inspection principle. The mentioned factors related to interferometrical systems have resulted in technical solutions less adapted to the requirements present in process plants on- and offshore.

Fig 1.
The Optonor system for non-destructive testing, SNT 410, is developed for inspection of composite materials under demanding conditions. Combined with the new Acoustic Derivative Detection (ADD) technology it provides robust and reliable inspection results.

SOLUTION

By introducing new technology for quality control and monitoring of composite wrap repairs the achievements will be:

•Better assurance of quality to new repairs.
•The efficient and cost-saving method of composite wrap repairs can be applied on more critical systems.
•Monitoring solutions for in-service inspection programs permits increased life-time.
•Improved product and operator qualification, verification and development.

Fig 2. The object surface is illuminated by an expanded laser beam.

TECHNICAL PRINCIPLES

Optonor developed the Acoustic Derivative Detection technology (ADD) for fast and efficient testing of composite structures. The object surface is illuminated by an expanded laser beam and the object is imaged by a zoom lens onto a CMOS sensor array. The SNT 410 instrument measures the spatial derivative of the dynamic surface deflections, as the deflection of each point on the surface is measured relative to a neighboring point. The distance between the SNT 410 optical head and the target surface can be up to 5 meters, or even further depending on surroundings, wind and thermal conditions.
The SNT 410 uses a signal generator for object excitation. The excitation results in structural vibrations or surface waves that propagate across the object field, revealing surface or subsurface defects. Vibration amplitude contour maps can be displayed in real-time or as numerical recordings.

For simple and informative interpretation and evaluation, Optonor has developed Defect Detection Scan in the SNT 410 system. This algorithm performs a frequency scan to detect discontinuities in vibration pattern and modes. The frequency range is modified according to the inspection material. By use of advanced filtering routines, the system detects and displays defects and discontinuities as bright spots or areas. Interpretation of complex vibration patterns is no longer necessary, and results are presented in real-time.

APPLICATION EXAMPLE

System: Gas line downstream Gas-Liquid Separator

Dimensions: 14", 8 mm WT

Inspection point: Wrap repair covering weld and 90 degree bend

Plant: Floating Production, Storage and Offloading Vessel – FPSO

Wrap Repair Details: Carbon Fibre Reinforced Polyester

INSPECTION PREPARATION

Work Permits and gas metering required prior to system set-up. The system does not generate any spark, heat or flame but the non-EX computerized system will require continuous gas monitoring during inspection.

By advanced filtering solutions the system is not affected by process vibrations, winds and waves. The use of piezo-electrical transducers for excitation of objects enables scanning through a range of frequencies providing increased sensitivity to deviations and anomalies. To establish probability of detection and system sensitivity it is recommended to have a sample/calibration object available.

Complete system with instrument, computer and excitation solution is established at the designated inspection site in few minutes. A frequency scan is performed to reveal response modes in analyzed object configuration. Based on the results the frequency range for Defect Detection Mapping is defined.

Fig 3. Complete system installed on site in few minutes.

Fig 4. Complex geometries are inspected by the non-contact, camera-based system.

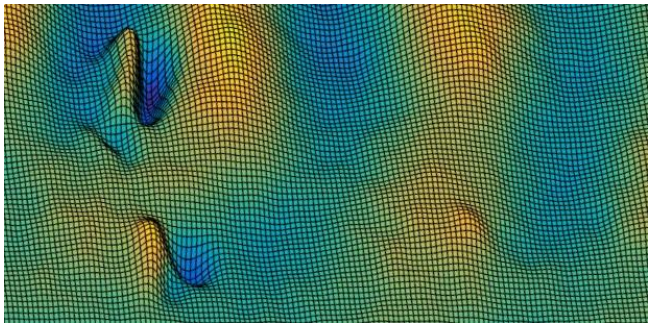


Fig 5. Vibration pattern revealing sub surface flaws.

INSPECTION EXECUTION

The wrap repair is inspected on port side covering 50% of wrap surface. The most significant defects located in the area of the welded pipe-support. The inspection of the selected inspection area is conducted and results are shown instantly on system monitor. A close visual inspection of the object is performed to verify if defect signals are related to object surface properties.

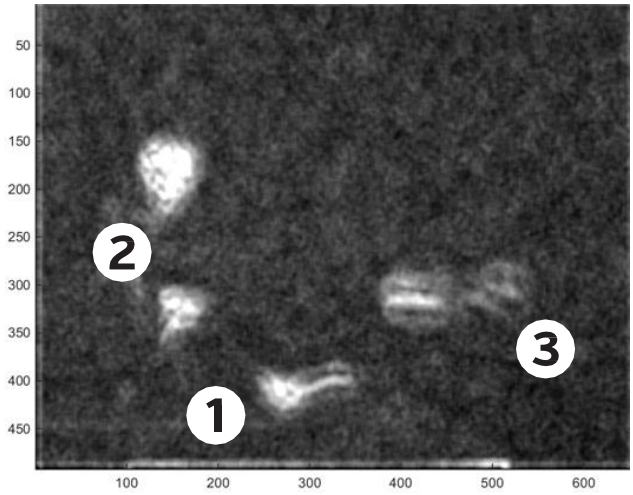


Fig 6. Defect Detection Scan of selected area. See fig. 7 for description of location and defects.

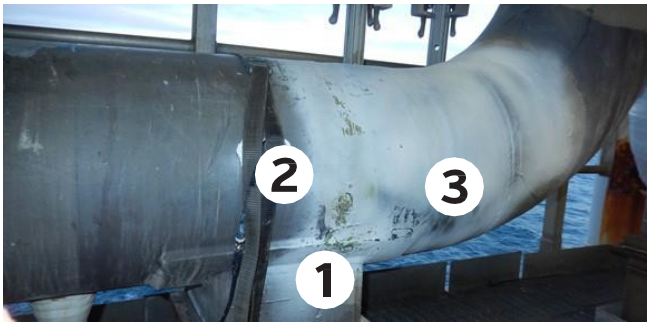
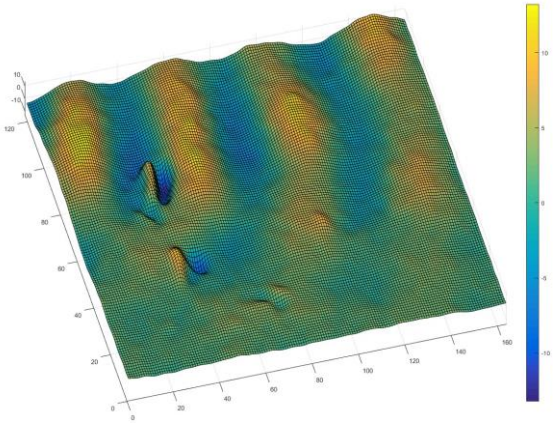


Fig 7. **Detected anomalies:**
1: Cold lap of composite repair resin.
2: Paint with poor adhesion in minor areas.
3: Lack of bonding / delamination in area for welded pipe-support.

INSPECTION REPORT

Defect Detection Scan is stored as conventional picture file for implementation in inspection report. Raw data from the acquisition process can also be stored and exported for future evaluation and comparison. As inspection parameters and defect position is known, the lack of bonding between substrate (support and pipe) and composite material can be re-assessed to monitor defect development.



FEATURES & BENEFITS

The special features of the SNT 410, making it an ideal solution for inspections of composite wrap repairs, are:

- Fast, accurate and efficient
- High resolution
- Robust technology for challenging environments
- User-friendly hardware and software

SPECIFICATIONS

- HOIS GP1, *"HOIS Good Practice Guide on In-Service inspection of Offshore Composite Components"*
- DNV-RP-G103, *"Non-Intrusive Inspection"*

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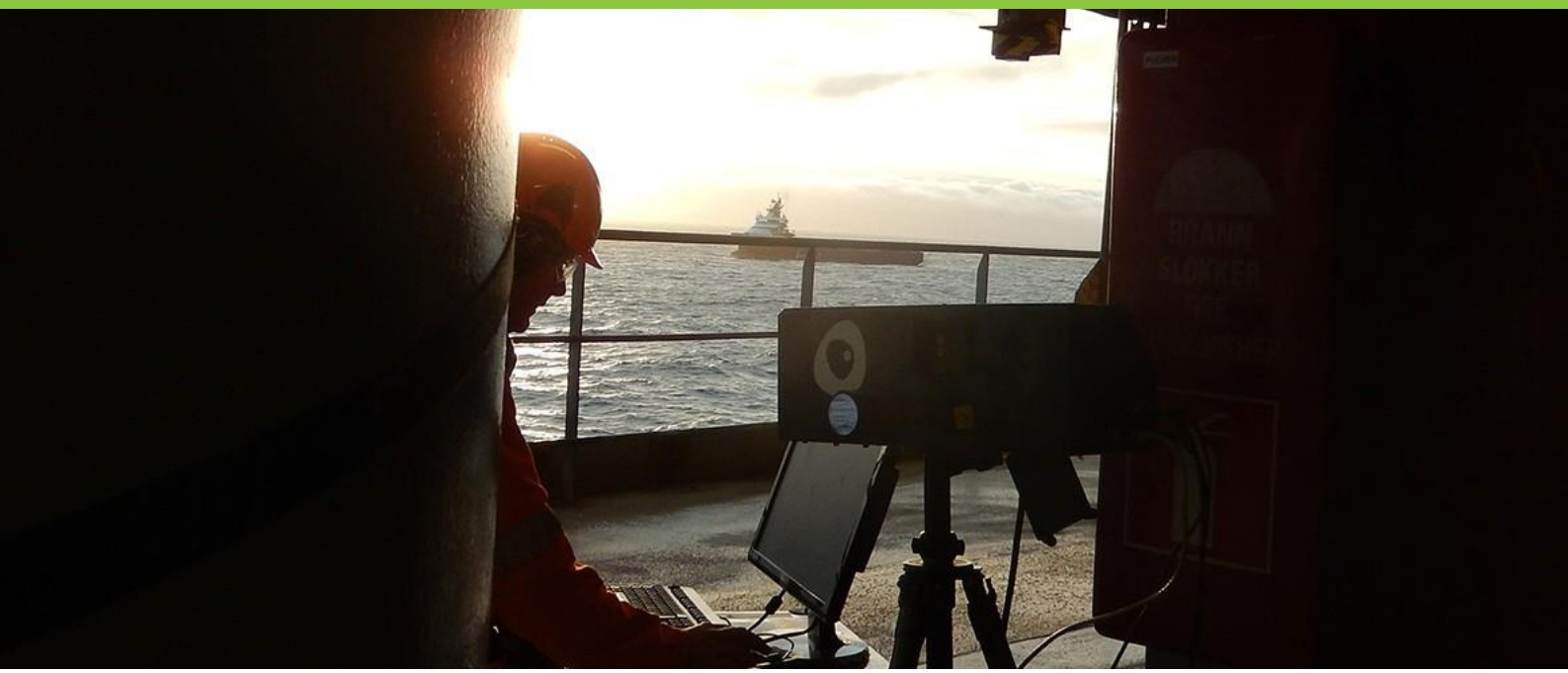
OPTICAL TESTING & METROLOGY



Optonor AS has delivered full-field laser systems for more than 20 years. The systems are based on modern interferometric technologies which are used in a large range of applications within the aerospace, automotive, audio and electronic industries. In addition to commercial customers, many research and educational environments and organizations use Optonor's systems.

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