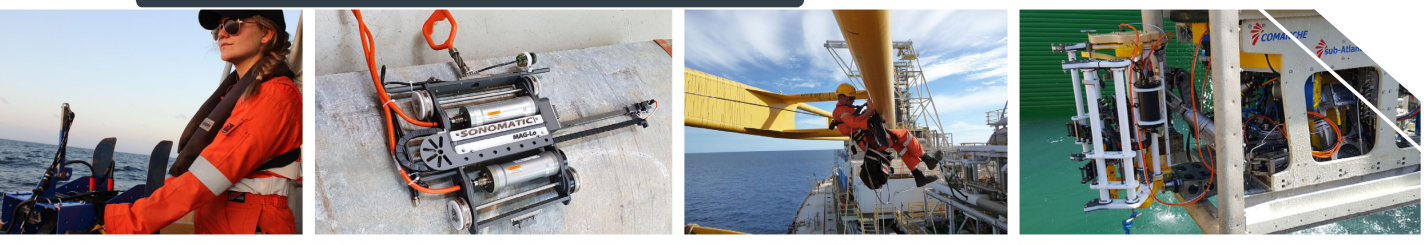
# DATA SHEET

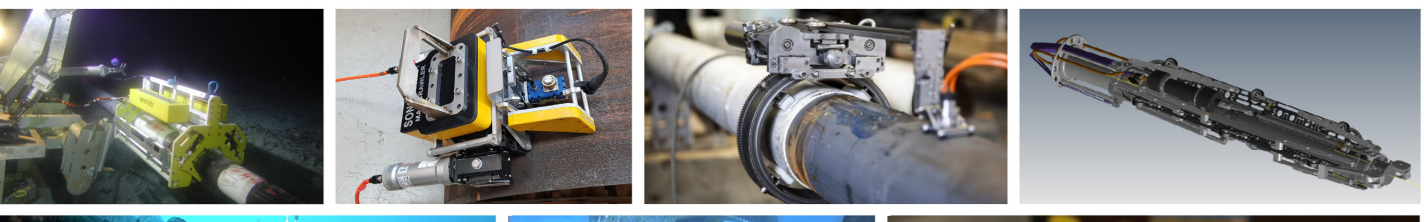
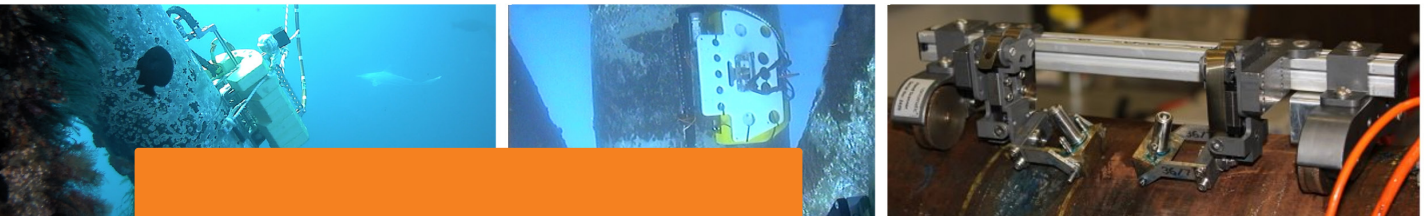
## FINITE ELEMENT ANALYSIS

SONOMATIC

## THE PURPOSE

This document is composed to assist our clients and the supply chain with a high-level understanding of the benefits and services associated with our Finite Element Analysis capabilities.

# FINITE ELEMENT ANALYSIS

Plant design and materials selection aim to minimise degradation of in-service pressure equipment, however, damage is inevitable in many cases. Hence there is a strong requirement to justify safe operation of damaged equipment, this is formally known as Fitness For Service (FFS) assessment. When damage is identified it is crucial to demonstrate not only whether the item is safe to operate but how much further degradation can be tolerated and what this means for the future of the asset.

Continuous operation of pressure piping and vessels is synonymous with increased productivity. Live pressure equipment also presents a significant, yet manageable, hazard to personnel. This is especially true in the context of toxic or volatile substance containment at high pressures and temperatures.

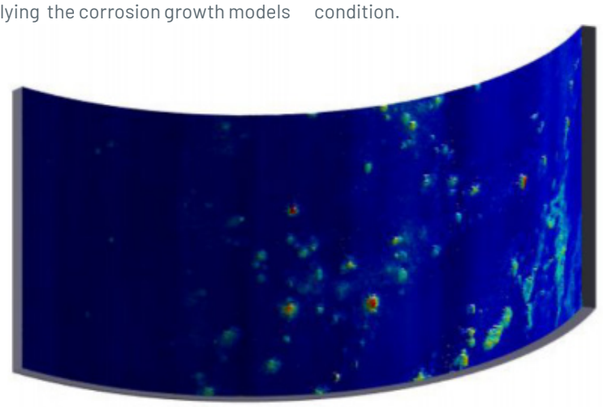
Sonomatic has developed efficient methods to take advantage of inspection data in the context of Fitness For Service (FFS) assessments. Finite element models of equipment can be generated with any areas of degradation defined by direct input of inspection data. The accuracy and full resolution of the inspection data is reflected in the 3D model. Non-linear analysis of the model provides representative information on the condition of the equipment. Sonomatic have extensive experience both in FFS assessments and the interpretation of inspection results for reliable defect characterisation.

Corrosion growth models have been developed by Sonomatic which allow the future condition of the damaged item to be estimated. Applying the corrosion growth models to the finite element analysis, allows the margins on limiting conditions to be determined and future inspection strategies to be defined.

As a result of these developments, the cost and turnaround time for a finite element FFS assessment is competitive with the simplified and more conservative assessments. It is now practical to proceed directly to finite element assessment to determine the integrity of a piece of equipment.

Industry FFS guidelines present a range of approaches to which a basic trade-off exists between ease of analysis and the level of conservatism. Level 1 or Level 2 assessment is possible through basic numerical methods which take advantage of conservatism built into the pressure equipment design codes. Coarse measurement and approximations of the damaged geometry may suffice at this level of analysis. Even when highly accurate geometric measurements exist, they are simplified to facilitate the analysis.

Level 3 assessment uses finite element analysis to build a 3D representation of the asset; the known operating conditions are applied to the model to determine whether the asset can be considered safe for continued operation. As the Level 3 analysis does not use the same simplifications used at Level 1 and Level 2, the results provide the most accurate assessment of the asset's condition. Sonomatic offer efficient, cost-effective Level 3 assessments based on inspection data, providing a true reflection an asset's condition.

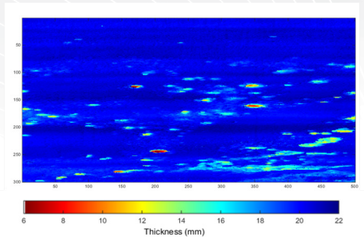


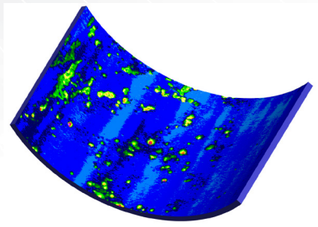
## ADVANCED INSPECTION

- High resolution
- Ultrasonic corrosion mapping
- Accurate measurement
- 3D laser scanning

## 3D GEOMETRY

- Richness and accuracy of inspection data maintained.
- No simplification of measured geometry.



## MATERIALS SPECIFICATION

Elastic - Plastic Behaviour

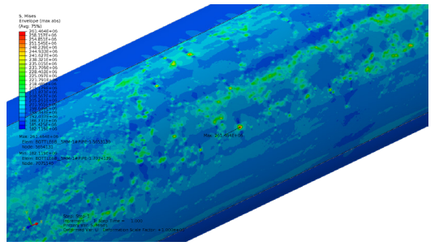
## LOADS AND CONSTRAINTS

- Design and operating conditions
- Global mechanical loading
- Thermal loading

## RELEVANT EXPERTISE

- Reliable interpretation of inspection data for geometry definition.
- Detailed statistical comparison of repeat inspection data to establish accurate corrosion rates.
- Finite element modelling.
- Fitness for service and Integrity Assessment.

## HIGHLY REPRESENTATIVE FINITE ELEMENT MODEL



Reliable understanding of limiting conditions.

Informed integrity decisions.

## QA AND HS&E

Sonomatic operate under an integrated QHSE management system and are committed to the highest quality and safety of service provision | ISO 9001: 2015: 00007140 | ISO 14001:2015:00037371 | ISO 45001:2018:00037372 | ISO 17020: 2012: 4276 | Achilles FPAL Verified: 076712 | SEQual 1988 | British Safety Council Member: S0388440 |

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