Introduction

Flanges are found everywhere in industry, they are the main form of connecting pipeline lengths to other pipes, valves, vessels etc. They are often exposed to corrosive fluids and challenging environments that can cause damage over time, potentially leading to failure. Accordingly, it is vital that any degradation is identified during inspections to maintain the asset and avoid leakage or catastrophic failure.

Visual inspection is a common method for inspecting flanges but this means having to shut down the plant and open the flanges which costs time and money. Phased array allows the inspection of flanges, in service, without having to take them apart, resulting in quicker and lower cost inspections.

Figure 1 – Flange face defects

Inspection information:

The inspection was performed from the flange face as shown in the image below, this is usually a fully accessible surface for in situ inspections.
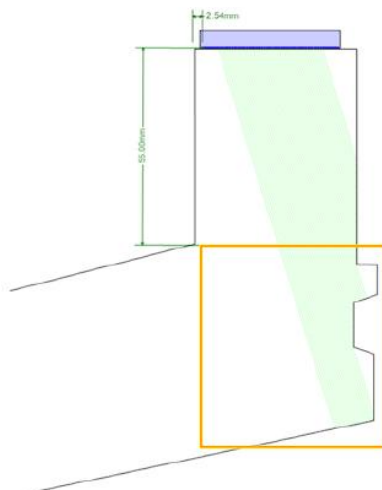

Figure 2 -Flange inspection scan plan

Industries
- Chemical & Petrochemical Sector
- Oil & Gas Sector
- Nuclear Energy Sector
- Wind Power Renewables Sector
- Pharmaceutical Sector
- Mining Sector
- Construction and Infrastructure
- NDT Service Providers

Application
- Corrosion / Thickness measurement
- Casting / Forging Inspection
- Storage Vessel Inspection
- Asset Integrity

Typical Parts
- Storage vessel ancillary attachment points
- Refinery Pipelines
- Oil and gas plant pipelines
- Chemical plant pipelines
- Fume tower flanges

Inspection Techniques
- PAUT L-Scan
- TFM

Features and Benefits
- Faster inspection speeds, lowers the cost of inspection
- Less downtime as the flanges do not need to be taken apart to check the faces visually
- Better resolution images can be achieved by using FMC/TFM, if required
- The Veo3 has a 128 Gb memory allowing many scans to be recorded without having to store externally

- A 5MHz, 64-element PAUT transducer was used for this inspection. Smaller probes may also be used to get a greater amount of coverage.
- For best results, the inspection should be encoded. Specific scanners can also be used, when applicable Between 50% and 70% coverage of the flange face is achievable when inspecting from the bolt face.
- using a PA scan. Combined with a TFM LL mode scan, the profile assessment is greatly improved. LL stands for direct mode and is based on the compression wave velocity TFM scan type.

The inspected flange has a groove for the gasket (it can be seen in the image above). It can be suspectable to corrosion and pitting. The following figures show the results of an inspection on this area.

When detecting defects on the flange face, the extractor box's position is moved so that it covers the area between the grove and inside corner of the flange. The image below shows the full top view. You can easily spot the good and bad areas.

The sample has two defects in the flange face: one central and one on the edge, as shown in the images at the beginning of this application note. Please see the images below, which show how the defects appear after an inspection.
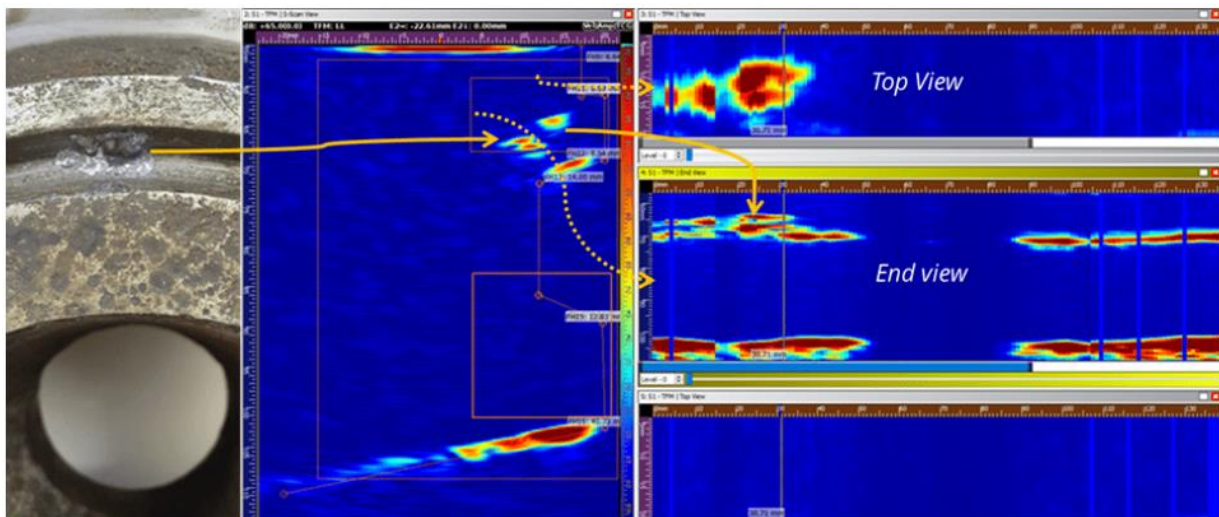

Figure 3 – Defect detection of wall losses in the flange face groove

The flange lip geometry generates a corner echo. A new or an undamaged flange will define a back-wall echo following the internal pipe. It is shown in Figure 4. The Live TFM view and extracted view include visual hints; any echo changes will be spotted immediately.
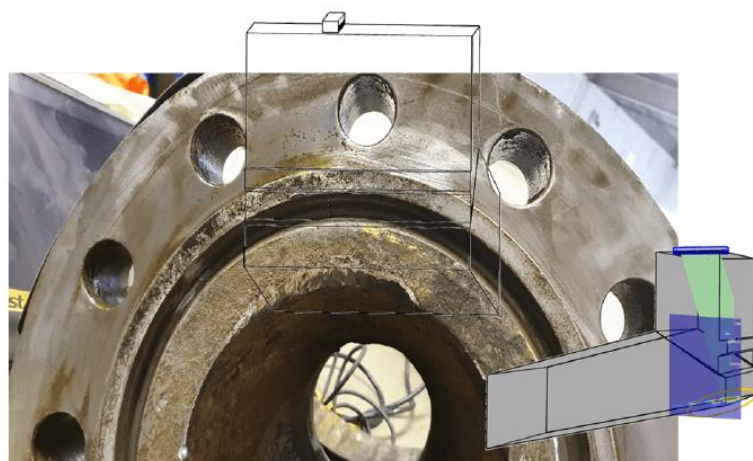

Figure 4 – Flange edge and its TFM scan location

Specifically, on the further flat echo, it matches the inner pipe surface location. It also reaches the flange corner when it is not damaged. The corroded feature #2 (encircled in orange in Figure 2) has an angled face that deflects the sound when the flange grooves are rounded. Therefore, this inner echo should fade away as it gets further damaged.

Conclusion:

- TFM, using the LL propagation mode, provides a clean "shot" of the flange's inner face and grooves.
- The interpretation of the scan is improved by using UTstudio+
- Using multiple extracted views on a specific area enhances the analysis of complex areas.
- With improved CAD tools, BeamTool 9 remains the best software to create this scan plan.
- It would not be possible to get 100% coverage of the flange face using this method as some areas are blocked by bolt holes.

For further information or support, please contact the Sonatest Applications Team: applications@sonatest.com

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Recommended Tool Package

Category	Part #	Description
Acquisition Unit	VEO3 phased array data acquisition unit	
Probe	D1A 5M32E probe and D1AW N60S wedge	
Encoder	AXYS Encoder	

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